Accessing Data

For most users, accessing data will almost always begin with searching the catalog at http://search.geothermaldata.org. From here, NGDS data consumers can search for, discover, preview, and access NGDS data and web services. Data is provided in a variety of formats including documents and PDFs to tabular forms like Excel to GIS compatible web services.

Having located their data as web services (WMS/WFS), shape files, or other GIS-compatible file formats, consumers can access it with any of a variety of client software.

NGDS Compatible Applications

ArcGIS Explorer	*http://www.esri.com/software/arcgis/explorer/index.html*
ArcGIS Online	*http://www.arcgis.com/home/webmap/viewer.html*
ArcMap	*http://www.esri.com/software/arcgis* (Software Not Free)
ArcMap Catalog Search Plug-in	*http://lab.usgin.org/applications/doc/3rd-version-csw-client-application*
Cadcorp Map Browser	*http://www.cadcorp.com/products_geographical_information_systems/map_browser.htm*
Dapple	*http://dapple.geosoft.com/about.asp*
GeoScene 3D	*http://i-gis.dk/Home/tabid/40/language/en-GB/Default.aspx*
Geozilla	*http://geozilla.de/index.php*
Google Earth	*http://www.google.com/earth/index.html*
gvSIG	*http://www.gvsig.org/web/*
Leaflet	*http://leafletjs.com/*
Mapbender	*http://www.mapbender.org/*
NGDS Catalog	*http://search.geothermaldata.org*
NGDS Data Explorer	*http://data.geothermaldatasystem.org/*
NGDS Node-in-a-Box (NIAB)	*http://demo.geothermaldatasystem.org/* (Demo Only)
NREL Geothermal Prospector	*http://maps.nrel.gov/gt_prospector*
OpenLayers	*http://openlayers.org/*
osgPlanet	*http://www.ossim.org/osgPlanet.html*
SimpleMapClient	*http://glmapclient.sourceforge.net/*
QGIS	*http://hub.qgis.org/projects/quantum-gis/wiki/Download*
uDig	*http://udig.refractions.net/*
USGS National Map Viewer	*http://viewer.nationalmap.gov/viewer/*
Worldwide Telescope	*http://www.worldwidetelescope.org/Home.aspx*

or

Write your own application!

(Visit http://geothermaldata.org/page/tools-apps for more information.)

Data Access Scenarios

There are many ways to access NGDS data, a few of which are presented here as user scenarios. The scenarios range from easy to advanced. Some only require a web browser and others require downloaded software. Each scenario clearly indicates its difficulty and the required tools.

Join us Wednesday, October 2nd from 2pm - 5pm for the NGDS Workshop to walk through some of these scenarios.

Scenarios

Easy Scenarios:

- NGDS Catalog Search: Discover Data and Accompanying Interpretations
- NDGS Data Explorer: Viewing a Well Log Service and Retrieving Scanned Logs
- NDGS Data Explorer: Wildcard Search
- NGDS Node-in-a-Box: The Future of NGDS

Intermediate Scenarios:

- NDGS Data Explorer: Merging Datasets from Different States
- Geothermal Prospector: Distance Between Power Lines and Boreholes
- OpenLayers: Creating your own Web Page to View a WMS
- Leaflet: Creating your own Web Page to View a WMS
- OneGeology: View and Download Multiple-Scale Geologic Maps

Advanced Scenarios:

- Powell & Cummings Geothermometry
- ArcMap: Finding Thermal Springs near Major Roads
- QGIS: Searching for and Displaying Data Variably by Temperature Attributes
- uDig: Discover Related Datasets Using Foreign Keys
- USGS National Map Viewer: Geologic Maps with Borehole Temperature Data

These scenarios are also available in the **Accessing NGDS Data** file in **GeothermalResourcesCouncil** folder at https://github.com/usgin/Workshops/.

NGDS Catalog Search: Discover Data and Accompanying Interpretations

Difficulty: Easy
Prerequisites: Web Browser

This data search scenario displays how single keyword searches from the NGDS Catalog will yield data from many sources, including raw data (in Excel files or Web Services) as well as publications with data interpretations.

1. Go to http://search.geothermaldata.org/ in a new window.
2. Type in **california well log** in the search field.
3. Click **Search.**
4. Click on the **California Well Log Observations** option.
4. Mouse-over the access options on the left.
5. Click on **Add WMS to Map**.
6. Scroll down the search returns and click the **Case History Report on East Mesa and Cerro Prieto Geothermal Fields** option.
7. On the left, click **More Details** to display more information about the selected resource. Close this box.
8. Mouse-over the **Access Options** on the left.
9. Click **Name for URL** to open the publication and discover more about well log analysis technology.

