Munitions Constituents in Sediment and Sea Water Collected Around the Perimeters of Offshore Bombing Targets BT-9 and BT-11, Marine Corps Air Station Cherry Point

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1. INTRODUCTION

A team of scientists and engineers from the University of South Carolina Beaufort (USCB) and The Georgia Institute of Technology – Savannah was contracted by the United States (U.S.) Marine Corps to identify and quantify munitions constituents in upland soil, intertidal and bottom sediments, and sea water at three U.S. Marine Corps installations: 1) Marine Corps Recruit Depot (MCRD) Parris Island, 2) Marine Corps Base (MCB) Camp Lejeune, and 3) Marine Corps Air Station (MCAS) Cherry Point (Figure 1). Consistent with the U.S. Marine Corps Range Environmental Vulnerability Assessment (REVA) program, the contractual tasks were designed to determine whether there is a release or substantial threat of a release of munitions constituents from the operational ranges or range complex areas to off-range areas. All three study sites are located in coastal/estuarine environments of the southeastern U.S. Sampling environments ranged from heavily wooded areas to intertidal marsh to coastal river, sound, and bay sites. Areas downrange of small arms firing ranges were the focus at the first two installations. At Cherry Point, munitions constituents resulting from aerial bombing training were of primary interest. This report deals exclusively with sediment and sea water sampling and analysis conducted at MCAS Cherry Point. Separate reports were prepared detailing similar activities at the other two installations.

Figure 1. Locations of Parris Island, SC, Camp Lejeune, NC, and Cherry Point, NC.

2. SITE DESCRIPTIONS

Piney Island (BT-11) and Brant Island Shoal (BT-9) are bombing target (BT) areas at MCAS Cherry Point that are located in the southern part of Pamlico Sound (Figure 2). These areas experience semi-diurnal tides with a mean range of 3 feet. Areas surrounding these bombing ranges are restricted to navigation, so all sampling was performed outside of the restricted areas. Water depths in the areas ranged from 4 feet to over 20 feet. BT-11 encompasses all of the 12,500-acre Piney Island and serves as a multi-purpose target complex for air-to-ground delivery of inert ordnance. BT-9 is a small island target consisting of a sunken freighter hulk and two sea-going tug boat hulks grounded on Brant Island Shoal. It hosts air-to-ground exercises with small, conventional ordnance and strafing authorized.

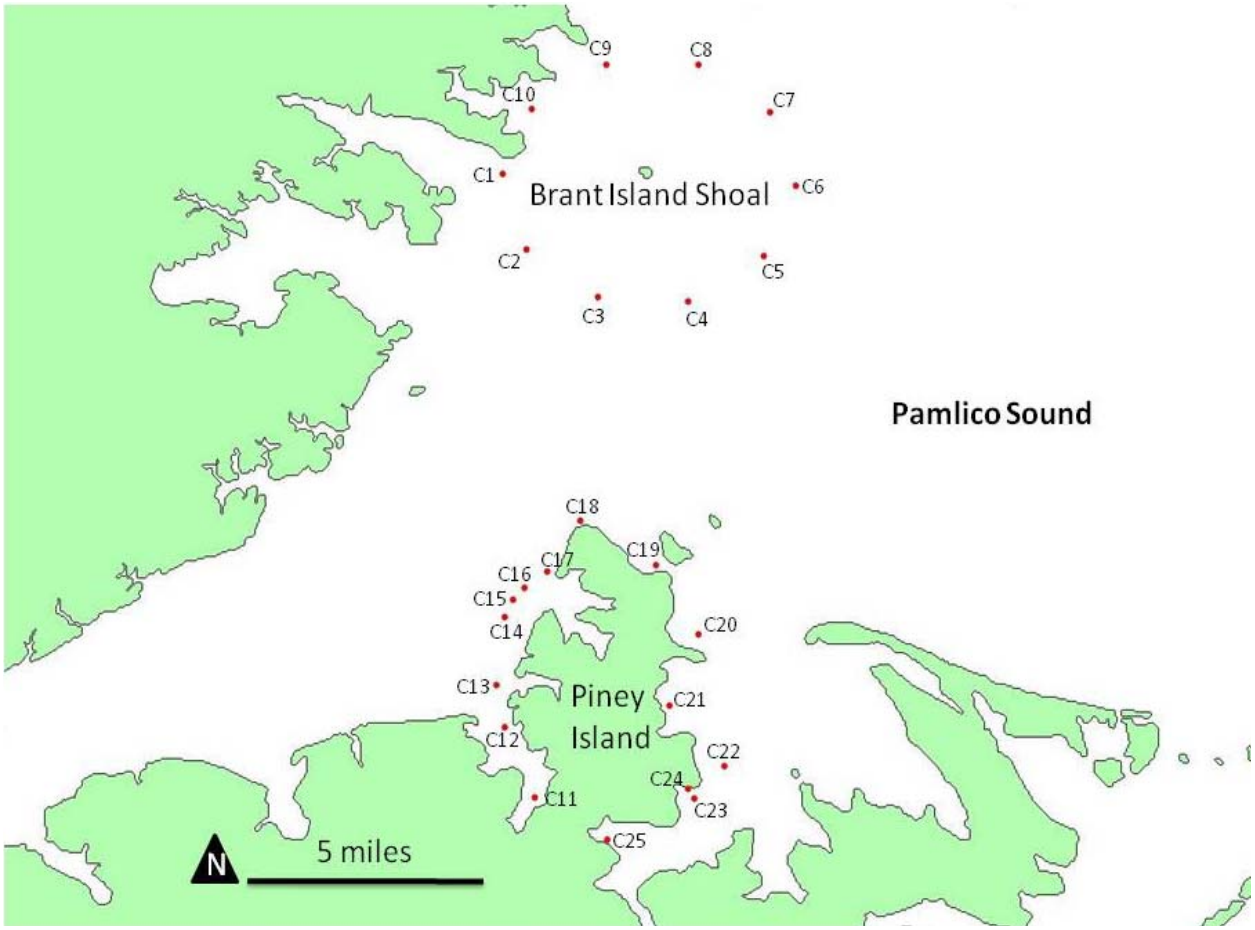

Figure 2. MCAS Cherry Point sampling locations around Piney Island (BT-11) and Brant Island Shoal (BT-9).

3. SAMPLE COLLECTION

The following text describes the methods used to collect bottom sediment and sea water samples for the subsequent determination of munitions constituent concentrations and general chemistry.

3.1 Global Positioning System (GPS)

A survey-grade, Ashtech Z-12 dual-frequency GPS was used to determine sampling locations (Figure 2 and Table 1). A GPS base station was set up near the survey areas and a rover GPS system was carried into the field via boat to each sampling location. All GPS data were post-processed with GraphNav processing software to provide a position fix with an estimated vertical and horizontal uncertainty of less than 5 cm.

Table 1. MCAS Cherry Point sampling dates, locations, and water depths. Sediment cores were taken at each location, along with water samples at mid-depth.

