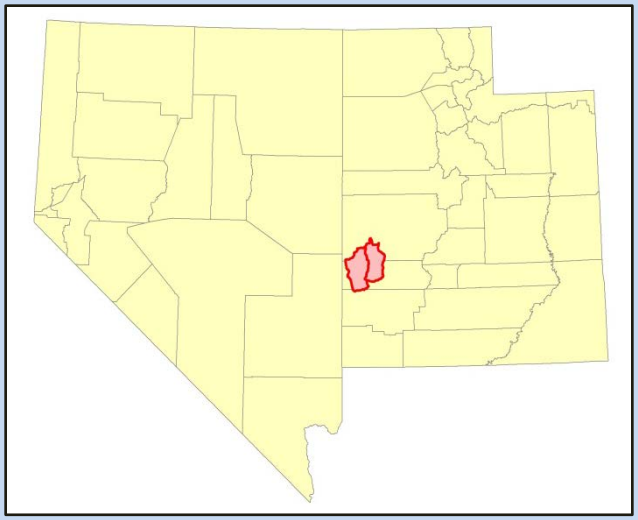
Assessing groundwater resources in Pine and Wah Wah Valleys, Iron, Beaver, and Millard Counties, Utah

Pine & Wah Wah are large, sparsely populated valleys in western Millard, Beaver, and Iron counties

- minimally developed groundwater resources
- limited springs & surface water resources are fully developed
- the groundwater system in these valleys is complicated and budget estimates, conceptual model, and numerical models are poorly constrained by hydrologic data



Study motivated by development proposals &water right filings

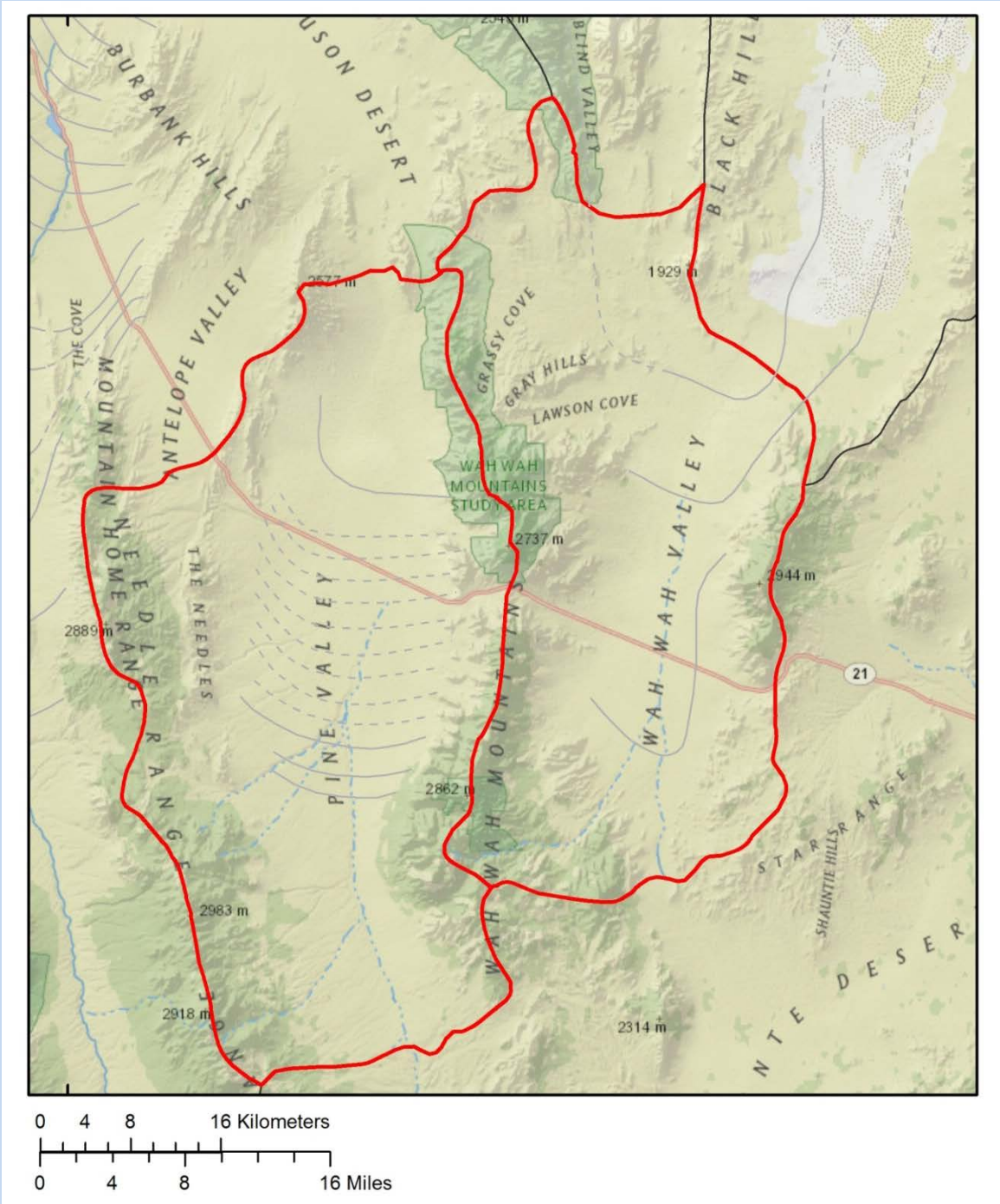
- likely to continue to be targeted for groundwater resource development

Project funded by CICWCD, Bureau of Land Management, Utah division of water rights, USGS cooperative water program

Hydrologic Setting

DNR Tech. Publications no. 47 and no. 51:

