Geothermal Resources in Wyoming

Seth Wittke,
Wyoming State Geological Survey

Overview

- Current Applications
- State-wide Potential
- Future of Geothermal Advancement in Wyoming

Current Geothermal Applications

- RMOTC's Enhanced Geothermal System
- Direct Use Applications
- Tourism

Direct Use Geothermal Applications

- Normal Temperature Reservoirs
  - Water in normal geothermal gradients
- Warm Water Systems
  - Water at higher temperatures than geothermal gradient

Normal Temperature Reservoirs

- Very little if any data on residential heat pump systems
- Snow melting
  - I-80 16th Street off-ramp in Cheyenne, Wy
    - 47°F < 1 gallon/minute (gpm)
  - East Grand Street Bridge in Laramie, Wy
    - 47°F < 1 gpm

Warm Water Systems

- Jackson National Fish Hatchery
  - 80º F, 100 gpm
  - Annual Geothermal Energy Production ~ 4.9 Gigawatt hours/year (GWh/yr)
- Countryman Well, Lander Wy.
  - Used to heat a private greenhouse.
  - 98º F, 50 gpm
  - 0.6 GWh/yr
- Van Norman Residence, Thermopolis, Wy
  - Used for in home heating
  - 124º F, 100 gpm
  - 0.2 GWh/yr

Warm Water Systems

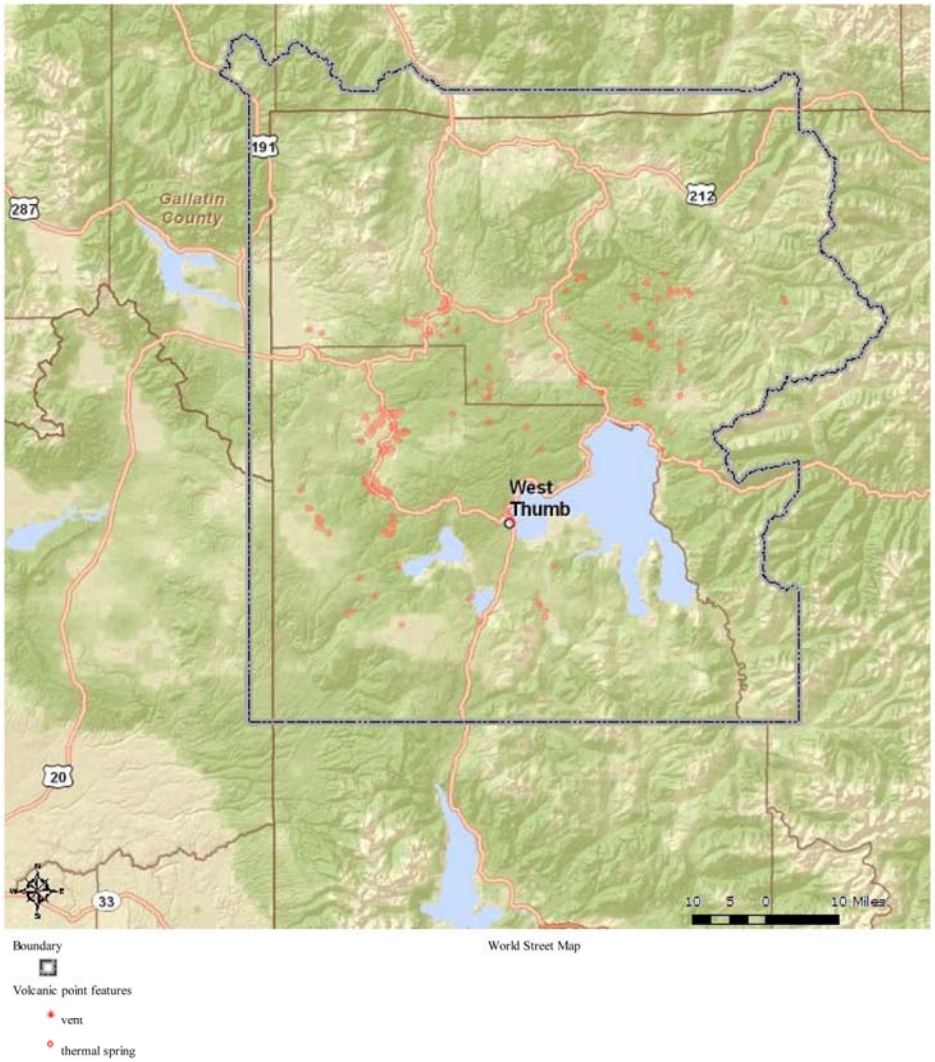
- 50 “Thermal” springs outside of Yellowstone National Park
- Temperatures range from 60º F in Conant Creek to 143º F at the Auburn Hot Springs
- Most flows are <1000 gpm

