Big Lost Aquifer System

Water Improvement and Solutions Team Meeting
December 10, 2014

Dennis Owsley, P.G. Technical Hydrogeologist
Idaho Department of Water Resources

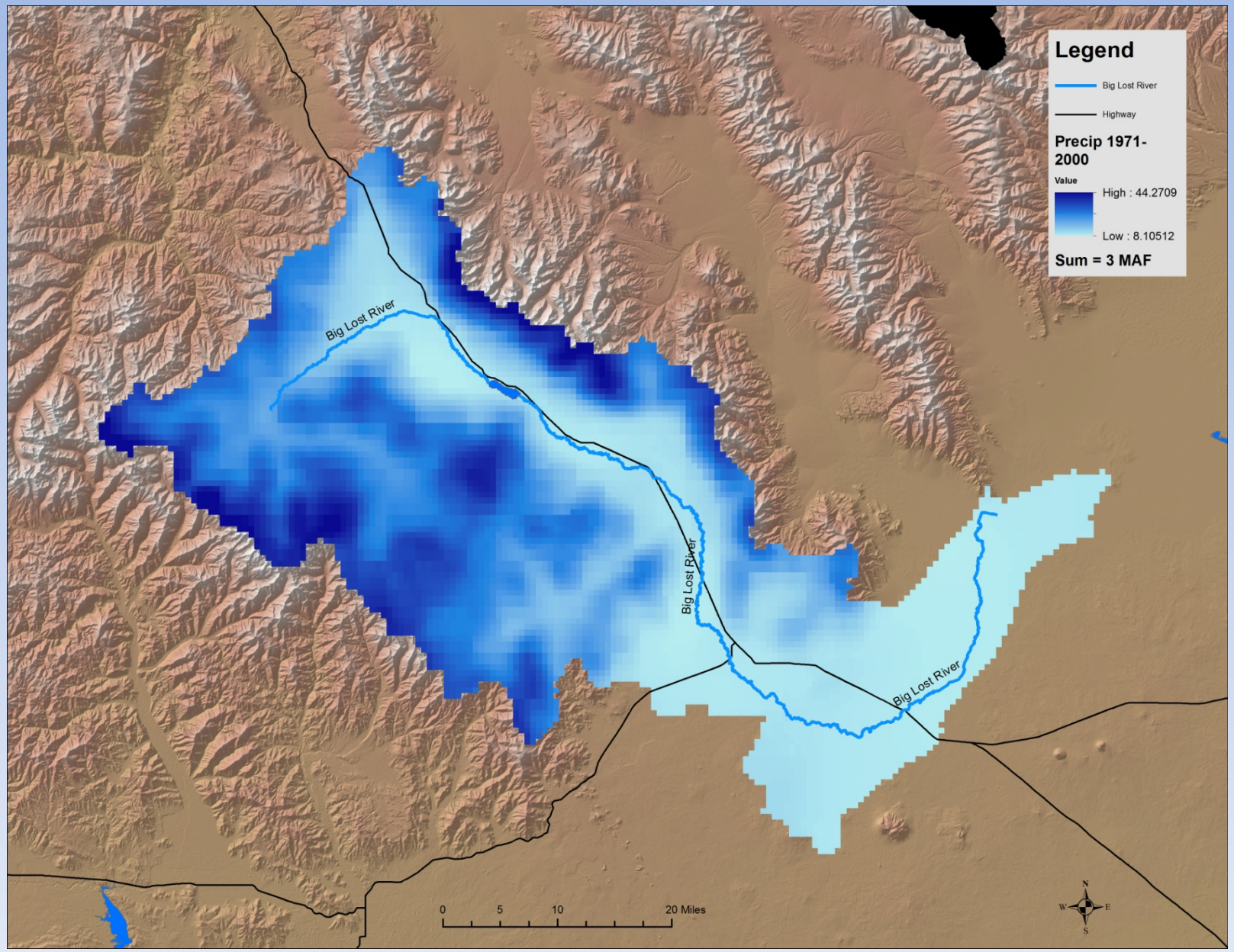
Overview

- Previous studies
- Climate
- Hydrology
- Geologic Setting
- Ground Water Conditions

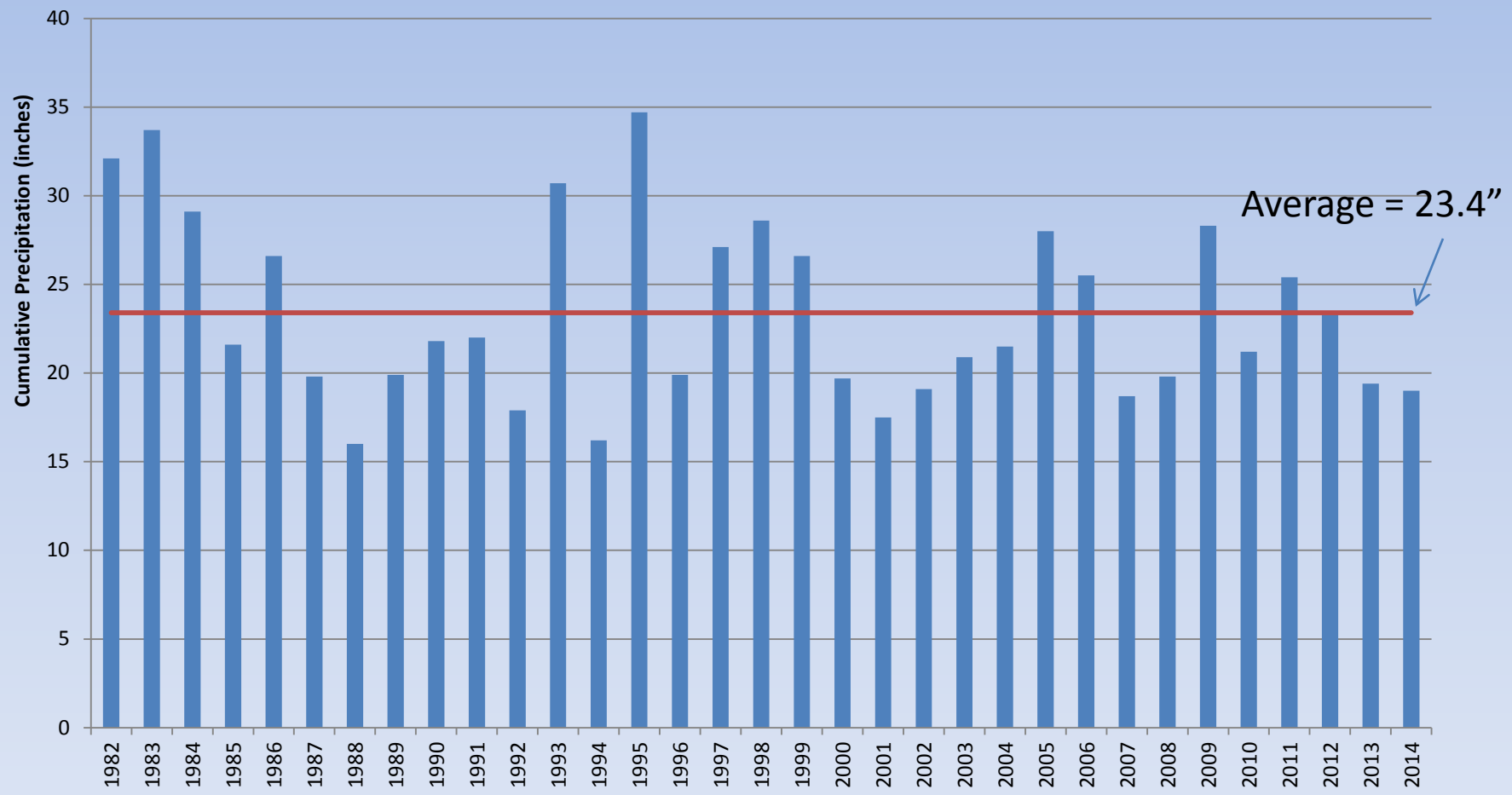
Previous Investigations

- 1938 – Stearns, Crandall, and Steward. Geology and ground-water resources of the Snake River Plain in southeastern Idaho
- 1970 – Crosthwaite, Thomas, and Dryer. Water Resources in the Big Lost River Basin
- 1982 – Szczepanowski. Review of Ground-Water Conditions in the Big Lost River Valley
- 1989 -- Baker. Possibility of a Transition Zone near the Mouth of the Big Lost River Valley
- 1991 – Baker. Comparative analysis of surface water / ground water relationships in the Big Lost River Basin
- 1991 – Johnson, Ralston, and Mink. Ground-Water Pumping Impacts on Surface Water Irrigation Diversions from Big Lost River
- 2008 – Boyd. Big Lost River Darlington Sinks Geomorphology, Loss Rates and Conceptual Alternatives Development
- Recent – Consultant and IDWR technical reports related to water right applications/transfers.

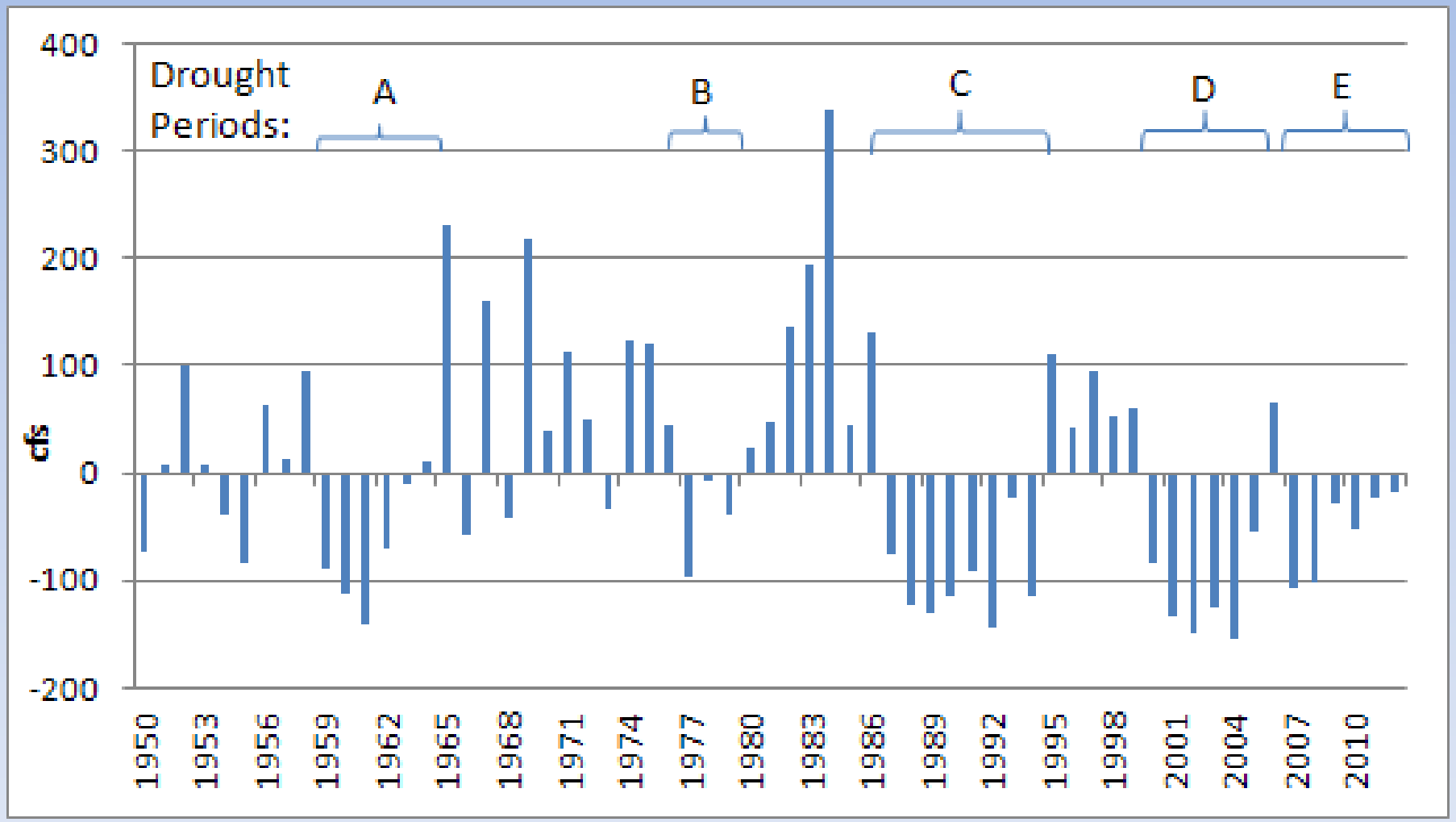
Climate


Legend
Big Lost River
Highway
Precip 1971-2000
Value
High : 44.2709
Low : 8.10512
Sum = 3 MAF
Big Lost River
Big Lost River
Big Lost River
0
5
10
20 Miles
N
W
E
S

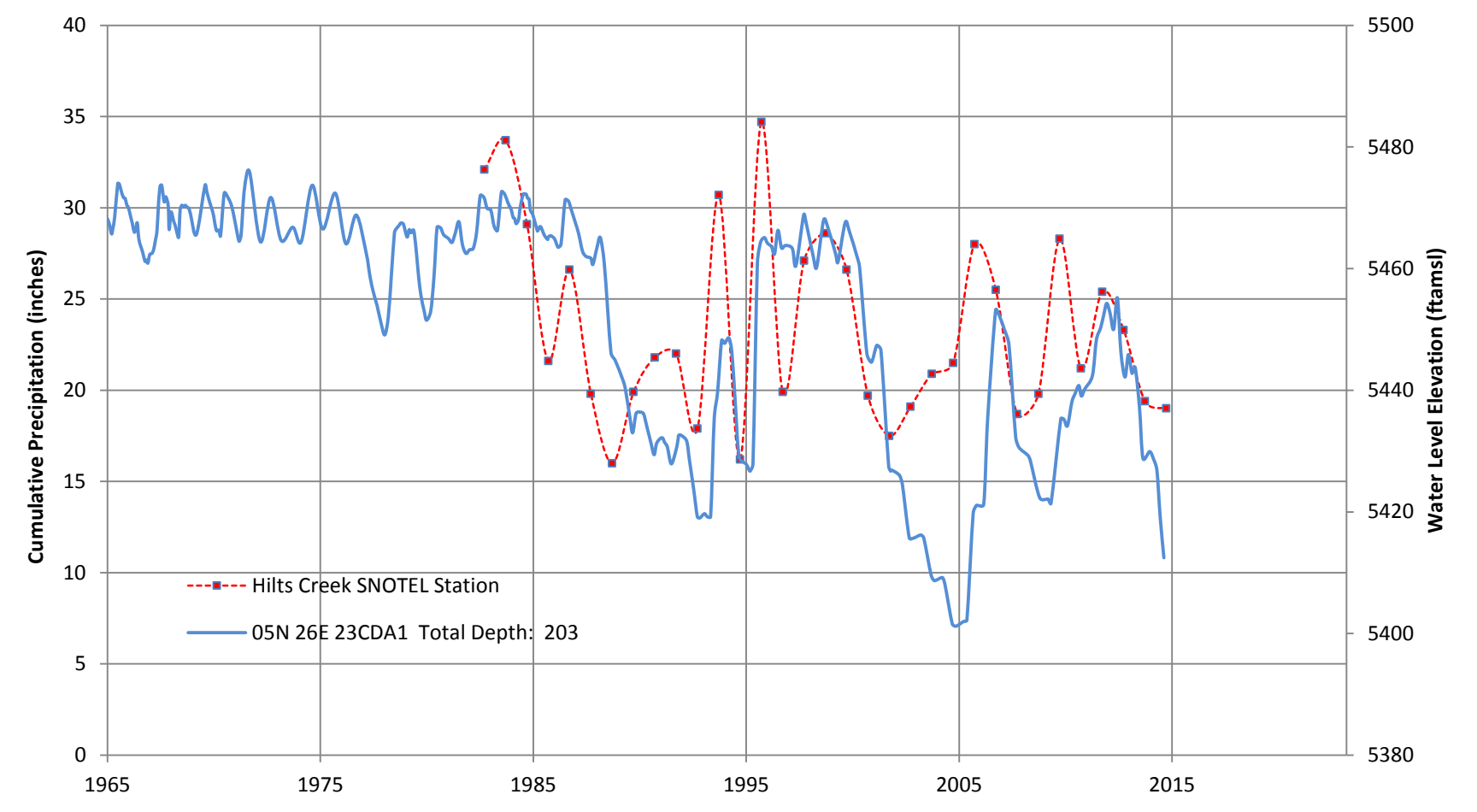
Precipitation – Hilts Creek SNOTEL



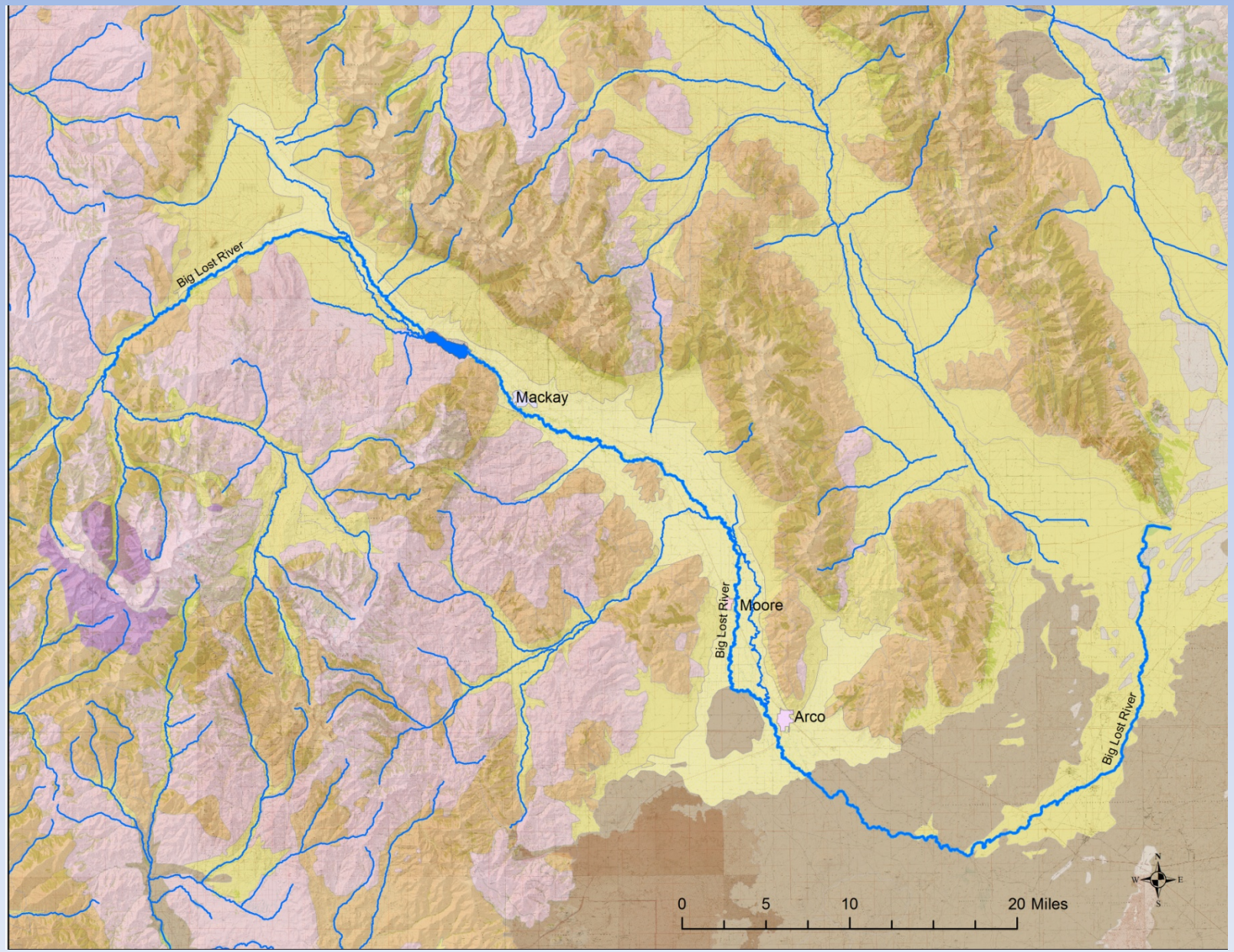
Mackay Outflows – Departure from Average



