ITLV/13052--026
DOE/NV/13052--026

PRELIMINARY ASSESSMENT

FOR

CAU 485:
CACTUS SPRING RANCH Pu AND DU SITE

CAS NO. TA-39-001-TAGR:
SOIL CONTAMINATION

TONOPAH TEST RANGE, NEVADA

Revision No. 1

IT CORPORATION
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Preliminary Assessment Team

JULY 1998

This work performed for the U.S. Department of Energy by IT Corporation under
Contract No.: DE-AC08-97NV13052

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List of Acronyms and Abbreviations

α	Alpha
β	Beta
AEC	U.S. Atomic Energy Commission
CAU	Corrective Action Unit(s)
CAS	Corrective Action Site(s)
cm	Centimeter(s)
DOE/NV	U.S. Department of Energy, Nevada Operations Office
DU	Depleted Uranium
FADL	Field Activity Daily Log
FIDLER	Field Instrument for Detecting Low Energy Radiation
ft	Foot (feet)
γ	Gamma
GPS	Global Positioning System
H&N	Holmes & Narver, Inc.
in.	Inch(es)
IT	IT Corporation
m	Meter(s)
REECo	Reynolds Electrical & Engineering Co., Inc.
TTR	Tonopah Test Range
USGS	U.S. Geological Survey

Executive Summary

Corrective Action Unit 485, Corrective Action Site TA-39-001-TAGR, the Cactus Spring Ranch Soil Contamination Area, is located approximately six miles southwest of the Area 3 Compound at the eastern mouth of Sleeping Column Canyon in the Cactus Range on the Tonopah Test Range. This site was used in conjunction with animal studies involving the biological effects of radionuclides (specifically plutonium) associated with Operation Roller Coaster. The location had been used as a ranch by private citizens prior to government control of the area.

According to historical records, Operation Roller Coaster activities involved assessing the inhalation uptake of plutonium in animals from the nonnuclear detonation of nuclear weapons. Operation Roller Coaster consisted of four nonnuclear destruction tests of a nuclear device. The four tests all took place during May and June 1963 and consisted of Double Tracks and Clean Slate I, II, and III. Eighty-four dogs, 84 burros, and 136 sheep were used for the Double Tracks test, and ten sheep and ten dogs were used for Clean Slate II. These animals were housed at Cactus Spring Ranch. Before detonation, all animals were placed in cages and transported to the field. After the shot, they were taken to the decontamination area where some may have been sacrificed immediately. All animals, including those sacrificed, were returned to Cactus Spring Ranch at this point to have autopsies performed or to await being sacrificed at a later date.

A description of the Cactus Spring Ranch activities found in project files indicates the ranch was used solely for the purpose of the Roller Coaster tests and bioaccumulation studies and was never used for any other project. No decontamination or cleanup had been conducted at Cactus Spring Ranch prior to the start of the project. When the project was complete, the pits at Cactus Spring Ranch were filled with soil, and trailers where dogs were housed and animal autopsies had been performed were removed. Additional pens and sheds were built to house and manage livestock involved with the Operation Roller Coaster activities in 1963.

According to field records, a hardened layer of livestock feces ranging from 2.54 centimeters (cm) (1 inch [in.]) to 10.2 cm (4 in.) thick is present in each of the main sheds. IT personnel conducted a field visit on December 3, 1997, and noted that the only visible feces were located within the east shed, the previously fenced area near the east shed, and a small area southwest of the west shed. Other historical records indicate that other areas may still be covered with animal feces, but heavy vegetation now covers it. It is possible that radionuclides are present in this layer, given the

history of operations in this area. Chemicals of concern may include plutonium and depleted uranium.

Surface soil sampling was conducted on February 18, 1998. An evaluation of historical documentation indicated that plutonium should not be and depleted uranium could not be present at levels significantly above background as the result of test animals being penned at the site. The samples were analyzed for isotopic plutonium using method NAS-NS-3058. The results of the analysis indicated that plutonium levels of the feces and surface soil were not significantly elevated above background.

There is a high degree of confidence that the animals used during Operation Roller Coaster were kept at Cactus Spring Ranch and that the animal feces currently there are from the animals used in this test. Some reports indicate that the bioaccumulation study took place immediately after the Double Tracks test of Operation Roller Coaster on May 15, 1963, which utilized the dogs, burros, and sheep exposed during that detonation. Other reports and interviews state that the bioaccumulation study was performed approximately ten years later during the early 1970s and that the animals used for the study were cattle. There is a low degree of confidence as to the time frame that the visible feces were deposited. Investigation of Cactus Spring Ranch Soil Contamination Area should be based on this information.

1.0 Site Location

1.1 Location

Cactus Spring Ranch, Tonopah Test Range (TTR), Nevada

1.2 Driving Directions

From the main gate, take Main Road south to Browns Lake Road/Cactus Spring Road, turn west (right) and drive for 4.8 miles to Cactus Spring Ranch (IT Corporation [IT], 1993).

1.3 Global Positioning System (GPS) Coordinates

GPS coordinates have been identified (Rodriguez, 1997).

2.0 Available Historical Information

2.1 Maps/Drawings of the Site Location

- Reference Number: Figure 2-1
  Title: "Tonopah Test Range Layout, Nye County, Nevada" (U.S. Department of Energy, Nevada Operations Office [DOE/NV], 1996).

- Reference Number: Figure B-5
  Title: "Site Location Map, Cactus Spring Ranch, Tonopah Test Range, Nye County, Nevada" (DOE/NV, 1996).

- Reference Number: JS-054-094-C20.1
  Title: "Project 4.1 Roller Coaster Cactus Spring Animal Holding Area, Area 54" (Holmes & Narver, Inc. [H&N], 1963).

2.1.1 Comments/Discussion

- Map/Drawing Figure 2-1 provides a general location of this Corrective Action Site (CAS) at the TTR (DOE/NV, 1996).

- Map/Drawing Figure B-5 provides the site-specific location of this CAS and associated physical remains (IT monument markers, building remains, and other associated features) (DOE/NV, 1996).

- Map/Drawing JS-054-094-C20.1 is a schematic drawing of the Cactus Spring Animal Holding Area, drawn in June 1963 (H&N, 1963).

2.2 Aerial Photographs

- Photo Number: OH-3517
  Frame Number: N/A
  Date Taken: 1963 (IT, Date Unknown)

- Photo Number: OH-3491
  Frame Number: N/A
  Date Taken: 05/02/63 (IT, Date Unknown)

2.2.1 Comments/Discussion

- Photo number OH-3517 shows an aerial view looking west with Cactus Spring in the foreground, Sleeping Column Canyon in midground, and the Double Track Fallout Array (Range 71- Nellis Air Force Range) in the background.

- Photo number OH-3491 is an aerial view of the Cactus Spring animal farm from 122 meters (m) (400 feet [ft]) above ground.

2.3 Ground-Level Photographs

- Photo Number: OH-3490, OH-3507 and OH-3513
  Frame Number: N/A
  Date Taken: 1963 (IT, Date Unknown)

- Photo Number: OH-3483 and 3511
  Frame Number: N/A
  Date Taken: 1963 (IT, Date Unknown)

- Photo Number: OR-3121
  Frame Number: N/A
  Date Taken: 04/02/63 (IT, Date Unknown)

- Photo Number: A-TTR-02-28
  Frame Number: N/A
  Date Taken: 08/93 (IT, Date Unknown)

2.3.1 Comments/Discussion

- Photo numbers OH-3490, 3507, and 3513 show various views of Cactus Spring Ranch, including the animal holding areas, holding pens, and animal trailers where dogs were housed and autopsies were performed.

- Photo numbers OH-3483 and 3511 show sheep and burros in the Cactus Spring animal holding area.

- Photo number OR-3121 shows beagles in their cages.

- Photo number A-TTR-02-28 shows the remains of the east burro shed at Cactus Spring Ranch as it appeared in August 1993. The wooden shed shows obvious decay, and the fence that once surrounded the perimeter is no longer there. Heavy desert vegetation covers the ground.

2.4 Interviews

- Person Contacted: Bob Wilson
  Company: University of Rochester, N.Y. (Retired)
  Phone Number: None Listed
  Date Interviewed: 05/02/95 (Wilson, 1995)

- Person Contacted: Harold Rarrick
  Company: Sandia National Laboratories (Retired)
  Phone Number: None Listed
  Date Interviewed: 09/22/93 (Rarrick, 1993)

2.4.1 Comments/Discussion

- Mr. Wilson stated that there may have been as many as 400 animals at Cactus Spring Ranch at one time and that after the Double Tracks test, the animals were kept in the holding pens, possibly as long as six weeks. He also stated the animal feces were not screened for radiation. The feces would have been put into a pit or left to accumulate in the pens (Wilson, 1995).

- Mr. Rarrick stated that the grazing experiments involving plutonium uptake and bioaccumulation studies of animals were totally different experiments and time frames than the Roller Coaster Project in 1963. He also stated cattle that had been grazing in the fallout area were purchased from ranchers and sacrificed and that this was only done after the Double Tracks test in May 1963. This was part of an environmental study at the TTR, which was conducted ten years later (Rarrick, 1993).

- Mr. Rarrick also stated that Cactus Spring Ranch was used as a sacrifice area. No additional radioactive material was brought in to feed the animals, and, in fact, the animals did not graze at all because they were kept in holding pens at all times. Feces would have been confined to the pen area and sheds that housed the animals. The Roller Coaster and bioaccumulation projects were the only activities conducted at Cactus Spring, and the potential for contamination would be from depleted uranium (DU) and plutonium (Rarrick, 1993).

2.5 Previous Sampling

Sampling was conducted by IT personnel in 1998 (IT, 1998).

2.5.1 Comments/Discussion

Surface soil sampling was conducted on February 18, 1998. An evaluation of historical documentation indicated that plutonium should not be and DU could not be present at levels significantly above background as the result of test animals being penned at the site. Sample locations were selected to ensure that feces and surface soil were sampled from areas defined by a January 1998 surface radiological survey to have the highest levels of radiological activity. The samples were analyzed for isotopic plutonium using method NAS-NS-3058. The results of the analysis indicated that plutonium levels of the feces and surface soil were not significantly elevated above background (IT, 1998).

2.6 Historic Site Activities

- Project Roller Coaster consisted of four different tests, two that involved animals. Double Tracks took place in Stonewall Flat on Range 71 in the Nellis Air Force Range on 05/15/63 and utilized 84 dogs (beagles), 84 burros, and 136 sheep. Clean Slate I took place on Cactus Flat on 05/25/63. This test utilized no animals. Clean Slate II took place on Cactus Flat on 05/31/63, and 10 dogs (beagles) and 10 sheep were used. Clean Slate III took place on Cactus Flat on 06/09/63, and no animals were used (U.S. Atomic Energy Commission [AEC], 1964).

- Cactus Spring Ranch was involved with the original Operation Roller Coaster activities in 1963. This site was used in conjunction with animal studies involving the biological effects of radionuclides (specifically plutonium). Cactus Spring had previously been used as a ranch by private citizens prior to government control of the area (DOE/NV, 1996).

- The grazing experiments involving plutonium uptake and bioaccumulation studies of animals were different experiments and had a different time frame than Project Roller Coaster (Rarrick, 1993).

2.6.1 Types of Activities Performed

- There are conflicting reports as to the dates of activities regarding the bioaccumulation studies at Cactus Spring Ranch. In May 1963, sheep and burros were kept at the ranch for possibly as long as six weeks after the Double Tracks test. A layer of animal feces remained in 1995, but it was believed that this was from a separate test conducted in the 1970s (Wilson, 1995).

2.7 Site Receptors

Site receptors were not identified.

2.8 Surface Geophysical Surveys

No surface geophysical surveys were identified.

2.9 Radiological Survey

Radiological surveys were conducted by IT personnel in 1993, 1997, and 1998.

2.9.1 Type of Survey

- Beta-gamma (β-γ) contamination survey (Ludlum Model 3 w/probe model 44-9) and alpha (α) contamination survey (Ludlum Model 3, w/probe Model 43-65) surveys (IT, 1993)

- α-β contamination survey (NE Technologies Electra w/probe model 6DP) (IT, 1997)

- α-β and γ contamination surveys (NE Technologies Electra w/probe model DP6BD and Eberline Model ESP-2 ratecounter with probe detector Field Instrument for Detecting Low Energy Radiation (FIDLER) Model 706204, respectively) (IT, 1998).

2.9.2 Date of Survey

- There were α and β-γ contamination surveys conducted on 07/22/93 by IT field personnel (IT, 1993).

- An α-β contamination survey was conducted on 12/03/97 by IT field personnel (IT, 1997).

- α-β and γ contamination surveys were conducted on 1/26/98 by IT personnel (IT, 1998).

2.9.3 Comments/Discussion

- Measurements were taken for β-γ and α contamination by placing probes approximately 0.64 centimeter (cm) (0.25 inch [in.]) from the surface to be measured, and allowing the reading to stabilize for approximately 1 minute. Readings were taken in both the east and west sheds (location shown on map/drawing Figure B-5) on the surface of hardened animal feces. Results were within background (IT, 1993).

- The α-β measurements were taken just inside the east shed and within the confines of where the fence was previously located (fence is now down). Within the west shed it appeared that all feces had either been removed or covered with gravel and cobble-size rocks. A small mound of feces was located on the southwest corner of the west shed, and a reading was taken at this location. One-minute measurements were taken with the probe directly on the ground. All results were background (IT, 1997).

- The area around Cactus Spring Ranch, including two animal trailers that were located northwest of the east burro shed were surveyed. There was no α ground contamination detected in this area (Reynolds Electrical & Engineering Co., Inc. [REECo], 1966).

- All measurements were taken within the east and west sheds and their corresponding holding pen areas. All results were within background (IT, 1998).

3.0 Site Description

3.1 Surface Structures/Conditions

- The Cactus Spring Site is located within a canyon on the east flank of the Cactus Range. The remains of several structures are located at this site and include dilapidated structure pre-date Operation Roller Coaster and two animal holding pens. The site terrain is comprised of uneven ground that slopes to the east. A natural spring discharges near the Cactus Spring Road and flows a short distance before infiltrating into the subsurface (DOE/NV, 1996). This natural spring could transport radionuclides, and this possibility should be considered.

- Coordinate information is available for IT monuments 45 through 50 (Rodriguez, 1997).

- See Figure B-5 for locations of IT monuments 45 through 50 (DOE/NV, 1996).

3.2 Surface and Subsurface Geological Conditions

The TTR consists primarily of alluvium-covered valleys separated by northerly trending mountain ranges, with igneous rocks of Tertiary age forming 90 percent of the outcrops. The general area surrounding Cactus Spring Ranch consists of thick sequences of conglomerate, quartzite, and limestone (Ekren et al., 1971).

3.3 Depth to Groundwater

A spring is located at the Cactus Spring Ranch Site where groundwater is discharged to the surface. An inferred, down-to-the-east normal fault may yield greater depths to groundwater at the eastern edge of the site. Alluvial-groundwater flow direction is generally northeast (Ekren et al., 1971).

3.4 Waste Description

A description of the waste has been identified.

3.4.1 Size, Shape, Depth

The site is a 198 m x 61 m (650 ft x 200 ft) rectangular area consisting of various buildings and animal holding pens (IT, 1993).

3.4.2 Form (solid, liquid, sludge, gas, etc.)

Animal feces are in solid form, ranging from 2.54 cm (1 in.) to 10.2 cm (4 in.) in depth (IT, 1993).

3.4.3 Type (pit, tank, landfill, brick, etc.)

- Feces are spread throughout the east shed and holding pen which housed burros. The feces are also found in a small area directly southwest of the west shed which housed sheep used during Operation Roller Coaster (IT, 1997).

- Feces and surface soil were sampled on 2/18/98 from both the east and west sheds (IT, 1998).

3.4.4 Estimate of Site Waste Volume

Site waste volume has not been identified.

3.5 Chemicals of Concern

- Plutonium (DOE/NV, 1996).

- Low-level uranium and plutonium on-site contamination primarily attached to dirt particles (Rarrick, 1993).

- Evaluation of historical documentation indicated that DU could not be present at the site as deposited by the test animals at levels significantly above background. Analysis for plutonium of samples taken of the feces and surface soil produced results at levels not significantly above background (IT,1998).

3.6 Type of Affected Media (soil, water, wood, concrete, etc.)

Feces affected soil in the area, acting as a fertilizer. Numerous desert plants and vegetation are currently growing in the previous animal holding area (IT, 1997).

3.7 Chemical Release Documentation

No documented releases from Cactus Spring Ranch were identified.

4.0 Annotated Bibliography

Ekren, E.B., R.E Anderson, C.L. Rogers, and D.C. Noble. 1971. *Geology of Northern Nellis Air Force Base Bombing and Gunnery Range, Nye County, Nevada*, U.S. Geological Survey (USGS) Professional Paper 651. Washington, DC.

Note: This report provides general surface and subsurface geological information as well as the location of Cactus Spring and the direction of surface water drainage (see Attachment H).
Location: IT Library, Reference 0063

Holmes & Narver, Inc. 1963. Cactus Spring Animal Holding Area Drawing. Produced for the AEC. Las Vegas, NV.

Note: This drawing provides locations of animal pens, sheds, corrals, trailers, and buildings at Cactus Spring Ranch (see Attachment L).
Location: IT Library, Reference 4238.

IT Corporation. Date Unknown. Photos from IT Corporation's Office of Public Affairs, Las Vegas, Nevada: OH-3517, OH-3491, OH-3490, OH-3507, OH-3513, OH-3483, OH-3511, OR-3121, and A-TTR-02-28. Las Vegas, NV. IT.

Note: These photos (aerial and ground-level) provide information regarding the layout of Cactus Spring Ranch, including the location of animal holding areas and sheds. Copies are located in two 3-ring binders at the IT Las Vegas office (see Attachment A).
Location: IT Office of Public Affairs in Operation Roller Coaster Photo Albums

IT Corporation. 1993. "General Field Data Form" and "Initial Site Radiological Survey Form." Las Vegas, NV. IT.

Note: IT visit to Corrective Action Unit (CAU) 485, CAS No. TA-39-001-TAGR conducted by M. Theodorakos and R. Dubiskas on 7/30/93 to gather site-specific information and conduct a radiological survey (see Attachment B).
Location: IT Project Files for CAU 485, CAS TA-39-001-TAGR

IT Corporation. 1997. "Field Activity Daily Log," 12/03/97. Las Vegas, NV.

Note: IT visit to CAU 485, CAS No. TA-39-001-TAGR conducted by C. Rodriguez, B. Bull, D. Wilson, D. Arnold, and C. Speer on 12/03/97 to gather information, conduct a radiological survey, and take photographs (see Attachment C).
Location: IT Project Files for CAU 485, CAS TA-39-001-TAGR

IT Corporation. 1998. Memorandum from Dustin Wilson regarding "CAU 485, CAS TA-39-001-TAGR, Sampling event on February 18, 1998." Las Vegas, NV.

Note: This memorandum states that samples of the feces and surface soil were analyzed for isotopic plutonium and showed no evidence of levels significantly above background. The attachments contain specific information regarding the 1998 radiological survey, recommendation for sampling, sample locations, sample collection logs, FADLs, analytical results, and a review of the analytical data (see Attachment M).
Location: IT Project Files for CAU 485, CAS TA-39-001-TAGR

Rarrick, Harold. Sandia National Laboratories (retired). 1993. Transcript of interview with M. Theodorakos regarding Operation Roller Coaster, 22 September. Las Vegas, NV: IT Corporation.

Note: This interview provides information regarding operational activities, animals used during Operation Roller Coaster, and chemicals of concern (see Attachment D).
Location: IT Central Files (TTR, M)

Reynolds Electrical & Engineering Co., Inc. 1966. *Radiological Conditions at Project Roller Coaster*. Prepared for DOE/NV. Las Vegas, NV.

Note: This report provides a brief discussion of radiological survey results at all sites involved with Project Roller Coaster, including Cactus Spring Animal Farm (see Attachment F).
Location: IT Library, Reference Gen Bks 0557

Rodriguez, Cheryl. IT Corporation. 1997. E-mail to M. Hagenow and M. England (IT) regarding GPS Coordinates for the IT Monuments at TTR, 24 September. Las Vegas, NV.

Note: This E-mail provides GPS coordinates and elevations for this CAS (see Attachment G).
Location: IT Central Files (TTR, E)

U.S. Atomic Energy Commission, Nevada Operations Office. 1964. *Project Manager's Report, Project Roller Coaster*. Las Vegas, NV: Reynolds Electrical & Engineering Co., Inc.

Note: This report provides a description of the Roller Coaster tests, dates, and locations where the tests were performed (see Attachment E).
Location: IT Library, Reference 4245

U.S. Department of Energy, Nevada Operations Office. 1996. *Corrective Action Unit Work Plan, Tonopah Test Range, Nevada*. Revision 0. Las Vegas, NV: IT Corporation.

Note: This report provides maps/drawings of this CAS as well as background information and site conditions (see Attachment J).
Location: IT Central Files (TTR, C)

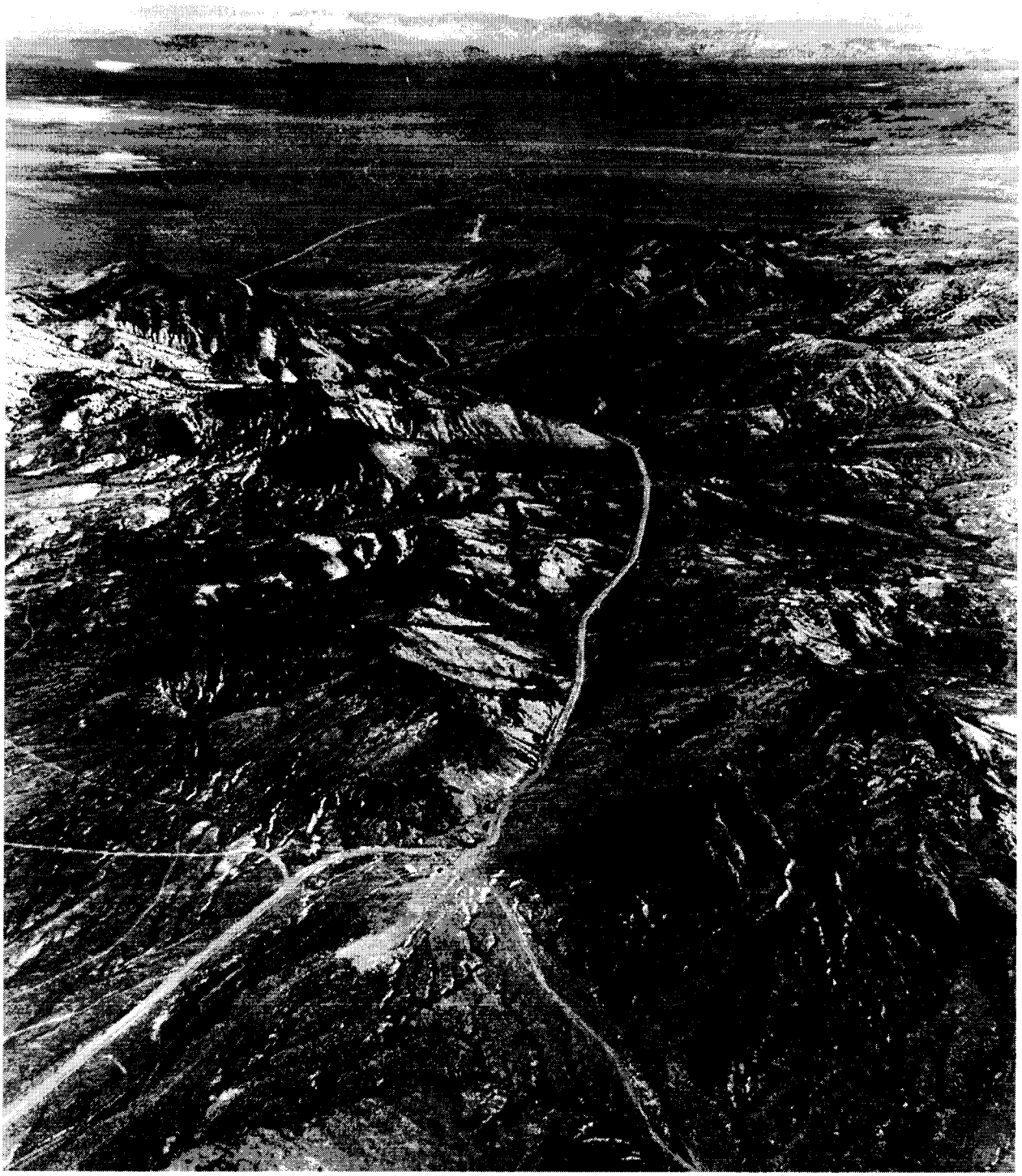
Wilson, Bob. University of Rochester, N.Y. (retired). 1995. Transcript of interview with R. Dubiskas regarding Operation Roller Coaster, 2 May. Las Vegas, NV: IT Corporation.

Note: This interview provides information regarding operational activities, animals used during Operation Roller Coaster, and chemicals of concern (see Attachment K).
Location: IT Central Files (TTR, M)

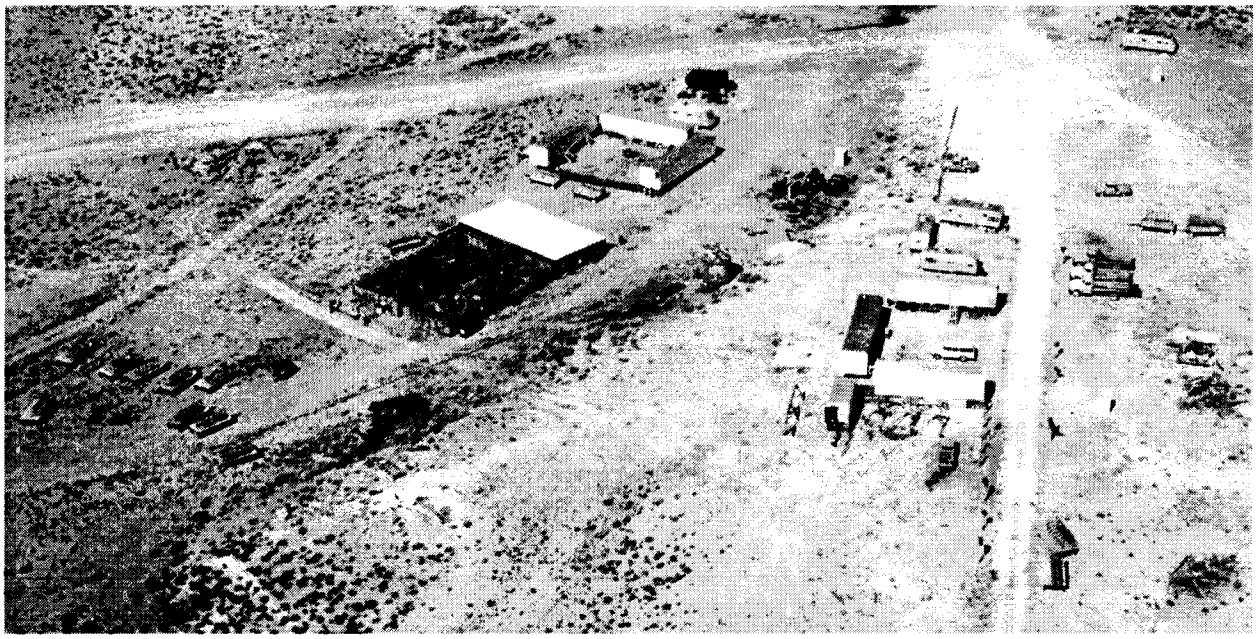
Attachment A

Cactus Spring Photos from IT Corporation's Office of Public Affairs, Las Vegas Nevada

Photo Numbers: OH-3517, OH-3491, OH-3490, OH-3507, OH-3513, OH-3483, OH-3511, OR-3121, and A-TTR-02-28



Aerial view of Cactus Spring: This view looking west shows Cactus Spring in foreground, Sleeping Column Canyon in midground, and Double Track Fallout Array on Range 71 (Nellis Air Force Base) in background (Photo # OH-3517). This photo was taken during or after 1963.



