# Watershed Management in Yellowstone National Park

**David E. Hallac**

Yellowstone National Park

Waterways and Means Workshop, Mountain West Water Institute, Idaho Falls, Idaho – May 15-16, 2012

# Native Water Use

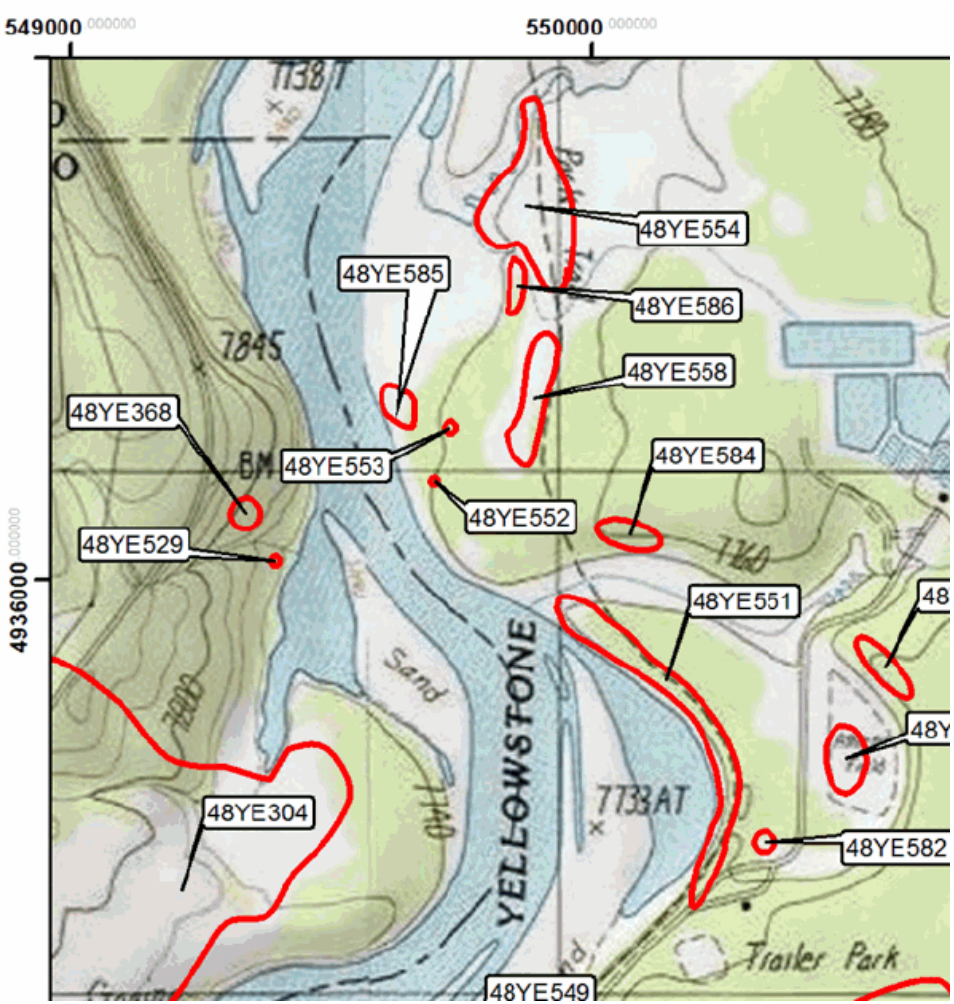
National Park Service
U.S. Department of the Interior
Yellowstone National Park

- Native peoples occupied the greater Yellowstone area for at least 11,500 years.
- Nearly all recorded archeological sites in YNP are associated with water sources.

# Native Water Use

National Park Service
U.S. Department of the Interior
Yellowstone National Park

- Major rivers served as travel corridors for wildlife and Native Americans alike.



# ENABLING LEGISLATION

**Yellowstone National Park Act (1872)**

"… is hereby reserved and withdrawn from settlement, occupancy, or sale…and dedicated and set apart as a public park or pleasuring-ground for the benefit and enjoyment of the people…for the preservation, from injury or spoilation, of all timber, mineral deposits, natural curiosities, or wonders within said park ….."

# Surface Waters of Yellowstone

- Park Area **3,468.4 $mi^2$ (8,983 $km^2$)**
- Water surface area **~5% of park area**
- Number of named lakes **150**
- Surface area of named lakes **24.7 $mi^2$ (63.9 $km^2$)**
- Number of lakes with fish **~45**
- YELL lake surface area **131.8–135.9 $mi^2$ (341–352 $km^2$)**
- Number of named streams **278**
- Total stream length **3,496,329 meters (2,172.52 mi)**
- Number of streams with fish **~200**

# Geothermal Protection

National Park Service
U.S. Department of the Interior
Yellowstone National Park

**Geothermal Steam Act (1970)**
**30 U.S.C. § 1001—1007**

**Esp. Significant thermal features**
**30 U.S.C. § 1026**

All of Yellowstone National Park declared "significant thermal feature" and stated that "The secretary shall maintain a monitoring program for significant thermal features within the units of the National Park System."