Tourism

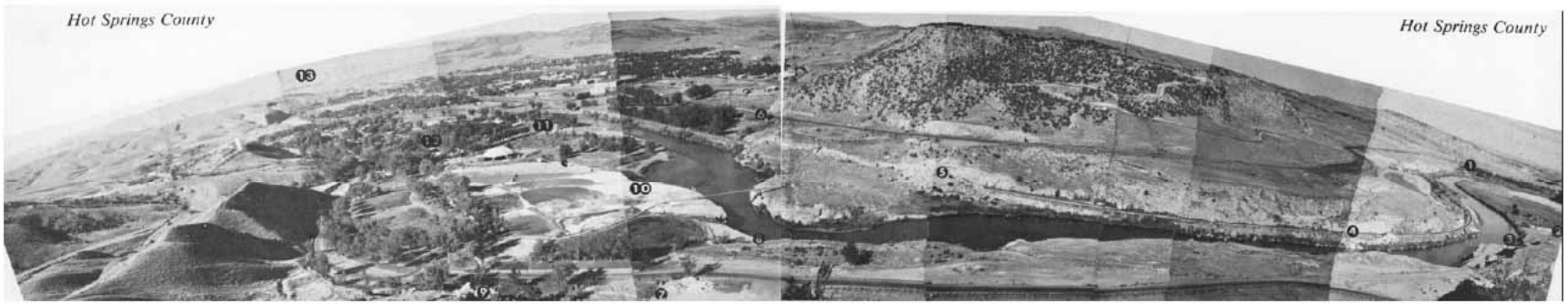
- Warm water systems which are used for recreation or “medical purposes”
  - Yellowstone National Park
  - Hot Springs State Park, Thermopolis
  - Various Warm Springs

Yellowstone National Park (YNP)

- 3472 square miles
- 100 hot spring groups
  - 318 springs > 194ºF
    - Steam vents > 280ºF
  - Nearly 100 springs produce superheated water



Hot Springs State Park, Thermopolis, Wy



- Advertised as “The World’s Largest Mineral Hot Springs”
- The Largest Spring (Big Spring) produces 2908 gpm at 132ºF

Various Warm Springs

- Saratoga Hot Springs
  - Water originally sold as "Radioactive Mineral Water"
  - Largest of 5 springs flows at 120 gpm with a temperature of 119ºF
- Kendall Warm Springs
  - Home of the Kendall Springs Dace
    - Federally protected species
  - Large terraces with flows of 3600 gpm at temperatures of 85ºF

