

Utilizing Geothermal Energy for Electric Power Generation on Contaminated Sites in the Great Basin Region of the U.S.

Introduction

In 2008, the Environmental Protection Agency (EPA) started the "RE-Powering America's Land Initiative" to encourage the development of renewable energy on contaminated land and mine sites in the United States (U.S.). Superfund sites, Brownfields, landfills, RCRA sites, and abandoned mine sites have the potential to provide significant amounts of renewable energy for electricity and heating. There are many benefits to these projects: the cost to build on these sites may be cheap, infrastructure (transmission lines, water access, buildings, roads) may already exist on the sites, and community awareness of these contaminated sites may increase. Society views contaminated sites as unattractive and shameful, but renewable energy projects can positively transform the image of these sites.

For my project, I determined the most optimal contaminated sites for geothermal-energy electricity development. I focused my analysis on the Great Basin region in the U.S. The variables I considered included: the proximity of each site to existing transmission lines (to connect to the grid), the subsurface temperature at each site, the proximity of each site to existing roads, the current status of the site (open/closed), and the number of sites in each county.



Figure 1. Project Region

Methodology

I performed a sequence of steps to identify the contaminated sites in the Great Basin region that are most suitable for geothermal-energy development.

- First, I identified the contaminated sites within the Great Basin region.

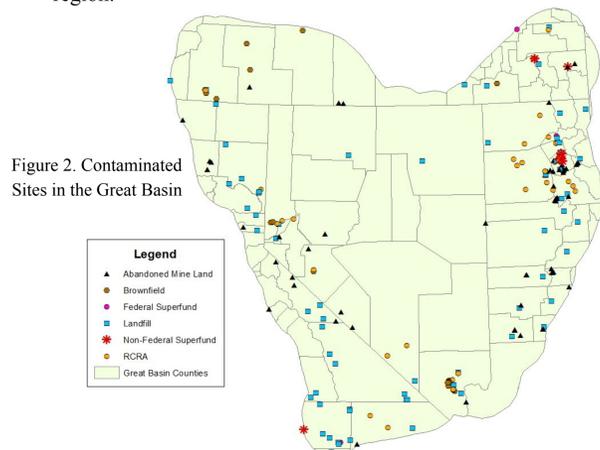


Figure 2. Contaminated Sites in the Great Basin

Determining which contaminated sites have the necessary subsurface temperature for geothermal electricity generation:

- I used the IDW Interpolation tool in the ArcGIS Toolbox to create a raster from the subsurface temperature shapefile, since the data was only given for certain points in the region.
- I created polygons to show where the subsurface temperature is 180 degrees Celsius or greater (this is the minimum temperature needed to generate electrical power).
- I selected the contaminated sites within the polygons to determine which sites have a subsurface temperature of 180 degrees Celsius or greater.

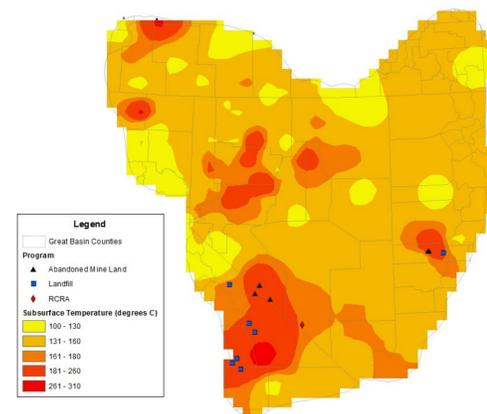


Figure 3. Sites with a Subsurface Temperature of 180 degrees Celsius or Greater

Determining which contaminated sites are near existing transmission line substations:

- I selected the endpoints of each transmission line because it is not possible to connect to the existing grid in the middle of a transmission line. Transmission lines can only be connected at the endpoints, because there is a substation at each endpoint.
- I determined the distance from each contaminated site to the closest transmission-line substation.
- I selected the sites that are less than ten miles from existing transmission-line substations. I chose ten miles in order to minimize construction costs and the electrical energy that is lost as thermal energy as it travels to the substations.

