

## Geothermal Prospector

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National Renewable Energy Laboratory

Systems Analysis, Resources Assessment, Data System  
Development & Population, Education

## 4.6.2.1 Data and Analysis Tools (Geothermal Prospector)

### Objective

- The Geothermal Prospector provides access to explore, query, visualize, and download data necessary for understanding the costs, risks, and potential for geothermal renewable energy.
- Reduce the inherent cost in finding and formatting data necessary for geothermal exploration by
  - Providing a venue where users can find the best data and analysis that can be freely provided by the federal government.
  - Providing a tool to identify areas with high geothermal potential with minimum of access constraints

### GTO Goals

#### Systems Analysis:

- Lowering risks and costs of development and exploration
- Providing the geothermal industry with information necessary to make informed decisions on exploration and development.
- Assist in identification of large commercial uses are near geothermal resources to spur direct use applications.

#### Hydrothermal:

- Assist in identification of new play fairways

#### EGS:

- Identify areas where EGS demonstrations could come online or where transmission is available for geothermal.

## 4.6.2.1 Data and Analysis Tools (Geothermal Prospector)

### Challenges Addressed

- Lowering costs and risk in exploration through the provision of data and analysis capabilities representing a large portion of the available spatial data related to geothermal exploration that can be provided for free by the US government.

### Industry/GTO Impact

- Geothermal Prospector will assist accelerating near-term geothermal growth by providing industry and researchers with the capability to identify potential exploration sites by integrating geologic and land use/access data sets.
- Geothermal Prospector provides a coordinating piece in the GTO suite of tools including NGDS and GDR by supporting the provision of spatial datasets to the NGDS (as a Node) as well as providing a venue to view and query data listed on the NGDS and served from other institutions.

### Integration

- Prospector provides an analysis platform with selected data to be drawn from NGDS and other data sources.
- Shapefiles acquired by NREL for analysis not currently available in NGDS will be made available to the NGDS as standards based web services.

