

Mine levels from ACM maps,
elevation reference point
based upon Alice Mine

- 0 to 900 feet
- 1000 to 1900 feet
- 2000 to 2900 feet
- 3000 to 3900 feet
- 4000 to 5100 feet

N
W E
S

Outer Camp Mines

Orphan Girl
MONTANA TECH
WORLD MUSEUM OF MINING

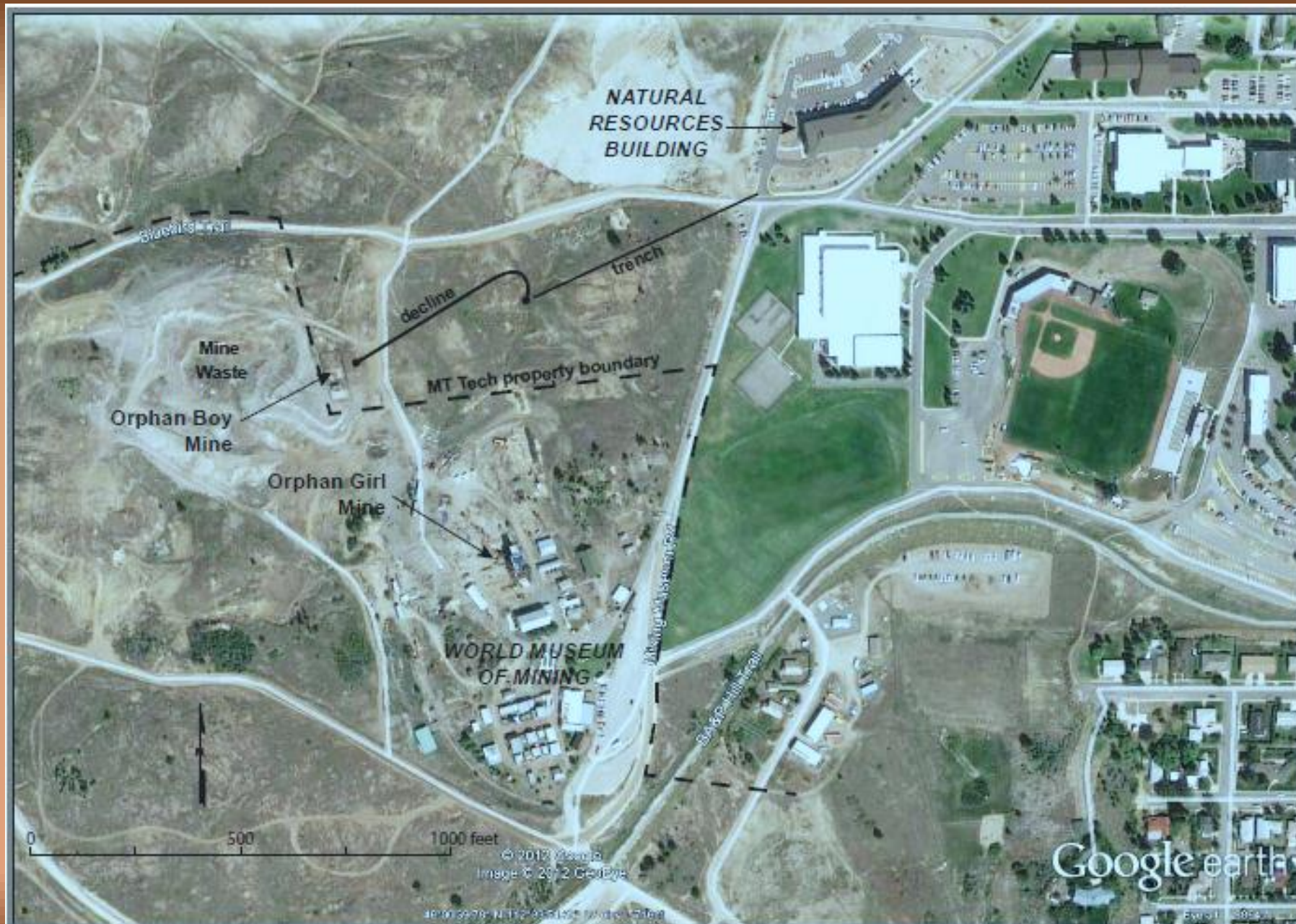
Anselmo
Steward
Kelley #1 & 2
Diamond
Mountain Con
Badger State
Granite Mountain
Modoc
Berkeley Pit
West Camp Mines
Travona