- Recharge = 28,000 acre-ft/yr
  - 21,000 in Pine Valley drainage basin
  - 7,000 in Wah Wah Valley drainage basin
- Discharge is 7,000 acre-ft/yr from springs and ET *in the mountains*
- Many (most) mountain springs are perched
- Deep valley water tables
- **No internal valley discharge**
- 21,000 acre-ft/yr leaves the valleys toward the NE via interbasin flow



Study Objectives

1) **Establish baseline discharge and natural variation at springs**
   (Wah Wah Springs & selected BLM springs)
2) **Collect information to *update conceptual model* of groundwater system**
3) **Evaluate connection of mountain springs to valley aquifer**
4) **Use new data to *update & improve GBCAAS numerical model***

Proposed Approach

1) Monitor spring discharge
2) Well inventory & update of pot. map
3) Geochemical /& environmental tracer sampling to evaluate
   - Groundwater ages
   - Groundwater flow paths
   - Groundwater sources
   - Connection between mountain springs and valley aquifers (susceptibility of springs to development)
4) Update groundwater evapotranspiration estimates at Sevier Lake and in Tule Valley
5) Update BCM recharge estimates BCM (1940 – 2013)
6) ~~Drill & construct new monitoring wells~~
7) Perform 2 aquifer tests
8) Update GBCAAS numerical model

3 year project - schedule

Project year 1 (work began September 2012)

- Begin continuous monitoring of Wah Wah Spring
- Well inventory & update of potentiometric map
- Geochemical sampling first set of sites

Project year 2

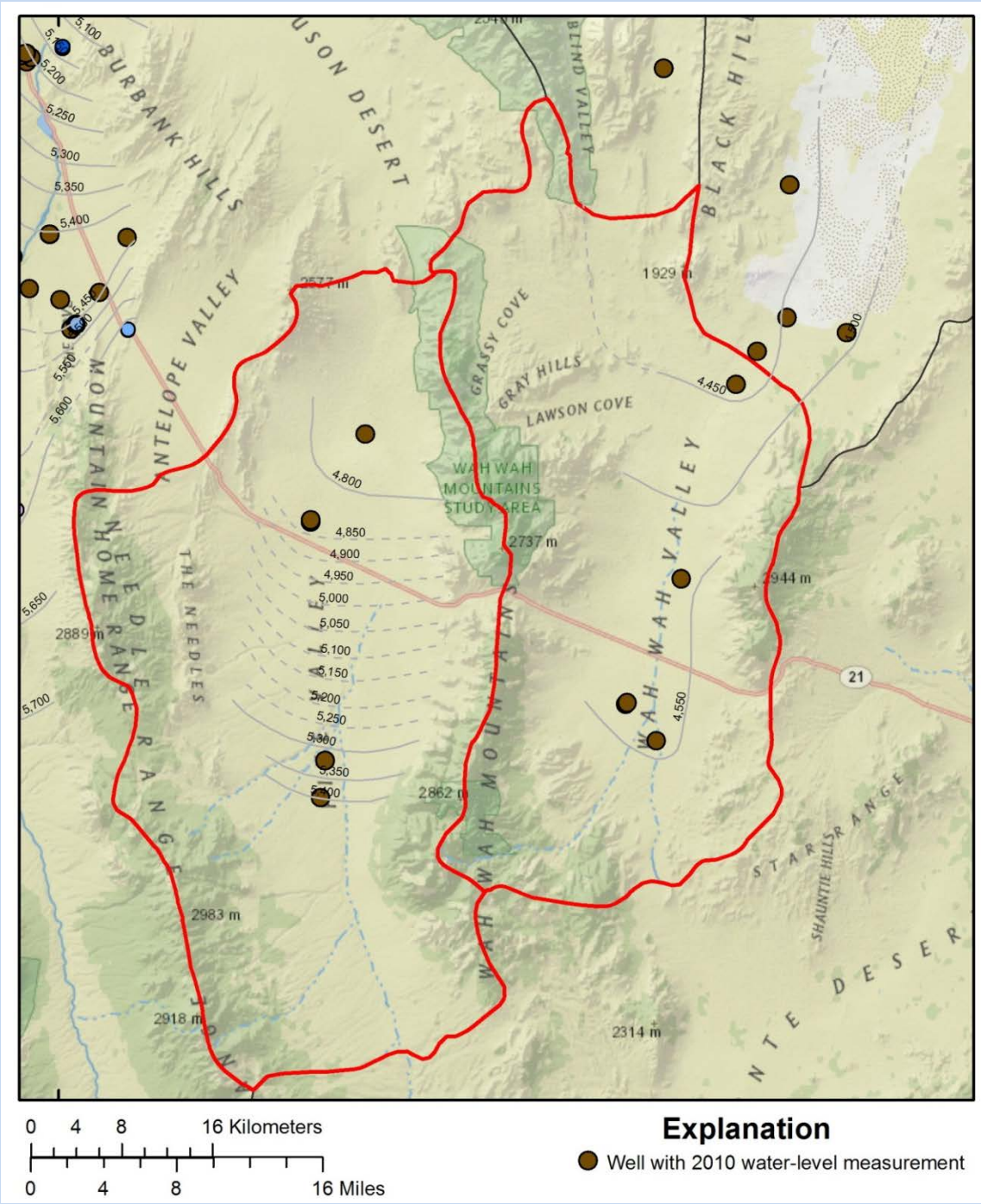
- Continue monitoring Wah Wah Spring + selected BLM springs
- Sevier Lake & Tule Valley ET update
- Perform aquifer test(s) in Pine and Wah Wah Valleys
- Geochemical sampling of second set of sites