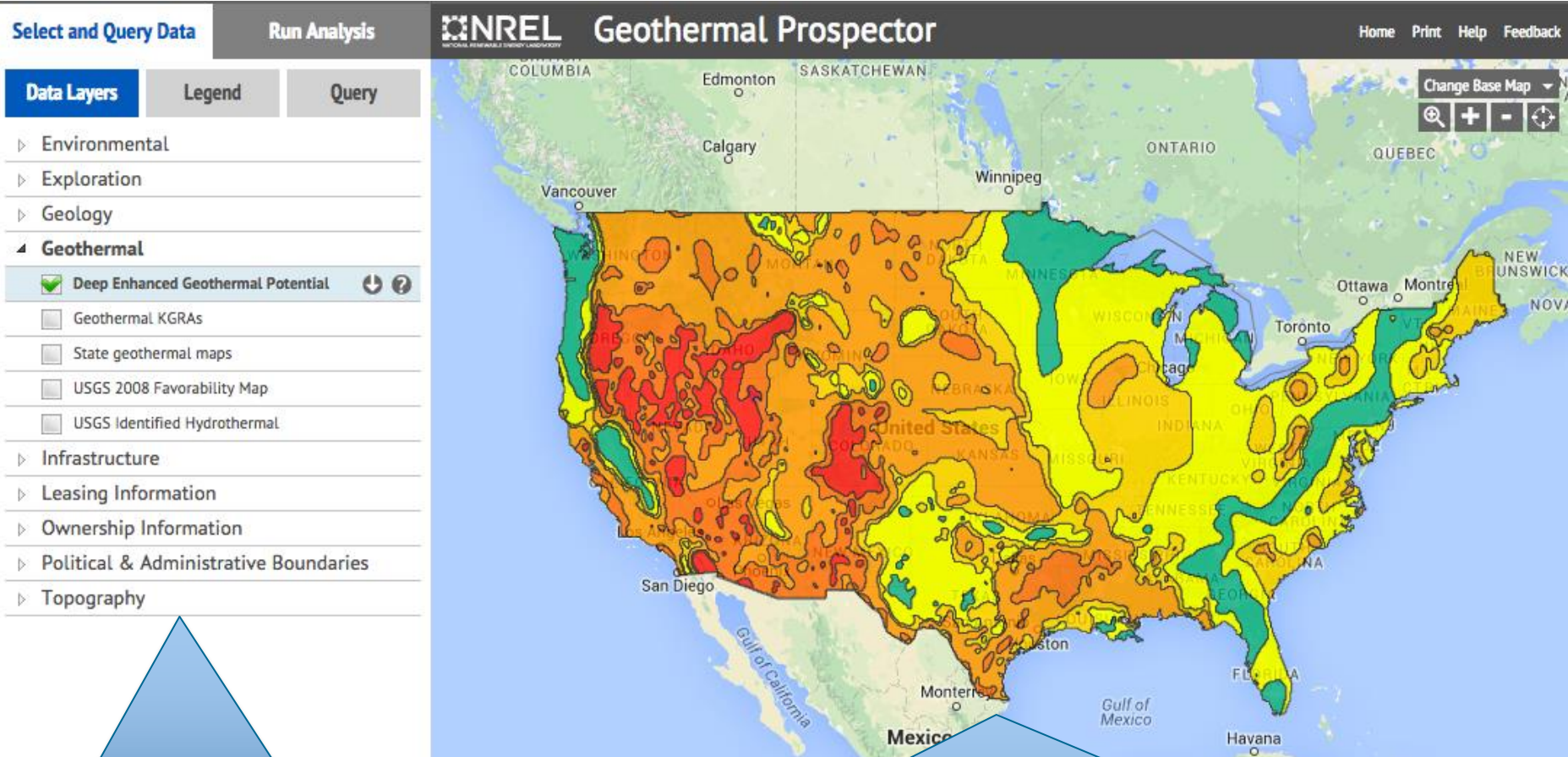
- Tenants of our Technical Approach
  - Integrative (as opposed to duplicative)
    - The Geothermal Prospector is built on the OpenCarto framework. OpenCarto was built by NREL to support web based GIS applications. It utilizes open source libraries and currently supports more than 14 individual applications focused on various RE technologies. Each project shares data, resources, and analysis capabilities which reduces short-term development costs and long-term maintenance costs.
  - Interoperable
    - Through the utilization of standards based data services, the Geothermal Prospector application is very much interoperable with the NGDS. This interoperability is key in our efforts to visualize data listed in NGDS within the prospector application and in the development of a catalog search that allows prospector to actually search datasets in the NGDS.
  - User Focused
    - User needs are the main driver in the development of the Geothermal Prospector. The new version of this application is focused on streamlining tools to focus on data download and visualization of complex data; both of which are direct requests from our user community.

- User Feedback and Engagement
  - The Geothermal Prospector is filling an important role for geothermal stakeholders, but there is great potential to increase its impact
  - Addressing this concern in FY 2015
    - Peer Review Presentation
      - Very much interested in feedback on
        - » Which datasets would be good to add and maintain in the prospector?
        - » Which projects can benefit by including their research in the prospector?
        - » Analysis and visualizations that can be added to support GTO activities?
      - Live demonstration and discussion planned for the end of this session
    - GRC Presentation
      - Looking for feedback from other researchers and industry in these same topics
    - Webinars
      - Making sure people know about the tool, how to use it, and that it is available for their use in accessing data as well as providing data to other researchers
    - Videos
      - Providing training on how to use the tool

# Accomplishments, Results and Progress

Original Planned Milestone/ Technical Accomplishment	Actual Milestone/Technical Accomplishment	Date Completed
Version 1 of Geothermal Prospector completed and delivered to DOE	As described	9/2012
Enhanced analysis capabilities and additional datasets added to the application and delivered to DOE	As described	9/2013
Initial integration with NGDS released	As described	4/2014
Prototype of Multivariate (Wells) Visualization capability released	As described	9/2014
Beta version of new OpenCarto architecture update to Geothermal Prospector released	Delayed: Was due 3/31/2014	9/2014
Final version of OpenCarto architecture update to Geothermal Prospector released	Delayed: Was due at the EOFY 2014	4/2015
<b><i>FY 2015 Milestone and Decision Point:</i></b> To present the Geothermal Prospector at the DOE annual peer review and receive feedback on its usefulness to geothermal research community.	As described	5/2015
Present the Geothermal Prospector at the GRC summit and receive feedback on its usefulness to geothermal research community.	As described	8/2015
Present the Geothermal Prospector at the GRC annual meeting and receive feedback on its usefulness to geothermal research community.	As described	9/2015

