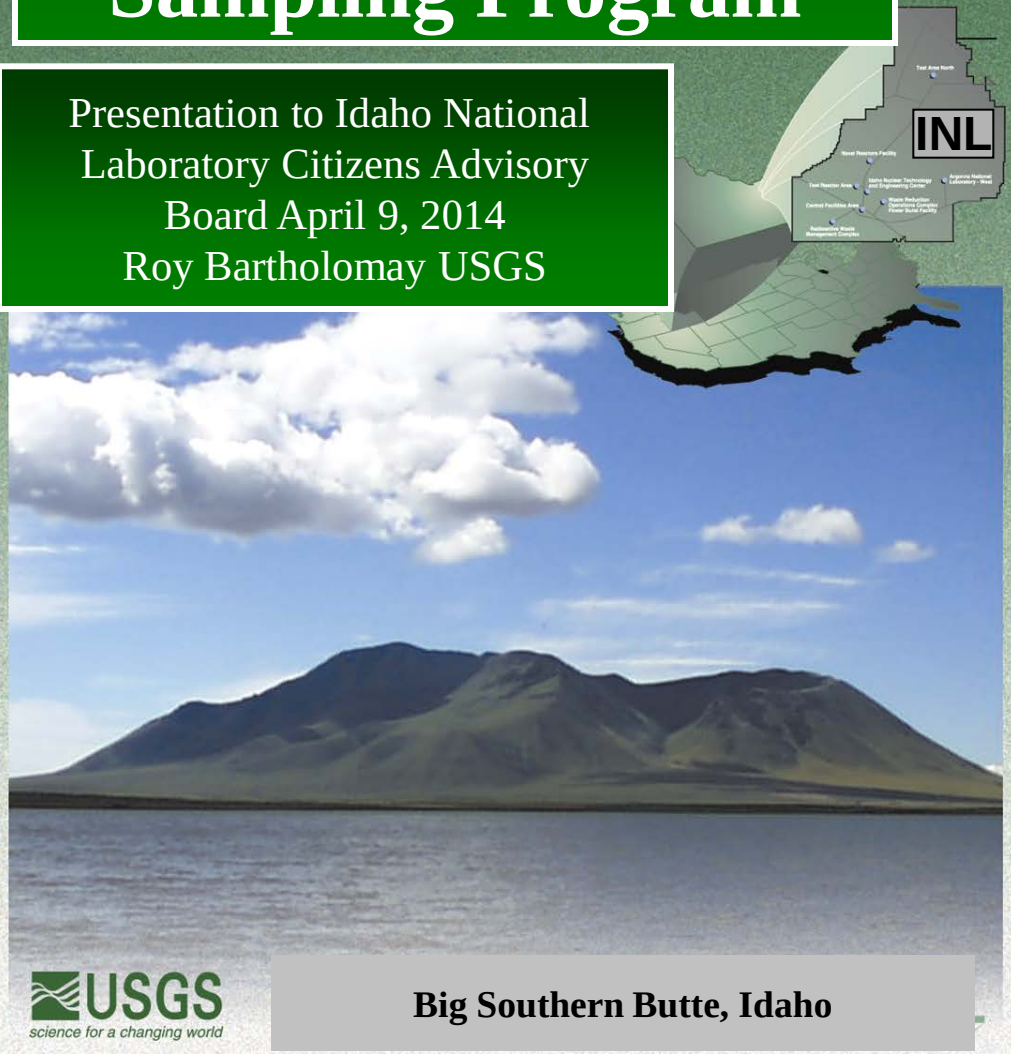
USGS INL Groundwater Sampling Program

Presentation to Idaho National Laboratory Citizens Advisory Board April 9, 2014

Roy Bartholomay USGS



Big Southern Butte, Idaho

Mission

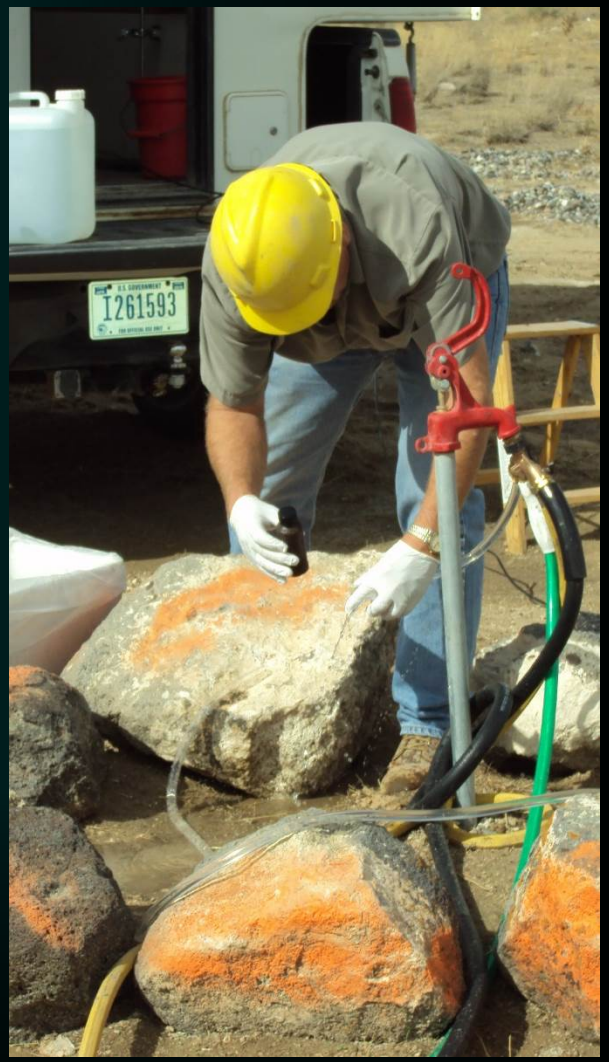
Maintain a comprehensive groundwater monitoring and hydrogeologic studies program to evaluate the availability and movement of water in the eastern Snake River Plain aquifer to align with DOE's strategic goal of safeguarding the environment

Describe processes controlling the fate of contaminants (advective transport, dispersion, adsorption, dilution, diffusion, radioactive decay, and chemical reactions)

Provide independent reviews of hydrogeological data and reports submitted by DOE and its contractors to the EPA and the State of Idaho

Outline

- Describe some of the programs and studies the USGS does at the Idaho National Laboratory.
- Describe the Groundwater Measurement and Sampling Program.
- Present some of our recent findings from wells with pumps in them.
- Describe our groundwater sampling using multilevel monitoring wells.
- Present some findings from the multilevel wells
- Present some findings from our groundwater flow model studies.
- Wrap up with how our studies are useful for the Idaho Cleanup Project.



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USGS INL Programs

- Hydrologic monitoring
- Streamflow monitoring
- Core and well drilling
- Geophysical logging
- Core library
- Geologic framework
- Geochemistry
- Hydraulic properties
- Groundwater flow and contaminant-transport modeling

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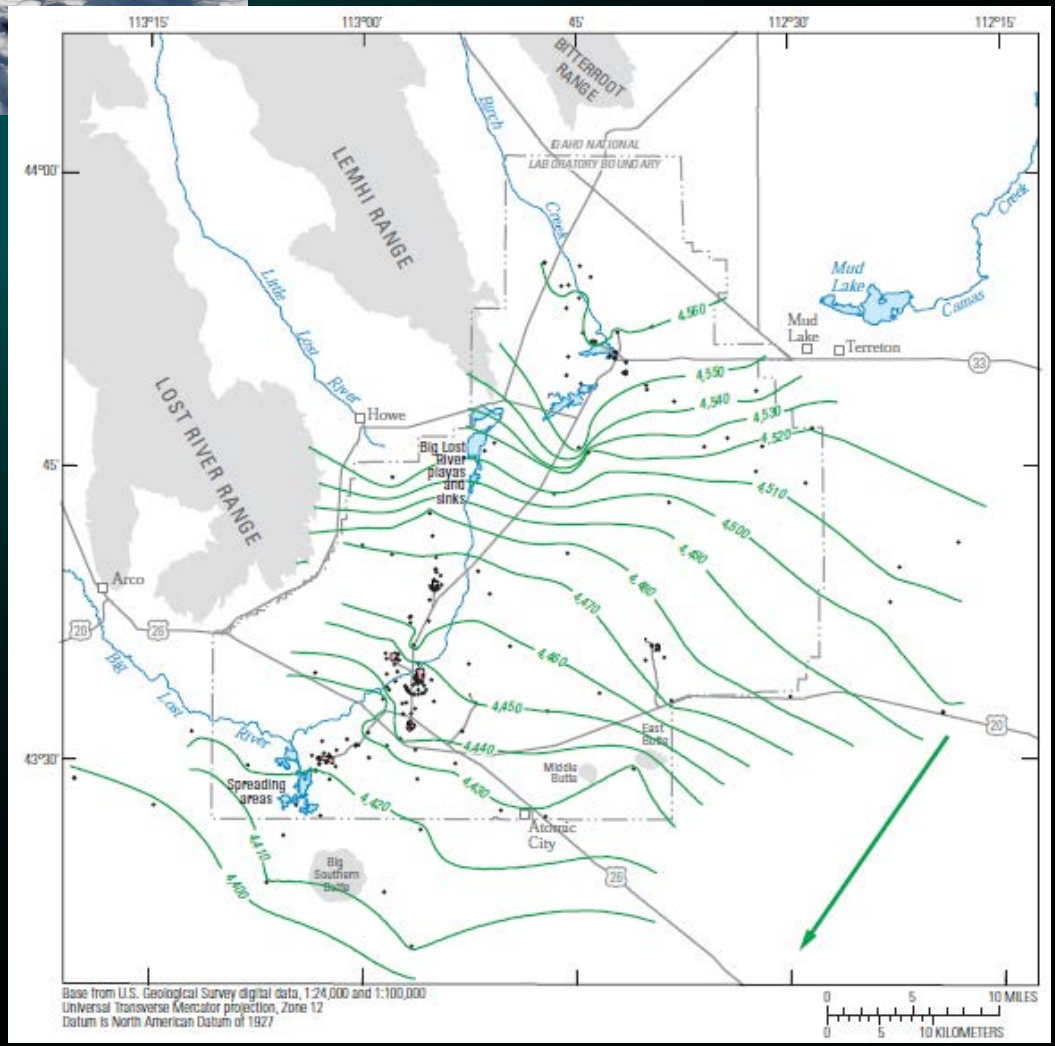
Water-level Monitoring

Water levels – monthly to annually at about 205 wells
(5 continuous recorders-2 real-time)

Measurements needed for water availability and model re-calibration

Water levels are cyclical, but are trending downwards. Some wells are going dry



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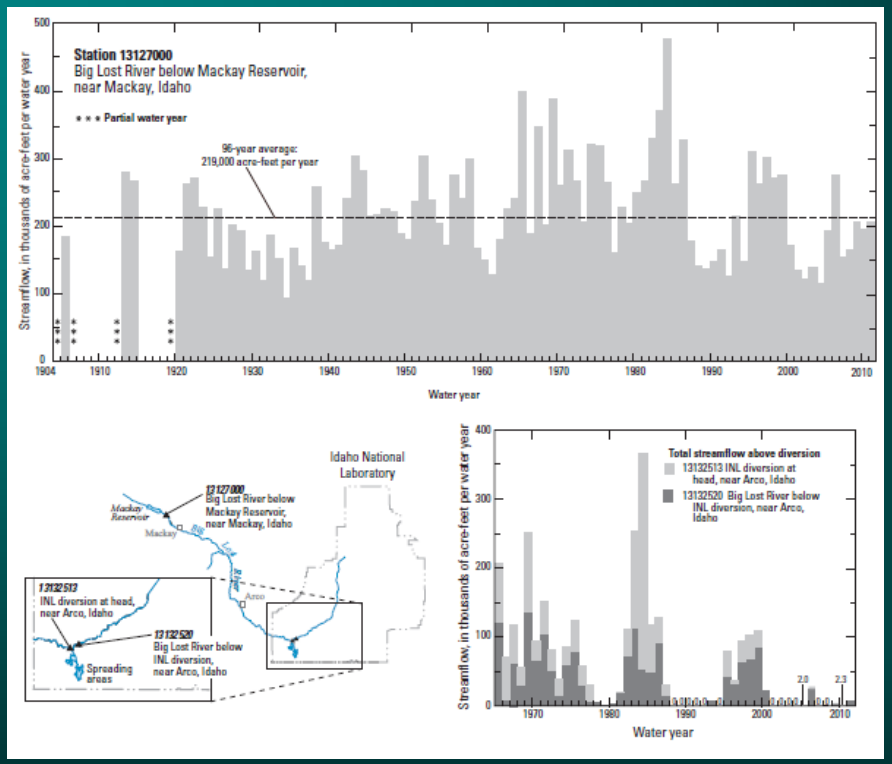

