Overview of Uranium In Situ Leach (ISL)/ In Situ Recovery (ISR) "Mining" in New Mexico



Understanding ISL/ISR methods is important because at least half of the 20 planned, proposed or licensed mines in New Mexico will use the ISR process

Chris Shuey, MPH
Southwest Research and Information Center

Webinar for MASE, Nov. 25, 2025, revised June 26, 2026

CHC Webinar, Nov. 5, 2026

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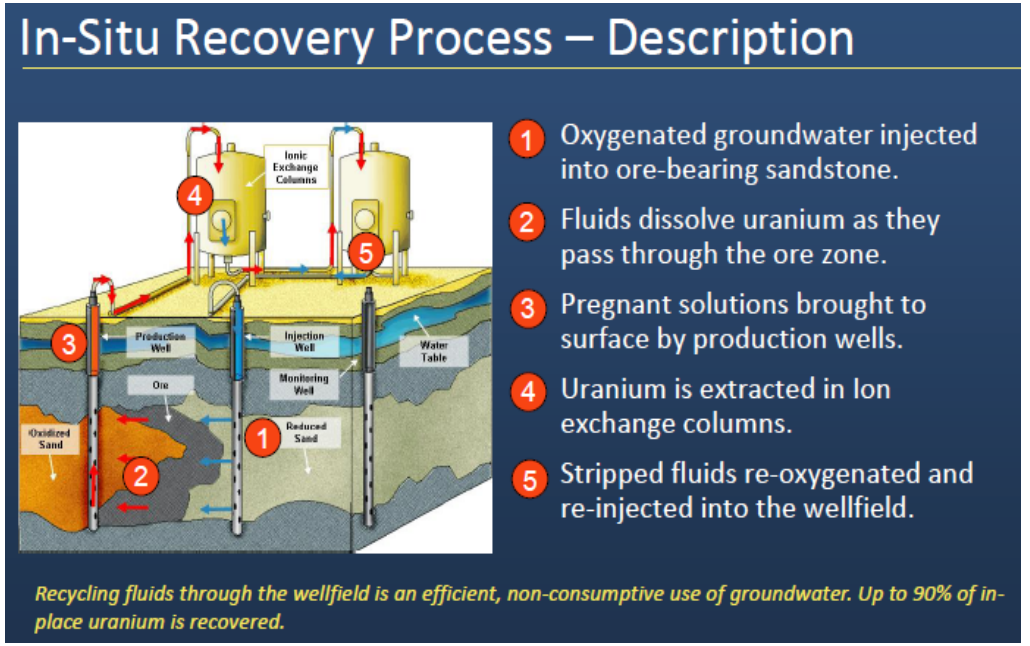
Retrieved from: https://www.cameco.com/businesses/uranium-operations/kazakhstan/inkai

Brief Overview of How ISL/ISR "Mining" Works and its Performance in NM and the US

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Our experience evaluating *in situ* leach (ISL)/*in situ* recovery (ISR) operations:

- **1994-2008:** Partnered with Eastern Navajo Diné Against Uranium Mining (ENDAUM) and NM Environmental Law Center (NMELC) to challenge NRC license to Hydro Resources Inc. for the **Crownpoint Uranium Solution Mining Project** before the NRC's Atomic Safety and Licensing Board
- Expert testimonies by six hydrologists, geochemists, water resource specialists, public health specialists
- Documented ISL industry performance, 1970s-2009
- Updated performance since 2009



From www.powertech.com August 10, 2009 Presentation at http://www.powertechuranium.com/s/Presentations.as

