



# New Mexico Environment Department

Los Alamos County Board of Public Utilities

Hexavalent Chromium Plume Control Interim Measures Overview

Hazardous Waste Bureau

February 16, 2022

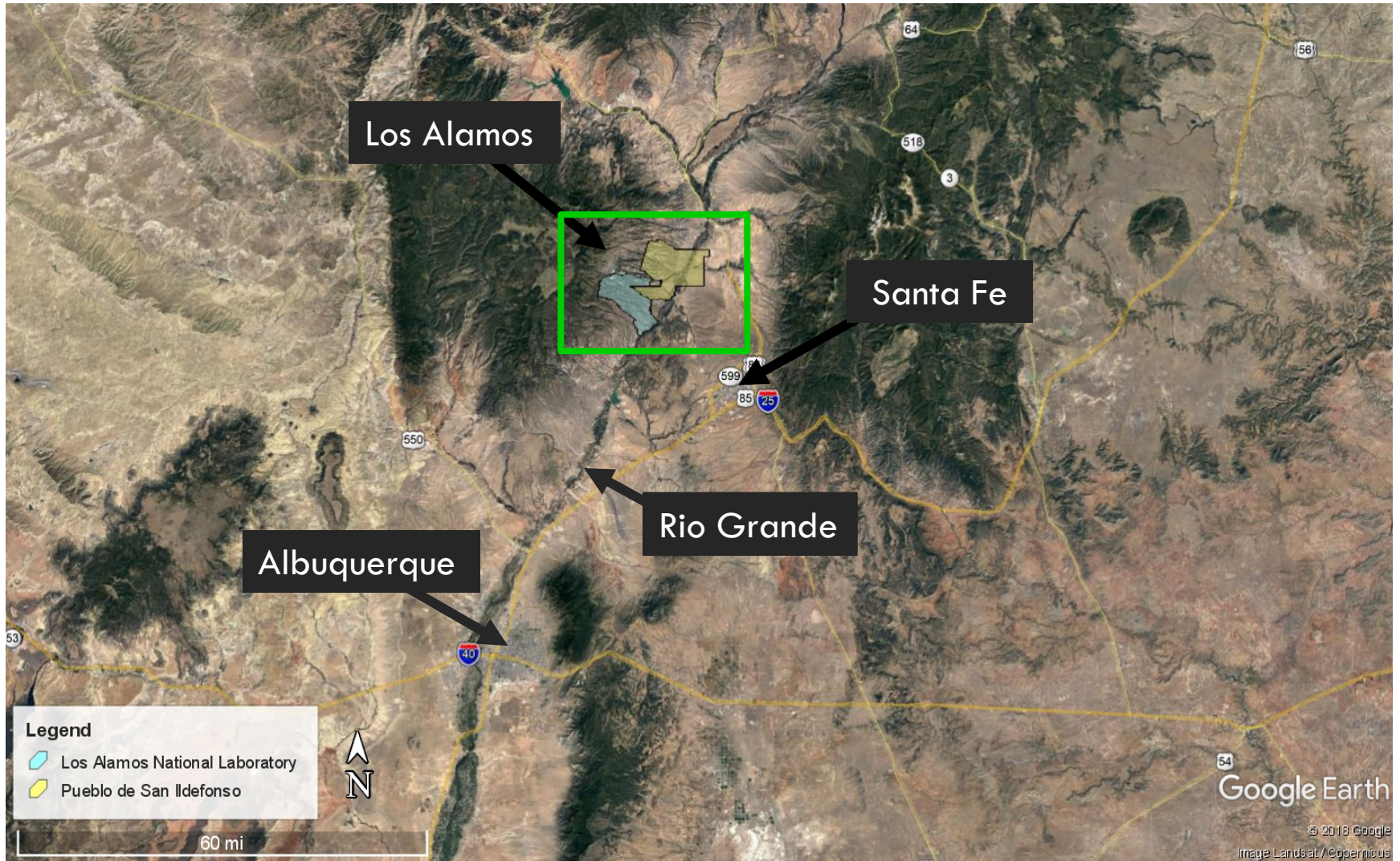


**Christopher Krambis, P.G.,  
Water Resource Professional IV  
505-231-5423**





# Site Location







# Site Specifics

Potassium dichromate used to control corrosion in power plant cooling towers

160,000 lbs. released to canyons between 1956-1972 as Cr(VI)