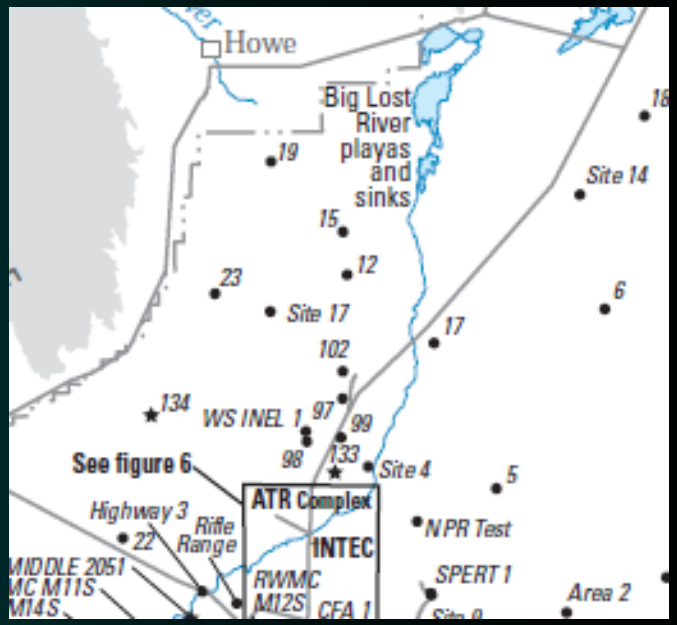

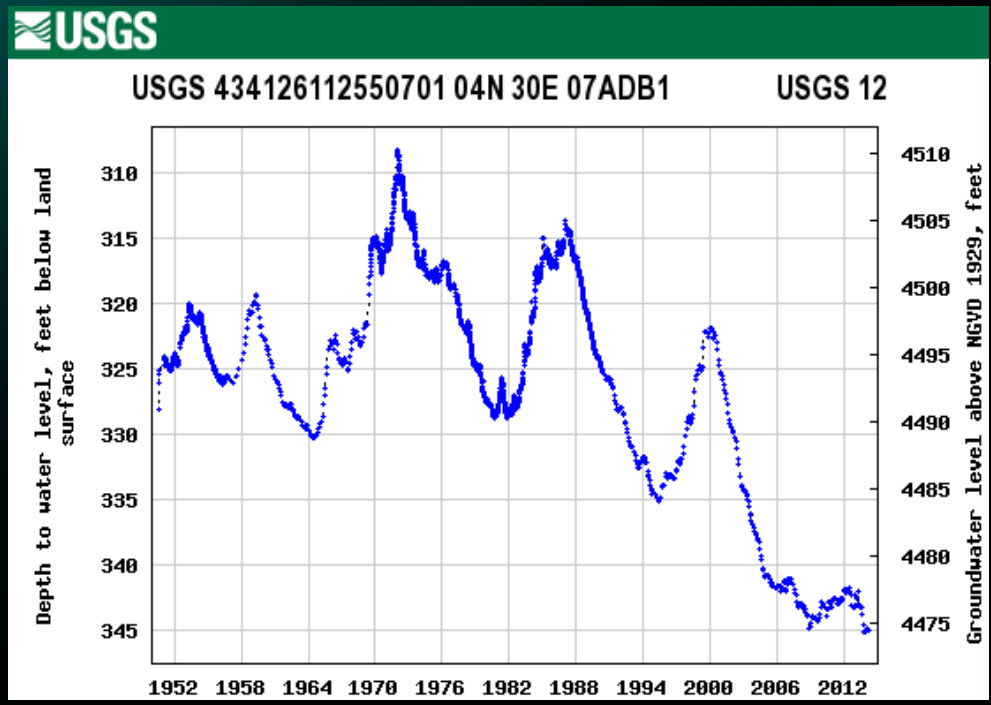

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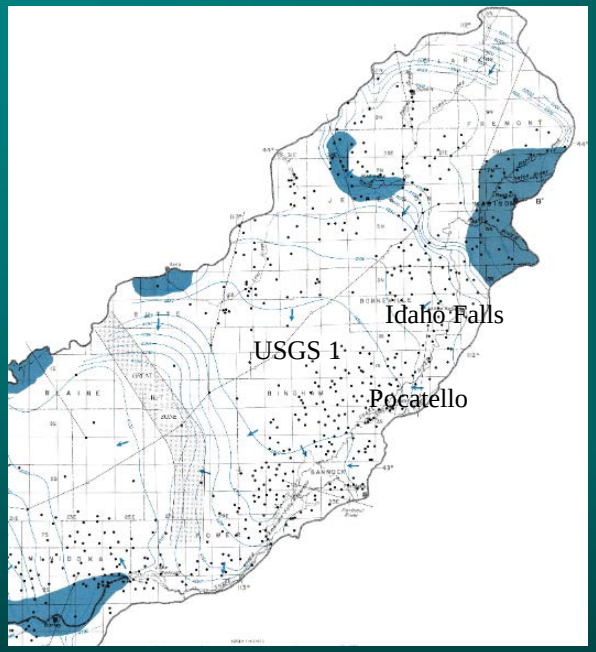
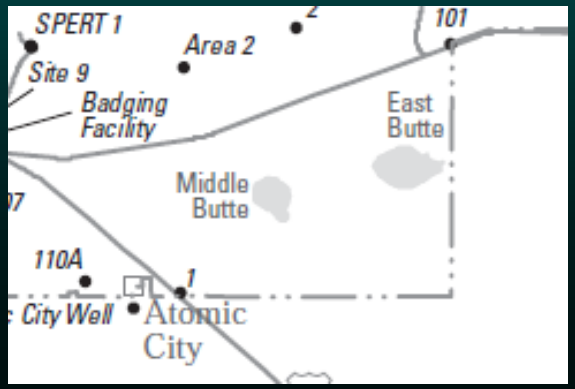
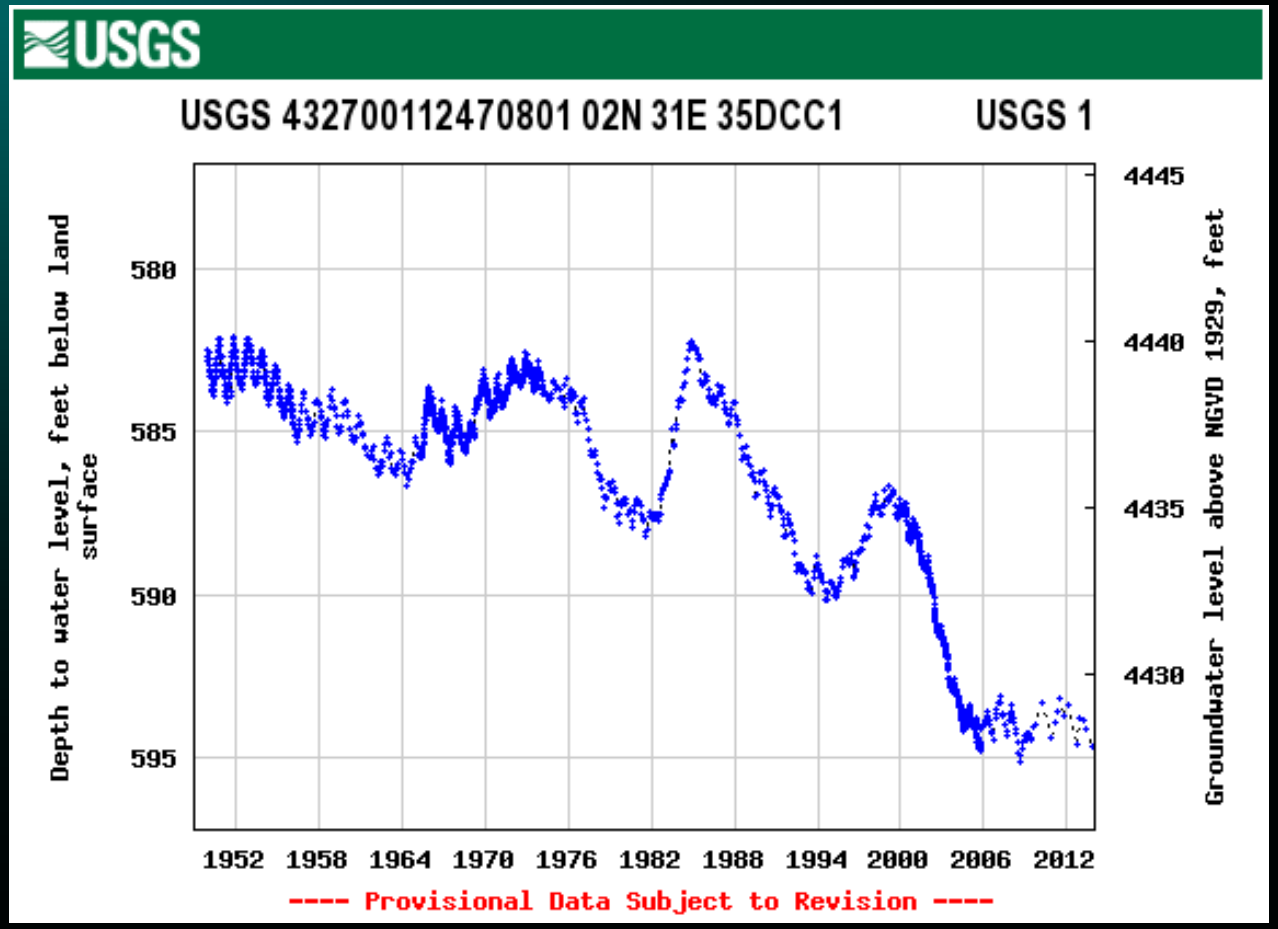
USGS Waterwatch well completed in basalt







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Water Sample Monitoring

Water quality – annually at 150 sites

Sample all sites for tritium and chloride

Selected sites for sulfate, sodium, fluoride, chromium, Sr-90, Pu, Am, alpha, beta, gamma, VOC's, suite of trace elements; periodic I-129

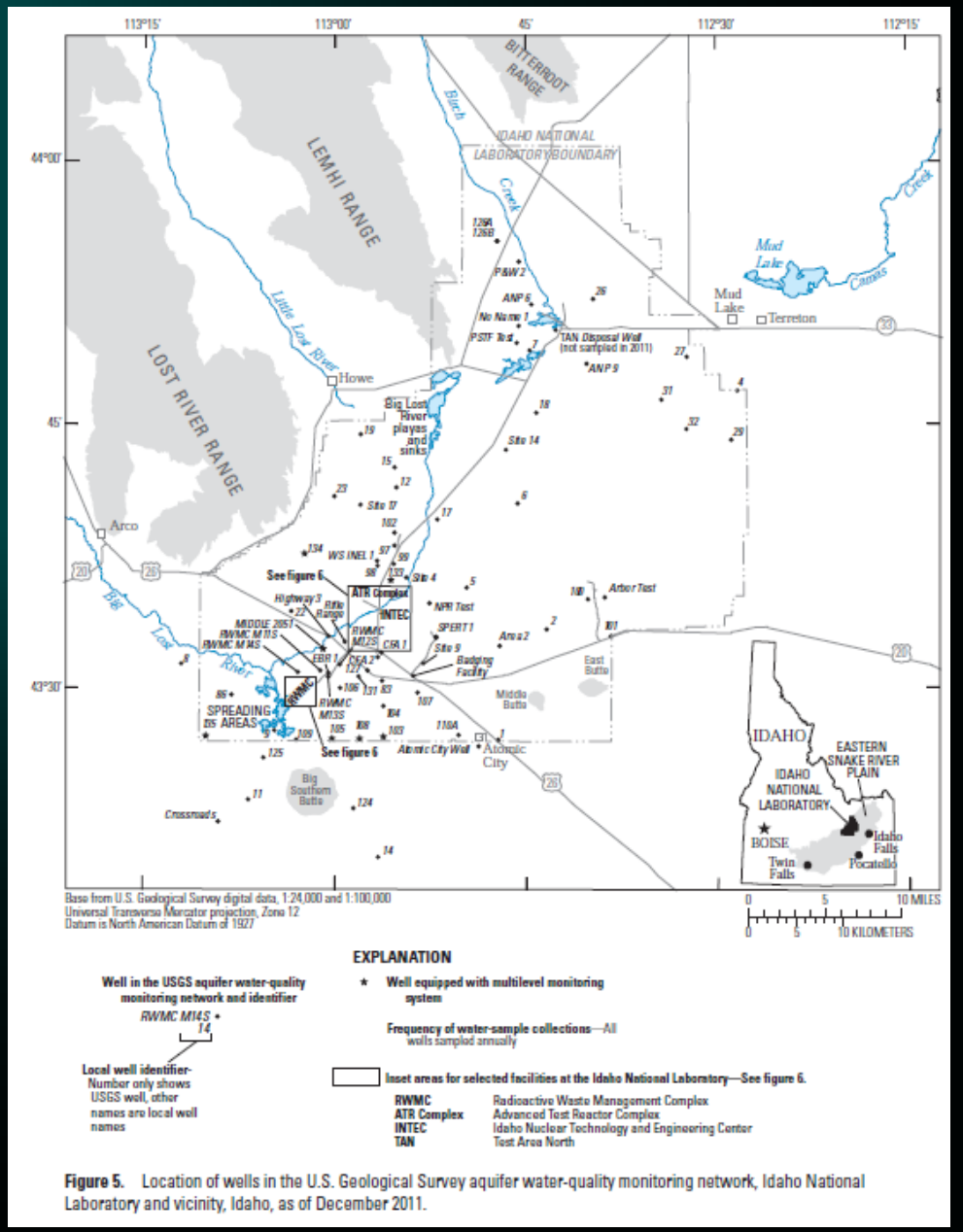

Figure 5. Location of wells in the U.S. Geological Survey aquifer water-quality monitoring network, Idaho National Laboratory and vicinity, Idaho, as of December 2011.

