New Frontiers in ASR Applications

- New Storage Applications
- Example Projects
- Constraints and Challenges
- Looking Ahead

Jeff Barry
GSI Water Solutions, Inc.

May 12, 2010

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New Frontiers in AS

- New Storage Applications
- Example Projects
- Constraints and Challenges
- Looking Ahead

New Applications

- Combined AR and ASR
- Thermal ASR
- Watershed enhancement and mitigation
- Down-hole electrical generation
- Storm water and treated wastewater ASR

New Frontiers in ASR Applications

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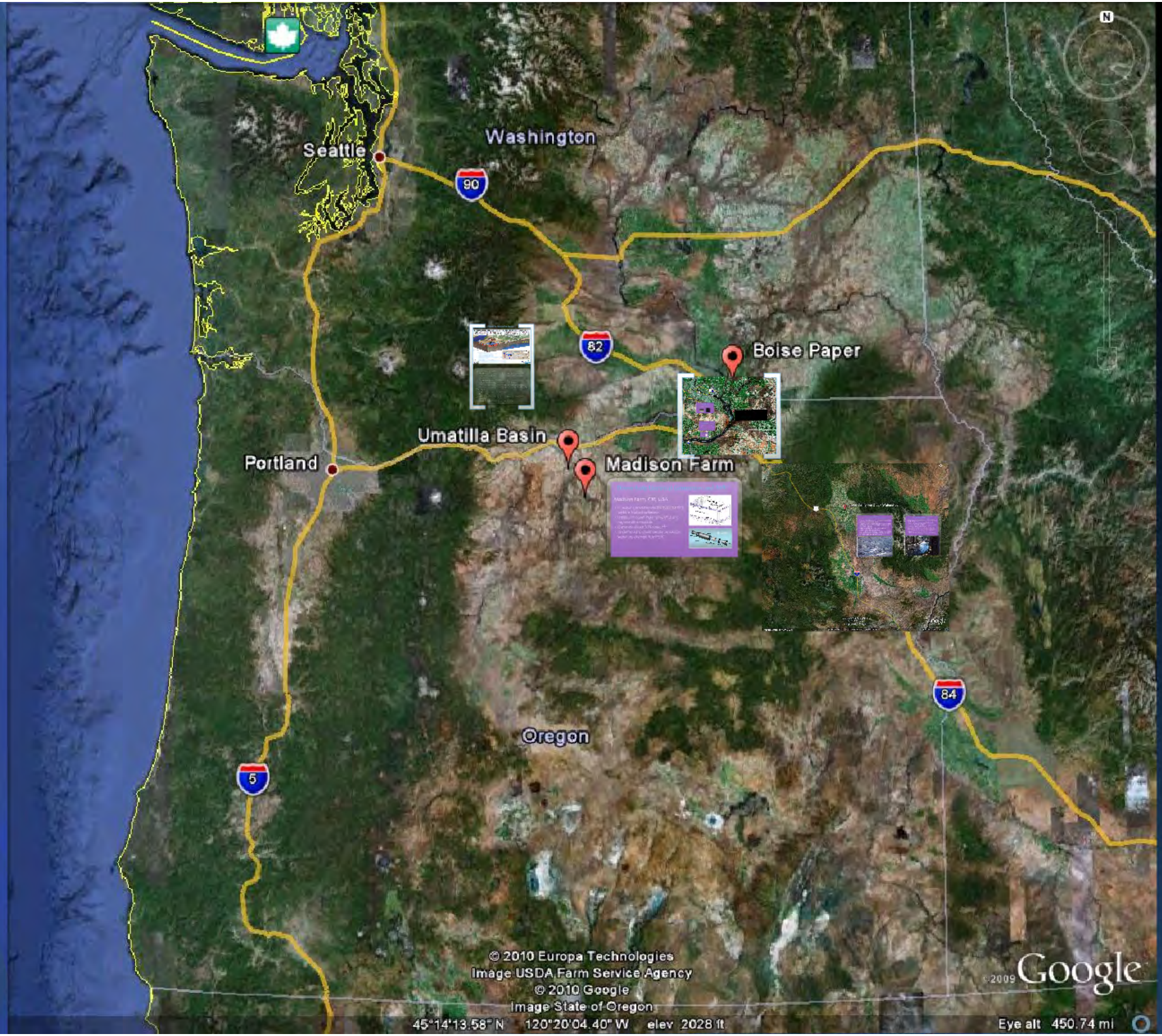
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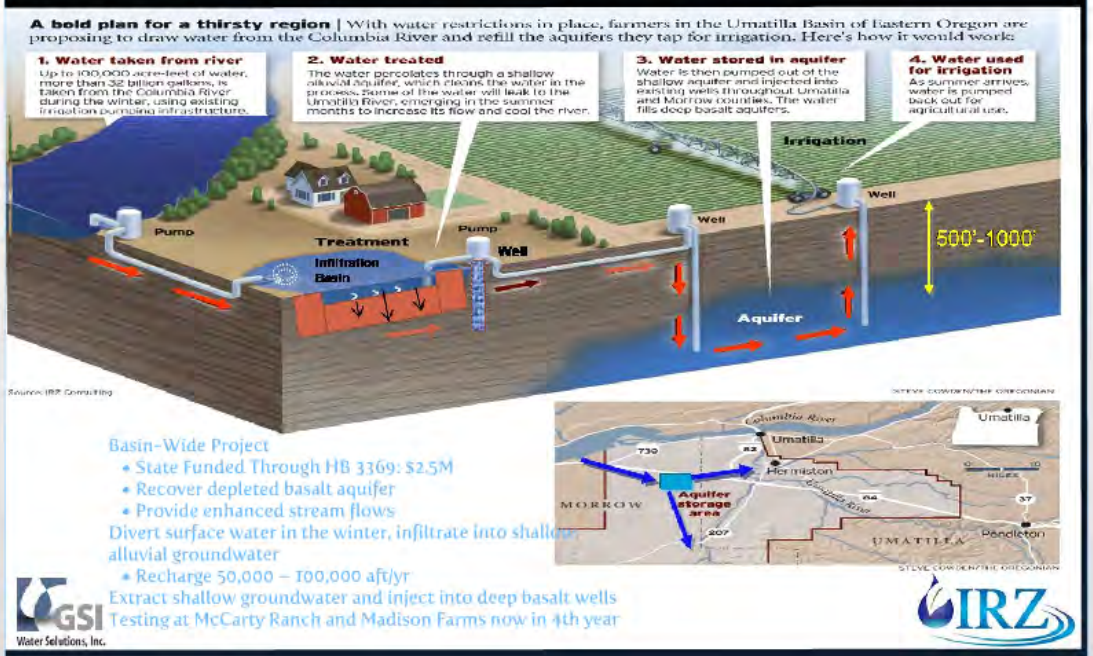
Umatilla Basin Recharge



Basin-Wide Project
- State Funded Through HB 3369: $2.5M
- Recover depleted basalt aquifer
- Provide enhanced stream flows

Divert surface water in the winter, infiltrate into shallow alluvial groundwater
- Recharge 50,000 – 100,000 aft/yr

Extract shallow groundwater and inject into deep basalt wells

Testing at McCarty Ranch and Madison Farms now in 4th year

GSI Water Solutions, Inc.

IRZ

Important Results thus Far:
- Recovery of infiltrated surface water and injection into the basalt, and recovery for irrigation is feasible and meets water quality criteria
- Recovery wells located > 200 feet from infiltration basins considered "groundwater" – no filtration needed
- DEQ has allowed injection of recovered alluvial groundwater into the deep basalt at up to 9.5 mg/L nitrate (with conditions).

Challenges:
- Developing a project that is affordable
- Water rights
- Identifying and protecting infiltrated water for environmental benefits
- Assessing peak and ecological flow impacts

Umatilla Basin Recharge

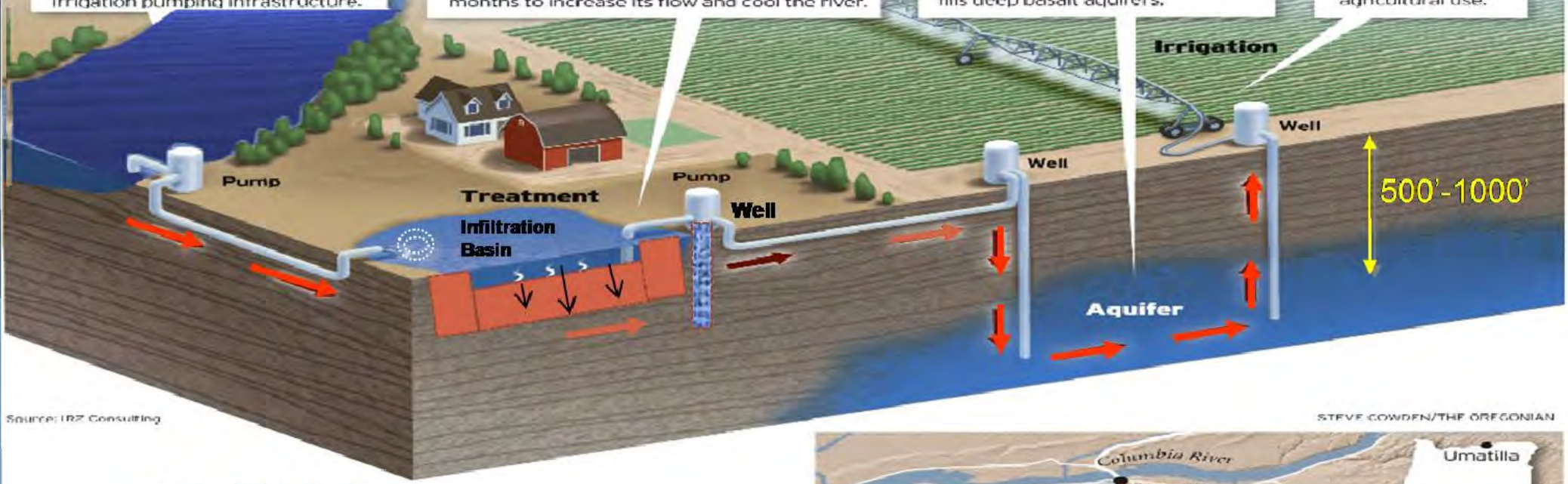
A bold plan for a thirsty region | With water restrictions in place, farmers in the Umatilla Basin of Eastern Oregon are proposing to draw water from the Columbia River and refill the aquifers they tap for irrigation. Here's how it would work:

1. Water taken from river
Up to 100,000 acre-feet of water, more than 32 billion gallons, is taken from the Columbia River during the winter, using existing irrigation pumping infrastructure.

