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February 7, 2023

### **MEMORANDUM**

**TO: Power Committee Members**

**FROM: Tina Jayaweera, Power Planning Resources Manager**

**SUBJECT: Boise Geothermal Heating**

### **BACKGROUND:**

**Presenter:** Jon Gunnerson P.E., City of Boise Geothermal Coordinator

**Summary:** The City of Boise, Idaho, has been tapping into a river of geothermally heated water that flows under the city's foothills for over 100 years. The city taps into this warm water to heat buildings around the city to create a heating district that, as of 2022, warms more than 6 million square feet of building space. It is the largest, municipally operated geothermal heating system in the country. This system requires minimal electricity use (only to operate the pumps), is a closed loop with collected water reinjected back into the aquifer, and has low environmental impact.

**Relevance:** As the electricity system is evolving and more jurisdictions are adopting climate action plans, alternative energy sources, such as geothermal district heating, can aid in the transition. Geothermal district systems, though more common in Europe, are limited in the U.S. However, awareness is growing as a low-carbon alternative to traditional energy supplies. While a geothermal heat pump system is not cost-effective on an individual home level as analyzed in the Council's plan, tapping into a district-wide system could be. Tracking projects like this is part of understanding emerging opportunities to meet future energy needs.

Background: The City of Boise has a climate action plan to be carbon neutral city-wide by 2050, with 100% clean electricity for city facilities by 2030 and carbon neutral municipal operations by 2035. The geothermal heating system aids in this transition by reducing the electricity and natural gas needs for a large portion of their buildings' energy requirements.

More Info: <https://www.cityofboise.org/departments/public-works/geothermal/>



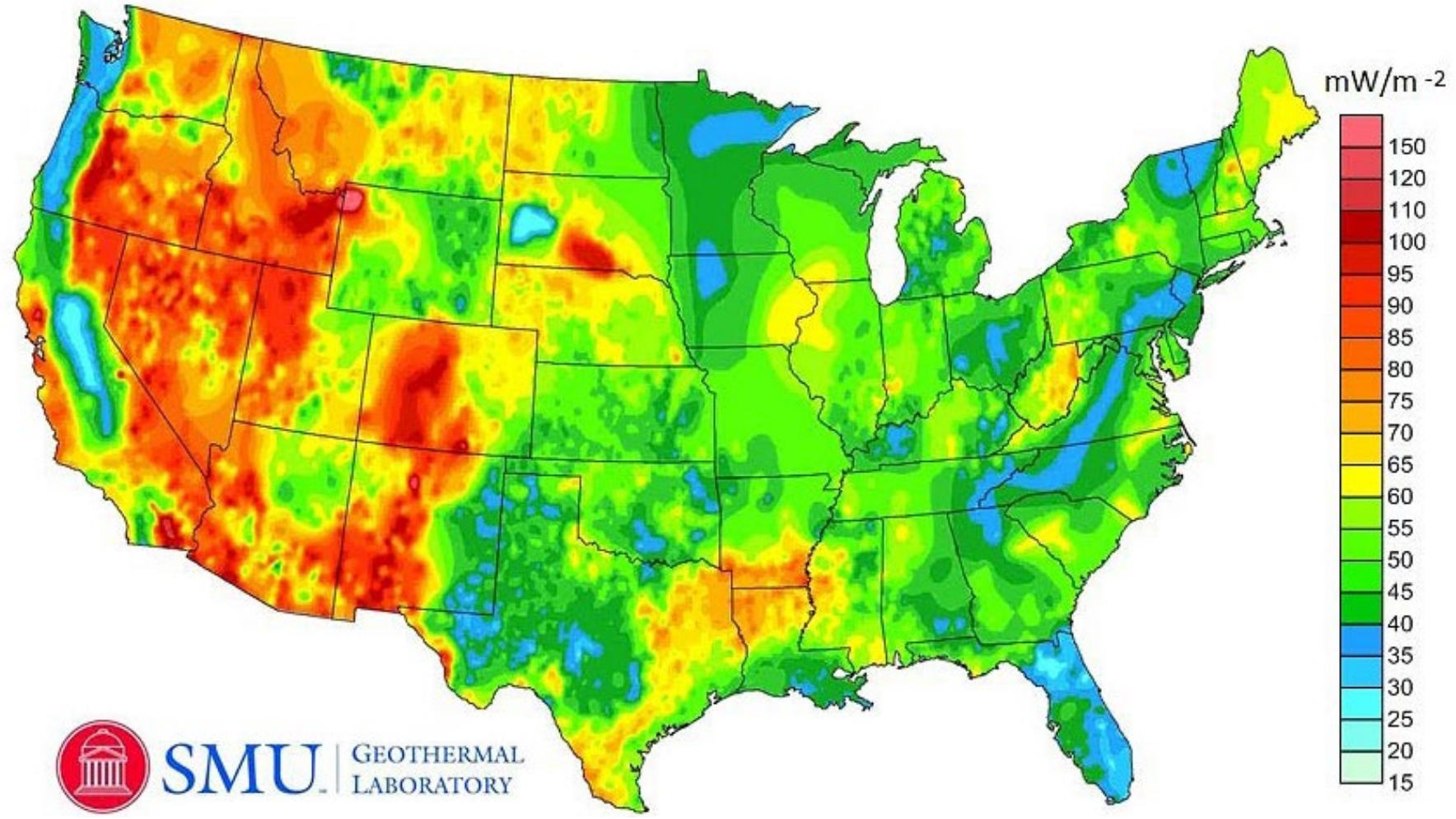
# DIRECT USE GEOTHERMAL HEATING DISTRICT