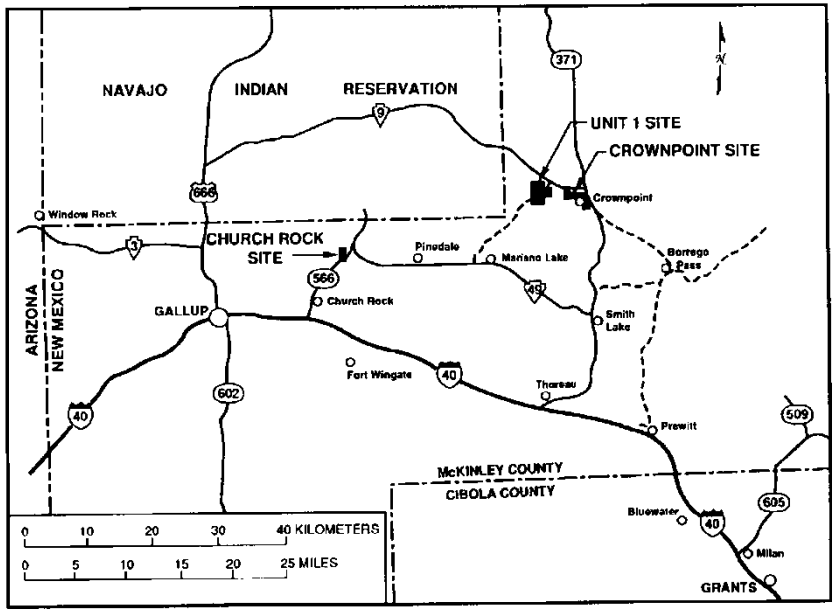
Key Terms:

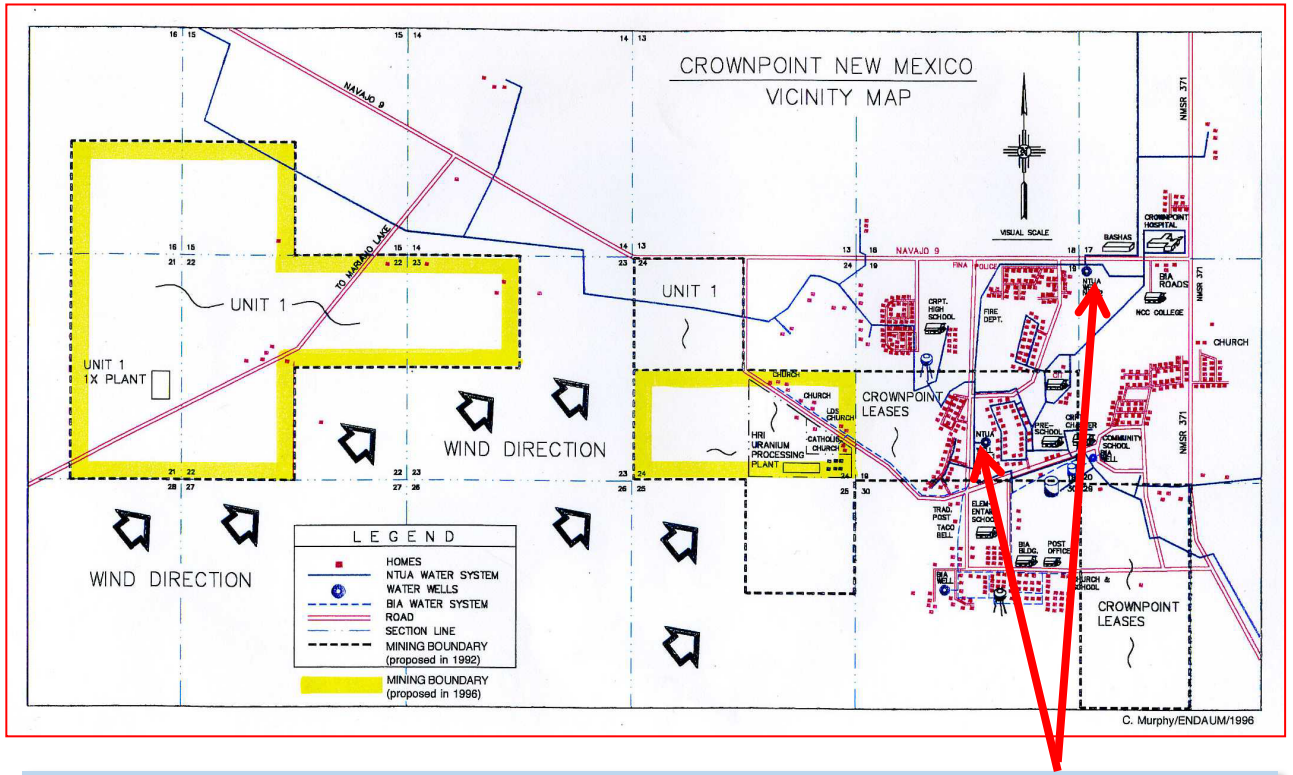
Lixiviant – Native groundwater mixed with oxygen and biocarbonate to change the chemistry of U in the orebody