Steamboat Geyser, 2006

# Geothermal System

National Park Service
U.S. Department of the Interior
Yellowstone National Park

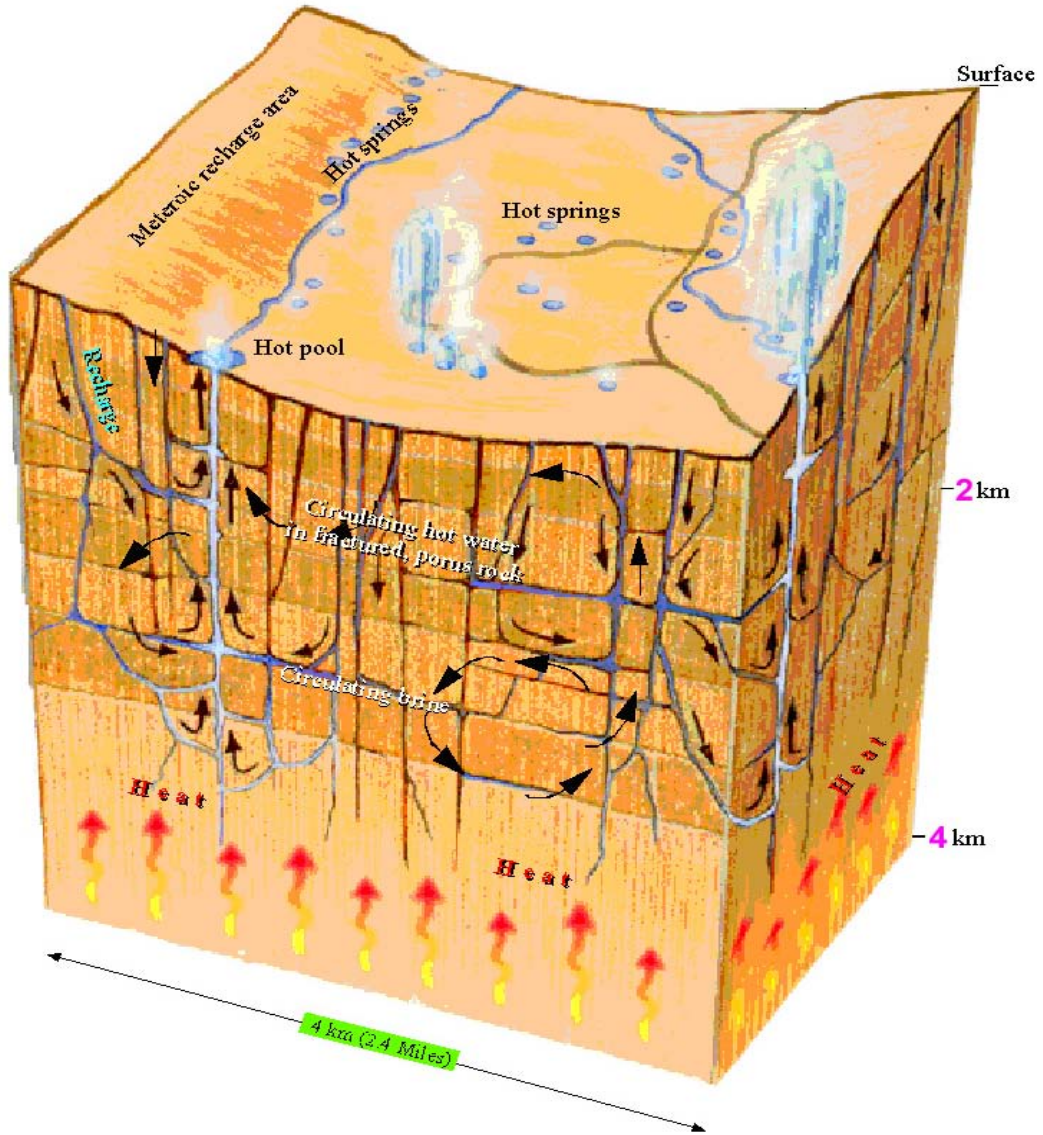
- A globally rare, composite natural resource that supports an array of recreational, economic, scientific, cultural, and natural heritage benefits.

Trail Spring

Sawmill Geyser

# Hydrothermal System

National Park Service
U.S. Department of the Interior
Yellowstone National Park



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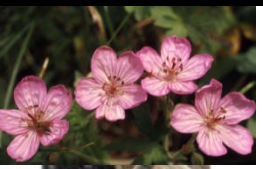
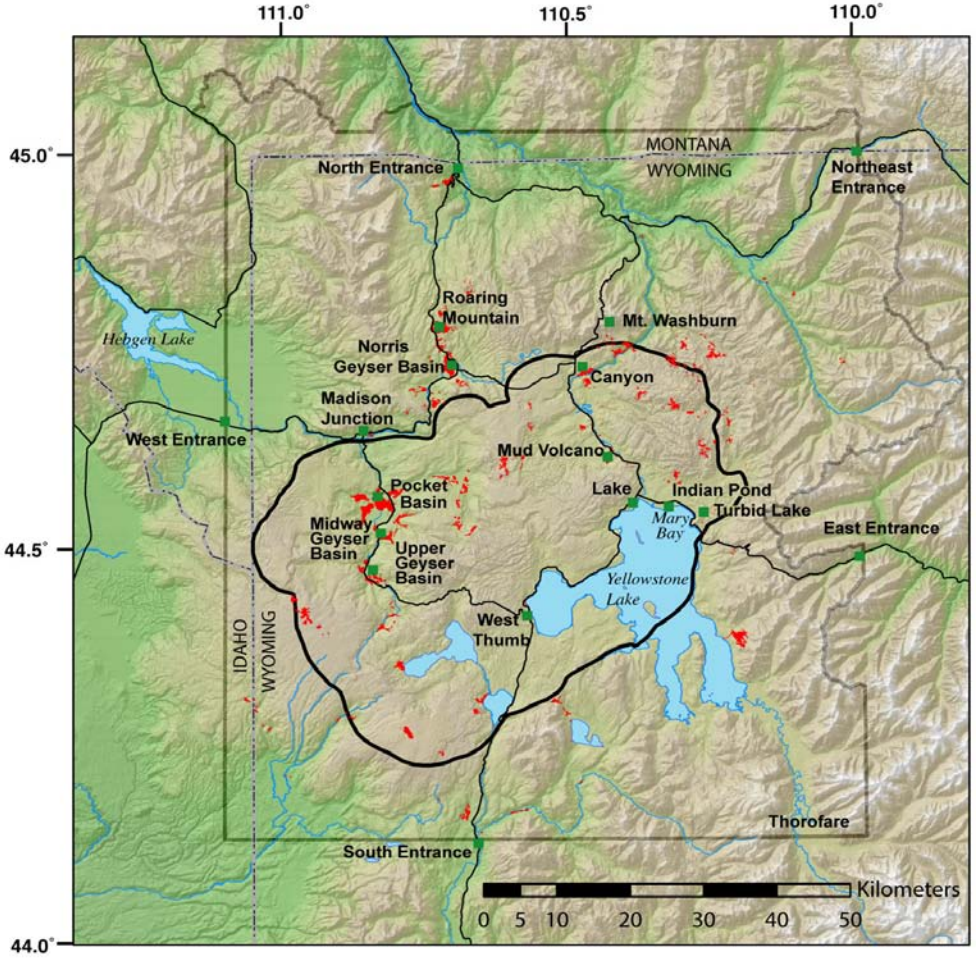






The largest concentration of hydrothermal features on the planet. Powered by the Yellowstone Volcano.

