Prepared in cooperation with Idaho Army National Guard

Assessment of Soil and Water Contaminants from Selected Locations in and near the Idaho Army National Guard Orchard Training Area, Ada County, Idaho, 2001–2003

Scientific Investigations Report 2004–5207

Version 1.0

U.S. Department of the Interior
U.S. Geological Survey

Cover left: Range Road landmark, Orchard Training Area, Ada County, Idaho
Cover right: Orchard Training Area sign, Elmer Road, April 2003

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Gale A. Norton, Secretary

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Charles G. Groat, Director

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Conversion Factors

Multiply	By	To obtain
acre	4,047	square meter (m^2)
foot (ft)	0.3048	meter (m)
gallon (gal)	3.785	liter (L)
inch (in.)	25.4	millimeter (mm)
mile (mi)	1.609	kilometer (km)
mile per hour (mph)	1.609	kilometer per hour (km/h)
ounce, fluid (fl. oz)	0.02957	liter (L)
square foot (ft^2)	0.09290	square meter (m^2)
square mile (mi^2)	2.590	square kilometer (km^2)

Refer to table A, appendix, for explanations of other units.

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F=(1.8\times°C)+32$$

Vertical coordinate information is referenced to the North American Datum of 1927 (NAD27).

Elevation, as used in this report, refers to distance above the vertical datum.

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

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Assessment of Soil and Water Contaminants from Selected Locations in and near the Idaho Army National Guard Orchard Training Area, Ada County, Idaho, 2001–2003

By D.J. Parliman

ABSTRACT

In 2001, the National Guard Bureau and the U.S. Geological Survey began a project to compile hydrogeologic data and determine presence or absence of soil, surface-water, and ground-water contamination at the Idaho Army National Guard Orchard Training Area in southwestern Idaho. Between June 2002 and April 2003, a total of 114 soil, surface-water, ground-water, precipitation, or dust samples were collected from 68 sample sites (65 different locations) in the Orchard Training Area (OTA) or along the vehicle corridor to the OTA. Soil and water samples were analyzed for concentrations of selected total trace metals, major ions, nutrients, explosive compounds, semivolatile organics, and petroleum hydrocarbons. Water samples also were analyzed for concentrations of selected dissolved trace metals and major ions.

Distinguishing naturally occurring large concentrations of trace metals, major ions, and nutrients from contamination related to land and water uses at the OTA was difficult. There were no historical analyses for this area to compare with modern data, and although samples were collected from 65 locations in and near the OTA, sampled areas represented only a small part of the complex OTA land-use areas and soil types. For naturally occurring compounds, several assumptions were made—anomalously large concentrations, when tied to known land uses, may indicate presence of contamination; naturally occurring concentrations cannot be separated from contamination concentrations in mid- and lower ranges of data; and smallest concentrations may represent the lowest naturally occurring range of concentrations and (or) the absence of contaminants related to land and water uses. Presence of explosive, semivolatile organic (SVOC), and petroleum hydrocarbon compounds in samples indicates contamination from land and water uses.

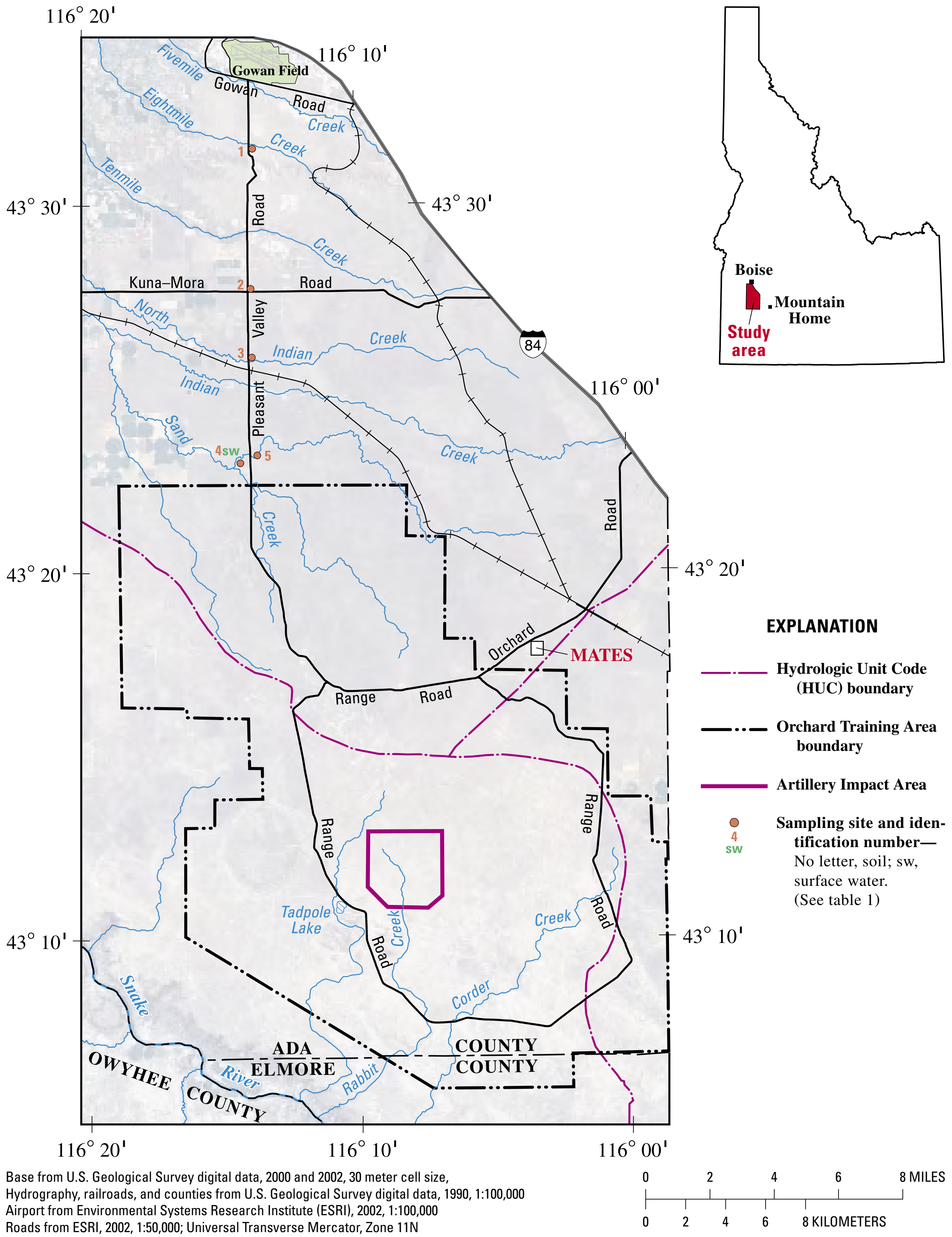
In areas along the vehicle corridor and major access roads within the OTA, most trace metal, major ion, and nutrient concentrations in soil samples were not in the upper 10th percentile of data, but concentrations of 25 metals, ions, or nutrients were in the upper 10th percentile in a puddle sample near the heavy equipment maneuvering area, MPRC-H. The largest concentrations of tin, ammonia, and nitrite plus nitrate (as nitrogen) in water from the OTA were detected in a sample from this puddle. Petroleum hydrocarbons were the most common contaminant, detected in all soil and surface-water samples. An SVOC, bis (2-ethylhexyl) phthalate, a plasticizer, was detected at a site along the vehicle corridor.

In Maneuver Areas within the OTA, many soil samples contained at least one trace metal, major ion, or nutrient in the upper 10th percentile of data, and the largest concentrations of cobalt, iron, mercury, titanium, sodium, ammonia, or total phosphorus were detected in 6 of 13 soil samples outside the Tadpole Lake area. The largest concentrations of aluminum, arsenic, beryllium, nickel, selenium, silver, strontium, thallium, vanadium, chloride, potassium, sulfate, and nitrite plus nitrate were detected in soil samples from the Tadpole Lake area. Water from Tadpole Lake contained the largest total concentrations of 19 trace metals, 4 major ions, and 1 nutrient. Petroleum hydrocarbons were detected in 5 soil samples and water from Tadpole Lake. SVOCs related to combustion of fuel or plasticizers were detected in 1 soil sample. Explosive compounds were detected in 1 precipitation sample.

In the Impact Area within the OTA, most soil samples contained at least one trace metal, major ion, or nutrient in the upper 10th percentile of data, and the largest concentrations of barium, chromium, copper, manganese, lead, or orthophosphate were detected in 6 of the 18 soil samples. Petroleum hydrocarbons were detected in 4 soil samples, SVOCs in 6 samples, and explosive compounds in 4 samples.

In the mobilization and training equipment site (MATES) compound adjacent to the OTA, all soil and water samples contained at least one trace metal, major ion, or nutrient in the upper 10th percentile of data. The largest concentrations of antimony, cadmium, molybdenum, tin, zinc, or fluoride were detected in 2 of the 7 soil samples. The largest concentrations of antimony, cadmium, zinc, or fluoride were detected in drain or pond water samples. Petroleum hydrocarbons were detected in 6 soil samples and 2 water samples. SVOCs were detected in 3 soil samples. The explosive compound RDX was detected in 1 soil sample and 1 ground-water sample.

Suggestions for future action or further investigations include containing water in the MATES northeast drain within the MATES boundary, resampling the MATES well for explosive compound analyses, collecting and analyzing soil



Base from U.S. Geological Survey digital data, 2000 and 2002, 30 meter cell size,
Hydrography, railroads, and counties from U.S. Geological Survey digital data, 1990, 1:100,000
Airport from Environmental Systems Research Institute (ESRI), 2002, 1:100,000
Roads from ESRI, 2002, 1:50,000; Universal Transverse Mercator, Zone 11N
Datum NAD83

Figure 1. Location of the Orchard Training Area, Gowen Field, vehicle corridor, and sampling sites along the Pleasant Valley Road vehicle corridor, Ada County, Idaho

and water from additional playas, and studying transport mechanisms, extent of transport, and effects of explosive compounds on wildlife in and moving through the OTA areas.

INTRODUCTION

In February 2001, the National Guard Bureau (NGB) and the U.S. Geological Survey (USGS) began a project to compile hydrogeologic data and determine presence or absence of soil, surface-water, and ground-water contamination[1] at selected installations, including the Idaho Army National Guard (IDARNG) Orchard Training Area (OTA), southwestern Idaho (figure 1). Several long-term activities within the OTA may have resulted in contamination of soil or water. The primary areas and contaminants of concern at the OTA were firing range, ordnance-impact, training, and bivouac sites; propellants and explosive compounds associated with point-of-firing and impact areas of the firing ranges; lead concentrations from ammunition at small arms training areas; fuels, coolants, and lubricants associated with vehicle and machinery uses; and sewage and gray water leakage, spillage, or disposal associated with bivouac sites. Impacts to soil, surface-water, or ground-water quality from land and water uses were highly variable within the OTA and could range from minimal to significant.

Description of the Area

The OTA is located approximately 13 mi south of Gowan Field (IDARNG headquarters) and 14 mi south of the city of Boise on lands administered by the Bureau of Land Management (BLM) and Idaho Department of Lands. Historically, the OTA was used for rangeland and wildlife habitat, and the area is included in the BLM's Snake River Birds of Prey National Conservation Area[2]. Army National Guard units have used the OTA since about 1953 for armor, combat engineer, helicopter, and artillery training. The OTA is composed of 138,051 acres (about 216 mi^2) of semiarid desert land divided into two main activity areas—a central Impact Area (102 mi^2, bounded by the Range Road) and surrounding Maneuver Areas (114 mi^2, figure 2). The Impact Area has 14 active ranges designated for tank and helicopter gunnery, field artillery and mortar unit firing, rifle and small arms firing, and grenade launching, and includes an Artillery Impact Area (Ogden Environmental and Energy Services, 1997, p. 1–7, 1–8). Maneuver Areas are used for training exercises, bivouac sites, and access to Impact Area ranges. Tanks from Gowen Field travel to the OTA by a dirt track (vehicle corridor) that parallels Pleasant Valley Road (figure 1). Tanks and other vehicles stored at the Mobilization and Training Equipment Site (MATES) compound move within the OTA on more than 70 mi of cinder or dirt roads.

The OTA is located on a widespread topographic mound. Soils derived from loess, volcanic ash, and cinders overlie undulating, fractured basalt and commonly are a few inches to few feet thick. Basalt outcrops are common throughout the area. Land surface elevations range from about 2,800 to 3,500 ft above sea level. The three most prominent topographic features in the area are volcanic domes or cinder cones—Christmas Mountain (3,497 ft), Bigfoot Butte (3,535 ft), and Cinder Cone Butte (3,426 ft).

The area includes three surface-water drainages (USGS, 1983)—northwestward to Indian Creek, southward or southeastward to Mountain Home, and southwestward to the Snake River. Surface-water flow is intermittent and occurs in a few small stream channels after snowmelt or thunderstorms. Water pools in rock outcrops, low points in silty soil, and numerous small playas throughout the OTA.

Two wells are located within the OTA Snake River Support Facility well and Ammunition Supply Point (ASP) well and one IDARNG well adjacent to the OTA (MATES well). Water levels are more than 480 ft below land surface. The hydrogeology for all other areas of the OTA is unknown. Deep-rooted volcanic structures underlying the OTA may affect directions of ground-water movement through the area, but generalized directions of movement may be northwestward to southwestward (H. Harrington, written commun., 2001; Newton, 1991, p. G7).

Weather data are measured at three sites in the OTA—two tipping-bucket rain gages maintained by the Idaho Army National Guard (near Impact Area Ranges 2 and 14), and a weather station maintained by Agricultural Research Service, Northwest Watershed Research Center (southwest of Impact Area Range 26). Weather systems generally move southeastward or northeastward through the OTA. Precipitation ranges from about 6.5 to 11 in. per year. Thunderstorms may produce no measurable precipitation or may cause localized flooding. Wind gusts may exceed 30 mph (Agricultural Research Service, written commun., 2002).

Detailed information on history of the OTA, land uses, hydrogeology, and soils is included in reports by Nace and others (1957), Young (1977), Norton and others (1982), CH2M Hill (1987), Othberg (1994), Ogden Environmental & Energy Services (1997), and U.S. Department of Agriculture (2001).

Phase I Assessment—Documentation and Compilation of Existing Information

The OTA assessment was conducted in two phases. The Phase 1 study was conducted from June through September 2001. This study documented locations of monitoring and water-supply wells within and adjacent to the OTA, compiled water-level and water-quality data for these wells, documented stream-gage locations within and adjacent to the OTA, and compiled surface-water data. A comprehensive work plan also was developed during Phase I for the second phase of investigation and included definition of data gaps and suggestions for actions to define

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[1] Contaminant—naturally occurring or manufactured compounds in soil or water that can limit suitability for use or can represent degradation of quality.

[2] A map of the Snake River Birds of Prey National Conservation Area and OTA boundaries can be accessed at http://www.birdsofprey.blm.gov/

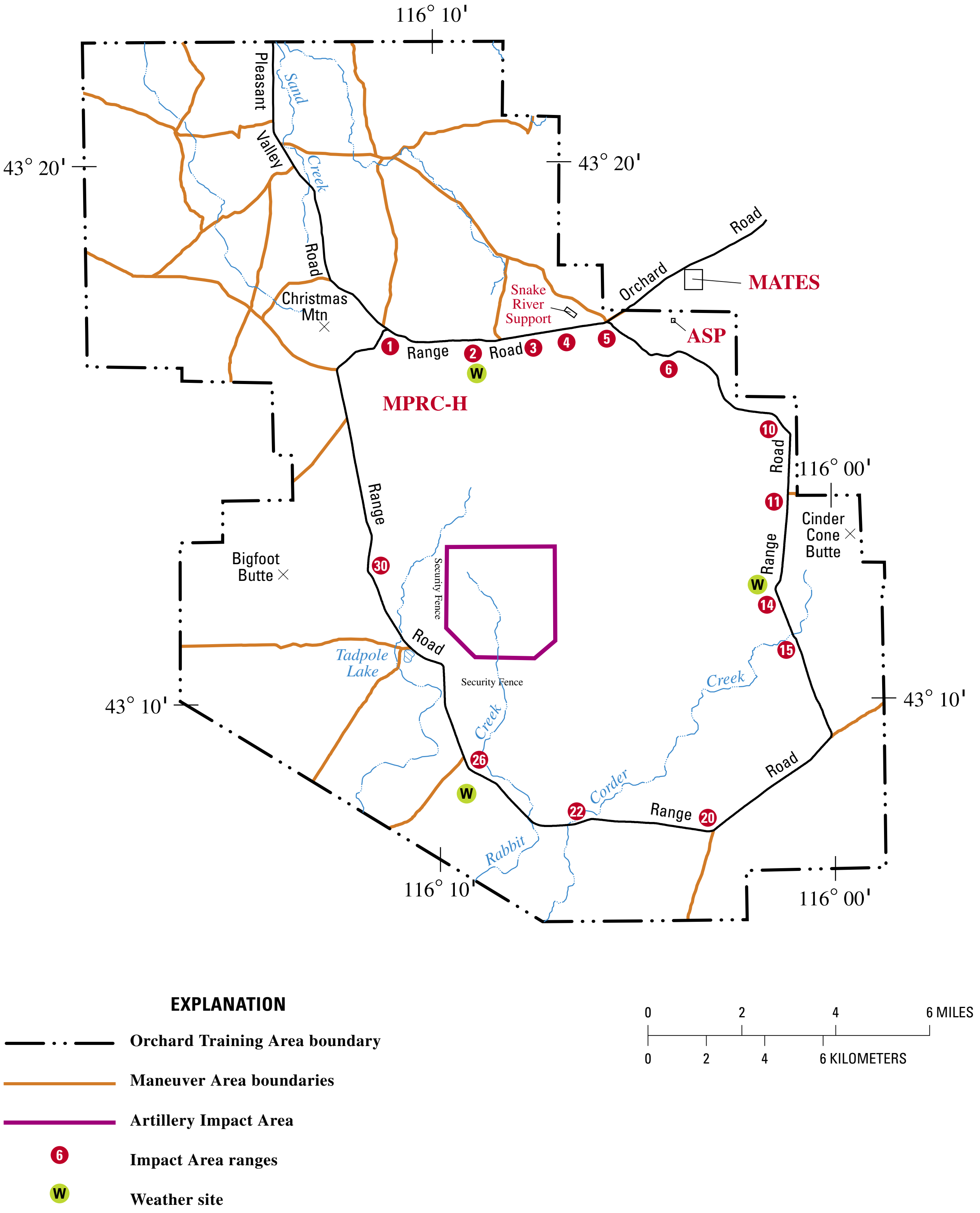

Figure 2. Location of selected features in and near the Orchard Training Area, Ada County, Idaho

characteristics, locations, and concentrations of soil and water contaminants. Copies of all data were sent to National Guard Bureau and IDARNG offices.

Findings of the Phase 1 study showed that prior to 2001, no data were available on surface-water discharge or soil, surface-water, streambed sediment, or ground-water quality conditions within the OTA or along the vehicle corridor. Limited ground-water analyses were available from a well used for public supply and irrigation at the MATES compound along the northeast boundary of the OTA. No ground-water analyses were available from two IDARNG wells located within the OTA. Ground-water level and (or) water-quality data were available from wells within a several-mile radius of the OTA. No ground-water level or water-quality data were available for relatively large areas adjacent to the OTA. Precipitation data were available from three sites in the OTA, and weather data were available from the site near Range 26.

Phase II Assessment—Determination of the Nature and Extent of Potential Soil, Surface-Water, and Ground-Water Contamination

Phase II was conducted between October 2001 and September 2003. The primary objective of the Phase II study was to determine the nature and extent of potential soil, surface-water, and ground-water contamination at the OTA. The secondary objective of the study was to collect and analyze precipitation samples to document types and concentrations of chemical compounds deposited by rain. Airborne dust samples were collected to document quantity and quality of sediments carried by wind.

If present in the area, contaminants resulting from land and water uses could move within the OTA or to private and public lands adjacent to the OTA by wind erosion, vehicle and animal movements, or infiltration of water through soil to underlying fractured basalt and ground water. Intermittent surface-water flow from snowmelt or intense rainstorms could transport contaminated water or sediments from the OTA to perennial stream channels and the Snake River. Contaminants could be incorporated into local plants and wildlife or domestic animal food chains. Also, exposure to contaminants could be a potential health risk to personnel working at the OTA.

Between June 2002 and April 2003, a total of 114 soil, surface-water, ground-water, precipitation, or dust samples were collected from 68 sample sites (65 different locations) in the OTA or along the vehicle corridor (figure 1 and figure 3). In some locations, pairs of soil and water samples were collected. In other locations, soil, precipitation, and dust samples were collected from the same general area. Locations and descriptions of 84 soil, 12 surface water, 4 ground water, 11 precipitation, and 3 dust samples are summarized in table 1. Notes on type of sample (soil, surface water, ground water, precipitation, or dust), sampling methods (grab versus grid soil samples), laboratory analyses (total versus dissolved constituents), quality control (duplicate and replicate samples), and analyzing laboratories also are included in table 1. Four quality-control samples are included in the table—two equipment blanks for precipitation samples and two equipment blanks for surface-water samples collected by peristaltic pump.

The purposes of this report are to describe sample locations and sampling methods, summarize laboratory analyses, and discuss selected sets of data from the Phase II investigations. Explanations and definitions for terms, abbreviations, and acronyms used in this report are listed in table A (appendix, back of report).

SITE SELECTION, SAMPLING METHODS, LABORATORY ANALYSES, AND DATA SUMMARIES

Site Selection

The OTA and vehicle corridor comprise a relatively large area with diverse historical and current land and water uses. Choice of soil sample locations primarily was based on one or more of the following criteria: areas with little or no historical or current land or water uses (background conditions); areas used for small arms training; areas in and near the Multi-Purpose Range Complex-Heavy (MPRC-H) tank maneuvering and firing ranges; areas near, downgradient, or downwind from the Artillery Impact Area; areas within the MATES and ASP compounds; sites within the Maneuver Areas used for bivouac and vehicle parking; areas near precipitation and weather data sites; areas in and near large playas, including Tadpole Lake; dry stream channels, especially those draining the Artillery Impact Area or larger channels near OTA boundaries; areas adjacent to major access roads to the OTA; and areas along the vehicle corridor outside the OTA boundaries. Where possible, locations representing these sampling criteria were selected within each of the three drainage basins within the OTA, and the sampling sites were distributed throughout the OTA. Sampling locations were not chosen, in most cases, on the basis of soil type or vegetation cover. There were few restrictions on access to Maneuver Areas and the MATES compound, but access to most locations within the Impact Area and ASP compound was restricted and required clearance from OTA range control or escort by IDARNG personnel. No samples were collected in the Artillery Impact Area.

