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Field Summary Report for Sediment Sampling Activity in Reaches CDB-3 East and PA-4, Cañada del Buey and Pajarito Canyon, Downgradient of Material Disposal Area G

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Field Summary Report for Sediment Sampling Activity in Reaches CDB-3 East and PA-4, Cañada del Buey and Pajarito Canyon, Downgradient of Material Disposal Area G

Steven Reneau, Paul Drakos, Danny Katzman, Andy Crowder, Kevin Reid, and Lenny Sabatino

Introduction

Sediment sampling and associated geomorphic characterization were conducted in Cañada del Buey and Pajarito Canyon in support of an evaluation of potential contaminant transport into these canyons from Material Disposal Area (MDA) G, Technical Area (TA) 54, Los Alamos National Laboratory (LANL or the Laboratory). MDA G consists of subsurface disposal units at Area G, and the latter also includes surface storage areas. The sampling areas are located immediately downgradient of the easternmost tributary drainages from Area G, and are designated reaches CDB-3 East (CDB-3E) in Cañada del Buey and PA-4 in Pajarito Canyon. Sediment deposits in these reaches potentially contain the combined effects of contaminants transported from Area G, including MDA G, and from other upstream locations. This work was in partial fulfillment of the "Investigation Work Plan for Material Disposal Area G at Technical Area 54" (LANL 2003, 81174, pp. 20 and 22). These two reaches were also specified in the "Work Plan for Sandia Canyon and Cañada del Buey" (LANL 1999, 64617) and the "Work Plan for Pajarito Canyon" (LANL 1998, 59577), and this work contributes to the completion of Phase 1 investigations in these plans.

Background

Reach CDB-3E extends for 275 m downstream from the easternmost point where runoff enters Cañada del Buey from Area G. Previous sampling of drainages from Area G into Cañada del Buey had identified some inorganic chemicals and radionuclides at low levels above sediment background values (BVs), including barium, chromium, iron, magnesium, americium-241, cesium-137, plutonium-238, plutonium-239,240, strontium-90, and tritium (LANL 1996, 54462; sediment BVs from LANL 1998, 59730, and McDonald et al. 2003, 76084; note that BVs for radionuclides include levels derived from atmospheric fallout of anthropogenically-created isotopes). In addition to potentially receiving contaminants from Area G, CDB-3E is also downgradient of other solid waste management units (SWMUs) or areas of concern (AOCs) at former TA-4 and at TA-46, TA-51, TA-52, and TA-54 (LANL 1999, 64617). CDB-3E is in an ephemeral part of Cañada del Buey, where surface water flow is only known to occur in response to stormwater runoff. No previous sediment sampling has occurred in CDB-3E, although a detailed sediment investigation has been completed in reach CDB-4, which starts about 0.8 km downstream from CDB-3E and extends to State Highway NM 4 (Drakos et al. 2000, 68739). No contaminants were identified in CDB-4 sediments, although it was found that a number of metals had elevated local background levels as compared to the Laboratory-wide background data set that had been obtained from other parts of

the Pajarito Plateau (LANL 1998, 59730; McDonald et al. 2003, 76084). It was hypothesized that erosion of old eolian-derived soils near CDB-4 was the likely source of elevated local background levels for several metals. The local background data set obtained in the vicinity of CDB-4 (Drakos et al. 2000, 68739) may be useful in evaluating data from CDB-3E.

Reach PA-4 extends for 550 m downstream from the easternmost point where runoff enters Pajarito Canyon from Area G, to just downstream of the E250 stream gaging station. Previous sampling of drainages from Area G into Pajarito Canyon had identified some inorganic chemicals and radionuclides at low levels above sediment BVs, including calcium, americium-241, cesium-137, plutonium-238, plutonium-239,240, and tritium (LANL 1996, 54462; sediment BVs from LANL 1998, 59730, and McDonald et al. 2003, 76084). In addition to potentially receiving contaminants from Area G, PA-4 is also downgradient of other SWMUs or AOCs at TA-3, TA-6, TA-7, TA-8, TA-9, former TA-12, TA-15, TA-18, TA-22, TA-36, TA-40, TA-48, TA-54, TA-55, TA-59, TA-64, and TA-69 (LANL 1998, 59577). PA-4 is in a part of Pajarito Canyon with an intermittent stream and extensive wetlands. The stream can flow for up to two months or more in response to snowmelt runoff, such as occurred in spring 2001 (stream gage E250, Shaull et al. 2002, 85499, p. 67). The wetlands are mostly in large borrow pits that were created before 1954 and therefore predate initial activities at Area G in 1957 (they are visible on aerial photographs taken in 1954; photographs in Bandelier National Monument files). Some sediment sampling had been previously conducted in PA-4 and downstream near State Highway NM 4 in summer 2000 as part of an effort to characterize contaminant levels in sediment deposits that predated the May 2000 Cerro Grande fire and that could potentially be eroded by postfire floods; a sample of postfire sediment was also collected near State Highway NM 4 in summer 2000 (unpublished data in the Environmental Restoration Database [ERDB]). Sediment samples have also been collected from PA-4, at the E250 gaging station, and downstream at State Highway NM 4 by the Environmental Surveillance Program since 1977, including both prefire and postfire sediment (e.g., ESP 2004, 83635). Pajarito Canyon has experienced multiple postfire floods, and postfire sediment deposits contain components of ash transported from the burned areas. This ash has elevated levels of many inorganic chemicals and radionuclides relative to sediment BVs, and evaluations of potential contamination in postfire deposits should involve a comparison with data obtained from sediment in baseline areas within and downstream from the burned areas and not affected by runoff or discharges from SWMUs or AOCs. A presentation of data from postfire baseline samples, including samples collected in the Pajarito Canyon watershed, is contained in the "Los Alamos and Pueblo Canyons Investigation Report" (LANL 2004, 87390).

