# New Mexico Environment Department

**Presentation to**
**Los Alamos County Board of Public Utilities**

## Nature and Extent and Remediation of the Chromium Plume at Los Alamos, New Mexico

**Hazardous Waste Bureau**
**July 5, 2023**

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## Topics of Interest

- Source(s) of Chromium
- Chromium Distributions in the Regional Aquifer
- Regional Aquifer System Response
  - Extraction wells (CrEX-1, CrEX-2, CrEX-3, CrEX-4, and CrEX-5)
  - Injection wells (CrIN-1, CrIN-2, CrIN-3, CrIN-4, and CrIN-5)
- Discharge Permit (DP)-1835
- Data Gaps & Latest Developments

# Location Map of LANL Technical Area-03 Power Plant and Chromium Plume in the Regional Aquifer (modified from DOE 2023)

Potassium dichromate used to control corrosion in power plant cooling towers.

158,400 lbs. released to Sandia Canyon between 1956-1972 as potassium dichromate.

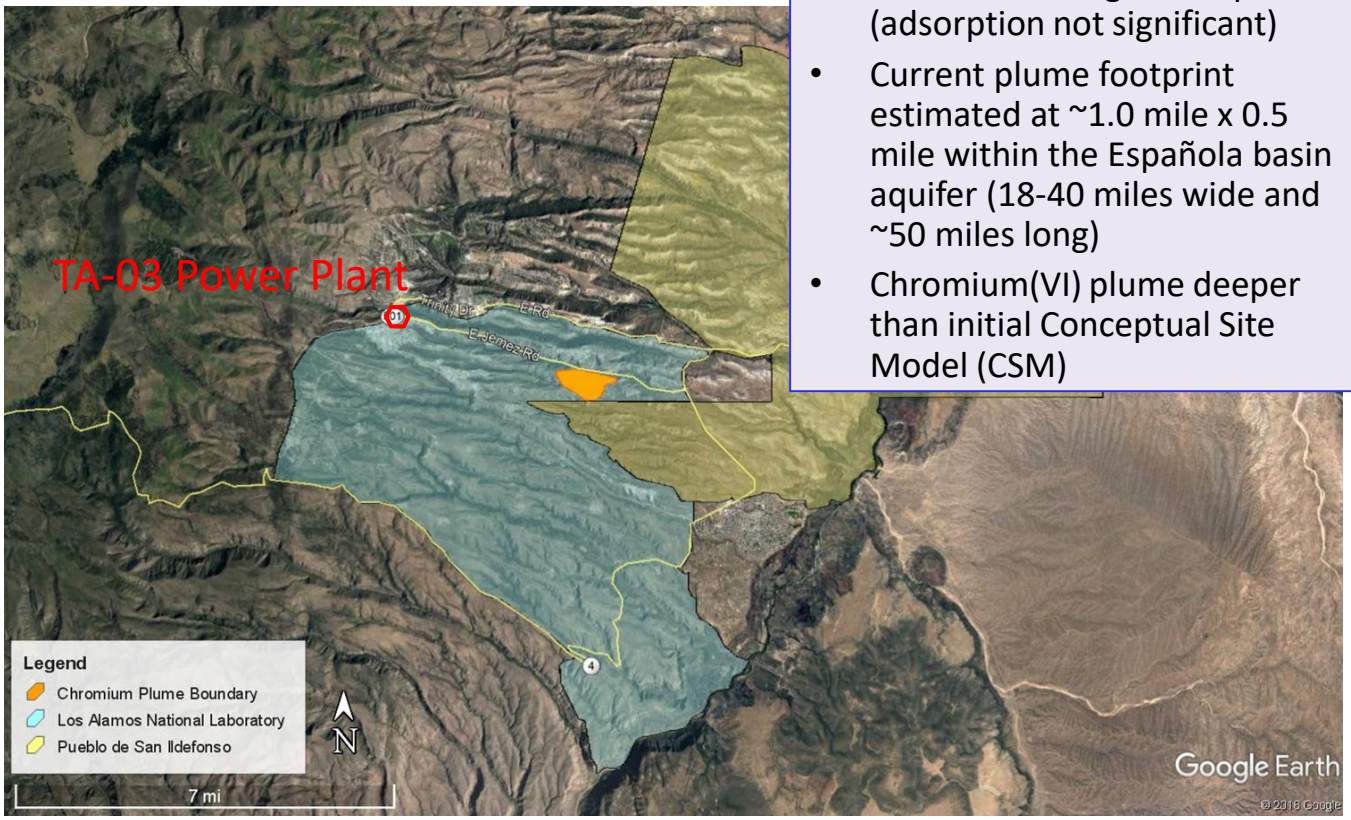
Migration from perched aquifer(s) to regional aquifer formed multiple sources.

Discovered in regional aquifer in December 2005.

NMED regulates total dissolved chromium(III, VI) in ground-water at 50 parts per billion (ppb) or 0.05 ppm.

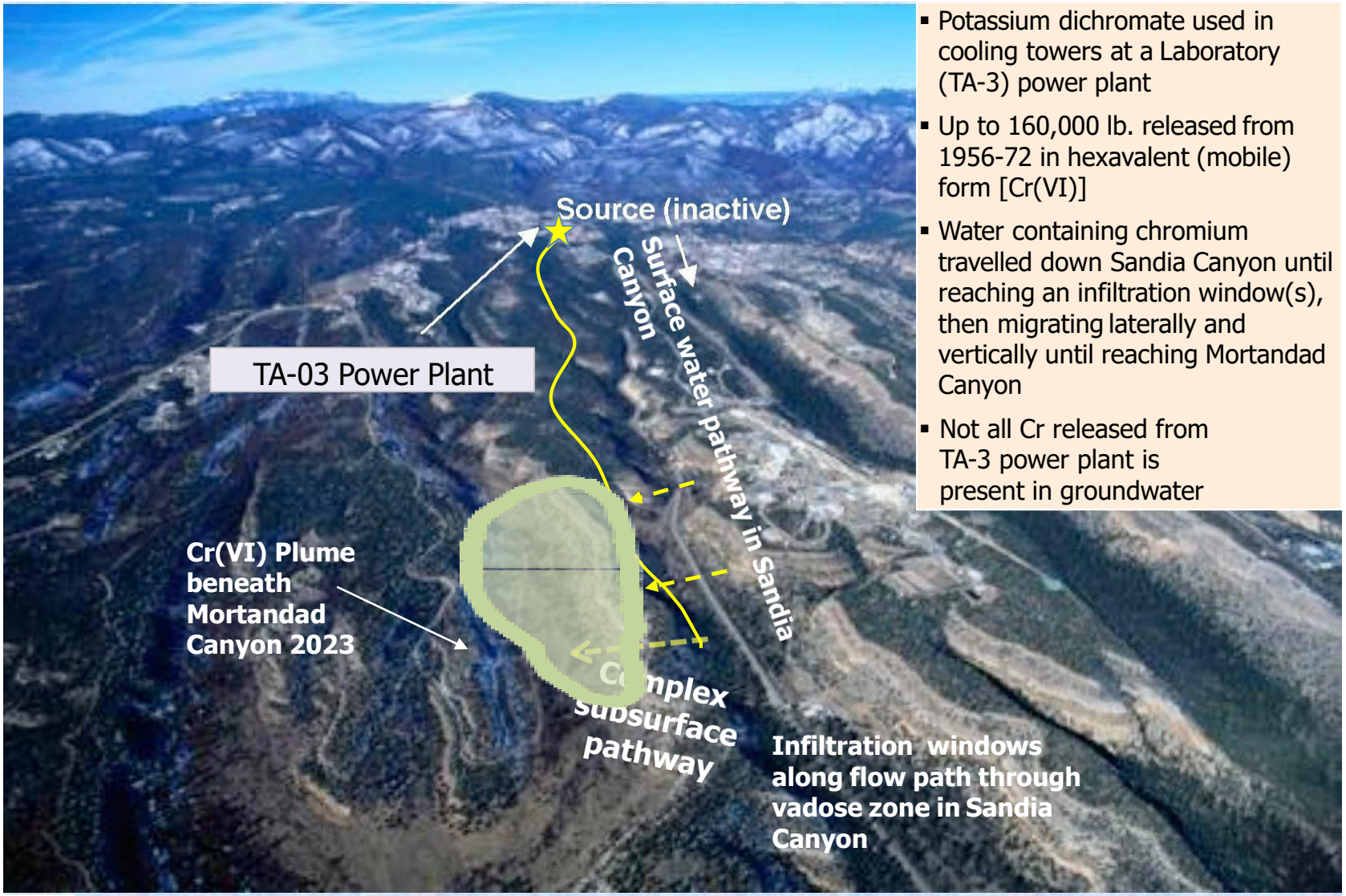
Nature & Extent remains uncertain – in Campaign Approach along with Interim Measures.