Migration from perched aquifer to regional aquifer formed multiple sources

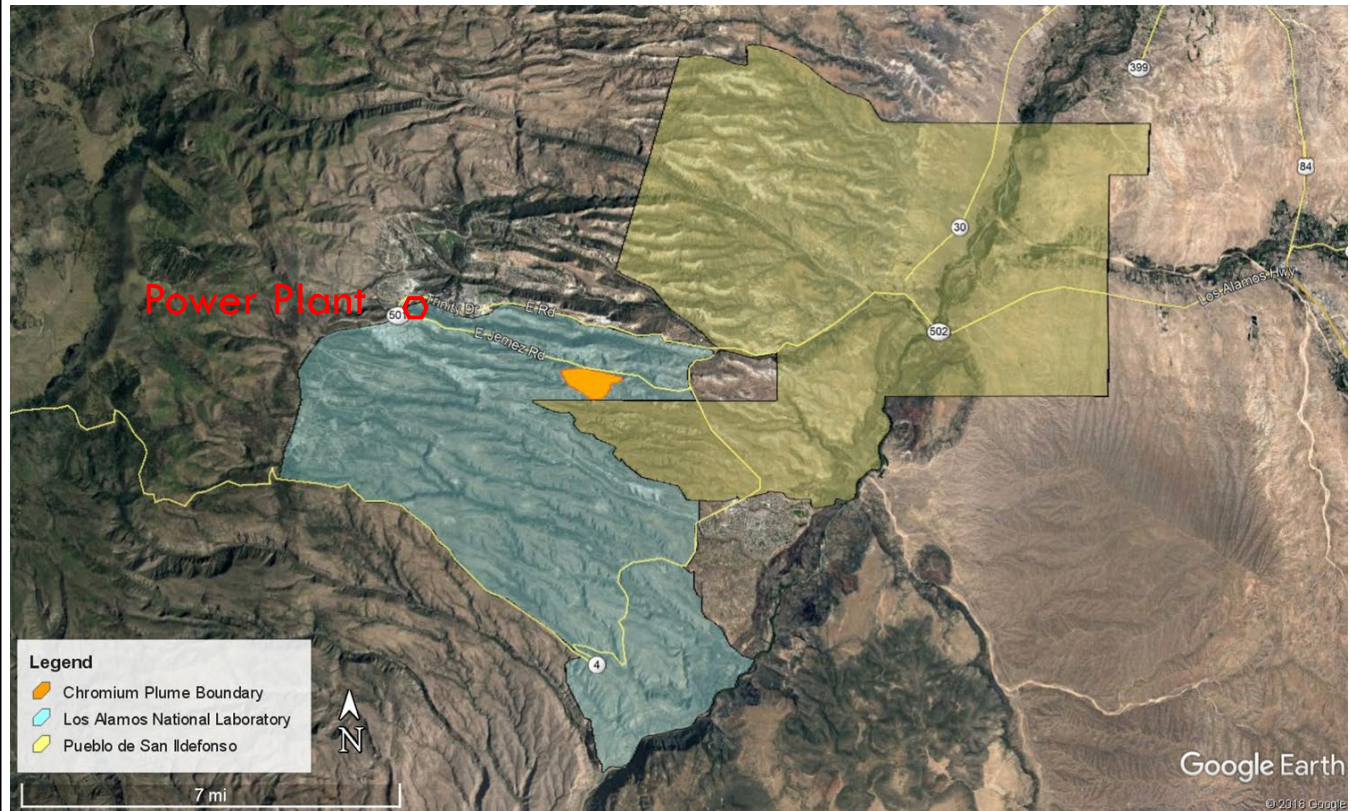
Discovered in regional aquifer in 2005

NMED regulates chromium in groundwater at 50 ppb

Plume is 1 mile long / half mile wide. Thickness is uncertain

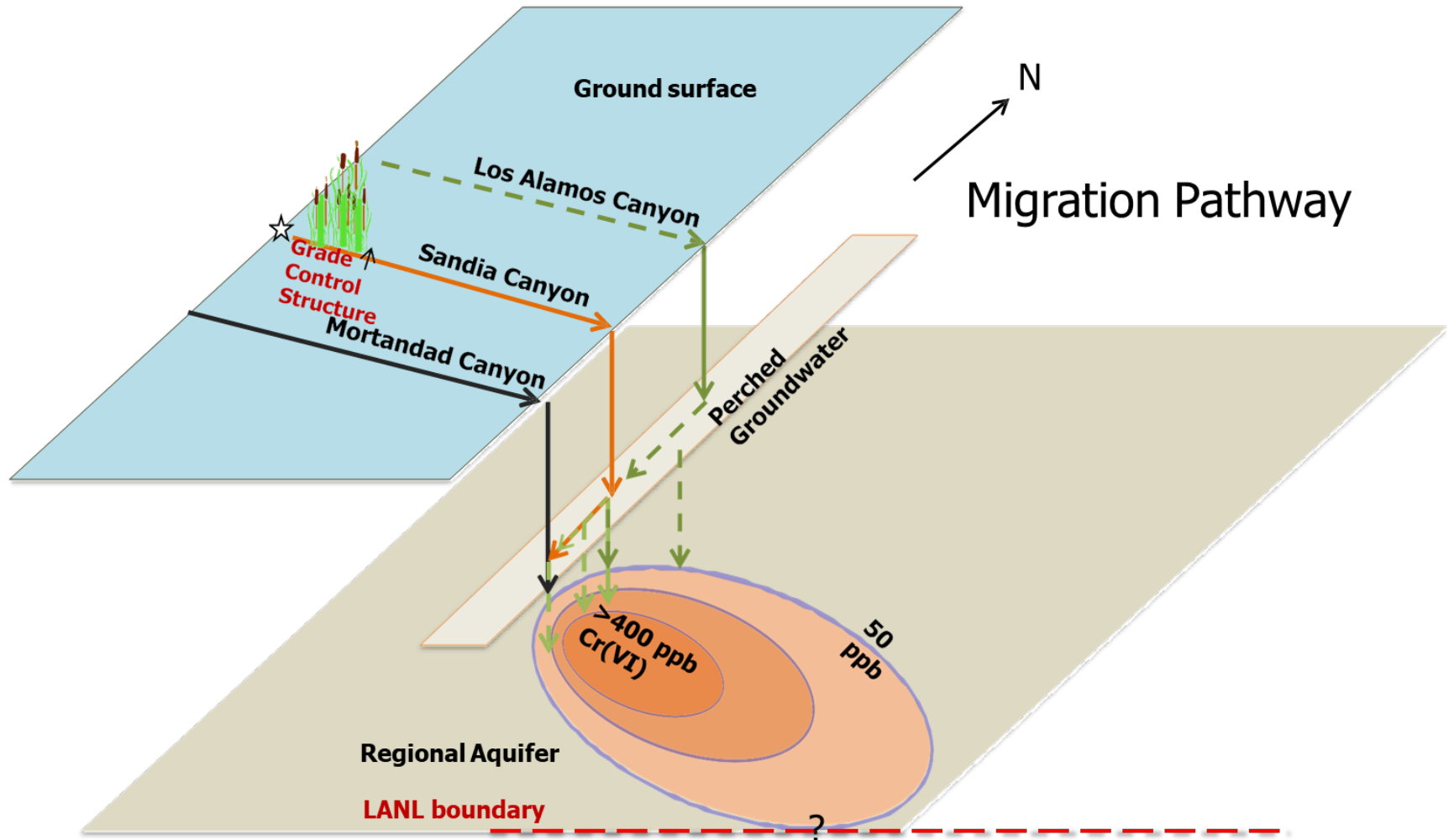
Nature & Extent remains uncertain – in Campaign Approach along with IM

Interim Measures - mid 2018 along SI boundary



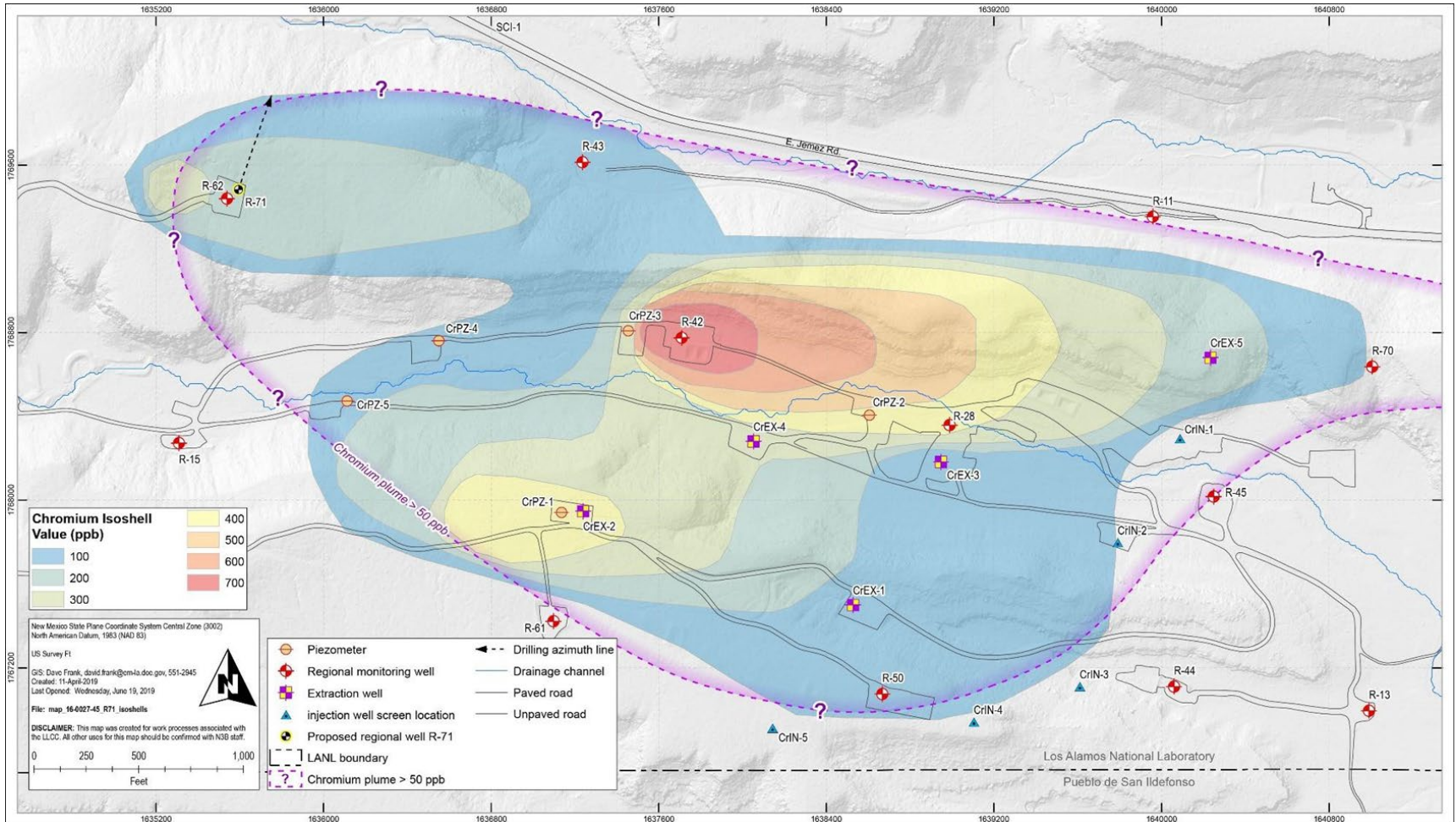


# Chromium Migration Schematic





# Plume Detail – Coalesced Plumes







# Overview of Plume Control IM Issues

## Interim Measures Goals

- ❑ Three Workplans
- ❑ Two Consent Orders
- ❑ First workplan: April 2013
  - Extraction/mass recovery
  - Found to be feasible – CrEX-1 (2014)
- ❑ Second workplan: May 2015
  - Migration Control
- ❑ Third workplan: April 2018
  - Assumption Cr(VI) in top 50-60 ft
  - Metrics and reporting
  - 3-Yr performance timeline
  - 6th semi-annual report submitted last September covering 3.5 years

## Interim Measures Performance

- ❑ Assumption not valid
- ❑ Plume depth unexplored
- ❑ Water table mapping
- ❑ No hydraulic control
- ❑ Unfavorable responses
- ❑ NMED Issued Numerous Technical Comments



# DOE'S Interim Measures Objectives

“The overarching assumption guiding the IM strategy is that the dominant mass and mass flux of contamination in the medial and peripheral portions of the plume is in the upper 50–60 ft of the water table in the strata with the highest hydraulic conductivity.”

