Coso Operating Company Hay Ranch Water Extraction Project Conditional Use Permit #2007-03

Update on Monitoring Data, Groundwater Modeling, 2021 Pumping Extension

Inyo County Water Commission
February 2022

Introduction

Coso Operating Company was granted a Conditional Use Permit (CUP) from Planning Commission in 2009 to transfer groundwater from Rose Valley into the Coso Mountains for its geothermal plant.

The project's EIR included a Hydrologic Monitoring and Mitigation Plan (HMMP)

In spring 2021 the project's groundwater model was updated by consultants, adaptive management as prescribed in the HMMP, resulting in a 4-year extension of pumping at a rate not to exceed 800 AF/yr from June 1, 2021 to May 31, 2025.

Tonight's discussion will briefly cover the project history and regulatory setting and detail the hydrologic data and recent modelling work.

Project History and Regulatory Setting

Coso has produced geothermal power since the 1980s. Fluid declines from evaporative cooling lead to decreased power production.

Coso owns land in Rose Valley including the “Hay Ranch” which pumped to produce alfalfa in the 1970-80s.

In the mid-2000s, Coso proposed to pump-groundwater from Rose Valley and construct a pipeline east into the Coso Mountains.

Inter-basin groundwater transfers are regulated by Inyo Co. Ordinance 1004 (Groundwater Ordinance) and require a CUP and CEQA analysis.

The Water Department serves as the technical lead on hydrogeologic issues.

Details: www.inyowater.org/projects/groundwater/coso-hay-ranch-project/

Project History and Regulatory Setting

From 2004-09 an EIR was prepared. There were significant concerns that drawdown would cause impacts to Little Lake spring discharge.

The HMMP relies on adaptive management using a numeric groundwater model and a monitoring network to prevent significant impacts to resources

The key EIR metric for determining significant impact was to limit groundwater discharge reduction at Little Lake to less than 10% of the pre-project amount

The CUP was approved by the Planning Commission and Inyo Board after appeal

Project has been implemented since 2009 according to the HMMP and from December 2009-21 (12 years), approximately 18,006 AF has been pumped.

Hydrology and Monitoring System

Rose Valley: 15 mi. long, 66 sq. miles, topographic and groundwater surfaces slope from north to south

Bounded by bedrock to west, east, and south. Hydrologic divide between Owens and Rose Valley

Southern groundwater discharges at Little Lake springs (9 miles south of Hay Ranch)

Similarities to Owens Valley: recharge from Sierra, subsurface sediments and structures, closed basin

Notable differences include: much less recharge and pumping, much deeper GW levels, isolated phreatophytic vegetation

Hydrology and Monitoring System

Monitoring network: 23 dedicated MWs and/or converted wells

MWs primarily along a N-S transect with E-W coverage

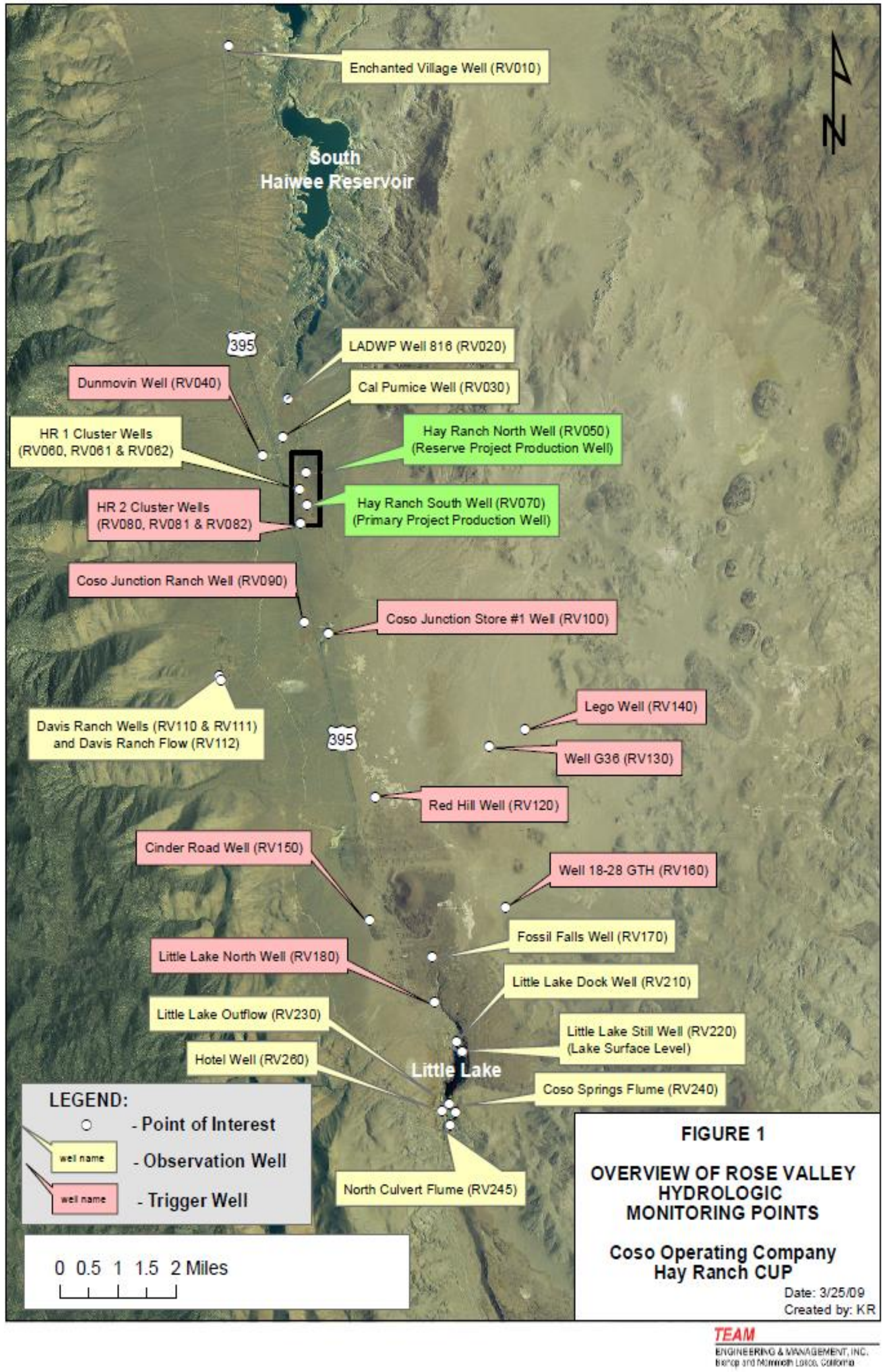
Totalizers on two Hay Ranch production wells

Precipitation gauges: South Haiwee and west of Little Lake Gap

Four flow gauges at Portuguese Bench (1) and Little Lake Ranch (3); and one staff gauge at Little Lake for lake level

Key MWs and all flow gauges have data loggers recording at 1 hour intervals with monthly manual measurements

Groundwater quality tracked by in-well salinity loggers and quarterly groundwater samples



Hydrology and Monitoring System

Bedrock impedes groundwater flow. Volcanic flows form a semi-confining layer. Springs form along N-S fractures.

