White Mesa Uranium Mill And Wind River UMTRA

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Outline

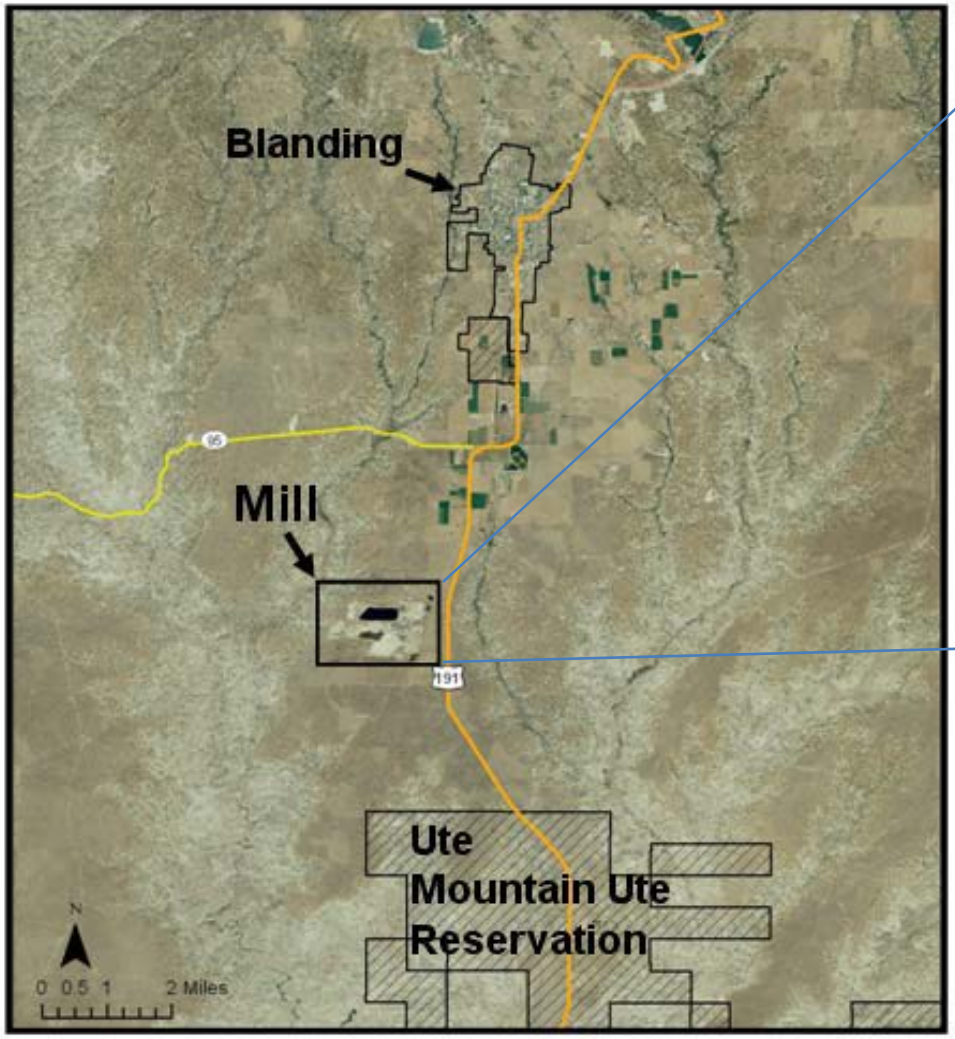
- USGS-EPA Tribal Water Quality Work
- White Mesa Uranium Mill
- Wind River Uranium Project

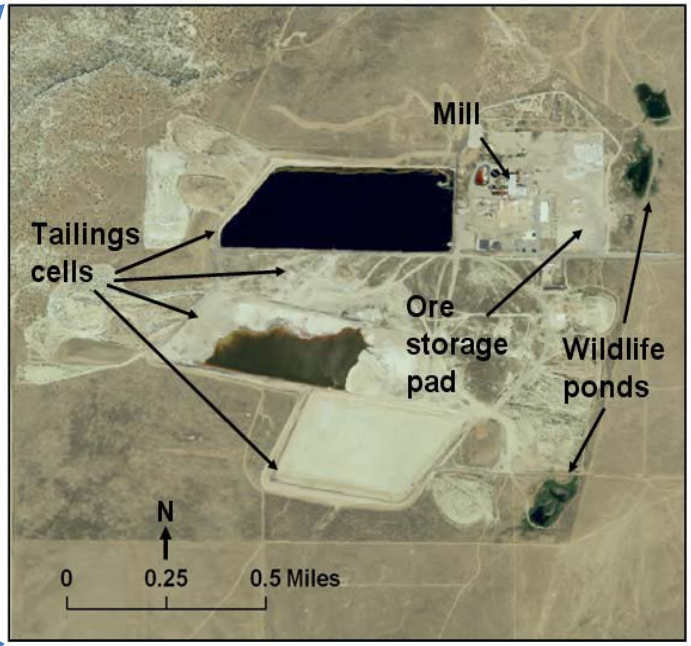
EPA-USGS-Tribal Cooperation

- Given 3-4 months per tribe to complete retrospective analysis
- One week visit to the reservation – meet with tribal environmental staff, tour reservation, meet with other state and federal agencies (BIA, IHS, USGS, BOR, NRCS, State Health Departments)
- Invite tribal staff to Denver in fall/winter to work with them one-on-one

EPA-USGS-Tribal Cooperation

- Uranium Study – White Mesa – Completed
- Uranium Study – Wind River Reservation – Ongoing
- Effects of Oil and Gas Drilling on Water Quality – Fort Berthold Reservation - Ongoing


Blanding
Mill
Ute
Mountain Ute
Reservation
N
0 0.5 1 2 Miles

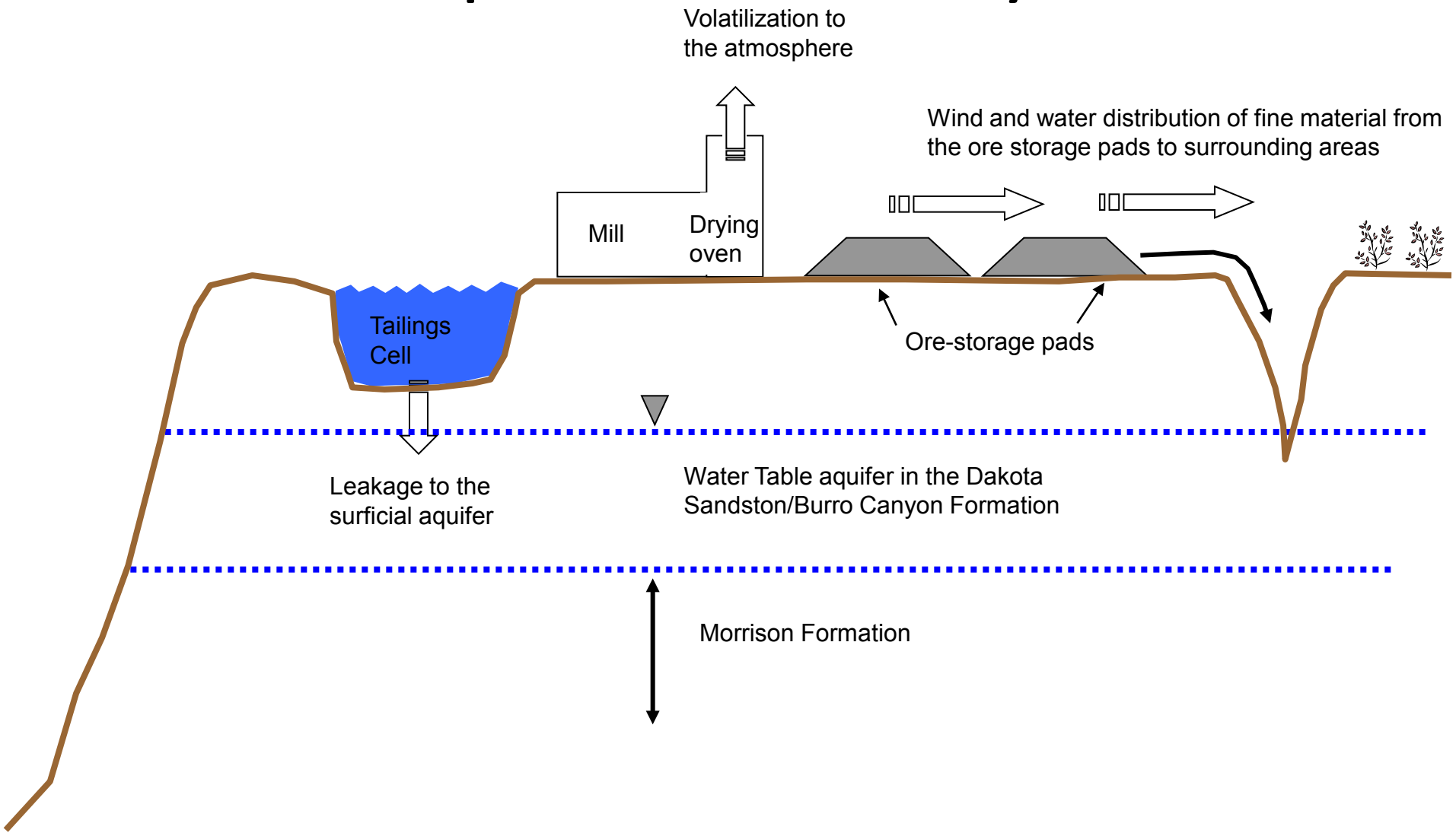

Mill
Tailings
cells
Ore
storage
pad
Wildlife
ponds
N
0 0.25 0.5 Miles


Utah

Mill History

- Began operations in 1980
- As of September 2007 the Mill has recovered 29 million pounds of U_3O_8 and 33 million pounds of V_2O_5 processed from 3.8 million tons of ore
- Greater than 1.6 million pounds of U_3O_8 recovered from alternate feed materials

