FINAL
HUMAN HEALTH RISK ASSESSMENT (HHRA): SITE 08 GROUND WATER

Naval Construction Battalion Center
Davisville, Rhode Island

Contract No. N62472-92-D-1296
Contract Task Order No. 0028

Prepared for

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Naval Facilities Engineering Command
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April 1998
29600.28.3310

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LIST OF ACRONYMS

AE	Average Exposure
COC	Chemical of Concern
CSM	Conceptual Site Model
DPDO	Defense Property Disposal Office
EPA	Environmental Protection Agency
FFCA	Federal Facilities Compliance Act
HHRA	Human Health Risk Assessment
HI	Hazard Index
HQ	Hazard Quotient
IAS	Initial Assessment Study
IRP	(Defense) Installation Restoration Program
NCBC	Naval Construction Battalion Center
QA	Quality Assurance
QC	Quality Control
RAGS	Risk Assessment Guidance For Superfund
RBC	Risk Based Concentration
RIDEM	Rhode Island Department of Environmental Management
RME	Reasonable Maximum Exposure
SQL	Sample Quantitation Limit
TRC	TRC Environmental Consultants/Corporation
VOC	Volatile Organic Compound

HUMAN HEALTH RISK ASSESSMENTS: SITE 08 NCBC DAVISVILLE

1.0 INTRODUCTION

This Human Health Risk Assessment presents the results of the human health risk assessment (HHRA) for ground water risks at Site 08 of the Naval Construction Battalion Center in Davisville, Rhode Island (NCBC Davisville). NCBC Davisville is located in the northeastern section of the Town of North Kingstown, Rhode Island, approximately 18 miles south of the state capital, Providence. This HHRA is prepared in support of the Ground Water Evaluation, currently being performed by Stone & Webster Environmental Technology & Services (S&W).

The purpose of this report was to determine whether there are potential human health risks associated with ground water at Site 08. In this HHRA, risks associated with potential onsite exposures to COC in media of concern at Site 08 were evaluated for: (1) future construction workers (2) future adult residents, and (3) future child residents. Ground water sampling results used for this risk assessment were obtained from efforts under Phase II of TRC Environmental Corporation's (TRC) sampling plan (TRC 1994).

This HHRA has been prepared to be consistent with the *Comprehensive Reuse Plan for the Davisville Naval Construction Battalion Center* prepared by the Base Reuse Committee and subsequently adopted by the Town of North Kingstown and the State of Rhode Island. This HHRA has been prepared in accordance with recommended guidance from the Environmental Protection Agency (EPA) for evaluating potential public health risks associated with Superfund sites. NCBC Davisville is a Superfund site, and assessment and cleanup are being conducted under the Federal Facilities Compliance Act (FFCA) as a part of the Department of Defense Installation Restoration (IR) Program (IRP). Accordingly, EPA risk assessment guidance is appropriate for use in evaluating potential human health risks at NCBC Davisville Sites. The following EPA guidance documents were consulted in preparing this HHRA:

- *Risk Assessment Guidance for Superfund (RAGS), Volume I: Human Health Evaluation Manual* (EPA 1989a);
- EPA Region I *Supplemental Risk Assessment Guidance for the Superfund Program* (EPA 1989b);
- EPA Region I *Risk Updates* (EPA 1994a);
- *Supplemental Guidance to Risk Assessment Guidance for Superfund: Calculating the Concentration Term* (EPA 1992a);

- *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening* (EPA 1993b);

- *EPA Region III Risk-Based Concentration Tables (RBC)* (EPA 1996a).

The above documents were designed to provide guidance for conducting health risk assessments. For some aspects of this HHRA, professional judgment was used in application of the guidance.

This Human Health Risk Assessment is expected to be used within a risk management framework. In making decisions concerning what actions, if any, should be taken at Site 08 (including, for example, the collection of additional data or implementation of a remedial program), the results of the site-specific HHRA should be used in concert with other information about NCBC Davisville. The HHRA identifies whether current and future anticipated land use conditions present unacceptable risks to human health. Potential risks to ecological receptors are presented in a separate document. The HHRA identifies the contaminants and exposure pathways contributing the greatest risk to the receptor populations. From this information, recommendations for future activities at each site can be made such that public health is protected.