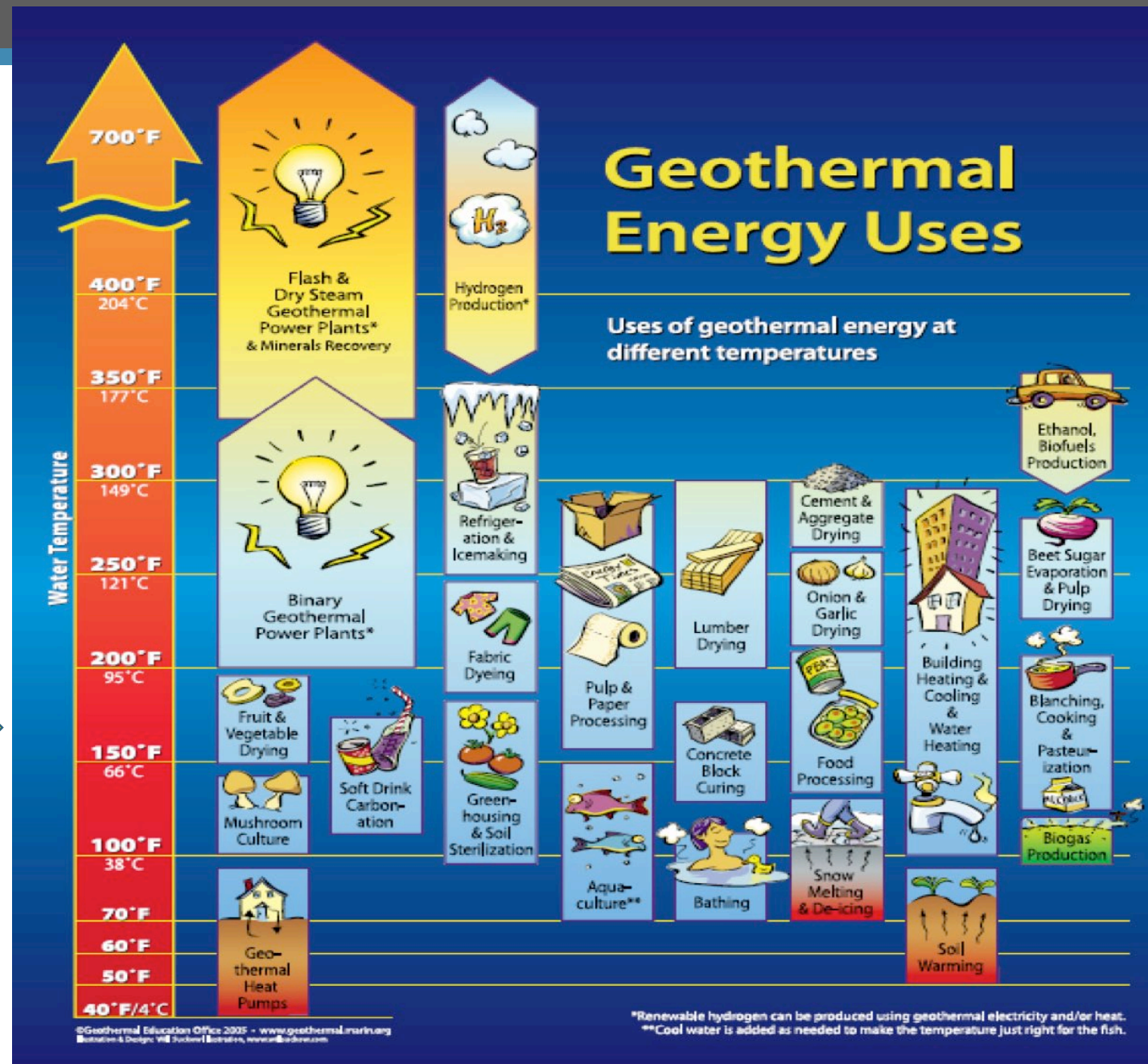
Jon Gunnerson, P.E. Geothermal Coordinator [geothermal@cityofboise.org](mailto:geothermal@cityofboise.org)

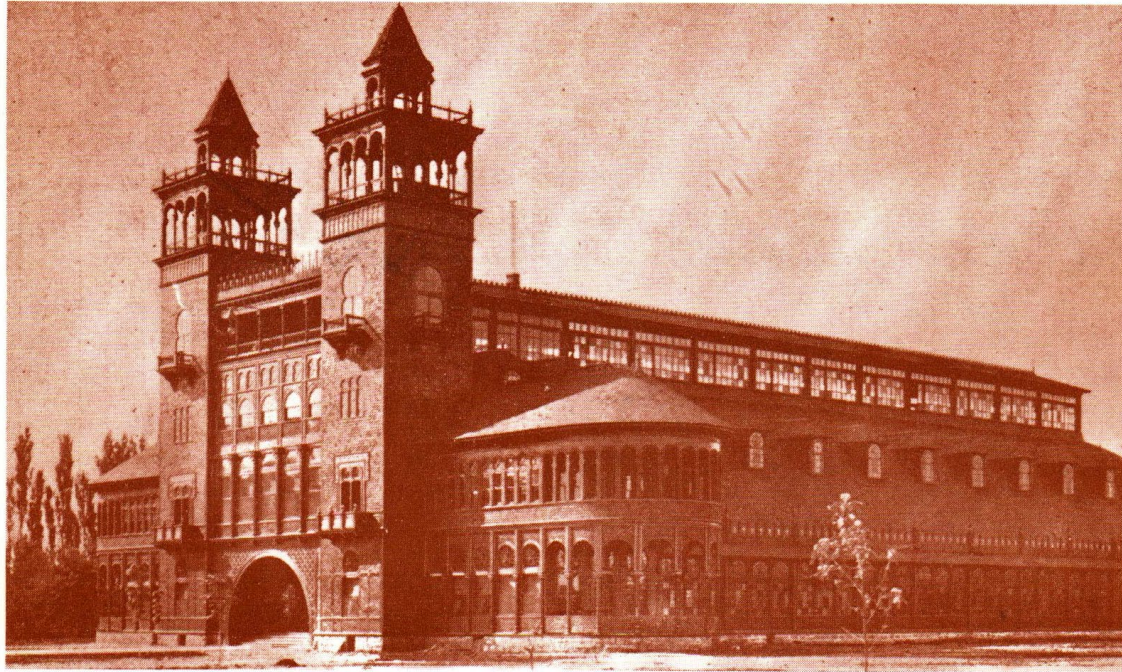
# GEO + THERMAL

(of or relating to the Earth's internal heat)

- High Temperature 350° F or higher
  - Electricity Generation
  - Raft River/Neal Hot Springs
- Low Temperature 150 - 250° F
  - Geothermal District Heating
  - What we're talking about today
- Ground Source 55° F ground temp
  - Geothermal Heat Pump
  - Earth's constant temperature