Exposure Pathways



Sample Design

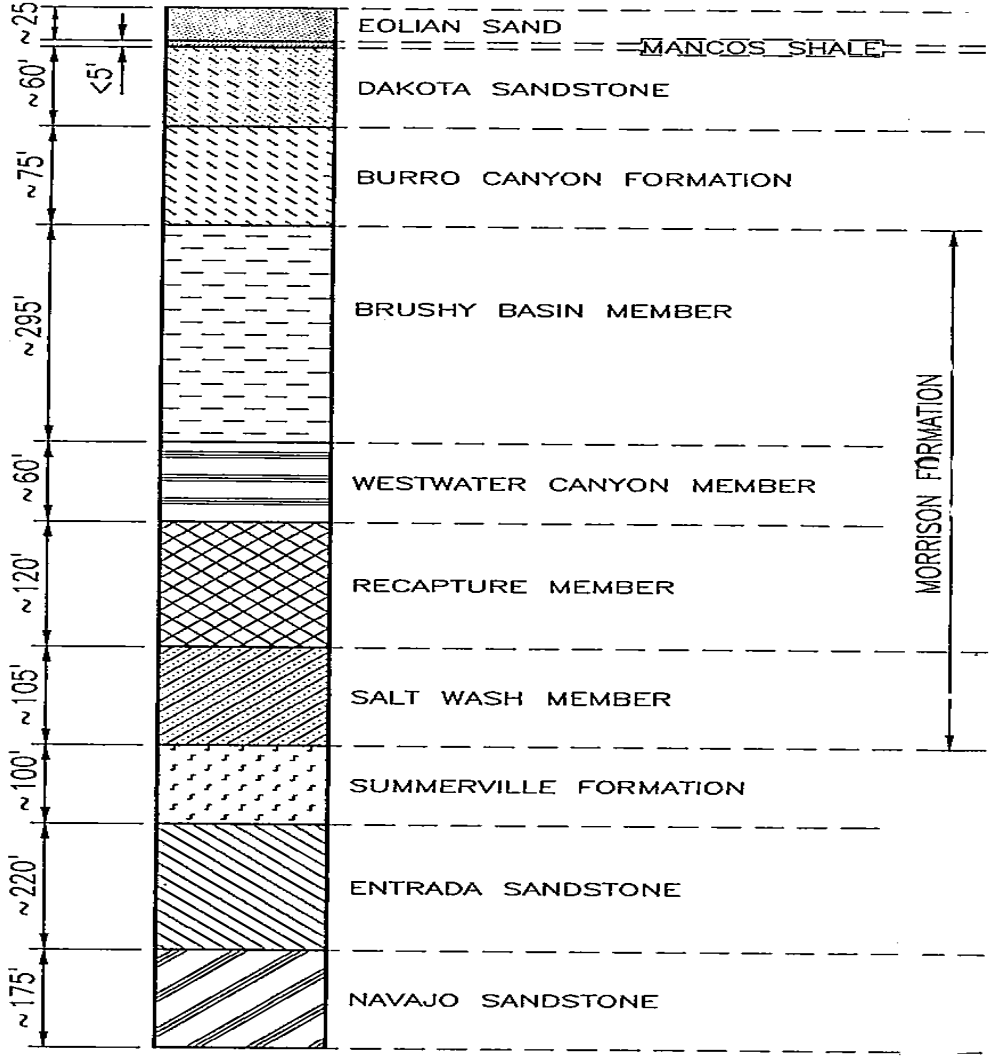
- Quarterly monitoring of wells and springs upgradient and downgradient of the Mill for field parameters, major ions, and total and dissolved metals
- Periodic sampling of springs and wells for uranium isotopes

Sample Design

- Soil survey with portable gamma radiation detectors
- Collection of stream sediment samples for analysis of metals from about 30 locations in the ephemeral stream channels draining the White Mesa
- Collection of sagebrush samples

DRAWING NUMBER 4111-A3

APPROXIMATE THICKNESS



NOTE:
1. THIS DRAWING IS NOT TO SCALE.
2. ALL THICKNESSES ARE APPROXIMATE.

REFERENCE:
DAMES & MOORE 1978

STRATIGRAPHY OF WHITE MESA
PREPARED FOR
ENERGY FUELS NUCLEAR
DENVER, COLORADO

No.	DATE	ISSUE / REVISION	DWN. BY	CK'D BY	AP'D BY
1		ISSUED FOR DRAFT SUBMITTAL	T.M.G.		

TITAN Environmental

DATE: 7-19-94
SCALE: N.T.S.

FIGURE 1.2

DRAWING NUMBER 4111-A3

White Mesa Hydrology

- Springs in the Burro Canyon are used by tribal members; groundwater flow is from the Mill south toward the reservation.
- The Brushy Basin Member and the Summerville Formation act as aquitards that prevent the mixing of groundwater with the formations above and below them (Freethey and Cordy, 1991).

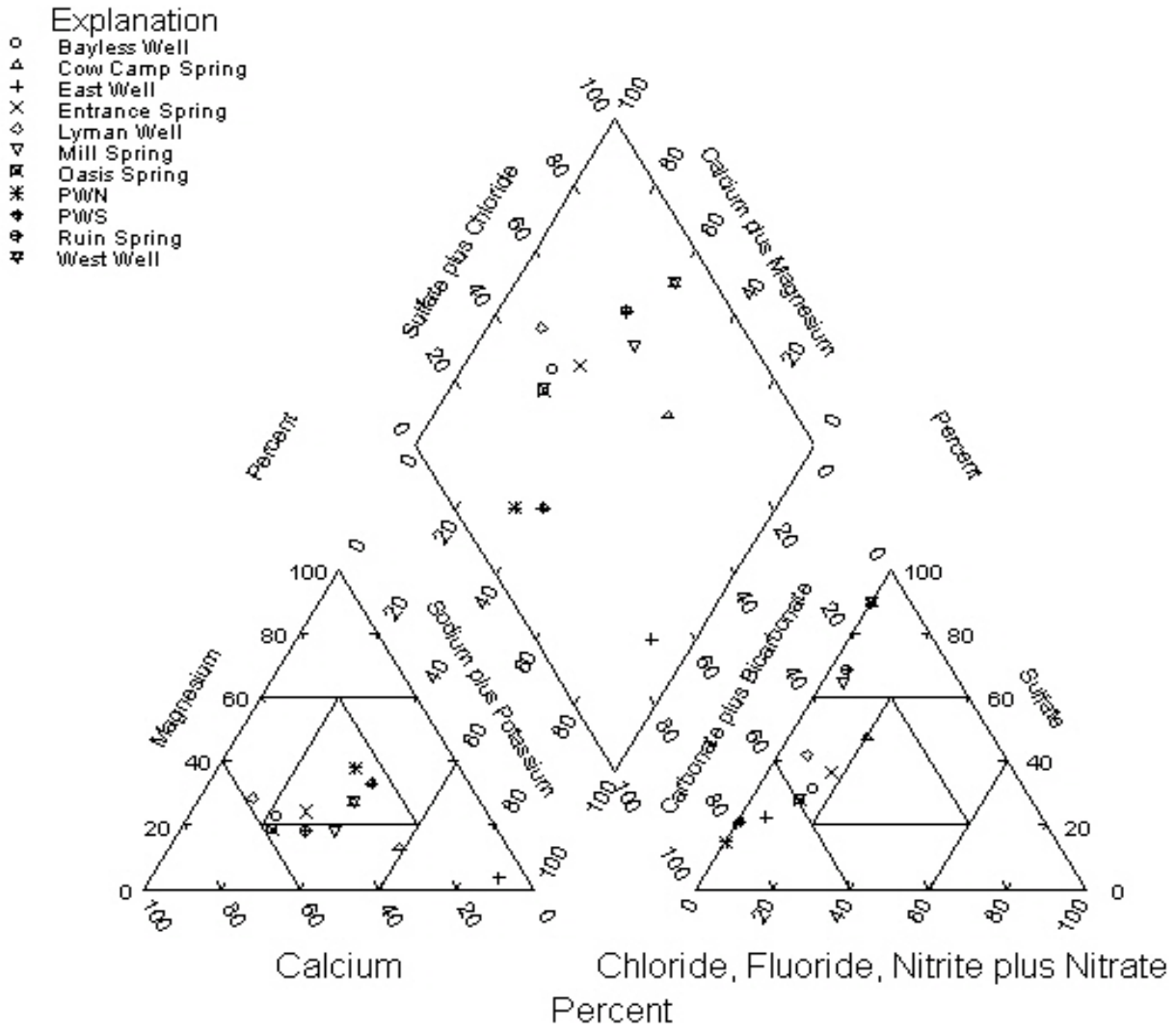
White Mesa Hydrology

- The Westwater Canyon, Recapture, and Salt Wash Members of the Morrison Formation are considered an aquifer by Freethey and Cordy (1991) but it is not used by tribal members.
- The Navajo Sandstone provides drinking water to the towns of White Mesa, Blanding, Bluff, and Montezuma Creek.