- ❑ The principal objective is to achieve and maintain the downgradient chromium plume edge with a specific metric of reduction of chromium concentrations at IM monitoring well R-50 to concentrations of 50  $\mu\text{g/L}$  or less over a period of approximately 3 yr.
- ❑ The principal objective has been met.
- ❑ A secondary objective is to hydraulically control plume migration in the eastern downgradient portion of the plume.
- ❑ The IM operations are in the early stages of implementation to meet the secondary objective.



# DOE's Interim Measures Performance

## The key evaluation tools for interim measures performance evaluation:

- ❑ Time-series plots that include data for chromium, perchlorate, nitrate, and tritium from monthly sampling in performance monitoring wells, and from extraction wells for capture zone analysis.
- ❑ Time-series plots that include data for injection well tracers from monthly sampling in performance monitoring wells.
- ❑ Water-table maps that evaluate potential changes in gradient associated with IM operations are used as an additional line of evidence for evaluating IM performance.
- ❑ Cumulative chromium mass removal estimates. Although mass removal rates and efficiency are not directly related to IM performance, they may provide insights into observed plume response.





# Monitoring and Interim Measures Wells

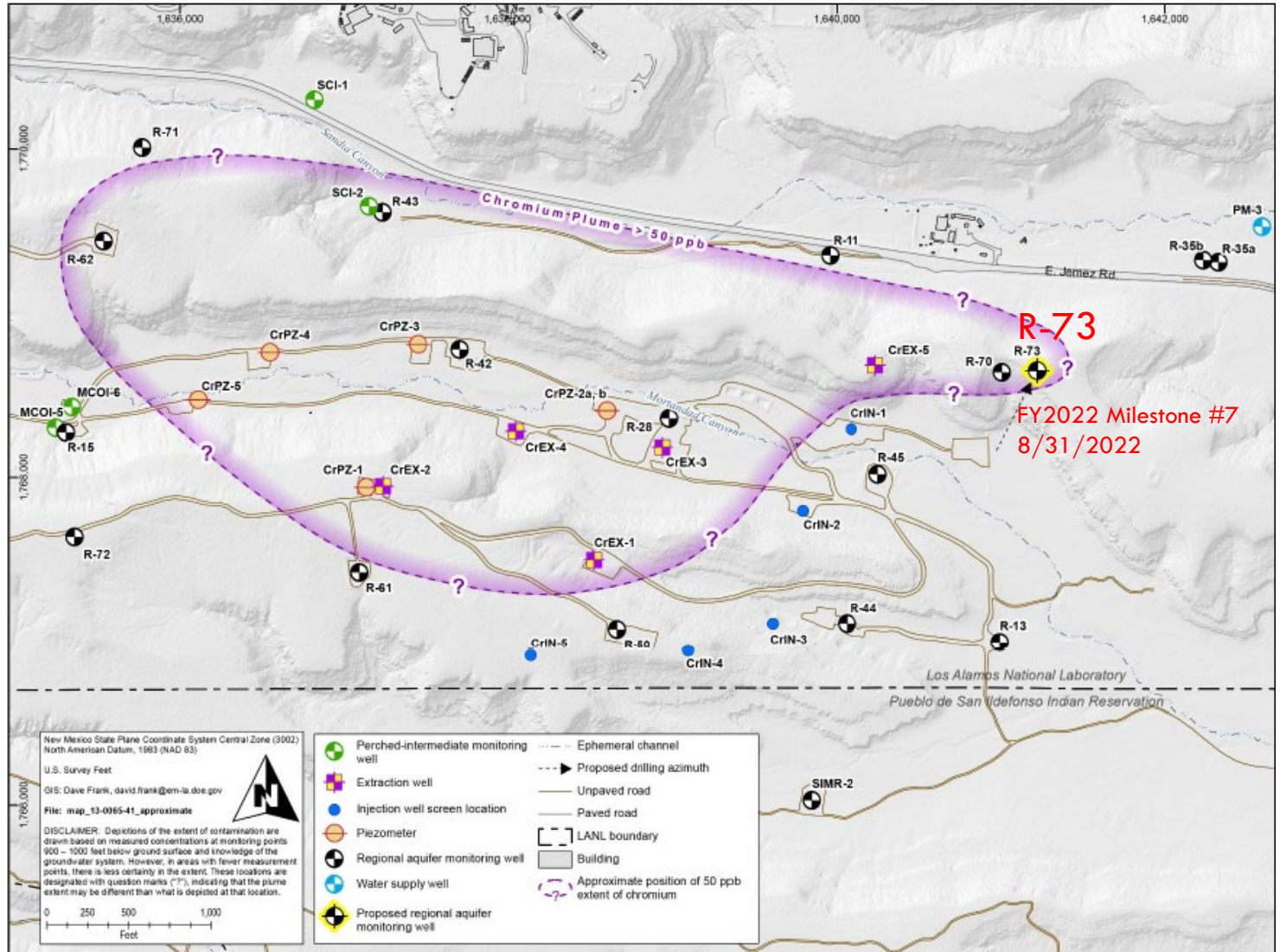
5 IM injection wells (blue)

5 IM extraction wells (purple/yellow)

PM-3 (light blue)

FY2022 Milestones:

- R-73 (#7)
- R-28R workplan (#8)
- R-77 workplan (#9)





# Interim Measures Performance Issues

In-situ study

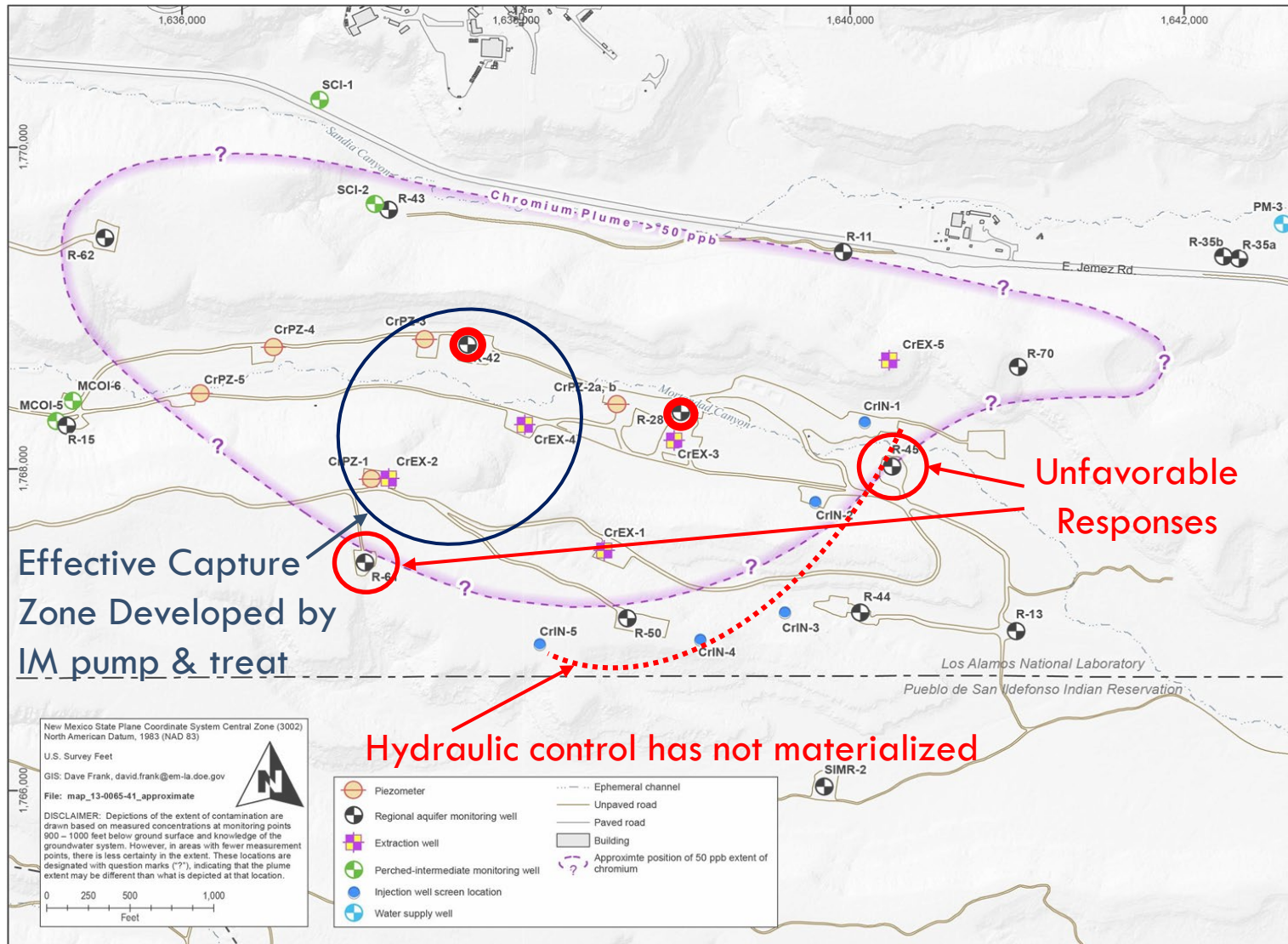
Hydraulic control in 3-yr period

Extraction is effective – but only 472 lbs. removed since 4<sup>th</sup> Q of 2016

March-Aug 2020 shutdown had no adverse effects.