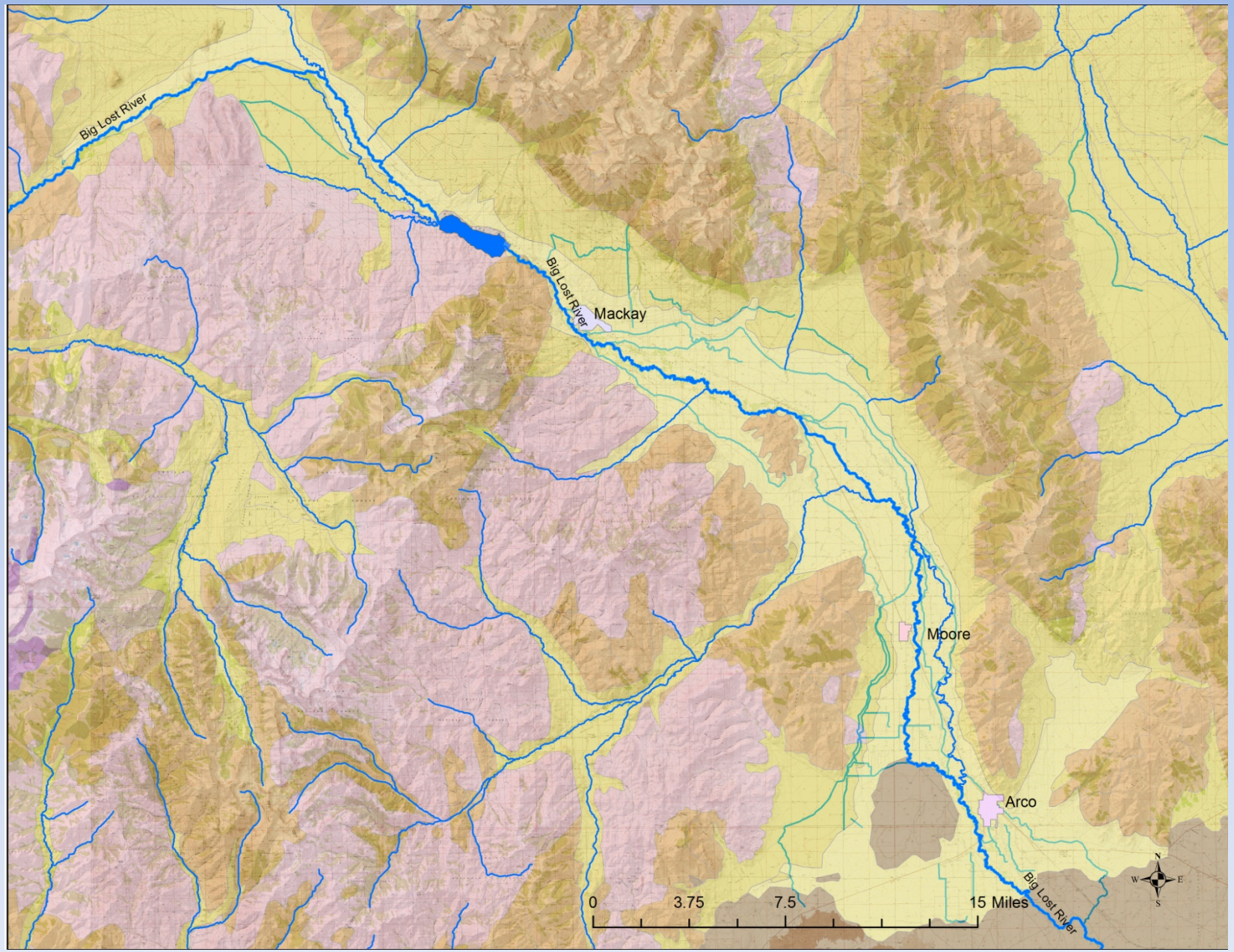
Precipitation vs. Water Level



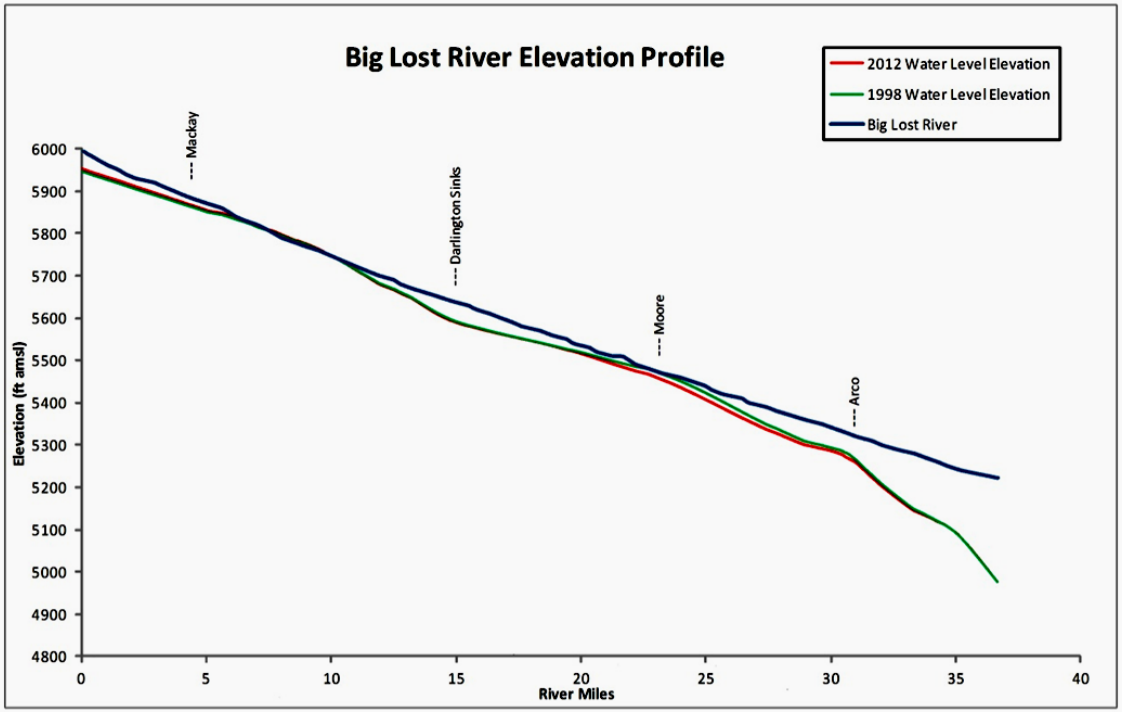
Surface Water Hydrology

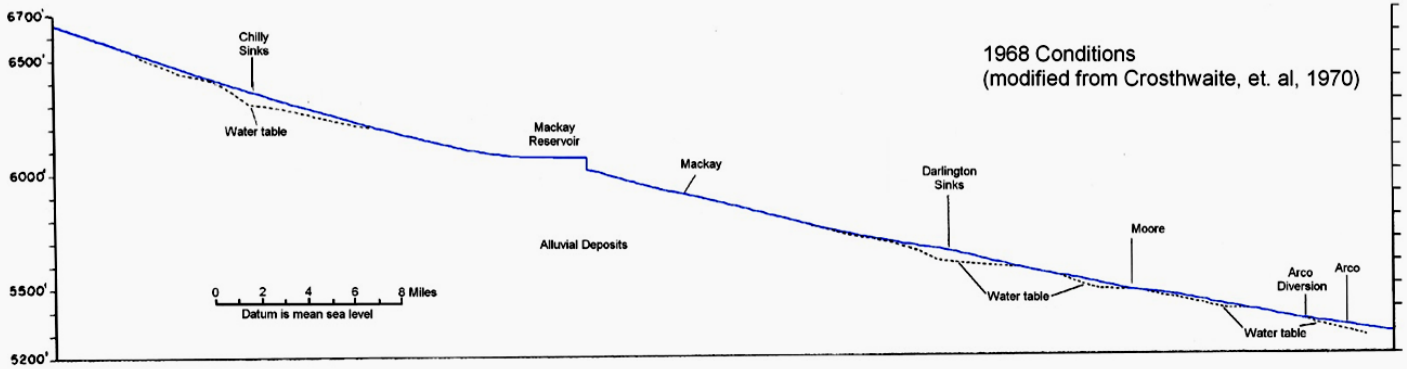


Irrigation Distribution

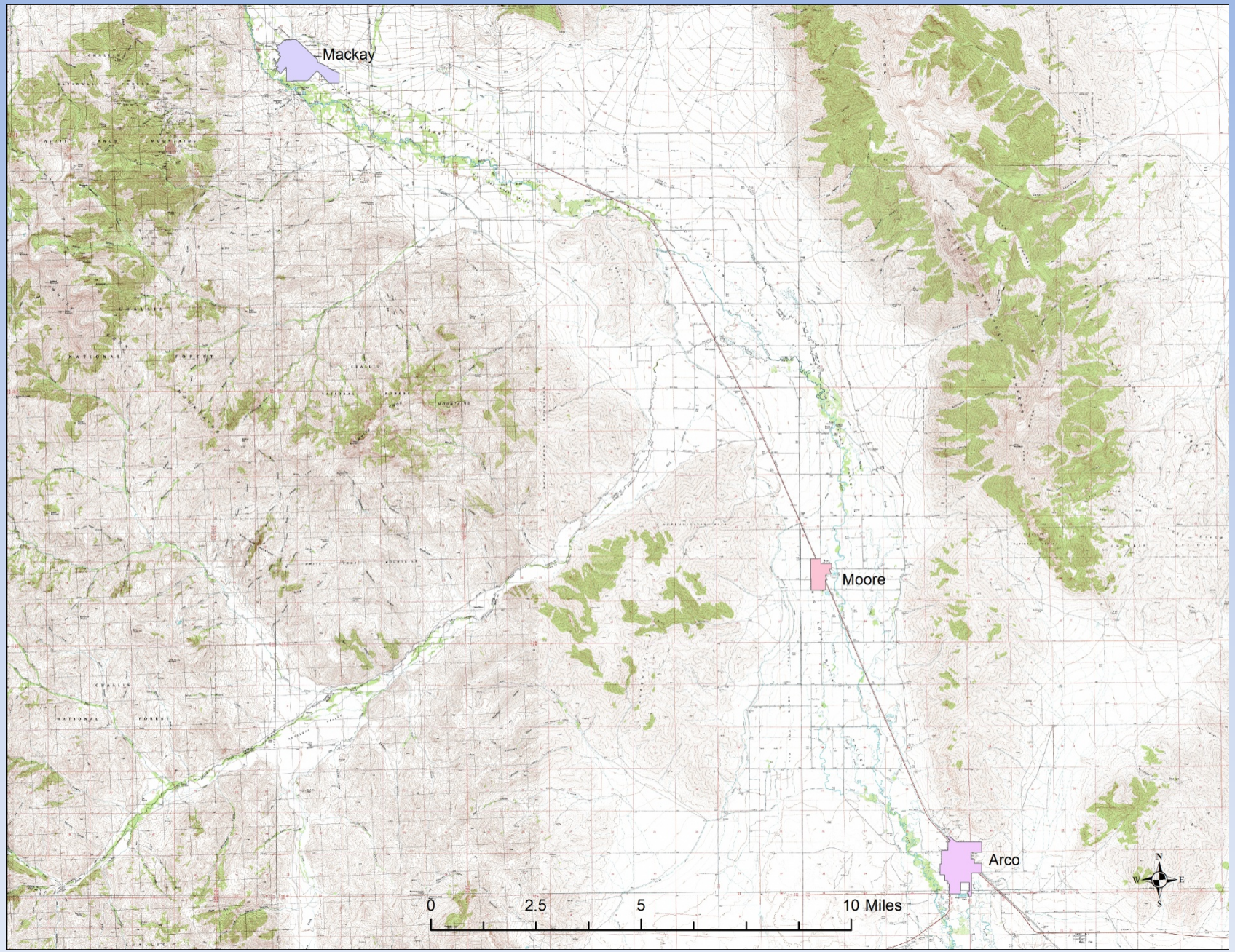


Gaining and Losing Reaches Over Time





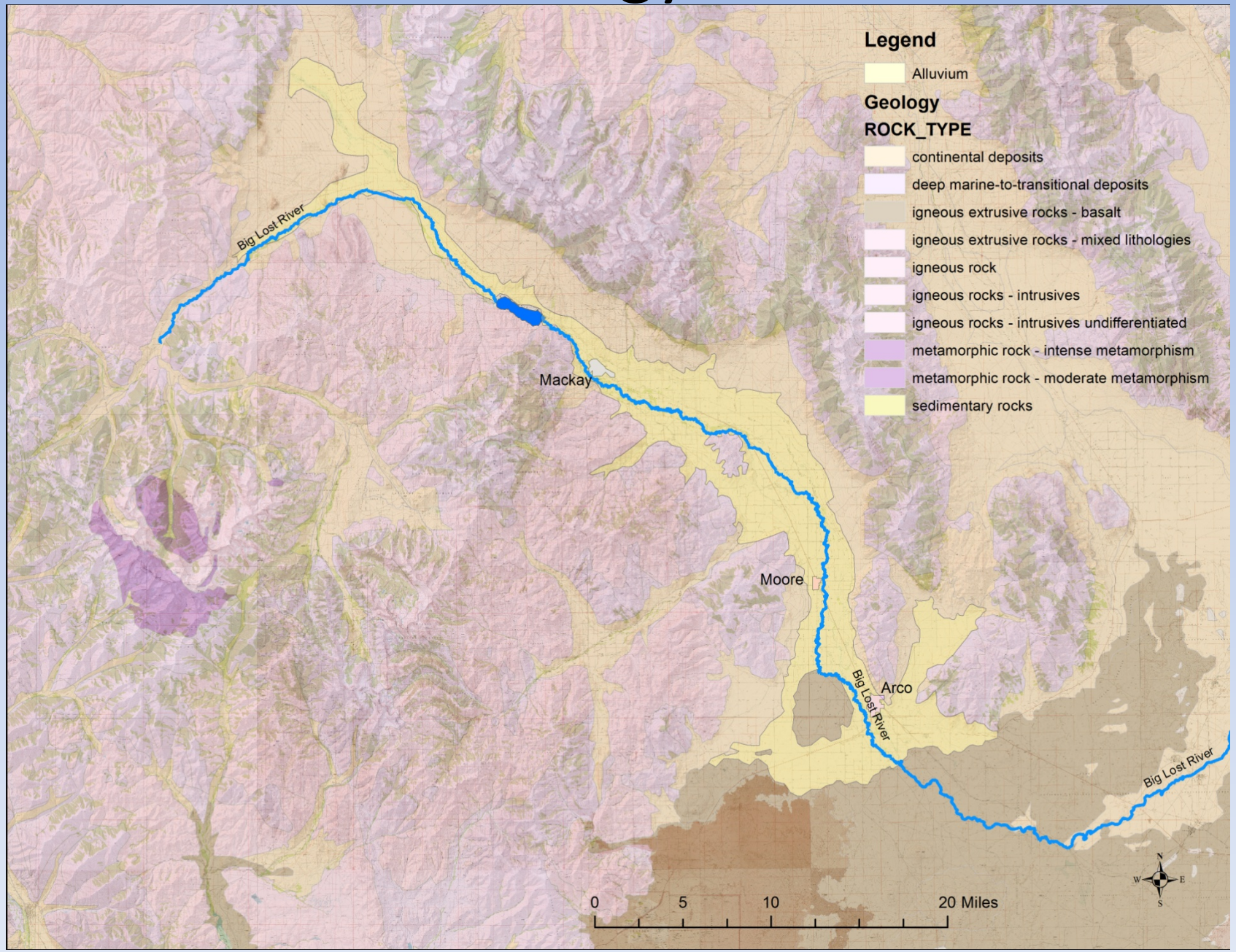
Historic Gaining Reaches



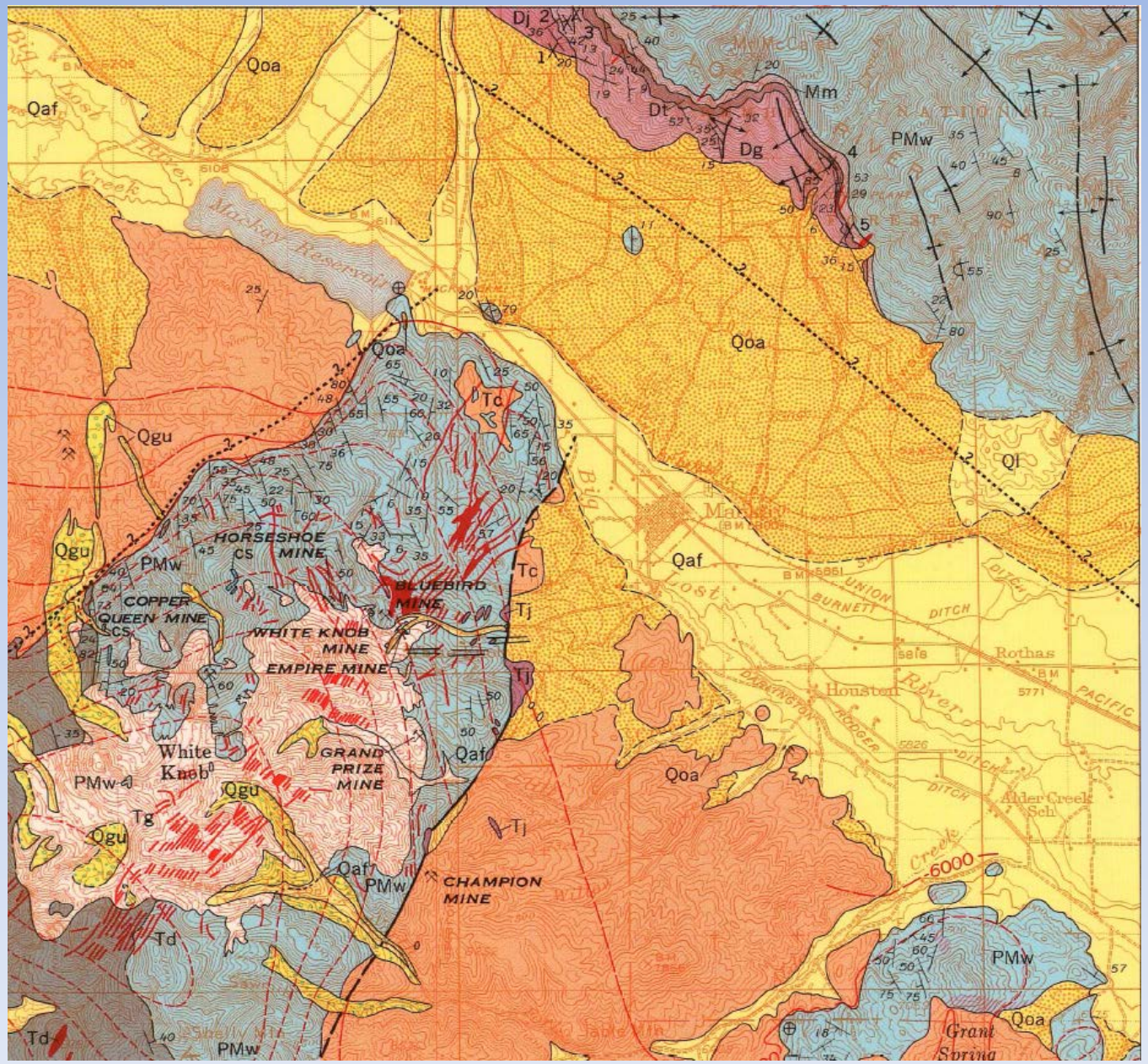
Geometry of Aquifer

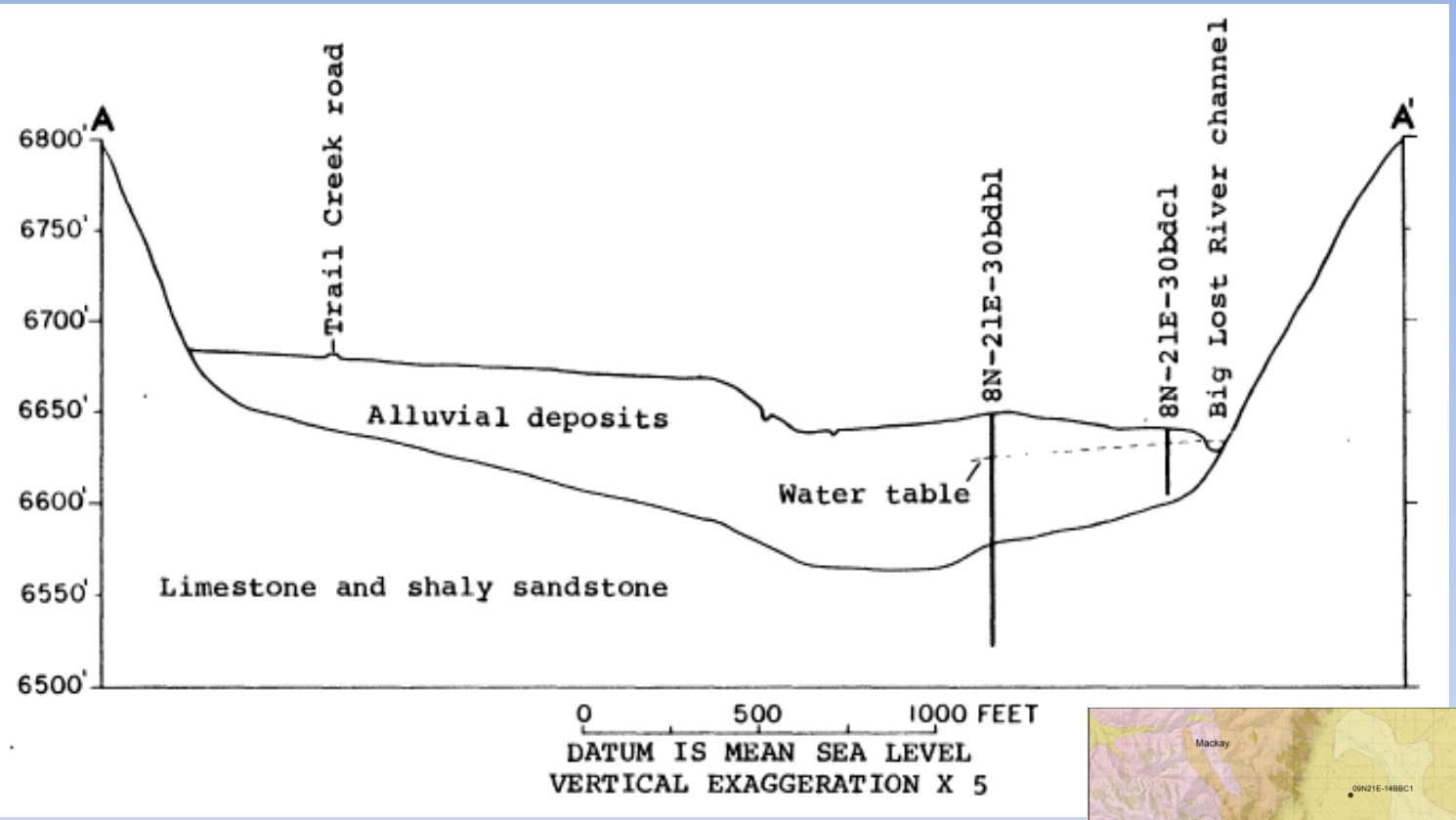
- Constriction of basin influences gaining and losing reaches.