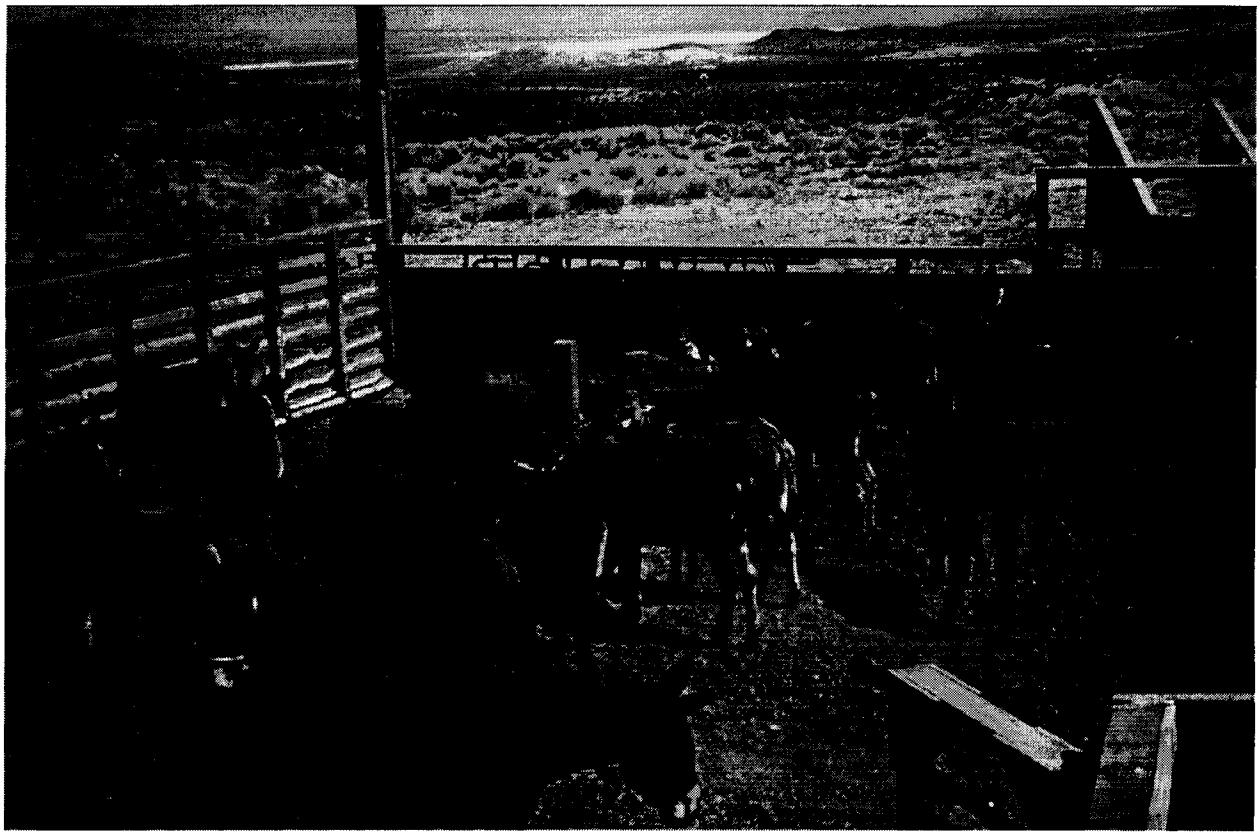
Aerial view of Cactus Spring Animal Farm from 400 feet above ground (Photo # OH-3491). Photo taken May 2, 1963.

View of Cactus Spring Ranch, Tonopah Test Range, Nevada (Photo # OH-3490). Photo taken May 1, 1963.

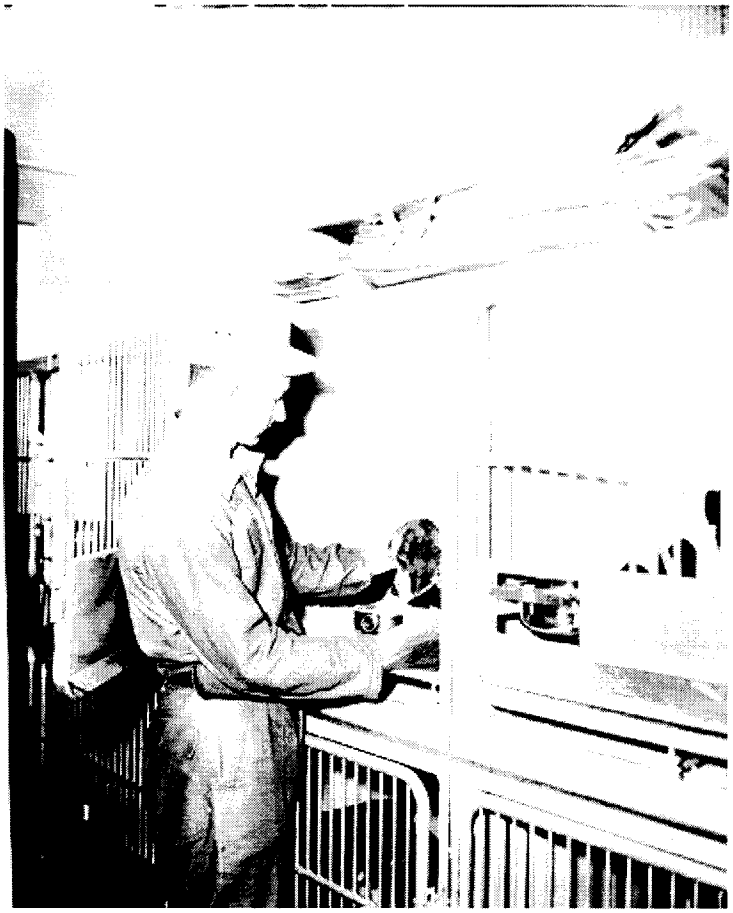
Cactus Spring Ranch/animal holding areas looking northeast (Photo # OH-3507). Photo taken in 1963.

Cactus Spring Ranch/animal holding area looking northeast (Photo # OH-3513). Photo taken in 1963.

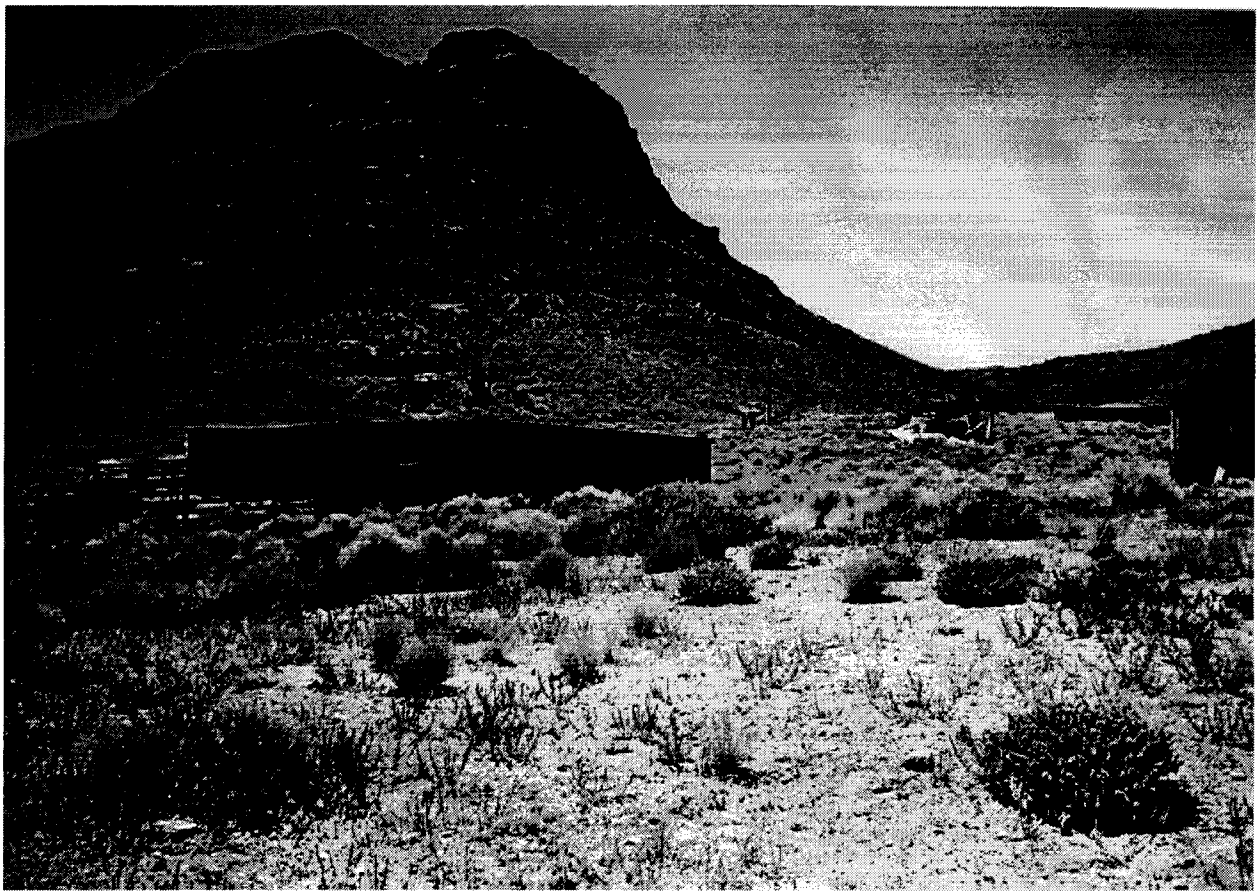
Sheep in Cactus Spring animal holding area (Photo # OH-3483). Photo taken April 2, 1963.



Burros in Cactus Spring animal holding area looking south (Photo # OH-3511). Photo taken in 1963.



Beagles housed at Cactus Spring Ranch
(Photo # OR-3121). Photo taken April 1, 1963.



Remains of east burro shed at Cactus Spring Ranch in August 1993 (photo taken from IT monument # 50) (Photo # A-TTR-02-28).

Attachment B

IT Corporation, 1993
“General Field Data Form”
“Initial Site Radiological Survey Form”

CAU 407 485

GENERAL FIELD DATA FORM

ER SITE INVENTORY FIELD DATA FORM 7

No mention of Waste Trenches/Pits from animal burial. No apparent links to outside files

TA-39-001-TA-GR ER SITE NAME: CACTUS SPRINGS [SN. #129 (30

TTR VERIFICATION DATE: 7/30/93

L: Michael Theodorakos

Richard A. Dubiskas

WAS SITE FOUND WHERE ANTICIPATED? (YES) NO ACCESSIBLE BY VEHICLE? (YES)

DRIVING INSTRUCTIONS: From Main Road Go to Browns Lake Road (East Side of Main Road) Intersection with and Cactus Spring Road (West side of Main Road). Proceed West 4.8 miles on Cactus Spring Road.

Site Map Attached

See

SECURITY REQUIREMENTS: TTR ~~NTS~~ UC BADGE Q CLEARANCE ESCORT

SITE DESCRIPTION: Site is an abandoned farm that was used to Conduct These two sheds (corral/west shed) are believed to be bioaccumulation Studies. Site Contains Two Sheds w/Connecting Corrals. Site Also Meeting for study animals Contains at least three dilapidated structures partially standing. ~~NA Site~~ is located NW of East Shed (~120FT) & A Grave enclosed in white wood fence exists @ SE Corner (approximately) beyond the SE boundary of site. In addition ~~TWO~~ ONE (NOT AT SITE) Water sources (Springs) are located within Site. Site Gently to moderate slopes to East w/some undulating Terrain. Area is Covered w/sparse vegetation (Sage, Snakeweed, Tumbleweed) Site is littered with wood debris, metal debris (Corr. Vehicle Sack, Pipe and Construction debris/Concrete, Cables, Bone Material) Appears to have been at least TWO (one with Cons. foundations in the NE Portion of site (Possible living/sleeping quarters for research employees) and two latrine

OPERATIONAL STATUS: ACTIVE (INACTIVE) ABANDONED UNKNOWN

Note: the only visible feces/dung is within Sheds. Feces/dung is not visible in corral areas. West of West Shed are two sets of Animal holding Pens

SITE SIZE: LENGTH: ~650 FEET _____ METERS

WIDTH: ~200 FEET _____ METERS

DEPTH / DIAMETER: _____ FEET _____ METERS (IF APPLICABLE)

PRESENT SITE USE: Watering point for Wild Horses

A Set of Two watering Tanks are located immediately outside of South Control Boundary

X GR IN THE ER SITE ID NO means Grave

SIGNATURE [signature] DATE 07/30/93

ER SITE ID NO. TA-39-001-TA-GR

INITIAL SITE RADIOLOGICAL SURVEY Performed on 7/22/93 (See FADL by M. The dated 7/22/93.
(COMPLETE THIS SECTION IF APPLICABLE)

SURVEY TECHNICIAN(S)/AFFILIATION: M. Theodorakos / Laura Whitesides - IT Corp.

COMPLETE AN IT RADIOLOGICAL SURVEY FORM (FRONT ONLY) AND ATTACH TO THIS FORM.

RADIOLOGICAL SURVEY DESCRIPTION: Used B/S pancake probe Ludlum Model 3, probe model 44-9. Used ∝ instrument, Ludlum Model 3, probe model 43-6 Took. Background measurement along road. Measurements were taken by placing probe ¼" from surface to be measured and allowing reading to stabilize for approximately one minute. Measurements were taken inside sheds on surface of hardened animal dung in each shed. See FADL dating 7/22

RADIOLOGICAL SURVEY RESULTS: for results.

SURVEY POINT	READING	COMMENTS
	See FADL 7/22/93	

WAS FIELD TESTING PERFORMED? YES (NO)

IF YES, COMPLETE AND ATTACH AN IT REAL TIME INSTRUMENT CALIBRATION LOG (IF APPLICAB

ALSO COMPLETE THE FIELD TEST DATA TABLE ON THE FOLLOWING PAGE.

IF LAB SAMPLES ARE COLLECTED, COMPLETE AND ATTACH IT SAMPLE COLLECTION LOG(S).

SIGNATURE [signature] 07/30/93

ER SITE ID NO. TA-39-001-TA-GR

INITIAL SITE RADIOLOGICAL SURVEY Performed on 7/22/93 (See FADL by M. Theodorakos dated 7/22/93.
(COMPLETE THIS SECTION IF APPLICABLE)

SURVEY TECHNICIAN(S)/AFFILIATION: M. Theodorakos / Laura Whitesides - IT Corp.

COMPLETE AN IT RADIOLOGICAL SURVEY FORM (FRONT ONLY) AND ATTACH TO THIS FORM.

RADIOLOGICAL SURVEY DESCRIPTION: Used B/S pancake probe Ludlum Model 3, probe model 44-9. Also a instrument Ludlum Model 3, probe model 43-65 Took Background measurement along road. Measurements were taken by placing probe ~ ¼" from surface to be measured and allowing reading to stabilize for approximately one minute. Measurements were taken inside sheds on surface of hardened animal dung in each shed. See FADL dating 7/22/9

RADIOLOGICAL SURVEY RESULTS: for results.

SURVEY POINT	READING	COMMENTS
	See FADL 7/22/93	

WAS FIELD TESTING PERFORMED? YES (NO)

IF YES, COMPLETE AND ATTACH AN IT REAL TIME INSTRUMENT CALIBRATION LOG (IF APPLICABLE)

ALSO COMPLETE THE FIELD TEST DATA TABLE ON THE FOLLOWING PAGE.

IF LAB SAMPLES ARE COLLECTED, COMPLETE AND ATTACH IT SAMPLE COLLECTION LOG(S).

SIGNATURE [signature] DATE 07/30/93

ER SITE ID NO. TA-39-001-TA-GR

FIELD TEST DATA:

TYPE TEST	LOCATION / SOURCE NUMBER	BACKGROUND (PPM)	RESULTS AND CONSTITUENTS (PPM)
	N/A		

NUMBER OF AREAS OF CONCERN IDENTIFIED AT THE ER SITE: 02

BASIS FOR THIS DETERMINATION: Anecdotal / Information & Historical Documentation & Site Visit

LIST AND BRIEFLY DESCRIBE EACH AOC AND ASSOCIATED SOURCES OR WASTE TYPE:

AOC NO.	DESCRIPTION
01	East Shed - Feces visible Bang. spotty within shed - Coral like a cone
02	West Shed feces visible Bang spotty within shed - Coral like a Conical
	Note: NO visible feces / Guano outside of sheds (covered area of sheds)

NUMBER OF SITE BOUNDARY MARKERS (e.g., GPS POINTS) PLACED: 05

MARKER NUMBER	MARKER LOCATION (Monument I.D #)
01 IT45	Southwest Corner
02 IT46	Southcentral
03 IT47	Southeast Corner
04 IT48	Northeast Corner
05 IT49	Northwest Corner & Baseline Photo (P1) 1 of 2

SIGNATURE [signature] DATE 07/26/05

ER SITE ID NO: TA-39-001-TA-GR

HEALTH AND SAFETY CONCERNS: Potential Plutonium and Depleted Uranium in animal dung from past experiment. Nails sticking up from boards, overhead timbers in sheds. Poorly supported structures

DRAW A SKETCH OF THE AREA ON IT GRAPH PAPER AND ATTACH TO THIS FORM. SHOW LOCATION OF THE SITE MARKERS AND THE NUMBERS ASSIGNED TO EACH. NOTE MEASURED DISTANCES. ATTACH ADDITIONAL SHEETS AS NEEDED.

OTHER COMMENTS CONCERNING THE MAP: NONE

ER SITE SOURCE INFORMATION

NUMBER OF IDENTIFIABLE SOURCES AT THIS ER SITE: 01

BASIS FOR DETERMINATION OF THE NUMBER OF SOURCES: Anecdotal Information and historical documents

USE THE FORM ON THE FOLLOWING PAGE TO DESCRIBE EACH INDIVIDUAL SOURCE AT THIS SITE. USE ONE FORM PER SOURCE. ATTACH ADDITIONAL FORMS AS NEEDED.

SIGNATURE [signature] DATE 07/20/95

ER SITE ID NO: 39-001-TA-GR

INDIVIDUAL SOURCE DESCRIPTION

SOURCE NO.: 01 AOC NO.: All

SOURCE TYPE: Animal feces

CONDITION / DESCRIPTION: Animals were grazed in Plutonium Contaminated (and possibly pu) fields and Transported to this location and held for bioaccumulation studies. Feces (DUNG) is currently in discontinuous ~~in~~ layers from 0-4 Inches thick and is found mainly in ~~in~~ eroded areas of Corals

SOURCE VOLUME / SIZE: unknown

LOCATION OF SOURCE WITHIN THIS AOC: East & West Sheds

SOURCE STATUS: ACTIVE (INACTIVE) ABANDONED UNKNOWN

WASTE OR CHEMICAL OF POTENTIAL CONCERN IDENTITY / DESCRIPTION:

Feces Potentially Contaminated w/ Pu & DU

IS WASTE RADIOACTIVE? YES NO (NOT KNOWN)

IS WASTE MIXED? YES NO (NOT KNOWN)

IF YES, ESTIMATE VOLUME OR AREAL EXTENT OF THE RADIOACTIVE/MIXED WASTE:

N/A

TOTAL WASTE / COPC VOLUME OR AREAL EXTENT : N/A

BASIS FOR ABOVE ESTIMATE: N/A

WASTE / COPC STATUS: ACTIVE (INACTIVE) ABANDONED

DUMPED/DISPOSED UNKNOWN

COMMENTS: IT Monument IDs For Site Boundary Markers are shown on Page 3 of 6

SIGNATURE [signature] DATE 07-Jan-03

TTR

NTS Area: Test Area

Site Name: Cactus Springs SNL#129 (FSN #30)

7/30/92

* Site ID No: TA-37-001-TA-GR

Site Coordinates:

N _____ E _____

N _____ E _____

N _____ E _____

N _____ E _____

Field Crew

Photographer: Randy Dubiskas

Affiliation: IT Corp

Field Team Member: Michael Theodorakos

Affiliation: IT Corp

Field Team Member: _____

Affiliation: _____

Subject of Photo: Cactus Springs

Note: This Monument is a Double Fora Site Boundary Marker 05

Frame #27 From NW Boundary Corner, Monument ID # IT 49

Film Roll No.: A-TTR-02

Photo ID No.: P1

Date Taken: 07/30/93

Time Taken: 1425

Compass Direction of Photo: S62E

Weather Conditions: Sunny, ~90°F, light breeze

Camera Type: Canon 35 mm

Camera ID No.: DOE # LVNE004117

Film Used: Kodak ISO 100

Baseline Photo: Y ✓ N _____

Monitoring Photo: Y _____ N ✓

Description of Photo: Cactus Springs from Northwest Boundary Corner. West Shed & Spring in Foreground. East Shed & Sink in Background

Any Other Observations: Spring is in front of Tree and to left of Tree. Spring is enclosed in Metal Fence

* GR in Site ID NO. means Grave

Attachment C

IT Corporation, 1997
“Field Activity Daily Logs,” from 12/03/97

INTERNATIONAL TECHNOLOGY CORPORATION

DAILY LOG	DATE	12	03	97
	NO.			
	SHEET	1	OF	4

FIELD ACTIVITY DAILY LOG

PROJECT NAME ER Sites | PROJECT NO.

FIELD ACTIVITY SUBJECT: Site Review

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

0715 Meet at Area 3 for Tailgate Safety Meeting

0730 Cheryl & Bob went to deliver hotel keys

0755 Left for Double Tracks Rad Safe Site

0820 Attempted to get permission for access onto Range 71 from Blackjack + Double Tracks - Denied because of lack of authorized Call Sign. Blackjack contacting T. Luke at IT office for call sign to use on range.

0845 Still waiting on call sign to enter Range 71 Note that for future trips onto Range will need a call sign.

0850 Cactus contacted us on RADIO, requested the group to go back to Bldg. 500 & get a call sign to use. Heading back.

0905 Arrived Bldg. 500 to speak to Air Force about call sign.

0920 Left Bldg 500, driving to Roller Coaster Rad Safe, will go back to Double Tracks at 1400-1600.

0930 Arrive at Roller Coaster Rad Safe Area.

VISITORS ON SITE:
Kirk Swanson (Geotrans)

CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS:
Unable to access Range 71 at 0800 due to lack of authorized call sign. ~~EE~~ was able to get access at 1400 with new call sign. Whenever

WEATHER CONDITIONS:
Sunny
High ~40-45°
Slightly breezy

~~IMPORTANT TELEPHONE CALLS:~~
Access is needed to Air Force Ranges must have authorized call sign recognized by Air Force.

IT PERSONNEL ON SITE: C. Rodriguez, B. Bull, D. Wilson, C. Speer, D. Arnold, L. Smith

SIGNATURE: Dawn Arnold DATE: 12-03-97

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG CONTINUATION SHEET

DAILY LOG				
	DATE	12	03	97
	NO.			
	SHEET	2	OF	4

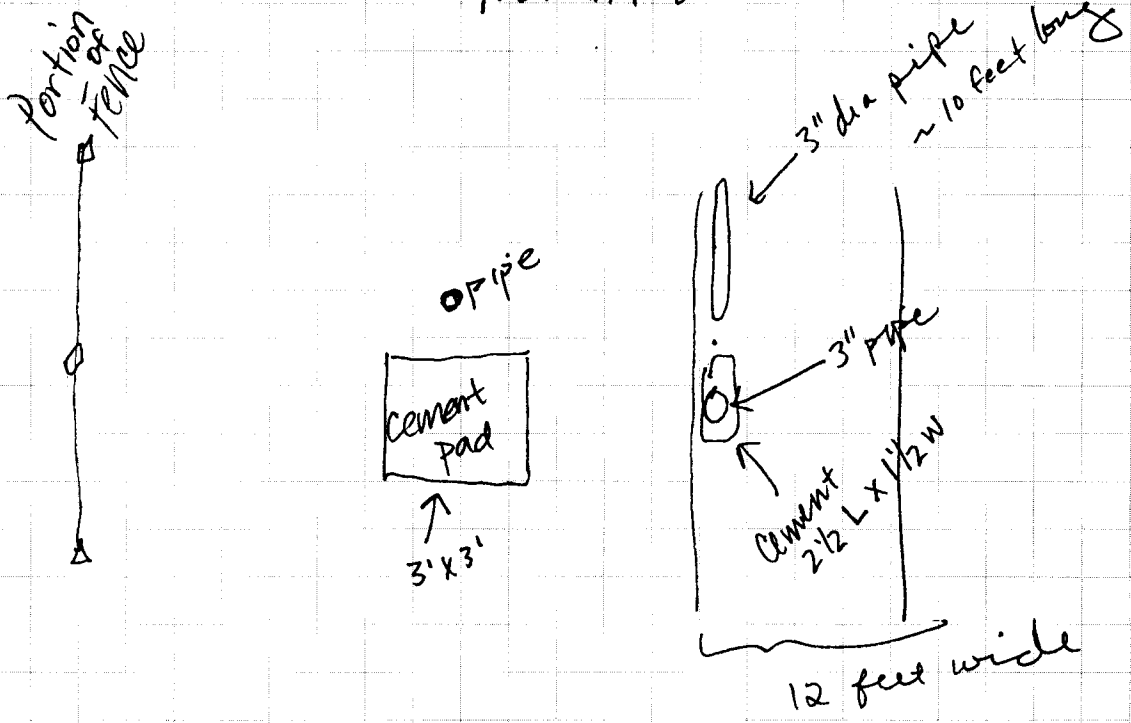
PROJECT NAME 2K sites PROJECT NO.

FIELD ACTIVITY SUBJECT Site Review

DESCRIPTION ON DAILY ACTIVITIES AND EVENTS

0930 continued: Hotline trench visible on surface running from Southwest corner of Fenced area

Signs Warn "Radioactive" Alpha Contamination. Access Prohibited



Found extra pipe holes 1 metal to west
1 clay to south of 2 on map

Carl taking Rad. Readings on several points around fence perimeter; pipes sticking out of ground.
Clay pipe, south one ~150 dpm
~~1000~~ Probe size ~100 cm²
NW corner 5 stakes down higher reading 89 dpm
Hotline at 95 dpm

1000 Left Roller Coaster, drive to Cactus Spring

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG CONTINUATION SHEET

DAILY LOG			
DATE	12	03	97
NO.			
SHEET 3	OF 4		

PROJECT NAME ER Sites PROJECT NO.

FIELD ACTIVITY SUBJECT site review

DESCRIPTION ON DAILY ACTIVITIES AND EVENTS

1015 Arrive at C.S.
- Carl & Dawn walked to Shed & Pen area to the east (built in 1963)

- Inside large shed - Dung several inches thick throughout entire floor area
No vegetation inside shed.

- Shed is divided into 2 parts with a wall as separtor, mirror images.
- Both sides contain dung.

- Carls Rad Reading JUST inside shed ~~showed~~ were at background.

- Outside Shed, front of openings which would place us inside penned area. Dung not noticeable

Walked over to original homestead area, lots of timber & barbed wire laying around on ground.

Inside Shed: dung not readily visible except in south end where rock cover not as thick. Rest of shed floor is covered with gravel, cobble size rocks

Outside just outside shed ~2 feet on south end is only visible mound of dung.
On back side of shed there are large mounds of what may be dung & soil mixture, slightly moist Difficult to be positive of how much dung is present.

Carls Rad Survey gave readings at background.
Cheryl took additional photos.

1045 left Cactus Springs
1055 Arrived at Area 3 office [IT]

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG CONTINUATION SHEET

DAILY LOG	DATE	12	03	97
	NO.			
	SHEET	4	OF	4

PROJECT NAME ER Sites PROJECT NO.

FIELD ACTIVITY SUBJECT Site Review

DESCRIPTION ON DAILY ACTIVITIES AND EVENTS

1100-1200 Dawn & Carl got ~~Bs~~ permanent badges; took lunch at the cafeteria.

1200 Bob, Dawn, Lynn, Cheryl, Dustin went to Area 9 for waste mgnt issues, site reviews.

1245 Went to Area 3 Landfill, waste mgnt. Area

~~1340~~ 1345 Left for Double Tracks site, stopped by Cactus Springs to take more pictures because earlier photos did not turn out

1420 Crossed Cactus Spring Gate

1430 Arrived at Double Track site - at intersection of main road & 1st graded road on the right. V-shaped Joshua Tree is good landmark. C. Speer took notes for this site.

1520 Left Double Tracks Site for Area 3 office

1545 Arrive back at Area 3 office to finish up Field work notes, prepare to leave for Las Vegas.

~~DO~~ 1600 1615 Left for Las Vegas by Cedar Gate route

2030 Arrived back at N. Las Vegas office

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG

DAILY LOG	DATE	12	03	97
	NO.			
	SHEET	1	OF	3

PROJECT NAME ER site Preliminary Assessment | PROJECT NO.

FIELD ACTIVITY SUBJECT: Site walkover

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

715 Met at Area 3 for tailgate Safety meeting.

800 Left for Double Tracks Rad Safe area.

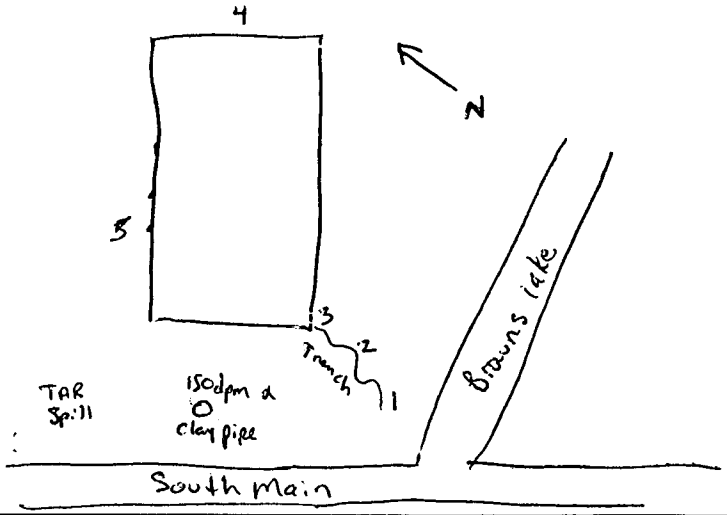
830 Denied access from Blackjack to enter Range 71. Left for Bldg 500 to get call sign. Got call-sign

920 Left Bldg. 500 for Roller Coaster Rad Safe Area.

930 Arrived at Roller Coaster Rad Area. Started walk over with PA team. Performed QC & Bkg check on Electra α, β meter. BKg 838 β, 0 α QC 1772 β, 528 α Surveyed exterior of fenced area, old (former) hot line and clay pipe.

