LAPSAR Meeting--March 6, 2002

- Discussion of the geomorphic approach, including:
- "basis for sediment package definition"
- "basis for determining extent of packages in the field"
- "evidence correlating contaminant concentrations with the defined sediment packages (the most important item)"

Why use a geomorphic approach?

- Present day contaminant concentrations and the future fate and transport of contaminants are strongly affected by geomorphic processes
  - Flooding and sediment transport
- Evaluating canyon bottoms from a geomorphic perspective provides the most robust foundation for understanding contamination
  - Present contaminant distribution
  - Temporal and spatial trends
    - Understanding what has happened provides a basis for understanding what will happen

Geomorphology

- "The study of landforms"
  - Includes evaluation of physical processes acting on the surface of the earth
- Physical processes
  - Runoff (flooding)
  - Erosion
  - Sediment transport and deposition
- Landforms
  - Stream channels
  - Floodplains
  - Terraces (pre-lab channels/floodplains)

Why use a "reach" approach?

- Premise is that detailed characterization of discrete reaches:
  - Provides information sufficient to:
    - Understand contaminant transport
    - Make decisions concerning need for remedial action
  - Is more efficient and cost effective, and provides higher quality data, than less-detailed characterization of entire length of canyons
- Premise accepted by NMED by approval of
  - Los Alamos/Pueblo Work Plan (1995)
  - Canyons Core Document (1997)

reach:
locations of contaminants
geologic boundaries
field judgement determines
length

Why define different "sediment packages"?

- Contaminant concentrations in sediments in any part of a canyon can vary by many orders of magnitude

- Subdivision of sediments in the landscape (horizontally and vertically) is required to adequately evaluate and display variations in contamination
  - Basis for understanding how system works
  - Guides sampling and identifying potential risk

"sediment package"

suspended load shows higher concentrations vs flood plain deposits
→ particle size is the key

- **Geomorphic unit**
  - **Areas designated on geomorphic map that share certain characteristics**
    - **sediment facies, sediment age, contaminant levels**
  - **Includes multiple "polygons"**

typically 75-80% of contaminant mass is found in fine-grained sediments

- **Sediment facies**
  - **Sediment deposits with different particle size distribution**
    - **fine facies (suspended sediment, overbank settings)**
    - **coarse facies (bed load sediment, channels)**

"basis for sediment package definition"

- **Differences in sediment age**
  - young vs. old (e.g., 1990s vs. 1950s)
- **Differences in sediment facies**
  - coarse vs. fine (e.g., coarse sand vs. silt)
- **Differences in contaminant levels**
  - high vs. low
    - field radiation measurements
    - fixed-lab analyses

weighted averaging
↳ corrects for biasing
↳ that was done based on geo units, area sampled, etc.

"basis for determining extent of packages in the field"

- Horizontal extent:
  - Surface characteristics (e.g., bare / vegetated)
  - Topographic breaks
  - Contaminant levels
    - including presence/absence
  - Sediment / soil characteristics
    - Burial of trees or "A" horizons of soil?
- Vertical extent:
  - Observations of stratigraphy (stratified layers)
  - Contaminant levels
    - including presence/absence

"evidence correlating contamination with defined packages"

- Geomorphic units in part broken out specifically based on variations in contaminant concentrations
  - high vs. low gamma or alpha radiation

field screening measurements correlate well to contaminant concentration

- Lab analyses used to confirm conceptual understanding that contaminants have affinity for fine-grained sediment particles
  - higher levels in fine facies than coarse facies in deposits of the same age

↑ [illegible] → ↑ [illegible] concentration

- Lab analyses used to evaluate differences in contamination as function of sediment age

Age of Sediments and Geomorphic Units

- Surface characteristics
  - bare = youngest, vegetated = older
- Aerial photographs (1935 to present)
- Tree age (dendrochronology: tree ring dating)
  - Sediment below base of tree older than tree
  - Sediment above base of tree younger than tree
- Isotopic ratios in sediment
  - e.g., Pu-238 releases increased ~1961
    - Pu-239,240/Pu-238 ratio drops
- Soil characteristics
  - dark "A" horizon = time break

