Uranium Mining TENORM Waste Studies

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2006 NMA/NRC Uranium Recovery Workshop

United States Environmental Protection Agency

Overview

- EPA TENORM Program
- Uranium Report Volume I
- EPA Uranium Location Database
- Uranium Report Volume II
- Summary and discussion

Goal of TENORM Program

- **Minimize exposures where natural sources of radioactivity are concentrated in the environment, or made more accessible due to human activities.**

EPA TENORM Program Elements

- Identify and characterize abandoned uranium mine risks
- Reduce risks from contaminated buildings
- Participate in activities that reduce risks from uranium mines on federal lands
- Get feedback

Stakeholder Involvement

- A part of EPA's TENORM program strategy
  - Is designed to determine interest and need for EPA technical, education, other assistance
  - Intended to find ways to partner to reduce radiation exposures

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Uranium Mining TENORM Report I

- *Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining, Volume I: Mining and Reclamation Background*
  - Available as bound copy, CD-ROM version and on the Internet at:

    http://www.epa.gov/radiation/pubs.htm/tenorm

    CD-ROM version includes past EPA studies on uranium mine wastes (1983, 1985, 1995)
- Requests for copies can also be made to:
  - radiation.questions@epa.gov

Uranium Mining TENORM Report II

- *Technologically Enhanced Naturally Occurring Radioactive Materials from Uranium Mining*, *Volume II: Investigation of Potential Health, Geographic and Environmental Issues From Abandoned Uranium Mines* is undergoing revision after peer review.

- Available for public comment on the Internet: http://www.epa.gov/radiation/pubs.htm/tenorm

Volume I Provides Overview of U.S. Uranium Mining

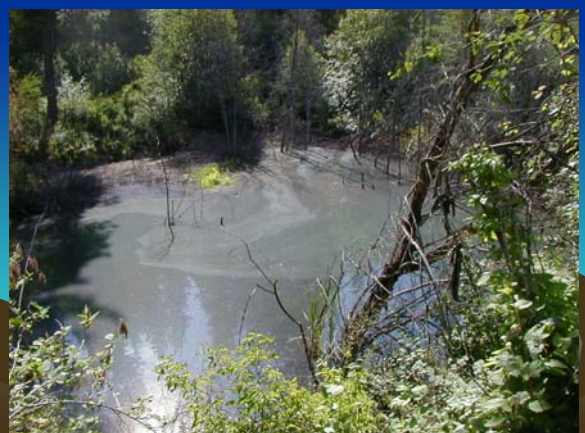
- History
- Mining methods
- Wastes generated
  - Physical and chemical characteristics,
  - Waste volumes,
- Reclamation methods
- Statutory and regulatory responsibilities as an appendix.

Volume I

- Covers wastes generated by open-pit & underground mines, as well as mills, ISL and heap leach operations, per EPA's Science Advisory Board recommendation.
  - Wastes considered byproduct materials under NRC or Agreement State authority identified in the text.

Volume I—Findings (Waste)

- TENORM at conventional mine sites includes overburden, unreclaimed protore, waste rock, evaporites, mine and pit lake water, drill core and cuttings, and contaminated refuse.
- Waste rock from ~4000 identified producing mines estimated to range from 1 to 9 billion MT, likely estimate of 3 billion MT. Ultimate numbers may be higher given EPA database study.



Volume I – Findings (Radiation)

- Radium-226 measurements higher than 20 pCi/g in overburden are unusual, but some previous surveys have found levels averaging 25 pCi/g.
- Protore --most material 30–600 pCi/g.
- Radon measurements in some abandoned underground mines can be elevated. A health/safety consideration for public recreation, government or contract workers.

Volume I— Findings (Hazards)

- Radionuclides, heavy metals, and radon are all potential hazards associated with U mining TENORM wastes
- Regulatory requirements affect selected reclamation techniques.
  - Remoteness and aridity of a site and reduced risk for human exposure may affect decisions on whether a site is in need of reclamation, or the extent that it is reclaimed.