Interim Measures - mid 2018 along Pueblo de San Ildefonso boundary.



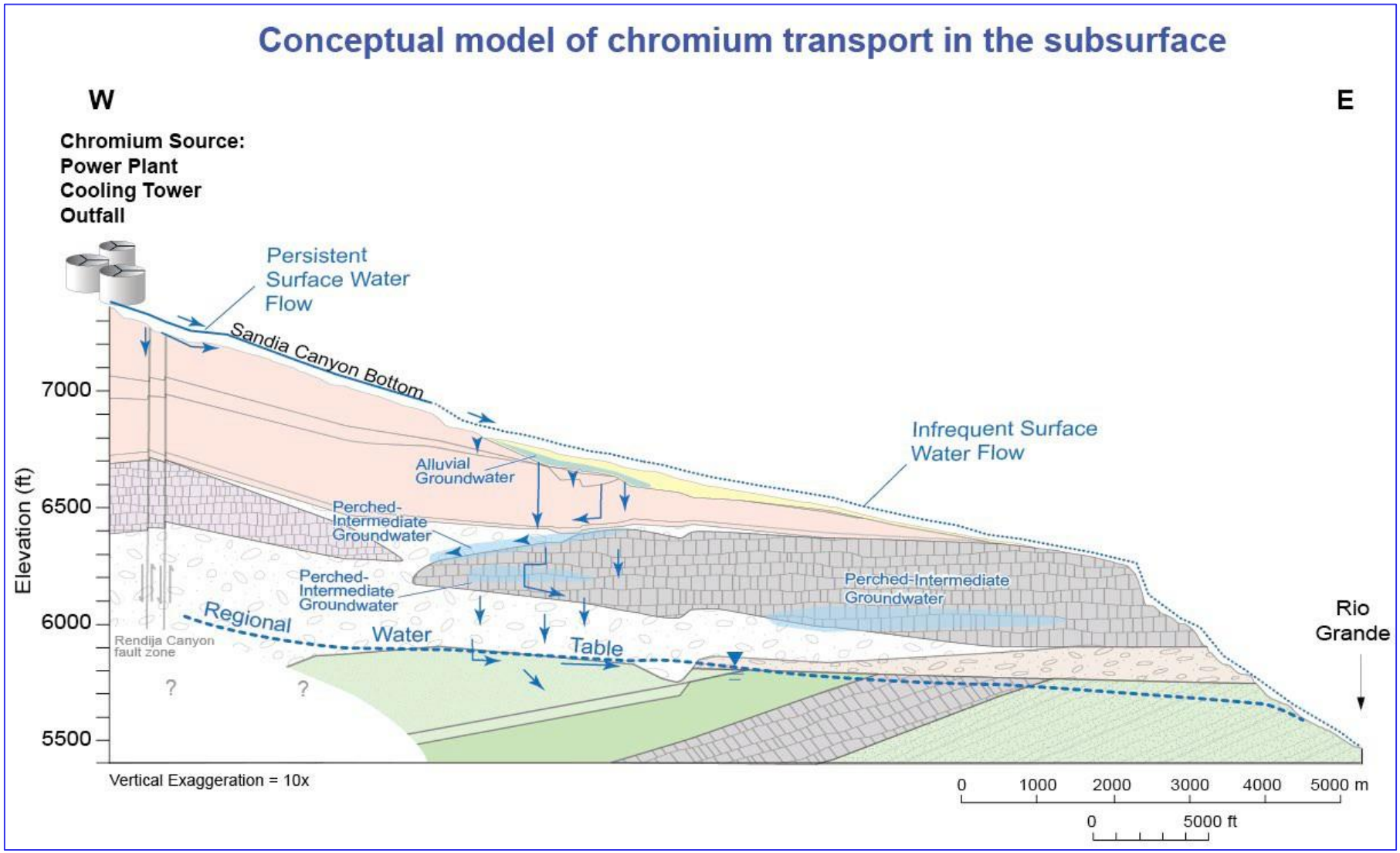

- Hexavalent Cr present in regional aquifer under oxidizing conditions of regional aquifer (adsorption not significant)
- Current plume footprint estimated at ~1.0 mile x 0.5 mile within the Española basin aquifer (18-40 miles wide and ~50 miles long)
- Chromium(VI) plume deeper than initial Conceptual Site Model (CSM)

# Photograph of the Jemez Mountains and Pajarito Plateau (view to the west with past industrial sources of chromium(VI) discharges)

