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Los Alamos Area Office, MS A316
Environmental Restoration Program
Los Alamos, New Mexico 87544
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Date: June 9, 1997
Refer to: EM/ER:97-220

Mr. Benito Garcia
NMED-HRMB
P.O. Box 26110
Santa Fe, NM 87502

SUBJECT: IA REPORT FOR TA-10 ACTIVITIES (FORMER OPERABLE UNIT 1079)

Dear Mr. Garcia:

Enclosed please find an informational copy of the Interim Action Report for Technical Area 10, Potential Release Sites 10-002(a,b), 10-003(a-o), 10-004(a,b), and 10-007 activities completed in Fiscal Year 1997. The Department of Energy has reviewed and approved this report. The approval form is attached to the report. Please note, we are continuing to use the term "interim action" until definitions of the various levels of stabilization and cleanup activities can be agreed upon with your staff.

If you have any questions, please call Garry Allen at (505) 667-3394 or Bonnie Koch at (505) 665-7202.

Sincerely,

Jorg Jansen, Program Manager
LANL/ER Project

Sincerely,

Theodore J. Taylor, Program Manager
DOE/LAAO

JJ/TT/rfr

Enclosures: (1) IA Report for TA-10, PRSs 10-002(a,b), 10-003(a-o), 10-004(a,b), and 10-007

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Interim Action Report for

Potential Release Sites

10-002(a-b)
10-003(a-o)
10-004(a-b)
10-007

Field Unit 1

Environmental Restoration Project

April 1997

A Department of Energy
Environmental Cleanup Program

Los Alamos
NATIONAL LABORATORY

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1.0 INTRODUCTION

This report describes the interim action conducted in February 1997 to address radioactively contaminated plants in the Technical Area (TA) 10 Central Area in Bayo Canyon. Initially, interim action activities were planned to address only radioactively contaminated chamisa. However, during a radiation survey conducted to determine which chamisa plants would be removed, surface soil and several plant species in addition to chamisa were found to be contaminated. A characterization plan was prepared and implemented to define the nature and extent of plant and soil contamination (LANL 1996, 06-0151). This information was used to prepare a revised interim action approach, which is documented in this report. This revised approach is expected to mitigate the potential for exposure to strontium-90 contamination in plants and soil at the TA-10 Central Area pending selection and implementation of a final remedy for the site. The final remedy for the site will address the surface pathway for deep subsurface strontium-90 contamination.

2.0 SITE CHARACTERIZATION

The primary objectives of the site characterization phase were to: 1) provide data necessary to evaluate the risk posed by surface and shallow subsurface soil contamination and/or contaminated plants, and 2) determine what type of interim action would be implemented to mitigate any risk to recreational users of Bayo Canyon pending determination of a final remedy for the site. The nature and extent of soil contamination were determined using an expedited site characterization approach, which is described below.

A soil sampling grid with 20-ft spacing between nodes was surveyed in the Central Area. Soil samples were collected at each grid node and analyzed using the field analytical method described in Section 2.1. Once the distribution and extent of surface contamination were determined, representative grid nodes that displayed surface contamination were sampled to evaluate shallow subsurface contaminant distribution. Subsurface samples were collected at 6-in. intervals to various depths as indicated in Table 1. These samples were analyzed using the field analytical method described in Section 2.1. Additional surface and subsurface soil samples were collected adjacent to representative contaminated plants and analyzed using the field analytical method.

2.1 Soil Analysis

Soil samples were dried in an oven and analyzed directly in petri dishes for beta and gamma radioactivity using an Eberline™ ESP-1 with a lead-shielded Geiger Mueller (GM)

probe. Strontium-90 concentrations were then estimated using conversion factors, which were derived as described below.

Conversion factors were established to correlate known concentrations of strontium-90 in soil standards with instrument measurements of those standards. Instrument measurements were recorded for five 5-minute counts for the following sets of soil standards: two standards with no strontium-90 added (background standards), one standard with 50 pCi/g of strontium-90 added, one standard with 150 pCi/g of strontium-90 added, three standards with 498 pCi/g of strontium-90 added, and three standards with 1 890 pCi/g of strontium-90 added. Soil and instrument background values were subtracted from each measurement (only the instrument background value was subtracted for the background soil standard). A mean and standard deviation were then calculated from the measurements on each group of standards having the same concentration of added strontium-90. The standard deviations ranged from 2% to 4% of the mean for all standards except the one with no strontium-90 added, which had a standard deviation of approximately 10% of the mean.

