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Range Characterization Studies at Donnelly Training Area, Alaska: 2001 and 2002

Marianne E. Walsh, Charles M. Collins, Alan D. Hewitt, Michael R. Walsh, Thomas F. Jenkins, Jeffrey Stark, Arthur Gelvin, Thomas A. Douglas, Nancy Perron, Dennis Lambert, Ronald Bailey, and Karen Myers

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Front cover: The 4/11 Field Artillery preparing to fire an M119A 105-mm howitzer.

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ABSTRACT

The U.S. Army Alaska seeks to conserve and protect natural resources on lands used for combat training exercises. Some of these exercises require live fire of ordnance containing high explosives. One aspect of managing the ranges so as to mitigate the environmental consequences of training is to identify the location, extent, and potential migration of munitions residues in soils, surface waters, and groundwater. This report summarizes analytical results for soil samples collected from firing points and some impact areas at the Donnelly Training Area near Delta Junction, Alaska. Explosives residues are for the most part undetectable or at very low concentrations (parts per billion) in the soils of impact areas. The exceptions are soils near or under partial ordnance detonations, targets, and rocket motor debris. We found high concentrations (parts per thousand) of TNT in soils next to partially detonated 500-lb and 2000-lb bombs; moderate concentrations (parts per million) of RDX and TNT around targets; and moderate concentrations (parts per million) of NG under rocket motor debris. At firing points used for 105-mm howitzers, 2,4-DNT is detectable in surface soils at parts-per-million concentrations. This analyte is associated with burned and unburned fibers of propellant that are sprayed to distances of at least 100 m from the muzzle. The highest concentrations of 2,4-DNT were in soils where excess propellant is burned for disposal. Because of the very low soil clean-up levels listed by the State of Alaska for this compound, appropriate and reproducible laboratory and field sampling procedures need to be developed to monitor this analyte.

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1 INTRODUCTION

The withdrawal of training lands from the public domain on Fort Wainwright and Donnelly Training Area (formerly Fort Greely) in Interior Alaska was renewed under the Military Lands Withdrawal Act (PL106-65). As part of the Environmental Impact Statement prepared for the renewal, the Army pledged to assess the amount of residues from explosive munitions at the currently used testing and training impact ranges in Donnelly Training Area and Fort Wainwright and the potential for surface water and groundwater contamination (U.S. Army Alaska 1999). The training lands of Fort Greely were renamed the Donnelly Training Area in 2001 when Fort Greely was realigned under the Base Realignment and Closure (BRAC) process. The main post area of Fort Greely was slated for closure, while the training lands were transferred administratively to Fort Wainwright. Subsequently, the Fort Greely main post has been withdrawn from BRAC and transferred to the Army Space and Missile Defense Command to support the Ground-Based Mid-Course Intercept Missile Defense (GMD) Program. Donnelly Training Area has 26,300 hectares (or 263 km^2) of impact areas where high-explosive ammunition is used, including the Washington and Mississippi Impact Areas located within the floodplain of the Delta River, the Delta Creek Impact Area located within the floodplain of Delta Creek, and the Oklahoma Impact Area located just east of Delta Creek.

Assessing the levels of explosives residues by sampling the soil and water is a challenge because of the large size and varied terrain of these impact areas, the safety hazards associated with unexploded ordnance, and on-going live-fire training. Of most interest is the potential for contamination of surface water and groundwater that would provide a route for migration of the explosives residues across military installation boundaries. We used an authoritative sampling strategy (sample locations were selected based on prior knowledge) to identify explosives source areas within the impact areas. In our opinion, authoritative sampling is a more efficient approach to the overall goal of protecting water sources than random sampling, which is used when there is little or no information about the potential distribution of the analytes of interest.

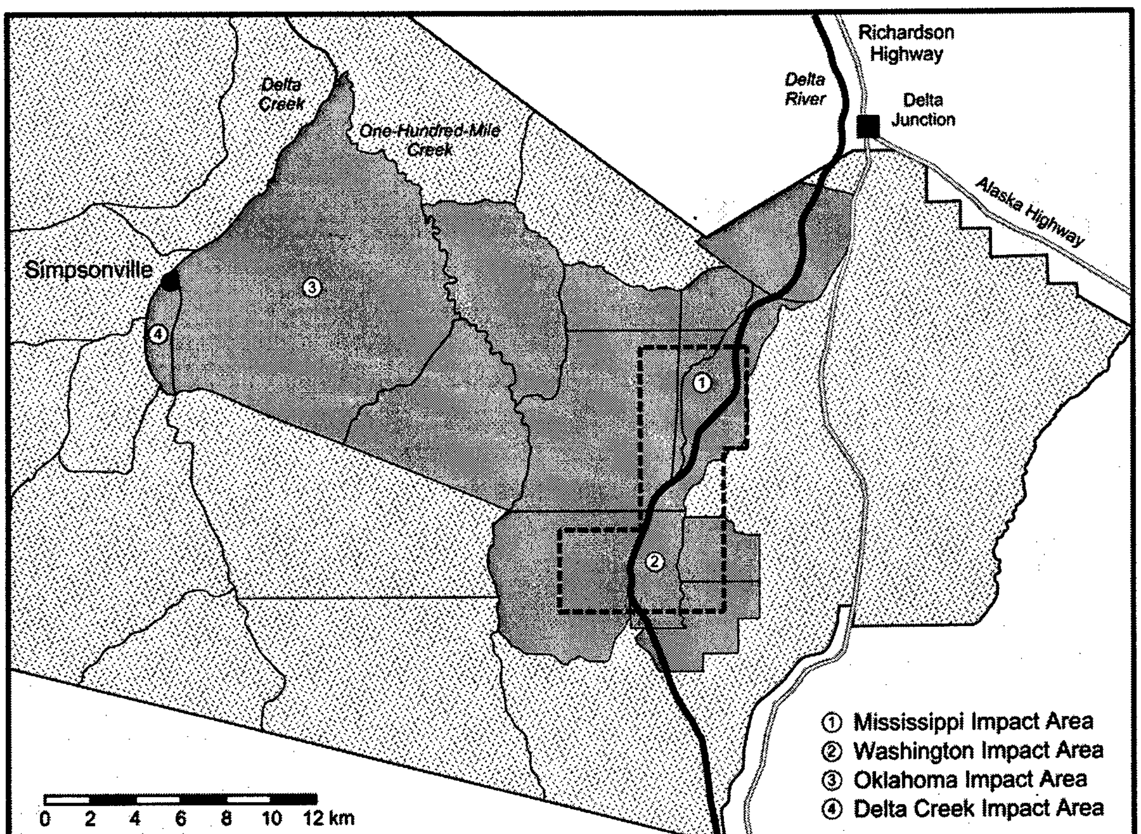
During July 2000, we undertook the initial sampling program on Washington Impact Area and Lampkin Range (Walsh et al. 2001), where we selected, based on guidance from the Cold Regions Test Center, specific locations within the impact area where known ordnance items had detonated. We collected discrete and multi-increment samples to determine if we could find any explosives residues in the surface soils. We detected explosives residues in 48% of the samples we collected, most frequently RDX and TNT. Concentrations were low (the median concentrations for RDX and TNT were 21 and 5 μg/kg, respectively) except where ordnance items failed to detonate completely and solid chunks of explosives were on the surface soil. We also detected propellant residues (2,4-DNT and NG) at the Lampkin Range firing point.

2 OBJECTIVES

In 2001, the objective of the sampling was to determine if we could detect any explosives residues and source areas that could contribute to groundwater contamination in the Donnelly Training Area. The impact areas that we sampled were Delta Creek, Georgia Island, and Washington Range West. We also sampled several firing points to determine concentrations of propellant residues. Based on the analytical results for the 2001 firing point samples, which showed that we needed to expand our sampled collection to distances greater than 50 m from the 105-mm gun firing platforms, we collected additional firing point samples in 2002. Our objective was to characterize the distribution of propellant residues around a firing position and to monitor the persistence of the residues after 30 days of weathering. An additional objective was to obtain more depth samples to determine the potential for downward migration of the residues. Because persistence and migration are influenced by the soil matrix, we chose two firing positions for intensive sampling, one that was vegetated and one that was sparsely vegetated.

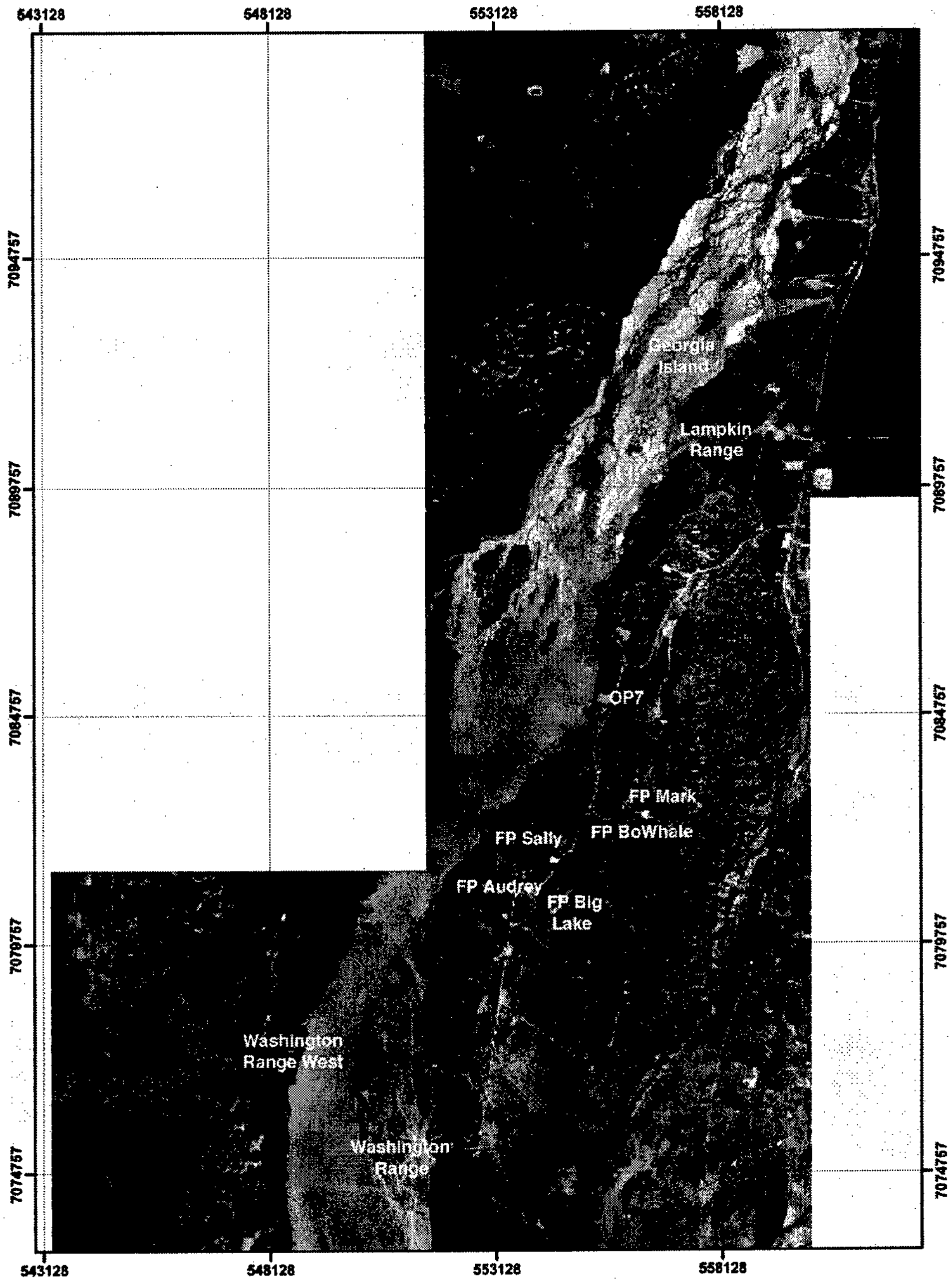
3 PHYSICAL SETTING

The Donnelly Training Area (Fig. 1) consists of 2,554 km^2 located in the northern foothills of the Alaska Range and the Tanana–Kuskokwim Lowlands. Several glacial outwash rivers, including the Delta River, Delta Creek, and the Little Delta River, flow northward from the Alaska Range across the training area to the Tanana River (U.S. Army Alaska 2003). Several large impact areas, totaling 263 km^2, are located within the training area, including the Washington and Mississippi Impact Areas along the Delta River, Oklahoma Impact Range east of Delta Creek, and Delta Creek Impact Area along Delta Creek. The Army uses Washington and Mississippi Impact Areas mainly for indirect-fire weapons (the target cannot by seen by the gunner), while Delta Creek (Table 1) and Oklahoma Impact Areas are used primarily for aerial bombing by the Air Force (U.S. Army Alaska 2002).



a. Donnelly Training Area, showing the impact areas sampled. The dashed lines indicate the area shown in Figure 1b.

Figure 1. Installation maps and orthophotos.



b. Orthophoto (AeroMap U.S. 2003), taken August 2002, showing the Delta River, the locations of firing points, Washington Range, Lampkin Range, and Georgia Island.

Figure 1 (cont.).

Table 1. Ordnance used by the Army at the impact areas and firing points that we sampled (based on 1998 to 1999 ammo reports).

	Target analyte potentially in residue		
Ordnance (DODIC)	Explosive	Propellant	Location used and sampled
5.56-mm cartridges (A059, A064, A066, A075)		NG PETN in pellet booster	FP: Simpsonville, Lampkin IA: Delta Creek
7.62-mm cartridges (A107, A127)		NG	FP: Simpsonville, Lampkin IA: Delta Creek
.50 caliber cartridges (A520, A555)		NG, 2,4-DNT, PETN	FP: Simpsonville, Lampkin IA: Delta Creek
30-mm cartridges (B103)			FP: Lampkin
40-mm cartridge (B470)	RDX	NG	FP: Simpsonville, Lampkin IA: Delta Creek
40-mm cartridge [B519(TP) B576 (TP) B535 (ILL), M918 (TP)]		NG	Simpsonville, Delta Creek, Lampkin
105-mm cartridges (C445)	TNT/RDX	2,4-DNT	FP: Mark, Sally, Audrey, Bo-Whale, Lampkin, Simpsonville IA: Delta Creek
105-mm cartridges [C508 (HEAT)]	TNT/RDX	NG	FP: Mark
105-mm cartridges (C511)		NG	FP: Audrey, Bo-Whale, Mark
105-mm cartridges (C520)		2,4-DNT	FP: Mark, Bo-Whale
105-mm cartridges [C449 (ILL)]		2,4-DNT	FP: Mark, Sally, Audrey, Bo-Whale IA: Delta Creek
60-mm (B642)	TNT/RDX	NG	FP: Lampkin, OP7, Simpsonville IA: Delta Creek
60-mm [B640 (ILL)]			FP: Lampkin, OP7, Simpsonville IA: Delta Creek
81-mm [C226 (ILL)]		NG	FP: Lampkin, OP7, Simpsonville
81-mm (C256)	TNT/RDX	NG	FP: Simpsonville
M67 (G881)	TNT/RDX		FP: Lampkin
2.75-inch rocket [H180 (ILL)]		NG	FP: Simpsonville IA: Delta Creek
Claymore mine (K143)	RDX		FP: Lampkin, Simpsonville IA: Delta Creek
84mm AT4 (C995)	M136?		FP: Lampkin, Simpsonville IA: Delta Creek
155-mm HC and ILL (D445, D505)			FP: Mark, Sally, Bo-Whale
C4 (M023)	RDX		Lampkin, Simpsonville
Bangalore torpedo (M028)	RDX/TNT		Lampkin, Simpsonville, Delta Creek
Detonation cord (MD15)	PETN		Simpsonville
TOW (PB25)	HMX		FP: Simpsonville IA: Delta Creek
Dragon (PL23)			FP: Simpsonville, Lampkin IA: Delta Creek

TP: Target practice rounds that do not contain high-explosive filler.

ILL: Illumination round.

IA: Impact Area. The Mississippi and Oklahoma Impact Areas were extensively used but were not sampled due to UXO hazards.

The Delta River is a large, glacially fed, braided river that starts out as a clear-water stream draining the Tangle Lakes on the south side of the Alaska Range. It cuts across the crest of the Alaska Range, receiving meltwater from a number of glaciers, including the Canwell, Castner, and Black Rapids Glaciers. In the vicinity of Donnelly Training Area, the river cuts through the Donnelly Moraine, a late-Pleistocene moraine marking the last major glacial advance down the Delta River valley (Péwé and Holmes 1964, Péwé 1975). The incised moraine forms large bluffs on either side of the river valley. The river through this area is braided and has a broad, gravel floodplain. In the vicinity of the Washington and Mississippi Impact Areas, there are large abandoned floodplain terraces, several meters above the present active floodplain. These terraces represent episodes of greater sedimentation in the past, probably associated with surges of the Black Rapids Glacier over the last several hundred years. Much of the terrace of the Washington Range is bare gravel, with localized areas of sparse shrubs mostly consisting of silverberry (*Eleagnus commutata*). Jorgenson et al. (2001) mapped the vegetation on Fort Greely and classified these areas as riverine gravelly barrens and riverine gravelly low scrub and dry dwarf scrub.

Delta Creek is also a glacially fed braided river that flows from the Alaska Range north, joining the Tanana River. It receives meltwater from the Trident and Hayes Glacier, as well as snowmelt from the Alaska Range. Like the Delta River, it has extensive sections of abandoned floodplain terraces several meters higher than the current active braided floodplain. One-Hundred-Mile Creek is a small, single-channel, clear-water stream originating in the foothills of the Alaska Range and flowing northward and then westward, joining Delta Creek. The Delta Creek Impact Area (Fig. 2), a 20-km^2 impact area, is located along 9 km of Delta Creek. Target arrays are located along abandoned floodplain terraces on the west side of the active creek. The western boundary of Oklahoma Impact Area, a 250-km^2 impact area, is located along 16 km of Delta Creek, north of Delta Creek Impact Range. The eastern and northern boundary of Oklahoma Impact Area runs along One-Hundred-Mile Creek. Simpsonville (Fig. 3) is a Military Operations in Urban Terrain/Combined Arms Live Fire Exercise (MOUT/CALFEX) site located on top of a bluff on the west bank of Delta Creek. The gently sloping area is mostly open, covered with tussock tundra vegetation.

The western side of Washington Impact Area is along the west bank of the Delta River. Here a narrow floodplain runs along the steep bluffs of the moraine to the west. The narrow floodplain is vegetated with lowland gravely dry mixed forest (Jorgenson et al. 2001) and shows little evidence of artillery use, such as cratering or range scrap, probably because of its location at the edge of the impact area. Georgia Island (Fig. 4) is a 4-km-long island within the active floodplain of the Delta River. It is sparsely to heavily vegetated [classified as riverine gravelly barrens to lowland gravely dry mixed forest by Jorgenson et al.

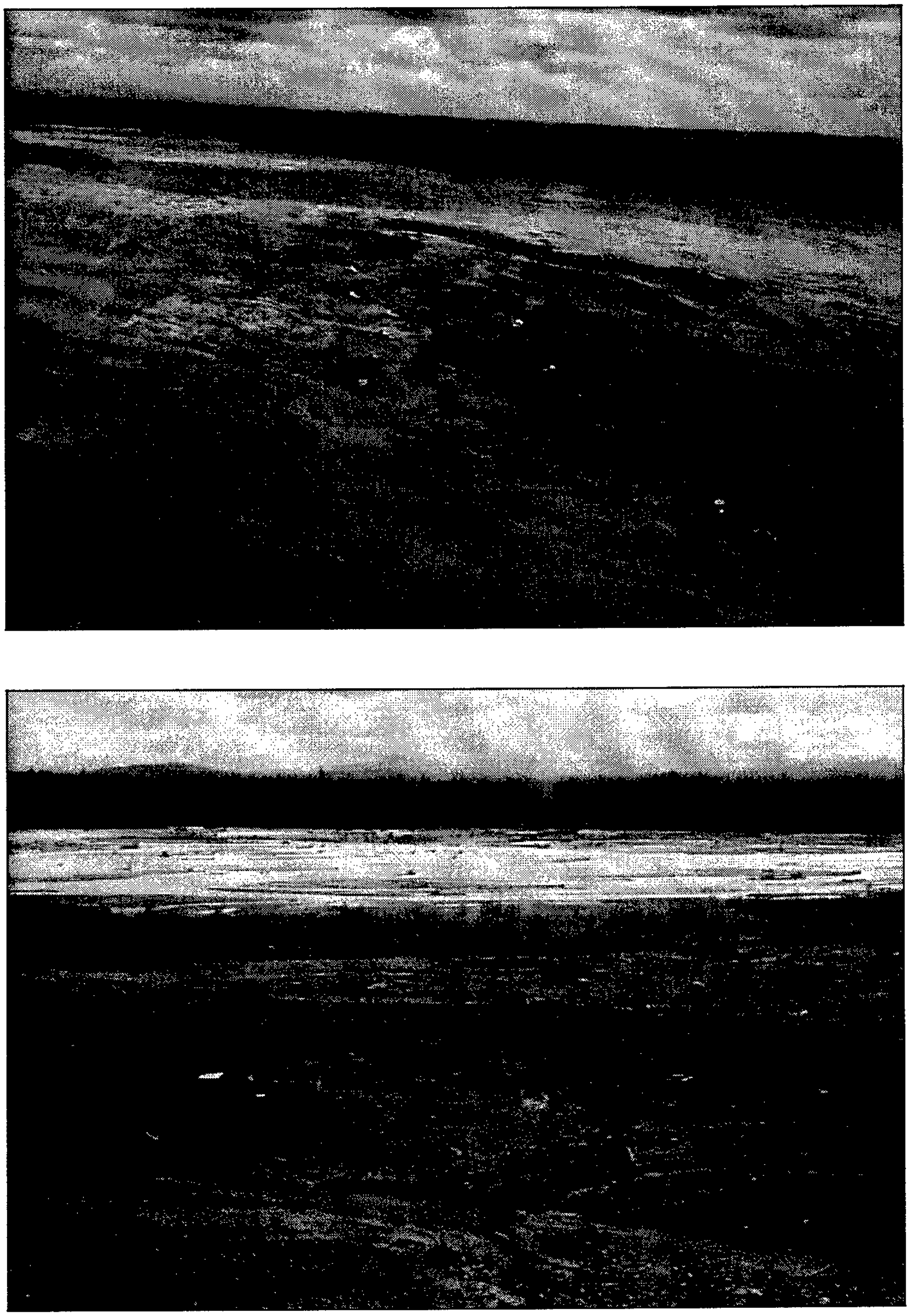


Figure 2. Aerial and near-ground views of a target array located 2 km downstream of Delta Creek Impact Area.

