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PHASE II

CONTAMINATION ASSESSMENT/ REMEDIAL ACTIVITIES INVESTIGATION WORK PIAN - GROUP G NAVAL AIR STATION PENSACOLA PENSACOLA, FLORIDA

Radium Spill Area (Site 25)
Radium Dial Shop Sewer (Site 27)

April 1992

Prepared for:

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SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
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1. INTRODUCTION

The purpose of this work plan is to outline the procedures and methodologies to be used in conducting a Contamination Assessment/ Remedial Activities Investigation at the Radium Spill Area (Site 25) and the Radium Dial Shop Sewer (Site 27) located at the Naval Air Station (NAS) in Pensacola, Escambia County, Florida. This work plan has been prepared by Ecology and Environment, Inc., (E & E) for the Southern Division, U.S. Navy, Naval Facilities Engineering Command, under Contract No. N62467-88-C-0200. The work plan has been developed based on information and file documents provided by the Navy, and on information gathered by E & E during preliminary site inspections conducted during January 1989.

E & E has developed a phased approach for performing the NAS Pensacola site investigations. Phase I (Field Screening) is directed toward identifying the principal area(s) and primary contaminants of concern at a site, thereby providing a mechanism for focusing the sampling and analytical efforts during subsequent phases of the investigation. Phase II (Characterization) is directed toward the formal confirmation and quantification of the full spectrum of site contaminants (if any), thereby allowing determination of whether further investigation is warranted. Thus, the necessity of implementing phases III and IV (Extent Delineation) will be dependent on the results of phases I and 11. Phases III and IV, if required, will be directed not only toward fully identifying the horizontal and vertical extents of contamination, but also toward providing the quantitative data base necessary to support the screening and evaluation of potential remedial alternatives. The main objectives/advantages of this phased approach are as follows:

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- Efficient identification of those sites where environmental contamination has actually occurred as a result of past and/or present operations, thereby allowing non-contaminated sites to be eliminated from the program in the most environmentally sound, Cost-effective, and timely manner possible;

- Focused placement of sampling locations and focused selection of analytical parameters in later phases of the investigation, thereby allowing full characterization of site contamination in the most environmentally sound, cost-effective, and timely manner possible; and

- Early screening of potential remedial alternatives, which, in turn, allows critical parameters necessary to the evaluation of these alternatives to be incorporated into the analytical program in later phases of the investigation.

It is anticipated that some of the NAS Pensacola sites may not require investigation beyond Phase II and hence will comprise Contamination Assessment-type investigations. On the other hand, sites which have documented contamination will likely require the additional phases of work, and hence will comprise a full-scale Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Remedial Investigation/Feasibility Study (RI/FS). For simplicity, the investigations for all NAS Pensacola sites will be referred to as Contamination Assessment/Remedial Activities Investigations. The final results of site investigations that do not require study beyond Phase II will be incorporated into a Contamination Assessment Report. If appropriate, these sites will be recommended for No Further Action. The final results of site investigations that require work beyond Phase II will be incorporated into a Remedial Investigation Report, which will provide all the information necessary for the development and completion of a Feasibility Study (PS).

2. SITE DESCRIPTION

21 Site 25—Radium Spill Area

The Radium Spill Area (Site 25) is a concrete-paved area immediately east of the radium decontamination building (Building 780; see figures 2-1 and 2-2). The site is confined by a chain link fence to the south and east. An unpaved area bounded by a fence containing scrapped helicopters is located approximately 35 feet east of the building. The entire area between the helicopter scrap yard and Building 780 is paved with concrete. The areas south and west of the building are paved with concrete and/or asphalt.

A radium spill reportedly occurred in 1978 on the concrete pad between Building 780 and the helicopter scrap yard (Naval Energy and Environmental Support Activity [NEESA] 1983). Drainage from the concrete pad appears to flow east to the unpaved scrap yard. No surface water bodies are present in the immediate site vicinity, but Bayou Grande is located approximately 1,300 feet north of the site (United States Geological Survey [USGS] 1970a).

The site vicinity is a generally flat area with land surface elevations averaging approximately 22 to 25 feet above mean sea level (MSL). In general, where exposed, the surface soils are sandy and well drained.

