Stone



K01, K02, K03

C24

# SOIL SAMPLING SITE CHARACTERIZATION NEAR THE ROCKY FLATS PLANT

James M. Stone
Scott B. Webb
F. W. Whicker

Colorado State University

Department of Radiological Health Sciences

Radioecology Group

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Figure 1: Planned transects for soil sampling and gamma spectroscopy measurement locations extending offsite from Rocky Flats (see Figure 2 for onsite transect locations). Four transects extent out from the 903 Pad in the directions of 60°, 90°, 120°, and 150° to a distance of 16 km beyond the plant boundary (approximately 20 km from the 903 Pad). In-situ gamma spectroscopy measurements were planned at each of the soil sampling sites and along 8 more transects spaced 10° north and south of each of the soil transects. The nearest undisturbed site to each of these macroplots was selected for sampling (See Figure 8a for location of sites actually sampled).

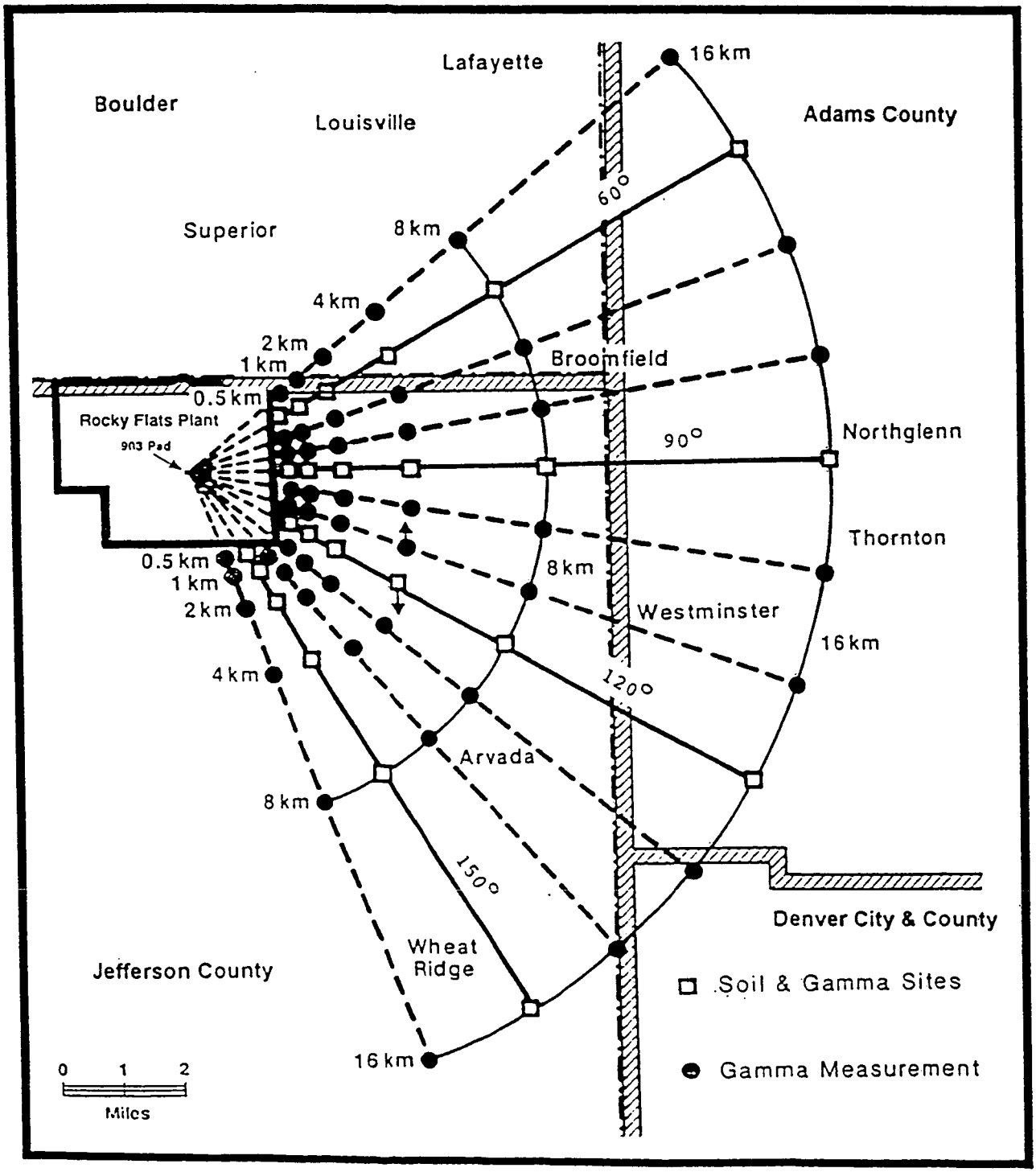


Figure 2: Planned transects for soil sampling and gamma spectroscopy measurement locations onsite at RFP. Three transects extent out from the 903 Pad in the directions of $60^{o}$, $90^{o}$, and $120^{o}$ In-situ gamma spectroscopy measurements were planned at each of the soil sampling sites and along 6 more transects spaced $10^{o}$ north and south of each of the soil transects The nearest undisturbed site to each of these macroplots was selected for sampling (See Figure 5a for location of sites actually sampled).

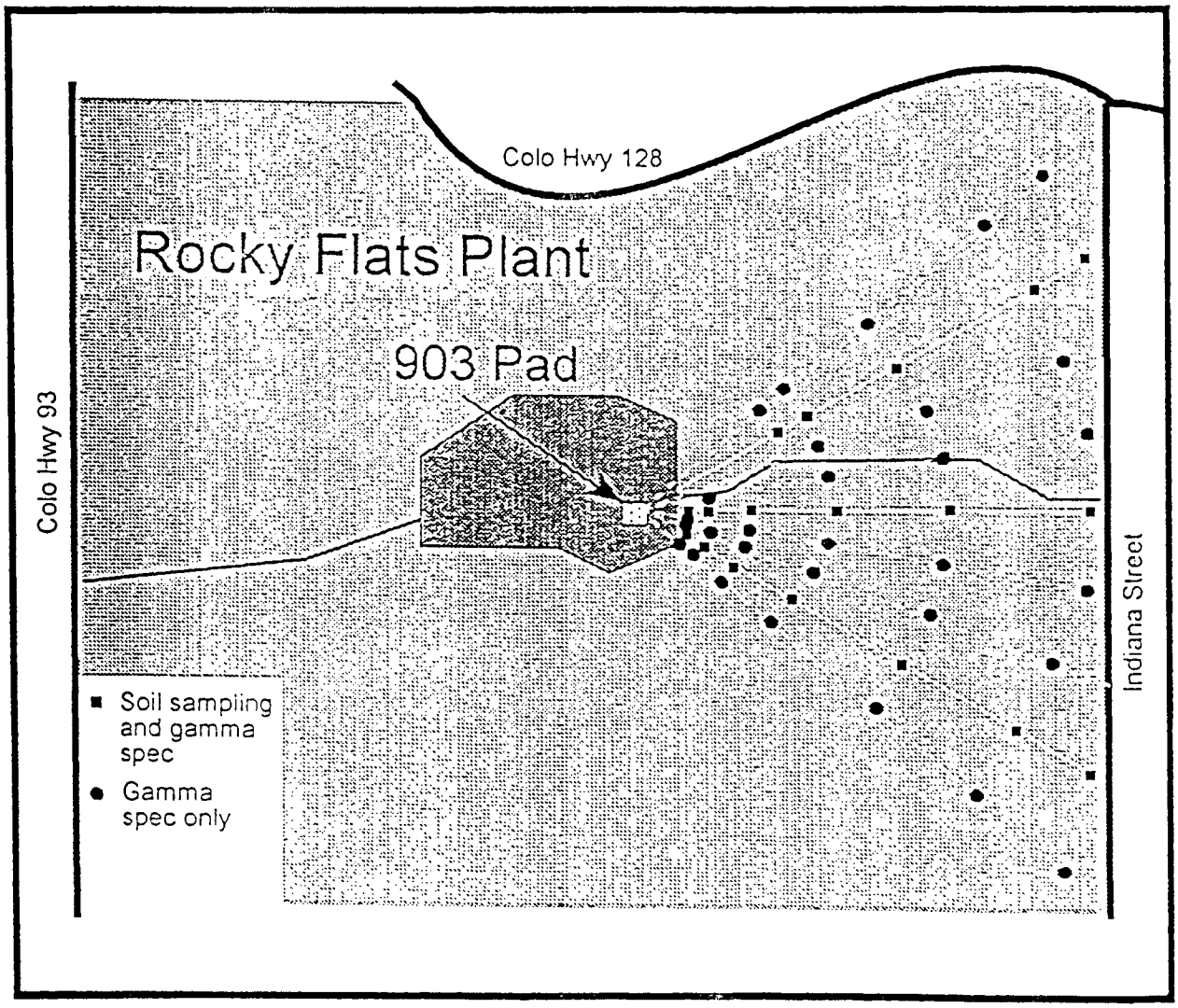


Figure 3: Community sampling locations (triangles) were selected at undisturbed sites in ten populated areas near the RFP. Soil samples were taken for 0-3 cm and 0-21 cm depths and in-situ gamma measurements were taken at these locations.

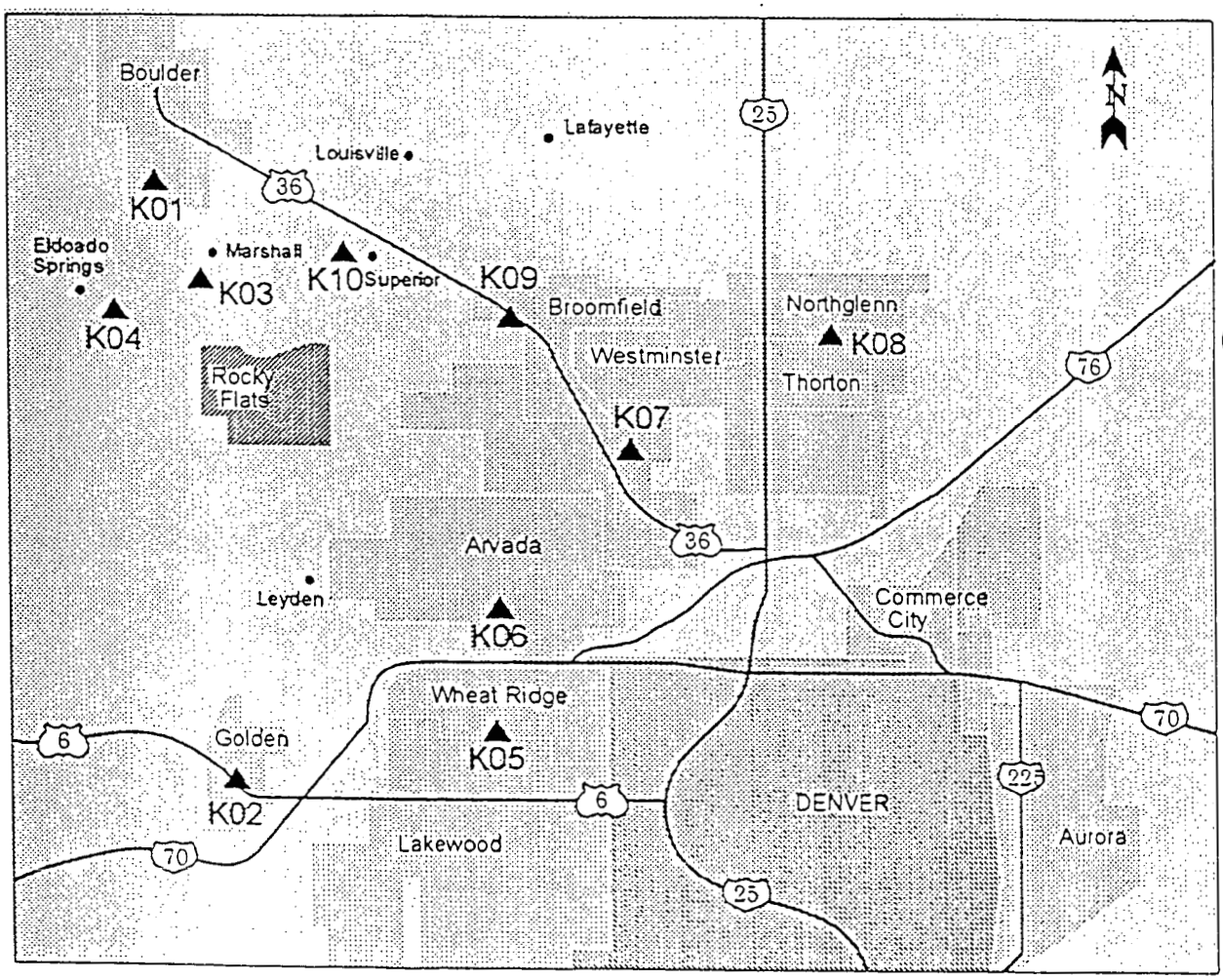


Figure 4: Map of 17 previous study areas east and south of the RFP boundary. The areas are each approximately 1/4 section in size and divided by land use type (pasture, tilled cropland, etc.). Ten samples were taken in each area (0-5 cm depth) and composited to obtain a single Pu value for each area.

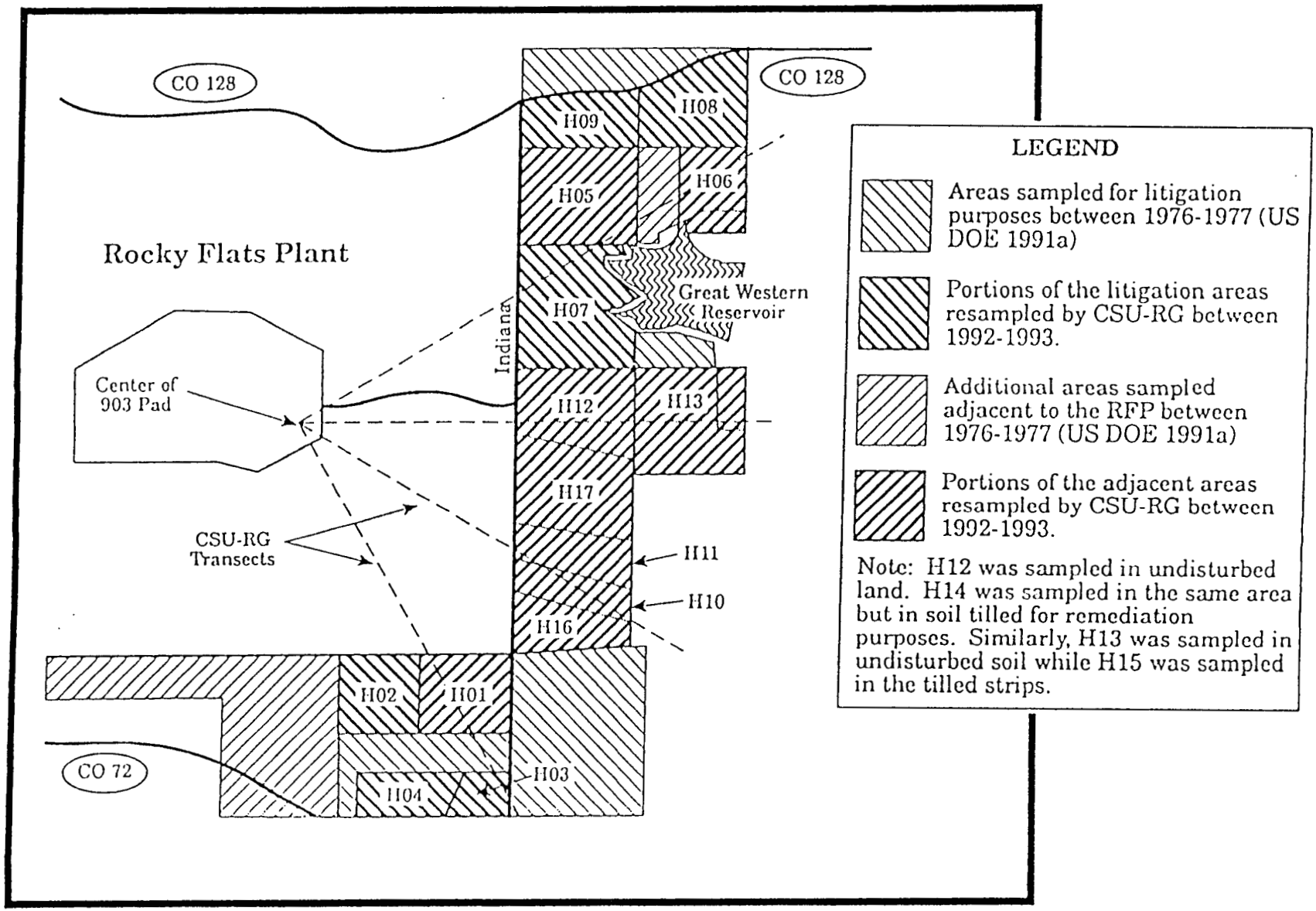


Figure 5: Map of 10 background areas sampled (dark circles) by CSU along the Front Range of Colorado. Ten microplots in each location were sampled for vegetation, 0-3 mm soil, 0-3 cm soil, and 0-21 cm soil. These were then composited by lift type for each background area sampled.

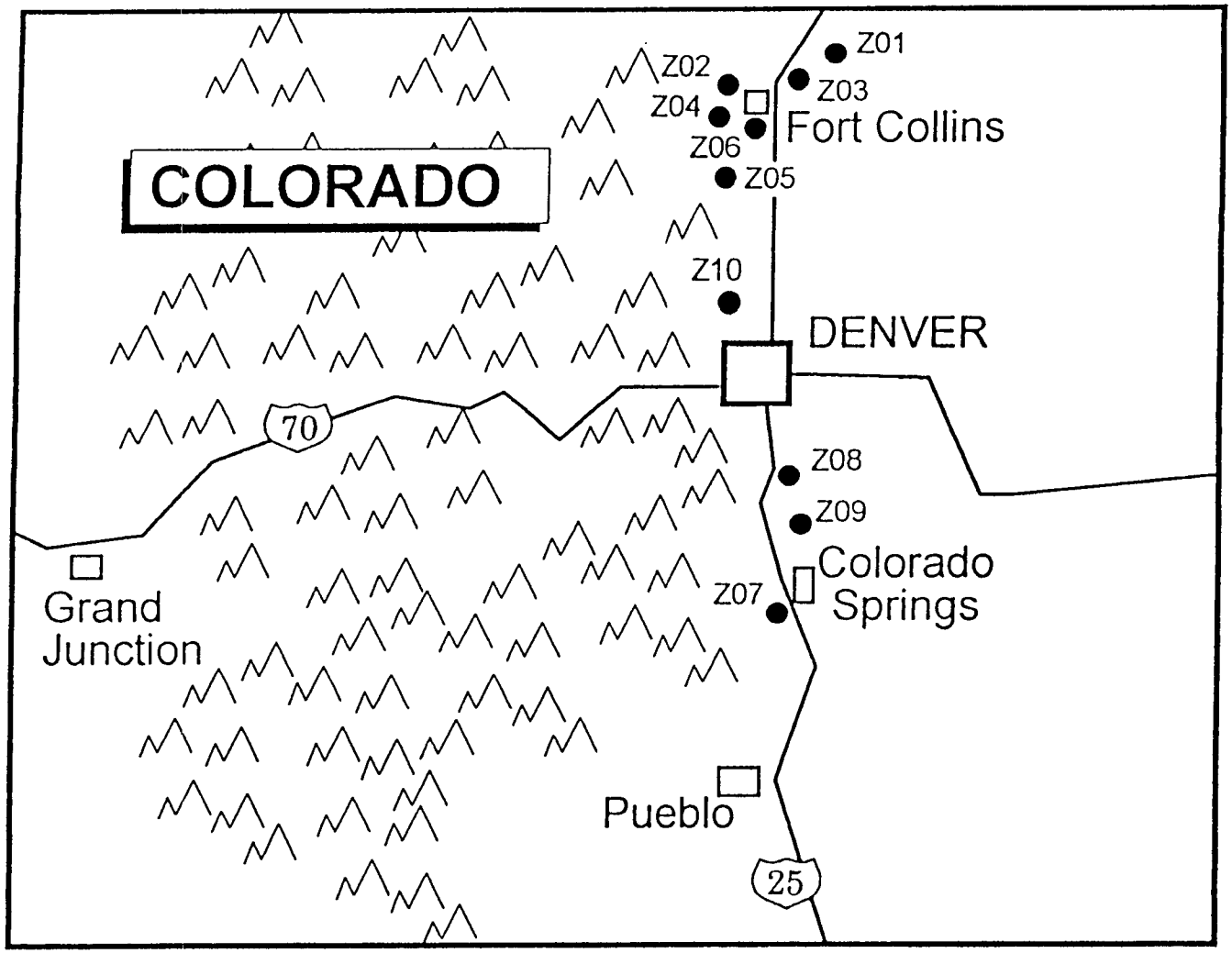


Figure 6: Microplot soil sampling diagram for vegetation, 0-3 mm surface scrapes, and 7 layer profile samples (each layer was 3 cm thick). Soils were sampled in this manner at 1 of the 4 microplots for offsite transect macroplots, and all microplots onsite.

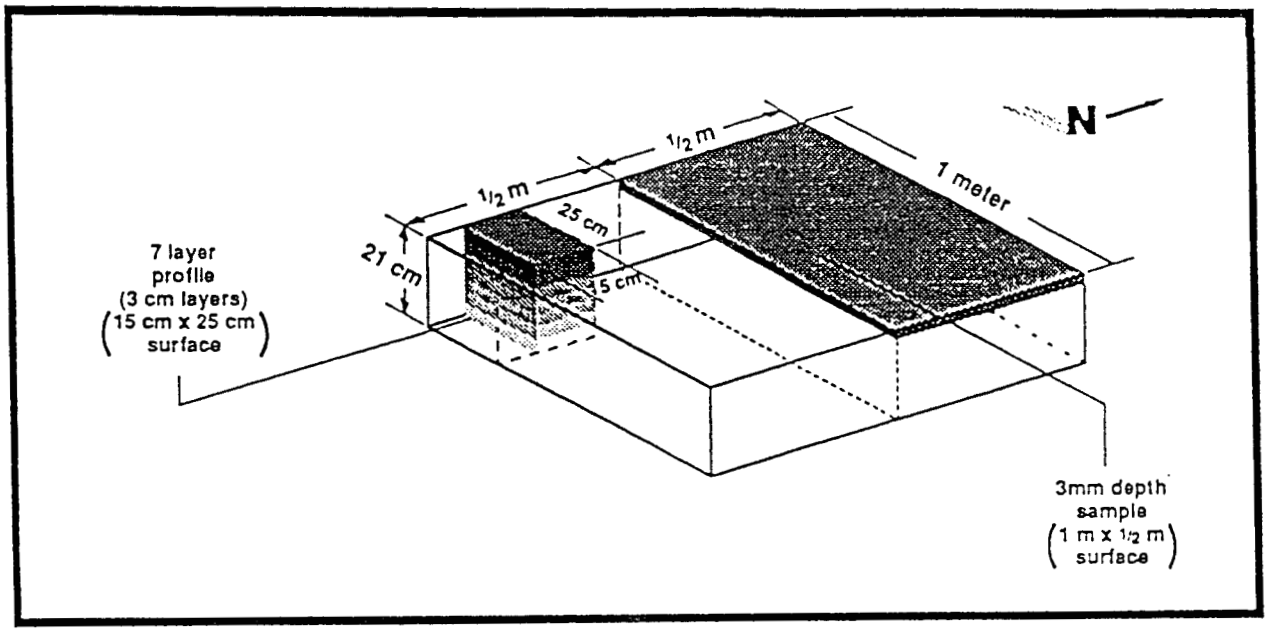



Figure 7: Microplot soil sampling diagram for vegetation, and 0-3 mm, 0-3 cm, and 0-21 cm depth samples. Soils were sampled in this manner at 3 of the 4 microplots for offsite transect macroplots, community sample sites, and at background locations.

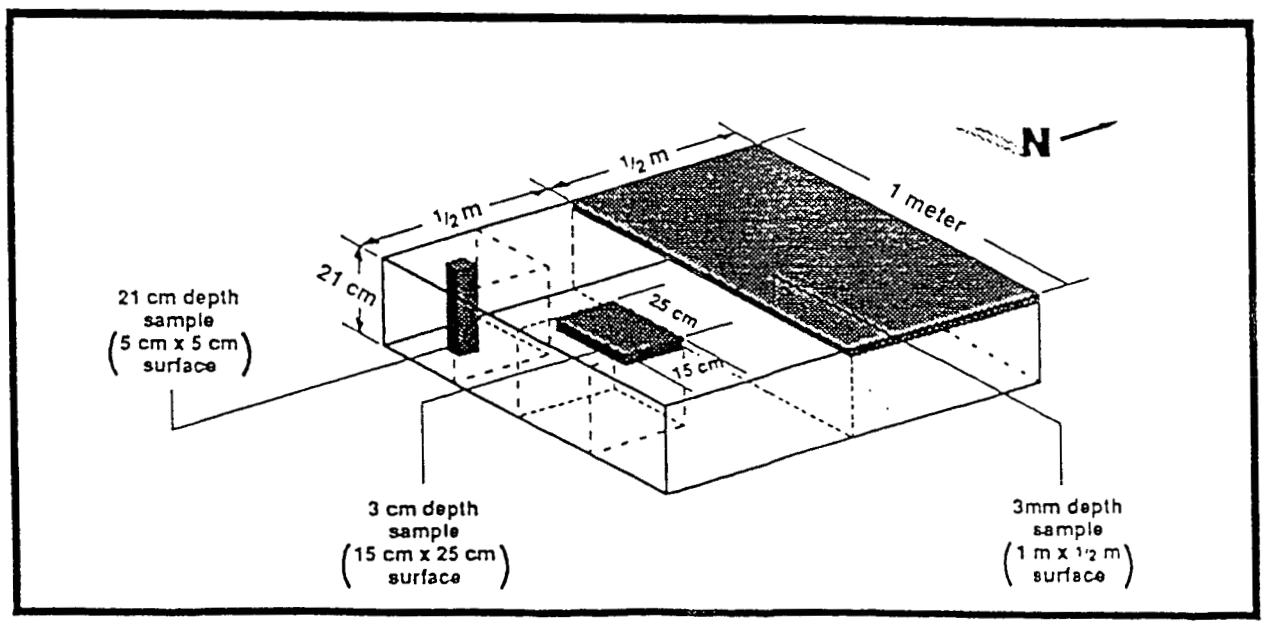


Figure 8a: Actual locations sampled offsite (dark squares) along four transects for vegetation and 0-3 mm, 0-3 cm, and 0-21 cm depth soils. These locations were the nearest undisturbed properties to the planned offsite macroplots shown in Figure 1.

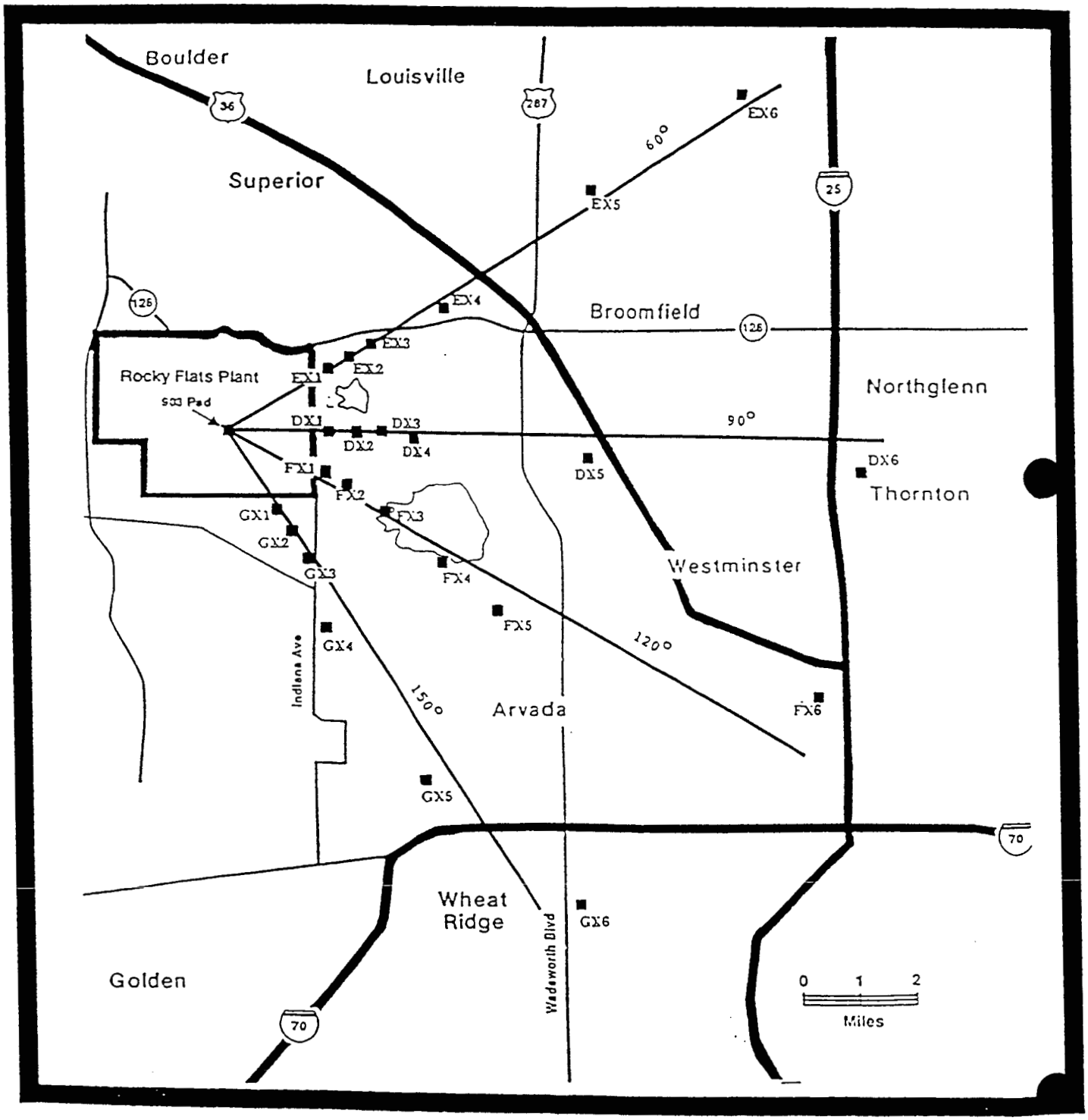
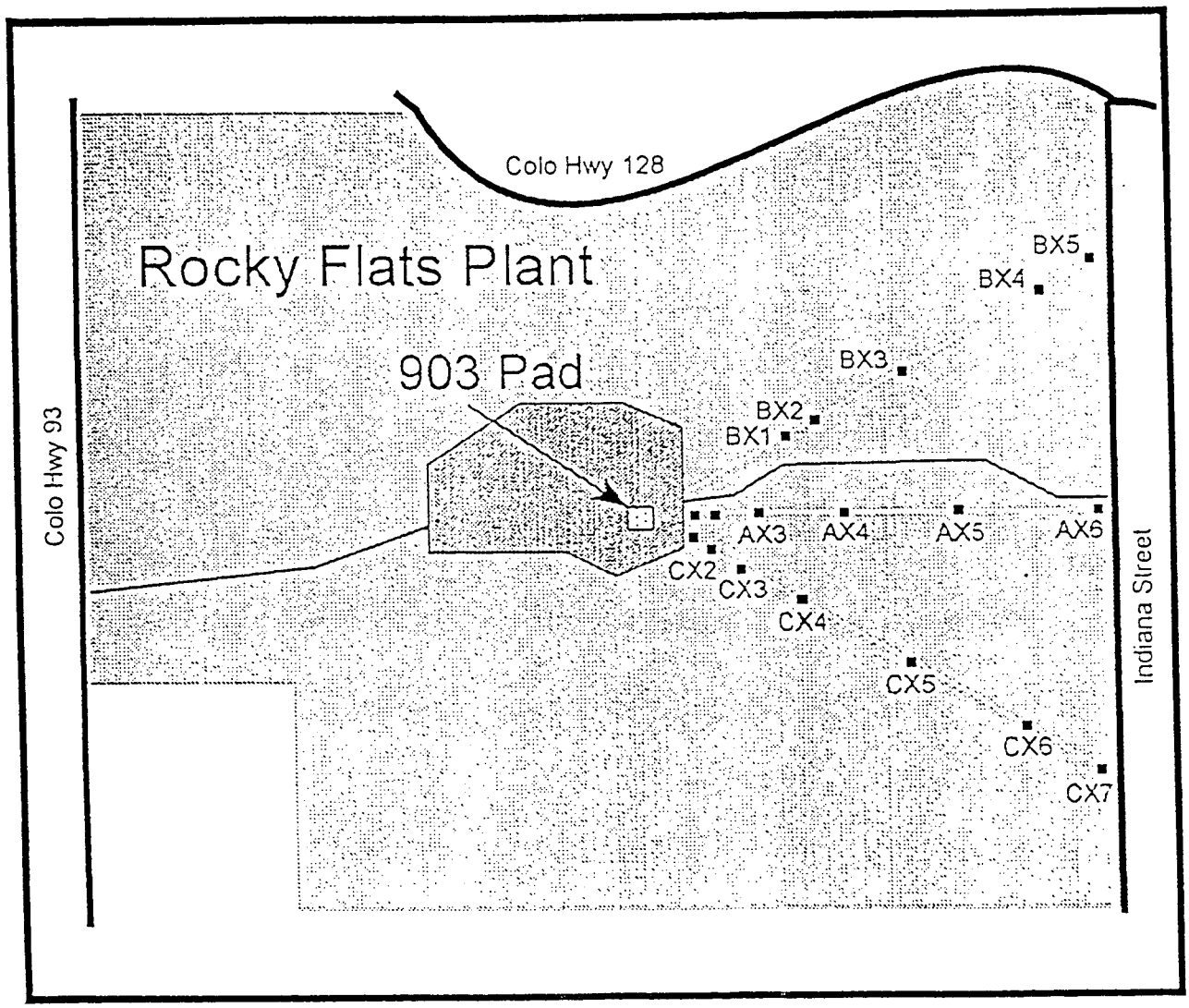


Figure 8b: Actual locations sampled onsite (dark squares) along three transects for vegetation and 0-3 mm soil scrapes, and 7 layer profile (0-21 cm depth) soils. These locations were very near to the planned locations shown in Figure 2 due to the undisturbed nature of the RFP buffer zone.