Lake fed by primary springs along west shore. Spring discharge exceeds ET in winter allowing LLR to divert water south of the lake

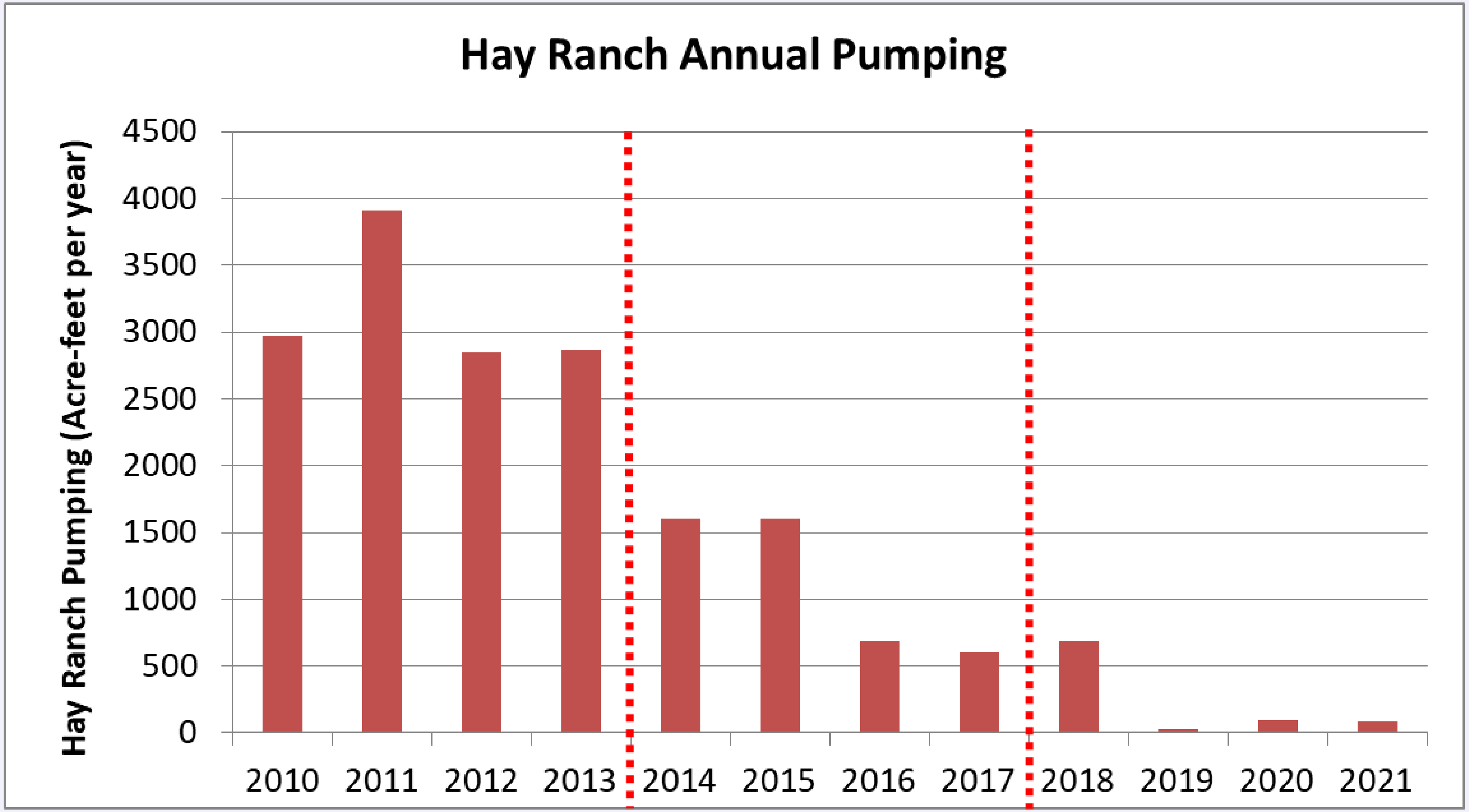
Monitoring gauges include: Little Lake North, Dock and Hotel wells, a Stilling well (lake stage); and three flow gauges (Lake Outflow, Coso Springs, and North Culvert)

A siphon well provides groundwater to two southern ponds

Surface water is totaled at the North Culvert flume before exiting south

Shallow groundwater and seepage near lake & ponds support phreatophytic/wetland vegetation

Monitoring Data



Average Annual Pumping

First 4 years = 3,150 AF/yr

Middle 4 years = 1,125 AF/yr

Last 4 years = 225 AF/yr

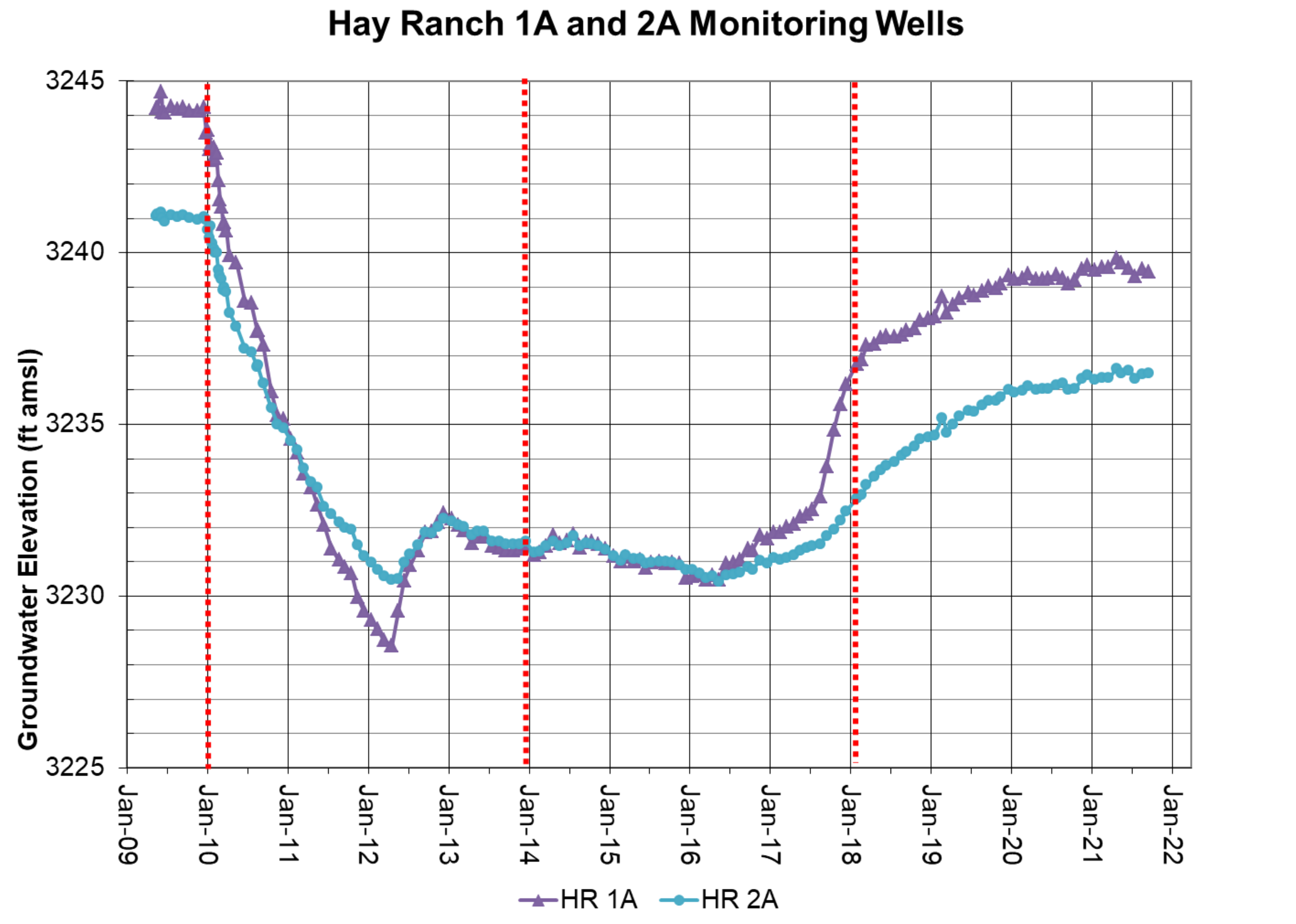
Recharge

Precipitation in Rose Valley: similar to OV but drier during drought years

12-yr average precip is 92% of long-term average

LADWP spread 3,862 AF in 2017 (appx 1 year's total recharge)

