Proposed Plan
for the Offshore Area
of the
Former Nansemond Ordnance Depot,
Suffolk, VA

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1. INTRODUCTION

This Proposed Plan describes investigations and the recommended Preferred Alternative for the Offshore Area at of the Former Nansemond Ordnance Depot (FNOD). The lead agencies for this action are the U.S. Army Corps of Engineers, Norfolk District, and the U.S. Environmental Protection Agency (EPA) Region III. Additionally, Virginia Department of Environmental Quality (VDEQ) is a support agency. These agencies propose that no further remedial action be conducted at the Offshore Area, based on current site conditions.

The U.S. Army Corps of Engineers and U.S. EPA, in consultation with VDEQ, will make the final decision regarding the remedial approach for the Offshore Area after reviewing and considering all information submitted during the 30-day public comment period. The U.S. Army Corps of Engineers and EPA, along with VDEQ, may modify the Preferred Alternative or select another remedial action based on new information or public concerns. Therefore, public comment on the Preferred Alternative is invited and encouraged. Information on how to participate in this decision-making process is presented in Section 10.

The Army Corps of Engineers is issuing this Proposed Plan as part of its public participation responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act, CERCLA Section 117(a), and National Contingency Plan, NCP, Section 300.430(f)(2)).

The FNOD is located on the southern banks of the James and Nansemond Rivers, in the northeast part of the City of Suffolk, Virginia (Figure 1-1). The Environmental Protection Agency (EPA) proposed the FNOD for inclusion on the National Priority List (NPL) on January 19, 1999, (64 Federal Register No. 27, 2950). The NPL final listing included several “Source Areas” and “Areas of Concern” (AoCs) requiring investigation at the FNOD. The FNOD Offshore Area, spanning the nearshore area from Streeter Creek to Pig Point (Figure 1-2) was included on this NPL listing as “Area of Concern Number 3” (USEPA, 1999), and is the subject of this Proposed Plan (PP).

The information provided in the Proposed Plan includes background information on the Offshore Area (Section 2), Site Characterization information (Section 3), how investigation of this Area of Concern fits in with the other investigations at FNOD (Section 4), a summary of the ecological and human health risks in the Offshore Area due to FNOD-related activities (Section 5) and the preferred remedial alternative (Section 9). Based on determinations that there are no ecological and human health risks posed from FNOD-related sources in the Offshore Area, the preferred alternative presented in this Proposed Plan for the Offshore Area is that no further action is necessary to protect ecological and human health, which is referred to as a No Further Action (NFA) determination.

Public comments on this Proposed Plan will be accepted during the comment period and at a public meeting to be held on December 4, 2004; refer to Section 10 for details. The overall goal in this process is to reach a final determination on the preferred remedial alternative for the Offshore Area, which would be published as a Record of Decision (ROD) in the Federal Register, documenting that investigations in the Offshore Area have been completed.

This Proposed Plan summarizes information compiled in several reports for FNOD and the Offshore Area. The complete reports referenced herein are available for public review and can be found in the associated Information Repository and Administrative Record files at the locations provided below:

Tidewater Community College Library
7000 College Drive
Portsmouth, Virginia 23703
(757) 822-2124

US Army Corps of Engineers, Norfolk District
803 Front Street
Norfolk, Virginia 23510-1096
(757) 441-7500

2. SITE BACKGROUND

The FNOD was constructed and commissioned as the Pig Point Ordnance Depot between November 1917 and December 1918 for munitions storage and shipment of these munitions overseas. Between World Wars I and II, operations at the Former Depot included preparation of ammunition and components for permanent storage, painting and marking shells and containers, segregation of certain lots of ammunition, transference of powder charges from fiber to metal containers, salvage of munitions parts, and inspection and disposal of unserviceable ammunition by defusing or burning. On April 9, 1945, the Former Depot was incorporated into the demobilization planning conducted by the Ordnance Department.

In 1950, the site was transferred to the Department of the Navy, and was subsequently named the Marine Corps Supply Forwarding Annex. Following Navy operation, the FNOD was deactivated in 1960, and ownership of the property was transferred to the Beasley Foundation. The FNOD land is now principally occupied by Tidewater Community College, the General Electric Company Jet Engine Division (GE), and the Hampton Roads Sanitation District (HRSD). Smaller parcels of land are owned by the Virginia Department of Transportation, Interstate 664, Dominion Lands, Inc., Continental Properties and SYSCO Food Services (USACE, 2000). Currently, the FNOD is classified as a Formerly Used Defense Site (FUDS).

Site investigations have been ongoing since the EPA proposed the FNOD for inclusion on the National Priority List in 1999, including investigations of Source Areas and Areas of Concern. The Offshore Area was evaluated separately from the intertidal zone (also presently under investigation), which has been designated the Nearshore Area (Figure 1-2). This phased approach was based on differences in the type of equipment that could be used for conducting surveys in the offshore and intertidal zones as well as the closer proximity of intertidal area to potential on-shore source areas. It is expected that the nearshore area would have an increased likelihood for wildlife and human contact with sediments due to the accessibility of the intertidal zone.

The Offshore Area includes the remnants of a pier, called the "Old Pier Area", that extends from the shoreline out into the James River roughly 3000' (Figure 1-2). The Offshore Area investigations include the Old Pier Area. Another pier is located along the Nansemond River shoreline, adjacent to a stone breakwater, at Pig Point referred to as the Fishing Pier Area. This pier does not extend as far out into the waterway and is the subject of a separate investigation.

The Offshore Area extends from the low tide line to approximately 1 mile offshore to the James River and Nansemond River channels. Low tide occurs at different sea level elevations (and hence, distances from shore) based on natural monthly variations in the tides ranging from the "Spring" strong tides to the "Neap" weak tides. In order to derive a precise definition of the shoreline boundary, the Mean Lower Low Water (MLLW) line is used, being the average seawater elevation of the lower low tides in the study area over a 19-year period. This is the designation used by the National Oceanic and Atmospheric Administration (NOAA) National Oceanographic Survey (NOS) office as a boundary for the seaward limit of the intertidal zone. For the FNOD Offshore Area, the MLLW line, when projected on the measured seafloor elevations along the FNOD coastline, varies between 200' and 300' from the shoreline. Conversely, the Nearshore Area extends from the MLLW line to the high tide line, which in most areas of FNOD is the embankment at the shoreline. As discussed above, the Nearshore Area is being investigated as a separate operable unit, and thus is not discussed in this PP. Additionally, the Fishing Pier Area is another waterway AOC that is being addressed separately.

Historical shoreline analysis of the FNOD Offshore Area shows that considerable loss of shoreline (greater than 300') has occurred over the past 50 years, suggesting the seaward extent of historical operations were greater than would be apparent at present. The James River Beachfront, identified as another Area of Concern, may be potentially impacted by former site use practices including the operation of burn pits for the destruction of materials related to the disarmament of ordnance. The beachfront also contains a large quantity of metal debris, concrete and asphalt. Material eroded from the James River Beach Source Area, S-2, could potentially be deposited in the Offshore Area.