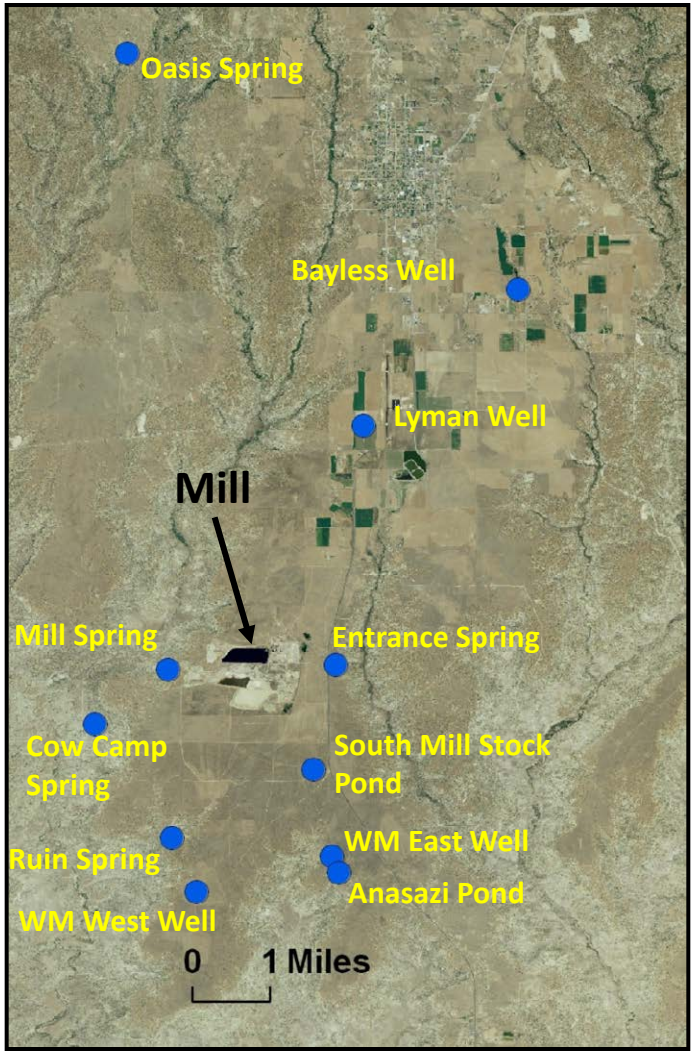
White Mesa Geochemistry

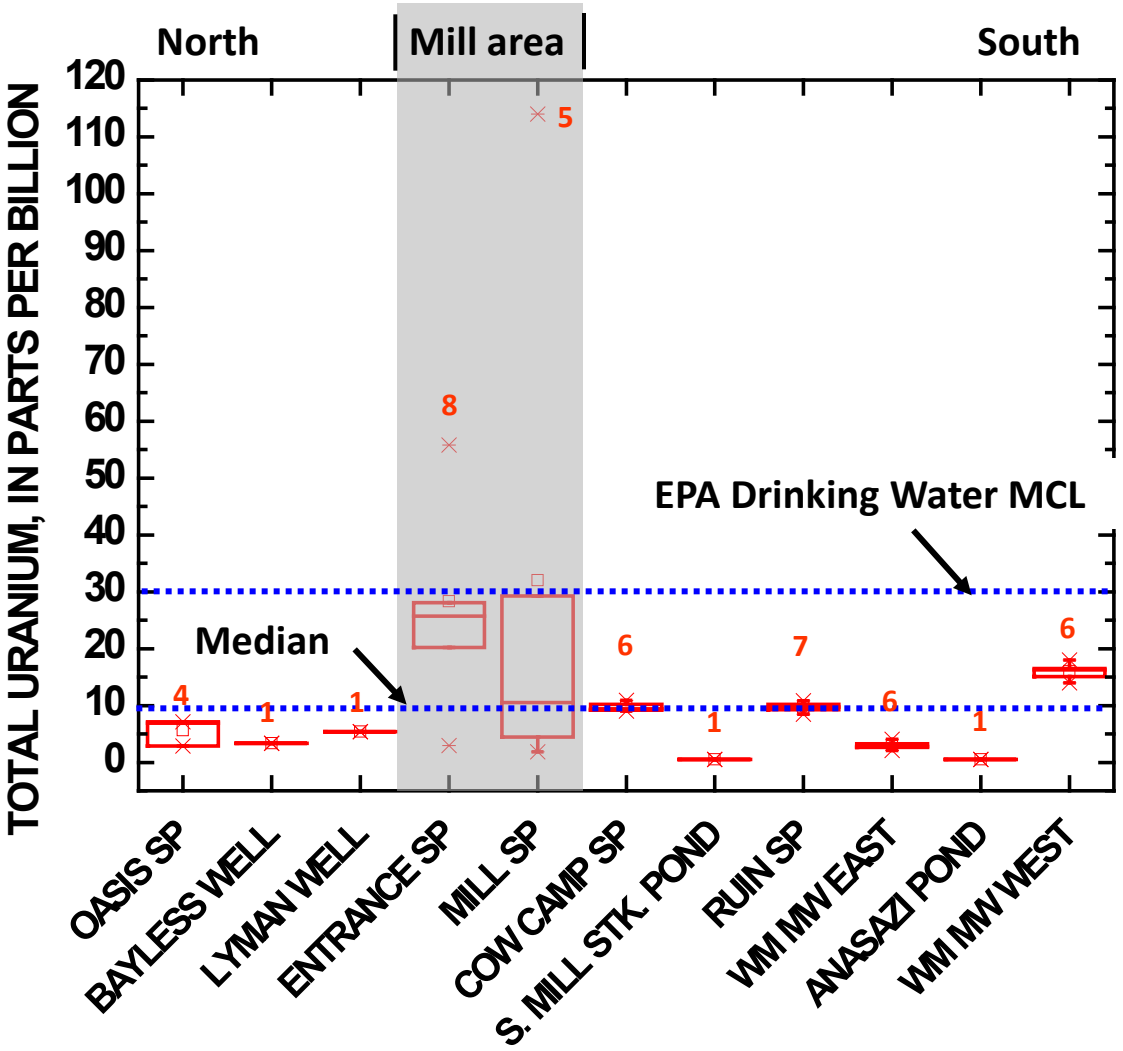
- Have measured some variability in the concentration of major ions and uranium among our sampling sites
- Despite variability in major ion composition, uranium is expected to be mobile in White Mesa groundwater
- Would expect low concentrations in groundwater (Johnson and Thordarson, 1966) .

