

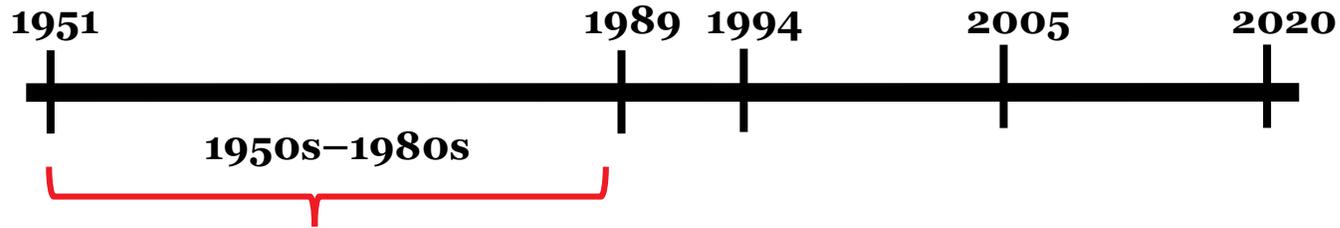


Rocky Flats

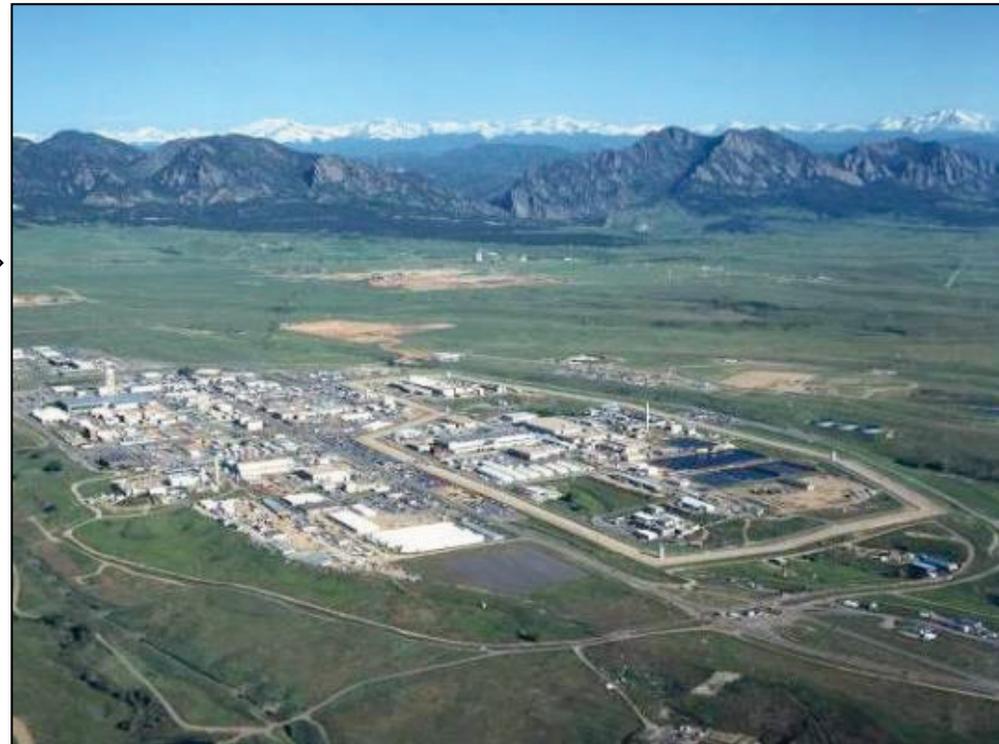
General Overview Briefing

Rocky Flats Stewardship Council
February 3, 2020

Rocky Flats Timeline



Key site in the U.S. nuclear weapons complex.



Industrial Area: Approximately 385 acres

Buffer Zone: Approximately 6,200 acres



1950s–1980s: Production



Most of the contamination was inside the buildings.

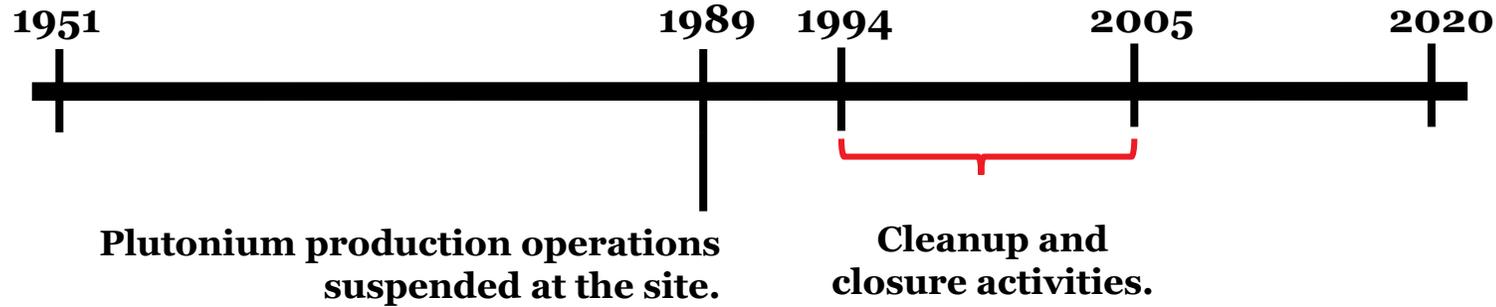
Some contamination was also released outside of the buildings.



Drums at the 903 Pad (in 1960s)



Rocky Flats Timeline



Building decommissioning and decontamination (D&D)