Project year 3 - Continue monitoring selected springs

- Update basin characterization model (BCM) recharge estimates
- Update Great Basin Carbonate and Alluvial Aquifer System (GBCAAS) numerical model
- Synthesize results and compile report

Water levels prior to 2012

- Minimal water level data
- Interpreted general direction of groundwater flow toward the N-NE



Updated water levels – September, 2012

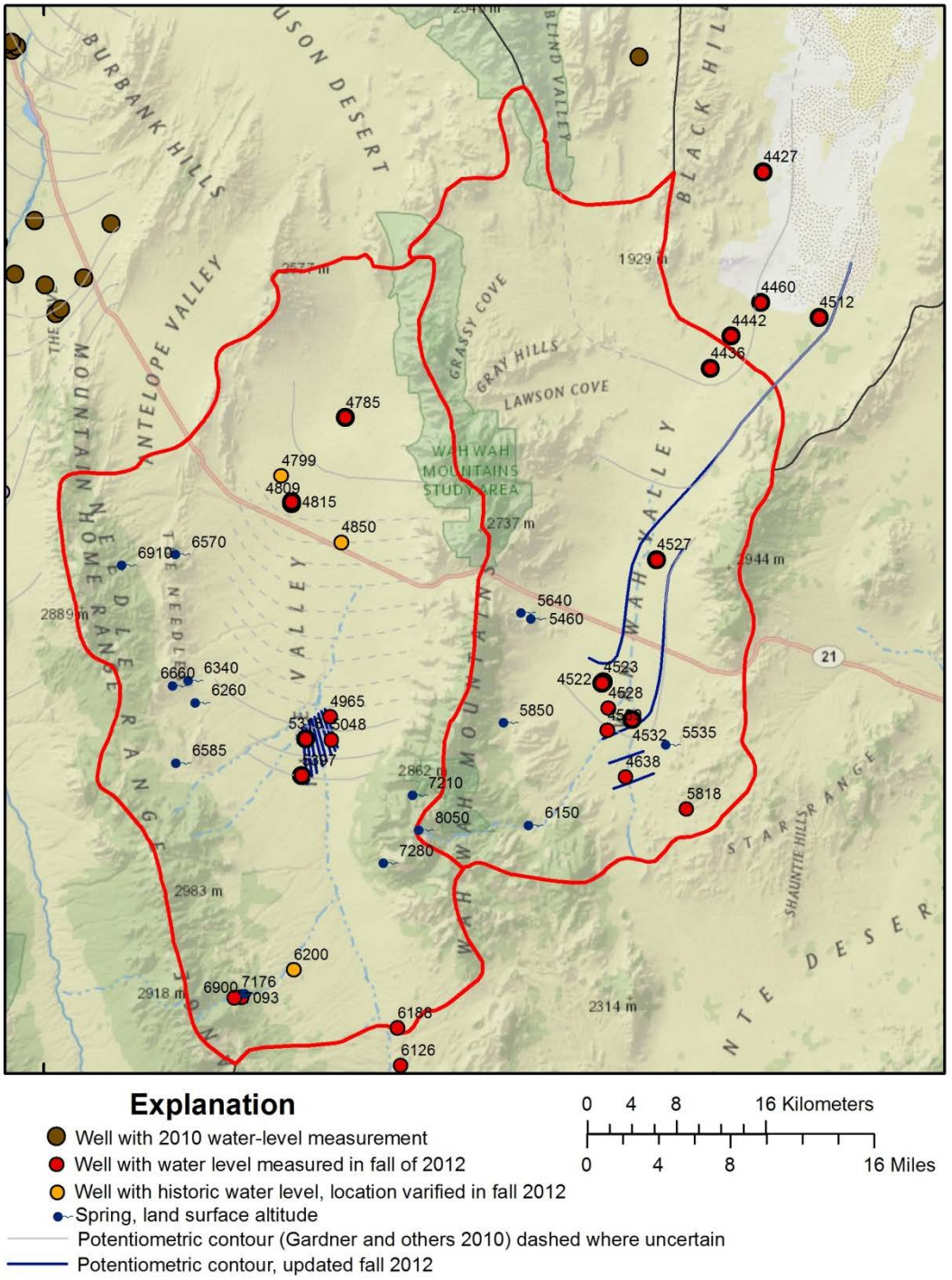
- 10 new “measured” water levels in valley wells

  (36 sites visited)