Appendix D: Site characteristics by macroplot for onsite, offsite, community, background, and previous study area locations.

| CSU Macroplot # | From the 903 Pad Direction (Deg. T) | Distance (km) | Landuse Type* N,P,E,O,G,T | Level Disturbed* (1 - 5) | Slope Angle (degrees) | Slope Direction (N,S,E,W) | Landform * Type (t,m,v) | Soil Type* (SL-CL-C) |
|---|---|---|---|---|---|---|---|---|
| | MACROPLOTS - ONSITE TRANSECTS | | | | | | | |
| (n) | (n=1) | (n=1) | (n=1) | (n=1) | (n=4) | (n=4) | (n=1) | (n=4) |
| AX1 | 88 | 0.20 | N | 1 | 0.5 | E | t | VCSL |
| AX2 | 92 | 0.33 | N | 2 | 8.0 | S | m | VCSL |
| AX3 | 89 | 0.68 | N,G | 5 | 3.0 | E | m | VCSL |
| AX4 | 91 | 1.21 | N | 1 | 4.0 | S | m | CL |
| AX5 | 90 | 1.63 | N | 2.5 | 2.5 | SSE | m | CL |
| AX6 | 91 | 2.29 | N | 1 | 0.5 | SE | v | CL |
| BX1 | 60 | 0.79 | N | 1 | 4.0 | NNE | t | VCSL |
| BX2 | 59 | 1.15 | N | 2 | 0.5 | NE | t | VCSL |
| BX3 | 59 | 1.68 | N | 1 | 0.5 | NE | t | VCSL |
| BX4 | 60 | 2.26 | N | 2 | 5.0 | NE | m | CL |
| BX5 | 58 | 2.76 | N,E? | 2 | 2.0 | SE | v | CL |
| CX1 | 116 | 0.21 | N | 1 | 4.0 | SE | m | CL |
| CX2 | 113 | 0.32 | N | 2 | 5.0 | SE | m | CL |
| CX3 | 124 | 0.72 | N | 1.5 | 3.0 | NNE | m | CL |
| CX4 | 121 | 1.22 | N | 2.5 | 5.0 | E | t | CL |
| CX5 | 121 | 1.61 | N | 2 | 2.0 | SE | t | CL |
| CX6 | 120 | 2.36 | N | 1 | 1.0 | E | v | CL |
| CX7 | 121 | 2.76 | N,T | 5 | 0.5 | SE | v | GCL |
| | MACROPLOTS - OFFSITE TRANSECTS | | | | | | | |
| (n) | (n=1) | (n=1) | (n=1) | (n=1) | (n=4) | (n=4) | (n=1) | (n=4) |
| DX1 | 90 | 2.76 | N | 2 | 1.0 | ESE | v | CL |
| DX2 | 91 | 3.17 | N | 2 | 1.0 | ESE | v | CL |
| DX3 | 93 | 4.28 | P | 1.5 | 4.0 | NNE | t | GCL |
| DX4 | 95 | 5.49 | P | 1.5 | 1.0 | E | t | GCL |
| DX5 | 96 | 10.55 | N,P | 1 | 2.5 | NNW | t | CL |
| DX6 | 96 | 18.97 | N,E? | 2.5 | 0.5 | E | t | CL |
| EX1 | 61 | 3.35 | T,N | 5 | 4.0 | S | m | CL |
| EX2 | 61 | 4.14 | N,E? | 2.5 | 7.5 | SE | m | CL |
| EX3 | 59 | 4.66 | P | 2 | 3.0 | SE | t | GCL |
| EX4 | 63 | 6.82 | N,P | 2 | 2.0 | W | t | CL |
| EX5 | 55 | 12.60 | N,P | 3 | 2.5 | NNW | t | CL |
| EX6 | 56 | 17.36 | N,P | 2 | 3.5 | S | t | GSL |
| FX1 | 119 | 3.04 | N | 2 | 0.5 | E | v | L |
| FX2 | 118 | 3.66 | N,P | 1 | 2.0 | SE | v | L |
| FX3 | 118 | 4.99 | N,P | 2 | 2.5 | NE | v | CL |
| FX4 | 121 | 7.19 | N,E | 2.5 | 3.0 | NNE | m | C |
| FX5 | 127 | 9.46 | N,E | 2 | 5.5 | W | m/t | CL |
| FX6 | 114 | 18.35 | N,E | 2.5 | 2.5 | SW | m/t | L |
| GX1 | 154 | 2.56 | N,P | 2 | 2.0 | SE | t | VCSL |
| GX2 | 155 | 3.27 | P,E | 2.5 | 4.5 | N | m | L |
| GX3 | 144 | 4.22 | T,N | 5 | 0.5 | ESE | v | GCL |
| GX4 | 155 | 6.23 | O,N | 3 | 1.0 | N | v | CL |
| GX5 | 149 | 11.76 | N,P | 1 | 5.0 | N | m | CL |
| GX6 | 146 | 18.05 | N,E | 3 | 1.0 | S | v | CL |

| CSU Macroplot # | From the 903 Pad Direction (Deg. T) | Distance (km) | Landuse Type* N,P,E,O,G,T | Level Disturbed* (1 - 5) | Slope Angle (degrees) | Slope Direction (N,S,E,W) | Landform * Type (t,m,v) | Soil Type* (SL-CL-C) |
|---|---|---|---|---|---|---|---|---|
| | COMMUNITY SAMPLES | | | | | | | |
| (n) | (n=1) | (n=1) | (n=1) | (n=1) | (n=1) | (n=1) | (n=1) | (n=1) |
| K01 | 330 | 9.50 | N | 1 | 1.5 | SSE | t | VCSL |
| K02 | 181 | 17.82 | N,P | 1 | 6.0 | W | t | CL |
| K03 | 333 | 7.40 | N,P | 1.5 | 2.5 | NW | m | SL |
| K04 | 314 | 7.60 | N,P | 2 | 0.5 | NNE | t | VCSL |
| K05 | 153 | 15.94 | N,E | 1.5 | 0.2 | E | v | CL |
| K06 | 141 | 12.61 | N,E | 1.5 | 2.5 | NW | t/m | CL |
| K07 | 110 | 14.63 | N | 1 | 1.5 | E | t/m | CL |
| K08 | 93 | 19.68 | N,E | 2.5 | 3.5 | NE | m | CL |
| K09 | 75 | 9.21 | N,E | 2 | 4.5 | ESE | t/m | GCL |
| K10 | 6 | 7.21 | N | 1 | 1.0 | E | t | CCL |
| | BACKGROUND LOCATIONS | | | | | | | |
| (n) | (n=1) | (n=1) | (n=1) | (n=1) | (n=10) | (n=10) | (n=1) | (n=10) |
| Z01 | 20 | 107.32 | N | 1 | 1.0 | W | t | SL |
| Z02 | 3 | 79.03 | N | 1.5 | 0.5 | NE | v | GCL |
| Z03 | 14 | 90.52 | N,P | 1 | 4.0 | WSW | m | CL |
| Z04 | 3 | 73.51 | N | 1.5 | 5.0 | ENE | m | CL |
| Z05 | 5 | 69.25 | N | 1.5 | 5.0 | E | t | L |
| Z06 | 9 | 68.86 | P | 2 | 2.5 | WNW | v | CL |
| Z07 | 166 | 123.29 | N | 1 | 1.0 | S | t | CL |
| Z08 | 162 | 58.47 | P | 2 | 3.0 | E | t | L |
| Z09 | 160 | 83.69 | P | 2 | 1.5 | var | t | SL |
| Z10 | 343 | 24.24 | N,P | 1.5 | 1.5 | E | t | CL |
| | PREVIOUS STUDY AREAS | | | | | | | |
| (n) | (n=1) | (n=1) | (n=1) | (n=1) | (n=10) | | (n=1) | (n=10) |
| H01 | SE | 3 to 4 | T | 5 | 2.0 | varies | t/m | GCL |
| H02 | SE | 2.5 to 3.5 | P | 1.5 | 3.0 | varies | t/m | SL - CL |
| H03 | SE | 4 to 5 | N,T | 5 | 2.0 | varies | v/m | GCL |
| H04 | SE | 3.5 to 4.5 | T | 5 | 1.0 | varies | v/m | GCL |
| H05 | NE | 3 to 4 | T | 5 | 1.5 | varies | v | CL |
| H06 | NE | 4 to 5 | N | 2 | 2.5 | varies | t/m/v | CL |
| H07 | ENE | 3 to 4 | N | 1.5 | 3.5 | varies | t/m/v | CL |
| H08 | NE | 4 to 5 | P | 2 | 2.5 | varies | t | GCL |
| H09 | NE | 3.5 to 4.5 | P | 2 | 2.0 | varies | t/m | CCL |
| H10 | E | 3 to 4 | N,E | 2.5 | 1.5 | varies | v | L |
| H11 | E | 3 to 4 | N | 2 | 1.0 | varies | t | CL |
| H12 | E | 3 to 4 | N | 2 | 2.0 | varies | t/m/v | CL |
| H13 | E | 3.5 to 4.5 | N | 2 | 2.5 | varies | t/m/v | CL - GCL |
| H14 | E | 3 to 4 | T | 5 | 2.0 | varies | t/m/v | CL |
| H15 | E | 3.5 to 4.5 | T | 5 | 1.5 | varies. | t/m/v | CL - GCL |
| H16 | ES | 3 to 4 | T | 5 | 0.5 | varies | t | GCL |
| H17 | ESE | 3 to 4 | T | 5 | 2.0 | varies | t/m | CL |

## * KEY FOR SITE CHARACTERISTICS TABLE

Landuse:

N = currently natural area or unused and returning to natural state
P = pastured recently ( <5yr )
E = may have been subject to erosion or deposition in past 20 yr.
O = old orchard ( unused for > 25 yr )
G = gravel borrow pit in the past ( < 20 yr ago )
T = tilled between 10 to 20 yr. ago

Disturbance Level:

1 = unused or moderate use in the past for pasture, natural grasses abundant.
2 = heavy pasturing activities and\or high prairiedog activity, invader vegetation present but not dominant (eg. brome grass and broadleaf weeds).
3 = some erosion or deposition noticable.
4 = heavy erosion or deposition present
5 = tilled land.

Landform:

t = Crest of flat topped hill or terraced area
m = midslope
v = Valley floor area

Soil Type:

VCSL=very cobbly sandy loam
GCL=gravelly clay loam
CCL = cobbly clay loam
CL=clay loam
C=clay
L=loam

Community Sampling Locations:

K01 = Boulder
K02 = Golden
K03 = Marshall
K04 = Eldorado Springs
K05 = Wheatridge
K06 = Arvada
K07 = Westminster
K08 = Thornton / Northglenn
K09 = Broomfield
K10 = Superior

Background Sampling locations:

| | |
|---|---|
| Z01 | Pawnee grasslands |
| Z02 | CSU Airport |
| Z03 | Weld County Line |
| Z04 | Dixon Reservoir |
| Z05 | SW Ft. Collins |
| Z06 | SE Ft. Collins |
| Z07 | Colorado Springs |
| Z08 | Castle Rock |
| Z09 | Monument |
| Z10 | Lefthand Reservoir |

Vegetation:

| # = common plant name (Scientific name) | # = common plant name (Scientific name) |
|---|---|
| 1 = yucca plants (Yucca glauca) | 11 = peppergrass (Lepidium virginicum) |
| 2 = Western wheatgrass (Agropyron species) | 12 = cactus (Echino cactus pexensif) |
| 3 = blue grama (Bouteloua gracilis) | 13 = mixed broadleaf weeds (Plantains) |
| 4 = buffalo grass (Buchloe dactyloides) | 14 = bindweed (Convolvulus arvensis |
| 5 = cheatgrass (Bromus tectorum) | 15 = goldenrod (Solidago canadensis) |
| 6 = Japanese brome (Bromus japonicus) | 16 = mullein (Verbascum thapsus) |
| 7 = mixed (Bromus species) | 17 = Thistle (Cirsium species) |
| 8 = bluegrass (Poa species) | 18 = ryegrass (Secale cereale) |
| 9 = needle and thread grass (Stipa comata) | 19 = fringed sage (Artemisia frigida) |
| 10 = cactus (Opuntia polyacantha) | 20 = rabbit brush (Chrysothamnus nauseosu |

# The Spatial Distribution of Plutonium in Soil Near the Rocky Flats Plant

Scott B. Webb
James M. Stone
Shawki A. Ibrahim
F. Ward Whicker

Colorado State University
Department of Radiological Health Sciences
Radioecology Group
Fort Collins, Colorado

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*Preliminary Draft*

## ABSTRACT

The spatial distribution of plutonium was measured in the environment east of the Rocky Flats Environmental Technology Site (RFETS) near Denver, Colorado during 1992-1994. The study area was centered on the primary plume of plutonium contamination in the area, which mostly originated from the 903 pad. The area ranged from 200 m to 19 km from the 903 pad and swept an arc from 60° T to 150° T which covered a large portion of the populated areas near Rocky Flats. Based on a total of ~1400 independent measurements, empirical equations were developed to mathematically describe the decrease in plutonium concentrations with depth into soil, distance from the 903 pad, and direction away from ~90° T. These equations, combined with soil density measurements, were integrated over the study area to estimate the total plutonium inventory in soil. The inventory was adjusted for the quantity of fallout plutonium by subtracting the mean background plutonium which was measured along the Front Range of Colorado. The best estimate of the total plutonium ($^{238,239,240}$Pu) in the study area attributable to the RFETS was 122 GBq (3.3 Ci), somewhat less than previously estimated by researchers in the 1970s.

Plutonium depth distributions were similar to those reported by previous investigators. Approximately 50% of the total plutonium was in the top 3 cm of soil, and concentrations decreased rapidly with depth, e.g., ~1% of the total plutonium was in the 18-21 cm layer. The plutonium concentrations decreased very rapidly with distance from the 903 pad, and power functions were used to describe the distance relationships. The main plume of contamination in the soil appeared to be between 90°-115° T from the 903 pad, thus the spatial distribution was similar to those previously reported

No unusual deposits of plutonium were discovered in the study area, and the spatial distribution was as expected. The observed mean (± 1 s.d.) level of global fallout plutonium of 2.1 ± 0.8 Bq kg$^{-1}$ was not significantly different than plutonium levels measured in soil samples collected in the center of ten communities surrounding the RFETS.

# INTRODUCTION

The Rocky Flats Environmental Technology Site (RFETS), formerly the Rocky Flats Plant, located approximately 25 km northwest of Denver, Colorado, is a US Department of Energy facility with the former mission of manufacturing plutonium triggers for nuclear warheads. Several incidents at the plant led to contamination of the area with plutonium. This has resulted in considerable concern for the health and safety of the public living in the vicinity. Adverse publicity, concerned citizens, pending litigation, and regulatory mandates have all contributed to the need to quantify and understand the distribution, movement and health risk of plutonium and other contaminants in the environs of the RFETS. A recent study indicated that, "Review and analysis of the available classified and unclassified information indicates that accidents having the greatest potential for off-site release of contaminants have been associated with plutonium. Such releases appear to have been primarily associated with the 1957 fire and the leakage of plutonium contaminated oil from drums stored at the 903 Pad" (Chem Risk 1992). Researchers investigating possible plutonium releases from a 1969 fire at the plant supported the conclusion that the fires contributed to environmental contamination, but the 903 Pad was the main source of off-site contamination (Krey and Hardy 1970; Hammond 1971; Seed *et. al.* 1971; Poet and Martell 1972; CDH 1972; Krey. 1974; Krey 1976; Krey, Hardy and Toonkel 1977; Terry 1994)

A study to investigate the distribution of plutonium in the Rocky Flats ecosystem was conducted between 1972 and 1974 (Little, Whicker and Winsor 1980). This work also concluded that wind erosion of contaminated soil from the 903 pad was the chief mechanism of plutonium transport, and that soil contained 99.7% of the total plutonium inventory in the terrestrial ecosystem. Little (1976) examined plutonium concentrations in vegetation, litter, arthropods, small mammals and soil to a depth of 21 cm. He found that plutonium concentrations in soil decreased rapidly with depth and distance from the 903 pad, increased with decreasing particle size, and were quite variable

spatially. He also found that plutonium concentrations in vegetation and litter were inversely correlated to downwind distance from the 903 pad and positively correlated to plutonium concentration in soil underneath. Webb (1992) repeated Little's study and concluded that plutonium concentrations in vegetation, litter, and 0-3 cm deep soil had significantly decreased on the same study plots over the 17 y interval between the studies.

The primary purpose of the current study was to quantitatively assess the human and ecological risks posed by the presence of radionuclide contamination in the environment surrounding Rocky Flats. This paper reports the results of the spatial distribution of plutonium in the more heavily contaminated area to the east of the 903 pad and the RFETS. Of specific interest was the depth distribution of plutonium in soil, the relationship of plutonium inventory to distance and direction from the 903 pad, the total plutonium inventory in soils that resulted from historical RFETS releases, and estimates of spatial variability and uncertainty.

## METHODS

### Study Area

The Colorado State University-Radioecology Group (CSU-RG) study area was established in the eastern part of the RFETS buffer zone (~30 $km^2$ area of land used to separate the public from plant operations) and in the northwestern part of the greater Denver metropolitan area. The area was in portions of Boulder, Jefferson, Adams and Denver Counties and included the Denver suburbs of Broomfield, Northglenn, Thornton, Westminster, Arvada, and Wheat Ridge (Fig. 1). The topography of the on-site lands is characterized by a series of flat, wind-scoured plateaus divided by five separate water drainages (Little and Whicker 1978). The strongest winds are from the west and northwest (Rockwell 1985). The off-site terrain is less severe than the RFETS site and generally slopes away from it, with elevations ranging from 1 740 m to 1 550 m. Land uses ranged from high density residential to agricultural, including light industrial,

recreational and open space. Vegetation types and level of disturbance varied with land use.

Sampling

The soil sampling plan was designed to provide data that could be used to develop mathematical relationships between plutonium concentrations (and inventories) with distance and direction from the 903 pad. Six to thirteen 100 $m^2$ macroplots (MP) were located along each of four transects and were spaced at exponentially increasing distances from the 903 pad. The transects originated at the 903 pad, were spaced every 30° from 60° T to 150° T (true bearing), and extended to approximately 19 km from the origin (Fig. 1). Since accurate estimates of inventories depended on soil concentration profiles which had not been disturbed, sites were selected in natural, undisturbed areas where possible.

The CSU-RG was interested in evaluating the spatial sampling variance in the plutonium data to enable quantification of uncertainty in the study results. To accomplish this, samples were replicated at four, randomly located, 1 $m^2$ microplots (mP) within each MP (Fig. 2). The types and quantities of samples collected at each mP differed between on-site and off-site locations, but generally the sampling procedure was to: (1) Clip the standing vegetation at ground level inside a 1 250 $cm^2$ frame then scrape 3 mm of surface soil using a "CDH scraper♣" inside the frame. (2) Clip the standing vegetation at ground level inside a 625 $cm^2$ frame then excavate a 25 cm long x 10 cm wide area of soil in 3 cm layers to a depth of 21 cm using a trench technique developed earlier (Little 1976, Webb 1992). (3) Clip the standing vegetation at ground level inside a 625 $cm^2$ frame then excavate a 25 cm long x 15 cm wide area of soil to a depth of 3 cm (Three of the four mP at all off-site MP). (4) Clip the standing vegetation at ground level inside a 625 $cm^2$ frame then excavate a 5 cm long x 5 cm wide area of soil to a depth of 21 cm (Three of four mP at off-site MP). These samples

♣ The scraper is a sampling jig developed by CDH (CDH 1972)

were assumed to reflect the total plutonium inventory at the site. (5) Collect site information, especially location data (Table 1) and soil density measurements (Appendix C) (Stone, Webb and Whicker 1994).

It was important to compare the plutonium concentrations and inventories near the RFETS to levels at various locations along the base of the Front Range of Colorado. Ten "background" sites were selected at locations where only global fallout plutonium would be expected to occur (Fig. 1). Ten each of the following samples were collected and composited at each background site: vegetation, 0-3 mm soil scrape, 0-3 cm deep soil, and 0-21 cm deep soil. Another important segment of the project was to measure the plutonium levels in the central part of the major communities surrounding Rocky Flats (Fig.1). These data (Appendix C) will be used to evaluate the level of risk to the citizens of each community.

Analysis

The soil preparation procedure was to dry, sieve to <2 mm, homogenize, grind, split, and package the samples for shipment to an escrow agent. The specific procedures for analyzing soil and vegetation samples for plutonium were developed in prior projects (Webb 1992) and modified for the current investigations. The most significant improvement in the analysis system was a batch-leaching procedure developed to accommodate soil sample sizes up to 50 g (Ibrahim, Webb and Whicker 1992). An internal tracer, $^{242}Pu$ purchased directly from the National Institute of Standards and Technology (NIST), was added to each sample and a reagent blank sample was processed with almost every batch of six to eight samples. Although the concentration calculation methods employed in the current investigation were based on earlier work (Sill 1971), the uncertainty analysis included all sources of laboratory error in the concentration measurements, i.e., the reported uncertainty values are cumulative statistical estimates of the total error. The specific procedures used during the project are in Appendix B.

Quality Assurance / Quality Control

The Quality Assurance / Quality Control (QA/QC) Program had the goal of providing confidence in the quality of the results, both by control of sample collection and analysis and by adequate replication to determine and quantify sources of variance and error (Whicker *et. al.* 1991). QA/QC data are presented in Appendix A.

The first component of the program was the utilization of an escrow agent to replace sample field codes, which contain location information, with randomized laboratory numbers. Thus, all samples were analyzed "in the blind."

Acid blanks were processed identically to, and along with, the normal samples. One acid blank was processed with at least 50% of the batches of six to eight samples. The blanks were useful in monitoring the radionuclide levels or contamination of reagents, glassware, etc., and were used as the analytical "background" for calculating net concentrations. The distribution of activities in the blanks was as expected (Fig. A1), i.e., heavily skewed towards lower values, with a few blanks that had significant activity. The median $^{239,240}Pu$ activity for all acid blanks was 497 μBq (n = 146) and 75% of all the blanks had activities less than 1.9 mBq. All samples processed with acid blanks having activities greater than 5 mBq were reanalyzed.

Approximately 5% of the samples were split after homogenization at the soil preparation laboratory, packaged identically to the standard samples, and sent through escrow to be used as blind replicates. Replicate analysis was a method to determine the degree of homogeneity of the samples and the level of analysis consistency by the laboratory. Sixty-seven pairs of split samples have been completed. Approximately 69% of the pairs of $^{239,240}Pu$ determinations were in agreement with one another ($\alpha = 0.005$). The pairs which did not statistically agree were at $^{239,240}Pu$ concentrations over the entire range of concentrations observed, i.e., they were not clustered (Fig. A2). The discrepancy between replicated samples may have been due to inadequate homogenization or

laboratory error. Perfect homogeneity in plutonium contaminated soil samples is not always possible to attain.

The CSU-RG participated in several interlaboratory comparison exercises, with the most significant being conducted by the International Atomic Energy Agency. This exercise provided a measure of the complete analytical accuracy of the individual laboratories as compared to laboratories throughout the world. Seven samples in four different exercises were analyzed (Table 2). The results indicated that the CSU-RG analysis method provided values which were in good agreement with the international community of radionuclide investigators.

## RESULTS

### General Results

Since $^{239}Pu$ and $^{240}Pu$ could not be resolved by the detector systems used during the project, all values reported as $^{239}Pu$ will also include $^{240}Pu$. The $^{240}Pu$ activity is expected to be approximately 19% of the combined activity for RFETS plutonium (~6% by weight, Krey and Krajewski 1972), but the $^{240}Pu/^{239}Pu$ ratio is expected to increase with distance from the 903 pad as global fallout plutonium increases in proportion to RFETS plutonium.

Approximately 1 400 individual plutonium measurements were made during the project. Pu-239 concentrations decreased rapidly with depth into soil and distance from the 903 pad. The concentrations ranged from ~40 kBq $kg^{-1}$ to ~4 Bq $kg^{-1}$ in 0-3 cm deep soil on the RFETS and ranged from ~120 Bq $kg^{-1}$ to background levels (~2 Bq $kg^{-1}$) in soils off site. (The greatest off site concentrations of $^{239}Pu$ were in previously remediated areas just east of the RFETS.) The main plutonium contamination plume seemed to be approximately due east of the RFETS since concentrations were elevated in the 90° T direction and were generally less on the other transects. The $^{239}Pu$ and $^{238}Pu$ concentrations for each soil sample are listed in Appendix C, and mean and standard deviations for $^{239}Pu$ concentrations in 0-3 cm soil are given by MP in Table 3.

Pu-239 concentrations measured in surface soils from background locations ranged from 1.1 - 4.6 Bq $kg^{-1}$ with a mean value of 2.1 Bq $kg^{-1}$ (Table 3),while concentrations of $^{239}Pu$ in 0-3 cm deep soil taken from ten community sites (Table 1) were slightly greater than background (mean value: 2.3 Bq $kg^{-1}$), but not significantly different ($p = 0.17$, Mann-Whitney Rank Sum Test). Specific trends in the plutonium data were explored in greater detail through statistical models as follows.

Distribution of $^{239}Pu$ in Soil with Depth and Distance

The distribution of $^{239}Pu$ with depth into soil was examined for each MP by regressing the natural log of the concentrations with the depth of the samples since previous works reported exponential depth distributions of plutonium (Little 1976, Webb 1992). A few MP had obviously been tilled, since the concentrations were not significantly different between layers. The undisturbed locations had a mean slope (± 1 sd) of $-0.26 \pm 0.13$ $cm^{-1}$. The intercept values from the regressions, however, ranged over several orders of magnitude and were correlated with distance from the 903 Pad (discussed below).

The rate of decrease in $^{239}Pu$ concentration from the surface was independent of the sample location ($p > 0.05$, Pearson Product Moment Correlation between slope, distance and direction from the 903 pad). To examine a generalized rate of decrease in the study area, $^{239}Pu$ concentrations in each layer were normalized to the 0-3 cm concentration for each soil profile. The medians of the normalized values at each depth (Fig. 3) were then fit to functions by trial and error, but the final regression parameters were determined with commercial curve fitting software♠. In the final regression, a total of 643 individual $^{239}Pu$ values were used to derive the depth relationship. The equation is:

$$[^{239}Pu]_d = [^{239}Pu]_{0\text{-}3\ cm} \bullet 1\text{-}(1\text{-}1.48e^{-0.627d}\text{-}0.13e^{-0.195d})^4 \qquad \text{(Eq. 1)}$$

♠ SigmaPlot® for Windows is a product of Jandel Scientific, San Rafael, CA 94912-8920.

where $[^{239}Pu]_{0\text{-}3\,cm}$ is the concentration of $^{239}Pu$ (Bq $kg^{-1}$) in 0-3 cm deep soil and $[^{239}Pu]_d$ is the $^{239}Pu$ concentration at depth d (cm).

Little (1976) described the relationship between plutonium concentrations and distance from the 903 pad as a decreasing power function. The relationship for each transect in the current study was determined by regressing the natural log of the 0-3 cm $^{239}Pu$ soil concentrations with the natural log of distance using a least absolute deviation, or LAD, technique (Narula and Wellington 1982, Mielke and Iyer 1982, Mielke 1986). The distance distribution equations for 0-3 cm soil were compared to one another to examine the angular relationship of $^{239}Pu$ concentrations (Fig. 4). The $^{239}Pu$ concentrations on the 90° T transect were greater than the $^{239}Pu$ concentrations on any of the other transects for comparable distances from the 903 Pad. The 0-3 cm concentrations on the 150° T transect (sampled only outside of RFETS property) were at or below the median background level (2.14 Bq $kg^{-1}$ in 0-3 cm soil taken along the Front Range of Colorado- Appendix C) and did not change significantly with distance. The equations for the plutonium concentrations with distance are:

$$
\begin{aligned}
[^{239}Pu]^{60}_{0\text{-}3\,cm} &= 77D^{-1.67} \\
[^{239}Pu]^{90}_{0\text{-}3\,cm} &= 650D^{-2.25} \\
[^{239}Pu]^{120}_{0\text{-}3\,cm} &= 150D^{-2.20} \\
[^{239}Pu]^{150}_{0\text{-}3\,cm} &= 12D^{-1.54}
\end{aligned}
\qquad \text{(Eqs. 2)}
$$

where $[^{239}Pu]^{\theta}_{0\text{-}3cm}$ is the $^{239}Pu$ concentration (Bq $kg^{-1}$) in 0-3 cm deep soil at direction θ° ($60° \le \theta° \le 150°$) and at distance D (0.2 km ≤ D ≤ 19 km).

It was clear that the distance power function multiplier and exponent varied with transect direction. These parameters were regressed against direction to form a general equation for $^{239}Pu$ as a function of distance and direction from the 903 pad. Again, trial and error was used to find suitable models, then commercial software* was used to fit the multiplier and exponent regressions to equations involving the direction angle θ. The general equation

developed for the $^{239}$Pu concentration in 0-3 cm deep soil at distance D (km) and direction θ° T from the 903 pad is:

$$[^{239}Pu]^{\theta,D}_{0-3cm} = [1.01e^{14.5\sin(\theta-3)-8.05}+9.90e^{0.94\sin(\theta-3)-0.33}]\ D^{-e^{1.13\sin(\theta-14)-0.295}} \quad \text{(Eq. 3)}$$

This complex equation may be broken down to examine the model. The multiplier is a double exponential with direction, thus the concentration falls off rapidly at first from the peak angle, where the sine is maximized, then decreases at a lower rate. Similarly, the exponent, or slope of the concentration *vs.* distance equation, changes as an exponential function with direction. The peak angle is 93° for the multiplier and 104° for the exponent. Why these differ, or whether they are really different, is not clear.

The derived models for the depth (Eq. 1) and distance (Eq. 3) distributions of $^{239}$Pu in soil were combined to estimate the concentrations throughout the study area. The predicted values were regressed with the 633 measured concentrations to estimate the error in the models (Fig. 5). The fact that the intercept (0.08) was small, the slope ( 0.92) was near 1.0, and the regression coefficient ($r^2 = 0.83$) was highly significant suggests little consistent bias and reasonable accuracy of the model. The precision of estimation was not so good, however, as the 95% confidence intervals for the population were only within a factor of 12.5 of the predicted value.

## $^{239}$Pu Inventories in Soil

One of the most important tasks of this project was to determine the total amount, or inventory, of plutonium in the study area. The empirical equations derived above for the $^{239}$Pu concentrations at any depth, distance or direction were combined and integrated to determine the $^{239}$Pu plutonium inventory. The concentrations were converted to activity per unit volume with a soil density correction. The soil density was measured in 0-3 cm deep soil and in 3-6 cm deep soil throughout the study area and at the background locations (Appendix C). At some sites the soil density was measured down to 12 cm. The density of the

0-3 mm layer was estimated by dividing the dry soil weight by the estimated volume of the sampled area, i.e., 100 cm long x 50 cm wide x 0.3 cm deep, or 1 500 $cm^3$. The median soil density values were then regressed as a power function of depth (Fig. 6). The equation that was used to describe the soil density $\rho_s$ (g $cm^{-3}$) as a function of depth d (cm) was:

$$\rho_s = 0.82\ d^{0.24} \qquad \text{(Eq. 4)}$$

This soil density equation is for prepared soil, i.e., the density values were adjusted for the weight and volume of rocks in the sample. It is not a bulk soil density. This is appropriate for the inventory analysis since the plutonium concentrations were measured on soil samples with the rocks removed. Again, the concentrations and densities were based on identically prepared soil samples, i.e., without rocks greater than 2 mm.

An equation for the $^{239}$Pu soil inventory at any location in the study area ($I^{\theta,D}$) was formed by integrating the concentration estimate at any distance D and direction θ (Eq. 1 and 3) combined with the soil density (Eq. 4) over the depth into soil.

$$I^{\theta,D} = [^{239}Pu]^{\theta,D} \int_0^{21cm} [^{239}Pu]_d\, \rho_s dd \qquad \text{(Eq. 5)}$$

The depth integral on the right was evaluated using Simpson's Rule (Franklin 1944) and equals 54 Gg $km^{-2}$. It was also evaluated to infinite depth using a gamma function with the result of 55 Gg $km^{-2}$. The results differed by only 1.5%. One may, therefore, estimate the inventory at any location in the study area by multiplying the $^{239}$Pu concentration in the 0-3 cm layer by 55 kg $m^{-2}$, or

$$I^{\theta,D} = 55 \cdot [^{239}Pu]^{\theta,D}\ \text{(Bq m}^{-2}\text{)} \qquad \text{(Eq. 6)}$$

This inventory model, which relied on empirical distance, direction and depth functions, was tested by predicting a 0-21 cm inventory at each MP outside the RFETS boundary and comparing those values to the 0-21 cm samples collected and analyzed. The concentration values from these samples were not used to derive the equations, thus they served as a legitimate test of

the model. The soil density for the 0-21 cm sample was calculated by dividing the weight of the prepared soil by the estimated volume of 525 $cm^3$ (5 cm x 5 cm x 21 cm). The results of the model prediction (Fig. 7) are in reasonable agreement with the estimated values. The 95% confidence intervals based on the regression analysis ranged from 20% to 500% of the predicted value.

The total inventory was determined by integrating the previous equation (Eq. 6) throughout the study area. The total $^{239}Pu$ inventory ($I_{239}$) in a sector from 60-150° ranging from 0.1-20 km and to a soil depth of 21 cm was estimated by:

$$I_{239}\ (Bq) = 55\ (Gg\ km^{-2}) \int_{0.1}^{20km} \int_{60}^{150} [^{239}Pu]_{0-3cm}^{\theta,D} d\theta dD \qquad \text{(Eq. 7)}$$

The integral was evaluated using numerical methods on a spreadsheet. The total $^{239}Pu$ in the study area was estimated to be 157 GBq (4.2 Ci). Using the same technique, the $^{239}Pu$ inventory for the portion of the study area outside of the current RFETS boundaries was calculated to be 38.1 GBq.

The estimated quantity of background, or global fallout, was calculated by multiplying the mean background $^{239}Pu$ concentration in 0-3 cm soil (2.14 Bq $kg^{-1}$) by 55 kg $m^{-2}$ and by the total area integrated above (~314 $km^2$) resulting in a total fallout inventory of 37 GBq. The net $^{239}Pu$ inventory in the study area attributable to the RFETS is, therefore, ~120 GBq (3.2 Ci). The fallout $^{239}Pu$ outside the RFETS boundaries (~308 $km^2$ in the study area) was 35.6 GBq. Therefore, the net $^{239}Pu$ inventory estimate for RFETS plutonium in the off-site portion of the study area was 2.5 GBq (68 mCi).

## $^{239}Pu$ Concentration Ratios and Environmental Variance

Examining relationships between $^{239}Pu$ concentrations in different environmental compartments may provide the ability to predict concentrations from samples which are easier to sample and analyze, such as vegetation. Knowing the concentration in the 0-3 cm layer, for example, one may predict the concentration at any depth down to 21 cm with the empirical depth equation

derived above (Eq. 1). This comparative technique of using concentration ratios (Whicker and Schultz 1982) was first examined for the $^{239}Pu$ values in two different particle sizes from the 0-3 mm soil layer. It was then examined for the isotopic ratios of $^{238}Pu$ and $^{239}Pu$. Finally, the concentration ratios between soil and vegetation were investigated, and the preliminary results were reported earlier (Webb, Ibrahim and Whicker 1994).

The 0-3 mm soil samples were split and a portion was sieved to retrieve the 0-45 μm size fraction. The 0-45 μm particle size $^{239}Pu$ concentrations were slightly greater than the 0-2 mm particle size concentrations in 0-3 mm deep soil. The median concentration ratio was 1.25 (n = 91) for the primary study area. The 0-45 μm particle size to 0-2 mm particle size median concentration ratio was 1.49 for the background area samples, but it was not significantly different than the primary study area ratios (Mann-Whitney Rank Sum Test, p = 0.125).

The median ratio of $^{239}Pu$ to $^{238}Pu$ in soil samples from the primary study area was ~58 for $^{239}Pu$ concentrations greater than 10 Bq $kg^{-1}$ (Fig. 8). At $^{239}Pu$ concentrations less than 10 Bq $kg^{-1}$, the ratio varied considerably and decreased with lower $^{239}Pu$ concentrations. There was no statistical difference between the background isotopic ratios (median = 19) and the primary study area ratios where the $^{239}Pu$ concentrations were less than 10 Bq $kg^{-1}$ (Mann-Whitney Rank Sum Test, p = 0.96).