Sample Date	Sample ID	Water Depth (m)
7/16/2008	CP-1	3.4
7/16/2008	CP-2	5.6
7/16/2008	CP-3	6.2
7/16/2008	CP-4	6.3
7/17/2008	CP-6	4.9
7/17/2008	CP-7	5.8
7/17/2008	CP-8	5.8
7/17/2008	CP-9	2.0
7/17/2008	CP-10	2.9
7/14/2008	CP-11	2.7
7/14/2008	CP-12	2.2
7/14/2008	CP-13	3.3
7/15/2008	CP-14	4.9
7/15/2008	CP-15	5.0
7/15/2008	CP-16	4.0
7/15/2008	CP-17	2.7
7/15/2008	CP-18	2.0
7/14/2008	CP-19	2.3
7/14/2008	CP-20	3.1
7/14/2008	CP-21	2.2
7/14/2008	CP-22	2.6
7/14/2008	CP-23	1.7
7/14/2008	CP-24	1.2
7/14/2008	CP-25	2.2

3.2 Decontamination

All sampling equipment was washed and decontaminated before each use to avoid cross-contamination of samples. Each piece of equipment with the potential to contact sediment or sea water was washed with Liqui-Nox (liquid detergent) and triple rinsed with distilled water prior to use. The decontaminated equipment was then wrapped in aluminum foil to prevent contamination en route to sampling sites. To verify the effectiveness of decontamination procedures, rinsate samples were collected during water sampler and vibracore decontamination and analyzed for the same analytes as sediment and sea water samples. The effectiveness of decontamination procedures had been previously demonstrated by the collection and analysis of numerous rinsate samples during the conduct of sampling activities at MCRD Parris Island and MCB Camp Lejeune.

3.3 Vibracore

The project required bottom sediment to be collected from locations surrounding the Piney Island (BT-11) and Brant Island Shoal (BT-9) bombing ranges. Twenty-five locations were originally identified for the collection of sediment cores, fifteen around BT-11 and ten around BT-9, all of which were located outside restricted areas. Rough water precluded the collection of a sample at the point designated C5 in Figure 2, thus a total of 24 locations were sampled. Sediment samples from the bottom of Pamlico Sound were collected with a vibracore deployed from a 24-foot pontoon boat over 4 days from July 14 to July 17, 2008 (Figure 3). A 4-inch diameter, 6-foot long steel tube was lined with a flexible plastic liner and attached to the vibracore head. The core tube has an attached stainless steel nose to penetrate the sediment and a core-catcher to retain the sample as the tube is pulled out. The entire assembly was lowered from a modified pontoon boat into the sediment and returned to the boat. Once on deck, the sediment-filled plastic liner was removed, sealed at both ends, labeled, and placed in a cooler on ice. The sample cores were subsequently divided into four 1-foot sections (0-12, 12-24, 24-36, and except at location CP-1, 36-48 inches) in order to establish a vertical profile of sediment concentrations, and each section was placed into a zip-lock storage bag and shipped to the analytical laboratory.

Figure 3. Pontoon boat retrofitted with vibracore (upper left); deploying the vibracore (upper right); vibracore samples in plastic liners (lower left); 1-foot vertical sections of sediment ready for shipment to analytical laboratory (lower right).

3.4 Sea Water Sampling

Water samples were collected from a support boat at mid-depth at each sampling location using a Niskin-style water sampler (Figure 4). These water samples were immediately transferred into pre-prepared sample bottles containing appropriate preservatives for each analyte tested. These bottles were stored on ice until they were shipped with the sediment samples to TestAmerica Laboratories, Inc. for analysis.

Figure 4: Support boat from which sea water samples were taken and all decontamination procedures conducted (upper left); decanting sea water from the Niskin-style sampler into a laboratory-supplied sample bottle (upper right); refrigerated sea water samples prior to shipment to analytical laboratory (lower left).

4. ANALYTICAL CHEMISTRY AND TOXICITY SCREENING VALUES

All sediment, sea water, and rinsate samples were sent to TestAmerica Laboratories, Inc. in Arvada, CO (Denver) for analysis. This laboratory is among those accredited under the Department of Defense (DoD) Environmental Laboratory Approval Program designed to promote interoperability among DoD components and the collection of data of known and documented quality. The analytes of interest are listed in Tables 2 and 3. Analytical results were compared to ecological toxicity screening values for surface water and marine sediment derived by the DoD's Range and Munitions Use Subcommittee (RMUS). The RMUS toxicity screening values are intended to be used in the range assessment process.

5. RESULTS

Sediment and sea water samples from locations circumnavigating Piney Island (BT-11) and Brant Island Shoal (BT-9) were tested for chemicals potentially associated with bombing range activities, as well as some general chemistry parameters. Those analytes are listed in Table 2.

5.1 Maximum Analyte Concentrations Relative to Toxicity Screening Values and Minimum Detection Limits

Table 2 shows a list of all analytes for which sediment samples were tested, as well as the RMUS toxicity screening value, maximum reported concentration, and minimum detection limit for each analyte. Table 3 shows similar data for sea water. None of the sediment or sea water samples, regardless of location or depth from which it came, contained any analyte at a concentration above its RMUS toxicity screening value. In fact, with the exception of general chemistry parameters, analytes other than perchlorate that are potentially associated with aerial bombing were not found at detectable concentrations. It should be pointed out, however, that four analytes have minimum detection limits in excess of the lower bound of their RMUS toxicity screening values. These four analytes all have RMUS toxicity screening values that are variable depending on the total organic content of sediment As for perchlorate, while present in four sediment samples above its minimum detection limit, in no case did it exceed its reporting limit. Thus, the quantification of perchlorate is suspect. Lastly, while of little significance given the lack of munitions constituents at detectable concentrations, rinsate analyses failed to indicate anything that would call into question the effectiveness of decontamination procedures (data not shown).

Table 2. RMUS toxicity screening values for marine sediment, maximum reported sediment concentrations, and minimum detection limits for each analyte.

Analyte	Screening Value (mg/kg)	Max Concentration (mg/kg)	Minimum Detection Limit (mg/kg)
1,3,5-Trinitrobenzene	.0024-.24 [1a]	ND	0.014
1,3-Dinitrobenzene	.0067-.67 [1a]	ND	0.017
2,4,6-Trinitrotoluene	.092-9.2 [1a]	ND	0.031
2,4-Dinitrotoluene	0.23 [a]	ND	0.015
2,6-Dinitrotoluene	0.55 [a]	ND	0.019
2-Amino-4,6-DNT	NA	ND	0.033
2-Nitrotoluene	NA	ND	0.047
3-Nitrotoluene	NA	ND	0.064
4-Amino-2,6-DNT	NA	ND	0.03
4-Nitrotoluene	NA	ND	0.036
HMX	.0047-.47 [1a]	ND	0.023
Nitrobenzene	27 [a]	ND	0.085
Nitroglycerin	NA	ND	0.22
PETN	NA	ND	0.49
RDX	.013-1.3 [1a]	ND	0.043
Tetryl	NA	ND	0.044
Perchlorate	NA	0.00032	0.00021
Carbonate	NA	31	11
Chloride	NA	53000	ZZ
Nitrate/Nitrite	NA	0.76	0.15
Sulfate	NA	9500	ZZ
Lead	30.2 [b]	21	0.018
Calcium	NA	64000	14
Magnesium	NA	7400	3.7
Potassium	NA	3500	41
Sodium	NA	30000	59

"ND" denotes analyte was not detected at the limit of detection; "NA" denotes no RMUS toxicity screening value was available; "DNT" denotes dinitrotoluene; "ZZ" indicates that due to high analyte concentration the sample had to be diluted to fall below the upper calibration limit and therefore, the minimum analytical detection limit varies based on volume of dilution.