No surface-water flow was observed or measured in stream channels within the Impact Area during this investigation. In March 2003, surface water was collected from Tadpole Lake, the wash water pond at MATES (September 2002 and March 2003), three storm-water puddles, and two storm-water drains at MATES. Sampling of storm-water puddles in March 2003 was limited, in part, to areas near all-season dirt roads, puddles where water samples could be collected without disturbing fine sediments in the puddle basin, and water not affected by muddy roadbed runoff (figure 4).

Ground-water samples were collected from two of three IDARNG wells located in or near the OTA. Water was collected from the MATES well in September 2002 and the ASP well in

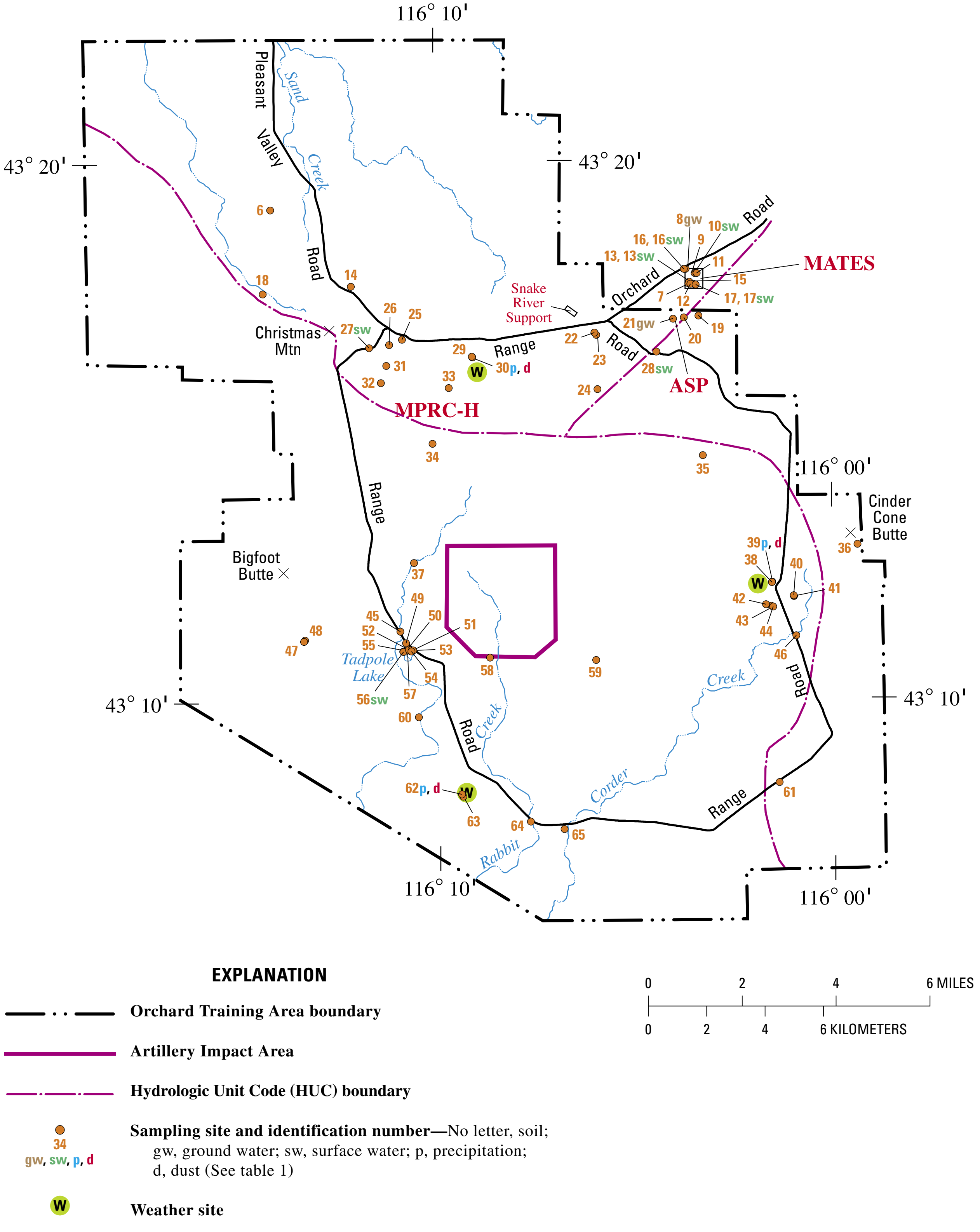

Figure 3. Location of sampling sites in and near the Orchard Training Area, Ada County, Idaho

Figure 4. Storm-water puddle and muddy runoff to Sand Creek from Pleasant Valley Road near the Orchard Training Area, Ada County, Idaho, March 2003 (near sample 4sw). (Shadow is from a power pole)

Figure 5. Sampling equipment and grab sample of soil at Tadpole Lake, Orchard Training Area, Ada County, Idaho, December 2002 (sample 50)

February 2003. A water sample was not collected from the Snake River Support Facility well located near the MATES and ASP wells, and water levels were not measured in these wells during this study. No other wells are located within the OTA.

Three to four precipitation samples were collected from each of the three OTA weather sites during the investigation (figure 3). The amount of precipitation from a storm varied from site to site depending on direction of storm movement and intensity of rainfall. Precipitation was collected from at least one site in August, October, and January. Samples were collected from all three sites after storms in December and April.

Dust samples were collected in December 2002 from collectors at each of the OTA weather sites. Sample collectors were in place from June to December 2002.

Sampling Methods

Soil sampling equipment comprised a 1-L glass jar, a small stainless steel scoop, and a zip-seal plastic bag (figure 5). The jar and Teflon-lined cap were prewashed with phosphate-free soap, soaked in dilute hydrochloric acid, rinsed with deionized water, air dried, and stored in zip-seal bags. Stainless steel scoops were washed in phosphate-free soap, rinsed with deionized water, air dried, and stored with each sample bottle in a zip-seal bag. Latex gloves were worn during sample collection and sample preparation.

Soil samples were collected by grid pattern or grab sample methods. The grid pattern method was used to sample a composite of surface soil within an approximately 40-by-100-ft area. Partial scoops of soil collected from about 10-ft intervals within the grid area were deposited in a sampling jar. Latitude and longitude of each scoop site were measured by Global Positioning System (GPS) and recorded. In stream channels, scoops were collected periodically in a zigzag pattern down the stream channel. Soil within the jar was later mixed by shaking before being transferred to smaller sample containers for laboratory analyses. The grid pattern method was used for soil collected in and near the OTA between August and October 2002.

The grab sample method was used to collect soil within approximately 1- to 2-ft^2 areas (figure 5). Soil was scooped into a glass sample jar, and soil within the jar was later mixed by shaking before being transferred to smaller sample containers for laboratory analyses. Latitude and longitude of the sample location were measured by GPS and recorded. The grab sample method was used when sampling areas were small (such as cinder pit walls or storm-water drains), when followup soil sampling was needed in areas with previous grid samples (areas in and around Tadpole Lake, samples 50, 51, and 53 to 57), or when special clustered sampling was needed in areas where anomalous trace metal or explosive compounds were detected (areas near MPRC-H BPB2, samples 26.1 – 26.5, or Range 2 weather, samples 29.1 – 29.8).

Surface-water samples were collected by either grab sample (sample bottles filled by laboratory-cleaned, 60-mL polyethylene syringe, figure 6a, figure 6g, and figure 6h) or peristaltic pump (laboratory-cleaned, polyethylene tubing flushed onsite with sample water, figure 6b, figure 6c, figure 6d, figure 6e, and figure 6f). When the peristaltic pump was used, the sample tubing was attached to floating, air-filled pillows, with the tube end extending several inches beyond the pillow in the water. Air-pillow support of the tubing allowed sampling away from muddy shorelines, control of sampling depth, and sampling without disturbing fine bottom sediments.

Ground-water samples were collected from an all-weather hydrant (MATES well) or pump-house faucet (ASP well). Water

Figure 6a. Storm-water puddle near Sand Creek near the Orchard Training Area, Ada County, Idaho, March 2003, syringe sample (sample 4sw)

Figure 6b. Tadpole Lake, Orchard Training Area, Ada County, Idaho, March 2003, peristalic pump (samples 55 and 56sw)

Figure 6c. MATES NE drain, Orchard Training Area, Ada County, Idaho, March 2003, peristaltic pump (samples 9 and 10sw)

Figure 6d. MATES wash water pond, Orchard Training Area, Ada County, Idaho, March 2003, peristaltic pump (samples 17 and 17sw)

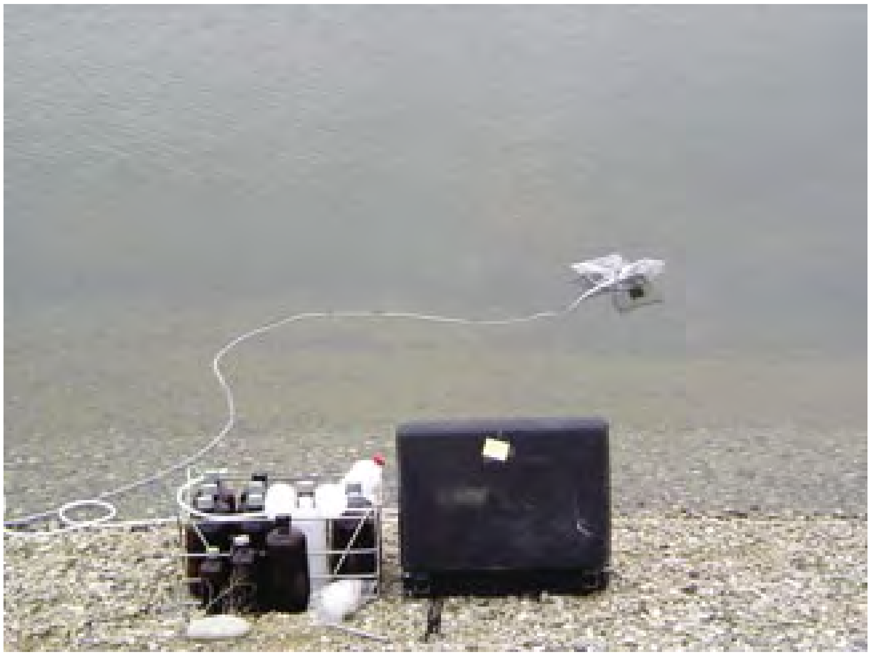

Figure 6e. MATES wash water pond, Orchard Training Area, Ada County, Idaho, March 2003, peristaltic pump (sample 17sw)

Figure 6f. MATES wash water pond, Orchard Training Area, Ada County, Idaho, March 2003, air-pillow support for sample tubing (sample17sw)

Figure 6g. MATES fueling area runoff, Orchard Training Area, Ada County, Idaho, March 2003 (sample 12)

Figure 6h. MATES east drain, Orchard Training Aream Ada County, Idaho, March 2003 syringe sample (samples 13 and 13sw)

was allowed to flow until onsite measurements of pH, specific conductance, dissolved oxygen, and water temperature were stable before samples were collected for laboratory analyses. Standard USGS water-sampling protocols were followed for collection of water samples (http://water.usgs.gov/owq/FieldManual).

Surface- and ground-water samples were collected in bottles prepared and supplied by either Severn Trent Laboratory (STL) or the USGS National Water Quality Laboratory (NWQL). STL added sample preservatives to specified bottles before shipping, but preservatives were added onsite to bottles being shipped to the NWQL. Sample container requirements for STL and NWQL are shown in table B and table C, appendix.

A precipitation sample collector was set up at each of the three weather sites in the OTA in June 2002 (figure 7a and figure 7b). The sample collector consisted of a 5-gal plastic bucket with an approximately 2-in. hole cut in the center of the bottom. A 1-L, laboratory-cleaned, Teflon or polypropylene separatory funnel was placed inside a large zip-seal plastic bag (to keep the tip of the funnel clean) and then set into the bucket with the stopcock end of the funnel hanging through the 2-in. hole. An 18-in.-diameter polyethylene funnel was set on top of the bucket with the neck of the large funnel fit into the top of the separatory funnel. The large funnel was zip-tied to the bucket, and the bucket collector was attached to a corner fencepost at each weather site.

Precipitation was captured in the large, polyethylene funnel and flowed into the separatory funnel. Samples were removed from the collector by cutting open the protective plastic bag around the separatory funnel tip, opening the stopcock valve, and letting water flow into a sample bottle. Collectors were emptied periodically and flushed with distilled water, and storm-water samples generally were collected within about a day after a major storm.

Although the precipitation collectors worked well overall, one problem with the collectors was that dust, insects, and bird droppings on the large funnel were carried to the separatory funnel during storms, which contaminated the precipitation sample. Also, when the collectors originally were set up, a small amount of lab-grade silicon oil was added to the separatory funnels to reduce evaporation losses (the precipitation samples were not to be analyzed for silica concentrations). The silicon oil flushed out of separatory funnels during larger storms, however, leaving a film of oil on the inside of the collector bucket and outside the separatory funnel. After the first few weeks of collector use, silicon oil was no longer used. The equipment was dismantled, cleaned, and set up again at the weather sites.

Dust samples were collected by two methods: plastic bucket with large collector funnel and Big Springs Number Eight (BSNE) field dust collectors (figure 7a and figure 7b). Bucket samplers were similar to precipitation samplers—a 5-gal plastic bucket with large, polyethylene funnel zip-tied to the bucket. A

Figure 7a. Precipitation, airborne dust, and BSNE collectors, Orchard Training Area, Ada County, Idaho, Range 26 weather site, June 2002 (samples 62p and 62d)

1-L, largemouth, polyethylene bottle was placed inside the bucket at the base of the collector funnel. Bucket samplers were attached to fenceposts at the weather sites so that the top of the collector funnel was about 5 ft above land surface.

The BSNE collector was developed and designed by Dr. Bill Fryrear of the U.S. Department of Agriculture Wind Erosion Field Laboratory located at Big Springs, Texas (http://www.csrl.ars.usda.gov/wewc/tooltech.htm). BSNE collectors consisted of an array of dust catchers, each attached to a pivoting wind vane and each mounted at a different height on a central pole. The heights of the individual collectors could be adjusted up or down the supporting pole. At the OTA, the samplers were set at about 2 and 3 ft above land surface.

Laboratory Analyses

Most soil and water samples were analyzed by the STL in Denver, Colorado, a Department of Defense Environmental Conservation (DODEC) Hydrology Program contract laboratory (http://water.usgs.gov/usgs/dodec). A few surface-water samples were analyzed for both total and dissolved concentrations of selected constituents. Precipitation samples were analyzed by the NWQL (http://nwql.usgs.gov/) in Denver, Colorado. Dust samples from the bucket collectors were sent to the USGS Cascades Volcano Observatory Sediment Laboratory (CVO) in Vancouver, Wash. (http://vulcan.wr.usgs.gov/Projects/SedLab/framework.html), for sand-break[3] and total sediment weight analyses only. No dust samples from the BSNE collectors were sent for analysis.

Samples were shipped with chain-of-custody records to laboratories for next-day delivery. Analyses turnaround times were about 30 days for STL and 30 to 60 days for NWQL and CVO.

Data Summaries

Copies of all STL and NWQL soil and water data and summaries of information related to the soil and water data have been sent to National Guard Bureau and IDARNG offices. The soil data comprises 15,361 lines of analyses, of which 10,370 are soil analyses and 4,991 are STL quality control analyses. The water data comprises 4,182 lines of STL analyses, of which 1,540 are water analyses and 2,642 are STL quality control analyses. Summaries of information related to soil and water data include USGS ground-water, surface-water, precipitation, and dust analyses; a comparison of STL dissolved and total analyses; and STL organic-free water and equipment blank analyses (table 1,

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[3] Sand-break analyses of sediment samples gives the percent of sediment be weight that is finer than 0.062 millimeter.

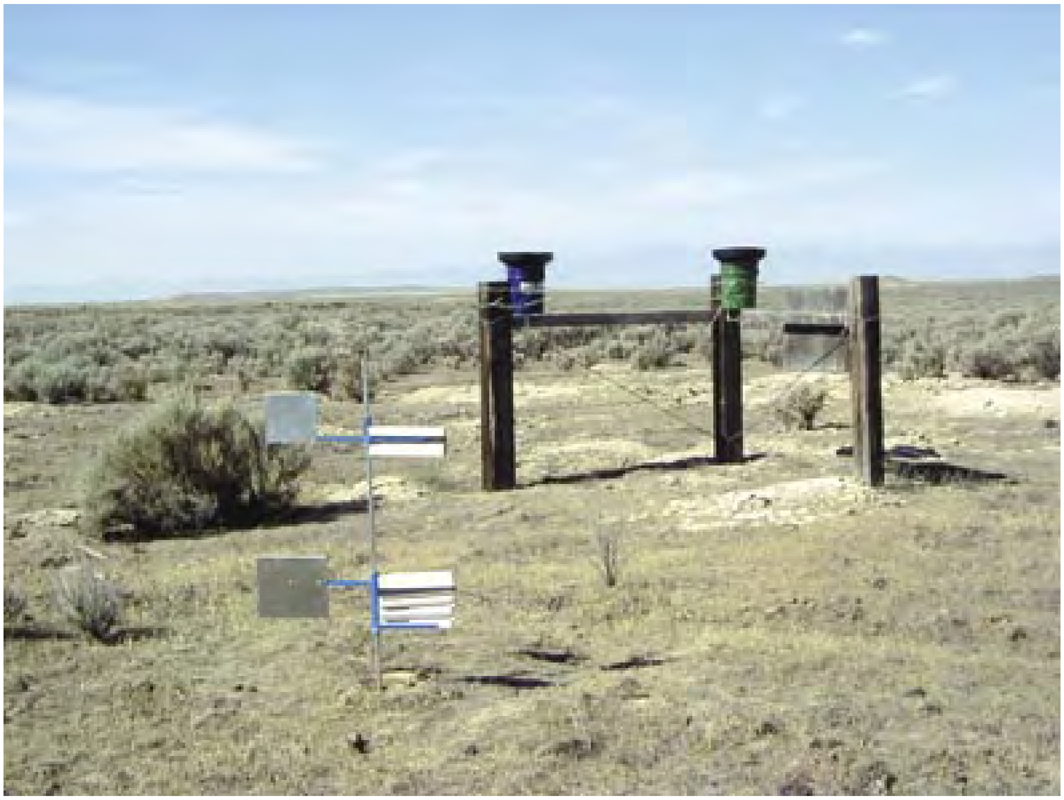


Figure 7b. Precipitation, airborne dust, and BSNE collectors, Orchard Training Area, Ada County, Idaho, Range 2 weather site, June 2002 (samples 30p and 30d)

table 2, table 3, table 4, table 5, table 6, table 7, and table 8, back of report). Additional information comprises summaries of STL and NWQL analysis descriptions (table C and table D, appendix), laboratory methods (table C and table E, appendix), definitions of STL quality control terms and qualifiers (table F, appendix).

SOIL

Discussions of soil data are divided into two parts—naturally occurring constituents and constituents related to land- and water-use contamination. Wide ranges of trace metal (aluminum, arsenic, chromium, and lead, for example), major ion (chloride, fluoride, potassium, sodium, and sulfate), and nutrient (nitrate and phosphorus, for example) concentrations were measured in soils at the OTA and are naturally occurring or are the result of contamination from land- and water-use activities. Explosive, semivolatile organic (SVOC), and petroleum hydrocarbon compounds (including diesel range organics, DRO; total petroleum hydrocarbons, TPH; and n-hexane extractable materials, HEM) are not naturally occurring in soils at the OTA, and detectable concentrations of these compounds are the result of land- and water-use contamination.

Selected Trace Metals, Major Ions, and Nutrients

Distinguishing naturally large concentrations of trace metals, major ions, and nutrients in soil from contamination related to land and water uses at the OTA was difficult. There were no historical soil analyses for this area to compare with modern data, and although 84 soil analyses were collected from 55 sample sites in and near the OTA, sampled areas represented only a small part of the complex OTA land-use history and soil types (U.S. Department of Agriculture, 2001).

For naturally occurring compounds, two assumptions were made—anomalously large concentrations, when tied to known land uses, may indicate presence of contamination; and naturally occurring concentrations cannot be separated from contamination concentrations in mid- and lower ranges of data. Selected statistical analyses of soil data, shown in table 2**,** were used to summarize the large number of analyses and define anomalous data.

Statistical analyses were calculated from grid or grab method data but did not include clustered or followup data for Tadpole Lake, MPRC-H BPB2, and Range 2. Ranges (minimum and maximum), average (mean), 50th percentile (median, and 75th percentile, and 90th percentile of concentrations are presented, and samples for the five smallest concentrations (the 90th percentile or greater) are listed for each.

Smallest concentrations may represent the lowest naturally occurring range of concentrations and (or) the absence of trace metal, major ion, or nutrient contaminants related to land and water uses. Sample numbers of sites with the five smallest concentrations, in order of increasing concentrations, are shown in table 2. The two sites where small concentrations of constituents were most common are highlighted. Smallest concentrations of trace metals, major ions, or nutrient compounds were from Sand Creek (5)[4] and vehicle corridor at railroad tracks (3). The next sample site with many small concentrations was cinder pit wall (40). The cinder pit wall sample was collected from undisturbed cinders in the wall of an excavated cinder cone in the southeastern part of the OTA and was intended to represent background conditions for areas with cinder soils in the OTA, including roadway and parking areas.

Concentrations in the 90th percentile or greater may represent the largest naturally occurring range of concentrations and (or) the presence of land-use contaminants. Sample numbers of sites with concentrations in the upper 10th percentile, in order of increasing concentrations, are shown in table 2. The two sites where large concentrations of constituents were most common are highlighted. Largest concentrations of trace metals and major ions were from Tadpole Lake (52) and a playa near Tadpole Lake (49). The next sample sites with large concentrations were MPRC-H BP3 (31), Range 5 parking (22), MATES east drain (13), MATES drain at tank parking gate (11), Range 5 firing (23), and cinder pit near Cinder Cone Butte (41).