Volume I— Findings (Reclamation)

- DOE study of 21 mines—reclamation costs ranged from $0.18/kg uranium produced to $23.74/kg uranium produced.
  - Average cost of ~$14 million per mine.
  - Differences based on mine size, accounting methods.
- EPA found smaller mines <25 acres may cost <$45,000 to reclaim, but some CERCLA cleanups may be much more.
- When uranium facilities close, some may require long-term monitoring; others can be released for other uses.

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Uranium Location Database

- A digital GIS database product to be released shortly.
- A sign up sheet is available at this meeting to receive a copy by mail. It can also be requested at:
  - radiation.questions@epa.gov
  - peake.tom@epa.gov

Uranium Location Database

- Compilation of State and Federal databases
- USGS MAS/MILS and MRDS
- BLM State databases
- Individual States, some with multiple datasets
  - WY TX CA SD
  - NM MT NV
  - UT AZ CO

Uranium Location Database Is Most Comprehensive

- Compilation of federal and state sources
- Production records document ~4,000 mines vs Uranium Location Database ~15,000 records
- Subset of mines compared to USGS topographic maps

Uranium Location Database Issues

- Completeness
  - Database contains more records than any other known database
- Redundancy
  - Use of multiple databases introduces redundant records
  - May not have caught all duplicates
- Reliability
  - Are the data good?
- Accuracy
  - How accurate are the data?

Uranium Location Database Issues

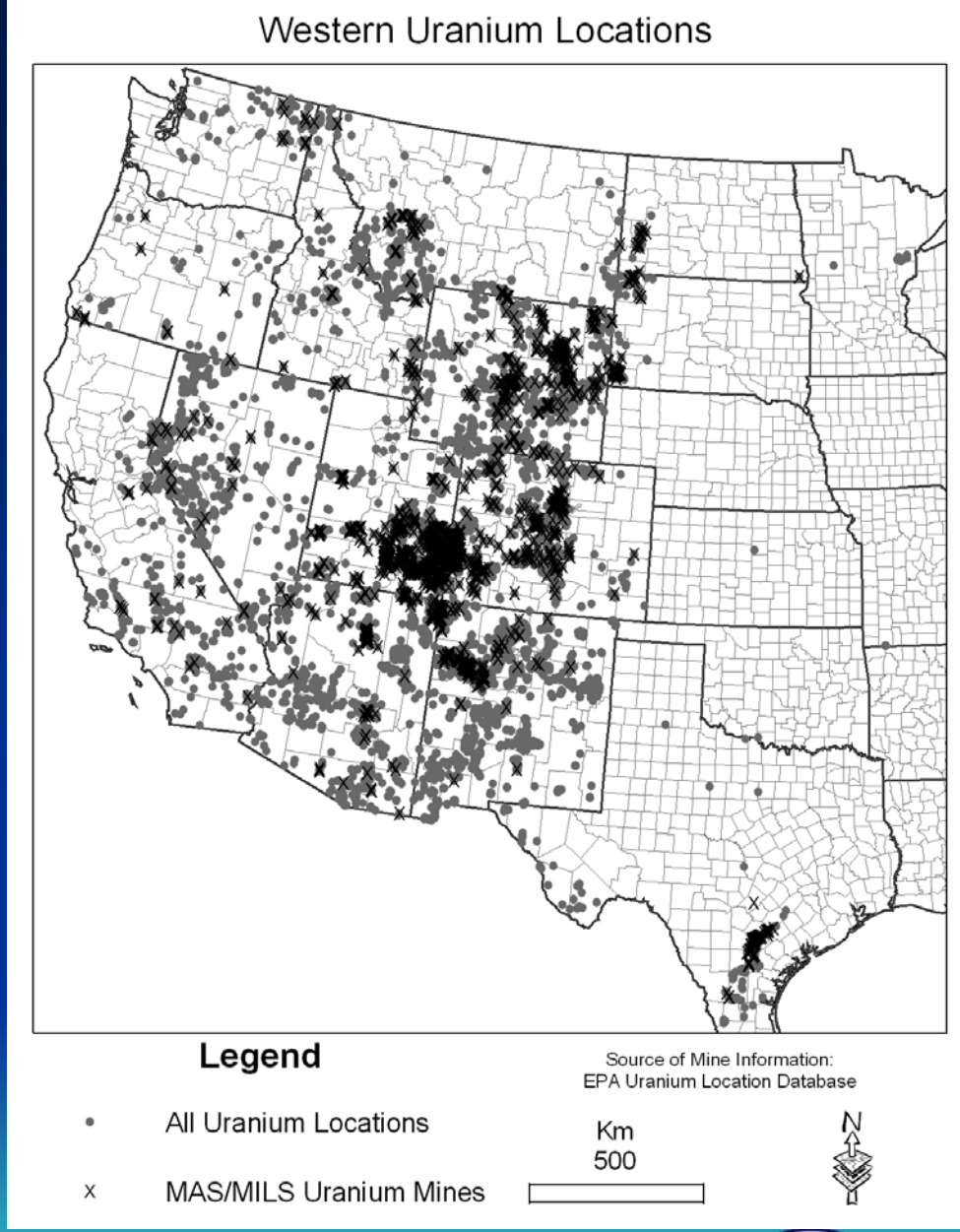
- Definition of a “mine”
  - Production?
  - Mine opening?
- Which mines are reclaimed?
  - We don’t have that information included yet
  - Some mines are reclaimed or in the process
- Accuracy of USGS topographic maps

