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RESPONSE TO SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL COMMENTS ON RESOURCE CONSERVATION AND RECOVERY FACILITY INVESTIGATION WORK PLAN CNC CHARLESTON SC

8/9/1993

ENSAFE/ ALLEN AND HOSHALL

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION CHARLESTON NAVAL SHIPYARD CHARLESTON, SOUTH CAROLINA

RESPONSE TO SCDHEC RFI WP COMMENTS CHARLESTON NAVAL SHIPYARD

Prepared for:

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CHARLESTON NAVAL SHIPYARD (NSY)
SOUTH CAROLINA DEPARTMENT OF HEALTH AND ENVIRONMENTAL CONTROL COMMENTS
AUGUST 9, 1993

GENERAL COMMENTS

COMMENT 1:

The NSY responded to the Department's previous comment on the development of base specific background levels by stating that the soils at NSY are predominantly river sediments and fill material. Therefore, representative background concentrations of naturally occurring constituents could not be developed. Instead, NSY proposed to compare levels of constituents detected in soil samples to RCRA Corrective Action Levels, as proposed in Subpart S (55 Federal Register 30798, July 27, 1990). However, site-specific levels of naturally occurring constituents must be developed. These levels are necessary in order to make comparisons so that it is possible to determine whether a release to the environment from a SWMU has occurred. RCRA corrective action levels cannot be used to make this determination since they are not intended for this purpose. While it may be appropriate to utilize the RCRA corrective action levels to determine when remediation of a media will be necessary, assessment of the degree of environmental contamination must be compared to site-specific, "background" concentrations. The Workplan should be revised accordingly.

RESPONSE: The reference to the proposed Subpart S action levels was included to allow the reader to put into perspective the concentrations of potential contaminants that have been identified at the NSY. The NSY still contends that site specific background concentrations of constituents of concern (particularly inorganics) are not attainable. A review Collection of soil samples at remote locations of the facility not built on fill material will result in comparing analytical results of chemically distinct soil. As discussed in the meeting held July 28, 1992 the NSY has proposed risk-based action levels as a reference point on which scoping of the RFI will be based. The document entitled *Proposed Risk-Based Action Levels, Charleston Naval Shipyard* was submitted under separate cover (as requested) from the RFI Workplan and has been attached to this response document for resubmittal since comments regarding the risk based approach were never received.

COMMENT 2:

Comment 17.B of the Department's previous review requested that NSY specify the exact metals that will be analyzed when the Workplan stated that analyses will be conducted for "RCRA metals". In response, NSY stated that the metals include cadmium, chromium, lead, arsenic,

barium, mercury, selenium, and silver. However, in addition to those metals, antimony, beryllium, nickel, and thallium, and complexes of copper, vanadium, and zinc are hazardous constituents listed in Appendix VIII of Part 261 of the SCHWMRs. The NSY did not include a discussion of why these metals are not to be included in the analyses. NSY must either analyze for these metals (antimony, beryllium, copper, nickel, thallium, vanadium, and zinc) or provide justification for not conducting these analyses.

RESPONSE: The proposed scope of work for the RFI will be revised to include analysis for the Target Analyte List (TAL) metals where analysis for RCRA metals had previously been specified. The TAL metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

COMMENT 3:

Section 4.21 of the Workplan describes management procedures for Investigation Derived Wastes (IDW) that will be generated during the RFI. The Workplan proposed to initially store drums of IDW within the boundaries of the respective SWMUs while awaiting analytical results necessary for waste identification. However, due to the fact that most of NSY consists of heavily industrialized areas, storage of potentially hazardous wastes in the areas of the SWMUs does not appear to be the most appropriate management practice for this waste. It is recommended that drums of IDW be transported to a permitted hazardous waste storage facility while awaiting the analytical results necessary to make a waste determination. Transport from the area that the waste was generated to a permitted storage facility can be completed without invoking the Land Disposal Restrictions (LDRs). LDRs will apply if it is determined that these wastes are hazardous. Drums of IDW should be labeled "In test" or "Waiting on analytical results" until the analytical results are received and the final waste determination made. The Workplan should be revised to allow movements of drums of IDW to a permitted hazardous waste storage area until the waste determination is made.

RESPONSE: The storage of drums containing IDW at the hazardous waste storage facility while awaiting analytical data may be the most appropriate waste management practice; however, the practicality of storing such a potentially large number of drums may create an undesirable logistical problem. The NSY realizes the need to provide a secure storage area for the drums until a waste determination is made and proposes the following alternative solution so that the current daily operations of the hazardous waste storage facility are not hampered by the storage of numerous drums, many of which are likely to be nonhazardous. Drums which are located in high traffic areas and are subject to being damage that may cause leakage of the contents will be transported to the storage facility. Drums located around more obscure areas such as SWMU #9 will instead be staged at a designated location within the boundary of the SWMU that

would still result in adequate protection of the drums and their contents until a waste determination is made. A fenced compound is already being prepared to enclose the decon area and drums generated by the decon process.

SPECIFIC COMMENTS

COMMENT 4: SWMU #3 - PESTICIDE MIXING AREA

The RFI Workplan describes this SWMU as approximately 50 feet by 25 feet ($\sim$139 yds^2) in size. Approximately 20 square yards of this area is devoid of vegetation. The Workplan goes on to note that the area is contaminated with low concentrations of various pesticides which are managed at this site and associated degradation products. The Department's previous review of the RFI Workplan noted that investigation of soil and groundwater contamination is warranted at this SWMU. In response, collection of soil samples and installation of two (2) groundwater monitoring wells are proposed in the current RFI Workplan. However, with only two (2) groundwater monitoring wells, it will be impossible to conclusively determine the groundwater flow direction. In order to insure that the monitoring wells are properly located to intercept groundwater migrating beneath this SWMU, a third monitoring well is required. Therefore, NSY must propose to install a third monitoring well at this SWMU. The RFI Workplan must be revised accordingly.

RESPONSE: The workplan will be revised to include the installation of one additional monitoring well to the west of the area described as "denuded". Also, the list of metals to be analyzed for will be revised to include the TAL metals.

COMMENT 5: SWMU #4 - PESTICIDE STORAGE BUILDING

The description of SWMU #4 - Pesticide Storage Building states that this building has been used to store various insecticides and rodenticides since 1980. Sink and floor drains within the building are either connected to the sanitary sewer or to blind sumps (sumps with no outlets). The RFI Workplan proposes to collect soil samples from five (5) locations and one (1) sediment sample from a nearby storm sewer for analyses. However, it is unclear whether any of these samples will be collected in or near the blind sumps discussed in the RFA Report. Collection of samples from this area should be given a priority since this would seem to be the most likely manner in which a release to the environment would occur. NSY should clarify that a sample(s) will be collected from in or beneath the blind sumps.

RESPONSE: A review of the building plans does not give any indication of the presence of blind sumps near or beneath the building. The current soil sampling program is designed to address surface releases and releases to the sanitary sewer. If, during the investigation, the

rumored blind sumps can be located, an attempt will be made to collect a sample of any liquid that may remain.

COMMENT 6: SWMU #5 - BATTERY ELECTROLYTE TREATMENT AREA

SWMU #5 - Battery Electrolyte Treatment Area includes a tank which was used to neutralize battery acids. Soil samples collected previously from around the tank indicated high levels of lead contamination (up to 21,722 parts per million (ppm)). The RFI Workplan has been revised per the Department's previous review to include installation of four (4) monitoring wells around this SWMU to determine the existence of groundwater contamination. However, upon review of the proposed locations of the monitoring wells, it appears that the location of one (1) well should be altered to provide more lateral spacing between wells. Specifically, a monitoring well should be placed adjacent to and on the northern side of the Acid Waste Treatment Tank. Increasing this spacing should allow construction of more accurate water-table maps for this area, once potentiometric data are collected. The RFI Workplan should be revised accordingly.

RESPONSE: The monitoring well located between the driveway and the area identified as the concrete pad will be moved to the northeast so that it is adjacent to the northern side of the tank.

COMMENT 7: SWMU #6 - PUBLIC WORKS STORAGE YARD

This SWMU is a former Interim Status Standards (ISS) hazardous waste storage unit. Closure of this SWMU is currently being conducted under an ISS Closure Plan (CP), last revised November 9, 1992. This closure plan has not received final approval from the Department, therefore, such statements as "The nature and extent of soil contamination at SWMU #6 has been adequately characterized..." are premature. Additional assessment and/or removal of contaminated soils may be necessary pending approval of the CP by the Department. The RFI Workplan should be revised accordingly.

RESPONSE: The statement will be qualified to indicate that the areal extent of the contamination appears to have been delineated, but the closure plan has not yet been approved.

COMMENT 8: SWMU #7 - PCB TRANSFORMER STORAGE AREA

This SWMU consists of Building 3902, the adjacent concrete slab located outside the building and surrounding areas that were used for storage of transformers and associated electrical equipment. Three comments were generated regarding the proposed assessment of this SWMU.

A. Section 3.12.1 of the RFI Workplan describes the proposed soil sampling strategy for this SWMU. The Workplan notes that soil samples were collected in February 1987 from an area east of the concrete pad, therefore, samples will not be collected from this area during the RFI, nor from beneath the concrete slab which comprises SWMU #7. However, review of the analytical results from this previous study (included in Appendix F of the RFI Workplan) indicates that the detection limits used in the analyses ranged from 500 and 1,000 parts per billion (ppb). It is further noted that the action level for PCBs in soil, as proposed in Subpart S, is 90 ppb. Since it is possible that PCBs remain in the soil at this SWMU in concentration above the proposed action level, additional analyses must be conducted using detection limits that are less than the proposed action level. Samples must be collected from the area east of the fence and from beneath the concrete pad of SWMU #7. The Workplan should be revised accordingly.

RESPONSE: The workplan will be revised to include the collection of samples from beneath the concrete pad and the area east of the fence. If sampling stations east of the fence are located beneath the cold storage warehouse, samples will only be collected along the foundation and not from underneath the floor of the building.

B. The RFI Workplan proposed the collection of soil samples from 28 sampling locations from depths of 0 to 1 foot, 1 to 2 feet, and 2 to 3 feet below land surface. All samples will be extracted by the laboratory. Analyses will be completed on the shallow samples (i.e., the samples from 0 to 1 foot depth) first, if PCBs are detected in these samples, the next deeper interval will be analyzed for PCBs. Analyses will be discontinued if PCBs are not detected above the method detection limit in any particular sample. However, this methodology may or may not adequately assess the extent of PCBs in the soils from this unit. It is possible that PCBs have leached deeper into the subsoils than three (3) feet. If this were true, this methodology may not detect PCBs. Therefore, this sampling strategy should be modified to allow collection and analyses of a representative number of soil samples from deeper soil intervals until the full vertical extent of soil contamination is determined.