There are no existing monitoring wells at Site 25, but two wells are located approximately 100 feet west on Site 27. A municipal supply well is located approximately 1,400 feet southwest of the site. Construction data for these wells can be found in the Site 27 description.

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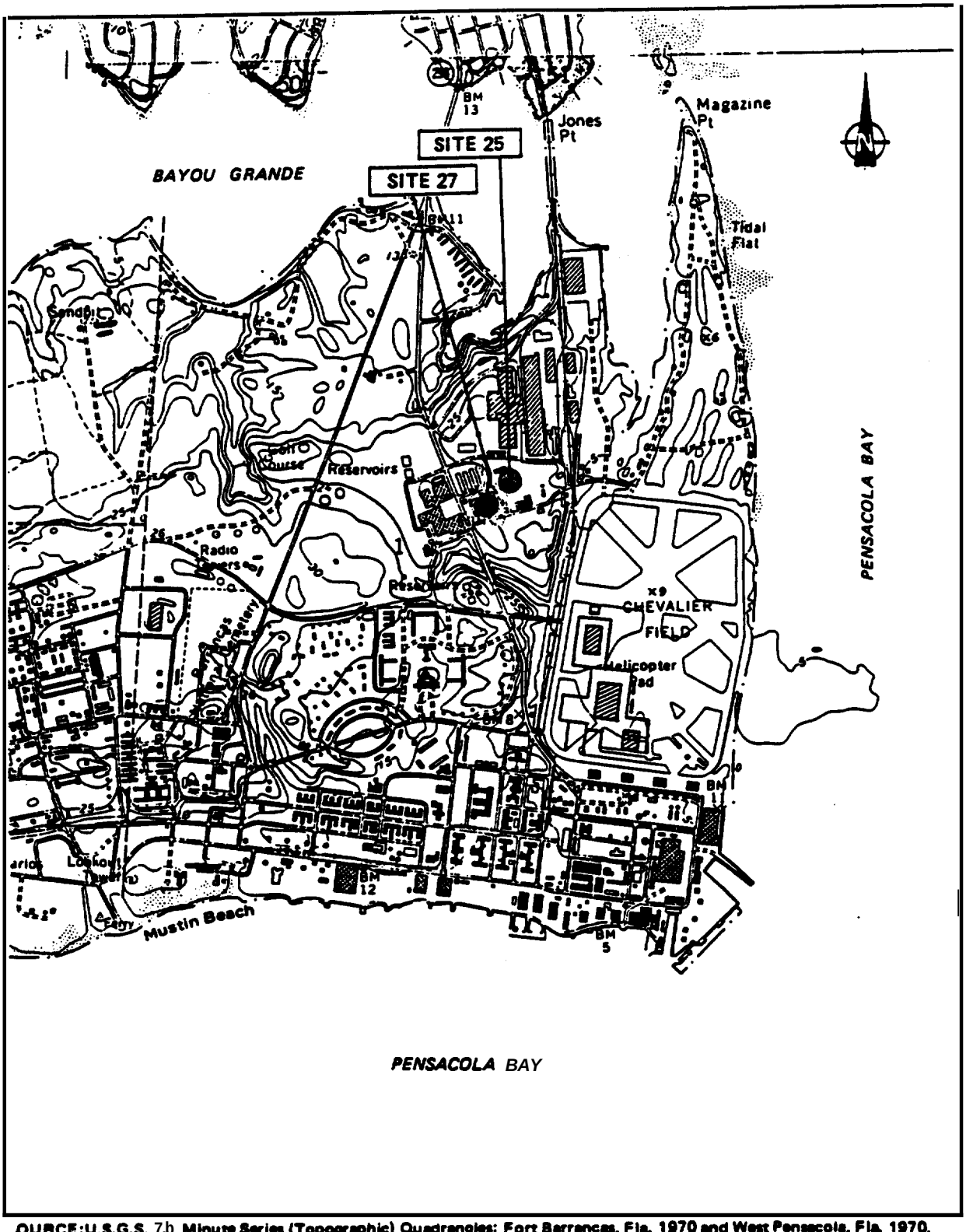