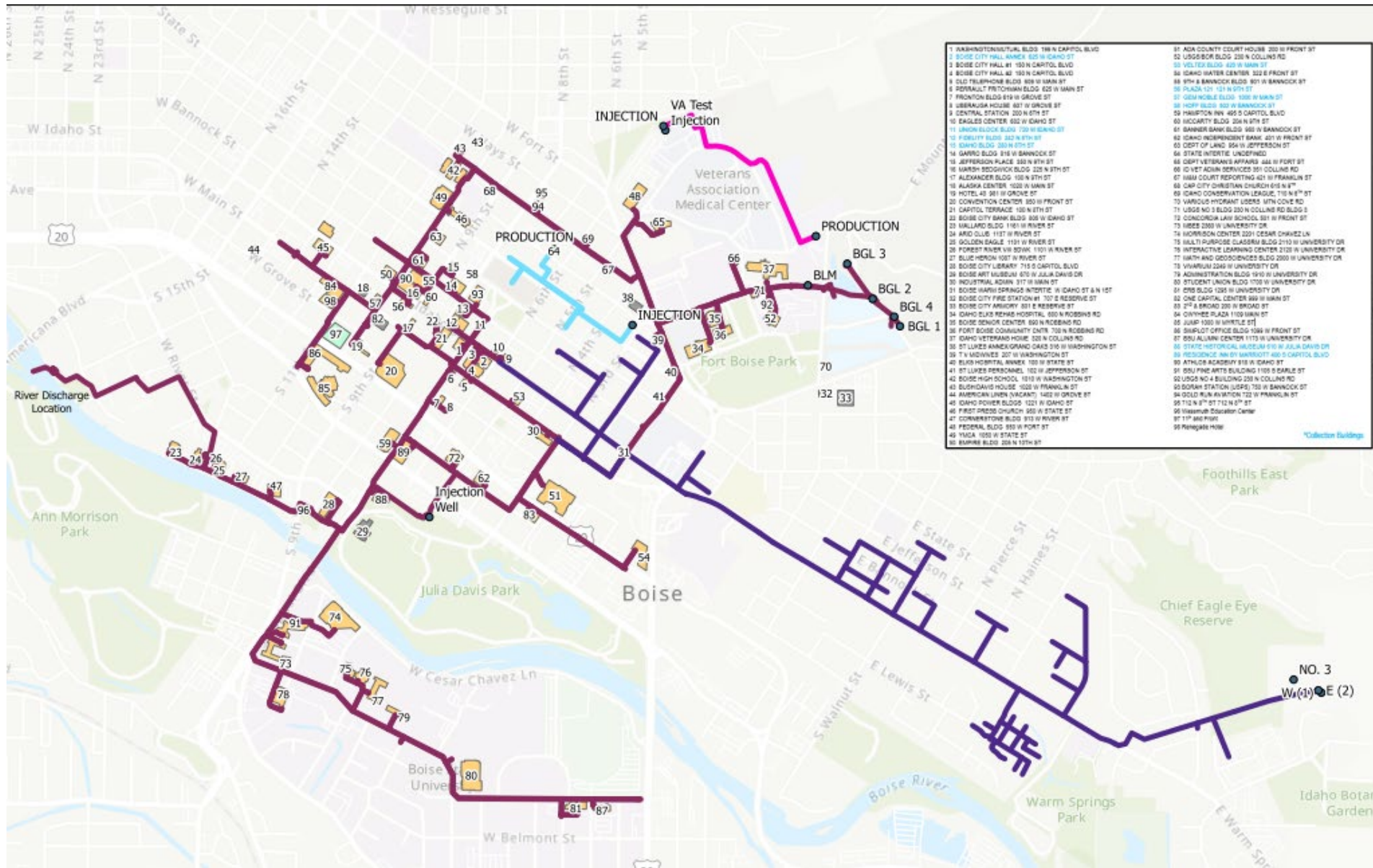


## Geothermal History

Heating historic homes on Warm Springs Ave. (right)



Boise Natatorium (1892-1934) (left)







# CITY OF BOISE - UTILITY



# OPERATIONAL OVERVIEW



- **Two Pipe System**
  - Supply 160 -175 F Water, 50-65 PSI
  - Collection 110 – 120 F Water, 25-35 PSI
- **Closed System – water collected after heat removed**
  - No potable use, no storage
  - Sell heat from the water, not the water, on a per gallon basis
- **Cross-Overs**
  - Connection between supply & collection lines
  - Used to maintain velocity in system
- **Direct use applications only**
  - No power generation