With injection - unfavorable response noted

NMED requested calculations and modeling







# DOE Water Table Map

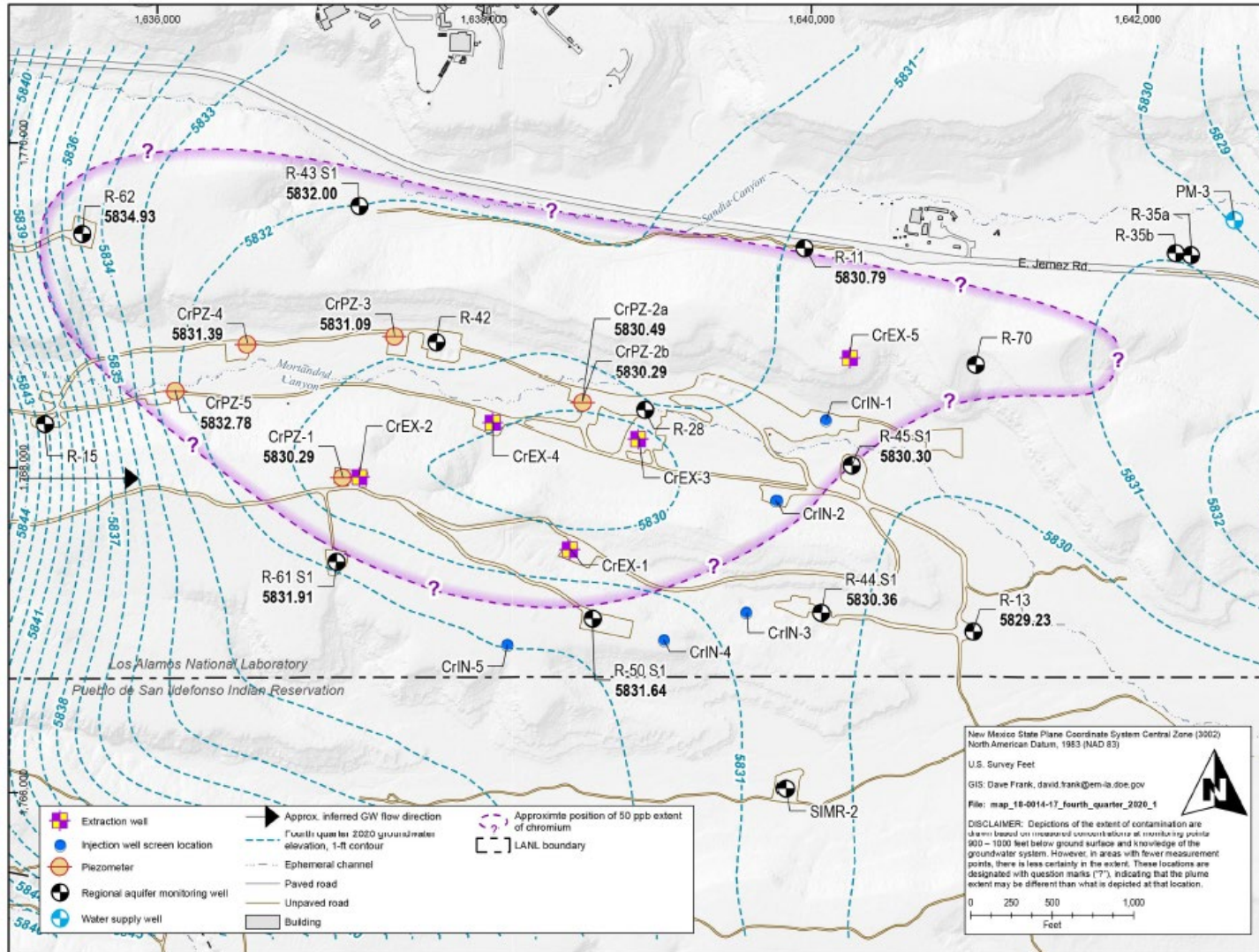
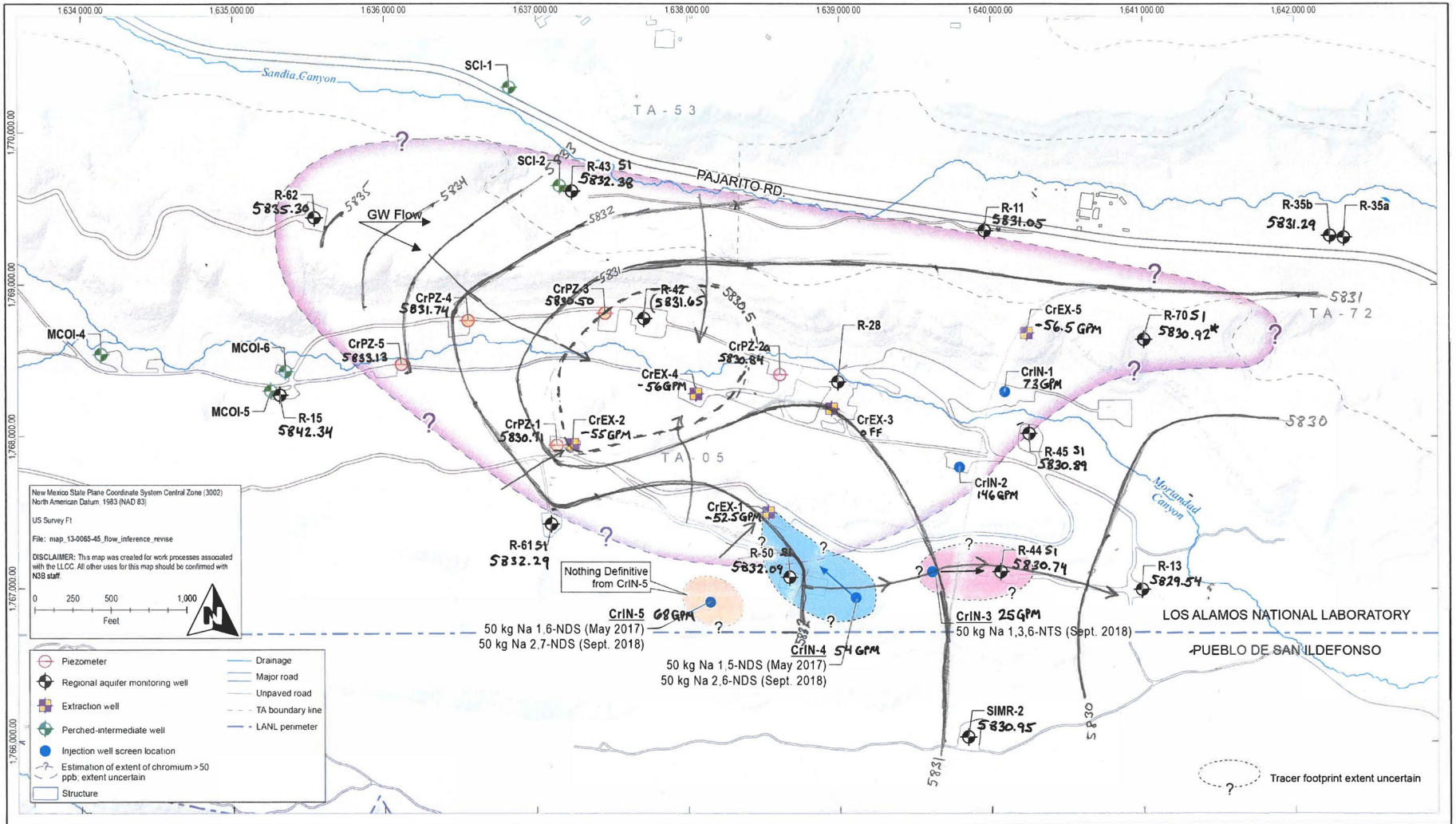