RESPONSE: The sampling program will be revised so that samples will be collected from the 0-1 foot interval and then over 2 foot intervals thereafter until groundwater is encountered (i.e. 1-3 feet, 3-5 feet, etc..). The proposed extraction and analysis strategy should adequately delineate the vertical extent of contamination given the low mobility of PCBs. It is highly unlikely that PCBs would not be detected at the surface interval, but would be found in samples collected at deeper intervals.

C. The RFI Workplan proposed to investigate groundwater contamination for both SWMUs #6 and #7 with the installation of monitoring wells around both units. Since these SWMUs appear to be contiguous on the site map provided (Figure 2-10), this approach

appears reasonable. The Workplan has been revised per the Department's previous review to include installation of seven (7) monitoring wells in the vicinity of these SWMUs. The Workplan further proposed to collect groundwater samples and to analyze these samples for pesticides, PCBs and the eight RCRA metals. However, it is noted in the RFA Report that vehicle maintenance was performed within SWMU #6 (the Public Works Storage Yard). As such, cleaning solvents and waste oils were generated during operations of this unit. Therefore, the RFI Workplan should be revised to include analyses for volatile and semi-volatile constituents, as well as the additional metals discussed above in comment 2. The Workplan should be revised accordingly.

RESPONSE: A review of the historical analytical data indicates that volatile and semivolatile constituents were present in soil samples collected at this site. The Workplan will be revised to include analysis for volatile organics, semivolatile organics, and TAL metals.

COMMENT 9: SWMU #8 - OIL SLUDGE PIT AREA

SWMU #8 - Oil Sludge Pit consists of three (3) separate pits in which oil sludges were disposed during the period of 1944 to 1971. Past investigations indicate that free-phase oil exists on the water table in the vicinity of this SWMU. Two comments have been generated from review of this section of the Workplan.

A. The RFI Workplan proposed to collect soil samples from 33 locations. Seven (7) of these locations will be inside the suspected areas of the former disposal pits, with the remaining locations outside the suspected pit areas. The soil samples from outside the pits are to be analyzed for Total Petroleum Hydrocarbons (TPH) using EPA method 418.1. However, since this method will detect only petroleum hydrocarbons and not metals and other constituents of interest at this SWMU, only limited information can be gained by using this method. Therefore, soil samples collected from locations outside the former pits should be analyzed for an expanded list of constituents including all RCRA metals (see comment 2), volatile and semi-volatile organic compounds, and PCBs.

RESPONSE: The workplan will be revised accordingly.

B. It is proposed in the Workplan to install six (6) monitoring wells in the vicinity of SWMU #8 to complement existing wells ,]-1, ,]-2, and ,]-3. This strategy conflicts with NSY's response to comment 6 of the Department's previous review of the Workplan where it stated that all pre-existing monitoring wells that could be located during the course of the RFI would be properly abandoned. It is acceptable to use existing monitoring wells for collection of groundwater samples if it can be shown that these wells meet current monitoring well construction standards. If this cannot be proven, then

it will be necessary to abandon these monitoring wells. If wells ,]-1, ,]-2, and ,]-3 require abandonment, then the locations of the proposed monitoring wells should be altered from those proposed in Figure 3-7 (SWMU 8 - Proposed Sampling Locations Oil Sludge Pit) to provide more spatial variation in the area of this SWMU.

RESPONSE: If the existing wells can be located, but their construction details can not be verified, they will only be used to obtain water level measurements prior to installation of the new wells. Following installation of the new wells, the preexisting monitoring wells will be properly abandoned. The proposed new monitoring well locations will be revised to provide better spatial variation.

COMMENT 10: SWMU #9 - CLOSED LANDFILL

This SWMU is a landfill used from the 1930's until 1973 for the disposal of many types solid wastes generated at the NSY. The area was originally marshland. The RFI Workplan proposed several phases of investigation of this area, including geophysical surveys consisting of a magnetometer survey and a resistivity survey. These will be followed by trenching into suspect areas identified during the geophysical surveys. Soil samples are to be collected during trenching and installation of monitoring wells. In the Department's previous review of the Workplan, comments were generated requesting additional information and detail regarding the investigations of this SWMU. However, the Workplan is still vague and lacking in technical detail with respect to the proposed work at this SWMU. Several comments have been generated as a result of this review, as outlined below.

A. The Workplan proposed to conduct two (2) geophysical surveys of SWMU #9, the first of which will be a magnetometer survey and the second a resistivity survey. The Workplan states that a variable grid spacing will be used, with tighter spacing in areas where conductivity irregularities or anomalies are found by the resistivity survey. The following comments have been generated concerning this proposed work.

   i. It is recognized that a variable grid spacing may be the most efficient manner by which to investigate this SWMU. However, the Workplan did not include a discussion of even an approximate grid spacing, or within what limits the spacing would vary, nor the exact area which the grid would cover. This type of detail must be included in the revised RFI Workplan to allow a thorough review of the technical merits of such a geophysical survey program.

RESPONSE: The grid spacing chosen for the geophysical survey was 10x10 feet over as much of the landfill as practical. The grid spacing was kept constant in order to facilitate Fourier data processing. Several tests were conducted over limited areas at a tighter grid spacing to establish the applicability of the 10x10 foot spacing.

ii. In Section 3.14.1 (Geophysical Surveys) the Workplan states the initial geophysical survey will be conducted with a magnetometer. In the paragraph describing the magnetometer survey, the workplan states that the grid spacing of the magnetometer survey will be dependent, in part, on the results of the resistivity survey. The Workplan should be revised to clarify this discrepancy.

RESPONSE: The Workplan will be revised accordingly. The magnetics grid was chosen independently of the conductivity results.

B. NSY's response to the Department's previous review states that the propose of a soil gas sampling program is to qualitatively determine whether constituents are present in appreciable concentrations in soil gas. However, the Workplan remains vague regarding the number of soil gas sampling points that will be emplaced and the exact constituents for which analyses will be conducted. Two comments have been generated regarding this work.

i. The Workplan states that the landfill will be surveyed with a 100 by 100 foot grid system used to transect the site and for locating soil gas sampling points. The Workplan further states that sample station locations will be selected based on information gathered from the geophysical survey, historical information on the landfill operations, and aerial photographs of the site, if possible. However, the Workplan does not propose a minimum number of soil gas sampling points. Also, historical information and information from aerial photographs should have been reviewed and used to plan the upcoming phase of work described in the current version of the RFI Workplan. It is impossible to determine the technical adequacy of such a program without this information. The Workplan must be revised to provide this information.

RESPONSE: During the soil gas survey conducted by Target in June 1992, a total of 440 locations were sampled utilizing the 100 x 100 foot grid system described in the Workplan. The grid system was employed over the entire landfill as defined by the geophysical survey and a review of aerial photos. The sampling scheme and results of the soil gas survey were described in the document *Draft-Final Preliminary RFI Field Activity (Soil-Gas, Geophysics)* prepared by EnSafe/Allen & Hoshall dated March 26, 1993. This document has been submitted for regulatory agency review.

ii. With respect to analyses of soil gas sampling using a field Gas Chromatograph with a Electron Capture Detector (GC/ECD) and a Flame Ionization Detector (FID), the Workplan states that "the actual compound list [able to be detected with such equipment] will be variable to the subcontractor selected". If this is the case, then the value of a soil gas survey cannot be determined. Due to the lack of detail included in the Workplan, it is impossible to determine whether it is

worthwhile to complete this survey. Instead, it appears that effort should be placed in areas that will provide the most information, such as conducting a grid-based soil sampling program and installation of groundwater monitoring well system.

RESPONSE: The compound list for the soil gas survey included 1,1-DCE; methylene chloride; trans-1,2-DCE; cis-1,2-DCE; chloroform; 1,1,1 TCA; carbon tetrachloride; TCE; 1,1,2 TCA; PCE; benzene; toluene; ethylbenzene; meta, para, and ortho xylene. While conducting a soil sampling program may provide the most information about the site, attempting to do so would be both cost prohibitive for the extensive analytical testing and labor required to collect the samples. The soil gas survey has provided a very cost effective approach to generate screening data that can be combined with the geophysical and historical data to develop a more refined soil and groundwater investigation.

C. The RFI Workplan does not include adequate technical detail regarding the proposed soil sampling program for this SWMU. Section 3.14.4 (Soil Sampling) of the Workplan states that the number of soil samples to be collected during assessment of this SWMU will be dependent on the results of the soil gas survey and the geophysical survey. It is proposed that soil samples will be collected during soil trenching and installation of groundwater monitoring wells, with a minimum of one soil sample collected from each trench and from "material leaking from drums or containers, sludge or fill material or any suspect material in the excavation." This is inadequate due to the fact that the number of trenches is not specified. Further, a successful soil sampling program must include collection of a representative minimum number of soil samples from the area under investigation. The number of samples should be based on available guidance (see Region IV Standard Operating Procedure). The Workplan should be revised accordingly.

RESPONSE: Based on the results of the soil gas survey, geophysical survey, and a review of historical documentation, an appropriate soil sampling program will be designed to encompass areas of concern around SWMU #9.

D. The Workplan is unclear with respect to the monitoring wells to be used in investigation of this SWMU. First, the Workplan states that monitoring wells LF1 through LF10, SLF1 and SLF2 were installed previously in the vicinity of the SWMU. The locations of these wells are depicted in Figure 2-19 (Closed Landfill Area Plan). Then it is noted in section 3.14.5 (Groundwater Sampling) of the Workplan that "a site survey conducted in the area of SWMU #9 did not identify all the wells installed under previous investigation. Therefore, during the RFI ten (10) additional wells will be installed (Figure 3-8)." Figure 3-8 (SWMUs #9 and #20 Proposed Sampling Locations - Closed Landfill and Waste Disposal Area) depicts wells labeled as those described above (LF1 through LF10, SLF1 and SLF2). The RFI Workplan must be revised to indicate whether

the monitoring wells described above actually exist or not. If any of these monitoring wells cannot be located and/or their well construction details verified, then abandonment and/or installation of replacement wells is required. Further, any wells installed per this investigation should not have the same designation as a well installed during previous work; its designation must be unique. The Workplan must be revised accordingly.

RESPONSE: During the geophysical survey only two of the existing wells, CSY-FMW2 and CSY-FMW4, were located. These wells are documented to have been installed in 1991 in accordance with the well permits issued by SCDHEC and are currently the only wells at the landfill to be used in the RFI. As previously stated, all wells for which well construction details can be verified will be properly abandoned during the RFI. A revised figure which illustrated the proposed well locations was submitted for regulatory agency review with the *Draft-Final Preliminary RFI Field Activity Report (Soil Gas/Geophysics)* prepared by EnSafe/Allen & Hoshall.