Field Investigations

Geomorphic mapping, associated geomorphic characterization, and sediment sampling were performed in reaches CDB-3E and PA-4 between June 11 and September 15, 2004. This work followed the basic investigation process described in the "Core Document for Canyons

Investigations" (LANL 1997, 55622; LANL 1998, 57666) and standard operating procedure SOP-3.08, "Geomorphic Characterization." The geomorphic mapping was conducted at a scale of 1:200 and focused on defining the boundaries of potentially contaminated sediment deposits that postdate initial Laboratory operations in these watersheds (referred to as post-1942 sediment for simplicity).

Control points that were surveyed with a global positioning system (GPS) were used to provide local ground control. The boundaries of post-1942 sediment in a large wetland area in PA-4 were also surveyed using a GPS. Following initial preliminary mapping, a series of soil pits were dug in each geomorphic unit in each reach to measure the thickness of post-1942 sediment and to describe variations in sediment characteristics, particularly the amount of fine-grained (fine facies) versus coarse-grained (coarse facies) sediment and the amount, if any, of ash-bearing sediment that postdated the Cerro Grande fire. Some revisions to the preliminary geomorphic maps occurred as a result of the examination of the soil pits. The final geomorphic maps, including the locations of the soil pits (stratigraphic section locations) and sample locations, are listed in Table 1 and are available from GISLab. The physical characteristics of each geomorphic unit are summarized in Table 2, and the thickness measurements at each soil pit are summarized in Tables 3 and 4.

The total area affected by post-1942 floods in reach CDB-3E averages about 15 m in width. Three geomorphic units are most important in CDB-3E, accounting for 95% of the estimated total sediment volume: c1, c2, and f1. Unit c1, the active channel, is dominated by coarse facies sediment and has an estimated average total thickness of post-1942 sediment of 60 cm. Unit c2, consisting of abandoned post-1942 channels, has large volumes of both fine facies and coarse facies sediment, and an estimated average total thickness of 43 cm. Unit f1, post-1942 floodplains, is dominated by fine facies sediment. Unit f1 has the largest area in CDB-3E, occupying about 61% of the area of post-1942 sediment deposition, but has relatively thin sediment, with an estimated average thickness of 14 cm. Although parts of the Cañada del Buey watershed were burned in the Cerro Grande fire, redeposition of ash from the burn area has apparently had little influence on sediments in CDB-3E, and no ash-rich postfire sediment layers were observed.

One geomorphic unit, c1w, dominates reach PA-4, occupying 78% of the area and containing an estimated 87% of the total volume of post-1942 sediment in the reach. Unit c1w is a grassy wetland area within a large pre-1954 borrow pit, is up to 90 m wide, and has an estimated average sediment thickness of 33 cm that postdates the excavation of the pit. Of this sediment, an estimated 73% is fine facies sediment that predates the Cerro Grande fire, 12% is prefire coarse facies sediment, and 15% is ash-rich postfire fine facies sediment. The remaining geomorphic units in PA-4 are largely contained within artificial channels bounded by berms that were excavated between the pits, and are typically 3 to 6 m in combined width. Ash-rich sediment is pervasive in each unit, constituting about 18% of the total post-1942 sediment in PA-4. In many areas, ash has apparently infiltrated down along root holes and animal holes into prefire sediment deposits, and

may affect analytical concentrations of some inorganic chemicals and radionuclides in samples of prefire sediment.

Sample selection included a process that allocated samples to different geomorphic units and sediment facies based on the respective volume of post-1942 sediment and expected differences in potential contaminant levels. Because investigations in other canyons have shown contaminant levels to be generally higher in fine facies sediment in comparison to coarse facies sediment (e.g., LANL 2004, 87390), the sample allocation used here was biased towards fine facies sediment by assuming that contaminant concentrations were three times higher in fine facies sediment than in coarse facies sediment. The specific sample locations and sample layers in each unit were selected to capture representative sediment layers and to provide representative spatial coverage within each reach. Sample layers were selected both near the surface and at depth to examine possible vertical variations in contamination. Samples from PA-4 include both prefire and postfire sediment. The samples collected in this investigation in 2004 are listed in Table 5, along with samples collected in PA-4 and farther downstream near State Highway NM 4 as part of the characterization of prefire and postfire sediment deposits in summer 2000. The analyte suites for these samples are listed in Table 6, and coordinates of the sample locations are listed in Table 7. Particle size, organic matter, and pH data for the samples collected in 2004 are presented in Table 8 (no data for these were obtained from 2000 samples).

