Nevada Test Site

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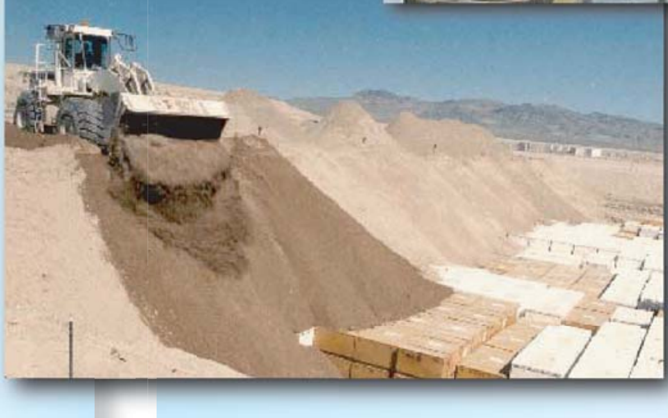
Waste Management Monitoring Report Area 3 and Area 5 Radioactive Waste Management Sites

2003

June 2004



Prepared for:
U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office

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Work Performed Under
Contract No. DE-AC08-96NV11718

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TABLE OF CONTENTS

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LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ASER	Annual Site Environmental Report
BD	Bulk Density
BEIDMS	Bechtel Environmental Integrated Data Management System
BJY	Buster-Jangle Y
BN	Bechtel Nevada
C	Celsius
CFR	Code of Federal Regulations
cm	centimeters
DCG	Derived Concentration Guide
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DQO	Data Quality Objectives
E	Evaporation
EIC	Electret Ion Chamber
EPA	U.S. Environmental Protection Agency
ET	Evapotranspiration
F	Farenheit
ft	feet
GCD	Greater Confinement Disposal
HDP	Heat Dissipation Probe
ICMP	Integrated Closure and Monitoring Plan
ICRP	International Commission on Radiological Protection
in	inches
km	kilometers
LLW	Low-Level Waste
LLWMU	Low-Level Waste Management Unit
MDC	Minimum Detectable Concentration
mi	miles
mm	millimeters
MSL	Mean Sea Level
NESHAP	National Emissions Standard for Hazardous Air Pollutants
NPCF	Neutron Probe Calibration Facility
NTS	Nevada Test Site
PA	Performance Assessment
PET	Potential Evapotranspiration
PPT	Precipitation
QAASP	Quality Assurance, Analysis, and Sampling Plan
REECo	Reynolds Electrical and Engineering Co., Inc.
REM	Roentgen Equivalent Man
RREMP	Routine Radiological Environmental Monitoring Plan
RWMS	Radioactive Waste Management Site
TDR	Time Domain Reflectometry
TLD	Thermoluminescent Dosimeter
TOC	Total Organic Carbon

TOX	Total Organic Halogen
TRU	Transuranic
TTR	Tonopah Test Range
VWC	Volumetric Water Content
WSS	Work Smart Standards

Executive Summary

Environmental, subsidence, and meteorological monitoring data were collected at and around the Area 3 and Area 5 Radioactive Waste Management Sites (RWMSs) at the Nevada Test Site (NTS) (Figure 1). The monitoring includes data associated with radiation exposure, air, groundwater, meteorology, vadose zone, subsidence, and biota. Although some of these media (e.g., radiation exposure, air, and groundwater) are reported in detail in other Bechtel Nevada (BN) reports (e.g., Annual Site Environmental Report [ASER], the National Emissions Standard for Hazardous Air Pollutants [NESHAP] report, and the Area 5 RWMS Annual Groundwater Monitoring Report), they are also summarized in this report to provide an overall evaluation of RWMS performance and environmental compliance. Direct-radiation monitoring data indicate that exposure at and around the RWMSs is not above background levels. Air-monitoring data indicate that tritium concentrations are slightly above background levels. Groundwater-monitoring data indicate that the groundwater in the uppermost aquifer beneath the Area 5 RWMS has not been impacted by facility operations. Meteorological data from 2003 indicate that rainfall totaled 150 millimeters (mm) (5.9 inches [in]) at the Area 3 RWMS and 154 mm (6.1 in) at the Area 5 RWMS. Vadose-zone monitoring data indicate that 2003 rainfall infiltrated approximately 60 centimeters (cm) (2 feet [ft]) before being returned to the atmosphere by evaporation. Soil-gas tritium monitoring data indicate slow subsurface migration, and tritium concentrations in biota were lower than in previous years. Special investigations conducted in 2003 included deploying an automated irrigation system at the Drainage Lysimeter Facility in Area 3. Additionally, Time Domain Reflectometry (TDRs) were installed and each lysimeter was calibrated at the Weighing Lysimeter Facility in Area 5. All 2003 monitoring data indicate that the Area 3 and Area 5 RWMSs are performing within expectations of the model and parameter assumptions for the facility Performance Assessments (PAs).

INTRODUCTION

This document summarizes the data acquired in Calendar Year 2003 for environmental, meteorology, and subsidence monitoring tasks. The data were obtained for the Waste Management monitoring program for the Area 3 and Area 5 RWMSs. Refer to the RWMS Integrated Closure and Monitoring Plan (ICMP) for details of the RWMS monitoring program (BN, 2001a). This report summarizes radiation data as monitored for various media, as briefly defined below.

- Direct radiation monitoring - conducted to confirm that RWMS activities do not result in significant exposure above background levels;
- Air monitoring - conducted to confirm that RWMS activities do not result in significant radionuclide concentrations above background levels and confirm compliance with NESHAP;
- Groundwater monitoring - conducted, as required by EPA regulations and U.S. Department of Energy (DOE) orders, to assess the water quality of the aquifer beneath the RWMS and confirm that RWMS activities are not affecting the aquifer;
- Vadose zone monitoring - conducted to assess the water balance of the RWMSs and confirm the assumptions made in the PAs, including no downward pathway, and evaluate the performance of the operational monolayer evapotranspiration (ET) waste covers;
- Soil-gas monitoring for tritium - conducted to evaluate the upward and downward pathways;
- Biota monitoring for tritium - conducted to evaluate the upward pathway through the waste covers; and

- Subsidence monitoring - conducted to ensure that subsidence features are repaired to prevent the development of preferential pathways through the covers.

These data are collected as required by BN and the DOE Contractual Work Smart Standards (WSS), which include various DOE orders and regulations from the Code of Federal Regulations (CFRs). For a detailed description of these regulatory drivers, refer to BN (2001a). These WSS and regulatory drivers exist to mitigate risk to the public and environment. The drivers include:

- DOE Order 5400.1, "General Environmental Protection Program"
- DOE Order 5400.5, "Radiation Protection of the Public and the Environment"
- DOE Order 435.1, "Radioactive Waste Management"
- Title 40 CFR 61, "Environmental Protection Agency [EPA]: National Emissions Standards for Hazardous Air Pollutants"
- Title 40 CFR 264, "EPA: Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"
- Title 40 CFR 265, "EPA: Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities"

Details of the Quality Assurance, Analysis, and Sampling Plans (QAASPs) can be found in the Routine Radiological Environmental Monitoring Plan (RREMP) (BN, 1998a; 2003b). The RREMP was written through a Data Quality Objectives (DQO)-driven process to identify what and how technically defensible environmental monitoring data are collected.

SITE DESCRIPTIONS

Area 3 RWMS

The Area 3 RWMS is located on Yucca Flat within the NTS. Yucca Flat is an elongated, sediment-filled basin that trends roughly north-south; the long axis extends approximately 27 kilometers (km) (17 mi), and the short axis approximately 16 km (10 miles [mi]). Yucca Flat is bound by Quartzite Ridge and Rainer Mesa on the north, the Halfpint Range on the east, the Massachusetts Mountains and Control Point Hills on the south, and Mine Mountain and the Eleana Range on the west. The Yucca Flat basin slopes from the north at an elevation of approximately 1,402 m (4,600 ft) above mean sea level (MSL) to the south toward Yucca playa, with the lowest part of the basin at an elevation of approximately 1,189 m (3,900 ft) above MSL. Yucca Flat was one of the several primary nuclear test areas and most of the length of the valley is marked with subsidence craters.

The thickness of the unsaturated zone at the Area 3 RWMS is estimated to be 488 m (1,600 ft) and the water table is assumed to occur in Tertiary tuff, based on data from surrounding boreholes. The tuff-alluvium contact is estimated to occur at a depth of between 305 and 457 m (1,000 and 1,500 ft) below land surface.

Air temperatures can vary from -18^{o}Celsius (C) (0^{o}Farenheit [F]) to 24^{o}C (75^{o}F) in winter and from 16^{o}C (60^{o}F) to 41^{o}C (105^{o}F) in summer. The climate of Yucca Flat is arid. The average annual precipitation based on a 43-year record (1961-2003) at a station located 4.5 km (2.8 mi) northwest of the Area 3 RWMS is 161.4 mm (6.4 inches). Precipitation is highly variable, with scant precipitation being recorded in some years. Average annual potential evapotranspiration (PET) at the Area 3 RWMS, calculated using local meteorology data, is approximately 10 times the annual average precipitation.

Area 5 RWMS

The Area 5 RWMS is located on northern Frenchman Flat at the juncture of three coalescing alluvial fan piedmonts (Snyder et al., 1995). Frenchman Flat is a closed intermontane basin located in the southeastern portion of the NTS. Frenchman Flat is bound by the Massachusetts Mountains and the Halfpint Range on the north, the Buried Hills on the east, the Spotted Range on the south, and the Wahmonie Volcanic Center on the west. The valley floor slopes gently toward a central playa. Ground-surface elevations range from 938 m (3,078 ft) above MSL at the playa to over 1,220 m (4,000 ft) above MSL in the nearby surrounding mountains.

The thickness of the unsaturated zone at the Area 5 RWMS is 235 m (770 ft) at the southeast corner of the RWMS (at Well Ue5PW-1), 256 m (840 ft) at the northeast corner of the RWMS (at Well Ue5PW-2), and 271 m (890 ft) to the northwest of the RWMS (at Well Ue5PW-3). The boreholes for wells Ue5PW-1 and Ue5PW-2 penetrate only alluvium, while the borehole for Well Ue5PW-3 encounters Tertiary tuff at a depth of approximately 189 m (620 ft).

Air temperatures can vary from -15^{o}C (5^{o}F) to 24^{o}C (75^{o}F) in winter and from 16^{o}C (60^{o}F) to 45^{o}C (113^{o}F) in summer. The climate of Frenchman Flat is arid. The average annual precipitation based on a 41-year record (1963-2003) at a station located 6.4 km (4 mi) south of the Area 5 RWMS is 124.0 mm (4.9 in). Precipitation is highly variable, with scant precipitation being recorded in some years. Average annual PET at the Area 5 RWMS, calculated using local meteorology data, is approximately 13 times the annual average precipitation.

Areas 3 and 5 are similar, except for slight differences in air temperature, precipitation, and soil texture. Area 3 receives approximately 30 percent more rainfall than Area 5; the annual average temperature at Area 3 is about 2^{o}C (4^{o}F) cooler than at Area 5; and soils at Area 3 are generally finer-grained than at Area 5.

Hydrologic Conceptual Model of the Area 3 and Area 5 RWMSs

Climate and vegetation strongly control the movement of water in the upper few meters of the alluvium at both RWMSs. The magnitude and direction of both liquid and vapor fluxes vary seasonally and often daily. Except for periods following precipitation events, water contents in the near-surface are quite low. Below the dynamic near surface is a region where relatively steady upward movement of water is occurring. In this region of slow upward flow, stable isotope compositions of soil pore water confirm that evaporation is the dominant process (Tyler et al., 1996). The upward flow region extends to depths from approximately 3 to 49 m (10 to 160 ft) in Area 3, and from approximately 3 to 40 m (10 to 131 ft) in Area 5. Below the upward flow region, water potential measurements indicate the existence of a static region. The static region begins between approximately 49 to 119 m (160 to 390 ft) in Area 3, and between approximately 40 to 90 m (131 to 295 ft) in Area 5 (Shott et al., 1997; 1998). In the static region, essentially no vertical liquid flow is currently occurring. Below the static region, flow is steady and downward due to gravity (Figure 2).

Stable isotope compositions of pore water from these depths indicate that infiltration into this zone occurred under cooler, past climatic conditions (Tyler et al., 1996). If water were to migrate below the current static zones, movement to the groundwater would be extremely slow due to the low water content of the alluvium. Estimates of travel time to the groundwater (assuming zero upward flux), based on hydraulic characteristics of the alluvium and assuming that current conditions would still apply, are in excess of 500,000 years in Area 3 (Levitt and Yucel, 2002) and 50,000 years in Area 5 (Shott et al., 1998).

Based on the results of extensive research, field studies, modeling efforts, and monitoring data, which are summarized in the Area 3 and Area 5 Performance Assessments (Shott et al., 1997; 1998), in Levitt et al. (1999), and in Levitt and Yucel (2002), groundwater recharge is not occurring under current climatic conditions at the RWMSs. Studies indicate that under bare-soil conditions such as those found at the operational waste cell covers, some drainage may eventually occur through the waste covers into the waste zone. This drainage is estimated to be about 1 percent of the annual rainfall at Area 5, and 10 percent of annual rainfall at Area 3, based on conservative one-dimensional modeling results (Levitt et al., 1999). In addition, monitoring data from a bare-soil weighing lysimeter located in Area 5 indicate that the soil water storage has increased slowly with time, although no free drainage has been measured through the bottom of the lysimeter.

PROJECT DESCRIPTION

The Area 3 and Area 5 RWMSs are designed and operated for the disposal of low-level waste (LLW) and mixed waste that is generated onsite (at the NTS), LLW from DOE offsite locations, and LLW from other approved offsite generators.

Area 3 RWMS

Waste disposal cells within the Area 3 RWMS are subsidence craters resulting from underground nuclear testing. The seven craters within the Area 3 RWMS, at the time of formation, ranged from 122 to 177 m (400 to 580 ft) in diameter and from 14 to 32 m (46 to 105 ft) in depth (Plannerer, 1996). Disposal in the U-3ax crater began in the late 1960s. Disposal began in U-3bl in 1984. Waste forms consisted primarily of contaminated soil and scrap metal, with some construction debris, equipment, and containerized waste. Craters U-3ax and U-3bl were combined to form the U-3ax/bl disposal unit, which is now covered with a vegetated, native alluvium closure cover that is at least 2.4 m (8 ft) thick. For details of the final closure plan of U-3ax/bl disposal unit, refer to BN (2000). Disposal in the combined unit U-3ah/at began in 1988. Disposal cell U-3ah/at is currently being used for disposal of bulk LLW from the NTS and approved offsite generators. Crater U-3bh was originally used for disposal of contaminated soils from the Tonopah Test Range (TTR) in 1997. The U-3bh unit remains open for waste disposal from other approved generators. The remaining two craters are not in use (Figure 3). For a detailed description of the facilities at the Area 3 RWMS refer to Shott et al. (1997).

Area 5 RWMS

Since the early 1960s, waste disposal at the Area 5 RWMS has occurred in an area referred to as the LLW Management Unit (LLWMU). The LLWMU consists of 28 landfill cells (pits and trenches) and 13 Greater Confinement Disposal (GCD) boreholes (Figure 4). Some previous documents list fewer landfill cells, but new cells continue to be constructed and trench 4 was separated into T04C and T-04C-1 in BN (2001a). Pits and trenches range in depth from 4.6 to 15 m (15 to 48 ft). Disposal consists of placing waste in various sealed containers in the unlined pits and trenches. Soil backfill is pushed over the containers in a single lift, approximately 2.4 m (8 ft) thick, as rows of containers reach approximately 1.2 m (4 ft) below original grade. For a detailed description of the facilities at the Area 5 RWMS, refer to Shott et al. (1998). For further descriptions of pits, trenches, and GCD boreholes, refer to BN (2001a) and Cochran et al. (2001).

Four of the GCD boreholes were used to bury classified transuranic (TRU) material and are no longer active. Pit 3 (P03U) is the only active mixed waste disposal unit. All other active units contain low-level radioactive waste. Pit 8 (P08U) and Pit 10 (P10C) are newer cells that are actively receiving waste. Pit 12 (P12U) and Pit 13 (P13U) are currently under construction, with construction pending for P14U and P15U in 2004. Landfill cells that have been closed, to date, include 4 pits (P01U, P02U, P04U, and P07U) and all 16 trenches (10 of which contain classified waste). The landfill cells that remain open include; P03U (mixed LLW), P05U (should be closed in 2004), P06U (asbestiform with thorium at bottom tier), P08U, P09U (drums), P10C, and P11U.

ENVIRONMENTAL MONITORING DATA

Data Summary

Area 3 RWMS monitoring locations are shown in Figure 3, and Area 5 RWMS monitoring locations are shown in Figures 4 and 5. Environmental monitoring data are in the process of being archived in BN's environmental monitoring database: Bechtel Environmental Integrated Data Management System (BEIDMS). This report provides a general description and graphical representations of some of these data. Monitoring data currently being collected include:

Radiation Exposure Data

- Quarterly thermoluminescent dosimeter (TLD) measurements

Air Monitoring Data

- Weekly alpha concentrations
- Weekly beta concentrations
- Bi-weekly tritium concentrations
- Monthly gamma concentrations
- Monthly americium concentrations
- Monthly plutonium concentrations
- Quarterly radon concentrations
- Annual radon flux measurements from waste covers

Groundwater Monitoring Data

- Quarterly water-level measurements (manual)

Semi-Annual Indicators of Contamination:

- pH (field measurement)
- Specific conductance (field measurement)
- Total organic carbon (TOC)
- Total organic halides (TOX)
- Tritium (^{3}H)

Semi-Annual General Water Chemistry Parameters:

- Total calcium, iron, magnesium, manganese, potassium, sodium, silicon
- Total sulfate, chloride, fluoride
- Alkalinity

Biennial Routine Radiological Environmental Monitoring Plan (RREMP) Analyses:

- Gross alpha
- Gross beta
- Gamma spectroscopy
- Plutonium as ^{238}Pu and $^{239+240}$Pu

Meteorology Monitoring Data

Daily Meteorology Data:

- Average air temperature at heights of 3 m (10 ft) and 9.5 m (31 ft) above ground level
- Maximum air temperature at heights of 3 m and 9.5 m above ground level
- Minimum air temperature at heights of 3 m and 9.5 m above ground level
- Average relative humidity at heights of 3 m and 9.5 m above ground level
- Maximum relative humidity at heights of 3 m and 9.5 m above ground level
- Minimum relative humidity at heights of 3 m and 9.5 m above ground level
- Average wind speed at heights of 3 m and 9.5 m above ground level
- Maximum wind speed at heights of 3 m and 9.5 m above ground level
- Average barometric pressure
- Maximum barometric pressure
- Minimum barometric pressure
- Total precipitation

Hourly Meteorology Data:

- Average air temperature at heights of 3 m and 9.5 m above ground level
- Average relative humidity at heights of 3 m and 9.5 m above ground level
- Average wind speed at heights of 3 m and 9.5 m above ground level
- Average wind direction at heights of 3 m and 9.5 m above ground level
- Average barometric pressure
- Average solar radiation
- Total precipitation

Vadose-zone Monitoring Data

Annual Soil Gas-Phase Monitoring Data:

- Soil gas tritium concentrations measured at GCD-05U gas sampling ports (9 depths)

Daily Weighing Lysimeter Data (Area 5):

- Daily evaporation from the bare-soil weighing lysimeter
- Daily evapotranspiration from the vegetated weighing lysimeter

Daily Drainage Lysimeter Data (Area 3):

- Soil volumetric water content (VWC), soil matric potential, and temperature with depth
- Total soil water storage

Daily Automated Vadose-Zone Monitoring System Data:

- Soil VWC with depth in waste covers
- Soil VWC beneath waste cells
- Soil matric potential with depth in waste covers
- Soil temperature with depth in waste covers
- Soil temperature beneath waste cells

Periodic Neutron Logging Data:

- Soil VWC with depth at selected neutron access tubes

Periodic Subsidence Monitoring Data (quarterly and/or after significant rainfall events):

- Locations and description of subsidence features on waste covers

Biota Monitoring Data

- Locations of sampled plants and plant water tritium concentrations

Bechtel Environmental Integrated Data Management System (BEIDMS)

BEIDMS is an Oracle®-based, relational database management system developed by Bechtel for the comprehensive management and processing of environmental data. This database management system has been licensed and tailored to support both small and large environmental projects at BN. BEIDMS will ensure consistency and promote advanced planning, while providing a central repository for all unclassified environmental data. BEIDMS is currently operational for environmental monitoring data from the NTS.