The degree of variation, attributable primarily to sampling, of $^{239}Pu$ concentrations in 0-3 cm soil was compared at each 100 $m^2$ Macroplot using the coefficient of variation, or CV[♦] (Table 3). There was no correlation between CV and distance from the 903 pad (p = 0.99), nor was there a correlation between the CV and transect direction (p = 0.35). The median CV in $^{239}Pu$ concentrations in 0-3 cm soil throughout the study area was 33%. Little (1976) and Webb (1992)

♦ The coefficient of variation, CV, is defined as the standard deviation ÷ mean (Rosner 1986).

reported the CV in 0-3 cm soil concentrations near the 903 pad as 73% and 36% respectively ($n \geq 8$).

## DISCUSSION

### Plutonium Depth Distribution in Soil

The complex equation reported for this study (Eq. 1), in its present form, is simply a mathematical description of the current plutonium depth structure. The two component exponential within Eq. 1 was required to model the trend in the concentrations to decrease at a slower rate below ~9 cm. Nonetheless, the observed rapid decrease in $^{239}$Pu concentration with depth into soil was similar to profiles reported by virtually all of the previous investigators of RFETS plutonium contamination (Krey and hardy 1970; Krey, Hardy and Toonkel 1977; Little 1976; Webb 1992).

Krey, Hardy and Toonkel (1977) sampled very thin layers of soil at the surface (to a depth of several millimeters) and recognized that the peak concentration of $^{239}$Pu occurred below the surface of the soil in a few plots on the RFETS. This is the first study, however, to include 0-3 mm deep concentrations with the soil profile data in an area extending from the 903 pad to the populated regions near Denver. Krey, Hardy and Toonkel (1977) suggested that a universal equation may be used to describe plutonium depth profiles when they reported, "reasonable results obtained from the application of the diffusion equation ... to all sites suggests a phenomenon which may be related more to the solubility or transportability of plutonium in soil water than to the characteristics of the soil." The current work supports this theory in that a single equation (Eq. 1) reflected the profile reasonably well (Fig. 5) over a large range of soil types in the study area (Stone, Webb and Whicker 1994).

The solubility factor may only be applicable to a short length of time the plutonium was on the surface of the soil. The basic structure of the profiles have not changed significantly in over 20 y of plutonium-soil-water interactions. Webb (1992) suggested that the initial plutonium may have been in a more

soluble, chloride form when it was deposited, which would allow it to penetrate into the soil rapidly at first then bind to the soil. Regardless of the mechanisms which caused the observed depth structure, the plutonium appears to be bound to the soil and is not subject to transport other than with the soil.

Spatial Distribution of Plutonium in Soil

Little (1976) was able to model the decrease in plutonium concentrations with distance as a power function using limited data on two transects, each less than 500 m long. That model held quite well for this study over much greater distances and for several directions of plutonium dispersion (Eqs. 2). This study, however, may be the first to completely describe the spatial distribution of plutonium in surface soil near the RFETS using a single equation (Eq. 3). Although Equations 1 and 3 are complex and completely empirical, they may be used to estimate $^{239}$Pu concentrations at sites within the primary study area domain which were not sampled.

The basic spatial pattern of plutonium dispersion observed in this study is consistent with previous investigations. Krey and Hardy (1970) reported a rapid decrease in plutonium concentrations with distance from the 903 pad with the highest concentrations being in the east and southeast directions. One project on the RFETS concluded that, "The most important finding of the recent work is the possible overestimation of plutonium loading in soils in the southeast direction [from the 903 pad]" (Litaor 1993). In the current study, the highest concentrations were estimated to be in the 93-114° T direction from the 903 pad (Eq.3) supporting the assumption that the plutonium contamination plume was mainly to the east.

The levels of plutonium in surface soil (0-3 mm and 0-3 cm depths) may have decreased from earlier studies as indicated by the apparent decrease in inventory (discussed below). Terry (1994) reported a steady decline in $^{239}$Pu concentrations throughout the RFETS and surrounding area in 0-3 mm deep soil since 1970. It was suggested that erosion may account for plutonium loss from

some sites on the RFETS (Webb 1992), but only minor erosion was observed on a few plots during the current study, although sites were not selected for sampling if they were heavily disturbed (Stone, Webb and Whicker 1994). A dedicated study to investigate the loss of plutonium from surface soil may be required to answer questions concerning the decrease in plutonium levels in the area.

## Concentration Ratios

The additional relationships for plutonium studied during this project were also similar to those found in previous work. The greater $^{239}Pu$ concentrations found in small soil particles, for example, was expected since Little (1976) was able to form significant plutonium concentration to particle size relationships for plutonium in soils collected near the 903 pad. Likewise, the $^{239}Pu/^{238}Pu$ isotopic ratio in the study area (~58) was predictable from earlier research (Little 1976, Webb 1992) where the median $^{239}Pu$ to $^{238}Pu$ ratio in surface soil on a plot near the 903 pad was approximately 55. Webb (1992) hypothesized that interferences from alpha emitting natural radionuclides extracted with plutonium during analysis confounds the $^{239}Pu$ to $^{238}Pu$ isotopic ratio in low level samples, i.e., interferences artificially reduce the ratio by adding counts to the $^{238}Pu$ region of interest. This effect was observed in the current study from the fact that the median isotopic ratio in background samples was only 19 (Fig. 8), but it was measured at ~28 with mass spectroscopy$^{\nabla}$ by Krey and Krajewski (1972).

## Plutonium Inventory

The total $^{239}Pu$ inventory estimate of 157 GBq is considerably less than what was stated by previous investigators. Krey (1976) stated, "Because of the assumptions which were made and insufficient data from the plant site, the estimated 11 Ci [407 GBq] of total plutonium released to the environment is

$^{\nabla}$ Mass spectroscopy is a more sensitive technique which is less affected by non-isotopic interferences.

uncertain. However, it agrees to within a factor of 2 of the 6.1 Ci [226 GBq] (86g) of plutonium which Seed *et. al.* (1971) estimated was lost to the soil." Poet and Martell (1972, 1974) felt that their $^{239}$Pu estimates were in good agreement with Krey and Hardy (1970) but they estimated an additional 4 Ci [148 GBq] of RFETS plutonium out to 68 km in the northwest direction. Any further comparison to previous estimates of the total plutonium inventory would require a complete examination of the sampling, analysis, assumptions, and spatial extent of the earlier projects.

The current estimate of 120 GBq of RFETS $^{239}$Pu outside of the 903 pad was calculated by reducing the total inventory by the estimated global fallout inventory . Subtracting the background in this manner relied on the assumption that fallout plutonium would be uniformly distributed with distance and direction, and distributed with depth similarly as RFETS plutonium. Krey, Hardy and Toonkel (1977) showed exponential depth distributions of fallout plutonium in samples from New York, therefore it is conceivable that fallout would behave similarly in the primary study area. The global fallout inventory was 24% of the total $^{239}$Pu inventory throughout the study area and >92% of the total in the off-site portion of the study area.

The total inventory must include the $^{238}$Pu inventory as well. Since the levels of $^{239}$Pu were 58 times greater than $^{238}$Pu, the addition of the $^{238}$Pu inventory would increase the $^{239}$Pu inventory by approximately 2% to 122 GBq. This amount is inconsequential compared to the estimated error in the $^{239}$Pu inventory at any given site, i.e., +500% / -20% based on regression analysis of off-site samples (Fig. 7). However, the error in the total inventory estimate (from summing or integrating inventories over all the study area) is expected to decrease since the uncertainty of a sum is less than the sum of the uncertainties (Knoll 1979).

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Table 1. Locations of sampling sites based on measurements using a global positioning system satellite receiver, USGS▼ topographic maps, and aerial photographs. The values shown are accurate to within 300 m. (Continued on next page.)

| Macroplot Location Code | UTM Coordinates[a] | | From 903 Pad | |
|---|---|---|---|---|
| | Easting (m) | Northing (m) | Direction (Deg. T) | Distance (km) |
| AX1 | 483601 | 4415509 | 88 | 0.2 |
| AX2 | 483732 | 4415489 | 92 | 0.3 |
| AX3 | 484083 | 4415515 | 89 | 0.7 |
| AX4 | 484614 | 4415486 | 91 | 1.2 |
| AX5 | 485030 | 4415490 | 90 | 1.6 |
| AX6 | 485693 | 4415448 | 91 | 2.3 |
| BX1 | 484086 | 4415895 | 60 | 0.8 |
| BX2 | 484382 | 4416096 | 59 | 1.2 |
| BX3 | 484853 | 4416354 | 59 | 1.7 |
| BX4 | 485367 | 4416624 | 60 | 2.3 |
| BX5 | 485749 | 4416954 | 58 | 2.8 |
| CX1 | 483588 | 4415410 | 116 | 0.2 |
| CX2 | 483691 | 4415378 | 113 | 0.3 |
| CX3 | 483997 | 4415098 | 124 | 0.7 |
| CX4 | 484443 | 4414867 | 121 | 1.2 |
| CX5 | 484779 | 4414660 | 121 | 1.6 |
| CX6 | 485447 | 4414323 | 120 | 2.4 |
| CX7 | 485769 | 4414078 | 121 | 2.8 |
| DX1 | 486167 | 4415493 | 90 | 2.8 |
| DX2 | 486579 | 4415466 | 91 | 3.2 |
| DX3 | 487688 | 4415281 | 93 | 4.3 |
| DX4 | 488878 | 4414970 | 95 | 5.5 |
| DX5 | 493921 | 4414448 | 96 | 10.6 |
| DX6 | 502328 | 4413641 | 96 | 19.0 |
| EX1 | 486345 | 4417106 | 61 | 3.4 |
| EX2 | 487016 | 4417524 | 61 | 4.1 |
| EX3 | 487409 | 4417892 | 59 | 4.7 |
| EX4 | 489488 | 4418608 | 63 | 6.8 |
| EX5 | 493820 | 4422622 | 55 | 12.6 |
| EX6 | 497869 | 4425135 | 56 | 17.4 |
| FX1 | 486071 | 4414038 | 119 | 3.0 |
| FX2 | 486631 | 4413766 | 118 | 3.7 |
| FX3 | 487807 | 4413140 | 118 | 5.0 |
| FX4 | 489588 | 4411817 | 121 | 7.2 |
| FX5 | 490974 | 4409820 | 127 | 9.5 |
| FX6 | 500234 | 4408098 | 114 | 18.4 |
| GX1 | 484521 | 4413197 | 154 | 2.6 |
| GX2 | 484804 | 4412549 | 155 | 3.3 |
| GX3 | 485871 | 4412075 | 144 | 4.2 |
| GX4 | 486028 | 4409858 | 155 | 6.2 |
| GX5 | 489449 | 4405424 | 149 | 11.8 |
| GX6 | 493437 | 4400496 | 146 | 18.1 |

▼ USGS is the US Geological Survey

[a] The coordinates listed are from Zone 13 of the Universal Transverse Mercator (UTM) system but they have not been corrected for the 1927 North American datum polyconic projection.

Table 1 (Continued). Locations of sampling sites.

| Location Code | Location | UTM Coordinates | | From 903 Pad Direction (Deg. T) | From 903 Pad Distance (km) |
|---|---|---|---|---|---|
| | | Easting (m) | Northing (m) | | |
| | **Background Locations** | | | | |
| Z01 | Pawnee Grassland, Weld Co. | 520524 | 4516126 | 20 | 107.3 |
| Z02 | CSU Airport | 487734 | 4494329 | 3 | 79.0 |
| Z03 | Weld / Larimer County Line | 505381 | 4503233 | 14 | 90.5 |
| Z04 | Dixon Reservoir, Larimer Co. | 487947 | 4488793 | 3 | 73.5 |
| Z05 | Southwest Fort Collins | 489303 | 4484305 | 5 | 69.3 |
| Z06 | Southeast Fort Collins | 494866 | 4483200 | 9 | 68.9 |
| Z07 | Colorado Springs | 513609 | 4295761 | 166 | 123.3 |
| Z08 | Castle Rock | 501481 | 4359837 | 162 | 58.5 |
| Z09 | Monument | 511224 | 4336527 | 160 | 83.7 |
| Z10 | Lefthand Valley Res., Boulder Co. | 476416 | 4438567 | 343 | 24.2 |
| | **Community Sample Locations** | | | | |
| K01 | Boulder | 478656 | 4423727 | 330 | 9.5 |
| K02 | Golden | 486018 | 4397711 | 181 | 17.8 |
| K03 | Marshall | 480047 | 4422093 | 333 | 7.4 |
| K04 | Eldorado Springs | 477952 | 4420840 | 314 | 7.6 |
| K05 | Wheatridge | 490677 | 4401214 | 153 | 15.9 |
| K06 | Arvada | 491362 | 4405615 | 141 | 12.6 |
| K07 | Westminster | 497184 | 4410443 | 110 | 14.6 |
| K08 | Thorton / Northglenn | 503091 | 4414425 | 93 | 19.7 |
| K09 | Broomfield | 492293 | 4417808 | 75 | 9.2 |
| K10 | Superior | 484127 | 4422542 | 6 | 7.2 |

Table 2. Results of interlaboratory comparison exercises. All values were within statistical agreement ($\alpha = 0.05$) with the reported median value. Exercises were concucted with the International Atomic Energy Agency (IAEA) (Ballestra et. al. 1991, Ballestra et. al. 1993) and the Republic of the Marshall Islands Nation Wide Radiological Study (Simon and Graham 1993).

| Sample | Statistic | Reported Value | CSU-RG (e) Value |
|---|---|---|---|
| IAEA-367 | n (a) | 31 | 4 |
| $^{239,240}Pu$ | median (b) | 38 | 39.8 |
| | range (b) | 24 - 51 | 36 - 45 |
| | 95% CI (c) | 34.4 - 39.8 | 36.6 - 43.0 |
| IAEA-367 | n | 12 | 4 |
| $^{238}Pu$ | median | 0.08 | 0.03 |
| | range | 0.02 - 0.26 | 0.0 - 0.17 |
| | 95% CI | 0.02 - 0.26 | -0.07 - 0.13 |
| IAEA-368 (d) | n | 25 | 3 |
| $^{239,240}Pu$ | median | 31.2 | 27.4 |
| | range | 18.5 - 51.1 | 24.8 - 29.4 |
| | 95% CI | 21.7 - 42.5 | 25.7 - 29.1 |
| MI-09S01V | n | 3 | 1 |
| $^{239,240}Pu$ | mean | 2445 | 2446 |
| | 95% CI | 2246 - 2645 | 1875 - 3017 |
| MI-09S83a | n | 4 | 1 |
| $^{239,240}Pu$ | mean | 669 | 674 |
| | 95% CI | 632 - 704 | 623 - 725 |
| MI-09S83a | n | 3 | 1 |
| $^{238}Pu$ | mean | 77.3 | 73 |
| | 95% CI | 65.1 - 89.6 | 51.6 - 94.5 |
| MI-09S43A | n | 4 | 1 |
| $^{239,240}Pu$ | mean | 3.7 | 3.7 |
| | 95% CI | 3.48 - 3.92 | 3.14 - 4.26 |
| IAEA-135 | n | 43 | 4 |
| $^{239,240}Pu$ | median | 213 | 215 |
| | range | 176 - 278 | 194 - 233 |
| | 95% CI | 205 - 226 | 187 - 241 |
| IAEA-135 | n | 37 | 4 |
| $^{238}Pu$ | median | 43 | 43.4 |
| | range | 35 - 52 | 36.9 - 44.0 |
| | 95% CI | 41.6 - 45.0 | 36.3 - 47.5 |

(a) Some of the reported values were rejected for statistical or quality control purposes, "n" is the number of accepted values.

(b) The median, mean, and range are in Bq $kg^{-1}$

(c) The 95% Confidence Interval (CI) is also in Bq $kg^{-1}$.

(d) Sample IAEA-368 results were reported as preliminary by the IAEA

(e) CSU-RG is the Colorado State University - Radioecology Group

Table 3. The variation in $^{239}Pu$ concentrations of 0-3 cm soil samples at each site was expressed as the coefficient of variation, CV.

| Macroplot Location Code | $^{239}Pu$ Concen. ($Bq\ kg^{-1}$) No. Samples | Mean | Standard Deviation | CV (a) (%) |
|---|---|---|---|---|
| AX1 | 3 | 33000 | 8200 | 25 |
| AX2 | 5 (b) | 7130 | 2340 | 33 |
| AX3 | 6 (b) | 79.3 (c) | 68.3 | 86 |
| AX4 | 4 | 586 | 175 | 30 |
| AX5 | 4 | 257 | 57.5 | 22 |
| AX6 | 4 | 115 | 32.0 | 28 |
| DX1 | 4 | 95.8 | 21.5 | 22 |
| DX2 | 5 (b) | 33.0 | 22.7 | 69 |
| DX3 | 4 | 29.3 | 13.6 | 46 |
| DX4 | 4 | 7.33 | 1.31 | 18 |
| DX5 | 4 | 2.39 | 0.41 | 17 |
| DX6 | 4 | 1.68 | 0.51 | 31 |
| BX1 | 4 | 151 | 33.3 | 22 |
| BX2 | 4 | 148 | 38.7 | 26 |
| BX3 | 4 | 24.8 | 16.1 | 65 |
| BX4 | 4 | 22.6 | 20.9 | 92 |
| BX5 | 4 | 7.06 (c) | 4.60 | 77 |
| EX1 | 5 (b) | 1.88 | 0.24 | 13 |
| EX2 | 4 | 8.91 | 2.64 | 30 |
| EX3 | 2 | 9.85 | 7.79 | 79 |
| EX4 | 5 (b) | 2.96 | 2.90 | 98 |
| EX5 | 4 | 0.96 | 0.53 | 55 |
| EX6 | 4 | 3.52 | 0.93 | 26 |
| CX1 | 4 | 5540 | 1230 | 22 |
| CX2 | 4 | 1880 | 673 | 36 |
| CX3 | 4 | 454 | 372 | 82 |
| CX4 | 4 | 54.4 | 6.78 | 12 |
| CX5 | 1 | 131 | - | - |
| CX6 | 3 | 52.3 | 11.1 | 21 |
| CX7 | 4 | 4.60 | 2.11 | 46 |
| FX1 | 4 | 18.4 | 4.74 | 26 |
| FX2 | 4 | 29.8 | 14.2 | 47 |
| FX3 | 4 | 7.66 | 5.42 | 71 |
| FX4 | 5 (b) | 1.00 | 0.46 | 46 |
| FX5 | 5 (b) | 1.26 (c) | 0.62 | 49 |
| FX6 | 4 | 0.20 | 0.10 | 50 |
| Background | 10 | 2.14 | 0.76 | 36 |

(a) CV = Standard Deviation ÷ Mean
(b) Number of samples includes one or two replicates.
(c) Not normally distributed ($p < 0.05$)

Figure 1. Map of study area showing sampling sites.

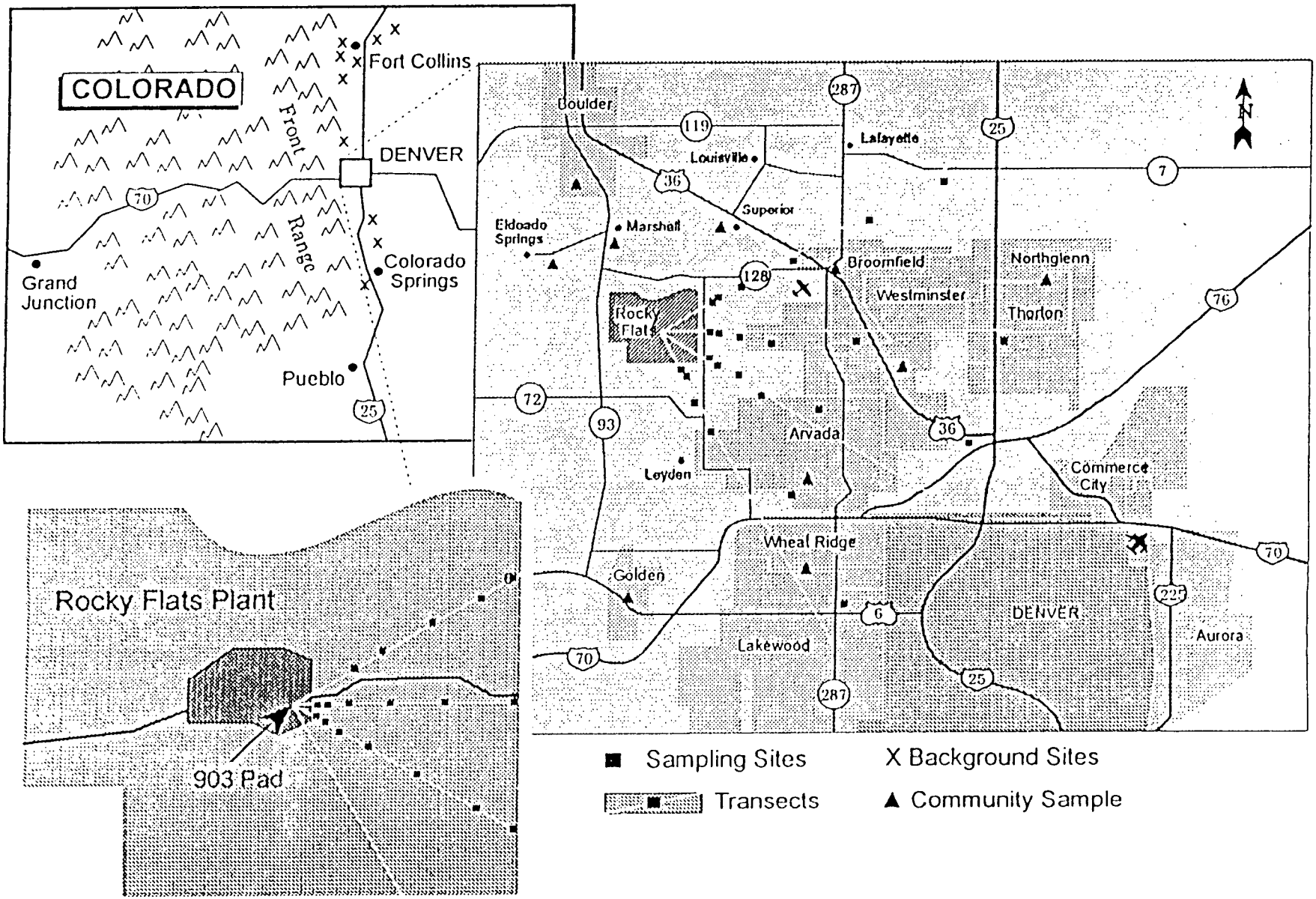


Figure 2. Four microplots were randomly located inside each transect Macroplot for the purpose of replicating samples at the sites. Vegetation and soil from different depths were collected from each microplot. The number and types of samples were different between plots located on or off of the Rocky Flats Plant (Fig. 1), but the diagram below shows a typical layout for an on-site Macroplot.

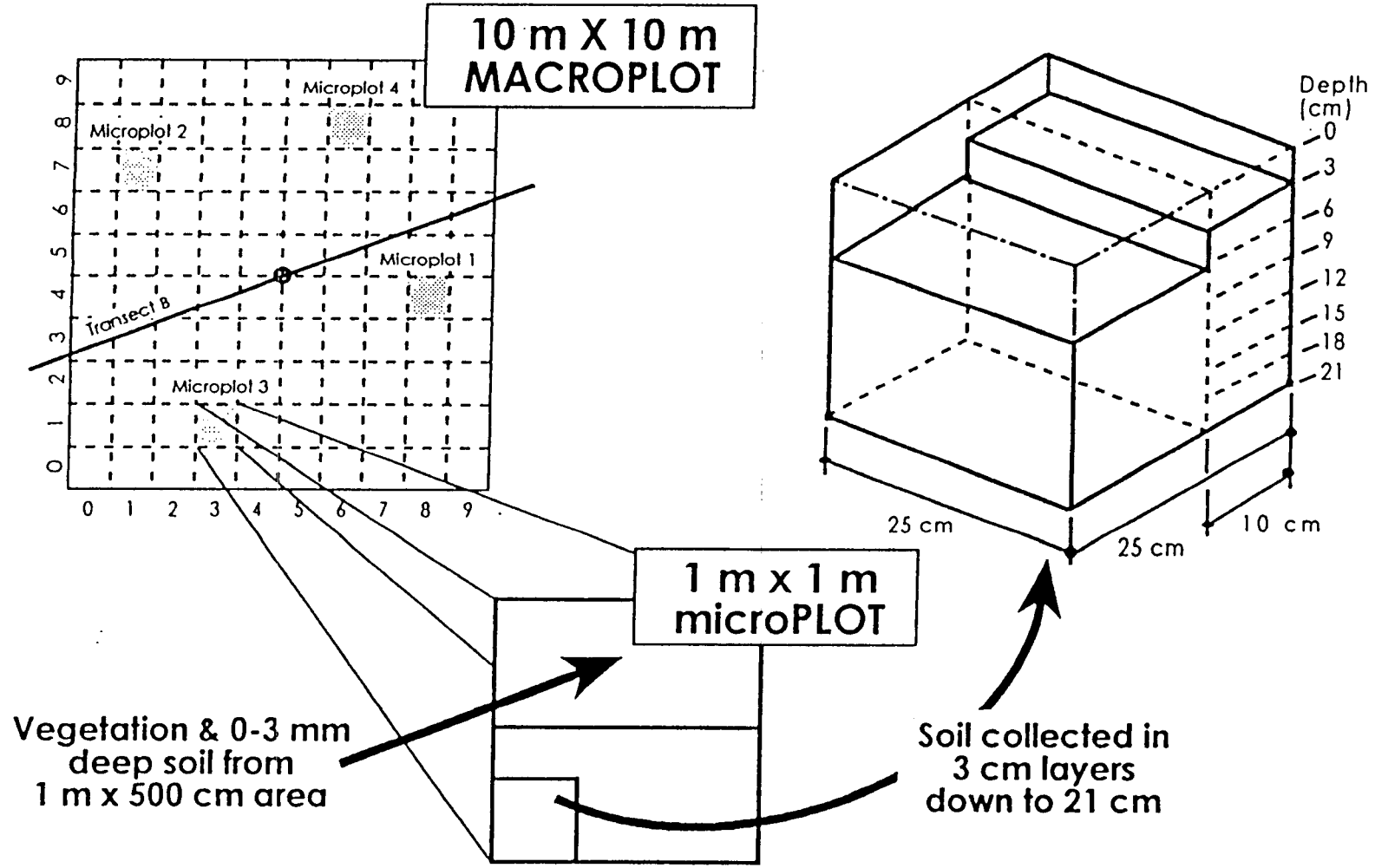


Figure 3. The $^{239}$Pu concentrations in soil were normalized to the 0-3 cm concentration to examine the general plutonium depth distribution in soil. The medians (bold numbers) of the normalized values were fit with the equation shown. The peak concentration occurs below the soil surface and the rate at which the plutonium concentrations decrease with depth changes to a lower rate at ~9 cm. (Fig. 9 describes the boxplots)

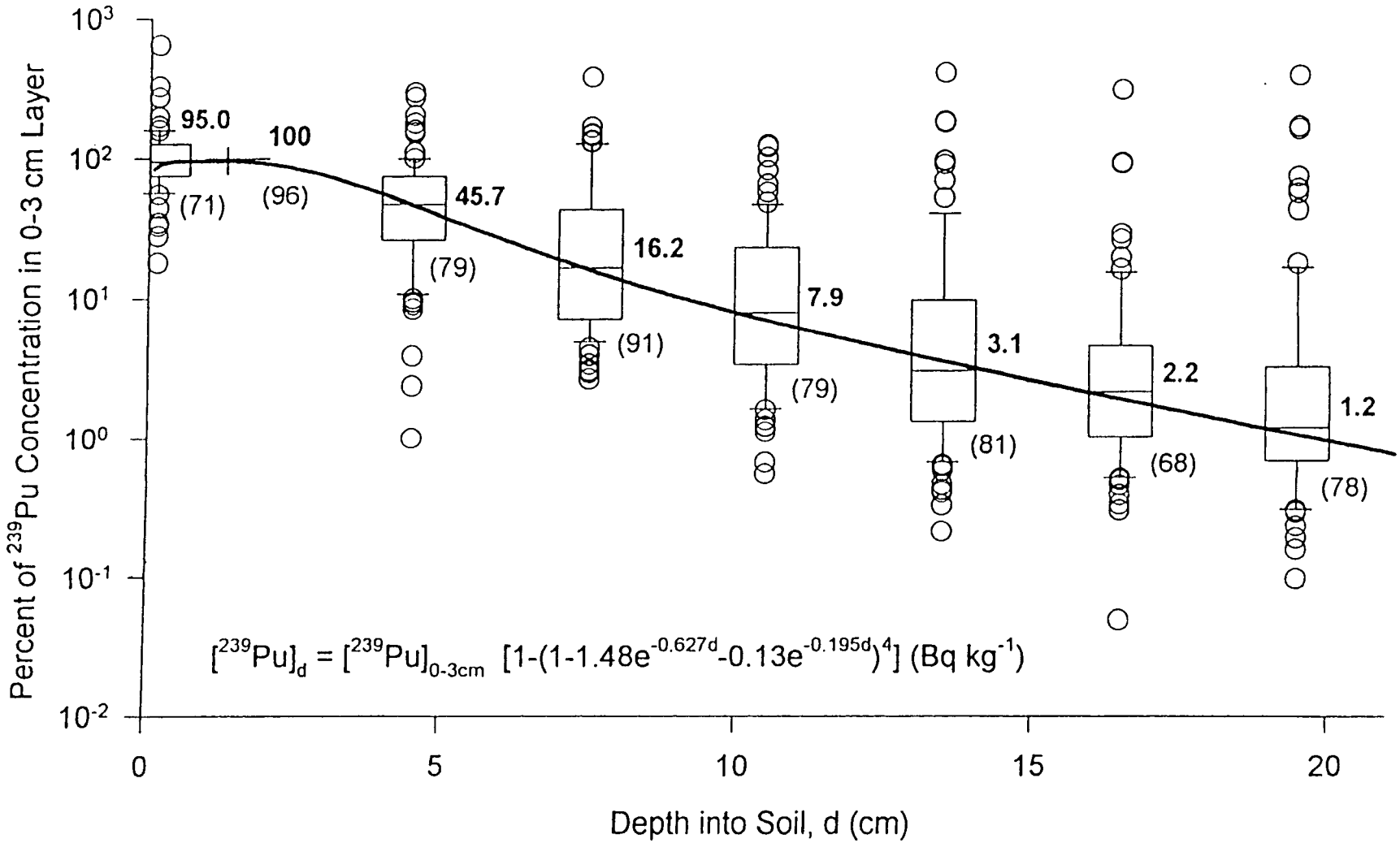


Figure 4. The distribution of $^{239}Pu$ in the top layer of soil (0-3 cm) was best described as a decreasing power function with distance from the 903 Pad. A significant difference in plutonium concentrations existed between the sampling transects ( $p < 0.05$) in four separate directions from the 903 Pad.

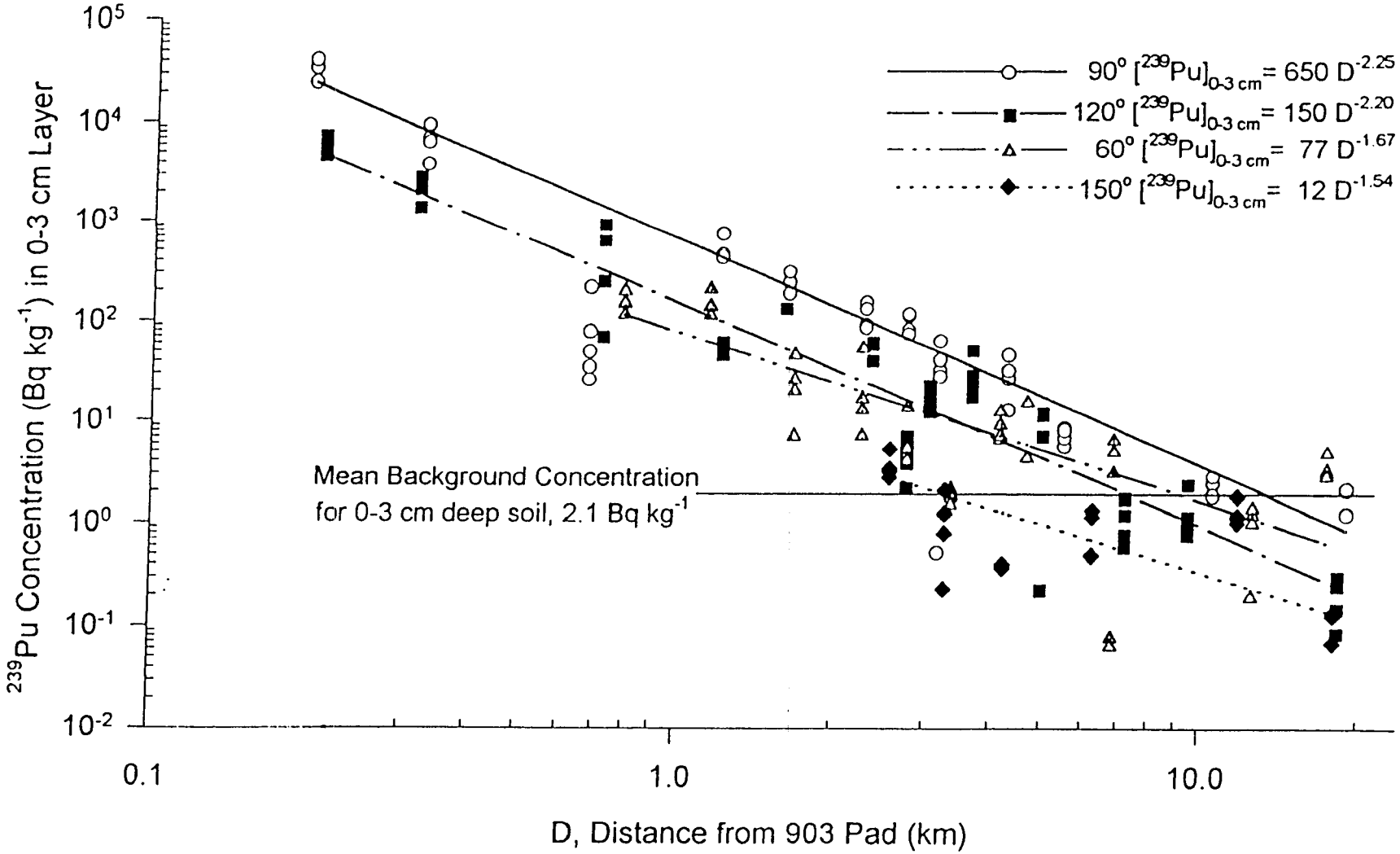


Figure 5. The model for predicting $^{239}Pu$ concentrations in the study area was tested by regressing the measured values with the predicted values. The 95% confidence interval was from 0.08-12 times the predicted value.