Alice
Lexington
Pilot Butte
Granite Mountain
Modoc
Berkeley Pit
West Camp Mines

Orphan Boy
Germania
Bonanza
Ophir
Belmont
Colorado
Emma
Gagnon
Original
Nipper
Blue Jay
Parrot
Ramondell Parrot
Moonlight
Pennsylvania Main
Silver Bow
Rarus
Minnie Healy
Leonard
Reins
East Colusa
West Colusa
Alex Scott
Ballaklava
Tuolumne
Speculator
Wake Up Jim
Bolt
High Ore
Mountain View
Anaconda
Moby Murphy
St. Lawrence
Never Sweal
Parnell
Corra
Cotter
Green Mountain
East Gray Rock
West Gray Rock
Moose
Emily
Elm Orie
Black Rock
Rainbow

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A Demonstration System for Capturing Geothermal Energy from Mine Waters Beneath Butte, MT

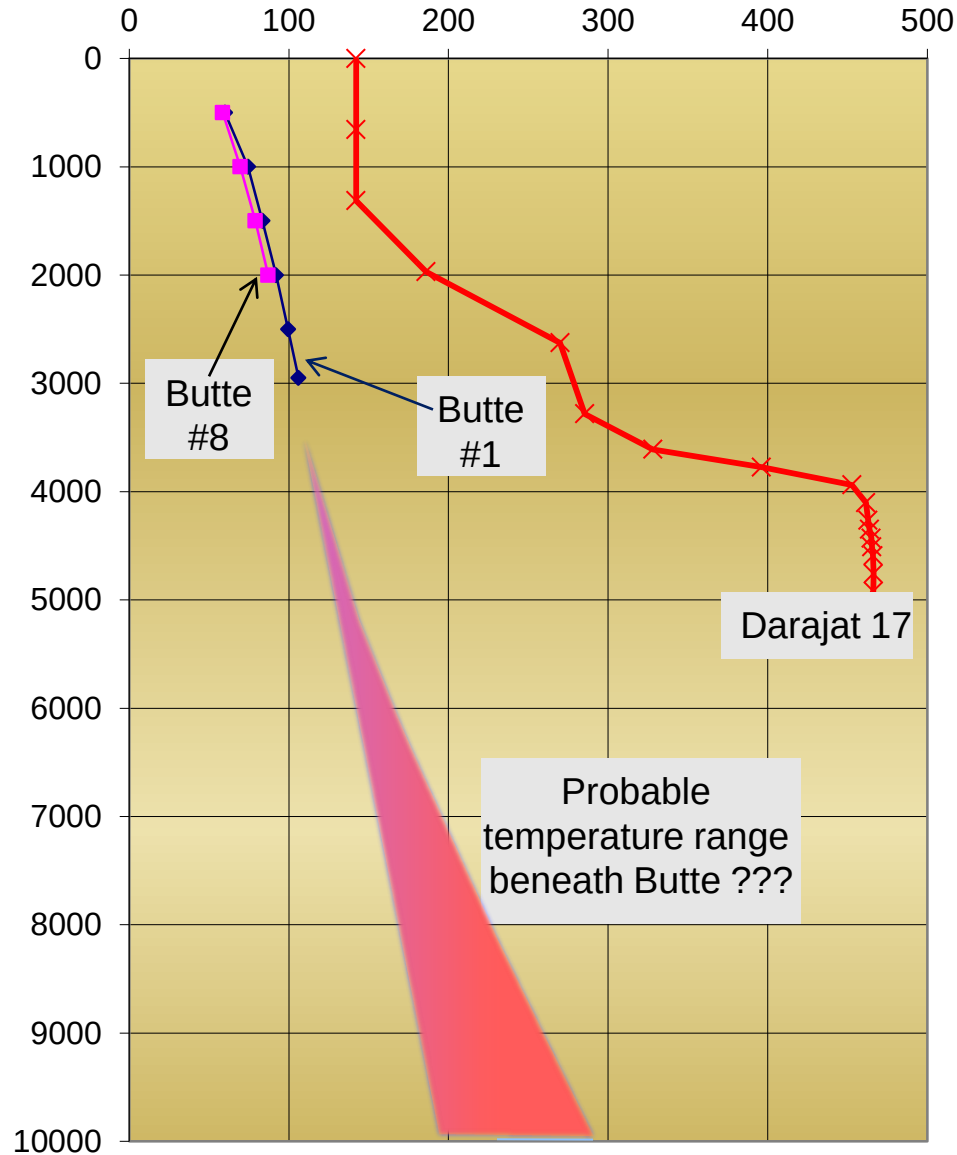


This is not the kind of geothermal system we're talking about.