[1] EPA Region 4a. These values are dependent on the sediment total organic carbon (TOC). The lower bound is for 1% TOC. Upper bound is for 100% TOC. To determine the site specific value, multiply the % TOC by the lower bound.

[a] EPA Region 4 Memorandum: "Amended Guidance on Ecological Risk Assessment at Military Bases: Process Consideration, Timing of Activities, and Inclusion of Stakeholders" (23 June 2000).

[b] MacDonald,D.D., C.G.Ingersoll, and T.A.Berger. 2000. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology, 39: 20-31.

Table 3. RMUS toxicity screening values for surface water, maximum reported sea water concentrations, and minimum detection limits for each analyte.

Analyte	Screening Value (µg/L)	Max Concentration (µg/L)	Minimum Detection Limit (µg/L)
1,3,5-Trinitrobenzene	10 [a]	ND	0.2
1,3-Dinitrobenzene	20 [a]	ND	0.089
2,4,6-Trinitrotoluene	90 [a]	ND	0.072
2,4-Dinitrotoluene	44 [b]	ND	0.084
2,6-Dinitrotoluene	42 [a]	ND	0.064
2-Amino-4,6-DNT	20 [a]	ND	0.051
2-Nitrotoluene	NA	ND	0.086
3-Nitrotoluene	750 [c]	ND	0.083
4-Amino-2,6-DNT	NA	ND	0.058
4-Nitrotoluene	1900 [c]	ND	0.2
HMX	150 [c]	ND	0.088
Nitrobenzene	270 [a]	ND	0.091
Nitroglycerin	138 [a]	ND	0.92
PETN	NA	ND	0.42
RDX	190 [a]	ND	0.052
Tetryl	NA	ND	0.079
Perchlorate	9300 [d]	ND	0.088
Carbonate	NA	ND	1100
Chloride	NA	18000000	ZZ
Nitrate/Nitrite	NA	93	19
Sulfate	NA	2000000	ZZ
Lead	2.5 [e,f,g]	ND	0.9
Calcium	NA	290000	1700
Magnesium	NA	910000	540
Potassium	NA	290000	12000
Sodium	NA	8100000	4600

"ND" denotes analyte was not detected at the limit of detection; "NA" denotes no RMUS toxicity screening value was available; "DNT" denotes dinitrotoluene; "ZZ" indicates that due to high analyte concentration the sample had to be diluted to fall below the upper calibration limit and therefore, the minimum analytical detection limit varies based on volume of dilution.

[a] EPA Region 4 Memorandum: "Amended Guidance on Ecological Risk Assessment at Military Bases: Process Consideration, Timing of Activities, and Inclusion of Stakeholders" (23 June 2000).
[b]EPA Office of Solid Waste and Emergency Response Ecotox Thresholds, January 1996.
[c]EPA Region 3, Ecological Risk Assessment Freshwater Screening Benchmarks, March 2007.
[d] Dean, K.E., R.M. Palachek, J.L Noel, et al. 2004. Development of Freshwater Water-Quality Criteria for Perchlorate. Environmental Toxicology and Chemistry 23(6):1441-1451.
[e]Value applies to dissolved metals.
[f]The value is dependent on the hardness of the water; provided value is for a water hardness of 100 mg/L as CaCO3.
[g]EPA Office of Water, Office of Science and Technology (4304T), National Recommended Water Quality Criteria, 2006.

5.2 Analytical Results by Sample ID

The following summary tables present data for the analytes of interest in the same order in which they appear in Tables 2 and 3 above.

Table 4. Concentrations of explosives constituents by sampling site around Piney Island (BT-11) and Brant Island Shoal (BT-9).

Sample ID	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene
CP-1A	ND	ND	ND	ND	ND
CP-1B	ND	ND	ND	ND	ND
CP-1C	ND	ND	ND	ND	ND
CP-1W	ND	ND	ND	ND	ND
CP-2A	ND	ND	ND	ND	ND
CP-2B	ND	ND	ND	ND	ND
CP-2C	ND	ND	ND	ND	ND
CP-2D	ND	ND	ND	ND	ND
CP-2W	ND	ND	ND	ND	ND
CP-3A	ND	ND	ND	ND	ND
CP-3B	ND	ND	ND	ND	ND
CP-3C	ND	ND	ND	ND	ND
CP-3D	ND	ND	ND	ND	ND
CP-3W	ND	ND	ND	ND	ND
CP-4A	ND	ND	ND	ND	ND
CP-4B	ND	ND	ND	ND	ND
CP-4C	ND	ND	ND	ND	ND
CP-4D	ND	ND	ND	ND	ND
CP-4W	ND	ND	ND	ND	ND
CP-6A	ND	ND	ND	ND	ND
CP-6B	ND	ND	ND	ND	ND

Table 4 (cont.)

Sample ID	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene
CP-6C	ND	ND	ND	ND	ND
CP-6D	ND	ND	ND	ND	ND
CP-6W	ND	ND	ND	ND	ND
CP-7A	ND	ND	ND	ND	ND
CP-7B	ND	ND	ND	ND	ND
CP-7C	ND	ND	ND	ND	ND
CP-7D	ND	ND	ND	ND	ND
CP-7W	ND	ND	ND	ND	ND
CP-8A	ND	ND	ND	ND	ND
CP-8B	ND	ND	ND	ND	ND
CP-8C	ND	ND	ND	ND	ND
CP-8D	ND	ND	ND	ND	ND
CP-8W	ND	ND	ND	ND	ND
CP-9A	ND	ND	ND	ND	ND
CP-9B	ND	ND	ND	ND	ND
CP-9C	ND	ND	ND	ND	ND
CP-9D	ND	ND	ND	ND	ND
CP-9W	ND	ND	ND	ND	ND
CP-10A	ND	ND	ND	ND	ND
CP-10B	ND	ND	ND	ND	ND
CP-10C	ND	ND	ND	ND	ND
CP-10D	ND	ND	ND	ND	ND
CP-10W	ND	ND	ND	ND	ND
CP-11A	ND	ND	ND	ND	ND
CP-11B	ND	ND	ND	ND	ND
CP-11C	ND	ND	ND	ND	ND
CP-11D	ND	ND	ND	ND	ND
CP-11W	ND	ND	ND	ND	ND
CP-12A	ND	ND	ND	ND	ND
CP-12B	ND	ND	ND	ND	ND
CP-12C	ND	ND	ND	ND	ND
CP-12D	ND	ND	ND	ND	ND
CP-12W	ND	ND	ND	ND	ND

Table 4 (cont.)

