

Final Technical Memorandum
Human Health Risk Assessment of
Shoreline Surface Waters and Sediments,
and Groundwater in Shallow Piezometers
Site 07, Calf Pasture Point

Former Naval Construction
Battalion Center Davisville
North Kingstown, Rhode Island



Naval Facilities Engineering Command
Mid-Atlantic

Contract Number N62472-03-D-0057

Contract Task Order 019

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FINAL TECHNICAL MEMORANDUM

**HUMAN HEALTH RISK ASSESSMENT OF
SHORELINE SURFACE WATERS AND SEDIMENTS,
AND GROUNDWATER IN SHALLOW PIEZOMETERS
SITE 07, CALF PASTURE POINT**

**FORMER NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE
NORTH KINGSTOWN, RHODE ISLAND**

**COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION – NAVY (CLEAN) CONTRACT**

**Submitted to:
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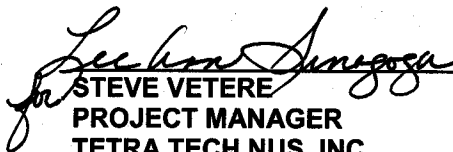
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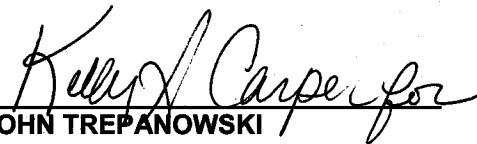
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FINAL TECHNICAL MEMORANDUM

HUMAN HEALTH RISK ASSESSMENT OF SHORELINE SURFACE WATERS AND SEDIMENTS, AND GROUNDWATER IN SHALLOW PIEZOMETERS SITE 07, CALF PASTURE POINT FORMER NAVAL CONSTRUCTION BATTALION CENTER DAVISVILLE NORTH KINGSTOWN, RHODE ISLAND

EXECUTIVE SUMMARY

This human health risk assessment (HHRA) was conducted to evaluate risks associated with potential human exposure to volatile organic compounds (for example trichloroethene) detected in surface water and shallow groundwater samples, and volatile organic compounds (VOCs) and metals detected in sediment samples collected along the Site 07 shoreline. The impetus for the assessment was the detection of VOCs in groundwater samples collected from shoreline piezometers at Site 07. The environmental samples were collected as part of the long-term monitoring program for Site 07 as required by the Record of Decision established for this site (September 1999). For purposes of completeness, the assessment also re-evaluated risks using the analytical data for shellfish previously collected during the Phase III Remedial Investigation for Site 07. The HHRA was prepared per methodology presented in the *Final Technical Memorandum, Human Health Risk Assessment Methodology for the Evaluation of Shoreline Surface Waters and Sediments, and Groundwater in Shallow Piezometers, Site 07 (Calf Pasture Point), Former Naval Construction Battalion Center (NCBC) Davisville, RI* (December 2006). The methodology was reviewed and approved by EPA Region I and the Rhode Island Department of Environmental Management (RIDEM).

The following chemicals of potential concern were selected for the HHRA utilizing a conservative toxicity screening protocol:

- **Shallow groundwater (from piezometers along the shoreline):** 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, benzene, chloroform, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride.
- **Surface water (along the shoreline):** 1,1,2,2-tetrachloroethane, cis-1,2-dichloroethene, trichloroethene, and vinyl chloride.
- **Sediments (along the shoreline):** Trichloroethene, vinyl chloride, aluminum, arsenic, beryllium, and iron.
- **Shellfish data (as presented in the Phase III Remedial Investigation for Site 07):** Polycyclic aromatic hydrocarbons (benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene), Aldrin, 4,4'-DDE, Aroclor-1242, Aroclor-1254, and Aroclor-1260, arsenic, cadmium, chromium, copper, iron, manganese, mercury, nickel, and silver.