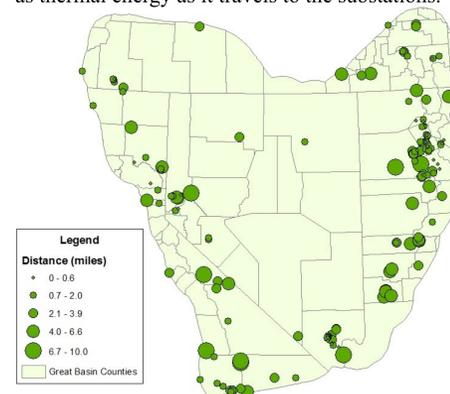


Figure 4. Sites within 10 miles of an Existing Transmission Line Substation

There are eight sites that meet both the subsurface temperature and transmission line qualifications.

Comparison of the Remaining Eight Sites:

- I did two spatial joins to determine the number of contaminated sites in each county and the distance from each contaminated site to the closest road.
- I used the results of these comparisons to decide which sites are more suitable for geothermal-energy development.

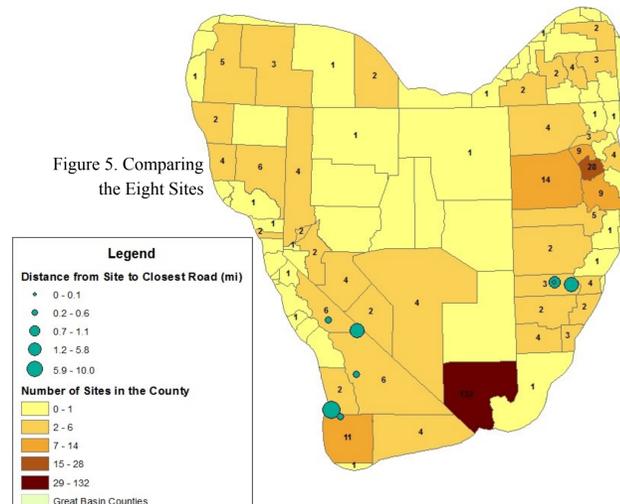


Figure 5. Comparing the Eight Sites

Results

Criteria for Decision:

- The requirements I set for geothermal development on a site were:
 - The site had to have the minimum subsurface temperature needed for electric power generation (180 degrees Celsius).
 - The site had to be within ten miles of an existing transmission-line substation.
- I compared the remaining eight sites based on three variables:
 - The distance from a site to the closest road. It is important that people can access the geothermal facility for maintenance and operation. The closer a site is to a road, the better.
 - The number of sites in the county that each site is within. If there are many contaminated sites in a county, then the county population is likely to be more aware of these sites and more supportive of transforming the sites into renewable systems.
 - The current status of the site (open/closed). Closed sites are more likely to be utilized for geothermal development because there would be less resistance to the project.

The most optimal contaminated sites for geothermal-energy development for electricity generation:

More Optimal	Kern Valley Landfill	} Tie
	Beaver County Tailings/Waste Rock	
Less Optimal	Lone Pine Disposal Site	
	Benton Crossing SLF	
	Milford Mill and Smelter	
	USDOJ BLM	
	Beaver County Landfill	
	Balance Rock Disposal Site	

[Note: The "tie" signifies that the sites had the same number of points in the point system I used to determine which of the eight sites are more optimal for geothermal development.]

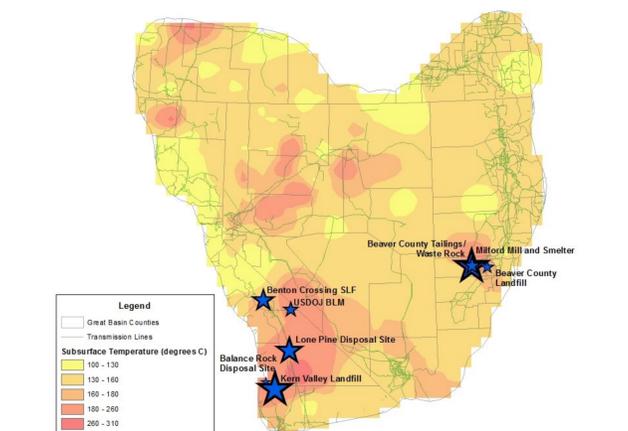


Figure 6. Comparison of the Eight Sites: More Optimal to Less Optimal