Some statistical analyses shown in table 2 also are presented as boxplot diagrams, figure 8a, figure 8b, figure 8c, figure 8d, and figure 8e. A boxplot diagram summarizes the distribution of a data set and is useful for comparing several related data sets. The boxplot 'box' shows the upper quartile (75th percentile), median, and lower quartile (25th percentile) of data. One and one-half (1.5) times the height of the box (25th percentile to 75th percentile) is a 'step,' and lines extending above and below the box ('whiskers') are 1 step away from the box. Small circles above and below the whiskers (outliers) show concentrations more than 1 step above or below the box and represent varying percentiles of concentrations (generally greater than the 90th percentile for larger concentrations). Because ranges of trace metal concentrations were very large (2.5 to 40,000,000 mg/kg), boxplot diagrams for trace metals were separated into small range (1 to 10,000 mg/kg), medium range (1,000 to 1,000,000 mg/kg), and large range (10,000 to 100,000,000 mg/kg) diagrams with log-10 scales.

Each set of trace metal, major ion, and nutrient analyses is represented by three boxplots—compiled data (All sites), MATES-only data (MATES sites), and Tadpole Lake-only data (Tadpole Lake sites). There are 48 analyses for each compiled data set (clustered and followup samples from Tadpole Lake, MPRC-H BPB2, and Range 2 are not included), 7 analyses for MATES-only data, and 7 analyses for Tadpole Lake-only data (the original sample and 6 followup samples).

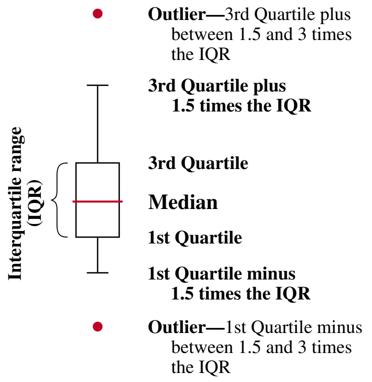
Median concentrations of molybdenum and ammonia were larger for compiled data than for MATES or Tadpole Lake data. Median concentrations of cadmium and fluoride were larger for MATES data than for compiled or Tadpole Lake data. Median concentrations of arsenic, chromium, copper, silver, strontium, zinc, and chloride were larger for MATES data than for compiled data but smaller than for Tadpole Lake data. Medians of 28 of 32 trace metals, major ions, and nutrients for Tadpole Lake data were larger than for compiled or MATES data. Largest concentrations of most constituents were from Tadpole Lake samples, but largest concentrations of cadmium, chromium, copper, iron, lead, mercury, molybdenum, titanium, zinc, chloride, sodium, ammonia, orthophosphate, and total phosphorus were from MATES or other OTA samples. A summary of statistical analyses and boxplots is shown in table 3.

Consistently and anomalously large concentrations from the original Tadpole Lake sample (grid sample method), 6 followup samples (grab sample method), and 1 sample from a playa near Tadpole Lake (grab sample method) are not understood at this time. Tadpole Lake and the playa are near the Artillery Impact Area, and there are empty shell casings in the Tadpole Lake sediments. Tadpole Lake is fenced, but cattle graze around the Lake and through the playa. There is standing water in both the Lake and playa for a few weeks each year, and algae were observed growing in Tadpole Lake water in late winter 2002. Concentrations of trace metals and major ions may be naturally occuring, related to historical land uses in the area, or a combination of both.

Chromium and Hexavalent Chromium

An anomalously large chromium concentration was reported for an August 2002 soil sample from the Range 2 weather site (sample 29, grid pattern sampling method, 97,000 mg/kg total chromium). In April 2003, eight additional soil samples (29.1–29.8, grab sample method) were collected from the Range 2 weather site area and analyzed for total trace metal concentrations. Chromium concentrations in these followup samples ranged from

EXPLANATION FOR BOXPLOT FIGURES 8a–8e



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[4] Numbers in parentheses refer to sample numbers shown in figure 1 and figure 3 and described in table 1.

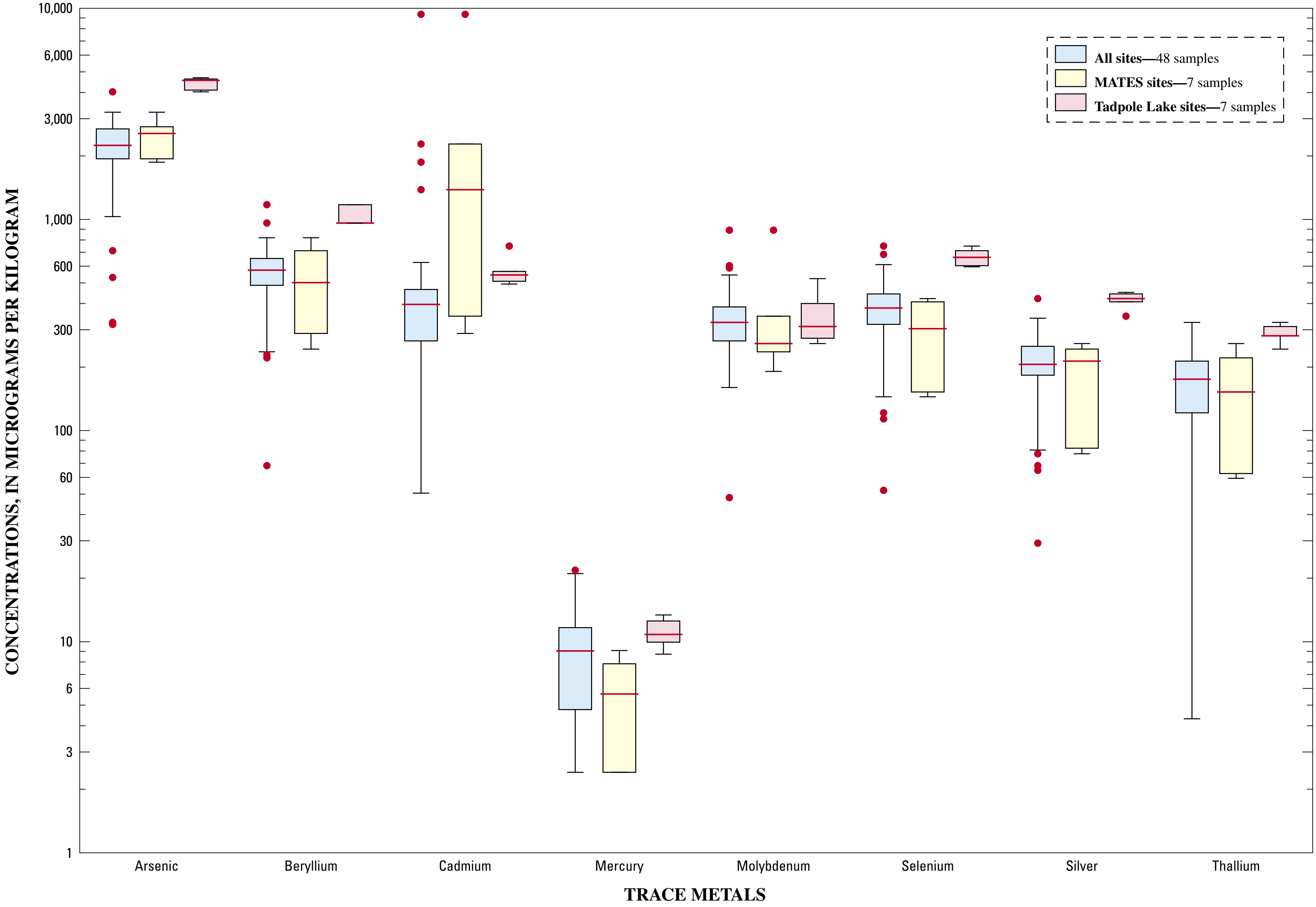

Figure 8a. Selected total trace metal concentrations, 1 to 10,000 micrograms per kilogram range, in soil samples from the Orchard Training Area, Ada County, Idaho

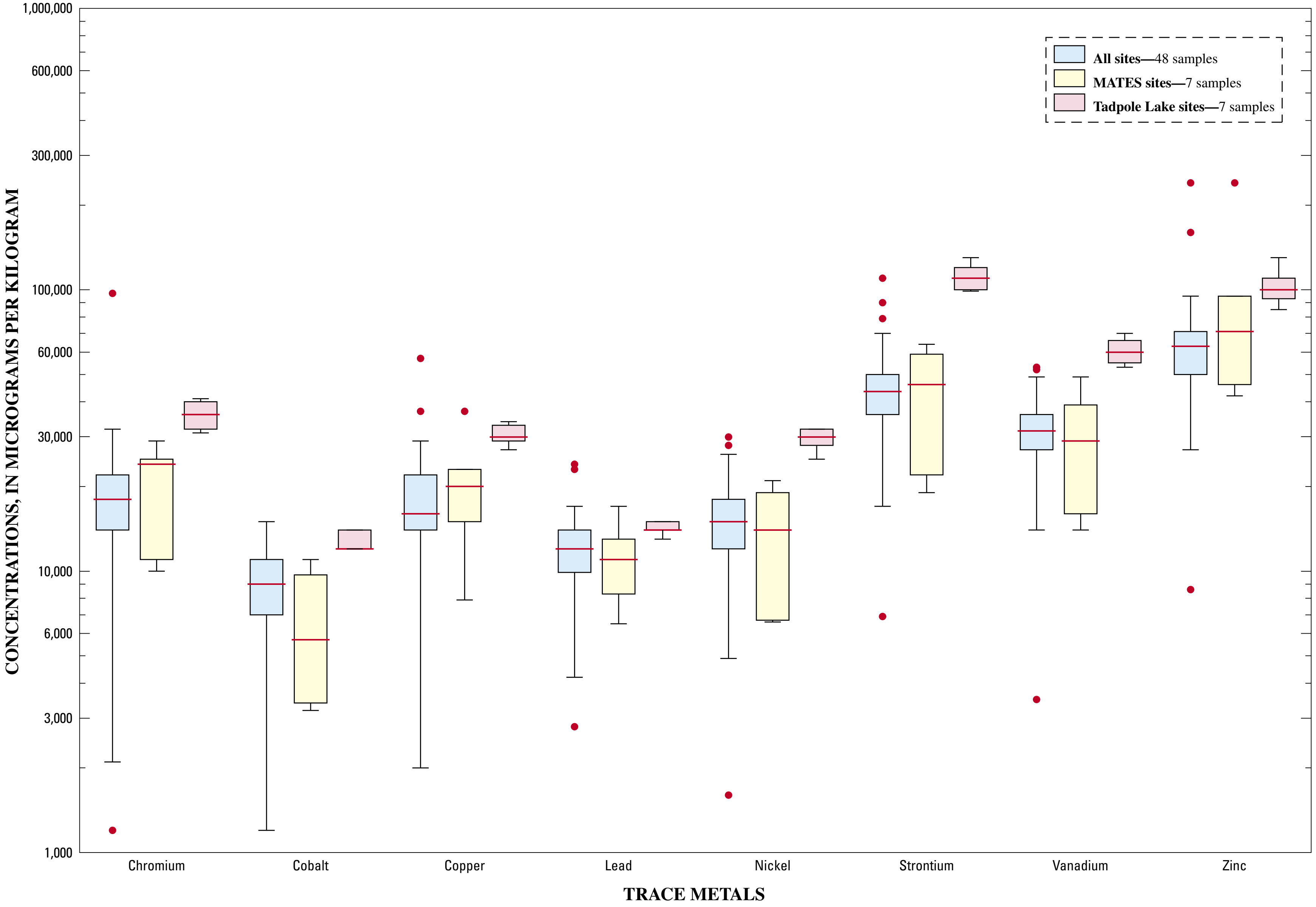

Figure 8b. Selected total trace metal concentrations, 1,000 to 1,000,000 micrograms per kilogram range, in soil samples from the Orchard Training Area, Ada County, Idaho

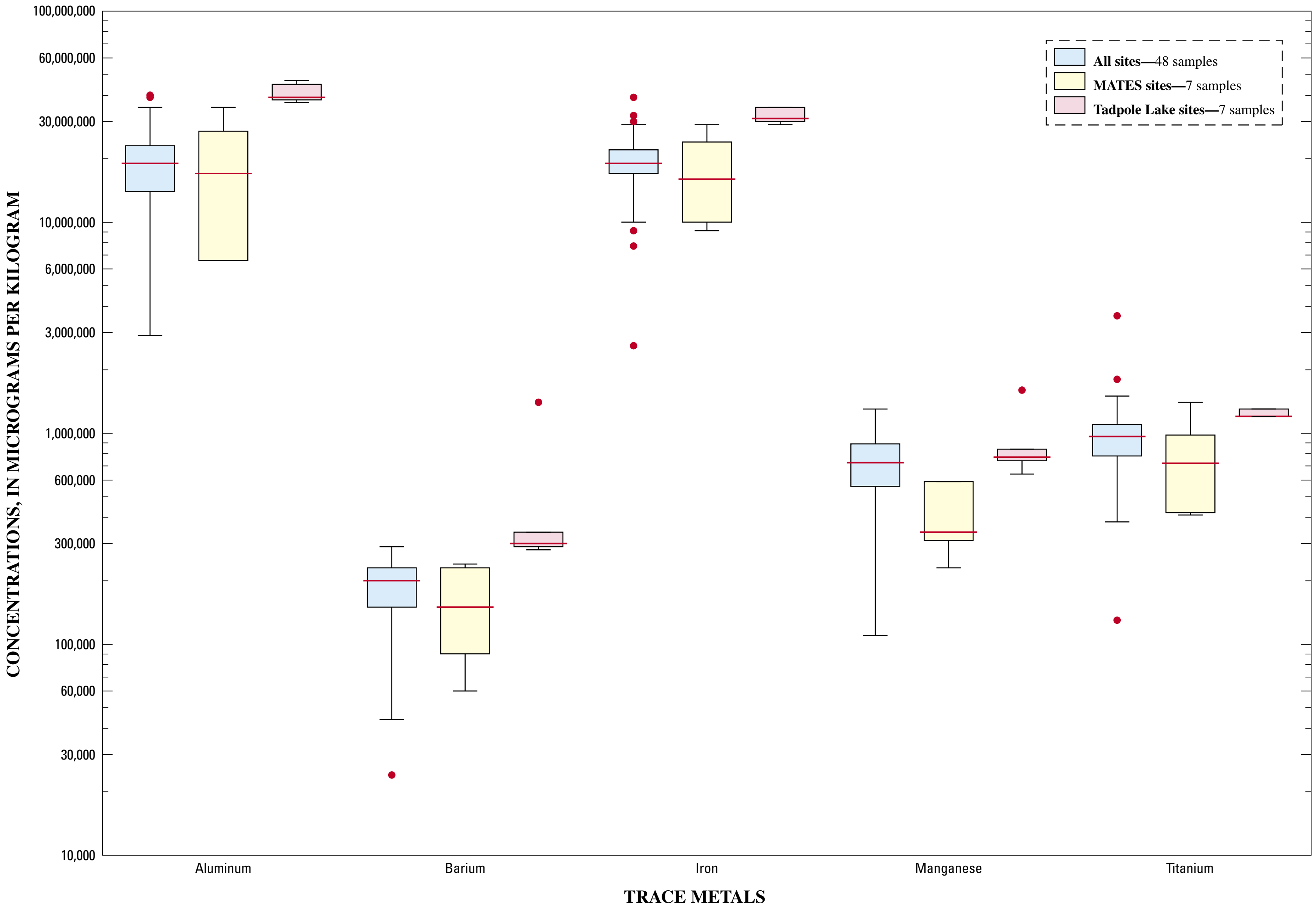

Figure 8c. Selected total trace metal concentrations, 10,000 to 100,000,000 micrograms per kilogram range, in soil samples from the Orchard Training Area, Ada County, Idaho

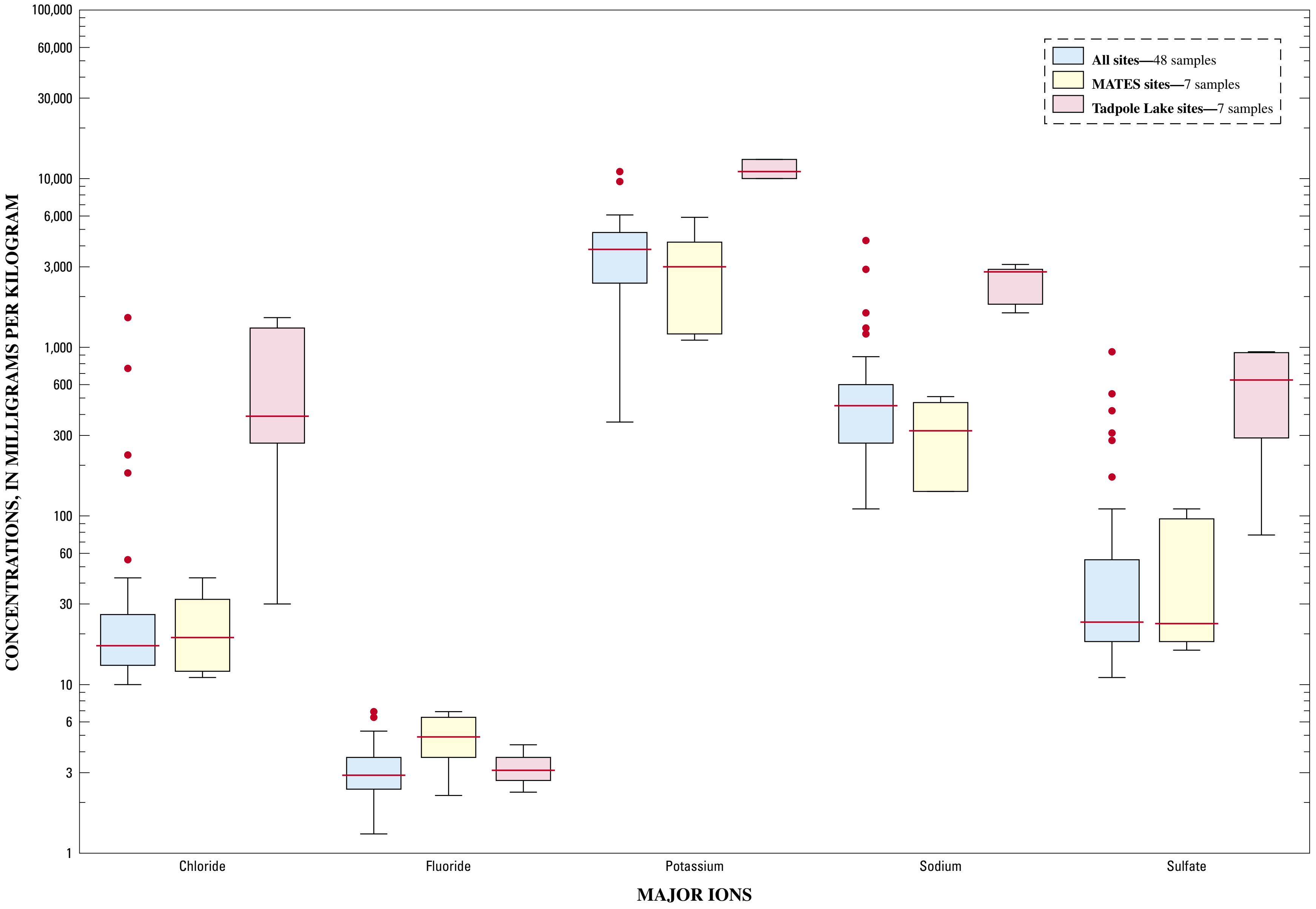

Figure 8d. Selected major ion concentrations, in soil samples from the Orchard Training Area, Ada County, Idaho

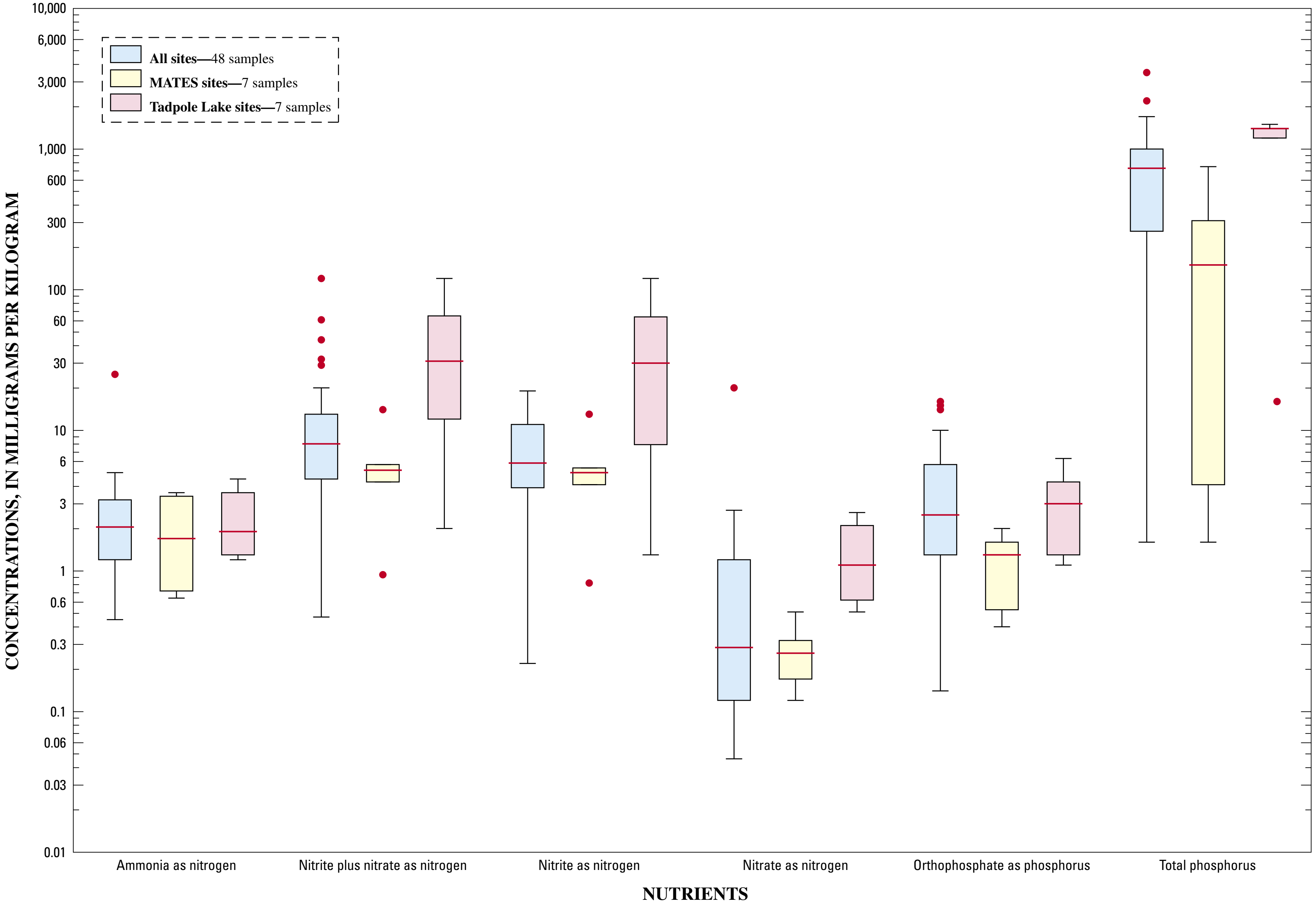

Figure 8e. Selected nutrient concentrations, in soil samples from the Orchard Training Area, Ada County, Idaho

21,000 to 25,000 mg/kg. There is no obvious explanation for the original anomalous concentration of chromium at this site.