1.1 ORGANIZATION OF THE HUMAN HEALTH RISK ASSESSMENT

Human Health Risk Assessments follow a four-component risk assessment paradigm: hazard identification, dose-response assessment, exposure assessment, and risk characterization.

- In the hazard identification, Section 1.3, key COCs are selected for inclusion throughout the remainder of the risk assessment and the scientific weight of evidence regarding the potential for each COC to cause adverse health effects in exposed populations is briefly summarized.

- In the dose-response assessment, the relationship between extent of exposure and extent of toxic injury or disease is estimated for each COC. Chemical-specific toxicity values, such as cancer slope factors (SFs) and reference doses (RfDs) or reference concentrations (RfCs) for health effects other than cancer, are presented along with a discussion of their scientific underpinnings and derivation.

- In the exposure assessment, potential receptors and pathways of exposure are identified. The exposure assessment should include a discussion of the magnitude, frequency, and duration of these exposures.

- Risk characterization, integrates the results of the dose-response assessment and the exposure assessment to derive quantitative estimates of human health risk, including both the risk of cancer and of health effects other than cancer. The major uncertainties and limitations associated with the estimates of risk and their potential ramifications are presented in this section.

The human health risk assessment for Site 08 was completed at the hazard identification step because no COCs in groundwater were identified (see Section 1.3). The information presented below describes the analyses performed to examine the site-specific data gathered at Site 08 groundwater.

1.2 SITE CHARACTERIZATION

1.2.1 Site Description

The location of Site 08 at Davisville NCBC are shown in Figure 1.

The Defense Property Disposal Office (DPDO) Film Processing Disposal Area is located adjacent to the DPDO warehouse, Building 314 in West Davisville. The site is an 80 by 40 ft, mowed, grass-covered area with a 10-ft wide paved road passing through the center of it. The eastern boundary of the site is a 10-ft high fence which delineates the present West Davisville property line. Site 08 surface water runoff is toward the east and Sandhill Brook, located below and directly northeast of Site 08. Shallow ground water flows toward a culverted portion of the northward-flowing Sandhill Brook. The culvert extends underground past Site 08 for approximately 2,000 ft. The property to the east was formerly used as a disposal area and is currently being investigated by the U.S. Army Corps of Engineers. Historical aerial photographs of the site indicate this general area may have been used as a storage area for trailers and drums.

For a six-month period during 1973, the DPDO recovered silver from photographic wastes. Waste liquids from this recovery process were reportedly discharged on the pavement outside of Building 314. Waste liquids generated consisted of photographic compounds, such as sodium thiosulfate and hydroquinone, and liquids containing small concentrations of formaldehyde, acetic acid, potassium hydroxide and sulfuric acid. No information on frequency or total quantity of discharge was available from interviews or record searches. However, the amounts were reportedly small. Only a small quantity of waste liquids were reportedly discharged at this site. The waste liquids were reportedly poured on a paved area and allowed to run off during rainfall events, according to the Initial Assessment Study (IAS) report (Hart 1984).

1.2.2 Media Sampling

Ground water samples for Site 08 were four Phase II ground water samples (TRC 1994). Samples were analyzed for inorganics and VOCs.

1.3 HAZARD IDENTIFICATION

Chemicals were selected for inclusion in this HHRA by first establishing the potential health hazards associated with each selected chemical according to an established set of selection criteria (i.e., presence above background, potential for human exposure, and toxicity). Once the list of selected chemicals was complete, the human health hazard associated with each chemical was identified by examining the scientific literature on its toxicity. Information sought in this exercise included:

- A causal relationship between the chemical and its potential for adverse human health effects;
- The health effect that is considered to be the most "critical" according to best professional judgment, based on such factors as severity of the health effect and toxicity; and
- The scientific weight of evidence for the "critical" health effect.