The human receptors considered in the HHRA were individuals potentially exposed to the chemicals of potential concern in the Site 07 shoreline surface waters, sediments, or shallow groundwater while swimming, wading, or gathering shellfish. The exposure pathways evaluated were:

- Dermal contact (skin surface exposure) with or the incidental ingestion of surface waters and sediments while swimming, wading, or gathering shellfish.
- Dermal contact with shallow groundwater while digging into the shoreline sediments to gather shellfish.
- Consumption of shellfish collected along the Site 07 shoreline.

Chemical intakes (or doses) resulting from exposure to chemicals of concern were estimated according to the exposure assumptions (e.g., water or sediment ingestion rates) and equations presented in aforementioned Technical Memorandum dated December 2006. The exposure assumptions and equations presented in this Technical Memorandum are conservative (i.e., the exposure assumptions were selected to error on the side of safety).

Standard EPA methodology, as presented in the EPA's Risk Assessment Guidance for Superfund (Part A) (December 1989), was used to estimate cancer and non-cancer risk. Cancer risk estimates were presented in terms of the probability of developing cancer. Non-cancer risk estimates were presented in terms of a hazard quotient which is simply the ratio of an exposure dose or concentration to an acceptable dose or concentration.

All of the cancer risk estimates developed for potential human exposure to chemicals of potential concern in the shallow groundwater, surface waters, and sediments while swimming, wading, or shell-fishing were within the EPA's generally acceptable cancer risk range and did not exceed the State of Rhode Island cancer risk benchmark of 10^{-5} . All of the hazard quotients and hazard indices for these same potential exposures were less than 1.

The cancer risk and non-cancer risk estimates developed for consumption of shellfish do exceed both EPA and State of Rhode Island risk management benchmarks. The primary chemicals of potential concern contributing to the cancer and non-cancer risk estimates are arsenic, mercury, and the polychlorinated biphenyls. However, a review of source area data for Site 07 and background data for sediments and shellfish indicates that these chemicals are not present in the shellfish as a consequence of disposal activities at Site 07. The shellfish samples were collected in the mid-1990's and the determination that mercury concentrations in shellfish are not related to Site 07 disposal activities is clearly documented in the September 1999 ROD for Calf Pasture Point.

1.0 INTRODUCTION

This technical memorandum presents the results of a human health risk assessment (HHRA) of volatile organic chemicals (VOCs) detected in the surface water and shallow groundwater (piezometers), and VOCs and metals detected in sediment samples collected along the shoreline at Site 07 Calf Pasture Point, Former Naval Construction Battalion Center (NCBC) Davisville, Kingstown, Rhode Island. The assessment was prepared to evaluate human health risks potentially associated with exposures to these environmental media while swimming, wading, and shell fishing along the Site 07 shoreline. A "No Wading" sign currently exists along the Site 07 shoreline.

This HHRA was prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. 62472-03-D-0057, Contract Task Order No. 19.

1.1 Site History

Calf Pasture Point is a peninsula located in the northeast portion of the former NCBC Davisville. Site 07 is located in the southern portion of Calf Pasture Point, bordered by Allen Harbor to the south and west and Narragansett Bay to the east (Figure 1-1). Site 07 is the former location of three earthen-covered munitions bunkers which were located in the middle of Calf Pasture Point to the north, east, and south of a bedrock outcrop. This outcrop is a prominent hill with a maximum elevation of approximately 55 feet above mean sea level (MSL), located north of well MW07-07S (Figure 1-2). The bunkers were demolished by the Navy in February 1997 and September 2000.

Some time between 1968 and 1974, in the area south of the former munitions bunkers, a trench was reportedly filled with cans that contained Decontaminating Agent Non-Corrosive (DANC) solution. This trench is believed to be the source of a chlorinated volatile organic compound (CVOC) groundwater plume that is present beneath Site 07. The approximate location of the disposal area has been inferred through various phases of investigation at Site 07.

The Navy completed a Remedial Investigation/Feasibility Study (RI/FS) for Site 07 in September 1998. In September 1999, a Record of Decision (ROD) was signed to document the selection of the following remedy for Site 07:

- A deed restriction prohibiting the use of groundwater in order to prevent human contact with, or use of, impacted groundwater (e.g. for drinking or showering purposes). The deed restriction also imposes restrictions on the future use of the property (recreational only) and requires that any

building, structure, or other improvement be designed and constructed to include adequate ventilation.