Radiation Exposure Data

Direct-radiation exposure data are acquired using TLDs at each RWMS and background locations several kilometers away from the RWMSs, Well 5B and Buster Jangle Y (BJY). The 2003 data indicate that direct radiation exposure at the RWMSs remains low. A comparison of 1998 – 2003 direct radiation exposure data has been completed (Figure 6).

During 2003, three new TLD locations (T3, T3 West, and T3A) were established outside of the Area 3 RWMS boundary. The three new locations, along with RWMS-S and U-3CO N (which are also outside the Area 3 RWMS boundary), had the highest exposure rates observed in 2003. All 5 of the sites are near ground zero locations for past atmospheric nuclear tests. Over the past 6 years, all monitoring sites had direct radiation less than 1.6 milliRoentgen (mR)/day. All but the 5 previously mentioned sites had exposure rates less than 0.6 mR/day. The average exposure rate at the 5, near ground zero, locations outside the Area 3 RWMS was 1.04 mR/day in 2003. In 2003, the average exposure rate at the RWMS boundaries and inside the RWMSs was 0.36 mR/day. The exposure rate at Well 5B and BJY averaged 0.31 mR/day during 2003.

The dose from 1 Roentgen can be approximated as 1 Roentgen Equivalent man (Rem) (International Commission on Radiological Protection [ICRP], 1987). Therefore, the exposure rate measured during 2003 corresponds to a dose of approximately 0.36 mRem/day within, or at, the RWMS boundaries. This rate is well below any dose of concern. Note that the average annual dose equivalent from all radiation sources to the general public is approximately 1 mRem/day. These data are also presented annually in the ASER for the NTS.

Air Monitoring Data

Tritium

Tritium is a highly mobile isotope of hydrogen that acts as a conservative tracer and is therefore an excellent performance indicator of volatile radionuclide migration from waste cells. The Derived Concentration Guide (DCG) level for the general public for tritium in air is 1E5 pCi/m^3, as provided in DOE Order 5400.5 (DOE, 1990). Atmospheric moisture is collected and analyzed for tritium at the Area 5 RWMS (Figure 7). Tritium concentrations in air from Schooner and Guard Station 510 are also included in the figure for comparison. Schooner is located near the northwest corner of the NTS and the site of a test that was conducted as part of the “Plowshare” series of tests. The test resulted in elevated tritium concentrations in surface soils. Data from Guard Station 510, located at the southwest edge of the NTS, can be considered background.

Sampling at the NE station of the Area 5 RWMS was terminated on June 19, 2003. This was done to eliminate costs for moving the station and electrical power lines when additional disposal pits are added. However, the Department of Defense (DoD) and Sugar Bunker stations are in prevailing downwind locations (north and south of the RWMS, respectively) from the buried tritium sources and continue to provide adequate environmental monitoring for the area. As shown in Figure 7 and in previous reports, the tritium concentrations in air at the NE station have been slightly greater than the concentrations at the DoD and Sugar Bunker N stations. All tritium concentrations near the Area 5 RWMS were well below any concentrations of concern. Descriptive statistics of the data for these stations are presented in the annual ASER report.

Past monitoring (through 1997) at the Area 3 RWMS indicated no detectable airborne tritium. Due to the lack of detectable tritium, and the lesser quantities of tritium sources disposed of within the Area 3 RWMS (in comparison to the Area 5 RWMS), monitoring for airborne tritium was terminated in 1997. Future sampling for airborne tritium at the Area 3 RWMS may resume should future waste streams justify the effort.

Particulates

Air particulate samples are collected on glass-fiber filters weekly near each RWMS and are screened for gross alpha and gross beta radioactivity to provide early detection of any change in environmental concentrations of airborne radioactivity. Monthly composites of the filters from each sampling location are analyzed by gamma spectroscopy for gamma-emitting radioactivity and by radiochemical analyses for americium and plutonium.

The results of the analyses for 2003 samples indicate that no man-made radioactivity was detected by gamma spectroscopy. However, concentrations of americium and plutonium near the MDCs of the measurements were detected. Figures 8, 9, and 10 compare the concentrations of americium and plutonium at the RWMSs with the results for other sampling stations. The concentrations near the RWMSs in 2003 were similar to the concentrations at stations in other NTS areas. The americium and plutonium concentrations at the Area 3 RWMS were slightly higher than the other NTS stations. However, the contaminated areas surrounding the Area 3 RWMS make it difficult to determine how much waste operations contributed, if anything, to the measured concentrations. Nevertheless, as shown in these figures, all the concentrations were below the DCG specified by DOE Order 5400.5. Descriptive statistics for these stations are also presented in the ASER.

Radon

Radon flux measurements were conducted on the waste cell cover of U-3ax/bl at the Area 3 RWMS on November 18 and 19, 2003. Measurements were also performed on the cover of P01U (Pit 1) at the Area 5 RWMS on December 16 and 17, 2003 (Figure 11). Measurements were made on the U-3ax/bl cover because it is the first, and only capped waste pit at the Area 3 RWMS and Pit 1 was selected because it has the highest radium inventory at the Area 5 RWMS. A group of 6 radon flux measurements were also taken, for comparison, at background locations outside each RWMS boundary. The CC Road background location was about 1.7 km east of the Area 3 RWMS and the Lysimeter background location was about 0.5 km west of the Area 5 RWMS (refer to Figure 11).

Measurements were made using radon flux domes (Rad Elec, Inc.) at 24 locations in an array of 4 x 6 spread over an area of approximately 4,500 m^2. A two sample t-test found no significant difference between the average radon flux at background locations and the flux rate inside the RWMSs ($P>0.17$). The radon flux measured during 2003 was slightly lower than measured during the previous three years and well below the performance objective of DOE Order 435.1, and regulatory limit of 20 $pCi/m^2/s$ as provided in 40 CFR 61, subpart Q (Figure 12).

Because compliance with the regulatory limit is demonstrated with radon flux measurements, radon concentrations in air were not measured during 2003. Radon concentrations in air at both RWMSs have been well characterized (BN, 2003c). Measurements will resume if conditions change in the future.

Groundwater Monitoring Data

There were 3 pilot wells (designated as Ue5PW-1, Ue5PW-2, and Ue5PW-3) drilled around the perimeter of the Area 5 RWMS in 1993 (refer to Figure 5). To date, all validated analytical data from groundwater sampling events from the wells indicate that the groundwater in the uppermost aquifer is unaffected by activities at the RWMS. Detailed information and data on the groundwater monitoring program at the Area 5 RWMS are presented in detail in the Annual Groundwater Data Report (BN, 2004). Groundwater elevation measurements are taken quarterly using an electronic tape. All groundwater elevation data from manual measurements since the wells were drilled in 1993 are shown in Figure 13. These data indicate that the water table beneath the Area 5 RWMS is nearly flat, with groundwater flowing in a northeastern direction at a velocity of approximately 23 cm (9 in) per year. Continuous water-level measurements were acquired using pressure transducers and dataloggers from July 1999 through February 2003. Recurrent problems with cable stretching had impacted the continuous water-level data records. The prolonged stretching of the cable resulted in an apparent rise in water levels. Regardless, water-level fluctuations as a response to changes in barometric pressure can be discerned in the data records from all three wells.

Meteorology Monitoring Data

Meteorology monitoring data collected in 2003 include precipitation, air temperature, humidity, wind speed and direction, barometric pressure, incoming solar radiation load, net radiation, and surface soil heat flux. These are basic meteorological parameters required to quantify the exchange of water and heat between the soil and the atmosphere. These data were collected from a meteorology station near the Area 3 RWMS and a meteorology station near the Area 5 RWMS (refer to Figures 3 and 4). The Area 3 RWMS meteorology station is located approximately 30 m (100 ft) northwest of the Area 3 RWMS. The Area 5 RWMS meteorology station is located southeast of the Area 5 RWMS, about 100 m (328 ft) from Well Ue5PW-1. Selected figures are included that illustrate basic weather data at each RWMS: daily maximum/minimum air temperature, daily average relative humidity, daily average barometric pressure, and daily maximum and average wind speeds are shown in Figures 14 through 18.

Precipitation Data

Rainfall at the Area 3 RWMS in 2003 was slightly below average, totaling 150.2 mm (5.9 in). The annual average at the BJY station in Area 3 is 160 mm (6.3 in). Rainfall at the Area 5 RWMS in 2003 was above average, totaling 154.4 mm (6.1 in). The annual average at the Well-5B station in Area 5 is 124 mm (4.9 in). It is notable that Area 3 received slightly less rain than Area 5 in 2003, despite the higher elevation of Area 3. Figures 19 and 20 depict the 2003 daily total precipitation at the Area 3 and Area 5 RWMSs, respectively. Historical precipitation data recorded at the BJY station (located about 3 km northwest of the Area 3 RWMS) and Well 5B station (located about 5.5 km south of the Area 5 RWMS) are provided in Figure 21.

Wind Roses

Wind rose diagrams illustrate wind direction (direction of wind source) and the occurrence of wind speed groupings in each direction, using hourly wind data, measured at a height of 3.0 m (10 ft) above the ground surface. Generally, low wind speeds tend to originate from the north, whereas high wind speeds tend to originate from the south. Wind roses from the Area 3 and Area 5 RWMS meteorology stations are presented in Figures 22 and 23, respectively. The one-year wind roses presented here are very similar to the multiple-year wind roses presented in BN (2001b).

Potential Evapotranspiration

The total calculated PET in 2003 for Areas 3 and 5 were 1,686 mm (66 in) and 1,789 mm (70 in), respectively. Total PET for Areas 3 and 5 are derived using a modified version of the radiation-based equation of Doorenbos and Pruitt (1977). This method provides results similar to the Penman Equation that was previously employed for the data reports through 2001 (Jensen et al., 1990). However, the Doorenbos and Pruitt equation reduces data input requirements (no net radiation data are needed) and lowers maintenance costs. The methodology of applying the Doorenbos and Pruitt equation is currently being refined so more reliable and defensible derivations can be completed.

The derived results using the Penman and Doorenbos and Pruitt equations were evaluated for the 2002 report. The results calculated using each equation proved to be similar. Due to the similarity in results and the difficulty in maintaining net radiometers in the arid environment of the NTS, the instrumentation required for the Penman Equation (net radiometer and soil heat flux plates) will be removed. Beginning with the 2003 report, PET values will be calculated using only the radiation-based equation of Doorenbos and Pruitt.

Vadose Zone Monitoring Data

Vadose-Zone Monitoring Strategy

Vadose-zone monitoring is conducted at the Area 3 and Area 5 RWMSs to demonstrate compliance with DOE Orders 5400.1 and 435.1. The monitoring is also performed to substantiate the assumptions (e.g., hydrologic conceptual models including soil water contents, upward and downward flux rates, and volatile radionuclide releases) made in the PA for each RWMS. The vadose-zone monitoring is also performed to detect changing trends in performance; provide added assurance to PA conclusions regarding facility performance; evaluate the performance of the operational monolayer waste covers; and confirm the PA performance objective of protecting groundwater resources.

The current vadose-zone monitoring program at the RWMSs is designed based on a comprehensive understanding of the vadose-zone system. The thorough understanding results from extensive characterization studies (BN, 1998b; Blout et al., 1995; Reynolds Electrical and Engineering Company, Inc. [REECo], 1993a, 1993b, 1994; Schmeltzer et al., 1996; Shott et al., 1998, 1997; Tyler et al., 1996) and modeling studies (Crowe et al., 1998; Levitt et al., 1999). In addition, the current program is designed, in part, as a result of an Alternative Evaluation Study on vadose zone monitoring (BN, 1998c) using an organized team approach and from vadose zone monitoring field experiences.

The objectives of the vadose-zone monitoring program are accomplished, in part, at each RWMS by measuring water balances. Water-balance surveillance involves the use of meteorology data to calculate PET values (the driving force of upward flow); directly measuring actual evapotranspiration and bare-soil evaporation (Area 5 RWMS weighing lysimeter facility); and measuring soil water content and soil water potential in waste cell covers and floors (automated waste cover monitoring systems). The vadose-zone monitoring strategy also includes sampling of soil gas for tritium at GCD-05U near the center of the Area 5 RWMS to evaluate the subsurface migration of tritium.

Gas-phase Tritium Monitoring Data

Gas-phase tritium monitoring is conducted via soil gas sampling at GCD-05U (see Figure 4 for location). This unit has a large tritium inventory (~2.2 million curies at time of disposal) and is instrumented with two strings of nine soil-gas sampling ports buried at depths ranging from 3 to 37 m (10 to 120 ft) below ground surface. Tritium sampling at GCD-05U provides a direct measure of temporal changes in tritium migration from waste packages due to degradation of waste containers and the natural transport processes of advection and diffusion.

Tritium in soil-gas was sampled from the nine GCD-05U sampling depths in June 2003. Results indicate that while soil-gas tritium concentrations generally continue to increase at depths between 15 and 37 m (50 and 120 ft), vertical migration is extremely slow. The tritium concentrations measured at depths of 15.2 m (50 ft) and 25.9 m (85 ft) have continued to decrease slightly since 2000 and 2001, respectively. It is not clear if these decreases are due to measurement error, or an actual reduction in tritium concentrations at these depths due to radioactive decay. This ten-year data set could be used to calibrate a tritium vapor transport model to predict travel times to the ground surface and atmosphere, and to validate the gaseous diffusion models developed in the PAs. Soil-gas tritium concentrations with depth and time are illustrated in Figures 24 and 25.

Area 5 Weighing Lysimeter Facility Data

The Area 5 weighing lysimeter facility consists of two precision weighing lysimeters located about 400 m (1,312 ft) southwest of the Area 5 RWMS. Each lysimeter consists of a steel box 2 m (6.6 ft) deep, filled with soil and having an area of 2 m x 4 m (6.6 ft x 13 ft). Each lysimeter is mounted on a sensitive scale, which is continuously monitored using an electronic loadcell. One lysimeter is vegetated with native plant species at the approximate density of the surrounding desert, and one lysimeter is kept bare to simulate the bare operational waste covers at the Area 5 RWMS. The loadcells have been monitored continuously since March 1994 and provide an accurate dataset of the surface water balance at the Area 5 RWMS. For details of the weighing lysimeters, refer to Levitt et al. (1996) and the most current ASER.

The weighing lysimeter data represent a simplified water balance; change in soil water storage is equal to precipitation (PPT) minus evaporation (E), or ET. The water balance is simplified because no drainage has ever been measured through the bottoms of the lysimeters and because a one-inch high lip around the edge of the lysimeters prevents run-on or run-off. Total soil water storage for the period of March 30, 1994, through December 31, 2003, is illustrated in Figure 27.

Note that the vegetated lysimeter is considerably drier than the bare-soil lysimeter, despite the paucity of plants in the vegetated lysimeter (about 15 percent cover). Fairly rapid decreases in soil water storage in the vegetated lysimeter following high-rainfall periods can be discerned. The soil water storage increases observable early in the data record for the vegetated lysimeter were due to periods of irrigation to ensure that transplanted vegetation survived. The higher soil water storage in the bare lysimeter may eventually lead to some drainage out the bottom of the lysimeter. This is supported by conservative modeling results that also indicate that some drainage (1 percent of rainfall) will eventually leak from the bottom of the bare-soil lysimeter (Levitt et al., 1999). During 2003, E from the bare lysimeter was slightly higher then ET from the vegetated lysimeter and there was an increase in soil water storage in both lysimeters (Figure 27). ET was greater then E in May 2003 (Figure 28).

In March 2000, core samples were extracted from the weighing lysimeters in order to confirm the total soil water storage recorded using the electronic loadcells. Continuous core was collected to determine VWC throughout the soil profile, which was integrated into total soil water storage in each lysimeter. To reflect this more accurate direct measurement, the historical lysimeter data were increased by about 7 cm (2.8 in) of total soil water storage to match the core data. Therefore, soil water storage from both weighing lysimeters is higher now than in documents published prior to 2000.

In September 2003, eight time-domain reflectometry (TDR) probes were installed in a vertical configuration in each lysimeter; new loadcells were installed at each lysimeter; and both lysimeters were calibrated. The calibration factors for the bare-soil and vegetated lysimeters from the September 2003 calibration were +0.03 and –1.03 percent different than the previous values, respectively. The results indicate that the precision scales, loadcells, and the weighing lysimeters themselves are extremely stable and robust monitoring systems that can provide consistent data for years.

Automated Waste Cover Monitoring System Data

In 1998, an automated monitoring system was installed in Area 5 adjacent to Well Ue5PW-1, at the Neutron Probe Calibration Facility (NPCF). This TDR system has 36 TDR probes buried at depths of 30, 60, and 90 cm (1, 2, and 3 ft) and has performed well for over 5 years.

In 1998 at the Area 5 RWMS, TDR probes were buried 1.2 m (4 ft) beneath the open pit floors of Pits 3 and 5. In 1999, TDR probes were also installed in the operational cover of Pit 3 at 2 sites (north and south) at depths ranging from 10 to 180 cm (0.3 to 5.9 ft). In 2000, TDR probes were installed in the operational covers of Pits 4 and 5 at depths ranging from 20 to 180 cm (0.7 to 5.9 ft). In January 2002, the cables for TDR probes in the floor of Pit 3 were permanently cut for operational purposes. Temporal changes in soil water content are illustrated in Figures 29 through 33 for the waste cover TDR systems at Pits 3, 4, and 5; and the floor TDR systems at Pits 3 and 5. The depth of infiltration from precipitation, before the water was returned to the atmosphere by evaporation, did not exceed 90 cm (3 ft) in the Pit 3 cover and 60 cm (2 ft) in the Pit 4 and Pit 5 covers. Slight increases in water contents at greater depths may be observed, but these are likely the result of thermal effects rather than actual liquid wetting fronts.