This methodology was employed to confirm that the selected chemicals were those that should be investigated further for their potential health risk at Site 08.

1.3.1 Selection of Chemicals Used to Estimate Human Health Risks

The screening process utilized to identify and select COCs for inclusion in the HHRA involved the following steps:

- Analytical data quality evaluation to identify potential COCs;
- Utilization of a risk-based concentration screening approach (EPA 1993b) to identify candidate COCs; and
- Further reductions in the list of COCs based on criteria from RAGS (EPA 1989a), followed by chemical-specific reevaluations of COCs that were

previously excluded but subsequently warranted inclusion in the quantitative risk assessment.

The process of identification and selection of COCs at Site 08 encompassed the following considerations: the presence or absence of specific analytes in ground water, the presence of analytes in blanks, the frequency with which analytes were reported, and the relative toxicities of analytes. The following sections present the COC selection process in more detail.

1.3.1.1 Data Quality Evaluation

Detailed chemical analyses of ground water samples from Site 08 were obtained. Potential COCs were defined as constituents identified in ground water samples that were considered likely to have originated from site-related activities. Selection processes for potential COCs in ground water are discussed in subsequent sections:

(1) The first step in the process of selecting COCs was the evaluation of analytical data on the basis of their qualifiers and detection frequencies in environmental media. Inclusion or exclusion of data on the basis of analytical qualifiers was performed in accordance with EPA guidance (EPA 1989b).

- Analytical results bearing the "U" qualifier (indicating that the analyte was not detected at the given sample quantitation limit (SQL)) were retained in the data set and regarded as a nondetect. For statistical purposes, the analyte was assumed to be present at a value of one-half the reported SQL.

- Analytical results bearing the "J" qualifier (indicating that the reported value is "estimated" because either the analyte was detected at a level below the SQL) were retained in the data set and regarded as a detected concentration at the given value.

- Analytical results bearing the "UJ" qualifier (indicating that the analyte was not detected at the estimated SQL) were eliminated from the data set due to an unusually high degree of uncertainty.

- Analytical results bearing the "R" qualifier (indicating that quality control suggests that the data are unusable and that the analyte may or may not be present) were eliminated from the data set.

- Analytical results bearing the "*" qualifier (indicating that the duplicate analysis was not within control limits) were treated as detected concentrations.

(2) In instances where duplicate samples were collected or duplicate analyses were conducted on a single sample, the following conventions were employed:

- If both samples/analyses indicated presence of the analyte, then the higher detected concentration was retained;
- If only one sample/analysis indicated presence of the analyte, then this detected concentration was retained; and
- If both samples/analyses were nondetects, then the higher SQL was retained.

(3) If the constituent was not reported in any sample (in any individual medium), it was not considered to be a potential COC that medium.

(4) Common laboratory contaminants, including acetone, 2-butanone, methylene chloride, toluene, and the phthalate esters were considered to be COCs unless there was reason to believe that their presence was not related to past site activities but was solely the result of laboratory contamination. Individual analytical results were evaluated following EPA (1989b) guidance concerning the occurrence of common laboratory contaminants in blank samples. For these common laboratory contaminants, individual sample results bearing the "B" or "BJ" qualifiers, indicating that the chemical was found in an associated blank, were treated as nondetects at the blank-related concentration if the reported concentrations were not more than ten times the concentration reported in any blank. Where blank data were not available, this comparison could not be made, and analytical results bearing the "B" qualifier were retained as a default.

1.3.1.2 Environmental Sampling Data Management and Evaluation

Analytical data were further evaluated for each constituent that was not eliminated from consideration in the above steps. As stated above, only those analytes that were found to be detected in at least one sample were included in the list of potential COCs. The sections below describe data management and evaluation steps that were taken for ground water COC selection.