Average Major Ion Composition

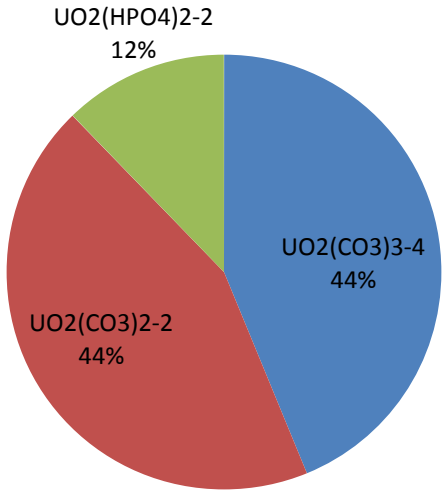


Uranium Distribution in Water

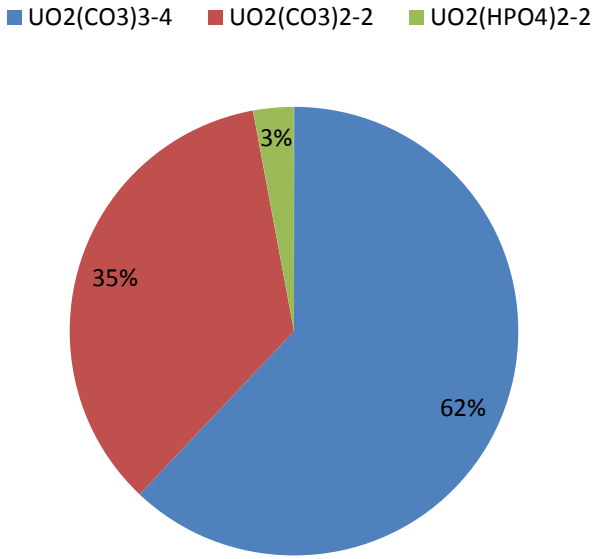




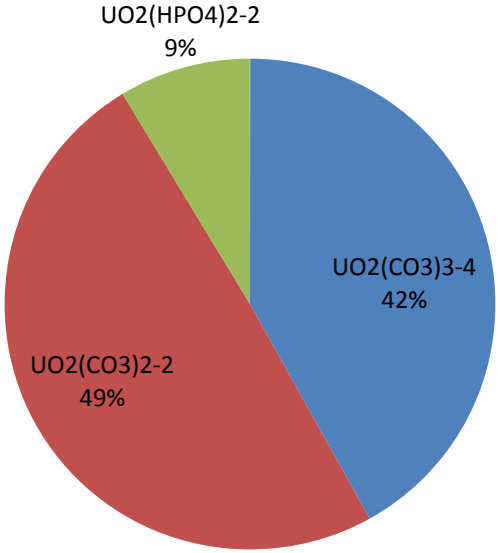
Cow Camp Spring - September 2008



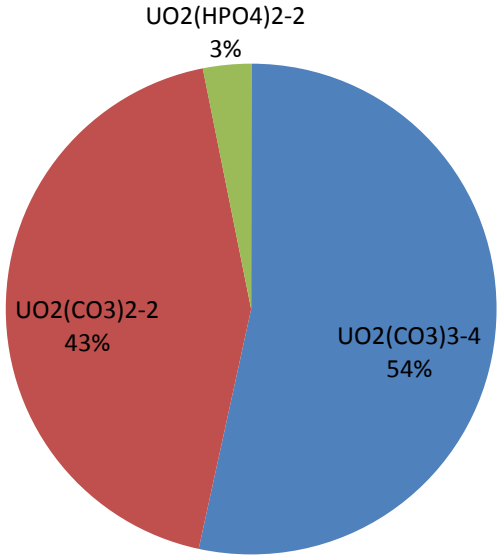
Entrance Spring - September 2008



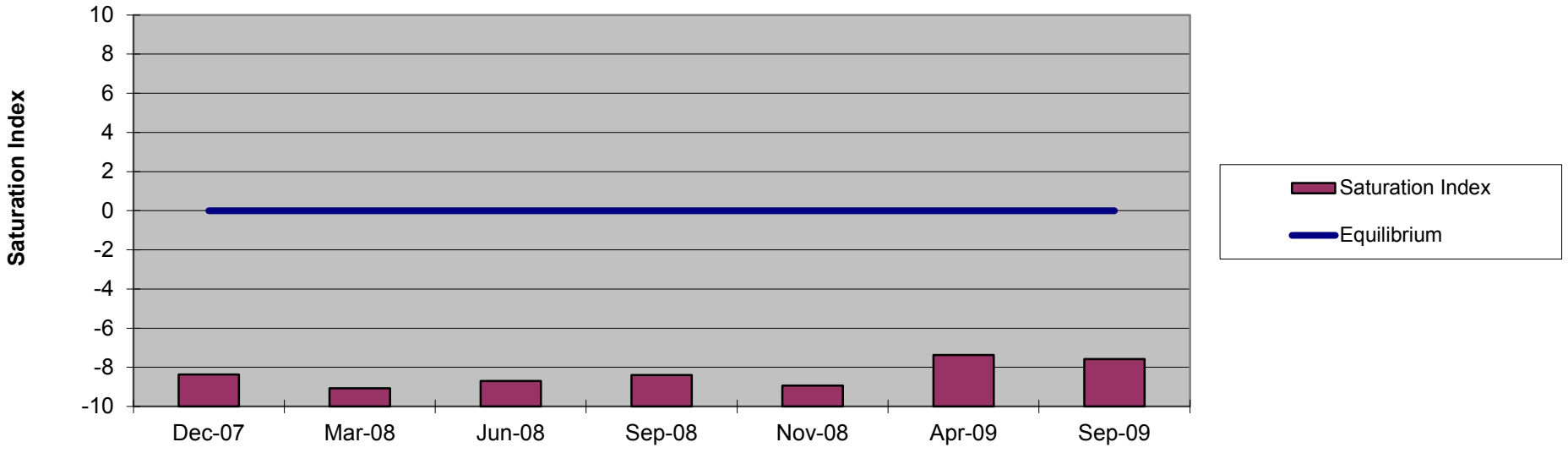
Ruin Spring - September 2008



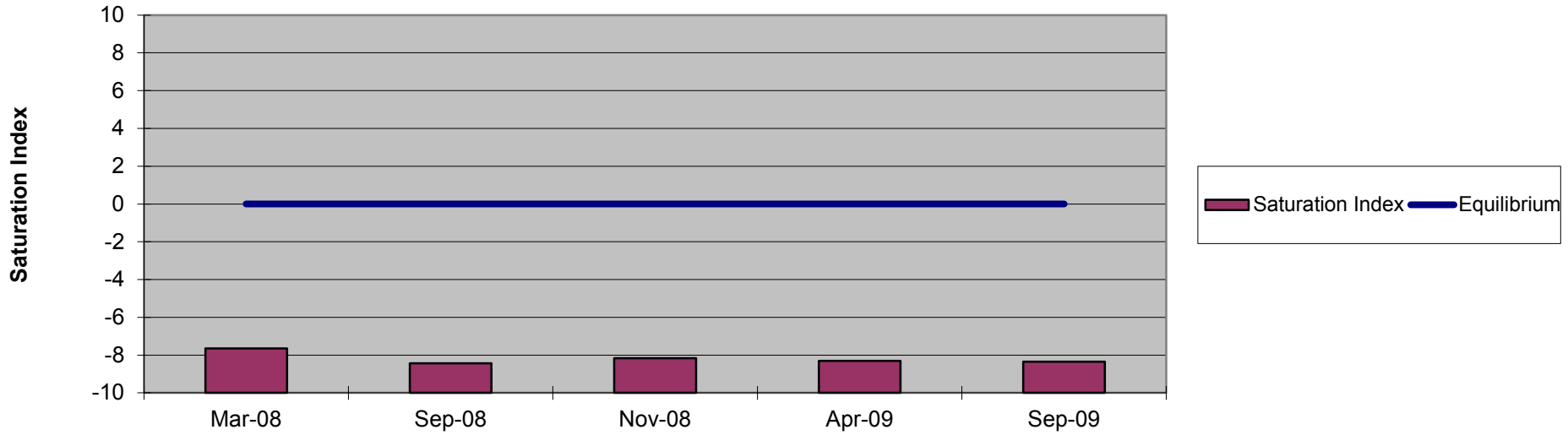
East Monitoring Well - September 2008



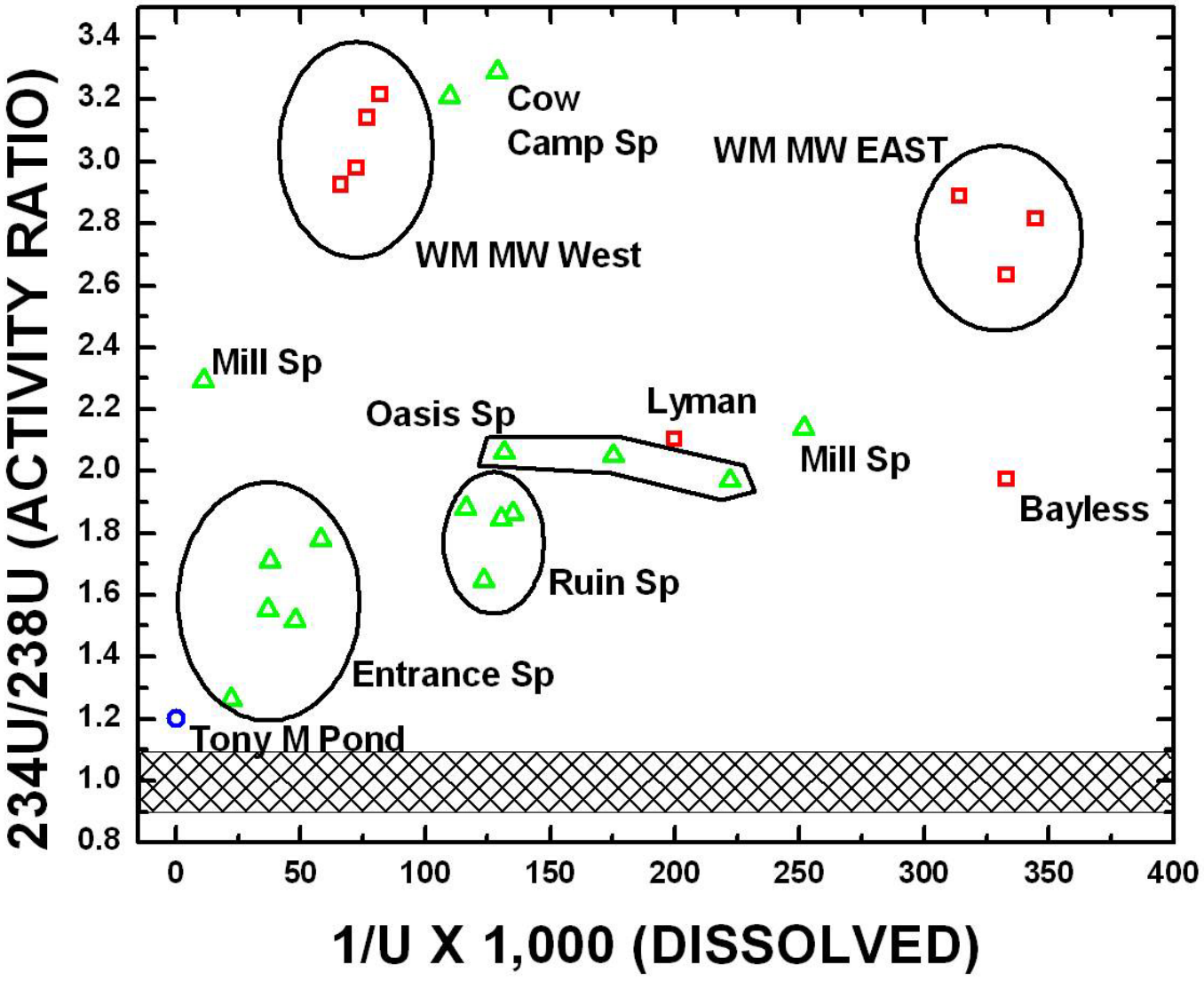
Coffinite Saturation Indices at Entrance Spring