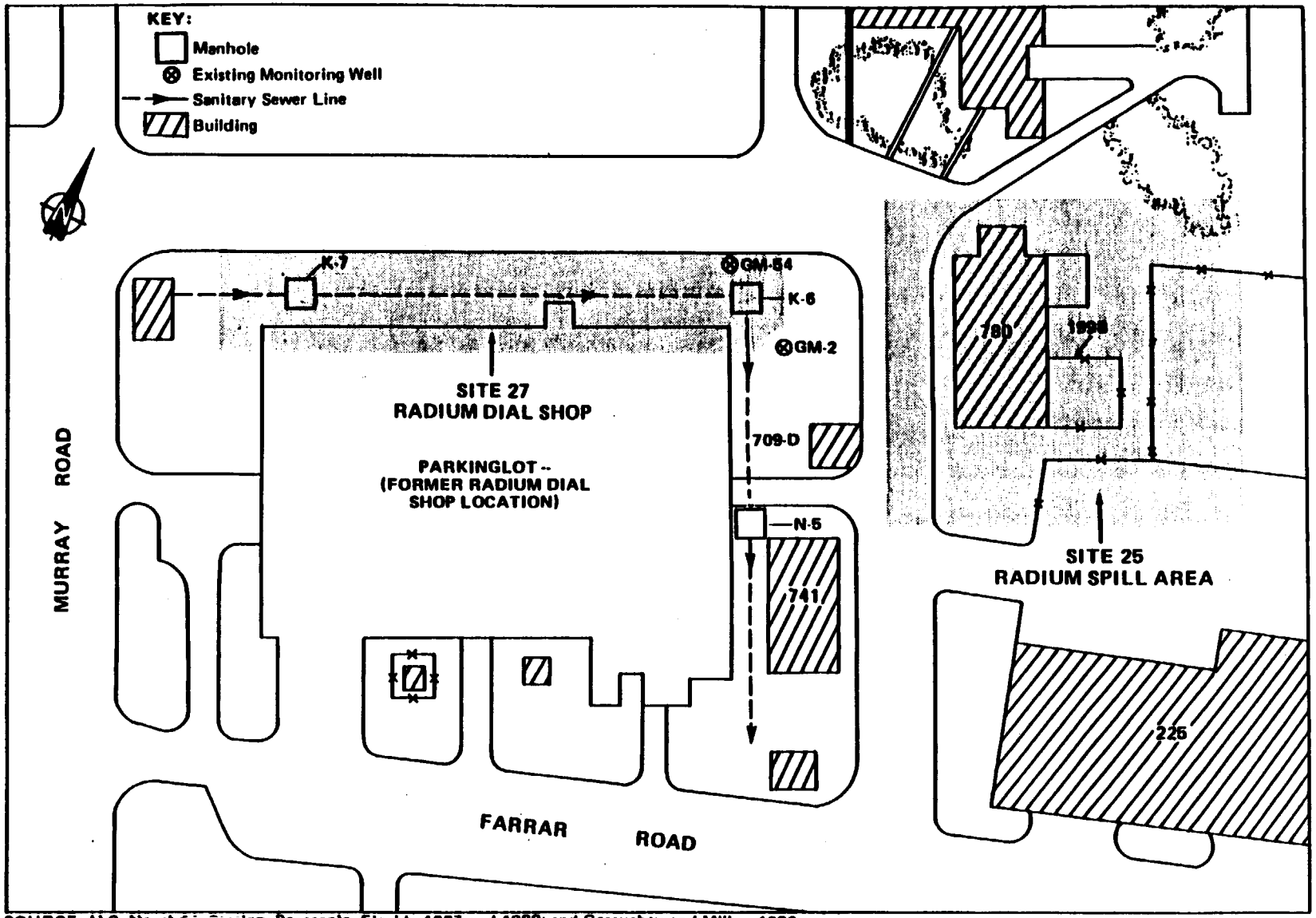
SOURCE: U.S.G.S. 7.b Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970, Photorevised 1987

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 2–1 LOCATION MAP – NAS PENSACOLA SITES 25 and 27



SOURCE: U.S. Naval Air Station, Pensacola, Florida, 1987 and 1988; and Geraughty and Miller, 1986.

