Lessons Learned
During Remediation of
More than 4,000 Properties in
Grand Junction, Colorado, USA

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Regulatory History

- Ore and uranium concentrate were purchased by the U.S. Atomic Energy Commission from 1947 to 1970 for defense-related purposes of the United States.
- No regulatory requirements for managing uranium mill tailings existed until the 1970s.
- Mill tailings were used by area communities as backfill around structures and utilities, and as a sand mixture in concrete and mortar.
- U.S. Congress passed the Uranium Mill Tailings Radiation Control Act (UMTRCA) in 1978 to manage inactive mill sites (Title I).
- DOE was given authorization to conduct remediation of 22 inactive mill sites and surrounding properties (5,335 remediated).
Grand Junction, Colorado

Mill site before remediation
Grand Junction Vicinity Properties

History

- The uranium processing mill was located in the heart of downtown; the operator encouraged the public to have mill tailings removed.
- Grand Junction had the largest number of vicinity properties (80 percent of the total program).
- The growing community prompted use of large quantities of mill tailings as construction material.
- Tailings were used to construct:
  - Golf courses
  - Parks
  - Power plant
  - Oil refinery
  - Junk yards
  - Schools
  - Hospitals
  - Police station
  - Businesses
  - Houses
Grand Junction Vicinity Properties
Unique Aspects

- Participation in vicinity property cleanup was voluntary
- Consequences for refusing cleanup
  - Denial of bank loans for contaminated property
  - Future property owners (often by inheritance) assumed costs associated with non-remediated properties
- Land records were to be annotated, documenting final property status; states refuse implementation of the program as designed
- States paid 10 percent of remedial action cost; however, they played a significant role in management of the program
Example of a Complex Vicinity Property

Downtown Grand Junction sidewalks during removal of mill tailings
Grand Junction Vicinity Properties
Final Status

- 10,907 vicinity properties were surveyed
- 6,605 (61 percent) vicinity properties were surveyed and excluded from remediation because they did not exceed cleanup standards
- 4,266 (39 percent) properties were successfully remediated
- 232 property owners refused participation
- 2.2 million cubic yards (1.7 million cubic meters) of materials contaminated by tailings were removed
- Vicinity property program lasted from 1983 to 1998 and cost $253 million (17 percent of the $1.5 billion program cost)
Junk Yard
Before and After Remediation
Management Structure

- The Grand Junction cleanup project involved tracking 26 milestones for each of the 4,266 properties that were remediated, and the 6,605 excluded properties.

- An assembly line approach was established to push the design and remediation of properties through each functional group.

- Task forces were developed to manage problem properties:
  - Difficult owners
  - High radon readings
  - Large and/or complex

- The quantity of tailings removed was tracked as a measure of demonstrating progress.

- A risk analysis system was used to identify issues that would impact future budgets and the probability of occurrence; the system helped to identify long-term funding needs.
Cost Reduction and Cost Avoidance

- U.S. Environmental Protection Agency (EPA) standards allowed for application of supplemental standards where cleanup did not make sense; this often resulted in leaving tailings behind for a variety of reasons
  - Remedial action posed greater risks to workers or the public
  - Remedial action would lead to excessive environmental damage
  - Cost of cleanup was unreasonable compared to the benefits
  - No known remedial action existed

- Supplemental Standards were applied to 30 specific projects, including several large utilities, resulting in over $20 million in savings
Cost Reduction and Cost Avoidance (continued)

- City streets and highways were not remediated, nor were the utilities that ran under them; this resulted in an estimated $100 million dollar cost avoidance.

- An incentive program was established that allowed employees to identify cost saving measures and share in part of the savings; the result was a $20 million savings over 10 years.