Preliminary Data Summary

Analytical data have been received and validated for the CDB-3E and PA-4 sediment samples collected in 2004 in this investigation. These data are summarized in Tables 9 through 14. As shown in these tables, several inorganic chemicals and radionuclides were detected above LANL sediment BVs in each reach, and some organic chemicals have also been detected in each reach. These analytes may have a variety of sources, including SWMUs or AOCs at TA-54 or other TAs in the Cañada del Buey or Pajarito Canyon watersheds, runoff from roads or developed areas, locally elevated background (e.g., as discussed for reach CDB-4 in Drakos et al. 2000, 68739), or reworked ash from areas burned in the Cerro Grande fire. For example, the two highest concentrations of americium-241, cesium-137, and plutonium-239,240 in the 2004 data set were from the two ash-rich samples collected from reach PA-4 (CAPA-04-53802 and CAPA-04-53809, Table 5), and the concentrations of these radionuclides are consistent with concentrations seen in postfire sediment samples collected from baseline areas (LANL 2004, 87390). Evaluation of potential sources of some or all of these analytes at Area G should include a more thorough comparison of these data to Laboratory-wide and local background data, to postfire baseline data, and to previously collected data from drainages below Area G (e.g., LANL 1996, 54462).

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Table 1. Geomorphic Maps of Reaches CDB-3E and PA-4	
Reach	**GISLab Map #**
CDB-3E	201286
PA-4, west half	201269
PA-4, east half	201277

Table 2. Physical Characteristics of Post-1942 Geomorphic Units in Reaches CDB-3E and PA-4

Reach	Geomorphic Unit	Average Unit Width (m) [1]	Sediment Facies	Estimated Average Sediment Thickness (m)	Notes
CDB-3E	c1	1.9	fine	0.13	Active channel
			coarse	0.47	
	c1b	0.4	fine	0.18	Area of fine-grained sediment deposition along active channel
			coarse	0.25	
	c2	3.3	fine	0.24	Abandoned post-1942 channel
			coarse	0.17	
	f1	9.1	fine	0.12	Post-1942 floodplain
			coarse	0.02	
	f2	0.1	fine	0.12	Possible post-1942 floodplain
			coarse	0.02	
	Total	**14.8**			
PA-4	c1	1.2	fine, post-fire	0.03	Active channel
			fine, pre-fire	0.04	
			coarse, pre-fire	0.02	
	c1 pool	0.8	fine, post-fire	0.13	Relatively wide and deep areas along active channel where water ponds
			fine, pre-fire	0.09	
			coarse, pre-fire	0.00	
	c1 willow	0.4	fine, post-fire	0.04	Relatively wide areas along an unincised active channel dominated by thick stands of willows
			fine, pre-fire	0.16	
			coarse, pre-fire	0.12	
	c1w	13.3	fine, post-fire	0.05	Large wetland areas in borrow pit where water in active channel spreads out during runoff periods
			fine, pre-fire	0.24	
			coarse, pre-fire	0.04	
	c2	1.3	fine, post-fire	0.05	Abandoned post-1942 channel
			fine, pre-fire	0.08	
			coarse, pre-fire	0.06	
	Total	**16.9**			

[1] Average unit width is the total area of the unit in the reach divided by the reach length.

Table 3. Sediment Thickness Measurements From Reach CDB-3E

Stratigraphic Section Location	Distance From Upstream End of Reach (m)	Side of Channel	Geomorphic Unit	Fine Facies Thickness (cm)	Coarse Facies Thickness (cm)	Sample Location ID
CDB3E-s1	0	-	c1	31	61	-
CDB3E-s2	1	north	c2	19	25	-
CDB3E-s3	6	south	f1	20	7	-
CDB3E-s4	5	north	c2	27	11	-
CDB3E-s5	8	north	f1	21	0	CB-22872
CDB3E-s6	25	-	c1	6	99	-
CDB3E-s7	26	south	f1	19	0	-
CDB3E-s8	33	-	c1b	22	27	-
CDB3E-s9	24	north	f1	9	0	-
CDB3E-s10	24	south	f1	3	0	-
CDB3E-s11	50	south	c2	22	2	-
CDB3E-s12	50	-	c1	0	43	-
CDB3E-s13	52	north	f1	10	0	-
CDB3E-s14	73	north	f1	14	0	CB-22875
CDB3E-s15	72	-	c1	18	18	-
CDB3E-s16	69	south	c2	47	18	CB-22873
CDB3E-s17	66	south	f1	9	0	-
CDB3E-s18	100	north	f1	10	0	-
CDB3E-s19	100	-	c1	15	4	CB-22876
CDB3E-s20	101	south	c2	13	0	-
CDB3E-s21	100	south	f1	7	10	-
CDB3E-s22	112	-	c1b	14	10	-
CDB3E-s23	130	north	c1b	17	39	-
CDB3E-s24	124	north	c2	30	3	-
CDB3E-s25	125	-	c1	5	65	-
CDB3E-s26	126	south	c2	38	18	CB-22877
CDB3E-s27	125	south	f1	9	0	-
CDB3E-s28	141	south	f1	16	0	CB-22878
CDB3E-s29	149	north	f1	11	0	-
CDB3E-s30	150	-	c1	10	0	-
CDB3E-s31	150	south	f1	5	0	-
CDB3E-s32	174	south	f1	7	13	-
CDB3E-s33	177	south	f1	18	0	-
CDB3E-s34	176	-	c1	21	44	-
CDB3E-s35	200	south	c2	14	81	CB-22880
CDB3E-s36	198	south	f1	28	0	CB-22879
CDB3E-s37	197	south	f1	10	0	-
CDB3E-s38	204	-	c1	0	73	-
CDB3E-s39	223	south	f1	3	10	-
CDB3E-s40	213	south	c2	21	0	-
CDB3E-s41	213	south	f1	6	0	-
CDB3E-s42	226	-	c1	40	14	CB-22881
CDB3E-s43	269	south	f1	15	0	-
CDB3E-s44	263	south	c2	10	8	-
CDB3E-s45	252	-	c1	2	91	-