Figure 3. Aerial view of Simpsonville MOUT/CALFEX, located on a bluff overlooking the Delta Creek Impact Area.

Figure 4. Aerial view of Georgia Island, showing the old target berm.

(2001)]. It is located immediately downstream of Mississippi Impact Area, a heavily used indirect fire range where we are not allowed to sample because of extreme UXO (unexploded ordnance) hazards. Georgia Island has been used to a lesser degree as an artillery impact area. It has also been used as a target area for direct-fire weapons from various ranges on the east side of the Delta River.

Firing Points Audrey, Bo-Whale, Big Lake, Mark, and Sally are located in the Donnelly East Training Area on the east side of the Delta River (Fig. 1b). The firing points are located on either side of Meadows Road, which runs south along the broad crest of the glacial lateral moraine forming the high bluffs on the east side of the river. The firing points are used for indirect fire into the Mississippi and Washington Impact Areas to the west. FP Big Lake, Bo-Whale, and Sally (Fig. 5a) are open vegetated areas with a ground cover of grasses, sedges, low forbs, and some low shrubs. Soils are fine-grained silt loam overlying coarser, poorly sorted gravel. The soils at FP Bo-Whale are wetter and have more organic material than those of the other firing points. FP Mark (Fig. 5b) and Audrey are mostly unvegetated open area with sporadic ground cover of mosses and grasses. Soils here are poorly sorted silty, sandy gravel. The Lampkin Range firing point (Fig. 6) is located on an elevated, broad, flat-topped gravel berm or platform built on the vegetated floodplain along the east bank of the Delta River. The berm where we sampled was constructed of silty, sandy gravel.

a. FP Sally (vegetated site), July 2002.

Figure 5. Firing points used for indirect fire into Mississippi and Washington Impact Areas.

b. FP Mark (sparsely vegetated site), July 2002.

Figure 5 (cont.).

Figure 6. Ground view from Lampkin Range Firing Point, which is used for direct fire at targets within the floodplain of the Delta River.

4 METHODS

Field Sample Collection

Delta Creek, 2001

In June 2001, we collected samples downstream of the boundaries of the Delta Creek Impact Area. We were not allowed to sample the actual Delta Creek Impact Area because of the hazards associated with unexploded submunitions. However, a series of targets and associated craters and range scrap (Fig. 2) were located 2 km downstream, where we collected both discrete and composite samples. The discrete samples were soil near what appeared to be partial detonations of 500-lb bombs. The composite samples consisted of fifty 40-g subsamples collected around craters of various dimensions, around targets, and in undisturbed areas. At 5, 8, 11, 14, and 17 km downstream were suitable helicopter-landing sites with fine-grain sediments, where we collected more samples. With the exception of two discrete samples collected under pieces of rocket motors, samples farther downstream were composites from 10- × 10-m areas on inactive and abandoned bar surfaces along the edge of the creek.

We also collected seven samples at the MOUT/CALFEX site known as Simpsonville located on a bluff overlooking Delta Creek (Fig. 3). Four of the samples were from explosive ordnance disposal craters, and the other three were from craters thought to be produced by 40-mm grenades.

Georgia Island, 2001

The sampling of Georgia Island, within the Delta River, was conducted by sampling approximately every 200 m along the centerline of the island and every 50 m along the base of a former target berm (Fig. 4). At each sampling location, a multi-increment sample was collected by taking approximately fifty 40-g random discrete subsamples over a 10- × 10-m area as was done at Delta Creek. A total of 44 composite samples were collected. Five discrete samples were collected near ordnance items such as empty 40-mm grenade casings and range scrap.

West side of Washington Impact Area, 2001

The sampling of the west side of Washington Impact Area, along the west bank of the Delta River, was to be conducted like the sampling of Georgia Island at every 200 m along the narrow vegetated floodplain. However, heavy vegetation and lack of suitable helicopter landing spots limited where we could sample along the bank. At several locations we collected samples at 50- to 100-m intervals, walking to several sites from a single landing site. At each sampling location a sample was collected by taking approximately fifty 40-g random discrete subsamples over a 10- × 10-m area as was done at Delta Creek and Georgia Island. Twenty-four composite samples were collected.

Firing Points, 2001

Previous sampling at Fort Greely, Fort Lewis, Yakima Training Center, and other training areas has shown that firing points are frequently contaminated with propellant residues (Walsh et al. 2001). The most common residues detected have been 2,4-DNT, which is an additive in single-base propellants, and NG, an ingredient in double- and triple-base propellants (U.S. Army 1984).

Our objective in sampling the firing points at Donnelly Training Area was to determine the average concentrations of propellant residues in the surface soil. Depending on the locations of the firing points, these residues could contaminate groundwater or be ingested by grazing animals. However, the samples we collect can be used to compute mean concentrations only if the concentration estimates for replicate samples agree within reasonable limits. Previous sampling efforts on firing ranges have indicated that concentration estimates in replicate samples can vary by more than a factor of ten. Recently, the problem of laboratory subsampling of unvegetated explosives-contaminated soil was solved by grinding soils using a ring mill, a practice routinely used in the mining industry but not in environmental laboratories. However, the problem of reproducible field sample collection has yet to be resolved.

During the week of July 31 to August 5, 2001, we sampled Donnelly East Training Area firing points that had been used during the second week of June 2001 by the 4/11 Field Artillery. About 100 rounds had been fired from M119A 105-mm howitzers at each of firing points Audrey, Sally, Big Lake, Bo-Whale, and Mark (Fig. 1). Major S. Houston accompanied us to various firing points, and he located the firing positions of several 105-mm howitzers at firing points Sally, Bo-Whale, and Big Lake. The firing positions were identified by the characteristic depressions left on the ground by the firing platform and spade of each howitzer (Fig. 7).

We collected surface samples in front of eight howitzer firing positions. First we staked a line representing the axis of the cannon tube position and parallel lines 3 m on either side (Fig. 8). At 3.5, 7, 14, 21, and 28 m distance from the center of each firing platform depression, we collected duplicate multi-increment samples. Each sample consisted of 30 increments of the surface soil and associated vegetation collected within a 1- × 6-m area. At three howitzer firing positions we collected five additional samples 50 m from the firing platform

a. M119A1 105-mm howitzers.

b. Depressions made by the firing platform and spade.

Figure 7. Locating howitzer firing positions in July 2001. The firing platform is located between the wheels and the spade is to the rear of the gun.

depression. One of these samples was along the axis of the cannon tube, and the other samples were ±30° and ±60° from the axis.

Each sample was returned to our field laboratory and air-dried on an aluminum pie pan. While the sample was drying, a subsample was taken for the field analysis described below. This analysis allowed us to identify which firing points

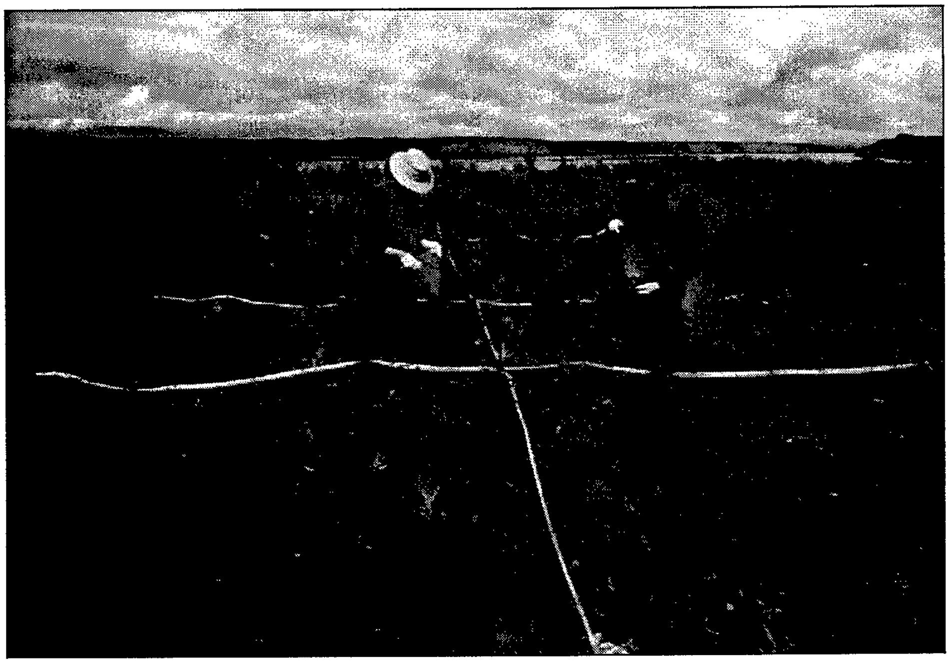


Figure 8. FP Sally in July 2001. The axis of the cannon tube corresponds to the yellow tape measure down the center of the photo. Multi-increment samples were collected within a 1- × 6-m area at 3.5, 7, 14, and 28 m from the center of the depression left by the firing platform.

had detectable concentrations of propellant residues. Based on these analyses, we returned to the sites of the samples with the four highest propellant residue concentrations and collected discrete samples and subsurface samples. Results from the field analysis also allowed us to select samples to send to CRREL (Hanover, NH) to test sample homogenization techniques. The remainder of the samples were sent to the ERDC's Environmental Lab (Vicksburg, Mississippi).

Firing Points, 2002

From June 19 to June 25, 2002, the 4/11th Field Artillery set up at the same firing points as in 2001 for indirect fire training and at the Lampkin Range for direct fire training. A. Gelvin and T. Douglas were on location for some of the firing and obtained exact howitzer positions from CPT Mandelloni of B Company. Gelvin and Douglas then started collecting six composite samples from each gun location. Each sample was nominally made up of 30 increments randomly collected with a bulb planter (Fig. 9) to a depth of 1 cm taken over a 2- × 6-m area. The sample locations were 25 and 50 m in front of each gun and at 60° left and 60° right (Fig. 10). These samples were returned to our field lab for drying, sieving, field-grinding (Hewitt and Walsh 2003), and field gas chroma-

a. Using a bulb planter.

b. Sample increment, nominally 1 cm thick.

Figure 9. Collecting surface samples at firing point Sally.

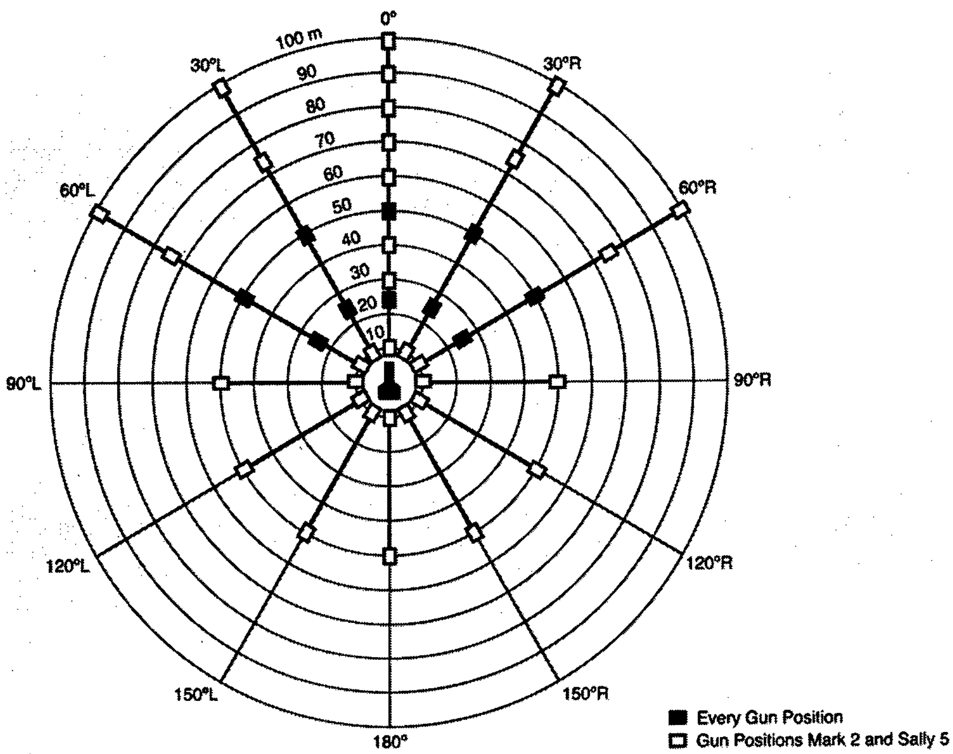


Figure 10. Sampling scheme used for characterization of propellant residues around a howitzer firing position.

tographic analysis. Based on these analyses, we chose two gun positions for intensive sampling. These positions were FP Sally Gun 5 (Fig. 5a), which was heavily vegetated, and FP Mark Gun 2 (Fig. 5b), which was sparsely vegetated. We collected samples radially every 30° at 10 and 50 m, where possible, from the gun platform location (Fig. 10). In some cases the boundary of the firing point was less than 50 m from the gun platform, so the samples were collected at the boundary. Additional samples were collected at 25-m intervals out to 100 m, where possible, ±30° and ±60° from the axis of the gun tube. Samples were collected at 10-m intervals directly in front of the gun platform.

In July 2002, we repeated the intensive sampling at FP Mark Gun 2 and FP Sally Gun 5. We also collected subsurface composite samples 25 and 50 m in front of the gun and at 60° left and 60° right. Each subsurface composite sample was made up of five increments collected at a depth of 15–20 cm using a Series 400 AMS corer.

Two additional sampling locations were OP7 (Fig. 1b), where excess propellant was burned, and the Lampkin Range firing point, where direct-fire exercises with howitzers, mortars, 40-mm grenades, and other ordnance occur (Table 1, Fig. 1b, 6).

Lab Processing of Samples

Firing Points, 2001 and 2002

Most of the firing points are located on well-vegetated fields, so the surface samples were a mix of soil, decayed organic matter, and vegetation. This very complicated matrix presented a considerable subsampling challenge. Most of the firing point samples were shipped to the ERDC Environmental Lab (Vicksburg, MS), where they were analyzed using standard homogenization methods (i.e., manual grinding with a mortar and pestle and sieving through a #30 mesh sieve). The remaining samples, which we selected based on the results of the field gas chromatographic analyses, were sent to CRREL to examine the subsampling heterogeneity associated with these surface samples and test homogenization techniques (Walsh et al. 2002). The selected samples were from a Bo-Whale firing point (Fig. 11).

First, we separated each sample into two size fractions using #10 mesh (2-mm) sieves. The <2-mm fraction consisted of soil and organic matter. The >2-mm fraction contained leafy and woody vegetation and some pebbles. We took duplicate 10-g subsamples from each size fraction of each sample for determination of propellant residues. Then we machine-ground (Fig. 12) each of the size fractions and took a second set of duplicate 10-g subsamples. The grinding, which was done for 60 s on a LabtechEssa LM2 ring mill at CRREL, reduced the particle size of the samples to less than 0.1 mm. Two of the ground samples were divided using a LabtechEssa RSD005 rotary divider.

All of the firing point samples in 2002 were sieved through a #10 (2-mm) mesh sieve, and the <2-mm fraction was machine-ground on a LabtechEssa LM2 ring mill. The grind time for vegetated samples was increased to 90 s. Duplicate 10-g subsamples were taken for analysis for each sample.

Delta Creek

All samples from Delta Creek were air-dried prior to shipment to CRREL for analysis. Those samples that were expected to contain explosives were subsampled by taking larger than normal (50-g) soil aliquots in an effort to reduce subsampling error. All others were subsampled by taking 10-g soil aliquots. The soils were extracted using acetone, and the extracts were analyzed using the colorimetric Method 8515 (U.S. EPA) to detect TNT and other nitroaromatics. This procedure was performed because some of the samples were collected near what appeared to be partial detonations of 500-lb bombs that contained TNT. We used the results of the colorimetric method to sort the samples by TNT concentration. Samples that were positive by the colorimetric method were analyzed by HPLC (see below), and all others were analyzed by GC-μECD. Selected samples

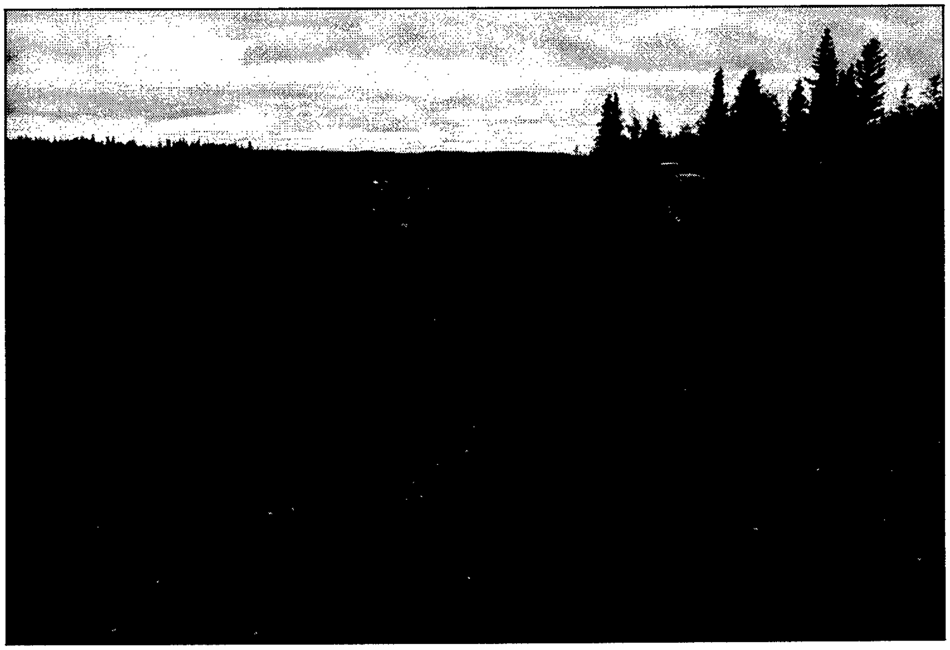


Figure 11. Firing position at Bo-Whale from which samples were collected for homogenization studies.

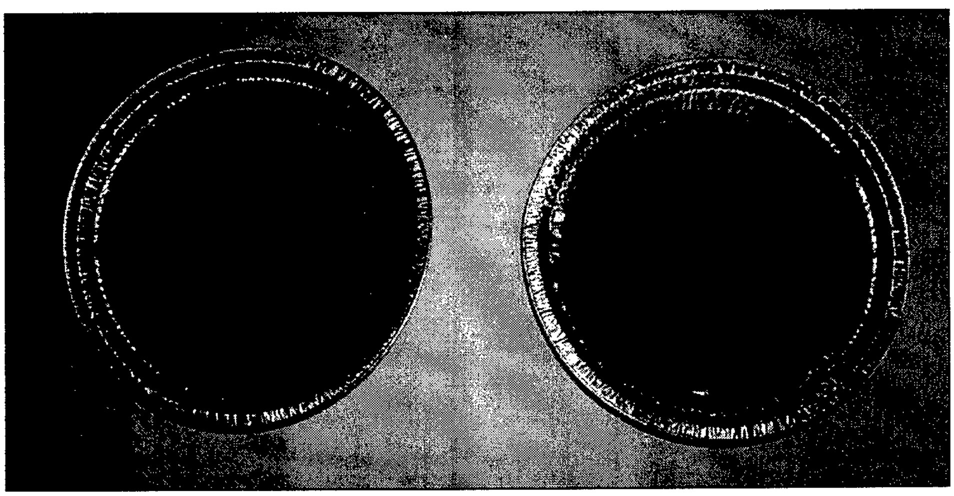


Figure 12. Unground (left) and ground (right) >2-mm fractions of a Bo-Whale sample.

(TNT concentrations between 1 and 200 µg/kg) were machine-ground on a LabTechtonics ring mill at Mineral Stats, Inc. (Broomfield, Colorado) and re-analyzed for explosives. This further processing was done to reduce the subsampling error associated with explosives-contaminated soils (Walsh et al. 2002).