In March 2003, soil samples from 17 sites in the OTA were analyzed for hexavalent chromium, Cr (VI), a possible contaminant related to air-scrubbing canisters in some older tanks. Samples were from MATES (7, 9, 11, 12, 13, 15, and 17), ASP (20), Range 2 weather (29), cinder pit wall (40), and Tadpole Lake (53, 55, and 57) sites, but no hexavalent chromium was detected in any of the samples.

Explosive, Semivolatile Organic, and Petroleum Hydrocarbon Compounds

Presence of explosive, SVOC, and petroleum hydrocarbon compounds in soil indicates contamination from land and water uses. Soil samples were analyzed for 16 explosive, 68 SVOC, and 4 petroleum hydrocarbon compounds. Concentrations of these compounds in soil samples from the OTA are presented in table 4.

The most common organic contaminants in soil are petroleum hydrocarbon compounds and compounds related to combustion of fuel (phenanthrene, fluorine, fluoranthene, pyrene, benzo-compounds, and chrysene). Soil from sample sites along the vehicle corridor, access roads, parking areas, and storm-water drains at MATES contained one or more of these compounds. Samples from the MATES drain at tank parking gate (11) contained the largest concentrations of petroleum hydrocarbon compounds. Pentachlorophenol, a wood preservative or pesticide, was detected in soil from the MATES drain at tank parking gate (11). The plasticizer bis (2-ethylhexyl) phthalate was detected at a site on the vehicle corridor (2), MATES storm-water basin and wash water pond (7 and 16), ASP loading (20), and Range 2 weather (29). Diphenylamine and di-n-butyl-phthalate (dibutylphthalate) are components of pesticides, explosive stabilizers, and rocket fuel, and these compounds were detected at Range 5 firing (23), MPRC-H BPB2L (26), and Range 14 firing (43). N-Nitrosodiphenylamine, a rubber stabilizer or pesticide component, was detected in soil from Range 14 firing. Explosive compounds were detected in soil from MATES fueling area runoff (12), Range 5 firing (23), MPRC-H BPB2L (26), and Range 14 firing (43).

The original soil sample from the MPRC-H BPB2L site (26) was collected by grid method and, in April 2002, a cluster of grab-method samples was collected from sites around the BPB2 tank pad in an effort to determine where the explosive concentrations were largest. Results of the resampling showed that concentrations of 2,4-dinitrotoluene, 2,6-dinitrotoluene, and nitroglycerin were largest in soil in front of the tank pad (26.4, a depression where rainwater puddles) and a concentration of 2,4-dinitrotoluene was largest in soil from the ditch draining the tank pad area (26.1).

WATER AND DUST

Contaminants in soil can be moved within the OTA or transported outside the OTA by water or dust. The principal source of water at the OTA is precipitation, and surface water commonly occurs as small puddles throughout the OTA. Surface water may recharge perched or regional ground-water systems by flowing into fractures in basalt outcrops and infiltrating streambed materials, soil, or pond beds.

As water moves over soils, soil constituents are dissolved or suspended in the water and, like soil, surface water at the OTA can contain large concentrations of dissolved or total concentrations of trace metals, major ions, and nutrients. Distinguishing naturally occurring large concentrations in surface water from contamination related to land and water uses was difficult.

Surface- and ground-water samples were analyzed for the same suites of constituents as were soil samples. Precipitation samples were analyzed for selected nutrients, major ions, and explosive compounds. Dust samples were analyzed for sand break and sediment weight only.

Surface-water samples were collected from storm-water drains at MATES (10sw and 13sw), MATES wash water pond (17sw), Tadpole Lake (56sw), and three storm-water puddles (4sw, 27sw, and 28sw). Ground-water samples were collected from the MATES well (8gw) and ASP well (21gw). Precipitation and dust samples were collected from the three weather sites (30p, 30d, 39p, 39d, 62p, and 62d).

Surface Water

In the Impact Area, storm-water runoff generally moves over land or follows poorly defined stream channels to playas or ditches adjacent to the Range Road within the Impact Area. Storm water on the roads generally flows to adjacent ditches. There are a few small-diameter drainage culverts under the Range Road and a few shallow channels constructed to divert water a relatively short distance from the Range Road ditches. Between July 2002 and April 2003, no water was observed flowing from the Impact Area to Maneuver Areas[5].

In Maneuver Areas, stream channels become better defined, and water may flow for some distance in stream channels after occasional snowmelt or rainfall. At the MATES facility, water flows from roadways and vehicle parking, fueling, and storage areas to large storm-water ditches and catch basins. Surface water was observed flowing from the OTA to offsite areas at two locations in late March 2003—streamflow in Rabbit Creek at the southern OTA boundary and storm-water flow in the MATES NE drain (10sw) under the perimeter fence.

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[5] During the week of February 16-20, 2004, water was observed ponding across the Range Road (from ditch to ditch) after a period of rapid snowmelt. Water flowed across the Range Road at several locations. Water ponding behind a berm near sample site 48 in the Impact Area overflowed the berm, eroded gullies in the Range Road roadbed, and flowed to a stream channel in the adjacent Maneuver Area.

A summary of selected statistical analyses for surface-water data is shown in table 5. Analytical results of explosive compounds in surface-water samples are described in the "Explosive, Semivolatile Organic, and Petroleum Hydrocarbon Compounds in Water Samples" section of this report.

Selected Trace Metals, Major Ions, and Nutrients in Surface Water

Nineteen of 23 trace metal, 4 of 5 major ion, and 1 of 4 nutrient concentrations were larger in water from Tadpole Lake (56w) than in any other water sample (table 5). Concentrations of total aluminum, beryllium, iron, molybdenum, titanium, chloride, potassium, and sulfate in water from Tadpole Lake were 6 to 15 times larger than the next largest concentration. Concentrations of constituents in both soil and water from the Tadpole Lake area were larger than from other locations at the OTA, and it is unknown whether these unusually large concentrations indicate naturally occurring conditions, contamination related to land uses, or both.

Concentrations of most metals in samples from Range Road puddle at MPRC-H (27sw), MATES wash water pond (17sw), or MATES NE drain (10sw) were relatively large, with the exception of mercury. Relatively large concentrations of total aluminum, beryllium, chromium, iron, nickel, selenium, silver, thallium, and titanium in the sample from Range 6 (28sw) cannot be explained. The Range 6 puddle was located east of Range Road and adjacent to an infrequently used dirt track. Relatively large metals concentrations in water from the MATES compound are related to vehicle storage, use, and washing areas.

Water from Sand Creek storm-water puddle (4sw), MATES east storm-water drain (13sw), and Tadpole Lake (56sw) contained the largest concentrations of mercury. Water from the Sand Creek puddle (4sw) contained a relatively large concentration of lead, and water from MATES east drain (13sw) contained relatively large concentrations of molybdenum and vanadium.

Concentrations of most major ions and nutrients were largest in water samples from the Range Road puddle at MPRC-H (27sw) and MATES wash water pond (17sw). Nutrients in the sample from the Range Road puddle at MPRC-H (27sw) may be related to cattle grazing in the area. Relatively large concentrations of nutrients in samples from Sand Creek (4sw) and MATES NE drain (10sw) may be related to plant growth, debris in the stream and storm drain channels, and animal grazing.

Precipitation

Analyses of precipitation were used to establish the lower range of compound concentrations, a comparative baseline of water quality for surface-water analyses. Because precipitation collectors were limited to 1 L of sample and STL required a minimum of 3 L of sample for analyses, selected trace metals, major ions, and nutrients in precipitation samples were analyzed by the NWQL (table 6 and table B, appendix). Three samples were collected from the Range 2 weather site, two from the Range 14 weather site, and three from the Range 26 weather site. Concentrations of constituents varied by sample dates for each site and from site to site for the same storm. Concentrations of all constituents on all dates (except manganese, December 18, 2002) in Range 14 precipitation samples were consistently small. Concentrations in the January 20, 2003, sample from Range 14 were the smallest among all dates and times.

Concentrations of all constituents (except manganese and nitrite plus nitrate) from the Range 2 weather site were larger than from Range 14 or Range 26 sites, and concentrations or measurements of 9 of 16 constituents from the October 29, 2002, precipitation sample from Range 2 were larger than all other precipitation concentrations or measurements. The largest concentrations of dissolved manganese and nitrite plus nitrate were analyzed in an October 29, 2002, sample from Range 26.

Differences in water quality between precipitation sites may be related to accumulations of airborne dust on the collector funnels. The dust was flushed into the separatory funnel during storms. The Range 14 dust collector accumulated the smallest amount of dust and the Range 26 collector accumulated the largest amount of dust. Dust analyses are discussed in the "Dust" section of this report.

Insect and bird dropping contaminants were persistent problems in all precipitation samples, and a special mixture of bird droppings (from the collector funnel) in deionized water was prepared for laboratory analyses of dissolved nutrients only. Nutrient concentrations in this sample were small and probably were not a significant source of nutrients in the precipitation samples. An equipment blank sample was prepared by pouring deionized water through a cleaned precipitation collector, and the resulting sample was analyzed for trace metals, major ions, and nutrients. Constituent concentrations from the equipment blank generally were less than the minimum laboratory reporting level.

A summary of precipitation analyses is presented in table 6. Selected statistical analyses for precipitation are included in table 5. Analytical results of explosive compounds in precipitation are described in the "Explosive, Semivolatile Organic, and Petroleum Hydrocarbon Compounds in Water" section of this report.

Ground Water

Analyses of ground-water samples were used, as were analyses of precipitation samples, to establish a baseline of water quality for surface-water analyses. Water from the MATES well at the OTA is used for lawn irrigation, potable supply for MATES and IDARNG personnel, and the large-scale vehicle wash facility. Vehicle wash water moves first to a concrete-lined pool to allow mud and debris to precipitate and then flows to a large, lined pond. Water in the pond evaporates, is recycled back to the wash facility, or is pumped to small, sand-filled spreading basins. Landscaped areas immediately adjacent to the MATES administration building are irrigated during dry months, and wastewater from the MATES facility is piped to a lined evaporation pond.

Ground-water quality conditions in most areas of the OTA are unknown because there are few wells. Total and dissolved concentrations of trace metals (except total iron), major ions, and nutrients in water from ASP and MATES wells along the eastern boundary of the OTA were similar and smaller than drinking-water limits for municipal water supplies (U.S. Environmental Protection Agency, 2004, p. 8–10). The secondary drinking-water limit is 300 mg/L for iron, and water from the ASP well contained a total iron concentration of 460 mg/L. The concentration of total iron in the MATES well sample was 18 mg/L. Dissolved iron in the ASP well sample was 440 mg/L, indicating that the large concentration of total iron analyzed in the water sample was not the result of suspended solids in the sample.

A summary of selected statistical analyses for ground-water data is shown in table 5. Analytical results of explosive compounds in ground-water samples are described in the "Explosive, Semivolatile Organic, and Petroleum Hydrocarbon Compounds in Water Samples" section of this report.

Total and Dissolved Concentrations in Water Samples

All surface- and ground-water samples from the OTA were analyzed for total (suspended plus dissolved) concentrations. Several duplicate surface-water samples and water from the ASP well were analyzed for both total and dissolved concentrations to determine the importance of suspended solids in overall water chemistry and movement of contaminants.

Dissolved and total concentrations of most constituents in surface-water samples were not noticeably different, which indicates that concentrations of most constituents were not determined by suspended solids (table 7). Dissolved and total concentrations of aluminum, iron, and titanium were noticeably different, which indicates that relatively large amounts were suspended in the water rather than dissolved in the water. It is not known whether these differences are related to low solubility and geochemical conditions of the water or to other factors.

Explosive, Semivolatile Organic, and Petroleum Hydrocarbon Compounds in Water Samples

Three explosive compounds were detected in an April 2003 precipitation sample from the Range 2 weather site, two compounds were detected in an April 2003 precipitation sample from the Range 26 weather site, and one compound was detected in a September 2002 water sample from the MATES well. Explosive compound detections in precipitation and ground water at the OTA were unanticipated. Airborne dust was present in all precipitation collectors, and it is unknown whether the source of explosive compounds in the April 2003 precipitation samples was precipitation at that site or dust transported by wind and flushed into the separatory funnel. The source of RDX in the water sample from the MATES well is unknown.

The source of hexadecanoic acid (palmitic acid) in water from Tadpole Lake also was unusual. Sources of hexadecanoic acid generally are animal or vegetable fats or oils. Possible sources of this compound in Tadpole Lake water are unknown. Petroleum hydrocarbon concentrations were detected in water from a MATES storm-water drain, the MATES wash water pond, a storm-water puddle near the Range Road at MPRC-H, and Tadpole Lake. Explosive, SVOC, and petroleum hydrocarbon compounds detected in surface-water, ground-water, and precipitation samples from the OTA are shown in table 4.

Dust

Dust may be an important factor in movement of contaminants, especially during summer and fall months when vehicle activities on roads, Impact Areas, and Maneuver Areas move fine dust from the soil to the air or vehicles. Weather systems may transport the dust within the OTA area or areas outside the OTA. Dust from contaminated soil can be transported by vehicles and deposited along roads, in vehicle parking areas, or washed into the wash water pond at MATES.

Dust samples were collected from bucket and BSNE samplers at Range 2, Range 14, and Range 26 weather sites (30d, 39d, and 62d). The original intent of this sampling was to measure the amount of airborne dust that accumulated in a 5-month period from late summer to winter, collect airborne dust from varying heights above land surface, and analyze dust for selected trace metals, explosive compounds, and petroleum products. If contaminants were being moved by wind and dust within the OTA and possibly outside the OTA area, contaminated dust would have been deposited in these collectors.

After 5 months of collection, however, the small amount of dust in the bucket collectors was an insufficient sample for most laboratory analyses. Precipitation had collected in the bucket collectors, and samples with water and sediment from the bucket collectors were sent to the CVO lab for sand break and sediment weight only. Each of the three samples was 97 percent finer than 0.063 mm grain size (silt or clay; percent by weight). Total weight of sediment was 1.24 g from Range 2, 0.65 g from Range 14, and 1.34 g from Range 26.

BSNE samples were not sent for laboratory analyses because only a thin coating of dust was present in each of the BSNE collectors. Sample volumes were very small, and samples would have to be scraped, brushed, or flushed off the galvanized collector surfaces, increasing the possibility of introducing contaminants from the collectors into the soil samples.

SUMMARY

The primary objective of the Phase II study was to determine the nature and extent of potential soil, surface-water, and ground-water contamination at the Orchard Training Area (OTA). The secondary objective of the study was to collect and analyze precipitation samples to document types and concentrations of chemical compounds deposited by rain. Airborne dust samples were collected to document quantity and quality of sediments carried by wind.

To facilitate interpretation and use of study results, largest concentrations of constituents and compounds in soil or water samples are summarized in table 8. Constituents with maximum (upper 10th percentile) concentrations are shown in red (refer also to table 2 and table 6). Explosive, semivolatile organic, and petroleum hydrocarbon compounds are shown in bold (refer also table 4). Sample numbers are grouped into four general areas of land and water use within the OTA — vehicle corridor and major access roads, Maneuver Areas, Impact Area, and MATES compound.

In areas along the vehicle corridor and major access roads within the OTA, most trace metal, major ion, and nutrient concentrations in soil samples were not in the upper 10th percentile of data, but concentrations of 25 metals, ions, or nutrients were in the upper 10th percentile in a puddle sample near the heavy equipment maneuvering area, MPRC-H. The largest concentrations of tin, ammonia, and nitrite plus nitrate (as nitrogen) in water from the OTA were detected in a sample from this puddle. Petroleum hydrocarbons were the most common contaminant, detected in all soil samples and surface-water samples. An SVOC, bis (2-ethylhexyl) phthalate, a plasticizer, was detected at a site on the vehicle corridor.

In Maneuver Areas within the OTA, many soil samples contained at least one trace metal, major ion, or nutrient in the upper 10th percentile of data, and the largest concentrations of cobalt, iron, mercury, titanium, sodium, ammonia, or total phosphorus were detected in 6 of 13 soil samples outside the Tadpole Lake area. The largest concentrations of aluminum, arsenic, beryllium, nickel, selenium, silver, strontium, thallium, vanadium, chloride, potassium, sulfate, and nitrite plus nitrate were detected in soil samples from the Tadpole Lake area. Water from Tadpole Lake contained the largest total concentrations of 19 trace metals, 4 major ions, and 1 nutrient. Petroleum hydrocarbons were detected in five soil samples and water from Tadpole Lake. SVOCs related to combustion of fuel or plasticizers were detected in one soil sample. Explosive compounds were detected in one precipitation sample.

In the central Impact Area within the OTA, most soil samples contained at least one trace metal, major ion, or nutrient in the upper 10th percentile of data, and the largest concentrations of barium, chromium, copper, manganese, lead, or orthophosphate were detected in 6 of the 18 soil samples. Petroleum hydrocarbons were detected in four soil samples, SVOCs in six soil samples, and explosive compounds in four soil samples.

In the MATES compound adjacent to the OTA, all soil and water samples contained at least one trace metal, major ion, or nutrient in the upper 10th percentile of data. Largest concentrations of antimony, cadmium, molybdenum, tin, zinc, or fluoride were detected in two of the seven soil samples. Largest concentrations of antimony, cadmium, zinc, or fluoride were detected in drain or pond water samples. Petroleum hydrocarbons were detected in six soil samples and two water samples. SVOCs were detected in three soil samples. The explosive compound RDX was detected in one soil sample and one ground-water sample.

SUGGESTIONS FOR FUTURE ACTION OR FURTHER STUDIES

Soil and water in the northeast drain at the MATES compound contained relatively large concentrations of trace metals, nitrite plus nitrate, and petroleum hydrocarbons, and water from this drain flows to a muddy wetland used for seasonal cattle grazing outside the MATES fenced boundary. Containing this water within the MATES area would eliminate surface-water transport of contaminants to privately owned land and access to the water by livestock.

RDX was detected in the September 2002 water sample, collected from an all-weather hydrant at the vehicle wash area, but it is unknown whether the source of the RDX was the well or the plumbing system between the well and the hydrant. If RDX exists in water collected at the well head, the source of the contaminant to the well or regional ground-water system will need to be determined. If RDX is detected in water from sampling points in the MATES area but not at the well head, the source of leakage to the buried pipes will need to be determined. Resampling the MATES public-supply well for explosive compound analyses would provide the information needed to confirm existence of RDX in the system.

Only 4 soil or water samples were collected from playas in and near the OTA (35, 49, 50, and 56sw). There were no anomalous concentrations of trace metals or major ions in soil from a playa west of Ranges 10 and 11 (35), but there were numerous anomalous concentrations of trace metals and major ions from areas in and near Tadpole Lake (49, 50, and 56sw). Collection and analyses of soil and water from additional playas in and near the OTA would help determine whether large concentrations from the Tadpole Lake area were the result of geologic and environmental conditions specific to the Tadpole Lake area or are the result of playa conditions in general in this area.

Possibilities for transport of explosive compounds to areas within and outside the OTA and effects of exposure or ingestion of explosive compounds on wildlife are unknown. Explosive compounds were detected in precipitation samples from Range 2 weather (30p) and Range 26 weather (62p) in the eastern and southwestern part of the OTA may have been transported by wind and dust. The extent of explosives transport by dust within and outside the OTA boundaries is not known. Additional precipitation samples for explosives analyses, periodically collected from various locations within the OTA, would provide needed data on extent of aerial transportation of explosive compounds.

Explosive compounds may adhere to or be absorbed by vegetation in the area; wildlife moving through areas where explosive compounds are present may ingest explosives-containing vegetation or dust; and explosive compounds may move within and outside the OTA through carnivore, birds of prey, and other predator activities. Additional information is needed on these transport mechanisms, extent of transport, and effects of explosive compounds on wildlife in and moving through the OTA areas.