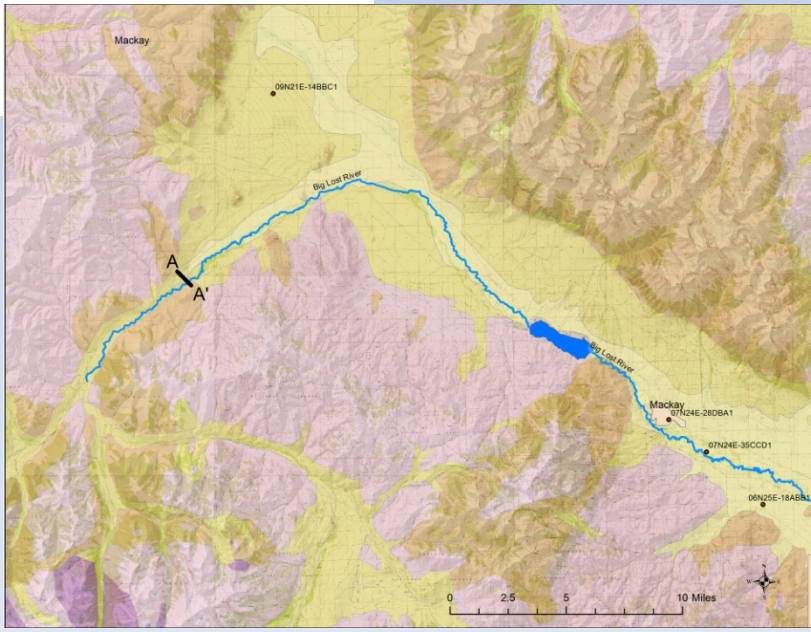
Geology


Legend
Alluvium
Geology
ROCK_TYPE
continental deposits
deep marine-to-transitional deposits
igneous extrusive rocks - basalt
igneous extrusive rocks - mixed lithologies
igneous rock
igneous rocks - intrusives
igneous rocks - intrusives undifferentiated
metamorphic rock - intense metamorphism
metamorphic rock - moderate metamorphism
sedimentary rocks
Big Lost River
Mackay
Moore
Arco
Big Lost River
Big Lost River
0
5
10
20 Miles
N
W
E
S

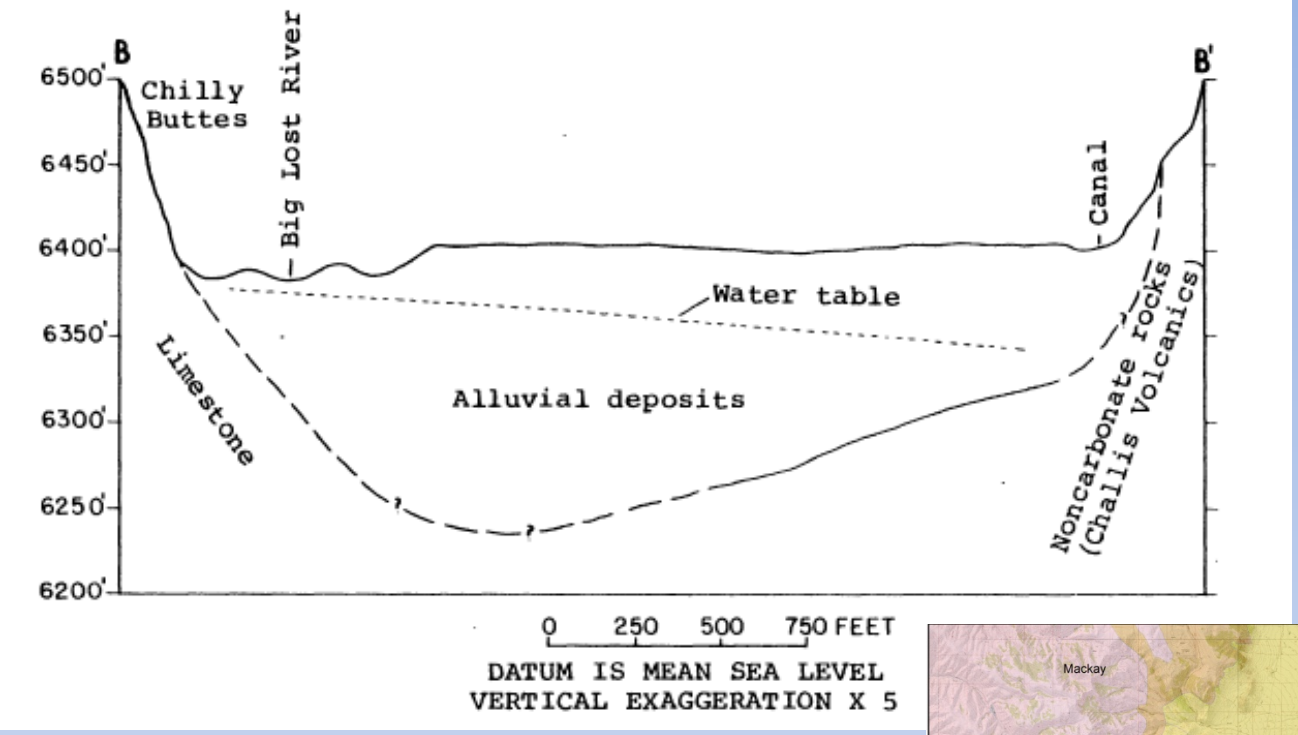
Geology

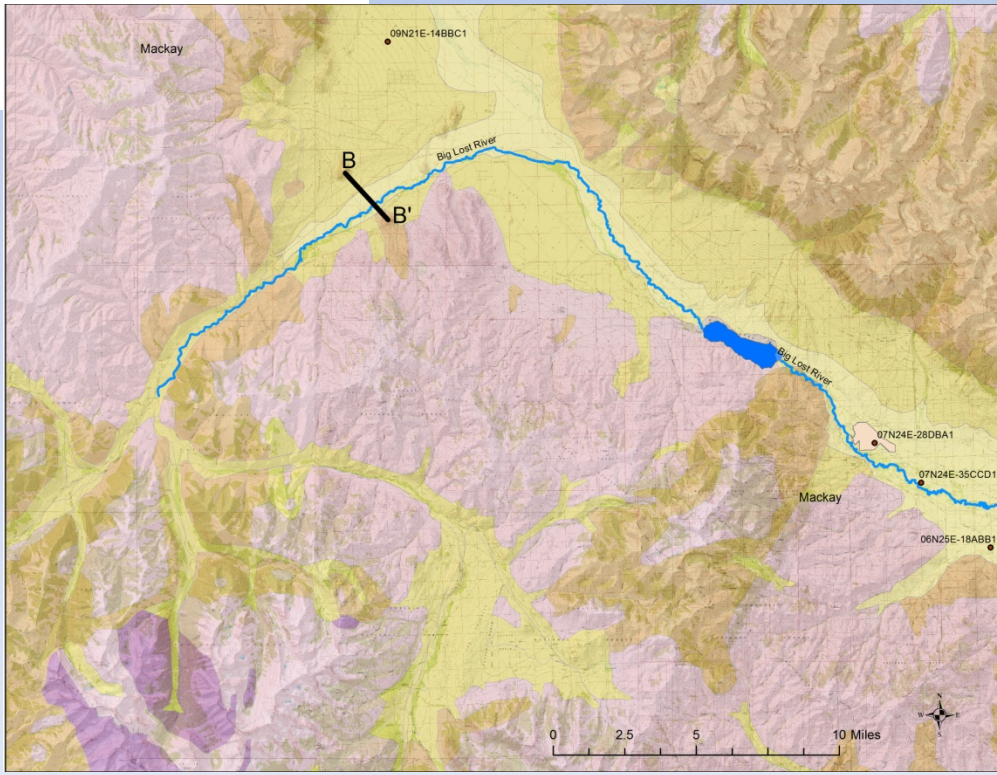

Qoa
Qaf
Dj
Dt
Dg
Mm
PMw
Qoa
Qgu
Qgu
PMw
HORSESHOE MINE
CS
COPPER QUEEN MINE
CS
BLUEBIRD MINE
WHITE KNOB MINE
EMPIRE MINE
Tc
Tj
Tj
Qaf
White Knob
GRAND PRIZE MINE
Qgu
Tg
Qgu
Qaf
PMw
CHAMPION MINE
Td
Td
PMw
Qoa
Qaf
Qoa
Ql
Rothas
Houston
Alder Creek Sch
6000
PMw
Qoa
Grant Spring



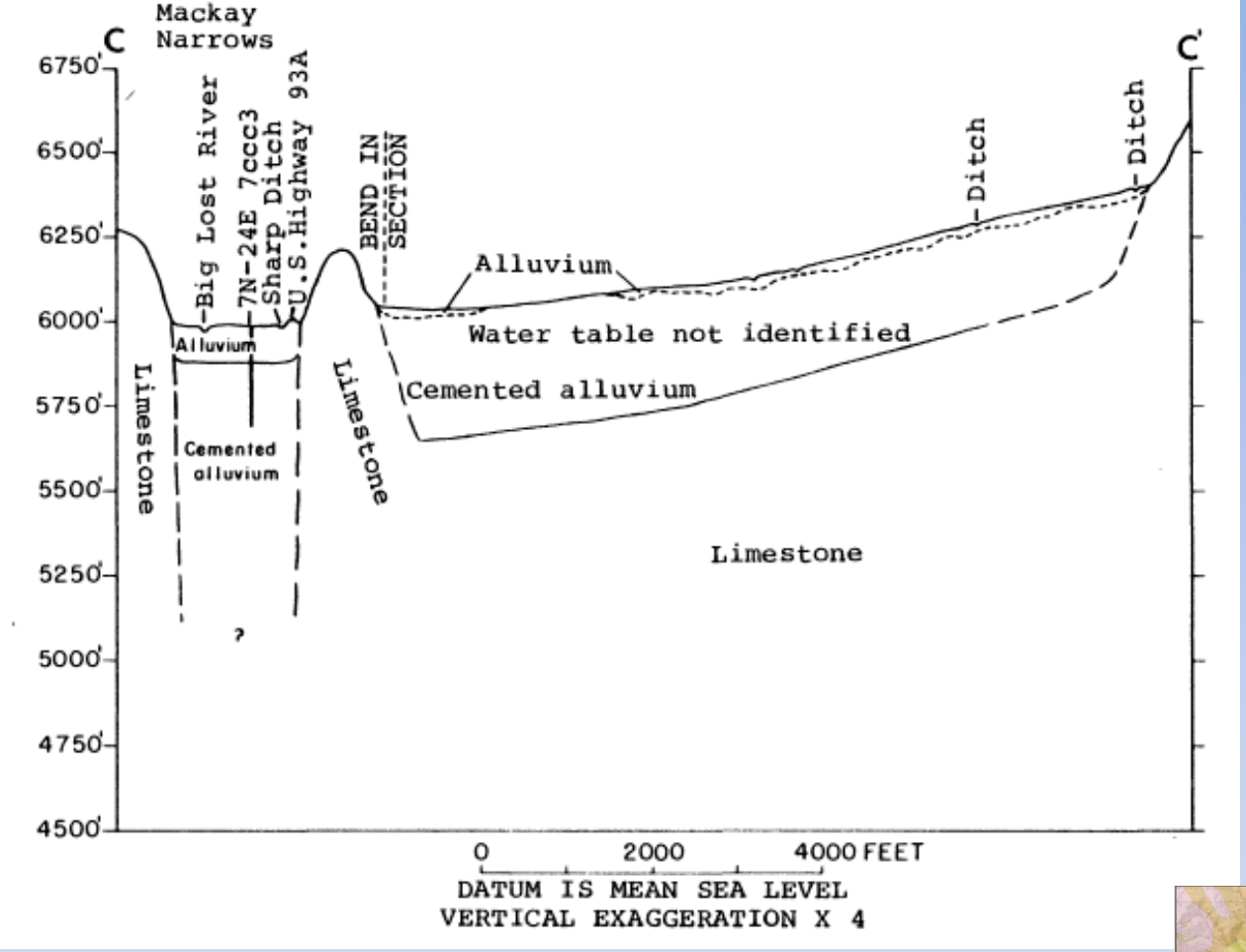


Cross Section A-A'.
Near Howell Ranch
Shallow Alluvial Aquifer

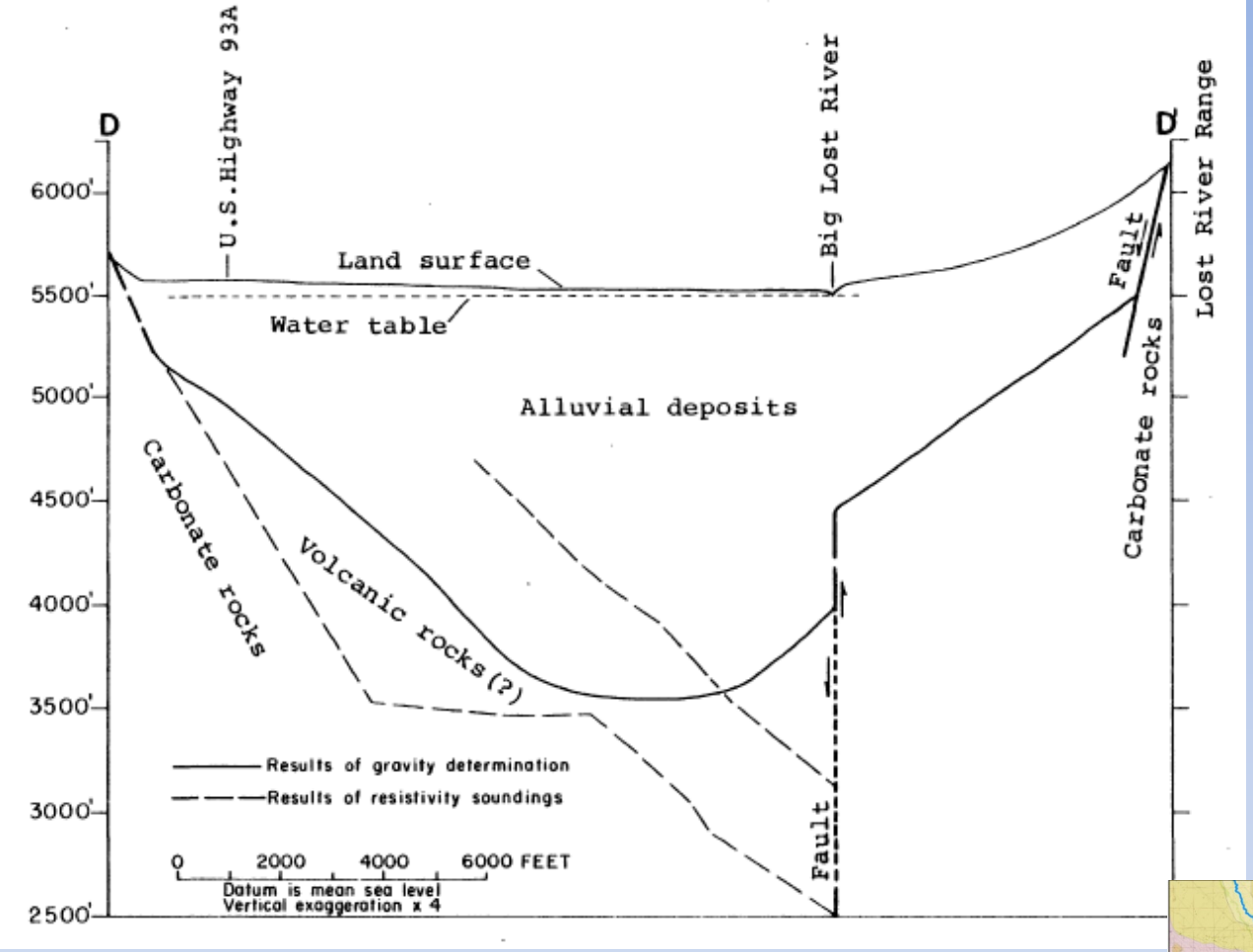




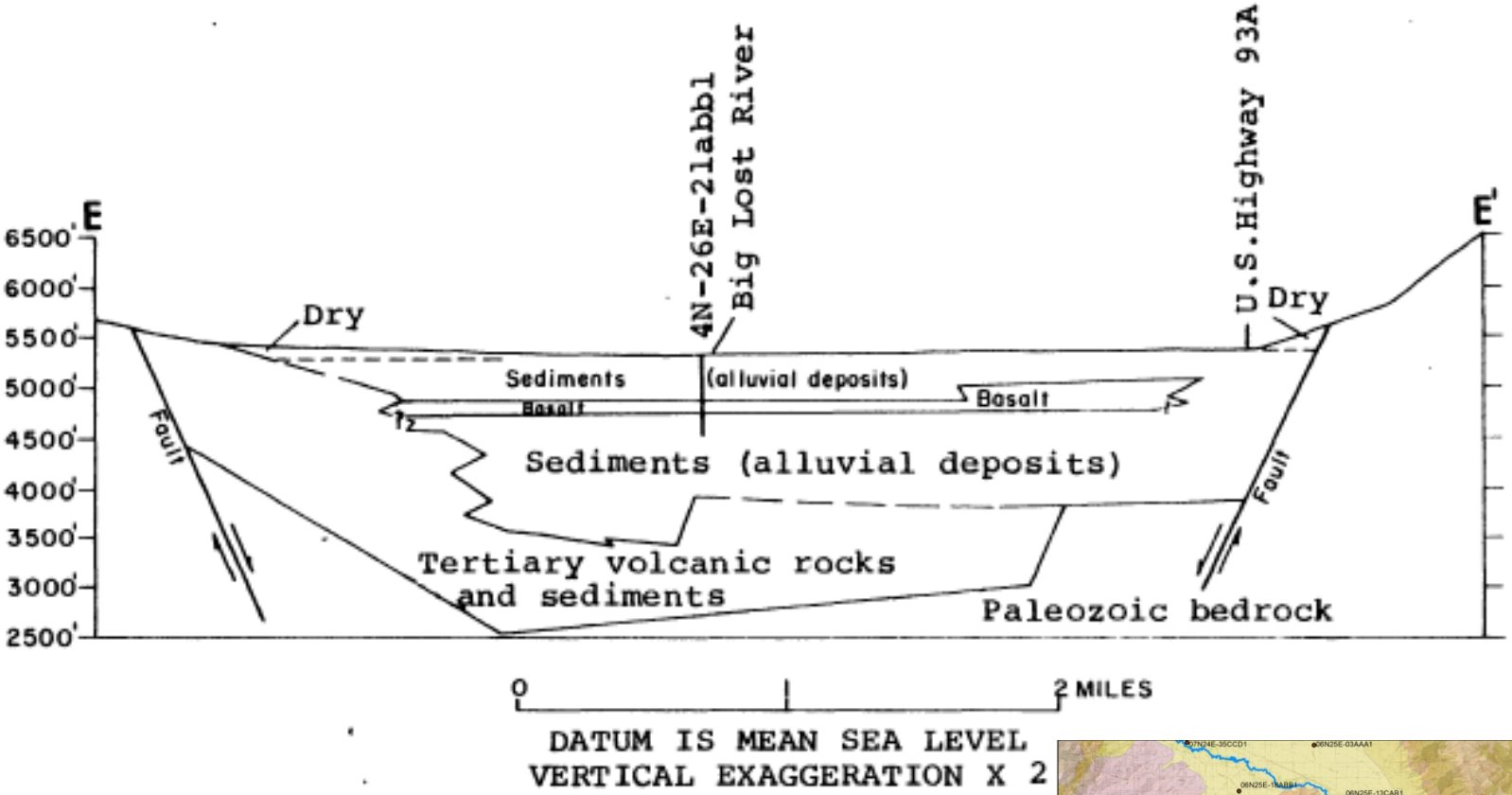
Cross Section B-B’
Near Chilly
Deeper, but still shallow alluvial aquifer



Cross Section C-C'
Just below Mackay Dam
Alluvial (uncemented) shallow and restricted