In December 2000, TDR probes were installed in the waste cover of the U-3ax/bl waste disposal unit at the Area 3 RWMS. Eight vertically arranged TDR probes were installed at four locations. These probes are wired into two datalogger stations. Measured soil water contents for one location in the U-3ax/bl waste cover are shown in Figure 34. The TDR data indicate the soil water content in the cover generally decreased over time as the vegetation on the cover has grown.

Vegetation density is critical to the effectiveness of the vegetative cover of U-3ax/bl. A long-term goal of 12% has been established for the vegetation density for the cover based on the vegetation density of similar native environments. Obtaining the optimal density of 12% is controlled by the germination success of applied seeds and seedlings. The maximum infiltration ever observed at the cover was approximately 2 m (6 ft) resulted from applied irrigation to ensure vegetation survival. It is worth noting that the moisture from these depths was quickly removed by ET within several months. A quantitative analysis of the vegetation density on the U-3ax/bl cover and the vegetated drainage lysimeters was conducted in the spring of 2002 (BN 2002a). The percent cover for U-3ax/bl and the seeded lysimeters were found to be 6 and 12 percent, respectively. For more information on the closure and monitoring of U-3ax/bl, refer to BN (2000).

Area 3 Drainage Lysimeter Facility Data

Construction of a drainage lysimeter facility, immediately northwest of the U-3ax/bl waste disposal unit at the Area 3 RWMS, was initiated in November 2000 (refer to Figure 3). The construction activities at the lysimeter facility were performed concurrent with the installation of the TDR probes, application of 30 cm (1 ft) of soil, and revegetation at the U-3ax/bl waste disposal unit (refer to BN, 2000). The lysimeter facility was constructed to fulfill data needs; including reducing uncertainty in the expected performance of monolayer-ET closure covers under various surface treatments and climatic change scenarios such as increased rainfall. The facility consists of 8 lysimeters, each one instrumented with water content (TDR probes) and water potential and temperature sensors (heat dissipation probes [HDPs]) at 8 depths per lysimeter. Each lysimeter was constructed such that drainage through each 2.4 m (8 ft)-thick cell can be directly measured using electronic tipping buckets. All sensors are wired into dataloggers for automated measurements.

Figures 35 and 36 illustrate VWC with time for a bare (Lysimeter A) and vegetated-native species (Lysimeter E) lysimeter, respectively. Since 2000, the vegetated lysimeter has been significantly drier than the bare lysimeter. The water content in the vegetated lysimeter has been approximately 8% at depth, while the water content at depth in the bare lysimeter has been approximately 14%. The vegetated lysimeter also has a more uniform water content throughout the soil profile. Figure 37 shows the calculated total water storage for all 8 lysimeters using the TDR data. Note the vegetated lysimeters (both native and invaders species cells) are significantly drier (lower soil water storage) than the bare cells. All vegetated lysimeters have similar soil water storage with the exception of the “G” lysimeter. This lysimeter has been observed to be less vegetated than the other cells with similar invader species. Irrigation has been applied at various times in some of the lysimeters. The irrigation has been performed to facilitate seeding efforts in the native vegetation lysimeters (E and F) and as an element of the recent enhanced precipitation study (lysimeters B, D, F, and H).

In 2003, an automated irrigation system was constructed and deployed over the south transect of 4 lysimeters (B, D, F, and H) to apply double the volume of natural rainfall events. By effectively inducing three times precipitation, shallow subsurface responses under a scenario of climate change will be assessed. Lysimeters E and F were reseeded in late 2002. Subsequently, they were periodically watered from late January through April 2003 to facilitate the establishment of the seedlings. These seedlings did not establish themselves in light of the continued drought in the region. Therefore, additional efforts to reseed the 2 lysimeters were conducted in November 2003.

Neutron Logging Data

Measurements of VWC in waste covers using the neutron probe method have been terminated with the installation of the automated TDR systems at various locations, as described above. Therefore, routine vadose zone water content monitoring by neutron logging was not conducted in the Area 3 or Area 5 RWMSs in 2003. Future water content monitoring at Areas 3 and 5 will be conducted using only the automated TDR systems. For a detailed history of the Neutron Logging Monitoring Program at Area 3 and Area 5 RWMSs, refer to BN (1997 and 2001b).

Waste Cover Subsidence Monitoring

Subsidence monitoring is conducted to ensure that subsidence features are expediently repaired to prevent the development of preferential pathways through the waste covers. Subsidence monitoring also helps to ensure that vadose zone monitoring data are representative of the entire RWMS. A formal program to monitor subsidence of waste covers was initiated in October 2000, including coordination with waste operations personnel to facilitate timely repair of subsidence features. The locations of subsidence features observed at the Area 5 RWMS in 2003 are shown in Table 1. These features were in locations of recently covered waste and concentrated in areas where compaction of the cover may be incomplete. In other locations within the Area 5 RWMS, only a few minor cracks and depressions required maintenance.

Biota Monitoring Data

No biota monitoring was conducted in 2003. In the past, vegetation monitoring within the disposal facilities has been performed to help characterize and define trends in potential transport of radionuclides from deposited waste. Tritium is a dominant radionuclide observed due to its high mobility as tritiated water. The primary mechanisms that transport tritium upward through waste covers and into the atmosphere include gaseous diffusion, gaseous advection, bioturbation, plant uptake and transpiration, and soil evaporation. Sampling of plant water for tritium has provided a direct measure of the plant uptake of tritium. Additionally, analysis of plant tissues for alpha- and gamma-emitting radionuclides and Sr-90 has provided information on uptake of those radionuclides.

The amount of tritium released into the atmosphere by plant transpiration is affected by several factors including plant size, species, and available moisture. For example, plants under drought conditions may use water from deeper in the vadose zone and consequently have higher concentrations due to the proximity of the water to the waste zone. For this reason, plants were generally sampled in late summer in prior years. Because of the dry conditions, measured plant water tritium concentrations may be a conservative representation of year-round concentrations. The range of tritium concentrations observed in vegetation from the last sampling event, 2002, was within that observed during the previous 3 years, but still much lower than that measured at the Area 5 RWMS in 1995 to 1996 (see BN 2001b, 2002b). Detectable concentrations of radionuclides in plants indicate that plants provide an upward pathway for radionuclide migration. Continued monitoring of this pathway will provide data on trends of radionuclides available for uptake over time.

CONCLUSIONS

The 2003 environmental and operational monitoring data from the Area 3 and Area 5 RWMSs indicate that these facilities are performing as expected for long-term isolation of buried waste. Direct radiation exposure data indicate a rate that is well below any dose of concern. Air monitoring data indicate that tritium concentrations remain below any concentrations of concern. Groundwater and vadose zone monitoring data indicate that the groundwater beneath the Area 5 RWMS is unaffected by the waste disposal operations. Soil-gas monitoring at GCD-05U indicates that tritium is slowly migrating away from a large tritium inventory due to natural transport processes. Vadose zone monitoring data indicate that infiltrating precipitation generally reached depths of less than 60 cm (2 ft) before returning to the atmosphere. Long-term vadose zone monitoring data from the weighing lysimeters indicate no drainage through the bottoms of the lysimeters in the past ten years of their operation.

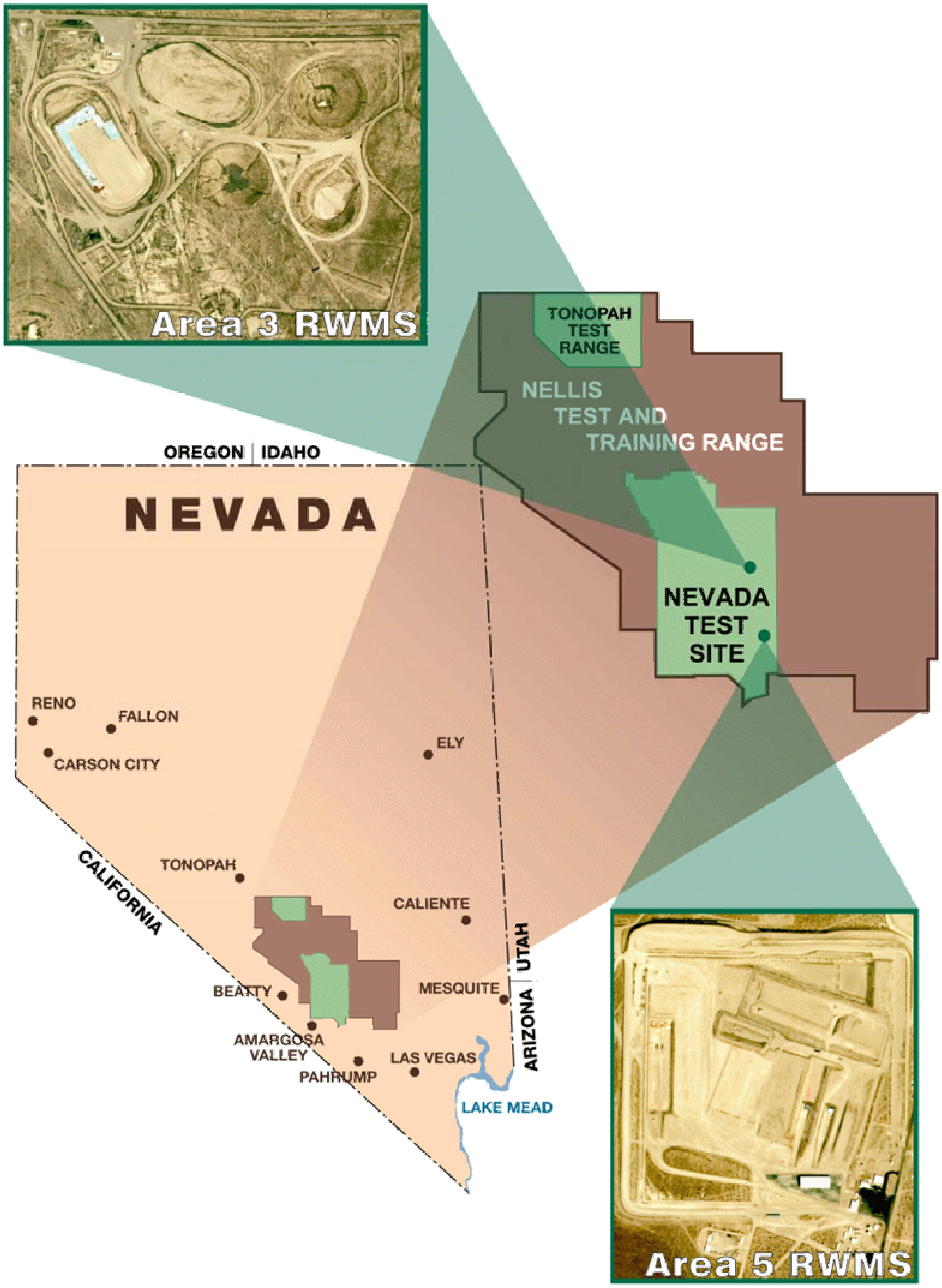

Figure 1. Location of the Area 3 and Area 5 RWMSs within the NTS and Nevada

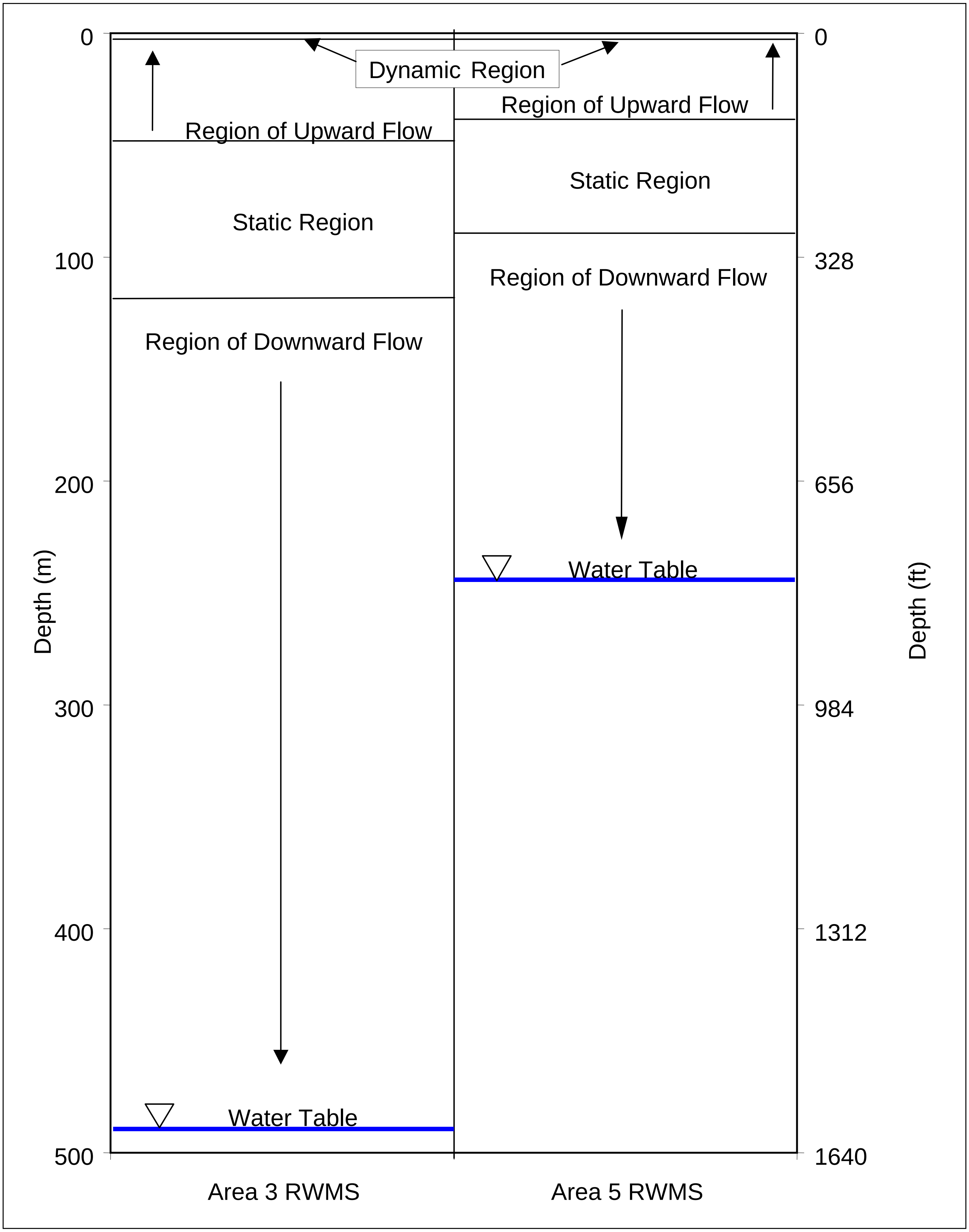

Figure 2. Vadose zone hydrologic conceptual models of the Area 3 and Area 5 RWMSs