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Tables 1–8

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Table 1. Description of soil, water, precipitation, airborne dust, and quality control samples from sites in and near the Orchard Training Area, Ada County, Idaho

[Abbreviations and acronyms are explained in table A, appendix]

Sample number (figure 1 and figure 3)	Sample date	Sample type	Sample identification	Comments
1	8/22/02	soil, grid	114-0822-1451 Can-Ada Concrete	vehicle corridor near Can-Ada Concrete
2	8/22/02	soil, grid	114-0822-1434 N. Kuna Road intersection	Pleasant Valley Road at N. Kuna Road, vehicle corridor next to road
3	8/22/02	soil, grid	114-0822-1412 railroad tracks	Pleasant Valley Road at vehicle corridor near railroad tracks
4sw	3/27/03	water, sw, STL	114-0327-1040 Sand Creek	grab sample from storm water puddle
5	8/22/02	soil, grid	114-0822-1354 Sand Creek at OTA boundary	Sand Creek--dry creek bed east of Pleasant Valley Road
6	12/18/02	soil, grid, background	114-1218-1530 NW of Christmas Mountain	NW of Christmas Mountain,1- to 2-ft-tall sage
7	9/12/02	soil, grid	101-0912-1300 MATES entrance storm water basin	storm water runoff basin at entrance to MATES
7	3/28/03	soil, grab, Cr(VI)	101-0328-1350 MATES entrance storm water basin	storm water runoff basin at entrance to MATES, Cr (VI) only
7	4/2/03	soil, grid, Cr(VI)	101-0912-1300 MATES entrance storm water basin	Cr (VI) only--from 9/12/02 soil sample
8gw	9/12/02	water, gw, STL	101-0912-1135 MATES well	water samples from hydrant at overhead filling hose, near wash water spreading (STL analyses)
8gw	9/12/02	water, gw, USGS, replicate	01S 03E 35ABBA1 MATES well, replicate	water samples from hydrant at overhead filling hose, near wash water spreading (USGS-NWQL analyses)
9	9/12/02	soil, grid	101-0912-1005 MATES NE drain	northeast storm water drain adjacent to tank parking area
9	4/2/03	soil, grid, Cr(VI)	101-0912-1005 MATES NE drain	Cr (VI) only--from 9/12/02 soil sample
10sw	3/28/03	water, sw, STL	101-0328-1150 MATES NE drain	northeast storm water drain adjacent to tank parking area
10sw	3/28/03	water, sw, STL	101-0328-1150 MATES NE drain	dissolved metals
11	3/28/03	soil, grab, plus Cr (VI)	101-0328-1220 MATES drain at tank parking gate	small drain at tank parking gate, plus Cr (VI)
12	9/12/02	soil, grid	101-0912-1050 MATES fueling area runoff	storm water runoff basin near fueling area
12	4/2/03	soil, grid, Cr(VI)	101-0912-1050 MATES fueling area runoff	Cr (VI) only--from 9/12/02 soil sample
12	3/28/03	soil, grab, Cr(VI)	101-0328-1255 MATES fueling area runoff	storm water runoff near fueling area, Cr (VI) only
13	3/28/03	soil, grab	101-0328-1310 MATES east drain	east storm water drain to new large basin, full analyses plus Cr (VI)
13sw	3/28/03	water, sw, STL	101-0328-1310 MATES east drain	east storm water drain to new large basin
14	8/29/02	soil, grid	114-0829-1338 maintenance area near Christmas Mountain	vehicle maintenance area near Christmas Mountain
15	9/12/02	soil, grid	101-0912-1220 MATES wash water spreading area	wash water spreading area

Table 1. Description of soil, water, precipitation, airborne dust, and quality control samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample date	Sample type	Sample identification	Comments
15	4/2/03	soil, grid, Cr(VI)	101-0912-1220 MATES wash water spreading area	Cr (VI) only—from 9/12/02 soil sample
15	3/28/03	soil, grab, Cr(VI)	101-0328-1240 MATES wash water spreading area	wash water spreading area, Cr (VI) only
16	9/12/02	soil, grid	101-0912-1235 MATES wash water pond	wash water pond at MATES, near concrete spillway
16sw	9/12/02	water, sw, USGS	101-0912-1230 MATES wash water pond	wash water pond at MATES, near concrete spillway
17	3/28/03	soil, grab, Cr(VI)	101-0328-1235 MATES wash water pond	Cr (VI) only
17sw	3/13/03	water, sw, STL	101-0313-1220 MATES wash water pond	wash water pond at MATES, east side, peristaltic pump
17sw	3/13/03	water, sw-dis, STL	101-0313-1220 MATES wash water pond	wash water pond at MATES, east side, peristaltic pump, dissolved metals
18	12/18/02	soil, grab, background	114-1218-1510 near Christmas Mountain	west of Christmas Mountain
19	1/30/03	soil, grab	101-0130-0950 ASP east	eastern ASP area, between fence and access road
20	1/30/03	soil, grab	101-0130-0844 ASP loading	Ammunition Supply Point, area between two boxes of shell casings
20	1/30/03	soil, grab, duplicate	101-0130-0845 ASP loading, duplicate	duplicate sample--explosives only
20	4/2/03	soil, grab, Cr(VI)	101-0130-0844 ASP loading	Cr (VI) only-- from 1/30/03 soil sample
21gw	2/13/03	water, gw, STL	101-0213-1046 ASP well	ASP well-- total and dissolved
21gw	2/13/03	water, gw, USGS	02S 03E 02ABCD1 ASP well	ASP well-- onsite measurements only
22	8/29/02	soil, grid	101-0829-0701 Range 5 parking	Range 5 parking area
23	8/29/02	soil, grid	101-0829-0719 Range 5 firing	Range 5 firing
24	8/29/02	soil, grid	101-0829-0743 Range 5 target	Range 5 target berm
25	1/30/03	soil, grab	114-0130-1030 MPRC-H BPB1	Battle Position B1
26	8/29/02	soil, grid	114-0829-0848 MPRC-H BPB2L	tank range--Battle Position B2L, near firing pad
26.1	4/14/03	soil, grab, explosives	114-0414-1105 MPRC-H BPB2 ditch	explosive only
26.2	4/14/03	soil, grab, explosives	114-0414-1120 MPRC-H BPB2 mud	explosive only
26.3	4/14/03	soil, grab, explosives	114-0414-1124 MPRC-H BPB2 mud-3	explosive only
26.4	4/14/03	soil, grab, explosives	114-0414-1150 MPRC-H BPB2 mud-edge	explosive only
26.5	4/14/03	soil, grab, explosives	114-0414-1130 MPRC-H BPB2 swale	explosive only
27sw	3/27/03	water, sw, STL	114-0327-1230 Range Road at MPRC-H	storm water puddle near Christmas Mountain
28sw	3/27/03	water, sw, STL	101-0327-1320 Range 6	storm water puddle near Range 6
29	8/29/02	soil, grid	114-0829-0815 Range 2 weather	adjacent to Range 2 weather
29	4/2/03	soil, grid, Cr(VI)	114-0829-0815 Range 2 weather	Cr (VI) only-- from 8/29/02 soil sample
29.1	4/9/03	soil, grab, metals	114-0410-1310 Range 2a	Range 2--metals only

Table 1. Description of soil, water, precipitation, airborne dust, and quality control samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample date	Sample type	Sample identification	Comments
29.2	4/9/03	soil, grab, metals	114-0410-1312 Range 2b	Range 2--metals only
29.3	4/9/03	soil, grab, metals	114-0410-1315 Range 2c	Range 2--metals only
29.4	4/9/03	soil, grab, metals	114-0410-1320 Range 2d	Range 2--metals only
29.5	4/9/03	soil, grab, metals	114-0410-1320 Range 2e	Range 2--metals only
29.6	4/9/03	soil, grab, metals	114-0410-1324 Range 2f	Range 2--metals only
29.7	4/9/03	soil, grab, metals	114-0410-1330 Range 2g	Range 2--metals only
29.8	4/9/03	soil, grab, metals	114-0410-1340 Range 2h	Range 2--metals only
30p	10/29/02	water, precip, USGS	114-0410-1300 Range 2 weather	Range 2 weather
30p	12/18/02	water, precip, USGS	114-0410-1300 Range 2 weather	Range 2 weather (bird droppings)
30p	1/30/03	water, precip, USGS	114-0410-1300 Range 2 weather	Range 2 weather (odor to water, insect parts)
30p	4/10/03	water, precip, STL, explosives	114-0410-1300 Range 2 weather	Range 2 weather- explosives only
31	1/30/03	soil, grab	114-0130-0955 MPRC-H BP3	tank range--Battle Position 3
32	1/30/03	soil, grab	114-0130-1010 MPRC-H C2CR	tank range--Center Road C2
33	8/29/02	soil, grid	114-0829-0911 MPRC-H BPA8	tank range--Battle Position A8
34	8/29/02	soil, grid	114-0929-0944 MPRC-H BPC13	tank range- Battle Position C13
35	8/28/02	soil, grid	103-0828-1432 playa west of Range 10/11	section 23/24 playa
36	8/26/02	soil, grid	101-0826-1040 Cinder Butte Road	south of Cinder Butte Road near OTA boundary
37	8/29/02	soil, grid	103-0829-1018 Range 30	Range 30 near the Artillery Impact Area
38	8/28/02	soil, grid	103-0828-1355 Range 14 weather	adjacent to Range 14 weather
39p	12/18/02	water, precip, USGS	103-0410-1510 Range 14 weather	Range 14 weather, ants in funnel
39p	1/20/03	water, precip, USGS	103-0410-1510 Range 14 weather	Range 14 weather
39p	4/10/03	water, precip, STL, explosives	103-0410-1510 Range 14 weather	Range 14 weather- explosives only
40	1/30/03	soil, grab, background	103-0130-1150 cinder pit wall	undisturbed wall in cinder pit
40	4/2/03	soil, grab, Cr(VI)	103-0130-1150 cinder pit wall	Cr (VI) only-- from 1/30/03 soil sample
41	8/23/02	soil, grid	103-0823-1432 cinder pit near Cinder Cone Butte	cinder pit--grid
42	8/28/02	soil, grid	103-0828/1306 Range 14 target	Range 14 target areas
43	8/28/02	soil, grid	103-0828-1231 Range 14 firing	Range 14 firing
44	8/28/02	soil, grid	103-0828-1331 Range 14 parking	Range 14 parking lot

Table 1. Description of soil, water, precipitation, airborne dust, and quality control samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample date	Sample type	Sample identification	Comments
45	1/30/03	soil, grab	103-0130-1108 draw N of Tadpole Lake	N of Tadpole Lake, adjacent to Range Road
46	8/23/02	soil, grid	103-0823-1350 Corder Creek near Range 15	Corder Creek bed near cinder pit
47	8/20/02	soil, background	103-0820-1309 badger diggings, dry draw	badger diggings near stream channel
48	8/20/02	soil, grid	103-0820-1307 dry draw NW of Tadpole Lake	stream channel near badger digging
49	4/9/03	soil, grab	103-0409-1128 playa N of Tadpole Lake	north of Tadpole Lake
50	12/18/02	soil, grab	103-1218-1426 Tadpole Lake pallet	Tadpole Lake, near wooden pallet
50	12/18/02	soil, grab, duplicate	103-1218-1427 Tadpole Lake pallet, duplicate	duplicate sample
51	12/18/02	soil, grab	103-1218-1330 Tadpole Lake SE	Tadpole Lake, outside fenced area, SE side
52	8/20/02	soil, grid	103-0820-1355 Tadpole Lake	Tadpole Lake, dry bed
53	12/18/02	soil, grab	103-1218-1422 Tadpole Lake rocks	Tadpole Lake, end of line of rocks
53	4/2/03	soil, grab, Cr(VI)	103-1218-1422 Tadpole Lake rocks	Cr (VI) only-- from 12/18/02 soil sample
54	12/18/02	soil, grab	103-1218-1400 Tadpole Lake W	Tadpole Lake, outside fence, west side
55	12/18/02	soil, grab	103-1218-1340 Tadpole Lake S	Tadpole Lake, inside fence, south side
55	4/2/03	soil, Cr(VI)	103-1218-1340 Tadpole Lake S	Cr (VI) only-- from 12/18/02 soil sample
56sw	3/11/03	water, sw, STL	103-0311-1205 Tadpole Lake	south side of lake, peristaltic pump
56sw	3/11/03	water, sw-dis, STL	103-0311-1205 Tadpole Lake	peristaltic pump-dissolved metals
56sw	3/11/03	water, sw-dis, replicate STL	103-0311-1206 Tadpole Lake, replicate	peristaltic pump - replicate dissolved metals
57	12/18/02	soil, grab	103-1218-1410 Tadpole Lake W2	Tadpole Lake, inside fence, west side
57	4/2/03	soil, grab, Cr(VI)	103-1218-1410 Tadpole Lake W2	Cr (VI) only-- from 12/18/02 soil sample
58	8/29/02	soil, grid	103-0829-1130 Rabbit Creek near Artillery Impact Area	Rabbit Creek near Artillery Impact Area
58	8/29/02	soil, grid, duplicate	103-0829-1135 Rabbit Creek near Artillery Impact Area, duplicate	duplicate sample
59	8/29/02	soil, grid	103-0829-1207 dry draw SE of Artillery Impact Area	draw near Little Joe Butte
60	4/9/03	soil, grab	103-0409-1154 Hood Road draw	Hood Road south of Tadpole Lake
61	8/26/02	soil, grid	101-0826-1013 Range Road near Range 20	Range Road SE, by Little Joe Butte
62p	8/1/02	water, precip, USGS	103-0409-1345 Range 26 weather	Range 26 weather
62p	10/29/02	water, precip, USGS	103-0409-1345 Range 26 weather	Range 26 weather
62p	12/18/02	water, precip, USGS	103-0409-1345 Range 26 weather	Range 26 weather

Table 1. Description of soil, water, precipitation, airborne dust, and quality control samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample date	Sample type	Sample identification	Comments
62p	4/9/03	water, precip, STL,explosives	103-0409-1345 Range 26 weather	Range 26 weather--explosives only
63	8/20/02	soil, grid	103-0820-1148 Range 26 weather	adjacent to Range 26 weather
64	8/23/02	soil, grid	103-0823-1112 Rabbit Creek near Range 26	Rabbit Creek bed near Range Road
65	8/23/02	soil, grid	103-0823-1209 Corder Creek near Range 22	Corder Creek channel near Range Road
30d	12/18/02	airborne dust, CVO	114-1218-1000 Range 2 weather	sand break and total sediment weight
39d	12/18/02	airborne dust, CVO	103-1218-1030 Range 14 weather	sand break and total sediment weight
62d	12/18/02	airborne dust, CVO	103-1218-1130 Range 26 weather	sand break and total sediment weight
	12/18/02	water, special nutrients, USGS	bird droppings solution	nutrients only--bird droppings from Range 26 precipitation collector added to deionized water
	12/18/02	water, QC, equipment,USGS	equipment blank, precipitation (Range 14)	equipment blank, deionized water thru filter unit in Boise USGS Lab
	3/13/03	water, QC, VOC-free, STL	equipment blank, 101-0313-1300 VOC-free water	equipment blank, VOC-free water thru cleaned peristaltic pump tubing in Boise USGS Lab
	3/13/03	water, QC, equipment, STL	equipment blank, 101-0313-1330 deionized water	equipment blank, deionized water through cleaned peristaltic pump tubing in Boise USGS lab

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Table 2. Selected statistical analyses of soil from sites in and near the Orchard Training Area, Ada County, Idaho

[Abbreviations are explained in table A, appendix; sample number information is shown in table 1; the most commonly occurring sample numbers are shown in red; **, concentrations in a few laboratory blank samples were equal to or greater than the laboratory minimum reporting limit; <, less than the laboratory method detection limit]

Constituent (total concentration)	Number of samples	Minimum	Mean	Median (50th percentile)	75th percentile	90th percentile	Maximum	Sample numbers, five smallest concentrations (in order of increasing concentrations)	Sample numbers, upper 10th percentile of concentrations (in order of increasing concentrations)
aluminum µg/kg	48	2,900,000	18,967,000	19,000,000	22,250,000	27,000,000	40,000,000	5, 40, 3, 15, 16	7, 19, 13, 52, 31, 49
** antimony µg/kg	48	< 2.9	133	20	29	42	5,100	1, 5, 40, 41, 3	13, 15, 23, 16, 43, 9, 11
arsenic µg/kg	48	410	3,143	3,150	3,800	4,230	5,800	5, 40, 41, 22, 44	49, 31, 34, 12, 33, 52
barium µg/kg	48	24,000	185,833	20,000	230,000	260,000	290,000	5, 40, 3, 16, 1	45, 49, 32, 6, 52, 31
beryllium, µg/kg	48	82	746	760	870	980	1,600	5, 40, 1, 3, 15	19, 24, 13, 31, 49, 52
cadmium µg/kg	48	60	876	515	610	816	14,000	5, 3, 40, 2, 1	32, 23, 16, 15, 9, 11
chromium µg/kg	48	1,200	18,844	18,000	21,250	26,200	97,000	40, 5, 41, 44, 22	9, 11, 13, 31, 49, 52, 29
cobalt µg/kg	48	1,200	8,619	9,000	11,000	12,000	15,000	5, 3, 1, 16, 15	6, 14, 24, 49, 52, 32, 45
copper µg/kg	48	2,000	17,719	16,000	22,000	25,300	57,000	5, 3, 1, 15, 2	31, 41, 19, 49, 52, 11, 23
iron µg/kg	48	2,600,000	19,195,833	19,000,000	22,000,000	26,200,000	39,000,000	5, 3, 15, 16, 1	22, 24, 13, 52, 31, 49, 41
lead µg/kg	48	2,800	12,046	12,000	14,000	16,000	24,000	41, 22, 5, 44, 3	6, 32, 11, 23, 33, 42
manganese µg/kg	48	110,000	708,333	725,000	890,000	1,100,000	1,300,000	5, 3, 1, 16, 2	14, 23, 37, 38, 45, 32
mercury µg/kg	48	< 2.5	10	10	12	19	25	3, 5, 15, 16, 22	64, 6, 46, 25, 32, 19
molybdenum µg/kg	48	57	433	410	490	575	1,200	5, 31, 15, 33, 3	23, 25, 43, 22, 41,11
nickel µg/kg	48	1,600	14,731	15,000	18,000	19,600	30,000	5, 3, 1, 22, 16	9, 60, 13, 24, 31, 49, 52
selenium µg/kg	48	62	487	495	558	653	1,000	5, 3, 1, 15, 16	47, 48, 40, 63, 49, 41, 52
silver µg/kg	48	34	263	260	313	355	550	5, 3, 1, 16, 40	32, 36, 22, 43, 31,49, 52
strontium µg/kg	48	6,900	45,602	43,500	50,000	70,000	110,000	5, 3, 15, 16, 11	33, 34, 49, 41, 31, 52
thallium µg/kg	48	4.6	191	205	240	283	380	40, 5, 41, 3, 22	7, 31, 58, 13, 49, 52
** tin µg/kg	48	79	364	350	495	571	720	5, 40, 41, 12, 1	23, 44, 43, 61, 36, 22, 11
titanium µg/kg	48	130,000	987,917	965,000	1,100,000	1,300,000	3,600,000	5, 3, 16, 15, 1	31, 49, 13, 44, 22, 41
vanadium µg/kg	48	3,500	30,885	31,500	36,000	40,800	53,000	5, 3, 15, 22, 1	6, 7, 31, 13, 49, 41, 52
zinc µg/kg	48	8,600	66,367	63,000	71,000	88,000	240,000	5, 3, 1, 40, 2	13, 49, 52, 9, 20, 11
** chloride mg/kg	48	10	73	17	25	47	1,500	5, 9, 59, 7, 40	12, 23, 22, 1, 2, 52
** fluoride mg/kg	48	1.3	3.2	2.9	3.7	4.8	6.9	40, 5, 45, 18, 25	33, 11, 42, 7, 12, 13
potassium mg/kg	48	360	3,749	3,800	4,650	5,360	11,000	40, 5, 3, 16, 15	19, 65, 63, 13, 60, 49, 52
sodium mg/kg	48	110	604	450	600	976	4,300	6, 5, 11, 16, 18	44, 40, 49, 22, 52, 41

Table 2. Selected statistical analyses of soil from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Constituent (total concentration)	Number of samples	Minimum	Mean	Median (50th percentile)	75th percentile	90th percentile	Maximum	Sample numbers, five smallest concentrations (in order of increasing concentrations)	Sample numbers, upper 10th percentile of concentrations (in order of increasing concentrations)
** sulfate mg/kg	48	11	82	24	53	203	940	40, 25, 32, 45, 18	43, 22, 2, 41, 63, 52
** ammonia as N mg/kg	48	< 0.45	2.6	2.1	3.1	4.0	25	45, 32, 31, 11, 7	2, 58, 35, 37, 1, 38, 60
nitrite + nitrate as N mg/kg	48	0.47	13	8	13	23	120	40, 11, 5, 32, 36	49, 22, 2, 48, 60, 52
orthophosphate as P mg/kg	48	< 0.14	4.2	2.5	5.6	9.6	16	40, 11, 31, 16, 63	42, 23, 38, 59, 60, 37
total phosphorus mg/kg	48	< 1.6	761	730	1,000	1,330	3,500	11, 13, 52, 48, 49	18, 41, 22, 44, 6, 19, 40

Table 3. Summary of statistical analyses of total metals, major ions, and nutrients in soil samples from sites in and near the Orchard Training Area, Ada County, Idaho

[Terms, abbreviations, and acronyms are explained in table A, appendix. Sample number information is shown in table 1]

Constituent (total concentration)	Sample numbers, upper 10th percentile of concentrations (in order of increasing concentrations, table 2)	Impacts from land and water uses?	Comments
Metals			
aluminum	7, 19, 13, 52, 31, 49	yes	Anomalous concentrations are from sites at and near Tadpole Lake, MPRC-H, MATES, and ASP areas.
antimony	13, 15, 23, 16, 43, 9, 11	yes	Anomalous concentration (MATES drain at tank parking gate, 5,100 µg/kg) is 28 times larger than the next largest concentration. Other large concentrations are from areas at MATES and firing ranges 14 and 5.
arsenic	49, 31, 34, 12, 33, 52	possibly	Anomalous concentration is from Tadpole Lake (5,800 µg/kg). Other large concentrations are from MPRC-H and MATES areas.
barium	45, 49, 32, 6, 52, 31	possibly	No anomalous concentrations but largest concentrations are from MPRC-H and Tadpole Lake areas.
beryllium	19, 24, 13, 31, 49, 52	yes	Largest concentrations at and near Tadpole Lake, MPRC-H, and MATES areas.
cadmium	32, 23, 16, 15, 9, 11	yes	Anomalous concentration (MATES drain at tank parking gate, 14,000 µg/kg) is more than 4 times larger than the next largest concentration. Other large concentrations are from sites at and near Tadole Lake, MPRC-H, MATES, and Range 5 areas.
chromium	9, 11, 13, 31, 49, 52, 29	yes	Anomalous concentration (Range 2 weather, 97,000 µg/kg) is more than 3 times larger than next largest concentration. Other large concentrations are from sites at and near Tadpole Lake, MPRC-H, and MATES drain sites.
cobalt	6, 14, 24, 49, 52, 32, 45	possibly	No anomalous concentrations; largest concentrations are from sites at and near Tadpole Lake.
copper	31, 41, 19, 49, 52, 11, 23	yes	Anomalous concentration (Range 5 firing pad, 57,000 µg/kg) is more than 1.5 times larger than the next largest concentration. Other large concentrations are from MATES drain and sites at and near Tadpole Lake.
iron	22, 24, 13, 52, 31, 49, 41	possibly	Largest concentration is from cinder pit site (39,000,000 µg/kg), but cinder pit wall concentrations are relatively low (12,000 µg/kg). Other large concentrations are from sites at and near Tadpole Lake and various activity areas at OTA.
lead	6, 32, 11, 23, 33, 42	yes	Anomalous concentrations are from Range 14 target, MPRC-H, Range 5 firing pad, and MATES drain sites.
manganese	14, 23, 37, 38, 45, 32	possibly	No anomalous concentrations but largest concentrations are from MPRC-H, Tadpole Lake, and Ranges 14, 30, and 5 (firing pad).
mercury	64, 6, 46, 25, 32, 19	possibly	No anomalous concentrations but largest concentrations are from ASP and MPRC-H sites.
molybdenum	23, 25, 43, 22, 41,11	yes	Anomalous concentration (MATES drain at tank parking gate, 1,200 µg/kg) is 1.5 times larger than the next largest concentration. Other large concentrations are from cinder pit, Range 14 and 5 firing pads, and MPRC-H sites.

