Aquifer Recharge on the Eastern Snake River Plain

Developing the Technology for Recharge

David Blew

Recharge on the Eastern Snake River Plain
Spring Recharge – Managed Recharge

Spring Recharge

- Recharge conducted in the spring of the year through incidental losses in canals
- Limited to 40,000 to 60,000 acft/year

Managed Recharge

- Recharge in a constructed facility with a designed capacity or natural basins
- Type of recharge envisioned in the Idaho Water Resource Board 1999 feasibility study
- The likely mechanism to pursue large-scale managed recharge

Types of Managed Recharge

Basin Recharge

- Conducted in a natural or constructed basin
- Requires high infiltration rates (>2ft/day)
- Most commonly conducted in alluvial or paleoallvuial soils (deep, coarse textured soils)
- Regulated activity in most states
- In Idaho requires a legal source of water and approved monitoring plan from DEQ


Basin recharge in Arizona

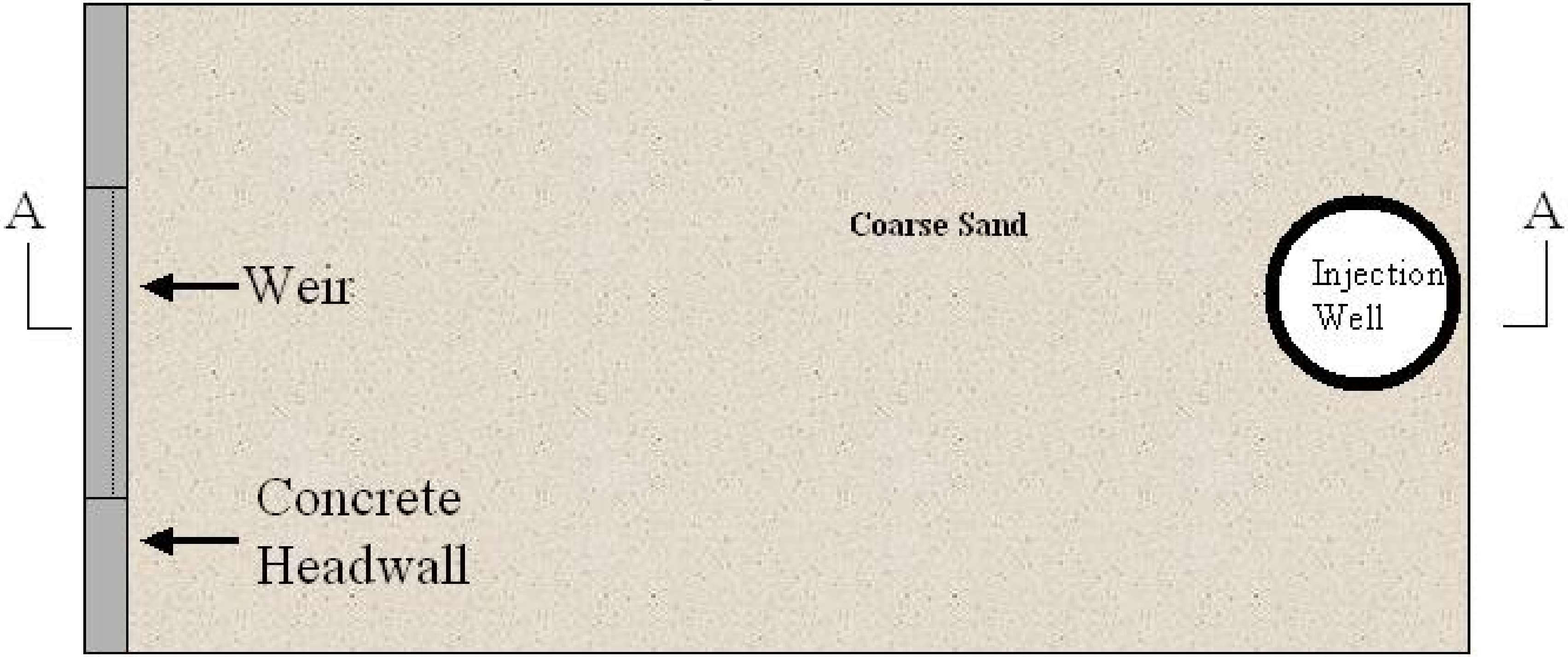

Bottom of infiltration basins
composed of coarse sand and gravels

Types of Managed Recharge

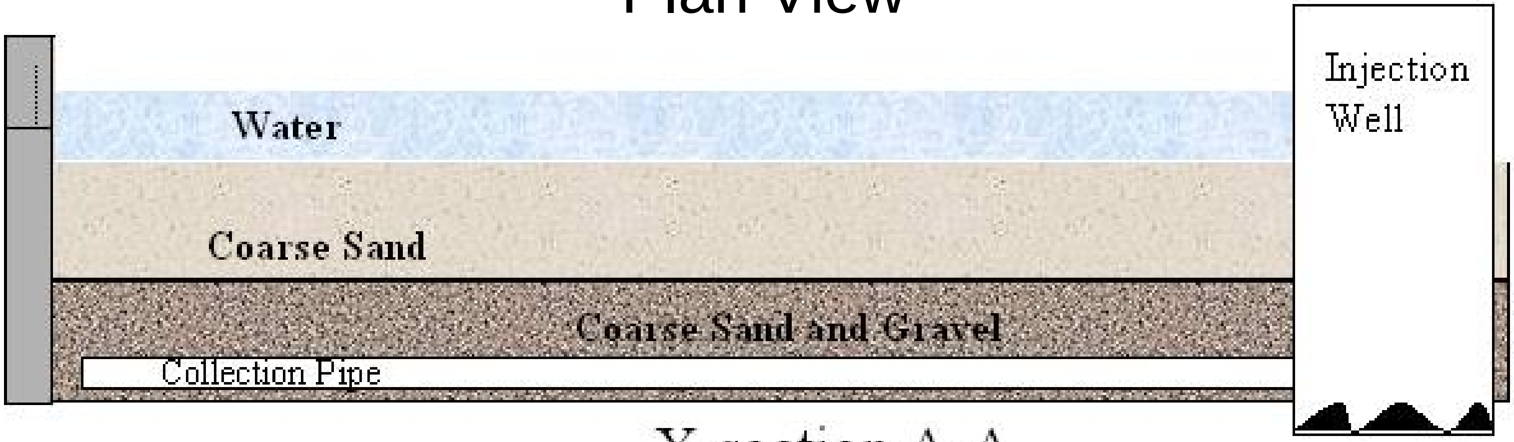
Injection Wells

- Conducted in either a dedicated injection well or modified production well
- Can have high injection rates in aquifers with high hydraulic conductivity
- Regulated activity in most states
- Requires pretreatment of water to prevent degradation of ground water quality
- In Idaho requires a legal source of water and an injection well permit from IDWR

Conceptual Design of an Injection Well



Plan View



X-section A-A

Managed Aquifer Recharge on the Eastern Snake River Plain

The prevailing thought about recharge on the Eastern Snake River Plain has been…….

It is a quick, inexpensive, and easy solution.

Managed Aquifer Recharge on the Eastern Snake River Plain

However……

If large-scale managed recharge was easy, we would already be doing it!

Numerous technical challenges require the development of appropriate technology to make recharge a viable management option.