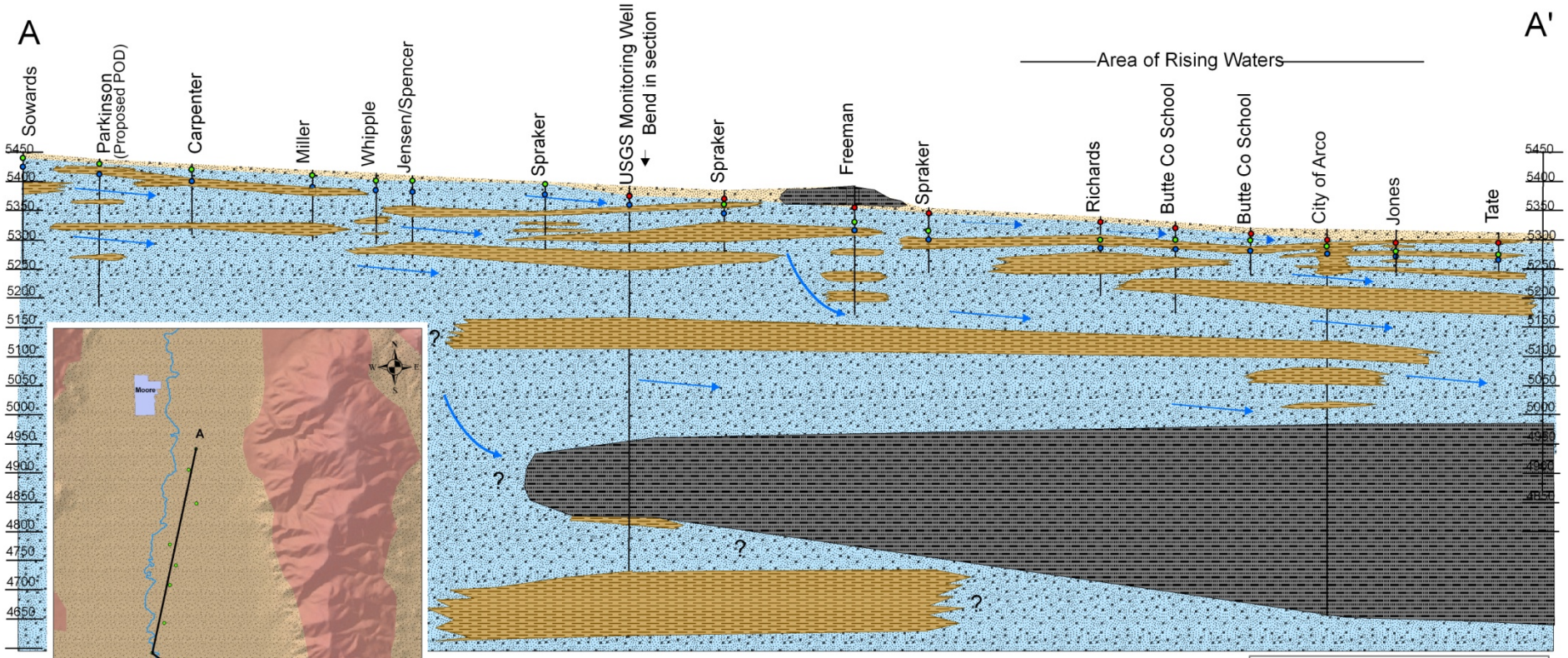


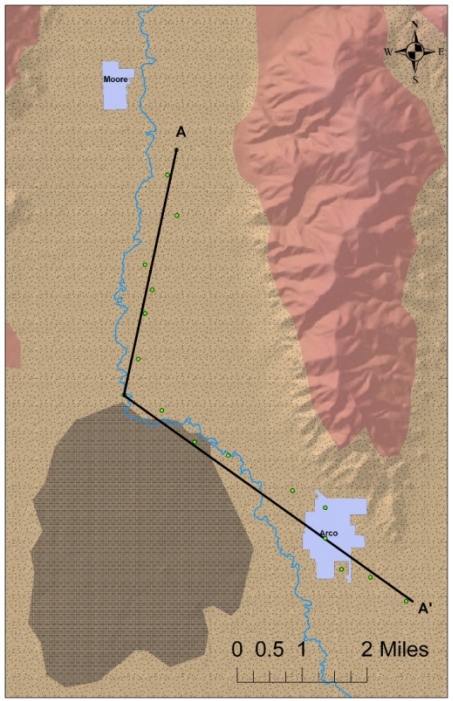
Cross Section D-D'
North of Moore
Substantially deeper alluvial aquifer



Cross Section E-E'
North of Arco
Alluvial sediments intermixed
with basalt and bedrock units

Conceptual Cross Section





Lithology is based on well driller's reports.
Wellhead elevations were taken from digital elevation model (DEM).
Well locations are based on IDWR database.

- Shallow Pre-1985 Water Level
- Regional 1985 Water Level
- Regional 2012 Water Level

Generalized ground water flow direction

1 Mile

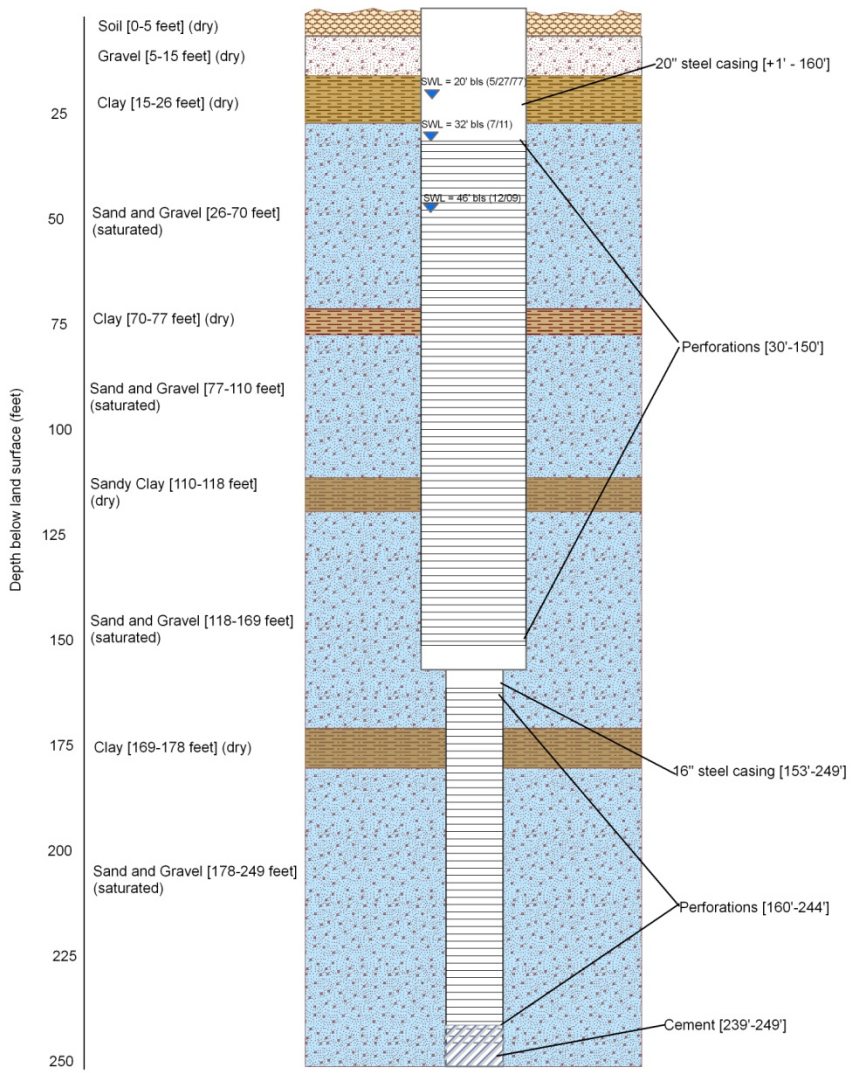
Vertical Exaggeration X 20

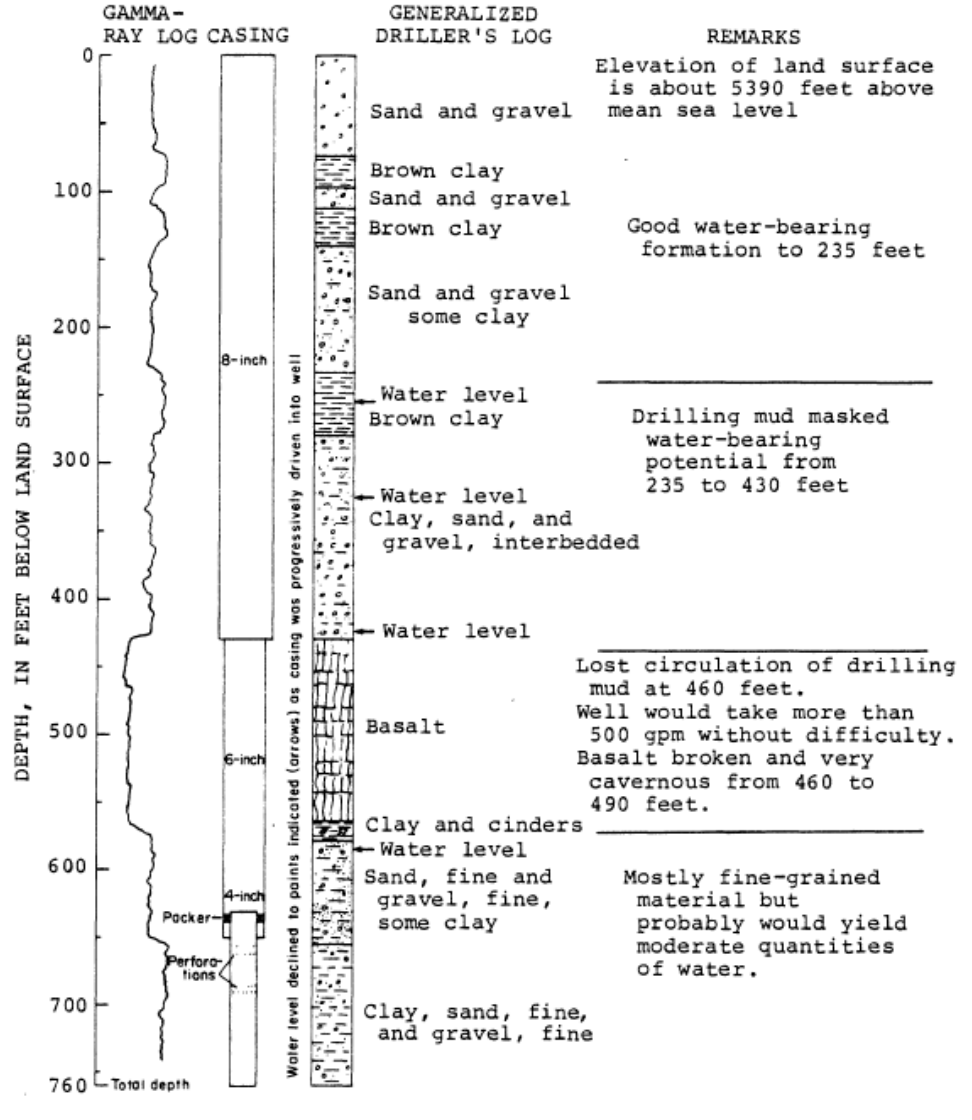
Datum is Mean Sea Level (feet)

Legend

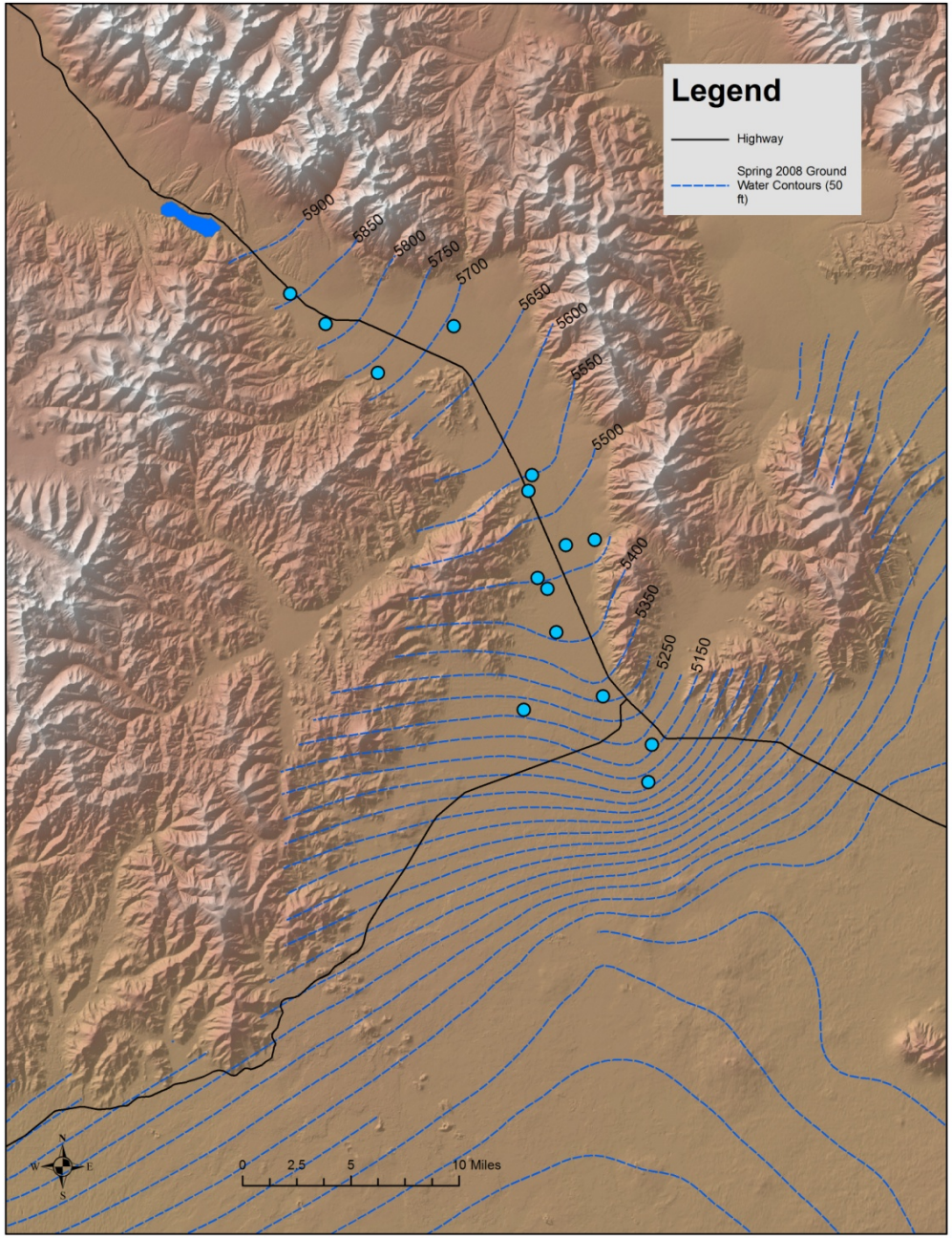
- Unsaturated Sand and Gravel
- Saturated Sand and Gravel
- Clay or Sandy Clay
- Basalt

Subsurface Lithology



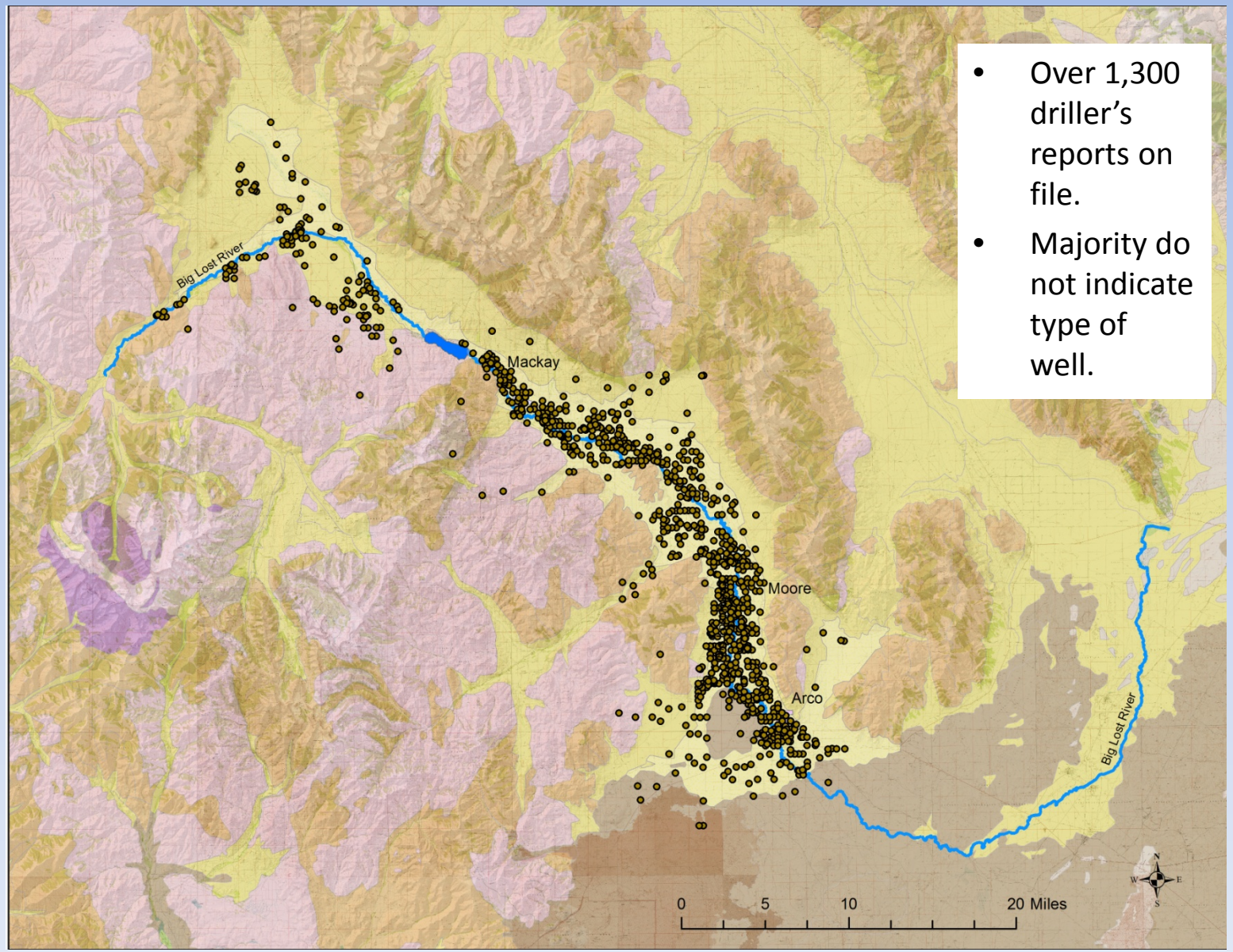


Ground Water Flow Direction



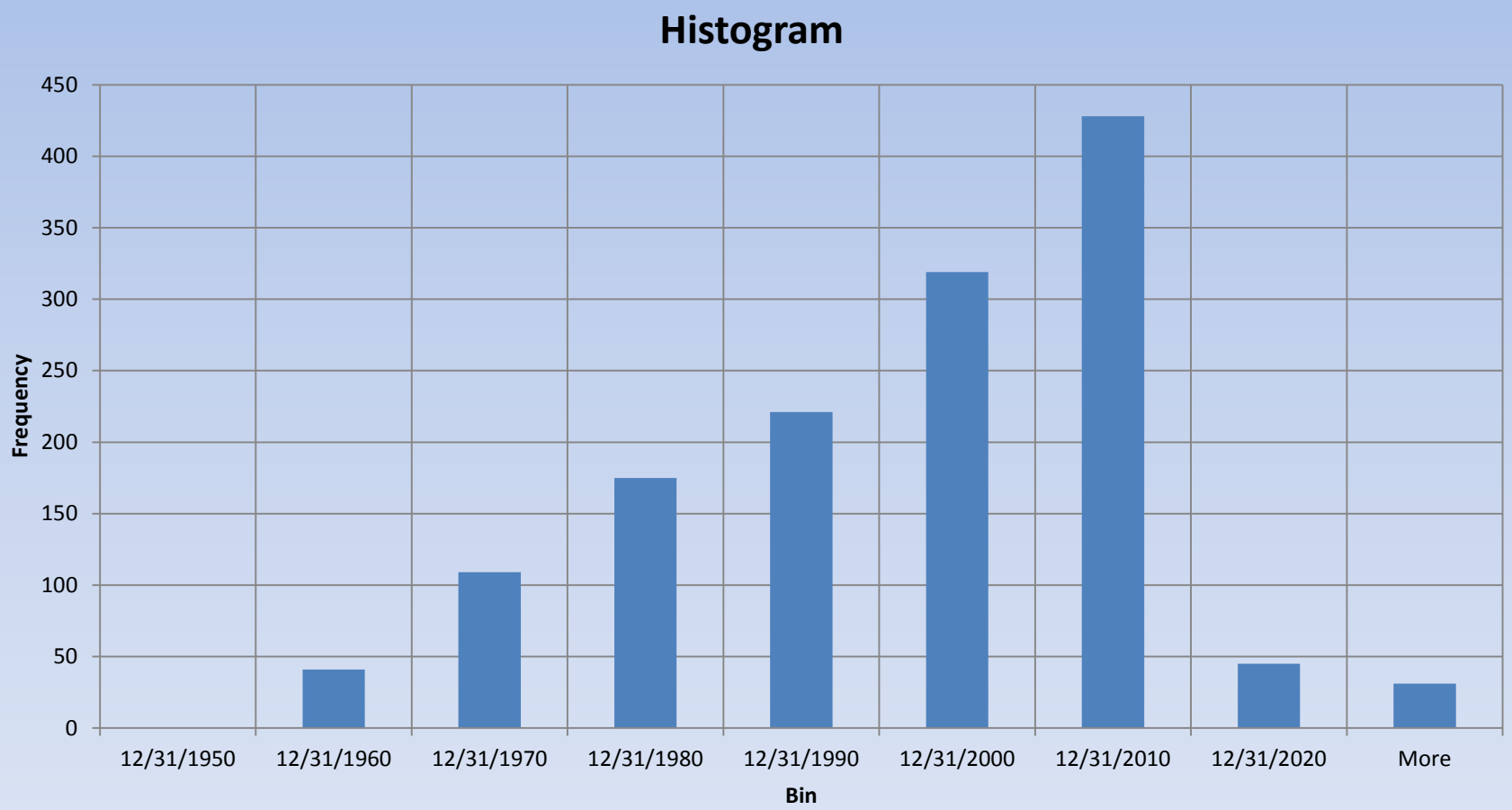
- Ground water flow is generally down valley, from north to south.
- Generally a flat water table within the valley.
- Contours tighten as the alluvial aquifer of the Big Lost merges with the Snake River Plain aquifer.