- Compiled springs and historic levels with verified locations

- Cannot assume homogeneous and isotropic basin fill as previously assumed

- Phelps Dodge water levels suggest a strong permeability contrast



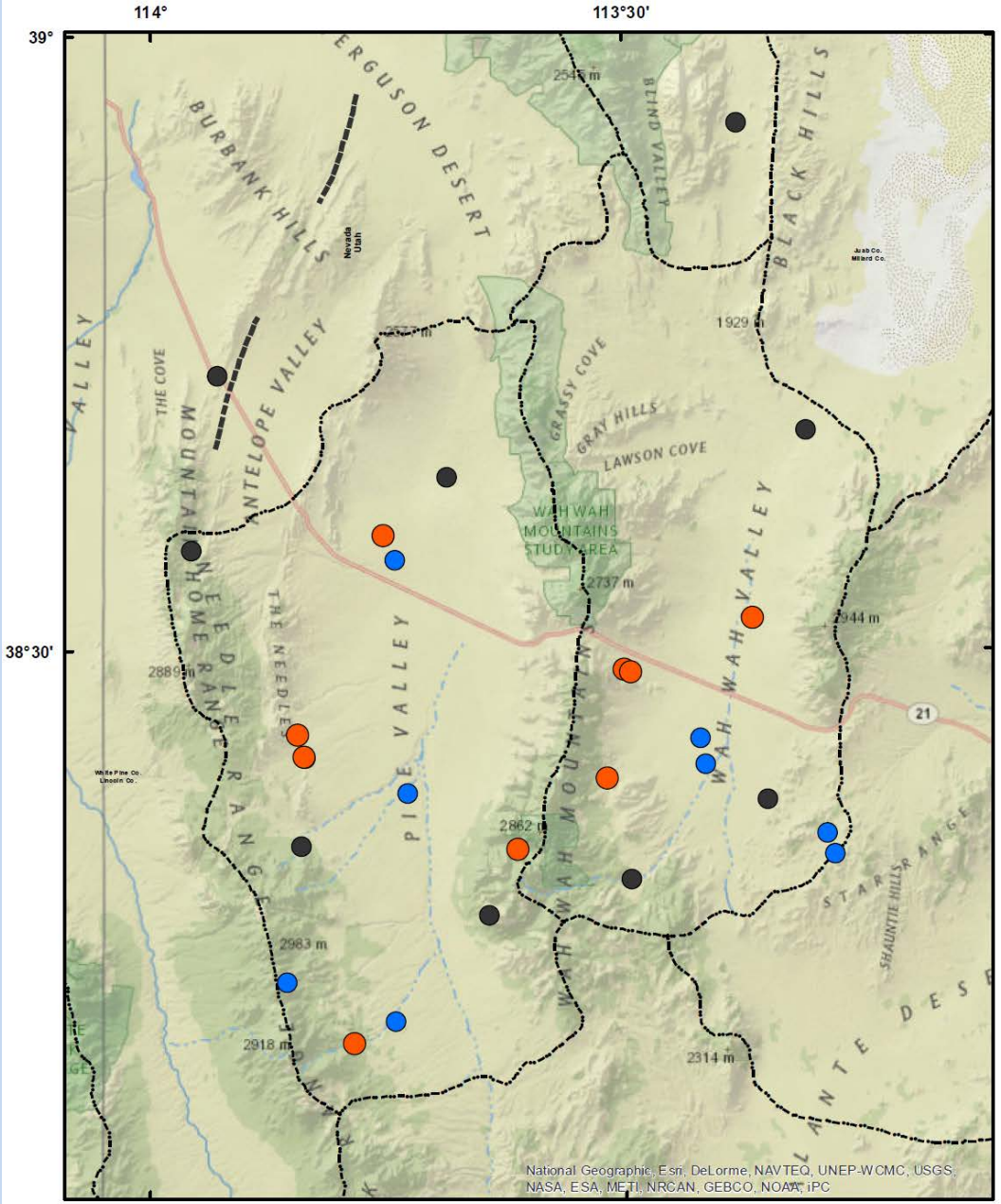
USGS

Sites sampled as of November 2013

Developing a piezometer prior to sampling at Willow Spring in Pine Valley

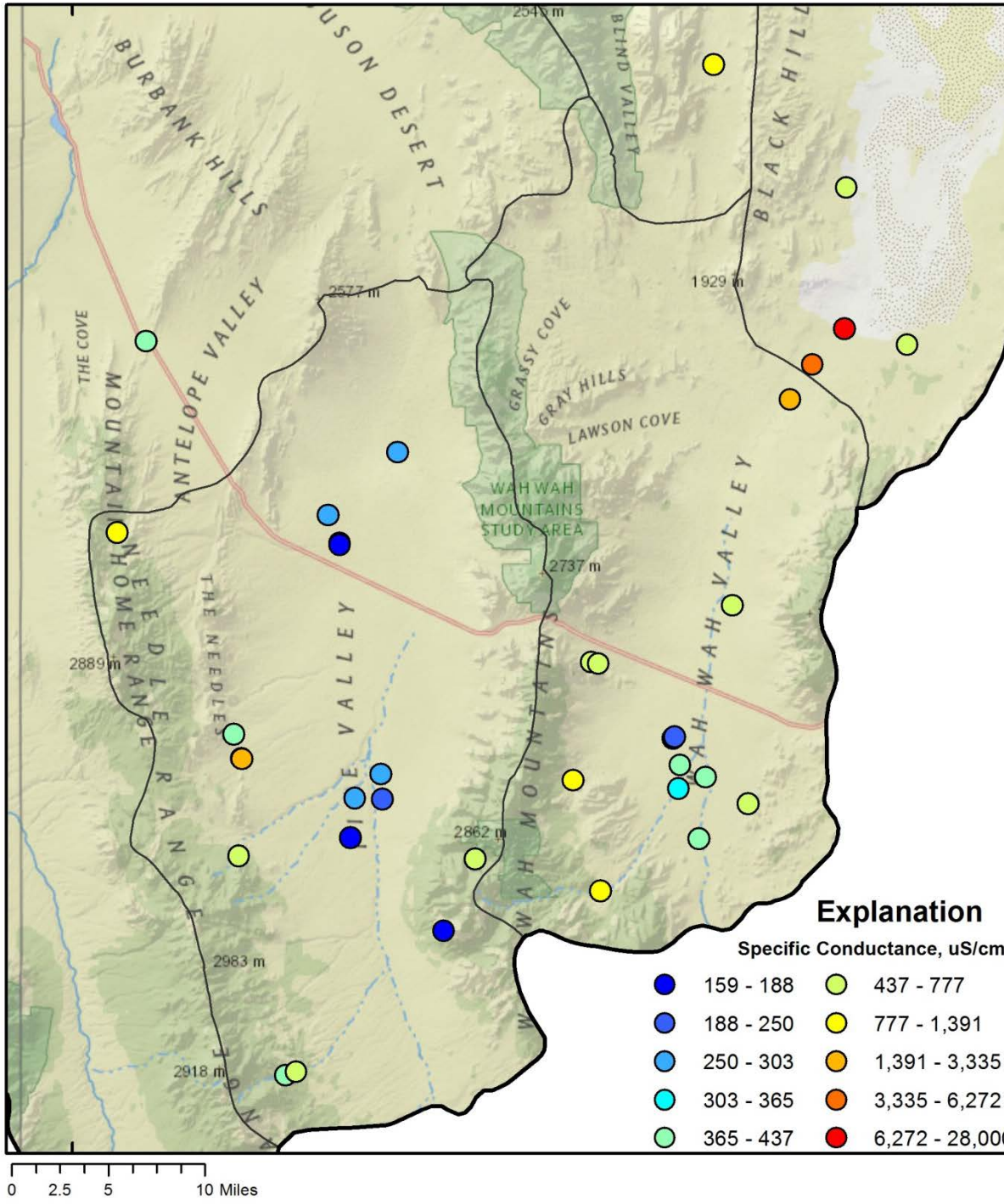
8 deep valley wells, 4 mtn. wells, & 12 mtn. springs