Table 3. Summary of statistical analyses of total metals, major ions, and nutrients in soil samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Constituent (total concentration)	Sample numbers, upper 10th percentile of concentrations (in order of increasing concentrations, table 2)	Impacts from land and water uses?	Comments
Metals—Continued			
nickel	9, 60, 13, 24, 31, 49, 52	possibly	Largest concentrations are from sites at and near Tadpole Lake, MPRC-H, Range 5 target, and MATES drain.
selenium	47, 48, 40, 63, 49, 41, 52	possibly	Anomalous concentration is from Tadpole Lake (1,000 µg/kg). Other large and many median to 75th-percentile concentrations are from firing ranges, MATES, and MPRC-H sites.
silver	32, 36, 22, 43, 31, 49, 52	possibly	No anomalous concentrations. Largest concentrations are from sites at and near Tadpole Lake, MPRC-H, and Range 14 firing.
strontium	33, 34, 49, 41, 31, 52	yes	Largest concentrations are from sites at and near Tadpole Lake, MPRC-H, and the cinder pit.
thallium	7, 31, 58, 13, 49, 52	possibly	Largest concentrations are from sites at and near Tadpole Lake, MATES drain, and Rabbit Creek near Artillery Impact Area.
tin	23, 44, 43, 61, 36, 22, 11	yes	Largest concentrations are from MATES drain at tank parking gate, parking and perimeter roads, and firing pad areas.
titanium	31, 49, 13, 44, 22, 41	yes	Anomalous concentration (cinder pit, 3,600,000 µg/kg) is 2 times larger than the next largest concentration. Other large concentrations are from parking areas, MATES drain, MPRC-H, and sites at and near Tadpole Lake.
vanadium	6, 7, 31, 13, 49, 41, 52	yes	Largest concentrations are from sites at and near Tadpole Lake, cinder pit, MATES drains, and MPRC-H.
zinc	13, 49, 52, 9, 20, 11	yes	Anomalous concentration (MATES drain at tank parking gate, 240,000 µg/kg) is 1.5 times larger than an ASP site which is 1.7 times larger than the next largest concentration. Other large concentrations are from sites at MATES drains and at and near Tadpole Lake.
Major ions			
chloride	12, 23, 22, 1, 2, 52	yes	Anomalous Tadpole Lake concentration (1,500 µg/kg) is 2 times larger than the next largest concentration. Other large concentrations are from vehicle corridor sites and Range 5 firing and parking areas.
fluoride	33, 11, 42, 7, 12, 13	yes	Largest concentrations are from MATES and Range 14 target areas.
potassium	19, 65, 63, 13, 60, 49, 52	possibly	Anomalous concentrations are from Tadpole Lake and the playa near Tadpole Lake. Other large concentrations are from Hood Road and a MATES drain.
sodium	44, 40, 49, 22, 52, 41	possibly	Anomalous concentration (cinder pit, 4,300 mg/kg) is nearly 1.5 times larger than the next largest concentration. Other large concentrations are from sites at and near Tadpole Lake, Range 5 parking, and the cinder pit wall.
sulfate	43, 22, 2, 41, 63, 52	possibly	Largest concentrations are from Tadpole Lake, Range 26 weather, cinder pit, N. Kuna Road, and Range 5 parking.

Table 3. Summary of statistical analyses of total metals, major ions, and nutrients in soil samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Constituent (total concentration)	Sample numbers, upper 10th percentile of concentrations (in order of increasing concentrations, table 2)	Impacts from land and water uses?	Comments
Nutrients			
ammonia as N	2, 58, 35, 37, 1, 38, 60	yes	Anomalous concentration (Hood Road draw, 25 mg/kg) is 5 times greater than the next largest concentration.
nitrite + nitrate as N	49, 22, 2, 48, 60, 52	yes	Tadpole Lake concentration (120 mg/kg) is nearly 3 times larger than the next largest concentration.
nitrite as N	38, 59, 24, 58, 37, 60	yes	Concentration from Hood Road draw (20 mg/kg) is 10 times larger than the next largest concentration. Other large concentrations are from Range 30, Rabbit Creek near the Artillery Impact Area, and Range 5 target areas.
orthophosphate as P	42, 23, 38, 59, 60, 37	possibly	Largest concentrations are from Range 30, Hood Road, SE of the Artillery Impact Area, and Ranges 14 and 5 areas.
total phosphorus	18, 41, 22, 44, 6, 19, 40	possibly	Anomalous concentration (cinder pit wall, 3,500 mg/kg) is more than 1.5 times larger than next largest concentration. Other large concentrations are from a variety of land use areas. May be naturally occurring in cinders.

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Table 4. Analyses of explosive, semivolatile organic, and petroleum hydrocarbons detected in soil and water samples from sites in and near the Orchard Training Area, Ada County, Idaho

[Result qualifiers—J, estimated result, result in less than the reporting limit; B, method blank contamination, the associated method blank contains the largest analyte at a reportable level; V, general chemistry elevated reporting limit due to limited sample volume. Other terms, abbreviations, and acronyms are explained in table A, table D, table E, and table F, appendix]

Sample number (figure 1 and figure 3)	Sample identification	Sample date	Compound name	Result	Units	Result qualifiers	Lab reporting limit	Lab method detection limit	Laboratory test method
SOIL									
1	114-0822-1451 Can-Ada Concrete	8/22/02	petroleum hydrocarbons	3.5	mg/kg	J	4	2.5	8015B
1	114-0822-1451 Can-Ada Concrete	8/22/02	petroleum hydrocarbons	280	mg/kg	B	500	160	9071B
1	114-0822-1451 Can-Ada Concrete	8/22/02	petroleum hydrocarbons	9.2	mg/kg		4	2.5	8015B
2	114-0822-1434 N. Kuna Road intersection	8/22/02	bis(2-Ethylhexyl) phthalate	200	µg/kg	J	330	70	8270C
2	114-0822-1434 N. Kuna Road intersection	8/22/02	petroleum hydrocarbons	40	mg/kg		4	2.5	8015B
2	114-0822-1434 N. Kuna Road intersection	8/22/02	petroleum hydrocarbons	210	mg/kg	B	510	160	9071B
2	114-0822-1434 N. Kuna Road intersection	8/22/02	Phenanthrene	54	µg/kg	J	330	37	8270C
2	114-0822-1434 N. Kuna Road intersection	8/22/02	petroleum hydrocarbons	58	mg/kg		4	2.5	8015B
3	114-0822-1412 railroad tracks	8/22/02	petroleum hydrocarbons	7.1	mg/kg		4	2.5	8015B
5	114-0822-1354 Sand Creek at OTA boundary	8/22/02	petroleum hydrocarbons	4.3	mg/kg		4	2.5	8015B
6	114-1218-1530 NW of Christmas Mountain	12/18/02	petroleum hydrocarbons	5.2	mg/kg		4.5	2.8	8015B
7	101-0912-1300 MATES entrance storm water basin	9/12/02	bis(2-Ethylhexyl) phthalate	170	µg/kg	J	340	72	8270C
9	101-0912-1005 MATES NE drain	9/12/02	petroleum hydrocarbons	58	mg/kg		4.1	2.6	8015B
11	101-0328-1220 MATES drain at tank parking gate	3/28/03	petroleum hydrocarbons	7500	mg/kg		140	85	8015B
11	101-0328-1220 MATES drain at tank parking gate	3/28/03	Fluorene	300	µg/kg	J	450	74	8270C
11	101-0328-1220 MATES drain at tank parking gate	3/28/03	petroleum hydrocarbons	5800	mg/kg		680	220	9071B
11	101-0328-1220 MATES drain at tank parking gate	3/28/03	Pentachlorophenol	220	µg/kg	J	2200	87	8270C
11	101-0328-1220 MATES drain at tank parking gate	3/28/03	Pyrene	160	µg/kg	J	450	76	8270C
11	101-0328-1220 MATES drain at tank parking gate	3/28/03	petroleum hydrocarbons	4500	mg/kg		680	330	9071B-MOD HEM-SGT

Table 4. Analyses of explosive, semivolatile organic, and petroleum hydrocarbons detected in soil and water samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample identification	Sample date	Compound name	Result	Units	Result qualifiers	Lab reporting limit	Lab method detection limit	Laboratory test method
SOIL—Continued									
12	101-0912-1050 MATES fueling area runoff	9/12/02	petroleum hydrocarbons	15	mg/kg		4.1	2.5	8015B
12	101-0912-1050 MATES fueling area runoff	9/12/02	RDX	0.1	mg/kg	J	0.25	0.1	8330
13	101-0328-1310 MATES east drain	3/28/03	petroleum hydrocarbons	17	mg/kg		5.5	3.5	8015B
15	101-0912-1220 MATES wash water spreading area	9/12/02	petroleum hydrocarbons	31	mg/kg		4	2.5	8015B
16	101-0912-1235 MATES wash water pond	9/12/02	bis(2-Ethylhexyl) phthalate	290	µg/kg	J	330	71	8270C
16	101-0912-1235 MATES wash water pond	9/12/02	petroleum hydrocarbons	99	mg/kg		4	2.5	8015B
18	114-1218-1510 near Christmas Mountain	12/18/02	petroleum hydrocarbons	5.6	mg/kg		4.3	2.7	8015B
20	101-0130-0844 ASP loading	1/30/03	Benzo(a)anthracene	140	µg/kg	J	410	48	8270C
20	101-0130-0844 ASP loading	1/30/03	Benzo(a)pyrene	100	µg/kg	J	410	63	8270C
20	101-0130-0844 ASP loading	1/30/03	Benzo(b)fluoranthene	150	µg/kg	J	410	78	8270C
20	101-0130-0844 ASP loading	1/30/03	Benzo(ghi)perylene	63	µg/kg	J	410	51	8270C
20	101-0130-0844 ASP loading	1/30/03	Benzo(k)fluoranthene	92	µg/kg	J	410	84	8270C
20	101-0130-0844 ASP loading	1/30/03	bis(2-Ethylhexyl) phthalate	150	µg/kg	J	410	87	8270C
20	101-0130-0844 ASP loading	1/30/03	Chrysene	150	µg/kg	J	410	42	8270C
20	101-0130-0844 ASP loading	1/30/03	petroleum hydrocarbons	7	mg/kg		4.9	3.1	8015B
20	101-0130-0844 ASP loading	1/30/03	Fluoranthene	75	µg/kg	J	410	48	8270C
22	101-0829-0701 Range 5 parking	8/29/02	petroleum hydrocarbons	4.3	mg/kg		4	2.5	8015B
23	101-0829-0719 Range 5 firing	8/29/02	2,4-Dinitrotoluene	0.49	mg/kg		0.25	0.042	8330
23	101-0829-0719 Range 5 firing	8/29/02	Di-n-butyl phthalate	290	µg/kg	J	340	78	8270C
25	114-0130-1030 MPRC-H BPB1	1/30/03	petroleum hydrocarbons	8.4	mg/kg		5.5	3.4	8015B
25	114-0130-1030 MPRC-H BPB1	1/30/03	petroleum hydrocarbons	250	mg/kg	B J	680	220	9071B
26	114-0829-0848 MPRC-H BPB2L	8/29/02	2,4-Dinitrotoluene	0.22	mg/kg	J	0.25	0.042	8330
26	114-0829-0848 MPRC-H BPB2L	8/29/02	2,4-Dinitrotoluene	0.91	mg/kg		340	98	8270C
26	114-0829-0848 MPRC-H BPB2L	8/29/02	petroleum hydrocarbons	300	mg/kg		4.1	2.6	8015B
26	114-0829-0848 MPRC-H BPB2L	8/29/02	Di-n-butyl phthalate	470	µg/kg		340	78	8270C
26	114-0829-0848 MPRC-H BPB2L	8/29/02	Diphenylamine	320	µg/kg	J	340	53	8270C
26	114-0829-0848 MPRC-H BPB2L	8/29/02	petroleum hydrocarbons	1700	mg/kg		510	160	9071B

Table 4. Analyses of explosive, semivolatile organic, and petroleum hydrocarbons detected in soil and water samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample identification	Sample date	Compound name	Result	Units	Result qualifiers	Lab reporting limit	Lab method detection limit	Laboratory test method
SOIL—Continued									
26	114-0829-0848 MPRC-H BPB2L	8/29/02	Nitroglycerin	2.9	mg/kg	J	5	0.69	8330
26	114-0829-0848 MPRC-H BPB2L	8/29/02	N-Nitrosodiphenylamine	410	µg/kg		340	74	8270C
26	114-0829-0848 MPRC-H BPB2L	8/29/02	petroleum hydrocarbons	1000	mg/kg		510	120	9071B
26.1	114-0414-1105 MPRC-H BPB2 ditch	4/14/03	2,4-Dinitrotoluene	0.048	mg/kg	J	0.25	0.04	8330
26.4	114-0414-1150 MPRC-H BPB2 mud-edge	4/14/03	2,4-Dinitrotoluene	7.8	mg/kg		0.25	0.04	8330
26.4	114-0414-1150 MPRC-H BPB2 mud-edge	4/14/03	2,6-Dinitrotoluene	0.22	mg/kg	J	0.25	0.05	8330
26.4	114-0414-1150 MPRC-H BPB2 mud-edge	4/14/03	Nitroglycerin	8.3	mg/kg		5	0.57	8330
29	114-0829-0815 Range 2 weather	8/29/02	bis(2-Ethylhexyl) phthalate	100	µg/kg	J	340	71	8270C
32	114-0130-1010 MPRC-H C2CR	1/30/03	petroleum hydrocarbons	3.9	mg/kg	J	5.4	3.4	8015B
37	103-0829-1018 Range 30	8/29/02	Dibutyl phthalate	220	µg/kg	J			8270C
41	103-0823-1432 cinder pit near Cinder Cone Butte	8/23/02	petroleum hydrocarbons	21	mg/kg		4	2.5	8015B
41	103-0823-1432 cinder pit near Cinder Cone Butte	8/23/02	petroleum hydrocarbons	190	mg/kg	B	500	160	9071B
41	103-0823-1432 cinder pit near Cinder Cone Butte	8/23/02	petroleum hydrocarbons	38	mg/kg		4	2.5	8015B
43	103-0828-1231 Range 14 firing	8/28/02	Diphenylamine	200	µg/kg	J	330	53	8270C
43	103-0828-1231 Range 14 firing	8/28/02	Nitroglycerin	15	mg/kg		5.1	0.7	8330
43	103-0828-1231 Range 14 firing	8/28/02	N-Nitrosodiphenylamine	250	µg/kg	J	330	73	8270C
46	103-0823-1350 Corder Creek near Range 15	8/23/02	petroleum hydrocarbons	2.8	mg/kg	J	4.1	2.5	8015B
60	103-0409-1154 Hood Road draw	4/9/03	petroleum hydrocarbons	550	mg/kg	B	590	190	9071B
64	103-0823-1112 Rabbit Creek near Range 26	8/23/02	petroleum hydrocarbons	3.9	mg/kg	J	4.1	2.6	8015B
WATER									
10sw	101-0328-1150 MATES NE drain	3/28/03	petroleum hydrocarbons	0.36	mg/L		0.25	0.043	8015B
10sw	101-0328-1150 MATES NE drain	3/28/03	petroleum hydrocarbons	2.8	mg/L	B	5	1	1664A HEM
17sw	101-0313-1220 MATES wash water pond	3/13/03	petroleum hydrocarbons	0.1	mg/L	J	0.25	0.043	8015B
17sw	101-0313-1220 MATES wash water pond	3/13/03	petroleum hydrocarbons	3.6	mg/L	B	5	1	1664A HEM
27sw	114-0327-1230 Range Road at MPRC-H	3/27/03	petroleum hydrocarbons	8.2	mg/L	B V	13	2.6	1664A HEM
30p	114-0410-1300 Range 2 weather	4/10/03	1,3,5-Trinitrobenzene	4.4	µg/L		0.2	0.03	8330

Table 4. Analyses of explosive, semivolatile organic, and petroleum hydrocarbons detected in soil and water samples from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample identification	Sample date	Compound name	Result	Units	Result qualifiers	Lab reporting limit	Lab method detection limit	Laboratory test method
WATER—Continued									
30p	114-0410-1300 Range 2 weather	4/10/03	2,4,6-Trinitrotoluene	0.54	µg/L		0.2	0.05	8330
30p	114-0410-1300 Range 2 weather	4/10/03	2,6-Dinitrotoluene	0.16	µg/L	J	0.2	0.03	8330
56sw	103-0311-1205 Tadpole Lake	3/11/03	petroleum hydrocarbons	0.077	mg/L	J	0.25	0.043	8015B
56sw	103-0311-1205 Tadpole Lake	3/11/03	Hexadecanoic acid	7.2	µg/L	J			8270C
62p	103-0409-1345 Range 26 weather	4/9/03	3-Nitrotoluene	4.8	µg/L		0.2	0.09	8330
62p	103-0409-1345 Range 26 weather	4/9/03	Nitroglycerin	0.78	µg/L	J	2	0.3	8330
8gw	101-0912-1135 MATES well	9/12/02	RDX	0.14	µg/L	J	0.2	0.08	8330

Table 5. Selected statistical analyses of water from sites in and near the Orchard Training Area, Ada County, Idaho

[Abbreviations and acronyms are explained in table A, appendix; sample number information is shown in table 1; <, less than laboratory method detection limit; ND, not detected]

	Precipitation	Ground water (STL)		Surface water (STL)					Surface water
Constituent (total concentration)	Maximum concentration (NWQL, dissolved)	MATES well	ASP well	Number of samples	Minimum	Mean	Median (50th percentile)	Maximum	Sample numbers, 3 largest concentrations (in order of increasing concentration)
aluminum, µg/L		ND	ND	7	76	28,325	4,300	170,000	10sw, 28sw, 56sw
antimony, µg/L		ND	1	7	0.28	1.6	0.85	5	56sw, 17sw, 10sw
arsenic, µg/L	1.8	4.5	2.8	7	2	8.74	4.9	26	27sw, 17sw, 56sw
barium, µg/L	15.7	17	5.8	7	23	107	46	410	10sw, 27sw, 56sw
beryllium, µg/L		0.048	ND	7	<0.22	1.25	0.4	6.8	27sw, 28sw, 56sw
cadmium, µg/L	0.26	0.033	0.036	7	0.078	0.89	0.27	4.2	27sw, 56sw, 10sw
chromium, µg/L		7	11	7	0.55	7.04	8.3	13	28sw, 27sw, 56sw
cobalt, µg/L		0.064	0.057	7	0.32	3.32	2.3	13	10sw, 27sw, 56sw
copper, µg/L		0.96	1.9	7	6.3	18	12	61	27sw, 17sw, 56sw
iron, µg/L	15	18	460	7	110	24,661	3,700	150,000	10sw, 28sw, 56sw
lead, µg/L		0.56	0.032	7	0.2	7.07	5.6	20	4sw, 10sw, 56sw
manganese, µg/L	22.3	0.32	4.5	7	13	157	110	530	27sw, 10sw, 56sw
mercury, µg/L		ND	0.049	7	<0.015	0.03	0.03	0.1	4sw, 13sw, 56sw
molybdenum, µg/L		1.6	2.1	7	0.41	10	4	50	13sw, 17sw, 56sw
nickel, µg/L		ND	ND	7	1.4	7.49	5	23	28sw, 27sw, 56sw
selenium, µg/L	E 0.3	ND	0.56	7	<0.19	0.52	0.24	2	28sw, 27sw, 56sw
silver, µg/L		ND	0.11	7	<0.012	0.14	0.09	0.4	28sw, 27sw, 56sw
strontium, µg/L		75	94	7	17	102	77	340	17sw, 27sw, 56sw
thallium, µg/L		0.021	0.015	7	<0.012	0.07	0.07	0.15	28sw, 27sw, 56sw
tin, µg/L		ND	0.79	7	<0.054	0.44	0.46	0.74	56sw, 10sw, 27sw
titanium, µg/L		1.1	ND	7	3.1	829	83	5,000	10sw, 28sw, 56sw
vanadium, µg/L		23	20	7	5.2	26	18	88	13sw, 27sw, 56sw

Table 5. Selected statistical analyses of water from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

	Precipitation	Ground water (STL)		Surface water (STL)					Surface water
Constituent (total concentration)	Maximum concentration (NWQL, dissolved)	MATES well	ASP well	Number of samples	Minimum	Mean	Median (50th percentile)	Maximum	Sample numbers, 3 largest concentrations (in order of increasing concentration)
zinc, μg/L		9.1	8.1	7	2.8	39	35	100	27sw, 56sw, 10sw
chloride, mg/L	5.79	3.9	5.6	6	1	46	13	220	17sw, 27sw, 56sw
fluoride mg/L	0.03	0.43	0.29	6	0.16	0.42	0.33	1.1	27sw, 56sw, 17sw
potassium, mg/L	7.22	3	3	7	2.9	13	4.4	66	27sw, 17sw, 56sw
sodium, mg/L	4.45	15	20	7	1.5	72	15	350	27sw, 17sw, 56sw
sulfate, mg/L	13.8	7.3	12	5	1	54	5.7	240	17sw, 27sw, 56sw
ammonia as N, mg/L	15.6	ND	ND	6	0.038	0.13	0.14	0.19	28sw, 4sw, 27sw
nitrite+nitrate as N, mg/L	2.35	0.71	1.1	6	0.012	0.5	0.11	2.5	4sw, 10sw, 27sw
orthophosphate as P, mg/L	3.71	ND	0.019	5	0.033	0.48	0.19	1.7	4sw, 27sw, 56sw
phosphorus, mg/L		0.4	ND	5	0.29	0.46	0.35	0.69	4sw, 56sw, 27sw

Table 6. Analyses of precipitation samples from weather sites in the Orchard Training Area, Ada County, Idaho

[NWQL analyses, dissolved concentrations; E = estimated value, trace = presence verified but not quantified; <, less than; ND, not detected; sample number information is shown in table 1; other terms and abbreviations are explained in table A, appendix]