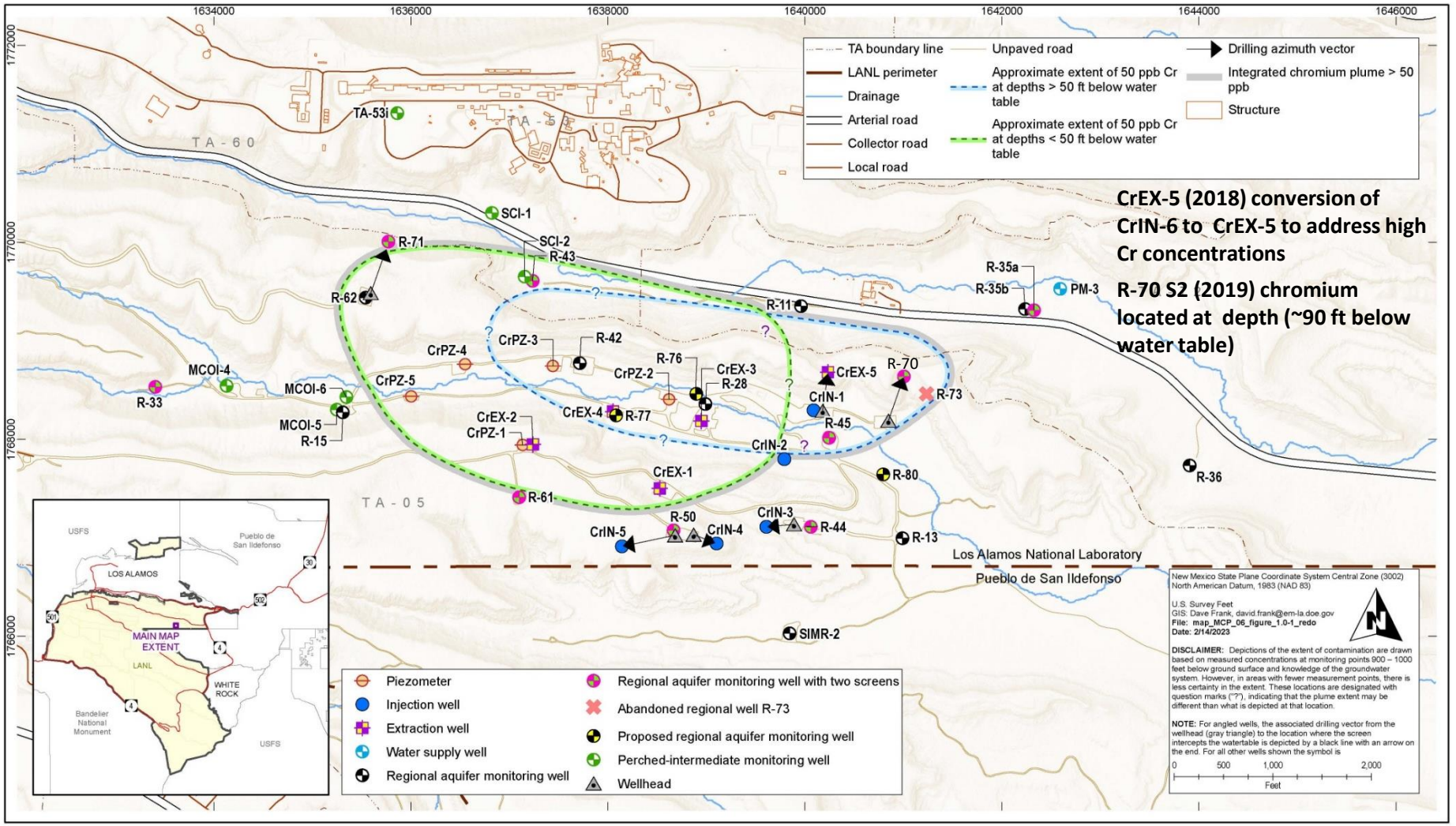



- Potassium dichromate used in cooling towers at a Laboratory (TA-3) power plant
- Up to 160,000 lb. released from 1956-72 in hexavalent (mobile) form [Cr(VI)]
- Water containing chromium travelled down Sandia Canyon until reaching an infiltration window(s), then migrating laterally and vertically until reaching Mortandad Canyon
- Not all Cr released from TA-3 power plant is present in groundwater

# Conceptual Model of Chromium(VI) Transport in the Environment at Los Alamos, New Mexico (DOE 2023)



# Boundary of the Chromium Plume (50 µg/L) Present in the Regional Aquifer LANL (DOE 2023)



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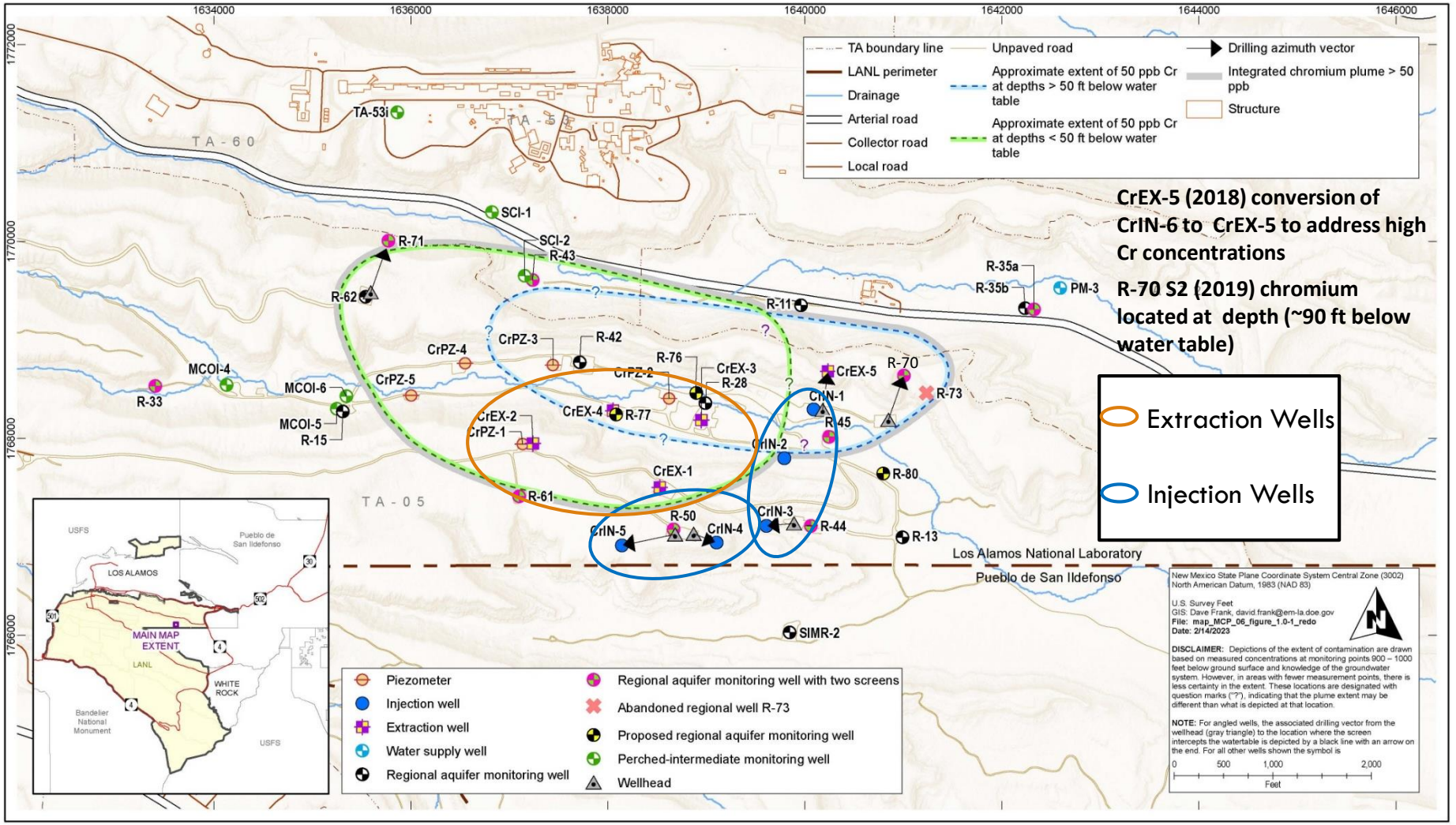
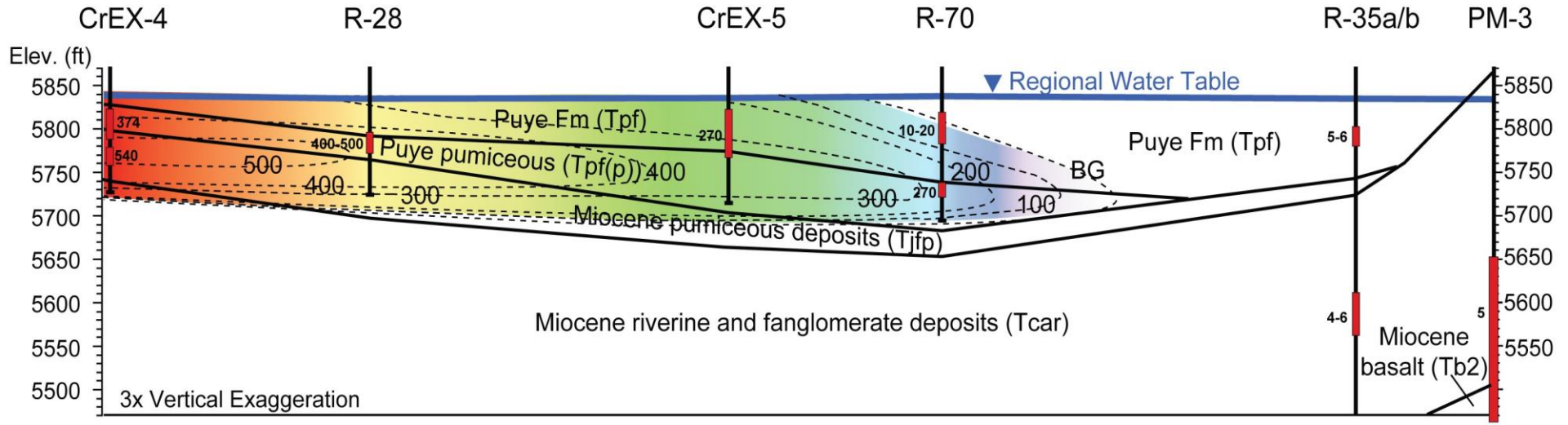