3. SITE CHARACTERISTICS

This section of the Proposed Plan contains information on the physical and biological conditions of the Offshore Area and the nature and extent of contamination. Site characteristics were documented by two marine investigations (2000 Environmental Survey, Section 3.1; and the 2002 Old Pier Survey, Section 3.2) summarized in the subsections below. The nature and extent of contamination was determined from these surveys, and identification of Contaminants of Potential Concern (CoPCs) was accomplished through the Ecological Risk Assessments (ERA) and Human Health Risk Assessment (HHRA). Summaries of ecological and human health CoPCs are provided in this section (Section 3.3), while summaries of site-related risks to wildlife and humans are provided in Section 5 below.

3.1. 2000 Environmental Survey

A broad environmental survey of the entire FNOD Offshore Area (Figure 3-1) was conducted in 2000 and involved a multipart geophysical survey employing bathymetry, side-scan sonar, sub-bottom profiling, magnetometry and sediment profile imaging (SPI) photography, as well as the collection of sediment cores and surface sediment samples to characterize extent and nature of chemical contamination (SAIC 2002). Duplicate sediment profile images were collected at 136 stations throughout the Offshore Area to characterize bottom sediments and benthic habitat conditions. Sediment grab samples and cores were collected at 31 stations for characterization of grain size, total organic carbon, sediment chemistry, and sediment toxicity tests.

Sediment core and grab sampling locations (Figure 3-1) were selected to ensure representative coverage of the various habitat characteristics observed within the survey area, and to include adequate sampling near potential onshore source areas. The side-scan sonar mosaic was used to identify differences in grain size across the site, and this in conjunction with bathymetry was used to identify sampling stations in deep-water areas, as well as the sloped transition areas between the intertidal zone and deeper water. Additionally, sub-bottom profiles were used to identify areas with both shallow and deep layering, to account for differences in depositional history across the survey area. The magnetometer data were used to identify buried metal, including potential ordnance items, to avoid sampling in areas with debris that could represent a safety concern.

The sediment cores collected were up to 2 meters in length and were used to evaluate sediment chemistry at greater depths than the surface (top 10-15 cm) grab sample sediment characterizations. Sediment chemistry analyses consisted of determination of metals, Polycyclic Aromatic Hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, dioxins and explosive compounds. Toxicity tests were also performed on the sediment samples.

The target analyte list for the Offshore Area investigations was derived based on the findings from onshore site investigations (Weston 1999) and as part of a consensus agreement among the Federal, State and community agencies. The list reflects contaminants detected during previous site investigations, and those chemicals known to be associated with past ammunition and ordnance disposal practices at the site.

Findings from the Environmental Survey investigation indicate that the FNOD Offshore Area consists of a relatively flat and shallow subtidal zone extending from the low tide line to a break in slope approximately 2500' to 3000' offshore. Scattered metal objects were detected during the magnetometer survey, including numerous identifiable objects (e.g., crab pots, with direct visual confirmation from surface buoys marking their locations), none of which were identifiable as hazardous items, as detected with the side-scan survey (Figure 3.4-1 from Environmental Survey, SAIC 2001). While confirmed identification of all metals objects could not be made, no obvious ordnance targets were identified.

Sub-bottom profiles showed evidence of sediment layering in areas closet to shore, presumably due to recent high rates of deposition associated with erosion of the adjacent uplands. Grain size consisted of predominantly of fine sand, with a trend toward finer grain sizes with increased depth. The sediment profile interface (SPI) photographs revealed that recently colonized organisms dominated the benthic community and were restricted to the top few centimeters of sandy sediment; this is likely due to frequent physical disturbance of the sediment from waves and currents that carry away any fine-grained material. The benthic community in this substrate was found to be dominated by recently colonized organisms (likely due to physical sediment reworking and high organic loading) and absent of deep-dwelling worms and bivalves. In comparison, the finer-grained sites near the seaward border of the survey area typically had a more diverse and abundant benthic community, and likely provides greater biomass that serves as a food source for bottom feeders such as crab and croaker.

Sediment chemistry and toxicity analyses were conducted on the surface samples and for selected depths from the core samples. Further discussion on sample location and depth selection is discussed in the study reports. Results of the analyses along with the identification of Contaminants of Potential Concern (CoPCs) for wildlife and for humans are summarized in Section 3.3 below.

3.2. 2002 OLD PIER SURVEY

Given the historical use of the Old Pier in the Offshore Area for transport of ordnance materials between vessels and the FNOD land-based facilities, investigations in that area were deemed warranted. While the 2000 Environmental Survey effectively characterized geophysical features and sediment chemistry within most of the Offshore Area, the initial survey effort of the Old Pier was hindered by the remnant pilings and shallow water depths. Accordingly, a supplemental survey of the Old Pier area was conducted in 2002, and involved sidescan sonar, SPI photography and sediment grab sampling as conducted for the 2000 Environmental Survey (Figure 3-2). In addition, the survey efforts were expanded to collect tissue samples (croaker and blue crab; Figure 3-3) at sediment grab locations to provide collocated sediment and tissue chemistry data needed to complete trophic models for the Baseline Ecological Risk Assessment (BERA) as well as to support the Human Health Risk Assessment (HHRA). As for the 2000 Environmental Survey, sediment samples were analyzed for metals, PAHs, PCBs, pesticides and explosive compounds. Dioxins were not measured in sediment samples as they were in the 2000 survey because substantial elevated concentrations were not detected during that investigation in the subset of samples analyzed. Additionally, as in the 2000 survey, toxicity testing was performed on collected sediments.

In all, approximately 60 sediment profile images, seven sediment grab samples and five croaker and six blue crab samples were collected in the Old Pier Area (Figure 3-2 and Figure 3-3). Results of the sediment toxicity tests, contaminant concentrations and tissue chemistry concentrations are summarized in Section 3.3 below. Results of a detailed evaluation of the measured contaminants in sediment and fauna with respect to possible ecological and human health risks are discussed in Section 5.

3.3. CONTAMINANTS OF POTENTIAL CONCERN

Contaminants of Potential Concern (CoPC) selection is a process that permits refinement of the list of the Target Analyte List (TAL) compounds to identify those chemicals that are potentially causing site related risks. The process involves screening maximum (or 95% confidence limit) site chemical concentrations against respective ecological and human benchmarks, with retention of analytes that have a maximum concentration that exceeds the appropriate, conservative benchmark value, per EPA guidance (EPA, 1992). Screening was performed using the combined chemical concentration dataset from the 2000 and 2002 surveys. Two separate CoPC lists were generated, one based on ecological risk, the other on human risk, because the benchmarks for each evaluation are different. The results of these screenings are provided in Table 3.6-3 (summary table) and Appendices A-1 to A-3 of the *Baseline Ecological Risk Assessment for the Marine Offshore Area* (SAIC, 2002) and in Table 2-1 of the *Human Health Risk Assessment of the Marine Offshore Area* (SAIC, 2002b). Details of the screening process are contained in the respective sections of the reports, and brief summaries of the findings are provided below.

Ecological Screening. For identification of sediment CoPCs, sediment concentrations were screened against the lowest available, conservative, sediment benchmarks, including NOAA Effects Range –Low (ER-L), EPA's Apparent Effects Threshold (AET), and Florida Department of Environmental Protection (DEP) Threshold and Probable Effects Levels (TEL/PEL) benchmarks. Comparisons to upper benchmarks (e.g., Effects Range- Medium or ER-Ms) were used to assess the magnitude of potential hazard posed by a CoPC. CoPCs consist of analytes detected in greater than 5% of the samples, and for which the maximum concentration exceeded the most conservative, lower screening benchmark.