Figure 3.3-1 Water table showing average water levels for November 2020



# NMED's Triangulation of Three Point Problem - A Better Representation

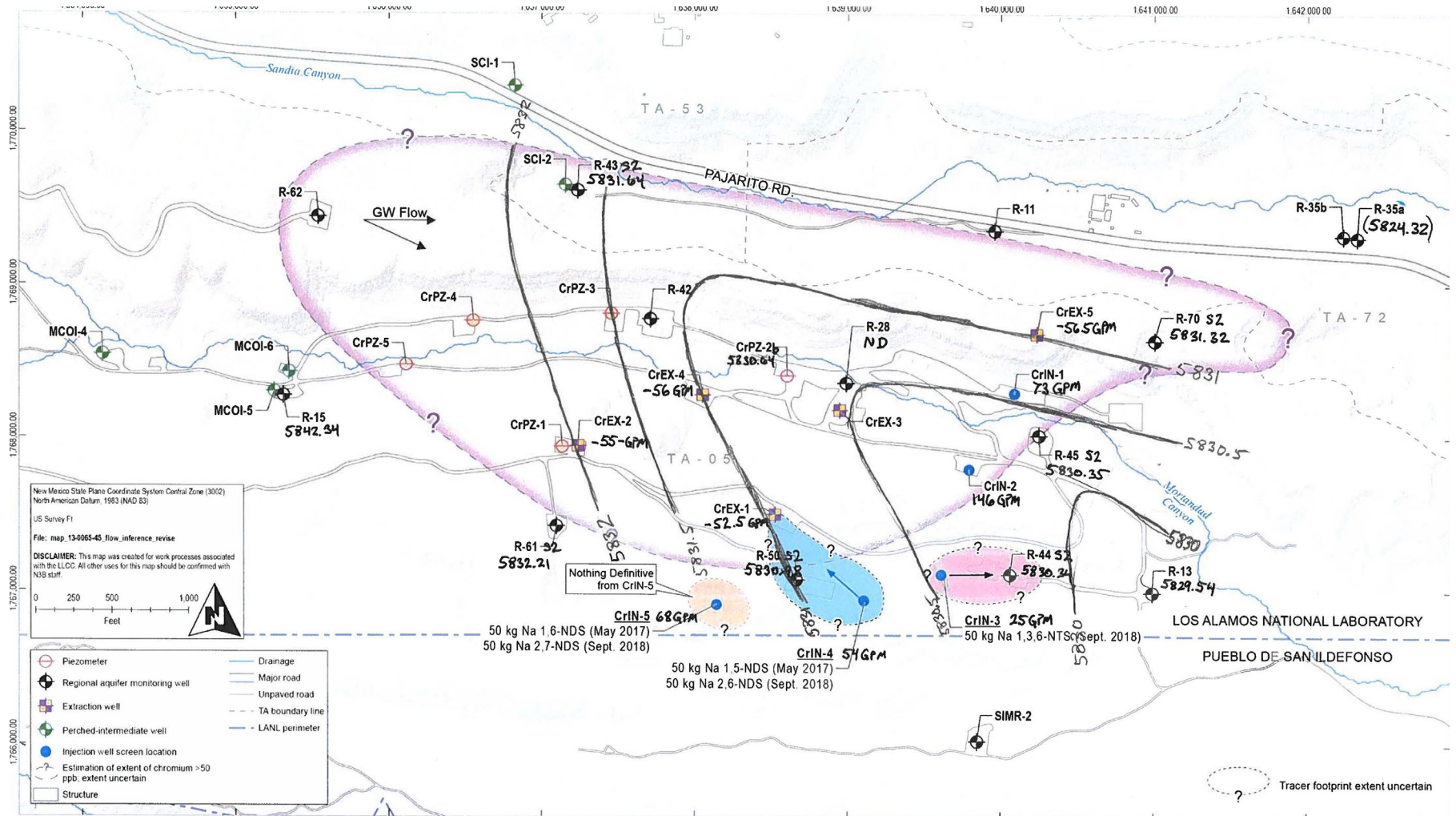


November 9, 2020, 07:00 potentiometric surface near the regional aquifer water table (monitoring well screen 1 heads)





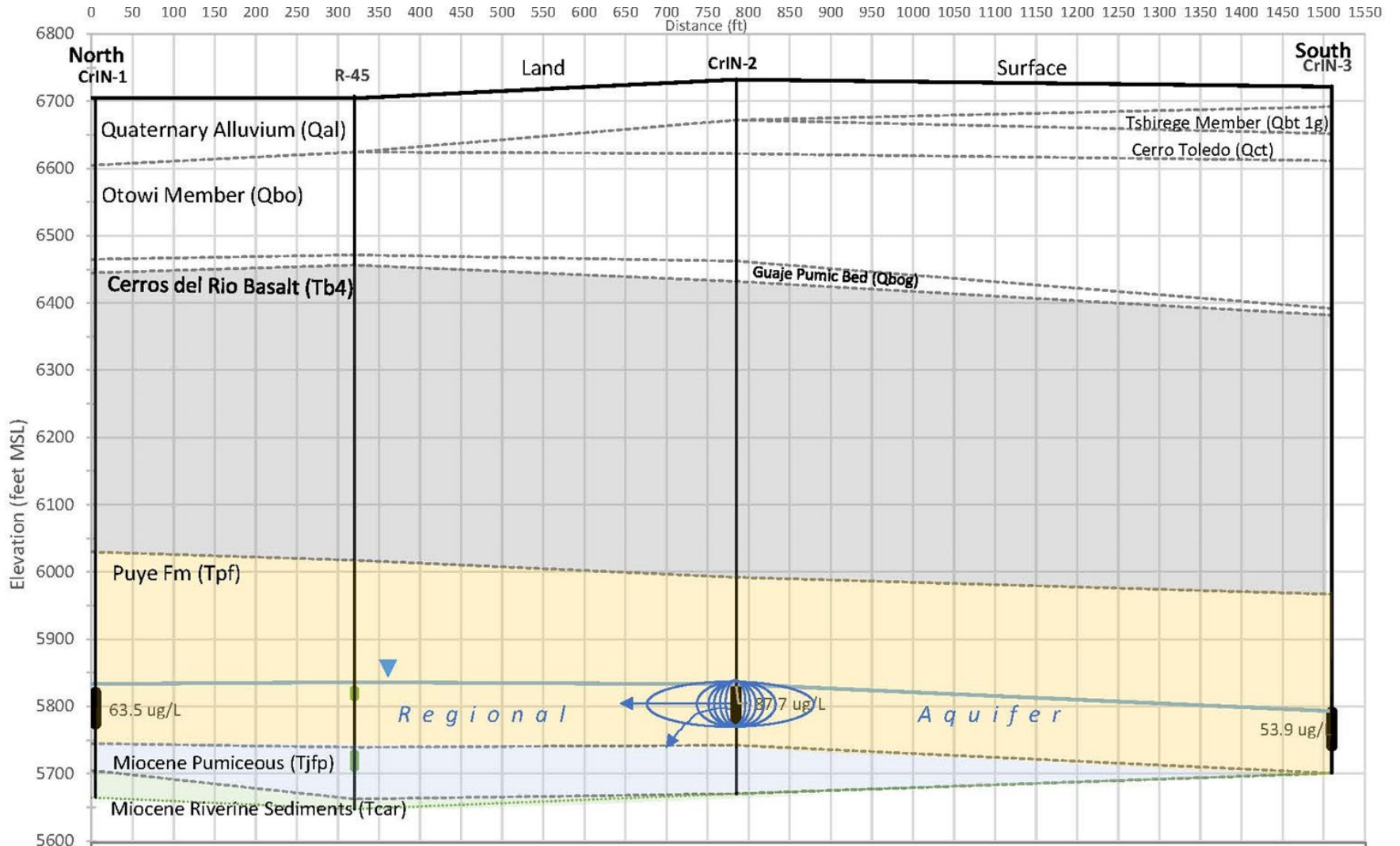
# Deep Screen 2 Water Level Map



November 9, 2020, 07:00 potentiometric surface at depth (monitoring well screen 2 heads)