# Hydrogeologic Cross Section and Chromium Concentrations in the Chromium Plume Present in the Regional Aquifer (modified from DOE 2023)

## Conceptual Site Hydrological Model for the Regional Aquifer

- Several hydrogeologic strata behave similarly and have similar hydraulic conductivities calculated from aquifer performance tests
- Strong anisotropy (non-homogeneous), non-continuous layering of sedimentary beds
- Unconfined near the water table, leaky-confined at depth



# Potentiometric Surface (Water Table) Map of the Regional Aquifer, October Through December 2021 (DOE 2023)

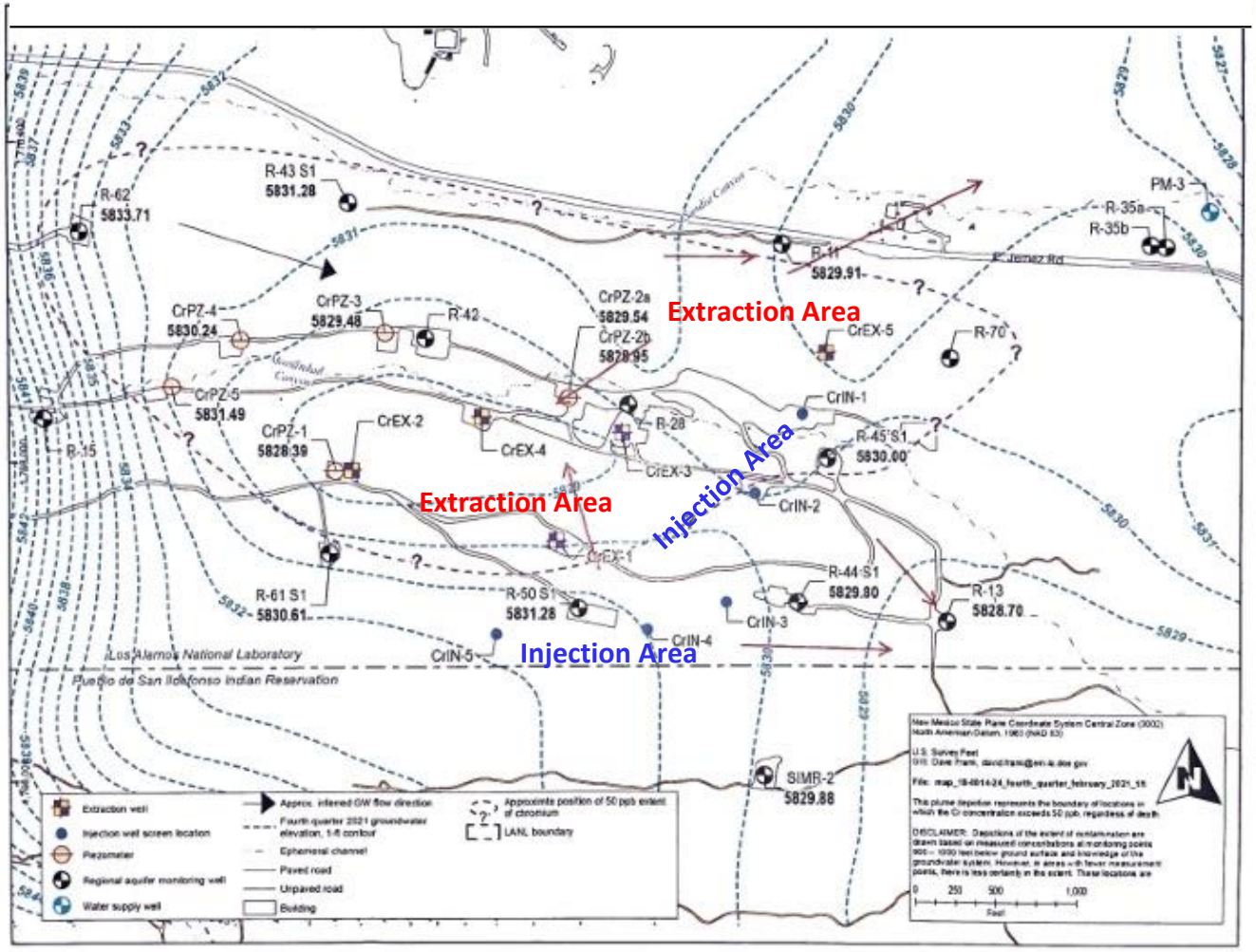
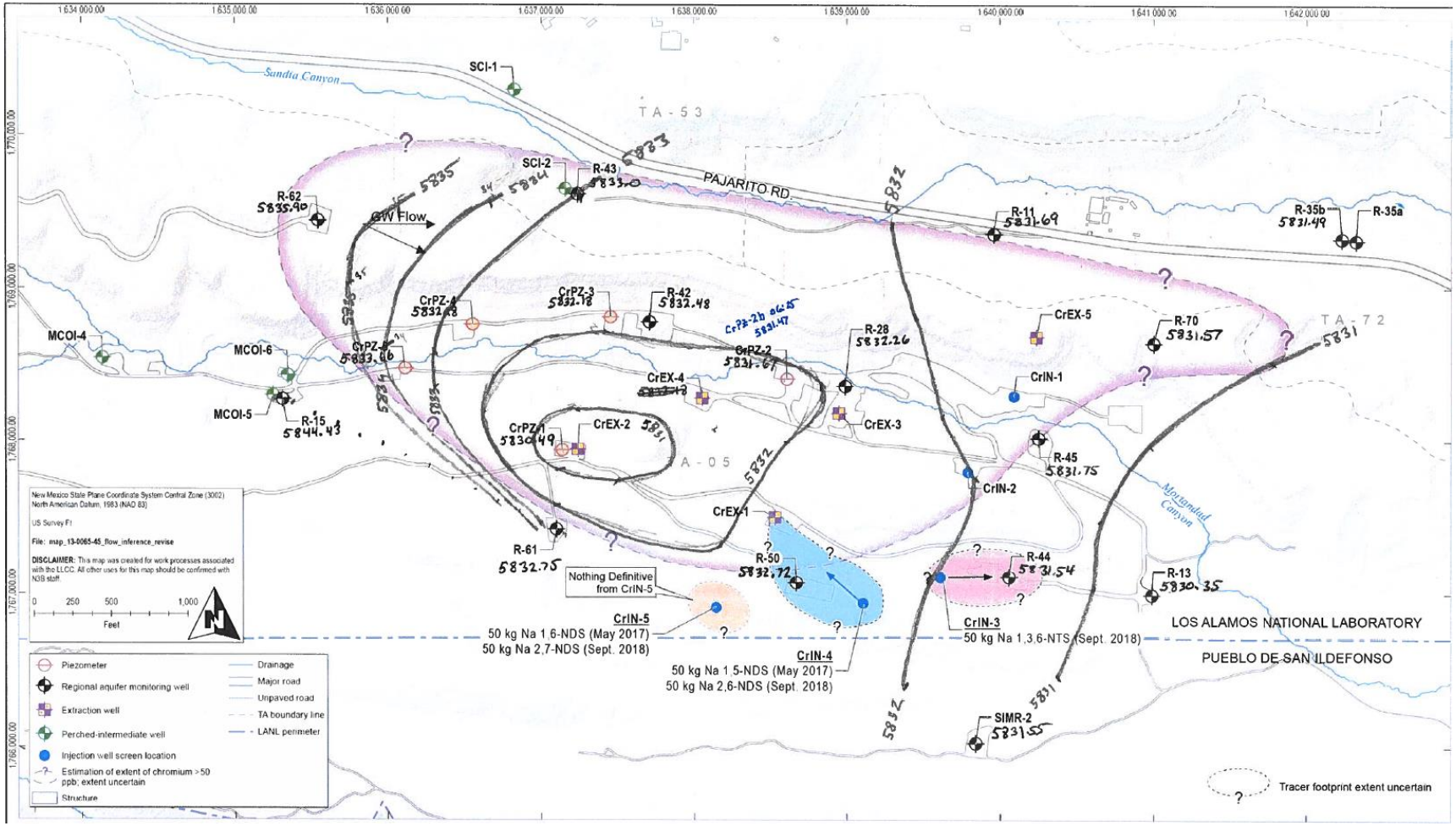