Challenge Question: Who is the distributor for the publication resource?
Answer: Geo-Heat Center, Oregon Institute of Technology

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

NDGS Data Explorer: Viewing a Well Log Service and Retrieving Scanned Logs

Difficulty: Easy
Prerequisites: Web Browser

This scenario shows how to use the NGDS Data Explorer to search for and view geothermal data while also viewing the actual digital well logs associated with a given record in a Well Logs web service.

1. Go to http://data.geothermaldatasystem.org/ in a new window.
2. In the Search the Catalog box in the top left panel type **well log**.
3. Click **Search**.
4. Scroll down to the **EGI Well Logs** Layer.
5. Click **Add Layer**.
6. After the points are added to the map in the Layers panel in the bottom left right click. on the **WellLog (Well log observations …)** layer.
7. Click on **Layer Metadata** to see the origins for the layer.
8. Click **Close**.
9. Right click on the layer again.
10. Click **Export All Features to a Table**. Also note that you can export the data as a CSV file.
11. Take a look at the table and close the window.
12. On the toolbar above the map click the blue **Identify** icon.
13. Click on a point to see information about that feature.
14. Click on the link in the **LogURI** field in one or more of the displayed pop-ups to view the actual log referenced by the data. This log will open in a separate tab in your browser.
15. Repeat this with a couple of points.
16. Click the blue **Identify** icon again to close all of the opened pop-ups at once.
17. Click on a few more points to select them.
18. Right click on the **WellLog (Well log observations …)** layer again.
19. Click **Export Selected Features to a Table** to only export the attributes of selected features.
20. Close the tab/window with the table.

Challenge Question: What is the greatest driller total depth for the well logs in the Maricopa County, AZ (Phoenix area)?
Answer: 9207 ft

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

NDGS Data Explorer: Wildcard Search

Difficulty: Easy
Prerequisites: Web Browser

The scenario shows how to search for all of the mappable data for a particular area.

1. Go to http://data.geothermaldatasystem.org/ in a new window.
2. On the toolbar above the map click the binoculars icon.
3. Type in **Los Angeles, CA**.
4. Click **OK** and the map will center on and zoom to the Los Angeles.
5. In the Catalog Search box in the top left panel type an asterisk (*****).
6. Check the box **Use Current Map Extent** to only search for datasets within the area of the map displayed on the screen.
7. Click **Search**.
8. The results will show all of the *mappable* data in NGDS for that area.
9. On the toolbar above the map, click **Set Extent**. This will limit any new features added to only points that fall within the visible extent of the map.
10. Click the **California Active Faults** Layer.
11. Click **Add Layer**.
12. The features in that layer located within the given area should be added to the map.
13. On the toolbar above the map click the blue **Identify** icon.
14. Click on the fault just north of downtown which runs east-west and you'll see a popup with information about that fault.
15. Click on the link in the **SpecificationURI** field to view additional information about the fault.

Challenge Question: What is the name of the fault just north of downtown Los Angeles which runs east-west?
Answer: Raymond Fault or Hollywood Fault

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

NGDS Node-in-a-Box: The Future of NGDS

Difficulty: Easy
Prerequisites: Web Browser

This scenario presents a demo of accessing data through the future NGDS gateway. It is still in development and as such feedback on the usability would be appreciated. Please see Sam Zheng at the UI Testing Station for more information and to provide your input on this exciting new project. (Alternatively, feedback may be submitted at http://geothermaldata.org/contact.)

1. Go to http://demo.geothermaldatasystem.org.
2. Click **MAP** toward the top of the page.
3. In the search box type **wells near Nevada**.
4. Click on **Nevada Well Headers**.
5. In the pop-up, click **Nevada Well Headers** (title). A new page will open with information about this particular dataset including the different ways in which it is published, like web services, Excel files and other publications.
6. Next to the Zipped Excel spreadsheet resource, click the **Explore** button on the right side of the page and select **Download**. The resource will be downloaded.
7. Click on **LIBRARY** near the top of the page. This page provides a means to search for data in the system, including publications and web services.
8. Type **arizona ground water** into the search box and click the magnifying glass to search.
9. Click the result **Basic Ground Water Data for Western Pinal County, Arizona**.
10. On the next page, click the **Explore** button on the right side of the page and select **Download**. The publication will be downloaded.
11. Click on **RESOURCES** near the top of the page. This pages gives links for additional websites to explore for geothermal information.
12. Click on **HARVEST** near the top of the page. This page will allow approved users to add (harvest) databases or other resources.
13. Be sure to see Sam Zheng to provide feedback or go to http://geothermaldata.org/contact. Your input is essential for further development of this project.