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DOE/ID-22225

Prepared in cooperation with the U.S. Department of Energy

Iodine-129 in the Eastern Snake River Plain Aquifer at and near the Idaho National Laboratory, Idaho, 2010–12

Scientific Investigations Report 2013–5195

U.S. Department of the Interior
U.S. Geological Survey

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DOE/ID-22226

Prepared in cooperation with the U.S. Department of Energy

An Update of Hydrologic Conditions and Distribution of Selected Constituents in Water, Eastern Snake River Plain Aquifer and Perched Groundwater Zones, Idaho National Laboratory, Idaho, Emphasis 2009–11

Scientific Investigations Report 2013–5214

U.S. Department of the Interior
U.S. Geological Survey

Tritium

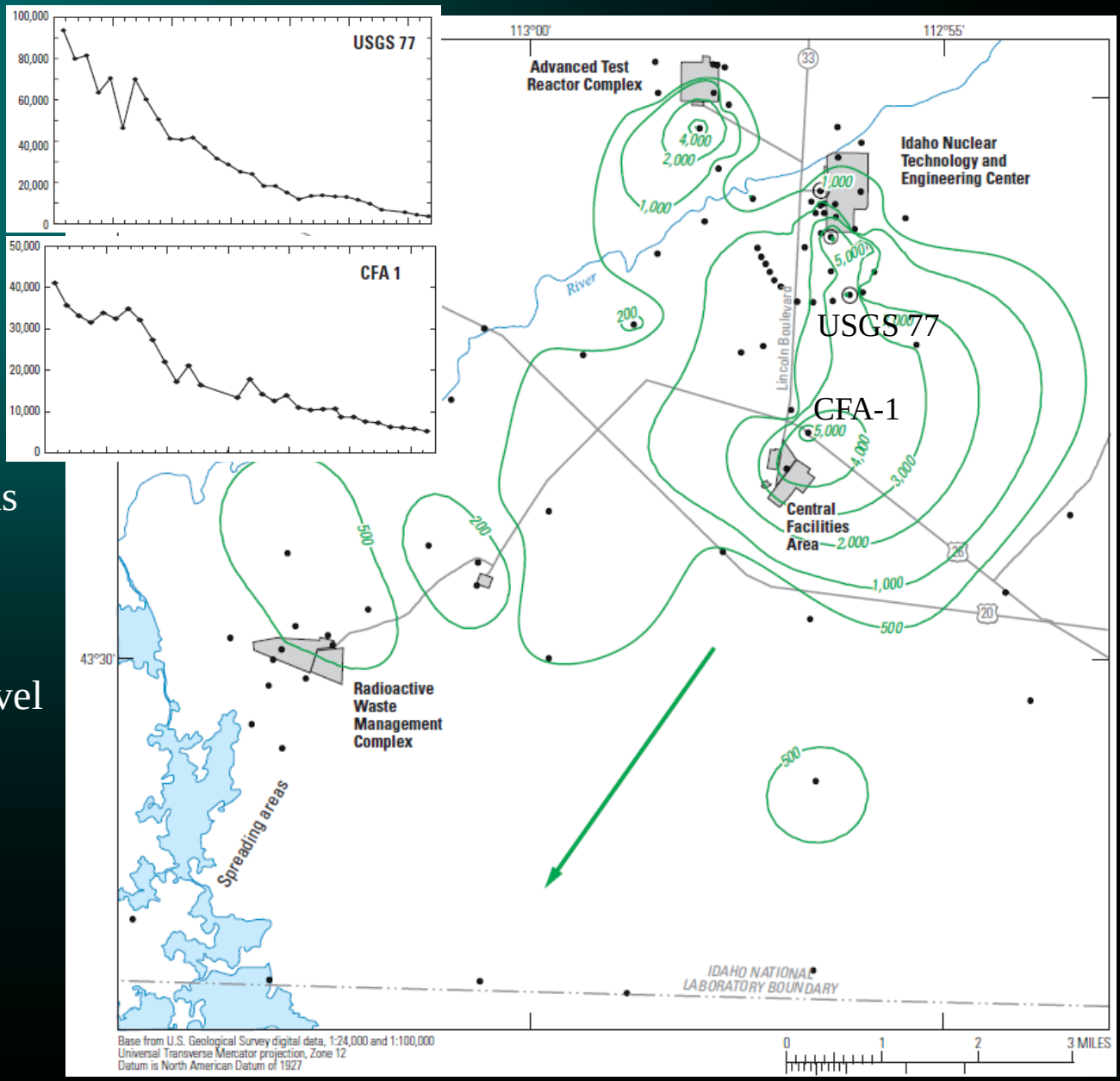
Drinking water standard is 20,000 pCi/L

Has a radioactive half life of 12.3 years.

Have not had concentrations above the drinking water standard since 1997

Our laboratory detection level is about 200 pCi/L

Background from non-INL activities is thought to be below 150 pCi/L



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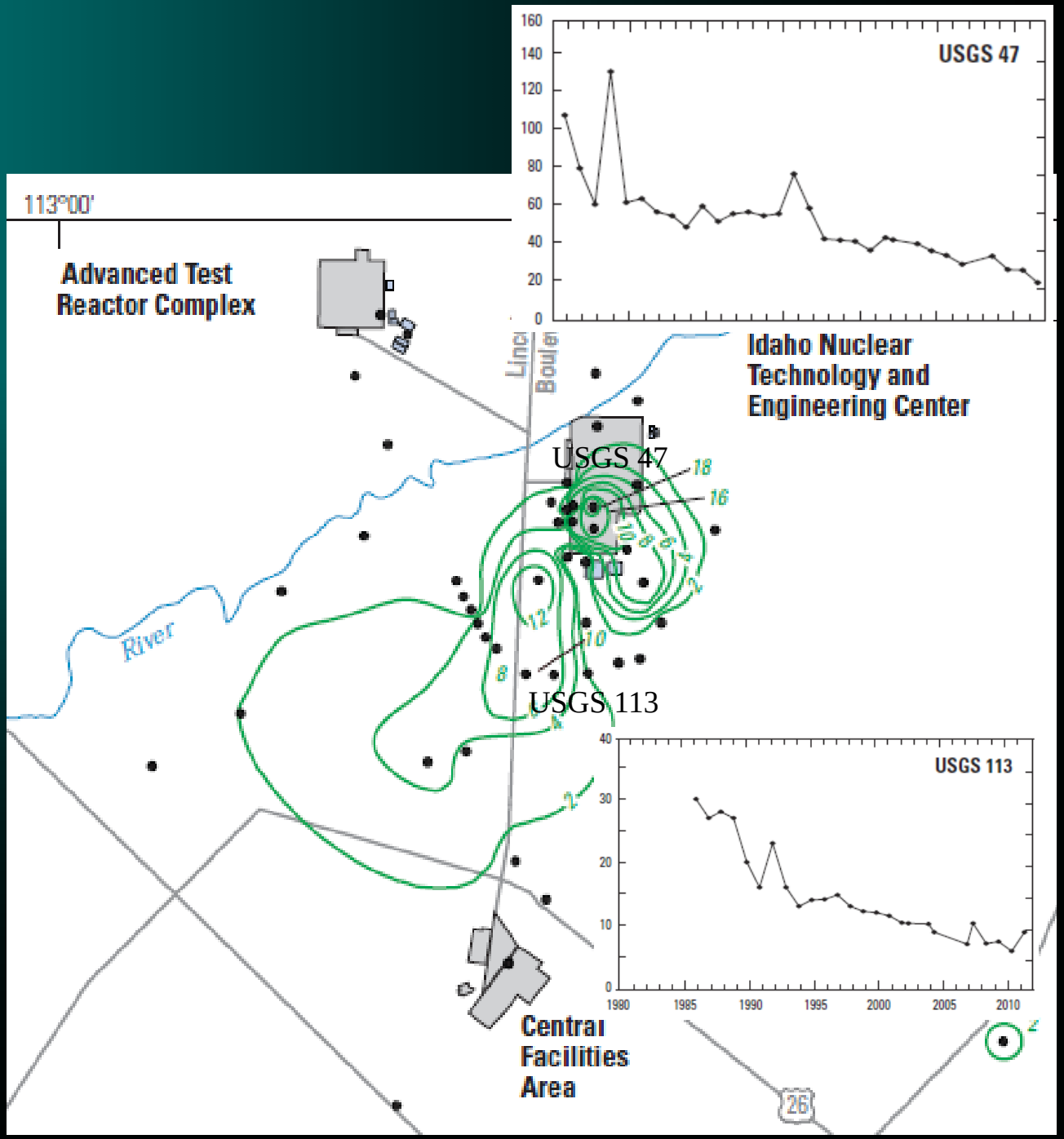
Strontium-90

Drinking water standard is 8 pCi/L

Has a radioactive half life of 29.1 years.

Still have several wells with concentrations above the drinking water standard.

Our laboratory detection level is about 2 pCi/L



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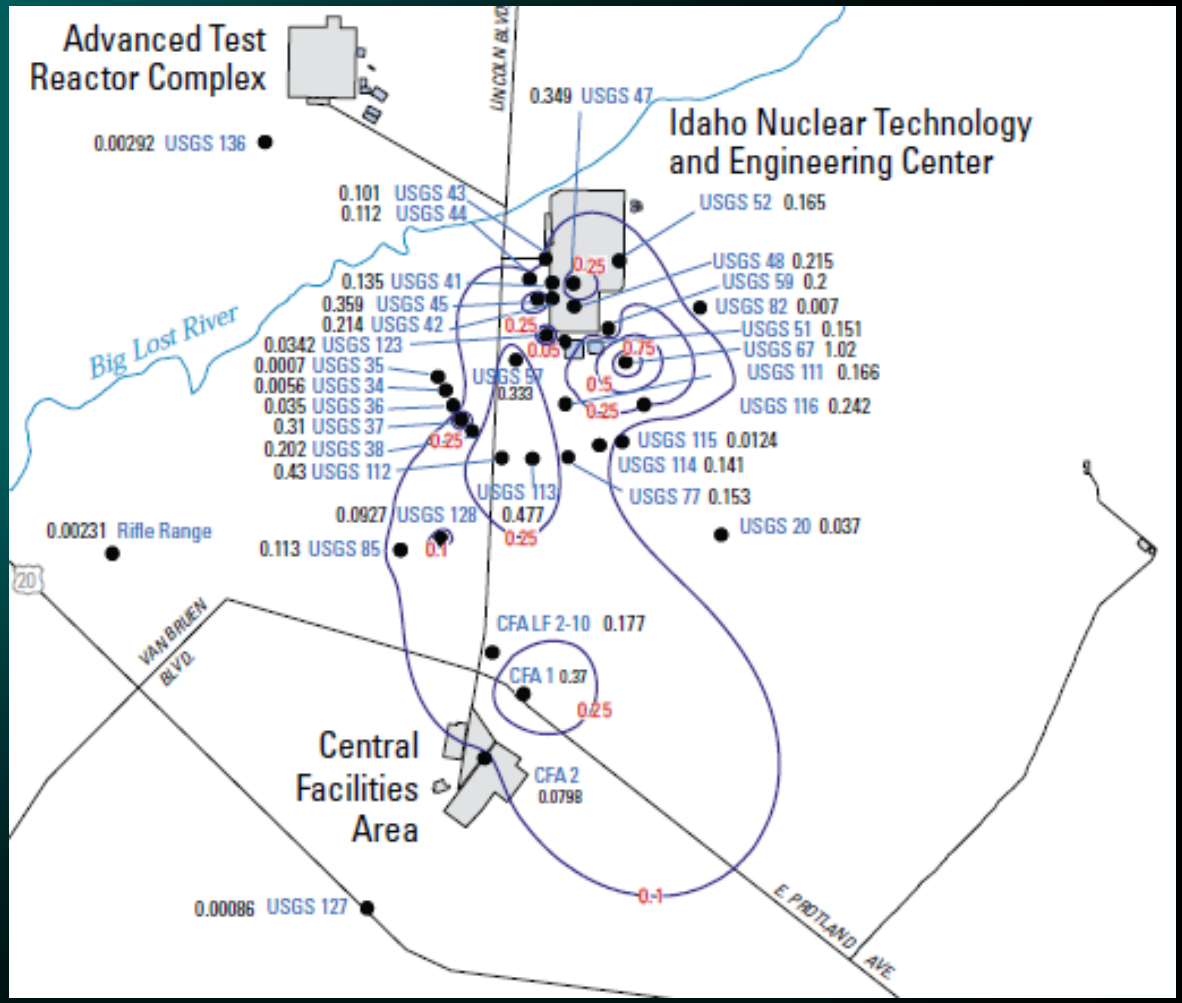
Iodine-129

Drinking water standard
is 1 pCi/L

Has a radioactive half life
of 15.7 million years.

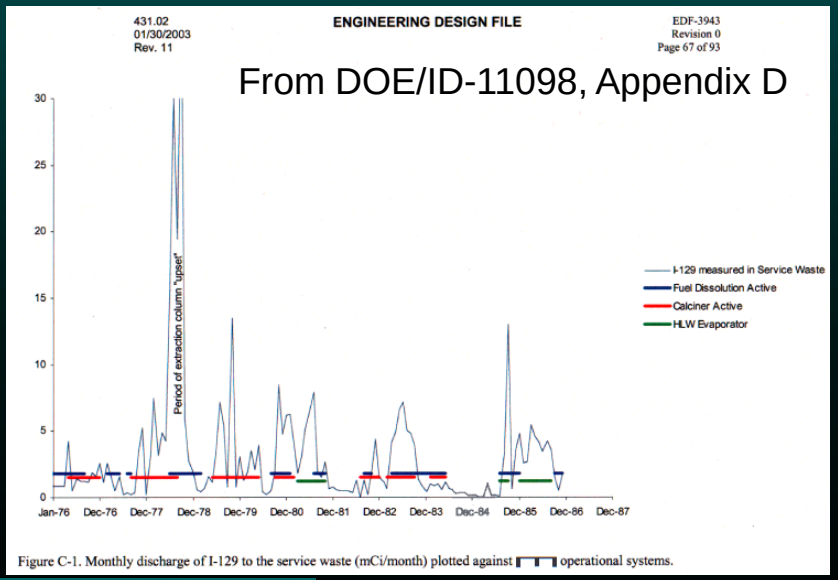
Still one well with a concentration
above the drinking water standard.