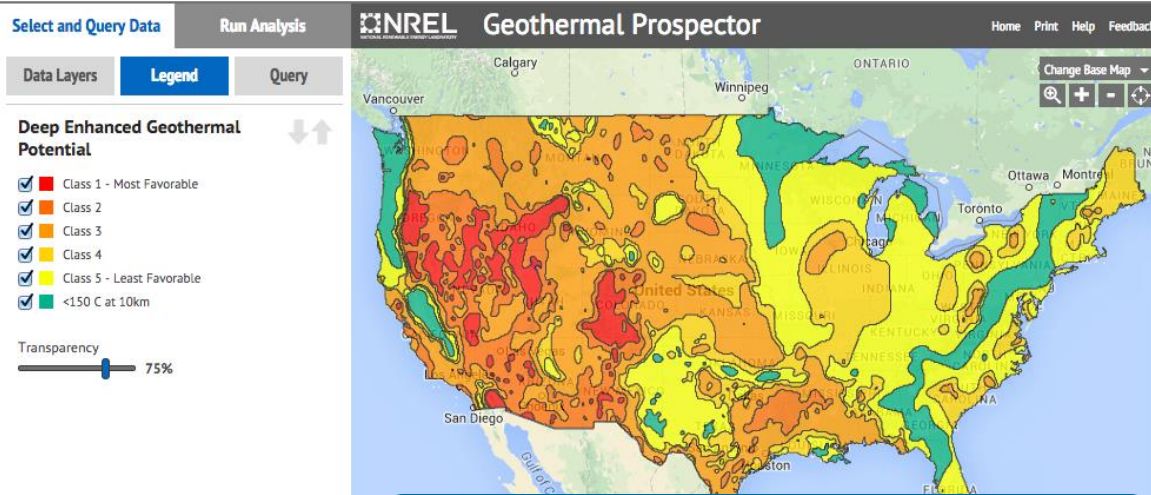
# Accomplishments, Results and Progress



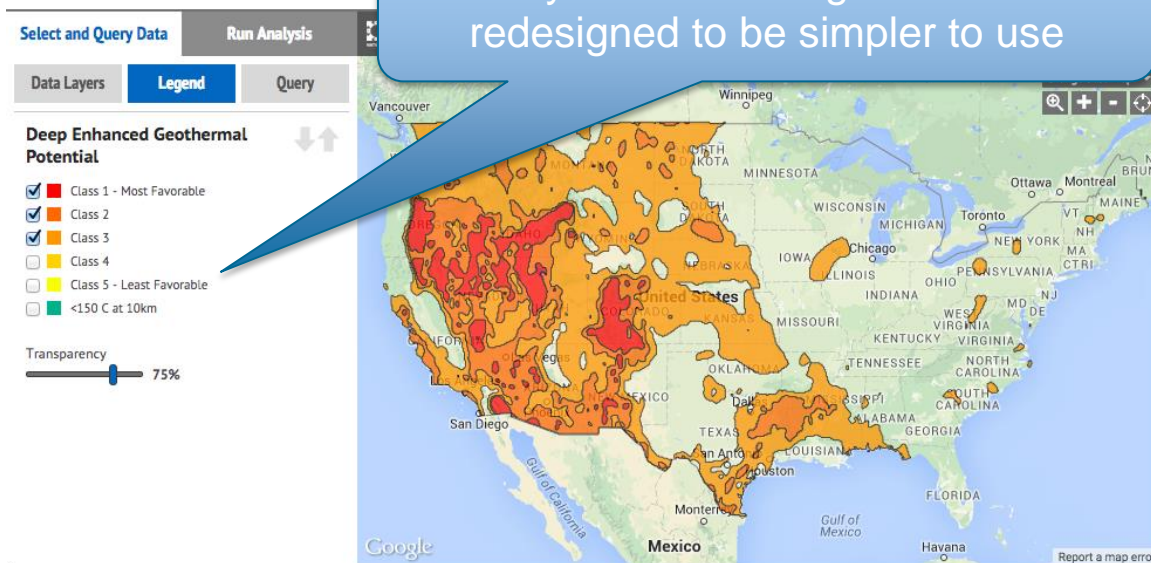
The interface has been completely redesigned based on user feedback to be simpler and more intuitive to use