Analytical Methods Used by CRREL

In the field lab during the July–August 2001 and June 2002 sampling periods, acetone extracts were analyzed on a field-portable gas chromatograph equipped with a thermionic ionization detector (Hewitt et al. 2001, USEPA 2001). The SRI Model 8610C gas chromatograph has a heated injection port, and chromatographic separations were achieved on a 15-m × 0.53-mm 100% dimethylpolysiloxane column. This procedure provides detection limits of 10 μg/kg for TNT and 2,4-DNT and 100 μg/kg for RDX.

In the laboratory, we used Method 8095 (Nitroaromatics and Nitramines by GC) (USEPA 2000), which uses an electron capture detector and provides detection limits near 1 μg/kg for TNT and RDX. We used an HP 6890 and a Restek 6-m × 0.53-mm id RTX-5ms (95% dimethyl–5% diphenyl polysiloxane) column. The method detection limits for Method 8095 are 1 μg/kg for the di- and trinitroaromatics, 3 μg/kg for RDX, 25 μg/kg for HMX, 10 μg/kg for NG, and 20 μg/kg for PETN.

We used Method 8330 [Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC)] (USEPA 1994) when we found higher-concentration samples (>0.2 μg/g). The HPLC separations were achieved on a 15-cm × 3.9-mm (4-μm) Nova Pak C_8 (Waters Millipore) column eluted with 1.4 mL/min 15:85 isopropanol:water and on a 25-cm × 4.6-mm (5-μm) Supelco LC-CN column eluted with 1.2-mL/min 65:14:21 water:methanol:acetonitrile. Detection was by UV (254 nm).

Collection of Propellant Residue from a Snow-covered Firing Point

To further examine the deposition of propellant residues from 105-mm howitzers, we had the opportunity to collect samples in conjunction with a research project that involves detonations of ordnance items on clean snow surfaces where the snow acts as a pristine collection surface for the post-blast residues (Hewitt et al. 2003). In March 2002, seventy-one 105-mm projectiles were fired from Firing Point Neiber (Fig. 13) at Fort Richardson, AK. The propellant residues were visible on the snow surface as either fibrous black soot (Fig. 14) or unburned yellow fibers. Samples of the residues were collected by shoveling into plastic bags the top layer of snow from 1-m^2 areas within and just beyond the visible plume forward and to the sides of the gun muzzle. Snow samples were also collected at the breaches of three guns, where the expended cartridges are removed from the howitzer. The snow was melted, and then the particulate residue fraction was obtained by filtration through glass fiber filters. The filtrate and the solid residue were analyzed separately for 2,4-DNT.

Figure 13. Winter firing of an M119A1 105-mm howitzer.

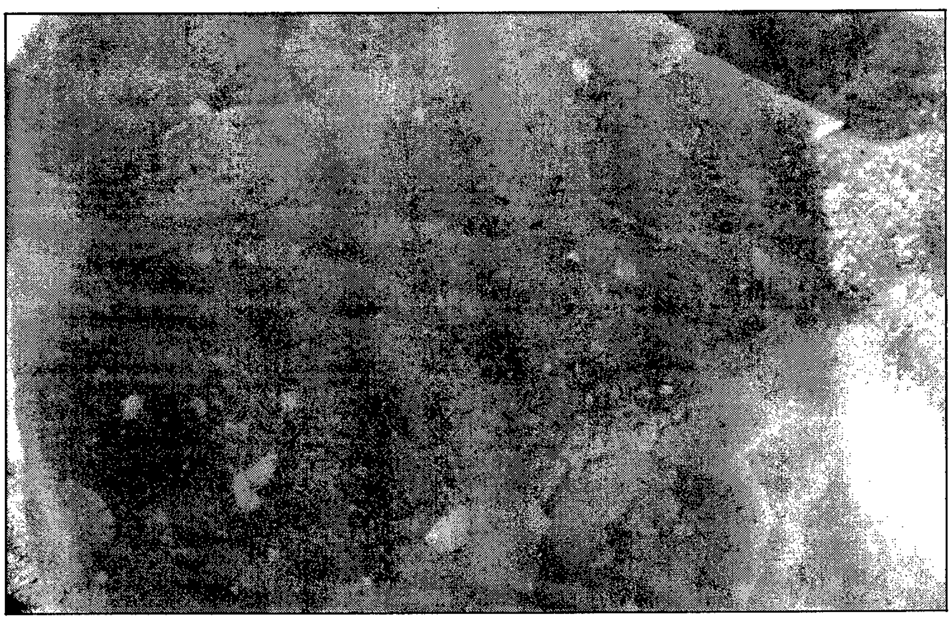


Figure 14. Fibrous residue deposited on the snow surface from the firing of a 105-mm howitzer.

5 RESULTS

Delta Creek Impact Area

Explosives residues were detected in all of the samples collected near the target array located 2 km downstream from the Delta Creek Impact Area. In the composite samples, the following residues were determined: TNT (<1–314,000 µg/kg); RDX (7–1,400 µg/kg); HMX (<25–110 µg/kg); 2,4-DNT (1–33 µg/kg), and NG (<15–51 µg/kg). Only four of the samples had TNT above 1,000 µg/kg, and the median concentration was 80 µg/kg. The amino-DNT reduction products were detected in each sample as well, but concentrations were low (<200 µg/kg). One of the discrete samples collected near a 500-lb bomb partial detonation had a TNT concentration of 17,300,000 µg/kg, a concentration far exceeding any other sample we collected. No explosives residues were detected upstream of the target array, and NG was the only propellant residue detected downstream of the target array. The NG (2,000 and 80 µg/kg) was found in two discrete samples that were collected under pieces of rocket motors.

Explosives residues were detected in each of the seven soil samples from Simpsonville, the MOUT/CALFEX site. The concentration ranges were: TNT (<d–140 µg/kg), RDX (<d–26 µg/kg), 2,4-DNT (<d–28 µg/kg), and NG (<d–1,500 µg/kg). The NG was associated with 40-mm grenade training, and the other residues were associated with explosive ordnance disposal craters.

Georgia Island

All composite samples collected along the centerline of Georgia Island and from the base of the target berm were negative for HMX, RDX, TNT, 2,4-DNT, and other target analytes. NG was detected in a discrete soil sample, GI003, taken under an empty 40-mm grenade cartridge casing. The concentration was 4,700 µg/kg.

West Side of Washington Impact Area

Explosives residues were not detectable in any of the samples from the narrow vegetated floodplain along the west side of Washington Impact Area.

Firing Points 2001

Each of the firing points that we sampled in 2001 at Donnelly Training Area had detectable concentrations of 2,4-DNT in at least one composite sample (Appendix Table 1). A typical chromatogram is shown in Figure 15. The spatial

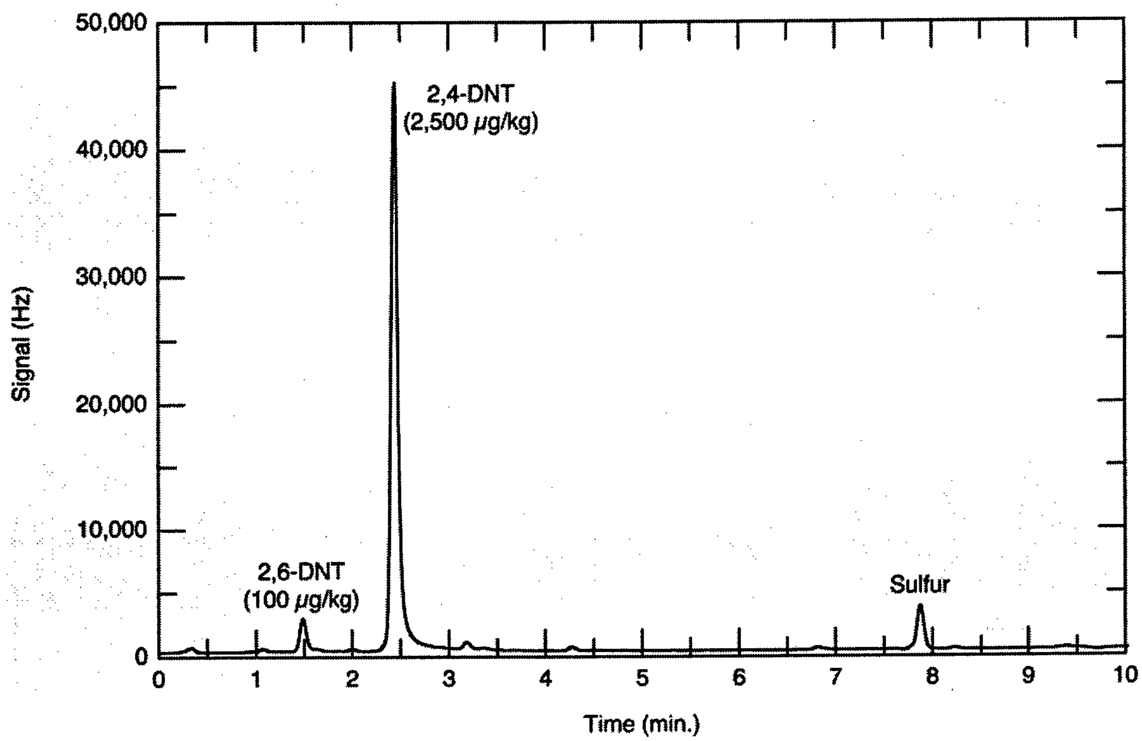


Figure 15. Typical chromatogram obtained by GC-µECD of an extract of a soil collected from a 105-mm howitzer firing point.

distribution of 2,4-DNT was extremely heterogeneous, as shown by the concentration estimates in discrete samples. For example, five discrete samples collected within the 1- × 6-m area from which Bo-Whale composite sample 1 was collected ranged in concentration from 25 to 7,900 µg/kg. There was also generally poor agreement between duplicate field samples that were processed by standard methods at EL.

Our sample homogenization experiments were done on the duplicate field samples that we collected at the Bo-Whale firing point (Fig. 11). First we took duplicate laboratory subsamples of the <2-mm and >2-mm size fractions. The >2-mm fraction is not routinely analyzed for contaminant concentrations (Paetz and Crößmann 1994). However, the propellant residues fall onto whatever substrate is near the howitzer, so we did not feel justified in excluding any part of the surface samples we collected. We then machine-ground each size fraction to a fine powder (Fig. 12) and took duplicate subsamples for analysis.

Concentration estimates of 2,4-DNT in the machine-ground and not-ground samples are shown in Table 2. To determine if machine grinding increased subsampling precision of the two size fractions, we used an F test. First, we computed the pooled variances for the laboratory duplicates using the following equation:

Table 2. Concentrations of 2,4-DNT in laboratory subsamples of the >2-mm and <2-mm fractions with and without machine grinding. Samples were collected July 2001 from FP Bo-Whale.

Distance from firing platform (m)	Angle from centerline (degrees)	Sample ID	Field rep.	Lab rep.	2,4-DNT concentration (µg/kg)			
					Machine ground		Not ground	
					>2 mm	<2 mm	>2 mm	<2 mm
3.5	0	1	A	1	903	8,540	14,400	5,000
3.5	0	1	A	2	1,560	5,470	1,570	1,720
3.5	0	1	B	1	301	3,400	219	1,120
3.5	0	1	B	2	397	3,640	3,320	1,500
7	0	2	A	1	130	1,860	369	1,700
7	0	2	A	2	143	2,550	1,070	3,800
7	0	2	B	1	1,270	3,030	3,230	6,500
7	0	2	B	2	623	3,660	131	972
14	0	3	A	1	483	1,750	299	580
14	0	3	A	2	616	732	136	157
14	0	3	B	1	84	1,400	68	2,470
14	0	3	B	2	224	2,000	123,000	11,600
21	0	4	A	1	450	1,280	<d	96
21	0	4	A	2	485	1,120	<d	984
21	0	4	B	1	2,400	1,520	440	36
21	0	4	B	2	1,940	2,300	140	356
28	0	5	A	1	3,870	16,900	12,900	29,000
28	0	5	A	2	3,450	29,900	9,430	16,500
28	0	5	B	1	10,800	24,000	11,100	12,500
28	0	5	B	2	15,300	29,100	9,450	6,300
50	–30	6		1	172	4,020	14	5,980
50	–30	6		2	193	2,840	104	2,030
50	–15	7		1	200	8,320	477	2,310
50	–15	7		2	186	5,860	843	2,630
50	0	8		1	4,510	6,790	1,670	794
50	0	8		2	3,130	5,730	9,800	18,600
50	+15	9		1	no sample	20	no sample	13
50	+15	9		2	no sample	39	no sample	37
50	+30	10		1	299	2,960	18	28
50	+30	10		2	322	1,530	7.8	40
Pooled variance for duplicates					840,000	7,300,000	592,000,000	22,000,000
F (Ratio of variances for not ground and ground)							700	3.0

$$s_p^2 = \frac{1}{2k}\sum_{1}^{k} d_i^2$$

where d_i is the difference of k sets of duplicates (Ku 1969). Then we computed the ratio of the variances for the not-ground and ground sets of samples. For the <2-mm fraction, 2,4-DNT was detectable in all 15 duplicates for both the not-ground and ground samples, and the F ratio was 3.0. The critical value of $F_{(14,14)}$ is 2.48 ($P = 0.05$) (Miller and Miller 1984), so the machine grinding resulted in a significant increase in precision. The F ratio for the >2-mm fraction was highly significant ($F = 700$), but most of the variation was due to sample 3A, where the concentration estimates differed by a factor of 1800. Even excluding this one sample, machine grinding significantly improved precision. However, the reduction in subsampling variance by grinding the Bo-Whale sample is less than the reduction we find when unvegetated samples contaminated with high explosives, such as those collected from hand grenade ranges, were ground. For unvegetated samples contaminated with TNT, RDX, and HMX, the relative standard deviation for 12 replicates was less than 10% (Walsh et al. 2002).

To test if machine sample division would reduce the laboratory subsampling variance over that obtained by manual subsampling, we divided Bo-Whale samples 3A and 6 into 12 subsamples each using a rotary divider. For these samples, the relative standard deviations for the 2,4-DNT concentration estimates were 55% and 32%, respectively (Table 3). The pooled relative standard deviation for the 15 sets of duplicates of the ground <2-mm fractions of Bo-Whale samples 1–10 was 44% (Table 2), so machine division does not appear to improve subsampling precision for these samples. Future homogenization experiments will examine the effect of longer grind times on 2,4-DNT-contaminated soils.

To determine if we were able to collect field samples in a reproducible manner, we used the laboratory duplicates to compute the mean concentrations in the five sets of field duplicates for the >2-mm and <2-mm fractions with and without machine grinding. Again, using the ratio of the pooled variances (Table 4), we see that machine grinding significantly improved precision for both size fractions. The field replicates for the <2-mm machine-ground fractions were in relatively good agreement, considering the heterogeneity of the substrate we were sampling. However, methods to reduce the field sampling variance are needed.

We collected four sets of subsurface samples using an AMS soil core sampler to determine if propellant residues deposited from firing activities were migrating downward through the soil column. The locations of the subsurface samples were chosen based on the highest concentrations of 2,4-DNT detected using the field

Table 3. Subsampling heterogeneity in two machine ground samples that were split by a rotary divider.

	2,4-DNT Concentration (µg/kg)	
Replicate	Bo-Whale Sample 6 (<2 mm)	Bo-Whale Sample 3A (<2 mm)
1	7,400	810
2	4,900	1,860
3	6,800	860
4	3,900	2,900
5	4,200	3,530
6	8,000	1,700
7	3,500	2,500
8	7,000	1,150
9	6,097	4,200
10	6,000	1,900
11	2,650	920
12	4,300	1,600
mean	5,396	1,993
min	2,650	810
max	8,000	4,200
median	5,450	1,775
RSD	32%	55%

Table 4. Mean concentration estimates of the >2-mm and <2-mm fractions with and without machine grinding in field duplicate multi-increment samples at FP Bo-Whale.

Distance from base plate (m)	Angle from centerline (degrees)	Sample ID	Field replicate	2,4-DNT Conc. (µg/g)			
				Machine ground		Not ground	
				>2 mm	<2 mm	>2 mm	<2 mm
3.5	0	1	A	1,230	7,000	7,990	3,360
3.5	0	1	B	349	3,520	1,770	1,310
7	0	2	A	136	2,200	718	2,750
7	0	2	B	948	3,341	1,680	3,740
14	0	3	A	549	1,240	217	368
14	0	3	B	154	1,700	61,550	7,020
21	0	4	A	467	1,200	not detected	540
21	0	4	B	2,170	1,900	290	196
28	0	5	A	3,660	23,400	11,200	22,750
28	0	5	B	13,100	26,600	10,300	9,410
Pooled Variance for Duplicates				9,360,000	2,440,000	380,000,000	22,800,000
F (Ratio of variances for not ground and ground)						41	9.4

GC analysis. Three sets were from FP Bo-Whale, and the fourth set was from FP Big Lake. The results in Table 5 show that the bulk of the residues were in the top 2 cm and that no analytes were detected below 5 cm deep.

Firing Points 2002

The firing point samples from 2001 showed that firing with 105-mm howitzers deposited 2,4-DNT on the surface soil in a heterogeneous manner resulting in parts-per-million residue concentrations and that the residue extended at least 50 m from the gun position. In 2002, we intensively sampled two howitzer firing positions, one vegetated and the other sparsely vegetated, shortly after the guns were used, and we repeated the sampling after 30 days. We must point out that the other guns at the firing points were positioned close enough so that some of the 2,4-DNT we detected may have been contributed by the firing of neighboring guns.

The range of 2,4-DNT concentrations at the sparsely vegetated gun position (FP Mark Gun 2) was <1–19,000 µg/kg shortly after firing in June and 2–32,000 µg/kg 30 days later in July (Table 6). At the vegetated gun position (FP Sally Gun 5) the range of 2,4-DNT concentrations was <1–5,800 µg/kg after

Table 5. Concentrations of propellant residues found in subsurface samples collected from FP Bo-Whale and Big Lake.

			Concentration (µg/kg)		
		Lab Rep	2,6-DNT	2,4-DNT	NG
Bo-Whale FP Discrete Location 1 (within area BW4 composite sample)					
Surface	Field GC		NA	7,900	NA
0 to 2.5 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	8.1	<15
2.5 to 5 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
5 to 9 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
9 to 13 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
FP Bo-Whale Discrete Location 2 (within area BW4 composite sample)					
Surface	Field GC		NA	4,600	<15
0 to 2.5 cm depth	Lab GC	A	616	13,300	550
	Lab GC	B	588	11,300	<15
2.5 to 5 cm depth	Lab GC	A	<1	19.6	250
	Lab GC	B	<1	5.4	<15
5 to 10 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
10 to 15 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
FP Bo-Whale Discrete Location 1.5 (within area BW4 composite sample)					
Surface	Lab GC		48.6	530	<15
0 to 2 cm depth	Lab GC	A	13.8	226	<15
	Lab GC	B	<1	8.3	<15
2 to 4 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
4 to 11 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
11 to 15 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
FP Big Lake Discrete Location 10 (within area BL14 composite sample)					
Surface	Field GC		NA	9,100	NA
Surface	Lab GC		345	6,790	<15
1 to 4 cm depth	Lab GC	A	<1	4.0	<15
	Lab GC	B	<1	<1	<15
4 to 8 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
8 to 15 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15
15 to 20 cm depth	Lab GC	A	<1	<1	<15
	Lab GC	B	<1	<1	<15

Table 6. Concentrations of 2,4-DNT determined in composite surface soil samples collected around a 105-mm howitzer within one week (June 2002) and five weeks (July) of firing.