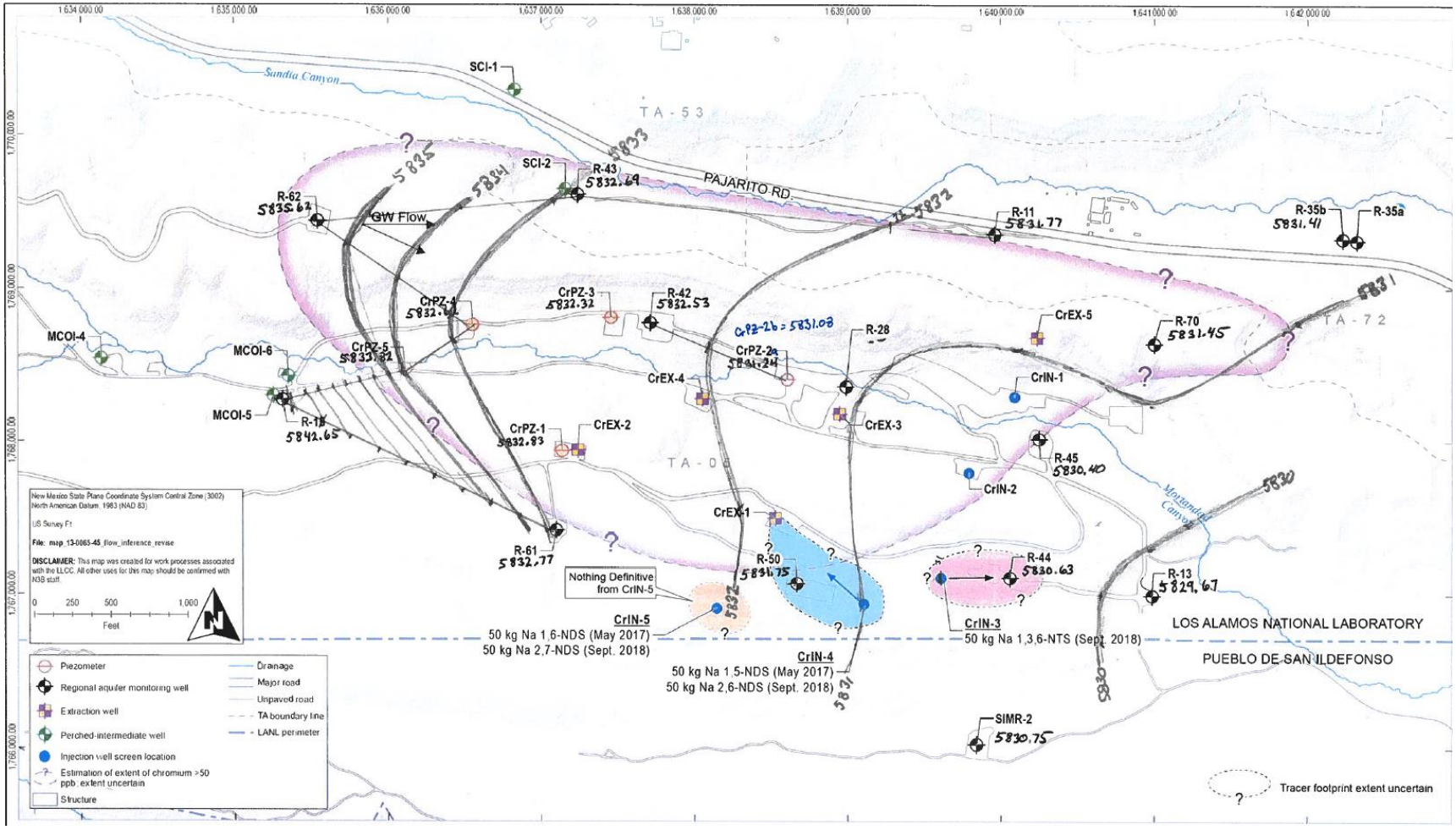

Figure 5.1-6 Potentiometric surface map to support DP-1835 for Quarter 4 2021. Red arrows are indicators of groundwater flow divide.