- 10,000+ thermal features
- ~ 500 geysers

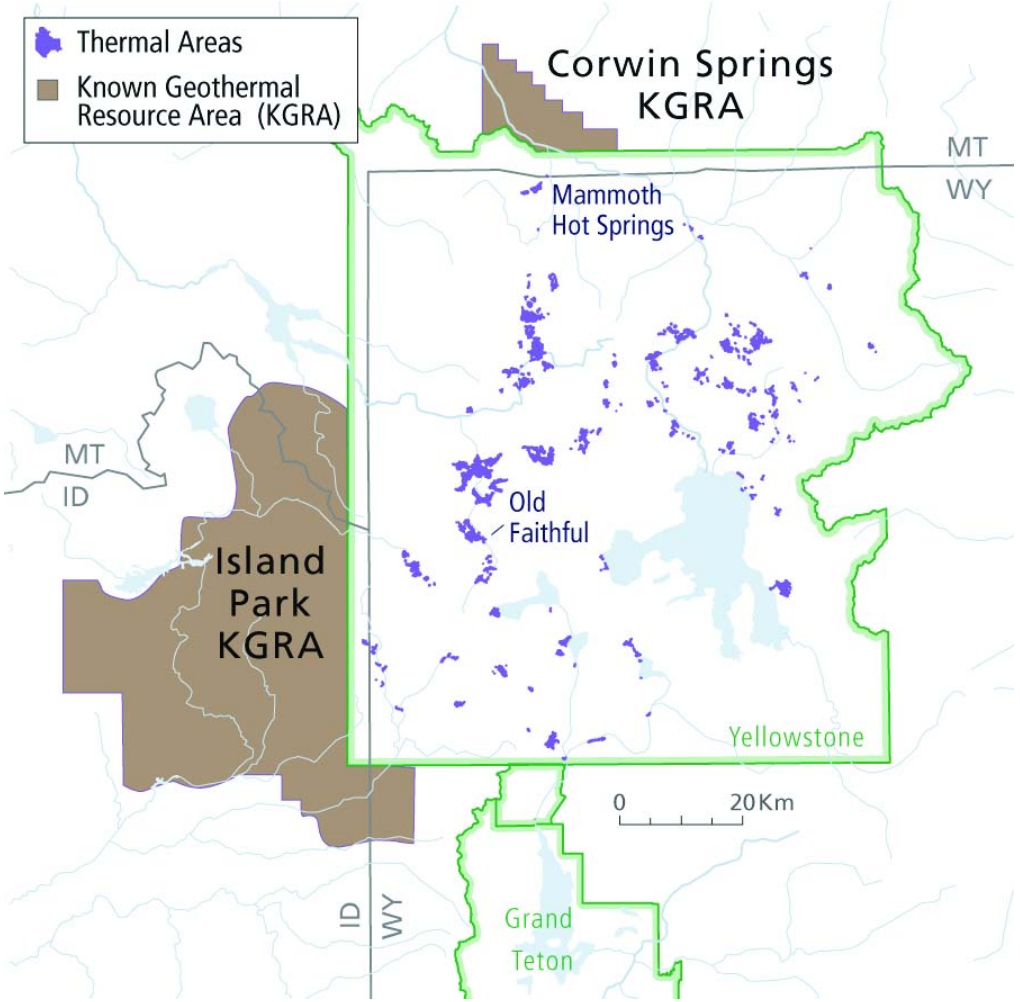


# Geothermal Monitoring

National Park Service
U.S. Department of the Interior
Yellowstone National Park

## Resource protection: External concerns

- Known Geothermal Resource Areas
- Oil, gas and water development immediately adjacent to the Park



# Geothermal Monitoring

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U.S. Department of the Interior
Yellowstone National Park

## Resource protection: Internal concerns

- Infrastructure development
  - Buildings
  - Water development
  - Trenching
  - Road construction
- Wildlife impacts
- Access – research, education
- Vandalism

# Geothermal Monitoring

National Park Service
U.S. Department of the Interior
Yellowstone National Park

## Strategy: *What are we trying to measure?*

- Natural variations in magmatic / hydrothermal system.
- Natural "thermal baseline vital signs" needed to identify human influence.
  - Thermal water flux
  - Heat flux (convective, radiative, and conductive)
  - Chemical output

# Watershed Classification

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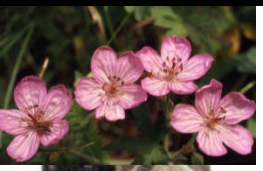
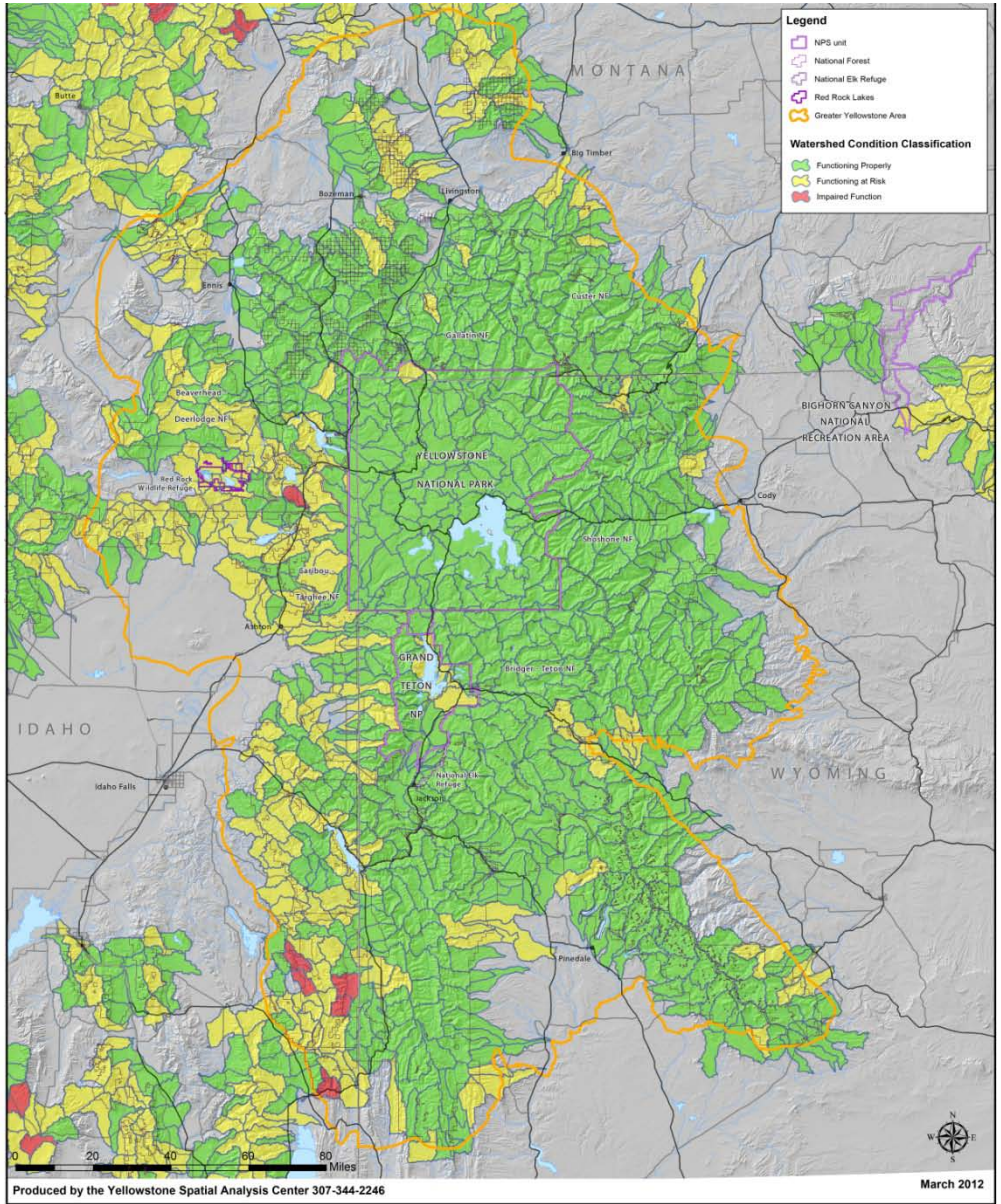
U.S. Department of the Interior
Yellowstone National Park









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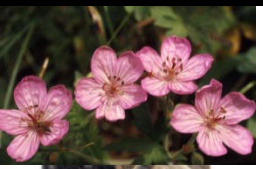