2. Water treated
The water percolates through a shallow alluvial aquifer, which cleans the water in the process. Some of the water will leak to the Umatilla River, emerging in the summer months to increase its flow and cool the river.

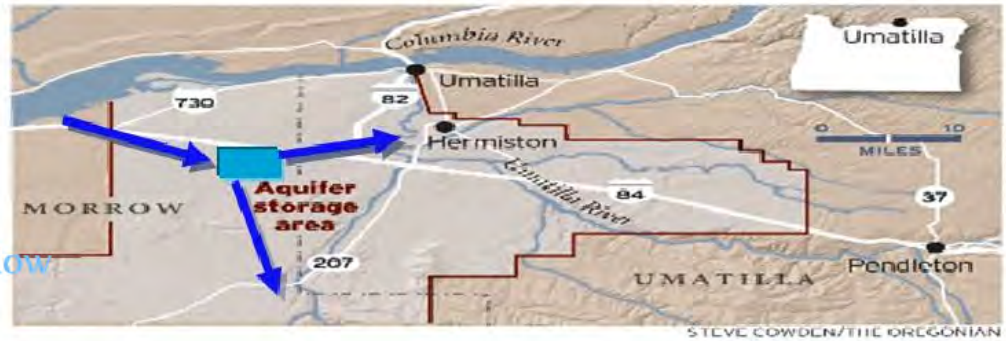
3. Water stored in aquifer
Water is then pumped out of the shallow aquifer and injected into existing wells throughout Umatilla and Morrow counties. The water fills deep basalt aquifers.

4. Water used for irrigation
As summer arrives, water is pumped back out for agricultural use.



Source: IRZ Consulting

STEVE COWDEN/THE OREGONIAN



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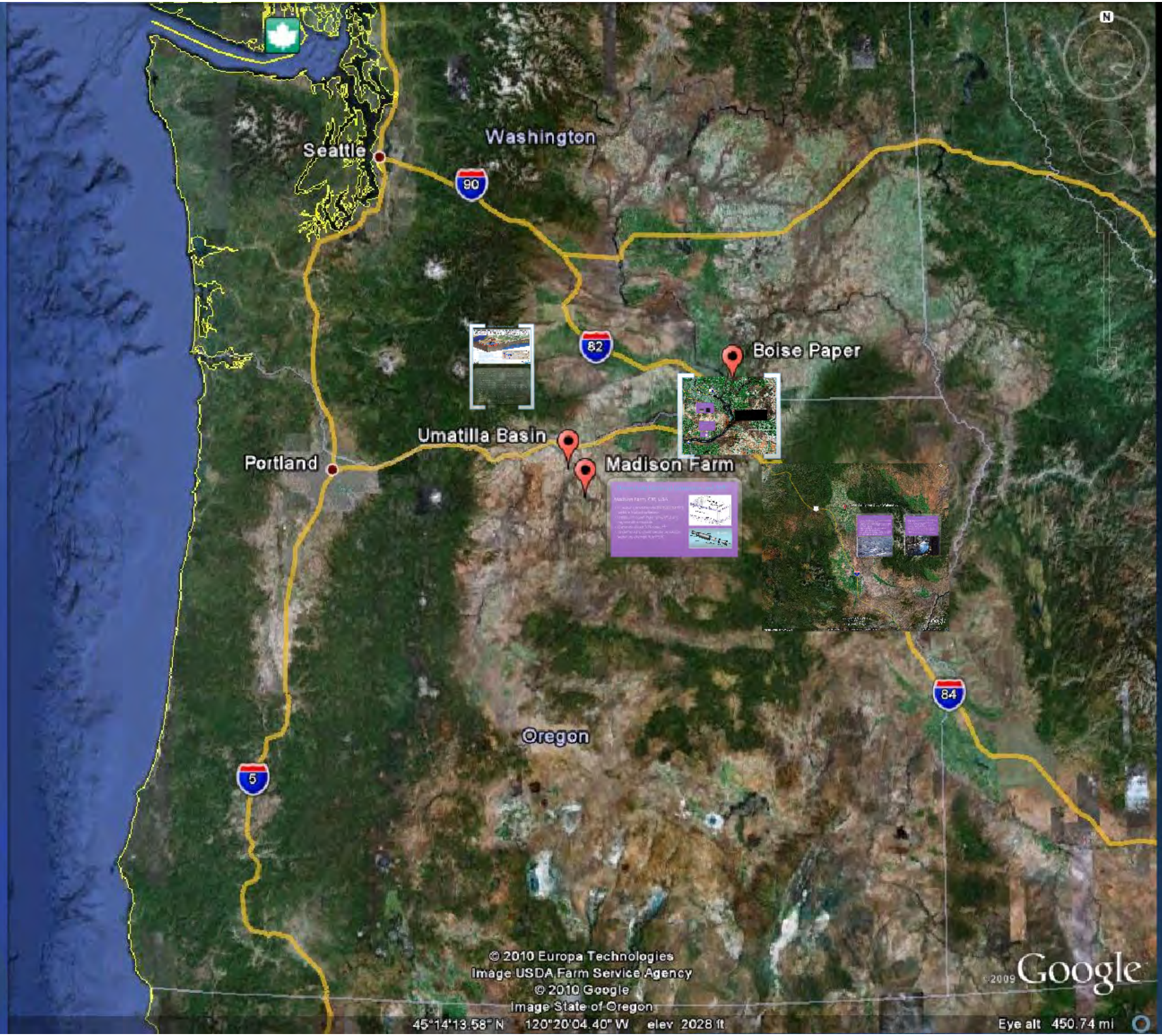
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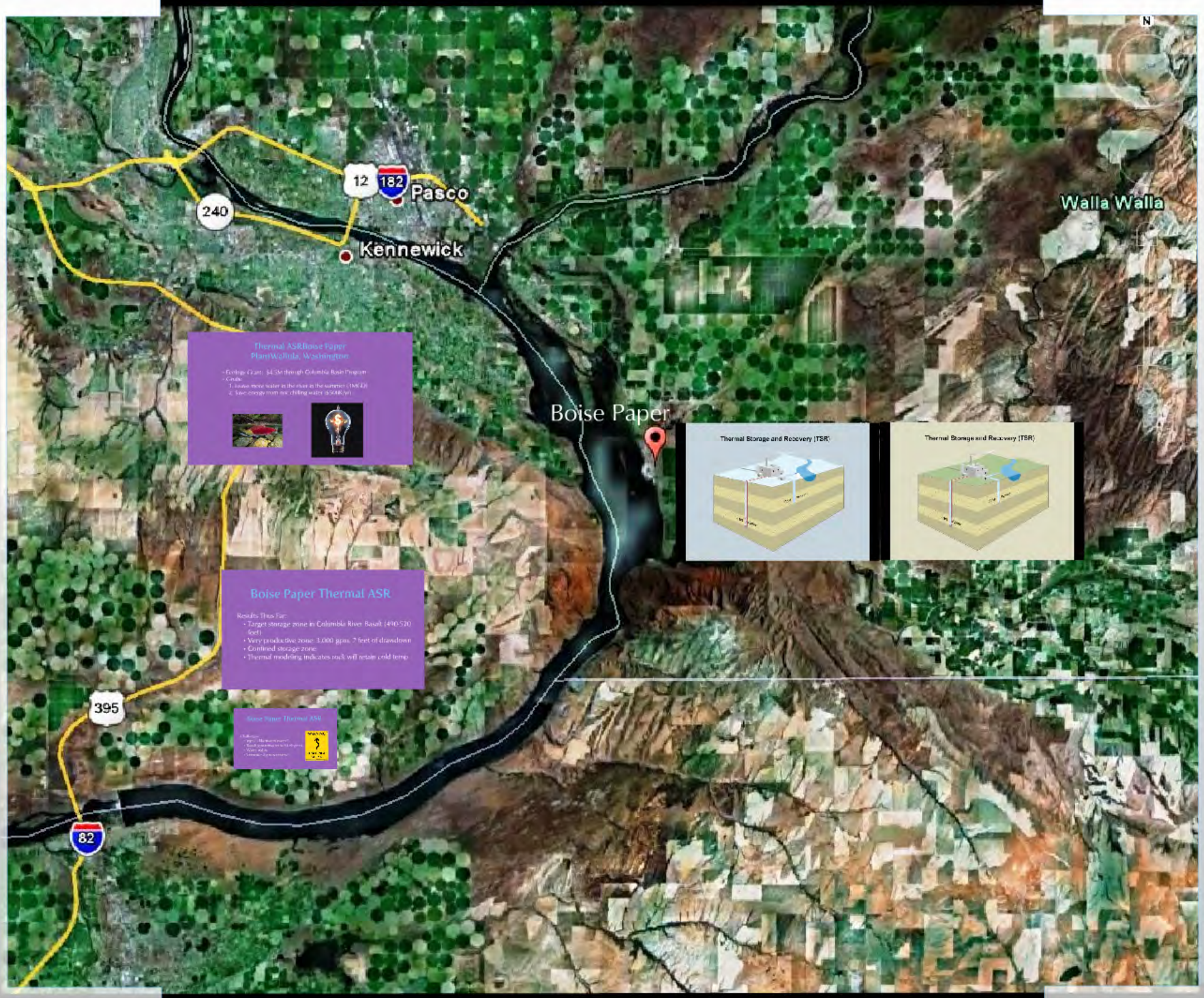
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Walla Walla
Boise Paper
Thermal ASRBoise Paper
PlantWalla, Washington
Thermal Storage and Recovery (TSR)
Thermal Storage and Recovery (TSR)
Boise Paper Thermal ASR
Results Thus Far:
• Target storage zone in Columbia River Basalt (490-520 feet)
• Very productive zone: 3,000 gpm, 7 feet of drawdown
• Confined storage zone
• Thermal modeling indicates rock will retain cold temp
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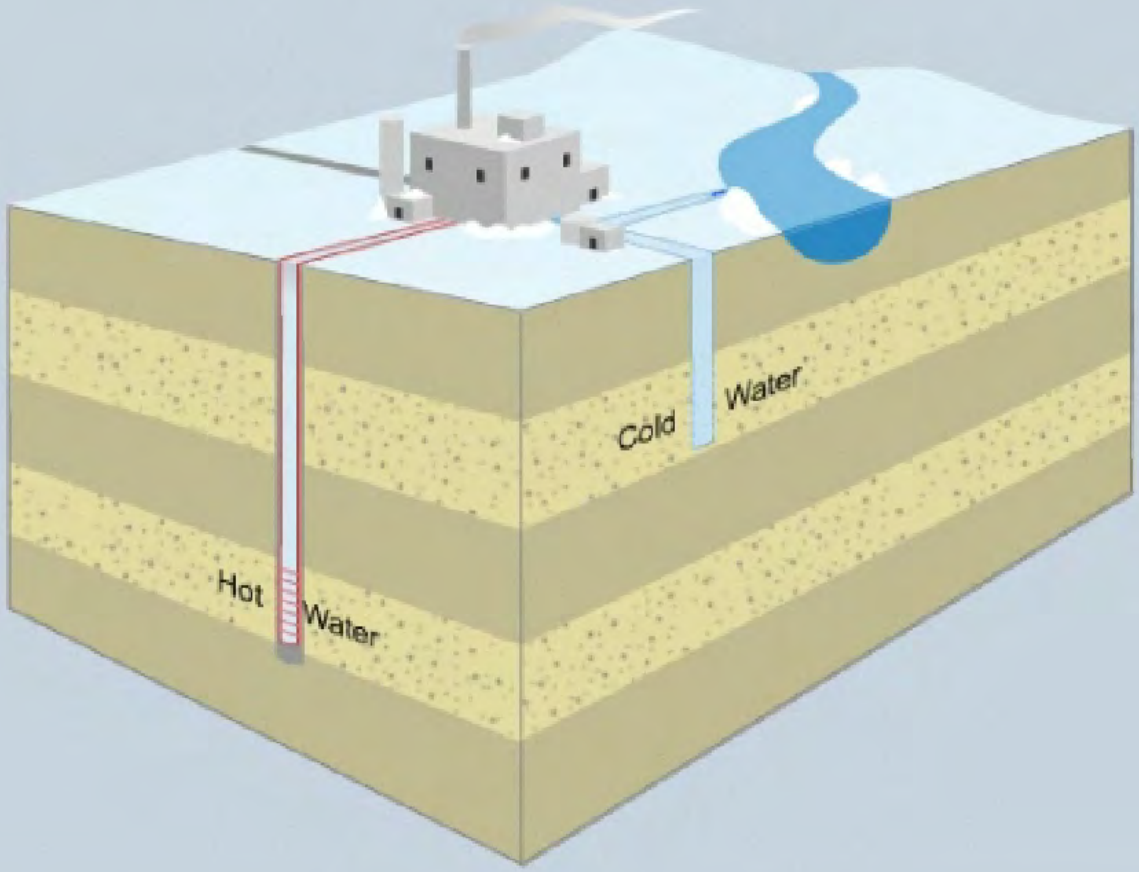
Thermal Storage and Recovery (TSR)