COMMENT 11: SWMU #12 - OLD FIRE FIGHTER TRAINING AREA

SWMU #12 - Old Fire Fighter Training Area consisted of a pit approximately 30 to 50 feet in diameter used between 1966 and 1971. Oil, gasoline, and alcohol were poured into the pit and ignited during fire training exercises. The pit was cited by the coast guard for an oil spill that occurred in 1971 following a heavy rain that resulted in oil flowing into Shipyard Creek. The RFI Workplan proposed to establish a grid over the suspected area of the pit. The nodes of the grid are to be spaced approximately 10 feet apart. According to Figure 3-9 (SWMU #12 -Old Fire Training Area Proposed Soil Boring Locations), the grid will be approximately 40 feet by 50 feet square. Soil samples will be collected from each node of the grid at two (2) foot intervals until groundwater is encountered. According to the Workplan, the location of the pit will be more precisely determined from examination of aerial photographs taken during the period of operation. This approach appears to be reasonable, although it is predicated on the assumption that the grid will be placed in the general area of the old fire pit. It is possible that if the grid is placed away from the actual location of the pit that the soil samples collected will not detect any contamination. Thus, the grid system used during assessment of this SWMU should be expanded to cover a wider area. The RFI Workplan should be revised accordingly.

RESPONSE: The proposed grid represents the minimum number of sample points thought to be necessary to fully delineate the pit. Prior to establishing the grid, soil samples will be collected over a larger area and screened with a PID to help locate the approximate boundary of the pit. Field sampling personnel will exercise professional judgement to determine whether or not the actual sampling grid will need to be expanded to fully encompass the perceived pit boundary.

COMMENT 12: SWMU #13 - CURRENT FIRE TRAINING AREA

The RFI Workplan describes SWMU #13 - Current Fire Fighting Training Area as a fire training area in which No. 2 diesel fuel and gasoline are burned for training purposes. This SWMU has been in use since 1973. Approximately 20,000 gallons of No. 2 diesel fuel and 2,000 gallons of gasoline are burned per year during the training exercises. Wastewater from the area is routed to a gravity oil-water separator prior to discharge into the sanitary sewer system. The RFI Workplan proposed to collect a single soil sample from the oil/water separator downgradient of this SWMU. The Workplan does not propose to collect groundwater samples unless it is determined that the sewer line lead from this SWMU has leaked and soils adjacent to the line have been impacted. Two comments have been generated from review of the proposed assessment activities of this SWMU.

A. The Workplan should be revised to include an inspection of the integrity of the pavement of this SWMU. Soil samples should be collected below any cracks or other flaws observed in the pavement during this inspection.

RESPONSE: The investigative activities planned for this SWMU will be revised to include a visual inspection of the asphalt. Soil samples will be collected from beneath the asphalt where significant cracks are observed. The soil horizon just below the asphalt surface is likely to contain semivolatile compounds which are result of the asphalt itself and not site activities.

B. The Workplan does not propose to collect any groundwater samples in and around this SWMU unless it is determined that a leak from the sewer line has occurred and soil adjacent to the line has been impacted. However, the Workplan did not discuss how the integrity of the sewer line was to be determined. The Workplan should be revised to describe how this determination will be made.

RESPONSE: If necessary, the integrity of the sewer line can be checked by pressure testing with compressed air. A minimal loss of air pressure is to be expected when conducted this type of test and does not necessarily indicate a fluid loss. Therefore, the logical approach would be to sample soil adjacent to the line (near the joints if it can be determined where they are located) to ascertain whether or not soil has been impacted. Furthermore, a breach in the sewer line integrity could mean seepage into the line rather than a loss of fluid.

COMMENT 13: SWMU #14 - CHEMICAL DISPOSAL AREA

The Chemical Disposal Area is located in the vicinity of the skeet and pistol ranges. Unknown amounts of various chemicals, including decontaminating agent non-corrosive (DANC) and DS-2 (a mixture of 70% diethylene triamine, 28% methyl cellosolve and 3% sodium hydroxide) have been reportedly disposed of at the site. It is noted that construction workers who unearthed drums of chemicals at the skeet range in 1972 and 1974 suffered chemical burns. The RFI

Workplan proposed to utilize magnetic and resistivity geophysical methods to locate buried metal containers and other areas of increased subsurface conductivity, then to choose locations to collect soil samples based on the findings of the geophysical surveys. Approximately 25 soil borings will be drilled, with three discrete samples collected from each boring. One comment has been generated from review of this section of the Workplan.

A. The Workplan states that a variable grid spacing will be used during the geophysical surveys, with tighter spacing in areas where conductivity irregularities or anomalies have been found by the resistivity survey. It is recognized that a variable grid spacing may be the most efficient manner by which to investigate this SWMU. However, the Workplan did not include a discussion of an approximate grid spacing, or within what limits the spacing must be included in the revised RFI Workplan to allow a thorough review of the technical merits of such a geophysical survey program. The Workplan must be revised accordingly.

RESPONSE: The grid spacing chosen for the geophysical survey was 10x10 feet over as much of the chemical disposal area as practical. The grid spacing was kept constant in order to facilitate Fourier data processing. Several tests were conducted over limited areas at a tighter grid spacing to establish the applicability of the 10x10 foot spacing.

COMMENT 14: SWMU #17 - OIL SPILL AREA

SWMU #17 - Oil Spill Area is located beneath building FBM61 where a spill of No. 5 NSF fuel oil occurred in June 1987 due to a ruptured pipe. Some soil samples collected after the spill were found to contain PCBs. The RFI Workplan proposed installation of four (4) monitoring wells in the vicinity of building FBM61 to assess possible impacts to groundwater from this SWMU. Eight (8) discrete soil samples will be collected from the monitoring well boreholes for analyses for PCBs, Total Petroleum Hydrocarbons, and Base/Neutral compounds. Two comments regarding the assessment proposed for this SWMU have been generated.

A. One comment included in the Department's previous review of this Workplan stated that the list of parameters for which soil and groundwater samples will be analyzed should be expanded to include metals which could reasonably be expected to have been components of the fuel. NSY responded that this type of fuel typically contains only "trace" amounts of two metals, vanadium and nickel. Therefore, metals would not be included in the analyses at this site. This is unacceptable. Fuels such as NSF #5 fuel oil may contain up to several hundred parts per million (ppm) of metals. Therefore, the RFI Workplan should be revised to include analyses for all RCRA metals (see Comment 2) that are present in the fuel.

RESPONSE: The list of analytical parameters will be expanded to include TAL metals.

B. The Workplan states that the releases which caused this SWMU resulted from a ruptured pipe located underneath Building No. FBM61. As a result, a thorough assessment of potential soil contamination is not feasible. Therefore, the RFI Workplan proposed to install four (4) groundwater monitoring wells around Building No. FBM61 and to collect soil samples from the boreholes of these monitoring wells. However, it does not appear that this is a sufficient number of soil sampling locations. In reviewing Figure 3-12 (Proposed Sampling Locations SWMU 17 Oil Spill Area), it does not appear that four (4) soil sampling locations will provide adequate coverage of the area of Building FBM61. Additional soil sampling locations should be proposed for this SWMU. The Workplan should be revised accordingly.

RESPONSE: The workplan will be revised to include a minimum of six soil sampling points around the building foundation to determine whether or not contaminants are migrating outward. Soil samples will be collected from 0-1 foot, 1-3 feet, 3-5 feet, etc..., until groundwater is encountered.

COMMENT 15: SWMU #18 - PCB SPILL AREA

SWMU #18 - PCB Spill Area occurred due to spillage of PCBs during the loading of a transformer onto a truck. Immediately following the spill, soil samples were collected and soil was removed based on the results of the analyses of these samples. The Department's previous comment on this SWMU requested clarification regarding sample identifications included in Appendix O of the Workplan. NSY responded that the Workplan would be revised to clarify this issue. However, SWMU #18 is not mentioned in the text of the Workplan. It is noted that Appendix L contains the Environmental Incident Report describing the spill which resulted in this SWMU. However, the information included in the Workplan is unclear with respect to documenting complete assessment of this spill. The RFI Workplan should be revised to clarify this issue. In addition, pending review of this additional information, additional soil and/or groundwater assessment may be necessary at this SWMU.

RESPONSE: The workplan will be revised to clarify the available data; however, the detection limits employed during the analysis of the confirmation sampling were 1 mg/kg. This presents the same problem that was addressed in Comment #8. If a detection limit of ≤ 90 μg/kg is required to satisfy the proposed Subpart S action levels, additional sampling will be required.

COMMENT 16: SWMU #19 - SOLID WASTE TRANSFER STATION

The RFA Report describes SWMU #19 - Solid Waste Transfer Station as an unpaved, open area which served as a staging area for temporary storage of solid waste. Photograph 19 (Solid Waste Transfer Station, taken 7/22/87) of the RFA Report depicts an area strewn with 55-gallon drums, tires and other debris. As part of past practices, solid wastes were stored on bare ground. Currently, the wastes are temporarily stored in containers prior to shipment offsite for disposal. In the Department's two previous reviews of the RFI Workplan, comments were generated stating that assessment of potential releases to the environment at this SWMU should be completed during the RFI. The NSY responded by stating that wastes collected here were staged from one to two days, during which time it was transferred from one container to another prior to shipment offsite for disposal. However, the Department believes that due to the types of wastes managed at the SWMU (empty 55 gallon drum, dry trash, etc.), the visual evidence of the potential contamination as evidenced by Photograph 19 of the RFA Report, the length of time the SWMU has been in operation (1982 to present), that assessment of potential releases to the environment must be completed during the RFI. The Workplan should be revised accordingly.

RESPONSE: SWMU #19 is located within the boundaries of SWMU #9 and will be addressed during the investigative activities conducted at SWMU #9 (in the same manner as SWMU #20).

COMMENT 17: SWMU #20 - WASTE DISPOSAL AREA

SWMU #20 - Waste Disposal Area is an open area in which solid wastes such as cardboard boxes, etc. are disposed. This SWMU is located adjacent to SWMU #19 - Solid Waste Transfer Station and within the area occupied by SWMU #9 (Closed Landfill). The RFI Workplan recommends assessment of this SWMU in conjunction with the assessment of SWMU #9 - The Closed Landfill. This approach appears reasonable given the locations of these SWMUs. The RFI Workplan states that during assessment of SWMU #9, one monitoring well will be installed in the area of SWMU #20 and will serve in a duel capacity to detect contamination from either SWMU. Since the specific areas occupied by SWMUs #9 and #20 are not indicated on maps included in the Workplan, it is impossible to verify this statement. The RFI Workplan should be revised to clarify this point.

RESPONSE: Figure 3-8 in the Workplan does illustrate the approximate boundary of SWMU #9. SMWU #20 is labeled on this figure but an exact boundary is not known. A revised figure which illustrates the landfill boundary based on results of the geophysical survey and aerial photographs will be generated. On this revised figure, the approximate boundaries of SWMUs #19 and #20 will be included.