Metals, PAHs, and dioxins were detected in sediments in more than 20% of the samples, but at low concentrations when compared to conservative ecological benchmarks (95% upper confidence limit of the mean were below lower benchmarks, NOAA Effects Range – Low, ER-Ls). Only arsenic and mercury exceeded the ER-L benchmarks for metals. Arsenic exceedances occurred in seven samples, of which only two were surface sediment samples (at the stations farthest from shore) and the remainder were samples from depths greater than 20 cm. Mercury exceeded the benchmark in three sub-surface samples, and not in any surface samples. An additional analysis for metals availability (SEM:AVS; see SAIC 2000) revealed that the divalent metals (copper, cadmium, lead, nickel, and zinc) were not biologically available to aquatic biota. The biological availability of arsenic and mercury could not be addressed in a manner similar to the divalent metals. However, the results of the biological testing of sediments that indicate a lack of toxicity provides evidence that these metals are not biologically available to the aquatic biota.

For PAHs, only acenaphthene and fluorene were found at concentrations higher than the NOAA ER-L (but not at concentrations exceeding the upper benchmarks, ER-Ms). Dioxins were detected in the majority of samples and thus were retained as a CoPC. Dioxin concentrations were compared to low- and high-risk thresholds using ecological sediment quality guidelines recommended by EPA, and sediment concentrations were an order of magnitude lower than the lower threshold for fish and birds, and only occasionally exceeded the lower threshold for mammals by a slight margin.

In the pesticide group, five chemicals, 4,4'-DDD, 4,4'-DDT, aldrin, dieldrin and endrin ketone, were detected with a frequency >5% and had maximum concentrations that exceeded the ER-L benchmark, and thus were retained as CoPCs. Of these, only dieldrin exceeded the upper screening benchmark (ER-M).

As for the PCBs, most of the 24 congeners were detected only infrequently. Seven congeners were detected with at least 5% frequency (52, 153, 169, 170, 180, 195, 206, and 209); PCB congener 153 was the most frequently detected (42% of the samples). However, total PCBs only exceeded the benchmark in one location, and total PCBs were not retained as a CoPC based on frequency of detection below 5%. Finally, neither explosives nor kepone were detected and thus were not retained as CoPCs.

Results of the sediment toxicity tests using 10-day exposures of the amphipod, *Leptocheirus plumulosus*, indicated no sediment toxicity.

In summary, the ecological CoPC screening process identified the following chemical classes and compounds as CoPCs:

- Metals: arsenic and mercury;
- PAHs: acenaphthene and fluorene; and
- Pesticides: 4,4'-DDD, 4,4'-DDT, aldrin, dieldrin and endrin ketone.

The ecological risk calculations conducted on the identified sediment CoPCs are summarized in Section 5.1 below.

Human Health Screening. The sediment and tissue chemistry data that were used in the BERA were also used for the HHRA. Based on water depths in the Offshore Area, it was determined that human contact with the sediment would be unlikely. The area is too deep for wading and it is unlikely that people would swim in that area. There is potential for human contact with sediment while pulling traps set in the Offshore Area, but based on the prevalence of sandy substrate, it is unlikely that any appreciable amount of sediment would be carried to the surface on a trap. It was therefore determined that direct contact with sediment was not a likely pathway for exposure of humans to contaminants in the FNOD Offshore Area. However, recreational fishing does occur in the Offshore Area and around the Old Pier pilings, and presents a plausible exposure pathway for humans based on consumption of chemicals in finfish and crabs that have be taken up chemicals into their tissues from ingestion of the sediment and sediment-associated prey items.

Tissue concentrations of croaker and blue crab collected during the Old Pier survey were compared to the human health Risk-Based Concentrations (RBCs) for fish. Appropriate adjustments were made to ensure consistent units and to account for additive effects on non-carcinogenic analytes, consistent with EPA Region 3 guidance (EPA 2002). Results are presented in Appendices B-1 to B-3 of the HHRA report, with comparisons to EPA RBC values provided in Section 2.2.3 of the report.

For six blue crab (claw meat analyzed) and five fish (croaker, cross-section of tail section analyzed) tissue samples analyzed, several metals were either not detected or were detected at low concentrations similar to those measured in blank samples (aluminum, antimony, cadmium, lead, nickel, silver). Arsenic, chromium, copper, iron, mercury, and zinc were detected frequently, while silver was detected in two of 11 samples.

PAHs were either not detected or were detected at low levels (e.g., maximum concentrations less than 100 µg/kg) with the exception of four PAHs detected at somewhat elevated concentrations (> 100 µg/kg), including benzo(b)fluoranthene, fluoranthene, phenanthrene and pyrene.

PCB congeners were either not detected or detected at very low concentrations (*i.e*., less than 10 µg/kg), with only one congener exceeding this value (PCB 153, 12 µg/kg). The highest Total PCB concentration observed was 33 µg/kg. Two pesticides, 4,4'-DDE and 4,4'-DDT, were detected at concentrations of 3.3 µg/kg and 7.7 µg/kg, respectively. Dioxins were not measured in fish tissue samples. Finally, 14 explosives compounds were analyzed in the tissues of crabs and fish, but concentrations were non-detect in all samples.

To address the fact that the tissue samples were collected from motile species that would be expected to feed over a broad area, not limited to the FNOD Offshore Area, tissue CoPCs were selected using a tiered analysis approach. First, predicted tissue residue concentrations were developed from the measured sediment chemical concentrations at the site (using regionally applicable bioaccumulation factors developed for this project) and compared to the EPA RBCs. Subsequently, for those chemicals where a prediction of fish tissue residues to exceed the RBCs was obtained, the corresponding measured fish and crab tissue concentrations were screened against the same RBCs. Because not all elevated CoPCs in tissue were elevated in site sediments, this method ensured that the human health risk analysis focused only on those site-related sediment-associated CoPCs.

The EPA Region III RBC screening values used in screening the predicted and measured fish tissue concentrations incorporated the EPA guidance regarding target lifetime cancer risks ($1x10^{-6}$) for carcinogenic analytes as well as possible cumulative additive effects of non-carcinogenic analytes. Comparison of predicted tissue concentrations with the appropriate RBCs eliminated all but eight analytes as CoPCs (Table 2-1 in the HHRA report). CoPCs include two metals (arsenic and manganese), three PAH compounds (benzo(a)anthracene, benzo(a)pyrene and benzo(b)fluoranthene, Total PCBs, and the pesticides aldrin and dieldrin.

Based on these exceedances, these analytes were further evaluated by comparing the measured tissue concentrations to the RBCs (Table 2-2 in the HHRA report). Aldrin and dieldrin were eliminated as CoPCs based on this screening as they were not detected in any of the tissue samples. Manganese is not on EPA's list of bioaccumulative chemicals and has no corresponding Bioaccumulation Factor (BAF), and thus was not retained as a CoPC. The remaining analytes initially identified as CoPCs were retained as CoPCs for further quantitative risk analysis.

In summary, the human health CoPC screening process identified the following chemical classes and compounds as CoPCs:

- Metals: arsenic;
- PAHs: benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene; and
- Total PCBs.

The human health risk calculations conducted on the identified tissue CoPCs are summarized in Section 5.2 below.