FP Mark (sparsely vegetated)			
Distance from firing platform (m)	Angle from centerline (degrees)	2,4-DNT (µg/kg) June	2,4-DNT (µg/kg) July
10	0	70	190
20	0	300	160
25	0	4,900	550
40	0	1,400	3,700
50	0	250	150
60	0	57	690
70	0	17	9.0
80	0	1,400	110
90	0	120	1,100
100	0	300	1,200
10	–30	120	120
25	–30	26	8
50	–30	870	1,900
75	–30	300	340
100	–30	4.0	36
10	+30	110	250
25	+30	1,800	1,800
50	+30	2,000	2,300
75	+30	2,300	1,400
95	+30	3,600	3,300
10	–60	240	950
25	–60	1,400	2,900
50	–60	120	53
75	–60	1,400	170
100	–60	160	160
10	+60	41	21
25	+60	1,700	1,800
50	+60	170	440
75	+60	1,500	1,800
100	+60	19,000	32,000
10	–90	120	100
50	–90	42	140
10	+90	72	68
50	+90	67	270
10	–120	50	4.0
36	–120	<d	100
10	+120	61	26
50	+120	1,000	940
10	–150	7.0	2.0
50	–150	<d	3
10	+150	27	7.5
30	+150	9.0	5.0
10	180	9.0	18
28	180	4.0	2.0
mean		1,070	1,390
median		121	165
max		19,000	32,000

FP Sally (vegetated)			
Distance from firing platform (m)	Angle from centerline (degrees)	2,4-DNT (µg/kg) June	2,4-DNT (µg/kg) July
10	0	3,800	3,000
20	0	1,900	1,000
25	0	800	230
40	0	290	1600
50	0	<d	270
60	0	<d	<d
70	0	<d	260
10	–30	2,200	7,400
25	–30	1,100	2,700
50	–30	70	60
10	+30	810	2400
25	+30	140	140
50	+30	530	490
75	+30	<d	64
100	+30	<d	<d
10	–60	5,800	4,400
25	–60	450	1,500
50	–60	240	63
10	+60	86	750
25	+60	670	810
50	+60	190	100
75	+60	<d	27
100	+60	<d	<d
10	–90	2,300	3,700
50	–90	160	770
10	+90	200	820
50	+90	<d	140
10	–120	620	1,400
50	–120	1,400	900
10	+120	32	210
50	+120	35	94
10	–150	230	160
50	–150	180	750
10	+150	220	360
50	+150	26	62
10	180	95	90
50	180	15	<d
mean		660	990
median		190	270
max		5,800	7,400

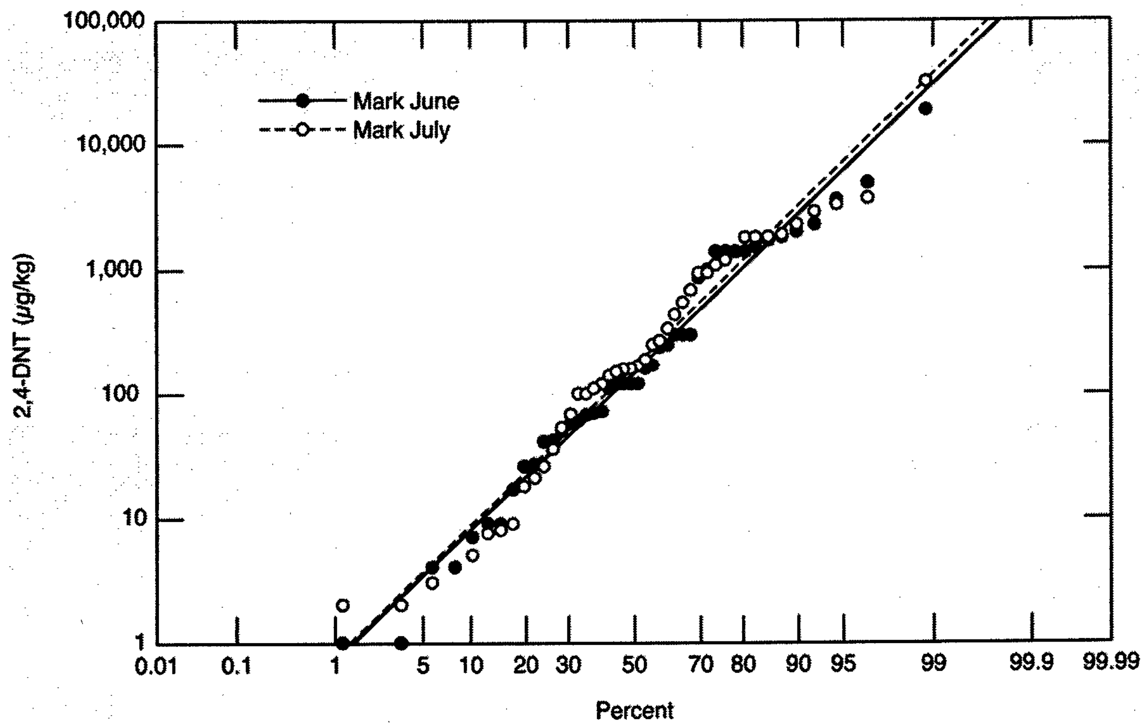


Figure 16. Probability plot of 2,4-DNT concentrations at FP Mark in June and July 2002. The data are log-normally distributed, and there was no significant change in 2,4-DNT concentration after 30 days of weathering.

firing and <1–7,400 µg/kg 30 days later. The data were not normally distributed; when the data for FP Mark are displayed on a log probability plot (Fig. 16), the points fall approximately along straight lines. We used Wilcoxon Matched Pairs Test to compare the June and July concentrations estimates, and there was no significant difference for FP Mark. There was a significant difference between the June and July medians for FP Sally; the July median was greater than the June median, probably because we paid more attention to maintaining the sampling depth at only 1 cm for the July samples.

We did not detect 2,4-DNT in subsurface samples collected in July 2002 at FP Sally, the vegetated firing point. However, we could detect some 2,4-DNT in subsurface samples at FP Mark, which had sparse vegetation (Table 7). The organic matter in the vegetated soil would be expected to sorb any 2,4-DNT that dissolves in the surface moisture.

Samples from the other gun positions at FP Mark, Sally, Audrey, and Bo-Whale (Tables 8–11) in 2002 showed similar patterns for 2,4-DNT. With the exception of Bo-Whale gun positions one and two, 2,4-DNT was detectable at concentrations ranging from 10 to 8,800 µg/kg.

Table 7. Concentrations of 2,4-DNT determined in composite surface (0–1 cm) and subsurface (15–20 cm) soil samples collected near a 105-mm howitzer within five weeks (July 2002) after firing.

Distance from firing platform (m)	Angle from centerline (degrees)	Depth	2,4-DNT (µg/kg)	
			Mark gun 2	Sally gun 5
25	0	Surface	550	230
		Subsurface	4.2	<d
50	0	Surface	150	270
		Subsurface	17	<d
25	–60	Surface	2,900	1,500
		Subsurface	260	<d
50	–60	Surface	53	63
		Subsurface	59	<d
25	+60	Surface	1,800	810
		Subsurface	100	<d
50	+60	Surface	440	100
		Subsurface	250	<d

Table 8. Concentrations of 2,4-DNT detected at FP Mark in June 2002.

Gun #	Distance from firing platform (m)	Angle from centerline (degrees)	2,4-DNT (µg/kg)
1	25	0	1,250
1	50	0	1,000
1	25	–60	410
1	50	–60	200
1	25	+60	2,750
1	50	+60	2,200

Table 9. Concentrations of 2,4-DNT detected at FP Sally in June 2002.

Gun #	Distance from firing platform (m)	Angle from centerline (degrees)	2,4-DNT (µg/kg)
1	25	0	62
1	50	0	110
1	25	–60	255
1	50	–60	740
1	25	+60	520
1	50	+60	4,800
2	25	0	225
2	50	0	8,800
2	25	–60	765
2	50	–60	3,900
2	50	+60	1,500
2	Shell case pile		5,800
3	25	0	3,300
3	50	0	480
3	25	–60	480
3	50	–60	165
3	25	+60	520
3	50	+60	3,200
4	25	0	170
4	50	0	10
4	25	–60	830
4	50	–60	2,400
4	25	+60	1,500
4	50	+60	790
6	25	0	815
6	50	0	490
6	25	–60	66
6	50	–60	110
6	25	+60	<d
6	50	+60	14

Table 10. Concentrations of 2,4-DNT detected at FP Audrey in June 2002.

Gun #	Distance from firing platform (m)	Angle from centerline (degrees)	2,4-DNT (µg/kg)
1	25	0	590
1	50	0	1,200
1	25	–60	77
1	50	–60	170
1	25	+60	330
1	50	+60	46
2	25	0	570
2	40	0	1,700
2	25	–60	2,100
2	50	–60	870
2	25	+60	70
2	44	+60	180
3	25	0	1,100
3	50	0	80
3	25	–60 and +60	110
3	50	–60 and +60	390
4	25	0	1,700
4	50	0	670
4	25	–60 and +60	360
4	50	–60 and +60	570
5	20	0	710
5	25	–60 and +60	230
5	50	–60 and +60	90
6	25	0	1,900
6	25	–60	6,800
6	50	–60	240
6	25	+60	10
6	35	+60	110

Table 11. Concentrations of 2,4-DNT detected at FP Bo-Whale in June 2002.

Gun #	Distance from firing platform (m)	Angle from centerline (degrees)	2,4-DNT (µg/kg)
1	25	0	<d
1	50	0	<d
1	25	–60	<d
1	50	–60	<d
1	25	+60	<d
1	50	+60	<d
2	25	0	<d
2	50	0	2,900
2	25	–60	320
2	50	–60	720
2	25	+60	<d
2	50	+60	<d
3	25	0	6,300
3	50	0	690
3	25	–60	6,800
3	50	–60	120
3	25	+60	5,400
3	50	+60	6,100
4	25	0	4,300
4	50	0	<d
4	25	–60	570
4	50	–60	1,500
4	25	+60	1,000
4	50	+60	620
5	25	0	470
5	50	0	1,400
5	25	–60	700
5	50	–60	400
5	25	+60	830
5	50	+60	1,100

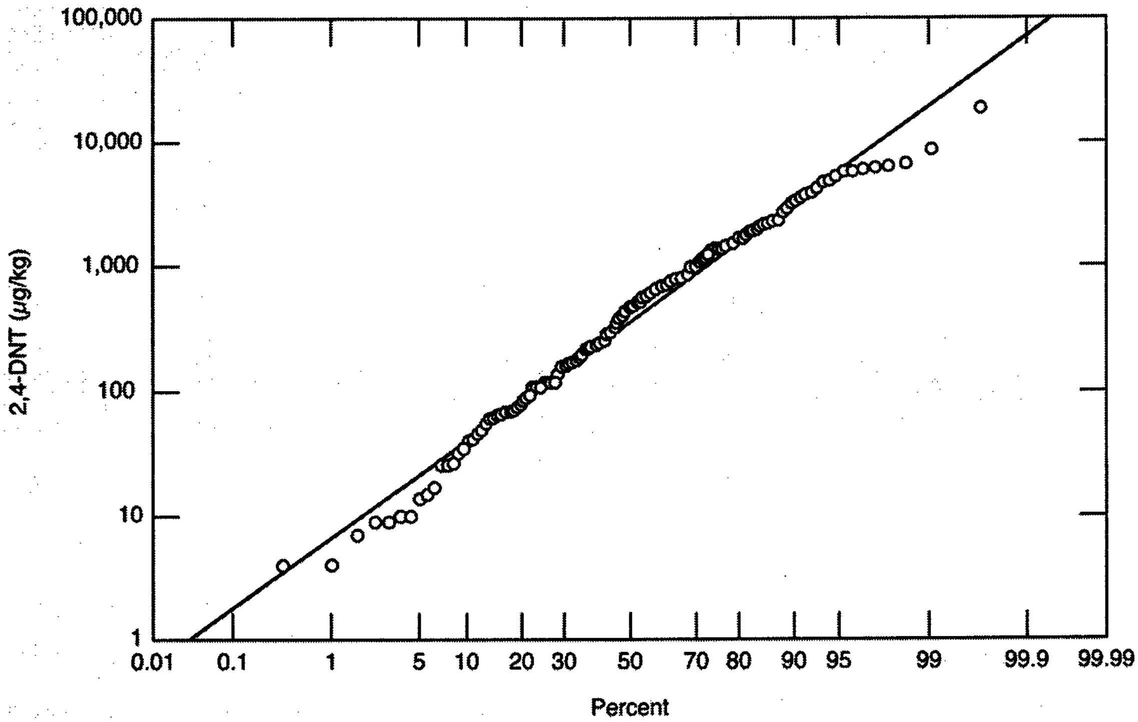


Figure 17. Probability plot of 2,4-DNT concentrations at FP Mark, Sally, Audrey, and Bo-Whale in June 2002. The data are log-normally distributed, and the median concentration was 480 µg/kg.

Pooling the data from FP Mark, Sally, Audrey, and Bo-Whale, we find 155 detections of 2,4-DNT out of the 175 samples collected in June 2002. The data were log-normally distributed (Fig. 17). The median concentration was 480 µg/kg.

The cartridge case for the 105-mm howitzer comes with a full complement of propellants arranged as seven individual bagged and numbered propelling charges (U.S. Army 1994). The distance the projectile is fired depends on the number of propelling charge increments. To fire at less than maximum range, excess propellant bags are removed. The previous practice was to burn these bags on the ground at the firing point. The current practice is to burn the excess propellant in pans at designated locations. The excess propellant for the training exercise in June 2002 was burned in a tray at Observation Point 7. The troops placed some soil in the tray so we could sample what would have been deposited on the soil surface if a tray had not been used. We also collected soil samples from the area downwind from the burn tray. The downwind side was to the southwest and was obvious from the dead leaves on the trees killed by the heat of the fire. Very high concentrations (2,300,000 µg/kg) of 2,4-DNT were detected in the soil from the burn tray 2 (Table 12). Downwind of the tray, concentrations were still high (120,000 µg/kg). We also detected 2,6-DNT in the burn samples, with concentrations approximately 5% of the corresponding 2,4-DNT concentration.

The Lampkin Range firing point was used for direct fire of the 105-mm howitzers and for other munitions, including mortars. In the two composite samples we collected in July 2002, we found the same two analytes as those we detected in July 2000 (Walsh et al. 2001), namely 2,4-DNT and NG. The 2,4-DNT concentrations (260 and 370 µg/kg) were similar to those detected at the other firing points. NG was detected at 59,000 and 35,000 µg/kg.

Table 12. Concentrations of 2,4-DNT and 2,6-DNT in soil at Observation Point 7 where excess propellant was burned.

	2,4-DNT (µg/kg)	2,6-DNT (µg/kg)
Soil SW of Tray	120,000	5,200
Soil in Burn Tray 1	15,000	630
Soil in Burn Tray 2	2,300,000	130,000

Collection of Propellant Residue from a Snow-covered Firing Point

We detected 2,4-DNT and 2,6-DNT in each of the surface snow samples (Table 13) we collected immediately after the winter firing of 105-mm projectiles (Fig. 13). We computed the equivalent soil concentrations based on the mass of residue deposited in each 1-m^2 sample area. Assuming that the residues reside in the top 1 cm of soil and that the bulk density of the soil is 1.5 g/cm^3, then the mass of soil containing residue in each 1-m^2 area would be 15 kg. For 2,4-DNT the range of soil concentrations in front of the howitzer would have been 22–1,900 µg/kg, with a median of 430 µg/kg, which is very similar to the median soil concentration for FP Mark, Sally, Audrey, and Bo-Whale (480 µg/kg). The variability of concentrations in neighboring snow samples is also similar to the variability in the soil samples from Donnelly Training Area.

Table 13. 2,4-DNT and 2,6-DNT concentrations detected on snow following the firing of 105-mm howitzers and the equivalent† soil concentration.

			2,4-DNT		2,6-DNT	
Sample ID	Distance from firing platform (m)	Angle from centerline (degrees)	Conc. found on snow (μg/m²)	Equivalent† soil conc. (μg/kg)	Conc. found on snow (μg/m²)	Equivalent† soil conc. (μg/kg)
1	4	+40	16,500	1,100	1,120	75
4	5	–10	15,400	1,027	1,060	71
2	6	+40	9,250	617	544	36
7	6	–40	28,200	1,880	1,510	101
3	8	+10	920	61	39	3
6	8	+30	2,770	185	158	11
15	9	+15	9,980	665	674	45
16	12	–20	13,800	920	882	59
8	13	+10	3,660	244	236	16
10	14	+30	1,060	71	69	5
17	15	–50	11,200	747	418	28
12	23	+15	494	33	27	2
13	23	+10	336	22	19	1
14	25	–10	744	50	29	2
5	Gun 3 Breach		305	20	14	1
9	Gun 2 Breach		162	11	12	1
11	Gun 4 Breach		1,430	95	55	4

†Assuming that 1-m² of soil with a bulk density of 1.5 g/cm³ is sampled to a depth of 1 cm, the mass of soil would be 15 kg.

6 DISCUSSION

Explosives Residues on Impact Areas

Two of the impact areas that we sampled (Georgia Island and Washington Range West) did not have detectable concentrations of explosives. Georgia Island has not been used for a number of years, and Washington Range West is really a buffer zone for the Washington Impact Area. On Delta Creek, the spatial distribution of explosives residues was similar to what has been observed on other active impact areas. Explosives residues, if detectable at all, are at very low concentrations (parts per billion) over most of the ranges. In contrast, localized areas where ordnance has failed to completely detonate may have solid explosives on the soil surface, and the underlying soil can have high parts-per-million concentrations. Targets, where ordnance detonations are concentrated, can also have detectable concentrations of explosives. On Delta Creek, we found localized high concentrations of TNT, the high-explosive filler of 500-lb bombs. We also found RDX, which could have come from a variety of ordnance items (Table 1), including C4, which is used to detonate unexploded ordnance. NG was also detected in soil under rocket motors. At Delta Creek, explosives residues from range scrap and partially detonated ordnance can move to the surface water by erosion of the floodplain terrace (Fig. 2b).

Propellant Residues at Firing Points

Unlike impact areas, where ordnance residues are for the most part undetectable, each of the howitzer firing points that we have sampled at the Donnelly Training Area and elsewhere have detectable concentrations of 2,4-DNT. The data were log-normally distributed, with median concentrations around 500 μg/kg.

The Agency for Toxic Substances and Disease Registry published a toxicological profile for 2,4-DNT and 2,6-DNT in December 1998 that summarizes information on the adverse health effects and numerous regulations associated with these compounds (Science International Inc. 1998). Munitions workers with chronic DNT exposure had a variety of health problems affecting the circulatory and nervous systems. Both 2,4- and 2,6-DNT caused liver cancer in laboratory animals, and the International Agency for Research on Cancer (IARC) has designated that these chemicals are probable human carcinogens, based on animal data (Group B2) (Science International Inc. 1998). The EPA-derived oral reference doses (RfDs), which are not applicable to cancer risk, are 0.002 mg/kg/day for 2,4-DNT and 0.001 mg/kg/day for 2,6-DNT. Based on these RfDs, the Drinking Water Equivalent Levels are 0.1 and 0.04 mg/L for 2,4-DNT and 2,6-DNT, respectively. Lifetime drinking water advisory values are not listed due to the cancer risk.

The EPA Region III Risk-Based Concentration Table gives soil screening levels for the protection of groundwater based on non-carcinogenic effects (U.S. EPA 2003). For 2,4-DNT and 2,6-DNT (an impurity in military-grade TNT and 2,4-DNT), these values are 29 and 12 µg/kg for 2,4-DNT and 2,6-DNT, respectively, if the dilution attenuation factor is one, and 570 and 250 µg/kg for 2,4-DNT and 2,6-DNT, respectively, if the dilution attenuation factor is 20.

In the last few years, states, including Alaska, have issued soil cleanup levels for 2,4-DNT, 2,6-DNT, and several other chemicals. The State of Alaska (Alaska Department of Environmental Conservation 2002) has three sets of soil cleanup standards that are based on climate zones: Arctic (continuous permafrost); Under 40 Inch Zone [less than 40 inches (102 cm) of annual precipitation]; and Over 40 Inch Zone [greater than 40 inches (102 cm) of annual precipitation]. The Big Delta National Weather Service Station receives an average of 12 inches (30 cm) of precipitation a year, so the Donnelly Training Area is in the Under 40 Inch Zone. Alaska Department of Environmental Conservation Title 18 Alaska Administrative Code Chapter 75 lists 2,4-DNT and 2,6-DNT as carcinogenic chemicals. As a result, the soil cleanup standards are extremely low for the protection of groundwater: 5 µg/kg for 2,4-DNT and 4.4 µg/kg for 2,6-DNT. The equations and input parameters used to derive these values are described in *Guidance on Cleanup Levels Equations and Input Parameters* (Alaska Department of Environmental Conservation 1999).

Most of the samples at firing points Sally, Mark, Audrey, and Bo-Whale had concentrations of 2,4-DNT that exceeded the Alaska soil cleanup levels by a wide margin. Alternative cleanup levels that are based on site-specific soil data and an approved fate and transport model may be approved if the alternative cleanup levels are "protective of human health, safety, and welfare and the environment" (Alaska Department of Environmental Conservation 2002). The alternative levels must not exceed the ingestion-based levels, which are 12,000 µg/kg for 2,4-DNT and 2,6-DNT. Most of the samples from the firing points were less than 12,000 µg/kg, but the propellant burn area far exceeded this level. The subsurface samples we collected indicated that downward migration of these contaminants was minimal, but prudent placement of firing points and especially propellant burn locations is desirable because of the low screening levels given for protection of groundwater.

The compound 2,4-DNT biotransforms in the environment and ultimately mineralizes through reductive and/or oxidative pathways. The persistence of 2,4-DNT associated with unburned propellant compositions is unknown, but it is probably enhanced by 2,4-DNT's residence within a nitrocellulose matrix. Nitrocellulose is insoluble in water and could only migrate to surface water by bulk movement of solids by water or wind.

7 CONCLUSIONS

We sampled some impact areas of the Donnelly Training Area using authoritative sampling, when possible, to try to detect explosives residues in surface soils. We did not detect explosives residues on Georgia Island and Washington Range West. We did detect NG, a propellant residue, in one discrete sample collected under a 40-mm cartridge case on Georgia Island. The target array downstream of the Delta Creek Impact Area appeared to be more heavily used than the previous two areas, and we found explosives residues in all of the samples collected around craters, targets, and ordnance debris. This impact area had been used by the Air Force for training with 500- and 2000-lb bombs, and partial detonations of these bombs created localized areas containing high concentrations of TNT. RDX was detected in several samples; the two highest RDX concentrations were associated with targets. We did not detect TNT, RDX, or other high-explosives residues in composite soil samples collected upstream and downstream from the target array. We did detect NG in discrete samples downstream from the target array; these discrete samples were collected under pieces of rockets. Explosives residues were detectable in each of the soils samples collected from a MOUT/CALFEX site. Specifically, NG was associated with 40-mm grenade training, and low concentrations of TNT, RDX, and 2,4-DNT were associated with explosive ordnance disposal craters.