Temperature (°F)

Well Depth (FT)



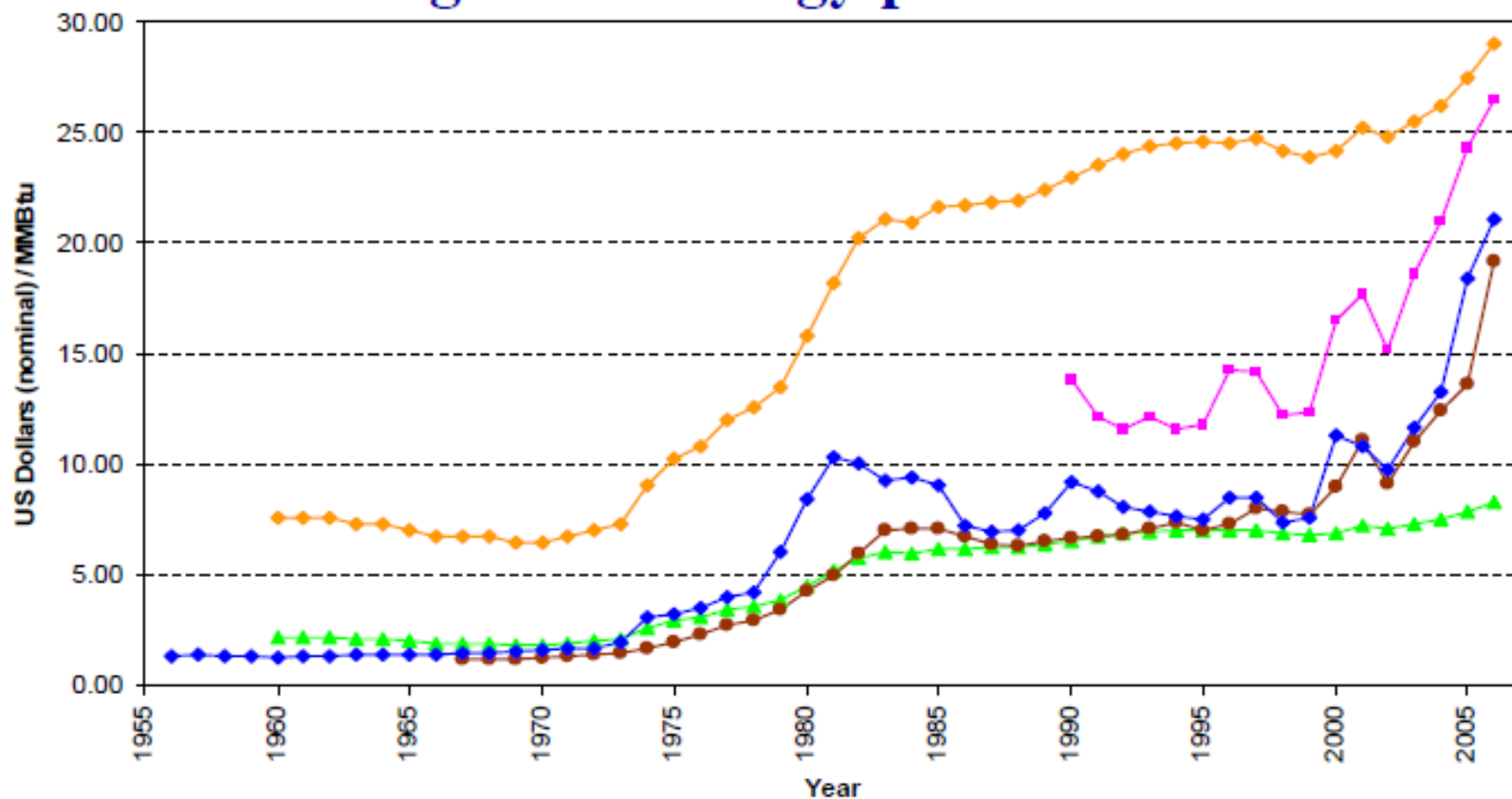
Why Heat Pumps?

3 to 4 kWh of thermal energy can be produced for every 1 kWh of electrical energy used to drive heat pump.