Building demolition



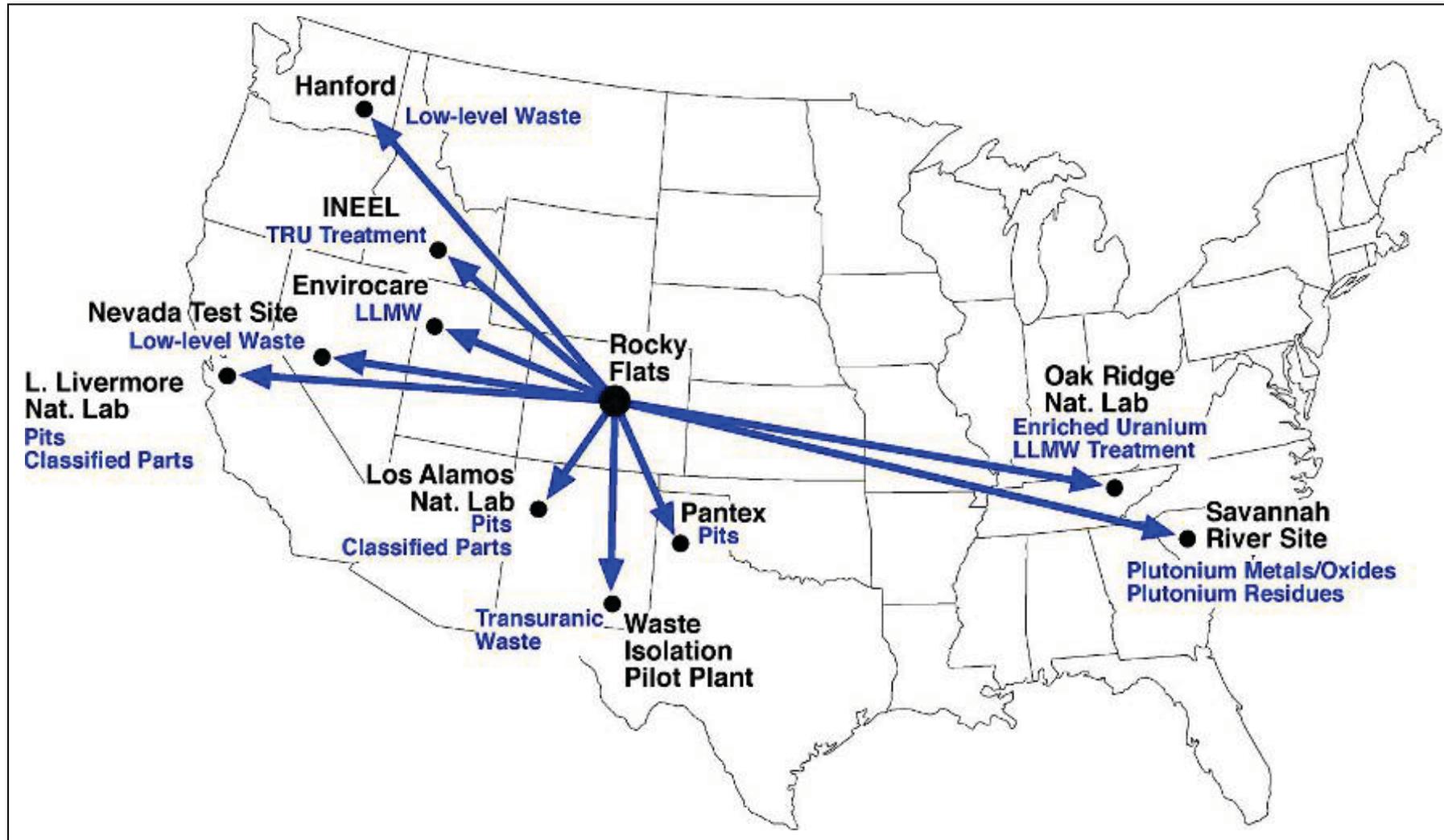
Environmental remediation



1994–2005: Cleanup and Closure



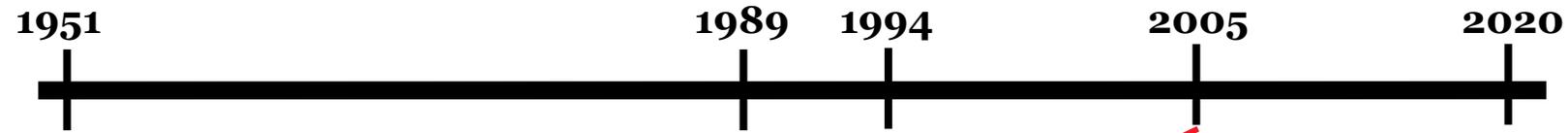
1994–2005: Cleanup and Closure Shipping Special Nuclear Materials and Waste



Significant DOE Complex integration was required to support Rocky Flats closure.



Rocky Flats Timeline



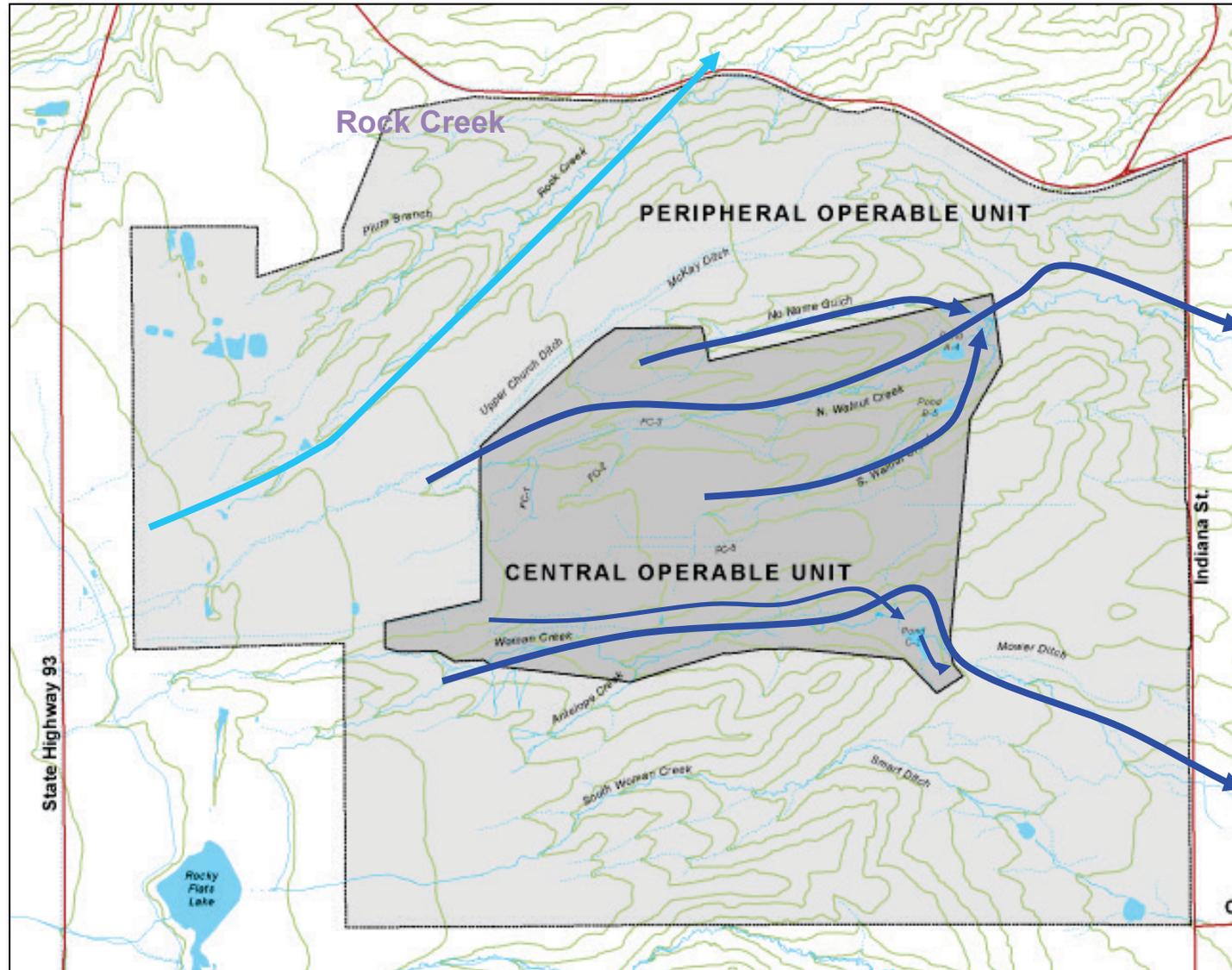
Cleanup and closure activities complete.



Present day.



