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memorandum

Chemical Science and Technology
Responsible Chemistry for America

Environmental Restoration Project
Los Alamos, New Mexico 87545

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Date: November 26, 1997

SUBJECT: REVIEW OF THE SAMPLING AND ANALYSIS PLAN FOR UPPER SANDIA CANYON

Accompanying this memo is a draft of the Sampling and Analysis Plan for Upper Sandia Canyon. This document is ready for your review. **Please return any comments to me by close of business on Wednesday, December 10**. Please let me know if you can not meet this deadline and I will try to work around your needs.

When you have finished your review, please let me know so that I can come by and pick up your copy. If you prefer, you can fax comments to me at 665-4632. If there is anything I can do to help in this process, please don't hesitate to call or send e-mail to ccrosby@lanl.gov.

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Sampling and Analysis Plan for
Upper Sandia Canyon

DRAFT

Field Unit 1

Environmental Restoration Project

November 26, 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

LA-UR-97-XXXX

1.0 INTRODUCTION

This sampling and analysis plan (SAP) describes the investigation planned for Upper Sandia Canyon as part of Los Alamos National Laboratory's (LANL's) Environmental Restoration (ER) Project. This investigation will assess the inventory of contaminants present in sediments and surface water in Upper Sandia Canyon, the current risk posed by these contaminants to ecological and human receptors, and the potential for future transport of these contaminants. The investigation will emphasize the wetland area within Upper Sandia Canyon. The investigation will also integrate with the future assessments of Sandia Canyon by the LANL ER Project Canyons Investigation Team (Core Document for Canyons Investigations, LA-UR-96-2083, April 1997).

Included in this SAP are the site description, problem definition, historical data, regulatory context, sampling approach, and sampling implementation plan. Guidance on the LANL ER Project's overall approach to site investigation, as well as the general history of the Laboratory, is available in the LANL ER Project Installation Work Plan (IWP) (LANL 1995, 1379). The IWP also includes the LANL ER Project Quality Assurance Project Plan (QAPP), which describes the requirements for personnel training, sample handling and custody, and data management, review, validation, and verification. When appropriate, this SAP will reference the administrative procedures, quality procedures, and standard operating procedures (SOPs) included in the QAPP.

1.1 Investigation Objectives

The Upper Sandia Canyon investigation is prompted by the remedial action conducted to address historical polychlorinated biphenyl (PCB) releases at Potential Release Site (PRS) 3-056(c). During that remedial action, the extent of contamination was observed to be greater than initially calculated. This led to further assessment of the human health and ecological risk associated with various residual levels of PCBs and other chemicals. Based on this further assessment, ecological risk was identified as the remedial action decision driver for PRS 3-056(c), and Upper Sandia Canyon was identified as the key location for assessing the potential impacts of residual contamination. Preliminary sampling of sediments in the wetland and sediments transported in surface water up-gradient from the wetland indicated detectable quantities of PCBs. Tissue samples collected from small mammals also showed detectable quantities of PCBs. These data suggest that other PCB sources in addition to PRS 3-056(c) may have contributed and may still be contributing to the PCB inventory in the Sandia Canyon wetland. Thus, characterization of the contaminant concentration in the wetland is an appropriate step for the overall Sandia Canyon

assessment. Sampling of biota may be necessary after the contaminant concentrations and distribution are better characterized.

This sampling and analysis plan is designed as the first step to answer the following questions:

(1) What is the inventory of PCBs or other contaminants stored in Upper Sandia Canyon sediments?

(2) Do elevated concentrations of PCBs or other contaminants pose an unacceptable risk to ecological receptors or humans?

(3) What is the nature of contaminant transport and mobility, and the potential for down-canyon transport of contaminants in surface water and sediment?

The conceptual model that provides the framework for Upper Sandia Canyon source term characterization is presented in Fig. 1.1-1. This model shows the nature of releases, the fate and transport of these releases in environmental media, and the exposure pathways used in the ecological and human health risk assessments. This investigation will provide data to refine the conceptual model, and will use the pathways presented in the model in estimating the risk associated with the site and the potential for future transport of contaminants. The biological pathways include both aquatic and terrestrial ecological food chains. If needed, biological sampling will be conducted once information on the source term has been gathered and refinements to the conceptual model have been made. Biological investigations will be detailed in an addendum to this SAP.

1.2 Site Description

Sandia Canyon originates on LANL property east of Diamond Drive, and the watershed includes portions of Technical Areas (TAs) 3, 60, and 61. PRSs within the Upper Sandia Canyon watershed are shown in Fig. 1.2-1. Some of these PRSs have been sampled and the existing data are summarized in Section 1.3.

Upper Sandia Canyon is cut into Units 3 and 4 of the Tshirege Member of the Bandelier Tuff. Upper Sandia Canyon includes a north tributary, a south tributary, and a wetlands area. The north and south tributaries are located east of Diamond Drive and west of a large debris dam that bridges the canyon, and the wetland is located immediately east of the debris dam (Fig. 1.2-2). The estimated length of the northern tributary from Diamond Drive to the confluence with the southern tributary is approximately 1 080 ft. The estimated length of the southern tributary from Diamond Drive to the western edge of the debris dam is approximately 1 775 ft. The estimated length of the

wetland from the eastern edge of the debris dam to the eastern edge of the wetland is approximately 2 275 ft.

1.1-1 Conceptual model for Upper Sandia Canyon. (Need to make some changes to this figure. Combine two figures. Need electronic copy from LATA)

Section 1

DRAFT

Figure 7: Aquatic Pathways Conceptual Model

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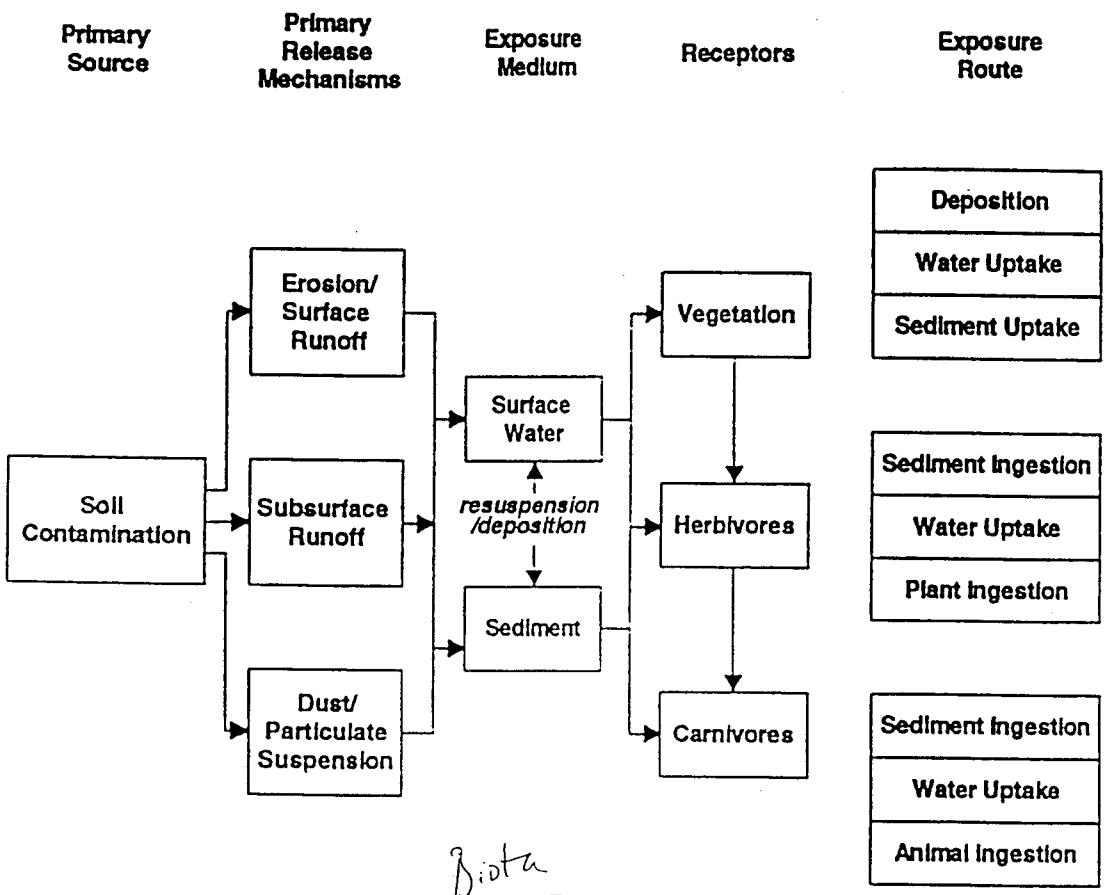


Biota

Combine with Figure 6.2 from Core Document

Fig. 1.1-1 Conceptual Model for Upper Sandia Canyon.

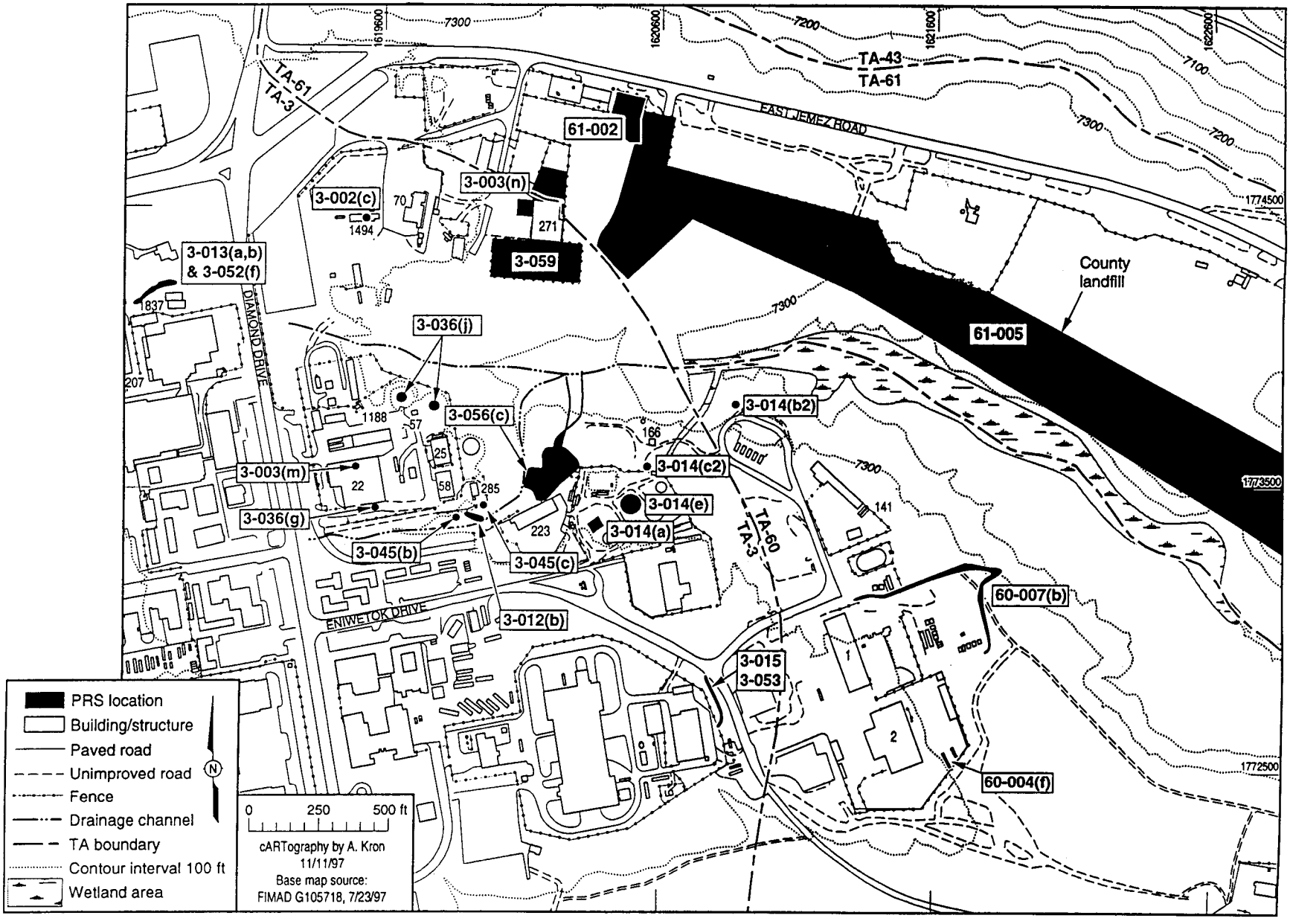


Fig. 1.2-1 Locations of PRSs contributing to the watershed at Upper Sandia Canyon.

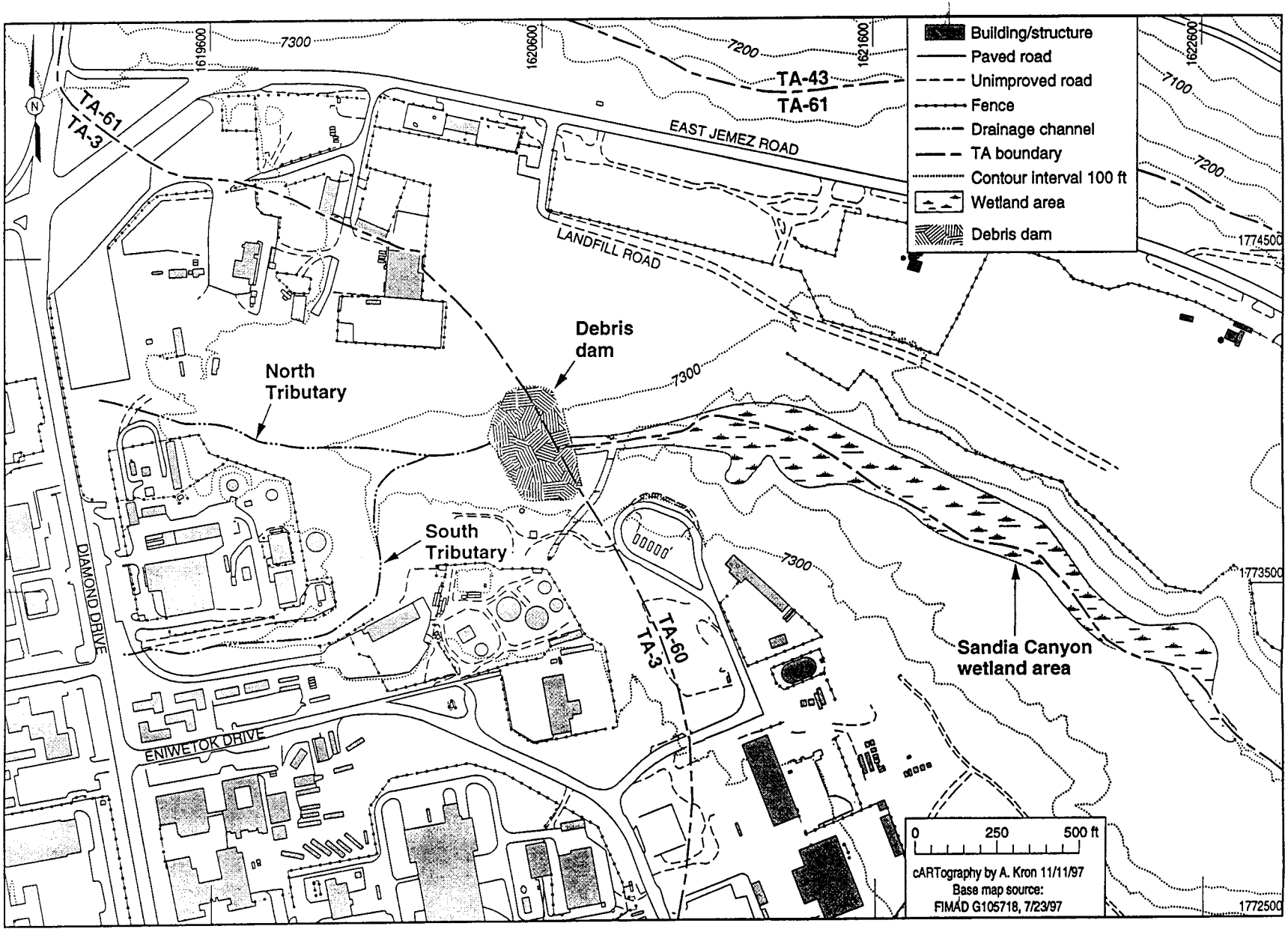


Fig. 1.2-2 Locations of tributaries, wetlands, and other features at Upper Sandia Canyon.

Expansion of the wetland in Upper Sandia Canyon from 1935 to 1991 has been estimated by reviewing a sequence of aerial photographs. The wetland changes are illustrated in Fig. 1.2-3. Information obtained from the series of aerial photographs will be used to provide information on the source of sediment and locations of sediment that may contain contaminants.

Current and former sources of water for Sandia Canyon include the following wastewater treatment plant outfalls, power plant outfalls, and storm drains:

- the former rolling mill outfall (PRS 3-015, National Pollutant Discharge Elimination System [NPDES] permit EPA04A140), which received effluent from janitor sinks, floor drains, and roof drains until early 1993 when the outfall was decommissioned;
- the current TA-3 wastewater treatment plant outfall (PRS 3-014[b2], NPDES permit EPASSS01S);
- the TA-3 storm drain outfall for the Johnson Controls Shop Building (TA-3-38) (PRS 3-013[a,b], NPDES permit EPA03A023), which receives storm water from two grated inlets and leads into the head of Sandia Canyon;
- the motor pool drainage area (PRS 60-007[b]), which is a storm drainage ditch located north of the motor pool building (TA-60-1);
- two TA-3 power plant outfalls (PRS 3-012[b], NPDES permit EPA01A001; and PRS 3-045[c], NPDES permit 031027);
- the TA-3 wastewater treatment plant abandoned outfall (PRS 3-014[c2], NPDES permit NM0024210 from 1975 to 1985.

Details of the site history for each PRS in this list are included in Section 1.3 of this sampling and analysis plan.