***Ground Water input (50 -59°F) ---
(76-78°F at Orphan Boy/Orphan Girl)***

Heat Pump output (104 -127°)

Costs for use of typical heating systems (based on average U. S. energy prices from 1990 – 2006)



▲ Geothermal Heat Pump

● Natural Gas

◆ Heating Oil

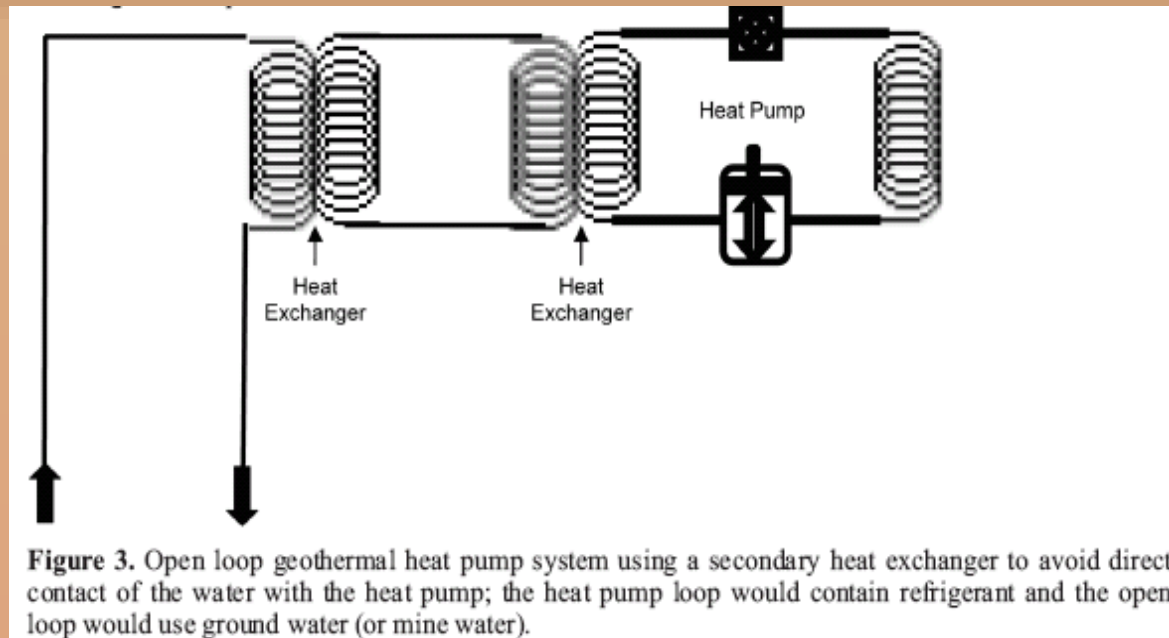
◆ Propane

◆ Electrical Resistance

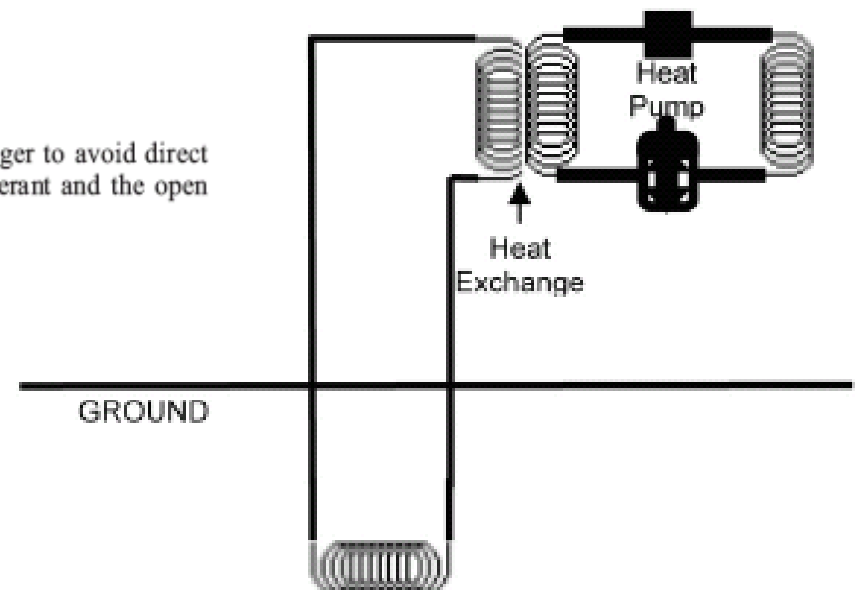
*Furnaces using propane, natural gas or fuel oil were assumed to be moderately efficient (84%).
Coefficient of performance (COP) of geothermal heat pump was assumed to be 3.5.*