Soils from recently used firing points have parts-per-million concentrations of NG and 2,4-DNT. These residues are most likely associated with partially burned propellant. The 2,4-DNT is found on the surface of vegetated firing points, and we could not detect any decrease in 2,4-DNT concentrations after 30 days of weathering at either vegetated or sparsely vegetated firing points. Results from replicate field and laboratory samples for 2,4-DNT indicate that sampling error is high; research to improve field and laboratory sampling is ongoing. The highest concentrations of 2,4-DNT were in soils where excess propellant is burned. Fixed firing points and propellant burn areas should be located away from groundwater recharge areas.

Both 2,4-DNT and 2,6-DNT are listed as hazardous substances by the State of Alaska, and very low soil cleanup levels for the protection of groundwater are given for these potentially carcinogenic compounds. Future work will focus on sample collection methods appropriate to obtain average concentrations over a firing point to provide data for possible risk assessment activities.

REFERENCES

AeroMap U.S. (2003) Fort Greely Ortho. AeroMap, Anchorage, Alaska.

Alaska Department of Environmental Conservation (1999) Guidance on cleanup levels equations and input parameters. July 28, 1999.

Alaska Department of Environmental Conservation (2002) 18 AAC 75 Oil and other hazardous substances pollution Control, Article 3, discharge reporting, cleaning and disposal of oil and other hazardous substances, Section 341, Soil cleanup levels; Tables.

Hewitt, A.D., and M.E. Walsh (2003) On-site processing and subsampling of surface soil samples for the analysis of explosives. ERDC/CRREL TR-03-14, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

Hewitt, A.D., T.F. Jenkins, and T.A. Ranney (2001) Field gas chromatography/ thermionic detector system for on-site determination of explosives in soils. ERDC/CRREL TR-01-9, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

Hewitt, A.D., T.F. Jenkins, T.A. Ranney, J.A. Stark, M.E. Walsh, S. Taylor, M.R. Walsh, D.J. Lambert, N.M. Perron, N.H. Collins, and R. Karn (2003) Estimates of explosives residues from the detonation of Army munitions. ERDC/CRREL Technical Report TR-03-16, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

Jorgenson, M.T., J.E. Roth, M.D. Smith, S. Schlentner, W. Lentz, E.R. Pullman, and C.H. Racine (2001) An ecological land survey for Fort Greely, Alaska. ERDC/CRREL TR-01-4, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

Ku, H.H. (1969) Statistical concepts in metrology. In *Precision Measurement and Calibration: Statistical Concepts and Procedures*. Volume 1, Special Publication 300, National Bureau of Standards, Washington, D.C.

Miller, J.C., and J.N. Miller (1984) *Statistics for Analytical Chemistry*. New York: John Wiley and Sons.

Paetz, A., and G. Crößmann (1994) Problems and results in the development of international standards for sampling and pretreatment of soils. In *Environmental Sampling and Analysis* (B. Market, ed.). Weinheim, Germany: VCH Verlagsgesellschaft mbH.

Péwé, T.L. (1975) Quaternary geology of Alaska. Professional Paper 835, U.S. Geological Survey.

Péwé, T.L., and G.W. Holmes (1964) Geology of the Mt. Hayes D-4 quadrangle, Alaska. Miscellaneous Geologic Investigations Map I-394, U.S. Geological Survey.

Sciences International, Inc. (1998) Toxicological profile for 2,4- and 2,6-dinitrotoluene. Report prepared under subcontract to Research Triangle Institute under Contract No. 205-93-0606 for the U.S. Department of Health and Human Services, Public Health Service, Agency for Toxic Substances and Disease Registry, Atlanta, Georgia.

U.S. Army (1984) Military explosives. Technical Manual TM9-1300-214, Department of the Army, Washington, D.C.

U.S. Army (1994) Army ammunition data sheets: Artillery ammunition, guns, howitzers, mortars, recoilless rifles, grenade launchers, and artillery fuzes. Technical Manual 43-0001-28, Department of the Army, Washington, D.C.

U.S. Army Alaska (1999) Final legislative environmental impact statement for Alaska Army lands withdrawal renewal. U.S. Army Alaska, Department of the Army, Fort Richardson, Anchorage, Alaska.

U.S. Army Alaska (2002) Training: USARAK range regulation. U.S. Army Alaska Regulation 350-2, U.S. Army Alaska, Department of the Army, Fort Richardson, Anchorage, Alaska.

U.S. Army Alaska (2003) Draft environmental impact statement for transformation of U.S. Army Alaska. U.S. Army Alaska, Department of the Army, Fort Richardson, Anchorage, Alaska.

U.S. Environmental Protection Agency (1994) SW846 Method 8330, Nitroaromatics and nitramines by HPLC. II Update (http://www.epa.gov/epaoswer/hazwaste/test/8330.pdf), September 1994.

U.S. Environmental Protection Agency (1996) Method 8515, Colorimetric screening method for trinitrotoluene (TNT) in soil. III Update (http://www.epa.gov/epaoswer/hazwaste/test/8515.pdf), December 1996.

U.S. Environmental Protection Agency (2000) SW846 8510, Colorimetric screening procedure for RDX and HMX in soil. IVB Update. (http://www.epa.gov/epaoswer/hazwaste/ test/8510.pdf), November, 2000.

U.S. Environmental Protection Agency (2001) Environmental technology verification report explosives detection technology: SRI Instruments Model 8610C, Gas chromatograph/thermionic ionization detection. EPA/600/R-01/065, Office of Research and Development, Washington, D.C.

U.S. Environmental Protection Agency (2003) Risk assessment, Mid-Atlantic Hazardous Site Cleanup. http://www.epa.gov/reg3hwmd/risk/index.htm, updated October 16, 2003.

Walsh, M.E., C.M. Collins, C.H. Racine, T.F. Jenkins, A.B. Gelvin, and T.A. Ranney (2001) Sampling for explosives residues at Fort Greely, Alaska: Reconnaissance visit, July 2000. ERDC/CRREL TR-01-15, U.S. Army Engineer Research and Development Center, Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire.

Walsh, M.E., C.A. Ramsey, and T.F. Jenkins (2002) The effect of particle size reduction by grinding on subsampling variance for explosives residues in soil. *Chemosphere*, **49:** 1267–1273.

Appendix A. Analytical results from 2001.

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Composite	JAS-CMC	DC007	4 m crater edge	6/8/2001	Simpsonville	521,232.2	7,091,682.5	601.5	CRREL Lab GC, Unground	DC007		µg/kg	<25	18.2	<1	<1	<1	57.7	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC008	3 m crater	6/8/2001	Simpsonville	521,238.1	7,091,680.6	601.1	CRREL Lab GC, Unground	DC008		µg/kg	<25	26.4	<1	<1	<1	142	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC009	4 m crater	6/8/2001	Simpsonville	521,224.6	7,091,679.0	601.0	CRREL Lab GC, Unground	DC009		µg/kg	<25	8.4	<1	<1	<1	14.8	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC007,8,9	DC007, DC008, DC009 combined						CRREL Lab GC, Ground, -2mm	DC007,8,9	1	µg/kg	<25	38	<1	<1	<1	102	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC007,8,9	DC007, DC008, DC009 combined						CRREL Lab GC, Ground, -2mm	DC007,8,9	2	µg/kg	<25	34.4	<1	<1	<1	102	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC010	4 m crater	6/8/2001	Simpsonville	521,231.6	7,091,681.7	601.9	CRREL Lab GC, Unground	DC010		µg/kg	<25	7.43	<1	<1	<1	22	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC011	40 mm (?) crater	6/8/2001	Simpsonville	521,171.6	7,091,757.6	612.1	CRREL Lab GC, Unground	DC011		µg/kg	<25	5.27	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC012	40 mm (?) crater	6/8/2001	Simpsonville	521,172.2	7,091,840.3	617.5	CRREL Lab GC, Unground	DC012		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	1,520	<2
Composite	JAS-CMC	DC013	40 mm (?) crater	6/8/2001	Simpsonville	521,240.9	7,091,740.6	610.2	CRREL Lab GC, Unground	DC013		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	23.2	<2
Composite	JAS-CMC	DC014	composite around lg 4 m crater	6/8/2001	Delta Creek	524,596.5	7,094,686.0	528.8	CRREL Lab GC, Ground, -2mm	DC014	1	µg/kg	<25	<3	13.7	<1	<1	0.4	16.7	8.32	<1	<1	NA	NA	NA	NA	1.8	3.36
Composite	JAS-CMC	DC014	composite around lg 4 m crater						CRREL Lab GC, Ground, -2mm	DC014	2	µg/kg	<25	<3	11.3	<1	<1	<1	12.6	<1	<1	<1	NA	NA	NA	NA	3.56	2.38
Composite	JAS-CMC	DC015	composite around 3 m crater	6/8/2001	Delta Creek	524,596.2	7,094,690.0	529.9	CRREL Lab GC, Ground, -2mm	DC015	1	µg/kg	<25	<3	8.94	<1	<1	3.04	17.2	47.6	<1	<1	NA	NA	NA	NA	1.12	4.94
Composite	JAS-CMC	DC015	composite around 3 m crater						CRREL Lab GC, Ground, -2mm	DC015	2	µg/kg	<25	<3	9.5	<1	<1	3.36	18.3	8.84	<1	<1	NA	NA	NA	NA	1.6	5.38
Composite	JAS-CMC	DC016	composite around 3 m crater	6/8/2001	Delta Creek	524,635.2	7,094,698.4	530.4	CRREL Lab GC, Ground, -2mm	DC016	1	µg/kg	<25	<3	58.4	<1	<1	81.6	18.9	15.4	<1	5.16	NA	NA	NA	NA	1.84	25.4
Composite	JAS-CMC	DC016	composite around 3 m crater						CRREL Lab GC, Ground, -2mm	DC016	2	µg/kg	<25	<3	49.2	<1	<1	68.6	15.6	19	<1	4.93	NA	NA	NA	NA	2.06	20.8
Composite	JAS-CMC	DC017	composite from 3 small (30mm ?) craters	6/8/2001	Delta Creek	524,645.2	7,094,727.4	529.8	CRREL Lab GC, Unground	DC017		µg/kg	<25	<3	<1	<1	<1	0.57	0.79	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC018	composite around lg crater	6/8/2001	Delta Creek	524,794.6	7,094,797.3	530.7	CRREL Lab GC, Ground, -2mm	DC018	1	µg/kg	<25	<3	6.24	<1	<1	0.44	5.34	1.08	<1	0.96	NA	NA	NA	NA	0.92	0.76
Composite	JAS-CMC	DC018	composite around lg crater						CRREL Lab GC, Ground, -2mm	DC018	2	µg/kg	<25	<3	6.59	<1	<1	0.6	8.08	3.1	<1	0.92	NA	NA	NA	NA	1.02	0.92
Discrete	JAS-CMC	DC019	low order det crater- 500 lb bomb, discrete sample below piece of bomb	6/8/2001	Delta Creek	524,811.5	7,094,825.4	530.6	CRREL Lab GC, Unground	DC019		µg/kg	NA	NA	NA	NA	NA	17,300,000	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Discrete	JAS-CMC	DC020	churned up area from 30mm?	6/8/2001	Delta Creek	524,853.7	7,094,848.7	534.4	CRREL Lab GC, Unground	DC020		µg/kg	<25	<3	<1	<1	<1	0.83	0.7	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC021	comp sample inside edge 4 m crater	6/8/2001	Delta Creek	525,030.4	7,094,897.5	534.4	CRREL Lab GC, Unground	DC021		µg/kg	<25	7.68	<1	<1	<1	5.81	15.8	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-CMC	DC022	grab sample from around low order bomb	6/8/2001	Delta Creek	524,938.9	7,094,827.8	533.1	CRREL Lab GC, Unground	DC022		µg/kg	<25	7.73	<1	<1	<1	844	33	<1	<1	1.68	NA	NA	NA	NA	18.8	
Composite	JAS-CMC	DC023	Comp sample from small crater	6/8/2001	Delta Creek	524,878.8	7,094,794.5	530.8	CRREL Lab GC, Ground, -2mm	DC023	1	µg/kg	<25	77.8	25.6	<1	<1	15.4	260	90	<1	5.4	NA	NA	NA	NA	38.4	20.6
Composite	JAS-CMC	DC023	Comp sample from small crater						CRREL Lab GC, Ground, -2mm	DC023	2	µg/kg	<25	62.6	21.8	<1	<1	12.1	206	72	<1	5.4	NA	NA	NA	NA	50.8	15.7
Composite	JAS-CMC	DC024	Comp sample from fresh 3m crater near pickup truck	6/8/2001	Delta Creek	524,790.9	7,094,733.2	530.6	CRREL Lab GC, Unground	DC024		µg/kg	<25	<3	10.3	<1	<1	3,900	215	<1	<1	18	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC025	Comp sample around pickup truck	6/8/2001	Delta Creek	524,795.5	7,094,737.1	531.1	CRREL Lab GC, Unground	DC025		µg/kg	<25	37.6	<1	<1	<1	24,000	680	<1	<1	32.8	NA	NA	NA	NA	5.37	<2
Composite	JAS-CMC	DC026	Comp sample around "undisturbed" area within vegetated floodplain	6/8/2001	Delta Creek	524,726.6	7,094,678.4	533.4	CRREL Lab GC, Unground	DC026		µg/kg	NA	NA	NA	NA	NA	314	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Composite	JAS-CMC	DC027	Comp sample around large crater	6/8/2001	Delta Creek	524,692.8	7,094,645.6	530.7	CRREL Lab GC, Ground, -2mm	DC027	1	µg/kg	1.8	8.28	75	<1	<1	1810	61	50.3	<1	1.96	NA	NA	NA	NA	<15	4.62
Composite	JAS-CMC	DC027	Comp sample around large crater						CRREL Lab GC, Ground, -2mm	DC027	2	µg/kg	2	6.6	70	<1	<1	1820	59.4	49.4	<1	1.94	NA	NA	NA	NA	<15	4.96
Composite	JAS-CMC	DC028	Comp sample in unveg gravel bar area	6/8/2001	Delta Creek	524,587.4	7,094,618.6	532.7	CRREL Lab GC, Ground, -2mm	DC028	1	µg/kg	4.6	<3	282	<1	<1	692	44	46	<1	3.2	NA	NA	NA	NA	1.26	44
Composite	JAS-CMC	DC028	Comp sample in unveg gravel bar area						CRREL Lab GC, Ground, -2mm	DC028	2	µg/kg	5	31.6	334	<1	<1	758	51.2	54	<1	3.4	NA	NA	NA	NA	2.4	54
Composite	JAS-CMC	DC029	Comp sample around target	6/8/2001	Delta Creek	524,602.9	7,094,638.1	532.4	CRREL Lab GC, Ground, -2mm	DC029	1	µg/kg	95.4	1,340	15.4	<1	<1	115	28	18	<1	2.2	NA	NA	NA	NA	2.6	5
Composite	JAS-CMC	DC029	Comp sample around target						CRREL Lab GC, Ground, -2mm	DC029	2	µg/kg	108	1,380	15.9	<1	<1	110	26	18	<1	2.3	NA	NA	NA	NA	2.7	4.8
Composite	JAS-CMC	DC030	Comp sample from gravel bar along Lt bank	6/9/2001	Delta Creek	526,236.8	7,098,235.2	510.6	CRREL Lab GC, Unground	DC030		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC031	Comp sample from gravel bar along Lt bank	6/9/2001	Delta Creek	526,322.3	7,098,300.4	510.4	CRREL Lab GC, Unground	DC031		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC032	Comp sample from gravel bar along Lt bank	6/9/2001	Delta Creek	526,454.1	7,098,448.3	507.2	CRREL Lab GC, Unground	DC032		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC033	Comp sample from vegetated abandoned floodplain surface (~20-30 year old surface)	6/9/2001	Delta Creek	526,325.9	7,096,485.2	504.9	CRREL Lab GC, Unground	DC033		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC034	Comp sample from gravel bar along Lt bank, ~ 2 km downstream	6/9/2001	Delta Creek	528,258.9	7,098,561.3	478.2	CRREL Lab GC, Unground	DC034		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-CMC	DC035	Sample of part of rocket motor (?) orange sheet of plastic looking material. Took material plus sand underneath.	6/9/2001	Delta Creek	528,261.9	7,098,563.0	478.5	CRREL Lab GC, Unground	DC035		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	1970	<2
Composite	JAS-CMC	DC036	Comp sample from gravel bar along Lt bank	6/9/2001	Delta Creek	528,308.4	7,098,666.7	477.1	CRREL Lab GC, Unground	DC036		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC037	Comp sample from gravel point bar between 2 small channels at Lt edge of floodplain	6/9/2001	Delta Creek	528,315.5	7,098,806.4	475.9	CRREL Lab GC, Unground	DC037		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2

# = not confirmed
NA = not analyzed for this compound
ND = not detected
NR = not reported

Appendix A (cont.).

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Discrete	JAS-CMC	DC038	Sample of part of rocket motor (?) orange sheet of plastic looking material. Took material plus sand underneath.	6/9/2001	Delta Creek	529,278.5	7,098,586.7	478.7	CRREL Lab GC, Unground	DC038		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	535	<2
		DC 35 and 38	DC 35 and 38 combined						CRREL Lab GC, Ground, -2mm	DC 35 and 38	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	87.5	<2
		DC 35 and 38	DC 35 and 38 combined						CRREL Lab GC, Ground, -2mm	DC 35 and 38	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	78.8	<2
Composite	JAS-CMC	DC039	Comp sample from gravel bar along Lt bank	6/9/2001	Delta Creek	529,969.6	7,101,396.6	450.1	CRREL Lab GC, Unground	DC039		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC040	Comp sample from gravel bar along Lt bank	6/9/2001	Delta Creek	530,098.6	7,101,505.0	452.1	CRREL Lab GC, Unground	DC040		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC041	Comp sample from gravel bar along Lt bank	6/9/2001	Delta Creek	530,271.7	7,101,624.7	451.2	CRREL Lab GC, Unground	DC041		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC042	Older, higher, partially vegetated gravel bar	6/9/2001	Delta Creek	530,060.0	7,101,575.1	453.2	CRREL Lab GC, Unground	DC042		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-CMC	DC043	Silt sample from within dry channel	6/9/2001	Delta Creek	529,974.9	7,101,412.8	452.9	CRREL Lab GC, Unground	DC043		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-CMC	DC044	Fine sand sample from within dry channel	6/9/2001	Delta Creek	529,975.2	7,101,411.1	452.7	CRREL Lab GC, Unground	DC044		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC045	Comp sample from gravel bar, just upstream of junc. with 100 Mile Creek	6/9/2001	Delta Creek	532,186.0	7,104,205.6	427.9	CRREL Lab GC, Unground	DC045		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC046	Comp sample from gravel bar, just upstream of junc. with 100 Mile Creek	6/9/2001	Delta Creek	532,129.5	7,104,397.2	427.9	CRREL Lab GC, Unground	DC046		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC047	Comp sample, older part of flood plain (~10 yr old)	6/9/2001	Delta Creek	532,013.2	7,104,516.1	426.7	CRREL Lab GC, Unground	DC047		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC048	Comp sample from gravel bar, downstream of junc. with 100 Mile Creek	6/9/2001	Delta Creek	531,725.3	7,106,160.4	407.6	CRREL Lab GC, Unground	DC048		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC049	Comp sample from gravel bar, downstream of junc. with 100 Mile Creek	6/9/2001	Delta Creek	531,796.7	7,106,109.4	406.6	CRREL Lab GC, Unground	DC049		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	DC050	Comp sample from gravel bar, just downstream of junc. with 100 Mile Creek	6/9/2001	Delta Creek	531,958.2	7,105,971.0	407.8	CRREL Lab GC, Unground	DC050		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC001	Comp sample along edge of point bar	6/9/2001	Hundred Mile Creek	532,793.0	7,104,097.6	425.0	CRREL Lab GC, Unground	HC001		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC002	Downstream, same side of channel	6/9/2001	Hundred Mile Creek	532,888.0	7,104,087.9	424.8	CRREL Lab GC, Unground	HC002		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC03	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	532,747.5	7,103,968.3	420.3	CRREL Lab GC, Unground	HC03		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC004	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	532,968.2	7,103,046.1	433.0	CRREL Lab GC, Unground	HC004		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC005	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	532,975.5	7,103,102.9	433.1	CRREL Lab GC, Unground	HC005		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC006	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	532,779.6	7,101,346.0	437.3	CRREL Lab GC, Unground	HC006		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC007	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	532,818.6	7,101,342.4	433.1	CRREL Lab GC, Unground	HC007		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC008	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	532,853.1	7,101,369.1	432.6	CRREL Lab GC, Unground	HC008		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC009	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	533,421.0	7,100,346.5	428.9	CRREL Lab GC, Unground	HC009		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC010	Comp sample, small point bar	6/9/2001	Hundred Mile Creek	533,412.2	7,100,307.2	432.1	CRREL Lab GC, Unground	HC010		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC011	upstream of small drainage entering from south	6/9/2001	Hundred Mile Creek	533,359.9	7,100,411.2	437.5	CRREL Lab GC, Unground	HC011		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC012	Downstream of small drainage entering from south	6/9/2001	Hundred Mile Creek	533,340.0	7,100,378.5	433.3	CRREL Lab GC, Unground	HC012		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC013	upstream of small drainage entering from south	6/10/2001	Hundred Mile Creek	535,999.1	7,098,588.1	450.1	CRREL Lab GC, Unground	HC013		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC014	Also upstream of small drainage entering from south	6/10/2001	Hundred Mile Creek	535,940.9	7,098,583.5	441.8	CRREL Lab GC, Unground	HC014		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-CMC	HC015	Grab sample from tributary	6/10/2001	Hundred Mile Creek	535,948.2	7,098,445.3	440.0	CRREL Lab GC, Unground	HC015		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-CMC	HC016	Grab sample from tributary	6/10/2001	Hundred Mile Creek	535,935.6	7,098,395.9	440.3	CRREL Lab GC, Unground	HC016		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-CMC	HC017	Grab sample from side channel of tributary	6/10/2001	Hundred Mile Creek	535,967.6	7,098,413.8	440.0	CRREL Lab GC, Unground	HC017		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC018	Comp sample, downstream of junc with tributary	6/10/2001	Hundred Mile Creek	536,004.7	7,098,690.0	445.0	CRREL Lab GC, Unground	HC018		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC019	Comp sample, downstream of HC018	6/10/2001	Hundred Mile Creek	536,070.3	7,098,720.2	444.5	CRREL Lab GC, Unground	HC019		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC020	Comp sample, downstream of HC019	6/10/2001	Hundred Mile Creek	536,058.8	7,098,810.3	442.9	CRREL Lab GC, Unground	HC020		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC021	Comp sample, small point bar	6/10/2001	Hundred Mile Creek	536,741.4	7,097,139.6	454.9	CRREL Lab GC, Unground	HC021		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC022	Comp sample, small point bar	6/10/2001	Hundred Mile Creek	536,752.9	7,097,221.8	452.3	CRREL Lab GC, Unground	HC022		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	HC023	Comp sample, small point bar	6/10/2001	Hundred Mile Creek	536,823.4	7,097,226.3	453.1	CRREL Lab GC, Unground	HC023		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Composite	JAS-CMC	GI001	Comp sample down CL of island	7/31/2001	Georgia Island	558,904.6	7,094,611.0	390.3	100439	GI001		µg/kg	NR	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<118	<118	<118	<118	NA	NA
Composite	JAS-CMC	GI002	Comp sample down CL of island	7/31/2001	Georgia Island	558,780.9	7,094,424.5	389.8	100440	GI002		µg/kg	NR	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<124	<124	<124	<124	NA	NA
Composite	JAS-CMC	GI003	Comp sample down CL of island	7/31/2001	Georgia Island	558,760.6	7,094,213.7	391.8	100441	GI003		µg/kg	NR	<24.4	54.0 #	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<122	<122	<122	<122	NA	NA
Composite	JAS-CMC	GI004	Comp sample down CL of island	7/31/2001	Georgia Island	558,586.2	7,094,012.0	388.8	100442	GI004		µg/kg	NR	<24.6	44.5 #	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<123	<123	<123	<123	NA	NA
Composite	JAS-CMC	GI005	Comp sample down CL of island	7/31/2001	Georgia Island	558,397.8	7,093,798.5	389.7	100412	GI005		µg/kg	NR	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<124	<124	<124	<124	NA	NA
Composite	JAS-CMC	GI006	Comp sample down CL of island	7/31/2001	Georgia Island	558,249.1	7,093,509.4	399.3	101325	GI006		µg/kg	<238	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<119	<119	<119	<119	NA	NA