Rad Readings

		α	β
location	1	44.9	1890
	2	95.5	1907
	3	16.9	1806
	4	20.1	1840
	5	89.9	1729



VISITORS ON SITE:
Kirk Swanson (Geotrans)

CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
Unable to access Range 71 because we did not have a valid call sign from Airforce.

WEATHER CONDITIONS:
Clear cool high 40° F

IMPORTANT TELEPHONE CALLS:
None

IT PERSONNEL ON SITE: C. Rodriguez, R. Bull, D. Wilson, C. Speer, D. Arnold, L. Smith

SIGNATURE Carl Speer

DATE: 12/3/97

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG CONTINUATION SHEET

DAILY LOG	DATE	12	3	97
	NO.			
	SHEET	2	OF	3

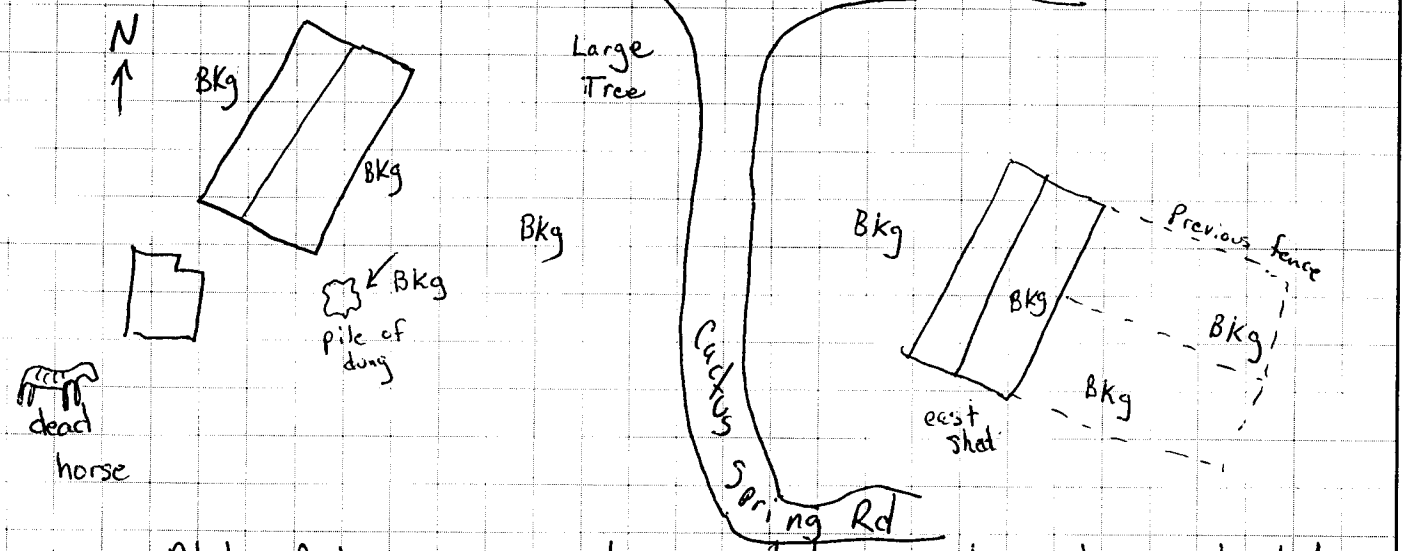
PROJECT NAME ER Sites Preliminary Assessment PROJECT NO.

FIELD ACTIVITY SUBJECT Site walk over

DESCRIPTION ON DAILY ACTIVITIES AND EVENTS

1000 Left RollerCoaster for Cactus Spring Soil Contamination Area.

1015 Arrived at Catus Spring. Performed spot checks with α,β probe taking one minute counts. Placed probe directly on ground.



Alpha-Beta measurements were taken just inside east shed and inside fence area. The fence is laying down. Numerous desert plants are growing in fence and surrounding areas. Feces are spread out through east shed and holding pens where the burros were kept. The west shed's floor was covered with rock no feces was present inside shed. It is not apparent if feces was covered over or removed. Surveyed west shed surrounding area including pile of dung on SW corner of shed. Noticed a dead horse on the SW side of old Ranch house.

1045 Left C.S Ranch.

1055 Arrived at Area 3 office for lunch

1345 Left for Double tracks Rad Safe Area.

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG CONTINUATION SHEET

DAILY LOG	DATE	12	3	97
	NO.			
	SHEET	3	OF	3

PROJECT NAME E.R Sites Preliminary Assessment PROJECT NO.

FIELD ACTIVITY SUBJECT Site Walk over

DESCRIPTION ON DAILY ACTIVITIES AND EVENTS

1430	Arrived at DT Rad Safe Area. C. Rodriguez took photos in approximately the same location / view as historical photos were taken. Performed site walk over. Found location of previous geophysical surveys, several ~~stack~~ stakes from the survey remain. Found UXO approx. 200 ft North of DT road under a bush. Could not find geodetic benchmark stake.
1520	Left DT site for Area 3.
1545	Arrived at A-3 office
1615	Left A-3 office for LV.
2030	Arrived back at Losee Rd facility.

Attachment D
Rarrick, 1993
Applicable Selections from
Rarrick Interview (Sandia National Laboratories, retired)
Pages 5, 7-9, 18, 20, 28-29

Interview Transcription
Interviewee: Harold Rarrick (Retired/SNL)
Interviewer: Michael A. Theodorakos (IT Corporation)

SUBJECT: Environmental Restoration Sites Related to Operation Roller Coaster

DATE: September 22, 1993

Other Participants: Paul Karas (Camp Dresser & McKee, Inc.)

Mike: The first site I would like to discuss is the Double Tracks Decontamination/Animal Hide Burial Area. However, there are a number of uncertainties about this site and whether or not there really is an animal hide burial. This location is still unknown as are most of the details surrounding it.

Harold: The location, and I can't pinpoint it, but it is on the Cactus Range Road going over the valley where Double Tracks is located and the last time I was there we went to the gate, the boundary gate between Tonopah Test Range and Nellis Air Force Range, and I'm quite certain that the initial animal decon area was west of that, which would be on the Air Force property. The sacrifice area was near Cactus Springs (a few hundred feet north and a little east of Cactus Springs) my understanding that most of the burials were in that area. I don't know that for sure. The idea of the decon was to take the animals that had been exposed to plutonium and decon them before bringing them to the sacrifice area so you don't contaminate the land.

Harold: Umm, what we were trying to do is get out there and see if we could find it and we couldn't get through the gate. We were there January and February, for one we didn't have keys and secondly there was about a foot of snow.

Mike: As far as the Double Tracks Decon Area, it was on the south side of the road.

For typing purposes, I just want to state today is September 22, 1993, Wednesday, currently about 11:55 a.m.

I'm going to lay this quadrangle map out and lets take a closer look maybe even doodle a little bit on the map. We are talking about the Double Tracks Decon/Animal Hides location. From what Harold has said it sounds as if we're talking about two different locations. Is that correct? We have a decon area and to the best of your knowledge the animal hide burial area was a different location then the decon. Is that correct? It sounded like you were saying that the burial was actually at the Cactus Springs location and the decon....

Harold: I don't know. It was not my understanding that sacrificing the animals occurred at the animal decon pad. They just deconned the animal, they didn't sacrifice them there. They

Double Tracks, there was nobody representing the Air Force for the Double Tracks crew, and all that was done to that site was there was some steel post put in and some magenta and yellow rope put around those fences and that was all that was done for close to ten years. The people from Goldfield would go out and use the area, you could see tire tracks around the ground zero area. There was some cattle out there too. We weren't concerned with that.

Mike: Ok. The grazing experiments were ...

Harold: The grazing experiments were totally ...

Mike: totally different and a different time frame as well.

Harold: That's right.

Mike: So they were not using the Cactus Springs location for the grazing uptake experiments.

Harold: No. In fact it wasn't a really defined experiment. What they did they took cattle that were grazing in that area and bought them from the ranchers and sacrificed them, and I've seen that report but its out of REECo. It's a NVO report and REECo environmental sciences people did the analyses. All this was a result of acute uptakes, the result of cloud passage and those animals to my understanding I think were only used on the Double Tracks experiment there were none on the clean slate experiments.

Mike: Ok, so forgive me for backtracking, but I'm going to cover these points frontwards and backwards. As far as the decon pad, our best estimate is west of the gate, separating TTR from Nellis and south of the road, and how far west of the gate would you say the decon pad would have been.

Harold: Maybe a mile. It was off the flats, in fact there was an old ghost town down right in here. It was up above that, I think it was in this area in here.

Mike: Ok, so the location was ...

Harold: Out of the flatlands, up in the hills. If you look to scale kind of like a mile from that gate, like in here.

Mike: I believe they are showing the gate right here. Let's see here, what do we got for a mile, 24,000 huh. Here's the gate. That's going to put us back in here someplace.

Harold: Its after you come out of this canyon, right here, and its after that before you get to the Flats so some place in there.

Mike: So we had no containment features, and you think a gravel base to the pad.

Harold: Probably with a decking over the top of that. So my guess is you should find french drain.

Mike: Good. It really gives us more information then we had. Where is the doggie decon pad. This is something I am unfamiliar with. This is a question from Randy Dubiskas.

Harold: It should be the same thing.

Mike: It should be, that's what he is wondering, if we are talking about the same thing, the doggie decon pad and the regular decon pad. Again, the animals used, sounded like earlier you'd mentioned dogs.

Harold: Yes, beagles.

Mike: Beagles and what else.

Harold: Possibly sheep.

Mike: Possibly sheep. Anything else?

Harold: I don't think so.

Mike: Ok.

Harold: And that is what we used on TG 57 was sheep and dogs. Beagles are specially breed and they still use them for Inhalation Toxicology.

Mike: As far the animal hide burial it sounds like we're, from our best shot at it, there may have been a burial at the decon pad, that is the Double Tracks Decon Pad, and there may have been a burial at Cactus Springs.

Harold: I think the main burial was at Cactus Springs, in there, north and east of the springs and they had a trailer complex in there north and east of the springs on the north side of the road. Maybe a couple of hundred yards east of the springs on the north side of the road there was a trailer complex and that's where they did all the surgery, that's where they did all the surgeries, the dissection of the animals and everything was done in those trailers. And I believe the pit was probably a little north of that. Because it kind of slopes back down again.

Mike: Could you describe the operational activities with the animals.

Harold: The animals were basically kept at Cactus Springs and then they were brought out to the field and put in cages. They had to be put in cages, some kind of a cage, so that they could breath but wouldn't lick themselves and they were placed shortly before the shot. Because they need water, you couldn't leave them out there for days. They brought them out early in the morning or maybe late the previous evening and they would bring them out and place the animals in the cages, then after the shot they go in and take out the cages and the animals, bring them to the decon pad, decon them, then bring them back to Cactus Springs. And some of them could have been sacrificed at the decon pad or not I don't know that.

Mike: Ok.

Harold: But all of the analysis was done, but the animals were cut up at Cactus Springs and that is where the organs were removed and sent back to someplace for chem analysis.

Mike: Ok, so Cactus Springs was used as a sacrifice area or the, sounds to me like the butchering location.

Harold: That's right.

Mike: Actual samples were collected there and sent off for analysis.

Harold: For off site analysis.

Mike: Ok. Well good, I think we have covered everything about Double Tracks that I wanted to address. Do you want to take a break at this point or....just tell me when you are getting tired of this stuff...

Harold: No, No. He's paying me, I don't care.

Mike: Ok, good deal. One thing I forgot to say at the beginning of the tape is whose present. I'm Michael T. with IT, and Paul Karas with Camp Dresser and McKee. Paul could you speak up so we could can get a voice recording.

Paul: This is Paul Karas, actually CDM Federal Programs Corporation. Work under contract to Sandia, Environmental Restoration Program.

Mike: Ok. Harold you are doing most of the talking, but I wanted you to identify yourself.

Harold: Hi I am Harold Rarrick, I'm retired Sandia, and I'm a consultant to the Sandia Environmental Restoration Program.

Mike: We are at Cactus Springs and our first question. Were any animals buried here and it sounds like yes. Is there anything you can tell me about the burial site?

Harold: As far as I know it's north of the trailer complex, the trailer complex was about 200 yards west of the springs on the north side of the road, a hundred yards maybe and I think the burial complex was probably north of that on the down slope facing north.

Mike: Ok, the trailer complex, I think earlier we said that the trailer complex was north and east of the Springs.

Harold: Did I say west, I meant east.

Mike: Is there any identifying landmarks or anything that might help us....

Harold: Not much. We went up and looked at the site in January and with a little imagination you could tell that there was stuff there. What can I tell ya.

Mike: Ok. Is there a report on the experiments, you've alluded to a WT series.

Harold: WT were the early test reports called Weapon Test reports. And these were put out by the old Abscap Air Force Special Weapon Project that became DNA. Now these were on the TG 57 reports on the Roller Coaster reports and this was an Air Force experiment, the animals were an Air Force experiments. There should be Air Force reports and those would be dated like late 63. Did you ever ask Becker if he had copies of those reports.

Mike: No. No, he said he had seen them, and he did elude to WT series, that's as far as he got. He said read them then talk to me.

Harold: My guess would be try the Kurtland Technical Library. Because that was a Kurtland Agency that did the animal experiment and they would have been published by a group from Kurtland Air Force Base, with the lab, Air Force Weapons Lab. But I would have them do the search at the Kurtland office.

Mike: Ok. We've talked about this one as well. Did animals just graze in the Roller Coaster shot areas or was additional radioactive material brought into Cactus Springs to feed the animals.

Harold: No.... No.

Mike: So nothing was brought in, in fact they did not graze.

Harold: That's right, they were all pinned in.

Mike: As we talked about earlier they were exposed to the fallout

Harold: Right, the cloud passage.

Harold: I was supervisor of Health Physics Division.

Mike: And your 1970 to 1972 tenure, you were...

Harold: Supervisor Range Operations. That's how you get out of the Health and Safety business.

Mike: Ok. Going through my form here we have reviewed photos, we've reviewed maps, and that's it, we really didn't dive into the report. Any glaring discrepancies stand out in your mind as to what I've talked about, I conveyed my conceptual understanding of what happened out there and you've given me yours.

Harold: The only discrepancy I really saw was the cattle grazing was not part of the Roller Coaster experiment, it was part of the environmental study at the Tonopah Test Range of the Roller Coaster sites, ten years later.

Mike: Again we're talking about the Roller Coaster Radioactive Decon Site. Was this the first project at the site, do you remember this area being used for other activities prior to being an established decon area.

Harold: Part of the test range.

Mike: Part of the test range, but I'm referring to this little area (Roller Coaster Radioactive Decontamination Site)..

Harold: There was no other radioactive test conducted on the range until Roller Coaster showed up.

Mike: Okay, so other than general site-wide operations this particular subsite, this ER Site, didn't have a function prior to...

Harold: No and neither did the man camp. That whole thing was built, including the well, was all built...

Mike: To your knowledge, has it been used for anything after its use as a decon area?

Harold: No.

Mike: So it was, indeed, the first project at the site and it was the last.

Harold: Yes.

Mike: First and last.

Harold: Oh, I'm sure we did. Yes because we had air samplers, and there were sticky trays, and you know all the equipment had to be deconned. Or at least if it was going to be deconned, somebody saw it was all monitored and bagged there. We might decon it in Albuquerque or somewhere, but it was all bagged and sealed up.

Mike: If you were to characterize the waste type, are we talking about strictly radioactive waste or is there a potential for anything else?

Harold: Low-level uranium and plutonium onsite contamination primarily attached to dirt particles.

Mike: But there were no solvents used? Only water and soap?

Harold: Yes.

Mike: At the completion of the project, you talked about the grading of the area. Was there any decon persay performed?

Harold: Only decontamination of the surface area was cleaned off and put into the pit.

Mike: Okay. So there was scraping and burial for decon and that was the cleanup operation. Is there any other waste or hazards present that are not detectable from the visual inspection or field testing. What they're getting at is unstable conditions that you might be aware of that are not readily apparent from a type of waste out there that would not be detected by monitoring or field testing. Anything that you're aware of?

Harold: No.

Mike: Okay, I'm down to the comments here. If you had to refer me to someone else that might be able to augment...

Harold: George Tucker.

Mike: George Tucker? Anybody else?

Harold: Yes, but he's dead. Jim, he was the Scientific Director.

Mike: Let me see if I have the name. You gave me Jim Shreeve.

Harold: Yes and he's dead. He was the Scientific Director.

Mike: Now another guy, Bruce Becker. A name that Bruce gave me was Robert H. Wilson.

Harold: At University of Rochester.

Mike: Good.

Harold: I have an interview that History Associates did with me that in the NVO public reading room. Its about Test Group 57, about the atmosphere bomb shocks, radiological safety and about Roller Coaster. Its done by History Associates under contract to NVO. Basically, the guys that worked for Penwell ran the decon station.

Mike: I got Cactus Springs here. Let's see if there's anything here that we might be able to add on top of what we've already...

Harold: Robert A. Wilson add to the Cactus Springs. Bruce said it was A, no H. Robert H. Wilson.

Mike: Robert H. Wilson, University of Rochester.

Harold: University of Rochester. Probably retired but he still may be on the faculty.

Mike: Okay, lets see here. Cactus Springs - first project at the site and the last?

Harold: Right.

Mike: Nature of the hazards and health precautions required due to existing conditions.

Harold: Normal decontamination.

Mike: Normal decon, so the hazards would have been the potential...

Harold: Plutonium and uranium.

Mike: There was no decon or cleanup prior to the start of the project, correct?

Harold; Right.

Mike: Anything at the completion of the project?

Harold: I think we just covered over the pits where the carcasses were buried and pulled out the trailers.

Mike: Okay, eluding back to the fact the carcasses were buried there, are you sure of this?

Harold: Would I bet my house on it, no.

Mike: Okay.

Mike: So as far as decon and cleanup, they just removed the equipment and to the best of your knowledge that was it?

Harold: Yes, because the levels would have been extremely low.

Mike: Yes, one thing I was thinking that the potential for the feces to be contaminated and creating a problem.

Harold: Ya, but you are still talking about picocuries.

Mike: Okay, site activities for the - Cactus Springs we talked about. Animal housing?

Harold: Yes.

Mike: Butchering and sample preparation.

Harold. Right. I think they used a nicer name than butchering, but that's what it is. You don't kill a live animal, you sacrifice it.

Mike: Okay. Again, nothing else out there, no other waste hazards present that we can't detect from visual inspection. Source condition - we don't know if we got a source out there, really.

Harold: It's a very low level one.

Mike: If there's anything.

Mike: Source location - uncertain. We've got potential for the feces and that's really the only thing. Feces would be confined within the corral. One thing I noticed out there and I forgot to bring out..

Harold: Feces are small compared with the horses.

Mike: I noticed at Cactus Springs, out in this area, there were stalls that looked like some type of animal holding stall where the animals head went through one area and just kind of held them.

Harold: Could have been sheep out there, it could have been the sheep.

Mike: Okay. But it doesn't ring a bell....

Harold: And I'm not sure if there were sheep, or just dogs. I wasn't there when they did the shot. Tucker was there when they actually did the shot. I was trying to think if they had sheep, no they had dogs.

Attachment E

AEC, 1964
Applicable Selections from
Project Manager's Report, Project Roller Coaster
Cover and Pages 7, 8, 11, 15

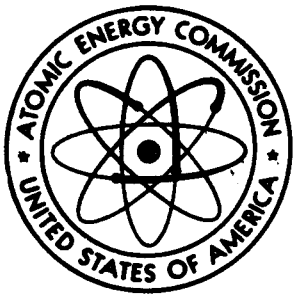
[redacted]

NVO 10

UNCLASSIFIED

PROJECT MANAGER'S REPORT

PROJECT ROLLER COASTER



UNITED STATES ATOMIC ENERGY COMMISSION
NEVADA OPERATIONS OFFICE

May 1964

ATT E-2

[redacted]

CHAPTER II

EXECUTION

A. PRE-EVENT TESTS

Nine high explosive (HE) shots were fired in April 1963 before the four Roller Coaster events. The purposes of the HE shots were:

(1) To determine the cloud height versus explosive yield.

(2) To study the effect of the burst height on the resulting cloud.

(3) To make detailed micrometeorological measurements to about 2000 feet above the surface.

(4) To study cloud growth and cloud turbulence.

(5) To provide training for operational and technical personnel.

The nine HE shots occurred as follows: Six 140-pound HE shots were fired singly 6 feet above the surface at various times on April 10; a 1500-pound shot was fired 1 foot above a steel plate at 0558 hours April 12; a 1300-pound shot was fired 1 foot above a steel plate at 0604 hours April 16; and a 2714-pound shot was fired in a trench with 8 feet of earth cover at 0516 hours April 18, 1963.

B. EXPERIMENT DESIGN

1. Double Tracks

Double Tracks was designed to investigate the characteristics of the plutonium-bearing particulate material formed from a one-point detonation of a device positioned one foot above a steel-faced concrete surface. The experiment required detailed study of the cloud resulting from the detonation and of the ground deposition pattern. Burros, dogs, and sheep were exposed to respirable concentrations of plutonium and uranium. An extensive array of ground and balloon-borne air samplers, fallout collectors, animal exposure stations, and special instruments extended more than 9 miles downwind over a 90-degree sector and encompassed an area of 70 square miles. Many features of the sampling array were movable up to one hour before shot time; certain others were manned and mobile through the period of cloud passage. Movable vertical curtains of sampling instrumentation, supported by large ballons, were placed in the downwind grid.

2. Clean Slate 1, 2, and 3

The three Clean Slate shots were designed to contrast weapons accidents with respect to hazard per unit plutonium mass contained for conditions of open storage, storage in a DASA igloo with 2 feet of earth cover, and storage in a proposed DASA igloo with 8 feet of earth cover. Extensive physical measurements similar to those made for Double Tracks were made for all Clean Slate shots, except that the arrays were shortened. A minor animal exposure program (10 dogs and 10 sheep) was conducted on Clean Slate 2. Balloon curtains were used only for Clean Slate 1 and 2. In Clean Slate 1, nine devices were detonated in sequence to simulate normal propagation (Figure 2). The igloos for Clean Slate 2 and 3 each contained 19 devices (Figure 3 and 4). The Clean Slate 2 igloo with 2 feet of earth cover had only one compartment. The Clean Slate 3 with 8 feet of earth cover had two compartments, one of which was used for blast instrumentation.

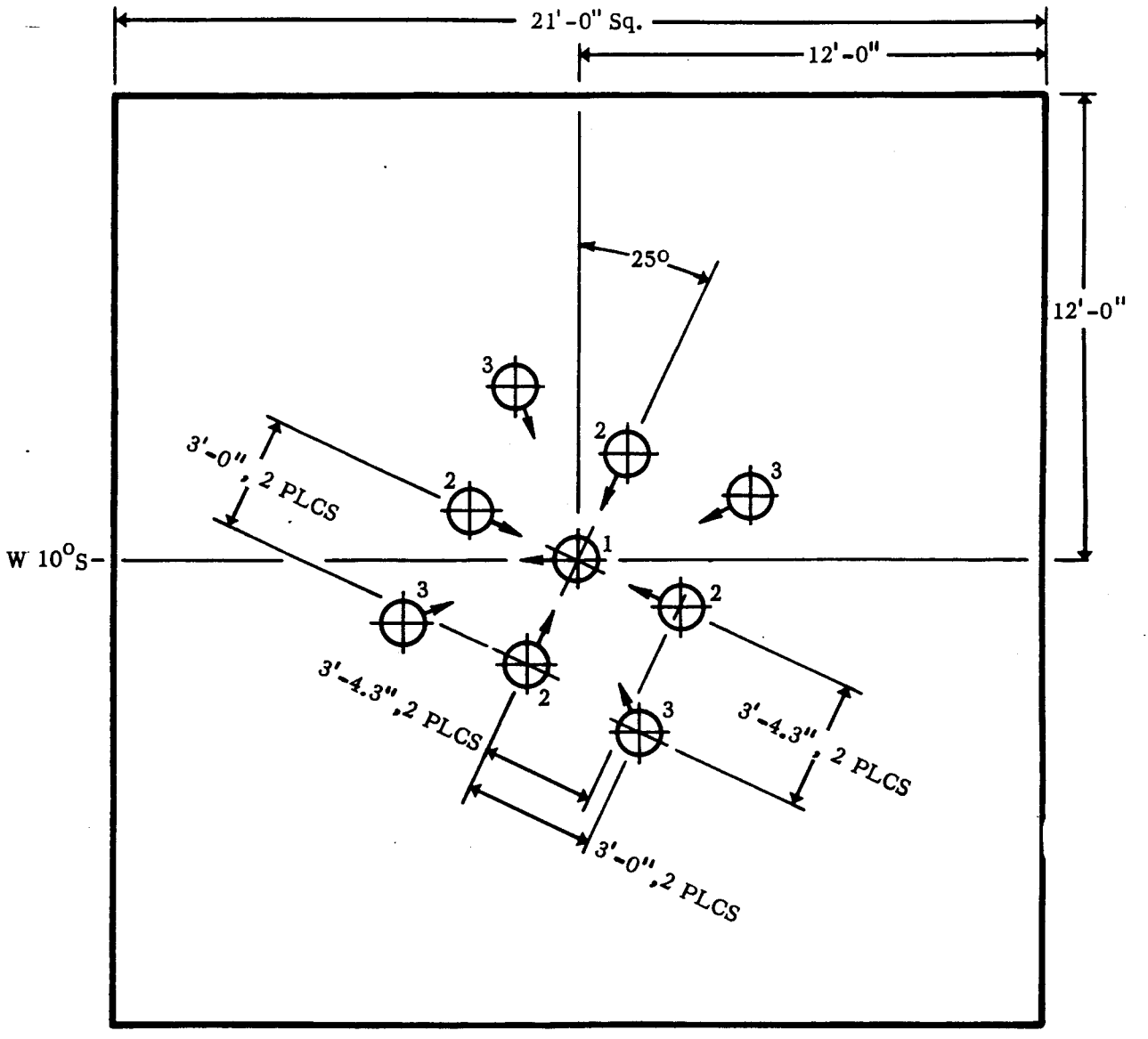
C. DEVICES

1. Double Tracks

Combinations of one basic device, with various modifications, were used in all Roller Coaster events. A modified plutonium-bearing device contained in an aluminum case was used for Double Tracks. The device contained approximately 131 pounds TNT equivalent of high explosive. All oralloy and tuballoy was removed and replaced with depletalloy. The device did not contain any form of initiation system and was modified to permit one-point detonation at one of three preidentified points.

2. Clean Slate 1

Clean Slate 1 used a total of nine devices. One of the devices contained plutonium and had the same modifications as the one used for Double Tracks. The other eight devices did not contain plutonium; all oralloy, tuballoy, and plutonium were replaced with a similar mass of depletalloy.



ARROW INDICATES DETONATOR ORIENTATION

Figure 2 – Clean Slate No. 1 Device Array

3. Clean Slate 2 and 3

Each of these events used nineteen devices. One of the devices in each event contained plutonium and was modified as for Double Tracks. The other eighteen devices in each event did not contain plutonium and had the same modifications as those used for Clean Slate 1.

D. EXECUTION DATES

The four Roller Coaster events were fired as follows:

EVENT	LOCATION	FIRING DATE	TIME
Double Tracks	37° 42' 22.53" N 116° 59' 14.23" W	May 15, 1963	0255
Clean Slate 1	37° 42' 30.92" N 116° 39' 25.09" W	May 25, 1963	0417
Clean Slate 2	37° 45' 40.43" N 116° 36' 48.58" W	May 31, 1963	0347
Clean Slate 3	37° 45' 33.22" N 116° 40' 48.88" W	June 9, 1963	0330

E. DESCRIPTION OF EVENTS

1. Double Tracks

Instrumentation for Double Tracks was in accordance with the experimental plan except that all of the desired balloon arrays were not used because of balloon failures. The event was originally scheduled for May 1, but severe winds and resulting balloon failures postponed it until 0100 May 13. On May 12 the ground and balloon arrays were rigged, but unacceptable winds prevailed and the shot was cancelled at 0300 May 13. The event was rescheduled on the basis of favorable weather forecasts for 0100 May 15. The balloon curtains were again established by 2359 May 14. At 0100 May 15, acceptable meteorological weather conditions existed except for excessive wind speed. The wind speed gradually decreased, and the event was fired at 0255, May 15, 1963. At shot time, wind speed at ground zero was 11 knots and of decreasing intensity further down the array. Wind shear of about 25 degrees existed within the vertical extent of the cloud. All instrumentation operated correctly with the exception of the incremental fallout samplers. Cloud photography, using 50-million candlepower flash bulbs, was successful. After the shot, the initial delineation of the fallout area was accomplished by the Project 2.5 mobile gamma scanner. This information was used to start the alpha-survey teams in optimal locations and permitted the survey to be completed by noon of D-day. Sample collection took place under good weather conditions.

2. Clean Slate 1

Instrumentation on the ground array was in accordance with the experimental plan with the following exceptions: water-filled collection trays were added at 21 stations to collect solubility samples; 40 additional air sampling instruments were positioned throughout the array; and several stations were equipped with double fallout collectors to allow comparison of the variations of fallout on separate collecting surfaces at the same location. Continuing high winds after Double Tracks caused further damage to ballons and it again proved impractical to rig the second balloon array.