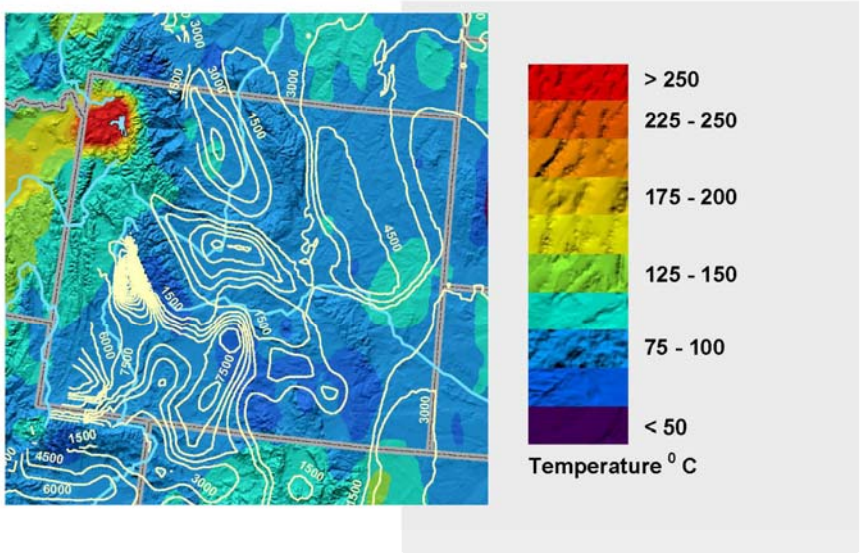
Geothermal Setting in Wyoming

Requirements for Large Scale Electrical Generation

- Temperature
  - Flash/Steam plants >210º F
  - > 300º F desired
  - Binary systems > 165º F
- Flow
  - 1 MW of power
    - 210º F >1,300 gpm
    - 300º F >450 gpm

Subsurface Temperatures (3km depth) in Wyoming

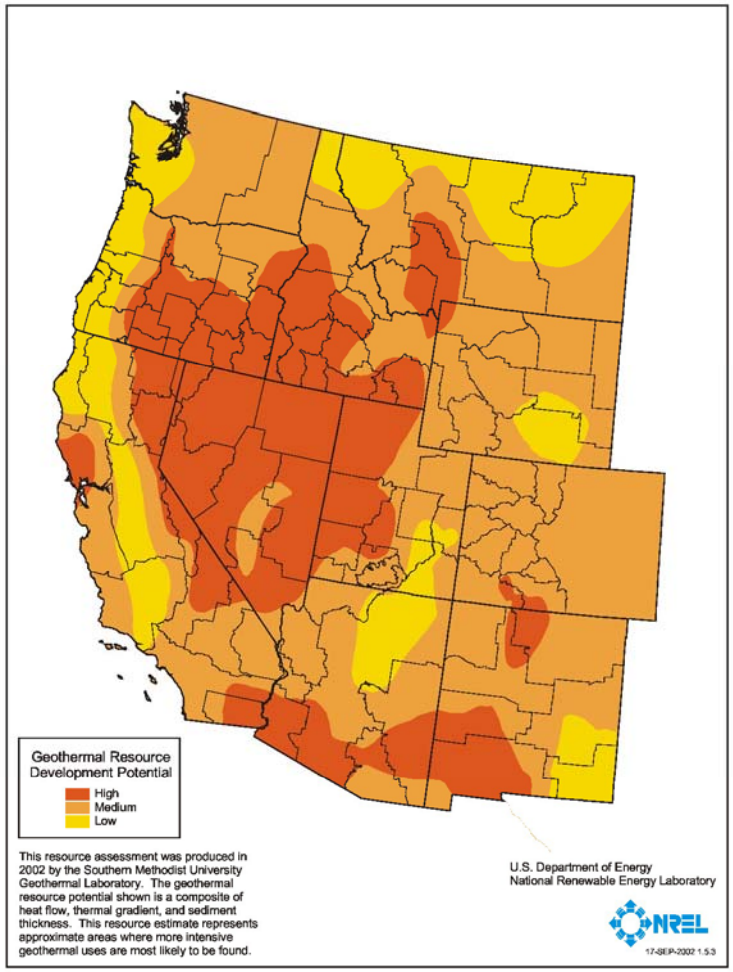
- Very small portions of Wyoming > 150ºC
- Binary systems require a minimum of 74ºC