Developing the Technology for Recharge on the ESRP

Technical Challenges for Managed Recharge on the Eastern Snake River Plain

Soils
Sub-Surface Geology
Water Quality

Developing the Technology for Recharge on the ESRP

Technical Challenges for Managed Recharge on the Eastern Snake River Plain

Soils

Sub-Surface Geology

Water Quality

Developing the Technology for Recharge on the ESRP

Limitations of Soils:

- Rely on soils for filtration of recharge water to protect ground water quality
- Soil clogging is the number one problem associated with management of recharge sites

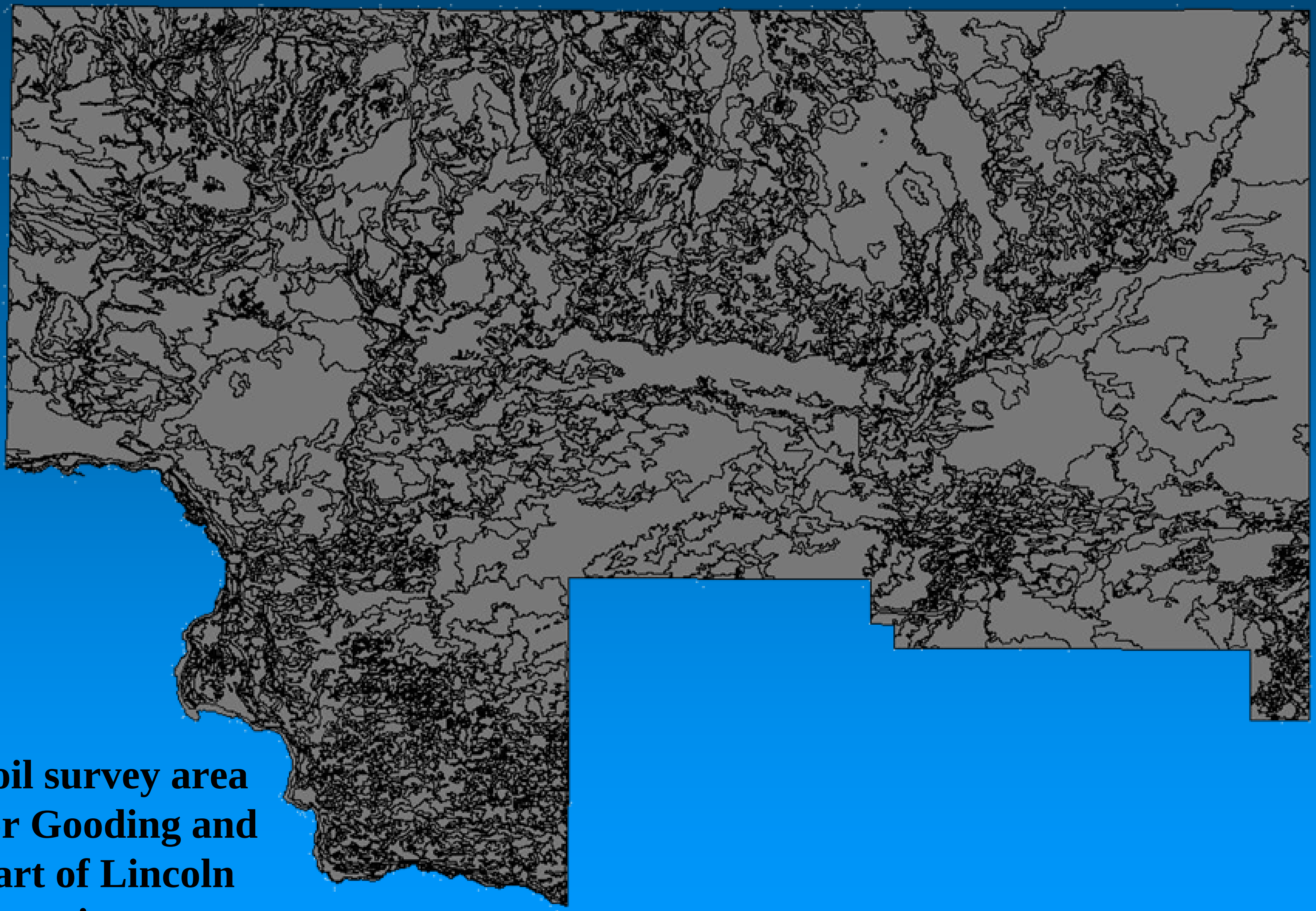
Developing the Technology for Recharge on the ESRP

Limitations of Soils:

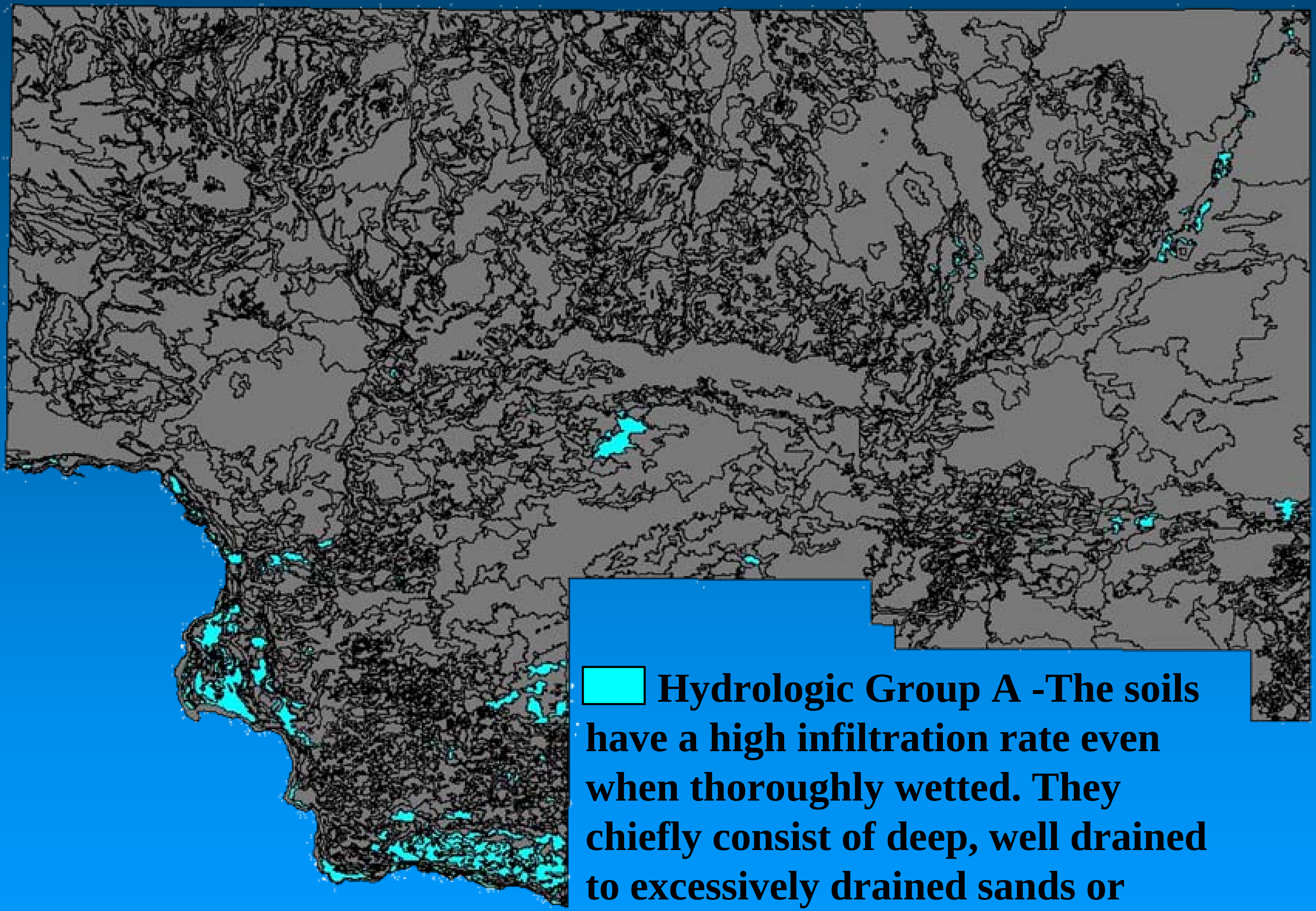
•Soils or filtration medium will require periodic cleaning and scarifying