Monitoring Data



HR 1A and 2A Monitoring Wells

Immediately next to pumping wells

Steep declines in initial years

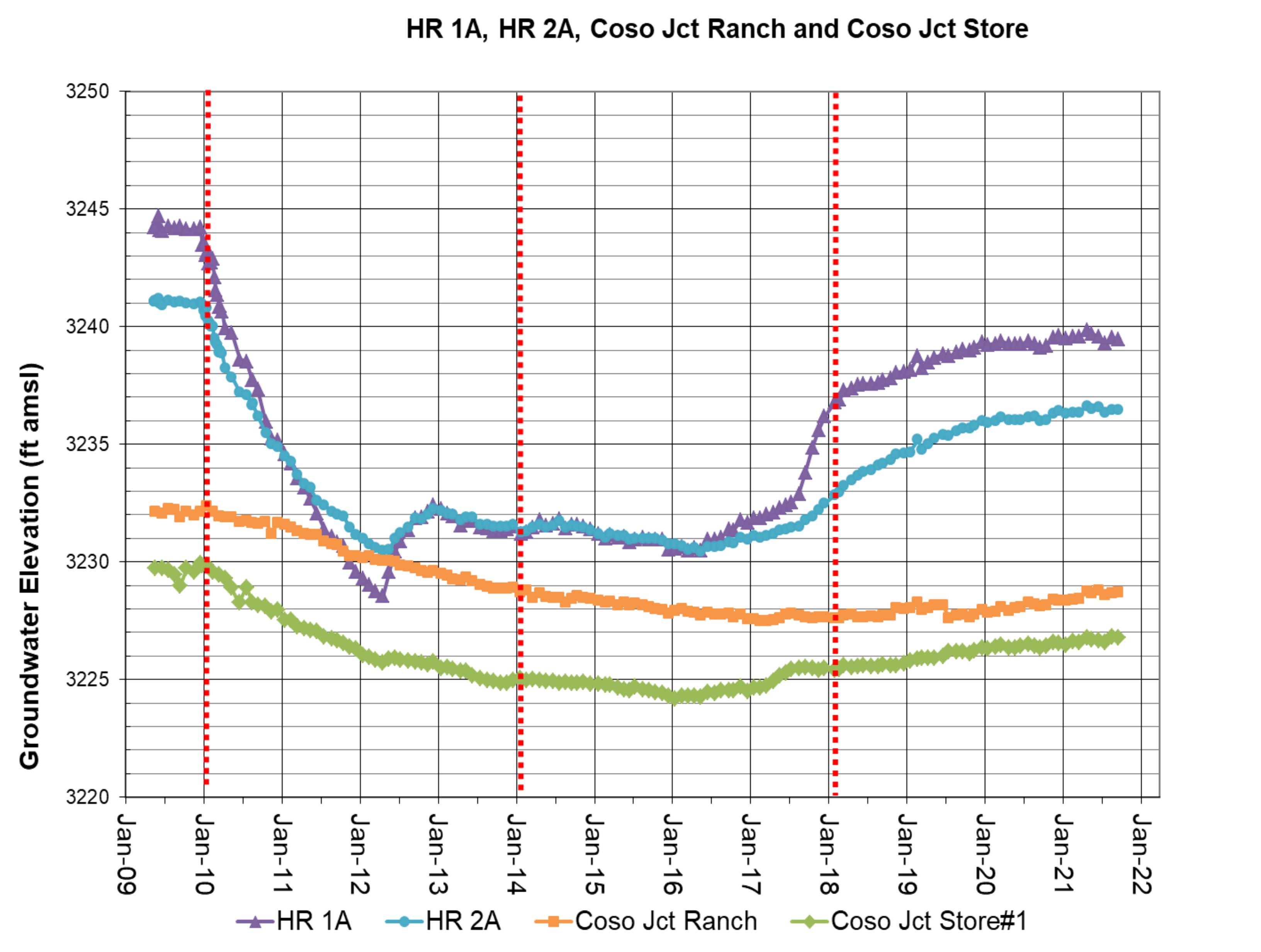
Stabilize as pumping slows (esp. 2016)

Continued recovery from 2017 water spreading and reduced pumping

Current depth-to-water (DTW) 5 feet below baseline

DTWs 200 feet below ground surface

Monitoring Data



Coso Ranch and Store Monitoring Wells

Appx 2 miles south of Hay Ranch itself

Drawdown begins within months of pumping, but at a much lower rate

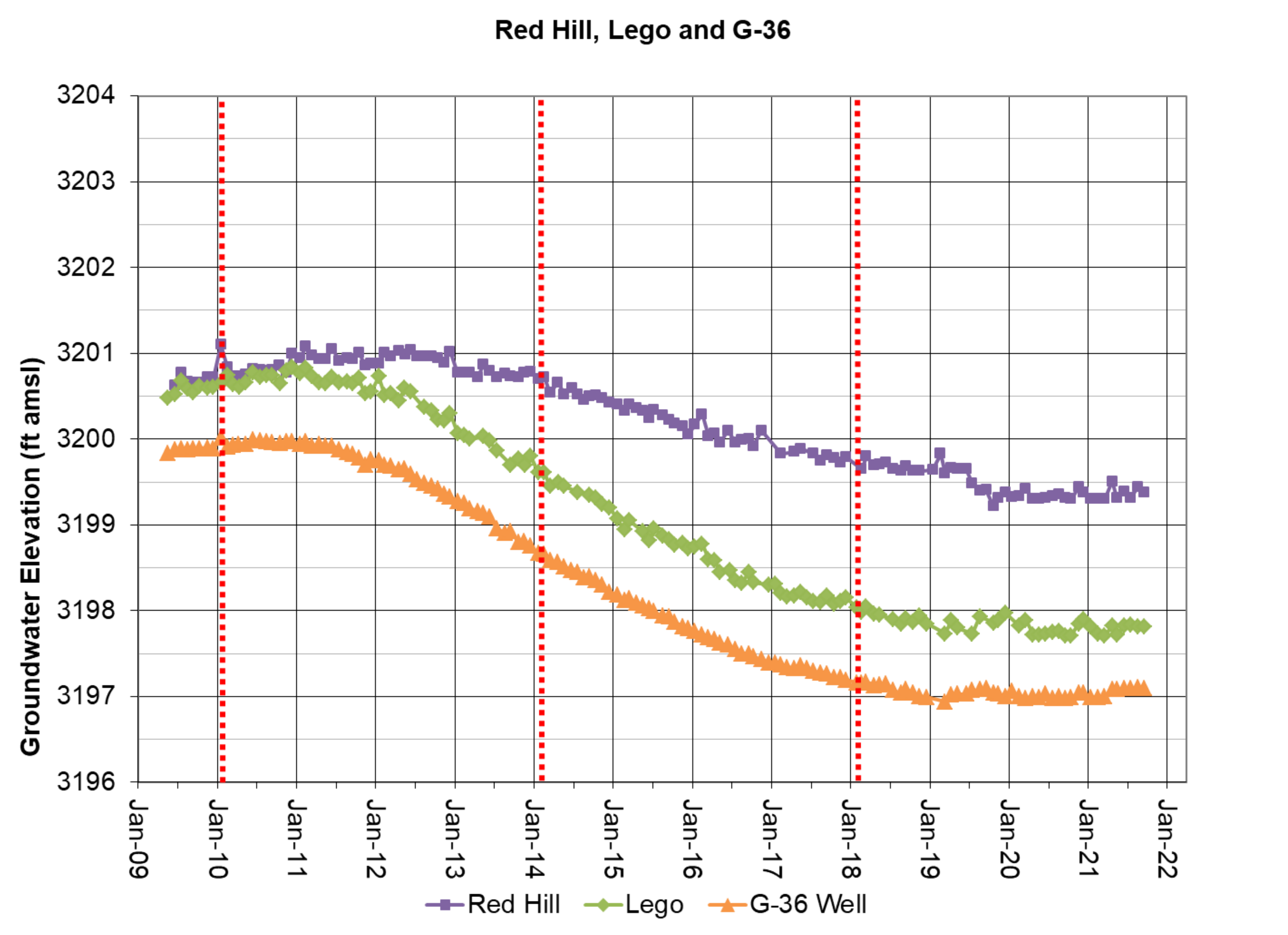
Stabilizes as pumping drops in mid years