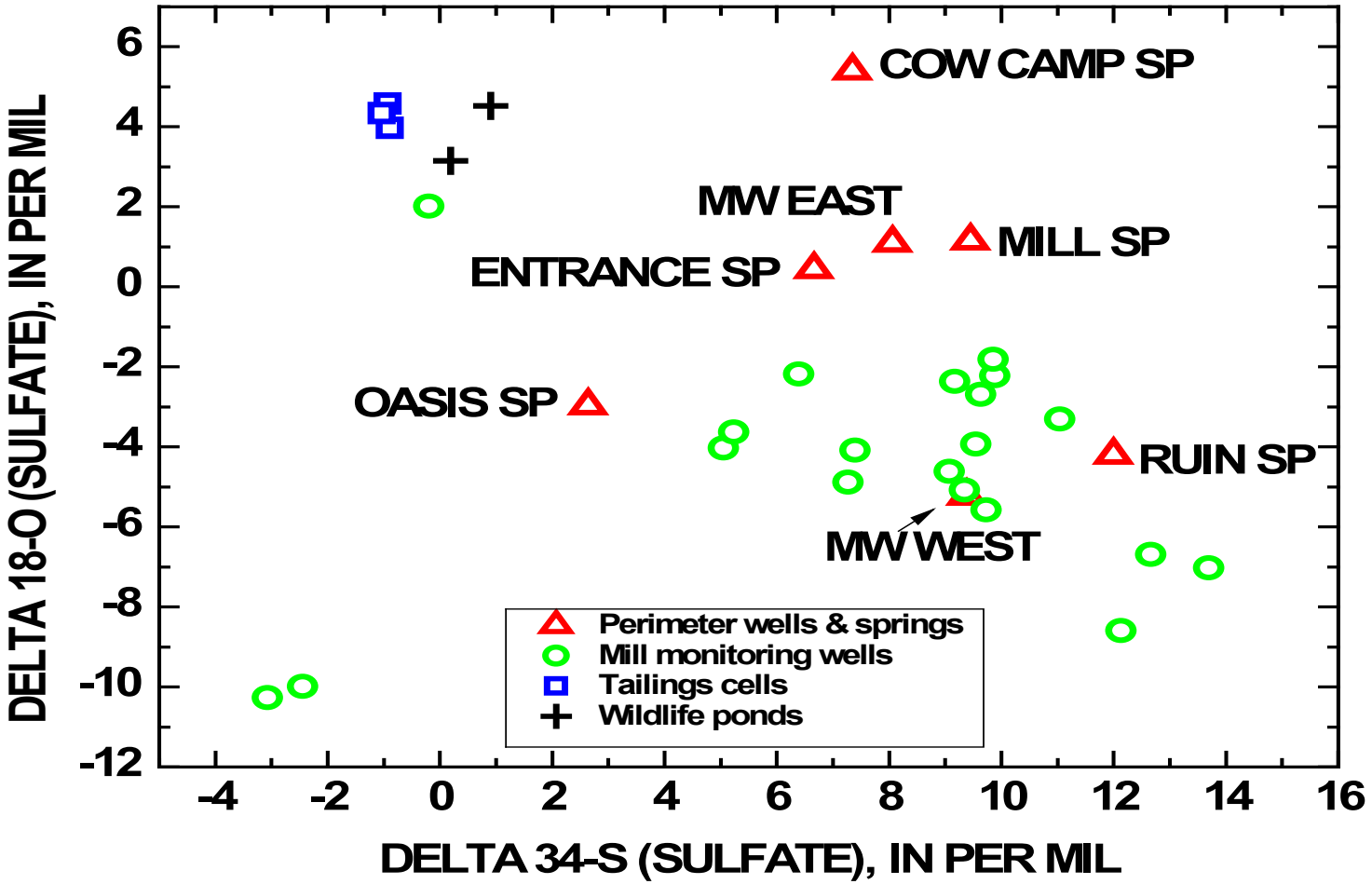
Uraninite Saturation Indices at Entrance Spring



Uranium Isotopes



S & O ISOTOPES IN SULFATE



White Mesa Soils

- Measurements with portable gamma detectors along Highway 191 for 2 miles south of the Mill recorded levels of <3 pCi/g Ra-226 – equivalent to background levels for the area.
- However, we measured levels up to 50 pCi/g Ra-226 near Entrance Seep on the east side of Highway 191 opposite the entrance road to the Mill and the area around Entrance Seep.

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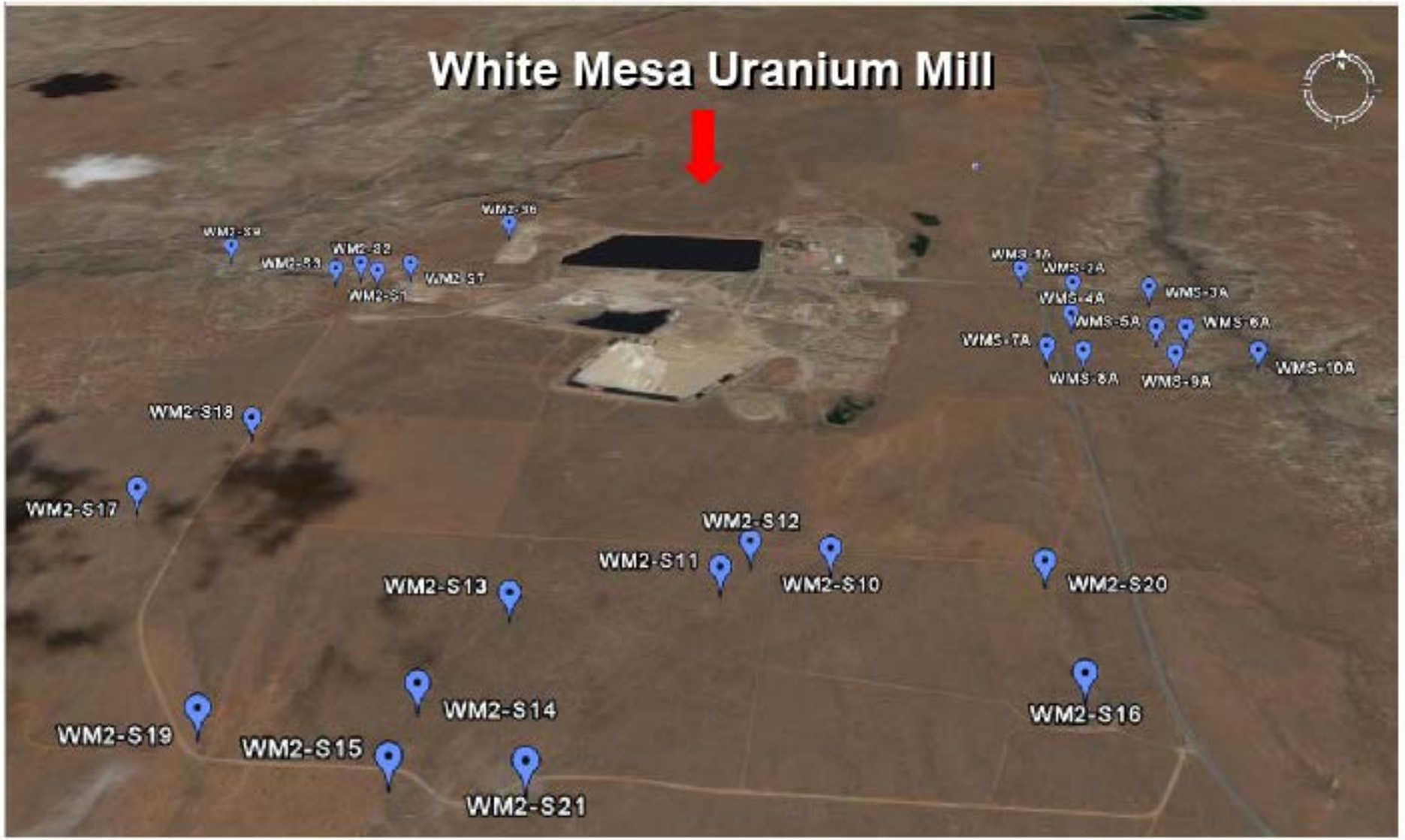
Sediment Sample Sites