Pregnant Lixiviant – Groundwater containing high levels of U that is pumped to the surface for further processing

Crownpoint Uranium Solution Mining Project ("CUP")

Four sites: Churchrock Sec. 8 and Sec. 17 (left), Unit 1 and Crownpoint Processing Plant (right)





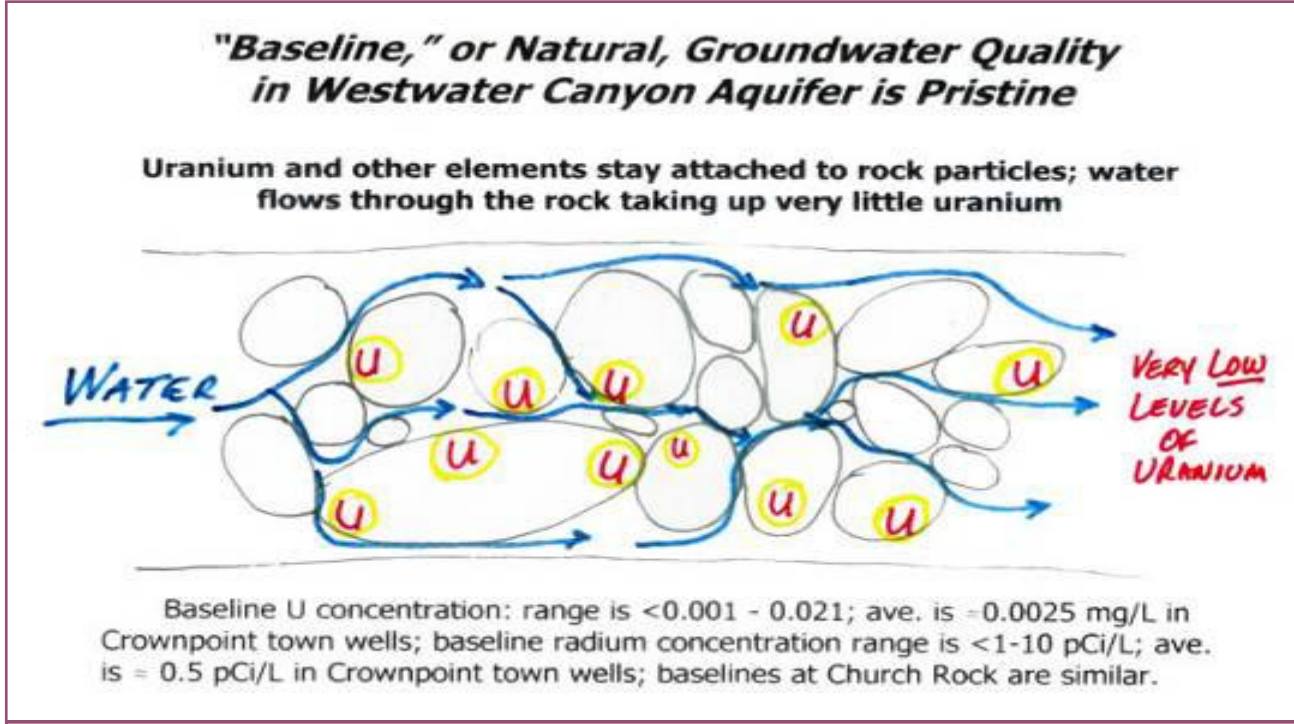
Licensee: NuFuels, Inc., subsidiary of Laramide Resources; acquired project sites from Hydro Resources Inc./Uranium Resources Inc. in 2017