- Major dissolved minerals
- Stable isotopes of O and H
- Tritium, Carbon-14, SF_6
- Dissolved noble gases



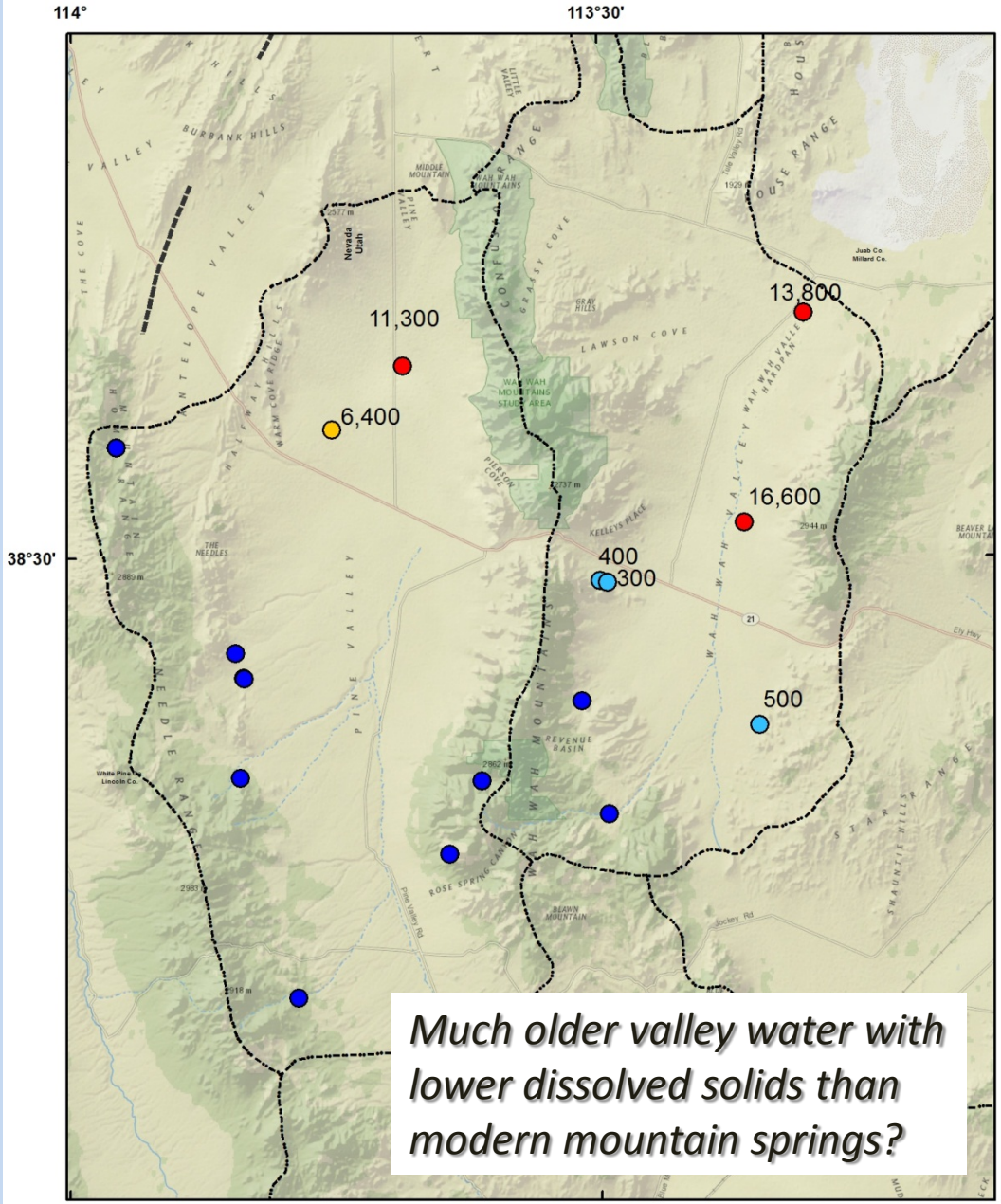
Initial look at dissolved solids

- 11 additional “valley” waters - SpC measured using E-tape USGS
- Suggests disconnect between valley-fill aquifers and mountain springs



Preliminary radiocarbon (^{14}C) ages

- Mtn. springs mostly modern
- Wah Wah & Antelope Springs Holocene but 100*s* of yrs old
- UNESCO DER well Holocene but 1,000*s* of yrs old
- Guyman Well, Wah Wah Well, & Wah Wah MX well look Pleistocene