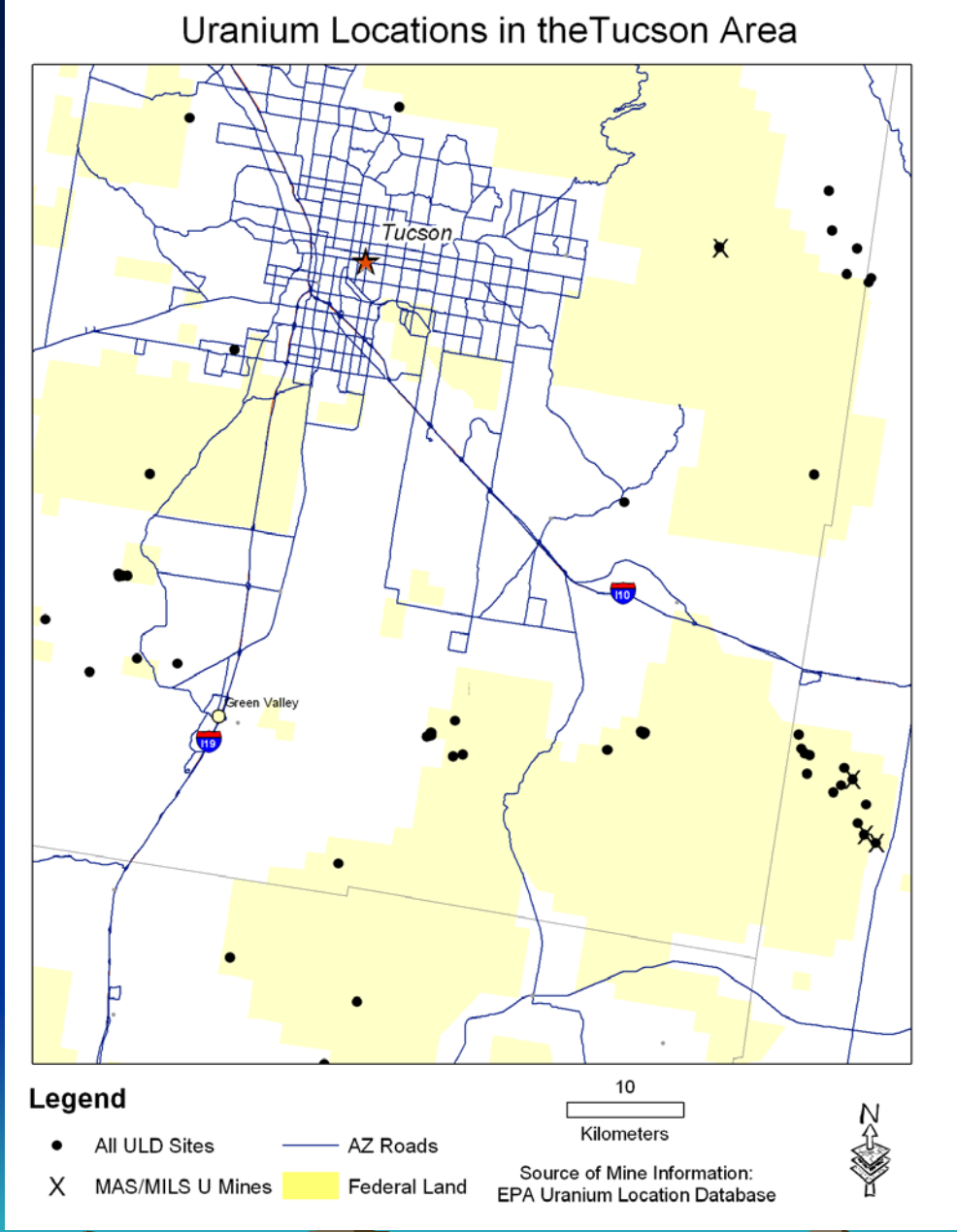
Uranium Location Database

- Most mines producing uranium as a primary commodity are, or were located, in Colorado, Utah, Wyoming, New Mexico and Arizona, and are typically on federal and Tribal lands
- Many mines in remote areas so recreational scenario may be most important

Data Comparisons

- Comparison of USGS MAS/MILS data & all ULD Data indicates ULD data more comprehensive
- MAS/MILS data focused in 4 Corners area and Wyoming