Data storage, data services, and all hardware are new and fit within an architecture that improves both performance and reliability

# Accomplishments, Results and Progress



Layer thresholding has been redesigned to be simpler to use



**Deep Enhanced Geothermal Potential**

Download map layer data in the following geospatial data formats:

Downloading the datasets and accessing metadata are exceedingly simple

Source data for deep EGS includes temperature at depth from 3 to 10 km provided by Southern Methodist University Geothermal Laboratory (Blackwell and Richards 2009) and analyses (for regions with temperatures  $\geq 150$  degrees C) performed by NREL (2011). Class values reflect relative favorability with 1 being most favorable 5 being least favorable and 999 not having been assessed due to temperatures less than 150 degrees C at 10 km depth.



# Accomplishments, Results and Progress

**Operating Geothermal Power Plants**

Result 1 of 2

- Conversion: Double Flash
- Technology:
- County: Lander
- Latitude: 40.554741
- Longitude: -116.617272
- Plant Capacity (MW): 15
- Plant Name: Beowave
- Plant Operator: Terra Gen
- Year operational: 1,985

Result 2 of 2

**Query Options:**

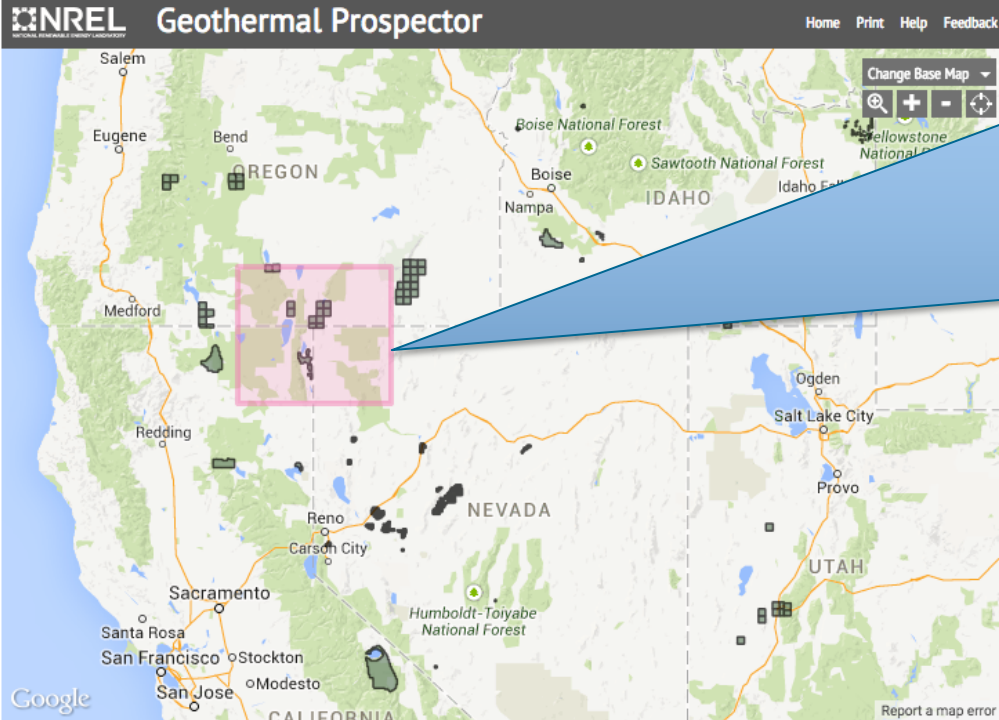
- Point Query:** Select a single point on the map and get data for that location.
- Region Query:** Select an area on the map and get data for that area.
- Custom Shape Query:** Draw a custom shape on the map and view data for that area.
- Attribute Query:** Use this advanced feature to filter your