Table 4. Sediment Thickness Measurements From Reach PA-4

Stratigraphic Section Location	Distance From Upstream End of Reach (m)	Side of Channel	Geomorphic Unit	Fine Facies Thickness, Post Cerro Grande Fire (cm)	Coarse Facies Thickness, Post Cerro Grande Fire (cm)	Fine Facies Thickness, Pre Cerro Grande Fire (cm)	Coarse Facies Thickness, Pre Cerro Grande Fire (cm)	Sample Location ID
PA4-s1	24	-	c1	4	4	0	0	-
PA4-s2	25	north	c2	9	0	0	30	PA-22882
PA4-s3	70	south	c2	4	0	12	13	-
PA4-s4	70	-	c1	2	0	0	10	-
PA4-s5	90	-	c1 pool	14	0	5	0	-
PA4-s6	100	-	c1 pool	12	0	3	0	-
PA4-s7	125	north	c1w	7	0	24	0	-
PA4-s8	125	central	c1w	7	0	8	6	-
PA4-s9	125	south	c1w	14	0	17	4	PA-22883
PA4-s10	150	south	c1w	4	0	20	0	-
PA4-s11	150	central	c1w	7	0	24	3	-
PA4-s12	150	north	c1w	6	0	42	8	PA-22884
PA4-s13	175	north	c1w	4	0	30	8	-
PA4-s14	175	central	c1w	4	0	50	4	-
PA4-s15	175	-	c1	3	0	0	0	-
PA4-s16	175	south	c1w	3	0	0	0	-
PA4-s17	200	south	c1w	4	0	28	10	-
PA4-s18	200	-	c1	5	0	8	4	-
PA4-s19	200	central	c1w	2	0	25	0	PA-22887
PA4-s20	200	north	c1w	3	0	17	0	-
PA4-s21	214	south	c2	5	0	9	0	-
PA4-s22	232	-	c1 pool	10	0	28	0	-
PA4-s23	235	south	c2	5	0	4	0	-
PA4-s24	256	south	c1 willow	5	0	18	18	-
PA4-s25	276	-	c1 willow	3	0	13	5	18-10096
PA4-s26	295	-	c1	1	0	15	0	18-10097
PA4-s27	317	north	c2	4	0	16	4	18-10098
PA4-s28	350	-	c1	3	0	0	0	-
PA4-s29	355	north	c2	4	0	5	0	-
PA4-s30	395	north	c2	4	0	5	4	-
PA4-s31	400	-	c1	1	0	13	0	-
PA4-s32	407	south	c2	3	0	0	9	-
PA4-s33	450	-	c1	1	0	0	2	-
PA4-s34	453	north	c2	4	0	14	0	PA-22889
PA4-s35	492	south	c2	9	0	11	0	-
PA4-s36	496	north	c2	6	0	10	8	-
PA4-s37	500	-	c1	5	0	0	0	-
PA4-s38	526	-	c1 pool	4	0	0	0	-
PA4-s39	538	-	c1 pool	26	0	9	0	PA-22890