SCALE

0 100 200 300 FEET

Figure 2-2 SITE MAP, NAS PENSACOLA SITES 25 AND 27

22 Site 27--Radium Dial Shop Sewer

The Radium Dial Shop (Site 27), located in Building 709, was dismantled in 1976, and the remaining concrete foundation is currently being used as a parking lot as shown in Figure 2-2. The site is located approximately 150 feet west of Building 780 (Site 25) and is bounded by Farrar and Hurray roads to the south and west, respectively. Site 31, which is located north of Building 648, is approximately 150 feet west of Site 27 across Hurray Road. Hanhole K-7, of the sanitary sever, is located immediately north of the foundation (see Figure 2-2).

The building foundation, which is presently a parking lot, is elevated from 2 to 4 feet above the surrounding area. The easement bordering the parking lot is generally unpaved. An unpaved parking lot is located immediately east of the building, and all surrounding roads are paved with either concrete or asphalt.

The Site 27 vicinity is a generally flat area with land surface elevations averaging approximately 20 to 25 feet above MSL. The direction of surface drainage is generally to the north-northeast (Geraghty 6 Hiller, Inc. [G & M] 1986). In general, where exposed, the surface soils are sandy and well-drained.

Two 2-inch polyvinyl chloride (PVC) monitoring wells (GM02 and GM54) are located near the northeast corner of the parking lot. Well GM02 is screened from 17.7 to 20.2 feet, and well GM54 is screened from 109.5 to 114.5 feet (G 6 M 1984, 1986). Well house No. 2, which contains an infrequently used NAS Pensacola municipal supply well, is located approximately 1,500 feet southwest of the site. The well is 160 feet deep and is screened from 110 to 160 feet. The well casing is 24 inches in diameter, and the screen is 12 inches in diameter (Wilkins et al. 1985).

Four other shallow monitoring wells are located in the site vicinity. Well GM01 is located 200 feet northwest of Site 27 on Site 31, which is northwest of the parking lot. Well GM02 is screened from 23.8 to 26.3

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feet. Approximately 1,500 feet southeast of Site 27 are shallow wells GM52, GM55, and GM58. These wells are 15, 26, and 25.5 feet deep respectively, and all are screened over the bottom 2.5 feet (G & M *1984*, 1986).

3. SITE HISTORY

3.1 Site 25—Radium Spill Area

The radium removal operations at NAS Pensacola involve stripping radium-containing paint from instrument dials prior to re-painting. From 1965 to 1975, these operations were conducted in Building 709. In 1975, all activities related to radium-painted instruments, including stripping and re-painting, were permanently moved to Building 780. At the present, aircraft instruments containing radium are disassembled in Building 780 (NEESA 1983).

It is estimated that 5,000 to 7,000 instruments a year were processed in Building 780. Dials were stripped using a thick paint thinner, then soaked in a lye and nitric acid solution. Contaminated instrument cases were processed by soaking in a "Turco" acid solution. The components were cleaned with a wire brush to remove all residue (NEESA 1983).

Approximately one drum of solid waste and two drums of liquid waste mixed with vermiculite were generated each year from the operations conducted in Building 780. Previous to 1970, the 55-gallon drums were stored temporarily on an asphalt pad between buildings 225 and 3215 (located 200 feet east of Building 225). The radioactive waste was disposed of at an unspecified location outside of NAS Pensacola (NEESA 1983). A fenced storage area adjacent to Building 780 has been used for drum storage since the 1970s (NEESA 1983). It is not known how many drums are currently being stored in this area or the procedures being used for the disposal of the radioactive waste.

In 1978, a corroded drum broke open, spilling approximately 25 gallons of radioactive waste from the the radium stripping operations onto the concrete-paved area east of Building 780 (NEESA 1983). The spill was reported to have been properly cleaned up: however, the procedure used for removal of the spill and the length of time between the spill and the cleanup operation is not known.