Plant Name	Plant Operator	Conversion Technology	Plant Capacity (MW)	County	Year operational	Latitude	Longitude
Wabuska I	Home Stretch Geothermal	Binary	1.2	Lyon	1,984	39.164456	-119.180797
Wineagle	Wineagle Development	Binary	0.7	Lassen	1,985	40.356934	-120.25641
Steamboat I	Ormat	Binary	6.9	Washoe	1,986	39.394003	-119.753659
San Emidio	US Geothermal	Binary	4.8	Washoe	1,987	40.369215	-119.405712
Soda Lake 1	Magma Energy	Binary	1.1	Churchill	1,987	39.555398	-118.838285
Wabuska II	Home Stretch Geothermal	Binary	1.1	Lyon	1,987	39.164456	-119.180797

# Accomplishments, Results and Progress

Select and Query Data

Run Analysis



## Geothermal Analysis

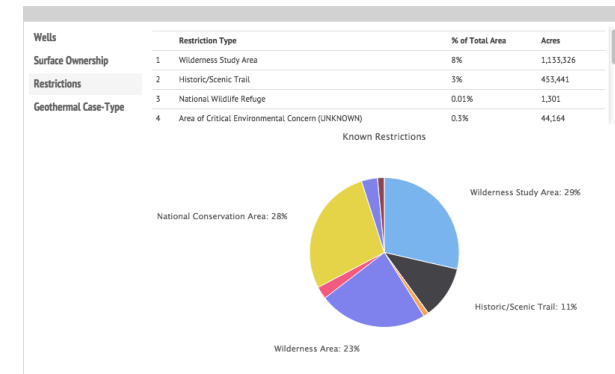
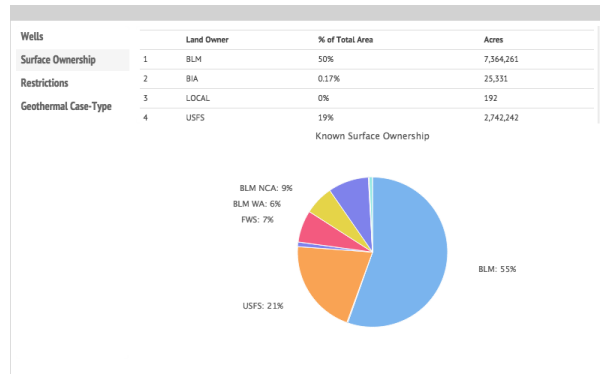
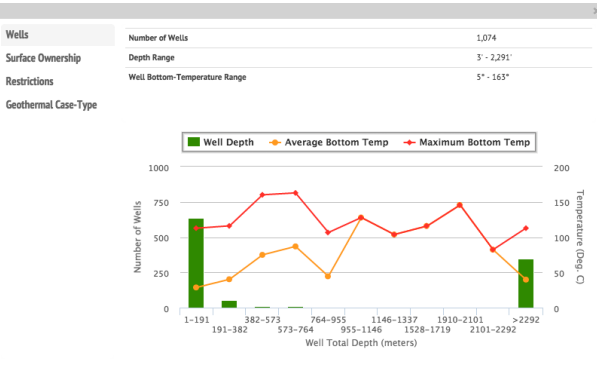
Use the drawing tool to select a single region. When a region has been selected the analysis will be displayed.

## Wells Visualization Tool

Several datasets representing a variety of well types have been consolidated into a single set of over 500k wells. These wells can be filtered and visualized based on maximum temperature and on total depth. Zooming into the map will display aggregate the data at the state level, then the county level, and finally show the actual wells.

Summary analysis for a user specified region provides summary of:

- Available wells
- Land Ownership
- Land Use Restrictions



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**Dataset extent**

Map data © OpenStreetMap contributors  
Tiles by MapQuest

**Ratings**

★★★★★ 0 reviews

[Dataset](#) | [Activity Stream](#) | [Related](#)

## Nevada Borehole Temperatures

This resource is a compilation of borehole temperature observation data from Nevada oil and gas, geothermal, and water wells obtained by the Nevada Bureau of Mines and Geology. The data are available in the following formats: web feature service, web map service, ESRI service endpoint, and an Excel workbook for download. The document contains 5 worksheets, including information about the template, resource provider information, the data, and a field list (data mapping view), as well as an extra worksheet detailing the data extraction from the NDWR Well Logs Database. This resource was provided by the Nevada Bureau of Mines and Geology and made available for distribution through the National Geothermal Data System.