COMMENT 18: SWMU #21 - OLD PAINT STORAGE AREA

This area was previously used for temporary storage of containerized paint waste and sand-blasting operations. The waste containers were stored on a 20 feet by 180 feet concrete pad prior to transport offsite. The Workplan proposes to collect soil samples from depths of 0 to 0.5 and 0.5 to 1.0 feet below grade. Soil samples will be collected from six locations, two on three sides of the pad, ranging in distance from the edge of the concrete pad of five, 25, and 45 feet. The fourth side of the pad is bordered by the Cooper River, from which three (3) sediment samples will be collected. All samples will be analyzed for RCRA metals (see comment 2), volatile organic and semivolatile organic compounds. The Workplan then states that the constituents detected in these samples will determine the types of analyses which will be performed on the remaining samples. The Workplan proposed to analyze the shallow soil samples first, then to analyze the samples collected from deeper intervals. However, the distances and depths proposed should be modified to provide more samples close to the pad and at greater depths. Therefore, The RFI Workplan should be revised to allow samples to be collected from one foot, 10 feet, and 25 feet away from the pad and at depths of 0 to 0.5 feet, 1.0 to 2.0 feet, and 5.0 feet depths. This sampling scheme will provide more information from closer to the pad and from greater depths below the surface. Finally, analyses should be conducted on soil samples from each depth interval previously described (0 to 0.5 feet, 1.0 to 2.0 feet and 5.0 feet below land surface) instead of basing additional analyses on the analytical results of surface samples.

RESPONSE: The NSY concurs with the revised horizontal spacing of the sample locations. The revised Workplan will propose that samples be collected for analysis from the 0-1 foot interval and on 2 foot intervals thereafter until groundwater is encountered.

COMMENT 19: SWMU #22 - OLD PLATING SHOP WASTE TREATMENT SYSTEM AND SWMU #25 - BUILDING 44, OLD PLATING OPERATION

The RFI Workplan proposed to assess potential releases from SWMU #22 and #25 together, due to their proximity. SWMU #22 consists of a treatment facility with two in-ground concrete tanks, one for chromic acid reduction, and one for cyanide oxidation. Additional treatment was conducted in a clarifier where soda ash was manually added and mixed with wastewater to adjust the pH to approximately 8.5 in order to precipitate chromium or other metals. Wastewater in the clarifier was allowed to settle 48 hours before being discharged to the sanitary sewer. SWMU #22 has not been in operation since 1982. SWMU #25 - Building 44, Old Plating Operation, is located in the northern portion of Building 44 and was phased out of operation in 1983 when it was replaced by a new non-cyanide process plating operation (SWMU #23 - New Plating Shop Waste Water Treatment System). Two comments have been generated from review of this section of the Workplan.

A. The Workplan proposes to collect soil samples from beneath the concrete floor in seven (7) locations. Soil samples will be collected with a hand auger at one-foot intervals to a depth of four (4) feet, unless groundwater is encountered first. The shallow soil samples will be analyzed first, and if contamination is detected, the next deeper sample will be analyzed. However, this approach may or may not detect contamination that has been released to the environment. It is possible that metals have migrated to depths below the shallowest zone from which samples will be collected, particularly with the decreased pH levels observed in soils at this SWMU. Thus, analyses of the shallow soil samples may not detect contamination, even though deeper contamination may be present. Therefore, the Workplan should be revised to include analyses of a representative number of samples from various depths to the water table.

RESPONSE: The Workplan will be revised to propose the collection of samples from 0-1 foot (zero will be considered the top of soil below the concrete surface) and on 2 foot intervals thereafter until groundwater is encountered.

B. The Workplan proposes to install five (5) groundwater monitoring wells around SWMUs #22 and #25. The locations of the proposed monitoring wells are depicted in Figure 3-14 (SWMU #22 and #25 Proposed Sampling Locations - Old Plating Shop Waste Water Treatment System and Old Plating Operation) of the RFI Workplan. It is noted that the proposed locations of these wells are predominantly along the northern side of Building 44, in approximately a linear orientation. Since the groundwater flow direction in this area is unknown (although it is likely to be flowing in an easterly direction toward the Cooper River), the locations of these wells should be modified to increase the spatial variability between wells. This will allow a more accurate determination of the groundwater flow direction once the wells are installed.

RESPONSE: The proposed well locations were sighted during a visit to the SWMU and are arranged as proposed in order to make them accessible. Spatial variation and orientation of the final well locations will be determined in the field using best professional judgement.

COMMENT 20: SWMU #24 - WASTE OIL RECLAMATION FACILITY

SWMU #24 - Waste Oil Reclamation Facility is utilized to reclaim waste oil from various base operations and from ships. Waste oil is pumped in underground pipelines from pier K, the railroad tank car loading facility, and the tank truck unloading facility. Gravity separation of water and oil occurs in two 740,880 gallon storage tanks (39 A and 39D). The RFI Workplan states that all underground lines and piping associated with this SWMU are periodically pressure tested to insure integrity and therefore a release to the environment is not expected.

RESPONSE: This comment appears to be incomplete; therefore, a response cannot be generated.

COMMENT 21: SWMUs #29 - BUILDING X-10, #34 - MORALE, WELFARE, AND RECREATION AND #35 - BUILDING X-12

The RFI Workplan proposes to assess the potential for releases to the environment from SWMUs #29 - Building X-10, #34 (Morale, Welfare, and Recreation) and #35 (Building X-12) together. Based on their proximity and the fact that these SWMUs were all used as one-time waste accumulation areas for waste paint, waste manoethanolamine, and waste solvents, this approach appears reasonable. Two comments have been generated from review of the RFI Workplan regarding assessment of these SWMUs.

A. The Workplan notes that most of the area around SWMU #29 (building X-10) is almost entirely covered with asphalt. The Workplan goes on to note that there is visual evidence of spillage on the soil and grassy areas surrounding the site. It is unclear in the Workplan whether any of the proposed soil sampling locations are located within the visually impacted areas. The Workplan should be revised to clarify that soil samples will be collected from these areas.

RESPONSE: The Workplan will be revised accordingly.

B. The Workplan proposed the collection of collect soil samples from ten (10) locations. Four (4) of these locations are in the vicinity of SWMU #29, four (4) in SWMU #34, and two (2) at SWMU #35. Samples will be collected from the surface to a depth of one foot for volatile organic analyses. The remainder of the samples collected from the same intervals within each SWMU area will be divided between a composite sample and grab samples. Ten subsamples will be divided and combined into three (3) distinct composites based on location. The remaining (grab) samples will temporarily archived at four degrees Celsius. The three (3) composite samples will then be assayed for semivolatile organics, total RCRA metals (See comment 2), cyanide, and PCBs. If contamination is present in the composite samples, then the individual grab samples will be assayed for the constituents identified in the composite sample. However, as noted in previous comments, this methodology may not properly determine if a release has occurred from these SWMUs since contamination may have migrated below the upper soil intervals. Therefore, the individual soil samples to the water table should be analyzed for the proposed constituents (volatiles, semivolatiles, total RCRA metals (see comment 2), cyanide, and PCBs). The Workplan should be revised accordingly.

RESPONSE: The soil sampling scheme will be revised to propose the collection of samples at each of the 10 locations from the 0-1 foot, 1-3 foot, and 3-5 foot intervals. Below 5 feet samples

will be collected on 5 foot centers (for analytical testing) until groundwater is encountered. Each discrete sample interval from each sample location will be submitted for analysis. No compositing of samples will be conducted.

COMMENT 22: SWMU #30 - SATELLITE ACCUMULATION AREA - BUILDING 13

The RFI Workplan notes that this SWMU is an asphalt area located between Buildings 13 and 187. This area receives waste from a laboratory in Building 13. A storm sewer drain is located 20 feet away. Spillage was noted on the asphalt beside two 55-gallon drums of oil sludge that were observed to be present during the EPA and DHEC site inspection on August 20-22, 1990. The Workplan goes on to note that additional construction, operation, and maintenance measures, such as installation of drip pans, construction of a roof, and posting of signs, have been completed for this SWMU. The Workplan notes that distinct cracks were observed in the asphalt in the vicinity of SWMU #30. Four comments are generated from review of proposed assessment activities for this SWMU.

A. The previous RFI Workplan noted that in addition to the installation of drip pans, a roof and posting of signs, that construction of a concrete berm around SWMU #30 would be completed. However, the current RFI Workplan does not indicate that a berm was constructed. NSY should provide clarification regarding whether this berm was constructed.

RESPONSE: At the present time a berm has not been constructed around SWMU #30. The Workplan will be revised to clarify this point.

B. The Workplan proposes to collect (1) sediment sample from the nearby sediment basin and analyze this sample for RCRA metals (see comment 2). However, soil samples should also be collected from beneath the cracks observed in the asphalt in the area of this SWMU, since it is likely that any spills that are occurred in this area would drain into these cracks.

RESPONSE: The Workplan will be revised to indicate that samples will be collected from topographically downgradient areas where significant cracks may exist. At the present time, a visual inspection of the asphalt surface has not been conducted.

C. As noted above, this SWMU is a waste accumulation area for a lab located in Building 13. However, the Workplan does not describe the types of wastes generated by the lab, although it is noted that the accumulation area contains a steel box for storage and containment of pails of less than five (5) gallons in size. In addition, two 55-gallon drums of oil sludge labelled as hazardous waste were observed during the EPA/DHEC

inspection conducted August 20-22, 1990. Therefore, analysis should be conducted not only for metals, but also for volatile and semivolatile organic constituents and PCBs.

RESPONSE: The list of analytical parameters for this SWMU will be revised to include volatiles, semivolatiles, and PCBs in addition to the metals.

D. The Workplan notes that four (4) monitoring wells are in place in the vicinity of the SWMU, apparently to monitor a nearby Underground Storage Tank (UST). The Workplan proposed to collect groundwater samples from these wells and to analyze these samples for volatiles, semivolatiles and RCRA metals (see comment 2). However, as noted in the general comments above, the conditions of these wells, construction details, dates of installation and other pertinent information must be determined before collecting groundwater samples from these wells. In addition, even if these wells can be demonstrated to be constructed properly, they must also be in the proper location to monitor a release from this SWMU.

RESPONSE: The installation of monitoring wells at this SWMU will be dependent on the results of the soil sample analyses. Construction details of the existing wells are not available therefore, they will not be used for groundwater monitoring at SWMU #30 if wells are necessary. However, if monitoring wells become necessary, water levels in the existing wells will be measured to determine groundwater flow direction prior to installation of the new wells. The existing wells at this site will not be abandoned during the RFI since they were installed for purposes unrelated to the investigation.