- Long-term monitoring (LTM) of groundwater, as well as sampling of sediment in the shoreline area as warranted based upon trends in the groundwater data. LTM at Site 07 also includes risk monitoring to demonstrate the protection of human health and the environment, which is the objective of this Technical Memorandum.
- Five-year reviews as required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

In November 2000, the Navy completed a Conceptual Long-Term Monitoring Plan (CLTMP) for Site 07, establishing the basis for the long-term monitoring program that is currently being implemented at the Site. In July 2001, the Navy completed a Quality Assurance Project Plan (QAPP) for the long-term monitoring program (LTMP). LTM at Site 07 commenced in August 2001 on a nine-month monitoring schedule. To date, seven monitoring events have been completed (the seventh event occurred in November 2006, but this HHRA was completed before validated data was available from this event).

In October 2004, based upon the detection of CVOCs in shoreline piezometers adjacent to the Allen Harbor entrance channel, and as directed by the LTM QAPP rules, the Navy performed supplemental groundwater and surface water sampling from P07-06 through P07-10 and P07-24. This supplemental sampling was performed bi-monthly until January 2006 to monitor the concentrations of CVOCs present in shallow groundwater and surface water along the Site 07 shoreline. The supplemental data, along with data collected during the first six 9-month sampling events, was used to support this shoreline HHRA.

1.2 Shoreline Human Health Risk Assessment

The shoreline HHRA utilizes shallow groundwater (piezometer), surface water, and sediment sampling results to calculate human health risks associated with wading and shellfishing along the Site 07 shoreline adjacent to the Allen Harbor entrance channel. The samples used to support the assessment were collected as part of the LTMP for Site 07 (and supplemental investigations) as described in the *Quality Assurance Project Plan for Long-Term Monitoring of Site 07 (Calf Pasture Point), NCBC, North Kingstown, Rhode Island* (EA, July 2001).

The shallow groundwater samples were collected from shoreline piezometers located along the northern bank of the entrance channel separating Narragansett Bay from Allen Harbor (i.e., the southern boundary of Site 07) and along the Allen Harbor shoreline which adjoins the western edge of Site 07. The screened

interval for the piezometers is approximately two to three feet below ground surface (bgs). The surface water samples (shallow shoreline samples) were collected from eight locations co-located with piezometer stations positioned along the northern bank of the entrance channel separating Narragansett Bay from Allen Harbor. The sediment samples were collected from six locations also located in this area. All samples were collected at low- to mid-tide. For purposes of completeness, the HHRA also re-assessed the analytical data for shellfish previously evaluated in the Phase III RI for Site 07.

The HHRA was prepared per methodology presented in the *Final Technical Memorandum, Human Health Risk Assessment Methodology for the Evaluation of Shoreline Surface Waters and Sediments, and Groundwater in Shallow Piezometers, Site 07 (Calf Pasture Point), Former Naval Construction Battalion Center (NCBC) Davisville, RI* (TtNUS, December 2006).

2.0 CHEMICAL OF POTENTIAL CONCERN SELECTION AND DETERMINATION OF THE EXPOSURE POINT CONCENTRATION

2.1 Determination of Chemicals of Potential Concern

Chemicals of Potential Concern (COPCs) are those chemicals evaluated qualitatively or quantitatively in a HHRA to determine potential human health risks as a result of exposure to an environmental medium. COPCs for this Site 07 Shoreline Risk Assessment (SRA) were selected primarily based on a toxicity screen (i.e., a comparison of site contaminant concentrations to conservative toxicity screening values). In addition, as discussed below, factors such as frequency of detection were considered in some cases.