Ground Water Development



- Over 1,300 driller's reports on file.
- Majority do not indicate type of well.

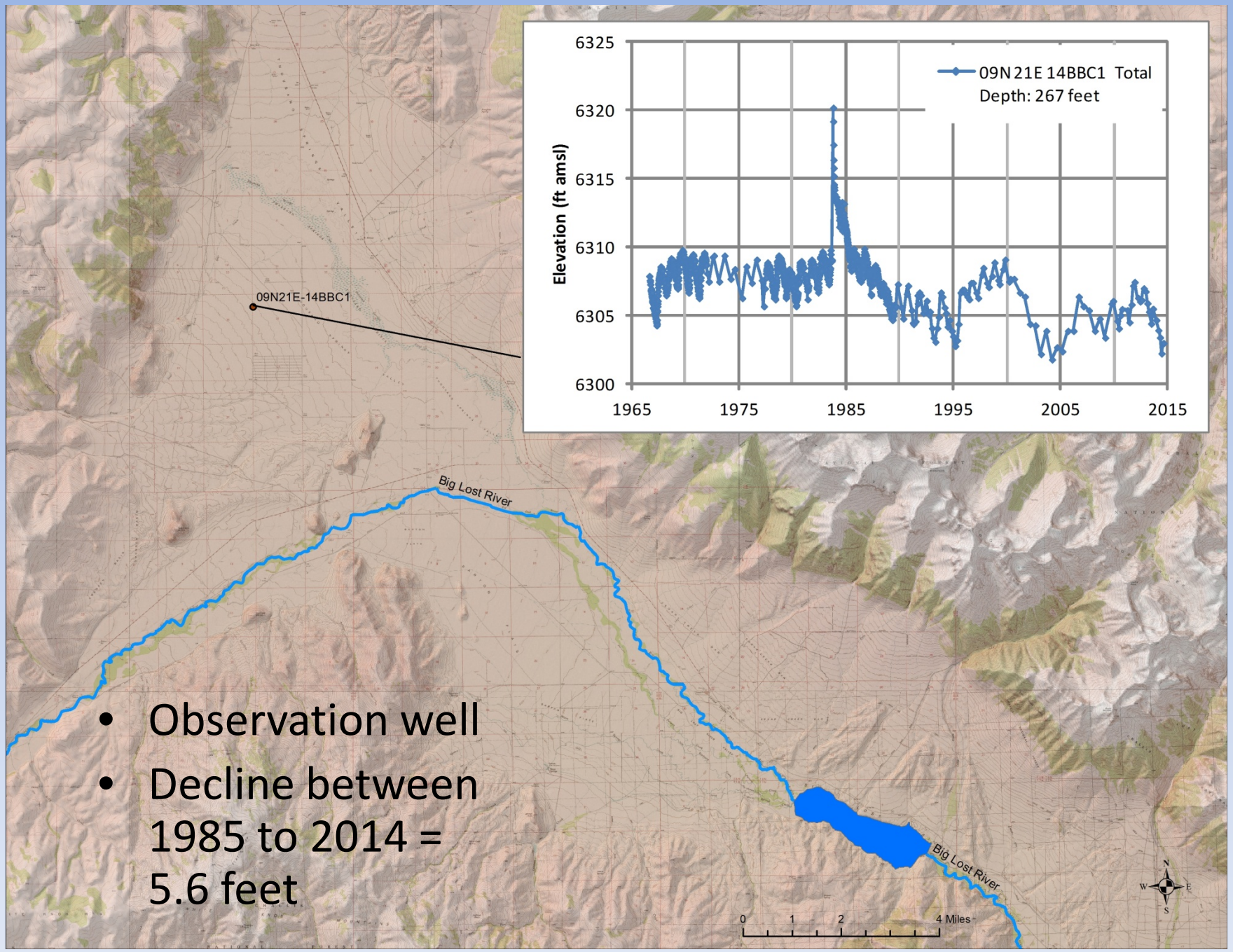
Well Development Over Time



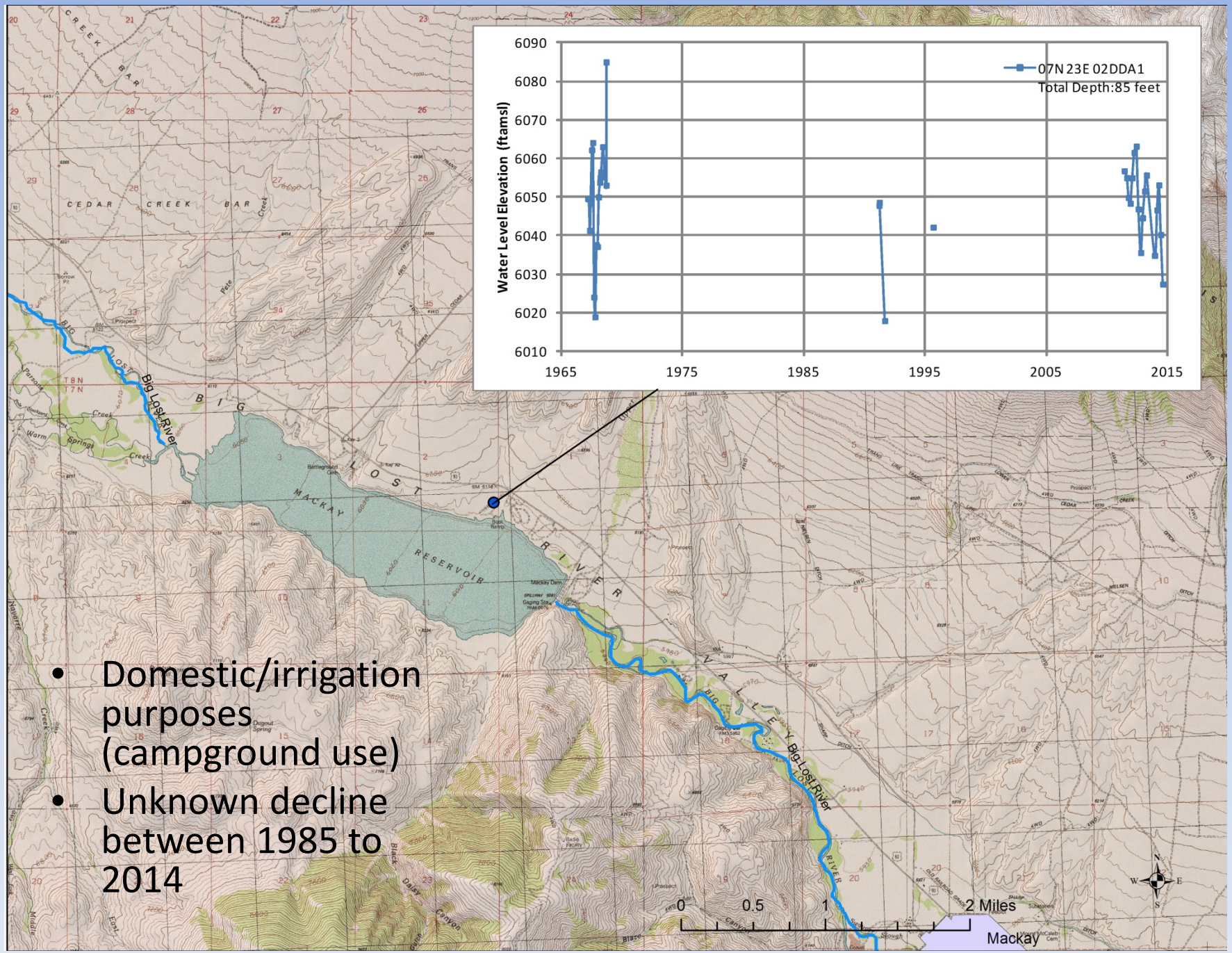
Ground Water Monitoring

Data Loggers

Ground Water Monitoring

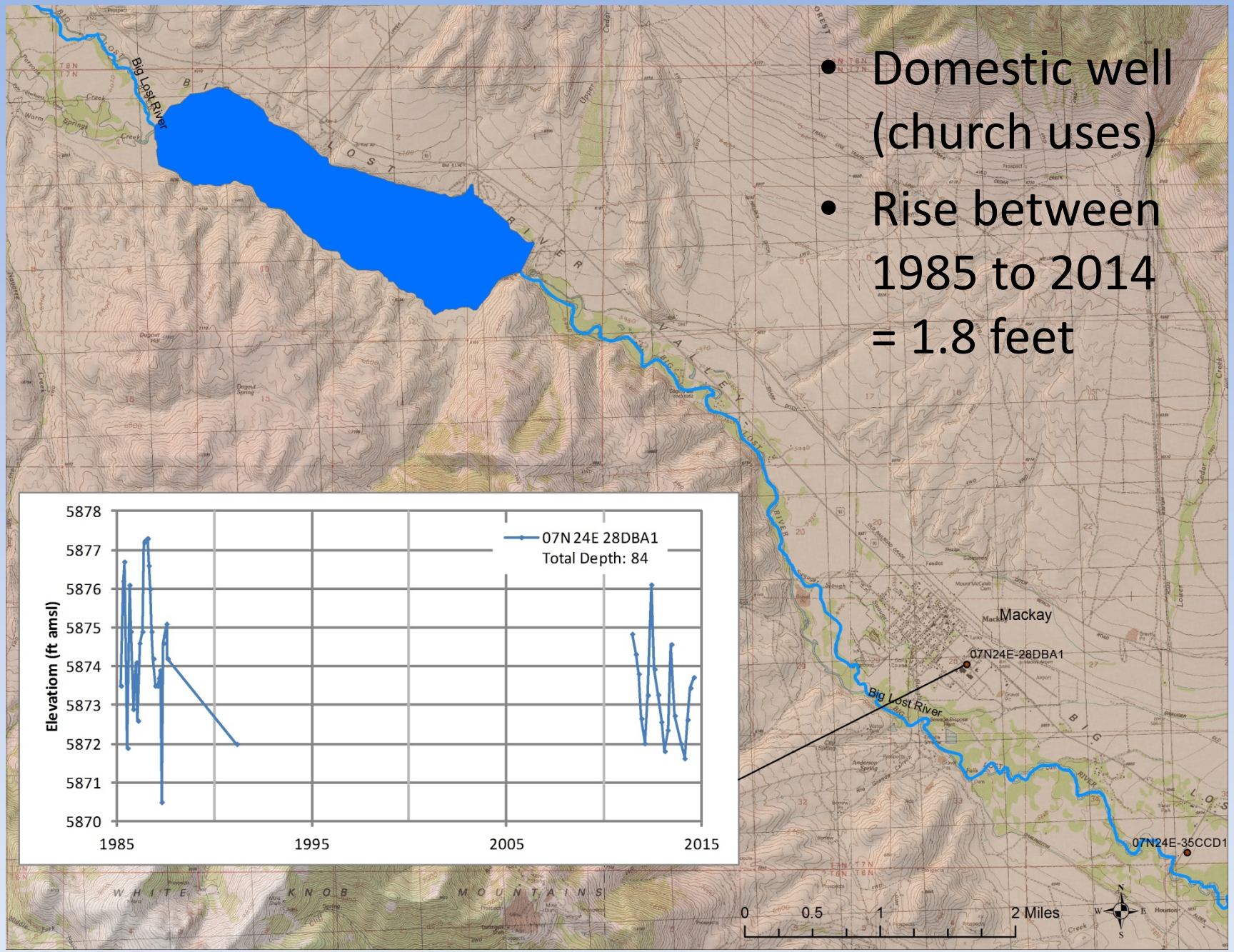


- Observation well
- Decline between 1985 to 2014 = 5.6 feet

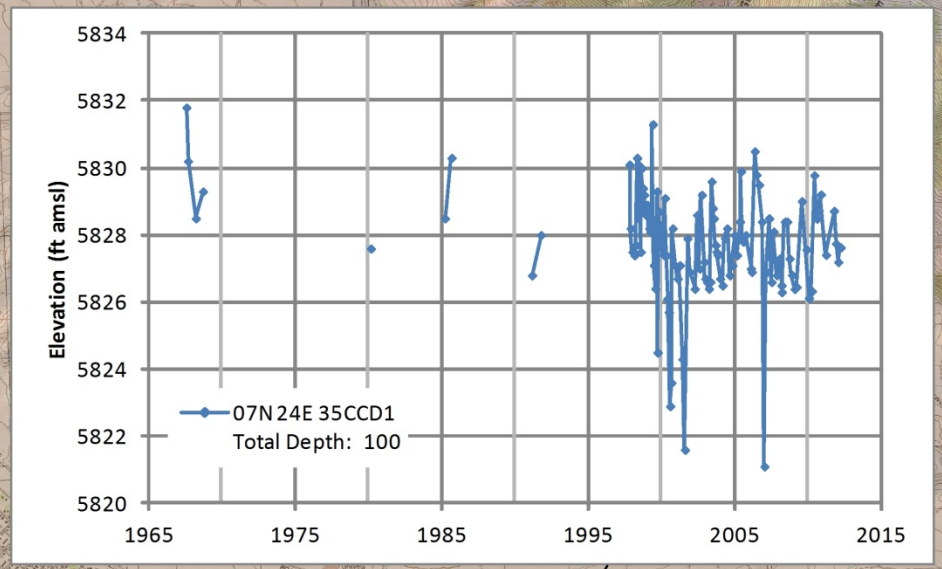


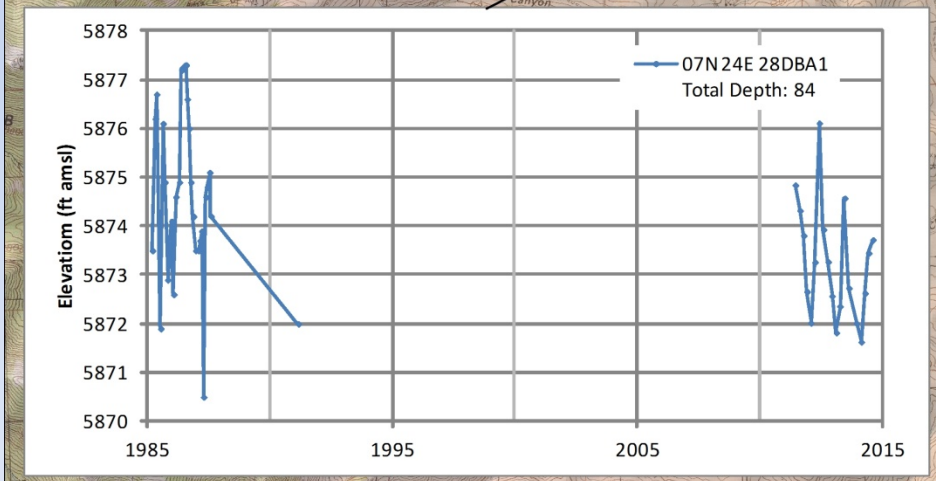
- Domestic/irrigation purposes (campground use)
- Unknown decline between 1985 to 2014