Recovery related to both 2017 water spreading and very low recent pumping

Drawdown 3 feet below baseline

DTWs appx 145-175 feet below ground

Monitoring Data



Red Hill, G36, Lego Monitoring Wells

Appx 5 miles south of Hay Ranch

Drawdown begins 2-3 years after pumping initiated

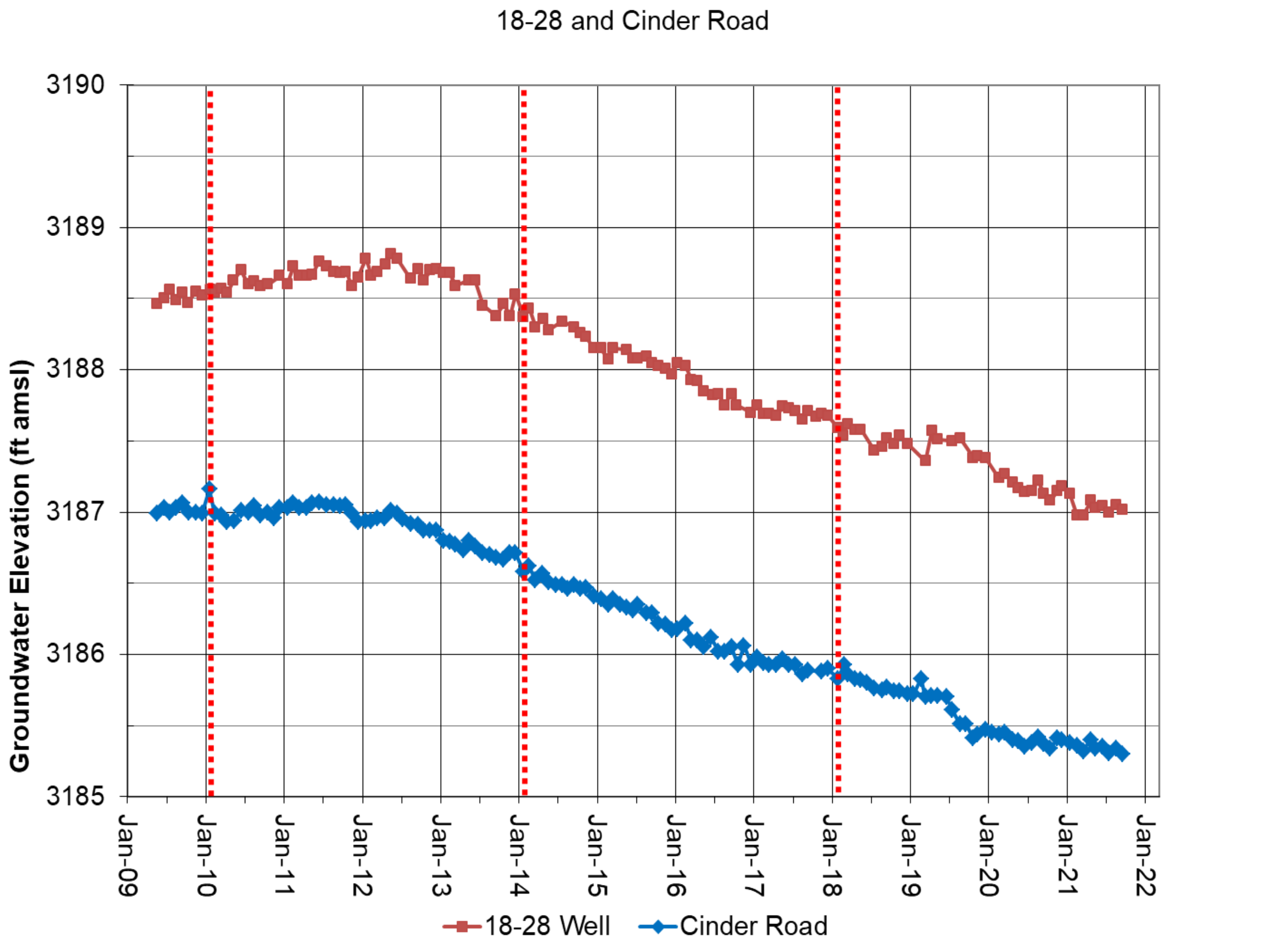
Drawdown stabilizes in 2018-2019

Earthquake step change in Red Hill well

Drawdown 2- 3 feet below baseline levels

DTWs appx 140-225 feet below ground

Monitoring Data



Cinder Road & 18-28 Monitoring Wells

Appx 7 miles south of Hay Ranch

Drawdown begins 2.5-3 years after pumping initiated

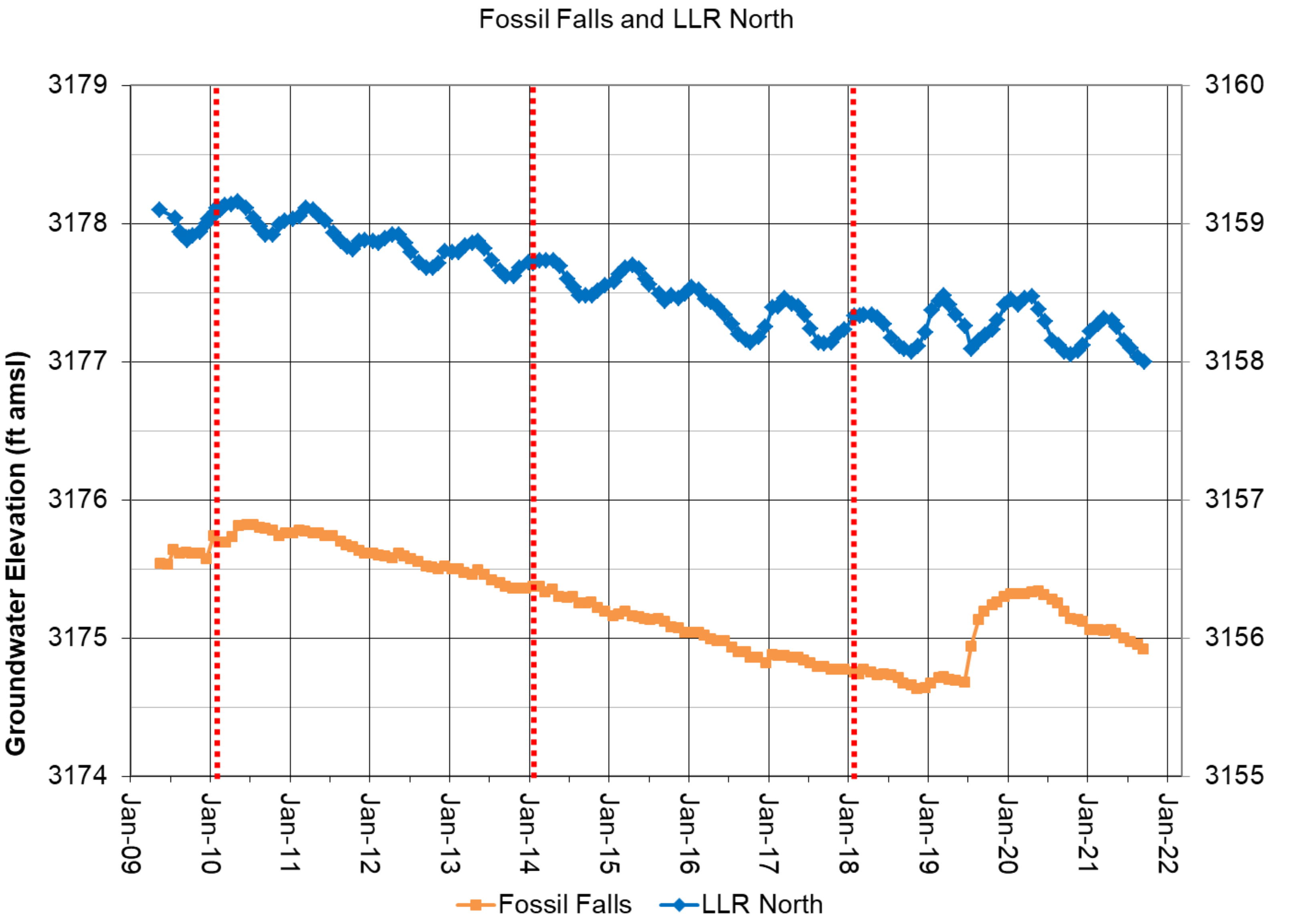
Drawdown stabilizes in 2021

Earthquake step change in Cinder Road

Drawdown 1-2 feet below baseline levels

DTWs appx 175-190 feet below ground

Monitoring Data



Fossil Falls and Little Lake North

8 miles south of Hay Ranch

Drawdown obscured by climate (drought) and annual lake cycle