Open vs Closed Loop Heat Pump Systems



Watzlaf and Ackman

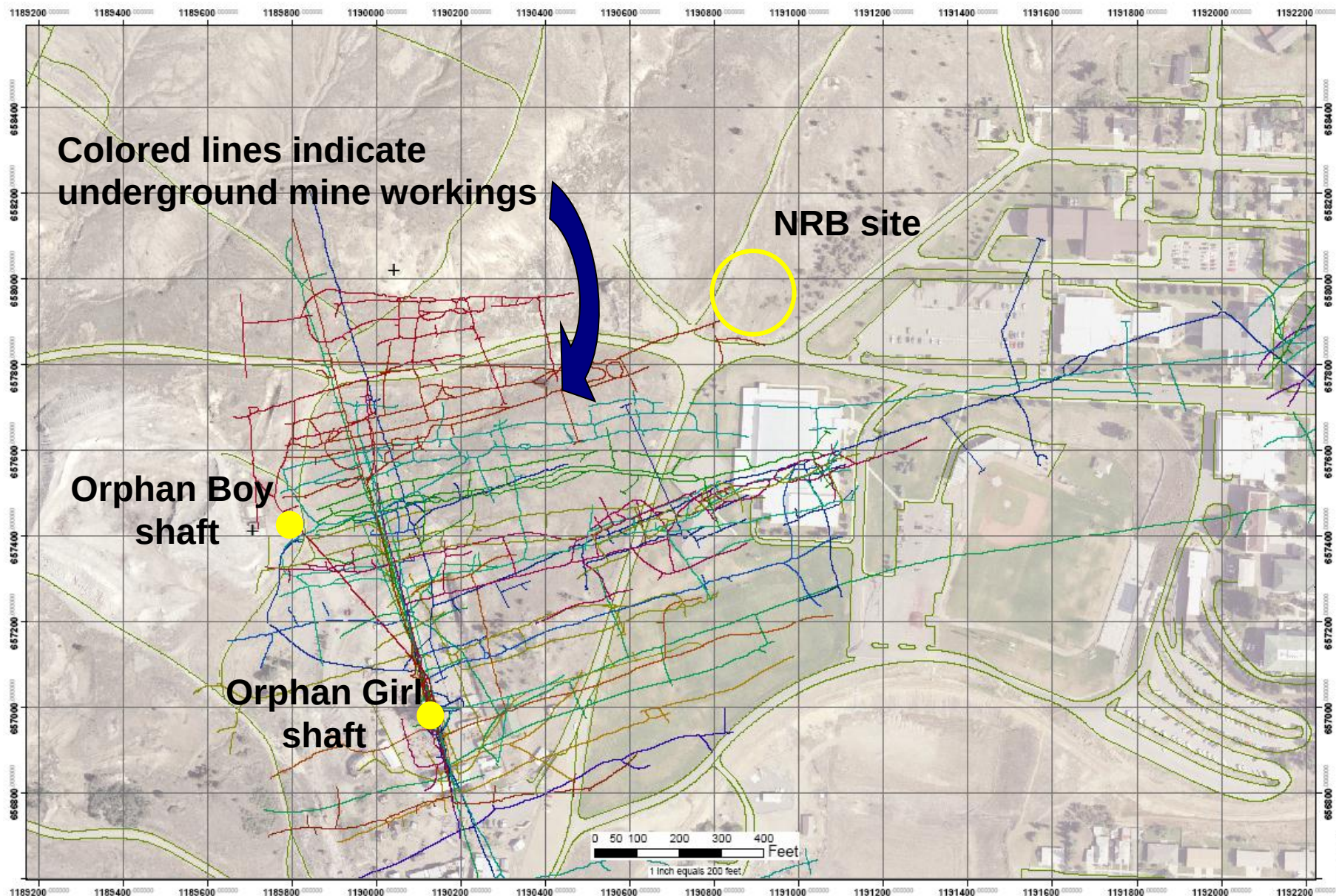


Why mine water as a heat source?

- Mine water (or groundwater) usually at constant temperature, making an excellent heat source or sink.
- Huge water volumes as compared with wells and the hole is already there.
- Natural convection in mine voids can help with heat transfer, so water temperatures are constantly replenished.

Mine Water Data

	<u>Date</u>	<u>Time</u>	<u>Sample</u> <u>Depth</u> (below water surface)	<u>pH</u>	<u>SC</u> (umhos/cm)	<u>Temp</u> (°C)	<u>Temp</u> (°F)
Orphan Girl	01/17/06	10:29	~10 ft	6.80	1655	26.4	79.5
Orphan Boy	05/16/05	10:10	42 ft	6.66	1580	26.3	79.5
	12/22/05	10:30	42 ft	6.81	1570	25.2	77.3



Cross section of Orphan Boy Mine shaft