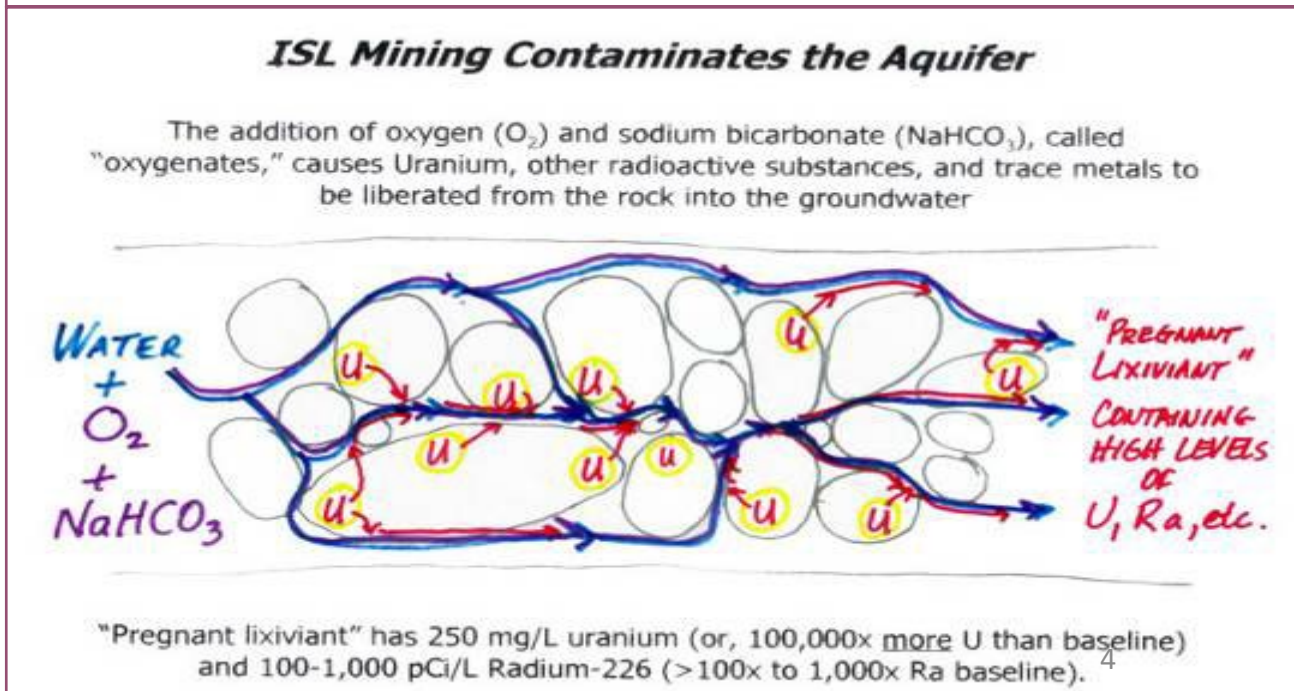
Municipal water wells completed in the Westwater Canyon Aquifer within 0.5 miles and 1.5 miles from the Crownpoint processing plant wellfields

SRIC Uranium Assessment Program

Lixiviant injection perturbs groundwater quality

- Under normal conditions (top R), very little uranium is dissolved in the groundwater; it's chemically **reduced** (U^{+4}) and stuck to sand grains in humate deposits in the rocks
- ISL mining solutions **oxidize** the rocks**, dissolving** high concentrations of uranium (U^{+6}), into the groundwater (bottom R)
- Uranium, radium increased by hundreds to thousands of times over baseline levels