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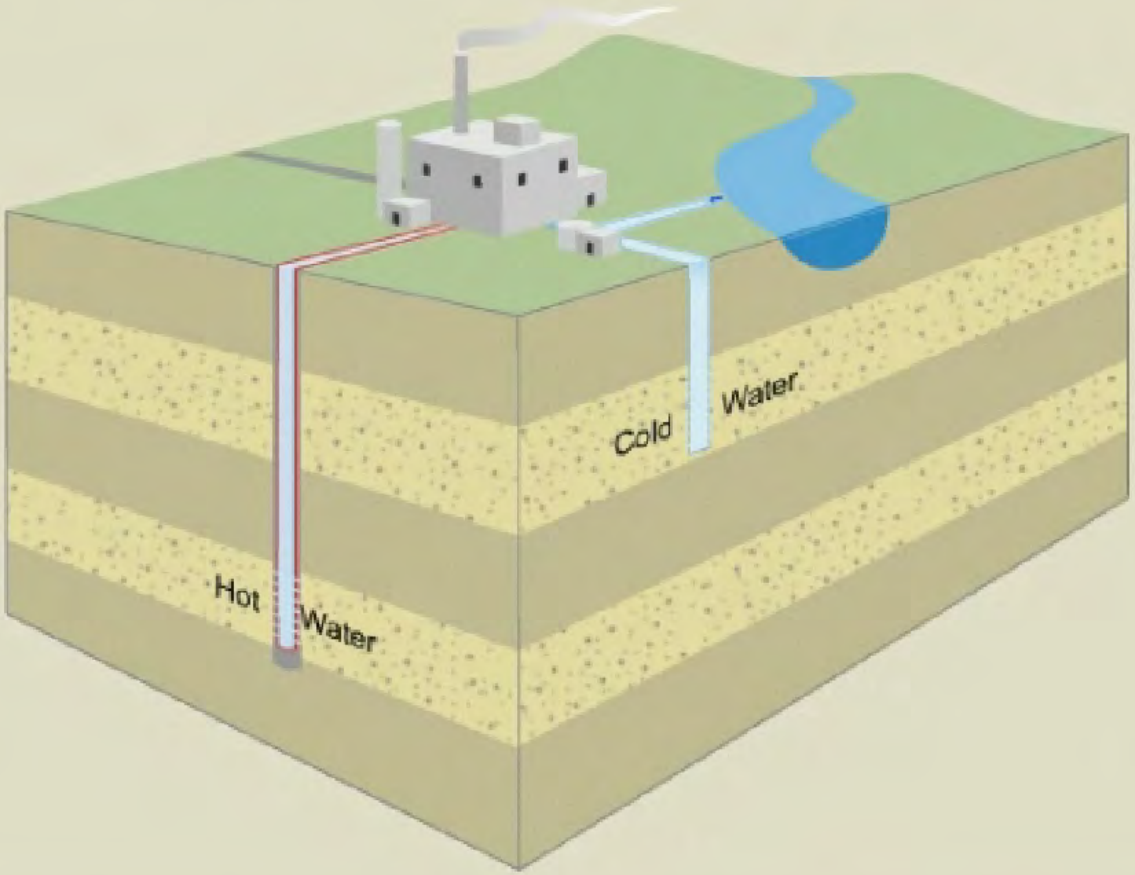

Thermal ASRBoise Paper PlantWallula, Washington

- Ecology Grant: $4.5M through Columbia Basin Program
- Goals:
  1. Leave more water in the river in the summer (3MGD)
  2. Save energy from not chilling water ($500K/yr)

Boise Paper Thermal ASR

Results Thus Far:

- Target storage zone in Columbia River Basalt (490-520 feet)
- Very productive zone: 3,000 gpm, 7 feet of drawdown
- Confined storage zone
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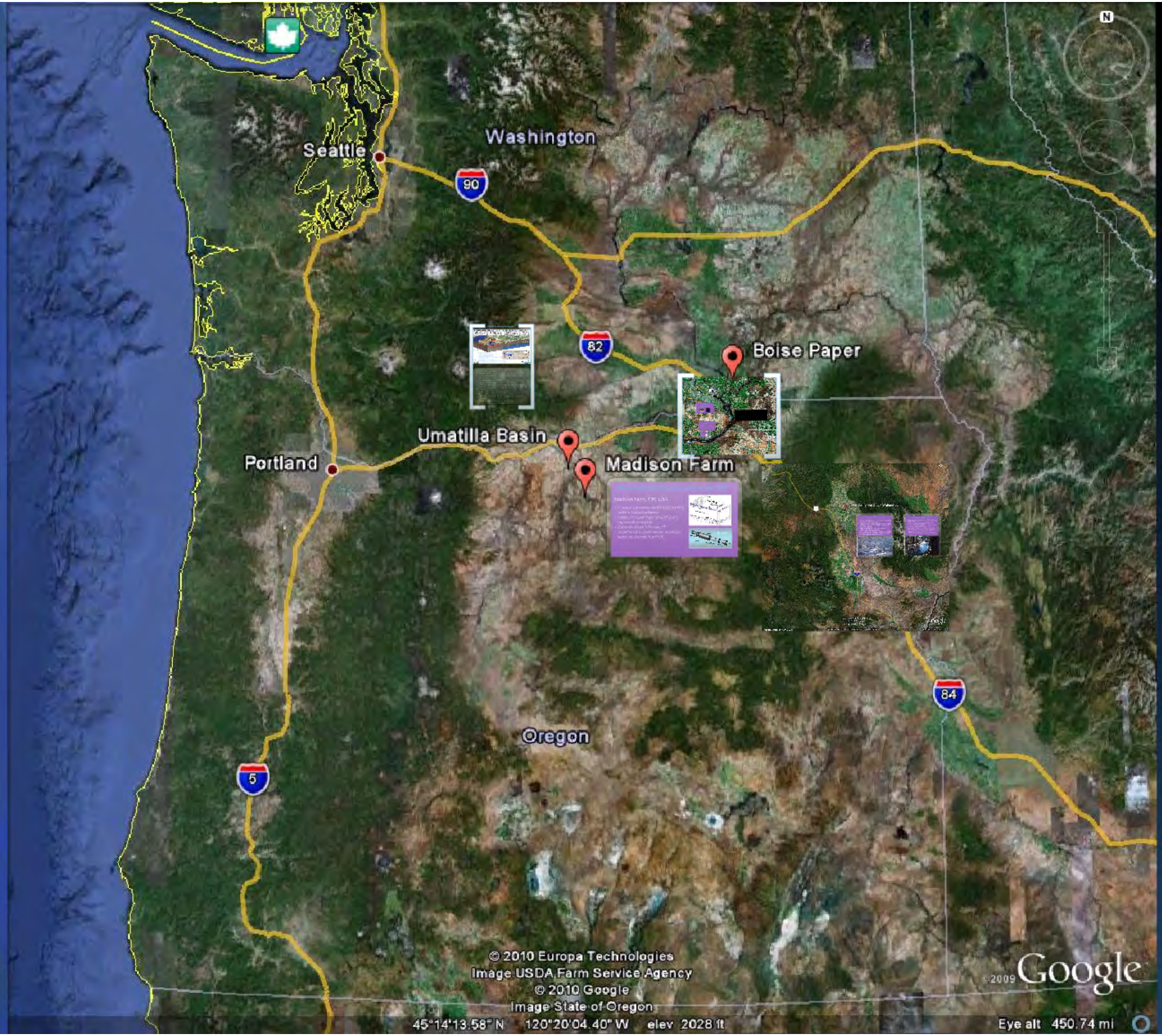
Boise Paper Thermal ASR