A conversion factor was calculated for each standard by dividing the known concentration of strontium-90 in the standard (in pCi/g) by the net instrument measurement (in counts per minute [cpm]), which was first corrected for instrument background count and soil background radiation. The conversion factors for each group of standards having the same concentration of added strontium-90 were then averaged. The four conversion factors were within approximately 15% of each other. To provide a conservative estimate of the strontium-90 concentration, the highest of the four conversion factors was used.

Eight soil samples were submitted to a fixed analytical laboratory for confirmation of the strontium-90 screening estimates. The results of the confirmation analyses indicate that the screening estimates correlate well to the relative strontium-90 concentrations determined by the fixed-laboratory. The results of the confirmation analyses also suggest that the lower limit for detecting strontium-90 using this screening method is 15 pCi/g (based on average background soil measurements).

2.2 Plant Analysis

Plants growing at or near each node in the sampling grid were screened with an Eberline ESP-1 with a lead-shielded GM probe. The results of this screening were compared to a background screening value based on the mean of the beta/gamma radioactivity (in cpm) plus three standard deviations.

In addition, plant samples were collected for fixed laboratory analysis. After collection, each sample was dried at 75° Celsius for approximately 72 hours, and ground using a mortar and pestle. The ground plant material was then analyzed directly in petri dishes for beta and gamma radioactivity using an Eberline ESP-1 with a lead-shielded GM probe. Strontium-90 concentrations were estimated using conversion factors as described in Section 2.1. Seven plant samples were submitted to a fixed analytical laboratory for strontium-90 analysis.

2.3 Results

The screening and analytical results for soil and plant samples are presented in Table 1. Table 1 is organized to show the relationship of strontium-90 concentrations in plants to strontium-90 concentrations in surface and subsurface soils adjacent to plants. Plant results in pCi/g are from laboratory analysis, and plant results in cpm are from hand-held field screening instruments. Soil results were calculated using the conversion factor approach described in Section 2.1. Soil was considered contaminated if beta and gamma radioactivity levels exceeded 230 cpm, and plants were considered contaminated if levels exceeded 264 cpm. These activity levels were calculated as the mean plus two standard deviations of background plant and soil samples. The locations of characterization samples are shown in Fig. 1. The results of the site characterization are shown in Fig. 2. The values on Fig. 2 are the results from surface soil analyses, and the leaf symbols represent the presence of plant contamination.