Sample ID	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene
CP-13A	ND	ND	ND	ND	ND
CP-13B	ND	ND	ND	ND	ND
CP-13C	ND	ND	ND	ND	ND
CP-13D	ND	ND	ND	ND	ND
CP-13W	ND	ND	ND	ND	ND
CP-14A	ND	ND	ND	ND	ND
CP-14B	ND	ND	ND	ND	ND
CP-14C	ND	ND	ND	ND	ND
CP-14D	ND	ND	ND	ND	ND
CP-14W	ND	ND	ND	ND	ND
CP-15A	ND	ND	ND	ND	ND
CP-15B	ND	ND	ND	ND	ND
CP-15C	ND	ND	ND	ND	ND
CP-15D	ND	ND	ND	ND	ND
CP-15W	ND	ND	ND	ND	ND
CP-16A	ND	ND	ND	ND	ND
CP-16B	ND	ND	ND	ND	ND
CP-16C	ND	ND	ND	ND	ND
CP-16D	ND	ND	ND	ND	ND
CP-16W	ND	ND	ND	ND	ND
CP-17A	ND	ND	ND	ND	ND
CP-17B	ND	ND	ND	ND	ND
CP-17C	ND	ND	ND	ND	ND
CP-17D	ND	ND	ND	ND	ND
CP-17W	ND	ND	ND	ND	ND
CP-18A	ND	ND	ND	ND	ND
CP-18B	ND	ND	ND	ND	ND
CP-18C	ND	ND	ND	ND	ND
CP-18D	ND	ND	ND	ND	ND
CP-18W	ND	ND	ND	ND	ND
CP-19A	ND	ND	ND	ND	ND
CP-19B	ND	ND	ND	ND	ND
CP-19C	ND	ND	ND	ND	ND

Table 4 (cont.)

Sample ID	1,3,5-Trinitrobenzene	1,3-Dinitrobenzene	2,4,6-Trinitrotoluene	2,4-Dinitrotoluene	2,6-Dinitrotoluene
CP-19D	ND	ND	ND	ND	ND
CP-19W	ND	ND	ND	ND	ND
CP-20A	ND	ND	ND	ND	ND
CP-20B	ND	ND	ND	ND	ND
CP-20C	ND	ND	ND	ND	ND
CP-20D	ND	ND	ND	ND	ND
CP-20W	ND	ND	ND	ND	ND
CP-21A	ND	ND	ND	ND	ND
CP-21B	ND	ND	ND	ND	ND
CP-21C	ND	ND	ND	ND	ND
CP-21D	ND	ND	ND	ND	ND
CP-21W	ND	ND	ND	ND	ND
CP-22A	ND	ND	ND	ND	ND
CP-22B	ND	ND	ND	ND	ND
CP-22C	ND	ND	ND	ND	ND
CP-22D	ND	ND	ND	ND	ND
CP-22W	ND	ND	ND	ND	ND
CP-23A	ND	ND	ND	ND	ND
CP-23B	ND	ND	ND	ND	ND
CP-23C	ND	ND	ND	ND	ND
CP-23D	ND	ND	ND	ND	ND
CP-23W	ND	ND	ND	ND	ND
CP-24A	ND	ND	ND	ND	ND
CP-24B	ND	ND	ND	ND	ND
CP-24C	ND	ND	ND	ND	ND
CP-24D	ND	ND	ND	ND	ND
CP-24W	ND	ND	ND	ND	ND
CP-25A	ND	ND	ND	ND	ND
CP-25B	ND	ND	ND	ND	ND
CP-25C	ND	ND	ND	ND	ND
CP-25D	ND	ND	ND	ND	ND
CP-25W	ND	ND	ND	ND	ND

"ND" denotes analyte was not detected at the limit of detection.

"A, B, C or D" indicates the vertical fraction of each sediment core as the top, second, third or fourth foot below the sediment-water interface, respectively.
"W" denotes the water sample at each sampling site.

Table 5. Concentrations of explosives constituents by sampling site around Piney Island (BT-11) and Brant Island Shoal (BT-9).

Sample ID	2-Amino-4,6-Dinitrotoluene	2-Nitrotoluene	3-Nitrotoluene	4-Amino-2,6-Dinitrotoluene	4-Nitrotoluene
CP-1A	ND	ND	ND	ND	ND
CP-1B	ND	ND	ND	ND	ND
CP-1C	ND	ND	ND	ND	ND
CP-1W	ND	ND	ND	ND	ND
CP-2A	ND	ND	ND	ND	ND
CP-2B	ND	ND	ND	ND	ND
CP-2C	ND	ND	ND	ND	ND
CP-2D	ND	ND	ND	ND	ND
CP-2W	ND	ND	ND	ND	ND
CP-3A	ND	ND	ND	ND	ND
CP-3B	ND	ND	ND	ND	ND
CP-3C	ND	ND	ND	ND	ND
CP-3D	ND	ND	ND	ND	ND
CP-3W	ND	ND	ND	ND	ND
CP-4A	ND	ND	ND	ND	ND
CP-4B	ND	ND	ND	ND	ND
CP-4C	ND	ND	ND	ND	ND
CP-4D	ND	ND	ND	ND	ND
CP-4W	ND	ND	ND	ND	ND
CP-6A	ND	ND	ND	ND	ND
CP-6B	ND	ND	ND	ND	ND
CP-6C	ND	ND	ND	ND	ND
CP-6D	ND	ND	ND	ND	ND
CP-6W	ND	ND	ND	ND	ND
CP-7A	ND	ND	ND	ND	ND
CP-7B	ND	ND	ND	ND	ND
CP-7C	ND	ND	ND	ND	ND
CP-7D	ND	ND	ND	ND	ND
CP-7W	ND	ND	ND	ND	ND

Table 5 (cont.)

Sample ID	2-Amino-4,6-Dinitrotoluene	2-Nitrotoluene	3-Nitrotoluene	4-Amino-2,6-Dinitrotoluene	4-Nitrotoluene
CP-8A	ND	ND	ND	ND	ND
CP-8B	ND	ND	ND	ND	ND
CP-8C	ND	ND	ND	ND	ND
CP-8D	ND	ND	ND	ND	ND
CP-8W	ND	ND	ND	ND	ND
CP-9A	ND	ND	ND	ND	ND
CP-9B	ND	ND	ND	ND	ND
CP-9C	ND	ND	ND	ND	ND
CP-9D	ND	ND	ND	ND	ND
CP-9W	ND	ND	ND	ND	ND
CP-10A	ND	ND	ND	ND	ND
CP-10B	ND	ND	ND	ND	ND
CP-10C	ND	ND	ND	ND	ND
CP-10D	ND	ND	ND	ND	ND
CP-10W	ND	ND	ND	ND	ND
CP-11A	ND	ND	ND	ND	ND
CP-11B	ND	ND	ND	ND	ND
CP-11C	ND	ND	ND	ND	ND
CP-11D	ND	ND	ND	ND	ND
CP-11W	ND	ND	ND	ND	ND
CP-12A	ND	ND	ND	ND	ND
CP-12B	ND	ND	ND	ND	ND
CP-12C	ND	ND	ND	ND	ND
CP-12D	ND	ND	ND	ND	ND
CP-12W	ND	ND	ND	ND	ND
CP-13A	ND	ND	ND	ND	ND
CP-13B	ND	ND	ND	ND	ND
CP-13C	ND	ND	ND	ND	ND
CP-13D	ND	ND	ND	ND	ND
CP-13W	ND	ND	ND	ND	ND
CP-14A	ND	ND	ND	ND	ND
CP-14B	ND	ND	ND	ND	ND
CP-14C	ND	ND	ND	ND	ND

Table 5 (cont.)