NDGS Data Explorer: Merging Datasets from Different States

Difficulty: Intermediate
Prerequisites: Web Browser, Excel (or some comparable software)

This scenario demonstrates how data from multiple sources can be easily merged into a single dataset and downloaded to a CSV file by using the NGDS Data Explorer.

1. Go to http://data.geothermaldatasystem.org/ in a new window.
2. Zoom into the four corners of Arizona, New Mexico, Utah and Colorado. (Hint: Hold down the Shift key and draw a box to zoom in.)
3. In the Catalog Search box type **Borehole Temperatures**
4. Check the box **Use Current Map Extent** to only search within the area of the map displayed on the screen.
5. Click **Search**.
6. There should be four Borehole Temperatures results, one for each of the states.
7. On the toolbar above the map, click **Set Extent**. This will limit any new data added to points that fall within the visible extent of the map.
8. Click **Arizona Borehole Temperatures**.
9. Click **Add Layer**.
10. The points for Arizona should be added to the map.
11. Repeat this for each of the other states. Depending on your zoom level New Mexico may have 0 points or you may get a warning that Colorado has too many. You can adjust the zoom level as desired or simply wait for Colorado points to load.
12. Once all the points have loaded click on the **Select Box** button on the map toolbar.
13. Draw a box around some points, including points in at least three states.
14. Next click on the **Merge Data & Export** button the map toolbar.
15. Select **Selected Features of Checked Layers to a CSV**.
16. This will create a single CSV file containing all of the attributes from the selected datasets.
17. Open the file in Excel to view your results.

Challenge Question: What is the name of the well with the api number 02-001-05193?
Answer: El Paso Natural Gas 7 Navajo

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

Geothermal Prospector: Distance Between Power Lines and Boreholes

Difficulty: Intermediate
Prerequisites: Web Browser

The Geothermal Prospector is an NREL (National Renewable Energy Laboratory)-built application that aggregates data from NGDS. NGDS data is displayed with data from other useful sources, such as Centerlines from the West-wide Energy Corridor Programmatic EIS Information Center (http://corridoreis.anl.gov/index.cfm). This scenario will show how to assess the distance between gridded power lines and higher-temperature boreholes.

1. Go to http://maps.nrel.gov/gt_prospector in a new window.
2. Click on the **Geothermal Analysis** button above the map
3. Using the cursor, draw a box over an area of interest, like the state of Nevada.
4. A pop-up box shows the results of a few types of analysis including land ownership percentages and a Temperature versus Depth plot for wells in the selected area.
5. Click the **X** in the upper-right corner to close the pop-up.
6. Click on the **Geothermal Analysis** button again to turn it off.
7. Zoom in to Phoenix, Arizona using the **Zoom** button and drawing a box in central Arizona.
8. Under **Layers** to the left of the map, expand the **Infrastructure** folder.
9. Expand the **Wells** folder.
10. Click in the box next to **AASG Geothermal Boreholes** to add NGDS borehole temperature data to the map.
11. Under **Layers**, expand the **Transmission** folder.
12. Click the box next to **368 Corridor Centerlines** to add transmission lines to the map.
13. Above the map, click **Query** and choose **Advanced Query** from the drop down list.
14. In the Advanced Query pop-up box, click **Draw Spatial Filter**.
15. Using the cursor, draw a box over Phoenix in central Arizona.
16. Back in the Advanced Query pop-up, choose **AASG Geothermal Boreholes** from the drop-down box.
17. Click **Add Layer to Query**.
18. Click **Add Attribute** next to the green + sign.
19. Choose **Temp (C)** from the drop down list.
20. Under **Operator**, click **>=**.
21. Under **Query Value**, type **100**.
22. Click **Submit Query** in the upper-right corner; Query results are found at the bottom of the page.
23. In the results, sort the **Temp (C)** by clicking once on the field header. If there are no results click Redefine Query. Under Spatial Query Constraint, right click on Intersects Chosen Polygon and select Update Spatial Filter. Draw a larger box than last time.
24. The greatest temperature, in Maricopa County, (127C, Well Name 02-013-20025) is

displayed on the map as the red-orange point west of Phoenix.