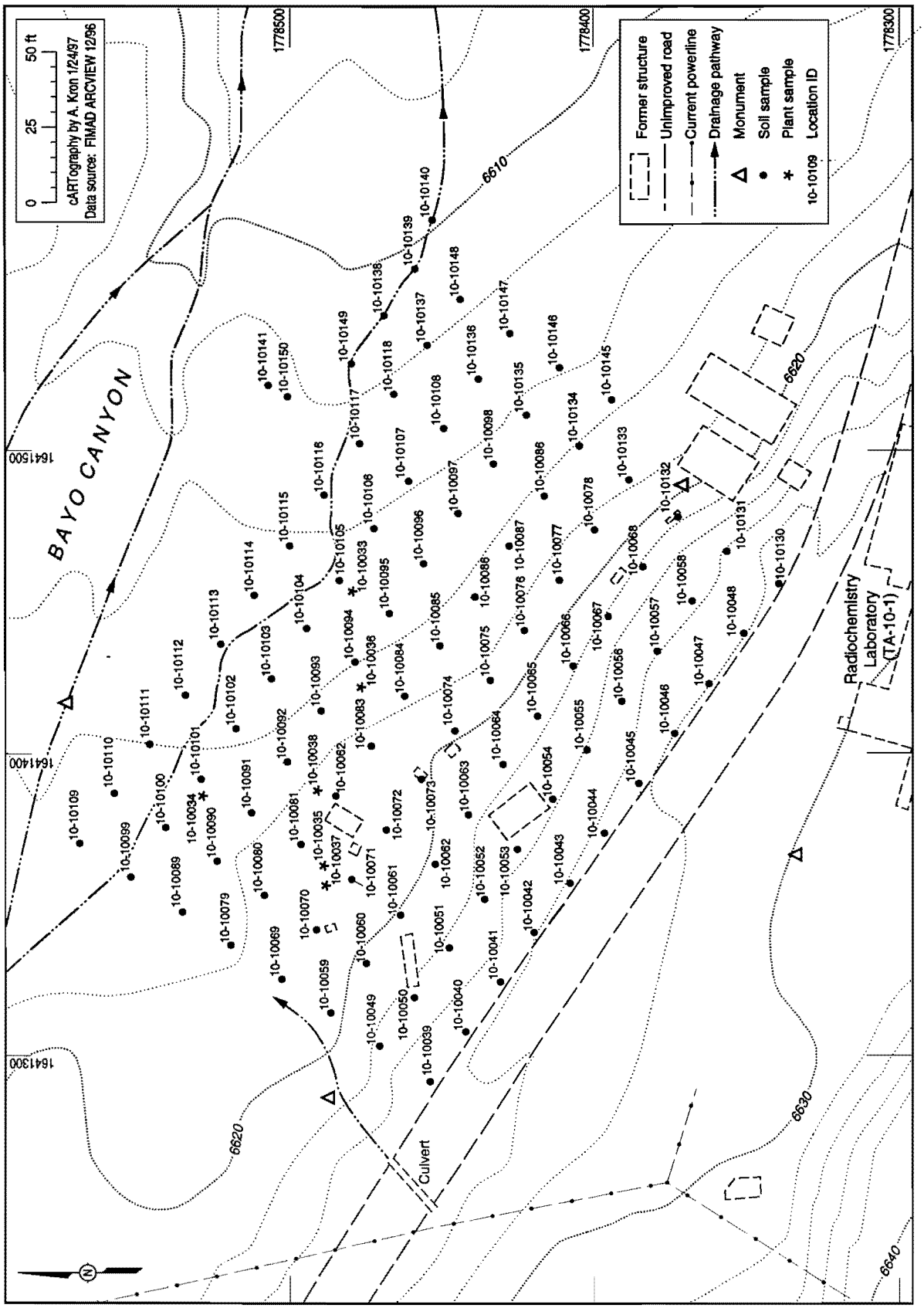

Fig. 1 Locations of characterization samples collected during the interim action in Bayo Canyon.