Sample ID	2-Amino-4,6-Dinitrotoluene	2-Nitrotoluene	3-Nitrotoluene	4-Amino-2,6-Dinitrotoluene	4-Nitrotoluene
CP-14D	ND	ND	ND	ND	ND
CP-14W	ND	ND	ND	ND	ND
CP-15A	ND	ND	ND	ND	ND
CP-15B	ND	ND	ND	ND	ND
CP-15C	ND	ND	ND	ND	ND
CP-15D	ND	ND	ND	ND	ND
CP-15W	ND	ND	ND	ND	ND
CP-16A	ND	ND	ND	ND	ND
CP-16B	ND	ND	ND	ND	ND
CP-16C	ND	ND	ND	ND	ND
CP-16D	ND	ND	ND	ND	ND
CP-16W	ND	ND	ND	ND	ND
CP-17A	ND	ND	ND	ND	ND
CP-17B	ND	ND	ND	ND	ND
CP-17C	ND	ND	ND	ND	ND
CP-17D	ND	ND	ND	ND	ND
CP-17W	ND	ND	ND	ND	ND
CP-18A	ND	ND	ND	ND	ND
CP-18B	ND	ND	ND	ND	ND
CP-18C	ND	ND	ND	ND	ND
CP-18D	ND	ND	ND	ND	ND
CP-18W	ND	ND	ND	ND	ND
CP-19A	ND	ND	ND	ND	ND
CP-19B	ND	ND	ND	ND	ND
CP-19C	ND	ND	ND	ND	ND
CP-19D	ND	ND	ND	ND	ND
CP-19W	ND	ND	ND	ND	ND
CP-20A	ND	ND	ND	ND	ND
CP-20B	ND	ND	ND	ND	ND
CP-20C	ND	ND	ND	ND	ND
CP-20D	ND	ND	ND	ND	ND
CP-20W	ND	ND	ND	ND	ND
CP-21A	ND	ND	ND	ND	ND

Table 5 (cont.)

Sample ID	2-Amino-4,6-Dinitrotoluene	2-Nitrotoluene	3-Nitrotoluene	4-Amino-2,6-Dinitrotoluene	4-Nitrotoluene
CP-21B	ND	ND	ND	ND	ND
CP-21C	ND	ND	ND	ND	ND
CP-21D	ND	ND	ND	ND	ND
CP-21W	ND	ND	ND	ND	ND
CP-22A	ND	ND	ND	ND	ND
CP-22B	ND	ND	ND	ND	ND
CP-22C	ND	ND	ND	ND	ND
CP-22D	ND	ND	ND	ND	ND
CP-22W	ND	ND	ND	ND	ND
CP-23A	ND	ND	ND	ND	ND
CP-23B	ND	ND	ND	ND	ND
CP-23C	ND	ND	ND	ND	ND
CP-23D	ND	ND	ND	ND	ND
CP-23W	ND	ND	ND	ND	ND
CP-24A	ND	ND	ND	ND	ND
CP-24B	ND	ND	ND	ND	ND
CP-24C	ND	ND	ND	ND	ND
CP-24D	ND	ND	ND	ND	ND
CP-24W	ND	ND	ND	ND	ND
CP-25A	ND	ND	ND	ND	ND
CP-25B	ND	ND	ND	ND	ND
CP-25C	ND	ND	ND	ND	ND
CP-25D	ND	ND	ND	ND	ND
CP-25W	ND	ND	ND	ND	ND

"ND" denotes analyte was not detected at the limit of detection.

"A, B, C or D" indicates the vertical fraction of each sediment core as the top, second, third or fourth foot below the sediment-water interface, respectively.

"W" denotes the water sample at each sampling site.

Table 6. Concentrations of explosives constituents by sampling site around Piney Island (BT-11) and Brant Island Shoal (BT-9).

Sample ID	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
CP-1A	ND	ND	ND	ND	ND	ND
CP-1B	ND	ND	ND	ND	ND	ND
CP-1C	ND	ND	ND	ND	ND	ND
CP-1W	ND	ND	ND	ND	ND	ND
CP-2A	ND	ND	ND	ND	ND	ND
CP-2B	ND	ND	ND	ND	ND	ND
CP-2C	ND	ND	ND	ND	ND	ND
CP-2D	ND	ND	ND	ND	ND	ND
CP-2W	ND	ND	ND	ND	ND	ND
CP-3A	ND	ND	ND	ND	ND	ND
CP-3B	ND	ND	ND	ND	ND	ND
CP-3C	ND	ND	ND	ND	ND	ND
CP-3D	ND	ND	ND	ND	ND	ND
CP-3W	ND	ND	ND	ND	ND	ND
CP-4A	ND	ND	ND	ND	ND	ND
CP-4B	ND	ND	ND	ND	ND	ND
CP-4C	ND	ND	ND	ND	ND	ND
CP-4D	ND	ND	ND	ND	ND	ND
CP-4W	ND	ND	ND	ND	ND	ND
CP-6A	ND	ND	ND	ND	ND	ND
CP-6B	ND	ND	ND	ND	ND	ND
CP-6C	ND	ND	ND	ND	ND	ND
CP-6D	ND	ND	ND	ND	ND	ND
CP-6W	ND	ND	ND	ND	ND	ND
CP-7A	ND	ND	ND	ND	ND	ND
CP-7B	ND	ND	ND	ND	ND	ND
CP-7C	ND	ND	ND	ND	ND	ND
CP-7D	ND	ND	ND	ND	ND	ND
CP-7W	ND	ND	ND	ND	ND	ND
CP-8A	ND	ND	ND	ND	ND	ND
CP-8B	ND	ND	ND	ND	ND	ND
CP-8C	ND	ND	ND	ND	ND	ND
CP-8D	ND	ND	ND	ND	ND	ND

Table 6 (cont.)

Sample ID	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
CP-8W	ND	ND	ND	ND	ND	ND
CP-9A	ND	ND	ND	ND	ND	ND
CP-9B	ND	ND	ND	ND	ND	ND
CP-9C	ND	ND	ND	ND	ND	ND
CP-9D	ND	ND	ND	ND	ND	ND
CP-9W	ND	ND	ND	ND	ND	ND
CP-10A	ND	ND	ND	ND	ND	ND
CP-10B	ND	ND	ND	ND	ND	ND
CP-10C	ND	ND	ND	ND	ND	ND
CP-10D	ND	ND	ND	ND	ND	ND
CP-10W	ND	ND	ND	ND	ND	ND
CP-11A	ND	ND	ND	ND	ND	ND
CP-11B	ND	ND	ND	ND	ND	ND
CP-11C	ND	ND	ND	ND	ND	ND
CP-11D	ND	ND	ND	ND	ND	ND
CP-11W	ND	ND	ND	ND	ND	ND
CP-12A	ND	ND	ND	ND	ND	ND
CP-12B	ND	ND	ND	ND	ND	ND
CP-12C	ND	ND	ND	ND	ND	ND
CP-12D	ND	ND	ND	ND	ND	ND
CP-12W	ND	ND	ND	ND	ND	ND
CP-13A	ND	ND	ND	ND	ND	ND
CP-13B	ND	ND	ND	ND	ND	ND
CP-13C	ND	ND	ND	ND	ND	ND
CP-13D	ND	ND	ND	ND	ND	ND
CP-13W	ND	ND	ND	ND	ND	ND
CP-14A	ND	ND	ND	ND	ND	ND
CP-14B	ND	ND	ND	ND	ND	ND
CP-14C	ND	ND	ND	ND	ND	ND
CP-14D	ND	ND	ND	ND	ND	ND
CP-14W	ND	ND	ND	ND	ND	ND
CP-15A	ND	ND	ND	ND	ND	ND
CP-15B	ND	ND	ND	ND	ND	ND
CP-15C	ND	ND	ND	ND	ND	ND

Table 6 (cont.)