4. SCOPE AND ROLE OF THE RESPONSE ACTION

This section of the Proposed Plan addresses the evaluation of remedial alternatives for the Offshore Area. This response action does not include or affect any other sites at the facility that fall under the CERCLA process. In addition to upland areas being investigated throughout FNOD, and as stated in Section 2 above, there are other waterway areas that are being evaluated separately from the Offshore Area, including the Nearshore Area, Fishing Pier, Streeter Creek, and the ponds that occur along the shoreline including TCC Lake, J Lake, and Horseshoe Pond. They are the subject of separate investigations and separate determinations of need for any remedial actions that may be necessary to protect human health and the environment.

Regarding the Offshore Area of Concern, the role of the preferred alternative in The Response Action is to address all potential FNOD-related threats posed by the Offshore Area and to eliminate current exposure pathways that may pose unacceptable human health or ecological risk from contamination. The specific objectives of the proposed remedy are referred to as Remedial Action Objectives (RAOs), listed in Section 6.

5. SUMMARY OF SITE RISKS

This section summarizes the current risks associated with the Offshore Area based on the Baseline Ecological Risk Assessment (BERA) and the Human Health Risk Assessment (HHRA) conducted for the area. Potential site-related risks from chemical contaminants measured in sediments and fish tissue collected from the Offshore Area were evaluated separately for ecological receptors and human health and are reported in Sections 5.1 and 5.2, respectively. The studies have concluded that ecological and human health risks presented by site-related contaminants in Offshore Area media are negligible and thus remedial action is not warranted.

5.1. 2002 BASELINE ECOLOGICAL RISK ASSESSMENT (BERA)

As indicated in Section 3 above, sediment chemistry and SPI data from the 2000 Environmental Survey, and sediment and tissue chemistry data from the 2002 Old Pier survey, were used to conduct the BERA, which was completed in September 2002 (*Baseline Ecological Risk Assessment for the Marine Offshore Area of the Former Nansemond Ordnance Depot*; SAIC, 2002). Several chemical constituents, including metals (arsenic and mercury), two PAH compounds (acenaphthene and fluorene), and five pesticides (4,4,'-DDD, 4,4'-DDT, aldrin, dieldrin and endrin ketone) were retained as CoPCs for exceedances of conservative ecological benchmarks.

The risk characterization approach to evaluate potential ecological risks associated with these CoPCs involved estimation of exposure to CoPCs and then calculation of risk based on this exposure, with sediment toxicity testing results providing supporting evidence in interpreting site-specific risk. Details of the exposure modeling efforts are presented in Section 4 of the BERA report. The analysis includes consideration of organisms that would be subject to direct, continuous exposure (Infaunal, Epibenthic and Demersal Receptors), and those that would be subject to discontinuous exposure to the sediments in the Offshore Area (avian and mammalian receptors), discussed in the sections below.

Risks to Infaunal, Epibenthic and Demersal Receptors. Direct, continuous exposure was conservatively assumed for organisms living in the sediment (e.g., clams, mussels, oysters) and demersal predators (e.g., blue crabs, croaker). Potential risk for these organisms was evaluated through the calculation of Hazard Quotients (HQs), or the division of measured sediment concentrations by threshold effects values (Table 4.2-1 in the BERA). Highly conservative threshold effects levels were used to account for all potential risk and to account for long-term, chronic effects of exposure. Risks were then evaluated by ranking these HQs according to four levels of probability of adverse exposure (negligible or below lower benchmark, low, intermediate, high or more than two-fold above the upper benchmark), and then comparing these findings to sediment toxicity test results.

Probability of adverse exposure was determined based on a qualitative evaluation of the frequency and magnitude of benchmark exceedances for each CoPC. Statistical comparisons among stations were not conducted, and estimations of FNOD background conditions were not incorporated into the evaluation. Consideration was given to the depth in the sediment at which the elevated concentrations occurred, as the type of organisms living in the sediment and feeding in the Offshore Area sediments would not likely be in contact with sediments at greater depth in the substrate. For identified ecological CoPCs, benchmark exceedances were generally of relatively low magnitude (i.e., not substantially higher than the very conservative screening benchmarks used), infrequent (occurred in a limited number of samples), and/or occurred at substrate depths greater than 20 cm.

Evaluation of the sediment CoPCs indicated that mercury exceeded the lower benchmark at only three locations and at depths greater than 20 cm. Arsenic exceeded the benchmark at seven stations, only two of which occurred in the upper 20 cm of sediment, located at stations furthest from the shoreline. PAH exceedances of the lower benchmark only occurred at one station. Similarly, isolated occurrences of benchmark exceedance for the pesticides DDD, DDT, and dieldrin were highly localized and appeared unrelated to any FNOD source areas.

Results of sediment toxicity tests (no toxicity observed) and evaluation of pore water exposure to CoPCs (modeled based on the sediment concentrations) supported the conclusions that the constituents identified as CoPCs do not appear to be an important source of risks to infaunal, epibenthic and demersal receptors at the site.

The characterizations of potential effects based on benchmarks are conservative given that many of the species do not spend their entire life span at a single location. The acute toxicity tests confirm the prediction of lack of effects based on these benchmark comparisons. The spatial analysis, indicating a lack of widespread contamination additionally suggests that any location-specific benchmark exceedances are likely not a significant concern given the mobility of most species.

Risks to Avian and Mammalian Receptors. Discontinuous exposure scenarios were evaluated for mammalian (raccoon) and avian (black-crowned night heron) aquatic predators that could feed in the Offshore Area. Trophic transfer models were employed to estimate the dose of contaminants to these higher-level predators. Exposure levels were calculated by determining the dose of chemical (chemical concentration in prey, sediment and/or pore water times the ingestion rate), the exposure factor (the duration the animal is exposed to the contaminants), and the bioavailability of the contaminants (how much chemical is absorbed by the animal's tissues per unit food consumed). These doses were screened against Toxicity Reference Values (TRVs) to represent the local species including black crowned night herons (Table 4.2-5 in BERA) and raccoons (Table 4.2-6 in BERA), to estimate probability for adverse effects on these representative species. Trophic transfer models include numerous assumptions about the food preferences, size and behavior of the animals that are incorporated from the available literature. The models include the highly conservative assumption that the animals spend their entire lives feeding in the Offshore Area. In addition, the most conservative dose-based benchmarks are used, or No Observed Adverse Effect Level (NOAEL), to provide the most conservative evaluation possible and account for possible chronic effects.

Results for black-crowned night heron indicated that only metals (chromium, lead and zinc) were detected in surface sediments at several sampling locations at sufficient concentrations to predict an exposure that would exceed the TRV. Hazard Quotients for the exceedances for these comparisons were all less than 10.

Results for raccoon indicated that the metals arsenic, cadmium, and chromium, were found in surface sediments at sufficient concentrations to predict an exposure that would exceed the TRV. Additionally, isolated exceedances were observed for PCBs, aldrin and heptachlor. All exceedances corresponded to Hazard Quotients less than 10, and none of the analytes with TRV exceedances indicated a trend of increased concentration near the FNOD shoreline.

These screenings were based on the NOAEL benchmark, which is a factor of ten below the LOAEL benchmark typically representing a chronic or sub-chronic (non-lethal) endpoint and is thus highly conservative. Additionally, calculation of a station-specific HQ (maximum site concentration compared to TRV) assumes the animal would feed on prey items exclusively at that particular station, which also represents a highly conservative approach.