Clean Slate 1 was scheduled for May 22. On May 20 the main balloon was damaged during inflation and had to be deflated for repair. The shot was delayed for 24 hours and rescheduled for May 23. Unsuitable meteorological conditions prevailed on May 23, and the event was further delayed to 0100 May 25. At the scheduled H-hour on May 25 the wind speed was too great but began

The contaminated debris was placed in it and covered with several feet of clean earth. Debris and fragments scattered out to a radius of 1,500 feet were collected and placed in the pit with the bladed material. The perimeters of the areas were then fenced at a radius of approximately 125 yards from ground zero. Contamination signs were affixed at intervals on each fence.

A contaminated waste disposal pit was provided at the main Rad-Safe check station. All contaminated debris and waste brought to the check station were placed in the pit along with the contamination from vehicles which accumulated in the vehicle decontamination area. The pit was then covered with several feet of clean earth, fenced, and posted. Ground surface contamination levels in the Clean Slate ground zeros vary from 2×10^2 to 1×10^5 d/m/55cm^2 alpha. Contamination levels in the Double Track ground zero area exceed 2×10^5 d/m/55cm^2 alpha in spots. (Alpha measurements were made with EIC PAC 3G with 55cm^2 probe.)

Surveys of the patterns were an objective of Projects 2.1 and 2.5. Accordingly, rad-safe initial surveys as such were not performed since traffic prior to surveys by Projects 2.1 and 2.5 would disturb the surface contamination and result in inaccurate data. Therefore, survey data from Projects 2.1 and 2.5 were used to plot isodose contours on initial survey maps. Survey data were plotted simultaneously in the AEC Operations Coordination Trailer and at the Muster Station for re-entry teams.

Resurveys of the contaminated areas were performed by Rad-Safe personnel to check on resuspension and to note changes in the pattern.

2. Off-Site:

The Off-Site Radiological Safety Program was conducted by the U. S. Public Health Service Off-Site Radiological Safety Organization. This program was carried out in accordance with the AEC-PHS Memorandum of Understanding and with Chapter 0524-05, Off-Site Rad-Safety Operations, of the SOP-NTS as revised June 26, 1961, wherein the responsibilities of the PHS Off-Site Rad-Safety Organization to the Project Manager, NVOO, are defined. Operational supervision of the off-site program during testing periods was delegated by the support director to the Off-Site Radiological Safety Officer.

To fulfill its responsibility for assessment and control of possible health hazards arising from the release of radioactive material to the off-site area, the Off-Site Organization was prepared to:

(a) Verify the off-site radiological situation associated with test site activities to insure public safety.

(b) Maintain a staff of trained personnel available to take emergency measures prescribed by the Atomic Energy Commission should an unacceptable situation develop.

(c) Obtain an adequate record of radioactive contaminants released to the off-site area.

(d) Maintain public confidence that all reasonable safeguards were being employed to preserve public health and keep property free from radiation hazards.

(e) Establish and maintain liaison with various local and state officials concerning radiological health within their administrative areas.

(f) Investigate reports of incidents attributed to radioactivity.

(g) Accumulate data to provide a basis for a better evaluation of cumulative radiation dose to people.

The PHS Southwestern Radiological Health Laboratory in Las Vegas provided technicians and facilities for radioanalysis of air and water samples.

For each event, mobile monitoring teams were deployed in the off-site area in both populated and nonpopulated areas. Eberline Model PAC-3G alpha survey meters and Eberline Model PAC-1S alpha scintillators were used to monitor these events.

Attachment F

REECo, 1966
Applicable Selections from
Radiological Conditions at Project Roller Coaster
Cover and Page 4

Duplicate Copy of reference # 557

RADIOLOGICAL CONDITIONS AT PROJECT ROLLER COASTER 1963

CHAPTER 3

JANUARY 24 THROUGH 30 SURVEY

A stationary air sample was taken at each of the Clean Slate sites. Air samples were also collected at each site with the sampler mounted on top of a trailer. The trailer was then towed around the exclusion fences and arcs of the three Clean Slate sites. Gross alpha activity results for air are presented in Table 1.

Gross alpha radioactivity of water samples collected at various springs on the Tonopah Test Range (Table 2) indicated either no detectable activity or activity that was so low as to require no further analysis.

All swipe surveys (Table 3) taken at Area 9 and the CP area indicated that no detectable alpha contamination was being transferred to populated work areas.

Table 4 and Figure 1 show the activity values for alpha readings which were recorded at Clean Slate 1. Average and maximum readings are tabulated; the average activity value being the average of two contact readings covering an area approximating one square meter. The highest detectable alpha readings were recorded along the southeast quadrant from ground zero. These values, however, are lower than those detected from previous surveys. (The frozen condition of the surveyed surfaces probably increased ground surface absorption of the alpha radiation.

The ground area within the Clean Slate 1 exclusion fence had an average reading of 100-200 cpm. The higher activities detected were relatively "fixed" on exposed concrete chips and other debris.

Table 5 and Figure 2 show the results of the survey for Clean Slate 2. There were a number of visible concrete flakes that were still exposed on the surface of the ground. These resulted in the highest detectable activities. Parts of the ground surface within the exclusion fence had been eroded to expose contaminated debris.

The highest recorded activities were found at Clean Slate 3. (Table 6 and Figure 3.)

A survey was performed around and within the exclusion fence of the former radiological safety base station. No detectable surface contamination was present.

The area around the "animal farm," (including two animal trailers), was surveyed. Alpha ground contamination was not detectable in this area. However, the animal trailers showed maximum levels of 300 cpm.

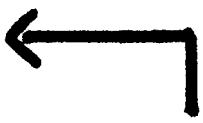
Attachment G

Rodriguez, 1997
GPS Coordinates for the IT Monuments at TTR

From: Cheryl L. Rodriguez
To: MENGLAND, MHAGENOW
Date: 9/24/97 10:53am
Subject: GPS coordinates for the IT monuments at TTR

Here you go.

IT Monument		Nevada State Plane Central NAD 27				UTM Zone 11 NAD 27		
Number		Sec East	North (ft)	Hgt (ft)	->	East	North (m)	Hgt (m)
IT 01		474240.6	1105322	5514.38		521501.8	4181948	1680.783
IT 02		473953.8	1106189	5484.76		521413.4	4182212	1671.755
IT 03		473977	1106416	5481.43		521420.3	4182281	1670.74
IT 04		473726	1106395	5480.4		521343.8	4182275	1670.426
IT 05		473255.1	1106141	5486.14		521200.6	4182197	1672.175
IT 06		473254	1106140	5486.28		521200.2	4182196	1672.218
IT 07		473465.6	1107339	5474.07		521263.4	4182562	1668.497
IT 08		473027.6	1104939	5500.34		521132.6	4181830	1676.504
IT 09		473129.3	1103461	5516.17		521165.1	4181380	1681.329
IT 10		474240.5	1105195	5512.6		521501.9	4181909	1680.24
IT 11		474210.5	1105290	5513.41		521492.6	4181938	1680.487
IT 12		474145.3	1105144	5510.42		521472.9	4181894	1679.576
IT 13		474087.1	1105213	5506.31		521455.1	4181915	1678.323
IT 14		474052.9	1105141	5508.83		521444.8	4181893	1679.091
IT 15		473698.9	1105732	5487.22		521336.3	4182073	1672.505
IT 16		473679.4	1105709	5486.86		521330.3	4182065	1672.395
IT 17		473943.3	1105818	5489.76		521410.6	4182099	1673.279
IT 18		473929	1105905	5489.58		521406.2	4182126	1673.224
IT 19		474117.5	1105625	5503.03		521463.9	4182040	1677.324
IT 20		474346.9	1105582	5511.18		521533.9	4182028	1679.808
IT 21		474343.9	1105517	5510.81		521533	4182008	1679.695
IT 22		474338.5	1105620	5510.63		521531.3	4182039	1679.64
IT 23		474291.1	1105666	5508.98		521516.8	4182053	1679.137
IT 24		474562.4	1104947	5515.87		521600.2	4181834	1681.237
IT 25		474832.5	1105311	5509.26		521682.1	4181945	1679.222
IT 26		474698.8	1105447	5515.19		521641.2	4181987	1681.03
IT 27		473570.2	1105341	5492.69		521297.5	4181953	1674.172
IT 28		474303.5	1104896	5515.81		521521.4	4181818	1681.219
IT 29		474104.9	1103720	5532.9		521462.2	4181460	1686.428
IT 30		474088.3	1103675	5533.52		521457.1	4181446	1686.617
IT 31		493590.4	1120033	5367.56		527381.8	4186452	1636.032
IT 32		493578.8	1120013	5367.94		527378.3	4186446	1636.148
IT 33		493585.6	1120045	5367.97		527380.4	4186455	1636.157
IT 34		493443.7	1120143	5366.87		527337	4186485	1635.822
IT 35		493423.7	1120108	5367.06		527330.9	4186474	1635.88
IT 36		488288.8	1127885	5344.78		525757.8	4188839	1629.089
IT 37		488212.3	1127768	5348.44		525734.7	4188803	1630.205
IT 38		488288.5	1127773	5348.73		525757.9	4188804	1630.293
IT 39		488283.5	1127827	5347.57		525756.3	4188821	1629.939
IT 40		488209.9	1127868	5344.96		525733.8	4188833	1629.144
IT 41		474666.8	1105428	5517.1		521631.5	4181981	1681.612
IT 42		474476.2	1105428	5517.7		521573.4	4181981	1681.795
IT 43		474357	1105592	5511.03		521536.9	4182031	1679.762
IT 44		474083.3	1105929	5494.47		521453.2	4182133	1674.714
IT 45		456258.3	1081724	6262.39		516048	4174738	1908.776
IT 46		456553.3	1081638	6244.82		516138	4174712	1903.421



IT 47		456965.5	1081555	6219.01		516263.7	4174687	1895.554
IT 48		457059	1081734	6225.1		516292	4174742	1897.41
IT 49		456339.2	1081910	6266.17		516072.5	4174795	1909.929
IT 50		457094.3	1081728	6222.79		516302.8	4174740	1896.706
IT 51		489879.9	1099213	5363.26		526273.8	4180104	1634.722
IT 52		489873.1	1099287	5364.03		526271.7	4180126	1634.956
IT 53		489887.3	1099226	5363.48		526276.1	4180108	1634.789
IT 54		489872.9	1099301	5363.82		526271.6	4180131	1634.892
IT 55		492211	1095461	5364.95		526988.2	4178963	1635.237
IT 56		492239	1095387	5364.87		526996.8	4178940	1635.212
IT 57		484274.5	1122721	5329.11		524540.3	4187261	1624.313
IT 58		484181.5	1122804	5329.13		524511.8	4187286	1624.319
IT 59		484114.6	1122750	5329.52		524491.5	4187269	1624.438
IT 60		484190.9	1122635	5329.22		524514.9	4187234	1624.346
IT 61		484342.8	1122658	5329.7		524561.1	4187241	1624.493
IT 62		488584.3	1126383	5342.21		525849.5	4188381	1628.306
IT 63		488691.1	1126470	5341.43		525882	4188408	1628.068
IT 64		488645.2	1126611	5341.51		525867.8	4188451	1628.092
IT 65		488520.2	1126551	5341.07		525829.8	4188432	1627.958
IT 66		488641	1126442	5341.49		525866.7	4188399	1628.086
IT 67		487022.7	1129630	5343.58		525370.1	4189369	1628.723
IT 68		486688.2	1129233	5340.17		525268.6	4189248	1627.684
IT 69		497977.4	1119564	5403.22		528719.1	4186314	1646.901
IT 70		498008.4	1119579	5403.15		528728.5	4186318	1646.88
IT 71		497976.8	1119622	5402.94		528718.9	4186331	1646.816
IT 72		497954	1119600	5402.75		528711.9	4186324	1646.758
IT 73		498033.6	1119578	5403.16		528736.2	4186318	1646.883
IT 74		494711.8	1102532	5385.01		527742.5	4181120	1641.351
IT 75		484811.3	1102535	5384.03		524725.8	4181111	1641.052
IT 76		484809.3	1102629	5383.6		524725.1	4181139	1640.921
IT 77		484709.5	1102627	5384.55		524694.7	4181138	1641.211
IT 78		484818.3	1102539	5384		524727.9	4181112	1641.043
IT 79		500268.7	1114234	5422.46		529423.1	4184692	1652.766
IT 80		500656.6	1114204	5426.15		529541.3	4184683	1653.891
IT 81		500297.3	1114365	5423.84		529431.6	4184732	1653.186
IT 82		500666.9	1114224	5426.41		529544.4	4184689	1653.97
IT 83		481084.4	1080392	5577.93		523614.2	4174359	1700.153
IT 84		481788.5	1080291	5557.65		523828.8	4174329	1693.972
IT 85		481462	1080760	5564.76		523728.8	4174472	1696.139
IT 86		481007.5	1080618	5576.84		523590.5	4174428	1699.821
IT 87		481541.8	1080484	5565.63		523753.4	4174388	1696.404
IT 88		481070.5	1080478	5577.07		523609.8	4174386	1699.891
IT 89		479826.6	1081589	5603.04		523229.6	4174723	1707.807
IT 90		482539	1082429	5533.06		524055.2	4174982	1686.477
IT 91		482473.8	1082826	5533.75		524034.9	4175102	1686.687
IT 92		482350.8	1082789	5536.99		523997.5	4175091	1687.675
IT 93		482220.2	1082445	5541.77		523958	4174986	1689.131
IT 94		479811	1081635	5602.58		523224.8	4174737	1707.666
IT 95		479787	1081576	5604.07		523217.6	4174718	1708.121

IT 96		482345.3	1082371	5539.28		523996.2	4174964	1688.373
IT 97		482432.1	1082400	5537.96		524022.7	4174973	1687.97
IT 98		482406.8	1082583	5537.73		524014.8	4175028	1687.9

Attachment H

Ekren et al., 1971
Applicable Selections from
***Geology of Northern Nellis Air Force Base Bombing and Gunnery Range, Nye County, Nevada*,**
USGS Professional Paper 651
Cover and Pages 1, 2, and 22

Geology of Northern Nellis Air Force Base Bombing and Gunnery Range, Nye County, Nevada

GEOLOGICAL SURVEY PROFESSIONAL PAPER 651

Prepared on behalf of the
U.S. Atomic Energy Commission

GEOLOGY OF NORTHERN NELLIS AIR FORCE BASE BOMBING AND GUNNERY RANGE, NYE COUNTY, NEVADA

By E. B. Ekren, R. E. Anderson, C. L. Rogers, and D. C. Noble

ABSTRACT

The area of study, covering about 2,400 square miles in Nye County, southwestern Nevada, lies east of Goldfield. Elevations range from 4,700 feet in the westernmost alluvial valley, Stonewall Flat, to more than 8,900 feet in the Reveille Range in the northeastern part of the area. The climate is arid; rainfall ranges from about 4 inches in the valleys to about 6 inches in the higher ranges and mesas. All the streams are intermittent and, with the exception of Thirsty Canyon and its tributaries, all end in closed basins, which make up about half of the total area. Igneous rocks of Tertiary age form at least 90 percent of the outcrops. The remainder consists of sedimentary rocks of late Precambrian and Paleozoic age and a single small horst of crystalline basement.

Rocks of late Precambrian age have an aggregate thickness of about 8,400 feet and include the Stirling Quartzite and the lower five-sixths of the Wood Canyon Formation; they consist of quartzite, siltstone, phyllite, and rather minor carbonate rock. The upper part of the Wood Canyon Formation is Early Cambrian in age and consists largely of micaceous siltstone and shale, with subordinate quartzite and a few carbonate layers.

The Wood Canyon Formation is overlain by the thin Zabriskie Quartzite of Early Cambrian age, which in turn is overlain by Lower to Middle Cambrian rocks that are at least 4,500 feet thick and are transitional between the older dominantly clastic rocks and younger dominantly carbonate rocks.

Younger rocks are dominantly of miogeosynclinal origin and belong to the eastern carbonate assemblage. At the base they include an incomplete section of the Middle and Upper Cambrian Bonanza King Formation (largely dolomite) and the Upper Cambrian Nopah Formation, which is about 3,000 feet thick and consists of the Dunderberg Shale and the Halfpint and Smoky Members.

Most of the Ordovician rocks occur in the Pogonip Group, which is also about 3,000 feet thick and consists of the Goodwin Limestone, Ninemile Formation, and Antelope Valley Limestone. The Pogonip is overlain by the Middle Ordovician Eureka Quartzite, about 315 feet thick, and this in turn is overlain by the Middle and Upper Ordovician Ely Springs Dolomite, which is about 340 feet thick.

The Ordovician rocks are succeeded by the dolomite of the Spotted Range, of Early Silurian to Early Devonian age. The dolomite is about 1,400 feet thick and is overlain by an incomplete section of the Nevada Formation. The Nevada is Early and Middle Devonian in age and at least 1,000 feet thick.

Most of the younger Paleozoic rocks appear to lie in the upper plate of a major thrust fault. They include a limestone and dolomite unit of Middle Devonian age, which has an exposed thickness of almost 1,300 feet, and the overlying Eleana Formation, which is Late Devonian to Mississippian in age and more than 4,000 feet thick.

Small, exposures of granite of Mesozoic age occur in the Cactus Range and southern Kawich Range. The granite is nearly void of mafic minerals and closely resembles the alaskite at Goldfield.

Rocks of Tertiary age form a composite section more than 20,000 feet thick. They include minor fanglomerate at base, numerous widespread ash-flow tuff sheets that range in age from about 27 to 7 m.y. (million years), thick piles of variegated lavas, and several sequences of interbedded ash-flow tuff and sedimentary rocks. The oldest volcanic rock is an ash-flow tuff of late Oligocene age named herein Monotony Tuff. The rock is rhyodacitic and contains abundant phenocrysts of plagioclase, quartz, and biotite. It is overlain by the tuffs of Antelope Springs in the western part of the mapped area and the Shingle Pass Tuff in the eastern part. Both units are dominantly rhyolitic and quartz latitic. The next higher unit of regional significance is the rhyolitic tuff of White Blotch Spring. This unit includes ash flows from more than one center, but all are characterized by abundant large crystals of quartz and sparse mafic minerals. In most areas the White Blotch Spring is overlain by minor sedimentary rocks and ash-flow tuff and then by widespread lavas of intermediate composition. The lavas were extruded from many vents that are widely scattered in the mapped area and beyond. They form the bulk of the outcrops in many parts of the area and are the principal host rocks for gold and silver ore at Goldfield and Tonopah adjacent to the area of study.

The Fraction Tuff, which overlies the lavas of intermediate composition, is more than 7,000 feet thick at the exhumed Cathedral Ridge caldera in the southern extension of the Kawich Range. The Fraction is a lithic-fragment-rich, crystal-rich, and generally quartz-rich ash-flow sheet of rhyolitic and quartz latitic composition. During a pause in volcanic activity after the eruption of Fraction Tuff, local areas were deeply eroded.

The period of relative quiescence and erosion was followed by extrusion of rhyolite lavas that overrode wide areas, and these eruptions in turn were followed by the extrusion of the Belted Range Tuff and related sodic rhyolites. The Belted Range is overlain by strata of the Paintbrush Tuff and by massive strata of the Timber Mountain Tuff of which two members are present: the Rainier Mesa Member and the Ammonia Tanks Member. In early Pliocene time, after the region had acquired a topography similar to that of the present, the Thirsty Canyon Tuff was extruded. This tuff, whose source was the Black Mountain caldera, forms the surface strata over broad areas in the western and southwestern parts of the area.

The project area contains eight structural blocks or units: the Belted Range, Kawich Range, Mellan Hills, Cactus Range, Trappman Hills, Mount Helen, Black Mountain, and Pahute Mesa. The Belted Range block exposes a major thrust fault having a displacement of several tens of miles. This fault places lower Paleozoic rocks over upper Paleozoic rocks and correlates with the C P thrust in the Yucca Flat area at the Nevada Test Site. Two normal fault systems are present throughout the mapped area, exclusive of Pahute Mesa and Black Mountain. The earlier system consists of two sets that strike northeast and northwest; the later system, a single set, strikes north. Both systems postdate the Tertiary volcanic rocks, but the older system is confined to rocks older than about 17 m.y.

Deposits of gold and silver occur in several localities, and small mines and prospect pits are abundant in parts of the Cactus Range and the southern Kawich Range. The deposits are small, and the combined gold and silver production to date is between 10,000 and 100,000 ounces.

Several localities within the area may provide favorable environments for underground nuclear testing.

INTRODUCTION

LOCATION AND GEOGRAPHY

The mapped area (fig. 1) lies within the Basin and Range physiographic province and consists primarily of alluvium-covered valleys separated by northerly trending mountain ranges. Pahute Mesa lies in the southern part of the mapped area and forms an east-west terminus to the north-trending mountains and valleys. Thick coalescing alluvial fans flank most of the mountain ranges. Relief in the area generally ranges from 1,000 to 3,000 feet; the lowest elevation, at Stonewall Flat on the west, is 4,729 feet, and the highest elevation, at Reveille Peak on the northeast, is 8,910 feet. All the streams are intermittent, and, with exception of Thirsty Canyon and its tributaries, all end in the closed basins of Cactus Flat, Reveille and Kawich Valleys, and

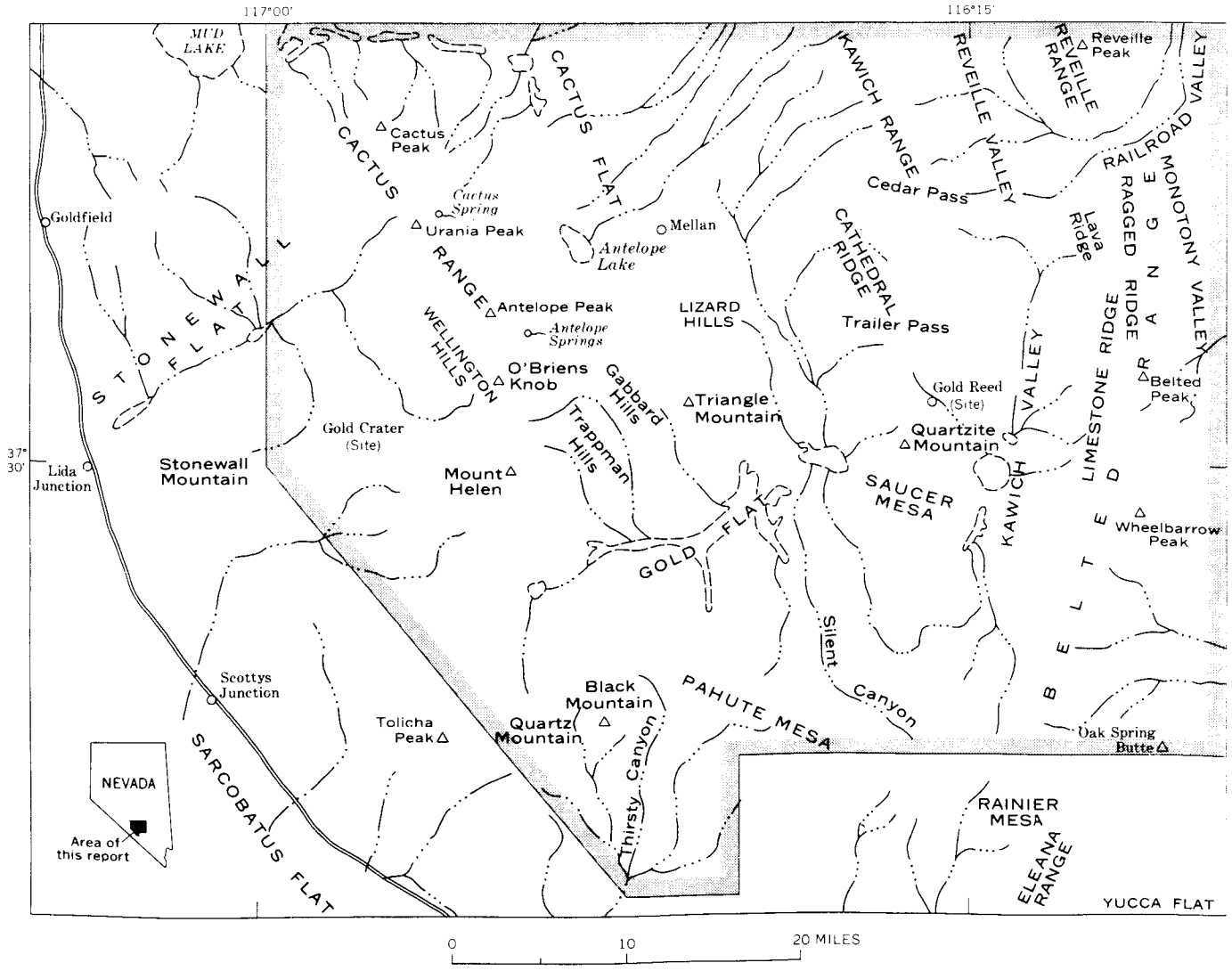


FIGURE 1.—Location of studied area (shaded outline) and major physiographic features.

the east flank of the Belted Range. Rocks that probably correlate with the Eleana occur on the west flank of the Cactus Range, and these are described separately.

LITHOLOGY

The Eleana Formation contains six distinctive units in the southeast part of the mapped area. These correspond to units A–E and G of Poole, Houser, and Orkild (1961). Units A, B, C, and the lower part of D have been studied and remeasured by F. G. Poole, C. L. Rogers, and Reginald Hammond.

Unit A is about 112 feet thick and rather heterogeneous. It consists of limestone conglomerate, limestone, silty to sandy limestone, calcareous sandstone, sandstone, and quartzite. A 60-foot-thick zone near the base resembles a reef complex and consists of fossiliferous limestone conglomerate, limestone, and sandy limestone. The rock is medium to light gray, commonly mottled, and aphanitic to coarsely crystalline; the conglomerate contains subrounded boulders as much as 4 feet in diameter. Another major zone consists of platy- to flaggy-splitting beds of limestone and silty limestone, which are medium gray to pale red or brown, laminated to thin bedded, and aphanitic to finely crystalline. The quartzite is light gray to olive gray, medium grained, and laminated to thin bedded, and it weathers to brown and yellowish-to light gray; it commonly contains small cavities that may have formed by the leaching of carbonate material.

Unit B, about 1,230 feet thick, is composed largely of argillite and quartzite. The basal 240 feet, which appears to be gradational into the underlying unit A, consists of flaggy- to platy-splitting laminated to thin-bedded limestone, silty to sandy limestone, limy sandstone, laminated limy argillite, subordinate quartzite and limestone conglomerate, and, in the lower part, minor chert. Dominantly orange-pink to grayish-orange shaly partly calcareous argillite and sparse thin beds and lenses of quartzite form the upper part. These basal beds are overlain by about 470 feet of yellowish-brown to medium-gray and light-olive-gray thinly laminated shaly argillite that weathers to various shades of pale yellowish brown, gray, and green. The lowermost beds contain argillite, which locally grades to fine-grained quartzite, and in some places they contain sparse fine- to medium-grained quartzite. The argillite contains many cubic iron oxide pseudomorphs after pyrite and, in many places, small sinuous markings on bedding surfaces that are probably worm trails. The shaly argillite sequence is overlain by about 520 feet of dominantly platy- to slabby-splitting very fine to fine-grained quartzite with subordinate coarser grained quartzite and many shaly argillite partings. A few plant stem imprints occur throughout the sequence, and abundant convolute laminae occur in the fine-grained quartzite. These upper beds contain features characteristic of turbidites (F. G. Poole, oral commun., 1965).

Unit C, 430 feet thick, consists of quartzite, subordinate conglomerite, and minor argillite. The quartzite is olive gray but weathers to brown. It is fine to medium grained, laminated to very thin bedded, and characterized locally by convolute laminae. The rock exhibits partly flaggy to slabby splitting, and it contains scattered granules and pebbles of chert and sparse plant stem imprints. The conglomerite weathers to olive gray and contains rounded to subrounded pebbles of chert, quartzite, and argillite as much as 2 inches long, which are set in a vitreous quartzitic matrix.

The lithologic descriptions of units D, E, and G are based on a report by Poole, Houser, and Orkild (1961).

Unit D is about 400 feet thick at Carbonate Wash and is predominantly grayish-orange to yellowish-brown laminated argillite; it also contains numerous beds of pale-brown to grayish-brown quartzite that is fine to coarse grained, thin bedded, and characterized by abundant convolute laminae and small-scale cross strata. Many of these beds contain features characteristic of turbidites (F. G. Poole, oral commun., 1965). These rocks generally weather into sharp elongate fragments and form steep rubble-covered slopes. According to F. G. Poole (oral commun., 1965), the original measured thickness of 520 feet (Poole and others, 1961) for this unit may be excessive, inasmuch as the unit was originally measured in an area where faulting has probably resulted in some duplication of beds. A nearby section that may be nearly complete was later measured by Poole and C. L. Rogers and found to have a thickness of about 375 feet.

Unit E, about 2,400 feet thick, consists largely of argillite with minor interbedded quartzite. The argillite is yellowish brown to pale red and greenish gray to dark gray and is laminated to thin bedded. The quartzite is similar to that in unit D.