•Most of the soils on the Easter Snake River Plain are fine textured, wind deposited soils

•Coarse textured, high permeability soils desirable for recharge are limited on the Eastern Snake River Plain



Soil survey area for Gooding and Part of Lincoln Counties



Hydrologic Group A -The soils have a high infiltration rate even when thoroughly wetted. They chiefly consist of deep, well drained to excessively drained sands or gravels. They have a high rate of water transmission.

Developing the Technology for Recharge on the ESRP

Limitations of Soils:

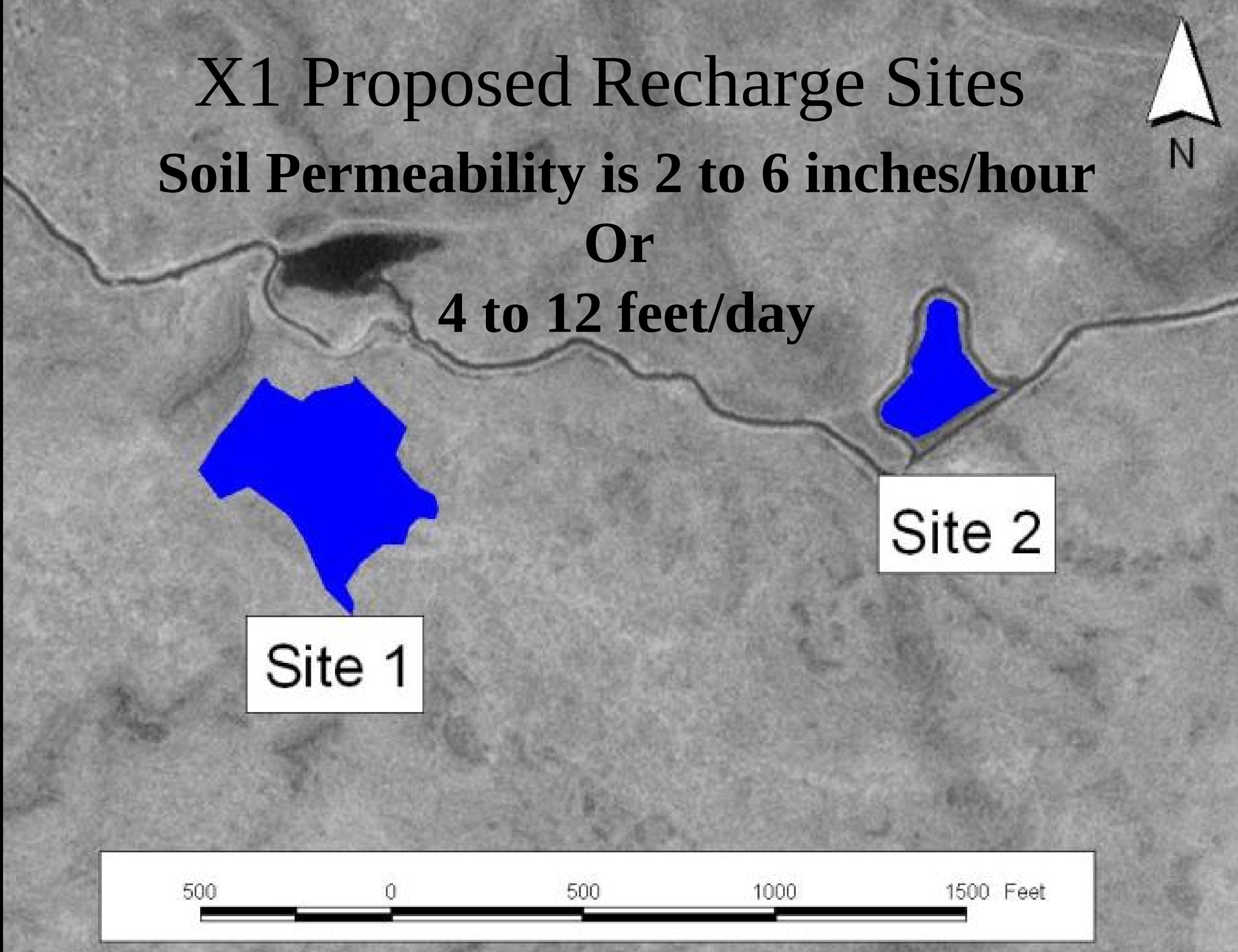
Measuring Soil Infiltration Rates on the Eastern Snake River Plain