Big Issues in ISL/ISR Projects

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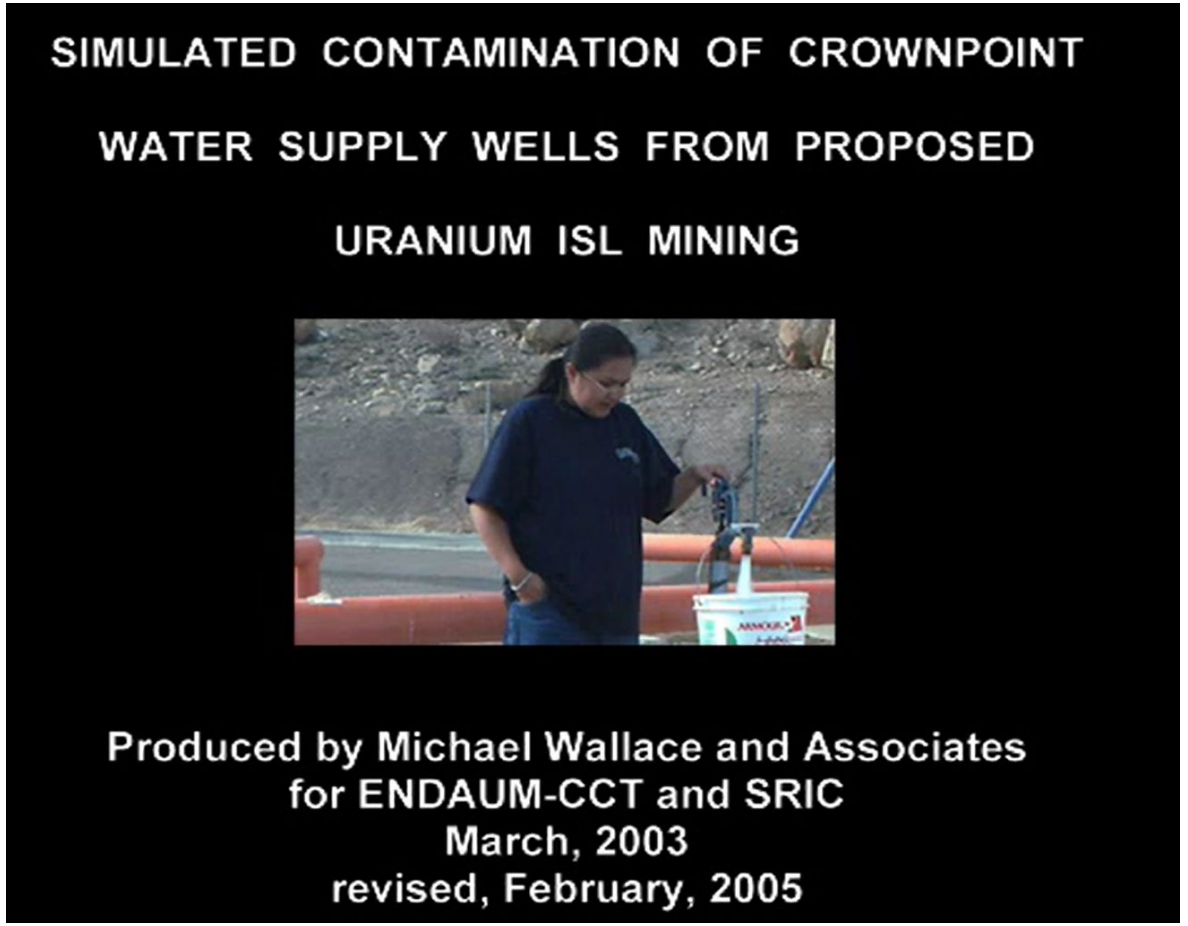
These issues were raised during the ENDAUM/SRIC Intervention and covered again, post-2009, in NMDOJ's July 2026 petition to intervene in NuFuels's license renewal process.

- **Prevent excursions** – the escape of mining fluids from the designated production area
- **Reduce uniform spacing** of monitoring wells consistent with geometry of orebodies in paleochannels
- Rigorously **define "background"** or "baseline" water quality
- Require **restoration standards** consistent with baseline water quality or MCLs
- Provide for **adequate number of "pore volumes"** to accomplish restoration by groundwater sweep
- **Limit exemptions** or variances from restoration standards

Excerpt from Declaration of Richard J. Abitz, Ph.D., geochemist, Exhibit 2 to New Mexico Department of Justice Petition for Leave to Intervene in NuFuels Inc.'s license renewal application before NRC's ASLB, July 27, 2026

In summary, the [Environmental Report's] approach to groundwater restoration and impact analysis is inadequate because it assumes successful aquifer restoration despite the failure at the Mobil Section 9 pilot site, it does not assess the complexity of the stratigraphy and preferred flow paths within the Westwater Canyon aquifer, and it lacks a discussion on how to collect representative samples for establishing true baseline values. Moreover, the restoration strategy invokes using the higher value of a non-representative background concentration over the drinking water MCL. Lastly, the ER mitigation strategy to replace Crownpoint drinking-water wells before production begins indicates that the NRC and NuFuels know they cannot restore the aquifer, and a large volume of drinking water will be lost to the people in and around Crownpoint.