# PRODUCTION WELLS

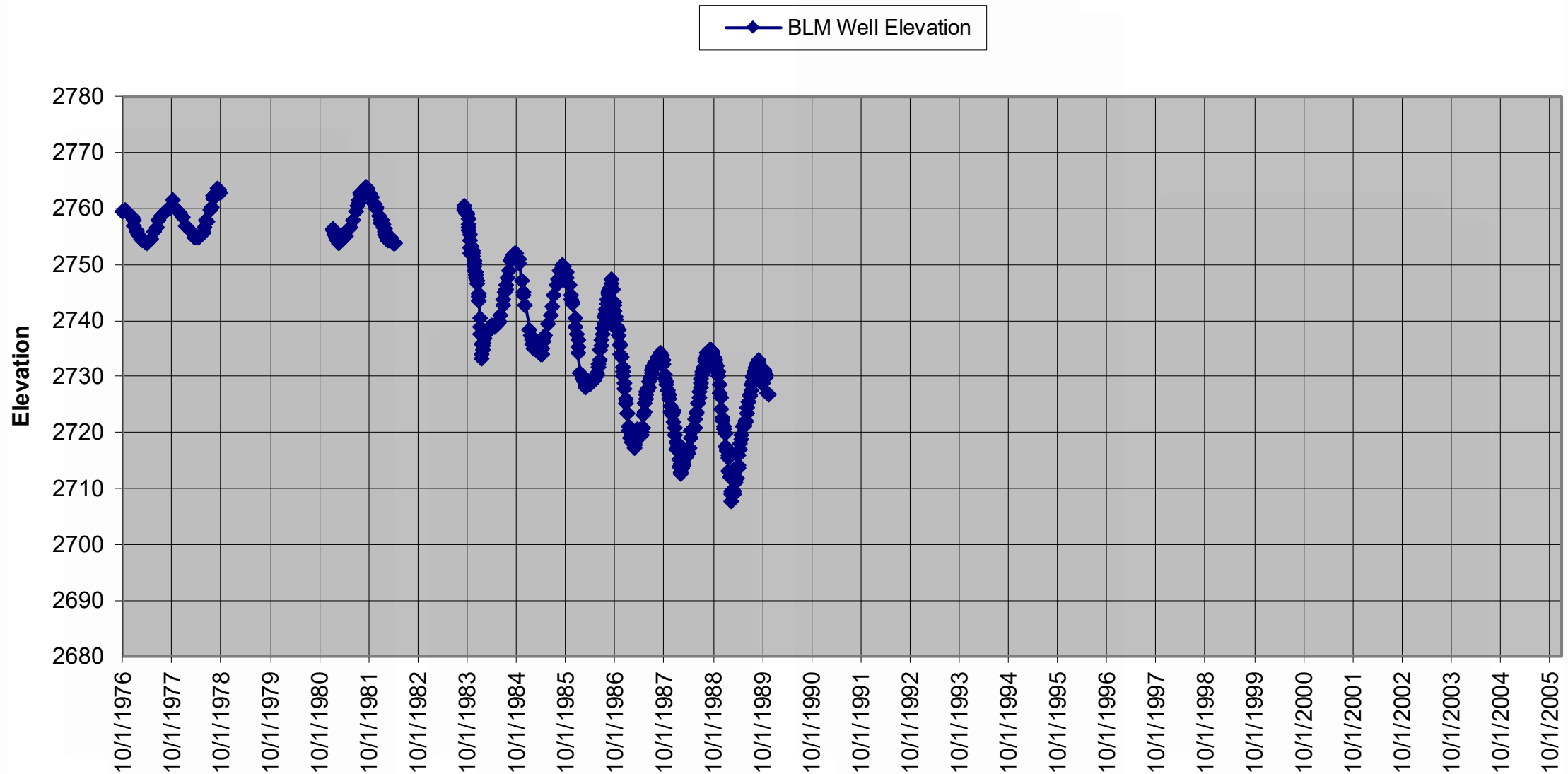
- 4 wells drilled by private company – 1981
- 3 wells purchased by City – 1983
- 3 Production wells
  - BGL 2 = 125Hp, 1200 GPM
  - BGL 3 = 200 Hp, 2000 GPM
  - BGL 4 = 50 Hp, 800 GPM
    - BGL 1 = Monitoring well
- **Maximum pumping demand = 1750 GPM**
- **Water Temperature = 177°F ± 1°**
  - 80.6°C



# RIVER DISCHARGE

- Until 1999 – All used geothermal water was disposed of in the Boise River
- In 2001 – Last buildings discharged directly to the river (Forest River)
- NPDES #ID-002548-8
  - < 1 MGD
  - < 66.4°C Max (Oct 1 – July 15)
  - < 88.2 °C Max (July 16 – Sep 30)