Unit G is 1,400 feet thick on Quartzite Ridge northwest of Yucca Flat, but only the lower part extends into the mapped area. The unit consists of quartzite, conglomerite, and argillite. The quartzite is brown to yellowish brown and gray, thin to thick bedded, and commonly cross-laminated. The conglomerite is brown to reddish brown and is composed of rounded fragments, as much as 2 feet long, of quartzite, chert, argillite, and limestone. The argillite is light brown to reddish, sandy, and laminated to thin bedded.

The exposure of the Eleana Formation located 5 miles southeast of Belted Peak (cross section *F–F′* of pl. 1) was visited by F. G. Poole (oral commun., 1963),

Attachment I

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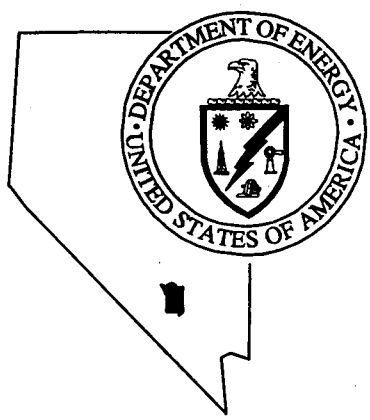
Attachment J
DOE/NV, 1996
Applicable Selections from
Corrective Action Unit Work Plan,
***Tonopah Test Range, Nevada*, Revision 0**
Cover and Pages 2-2, B.3-3 through B.3-5, B.5-2

DOE/NV–443

Nevada
Environmental
Restoration
Project



Corrective Action Unit Work Plan Tonopah Test Range, Nevada

Revision: 0

July 1996

Environmental Restoration
Division

U.S. Department of Energy
Nevada Operations Office

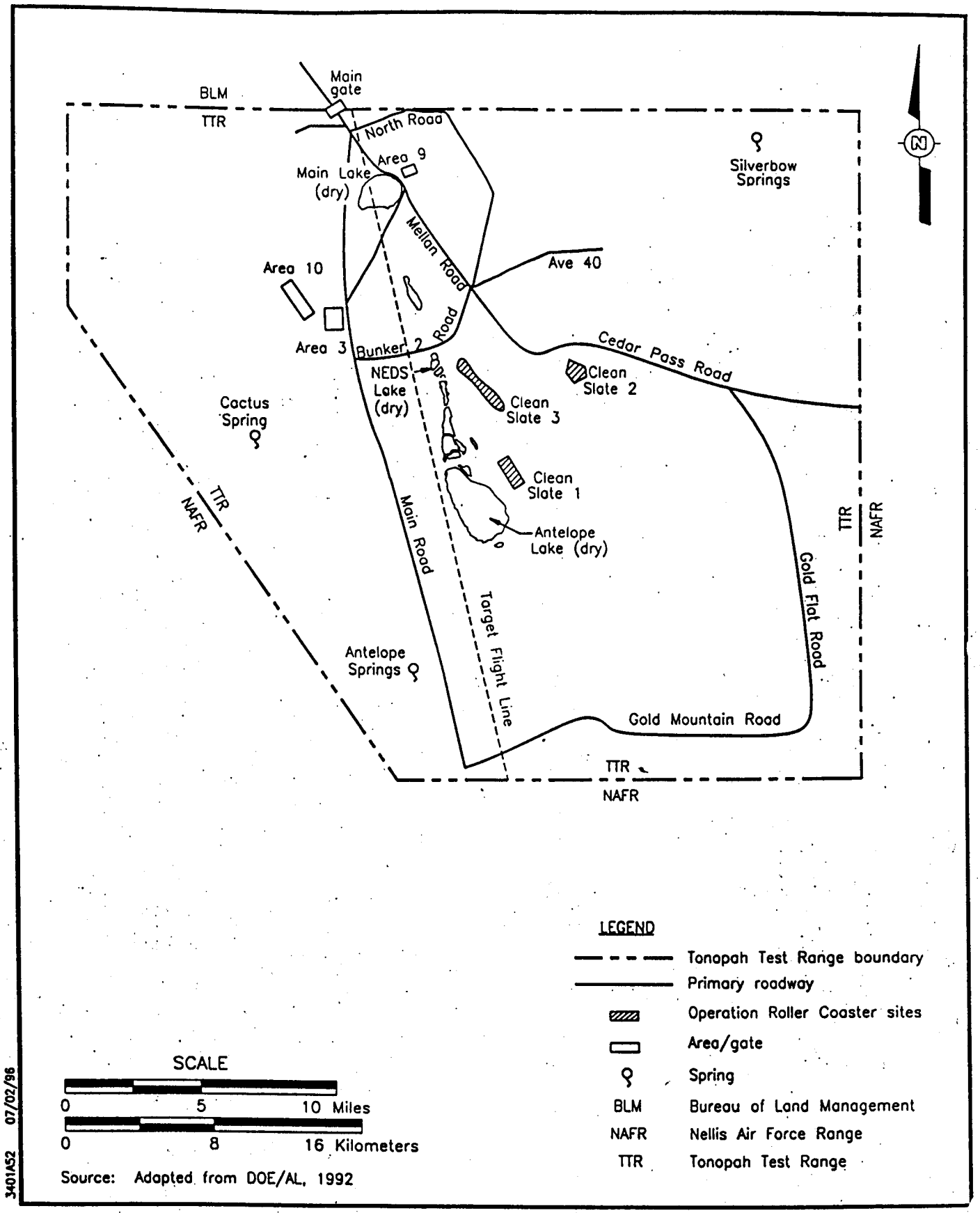


Figure 2-1
Tonopah Test Range Layout
Nye County, Nevada

approximately 0.7 to 1 m thick (2 to 3 ft) and was covered with decking. The areal extent of the gravel-filled pit is assumed to be large enough to accommodate vehicle (e.g., trucks and bulldozers) decontamination. Dirt was placed over the decontamination area at the conclusion of the Operation Roller Coaster Project (Rarrick, 1993).

B.3.1.2 Site Conditions

This CAS consists of a 70-m by 23-m (230-ft by 75-ft) fenced area which is posted for buried alpha radiation contamination (Figure B-4). A 37-m by 12-m (120-ft by 40-ft) earthen mound with a maximum height of approximately 3 m (10 ft) is located along the southern portion of this site. The 1993 field-radiation measurements of this site (outside fenced area) indicate radiation levels similar to background (IT, 1993b). This CAS is comprised of disturbed, level soil with sparse vegetation. The depth to groundwater near the Roller Coaster Rad Safe Area is approximately 120 to 130 m (394 to 427 ft) bgs (Table F-1, Appendix F). Alluvial groundwater-flow direction is generally northeast beneath this site (refer to Figure 2-2 in Section 2.0).

B.3.2 Cactus Spring Ranch

The Cactus Spring Ranch site consists of CAS No. TA-39-001-TA-CR.

B.3.2.1 Background

The Cactus Spring Ranch is located approximately 9 km (5.6 mi) southwest of the Area 3 Compound, at the eastern mouth of Sleeping Column Canyon (Plate 2, Appendix G). This CAS served as a staging area that supported the biological experimental activities associated with Operation Roller Coaster. These studies, performed in 1963, assessed the inhalation uptake of plutonium in animals from the nonnuclear detonation of nuclear weapons (AEC, 1965).

Animal holding pens adjacent to the West and East Sheds contain animal waste that may be contaminated from the tests (Figure B-5). However, the 1993 field survey performed in conjunction with ER Sites Inventory activities did not indicate radiation measurements above background at these locations (IT, 1993b). In addition, animal holding stalls located in the northwest portion of the site were not surveyed and may be contaminated (Figure B-5).

B.3.2.2 Site Conditions

The Cactus Spring Ranch CAS is the former Operation Roller Coaster animal holding facility and is located on the east flank of the Cactus Range. The facility is situated on a broad, moderately protected saddle at the east mouth of the Sleeping Column Canyon. The remains of several structures are located at this site and include dilapidated structures that pre-date

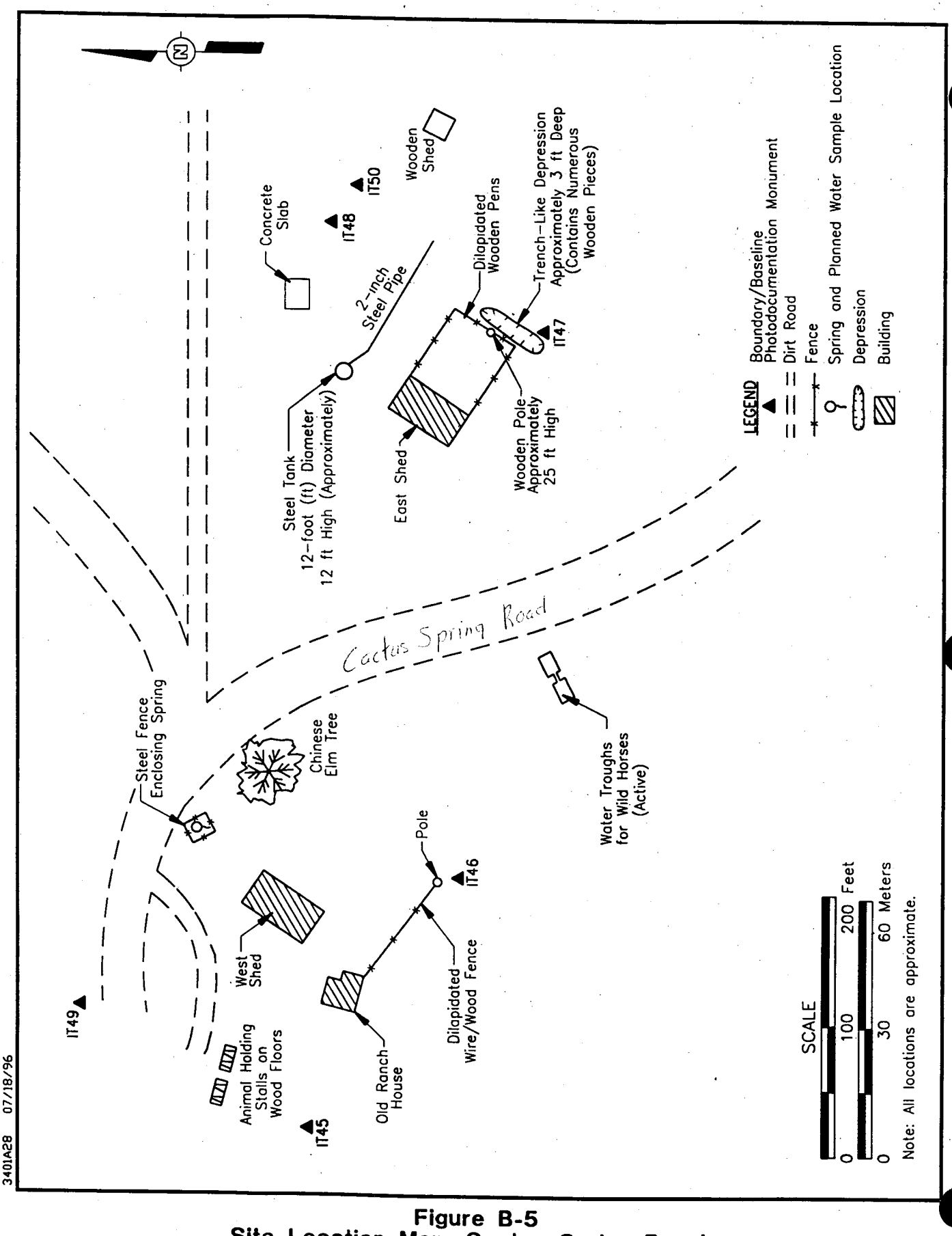


Figure B-5
Site Location Map, Cactus Spring Ranch,
Tonopah Test Range, Nye County, Nevada

Operation Roller Coaster and two animal holding corrals that were constructed to support Operation Roller Coaster (Wilson, 1995a). The site terrain is comprised of uneven ground that slopes gently to the east. A natural spring discharges near the Cactus Spring road and flows a short distance to the southeast before infiltrating into the subsurface. The historical and archeological importance of the site have not been evaluated at this time.

B.3.3 Double Tracks Rad Safe Area

The Double Tracks Rad Safe Area consists of CAS No. 71-23-001-71-DT.

B.3.3.1 Background

The Double Tracks Rad Safe Area is located on the west side of Cactus Range in Area 71N of the Nellis Air Force Range approximately 8 km (5 mi) west of the TTR gate in Sleeping Column Canyon (Plate 2 in Appendix G and Figure B-6). It is one of three areas identified as a potential location of burial pits that were excavated for the disposal of radioactively contaminated materials from the Double Tracks experiment. The second area to be investigated is the Cactus Spring Waste Trenches (Section B.5.0); the third area was discussed in Section B.3.1. The Double Tracks experiment, conducted in 1963, was designed to assess the inhalation uptake of plutonium in animals from the nonnuclear detonation of nuclear weapons. Muslin shrouds were used to cover the experimental animals during the detonation to prevent the airborne plutonium contamination from contacting the major portion of the animals' bodies (AEC, 1965).

Interviews with former site workers indicate that a burial pit may have been dug at the Double Tracks Rad Safe Area to support the Double Tracks event (Wilson, 1995a). Two areas were identified at the Rad Safe Area as possible locations for the burial pit (Figure B-6). The materials that may be buried at this site include the muslin shrouds and the hides of dogs, sheep, and burros that were sacrificed immediately following the Double Tracks event.

B.3.3.2 Site Conditions

The Double Tracks Rad Safe Area is an area of disturbed ground at the intersection of Cactus Spring Road and the road to the Double Tracks control point (Figure B-6). The area lies west of the Cactus Range on a southwest sloping alluvial fan near the north end of Stonewall Flat. The high-altitude desert terrain is mostly flat and contains sparse vegetation.

The depth to groundwater is unknown but is anticipated to be approximately 250 to 270 m (820 to 886 ft) bgs (Table F-1, Appendix F). In this area of Stonewall Flat, the groundwater flow direction in the alluvial aquifer is generally southwest.

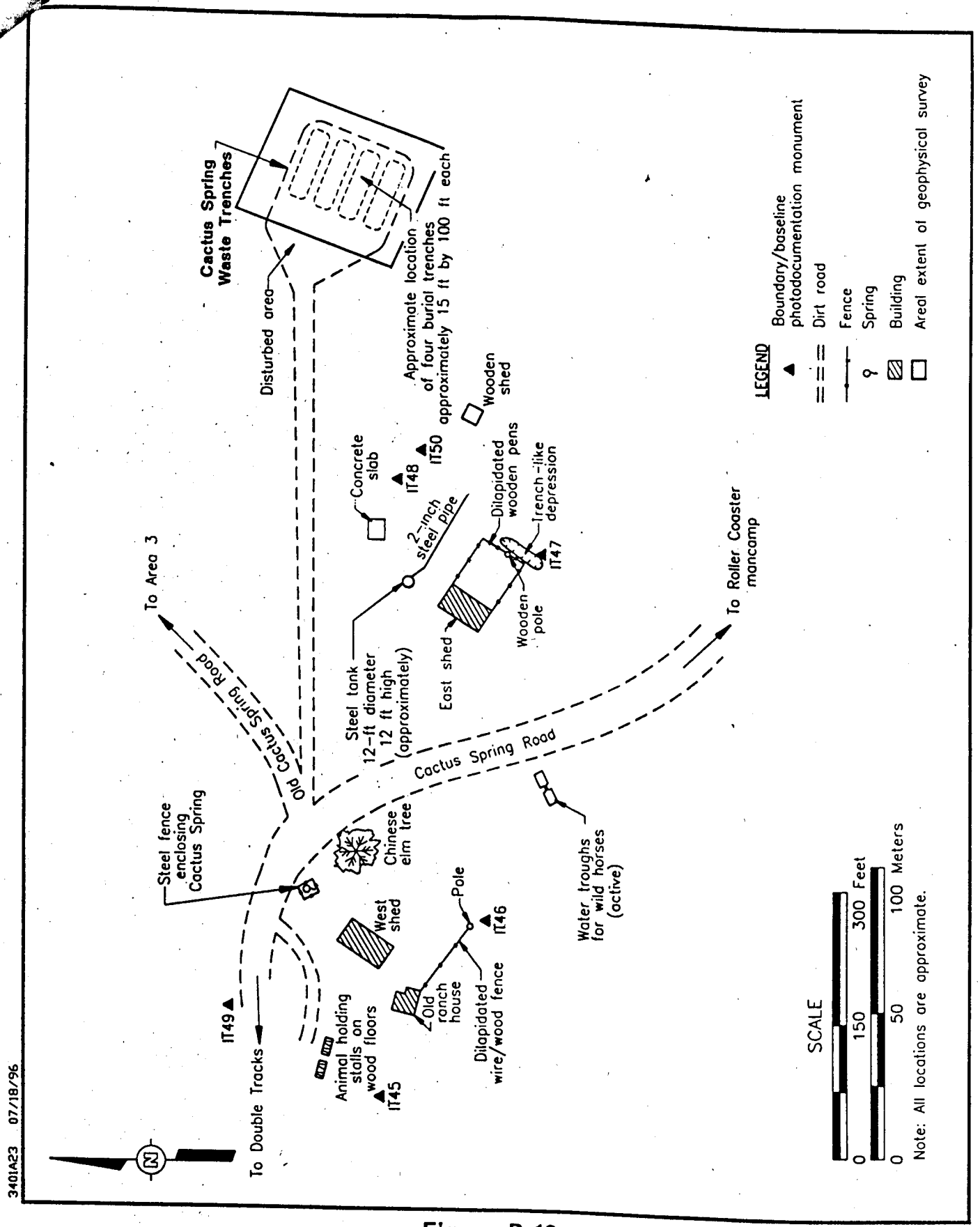


Figure B-12
Site Location Map, Cactus Spring Waste Trenches, Tonopah Test Range, Nye County, Nevada

Attachment K

Wilson, 1995
Applicable Selections from
Wilson Interview (University of Rochester, NY, retired)
Cover and Pages 29 through 32

TTR-Double Tracks Investigation

Taped Interview with Bob Wilson

May 2, 1995

Interviewers:

Randy Dubiskas, IT Corporation

Brad Schier, Daniel B. Stephens and Associates

Kevin Cable, U.S. Department of Energy

Brad: They talked about having to convert some supply trailers into more housing to facilitate all the people. So twelve holes and urinals is not hard to .....

Randy: After the shot how long were the animals kept in the animal holding pens.

Bob: Well they were kept there through Clean Slate 2 and I would say probably two weeks after that. A month or so.

Randy: So may be six weeks after the shot.

Bob: Yeah.

Brad: Bob, these were the laboratories I imagine you were there.

Bob: Yeah. At one time.

Brad: We talked about a pit that you . . .

Bob: They are not shown here on this map. . . oh yeah, office trailers, this was my office right there.

Brad: Okay. You showed us the pit with the over turned jeep which is probably over here some where, is there any other pit around here that was just strictly for biological waste that you know of.

Bob: No. Not that I can recall.

Brad: Okay. Were there any underground storage tanks to your knowledge out there, dug for any reason.

Bob: No. The fuel was propane for the various trailers.

Brad: Okay. That is important to note. Could there be some old propane tanks . . .

Bob: Well, no cause I noticed in one of my reports I don't remember which one now, I carefully specified the refillable tank, that could be refilled right on line. It has a special name, filler tank or something like that you stick fuel right in it.

Brad: Were the animals feces screened for rad?

Bob: No.

Brad: Where were they deposed of, do you know?

Bob: I think in the same pit.

Brad: Do you think they were scrapped up and transported or just moved into the dirt?

Bob: Put into the pit.

Kevin: Or just left in the pen.

Bob: No, no. That was part of the . . . you start raking out after eight-four burros and that's a lot of doo doos. The animal quarters were meticulously cleaned every day.

Randy: There is a pretty good layer of it now, but I think that was from the test in the 70's that other people did.

Kevin: Or from the wild horses.

Randy: Right in the corrals is where I am talking about.

Bob: They didn't clean up.

Randy: The fences are down. Wild horses could come and go . . .

Randy: I'm talking about right inside the building . . . it was obviously they were penned up animals.

Kevin: In bad whether the horses might go in there too.

Bob: Yeah. They like a little protection if it is available.

Kevin: There's a lot, I know what your talking about.

Randy: It is very clear that inside the shed there is a difference between the surrounding area where the horses are wandering ... I mean there is a thick 2 inch layer and it is very continuous and stops at the boundary of the building.

Bob: And of course if the roof is in any king of shape, it's not going to deteriorate as rapidly as it would out in the sun.

Randy: I sure that might be from a later . . .

Bob: That may be but I just saying that any feces left here is . . . it may not rain very much but it does rain.

Kevin: When you get that snow and rain out there I wouldn't be surprised if the horses herd in there.

Bob: I bet they do. Cause we had some real trouble with snow I know that, that early part of April.

Randy: There is big horn sheep up there too.

Bob: Is there now? We had a lion come through and that kind of shook me up because lions like the sheep.

Brad: And dogs and burros . . .

Bob: Yeah. Dogs were in the cages and burros are pretty tough customers, but sheep are stupid.

Brad: You mentioned that this was your office.

Bob: Yes.

Brad: What buildings were the autopsies done in.

Bob: These are trailers. This as I recall is the hematology trailer, and my recollection is that this was the autopsy trailer. Now I say that but some of the autopsies were done. . . the dogs were done in the dog trailers. Two thirds of these were cages and the other third was laboratory facilities in each of these trailers.

Brad: Okay. I think we've got that pit up here at the animal holding area pretty well nailed down with the photos and with what we have discussed. My final question again like I said we will hit on every area are you aware of any accidental or intentional controlled or uncontrolled releases of any type of hazardous materials in this area.

Bob: No.

Brad: In this case, chemicals like formaldehyde or anything like that, fuels.

Bob: No.

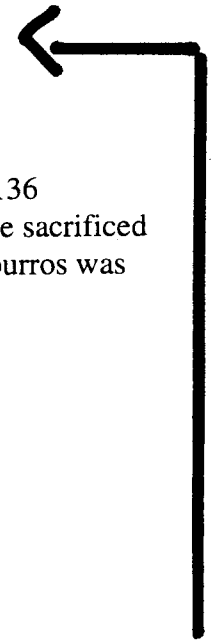
Brad: Anything more about this area?

Kevin: Is there a total number of animals?

Bob: About two hundred. There was 84 experimental burros and dogs and an 136 experimental sheep but the original sheep population was 200 of which we sacrificed some for experimental purposes and the original population of dogs and burros was about 100 each.

Brad: Your report says 300.

Bob: That would be about right. Yeah.



Brad: I'm not trying to dispute I just want to make it clear and it does say 300 and you go through and list some were controlled, not all the 300 were exposed, that's probably your 200 were exposed and 100 were for control.

Bob: Yeah.

Kevin: Do you think there was a pretty good chance that the pit at Cactus Springs has animal parts in it too?

Bob: Could very well have, yeah. Matter of fact it would be close to 300 experimentals, 84 plus 84 plus 136. The controls and the rejects and that kind of thing. There may have been close to 400 altogether at one time.

Brad: That's right, its 300 at the array itself. I do recall that now and there were others back at the camp for control.

Kevin: There were others that went for Clean Slate 2.

Bob: Some of the controls that were left over. I guess you could call them the more spares than control. They could have been controls if we would have treated them as such but because we had enough controls we thought we would sacrifice them to the Clean Slate study.

Kevin: How many did you use on that?

Bob: About 6 burros and . . . I think they were only burros or sheep.

Kevin: But they were probably sacrificed back at the springs or not down . . .

Bob: No.

Brad: We will get to that, we have real important black hole right down on what happened to those animals. Going to man camp working our way to the east now, did you stay at the man camp?

Bob: Yeah. There weren't many options. Goldfield was the next stop.

Brad: Are you familiar with the camps sewage lagoons and landfills.

Bob: I knew there were some but I . . .

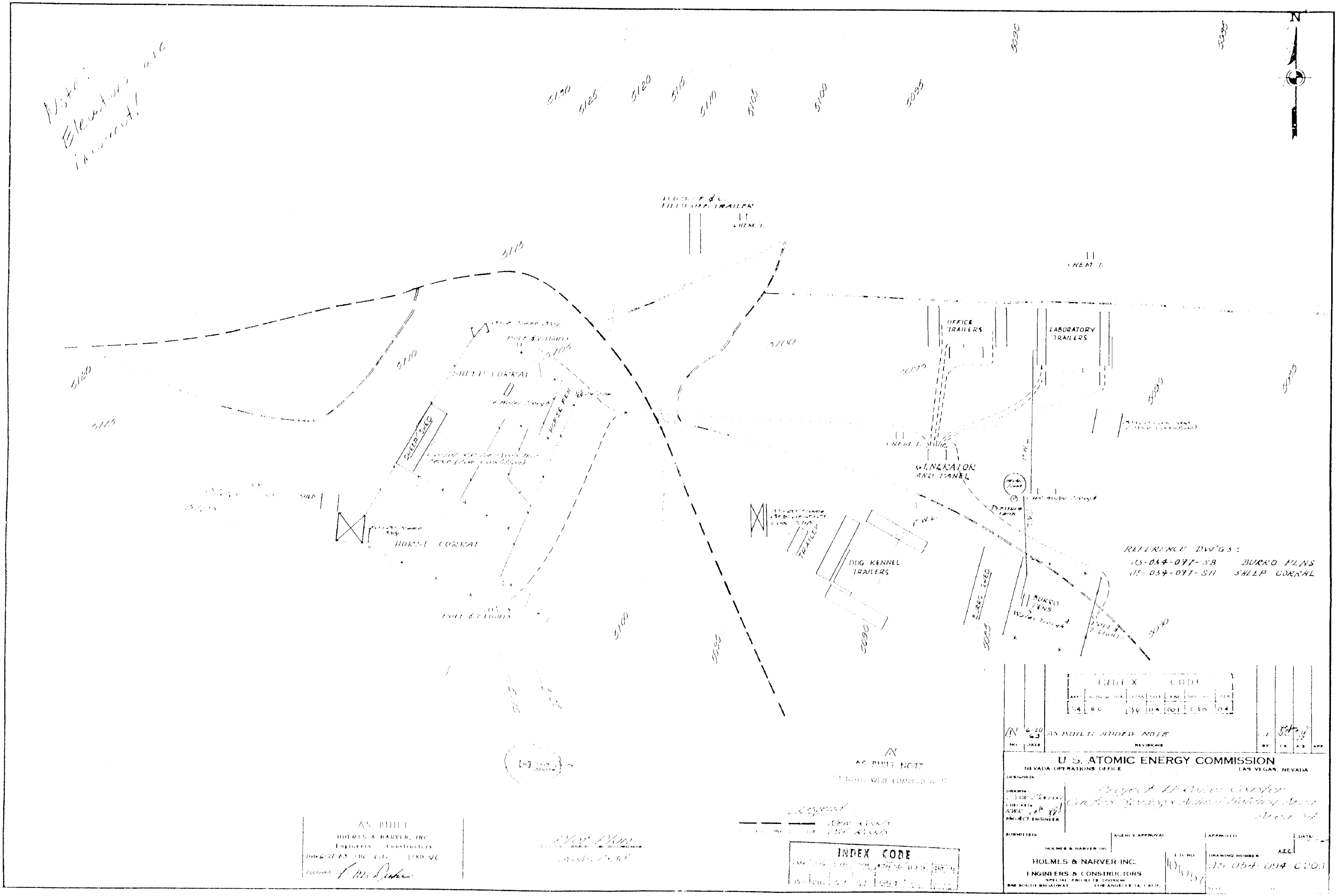
Brad: Did you ever see them?

Bob: No.

Brad: Were you ever close enough to a lagoon to see the waste that was in them?

Attachment L

H&N, 1963
Drawing of Cactus Spring Animal Holding Area


Note: Elevations are incorrect!
5130
5125
5120
5115
5110
5105
5100
5095
5090
5085
D.O.D. - F. & C.
FIELD OFF. TRAILER
CHEM. T.
OFFICE TRAILERS
LABORATORY TRAILERS
SHEEP CORRAL
SHEEP SHED
HORSE PEN
HORSE CORRAL
POLE & 2 LIGHTS
GENERATOR AND PANEL
DOG KENNEL TRAILERS
TRAILER
BURRO SHED
BURRO PENS
Water Trough
Pressure Tank
P.W.L.
POLE & 2 LIGHTS
REFERENCE DWG'S:
JS-034-097-S8 BURRO PENS
JS-034-097-S11 SHEEP CORRAL
N
AS BUILT NOTE
Legend
New Roads
Old Roads
Plot Plan
INDEX CODE
AS BUILT
HOLMES & NARVER, INC.
Engineers Constructors
Date 6-21-63 By C.L. CKD VC
Approved
AS BUILT: ADDED NOTE
NO. DATE REVISIONS BY CK A.E. APP.
U.S. ATOMIC ENERGY COMMISSION
NEVADA OPERATIONS OFFICE
LAS VEGAS, NEVADA
DESIGNED
DRAWN
CHECKED
KWK
PROJECT ENGINEER
SUBMITTED
HOLMES & NARVER INC.
AGENCY APPROVAL
APPROVED
DATE
A.E.C.
HOLMES & NARVER INC.
ENGINEERS & CONSTRUCTORS
SPECIAL PROJECTS DIVISION
849 SOUTH BROADWAY LOS ANGELES 14, CALIF.
I.D. NO. 010057
DRAWING NUMBER
JS-034-094-C20.1

Attachment M

IT Corporation, 1998
Memorandum from Dustin Wilson to Ronald Jackson,
regarding "CAU 485, CAS TA-39-001-TAGR,
Sampling Event on February 18"

INTERNATIONAL TECHNOLOGY CORPORATION

Memorandum

To: Ronald Jackson, Robert Bull, FFACO File

Date: March 16, 1998

From: Dustin R. Wilson DRW 3/16/98

Project No. 772857.03110000

Subject: CAU 485, CAS TA-39-001-TAGR, Sampling event on February 18,1998

Corrective Action Unit (CAU) 485, Corrective Action Site (CAS) TA-39-001-TAGR, Cactus Spring Ranch, Soil Contamination, is located on an abandoned ranch homestead within a canyon on the east flank of the Cactus Range on the Tonopah Test Range (TTR).