Implications for Groundwater Flow during ISL Operations: Crownpoint Case



Video simulation of effects of modeling groundwater flow in heterogenous vs. homogenous sandstones made by hydrogeologist **Michael Wallace** for ENDAUM in 2003-2005

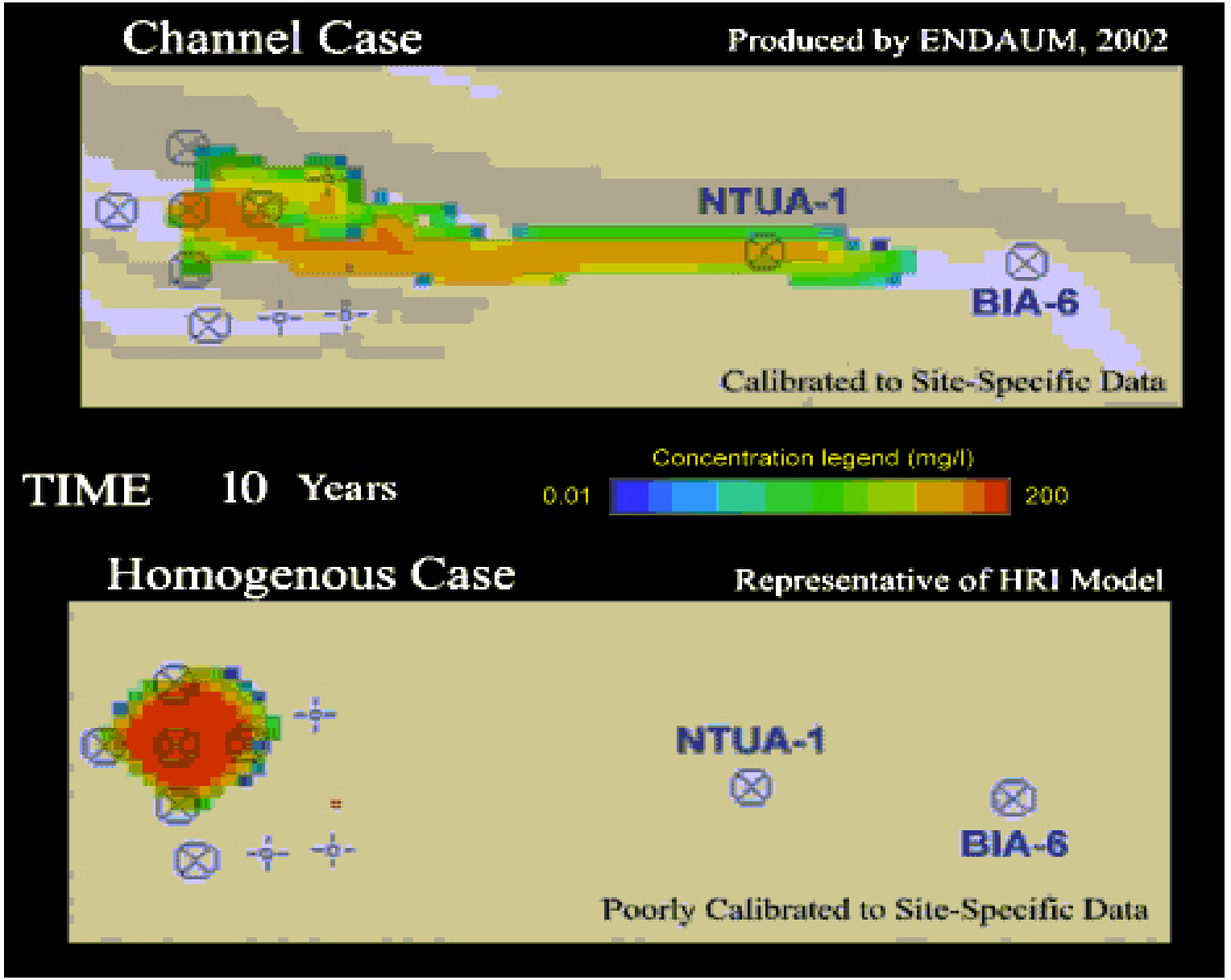
Homogenous Case: Groundwater flow is slow in Westwater Canyon Aquifer when modeled as "one big pile of sand"

Channel Case: Groundwater flow is modeled in WCA paleochannels, based on HRI's own hydraulics

[Cue the video file…]

Possible Impacts of ISL Mining on Crownpoint Water Supply Wells

Groundwater modeling performed by hydrologist Mike Wallace, shows contaminated mining fluids escaping the ISL wellfield via channels in the Westwater Canyon Aquifer and contaminating town well NTUA-1 in less than 10 years (top). HRI's modeling, which did not take into account buried channels, shows no escape of mining fluids from the wellfield (bottom).