# BLM MONITORING WELL LEVELS LONG TERM

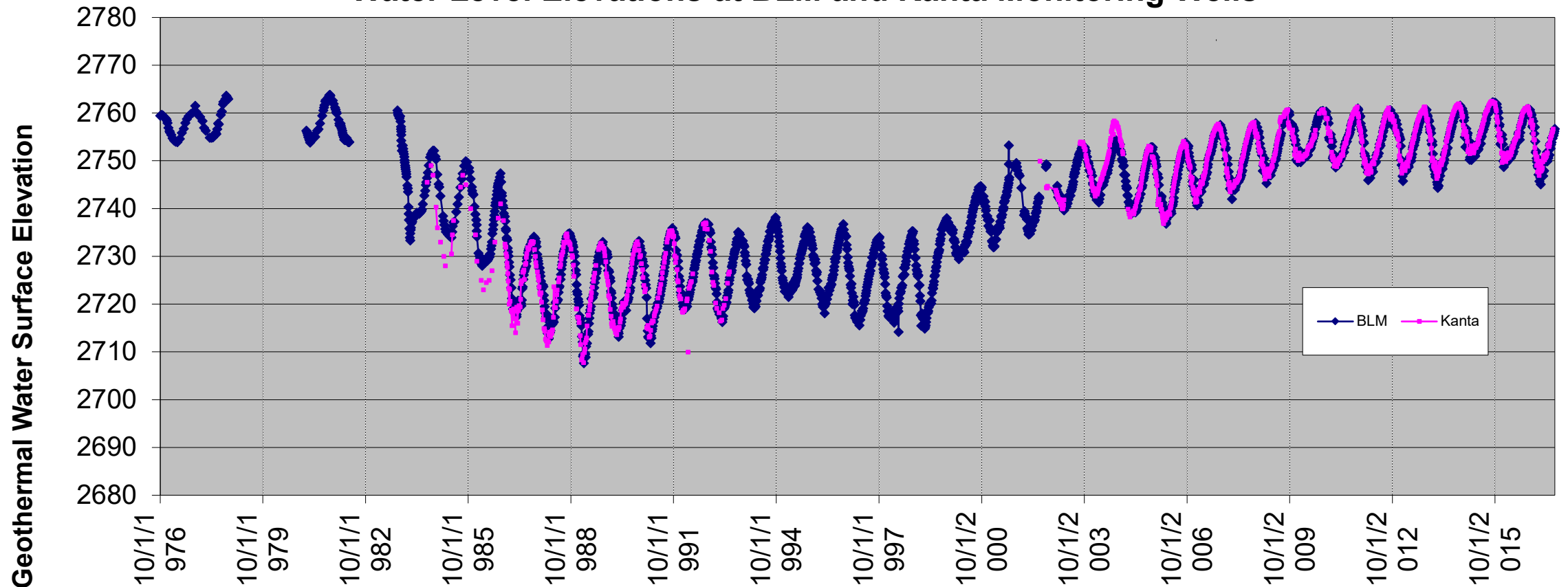


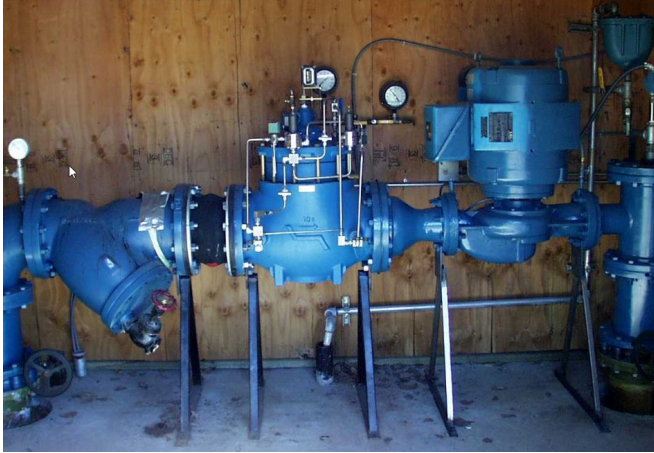
# INJECTION WELL COMPLETED 1999



# SUCCESS OF INJECTION - AQUIFER

Water Level Elevations at BLM and Kanta Monitoring Wells





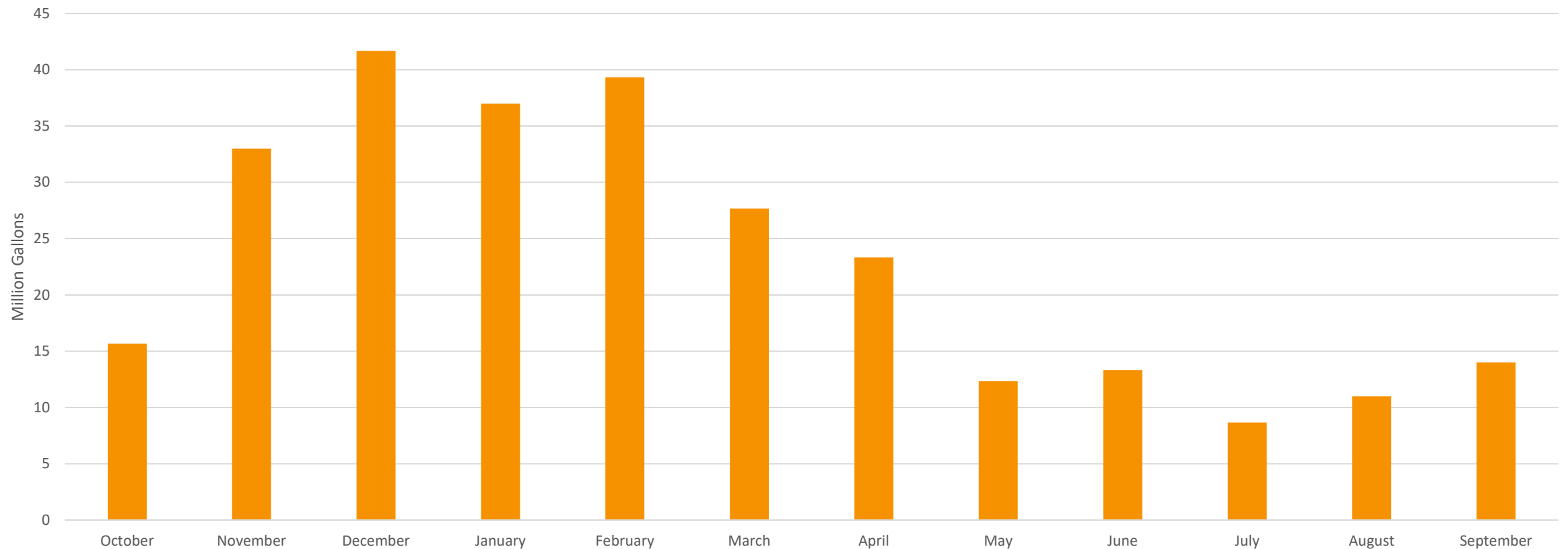
# INJECTION WELL

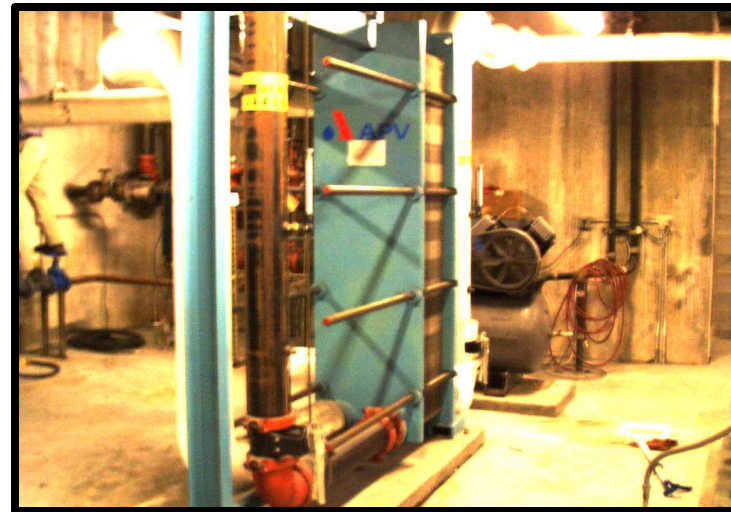