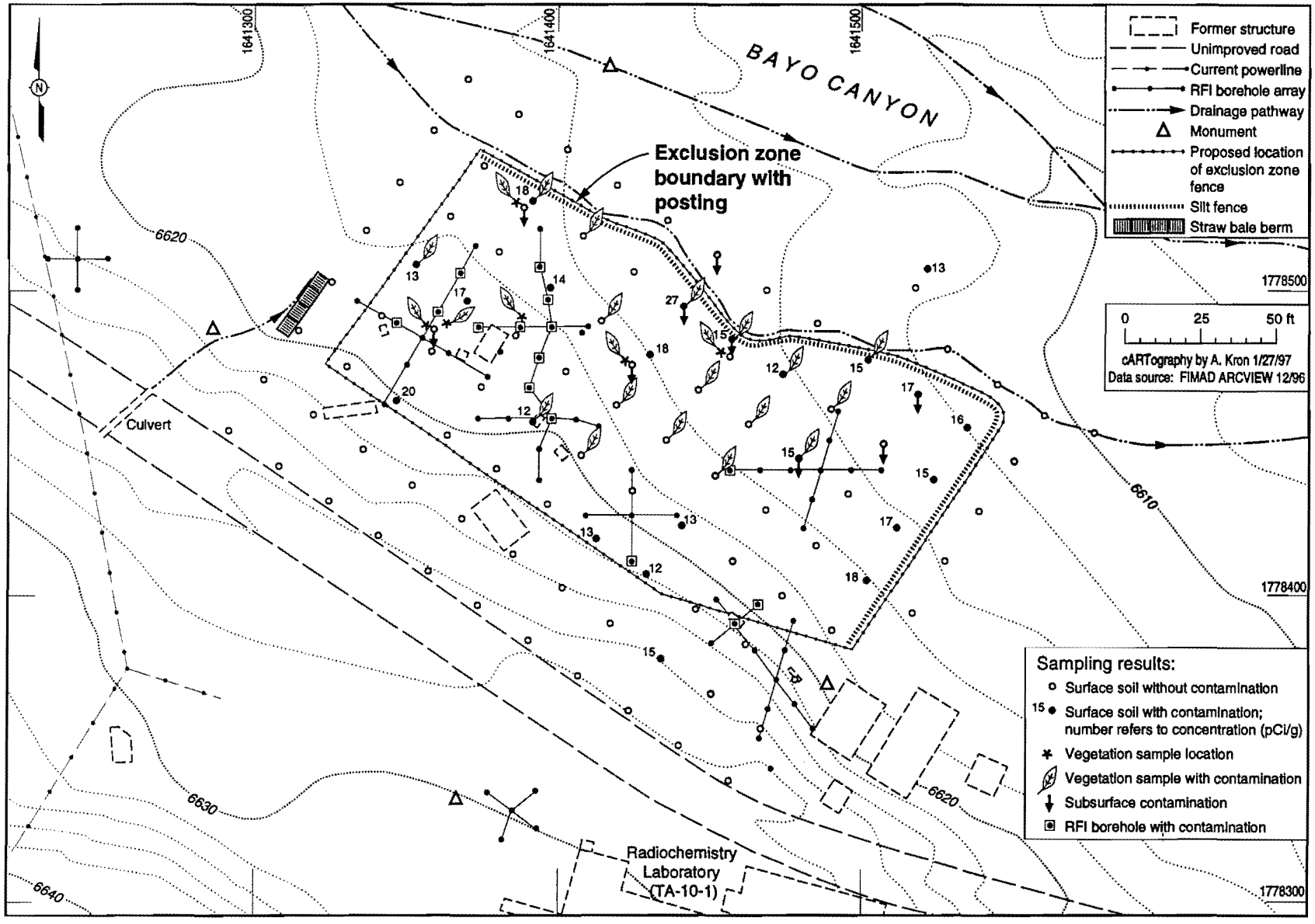

Fig. 2 **Results of site characterization and locations of the exclusion zone fence and storm water control measures established during the interim action in Bayo Canyon.**

TABLE 1

CENTRAL AREA INTERIM ACTION CHARACTERIZATION RESULTS

SAMPLE NUMBER	PLANTS		SOIL				
	TYPE	RESULTS	DEPTH (in.)	CPM[a]	ERROR[b] (+/-)	CALCULATED STRONTIUM-90 (pCi/g)	ERROR[b] (+/-)
LOCATION 10-10033							
NA[c]	Ponderosa	63.3 pCi/g	–[d]	–	–	–	–
LOCATION 10-10034							
NA	Chamisa--leafy portion	118 pCi/g	–	–	–	–	–
NA	Chamisa--woody portion	199 pCi/g	–	–	–	–	–
0110-96-0140	–	–	0–2	171	13	2	0.18
0110-96-0141	–	–	2–8	240	15	13	0.87
0110-96-0142	–	–	8–14	269	16	18	1.11
0110-96-0143	–	–	14–20	369	19	34	1.79
0110-96-0144	–	–	20–26	458	21	49	2.27
0110-96-0145	–	–	26–32	342	18	30	1.62
0110-96-0146	–	–	32–38	227	15	11	0.76
0110-96-0147	–	–	38–44	213	15	9	0.63
0110-96-0148	–	–	44–50	207	14	8	0.57
0110-96-0149	–	–	50–56	220	15	10	0.69
0110-96-0150	–	–	56–62	240	15	13	0.87
0110-96-0151	–	–	62–68	191	14	6	0.40
0110-96-0152	–	–	68–74	240	15	13	0.87
LOCATION 10-10035							
NA	Annual	83.8 pCi/g	–	–	–	–	–
LOCATION 10-10036							
NA	Annual	45.3 pCi/g	–	–	–	–	–
0110-96-0158	–	–	0–2	235	15	11	0.73
0110-96-0159	–	–	2–8	222	15	9	0.61
0110-96-0160	–	–	8–14	238	15	12	0.75

TABLE 1 (CONTINUED)