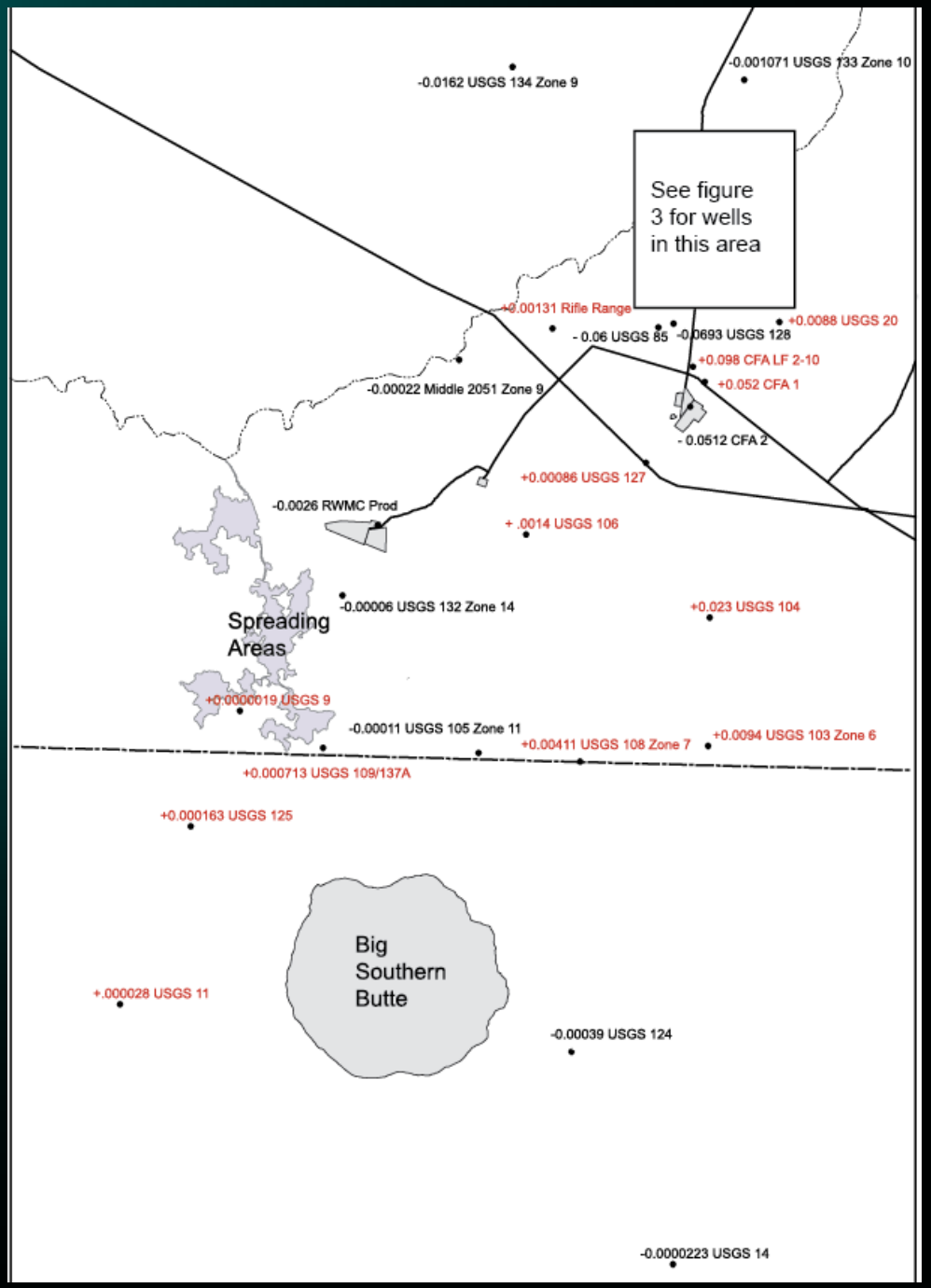
Background concentrations in the
Eastern Snake River Plain aquifer
are about 0.000005 pCi/L



When comparing previous data with 2011-12 data, concentrations in several wells near CFA, near the INL boundary, and south of the boundary showed slight increases.

Increases may represent masses of water from larger disposal events such as those from 1957 and 1978 finally reaching these wells or may represent water from some other disposal period reaching the wells.





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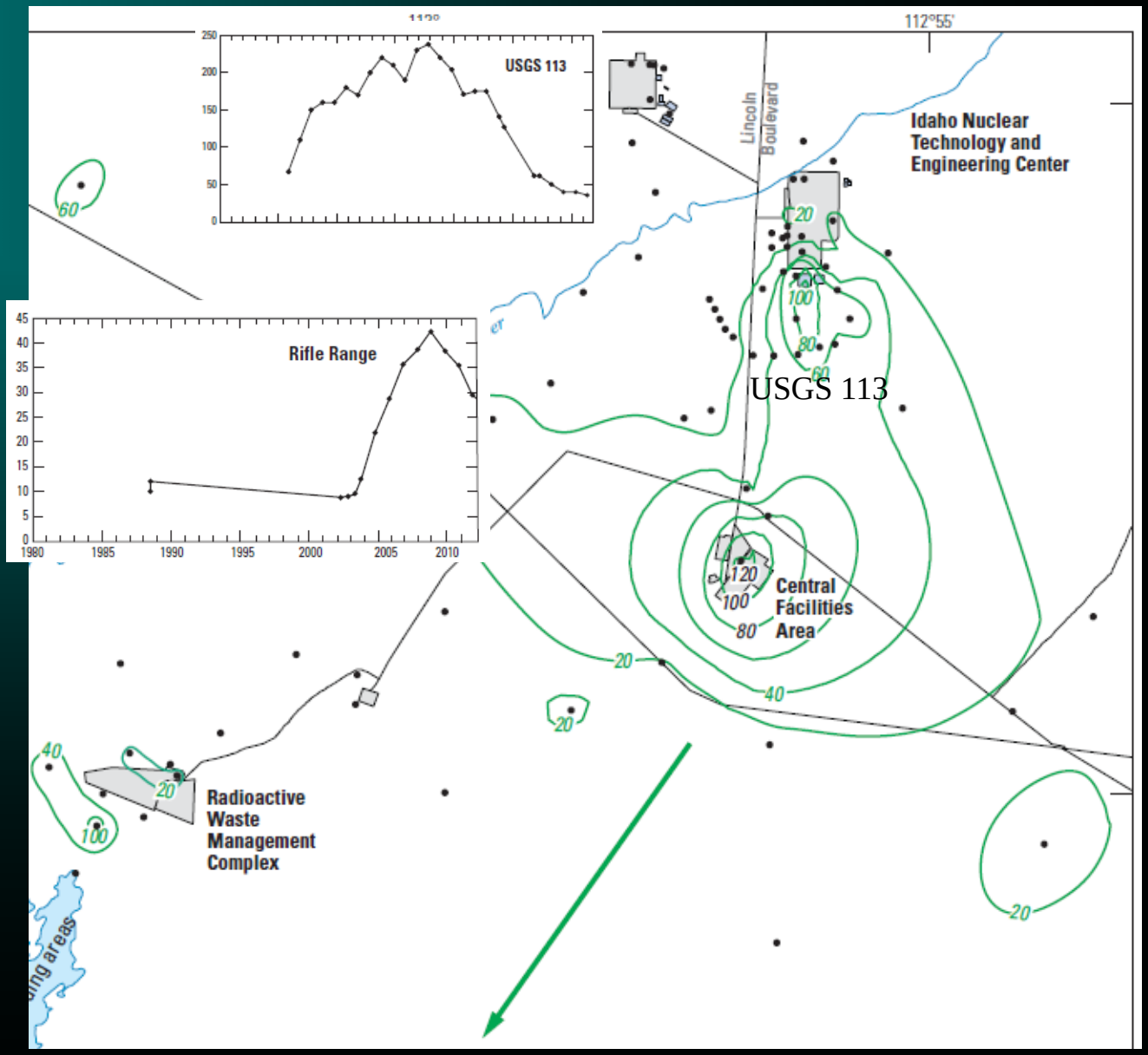
Chloride

Secondary drinking water standard is 250 mg/L

Background concentration is about 15 mg/L



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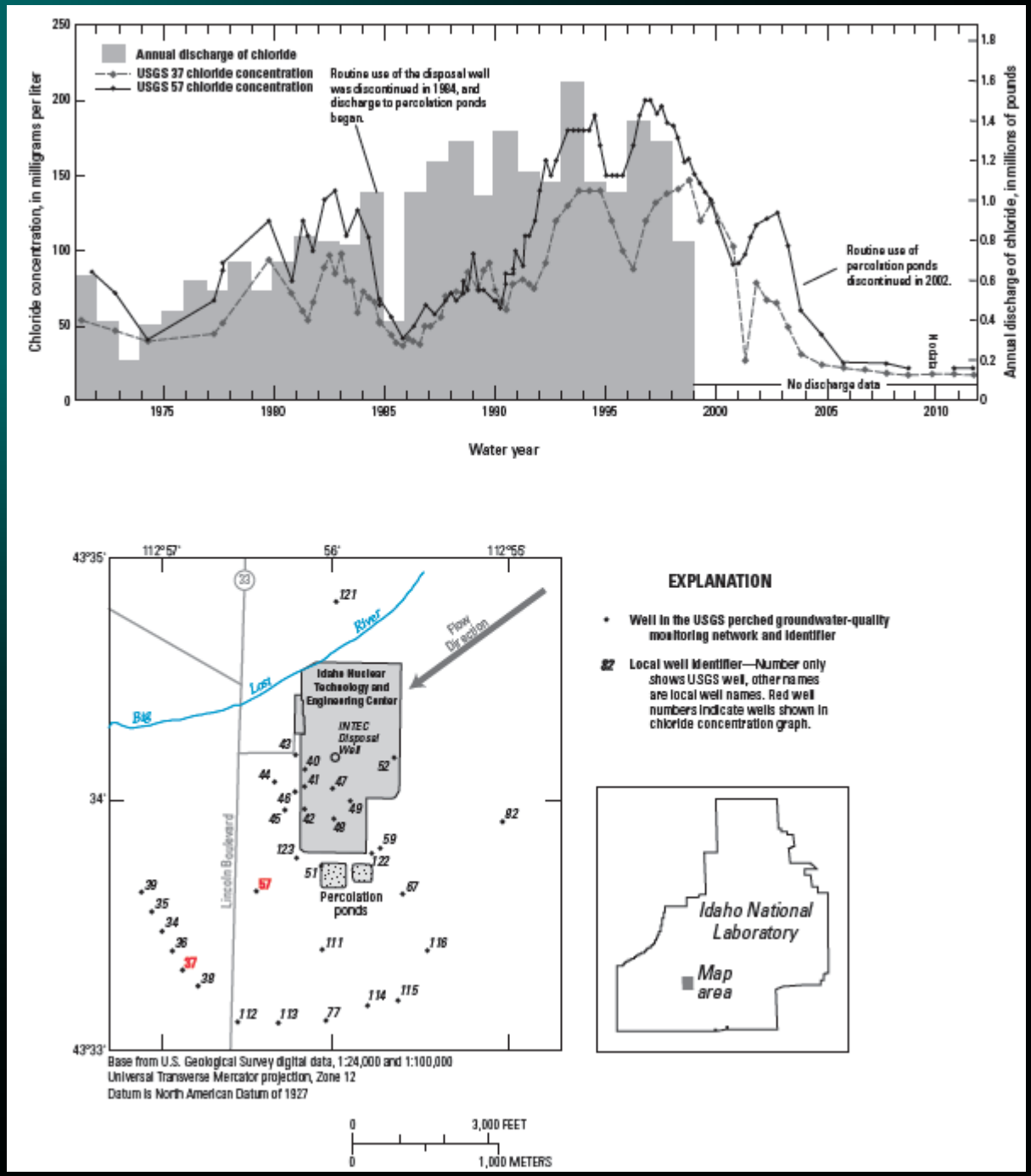
We do see a lag between disposal and when it shows up in the wells, and the relation of chloride does correspond to disposal amounts.



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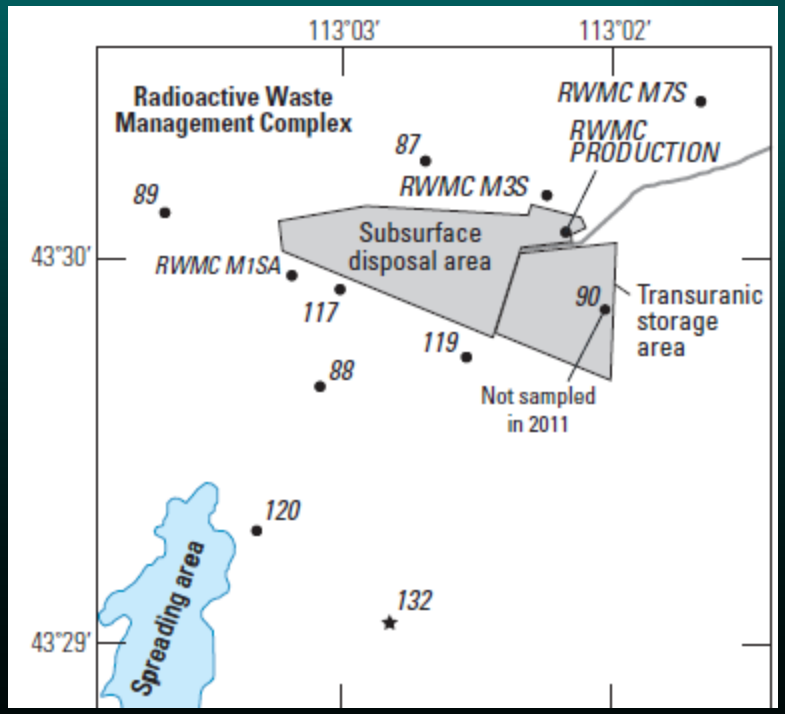
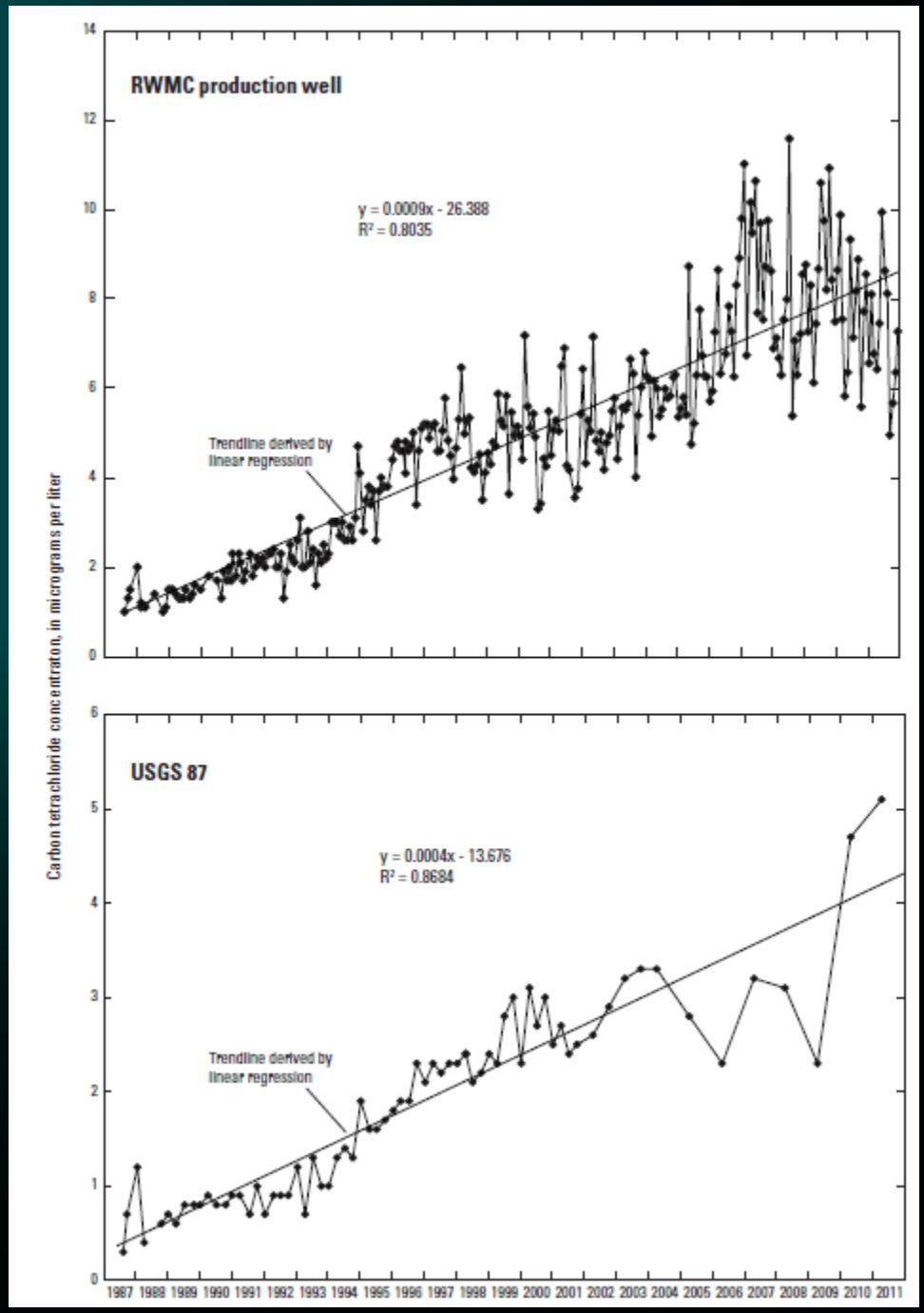
Carbon tetrachloride