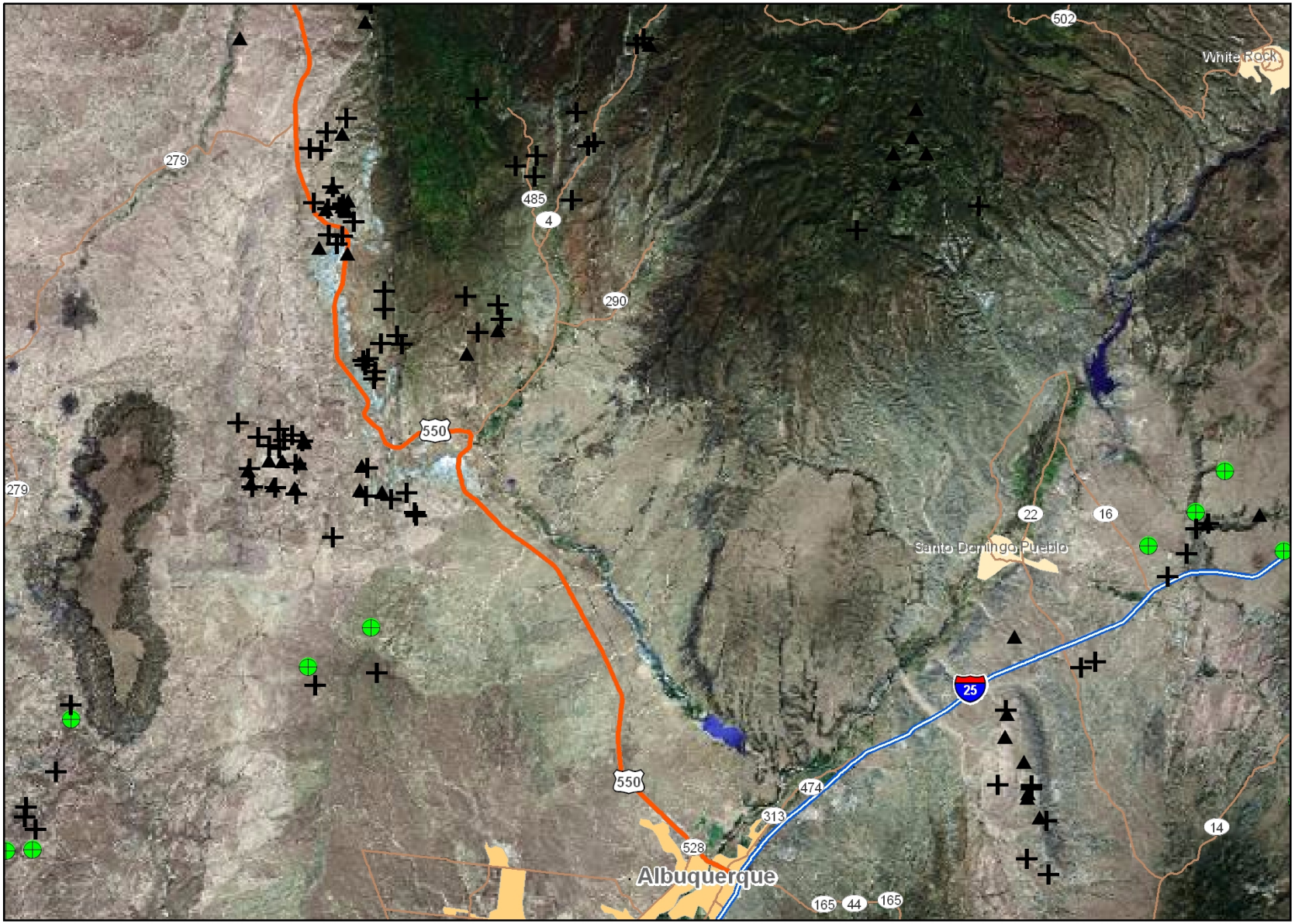




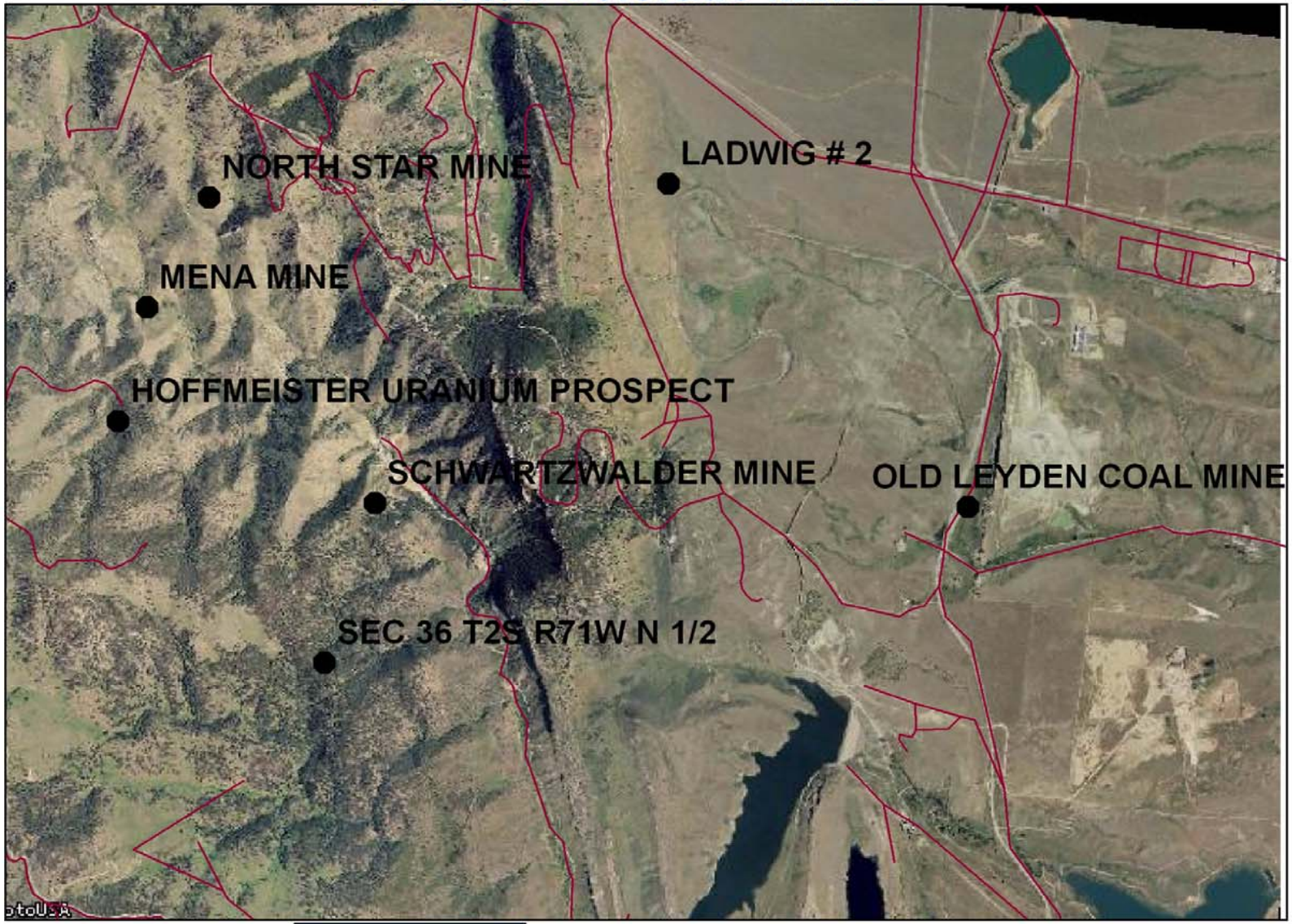
Data Comparisons