In June 1983, an Initial Assessment Study (IAS) was completed by NEESA in which 29 sites, including Site 25, were evaluated based on information from historical records, field inspections, and personal interviews. The study concluded that because the material was spilled on pavement and properly cleaned up, there was no potential hazard to human health or the the environment. Further study vas not recommended.

32 Site 27—Radium Dial Shop Sever

From the 1940s to 1976, Building 709 was used to rework instrument dials that were painted with radium-containing paint. Radium dial painting was discontinued in 1950 when the Navy began to use a non-radioactive paint. It is reported that radium dial stripping and repainting was conducted for a total of 10 to 14 years (NEESA 1983).

Solid waste from the painting operations including brushes, vials, wiping papers, and old dials, which were temporarily stored in a shed adjacent to Building 709 and reportedly disposed of at sea. The total quantity of solid waste generated at Building 709 is estimated to be three or four 55-gallon drums a year (NEESA 1983).

It is estimated that 5,000 to 7,000 luminous dial instruments were re-worked each year using cleaning solutions containing benzene, acid, and other caustics. These solutions removed pigments, phosphors, and radium from the instrument dials. Approximately 1,500 gallons per year of cleaning solution contaminated with radium was poured down the drains of Building 709, which emptied into the sanitary sewer (NEESA 1983). Wet scraping was done in a liquid bath of either water or benzene, and dry scraping and painting was performed in ventilation hoods (NEESA 1983).

It is stated that the contents of the liquid scraping bath were poured down the drain in Building 709 at the end of each day; however, it is believed that the benzene was disposed of with the solid wastes (NEESA 1983).

The paint stripping operations were transferred to Building 780 in 1975. Building 709 was dismantled in 1976, and the foundation is currently used as a parking lot. A pre-demolition survey of the dial painting shop, ventilation ducts, drains, and the areas adjacent to the building was conducted by the NEESA Radiological Affairs Support Office (RASO). It is stated that the drainpipe, portions of the linoleum floor covering, walls, and wooden flooring in the building were found to be radioactively contaminated. RASO supervised the removal of these materials, which were sent to the Naval Air Rework Facility for disposal. The disposal location of these materials is not known.

A portion of the above-mentioned drainpipe was excavated to 18 inches below ground surface and found to emit radiation at a rate of 1.2 milliRoentgens per hour (mR/hr). The hole was refilled with concrete (NEESA 1983). Normal background levels are estimated to be 0.02 mR/hr. The remaining portion of pipe leading to manhole K-7 was then sealed over with concrete. RASO recommended that the manhole associated with the drainpipe, and the outfall be located and sampled (NEESA 1983); however, the exact locations were not specified, and there is no evidence that this sampling ever took place.

The sewer pipe leading from Building 709 connects to a 10-inch-diameter sewer line accessed by manhole K-7. Flow in the 10-inch sewer line is assumed to proceed east to manhole K-6. The sewer line subsequently intersects a series of nine other manholes via pumping station 709 and terminates in the sewage treatment plant (Building 771A-D).

The IAS completed by NEESA, in which the Radium Dial Shop Sewer (Site 27) was evaluated, is based on information from historical records, field inspections, and personal interviews. NEESA found that no samples had been taken by RASO and recommended that further study be conducted

on the sewer system associated with the Radium Dial Shop. The site was discussed during a meeting between the Navy and the Florida Department of Environmental Regulation (FDER) on November 17, 1983, and was again recommended for further study.

In July 1984, a Verification Study of 18 NAS Pensacola sites was completed by G & H, which included findings and recommendations concerning Site 27. During the study, a monitoring well (GM02) was installed near the northeast corner of the foundation of former Building 709. Samples from the well were analyzed for gross alpha and volatile organic compounds (VOCs). The level of gross alpha (6.5 picocuries/ liter) was found to be below FDER's primary drinking water standard; however, chlorinated hydrocarbons were found in concentrations as high as 29 micrograms per liter (µg/L) as shown in Table 3-1. Shallow monitoring well GM01 was also installed during the Verification Study and is located on Site 31 approximately 200 feet northeast and upgradient of Site 27. Due to the proximity of sites 31 and 27 and the fact that Site 27 is hydraulically downgradient of the potential contamination sources on Site 31, the two sites were grouped together for the verification study (G & H 1984). G & H recommended that a deep monitoring well be installed adjacent to GM02 to determine the vertical hydraulic gradient (G & M 1984).