Water levels decline during drought, stabilize during wet years at lower level

Earthquake step change in Fossil Falls

Water levels 0.75-1 foot below baseline

DTWs appx 40-140 feet below ground

LL North well and Lake Stage are in good hydrologic communication

Monitoring Data

Little Lake Area Monitoring Data

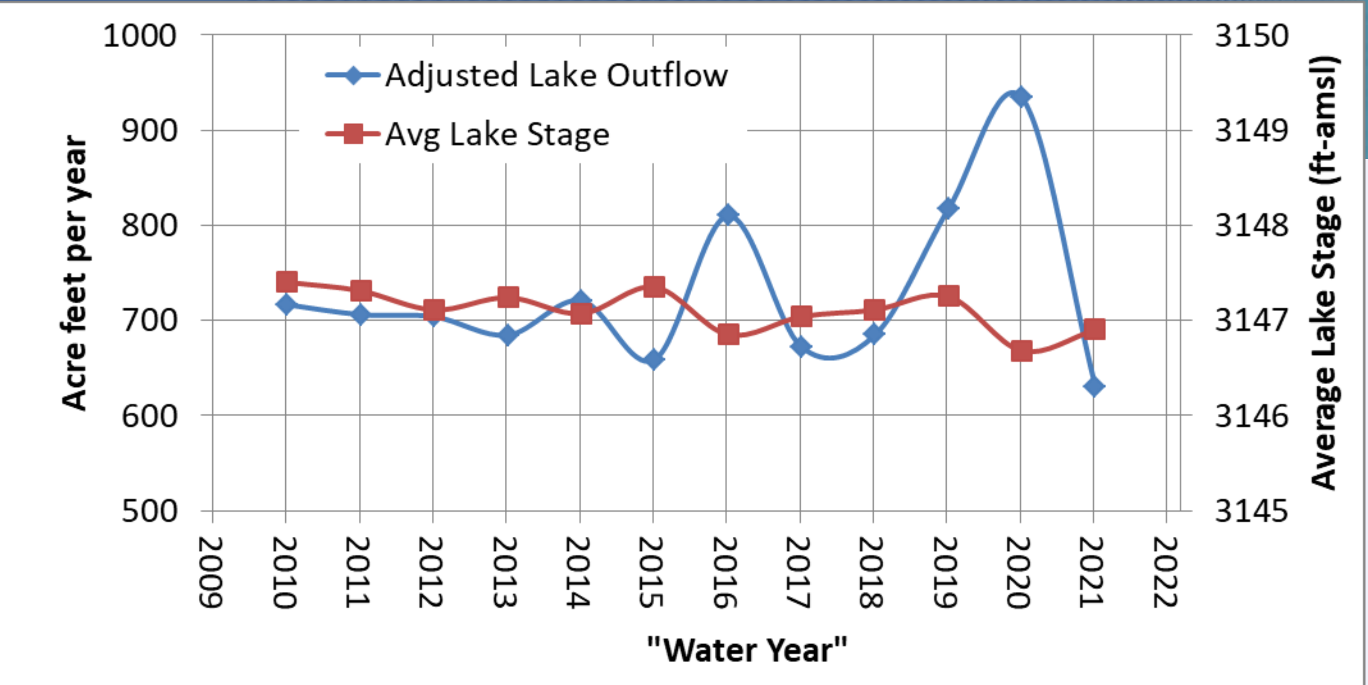
Spring flow is relatively constant but ET varies seasonally; lake stage is high in winter, low in summer

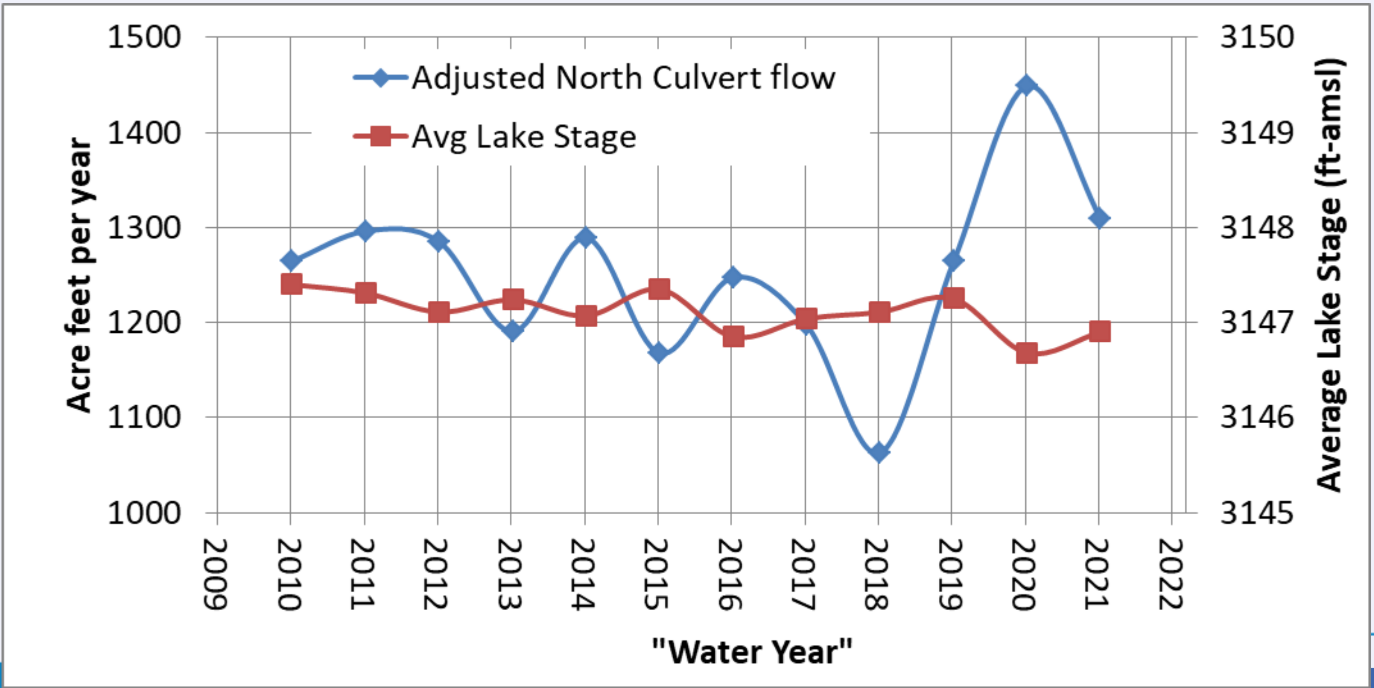
Flow from Lake, Coso Springs and North Culvert are measured; with North Culvert being the total

“Adjusted Flow Totals” use measured flow combined with precipitation, ET and stage change to estimate total discharge on an annual basis

Lake management actions are detected by monitoring system and affect annual outflows

Significant year-to-year variability, but long term trend in flows is stable/upward.