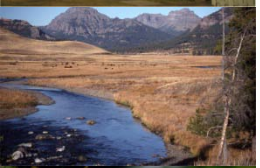


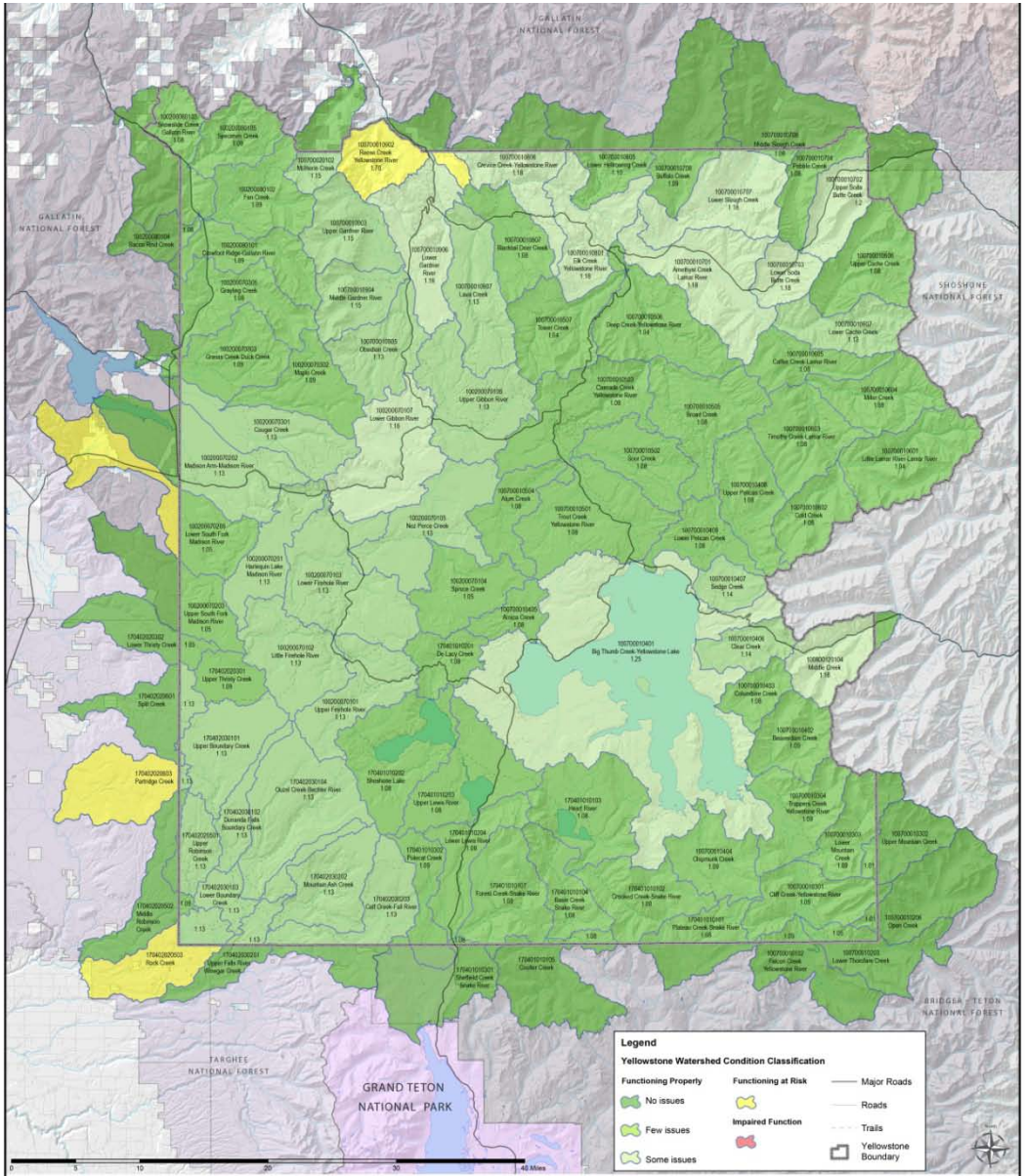

# Water Quality

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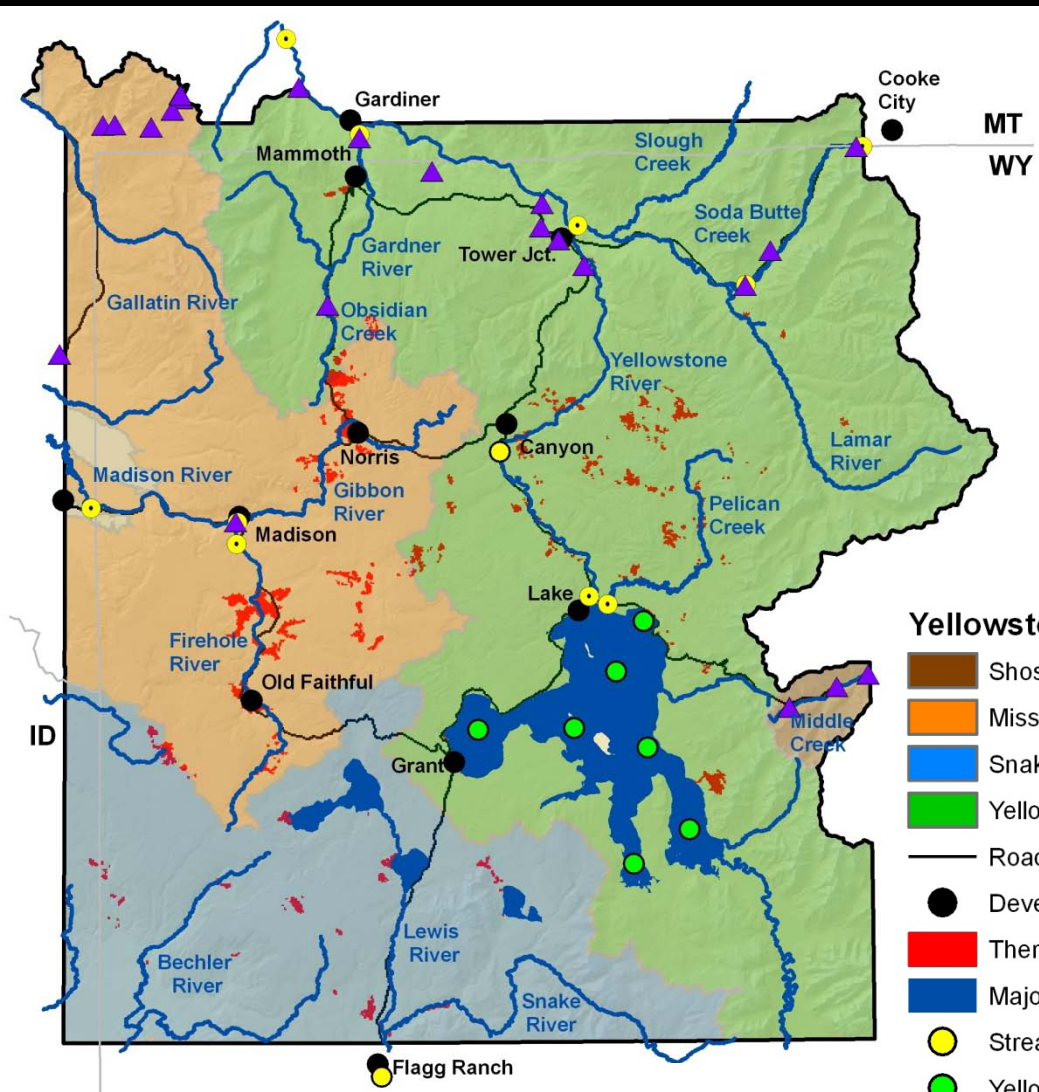
Yellowstone National Park