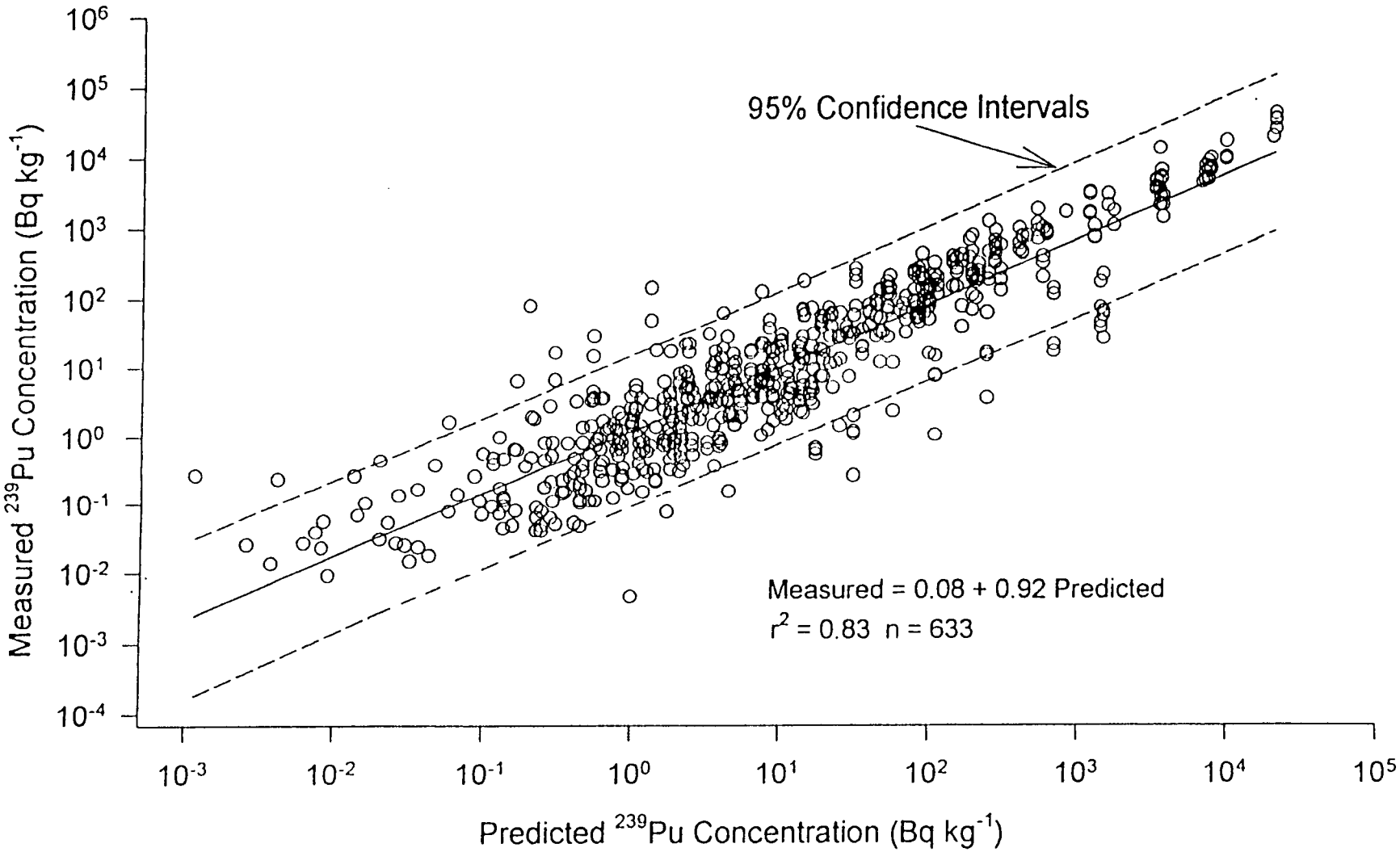


Figure 6. The soil density was measured throughout the study area using a volume displacement method. The soil density for the 0-3 mm scrape was estimated from the approximate sample volume. The soil densities are adjusted for the rock weight and volume. (See Fig. 9 for explanation of boxplots.)

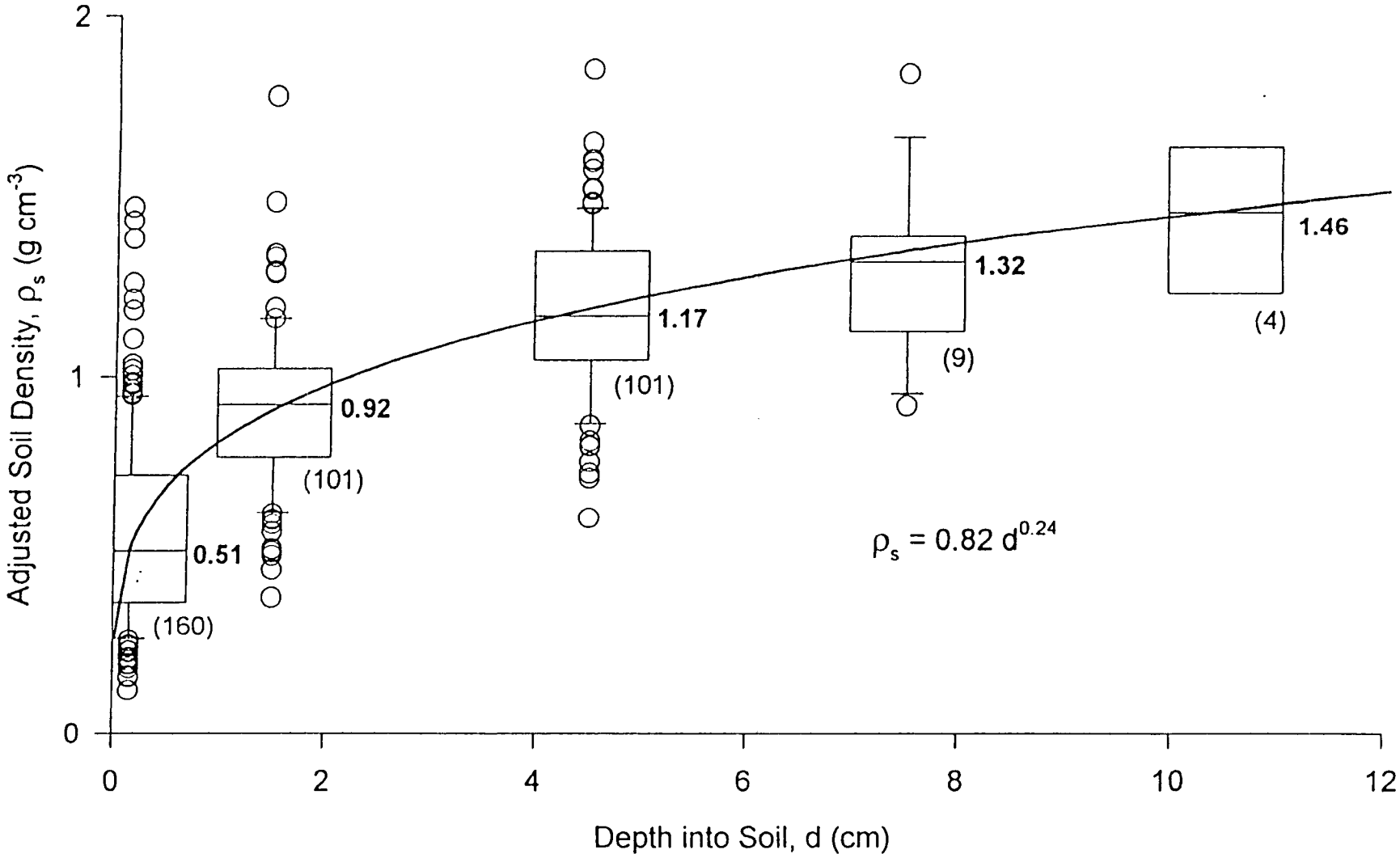


Figure 7. The inventory model was tested by predicting the plutonium inventory down to 21 cm and comparing the values to measured inventories in 0-21 cm deep soil. There was no statistical difference between the measured and predicted groups (p = 0.71). The regression line (center) is shown with the 95% confidence intervals.

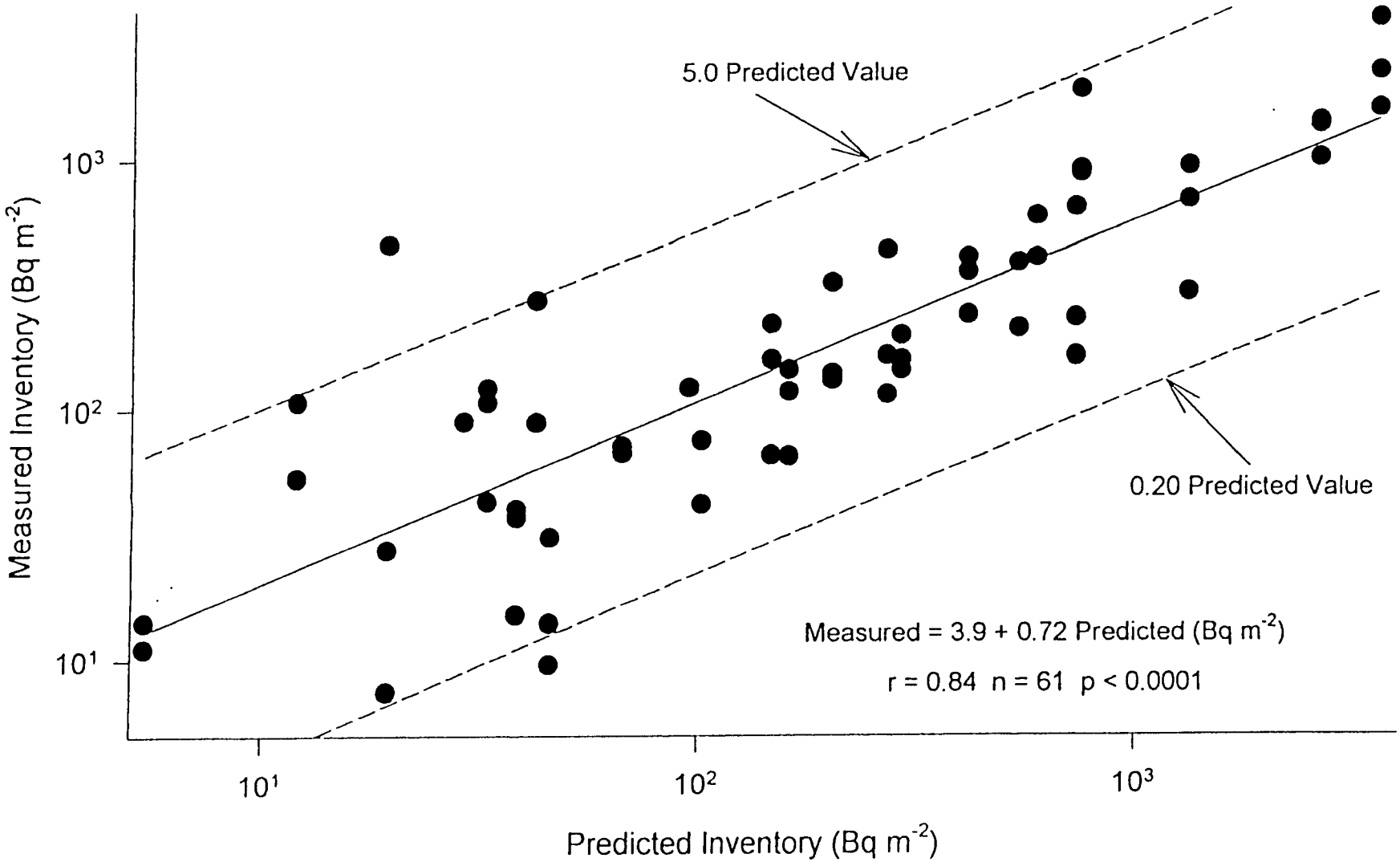


Figure 8. The plutonium isotopic ratios were examined as a function of $^{239}Pu$ concentration to investigate the possibility that non-plutonium radionuclide interfered with the determination of $^{238}Pu$. There were no significant correlations between the isotopic ratio and sample depth ($p = 0.27$) or distance ($p = 0.1$).

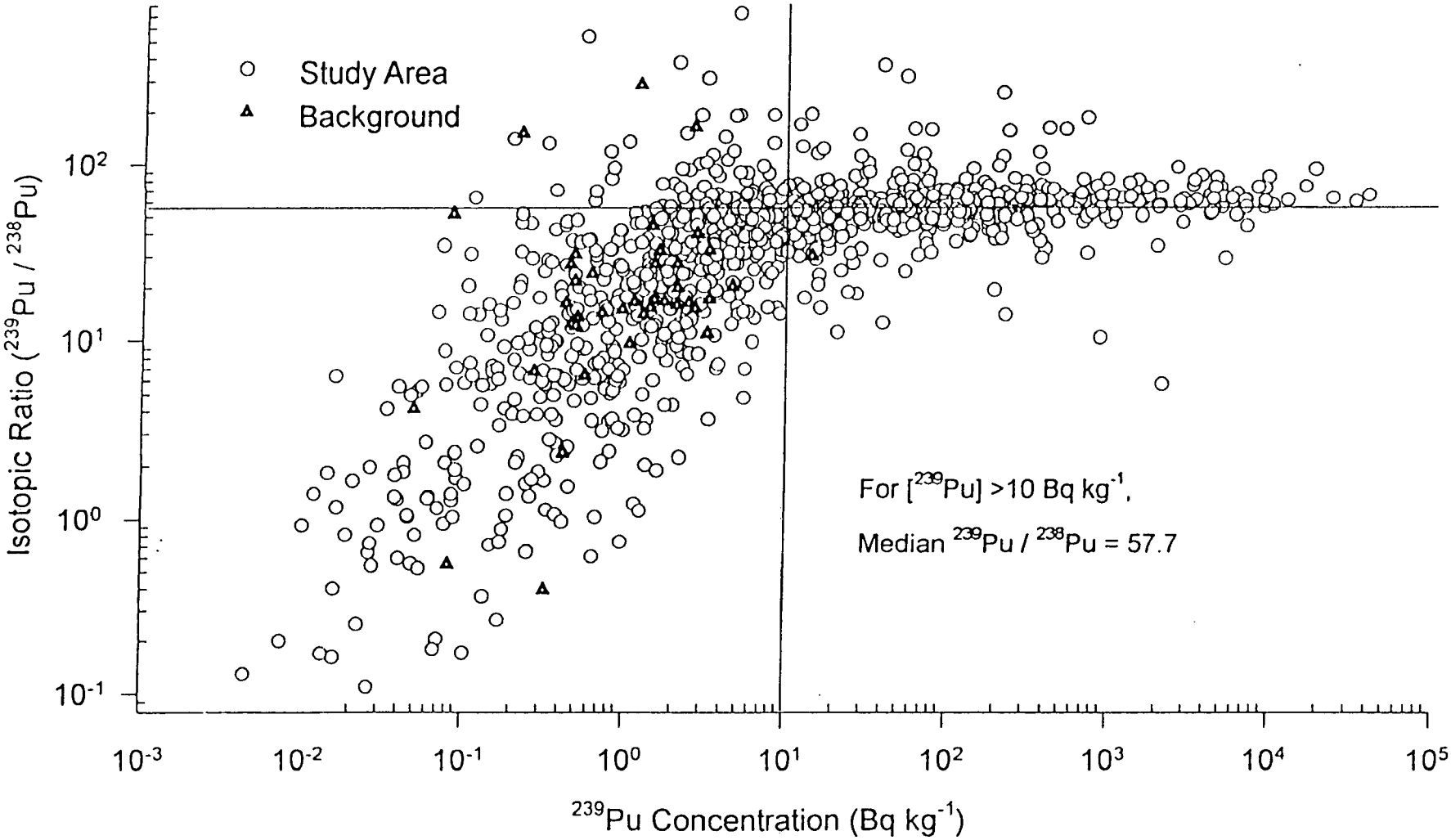
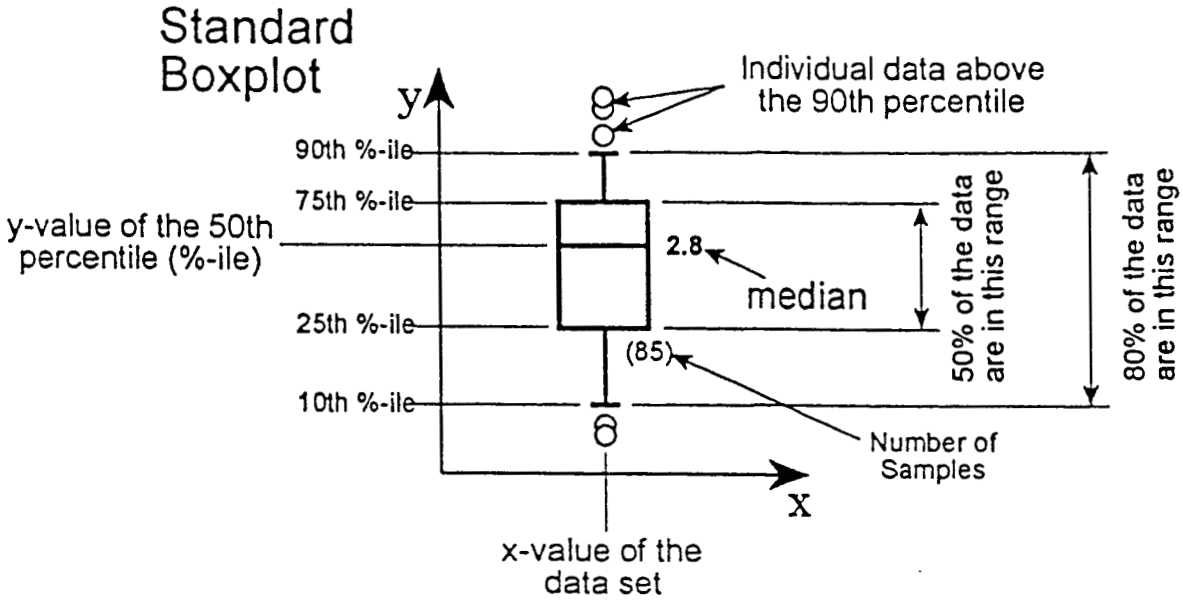
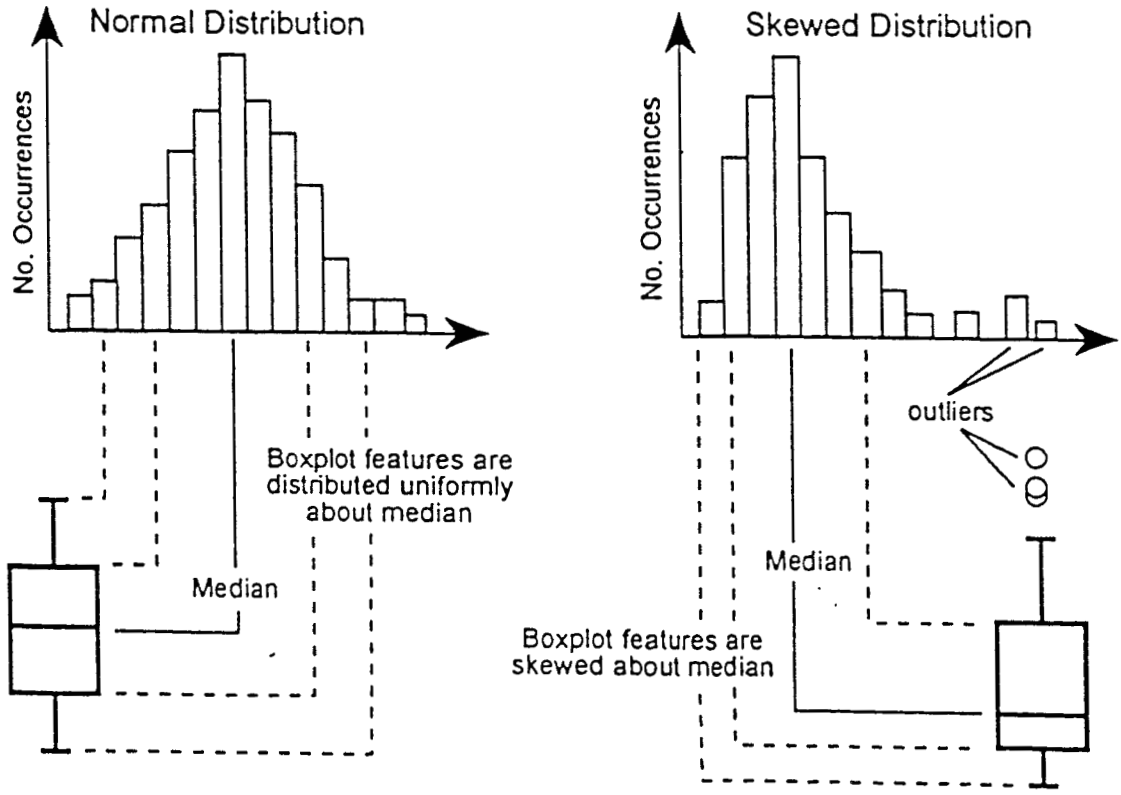


Figure 9. Boxplots are useful for describing both the central tendancy (median) and the distribution of the data set being plotted. The features of boxplots are explained in the diagram below along with some examples.




## Examples



# APPENDIX A

## QA / QC Results

The following two graphs show the results of acid blank analyses (Fig. A1) and replicate analyses (Fig. A2).

Figure A1. Histogram of activities in acid blanks processed during the project.

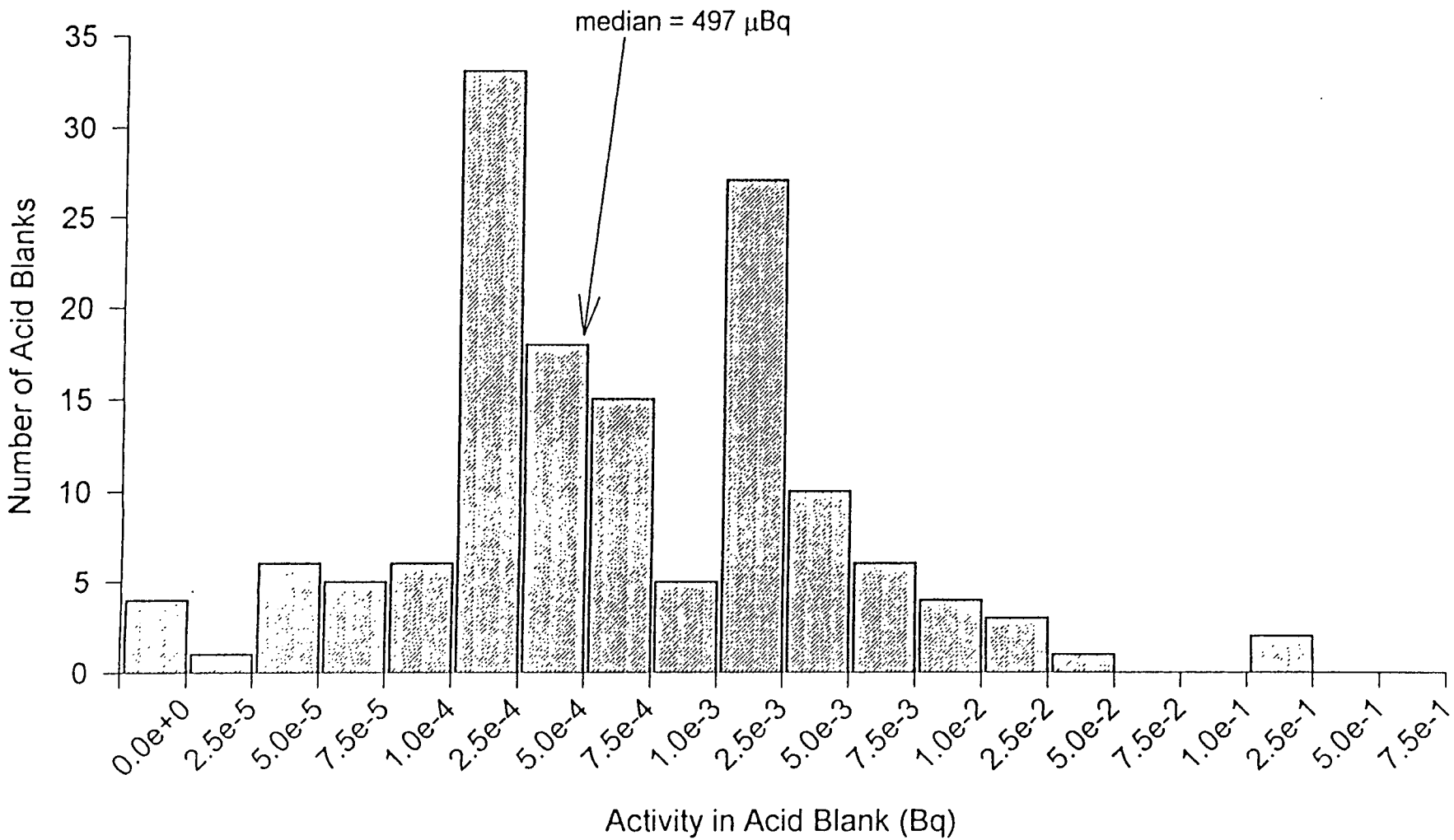
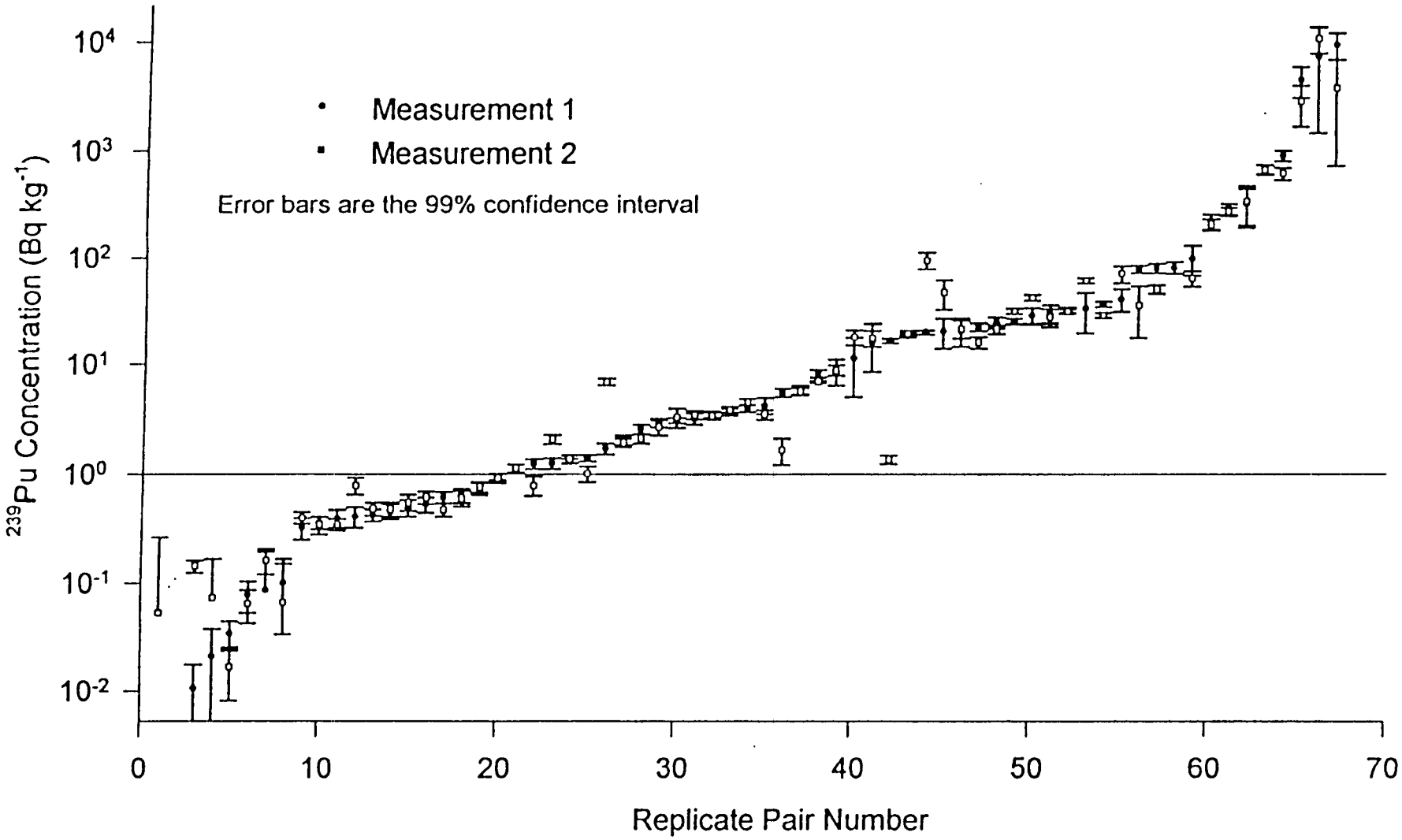


Figure A2. Soil sample replicate analysis results. Overlapping error bars indicate equivalent concentrations.



# APPENDIX C

## Plutonium Concentration Measurement Data and Soil Density Measurement Data

The **concentration** values (Bq $kg^{-1}$) for $^{238}Pu$ and $^{239,240}Pu$ (listed as $^{239}Pu$) as measured in the laboratory are listed in the following table. Error values (one standard deviation) are also included for each measurement. The table is organized into four main sections, and the data are grouped by macroplot.



The **soil density** measurements (g $cm^{-3}$) for bulk soil (including rocks) and adjusted values (density for 0-2 mm particle size soil only) begin on page C26. This table is organized into three sections which are grouped by macroplot.



The Sample Location Codes are listed for reference to specific samples.