Groundwater Modeling and Adaptive Management

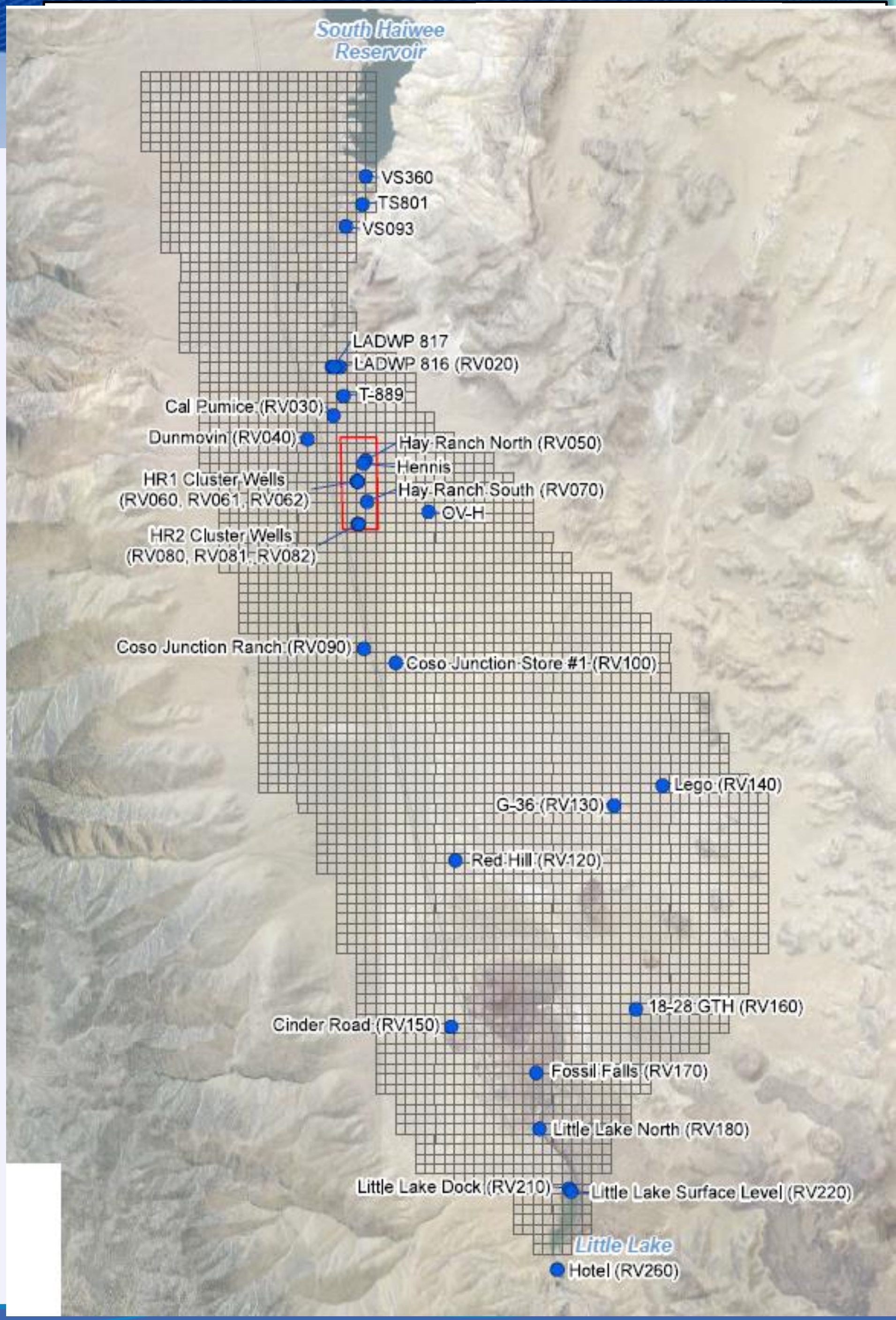
MODFLOW groundwater model calibrated to historic data including estimated pumping amounts from 1970-80s Hay Ranch and aquifer test

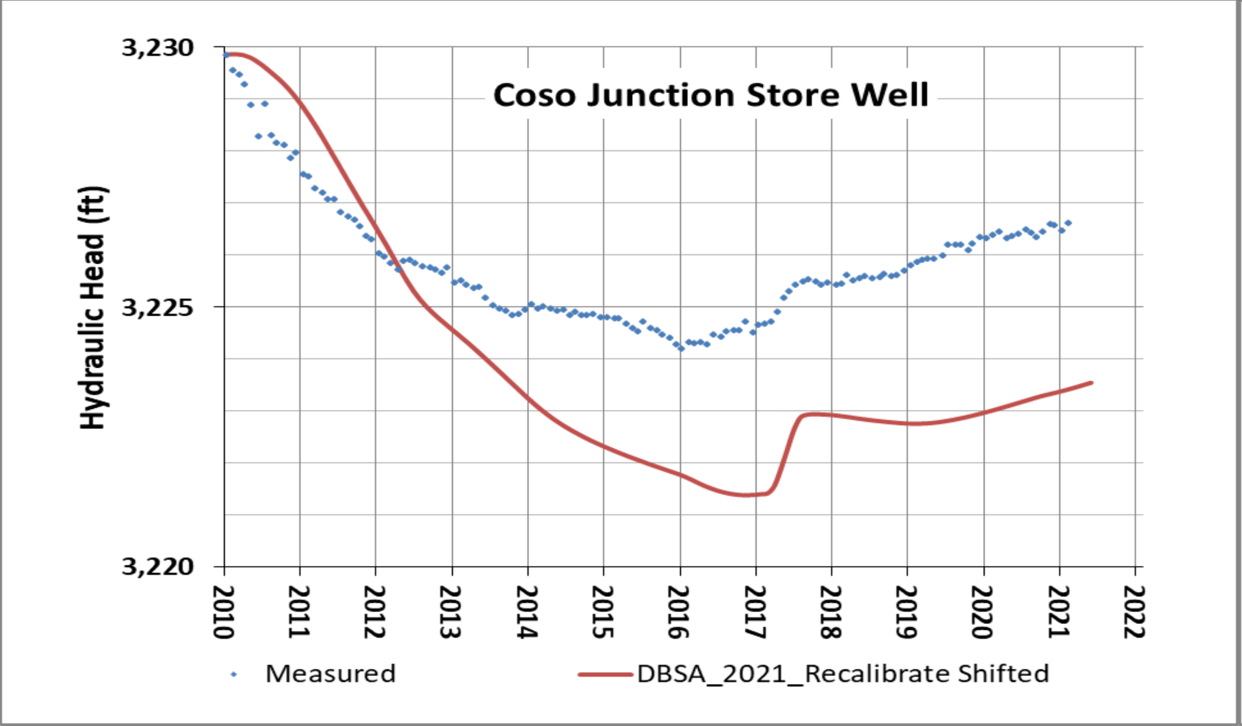
Initial model contained conservative assumptions; baseline data was collected from monitoring network before pumping begins