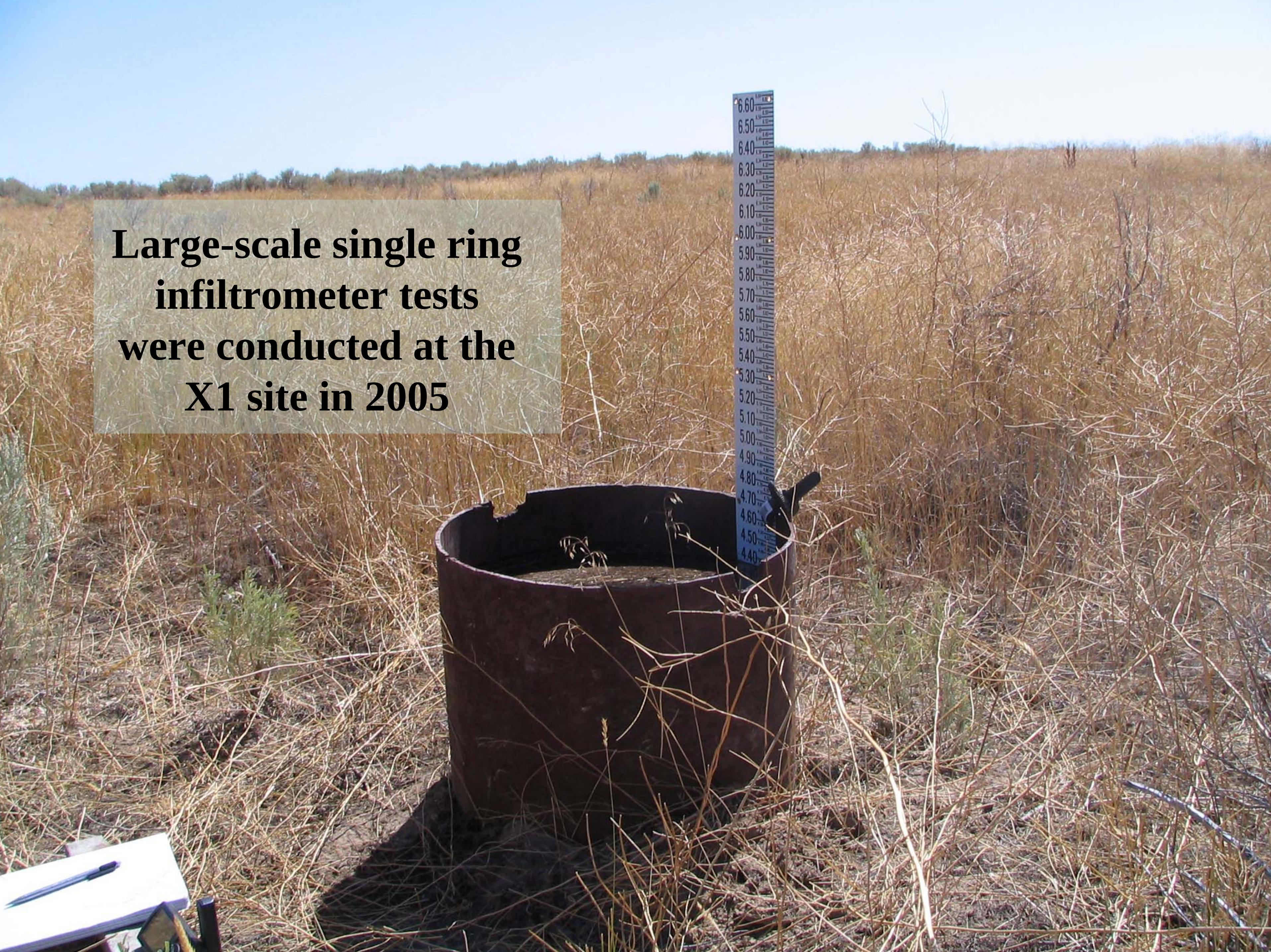
X1 Proposed Recharge Sites

Soil Permeability is 2 to 6 inches/hour

Or

4 to 12 feet/day




Large-scale single ring infiltrometer tests were conducted at the X1 site in 2005
6.60
6.50
6.40
6.30
6.20
6.10
6.00
5.90
5.80
5.70
5.60
5.50
5.40
5.30
5.20
5.10
5.00
4.90
4.80
4.70
4.60
4.50
4.40

Developing the Technology for Recharge on the ESRP

Limitations of Soils:

Results of the X1 Infiltration Test

- Soil permeability rates average 9ft/day
- Long-term hydraulic conductivity was calculated at 0.8 to 1.1 ft/day or about 10% of permeability
- Recharging 100cfs (200acft/day) would require 200 acres

Developing the Technology for Recharge on the ESRP

Limitations of Soils:

<u>Milepost 31 Recharge Site</u>

Recharge capacity was first estimated at 1500 cfs

Based on soil permeability recharge capacity of 210 cfs

Long-term hydraulic conductivity is about 10% of permeability reducing capacity to about 21 cfs.

Developing the Technology for Recharge on the ESRP

Limitations of Soils: Conclusions

•Most soils on the Easter Snake River Plain are fine textured wind deposited soils.

•Fine textured soils on the Eastern Snake River Plain have limited infiltration capacity and intake rates.

•Based on soils, there is limited opportunity for basin recharge on the Eastern Snake River Plain

Developing the Technology for Recharge on the ESRP

Technical Challenges for Managed Recharge on the Eastern Snake River Plain

Soils

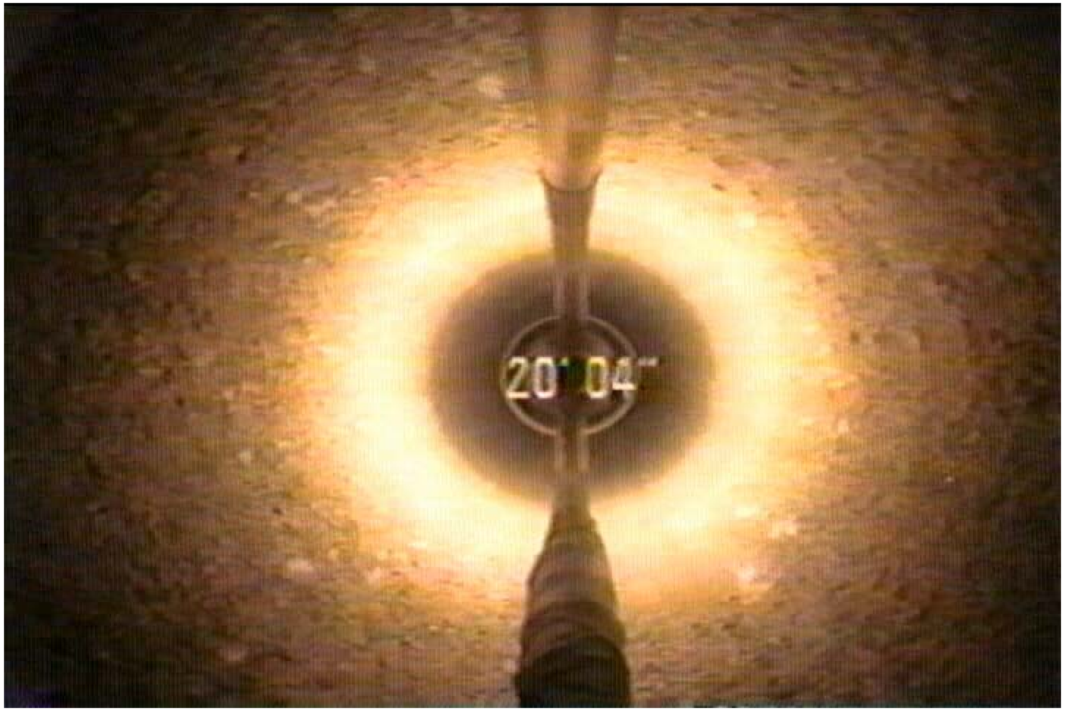
Sub-Surface Geology

Water Quality

Developing the Technology for Recharge on the ESRP

Limitations of sub-Surface Geology

Dense basalts or clay innerbeds between basal flows can inhibit the flow of water from infiltration basins to underlying aquifers



Developing the Technology for Recharge on the ESRP

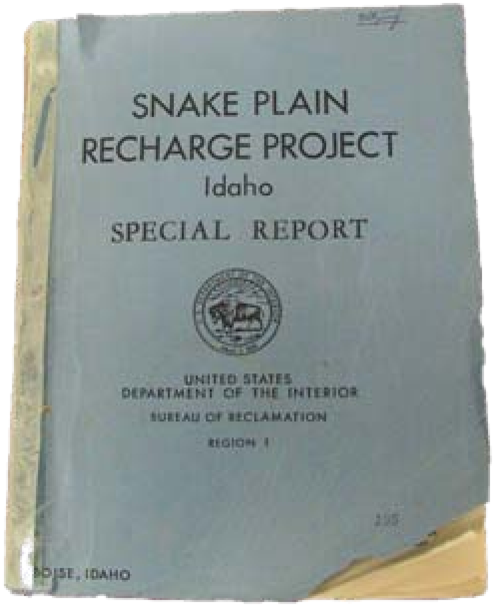
Limitations of sub-Surface Geology

In order to get through layers of massive basalt, injection wells may need to be used.