CENTRAL AREA INTERIM ACTION CHARACTERIZATION RESULTS

SAMPLE NUMBER	PLANTS		SOIL				
	TYPE	RESULTS	DEPTH (in.)	CPM[a]	ERROR[b] (+/-)	CALCULATED STRONTIUM-90 (pCi/g)	ERROR[b] (+/-)
LOCATION 10-10037							
NA	Annual	14.1 pCi/g	–	–	–	–	–
0110-96-0153	–	–	0–2	320	18	25	1.39
0110-96-0154	–	–	4–10	222	15	9	0.61
0110-96-0155	–	–	10–16	209	14	7	0.48
0110-96-0156	–	–	16–22	198	14	5	0.37
0110-96-0157	–	–	22–28	213	15	8	0.52
LOCATION 10-10038							
NA	Annual	45.3 pCi/g	–	–	–	–	–
LOCATION 10-10097							
NA	Other[e]	433 cpm[f]	–	–	–	–	–
0110-96-0118	–	–	0–2	262	16	15	0.95
0110-96-0182	–	–	4–10	293	17	21	1.20
0110-96-0183	–	–	10–16	353	19	30	1.61
0110-96-0184	–	–	16–22	340	18	28	1.52
0110-96-0161	–	–	22–26	293	17	21	1.20
LOCATION 10-10104							
NA	Chamisa	529 cpm[f]	–	–	–	–	–
0110-96-0125	–	–	0–2	333	18	27	1.46
0110-96-0162	–	–	2–7	220	15	9	0.59
0110-96-0163	–	–	7–17	307	18	23	1.30
0110-96-0164	–	–	17–21	444	21	45	2.13
0110-96-0165	–	–	21–28	415	20	40	1.97

TABLE 1 (CONTINUED)

CENTRAL AREA INTERIM ACTION CHARACTERIZATION RESULTS

SAMPLE NUMBER	PLANTS		SOIL				
	TYPE	RESULTS	DEPTH (in.)	CPM[a]	ERROR[b] (+/-)	CALCULATED STRONTIUM-90 (pCi/g)	ERROR[b] (+/-)
LOCATION 10-10105							
NA	Grass	349 cpm[f]	–	–	–	–	–
0110-96-0126	–	–	0–2	250	16	15	0.97
0110-96-0185	–	–	2–6	260	16	17	1.03
0110-96-0186	–	–	6–15	304	17	24	1.33
0110-96-0187	–	–	15–20	267	16	18	1.07
0110-96-0188	–	–	20–24	584	24	69	2.84
LOCATION 10-10108							
NA	Other	191 cpm[f]	–	–	–	–	–
0110-96-0129	–	–	0–2	182	13	4	0.29
0110-96-0189	–	–	2–6	291	17	22	1.27
0110-96-0190	–	–	6–15	215	15	9	0.65
0110-96-0191	–	–	15–25	224	15	11	0.73
0110-96-0192	–	–	25–29	269	16	18	1.08
LOCATION 10-10114							
NA	Young Ponderosa	160 cpm[f]	–	–	–	–	–
0110-96-0135	–	–	0–4	198	14	5	0.36
0110-96-0166	–	–	4–10	187	14	3	0.25
0110-96-0167	–	–	10–16	202	14	6	0.41
0110-96-0168	–	–	16–21	184	14	3	0.21
0110-96-0169	–	–	21–28	193	14	4	0.31

TABLE 1 (CONTINUED)

CENTRAL AREA INTERIM ACTION CHARACTERIZATION RESULTS

SAMPLE NUMBER	PLANTS		SOIL				
	TYPE	RESULTS	DEPTH (in.)	CPM[a]	ERROR[b] (+/-)	CALCULATED STRONTIUM-90 (pCi/g)	ERROR[b] (+/-)
LOCATION 10-10115							
NA	Other	213 cpm[f]	–	–	–	–	–
0110-96-0136	–	–	0–2	189	14	5	0.39
0110-96-0193	–	–	2–6	187	14	5	0.37
0110-96-0194	–	–	6–16	222	15	11	0.71
0110-96-0195	–	–	16–20	231	15	12	0.78
0110-96-0196	–	–	20–23	202	14	7	0.51
LOCATION 10-10118							
NA	Grass	227 cpm[f]	–	–	–	–	–
0110-96-0139	–	–	0–4	269	16	17	0.99
0110-96-0170	–	–	4–10	458	21	47	2.20
0110-96-0171	–	–	10–15	1070	33	146	4.47
0110-96-0172	–	–	15–21	902	30	119	3.96
0110-96-0173	–	–	21–27	595	24	69	2.84

[a] cpm = Counts per minute. Results are for dry soil samples using shielding. Screening values exceeding 230 cpm are considered statistically elevated above the mean of background plus 2 standard deviations.

[b] These values are a function of the random nature of radioactive decay. They do not include uncertainties associated with the instrument, conversion factor, or background soil measurement.

[c] NA = Not applicable.

[d] – = No data were collected.

[e] Other forbs, grasses, shrubs, etc.

[f] Value is the result of field measurements of plants in their original locations. No correction has been made for instrument uncertainty or background. Values exceeding 264 cpm are considered statistically elevated above background.