Based on the highly conservative assumptions used in the exposure assessment, and the very conservative TRV values used, it was concluded that the few identified exceedances do not represent a high probability of adverse effects to aquatic predators such as black-crowned night heron, and mammalian predators, such as raccoon, at the site.

Summary. Based on these assessments presented in the BERA, chemical contaminants detected in the sediments of the Offshore Area do not appear to be related to activities on the site and are unlikely to pose risks to ecological receptors. Uncertainties associated with this conclusion are discussed in Section 4.2.3 of the BERA and include uncertainties associated with sample collection and identification of CoPCs, and uncertainties associated with the various modeling efforts undertaken to assess the potential risks of those CoPCs to ecological receptors. The final determination of the BERA is that ecological risks in the FNOD Offshore Area, including the Old Pier area, are negligible and there is no need for remediation because of ecological risk.

The BERA was based on thorough documentation of the site conditions and chemical distributions; thorough review of site history; development of conceptual models, data needs, study boundary and decision criteria, following Data Quality Objectives (DQOs); exposure estimates based on conservative assumptions and using maximum chemical concentrations; calculation of Hazard Quotients using conservative benchmarks to indicate which contaminants might pose ecological threats; and incorporation of sediment toxicity test results using site sediments. Uncertainties were minimized to the extent possible for the BERA, and multiple approaches were undertaken to substantiate the lack of site-related risks to ecological receptors. Therefore, it was concluded that this finding was adequately documented and technically defensible, as all data needs were adequately fulfilled by investigations to date.

5.2. 2003 HUMAN HEALTH RISK ASSESSMENT

The HHRA, completed in September, 2003, (*Final Report Human Health Risk Assessment for the Marine Offshore Areas of the Former Nansemond Ordnance Depot, Suffolk, VA*; SAIC 2003),was prepared in accordance with EPA guidance described in Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual, Part A (EPA, 1989) and Part D (EPA, 2001), and EPA Region III guidance documents for Risk Assessment. In the Conceptual Site Model for the FNOD Offshore area, potential routes of exposure to FNOD-related contaminants include the consumption of chemicals in fish and crabs by adults, adolescents and children. As the area is limited to waters offshore of the subtidal zone, there is no residential access. Other recreational activities such as swimming are not likely to occur in the Offshore Area. Accordingly, these pathways were not evaluated. The ingestion of sediment or water during fishing is possible but is not considered a likely route of chemical exposure and therefore this pathway was not evaluated quantitatively. The conceptual site model included evaluation of potential exposure from consumption of fish and crabs by adults, adolescents, and children based on recreational (i.e., not commercial) fishing patterns, based on known patterns of use in the area.

Results of the tissue screening (Section 3 above) resulted in retaining arsenic, three PAH compounds, and total PCBs as CoPCs. In order to evaluate potential risks associated with these tissue CoPCs, exposure assessments (estimates of the magnitude, frequency and duration of exposure) and toxicity assessments (assessment of potential adverse health effects of the CoPCs) were used to develop numerical human health risk estimates. Exposure point concentrations were estimated from the data for the highest exposures reasonably expected to occur.

Exposure parameters required include body weight, exposure duration, averaging time, which are common to all or most exposure pathways, and fish ingestion rate, exposure frequency and fraction ingested from the contaminated source, which would be variable for given populations. Selection of these factors for adults, adolescents, and children is described in Section 3.3.2 of the HHRA report. These factors and the exposure point concentrations were used to quantify chemical intakes for each segment of the population. The chemical intakes for the five tissue CoPCs were then evaluated in terms of toxicity risks to humans using hazard identification and dose-response assessment for carcinogenic and non-carcinogenic risks.

Carcinogenic effects to humans from exposure to chemicals were estimated quantitatively using cancer slope factors (CSFs) that convert estimated exposures to incremental lifetime cancer risks, and using EPA classifications for potential carcinogens (classes defining known, probably, possible, etc., carcinogens). Of the five tissue CoPCs, arsenic is a Group A carcinogen or has known carcinogenic effects, while the remainder are Group B2 carcinogens or agents for which there is sufficient evidence for carcinogenicity in animals but inadequate or lack of evidence in humans.

Cancer risks were characterized as the incremental increase in the probability that an individual would develop cancer during his or her lifetime due to site-specific exposure. The term "incremental" implies the risk due to environmental chemical exposure above the background cancer risk experienced by all individuals in the course of daily life. For example, a $2x10^{-6}$ cancer risk means that for every one million people exposed to the carcinogen under the specified exposure conditions throughout their lifetimes, the incidence of cancer may increase by two cases.

The combined risk from exposure to multiple chemicals was evaluated by adding the risks from individual CoPCs for adults, adolescents and children. The EPA (EPA, 1991) considers action to be warranted at a site when the total carcinogenic risk to a receptor exceeds 10^{-4}. Action is generally not required for risks falling within 10^{-4} to 10^{-6}; however, this is judged on a case-by-case basis. Risks less than 10^{-6} usually are not of concern to regulatory agencies.

The Reasonable Maximum Exposure (RME) risks were calculated for adult, adolescent and child receptors (summarized in Tables 7-1 to Table 7-3 in the HHRA report). Risks from exposures to Arsenic, the three PAHs and total PCBs were each greater than 10^{-6} for all receptors (adult, adolescent and child); the respective combined risks were 1×10^{-4}, 2×10^{-5} and 6×10^{-5}. In each case, the majority of risks were due to benzo(a)pyrene. Risks were higher for adult exposures due to a substantially higher rate of fish ingestion and exposure duration. As the calculated risks to adults, adolescents and children are within EPA's acceptable risk range of $1 \text{ x}10^{-4}$ to $1 \text{ x}10^{-6}$, risks to these receptor groups due to carcinogenic effects is considered acceptably low.

In the present study, all PCB congeners were non-detect for the crab samples. A few positive detections for dioxin-like congeners were observed in fish samples from two stations. To address the dioxin-like toxicity of these PCB detections, dioxin toxic equivalence concentrations (TECs) were calculated to evaluate potential for dioxin-like toxicity associated with PCBs. The maximum calculated TEC concentration for the two fish samples was 1.62×10^{-7} mg/kg. Using this value as the EPC value for dioxin, a risk value of 0.026×10^{-4} for dioxin-like PCB congeners was obtained. From this calculation, it is clear that the dioxin-like congeners contributed little to the observed overall risk to adult receptor (RME risk = 1×10^{-4}).

Non-carcinogenic effects were evaluated using chronic reference doses, which define the daily exposure likely to be without appreciable risk of adverse effects during a lifetime. The sole non-carcinogenic tissue CoPC was arsenic. Estimated exposure point concentrations for arsenic were an order of magnitude below reference dose values for each population (adult, adolescent and child receptors). As arsenic was the only CoPC contributing to the total non-cancer risk resulting from the fish ingestion, and HI values were < 1, it was concluded that acceptable risks to all human receptor populations were present for consumption of non-carcinogenic chemicals in fish and shellfish due to recreational fishing in the FNOD Offshore area.

6. REMEDIAL ACTION OBJECTIVES

It is the U.S. Army Corps of Engineers and U.S. EPA's current judgment, after consultation with VDEQ, that the preferred alternative identified in the Proposed Plan will protect public health, welfare, and the environment from actual or threatened releases of hazardous substances. The site-specific remedial action objective (RAO) for the Offshore Area is prevention or minimization of direct contact of human and ecological receptors with FNOD-related contaminants in the Offshore Area.