Surface Water – Main Drainages



Walnut Creek

Woman Creek



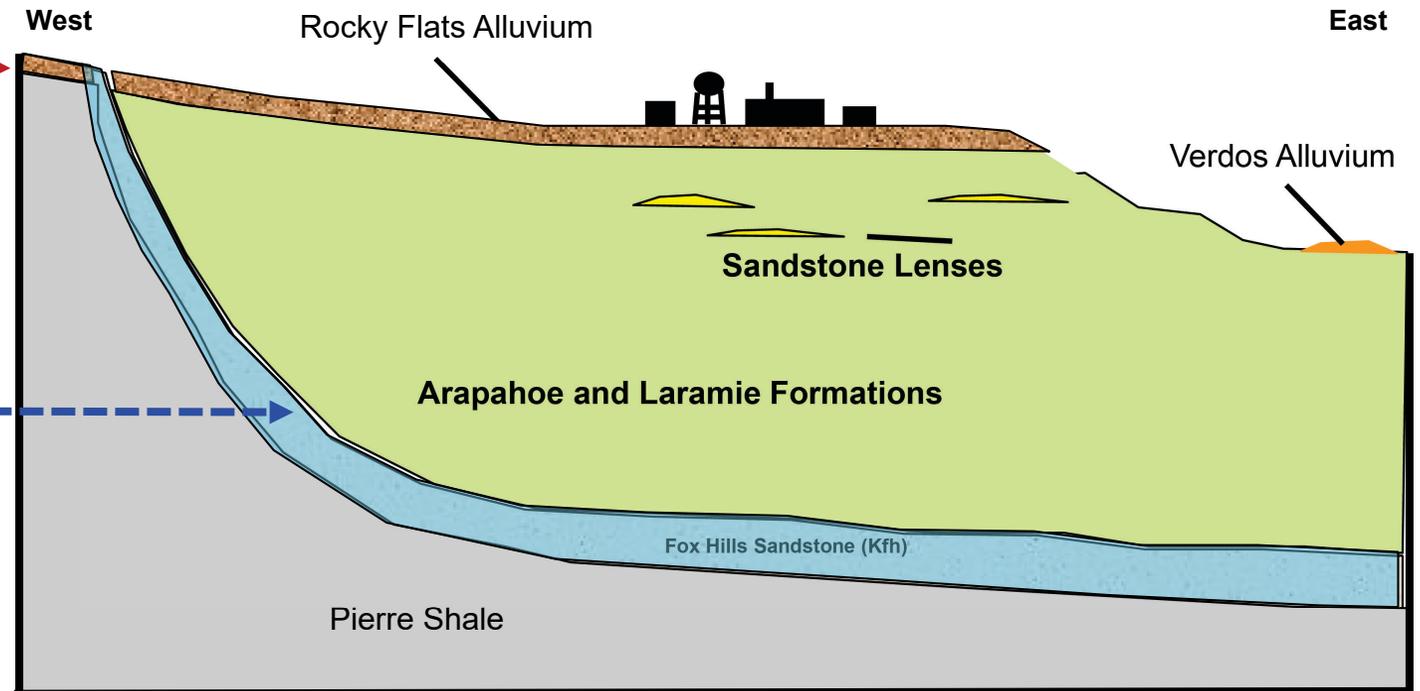
Hydrogeology/Groundwater

Shallow Groundwater

- Rocky Flats Alluvium
- Weathered bedrock
- **Potential transport pathway**

Deep Groundwater

- Regional Fox Hills Sandstone aquifer
 - 200 to 300 m below surface
- Isolated from shallow groundwater by Laramie Formation claystones (hydraulic conductivity 10⁻⁷ cm/sec)
- **Not a transport pathway**



Generalized Geologic Cross-Section of Rocky Flats (not to scale).

The Rocky Flats Site does not impact any groundwater drinking water sources.

For more information on the hydrogeology at the Rocky Flats Site, refer to http://www.lm.doe.gov/Rocky_Flats/.



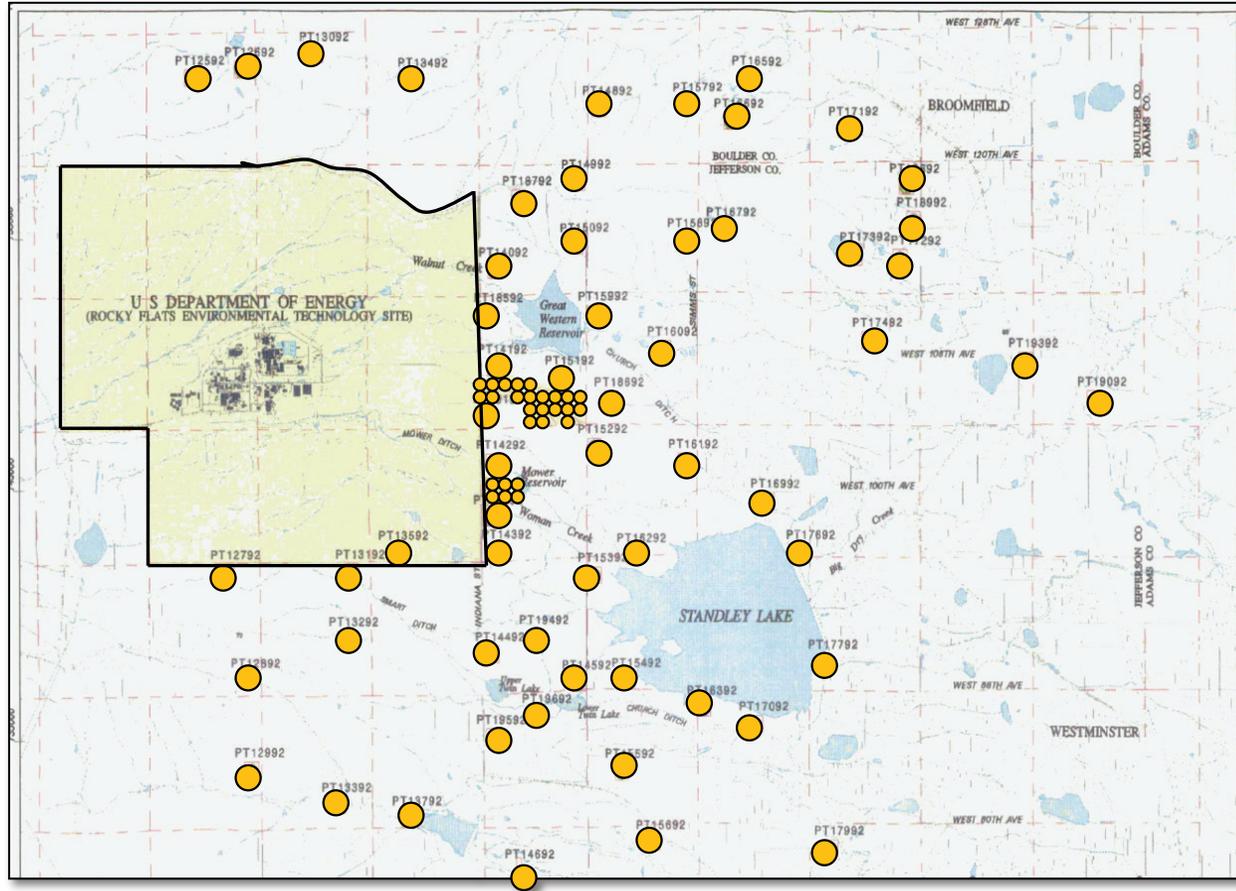
Historic Contaminants at Rocky Flats

Historic, or “legacy,” contamination at Rocky Flats includes:

- Radionuclides
 - Plutonium (Pu)
 - Americium (Am)
 - Uranium (U)
- Other contaminants
 - Metals
 - Nitrate
 - Organic compounds (solvents)



Surface Soil – Offsite (Plutonium)



- Numerous studies collected offsite samples
- Some sample results immediately east of the site are above background levels (highest = 6.5 pCi/g; most are near background)
- Concentrations west, north, and south of the site are within range of background
- **Final regulatory decision for Operable Unit 3 (offsite areas): No cleanup action was necessary to protect human health or the environment because contaminant levels were so low ***