The analytical ground water data (i.e., low-flow samples) collected by TRC for the Phase II RI were used for Site 08. (TRC 1994). Both filtered and unfiltered ground water samples were collected. However, only unfiltered ground water samples were used in estimating potential exposures and risks in this risk assessment, per EPA Region I preference for using unfiltered samples in the HHRA (EPA 1994a).

1.3.1.3 Risk-Based Concentration Screening

The risk-based screening process utilized for Site 08 followed that developed by EPA Region III. The purpose of the risk-based screen was to identify for inclusion in the HHRA only those constituents that would likely impact the overall estimation of potential health risks. The risk-based concentration screen was performed by following the steps outlined below (EPA 1993b):

(1) The maximum concentration of each potential COC detected in ground water was identified.

(2) If the maximum concentration of a specific constituent exhibiting carcinogenic effects exceeded its (RBC)[1] for this medium, the chemical was retained for risk assessment for all routes of exposure involving that medium. Otherwise, the constituent was omitted from further consideration in that medium. In this HHRA, the RBCs for tap water were utilized in the risk-based screening of constituents of concern in ground water.

(3) If the maximum concentration of a specific chemical exhibiting adverse health effects other than cancer exceeded one-tenth its RBC for any medium, the constituent was included for further consideration in the risk assessment. Otherwise, the constituent was omitted from further consideration in that medium. In this HHRA, the RBCs for tap water were utilized in the risk-based screening of constituents of concern in ground water.

(4) Maximum detected concentration of each ground water constituent was also compared to Rhode Island Department of Environmental Management (RIDEM)

[1] Risk-based concentrations have been estimated for hundreds of chemicals in soil, water, fish, and air as the chemical concentration in each medium, which under default exposure assumptions, corresponds to an increased lifetime cancer risk of 1×10^{-6} or a noncancer hazard quotient (HQ) of 1.0 (EPA 1993a). Following EPA Region I guidance, RBCs for noncarcinogens were set at an HQ of 0.1 (EPA 1995b) in this risk assessment.

Method I Ground Water Quality Standard (RIDEM 1996), if the Method I value was more stringent than the RBC value.

(5) In ground water, if no carcinogenic chemicals were present at concentrations exceeding either their RBCs for carcinogenic effects and no chemicals exhibiting adverse effects other than cancer were present at concentrations exceeding one-tenth their RBCs for noncancer effects, then the medium was excluded from the risk assessment.

(6) If a chemical was reported to be present in at least one sample in ground water, it was retained for further consideration for all routes of exposure involving the medium unless its frequency of detection was less than 5% (EPA 1989a). If the chemical was retained, all reported nondetects for the chemical were considered to be present at one-half the SQL.

(7) If an RBC was not available for a specific chemical in ground water, the chemical was retained for further evaluation as a COC, except as discussed in Section 1.3.1.3.1.

(8) All omitted chemicals and exposure routes were reconsidered for inclusion based on special considerations (see Section 1.3.1.3.1)

1.3.1.3.1 Additional Considerations in Screening for Ground Water COC

The preliminary list of ground water COC selected on the basis of risk-based screening (EPA 1993a, 1997b) was further evaluated, using additional considerations:

(1) If an RBC was not available for a specific chemical in a particular medium, the RBC for a structurally similar compound was used, if warranted:

a. Because chromium III and chromium VI were not analyzed for separately, as a conservatively prudent measure, the RBC for the more toxic constituent, chromium VI, was used.

b. The action level of 15 μg/L lead were used for lead screening in ground water.

(2) For inorganic constituents in ground water, statistical comparisons between naturally-occurring background concentrations and on-site concentrations were

made using the method of evaluation of exceedences. Detected concentrations of each chemical were compared with ground water background levels (Table 1-1) developed by Stone & Webster (1996) for each specific constituent in ground water to determine whether or not the number of exceedences above the background levels were statistically significant. Because the background levels developed by Stone & Webster represent extreme upper limits on typical background concentrations, geometric means of sample and background data sets could not be compared to investigate if the site concentrations were related to background levels. Therefore, the method of choice for background comparison was the method of evaluation of number of exceedences using the binomial distribution. The more exceedences observed, the higher the significance or smaller the p-value (i.e., the probability of finding the observed number of exceedence, or more, due to chance alone). This nonparametric approach is a scientifically sound approach to evaluate the number of occurrences of concentrations falling above some hypothetical limit that represent a background situation.