25. Click the **Query** button again, and choose **By Point**.
26. Choose this red-orange point, and confirm the temperature (Temp (C)) by expanding the AASG Geothermal Boreholes arrow, in the pop-up box and then expanding the Results arrow.
27. Close this box.
28. Click on the **Measure** button.
29. From the transmission line (shown in dark black lines) just north of the Sonoran Desert National Monument, measure to this red-orange borehole using the cursor.
30. Double-click to end the measurement.
31. The Measurement Tools pop-up box will indicate the distance between this point and the closest mapped transmission lines.

Challenge Question: What is the distance between the nearest power lines and the borehole with the greatest recorded temperature in central Arizona?
Answer: 22.75 miles

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

OpenLayers: Creating your own Web Page to View a WMS

Difficulty: Intermediate
Prerequisites: Web Browser, Text Editor (e.g. Notepad, Notepad++)

This scenario demonstrates how to write your own very basic web map application using OpenLayers to access NGDS data published as a Web Map Service (WMS). The code below overlays an image of the Missouri borehole data on an Open Street Map. The map can be further customizied by using the OpenLayers Javascript library at http://openlayers.org/.

1. Go to http://search.geothermaldata.org/.
2. Type in **missouri borehole temperatures** in the search field.
3. Click on the **Missouri Borehole Temperatures** option.
4. Mouse-over the access options on the left.
5. Right click on **WMS Capabilities**.
6. Select **Copy Link Location/Address/Shortcut**.
7. Open your text editor.
8. Type in the following code. The link copied above can be pasted in for the bolded text below but the question mark (?) and all subsequent text must be deleted from the copied link. Be sure to keep the quotes.

```
<html>
<title>Simple OpenLayers WMS Example</title>
<div id="map" style="width: 800px; height: 600px"></div>
<script src="http://openlayers.org/dev/OpenLayers.js"></script>
<script>

        // Define the map
        var map = new OpenLayers.Map('map', {projection: new OpenLayers.Projection('EPSG:3857')});

        // Add the Open Street Map baselayer
        map.addLayer(new OpenLayers.Layer.OSM());

        // Center the map over the US
        map.setCenter(new OpenLayers.LonLat(-98.583, 39.833).transform(
                new OpenLayers.Projection("EPSG:4326"),map.getProjectionObject()), 4);

        // Add NGDS data as an overlay
        var wmsLayer = new OpenLayers.Layer.WMS(
                'WMS Layer',
'http://geothermal.isgs.illinois.edu/ArcGIS/services/aasggeothermal/MOBoreholeTemperatures/MapServer/WMSServer',
                {layers: 'BoreholeTemperature', transparent: true});
        map.addLayer(wmsLayer);

</script>
<html>
```

9. **Save** the file as **OLExample.html**.
10. **Close** OLExample.html.
11. Double-click OLExample.html to open it in your web browser.
12. See **http://openlayers.org/** for more enhancements that can be added to the map.

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

Leaflet: Creating your own Web Page to View a WMS

Difficulty: Intermediate
Prerequisites: Web Browser, Text Editor (e.g. Notepad, Notepad++)

This scenario demonstrates how to write your own very basic web map application using Leaflet to access NGDS data published as a Web Map Service (WMS). The code below overlays an image of the Missouri borehole data on an Open Street Map. The map can be further customizied by using the Leaflet Javascript library at http://leafletjs.com/.

1. Go to http://search.geothermaldata.org/.
2. Type in **missouri borehole temperatures** in the search field.
3. Click on the **Missouri Borehole Temperatures** option.
4. Mouse-over the access options on the left.
5. Right click on **WMS Capabilities**.
6. Select **Copy Link Location/Address/Shortcut**.
7. Open your text editor.
8. Type in the following code. The link copied above can be pasted in for the bolded text below but the question mark (?) and all subsequent text must be deleted from the copied link. Be sure to keep the quotes.

```
<html>
<title>Simple Leaflet WMS Example</title>
<link rel="stylesheet" href="http://leafletjs.com/dist/leaflet.css"/>
<div id="map" style="width: 800px; height: 600px"></div>
<script src="http://leafletjs.com/dist/leaflet.js"></script>
<script>

        // Define the map
        map = new L.Map('map');

        // Add the Open Street Map baselayer
        map.addLayer(new L.TileLayer('http://{s}.tile.openstreetmap.org/{z}/{x}/{y}.png'));

        // Center the map over the US
        map.setView(new L.LatLng(39.833, -98.583), 4);

        // Add NGDS data as an overlay
        var wmsLayer = L.tileLayer.wms(
'http://geothermal.isgs.illinois.edu/ArcGIS/services/aasggeothermal/MOBoreholeTemperatures/MapServer/WMSServer',
                {layers: 'BoreholeTemperature', format: 'image/png', transparent: true});
        map.addLayer(wmsLayer);

</script>
</html>
```

9. **Save** the file as **LeafletExample.html**.