Challenges:

- Inject chlorinated water?
- Basalt groundwater is 80 degrees
- Water rights
- Extensive agency review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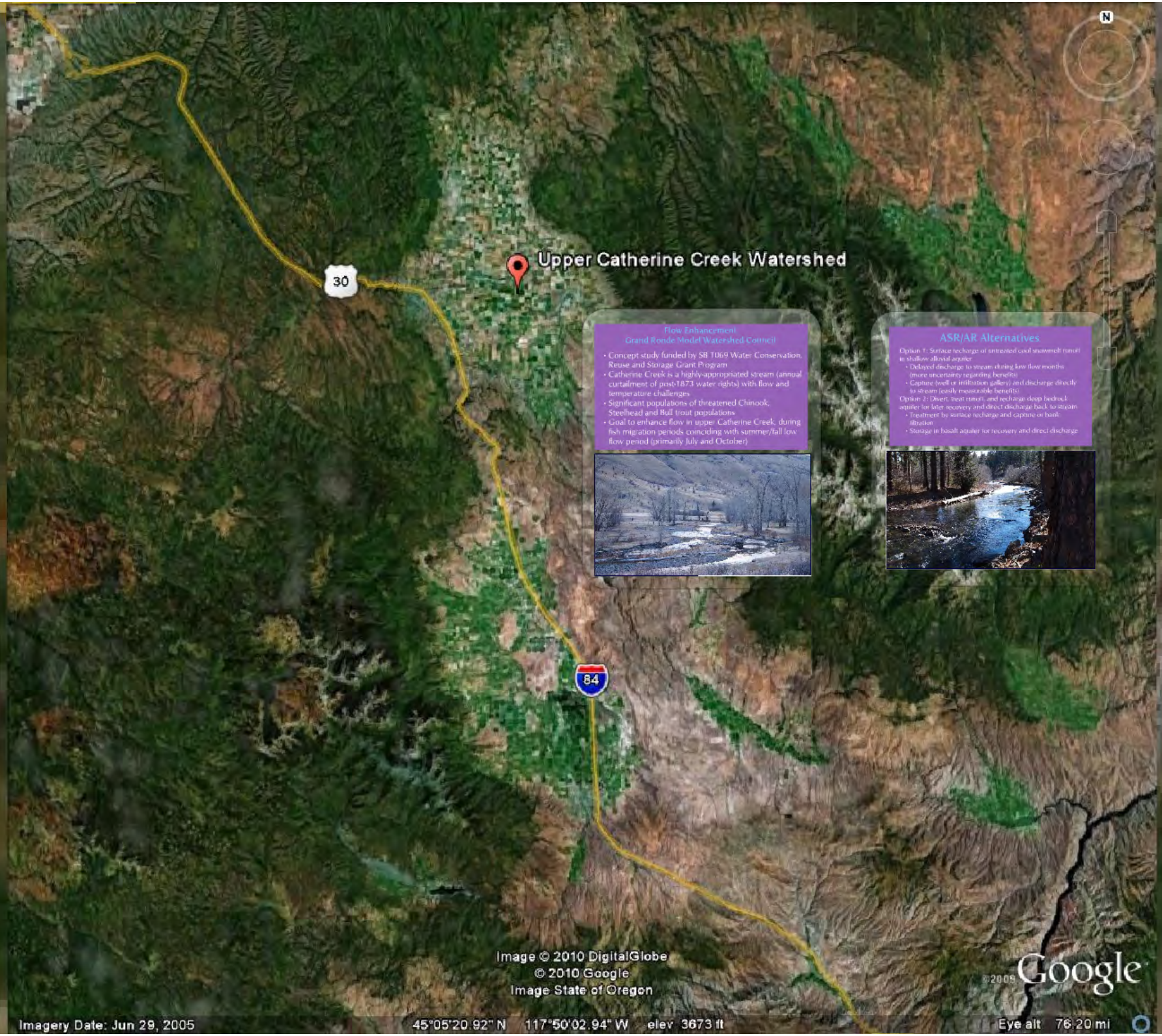
Upper Catherine Creek Watershed
30
84
Flow Enhancement
Grand Ronde Model Watershed Council
• Concept study funded by SB 1069 Water Conservation, Reuse and Storage Grant Program
• Catherine Creek is a highly-appropriated stream (annual curtailment of post-1873 water rights) with flow and temperature challenges
• Significant populations of threatened Chinook, Steelhead and Bull trout populations
• Goal to enhance flow in upper Catherine Creek, during fish migration periods coinciding with summer/fall low flow period (primarily July and October)
ASR/AR Alternatives
Option 1: Surface recharge of untreated cool snowmelt runoff in shallow alluvial aquifer
• Delayed discharge to stream during low flow months (more uncertainty regarding benefits)
• Capture (well or infiltration gallery) and discharge directly to stream (easily measurable benefits)
Option 2: Divert, treat runoff, and recharge deep bedrock aquifer for later recovery and direct discharge back to stream
• Treatment by surface recharge and capture or bank filtration
• Storage in basalt aquifer for recovery and direct discharge
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Imagery Date: Jun 29, 2005
45°05'20.92" N 117°50'02.94" W elev 3673 ft
Eye alt 76.20 mi

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Grand Ronde Model Watershed Council

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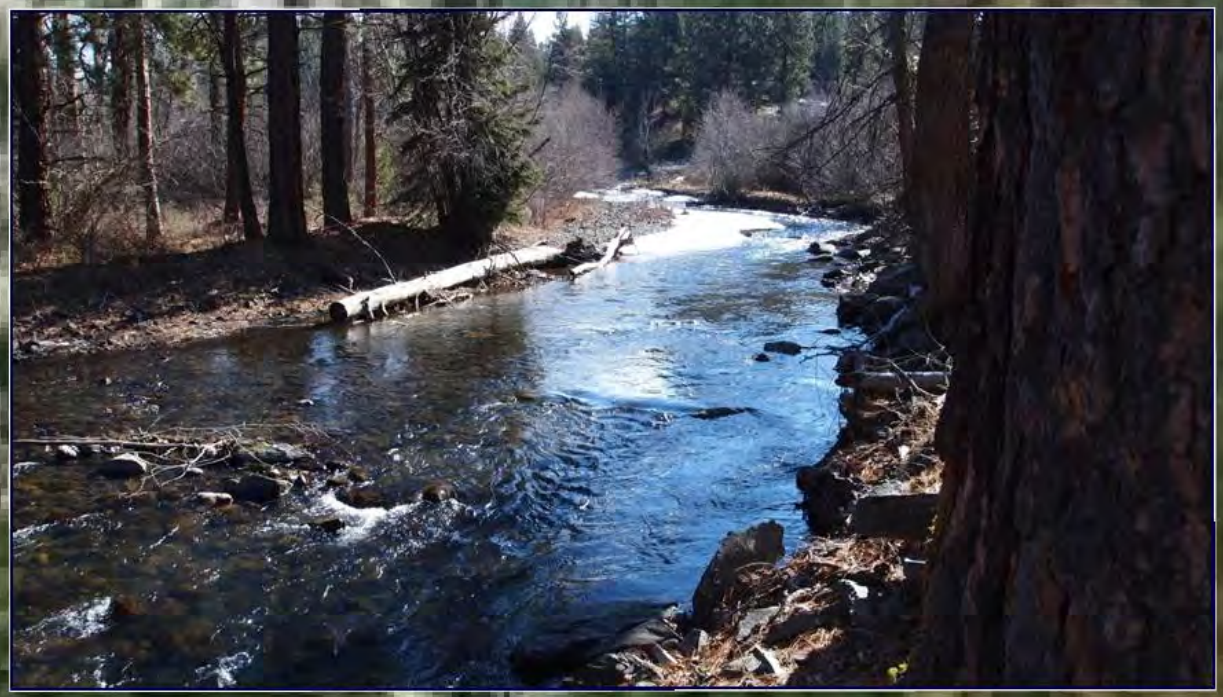