Table 5. Sediment Samples from Reaches CDB-3E and PA-4

Reach	Sample ID	Location ID	Stratigraphic Section ID	Distance From Upper End of Reach (m)	Side of Channel or Wetland	Geomorphic Unit	Facies	Depth (cm)	Date Collected	Notes
CDB-3E	CACB-04-53722	CB-22872	CDB3E-s5	8	north	f1	fine	5-16	9/1/04	Very fine sand
CDB-3E	CACB-04-53723	CB-22873	CDB3E-s16	69	south	c2	fine	4-18	9/1/04	Fine sand
CDB-3E	CACB-04-53724	CB-22873	CDB3E-s16	69	south	c2	fine	21-40	9/1/04	Clean fine to very fine sand
CDB-3E	CACB-04-53725	CB-22875	CDB3E-s14	73	north	f1	fine	0-9	9/1/04	Very fine sand
CDB-3E	CACB-04-53726	CB-22876	CDB3E-s19	100	-	c1	fine	0-15	9/1/04	Fine and very fine sand
CDB-3E	CACB-04-53727	CB-22877	CDB3E-s26	126	south	c2	fine	0-20	9/1/04	Fine to very fine sand
CDB-3E	CACB-04-53728	CB-22878	CDB3E-s28	141	south	f1	fine	0-16	9/1/04	Fine and very fine sand; in f1 swale
CDB-3E	CACB-04-53729	CB-22879	CDB3E-s36	198	south	f1	fine	0-28	9/1/04	Fine sand
CDB-3E	CACB-04-53730	CB-22880	CDB3E-s35	200	south	c2	coarse	14-42	9/1/04	Medium to coarse sand
CDB-3E	CACB-04-53731	CB-22881	CDB3E-s42	226	-	c1	coarse	0-40	9/1/04	Medium and coarse sand and gravel
CDB-3E	CACB-04-53732	CB-22879	CDB3E-s36	198	south	f1	fine	0-28	9/1/04	QA duplicate of CACB-04-53729
PA-4	CAPA-04-53801	PA-22882	PA4-s2	25	north	c2	coarse	9-39	9/15/04	Medium to very coarse sand, with abundant fines
PA-4	CAPA-04-53802	PA-22883	PA4-s9	125	south	c1w	fine	0-14	9/15/04	Ash-rich very fine sandy silt, postfire
PA-4	CAPA-04-53803	PA-22884	PA4-s12	150	north	c1w	fine	14-24	9/15/04	Very fine sandy silt
PA-4	CAPA-04-53804	PA-22884	PA4-s12	150	north	c1w	coarse	24-32	9/15/04	Very coarse sand with scattered granules
PA-4	CAPA-04-53805	PA-22884	PA4-s12	150	north	c1w	fine	32-56	9/15/04	Orange mottled silty very fine sand
PA-4	CAPA-04-53806	PA-22887	PA4-s19	200	central	c1w	fine	2-19	9/15/04	Fine to very fine sand with orange mottling
PA-4	CAPA-04-53807	PA-22887	PA4-s19	200	central	c1w	fine	19-27	9/15/04	Very fine sandy silt
PA-4	CAPA-04-53808	PA-22889	PA4-s34	453	north	c2	fine	4-18	9/15/04	Orange fine to very fine sand, root bioturbated, possibly with some ash
PA-4	CAPA-04-53809	PA-22890	PA4-s39	538	-	c1 pool	fine	0-26	9/15/04	Ash-rich silt, postfire
PA-4	CAPA-04-53810	PA-22890	PA4-s39	538	-	c1 pool	fine	26-35	9/15/04	Orange silty very fine sand, possibly with some ash in cracks
PA-4	CAPA-04-53811	PA-22884	PA4-s12	150	north	c1w	fine	32-56	9/15/04	QA duplicate of CAPA-04-53805
PA-4	CA18-00-0033	18-10096	PA4-s25	276	-	c1 willow	fine	0-9	7/5/00	Fine to very fine sand
PA-4	CA18-00-0034	18-10097	PA4-s26	295	-	c1	fine	1-15	7/5/00	Very fine to medium sand
PA-4	CA18-00-0035	18-10098	PA4-s27	317	north	c2	fine	8-20	7/5/00	Very fine to medium sand
east of PA-4	CA18-00-0036	18-10099	-	-	-	c1 willow? *	fine	0-36	7/5/00	Very fine sand and silt
east of PA-4	CA18-00-0037	18-10100	-	-	-	c1 willow? *	fine	4-21	7/5/00	Fine to very fine sand and silt
east of PA-4	CA18-00-0038	18-10100	-	-	-	c1 willow? *	fine	30-63	7/5/00	Very fine sand and silt
east of PA-4	CA18-00-0039	18-10101	-	-	-	c2? *	fine	5-32	7/5/00	Very fine sand and silt
east of PA-4	CA18-00-0040	18-10099	-	-	-	c1 willow? *	fine	0-36	7/5/00	QA duplicate of CA18-00-0036
east of PA-4	CA18-00-0041	18-10102	-	-	-	c1	fine	0-6	6/29/00	Postfire ash-rich sediment (muck) at NM 4 culvert (6/28/00 deposit)

* Area not mapped, and geomorphic unit inferred from field descriptions.

Table 6. Analyte Suites for Reach CDB-3E and PA-4 Sediment Samples

Analyte Suite	Reach CDB-3E, 2004	Reach PA-4, 2004	Reach PA-4 and Downstream, 2000
Americium-241 (alpha spectrometry)	x	x	x
Gamma Spectroscopy Radionuclides	x	x	x
Isotopic Plutonium	x	x	x
Isotopic Thorium	x	x	-
Isotopic Uranium	x	x	x
Strontium-90	x	x	-
Tritium	x	x	-
Nitrates	x	x	-
Perchlorate	x	x	-
Target Analyte List Metals	x	x	x
Total Cyanide	x	x	x
High Explosives	x	x	x
Pesticides	x	x	x
Polychlorinated Biphenyls	x	x	x
Polycyclic Aromatic Hydrocarbons (8310 method)	x	x	-
Semivolatile Organic Compounds (8270 method)	x	x	x
Organic Matter (loss on ignition method)	x	x	-
Particle Size Distribution Analysis	x	x	-
pH	x	x	-