Drinking water standard is 5 µg//L





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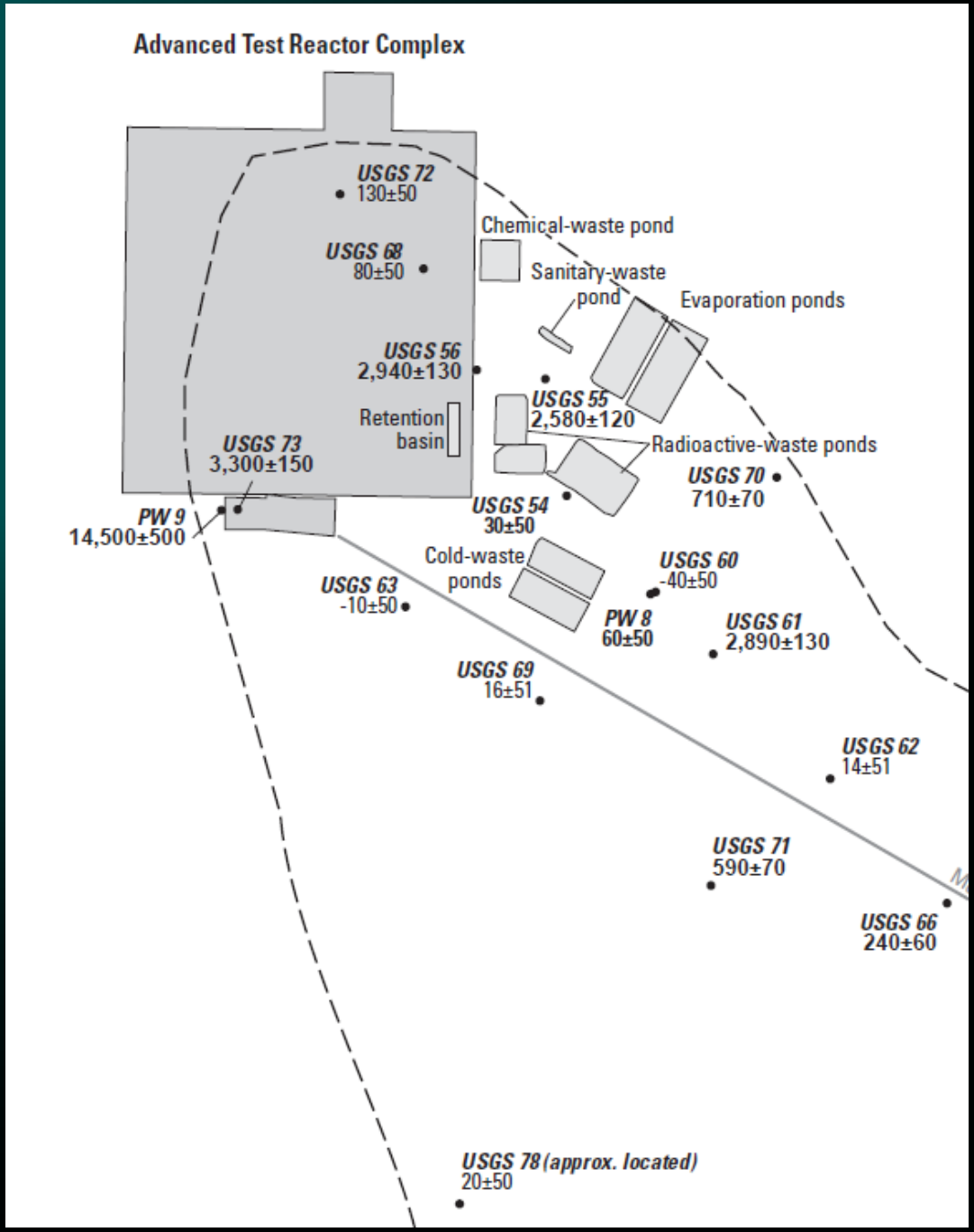
Perched Groundwater around ATRC

Key findings in 2011 was that tritium was below the drinking water standard in all wells.

Strontium-90 exceeded the drinking water standard in 4 wells.

One well had sulfate that exceeded its secondary drinking water standard of 250 mg/L.



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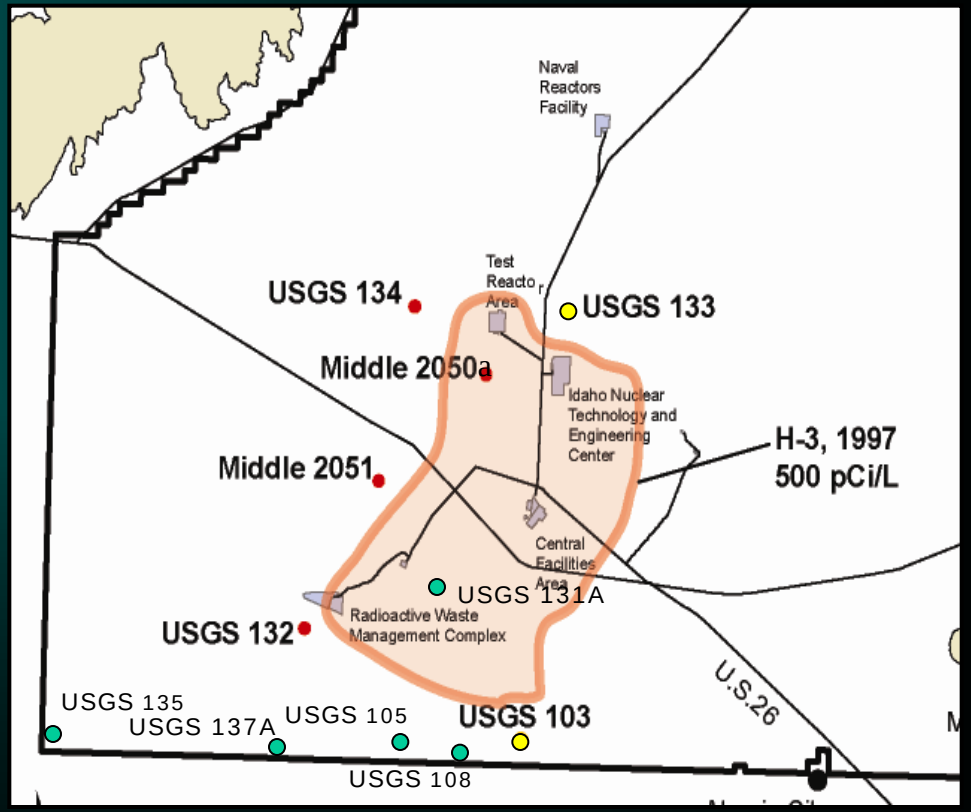
Multilevel Monitoring Site Locations



Monitor zones from 11 wells

Each well has from 4 to 7 sample ports

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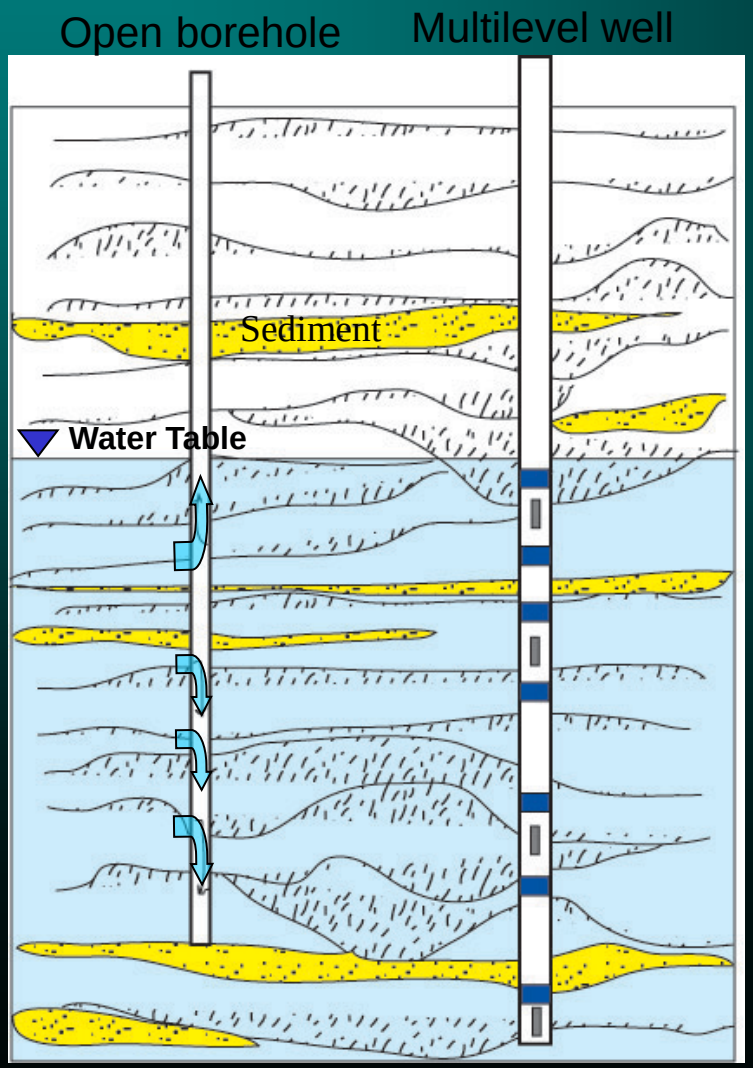
Advantages of Multilevel Systems



- Eliminates vertical mixing from open boreholes.
- Allow for discrete water sampling and piezometric head profiles without drilling multiple boreholes.
- Monitor data trends with time (contaminant movement, recharge waters).

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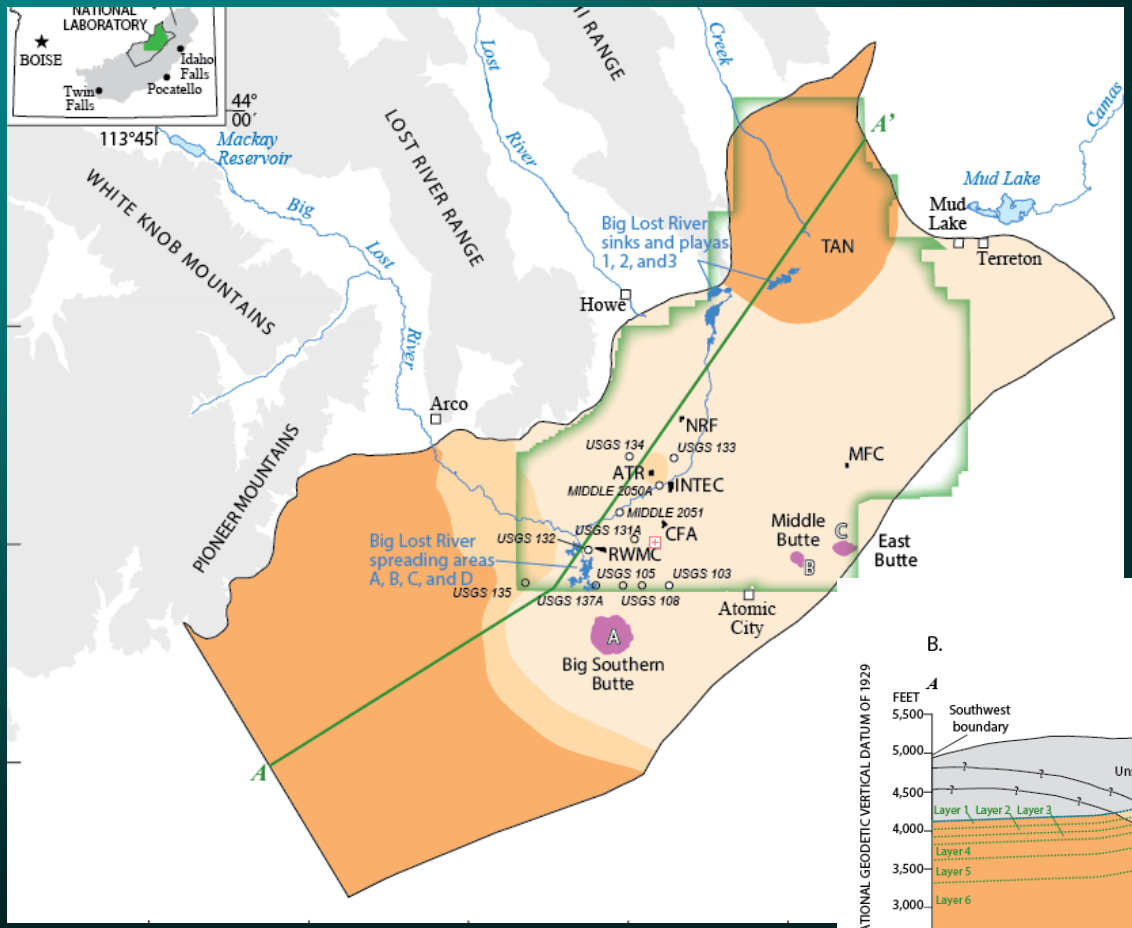