This site was originally listed in the Federal Facility Agreement and Consent Order (FFACO) because animals used in the Roller Coaster Project were penned here. These animals were positioned downwind of aboveground detonations of plutonium (Pu) and depleted uranium (DU) devices. The concern was that Pu/DU aerosols were inhaled by the animals and then biologically processed and excreted via dung and urine into the soil. A review of historical documents and surface radiological surveys indicated that there is a low likelihood that significant levels of Pu/DU are present at the Cactus Spring Ranch. To support this, samples of the remaining dung and surface soil were obtained from the penned areas on February 18, 1998.

In January 1998, surface radiological surveys for alpha, beta, and gamma-emitting radionuclides revealed concentrations within the range of typical background levels. The detected concentrations were contoured to reveal the trends and areas of highest concentration. Based on these contours, two sample locations were chosen in the areas of high gamma concentrations within each of the two animal holding areas. Once on site, the Site Supervisor chose two additional sample locations within each of the animal holding areas where dung was present to ensure that dung was sampled. If dung was present at a sample location, then it was sampled from its uppermost surface to the dung/soil interface. A separate sample was then collected from the dung/soil interface to an approximate depth of six inches within the soil. If dung was not present at the sample location, then a surface sample was collected from 0-6 inches.

These samples were analyzed for isotopic Pu using method NAS-NS-3058. The samples were not analyzed for DU because the DU concentration in surface soils at the Roller Coaster sites cannot be measured, even at ground zero. The DU concentration is too small to compare against the higher natural concentration of ^{238}U found at these sites. Since the DU concentration in soil and aerosols at these sites was not distinguishable from background, then it cannot exist at elevated concentrations at the Cactus Spring animal holding areas.

Fourteen soil/dung samples, including one field duplicate, were collected and numbered consecutively from TTR001157 through TTR001170. Two water samples were collected for quality control and were numbered TTR001155 and TTR001156. All samples were collected using approved contractor procedures. All sample results were assigned a "U" qualifier in the Tier I and Tier II evaluation process which indicates that all results were below their minimum detectable concentrations. Therefore, no Potential Contaminants of Concern have been identified for CAU 485.

Digital photographs were taken during the sampling event. These photographs and other related project information are retained in the project file.

For detailed information on sampling rationale and analytical results, please refer to the attachments.

Attachments:
Attachment 1 - Recommend Sampling at the CAU 485 Cactus Spring Pu/DU Site
Attachment 2 - Gamma Count Measurement Contours and Sample Locations
Attachment 3 - Sample Collection Logs
Attachment 4 - Field Activities Daily Logs
Attachment 5 - Analytical Results
Attachment 6 - Radiological Data Review

Attachment 1
Recommend Sampling at the CAU 485 Cactus Spring Pu/DU Site

INTERNATIONAL TECHNOLOGY CORPORATION

Memorandum

To: Dustin Wilson

Date: February 12, 1998

From: Steve Adams SRA

Project No. 772857.03110000

Subject: **RECOMMENDED SAMPLING AT THE CAU 485 CACTUS SPRING Pu/DU SITE**

Summary

The objective of this report is to provide recommendations on sampling locations and sampling depth at the east and west sheds and holding pens located at Corrective Action Unit 485, the Cactus Spring Pu/DU site. The recommended sampling locations and depths are based upon the radiological surveys performed by IT Corporation during the preliminary assessment in February 1998, knowledge of the Roller Coaster tests, and the historical information of the Cactus Spring Pu/DU Site.

The recommended sampling locations have been chosen where the likelihood of plutonium contamination is highest and are not representative of the site. The preliminary assessment survey results and the recommended sampling locations are addressed in Attachment 1. In addition, Attachment 1 includes recommended guidance on sampling procedures. The history and radiological source terms for the Cactus Spring Pu/DU site are included in Attachment 2. The references for Attachment 1 and 2 are listed in Attachment 3.

Attachment 1. Preliminary Assessment Survey Data

Introduction

Preliminary assessments were performed at the Cactus Spring Pu/DU site in February 1998 by IT Corporation. The assessment consisted of radiological surveys of the soil surface. Approximately 5×10^4 square meters (m^2) were surveyed using Field Instrument for Detecting Low Energy Radiation (FIDLER) probes and the NE Technology "Electra" alpha/beta survey instruments. .

Methodology

The radiological surveys performed at the Cactus Spring Pu/DU site were conducted in two areas: the east shed and holding pens and the west shed and holding pens (see Figure 1). The areas were grided into 7.3-m (meter) × 7.3-m (24 foot) squares. Alpha, beta, and gamma surveys were conducted. All measurements were plotted as contours with the software program Surfer® (Golden Software Inc., 1994) The integrated gamma count rate over the 7.3-m × 7.3-m area was assigned to the center of the grid area. The gamma plots start at local grid coordinate Northing 12, Easting 12, but encompass the total 7.3-m × 7.3-m area. The sheds may extend outside of the contour plot on the gamma measurement figures. The alpha and beta measurements were taken on the nodes of each grid area, and readings were assigned to that node for the purpose of inputting the measurements to the Surfer® plotting program.

The results of the surveys are shown in Figures 2 through 7. Figures 2 through 4 show isoactivity lines for the alpha, beta, and gamma surveys performed at the east shed and holding pen. Figure 2 is the alpha activity survey for the east shed and holding pen. The survey results do not demonstrate the presence of elevated surface alpha activity above that found at background locations. The alpha areal activity concentration varies from 10 to 65 disintegration per minute per square decimeter ($dpm/dm^{2)}$. The alpha activity changes slowly from one location to another without any abrupt increases. This would be expected for two reasons. First, the activity of the animals would tend to distribute the surface soil uniformly around the pen and shed area. Secondly, the potential Pu activity from the burros' excretions is minimal in comparison to the alpha activity emitted from the natural alpha emitters present in the soil. The Pu expected to be present on the soil surface, less than 1 picocuries per gram (pCi/g), is only a small fraction of the alpha activity emitted from natural uranium and thorium isotopes and their alpha-emitting decay products, which range from 12 to 25 pCi/g of total alpha emissions (McArthur and Miller, 1989; Atlan-Tech, 1992). There is elevated alpha activity in the vicinity of coordinates easting 48-feet (ft) to 49-ft and northing 0 to 3-ft. The area defined by the easting 48-ft and northing 3-ft coordinates represents the highest alpha activity measured in the east shed and holding pen area. The alpha activity concentration represents the normal variation in concentration of background alpha emitters.

The beta contamination survey results for the east shed and holding pen are shown in Figure 3. Like the alpha survey results discussed previously, no elevated concentrations were detected above background. The beta activity varies from 1,400 to 1,550 dpm/dm^2. The only Pu isotope that is a beta emitter is ^{241}Pu and it contributes about thirty percent of the total Pu activity source material (DOE, 1996). No other beta emitting Pu decay product will have grown-in sufficiently during the last thirty-five years to contribute significantly to the beta activity. The natural, total beta activity in surface soils ranges from 50 to 80 pCi/g (McArthur and Miller, 1989; Atlan-Tech, 1992). The highest beta survey results are in the vicinity of coordinates easting 52-ft and northing 3-ft. The beta survey results are not inconsistent with the variations in natural background.

The gamma count rate measurements for the east shed and holding pen are shown in Figure 4. The source material used in the Roller Coaster tests emits gamma photons, most of them coming from the americium-241 (^{241}Am) growing in from the decay of the ^{241}Pu. The ^{241}Am emits a 59.6 kiloelectron volt (keV) photon during 35.7 percent of its emissions (Shleien, 1992). Like the previous two surveys, this survey did not detect count rates exceeded that found in background locations. The gamma count rate varies from 4,920 to 5,080 count per minute (cpm). These values are not different from the background count rates taken from the vicinity of the east shed and holding pen area (Speer, 1998). There is a trend of elevated gamma contamination in the vicinity of coordinates easting 36 to 38-ft and northing 23 to 25-ft. These values are more due to the variation in the natural background, but based upon the data shown in Figure 4, they represent the highest gamma count rate.

The data for the west shed and holding pen are not unlike the data compiled for the east shed and holding pen. Figure 5 shows the alpha activity measurements in isoactivity lines. The values vary from 12 to 36 dpm/dm^2. This is lower than the values shown in Figure 2 for the east shed and pens, but not significantly lower. There is elevated alpha contamination in the vicinity of coordinates easting 24-ft and northing 48-ft. These values are due to the variation in the natural background, but based upon the data shown in Figure 5, they represent the highest alpha activity.

The beta contamination data for the west shed and holding pen are shown in Figure 6. The values range from 1,300 to 1,850 dpm/dm^2. The absolute difference between the beta contamination data for the west shed and holding pen and the east shed and holding pen are not significant, the difference is less than 20 percent. However, there is an increase in the beta concentration from the middle of the area to the coordinate easting 0 to 2-ft and northing 47 to 48-ft. These values are due to the variation in the natural background, but based upon the data shown in Figure 6, they represent the highest beta concentration.

The gamma count rate measurements for the west shed and holding pen are shown in Figure 7. Like the previous gamma surveys, this survey did not detect any elevated gamma activity exceeding that found in background locations. The gamma count rate varies from 4,915 to 5,125 cpm. These results are not different from the gamma count rates taken from the east shed and

holding pen area and areas outside the east shed and holding pen that would be expected to be at background (Speer, 1998). There is elevated gamma activity in the vicinity of coordinates easting 12 to 17-ft and northing 50 to 60-ft. These values are due to the variation in the natural background, but based upon the data shown in Figure 7, they represent the highest gamma count rate.

Conclusion

There is little or no correlation between the alpha, beta, and gamma measurements. This lack of correlation supports the hypothesis that the measurements represent the typical variation in natural background and not significant Pu contamination. If there were significant quantities of Pu present on or near the soil surface, the measurements of the alpha, beta, and gamma activity would be higher, show a stronger correlation, and be represented by similar contour lines in each of Figures 2 through 4 and in each of Figures 5 through 7 .

Based upon the preassessment measurements, the recommended sampling locations are listed in Table 1.

Table 1. Sampling Locations at the Cactus Spring Pu/DU Site

Cactus Spring Sampling Sites	Sampling Point Coordinates
East Shed and Holding Pen	Easting 52 ft and Northing 3 ft (Fig 2 and 3) Easting 36 to 38 ft and Northing 23 to 25 ft (Fig. 4)
West Shed and Holding Pen	Easting 12 to 17 ft and Northing 50 to 60 ft (Fig. 7) Easting 54 to 64 ft and Northing 57 to 60 ft (Fig 7)

Sampling Procedures

This section outlines the sampling methods recommended for use at the Cactus Spring site. The proposed sampling methodology should ensure that the sample results will represent the maximum potential Pu contamination at the Cactus Spring Pu/DU site. The preassessment survey data do not indicate the existence of any hot spots, and the variation in the measurements does not demonstrate any strong trends or any obvious indication of Pu contamination. General sampling requirements are listed in the following paragraphs of this section.

Sampling equipment should be decontaminated before mobilization to the field, using procedures given in SQP ITLV-0405, "Sampling Equipment Decontamination"(IT, 1995a). Soil samples must be collected and packaged in accordance with the Industrial Sites QAPP; SQP ITLV-0605, "Vertical Profile Soil Sampling" (IT, 1997a); and SQP ITLV-0403, "Sample Handling, Packaging, and Shipping" (IT, 1997b).

Recommended sampling locations are listed in Table 1. These sample locations have been

chosen to bias sample results for the highest potential Pu contamination based upon preassessment survey data.

Investigations performed by the Nevada Applied Ecology Group and by IT have shown that the contamination at the Roller Coaster Sites is limited to the uppermost soil profiles (DOE, 1996; 1997). Vertical-profile soil samples have been collected at Double Tracks and Clean Slate sites and demonstrate that approximately 90 percent of the Pu activity is in the top 3 centimeter (cm) . It is expected that the Pu contamination at the Cactus Spring site should extend deeper than at other Operation Roller Coaster sites on the TTR because the hooves of the sheep and burros would turn the soil over, thus presenting a mechanism for any Pu present to move below the soil surface. Based upon depth profiles taken at Pu contaminated sites, the Pu is not expected to move more than a few inches below the surface (DOE, 1996; 1997). The chemical forms of the Pu created during Operation Roller Coaster tests are insoluble and are expected to be immobile in the environment (Perry et al., 1966; Tamura, 1975).

To collect soil samples, the sampling team should locate and mark each sample location that is listed in Table 1 with a wooden stake. Sample locations may change if it is determined by the Field Supervisor that the location is inadequate for sampling. An acceptable rational for changing to an alternative sample location would be that the local soil conditions make it impossible to take a sample. Sample locations should be thoroughly documented and surveyed to determine Nevada grid coordinates during sampling or at a later date. Samples should be collected in accordance with SQP ITLV-0605, "Vertical Profile Soil Sampling." Two separate intervals (subsamples) should be collected from each soil-sample location. These recommended intervals are as follows:

- Dried dung that is on the soil surface
- A soil surface sample from the 0 cm to 15 cm depth (0 to 6 inches)

At each sample location and for each depth interval, sufficient soil should be collected to fill one 8-ounce glass or polyethylene container. The sample containers with the dried dung and the 0-cm to 15-cm depth samples should be submitted for Pu-isotopic analysis using alpha spectroscopy.

In the event sample locations are covered with gravel (desert pavement), the gravel should be removed prior to sample collection. Also, cobbles and coarse gravel (diameter $\geq$ 2 cm [0.8 inch (in.)]) should be removed from samples, regardless of the depth at which they occur. The total sample depth, 15 cm (6 in.), is assumed to be sufficient because downward transport of Pu in soil under arid and semiarid conditions has not been shown to exist at the Nevada Test Site or other sites in the arid and semiarid west.

Soil samples should be handled, packaged, and shipped in accordance with SQP ITLV-0403 "Sample Handling, Packaging, and Shipping" (IT, 1997b). The required sample containers and

volumes, preservation procedures, and holding times for the analysis are as follows:

- The containers should be 1,000 milliliter (mL) glass or polyethylene wide-mouth bottles.
- No preservation is required.
- The maximum holding time is 180 days from time of sample collection.

Sample containers should be obtained from an approved laboratory and certified clean according to U.S. Environmental Protection Agency (EPA) protocol. The containers should remain sealed until they are used.

Immediately after collection, the sample containers should be labeled with black waterproof markers with, at a minimum, the following information:

- Unique identification number assigned by program sample coordinator
- Project name and number
- Date and time (military) of the sample collection
- Sample location
- Sample depth interval
- Sample medium (soil or dung)
- Requested analysis (Pu-isotopic by alpha spectroscopy)
- Bottle number
- Names of the initial sample custodians (collectors)

Filled sample containers should be packaged in a shipping container as described in SQP ITLV-0403 "Sample Handling, Packaging, and Shipping" (IT, 1997b). The shipping container and the outside surface of filled sample bottles must be screened for radiological contamination either in the field or at a designated location by qualified IT or contractor personnel in compliance with U.S. Department of Energy (DOE) requirements and U.S. Department of Transportation (DOT) regulations.

Documentation of sample handling, packaging, and shipping should be completed daily, in ink, by the soil sampling team in accordance with SQP ITLV-0401, "Field Activities" (IT, 1997c)

Quality control samples, such as equipment rinsate blank samples, field blank samples, and duplicate samples, should be performed in accordance with the Industrial Sites Quality Assurance Project Plan (QAPP) and SQP ITLV-0404, "Collection of Field Quality Control Samples" (IT, 1995b). The procedures defined in SQP ITLV-0402, "Chain of Custody", should be followed for initiating, maintaining, and documenting sample chain of custody (IT, 1997d). Field activities should be documented in accordance with SQP ITLV-0401, "Field Activities" (IT, 1997c). Decontamination of sampling equipment should be performed according to SQP ITLV-0405, "Sampling Equipment Decontamination" (IT, 1995a). Sampling equipment will be decontaminated in the field between collection of samples, and waste from decontamination

should be handled and dispositioned according to written, approved operating procedures. Field-derived waste should be minimized to the greatest extent possible through process controls, control of hazardous materials, and segregation of waste.

Attachment 2. Cactus Spring Site History

Operation Roller Coaster

Operation Roller Coaster was a series of four nonnuclear, chemical-explosive, destruction tests of nuclear devices which were detonated at the Double Tracks and Clean Slate 1, 2, and 3 Sites. Dogs, sheep, and burros were positioned downwind of the detonations at Double Tracks and Clean Slate 2. The objectives of these four tests were to complete the following:

- Collect physical and biological data on plutonium airborne particulates to assess the acute inhalation dose due to chemical explosions in different weapons storage configurations.
- Measure the distribution of Pu on the ground to permit detailed accountability of the amount dispersed, and compare the acute inhalation exposure to the exposure from resuspended Pu.
- Evaluate the Pu-scavenging effectiveness of storage structures with varying earth cover thicknesses for determining the radiologic hazard from a chemical explosion.
- Obtain aerosol and particulate size distribution data needed in forecasting the airborne transport and diffusion of a Pu cloud subsequent to a chemical explosion.

At each of the Roller Coaster tests, Pu and depleted uranium devices were destroyed using various amounts of high explosives and detonation platforms (DOE, 1996). The Double Tracks test was detonated on May 15, 1963, and the Clean Slate 2 test was detonated on May 31, 1963.

The Roller Coaster tests resulted in the creation of aerosols that were transported downwind. During the Double Tracks test, 300 animals (84 dogs, 132 sheep, and 84 burros) were exposed to the downwind aerosols created during the detonation (Wilson and Terry, 1968). The dogs and sheep were placed in cages built on farm wagons which were pulled to their assigned locations by jeeps and weapons carriers. Burros were secured in milking stalls and stanchions. Wagons, milking stalls, and stanchions were placed 6,250 feet, 8,750 feet, and 11,500 feet from ground zero in the downwind direction. The average Pu surface concentration at these locations subsequent to the test were < 100 pCi/g, based upon Figure 13 in the Double Tracks Characterization Report (DOE, 1996). For the Clean Slate 2 test 10 sheep and ten dogs were exposed at 6,250 feet from ground zero in the manner previously described. The average Pu concentration in surface soil at this location was in the range of 100 to 200 pCi/g (DOE, 1997). All animals were covered with shrouds consisting of sheets of muslin taped snugly around the neck, brisket, and abdomen so that only the head and legs were exposed to the Pu cloud (Wilson and Terry, 1968). Careful removal of the shrouds was performed to minimize external contamination of the animals. Immediately after the tests, the animals were transported to the Cactus Spring Pu/DU site where they were penned prior to being killed, dissected, and their tissue specimens analyzed using alpha spectroscopy (Wilson and Terry, 1968).

History of the Cactus Spring Pu/DU Site

The Cactus Spring Pu/DU Site was used to pen animals used in the Double Tracks and Clean Slate 2 tests that were part of Operation Roller Coaster. All animals not killed on the day of the test were moved to the site formerly known as the Cactus Spring Animal Holding Area in Area 54, now known as the Cactus Spring Pu/DU site (see Figure 1, Barron, 1963). The burros were placed in the east shed and holding pen while the sheep were placed in the west shed and corral (Barron, 1963). The dogs were not penned in either area but kept in dog kennel trailers. The Cactus Spring Pu/DU site is located on an abandoned ranch homestead within a canyon on the east flank of the Cactus Range. The remains of several structures are located at this site, and include an abandoned ranch house, two animal holding pens, the east and west sheds, and other dilapidated structures. Piles and layers of dried dung are present within the sheds. The site terrain comprises uneven ground that slopes to the southeast.

During the Double Tracks tests the animals were eventually killed, starting on the day of the test and periodically thereafter over a period of 2.5 years. The schedule for killing the animals for the Double Tracks test is listed in Table 2.1 of Wilson and Terry (1968). Seventy-two of the 84 burros were killed during the first two weeks after the test and, therefore, were not present in the east shed and holding pen after June 1, 1963. Seventy-four of the 132 sheep were killed during the first two weeks after the test. During the Clean Slate 2 test, all animals were killed at either three or seven days subsequent to the day of the test.

Radiological Source Term

The only known radiological source term at the Cactus Spring Pu/DU site is the Pu excreted in the urine and the feces of the sheep and burros while they were on the site, and that could have been collected on their coats and fell off onto the surface soil. The Pu source term at the Double Tracks and Clean Slate 2 sites was approximately 1,370 grams (g). A very small fraction of the Pu source term was intercepted by the sheep and burros, inhaled, and later excreted in their urine and feces (Wilson and Terry, 1968). Only a small fraction of the airborne Pu particulates was inhaled by the animals. Nearly all of the source term was either deposited on the surface soils in the vicinity of ground zero or transported and diffused at low concentrations over a large area (DOE, 1996; 1997). In addition, the Pu aerosols that did remain suspended were relatively large; 90 to 99 percent of them exceeded 10 micrometers (μm). These relatively large particles are not respirable and are not expected to reach the pulmonary lung during inhalation. Air monitoring results demonstrated that the airborne particles reaching the animal locations had activity median aerodynamic diameters in the range of 34 to 68 μm (Wilson and Terry, 1968). Virtually all particles of this size range are nonrespirable and do not reach the pulmonary lung. Instead, the particles are entrained in the upper respiratory sinuses, and expelled with mucous or swallowed and eliminated via the feces. Approximately 25 percent of all Pu intakes by the burros and sheep were estimated to be eliminated in the urine and feces during the first day (Wilson and Terry, 1968). Median Pu excretion activity as a function of time for sheep is listed in Table 3.8 of Wilson and Terry (1968). A rough approximation was made of the potential $^{239/240}$Pu concentration in soil at the east and west sheds and pens at the Cactus Spring Animal

Holding Area. This rough approximation has been based upon the following assumptions (Wilson and Terry, 1968):

- The median Pu levels found in sheep urine and fecal samples as a function of time
- Aerosol measurements taken during the tests
- The number of sheep and burros used in each test
- The time each sheep and burro spent in the east and west shed and pen areas
- The fraction of the Pu that was deposited in lungs and other tissue and organs
- The area of the sheds and pens
- The inhalation rates of burros and sheep range from 5 to 50 L/minute

The average $^{239/240}$Pu concentration in the Cactus Spring Pu/DU site soil has been estimated to be less than 1 pCi/g. This is the estimated Pu concentration for the surface soil. Precise estimates cannot be calculated due to the broad variability in the data collected during Project Roller Coaster. The concentration of Pu in surface soils taken from background locations in the vicinity of the Nevada Test Site in the last twenty years ranges from 0.004 to 0.19 pCi/g (McArthur and Miller, 1989).

There is no reason to analyze soil samples for depleted uranium in support of environmental remediation at the Cactus Spring Pu/DU site. The DU concentration is simply too small to distinguish from the much higher natural concentration of ^{238}U found in soil. The following paragraphs discuss the concentration of DU in soil at the Roller Coaster and Cactus Spring site.

DU was included in the Project Roller Coaster detonation devices (Shreve, 1964). The Double Tracks device included 4 kilogram (kg) of DU while the Clean Slate 2 device included 114 kg of DU. The isotopic activity abundance of DU consists of approximately 90 percent uranium-238 (^{238}U), 1.5 percent ^{235}U, and 8.5 percent ^{234}U (Rich et al., 1988). The DU source terms, if assumed to be uniformly distributed on the surface soils in the plume area of the Roller Coaster sites, are not measurable against the background concentration of uranium $^{(238/235/234)}$U (DOE, 1996 and 1997). At Double Tracks, if it is assumed that the 4 kg of DU is distributed uniformly in the top 5 cm of soil in the contaminated plume area (1.80E+5 m^2) in the same manner as was the Pu (approximately 1/3 of the source term remained in the surface soils downwind from ground wind), the average ^{238}U concentration would be 0.03 pCi/g (Shreve, 1964). The mean concentration of ^{238}U was 8.7 ± 3 pCi/g in seven surface soil samples taken at Double Tracks. The uranium concentration in the samples was measured prior to the Roller Coaster tests using neutron activation analysis (Perry et al., 1966). It is not possible to detect an increase of 0.03 pCi/g from a background of 8.7 ± 3 pCi/g. If the 114 kg of DU detonated at Clean Slate 2 is assumed to be distributed on the 1.35E+6-m^2 area like the Pu contamination (about 1/3 of the source term remained in the surface soils downwind from ground zero), than the average DU concentration in the top 5 cm of soil would be 0.11pCi/g. The ^{238}U mean concentration in surface soils at Clean Slates prior to Operation Roller Coaster was 4.8 ± 2 pCi/g. The additional DU contamination at these two Roller Coaster sites is less than three percent of the natural ^{238}U

concentration in the soil. The DU could not be measured in the surface soil or in the aerosols after the Roller Coaster tests. During Double Tracks and Clean Slate 2 site characterization activities, another attempt was made to measure the DU concentration in surface soils downwind from ground zero. Even with the use of more sophisticated instrumentation and detectors, the DU could not be detected in the surface soil samples above the background ^{238}U concentration (DOE, 1996; 1997).