7. SUMMARY OF REMEDIAL ALTERNATIVES

Based on the results of the Baseline Ecological Risk Assessment (BERA) and Human Health Risk Assessment (HHRA), the Army Corps of Engineers, EPA and VDEQ have determined that the site does not pose an unacceptable risk. Therefore, no other alternative beyond the No Further Action (NFA) alternative was considered or evaluated.

8. EVALUATION OF ALTERNATIVES

No remedial actions have been selected for the FNOD Offshore Area due to the findings of negligible risk to ecological and human receptors as described in Section 4.

9. PREFERRED ALTERNATIVE

The investigations described in Sections 2, 3 and 4 were conducted to evaluate the need for remedial action in the FNOD Offshore Area based on risk from chemical contaminants. The investigations were thorough, involving two separate data collection efforts (conducted in 2000 and 2002). These data were used to evaluate risk to ecological receptors in the BERA, and to humans in the HHRA. The BERA and HHRA concluded that the FNOD Offshore Area presented negligible risk to ecological receptors and to humans and that no further remedial action is needed in this area (No Further Action or NFA determination).

Based on the information currently available, the U.S. Army Corps of Engineers, EPA, and VDEQ believe the Preferred Alternative meets the threshold criteria and provides the best balance of tradeoffs among other alternatives and with respect to the balancing and modifying criteria. These agencies expect the Preferred Alternative (No Further Action) to satisfy the statutory requirements of CERCLA §121(b) and to be protective of human health and the environment. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) (or justification for a waiver), cost-effectiveness, utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable, and a determination that the Preferred Alternative satisfies the preference for treatment as a principle element (or justifies not meeting the preference) were not included in the evaluation of this Area of Concern based on the NFA determination.

10. COMMUNITY PARTICIPATION

As indicated in Section 1 above, the purpose of this Proposed Plan is to gather public comment in accordance with the requirements of CERCLA Section 117(a). A 30-day public comment period for the Proposed Plan will begin on December 4, 2003, and end on January 4, 2004. Comments may be made verbally or in writing at the December 4, 2003, Public Meeting or submitted in writing at any time during the public comment period to:

- U.S. Army Corps of Engineers: Adriane James, FUDS Program Manager, Norfolk District U.S. Army Corps of Engineers, 803 Front Street, Norfolk VA. 63510. Comments may also be submitted by e-mail to Ms. James at: Adriane.B.James@usace.army.mil.

- U.S. EPA Region III: Robert Thomson, P.E., Hazardous Sites, U.S. EPA Region III, 1650 Arch Street, Philadelphia, PA 19103-2029. Comments may also be submitted by e-mail to Mr. Thomson at: Thomson.Bob@epamail.epa.gov.

- Virginia Department of Environmental Quality (VDEQ): Ms. Debra Miller, Remedial Project Manager, Federal Facilities Restoration Program, VDEQ, 629 East Main Street, Richmond, Virginia. Comments may also be submitted by e-mail to Ms. Miller at damiller@deq.state.va.us.

All comments received during the public comment period and at the public meeting will be considered and addressed for development of the final Proposed Plan for the Offshore Area. Once the Proposed Plan is finalized, Record of Decision (ROD) will be prepared for publication in the Federal Register, which would constitute completion of the evaluation of the Offshore Area.

As indicated in Section 1 above, the complete reports referenced in this Proposed Plan are available to the public and can be found in the Information Repository and Administrative Record files at the Tidewater Community College Library and through the U.S. Army Corps of Engineers, at the addresses listed in Section 1 above.

11. ACRONYMS

AET	Apparent Effects Threshold
AOC	Area of Concern
ARAR	Applicable or Relevant and Appropriate Requirements
AVS	Acid Volatile Sulfide
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CoPC	Chemical of Potential Concern
CSF	Cancer Slope Factor
BAF	Bioaccumulation Factors
BERA	Baseline Ecological Risk Assessment
BSAF	Biota-Sediment Accumulation Factors
DQO	Data Quality Objective
EPA	Environmental Protection Agency
ERA	Ecological Risk Assessment
EPC	Exposure Point Concentration
ER-L	Effects Range – Low
ER-M	Effects Range - Medium
FDA	Food and Drug Administration
FNOD	Former Nansemond Ordnance Depot
FUDS	Formerly Used Defense Site
GE	General Electric

HHRA	Human Health Risk Assessment
HRSD	Hampton Roads Sanitation District
HQ	Hazard Quotient
MLLW	Mean Lower Low Water
NCP	National Contingency Plan
NFA	No Further Action
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observed Adverse Effect Level
NOS	National Oceanographic Survey
NPL	National Priority List
PAH	Polycyclic Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyls
PEL	Probable Effects Level
PP	Proposed Plan
RAGS	Risk Assessment Guidance for Superfund
RAO	Remedial Action Objective
RBC	Risk-Based Concentration
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SEM	Simultaneously Extracted Metals
SLERA	Screening Level Ecological Risk Assessment
SPI	Sediment Profile Image
TAL	Target Analyte List
TEC	Toxic Equivalence Concentration
TEL	Threshold Effects Level
TRV	Toxicity Reference Dose
USACE	United States Army Corp of Engineers
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality

12. REFERENCES

Science Applications International Corporation (SAIC). 2002. Findings of an Environmental Survey of the Marine Offshore Areas of the Former Nansemond Ordnance Depot, Final. Prepared for: USACE-Norfolk District. September.

SAIC. 2002b. Baseline Ecological Risk Assessment (BERA) for Former Nansemond Ordnance Depot, Draft. Prepared for: USACE- Norfolk District. September.

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USACE (U.S. Army Corps of Engineers). 2000. Draft Final Site Management Plan, Former Nansemond Ordnance Depot. Prepared by Norfolk District, Norfolk, VA. January.

USEPA (United States Environmental Protection Agency). 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A. Office of Emergency and Remedial Response, December 1989. EPA/540/1-89/002.

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USEPA. 2002. EPA Region III Risk-Based Concentration Table. http://www.epa.gov/reg3hwmd/risk/rbc1002.pdf

Weston 1999. Engineering Evaluation/Cost Analysis (EE/CA) for the James River Beachfront Area, Former Nansemond Ordnance Depot, Suffolk, VA. September.

Figure 1-1. Location of the Former Nansemond Ordnance Depot (FNOD) in Suffolk, VA.