x = in analyte suite; - = not in analyte suite

Table 7. Coordinates of Sample Locations			
Location ID	x coordinate (easting, ft)	y coordinate (northing, ft)	Method
CB-22872	1646880.073	1757632.975	GPS
CB-22873	1647044.398	1757537.763	GPS
CB-22875	1647062.039	1757542.744	GPS
CB-22876	1647114.952	1757468.980	GPS
CB-22877	1647175.979	1757408.852	GPS
CB-22878	1647206.426	1757370.223	GPS
CB-22879	1647336.171	1757231.493	GPS
CB-22880	1647347.024	1757246.950	GPS
CB-22881	1647430.003	1757239.265	GPS
PA-22882	1645501.863	1755736.597	GPS
PA-22883	1645742.887	1755648.450	GPS
PA-22884	1645933.086	1755732.121	GPS
PA-22887	1645997.809	1755554.657	GPS
PA-22889	1646698.518	1755165.043	GPS
PA-22890	1646944.524	1755236.175	GPS
18-10096	1646197	1755409	estimated
18-10097	1646255	1755379	estimated
18-10098	1646315	1755354	estimated
18-10099	1648331	1754556	estimated
18-10100	1648342	1754584	estimated
18-10101	1648322	1754574	estimated
18-10102	1648440	1754462	estimated

Table 8. Particle Size, Organic Matter, and pH Data from Reach CDB-3E and PA-4 Sediment Samples

Reach	Sample ID	Gravel (> 2 mm) (wt%)	Very Coarse Sand (2-1 mm) (wt%)	Coarse Sand (1-0.5 mm) (wt%)	Medium Sand (0.5-0.25 mm) (wt%)	Fine Sand (0.25-0.125 mm) (wt%)	Very Fine Sand (0.125-0.0625 mm) (wt%)	Coarse Silt (62.5-15 µm) (wt%)	Fine Silt (15-2 µm) (wt%)	Clay (<2 µm) (wt%)	Median Particle Size Class*	Total Silt + Clay (wt%)	Organic Matter (wt%)	pH
CDB-3E	CACB-04-53722	3.6	5.6	6.0	9.1	16.9	25.2	23.8	3.8	9.5	vfs	37.1	2.0	6.62
CDB-3E	CACB-04-53723	2.3	2.9	3.1	1.7	4.4	15.5	50.8	9.0	12.5	csi	72.3	3.9	6.50
CDB-3E	CACB-04-53724	1.4	1.8	4.0	5.0	9.0	20.5	40.5	7.3	11.9	csi	59.7	2.6	6.46
CDB-3E	CACB-04-53725	1.1	0.2	0.4	0.9	3.2	12.2	49.1	17.6	16.3	csi	83.0	5.4	5.85
CDB-3E	CACB-04-53726	1.6	5.1	7.0	4.1	3.6	8.6	38.7	16.2	16.6	csi	71.5	3.3	6.25
CDB-3E	CACB-04-53727	3.2	7.2	6.7	2.9	2.9	10.6	41.9	11.5	16.1	csi	69.5	3.2	6.39
CDB-3E	CACB-04-53728	1.3	5.8	13.1	14.8	8.9	11.0	28.7	7.0	10.6	vfs	46.3	2.6	6.24
CDB-3E	CACB-04-53729	2.5	4.6	6.9	8.0	10.1	14.2	34.5	9.6	11.9	csi	56.1	3.2	6.34
CDB-3E	CACB-04-53730	3.3	35.1	36.4	15.7	3.7	1.5	1.4	2.5	3.8	cs	7.6	0.8	6.39
CDB-3E	CACB-04-53731	12.7	36.6	36.3	13.7	3.0	1.3	2.8	2.6	3.7	cs	9.1	0.7	6.34
PA-4	CAPA-04-53801	22.5	23.1	33.9	23.0	4.4	1.2	3.3	3.6	7.3	cs	14.3	1.27	6.11
PA-4	CAPA-04-53802	0.0	0.1	0.3	0.5	0.6	0.6	9.1	49.4	39.4	fsi	97.9	12.37	6.22
PA-4	CAPA-04-53803	0.1	0.6	1.7	1.3	3.4	8.1	36.4	26.1	22.1	csi	84.6	4.93	5.85
PA-4	CAPA-04-53804	8.0	48.4	40.4	4.1	0.5	1.0	2.0	1.6	2.0	cs	5.5	0.53	5.80
PA-4	CAPA-04-53805	0.1	0.3	0.5	0.4	1.2	12.2	61.0	11.3	13.1	csi	85.4	3.00	5.73
PA-4	CAPA-04-53806	2.5	4.8	3.4	3.9	14.6	16.0	35.2	10.7	11.4	csi	57.3	13.17	6.25
PA-4	CAPA-04-53807	0.0	0.1	0.4	0.8	1.6	4.0	49.9	25.8	17.3	csi	93.0	3.02	6.35
PA-4	CAPA-04-53808	3.9	4.8	13.8	19.4	11.1	6.9	15.9	11.1	16.7	vfs	43.7	4.71	6.60
PA-4	CAPA-04-53809	0.0	0.1	0.5	0.8	0.6	0.6	8.3	55.7	33.4	fsi	97.3	10.25	6.84
PA-4	CAPA-04-53810	5.7	2.3	5.5	5.6	4.6	5.2	19.3	21.3	36.2	fsi	76.8	5.17	6.82

* Refers to median particle size class in <2 mm fraction of samples; cs = coarse sand; csi = coarse silt; fsi = fine silt; vfs = very fine sand