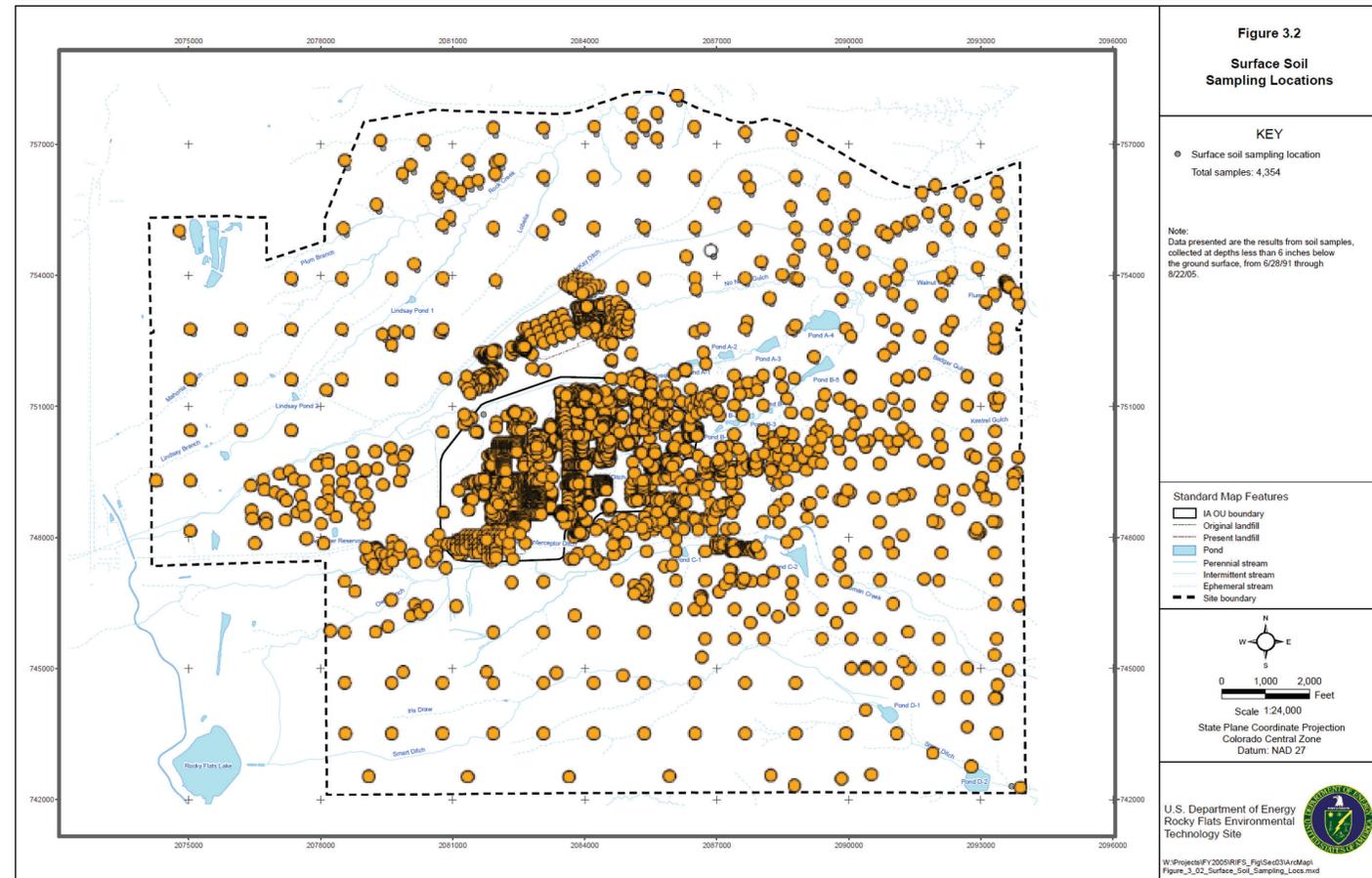
*This decision was based on a 3-volume RCRA Facility Investigation/Remedial Investigation report that provided data on surface water, groundwater, surface soil, subsurface soil, sediments, and air. See Volume I:

http://www.lm.doe.gov/cercla/documents/rockyflats_docs/OU03/OU03-A-000465.pdf



Surface Soil – Onsite

- More than 7,200 locations sampled since June 1991
- More than 220,000 results used to evaluate the nature and extent of surface-soil contamination



Map adapted from Section 3 of the RCRA Facility Investigation – Remedial Investigation/Corrective Measures Study – Feasibility Study Report for the Rocky Flats Environmental Technology Site (http://www.lm.doe.gov/Rocky_Flats/Regulations.aspx).



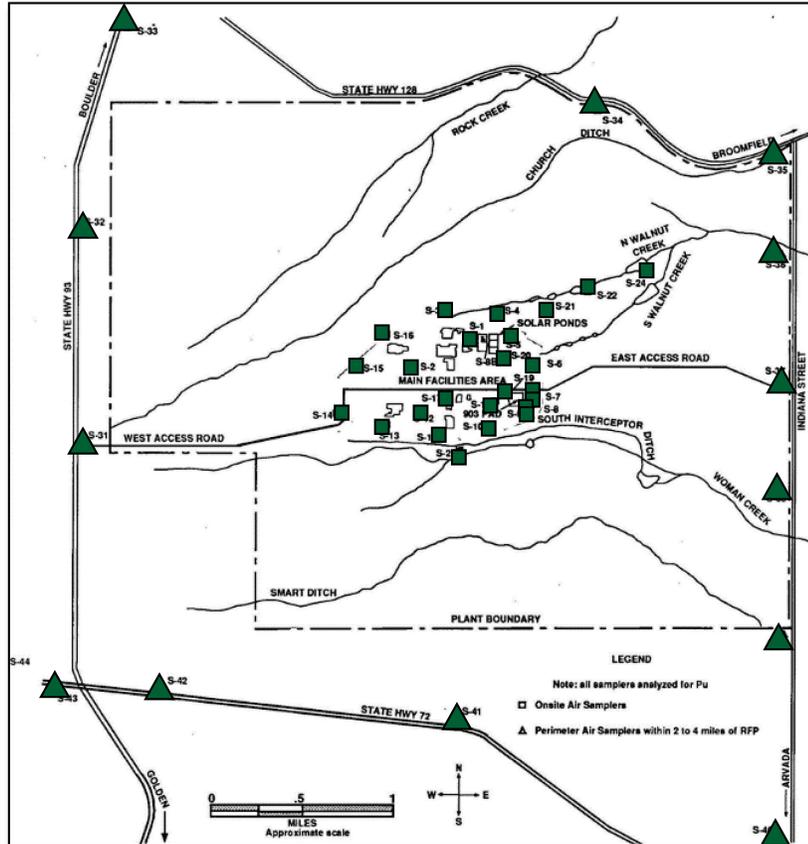
Air – Monitoring

- Effluent monitoring:
 - Emissions monitored in exhaust from building stacks and vents
 - Conducted from 1953 until flow in ducts was disrupted by building decommissioning
- Ambient monitoring:
 - Concentration of contaminants measured in the “outside” air (onsite, at the perimeter, and in the communities)
 - Conducted from 1952 until 2008