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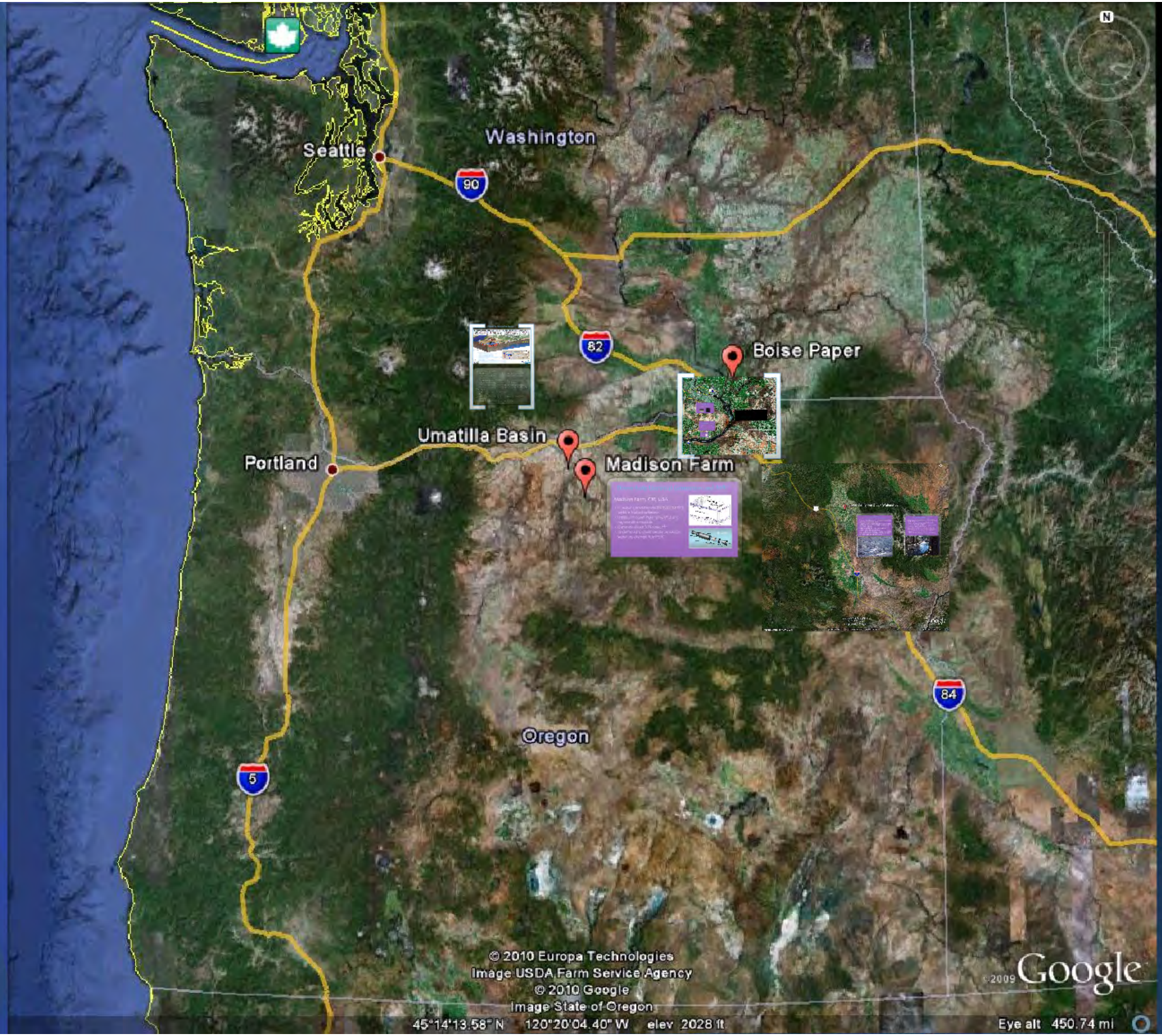
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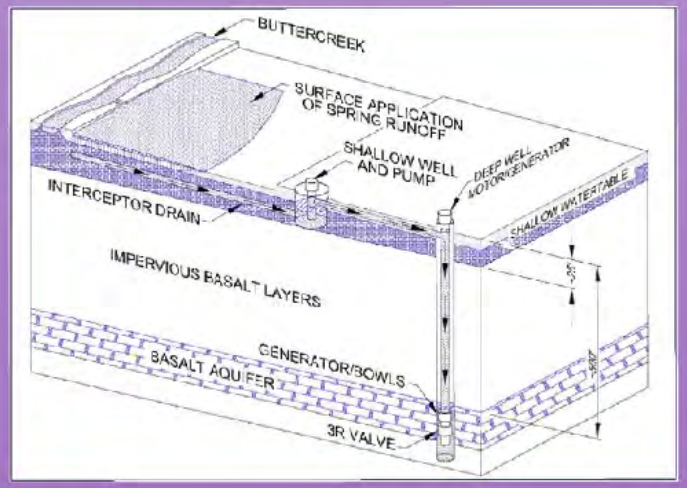
Down-hole Electrical Generation and ASR

Madison Farm, OR, USA

- Injection generates electricity by turning turbine motor backwards
- Utilizes 3R down hole valve, VFD, and regenerative module
- Generate about 50% rated HP
- Systems using groundwater as source water are exempt from FERC



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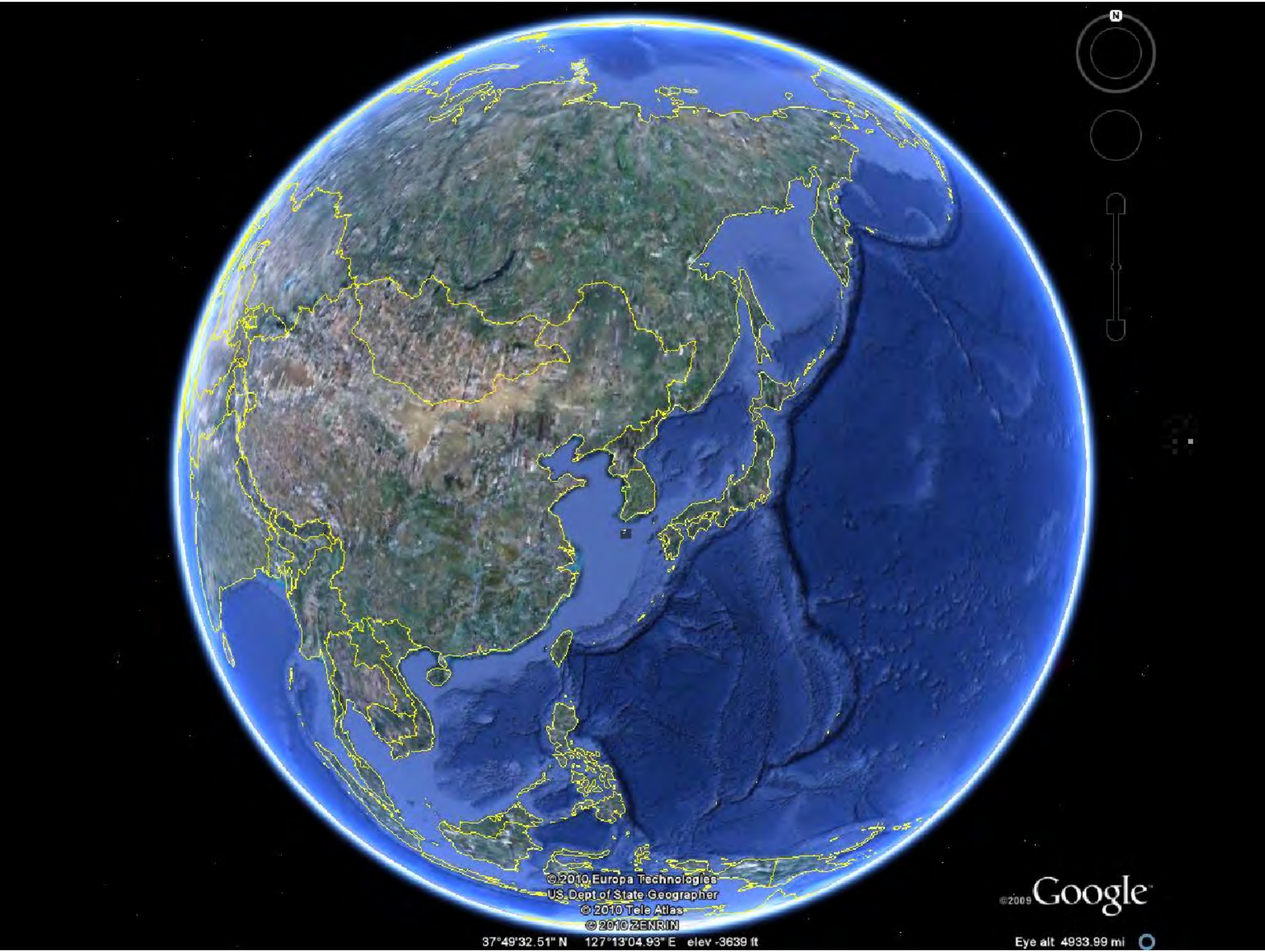
Reclaimed Water and Storm Water ASR

- Few projects in US due to UIC constraints
- Most projects store water in saline/brackish aquifers unless water is highly treated
- Most uses are for irrigation

- Australia
- Florida
- California
- Korea

Check out a great website on this topic at:
http://www.reclaim-water.org/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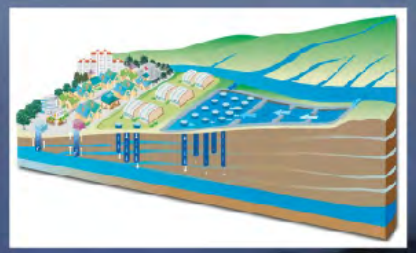
Storm Water Injection, Jeju Island, Korea