In Harch 1986, a Characterization Study was completed by G & 11 during which the proposed deep well (GM54) was installed. This well was sampled, and no VOCs were detected. As shown on Table 3-1, shallow monitoring wells GM52, GM55, and GM58 were also installed and sampled as part of the Characterization Study. These wells are approximately 1,500 feet hydraulically downgradient (southeast) of Site 27; however, they are not directly associated with Site 27. G & M concluded that Site 27 did not pose an imminent hazard to human health or the environment, and no further action was recommended (G & H 1986).

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Table 3-1

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS FOR SITES 25 and 27 (µg/L [ppb])

Compounds Detected (SPA Methods 601 and 602)	Monitoring Well Number											
	an-1		an-2		GM-52		an-54		an-5s		an-58	
	V.S.	C.S.	V.S.	C.S.	V.S.	C.S.	V.S.	C.S.	V.S.	C.S.	V.S.	C.S.
Methylene chloride	2.1	—	—	—	N.A.	—	N.A.	—	N.A.	—	N.A.	—
1,1-Dichloroethene	0.1	—	—	—	N.A.	—	N.A.	—	N.A.	—	N.A.	—
Chloroform	4.6	—	3.7	—	N.A.	—	N.A.	—	N.A.	—	N.A.	—
1,2-Dichloroethane	—	—	29	—	N.A.	—	..A.	—	N.A.	—	N.A.	—
1,1,1-Trichloroethane	1.7	—	2.5	—	N.A.	—	N.A.	—	N.A.	8	N.A.	—
Trichloroethene	—	—	5.2	3	N.A.	—	N.A.	—	N.A.	—	N.A.	210
Tetrachloroethene	0.4	—	0.6	—	N.A.	—	..A.	—	..A.	—	N.A.	—
Trans-1,2-dichloroethene	—	—	—	—	N.A.	—	N.A.	—	N.A.	—	N.A.	530
Vinyl chloride	—	—	—	—	N.A.	—	N.A.	—	N.A.	—	N.A.	73

Notes: V.S. = Verification Study, Geraghty and Miller, 1984.
C.S. = Characterization Study, Geraghty and Miller, 1986.

Key: — = Not present above detection limits.
W.A. = Not Applicable — wells were not installed at this date.

[Source: Ecology and Environment, Inc., 1992.1

4. CLIMATOLOGY

NAS Pensacola is located in an area that typically experiences a mild, subtropical climate. This climate is a result of the latitude (approximately 30° North) and the stabilizing effect of the adjacent Gulf of Mexico (Volfe et at. 1988). The average annual temperature ranges from 55° Fahrenheit (P) in the winter to 81° P in the summer. Although the annual temperature range is fairly stable, actual daily values can be more extreme, ranging from less than 7° P in the winter to more than 102° P in the summer. Thunderstorms occur during approximately half of the days during the summer months and can cause a 10° to 20° P drop in temperature in only a few minutes (Volfe et al. 1988).

Precipitation rates in the NAS Pensacola vicinity are relatively high with an average annual rainfall of approximately 60 inches. Rainfall amounts are highest in July and August during almost daily thunderstorms (averaging 7 inches per month) and lowest during spring and fall (averaging 4 inches per month; Kennedy 1982). High intensity thunderstorms are common, producing as much as 3 to 4 inches of rainfall during a single hour. Because evaporation rates are also highest in the summer months, the potential recharge resulting from heavy summer rains is reduced. Spring and fall rains are generally less intense, but longer in duration, producing less surface runoff and higher rates of infiltration and net recharge.

Vind velocities are generally moderate except during thunderstorms (Carlisle 1960). Prevailing winds are northerly during the winter and southerly during the summer. *An* ocean-land temperature differential produces a daily clockwise rotation of the surface wind direction near

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the coast, commonly known as the sea-breeze effect (Flood and Associates 1978). Hurricanes and tornadoes are infrequent but can cause substantial damage to the nearshore environment. Six hurricanes have passed within 50 miles of Pensacola since 1980.