### Data and Resources

- NGDS RSS feed for services notifications**  
*No description for this resource*
- Service Description**  
 parameters:{layers:"BoreholeTemperature"}
- Service Description**  
 parameters:{typeName:"BoreholeTemperature"}
- Service Description**  
*No description for this resource*
- Zippped Excel Workbook containing Borehole**  
*No description for this resource*

[View Resource](#) | [Preview](#) | [GetCapabilities](#) | [Geothermal Prospector](#)

Integration with NGDS allows users to launch the GTP with data listed in the NGDS catalog

Through developments in collaboration with USGIN, the Geothermal Prospector will be capable of searching the NGDS and loading data directly from that catalog.

**Geothermal Prospector**

Home | Print | Help | Feedback

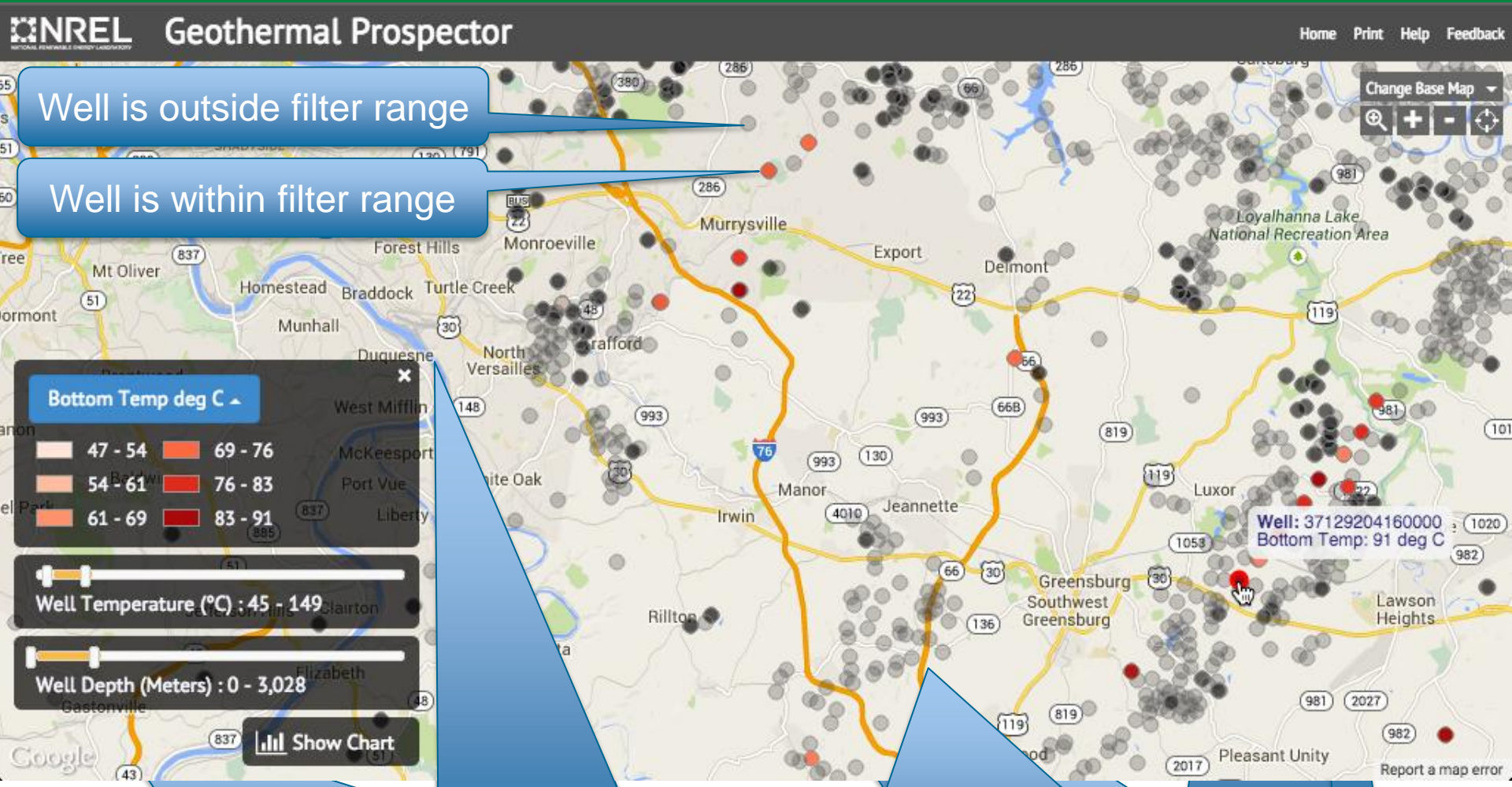
[Select and Query Data](#) | [Run Analysis](#)