Wellfield Restoration Experience

Mobil Sec. 9 Pilot ISL (1979-1988)

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- Mobil Section 9 Pilot Project
  - Ore zone: before mining vs. after restoration
  - Significant variability, except HCO_3^-

	Na^+	HCO_3^-	SO_4^{2-}	Cl^-	$HMoO_4^-$	$UO_2(CO_3)_2^{2-}$	$^{226}Ra^{2+}$
	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	pCi/L
OZbm	93	206	37	15.9	0.121	0.011	1.6
OZar	141	225	85	101	8.05	0.459	37.4

R. Abitz. Water Quality in the Westwater Canyon Member of the Morrison Formation. Presentation to Gallup Water Board, Feb. 2007.

- Sec. 9 ISL Pilot project operated by Mobil Oil at site 5 miles west of Crownpoint
- Injection and production in ~12 wells on 40 acres in 1979-1980
- Ore zone background before injection showed good quality water
- Six years of restoration using various restoration techniques ***could not restore groundwater to pre-mining water quality***
- Most analogous ISL experience for evaluating NuFuels' (Laramide Resources) proposed ISL mines at Churchrock and Crownpoint

USGS Reviews of Restoration Performance at ISL/ISR Operations in Texas

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"To date, no remediation of an ISR operation in the United States has successfully returned the aquifer to baseline conditions. Often at the end of monitoring, contaminants continue to increase by

- reoxidation and resolubilization of species reduced during remediation;
- slow contamination movement from low to high permeability zones; and
- slow desorption of contaminants adsorbed to various mineral phases"

IAEA-CN-175/87

In-situ recovery uranium mining in the United States: Overview of production and remediation issues

J.K. Otton, S. Hall

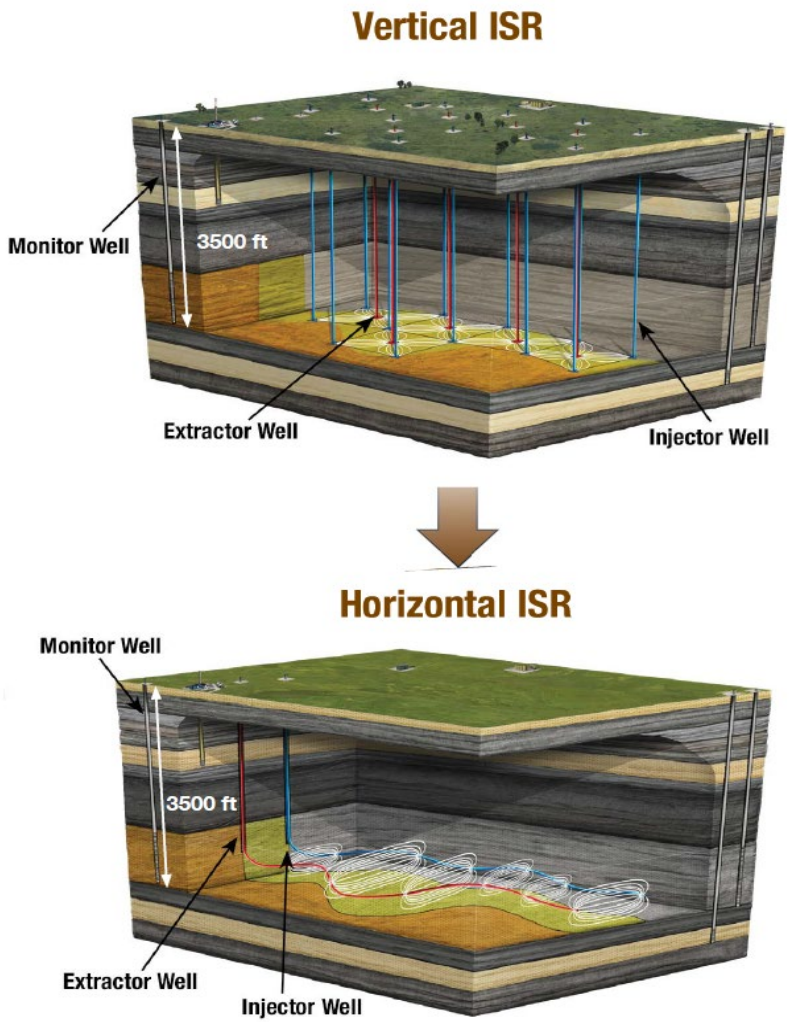
U.S. Geological Survey, Lakewood, Colorado, United States of America

E-mail address of main author: jkotton@usgs.gov

IAEA-CN-175/87 at: http://www-pub.iaea.org/MTCD/Meetings/PDFplus/2009/cn175/URAM2009/Session%204/08_56_Otton_USA.pdf

The USGS (Otton and Hall) was cited in NuFuels's 2023 application to USDOE for a grant to have LANL conduct restoration tests on core samples from Churchrock Sec. 17.