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| **Locations On Rocky Flats Plant Site** | | | | | | | | | |
| AX1 | 1 | 88 | 0.2 | 0-3 | 24425.52 | 1121.80 | 385.30 | 21.44 | AX1110 |
| | | | | 3-6 | 9361.96 | 1119.30 | 165.86 | 26.06 | AX1120 |
| | | | | 6-9 | 3488.14 | 254.45 | 56.17 | 7.68 | AX1130 |
| | | | | 18-21 | 217.58 | 19.84 | 1.96 | 0.86 | AX1170 |
| | | | | Veg | 375.87 | 33.23 | 4.95 | 0.86 | AX11VFU |
| AX1 | 2 | 88 | 0.2 | 0-0.3 | 19008.23 | 3967.92 | 202.09 | 92.91 | AX1200 |
| | | | | 0-3 | 33999.55 | 14383.39 | 559.51 | 267.80 | AX1210 |
| | | | | 3-6 | 7264.90 | 2910.42 | 163.50 | 74.15 | AX1220 |
| | | | | 3-6 | 10509.23 | 1401.38 | 180.97 | 31.40 | AX1220 |
| | | | | 6-9 | 4325.47 | 537.20 | 63.63 | 13.85 | AX1230 |
| | | | | 9-12 | 2003.95 | 207.89 | 58.50 | 11.50 | AX1240 |
| | | | | 12-15 | 1634.99 | 42.91 | 26.14 | 1.83 | AX1250 |
| | | | | 15-18 | 743.40 | 65.30 | 12.10 | 2.87 | AX1260 |
| | | | | 18-21 | 178.97 | 12.05 | 4.26 | 1.11 | AX1270 |
| AX1 | 3 | 88 | 0.2 | 0-3 | 40757.59 | 5718.04 | 619.38 | 94.37 | AX1310 |
| | | | | 3-6 | 16508.70 | 2979.64 | 221.73 | 51.30 | AX1320 |
| | | | | 6-9 | 12977.80 | 744.63 | 210.18 | 15.44 | AX1330 |
| | | | | 9-12 | 2908.49 | 1129.67 | 46.32 | 18.94 | AX1340 |
| | | | | 18-21 | 449.19 | 40.18 | 7.07 | 2.19 | AX1370 |
| | | | | Veg | 568.79 | 94.03 | 9.18 | 1.94 | AX13VFU |
| AX1 | 4 | 88 | 0.2 | 0-0.3 | 2163.37 | 155.76 | 375.78 | 30.28 | AX1400 |
| | | | | 3-6 | 9787.91 | 944.96 | 115.77 | 16.36 | AX1420 |
| | | | | 6-9 | 2024.58 | 188.87 | 35.42 | 7.05 | AX1430 |
| | | | | 18-21 | 1196.09 | 118.32 | 18.68 | 4.05 | AX1470 |
| | | | | Veg | 222.59 | 14.46 | 3.23 | 0.42 | AX14VFU |
| AX2 | 1 | 92 | 0.33 | 0-0.3 | 6329.66 | 1195.29 | 122.07 | 37.37 | AX2100 |
| | | | | 0-3 | 6990.79 | 696.27 | 123.19 | 17.68 | AX2110 |
| | | | | 3-6 | 6229.24 | 758.74 | 121.69 | 21.41 | AX2120 |
| | | | | 6-9 | 732.60 | 168.76 | 23.38 | 10.89 | AX2130 |
| | | | | 9-12 | 383.65 | 37.43 | 4.08 | 1.68 | AX2140 |
| | | | | 12-15 | 127.61 | 12.99 | 1.55 | 0.84 | AX2150 |
| | | | | 15-18 | 38.32 | 2.59 | 1.35 | 0.46 | AX2160 |
| | | | | 18-21 | 61.14 | 2.41 | 1.26 | 0.31 | AX2170 |
| | | | | Veg | 44.60 | 3.04 | 1.00 | 0.20 | AX21VFU |
| AX2 | 2 | 92 | 0.33 | 0-0.3 | 4911.89 | 835.51 | 66.71 | 14.69 | AX2200 |
| | | | | 0-3 | 9272.80 | 1227.32 | 127.57 | 24.15 | AX2210 |
| | | | | 0-3 | 3753.55 | 1517.41 | 43.24 | 25.53 | AX2210 |
| | | | | 6-9 | 704.84 | 37.37 | 13.30 | 2.22 | AX2230 |
| | | | | 9-12 | 316.28 | 39.78 | 4.31 | 2.32 | AX2240 |
| | | | | 12-15 | 181.84 | 5.51 | 2.83 | 0.42 | AX2250 |
| | | | | 15-18 | 75.91 | 12.33 | -0.23 | 0.09 | AX2260 |
| | | | | 18-21 | 82.57 | 2.77 | 1.38 | 0.29 | AX2270 |
| | | | | Veg | 41.82 | 2.20 | 0.72 | 0.10 | AX22VFU |
| AX2 | 3 | 92 | 0.33 | 0-0.3 | 8404.94 | 1722.74 | 114.07 | 28.20 | AX2300 |
| | | | | 0-3 | 9379.57 | 342.67 | 152.71 | 7.51 | AX2310 |
| | | | | 3-6 | 4734.84 | 790.33 | 78.83 | 21.45 | AX2320 |
| | | | | 6-9 | 1024.59 | 71.53 | 22.07 | 3.77 | AX2330 |
| | | | | 9-12 | 961.37 | 53.37 | 11.69 | 1.87 | AX2340 |
| | | | | 12-15 | 249.55 | 66.48 | -0.09 | 0.02 | AX2350 |
| | | | | 15-18 | 401.61 | 24.01 | 12.11 | 2.11 | AX2360 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| AX2 | 3 | 92 | 0.33 | 18-21 | 104.21 | 4.02 | 2.01 | 0.41 | AX2370 |
| | | | | Veg | 97.13 | 23.60 | 1.58 | 0.80 | AX23VFU |
| AX2 | 4 | 92 | 0.33 | 0-0.3 | 4639.32 | 624.61 | 69.77 | 12.33 | AX2400 |
| | | | | 0-0.3* | 7152.60 | 1546.71 | 115.50 | 40.53 | AX240P |
| | | | | 0-3 | 6256.75 | 998.66 | 92.14 | 21.71 | AX2410 |
| | | | | 3-6 | 5043.40 | 1967.47 | 89.04 | 37.32 | AX2420 |
| | | | | 6-9 | 1015.56 | 99.29 | 17.52 | 4.77 | AX2430 |
| | | | | 9-12 | 195.83 | 38.00 | 10.05 | 4.87 | AX2440 |
| | | | | 12-15 | 556.23 | 147.86 | -0.09 | 0.02 | AX2450 |
| | | | | 15-18 | 327.69 | 26.70 | 5.19 | 1.31 | AX2460 |
| | | | | 18-21 | 176.88 | 21.47 | 3.86 | 1.56 | AX2470 |
| AX3 | 1 | 89 | 0.68 | 0-0.3 | 71.56 | 4.13 | 1.12 | 0.46 | AX3100 |
| | | | | 0-0.3* | 360.11 | 40.00 | 7.99 | 3.10 | AX310P |
| | | | | 0-3 | 34.84 | 8.77 | 0.00 | 0.00 | AX3110 |
| | | | | 0-3 | 76.36 | 3.26 | 0.86 | 0.27 | AX3110 |
| | | | | 3-6 | 21.02 | 0.64 | 0.43 | 0.09 | AX3120 |
| | | | | 6-9 | 3.53 | 0.43 | -0.03 | 0.07 | AX3130 |
| | | | | 9-12 | 1.03 | 0.28 | 0.00 | 0.08 | AX3140 |
| | | | | 15-18 | 0.26 | 0.20 | 0.39 | 0.13 | AX3160 |
| | | | | 18-21 | 0.67 | 0.33 | 0.65 | 0.22 | AX3170 |
| | | | | Veg | 2.36 | 0.12 | 0.04 | 0.01 | AX31VFU |
| AX3 | 2 | 89 | 0.68 | 0-0.3 | 32.36 | 6.53 | 0.50 | 0.55 | AX3200 |
| | | | | 0-0.3 | 59.17 | 1.49 | 0.78 | 0.13 | AX3200 |
| | | | | 0-3 | 77.88 | 4.25 | 0.49 | 0.29 | AX3210 |
| | | | | 0-3 | 49.01 | 2.28 | 1.18 | 0.30 | AX3210 |
| | | | | 3-6 | 111.87 | 7.98 | 3.09 | 0.81 | AX3220 |
| | | | | 6-9 | 15.95 | 2.84 | 0.68 | 0.48 | AX3230 |
| | | | | 9-12 | 7.65 | 0.77 | 0.09 | 0.12 | AX3240 |
| | | | | 12-15 | 2.29 | 0.31 | 0.32 | 0.11 | AX3250 |
| | | | | 15-18 | 1.17 | 0.21 | 0.07 | 0.08 | AX3260 |
| | | | | 18-21 | 0.54 | 0.09 | -0.21 | 0.05 | AX3270 |
| | | | | Veg | 4.03 | 0.23 | 0.03 | 0.04 | AX32VFU |
| AX3 | 3 | 89 | 0.68 | 0-0.3 | 37.81 | 0.72 | 0.60 | 0.06 | AX3300 |
| | | | | 0-3 | 211.85 | 14.37 | 5.01 | 1.06 | AX3310 |
| | | | | 3-6 | 135.51 | 10.41 | 3.50 | 0.94 | AX3320 |
| | | | | 6-9 | 61.54 | 7.28 | 0.38 | 0.51 | AX3330 |
| | | | | 9-12 | 7.22 | 1.69 | -0.08 | 0.02 | AX3340 |
| | | | | 12-15 | 11.46 | 0.69 | 0.16 | 0.17 | AX3350 |
| | | | | 15-18 | 1.07 | 0.44 | 0.03 | 0.12 | AX3360 |
| | | | | 18-21 | 0.62 | 0.10 | 0.13 | 0.05 | AX3370 |
| | | | | Veg | 5.38 | 0.38 | 0.17 | 0.04 | AX33VFU |
| AX3 | 4 | 89 | 0.68 | 0-0.3 | 167.34 | 13.51 | 2.12 | 0.52 | AX3400 |
| | | | | 0-3 | 25.85 | 2.55 | 0.94 | 0.42 | AX3410 |
| | | | | 3-6 | 15.96 | 3.78 | -0.07 | 0.02 | AX3420 |
| | | | | 3-6 | 17.41 | 1.52 | 0.34 | 0.21 | AX3420 |
| | | | | 6-9 | 11.28 | 3.16 | 0.31 | 0.68 | AX3430 |
| | | | | 6-9 | 17.72 | 1.40 | 0.50 | 0.20 | AX3430 |
| | | | | 9-12 | 14.52 | 1.09 | 0.46 | 0.16 | AX3440 |
| | | | | 15-18 | 1.98 | 0.16 | 0.18 | 0.05 | AX3460 |
| | | | | Veg | 5.46 | 0.43 | 0.07 | 0.03 | AX34VFU |
| AX4 | 1 | 91 | 1.21 | 0-0.3 | 952.50 | 76.31 | 19.10 | 3.74 | AX4100 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 µm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| AX4 | 1 | 91 | 1.21 | 0-0.3* | 831.48 | 21.52 | 11.14 | 1.24 | AX410P |
| | | | | 0-3 | 747.28 | 121.55 | 12.58 | 2.30 | AX4110 |
| | | | | 3-6 | 196.87 | 19.21 | 3.34 | 0.45 | AX4120 |
| | | | | 6-9 | 48.59 | 3.31 | 0.64 | 0.11 | AX4130 |
| | | | | 12-15 | 5.58 | 0.22 | 0.06 | 0.01 | AX4150 |
| | | | | 12-15 | 5.81 | 0.27 | 0.14 | 0.02 | AX4150 |
| | | | | 15-18 | 3.89 | 0.27 | 0.07 | 0.02 | AX4160 |
| | | | | 18-21 | 1.45 | 0.18 | 0.03 | 0.02 | AX4170 |
| | | | | Veg | 15.68 | 2.47 | 0.23 | 0.10 | AX41VFU |
| AX4 | 2 | 91 | 1.21 | 0-0.3 | 591.14 | 44.12 | 9.95 | 2.24 | AX4200 |
| | | | | 0-3 | 447.02 | 35.90 | 8.40 | 0.89 | AX4210 |
| | | | | 3-6 | 211.59 | 20.58 | 3.69 | 0.57 | AX4220 |
| | | | | 6-9 | 62.02 | 4.18 | 0.92 | 0.17 | AX4230 |
| | | | | 9-12 | 31.29 | 0.86 | 0.57 | 0.05 | AX4240 |
| | | | | 9-12 | 30.36 | 0.76 | 0.58 | 0.05 | AX4240 |
| | | | | 12-15 | 20.24 | 0.68 | 0.36 | 0.05 | AX4250 |
| | | | | 15-18 | 8.75 | 0.25 | 0.57 | 0.04 | AX4260 |
| | | | | 18-21 | 5.54 | 0.17 | 0.27 | 0.03 | AX4270 |
| AX4 | 3 | 91 | 1.21 | 0-0.3 | 478.54 | 40.71 | 10.17 | 2.62 | AX4300 |
| | | | | 0-0.3* | 689.03 | 65.77 | 14.73 | 3.50 | AX430P |
| | | | | 0-3 | 422.84 | 38.21 | 6.89 | 0.89 | AX4310 |
| | | | | 3-6 | 110.17 | 15.17 | 1.77 | 0.52 | AX4320 |
| | | | | 6-9 | 28.13 | 0.79 | 0.42 | 0.04 | AX4330 |
| | | | | 6-9 | 35.60 | 1.01 | 0.61 | 0.05 | AX4330 |
| | | | | 9-12 | 93.25 | 8.39 | 1.57 | 0.34 | AX4340 |
| | | | | 9-12 | 19.73 | 0.52 | 0.41 | 0.04 | AX4340 |
| | | | | 12-15 | 5.01 | 0.20 | 0.27 | 0.03 | AX4350 |
| | | | | 15-18 | 13.10 | 0.38 | 0.24 | 0.03 | AX4360 |
| | | | | 18-21 | 6.23 | 0.23 | 0.25 | 0.03 | AX4370 |
| | | | | Veg | 91.68 | 18.46 | 1.34 | 0.36 | AX43VFU |
| AX4 | 4 | 91 | 1.21 | 0-0.3* | 729.41 | 31.61 | 14.51 | 1.55 | AX440P |
| | | | | 0-3 | 728.41 | 123.05 | 3.94 | 3.00 | AX4410 |
| | | | | 3-6 | 190.92 | 30.29 | 4.49 | 1.07 | AX4420 |
| | | | | 6-9 | 104.17 | 2.85 | 1.78 | 0.10 | AX4430 |
| | | | | 9-12 | 57.34 | 2.96 | 1.14 | 0.14 | AX4440 |
| | | | | 12-15 | 72.13 | 2.08 | 1.22 | 0.10 | AX4450 |
| | | | | 15-18 | 16.22 | 0.57 | 0.20 | 0.04 | AX4460 |
| | | | | 18-21 | 8.74 | 3.04 | -0.00 | 0.00 | AX4470 |
| | | | | Veg | 2.05 | 0.10 | 0.04 | 0.00 | AX44VFU |
| AX5 | 1 | 90 | 1.63 | 0-0.3 | 169.00 | 17.59 | 2.82 | 0.41 | AX5100 |
| | | | | 0-3 | 302.83 | 48.45 | 3.79 | 1.01 | AX5110 |
| | | | | 3-6 | 50.00 | 3.67 | 0.92 | 0.19 | AX5120 |
| | | | | 6-9 | 19.03 | 0.49 | 0.34 | 0.03 | AX5130 |
| | | | | 9-12 | 3.39 | 0.13 | 0.10 | 0.02 | AX5140 |
| | | | | 12-15 | 1.24 | 0.05 | 0.06 | 0.00 | AX5150 |
| | | | | 15-18 | 0.15 | 0.02 | 0.02 | 0.00 | AX5160 |
| | | | | 18-21 | 0.92 | 0.09 | 0.12 | 0.03 | AX5170 |
| | | | | Veg | 14.59 | 0.92 | 0.23 | 0.05 | AX51VFU |
| AX5 | 2 | 90 | 1.63 | 0-0.3 | 180.01 | 4.16 | 3.04 | 0.10 | AX5200 |
| | | | | 0-0.3* | 240.98 | 9.27 | 3.70 | 0.38 | AX520P |
| | | | | 0-3 | 236.73 | 30.66 | 1.51 | 1.16 | AX5210 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| AX5 | 2 | 90 | 1.63 | 3-6 | 75.96 | 4.40 | 1.52 | 0.16 | AX5220 |
| | | | | 6-9 | 15.15 | 0.24 | 0.33 | 0.02 | AX5230 |
| | | | | 9-12 | 4.02 | 0.20 | 0.10 | 0.03 | AX5240 |
| | | | | 12-15 | 2.46 | 0.13 | 0.08 | 0.02 | AX5250 |
| | | | | 15-18 | 1.91 | 0.09 | 0.09 | 0.02 | AX5260 |
| | | | | 18-21 | 0.73 | 0.06 | 0.12 | 0.02 | AX5270 |
| | | | | Veg | 2.76 | 0.12 | 0.04 | 0.01 | AX52VFU |
| AX5 | 3 | 90 | 1.63 | 0-3 | 303.51 | 19.74 | 5.53 | 0.44 | AX5310 |
| | | | | 3-6 | 95.97 | 9.49 | 1.62 | 0.27 | AX5320 |
| | | | | 6-9 | 35.45 | 1.35 | 0.60 | 0.06 | AX5330 |
| | | | | 9-12 | 3.83 | 0.61 | 0.22 | 0.09 | AX5340 |
| | | | | 12-15 | 6.30 | 0.90 | 0.20 | 0.09 | AX5350 |
| | | | | 15-18 | 5.02 | 0.18 | 0.13 | 0.02 | AX5360 |
| | | | | 18-21 | 4.60 | 0.16 | 0.07 | 0.01 | AX5370 |
| | | | | Veg | 60.11 | 6.55 | 0.74 | 0.18 | AX53VFU |
| AX5 | 4 | 90 | 1.63 | 0-0.3 | 100.20 | 10.64 | 1.49 | 0.36 | AX5400 |
| | | | | 0-3 | 184.63 | 18.76 | 3.14 | 0.52 | AX5410 |
| | | | | 3-6 | 15.62 | 2.16 | 0.46 | 0.21 | AX5420 |
| | | | | 6-9 | 20.22 | 0.56 | 0.37 | 0.04 | AX5430 |
| | | | | 9-12 | 12.69 | 0.39 | 0.33 | 0.04 | AX5440 |
| | | | | 12-15 | 5.79 | 0.47 | 0.16 | 0.06 | AX5450 |
| | | | | 15-18 | 1.97 | 0.11 | 0.03 | 0.02 | AX5460 |
| | | | | 18-21 | 1.79 | 0.10 | 0.06 | 0.02 | AX5470 |
| | | | | Veg | 1.99 | 0.19 | 0.45 | 0.08 | AX54VFU |
| AX6 | 1 | 91 | 2.29 | 0-0.3 | 114.68 | 2.22 | 1.79 | 0.06 | AX6100 |
| | | | | 0-0.3* | 93.22 | 16.27 | 2.08 | 0.87 | AX610P |
| | | | | 0-3 | 151.72 | 7.88 | 2.61 | 0.26 | AX6110 |
| | | | | 3-6 | 51.99 | 2.91 | 0.97 | 0.13 | AX6120 |
| | | | | 6-9 | 4.58 | 0.21 | 0.21 | 0.04 | AX6130 |
| | | | | 9-12 | 1.02 | 0.05 | 0.04 | 0.00 | AX6140 |
| | | | | 12-15 | 0.71 | 0.05 | 0.11 | 0.02 | AX6150 |
| | | | | 15-18 | -0.07 | 0.04 | 0.06 | 0.02 | AX6160 |
| | | | | 18-21 | 0.15 | 0.02 | 0.21 | 0.02 | AX6170 |
| | | | | Veg | 5.66 | 0.70 | 0.27 | 0.09 | AX61VFU |
| AX6 | 2 | 91 | 2.29 | 0-0.3 | 142.33 | 11.02 | 3.32 | 0.56 | AX6200 |
| | | | | 0-0.3* | 137.81 | 14.46 | 3.47 | 0.69 | AX620P |
| | | | | 0-3 | 131.60 | 12.76 | 2.26 | 0.42 | AX6210 |
| | | | | 3-6 | 123.45 | 6.95 | 1.86 | 0.22 | AX6220 |
| | | | | 6-9 | 30.59 | 0.99 | 0.57 | 0.06 | AX6230 |
| | | | | 9-12 | 6.33 | 0.18 | 0.11 | 0.02 | AX6240 |
| | | | | 15-18 | 1.82 | 0.09 | 0.17 | 0.02 | AX6260 |
| | | | | 18-21 | 0.84 | 0.06 | 0.05 | 0.01 | AX6270 |
| AX6 | 3 | 91 | 2.29 | 0-0.3* | 153.03 | 4.65 | 2.63 | 0.14 | AX630P |
| | | | | 0-3 | 91.15 | 4.14 | 1.36 | 0.21 | AX6310 |
| | | | | 3-6 | 31.80 | 1.51 | 0.31 | 0.06 | AX6320 |
| | | | | 6-9 | 9.25 | 0.41 | 0.31 | 0.05 | AX6330 |
| | | | | 9-12 | 3.69 | 0.11 | 0.15 | 0.02 | AX6340 |
| | | | | 12-15 | 0.94 | 0.03 | 0.02 | 0.00 | AX6350 |
| | | | | 15-18 | 0.64 | 0.04 | 0.01 | 0.00 | AX6360 |
| | | | | 18-21 | 0.65 | 0.07 | 0.00 | 0.01 | AX6370 |
| | | | | Veg | 3.35 | 0.20 | 0.13 | 0.03 | AX63VFU |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| AX6 | 4 | 91 | 2.29 | 0-0.3* | 143.81 | 8.58 | 2.07 | 0.30 | AX640P |
| | | | | 0-3 | 85.27 | 5.35 | 1.54 | 0.21 | AX6410 |
| | | | | 3-6 | 11.66 | 0.49 | 0.00 | 0.16 | AX6420 |
| | | | | 6-9 | 2.93 | 0.14 | 0.10 | 0.02 | AX6430 |
| | | | | 9-12 | 1.36 | 0.06 | 0.66 | 0.04 | AX6440 |
| | | | | 9-12 | 16.35 | 0.41 | 1.06 | 0.06 | AX6440 |
| | | | | 12-15 | 0.85 | 0.06 | 0.09 | 0.02 | AX6450 |
| | | | | 15-18 | 0.49 | 0.04 | 0.11 | 0.02 | AX6460 |
| | | | | 18-21 | 0.33 | 0.05 | 0.01 | 0.01 | AX6470 |
| | | | | Veg | 5.10 | 0.62 | 0.11 | 0.05 | AX64VFU |
| BX1 | 1 | 60 | 0.79 | 0-0.3 | 176.95 | 10.31 | 3.11 | 0.26 | BX1100 |
| | | | | 0-0.3* | 177.02 | 6.89 | 2.36 | 0.56 | BX110P |
| | | | | 0-3 | 146.46 | 9.29 | 2.04 | 0.27 | BX1110 |
| | | | | 3-6 | 72.36 | 1.91 | 1.24 | 0.08 | BX1120 |
| | | | | 6-9 | 38.98 | 1.11 | 0.68 | 0.06 | BX1130 |
| | | | | 9-12 | 10.36 | 0.32 | 0.20 | 0.03 | BX1140 |
| | | | | 12-15 | 3.31 | 0.13 | 0.91 | 0.07 | BX1150 |
| | | | | 15-18 | 2.23 | 0.08 | 0.07 | 0.01 | BX1160 |
| | | | | 18-21 | 0.72 | 0.05 | 0.34 | 0.04 | BX1170 |
| | | | | Veg | 1.28 | 0.08 | 0.07 | 0.02 | BX11VFU |
| BX1 | 2 | 60 | 0.79 | 0-3 | 150.58 | 25.68 | 2.88 | 0.90 | BX1210 |
| | | | | 3-6 | 118.45 | 4.25 | 2.31 | 0.18 | BX1220 |
| | | | | 6-9 | 45.03 | 1.12 | 0.67 | 0.06 | BX1230 |
| | | | | 9-12 | 18.27 | 0.42 | 0.37 | 0.03 | BX1240 |
| | | | | 9-12 | 19.32 | 0.54 | 0.34 | 0.04 | BX1240 |
| | | | | 12-15 | 3.10 | 0.18 | 0.07 | 0.03 | BX1250 |
| | | | | 15-18 | 5.52 | 0.21 | 0.11 | 0.02 | BX1260 |
| | | | | 18-21 | 2.91 | 0.12 | 0.12 | 0.02 | BX1270 |
| | | | | Veg | 4.91 | 0.35 | 0.32 | 0.06 | BX12VFU |
| BX1 | 3 | 60 | 0.79 | 0-0.3 | 203.30 | 29.58 | 3.34 | 0.66 | BX1300 |
| | | | | 0-0.3* | 371.65 | 16.58 | 10.14 | 1.06 | BX130P |
| | | | | 0-3 | 194.82 | 15.01 | 5.19 | 1.48 | BX1310 |
| | | | | 3-6 | 27.66 | 5.84 | 0.48 | 0.36 | BX1320 |
| | | | | 6-9 | 47.63 | 4.42 | 0.83 | 0.23 | BX1330 |
| | | | | 9-12 | 37.48 | 0.92 | 0.85 | 0.05 | BX1340 |
| | | | | 12-15 | 5.51 | 0.57 | 0.79 | 0.17 | BX1350 |
| | | | | 15-18 | 16.76 | 0.49 | 0.28 | 0.04 | BX1360 |
| | | | | 18-21 | 141.97 | 10.48 | 2.24 | 0.33 | BX1370 |
| BX1 | 4 | 60 | 0.79 | 0-0.3 | 309.49 | 21.39 | 6.13 | 0.53 | BX1400 |
| | | | | 0-3 | 113.86 | 4.60 | 1.72 | 0.17 | BX1410 |
| | | | | 3-6 | 75.23 | 10.11 | 1.64 | 0.49 | BX1420 |
| | | | | 6-9 | 55.11 | 6.71 | 0.17 | 0.13 | BX1430 |
| | | | | 9-12 | 48.46 | 4.57 | 0.55 | 0.21 | BX1440 |
| | | | | 12-15 | 24.85 | 0.75 | 0.60 | 0.06 | BX1450 |
| | | | | 12-15 | 30.80 | 0.85 | 0.60 | 0.05 | BX1450 |
| | | | | 15-18 | 21.80 | 0.58 | 0.87 | 0.06 | BX1460 |
| | | | | 18-21 | 48.12 | 1.43 | 0.77 | 0.08 | BX1470 |
| | | | | Veg | 78.30 | 4.35 | 1.53 | 0.13 | BX14VFU |
| BX2 | 1 | 59 | 1.15 | 0-0.3 | 133.93 | 2.97 | 2.27 | 0.08 | BX2100 |
| | | | | 0-3 | 136.91 | 7.62 | 2.58 | 0.26 | BX2110 |
| | | | | 3-6 | 12.96 | 0.37 | 0.31 | 0.03 | BX2120 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| BX2 | 1 | 59 | 1.15 | 6-9 | 3.71 | 0.11 | 0.20 | 0.02 | BX2130 |
| | | | | 9-12 | 3.31 | 0.13 | 0.13 | 0.02 | BX2140 |
| | | | | 12-15 | 1.31 | 0.08 | 0.03 | 0.00 | BX2150 |
| | | | | 15-18 | 1.39 | 0.07 | 0.05 | 0.01 | BX2160 |
| | | | | 18-21 | 0.22 | 0.05 | 0.10 | 0.02 | BX2170 |
| | | | | Veg | 17.64 | 0.57 | 0.43 | 0.07 | BX21VFU |
| BX2 | 2 | 59 | 1.15 | 0-0.3 | 167.40 | 12.44 | 3.05 | 0.33 | BX2200 |
| | | | | 0-3 | 139.55 | 5.92 | 2.45 | 0.21 | BX2210 |
| | | | | 3-6 | 1.41 | 0.15 | 0.06 | 0.02 | BX2220 |
| | | | | 6-9 | 7.55 | 0.34 | 0.14 | 0.02 | BX2230 |
| | | | | 9-12 | 0.78 | 0.04 | 0.08 | 0.01 | BX2240 |
| | | | | 12-15 | 0.30 | 0.03 | 0.03 | 0.00 | BX2250 |
| | | | | 18-21 | 0.43 | 0.03 | 0.07 | 0.01 | BX2270 |
| BX2 | 3 | 59 | 1.15 | 0-0.3 | 142.44 | 3.28 | 2.41 | 0.09 | BX2300 |
| | | | | 0-0.3* | 48.57 | 2.21 | 0.80 | 0.19 | BX230P |
| | | | | 0-3 | 202.99 | 37.88 | 3.05 | 0.72 | BX2310 |
| | | | | 3-6 | 61.48 | 3.26 | 1.11 | 0.09 | BX2320 |
| | | | | 6-9 | 16.68 | 2.62 | 0.33 | 0.13 | BX2330 |
| | | | | 9-12 | 9.65 | 0.81 | 0.21 | 0.05 | BX2340 |
| | | | | 12-15 | 6.02 | 0.58 | 0.16 | 0.05 | BX2350 |
| | | | | 18-21 | 1.66 | 0.09 | 0.03 | 0.00 | BX2370 |
| | | | | Veg | 2.09 | 0.13 | 0.00 | 0.03 | BX23VFU |
| BX2 | 4 | 59 | 1.15 | 0-0.3 | 65.62 | 5.26 | 0.99 | 0.13 | BX2400 |
| | | | | 0-0.3* | 177.39 | 7.29 | 3.65 | 0.53 | BX240P |
| | | | | 0-3 | 112.46 | 8.21 | 1.56 | 0.17 | BX2410 |
| | | | | 3-6 | 28.65 | 4.67 | 0.35 | 0.13 | BX2420 |
| | | | | 6-9 | 17.23 | 1.45 | 0.36 | 0.07 | BX2430 |
| | | | | 9-12 | 13.67 | 0.44 | 0.36 | 0.03 | BX2440 |
| | | | | 12-15 | 7.96 | 0.78 | 0.16 | 0.05 | BX2450 |
| | | | | 15-18 | 3.53 | 0.16 | 0.07 | 0.01 | BX2460 |
| | | | | 18-21 | 3.62 | 0.13 | 0.19 | 0.02 | BX2470 |
| | | | | Veg | 26.20 | 2.26 | 0.31 | 0.08 | BX24VFU |
| BX3 | 1 | 59 | 1.68 | 0-3 | 7.16 | 1.11 | 0.14 | 0.07 | BX3110 |
| | | | | 3-6 | 11.31 | 0.34 | 0.25 | 0.02 | BX3120 |
| | | | | 9-12 | 2.39 | 0.08 | 0.14 | 0.01 | BX3140 |
| | | | | 12-15 | 0.81 | 0.14 | 0.00 | 0.02 | BX3150 |
| | | | | 15-18 | 0.65 | 0.07 | 0.10 | 0.03 | BX3160 |
| | | | | Veg | 0.45 | 0.02 | 0.08 | 0.00 | BX31VFU |
| BX3 | 2 | 59 | 1.68 | 0-0.3 | 21.47 | 1.43 | 0.35 | 0.05 | BX3200 |
| | | | | 3-6 | 16.88 | 0.78 | 0.30 | 0.03 | BX3220 |
| | | | | 6-9 | 1.89 | 0.25 | 0.11 | 0.05 | BX3230 |
| | | | | 9-12 | 1.04 | 0.05 | 0.05 | 0.00 | BX3240 |
| | | | | 12-15 | 0.40 | 0.03 | 0.02 | 0.00 | BX3250 |
| | | | | 15-18 | 0.30 | 0.03 | 0.06 | 0.02 | BX3260 |
| | | | | 18-21 | 0.22 | 0.02 | 0.03 | 0.01 | BX3270 |
| | | | | Veg | 0.04 | 0.00 | 0.02 | 0.00 | BX32VFU |
| BX3 | 3 | 59 | 1.68 | 0-0.3 | 30.97 | 1.25 | 0.59 | 0.05 | BX3300 |
| | | | | 0-0.3* | 352.74 | 32.11 | 5.82 | 1.33 | BX330P |
| | | | | 0-3 | 26.00 | 2.67 | 0.44 | 0.10 | BX3310 |
| | | | | 3-6 | 15.28 | 0.98 | 0.32 | 0.05 | BX3320 |
| | | | | 6-9 | 10.97 | 1.12 | 0.18 | 0.07 | BX3330 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{241}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{241}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| BX3 | 3 | 59 | 1.68 | 9-12 | 2.12 | 0.14 | 0.13 | 0.03 | BX3340 |
| | | | | 12-15 | 0.55 | 0.03 | 0.09 | 0.01 | BX3350 |
| | | | | Veg | 0.33 | 0.02 | 0.00 | 0.00 | BX33VFU |
| BX3 | 4 | 59 | 1.68 | 0-0.3 | 38.23 | 3.50 | 0.71 | 0.13 | BX3400 |
| | | | | 0-0.3* | 54.40 | 2.86 | 2.20 | 0.37 | BX340P |
| | | | | 0-3 | 45.83 | 7.06 | 1.05 | 0.31 | BX3410 |
| | | | | 0-3 | 20.08 | 3.13 | 0.36 | 0.15 | BX3410 |
| | | | | 3-6 | 3.30 | 0.70 | 0.15 | 0.09 | BX3420 |
| | | | | 6-9 | 7.51 | 1.16 | 0.35 | 0.13 | BX3430 |
| | | | | 9-12 | 0.89 | 0.07 | 0.02 | 0.01 | BX3440 |
| | | | | 12-15 | 0.98 | 0.07 | 0.14 | 0.02 | BX3450 |
| | | | | 15-18 | 0.38 | 0.04 | 0.14 | 0.02 | BX3460 |
| | | | | 18-21 | 0.15 | 0.03 | 0.02 | 0.00 | BX3470 |
| | | | | Veg | 0.70 | 0.04 | 0.04 | 0.00 | BX34VFU |
| BX4 | 1 | 60 | 2.26 | 0-0.3 | 7.35 | 0.89 | 0.10 | 0.05 | BX4100 |
| | | | | 0-3 | 16.84 | 1.48 | 0.32 | 0.07 | BX4110 |
| | | | | 3-6 | 5.29 | 0.26 | 0.15 | 0.02 | BX4120 |
| | | | | 6-9 | 0.66 | 0.04 | 0.02 | 0.00 | BX4130 |
| | | | | 9-12 | 0.21 | 0.03 | 0.04 | 0.03 | BX4140 |
| | | | | 12-15 | 0.12 | 0.04 | -0.00 | 0.01 | BX4150 |
| | | | | 15-18 | 0.05 | 0.01 | 0.00 | 0.00 | BX4160 |
| | | | | 18-21 | 0.04 | 0.01 | 0.03 | 0.00 | BX4170 |
| | | | | Veg | 0.87 | 0.04 | 0.10 | 0.01 | BX41VFU |
| BX4 | 2 | 60 | 2.26 | 0-0.3 | 18.28 | 0.57 | 0.55 | 0.04 | BX4200 |
| | | | | 0-0.3* | 27.36 | 2.28 | 1.48 | 0.51 | BX420P |
| | | | | 0-3 | 13.03 | 0.73 | 0.74 | 0.08 | BX4210 |
| | | | | 3-6 | 1.66 | 0.11 | 0.02 | 0.00 | BX4220 |
| | | | | 6-9 | 0.81 | 0.05 | 0.02 | 0.00 | BX4230 |
| | | | | 9-12 | 0.22 | 0.02 | 0.01 | 0.00 | BX4240 |
| | | | | 15-18 | 0.29 | 0.03 | 0.02 | 0.00 | BX4260 |
| | | | | 18-21 | 0.06 | 0.01 | 0.05 | 0.02 | BX4270 |
| | | | | Veg | 0.43 | 0.02 | 0.18 | 0.01 | BX42VFU |
| BX4 | 3 | 60 | 2.26 | 0-0.3* | 11.95 | 0.84 | 0.40 | 0.15 | BX430P |
| | | | | 0-3 | 7.21 | 0.69 | 0.20 | 0.06 | BX4310 |
| | | | | 3-6 | 3.29 | 0.08 | 0.07 | 0.00 | BX4320 |
| | | | | 9-12 | 1.35 | 0.16 | 0.04 | 0.03 | BX4340 |
| | | | | 12-15 | 0.91 | 0.07 | 0.05 | 0.01 | BX4350 |
| | | | | 15-18 | 0.19 | 0.02 | 0.13 | 0.01 | BX4360 |
| | | | | 18-21 | 0.09 | 0.02 | -0.00 | 0.00 | BX4370 |
| | | | | Veg | 1.52 | 0.05 | 0.05 | 0.00 | BX43VFU |
| BX4 | 4 | 60 | 2.26 | 0-0.3 | 18.13 | 0.94 | 0.50 | 0.07 | BX4400 |
| | | | | 0-3 | 53.33 | 3.21 | 1.09 | 0.11 | BX4410 |
| | | | | 6-9 | 3.11 | 0.44 | 0.07 | 0.04 | BX4430 |
| | | | | 9-12 | 17.78 | 5.07 | 0.34 | 0.26 | BX4440 |
| | | | | 12-15 | 0.31 | 0.05 | 0.01 | 0.01 | BX4450 |
| | | | | 15-18 | 0.47 | 0.05 | 0.04 | 0.01 | BX4460 |
| | | | | Veg | 6.40 | 0.23 | 0.21 | 0.03 | BX44VFU |
| BX5 | 1 | 58 | 2.76 | 0-0.3 | 8.63 | 0.23 | 0.17 | 0.02 | BX5100 |
| | | | | 0-0.3* | 9.09 | 2.38 | -0.09 | 0.03 | BX510P |
| | | | | 0-3 | 13.91 | 1.34 | 0.33 | 0.10 | BX5110 |
| | | | | 3-6 | 3.20 | 0.15 | -0.10 | 0.15 | BX5120 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| BX5 | 1 | 58 | 2.76 | 6-9 | 0.55 | 0.04 | 0.06 | 0.01 | BX5130 |
| | | | | 9-12 | 0.26 | 0.03 | 0.00 | 0.00 | BX5140 |
| | | | | 12-15 | 0.05 | 0.02 | 0.04 | 0.01 | BX5150 |
| | | | | 15-18 | 0.02 | 0.00 | 0.01 | 0.00 | BX5160 |
| | | | | 15-18 | 0.07 | 0.05 | -0.00 | 0.00 | BX5160 |
| | | | | 18-21 | 0.09 | 0.02 | 0.05 | 0.02 | BX5170 |
| | | | | Veg | 0.26 | 0.01 | 0.00 | 0.00 | BX51VFU |
| BX5 | 2 | 58 | 2.76 | 0-0.3 | 4.16 | 0.11 | 0.10 | 0.01 | BX5200 |
| | | | | 0-0.3* | 2.83 | 0.17 | 0.03 | 0.02 | BX520P |
| | | | | 0-3 | 4.85 | 0.18 | 0.17 | 0.03 | BX5210 |
| | | | | 3-6 | 1.88 | 0.21 | 0.05 | 0.03 | BX5220 |
| | | | | 6-9 | 0.79 | 0.11 | -0.18 | 0.15 | BX5230 |
| | | | | 9-12 | 0.35 | 0.08 | 0.12 | 0.05 | BX5240 |
| | | | | 12-15 | 0.17 | 0.02 | 0.64 | 0.05 | BX5250 |
| | | | | 15-18 | 0.08 | 0.00 | 0.00 | 0.00 | BX5260 |
| | | | | 18-21 | 0.09 | 0.05 | 0.07 | 0.02 | BX5270 |
| | | | | 18-21 | 0.16 | 0.02 | 0.02 | 0.00 | BX5270 |
| | | | | Veg | 2.24 | 0.15 | 0.25 | 0.03 | BX52VFU |
| BX5 | 3 | 58 | 2.76 | 0-0.3* | 7.56 | 0.43 | 0.15 | 0.06 | BX530P |
| | | | | 0-3 | 5.38 | 0.11 | 0.17 | 0.01 | BX5310 |
| | | | | 3-6 | 2.50 | 0.12 | 0.13 | 0.02 | BX5320 |
| | | | | 6-9 | 0.80 | 0.05 | 0.02 | 0.00 | BX5330 |
| | | | | 9-12 | 0.33 | 0.05 | 0.29 | 0.04 | BX5340 |
| | | | | 12-15 | 0.10 | 0.02 | 0.02 | 0.00 | BX5350 |
| | | | | 15-18 | 0.04 | 0.00 | 0.00 | 0.00 | BX5360 |
| | | | | 18-21 | 0.04 | 0.01 | 0.02 | 0.00 | BX5370 |
| BX5 | 4 | 58 | 2.76 | 0-0.3 | 6.96 | 0.34 | 0.11 | 0.02 | BX5400 |
| | | | | 0-0.3* | 5.88 | 0.25 | 0.12 | 0.04 | BX540P |
| | | | | 0-3 | 4.10 | 0.20 | 0.08 | 0.02 | BX5410 |
| | | | | 3-6 | 1.91 | 0.14 | 0.05 | 0.02 | BX5420 |
| | | | | 6-9 | 0.93 | 0.06 | 0.16 | 0.02 | BX5430 |
| | | | | 9-12 | 0.25 | 0.03 | 0.15 | 0.02 | BX5440 |
| | | | | 12-15 | 0.11 | 0.01 | -0.00 | 0.00 | BX5450 |
| | | | | 15-18 | -0.05 | 0.04 | 0.01 | 0.00 | BX5460 |
| | | | | 18-21 | 0.46 | 0.03 | 0.01 | 0.00 | BX5470 |
| | | | | Veg | 0.12 | 0.02 | 0.00 | 0.02 | BX54VFU |
| CX1 | 1 | 116 | 0.21 | 0-0.3 | 4287.63 | 125.44 | 82.24 | 6.53 | CX1100 |
| | | | | 0-0.3* | 5162.41 | 559.47 | 79.67 | 12.83 | CX110P |
| | | | | 0-3 | 4516.78 | 452.08 | 81.52 | 14.33 | CX1110 |
| | | | | 3-6 | 3307.27 | 158.36 | 43.83 | 4.33 | CX1120 |
| | | | | 6-9 | 2896.89 | 442.54 | 62.29 | 16.79 | CX1130 |
| | | | | 9-12 | 1771.57 | 107.45 | 27.21 | 3.13 | CX1140 |
| | | | | 12-15 | 879.80 | 28.66 | 14.32 | 1.16 | CX1150 |
| | | | | 15-18 | 261.96 | 7.05 | 4.54 | 0.47 | CX1160 |
| | | | | 18-21 | 257.22 | 13.34 | 4.85 | 0.97 | CX1170 |
| | | | | Veg | 7.66 | 0.63 | 0.11 | 0.05 | CX11VFU |
| CX1 | 2 | 116 | 0.21 | 0-0.3 | 4276.58 | 303.35 | 63.88 | 14.30 | CX1200 |
| | | | | 0-0.3* | 5360.74 | 2325.65 | 183.37 | 102.47 | CX120P |
| | | | | 0-3 | 5841.57 | 479.24 | 91.72 | 11.20 | CX1210 |
| | | | | 3-6 | 4363.71 | 476.91 | 82.08 | 13.52 | CX1220 |
| | | | | 6-9 | 1506.27 | 102.42 | 18.50 | 3.69 | CX1230 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{241}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{241}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| CX1 | 2 | 116 | 0.21 | 9-12 | 687.30 | 90.72 | 8.40 | 3.36 | CX1240 |
| | | | | 15-18 | 142.86 | 10.52 | 1.51 | 0.68 | CX1260 |
| | | | | Veg | 28.58 | 1.51 | 0.26 | 0.08 | CX12VFU |
| CX1 | 3 | 116 | 0.21 | 0-3 | 4643.40 | 561.43 | 55.14 | 13.23 | CX1310 |
| | | | | 3-6 | 4574.19 | 320.88 | 62.08 | 8.43 | CX1320 |
| | | | | 6-9 | 3140.97 | 147.95 | 53.76 | 5.09 | CX1330 |
| | | | | 9-12 | 1091.82 | 28.87 | 21.16 | 1.41 | CX1340 |
| | | | | 12-15 | 494.12 | 99.98 | 7.50 | 4.67 | CX1350 |
| | | | | 15-18 | 365.54 | 40.02 | 3.11 | 1.66 | CX1360 |
| | | | | 18-21 | 189.96 | 8.36 | 4.60 | 0.75 | CX1370 |
| CX1 | 4 | 116 | 0.21 | 0-0.3* | 7013.21 | 520.22 | 113.87 | 12.35 | CX140P |
| | | | | 0-3 | 7145.18 | 964.81 | 126.26 | 24.65 | CX1410 |
| | | | | 3-6 | 2785.59 | 571.79 | 48.77 | 19.30 | CX1420 |
| | | | | 3-6 | 4466.98 | 726.65 | 70.86 | 19.52 | CX1420 |
| | | | | 6-9 | 1602.99 | 226.00 | 31.61 | 9.34 | CX1430 |
| | | | | 9-12 | 889.21 | 54.28 | 85.22 | 7.03 | CX1440 |
| | | | | 12-15 | 412.72 | 36.17 | 5.69 | 1.89 | CX1450 |
| | | | | 15-18 | 229.77 | 44.52 | 16.42 | 6.85 | CX1460 |
| | | | | 18-21 | 227.06 | 59.08 | -0.09 | 0.02 | CX1470 |
| | | | | Veg | 448.21 | 60.24 | 6.27 | 1.10 | CX14VFU |
| CX2 | 1 | 113 | 0.32 | 0-0.3 | 1513.80 | 143.12 | 25.01 | 4.99 | CX2100 |
| | | | | 0-0.3* | 1320.21 | 98.18 | 16.96 | 3.62 | CX210P |
| | | | | 0-3 | 2761.05 | 338.81 | 45.59 | 8.01 | CX2110 |
| | | | | 6-9 | 836.25 | 42.03 | 13.48 | 1.87 | CX2130 |
| | | | | 9-12 | 336.66 | 67.26 | 8.22 | 5.18 | CX2140 |
| | | | | 9-12 | 317.34 | 63.21 | 5.20 | 4.72 | CX2140 |
| | | | | 12-15 | 145.48 | 6.39 | 2.40 | 0.35 | CX2150 |
| | | | | 15-18 | 128.97 | 5.51 | 2.79 | 0.35 | CX2160 |
| | | | | 18-21 | 28.23 | 0.69 | -0.43 | 0.15 | CX2170 |
| | | | | Veg | 6.08 | 0.32 | 0.12 | 0.04 | CX21VFU |
| CX2 | 2 | 113 | 0.32 | 0-0.3 | 2079.04 | 124.41 | 35.91 | 4.49 | CX2200 |
| | | | | 0-0.3* | 3357.51 | 434.54 | 41.36 | 8.17 | CX220P |
| | | | | 0-3 | 2042.29 | 205.12 | 36.09 | 6.78 | CX2210 |
| | | | | 3-6 | 1705.93 | 107.85 | 23.50 | 2.71 | CX2220 |
| | | | | 9-12 | 535.59 | 85.98 | 3.35 | 2.68 | CX2240 |
| | | | | 12-15 | 328.92 | 23.51 | 7.56 | 1.77 | CX2250 |
| | | | | 15-18 | 242.46 | 17.59 | 4.59 | 1.23 | CX2260 |
| | | | | 18-21 | 92.00 | 10.16 | -0.12 | 0.02 | CX2270 |
| | | | | Veg | 9.00 | 0.34 | 0.14 | 0.02 | CX22VFU |
| CX2 | 3 | 113 | 0.32 | 0-0.3* | 2093.88 | 261.58 | 28.28 | 7.16 | CX230P |
| | | | | 0-3 | 1353.47 | 102.94 | 21.18 | 1.95 | CX2310 |
| | | | | 3-6 | 1045.02 | 122.15 | 15.79 | 2.32 | CX2320 |
| | | | | 6-9 | 882.52 | 126.65 | 15.72 | 2.70 | CX2330 |
| | | | | 9-12 | 635.88 | 38.32 | 10.53 | 0.89 | CX2340 |
| | | | | 12-15 | 300.82 | 50.03 | 4.27 | 1.11 | CX2350 |
| | | | | 15-18 | 215.20 | 16.33 | 5.71 | 0.63 | CX2360 |
| | | | | 18-21 | 80.40 | 5.80 | 1.38 | 0.24 | CX2370 |
| CX2 | 4 | 113 | 0.32 | 0-0.3 | 2641.41 | 203.00 | 27.41 | 4.39 | CX2400 |
| | | | | 0-3 | 1352.77 | 54.68 | 20.92 | 2.32 | CX2410 |
| | | | | 6-9 | 786.43 | 87.80 | 14.86 | 4.08 | CX2430 |
| | | | | 9-12 | 306.27 | 17.35 | 4.91 | 0.94 | CX2440 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| CX2 | 4 | 113 | 0.32 | 12-15 | 383.22 | 41.32 | 13.00 | 3.67 | CX2450 |
| | | | | 15-18 | 90.28 | 5.10 | 1.65 | 0.45 | CX2460 |
| | | | | 18-21 | 53.31 | 14.44 | -0.12 | 0.05 | CX2470 |
| | | | | Veg | 69.96 | 29.44 | 1.05 | 0.51 | CX24VFU |
| CX3 | 1 | 124 | 0.72 | 0-0.3 | 662.85 | 33.91 | 10.56 | 0.95 | CX3100 |
| | | | | 0-0.3 | 670.33 | 32.67 | 9.88 | 0.86 | CX3100 |
| | | | | 0-3 | 895.26 | 49.49 | 13.63 | 1.20 | CX3110 |
| | | | | 0-3 | 613.59 | 40.02 | 11.10 | 1.28 | CX3110 |
| | | | | 3-6 | 420.19 | 36.82 | 2.60 | 1.55 | CX3120 |
| | | | | 6-9 | 203.54 | 12.98 | 3.48 | 1.04 | CX3130 |
| | | | | 6-9 | 217.77 | 17.33 | 0.85 | 0.92 | CX3130 |
| | | | | 9-12 | 173.89 | 5.04 | 3.38 | 0.40 | CX3140 |
| | | | | 12-15 | 19.50 | 3.54 | 0.30 | 0.35 | CX3150 |
| | | | | 15-18 | 21.91 | 0.90 | 0.43 | 0.09 | CX3160 |
| | | | | 15-18 | 15.77 | 0.99 | 0.76 | 0.16 | CX3160 |
| | | | | 18-21 | 21.58 | 0.89 | 0.32 | 0.12 | CX3170 |
| | | | | Veg | 3.91 | 1.54 | -0.08 | 0.11 | CX31VFU |
| CX3 | 2 | 124 | 0.72 | 0-0.3 | 372.49 | 23.41 | 6.04 | 0.76 | CX3200 |
| | | | | 0-0.3* | 550.27 | 22.57 | 9.18 | 0.76 | CX320P |
| | | | | 0-3 | 238.86 | 17.79 | 4.66 | 0.84 | CX3210 |
| | | | | 3-6 | 204.66 | 13.21 | 2.09 | 0.81 | CX3220 |
| | | | | 6-9 | 168.28 | 5.54 | 2.55 | 0.26 | CX3230 |
| | | | | 9-12 | 58.46 | 1.93 | 0.96 | 0.12 | CX3240 |
| | | | | 12-15 | 20.84 | 0.95 | 1.87 | 0.20 | CX3250 |
| | | | | 12-15 | 24.20 | 1.38 | 1.28 | 0.23 | CX3250 |
| | | | | 15-18 | 9.14 | 0.42 | 0.64 | 0.12 | CX3260 |
| | | | | 18-21 | 4.86 | 0.38 | 0.18 | 0.07 | CX3270 |
| | | | | Veg | 11.98 | 5.56 | 0.34 | 0.15 | CX32VFU |
| CX3 | 3 | 124 | 0.72 | 0-3 | 67.60 | 2.55 | 1.47 | 0.20 | CX3310 |
| | | | | 3-6 | 135.60 | 11.21 | 2.48 | 0.61 | CX3320 |
| | | | | 6-9 | 257.18 | 26.64 | 3.09 | 0.94 | CX3330 |
| | | | | 9-12 | 55.06 | 9.47 | 0.46 | 0.51 | CX3340 |
| | | | | 12-15 | 123.28 | 10.48 | 2.49 | 0.61 | CX3350 |
| | | | | 15-18 | 60.81 | 2.37 | 0.97 | 0.16 | CX3360 |
| | | | | Veg | 20.33 | 1.49 | 0.44 | 0.08 | CX33VFU |
| CX3 | 4 | 124 | 0.72 | 0-0.3 | 224.00 | 7.89 | 4.46 | 0.37 | CX3400 |
| | | | | 3-6 | 282.85 | 17.05 | 4.46 | 0.60 | CX3420 |
| | | | | 3-6 | 267.35 | 12.05 | 5.54 | 0.55 | CX3420 |
| | | | | 6-9 | 76.56 | 10.09 | 1.83 | 0.75 | CX3430 |
| | | | | 9-12 | 13.55 | 0.50 | 0.32 | 0.06 | CX3440 |
| | | | | 12-15 | 6.00 | 0.15 | 0.09 | 0.02 | CX3450 |
| | | | | 15-18 | 9.27 | 0.35 | 0.28 | 0.06 | CX3460 |
| | | | | 18-21 | 4.91 | 0.34 | 0.12 | 0.05 | CX3470 |
| | | | | Veg | -4.25 | 2.06 | -0.04 | 0.05 | CX34VFU |
| CX4 | 1 | 121 | 1.22 | 0-0.3 | 59.59 | 2.63 | 0.97 | 0.16 | CX4100 |
| | | | | 0-0.3* | 115.49 | 4.52 | 1.92 | 0.18 | CX410P |
| | | | | 0-3 | 59.14 | 7.26 | 1.17 | 0.27 | CX4110 |
| | | | | 3-6 | 65.26 | 3.17 | 1.15 | 0.10 | CX4120 |
| | | | | 6-9 | 12.94 | 0.35 | 0.29 | 0.03 | CX4130 |
| | | | | 9-12 | 9.17 | 0.29 | -0.05 | 0.15 | CX4140 |
| | | | | 12-15 | 3.51 | 0.13 | 0.14 | 0.02 | CX4150 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| CX4 | 1 | 121 | 1.22 | 15-18 | 2.96 | 0.20 | 0.06 | 0.02 | CX4160 |
| | | | | 18-21 | 1.66 | 0.08 | 0.03 | 0.00 | CX4170 |
| | | | | Veg | 2.77 | 0.11 | 0.08 | 0.01 | CX41VFU |
| CX4 | 2 | 121 | 1.22 | 0-0.3 | 51.59 | 2.35 | 0.68 | 0.14 | CX4200 |
| | | | | 0-0.3* | 87.66 | 2.86 | 1.24 | 0.12 | CX420P |
| | | | | 0-3 | 45.43 | 11.98 | 0.58 | 0.30 | CX4210 |
| | | | | 3-6 | 39.75 | 9.89 | 3.15 | 2.42 | CX4220 |
| | | | | 6-9 | 65.68 | 9.76 | 1.09 | 0.28 | CX4230 |
| | | | | 9-12 | 16.24 | 0.49 | 0.35 | 0.04 | CX4240 |
| | | | | 12-15 | 3.72 | 0.13 | 0.07 | 0.01 | CX4250 |
| | | | | 15-18 | 1.97 | 0.12 | 0.04 | 0.01 | CX4260 |
| | | | | 18-21 | 1.54 | 0.06 | 0.04 | 0.00 | CX4270 |
| | | | | Veg | 1.70 | 0.20 | 0.17 | 0.08 | CX42VFU |
| CX4 | 3 | 121 | 1.22 | 0-0.3 | 52.95 | 1.35 | 1.11 | 0.11 | CX4300 |
| | | | | 0-3 | 60.12 | 8.43 | 1.00 | 0.25 | CX4310 |
| | | | | 3-6 | 60.27 | 14.38 | 1.02 | 0.37 | CX4320 |
| | | | | 6-9 | 29.27 | 2.75 | 0.58 | 0.12 | CX4330 |
| | | | | 6-9 | 27.04 | 2.48 | 0.50 | 0.11 | CX4330 |
| | | | | 9-12 | 17.63 | 1.58 | 0.21 | 0.08 | CX4340 |
| | | | | 12-15 | 30.67 | 5.84 | 0.34 | 0.18 | CX4350 |
| | | | | 15-18 | 17.11 | 0.85 | 0.24 | 0.04 | CX4360 |
| | | | | Veg | 1.27 | 0.13 | 0.12 | 0.03 | CX43VFU |
| CX4 | 4 | 121 | 1.22 | 0-0.3 | 72.27 | 3.00 | 1.51 | 0.27 | CX4400 |