White Mesa Study Team

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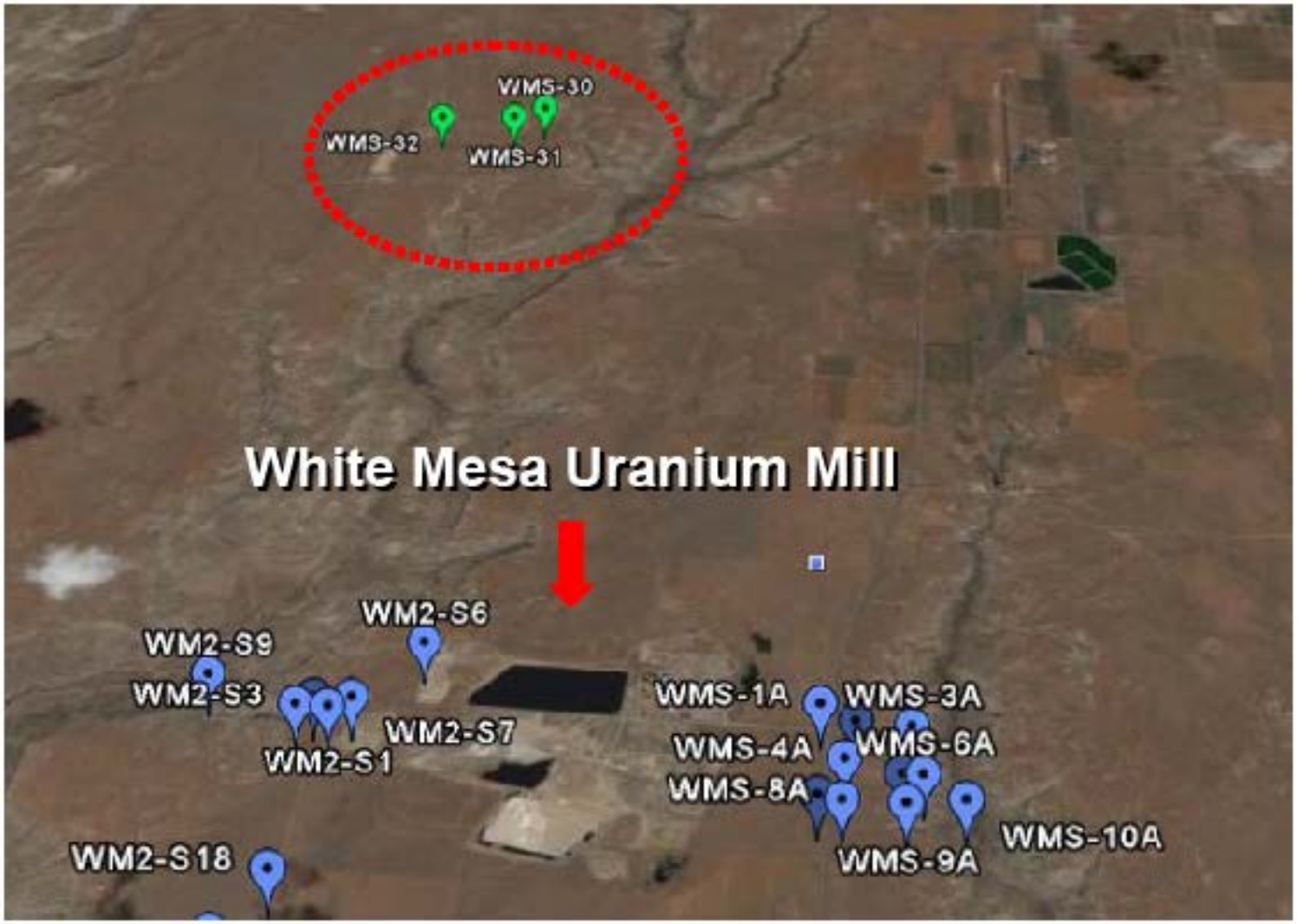
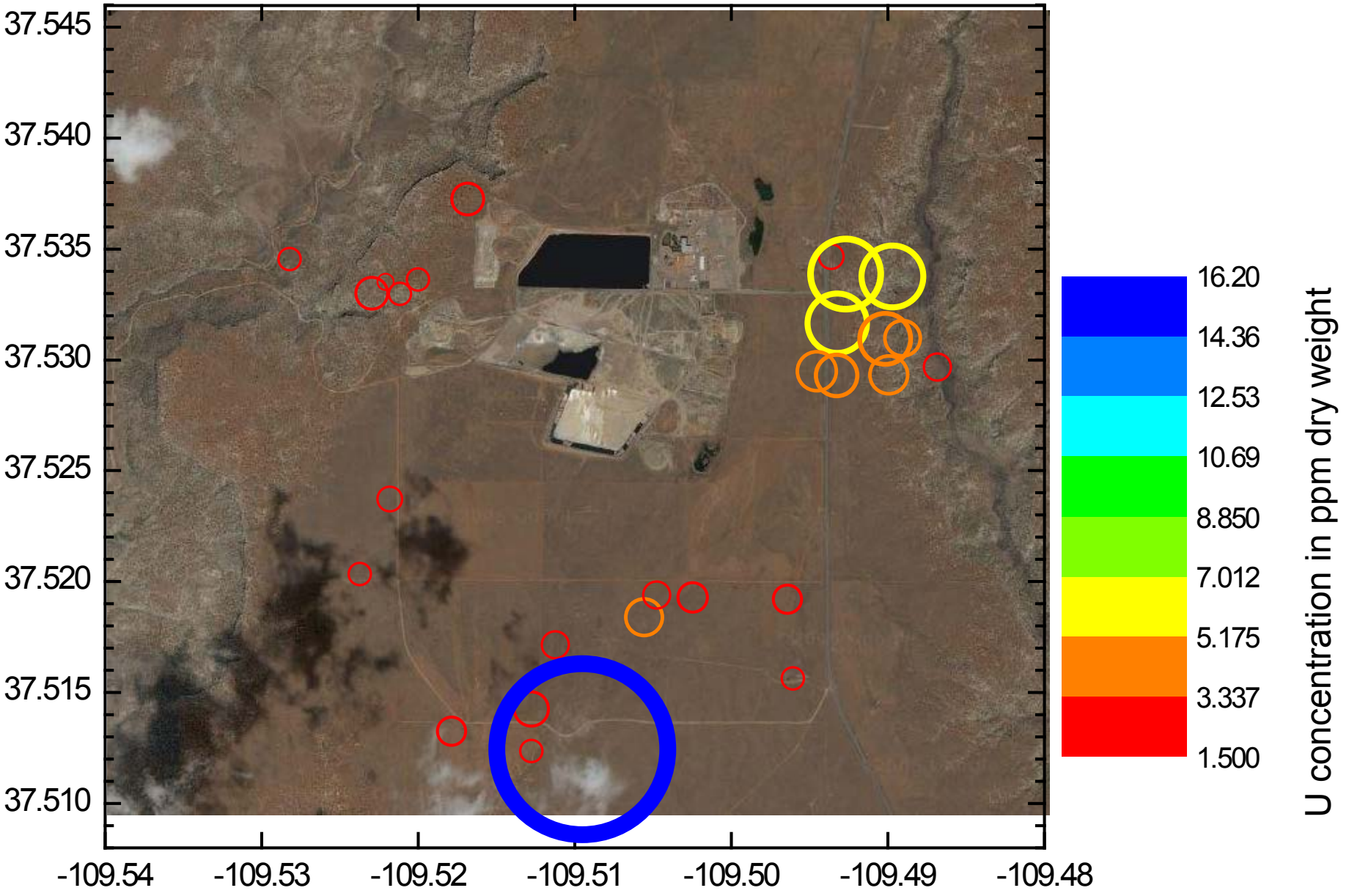
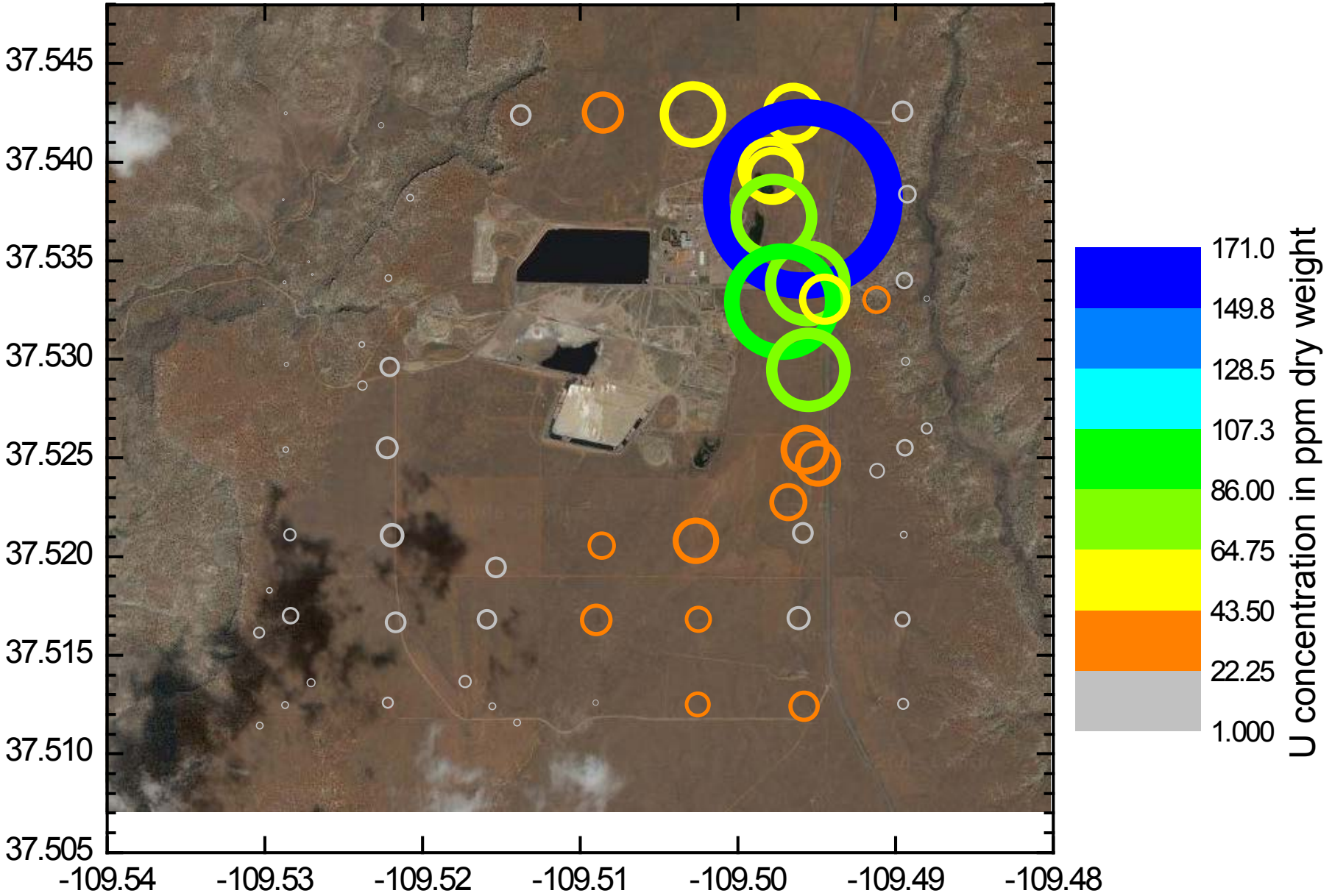
Background Sites