# Profile Through Injection Wells







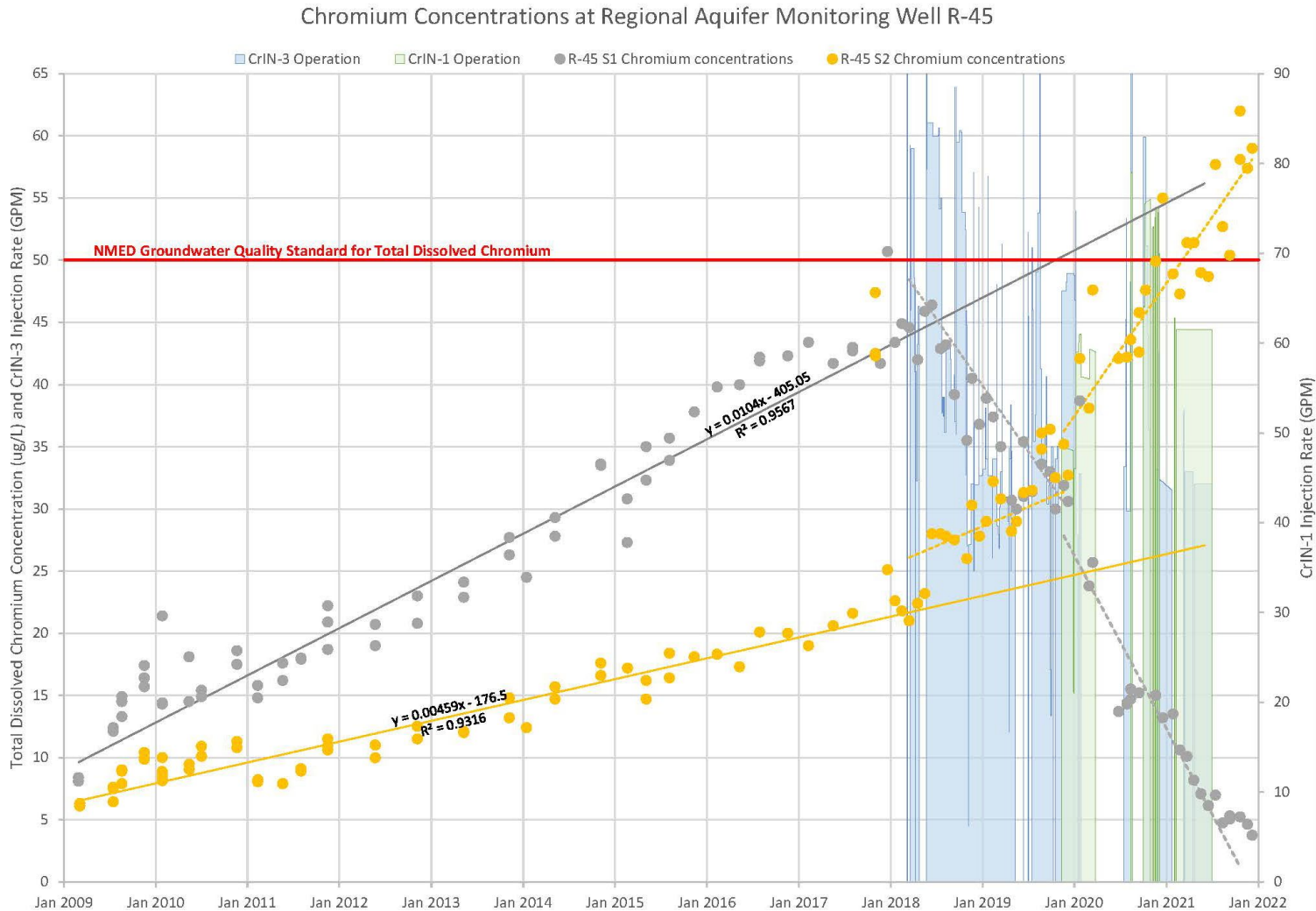
# Injection Operations Unfavorable Response at Performance Monitoring Well R-45

Plume migrates with ambient flow rate linearly and predictably

Predicted Cr(VI) exceedance at R-45 in 2019 and 2036 for screens 1 and 2, respectively

Trends then altered when CrIN-3 went online in mid-2018, and again, in Nov 2019 when CrIN-1 & CrIN-2 went online

Modeling calculations requested by NMED





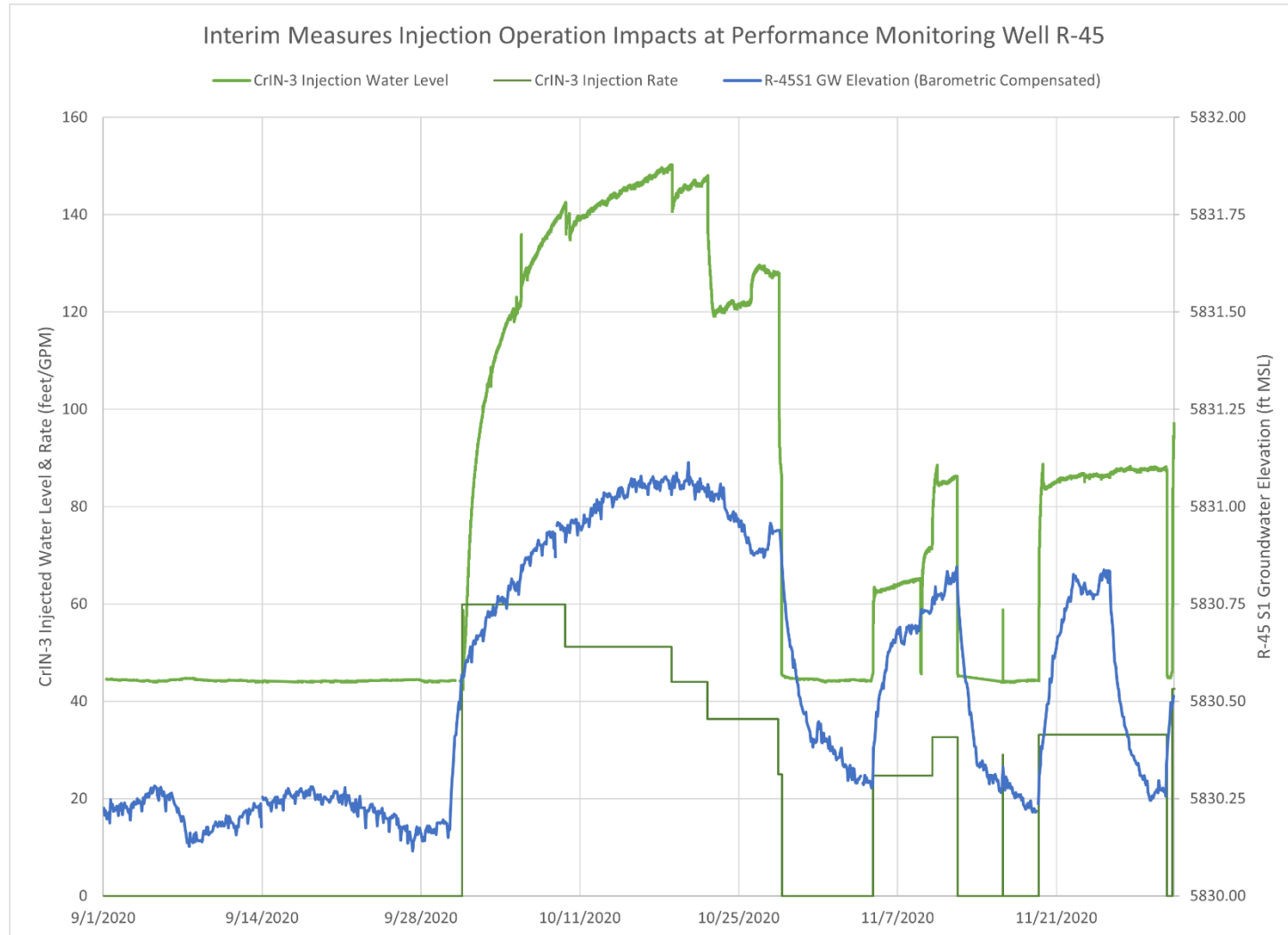
# Injection Operations Unfavorable Response Second Line of Evidence

High injection rates into CrIN-3 created a distinct pattern of water level rise in the injection well that are also observed in the top screen at R-45 during October 2020

The anomalously high injection rates raise the water level in CrIN-3 by over 100 feet