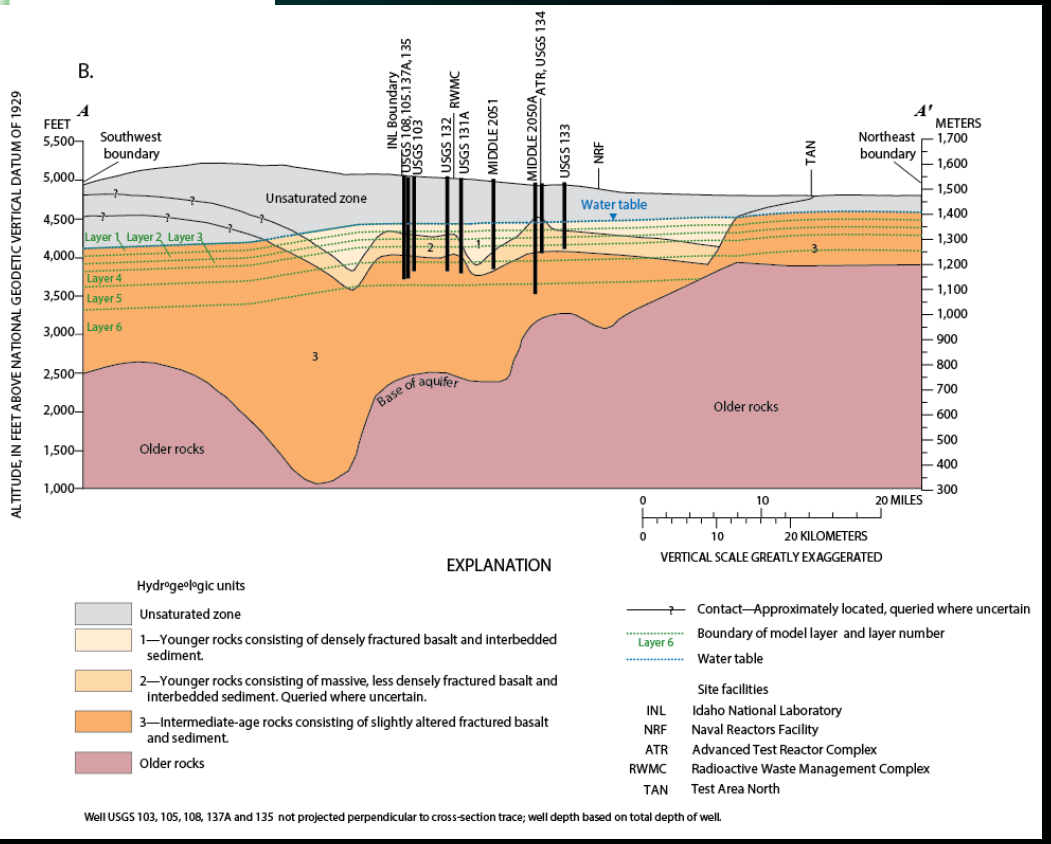

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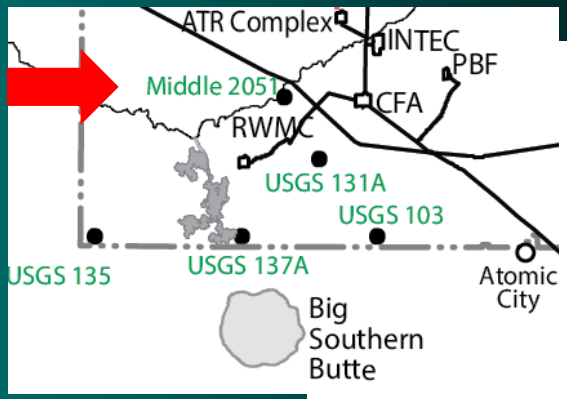
Middle 2051



2008 tritium

52+/-3 pCi/L

2012 Iodine-129

0.00057+/-0.000086 pCi/L

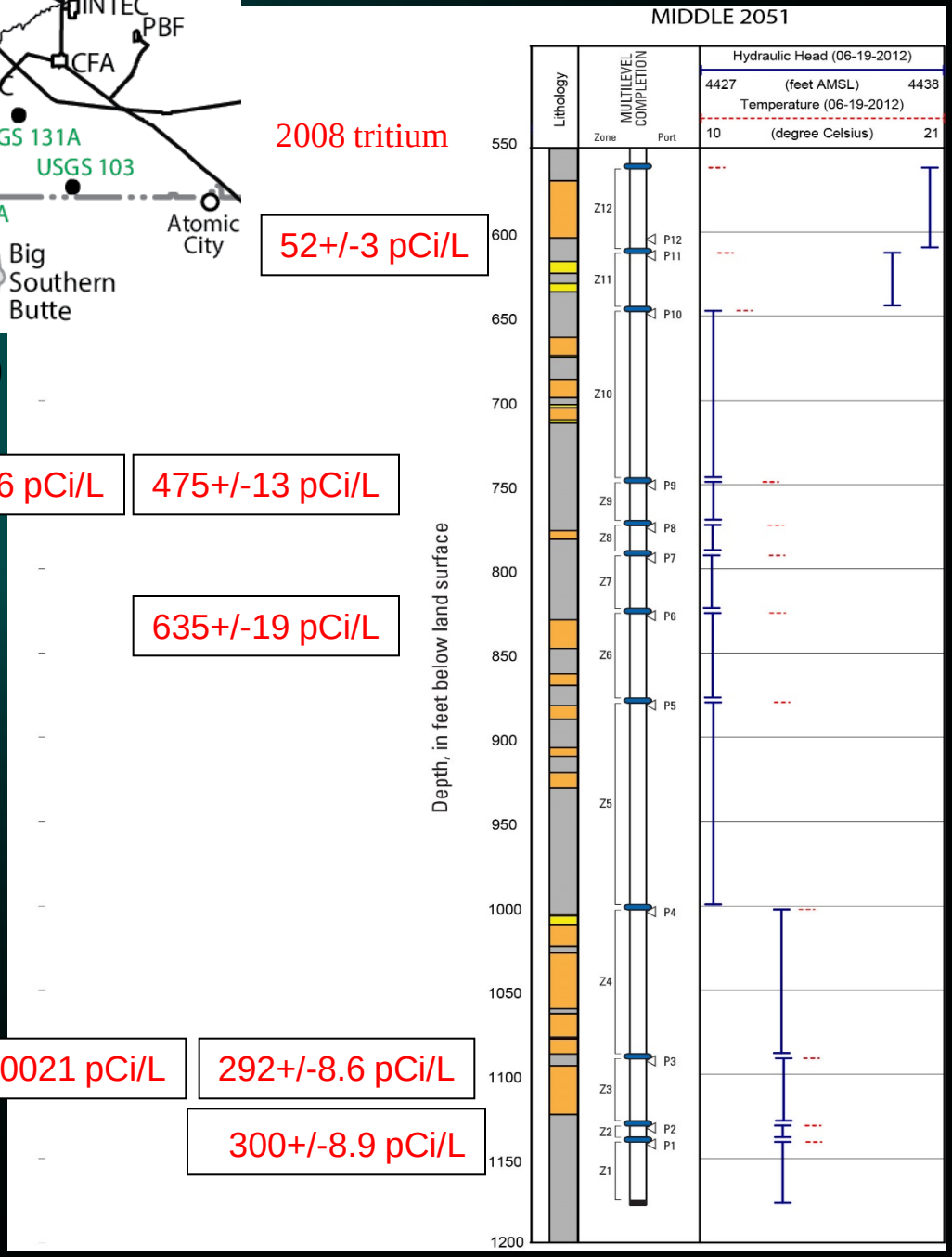
475+/-13 pCi/L

635+/-19 pCi/L

0.00507+/-0.00021 pCi/L

292+/-8.6 pCi/L

300+/-8.9 pCi/L



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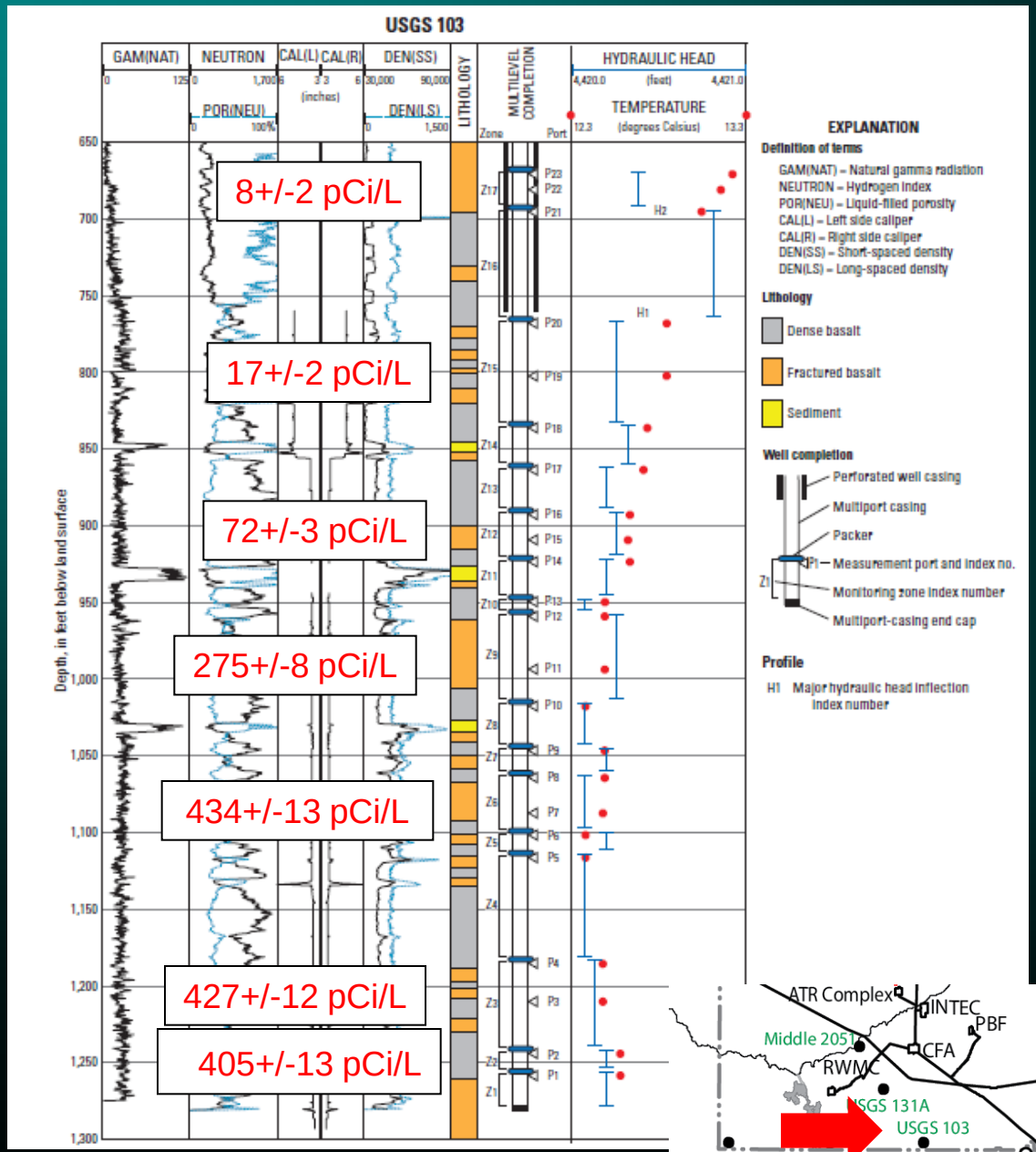
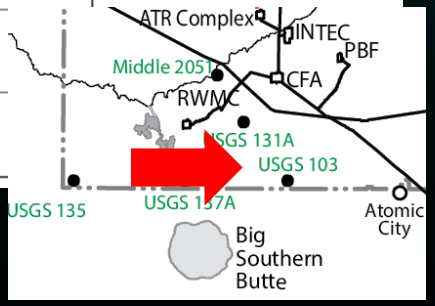
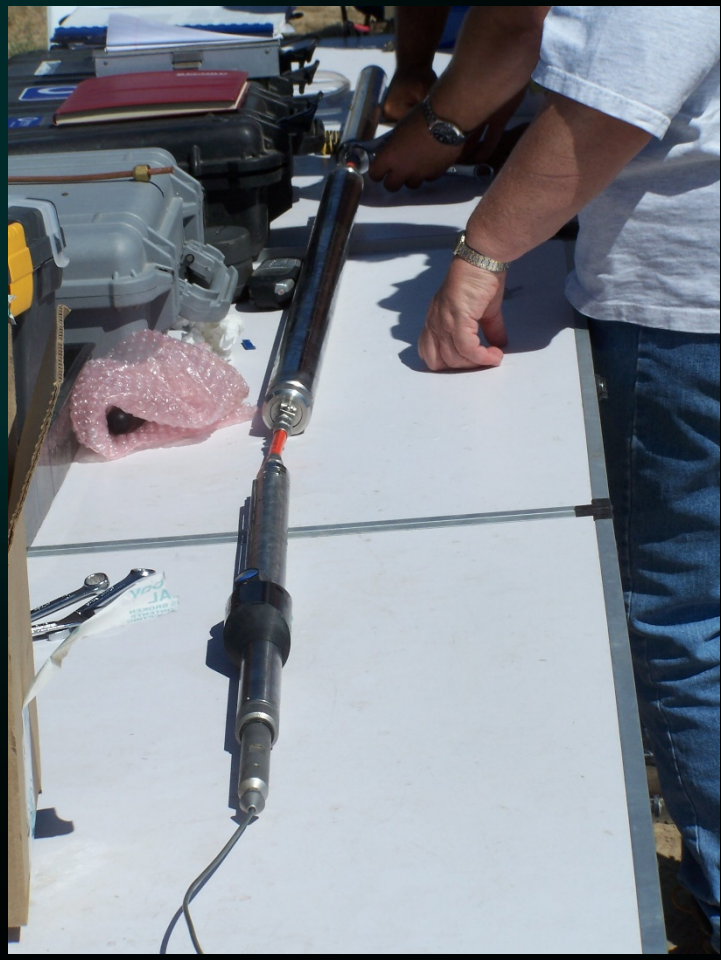
USGS 103