10. **Close** LeafletExample.html.
11. Double-click LeafletExample.html to open it in your web browser.
12. See **http://leafletjs.com/** for more enhancements that can be added to the map.

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

OneGeology: View and Download Multiple-Scale Geologic Maps

Difficulty: Intermediate
Prerequisites: Web Browser

View OneGeology geologic maps registered with NGDS.

1. Go to http://portal.onegeology.org/ to access OneGeology data.
2. In the top right of the page, deselect the box next to **Automatically display layers depending on scale and location**.
3. Zoom into the southwestern United States, centered on Nevada.
4. Click the **Add OneGeology map layers** icon (with the green + sign and folder image).
5. In the pop-up window, scroll down to **North America** and expand the **United States of America** folder.
6. Expand the **Nevada** folder.
7. Turn on and off a few of the layers listed for a better understanding of the scope of the Nevada geologic data available.
8. Turn on the last 3 layers by clicking the boxes of Contacts, Faults, and Geology for **US-NV NBMG 1:62.5k**.
9. Close the pop-up window.
10. Zoom in to the largest and most southern map section.
11. Zoom in again to the smaller of the two areas.
12. Click the icon with the arrow and blue identify symbol.
13. Click on any of the light blue map sections. A pop-up window appears with the features in the web service.
14. Move the scroll bar of the window to the right to find the **metadata_uri** field. This indicates the URL for the metadata housed at NGDS.
15. Using your mouse, highlight the entire URL in the field and right-click. Select **Copy**.
16. Paste this URL into a new browser tab. This shows the NGDS metadata record for that specific geologic quad map, having downloadable shapefiles and more information about the map.

Challenge Question: What is the age and lithology of the light blue unit on this map?
Answer: Jurassic Quartz Monzonite

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

Powell & Cummings Geothermometry

Difficulty: Intermediate
Prerequisites: Web Browser, Microsoft Excel (or some comparable software)

This scenario is designed to show how NGDS geothermometry data can provide geochemical ternary diagrams and other helpful analyses by exploiting *Spreadsheets for Geothermal Water and Gas Geochemistry*, Powell and Cummings 2010.

1. Go to http://search.geothermaldata.org/.
2. Type **California Powell Cummings** into the search box.
3. In the results, click on **California Powell and Cummings Geothermometry Analyses** option.
4. Mouse-over the access options on the left.
5. Click on Excel workbook containing geothermometry data for the state of California opening an Excel file containing all of the attributes from the CAPowellCummingsGeothermometry web service as a data download. Save this file to Desktop.
6. Back at the search page http://search.geothermaldata.org/ type **stanford geothermometry reports** into the search box.
7. In the results, click on **Geothermal Water and Gas Geochemistry; Constructing Geothermometry Reports (Stanford)** option.
8. Mouse-over the access options on the left.
9. Click on Liquid Analysis Excel Spreadsheets, Powell and Cumming 2010.xlsx to download and open. Click on the tab labeled **Input**.
10. You will now input the data download into the Powell and Cummings Liquid Chemistry analytical workbook.
    a. Open the data download file saved on Desktop in Step 5 and click on the tab labeled **LiquidAnalysis**.
    b. Copy the data in the entire column labeled **AnalysisName**. Paste this into the Powell and Cummings spreadsheet under the field labeled **Sample Name**.
    c. From the data download, copy the data in the entire column labeled **FluidTemperature_C**. Paste this into the Powell and Cummings spreadsheet under the field labeled **Temp C**.
    d. From the data download, copy the data in entire columns labeled **ph** through **del_D**. Paste this into the Powell and Cummings spreadsheet under the fields labeled **ph** through **del D**.
11. Note that in tabs labeled **Kmckn**, **Xkmc**, **Trlc** and **Tclb** the ternary diagrams have been populated based on the data entered.

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

ArcMap: Finding Thermal Springs near Major Roads

Difficulty: Advanced
Prerequisites: Web Browser, ArcMap

This scenario demonstrates how to perform simple analysis with ArcMap using NGDS data and freely available infrastructure data from the US Census Bureau.