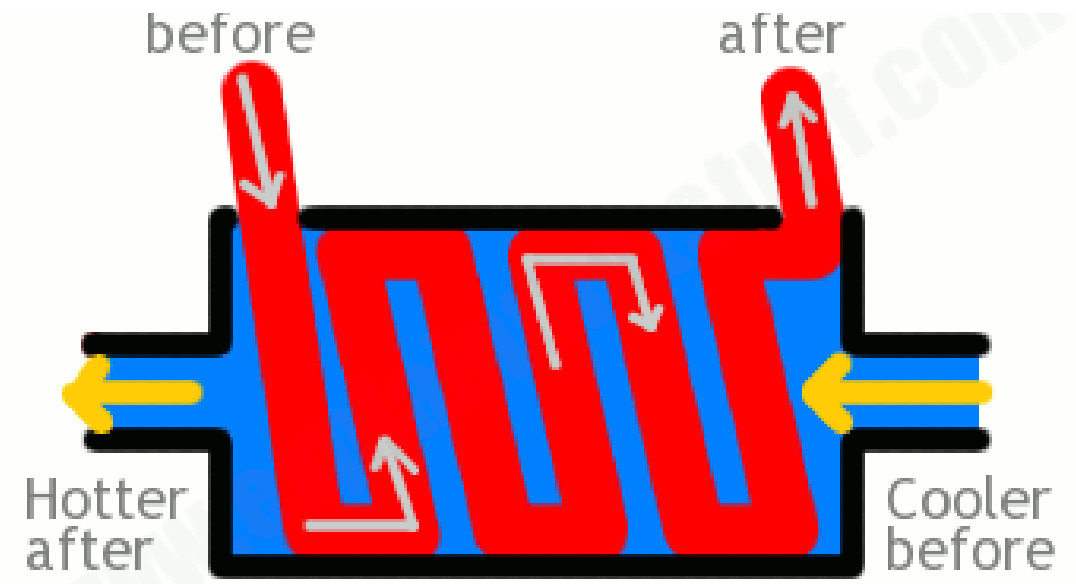
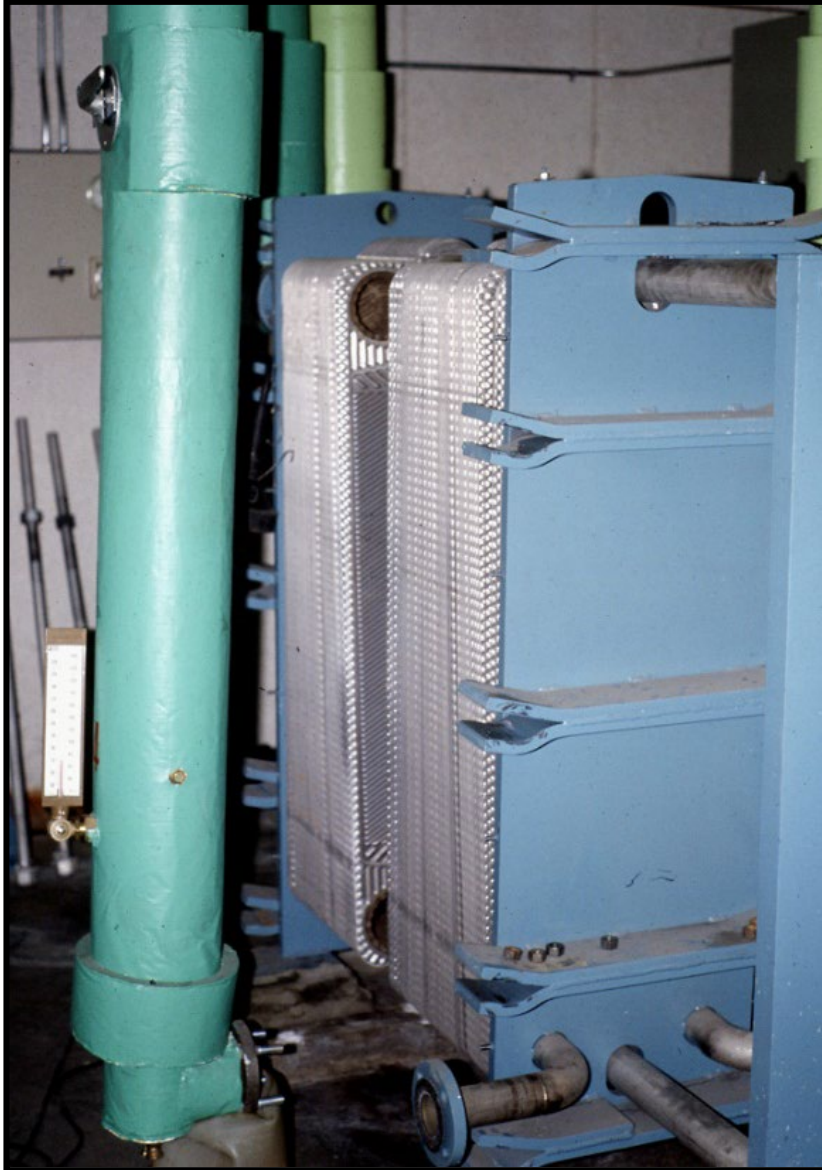
- Drilled Injection Well – 1999
  - Injection Well Permit #63-W-133
- Located in back of Julia Davis Park
- Average temperature of water inject ~115°F
- Total receiving capacity > 3500 GPM
  - With pump upgrades