- Recharge deep volcanic aquifers using runoff
- Augment natural recharge on the Island
- First site: 10 injection wells1,000 gpm each



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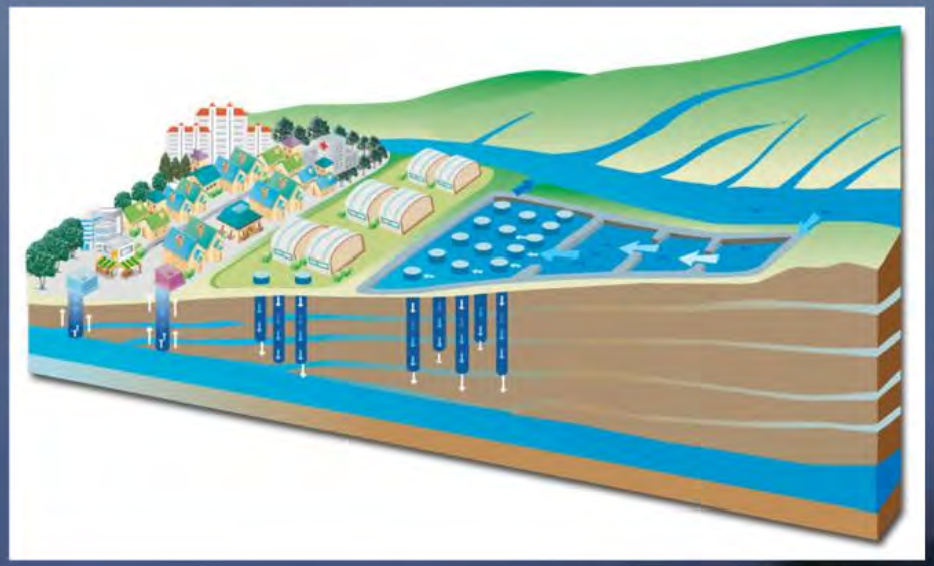
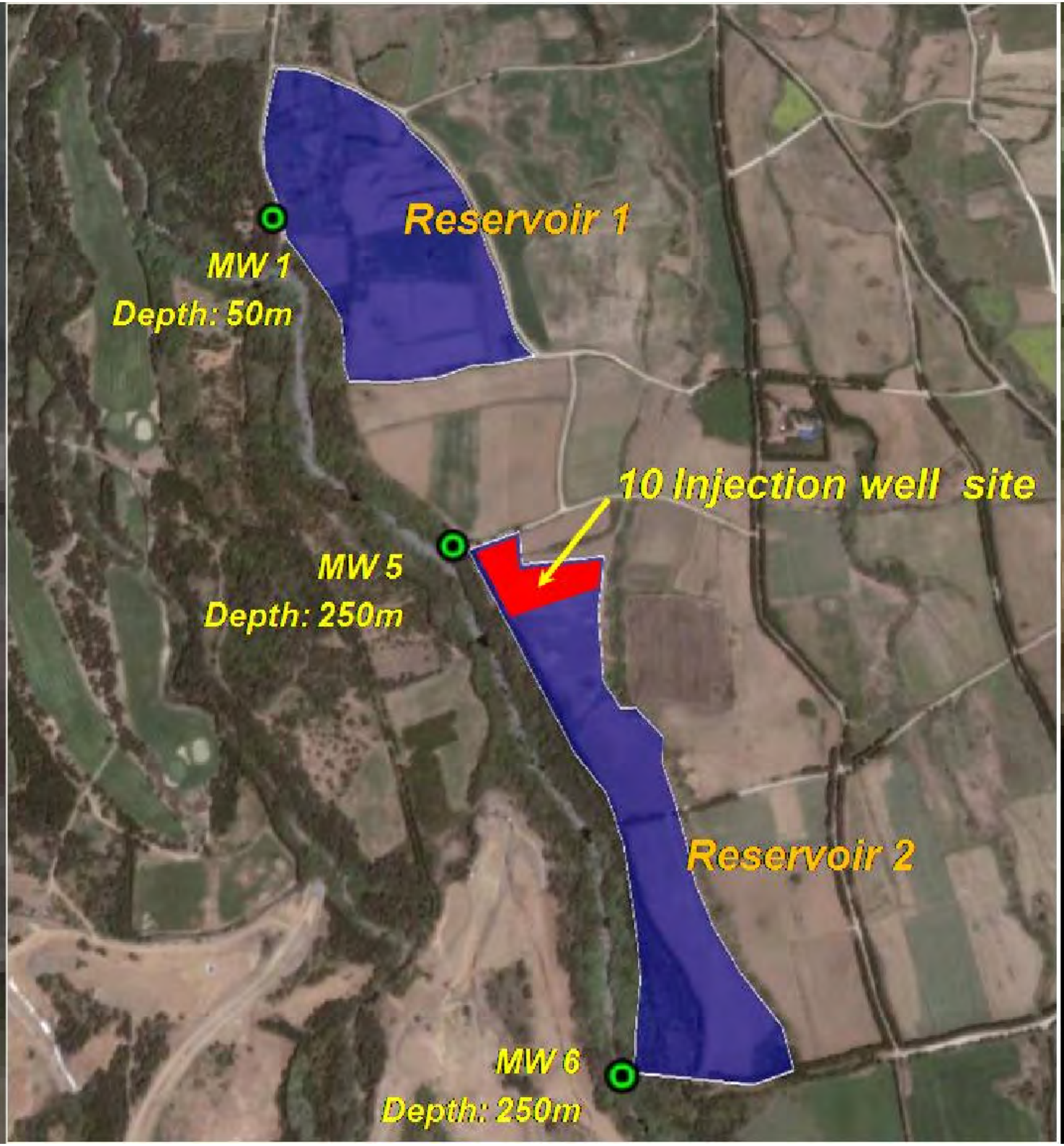
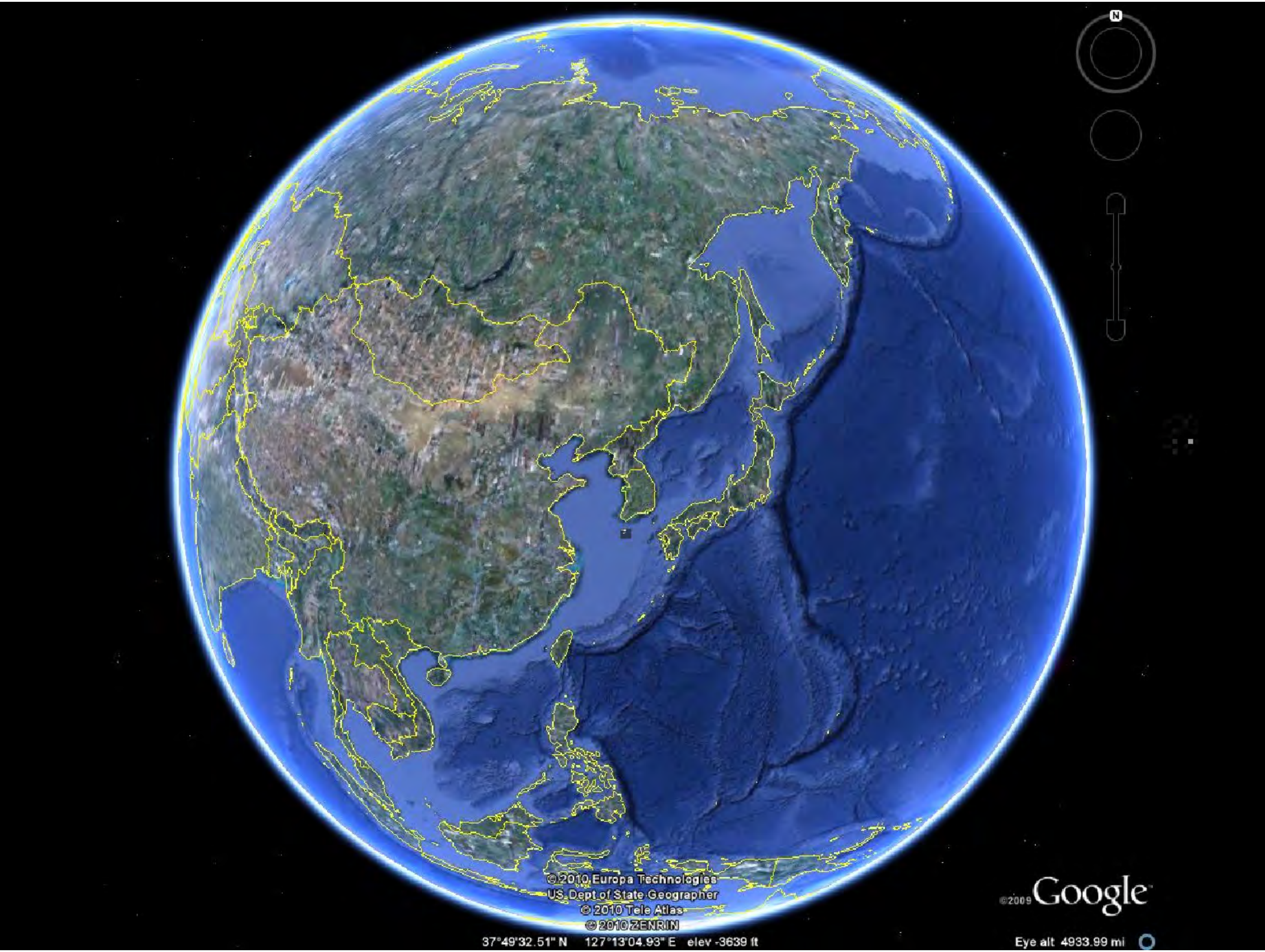