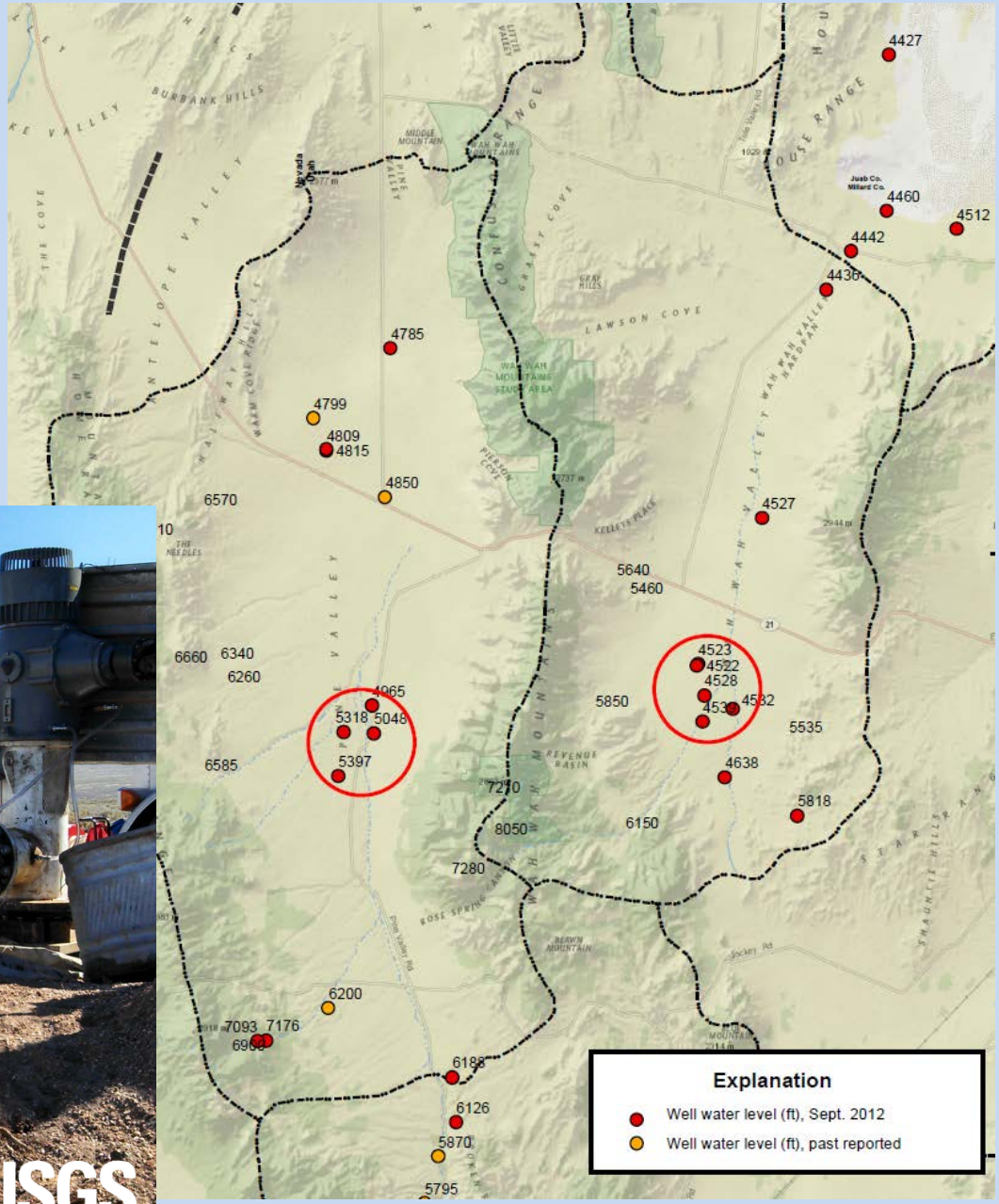
Aquifer Tests

- *Phelps Dodge wells in Pine Valley*
- *ESI Test Wells in Wah Wah Valley*

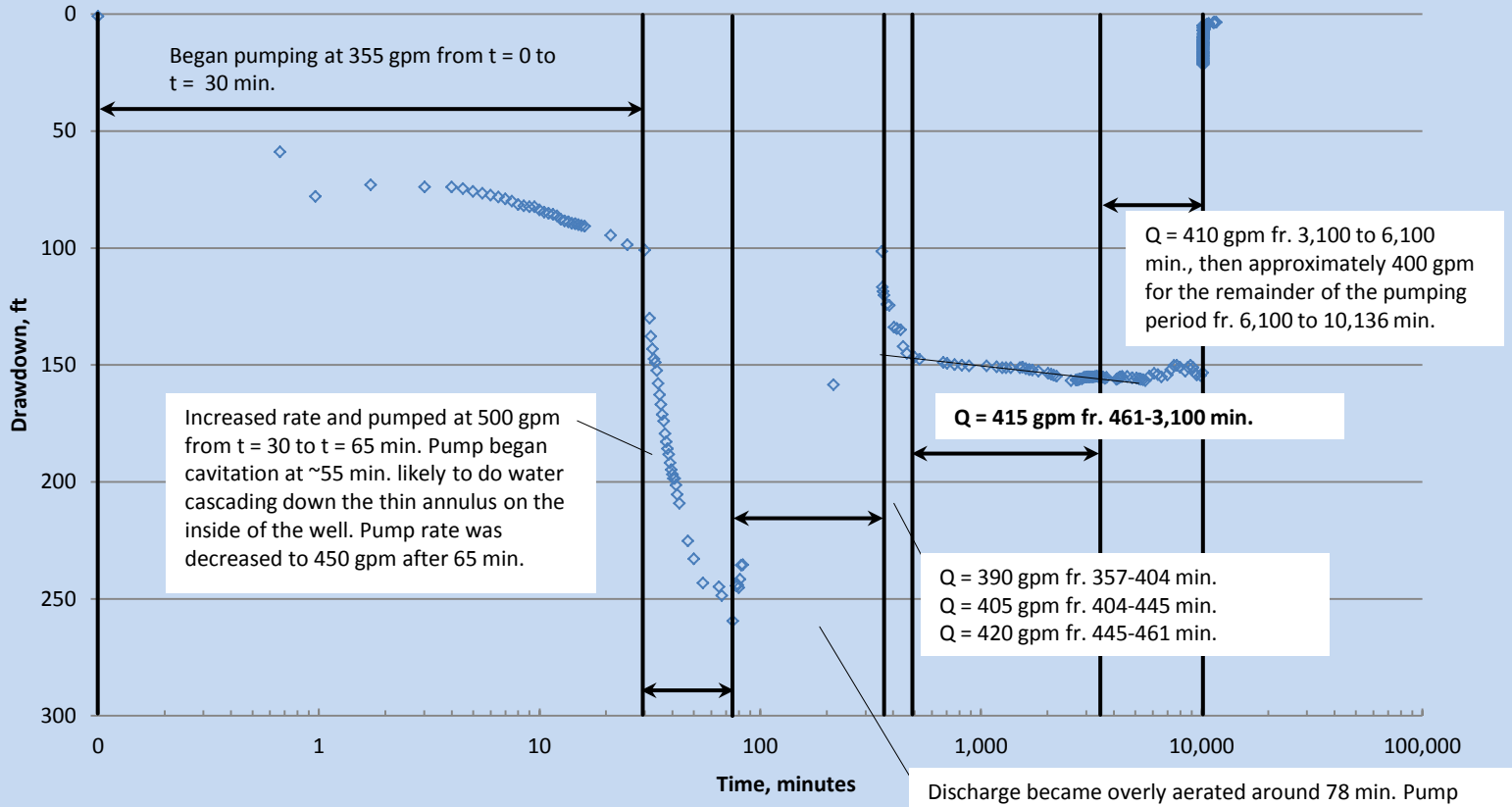
Challenges

- ***Existing wells, R > 1.5 miles***
- ***Static water levels > 600 ft bls.***

Beginning of pumping at Pine Valley aquifer test, Operational logistics by Grimshaw Drilling