- Value engineering was used to streamline processes, such as reducing the length of time to remediate a property as a program deadline approached.
Interior Cleanup Standards

- UMTRCA standards required remedial action if radon daughter concentration (RDC) exceeded 0.02 working level (4 pCi/L), or gamma exceeded 20 microRoentgen/hour
- Numerous structures failed the RDC standard after remediation
- Adding vents to crawl spaces lowered RDCs
- Subfloor ventilation systems were placed under concrete slabs and activated
- A protocol was developed to take additional readings and borings around foundations
- It was determined that elevated RDC in many of the structures was due to naturally occurring soils
Reconstruction Under Floor Using a New Ventilation System
Managing Hazardous Materials and Hazardous Wastes

Hazardous materials and wastes were identified at numerous properties

- Asbestos
- Petroleum products
- Landfills with solid waste
- Medical waste
- Hazardous wastes included heavy metals (lead, chromium, arsenic), Polychlorinated biphenyls (PCBs), and organics (dry cleaning solvents)

Field workers were trained to identify suspect waste; several field screening and sampling techniques were used

Biased sampling solved some problems while also creating new problems (did not represent average concentration)
Unique Hazardous Waste Property—Drum Recycler
Management of hazardous waste required lengthy negotiations with the State of Colorado.

DOE did not want to incur additional liability; only hazardous waste mixed with radioactive tailings was addressed.

The State determined that DOE could use a provision in hazardous waste regulations called Permit by Rule.

Regulation required treatment in an onsite container, such as a cement mixer.

Cement was used to treat and stabilize heavy metals.
Cleanup of PCBs involved using unique law provisions and negotiating with EPA

Asbestos cleanup followed State regulations
- Small quantities were placed in drums
- The State allowed large quantities to be encased in a fabric wrap and placed inside a dump truck

In most cases petroleum waste required onsite aeration on a lined pad

Cleanup of landfills required agreement with the State to allow hazardous waste to be picked up and placed back in the excavation point
- Several methods were used to screen contaminated trash in a landfill containing 100,000 cubic yards (76,000 cubic meters) of waste
Long-Term Management of Radioactive Tailings

- Tailings remained in place under some city streets; other deposits were not identified.

- The State of Colorado and DOE agreed to leave a portion of the Grand Junction disposal cell open for 25 years:
  - DOE would manage the disposal cell.
  - The State would monitor all building permits on suspect properties.
  - Owners would pay for remediation of their property.

- To date, over 40,000 cubic yards of contaminated materials (30,000 cubic meters) have been remediated since the program was completed in 1998.
Grand Junction, Colorado

Disposal cell with room left for future tailings
Long-Term Management of Radioactive Tailings (continued)

- Although DOE demonstrated that contaminated material that was left under city streets was safe; the material has been exposed more quickly than was anticipated due to projects that have taken place since 1998
  - Reconstruction of Main Street shopping park
  - Demolition of a power plant
  - Numerous building remolds
- Tailings are shipped from several states
- Hindsight suggests that it is more cost effective to clean up as much as financially affordable the first time
Records Management

- Vicinity property records were microfilmed using technology available at the time.

- Today, digital storage is a convenient platform; however, technology may not support retrieval in 20 years.

- Because of the functional groups and milestones used by the program, similar documents were produced throughout the remediation of most of the properties.

- In the future, records will have many uses such as litigation and responding to real estate transactions and homeowners’ inquiries.

- People will question the degree of cleanup.

- Despite the hundreds of people who worked on the Grand Junction cleanup program, in less than 20 years, the number of employees with global knowledge of the program has dwindled to only a few.

- An index and description of the program should be developed so the next generation understands all of the terminology, acronyms, abbreviations, etc. that were developed during the program.
Conclusion

- A robust management structure is required to track properties and to manage issues.
- “Scope creep” needs to be identified and managed; expect residential cleanup programs to cost more than anticipated.
- Develop a particular work culture (similar to safety) so employees think about ways to reduce costs.
- Work with regulators to manage unique waste streams (hazardous waste and medical waste).
- Think of long-term consequences and what will happen if tailings are uncovered after the current program ends.