2.1.1 Derivation of Screening Criteria

The toxicity screening levels used to identify **COPCs** for the Site 07 SRA were based on preliminary remediation goals (PRGs) for residential soil and tap-water developed by USEPA Region 9 (USEPA Region 9, October 2004, updated December 28, 2004), criteria established by the Rhode Island Department of Environmental Management, Office of Waste Management (RIDEM, February 2004), and USEPA Region 3 risk-based concentrations (RBCs) for fish tissue (USEPA, Region 3, October 20, 2006). COPCs were selected based on the lowest screening level derived from these criteria.

The screening concentrations based on the PRGs and RBCs correspond to a systemic hazard quotient (HQ) of 0.1 for non-carcinogens or an incremental lifetime cancer risk of 1×10^{-6} for carcinogens. Note that the USEPA Region 9 PRGs and the USEPA Region 3 RBCs for non-carcinogens are based on an HQ of 1.0, whereas the screening concentrations are based on an HQ of 0.1. The screening concentrations are based on an HQ of 0.1 to account for the potential cumulative effects of several

chemicals affecting the same target organ or producing the same adverse non-carcinogenic effect. Chemicals detected at maximum concentrations in surface water or groundwater that exceed screening concentrations based on the Region 9 PRGs for tap water or the RIDEM criteria for groundwater were selected as COPCs for groundwater or surface water. Chemicals detected at maximum concentrations in sediment that exceed screening concentrations based on the Region 9 PRGs for residential soil or the RIDEM direct contact for residential soils were selected as COPCs for sediment. Chemicals detected at maximum concentrations in shellfish tissue samples that exceed screening concentrations based on the Region 3 RBCs for consumption of fish were selected as COPCs for shell-fish consumption.

Individual chemicals were eliminated as COPCs if they are detected at a frequency less than 5 percent in any given medium but only if there were no other indications that the chemical would pose an unacceptable risk to receptors (e.g., there was no evidence of a contaminant "hot spot").

2.1.2 Selection of COPCs

Groundwater

Analytical data for shallow groundwater samples collected between August 2001 and January 2006 from piezometers locations PZ1 through PZ33 were evaluated in the COPC selection. Eighteen VOCs were detected in the shallow groundwater samples collected at the Site 07. A comparison of the maximum detected groundwater concentrations to screening levels based on the USEPA Region 9 PRGs for ingestion of tap water and RIDEM GA groundwater objectives is presented in Table 2-1. The following chemicals were detected in the shallow groundwater samples at maximum concentrations exceeding the COPC screening levels and were retained as COPCs for shallow groundwater at Site 07:

1,1,2,2-TCA	1,1,2-TCA	1,1-DCE	1,2-DCA	Benzene
Chloroform	<i>cis</i> -1,2-DCE	<i>trans</i> -1,2-DCE	TCE	Vinyl Chloride

- TCA = tetrachloroethane, DCA = dichloroethane, TCE = trichloroethene, DCE = dichloroethene

Concentrations of tetrachloroethene also exceeded the USEPA Region 9 PRG but were less than the RIDEM GA groundwater objectives. The maximum detected concentration of tetrachloroethene (1.19 µg/L) is also less than the USEPA MCL (5 µg/L). Tetrachloroethene was detected in only 6 of 238 samples. Tetrachloroethene was not retained as a COPC because it was detected infrequently in groundwater (less than 2.5 percent of the samples) and at low concentrations (i.e., less than the EPA MCL and RIDEM GA groundwater objectives). Concentrations of total 1,2-DCE also exceeded the screening criteria. The analytical result reported for total 1,2-DCE for each sample is the sum of the

results reported for the "cis" and "trans" isomers of 1,2-DCE. Consequently 1,2-DCE was evaluated in this HHRA as cis-1,2-DCE and trans-1,2-DCE.