- Domestic well (church uses)
- Rise between 1985 to 2014 = 1.8 feet

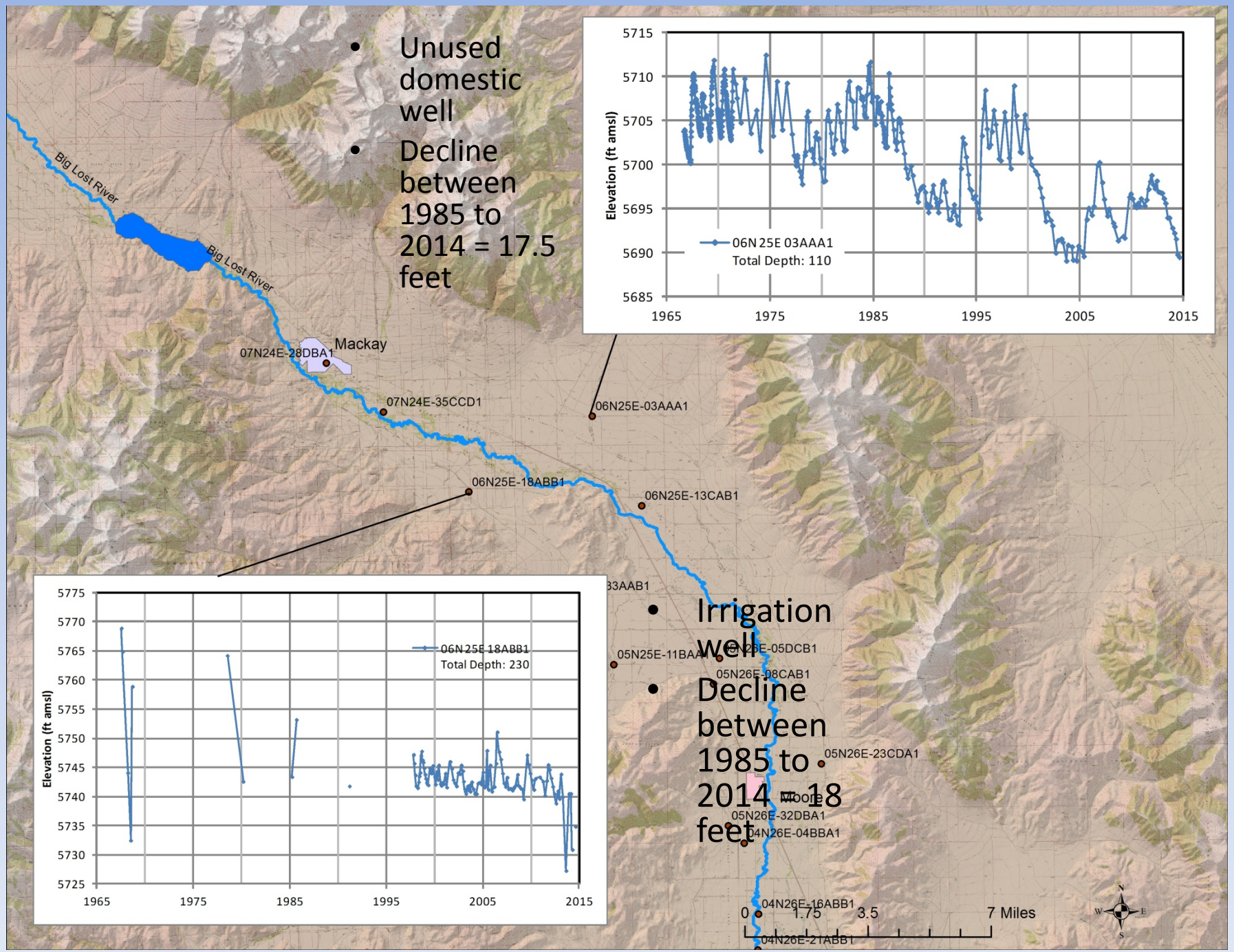


- Irrigation Well
- No change between 1985 to 2014



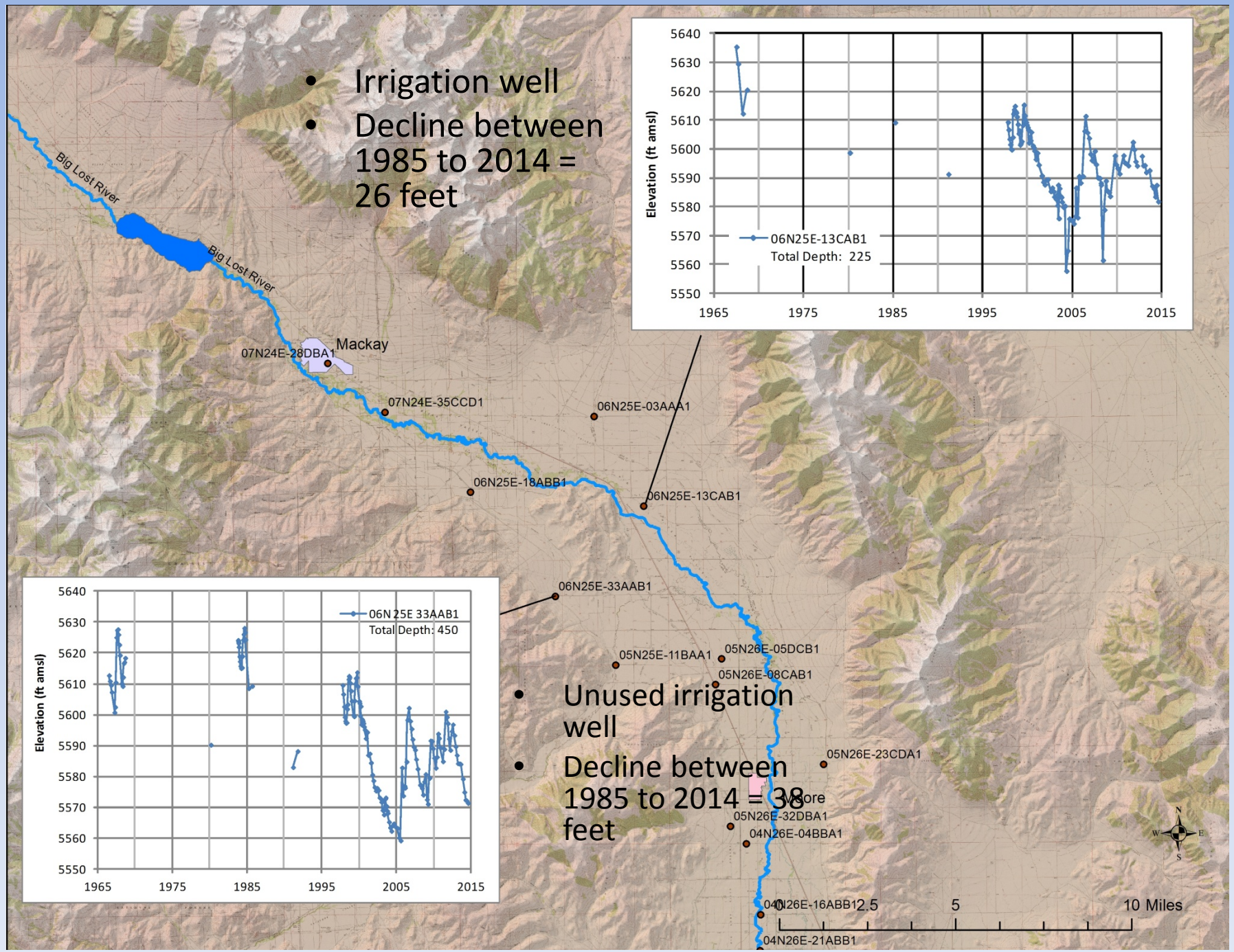


- Unused domestic well
- Decline between 1985 to 2014 = 17.5 feet

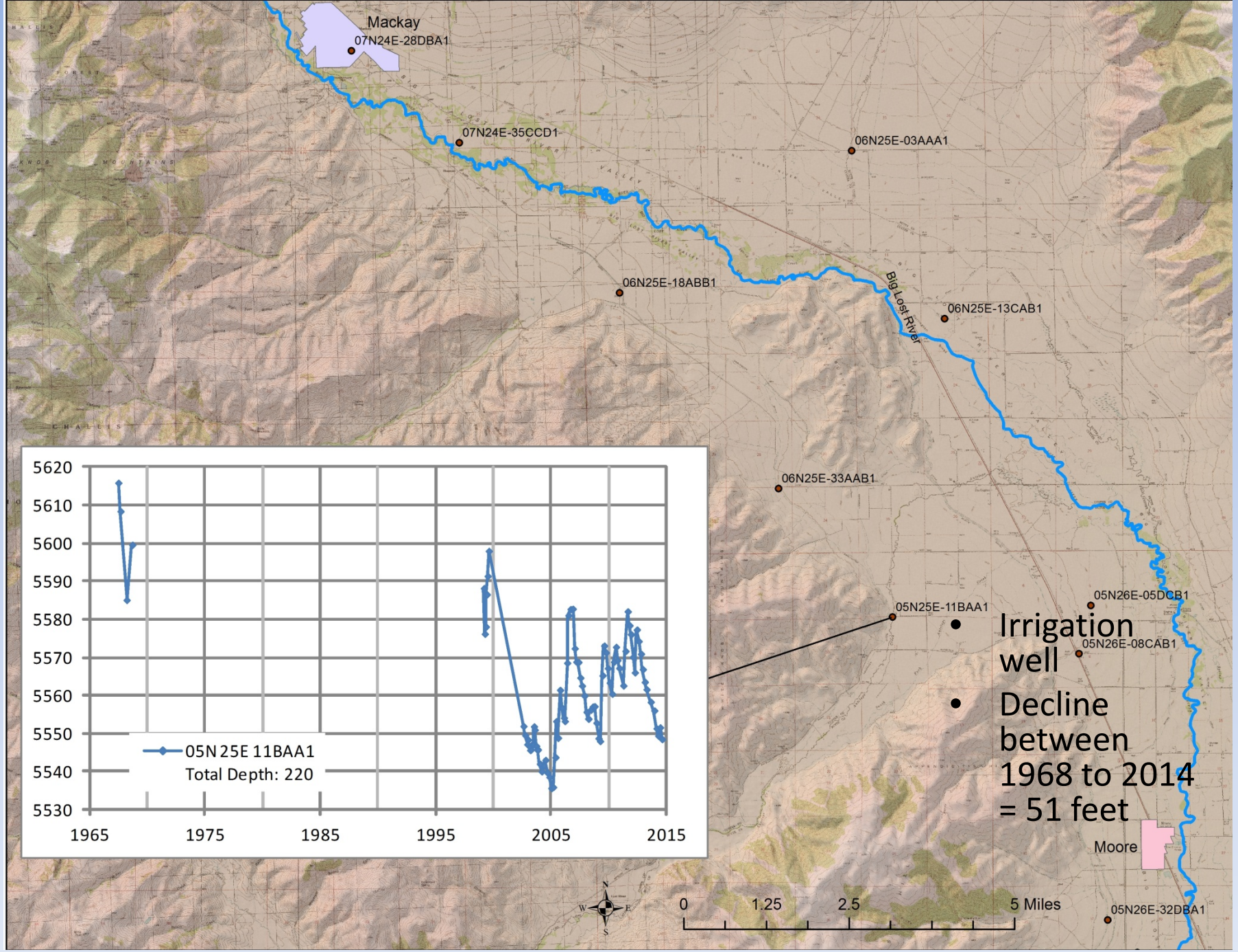


- Irrigation well
- Decline between 1985 to 2014 = 18 feet

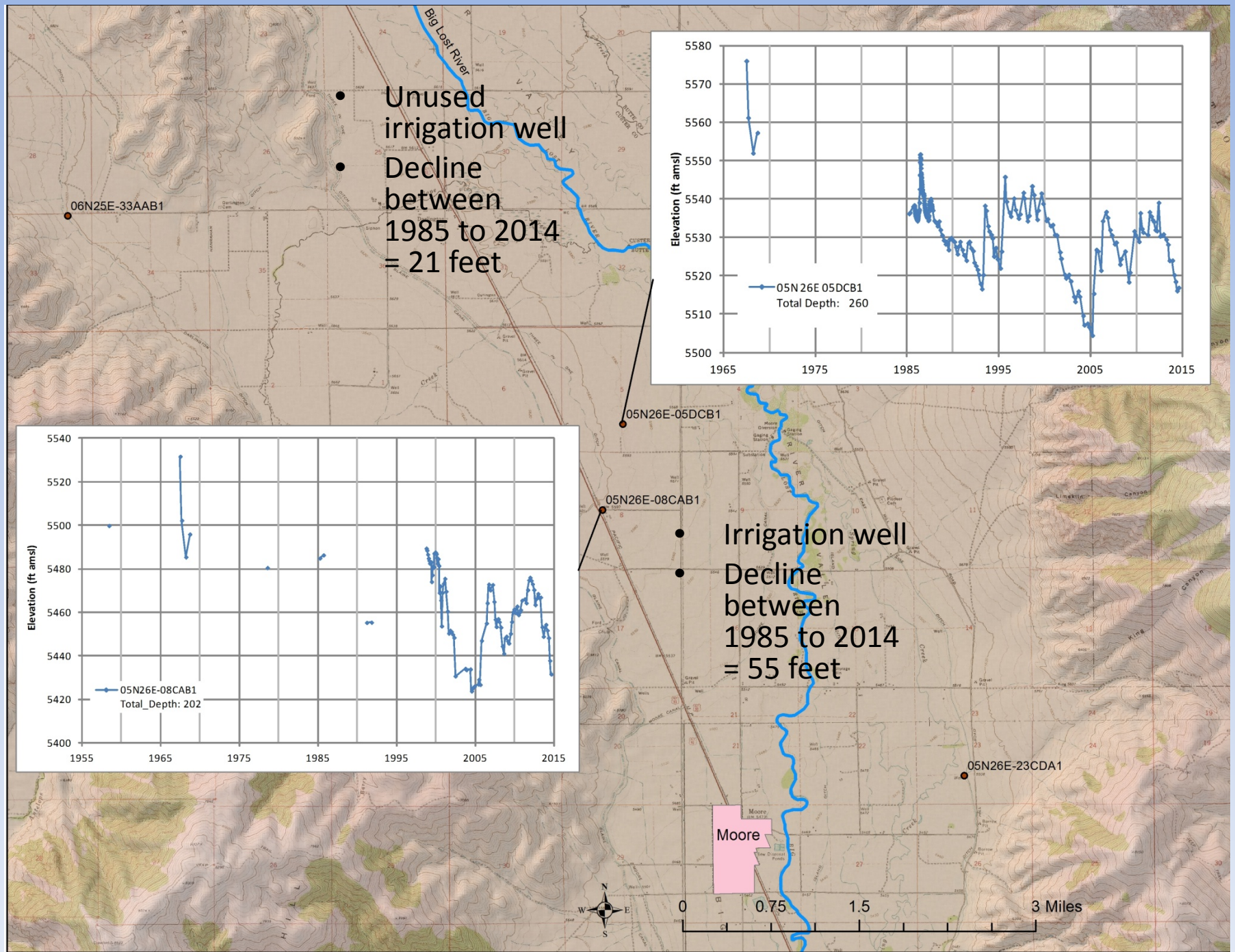
- Irrigation well
- Decline between 1985 to 2014 = 26 feet



- Unused irrigation well
- Decline between 1985 to 2014 = 38 feet

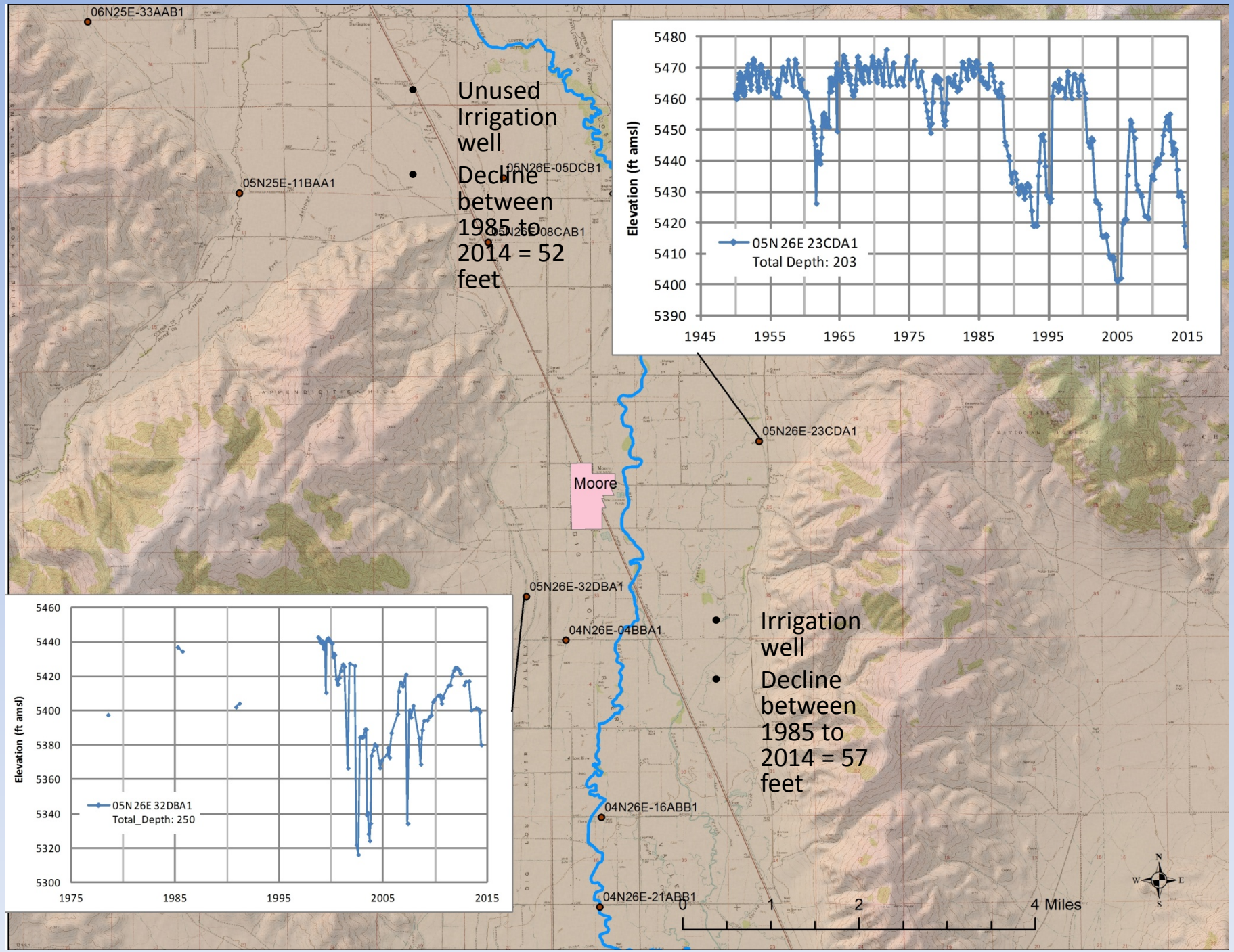


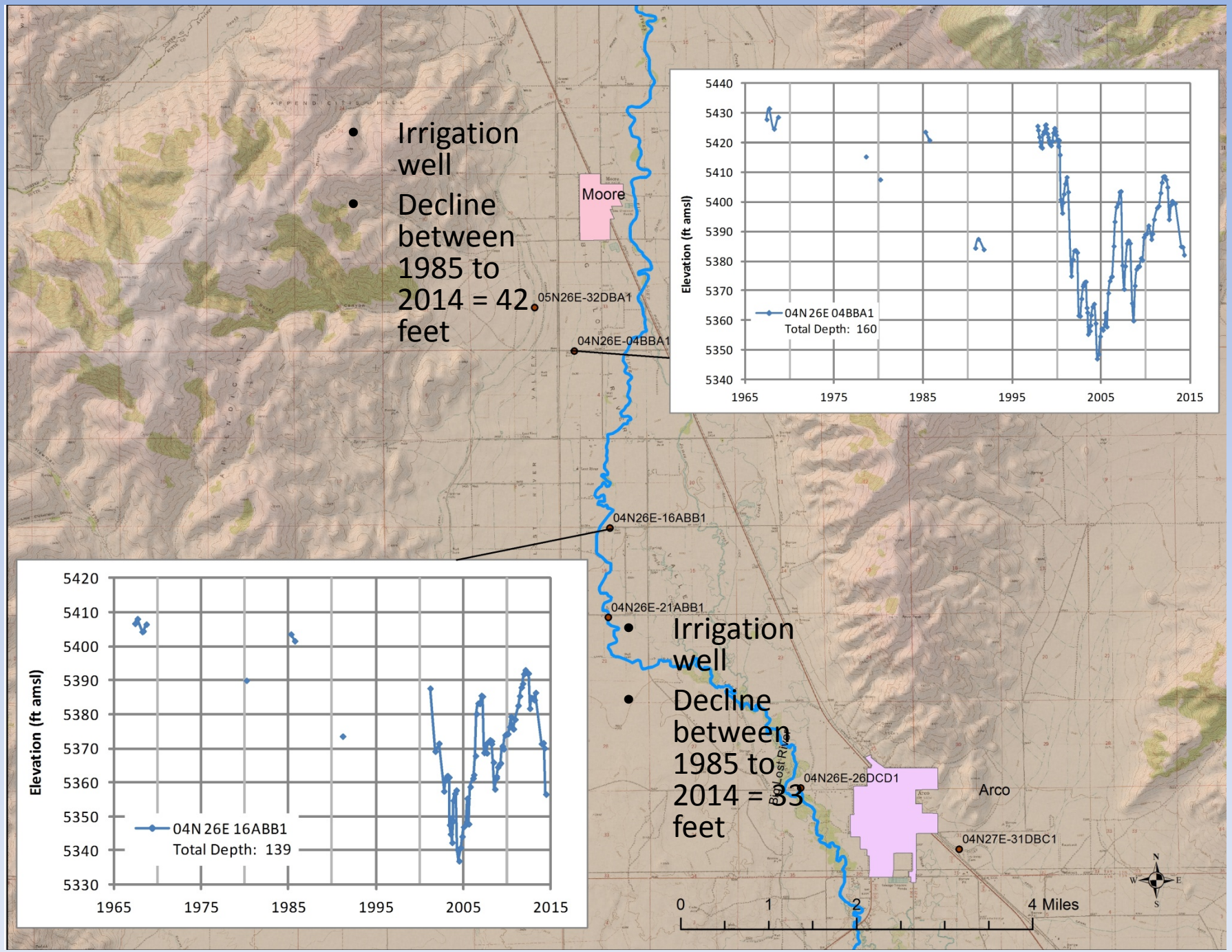
- Irrigation well
- Decline between 1968 to 2014 = 51 feet

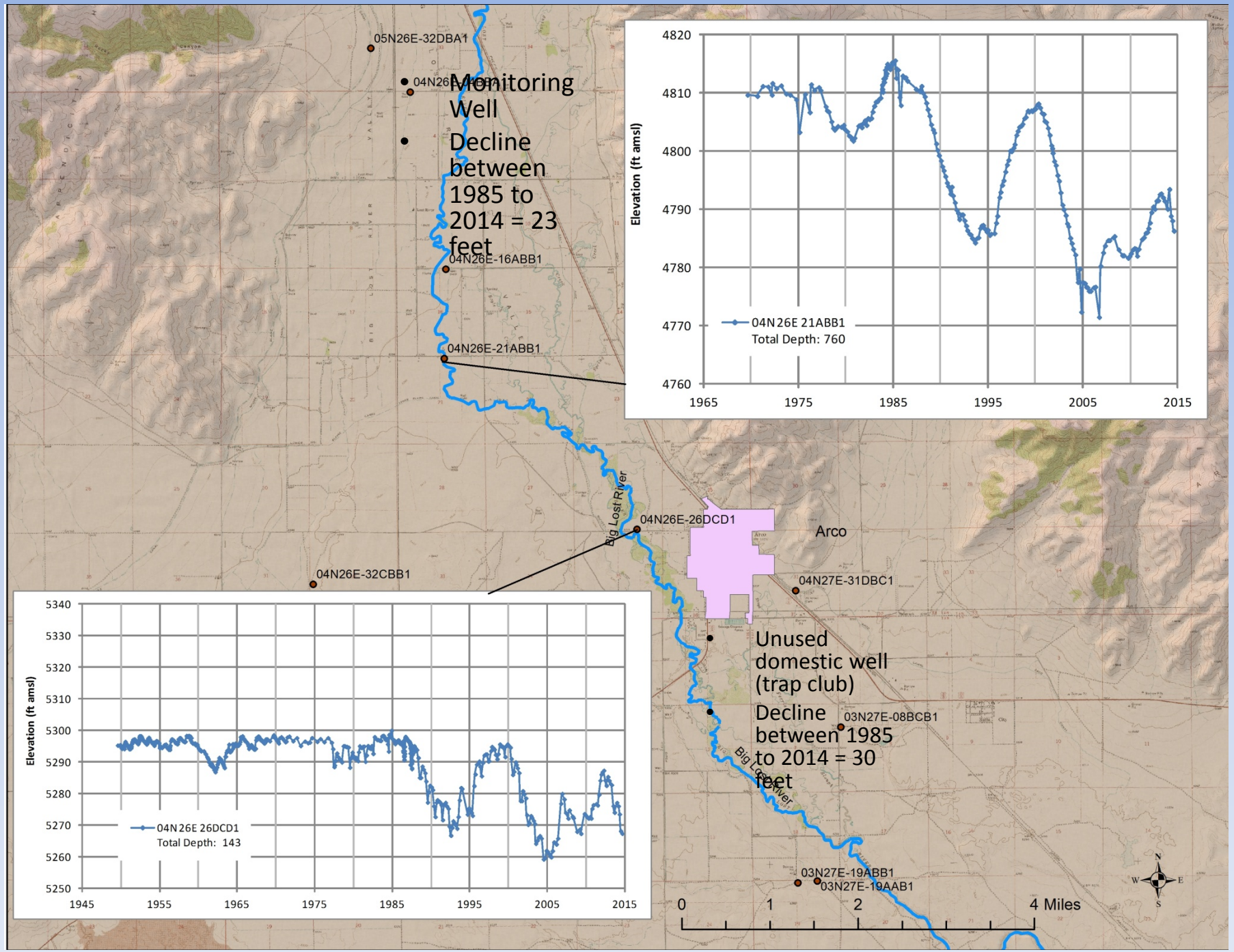


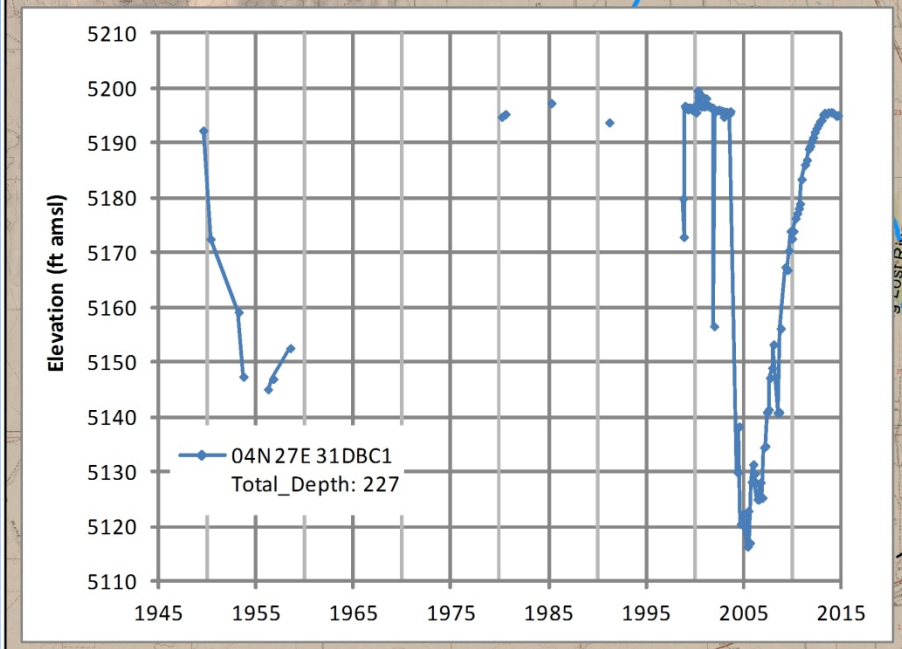
- Unused irrigation well
- Decline between 1985 to 2014 = 21 feet