	Range 2 weather (30p)			Range 14 weather (39p)		Range 26 weather (62p)			Special sample	Equip-ment blank
Property or constituent	**10/29/02**	**12/18/02**	**01/30/03**	**12/18/02**	**01/20/03**	**08/01/02**	**10/29/02**	**12/18/02**	**12/18/02**	**12/18/02**
specific conductance, µS/cm at 25°C (lab)	E145	192	58	27	16	68	E76	38	ND	E4
pH standard units (lab)	7.4	7.2	6.8	7.2	7.0	7.2	7.2	7.0	ND	6.9
arsenic, µg/L	1.8	0.7	E0.2	0.4	E0.1	0.7	0.7	0.3	ND	<0.3
barium, µg/L	15.7	10.4	2.6	4.5	E0.6	7.8	10.4	2.9	ND	<0.9
cadmium, µg/L	0.11	0.11	0.26	0.06	E0.02	E0.03	0.07	<0.04	ND	<0.04
iron, µg/L	12	15	13	E6	<10	<10	E7	<10	ND	<10
manganese, µg/L	9.4	3.5	7.7	12.7	E1.4	E0.9	22.3	E1.4	ND	<2.0
selenium, µg/L	E0.4	E0.3	<0.5	E0.3	<0.5	<0.3	E0.3	E0.3	ND	<0.5
chloride, mg/L	5.79	3.43	0.84	0.34	<0.20	0.76	2.07	0.36	ND	<0.20
fluoride mg/L	0.03	<0.17	0.01	<0.17	trace	<0.1	<0.2	<0.17	ND	<0.17
potassium, mg/L	7.22	4.84	1.44	0.52	<0.10	1.14	2.16	0.49	ND	<0.10
sodium, mg/L	4.45	2.15	1.11	0.9	0.69	1.37	2.07	0.99	ND	<0.09
sulfate, mg/L	13.8	7.6	2.5	1.1	0.7	2.3	4.4	1.6	ND	<0.2
ammonia as N, mg/L	4.41	15.6	3.7	1.9	0.84	1.38	0.92	0.77	0.83	0.06
nitrite+nitrate as N, mg/L	0.72	0.49	0.37	0.035	0.033	1.69	2.35	0.55	<0.06	E0.04
orthophosphate as P, mg/L	3.71	3.32	1.11	0.25	<0.02	0.03	0.06	0.05	E0.01	0.09

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Table 7. Concentrations of dissolved and total constituents in surface water from sites in and near the Orchard Training Area, Ada County, Idaho

[Concentrations are in micrograms per liter for trace metals and milligrams per liter for potassium and sodium; ND, not detected]

Aluminum DISSOLVED	Aluminum TOTAL	Antimony DISSOLVED	Antimony TOTAL	Arsenic DISSOLVED	Arsenic TOTAL	Barium DISSOLVED	Barium TOTAL	Beryllium DISSOLVED	Beryllium TOTAL
95	76	1.1	0.28	2.3	2	14	23	ND	0.4
ND	1,200	2.8	0.55	12	3.2	22	25	ND	0.42
ND	1,300	5.1	0.6	25	3.4	410	25	ND	0.49
	4,300		0.85		4.9		46		6.8
	8,400		1.3		8.7		100		ND
	13,000		2.6		13		120		ND
	170,000		5		26		410		ND

Cadmium DISSOLVED	Cadmium TOTAL	Chromium DISSOLVED	Chromium TOTAL	Cobalt DISSOLVED	Cobalt TOTAL	Copper DISSOLVED	Copper TOTAL	Iron DISSOLVED	Iron TOTAL
0.22	0.078	0.45	0.55	0.17	0.32	4.1	6.3	20	110
0.95	0.16	0.91	1.6	0.27	0.55	13	6.4	ND	920
0.97	0.23	7.5	3.8	11	0.98	54	12	ND	1,100
	0.27		8.3		2.3		12		3,700
	0.27		11		2.3		13		6,800
	1		11		3.8		15		10,000
	4.2		13		13		61		150,000

Lead DISSOLVED	Lead TOTAL	Manganese DISSOLVED	Manganese TOTAL	Mercury DISSOLVED	Mercury TOTAL	Molybdnum DISSOLVED	Molybdenum TOTAL	Nickel DISSOLVED	Nickel TOTAL
18	0.2	7.4	13	0.018	0.024	2.2	0.41	0.69	1.4
ND	0.91	9.3	42	ND	0.026	7.9	0.93	1.1	1.7
ND	4.7	460	47	ND	0.029	49	2.3	18	3.3
	5.6		110		0.033		4		5
	7.1		170		0.1		4.7		8.2
	11		190		ND		8.2		9.8
	20		530		ND		50		23

Table 7. Concentrations of dissolved and total constituents in surface water from sites in and near the Orchard Training Area, Ada County, Idaho—Continued

Selenium DISSOLVED	Selenium TOTAL	Silver DISSOLVED	Silver TOTAL	Strontium DISSOLVED	Strontium TOTAL	Thallium DISSOLVED	Thallium TOTAL	Tin DISSOLVED	Tin TOTAL
2	0.35	0.27	0.069	52	17	0.086	0.032	0.072	0.33
ND	0.55	ND	0.089	87	30	ND	0.074	0.25	0.46
ND	2	ND	0.15	120	51	ND	0.11	0.48	0.55
	ND		0.17		77		0.11		0.68
	ND		0.4		96		0.15		0.74
	ND		ND		100		ND		ND
	ND		ND		340		ND		ND
Titanium DISSOLVED	**Titanium TOTAL**	**Vanadium DISSOLVED**	**Vanadium TOTAL**	**Zinc DISSOLVED**	**Zinc TOTAL**				
ND	3.1	3.6	5.2	6.2	2.8				
ND	31	14	13	57	11				
ND	38	77	15	ND	14				
	83		18		35				
	290		20		37				
	360		24		73				
	5,000		88		100				
Potassium DISSOLVED	**Potassium TOTAL**	**Sodium DISSOLVED**	**Sodium TOTAL**						
2.2	2.9	5.1	1.5						
7.5	3.4	70	6						
15	3.7	340	15						
	4.4		16						
	6.5		45						
	6.6		73						
	66		350						

Table 8. Summary of large concentrations of trace metals, major ions, and nutrients, and detections of explosive, semivolatile organic, and petroleum hydrocarbon compounds in soil and water, by land- and water-use area in and near the Orchard Training Area, Ada County, Idaho

[Terms, acronymns, and abbreviations are explained in table A, appendix; sample number information is shown in table 1; constituents with maximum concentrations in soil and water (summarized from table 2 and table 6) are shown in red; explosive, semivolatile organic, and petroleum hydrocarbon compounds (summarized from table 4) are shown in **bold**; blank lines indicate no large concentrations found in sample]

Sample number (figure 1 and figure 3)	Sample identification	Constituents
Vehicle corridor and major access roads		
1	Can-Ada Concrete entrance	chloride, ammonia, **petroleum hydrocarbons**
2	N. Kuna Road intersection	chloride, ammonia, nitrate, **bis(2-ethylhexyl) phthalate, petroleum hydrocarbons, phenanthrene**
3	railroad track intersection	**petroleum hydrocarbons**
5	Sand Creek	**petroleum hydrocarbons**
36	Cinder Butte Road	silver, tin
46	Corder Creek near Range 15	mercury, nitrate, **petroleum hydrocarbons**
61	Range Road near Range 20	tin
64	Rabbit Creek near Range 26	mercury, **petroleum hydrocarbons**
65	Corder Creek near Range 22	potassium
4sw	Sand Creek	lead, mercury, nitrite + nitrate, orthophosphate, phosphorus
27sw	Range Road at MPRC-H	arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, manganese, nickel, selenium, silver, strontium, tin, thallium, vanadium, zinc, chloride, fluoride, potassium, sodium, sulfate, ammonia, nitrite + nitrate, orthophosphate, phosphate, **petroleum hydrocarbons**
28sw	Range 6	aluminum, beryllium, chromium, iron, nickel, selenium, silver, thallium, titanium, ammonia
Maneuver Areas		
6	NW of Christmas Mountain	barium, cobalt, mercury, vanadium, total phosphorus, **petroleum hydrocarbons**
14	maintenance area near Christmas Mountain	cobalt, manganese
18	near Christmas Mountain	total phosphorus, petroleum hydrocarbons
19	ASP east	aluminum, beryllium, copper, mercury, potassium, total phosphorus
20	ASP loading	zinc, **benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, bis(2-ethylhexyl) phthalate, chrysene, petroleum hydrocarbons, fluoranthene**
40	cinder pit wall	selenium, sodium, total phosphorus
41	cinder pit	copper, iron, molybdenum, selenium, strontium, titanium, vanadium, sodium, sulfate, total phosphorus, petroleum hydrocarbons
45	draw N of Tadpole Lake	barium, cobalt, manganese
47	badger diggings, dry draw	selenium
48	dry draw NW of Tadpole Lake	selenium, nitrite + nitrate
49	playa N of Tadpole Lake	aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, iron, nickel, selenium, silver, strontium, thallium, titanium, vanadium, zinc, potassium, sodium, nitrite + nitrate
50	Tadpole Lake pallet	
51	Tadpole Lake SE	

Table 8. Summary of large concentrations of trace metals, major ions, and nutrients, and detections of explosive, semivolatile organic, and petroleum hydrocarbon compounds in soil and water, by land- and water-use area in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample identification	Constituents
Maneuver Area—Continued		
52	Tadpole Lake (grid sample)	aluminum, arsenic, barium, beryllium, chromium, cobalt, copper, iron, nickel, selenium, silver, strontium, thallium, vanadium, zinc, chloride, potassium, sodium, sulfate, nitrite + nitrate
53	Tadpole Lake rocks	
54	Tadpole Lake W	
55	Tadpole Lake S	
57	Tadpole Lake W2	
60	Hood Road draw	nickel, potassium, ammonia, nitrite + nitrate, orthophosphate, **petroleum hydrocarbons**
63	Range 26 weather	selenium, potassium, sulfate
21gw	ASP well (ground water)	iron
56sw	Tadpole Lake (surface water)	aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, selenium, silver, strontium, thallium, tin, titanium, vanadium, zinc, chloride, fluoride, potassium, sodium, sulfate, orthophosphate, **petroleum hydrocarbons, hexadecanoic acid**
62p	Range 26 weather (precipitation)	**3-nitrotoluene, nitroglycerin**
Impact Area		
22	Range 5 parking	iron, molybdenum, silver, tin, titanium, chloride, sodium, sulfate, nitrite + nitrate, total phosphorus, **petroleum hydrocarbons**
23	Range 5 firing	antimony, cadmium, copper, lead, manganese, molybdenum, tin, chloride, orthophosphate, **2,4-dinitrotoluene, di-n-butyl phthalate**
24	Range 5 target	beryllium, cobalt, iron, nickel
25	MPRC-H BPB1	mercury, molybdenum, **petroleum hydrocarbons**
26	MPRC-H BPB2L	**petroleum hydrocarbons, 2,4-dinitrotoluene, di-n-butyl phthalate, diphenylamine, nitroglycerin, n-nitrosodiphenylamine**
29	Range 2 weather	chromium, **bis(2-ethylhexyl) phthalate**
31	MPRC-H BP3	aluminum, arsenic, barium, beryllium, chromium, copper, iron, nickel, silver, strontium, thallium, titanium, vanadium
32	MPRC-H C2CR	barium, cadmium, cobalt, lead, manganese, mercury, silver, **petroleum hydrocarbons**
33	MPRC-H BPA8	arsenic, lead, strontium, fluoride
34	MPRC-H BPC13	arsenic, strontium
35	playa west of Range 10/11	ammonia
37	Range 30	manganese, ammonia, orthophosphate, **dibutyl phthalate**
38	Range 14 weather	manganese, ammonia, orthophosphate, **dibutyl phthalate**
42	Range 14 target	lead, fluoride, orthophosphate
43	Range 14 firing	antimony, molybdenum, silver, sulfate, **diphenylamine, nitroglycerin, n-nitrosodiphenylamine**
44	Range 14 parking	sodium, total phosphorus, titanium
58	Rabbit Creek near Artillery Impact Area	thallium, ammonia
59	dry draw SE of Artillery Impact Area	orthophosphate
30p	Range 2 weather (precipitation)	**1,3,5-trinitrobenzene, 2,4,6-trinitrotoluene, 2,6-dinitrotoluene**
39p	Range 14 weather (precipitation)	

Table 8. Summary of large concentrations of trace metals, major ions, and nutrients, and detections of explosive, semivolatile organic, and petroleum hydrocarbon compounds in soil and water, by land- and water-use area in and near the Orchard Training Area, Ada County, Idaho—Continued

Sample number (figure 1 and figure 3)	Sample identification	Constituents
MATES compound		
7	entrance storm water basin	aluminum, thallium, vanadium, fluoride, **bis(2-ethylhexyl) phthalate**
9	NE drain	antimony, cadmium, chromium, nickel, zinc, **petroleum hydrocarbons**
11	drain at tank parking gate	antimony, cadmium, chromium, copper, lead, molybdenum, tin, zinc, fluoride, **petroleum hydrocarbons**, **fluorene**, **pentachlorophenol**, **pyrene**
12	fueling area runoff	arsenic, chloride, fluoride, **petroleum hydrocarbons, RDX**
13	east drain	aluminum, antimony, beryllium, chromium, iron, nickel, thallium, titanium, vanadium, zinc, fluoride, potassium, **petroleum hydrocarbons**
15	wash water spreading area	antimony, cadmium, **petroleum hydrocarbons**
16	wash water pond (grid)	antimony, cadmium, **bis(2-ethylhexyl) phthalate, petroleum hydrocarbons**
8gw	Mates well	**RDX**
10sw	NE drain	aluminum, antimony, barium, cadmium, cobalt, iron, lead, manganese, tin, zinc, nitrite + nitrate, **petroleum hydrocarbons**
13sw	east drain	mercury, vanadium
17sw	wash water pond	antimony, arsenic, copper, molybdenum, strontium, fluoride, chloride, potassium, sodium, sulfate, **petroleum hydrocarbons**

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Appendices

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Table A. Explanation of terms, abbreviations, and acronyms

ASP	Ammunition Supply Point
aliquot	type of sample: portion of sample used for analyses: DUP = laboratory duplicate, LR = laboratory replicate, LCS = Laboratory Control Sample; LCSD = second Laboratory Control Sample, MB = method blank, MS = matrix spike, MSD = matrix spike duplicate, RA = re-analysis, SA = standard analysis, SD = sample duplicate; left blank for LABQC samples
background	soil sample collected from area with little or no recent land uses
CAS Number	Chemical Abstract Service number
CmpdName	chemical compound name
Cr(VI)	analyses for hexavalent chromium only
CVAA	cold vapor atomic absorption
CVO	analyses by USGS Cascades Volcano Observatory Sediment Laboratory, Vancouver, Washington
d	airborne dust
deg C	degrees Celsius
DIL, dilution factor	default value is 1.00
Dissolved or Dis	water filtered through 0.45-um Gelman filter
DRO	diesel range organics
duplicate or DUP	second set of soil samples from the original composite sample container
E	east
explosives	analyses for explosive compounds only
g	gram
GC/MS	gas chromatography/mass spectrometry
GPS	Global Positioning System
g/kg	grams per kilogram
grab (sample)	soil sample scooped from one location
grid (sample)	a composite soil sample from an approximately rectangular grid area
gw	ground water
H_2SO_4	sulfuric acid
HEM	N-hexane extractable materials (see also SGT-HEM)
HMX	explosive compound – high melting point explosive, Cyclotetramethylene tetranitramine
HNO_3	nitric acid
HPLC	high performance liquid chromatography
IC	ion chromatography
ICP	inductively coupled plasma
L	liter
MATES	Mobilization And Training Equipment Site
MDL	method detection limit
metals	analyses for metals only
µg/g	micrograms per gram
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
µm	micrometer
µS/cm at 25 °C	microsiemens per centimeter at 25 degrees Celsius
mg/kg	milligrams per kilogram
mg/L	milligrams per liter, approximately equal to parts per million

Table A. Explanation of terms, abbreviations, and acronyms—Continued

mL or ml	milliliter
mm	millimeter
MPRC-H	Multi-Purpose Range Complex- Heavy
MS	mass spectrometry
N	north (direction) or nitrogen (constituent)
ND	not detected
NE	northeast
NW	northwest
NWQL	(USGS) National Water Quality Laboratory, Denver, Colorado
OTA	Orchard Training Area
PETN	explosive compound–Pentaerythritol tetranitrate
P	phosphorus
p	precipitation
poly	polyethylene
QC	quality control
RDX	explosive compound–Royal Demolition Explosive, Cyclotrimethylene trinitramine
RL or Reporting Level	USGS National Water Quality Laboratory- practical quantitation limit for lab; irl, interim reporting level ; lrl, laboratory reporting level ; mrl, minimum reporting level
replicate or REP	second set of samples from consecutively filled sample containers
S	south
Sample number (figure 1 and figure 3)	USGS designated identification number for samples: sw=surface water, gw=ground water, p=precipitation, d=airborne dust
SE	southeast
special	soil analyses for hexavalent chromium–Cr(VI), explosive, or total metals only
SGT-HEM	silica gel treated hexane extractable materials
STL	analyses by Severn Trent Laboratory, Denver, Colorado
SVOC	semivolatile organic compounds
SW	southwest
sw	surface water
test method	method of analysis
Tetryl	explosive compound–N-methyl-N,2,4,6-tetranitrobenzenamine
TOC	total organic carbon
Total	sample unfiltered
TRPH	total recoverable petroleum hydrocarbons
USGS	U.S. Geological Survey
VOC	volatile organic compound
W	west
wm	wide-mouth (jar)
unsp	unspecified

Table B. Severn Trent Laboratory sample container requirements

Analysis	Soils		Waters	
	Container	**Preservative**	**Container**	**Preservative**
Metals by 6020/6010/7470/7471	1 x 4 oz wm jar	None	1 x 500 mL poly	HNO_3
Common Ions	1 x 8 oz wm jar	None	1 x 1 L poly	None
Nutrients	NA*	None	2 x 500 mL amber glass	H_2SO_4
Total organic carbon (TOC) 9060	NA *	None	1 x 250 mL amber glass	H_2SO_4
N-hexane extractable materials (HEM) 9071/1664	NA *	None	2 x 1 L amber glass	H_2SO_4
Semivolatile organic compounds (SVOC)	1 x 8 oz wm jar **	None	2 x 1 L amber glass	None
Explosives	1 x 4 oz wm jar **	None	2 x 1 L amber glass	None
% Moisture	NA*	None	NA	NA
Diesel range organics (DRO) 8015	1 x 4 oz wm jar **	None	2 x 1 L amber glass	None

* Nutrients, TOC, % moisture, HEM, and common ions can all come from a single 8-oz (250-mL) jar.
** SVOCs, DRO, and explosives can come from a single 8-oz jar. Where explosives and DRO are required, a 4-oz (125-mL) jar is adequate.
A single 500-mL poly or 4-oz jar is adequate for all the metals; for dissolved and total metals, a raw and field-filtered fraction must be collected.

If SVOC, DRO, and explosives are collected in a water sample, a total of five 1-liter amber glass is adequate. Each of these analyses requires a full liter, so the additional volume requested is to cover breakage and possible re-analysis due to QC problems in the lab. So, the minimum volume you could collect is 3 liters. The same applies to HEM: we request two H_2SO_4 preserved ambers. The analysis requires 1 liter. Unfortunately, the liter ambers are the most commonly broken container during shipment.

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Table C. USGS-NWQL Analysis Description; Sample Container and Preservative Requirements

[USGS, U.S. Geological Survey; NWQL, National Water-Quality Laboratory; M,method]

Analyte	Lab Code	Parameter Code	M	CAS Number	RL	Unit	RL Type	Container
Acid Neutralizing Capacity (ANC), laboratory	70	90410	A	471-34-1	2	mg/L	mrl	RU
Calcium	659	00915	D	7440-70-2	0.010	mg/L	irl	FA
Chloride	1571	00940	J	16887-00-6	0.20	mg/L	lrl	FU
Fluoride	31	00950	B	16984-48-8	0.17	mg/L	mrl	FU
Inductively coupled plasma (ICP) setup	2002	L2002				unsp	lrl	FA
Magnesium	663	00925	C	7439-95-4	0.008	mg/L	irl	FA
pH, laboratory	68	00403	A		0.1	pH	mrl	RU
Potassium	2773	00935	C	7440-09-7	0.16	mg/L	irl	FA
Silica	56	00955	C	7631-86-9	0.20	mg/L	lrl	FU
Sodium	675	00930	C	7440-23-5	0.10	mg/L	irl	FA
Specific conductance, laboratory	69	90095	A		2.6	µS/cm	mrl	RU
Sulfate	1572	00945	G	14808-79-8	0.18	mg/L	lrl	FU
Nitrogen, ammonia	1976	00608	F	7664-41-7	0.04	mg/L	lrl	FCC
Nitrogen, nitrite	1973	00613	F	14797-65-0	0.008	mg/L	lrl	FCC
Nitrogen, nitrite + nitrate	1975	00631	E		0.060	mg/L	lrl	FCC
Phosphorus, phosphate, ortho	1974	00671	H	14265-44-2	0.018	mg/L	lrl	FCC
Arsenic	1503	01000	D	7440-38-2	0.2	µg/L	lrl	FA
Barium	641	01005	C	7440-39-3	2	µg/L	irl	FA
Cadmium	1788	01025	G	7440-43-9	0.04	µg/L	lrl	FA
ICP Mass Spectrometry (ICPMS) setup	2181	L2181				unsp	mrl	FA
Inductively coupled plasma (ICP) setup	2002	L2002				unsp	lrl	FA
Iron	645	01046	D	7439-89-6	6.4	µg/L	irl	FA
Manganese	648	01056	C	7439-96-5	0.8	µg/L	irl	FA
pH, laboratory	68	00403	A		0.1	pH	mrl	RU
Selenium	2506	01145	C	7782-49-2	0.4	µg/L	lrl	FA
Specific Conductance, laboratory	69	90095	A		2.6	µS/cm	mrl	RU

CONTAINER REQUIREMENTS

1 250 mL - **FA**

Description: 250 ML Polyethylene bottle, acid-rinsed.

Treatment and Preservation: Filter through 0.45- µm filter, use filtered sample to rinse containers and acidify sample with mitric acid (HNO3) to pH <2.

1 100 mL - **FU**

Description: 250 or 500 mL Polyethylene bottle.