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5. BIOLOGICAL RESOURCES

The NAS Pensacola facility consists of approximately 5,800 acres and encompasses approximately 15 terrestrial and aquatic habitats. The majority of the land on the eastern side of the facility is developed for military use or is designated as a historical or cultural resource. Eowever, the NAS Pensacola installation has approximately 3,500 acres in natural or seminatural (plantation) condition, primarily in the western portion of the facility.

51 Regional Biological Resources

5.1.1 Terrestrial

Vegetation. The primary vegetated communities of the NAS Pensacola facility can be considered one of two types: north Florida coastal strand communities and sand pine scrub communities. The north Florida coastal strand communities are stabilized coastal dunes with a sand substrate, vegetatively characterized by the plants Uniola paniculata (sea oats), Hydrocotyle bonariensis (beach pennywort), Ipomoea stolonifera (beach morning-glory), Coccoloba uvifera (sea grape), Quercus geminata (twin live oak), and the stunted shrubs species Yucca aloifolia (yucca), Opuntia, and Cereus. This community type has been ranked by the Florida Natural Areas Inventory (FNAI) as locally restricted and vulnerable to extinction due to developmental activities. This community type can have three to five distinct habitat types (Wolfe et al. 1988).

The sand pine scrub community is a more upland coastal community characterized by coastal dune formations from an older geologic age with deep, fine, white sand substrate and the plants Pinus clausa (sand

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pine), Quercus spp. (scrub *oak* species, geminata, champanii, myrtifolia, and inopina), Cladonia species, and Ceratiola ericoides (rosemary). This community type has been ranked by FNAI as imperiled statewide because of its rarity and because of its vulnerability to extinction due to some artificial or biological factor. This community type can have three to five distinct habitats (Wolfe et al. 1988).

Two other community types my be found in the western portions of the NAS Pensacola facility. These are flatwoods and sandhill vegetative communities. Platwoods vegetation occupies areas which were ocean bottoms in recent geologic times. Primary overstory vegetation is dominated by Pinus palustris (longleaf pine), Pinus elliottii (slash pine), and Serenoa repens (saw palmetto). Platwoods communities also occupy areas of low depressions and small creeks and drainage courses, but the overstory vegetation is usually replaced by Taxodium ascendens (pond cypress), Cliftonia monophylla (black titi), Cyrilla racemiflora (swamp titi), and other hydric or riparian species. Open moist savannah areas within flatwoods are dominated by the herbaceous plants Pinguicula spp. (butterwort), Sarracenia spp. (pitcher-plants), Uticularia spp. (bladderworts), Polygala spp. (milkworts), and Drosera spp. (sundews; Wolfe et al. 1988).

Sandhill communities are found in dry soils which are lower in fertility than flatwoods soils. The overstory of this community type is dominated by Pinus palustris (longleaf pine), Quercus laevis (turkey *oak)*, Q. marilandica (bluejack *oak)*, Q. stellata (post *oak)*, and Q. falvata (southern red *oak).* The understory is dominated by Diospyros virginiana (wild persimmon) and Crataegus lacrimata (Pensacola hawthorn). The more abundant herbaceous plants found in moist areas are Pteridium aquilinum (bracken fern) and Aristida stricta (wire grass). These habitats were verified with walk-through surveys and ground truthing by the Navy in March 1986 (Navy 1986).

Freshwater Wetland Vegetation. Much of the geological material underlying the NAS Pensacola facility is deep, porous sand often containing relatively impermeable clay lenses. In combination with high

annual rainfall, this geologic condition causes the formation of small areas of perched groundwater. In areas with relatively steep slopes, groundwater seepage escapes into well-defined stream channels called steepheads as found near Site 30. In gently sloping areas, the presence of perched groundwater conditions results in the formation of wetland bogs, as found near Sherman Field. Wetland or seepage bogs are characterized by herbaceous plant species as described in the sections above for flatwoods and sandhill communities. Most of these communities and other vegetative communities east of Sherman Field have been considerably altered by development on the base that has changed surface and/or groundwater flow (NEESA 1983).