- Tritium – Sampled August 2008







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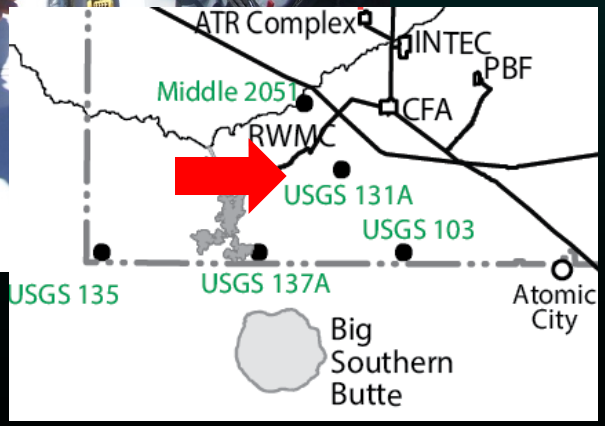
USGS 131A

- Tritium – Sampled October 2012

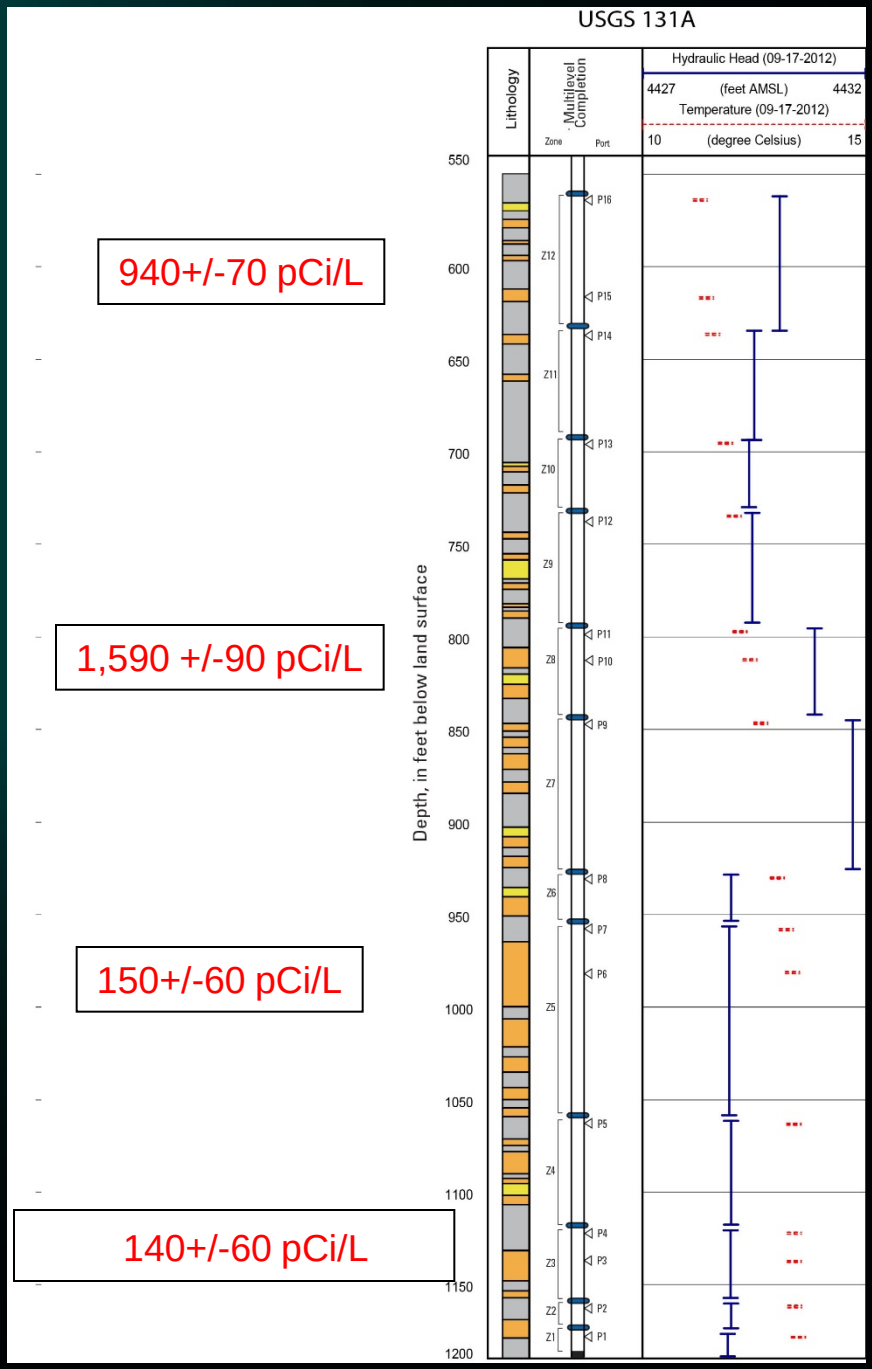


940+/-70 pCi/L

1,590 +/-90 pCi/L

150+/-60 pCi/L

140+/-60 pCi/L



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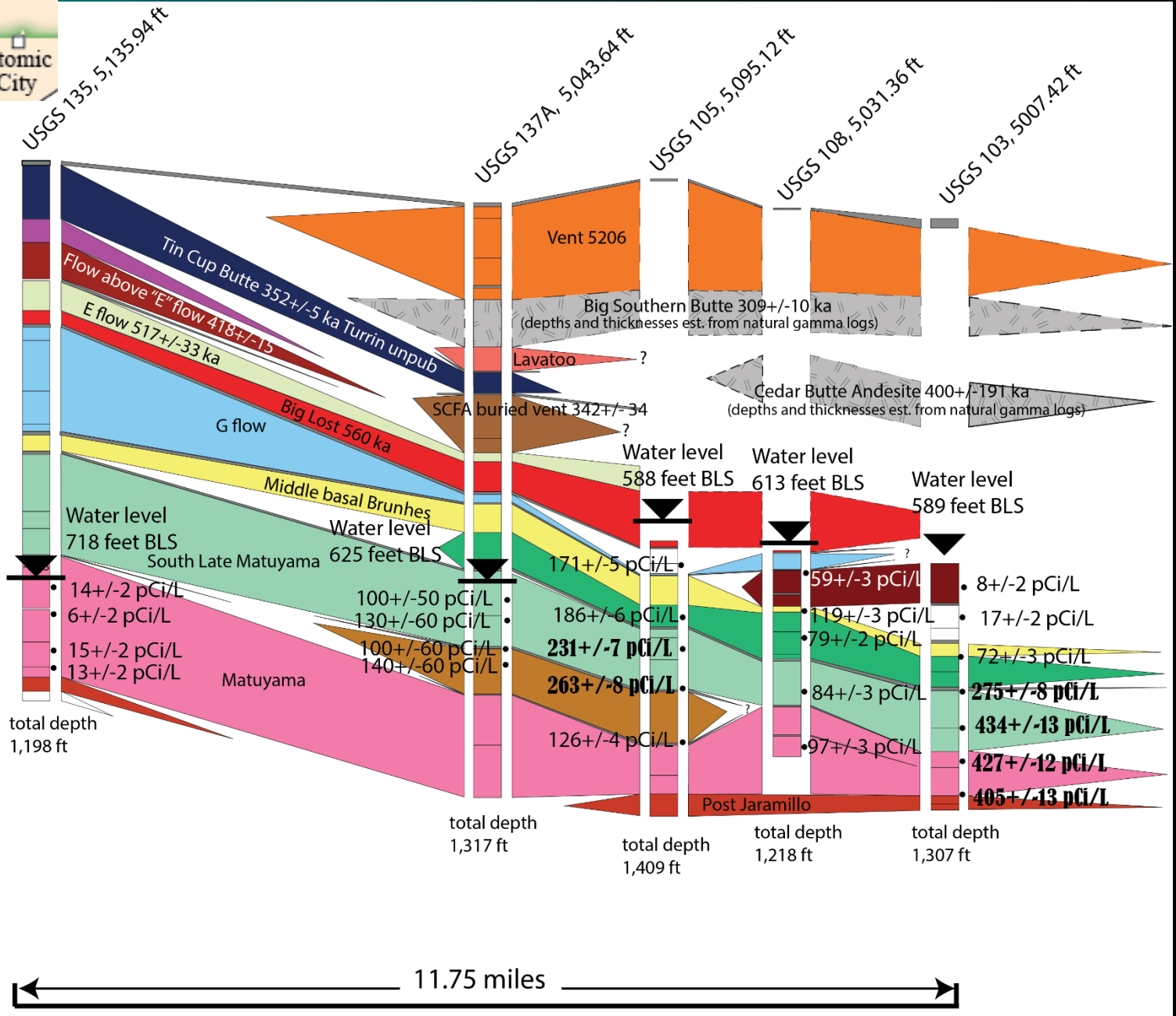

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http://id.water.usgs.gov/projects/INL/monitor.html

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- Geochemical Modeling

Water Monitoring

The USGS has been studying the area's water resources since the INL was established in 1949. Initially, our studies focused on quantifying the volume of water in the eastern Snake River Plain aquifer and determining if the water quality was adequate for industrial use. As concerns mounted about the presence of radioactive and chemical wastes in the eastern Snake River Plain aquifer, we turned our attention to understanding the extent and movement of contamination in the area's vital groundwater.

USGS technician sampling for dissolved gases, photo by USGS

In cooperation with the U.S. Department of Energy, we currently monitor groundwater and surface-water quality as well as streamflow at seven surface water sites. Stage information at Mackay Reservoir is also available through other funding partners.

Water samples are collected and analyzed for selected common ions, trace elements, nutrients, radiochemical constituents, and organic compounds. Samples are analyzed by the Radiological and Environmental Sciences Laboratory and the USGS National Water Quality Laboratory.

Since 1966, we've archived "raw" samples from each of our groundwater and surface water monitoring events. These samples are available to researchers.

Multilevel monitoring systems

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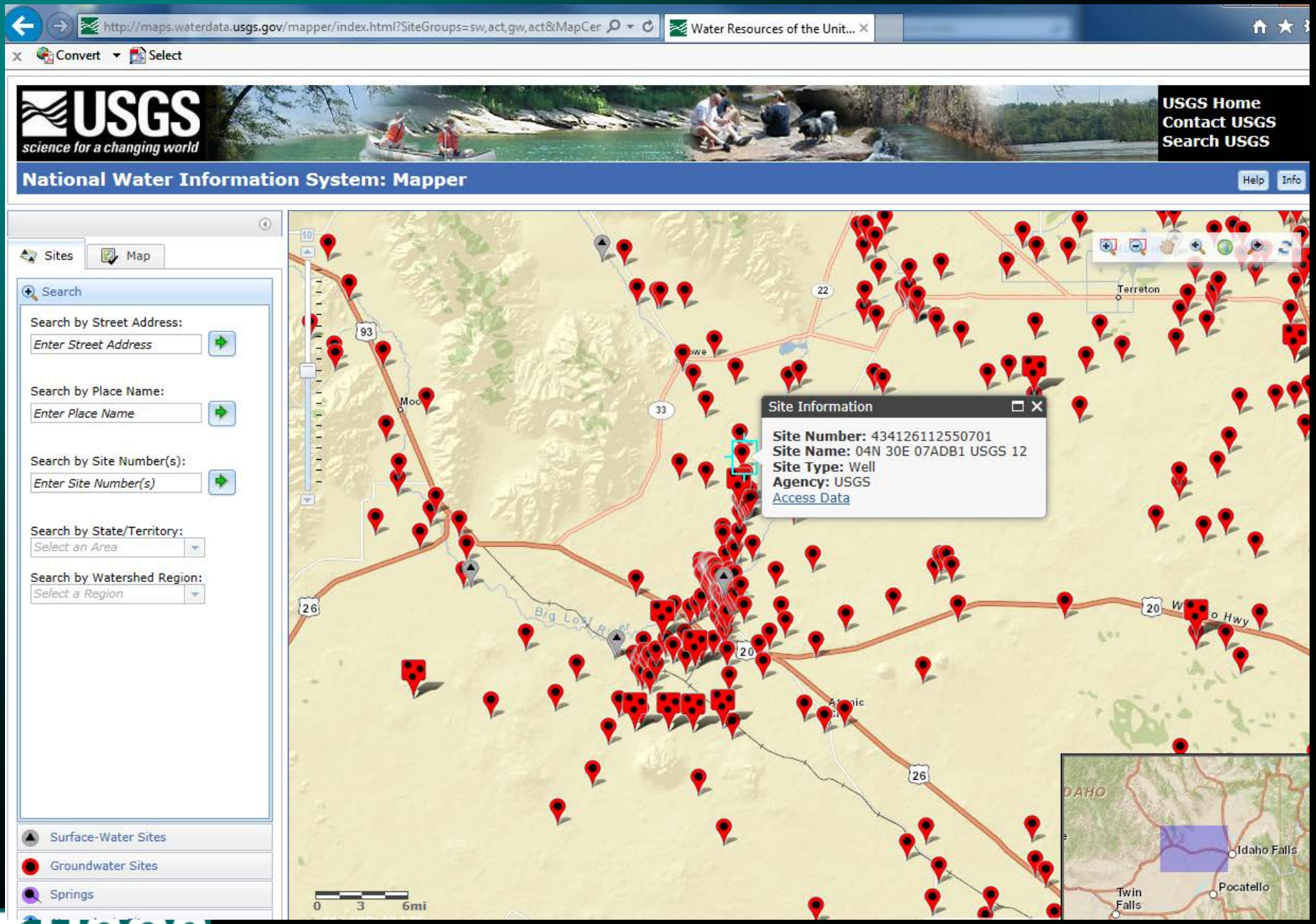
http://id.water.usgs.gov/projects/INL