- State & Federal datasets add additional locations
- BLM Data in the Tucson, AZ area appear to be separate from MAS/MILS

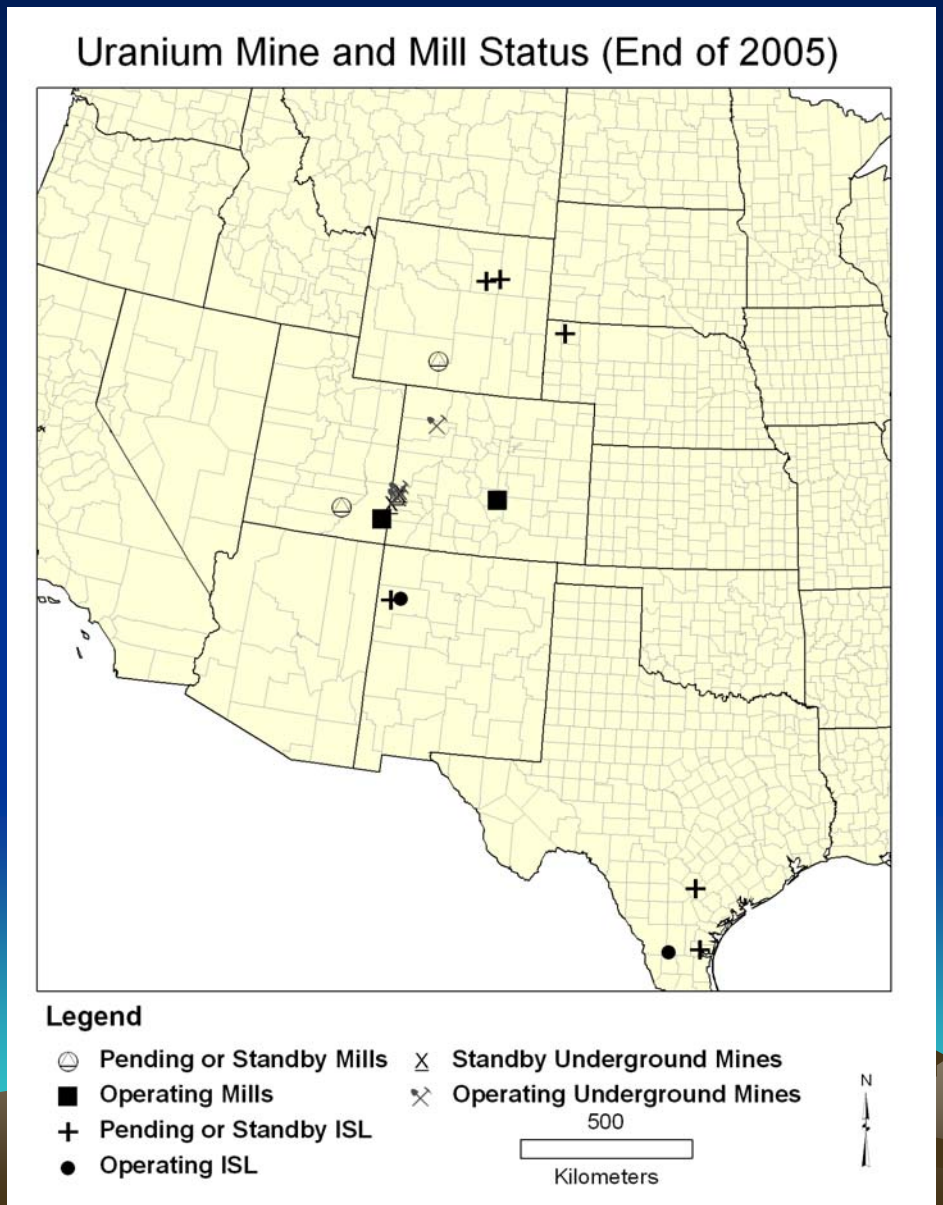
New Mexico Uranium Locations From Three Databases