# = not confirmed
NA = not analyzed for this compound
ND = not detected
NR = not reported

Appendix A (cont.). Analytical results from 2001.

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Composite	JAS-CMC	GI007	Comp sample down CL of island	7/31/2001	Georgia Island	558,233.9	7,093,564.5	398.5	100443	GI007		µg/kg	NR	<24.0	<24.0	<24.0	117	<24.0	<24.0	<24.0	<24.0	<24.0	<120	<120	<120	<120	NA	NA
Composite	JAS-CMC	GI008	Comp sample down CL of island	7/31/2001	Georgia Island	557,966.4	7,093,397.4	400.9	100444	GI008		µg/kg	NR	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<125	<125	<125	<125	NA	NA
Composite	JAS-CMC	GI009	Comp sample down CL of island	7/31/2001	Georgia Island	557,801.5	7,093,273.4	400.0	100445	GI009		µg/kg	NR	<24.3	52.6 #	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<122	<122	<122	<122	NA	NA
UXO		20mm		8/1/2001	Georgia Island	557,851.9	7,093,686.6	396.9																				
Composite	JAS-TJ-KM	GI010 begin	Comp sample along base of target berm	8/1/2001	Georgia Island	557,746.0	7,093,301.1	399.8	100446	GI010		µg/kg	NR	<24.0	<24.0	<24.0	131 #	<24.0	<24.0	<24.0	<24.0	<24.0	<120	<120	<120	<120	NA	NA
		GI010 end		8/1/2001	Georgia Island	557,747.7	7,093,324.1	398.7																				
Composite	JAS-TJ-KM	GI011 begin	Comp sample along base of target berm	8/1/2001	Georgia Island	557,745.0	7,093,343.6	398.3	100447	GI011		µg/kg	NR	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<118	<119	<119	<119	NA	NA
		GI011 end		8/1/2001	Georgia Island	557,744.3	7,093,365.2	398.5																				
Composite	JAS-TJ-KM	GI012 begin	Comp sample along base of target berm	8/1/2001	Georgia Island	557,744.7	7,093,388.1	398.2	101326	GI012		µg/kg	<272	<27.2	<27.2	<27.2	<27.2	<27.2	<27.2	<27.2	<27.2	<27.2	<136	<136	<136	<136	NA	NA
		GI012 end		8/1/2001	Georgia Island	557,743.8	7,093,410.1	400.3																				
Composite	JAS-TJ-KM	GI013 begin	Comp sample along base of target berm	8/1/2001	Georgia Island	557,742.5	7,093,431.4	398.3	101327	GI013		µg/kg	<243	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<122	<122	<122	<122	NA	NA
		GI013 end		8/1/2001	Georgia Island	557,742.4	7,093,452.5	397.7																				
Discrete		DISCRETE GI001	Discrete sample	8/1/2001	Georgia Island	557,741.9	7,093,443.3	398.0	100415	DISCRETE 002 GI		µg/kg	NR	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<122	<122	<122	<122	NA	NA
UXO		20 mm		8/1/2001	Georgia Island	557,741.8	7,093,443.7	398.4																				
Composite	JAS-TJ-KM	GI014 begin	Comp sample along base of target berm	8/1/2001	Georgia Island	557,741.1	7,093,474.0	397.3	100446	GI014		µg/kg	NR	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<128	<128	<128	<128	NA	NA
		GI014 end		8/1/2001	Georgia Island	557,741.0	7,093,495.8	398.6																				
Composite	JAS-TJ-KM	GI015	Comp sample down center line of island	8/1/2001	Georgia Island	557,801.4	7,093,515.0	396.8	101328	GI015		µg/kg	<244	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<122	<122	<122	<122	NA	NA
Composite	JAS-TJ-KM	GI016	Comp sample down center line of island	8/1/2001	Georgia Island	557,805.8	7,093,461.3	393.8	101329	GI016		µg/kg	<222	<22.2	<22.2	<22.2	<22.2	<22.2	<22.2	<22.2	<22.2	<22.2	<111	<111	<111	<111	NA	NA
Composite	JAS-TJ-KM	GI017	Comp sample down center line of island	8/1/2001	Georgia Island	557,803.3	7,093,409.9	395.6	101330	GI017		µg/kg	<262	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<131	<131	<131	<131	NA	NA
Composite	JAS-TJ-KM	GI018	Comp sample down center line of island	8/1/2001	Georgia Island	557,790.8	7,093,362.3	396.0	101331	GI018		µg/kg	<255	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<128	<128	<128	<128	NA	NA
Composite	JAS-TJ-KM	GI019	Comp sample down center line of island	8/1/2001	Georgia Island	557,785.4	7,093,309.0	394.8	100449	GI019		µg/kg	NR	<25.6	<25.6	<25.6	152 #	<25.6	<25.6	<25.6	<25.6	<25.6	<128	<128	<128	<128	NA	NA
Composite	JAS-TJ-KM	GI020	Comp sample down center line of island	8/1/2001	Georgia Island	557,783.2	7,093,002.9	394.7	101332	GI020		µg/kg	<229	<22.9	<22.9	<22.9	<22.9	<22.9	<22.9	<22.9	<22.9	<22.9	<115	<115	<115	<115	NA	NA
Composite	JAS-TJ-KM	GI021	Comp sample down center line of island	8/1/2001	Georgia Island	557,568.7	7,092,883.6	396.5	101333	GI021		µg/kg	<256	<25.6	<25.6	<25.6	<25.6	775 #	42.8 #	<25.6	<25.6	<25.6	<128	<128	<128	<128	NA	NA
Composite	JAS-TJ-KM	GI022	Comp sample down center line of island	8/1/2001	Georgia Island	557,412.8	7,092,758.4	399.1	101334	GI022		µg/kg	<240	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<120	<120	<120	<120	NA	NA
Composite	JAS-TJ-KM	GI023	Comp sample down center line of island	8/1/2001	Georgia Island	557,264.4	7,092,626.2	401.1	100450	GI023		µg/kg	NR	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<128	<128	<128	<128	NA	NA
Composite	JAS-TJ-KM	GI025	Comp sample down center line of island	8/1/2001	Georgia Island	557,099.6	7,092,511.9	403.7	101335	GI025		µg/kg	<233	<23.3	<23.3	<23.3	<23.3	<23.3	<23.3	<23.3	<23.3	<23.3	<117	<117	<117	<117	NA	NA
Composite	JAS-TJ-KM	GI026	Comp sample down center line of island	8/1/2001	Georgia Island	556,954.4	7,092,372.9	404.5	100451	GI026		µg/kg	NR	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<117	<117	<117	<117	NA	NA
Composite	JAS-TJ-KM	GI027	Comp sample down center line of island	8/1/2001	Georgia Island	556,829.1	7,092,217.9	407.4	100452	GI027		µg/kg	NR	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<118	<118	<118	<118	NA	NA
Composite	JAS-TJ-KM	GI028	Comp sample down center line of island	8/1/2001	Georgia Island	556,739.1	7,092,036.3	406.5	100453	GI028		µg/kg	NR	<23.4	40.7 #	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<117	<117	<117	<117	NA	NA
Composite	JAS-TJ-KM	GI029	Comp sample down center line of island	8/1/2001	Georgia Island	556,610.8	7,091,881.4	408.3	101336	GI029		µg/kg	<263	<26.3	<26.3	<26.3	<26.3	<26.3	<26.3	<26.3	<26.3	<26.3	<132	<132	<132	<132	NA	NA
Composite	JAS-TJ-KM	GI030	Comp sample down center line of island	8/1/2001	Georgia Island	556,568.3	7,091,685.1	408.2	101337	GI030		µg/kg	<262	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<131	<131	<131	<131	NA	NA
Composite	JAS-CMC	GI031	Comp sample down center line of island	8/2/2001	Georgia Island	556,536.5	7,091,486.4	408.3	101338	GI031		µg/kg	<238	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<119	<119	<119	<119	NA	NA
Composite	JAS-CMC	GI032	Comp sample down center line of island	8/2/2001	Georgia Island	556,437.2	7,091,309.1	409.9	100454	GI032		µg/kg	NR	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<127	<127	<127	<127	NA	NA
Discrete	JAS-CMC	DISCRETE GI002	Discrete sample-next to 105 HC uxo	8/2/2001	Georgia Island	556,382.6	7,091,193.1	408.4	CRREL FIELD GC	DISCRETE GI002		µg/kg	NA	ND	NA	NA	ND	ND	NA	NA	ND	ND	NA	NA	NA	NA	ND	NA
Composite	JAS-CMC	GI033	Comp sample down CL of island	8/2/2001	Georgia Island	556,302.2	7,091,161.7	408.3	101339	GI033		µg/kg	<244	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<122	<122	<122	<122	NA	NA
Composite	JAS-CMC	GI034	Comp sample down CL of island	8/2/2001	Georgia Island	556,305.4	7,090,961.8	411.3	100455	GI034		µg/kg	NR	<25.8	<25.8	<25.8	123	<25.8	<25.8	<25.8	<25.8	<25.8	<129	<129	<129	<129	NA	NA
Composite	JAS-CMC	GI035	Comp sample down CL of island	8/2/2001	Georgia Island	556,238.6	7,090,772.8	413.5	100456	GI035		µg/kg	NR	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<127	<127	<127	<127	NA	NA
Discrete	JAS-CMC	DISCRETE GI003	Discrete sample-next to 40 mm cases	8/2/2001	Georgia Island	556,201.3	7,090,675.3	408.0	CRREL Field GC	DISCRETE GI003		µg/kg	NA	ND	NA	NA	ND	ND	NA	NA	ND	ND	NA	NA	NA	NA	4,700	NA
Composite	JAS-CMC	GI036	Comp sample down CL of island	8/2/2001	Georgia Island	556,173.8	7,090,583.9	412.1	101340	GI036		µg/kg	<255	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<128	<128	<128	<128	NA	NA
Composite	JAS-CMC	GI037	Comp sample down CL of island	8/2/2001	Georgia Island	556,103.9	7,090,397.2	413.4	100457	GI037		µg/kg	NR	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<120	<120	<120	<120	NA	NA
Composite	JAS-CMC	GI038	Comp sample down CL of island	8/2/2001	Georgia Island	556,084.3	7,090,199.3	412.8	101341	GI038		µg/kg	<267	<26.7	<26.7	<26.7	<26.7	<26.7	<26.7	<26.7	<26.7	<26.7	<134	<134	<134	<134	NA	NA
Composite	JAS-CMC	GI039	Comp sample South end of Georgia Is	8/2/2001	Georgia Island	556,057.7	7,090,034.4	413.2	101342	GI039		µg/kg	<240	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<120	<120	<120	<120	NA	NA
Discrete	JAS-CMC	DISCRETE GI004	Sample top of SE facing bluff	8/2/2001	Georgia Island	556,468.3	7,090,332.0	419.5	CRREL Field GC	DISCRETE GI004		µg/kg	NA	ND	NA	NA	ND	ND	NA	NA	ND	ND	NA	NA	NA	NA	ND	NA
Discrete	JAS-CMC	DISCRETE GI05	Sample to of S facing bluff	8/2/2001	Georgia Island	556,333.2	7,090,363.1	425.7	100416	DISCRETE 005 GI SAND		µg/kg	NR	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<121	<121	<121	<121	NA	NA
Composite	JAS-CMC	GI040	Comp sample along base of bluff	8/2/2001	Georgia Island	556,384.8	7,090,306.0	410.5	100458	GI040		µg/kg	NR	<22.6	<22.6	<22.6	<22.6	<22.6	<22.6	<22.6	<22.6	<22.6	<113	<113	<113	<113	NA	NA
Composite	JAS-CMC	GI041	Comp sample along base of bluff	8/2/2001	Georgia Island	556,260.4	7,090,212.1	410.2	100459	GI041		µg/kg	NR	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<122	<122	<122	<122	NA	NA
Composite	TJ-KM-MC-MEW	BW1-A	3.5 m from Base Plate	8/2/2001	Bow Whale FP	555,827.1	7,082,252.0	503.6	CRREL Lab HPLC and GC, Ground, -2mm	BW1-A	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	335	8540	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW1-A	3.5 m from Base Plate	8/2/2001	Bow Whale FP	555,827.1	7,082,252.0	503.6	CRREL Lab HPLC and GC, Ground, -2mm	BW1-A	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	143	5470	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW1-B	3.5 m from Base Plate	8/2/2001	Bow Whale FP	555,827.1	7,082,252.0	503.6	CRREL Lab HPLC and GC, Ground, -2mm	BW1-B	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	110	3400	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW1-B	3.5 m from Base Plate	8/2/2001	Bow Whale FP	555,827.1	7,082,252.0	503.6	CRREL Lab HPLC and GC, Ground, -2mm	BW1-B	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	89.9	3640	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW2-A	7 m from Base Plate	8/2/2001	Bow Whale FP	555,825.5	7,082,255.1	503.1	CRREL Lab HPLC and GC, Ground, -2mm	BW2-A	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	37.2	1860	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW2-A	7 m from Base Plate	8/2/2001	Bow Whale FP	555,825.5	7,082,255.1	503.1	CRREL Lab HPLC and GC, Ground, -2mm	BW2-A	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	48.3	2550	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BS2-B	7 m from Base Plate	8/2/2001	Bow Whale FP	555,825.5	7,082,255.1	503.1	CRREL Lab HPLC and GC, Ground, -2mm	BS2-B	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	83.2	3030	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BS2-B	7 m from Base Plate	8/2/2001	Bow Whale FP	555,825.5	7,082,255.1	503.1	CRREL Lab HPLC and GC, Ground, -2mm	BS2-B	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	53.1	3680	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW3-A	14 m from Base Plate	8/2/2001	Bow Whale FP	555,822.3	7,082,261.2	503.0	CRREL Lab HPLC and GC, Ground, -2mm	BW3-A	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	59	1750	NA	NA	NA	NA	<15	<2

# = not confirmed
NA = not analyzed for this compound
ND = not detected
NR = not reported

Appendix A (cont.).

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Composite	TJ-KM-MC-MEW	BW3-A	14 m from Base Plate	8/2/2001	Bow Whale FP	555,822.3	7,082,261.2	503.0	CRREL Lab HPLC and GC, Ground, -2mm	BW3-A	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	26.6	732	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW3-B	14 m from Base Plate	8/2/2001	Bow Whale FP	555,822.3	7,082,261.2	503.0	CRREL Lab HPLC and GC, Ground, -2mm	BW3-B	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	46	1400	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW3-B	14 m from Base Plate	8/2/2001	Bow Whale FP	555,822.3	7,082,261.2	503.0	CRREL Lab HPLC and GC, Ground, -2mm	BW3-B	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	77.9	2010	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW4-A	21 m from Base Plate	8/2/2001	Bow Whale FP	555,819.2	7,082,267.4	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BW4-A	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	35.7	1280	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW4-A	21 m from Base Plate	8/2/2001	Bow Whale FP	555,819.2	7,082,267.4	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BW4-A	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	31	1120	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BS4-B	21 m from Base Plate	8/2/2001	Bow Whale FP	555,819.2	7,082,267.4	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BS4-B	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	51.9	1520	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BS4-B	21 m from Base Plate	8/2/2001	Bow Whale FP	555,819.2	7,082,267.4	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BS4-B	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	98.1	2300	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW5-A	28 m from Base Plate	8/2/2001	Bow Whale FP	555,816.2	7,082,273.7	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BW5-A	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	763	16900	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW5-A	28 m from Base Plate	8/2/2001	Bow Whale FP	555,816.2	7,082,273.7	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BW5-A	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	1300	29900	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW5-B	28 m from Base Plate	8/2/2001	Bow Whale FP	555,816.2	7,082,273.7	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BW5-B	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	1160	24000	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW5-B	28 m from Base Plate	8/2/2001	Bow Whale FP	555,816.2	7,082,273.7	502.8	CRREL Lab HPLC and GC, Ground, -2mm	BW5-B	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	1330	29100	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW6	50 m from Base Plate (-30 degrees)	8/2/2001	Bow Whale FP	555,787.2	7,082,278.3	499.3	CRREL Lab HPLC and GC, Ground, -2mm	BW6	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	153	4020	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW6	50 m from Base Plate (-30 degrees)	8/2/2001	Bow Whale FP	555,787.2	7,082,278.3	499.3	CRREL Lab HPLC and GC, Ground, -2mm	BW6	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	126	2640	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW7	50 m from Base Plate (-15 degrees)	8/2/2001	Bow Whale FP	555,796.6	7,082,286.0	499.7	CRREL Lab HPLC and GC, Ground, -2mm	BW7	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	365	8320	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW7	50 m from Base Plate (-15 degrees)	8/2/2001	Bow Whale FP	555,796.6	7,082,286.0	499.7	CRREL Lab HPLC and GC, Ground, -2mm	BW7	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	235	5960	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW8	50 m from Base Plate (0 degrees)	8/2/2001	Bow Whale FP	555,805.8	7,082,293.8	501.1	CRREL Lab HPLC and GC, Ground, -2mm	BW8	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	219	8790	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW8	50 m from Base Plate (0 degrees)	8/2/2001	Bow Whale FP	555,805.8	7,082,293.8	501.1	CRREL Lab HPLC and GC, Ground, -2mm	BW8	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	208	5730	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW9	50 m from Base Plate (+15 degrees)	8/2/2001	Bow Whale FP	555,818.1	7,082,295.5	499.9	CRREL Lab HPLC and GC, Ground, -2mm	BW9 (in road)	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	0	20	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW9	50 m from Base Plate (+15 degrees)	8/2/2001	Bow Whale FP	555,818.1	7,082,295.5	499.9	CRREL Lab HPLC and GC, Ground, -2mm	BW9 (in road)	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	0	39	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW10	50 m from Base Plate (+30 degrees)	8/2/2001	Bow Whale FP	555,830.3	7,082,299.2	502.6	CRREL Lab HPLC and GC, Ground, -2mm	BW10	1	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	120	2960	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW10	50 m from Base Plate (+30 degrees)	8/2/2001	Bow Whale FP	555,830.3	7,082,299.2	502.6	CRREL Lab HPLC and GC, Ground, -2mm	BW10	2	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	64	1530	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW11	3.5 m from Base Plate	8/2/2001	Bow Whale FP	555,981.8	7,082,212.3	503.1	100417	BW11-A		µg/kg	NR	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<125	<125	<125	<125	NA	NA
Composite	TJ-KM-MC-MEW	BW11	3.5 m from Base Plate	8/2/2001	Bow Whale FP	555,981.8	7,082,212.3		100418	BW11-B		µg/kg	NR	<25.3	<25.3	<25.3	<25.3	15.6 J	<25.3	<25.3	<25.3	<25.3	<127	<127	<127	<127	NA	NA
Composite	TJ-KM-MC-MEW	BW12	7 m from Base Plate	8/2/2001	Bow Whale FP	555,980.6	7,082,215.3	503.9	100419	BW12-A		µg/kg	NR	<23.4	<23.4	<23.4	65.1	<23.4	<23.4	<23.4	<23.4	<23.4	<117	<117	<117	<117	NA	NA
Composite	TJ-KM-MC-MEW	BW12	7 m from Base Plate	8/2/2001	Bow Whale FP				100420	BW12-B		µg/kg	NR	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	32.8	<118	<118	<119	<118	NA	NA
Composite	TJ-KM-MC-MEW	BW13	14 m from Base Plate	8/2/2001	Bow Whale FP	555,976.7	7,082,221.0	503.9	100421	BW13-A		µg/kg	NR	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	626	<125	<125	<125	<125	NA	NA
Composite	TJ-KM-MC-MEW	BW13	14 m from Base Plate	8/2/2001	Bow Whale FP				100422	BW13-B		µg/kg	NR	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	77.8	<126	<126	<126	<126	NA	NA
Composite	TJ-KM-MC-MEW	BW14	21 m from Base Plate	8/2/2001	Bow Whale FP	555,972.8	7,082,227.0	504.4	100423	BW14-A		µg/kg	NR	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<125	<125	<125	<125	NA	NA
Composite	TJ-KM-MC-MEW	BW14	21 m from Base Plate	8/2/2001	Bow Whale FP				CRREL Lab GC, Ground	BW14-B		µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	84	1974	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW15	28 m from Base Plate	8/2/2001	Bow Whale FP	555,968.9	7,082,232.7	504.5	100424	BW15-A		µg/kg	NR	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<123	<123	<123	<123	NA	NA
Composite	TJ-KM-MC-MEW	BW15	28 m from Base Plate	8/2/2001	Bow Whale FP				100425	BW15-B		µg/kg	NR	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<24.6	<123	<123	<123	<123	NA	NA

# = not confirmed
NA = not analyzed for this compound
ND = not detected
NR = not reported

Appendix A (cont.). Analytical results from 2001.