COMMENT 23: SWMU #36 - BUILDING 68 - BATTERY SHOP

This SWMU - Building 68, Battery Shop was discovered by the NSY. An RFA Report was transmitted to the EPA and the Department in October 1991 (Sneed to Scarbrough, 10/18/91). This RFA Report describes the Battery Shop as a building in which operations began in the 1940's and which is still in use. The RFA Report further notes that on two occasions the floor drain to the holding tank separated from the floor, allowing approximately 1025 gallons of sulfuric acid to discharge to the soil below the building. In the text, the RFI Workplan proposed to collect soil samples from two (2) locations that are reportedly depicted in Figure 3-21 (SWMU 36 - Proposed Soil Borings Building 68, Battery Shop). However, Figure 3-21 depicts four (4) soil sampling locations. In any event, NSY should collect soil samples from the four (4) locations shown in Figure 3-21.

RESPONSE: Soil samples are proposed to be collected at all four locations depicted on Figure 3-21. The text will be revised accordingly.

SECTION 4.6.1 SHALLOW MONITORING WELL INSTALLATIONS

COMMENT 24:

The RFI Workplan proposes installation of monitoring wells in several areas of the base. Since the subsurface structure is currently unknown, NSY should propose to collect continuous soil cores during installation of monitoring wells. This information will be necessary to insure that monitoring wells are screened in appropriate zones.

RESPONSE: During the installation of monitoring wells in areas of the facility where no boring logs exist, wells installed at opposite extremities of each SWMU will be sampled continuously to observe the subsurface stratigraphy. Field personnel will then exercise best professional judgement to determine if continuous sampling will be necessary in additional borings for proper well control. Otherwise, sampling on 5 foot centers should provide sufficient lithologic detail.

COMMENT 25:

This section of the Workplan describes general construction details for shallow groundwater monitoring wells. It is noted that the screen slot size is not specified in the text in this section of the Workplan, however, it is noted that on Figure 4-2 (Type II Monitoring Well) that a 0.010" slotted screen is indicated. During construction of monitoring wells, NSY should conduct sieve analyses to insure that the correct screen slot size and corresponding filter pack grain size are chosen for the interval to be monitored. A description of the methodology for conducting the sieve analyses should be included in the monitoring well installation request described by comment 22 above.

RESPONSE: The well schematic submitted as Figure 4-2 is a generic drawing of a typical monitoring well as is the filter pack size specified. A review of the grain size analysis data from samples collected at various depth intervals during a previous investigation indicates that either a 20/40 sand - 0.015" screen slot or a 20/50 sand - 0.010" screen slot would be appropriate for the finer grain material observed at depths <20 feet. Both sand sizes selected would have a uniformity coefficient of 2-3. While some of the aquifer matrix may be somewhat coarser, the selected sand/slot size is appropriate for **monitoring purposes** (Driscoll, 1986). The sand/slot size combinations specified above were derived by multiplying the 50 percent retained (aquifer material) by a factor of 2 for the filter pack size. The screen was selected to retain 90 percent of the filter pack. This approach is slightly more conservative than the one recommended by USEPA, but at the same time will accommodate a wider range of aquifer material sizes. This is important since it is not practical to purchase assorted sand and screen sizes which may not be utilized. Additional grain size analyses will be performed on samples collected from a representative number of locations across the facility to design a more appropriate sand/screen

slot size combination to install wells more suitable for aquifer testing, if necessary, at SWMU #9.

COMMENT 26:

The RFI Workplan notes that gauging of the monitoring wells (e.g., collection of groundwater levels) will be conducted on a regular basis during the investigation to allow construction of a series of groundwater surface contour maps for the site. However, the time period and the frequency in which these measurements will be made were not discussed. Specific details should be given regarding the frequency and time period regarding these measurements. In addition, the NSY should insure that water levels are measured in as short a time frame as possible. This is important since it is likely that groundwater levels exhibit tidal influences.

RESPONSE: At a minimum, water level measurements will be recorded at high and low tides respectively during the quarterly groundwater sampling events.

COMMENT 27:

In order to develop an appropriate database upon which to base decisions, NSY should propose to sample monitoring wells on a routine basis. Development of such a database will facilitate the Corrective Measures Study (CMS), should this become necessary. It is recommended that, at a minimum, NSY collect groundwater samples from monitoring wells quarterly for a period of one year. Analytical results over a period of time such as this will provide a more complete database upon which to base future decisions. It should be stressed that this should be considered a minimum data base that is necessary upon which to base decisions. Additional data may be required dependent on site-specific requirements.

RESPONSE: The workplan will be revised to indicate sampling of monitoring wells will be conducted quarterly for a period of one year.

SECTION 4.6.3 WELL HEAD COMPLETIONS

COMMENT 28:

Section 4.6.3 of the Workplan notes that monitoring wells located in high traffic areas will be completed in flush-mounted manholes. It is recognized that it may be necessary to construct a few monitoring wells in this manner, however, this construction should be avoided if at all possible. The flush-mounted well vaults typically do not provide long term protection against

surface infiltration into the area surrounding the monitoring well stickup. Therefore, standard above-grade monitoring wells should be constructed it at all possible.

RESPONSE: The NSY concurs with this comment.

SECTION 4.7 GROUNDWATER SAMPLING PROCEDURES

COMMENT 29:

The Workplan states that indicator parameters (temperature, pH, conductivity, turbidity) will be measured during purging of monitoring wells. The Workplan further states that sample collection will proceed when two consecutive measurements of pH, temperature and conductivity have stabilized. However, the Workplan does not indicate how often these parameters will be measured during purging. These parameters should be measured following removal of each well casing volume. In addition, a minimum of three (3) well casing volumes should be removed prior to collection of groundwater samples.

RESPONSE: The workplan will be revised to indicate the stability parameters will be measured following the evacuation of each well casing and that a minimum of three well casing volumes will be purged.

SECTION 4.11.2 SAMPLE IDENTIFICATION SYSTEM

COMMENT 30:

This section of the Workplan describes how samples are to be labeled. In general, the system for sample identification is logical and clear, however, it is noted that blanks will be identified as such by this labeling scheme. In accordance with Section 4.6.9 of the EPA Region IV SOP/QAM, blanks should be submitted to a laboratory on a "blind" basis, so that the laboratory is unable to determine whether or not a particular sample is a blank. The Workplan should be revised accordingly.

RESPONSE: The sample identification scheme will be modified so that all blanks are submitted blind to the laboratory.

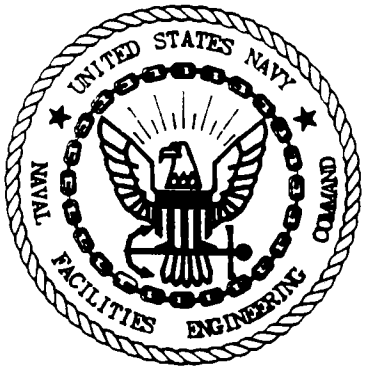
SECTION 4.15 FIELD LABORATORY QUALITY CONTROL CHECKS

COMMENT 31:

Table 4-4 (QC Sample Frequencies) lists the proposed minimum number of quality control blanks that will be collected during field investigations. The Workplan proposed to collect one (1) field blank for each groundwater sampling event. The meaning of "sampling event" is unclear, however, a minimum of one (1) field blank should be collected per day of sampling. In addition, considering the various industrial areas in which groundwater samples will be collected, NSY may decide to increase the number of field blanks collected beyond this minimum requirement. The Workplan should be revised accordingly.

RESPONSE: The term "sampling event" refers to the sampling of all wells at a particular SWMU. One field blank per day will be collected for each SWMU at which sampling is being conducted on that day.

ATTACHMENT A



COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION CHARLESTON NAVAL SHIPYARD CHARLESTON, SOUTH CAROLINA

PROPOSED RISK-BASED ACTION LEVELS CHARLESTON NAVAL SHIPYARD

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
Washington, DC

SOUTHDIV Contract Number:
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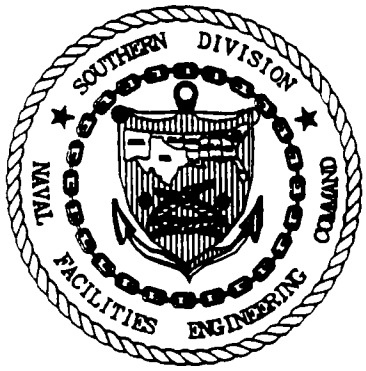

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RISK-BASED ACTION LEVELS FOR RCRA FACILITY INVESTIGATION

CHARLESTON NAVAL SHIP YARD
CHARLESTON, SOUTH CAROLINA

INTRODUCTION

In December 1984 the Charleston Naval Shipyard, Charleston, South Carolina submitted a closure plan for each interim Status facility. A new hazardous waste container storage and transfer facility was to begin construction in 1985. As a consequence of construction of the new facility, all interim status facilities were to be closed in accordance with 40 CFR 265 Subpart G standards.

The original closure of the interim status facilities involved the determination of the presence and/or extent of contamination with respect to the corresponding facility. Under RCRA closure standards, closure and post closure has been based on a quantified reference. However, during closure of the facilities at the shipyard anomalous levels of analytes were observed in samples collected. Since soil materials can not be assumed to be native, comparison to native soils is inappropriate.

During closure of these facilities South Carolina Department of Health and Environment (SCDHEC) has been receptive to the use of health based risk criteria. In March 1987, USEPA published proposed rules for "alternate clean closure" which would permit residual contaminant levels above background if the operator demonstrates through a risk assessment that no human health or environmental threat results. Due to the high degree of heterogeneity identified under previous studies, corrective measures may be based on health based risk. Preliminary remediation goals have been generated from data. Final remediation goals will be based on current data generated during the RCRA Facility Investigation.

PRELIMINARY REMEDIATION GOALS

Conservative preliminary remediation goals (or Action Levels) for soil and groundwater at the Charleston Naval Ship Yard may be established through the use of formulae presented in US EPA's 'Risk Assessment Guidance for Superfund, Human Health Evaluation Manual, Volume I, Parts A & B' (RAGS Part A & B). In order to establish a point of reference for scoping of RFI activities, remediation goals under residential exposure scenarios will be calculated. These goals will serve as indicators of when additional investigations are not necessary to delineate the extent of contamination. Cessation of investigative activities will be dictated by identification of media samples having contaminant concentrations at or below the calculated Action Levels. As part of subsequent Corrective Measures Studies (CMS), additional media sampling may be required for engineering design purposes, but may be scaled to meet specific engineering/design data requirements.