3.0 RISK ASSESSMENT

3.1 Risk Assessment Previous to the Interim Action

A risk assessment was conducted previous to the interim action based on strontium-90 data from a single chamisa plant that had been removed from the site in 1994. This risk assessment assumed ingestion of the highest strontium-90 concentration detected in the chamisa plants at the site (22 000 pCi/g assuming a moisture content of 75%). The results of this assessment indicated that a single ingestion incident of plant material with this concentration of strontium-90 represented an unacceptable human health risk and a radiologic dose of greater than 100 mrem. This is equivalent to an excess cancer risk of 4×10^{-5}, although cancer would be more likely to result from repeated exposure throughout a chronic exposure duration than from the single ingestion incident used in this scenario. The results of this risk assessment led to the interim action plan that all radioactively contaminated chamisa be removed from the site.

Further characterization of the nature and extent of contamination was conducted in 1996. As discussed in Section 2.0, data were collected to characterize soil and plants that are currently present at the site. Because the data used in the original risk assessment were characteristic of plants that had been removed from the site and were not representative of current site contaminant levels, a second risk assessment was conducted to determine the risk associated with current conditions in the TA-10 Central Area, as discussed in Section 3.2.

3.2 Risk Assessment Based on Interim Action Characterization Data

A risk assessment assuming a recreational land-use scenario was conducted for the site using characterization data collected during the interim action. These data were collected from soil and plants currently existing at the site. This assessment assumes that a final remedial action to address surface and subsurface soil and plant contamination will occur in the next two to three years.

Four exposure pathways were evaluated using the RESRAD computer code (Version 5.61):

- inhalation of resuspended dust/soil particulates,
- incidental ingestion of soil,
- ingestion of plant material, and
- ingestion of meat from animals that have foraged in the affected area.

In addition to these pathways, a screening calculation was conducted to address inhalation of wood smoke assuming that firewood gathered from the area might be burned in a home.

Of these pathways, inhalation of wood-smoke did not contribute significantly to dose (0.03 mrem/year). In addition, incidental ingestion of soil and inhalation of resuspended dust contributed less than 1 mrem to the potential annual dose. Plant ingestion was the primary contributor to annual dose (93%), and ingestion of game meat was the second highest contributor (5%).

The plant ingestion pathway assumes consumption of 30 grams of leafy material (e.g., in the form of herbal tea), and 200 grams of prickly pear fruit. Under these assumptions, a soil concentration of approximately 100 pCi of strontium-90 per 1 gram of soil, and a plant concentration of 200 to 300 pCi/g, correlate to an annual dose level of 10 mrem. If this scenario were repeated over a three to five year period, the chance of lifetime excess cancer risk would be approximately 1 in 100 000 (1×10^{-5}). The maximum strontium-90 concentration in surface soil at the site is 27 pCi/g. Only one chamisa plant and one mullein (skunk cabbage) were found to be contaminated at levels approaching 200 pCi/g (the chamisa plant measured 118 pCi/g in the leafy consumable portion, and the mullein, which is not typically considered consumable, measured 158 pCi/g) (Table 1). Thus, the risk posed by soil and plant contamination at this site is within the acceptable risk range of 1 in 10 000 to 1 in 1 000 000 specified by the National Contingency Plan (EPA 1990, 0559).

4.0 INTERIM ACTION

While the exposure levels discussed in Section 3.0 indicate that the current risk associated with the site is within acceptable levels, the strontium-90 concentrations in site plants potentially vary with each season. Therefore, a revised interim action approach was developed. One objective of this approach was to minimize the potential for exposure of humans and foraging animals to strontium-90 contamination remaining at the site until a final remedy is implemented. The second objective of the revised approach was to reduce the potential for contaminants in soil and plant litter to migrate as a result of storm water runoff. The measures taken to achieve these objectives are discussed in Sections 4.1 an 4.2.

4.1 Risk Management Measures

Becuase the strontium-90 concentrations in site plants potentially vary with each season, measures were taken to control the access of people and foraging animals to the area with plants contaminated by strontium-90. An exclusion zone was established encompassing the

area in which elevated concentrations of strontium-90 were detected in surface soil and plants. This exclusion zone was constructed using steel posts and snow fencing. The resulting fence is approximately 4 ft tall, and "Soil Contamination Area" signs are posted every 30 ft along the fence. Fig. 2 shows the location of the exclusion zone. Attachment A includes photographs of the exclusion zone fence and postings.