**Groundwater Flow Direction** →

# March 22, 2020, 03:00 Water Table Map Using Three-point Method With IM Operational



# June 14, 2020, 03:00 Water Table Map Using Three-point Method With IM Total Shutdown



# Chromium Interim Measures workplan

- Updated Chromium Interim Measures and Characterization workplan was delivered to HWB in September 2022 as a milestone in the FY 2022 Consent Order Appendix B
- NMED reviewed the workplan and delivered comments in a Notice of Disapproval (NOD)
- General Comments
  - Some workplan updates stemmed from DP-1835 discharge permit modifications by GWQB
  - NMED required that revision to include alternative locations for injection outside the plume boundary
  - NMED agrees with extraction, DOE must find a new location for injection of treated water to continue IM operations

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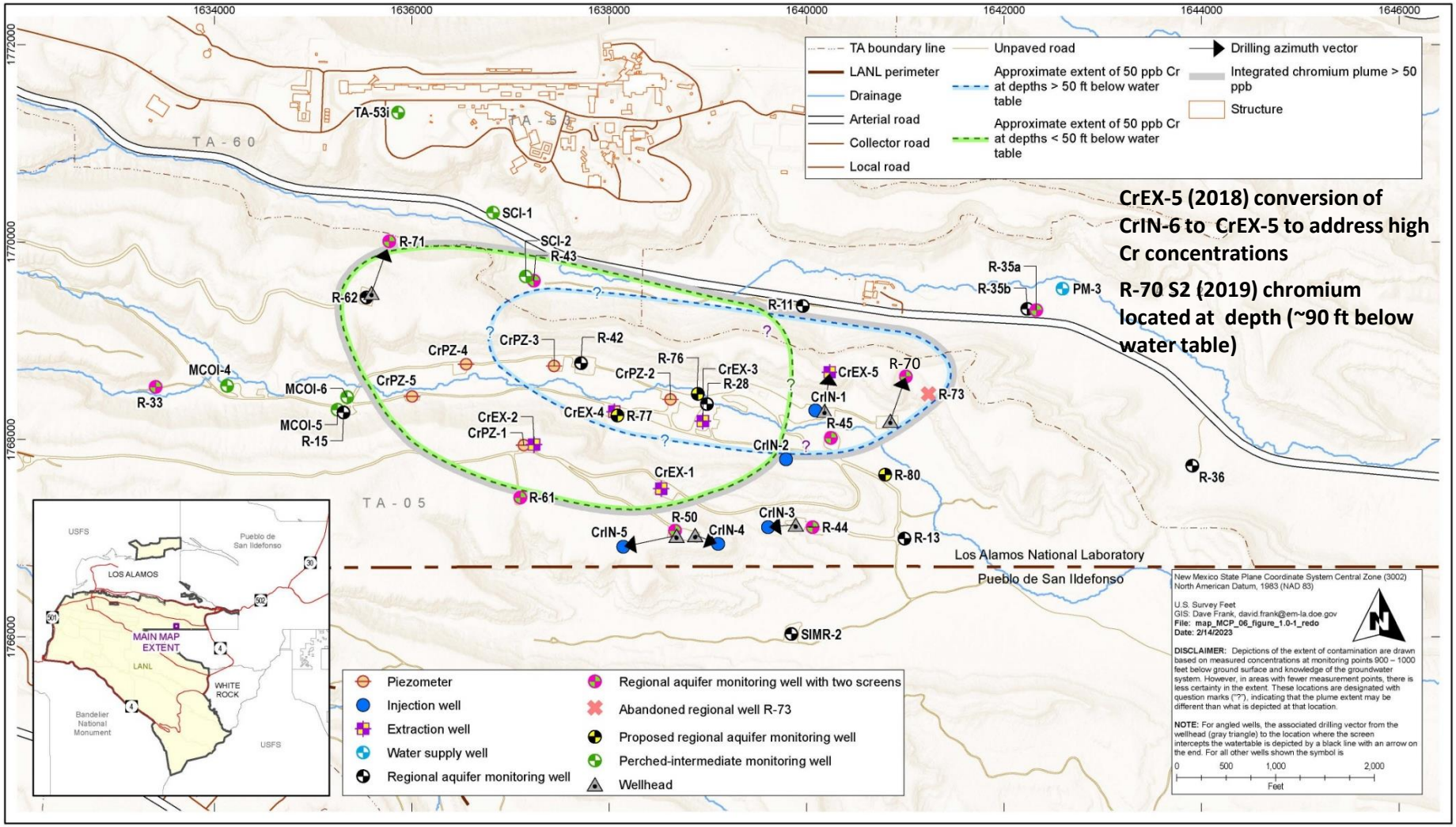
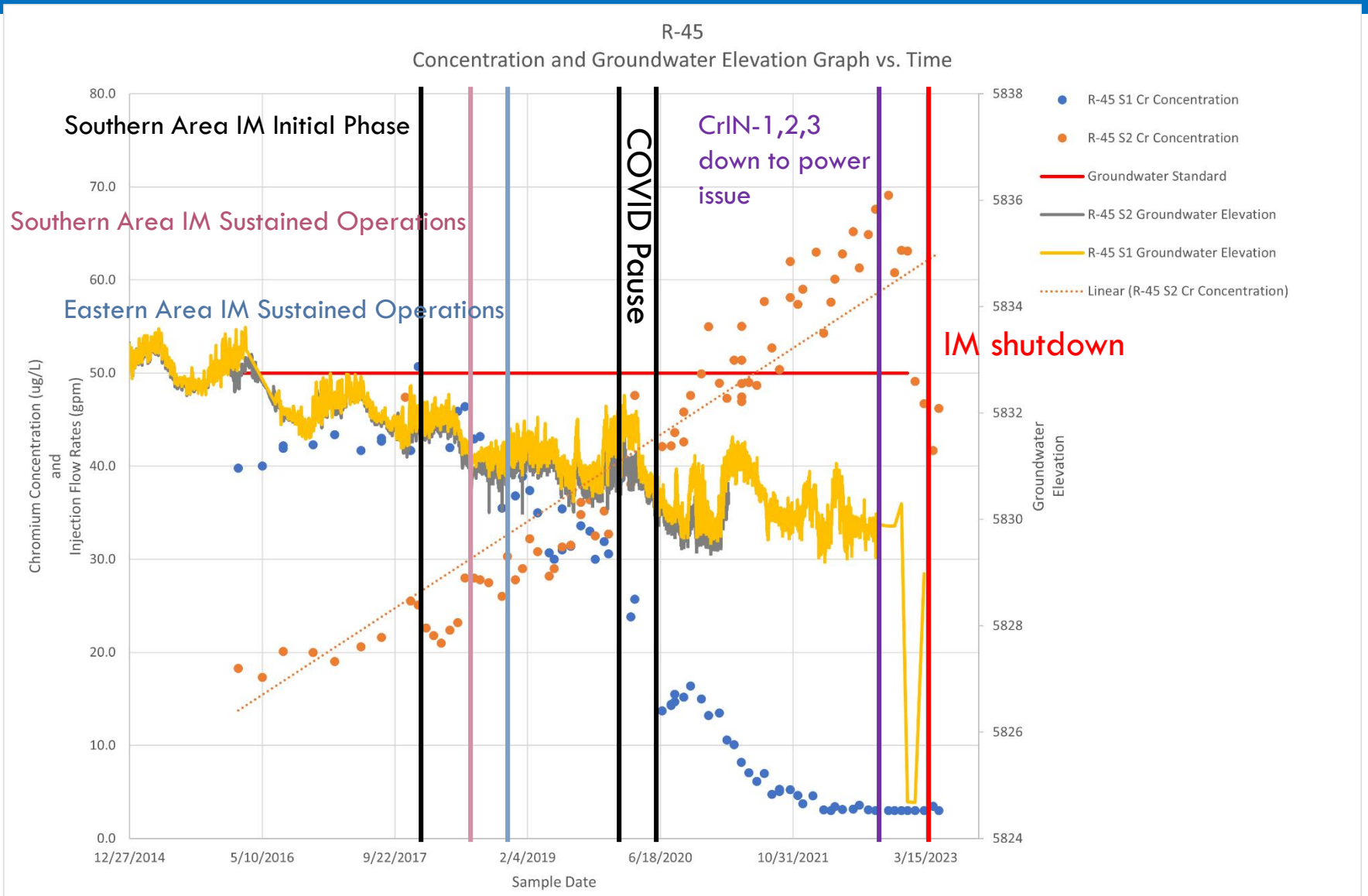