Sample ID	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
CP-15D	ND	ND	ND	ND	ND	ND
CP-15W	ND	ND	ND	ND	ND	ND
CP-16A	ND	ND	ND	ND	ND	ND
CP-16B	ND	ND	ND	ND	ND	ND
CP-16C	ND	ND	ND	ND	ND	ND
CP-16D	ND	ND	ND	ND	ND	ND
CP-16W	ND	ND	ND	ND	ND	ND
CP-17A	ND	ND	ND	ND	ND	ND
CP-17B	ND	ND	ND	ND	ND	ND
CP-17C	ND	ND	ND	ND	ND	ND
CP-17D	ND	ND	ND	ND	ND	ND
CP-17W	ND	ND	ND	ND	ND	ND
CP-18A	ND	ND	ND	ND	ND	ND
CP-18B	ND	ND	ND	ND	ND	ND
CP-18C	ND	ND	ND	ND	ND	ND
CP-18D	ND	ND	ND	ND	ND	ND
CP-18W	ND	ND	ND	ND	ND	ND
CP-19A	ND	ND	ND	ND	ND	ND
CP-19B	ND	ND	ND	ND	ND	ND
CP-19C	ND	ND	ND	ND	ND	ND
CP-19D	ND	ND	ND	ND	ND	ND
CP-19W	ND	ND	ND	ND	ND	ND
CP-20A	ND	ND	ND	ND	ND	ND
CP-20B	ND	ND	ND	ND	ND	ND
CP-20C	ND	ND	ND	ND	ND	ND
CP-20D	ND	ND	ND	ND	ND	ND
CP-20W	ND	ND	ND	ND	ND	ND
CP-21A	ND	ND	ND	ND	ND	ND
CP-21B	ND	ND	ND	ND	ND	ND
CP-21C	ND	ND	ND	ND	ND	ND
CP-21D	ND	ND	ND	ND	ND	ND
CP-21W	ND	ND	ND	ND	ND	ND
CP-22A	ND	ND	ND	ND	ND	ND
CP-22B	ND	ND	ND	ND	ND	ND

Table 6 (cont.)

Sample ID	HMX	Nitrobenzene	Nitroglycerin	PETN	RDX	Tetryl
CP-22C	ND	ND	ND	ND	ND	ND
CP-22D	ND	ND	ND	ND	ND	ND
CP-22W	ND	ND	ND	ND	ND	ND
CP-23A	ND	ND	ND	ND	ND	ND
CP-23B	ND	ND	ND	ND	ND	ND
CP-23C	ND	ND	ND	ND	ND	ND
CP-23D	ND	ND	ND	ND	ND	ND
CP-23W	ND	ND	ND	ND	ND	ND
CP-24A	ND	ND	ND	ND	ND	ND
CP-24B	ND	ND	ND	ND	ND	ND
CP-24C	ND	ND	ND	ND	ND	ND
CP-24D	ND	ND	ND	ND	ND	ND
CP-24W	ND	ND	ND	ND	ND	ND
CP-25A	ND	ND	ND	ND	ND	ND
CP-25B	ND	ND	ND	ND	ND	ND
CP-25C	ND	ND	ND	ND	ND	ND
CP-25D	ND	ND	ND	ND	ND	ND
CP-25W	ND	ND	ND	ND	ND	ND

"ND" denotes analyte was not detected at the limit of detection.

"A, B, C or D" indicates the vertical fraction of each sediment core as the top, second, third or fourth foot below the sediment-water interface, respectively.

"W" denotes the water sample at each sampling site.

Table 7. Concentrations of ionic salts by sampling site around Piney Island (BT-11) and Brant Island Shoal (BT-9).

Sample ID	Perchlorate	Carbonate	Chloride	Nitrate/Nitrite	Sulfate
CP-1A	ND	ND	2700	0.37	410
CP-1B	ND	ND	2400	0.35	380
CP-1C	ND	ND	2800	0.27	430
CP-1W	ND	ND	15000	0.072	1900
CP-2A	ND	ND	14000	0.34	2000
CP-2B	ND	ND	7400	0.39	1300
CP-2C	ND	14	4800	0.34	780
CP-2D	ND	25	3400	0.33	710
CP-2W	ND	ND	15000	0.056	1900
CP-3A	ND	ND	6700	0.33	1000
CP-3B	ND	ND	4900	0.34	730
CP-3C	ND	ND	3300	0.23	550
CP-3D	ND	ND	2700	0.2	430
CP-3W	ND	ND	16000	0.06	2000
CP-4A	ND	ND	16000	0.48	2000
CP-4B	ND	ND	14000	0.51	1700
CP-4C	ND	ND	16000	0.75	1600
CP-4D	ND	ND	18000	0.72	1400
CP-4W	ND	ND	16000	0.06	2000
CP-6A	ND	ND	2900	0.39	560
CP-6B	ND	12	3300	0.42	740
CP-6C	ND	ND	2900	0.39	710
CP-6D	ND	ND	2900	0.39	610
CP-6W	ND	ND	18000	0.052	2000
CP-7A	ND	ND	16000	0.39	1900
CP-7B	ND	ND	11000	0.46	1200
CP-7C	ND	ND	13000	0.4	1400
CP-7D	ND	ND	12000	0.49	970

Table 7 (cont.)

Sample ID	Perchlorate	Carbonate	Chloride	Nitrate/Nitrite	Sulfate
CP-7W	ND	ND	18000	0.063	2000
CP-8A	0.21	ND	12000	0.51	1400
CP-8B	ND	ND	12000	0.34	1600
CP-8C	ND	ND	8800	0.36	700
CP-8D	0.32	ND	10000	0.48	530
CP-8W	ND	ND	18000	0.049	2000
CP-9A	ND	ND	3200	0.32	570
CP-9B	ND	ND	3400	0.34	710
CP-9C	ND	ND	2700	0.33	560
CP-9D	ND	ND	2900	0.28	450
CP-9W	ND	ND	11000	0.047	1600
CP-10A	ND	ND	13000	0.49	1900
CP-10B	ND	ND	12000	0.48	1800
CP-10C	ND	ND	11000	0.51	1400
CP-10D	ND	ND	9100	0.61	360
CP-10W	ND	ND	14000	0.056	1700
CP-11A	ND	ND	19000	0.5	1100
CP-11B	ND	ND	12000	0.55	1100
CP-11C	ND	ND	17000	0.56	1800
CP-11D	ND	ND	20000	0.59	1500
CP-11W	ND	ND	12000	0.057	1700
CP-12A	ND	ND	2100	0.31	560
CP-12B	ND	ND	2300	0.34	570
CP-12C	ND	ND	2700	0.33	540
CP-12D	ND	ND	2700	0.38	490
CP-12W	ND	ND	12000	0.058	1700
CP-13A	ND	ND	2900	0.29	580
CP-13B	ND	ND	3200	0.4	660
CP-13C	ND	ND	3300	0.54	880
CP-13D	ND	ND	3200	0.66	680
CP-13W	ND	ND	12000	0.055	1700
CP-14A	ND	ND	2800	0.35	450
CP-14B	ND	ND	2600	0.39	440

Table 7 (cont.)