Pine Valley Aquifer Test



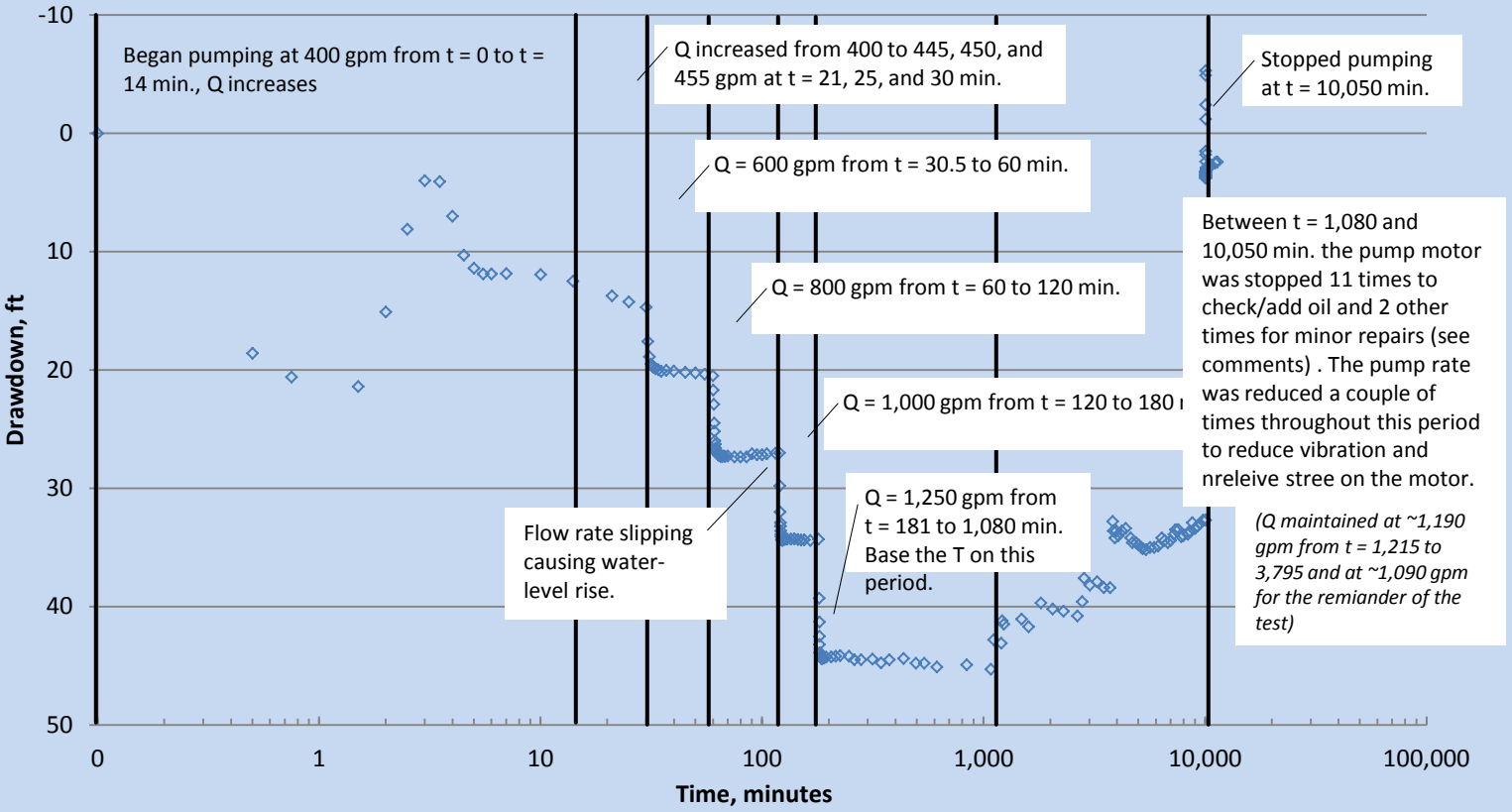
Preliminary results from pumping wells similar to single well tests from the 1980s

Discharge became overly aerated around 78 min. Pump operator advised we stop and surge to attempt to improve well development.
Surging was done from ~t = 92 to t = 187 min.