Injection wells must reach layers with high hydraulic conductivity, areas with vertical and horizontal fractures.

Developing the Technology for Recharge on the ESRP

Limitations of sub-Surface Geology: Conclusions



"one of the major problems in artificial recharge in the Snake River Plain is to get water through layers of low-permeability materials, down to the main water table. These materials of low-permeability at some places cover the basalt surfaces, and at others they occur as interbeds."

Mundorff, M. J.. 1962. *Feasibility of Artificial Recharge in the Snake River Basin*, United State Department of the Interior, Geological Survey, Water Resource Division, Ground Water Branch. Prepared in cooperation with the U.S. Bureau of Reclamation, Boise, Idaho

Developing the Technology for Recharge on the ESRP

Technical Challenges for Managed Recharge on the Eastern Snake River Plain

Soils

Sub-Surface Geology

Water Quality

Developing the Technology for Recharge on the ESRP

Water Quality Issues

•Studies conducted indicate the presence of fecal coliform and E coli in canal water

•In many cases there is a short travel time between recharge sites and downstream users

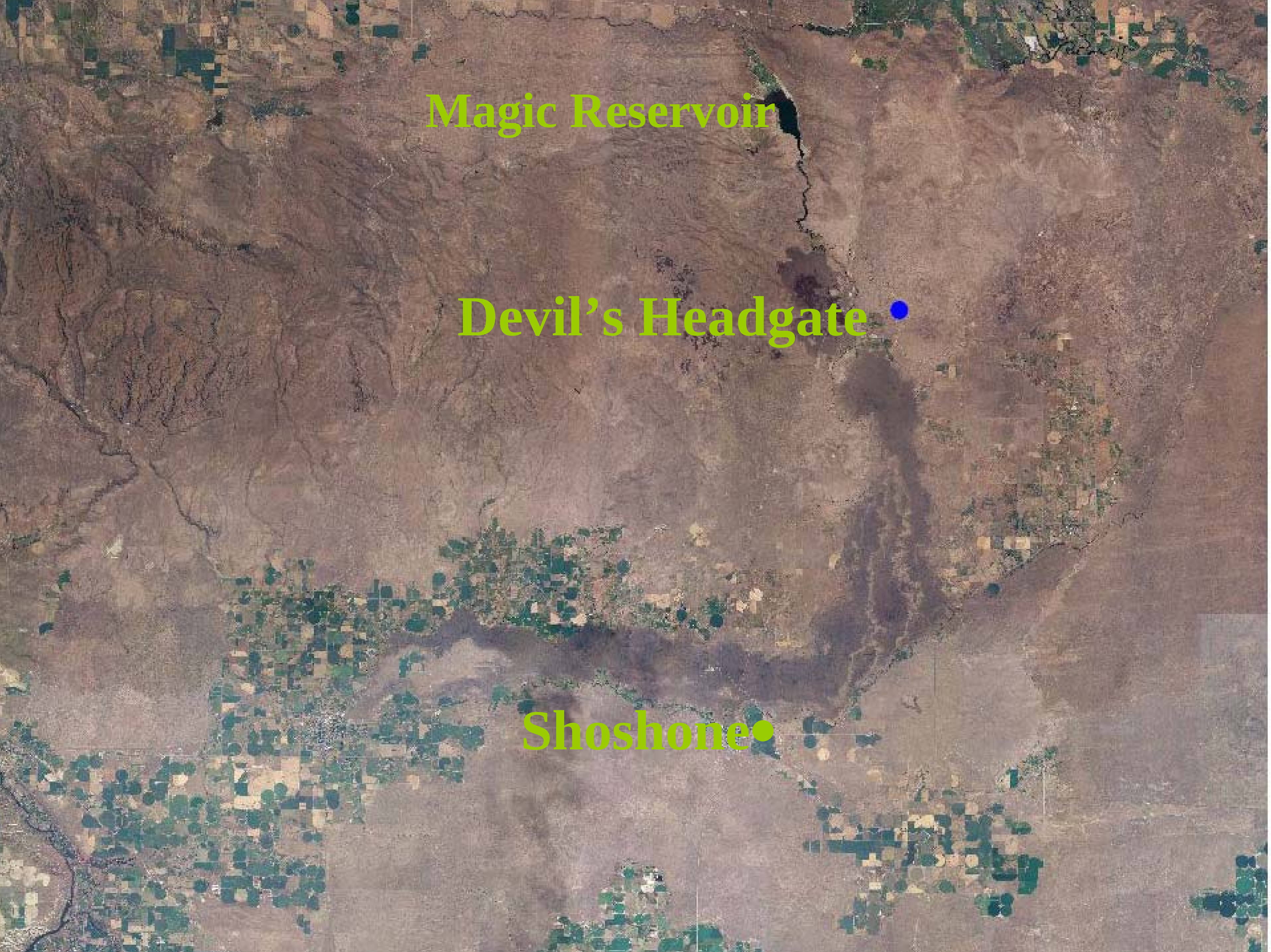
•The filtration of water through some type of medium is critical to protection ground water quality

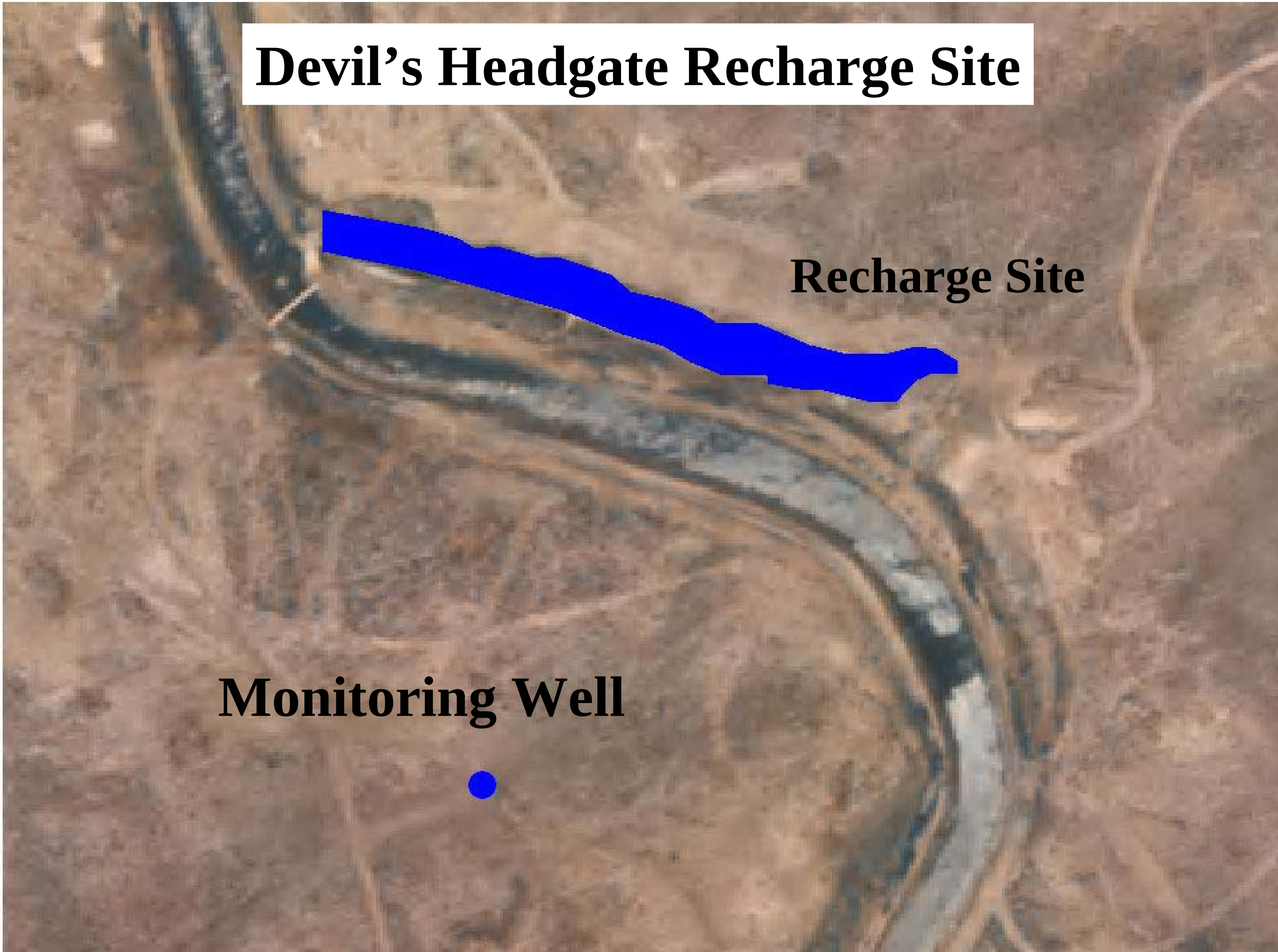
Developing the Technology for Recharge on the ESRP