4.2 Storm Water Runoff Control Measures

Contaminated surface soil and plant litter are present at the site, and this material could be mobilized during storm water runoff events. Therefore, storm water control measures were installed to prevent soil and plant debris from being transported off site. These measures included the following.

- A silt fence was installed inside the exclusion zone fence along the northern and eastern portions of the site to trap soil or debris that might be transported by sheet flow across the contaminated area. Fig. 2 shows the location of the silt fence. Attachment A includes photographs of the silt fence.

- Straw bales were placed along the edge of a channel that emerges from a culvert along the western portion of the site as a measure to prevent a potential high-discharge storm event from flowing onto the site. Fig. 2 shows the configuration of the straw bales. Attachment A includes a photograph of the storm water controls.

In addition to these measures, the condition of the storm water runoff control measures will be inspected on a monthly basis and/or within 72 hours of rainfall events that exceed one-half inch in the Bayo Canyon area.

5.0 CONCLUSIONS

The interim action activities conducted in the TA-10 Central Area are expected to limit the access of people and foraging animals to the area with elevated strontium-90 concentrations, and to prevent soil and plant debris from being transported off site during storm water runoff events. This interim action is expected to mitigate the potential for exposure to strontium-90

contamination in plants and soil at the TA-10 Central Area for two to three years, pending selection and implementation of a final remedy for the site.

6.0 REFERENCES

LANL (Los Alamos National Laboratory), October 1996. "Bayo Canyon Interim Action Pilot Field Implementation Plan," Los Alamos National Laboratory Environmental Restoration report, Los Alamos, New Mexico. (LANL 1996, 06-0151)

EPA (US Environmental Protection Agency), March 8, 1990. "National Oil and Hazardous Substances Pollution Contingency Plan," Final Rule, 40 CFR Part 300, *Federal Register*, Vol. 55, No. 46, p. 8666. (EPA 1990, 0559)

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ATTACHMENT A PHOTOGRAPHIC LOG

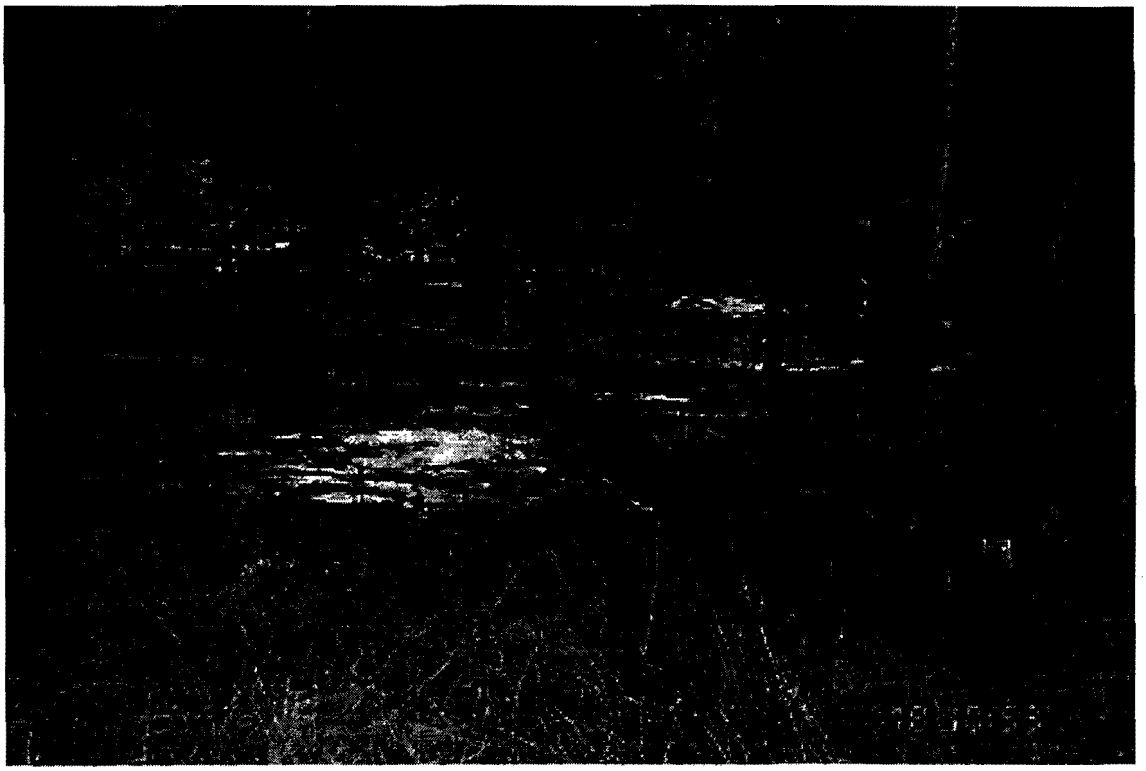

Fig. 1. View north of exclusion zone fence (pale fence in foreground) and silt fence (shorter dark fence).