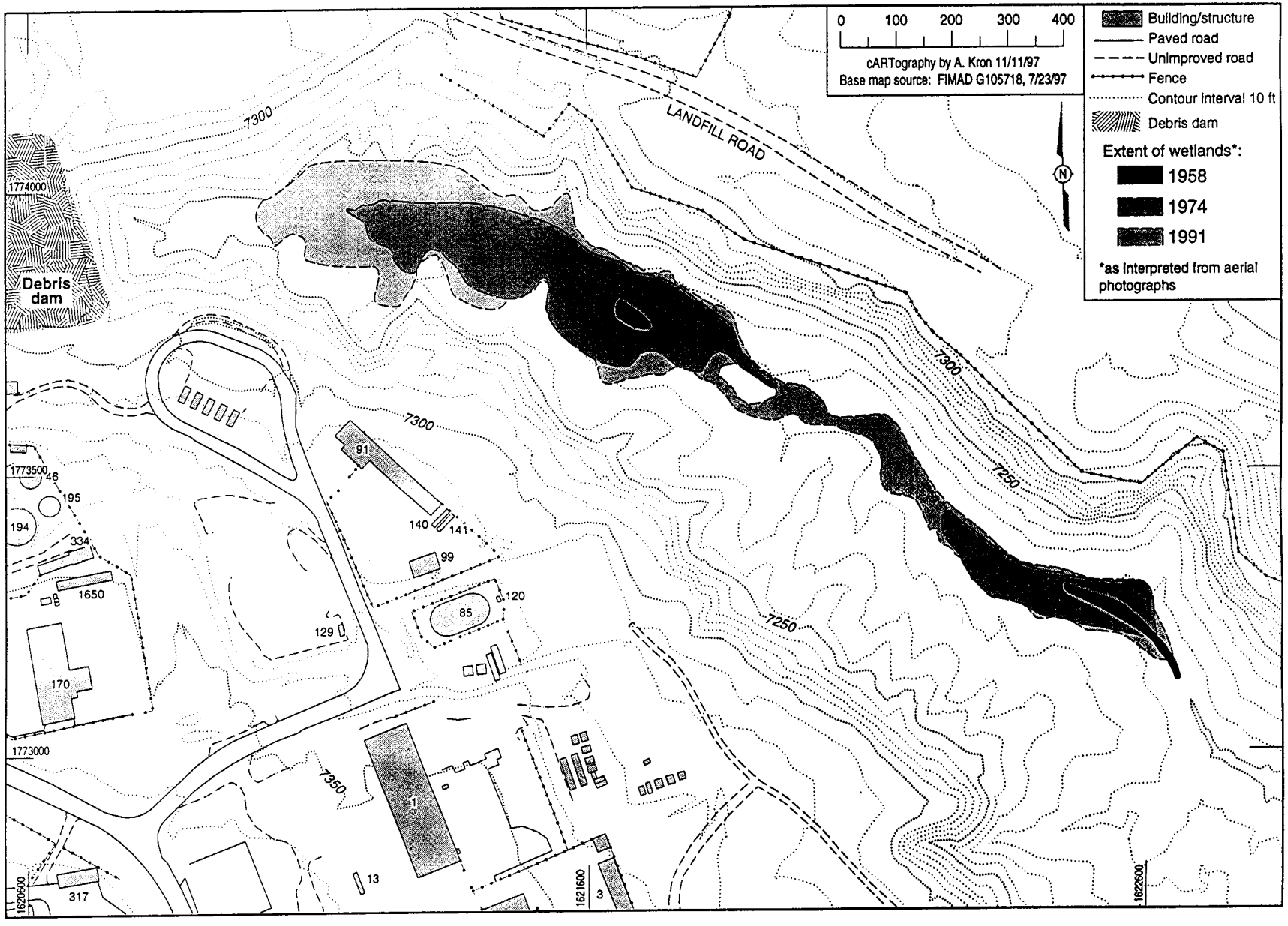


Fig. 1.2-3 Approximate extent of wetlands in Sandia Canyon during 1958, 1974 and 1991.

1.3 Existing Data

A variety of data (such as biological, soil, storm water, and surface water data) are currently available for Upper Sandia Canyon. These include data from Resource Conservation and Recovery Act (RCRA) facility investigations (RFIs) and Voluntary Corrective Actions (VCAs). This section presents existing historical information, analytical data above background upper tolerance limits (UTLs) for individual PRSs, and summaries of chemicals of potential concern (COPCs) based on process knowledge for PRSs where no samples have been collected. Analytical data for radionuclides and inorganics that exceed background UTLs and detected organics at each investigated PRS are summarized in Table 1.3-1. For detailed information for each PRS please refer to the RFI Work Plan for Operable Unit (OU) 1114 (LANL 1993, 1090), the RFI Work Plan for OU 1114 Addendum 1 (LANL 1995, 17-1275), and the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726).

TABLE 1.3-1

UPPER SANDIA CANYON RADIONUCLIDE AND INORGANIC DATA EXCEEDING BACKGROUND UTLs AND DETECTED ORGANIC COMPOUNDS[a]

ANALYTE	MAXIMUM VALUE (mg/kg or pCi/g)	PRS
VOLATILE ORGANIC COMPOUNDS		
4-Isopropyl toluene	0.28	3-014(b2)
Toluene	0.008	3-014(b2)
SEMIVOLATILE ORGANIC COMPOUNDS		
Acenaphthene	12	3-015 and 3-053
Anthracene	1.5	3-012(b) and 3-045(b,c)
	22	3-015 and 3-053
Benzo[a]anthracene	5.9	3-012(b) and 3-045(b,c)
	4.6	3-013(a,b) and 3-052(f)
	63	3-015 and 3-053
Benzo[a]pyrene	4.1	3-012(b) and 3-045(b,c)
	4.6	3-013(a,b) and 3-052(f)
	1.8	3-014(c2)
	57	3-015 and 3-053
Benzo[b]fluoranthene	4.9	3-012(b) and 3-045(b,c)
	4.3	3-013(a,b) and 3-052(f)
	1.7	3-014(c2)
	54	3-015 and 3-053
Benzo[g,h,i]perylene	1.2	3-012(b) and 3-045(b,c)
	0.43	3-014(c2)
	40	3-015 and 3-053
Benzo[k]fluoranthene	1.2	3-012(b) and 3-045(b,c)
	3.6	3-013(a,b) and 3-052(f)

	2	3-014(c2)
	38	3-015 and 3-053
Bis(2-ethylhexyl)phthalate	0.6	3-014(b2)
	5.3	60-007(b)
Butylbenzylphthalate	0.37	3-015 and 3-053
	0.92	61-002
Chrysene	3.5	3-012(b) and 3-045(b,c)
	5.4	3-013(a,b) and 3-052(f)
	1.8	3-014(c2)
	60	3-015 and 3-053
Dibenzo[a,h]anthracene	0.5	3-012(b) and 3-045(b,c)
	14	3-015 and 3-053
Fluoranthene	11	3-012(b) and 3-045(b,c)
	12	3-013(a,b) and 3-052(f)
	3.2	3-014(c2)
	120	3-015 and 3-053
Fluorene	10	3-015 and 3-053
Indeno[1,2,3-cd]pyrene	1.6	3-012(b) and 3-045(b,c)
	0.66	3-014(c2)
	45	3-015 and 3-053
Naphthalene	7.2	3-015 and 3-053
Phenanthrene	6.3	3-012(b) and 3-045(b,c)
	13	3-013(a,b) and 3-052(f)
	1.3	3-014(c2)
	88	3-015 and 3-053
Pyrene	7.8	3-012(b) and 3-045(b,c)
	10	3-013(a,b) and 3-052(f)
	3.2	3-014(c2)
	120	3-015 and 3-053
PESTICIDES AND PCBs		
Alpha-chlordane	0.13	3-002(c)
DDT	0.22	3-002(c)
Dibenzofuran	5.6	3-015 and 3-053
Gamma-chlordane	0.15	3-002(c)
PCBs	<25.0	3-003(m)
	7.6	3-012(b) and 3-045(b,c)
	0.137	3-013(a,b) and 3-052(f)
	0.73	3-014(a,e)
	0.63	3-014(c2)
	See Table 1.3-2 for the PCB range	3-056(c)
	0.24 (for 3-059)	3-059 and 3-003(n)
	0.0995	60-004(f)
	1.6	61-002
INORGANICS		
Barium	341	3-002(c)
Cadmium	5.2	3-012(b) and 3-045(b,c)
	4	3-014(a,e)
	7.3	3-014(c2)
Calcium	16 300	3-002(c)

	6 970	3-014(c2)
Chromium	2 080	3-012(b) and 3-045(b,c)
	239	3-014(a,e)
	86	3-014(b2)
	118	3-014(c2)
Copper	114	3-013(a,b) and 3-052(f)
	220	3-014(a,e)
	105	3-014(c2)
Cyanide	13.3	3-012(b) and 3-045(b,c)
	4.9	3-014(a,e)
	33.9	3-014(b2)
	32.1	3-014(c2)
Lead	224	3-012(b) and 3-045(b,c)
	60.6	3-013(a,b) and 3-052(f)
	115	3-014(a,e)
	30.5	3-014(b2)
	1 550	3-014(c2)
	71.5	3-015 and 3-053
Mercury	0.17	3-002(c)
	1.2	3-012(b) and 3-045(b,c)
	0.14	3-013(a,b) and 3-052(f)
	2.6	3-014(a,e)
	0.2	3-014(b2)
	1.3	3-014(c2)
	2.4	3-015 and 3-053
	2.3	60-004(f)
Nickel	26.5	3-014(c2)
Silver	12.5	3-002(c)
	108	3-012(b) and 3-045(b,c)
	110	3-014(a,e)
	42.4	3-014(b2)
	60.2	3-014(c2)
	2.7	3-015 and 3-053
Zinc	88.8	3-002(c)
	111	3-013(a,b) and 3-052(f)
	125	3-014(a,e)
	106	3-014(c2)
	160	60-004(f)
	59.9	61-002
RADIONUCLIDES		
Cesium-137	2.49	3-014(b2)
Plutonium-238	0.207	3-014(a,e)
Plutonium-239	0.57	3-014(a,e)
	0.257	3-014(c2)
Uranium-234	10.011	3-014(a,e)
	2.41	3-014(c2)
	6.31	3-015 and 3-053
Uranium-235	0.543	3-014(a,e)
	0.104	3-014(c2)

	0.39	3-015 and 3-053
Uranium-238	2.581	3-014(a,e)
	6.33	3-015 and 3-053

[a] All data are taken from the RFI Work Plan for OU 1114 Addendum I (LANL 1995, 17-1275).

TABLE 1.3-2

RESULTS OF VERIFICATION GRID SAMPLING AT PRS 3-056(c)

SAMPLE DATE	COMPOSITE GROUP	NUMBER OF SAMPLES WITH PCB CONCENTRATION <10 mg/kg	LIST OF SAMPLE NUMBER AND PCB CONCENTRATIONS >10 mg/kg[a]
NORTH SLOPE VERIFICATION SAMPLING			
2/1/96	A	9	0103-96-0100 = 19 0103-96-0096 = 20 0103-96-0077 = 22
2/1/96	B	7	0103-96-0070 = 14 0103-96-0075 = 47
2/1/96	C	6	0103-96-0095 = 12 0103-96-0102 = 12 0103-96-0089 = 13 0103-96-0097 = 30
2/1/96	D	8	0103-96-0106 = 30 0103-96-0103 = 63
3/22/96	na[b]	4	0103-96-0112 = 15 0103-96-0113 = 15
WEST SLOPE VERIFICATION SAMPLES			
1/15/96	A	8	0103-96-0054 = 34
1/15/96	B	7	0103-96-0058 = 13 0103-96-0064 = 13
12/15/95	C	1[c]	none
12/15/95	D	1[c]	none

[a] Proposed PCB clean-up level was 10 mg/kg. LANL intends to remove PCBs above 10 mg/kg during site restoration activities.

[b] These samples were collected after expanding the north slope verification grid in an attempt to establish the extent of the 10 mg/kg contour.

[c] The analytical result was for one composite grid sample from this quadrant.

Note: Make write-ups for each PRS more similar in content

PRS 3-002(c), Former Pesticide Storage Shed. PRS 3-002(c) is the site of a former pesticide storage shed located 100 ft west of the Johnson Controls, Inc. (JCI) administrative office for roads and grounds (TA-3-70) (Fig. 1.2-1). The 15- by 19-ft wooden pesticide storage shed was formerly designated TA-3-1494. The site includes an unbermed cement pad that was under the center portion of the shed and in place before the shed was erected. Directly east of the shed there is a 12- by 19-ft cement pad with 6-in. high curbing. This pad was used as a secondary containment for the pesticide application vehicles. The pad was asphalted in 1989 to level the surface with the top of the curbing.

From the early 1960s through 1984, the shed was used to store drums of liquid and powdered pesticides, and possibly herbicides. It is likely that spills occurred within the shed; the floor of the shed was reported to be permeated with pesticides (Weston 1992, 17-582). The shed was removed in 1989, and the floor was demolished and disposed of as hazardous waste (Weston 1992, 17-582). PRS 3-002(c) is discussed in detail in the RFI Work Plan for OU 1114 and the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (LANL 1993, 1090; 1996, LA-UR-96-726).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether the storage and transfer of pesticides at the shed resulted in the release of any contaminants (LANL 1993, 1090). Six samples were collected from five locations at depths ranging from 0- to 6-in. Samples were submitted for analysis of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/PCBs, herbicides, and target analyte list (TAL) metals. The data for inorganics that exceeded background UTLs and detected organics are summarized by analyte in Table 1.3-1. No chemicals were retained as COPCs by the screening assessment process. Therefore, PRS 3-002(c) was recommended for no further action (NFA) in the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726).

PRS 3-003(m), Capacitor Banks. PRS 3-003(m) includes two capacitor banks located at building TA-3-1188 in a limited-access, fenced area. These capacitor banks were installed in 1973. The two banks consisted of 55 PCB capacitors on wooden poles on minimal topsoil over welded tuff. Over a four-year period during the 1980s, numerous capacitors ruptured. Three capacitors ruptured in 1987, and oil was released onto the rack and the surrounding soil. The capacitor bank was shut down. Cleanup of the area began in 1988. All 55 capacitors and two racks were removed and both racks were washed using the double-wash/double-rinse method. Concrete footings were removed and disposed of, and approximately 357 yd^3 of soil beneath the capacitor banks was excavated until PCB concentrations were below 25 parts per million (ppm) (see Table 1.3-1) (LANL 1989, 17-980). The area was backfilled with clean soil, new concrete footings, racks, and 55 non-PCB capacitors were installed. PRS 3-003(m) is discussed in detail in the RFI Work Plan for OU 1114 Addendum 1 (LANL 1995, 17-1275).

This site was recommended for NFA in the RFI Work Plan for OU 1114 Addendum 1 because the PCB-containing transformers have all been removed or replaced with non-PCB equipment (LANL 1995, 17-1275). The documented PCB releases were remediated in accordance with the Toxic Substances Control Act (TSCA) requirements in the Code of Federal Regulations (CFR) under 40 CFR 761.

PRS 3-012(b), Power Plant Outfall. PRS 3-012(b) is an outfall associated with the power plant (TA-3-22) (Fig. 1.2-1). From 1951 to 1985, the outfall discharged cooling water that originated

from treated effluent generated by the TA-3 Waste Water Treatment Plant (WWTP). The outfall discharges to a small tributary of Sandia Canyon south of the power plant. In the past, water from the WWTP was treated with chromates before being used as cooling water at the power plant. The NPDES permit number of the outfall is EPA01A001. Each PRS is discussed in detail in the RFI Work Plan for OU 1114 and/or the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (LANL 1993, 1090; 1996, LA-UR-96-726).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether the outfall discharge resulted in the release of any contaminants (LANL 1993, 1090). Eleven samples were collected from five locations below the outfall. All samples were collected from a depth of 0- to 6-in. Samples were submitted for analysis of VOCs, SVOCs, pesticides/PCBs, herbicides, TAL metals, and radionuclides. The data for radionuclides and inorganics that exceeded background UTLs and detected organics for each PRS are summarized by analyte in Table 1.3-1. The screening assessment process retained ten chemicals [PCBs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, chromium, cadmium, lead, and silver]. Therefore PRS 3-012(b) is recommended for a Phase II investigation during which samples will be collected to provide information on other possible contaminant sources and to define the extent of contamination [see the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726)].

PRS 3-013(a,b) and 3-052(f), TA-3 Storm Drain Outfall. PRS 3-013(a) is a 1 500-ft long storm drain serving the JCI Shop Building (TA-3-38) (Fig. 1.2-1). There are two grated inlets to this storm drain from building TA-3-38; one is located northwest of the building and the other is located at the northeast corner of the building. The majority of the storm drain is an underground corrugated metal pipe that runs south, then east around TA-3-38, and then east along the south side of the Otowi Building (TA-3-261). The storm drain merges with several others before it surfaces in an open, concrete, rock-lined ditch approximately 100 ft east of the Otowi Building. It then passes under streets and sidewalks and surfaces again at the permitted outfall (NPDES permit EPA03A023). The outfall is located just north of building TA-3-1837. PRS 3-013(a) is discussed in detail in the RFI Work Plan for OU 1114 and/or the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (LANL 1993, 1090; 1996, LA-UR-96-726).

PRS 3-013(b) consists of floor drains in the basement of the Nevada Test Site (NTS) shop in building TA-3-38. These floor drains are located in the plasma-burning machine area, metals cutting room, and pipe fabrication shop. They may have been previously routed to the storm drain (PRS 3-013([a]). These floor drains now drain to the sanitary sewer system. PRS 3-013(b) is

discussed in detail in the RFI Work Plan for OU 1114 and/or the RFI Report for 53 Potential Release Sites in TA-3, TA-59, TA-60, and TA-61 (LANL 1993, 1090; 1996, LA-UR-96-726).

PRS 3-052(f) is an outfall northeast of building TA-3-207. The outfall, which received effluent from drains, sumps, sinks, and water fountains from several buildings at TA-3, discharges to Sandia Canyon. In addition, PCB-containing oils from the Sherwood Building, TA-3-105, may have been discharged to this outfall. PRS 3-052(f) is discussed in detail in the RFI Work Plan for OU1114 Addendum 1 (LANL 1995, 17-1275).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether the storm drain discharge at the outfall resulted in the release of contaminants to the drainage ditch (LANL 1993, 1090). Seven samples were collected from five locations at depths ranging from 0- to 8-in. Samples were submitted for analysis of VOCs, SVOCs, PCBs, and TAL metals. The data for inorganics that exceeded background UTLs and detected organics at each PRS are summarized by analyte in Table 1.3-1. Three polycyclic aromatic hydrocarbons (PAHs) were retained as COPCs; however, the detection of these PAHs is most likely a result of runoff from the parking lot next to PRSs 3-013(a,b) and 3-052(f). Therefore, PRSs 3-013(a,b) and 3-052(f) were recommended for NFA in the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726).