The most conservative residential exposure assumptions were applied (i.e. maximum exposure durations; uniform, chronic exposure to contaminated media; etc.). Tables 1 through 8 provide

TABLE 1-GROUNDWATER RISK-(HAZARD INDEX) BASED ACTION LEVELS
VOLATILE COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	SLOPE FACTOR INHALATION (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	REFERENCE DOSE INHALATION (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/L)	HAZARD INDEX-BASED ACTION LEVEL (MG/L)
BENZENE	2.90E-02	2.90E-02	0.00E+00	0.00E+00	6.18E-04	ERR
CARBON TETRACHLORIDE	1.30E-01	5.30E-02	7.00E-04	0.00E+00	2.59E-04	2.56E-02
CHLOROBENZENE	0.00E+00	0.00E+00	2.00E-02	6.00E-03	ERR	5.41E-02
CHLOROFORM	6.10E-03	8.10E-02	1.00E-02	0.00E+00	2.75E-04	3.65E-01
DIBROMOCHLOROMETHANE	8.40E-02	0.00E+00	2.00E-02	0.00E+00	1.01E-03	7.30E-01
DICHLOROFLUOROMETHANE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	ERR	ERR
DIETHYL ETHER	0.00E+00	0.00E+00	0.00E+00	0.00E+00	ERR	ERR
ETHYLBENZENE	0.00E+00	0.00E+00	1.00E-01	2.80E-01	ERR	1.56E+00
ETHYLENE DICHLORIDE	0.00E+00	9.10E-02	0.00E+00	0.00E+00	2.50E-04	ERR
ETHYLENE OXIDE	1.02E+00	3.50E-01	0.00E+00	0.00E+00	3.65E-05	ERR
FORMALDEHYDE	0.00E+00	4.50E-02	2.00E-01	0.00E+00	5.05E-04	7.30E+00
METHYLENE CHLORIDE	7.50E-03	1.00E-10	6.00E-02	8.40E-01	1.14E-02	1.62E+00
METHYLETHYL KETONE	0.00E+00	0.00E+00	5.00E-02	0.00E+00	ERR	1.83E+00
METHYLISOBUTYL KETONE	0.00E+00	0.00E+00	5.00E-02	0.00E+00	ERR	1.83E+00
1,1,2,2-TETRACHLOROETHANE	2.00E-01	2.00E-01	0.00E+00	0.00E+00	8.96E-05	ERR
TETRACHLOROETHENE	5.00E-02	2.00E-03	1.00E-02	0.00E+00	1.46E-03	3.65E-01
TOLUENE	0.00E+00	0.00E+00	2.00E-01	1.20E-01	ERR	1.01E+00
1,1,1-TRICHLOROETHANE	0.00E+00	0.00E+00	9.00E-02	0.00E+00	ERR	3.29E+00
TRICHLOROETHYLENE	1.10E-02	6.00E-03	0.00E+00	0.00E+00	2.54E-03	ERR
TRICHLOROFLUOROETHANE	0.00E+00	0.00E+00	0.00E+00	0.00E+00	ERR	ERR
TRICHLOROFLUOROMETHANE	0.00E+00	0.00E+00	3.00E-01	2.00E-01	ERR	1.65E+00

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992
Inhalation exposure is not a factor for these parameters.

TABLE 2-GROUNDWATER RISK-(HAZARD INDEX) BASED ACTION LEVELS
SEMI-VOLATILE COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	SLOPE FACTOR INHALATION (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	REFERENCE DOSE INHALATION (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/L)	HAZARD INDEX-BASED ACTION LEVEL (MG/L)
ACENAPHTHENE	0.00E+00	NA	6.00E-02	NA	ERR	5.11E+00
ACENAPHTHYLENE	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
AMINOPYRIDINE	0.00E+00	NA	2.00E-05	NA	ERR	1.70E-03
ANTHRACENE	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
BENZO(A)ANTHRACENE	4.30E-01	NA	0.00E+00	NA	1.98E-04	0.00E+00
BENZO(B)FLUORANTHENE	4.30E-01	NA	0.00E+00	NA	1.98E-04	0.00E+00
BENZO(K)FLUORANTHENE	4.30E-01	NA	0.00E+00	NA	1.98E-04	0.00E+00
BENZO(A)PYRENE	5.80E+00	NA	0.00E+00	NA	1.47E-05	0.00E+00
bis(2-ETHYLHEXYL)PHTHALATE	1.40E-02	NA	2.00E-02	NA	6.08E-03	1.70E+00
BUTYLBENZYLPHTHALATE	0.00E+00	NA	2.00E-01	NA	ERR	1.70E+01
CHRYSENE	4.30E-01	NA	0.00E+00	NA	1.98E-04	0.00E+00
CRESOL	0.00E+00	NA	5.00E-02	NA	ERR	4.26E+00
p-DICHLOROBENZENE	2.40E-02	NA	2.00E-01	NA	3.55E-03	1.70E+01
DICHLORODIMETHYLHYDRANTOIN	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
DICHLOROPHENOL	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
DIETHYLENE TRIAMINE	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
DIETHYL PHTHALATE	0.00E+00	NA	8.00E-01	NA	ERR	6.81E+01
4,6-DINITRO-o-CRESOL	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
2,4-DINITROTOLUENE	6.80E-01	NA	2.00E-03	NA	1.25E-04	1.70E-01
FLUORANTHENE	0.00E+00	NA	4.00E-02	NA	ERR	3.41E+00
FLUORENE	0.00E+00	NA	4.00E-02	NA	ERR	3.41E+00
METHYL CELLOSOLVE	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
HYDRAZINE	3.00E+00	NA	0.00E+00	NA	2.84E-05	0.00E+00
INDENO(1,2,3-cd)PYRENE	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
1-METHYLNAPHTHALENE	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
2-METHYLNAPHTHALENE	4.90E-03	NA	0.00E+00	NA	1.74E-02	0.00E+00
NAPHTHALENE	0.00E+00	NA	4.00E-02	NA	ERR	3.41E+00
n-NITROSODIPHENYLAMINE	4.90E-03	NA	0.00E+00	NA	1.74E-02	0.00E+00
PENTACHLOROPHENOL	1.20E-01	NA	3.00E-02	NA	7.10E-04	2.56E+00
PHENANTHRENE	0.00E+00	NA	0.00E+00	NA	ERR	0.00E+00
PHENOL	0.00E+00	NA	6.00E-01	NA	ERR	5.11E+01
PYRENE	0.00E+00	NA	3.00E-02	NA	ERR	2.56E+00
2,4,6-TRICHLOROPHENOL	1.10E-02	NA	0.00E+00	NA	7.74E-03	0.00E+00

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992
Inhalation exposure is not a factor for these parameters; inhalation exposure pathway risk is not considered appropriate due to the non-volatile nature of these contaminants

TABLE 3-GROUNDWATER RISK-(HAZARD INDEX) BASED ACTION LEVELS
PESTICIDE/PCB COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	SLOPE FACTOR INHALATION (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	REFERENCE DOSE INHALATION (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/L)	HAZARD INDEX-BASED ACTION LEVEL (MG/L)
alpha-BHC	6.3	NA	0	NA	1.35E-05	0.00E+00
beta-BHC	1.8	NA	0	NA	4.73E-05	0.00E+00
delta-BHC	0	NA	0	NA	ERR	0.00E+00
gamma-BHC	1.3	NA	0.0003	NA	6.55E-05	2.55E-02
4,4'-DDT	0.34	NA	0.0005	NA	2.50E-04	4.26E-02
4,4'-DDD	0.24	NA	0	NA	3.55E-04	0.00E+00
4,4'-DDE	0.34	NA	0	NA	2.50E-04	0.00E+00
HEPTACHLOR	4.5	NA	0.0005	NA	1.89E-05	4.26E-02
AROCHLOR 1260	7.7	NA	0	NA	1.11E-05	0.00E+00

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992
Inhalation exposure is not a factor for these parameters; inhalation exposure pathway risk is not considered

TABLE 4-GROUNDWATER RISK-(HAZARD INDEX) BASED ACTION LEVELS
INORGANIC COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	SLOPE FACTOR INHALATION (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	REFERENCE DOSE INHALATION (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/L)	HAZARD INDEX-BASED ACTION LEVEL (MG/L)
ANTIMONY	0	NA	0.0004	NA	ERR	3.41E-02
ARSENIC	0.00	NA	0.00	NA	ERR	2.55E-02
BARIUM	0	NA	0.07	NA	ERR	5.96E+00
BERYLLIUM	4.3	NA	0.005	NA	1.98E-05	4.26E-01
CADMIUM	0	NA	0.001	NA	ERR	8.52E-02
CHROMIUM	0	NA	0.005	NA	ERR	4.26E-01
COPPER	0	NA	0.037	NA	ERR	3.15E+00
LEAD	0	NA	0.0014	NA	ERR	1.19E-01
MERCURY	0	NA	0.0004	NA	ERR	3.41E-02
NICKEL	0	NA	0.02	NA	ERR	1.70E+00
SELENIUM	0	NA	0.005	NA	ERR	4.26E-01
SILVER	0	NA	0.005	NA	ERR	4.26E-01
ZINC	0	NA	0.2	NA	ERR	1.70E+01

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992

Lead has been shown to be non-bioavailable at soil concentrations below 200 mg/kg (personal communication with Dr. Harlal Choudhury, USEPA/ECAO, June 1991)

TABLE 5-SOIL RISK-(HAZARD INDEX) BASED ACTION LEVELS
VOLATILE COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/KG)	HAZARD INDEX-BASED ACTION LEVEL (MG/KG)
BENZENE	2.90E-02	0.00E+00	1.69E+01	0.00E+00
CARBON TETRACHLORIDE	1.30E-01	7.00E-04	3.76E+00	1.47E+02
CHLOROBENZENE	0.00E+00	2.00E-02	ERR	4.19E+03
CHLOROFORM	6.10E-03	1.00E-02	8.02E+01	2.10E+03
DIBROMOCHLOROMETHANE	8.40E-02	2.00E-02	5.82E+00	4.19E+03
DICHLOROFLUOROMETHANE	0.00E+00	0.00E+00	ERR	0.00E+00
DIETHYL ETHER	0.00E+00	0.00E+00	ERR	0.00E+00
ETHYLBENZENE	0.00E+00	1.00E-01	ERR	2.10E+04
ETHYLENE DICHLORIDE	0.00E+00	9.10E-02	ERR	1.91E+04
ETHYLENE OXIDE	1.02E+00	0.00E+00	4.80E-01	0.00E+00
FORMALDEHYDE	0.00E+00	2.00E-01	ERR	4.19E+04
METHYLENE CHLORIDE	7.50E-03	6.00E-02	6.52E+01	1.26E+04
METHYLETHYL KETONE	0.00E+00	5.00E-02	ERR	1.05E+04
METHYLISOBUTYL KETONE	0.00E+00	5.00E-02	ERR	1.05E+04
1,1,2,2-TETRACHLOROETHANE	2.00E-01	0.00E+00	2.45E+00	0.00E+00
TETRACHLOROETHENE	5.00E-02	1.00E-02	9.79E+00	2.10E+03
TOLUENE	0.00E+00	2.00E-01	ERR	4.19E+04
1,1,1-TRICHLOROETHANE	0.00E+00	9.00E-02	ERR	1.89E+04
TRICHLOROETHYLENE	1.10E-02	0.00E+00	4.45E+01	0.00E+00
TRICHLOROFLUOROETHANE	0.00E+00	0.00E+00	ERR	0.00E+00
TRICHLOROFLUOROMETHANE	0.00E+00	3.00E-01	ERR	6.29E+04

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992
Inhalation exposure is not a factor for these parameters.