If the p-value was greater than 0.1 number of exceedences was deemed to be not significant and the chemical was excluded from the risk assessment.

(3) A chemical was eliminated from the list of COCs if it was an essential nutrient of low toxicity, and if its reported maximum concentration was unlikely to be associated with adverse health impacts. COCs excluded from further consideration on this basis included calcium, magnesium, iron, potassium, and sodium.

1.3.1.3.2 Site-Specific COC in Ground Water

Summary data for detected analytes in Site 08 ground water, relevant tap water RBCs, and the screening steps used to select COCs, are presented in Table 1-2. Chemicals for which the maximum concentration did not exceed the medium-specific RBC were marked "No" in the RBC screening tables and were eliminated from further consideration. Tables 1-2 also details the additional screening steps applied to screen the list of potential COCs for inclusion on the list of final COCs.

A close examination of analysis presented in Table 1-2 shows that no COCs are identified in Site 08 ground water. It should be noted that the maximum detected concentrations of arsenic, beryllium, and manganese at Site 08 exceeds the risk-based screening criteria. However, when background data is available it is prudent that a statistical comparison

between site concentrations and background concentrations be performed to identify the non-site related chemicals that are found at or near the site (EPA 1989a, pg 5-18, Section 5.7, first paragraph). This exercise is part of data evaluation in a human health risk assessment. EA consulted with the EPA Region I on behalf of the Navy and received written approval of the statistical procedure described in Section 1.3.1.3.1 for comparison of site samples with background (e-mail from Jayne Michaud of EPA Region I dated April 17, 1997). The statistical evaluation showed that none of these three chemicals are associated with potential onsite contamination, thus excluded from further analyses as chemicals of potential concern at Site 8 ground water. The analysis in this HHRA and the rational presented above eliminates the need to perform a quantitative evaluation of exposures and risks to potential human receptors at Site 08.

1.3.1.4 Uncertainty in Application of a Risk-Based Screening Level Approach

As stated in *Selecting Exposure Routes and Contaminants of Concern by Risk-Based Screening - Technical Guidance Manual* (EPA 1993b), the EPA Region III RBCs are likely to be protective as no-action levels for human health for sites where: (1) a single medium is contaminated; (2) a single contaminant contributes nearly all of the health risk; (3) volatilization or leaching of that contaminant from soil is expected not to be significant; and (4) the exposure scenarios used in developing the values in the RBC table are appropriate for the site. In addition, site-specific conditions that would affect the tendency of chemicals to volatilize or leach from soil introduces additional uncertainty in the use of SSLs.

For Site 08, no chemical of concern is the predominant contributor to potential risk. These factors help minimize uncertainty in ground water risk screening outcomes.

1.4 SUMMARY AND CONCLUSIONS

The objective of this human health risk assessment was to evaluate the potential for adverse health effects to populations exposed to chemicals of concern in ground water at Site 08. Exposed populations included future construction workers, and future resident adults and children.

Risk-based screening performed for Site 08 groundwater, as described in detail in Section 1.3.1.3, resulted in no COCs exceeding their respective risk-based screening concentrations. RBCs are chemical concentrations that correspond to fixed levels of risk (i.e., either a one-in-one-million cancer risk or a noncarcinogenic hazard quotient of one,

whichever occurs at a lower concentration) in tap water. They are derived to be protective of human consumers of tap water.

Based on the analysis presented in this HHRA, it could be concluded that there were no COCs in Site 08 groundwater at levels of concern from public health protection standpoint. In the absence of COCs in Site 08 groundwater, a quantitative evaluation of exposures and risks to potential human receptors at Site 08 was not deemed to be warranted.