Fig. 2. View eastward of exclusion zone fence and silt fence.

Fig. 3. Exclusion zone posting.

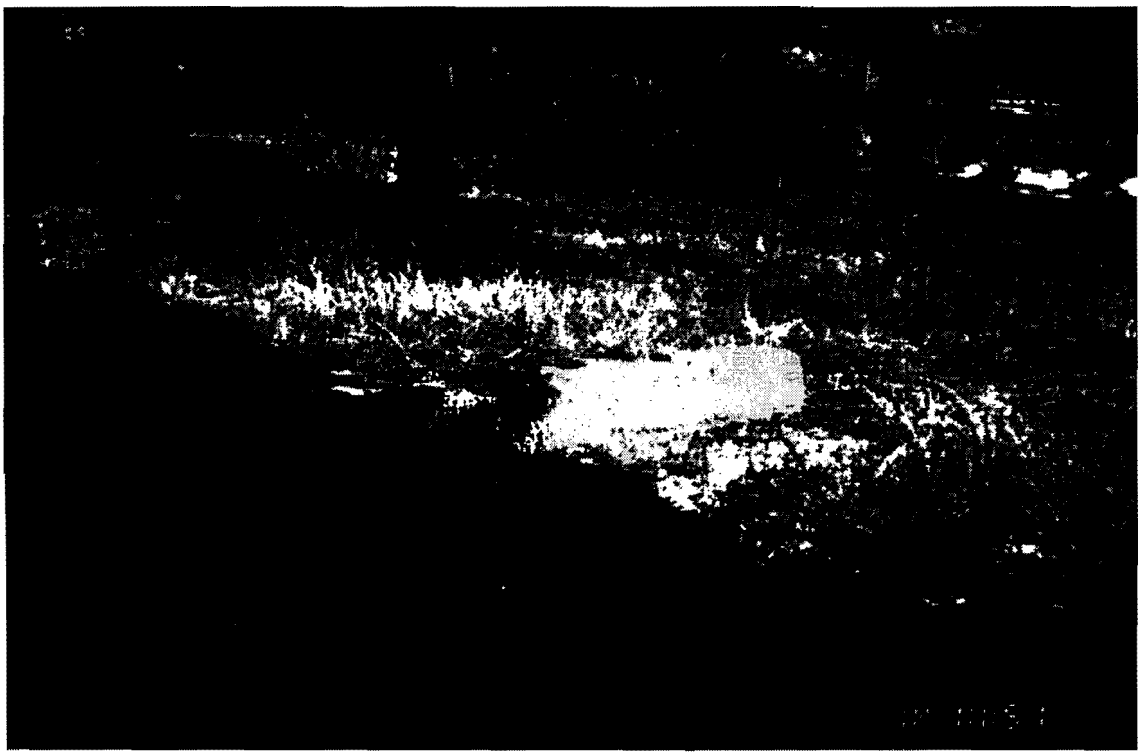

Fig. 4. Small straw-bale berm to divert flow from culvert.

INTERIM ACTION REPORT
APPROVAL/DISAPPROVAL FORM

PRSs 10-002(a,b), 10-003(a-o), 10-004(a,b) 10-007

The undersigned have reviewed the Interim Action Report and believe that the Intent and goals of the Interim Action Plan have been met.

Garry Allen GRAllen Date 22 April 97

Bonnie Koch [signature] Date 22 April 97

I, Theodore J. Taylor, DOE-LAAO, **APPROVE** __√__, **DISAPPROVE** _____, the accompanying Interim Action Report for PRSs 10-002(a,b), 10-003(a-o), 10-004(a,b) 10-007, TA-10.

The following reasons reflect the decision for disapproval:

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_____

_____

_____

_____

_____

Signed: [signature] Date: 6/2/97