# Time Versus Dissolved Chromium Concentrations at Regional Aquifer Well R-45 (NMED)



# Ground Water Quality Bureau Discharge Permit (DP)-1835

- DP-1835 (Underground Injection Control Wells) was issued by NMED-Ground Water Quality Bureau (GWQB) to DOE and Los Alamos National Security (LANS) on August 31, 2016.
- On April 24, 2018 (effective April 30, 2018), LANS notified NMED (GWQB) that LANS is transferring its permit responsibilities under DP-1835 to Newport News Nuclear BWXT-Los Alamos.
- The fourth quarterly monitoring report for calendar year 2020, submitted to NMED (GWQB) on February 26, 2021, showed that concentrations of total dissolved chromium (Cr) of 0.055 mg/L at regional aquifer well R-45 screen 2 exceeded the WQCC ground-water standard of 0.050 mg/L. Higher concentrations have observed at the well since 2020.

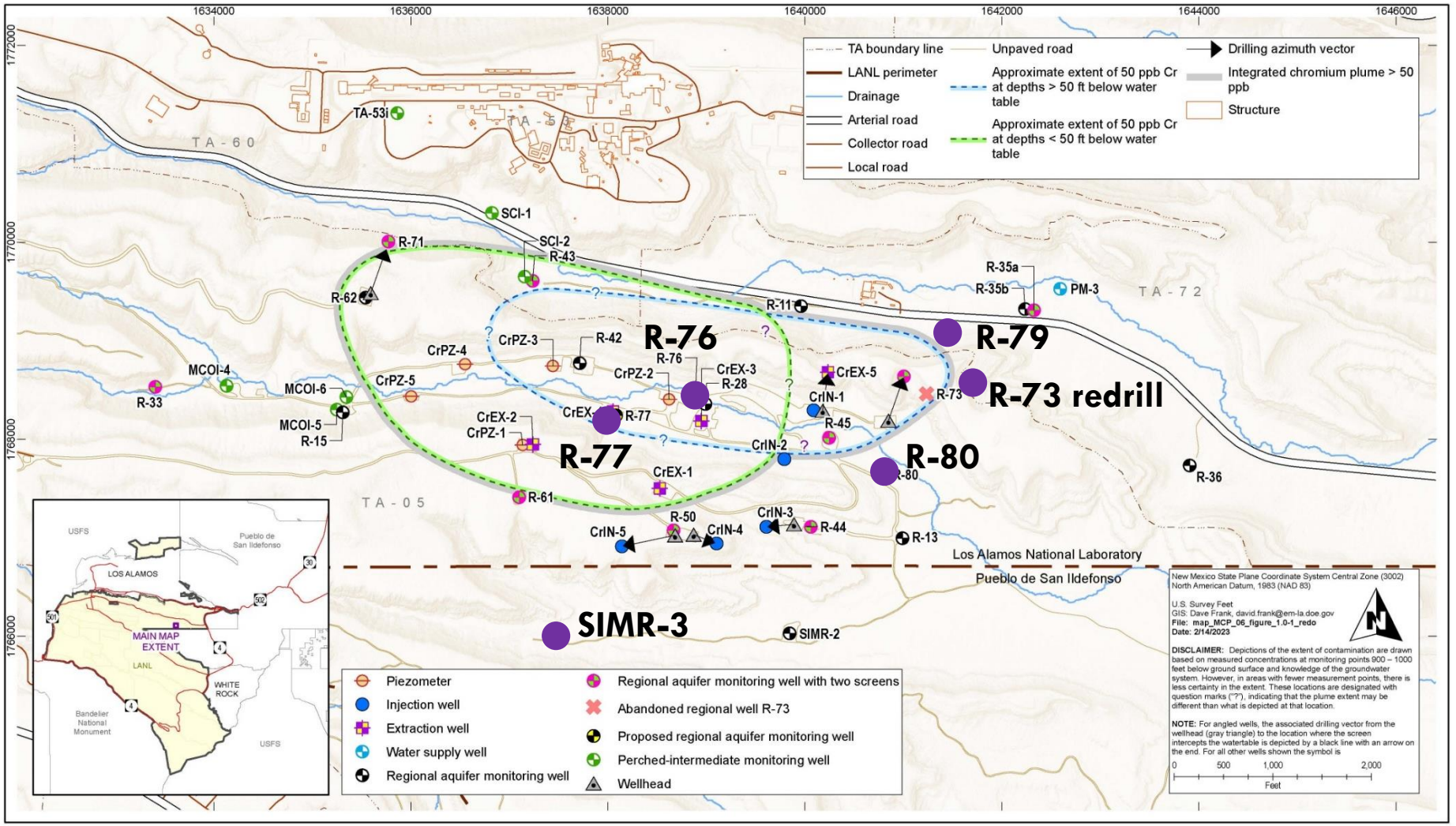
# Ground Water Quality Bureau Discharge Permit (DP)-1835

- On April 28, 2022, NMED (GWQB) notified LANL/DOE that LANL/DOE is not in compliance with the conditions of DP-1835, the Water Quality Control Commission (WQCC) Regulations, and the Water Quality Act (WQA).
- On May 27, 2022, LANL/DOE responded to the non-compliance with a letter refuting the non-compliance and that LANL/DOE would proceed without further action.
- On September 30, 2022, LANL/DOE responded to the notice of violation with an Action Plan outlining a proposed process for modeling the impacts of the remediation injections on R-45 screen 2 and the installation of additional monitoring wells to determine if elevated chromium levels extend beyond R-45.

# Ground Water Quality Bureau Discharge Permit (DP)-1835 (Continued)

- On December 12, 2022, NMED (GWQB) issued at Corrective Action Plan Response and Further Action Required letter informing LANL/DOE that the plan as submitted is deficient. The response from NMED to the Corrective Action Plan requires LANL/DOE to cease injecting into all wells associated with DP-1835 by April 1, 2023.
- On March 1, 2023, LANL/DOE delivered a white paper that describes the different potential operational modifications to the injections. The white paper includes modeling that predicts how the chromium plume will react to cessation of injection and under other reduced operational scenarios.
- On March 20, 2023, a managers meeting was held and representatives from NMED, Pueblo de San Ildefonso, and DOE were present to discuss the white paper and paths forward.