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Composite	TJ-KM-MC-MEW	BW17	50 m from Base Plate (-15 degrees)	8/2/2001	Bow Whale FP	555,949.0	7,082,241.8	502.6	CRREL Lab GC, Ground			µg/kg	<3	<1	<1	<1	<1	<1	<1	<3	13.8	880	NA	NA	NA	NA	<15	<2
Composite	TJ-KM-MC-MEW	BW16	50 m from Base Plate (-30 degrees)	8/2/2001	Bow Whale FP	555,940.1	7,082,233.3	504.8	100426	BW15		µg/kg	NR	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<128	<128	<128	<128	NA	NA
Composite	TJ-KM-MC-MEW	BW18	50 m from Base Plate (0 degrees)	8/2/2001	Bow Whale FP	555,956.5	7,082,251.6	504.2	100427	BW18		µg/kg	NR	<25.8	<25.8	<25.8	<25.8	<25.8	<25.8	<25.8	<25.8	<25.8	<129	<129	<129	<129	NA	NA
Composite	TJ-KM-MC-MEW	BW19	50 m from Base Plate (+15 degrees)	8/2/2001	Bow Whale FP	555,968.5	7,082,256.8	503.7	100428	BW19		µg/kg	NR	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<123	<123	<123	<123	NA	NA
Composite	TJ-KM-MC-MEW	BW20	50 m from Base Plate (+30 degrees)	8/2/2001	Bow Whale FP	555,979.8	7,082,260.4	502.4	100429	BW20		µg/kg	NR	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<128	<128	<128	<128	NA	NA
Composite	TJ-JW-JAS	BL1	3.5 m from Base Plate	8/3/2001	Big Lake FP	554,821.6	7,080,705.6	492.1	101314	BL001		µg/kg	<373	<37.3	107	<37.3	<37.3	<37.3	<37.3	<37.3	<37.3	<37.3	<187	<187	<187	<187	NA	NA
Composite	TJ-JW-JAS	BL2	3.5 m from Base Plate	8/3/2001	Big Lake FP				101315	BL002		µg/kg	<370	<37.0	278 #	<37.0	<37.0	<37.0	<37.0	37	<37.0	<37.0	<185	<185	<185	<185	NA	NA
Composite	TJ-JW-JAS	BL3	7 m from Base Plate	8/3/2001	Big Lake FP	554,820.5	7,080,708.9	492.5	100430	BL003		µg/kg	NR	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	<25.4	870	<127	<127	<127	<127	NA	NA
Composite	TJ-JW-JAS	BL4	7 m from Base Plate	8/3/2001	Big Lake FP				100431	BL004		µg/kg	NR	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	29.6 #	<128	<128	<128	<128	NA	NA
Composite	TJ-JW-JAS	BL5	14 m from Base Plate	8/3/2001	Big Lake FP	554,818.6	7,080,715.4	492.3	100432	BL005		µg/kg	NR	<21.9	<21.9	<21.9	<21.9	<21.9	<21.9	<21.9	<21.9	<21.9	<110	<110	<110	<110	NA	NA
Composite	TJ-JW-JAS	BL6	14 m from Base Plate	8/3/2001	Big Lake FP				101316	BL006		µg/kg	<472	<47.2	217 #	<47.2	<47.2	<47.2	<47.2	<47.2	<47.2	<47.2	<236	<236	<236	<236	NA	NA
Composite	TJ-JW-JAS	BL7	21 m from Base Plate	8/3/2001	Big Lake FP	554,816.7	7,080,721.8	491.9	100433	BL007		µg/kg	NR	<23.9	<23.9	<23.9	<23.9	<23.9	<23.9	<23.9	<23.9	612	<120	<120	<120	<120	NA	NA
Composite	TJ-JW-JAS	BL8	21 m from Base Plate	8/3/2001	Big Lake FP				101317	BL008		µg/kg	<309	<30.9	100 #	<30.9	<30.9	<30.9	<30.9	<30.9	<30.9	<30.9	<155	<155	<155	<155	NA	NA
Composite	TJ-JW-JAS	BL9	28 m from Base Plate	8/3/2001	Big Lake FP	554,814.8	7,080,728.5	491.9	100434	BL009		µg/kg	NR	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<118	<118	<118	<118	NA	NA
Composite	TJ-JW-JAS	BL10	28 m from Base Plate	8/3/2001	Big Lake FP				100435	BL010		µg/kg	NR	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<127	<127	<127	<127	NA	NA
Composite	TJ-MW	BL11	3.5 m from Base Plate	8/3/2001	Big Lake FP	554,895.3	7,080,779.0	491.2	101318	BL011		µg/kg	<323	<32.3	<32.3	<32.3	44	<32.3	<32.3	<32.3	425	7,450	<162	<162	<162	<162	NA	NA
Composite	TJ-MW	BL12	3.5 m from Base Plate	8/3/2001	Big Lake FP				100436	BL012		µg/kg	NR	<23.9	<23.9	<23.9	<23.9	<23.9	<23.9	<23.9	<23.9	5,100	<120	<120	<120	<120	NA	NA
Composite	TJ-MW	BL13	7 m from Base Plate	8/3/2001	Big Lake FP	554,894.2	7,080,782.1	492.1	100437	BL013		µg/kg	NR	<22.8	<22.8	<22.8	<22.8	<22.8	<22.8	<22.8	<22.8	<22.8	<114	<114	<114	<114	NA	NA
Composite	TJ-MW	BL14	7 m from Base Plate	8/3/2001	Big Lake FP				101319	BL014		µg/kg	<455	<45.5	<45.5	<45.5	<45.5	<45.5	<45.5	<45.5	<45.5	<45.5	<228	<228	<228	<228	NA	NA
Composite	TJ-MW	BL15	14 m from Base Plate	8/3/2001	Big Lake FP	554,892.3	7,080,788.4	490.7	101320	BL015		µg/kg	<385	<38.5	178	<38.5	<38.5	<38.5	<38.5	<38.5	<38.5	<38.5	<193	<193	<193	<193	NA	NA
Composite	TJ-MW	BL16	14 m from Base Plate	8/3/2001	Big Lake FP				101321	BL016		µg/kg	<420	<42.0	<42.0	<42.0	<42.0	16.8 #	<42.0	<42.0	<42.0	<42.0	<210	<210	<210	<210	NA	NA
Composite	TJ-MW	BL17	21 m from Base Plate	8/3/2001	Big Lake FP	554,889.6	7,080,795.0	490.2	101322	BL017		µg/kg	<368	<36.8	<36.8	<36.8	<36.8	<36.8	<36.8	<36.8	<36.8	<36.8	<184	<184	<184	<184	NA	NA
Composite	TJ-MW	BL18	21 m from Base Plate	8/3/2001	Big Lake FP				101323	BL018		µg/kg	<350	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<175	<175	<175	<175	NA	NA
Composite	TJ-MW	BL19	28 m from Base Plate	8/3/2001	Big Lake FP	554,887.5	7,080,801.5	490.5	100438	BL019		µg/kg	NR	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<24.0	<120	<120	<120	<120	NA	NA
Composite	TJ-MW	BL20	28 m from Base Plate	8/3/2001	Big Lake FP				101324	BL020		µg/kg	<282	<28.2	<28.2	<28.2	<28.2	<28.2	<28.2	<28.2	<28.2	<28.2	<141	<141	<141	<141	NA	NA
Composite	TJ-MW	SAL1A Begin	Next to bulldozed area, 7 m from edge.	7/31/2001	Sally FP	554,887.8	7,081,938.7	488.5	101345	SALLY 1-1		µg/kg	<313	<31.3	<31.3	<31.3	<31.3	<31.3	<31.3	<31.3	<31.3	<31.3	<157	<157	<157	<157	NA	NA
Composite	TJ-MW	SAL1B End	Next to bulldozed area, 7 m from edge.	7/31/2001	Sally FP	554,908.5	7,081,936.0	488.8	100460	SALLY 1-2		µg/kg	NR	<30.7	<30.7	<30.7	<30.7	<30.7	<30.7	<30.7	<30.7	<30.7	<154	<154	<154	<154	NA	NA
Composite	TJ	SAL BKG2	Behind firing position	8/2/2001	Sally FP	554,790.4	7,081,952.5	487.0	101343	SALLY BKG-002		µg/kg	<370	<37.0	<37.0	<37.0	<37.0	<37.0	<37.0	<37.0	<37.0	<37.0	<185	<185	<185	<185	NA	NA
Composite	MW	SAL BKG3	Behind firing position	8/2/2001	Sally FP	554,771.2	7,081,924.8	486.0	101344	SALLY BKG-003		µg/kg	<373	<37.3	125	<37.3	<37.3	<37.3	<37.3	<37.3	<37.3	704	<187	<187	<187	<187	NA	NA
Composite	KM	SAL BKG1	Behind firing position	8/2/2001	Sally FP	554,763.9	7,081,961.3	488.3	100492	SALLY BKG #1		µg/kg	NR	<26.2	65.2	<26.2	211 #	<26.2	<26.2	<26.2	<26.2	96.7	<131	<131	<131	<131	NA	NA
Composite	TJ-KM-MW	SAL7	3.5 m from Base Plate	7/31/2001	Sally FP	554,778.9	7,081,977.3	489.0	100469	SALLY 7-1		µg/kg	NR	<27.5	<27.5	<27.5	221 #	<27.5	<27.5	<27.5	<27.5	395 #	<138	<138	<138	<138	NA	NA
Composite	TJ-KM-MW	SAL7	3.5 m from Base Plate	7/31/2001	Sally FP	554,778.9	7,081,977.3	489.0	100470	SALLY 7-2		µg/kg	NR	<27.9	67.4	<27.9	225 #	<27.9	<27.9	<27.9	<27.9	70.1	<140	<140	<140	<140	NA	NA
Composite	TJ-KM-MW	SAL8	7 m from Base Plate	7/31/2001	Sally FP	554,778.7	7,081,980.6	488.8	100471	SALLY 8 REP-1		µg/kg	NR	<28.4	86.9 #	<28.4	228 #	<28.4	<28.4	<28.4	<28.4	208	<142	<142	<142	<142	NA	NA
Composite	TJ-KM-MW	SAL8	7 m from Base Plate	7/31/2001	Sally FP	554,778.7	7,081,980.6	488.8	101349	SALLY REP-2		µg/kg	<253	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	7,680	<127	<127	<127	<127	NA	NA
Composite	TJ-KM-MW	SAL9	14 m from Base Plate	7/31/2001	Sally FP	554,776.5	7,081,987.1	488.3	100472	SALLY 9 REP 1		µg/kg	NR	<28.2	77.5	<28.2	229 #	<28.2	<28.2	<28.2	149	1,900	<141	<141	<141	<141	NA	NA
Composite	TJ-KM-MW	SAL9	14 m from Base Plate	7/31/2001	Sally FP	554,776.5	7,081,987.1	488.3	100473	SALLY 9 REP 2		µg/kg	NR	<27.6	<27.6	<27.6	223 #	<27.6	<27.6	<27.6	<27.6	<27.6	<138	<138	<138	<138	NA	NA
Composite	TJ-KM-MW	SAL10	21 m from Base Plate	7/31/2001	Sally FP	554,774.4	7,081,993.7	488.5	100474	SALLY 10 REP 1		µg/kg	NR	<28.9	<28.9	<28.9	232	<28.9	<28.9	<28.9	<28.9	129 #	<145	<145	<145	<145	NA	NA
Composite	TJ-KM-MW	SAL10	21 m from Base Plate	7/31/2001	Sally FP	554,774.4	7,081,993.7	488.5	101350	SALLY 10 REP 2		µg/kg	<321	<32.1	<32.1	<32.1	<32.1	<32.1	<32.1	<32.1	17.6 J	<32.1	<161	<161	<161	<161	NA	NA
Composite	TJ-KM-MW	SAL11	28 m from Base Plate	7/31/2001	Sally FP	554,772.5	7,082,000.3	488.3	100475	SALLY 11 REP 1		µg/kg	NR	<31.3	113	<31.3	269 #	<31.3	<31.3	<31.3	32.8 #	107 #	<157	<157	<157	<157	NA	NA
Composite	TJ-KM-MW	SAL11	28 m from Base Plate	7/31/2001	Sally FP	554,772.5	7,082,000.3	488.3	101351	SALLY 11 REP 2		µg/kg	<342	<34.2	<34.2	<34.2	<34.2	<34.2	<34.2	<34.2	<34.2	8,530	<171	<171	<171	<171	NA	NA
No sample		Centerpoint SAL2		7/31/2001	Sally FP	554,716.6	7,081,969.5	488.2																				
Composite	TJ-KM-MW	SAL2	3.5 m from Base Plate	7/31/2001	Sally FP	554,715.2	7,081,971.9	487.6	100461	SALLY 2-1		µg/kg	NR	<28.2	76.7	<28.2	226 #	23.4 J	<28.2	<28.2	<28.2	297 #	<141	<141	<141	<141	NA	NA
Composite	TJ-KM-MW	SAL2	3.5 m from Base Plate	7/31/2001	Sally FP	554,715.2	7,081,971.9	487.6	100462	SALLY 2-2		µg/kg	NR	<27.9	86.3	<27.9	224 #	<27.9	<27.9	<27.9	<27.9	389	<140	<140	<140	<140	NA	NA
Composite	TJ-KM-MW	SAL3	7 m from Base Plate	7/31/2001	Sally FP	554,714.3	7,081,975.3	487.6	100463	SALLY 3-1		µg/kg	NR	<26.6	59.7	<26.6	215	<26.6	<26.6	<26.6	<26.6	369	<133	<133	<133	<133	NA	NA
Composite	TJ-KM-MW	SAL3	7 m from Base Plate	7/31/2001	Sally FP	554,714.3	7,081,975.3	487.6	101347	SALLY 3-2		µg/kg	<270	<27.0	<27.0	<27.0	<27.0	<27.0	<27.0	<27.0	<27.0	2,130	<135	<135	<135	<135	NA	NA
Composite	TJ-KM-MW	SAL4	14 m from Base Plate	7/31/2001	Sally FP	554,712.1	7,081,981.9	486.9	100464	SALLY 4-1		µg/kg	NR	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	117	<128	<128	<128	<128	NA	NA
Composite	TJ-KM-MW	SAL4	14 m from Base Plate	7/31/2001	Sally FP	554,712.1	7,081,981.9	486.9	100465	SALLY 4-2		µg/kg	NR	<24.2	58.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	273	<121	<121	<121	<121	NA	NA
Composite	TJ-KM-MW	SAL5	21 m from Base Plate	7/31/2001	Sally FP	554,710.1	7,081,988.6	486.4	100466	SALLY 5-1		µg/kg	NR	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<23.8	<119	<119	<119	<119	NA	NA
Composite	TJ-KM-MW	SAL5	21 m from Base Plate	7/31/2001	Sally FP	554,710.1	7,081,988.6	486.4	101348	SALLY 5-2		µg/kg	<243	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<24.3	<122	<122	<122	<122	NA	NA
Composite	TJ-KM-MW	SAL6	28 m from Base Plate	7/31/2001	Sally FP	554,708.1	7,081,995.3	485.8	100467	SALLY 6-1		µg/kg	NR	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<126	<126	<126	<126	NA	NA
Composite	TJ-KM-MW	SAL6	28 m from Base Plate	7/31/2001	Sally FP	554,708.1	7,081,995.3	485.8	100468	SALLY 6-2		µg/kg	NR	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<25.0	<125	<125	<125	<125	NA	NA
Composite	TJ-KM-MW	SAL12	3.5 m from Base Plate	8/2/2001	Sally FP	554,739.3	7,081,923.6	489.9	101353	SALLY 12-1		µg/kg	<368	<36.8	114	<36.8	80.4	<36.8	<36.8	<36.8	<36.8	44.7 #	<184	<184	<184	<184	NA	NA
Composite	TJ-KM-MW	SAL12	3.5 m from Base Plate	8/2/2001	Sally FP	554,739.3	7,081,923.6	489.9	101346	SALLY 2-2 (12-2 ?)		µg/kg	<305	<30.5	<30.5	<30.5	<30.5	<30.5	<30.5	<30.5	<30.5	<30.5	<153	<153	<153	<153	NA	NA
Composite	TJ-KM-MW	SAL13	7 m from Base Plate	8/2/2001	Sally FP	554,737.6	7,081,926.8	490.3	101352	SALLY 11 12-1 (13-1?)		µg/kg	<342	<34.2	<34.2	<34.2	86.2	<34.2	<34.2	<34.2	<34.2	1,680	<171	<171	<171	<171	NA	NA
Composite	TJ-KM-MW	SAL13	7 m from Base Plate	8/2/2001	Sally FP	554,737.6	7,081,926.8	490.3	101354	SALLY 13-2		µg/kg	<382	<38.2	<38.2	<38.2	123	<38.2	<38.2	<38.2	<38.2	493 #	<191	<191	<191	<191	NA	NA
Composite	TJ-KM-MW	SAL14	14 m from Base Plate	8/2/2001	Sally FP	554,734.1	7,081,932.9	488.9	101355	SALLY 14-1		µg/kg	<370	<37.0	<37.0	<37.0	<37.0	<37.0	<37.0	<37.0	<37.0	41.1	<185	<185	<185	<185	NA	NA
Composite	TJ-KM-MW	SAL14	14 m from Base Plate	8/2/2001	Sally FP	554,734.1	7,081,932.9	488.9	101356	SALLY 14-2		µg/kg	<278	<27.8	<27.8	<27.8	77.2	<27.8	<27.8	<27.8	<27.8	57.8	<139	<139	<139	<139	NA	NA
Composite	TJ-KM-MW	SAL15	21 m from Base Plate	8/2/2001	Sally FP	554,730.9	7,081,939.2	489.4	101357	SALLY 15-1		µg/kg	<379	<37.9	<37.9	<37.9	<37.9	685 #	<37.9	<37.9	<37.9	26100	<190	<190	<190	<190	NA	NA
Composite	TJ-KM-MW	SAL15	21 m from Base Plate	8/2/2001	Sally FP	554,730.9	7,081,939.2	489.4	101358	SALLY 15-2		µg/kg	<301	<30.1	<30.1	<30.1	<30.1	<30.1	<30.1	<30.1	<30.1	68.4	<151	<151	<151	<151	NA	NA
Composite	TJ-KM-MW	SAL16	28 m from Base Plate	8/2/2001	Sally FP	554,727.7	7,081,945.4	489.4	100476	SALLY 16-1		µg/kg	NR	<26.0	61.1	<26.0	<26.0	<26.0	<26.0	<26.0	<26.0	350 #	<130	<130	<130	<130	NA	NA
Composite	TJ-KM-MW	SAL16	28 m from Base Plate	8/2/2001	Sally FP	554,727.7	7,081,945.4	489.4	101359	SALLY 16-2		µg/kg	<350	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	<35.0	24.6	<175	<175	<175	<175	NA	NA
Composite	TJ-KM-MW	SAL17	3.5 m from Base Plate	8/2/2001	Sally FP	554,657.9	7,081,906.5	487.6	101360	SALLY 17-1		µg/kg	<333	<33.3	<33.3	<33.3	<33.3	<33.3	<33.3	<33.3	<33.3	597	<167	<167	<167	<167	NA	NA
Composite	TJ-KM-MW	SAL17	3.5 m from Base Plate	8/2/2001	Sally FP	554,657.9	7,081,906.5	487.6	100477	SALLY 17-2		µg/kg	NR	<31.3	<31.3	<31.3	<31.3	<31.3	<31.3	<31.3	<31.3	131 #	<157	<157	<157	<157	NA	NA
Composite	TJ-KM-MW	SAL18	7 m from Base Plate	8/2/2001	Sally FP	554,656.9	7,081,910.1	488.7	100478	SALLY 18-1		µg/kg	NR	<31.4	78.6	<31.4	257	21.3 #	<31.4	<31.4	<31.4	183	<157	<157	<157	<157	NA	NA
Composite	TJ-KM-MW	SAL18	7 m from Base Plate	8/2/2001	Sally FP	554,656.9	7,081,910.1	488.7	101361	SALLY 18-2		µg/kg	<427	<42.7	<42.7	<42.7	<42.7	<42.7	<42.7	<42.7	<42.7	228 #	<214	<214	<214	<214	NA	NA
Composite	TJ-KM-MW	SAL19	14 m from Base Plate	8/2/2001	Sally FP	554,654.5	7,081,917.2	488.6	101362	SALLY 19-1		µg/kg	<323	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<162	<162	<162	<162	NA	NA
Composite	TJ-KM-MW	SAL19	14 m from Base Plate	8/2/2001	Sally FP	554,654.5	7,081,917.2	488.6	101363	SALLY 19-2		µg/kg	<316	<31.6	<31.6	<31.6	<31.6	<31.6	<31.6	<31.6	<31.6	<31.6	<159	<159	<159	<159	NA	NA
Composite	TJ-KM-MW	SAL20	21 m from Base Plate	8/2/2001	Sally FP	554,652.3	7,081,923.2	488.2	101364	SALLY 20-1		µg/kg	<355	<35.5	<35.5	<35.5	159	<35.5	<35.5	<35.5	<35.5	<35.5	<178	<178	<178	<178	NA	NA
Composite	TJ-KM-MW	SAL20	21 m from Base Plate	8/2/2001	Sally FP	554,652.3	7,081,923.2	488.2	101365	SALLY 20-2		µg/kg	<450	<45.0	<45.0	<45.0	<45.0	<45.0	<45.0	<45.0	<45.0	<45.0	<225	<225	<225	<225	NA	NA
Composite	TJ-KM-MW	SAL21	28 m from Base Plate	8/2/2001	Sally FP	554,649.6	7,081,929.8	487.3	100479	SALLY 21-1		µg/kg	NR	<25.5	81.7	<25.5	<25.5	<25.5	<25.5	<25.5	<25.5	103	<128	<128	<128	<128	NA	NA
Composite	TJ-KM-MW	SAL21	28 m from Base Plate	8/2/2001	Sally FP	554,649.6	7,081,929.8	487.3	101366	SALLY 21-2		µg/kg	<342	<34.2	<34.2	<34.2	<34.2	<34.2	<34.2	<34.2	<34.2	<34.2	<171	<171	<171	<171	NA	NA