1. Go to http://search.geothermaldata.org/.
2. Type in **Utah Thermal Spring Features** in the search field.
3. Click on the **Utah Thermal Spring Features** option.
4. Mouse-over the access options on the left.
5. Right click on **WFS Capabilities**.
6. Select **Copy Link Location/Address/Shortcut**.
7. Open **ArcMap** from the icon on the Desktop.
8. On the toolbar, under **Geoprocessing**, select **Search For Tools.**
9. In the search box type **wfs**.
10. From the results click on **WFS To Feature Class (Conversion)**.
11. In **WFS Server** paste the link copied from above (http://web2.nbmg.unr.edu/ArcGIS/services/UT_Data/UTThermalSprings/MapServer/WFSServer?request=GetCapabilities&service=WFS).
12. Delete the question mark (**?**) and all text after it from the link, so that the text in the box now reads: http://web2.nbmg.unr.edu/ArcGIS/services/UT_Data/UTThermalSprings/MapServer/WFSServer.
13. Click in the box **Select Feature Type to Extract** and select **ThermalSpring**.
14. Choose the OutputLocation of **Default** geodatabase in Documents/ArcGIS.
15. Click **OK** and the thermal springs will be added to the map. *If the feature class is not automatically added to the map, go to **Windows** and choose **Catalog**. Navigate to the Documents/ArcGIS folder, Default.gdb, then click on ThermalSpring feature class and drag it directly onto the map.*
16. Back in your web browser go to http://www.census.gov/cgi-bin/geo/shapefiles2013/main.
17. Select **Roads** as the layer type from the **Select a layer type** drop-down list.
18. Click **Submit**.
19. Under Primary and Secondary Roads, select **Utah**.
20. Click **Download** to download a shapefile of major roads in Utah. Choose **Save**.
21. Open a Windows Explorer window and navigate to the **Downloads** folder.
22. Choose the tl_2013_49_prisecroads.zip file, right-click and choose **Extract All…** This will pop-up a new window with the extracted files.
23. Highlight and drag the files directly onto the map in **ArcMap.** *If you receive a Geographic Coordinate Systems Warning, click **Close**.*
24. On the map toolbar, under **Selection**, choose **Select By Location...**.

25. For Selection Method choose **select features from**.
26. Check **ThermalSpring** as the Target layer.
27. Select the downloaded Roads file, **tl_2013_49_prisecroads**, as the Source layer.
28. For the Spatial selection method choose **Target layer(s) features are within a distance of the Source layer feature**.
29. Apply a search distance of **5 miles**. Click **OK**.
30. In the Layers list right click on the **ThermalSpring** layer.
31. Select **Open Attribute Table** to view all of the thermal springs in Utah within 5 miles of a major road.

Challenge Question: How many thermal springs are there in Utah within 5 miles of major road?
Answer: 170

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

QGIS: Searching for and Displaying Data Variably by Temperature Attributes

Difficulty: Advanced
Prerequisites: Web Browser, Excel or text editor, QGIS (Free download at http://qgis.org)

This scenario exemplifies how web service data is arguably the most accessible form of data distribution, as is the format ingested by countless free and open source GIS applications and map viewer. QGIS (QuantumGIS) is such an application which runs on a variety of platforms with numerous available plugins which allow the user to perform terrain analysis and input GPX and DEM data as well as WFS and WMS. Additionally, this application has the functionality to display points variably based on the WFS data.

1. In a browser, go to http://search.geothermaldata.org/. Type in arizona borehole temperatures in the search field.
2. Click on the Arizona Borehole Temperatures option.
3. Mouse-over the access options on the left. Right click on WFS Capabilities.
4. Select Copy Link Location/Address/Shortcut.(http://services.azgs.az.gov/ArcGIS/services/aasggeothermal/AZBoreholeTemperatures/MapServer/WFSServer?request=GetCapabilities&service=WFS)
5. Open QGIS.
6. On the toolbar select Layer then choose Add WFS Layer.
7. In the window Add WFS Layer from a Server, choose New.
8. In the Connection Details area type AZBoreholeTempertures for the name and paste the WFS link copied from the steps above into the URL box. Click OK.
9. Click Connect and then highlight the layer displayed in the box below.
10. Click Add to add the layer to the map.
11. To identify a feature, click the Identify tool (in the middle of the lowest toolbar) and choose a point on the map. A pop-up box will display with the data from the chosen feature. Click Close to close the pop-up.
12. In the toolbar, click the down arrow next to the Select Single Feature icon (yellow box with white arrow) and choose Select Features by Rectangle.
13. Draw a rectangle around a subset of features.
14. Right-click the layer from the Layers tree on the left. Choose Open Attribute Table.
15. In the Attribute Table window in the drop-down menu in the bottom left select Show Selected Features. Choose the Copy selected rows to clipboard icon at the top or press Ctrl+C on your keyboard.
16. Open an Excel or text file and paste or press Ctrl+V on your keyboard for a copy of the selected data.
17. Back in QGIS, right-click on the WFS layer (aasg:BoreholeTemperature) and choose Properties from the list.