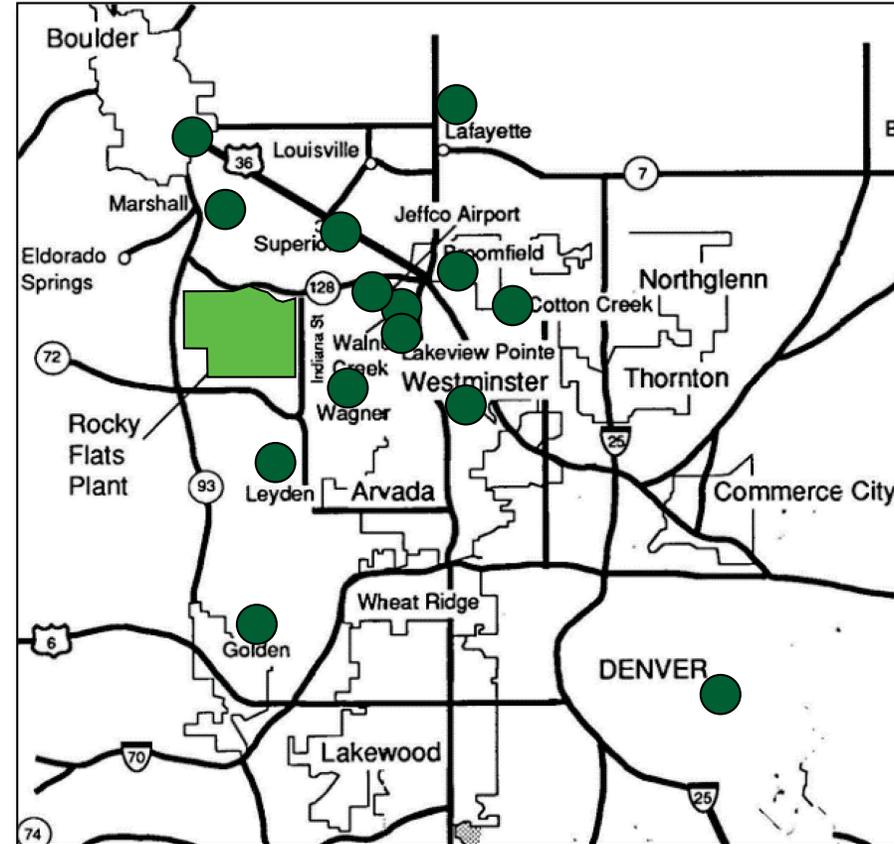
Monitoring equipment was upgraded periodically as regulations changed and science and technology advanced.



Air – Monitoring (continued)



Onsite and perimeter ambient monitoring locations

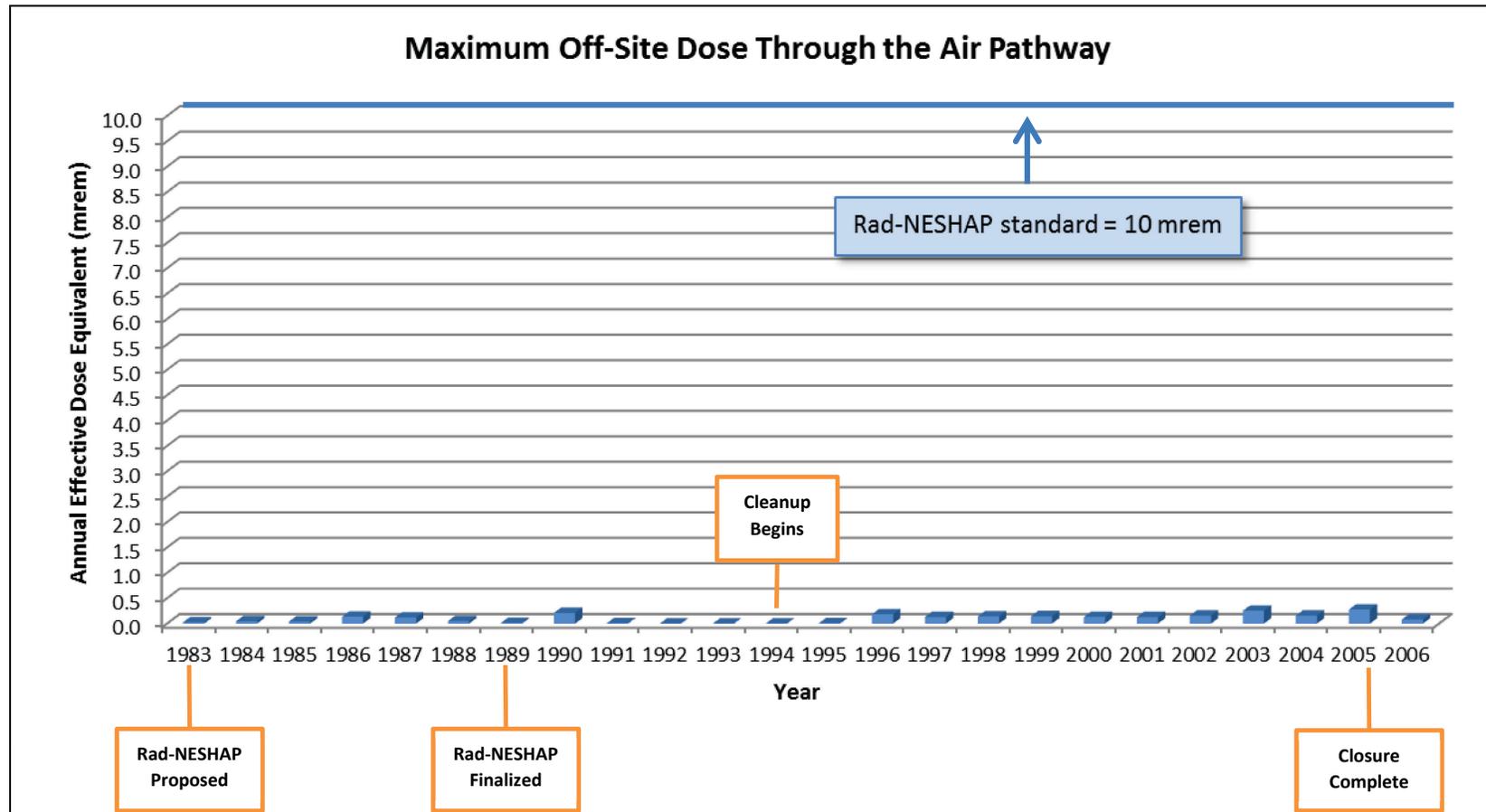


Community ambient monitoring locations

1990 snapshot of ambient monitoring configuration.



Air – Monitoring Results (continued)



Air samplers collected not only site-derived radionuclides, but also naturally occurring and background radionuclides (particularly uranium isotopes). As a result, **naturally occurring uranium made up the majority of the reported annual measured dose**. Data are compiled from annual environmental monitoring and air emissions reports.

These data support the exclusion of air monitoring from the current monitoring program.



Actinide Migration Evaluation (AME) Panel



AME advisors quarterly site visit.



Stakeholder interaction.