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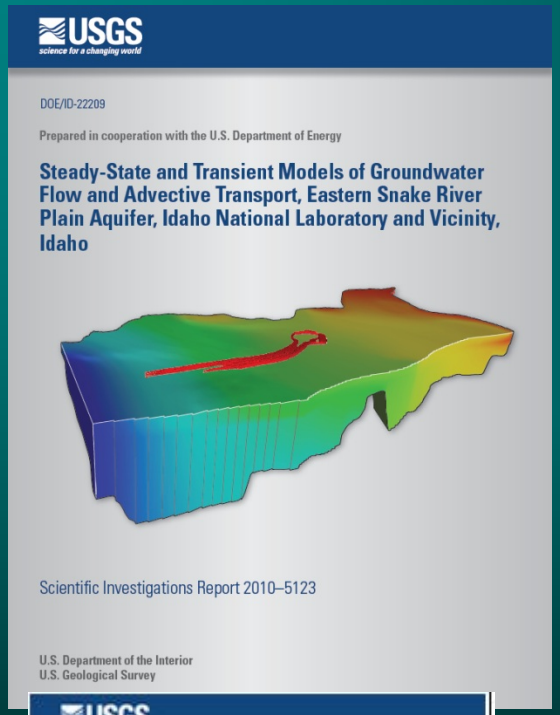
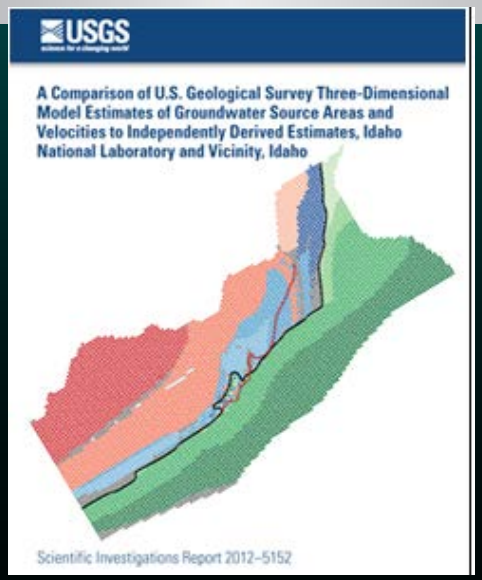
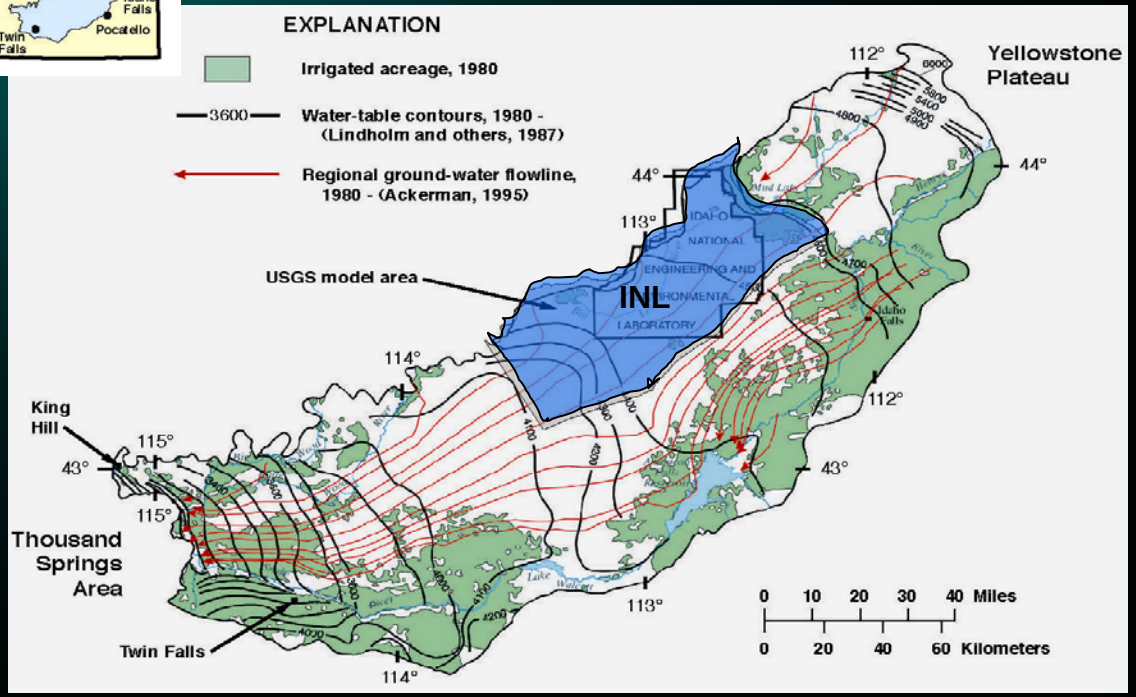
Groundwater Model Development





Eastern Snake River Plain Aquifer



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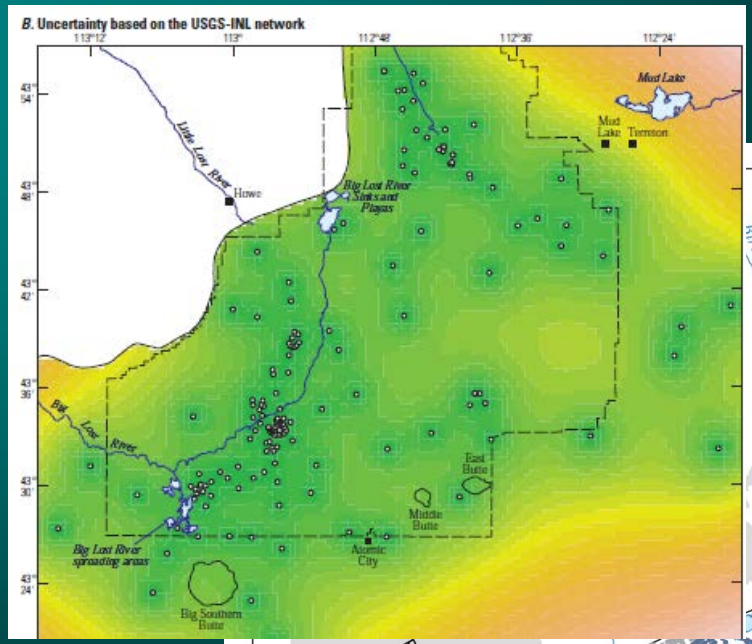
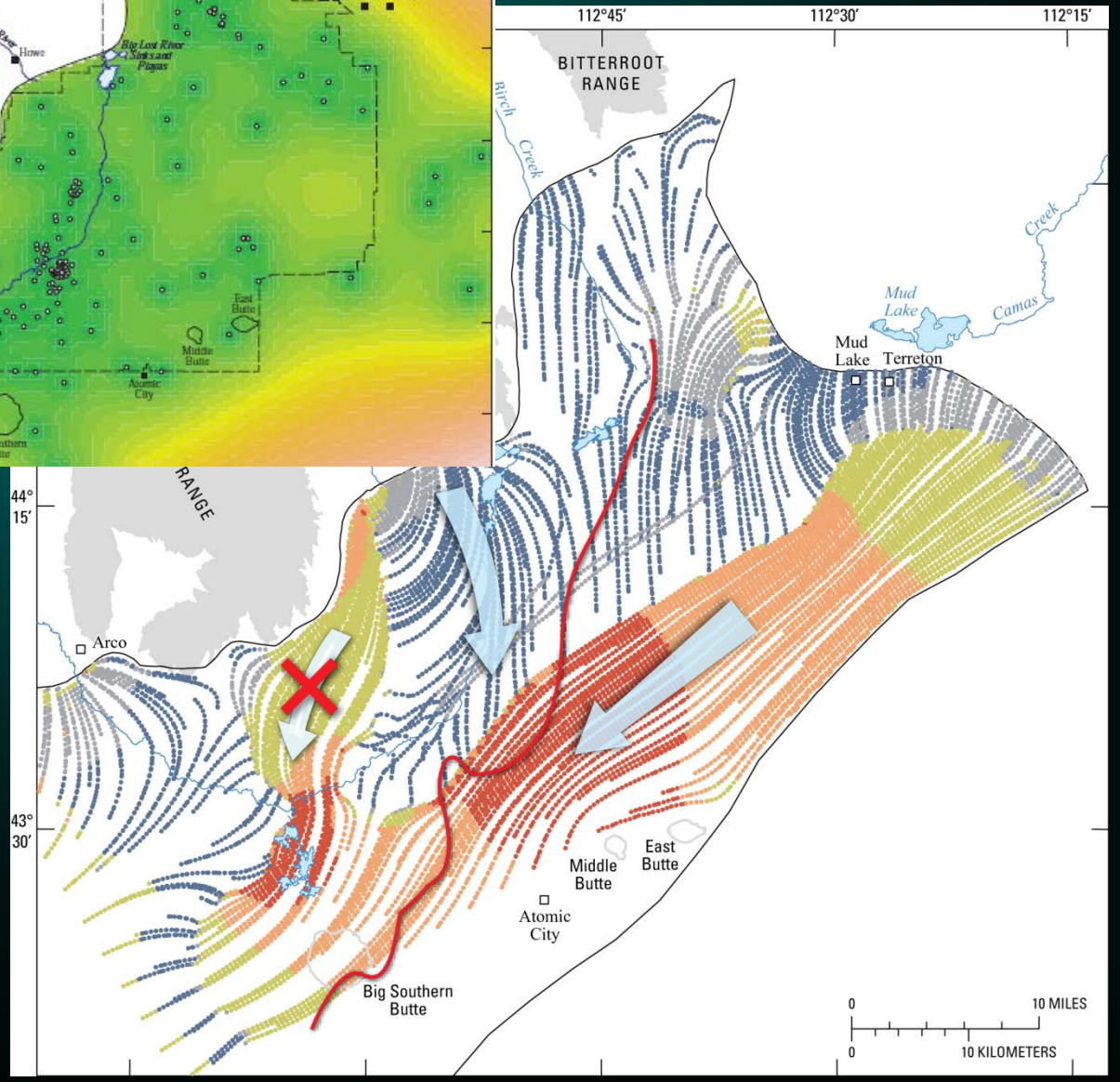
Groundwater Velocity





General weakness of the model is too fast of flow in the eastern part of INL and south of Howe; model does OK in sediment-rich areas, not as well in sediment-poor areas

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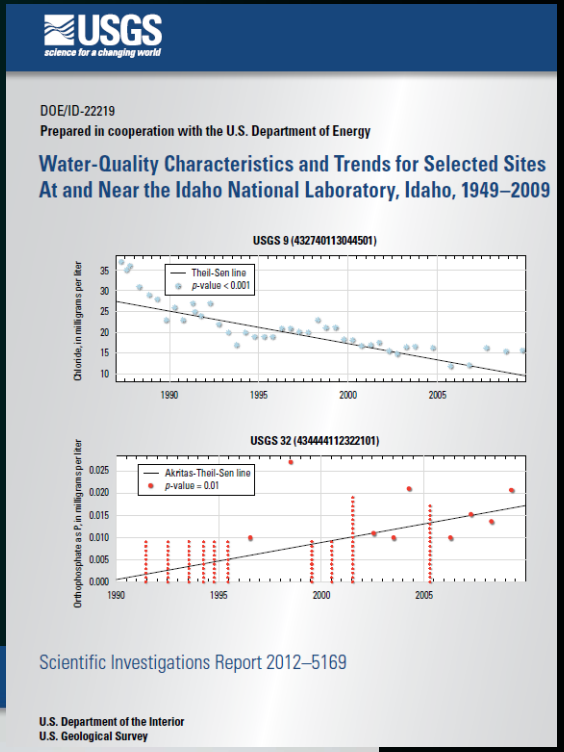
Idaho Completion Project

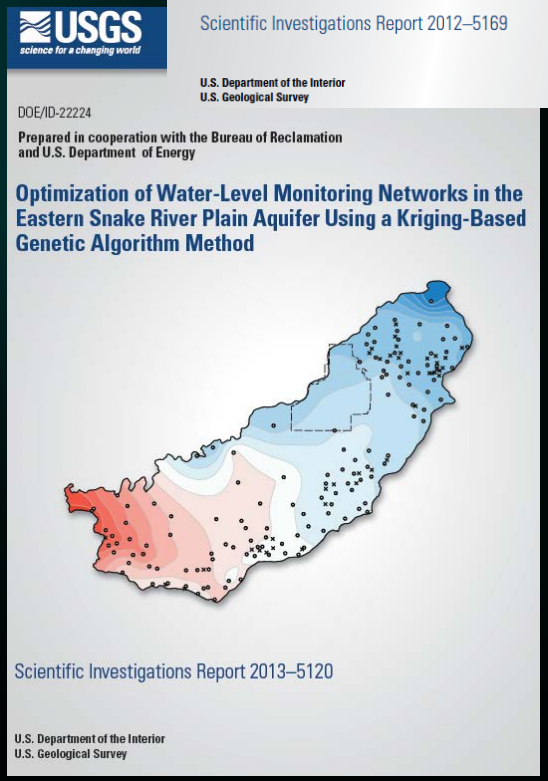
Where is the best place to monitor?

How many wells are needed to do the job?

Can it be shown that sites selected for long-term monitoring are reliable … can they be depended upon for early-warning?

Are model predictions of contaminant movement reliable and defensible?





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Any Questions?

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