Surface Water

Analytical data for surface water samples collected between December 1995 and January 2006 from locations SW04 through SW10 and location SW24 were evaluated in the COPC selection. Six VOCs were detected in the surface water samples collected at the Site 07. A comparison of the maximum detected surface water concentrations to screening levels based on the USEPA Region 9 PRGs for ingestion of tap water and RIDEM GA groundwater objectives is presented in Table 2-2. The following chemicals were detected in the surface water samples at maximum concentrations exceeding the COPC screening levels and were retained as COPCs for surface water at Site 07:

- 1,1,2,2-tetrachloroethane, cis-1,2-dichloroethene, trichloroethene, and vinyl chloride

Concentrations of 1,1,2-trichloroethane also exceeded the USEPA Region 9 PRG but were less than the RIDEM GA groundwater objectives. The maximum detected concentration of 1,1,2-trichloroethane (3 µg/L) is also less than the USEPA MCL (5 µg/L). 1,1,2-Trichloroethane was detected in only 2 of 89 samples. 1,1,2-Trichloroethane was not retained as a COPC because it was detected infrequently in groundwater (less than 2.2 percent of the samples) and at low concentrations (i.e., less than the EPA MCL and RIDEM GA groundwater objectives).

Sediment

Analytical data for sediment samples collected between September 2002 and September 2005 from locations SD05 through SD10, SD15, SD16, SD20, SD21, and SD22 were used in the COPC selection. 10 VOCs and 12 inorganics were detected in sediment samples collected at Site 07. A comparison of the maximum detected sediment concentrations to screening levels based on the USEPA Region 9 PRGs and RIDEM direct contact criteria for residential exposures is presented in Table 2-3. The following chemicals were detected in sediments at maximum concentrations exceeding the COPC screening levels and were retained as COPCs for sediment at Site 07.

- VOCs [trichloroethene and vinyl chloride]
- Inorganics [aluminum, arsenic, beryllium, and iron]

Concentrations of trichloroethene, arsenic, and iron exceeded the USEPA Region IX PRGs but were less than the RIDEM direct contact criteria. Concentrations of beryllium exceeded the RIDEM direct contact criteria but were less than the USEPA Region 9 PRGs.

Shellfish

Analytical data for shellfish samples evaluated in the human health risk assessment prepared for the Phase III Remedial Investigation Report (dated September 1998) were used in the COPC selection. Twenty-one SVOCs, 12 pesticides/PCBs, and 12 inorganics were detected in shellfish samples collected from Allen Harbor in the general vicinity of Site 07. A comparison of the maximum detected concentrations in shellfish to USEPA Region 3 RBCs for fish tissue is presented in Table 2-4. The following chemicals were detected in shellfish at maximum concentrations exceeding the COPC screening levels and were retained as COPCs for shellfish at Site 07.

- SVOCs [benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene]
- Pesticides/PCBs [Aldrin, 4,4'-DDE, Aroclor-1242, Aroclor-1254, and Aroclor-1260]
- Inorganics [arsenic, cadmium, chromium, copper, iron, manganese, mercury, nickel, and silver]

2.2 Calculation of the Exposure Point Concentration

The **exposure point concentration (EPC)**, which is calculated for COPCs only, is an estimate of the chemical concentration within an exposure unit (EU). The EPC is an estimate of the concentration to which a receptor may be exposed and is used to estimate exposure intakes. An EU is the area over which receptor activity is expected to occur. The two most important considerations in defining an EU are: 1) the anticipated receptor activity, and 2) the spatial distribution of contaminant concentrations. The EPCs calculated for receptors potentially exposed to the environmental media along the Site 07 shoreline considered the presence of a "hot spot" area along the southern boundary of Site 07 (locations 07-02 through 07-10 and 07-20 through 07-24, (see Figure 2-1). The EPC calculations also considered the fact that COPC levels have changed at some locations over the time-span that the Site 07 long-term monitoring program has been conducted. For example, VOC concentrations in the more recent sediment data (2004, 2005) exceed VOC concentrations detected in samples collected in 2002 and 2003. Consequently, the Site 07 SRA evaluated the following different data groupings/EUs for shallow groundwater, surface waters, and sediments:

Shallow Groundwater (Piezometers) (Table 2-5):

- **Case 1:** All available VOC data for 2005 and 2006 for locations 07-02 through 07-10, and locations 07-20 through 07-24 (i.e., the southern boundary area).