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Laura Tryboski
Chrono File

Attachment 3

References

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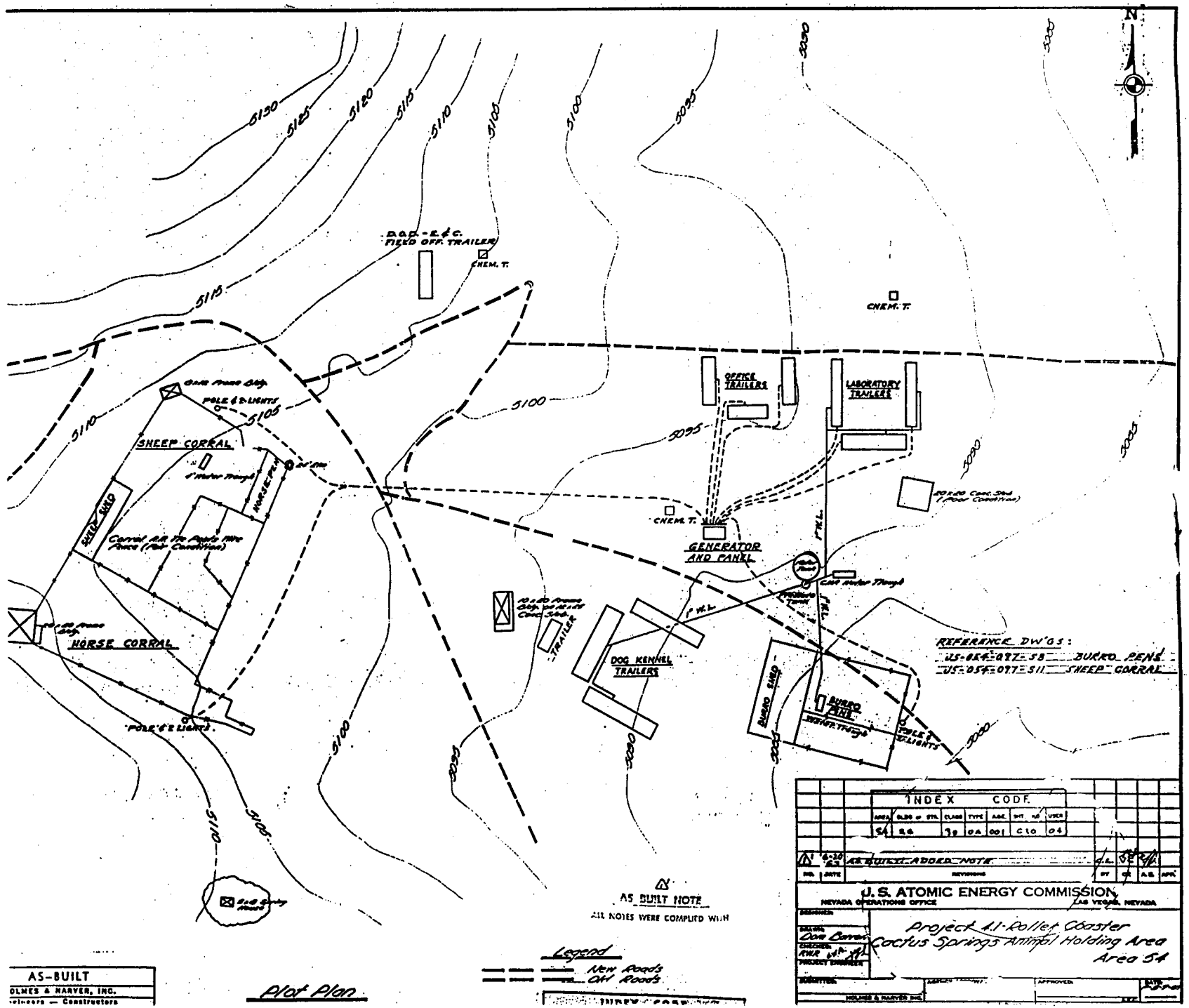
Figure 1



ATT M-18

Cactus Spring Soil Contamination East Shed and Holding Pen

Alpha Measurements (DPM/100 sq. cm)

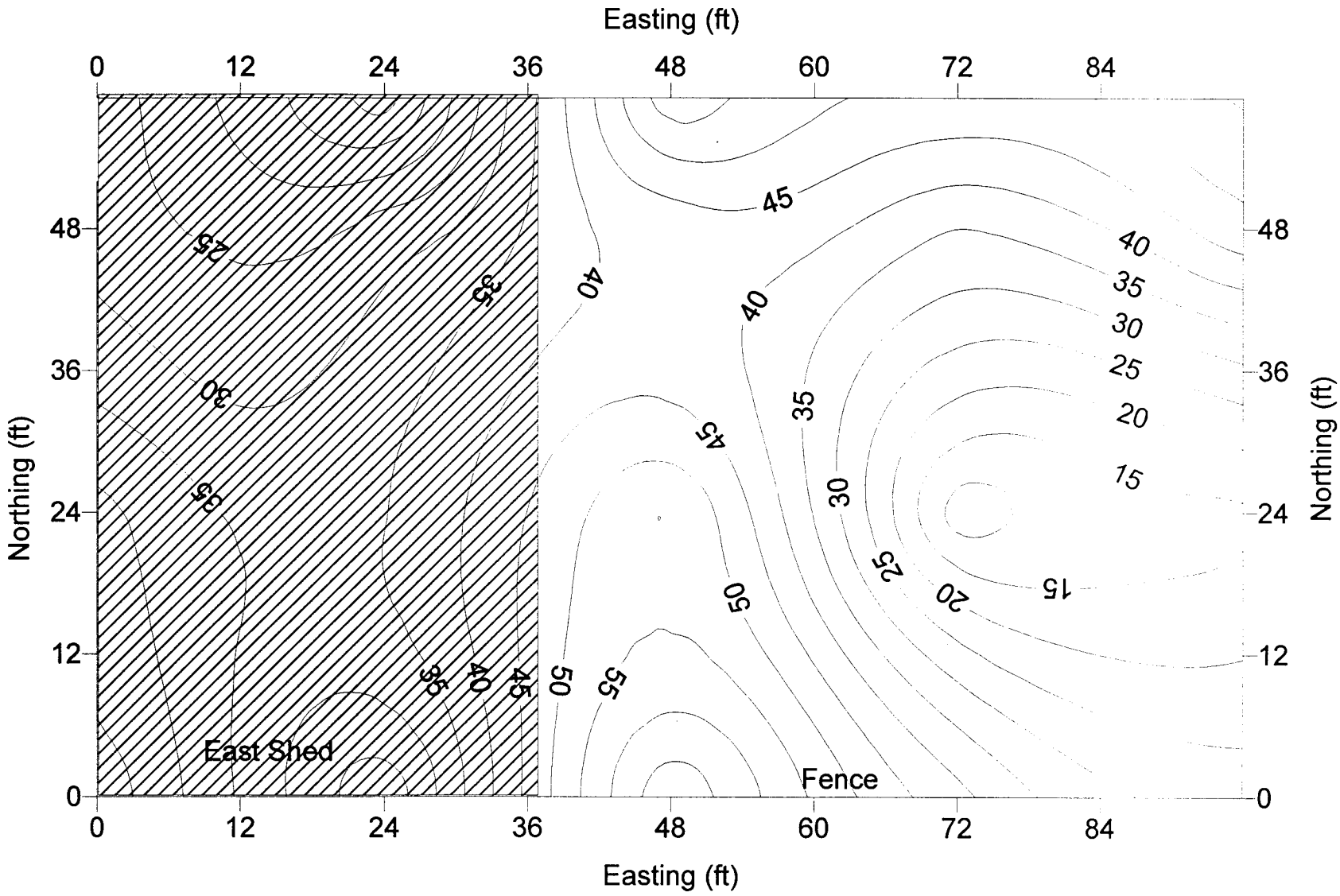


Figure 2

Cactus Spring Soil Contamination East Shed and Holding Pen

Beta Measurements (DPM/100 sq. cm)

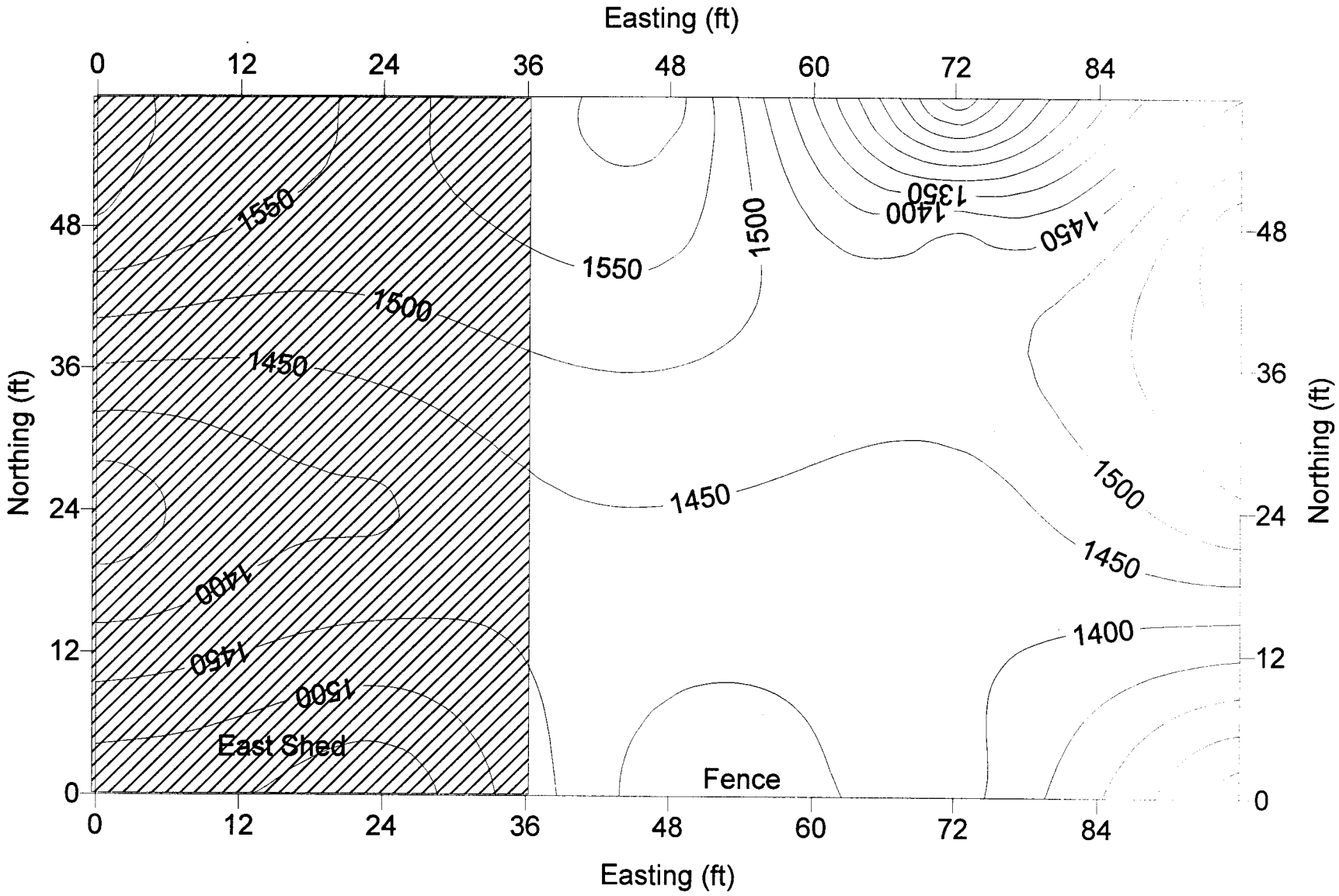


Figure 3

ATT M-20

Cactus Spring Soil Contamination East Shed and Holding Pen

Gamma Count Rate Measurements (CPM)

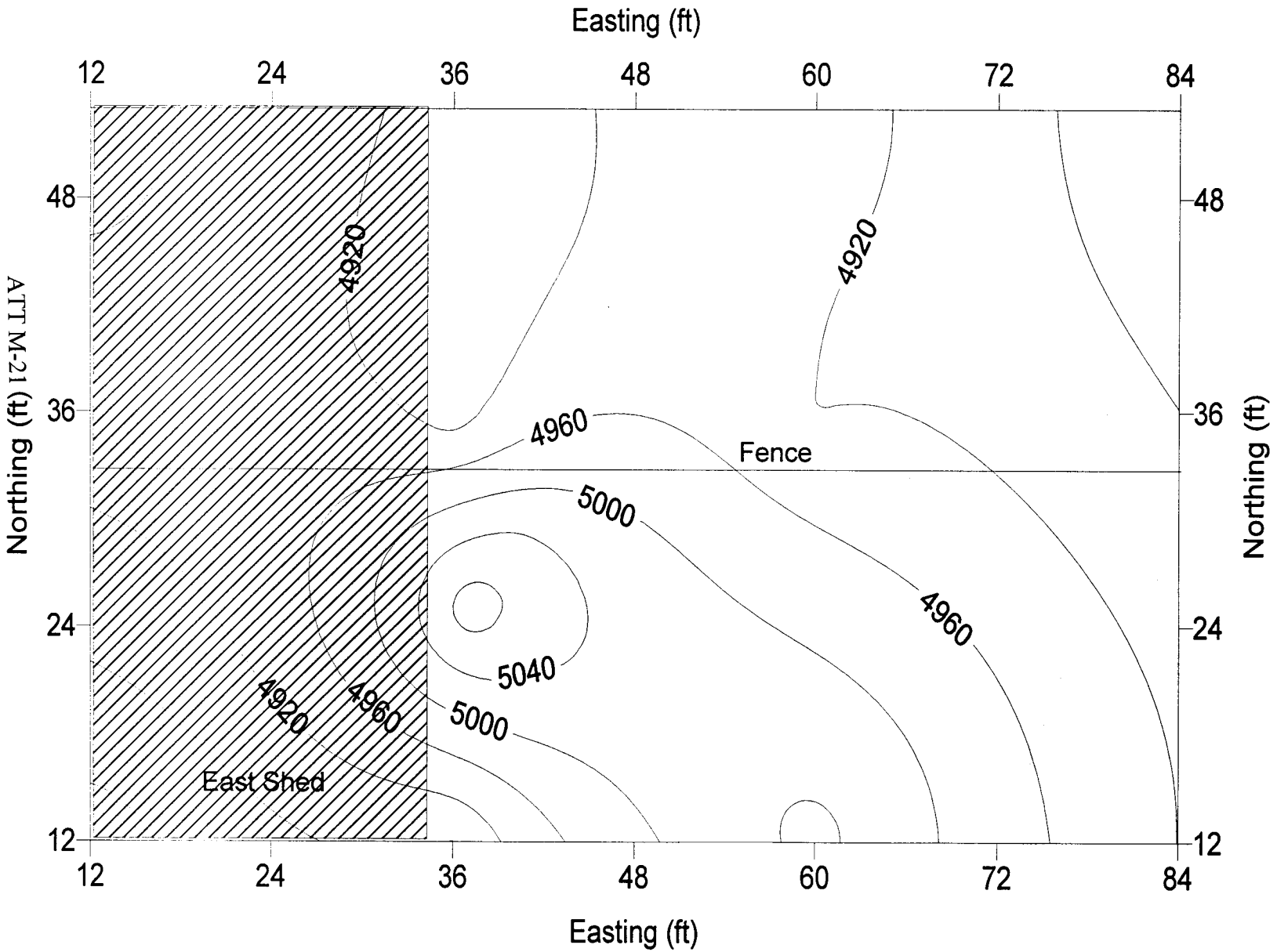


Figure 4

Cactus Spring Soil Contamination West Shed and Holding Pen

Alpha Measurements (DPM/100 sq. cm)

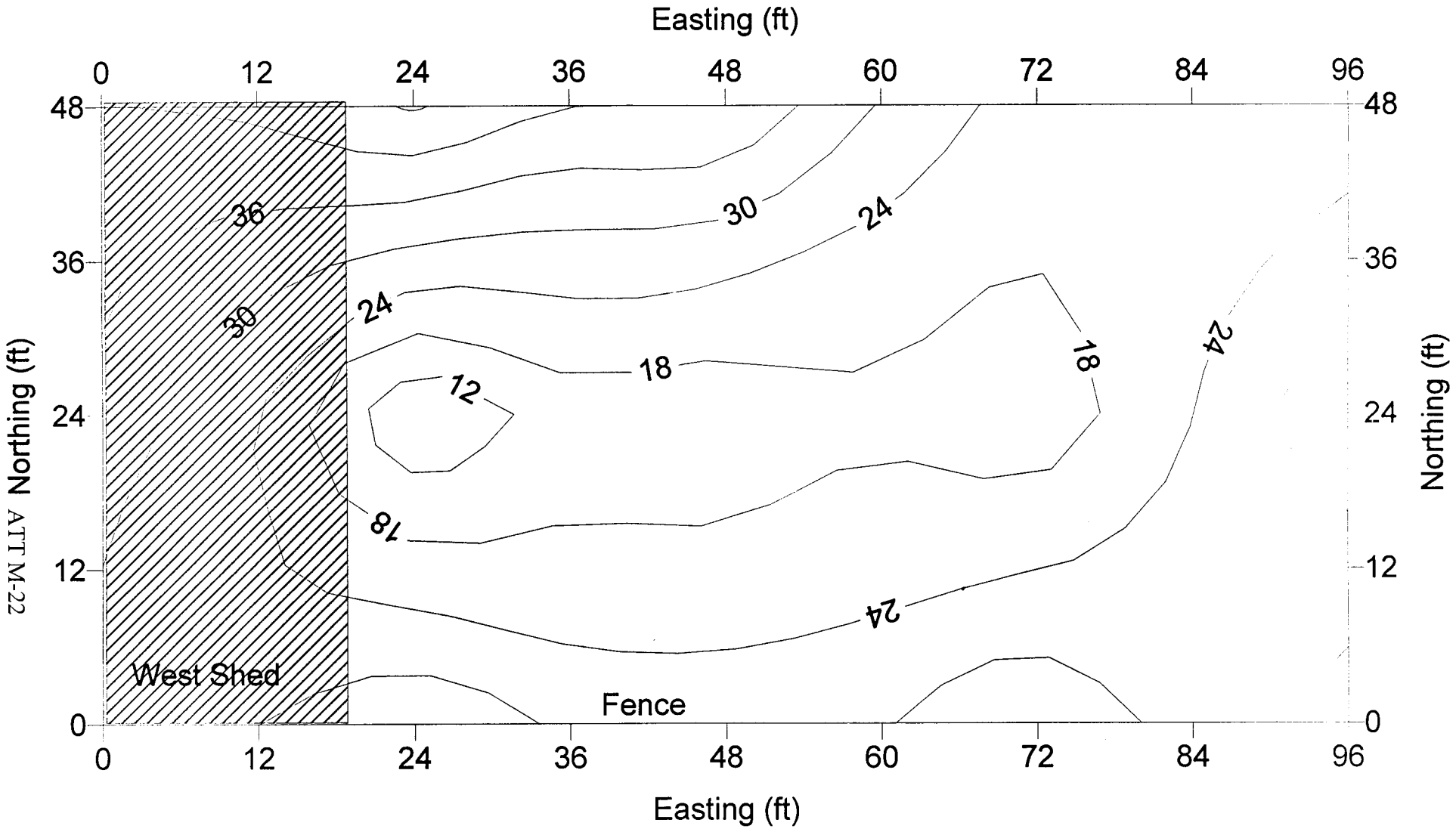
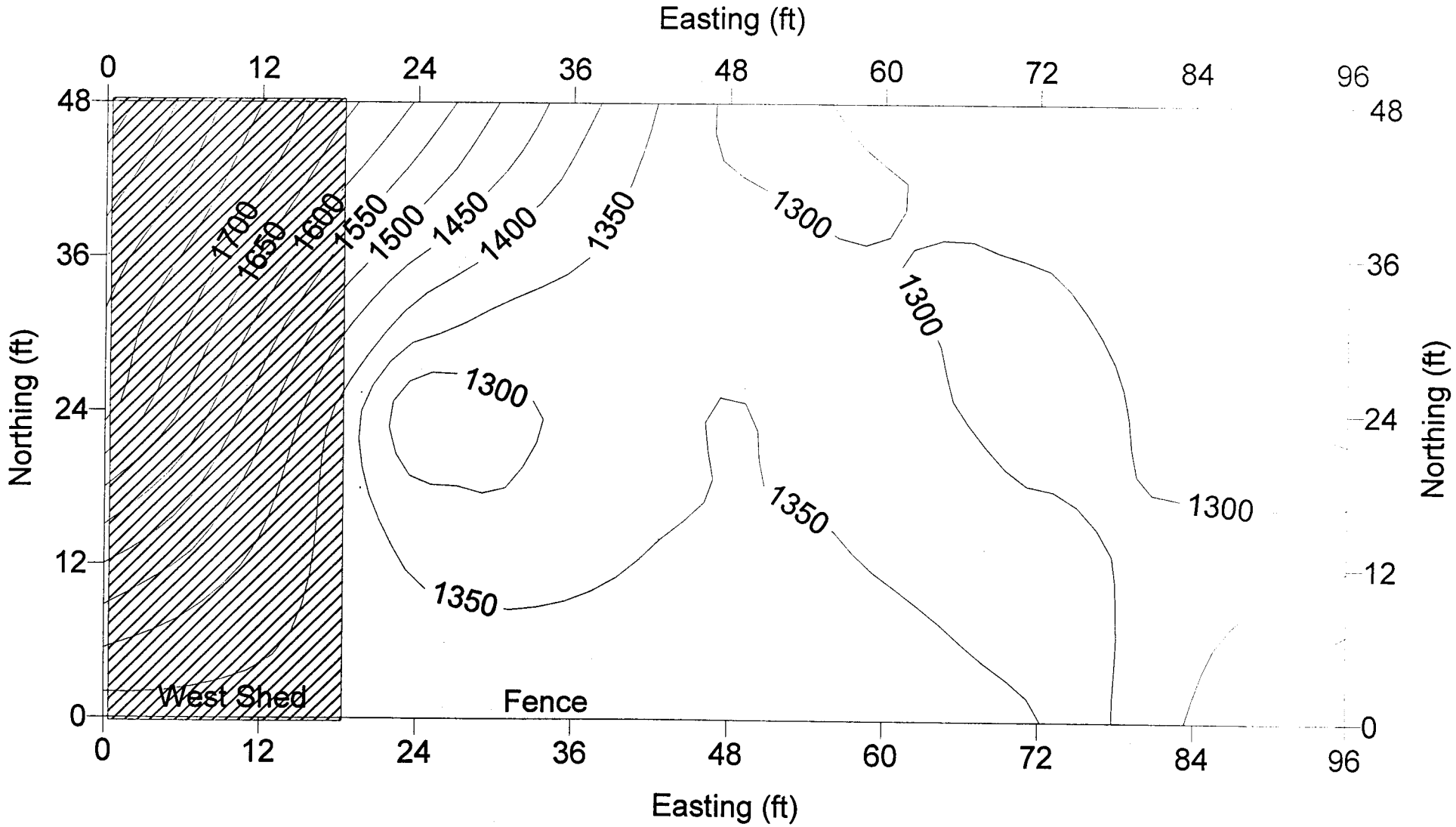


Figure 5

Cactus Spring Soil Contamination West Shed and Holding Pen

Beta Measurements (DPM/100 sq. cm)

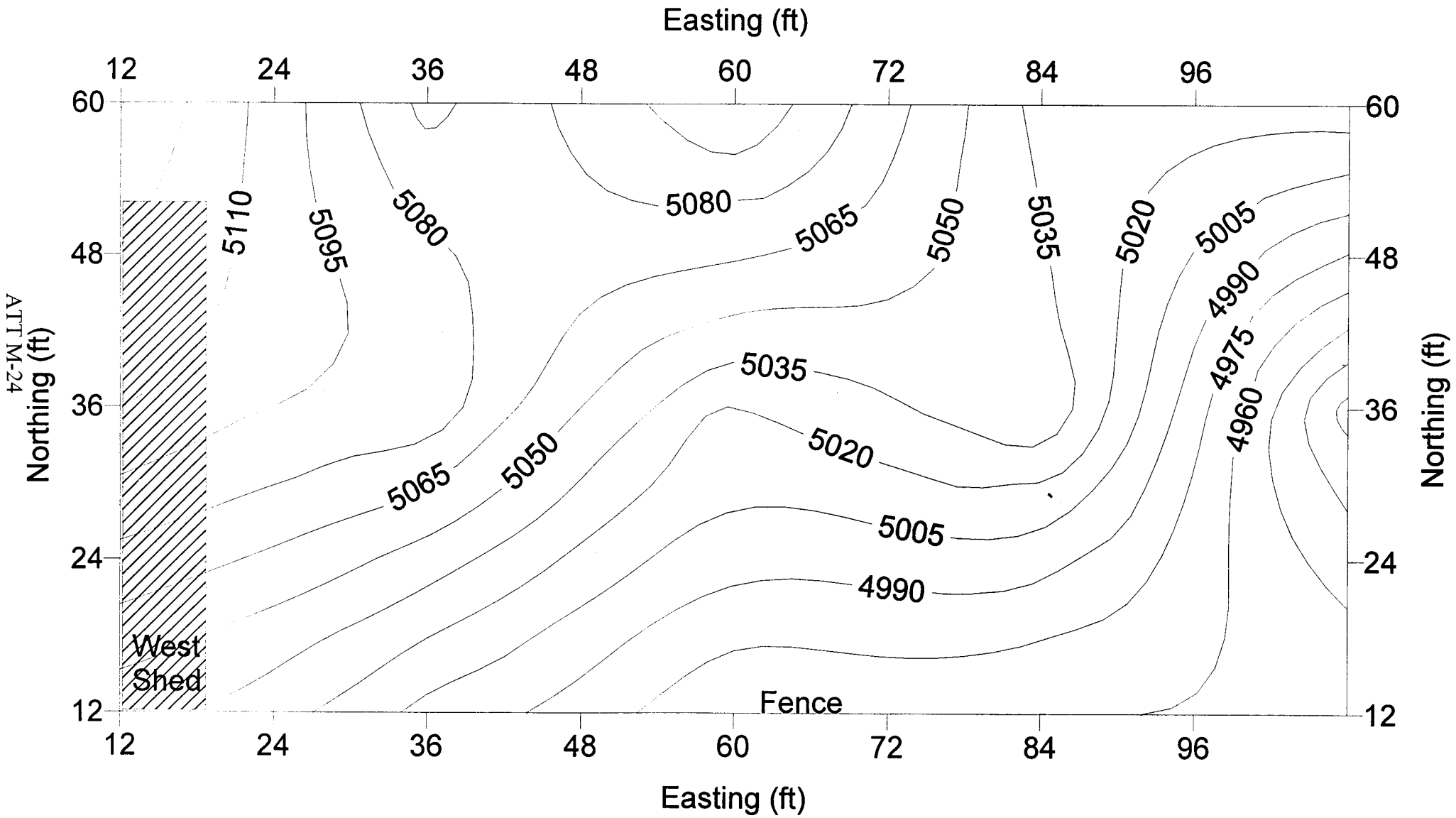


ATT M-23

Figure 6

Cactus Spring Soil Contamination West Shed and Holding Pen

Gamma Count Rate Measurements (CPM)



ATT M-24

Figure 7

Attachment 2
Gamma Count Measurement Contours and Sample Locations

Cactus Spring Soil Contamination East Shed and Holding Pen

Gamma Count Rate Measurements (CPM)

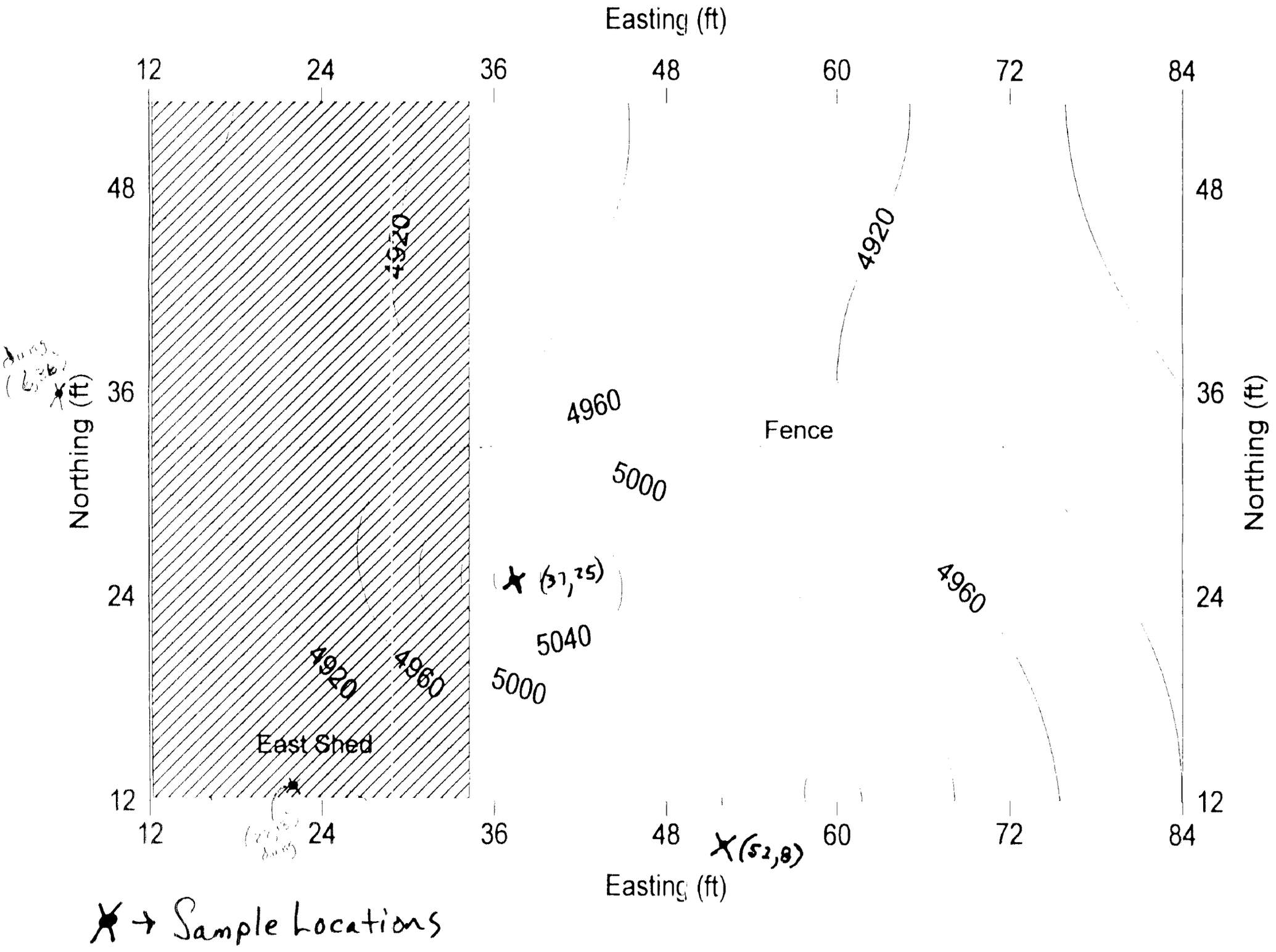


Figure 2

Cactus Spring Soil Contamination West Shed and Holding Pen

Gamma Count Rate Measurements (CPM)

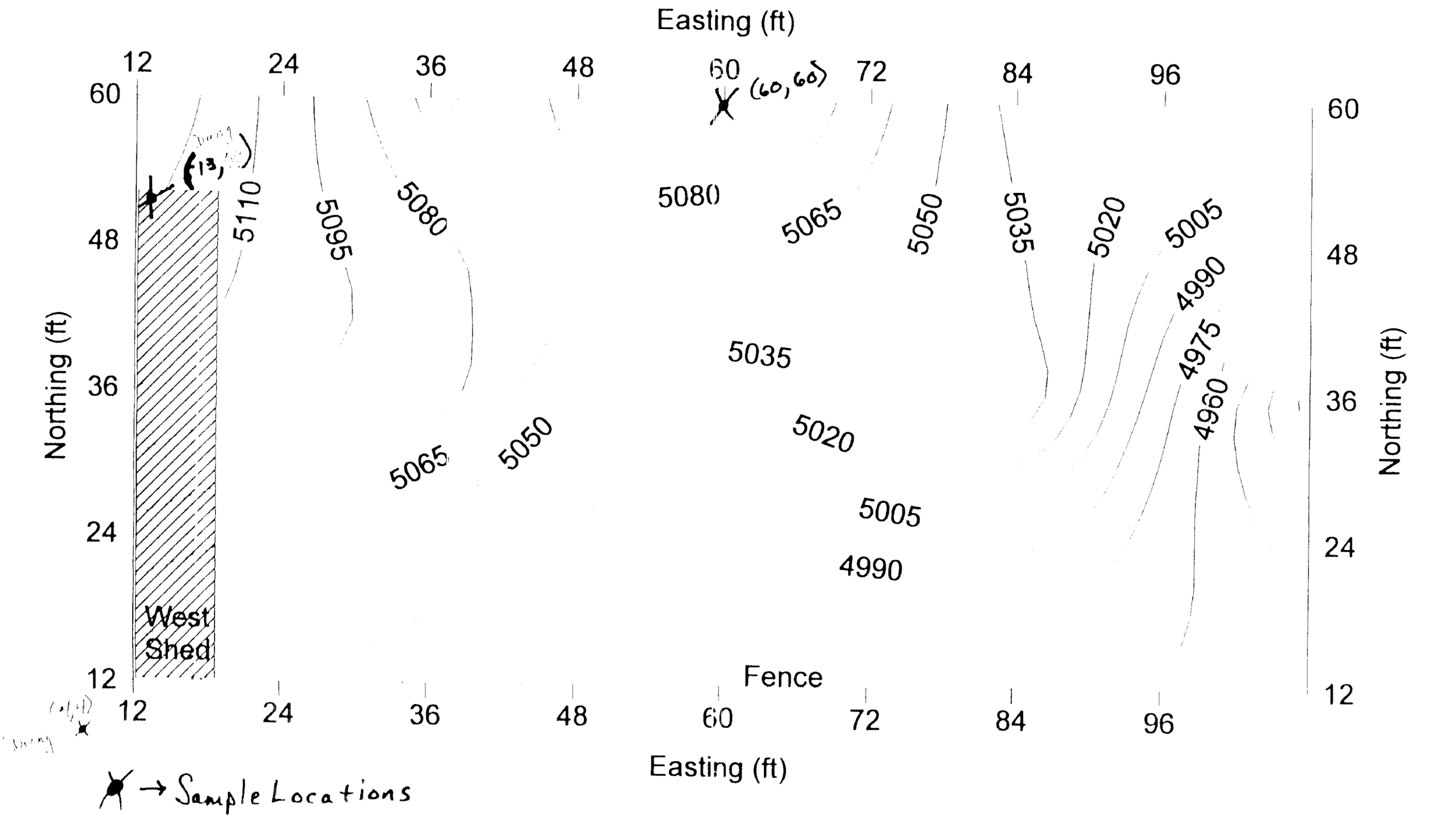


Figure 3

Attachment 3
Sample Collection Logs

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/16/1998
Time	145859
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01155 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Water matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: n/a END DEPTH: n/a	SAMPLE PURPOSE: Equipment rinsate
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: Rinsate Blank
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: n/a	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	HDPE 1000	1	1000	ml	HNO3<2	n/a	N/A	N/A	N/A	02/16/1998 145837

ATT M-29

COMMENTS (sample color, appearance, odor, etc.)