TABLE B6-1

SUMMARY OF SEDIMENT SAMPLING EVENTS IN PUEBLO CANYON

Reach	Sampling Event	Sampling Dates	Number of Samples Collected*	Type of Analyses and Primary Goals
P-1	1	5/30/96	7	Full-suite analyses; determine contaminants present above background values and primary risk drivers; examine general variations in contaminants between geomorphic units
P-1	2	9/25/96	24	Plutonium analyses; evaluate vertical variations in plutonium activity; provide initial estimate of plutonium inventory
P-1	3	6/25/97	31	Plutonium analyses plus seven limited-suite analyses; reduce uncertainty in plutonium inventory; test adequacy of geomorphic unit designations; evaluate dispersion of plutonium on floodplains and contributions of mercury from P-1 West vs. Acid Canyon
P-2	1	9/29/97–9/30/97	48	Plutonium analyses; test adequacy of geomorphic unit designations; evaluate vertical variations in plutonium; provide initial estimate of plutonium inventory
P-2	2	11/24/97	26	Plutonium analyses plus eight limited-suite analyses; reduce uncertainty in plutonium inventory; test adequacy of geomorphic unit designations; evaluate vertical variations in plutonium and levels of other contaminants
P-2	3	2/2/98	4	Plutonium analyses from drill hole; evaluate vertical variations and vertical extent of plutonium below thick channel unit
P-3	0	8/18/97	5	Plutonium analyses from core from well PAO-1; evaluate vertical variations and vertical extent of plutonium
P-3	1	9/30/97–10/1/97	32	Plutonium analyses; test adequacy of geomorphic unit designations; evaluate vertical variations in plutonium; provide initial estimate of plutonium inventory
P-3	2	11/24/97–11/25/97	23	Plutonium analyses plus eight limited-suite analyses; reduce uncertainty in plutonium inventory; test adequacy of geomorphic unit designations; evaluate vertical variations in plutonium and levels of other contaminants
P-3	3	1/30/98, 2/3/98, 2/4/98, 2/10/98	8	Plutonium analyses from drill holes; evaluate vertical variations and vertical extent of plutonium below thick channel units
P-4	1	4/22/96	9	Full-suite analyses; determine contaminants present above background values and primary risk drivers; examine general variations in contaminants between geomorphic units
P-4	2	9/24/96	18	Plutonium analyses; evaluate vertical variations in plutonium activity, age trends in plutonium in channel facies deposits, and dispersion of plutonium on floodplains; provide initial estimate of plutonium inventory
P-4	3	5/13/97–5/14/97	43	Plutonium analyses plus one limited-suite analysis; reduce uncertainty in plutonium inventory; evaluate dispersion of plutonium on floodplains and vertical variations in plutonium activity; test adequacy of geomorphic unit designations; obtain limited-suite analysis from layer with highest plutonium activity
P-4	4	7/25/97	4	Plutonium analyses; examine vertical extent of plutonium in previously sampled sections
P-4	5	11/25/97	5	Plutonium analyses plus one limited-suite analysis; evaluate vertical variations in plutonium at site with highest plutonium activity; obtain limited-suite analysis from layer with highest plutonium activity

*Number of samples does not include quality assurance duplicates.

South Fork Acid Canyon Samples					
April 2000 Interim Report					
Unit	**Description**	**Area (m2)**	**% of Total Area**	**Number of Samples**	**% of Total Samples**
c1	active channel	401	37%	3	6%
c1b	recently abandoned channel	21	2%	1	2%
c2	older abandoned channel, low alpha (< 1000 pCi/g)	399	36%	16	33%
f1	floodplain, low alpha (< 1000 pCi/g)	223	20%	15	31%
c3	older abandoned channel, high alpha (> 1000 pCi/g)	17	2%	6	12%
f1a	floodplain, high alpha (> 1000 pCi/g)	36	3%	8	16%
	Total	**1097**	**100%**	**49**	**100%**

For aggregate report → How do we deal w/ "not spots"?