Water Quality Issues

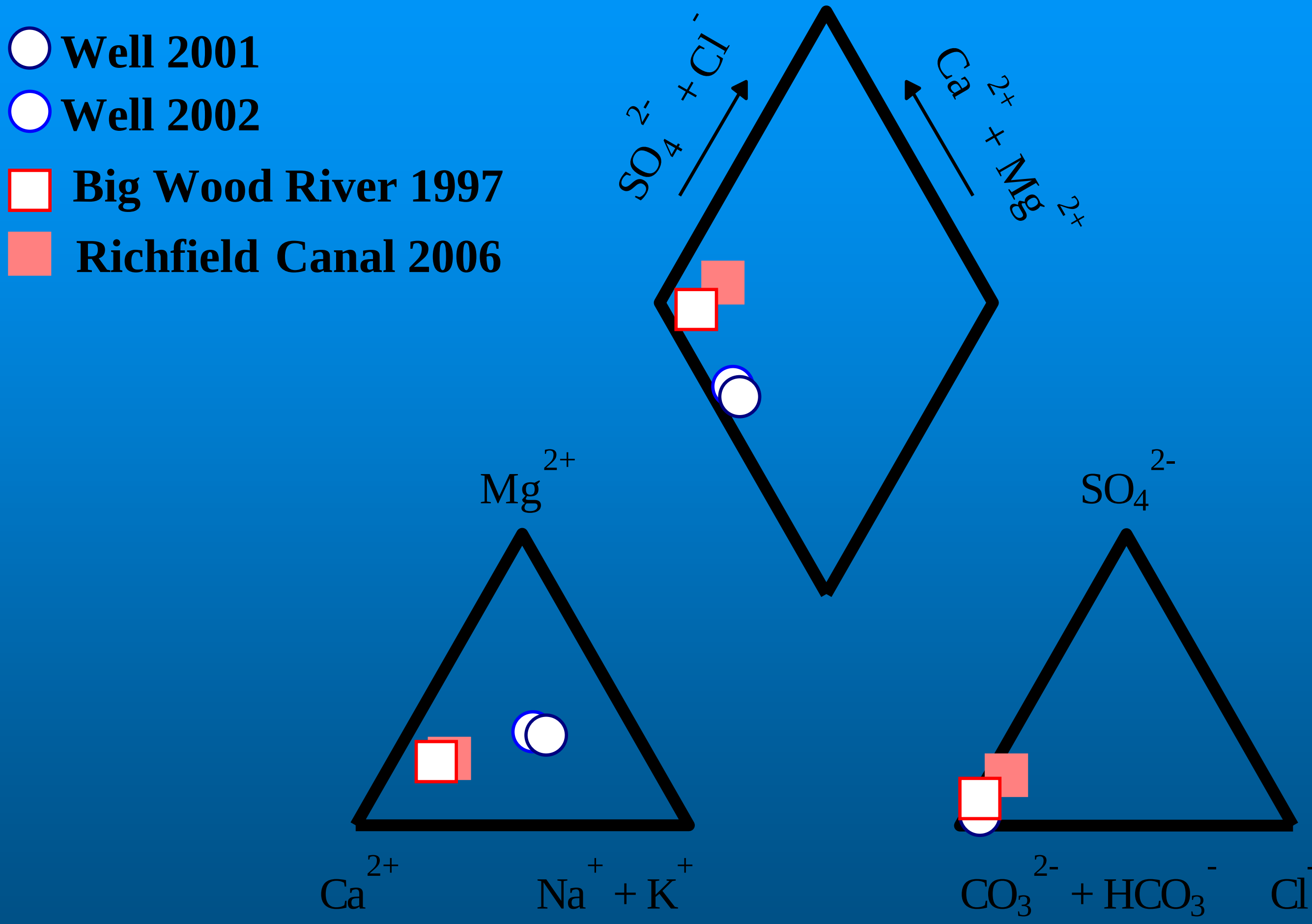
Devil’s Headgate Recharge Site

- Spring of 2006, recharged up to 60 cfs with a total recharge of approximately 2000 acre-feet as part of a flood control effort
- Monitoring well is approximately 550 feet from the recharge site
- Monitoring well is 536 feet deep, static water level is approximately 525 feet below ground surface
- Recharge site is a “sink hole” with no surface filtration