# = not confirmed
NA = not analyzed for this compound
ND = not detected
NR = not reported

Appendix A (cont.).

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Composite	TJ-KM-MW	SAL22	50 m from Base Plate (-15 degrees)	8/2/2001	Sally FP	554,622.3	7,081,937.8	479.6	100480	SALLY 22		µg/kg	NR	<25.8	<25.8	<25.8	207 #	<25.8	<25.8	<25.8	<25.8	<25.8	<129	<129	<129	<129	NA	NA
Composite	TJ-KM-MW	SAL23	50 m from Base Plate (-30 degrees)	8/2/2001	Sally FP	554,632.0	7,081,948.3	484.1	101367	SALLY 23		µg/kg	<272	<27.2	<27.2	<27.2	72.8	<27.2	<27.2	<27.2	<27.2	<27.2	<136	<136	<136	<136	NA	NA
Composite	TJ-KM-MW	SAL24	50 m from Base Plate (0 degrees)	8/2/2001	Sally FP	554,642.0	7,081,953.6	485.4	100481	SALLY 24		µg/kg	NR	<26.6	<26.6	<26.6	217 #	<26.6	<26.6	<26.6	<26.6	<26.6	<133	<133	<133	<133	NA	NA
Composite	TJ-KM-MW	SAL25	50 m from Base Plate (+15 degrees)	8/2/2001	Sally FP	554,664.8	7,081,954.1	484.6	101368	SALLY 25		µg/kg	<299	<29.9	<29.9	<29.9	81.6	<29.9	<29.9	<29.9	<29.9	<29.9	<150	<150	<150	<150	NA	NA
Composite	TJ-KM-MW	SAL26	50 m from Base Plate (+30 degrees)	8/2/2001	Sally FP	554,667.6	7,081,954.8	485.0	101369	SALLY 26		µg/kg	<373	<37.3	<37.3	<37.3	<37.3	<37.3	<37.3	37.3	<37.3	36.9 J	<187	<187	<187	<187	NA	NA
Composite	TJ-KM	Crater 1 center	In large bomb crater	8/3/2001	Washington Range	550,162.9	7,075,559.3	478.3	100402	WASH RANGE BOMB CRATER 1-A		µg/kg	NR	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<122	<122	<122	<122	NA	NA
Composite	TJ-KM	Crater 1	In large bomb crater	8/3/2001	Washington Range				100403	WASH RANGE BOMB CRATER 1-B		µg/kg	NR	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<23.4	<117	<117	<117	<117	NA	NA
Composite	TJ-KM	Crater 1	In halo around crater	8/3/2001	Washington Range				100404	WASH RANGE BOMB CRATER 1-C		µg/kg	NR	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<24.9	<125	<125	<125	<125	NA	NA
Composite	TJ-KM	Crater 1	In halo around crater	8/3/2001	Washington Range				100405	WASH RANGE BOMB CRATER 1-D		µg/kg	NR	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<23.5	<118	<118	<118	<118	NA	NA
Composite	TJ-KM	Crater 1	Around outside of crater halo.	8/3/2001	Washington Range				100406	WASH RANGE BOMB CRATER 1-E		µg/kg	NR	<23.7	<23.7	<23.7	<23.7	<23.7	<23.7	<23.7	<23.7	<23.7	<119	<119	<119	<119	NA	NA
Composite	TJ-KM	Crater 1	Around outside of crater halo.	8/3/2001	Washington Range				100407	WASH RANGE BOMB CRATER 1-		µg/kg	NR	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<24.5	<123	<123	<123	<123	NA	NA
Composite	TJ-KM	Crater 2 center	In large bomb crater	8/3/2001	Washington Range	550,208.2	7,075,823.3	478.4	100408	WASH RANGE BOMB CRATER 2-A		µg/kg	NR	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<24.8	<124	<124	<124	<124	NA	NA
Composite	TJ-KM	Crater 2	In large bomb crater	8/3/2001					100409	WASH RANGE BOMB CRATER 2-B		µg/kg	NR	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	121	<121	<121	<121	NA	NA
Composite	TJ-KM-MW	Crater 5	Disposal crater (60mm with time fuse)	8/3/2001	Washington Range	550,803.2	7,075,001.4	483.2	CRREL FIELD GC	CRATER 5		µg/kg	NA	ND	NA	NA	ND	ND	NA	NA	ND	ND	NA	NA	NA	NA	ND	NA
Composite	TJ-KM-MW	Crater 3	Disposal crater	8/3/2001	Washington Range	550,543.9	7,074,999.5	482.7	100413	DISPOSAL CRATER 3-A		µg/kg	NR	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<121	<121	<121	<121	NA	NA
Composite	TJ-KM-MW	Crater 3	Disposal crater	8/3/2001					100410	CRATER 3-B		µg/kg	NR	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<118	<118	<118	<118	NA	NA
Composite	JAS-CMC	WRW001	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,254.8	7,078,158.1	465.9	101370	WRW-001		µg/kg	<253	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<127	<127	<127	<127	NA	NA
Composite	JAS-CMC	WRW002	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,228.9	7,078,007.5	468.0	101371	WRW-002		µg/kg	<259	<25.9	<25.9	<25.9	<25.9	<25.9	<25.9	<25.9	<25.9	<25.9	<130	<130	<130	<130	NA	NA
Composite	JAS-CMC	WRW003	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,198.8	7,077,862.1	458.5	100411	WRW003		µg/kg	NR	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<126	<126	<126	<126	NA	NA
Composite	JAS-CMC	WRW004	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,183.0	7,077,712.4	469.1	101372	WRW-004		µg/kg	<253	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<25.3	<127	<127	<127	<127	NA	NA
Composite	JAS-CMC	WRW005	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,148.1	7,077,568.6	471.2	101373	WRW-005		µg/kg	<244	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<122	<122	<122	<122	NA	NA
Composite	JAS-CMC	WRW006	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,064.3	7,077,441.0	470.9	101374	WRW-006		µg/kg	<236	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<23.6	<118	<118	<118	<118	NA	NA
Composite	JAS-CMC	WRW007	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	548,963.7	7,077,330.5	468.1	101375	WRW-007		µg/kg	<251	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<126	<126	<126	<126	NA	NA
Composite	JAS-CMC	WRW008	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	548,979.0	7,077,160.3	469.4	101376	WRW-008		µg/kg	<251	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<25.1	<126	<126	<126	<126	NA	NA
Composite	JAS-CMC	WRW009	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	548,941.2	7,077,111.8	470.4	101377	WRW-009		µg/kg	<244	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<24.4	<122	<122	<122	<122	NA	NA
Composite	JAS-CMC	WRW010	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	548,988.6	7,077,479.9	467.1	101378	WRW-010		µg/kg	<278	<27.8	<27.8	<27.8	<27.8	<27.8	<27.8	<27.8	<27.8	<27.8	<139	<139	<139	<139	NA	NA
Composite	JAS-CMC	WRW011	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,005.4	7,077,650.5	466.9	101379	WRW-011		µg/kg	<273	<27.3	<27.3	<27.3	<27.3	<27.3	<27.3	<27.3	<27.3	<27.3	<137	<137	<137	<137	NA	NA
Composite	JAS-CMC	WRW012	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,094.4	7,077,767.5	465.9	101380	WRW-012		µg/kg	<242	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<24.2	<121	<121	<121	<121	NA	NA
Composite	JAS-CMC	WRW013	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,076.4	7,077,903.1	466.5	101381	WRW-013		µg/kg	<270	<27.0	<27.0	<27.0	<27.0	<27.0	<27.0	<27.0	<27.0	<27.0	<135	<135	<135	<135	NA	NA
Composite	JAS-CMC	WRW014	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,166.6	7,078,026.2	466.0	101382	WRW-014		µg/kg	<269	<26.9	<26.9	<26.9	<26.9	<26.9	<26.9	<26.9	<26.9	<26.9	<135	<135	<135	<135	NA	NA
Composite	JAS-CMC	WRW015	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	549,213.2	7,078,116.3	465.4	101383	WRW-015		µg/kg	<294	<29.4	<29.4	<29.4	<29.4	<29.4	<29.4	<29.4	<29.4	<29.4	<147	<147	<147	<147	NA	NA
Composite	JAS-CMC	WRW016	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	548,705.7	7,073,252.4	500.7	101384	WRW-016		µg/kg	<286	<28.6	<28.6	<28.6	<28.6	<28.6	<28.6	<28.6	<28.6	<28.6	<143	<143	<143	<143	NA	NA
Composite	JAS-CMC	WRW017	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	548,602.7	7,073,793.3	482.0	101385	WRW-017		µg/kg	<275	<27.5	<27.5	<27.5	<27.5	<27.5	<27.5	<27.5	<27.5	<27.5	<138	<138	<138	<138	NA	NA
Composite	JAS-CMC	WRW018	Composite sample along Lt (west) bank of	8/4/2001	Wash. Range-	548,583.2	7,073,847.2	484.0	101386	WRW-018		µg/kg	<303	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<152	<152	<152	<152	NA	NA
Composite	JAS-CMC	WRW019	Composite sample along Lt (west) bank of	8/5/2001	Wash. Range-	548,566.3	7,074,520.4	481.4	101387	WRW-019		µg/kg	<303	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<30.3	<152	<152	<152	<152	NA	NA
Composite	JAS-CMC	WRW020	Composite sample along Lt (west) bank of	8/5/2001	Wash. Range-	548,513.0	7,074,394.7	485.6	101388	WRW-020		µg/kg	<325	32.5	<32.5	<32.5	<32.5	<32.5	<32.5	<32.5	<32.5	<32.5	<163	<163	<163	<163	NA	NA
Composite	JAS-CMC	WRW021	Composite sample along Lt (west) bank of	8/5/2001	Wash. Range-	548,569.1	7,074,689.5	483.9	101389	WRW-021		µg/kg	<314	<31.4	<31.4	<31.4	<31.4	<31.4	<31.4	<31.4	<31.4	<31.4	<157	<157	<157	<157	NA	NA
Composite	JAS-CMC	WRW022	Composite sample along Lt (west) bank of	8/5/2001	Wash. Range-	548,559.0	7,074,725.5	491.0	101390	WRW-022		µg/kg	<323	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<32.3	<162	<162	<162	<162	NA	NA
Composite	JAS-CMC	WRW023	Composite sample along Lt (west) bank of	8/5/2001	Wash. Range-	548,799.9	7,076,770.7	479.5	101391	WRW-023		µg/kg	<256	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<25.6	<128	<128	<128	<128	NA	NA
Composite	JAS-CMC	WRW024	Composite sample along Lt (west) bank of	8/5/2001	Wash. Range-	548,789.2	7,076,717.1	478.9	101392	WRW-024		µg/kg	<262	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<26.2	<131	<131	<131	<131	NA	NA
Discrete	JAS-TJ-KM-MW	DISCRETE	Surface (Within area BW4 composite sample)	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Field GC	Surface discrete BW1 within BW4 Comp		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	7,900	NA	NA	NA	NA	NA	NA
Discrete/ subsurface	JAS-SH	BW1 DISCRET	0 to 2.5 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW1 DISCRET	0 to 2.5 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	8.14	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW1 DISCRET	2.5 to 5 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW1 DISCRET	2.5 to 5 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW1 DISCRET	5 to 9 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW1 DISCRET	5 to 9 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW1 DISCRET	9 to 13 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW1 DISCRET	9 to 13 cm depth	8/4/2001	Bow Whale FP	555,817.6	7,082,263.5	500.1	CRREL Lab GC	Subsurface discrete BW1	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-TJ-KM-MW	BW2 DISCRET	Surface (Within area BW4 composite sample)	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Field GC	Surface discrete BW2 within BW4		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	4,600	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW2 DISCRET	0 to 2.5 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	616	13,300	NA	NA	NA	NA	550	<2
Discrete/ subsurface	JAS-SH	BW2 DISCRET	0 to 2.5 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	588	11,300	NA	NA	NA	NA	<15	<2

\# = not confirmed
NA = not analyzed for this compound
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NR = not reported

Appendix A (cont.). Analytical results from 2001.

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Discrete/ subsurface	JAS-SH	BW2 DISCRET	2.5 to 5 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	19.6	NA	NA	NA	NA	250	<2
Discrete/ subsurface	JAS-SH	BW2 DISCRET	2.5 to 5 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	5.4	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW2 DISCRET	5 to 10 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW2 DISCRET	5 to 10 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW2 DISCRET	10 to 15 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW2 DISCRET	10 to 15 cm depth	8/4/2001	Bow Whale FP	555,818.8	7,082,263.3	500.0	CRREL Lab GC	Subsurface discrete BW2	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-TJ-KM-MW	BW 1.5 DISCRETE	Surface (Within area BW4 composite sample)	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Surface Discrete BW1.5 within BW4 Comp	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	48.6	530	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	0 to 2 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	13.8	226	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	0 to 2 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	8.3	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	2 to 4 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	2 to 4 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	4 to 11 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	4 to 11 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	11 to 15 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BW 1.5 DISCRETE	11 to 15 cm depth	8/4/2001	Bow Whale FP	555,818.1	7,082,263.3	499.8	CRREL Lab GC	Subsurface Discrete BW1.5 within BW4 Comp	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-TJ-KM-MW	BW3 DISCRET	Surface (Within area BW4 composite sample)	8/4/2001	Bow Whale FP	555,819.6	7,082,265.1	499.9	CRREL Field GC	BW3 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	50	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BW4 DISCRET	Surface (Within area BW4 composite sample)	8/4/2001	Bow Whale FP	555,821.1	7,082,264.9	500.0	CRREL Field GC	BW4 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	46	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BW5 DISCRET	Surface (Within area BW4 composite sample)	8/4/2001	Bow Whale FP	555,822.1	7,082,266.0	500.1	CRREL Field GC	BW5 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	25	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BW6 DISCRET	Surface (Within area BW5 composite sample)	8/4/2001	Bow Whale FP	555,814.0	7,082,269.9	499.4	CRREL Field GC	BW6 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	580	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BW7 DISCRET	Surface (Within area BW5 composite sample)	8/4/2001	Bow Whale FP	555,815.6	7,082,270.4	499.9	CRREL Field GC	BW7 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BW8 DISCRET	Surface (Within area BW5 composite sample)	8/4/2001	Bow Whale FP	555,816.9	7,082,270.8	498.3	CRREL Field GC	BW8 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	50	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BW9 DISCRET	Surface (Within area BW5 composite sample)	8/4/2001	Bow Whale FP	555,818.1	7,082,271.8	498.5	CRREL Field GC	BW9 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BW10 DISCRET	Surface (Within area BW5 composite sample)	8/4/2001	Bow Whale FP	555,818.9	7,082,272.2	500.2	CRREL Field GC	BW10 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL1 DISCRET	Surface (Within area BL1 composite sample)	8/4/2001	Big Lake FP	554,824.6	7,080,708.3	491.4	CRREL Field GC	BL1 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL2 DISCRET	Surface (Within area BL1 composite sample)	8/4/2001	Big Lake FP	554,823.8	7,080,705.7	490.9	CRREL Field GC	BL2 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	Trace	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL3 DISCRET	Surface (Within area BL1 composite sample)	8/4/2001	Big Lake FP	554,822.9	7,080,704.7	491.0	CRREL Field GC	BL3 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	19	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL4 DISCRET	Surface (Within area BL1 composite sample)	8/4/2001	Big Lake FP	554,820.9	7,080,704.0	490.6	CRREL Field GC	BL4 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL5 DISCRET	Surface (Within area BL1 composite sample)	8/4/2001	Big Lake FP	554,820.1	7,080,703.4	490.9	CRREL Field GC	BL5 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	Trace	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL6 DISCRET	Surface (Within area BL14 composite sample)	8/4/2001	Big Lake FP	554,896.2	7,080,783.3	490.6	CRREL Field GC	BL6 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	Trace	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL8 DISCRET	Surface (Within area BL14 composite sample)	8/4/2001	Big Lake FP	554,895.4	7,080,782.3	491.1	CRREL Field GC	BL8 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	Trace	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL9 DISCRET	Surface (Within area BL14 composite sample)	8/4/2001	Big Lake FP	554,893.6	7,080,781.3	491.5	CRREL Field GC	BL9 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL10 DISCRET	Surface (Within area BL14 composite sample)	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Field GC	BL10 DISCRETE		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	9,100	NA	NA	NA	NA	NA	NA
Discrete	JAS-TJ-KM-MW	BL10 DISCRET	Surface	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Surface Discrete BL10 within BL14	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	345	6,790	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BL10 DISCRET	1 to 4 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	4	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BL10 DISCRET	1 to 4 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BL10 DISCRET	4 to 8 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BL10 DISCRET	4 to 8 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BL10 DISCRET	8 to 15 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2

# = not confirmed
NA = not analyzed for this compound
ND = not detected
NR = not reported

Appendix A (cont.).

Sample Type	Collector	Unique ID	Field Notes	Date Collected	Area	East (m)	North (m)	Elevation (m)	Lab Notes or ID	Field ID	Lab Rep	Units	HMX	RDX	TNB	DNB	TETRYL	TNT	4A-DNT	2A-DNT	2,6-DNT	2,4-DNT	NB	2-NT	3-NT	4-NT	NG	3,5-DNA
Discrete/ subsurface	JAS-SH	BL10 DISCRET	8 to 15 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BL10 DISCRET	15 to 20 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	A	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete/ subsurface	JAS-SH	BL10 DISCRET	15 to 20 cm depth	8/4/2001	Big Lake FP	554,892.2	7,080,781.1	491.5	CRREL Lab GC	Subsurface Discrete BL10 within BL14	B	µg/kg	<25	<3	<1	<1	<1	<1	<1	<1	<1	<1	NA	NA	NA	NA	<15	<2
Discrete	JAS-TJ-KM-MW	BL7 Discrete	Surface (Within area BL14 composite sample)						CRREL Field GC	BL7 Discrete		µg/kg	NA	NA	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA

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