Formed in 1996:

- Independent experts brought to the site
 - Carefully examine site data
 - Direct collection of new data
 - Recommend and perform experiments and analyses with computer models (numerous studies conducted)
 - Help to quantify actinide migration pathways

Objective:

- Develop scientific understanding of actinide transport at the site
 - Help guide cleanup decisions based on science

The *AME Pathway Analysis Summary Report* can be found at:

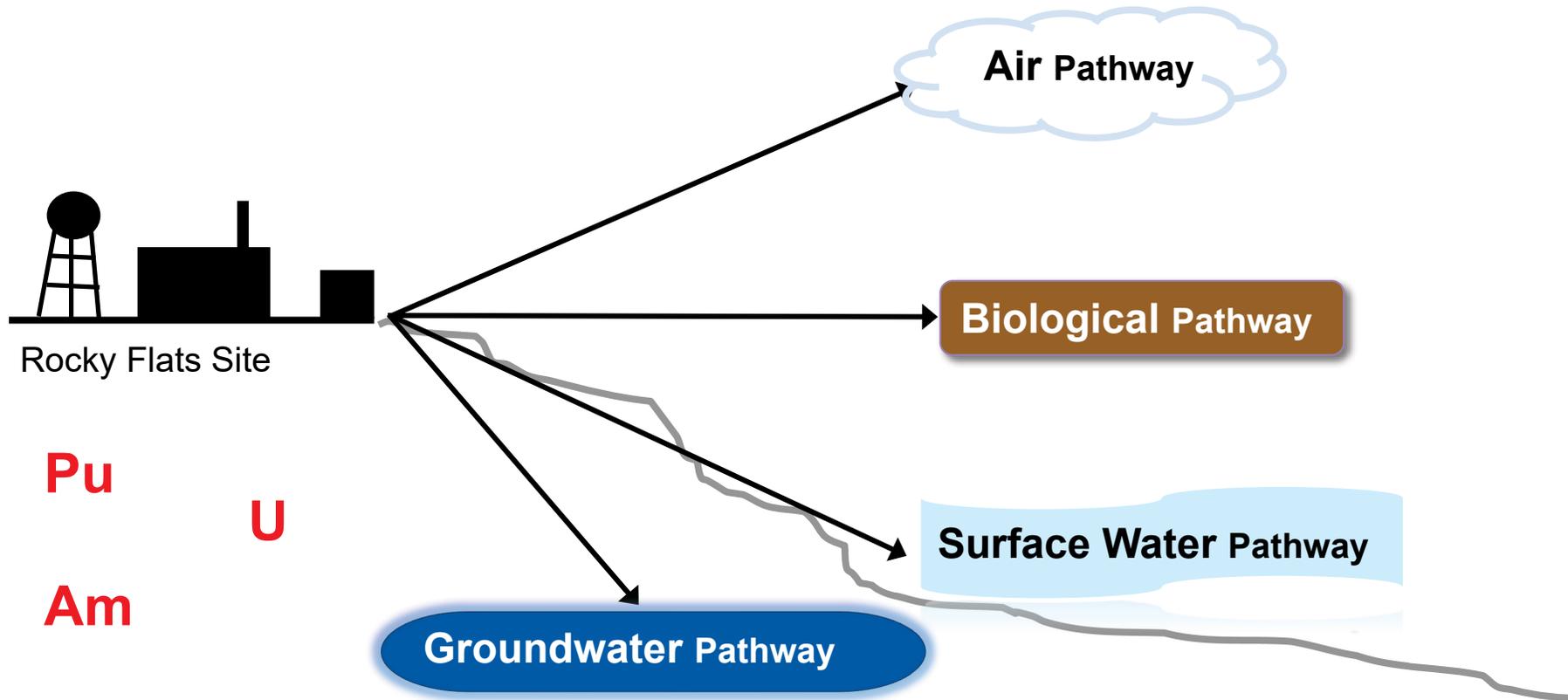
http://www.lm.doe.gov/cercla/documents/rockyflats_docs/SW/SW-A-004544.PDF

The *AME Pathway Analysis Report Technical Appendix* can be found at:

http://www.lm.doe.gov/cercla/documents/rockyflats_docs/SW/SW-A-004547.pdf



AME Conclusion: Actinide Transport Pathways



The AME Pathway Analysis Summary Report can be found at:

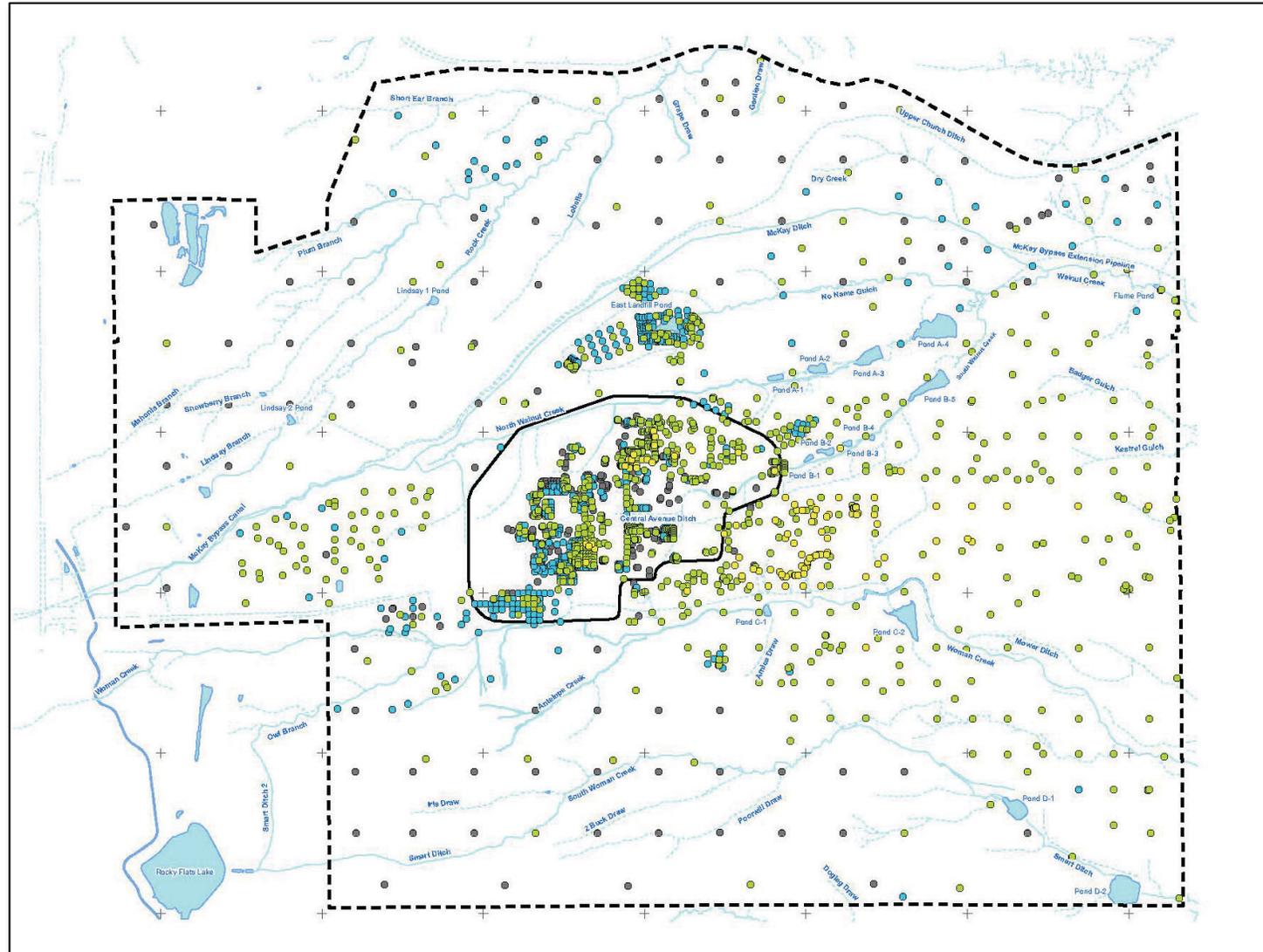
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The AME Pathway Analysis Report Technical Appendix can be found at:

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Plutonium Sample Locations



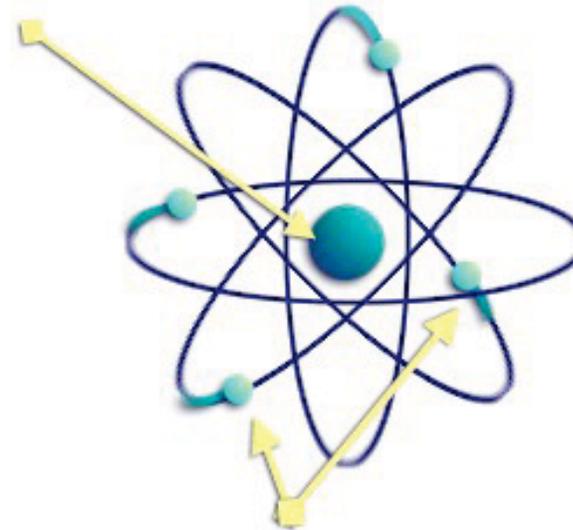
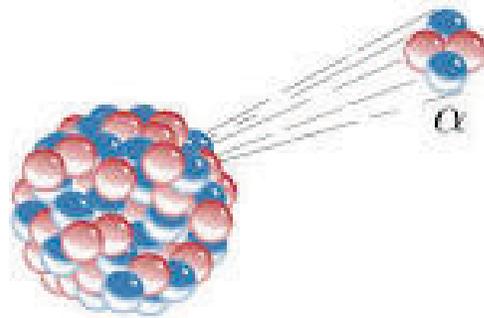
What Is Risk?

- Risk
- Uncertainty
- Risk perception
- Acceptable risk
- Risk assessment

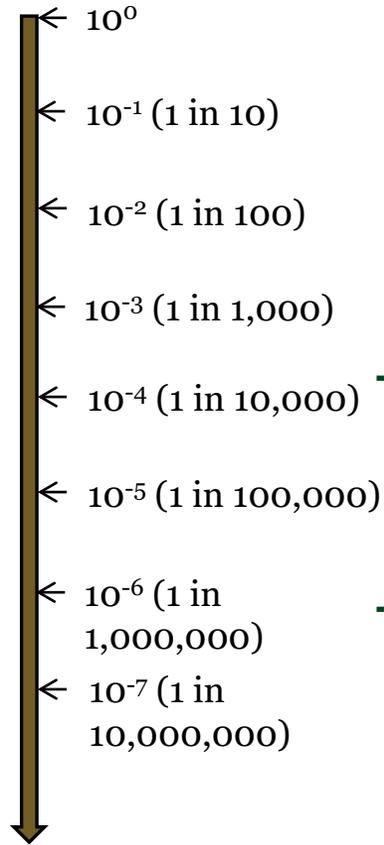
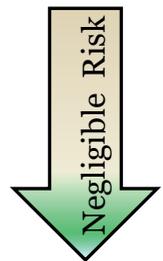
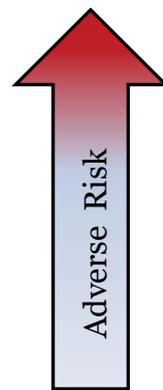


Radiation Risks

- Ionizing radiation
 - alpha particles
 - beta particles
 - gamma rays
- Risk of harm is dependent on both the dose and the dose rate
- Acute (high level) exposure
- Chronic (low level) exposure



CERCLA Risk Range



“Excess Risk” of contracting cancer.

Target Risk Range



Radionuclide Soil Action Levels (RSALs)

- 2003 – RFCA modifications
 - Established action levels and procedures for applying them
 - Definition: Action levels are numeric levels that, when exceeded, trigger an evaluation, remedial action, and/or management action
- 2003 – RSAL calculations risk-based

Based on input from:

- AME advisory group
- Stakeholder Focus Group
- RSALs Oversight Panel
- RSALs Working Group
 - 1) Regulatory analysis
 - 2) Computer modeling
 - 3) RSAL calculations
 - 4) New scientific information
 - 5) Determining cleanup levels at other sites



Key Points

- RSALs
 - Based on risk-based approach:
 - Lifetime excess cancer risk: 0.00001 (or 1×10^{-5})
 - Calculations include exposure time, exposure scenarios
 - Based on input from:
 - Multiple working groups
 - Citizen organizations
 - Computer models
- RFCA parties agreed to require actions for soils with Pu activity levels greater than 50 pCi/g
 - Actual risk-based calculated value: 116 pCi/g



RFCA

Accelerated Action Process

- Individual Hazardous Substance Sites (IHSSs) were investigated and characterized using EPA-approved methods in accordance with RFCA
- Contaminated soil was excavated, packaged and removed
- Remedial actions were completed and documented, then reviewed by regulatory agencies
- Approved actions were compiled in the HRR



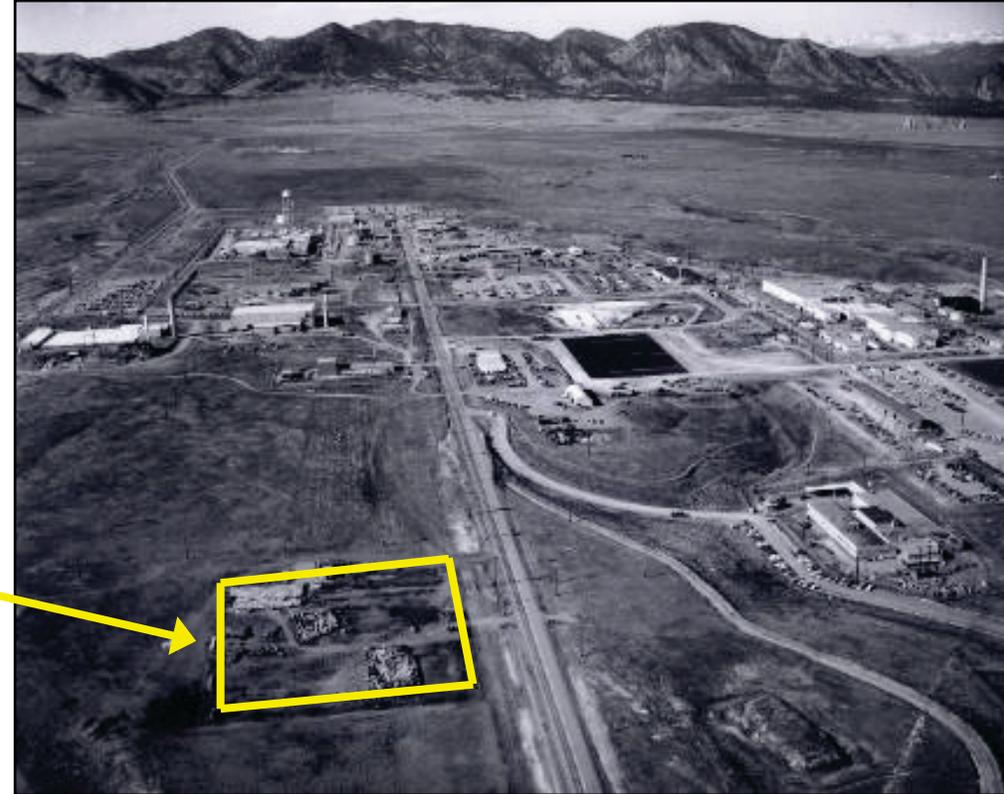
The HRR is Appendix B of the RCRA Facility Investigation – Remedial Investigation/ Corrective Measures Study – *Feasibility Study Report for the Rocky Flats Environmental Technology Site* (http://www.lm.doe.gov/Rocky_Flats/Regulations.aspx)



Example Projects: 903 Pad and Lip Area



903 Pad – 1960s



903 Pad – 1967

903 Pad area:

Primary source of Pu and Am in surface soil at the site (Am distribution is similar to Pu).