18. Under the Style tab, choose Rule-based from the drop-down list in the upper-left corner.
19. Click the Add Rule icon (green plus symbol) at the bottom.
20. In the new Rule properties pop-up, type 100F-200F into the Label field.
21. Click … button next to Filter.
22. In the Expression box of the new pop-up, type in the following expression: "MeasuredTemperature" > '100' AND "MeasuredTemperature" < '200'. Click OK.
23. Back in the Rule Properties pop-up, click the color box to change the color of the symbol to orange. Click OK.
24. Click OK again to close the Rule Properties window.
25. Back in the Layer Properties pop-up, click Add Rule again.
26. In the new Rule properties pop-up, type 200F+ into the Label field.
27. Click … button next to Filter.
28. In the Expression box of the new pop-up, type in the following expression: "MeasuredTemperature" > '200'. Click OK.
29. Back in the Rule Properties pop-up, click the color box to change the color of the symbol to dark red-orange. Click OK.
30. Next to the Size parameter, change the size to 4.00. Click OK.
31. Click OK again in the Layer Properties pop-up to close it.
32. Back in the Attribute Table window click the Select Features by using an Expression icon.
33. In the Expression box of the new pop-up, type in the following expression: "MeasuredTemperature" > '200'. Click Select and then Close.
34. Look next to the title of the Attribute Table window to see how many features have been selected.

Challenge Question: How many Arizona wells are documented with temperatures higher than 200F?
Answer: 43

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

uDig: Discover Related Datasets Using Foreign Keys

Difficulty: Advanced
Prerequisites: Web Browser, uDig (Free download from http://udig.refractions.net/)

This scenario show how the free desktop GIS platform, uDig, provides data access, editing, and viewing for NGDS data published as either a Web Map Service (WMS) or Web Feature Service (WFS). Additionally, discover how NGDS web services use foreign keys to make associated data services discoverable.

1. Go to http://search.geothermaldata.org/. Type in **california aqueous chemistry** in the search field.
2. Click on the **California Aqueous Chemistry** option.
3. Mouse-over the access options on the left. Right click on **WMS Capabilities**.
4. Select **Copy Link Location/Address/Shortcut**.
5. Open **uDig**.
6. On the toolbar click on the **Layer** drop-down list and choose **Add** to add data.
7. Select **Web Map Server** and click **Next**.
8. **Paste** the link copied in the steps above http://services.azgs.az.gov/ArcGIS/services/aasggeothermal/CAAqueousChemistry1_10/MapServer/WMSServer?request=GetCapabilities&service=WMS) and click **Next**.
9. Make sure all of the layers are **checked**. Click **Finish** to add the data to the map.
10. In the Layers Box, right click **CommonAnalytes**. Select **ZoomToLayer**.
11. Uncheck all of the layers in the Layers box except **CommonAnalytes**.
12. On the far right of the uDig window click **Info** to expand and in the **Info** submenu click **Info**.
13. Click on any point to show the attributes for that feature in the **Information** window below.
14. In the Information display, move the horizontal scroll bar to the right to find the **SamplingFeatureURI** field. This field acts as a foreign key to another Tier 3 NGDS service (in this case, the CAThermalSprings service) associated with the features in this service.
15. Use your cursor to highlight the entire URL listed in that field. Right-click and choose **Copy**.
16. Open a new tab in your browser and paste in the copied URL. You will get an XML-representation of that data point from the associated service.
17. Also explore California well headers related resources by adding the CAWellHeaders WFS.
18. Go to http://search.geothermaldata.org/. Type in **california well headers** in the search field.
19. Click on the **California Well Headers** option.
20. Mouse-over the access options on the left. Right click on **WFS Capabilities**.

21. Select **Copy Link Location/Address/Shortcut**.
22. Back in uDig, click on the **Layer** drop-down list and choose **Add** to add data.
23. Select **Web Feature Server** and click **Next**.
24. **Paste** the link copied in the steps above (http://services.azgs.az.gov/arcgis/services/aasggeothermal/CAWellHeaders/MapServer/WFSServer?request=GetCapabilities&service=WFS) and click **Next**.
25. Choose **Window** then **Show View**.
26. From that drop-down list, choose **Table**. The features from the WFS will be added to the Table window below the map.
27. In the Table display, move the horizontal scroll bar to the right to find the **RelatedResource** field. Some links in this field act as a foreign key to another Tier 3 NGDS service (in this case, the CAWellLogs service), while some links explore other related material.
28. Use your cursor to highlight an entire URL listed in that field. Right-click and choose **Copy**.
29. Open a new tab in your browser and paste in the copied URL. You will get an XML-representation of that data point from the associated service.