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Table 1-1 Summary of Background Data for Inorganics in Ground Water (Stone & Webster 1996)

Inorganic Chemical	Background Concentration (µg/L units)
Aluminum	5315
Antimony	6
Arsenic	6.4
Barium	80.5
Beryllium	1.3
Cadmium	3
Calcium	13302
Chromium	214
Cobalt	24.9
Copper	25.8
Cyanide	-
Iron	25500
Lead	4.8
Magnesium	5126
Manganese	3292
Mercury	-
Nickel	-
Potassium	3843
Selenium	-
Silver	1
Sodium	12346
Thallium	-
Vanadium	24.4
Zinc	89.9

TABLE 1-2 Selection of Chemicals of Concern from List of Detected Analytes in Groundwater-- Site 08, Davisville

Chemical [1]	Max Detected Concentration [2,*]	Risk-Based Concentration [3]	RIDEM Method 1	Max > RBC?	Frequency of Detection	Frequency of Detection [4]	Frequency of Detection > 5%?	Statistically Elevated Above Background? [5]	Essential Nutrient? [6]	COC? [7]
Inorganics										
Aluminum	3380	3700		No	4/4	100.00%	Yes	No	No	No
Arsenic	1.8	0.045		Yes	3/4	75.00%	Yes	No	No	No
Barium	41.9	260	2000	No	4/4	100.00%	Yes	No	No	No
Beryllium	1	0.016	4	Yes	1/4	25.00%	Yes	No	No	No
Chromium	7.1	18	100	No	3/4	75.00%	Yes	No	No	No
Cobalt	4.7	220		No	2/4	50.00%	Yes	No	No	No
Copper	7.9	150		No	3/4	75.00%	Yes	No	No	No
Cyanide	3.1	73	200	No	1/4	25.00%	Yes	NA	No	No
Lead	3.3	15	15	No	3/4	75.00%	Yes	No	No	No
Manganese	1300	84		Yes	4/4	100.00%	Yes	No	No	No
Vanadium	4.6	26		No	1/4	25.00%	Yes	No	No	No
Volatiles										
Acetone	92	370		No	2/4	50.00%	Yes	NA	NA	No

Notes: 1- Table presents only those constituents identified above laboratory detection limits
2- Maximum detected concentration of low-flow samples collected by TRC in 1993
3- RBC screening was conducted by comparing maximum detected concentration of a chemical to its USEPA Region III RBC. If the max. concentration of a carcinogen exceeded its RBC in tap water, or if the max. concentration of a noncarcinogen exceeded one-tenth its RBC in tapwater, the chemical was included for further consideration.
4- The chemicals with frequency of detection (ie, detection above laboratory detection limit) greater than or equal to 5 % were retained for further consideration.
5- A statistical analysis was performed to determine whether the difference between site concentrations and the background concentrations proposed by Stone & Webster (1996) were statistically significant or not. The statistical method used was the method of evaluation of exceedance, based on the number of exceedances above the background levels, per discussion with EPA Region I. The chemicals with concentrations statistically elevated above the background levels were retained for further consideration.
6- A chemical was eliminated from the list of COC if it was an essential nutrient of low toxicity.
7-Constituent of Concern
NA- Not Available
*Maximum concentration of each chemical was also compared to RIDEM Method I Groundwater Quality Standard (mg/l), if available. The RBC concentrations were more stringent than the Method I values in all cases.