Figure 3. Monitoring locations at the Area 3 RWMS

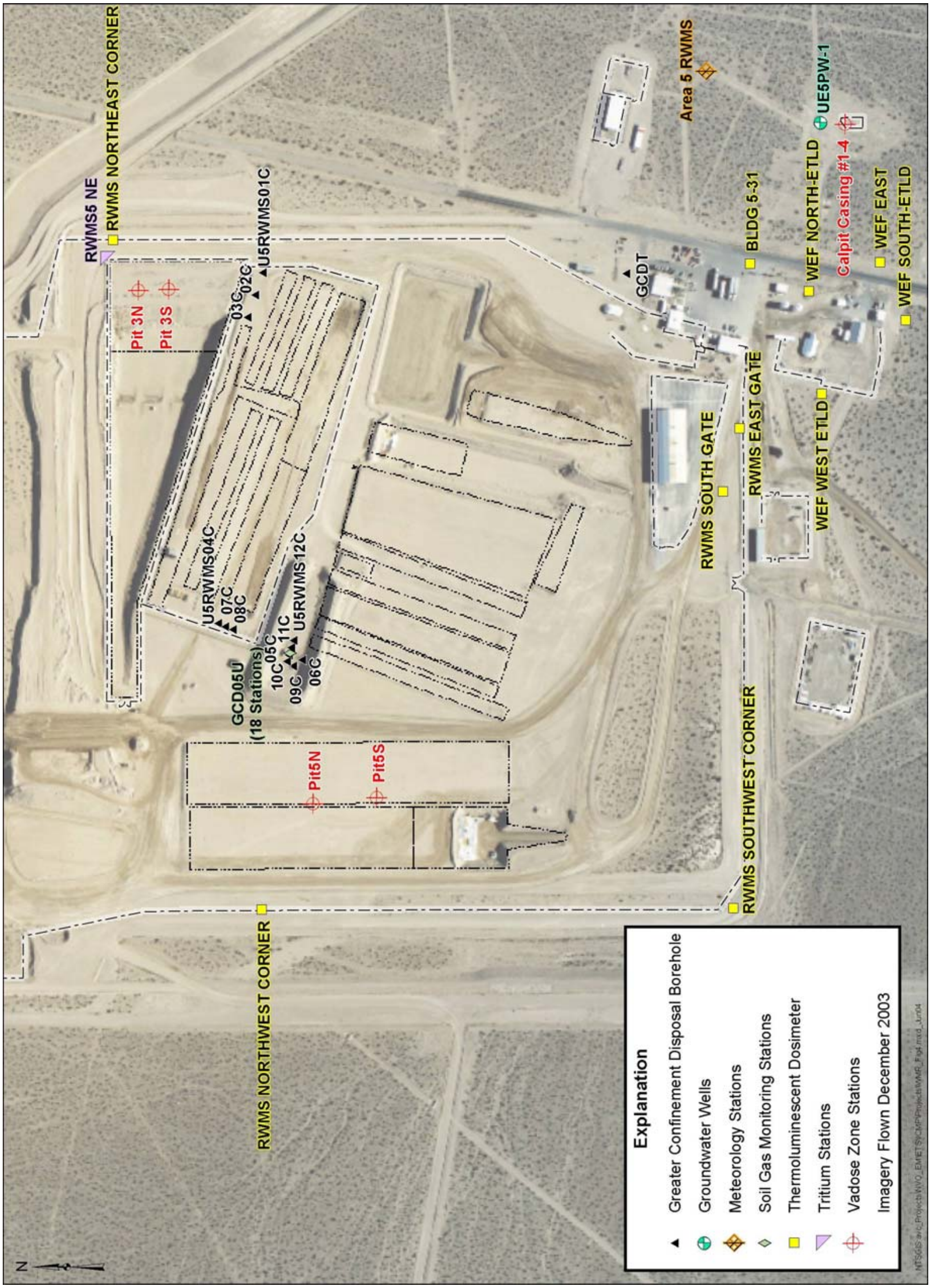

Figure 4. Monitoring locations at the Area 5 RWMS

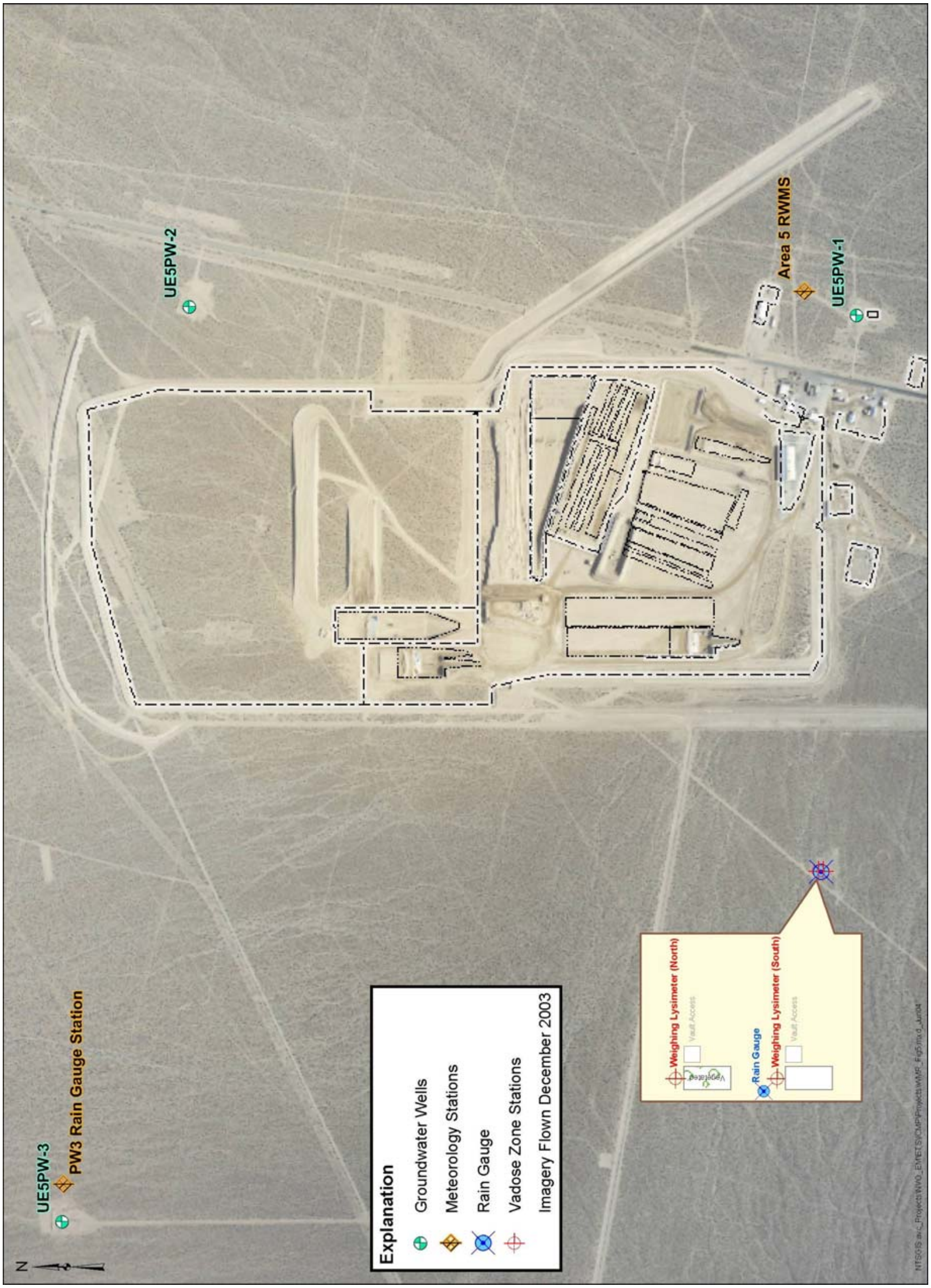

Figure 5. Location of the Area 5 RWMS pilot wells and weighing lysimeter facility

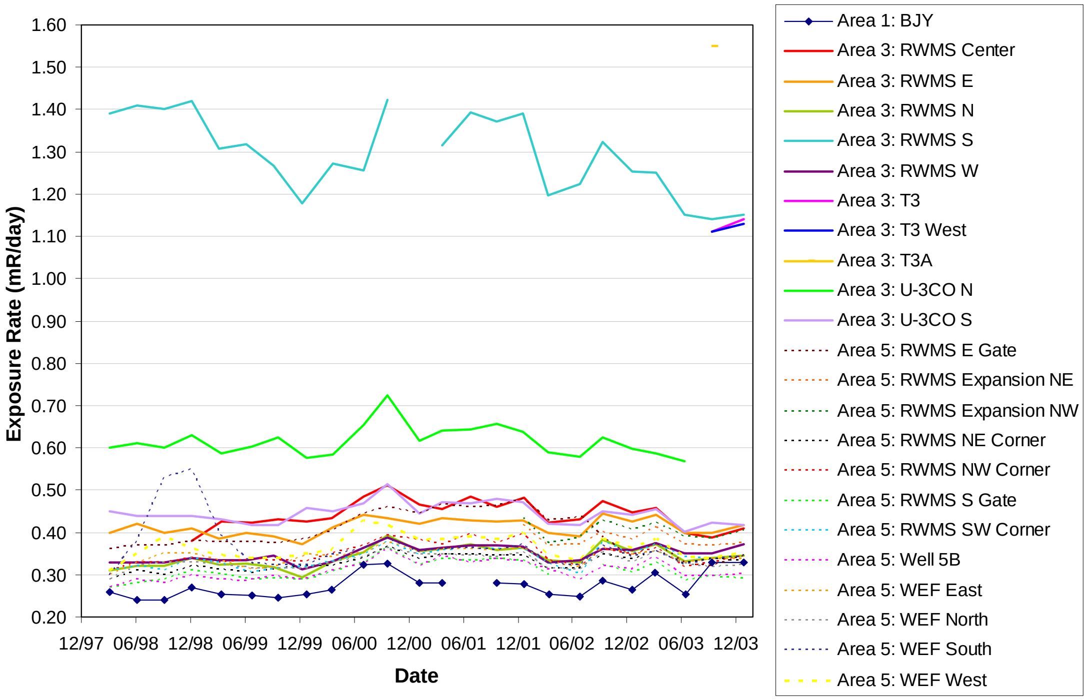

Figure 6. Exposure rate at the RWMSs, Well 5B, and BJY locations (1998 – 2003)

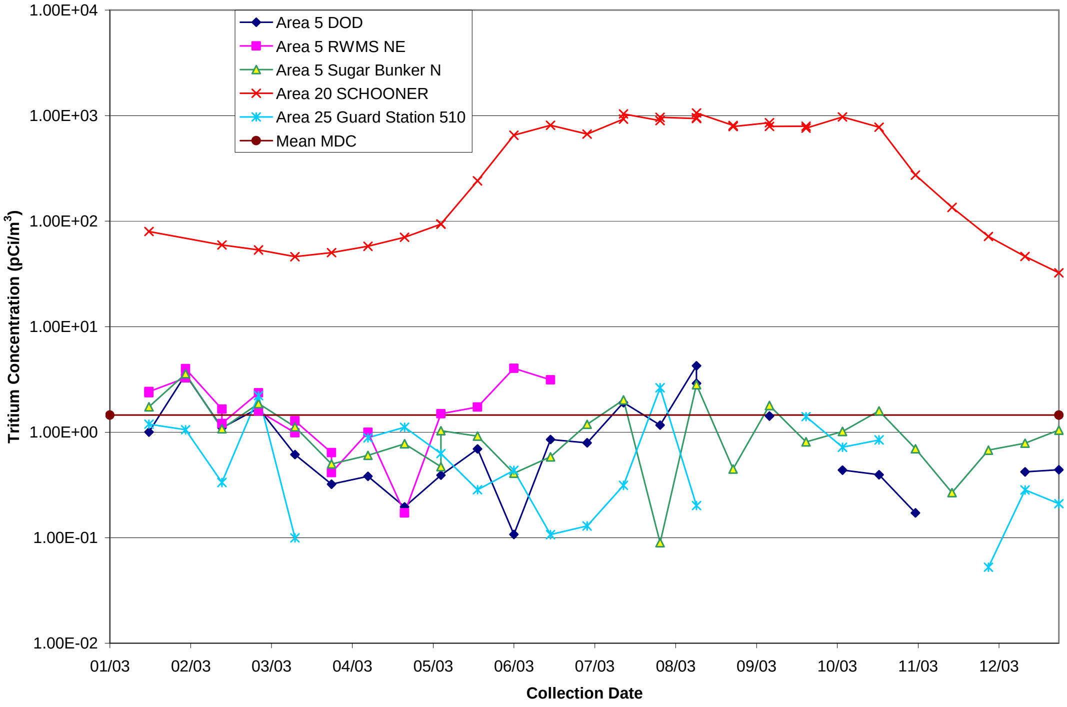

Figure 7. Tritium concentrations in air at the Area 5 RWMS compared to Schooner and Guard Station 510