Table 9. Summary of Inorganic Chemical Data from Reach CDB-3E Sediment Samples

Analyte	Number of Analyses	Number of Detects	Concentration Range (mg/kg) *	Sediment Background Value (mg/kg)	Frequency of Detects above Background Value	Frequency of Nondetects above Background Value
Aluminum	11	11	2060 to 25000	15400	3/11	0/11
Arsenic	11	11	0.544 to 5.71	3.98	1/11	0/11
Barium	11	11	14.3 to 245	127	4/11	0/11
Beryllium	11	11	0.247 to 1.06	1.31	0/11	0/11
Bromide	11	0	[2.01 to 2.14]	NA	NA	NA
Cadmium	11	9	0.0695 to [0.526]	0.4	0/11	2/11
Calcium	11	11	340 to 4260	4420	0/11	0/11
Chloride	11	8	0.628 to [2.09]	17.1	0/11	0/11
Chromium	11	11	1.44 to 17.2	10.5	1/11	0/11
Cobalt	11	11	0.527 to 8.73	4.73	1/11	0/11
Copper	11	11	2.11 to 14.7	11.2	1/11	0/11
Cyanide (Total)	11	0	[0.239 to 0.263]	0.82	0/11	0/11
Fluoride	11	10	0.743 to 1.93	NA	NA	NA
Iron	11	11	3320 to 23800	13800	1/11	0/11
Lead	11	11	2.4 to 23.1	19.7	1/11	0/11
Magnesium	11	11	322 to 4370	2370	4/11	0/11
Manganese	11	11	129 to 732	543	1/11	0/11
Mercury	11	11	0.0017 to 0.0225	0.1	0/11	0/11
Nickel	11	11	0.983 to 7.12	9.38	0/11	0/11
Perchlorate	11	1	0.0151 to [0.0427]	NA	NA	NA
Potassium	11	11	349 to 4420	2690	2/11	0/11
Selenium	11	8	0.328 to 1.51	0.3	8/11	3/11
Silver	11	11	0.0197 to 0.105	1	0/11	0/11
Sodium	11	11	35.2 to 230	1470	0/11	0/11
Sulfate	11	0	[4.02 to 4.28]	58.2	0/11	0/11
Thallium	11	11	0.0233 to 0.169	0.73	0/11	0/11
Vanadium	11	11	2.92 to 35	19.7	1/11	0/11
Zinc	11	11	16.6 to 76.5	60.2	1/11	0/11

* Values in brackets are nondetects

NA = not available

Table 10. Summary of Organic Chemical Data from Reach CDB-3E Sediment Samples

Analyte	Number of Analyses	Number of Detects	Concentration Range (mg/kg) *	Frequency of Detects
Aroclor-1242	11	1	[0.0034] to 0.0122	1/11
Aroclor-1254	11	3	0.0018 to 0.0186	3/11
Aroclor-1260	11	2	[0.0034] to 0.0069	2/11
Bis(2-ethylhexyl)phthalate	11	1	0.0317 to [0.364]	1/11
Di-n-butylphthalate	11	1	0.0263 to [0.364]	1/11
Pyrene	11	1	[0.00168] to 0.0106	1/11

* Values in brackets are nondetects

Table 11. Summary of Radionuclide Data from Reach CDB-3E Sediment Samples

Analyte	Number of Analyses	Number of Detects	Concentration Range (pCi/g) *	Sediment Background Value (pCi/g)	Frequency of Detects above Background Value
Americium-241	11	3	[-0.00373] to 0.0482	0.04	1/11
Cesium-134	3	0	[0.014 to 0.0206]	NA	NA
Cesium-137	9	8	[0.0922] to 0.305	0.9	0/9
Cobalt-60	11	0	[-0.0311 to 0.0358]	NA	NA
Europium-152	11	0	[-0.0178 to 0.0528]	NA	NA
Plutonium-238	11	5	[-0.00158] to 0.0628	0.006	5/11
Plutonium-239,240	11	6	[0.00299] to 0.0767	0.068	1/11
Ruthenium-106	11	0	[-0.06 to 0.107]	NA	NA
Sodium-22	10	0	[-0.0254 to 0.0219]	NA	NA
Strontium-90	11	1	[-0.121] to 0.269	1.04	0/11
Thorium-228	11	11	0.796 to 1.94	2.28	0/11
Thorium-230	11	11	0.627 to 1.77	2.29	0/11
Thorium-232	11	11	0.587 to 1.96	2.33	0/11
Tritium	11	1	[-0.0423 to 0.137]	0.093	0/11
Uranium-234	11	11	0.462 to 1.49	2.59	0/11
Uranium-235	11	1	[0.0422] to 0.153	0.2	0/11
Uranium-238	11	11	0.284 to 1.39	2.29	0/11