Treatment and Preservation: Filter through 0.45-µm filter. Use filtered ample to rinse containers.

1 250 mL - **RU**

Description: 250 or 500 mL polyethylene bottle.

Treatment and Preservation: 250 or 500 mL Polyethylene bottle, Use unfiltered sample to rinse bottles.

1 125 mL - **FCC**

Description: 125 mL Brown polyethylene bottle.

Treatment and Preservation: Filter through 0.45-µm filter, use filtered sample to rinse containers, chill and maintain at 4 deg C, ship immediately.

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Table D. Severn Trent Laboratory analysis descriptions

[Modified from J. Powell, USGS, written communication, April 2001, and R. Daddow, USGS, written communication, October 2001; --, not available]

		Soils		STL RLs	STL MDL	Water		STL RLs	STL MDL
		Method	Unit			Method	Unit		
METALS by ICP/MS (dissolved or total)		6020				6020			
Suite	Antimony	6020	mg/kg	0.2	0.02	6020	µg/L	2.0	0.2
	Arsenic	6020	mg/kg	0.5	0.0076	6020	µg/L	5.0	0.2
	Barium	6020	mg/kg	0.1	0.0265	6020	µg/L	1.0	0.092
	Beryllium	6020	mg/kg	0.1	0.0023	6020	µg/L	1.0	0.2
	Cadmium	6020	mg/kg	0.1	0.0027	6020	µg/L	1.0	0.057
	Chromium	6020	mg/kg	0.2	0.0336	6020	µg/L	2.0	0.212
	Cobalt	6020	mg/kg	0.1	0.0022	6020	µg/L	1.0	0.2
	Copper	6020	mg/kg	0.2	0.0614	6020	µg/L	2.0	0.165
	Lead	6020	mg/kg	0.1	0.02	6020	µg/L	1.0	0.228
	Manganese	6020	mg/kg	0.1	0.0252	6020	µg/L	1.0	0.076
	Molybdenum	6020	mg/kg	0.2	0.002	6020	µg/L	2.0	0.2
	Nickel	6020	mg/kg	0.1	0.0111	6020	µg/L	2.0	0.2
	Selenium	6020	mg/kg	0.5	0.018	6020	µg/L	5.0	1.14
	Silver	6020	mg/kg	0.1	0.002	6020	µg/L	1.0	0.054
	Thallium	6020	mg/kg	0.1	0.002	6020	µg/L	1.0	0.02
	Tin	6020	mg/kg	1.0	0.00197	6020	µg/L	10	2.0
	Vanadium	6020	mg/kg	0.5	0.007	6020	µg/L	5.0	0.2
	Zinc	6020	mg/kg	1.0	0.125	6020	µg/L	10	7.064
METALS including common cations by ICP (dissolved or total)		6010B							
Suite	Aluminum	6010B	mg/kg	10	3.1	6010B	µg/L	100	22
	Beryllium	6010B	mg/kg	0.5	0.14	6010B	µg/L	5	0.50
	Iron	6010B	mg/kg	10	2.0	6010B	µg/L	100	12
	Potassium	6010B	mg/kg	300	31	6010B	µg/L	3000	180
	Sodium	6010B	mg/kg	500	120	6010B	µg/L	5000	350
Other METALS that can be added to 6010B suite									
	Strontium	6010B	mg/kg	1	0.15	6010B	µg/L	10	0.50
	Titanium	6010B	mg/kg	1	0.20	6010B	µg/L	10	0.50
	Mercury by CVAA	7471A	mg/kg	0.033	0.0037	7470A	µg/L	0.2	0.028
	Hexavalent chromium Cr (VI), soil only	7196A	mg/kg						
	COMMON ANIONS by IC								
Suite	Chloride	9056	mg/kg	30	1.0	300	mg/L	3.0	0.10
	Fluoride	9056	mg/kg	10	0.35	300	mg/L	1.0	0.035
	Sulfate	9056	mg/kg	50	1.0	300	mg/L	5.0	0.10
	NUTRIENTS								
	Nitrogen, ammonia	350.1	mg/kg	1.0	0.29	350.1	mg/L	0.1	0.029
	Nitrogen, total kjeldahl (TKN) (9/12/02 samples only)	351.2	mg/kg	50	9.435	351.2	mg/L	0.5	0.246
	Nitrogen, nitrate	353.2	mg/kg	1.0	--	353.2	mg/L	0.1	--

Table D. Severn Trent Laboratory analysis descriptions—Continued

		Soils		STL RLs	STL MDL	Water		STL RLs	STL MDL
		Method	Unit			Method	Unit		
	NUTRIENTS—Continued								
	Nitrogen, nitrite plus nitrate	353.2	mg/kg	1.0	0.21	353.2	mg/L	0.1	0.021
	Nitrogen, nitrite	353.2	mg/kg	1.0		354.1	mg/L	0.1	--
	Orthophosphate	365.3	mg.kg	0.5	--	365.3	mg/L	0.05	0.0154
	Phosphorus, total	365.3	mg/kg	5	0.63	365.3	mg/L	0.05	0.0216
	Diesel Range Organics (DRO)	8015 M (DRO)	mg/kg	10	3.6	8015 M (DRO)	mg/L	0.25	0.19
	Total organic carbon	9060	mg/kg	2000	648	415.1	mg/L	1.0	0.37
	HEM and SGT-HEM (TRPH)	9071B	--	--	--	1664	mg/L	5.0	2.9
CAS #	**Semivolatile organic compounds**								
83-32-9	Acenaphthene	8270C	µg/kg	330	34.7	8270C	µg/L	10	1.39
208-96-8	Acenaphthylene	8270C	µg/kg	330	36.5	8270C	µg/L	10	1.73
120-12-7	Anthracene	8270C	µg/kg	330	52.9	8270C	µg/L	10	1.43
56-55-3	Benzo(a)anthracene	8270C	µg/kg	330	42.4	8270C	µg/L	10	1.1
205-99-2	Benzo(b)fluoranthene	8270C	µg/kg	330	37.9	8270C	µg/L	10	2.21
205-82-3	Benzo(j)fluoranthene	8270C	µg/kg	330	--	8270C	µg/L	10	--
207-08-9	Benzo(k)fluoranthene	8270C	µg/kg	330	79.8	8270C	µg/L	10	1.91
65-85-0	Benzoic acid	8270C	µg/kg	1600	409.4	8270C	µg/L	50	18.66
50-32-8	Benzo(a)pyrene	8270C	µg/kg	330	47.2	8270C	µg/L	10	1.73
191-24-2	Benzo(g,h,I)perylene	8270C	µg/kg	330	42.9	8270C	µg/L	10	2.0
100-51-6	Benzyl alcohol	8270C	µg/kg	330	75.2	8270C	µg/L	10	3.75
111-91-1	Bis(2-chloroethoxy)methane	8270C	µg/kg	330	51.1	8270C	µg/L	10	2.5
111-44-4	Bis(2-chloroethyl)ether	8270C	µg/kg	330	49.4	8270C	µg/L	10	3.0
108-60-1	Bis(2-chloroisopropyl)ether	8270C	µg/kg	330	47.3	8270C	µg/L	10	1.19
117-81-7	Bis(2-ethylhexyl)phthalate	8270C	µg/kg	330	58.4	8270C	µg/L	10	2.02
101-55-3	Bromophenylphenyl ether [4-]	8270C	µg/kg	330	45.1	8270C	µg/L	10	2.72
85-68-7	Butyl benzyl phthalate	8270C	µg/kg	330	45.8	8270C	µg/L	10	2.89
59-50-7	Chloro-3-methylphenol [4-]	8270C	µg/kg	330	58.7	8270C	µg/L	10	2.04
91-58-7	Chloronaphthalene [2-]	8270C	µg/kg	330	33.0	8270C	µg/L	10	1.36
95-57-8	Chlorophenol [2-]	8270C	µg/kg	330	50.1	8270C	µg/L	10	2.16
7005-72-3	Chlorophenyl phenyl ether [4-]	8270C	µg/kg	330	53.8	8270C	µg/L	10	1.62
218-01-9	Chrysene	8270C	µg/kg	330	53.2	8270C	µg/L	10	1.81
53-70-3	Dibenzo(a,h)anthracene	8270C	µg/kg	330	51.7	8270C	µg/L	10	2.21
132-64-9	Dibenzofuran	8270C	µg/kg	330	43.5	8270C	µg/L	10	1.54
95-50-1	Dichlorobenzene (1,2)	8270C	µg/kg	330	52.7	8270C	µg/L	10	2.06
541-73-1	Dichlorobenzene (1,3)	8270C	µg/kg	330	58.3	8270C	µg/L	10	1.44

Table D. Severn Trent Laboratory analysis descriptions—Continued

		Soils		STL RLs	STL MDL	Water		STL RLs	STL MDL
		Method	Unit			Method	Unit		
CAS #	**Semivolatile organic compounds—Continued**								
106-46-7	Dichlorobenzene (1,4)	8270C	µg/kg	330	50.4	8270C	µg/L	10	2.09
91-94-1	Dichlorobenzidine [3,3'-]	8270C	µg/kg	1600	167.8	8270C	µg/L	50	5.08
120-83-2	Dichlorophenol [2,4-]	8270C	µg/kg	330	45.9	8270C	µg/L	10	2.2
84-66-2	Diethyl phthalate	8270C	µg/kg	330	41.7	8270C	µg/L	10	1.24
131-11-3	Dimethyl phthalate	8270C	µg/kg	330	38.4	8270C	µg/L	10	1.78
105-67-9	Dimethylphenol [2,4-]	8270C	µg/kg	330	67.5	8270C	µg/L	10	2.79
84-74-2	Di-n-butyl phthalate	8270C	µg/kg	330	57.9	8270C	µg/L	10	2.27
534-52-1	Dinitro-2-methylphenol [4,6-]	8270C	µg/kg	1600	191.5	8270C	µg/L	50	2.61
51-28-5	Dinitrophenol [2,4-]	8270C	µg/kg	1600	485.1	8270C	µg/L	50	5.77
121-14-2	Dinitrotoluene [2,4-]	8270C	µg/kg	330	43.6	8270C	µg/L	10	1.44
606-20-2	Dinitrotoluene [2,6-]	8270C	µg/kg	330	51.9	8270C	µg/L	10	1.15
117-84-0	Di-n-octyl phthalate	8270C	µg/kg	330	46.3	8270C	µg/L	10	2.01
206-44-0	Fluoranthene	8270C	µg/kg	330	56.8	8270C	µg/L	10	1.92
86-73-7	Fluorene	8270C	µg/kg	330	41.1	8270C	µg/L	10	1.60
118-74-1	Hexachlorobenzene	8270C	µg/kg	330	48.5	8270C	µg/L	10	2.73
87-68-3	Hexachlorobutadiene	8270C	µg/kg	330	41.8	8270C	µg/L	10	2.25
77-47-4	Hexachlorocyclopentadiene	8270C	µg/kg	1600	33.0	8270C	µg/L	50	5.0
67-72-1	Hexachloroethane	8270C	µg/kg	330	61.5	8270C	µg/L	10	1.72
193-39-5	Indeno(1,2,3-cd)pyrene	8270C	µg/kg	330	53.0	8270C	µg/L	10	1.73
78-59-1	Isophorone	8270C	µg/kg	330	52.5	8270C	µg/L	10	2.01
91-57-6	Methylnaphthalene [2-]	8270C	µg/kg	330	57.5	8270C	µg/L	10	1.6
95-48-7	Methylphenol [2-]	8270C	µg/kg	330	44.0	8270C	µg/L	10	3.18
108-39-4	Methylphenol [3-]	8270C	µg/kg	330	58.9	8270C	µg/L	10	5.1
106-44-5	Methylphenol [4-]	8270C	µg/kg	330	--	8270C	µg/L	10	--
91-20-3	Naphthalene	8270C	µg/kg	330	--	8270C	µg/L	10	--
88-74-4	Nitroaniline [2-]	8270C	µg/kg	1600	44.9	8270C	µg/L	50	2.52
99-09-2	Nitroaniline [3-]	8270C	µg/kg	1600	57.0	8270C	µg/L	50	3.58
100-01-6	Nitroaniline [4-]	8270C	µg/kg	1600	68.4	8270C	µg/L	50	2.18
98-95-3	Nitrobenzene	8270C	µg/kg	330	68.0	8270C	µg/L	10	2.45
88-75-5	Nitrophenol [2-]	8270C	µg/kg	330	42.8	8270C	µg/L	10	2.77
100-02-7	Nitrophenol [4-]	8270C	µg/kg	1600	160	8270C	µg/L	50	7.14
62-75-9	Nitrosodimethylamine [N-]	8270C	µg/kg	330	57.8	8270C	µg/L	10	2.33
621-64-7	Nitrosodi-n-propylamine [N-]	8270C	µg/kg	330	62.9	8270C	µg/L	10	2.33
86-30-6	Nitrosodiphenylamine [N-]	8270C	µgµg/kg	330	56.0	8270C	µg/L	10	2.91

Table D. Severn Trent Laboratory analysis descriptions—Continued

		Soils		STL RLs	STL MDL	Water		STL RLs	STL MDL
		Method	Unit			Method	Unit		
CAS #	**Semivolatile organic compounds—Continued**								
87-86-5	Pentachlorophenol	8270C	µg/kg	1600	160	8270C	µg/L	50	5.0
85-01-8	Phenanthrene	8270C	µg/kg	330	41.7	8270C	µg/L	10	2.01
108-95-2	Phenol	8270C	µg/kg	330	50.3	8270C	µg/L	10	1.75
129-00-0	Pyrene	8270C	µg/kg	330	38.0	8270C	µg/L	10	2.00
95-94-3	Tetrachlorobenzene [1,2,4,5-]	8270C	µg/kg	330	33.0	8270C	µg/L	10	1.9
120-82-1	Trichlorobenzene [1,2,4-]	8270C	µg/kg	330	35.6	8270C	µg/L	10	1.78
95-95-4	Trichlorophenol [2,4,5-]	8270C	µg/kg	330	33.0	8270C	µg/L	10	2.45
88-06-2	Trichlorophenol [2,4,6-]	8270C	µg/kg	330	36.4	8270C	µg/L	10	2.27
	Explosives by HPLC								
355-72-78-2	Amino-2, 6-dinitrotoluene [4-]	8330	µg/g	0.25	0.120	8330	µg/L	0.25	0.182
1946-51-0	Amino-4,6-dinitrotoluene [2-]	8330	µg/g	0.25	0.143	8330	µg/L	0.25	0.144
99-65-0	Dinitrobenzene [1,3-]	8330	µg/g	0.25	0.073	8330	µg/L	0.25	0.134
121-14-2	Dinitrotoluene [2,4]	8330	µg/g	0.25	0.116	8330	µg/L	0.25	0.142
606-20-2	Dinitrotoluene [2,6]	8330	µg/g	0.25	0.059	8330	µg/L	0.25	0.155
2691-41-0	HMX	8330	µg/g	0.25	0.168	8330	µg/L	0.25	0.1
98-95-3	Nitrobenzene	8330	µg/g	0.25	0.128	8330	µg/L	0.25	0.111
55-63-0	Nitroglycerin	8330	µg/g	5.0	1.09	8330	µg/L	2.5	0.661
88-72-2	Nitrotoluene [2-]	8330	µg/g	0.25	0.196	8330	µg/L	0.25	0.084
99-08-1	Nitrotoluene [3-]	8330	µg/g	0.25	0.152	8330	µg/L	0.25	0.185
99-99-0	Nitrotoluene [4-]	8330	µg/g	0.25	0.137	8330	µg/L	0.25	0.202
78-11-5	PETN	8330	µg/g	2.5	1.01	8330	µg/L	2.5	0.785
121-82-4	RDX	8330	µg/g	0.25	0.215	8330	µg/L	0.25	0.204
479-45-8	Tetryl	8330	µg/g	0.50	0.183	8330	µg/L	0.5	0.120
99-35-4	Trinitrobenzene [1,3,5-]	8330	µg/g	0.25	0.125	8330	µg/L	0.25	0.166
118-96-7	Trinitrotoluene [2,4,6]	8330	µg/g	0.25	0.111	8330	µg/L	0.25	0.078
	Moisture content	D2216	%	0.25					

Table E. Severn Trent Laboratory methods summary

Constituent	Analytical method	Preparation method
9071B silica gel treated	SW846 9071B	SW846 9071B
Chloride	MCAWW 300.0A	MCAWW 300.0A
Chloride	SW846 9056	SW846 9056
Extractable petroleum hydrocarbons	SW846 8015B	SW846 3550B
Extractable petroleum hydrocarbons	SW846 8215B	SW846 8215B
Extractable petroleum hydrocarbons	SW846 6015B	SW846 6015B
Fluoride	MCAWW 300.0A	MCAWW 300.0A
Fluoride	SW846 9056	SW846 9056
ICP-MS (6020)	SW846 6020	SW846 3010
ICP-MS (6020)	SW846 6020	SW846 3050B
Inductively coupled plasma (ICP) metals	SW846 6010B	SW846 3010A
Inductively coupled plasma (ICP) metals	SW846 6010B	SW846 3050B
Mercury in liquid waste (manual cold-vapor)	SW846 7470A	SW846 7470A
Mercury in liquid waste (manual cold-vapor)	SW846 7471A	SW846 7471A
n-Hexane extractable material	SW846 9071B	SW846 9071B
N-Hexane extractable material (1664A)	CFR136A 1664A H	CFR136A 1664A H
N-Hexane extractable material, silica gel treated (1664A)	CFR136A 1664A S	CFR136A 1664A S
Nitrate as N	MCAWW 353.2	MCAWW 353.2
Nitrate as N	SW846 9056	SW846 9056
Nitrite plus nitrate as N	MCAWW 353.2	MCAWW 353.2
Nitrite as N	MCAWW 353.2	MCAWW 353.2
Nitroaromatics and nitramines by HPLC	SW846 8330	SW846 3535
Nitroaromatics and nitramines by HPLC	SW846 8330	SW846 8330
Nitrogen, ammonia as N	MCAWW 350.1	MCAWW 350.1
Orthophosphate as P	MCAWW 365.3	MCAWW 365.3
Percent moisture	MCAWW 160.3 MOD	MCAWW 160.3 MOD
Semivolatile organic compounds by GC/MS	SW846 8270C	SW846 3520C
Semivolatile organic compounds by GC/MS	SW846 8270C	SW846 3550B
Sulfate	MCAWW 300.0A	MCAWW 300.0A
Sulfate	SW846 9056	SW846 9056
Total kjeldahl nitrogen	MCAWW 351.2	MCAWW 351.2
Total organic carbon	MCAWW 415.1	MCAWW 415.1
Total organic carbon	SW846 9060	SW846 9060
Total phosphorus	MCAWW 365.3	MCAWW 365.3

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Table F. Severn Trent Laboratory definitions of quality control terms and qualifiers

Term	Definition
Batch	A set of up to 20 field samples plus associated laboratory QC samples that are similar in composition (matrix) and that are processed within the same time period with the same reagent and standard lots.
Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD)	A volume of reagent water for aqueous samples or a contaminant-free solid matrix (Ottawa sand) for soil and sediment samples which is spiked with known amounts of representative target analytes and required surrogates. An LCS is carried through the entire analytical process and is used to monitor the accuracy of the analytical process independent of potential matrix effects. An LCSD is a second Laboratory Control Sample.
Matrix Spike and Matrix Spike Duplicate (MS/MSD)	A field sample fortified with known quantities of target analytes that are also added to the LCS. Matrix spike duplicate is a second matrix spike sample. MSs/MSDs are carried throughout the entire analytical process and are used to determine sample matrix effect on accuracy of the measurement system. The accuracy and precision estimated using MS/MSD is only representative of the precision of the sample that was spiked.
Method Blank	A sample composed of all the reagents (in the same quantities) in reagent water carried through the entire analytical process. The method blank is used to monitor the level of contamination introduced during sample preparation steps.
Surrogate	Organic constituents not expected to be detected in environmental media and are added to every sample and QC at a known concentration. Surrogates are used to determine the efficiency of the sample preparation and the analytical process.
Sample Duplicate	A second aliquot of an environmental sample, taken from the same sample container when possible, that is processed independently with the first sample aliquot. The results are used to assess the effect of the sample matrix on the precision of the analytical process. The precision estimated using this sample is not necessarily representative of the precision for other samples in the batch.
Method Detection Limit (MDL)	The method detection limit is defined as the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from replicate analyses of low-level standards in a typical representative matrix.
Reporting Limit (RL)	The STL reporting limit is normally the lowest level at which measurements become quantitatively meaningful, ie., the quantitation limit, which is approximately three times the MDL. Some projects require RLs that are less than the quantitation limit to achieve particular maximum contaminant levels (MCLs) or relevant and appropriate requirements (ARARs), but RLs cannot be less than the statistically determined MDL.

Qualifier	Definition
*	Surrogate or Relative Percent Difference (RPD) is outside control limits.
a	Spiked analyte recovery is outside control limits.
B	Organics: Method blank contamination. The associated method blank contains the target analyte at a reportable level. Inorganics: Estimated result. Result is less than the RL.
COL	More than 40% difference between the primary and confirmation detector results. The lower of the two results is reported.
DIL	The concentration is estimated or not reported due to dilution.
E	Estimated result. Result concentration exceeds the calibration range.
G	Inorganics: Elevated reporting limit. The reporting limit is elevated due to matrix interference.
J	Organics: Estimated result. Result is less than RL. Inorganics: Method blank contamination. The associated method blank contains the target analyte at a reportable level.
L	Serial dilution of a digestate in the analytical batch indicates that physical and chemical interferences are present.
N	Spiked analyte recovery is outside stated control limits.
NC	The recovery and/or RPD were not calculated.
ND	The analyte was not detected at the MDL concentration and, with a measurable degree of confidence, can be said not to be present at or above the RL concentration.
p	Relative percent difference (RPD) is outside stated control limits.
Q	Elevated reporting limit. The reporting limit is elevated due to high analyte levels.
V	General Chemistry: Elevated reporting limit due to limited sample volume.
Wa	Post digestion spike recovery fell between 40-85% due to matrix interference.
Wb	Post digestion spike recovery fell between 115-150% due to matrix interference.
I	Percent recovery is estimated since the results exceeded the calibration range.
T1	A tentatively identified compound that did not generate a spectral match of 80% or greater. Typically called “unknown.”
T2	A tentatively identified compound with a spectral match of 80% or better.
T3	A tentatively identified compound that was calibrated for by the lab, but not on the client target analyte list.
IC	Diluted due to high inorganic chloride.

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