# Flow Regimes

National Park Service
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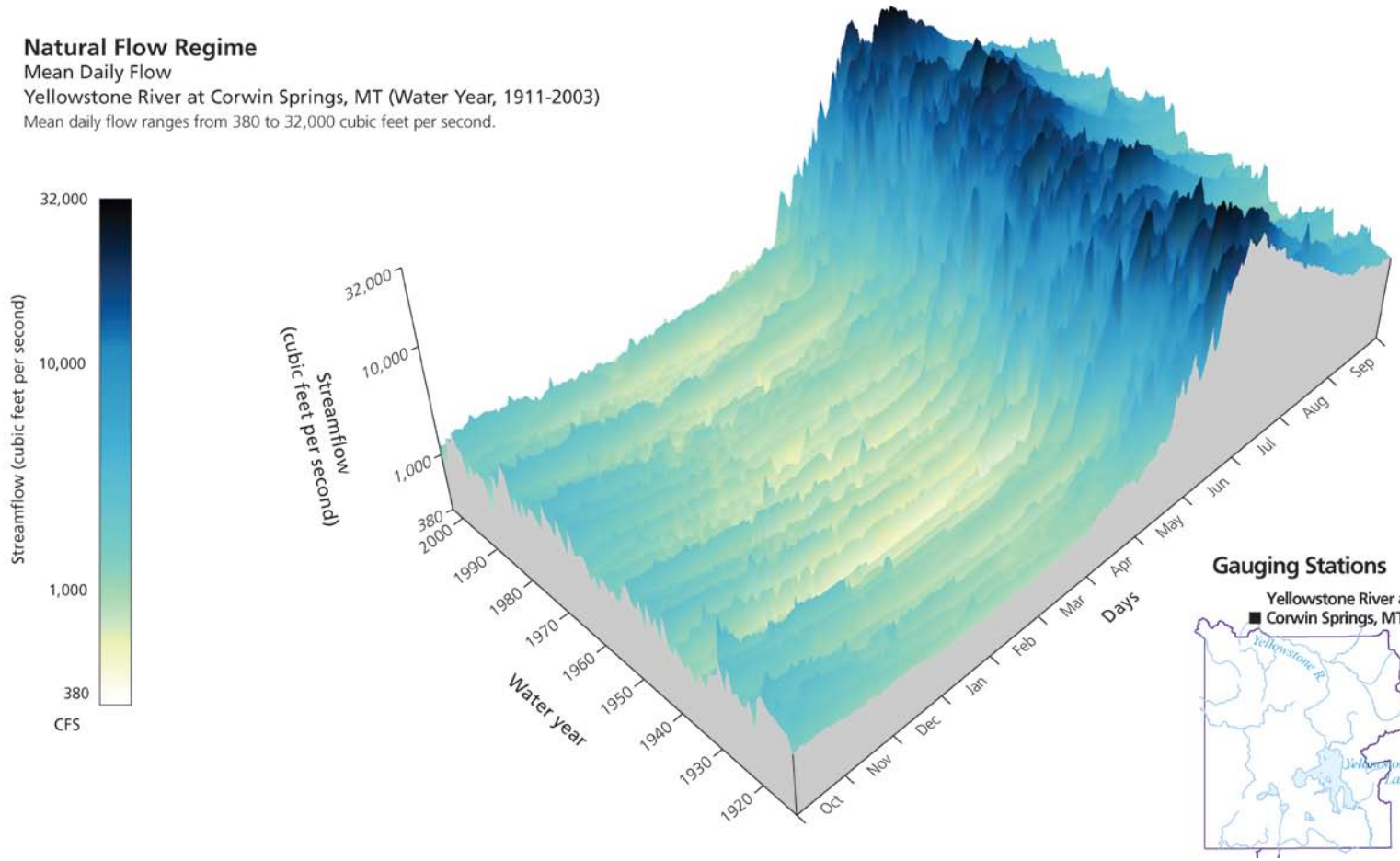
Yellowstone National Park

- Yellowstone River



# Flow Regimes

National Park Service
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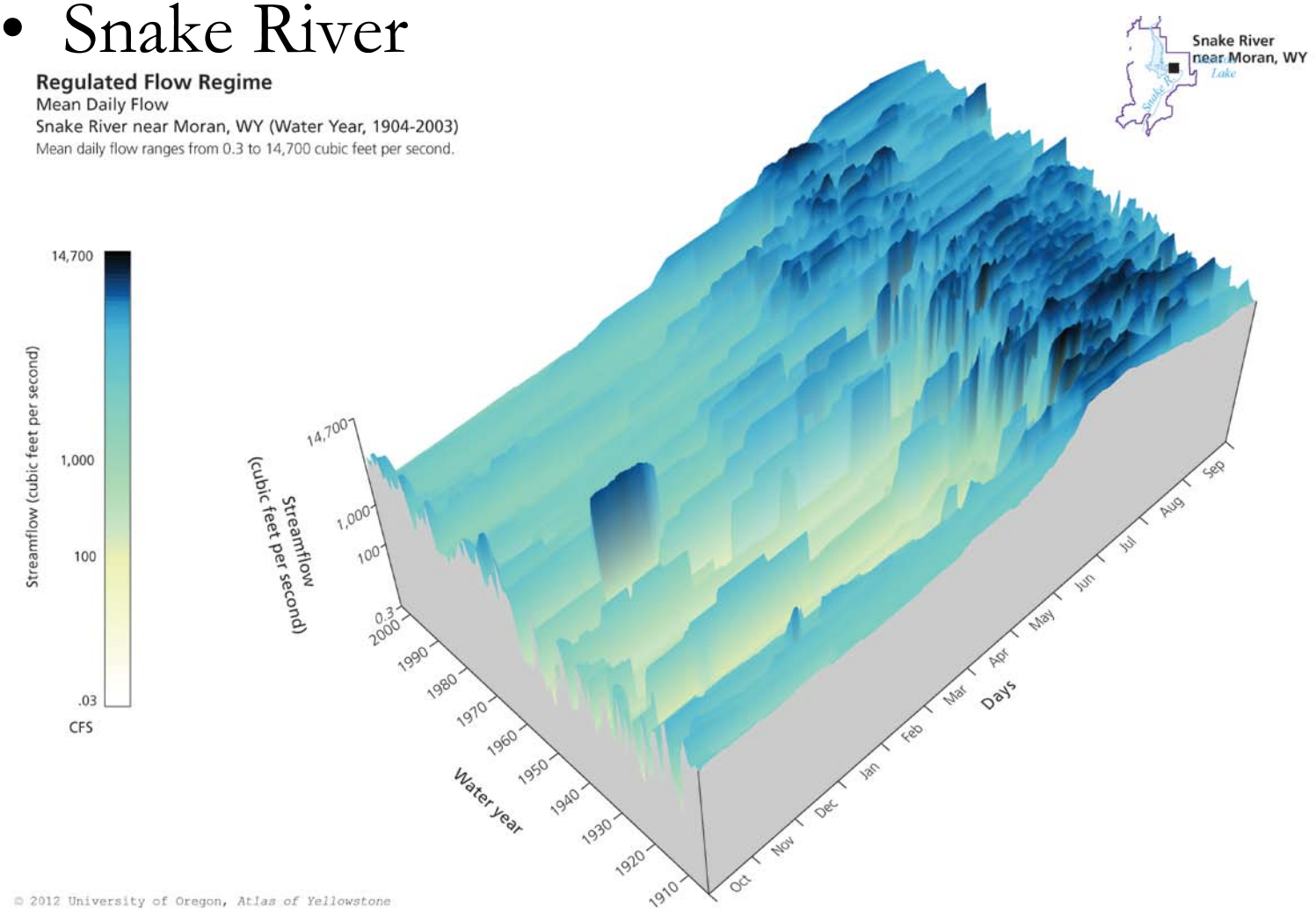
- Snake River