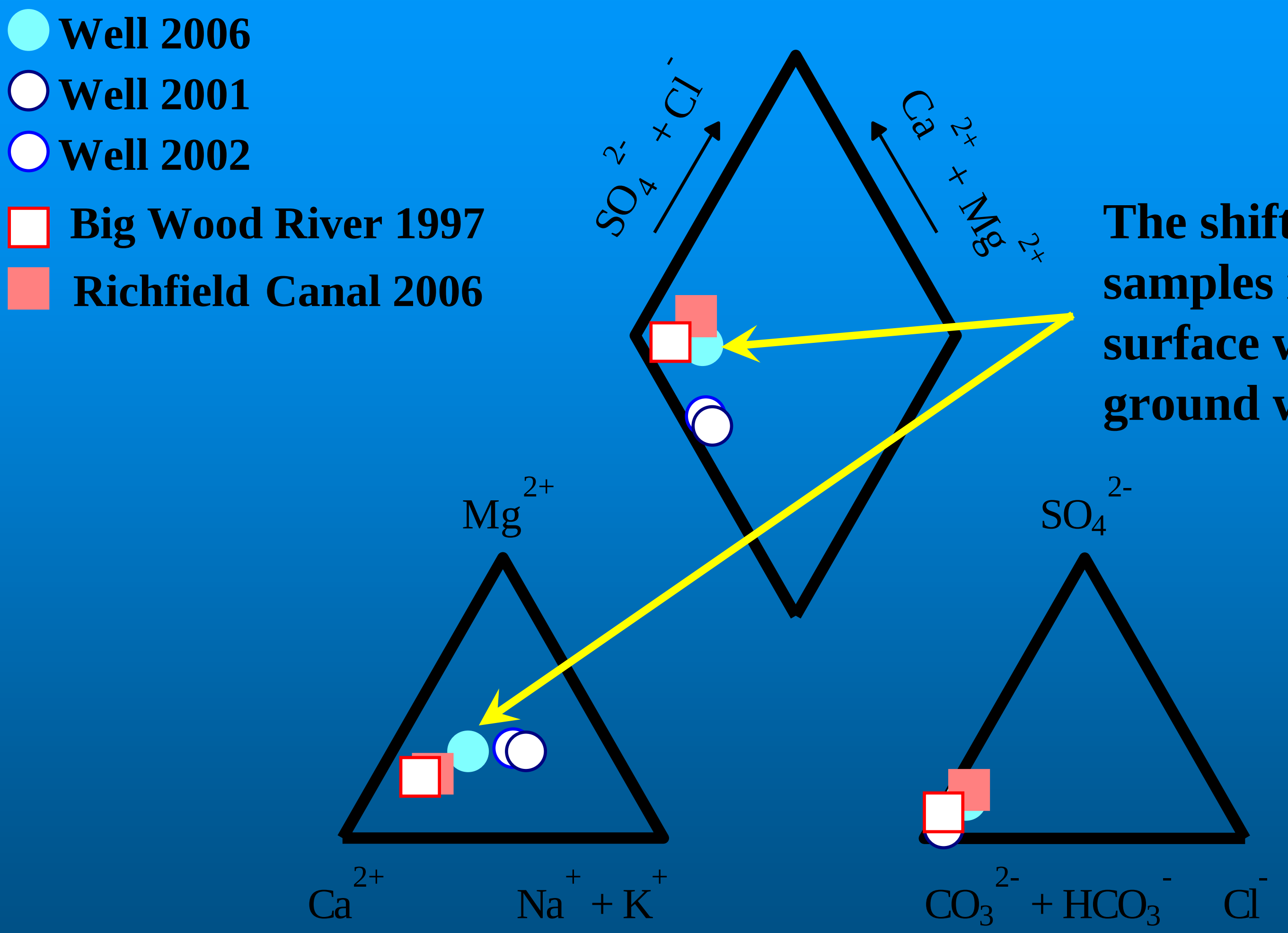

Magic Reservoir
Devil's Headgate
Shoshone


Devil’s Headgate Recharge Site
Recharge Site
Monitoring Well

Devil's Headgate Recharge Site



Devil's Headgate Recharge Site



The shift in the 2006 well samples indicate that surface water impacted ground water

Devil's Headgate Monitoring

Location	Date	Total Coliform	Fecal Coliform	E-Coli
Canal Water	2006	35 MPN/100 ml	8 CFU/100 mls	4 MPN/100 ml

High quality surface water

Developing the Technology for Recharge on the ESRP

Water Quality Issues

Devil's Headgate Monitoring

Location	Date	Total Coliform	Fecal Coliform	E-Coli
Monitoring Well	2001	<1 CFU/100 mls	<1 CFU/100 mls	—
Monitoring Well	2002	<1 CFU/100 mls	<1 CFU/100 mls	—
Monitoring Well	**2006**	**8 MPN/100 ml**	**2 CFU/100 mls**	**2 MPN/100 ml**

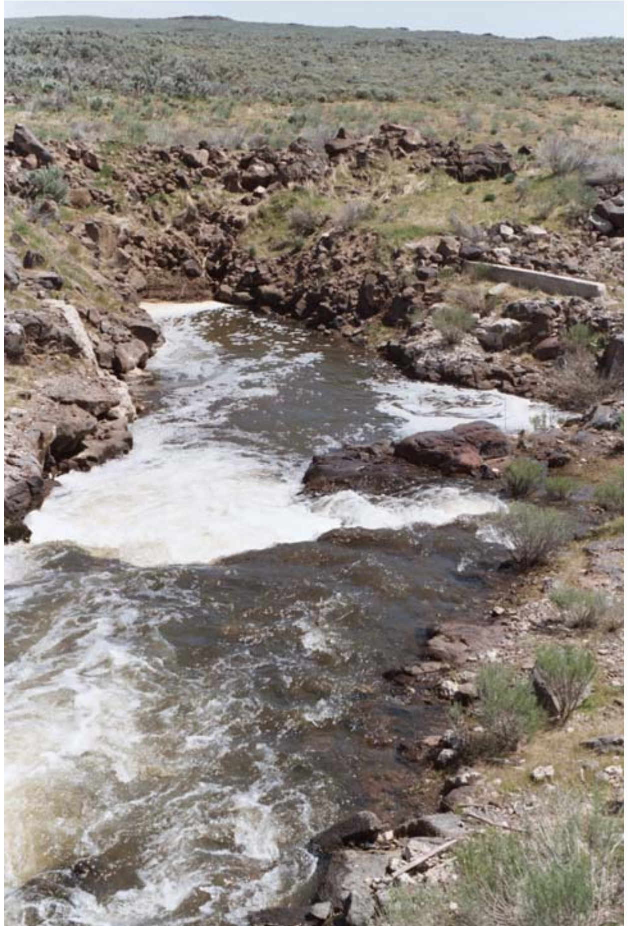
Developing the Technology for Recharge on the ESRP

Water Quality Issues

Even with high quality surface water, contamination of the ground water resource occurred at the Devil's Headgate in 2006