PRSs 3-014(a,e), WWTP Imhoff Tanks. PRSs 3-014(a,e) are the grassy areas surrounding the Imhoff tanks and other structures at the former TA-3 WWTP (Fig. 1.2-1). It is reported that dried sludge and effluent were applied to the grass around the Imhoff tanks as a soil amendor. These areas are also associated with possible spill-over from the Imhoff tanks during treatment processes. PRSs 3-014(a,e) are discussed in detail in the RFI Work Plan for OU 1114 (LANL 1993, 1090).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether any contaminants were released to the environment as a result of sludge application or tank spill-over onto the surrounding soil (LANL 1993, 1090). Twelve samples were collected from five locations around the tanks at depths ranging from 0- to 18-in. Samples were submitted for analysis of VOCs, SVOCs, pesticides/PCBs, herbicides, TAL metals, and radionuclides. The data for radionuclides and inorganics that exceeded background UTLs and detected organics at each PRS are summarized by analyte in Table 1.3-1. Only chromium was present at concentrations exceeding SAL. The conclusions of the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 indicate that the presence of chromium at 239 mg/kg should not pose an unacceptable risk given that the SALs are derived based on conservative residential exposure assumptions and this

PRS is within the primary industrial part of the Laboratory (1996, LA-UR-96-726). Therefore PRSs 3-014(a,e) were recommended for NFA (1996, LA-UR-96-726).

PRS 3-014(b2), WWTP Current Outfall. PRS 3-014(b2) is the current outfall from the TA-3 WWTP (Fig. 1.2-1). The outfall discharges to the north tributary of Sandia Canyon south of the power plant (TA-3-22). The NPDES permit number of the outfall is EPASSS01S. The outfall discharges at a rocky outcrop on the canyon edge and flows down a steep, rocky channel to the wetland area on the canyon floor. PRS 3-014(b2) is discussed in detail in the RFI Work Plan for OU 1114 (LANL 1993, 1090).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether discharge at the outfall resulted in the release of any contaminants (LANL 1993, 1090). Twelve samples were collected from four locations within the outfall channel at depths ranging from 0- to 18-in. Samples were submitted for analysis of VOCs, SVOCs, pesticides/PCBs, herbicides, TAL metals, and radionuclides. The data for radionuclides and inorganics that exceeded background UTLs and detected organics are summarized by analyte in Table 1.3-1. No chemicals were retained as COPCs by the screening assessment process. Therefore PRS 3-014(b2) was recommended for NFA in the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726).

PRS 3-014(c2), WWTP Abandoned Outfall. PRS 3-014(c2) is the abandoned outfall associated with the TA-3 WWTP (Fig. 1.2-1). It is located on the north side of the pump building (TA-3-166). The outfall discharges into an erosion channel that also serves as a storm sewer. The channel discharges to a small tributary of Sandia Canyon south of the power plant (TA-3-22). On occasion, soils within the outfall channel were cleaned out with a backhoe and the removed soil was piled onto the channel bank. The outfall was abandoned in 1985 when a chlorinator system was added to the WWTP. PRS 3-014(c2) is discussed in detail in the RFI Work Plan for OU 1114 (LANL 1993, 1090).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether discharge from the pump house overflow pipe resulted in the release of any contaminants (LANL 1993, 1090). Twenty samples were collected from nine locations down-gradient from the outfall at depths ranging from 0- to 18-in. Samples were submitted for analysis of VOCs, SVOCs, pesticides/PCBs, herbicides, TAL metals, and radionuclides. The data for radionuclides and inorganics that exceeded background UTLs and detected organics are summarized by analyte in Table 1.3-1. The screening assessment process retained seven chemicals as COPCs [benzo(a)pyrene, benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, lead cadmium, chromium, and silver]. Therefore PRS 3-014(c2) was recommended for a Phase II investigation to determine

whether a release had occurred from the newly identified outfall or sludge drying beds, to confirm the lead and PAH analytical results, to determine the extent of contamination, and to provide information for a baseline risk assessment [see the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726)].

PRSs 3-015 and 3-053, Rolling Mill Outfall. The basement area of the rolling mill building (TA-3-141), which is designated PRS 3-053, housed electrochemical and depleted uranium processing facilities (Fig. 1.2-1). Powder characterization, plasma flame spray processing, beryllium processing, and depleted uranium processing are ongoing operations. It is not known whether releases occurred through the basement floor drains formerly connected to the storm water system that leads to the PRS 3-015 outfall. PRS 3-015 is an outfall that received water from building TA-3-141. The outfall received effluent from janitor sinks and floor and roof drains until early 1993 when the lines to the outfall were decommissioned. The outfall is located northeast of building TA-3-141, outside the security fence and between the fence and the pavement. The outfall area is level and covered with grasses, forming a narrow channel that drains northeast. The outfall is permitted under NPDES with outfall number EPA04A140. Each PRS is discussed in detail in the RFI Work Plan for OU 1114 and/or the RFI Work Plan for OU 1114 Addendum 1 (LANL 1993, 1090; LANL 1995, 17-1275).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether any contaminants were released through the outfall (LANL 1993, 1090). Because PRS 3-053 was connected to the PRS 3-015 outfall, information from sampling activities at PRS 3-015 apply to PRS 3-053. Six samples were collected from five locations below the outfall from a depth of 0- to 18-in. Samples were submitted for analysis of SVOCs, TAL metals, and radionuclides. The data for radionuclides and inorganics that exceeded background UTLs and detected organics at each PRS are summarized by analyte in Table 1.3-1. The screening assessment process retained six PAHs as COPCs; however, given that PAHs are not expected to be present as a result of the processing in building TA-3-141, the detection of PAHs is consistent with impact from road runoff or the presence of asphalt in the sample. Therefore PRSs 3-015 and 3-053 were recommended for NFA in the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726).

PRS 3-036(g), Aboveground Tank. PRS 3-036(g) is an active 5 000-gal., steel, aboveground storage tank located south of building TA-3-22. The tank, installed in 1951, contains sulfuric acid used to neutralize cooling water from building TA-3-22. Secondary containment was installed around the tank after a noncompliance violation in 1990 resulted in a release to NPDES outfall 01A001.

The tank has never managed hazardous waste and has excellent integrity and secondary containment. Additionally, the New Mexico Environment Department (NMED) approved the spill report on the acid release conditionally, based upon completion of corrective actions listed in the report to the Environmental Protection Agency (EPA) (Tiedman 1991, 17-829). Investigation indicated that the release was caused primarily by operational problems and communication deficiencies. Operational and administrative changes were initiated to correct these problems and interim physical plant modifications of the neutralization system were completed. These modifications included new pH monitoring equipment and a lock on the discharge valve from the environmental tank (Sneesby 1994, 17-1159). The NMED closed out this incident after the Laboratory paid a fine (NMED 1992, 17-832). This PRS is recommended for NFA under Criterion 4 (Permit Modification, Sept. 1996).

PRS 3-036(j), Aboveground Tanks. PRS 3-036(j) consists of two 150 000-gal. diesel fuel tanks installed in 1954 as backup power for building TA-3-22. The two tanks are connected to a pump house, building TA-3-57, which then connects to building TA-3-22. The only release to the environment from these tanks occurred in 1991. An odor of natural gas was detected and analysis indicated that a fitting on a gas line needed to be replaced. The backup fuel system was brought on-line and pressurized, and JCI personnel immediately discovered a leak in the underground line connecting buildings TA-3-57 and TA-3-22. Diesel fuel from one of the tanks was discharged onto the ground and entered a storm water channel where it drained into a watercourse. JCI operators immediately discovered the spill and shut off the fuel line, ending the discharge. The fuel discharged to a small drainage to Sandia Canyon. The total amount discharged was estimated to be 100- to 200-gal. (LANL 1992, 17-834). The Laboratory's Emergency Management Office was notified of the diesel spill and subsequently notified the Department of Energy (DOE), NMED, AND EPA (LANL 1992, 17-834; Bellows 1991, 17-835).

The diesel spill was contained in the watercourse within minutes of the spill using absorbent booms and pillows. Pools of diesel fuel were removed using a wet/dry vacuum and absorbents. The removed fuel and absorbents were placed in drums and properly disposed of. Contaminated soil was removed, sampled, and properly disposed of. Contaminated rocks were cleaned with low-pressure water and any discharge associated with the cleanup was contained and properly disposed of. NPDES outfalls located downstream of the spill were controlled by rerouting or stopping their discharges to ensure that the spill was contained (NMED 1992, 17-832). The corrective action was to install a temporary fuel line until JCI designed and installed a permanent replacement (LANL 1992, 17-834). In addition, there was continuous monitoring of water flow in the canyon for a period of one year and annual leak testing for the backup fuel systems at all three

steam plants. NMED inspected the site in February 1992 and found that the corrective actions were satisfactory.

The two tanks are structurally sound and have automatic leak detection systems. In addition, no hazardous waste has been managed in either tank. The only historical release on record is the 1991 spill from the pump house line which was addressed. Because this PRS has not managed hazardous waste or constituents it is recommended for NFA under Criterion 2 (Permit Modification, Sept. 1996).

PRS 3-045(b,c), Power Plant Outfall. PRS 3-045(b) is the outfall from cooling towers TA-3-25 and TA-3-58 which serve the power plant (TA-3-22) (Fig. 1.2-1). The discharge point is identified as NPDES permitted outfall EPA01A001 and is identical to PRS 3-012(b). Cooling tower TA-3-25 was demolished in 1990, and only the concrete basin remains. Cooling tower TA-3-58 remains in operation. Effluent originates from the neutralization tank, the chlorine building, and the cooling tower, and is kept between a pH of six and nine. Storm water that collects in the concrete foundation of TA-3-25 also flows from this outfall. A one-time release of sulfuric acid was discharged in 1990.

PRS 3-045(c) is an outfall identified by NPDES permit number EPA03A027 and is located approximately 55 ft east of PRS 3-012(b). This outfall receives effluent from cooling tower TA-3-285, which serves the generators powering the Laboratory's computer system. Both outfalls may have received water that had been treated with chromates. Each PRS is discussed in detail in the RFI Work Plan for OU 1114 Addendum 1 (LANL 1995, 17-1275).

The sampling approach in the RFI Work Plan for OU 1114 Addendum 1 (LANL 1995, 17-1275) was designed to determine whether the outfall discharge resulted in the release of any contaminants (LANL 1993, 1090). Samples collected from PRS 3-012(b) apply to PRS 3-045(b,c). Eleven samples were collected from five locations below the outfall. All samples were collected from a depth of 0- to 6-in. Samples were submitted for analysis of VOCs, SVOCs, pesticides/PCBs, herbicides, TAL metals, and radionuclides. The data for radionuclides and inorganics that exceeded background UTLs and detected organics at each PRS are summarized by analyte in Table 1.3-1. The screening assessment process retained ten chemicals [PCBs, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, chromium, cadmium, lead, and silver]. Therefore PRS 3-045(b,c) is recommended for a Phase II investigation during which samples will be collected from eight additional locations (see the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726). These new samples will provide information on other possible sources for contaminants and further define the extent of contamination.

PRS 3-056(c), Transformer Storage Area PRS 3-056(c) was used from 1967 to approximately 1992 as a storage area for electrical equipment such as capacitors and transformers filled with PCB-containing oil, new and used dielectric fluids, and waste solvent (LANL 1993, 1090). Solvents were used to clean electrical equipment. The types of cleaning solvents potentially used and stored at the site include an unknown solvent from 1967 to approximately 1981 and trichloroethane from 1981 to 1990. Since 1990, a nonhazardous citrus-based solvent has been used to clean electrical equipment. Transclene®, which contained PCE, was used by an electrical equipment maintenance subcontractor to retrofill transformers in the field, and it may have been stored at the site. The subcontractor was responsible for the disposal of all waste materials from this activity; hence, no wastes were returned to the PRS 3-056(c) storage area. In 1991, approximately 1 to 2 ft of clean fill was placed on the site and surrounding area to change drainage patterns.

The PRS 3-056(c) storage area was decommissioned in 1992 (LANL 1995, 3-1232). PRS 3-056(c) is an inactive storage area located on the north side of a utilities shop, building TA-3-223 (Fig. 1.2-1). The PRS is located north and north east of building TA-3-223. A small portion of this area (located near the fence line north of the northeast corner of TA-3-223) was used as a storage area for electrical equipment with PCB-containing oil. PRS 3-059(c) is discussed in detail in the RFI Work Plan for OU 1114 (LANL 1993, 1090).

West Slope Remediation. Remedial activities were initiated in August 1995 to remove PCB-contaminated soil. As excavation of the contaminated material progressed, a 10-ft by 10-ft grid was laid across the site and samples were collected on the nodes of the grid in order to provide an organized approach to the excavation-guidance sampling. Samples were collected before excavating an area to define the lateral and vertical extent of PCB contamination and after excavating an area to assess the presence and concentrations of any remaining PCBs.

As contaminated soil was excavated and additional excavation-guidance samples were collected, the lateral extent and volume of contaminated soil were observed to be greater than expected. Ultimately, the lateral extent of soil contamination was determined to encompass an area approximately 130 ft long by 70 ft wide, which became known as the west slope. Cleanup of the west slope was completed to the proposed cleanup level of 10 mg/kg using a soil vacuuming technology in December 1995.

North Slope Remediation. A second excavation area, referred to as the "North Slope," was located on the north side of the electrical equipment storage area where the mesa edge slopes to the north. As the west slope excavation area increased in a northerly direction along the mesa edge, site characterization samples were collected from the mesa top and north slope. Analytical results of these samples revealed the presence of PCB-contaminated soil on this slope. The north slope was remediated using soil vacuuming technology. Remediation of the north slope to the proposed cleanup level was completed in January 1996.

Verification Sampling. To verify that the proposed 10 mg/kg cleanup level for PCBs had been met, a verification sample location grid was laid out on both the north and west slopes and divided into four composite zones in accordance with "Verification of PCB Spill Cleanup by Sampling and Analysis" (EPA-560/5-85-026). Samples from either nine or ten grid locations within each zone were collected and composited before submittal to a fixed laboratory for analysis of PCBs by EPA SW 846 Method 8080.

Analytical results of the composite verification samples collected on the west slope indicated that PCB concentrations in two of the four zones were less than 10 mg/kg. Analytical results for the remaining two zones suggested that the proposed 10 mg/kg cleanup level had not been statistically achieved. Additional sample material was collected at each discrete sample location in these two zones and submitted to a fixed laboratory for analysis. The analytical results indicated that 15 of the 18 sample locations had PCB concentrations below the proposed 10 mg/kg cleanup level. Two of the remaining three locations had PCBs at a concentration of 13 mg/kg. The remaining sample contained PCBs at a concentration of 34 mg/kg.

Analytical results of the composite verification samples collected on the north slope suggested that PCB concentrations in all four of the composite zones were still too high to indicate that the proposed 10 mg/kg cleanup level had been achieved. Discrete samples from each location were then analyzed to isolate those areas that exceeded 10 mg/kg. The analytical results for the discrete samples indicated that 12 of the 38 locations contained PCBs at concentrations greater than 10 mg/kg. A summary of the verification sample analytical results are presented in Table 1.3-2.

Interim measures are being taken to prevent storm water flow across the mesa, and the north and west slopes of the site by installing Curlex® erosion control blankets and asphalt berms. Measures for final corrective action are pending.

PRSs 3-059 and 3-003(n), Salvage Yard Adjacent to TA-3-271. PRS 3-059, a former salvage yard, includes storage areas north and south of building TA-3-271 (Fig. 1.2-1). LANL support contractors used PRS 3-059 as a salvage yard from the early 1960s through May 1993. Transformers, electrical equipment, batteries, and scrap metal were stored at the site pending sale or reuse. Sections of the salvage yard were paved intermittently with some sections remaining unpaved until the late 1980s. The exact dates of paving are unknown. In 1993 two storm water runoff samples were collected and analyzed for radionuclides, metals, cyanide, total phenols, VOCs, and SVOCs (LANL 1993,17-851). A review of the analytical data suggests there were no COPCs in the storm water samples (see the RFI Work Plan for OU 1114, Addendum 1, LANL 1995, 17-1275). Twelve asphalt and soil samples were collected during late 1994 and early 1995 to determine PCB concentrations for workers at the PRS. No PCB concentrations were detected in any of the samples.

The OU 1114 RFI Work Plan describes a detailed Phase I/II sampling plan for PRSs 3-053 and 3-003(n); however, these samples have not been collected (LANL 1995, 17-1275). The COPCs include PCBs, SVOCs, total petroleum hydrocarbons (TPH), and TAL metals.

PRS 60-004(f), Motor Pool Storage Pads. PRS 60-004(f) consists of two unpaved, bermed storage pads used for new product storage (Fig. 1.2-1). These pads are located southeast of the maintenance warehouse (TA-60-2). Both pads have been used to store drums of Stoddard solvent, antifreeze, motor oil, grease, transmission fluids, and window-washing fluid. The materials were dispensed directly from the storage drums on the pads. Prior to 1985, neither pad was completely bermed. The pads are discolored and a petroleum odor is evident. Several COPCs were detected in samples collected in 1990 (trichlorotrifluoroethane, methylene chloride, carbon disulfide, naphthalene, 1,3,5-trimethylbenzene). All drummed liquids were removed from the pads in 1990. PRS 60-004(f) is discussed in detail in the RFI Work Plan for OU 1114 (LANL 1993, 1090).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether the drums stored on the unpaved pads resulted in the release of contaminants (LANL 1993, 1090). Twenty six samples were collected from eight locations along the drainage channel at depths ranging from 0- to 7-ft. Samples were submitted for analysis of VOCs, SVOCs, PCBs, and TAL metals. The data for inorganics that exceeded background UTLs and detected organics are

summarized by analyte in Table 1.3-1. No chemicals were retained as COPCs by the screening assessment process. Therefore PRS 60-004(f) was recommended for NFA in the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726).