Selected Colorado Mines



Operational or Standby Operations
(End of 2005)



- Information determined from State and Federal sources
- Have included one new mine in Nebraska

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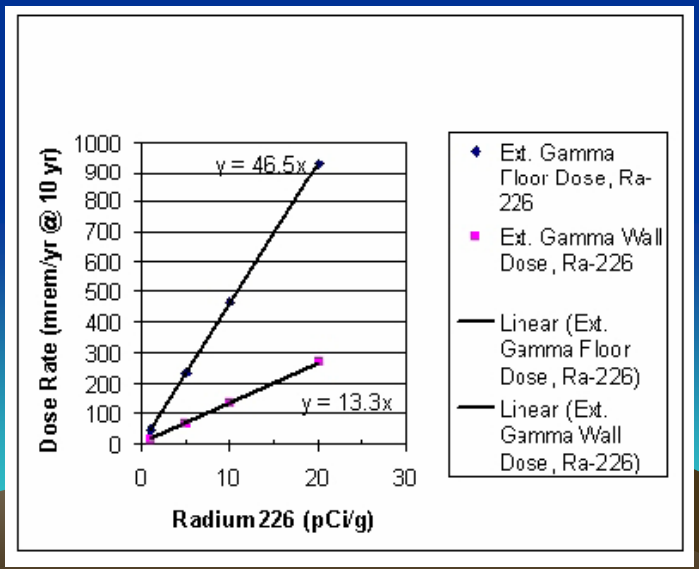
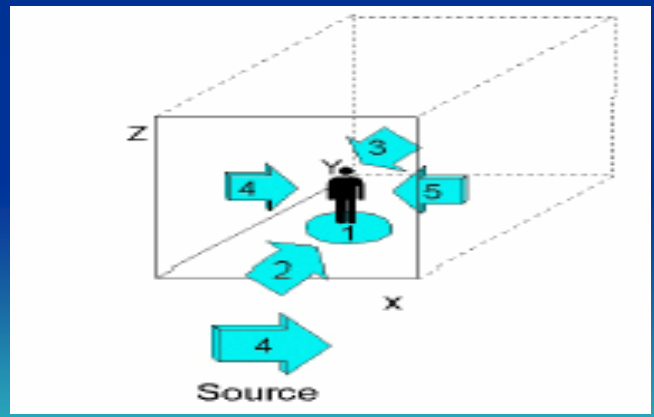
Volume II—Approach Used

- Geographic Information System (GIS) analyses using Uranium Location Database:
  - Provides spatial distribution and co-location of uranium mine sites with human-environmental resources, land ownership patterns, etc.
- Risk analyses using analytical and computer models provides a measure of cancer risk from variety of human radiation exposure situations, and information obtained from GIS analyses.