# GEOHERMAL PRODUCTION RATES

Geothermal Water Pumped







## Uses of Geothermal





## Large Geothermal Customers - Downtown

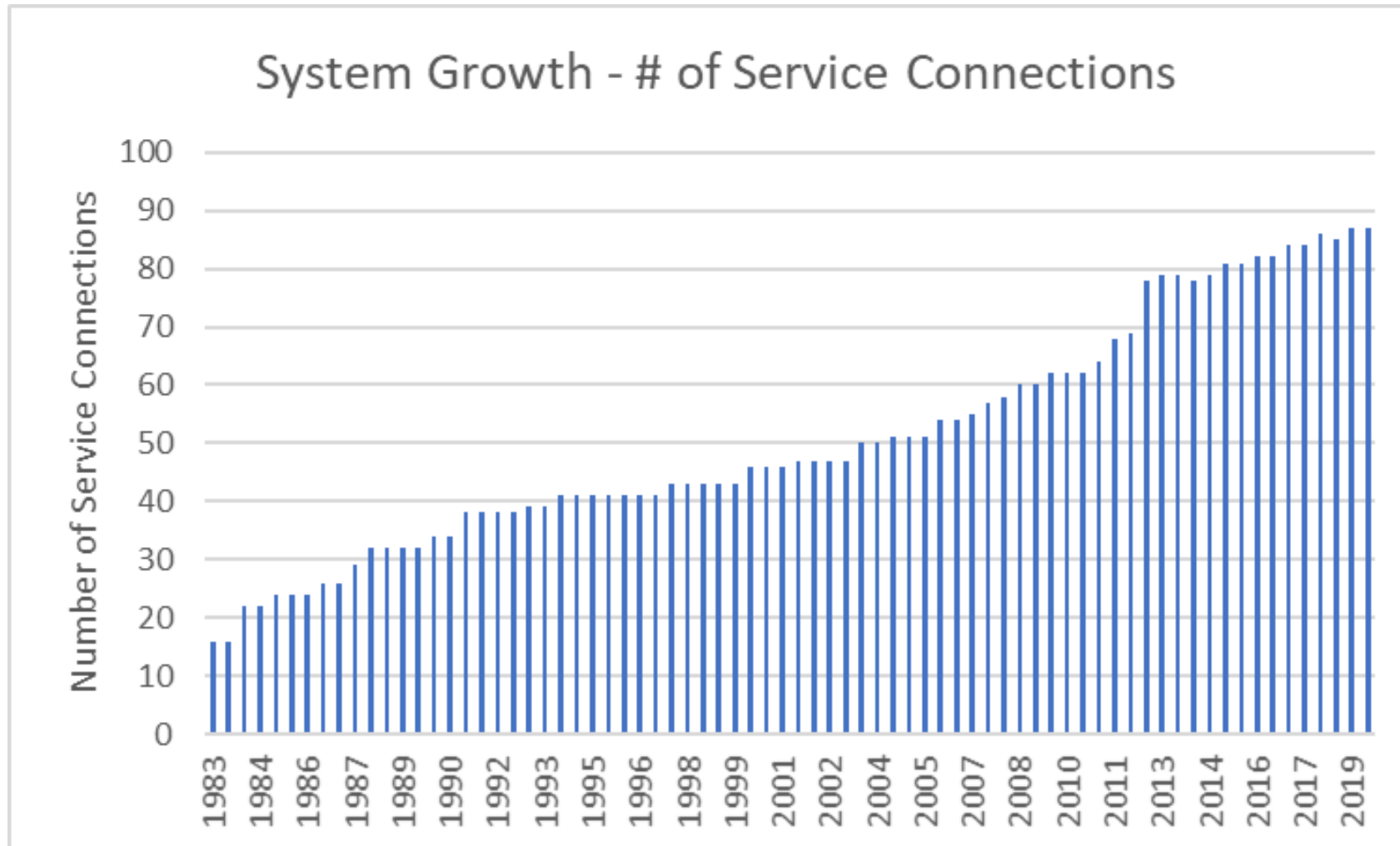




## Campus Heating



# SYSTEM GROWTH

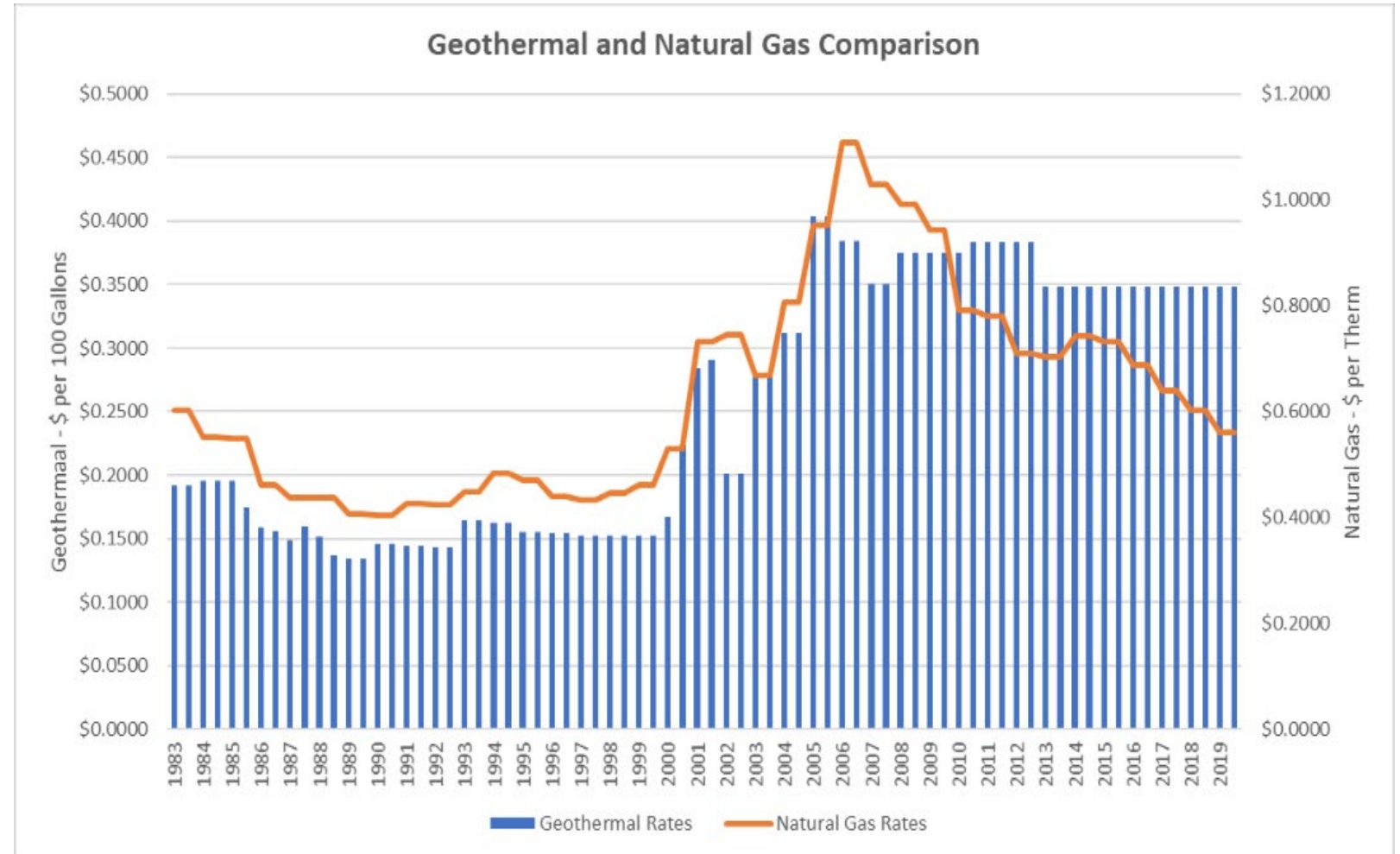


# RATES & INCENTIVES

- General Service
  - \$4 monthly fixed administration fee
  - Supply Water Rates: \$.3485 per 100 gallons
  - Collection Water Rates: \$.1334 per 100 gallons or \$.8195/therm
- Line Extension Policy
- Central Addition
  - Reduced collection water rates to incentivize use in downtown sustainability focused district