[Data Layers](#) | [Legend](#) | [Query](#)

**User Added External Layers**

- BoreholeTemperature
- Environmental
- Exploration
- Geology
- Geothermal
- Infrastructure
- Leasing Information
- Ownership Information
- Political & Administrative Boundaries
- Topography

Report a map error



- Future plans, beyond FY 2015, for the Geothermal Prospector will be focused in four areas
  - User feedback
  - Data enhancements and maintenance
  - Systems integration and interoperability (NGDS and GDR)
  - Development of new analysis and visualization focused on enhancing GTO efforts in play fairways and other analysis focus areas

## Milestone or Go/No-Go

## Status & Expected Completion Date

***FY 2015 Milestone and Decision Point:*** To present the Geothermal Prospector at the DOE annual peer review and receive feedback on its usefulness to geothermal research community.

5/2015 – Meetings will occur based on feedback from this presentation and follow on conversations

- Geothermal Prospector helps GTO meet its goals and objectives of lowering the risk and cost of geothermal exploration by providing current relevant geothermal data and tools to a wide group of stakeholders
- Geothermal Prospector currently supports several important needs in the geothermal research community
  - Provides access to explore, query, visualize, and download data necessary for understanding the costs, risks, and potential for geothermal renewable energy.
  - Provides a venue for spatial datasets resulting from DOE funded research to be shared with the public, research communities, and industry
  - Provides a visualization capability that can be used to explore complex datasets
  - Fills an important role in the GTO tool set, currently comprised of the NGDS, the GDR, and the Geothermal Prospector
- There is a direct need to ensure stakeholders are aware of the application and GTO project participants are using it to download and provide access to their own data

**Select and Query Data**    **Run Analysis**    **NREL Geothermal Prospector**    Home Print Help Feedback

**Data Layers**    Legend    Query

- Environmental
- Exploration
- Geology
- Geothermal
  - Deep Enhanced Geothermal Potential
  - Geothermal KGRAs
  - State geothermal maps
  - USGS 2008 Favorability Map
  - USGS Identified Hydrothermal
- Infrastructure
  - Operating Geothermal Power Plants
  - Developing Geothermal Projects
- Transmission
- Wells
  - AASG Geothermal Boreholes
    - BLM GRASS Wells
    - Great Basin Temperature Profile Wells
    - Regional Heat Flow Database
    - SMU Borehole Temperatures
    - SMU Geothermal Boreholes
    - SMU Heat Flow
    - SMU Thermal Conduction
    - Western Geothermal Area Database
- Leasing Information
- Ownership Information
- Political & Administrative Boundaries

**NREL Geothermal Prospector**    Home Print Help Feedback

State: California    Max Drill Depth: 8,019 m

**Max Drill Depth m**

- 350 - 3,212
- 3,212 - 6,075
- 6,075 - 8,935
- 8,935 - 11,796
- 11,796 - 14,658
- 14,658 - 17,520

**Summary of Wells for California**

Well Depth    Average Bottom Temp    Maximum Bottom Temp

Number of Wells

Well Temperature (°C) : 0 - 1,000

Well Depth (Meters) : 0 - 17,520

Your questions and feedback are very much appreciated

Surface Ownership	% of Total Area	Acres
1 National Conservation Area	4%	481,875
2 Area of Critical Environmental Concern (OPEN)	0.57%	78,490
3 Historic/Scenic Trail	1%	170,250
4 Wilderness Study Area	2%	289,521

**Known Restrictions**

- National Conservation Area: 18%
- Wilderness Area: 35%
- National Recreation Area: 18%
- Area of Critical Environmental Concern (LNU): 1%
- Historic/Scenic Trail: 6%
- Wilderness Study Area: 13%

## Geothermal Prospector

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[http://maps.nrel.gov/gt\\_prospector](http://maps.nrel.gov/gt_prospector)