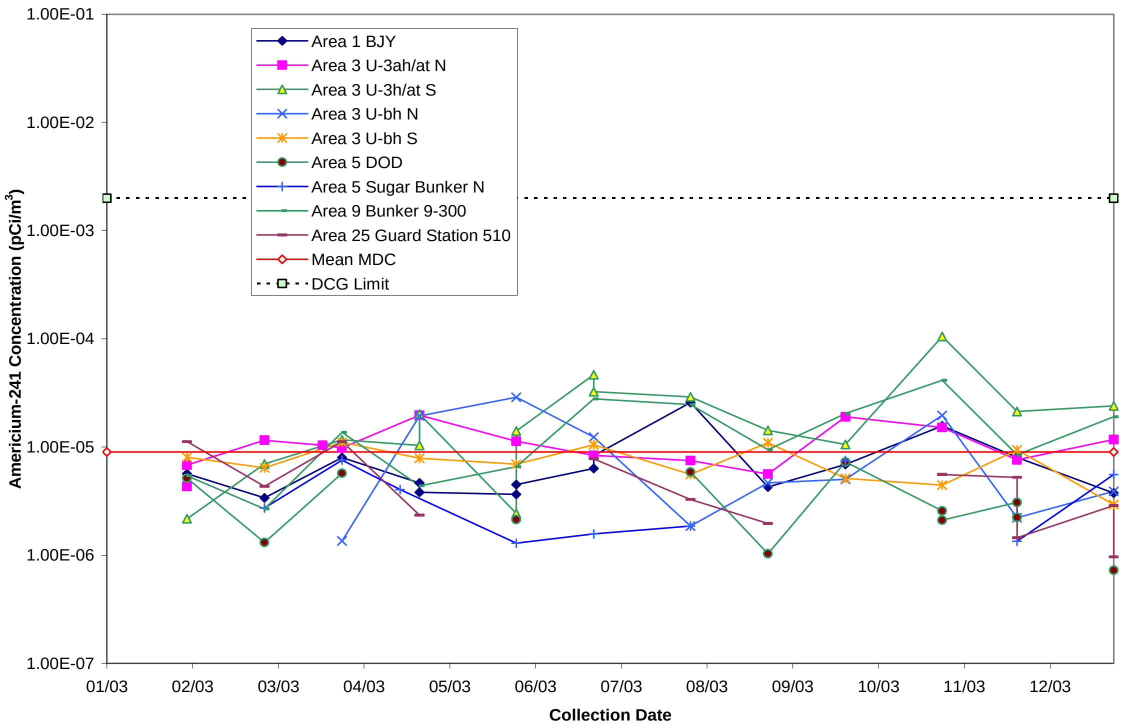

Figure 8. Americium-241 concentrations in air at the RWMSs and other locations

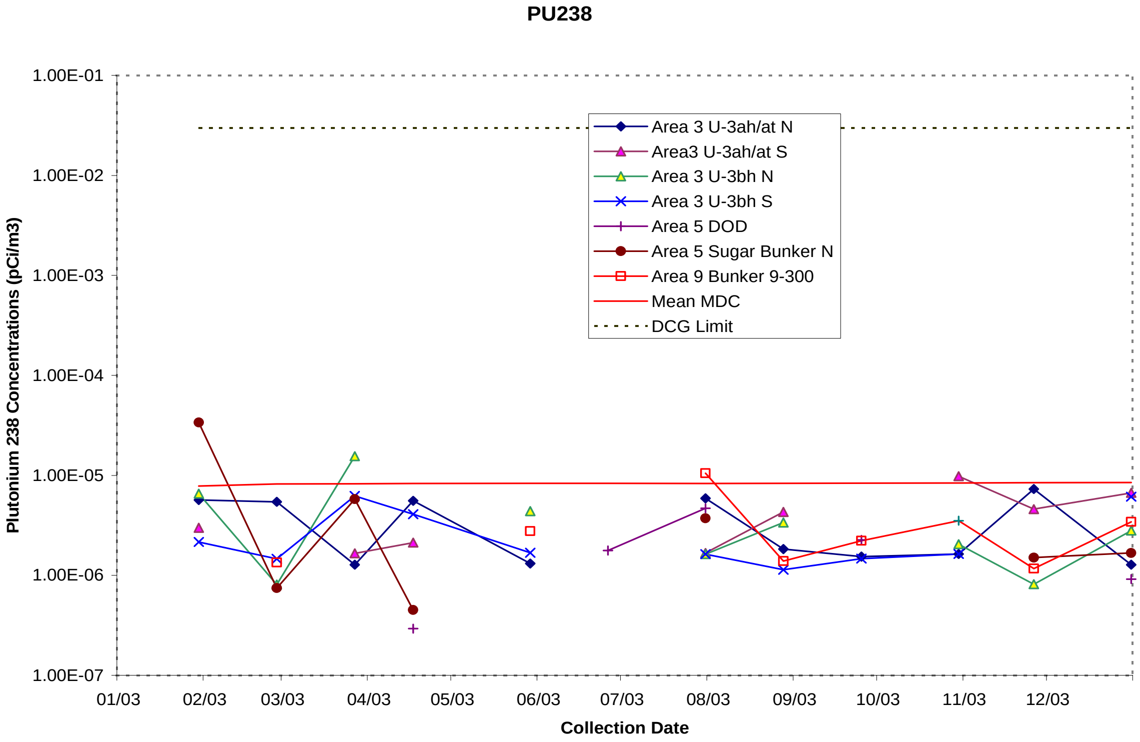

Figure 9. Plutonium-238 concentrations in air at the RWMSs and other locations

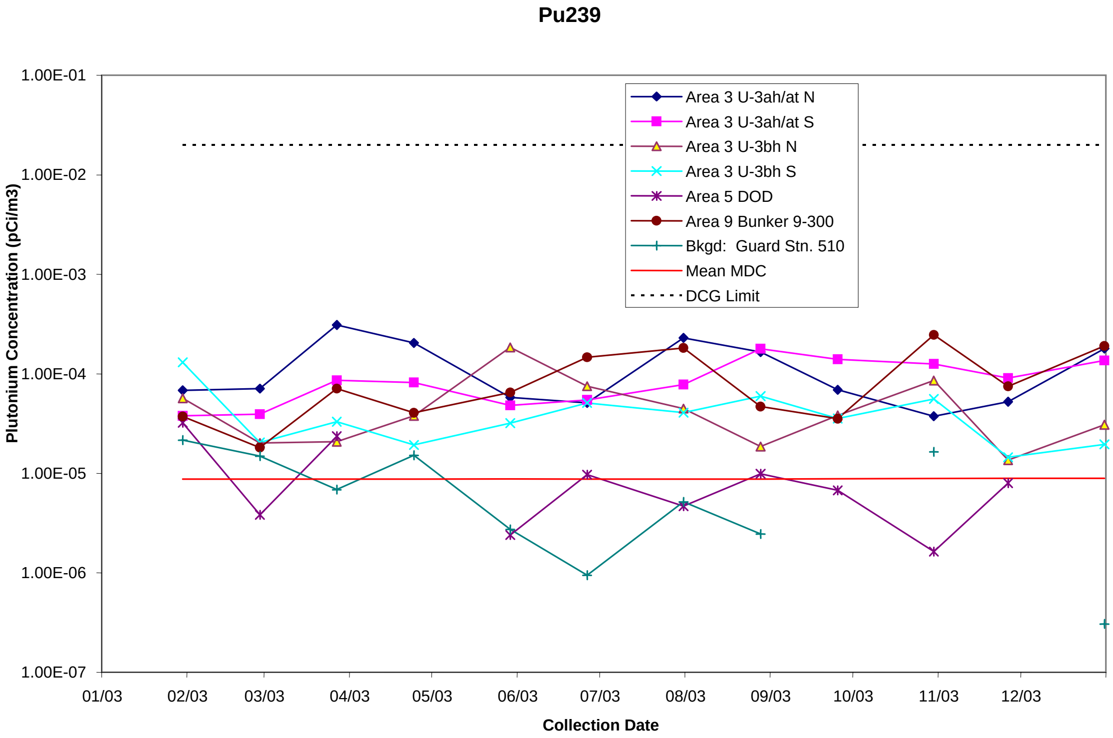

Figure 10. Plutonium-239 concentrations in air at the RWMSs and other locations

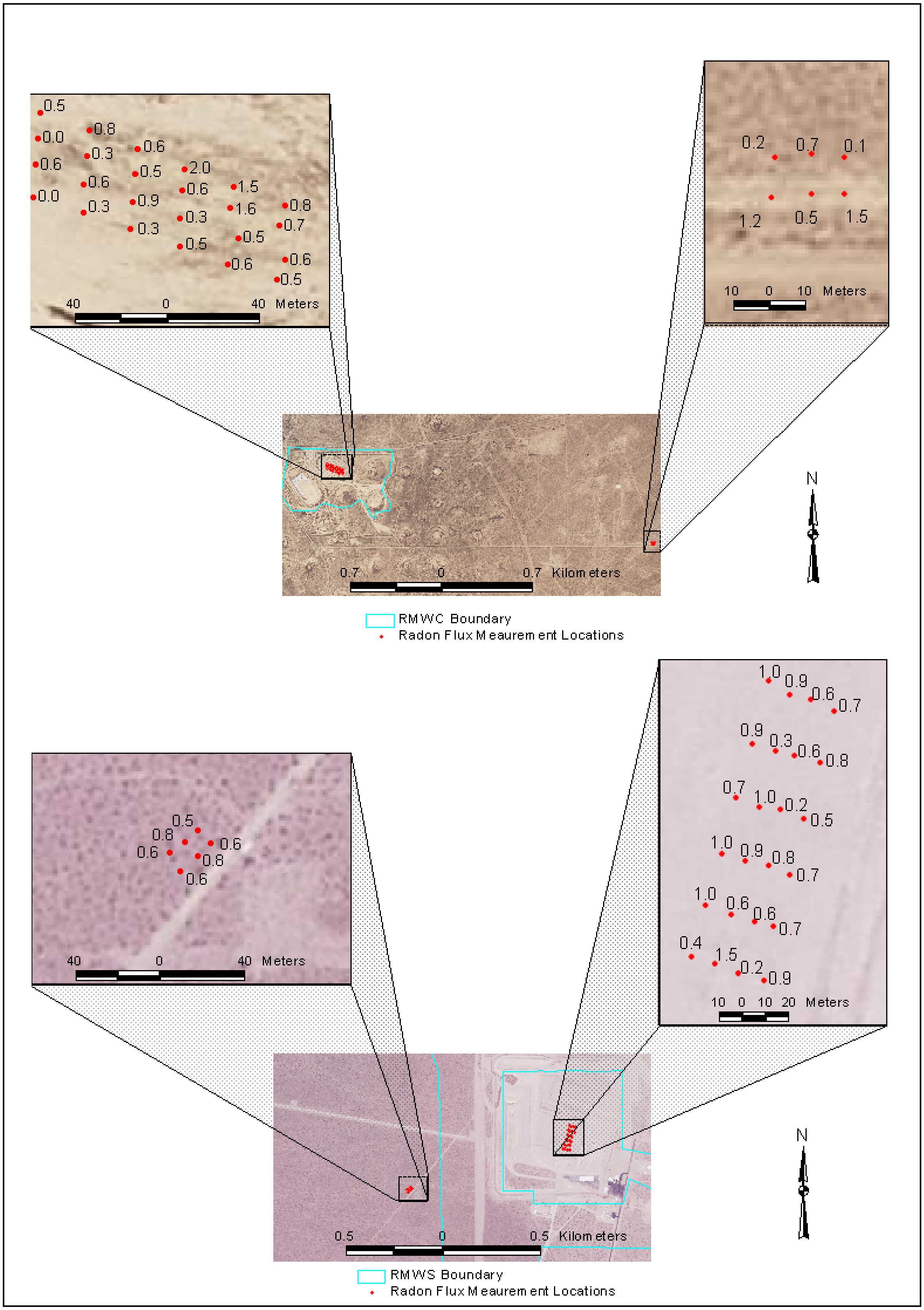

Figure 11. Radon flux measurement locations and results

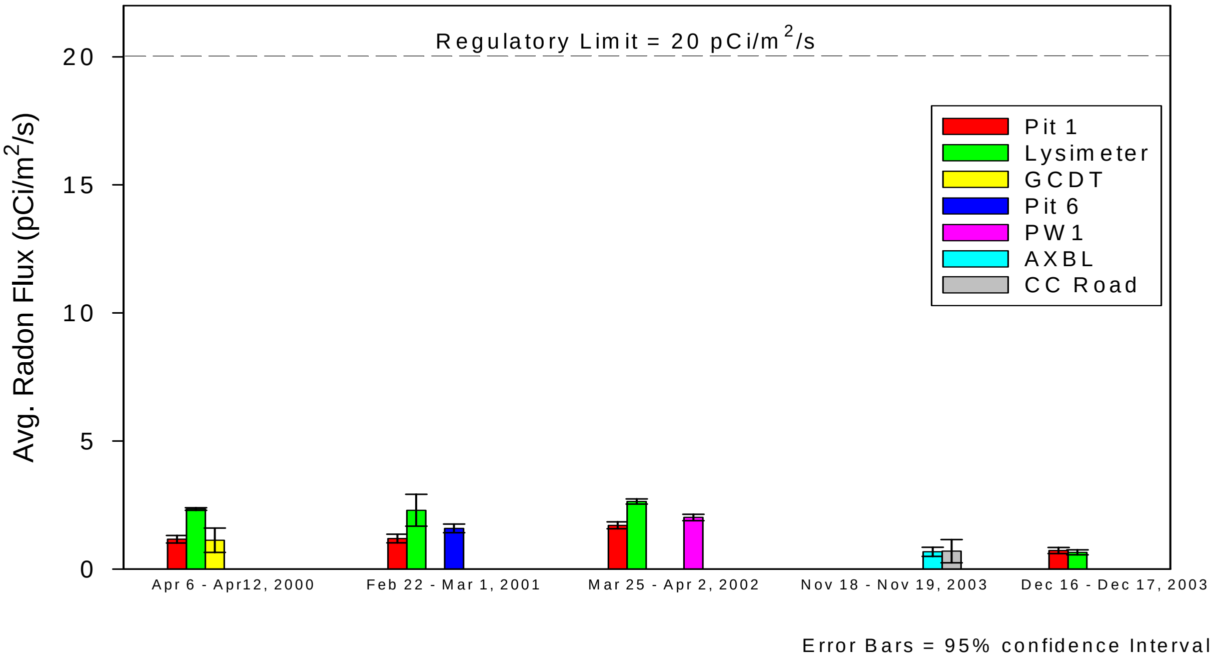

Figure 12. Radon flux measurements made at the Area 5 RWMS (2000 – 2003)

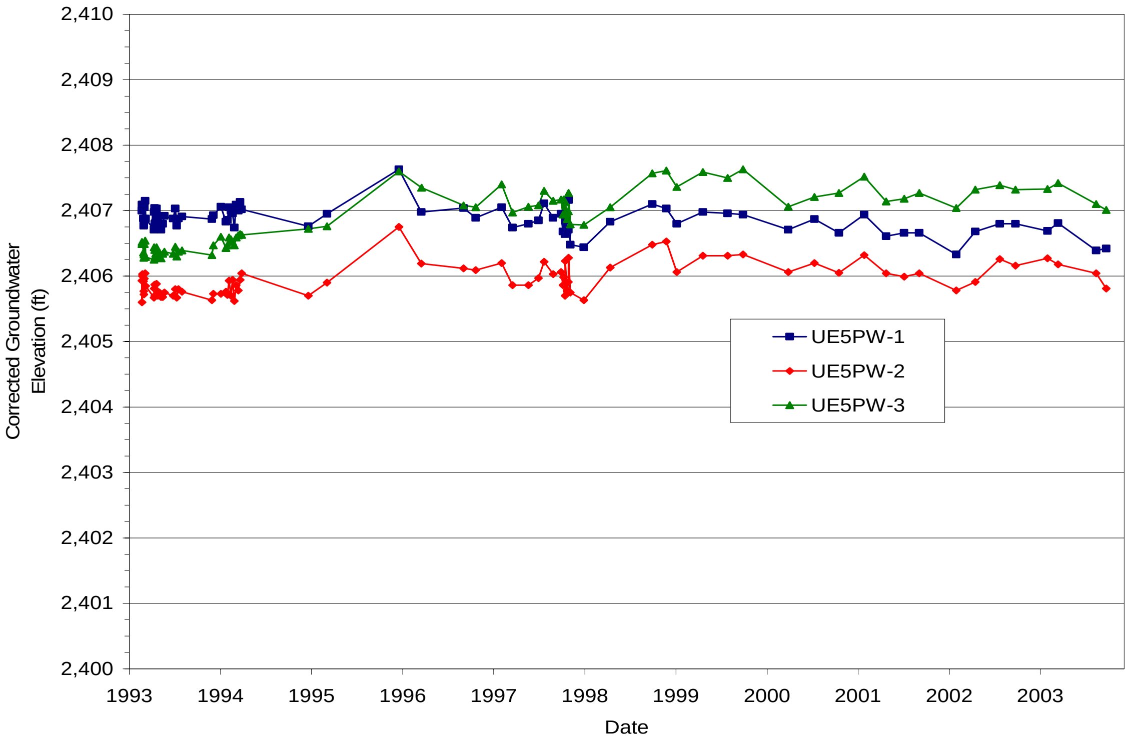

Figure 13. Groundwater elevation measurements recorded at the three Area 5 RWMS pilot wells by tagging

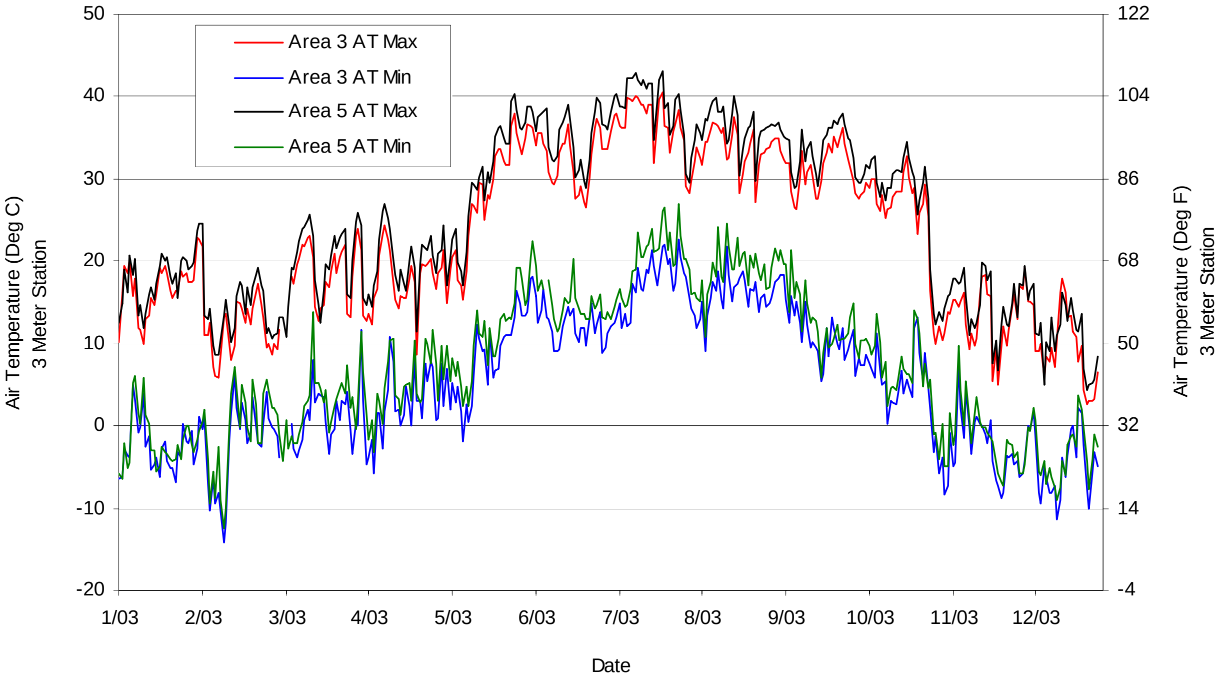

Figure 14. Daily air temperatures recorded at Area 3 and Area 5 RWMS meteorology stations

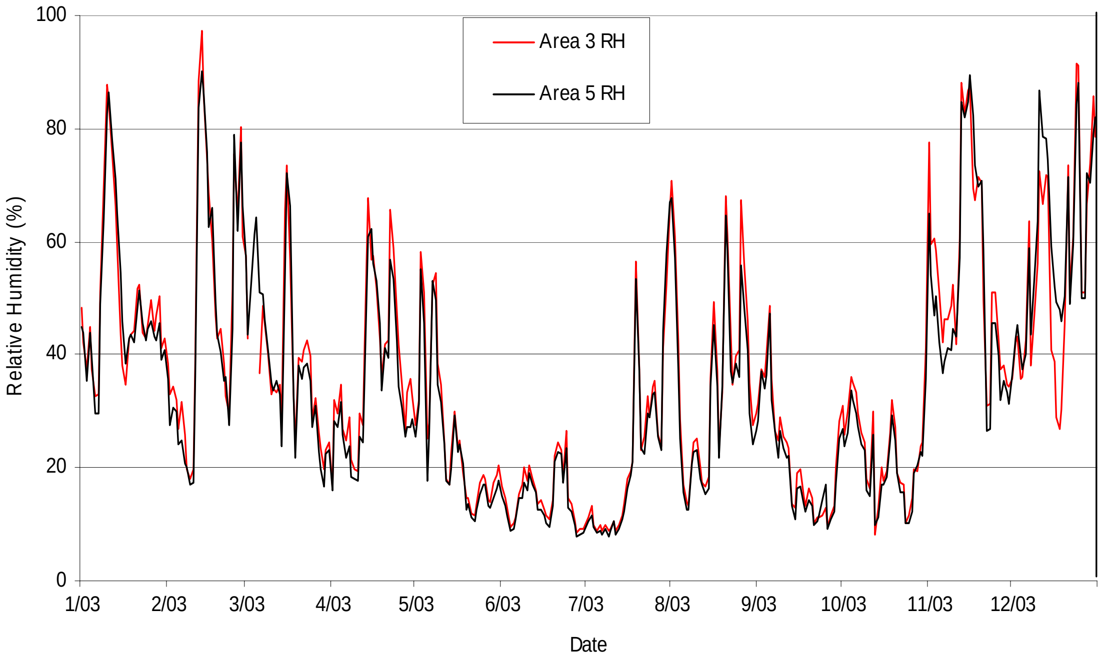

Figure 15. Daily average humidity recorded at Area 3 and Area 5 RWMS meteorology stations

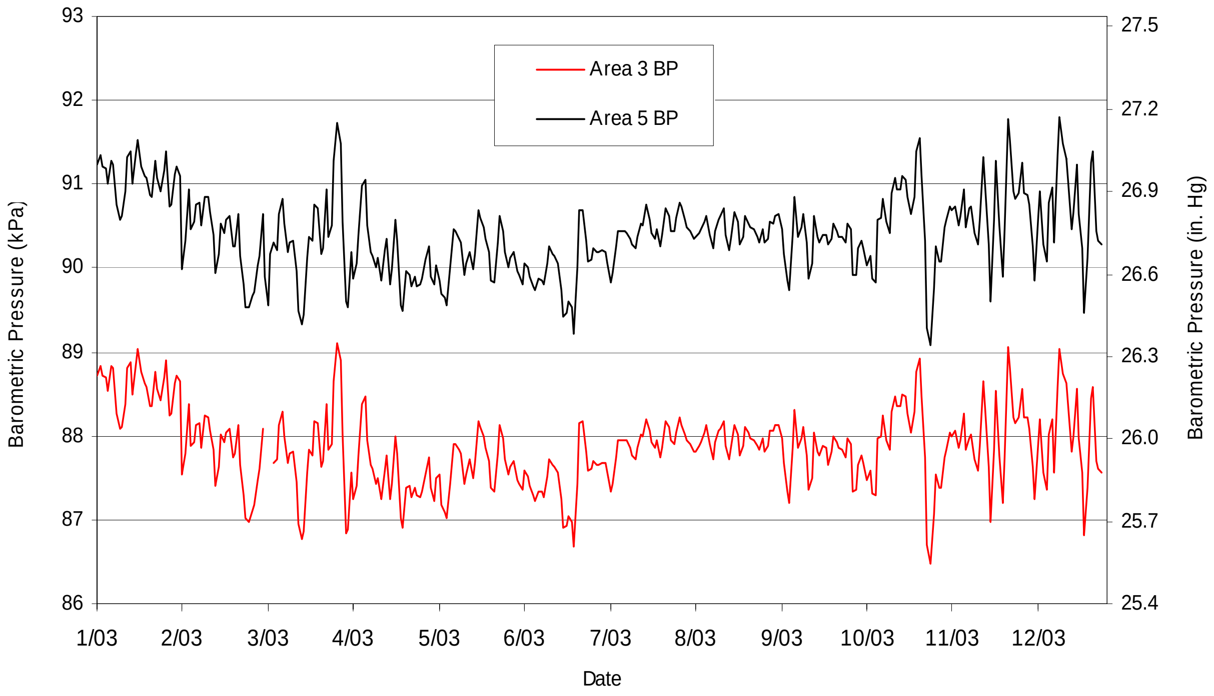

Figure 16. Daily average barometric pressure recorded at Area 3 and Area 5 RWMS meteorology stations

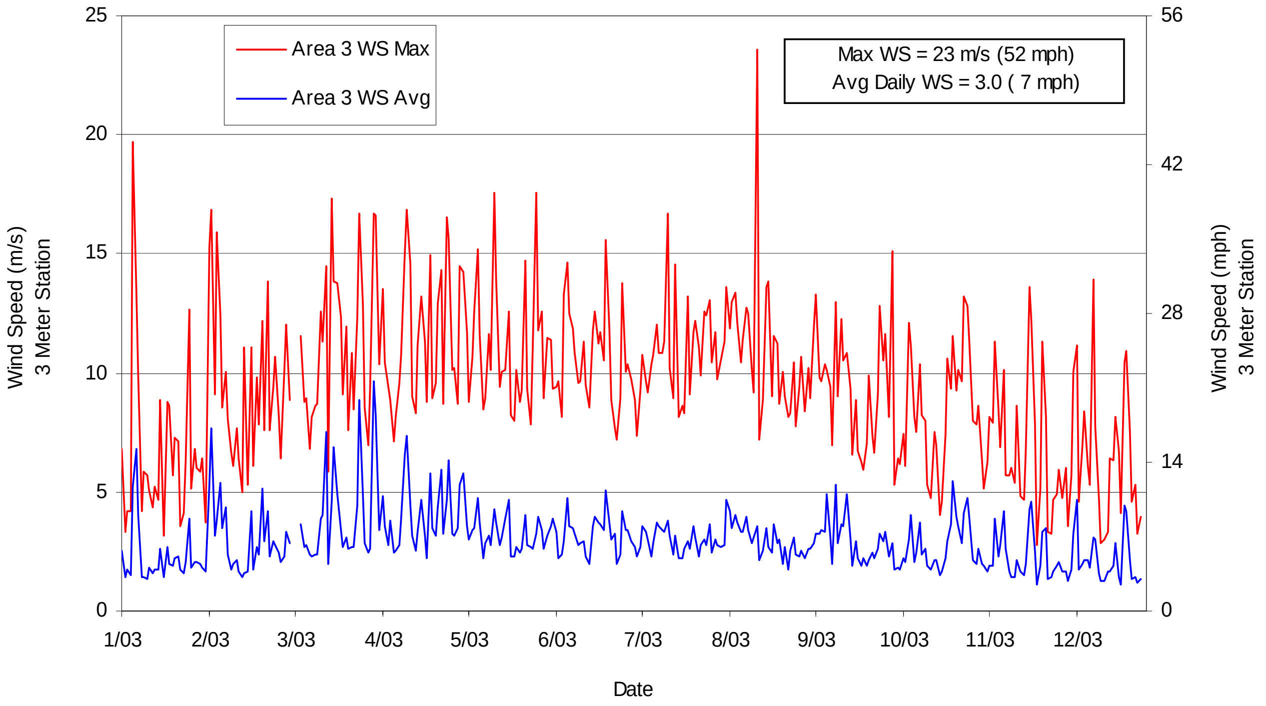

Figure 17. Daily wind speed recorded at Area 3 RWMS meteorology station at a height of 3 m