| | | | | 0-3 | 52.92 | 4.93 | 1.24 | 0.22 | CX4410 |
| | | | | 3-6 | 80.18 | 3.42 | 1.22 | 0.12 | CX4420 |
| | | | | 6-9 | 70.04 | 3.69 | 0.61 | 0.19 | CX4430 |
| | | | | 9-12 | 8.02 | 0.20 | 0.33 | 0.03 | CX4440 |
| | | | | 12-15 | 3.46 | 0.13 | 0.08 | 0.01 | CX4450 |
| | | | | 15-18 | 1.03 | 0.12 | -0.15 | 0.15 | CX4460 |
| | | | | 18-21 | 1.39 | 0.05 | 0.05 | 0.00 | CX4470 |
| | | | | Veg | 0.65 | 0.05 | 0.09 | 0.02 | CX44VFU |
| CX5 | 1 | 121 | 1.61 | 0-0.3 | 73.81 | 7.11 | 1.62 | 0.35 | CX5100 |
| | | | | 0-0.3* | 92.74 | 3.08 | 1.97 | 0.16 | CX510P |
| | | | | 6-9 | 7.61 | 0.20 | 0.15 | 0.01 | CX5130 |
| | | | | 9-12 | 3.58 | 0.80 | 0.00 | 0.00 | CX5140 |
| | | | | 12-15 | 1.30 | 0.21 | 0.02 | 0.03 | CX5150 |
| | | | | 15-18 | 3.73 | 0.31 | 0.04 | 0.02 | CX5160 |
| | | | | Veg | 7.65 | 0.60 | 0.30 | 0.08 | CX51VFU |
| CX5 | 2 | 121 | 1.61 | 0-0.3 | 72.85 | 2.92 | 1.92 | 0.18 | CX5200 |
| | | | | 0-0.3* | 113.07 | 3.17 | 1.60 | 0.17 | CX520P |
| | | | | 3-6 | 28.49 | 2.74 | 0.48 | 0.09 | CX5220 |
| | | | | 6-9 | 21.88 | 3.16 | 0.55 | 0.17 | CX5230 |
| | | | | 9-12 | 4.96 | 0.64 | 0.03 | 0.03 | CX5240 |
| | | | | 12-15 | 3.87 | 0.28 | 0.08 | 0.03 | CX5250 |
| | | | | 15-18 | 2.53 | 0.21 | 0.23 | 0.04 | CX5260 |
| | | | | 18-21 | 14.70 | 1.03 | 0.34 | 0.07 | CX5270 |
| CX5 | 3 | 121 | 1.61 | 0-0.3 | 96.33 | 15.09 | 1.36 | 0.63 | CX5300 |
| | | | | 0-0.3 | 62.11 | 5.22 | 0.61 | 0.23 | CX5300 |
| | | | | 0-0.3* | 114.88 | 8.91 | 2.43 | 0.53 | CX530P |
| | | | | 0-3 | 131.38 | 7.44 | 2.10 | 0.16 | CX5310 |
| | | | | 3-6 | 11.14 | 0.21 | 0.28 | 0.01 | CX5320 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{241}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{241}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| CX5 | 3 | 121 | 1.61 | 6-9 | 8.60 | 1.15 | 0.21 | 0.09 | CX5330 |
| | | | | 6-9 | 8.76 | 0.47 | 0.34 | 0.05 | CX5330 |
| | | | | 9-12 | 8.11 | 0.22 | 0.19 | 0.02 | CX5340 |
| | | | | Veg | 1.87 | 0.06 | 0.03 | 0.01 | CX53VFU |
| CX5 | 4 | 121 | 1.61 | 0-0.3 | 125.67 | 3.95 | 2.38 | 0.15 | CX5400 |
| | | | | 0-0.3* | 175.79 | 8.13 | 2.97 | 0.25 | CX540P |
| | | | | 3-6 | 37.10 | 7.83 | 0.74 | 0.32 | CX5420 |
| | | | | 6-9 | 27.99 | 4.52 | 0.19 | 0.11 | CX5430 |
| | | | | 9-12 | 10.38 | 0.74 | 0.22 | 0.05 | CX5440 |
| | | | | 12-15 | 4.47 | 0.14 | 0.10 | 0.01 | CX5450 |
| | | | | 12-15 | 3.94 | 0.15 | 0.07 | 0.01 | CX5450 |
| | | | | 18-21 | 4.47 | 0.12 | 0.09 | 0.01 | CX5470 |
| | | | | Veg | 13.49 | 0.90 | 0.22 | 0.05 | CX54VFU |
| CX6 | 1 | 120 | 2.36 | 0-0.3 | 71.61 | 3.96 | 1.24 | 0.11 | CX6100 |
| | | | | 0-3 | 56.83 | 5.82 | 0.98 | 0.17 | CX6110 |
| | | | | 3-6 | 29.88 | 3.84 | 0.50 | 0.16 | CX6120 |
| | | | | 6-9 | 11.86 | 1.34 | 0.21 | 0.08 | CX6130 |
| | | | | 9-12 | 6.14 | 0.63 | 0.62 | 0.12 | CX6140 |
| | | | | 12-15 | 1.81 | 0.10 | 0.23 | 0.03 | CX6150 |
| | | | | 15-18 | 1.36 | 0.12 | 0.11 | 0.03 | CX6160 |
| | | | | 18-21 | 0.81 | 0.13 | 0.23 | 0.06 | CX6170 |
| CX6 | 2 | 120 | 2.36 | 0-0.3 | 72.29 | 8.32 | 1.47 | 0.48 | CX6200 |
| | | | | 0-0.3* | 57.89 | 1.58 | 0.81 | 0.10 | CX620P |
| | | | | 0-3 | 60.41 | 8.41 | 1.34 | 0.27 | CX6210 |
| | | | | 3-6 | 24.71 | 2.43 | 0.46 | 0.11 | CX6220 |
| | | | | 6-9 | 5.39 | 0.86 | 0.17 | 0.10 | CX6230 |
| | | | | 9-12 | 2.42 | 0.08 | 0.17 | 0.02 | CX6240 |
| | | | | 12-15 | 0.82 | 0.05 | 0.16 | 0.02 | CX6250 |
| | | | | 15-18 | 0.82 | 0.07 | 0.34 | 0.04 | CX6260 |
| | | | | 18-21 | 0.45 | 0.04 | 0.03 | 0.01 | CX6270 |
| | | | | Veg | 0.26 | 0.06 | 0.04 | 0.01 | CX62VFU |
| CX6 | 3 | 120 | 2.36 | 0-0.3 | 52.19 | 9.00 | -0.17 | 0.04 | CX6300 |
| | | | | 0-3 | 39.63 | 1.39 | 0.79 | 0.05 | CX6310 |
| | | | | 3-6 | 20.39 | 1.57 | 0.37 | 0.07 | CX6320 |
| | | | | 6-9 | 4.96 | 0.17 | 0.35 | 0.03 | CX6330 |
| | | | | 9-12 | 1.66 | 0.22 | 0.08 | 0.04 | CX6340 |
| | | | | 9-12 | 5.46 | 0.23 | 1.14 | 0.07 | CX6340 |
| | | | | 12-15 | 0.65 | 0.03 | 1.05 | 0.04 | CX6350 |
| | | | | 15-18 | 0.31 | 0.02 | 0.18 | 0.02 | CX6360 |
| | | | | 18-21 | 0.18 | 0.02 | 0.20 | 0.02 | CX6370 |
| | | | | Veg | 0.53 | 0.04 | -0.00 | 0.01 | CX63VFU |
| CX6 | 4 | 120 | 2.36 | 3-6 | 2.04 | 0.09 | 0.04 | 0.00 | CX6420 |
| | | | | 6-9 | 16.99 | 0.61 | 0.32 | 0.03 | CX6430 |
| | | | | 9-12 | 0.89 | 0.07 | 0.05 | 0.02 | CX6440 |
| | | | | 12-15 | 0.22 | 0.03 | 0.00 | 0.00 | CX6450 |
| | | | | 15-18 | 0.38 | 0.03 | 0.35 | 0.03 | CX6460 |
| | | | | 18-21 | 0.17 | 0.00 | 0.01 | 0.00 | CX6470 |
| | | | | Veg | 0.04 | 0.00 | 0.07 | 0.00 | CX64VFU |
| CX7 | 1 | 121 | 2.76 | 0-0.3 | 3.16 | 0.23 | 0.01 | 0.04 | CX7100 |
| | | | | 0-0.3* | 3.01 | 0.22 | 0.04 | 0.03 | CX710P |
| | | | | 0-3 | 3.80 | 0.09 | 0.10 | 0.02 | CX7110 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| CX7 | 1 | 121 | 2.76 | 3-6 | 3.65 | 0.38 | 0.05 | 0.03 | CX7120 |
| | | | | 6-9 | 5.05 | 0.25 | 0.09 | 0.03 | CX7130 |
| | | | | 9-12 | 2.44 | 0.06 | 0.37 | 0.02 | CX7140 |
| | | | | 12-15 | 3.39 | 0.18 | 0.11 | 0.02 | CX7150 |
| | | | | 18-21 | 6.33 | 0.17 | 0.47 | 0.03 | CX7170 |
| | | | | Veg | 0.23 | 0.01 | 0.00 | 0.00 | CX71VFU |
| CX7 | 2 | 121 | 2.76 | 0-0.3 | 4.18 | 0.23 | 0.04 | 0.04 | CX7200 |
| | | | | 0-3 | 2.15 | 0.09 | 0.17 | 0.02 | CX7210 |
| | | | | 3-6 | 5.87 | 0.28 | 0.10 | 0.02 | CX7220 |
| | | | | 6-9 | 3.56 | 0.12 | 0.33 | 0.03 | CX7230 |
| | | | | 9-12 | 2.56 | 0.11 | 0.19 | 0.02 | CX7240 |
| | | | | Veg | 0.38 | 0.02 | 0.04 | 0.00 | CX72VFU |
| CX7 | 3 | 121 | 2.76 | 0-0.3 | 3.10 | 0.36 | -0.04 | 0.05 | CX7300 |
| | | | | 0-0.3* | 1.77 | 0.51 | -0.11 | 0.09 | CX730P |
| | | | | 0-3 | 5.39 | 0.43 | 0.14 | 0.04 | CX7310 |
| | | | | 3-6 | 3.49 | 0.18 | 0.09 | 0.02 | CX7320 |
| | | | | 6-9 | 7.05 | 0.80 | 0.12 | 0.05 | CX7330 |
| | | | | 9-12 | 5.44 | 0.21 | 0.10 | 0.01 | CX7340 |
| | | | | 12-15 | 3.68 | 0.10 | 0.52 | 0.03 | CX7350 |
| | | | | 15-18 | 16.51 | 1.04 | 0.33 | 0.06 | CX7360 |
| | | | | 18-21 | 0.63 | 0.04 | 0.18 | 0.02 | CX7370 |
| | | | | Veg | 0.38 | 0.03 | 0.06 | 0.01 | CX73VFU |
| CX7 | 4 | 121 | 2.76 | 0-0.3 | 2.28 | 0.19 | -0.05 | 0.03 | CX7400 |
| | | | | 0-0.3* | 2.15 | 0.17 | 0.03 | 0.03 | CX740P |
| | | | | 0-3 | 7.06 | 0.80 | 0.14 | 0.05 | CX7410 |
| | | | | 3-6 | 4.37 | 0.23 | 0.24 | 0.04 | CX7420 |
| | | | | 6-9 | 3.33 | 0.22 | 0.05 | 0.02 | CX7430 |
| | | | | 9-12 | 4.53 | 0.21 | 0.12 | 0.02 | CX7440 |
| | | | | 12-15 | 28.83 | 2.14 | 0.88 | 0.12 | CX7450 |
| | | | | 15-18 | 6.57 | 0.18 | 0.21 | 0.02 | CX7460 |
| | | | | Veg | 0.18 | 0.03 | 0.04 | 0.01 | CX74VFU |
| **Locations Off Rocky Flats Plant Site** | | | | | | | | | |
| DX1 | 1 | 90 | 2.76 | 0-0.3 | 66.03 | 2.53 | 1.09 | 0.07 | DX1100 |
| | | | | 0-3 | 81.28 | 5.35 | 1.50 | 0.23 | DX1110 |
| | | | | 3-6 | 30.72 | 1.36 | 0.64 | 0.08 | DX1120 |
| | | | | 6-9 | 2.45 | 0.09 | 0.03 | 0.00 | DX1130 |
| | | | | 9-12 | 1.50 | 0.09 | 0.06 | 0.02 | DX1140 |
| | | | | 12-15 | 0.56 | 0.05 | 0.00 | 0.00 | DX1150 |
| | | | | 12-15 | 0.50 | 0.04 | 0.07 | 0.02 | DX1150 |
| | | | | 15-18 | 0.32 | 0.03 | 0.06 | 0.01 | DX1160 |
| | | | | 18-21 | 0.63 | 0.04 | 0.05 | 0.01 | DX1170 |
| | | | | Veg | 4.51 | 1.79 | 0.09 | 0.06 | DX11VU |
| DX1 | 2 | 90 | 2.76 | 0-3 | 73.67 | 12.74 | 2.09 | 0.57 | DX1210 |
| | | | | 0-21 | 8.82 | 0.28 | 0.21 | 0.02 | DX12F0 |
| | | | | Veg | 2.44 | 1.00 | -0.04 | 0.02 | DX12VU |
| DX1 | 3 | 90 | 2.76 | 0-0.3 | 50.72 | 6.57 | 0.62 | 0.24 | DX1300 |
| | | | | 0-3 | 111.44 | 9.26 | 2.03 | 0.28 | DX1310 |
| | | | | 0-21 | 6.38 | 0.40 | 0.10 | 0.04 | DX13F0 |
| | | | | Veg | 7.66 | 3.62 | 0.50 | 0.21 | DX13VU |
| DX1 | 4 | 90 | 2.76 | 0-0.3 | 59.01 | 6.87 | 0.91 | 0.18 | DX1400 |
| | | | | 0-0.3* | 111.49 | 7.37 | 1.65 | 0.34 | DX140P |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| DX1 | 4 | 90 | 2.76 | 0-3 | 116.90 | 8.84 | 2.20 | 0.27 | DX1410 |
| | | | | 0-21 | 17.67 | 0.74 | 0.32 | 0.04 | DX14F0 |
| | | | | Veg | 13.48 | 5.35 | 0.25 | 0.11 | DX14VU |
| DX2 | 1 | 91 | 3.17 | 0-0.3 | 50.67 | 3.02 | 0.89 | 0.11 | DX2100 |
| | | | | 0-0.3* | 65.44 | 4.16 | 2.15 | 0.47 | DX210P |
| | | | | 0-3 | 32.09 | 3.37 | 0.60 | 0.18 | DX2110 |
| | | | | 3-6 | 5.02 | 0.18 | 0.10 | 0.02 | DX2120 |
| | | | | 6-9 | -0.07 | 0.03 | 0.05 | 0.02 | DX2130 |
| | | | | 9-12 | 0.36 | 0.03 | -0.11 | 0.02 | DX2140 |
| | | | | 15-18 | 0.28 | 0.03 | 0.02 | 0.00 | DX2160 |
| | | | | 18-21 | 0.75 | 0.05 | 0.05 | 0.01 | DX2170 |
| | | | | Veg | 2.82 | 1.18 | 0.06 | 0.03 | DX21VU |
| DX2 | 2 | 91 | 3.17 | 0-0.3 | 59.53 | 4.57 | 1.01 | 0.15 | DX2200 |
| | | | | 0-0.3* | 57.86 | 5.07 | 1.06 | 0.26 | DX220P |
| | | | | 0-3 | 41.02 | 1.27 | 0.80 | 0.06 | DX2210 |
| | | | | 0-3 | 28.03 | 2.29 | 0.49 | 0.12 | DX2210 |
| | | | | 0-21 | 7.73 | 0.25 | 0.13 | 0.03 | DX22F0 |
| | | | | Veg | 3.52 | 1.43 | 0.04 | 0.02 | DX22VU |
| DX2 | 3 | 91 | 3.17 | 0-0.3 | 54.54 | 1.95 | 0.95 | 0.06 | DX2300 |
| | | | | 0-3 | 63.26 | 3.29 | 1.00 | 0.11 | DX2310 |
| | | | | 0-21 | 5.46 | 0.16 | 0.11 | 0.01 | DX23F0 |
| | | | | Veg | 1.88 | 1.29 | 0.09 | 0.05 | DX23VU |
| DX2 | 4 | 91 | 3.17 | 0-0.3 | 41.55 | 7.90 | 0.87 | 0.30 | DX2400 |
| | | | | 0-0.3* | 74.37 | 14.01 | 0.93 | 0.56 | DX240P |
| | | | | 0-3 | 0.52 | 0.05 | 0.01 | 0.01 | DX2410 |
| | | | | 0-21 | 4.61 | 0.20 | 0.11 | 0.02 | DX24F0 |
| | | | | Veg | 3.15 | 1.27 | 0.11 | 0.05 | DX24VU |
| DX3 | 1 | 93 | 4.28 | 0-0.3 | 11.52 | 0.61 | 0.15 | 0.04 | DX3100 |
| | | | | 0-3 | 26.54 | 1.19 | 0.50 | 0.07 | DX3110 |
| | | | | 3-6 | 3.39 | 0.16 | 0.03 | 0.01 | DX3120 |
| | | | | 6-9 | 1.85 | 0.13 | -0.07 | 0.06 | DX3130 |
| | | | | 9-12 | 0.32 | 0.12 | -0.33 | 0.14 | DX3140 |
| | | | | 12-15 | 0.17 | 0.06 | 0.01 | 0.04 | DX3150 |
| | | | | 15-18 | 0.55 | 0.05 | -0.03 | 0.03 | DX3160 |
| | | | | 18-21 | 0.21 | 0.05 | -0.07 | 0.04 | DX3170 |
| | | | | Veg | 0.92 | 0.06 | 0.03 | 0.01 | DX31VU |
| DX3 | 2 | 93 | 4.28 | 0-0.3 | 39.56 | 4.66 | 0.11 | 0.12 | DX3200 |
| | | | | 0-0.3 | 68.94 | 6.62 | 0.70 | 0.20 | DX3200 |
| | | | | 0-0.3* | 60.86 | 4.09 | 0.61 | 0.34 | DX320P |
| | | | | 0-3 | 12.92 | 0.53 | 0.27 | 0.05 | DX3210 |
| | | | | 0-21 | 5.78 | 0.28 | -0.03 | 0.03 | DX32F0 |
| | | | | 0-0.3 | 21.29 | 1.98 | 0.47 | 0.11 | DX3300 |
| | | | | 0-3 | 32.13 | 6.19 | 0.35 | 0.22 | DX3310 |
| | | | | 0-21 | 4.08 | 0.35 | 0.06 | 0.03 | DX33F0 |
| | | | | Veg | 1.93 | 0.06 | 0.13 | 0.02 | DX33VU |
| DX3 | 4 | 93 | 4.28 | 0-0.3 | 20.36 | 3.02 | 0.31 | 0.13 | DX3400 |
| | | | | 0-0.3 | 21.20 | 2.02 | 0.28 | 0.09 | DX3400 |
| | | | | 0-0.3* | 45.28 | 3.23 | 0.74 | 0.26 | DX340P |
| | | | | 0-3 | 45.73 | 3.97 | 0.95 | 0.15 | DX3410 |
| | | | | 0-21 | 2.37 | 0.13 | -0.00 | 0.04 | DX34F0 |
| | | | | Veg | 3.98 | 0.14 | 0.09 | 0.02 | DX34VU |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{241}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{241}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| DX4 | 1 | 95 | 5.49 | 0-0.3* | 10.13 | 0.60 | 0.32 | 0.09 | DX410P |
| | | | | 6-9 | 0.37 | 0.04 | 0.00 | 0.00 | DX4130 |
| | | | | 9-12 | 0.00 | 0.03 | 0.03 | 0.01 | DX4140 |
| | | | | 12-15 | 0.11 | 0.01 | -0.00 | 0.00 | DX4150 |
| | | | | 15-18 | 0.06 | 0.02 | 0.05 | 0.01 | DX4160 |
| | | | | 18-21 | 0.05 | 0.01 | 0.00 | 0.00 | DX4170 |
| | | | | Veg | 1.52 | 0.63 | 0.09 | 0.04 | DX41VU |
| DX4 | 2 | 95 | 5.49 | 0-0.3 | 3.93 | 0.10 | 0.11 | 0.01 | DX4200 |
| | | | | 0-0.3* | 4.47 | 0.31 | 0.09 | 0.08 | DX420P |
| | | | | 0-3 | 5.71 | 0.19 | 0.39 | 0.03 | DX4210 |
| | | | | 0-21 | 0.85 | 0.05 | 0.23 | 0.02 | DX42F0 |
| | | | | Veg | 1.14 | 0.44 | 0.02 | 0.03 | DX42VU |
| DX4 | 3 | 95 | 5.49 | 0-3 | 8.58 | 0.31 | 0.24 | 0.02 | DX4310 |
| | | | | 0-21 | 3.10 | 0.19 | 0.05 | 0.02 | DX43F0 |
| | | | | Veg | 0.60 | 0.34 | 0.02 | 0.02 | DX43VU |
| DX4 | 4 | 95 | 5.49 | 0-0.3 | 4.81 | 0.17 | 0.09 | 0.01 | DX4400 |
| | | | | 0-3 | 6.85 | 0.09 | 0.18 | 0.00 | DX4410 |
| | | | | 0-3 | 8.18 | 0.30 | 0.04 | 0.03 | DX4410 |
| | | | | 0-21 | 1.22 | 0.06 | -0.10 | 0.02 | DX44F0 |
| | | | | Veg | 1.17 | 0.52 | 0.07 | 0.04 | DX44VU |
| DX5 | 1 | 96 | 10.55 | 0-0.3 | 1.76 | 0.07 | 0.06 | 0.01 | DX5100 |
| | | | | 0-0.3* | 9.53 | 0.56 | 0.24 | 0.04 | DX510P |
| | | | | 0-3 | 2.38 | 0.10 | 0.19 | 0.03 | DX5110 |
| | | | | 6-9 | 0.16 | 0.03 | -0.08 | 0.02 | DX5130 |
| | | | | 12-15 | 0.09 | 0.02 | -0.00 | 0.01 | DX5150 |
| | | | | 18-21 | -0.21 | 0.04 | -0.00 | 0.03 | DX5170 |
| | | | | Veg | 0.17 | 0.02 | 0.05 | 0.01 | DX51VU |
| DX5 | 2 | 96 | 10.55 | 0-0.3 | 1.06 | 0.08 | -0.10 | 0.06 | DX5200 |
| | | | | 0-0.3* | 5.36 | 0.66 | 0.37 | 0.13 | DX520P |
| | | | | 0-3 | 2.45 | 0.07 | 0.05 | 0.01 | DX5210 |
| | | | | 0-21 | 0.29 | 0.02 | 0.07 | 0.01 | DX52F0 |
| | | | | Veg | 0.20 | 0.02 | 0.05 | 0.01 | DX52VU |
| DX5 | 3 | 96 | 10.55 | 0-0.3 | 1.99 | 0.10 | 0.10 | 0.02 | DX5300 |
| | | | | 0-0.3* | 4.13 | 0.20 | -0.23 | 0.12 | DX530P |
| | | | | 0-3 | 1.85 | 0.09 | 0.08 | 0.01 | DX5310 |
| | | | | 0-21 | 0.50 | 0.04 | 0.04 | 0.01 | DX53F0 |
| | | | | Veg | 0.09 | 0.01 | 0.04 | 0.01 | DX53VU |
| DX5 | 4 | 96 | 10.55 | 0-0.3 | 2.33 | 0.12 | 0.07 | 0.02 | DX5400 |
| | | | | 0-0.3* | 4.34 | 0.21 | 0.09 | 0.13 | DX540P |
| | | | | 0-3 | 2.85 | 0.12 | -0.06 | 0.06 | DX5410 |
| | | | | 0-21 | 0.48 | 0.06 | -0.11 | 0.06 | DX54F0 |
| | | | | Veg | 0.02 | 0.00 | 0.10 | 0.01 | DX54VU |
| DX6 | 1 | 96 | 18.97 | 0-0.3 | 1.49 | 0.04 | 0.25 | 0.01 | DX6100 |
| | | | | 0-0.3* | 1.91 | 0.10 | 0.18 | 0.03 | DX610P |
| | | | | 0-3 | 1.25 | 0.07 | 0.15 | 0.02 | DX6110 |
| | | | | 6-9 | 0.07 | 0.00 | 0.34 | 0.02 | DX6130 |
| | | | | 12-15 | 0.02 | 0.00 | 0.67 | 0.03 | DX6150 |
| | | | | 18-21 | 0.00 | 0.00 | 0.32 | 0.03 | DX6170 |
| | | | | Veg | 0.19 | 0.02 | 0.18 | 0.02 | DX61VU |
| DX6 | 2 | 96 | 18.97 | 0-0.3 | 1.56 | 0.06 | 0.12 | 0.01 | DX6200 |
| | | | | 0-0.3* | 2.03 | 0.13 | 0.17 | 0.03 | DX620P |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| DX6 | 2 | 96 | 18.97 | 0-3 | 2.09 | 0.09 | 0.22 | 0.02 | DX6210 |
| | | | | 0-21 | 0.88 | 0.07 | 0.08 | 0.02 | DX62F0 |
| | | | | Veg | 0.38 | 0.03 | 0.10 | 0.02 | DX62VU |
| DX6 | 3 | 96 | 18.97 | 0-0.3 | 1.37 | 0.06 | 0.38 | 0.03 | DX6300 |
| | | | | 0-0.3 | 1.33 | 0.03 | 0.41 | 0.01 | DX6300 |
| | | | | 0-0.3* | 1.29 | 0.10 | 0.26 | 0.04 | DX630P |
| | | | | 0-3 | 1.22 | 0.05 | 0.15 | 0.01 | DX6310 |
| | | | | Veg | 0.18 | 0.00 | 0.02 | 0.00 | DX63VU |
| DX6 | 4 | 96 | 18.97 | 0-0.3 | 1.53 | 0.06 | 0.12 | 0.01 | DX6400 |
| | | | | 0-0.3* | 1.42 | 0.08 | 0.07 | 0.02 | DX640P |
| | | | | 0-3 | 2.15 | 0.13 | 0.21 | 0.03 | DX6410 |
| | | | | 0-21 | 0.47 | 0.04 | 0.06 | 0.02 | DX64F0 |
| | | | | Veg | 0.37 | 0.03 | 0.04 | 0.01 | DX64VU |
| EX1 | 1 | 61 | 3.35 | 0-0.3 | 2.74 | 0.11 | 0.05 | 0.03 | EX1100 |
| | | | | 0-0.3* | -0.57 | 0.31 | -0.72 | 0.19 | EX110P |
| | | | | 0-3 | 1.78 | 0.31 | 0.41 | 0.11 | EX1110 |
| | | | | 6-9 | 2.20 | 0.08 | 0.98 | 0.05 | EX1130 |
| | | | | 9-12 | 2.20 | 0.16 | 0.02 | 0.04 | EX1140 |
| | | | | 12-15 | 3.22 | 0.35 | 0.06 | 0.04 | EX1150 |
| | | | | 18-21 | 0.98 | 0.06 | -0.00 | 0.02 | EX1170 |
| | | | | Veg | 0.10 | 0.03 | -0.05 | 0.03 | EX11VU |
| EX1 | 2 | 61 | 3.35 | 0-0.3 | 2.89 | 0.12 | 0.02 | 0.03 | EX1200 |
| | | | | 0-0.3 | 2.65 | 0.21 | -0.03 | 0.03 | EX1200 |
| | | | | 0-0.3* | 2.12 | 0.16 | -0.05 | 0.08 | EX120P |
| | | | | 0-3 | 2.04 | 0.10 | -0.04 | 0.03 | EX1210 |
| | | | | 0-3 | 1.93 | 0.09 | -0.04 | 0.03 | EX1210 |
| | | | | Veg | 0.00 | 0.03 | -0.07 | 0.03 | EX12VU |
| EX1 | 3 | 61 | 3.35 | 0-0.3 | 2.53 | 0.12 | 0.07 | 0.02 | EX1300 |
| | | | | 0-0.3* | 0.71 | 0.30 | -0.43 | 0.17 | EX130P |
| | | | | 0-3 | 2.12 | 0.10 | 0.05 | 0.03 | EX1310 |
| | | | | 0-21 | 2.25 | 0.09 | 0.04 | 0.02 | EX13F0 |
| | | | | Veg | 0.18 | 0.02 | -0.03 | 0.02 | EX13VU |
| EX1 | 4 | 61 | 3.35 | 0-0.3 | 2.35 | 0.15 | -0.03 | 0.03 | EX1400 |
| | | | | 0-0.3* | 2.33 | 0.20 | 0.14 | 0.04 | EX140P |
| | | | | 0-3 | 1.52 | 0.13 | 0.03 | 0.04 | EX1410 |
| | | | | 0-21 | 1.65 | 0.08 | 0.19 | 0.03 | EX14F0 |
| | | | | Veg | -0.02 | 0.03 | -0.07 | 0.03 | EX14VU |
| EX2 | 1 | 61 | 4.14 | 0-0.3 | 5.83 | 0.22 | -0.03 | 0.05 | EX2100 |
| | | | | 0-0.3* | 6.29 | 0.18 | 0.16 | 0.05 | EX210P |
| | | | | 0-3 | 6.67 | 0.23 | 0.14 | 0.04 | EX2110 |
| | | | | 3-6 | 1.44 | 0.06 | 0.07 | 0.01 | EX2120 |
| | | | | 6-9 | 0.30 | 0.04 | -0.04 | 0.03 | EX2130 |
| | | | | 9-12 | 0.11 | 0.05 | 0.00 | 0.04 | EX2140 |
| | | | | 12-15 | 0.11 | 0.02 | -0.10 | 0.03 | EX2150 |
| | | | | 15-18 | -0.00 | 0.03 | -0.00 | 0.03 | EX2160 |
| | | | | 18-21 | -0.04 | 0.04 | -0.11 | 0.05 | EX2170 |
| | | | | Veg | 0.63 | 0.04 | -0.03 | 0.02 | EX21VU |
| EX2 | 2 | 61 | 4.14 | 0-0.3 | 5.87 | 0.33 | 0.09 | 0.03 | EX2200 |
| | | | | 0-0.3* | 4.54 | 0.25 | 0.37 | 0.08 | EX220P |
| | | | | 0-3 | 7.25 | 0.20 | 0.17 | 0.02 | EX2210 |
| | | | | 0-21 | 2.27 | 0.05 | 0.04 | 0.01 | EX22F0 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| EX2 | 3 | 61 | 4.14 | Veg | 0.42 | 0.03 | -0.05 | 0.02 | EX22VU |
| | | | | 0-0.3 | 4.83 | 0.46 | -0.04 | 0.05 | EX2300 |
| | | | | 0-0.3* | 1.63 | 0.32 | -0.49 | 0.16 | EX230P |
| | | | | 0-3 | 9.19 | 0.48 | 0.24 | 0.04 | EX2310 |
| | | | | 0-21 | 1.81 | 0.33 | -0.08 | 0.04 | EX23F0 |
| | | | | Veg | 0.40 | 0.03 | -0.00 | 0.00 | EX23VU |
| EX2 | 4 | 61 | 4.14 | 0-0.3 | 5.56 | 0.55 | 0.08 | 0.05 | EX2400 |
| | | | | 0-0.3* | 3.78 | 0.21 | 0.51 | 0.09 | EX240P |
| | | | | 0-3 | 12.52 | 0.54 | 0.17 | 0.04 | EX2410 |
| | | | | 0-21 | 1.46 | 0.07 | -0.06 | 0.03 | EX24F0 |
| | | | | Veg | 0.52 | 0.02 | 0.03 | 0.00 | EX24VU |
| EX3 | 1 | 59 | 4.66 | 0-0.3 | 4.57 | 0.16 | 0.04 | 0.03 | EX3100 |
| | | | | 0-0.3* | 5.39 | 0.26 | -0.72 | 0.17 | EX310P |
| | | | | 0-3 | 4.33 | 0.29 | 0.11 | 0.04 | EX3110 |
| | | | | 6-9 | -0.10 | 0.04 | -0.01 | 0.03 | EX3130 |
| | | | | 12-15 | -0.06 | 0.04 | -0.05 | 0.03 | EX3150 |
| | | | | 18-21 | -0.15 | 0.10 | -0.42 | 0.13 | EX3170 |
| | | | | Veg | 0.16 | 0.02 | -0.02 | 0.01 | EX31VU |
| EX3 | 2 | 59 | 4.66 | 0-0.3 | 3.33 | 0.13 | -0.20 | 0.09 | EX3200 |
| | | | | 0-0.3 | 3.45 | 0.12 | -0.19 | 0.09 | EX3200 |
| | | | | 0-3 | 15.36 | 0.79 | 0.13 | 0.07 | EX3210 |
| | | | | 0-21 | 0.79 | 0.05 | 0.00 | 0.02 | EX32F0 |
| EX3 | 3 | 59 | 4.66 | 0-0.3 | 4.72 | 0.20 | 0.02 | 0.03 | EX3300 |
| | | | | 0-0.3* | 1.64 | 0.34 | -0.55 | 0.18 | EX330P |
| | | | | 0-21 | 0.57 | 0.04 | 0.06 | 0.01 | EX33F0 |
| | | | | Veg | 0.19 | 0.02 | -0.00 | 0.01 | EX33VU |
| EX3 | 4 | 59 | 4.66 | 0-0.3 | 4.92 | 0.21 | 0.00 | 0.06 | EX3400 |
| | | | | 0-0.3* | 3.56 | 0.34 | -0.62 | 0.18 | EX340P |
| | | | | 0-21 | 0.80 | 0.05 | -0.01 | 0.03 | EX34F0 |
| | | | | Veg | 0.36 | 0.02 | 0.00 | 0.00 | EX34VU |
| EX4 | 1 | 63 | 6.82 | 0-0.3 | 10.14 | 0.52 | 0.13 | 0.04 | EX4100 |
| | | | | 0-0.3* | 7.12 | 0.37 | -0.04 | 0.09 | EX410P |
| | | | | 0-3 | 3.10 | 0.17 | 0.03 | 0.04 | EX4110 |
| | | | | 3-6 | 0.07 | 0.05 | -0.14 | 0.05 | EX4120 |
| | | | | 6-9 | 3.46 | 0.10 | 0.10 | 0.02 | EX4130 |
| | | | | 9-12 | -0.02 | 0.04 | 0.00 | 0.03 | EX4140 |
| | | | | 12-15 | -0.05 | 0.04 | -0.13 | 0.06 | EX4150 |
| | | | | 15-18 | -0.05 | 0.03 | -0.00 | 0.03 | EX4160 |
| | | | | 18-21 | 0.02 | 0.00 | -0.05 | 0.01 | EX4170 |
| EX4 | 2 | 63 | 6.82 | 0-0.3 | 4.31 | 0.36 | 0.16 | 0.04 | EX4200 |
| | | | | 0-0.3* | 6.59 | 0.32 | -0.04 | 0.13 | EX420P |
| | | | | 0-3 | 5.02 | 0.60 | 0.06 | 0.08 | EX4210 |
| | | | | 0-21 | 0.95 | 0.04 | 0.04 | 0.02 | EX42F0 |
| | | | | Veg | 0.97 | 0.30 | 1.29 | 0.37 | EX42VU |
| EX4 | 3 | 63 | 6.82 | 0-0.3 | 14.50 | 1.13 | 0.30 | 0.06 | EX4300 |
| | | | | 0-0.3* | 8.11 | 0.36 | 0.34 | 0.07 | EX430P |
| | | | | 0-3 | 0.08 | 0.01 | 0.04 | 0.01 | EX4310 |
| | | | | 0-3 | 0.06 | 0.01 | -0.06 | 0.01 | EX4310 |
| | | | | 0-21 | 1.80 | 0.07 | 0.07 | 0.01 | EX43F0 |
| EX4 | 4 | 63 | 6.82 | 0-0.3 | 6.32 | 0.25 | 0.11 | 0.02 | EX4400 |
| | | | | 0-3 | 6.53 | 0.33 | 0.17 | 0.03 | EX4410 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| EX4 | 4 | 63 | 6.82 | 0-21 | 0.88 | 0.05 | -0.08 | 0.04 | EX44F0 |
| | | | | Veg | 0.42 | 0.04 | 0.00 | 0.00 | EX44VU |
| EX5 | 1 | 55 | 12.6 | 0-0.3 | 0.76 | 0.06 | 0.06 | 0.02 | EX5100 |
| | | | | 0-3 | 1.22 | 0.07 | 0.05 | 0.01 | EX5110 |
| | | | | 6-9 | 0.11 | 0.01 | 0.02 | 0.00 | EX5130 |
| | | | | 12-15 | 0.01 | 0.00 | 0.00 | 0.00 | EX5150 |
| | | | | 18-21 | -0.11 | 0.05 | -0.30 | 0.08 | EX5170 |
| | | | | Veg | 0.43 | 0.03 | 0.02 | 0.01 | EX51VU |
| EX5 | 2 | 55 | 12.6 | 0-0.3 | 0.60 | 0.09 | -0.26 | 0.09 | EX5200 |
| | | | | 0-0.3* | 1.27 | 0.08 | 0.09 | 0.02 | EX520P |
| | | | | 0-3 | 0.19 | 0.06 | -0.24 | 0.09 | EX5210 |
| | | | | 0-21 | 0.11 | 0.02 | 0.00 | 0.02 | EX52F0 |
| EX5 | 3 | 55 | 12.6 | 0-0.3 | 0.79 | 0.08 | -0.24 | 0.09 | EX5300 |
| | | | | 0-0.3 | 1.24 | 0.07 | 0.05 | 0.01 | EX5300 |
| | | | | 0-0.3* | 1.88 | 0.06 | 0.12 | 0.02 | EX530P |
| | | | | 0-3 | 1.01 | 0.08 | 0.05 | 0.02 | EX5310 |
| | | | | 0-3 | 1.41 | 0.04 | 0.06 | 0.00 | EX5310 |
| | | | | 0-21 | 0.05 | 0.06 | -0.31 | 0.08 | EX53F0 |
| | | | | Veg | 0.33 | 0.02 | 0.03 | 0.02 | EX53VU |
| EX5 | 4 | 55 | 12.6 | 0-0.3 | 0.73 | 0.04 | 0.03 | 0.01 | EX5400 |
| | | | | 0-0.3* | 1.59 | 0.11 | -0.24 | 0.09 | EX540P |
| | | | | 0-21 | 0.03 | 0.01 | 0.04 | 0.02 | EX54F0 |
| | | | | Veg | 0.22 | 0.02 | 0.01 | 0.01 | EX54VU |
| EX6 | 1 | 56 | 17.36 | 0-0.3 | 2.51 | 0.08 | 0.29 | 0.02 | EX6100 |
| | | | | 6-9 | 0.26 | 0.02 | 0.03 | 0.01 | EX6130 |
| | | | | 12-15 | 0.03 | 0.00 | 0.03 | 0.01 | EX6150 |
| | | | | 15-18 | -0.02 | 0.02 | 0.00 | 0.00 | EX6160 |
| | | | | 18-21 | 0.03 | 0.00 | 0.24 | 0.03 | EX6170 |
| | | | | Veg | 0.98 | 0.02 | 0.31 | 0.00 | EX61VU |
| EX6 | 2 | 56 | 17.36 | 0-0.3 | 2.37 | 0.08 | 0.13 | 0.01 | EX6200 |
| | | | | 0-0.3* | 3.05 | 0.20 | 0.15 | 0.04 | EX620P |
| | | | | 0-3 | 3.27 | 0.33 | 0.10 | 0.04 | EX6210 |
| | | | | 0-3 | 3.06 | 0.09 | 0.21 | 0.02 | EX6210 |
| | | | | Veg | -1.81 | 0.19 | 0.06 | 0.02 | EX62VU |
| EX6 | 3 | 56 | 17.36 | 0-0.3 | 2.35 | 0.26 | 0.10 | 0.04 | EX6300 |
| | | | | 0-0.3* | 1.75 | 0.26 | 0.16 | 0.04 | EX630P |
| | | | | 0-3 | 4.88 | 0.11 | 0.16 | 0.01 | EX6310 |
| | | | | Veg | 0.35 | 0.25 | 0.03 | 0.02 | EX63VU |
| EX6 | 4 | 56 | 17.36 | 0-0.3 | 2.93 | 0.15 | 0.18 | 0.03 | EX6400 |
| | | | | 0-3 | 2.84 | 0.14 | 0.33 | 0.03 | EX6410 |
| | | | | 0-21 | 0.73 | 0.19 | 0.23 | 0.10 | EX64F0 |
| | | | | Veg | 1.46 | 0.04 | 0.12 | 0.00 | EX64VU |
| FX1 | 1 | 119 | 3.04 | 0-0.3 | 20.01 | 1.07 | 0.36 | 0.05 | FX1100 |
| | | | | 0-0.3* | 29.97 | 1.56 | 0.66 | 0.16 | FX110P |
| | | | | 0-3 | 22.42 | 1.13 | 0.42 | 0.05 | FX1110 |
| | | | | 3-6 | 3.47 | 0.17 | 0.10 | 0.03 | FX1120 |
| | | | | 6-9 | 8.57 | 2.12 | 0.24 | 0.21 | FX1130 |
| | | | | 9-12 | 2.01 | 0.06 | 0.06 | 0.00 | FX1140 |
| | | | | 12-15 | 1.42 | 0.12 | -0.01 | 0.02 | FX1150 |
| | | | | 15-18 | 0.81 | 0.05 | -0.00 | 0.02 | FX1160 |
| | | | | 18-21 | 0.66 | 0.03 | 0.02 | 0.00 | FX1170 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| FX1 | 2 | 119 | 3.04 | Veg | 2.43 | 1.64 | 0.16 | 0.07 | FX11VU |
| | | | | 0-0.3* | 28.68 | 1.28 | 0.58 | 0.12 | FX120P |
| | | | | 0-3 | 12.43 | 0.55 | 0.28 | 0.04 | FX1210 |
| | | | | 0-21 | 4.17 | 0.35 | 0.11 | 0.04 | FX12F0 |
| | | | | 0-21 | 3.44 | 0.18 | 0.07 | 0.03 | FX12F0 |
| | | | | Veg | 6.00 | 2.42 | 0.12 | 0.06 | FX12VU |
| FX1 | 3 | 119 | 3.04 | 0-0.3 | 18.13 | 1.10 | 0.37 | 0.06 | FX1300 |
| | | | | 0-0.3* | 28.55 | 1.35 | 0.53 | 0.08 | FX130P |
| | | | | 0-3 | 21.93 | 3.49 | 0.57 | 0.18 | FX1310 |
| | | | | 0-21 | 3.03 | 0.28 | 0.09 | 0.03 | FX13F0 |
| | | | | Veg | 4.64 | 2.43 | 0.17 | 0.08 | FX13VU |
| FX1 | 4 | 119 | 3.04 | 0-0.3 | 20.28 | 2.29 | 0.36 | 0.11 | FX1400 |
| | | | | 0-3 | 16.60 | 2.57 | 0.13 | 0.08 | FX1410 |
| | | | | 0-21 | 12.36 | 0.28 | 0.10 | 0.01 | FX14F0 |
| | | | | Veg | 1.60 | 1.39 | 0.84 | 0.34 | FX14VU |
| FX2 | 1 | 118 | 3.66 | 0-0.3 | 18.43 | 0.66 | 0.27 | 0.05 | FX2100 |
| | | | | 0-3 | 23.53 | 1.01 | 0.45 | 0.07 | FX2110 |
| | | | | 3-6 | 2.13 | 0.13 | -0.11 | 0.06 | FX2120 |
| | | | | 6-9 | 0.73 | 0.05 | 0.09 | 0.02 | FX2130 |
| | | | | 9-12 | 0.32 | 0.03 | 0.19 | 0.02 | FX2140 |
| | | | | 12-15 | 0.25 | 0.02 | -0.05 | 0.01 | FX2150 |
| | | | | 15-18 | 0.49 | 0.03 | 0.03 | 0.00 | FX2160 |
| | | | | 18-21 | 0.39 | 0.05 | -0.11 | 0.04 | FX2170 |
| FX2 | 2 | 118 | 3.66 | 0-0.3 | 13.96 | 1.90 | 0.07 | 0.07 | FX2200 |
| | | | | 0-3 | 49.95 | 2.84 | 0.86 | 0.10 | FX2210 |
| | | | | 0-21 | 1.75 | 0.22 | -0.08 | 0.05 | FX22F0 |
| FX2 | 3 | 118 | 3.66 | 0-0.3 | 12.94 | 0.65 | 0.24 | 0.04 | FX2300 |
| | | | | 0-0.3* | 15.12 | 0.58 | 0.52 | 0.10 | FX230P |
| | | | | 0-3 | 28.43 | 0.97 | 0.59 | 0.07 | FX2310 |
| FX2 | 4 | 118 | 3.66 | 0-0.3 | 24.85 | 1.27 | 0.80 | 0.08 | FX2400 |
| | | | | 0-3 | 17.42 | 2.82 | 0.44 | 0.18 | FX2410 |
| | | | | 0-21 | 3.05 | 0.10 | -0.07 | 0.06 | FX24F0 |
| | | | | Veg | 2.26 | 0.21 | 0.09 | 0.00 | FX24VU |
| FX3 | 1 | 118 | 4.99 | 0-0.3 | 15.48 | 1.24 | 0.23 | 0.06 | FX3100 |
| | | | | 0-0.3* | 9.57 | 0.45 | -0.02 | 0.14 | FX310P |
| | | | | 0-3 | 11.92 | 1.44 | 0.07 | 0.07 | FX3110 |
| | | | | 6-9 | 0.92 | 0.07 | -0.02 | 0.02 | FX3130 |
| | | | | 9-12 | 0.79 | 0.04 | -0.02 | 0.03 | FX3140 |
| | | | | 12-15 | 0.36 | 0.02 | -0.01 | 0.01 | FX3150 |
| | | | | 18-21 | 0.08 | 0.02 | -0.07 | 0.03 | FX3170 |
| | | | | Veg | 0.11 | 0.01 | 0.00 | 0.00 | FX31VU |
| FX3 | 2 | 118 | 4.99 | 0-0.3 | 8.21 | 0.17 | 0.06 | 0.04 | FX3200 |
| | | | | 0-3 | 11.46 | 0.32 | 0.21 | 0.03 | FX3210 |
| | | | | 0-21 | 2.25 | 0.10 | -0.03 | 0.03 | FX32F0 |
| | | | | Veg | 1.15 | 0.07 | 0.03 | 0.01 | FX32VU |
| FX3 | 3 | 118 | 4.99 | 0-0.3 | 4.24 | 0.61 | -0.03 | 0.05 | FX3300 |
| | | | | 0-0.3* | 15.11 | 0.31 | 0.46 | 0.06 | FX330P |
| | | | | 0-3 | 0.22 | 0.02 | 0.00 | 0.00 | FX3310 |
| | | | | 0-21 | 0.68 | 0.03 | 0.00 | 0.01 | FX33F0 |
| FX3 | 4 | 118 | 4.99 | 0-0.3 | 9.43 | 0.22 | 0.13 | 0.02 | FX3400 |
| | | | | 0-3 | 7.04 | 0.41 | 0.07 | 0.04 | FX3410 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| FX3 | 4 | 118 | 4.99 | 0-21 | 0.99 | 0.05 | -0.07 | 0.03 | FX34F0 |
| | | | | Veg | 0.20 | 0.02 | 0.01 | 0.00 | FX34VU |
| FX4 | 1 | 121 | 7.19 | 0-0.3 | 0.83 | 0.03 | 0.00 | 0.01 | FX4100 |
| | | | | 0-0.3* | 1.74 | 0.15 | -0.04 | 0.08 | FX410P |
| | | | | 0-3 | 0.74 | 0.05 | -0.05 | 0.03 | FX4110 |
| | | | | 0-3 | 0.76 | 0.04 | -0.07 | 0.03 | FX4110 |
| | | | | 3-6 | 0.52 | 0.06 | -0.13 | 0.05 | FX4120 |
| | | | | 6-9 | 0.52 | 0.09 | -0.11 | 0.06 | FX4130 |
| | | | | 9-12 | 0.17 | 0.05 | -0.13 | 0.05 | FX4140 |
| | | | | 12-15 | 0.14 | 0.02 | -0.09 | 0.03 | FX4150 |
| | | | | 15-18 | 0.02 | 0.04 | -0.16 | 0.05 | FX4160 |
| | | | | 18-21 | 0.45 | 0.03 | 0.18 | 0.02 | FX4170 |
| | | | | Veg | 0.05 | 0.00 | 0.06 | 0.00 | FX41VU |
| FX4 | 2 | 121 | 7.19 | 0-0.3 | 0.67 | 0.04 | -0.07 | 0.03 | FX4200 |
| | | | | 0-0.3* | 1.16 | 0.10 | 0.30 | 0.07 | FX420P |
| | | | | 0-3 | 1.71 | 0.09 | -0.00 | 0.03 | FX4210 |
| | | | | 0-21 | 0.62 | 0.04 | -0.02 | 0.03 | FX42F0 |
| | | | | 0-21 | 0.54 | 0.04 | -0.08 | 0.03 | FX42F0 |
| FX4 | 3 | 121 | 7.19 | 0-0.3 | 0.76 | 0.04 | 0.14 | 0.02 | FX4300 |
| | | | | 0-0.3* | 0.85 | 0.08 | 0.16 | 0.04 | FX430P |
| | | | | 0-3 | 1.19 | 0.05 | -0.00 | 0.01 | FX4310 |
| | | | | Veg | 0.05 | 0.00 | 0.04 | 0.00 | FX43VU |
| FX4 | 4 | 121 | 7.19 | 0-0.3 | 1.17 | 0.05 | 0.94 | 0.05 | FX4400 |
| | | | | 0-0.3* | 1.47 | 0.36 | -0.44 | 0.18 | FX440P |
| | | | | 0-3 | 0.59 | 0.03 | -0.09 | 0.03 | FX4410 |
| | | | | Veg | 0.05 | 0.00 | 0.09 | 0.00 | FX44VU |
| FX5 | 1 | 127 | 9.46 | 0-0.3 | 0.89 | 0.04 | 0.15 | 0.02 | FX5100 |
| | | | | 0-0.3* | 0.99 | 0.07 | -0.39 | 0.12 | FX510P |
| | | | | 0-3 | 0.93 | 0.05 | -0.03 | 0.02 | FX5110 |
| | | | | 3-6 | 2.75 | 0.11 | 0.06 | 0.03 | FX5120 |
| | | | | 6-9 | 0.56 | 0.05 | -0.08 | 0.04 | FX5130 |
| | | | | 12-15 | -0.02 | 0.11 | -0.37 | 0.14 | FX5150 |
| | | | | 12-15 | 0.05 | 0.11 | -0.39 | 0.13 | FX5150 |
| | | | | 18-21 | -0.02 | 0.04 | -0.09 | 0.04 | FX5170 |
| | | | | 18-21 | -0.02 | 0.04 | -0.08 | 0.04 | FX5170 |
| FX5 | 2 | 127 | 9.46 | 0-0.3 | 0.44 | 0.08 | 0.03 | 0.03 | FX5200 |
| | | | | 0-0.3* | 1.40 | 0.11 | -0.62 | 0.17 | FX520P |
| | | | | 0-3 | 0.77 | 0.05 | -0.08 | 0.04 | FX5210 |
| | | | | 0-21 | 0.31 | 0.04 | -0.10 | 0.04 | FX52F0 |
| FX5 | 3 | 127 | 9.46 | 0-0.3 | 78.48 | 7.10 | 2.48 | 0.44 | FX5300 |
| | | | | 0-3 | 1.14 | 0.05 | 0.06 | 0.01 | FX5310 |
| | | | | 0-3 | 1.12 | 0.05 | 0.05 | 0.01 | FX5310 |
| | | | | 0-21 | 0.69 | 0.07 | 0.09 | 0.02 | FX53F0 |
| | | | | Veg | -0.00 | 0.00 | -0.01 | 0.02 | FX53VU |
| | | | | Veg | 0.08 | 0.01 | 0.08 | 0.02 | FX53VU |
| FX5 | 4 | 127 | 9.46 | 0-0.3 | 1.10 | 0.06 | -0.01 | 0.02 | FX5400 |
| | | | | 0-0.3* | 0.94 | 0.11 | -0.30 | 0.12 | FX540P |
| | | | | 0-3 | 2.34 | 0.13 | 0.02 | 0.02 | FX5410 |
| | | | | 0-21 | 0.81 | 0.09 | -0.02 | 0.04 | FX54F0 |
| FX6 | 1 | 114 | 18.35 | 0-0.3 | 0.14 | 0.03 | 0.01 | 0.00 | FX6100 |
| | | | | 0-0.3* | -1.22 | 0.18 | 0.02 | 0.02 | FX610P |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{240}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{240}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| FX6 | 1 | 114 | 18.35 | 0-3 | 0.15 | 0.00 | 0.03 | 0.00 | FX6110 |
| | | | | 3-6 | 0.08 | 0.00 | 0.01 | 0.00 | FX6120 |
| | | | | 6-9 | 1.64 | 0.04 | 0.03 | 0.00 | FX6130 |
| | | | | 9-12 | 0.03 | 0.00 | 0.01 | 0.00 | FX6140 |
| | | | | 12-15 | 0.26 | 0.01 | 0.19 | 0.01 | FX6150 |
| | | | | 15-18 | 0.04 | 0.00 | 0.02 | 0.00 | FX6160 |
| | | | | 18-21 | 0.24 | 0.01 | 0.06 | 0.00 | FX6170 |
| | | | | Veg | -0.05 | 0.06 | 0.00 | 0.00 | FX61VU |
| FX6 | 2 | 114 | 18.35 | 0-0.3 | 0.33 | 0.03 | 0.04 | 0.00 | FX6200 |
| | | | | 0-0.3* | 0.25 | 0.08 | 0.39 | 0.05 | FX620P |
| | | | | 0-3 | 0.25 | 0.02 | 0.02 | 0.00 | FX6210 |
| | | | | 0-21 | 0.14 | 0.00 | 0.00 | 0.00 | FX62F0 |
| | | | | 0-21 | 0.01 | 0.00 | -0.00 | 0.00 | FX62F0 |
| | | | | Veg | -0.17 | 0.09 | -0.00 | 0.00 | FX62VU |
| FX6 | 3 | 114 | 18.35 | 0-0.3 | 0.46 | 0.04 | 0.04 | 0.01 | FX6300 |
| | | | | 0-0.3* | -0.02 | 0.08 | 0.22 | 0.03 | FX630P |
| | | | | 0-3 | 0.09 | 0.01 | 0.06 | 0.00 | FX6310 |
| | | | | 0-21 | 0.03 | 0.00 | 0.04 | 0.00 | FX63F0 |
| | | | | Veg | 0.06 | 0.03 | 0.02 | 0.03 | FX63VU |
| FX6 | 4 | 114 | 18.35 | 0-0.3 | 0.31 | 0.05 | 0.05 | 0.02 | FX6400 |
| | | | | 0-0.3* | 0.39 | 0.10 | 0.17 | 0.04 | FX640P |
| | | | | 0-3 | 0.30 | 0.22 | -0.05 | 0.02 | FX6410 |
| | | | | 0-21 | 1.82 | 0.06 | 0.04 | 0.00 | FX64F0 |
| | | | | Veg | 0.02 | 0.05 | 0.04 | 0.02 | FX64VU |
| GX1 | 1 | 154 | 2.56 | 0-0.3 | 3.63 | 0.11 | 0.12 | 0.02 | GX1100 |
| | | | | 0-0.3* | 5.21 | 0.24 | -0.81 | 0.23 | GX110P |
| | | | | 0-3 | 2.76 | 0.14 | -0.05 | 0.06 | GX1110 |
| | | | | 3-6 | 0.79 | 0.07 | 0.06 | 0.02 | GX1120 |
| | | | | 3-6 | 0.42 | 0.05 | 0.43 | 0.04 | GX1120 |
| | | | | 6-9 | 0.20 | 0.02 | 0.00 | 0.01 | GX1130 |
| | | | | 12-15 | -0.02 | 0.04 | -0.03 | 0.06 | GX1150 |
| | | | | 18-21 | -0.05 | 0.04 | -0.02 | 0.06 | GX1170 |
| | | | | Veg | 0.09 | 0.01 | 0.08 | 0.00 | GX11VU |
| GX1 | 2 | 154 | 2.56 | 0-0.3 | 4.53 | 0.15 | 0.13 | 0.02 | GX1200 |
| | | | | 0-0.3* | 6.35 | 0.21 | -0.27 | 0.14 | GX120P |
| | | | | 0-3 | 3.41 | 0.15 | -0.01 | 0.06 | GX1210 |
| | | | | 0-3 | 3.16 | 0.18 | -0.11 | 0.09 | GX1210 |
| | | | | 0-21 | 0.48 | 0.06 | -0.07 | 0.06 | GX12F0 |
| | | | | Veg | 0.31 | 0.03 | 0.05 | 0.01 | GX12VU |
| GX1 | 3 | 154 | 2.56 | 0-0.3 | 4.35 | 0.17 | 0.14 | 0.02 | GX1300 |
| | | | | 0-3 | 5.31 | 0.36 | 0.10 | 0.03 | GX1310 |
| | | | | 0-21 | 1.11 | 0.07 | 0.08 | 0.02 | GX13F0 |
| GX1 | 4 | 154 | 2.56 | 0-0.3* | 7.55 | 0.21 | -0.13 | 0.12 | GX140P |
| | | | | 0-3 | 3.31 | 0.37 | -0.05 | 0.08 | GX1410 |
| | | | | 0-21 | 1.01 | 0.09 | -0.06 | 0.06 | GX14F0 |
| | | | | Veg | 0.42 | 0.04 | 0.07 | 0.00 | GX14VU |
| GX2 | 1 | 155 | 3.27 | 0-0.3 | 0.46 | 0.02 | 0.03 | 0.00 | GX2100 |
| | | | | 0-0.3* | 0.53 | 0.08 | -0.47 | 0.12 | GX210P |
| | | | | 0-3 | 2.08 | 0.09 | -0.01 | 0.06 | GX2110 |
| | | | | 0-3 | 1.26 | 0.07 | 1.11 | 0.08 | GX2110 |
| | | | | 6-9 | 0.05 | 0.04 | -0.13 | 0.05 | GX2130 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

# Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{238}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{238}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| GX2 | 1 | 155 | 3.27 | 12-15 | -0.07 | 0.04 | -0.10 | 0.05 | GX2150 |
| | | | | 18-21 | -0.00 | 0.01 | 0.06 | 0.02 | GX2170 |
| | | | | Veg | 0.04 | 0.00 | 0.03 | 0.00 | GX21VU |
| GX2 | 2 | 155 | 3.27 | 0-0.3 | 0.37 | 0.02 | 0.07 | 0.01 | GX2200 |
| | | | | 0-0.3* | 0.31 | 0.05 | -0.20 | 0.12 | GX220P |
| | | | | 0-3 | 0.23 | 0.04 | -0.03 | 0.05 | GX2210 |
| | | | | 0-21 | 0.22 | 0.06 | -0.07 | 0.06 | GX22F0 |
| GX2 | 3 | 155 | 3.27 | 0-0.3 | 0.75 | 0.05 | 0.03 | 0.01 | GX2300 |
| | | | | 0-0.3* | 0.77 | 0.11 | 0.05 | 0.06 | GX230P |
| | | | | 0-3 | 0.80 | 0.05 | 0.11 | 0.02 | GX2310 |
| | | | | 0-21 | 0.59 | 0.07 | 0.03 | 0.02 | GX23F0 |
| GX2 | 4 | 155 | 3.27 | 0-0.3 | 0.92 | 0.04 | 0.28 | 0.02 | GX2400 |
| | | | | 0-0.3 | 0.94 | 0.03 | 0.04 | 0.00 | GX2400 |
| | | | | 0-0.3* | 1.31 | 0.11 | -0.43 | 0.11 | GX240P |
| | | | | 0-3 | 1.24 | 0.14 | 0.03 | 0.05 | GX2410 |
| GX3 | 1 | 144 | 4.22 | 0-0.3 | 0.35 | 0.02 | 0.04 | 0.02 | GX3100 |
| | | | | 0-0.3 | 0.40 | 0.04 | 0.02 | 0.01 | GX3100 |
| | | | | 0-0.3* | 0.91 | 0.13 | 0.14 | 0.05 | GX310P |
| | | | | 6-9 | -0.00 | 0.05 | -0.00 | 0.03 | GX3130 |
| | | | | 6-9 | 79.13 | 5.19 | 1.62 | 0.15 | GX3130 |
| | | | | 12-15 | 0.38 | 0.02 | -0.05 | 0.02 | GX3150 |
| | | | | 18-21 | 0.07 | 0.02 | 0.38 | 0.04 | GX3170 |
| | | | | Veg | 0.07 | 0.00 | 0.00 | 0.00 | GX31VU |
| GX3 | 2 | 144 | 4.22 | 0-0.3 | 0.41 | 0.03 | -0.02 | 0.02 | GX3200 |
| | | | | 0-0.3 | 0.33 | 0.04 | -0.06 | 0.02 | GX3200 |
| | | | | 0-3 | 0.37 | 0.04 | -0.05 | 0.02 | GX3210 |
| | | | | 0-21 | -0.33 | 0.03 | 0.05 | 0.04 | GX32F0 |
| | | | | Veg | 0.03 | 0.00 | 0.05 | 0.00 | GX32VU |
| GX3 | 3 | 144 | 4.22 | 0-0.3 | 0.35 | 0.03 | 0.01 | 0.00 | GX3300 |
| | | | | 0-0.3 | 0.37 | 0.03 | 0.06 | 0.01 | GX3300 |
| | | | | 0-0.3* | 0.45 | 0.03 | 0.29 | 0.03 | GX330P |
| | | | | 0-21 | 0.51 | 0.05 | 0.05 | 0.01 | GX33F0 |
| | | | | Veg | 0.02 | 0.00 | -0.00 | 0.00 | GX33VU |
| GX3 | 4 | 144 | 4.22 | 0-0.3 | 0.35 | 0.02 | 0.09 | 0.01 | GX3400 |
| | | | | 0-0.3* | 0.45 | 0.07 | -0.00 | 0.06 | GX340P |
| | | | | 0-3 | 0.41 | 0.03 | -0.04 | 0.02 | GX3410 |
| | | | | 0-21 | 0.43 | 0.03 | 0.00 | 0.02 | GX34F0 |
| | | | | Veg | 0.21 | 0.02 | 0.10 | 0.01 | GX34VU |
| GX4 | 1 | 155 | 6.23 | 0-0.3 | 1.25 | 0.07 | 0.03 | 0.01 | GX4100 |
| | | | | 0-0.3* | 0.82 | 0.13 | -0.10 | 0.12 | GX410P |
| | | | | 0-3 | 1.34 | 0.08 | 0.06 | 0.02 | GX4110 |
| | | | | 6-9 | 0.49 | 0.04 | 0.02 | 0.01 | GX4130 |
| | | | | 12-15 | 0.13 | 0.02 | 0.02 | 0.01 | GX4150 |
| | | | | 18-21 | 0.02 | 0.02 | 0.09 | 0.02 | GX4170 |
| | | | | Veg | 0.17 | 0.01 | 0.23 | 0.02 | GX41VU |
| GX4 | 2 | 155 | 6.23 | 0-0.3 | 0.61 | 0.05 | 0.04 | 0.01 | GX4200 |
| | | | | 0-0.3 | 0.65 | 0.05 | 0.02 | 0.01 | GX4200 |
| | | | | 0-0.3* | 0.53 | 0.05 | 0.04 | 0.04 | GX420P |
| | | | | 0-3 | 0.50 | 0.03 | 0.01 | 0.00 | GX4210 |
| | | | | 0-21 | 0.12 | 0.04 | -0.07 | 0.04 | GX42F0 |
| GX4 | 3 | 155 | 6.23 | 0-0.3 | 0.48 | 0.04 | 0.03 | 0.01 | GX4300 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{241}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{241}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| GX4 | 3 | 155 | 6.23 | 0-0.3* | 0.55 | 0.03 | 0.04 | 0.01 | GX430P |
| | | | | 0-3 | 1.16 | 0.07 | 0.07 | 0.01 | GX4310 |
| | | | | 0-21 | 0.22 | 0.02 | 0.02 | 0.00 | GX43F0 |
| | | | | Veg | 0.07 | 0.00 | 0.06 | 0.00 | GX43VU |
| GX4 | 4 | 155 | 6.23 | 0-0.3 | 0.58 | 0.05 | 0.02 | 0.02 | GX4400 |
| | | | | 0-0.3* | 0.63 | 0.07 | -0.08 | 0.05 | GX440P |
| | | | | 0-3 | 0.50 | 0.04 | 0.03 | 0.01 | GX4410 |
| | | | | 0-21 | 0.21 | 0.02 | 0.03 | 0.00 | GX44F0 |
| GX5 | 1 | 149 | 11.76 | 0-0.3 | 1.91 | 0.06 | 0.07 | 0.01 | GX5100 |
| | | | | 0-3 | 1.81 | 0.08 | 0.07 | 0.01 | GX5110 |
| | | | | 6-9 | 0.16 | 0.02 | 0.03 | 0.00 | GX5130 |
| | | | | 12-15 | 0.06 | 0.00 | 0.00 | 0.00 | GX5150 |
| | | | | 18-21 | 0.02 | 0.00 | 0.01 | 0.00 | GX5170 |
| | | | | 18-21 | 0.03 | 0.00 | 0.00 | 0.00 | GX5170 |
| | | | | Veg | 0.30 | 0.01 | 0.16 | 0.01 | GX51VU |
| GX5 | 2 | 149 | 11.76 | 0-3 | 1.14 | 0.07 | 0.07 | 0.02 | GX5210 |
| | | | | Veg | 0.05 | 0.01 | 0.10 | 0.02 | GX52VU |
| GX5 | 3 | 149 | 11.76 | 0-3 | 1.01 | 0.05 | 0.06 | 0.01 | GX5310 |
| | | | | 0-21 | 0.33 | 0.02 | 0.03 | 0.00 | GX53F0 |
| | | | | Veg | 0.09 | 0.01 | 0.01 | 0.00 | GX53VU |
| GX5 | 4 | 149 | 11.76 | 0-0.3 | 0.92 | 0.03 | 0.02 | 0.00 | GX5400 |
| | | | | 0-3 | 1.20 | 0.03 | 0.09 | 0.00 | GX5410 |
| | | | | 0-21 | 0.34 | 0.03 | 0.03 | 0.00 | GX54F0 |
| | | | | Veg | 0.07 | 0.02 | -0.00 | 0.00 | GX54VU |
| | | | | Veg | 0.11 | 0.02 | 0.00 | 0.00 | GX54VU |
| GX6 | 1 | 146 | 18.05 | 0-0.3 | 0.11 | 0.02 | 0.01 | 0.01 | GX6100 |
| | | | | 0-3 | 0.07 | 0.02 | 0.00 | 0.02 | GX6110 |
| | | | | 6-9 | 0.10 | 0.01 | 0.60 | 0.03 | GX6130 |
| | | | | 12-15 | 0.01 | 0.02 | 0.08 | 0.03 | GX6150 |
| | | | | 18-21 | 0.27 | 0.03 | 0.16 | 0.02 | GX6170 |
| | | | | Veg | 0.02 | 0.00 | 0.02 | 0.01 | GX61VU |
| GX6 | 2 | 146 | 18.05 | Veg | 0.01 | 0.00 | 0.00 | 0.00 | GX62VU |
| GX6 | 3 | 146 | 18.05 | 0-0.3 | 0.12 | 0.02 | 0.05 | 0.01 | GX6300 |
| | | | | 0-3 | 0.13 | 0.02 | 0.03 | 0.00 | GX6310 |
| | | | | 0-21 | 0.10 | 0.02 | 0.06 | 0.01 | GX63F0 |
| | | | | Veg | 0.02 | 0.00 | 0.00 | 0.00 | GX63VU |
| GX6 | 4 | 146 | 18.05 | 0-3 | 0.14 | 0.02 | 0.37 | 0.03 | GX6410 |
| | | | | 0-21 | 0.09 | 0.01 | 0.05 | 0.01 | GX64F0 |
| | | | | Veg | 0.01 | 0.00 | 0.01 | 0.01 | GX64VU |
| | | | | Veg | 0.00 | 0.00 | 0.04 | 0.01 | GX64VU |
| | | | | Veg | 0.03 | 0.00 | -0.00 | 0.00 | GX64VU |
| **Background Locations** | | | | | | | | | |
| Z01 | 1-10 | 20 | 107.32 | 0-0.3 | 0.86 | 0.04 | -0.02 | 0.01 | Z01C00 |
| | | | | 0-0.3* | 2.13 | 0.12 | -0.20 | 0.07 | Z01C0P |
| | | | | 0-3 | 1.20 | 0.08 | 0.00 | 0.02 | Z01C10 |
| | | | | 0-21 | 0.22 | 0.02 | 0.00 | 0.01 | Z01CF0 |
| | | | | Veg | 0.27 | 0.03 | 0.04 | 0.01 | Z01CVU |
| Z02 | 1-10 | 3 | 79.03 | 0-0.3 | 1.52 | 0.06 | 0.06 | 0.02 | Z02C00 |
| | | | | 0-0.3* | -0.44 | 0.28 | -0.60 | 0.17 | Z02C0P |
| | | | | 0-3 | 2.10 | 0.05 | 0.08 | 0.01 | Z02C10 |
| | | | | 0-21 | 0.45 | 0.02 | 0.02 | 0.01 | Z02CF0 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{241}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{241}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| Z02 | 1-10 | 3 | 79.03 | Veg | 0.08 | 0.00 | 0.00 | 0.00 | Z02CVU |
| Z03 | 1-10 | 14 | 90.52 | 0-0.3 | 1.62 | 0.09 | 0.05 | 0.02 | Z03C00 |
| | | | | 0-0.3* | 2.65 | 0.20 | 0.02 | 0.08 | Z03C0P |
| | | | | 0-3 | 1.46 | 0.05 | 0.03 | 0.01 | Z03C10 |
| | | | | 0-21 | 0.33 | 0.02 | 0.82 | 0.04 | Z03CF0 |
| | | | | Veg | 0.42 | 0.09 | 0.18 | 0.06 | Z03CVU |
| Z04 | 1-10 | 3 | 73.51 | 0-0.3 | 1.29 | 0.08 | 0.09 | 0.02 | Z04C00 |
| | | | | 0-0.3* | 1.75 | 0.11 | 0.11 | 0.02 | Z04C0P |
| | | | | 0-3 | 2.10 | 0.10 | 0.11 | 0.02 | Z04C10 |
| | | | | 0-21 | 0.49 | 0.04 | 0.02 | 0.01 | Z04CF0 |
| | | | | 0-21 | 0.46 | 0.04 | 0.04 | 0.01 | Z04CF0 |
| | | | | Veg | 0.05 | 0.01 | 0.01 | 0.01 | Z04CVU |
| Z05 | 1-10 | 5 | 69.25 | 0-0.3 | 2.33 | 0.12 | -0.18 | 0.09 | Z05C00 |
| | | | | 0-0.3* | 2.15 | 0.14 | -0.22 | 0.09 | Z05C0P |
| | | | | 0-3 | 2.10 | 0.10 | -0.09 | 0.09 | Z05C10 |
| | | | | 0-21 | 0.51 | 0.04 | 0.04 | 0.01 | Z05CF0 |
| | | | | Veg | 0.57 | 0.04 | 0.09 | 0.02 | Z05CVU |
| Z06 | 1-10 | 9 | 68.86 | 0-0.3 | 0.96 | 0.06 | 0.06 | 0.01 | Z06C00 |
| | | | | 0-0.3* | 1.07 | 0.05 | 0.11 | 0.02 | Z06C0P |
| | | | | 0-3 | 1.14 | 0.06 | 0.07 | 0.01 | Z06C10 |
| | | | | 0-21 | 0.43 | 0.03 | 0.03 | 0.00 | Z06CF0 |
| | | | | 0-21 | 0.49 | 0.03 | 0.04 | 0.01 | Z06CF0 |
| | | | | Veg | 0.08 | 0.02 | 0.15 | 0.02 | Z06CVU |
| Z07 | 1-10 | 166 | 123.29 | 0-3 | 3.29 | 0.07 | 0.19 | 0.01 | Z07C10 |
| | | | | Veg | 0.72 | 0.14 | 0.05 | 0.03 | Z07CVU |
| Z08 | 1-10 | 162 | 58.47 | 0-0.3 | 1.51 | 0.05 | 0.09 | 0.00 | Z08C00 |
| | | | | 0-0.3* | 14.35 | 0.59 | 0.48 | 0.08 | Z08C0P |
| | | | | 0-3 | 3.22 | 0.13 | 0.29 | 0.03 | Z08C10 |
| | | | | 0-21 | 0.48 | 0.03 | 0.02 | 0.00 | Z08CF0 |
| | | | | 0-21 | 0.62 | 0.03 | 0.03 | 0.00 | Z08CF0 |
| Z09 | 1-10 | 160 | 83.69 | 0-0.3 | 1.43 | 0.10 | 0.09 | 0.02 | Z09C00 |
| | | | | 0-0.3* | 4.59 | 0.37 | 0.23 | 0.08 | Z09C0P |
| | | | | 0-3 | 2.07 | 0.08 | 0.13 | 0.02 | Z09C10 |
| Z10 | 1-10 | 343 | 24.24 | 0-0.3 | 2.47 | 0.12 | 0.15 | 0.02 | Z10C00 |
| | | | | 0-0.3* | 2.76 | 0.26 | 0.07 | 0.05 | Z10C0P |
| | | | | 0-3 | 2.70 | 0.11 | 0.18 | 0.02 | Z10C10 |
| | | | | 0-21 | 3.27 | 0.15 | 0.10 | 0.02 | Z10CF0 |
| **Community Locations** | | | | | | | | | |
| K01 | 1 | 330 | 9.5 | 0-3 | 2.00 | 0.08 | 0.11 | 0.02 | K01110 |
| | | | | 0-21 | 0.56 | 0.05 | 0.02 | 0.01 | K011F0 |
| K02 | 1 | 181 | 17.82 | 0-3 | 1.17 | 0.05 | 0.09 | 0.01 | K02110 |
| | | | | 0-21 | 0.56 | 0.03 | 0.07 | 0.01 | K021F0 |
| K03 | 1 | 333 | 7.4 | 0-3 | 2.58 | 0.10 | 0.16 | 0.02 | K03110 |
| | | | | 0-21 | 0.77 | 0.05 | 0.04 | 0.01 | K031F0 |
| K04 | 1 | 314 | 7.62 | 0-3 | 3.66 | 0.15 | 0.18 | 0.02 | K04110 |
| K05 | 1 | 153 | 15.94 | 0-3 | 1.12 | 0.05 | 0.15 | 0.02 | K05110 |
| | | | | 0-21 | 0.51 | 0.03 | 0.09 | 0.01 | K051F0 |
| K06 | 1 | 141 | 12.61 | 0-3 | 1.44 | 0.04 | 0.11 | 0.01 | K06110 |
| | | | | 0-21 | 0.39 | 0.02 | 0.04 | 0.01 | K061F0 |
| K07 | 1 | 110 | 14.63 | 0-3 | 1.91 | 0.08 | 0.38 | 0.03 | K07110 |
| | | | | 0-21 | 0.67 | 0.02 | 0.18 | 0.01 | K071F0 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