**Regulated Flow Regime**
Mean Daily Flow
Snake River near Moran, WY (Water Year, 1904-2003)
Mean daily flow ranges from 0.3 to 14,700 cubic feet per second.

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# Soda Butte Creek



- Historic mine tailings persist upstream, outside the park.
- Annually monitored for the presence of potential contaminants.
- Listed by state authorities as 303(d) impaired.

# Stream Flow



## Reese creek

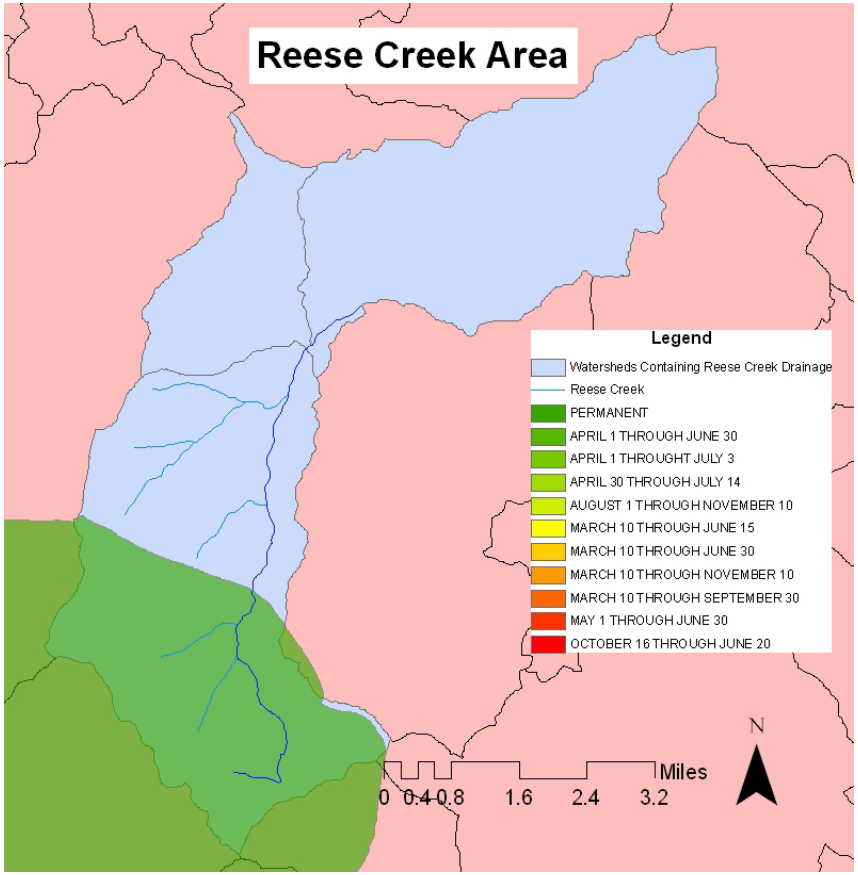
- Historical irrigation often dewatered the stream during mid-summer and fall, making it unsuitable for trout.
- Weekly monitoring of discharge occurs at 2 sites on Reese Creek during August and September.
- Listed by state authorities as 303(d) impaired.

# Water Rights

National Park Service
U.S. Department of the Interior
Yellowstone National Park

## Reese creek

- Adjudicated water rights stipulate that Reese Creek is to have a minimum flow of 1.306 $ft^3$/sec between 15 April and 15 October.

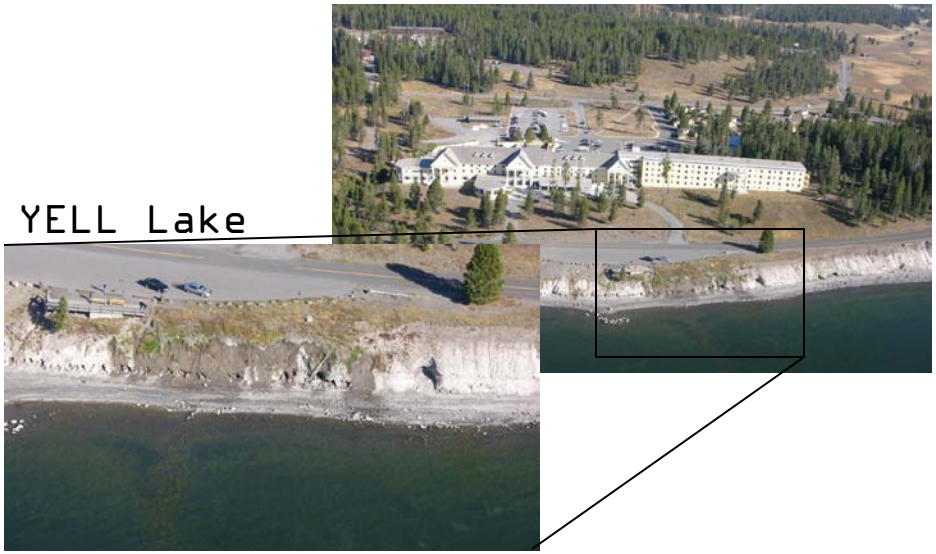


# Erosion Control

National Park Service
U.S. Department of the Interior
Yellowstone National Park

- Project Locations proposed for 2012
  - Lost Creek Drainage
  - Pebble Creek Bridge
  - Yellowstone River
  - Peale Island
  - Yellowstone Lake
  - Soda Butte Creek

Yellowstone River



YELL Lake

Lost Creek Drainage

# Soda Butte—Lamar Confluence

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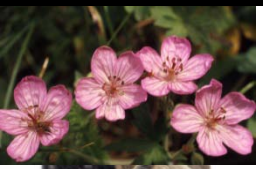
Yellowstone National Park