PRS 60-007(b), Motor Pool Drainage Areas. PRS 60-007(b) is a storm drainage ditch located north of the motor pool building (TA-60-1) (Fig. 1.2-1). The ditch extends approximately 600 ft from a paved area directly north of building TA-60-1 to the bottom of Sandia Canyon. Two parking lots located east of building TA-60-1 drain to a ditch on the east that joins PRS 60-007(b). There were several potential sources of contamination to PRS 60-007(b), including a steam-cleaning pad that drained to the ditch, a used-oil storage tank that is know to have had several spills, and an oil/water separator that periodically drained to the ditch. Another source of possible contamination was PCB equipment stored on the asphalt area east of building TA-60-1. The area of the ditch visibly affected by these sources was remediated in 1986 by removing the stained soil down to the bedrock channel of the ditch. PRS 60-007(b) is discussed in detail in the RFI Work Plan for OU 1114 (LANL 1993, 1090).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether contamination remained in the sediments of PRS 60-007(b) after the soil removal in 1986 (LANL 1993, 1090). Six samples were collected from four locations along the drainage channel at depths ranging from 0- to 18-in. Samples were submitted for analysis of VOCs, SVOCs, PCBs, and TAL metals. The data for inorganics that exceeded background UTLs and detected organics are summarized by analyte in Table 1.3-1. Samples were not analyzed for TPH because TPH is not a RCRA-regulated waste. No chemicals were retained as COPCs by the screening assessment process. Therefore PRS 60-004(f) was recommended for NFA in the RFI Report for 53 PRSs in TA-3, TA-59, TA-60, and TA-61 (1996, LA-UR-96-726).

PRS 61-002, Radio Repair Shop PCB Storage. PRS 61-002 is a storage area located on East Jemez Road near the Radio Repair Shop (TA-61-23) (Fig. 1.2-1). The area was originally unpaved and was used as a storage yard for PCB-containing drums and equipment; storage was discontinued in 1985. In 1986, surface soil samples were collected and analyzed for PCBs. The results indicated PCB concentrations up to 691 mg/kg. The area was then excavated to a depth of at least 10-in. and resampled. The results of the second sampling effort indicated that the PCB concentrations had decreased to a maximum of 51.3 mg/kg. The area was then covered with clean fill and asphalted. After the area was asphalted, it was again used to store PCB-containing drums and equipment for a period of time. This practice has been discontinued.

PRS 61-002 includes the area down-gradient of the current asphalted area. This area may have been affected by sediments carried off site prior to asphalt application. This area is currently part of

the Los Alamos County Landfill and is used for employee parking and equipment storage. PRS 61-002 is discussed in detail in the RFI Work Plan for OU 1114 (LANL 1993, 1090).

The sampling approach in the RFI Work Plan for OU 1114 was designed to determine whether PCBs were present in stains on the asphalt or in the surface soils down-gradient from PRS 61-002 (LANL 1993, 1090). Sixteen samples were collected from fourteen locations at depths ranging from 0- to 6-in. Samples were submitted for analysis of VOCs, SVOCs, PCBs, and TAL metals. The data for inorganics that exceeded background UTLs and detected organics are summarized by analyte in Table 1.3-1. Only PCBs were present at concentrations exceeding SALs, and the extent of contamination is not defined. Therefore, a Phase II investigation is recommended at PRS 61-002 during which samples will be collected from locations along the southern edge of the PRS (1996, LA-UR-96-726). Additional data will confirm the PCB concentrations and determine the extent of contamination. The data will also provide additional information for a baseline risk assessment for PCBs.

Streambed Sediment Samples. Three sediment samples were collected during September 1995 in the streambed upstream from the debris dam, and four samples were collected during October 1995 downstream from the debris dam in the streambed of the wetland. All samples except one indicated no detectable PCBs. The sample collected approximately 50 ft downstream from the debris dam culvert on the south side of the stream bank contained a total-PCB concentration of 3.3 mg/kg. Analytical results are presented in Table 1.3-3. Sampling locations are presented in Fig. 1.3-1.

TABLE 1.3-3

TRIBUTARY AND WETLAND SEDIMENT SAMPLES RESULTS

SAMPLE DATE	SAMPLE NUMBER	TOTAL PCB CONCENTRATION (mg/kg)	LOCATION
9/5/95	0103-95-0333	<0.10	In streambed, 40 ft upstream of steam lines and west of PRS 3-056(c).
9/5/95	0103-95-0334	<0.10	In streambed, 100 ft upstream of sample 0103-95-0333.
9/5/95	0103-95-0335	<0.10	In streambed, 65 ft downstream of sample 0103-95-0333.
10/11/95	0103-95-0725	<0.10	Collected at west edge of bar, 20 ft downstream from debris dam culvert.
10/11/95	0103-95-0726	<0.10	Collected in point bar, 50 ft downstream of debris dam culvert along north bank.
10/11/95	0103-95-0727	3.3	Collected from south bank across from sample 0103-95-0726.
10/11/95	0103-95-0728	<0.10	Collected from south bank, 70 ft downstream of debris dam culvert.

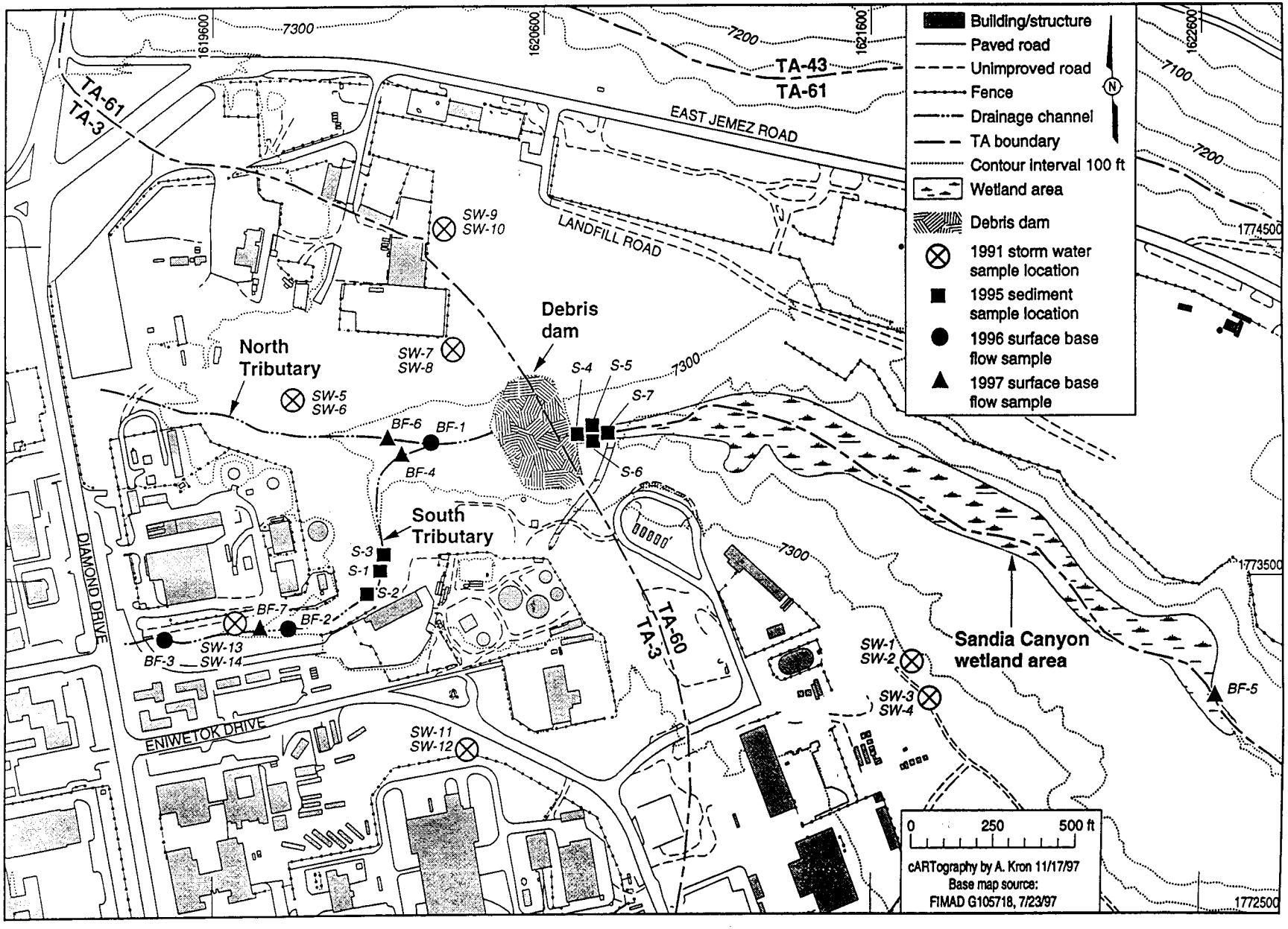


Fig. 1.3-1 Approximate locations of sediment, storm water, and surface base flow samples.

Storm water and Surface Water Base Flow Samples. In August 1991, LANL's Environment, Safety, and Health (ESH) Division **What group title?** (Group19) collected storm water samples from storm drains leading into Sandia Canyon. Samples were analyzed for radionuclides, inorganics, VOCs, SVOCs, pesticides, and PCBs. The analytical data are summarized in Table 1.3-4. Sampling locations are illustrated in Fig.1.3-1.

In March 1997, LANL ESH-19 and ER Project representatives collected four surface water base-flow samples at various locations both upstream and downstream from the debris dam in Upper Sandia Canyon. Samples were analyzed for select metals and PCBs. The analytical data are presented in Table 1.3-4. Sampling locations are illustrated in Fig. 1.3-1.

Los Alamos County Landfill. Another potential source of contaminants for the wetland is PRS 61-005, the Los Alamos County Landfill. Samples from the landfill sediments along the north side of Sandia Canyon have not been collected and analyzed.

TABLE 1.3-4

SUMMARY OF WATER, BASEFLOW, AND STORMWATER SAMPLES ANALYTICAL DATA FOR UPPER SANDIA CANYON

ASSOCIATED PRS	LOCATION DESCRIPTION	SAMPLE ID	SAMPLE COLLECTION DATE	VOCS (ug/L)	SVOCS (ug/L)	PCBS (ug/L)	INORGANICS (mg/L)	RADIONUCLIDES (pCi/L)
NA[a]	Below 3-056(c) and debris dam	BF-1 (filtered sample)	June 1996	NR[b]	NR	ND[c] in water; 5.41 total PCBs in sediment	NR	NR
NA	Upstream of 3-056(c) and debris dam	BF-2 (filtered sample)	June 1996	NR	NR	ND in water; 3.16 total PCBs in sediment	NR	NR
NA	Upstream of TA-3 power plant	BF-3 (filtered sample)	June 1996	NR	NR	ND in water; 6.33 total PCBs in sediment	NR	NR
NA	Below 3-056(c) in southern tributary	BF-4[d]	March 14, 1997	NR	NR	PCB-1260=0.22	Barium=0.03	NR
NA	Sandia Wetland (east end)	BF-5[d]	March 14, 1997	NR	NR	ND	Barium=0.03 Chromium=0.02	NR
NA	Northern Sandia tributary	BF-6[d]	March 14, 1997	NR	NR	ND	Barium=0.13	NR
NA	Above 3-056(c) in southern tributary	BF-7[d]	March 14, 1997	NR	NR	ND	Barium=0.05	NR
60-007(b)	Above 3-056(c) in southern tributary	SW-1	August 1, 1991	ND	ND	ND	Oil & Grease=1.0 Chromium=0.025 Copper=0.039 Lead=0.047 Zinc=0.31	Gross Alpha=8.4 Gross Beta=16 Radium 226=0.4 Radium 228=1.1
60-007(b)	TA-60-1 (motorpool), north composite sample	SW-2[d]	August 1, 1991	ND	ND	ND	Arsenic=0.005 Chromium=0.014 Copper=0.023 Lead=0.06 Zinc=0.28	Gross Alpha=5.7 Gross Beta=8.5 Radium 226=1.2 Radium 228=2.3
60-004(f)	TA-60-2 (warehouse), south grab sample	SW-3[d]	August 1, 1991	ND	ND	ND	Chromium=0.011 Copper=0.029 Lead=0.018 Zinc=0.12	Gross Alpha=2.5 Gross Beta=9.8 Radium 226=0.1 Radium 228=3.2
60-004(f)	TA-60-2 (Warehouse), south composite sample	SW-4[d]	August 1, 1991	ND	ND	ND	Chromium=0.017 Copper=0.028 Lead=0.035 Zinc=0.2	Gross Alpha=4.7 Gross Beta=5.5 Radium 226=0.4 Radium 228=0.6

NA	TA-3-1996 (asphalt plant culvert), composite sample	SW-5[d,e]	August 2, 1991	ND	ND	Heptachlor epoxide=0.11	Copper=0.027 Lead=0.029 Zinc=0.15	Gross Alpha=3.5 Gross Beta=7.9
NA	TA-3-1996 (asphalt plant culvert), grab samle	SW-6[d,i]	August 2, 1991	ND	ND	ND	Copper=0.027 Lead=0.017 Zinc=0.26	Gross Alpha=4.0 Gross Beta=17 Radium 228=1.5
3-059	TA-3-271-S (salvage yard), grab sample	SW-7[d]	September 4, 1991	ND	bis(2-ethylhexylphthalate)=11	ND	Oil & Grease=3.8 Cadmium=0.041 Chromium=0.017 Copper=0.16 Iron=2.7 Lead=0.14 Mercury=0.00036 Zinc=0.79	Gross Alpha=1.7 Gross Beta=6.4
3-059	TA-3-271-S (salvage yard), composite sample	SW-8[d]	September 4, 1991	ND	bis(2-ethylhexylphthalate)=17	ND	Cadmium=0.028 Chromium=0.014 Copper=0.11 Iron=2.8 Lead=0.15 Mercury=0.00034 Zinc=0.55	Gross Alpha=2.1 Gross Beta=8.3 Radium 226=0.3
3-059	TA-3-271-E (salvage yard), grab sample	SW-9[d]	August 26, 1991	ND	ND	ND	Oil & Grease=1.1 Arsenic=0.0065 Cadmium=0.0055 Chromium=0.024 Copper=0.046 Iron=22.6 Lead=0.26 Zinc=0.75	Gross Alpha=7.6 Gross Beta=18 Radium 226=0.6
3-059	TA-3-271-E (salvage yard), composite sample	SW-10[d]	August 26, 1991	ND	ND	ND	Arsenic=0.012 Beryllium=0.0028 Chromium=0.036 Copper=0.076 Iron=41.6 Lead=0.15 Mercury=0.00025 Zinc=0.39	Gross Alpha=11 Gross Beta=13 Radium 226=1.5 Radium 228=0.2
NA	TA-3-66-N (Sigma Foundry), north grab sample	SW-11[d]	August 26, 1991	ND	ND	ND	Beryllium=0.003 Chromium=0.03 Copper=0.055 Iron=29.4 Lead=0.079 Mercury=0.0021 Zinc=0.53	Gross Alpha=21 Gross Beta=20 Radium 226=0.4 Radium 228=0.4

NA	TA-3-66-N (Sigma Foundry), north composite sample	SW-12[d]	August 26, 1991	Methylene chloride=11	ND	ND	Chromium=0.011 Copper=0.025 Iron=12.5 Lead=0.028 Mercury=0.0024 Zinc=0.14	Gross Alpha=7.8 Gross Beta=10 Radium 226=0.8
NA	TA-3-22, grab sample	SW-13[d]	August 26, 1991	Methylene chloride=9.0	ND	ND	Oil & Grease=2.4; Chromium=0.01 Copper=0.027 Iron=7.1 Lead=0.018 Zinc=0.12	Gross Alpha=2.2 Gross Beta=10
NA	TA-3-22, composite sample	SW-14[d]	August 26, 1991	Methylene chloride=100	ND	ND	Chromium=0.0 Copper=0.02 Iron=4.4 Lead=0.011 Zinc=0.099	Gross Alpha=1.4 Gross Beta=3.1

[a] NA = Not available.
[a] NR = Not requested.
[c] ND = Not detected.
[d] Information is from ESH-18. Samples were not filtered.
[e] Sample is also listed as TA-3-1966 comp.
[f] Sample is also listed as TA-3 1966 grab.

Biological Investigations. Studies of water quality and aquatic invertebrates have been conducted in Upper Sandia Canyon since 1990. Three locations have been sampled: two in the wetland and one down-gradient from the wetland (Fig. 1.3-1). These reports have shown that water quality parameters (dissolved oxygen, pH, temperature, and conductivity) are within ranges that do not cause gross impacts to aquatic invertebrates. However, the number of aquatic invertebrates is lower at the two wetland locations compared to the downstream location. It was suggested that lower abundance of aquatic invertebrates resulted from several factors, including erosion from the Los Alamos County Landfill, channelization of water flow in the wetland, lack of acceptable substrates for aquatic invertebrates, and Laboratory releases from PRSs (see section 1.3 for more details) (Cross and Nottelman 1996, ????). More information on the aquatic invertebrate and water quality investigations can be found in the following reports: Bennett (1994, ????), Cross (1994, ????), Cross (1995, ????), and Cross and Nottelman (1996, ????).

Studies of small mammals have been conducted in Upper Sandia Canyon since 1994. These studies determined the presence and density of various small mammals in the wetland and an area down-canyon from the wetland. These studies used three live-trapping arrays (webs) at locations similar to the aquatic invertebrate sampling locations. Two locations were within the wetland and the third was down-canyon from the wetland (Fig. 1.3-2). These data show that small mammal density is higher in the wetland (where average density was 116 animals per hectare) than in the downstream location (where average density was 24 animals per hectare) (Bennett and Biggs 1996, ????). Species composition also differed. Shrews and voles were found in the wetland but not in the downstream location. In addition to the published report on the 1994 and 1995 Sandia Canyon small mammal data, 64 samples of animal carcasses were also submitted for PCB analysis. Preliminary analytical data indicated nine of 30 animal samples had detectable quantities of PCBs from the 1995 sampling (K. Bennett, personal communication, 1997). Preliminary analytical data from the 1996 sampling indicated that 16 of 34 animal samples had detectable quantities of PCBs (K. Bennett, personal communication, 1997). Fig. 1.3-3 shows the location of the animal trapping webs. The locations where small mammals containing PCBs were collected are shown on Fig. 1.3-5. The range of PCB concentrations detected in small mammals for the 1995 and 1996 sampling activities are presented in Table 1.3-5. These preliminary results suggest that PCBs are being taken up into the Sandia Canyon food web, however, area baseline data for PCBs in small mammals is not available for comparison. It should also be noted that the small mammal studies suggest that the wetland harbors more small mammals, and gross population characteristics such as mean body size do not show any differences between trapping grids.