This sample was taken at ITLV storeroom by pouring DI water over deconned sampling equipment and then pourring the water into the container. The pH was checked with pH paper and found to be less than two. The sample container was wiped dry, custody sealed, labeled and placed in a selfsealing bag. COC# 980218124600

*** Included in container printed above

Containers: HDPE 1000-1000 high density polyethylene

Prepared By: _____

Print Date: 02/19/1998 01:17:10 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
Time	081653
Project No.	772857.03110000
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01156 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Water matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: N/A END DEPTH: N/A	SAMPLE PURPOSE: Field blank (EPA definition).
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: General sample - liquid.
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: Mid 30's (F), clear, no wind	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	HDPE 1000	1	1000	ml	HNO3<2	<2	C715603	N/A	N/A	02/18/1998 081602

ATT M-30

COMMENTS (sample color, appearance, odor, etc.)

COC# 980218124600 This sample was obtained by pouring distilled water directly into the preserved HDPE 1000 mL bottle while snow was being cleared from the sampling area at E 37,25. The sample was tested for pH using pH paper and found to have a pH of less than 2. The bottle was then wiped dry, custody sealed, labeled, and placed into a self sealing bag.

*** Included in container printed above

Containers: HDPE 1000-1000 high density polyethylene

Prepared By: _____

Print Date: 02/19/1998 12:31:28 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
Time	081816
Project No.	772857.03110000
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01157	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0	END DEPTH: 0.25	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: mid 30's F, clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 081811

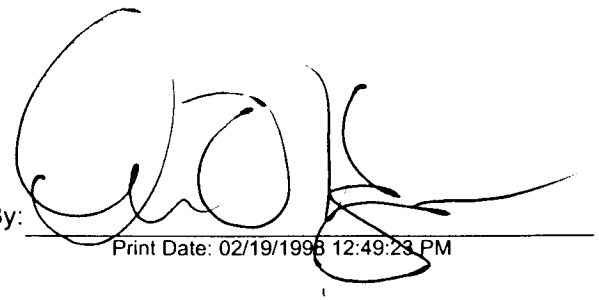
ATT M-31

COMMENTS (sample color, appearance, odor, etc.)

This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula to take the surface soil from E 6,36. The material sampled appeared to be livestock dung as it had visible bits of hay in it. The dung was dry and had no odor. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag on ice. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: 

Print Date: 02/19/1998 12:49:23 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
Time	083238
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01158	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.5	END DEPTH: 0.75	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: 30's F, clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 083254

ATT M-32

COMMENTS (sample color, appearance, odor, etc.)

The area at E 6, 36 was dug out until soil was reached. This sample was taken using a split spoon and a slide hammer to drive to a depth of approximately 9 inches. The soil was very rocky. The split spoon was driven three times in order to collect enough sample. The spoon was emptied into a deconned stainless steel bowl and then scooped into the sample jar using a deconned plastic scoop. The jar was wiped clean, custody sealed, labeled and placed in a self sealing bag.

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By:

Print Date: 02/19/1998 12:49:50 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
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Project No.	772857.03110000
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01159 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0 END DEPTH: 0.25	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: Mid 30's, clear	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	N/A	N/A	N/A	02/18/1998 084436

ATT M-33

COMMENTS (sample color, appearance, odor, etc.)

This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula to take the surface soil from E 22, 13. The material sampled appeared to be livestock dung as it had visible bits of hay in it. The dung was dry and had no odor. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag on ice. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 01:02:15 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
Time	085516
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01160	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.5	END DEPTH: 0.75	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: mid thirties (F), clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 085519

ATT M-34

COMMENTS (sample color, appearance, odor, etc.)

The area at E 22,13 was dug down until soil was reached. This sample was taken using a deconned split spoon and a slide hammer to drive to a depth of approximately 9 inches. There was a very definite dung, soil interface visible and a photo was taken to show it. The soil was rocky. The split spoon was driven twice in order to collect enough sample. The spoon was emptied into a deconned stainless steel bowl and then scooped into the sample jar using a deconned plastic scoop. The jar was wiped clean, custody sealed, labeled and placed in a self sealing bag. COC# 980218124600

***** Included in container printed above**

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 12:51:39 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01161	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0	END DEPTH: 0.5	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: mid thirties F, clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 091244

ATT M-35

COMMENTS (sample color, appearance, odor, etc.)

This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula to take the surface soil from E 37, 25. The material sampled was very moist with a clayey texture. It did not appear to be dung. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 12:54:54 PM

INTERNATIONAL TECHNOLOGY CORPORATION

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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01162	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0	END DEPTH: 0.25	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: mid thirties (F), clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 092137

ATT M-36

COMMENTS (sample color, appearance, odor, etc.)

This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula to take the surface soil from E 52, 8. This location was moved 5 feet north from the planned location in the FI to avoid the wood remains that covered the area to the south. The material sampled appeared to be soil. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag on ice. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 12:55:43 PM

INTERNATIONAL TECHNOLOGY CORPORATION

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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01163 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0 END DEPTH: 0.25	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: mid thirties F, clear	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 095320

ATT M-37

COMMENTS (sample color, appearance, odor, etc.)

This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula to take the surface soil from W 4, 4. The material sampled appeared to be livestock dung as it had visible bits of hay in it. The dung was dry and had no odor. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag on ice. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 01:01:24 PM

INTERNATIONAL TECHNOLOGY CORPORATION

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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01164 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.5 END DEPTH: 1.0	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: mid thirties F, clear	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 100236

ATT M-38

COMMENTS (sample color, appearance, odor, etc.)

The area at W 4, 4 was dug down until soil was reached. This sample was taken using a split spoon and a slide hammer to drive to a depth of approximately 9 inches. The soil contained alot of rock material. The spoon was emptied into a deconned stainless steel bowl and then scooped into the sample jar using a deconned plastic scoop. The jar was wiped clean, custody sealed, labeled and placed in a self sealing bag. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 01:01:38 PM

INTERNATIONAL TECHNOLOGY CORPORATION

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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01165	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0	END DEPTH: 0.25	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: mid thirties F, clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U529301	N/A	N/A	02/18/1998 100615

ATT M-39

COMMENTS (sample color, appearance, odor, etc.)

This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula to take the surface soil from W 13, 49. The gravel covering the area was scraped aside to reveal what appeared to be livestock dung as it had visible bits of hay in it. The dung was dry and had no odor. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag on ice. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 01:01:56 PM

INTERNATIONAL TECHNOLOGY CORPORATION

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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01166	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.5	END DEPTH: 0.7 1.0 OK 3/9/98	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: mid thirties F, clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 101056

ATT M-40

COMMENTS (sample color, appearance, odor, etc.)

The area at W 13, 49 was dug down until soil was reached. This sample was taken using a split spoon and a slide hammer to drive to a depth of approximately one foot. The soil was very rocky and had a very dark brown color. The split spoon picked up a large rock on the first run and had to be sent down twice in order to collect enough sample. The spoon was emptied into a deconned stainless steel bowl and then scooped into the sample jar using a deconned plastic scoop. The jar was wiped clean, custody sealed, labeled and placed in a self sealing bag. COC# 980218124600

*** Included in container printed above
Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 01:02:32 PM

INTERNATIONAL TECHNOLOGY CORPORATION

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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01167 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0 END DEPTH: 0.75	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: thirties F, clear	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 103552

ATT M-41

COMMENTS (sample color, appearance, odor, etc.)

GOH 3/9/98

The area at W 17, -19 was cleared of snow until soil was reached. This area was supposed to have a dung heap but did not appeared to have only soils were present. The snow obscured the location of a heap. The ground was very hard, probably frozen, and very rocky. Recovery was very slight. This sample was taken using a split spoon and a slide hammer to drive to a depth of approximately 9 inches. The spoon was emptied into a deconned stainless steel bowl and then scooped onto the sample jar using a deconned plastic scoop. The jar was wiped clean, custody sealed, labeled and placed in a self sealing bag. COC# 980218124600

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: GOH

Print Date: 02/19/1998 01:02:51 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01168 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0 END DEPTH: 0.25	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: mid thirties F, clear	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 105058

COMMENTS (sample color, appearance, odor, etc.)

At this location (W 60, 60) the snow was first cleared aside and a scrape of soil was overturned with a shovel. The bottomside of the scrape appeared to be dung so this was sampled. A duplicate, TTR01170, was also taken here. This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag. COC# 980218124600

ATT M-42

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By:

Print Date: 02/19/1998 01:07:53 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
Time	105800
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A		
SAMPLE NO.: TTR01169	PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a		SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.5	END DEPTH: 0.75	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A	QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla		SAMPLING ZONE: N/A
WEATHER: thirties, clear		

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 105858

COMMENTS (sample color, appearance, odor, etc.)

The area at W 60, 60 was cleared down until soil was reached. This sample was taken using a split spoon and a slide hammer to drive to a depth of approximately 9 inches. The soil contained bits of roots from the adjacent shrub. The spoon was emptied into a deconned stainless steel bowl and then scooped onto the sample jar using a deconned plastic scoop. The jar was wiped clean, custody sealed, labeled and placed in a self sealing bag. COC# 980218124600

ATT M-43

*** Included in container printed above

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 01:09:01 PM

INTERNATIONAL TECHNOLOGY CORPORATION

Date	02/18/1998
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SAMPLE COLLECTION LOG

SAMPLE LOCATION.: CACTUS SPRINGS COORDINATES: N/A	
SAMPLE NO.: TTR01170 PROJECT NAME: Industrial Sites	SAMPLE MATRIX: Soil matrix
COMPOSITE: N/A COMPOSITE TYPE: n/a	SAMPLING METHOD: Grab sample
SAMPLE DEPTH: n/a START DEPTH: 0.0 END DEPTH: 0.25	SAMPLE PURPOSE: Regular environmental field
COORDINATES: N/A QC Required: N/A	SAMPLE TYPE: Surface soil.
SAMPLE TEAM: A. O'Hagan, S. Bonilla	SAMPLING ZONE: N/A
WEATHER: Thirties F, clear	

REQUESTED TESTING PROGRAM	CONTAINERS	QTY	VOLUME	UNITS	PRESERVATIVE	PH	BOTTLE LOT #	REQ 4C	Filtered	COLLECTION DATE/TIME
UGTAISOPU - Isotopic	AWMJ500	1	8	oz	NONE	n/a	U608601	N/A	N/A	02/18/1998 111558

COMMENTS (sample color, appearance, odor, etc.)

At this location (W 60, 60) the snow was first cleared aside and a scrape of soil was overturned with a shovel. The bottomside of the scrape appeared to be dung so this was sampled. This sample was taken using a disposable deconned plastic scoop and a deconned stainless steel spatula. The sample bottle was wiped clean, custody sealed, labeled, and placed in a self sealing bag. COC# 980218124600 This sample is a duplicate of sample TTR01170.

ATT M-44

***** Included in container printed above**

Containers: AWMJ500-8 oz amber glass jar

Prepared By: _____

Print Date: 02/19/1998 01:09:40 PM

Attachment 4
Field Activities Daily Logs

INTERNATIONAL TECHNOLOGY CORPORATION

DAILY LOG	DATE	02	18	98
	NO.			
	SHEET	1	OF	1

FIELD ACTIVITY DAILY LOG

PROJECT NAME CAU 485 Cactus Spring PA/DBL TRX PA | PROJECT NO. 772859.0311000

FIELD ACTIVITY SUBJECT: Soil Sampling and PA Site Visit

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

06:00 Crew meets at vehicles at Mercury to start day. Drive to IT Field Office.

06:15 At IT Field Office to prepare for day

06:45 Call ASI at 5-8285 to have them open Gate to Range 71 North. "Encerto" w/ ASI will arrange for gate to open for our 07:00 - 09:30 window.

06:55 Tailgate Safety Meeting conducted by Steve Hellerman.

See FADLs by Ann O'Hagan & Marjorie England for remainder of Day.

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
None	
WEATHER CONDITIONS: Clear, Cold, Snow on ground	IMPORTANT TELEPHONE CALLS:

IT PERSONNEL ON SITE: D. Wilson, M. England, Ann O'Hagan, Steve Hellerman, Sam Bonilla

SIGNATURE Dustin Wilson DATE: 2/18/98

327A-7-86

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG

DAILY LOG | DATE 02 17 98 | NO. | SHEET 1 OF 1

PROJECT NAME CAU485 Cactus Spring Pu/DU | PROJECT NO. 77285 7. 03110000

FIELD ACTIVITY SUBJECT: Preliminary Assessment Sampling

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

12:30 Arrive at IT field office (Steve Helleman - SSO, Ann O'Hagen - Field Team Leader, Sam Bonilla - Sampling Tech, Dustin Wilson - Site Supervisor, Margorie England - To view DOUBLE TRACKS tomorrow). Unload vehicles and prepare equipment for marking sample locations today and sampling tomorrow.

13:30 D. Wilson obtains Picture Badge

13:45 Tailgate Safety Meeting conducted by Steve Helleman

14:00 Mobilize to Cactus Spring

14:15 Arrive at Cactus Spring. Mark sampling locations at East Shed. Location (52,3) was relocated to (52,8) due to surface debris from the corral. Location (37,25) was marked as (37,25). Two locations were chosen inside shed where dung was visible at (22,13) and (36,6). Moved team to West shed to mark locations. (60,60) was marked as (60,60). (13, ~~49~~ 51) was moved to (13,49) due to debris and to stay inside shed as (0,50) was at the NW corner of shed. Two new locations were chosen. One at (4,4) were visible dung could be seen and one at a spot out side the Rad Survey area where a dung mound may potentially exist at (17,-19).

16:00 Return to Field Office. Discuss tomorrows activities

16:30 Head to Man Camp

DWW

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
None	None
WEATHER CONDITIONS: Cold, few inches of snow, slight breeze, occasional flurries	IMPORTANT TELEPHONE CALLS: None

IT PERSONNEL ON SITE: A. O'Hagen, S. Bonilla, S. Helleman, D. Wilson, M. England

SIGNATURE Dustin Wilson DATE: 2/17/98

327A-7-86

INTERNATIONAL TECHNOLOGY CORPORATION

DAILY LOG | DATE 02 18 98 | NO. | SHEET 01 OF 03

FIELD ACTIVITY DAILY LOG

PROJECT NAME Cactus Springs PU/DU | PROJECT NO. 772857.031100

FIELD ACTIVITY SUBJECT: Soil Sampling

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

0600 Leave for office
0655 TSB by S. Hellemann
0700 SQP 0404 FTLV will be modified by using Distilled Water instead of DI. No Metals will be analyzed. Distilled will be used for Field Blank only. Decon has already been done prior to leaving LV. (See FADL 2/14/98)
0740 Depart for Cactus Springs)
0915 Field Blank taken as site was cleared from E 37,25 TTR01156
0818 E ~~3~~,6~~3~~ TTR01157 From surface, dung - dried and organic matter present in it (hay?)
0935 Slide hammer to 6-8 in collect TTR01155 3 times to collect enough soil (very rocky)
0946 Surface Sample, organic, E22,13 TTR01159
0959 Sample TTR01160 soil, 6-9 in. E22,13
0912 Sample TTR01161 soil very moist, clayey E37,25 0-6 in.
0921 Sample TTR01162 soil 0-6 in E52,8 (on plan 52,0) moved 5 feet N to avoid wooden thing
0940 Clean up pack waste Affix sample #'s to stakes
0951 Moved to Westshed.

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
N/A	See 0700, 0921
WEATHER CONDITIONS:	**IMPORTANT TELEPHONE CALLS:**
Clear mid thirties (F)	N/A

IT PERSONNEL ON SITE: S. Bonilla, A. Hagan S. Hellerman D. Wilson ME Engr

SIGNATURE: [signature] DATE: 2/18/98

327A-7-86

INTERNATIONAL TECHNOLOGY CORPORATION

DAILY LOG | DATE 02 18 98 | NO. | SHEET 02 OF 03

FIELD ACTIVITY DAILY LOG

PROJECT NAME Cactus Springs | PROJECT NO. 772857 031100

FIELD ACTIVITY SUBJECT: Sampling (west shed)

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

0953 Sample TTR01163 at West shed W 4,4 Surface organic material

1002 Sample TTR01164 at West shed W 4,4 Soils very rock

1006 W 13,49 scaped aside gravel sample TTR01165 organic material. then scraped to 3 inches to very dark soil

1010 sample TTR01166. soil. 6 to 12 in. (picked up a rock on first run West down twice)

1023 Sample TTR01167 at W 17,-19 This location did not appear to have dung present but was sampled by the direction of D. Wilson. The soil was extremely hard probably frozen. Very rocky Recovery with split spoon was very slight. Spoon was drive to a depth of 9 in to collect sufficient sample (Difficult to find another location with dung because of snow cover)

1050 Sample TTR01168 W 60,60 snow was cleared from this area and a mat of dead growth (vegetation) was overturned. the underside of the mat appeared to be dung so this was sampled. (Monogenous material with organic matter [hay bits] throughout). 0 - 3 inches

1058 Sample TTR01169 W 60,60 6-9 inches soil (w/ roots)

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
N/A	(see pg 01)
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
Clear mid 30's	N/A

IT PERSONNEL ON SITE: Stellemann, S. Bonilla A Ottaga

SIGNATURE DATE: 2/18/98

327A-7-86

INTERNATIONAL TECHNOLOGY CORPORATION

FIELD ACTIVITY DAILY LOG CONTINUATION SHEET

DAILY LOG	DATE	02	18	98
	NO.			
	SHEET	03	OF	03

PROJECT NAME Cactus Springs PROJECT NO. 772857031100

FIELD ACTIVITY SUBJECT Soil Sampling

DESCRIPTION ON DAILY ACTIVITIES AND EVENTS

1115 Duplicate of TTR01168 taken same depth 0-3 inches ~~2/18~~ 3/18/98 at W 60,60 (TTR01170)

1120 All stakes marked w/ sample #s Decon done, Waste packed in drum demob for field office.

2/18/98

632-3-88

IT INTERNATIONAL TECHNOLOGY CORPORATION

DAILY LOG | DATE 02 16 98 | NO. | SHEET 01 OF 01

FIELD ACTIVITY DAILY LOG

PROJECT NAME Cactus Spring Pu/DU | PROJECT NO. 772857.0311.000

FIELD ACTIVITY SUBJECT: Decon

DESCRIPTION OF DAILY ACTIVITIES AND EVENTS:

1330 Told Sammy of change to FI including tech change 01 approved 2/16/98 to page 08 of 08 (changing water preservative to HNO_3). Have verbal approval (in absence of Records management controlled copies) to proceed with equipment rinsate sampling. Pack sampling equipment and field supplies.

1400 Decon equipment (bowls, spatulas, split spoon, plastic scoops) allow to air dry.

1450 Pour DI water over decanned equipment and catch in 1L HNO_3 PE bottle for UGTAISOPU analysis. DI Lot PUR 97279 check pH (<2) label, custody seal and bag - Place in secured storage with COC and log. Package decanned equipment in dated bags

1650 End of Day

VISITORS ON SITE:	CHANGES FROM PLANS AND SPECIFICATIONS, AND OTHER SPECIAL ORDERS AND IMPORTANT DECISIONS.
N/A	N/A
WEATHER CONDITIONS:	IMPORTANT TELEPHONE CALLS:
N/A	N/A

IT PERSONNEL ON SITE: S. Bonilla (inside) A. Ollagan

SIGNATURE: [signature] DATE: 2/16/98

327A-7-86

Attachment 5
Analytical Results

CAU 485, CAS TA-39-001-TAGR Radiological Analysis (by NAS-NS-3058)

IT Corp. Sample No.	Laboratory Sample No.	Sample Date	Parameter	Result	Units	Minimum Dectable Concentration	Qualifier	Error
TTR01155	16988-001	16-Feb-98	Plutonium 238	0.018	PCI/L	0.17	U	0.064
TTR01155	16988-001	16-Feb-98	Plutonium 239/240	-0.018	PCI/L	0.19	U	0.022
TTR01156	16988-002	18-Feb-98	Plutonium 238	0.012	PCI/L	0.27	U	0.094
TTR01156	16988-002	18-Feb-98	Plutonium 239/240	-0.031	PCI/L	0.29	U	0.074
TTR01157	16988-003	18-Feb-98	Plutonium 238	0.028	PCI/G	0.10	U	0.051
TTR01157	16988-003	18-Feb-98	Plutonium 239/240	0.048	PCI/G	0.089	U	0.058
TTR01158	16988-004	18-Feb-98	Plutonium 238	-0.00002	PCI/G	0.15	U	0.054
TTR01158	16988-004	18-Feb-98	Plutonium 239/240	-0.003	PCI/G	0.11	U	0.032
TTR01159	16988-005	18-Feb-98	Plutonium 238	-0.003	PCI/G	0.15	U	0.047
TTR01159	16988-005	18-Feb-98	Plutonium 239/240	0.16	PCI/G	0.072	U	0.11
TTR01160	16988-006	18-Feb-98	Plutonium 238	0.074	PCI/G	0.12	U	0.078
TTR01160	16988-006	18-Feb-98	Plutonium 239/240	0.003	PCI/G	0.11	U	0.033
TTR01161	16988-007	18-Feb-98	Plutonium 238	-0.015	PCI/G	0.16	U	0.047
TTR01161	16988-007	18-Feb-98	Plutonium 239/240	-0.012	PCI/G	0.13	U	0.034
TTR01162	16988-008	18-Feb-98	Plutonium 238	0.054	PCI/G	0.12	U	0.067
TTR01162	16988-008	18-Feb-98	Plutonium 239/240	-0.025	PCI/G	0.12	U	0.029
TTR01163	16988-009	18-Feb-98	Plutonium 238	0.036	PCI/G	0.12	U	0.059
TTR01163	16988-009	18-Feb-98	Plutonium 239/240	0.036	PCI/G	0.10	U	0.053
TTR01164	16988-010	18-Feb-98	Plutonium 238	0.016	PCI/G	0.092	U	0.039
TTR01164	16988-010	18-Feb-98	Plutonium 239/240	0.019	PCI/G	0.084	U	0.039
TTR01165	16988-011	18-Feb-98	Plutonium 238	0.023	PCI/G	0.093	U	0.044
TTR01165	16988-011	18-Feb-98	Plutonium 239/240	0.060	PCI/G	0.050	U	0.053
TTR01166	16988-012	18-Feb-98	Plutonium 238	-0.011	PCI/G	0.13	U	0.033
TTR01166	16988-012	18-Feb-98	Plutonium 239/240	-0.011	PCI/G	0.15	U	0.046
TTR01167	16988-013	18-Feb-98	Plutonium 238	0.013	PCI/G	0.10	U	0.041
TTR01167	16988-013	18-Feb-98	Plutonium 239/240	-0.025	PCI/G	0.11	U	0.016
TTR01168	16988-014	18-Feb-98	Plutonium 238	-0.021	PCI/G	0.14	U	0.038
TTR01168	16988-014	18-Feb-98	Plutonium 239/240	0.014	PCI/G	0.12	U	0.049
TTR01169	16988-015	18-Feb-98	Plutonium 238	0.014	PCI/G	0.10	U	0.043
TTR01169	16988-015	18-Feb-98	Plutonium 239/240	0.012	PCI/G	0.086	U	0.035
TTR01170	16988-016	18-Feb-98	Plutonium 238	0.022	PCI/G	0.094	U	0.043
TTR01170	16988-016	18-Feb-98	Plutonium 239/240	0.055	PCI/G	0.099	U	0.061

Attachment 6
Radiological Data Review

DATE: MARCH 16, 1998

TO: DUSTIN WILSON

FROM: STEVE ADAMS

SUBJECT: Review of Plutonium Alpha Spectroscopy Results of Cactus Spring Soil and Rinsate Water Samples

Summary

Based on the plutonium isotopic alpha spectroscopy analysis of soil samples, I have concluded that there is no plutonium contamination on the Cactus Spring site. The Tier II review of the Cactus Spring analytical data package demonstrates that the data are acceptable. All quality assurance and quality control requirements were met. The concentration of ^{238}Pu and $^{239/240}Pu$ in all soil and water rinsate samples was less than the method minimum detectable concentration (MDC). Details on the plutonium analysis are discussed below and are based upon my review of analytical data package.

Background

The MDC for the ^{238}Pu in the soil samples varied from a low of 0.093 picocuries per gram (pCi/g) to a high of 0.16 pCi/g. None of the ^{238}Pu concentrations were positive; the 2σ counting error exceeded the measurement for every sample. The concentration of ^{238}Pu in soil at background locations has been estimated to be less than 0.002 pCi/g (McArthur and Miller, 1989).

The MDC for the $^{239/240}Pu$ concentration in the soil samples varied from a low of 0.05 pCi/g to a high of 0.15 pCi/g. Two soil samples, 16988-005 and 16988-011, were positive, but were not statistically greater than their sample-specific MDC. The concentration of $^{239/240}Pu$ in soil samples taken from background locations is less than 0.19 pCi/g (McArthur and Miller, 1989). The plutonium alpha spectroscopy results demonstrate that there is no plutonium contamination in Cactus Spring soil.

The MDC for the ^{238}Pu in the rinsate water samples varied from a low of 0.017 picocuries per liter (pCi/L) to a high of 0.27 pCi/L. The ^{238}Pu concentration in water samples was not positive; the 2σ counting error exceeded the measurement for every sample. There is no data on the concentration of plutonium in water samples taken from background locations. The derived concentration guide (DCG) for ^{238}Pu established in DOE Order 5400.5 for protection of members of the public from DOE operations is 40 to 3,000 pCi/L, depending on the chemical form of the plutonium (DOE, 1993). The MDCs for ^{238}Pu in water were two orders of magnitude less than the most restrictive DCG.

The MDC for $^{239/240}Pu$ in the rinsate water samples varied from a low of 0.19 pCi/L to a high of 0.29 pCi/L. The DCG for $^{239/240}Pu$ in water varies from 30 to 2,000 pCi/L. The MDCs for $^{239/240}Pu$ in water were at least two orders of magnitude less than the most restrictive DCG. The plutonium alpha spectroscopy results demonstrate that there is no plutonium contamination in the

Cactus Spring rinsate water samples.

cc: Mike O'Hagan
Mike Foley
Laura Tryboski
Jeff Whitesides
Cindy Dutro
Stacey Sorg
Chrono File

References

McArthur R. D. and F. L. Miller 1989. *Off-Site Radiation Exposure Review Project Phase II Soils Program.* Published by the Water Resources Center of the Dessert Research Institute as Publication #45064. Desert Research Institiute, University of Nevada Las Vegas, Las Vegas, NV.

DOE See U. S. Department of Energy

U.S. Department of Energy 1993. DOE Order 5400.5, Change 2. *Radiation Protection of the Public and the Environment.* U.S. Department of Energy, Washington, DC.

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