Sources: Background Value - Final Basewide Ground Water Inorganics Study Report, Stone & Webster, 06 September 1996, as revised 15 November 1996
EPA Region III RBC - Risk-Based Concentration Table, January-June 1996, US EPA Region III, April 1996
Draft Final Phase II Remedial Investigation, TRC 1994
Draft Environmental Baseline Survey - EA Engineering 1996
Risk Assessment Guidance for Superfund. Volume I: Human Health Evaluation Manual (Part A). EPA/540/1-89/002. December 1989.
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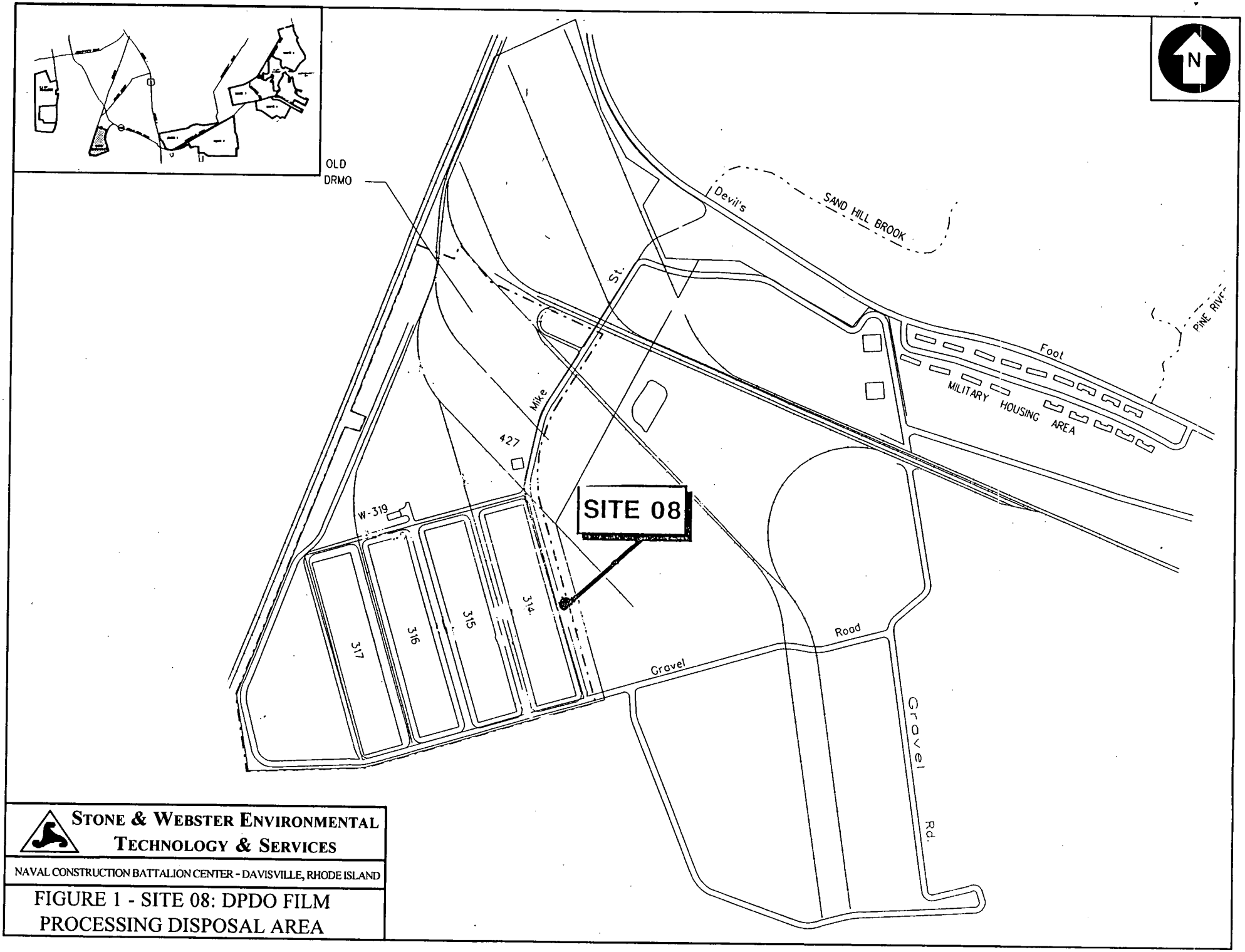

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TECHNOLOGY & SERVICES

NAVAL CONSTRUCTION BATTALION CENTER - DAVISVILLE, RHODE ISLAND

FIGURE 1 - SITE 08: DPDO FILM PROCESSING DISPOSAL AREA