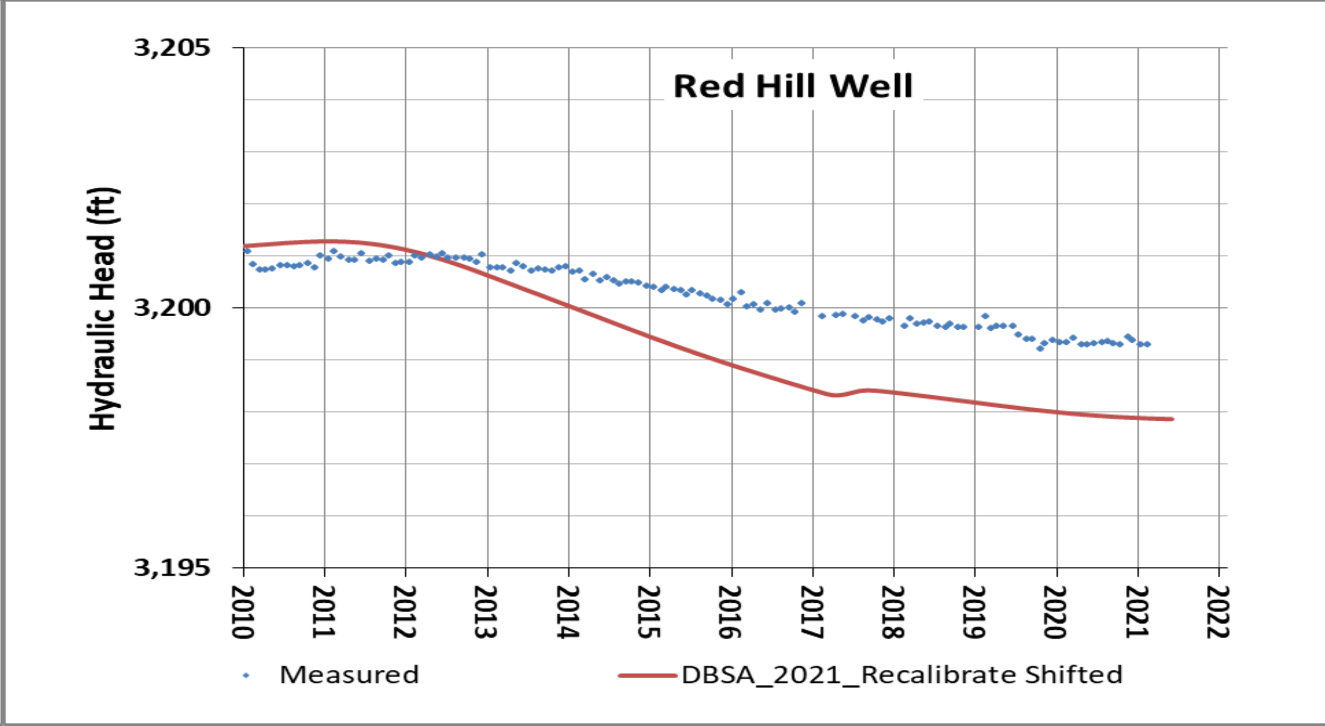
Begin pumping and observe hydrologic changes. Revise and recalibrate model as additional data from pumping is collected

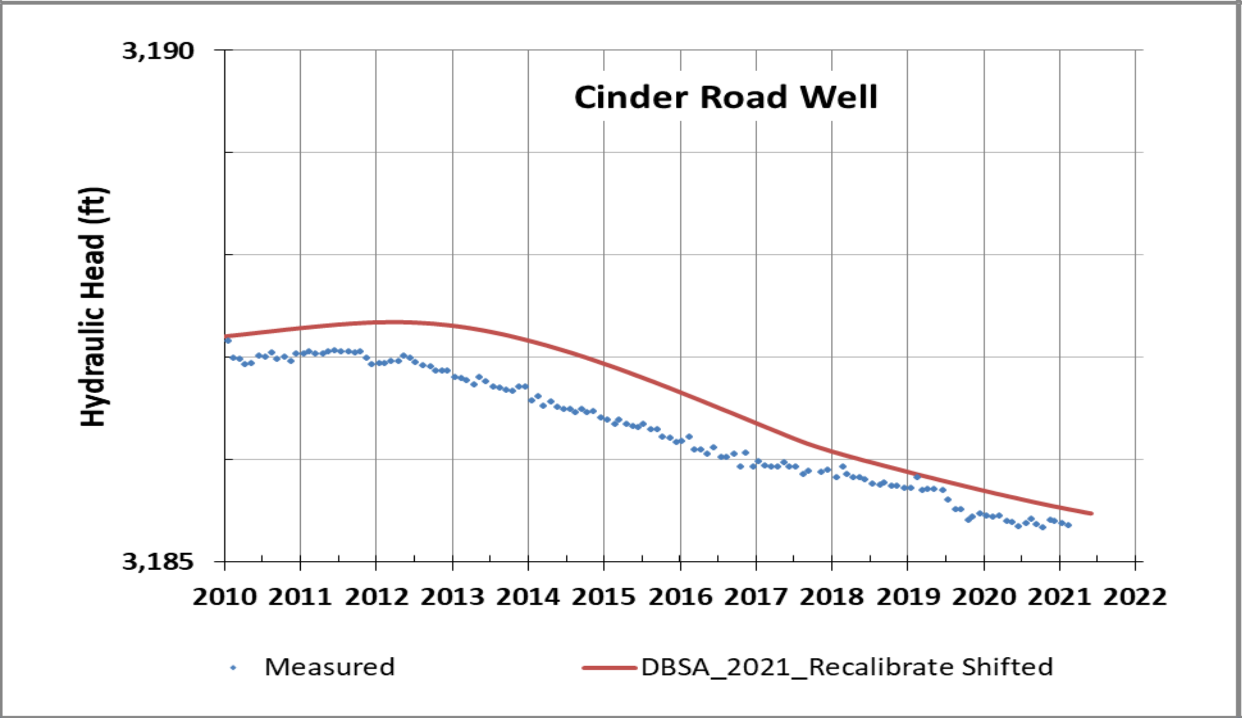
2011 model overhaul based on new data. Subsequent revisions update data (pumping, recharge, GW levels) and make minor changes

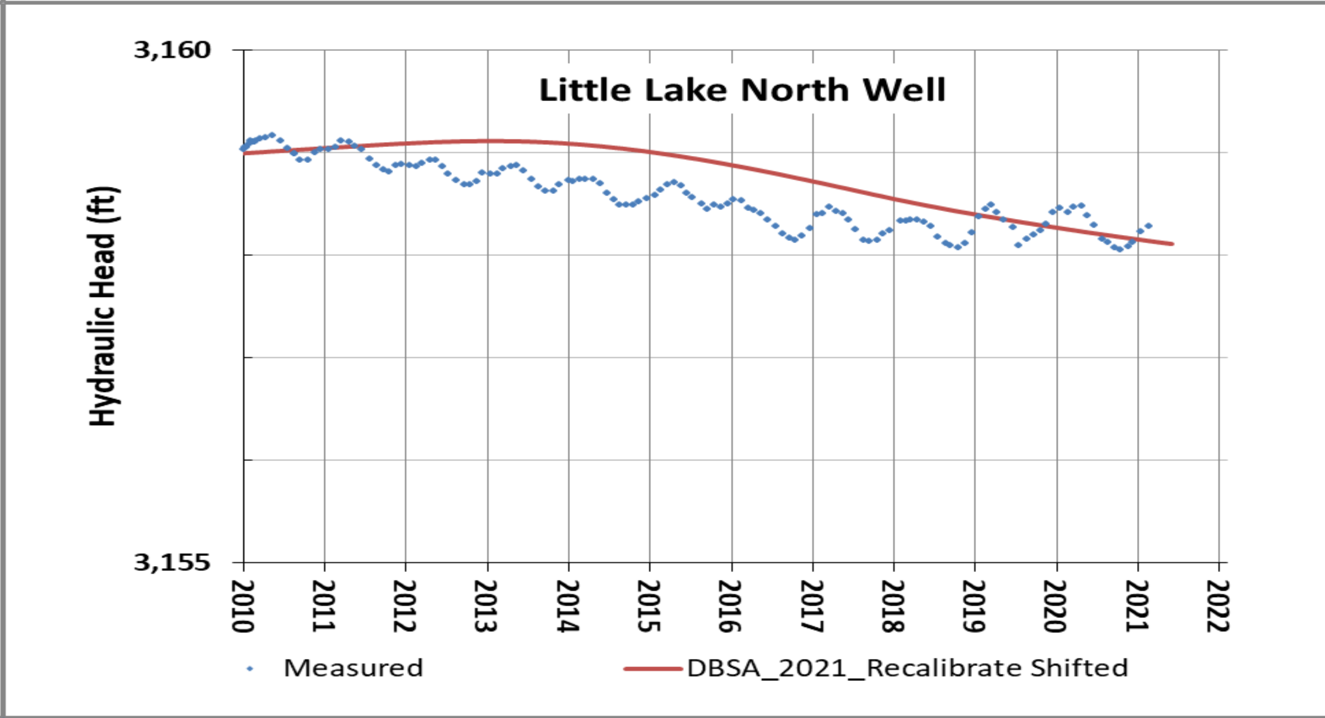
After each model calibration or update, additional scenarios predict changes and manage pumping to avoid impacts to LLR area (less than 10% reduction in flow), domestic wells, and other springs.