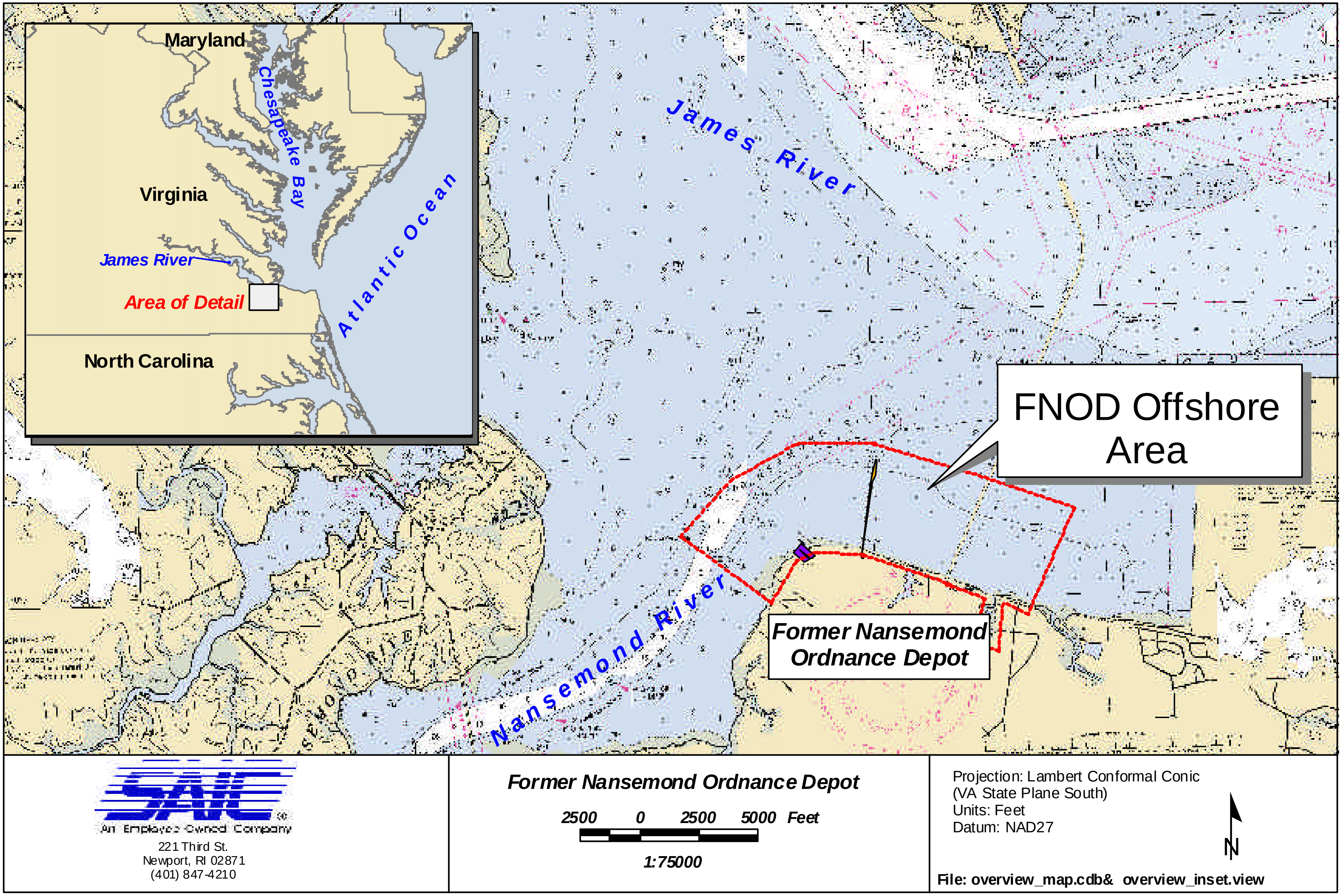

Figure 1-2. Marine aquatic areas being investigated at the FNOD site.

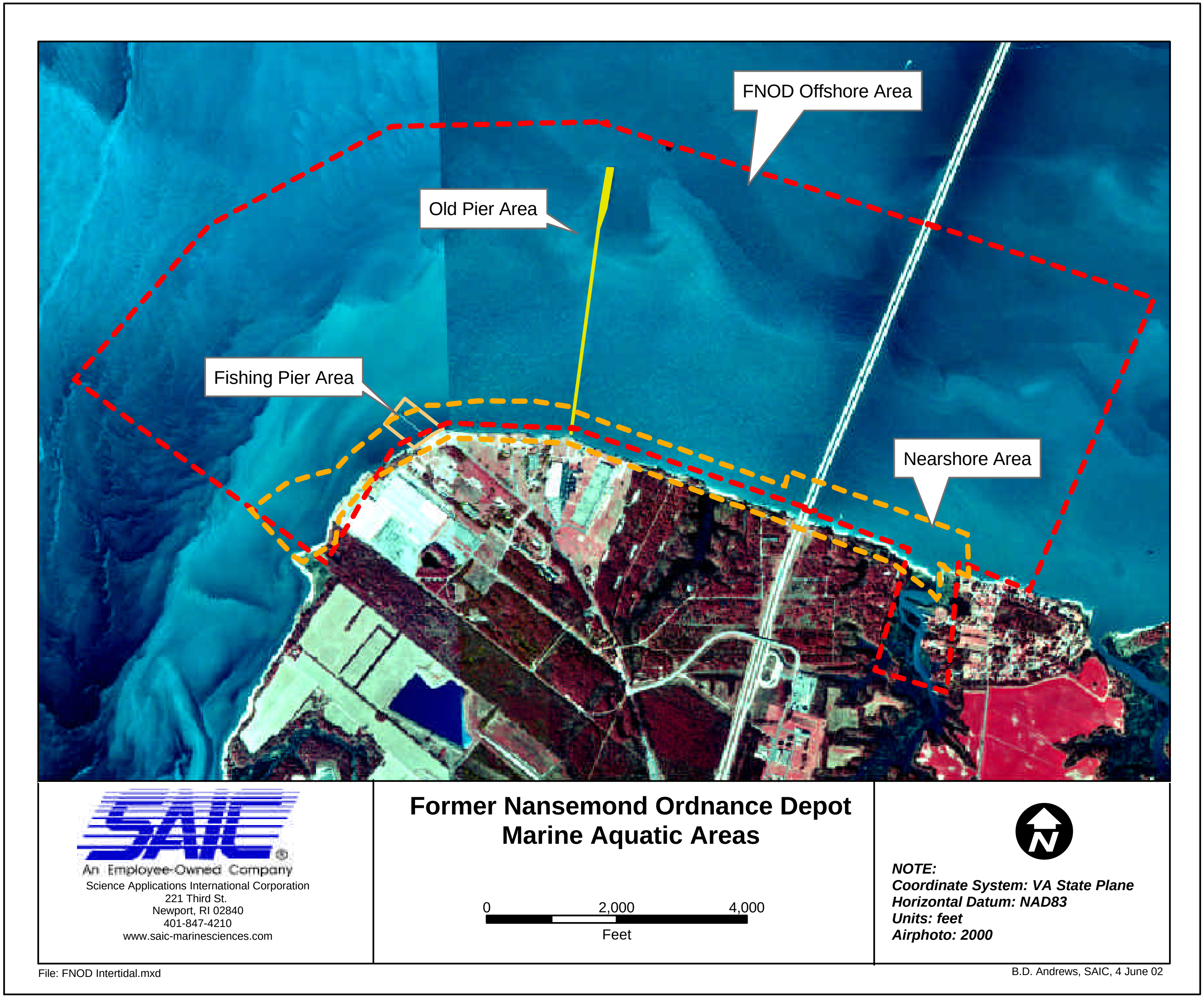

Figure 3-1. Sediment sampling locations in the FNOD Offshore Area.