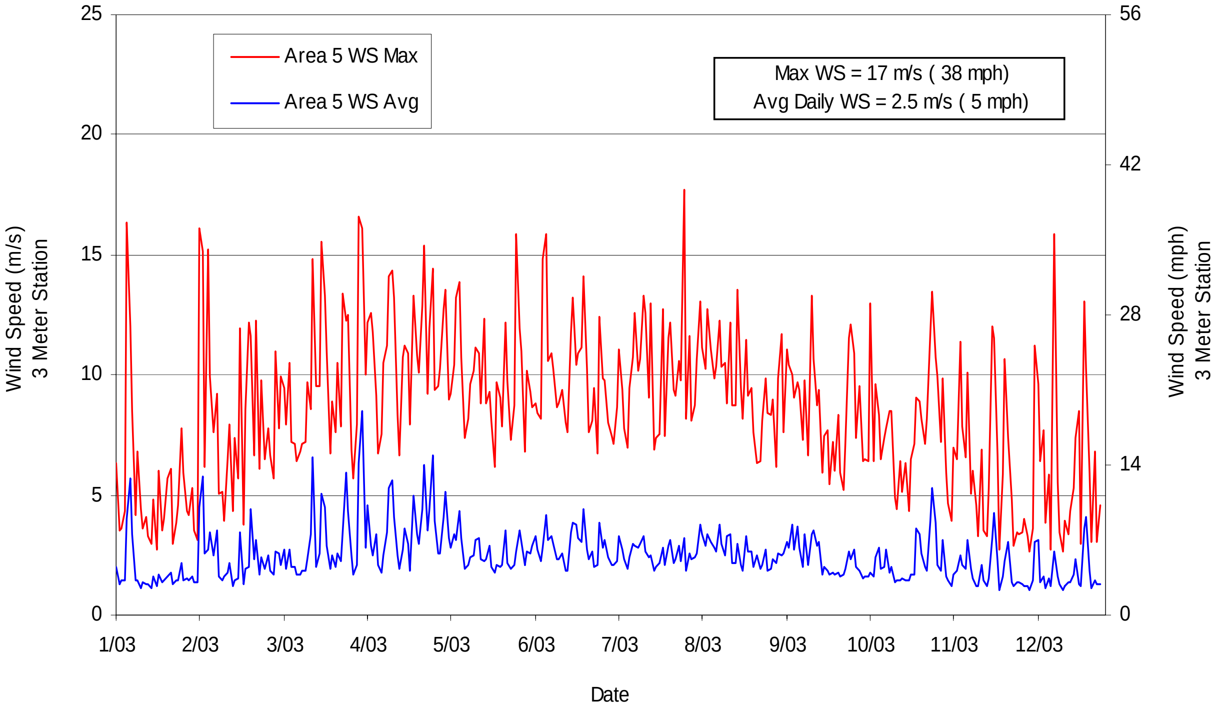

Figure 18. Daily wind speed recorded at Area 5 RWMS meteorology station at a height of 3 m

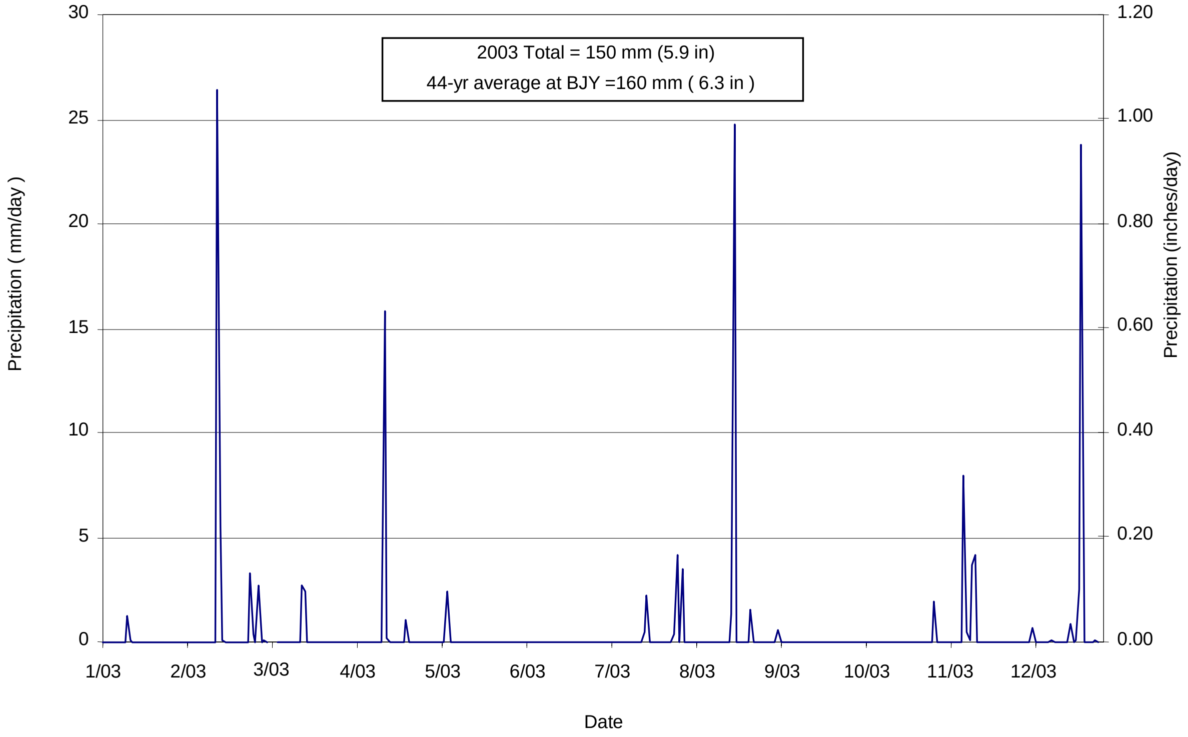

Figure 19. Daily precipitation recorded at Area 3 RWMS meteorology station

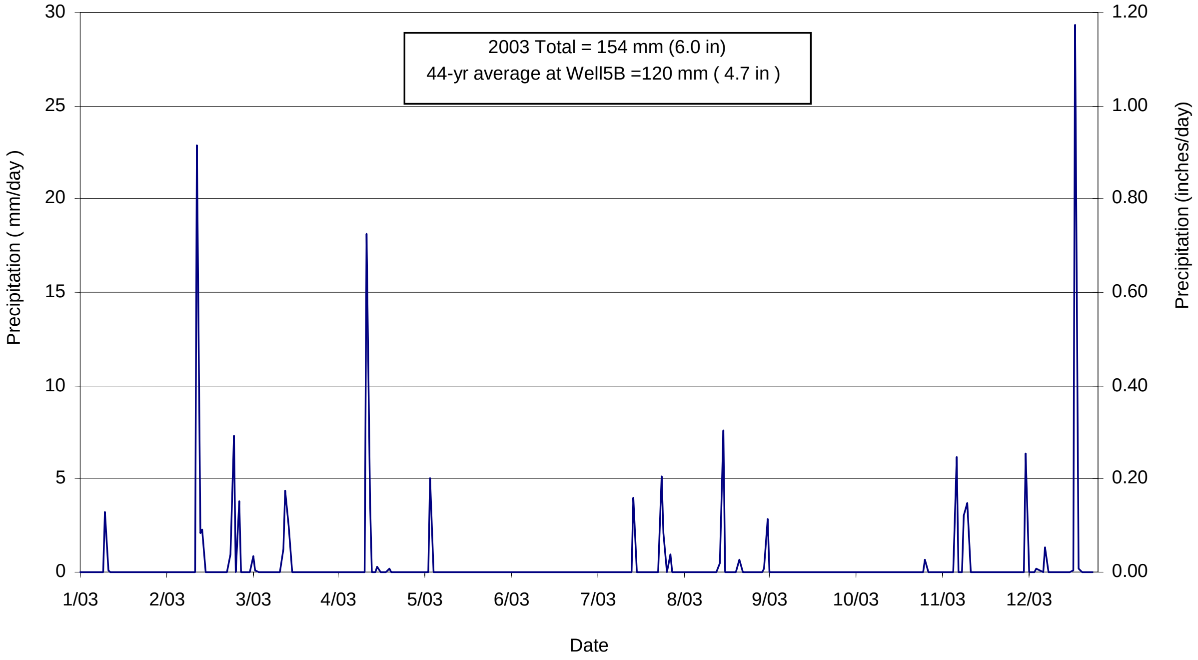

Figure 20. Daily precipitation recorded at Area 5 RWMS meteorology station

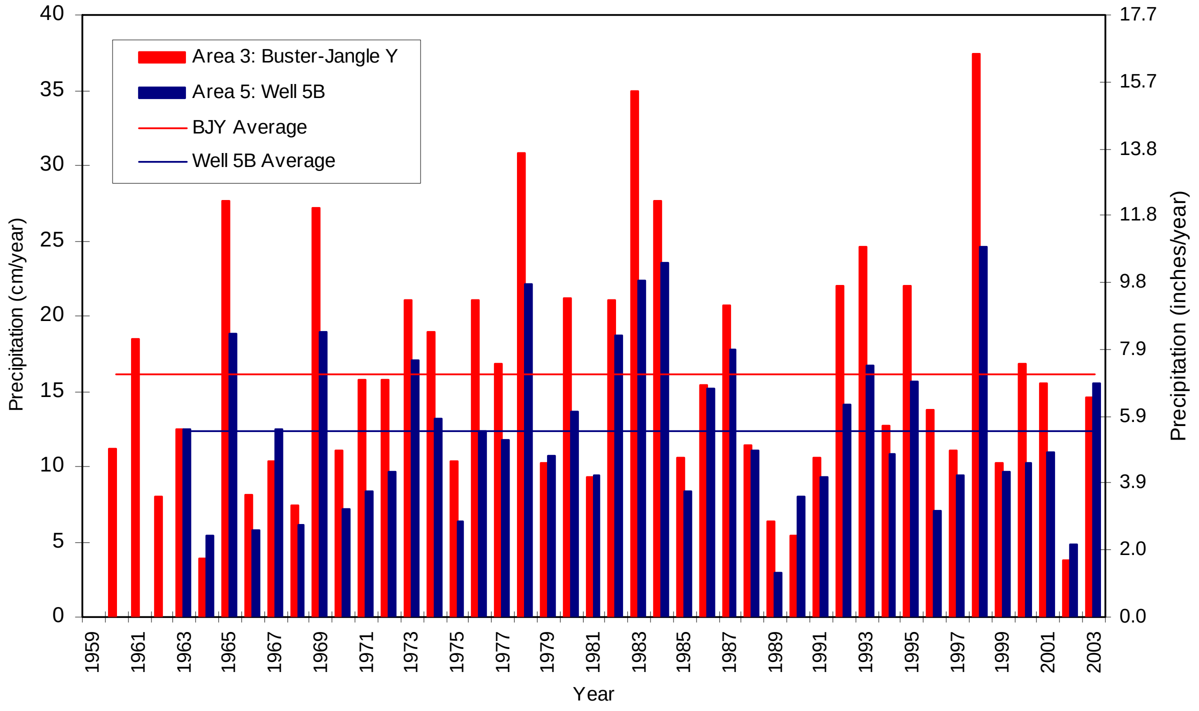

Figure 21. Historical precipitation record for Area 3 and Area 5

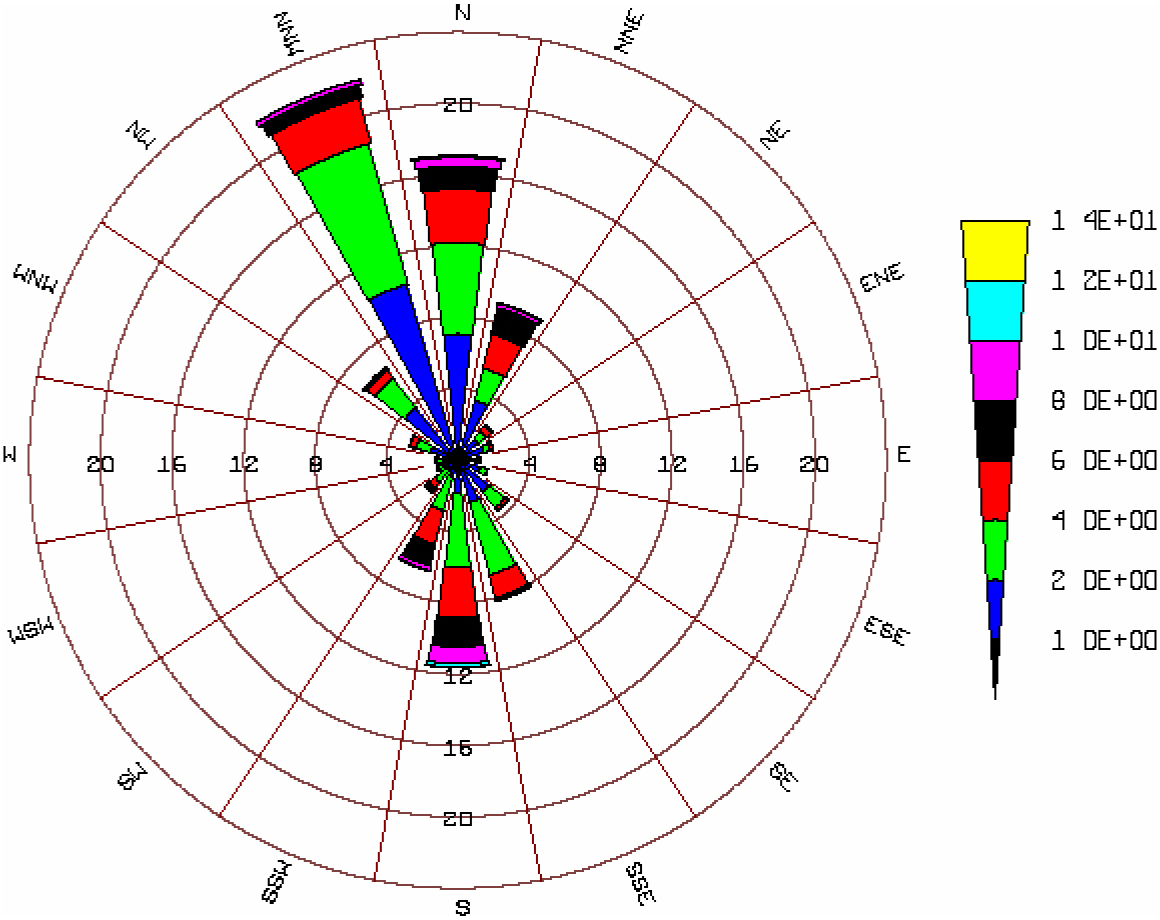

Figure 22. Wind rose diagram for the Area 3 RWMS meteorology station. Concentric labels indicate percent frequency, petal shading indicates wind speed in meters per second at a height of 3 m, and petal direction indicates direction of wind source

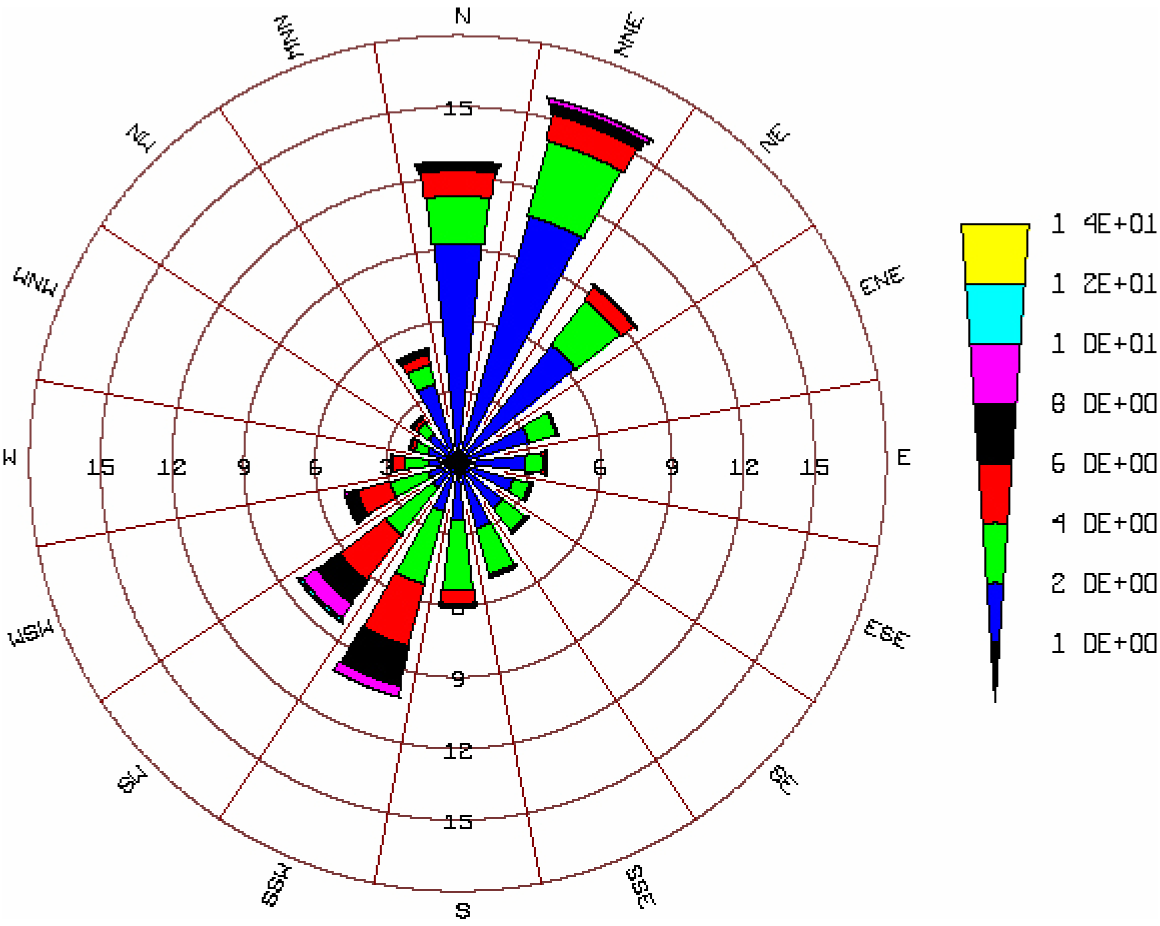

Figure 23. Wind rose diagram for the Area 5 RWMS meteorology station. Concentric labels indicate percent frequency, petal shading indicates wind speed in meters per second at a height of 3 m, and petal direction indicates direction of wind source