Challenges on Jeju Island


Reservoir 1
MW 1
Depth: 50m
10 Injection well site
MW 5
Depth: 250m
Reservoir 2
MW 6
Depth: 250m

Challenges on Jeju Island

- Must inject 120 MG in 11-17 days
- Limited land area for siting wells
- Clogging of injection wells
- Infrequent floods – variable quality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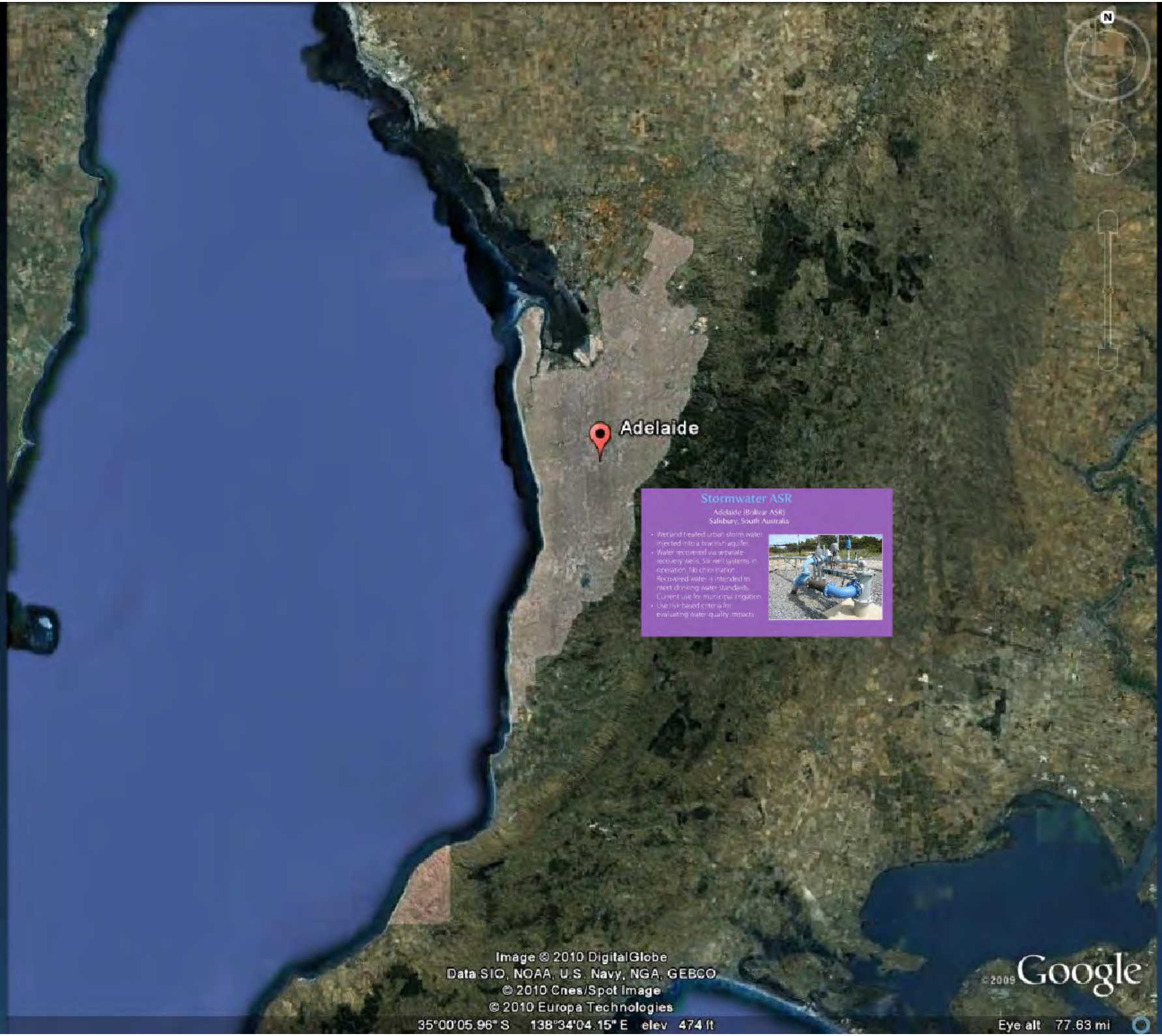
Adelaide
Stormwater ASR
Adelaide (Bolivar ASR)
Salisbury, South Australia
• Wetland treated urban storm water injected into a brackish aquifer.
• Water recovered via separate recovery wells. Six well systems in operation. No chlorination.
Recovered water is intended to meet drinking water standards.
Current use for municipal irrigation.
• Use risk based criteria for evaluating water quality impacts
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Stormwater ASR

Adelaide (Bolivar ASR)
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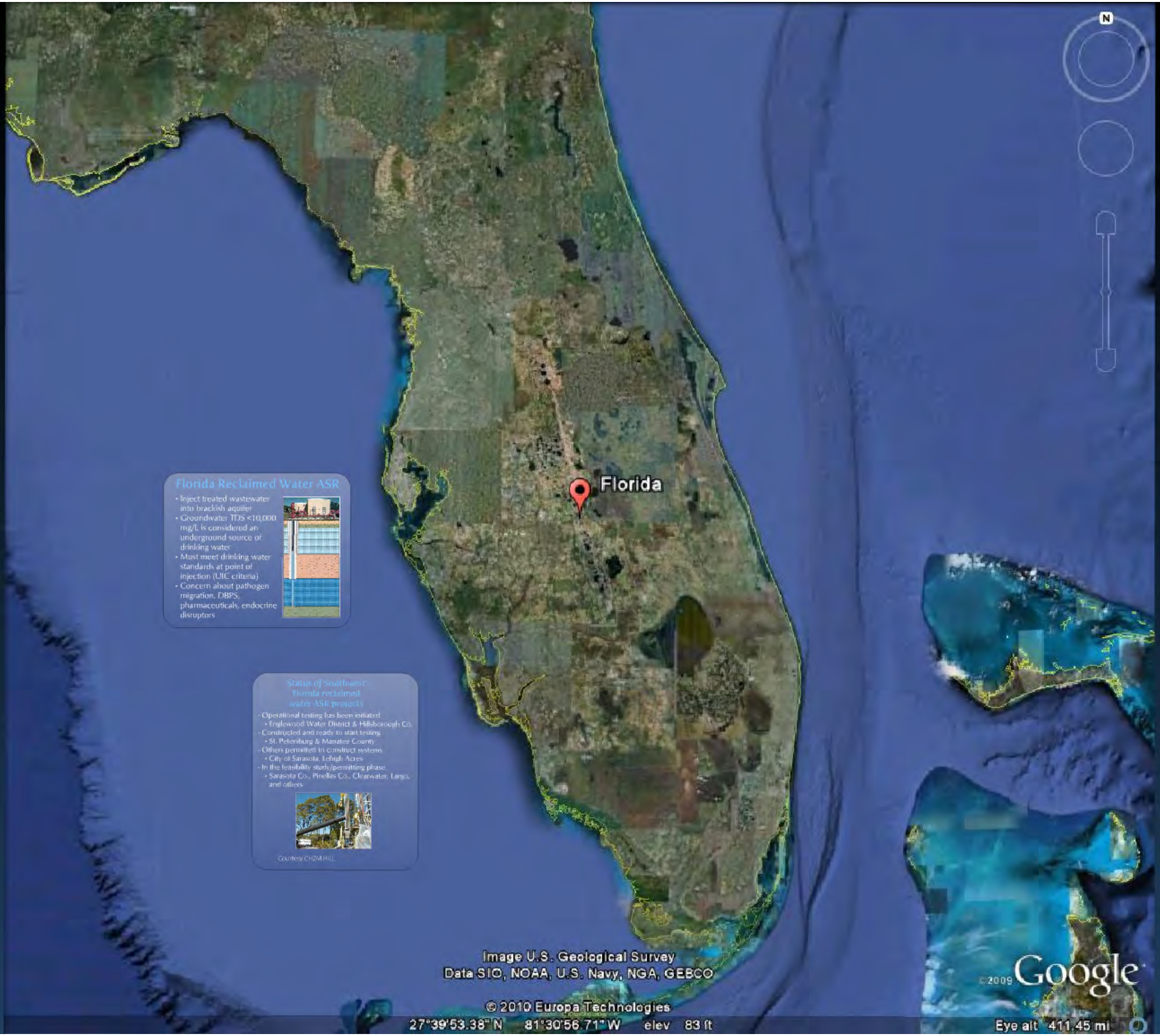
Florida
Florida Reclaimed Water ASR
• Inject treated wastewater into brackish aquifer
• Groundwater TDS <10,000 mg/L is considered an underground source of drinking water
• Must meet drinking water standards at point of injection (UIC criteria)
• Concern about pathogen migration, DBPS, pharmaceuticals, endocrine disruptors
Status of Southwest Florida reclaimed water ASR projects
- Operational testing has been initiated
• Englewood Water District & Hillsborough Co.
- Constructed and ready to start testing
• St. Petersburg & Manatee County
- Others permitted to construct systems
• City of Sarasota, Lehigh Acres
- In the feasibility study/permitting phase
• Sarasota Co., Pinellas Co., Clearwater, Largo, and others
Courtesy CH2M HILL
Image U.S. Geological Survey
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
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27°39'53.38" N 81°30'56.71" W elev 83 ft
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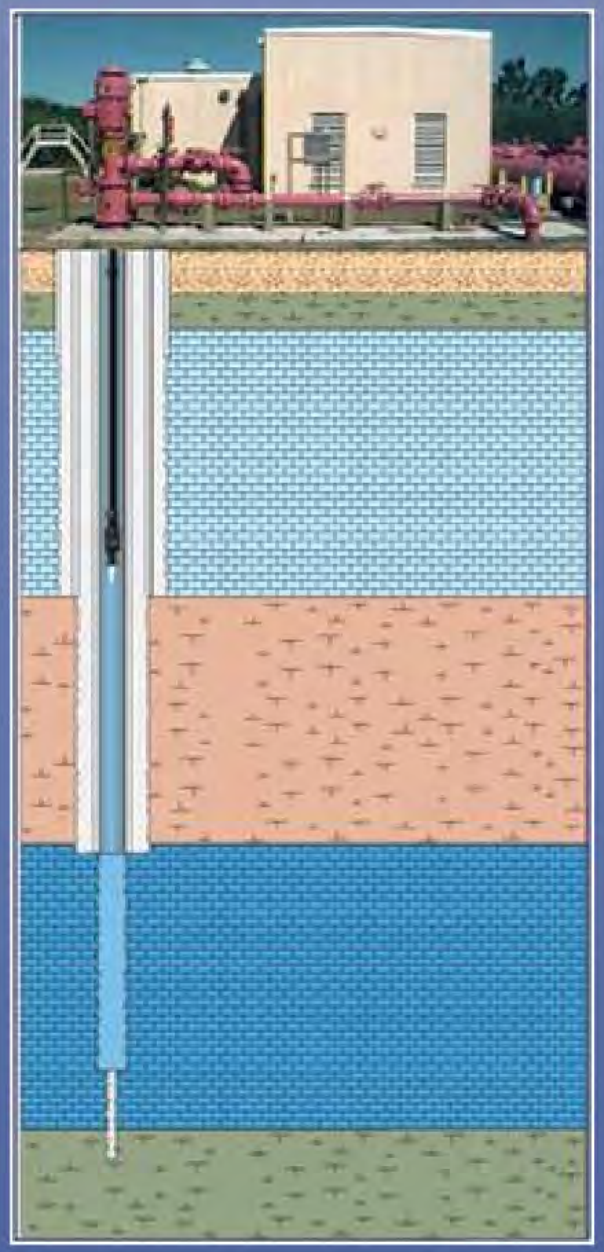
Florida Reclaimed Water ASR