These biological investigations imply that pathways are significant for ecological risk assessment. The existing aquatic data for Upper Sandia Canyon suggest that physical impacts of erosion and

lack of habitat for aquatic invertebrates significantly reduce their density in the wetland. Thus, the aquatic pathway for contaminant uptake from wetland sediments is currently limited by the low density of aquatic invertebrates. However, elevated small-mammal density in the wetland represents a significant food resource for higher trophic levels. The detection of PCBs in these animals seems to suggest that bioconcentration from small mammals to carnivores represents a significant pathway that should be evaluated. At this point, neither the aquatic nor terrestrial pathway can be entirely eliminated from further assessment.

TABLE 1.3-5

SUMMARY OF PRELIMINARY PCB CONCENTRATIONS IN TRAPPED SMALL MAMMALS FROM 1995 AND 1996

GROUP	MAMMAL COUNT	MINIMUM PCB CONCENTRATION (mg/kg)	MAXIMUM PCB CONCENTRATION (mg/kg)
Mouse	16	140	920
Vole	45	40	2 500
Shrew	3[a]	8 400	19 000

[a] Composite sample of five animals (K. Bennett, personal communication, 1997).

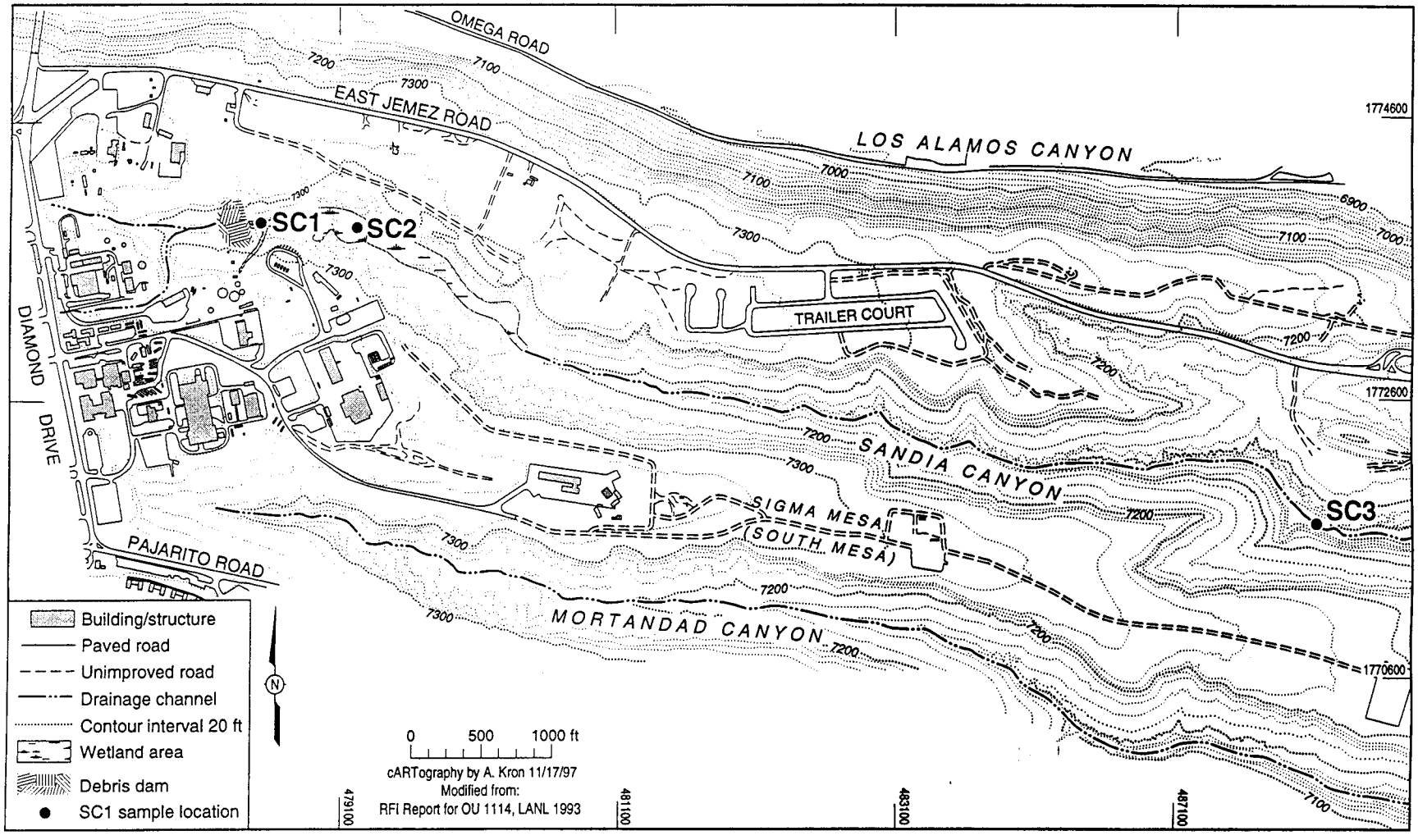


Fig. 1.3-2 Locations of the 1995 water quality and invertebrate sampling stations within Sandia Canyon.

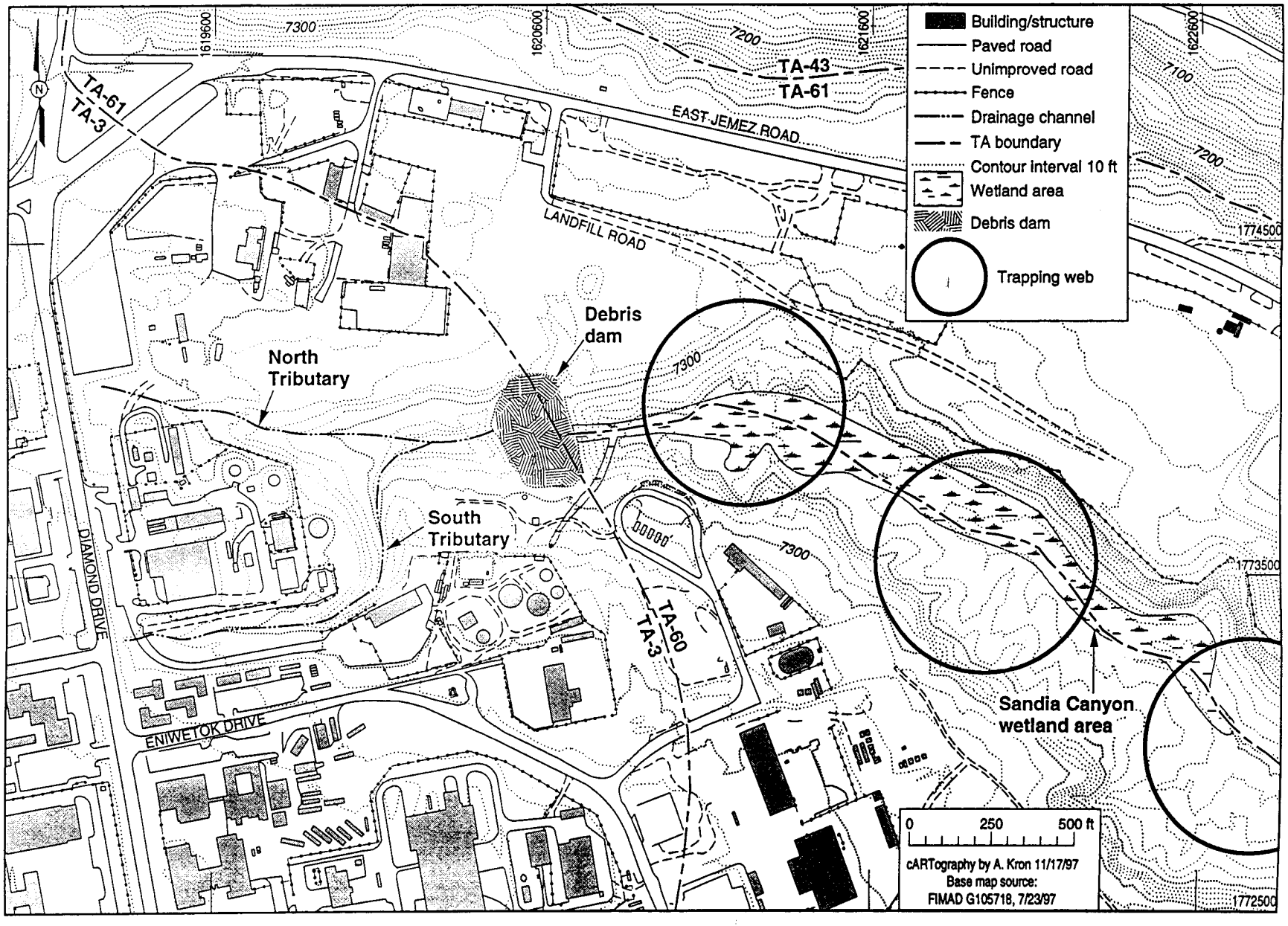


Fig. 1.3-3 Locations of live trapping webs for small mammals within Sandia Canyon (from Bennett and Biggs 1996).

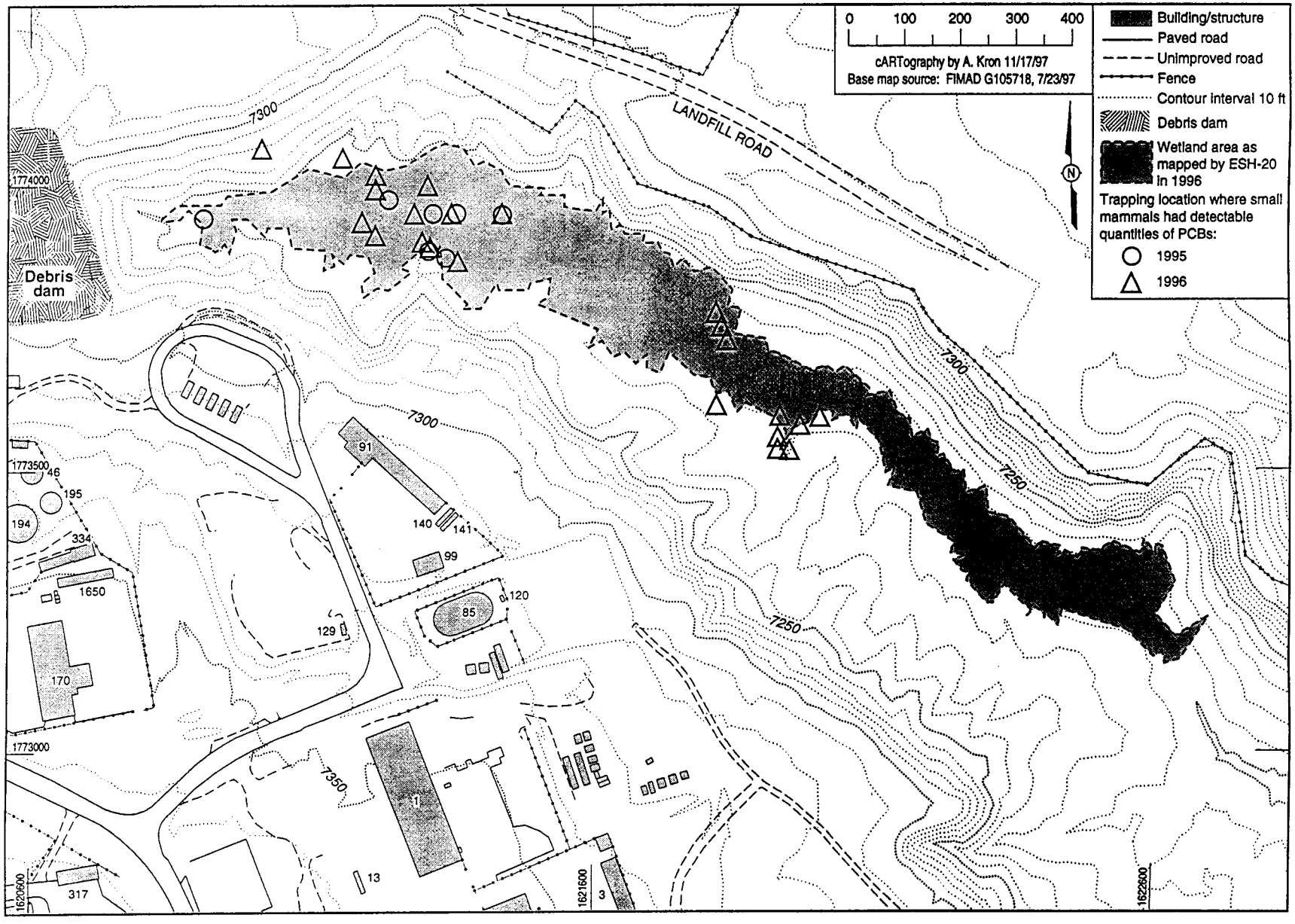


Fig. 1.3-4 Trapping locations where small mammals had detectable quantities of PCBs in 1995 and 1996.

1.4 Regulatory Context

This investigation, in coordination with other investigations by the LANL ER Canyons Investigation Team, fulfills part of the Hazardous and Solid Waste Amendments (HSWA) requirements described in Section 1.5 of the HSWA Module (EPA 1990, 1585). These requirements call for one or more task/site work plans for studies to evaluate the potential impact of contaminants from PRSs on LANL's 19 major drainage areas and canyon systems. The work plans must address whether contamination is present, the potential for movement or transport of contaminants to or within canyon watersheds, and the potential for interaction with alluvial aquifers and the main aquifer. The work plans must also evaluate the potential for off-site exposure through pathways including groundwater, and the possible impact on the Rio Grande. The investigation described in this site work/sampling plan will integrate with the Canyons Investigation Team's ongoing assessments (LANL 1995, 01-0049).

Remediation action levels for PCBs will be developed according to TSCA regulations. Relevant regulations include the PCB spill policy (CFR 761 §120,125) and the EPA Region 6 PCB policy (Reference). **Need confirmation of this regulatory information from the regulations focus people.** TSCA allows for site-specific risk assessments to determine potential impacts of PCB releases. This provision of TSCA drives the ecological and human health risk assessment of Upper Sandia Canyon.

Values reported for surface water collected during this investigation will be compared to NMED Water Quality Control Commission (WQCC) water standards for wildlife (State of New Mexico 1995, 1267). This is a narrative standard that specifies that no discharge "... shall contain any substance, including, but not limited to selenium, DDT, PCBs and dioxin, at a level which, when added to background concentrations, can lead to bioaccumulation to toxic levels in any animal species." For PCBs, the wildlife standard has been interpreted as a value of 0.008 µg/L in unfiltered samples, which is lower than the standard PCB water detection limit. Thus, the analytical quantitation limit of 1 µg/L total PCBs is the nominal quantitative wildlife protection standard (Yanicak, DOE Oversight Bureau, Sept. 1997).

Implementation of the sampling and analysis plan will be compliant with requirements developed by the Army Corps of Engineers for intrusive activities in wetlands (Department of Defense, Department of the Army Corps of Engineers, 33 CFR 325).

2.0 SAP DESIGN

2.1 Project Overview

This investigation will follow the general technical approach and objectives for canyons investigations outlined in the Core Document for Canyons Investigations (LA-UR-96-2083, April 1997). The primary exception to this is that, for Upper Sandia Canyon, ecological risk is considered to be potentially more relevant to risk management and potential remediation requirements than human health risk. One reason to emphasize ecological risk is that PCBs are bioaccumulating contaminants, particularly in aquatic environments. A second reason is that the ecological risk potential for PRS 3-056(c) appears to be greater than the potential for human health risks, suggesting that an ecological risk assessment would be more conservative for this site than a human health risk assessment. A final reason is that many of the exposure pathways for human health are not complete, especially if the bulk of the inventory resides in buried sediments. In conclusion, the accuracy of contaminant inventory estimates and resulting ecological risk will be used as a framework for determining the type and number of samples needed in this investigation. This information is also expected to be adequate for estimating human health risk and the likelihood of future contaminant transport.

This investigation will include the following phases: (1) geomorphic mapping of canyon bottom sediments with an emphasis on defining the extent of sediment packages most likely to contain contaminants; (2) collection of sediment samples from numerous locations for analysis of indicator constituents (i.e., constituents such as PCBs and metals that are expected to be the most common contaminants in Upper Sandia Canyon and that are likely collocated with other potential contaminants) to confirm the geomorphic mapping and the location of contaminated sediments; (3) collection of sediment samples for an additional suite of analyses from locations that better define the contaminant inventory in specific geomorphic units; (4) collection of surface water samples for analysis of indicator constituents to quantify transport of contaminants in the aqueous phase and as suspended solids, and, if needed, (5) collection of biota samples to assess contaminant uptake after contaminant inventory has been established. It is not expected that any additional samples from PRSs or PCB source areas will be needed to meet the objectives of this investigation.

2.2 Design Assumptions

Upper Sandia Canyon will be considered as two primary reaches that will be treated separately for sampling, analysis, and risk assessment. Each reach has a distinct physiographic and geomorphic setting consisting of an active channel and buried channel deposits, as well as active and abandoned floodplain surfaces and deposits. These geomorphic features provide evidence of processes that result in storage and/or transport of contaminants. This investigation will focus on sediments that were deposited after Laboratory operations were underway within the canyon watershed. The two Upper Sandia Canyon reaches are described in Section 2.3.

The initial design assumption is that releases from PRS 3-056(c), mainly PCBs, represent the main contaminant source in Upper Sandia Canyon. In addition, metals associated with potential releases from other PRSs in the Upper Sandia Canyon watershed are also a concern. Therefore, PCBs and metals will be used as indicator constituents in this investigation. A total of 60 samples will be collected for analysis of these indicator constituents. The proposed indicator suite analyses are further discussed in Section 2.5.

The design of this investigation is based on the assumption that collecting samples initially for an indicator suite of analyses will help determine which geomorphic unit(s) and sediment packages warrant further assessment for contaminant inventory and ecological risk considerations. Based on the results from samples analyzed for the indicator suite, a subset of the sampled locations will be submitted for additional analyses. These additional analyses are described in Section 2.5.