Developing the Technology for Recharge on the ESRP

Water Quality Issues

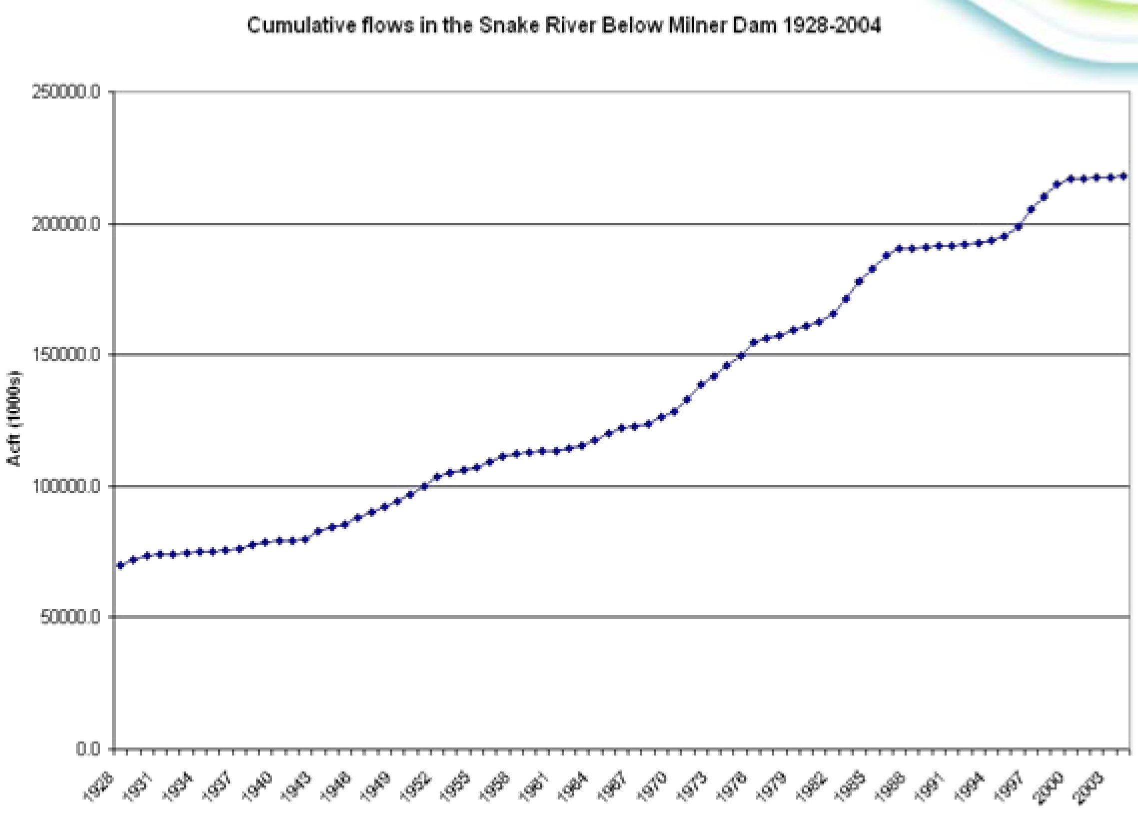


The risk of ground water contamination exists if soils or sub-surface material are not adequate to filter recharge water

Other Recharge Related Issues

Developing the Technology for Recharge on the ESRP

Other Recharge Related Issues



- **Water Availability**

  Is there enough water to support aquifer recharge?

  In recent years there has been an overall decline in the discharge past Milner Dam.

Developing the Technology for Recharge on the ESRP

Other Recharge Related Issues

Developing the Required Recharge Capacity

Data Reported by IDWR in 2004

- To average 170,000 acft/year requires an annual recharge capacity of 322,000 acft
- Estimated 10 year budget of $7,634,000, did not include personnel cost
- Only allowed $1,700,000 for construction of recharge sites

Developing the Technology for Recharge on the ESRP

Summary

Cost of construction at selected recharge sites

Project	Cost	Yearly Capacity (acft)	Construction Cost/acft
City of Wichita	$137,000,000	200,000	$685
Orange County Water District	$4,700,000	20,300	$231
Salt River Project NUASP	$13,000,000	75,000	$173
Agua Fria (CAP)	$10,500,000	100,000	$105
Lower Santa Cruz (CAP)	$3,900,000	50,000	$78
W Canal (IWRB)	(est)$600,000	(est)10,000	$60

Developing the Technology for Recharge on the ESRP

Other Recharge Related Issues

Safety and security issues at recharge sites

–What are appropriate security measures?

–How limited should access be?

–What liability issues need to be addressed?

Security fence around recharge monitoring well in Arizona


All gates include electronic monitoring devices
Six-foot chain link fence surrounding a recharge site
Paved Private Service Road

Developing the Technology for Recharge on the ESRP

Other Recharge Related Issues

Water Delivery Considerations

–Is it cheaper to deliver water to end users

•Irrigation system conversions (ground water to surface supplies)

•Water supplies for municipalities and industry

–What are the impact of diversions for recharge on downstream users (external costs)

Developing the Technology for Recharge on the ESRP

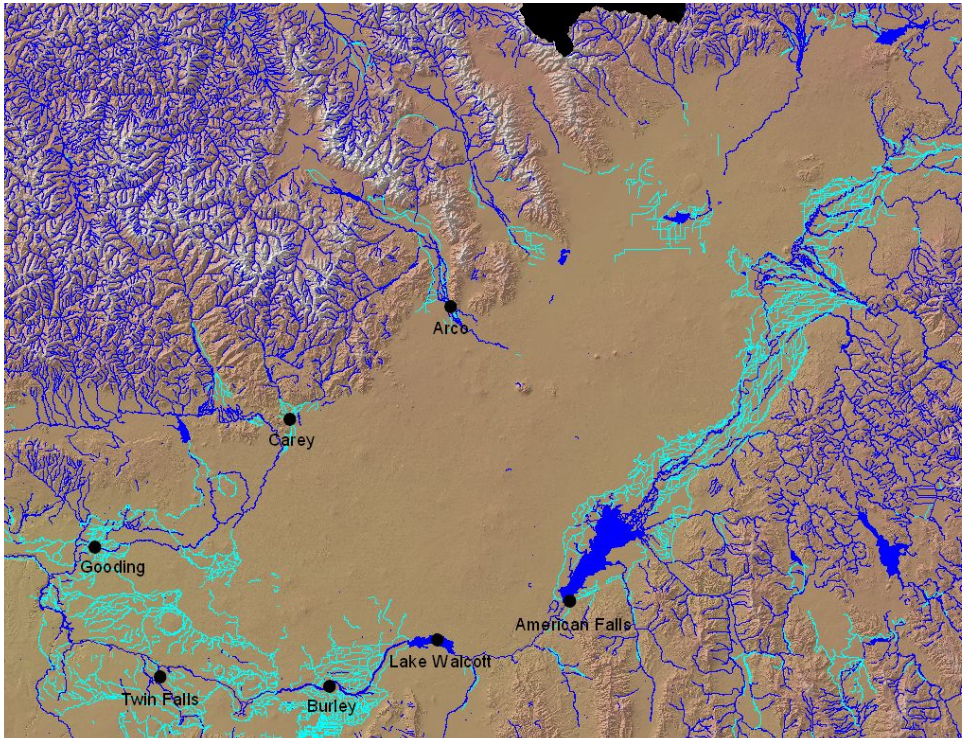
Other Recharge Related Issues

What are the long-term goals for recharge?

–Target short-term response in springs

–Target long-term storage in the aquifer

–What is the efficacy of recharge to solve specific problems?



Summary

Developing the Technology for Recharge on the ESRP

Summary

- **Support the Idaho Water Resource Board's W Canal pilot project**
  - ✓Project will help develop the required technology for managed recharge on the ESPA
  - ✓Project will help establish construction and maintenance cost for managed recharge
  - ✓Project will most likely rely on injection wells and filtration beds
  - ✓Assess impacts to local ground water conditions
  - ✓May take several years to get the required information

Developing the Technology for Recharge on the ESRP

Summary

- **Develop the legal and administrative framework under which recharge can be conducted**
  - ✓Who will operate and maintain recharge sites?
  - ✓Who holds the liability for recharge operations?
  - ✓When can recharge occur (water rights)?

Developing the Technology for Recharge on the ESRP

Summary

- **Long-term funding of recharge. Who pays for it?**
  - ✓Recharge is not a cheap operation
  - ✓Ongoing expense even when sites are not used
  - ✓Will require full-time staff on the ground
  - ✓Will require a commitment to monitoring and water quality protection
  - ✓Assess the out of basin cost for recharge

Developing the Technology for Recharge on the ESRP

Conclusions

Soils and sub-surface geology present technological challenges for managed recharge

•Need to develop the technology for recharge through the IWRB's pilot project(s)

Developing the Technology for Recharge on the ESRP

Conclusions

- Managed recharge is not a short-term, easy solution
- Managed recharge is not a cheap fix, will require substantial funding, not a one-time cost, recharge sites have to be managed, monitored and maintained

Questions?

David Blew
Dblew@idahopower.com
(208) 388-5292