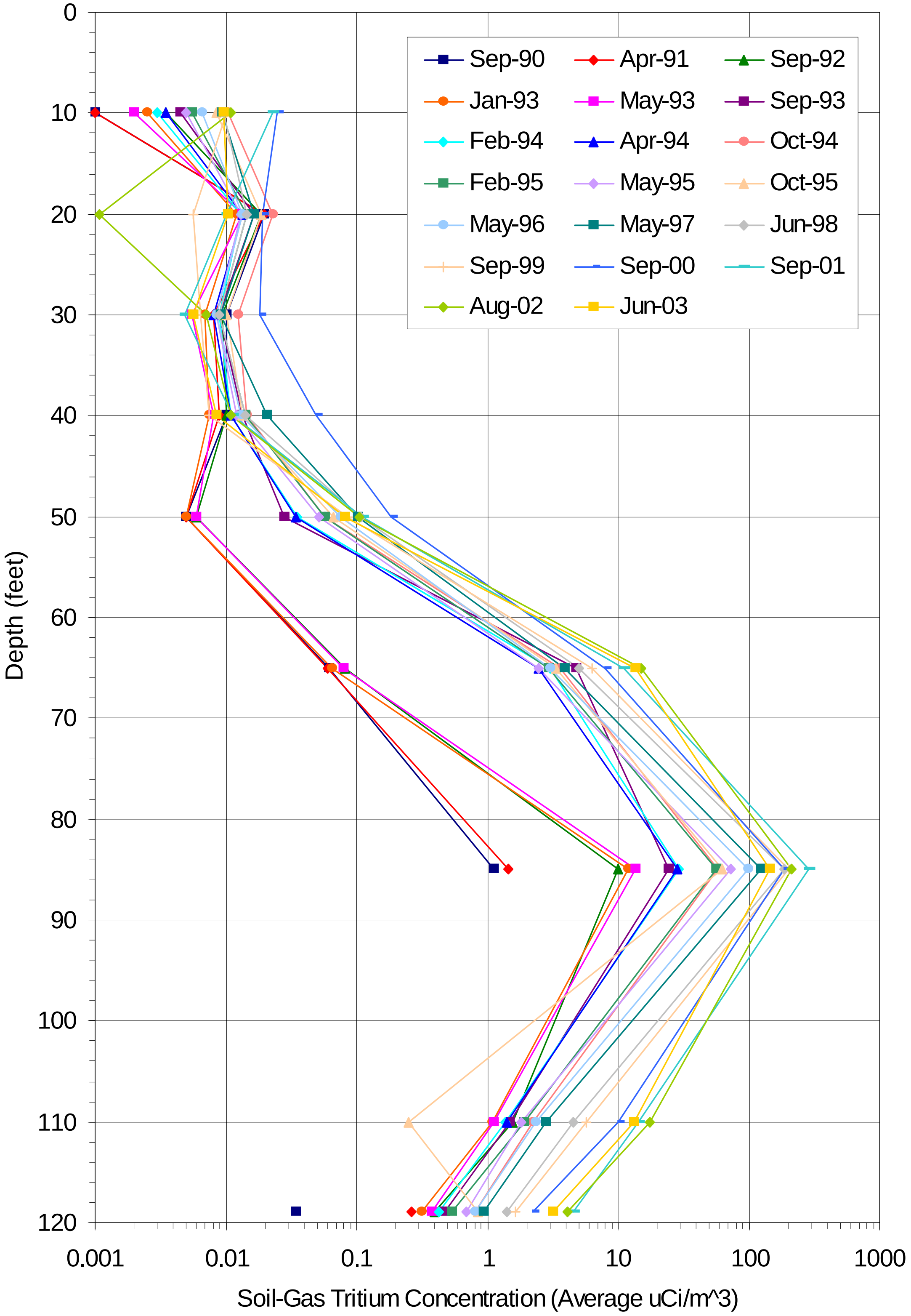

Figure 24. Soil-gas tritium concentrations with depth at GCD-05U

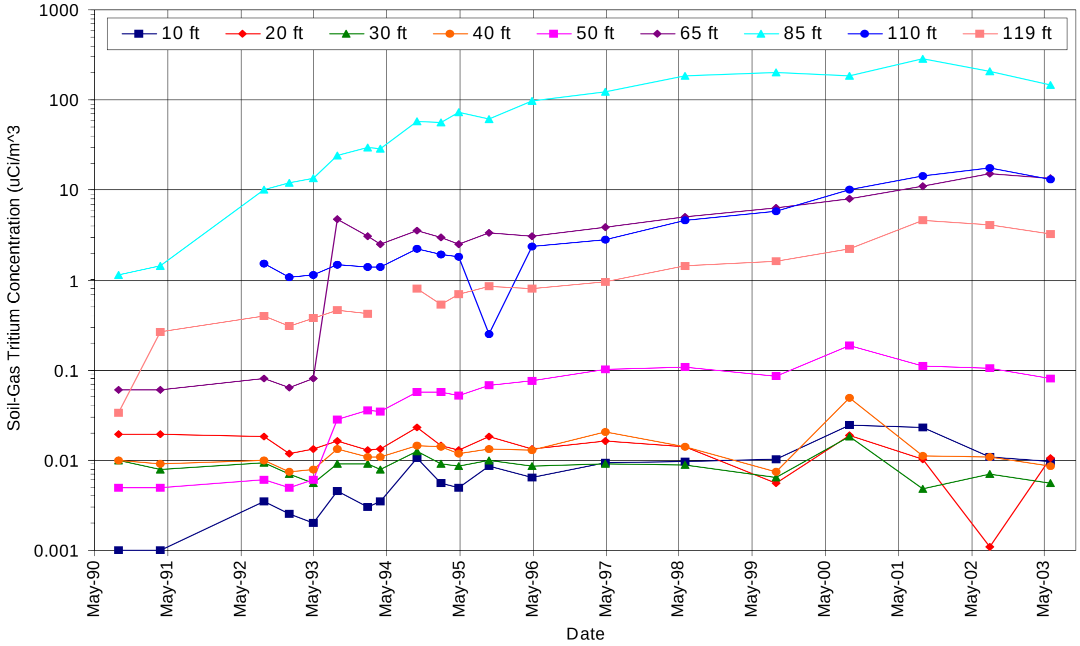

Figure 25. Soil-gas tritium concentrations with time at GCD-05U

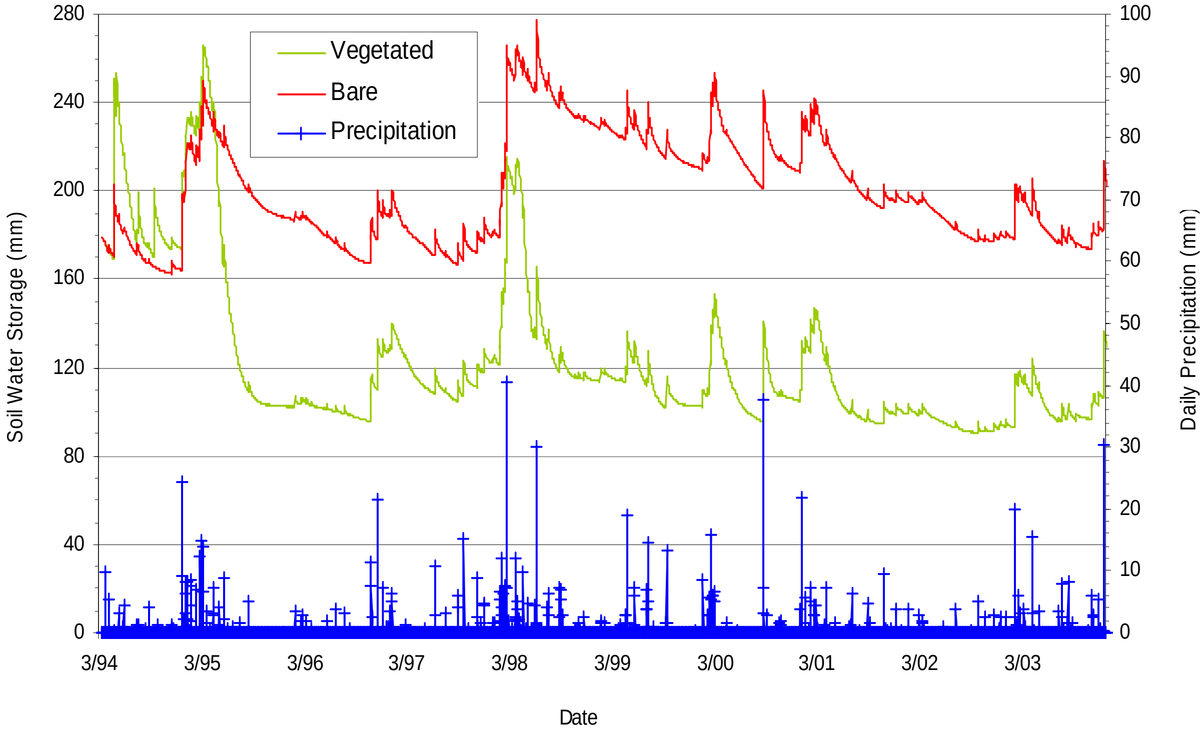

Figure 26. Weighing lysimeter and precipitation data from March 1994 to December 2003

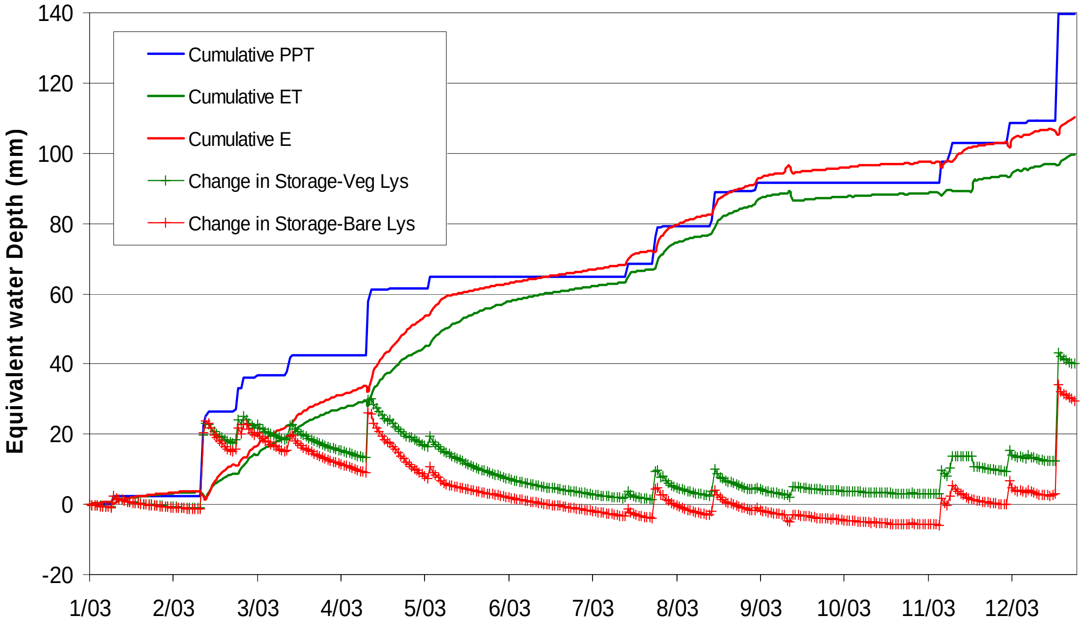

Figure 27. Cumulative PPT, ET, E, and change in storage for the weighing lysimeters in 2003

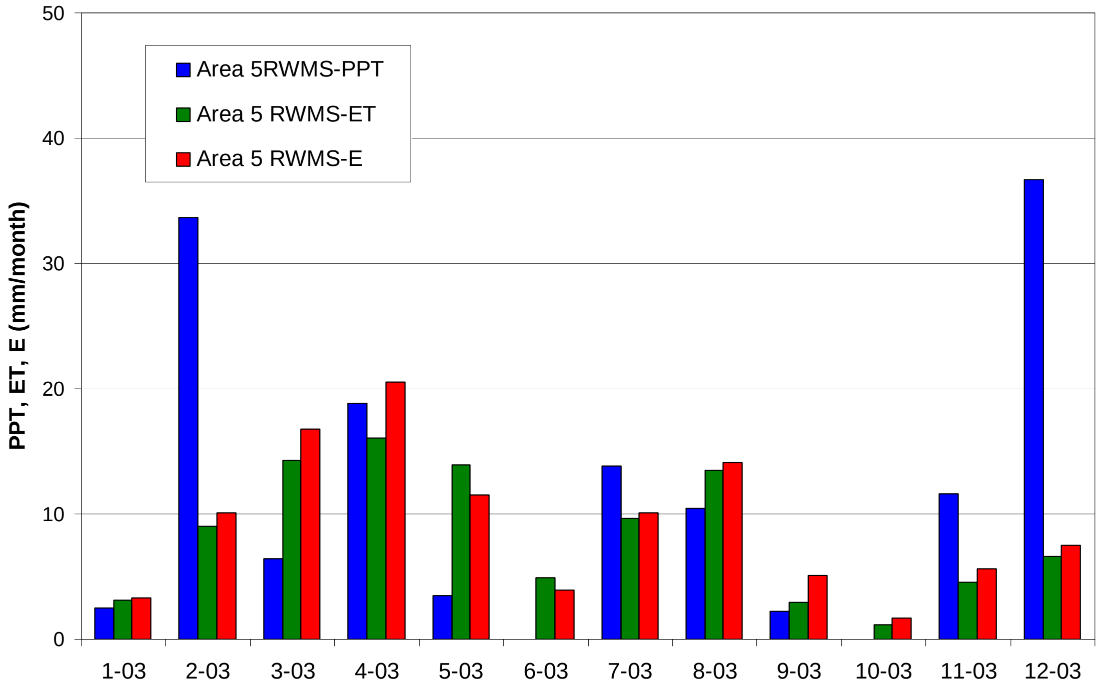

Figure 28. Monthly PPT, E, and ET measured in weighing lysimeters

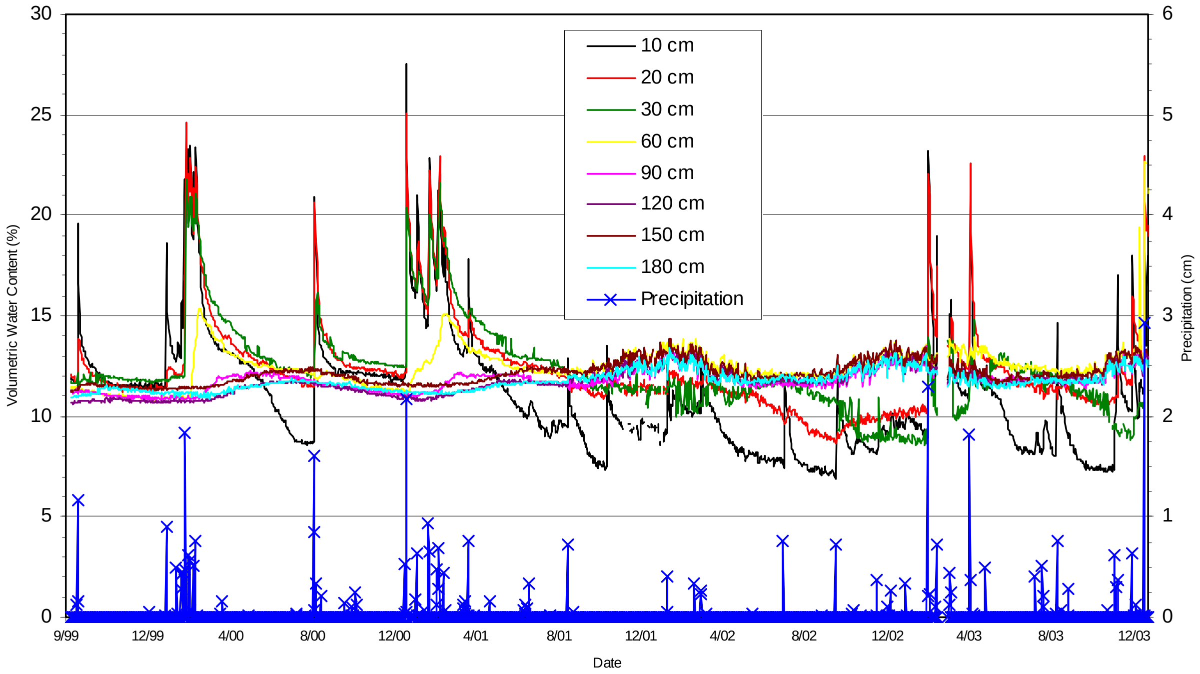

Figure 29. Soil water content in Pit 3 waste cover (north site) using an automated TDR system

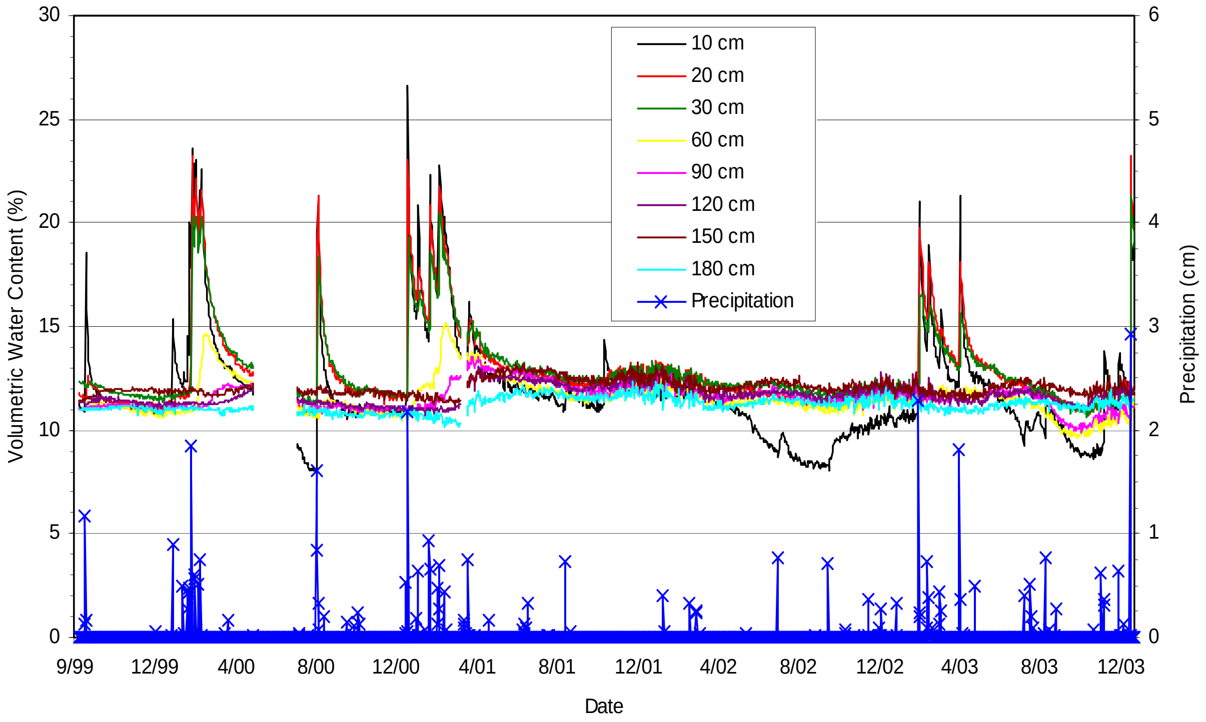

Figure 30. Soil water content in Pit 3 waste cover (south site) using an automated TDR system