- Irrigation well
- Decline between 1985 to 2014 = 55 feet

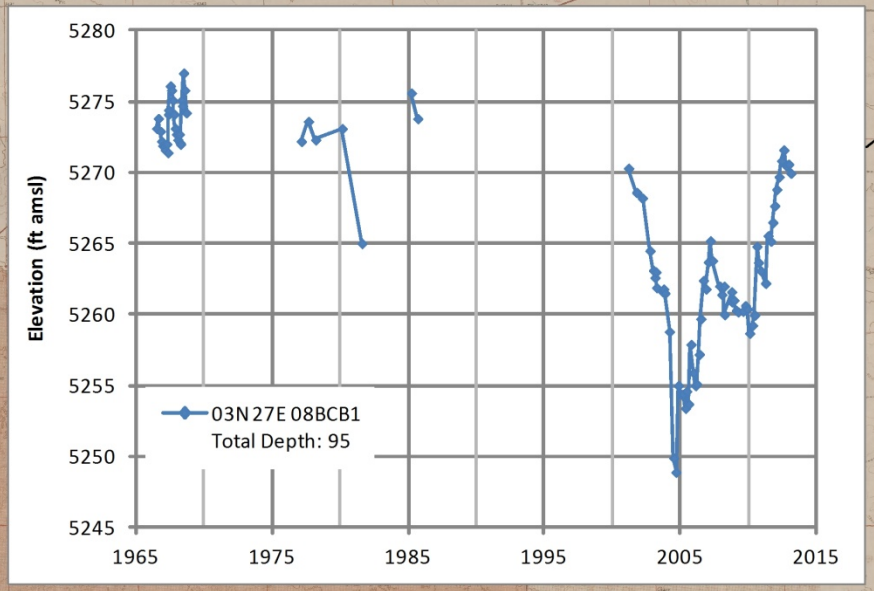

06N25E-33AAB1
05N25E-11BAA1
05N26E-05DCB1
05N26E-08CAB1
Unused Irrigation well
Decline between 1985 to 2014 = 52 feet
05N26E-23CDA1
Moore
05N26E-32DBA1
04N26E-04BBA1
Irrigation well
Decline between 1985 to 2014 = 57 feet
04N26E-16ABB1
04N26E-21ABB1
0
1
2
4 Miles
N
S
E
W
Elevation (ft amsl)
05N 26E 23CDA1
Total Depth: 203
5480
5470
5460
5450
5440
5430
5420
5410
5400
5390
1945
1955
1965
1975
1985
1995
2005
2015
Elevation (ft amsl)
05N 26E 32DBA1
Total_Depth: 250
5460
5440
5420
5400
5380
5360
5340
5320
5300
1975
1985
1995
2005
2015


Irrigation well
Decline between 1985 to 2014 = 42 feet
Moore
05N26E-32DBA1
04N26E-04BBA1
04N26E-16ABB1
04N26E-21ABB1
Irrigation well
Decline between 1985 to 2014 = 33 feet
04N26E-26DCD1
Arco
04N27E-31DBC1
Big Lost River
0
1
2
4 Miles
N
S
E
W
Elevation (ft amsl)
5440
5430
5420
5410
5400
5390
5380
5370
5360
5350
5340
1965
1975
1985
1995
2005
2015
04N 26E 04BBA1
Total Depth: 160
Elevation (ft amsl)
5420
5410
5400
5390
5380
5370
5360
5350
5340
5330
1965
1975
1985
1995
2005
2015
04N 26E 16ABB1
Total Depth: 139

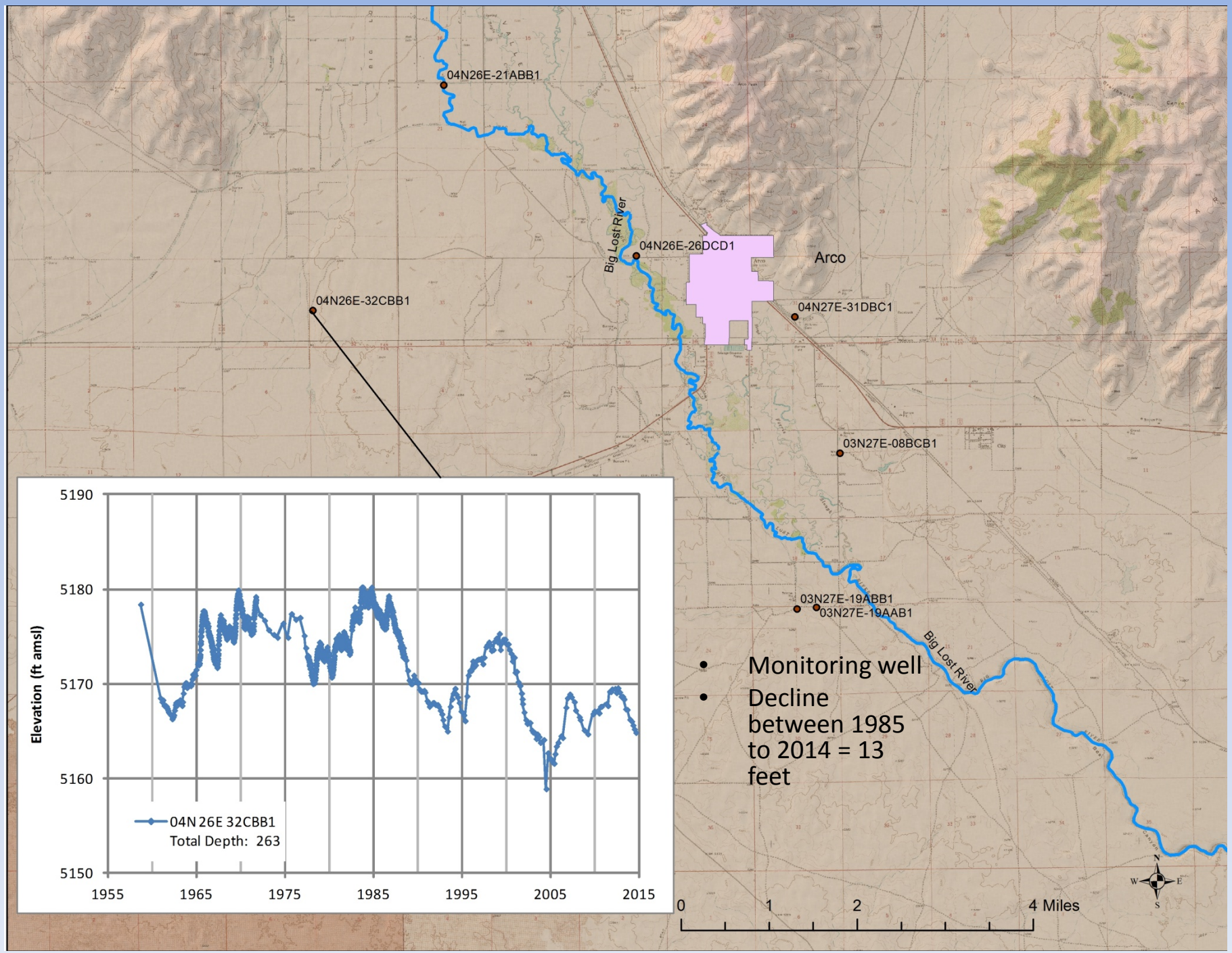

05N26E-32DBA1
04N26E-16ABB1
04N26E-21ABB1
04N26E-26DCD1
04N26E-32CBB1
04N27E-31DBC1
03N27E-08BCB1
03N27E-19ABB1
03N27E-19AAB1
Big Lost River
Arco
Monitoring Well
Decline between 1985 to 2014 = 23 feet
Unused domestic well (trap club)
Decline between 1985 to 2014 = 30 feet
Elevation (ft amsl)
04N 26E 21ABB1
Total Depth: 760
04N 26E 26DCD1
Total Depth: 143
0
1
2
4 Miles
N
S
E
W



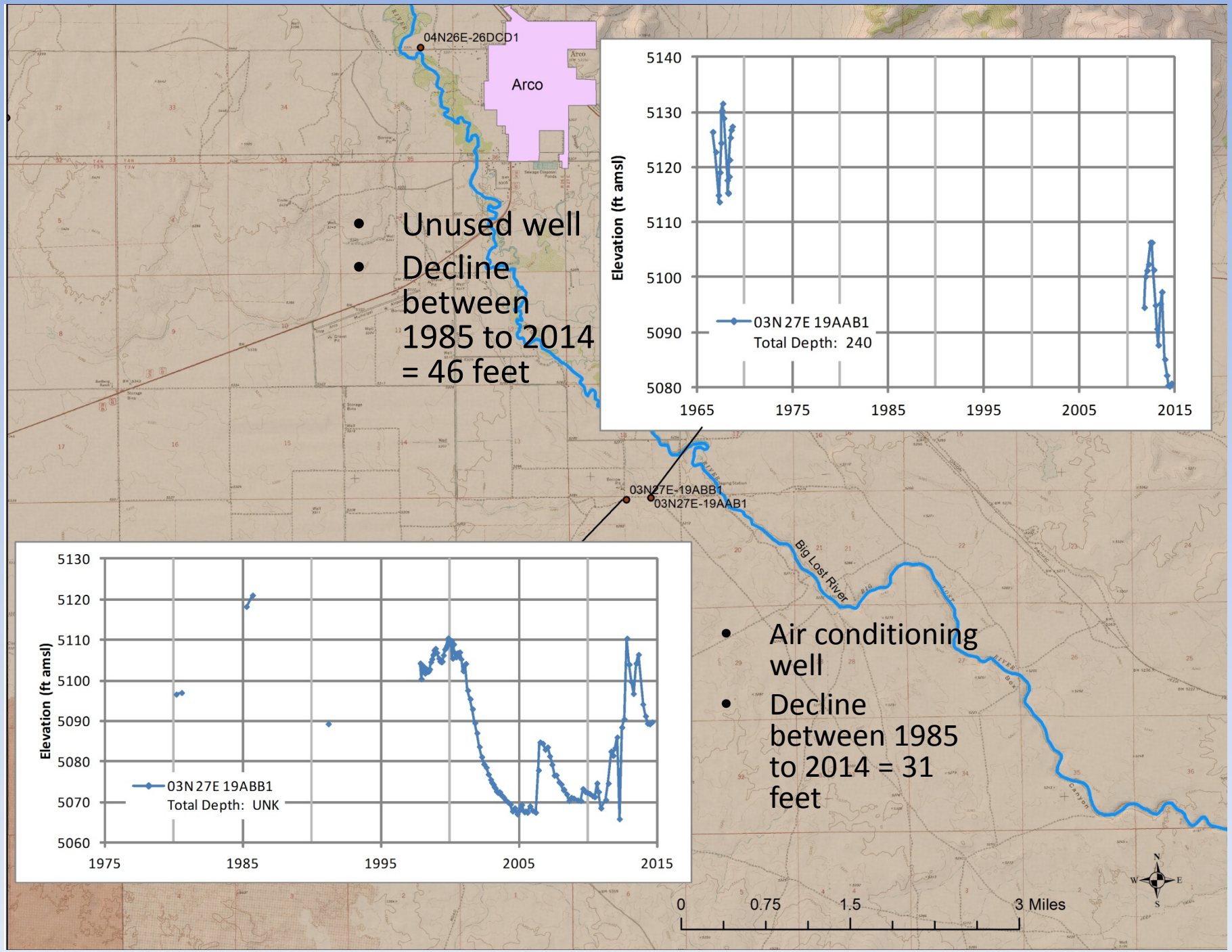
- Unused domestic well
- Decline between 1985 to 2014 = 2 feet



- Irrigation well
- Decline between 1985 to 2014 = 10 feet



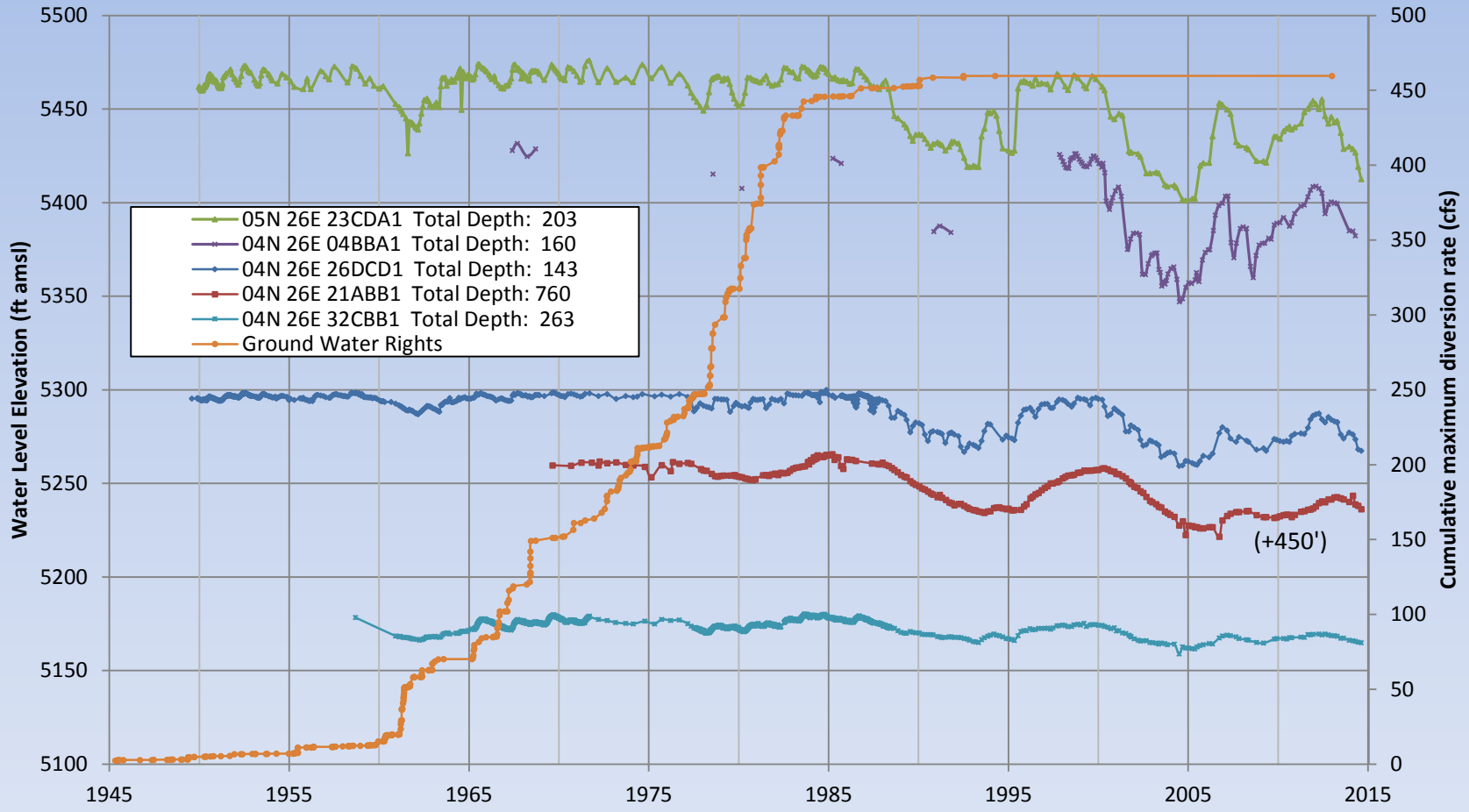
- Monitoring well
- Decline between 1985 to 2014 = 13 feet



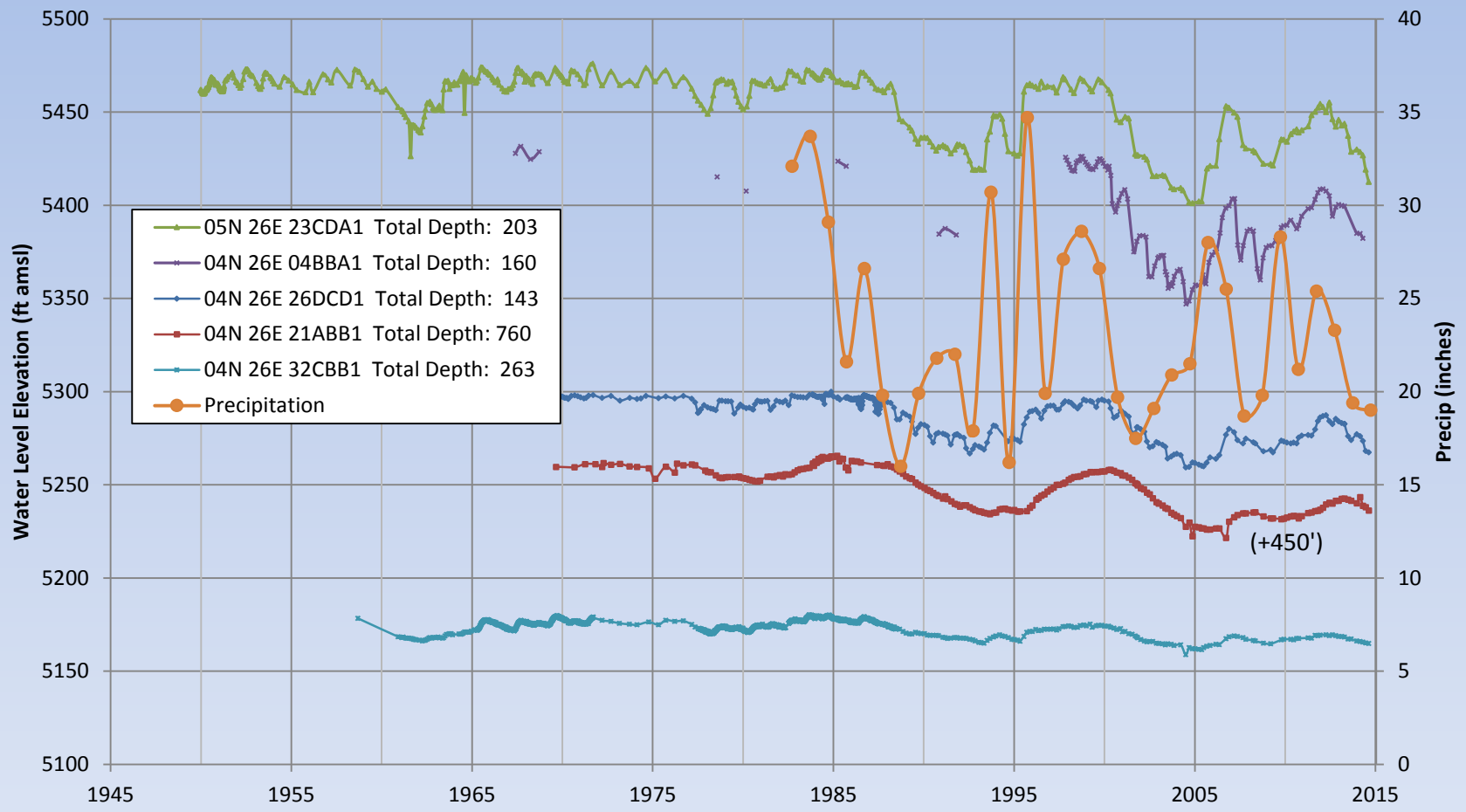
- Unused well
- Decline between 1985 to 2014 = 46 feet