Challenge Question: What is the Information Source of the California Well Header data?
Answer: CADOGGR, California Division of Oil, Gas & Geothermal Resources

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.

USGS National Map Viewer: Geologic Maps with Borehole Temperature Data

Difficulty: Advanced
Prerequisites: Web Browser

The scenario demonstrates how to view a Geologic Map and Borehole Temperature Data using the USGS National Map View and then query for information. For example, what wells and temperature data exist in a given geologic formation?

1. Go to http://search.geothermaldata.org/. Type in **arizona geologic map** in the search field.
2. Click on the **Geologic Map of Arizona at 1:1,000,000-scale** option.
3. Mouse-over the access options on the left. Right click on ESRI Service Endpoint.
4. Select **Copy Link Location/Address/Shortcut**.
5. In a new web browser tab or window go to the National Map Viewer at http://viewer.nationalmap.gov/viewer/.
6. Under the Advanced tab, choose the green **Add Data** button. Add data to the **AGS, ArcGIS Server** option.
7. In the Rest Url box paste the link copied in the steps above (http://services.azgs.az.gov/ArcGIS/rest/services/OneGeology/AZGS_Arizona_Geology/MapServer).
8. Click **Connect**. This will add the Arizona Geologic data to the map.
9. Under User Added Content on the Overlays tab to the left of the map, click the down arrow to the left of the **AZGS_Arizona_Geology** layer.
10. Click **Transparency** and move the slider to 50%.
11. Back at the Catalog Search http://search.geothermaldata.org/ type in **arizona borehole temperatures** in the search field.
12. Click on **Arizona Borehole Temperatures**.
13. Mouse-over the **Access Options** on the left. Right click on ESRI Service Endpoint.
14. Select **Copy Link Location/Address/Shortcut**.
15. Go back to the National Map Viewer. Under the Advanced tab, again choose the green **Add Data** button. Add data to **AGS, ArcGIS Server**.
16. In the Rest Url box paste the link copied from the steps above (http://services.azgs.az.gov/ArcGIS/rest/services/aasggeothermal/AZBoreholeTemperatures/MapServer). Click **Connect.**
17. Still in the **Advanced** tab, click the **Query Builder** button. Click **Next** to Build a Simple Query.
18. On the drop down list for Select Service choose **AZGS_Arizona_Geology**. Click **Next**.
19. In the drop down list choose the **US-AZ_AZGS_1M_Lithostratigraphy** layer a. Click **Next**.
20. In Columns, click once on **geologicHistory** to add it the Query box. *It will not look like anything happens with one click, but in the Query box below the columns list you'll see*

geologicHistory is now listed as part of the query being created.

21. Click once on the **=** sign under Operators.
22. Click **Get Sample Values**; the Sample Values box will display the unique data within that field.
23. Click once on the result **Early Jurassic, about 180-210 MA** to add it to the query.
24. Click **Run Query** at the bottom. When the query runs, a pop-up box is displayed to show how many features have been selected by the query. There should be 20. Click **OK.** The Early Jurassic, about 180-210 MA selected areas are now highlighted in green.
25. Above the Map, go to the Standard Tab and click the **Zoom In Box** button (magnifying glass + icon). Zoom in to the green selected area near the Utah-Arizona border between St. George, UT and Kanab, UT.
26. From the Standard tab, click the **Identify** button.
27. In the panel to the left of the map, in the Selection - Identify Layers tab **uncheck** every layer except AZBoreholeTemptures.
28. Draw a box around the two points near Hildale, UT which are in the green highlighted Early Jurassic lithostratigraphy.
29. In the Results tab to the left of map, for each of the two points, click **More** and then **Get Elevation**.
30. A pop-up will appear with more details about the boreholes with a recorded temperatures in the Early Jurassic lithostratigraphy.

Challenge Question: What is the Measured Temperature for these two Arizona wells located near Hildale, UT in the Early Jurassic lithostratigraphy?
Answer: 80F & 84F

If you've completed this scenario, please visit http://NGDS2.geothermaldata.org to take a short survey that will help us to enhance the user experience.