Uranium Concentration in Sediments



Uranium concentration in Big Sagebrush



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Potential Ore Migration Sites

Conclusions

- Uranium introduced into the groundwater in the Dakota Sandstone/Burro Canyon Aquifer would be mobile
- $^{234}U/^{238}U$ values indicate a natural source of uranium in the groundwater at all sampling sites with the possible exception of Entrance Seep
- At Entrance Seep there is a decrease in the values of $^{234}U/^{238}U$ with an increase in concentration of dissolved uranium

Conclusions

- S and O isotopes of sulfate – no tailing cell influence on Entrance Seep
- All these facts suggest that small sized particles are being blown off the ore storage pads and are dissolving in Entrance Seep
- Spatial patterns of uranium concentration in sediment and vegetation samples support this hypothesis

Lessons Learned

- Use of uranium concentration data only is not sufficient for identifying source(s) (background and/or offsite migration) of uranium in groundwater
- Localized nature of uranium deposits and natural processes (evaporation) can result in large spatial variations in the concentration of uranium in groundwater

Lessons Learned

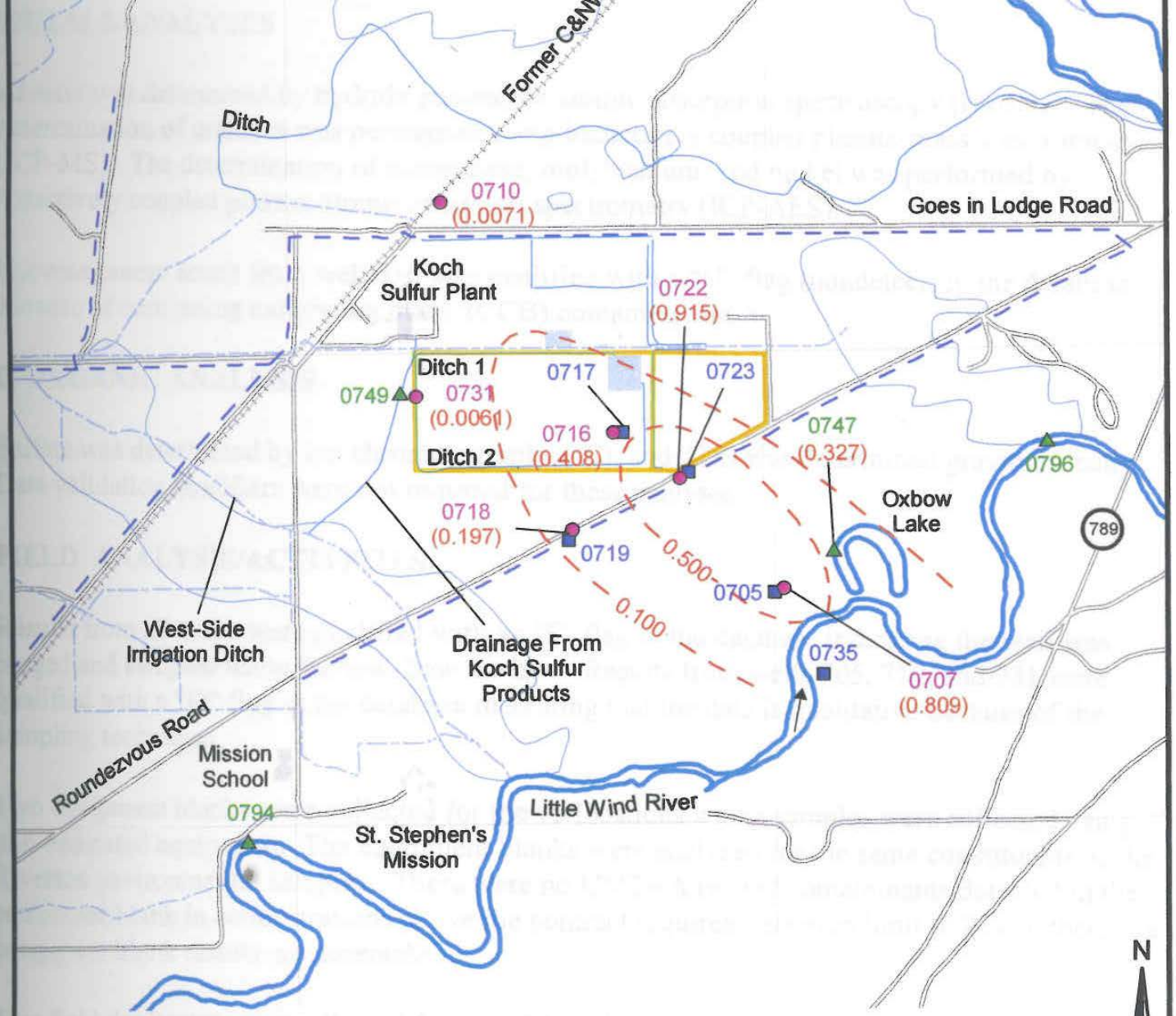
- $^{234}U/^{238}U$ alpha activity ratios - useful in distinguishing sources of uranium (ore vs. natural weathering)
- $\delta^{34}S$ and $\delta^{18}O$ in sulfate - sulfuric acid in tailing cells has distinctive isotopic signature relative to sulfate in groundwater

Lessons Learned

- Uranium concentration data in soils and vegetation can confirm that spatial variations in uranium concentration in groundwater is due to off-site migration
- $^{235}U/^{238}U$ and $^{236}U/^{238}U$ ratios can be useful in monitoring other types of facilities (Ketterer and others, 2000; and Ketterer and others, 2003)

Wind River Reservation

- Began a project similar to the White Mesa Project but bigger in scope in 2011
- Groundwater contaminated with uranium and other metals headed toward the Little Wind River
- WREQC has asked for verification of DOE's assessment of the situation


Former C&NW
Ditch
0710
(0.0071)
Goes in Lodge Road
Koch
Sulfur Plant
0722
(0.915)
Ditch 1
0717
0723
0749
0731
(0.006)
0716
(0.408)
Ditch 2
0747
(0.327)
0796
Oxbow
Lake
789
0718
(0.197)
0719
0.500
0.100
0705
West-Side
Irrigation Ditch
Drainage From
Koch Sulfur
Products
0735
0707
(0.809)
Roundezvous Road
Mission
School
0794
Little Wind River
St. Stephen's
Mission
N
Surface Sample Location (sediment, vegetation, or surface water)
Surficial Aquifer Sample Location
Semiconfined Aquifer Sample Location
(0.533) Uranium Concentrations (mg/L) from May 2002
Contours of Uranium Concentration (mg/L)
Alternate Water Supply Line
Road
2000
0
2000 Feet
Stoller–GJO
U.S. DEPARTMENT OF ENERGY
GRAND JUNCTION OFFICE, COLORADO