## Appendix C: Plutonium Concentration Measurement Data

| Macro Plot Code | Micro Plot No | From 903 Pad Dir (Deg) | From 903 Pad Dist (km) | Depth in Soil (cm) | $^{239}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{239}$Pu Concentration SD[b] (Bq kg$^{-1}$) | $^{241}$Pu Concentration MV[a] (Bq kg$^{-1}$) | $^{241}$Pu Concentration SD[b] (Bq kg$^{-1}$) | Sample Location Code |
|---|---|---|---|---|---|---|---|---|---|
| K08 | 1 | 93 | 19.68 | 0-3 | 1.03 | 0.05 | 0.17 | 0.02 | K08110 |
| | | | | 0-21 | 0.38 | 0.03 | 0.26 | 0.02 | K081F0 |
| K09 | 1 | 75 | 9.21 | 0-3 | 3.82 | 0.12 | 0.19 | 0.02 | K09110 |
| K09 | 1 | 75 | 9.21 | 0-3 | 3.64 | 0.14 | 0.24 | 0.02 | K09110 |
| | | | | 0-21 | 1.03 | 0.10 | 0.09 | 0.03 | K091F0 |
| K10 | 1 | 6 | 7.21 | 0-3 | 2.55 | 0.11 | 0.17 | 0.02 | K10110 |
| | | | | 0-21 | 1.04 | 0.03 | 0.11 | 0.01 | K101F0 |

(a) Measured Value. (b) Standard Deviation (*) 0-45 μm particle size

Appendix C: Soil Density Measurement Data

## Soil Density Data

| Macro Plot Code | From 903 Pad Direction (Deg. T) | From 903 Pad Dist (km) | Depth in Soil (cm) | Soil Density Bulk[c] (g cm$^{-3}$) | Soil Density Adjusted[d] (g cm$^{-3}$) | Sample Location Code |
|---|---|---|---|---|---|---|
| AN2 | 100 | 0.3 | 0-3 | 0.83 | 0.81 | AN2D1 |
| | | | 3-6 | 1.90 | 1.05 | AN2D2 |
| AN4 | 100 | 1.2 | 0-3 | 0.79 | 0.73 | AN4D1 |
| | | | 3-6 | 1.25 | 1.08 | AN4D2 |
| AN6 | 80 | 2.5 | 0-3 | 1.09 | 1.00 | AN6D1 |
| | | | 3-6 | 1.20 | 1.08 | AN6D2 |
| AS3 | 100 | 0.7 | 0-3 | 1.17 | 1.01 | AS3D1 |
| | | | 3-6 | 1.47 | 1.15 | AS3D2 |
| AS4 | 95 | 1.3 | 0-3 | 1.54 | 0.95 | AS4D1 |
| | | | 3-6 | 1.68 | 1.14 | AS4D2 |
| AS5 | 95 | 1.8 | 0-3 | 1.24 | 1.08 | AS5D1 |
| | | | 3-6 | 1.35 | 1.30 | AS5D2 |
| AS6 | 98 | 2.4 | 0-3 | 1.06 | 0.64 | AS6D1 |
| | | | 3-6 | 1.33 | 0.81 | AS6D2 |
| AX1 | 88 | 0.2 | 0-3 | 1.06 | 0.62 | AX1D1 |
| | | | 3-6 | 1.68 | 1.10 | AX1D2 |
| AX2 | 92 | 0.3 | 0-3 | 0.86 | 0.82 | AX2D1 |
| | | | 3-6 | 1.10 | 1.03 | AX2D2 |
| AX3 | 89 | 0.7 | 0-3 | 1.16 | 0.83 | AX3D1 |
| | | | 3-6 | 0.95 | 0.71 | AX3D2 |
| AX4 | 91 | 1.2 | 0-3 | 1.16 | 1.01 | AX4D1 |
| | | | 3-6 | 1.71 | 1.16 | AX4D2 |
| AX5 | 90 | 1.6 | 0-3 | 0.71 | 0.60 | AX5D1 |
| | | | 3-6 | 1.31 | 0.73 | AX5D2 |
| AX6 | 91 | 2.3 | 0-3 | 0.84 | 0.76 | AX6D1 |
| | | | 3-6 | 1.34 | 1.19 | AX6D2 |
| BN2 | 50 | 1.2 | 0-3 | 1.18 | 1.16 | BN2D1 |
| | | | 3-6 | 1.12 | 1.11 | BN2D2 |
| BN3 | 50 | 1.7 | 0-3 | 1.10 | 1.05 | BN3D1 |
| | | | 3-6 | 1.21 | 1.10 | BN3D2 |
| BN4 | 50 | 2.4 | 0-3 | 1.24 | 1.19 | BN4D1 |
| | | | 3-6 | 1.29 | 1.22 | BN4D2 |
| BN5 | 50 | 2.9 | 0-3 | 1.77 | 0.91 | BN5D1 |
| | | | 3-6 | 1.87 | 1.02 | BN5D2 |
| BS2 | 70 | 1.2 | 0-3 | 0.74 | 0.68 | BS2D1 |
| | | | 3-6 | 1.48 | 1.02 | BS2D2 |
| BS3 | 70 | 1.7 | 0-3 | 1.48 | 0.94 | BS3D1 |
| | | | 3-6 | 2.27 | 1.85 | BS3D2 |
| BS4 | 68 | 2.4 | 0-3 | 0.85 | 0.76 | BS4D1 |
| | | | 3-6 | 1.34 | 0.89 | BS4D2 |
| BX1 | 60 | 0.8 | 0-3 | 1.45 | 0.98 | BX1D1 |
| | | | 3-6 | 1.71 | 1.13 | BX1D2 |
| BX2 | 59 | 1.2 | 0-3 | 1.47 | 1.19 | BX2D1 |
| | | | 3-6 | 1.69 | 0.86 | BX2D2 |
| BX3 | 59 | 1.7 | 0-3 | 0.88 | 0.59 | BX3D1 |
| | | | 3-6 | 1.43 | 0.60 | BX3D2 |
| BX4 | 60 | 2.3 | 0-3 | 0.90 | 0.85 | BX4D1 |
| | | | 3-6 | 1.24 | 1.17 | BX4D2 |

(c) Bulk density includes rocks. (d) Adjusted density is for soil, 0-2 mm size.

## Appendix C: Soil Density Measurement Data

| Macro Plot Code | From 903 Pad Direction (Deg. T) | From 903 Pad Dist (km) | Depth in Soil (cm) | Soil Density Bulk[c] ($g\ cm^{-3}$) | Soil Density Adjusted[d] ($g\ cm^{-3}$) | Sample Location Code |
|---|---|---|---|---|---|---|
| FS3 | 129 | 5.3 | 0-3 | 1.21 | 1.19 | FS3D1 |
| | | | 3-6 | 1.60 | 1.53 | FS3D2 |
| FX1 | 119 | 3.0 | 0-3 | 1.01 | 1.00 | FX1D1 |
| | | | 3-6 | 1.34 | 1.08 | FX1D2 |
| FX2 | 118 | 3.7 | 0-3 | 0.93 | 0.91 | FX2D1 |
| | | | 3-6 | 1.36 | 1.35 | FX2D2 |
| FX3 | 118 | 5.0 | 0-3 | 0.96 | 0.95 | FX3D1 |
| | | | 3-6 | 1.35 | 1.35 | FX3D2 |
| FX4 | 121 | 7.2 | 0-3 | 1.07 | 1.02 | FX4D1 |
| | | | 3-6 | 1.36 | 1.34 | FX4D2 |
| FX5 | 127 | 9.5 | 0-3 | 0.91 | 0.79 | FX5D1 |
| | | | 3-6 | 1.47 | 1.17 | FX5D2 |
| FX6 | 114 | 18.4 | 0-3 | 1.36 | 1.34 | FX6D1 |
| | | | 3-6 | 1.45 | 1.43 | FX6D2 |
| GE3 | 143 | 4.4 | 0-3 | 1.17 | 1.15 | GE3D1 |
| | | | 3-6 | 1.72 | 1.52 | GE3D2 |
| | | | 6-9 | 1.62 | 1.31 | GE3D3 |
| GN1 | 140 | 3.2 | 0-3 | 1.10 | 0.95 | GN1D1 |
| | | | 3-6 | 1.63 | 1.58 | GN1D2 |
| GN3 | 132 | 5.4 | 0-3 | 0.75 | 0.74 | GN3D1 |
| | | | 3-6 | 1.39 | 1.37 | GN3D2 |
| | | | 6-9 | 1.47 | 1.40 | GN3D3 |
| | | | 9-12 | 1.69 | 1.63 | GN3D4 |
| GN4 | 142 | 6.4 | 0-3 | 1.18 | 1.04 | GN4D1 |
| | | | 3-6 | 1.72 | 1.65 | GN4D2 |
| GS1 | 160 | 2.7 | 0-3 | 1.11 | 1.10 | GS1D1 |
| | | | 3-6 | 1.36 | 1.35 | GS1D2 |
| GS2 | 159 | 3.1 | 0-3 | 1.55 | 1.33 | GS2D1 |
| | | | 3-6 | 1.64 | 1.24 | GS2D2 |
| GS3 | 168 | 5.2 | 0-3 | 0.95 | 0.93 | GS3D1 |
| | | | 0-3 | 1.36 | 0.84 | GS3D1 |
| | | | 3-6 | 1.27 | 1.27 | GS3D2 |
| | | | 3-6 | 0.95 | 0.76 | GS3D2 |
| GX1 | 154 | 2.6 | 0-3 | 0.60 | 0.51 | GX1D1 |
| | | | 3-6 | 1.58 | 1.02 | GX1D2 |
| GX2 | 155 | 3.3 | 0-3 | 0.70 | 0.68 | GX2D1 |
| | | | 3-6 | 1.39 | 1.38 | GX2D2 |
| GX3 | 144 | 4.2 | 0-3 | 0.77 | 0.76 | GX3D1 |
| | | | 3-6 | 1.12 | 1.06 | GX3D2 |
| GX4 | 155 | 6.2 | 0-3 | 0.57 | 0.56 | GX4D1 |
| | | | 3-6 | 0.91 | 0.91 | GX4D2 |
| GX5 | 149 | 11.8 | 0-3 | 0.71 | 0.70 | GX5D1 |
| | | | 3-6 | 0.86 | 0.86 | GX5D2 |
| GX6 | 146 | 18.1 | 0-3 | 0.97 | 0.96 | GX6D1 |
| | | | 3-6 | 1.41 | 1.41 | GX6D2 |
| **Background Locations** | | | | | | |
| Z01 | 20 | 107.3 | 0-3 | 1.39 | 1.37 | Z010D1 |
| | | | 3-6 | 1.50 | 1.48 | Z010D2 |
| | | | 0-3 | 1.19 | 1.16 | Z011D1 |
| | | | 3-6 | 1.62 | 1.50 | Z011D2 |

(c) Bulk density includes rocks. (d) Adjusted density is for soil, 0-2 mm size.

## Appendix C: Soil Density Measurement Data

| Macro Plot Code | From 903 Pad | | Depth in Soil (cm) | Soil Density | | Sample Location Code |
|---|---|---|---|---|---|---|
| | Direction (Deg. T) | Dist (km) | | Bulk[c] (g cm$^{-3}$) | Adjusted[d] (g cm$^{-3}$) | |
| Z01 | | | 0-3 | 1.53 | 1.49 | Z01D1 |
| | | | 3-6 | 1.33 | 1.30 | Z01D2 |
| Z02 | 3 | 79.0 | 0-3 | 1.20 | 0.94 | Z0205D1 |
| | | | 3-6 | 1.54 | 1.14 | Z0205D2 |
| | | | 0-3 | 1.09 | 0.88 | Z02D1 |
| | | | 3-6 | 1.24 | 0.96 | Z02D2 |
| Z03 | 14 | 90.5 | 0-3 | 1.26 | 1.24 | Z032D1 |
| | | | 3-6 | 1.36 | 1.34 | Z032D2 |
| Z04 | 3 | 73.5 | 0-3 | 1.02 | 1.01 | Z040D1 |
| | | | 3-6 | 1.20 | 1.18 | Z040D2 |
| Z05 | 5 | 69.3 | 0-3 | 0.80 | 0.73 | Z054D1 |
| | | | 3-6 | 1.24 | 0.87 | Z054D2 |
| | | | 0-3 | 0.95 | 0.85 | Z05D1 |
| | | | 3-6 | 1.06 | 0.99 | Z05D2 |
| Z06 | 9 | 68.9 | 0-3 | 0.90 | 0.89 | Z061D1 |
| | | | 3-6 | 1.16 | 1.15 | Z061D2 |
| | | | 0-3 | 0.89 | 0.88 | Z062D1 |
| | | | 3-6 | 1.24 | 1.24 | Z062D2 |
| | | | 6-9 | 1.24 | 1.24 | Z062D3 |
| | | | 9-12 | 1.44 | 1.44 | Z062D4 |
| | | | 12-15 | 1.61 | 1.60 | Z062D5 |
| | | | 15-18 | 1.39 | 1.38 | Z062D6 |
| | | | 18-21 | 1.50 | 1.48 | Z062D7 |
| | | | 0-3 | 1.19 | 1.19 | Z06D1 |
| | | | 3-6 | 1.52 | 1.52 | Z06D2 |
| Z07 | 166 | 123.3 | 0-3 | 0.74 | 0.68 | Z07D1 |
| | | | 3-6 | 1.30 | 1.23 | Z07D2 |
| Z08 | 162 | 58.5 | 0-3 | 1.25 | 1.23 | Z081D1 |
| | | | 3-6 | 1.41 | 1.35 | Z081D2 |
| | | | 0-3 | 0.86 | 0.83 | Z085D1 |
| | | | 3-6 | 1.40 | 1.34 | Z085D2 |
| Z09 | 160 | 83.7 | 0-3 | 1.30 | 1.27 | Z090D1 |
| | | | 3-6 | 1.65 | 1.56 | Z090D2 |
| | | | 0-3 | 1.26 | 1.20 | Z093D1 |
| | | | 3-6 | 1.57 | 1.48 | Z093D2 |
| Z10 | 343 | 24.2 | 0-3 | 1.02 | 0.90 | Z100D1 |
| | | | 3-6 | 1.55 | 1.05 | Z100D2 |
| | | | 6-9 | 1.47 | 1.31 | Z100D3 |
| | | | 0-3 | 1.03 | 0.95 | Z103D1 |
| | | | 3-6 | 1.60 | 1.10 | Z103D2 |
| | | | 6-9 | 1.17 | 1.01 | Z103D3 |
| **Community Locations** | | | | | | |
| K01 | 330 | 9.5 | 0-3 | 0.94 | 0.92 | K01D1 |
| | | | 3-6 | 1.61 | 1.21 | K01D2 |
| K02 | 181 | 17.8 | 0-3 | 1.14 | 1.13 | K02D1 |
| | | | 3-6 | 1.07 | 1.05 | K02D2 |
| K03 | 333 | 7.4 | 0-3 | 1.05 | 1.02 | K03D1 |
| | | | 3-6 | 1.59 | 1.40 | K03D2 |
| K04 | 314 | 7.6 | 0-3 | 1.74 | 1.49 | K04D1 |
| | | | 3-6 | 2.16 | 1.34 | K04D2 |

(c) Bulk density includes rocks. (d) Adjusted density is for soil, 0-2 mm size.

## Appendix C: Soil Density Measurement Data

| Macro Plot Code | From 903 Pad | | Depth in Soil (cm) | Soil Density | | Sample Location Code |
|---|---|---|---|---|---|---|
| | Direction (Deg. T) | Dist (km) | | Bulk[c] ($g\ cm^{-3}$) | Adjusted[d] ($g\ cm^{-3}$) | |
| K05 | 153 | 15.9 | 0-3 | 0.54 | 0.52 | K05D1 |
| | | | 3-6 | 1.02 | 0.99 | K05D2 |
| K06 | 141 | 12.6 | 0-3 | 1.05 | 1.01 | K06D1 |
| | | | 3-6 | 1.19 | 1.16 | K06D2 |
| K07 | 110 | 14.6 | 0-3 | 0.78 | 0.76 | K07D1 |
| | | | 3-6 | 1.52 | 1.46 | K07D2 |
| K08 | 93 | 19.7 | 0-3 | 0.89 | 0.73 | K08D1 |
| | | | 3-6 | 0.81 | 0.80 | K08D2 |
| | | | 6-9 | 1.25 | 1.24 | K08D3 |
| K09 | 75 | 9.2 | 0-3 | 0.97 | 0.93 | K09D1 |
| | | | 3-6 | 1.41 | 1.04 | K09D2 |
| | | | 6-9 | 1.87 | 1.16 | K09D3 |
| K10 | 6 | 7.2 | 0-3 | 1.22 | 1.04 | K10D1 |
| | | | 3-6 | 1.81 | 1.19 | K10D2 |

(c) Bulk density includes rocks. (d) Adjusted density is for soil 0.2 mm size