TABLE 6-SOIL RISK-(HAZARD INDEX) BASED ACTION LEVELS
SEMI-VOLATILE COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/KG)	HAZARD INDEX-BASED ACTION LEVEL (MG/KG)
ACENAPHTHENE	0.00E+00	6.00E-02	ERR	1.26E+04
ACENAPHTHYLENE	0.00E+00	0.00E+00	ERR	0.00E+00
AMINOPYRIDINE	0.00E+00	2.00E-05	ERR	4.19E+00
ANTHRACENE	0.00E+00	0.00E+00	ERR	0.00E+00
BENZO(A)ANTHRACENE	4.30E-01	0.00E+00	1.14E+00	0.00E+00
BENZO(B)FLUORANTHENE	4.30E-01	0.00E+00	1.14E+00	0.00E+00
BENZO(K)FLUORANTHENE	4.30E-01	0.00E+00	1.14E+00	0.00E+00
BENZO(A)PYRENE	5.80E+00	0.00E+00	8.44E-02	0.00E+00
bis(2-ETHYLHEXYL)PHTHALATE	1.40E-02	2.00E-02	3.49E+01	4.19E+03
BUTYLBENZYLPHTHALATE	0.00E+00	2.00E-01	ERR	4.19E+04
CHRYSENE	4.30E-01	0.00E+00	1.14E+00	0.00E+00
CRESOL	0.00E+00	5.00E-02	ERR	1.05E+04
p-DICHLOROBENZENE	2.40E-02	2.00E-01	2.04E+01	4.19E+04
DICHLORODIMETHYLHYDRANT	0.00E+00	0.00E+00	ERR	0.00E+00
DICHLOROPHENOL	0.00E+00	0.00E+00	ERR	0.00E+00
DIETHYLENE TRIAMINE	0.00E+00	0.00E+00	ERR	0.00E+00
DIETHYL PHTHALATE	0.00E+00	8.00E-01	ERR	1.68E+05
4,6-DINITRO-o-CRESOL	0.00E+00	0.00E+00	ERR	0.00E+00
2,4-DINITROTOLUENE	6.80E-01	2.00E-03	7.20E-01	4.19E+02
FLUORANTHENE	0.00E+00	4.00E-02	ERR	8.39E+03
FLUORENE	0.00E+00	4.00E-02	ERR	8.39E+03
METHYL CELLOSOLVE	0.00E+00	0.00E+00	ERR	0.00E+00
HYDRAZINE	3.00E+00	0.00E+00	1.63E-01	0.00E+00
INDENO(1,2,3-cd)PYRENE	0.00E+00	0.00E+00	ERR	0.00E+00
1-METHYLNAPHTHALENE	0.00E+00	0.00E+00	ERR	0.00E+00
2-METHYLNAPHTHALENE	4.90E-03	0.00E+00	9.99E+01	0.00E+00
NAPHTHALENE	0.00E+00	4.00E-02	ERR	8.39E+03
n-NITROSODIPHENYLAMINE	4.90E-03	0.00E+00	9.99E+01	0.00E+00
PENTACHLOROPHENOL	1.20E-01	3.00E-02	4.08E+00	6.29E+03
PHENANTHRENE	0.00E+00	0.00E+00	ERR	0.00E+00
PHENOL	0.00E+00	6.00E-01	ERR	1.26E+05
PYRENE	0.00E+00	3.00E-02	ERR	6.29E+03
2,4,6-TRICHLOROPHENOL	1.10E-02	0.00E+00	4.45E+01	0.00E+00

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992
Inhalation exposure is not a factor for these parameters; inhalation exposure pathway risk is not considered appropriate due to the non-volatile nature of these contaminants

TABLE 7-SOIL RISK-(HAZARD INDEX) BASED ACTION LEVELS
PESTICIDE/PCB COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/KG)	HAZARD INDEX-BASED ACTION LEVEL (MG/KG)
alpha-BHC	6.3	0	7.77E-02	0.00E+00
beta-BHC	1.8	0	2.72E-01	0.00E+00
delta-BHC	0	0	ERR	0.00E+00
gamma-BHC	1.3	0.0003	3.76E-01	6.29E+01
4,4'-DDT	0.34	0.0005	1.44E+00	1.05E+02
4,4'-DDD	0.24	0	2.04E+00	0.00E+00
4,4'-DDE	0.34	0	1.44E+00	0.00E+00
HEPTACHLOR	4.5	0.0005	1.09E-01	1.05E+02
AROCHLOR 1260	7.7	0	6.35E-02	0.00E+00

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992
Inhalation exposure is not a factor for these parameters; inhalation exposure pathway risk is not considered appropriate due to the non-volatile nature of the contaminants.

TABLE 8-SOIL RISK-(HAZARD INDEX) BASED ACTION LEVELS
INORGANIC COMPOUNDS
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	SLOPE FACTOR ORAL (MG/KG/DAY)-1	REFERENCE DOSE ORAL (MG/KG/DAY)	CANCER RISK-BASED ACTION LEVEL (MG/KG)	HAZARD INDEX-BASED ACTION LEVEL (MG/KG)
ANTIMONY	0	0.0004	ERR	8.39E+01
ARSENIC	0.00	0.00	ERR	6.29E+01
BARIUM	0	0.07	ERR	1.47E+04
BERYLLIUM	4.3	0.005	1.14E-01	1.05E+03
CADMIUM	0	0.001	ERR	2.10E+02
CHROMIUM	0	0.005	ERR	1.05E+03
COPPER	0	0.037	ERR	7.76E+03
LEAD	0	0.0014	ERR	2.94E+02
MERCURY	0	0.0004	ERR	8.39E+01
NICKEL	0	0.02	ERR	4.19E+03
SELENIUM	0	0.005	ERR	1.05E+03
SILVER	0	0.005	ERR	1.05E+03
ZINC	0	0.2	ERR	4.19E+04

NOTE: RfD and Slope Factor (a.k.a. Cancer Potency Factor) values obtained from IRIS and/or HEAST 1992

Lead has been shown to be non-bioavailable at soil concentrations below 200 mg/kg (personal communication with Dr. Harlal Choudhury, USEPA/ECAO, June 1991)

the action levels computed for soils and groundwater using the methods described below. Table 9 provides alternative action levels for groundwater based on the Maximum Contaminant Levels (MCLs) established by the US EPA. Table 10 provides the exposure assumptions for the soil exposure pathway. Figures 1 and 2 provide the expanded formulae for calculating groundwater and soil action levels, respectively.

Due to a lack of existing data (qualitative and quantitative) for the surface water, sediment and related exposure pathways (i.e. fish and shellfish, recreation uses, etc.), it is premature to speculate on establishing Action Levels for these media. Once a preliminary body of data (qualitative at a minimum) for surface water and/or sediment is available, Action Levels will be established for these media.

Action Levels have been established for each compound/element identified (or suspected to be present) in soil and groundwater during previous investigations. If additional parameters are identified in either medium during the initial phase of the RFI, these compounds/elements will be added to the list of potential contaminants of concern and Action Levels will be established for these parameters.

This approach is applicable because remediation to 'background' is not feasible under conditions that exist at the CNSY. The CNSY facility consists of heterogeneous fill material which was dredged from the adjacent Cooper River. Previous studies have attempted to establish 'background' concentration but have been unsuccessful due to the variability of media composition. Use of the risk-based approach is justified in that 1) establishment of true background contaminant concentrations is not feasible due to site conditions; 2) the industrialized nature of the surrounding areas increases the probability that non site-related anthropogenic contaminants are ubiquitous in the area of the facility; and 3) the final remedy selection process will be based on reduction of identified contaminant concentrations to below risk-based cleanup criteria.

The CNSY and surrounding parcels may be characterized as light to heavy industrial facilities. Historical information supplied in previous site investigation documents indicates that the area has been heavily developed for at least 50 years. Furthermore, it is anticipated that the area will continue to exist under current usage patterns for the foreseeable future. As a result, any human health risk assessment performed subsequent to the RFI would utilize industrial exposure scenarios to characterize risk posed by the site. By applying residential scenario exposure assumptions on the 'front end', an Action Level (or risk) buffer factor of an order of magnitude or more will be realized for both the soil and groundwater exposure pathways. The existence of the risk 'buffer' will assist in protecting against exceedance of cumulative risk limits for media which have been impacted by multiple contaminants.

It should be mentioned that the Action Levels established for soil and groundwater are not necessarily protective from the standpoint of cross media contaminant transfer. Subsequent to collection of RFI data for both environmental media composition and characteristics, it may be necessary to evaluate the following cross media transfer pathways:

- Soil to Groundwater Transport (Leaching)

TABLE 9-ALTERNATIVE GROUNDWATER ACTION LEVELS
MAXIMUM CONTAMINANT LEVELS (MCLs)
CHARLESTON NAVAL SHIPYARD
CHARLESTON, SOUTH CAROLINA

PARAMETER	MCL (MG/L)	NOTES
VOLATILE COMPOUNDS		
BENZENE	0.005	MCL
CARBON TETRACHLORIDE	0.005	MCL
CHLOROBENZENE	NA	
CHLOROFORM	0.1	MCL
DIBROMOCHLOROMETHANE	NA	
DICHLOROFLUOROMETHANE	NA	
DIETHYL ETHER	NA	
ETHYLBENZENE	0.7	MCL
ETHYLENE DICHLORIDE	0.005	MCL
ETHYLENE OXIDE	NA	
FORMALDEHYDE	1	LIFEHA
METHYLENE CHLORIDE	0.005	MCL
METHYLETHYL KETONE	0.2	LIFEHA
METHYLISOBUTYL KETONE	NA	
1,1,2,2-TETRACHLOROETHANE	NA	
TETRACHLOROETHENE	0.005	MCL
TOLUENE	1	MCL
1,1,1-TRICHLOROETHANE	0.2	MCL
TRICHLOROETHYLENE	NA	
TRICHLOROFLUOROETHANE	NA	
TRICHLOROFLUOROMETHANE		
PESTICIDES/PCBs COMPOUNDS		
alpha-BHC	NA	
beta-BHC	NA	
delta-BHC	NA	
gamma-BHC	0.0002	MCL
4,4'-DDT	NA	
4,4'-DDD	NA	
4,4'-DDE	NA	
HEPTACHLOR	0.0004	MCL
AROCHLOR 1260	0.0005	MCL
INORGANICS		
ANTIMONY	0.003	MCLG
ARSENIC	0.05	MCL
BARIUM	2	MCL
BERYLLIUM	0.001	MCL
CADMIUM	0.005	MCL
CHROMIUM	0.1	MCL
COPPER	1.3	MCLTT
LEAD	0.015	MCLTT
MERCURY	0.002	MCL
NICKEL	0.1	MCL
SELENIUM	0.05	MCL
SILVER	0.1	LIFEHA
ZINC	2	LIFEHA