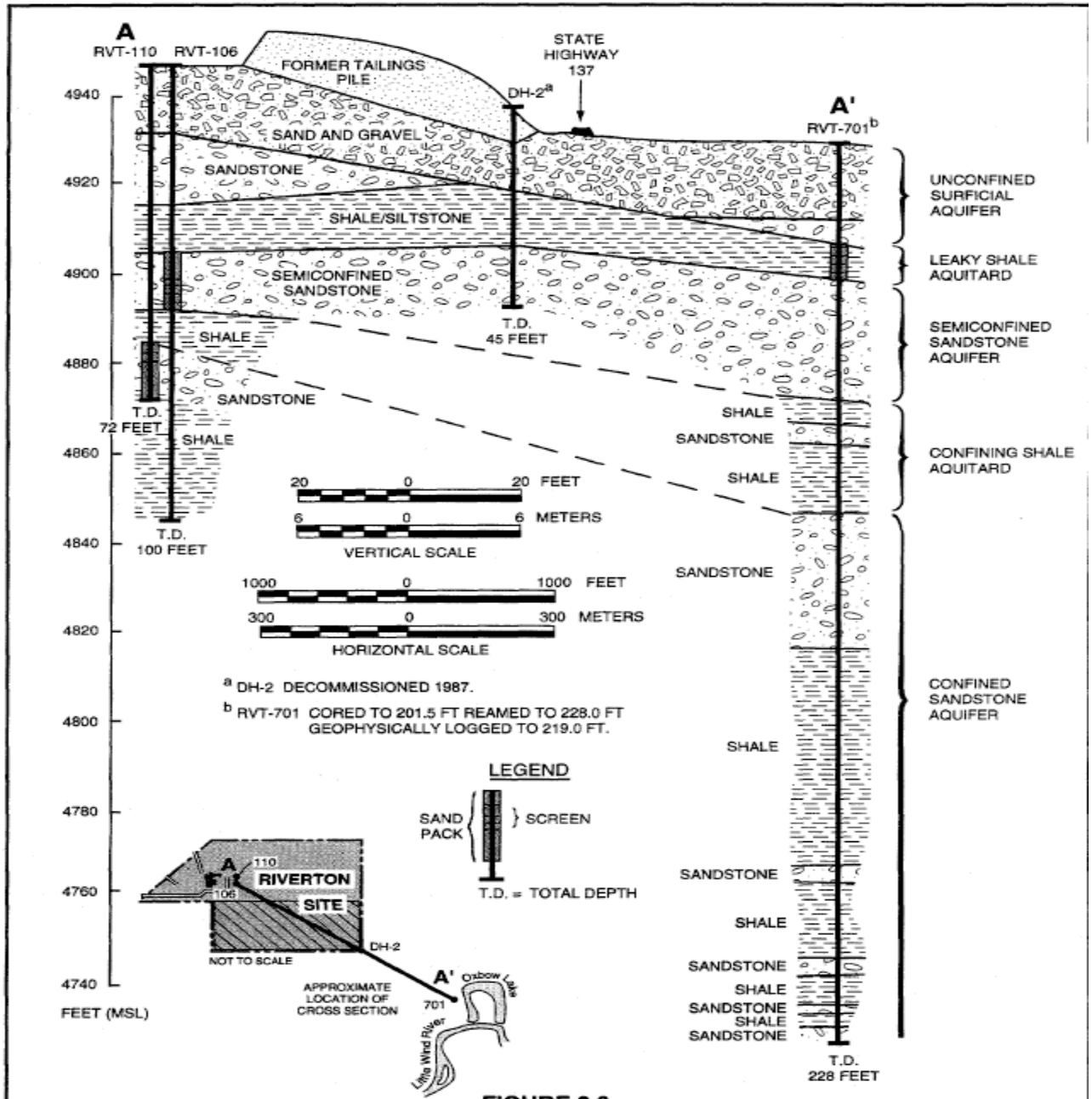
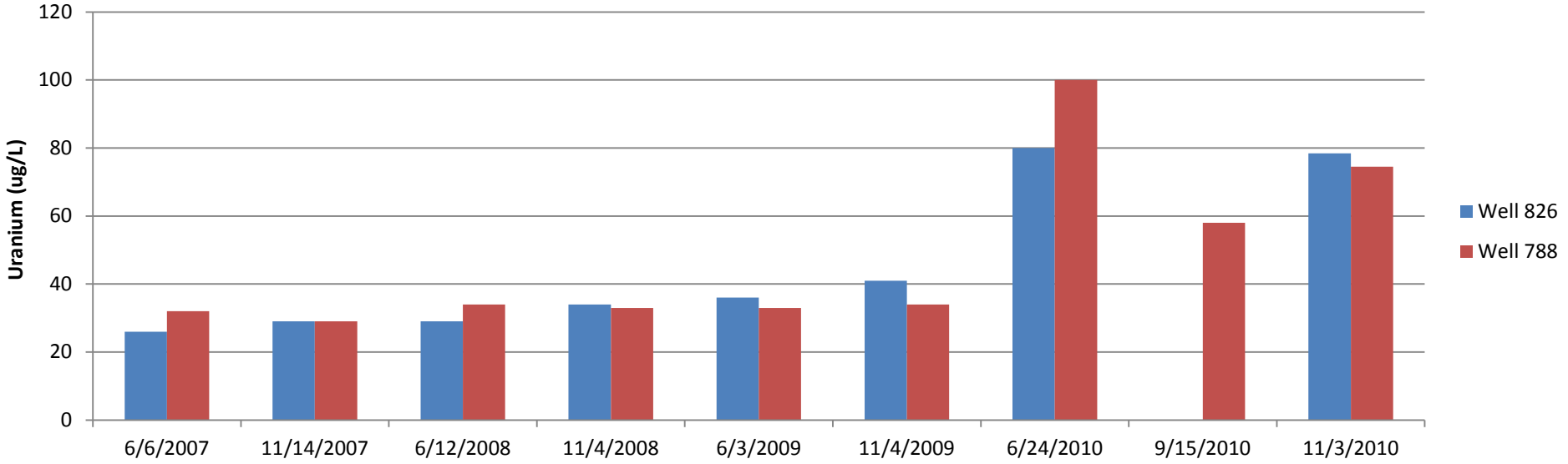
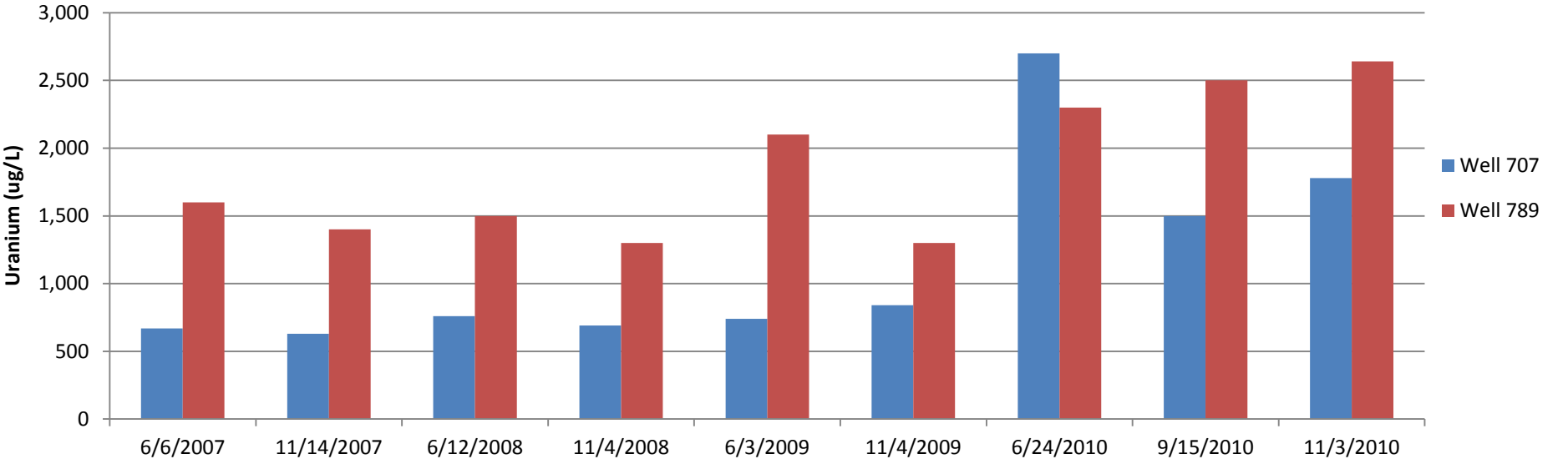


FIGURE 2.3
GEOLOGIC CROSS SECTION
RIVERTON, WYOMING, SITE

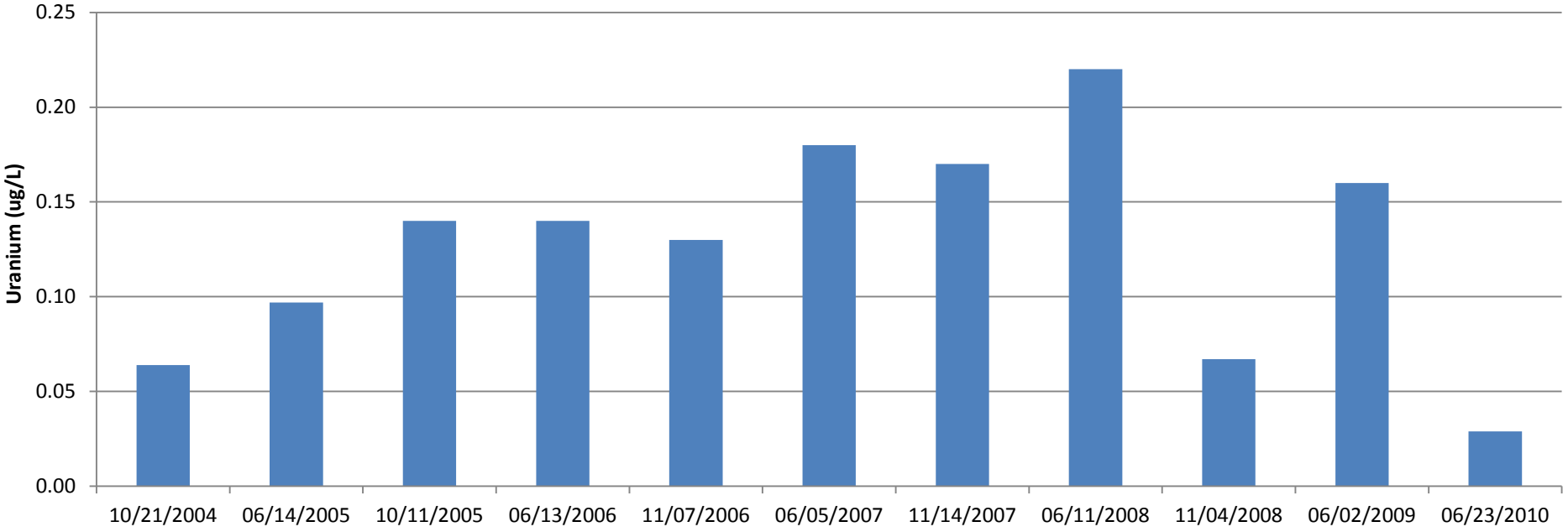
DOE Wells 826 and 788



DOE Wells 707 and 789



DOE Well 828


0.25
0.20
0.15
0.10
0.05
0.00
Uranium (ug/L)
10/21/2004
06/14/2005
10/11/2005
06/13/2006
11/07/2006
06/05/2007
11/14/2007
06/11/2008
11/04/2008
06/02/2009
06/23/2010

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- Travis Shakespeare and Dean Goggles - WREQC

White Mesa-Acknowledgements

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- Dave Parkhurst–USGS WRD-PHREEQC