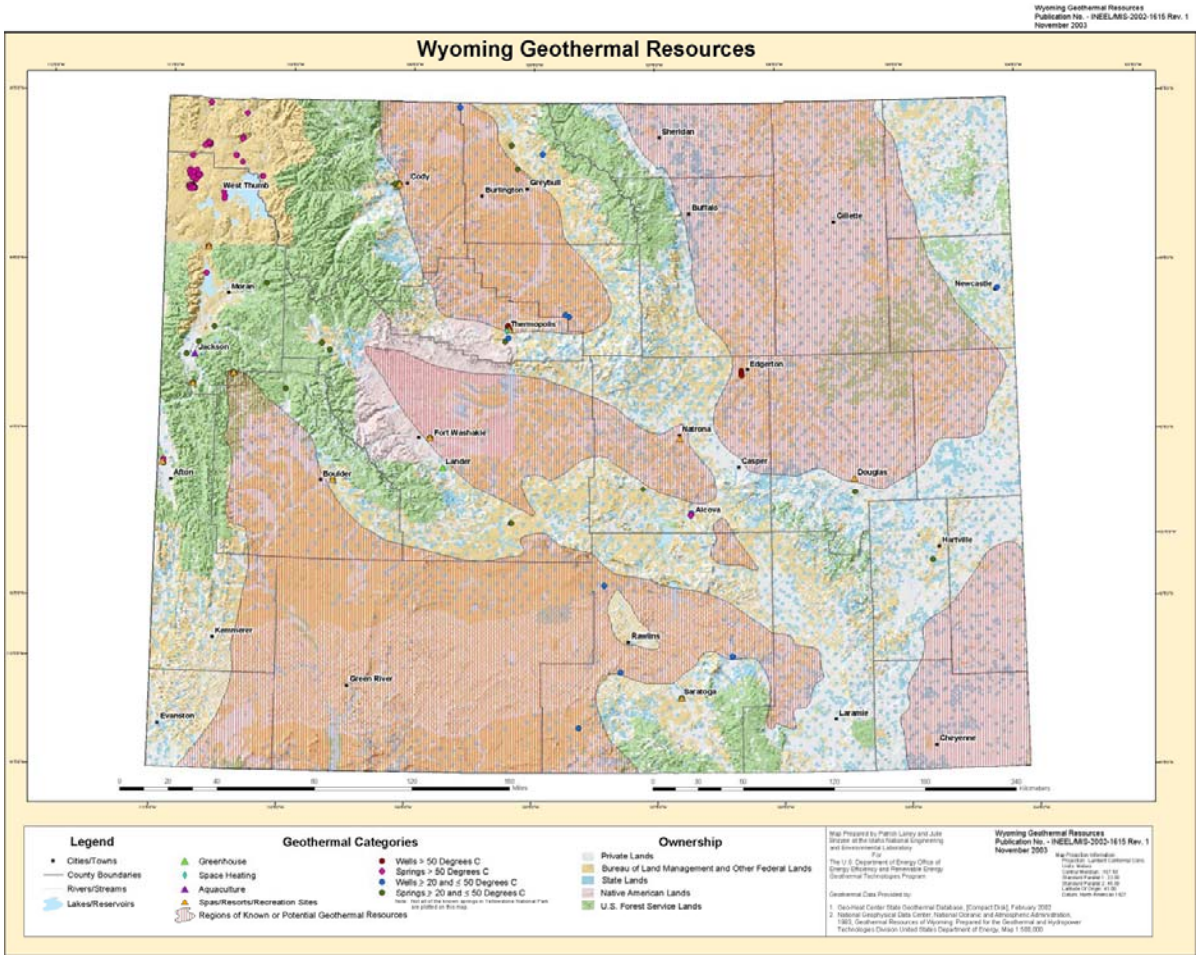
Modified from Idaho National Labs Estimated Temperatures at 3 Kilometers Map, 2005