Grants Energy's proposed ISR Project: Unprecedented depths



Graphic from Grantsenergy.com, 2025 Fact Sheet

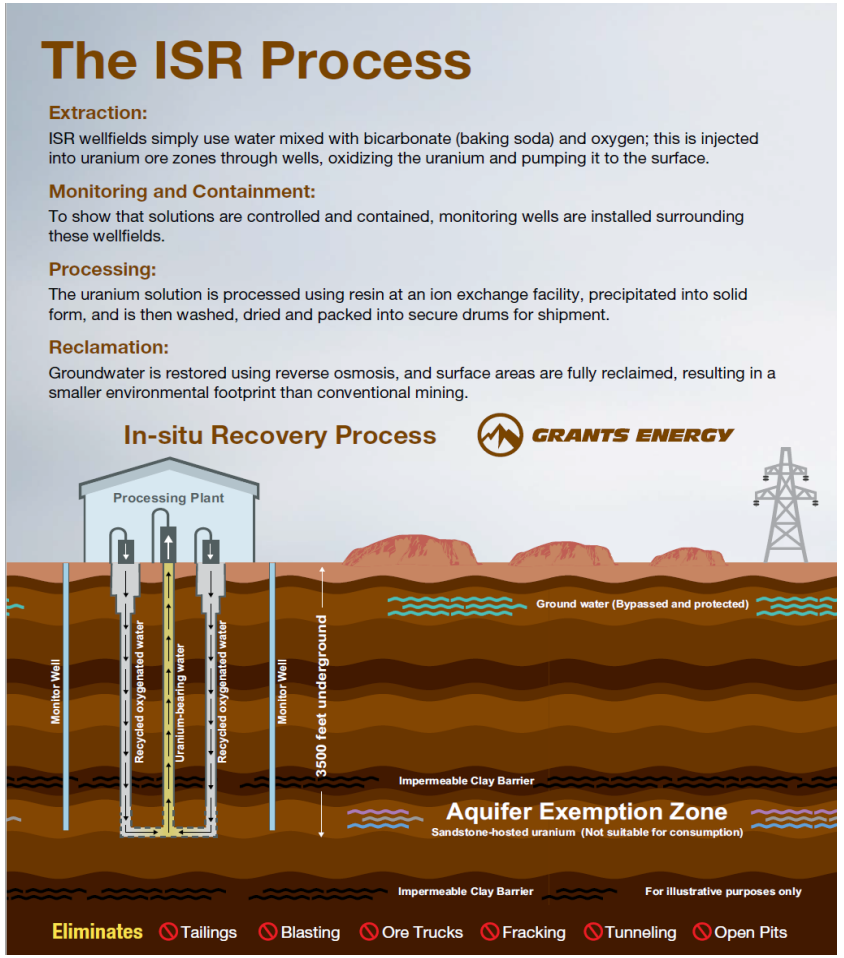
Grants Energy's proposed Precision ISR project may be the deepest ISL/ISR operation in the world

- Reported to be 3,500 ft deep (1,067 m) (see graphic at left)
- Deepest ISL mine reported to be in Kazakhstan, 750 m (2,460 ft)
- Crownpoint and Unit 1 proposed ISL wellfields, 1,800-2,200 ft deep
- Churchrock Secs. 8 and 17 depths: 700-900 ft
- Most ISL mines operate at less than 1,000 ft in depth
- None is known to use horizontal drilling

Questions about Grants Precision ISR

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- Few technical details revealed
- While named a “Fast-41” mining project, at this time, no ISR license application submitted to NRC for this project
- What is impact of Mt. Taylor underground mine workings on proposed ISR operations, lixiviant control, groundwater restoration?
- What are challenges for lixiviant control posed by horizontally drilled injection and production wells?
- What are cumulative effects of concurrent ISR mining at Mt. Taylor Mine location with Roca Honda conventional underground mine three miles away?



Excerpt from Grantsenergy.com, 2025 Fact Sheet