Sample ID	Perchlorate	Carbonate	Chloride	Nitrate/Nitrite	Sulfate
CP-14C	ND	ND	2600	0.3	390
CP-14D	ND	ND	2800	0.3	420
CP-14W	ND	ND	13000	0.048	1900
CP-15A	ND	ND	2800	0.37	490
CP-15B	ND	ND	2800	0.31	460
CP-15C	ND	ND	3000	0.31	520
CP-15D	0.26	ND	2900	0.3	460
CP-15W	ND	ND	13000	0.051	1900
CP-16A	ND	ND	3700	0.34	640
CP-16B	ND	ND	2600	0.3	450
CP-16C	ND	ND	2100	0.26	380
CP-16D	ND	ND	2100	0.41	350
CP-16W	ND	ND	13000	0.048	1900
CP-17A	ND	ND	2500	0.26	410
CP-17B	ND	ND	2400	0.29	350
CP-17C	ND	ND	2000	0.29	320
CP-17D	ND	ND	2200	0.29	330
CP-17W	ND	ND	13000	0.052	1900
CP-18A	ND	ND	2700	0.66	450
CP-18B	ND	ND	2200	0.38	390
CP-18C	ND	ND	2300	0.49	410
CP-18D	ND	ND	2300	0.76	430
CP-18W	ND	ND	13000	0.052	1900
CP-19A	ND	ND	2800	0.2	560
CP-19B	ND	ND	3100	0.19	690
CP-19C	ND	ND	1700	0.41	440
CP-19D	ND	ND	1400	0.25	250
CP-19W	ND	ND	13000	0.05	1900
CP-20A	0.21	ND	3300	0.21	640
CP-20B	ND	ND	2900	0.22	540
CP-20C	ND	ND	2600	0.28	470
CP-20D	ND	ND	3200	0.26	610
CP-20W	ND	ND	14000	0.05	1900

Table 7 (cont.)

Sample ID	Perchlorate	Carbonate	Chloride	Nitrate/Nitrite	Sulfate
CP-21A	ND	ND	3400	0.26	650
CP-21B	ND	ND	3500	0.3	610
CP-21C	ND	31	4400	0.29	760
CP-21D	ND	18	3700	0.43	670
CP-21W	ND	ND	13000	0.093	1900
CP-22A	ND	ND	2600	0.23	510
CP-22B	ND	ND	2700	0.23	490
CP-22C	ND	ND	3800	0.23	730
CP-22D	ND	23	4600	0.26	830
CP-22W	ND	ND	15000	0.055	2000
CP-23A	ND	ND	4400	0.34	840
CP-23B	ND	ND	4500	0.41	910
CP-23C	ND	ND	6000	0.31	1700
CP-23D	ND	ND	53000	0.34	9500
CP-23W	ND	ND	14000	0.057	2000
CP-24A	ND	ND	12000	0.41	2400
CP-24B	ND	ND	25000	0.27	3000
CP-24C	ND	ND	5700	0.32	640
CP-24D	ND	ND	680	0.3	88
CP-24W	ND	ND	14000	0.069	2000
CP-25A	ND	ND	12000	0.3	1800
CP-25B	ND	ND	13000	0.27	1900
CP-25C	ND	ND	3000	0.48	910
CP-25D	ND	ND	2200	0.47	730
CP-25W	ND	ND	14000	0.053	1900

"ND" denotes analyte was not detected at the limit of detection.

"A, B, C or D" indicates the vertical fraction of each sediment core as the top, second, third or fourth foot below the sediment-water interface, respectively.

"W" denotes the water sample at each sampling site.

Perchlorate sediment and sea water results are in µg/kg and µg/L, respectively. All other sediment and sea water results are in mg/kg or mg/L, respectively.

Table 8. Concentrations of chemical elements by sampling site around Piney Island (BT-11) and Brant Island Shoal (BT-9).

Sample ID	Fraction	Lead	Calcium	Magnesium	Potassium	Sodium
CP-1A		6300	430	1100	1100	2600
CP-1B		6800	390	1400	1200	2400
CP-1C		6000	350	1100	960	2200
CP-1W	Dissolved	ND	240000	750000	230000	6500000
CP-1W	Total	0.92	260000	780000	240000	6800000
CP-2A		21000	2700	5400	2700	12000
CP-2B		6400	780	2500	1300	5100
CP-2C		3200	3800	1600	840	2800
CP-2D		2700	14000	1000	550	2300
CP-2W	Dissolved	ND	260000	800000	240000	6900000
CP-2W	Total	ND	260000	810000	240000	6900000
CP-3A		5500	910	2600	1300	4600
CP-3B		4500	780	2500	1200	3600
CP-3C		1900	280	860	450	1900
CP-3D		1300	180	480	240	1400
CP-3W	Dissolved	ND	270000	830000	250000	7200000
CP-3W	Total	ND	270000	850000	260000	7400000
CP-4A		15000	2500	6800	3300	11000
CP-4B		12000	2800	7400	3500	10000
CP-4C		12000	2900	6800	3300	9100
CP-4D		12000	2300	6800	3400	10000
CP-4W	Dissolved	ND	280000	850000	260000	7400000
CP-4W	Total	ND	290000	870000	280000	8100000
CP-6A		2400	23000	950	370	2400
CP-6B		2700	12000	1500	580	2400
CP-6C		2400	3700	1300	530	2100
CP-6D		2100	1100	1200	500	2000
CP-6W	Dissolved	ND	270000	850000	250000	7300000
CP-6W	Total	ND	270000	840000	250000	7200000
CP-7A		16000	2000	6100	2900	12000
CP-7B		12000	2500	7000	3400	10000
CP-7C		12000	3100	6900	3300	9100
CP-7D		11000	6700	6700	3200	8900

Table 8 (cont.)