Wyoming's Geothermal Potential

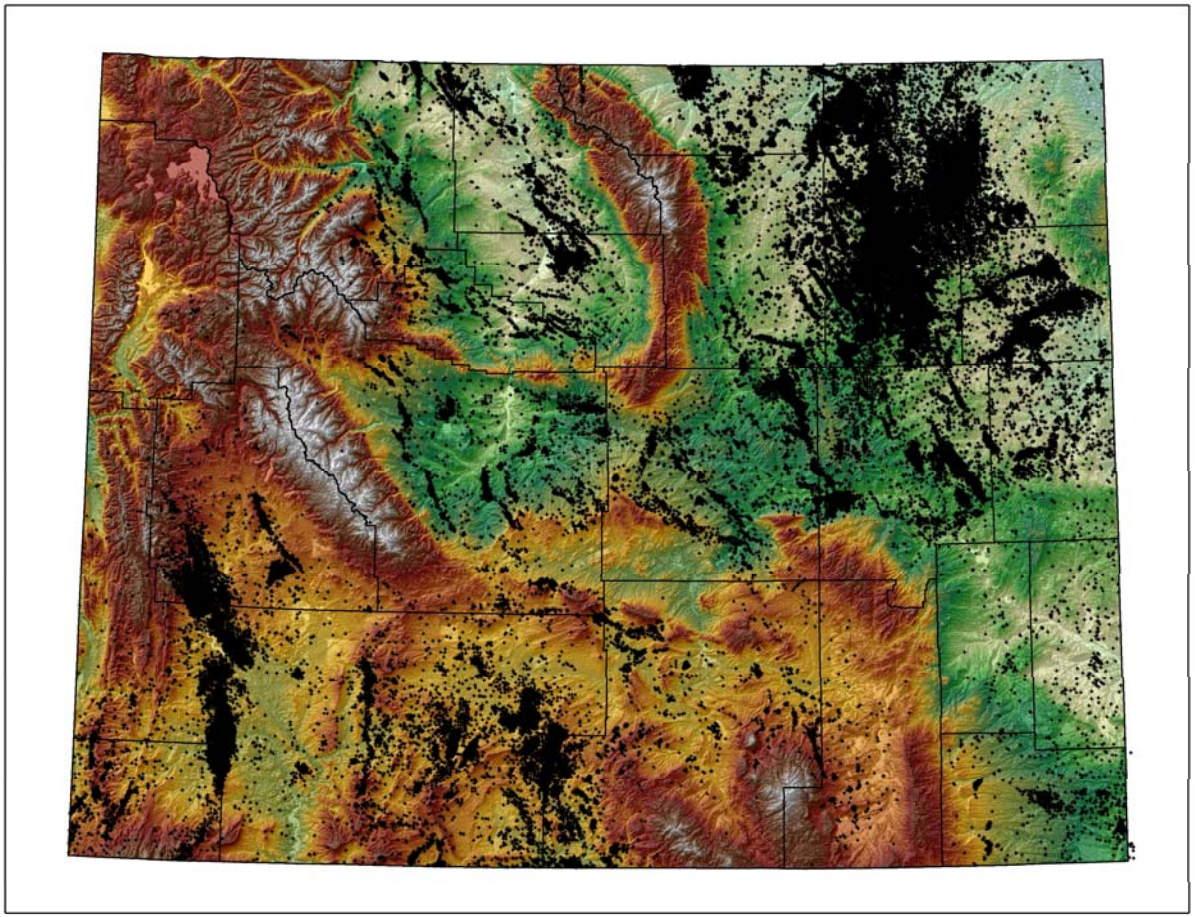
- Yellowstone is the only high potential geothermal area in Wyoming



Wyoming Geothermal Resources



Oil and Gas Well Distribution



Statewide Potential

- Statewide potential is low
  - Lack of near surface resources
  - Federal Protection
  - Aging electrical infrastructure
  - Much cheaper energy options
- Deep basins provide temperatures over 150ºC at great depth
  - Infield resources are viable

Future of Geothermal Development in Wyoming

- Likely to be direct use
  - Lack of high temperature water near the surface
  - Outside of YNP warm springs <160ºC
- Infield applications
  - Wells already exist and are producing hot fluids
  - As technology increases infield development will become more viable

Conclusions

- Outside of BHT, very little data has been compiled
- Near surface water/fluid is close to normal gradient
- Deep basins require deep access to hot water/fluids
- As technology evolves new opportunities may develop