- Inject treated wastewater into brackish aquifer
- Groundwater TDS <10,000 mg/L is considered an underground source of drinking water
- Must meet drinking water standards at point of injection (UIC criteria)
- Concern about pathogen migration, DBPS, pharmaceuticals, endocrine disruptors



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Courtesy CH2M HILL

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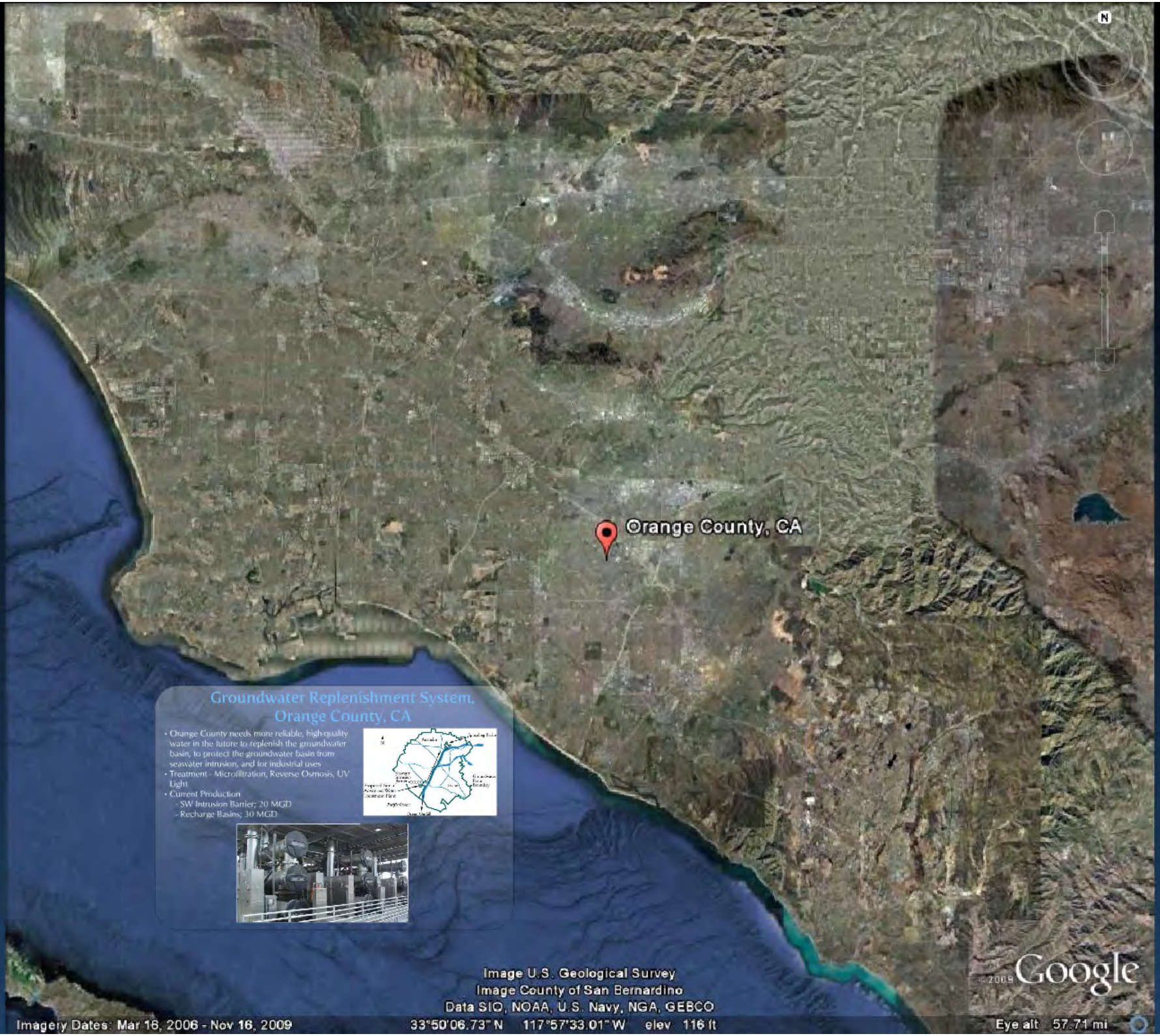
Orange County, CA
Groundwater Replenishment System,
Orange County, CA
• Orange County needs more reliable, high-quality water in the future to replenish the groundwater basin, to protect the groundwater basin from seawater intrusion, and for industrial uses
• Treatment - Microfiltration, Reverse Osmosis, UV Light
• Current Production
- SW Intrusion Barrier; 20 MGD
- Recharge Basins; 30 MGD
Image U.S. Geological Survey
Image County of San Bernardino
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Imagery Dates: Mar 16, 2006 - Nov 16, 2009
33°50'06.73" N 117°57'33.01" W elev 116 ft
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Groundwater Replenishment System, Orange County, CA

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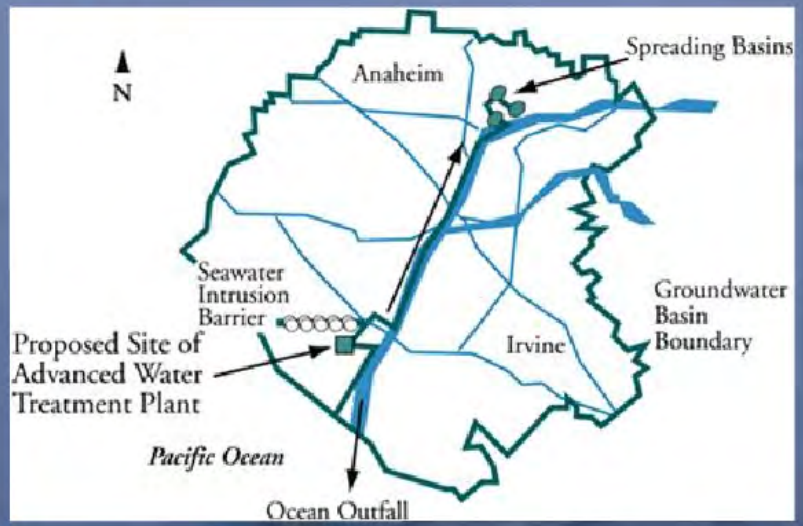

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New Frontiers in AS

- New Storage Applications
- Example Projects
- Constraints and Challenges
- Looking Ahead

Constraints and Challenges

Oregon

- Diversion and storage are junior to other users during limited license testing period
- Final ASR permit can be conditioned to limit diversion period
- New water right naming recharge is required for AR projects
- Developing sources that can meet SDWA standards for ASR difficult
- Other users can "capture" stored water
- Ecological/Peak flow analysis may be required and may limit storage

Washington

- New water right for storage may be needed
- Uncertainty whether disinfection chemicals can be injected
- Recovery percentage is difficult to compute and may make project not cost effective
- Expensive and complicated regulatory process

New Frontiers in AS

- New Storage Applications
- Example Projects
- Constraints and Challenges
- Looking Ahead

Looking Ahead

Looking Ahead

We need more storage and creative solutions!

- Climate change will impact surface water reliability
- Restrictions on new permits and conditions on water right extensions
- Mitigation increasingly required
- Ecological flows will have to be maintained for winter storage diversion
- Set aside for environmental benefit and in-stream flow
- Pressure to retire surface water rights

- More flexible regulatory framework needed
- Reduce costs for projects utilizing high quality source water
- Allow pilot projects to prove technology and assess impacts without excessive conditions
- Utilize AR for stormwater, reclaimed water and surface water sources to achieve water quality targets for ASR source water
- Allow points of compliance at the property boundary in the aquifer rather than wellhead
- Combine energy and quantity projects

Looking Ahead

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Data SIO, NOAA, U.S. Navy, NGA, GEBCO

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41°07'01.68" N 99°19'50.01" W elev 2294 ft

Eye alt 39588.06 mi

THANK YOU!

Jeff Barry
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