Data from analysis of indicator and additional constituents will be used to help locate areas (receptor home ranges) for biological measurements and sampling. The assumption is that raptors will be **assessment** endpoints for this ecological risk assessment, where small mammals and omnivorous birds will serve as **measurement** endpoints. **We should clarify the distinction.** Biological parameters that will be measured include reproductive success, biomarkers, contaminant body burdens, and aquatic insect diversity/abundance.

A geomorphic understanding of the wetland is necessary for this investigation to help identify areas of historic sediment accumulation. The preliminary geomorphic mapping will be based on aerial photos and canyon walkovers. A schematic diagram showing the types of sedimentary packages likely to contain contaminants is shown as Fig. 2.2-1.

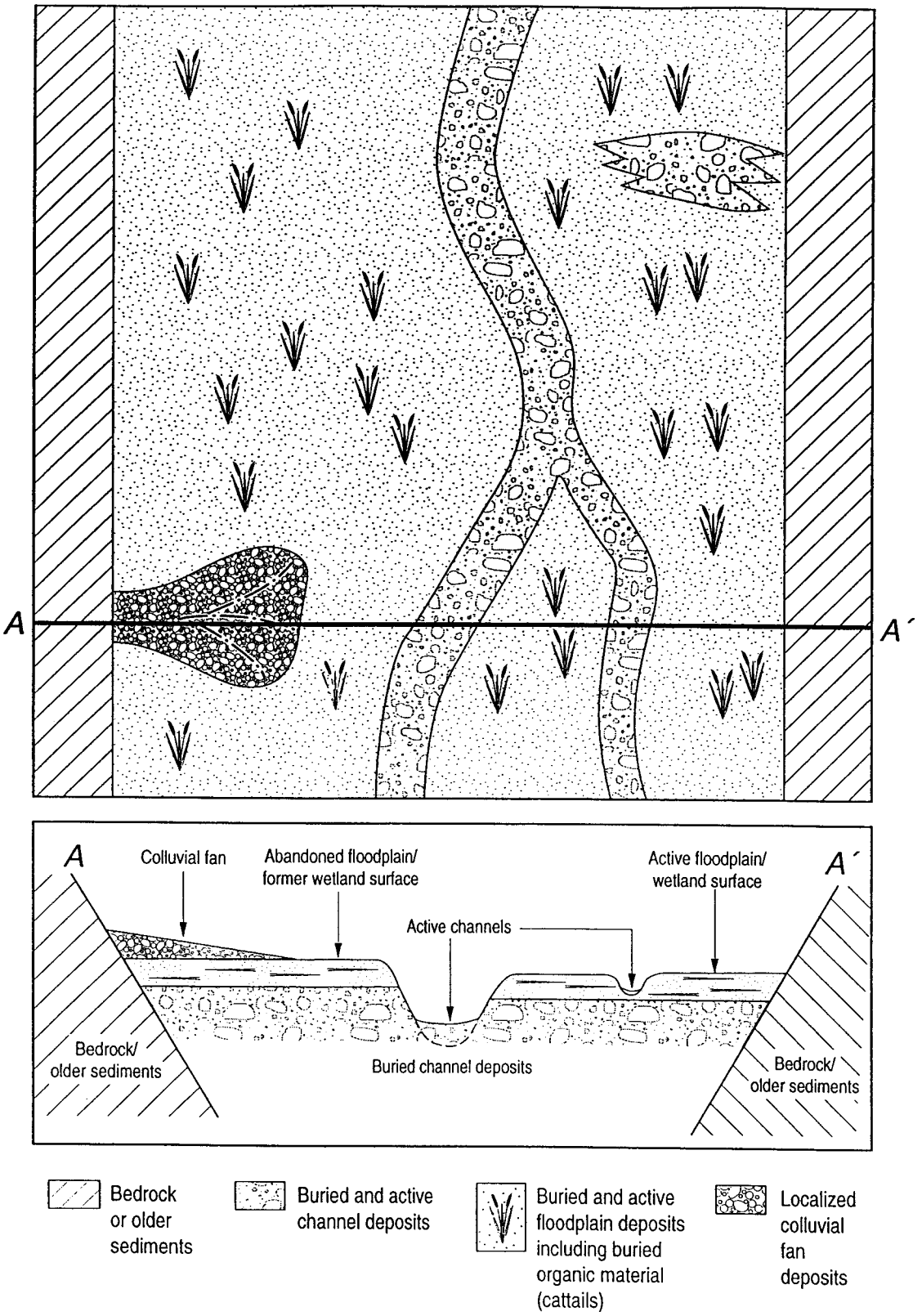


Fig. 2.2-1 Schematic map and cross section of Sandia Canyon floor showing generalized geomorphic units and sedimentary deposits likely to contain contamination.

The geomorphic mapping will identify sediment packages of different ages and depositional settings (e.g., channel, floodplain), which may contain significantly different concentrations of contaminants based on variability in the release histories of PRSs in the Upper Sandia Canyon watershed and the affinity of particular contaminants for varying sediment properties. In addition to variations in contaminant concentration in deposits of different age, it is expected that the total organic carbon content and grain size will also explain some of the variability in contaminant concentration. Total organic carbon and pH are also important for understanding mobility and bioavailability of contaminants and therefore for assessing ecological risk.

2.3 Sandia Canyon Reach Descriptions

Upper Sandia Canyon will be considered as two primary reaches that will be treated as distinct areas for characterization and risk assessment (Fig. 2.3-1). Each reach has a distinct physiographic and geomorphic setting. This setting may consist of an active channel and buried channel deposits, and active and abandoned floodplain surfaces and deposits. These features provide evidence of processes that result in storage and/or transport of contaminants. The Upper Sandia Canyon investigation will focus on sediments that were deposited after Laboratory operations were underway within the canyon watershed. The two Upper Sandia Canyon reaches are described below.

Reach S-1. Reach S-1 comprises the section of Upper Sandia Canyon from Diamond Drive to the west end of the large debris dam across Sandia Canyon. This reach consists of the two tributary canyons, Reaches S-1 North and S-1 South, that comprise the head of Upper Sandia Canyon (Fig. 2.3-2). Both tributaries in Reach S-1 are characterized by a narrow canyon with minimal sediment storage largely confined to a narrow zone along the active channel. Most of the PRSs that are potential contaminant contributors to Sandia Canyon are situated within Reach S-1.

Reach S-2. Reach S-2 comprises the section of Upper Sandia Canyon from the east end of the debris dam to the toe of the wetland area approximately 2 275 ft down-canyon from the debris dam (Fig. 2.3-3). Reach S-2 is characterized by a wide canyon with a low-gradient valley floor. Several channels are present through the reach, with most surface water flow occurring through a single, deeply incised channel. Initial observations suggest that much of the sediment in the wetland has been derived from fill material and/or road aggregate from surrounding TA-3, TA-61 (the Los Alamos County Landfill), and TA-60. Several PRSs [3-014(b2), 60-007(b), 60-004(f)] could contribute contamination to Reach S-2.

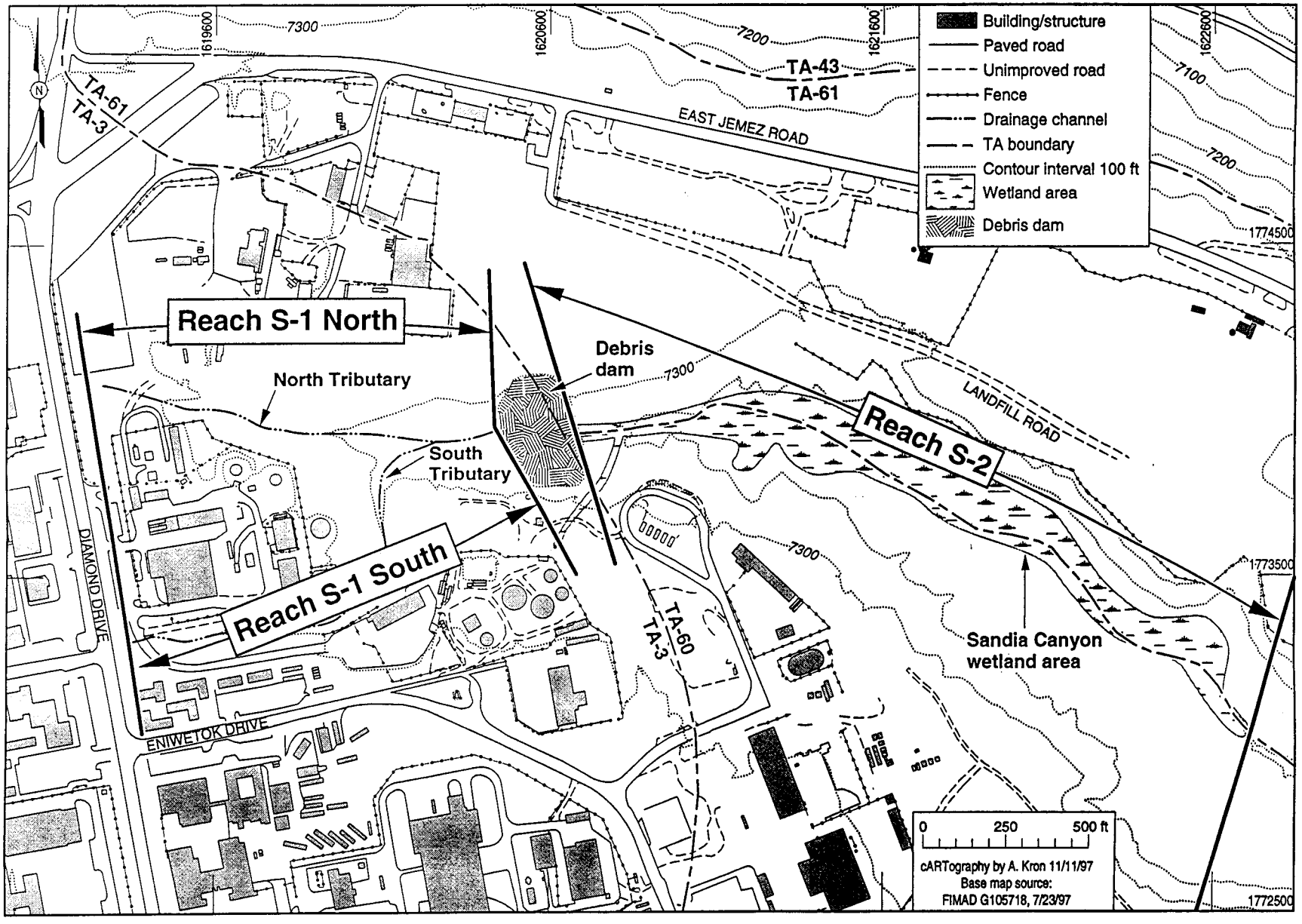
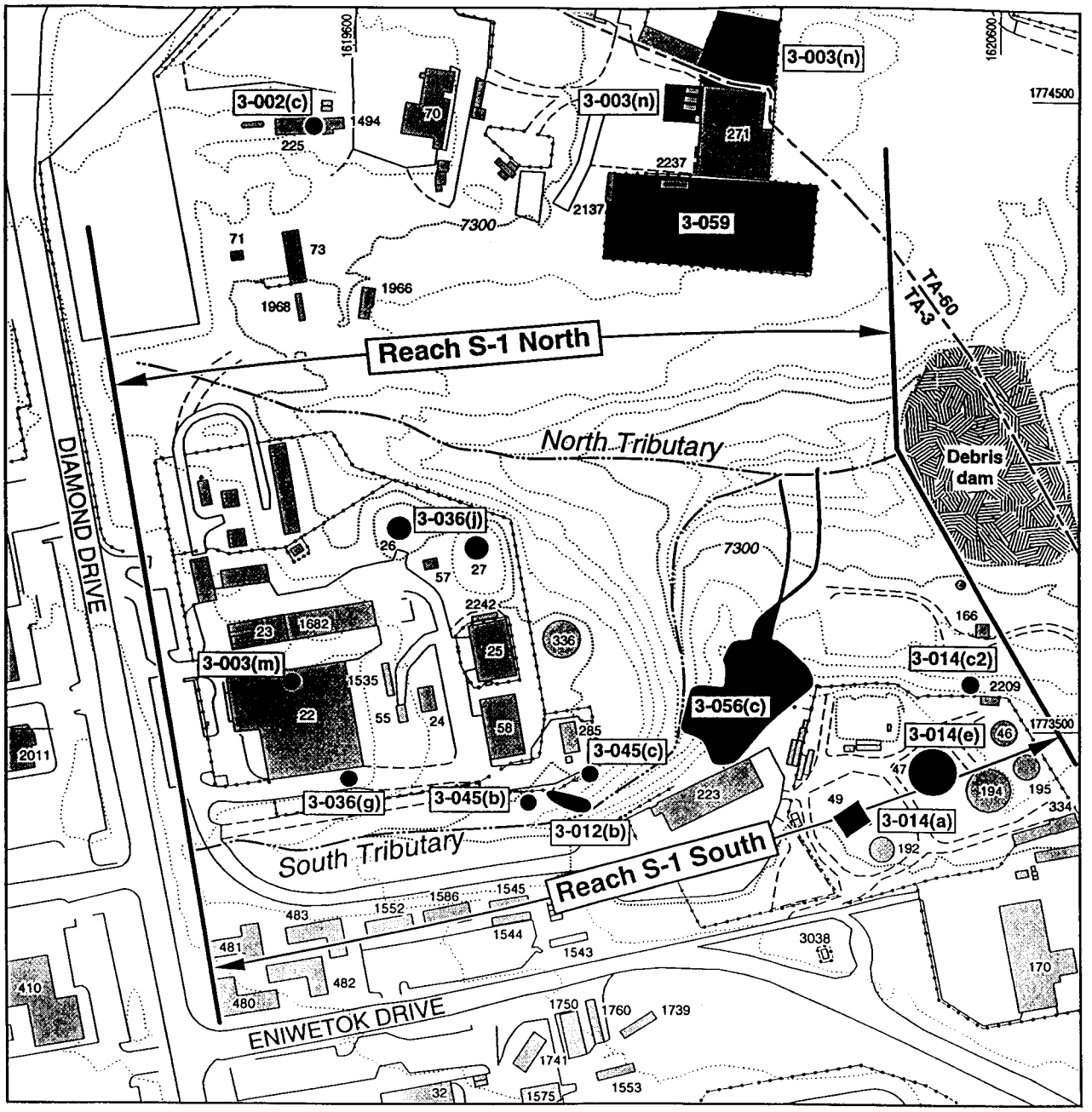


Fig. 2.3-1 Sandia Canyon Reaches.



PRS location
Building/structure
Paved road
Unimproved road
Fence
Drainage channel
TA boundary
Contour interval 10 ft
Debris dam

0 100 200 300 400

cARTography by A. Kron 11/11/97
Base map source: FIMAD G105718, 7/23/97

Fig. 2.3-2 Sandia Canyon Reaches S-1 North and S-1 South.

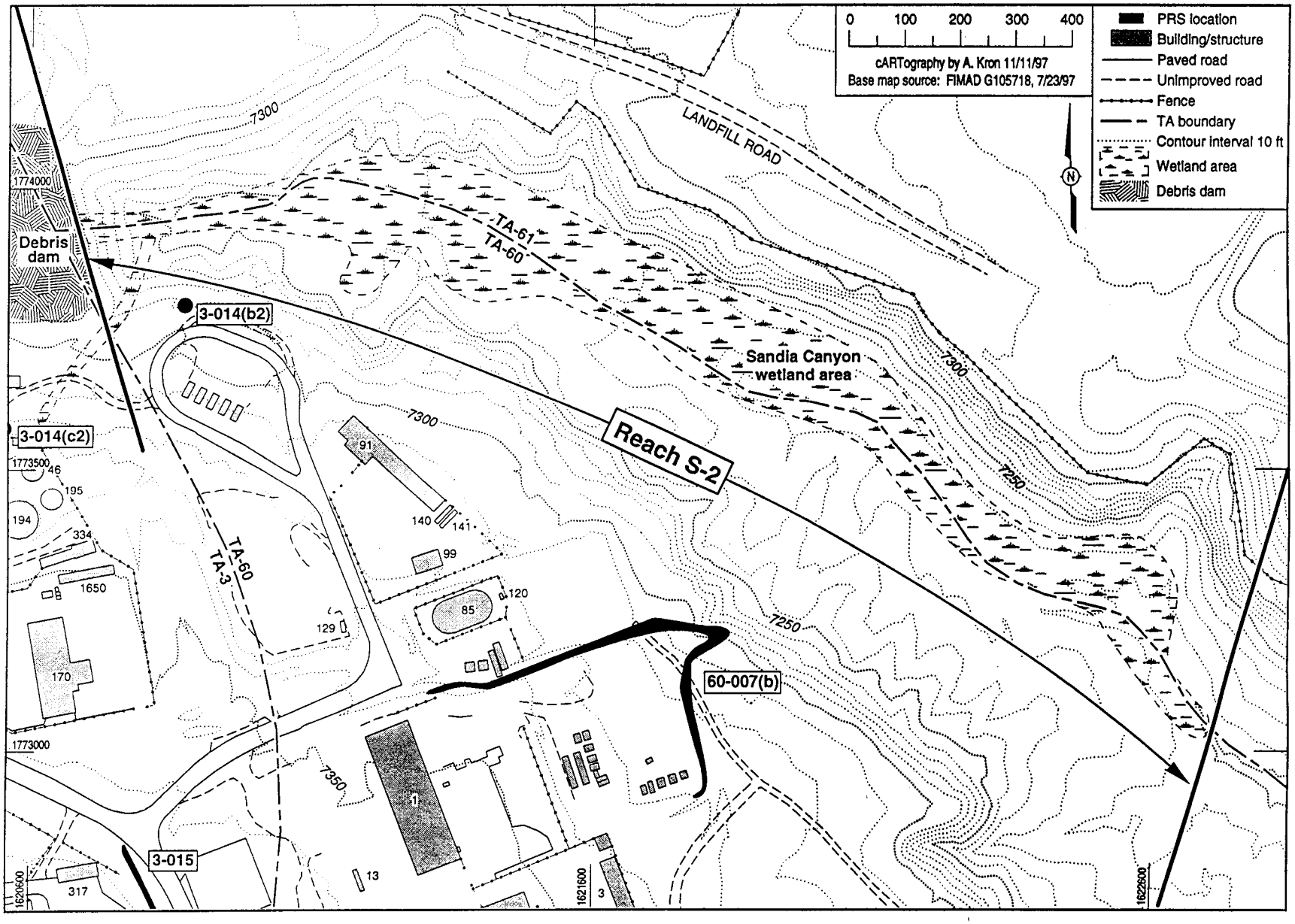


Fig. 2.3-3 Sandia Canyon Reach S-2.