# Vulnerable Areas

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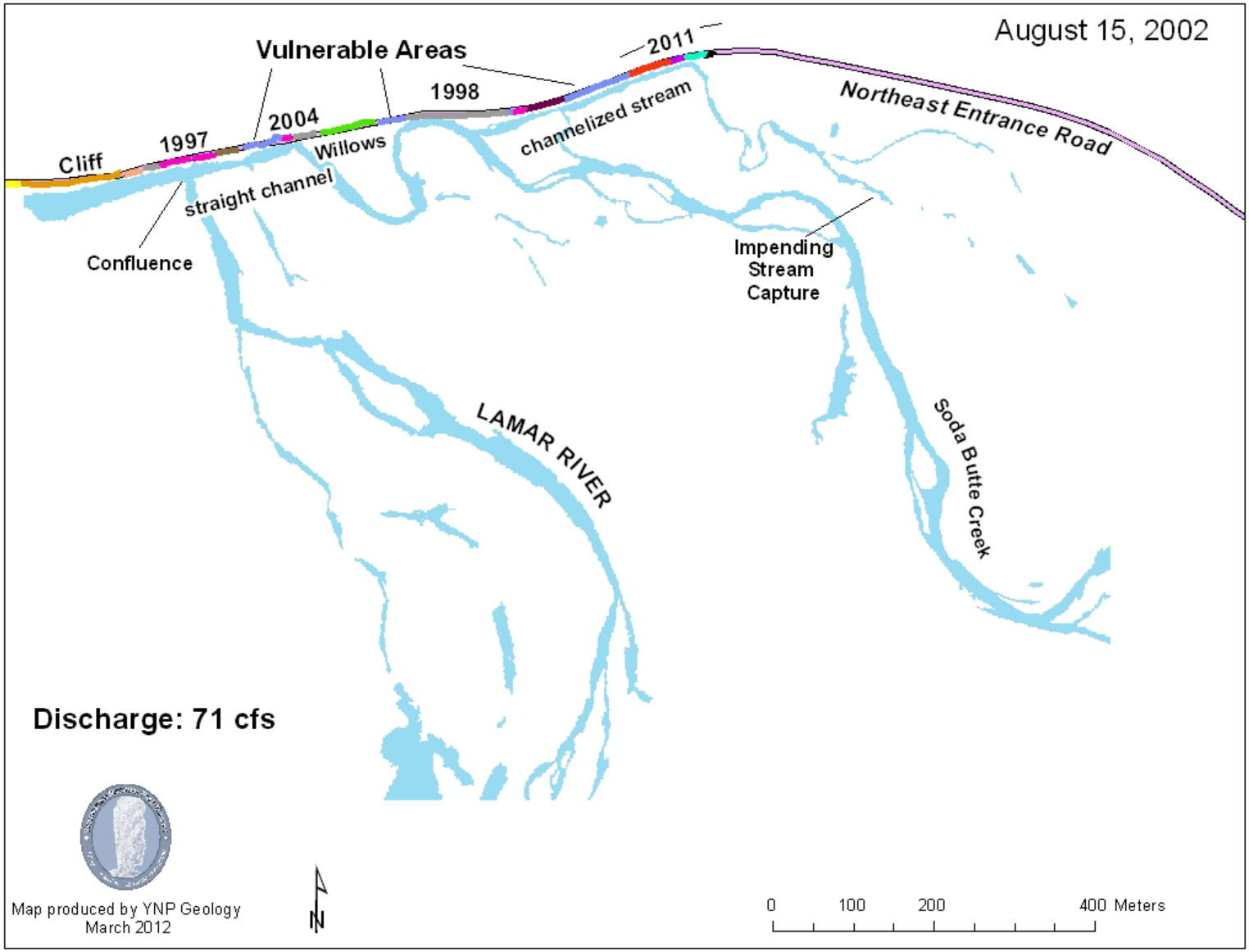

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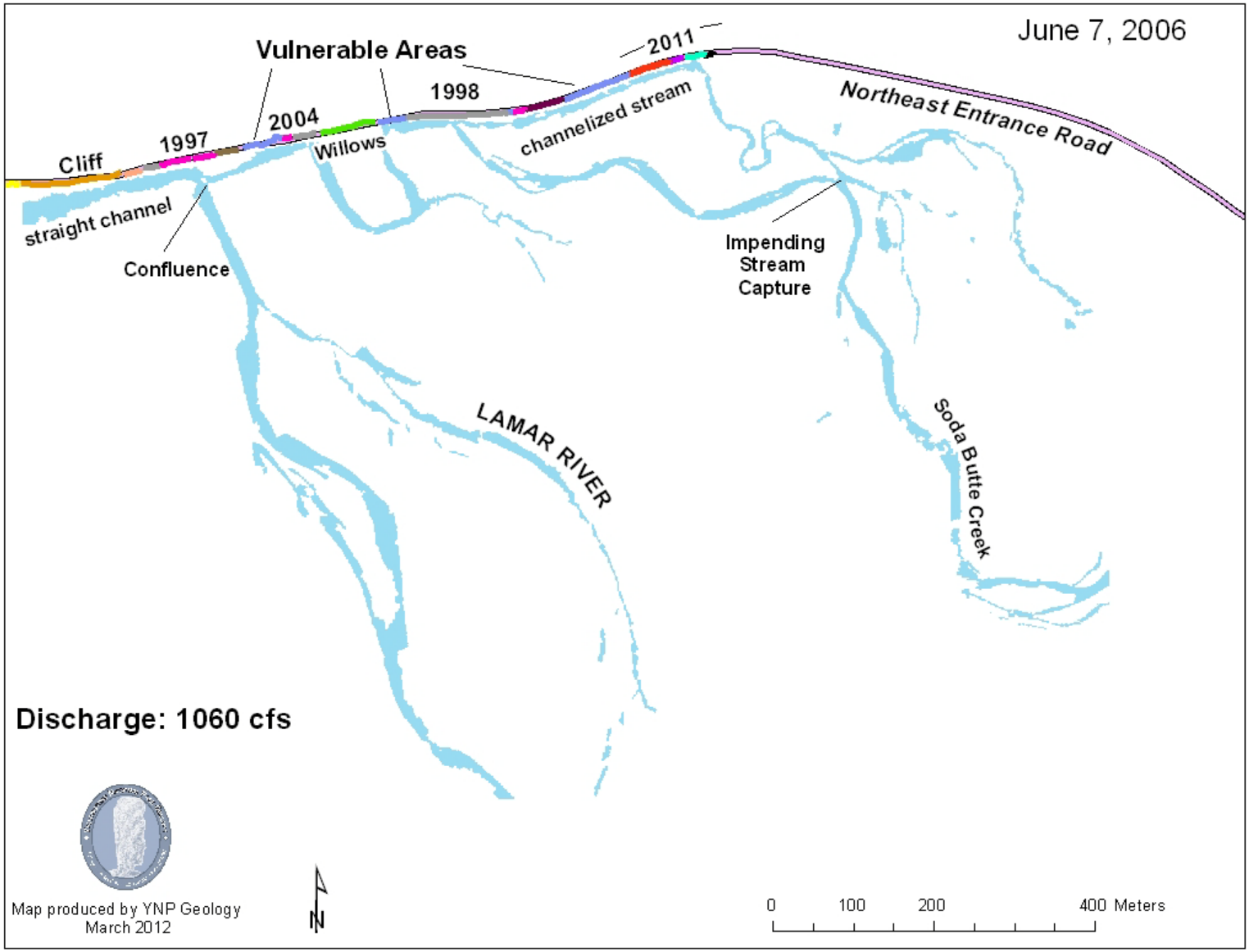