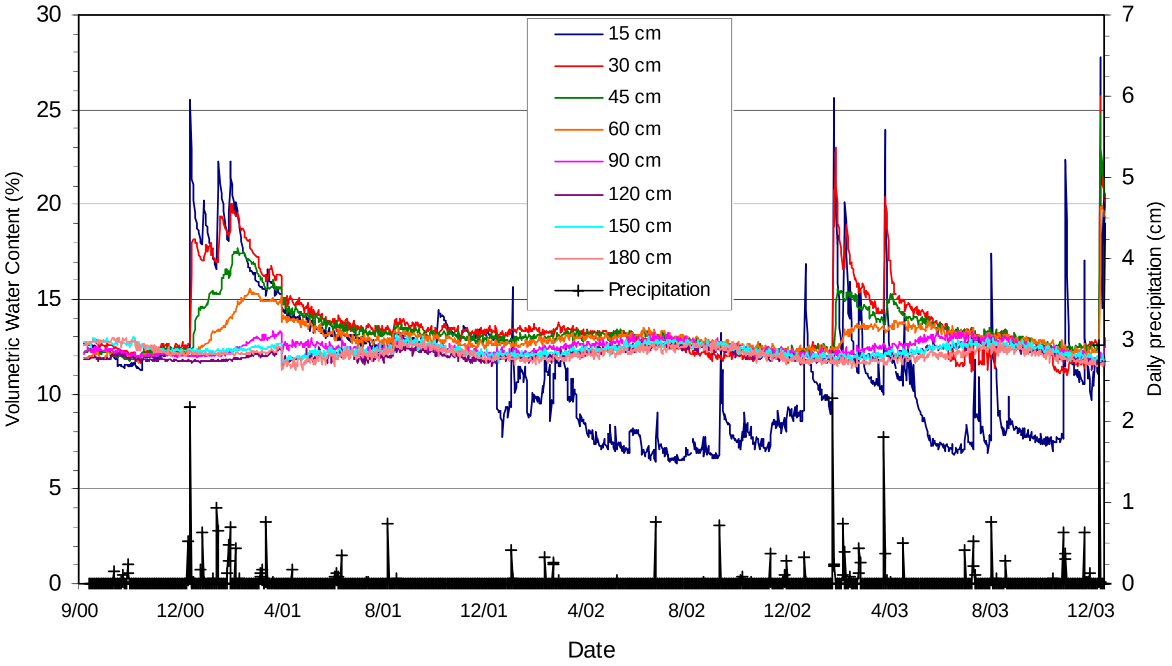

Figure 31. Soil water content in Pit 4 waste cover using an automated TDR system

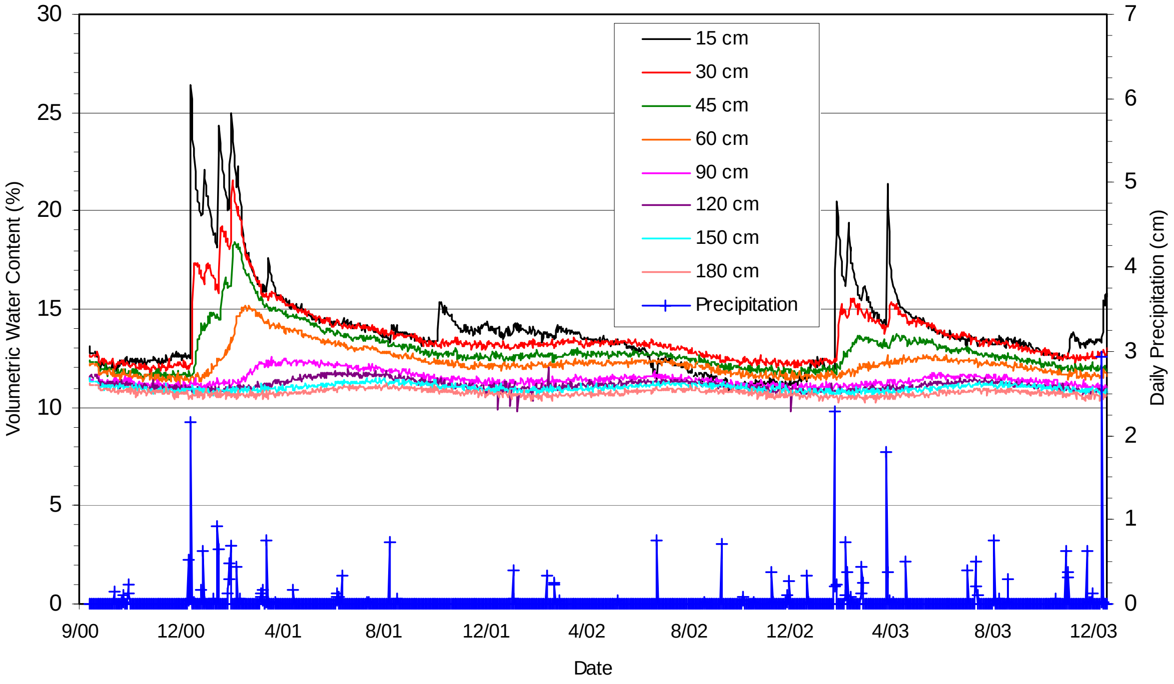

Figure 32. Soil water content in Pit 5 waste cover using an automated TDR system

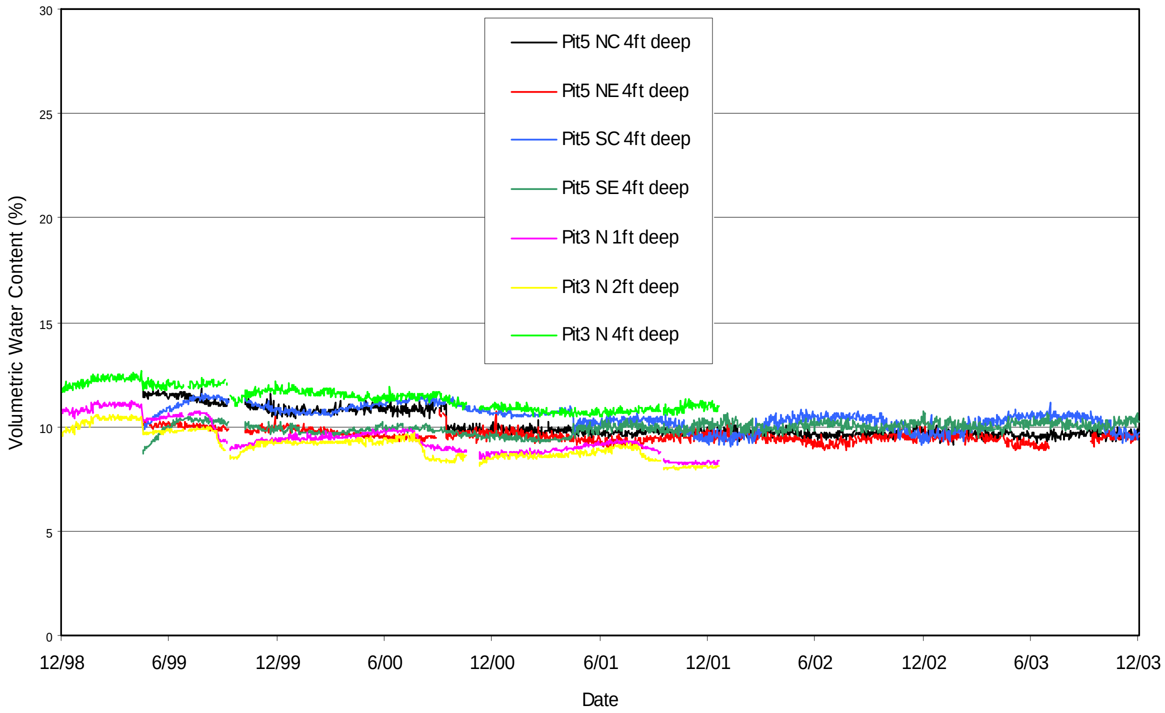

Figure 33. Soil water content in Pit 3 and Pit 5 floors using automated TDR systems

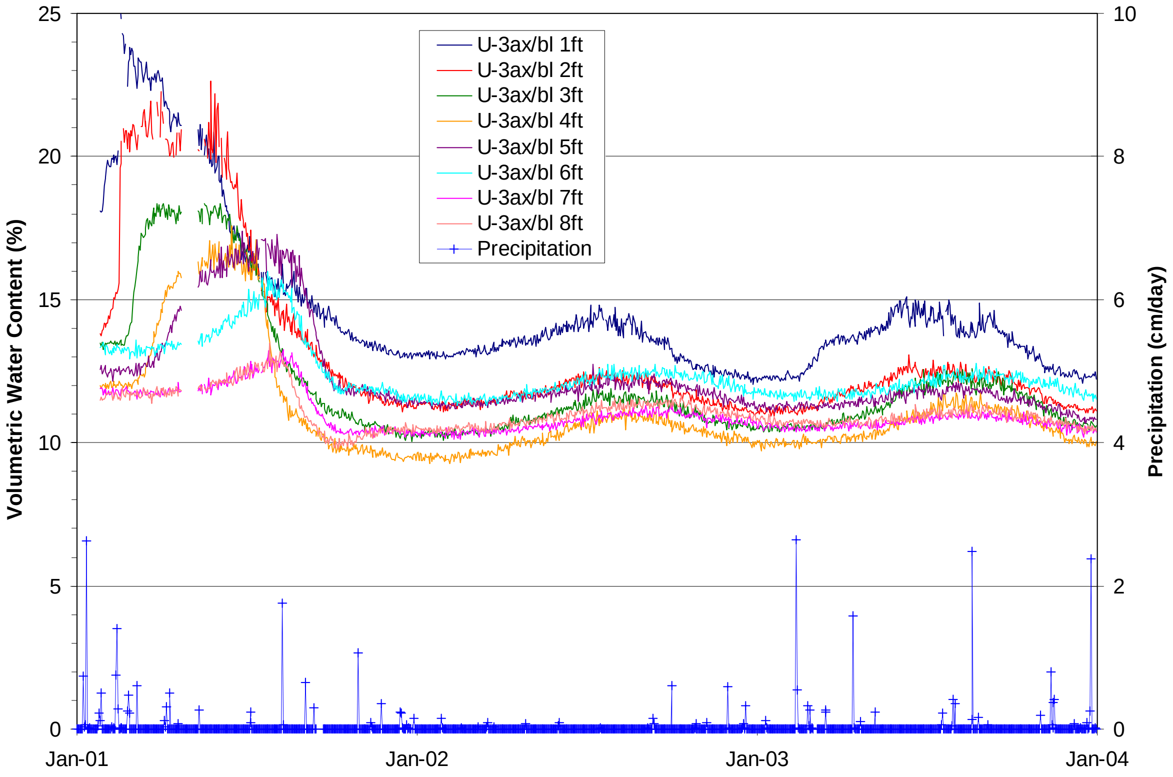

Figure 34. Soil water content in U-3ax/bl waste cover (west station) using a TDR system

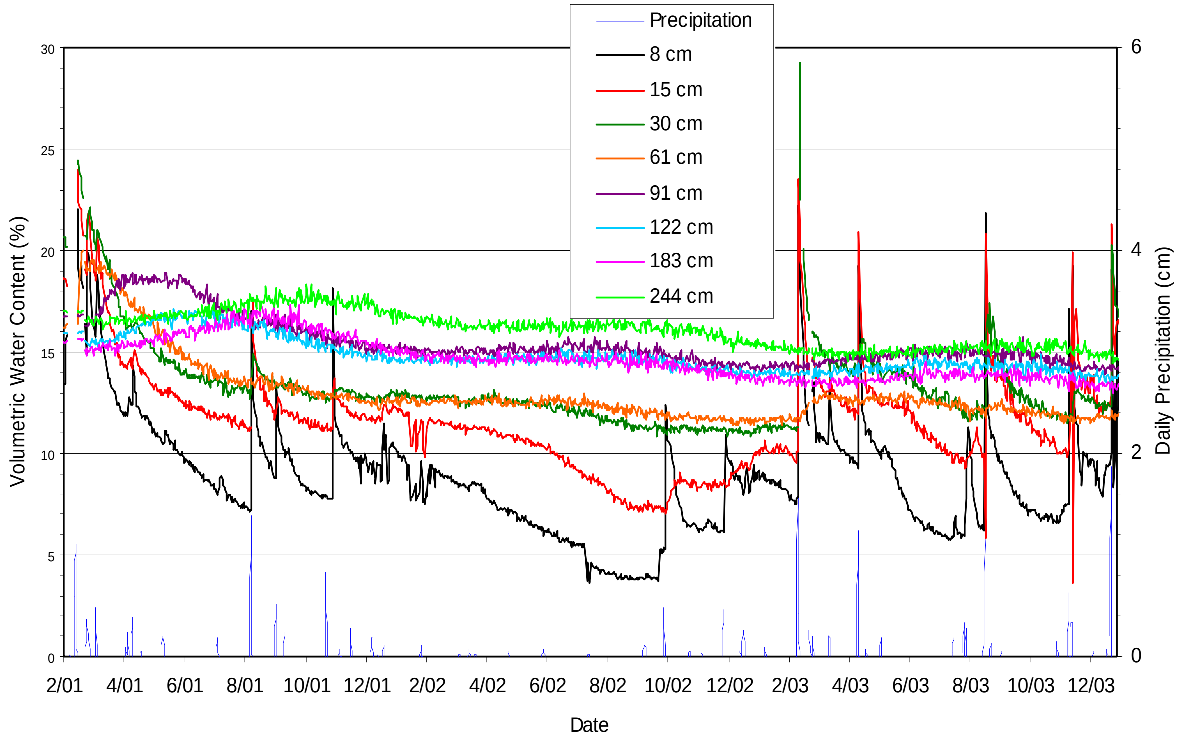

Figure 35. Soil water content in bare drainage lysimeter (A) using a TDR system

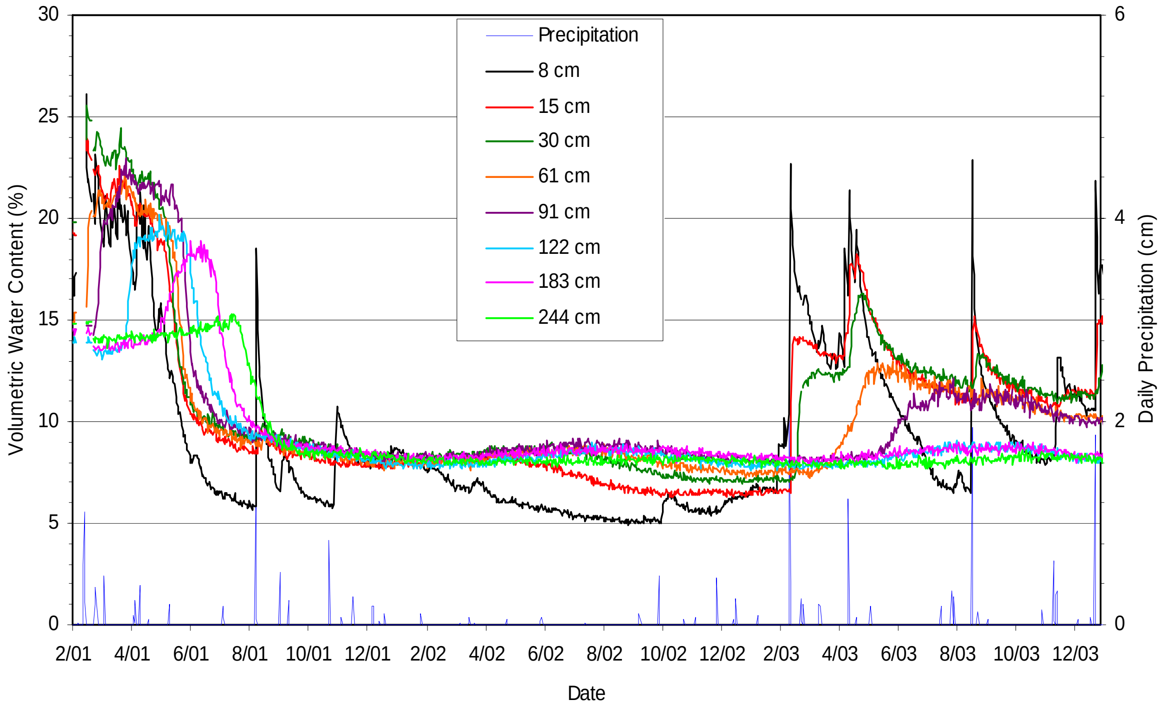

Figure 36. Soil water content vegetated drainage lysimeter (E) using TDR system

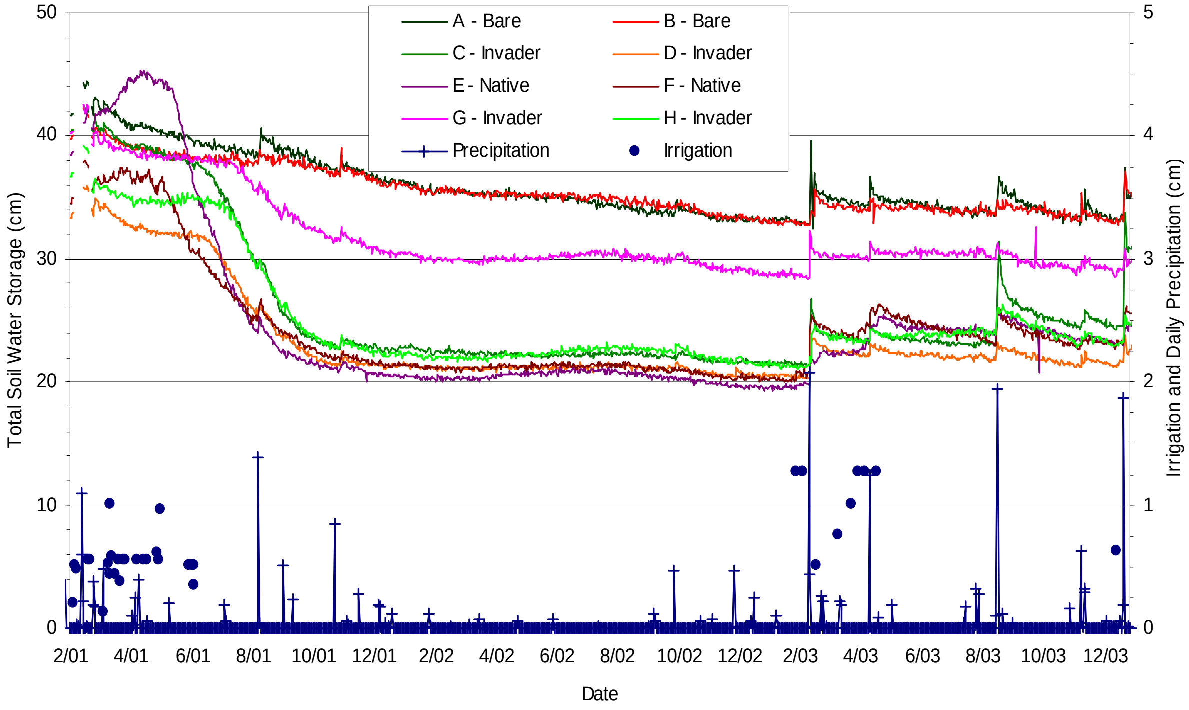

Figure 37. Soil water storage in drainage lysimeters

Table 1. Locations and descriptions of subsidence features observed in 2003

Date	Area	Cell #	Northing	Easting	Feature Description
11/13/2003	5	Pit 3	767,775.705	709,289.625	Fissure; north-south, ~30 ft from slope/face, under logger stations
			767,971.198	709,289.183	
11/13/2003	5	Pit 4	766,956.877	707764.847	Pocket; 2 ft diameter
11/13/2003	5	Pit 5	767,084.487	707,584.570	Pocket/AEI; 9 ft diameter
11/13/2003	5	Pit 5	767,628.553	707,660.902	Pocket; 3 ft diameter
11/13/2003	5	Pit 5	767,285.008	707,516.883	Potential fill by operations? SW of station Pit 5-North
			767,280.576	707,590.727	

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