2.4 Geomorphic Units and Sedimentary Deposits in Sandia Canyon

The following is a description of the major geomorphic units and sedimentary deposits that are expected to contain contaminants in Sandia Canyon. Four primary geomorphic units/sedimentary deposits may be present within each reach: (1) active channel sediments, (2) buried channel deposits, (3) active and buried flood-plain deposits (current wetland surface), and (4) buried or abandoned floodplain deposits.

Active Channel Deposits. An active channel contains either intermittent or continuous flow. Sediment in these channels is predominantly coarse sand and gravel. Because heavy metals and most radionuclides discharged from the Laboratory preferentially adsorb to finer-sized sediment particles, and because the active channel sediments are young relative to the period of contaminated discharges, it is expected that active channel sediments will contain the lowest concentrations of contaminants. The sediments in the active channels are the most likely to be transported downstream, both by the relatively frequent storm water discharges and by occasional large floods in the canyons.

Buried Channel Deposits. Buried channel deposits contain coarse channel sediment (deposited when the channels were active), and often fine sediment (deposited by flooding after the channel was abandoned or by deposition of fines during waning storm water flow). Contaminant concentrations are expected to vary, depending both on the grain size and the age of the deposit, as contaminant input will have varied over time. Available data suggest that buried channel deposits may contain significant concentrations of contaminants that are available for transport farther downstream either by large floods or by lateral erosion of the stream bank.

Active and Buried Flood Plain Deposits. Flood plains are usually located adjacent to stream channels and are often characterized by buried coarse-grained channel deposits overlain by fine-grained sediment deposited from the suspended load of overbank floodwater. In Sandia Canyon these geomorphic units and deposits may also contain dense cat tail growth. Because heavy metals, organic constituents, and most radionuclides preferentially adsorb onto the fine-grained sediment, the contaminant concentrations may be highest in sediments within the flood plain deposits. The contaminant concentrations may vary with the age of the deposit depending on contaminant release history. The sediment in the flood plains may have the longest residence times in the canyons because it probably moves little until mobilized by lateral erosion of the stream bank.

Identifying the historic flood plains will serve to focus the geomorphic surveys within each reach. Boundaries of geomorphic units are commonly marked by distinct topographic breaks, although in

places such boundaries may be gradual and more difficult to delineate. Direct visual observation of partially buried objects (e.g. young, live ponderosa pine trees) and debris, especially debris that can be linked to Laboratory activities (e.g., road aggregate containing quartzite cobbles), provide conclusive evidence of post-1942 (i.e. Laboratory-related) sediment deposition and, therefore, the age of some geomorphic units. Further evidence of the age of geomorphic units can be obtained by observing the nature and age of vegetation in different areas of the reach, such as whether the bases of trees are buried by sediment. Flood debris, such as driftwood, may provide additional evidence of the extent of historic flooding and the distribution of overbank sediment deposition.

2.5 Sediment Investigation

This section discusses the design of the sediment investigation of Sandia Canyon. The two Sandia Canyon reaches will be characterized by photo analysis and geomorphic surveys, mapping, and laboratory analysis of sediment samples.

2.5.1 Field Surveys and Mapping of DP Canyon Reaches

Each of the two canyon reaches will be surveyed and mapped, using nonintrusive and intrusive techniques. The objective of the surveys is to produce maps of each reach to indicate the location, extent, and nature of key geomorphic features for sampling.

2.5.1.1 Geomorphic Survey

The objective of the geomorphic survey is to identify, describe, and map surficial deposits and land forms that provide evidence for processes that can result in storage and/or transport of contaminants. In particular, the survey will focus on identifying potentially contaminated sedimentary deposits.

The geomorphic survey of each canyon reach will be guided by the conceptual model of the significant geomorphic features and sedimentary deposits illustrated in Fig. 2.2-1. Laboratory-related contaminants could occur in any of the geomorphic units, but the greatest concentrations are expected in the active and buried flood plain deposits because of their fine-grained nature.

2.5.1.2 Geodetic Survey

The objectives of the geodetic survey are to provide coordinates for the boundaries of each reach and provide accurate mapping of the field data and sample locations. Licensed surveyors will provide data in the New Mexico state plane coordinate system.

2.5.2 Sediment Sample Collection and Analysis

Because PCBs and metals are the potential contaminants likely associated with the history of contaminant releases in Upper Sandia Canyon, the sediment characterization approach will employ sample collection and analysis within each geomorphic units for these indicator contaminants to determine which sedimentary packages may contain other possible contaminants. Identifying the COPC inventory will help define the strategy for assessing potential impacts to **measurement** endpoints in the ecological risk assessment. Ecological risk will be based on determining if a pathway to the **assessment** endpoint exists, quantifying COPC uptake through the food chain to the **assessment** endpoint, and determining the probability of adverse effects given uptake. To facilitate risk assessment for terrestrial receptors, prey species concentrations that would yield a significant effect in predaceous birds for selected chemicals have been developed. This information is summarized in Table 2.5-1. Other benchmark values for other chemicals and receptors will be developed on an as-needed basis.

TABLE 2.5-1

SELECTED CHEMICAL CONCENTRATIONS IN PREY THAT PRODUCE NO EFFECT IN RED-TAILED HAWKS

CHEMICAL	PREY SPECIES CONCENTRATION [a] (mg/kg)
Aroclor 1242	4.2
Aroclor 1254	1.9
Lead (metallic)	40

[a] From Sample *et al.* (1996).

2.5.2.1 Indicator-Contaminant Analysis

Sample analysis will be conducted for a suite of indicator contaminants to identify which sedimentary packages in Upper Sandia Canyon contain contaminants and to provide information on the source term for ecological risk assessment.

2.5.2.2 Additional Contaminant Suite

Sampling for additional constituents (e.g., radionuclides and SVOCs) will be conducted at locations where the indicator constituents show the presence of contaminated sediments. Geomorphic units and sediment packages that are believed to be uncontaminated (based on the results of the indicator-constituent analysis) will also be sampled to confirm presence or absence of contaminants.

Planned data uses include determining the COPC list based on preliminary ecological risk assessment and making preliminary assessments of the COPC inventory. The preliminary ecological risk assessment will be based on assumptions of contaminant transport and bioavailability that are consistent with the LANL ecological risk conceptual model. Based on this ecological conceptual model, sediment sample results will be compared to sediment screening values. Those COPCs that represent 90% of the normalized hazard quotient will be carried forward for further analysis in the samples submitted for limited-suite analyses.

It is expected that the limited- and additional-suite data collected will be adequate to evaluate potential for transport under current conditions, and to perform a human health risk assessment representing current day conditions.

2.5.2.3 Particle Size Distribution Analysis, Total Organic Carbon, and pH

Sediment samples chosen after analytical results of initial sampling are available will be sieved and key particle-size fractions (e.g., silt-sized fraction, fine sand-sized fraction) will be analyzed to provide information on the association between contaminant concentration and particle size. All sediment samples will be analyzed for total organic carbon to determine the relationship between the amount of organic material in the sediment and contaminant concentrations. Total organic carbon, in conjunction with pH, may be useful for understanding bioavailability of contaminants, contaminant migration potential, mitigating sediment (and contaminant) transport, or designing remedial and/or waste volume reduction alternatives.

2.6 Storm and Surface Water Investigation

The objective of the storm and surface water investigation in Upper Sandia Canyon is to evaluate current day surface water transport of contaminants in the Upper Sandia Canyon system.

Water quality samples will be collected from locations above and below the wetland area (Reach S-2). Samples will be collected to characterize both base-flow conditions and storm water runoff conditions. This data will be used to evaluate differences in water quality at the sample locations and assess the role of the wetland environment in affecting the water quality.

3.0 SAMPLING AND ANALYSIS PLAN IMPLEMENTATION

3.1 Field Survey Implementation

3.1.1 Geomorphic Survey

Each canyon reach will be investigated according to LANL-ER-SOP-3.08, Geomorphic characterization (LANL, 0875). Field activities will be documented according to LANL-ER-SOP-03.12, Field and Laboratory Notebook documentation for ER Earth Sciences Studies (LANL, 0875).

The geomorphic survey will identify all sedimentary units including those that are likely to contain contaminants. The units which are likely to contain contaminants will be considered candidates for sampling.

3.1.2 Geodetic Survey

State planar coordinates will be identified for sample collection sites by licensed surveyors for sample locations and boundaries of geomorphic units. All survey data will be submitted to the LANL ER Project's Facility for Information Management, Analysis, and Display (FIMAD). Surveys will be conducted in accordance with LANL-ER-SOP 03.01, Land Surveying Procedures (LANL, 0875).

3.2 Sediment Sampling and Analysis Implementation

Two primary sampling tasks have been defined for the sediment investigation: sample collection for analysis of indicator constituents, and sample collection for analysis of additional constituents. Analysis for soil pH, particle size distribution, and total organic carbon content will also be conducted on each sample. All samples will be collected to according to all applicable LANL ER SOPs.

Each sample location will be marked, surveyed, and assigned a unique ER Project sample location identification number. Before shipment from the Sample Management Office to the analytical laboratory, gross-alpha, gross-beta, and gross-gamma radiation measurements will be analyzed for each sample for Department of Transportation shipping purposes.

Field duplicate samples will be collected according to ER Project guidance (LANL 1995, 1164). These quality control samples are not included in the predetermined number of samples allocated for each canyon reach.

3.2.1 Sample Collection for Indicator-Contaminant Analysis

Samples will be allocated for analysis of indicator constituents based on the statistical sampling design described in Appendix A. The indicator-constituent suite consists of PCBs and metals. The statistical design requires information on the estimated volume of potentially contaminated sediments in each reach and the possible concentration of contaminants in each volume of sediment (Appendix A). Samples will be submitted for analysis of indicator constituents to identify which sedimentary deposits contain contamination and for use in estimating contaminant inventory. These data will also be used to assess current ecological risk and to test the assumptions of the geomorphic model. Table 3.2.1-1 presents the proposed number of samples that will be submitted to provide this information.

TABLE 3.2.1-1

PROPOSED NUMBER OF SAMPLES TO ASSESS INVENTORY AND TEST ASSUMPTIONS OF THE GEOMORPHIC MODEL

REACH	MINIMUM NUMBER OF SAMPLES FOR INVENTORY ESTIMATION	ADDITIONAL SAMPLES TO ASSESS CONCENTRATION VARIABILITY AND GEOMORPHIC MODEL	TOTAL NUMBER OF SEDIMENT SAMPLES PLANNED
S-1 N Tributary	1	5	6
S-1 S Tributary	1	7	8
S-2	30	16	46

3.2.2 Sample Collection for Analysis of Additional Constituents

The suite of additional constituents will consist of SVOCs and radionuclides. Samples will be collected for analysis of these additional constituents from locations where the indicator constituent results show contamination to be present. Samples will also be collected from sedimentary units where no indicator contaminants are found. These samples will be analyzed for the additional contaminant suite to confirm that those units are not contaminated.

3.2.3 Sample Collection for Soil pH, Particle Size Distribution, and Total Organic Carbon Analysis

All sediment samples submitted for laboratory analysis will be sieved in the field to remove the particle fraction greater that 2 mm. Some samples will be sieved at a fixed laboratory and each particle size fraction (e.g., silt-sized fraction, fine sand-sized fraction) will be analyzed to provide

information on the association between contaminant concentration and particle size. All sediment samples will be analyzed for pH and total organic carbon.

3.2.4 Sediment Sampling Methods

Surface sediment samples will be collected in accordance with LANL-ER-SOP-06.09, Spade and Scoop Method for Collection of Soil Samples; and LANL-ER-SOP-06.10, Hand Auger and Thin-Wall Tube Sampler (LANL, 0875). Most samples collected in the initial sampling tasks will be grab or vertical composite samples. The tools used to collect the sediment samples will depend on the cohesion of the sediment, the collection depth, and the presence of flowing or standing surface water.

All samples will be collected using the applicable ER Project SOPs for the collection, preservation, identification, storage, transport, and documentation of environmental samples, as described in Section 4.4 in Chapter 4 of the IWP (LANL 1996, 1379). Decontamination of sampling equipment will be performed in accordance with LANL-ER-SOP-01.08, Field Decontamination of Drilling and Sampling Equipment (LANL, 0875). Wash water and other wastes generated during the sampling operation will be managed and disposed of in accordance with LANL-ER-AP-05.3, Management of ER Program Wastes (LANL, 0875).

3.2.5 Analytical Methods for Sediment Samples

Sediment samples will be sent for analysis of indicator constituents, which include PCBs and metals. The additional suite of analyses will include SVOCs and radionuclides (gamma-emitting radionuclides by gamma spectroscopy, gross beta radioactivity, and alpha-emitting radionuclides by alpha spectroscopy. The analytical suites and methods are listed in Table 3.2.5-1. All analyses will be performed at a fixed laboratory approved by the LANL ER Project, and will be conducted in accordance with EPA SW-846 protocols (EPA, 1222). The detailed analyte lists, estimated quantitation limits (EQLs), required quality control (QC) procedures, and the acceptance criteria are found in the ER Project analytical services statement of work (LANL 1995, 1278).

All sediment samples will be homogenized and sieved in the field to remove the particle fraction greater that 2 mm. More detailed analysis for particle size will use either LANL or off-site facilities using the American Society for Testing and Materials (ASTM) methods described in LANL-ER-SOP-11.02, Particle Size Distribution of Soil/Rock Samples (LANL, 0875). Other analyses, such as determination of mineralogy, may be performed if it is thought that there is an important relationship with sorption of contaminants.

TABLE 3.2.5-1

PROPOSED ANALYTICAL SUITES AND METHODS

ANALYTE SUITE	ANALYTICAL LABORATORY METHOD
Inorganic Constituents	
TAL metals	Inductively coupled plasma emission spectroscopy, graphite furnace atomic absorption, inductively coupled plasma mass spectrometry, and cold vapor atomic absorption
Organic Constituents	
Polychlorinated biphenyl compounds	Gas chromatography/electron capture detection
Semivolatile organic compounds (including polycyclic aromatic hydrocarbons)	Gas chromatography/mass spectroscopy
Total petroleum hydrocarbons	Infrared
Radionuclides	
Gamma-emitting radionuclides	Gamma spectroscopy
Gross beta radiation	Gas proportional counting
Alpha-emitting radionuclides	Alpha spectroscopy
Tritium	Liquid scintillation

3.3 Storm Water Runoff and Surface Base Flow Sampling

Surface water samples will be collected quarterly above and below the wetland section of upper Sandia Canyon (Reach S-2) during both base flow and storm water runoff (or snowmelt) conditions. Both filtered and unfiltered samples will be will be analyzed. The amount of total suspended solids will be determined for the filtered samples. The samples will be analyzed for metals, PCBs, TPH, SVOCs, and radionuclides.

3.3.1 Base-flow Sampling

To characterize base-flow water quality in upper Sandia Canyon, samples will be collected above and below the wetland section (Reach S-2) quarterly for a period of one year. Base flow in Sandia Canyon is primarily a result of effluent discharged from the Sanitary Wastewater System Consolidation (SWSC) Facility. Samples will be collected during base-flow conditions at the head of the wetland to characterize the quality of water entering the wetland; samples will be collected at the toe of the wetland during the same sampling event to characterize the quality of water

exiting the wetland area (Fig. 3.3.1-1). Surface water will be sampled in accordance with LANL-ER-SOP-06.29, Single-Stage Sampling for Surface Water Run Off (LANL, 0875).

3.3.2 Storm Water Runoff Sampling

To characterize water quality associated with storm water runoff in upper Sandia Canyon, samples will be collected during one storm or snow melt event each quarter for a period of one year. These types of events have the potential for mobilizing sediments (and possibly contaminants) stored in the wetland, potentially affecting water quality. Collection of samples during a runoff event helps assess the variability in water quality associated with variations in discharge and suspended solids and dissolved constituents. The sample locations for these samples will be the same as for the base-flow sampling (Fig. 3.3.1-1). Storm water runoff water will be sampled in accordance with ESH-18 protocols.

3.3.3 Analytical Methods for Water Samples

Base-flow water samples and storm water runoff and snowmelt samples will be sent for the suite of analyses described in Section 3.2.5. The analytical suites and methods are listed in Table 3.2.5-1. All analyses will be performed at a fixed laboratory approved by the LANL ER Project, and will be conducted in accordance with EPA SW-846 protocols (EPA, 1222). The detailed analyte lists, EQLs, required QC procedures, and acceptance criteria are found in the ER Project analytical services statement of work (LANL 1995, 1278).

3.4 Schedule

Implementation of this SAP is scheduled to begin during the winter of 1998.

4.0 DATA ASSESSMENT

4.1 Verification and Routine Data Validation

All data to be used for site decision-making will be loaded into the ER Project electronic data system (the Oracle database run by FIMAD). These data will include field sample information, field measurements, and laboratory analyses. The analytical data produced by the contract laboratories will use the standard data verification and baseline validation procedures **(see LANL contract #N63210002-8S Task 16--I need information for this reference)**.