* Values in brackets are nondetects

NA = not available

Table 12. Summary of Inorganic Chemical Data from Reach PA-4 Sediment Samples

Analyte	Number of Analyses	Number of Detects	Concentration Range (mg/kg) *	Sediment Background Value (mg/kg)	Frequency of Detects above Background Value	Frequency of Nondetects above Background Value
Aluminum	11	11	2180 to 32300	15400	4/11	0/11
Antimony	11	2	0.065 to [0.445]	0.83	0/11	0/11
Arsenic	11	10	[0.539] to 7.5	3.98	2/11	0/11
Barium	11	11	16.8 to 738	127	4/11	0/11
Beryllium	11	11	0.105 to 1.51	1.31	1/11	0/11
Cadmium	11	2	[0.0654] to 1.02	0.4	2/11	2/11
Calcium	11	11	418 to 23400	4420	3/11	0/11
Chromium	11	11	1.8 to 19.8	10.5	4/11	0/11
Cobalt	11	11	0.548 to 10.8	4.73	3/11	0/11
Copper	11	11	2.25 to 37.7	11.2	4/11	0/11
Cyanide (Total)	11	4	0.0792 to 2.3	0.82	3/11	0/11
Iron	11	11	3360 to 23600	13800	5/11	0/11
Lead	11	11	4.79 to 48.3	19.7	3/11	0/11
Magnesium	11	11	317 to 4650	2370	4/11	0/11
Manganese	11	11	58.5 to 2310	543	3/11	0/11
Mercury	11	11	0.0057 to 0.0733	0.1	0/11	0/11
Nickel	11	11	0.88 to 16.4	9.38	3/11	0/11
Nitrate	11	5	0.4 to 51.2	NA	NA	NA
Perchlorate	11	0	[0.0333 to 0.0443]	NA	NA	NA
Potassium	11	11	339 to 4590	2690	3/11	0/11
Selenium	11	9	0.334 to 1.45	0.3	9/11	2/11
Silver	11	11	0.11 to 1.7	1	2/11	0/11
Sodium	11	11	57.2 to 448	1470	0/11	0/11
Thallium	11	11	0.0241 to 0.361	0.73	0/11	0/11
Vanadium	11	11	5.38 to 36.1	19.7	6/11	0/11
Zinc	11	11	15.8 to 126	60.2	5/11	0/11

* Values in brackets are nondetects

NA = not available

Table 13. Summary of Organic Chemical Data from Reach PA-4 Sediment Samples

Analyte	Number of Analyses	Number of Detects	Concentration Range (mg/kg) *	Frequency of Detects
Acenaphthene	11	3	[0.0167] to 0.0806	3/11
Anthracene	11	3	[0.00475] to 0.0821	3/11
Aroclor-1254	11	1	[0.0033] to 0.0587	1/11
Aroclor-1260	11	4	[0.0033] to 0.0357	4/11
Benzo(a)anthracene	11	4	[0.00112] to 0.169	4/11
Benzo(a)pyrene	11	4	[0.00167] to 0.138	4/11
Benzo(b)fluoranthene	11	3	[0.00161] to 0.219	3/11
Benzo(g,h,i)perylene	11	4	[0.00167] to 0.0865	4/11
Benzo(k)fluoranthene	11	1	[0.00331 to 0.0736]	1/11
Bis(2-ethylhexyl)phthalate	11	1	0.0399 to [0.386]	1/11
Chrysene	11	6	[0.00145] to 0.128	6/11
DDD[4,4'-]	11	1	[0.00134 to 0.0154]	1/11
DDE[4,4'-]	11	4	[0.00134 to 0.0141]	4/11
Dieldrin	11	1	[0.00134 to 0.0154]	1/11
Di-n-butylphthalate	11	3	0.0497 to [0.386]	3/11
Fluoranthene	11	9	[0.00237] to 0.35	9/11
Fluorene	11	3	[0.00858] to 0.0726	3/11
Indeno(1,2,3-cd)pyrene	11	3	[0.00428] to 0.0834	3/11
Phenanthrene	11	8	[0.00217] to 0.359	8/11
Pyrene	11	10	[0.0024] to 0.33	10/11

* Values in brackets are nondetects

Table 14. Summary of Radionuclide Data from Reach PA-4 Sediment Samples					
Analyte	Number of Analyses	Number of Detects	Concentration Range (pCi/g) *	Sediment Background Value (pCi/g)	Frequency of Detects above Background Value
Americium-241	11	2	[0] to 0.102	0.04	2/11
Cesium-134	2	0	[0.00905 to 0.0468]	NA	NA
Cesium-137	11	9	[0.0201] to 4.18	0.9	2/11
Cobalt-60	11	0	[-0.0449 to 0.0584]	NA	NA
Europium-152	10	0	[-0.111 to 0.0451]	NA	NA
Plutonium-238	11	1	[-0.0016] to 0.0432	0.006	1/11
Plutonium-239,240	11	8	[0.00682] to 0.187	0.068	4/11
Ruthenium-106	11	0	[-0.164 to 0.102]	NA	NA
Sodium-22	11	0	[-0.0313 to 0.0224]	NA	NA
Strontium-90	11	10	[0.116] to 0.865	1.04	0/11
Thorium-228	11	11	1.24 to 2.37	2.28	1/11
Thorium-230	11	11	0.785 to 1.72	2.29	0/11
Thorium-232	11	11	1.23 to 2	2.33	0/11
Tritium	11	0	[0.0016 to 0.109]	0.093	0/11
Uranium-234	11	11	0.733 to 1.88	2.59	0/11
Uranium-235	11	10	[0.0338] to 0.119	0.2	0/11
Uranium-238	11	11	0.832 to 2.03	2.29	0/11
* Values in brackets are nondetects					
NA = not available					

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