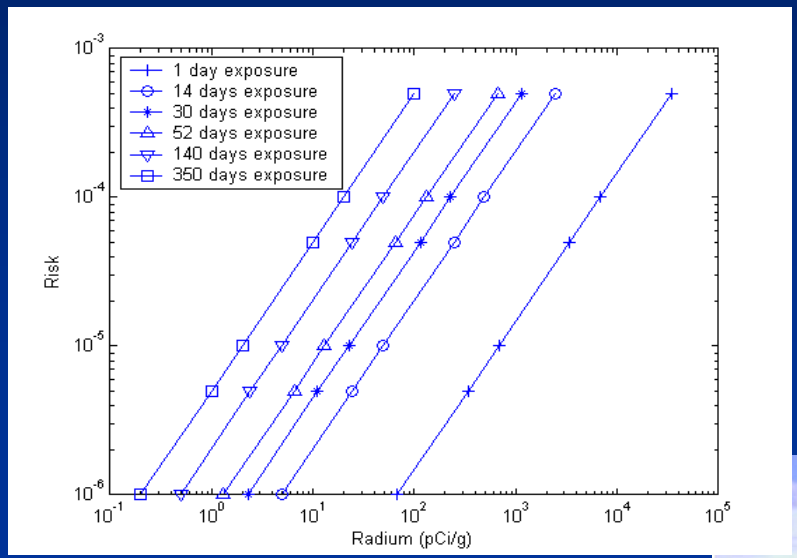
Modeling Scenarios – Building Materials





Primary Scenario is Recreational

- Time & Concentration → Risk



Volume II--Findings

- Focus is abandoned uranium mines; previous EPA studies have been done on active uranium mine sites.
- Abandoned, unreclaimed U mines have the potential to become health hazards from radioactivity and metals.
  - Radium is probably the most important concern.
  - Uranium can pose a problem for groundwater.
  - Other metals associated with uranium, such as arsenic, can also pose health risks.

Volume II--Findings

- Many mines found on hard to reach federal lands, as well as Tribal lands.
- Most likely affected groups:
  - Native American families that live close to the mines
  - Recreational users
  - Federal land managers for policy implications
- Watersheds with high uranium mine density may have the potential to pose ecological risks.

Volume II—Findings

- Misuse of mine waste for buildings, mines in communities, homes on/adjacent to mines
  - Risks up to 10^{-2} or 10^{-3} for most exposed individuals
  - However, most common exposure scenario is likely to be recreational
- Uranium mine disturbed lands widespread throughout western U.S. in many locations

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Summary

- U Volume I Provides Background on Uranium Mining, Waste Characteristics, & Reclamation
- U Volume II is a Scoping Study of Abandoned Uranium Distribution and Risks
- Uranium Location Database is Available
- We Would Like Input on Priorities

Program Elements (1)

- **Identify and characterize abandoned uranium mine risks**
  - Database
    - Add new data set on closed mines
  - Human Risk assessment
    - Provide assistance to EPA regions, federal, state, Tribal agencies as requested
  - Ecological assessment
    - Collect additional data, provide assistance to EPA regions, others

Program Elements (2)

- **Reduce risks from contaminated buildings**
  - Navajo
  - Other Tribes/areas with contaminated buildings
  - Develop educational materials

Program Elements (3)

- **Participate in activities that reduce risks from uranium mines on federal lands**
  - Guidance (non-CERCLA) on when, and to what level to reclaim sites
  - Site assessments as requested
  - Ecological assessments as requested

Discussion

- Do our findings agree with your experience?
- Do you see your priorities reflected in our program?
- What do you think needs to be done?