Example Project: 903 Pad Soil Remediation

- “Tents” used to enclose excavation
- Removed 32,000 tons of soil
 - 900 grams of Pu
 - Clean fill added on top
- Air, water quality – continually compliant
- Completed December 2003



903 Pad before remediation

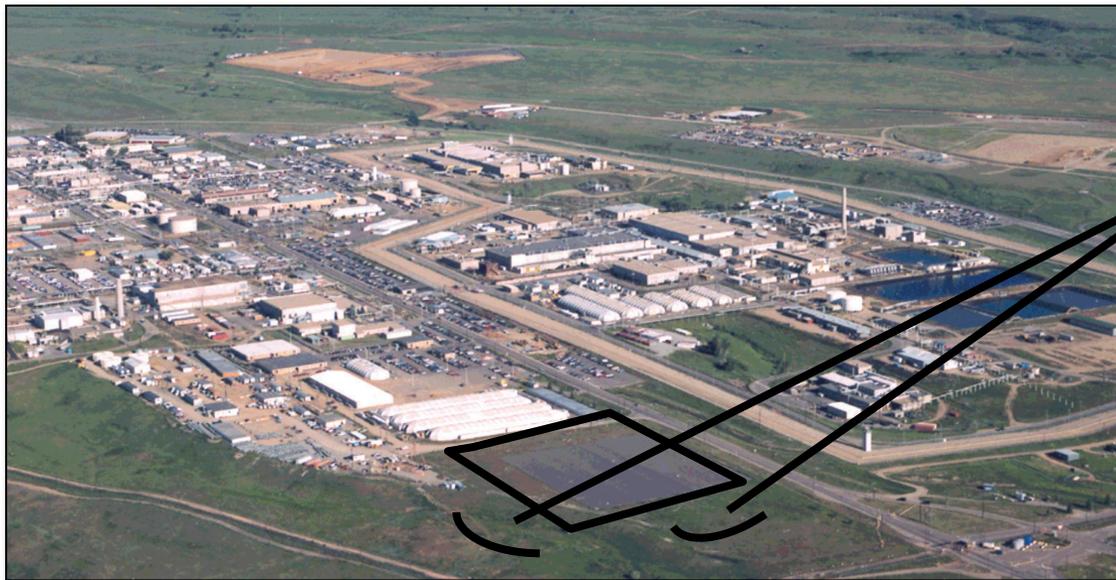


2003 weather enclosure over 903 pad.



Example Project: 903 Lip Area Soil Remediation

- 903 Lip Area (east of 903 Pad)
 - Remove soil >50 pCi/g
 - Around 34 acres
 - Stringent dust and erosion controls
 - Completed September 2004



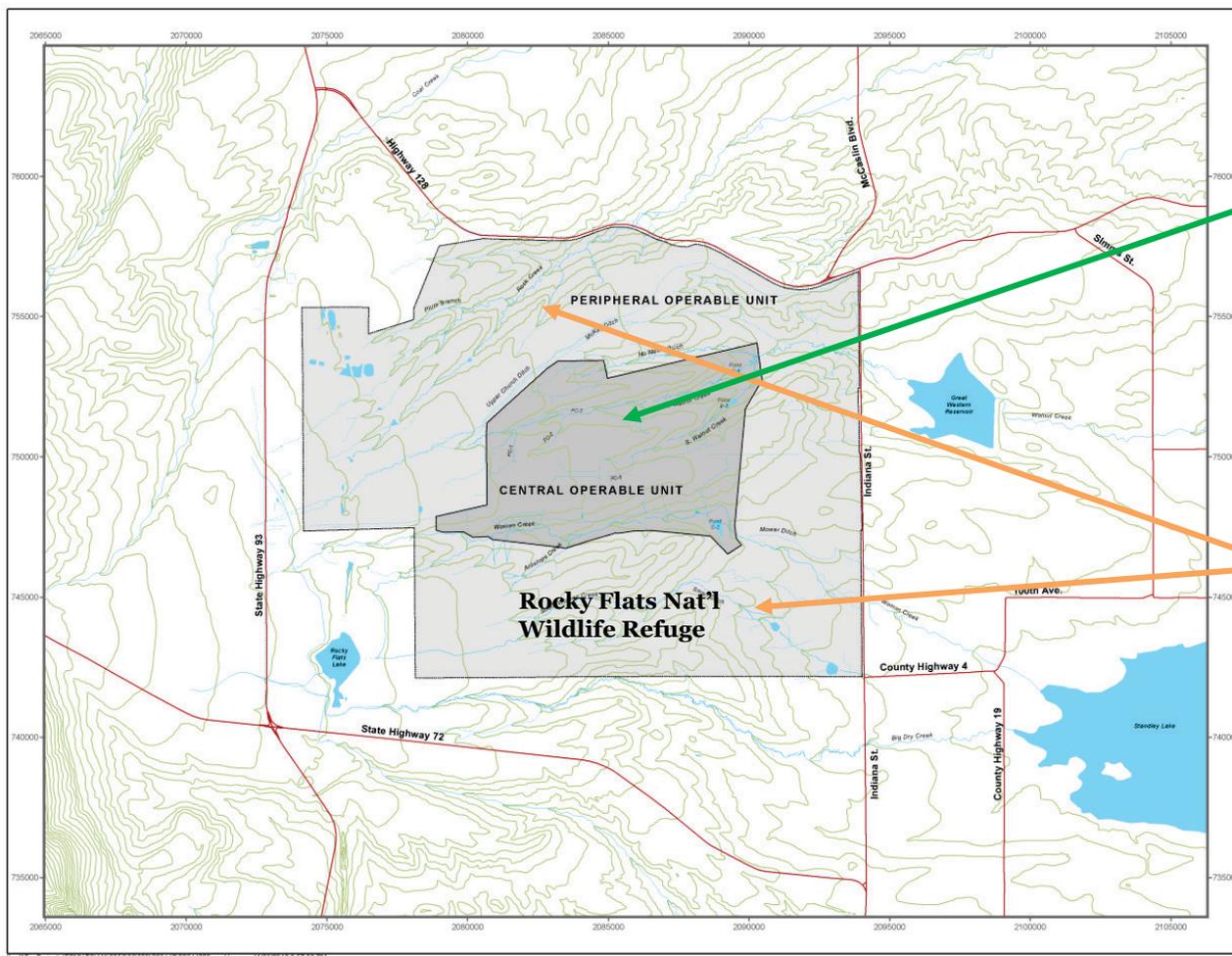
903 Pad and lip area before remediation



Erosion "blanket"



Site Remedy



Central Operable Unit (COU)

- Response actions: Institutional controls, physical controls, and continued monitoring (because of residual contamination and to protect the remedy from human intrusion)

Peripheral Operable Unit (POU)

- Suitable for unlimited use and unrestricted exposure (based on very conservative exposure assumptions)

The Corrective Action Decision/Record of Decision for Rocky Flats Plant (USDOE) Peripheral Operable Unit and Central Operable Unit (CAD/ROD) can be found at (http://www.lm.doe.gov/Rocky_Flats/Regulations.aspx)



Summary

- Characterization of site contaminants
 - Extensively sampled
- Regulatory process to guide cleanup
 - Rigorous CERCLA process with public participation
- Cleanup standards
 - Conservative
- Resulting risk
 - Low
- Environmental monitoring
 - Long-term, ongoing monitoring



Summary (continued)

- The monitoring program provides information on the movement of residual contamination
 - Surface-water monitoring provides a direct measurement of soil contamination being transported in water
 - Measured changes in concentrations of contaminants in surface water are an indicator of changes in the environment