Sample ID	Fraction	Lead	Calcium	Magnesium	Potassium	Sodium
CP-7W	Dissolved	ND	280000	860000	260000	7500000
CP-7W	Total	ND	280000	910000	270000	7500000
CP-8A		12000	2200	6700	3400	9500
CP-8B		14000	2200	6200	3100	10000
CP-8C		12000	2500	6500	3300	8600
CP-8D		12000	3200	6800	3400	8500
CP-8W	Dissolved	ND	270000	840000	250000	7300000
CP-8W	Total	ND	280000	880000	270000	7500000
CP-9A		6200	480	1100	860	2800
CP-9B		5500	530	980	840	2900
CP-9C		4000	270	1300	980	2400
CP-9D		3300	8100	1700	1100	2600
CP-9W	Dissolved	ND	220000	680000	200000	5900000
CP-9W	Total	0.94	230000	710000	210000	6100000
CP-10A		14000	2800	3600	1900	9800
CP-10B		11000	1800	3900	2100	9200
CP-10C		9500	1700	4500	2500	8800
CP-10D		9000	1700	4500	2600	7500
CP-10W	Dissolved	ND	230000	690000	210000	6000000
CP-10W	Total	1	230000	710000	210000	6100000
CP-11A		18000	4500	4500	2300	11000
CP-11B		11000	1700	3300	1700	7500
CP-11C		7300	2600	4300	2200	11000
CP-11D		7900	3200	4900	2500	13000
CP-11W	Dissolved	ND	240000	740000	250000	6600000
CP-11W	Total	0.58	240000	730000	230000	6200000
CP-12A		3600	430	470	360	1100
CP-12B		3000	230	610	480	1200
CP-12C		2100	230	630	450	1400
CP-12D		2000	2100	730	530	1500
CP-12W	Dissolved	ND	250000	750000	250000	6700000
CP-12W	Total	ND	250000	760000	240000	6400000
CP-13A		2700	160	340	180	1500
CP-13B		2100	140	360	190	1600

Table 8 (cont.)

Sample ID	Fraction	Lead	Calcium	Magnesium	Potassium	Sodium
CP-13C		5600	340	1300	1100	2500
CP-13D		7700	750	1600	1500	2600
CP-13W	Dissolved	ND	250000	770000	260000	6900000
CP-13W	Total	ND	250000	780000	250000	6600000
CP-14A		2300	120	290	110	1800
CP-14B		3900	130	350	150	1900
CP-14C		2100	110	260	85	1500
CP-14D		1900	130	250	74	1800
CP-14W	Dissolved	ND	240000	740000	250000	6700000
CP-14W	Total	ND	280000	860000	280000	7300000
CP-15A		2400	240	360	150	2000
CP-15B		2600	140	400	170	1700
CP-15C		2200	170	510	250	2000
CP-15D		1600	150	330	140	1800
CP-15W	Dissolved	ND	240000	740000	250000	6600000
CP-15W	Total	ND	280000	850000	280000	7300000
CP-16A		3000	200	460	190	2000
CP-16B		2200	150	440	220	1700
CP-16C		1600	90	280	140	1600
CP-16D		730	88	270	100	1600
CP-16W	Dissolved	ND	240000	750000	250000	6600000
CP-16W	Total	ND	260000	820000	270000	7000000
CP-17A		1300	93	220	63	1600
CP-17B		2100	180	310	160	1500
CP-17C		2500	88	300	150	1500
CP-17D		2000	100	370	210	1500
CP-17W	Dissolved	ND	240000	750000	250000	6700000
CP-17W	Total	ND	270000	840000	270000	7200000
CP-18A		1900	340	250	94	1700
CP-18B		2900	130	330	210	1600
CP-18C		4400	190	550	430	1900
CP-18D		4100	190	560	450	1900
CP-18W	Dissolved	ND	240000	760000	250000	6700000

Table 8 (cont.)

Sample ID	Fraction	Lead	Calcium	Magnesium	Potassium	Sodium
CP-18W	Total	ND	270000	840000	270000	7200000
CP-19A		4100	820	760	410	1500
CP-19B		5000	1300	1200	680	1900
CP-19C		5400	600	530	440	1000
CP-19D		4300	290	400	350	960
CP-19W	Dissolved	ND	290000	890000	290000	7800000
CP-19W	Total	ND	280000	860000	280000	7000000
CP-20A		5000	660	780	470	1800
CP-20B		5200	620	1100	870	1900
CP-20C		6800	290	1400	990	1800
CP-20D		7900	1300	2400	1400	2300
CP-20W	Dissolved	ND	290000	870000	290000	7700000
CP-20W	Total	ND	270000	850000	270000	7200000
CP-21A		4800	500	1200	910	2100
CP-21B		4300	520	1700	1000	2000
CP-21C		4300	11000	2400	1300	2900
CP-21D		1900	64000	870	520	2600
CP-21W	Dissolved	ND	280000	860000	290000	7600000
CP-21W	Total	ND	270000	840000	270000	7200000
CP-22A		5500	290	950	640	1800
CP-22B		4100	220	1400	820	1900
CP-22C		7000	310	2900	1800	2600
CP-22D		7500	440	3100	1800	2600
CP-22W	Dissolved	ND	290000	880000	290000	7900000
CP-22W	Total	ND	290000	890000	290000	7600000
CP-23A		3200	2300	600	280	2400
CP-23B		3800	700	880	470	2400
CP-23C		3400	550	1000	520	3300
CP-23D		3000	2400	4900	1500	30000
CP-23W	Dissolved	ND	260000	800000	270000	7300000
CP-23W	Total	ND	280000	870000	290000	7500000
CP-24A		6400	2400	2100	890	6500
CP-24B		4800	10000	5100	950	15000

Table 8 (cont.)

Sample ID	Fraction	Lead	Calcium	Magnesium	Potassium	Sodium
CP-24C		2300	480	260	110	550
CP-24D		2000	380	210	93	470
CP-24W	Dissolved	ND	250000	780000	270000	7100000
CP-24W	Total	ND	290000	880000	290000	7500000
CP-25A		6600	1400	2200	1100	6100
CP-25B		5900	1900	3200	1600	7700
CP-25C		3000	610	950	480	2000
CP-25D		1800	420	570	260	1200
CP-25W	Dissolved	ND	290000	880000	290000	8000000
CP-25W	Total	ND	290000	900000	290000	7700000

"ND" denotes analyte was not detected at the limit of detection.
"A, B, C or D" indicates the vertical fraction of each sediment core as the top, second, third or fourth foot below the sediment-water interface, respectively.
"W" denotes the water sample at each sampling site. Water samples were analyzed for both dissolved and total concentrations of the analytes in Table 8. The column labeled "Fraction" distinguishes between the two.
All sea water results are in µg/L. All sediment results are in mg/kg, except for lead that is reported in µg/kg.

6. DISCUSSION

Piney Island (BT-11) and Brant Island Shoal (BT-9) provide a variety of aerial bombing targets and as such, are valuable military assets. It is thus important that these ranges be operated in a sustainable manner, one in which the military's needs are met without unacceptable risk to human health or the environment. To this end, the U.S. Marine Corps is evaluating whether there has been a release or substantial threat of release of munitions constituents from its operational ranges to off-range areas that might jeopardize long-term range use. To make this determination, bottom sediment and sea water samples from 24 locations, fifteen around BT-11 and nine around BT-9, were collected and subsequently analyzed for a variety of analytes, including explosives constituents. With the exception of perchlorate that was found at extremely low concentrations in only four of ninety-five sediment samples, no explosive constituent was found above its minimum detection limit. The concentrations of all other analytes are believed to be consistent with background levels in near-shore bottom sediment and sea water. As for perchlorate in bottom sediment, it is likely naturally occurring rather than associated with bombing range activities given its extreme water solubility. *Therefore, the data presented herein do not indicate munitions constituents are migrating from BT-11 or BT-9 to the off-range areas examined and accumulating at concentrations that pose unacceptable health risks to ecological or human receptors.*