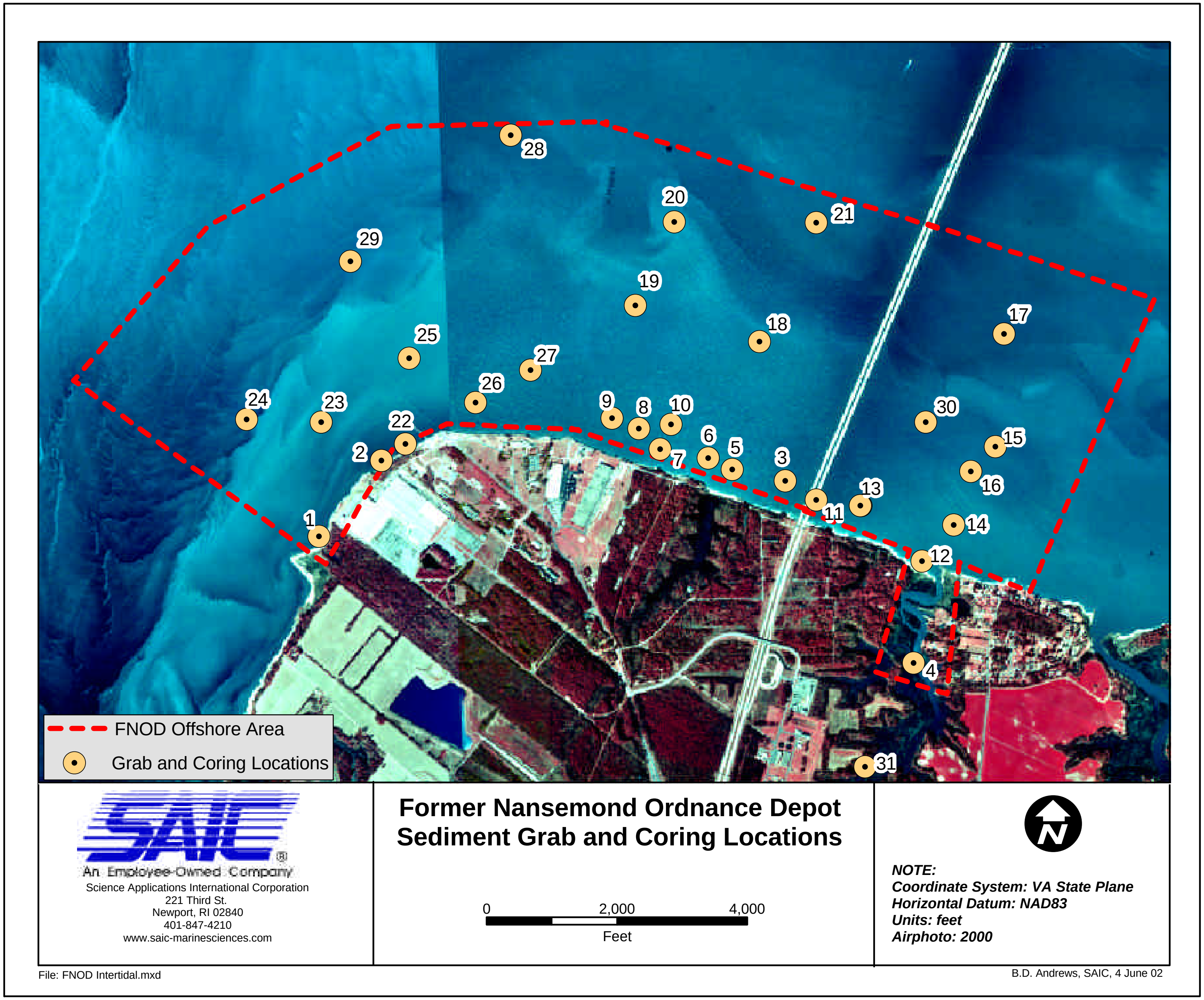

Figure 3-2. Sediment sampling locations in the FNOD Old Pier Area.

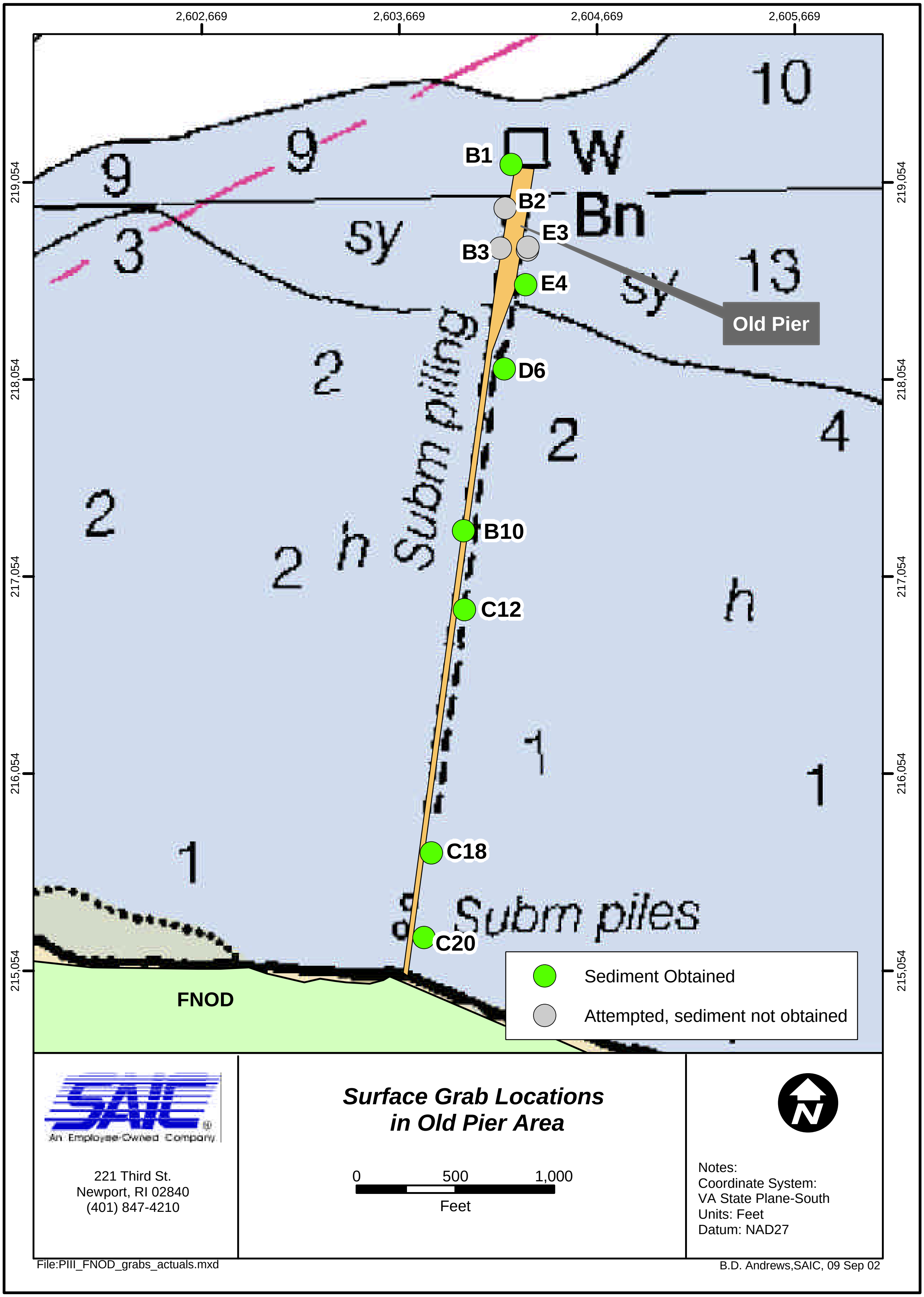

Figure 3-3. Crab and croaker sampling locations in the FNOD Old Pier Area.