At R-45 S1, a similar rise in the water level is observed to be about 1 ft

Modeling may provide some insight to this observation





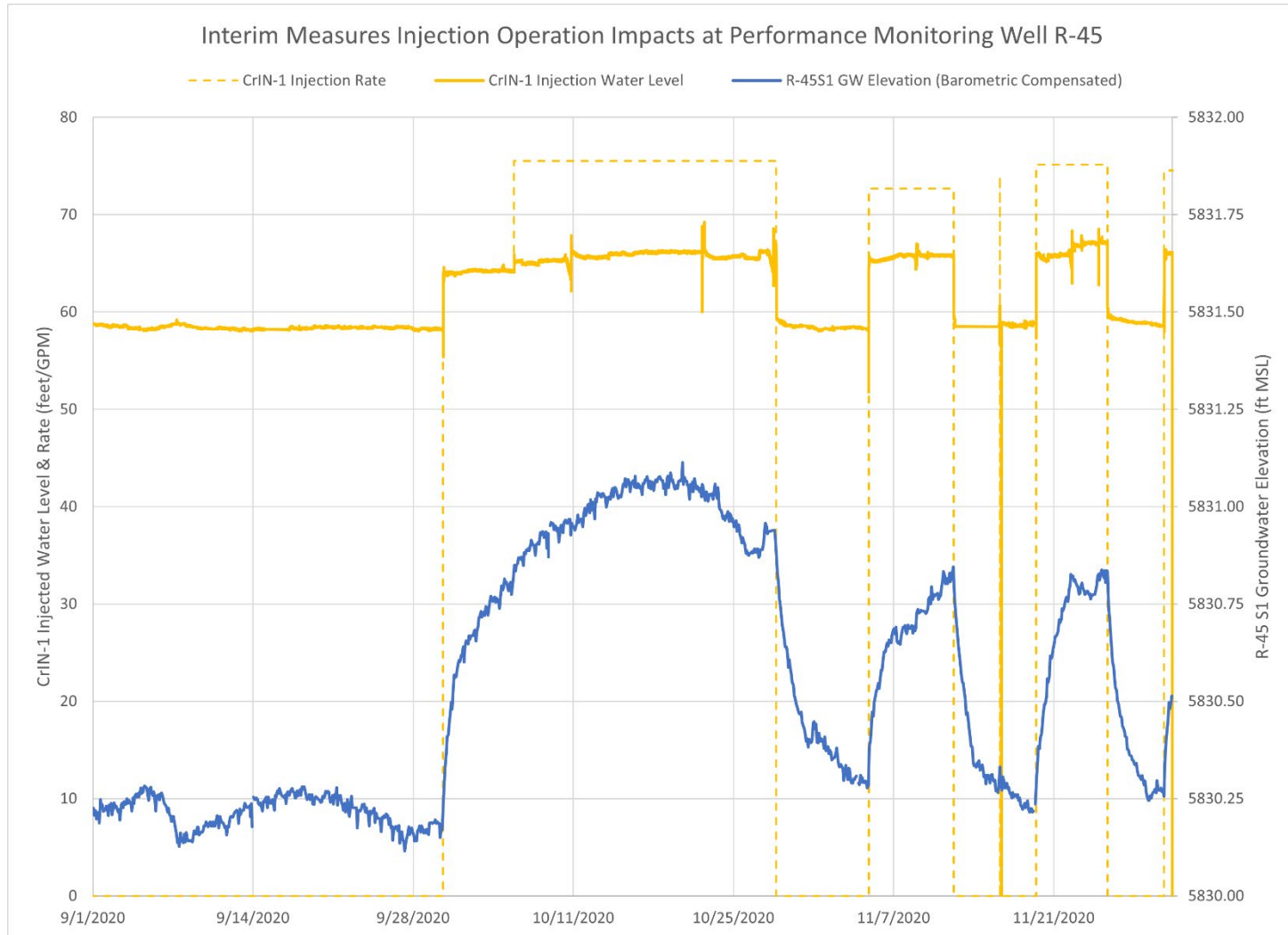


# Injection Operations Unfavorable Response Second Line of Evidence

Typical injection rates into CrIN-1 created no distinct pattern of water level rise in the injection well that can explain the pattern observed in the top screen at R-45 during October 2020

Typical CrIN-1 injection rates only raised the water level in that well by about 5-8 feet

Modeling may provide some insight to this observation





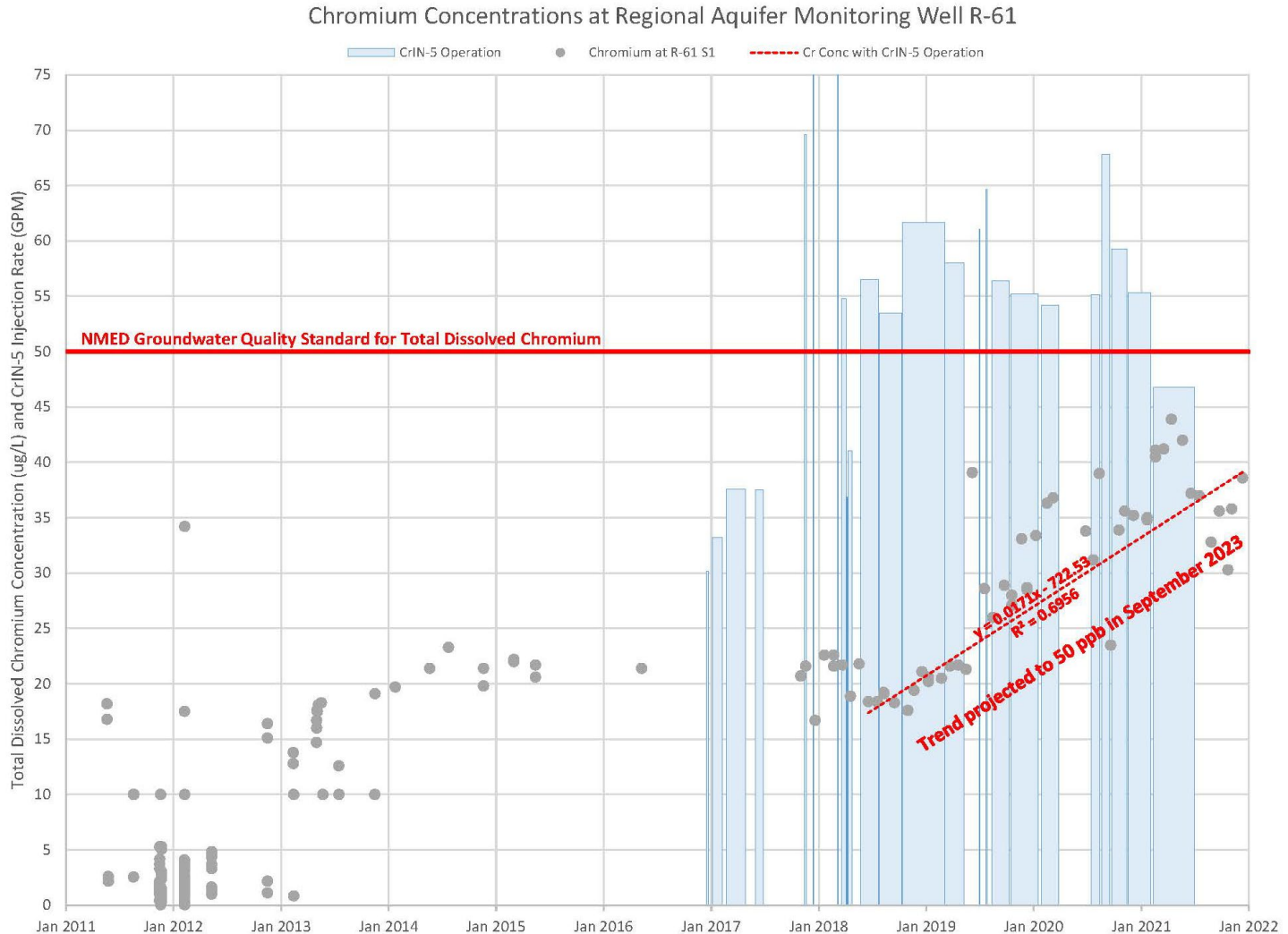
# Injection Operations Unfavorable Response Performance Monitoring Well R-61

Upgradient to injection operation

Trends altered after injection operations started

Appears delayed compared to R-45 response due to distance and upgradient location