Coso Junction Store Well
Hydraulic Head (ft)
3,230
3,225
3,220
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Measured
DBSA_2021_Recalibrate Shifted


Red Hill Well
Hydraulic Head (ft)
3,205
3,200
3,195
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Measured
DBSA_2021_Recalibrate Shifted


Cinder Road Well
Hydraulic Head (ft)
3,190
3,185
2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022
Measured
DBSA_2021_Recalibrate Shifted


Little Lake North Well
Hydraulic Head (ft)
3,160
3,155
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Measured
DBSA_2021_Recalibrate Shifted

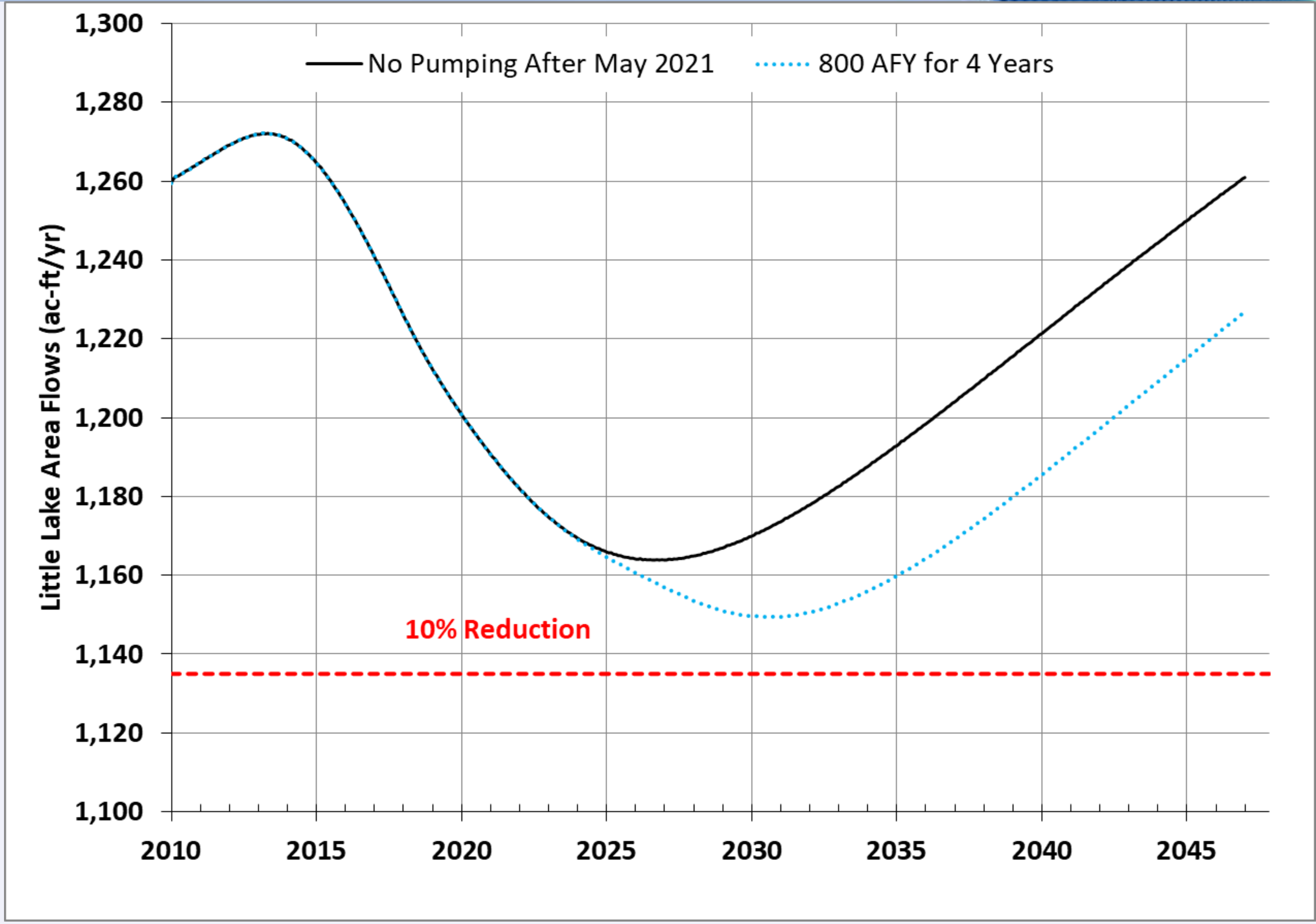
Groundwater Modeling and Adaptive Management

Trigger levels and Maximum Drawdown are key concepts of HMMP

Using the GW model we predict the changes in GW surface and drawdown moving forward in time towards LLR.

GW levels & spring discharge relationship: GWE north of lake has to be above known trigger level at a specific time to maintain discharge

Flow reduction must never exceed 10% - at any point in time.



Groundwater Modeling and Adaptive Management

Trigger Well	Name	Model and Time Sensitive				Model Sensitive			
		2011	2021	2021 vs 2011	**2022 GWE**	2011	2021	2021 vs. 2011	**2021 GWE**
		Trigger	Trigger	Trigger Change	**Above Trigger**	Max dd	Max dd	Max dd Change	**Above Max dd**
RV-80	HR 2A	27.6	13.6	-14.0	**9.4**	27.6	17.6	-10.0	**13.4**
RV-90	Coso Jct Ranch	11.3	8.3	-3.0	**6.5**	11.7	9.4	-2.3	**7.9**
RV-100	Coso Jct Store #1	9.5	7.6	-1.9	**6.9**	10.1	8.4	-1.7	**8.0**
RV-120	Red Hill Well	1.8	3.4	1.6	**2.0**	3.9	3.5	-0.4	**2.6**
RV-130	G-36	1	3.0	2.0	**1.8**	3.4	3.1	-0.3	**2.4**
RV-140	Lego	0	2.1	2.1	**0.7**	2.3	2.5	0.2	**1.3**
RV-150	Cinder Road	0.2	2.0	1.8	**0.4**	2.3	2.2	-0.1	**0.8**
RV-160	18-28 GTH	0	1.9	1.9	**1.2**	2.1	2.1	0.0	**1.6**
RV-180	LLR North Well	0	1.1	1.1	**0.4**	1.3	1.3	0.0	**0.7**

Triggers and maximum acceptable drawdown (max dd) are produced from model versions

Majority of project pumping occurred in initial 8 years; max drawdown in northern wells has already occurred.

As drawdown continues to communicate (equalize); triggers in southern wells deepen, approaching max dd.

Max dd in central and southern Rose Valley wells have changed very little throughout model revisions.

Groundwater Modeling and Adaptive Management

Video of Drawdown vs. time

Summary

- Hay Ranch Project implemented for the past 12 years with appx 18,000 AF pumped
- Adaptive management has included robust monitoring and model updates and recalibrations from third-party, objective consultants
- Model continues to accurately represent the hydrologic system of Rose Valley
- Preventing a 10% decrease in flow at Little Lake has been maintained throughout the project
- May 2021 model update allows for 800 AF/yr pumping for the next four years