PARAMETER	MCL (MG/L)	NOTES
SEMI-VOLATILE COMPOUNDS		
ACENAPHTHENE	NA	
ACENAPHTHYLENE	NA	
AMINOPYRIDINE	NA	
ANTHRACENE	NA	
BENZO(A)ANTHRACENE	0.0001	MCL
BENZO(B)FLUORANTHENE	0.0002	MCL
BENZO(K)FLUORANTHENE	0.0002	MCL
BENZO(A)PYRENE	0.0002	MCL
bis(2-ETHYLHEXYL)PHTHALATE	NA	
BUTYLBENZYLPHTHALATE	0.1	MCL
CHRYSENE	0.0002	MCL
CRESOL	NA	
p-DICHLOROBENZENE	0.075	MCL
DICHLORODIMETHYLHYDRANT	NA	
DICHLOROPHENOL	0.02	LIFEHA
DIETHYLENE TRIAMINE	NA	
DIETHYL PHTHALATE	5	LIFEHA
4,6-DINITRO-o-CRESOL	NA	
2,4-DINITROTOLUENE	NA	
FLUORANTHENE	NA	
FLUORENE	NA	
METHYL CELLOSOLVE	NA	
HYDRAZINE	NA	
INDENO(1,2,3-cd)PYRENE	0.0004	MCL
1-METHYLNAPHTHALENE	NA	
2-METHYLNAPHTHALENE	NA	
NAPHTHALENE	0.02	LIFEHA
n-NITROSODIPHENYLAMINE	NA	
PENTACHLOROPHENOL	0.001	MCL
PHENANTHRENE	NA	
PHENOL	4	LIFEHA
PYRENE	NA	
2,4,6-TRICHLOROPHENOL	0.003	UNITRISK

NOTES: MCL=MAXIMUM CONTAMINANT LEVEL; MCLG=MAXIMUM CONTAMINANT LEVEL GOAL;
MCLTT=TREATMENT TECHNOLOGY-BASED MCL; LIFEHA=LIFETIME HEALTH ADVISORY LEVEL
UNIT RISK=WATER CONCENTRATION EQUIVALENT TO 10-6 RISK

TABLE 10
Assumptions for Ingestion and Dermal Contact Exposure to Soil Contaminants of Concern at the Charleston Naval Ship Yard[a]

Exposure	Future Child Resident	Future Adult Resident
ORAL		
Daily soil ingestion level	200 mg	100 mg
Fraction of time on-site in contaminated areas	100%[b]	100%[b]
Portion of ingested contaminant absorbed	100%	100%
Days per year on-site	350 days	350 days
Years on-site	6 years	24 years
Body weight	16 kg	70 kg
Lifetime	Averaging time based on 30 years for non-carcinogens, and 70 years for carcinogens (see Soil Exposure Formulae Key)	
DERMAL		
Skin area contaminated	2430 cm^2	2300 cm^2
Soil adherence per cm^2 of skin	2 mg	2 mg
Portion of contaminant absorbed	0.01°	0.01°
Days per year on-site	350 days	350 days
Years on-site	6 years	24 years
Body weight	16 kg	70 kg
Lifetime	Averaging time based on 30 years for non-carcinogens, and 70 years for carcinogens (see Soil Exposure Formulae Key)	

[a] References values from USEPA, RAGS, 12/89 and OSWER Directive #9285.6-03.

[b]Uniform contaminant distribution over the entire site area is assumed. No fraction of time factor was utilized in these calculations, uniform exposure to the entire site (conservative).

° 1.0% dermal transfer assumed; includes consideration of soil matrix effect

Figure 1
Formulae for Calculating Action Levels for Groundwater

The following formulae for computing groundwater risk (carcinogenic and non-carcinogenic) were excerpted from RAGS, Volume I, Part A. If carcinogenic risk is set equal to the 10^{-6} point of departure and the hazard index is set equal to unity (1), the formulae may be rearranged to calculate individual groundwater contaminant levels which will pose carcinogenic and/or non-carcinogenic risk above the standard thresholds.

FUTURE SITE RESIDENT

Cancer Risk Formula:

$$\text{Risk} = \frac{[\text{contaminant}] \times EF \times ED \times [(CPF_i \times K \times IR_a) + (CPF_o \times IR_w)]}{BW \times AT \times 365 \text{ days/year}}$$

Non-Carcinogenic Risk (Hazard Index) Formula:

$$\text{Hazard Index} = \frac{[\text{contaminant}] \times IR_w \times EF \times ED}{RfD_o \times BW \times AT \times 365 \text{ days/year}} + \frac{[\text{contaminant}] \times K \times IR_a \times EF \times ED}{RfD_i \times BW \times AT \times 365 \text{ days/year}}$$

Where:

BW= Body Weight= 70 kg
EF= Exposure Frequency= 350 days/year
CPF_i= Inhalation cancer potency factor= chemical-specific
K= volatilization factor= 0.0005 x 1000 L/m^3
IR_w= daily water ingestion rate= 2 L/day
RfD_i= inhalation reference dose= chemical-specific
AT= Averaging Time= 70 years
ED= Exposure Duration= 30 years
CPF_o= Oral cancer potency factor= chemical-specific
IR_a= daily indoor inhalation rate= 15 m^3/day
RfD_o= oral reference dose= chemical-specific

Risk (hazard index) formulae were obtained from USEPA's Risk Assessment Guidance for Superfund, Volume I, Parts A & B.

Figure 2
Formulae for Calculating Action Levels for Soil

The following formulae for computing soil risk (carcinogenic and non-carcinogenic) were excerpted from RAGS, Volume I, Part A. If carcinogenic risk is set equal to the 10^{-6} point of departure and the hazard index is set equal to unity (1), the formulae may be rearranged to calculate individual soil contaminant levels which will pose carcinogenic and/or non-carcinogenic risk above the standard thresholds.

SOIL INGESTION PATHWAY

Age-adjusted Ingestion Factor ($IF_{soil/adj}$)

$$IF_{soil/adj}\ (\text{mg-yr/kg-day}) = \frac{IR_{soil/age1\text{-}6} \times ED_{age1\text{-}6}}{BW_{age1\text{-}6}} + \frac{IR_{soil/age7\text{-}31} \times ED_{age7\text{-}31}}{BW_{age7\text{-}31}}$$

where:

		Default Value
$IF_{soil/adj}$	age-adjusted soil ingestion factor (mg-yr/kg-day)	114 mg-yr/kg-day
$BW_{age1\text{-}6}$	average body weight from ages 1-6 (kg)	16 kg
$BW_{age7\text{-}31}$	average body weight from ages 7-31 (kg)	70 kg
$ED_{age1\text{-}6}$	exposure duration during ages 1-6 (yr)	6 years
$ED_{age7\text{-}31}$	exposure duration during ages 7-31 (yr)	24 years
$IR_{soil/age1\text{-}6}$	ingestion rate of soil age 1 -6 (mg/day)	200 mg/day
$IR_{soil/age7\text{-}31}$	ingestion rate of soil age 7-31 (mg/day)	100 mg/day
$IF_{soil/adj}$	age-adjusted ingestion factor (mg-yr/kg-day)	114 mg-yr/kg-day

DERMAL CONTACT PATHWAY

Age-adjusted Contact Factor ($CF_{soil/adj}$)

$$CF_{soil/adj}\ (\text{mg-yr/kg-day}) = \frac{SA_{age1\text{-}6} \times AF \times ED_{age1\text{-}6}}{BW_{age1\text{-}6}} + \frac{SA_{age7\text{-}31} \times AF \times ED_{age7\text{-}31}}{BW_{age7\text{-}31}}$$

where:

		Default Values
$CF_{soil/adj}$	age-adjusted contact factor (mg-yr-event/kg-day)	3520 mg-yr-event/kg-day
$SA_{age1\text{-}6}$	skin surface area available for contact (cm^2/event)	2430 cm^2/event
$SA_{age7\text{-}31}$	skin surface area available for contact (cm^2/event)	2300 cm^2/event
AF	soil to skin adherence factor (mg/cm^2)	2 mg/cm^2
$ED_{age1\text{-}6}$	exposure duration during age 1-6 (yr)	6 yr
$ED_{age7\text{-}31}$	exposure duration during age 7-31 (yr)	24 yr

RISK (HAZARD INDEX) BASED ON COMBINED DAILY ABSORBED DOSE (INGESTION + DERMAL CONTACT)

Non-Carcinogens

Hazard Index =

$$(C_s \times ((IF_{soil/adj} \times 10^{-6}\text{kg/mg} \times EF_R)/AT_{NC}) + ((CF_{soil/adj} \times 10^{-6}\text{kg/mg} \times EF_R \times ABS)/AT_{NC}))/RfD$$

Carcinogens

Risk =

$$(C_s \times ((IF_{soil/adj} \times 10^{-6}\text{kg/mg} \times EF_R)/AT_C) + ((CF_{soil/adj} \times 10^{-6}\text{kg/mg} \times EF_R \times ABS)/AT_C)) \times SF_o$$

where:

		Default Values
C_s	Chemical concentration in soil	Chemical-specific
EF_R	Residential exposure frequency	350 days/year
AT_{NC}	Averaging time (non-carcinogen)	10,950 days
AT_C	Averaging time (carcinogen)	25,550 days
ABS*	Absorption factor (unitless)	0.01
RfD	Reference Dose (mg/kg/day)	Chemical-specific
SF_o	Slope Factor $(\text{mg/kg/day})^{-1}$	Chemical-specific

Action Level Formulae Notes
Figures 1 and 2

Notes:

[a]Reference: USEPA, RAGS, Volume I, Part A, 12/89, pp. 6-40 and 6-41 and USEPA, RAGS, Volume I, Part B, pp. 23-25

[b]Oral and dermal absorbed doses for the soil pathway are combined within the formulae. The sum is then multiplied by the CPF (or SF_o) to obtain the upper bound risk. The sum is divided by the RfD to obtain the Hazard Index (unitless) for noncarcinogens. The exposure assumptions listed in Table 3 were applied for future site resident exposure scenarios.

[c]Absorbed doses for ingestion exposure are assumed to be the equivalent of administered doses (100% oral ingestion). Therefore, no conversion factor is incorporated into the associated formulae.

" - absorption factor assumes one percent of contaminants present in adsorbed soils will be absorbed by the exposed individual via the dermal contact pathway.

"- Absorbed dose for the dermal exposure pathway is assumed to be 1% of the administered (adsorbed) dose.

- Groundwater to Surface Water Transport (Gaining Stream Phenomena)
- Soil to Air Transport (Volatilization and Fugitive Dust)
- Surface Water/Sediment Partitioning and Transport

Any data gaps which exist for the evaluation of these phenomena may be filled during subsequent RFI phases or during the CMS (if applicable).