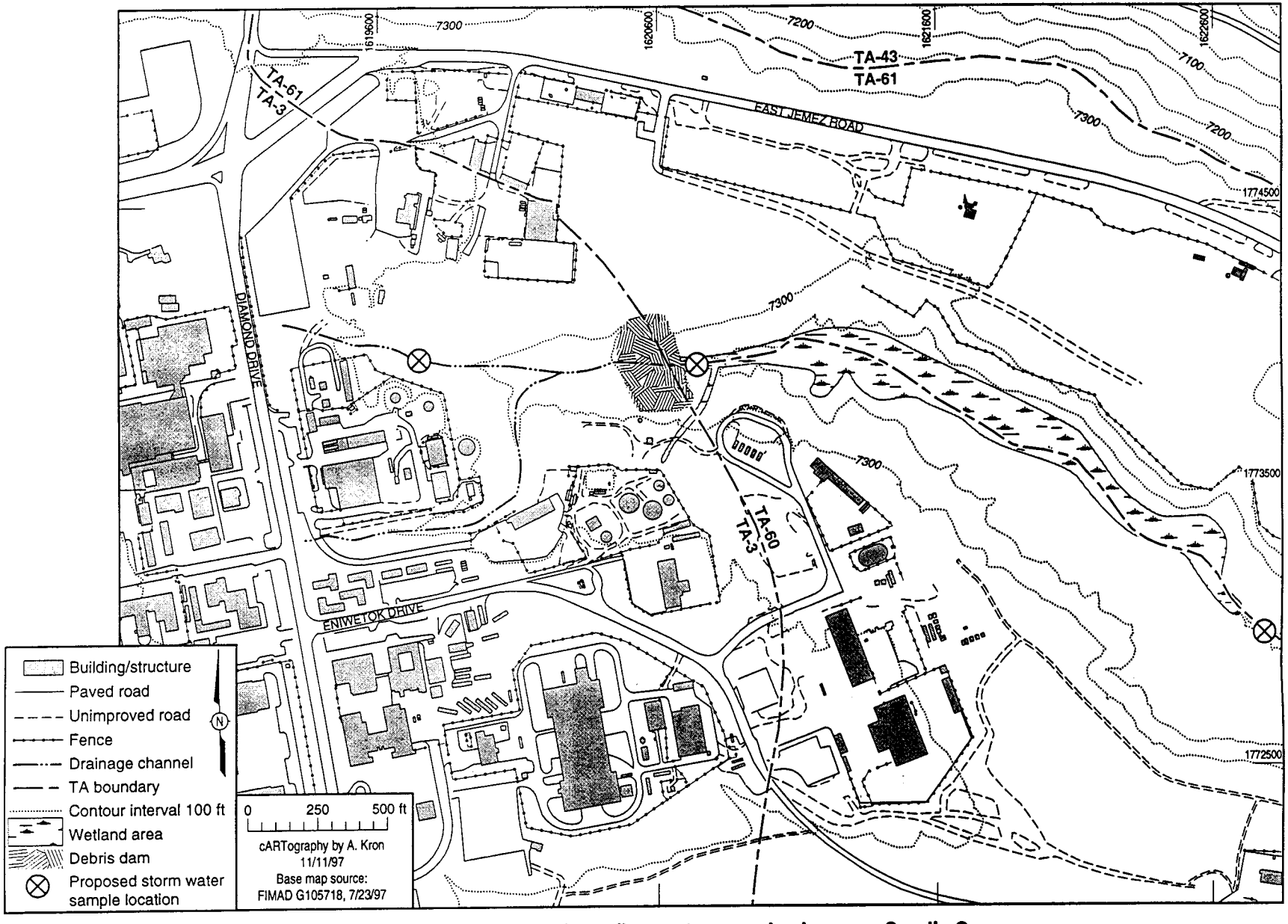


Fig. 3.3.1-1 Proposed locations of storm water and surface base flow water samples in upper Sandia Canyon.

4.2 Data Quality Assessment

Data quality assessment (DQA) for the results from this sampling and analysis plan will use the general framework outlined in Section D3 of the LANL ER Project QAPP **(reference to new QAPP here)**. The DQA for this project will be specialized to meet the needs of the LANL ER Project Canyons Investigation Team.

The Canyons Investigation Team's objectives are to estimate the current inventory of chemicals, current risk, and future risk and transport associated with contaminants in the canyons. The DQA will focus on determining if adequate data have been collected to estimate the contaminant inventory. The estimated inventory will be expressed as a statistical distribution. Data will be considered adequate if 75% of the statistical distribution is within 20% of the median inventory estimate.

The key data inputs to the inventory calculation include the following:

- the volume of sediment contained within geomorphic units to be determined from aerial photos, and
- the concentration of contaminants within geomorphic units to be determined from knowledge of chemicals identified at source PRSs and correlation between indicator contaminants and other contaminants.

5.0 ADMINISTRATION

5.1 Project Task Organization

Table 5.1-1 shows the project task organization for the Upper Sandia Canyon Phase I investigation.

TABLE 5.1-1

PROJECT TASK ORGANIZATION AND PERSONNEL

TITLE	NAME	ORGANIZATION
Field Project Management		
Field Project Leader (FPL)	Allyn Pratt	EM/ER[A]
Field Operation Manager (FOM)	Lynda Hartman	EM/ER
Field Team Manager (FTM)	TBD[b]	TBD
Field Team		
Field Team Leader (FTL)	TBD	TBD
Site Safety Officer (SSO)/ Radiation Screening Personnel (RSP)	TBD	TBD
Sampler/Waste Manager (WM)	TBD	TBD
Alternate Personnel		
All positions	TBD	TBD

[a] EM/ER = LANL Environmental Management/Environmental Restoration personnel.
[b] ERM/Golder is a LANL contractor.

5.2 Training

All personnel involved with the implementation of the work plan will have fulfilled the required training for applicable roles in accordance with LANL-ER-AP-05.2, R1, "Determination, Completion, and Documentation of Environmental Restoration Worker Training" (LANL, 0875). At a minimum, all field team members will have documentation of 40-hour Occupational Safety and Health Act (OSHA) Hazardous Waste Operations (HAZWOPER) training, a current 8-hour annual HAZWOPER Refresher (if applicable), LANL Radiological Worker II, LANL General Employee Training, a current medical fit-for-work statement, and employer hazard communication. Personnel training records will be on site during field activities and available for inspection.

5.3 Reporting and Records

A daily activity log will be prepared during active field operations. Each log will describe the specific field activities conducted during the day, any surveys performed, sampling activities (including number and types of samples collected), field monitoring or screening results, and unexpected events. Field records will also be generated to document sample collection and tracking, health and safety briefings and monitoring-equipment performance checks. Field records include, but are not limited to:

- Sample Collection Log
- Chain of Custody/Request for Analysis Form
- Tailgate Safety Meeting/Attendee Sign-off Sheet
- Daily Safety Inspection Checklist
- PPE Inspection Checklist
- Radiation Monitoring/Performance Check
- Site Access/Exclusion Zone Logbook
- Field Team Leader (FTL) Logbook
- Site Safety Officer (SSO) Logbook
- Waste Management Logbook
- Visitors Logbook
- Field Photographic Log

All original documents will be transferred to the LANL ER Project Records Processing Facility (RPF) in accordance with LANL-ER-AP-02.1, R1, "Procedure for LANL ER Records Management" (LANL, 0875).

REFERENCES (WILL BE COMPLETED WITH FINAL)

Canyons Core Work Plan

LANL (Los Alamos National Laboratory), December 1996. "Installation Work Plan for Environmental Restoration Program," Revision 6, Los Alamos National Laboratory Report LA-UR-96-4629, Los Alamos, New Mexico. **(LANL 1996, 1379)**

LANL (Los Alamos National Laboratory), July 1993. "RFI Work Plan for Operable Unit 1114," Los Alamos National Laboratory Report LA-UR-93-1000, Los Alamos, New Mexico. **(LANL 1993, 1090)**

LANL 1995, 17-1275

LA-UR-96-726

Weston 1992, 17-582

LANL 1989, 17-980

Tiedman 1991, 17-829

Sneesby 1994, 17-1159

NMED 1992, 17-832

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LANL 1992, 17-834

Bellows 1991, 17-835

LANL 1995, 3-1232

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LANL 1993, 17-851

Cross, S. and H. Nottelman. 1996. Aquatic Macroinvertebrates and Water Quality of Sandia Canyon, Los Alamos National Laboratory, 1995. LA-UR-96-3684, November 1996

Bennett, K. 1994. Aquatic Macroinvertebrates and Water Quality in Sandia Canyon. LA-12738-MS, May 1994

Cross, S. 1994. Aquatic Macroinvertebrates and Water Quality of Sandia Canyon, Los Alamos National Laboratory, December 1992 - October 1993. LA-12734-SR, September 1994

Cross, S. 1995. Aquatic Macroinvertebrates and Water Quality of Sandia Canyon, Los Alamos National Laboratory, November 1993 - October 1994. LA-12971-SR, August 1995

Bennett, K. and J. Biggs. 1996. Small Mammal Study of Sandia Canyon, 1994 and 1995. LA-13199-MS, November 1996

K. Bennett, personal, 1997

EPA 1990, 1585

LANL (Los Alamos National Laboratory), November 1995. "Task/Site Work Plan for Operable Unit 1049, Los Alamos Canyon and Pueblo Canyon," Los Alamos National Laboratory Report LA-UR-95-2053, Los Alamos, New Mexico. **(LANL 1995, 01-0049)**

State of New Mexico, January 23, 1995. "Standards for Interstate and Intrastate Streams," Title 20, Chapter 6, Part 1, Water Quality Control Commission, Santa Fe, New Mexico. **(State of New Mexico 1995, 1267)**

Yanicek, DOE OB, 9/97

Federal Register, Vol. 61, No. 241, Dec. 13, 1996, Department of Defense, Department of the Army Corps of Engineers, 33CFR325.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. Toxicological Benchmarks for Wildlife: 1996 Revision. Lockheed Martin Energy Systems ES/ER/TA-86/R3, June 1996.

LANL (Los Alamos National Laboratory). "Los Alamos National Laboratory Environmental Restoration Program Standard Operating Procedures," Los Alamos National Laboratory report, Los Alamos, New Mexico. **(LANL, 0875)**

LANL (Los Alamos National Laboratory), February 1995. "Installation Work Plan for Environmental Restoration," Revision 4, Los Alamos National Laboratory Report LA-UR-95-740, ER ID No. 49822, Los Alamos, New Mexico. **(LANL 1995, 1164)**

EPA (US Environmental Protection Agency). "Test Methods for Evaluating Solid Waste," Volumes IA, IB, IC, and II, SW-846, Third Edition, Office of Solid Waste and Emergency Response, Washington, DC. **(EPA, 1222)**

LANL (Los Alamos National Laboratory), July 1995. "Statement of Work–Analytical Support," Revision 2, RFP No. 9-XS1-Q4257, ER ID No. 49738, Los Alamos, New Mexico. **(LANL 1995, 1278)**

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APPENDIX A DATA QUALITY REQUIREMENTS AND STATISTICAL SAMPLING DESIGN

The three requirements of the Upper Sandia Canyon data are to (1) provide a quantitative estimate of the inventory of chemicals of potential concern (COPCs) where the initial target is to estimate total COPC mass to within +/-20% of the estimated median with 75% confidence; (2) provide information for a baseline ecological risk assessment of Upper Sandia Canyon, where this risk assessment is performed to evaluate potential remedial actions; and (3) provide data to the Los Alamos National Laboratory (LANL) Environmental Restoration (ER) Project Canyons Investigation Team for modeling the remainder of Sandia Canyon. Samples will be allocated for analysis of indicator constituents based on a statistical sampling design, which is described below. The statistical design requires information on the expected volume of potentially contaminated sediments in each reach and the possible concentration of contaminants in each volume.

Based on aerial photographs, existing data, and a field survey of Upper Sandia Canyon, two distinct reaches have been defined. Table A-1 summarizes the surface area and depth of Laboratory-related sediment deposits in the Upper Sandia Canyon reaches. The areas were estimated from maps provided by the LANL ER Project's Facility for Information Management, Analysis, and Display (FIMAD) (see FIMAD plot ID G105441). The volume of potentially contaminated sediment in each reach was calculated by multiplying the area by the depth. These volumes are also presented in Table A-1. The estimated total area and volume of Upper Sandia Canyon sediments and the fraction that each reach comprises of the total area are also presented in Table A-1. The most important conclusion is that Reach S-2 comprises more than 95% of the area and the volume of sediments located in DP Canyon.

TABLE A-1

SUMMARY OF CURRENT AREA, DEPTH, AND VOLUME ESTIMATES FOR UPPER SANDIA CANYON REACHES

REACH	AREA (m^2)	PERCENT OF TOTAL AREA	DEPTH (m)	VOLUME (m^3)	PERCENT OF TOTAL VOLUME
S-1 N Trib	642	2.8	0.65	417	1.7
S-1 S Trib	1082	4.8	0.65	703	2.8
S-2	21 000	92.4	1.13	23 730	95.5
Total area	22 724		**Total volume**	24 851	

One objective of the Upper Sandia Canyon investigation is to estimate the inventory of contaminants in sediments. Common sense and simple statistical formulae suggest that half the sampling effort should be directed to a reach that contains half the volume of sediments. The statistical term for reaches is "strata", and the statistical methodology for analyzing reaches is known as stratified random sampling (SRS). Gilbert (1987, pp. 45-57) presents the equations used for SRS. The simplest SRS allocation is based on the proportion of the total represented by each strata. Thus, the percentage of area and volume presented in Table A-1 represent a simple SRS sample allocation. Another sample allocation consideration is the expected average concentration of contaminants present in each reach.

Historical information on releases from Technical Area (TA) 3 and the existing Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) data for source PRSs suggest that the majority of the PCBs currently located in Upper Sandia Canyon originated from releases at Potential Release Site (PRS) 3-056(c). Because of the limited storage of sediments in the two tributaries associated with Reach S-1, polychlorinated biphenyl (PCB) concentrations are expected to be low in these reaches. Most of the stored PCBs are expected to be contained in the wetland proper, which comprises Reach S-2 (see Table A-2). This assumption was made to adjust sample allocation for the expected concentration of contaminants in reach sediments. The optimal allocation suggests that nearly all of the samples should be collected from Reach S-2.

The next consideration in developing the sample allocation is to establish an adequate number of samples. The stratified random sampling formulae provide an estimate of the expected standard error in the mean concentration as a function of the number of samples. This relationship for the assumptions made for Upper Sandia Canyon is presented in Fig. A-1. At a value of approximately 30 samples, adding additional samples is reaching a point of diminishing returns. Each additional sample reduces the expected uncertainty in the estimate of the mean PCB concentration but such improvements in the estimate of mean are rapidly diminishing. Thus, 30 samples are proposed as the minimum number of samples need to establish contaminant inventory in Upper Sandia Canyon.

In addition to estimating inventory, samples should be allocated to address specific ecological risk issues as well as test the assumptions of the geomorphic model for Upper Sandia Canyon. Table A-3 presents the proposed number of samples to address these other issues.

TABLE A-2

ESTIMATED STANDARD DEVIATION (SD) OF PCBs AND VOLUME OF REACHES USED FOR SRS OPTIMAL SAMPLE ALLOCATION[a]

REACH	ESTIMATED REACH SD (mg/kg of PCBs)	VOLUME (m^3)	SAMPLING WEIGHTING FACTOR	PERCENT ALLOCATION TO REACH FOR "OPTIMAL" NUMBER OF SAMPLES
S-1 N Tributary	1.0	417	0.017	0.2
S-1 S Tributary	1.0	703	0.028	0.3
S-2	10.0	23 730	9.549	99.5
Total volume		24 851		

[a] The optimal allocation for stratified random sampling designs is based on equation 5.10 presented in **Gilbert (1987)**. The equation is:

$$f_h = \frac{\left(v_h / v_{total}\right) \cdot \sigma_h}{\sum_{h=1}^{L} \left(v_h / v_{total}\right) \cdot \sigma_h}$$

where:
f_h = fraction of samples in the hth reach,
v_h = volume of the hth reach,
v_{total} = total volume, and
σ_h = estimated standard deviation of concentration in the hth reach.

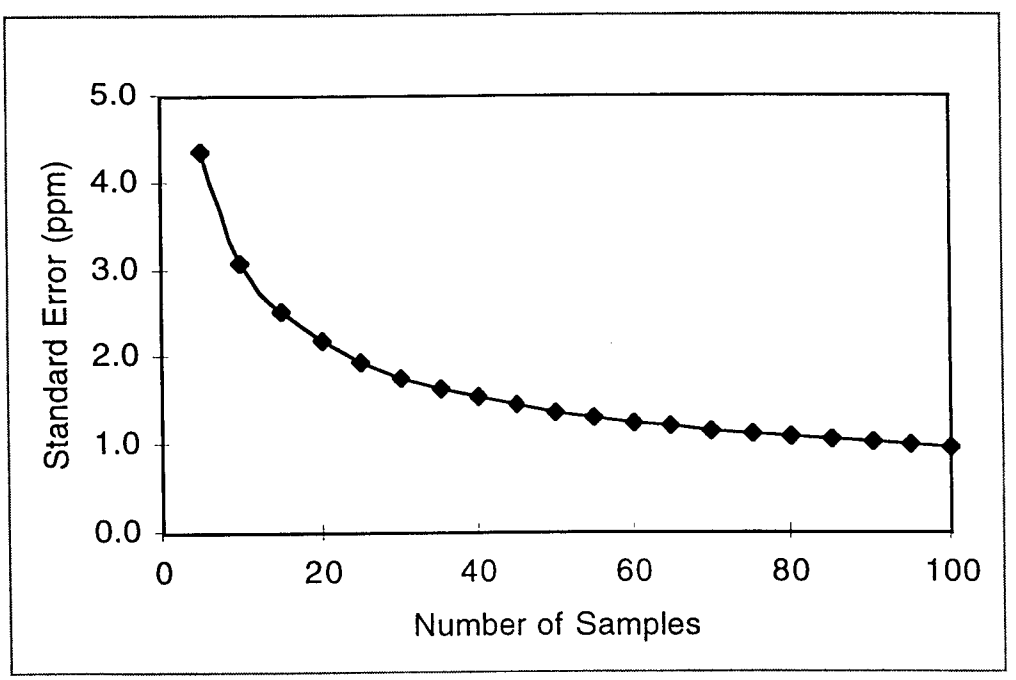

Figure A-1. Relationship between the standard of the estimate of the mean PCB concentration versus the number of samples collected in Upper Sandia Canyon.

TABLE A-3

PROPOSED NUMBER OF SAMPLES TO ADDRESS INVENTORY ESTIMATION, AND ASSESS THE ADEQUACY OF THE CURRENT GEOMORPHIC MODEL

REACH	MINIMUM NUMBER OF SAMPLES FOR INVENTORY ESTIMATION	ADDITIONAL SAMPLES TO ASSESS CONCENTRATION VARIABILITY AND GEOMORPHIC MODEL	TOTAL NUMBER OF SEDIMENT SAMPLES PLANNED
S-1 N Tributary	1	5	6
S-1 S Tributary	1	7	8
S-2	30	16	46

REFERENCES

Gilbert (1987, pp. 45-57)