- Air conditioning well
- Decline between 1985 to 2014 = 31 feet

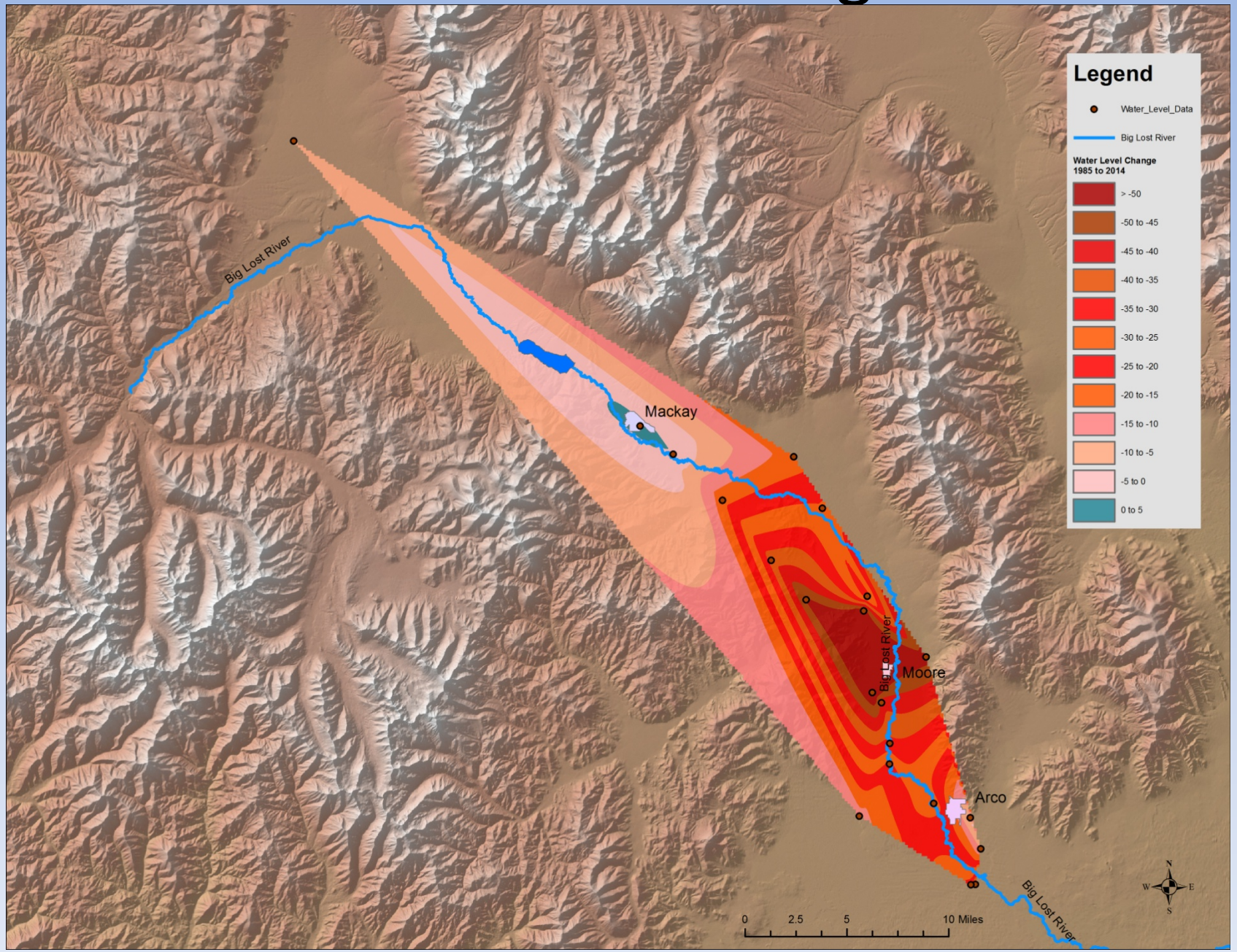
Summary of hydrographs



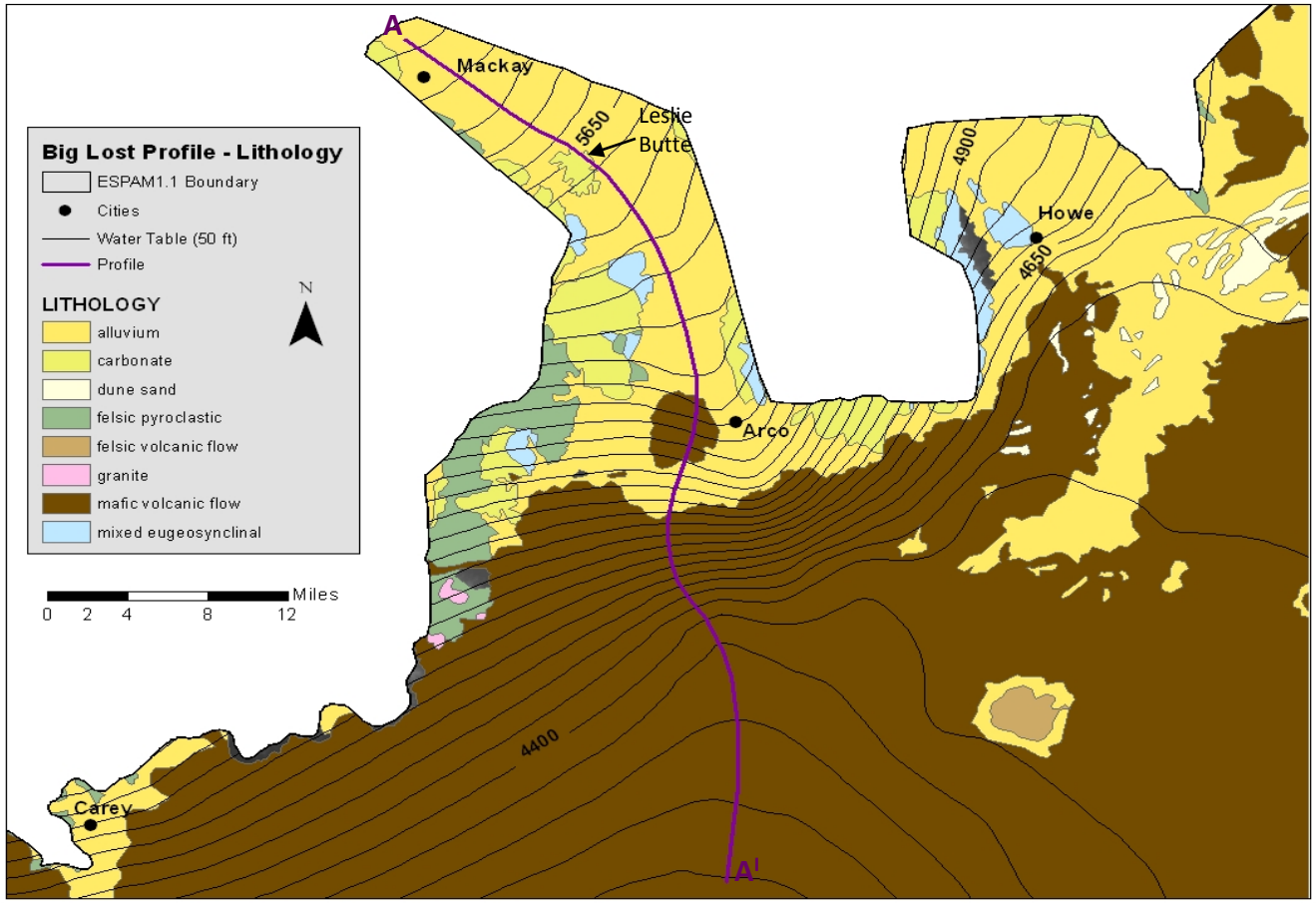
Water Levels vs. Precip



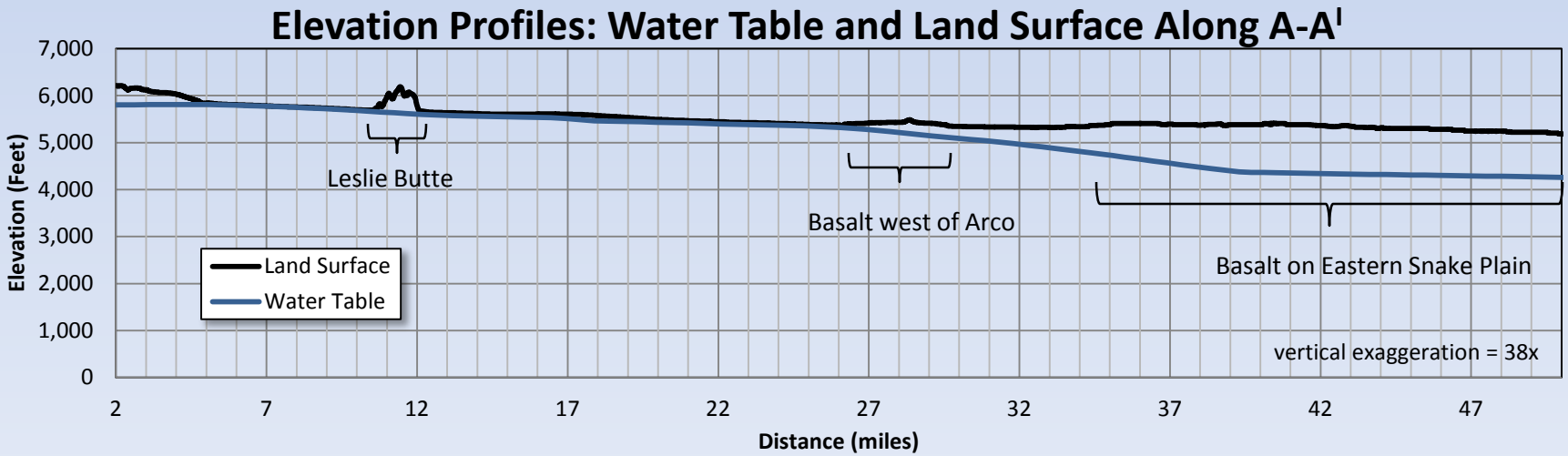
Water Level Changes



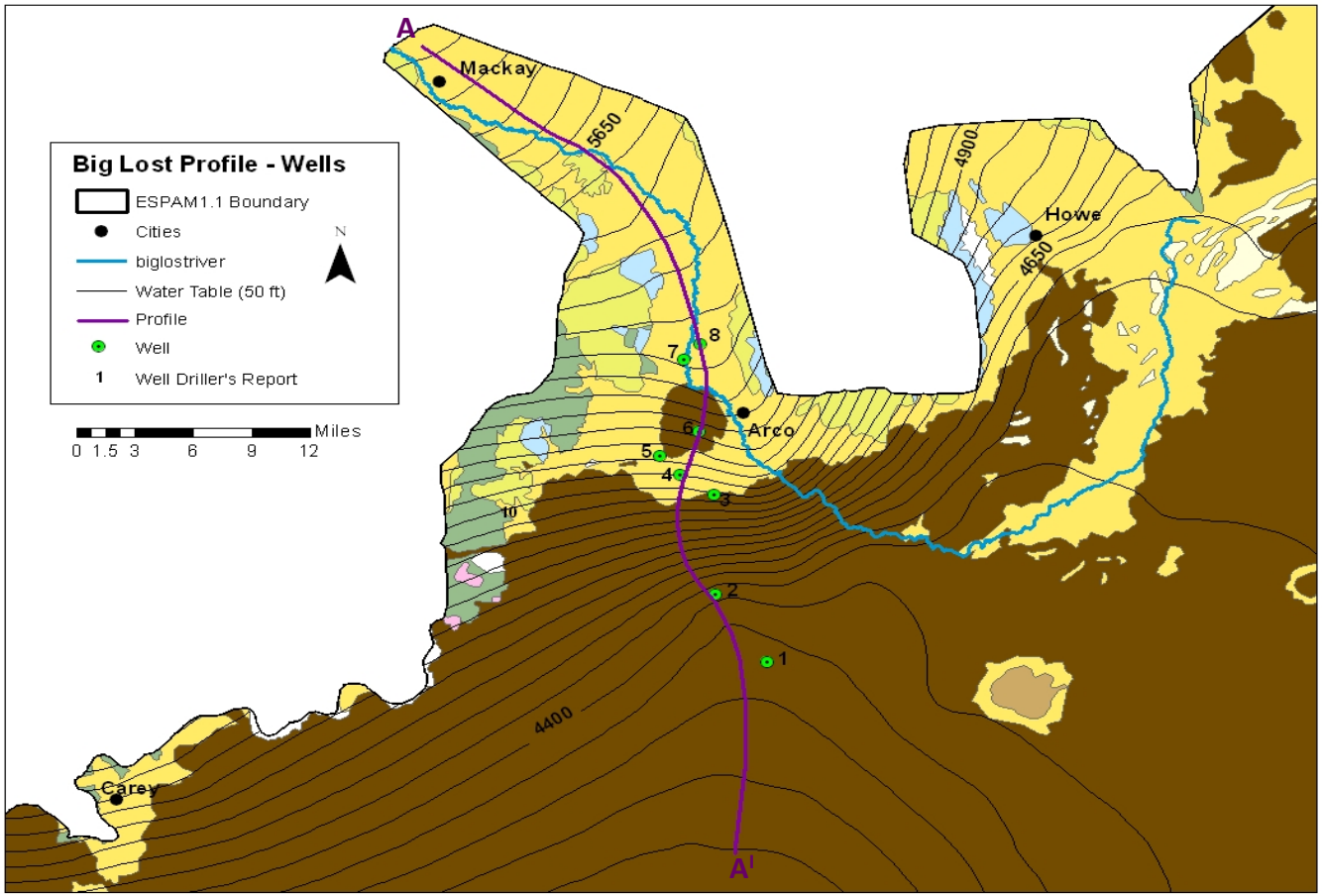
Big Lost – Snake Plain Lithology



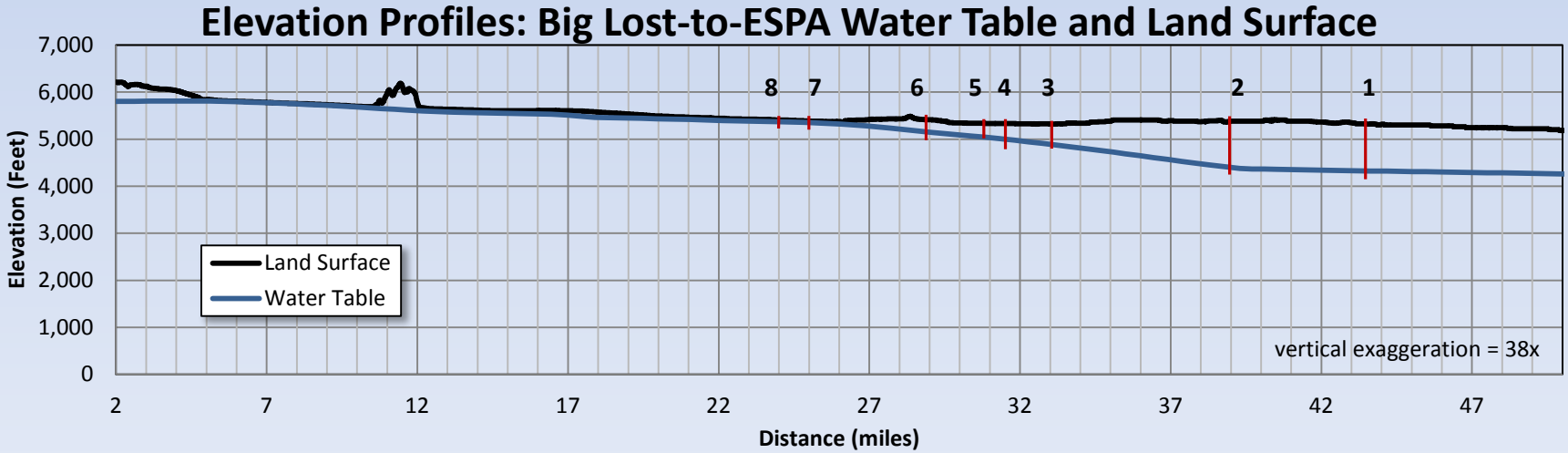
Lithology map for the Big Lost area (USGS, 1995).
Water table based on Spring 2008 data.



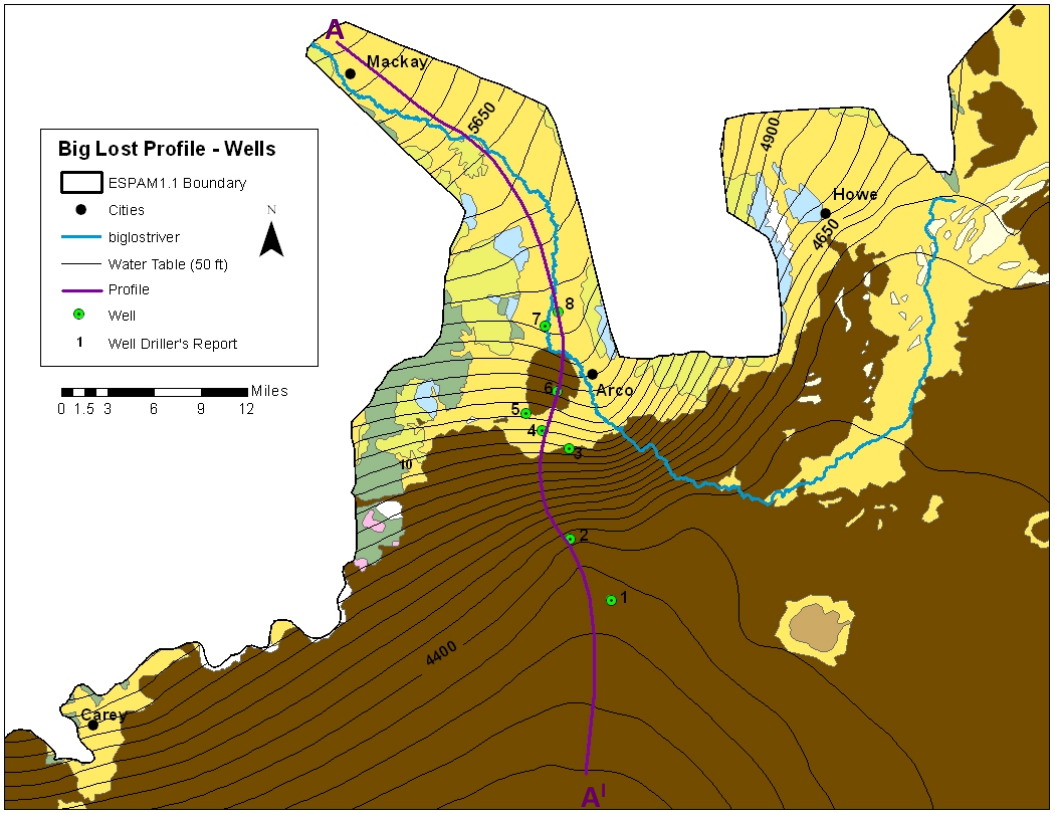
Big Lost – Snake Plain Lithology and Wells



Lithology map for the Big Lost area (USGS, 1995) illustrating selected wells. Water table based on Spring 2008 data.



Big Lost – Snake Plain Transition Hydrogeology



Lithology map for the Big Lost area (USGS, 1995) illustrating selected wells.

Inspection of the surface lithology and well drilling reports (well logs) in the Big Lost area indicates that the boundary between the Big Lost basin the regional Snake River Plain is characterized by a transition from a sedimentary filled basin to a basalt plain (Wells 3, 4, 5 and 6). Wells in the transition area show that water is produced from mixed sediments and basalt. Up-gradient of the transition area, the aquifer is typically composed of fluvial sediments – sand, gravel and clay (Wells 7 and 8), and show that water is in sand and gravel deposits. Downstream of the transition area, the aquifer is characterized by thick sequences of high-transmissivity basalt (Wells 1 and 2).

The transmissivity in the area south of Arco, where there is a transition from sediments to basalt, is effectively reduced via two mechanisms:

1. Fine sediment deposition. As encroaching basalt flows dammed the ancestral Big Lost River, areas of slack water were created, which facilitated the deposition of clay. The lacustrine clay deposits are more laterally extensive than fluvial clay deposits, and therefore retard ground water more effectively.
2. The inter-fingering of basalt and sediments reduces the aquifer thickness in the transition area due to clay and impermeable basalts. The water bearing portions of basalt are typically at contacts between basalt flows and within connected fractures. The interfingered geometry does not possess the basalt-to-basalt contacts (or as many as on the plain), and the layering of sediments with basalt often results in basalt fractures that are filled with fine sediments.

Lithology shape file created from USGS Open File Report 95-0680, 1995.

Summary

- Overall water supply is governed by precipitation in nearby mountains.
- Historical gaining and losing reaches were geologically controlled.
- Current gaining and losing reaches are impacted by lowered ground water levels (less gaining reaches).
- Ground water levels are lower than 1985 conditions and appear to be continually dropping (last two years have seen record low water levels in some wells).
- Detailed investigations have not been recently conducted.
  - Water budget development
  - Detailed stream gaging
- Ongoing water level monitoring should continue to monitor aquifer levels within the valley.