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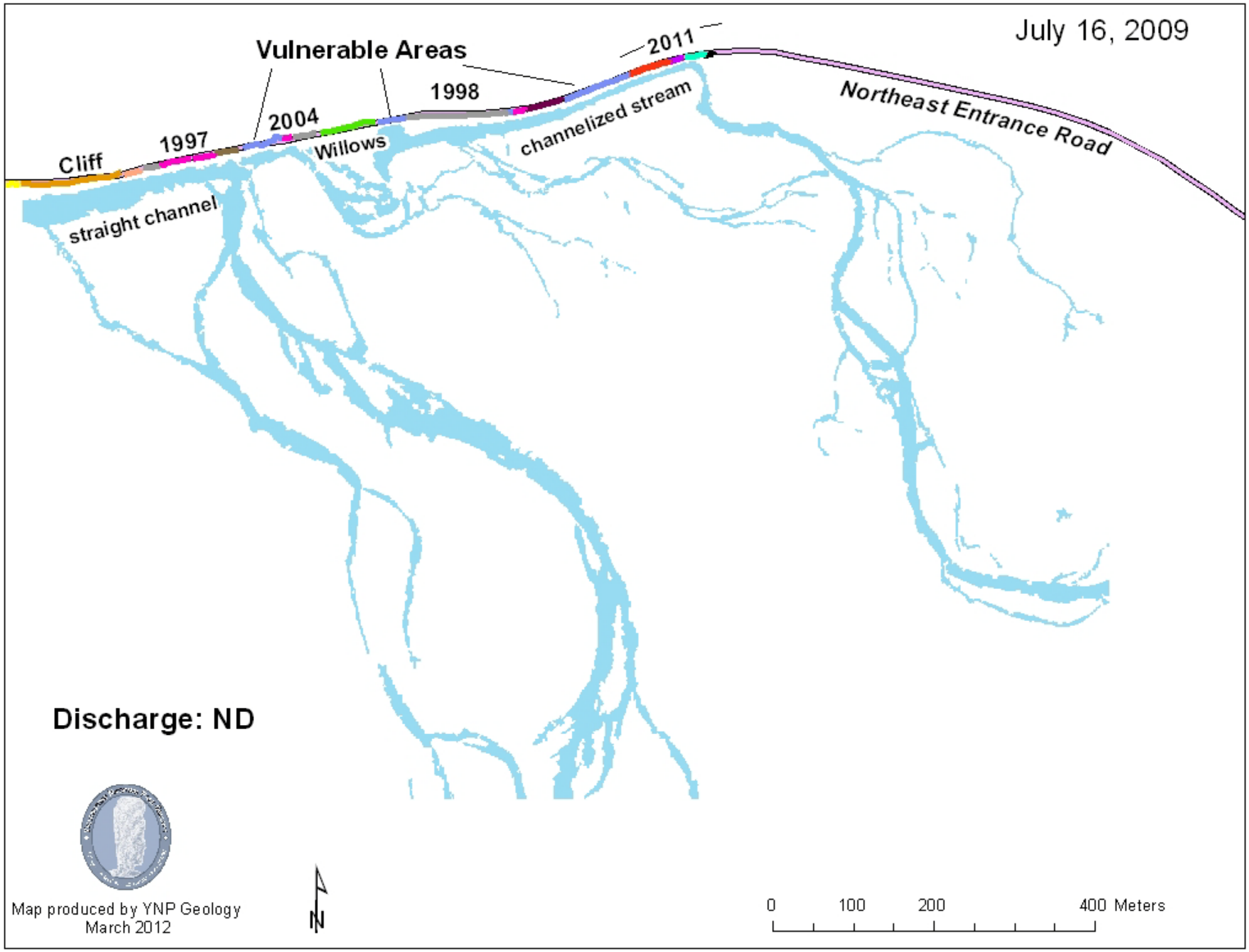

# Historic Landscapes



- Most historic landscapes in YNP are rustic and have native vegetation—not Mammoth Hot Springs Historic District.
- Mammoth also contains the Fort Yellowstone National Historic Landmark District.

# Mechanized Irrigation

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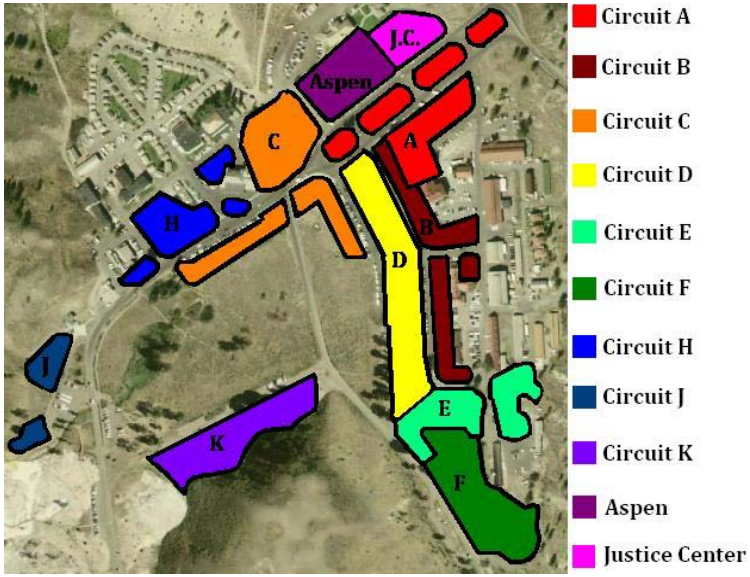
U.S. Department of the Interior
Yellowstone National Park

Existing System:

- NPS- Automated system
- Lower Mammoth residential- manual
- Hotel & Cabins- manual




# Irrigation Water Use

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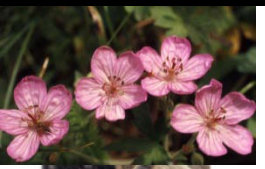
Yellowstone National Park







- 26% of Mammoth's annual water use.
- Cost= ~$131,000 per year



| | NPS Irrigation System | Lower Mammoth Residential | Mammoth Hotel and Cabins | |
|---|---|---|---|---|
| Area (Acres) | 25.7 | 11.0 | 0.6 | 37.3 |
| Approximate Annual Water Use (gallons) | 12,800,000 | 8,600,000 | 1,000,000 | 22,400,000 |
| Annual Water Application Rates (gallons/ft^2) | 11.43 | 17.95 | 38.26 | |

# Wildlife Conflict

National Park Service
U.S. Department of the Interior
Yellowstone National Park

- Elk habituation?
  - Grass green and available longer than other food sources.
  - Drink water from the irrigation system.
  - Abundant despite human presence.

# Water Conservation

National Park Service
U.S. Department of the Interior
Yellowstone National Park

Mammoth:

- Irrigation Improvement Options
  - Lawn Reduction
  - Alternative Water Reservoir
  - Harvested Rainwater
  - Condition-Based Irrigation Controllers
  - Modify Current Sprinkler System La
  - Reform Sprinkler Schedule

# Aquatic Invasive Species

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# Thank You

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