No water levels measured during surging.

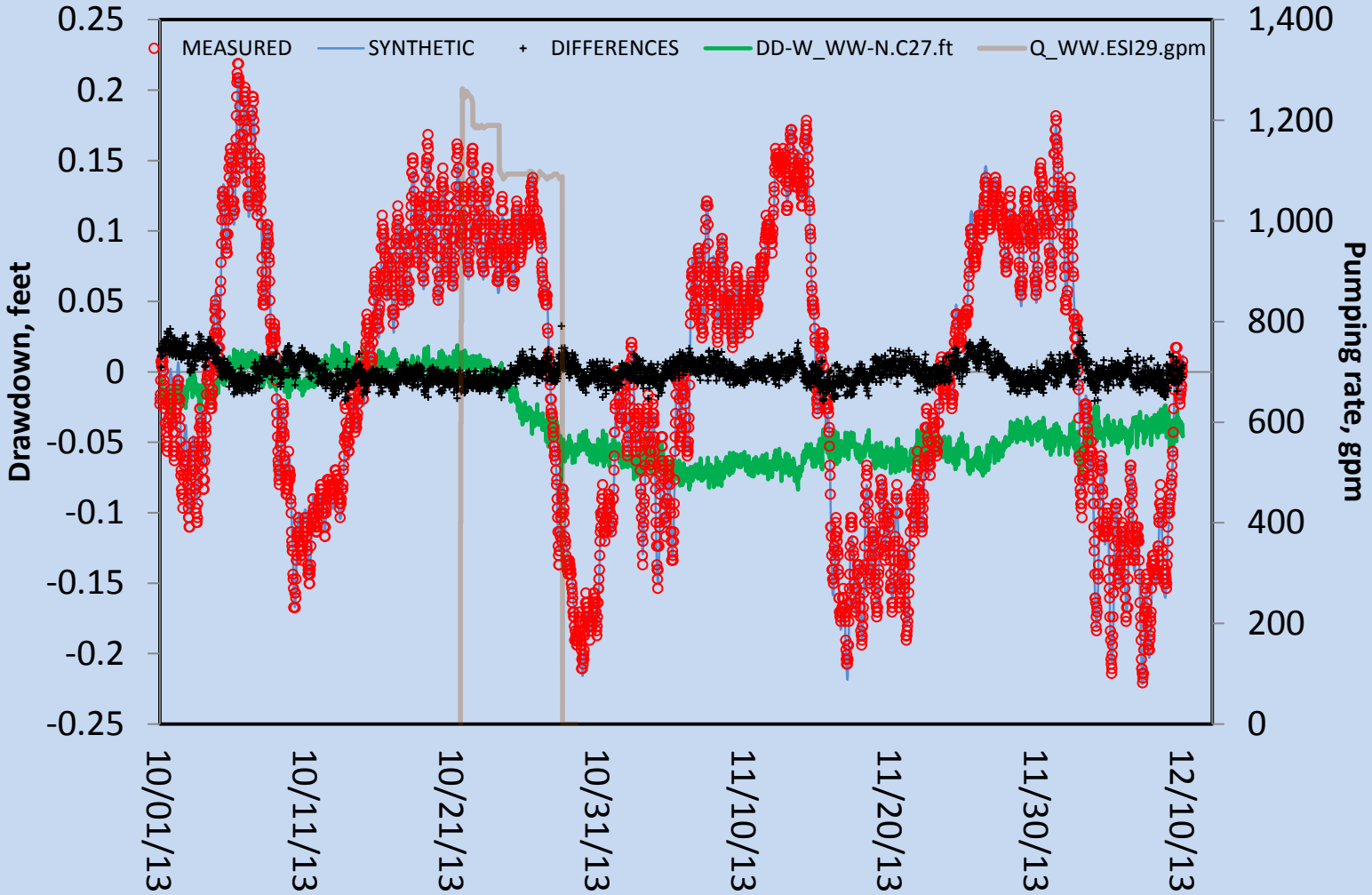
Then attempted to find sustainable pumping rate:
Q = 420 gpm fr. 187-220 min.
Q = 390 gpm fr. 220-240 min.
Q = 355 gpm fr. 240-284 min.
Stopped for 2 min to install restrictor plate.
Q = 355 gpm fr. 286-357 min. during sampling.

Wah Wah Valley Aquifer Test



Preliminary results from pumping wells similar to single well tests from the 1980s → other 24 hr single well tests are good indicator of transmissivity variation

Wah Wah Valley Aquifer Test



Drawdown observed 1.5 miles away from pumping well

→ T is higher to the north ands lower to the south

Project to finish end of federal FY 2015

All field work is completed, major tasks remain…

1) Await last round of chemistry results
2) Finalize aquifer test interpretation
3) Tule & Sevier Lake discharge update (*S. Buto, NV WSC*)
4) BCM recharge estimates (*A. Flint, CA WSC*)
5) Need to incorporate into *GBCAAS numerical model*