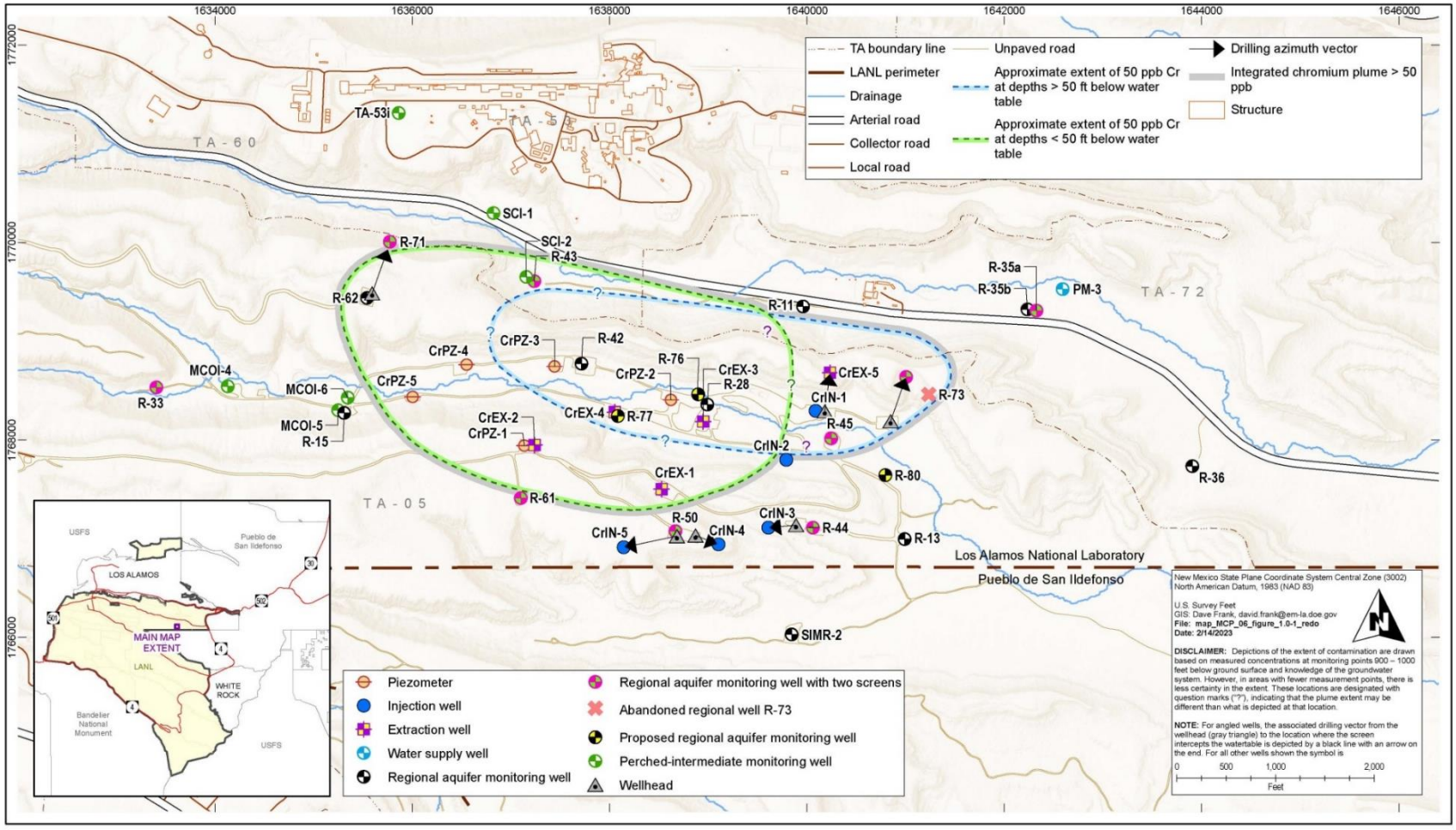
# Data Gaps for Nature and Extent and Remediation of the Chromium Plume



# Latest Progress

- Nature & Extent of the plume area is still not fully defined at depth (Chamita Formation) and laterally (aquifer sources West of Plume, Northeast portion of plume (CrEX-5, R-70, etc.))
- Chromium IM has been shut off since April 1, 2023 after direction from NMED-GWQB to cease injection at CrIN-1, 2, 3, 4 & 5.
- NMED-GWQB and NMED-HWB are encouraging DOE to investigate other areas to inject treated water
- DOE states that it will propose alternate injection scenarios in a Corrective Measures Evaluation (CME) for final remedy
- NMED-HWB will not review a CME until the Chromium Interim Measures and Characterization Work Plan activities are completed, including the installation and sampling of data gap wells to determine nature & extent of the contaminated plume
- Well priorities for the Cr plume are:
  - Plug & Abandon R-73 – currently plugged above water table
  - SIMR-3 – Well on Pueblo de San Ildefonso property West of SIMR-2 and South of R-50
  - R-80 – downgradient (Southeast) from R-45, screened at the same depths as R-45, requirement from updates to GWQB discharge permit
- Well drilling & Construction update: NMOSE will only approve single-screen wells for DOE. Wells that were designed as dual-screen wells are being revised to ‘cluster’ wells like R-35a and R-35b.

# Questions?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TA-53i
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SCI-2
R-71
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R-62
R-11
R-35a
R-35b
PM-3
CrPZ-4
CrPZ-3
R-42
CrPZ-2
R-76
CrEX-3
R-28
CrEX-5
CrIN-1
R-73
R-45
MCOI-4
R-33
MCOI-6
CrPZ-5
MCOI-5
R-15
CrEX-2
CrPZ-1
CrEX-4
R-77
CrIN-2
CrEX-1
R-61
R-80
R-36
R-50
CrIN-5
CrIN-4
CrIN-3
R-44
R-13
Los Alamos National Laboratory
Pueblo de San Ildefonso
SIMR-2
TA boundary line
LANL perimeter
Drainage
Arterial road
Collector road
Local road
Unpaved road
Approximate extent of 50 ppb Cr at depths > 50 ft below water table
Approximate extent of 50 ppb Cr at depths < 50 ft below water table
Drilling azimuth vector
Integrated chromium plume > 50 ppb
Structure
Piezometer
Injection well
Extraction well
Water supply well
Regional aquifer monitoring well
Regional aquifer monitoring well with two screens
Abandoned regional well R-73
Proposed regional aquifer monitoring well
Perched-intermediate monitoring well
Wellhead
USFS
Pueblo de San Ildefonso
LOS ALAMOS
MAIN MAP EXTENT
LANL
WHITE ROCK
Bandelier National Monument
USFS
New Mexico State Plane Coordinate System Central Zone (3002)
North American Datum, 1983 (NAD 83)
U.S. Survey Feet
GIS: Dave Frank, david.frank@em-la.doe.gov
File: map_MCP_06_figure_1.0-1_redo
Date: 2/14/2023
DISCLAIMER: Depictions of the extent of contamination are drawn based on measured concentrations at monitoring points 900 – 1000 feet below ground surface and knowledge of the groundwater system. However, in areas with fewer measurement points, there is less certainty in the extent. These locations are designated with question marks ("?"), indicating that the plume extent may be different than what is depicted at that location.
NOTE: For angled wells, the associated drilling vector from the wellhead (gray triangle) to the location where the screen intercepts the watertable is depicted by a black line with an arrow on the end. For all other wells shown the symbol is
0
500
1,000
2,000
Feet