Modeling calculations requested by NMED







# PM-3 Pumping Recorded at R-35a

**DOE: PM-3 draws below Miocene basalt, isolated from chromium plume**

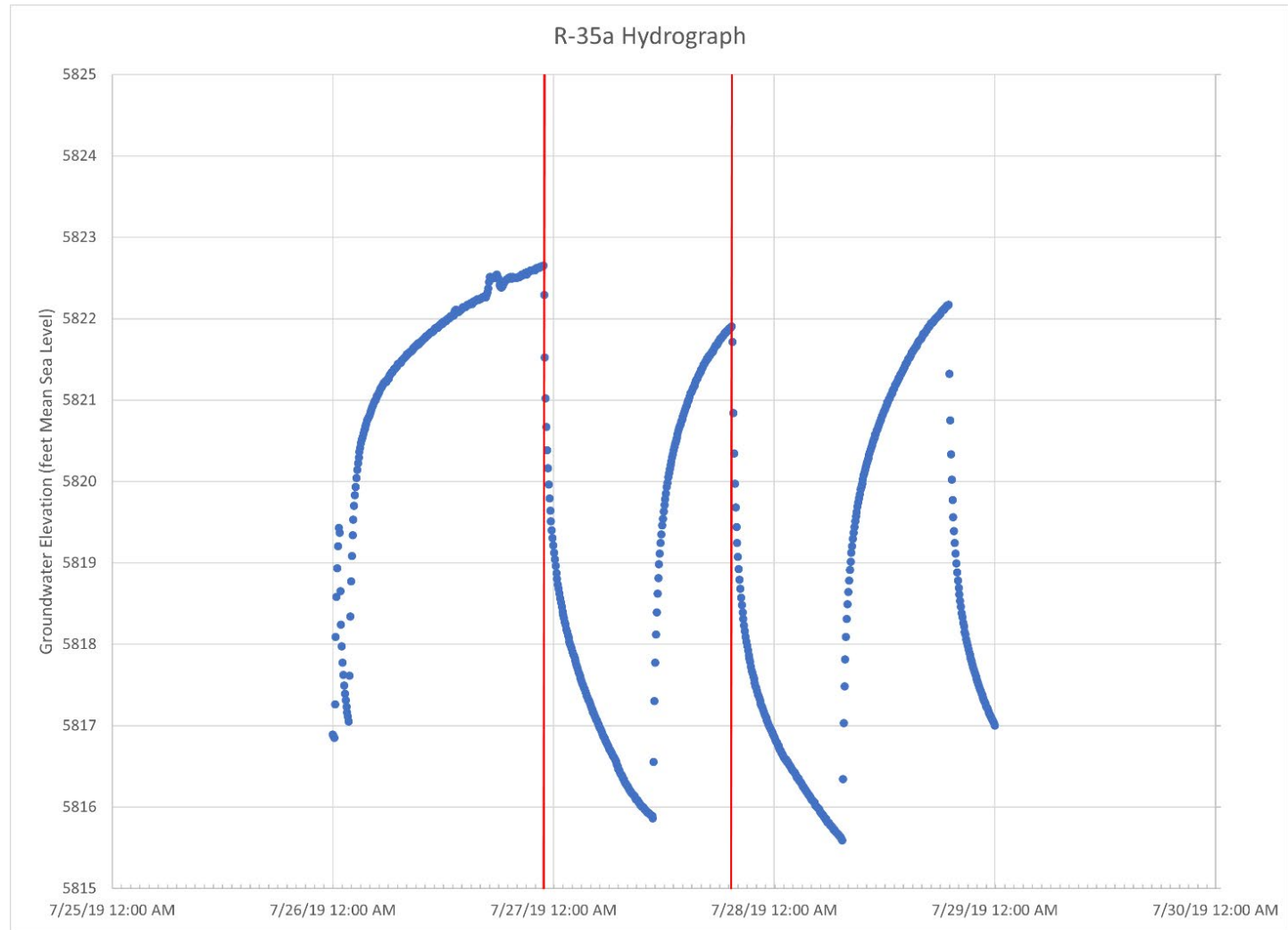
**NMED:**

- Spinner logs
- Pump settings
- Hydrograph
- LANL model

Used Intellus to obtain data

7/27-28/2019  
1,450 GPM  
Operation

Significant effects recorded at R-35a 345 ft southwest





# Potential Pathway Aquifer Properties

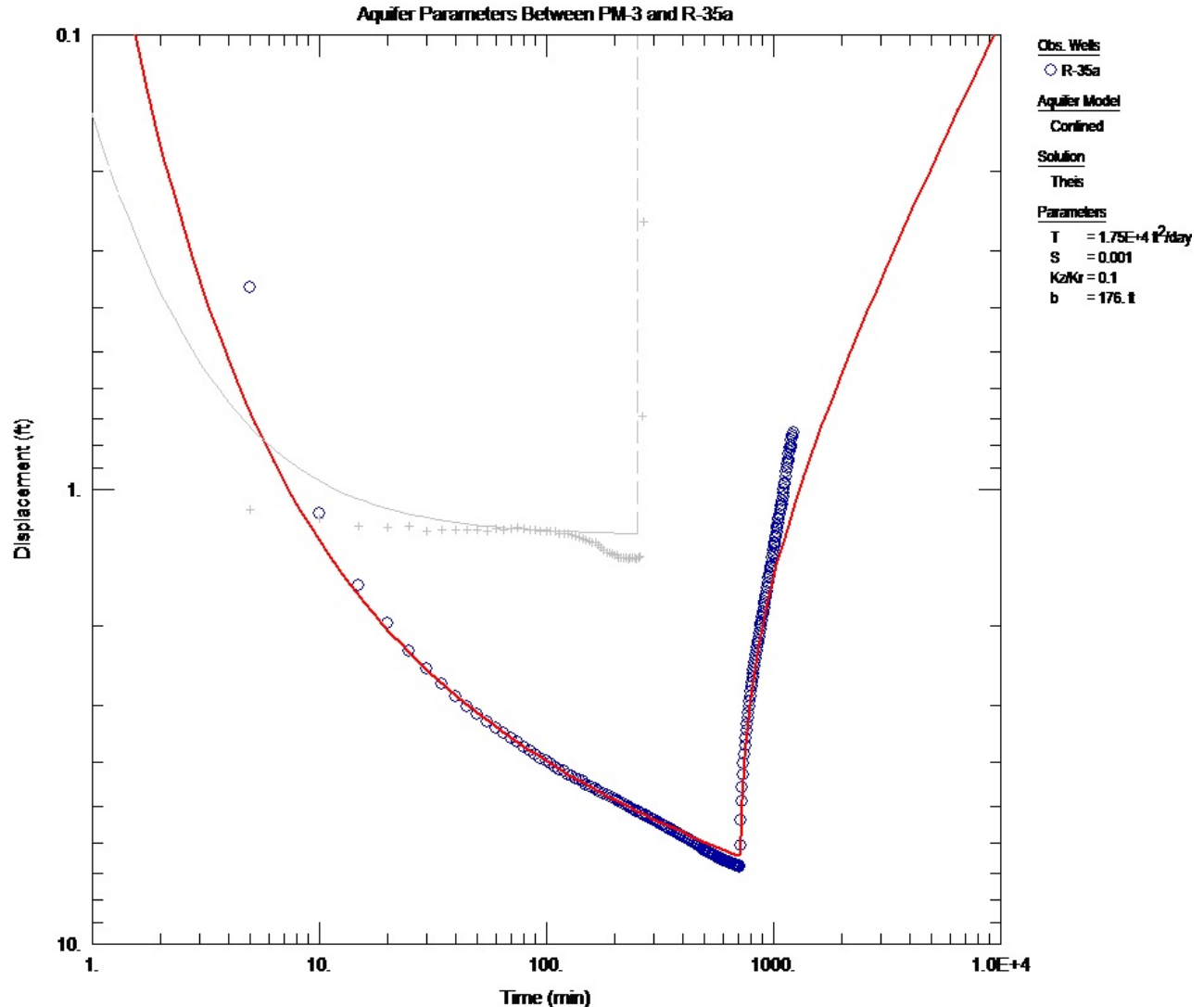
HydroSOLVE, Inc.  
AQTESOLV®  
software

Chamita Fm  
pathway

R-73 to be in  
Chamita Fm

FY2022  
Milestone #7

R-35c FY2023  
Target





# Time to Reassess DOE's Strategy

NMED persuaded DOE to submit a new workplan that incorporates the new understanding of the system dynamics and goal for mass removal to move to final remedy. The new workplan is **FY2022 Milestone #2** due **September 30, 2022**, and should:

- Provide flexibility for adjustments to system operation
- Focus upon extraction to control migration and mass removal
- Address injection issues with NMED input
- Include groundwater flow modeling results with NMED input
- Be able to control migration through the entire plume depth
- Provide better metrics for performance evaluation
- Provide a basis for moving forward to corrective measures





# Thank You!

# QUESTIONS?

LANL Community Engagement Meeting, October 21, 2021  
2016 Compliance Order on Consent Appendix B – Milestones and Targets – updated December 2021  
<https://www.env.nm.gov/hazardous-waste/lanl/>

Data obtained from Intellus New Mexico and Electronic Public Reading Room  
<https://www.intellusnm.com>  
<https://ext.em-la.doe.gov/EPRR/>