# CHALLENGES

- Natural Gas







## Corrosion & Aging System



**ENGINEERING  
FAILURE  
ANALYSIS**

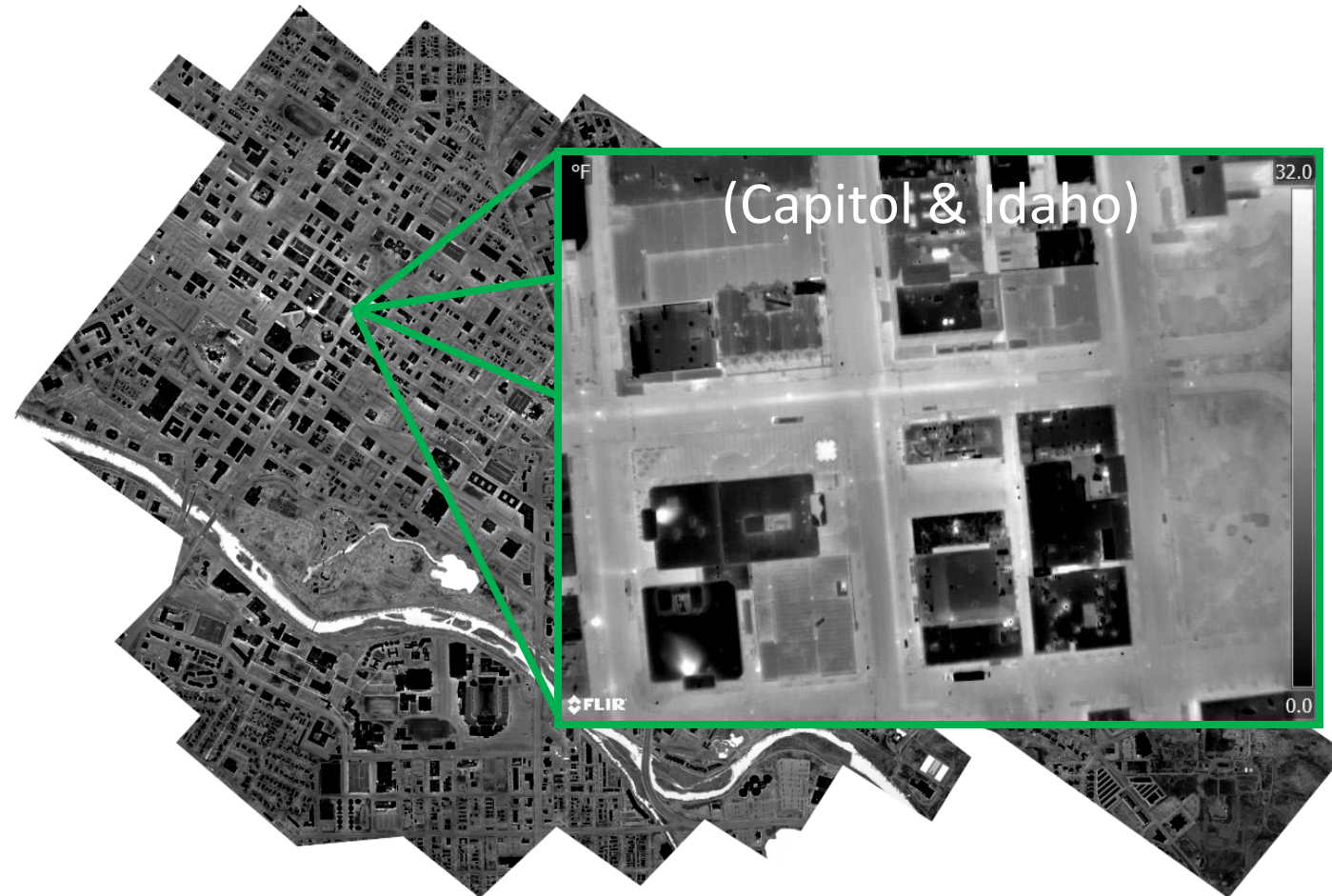
Editor-in-Chief  
Richard Clegg

Materials

Structures

Components

# INNOVATION - THERMOGRAPHY







**PUBLIC  
EDUCATION**

**COMMUNITY  
RESOURCE**



# BENEFITS OF GEOTHERMAL

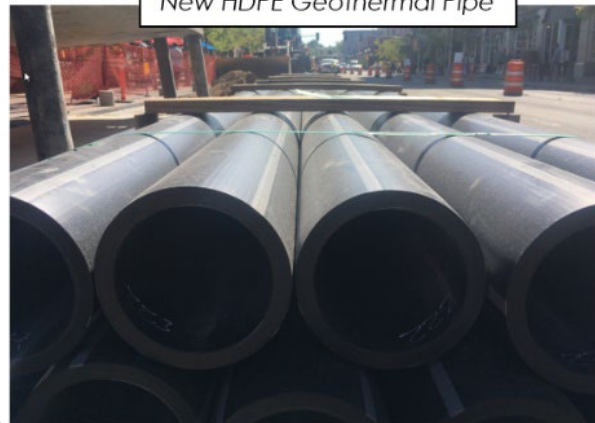
- Local Energy
- Clean – Carbon free
- Renewable
- Sustainable
- Stable Pricing



Geothermal Heating avoided  
8,000 tons of CO<sub>2</sub> emissions in  
2021 = to 16,000,000 vehicle miles



New HDPE Geothermal Pipe



## WHAT'S NEXT

- **Grow the geothermal system**
  - Infill & expansion
  - Asset replacement prior to failure
- **Study incorporation of cooling district**
- **Showcase geothermal**
  - Heated park, bike lanes, bus stops, community greenhouse
- **Feasibility of Hot Springs/Resort**
- **Small scale power generation**
- **Innovative technologies & materials**

Innovation

Growth

Existing Customers / System Operation



# QUESTIONS?

Jon Gunnerson, P.E.

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