Shrub bogs are found within flatwoods, downslope of herbaceous bogs. These evergreen bogs are dominated by Cliftonia monophylla (black titi), and/or Cyrilla racemiflora (swamp titi). Associated species include Clethra almifolia (sweet pepperbush), Ilex cassine (dahoon holly), and Lyonia spp. (fctterbushes; Uolfe et al. 1988).

Intermittent streams found on NAS Pensacola have lost most of the original vegetation associated with this habitat. For example, at Site 30, the stream that empties the small swamp into Bayou Grande has lost a considerable amount of vegetation along the stream banks and near Bayou Grande as a result of base development. In areas unaffected by development, hardwoods dominate the canopy around the stream. Such species as Magnolia virginiana (sweetbay), Illicum floridanum (star anise), and Smilax bona-nox (spiked cat brier) are dominants of seepage or steephead streams (Uolfe et al. 1988).

Biota surveys must be conducted for any wetland or stream habitat that is influenced by a site to determine which specific flora and fauna may be affected by site activities.

Birds. A literature search reveals 250 possible bird species associated with the area. Thirteen of these species are endangered, and seven are species of concern (see Appendix C). In March 1986, the Navy conducted a survey and found 23 species of birds on the NAS Pensacola facility.

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The Navy recorded moderate size rookeries of the great blue heron and found large numbers of nesting osprey in the southwestern portions of the NAS Pensacola facility. Because of the large number and diversity of habitats found around the facility and considering that the survey was conducted during a predominantly non-mating season, it is likely that there are more species of birds using the facility and surrounding waters as feeding and nesting sites than have been found.

Reptiles and Amphibians. During the 1986 survey conducted by the Navy, only four out of a possible 30 species of reptiles and amphibians associated with the area were identified on the NAS Pensacola facility, none of which are endangered. A recent check of the FNAI files confirms that the presence of the gopher tortoise (Gopherus polyphemus) can most likely be found in suitable habitats on the western portions of the facility (see Appendix C). Host of the reptiles and amphibians that may be found on the facility can be expected to use the surface water bodies in some stage of their life cycle. Any contamination of surface water bodies can be detrimental to existing populations of reptiles and amphibians utilizing that water body.

5.1.2 Aquatic

Freshwater. Little is known of the flora and fauna inhabiting the streams, swamps, and bogs found on NAS Pensacola. These habitats may have been significantly altered for drainage control and base development. Some of the species associated with aquatic habitats are Semotilus atromaculatus (creek chub), Gambusia affinis (mosquitofish), and Etheostoma sp. (darters). Birds, mammals, reptiles, and amphibians that associate with aquatic habitats may also be found in and around those sites with surface waters (Wolfe et al. 1988).

Coastal Vetlands. There are no reported coastal marshes or estuarine wetlands around the NAS Pensacola facility, principally along the low energy shores of Bayou Grande. The habitat type is usually dominated by saltmarsh cordgrass (Spartina alterniflora) or black needlerush (Juncus roemarianus). A biota survey of these and other potential habitat areas will be conducted to determine the extent of estuarine flora and fauna.

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Seagrass beds are reported to be present within Big Lagoon along the southwestern portion of the NAS facility. These grassbeds are composed primarily of Thalassia testudinum, Syringodium filiforme, and Halodule beaudettei. Seagrass beds in the area surrounding the facility have not been historically mapped, and very little is known of their composition, locality, or areal extent. Grass beds of unknown species composition extending along the north shore of Pensacola Bay in the 1950s disappeared by 1961. *An* examination of historical aerial photographs (see Section 12) may elucidate past distributions of seagrasses.

Plankton. The only existing study of the phytoplankton and zooplankton in the waters surrounding the NAS Pensacola facility was conducted by the Navy in March 1986. The phytoplankton has been characterized as low in productivity (as compared to other Gulf coast estuaries), and mainly dominated by the diatoms Navicula tripuncata, Bacteriastrum spp., Chaetocerus spp., Thalassionema nitzschoides, and Hemiaulus spp. The zooplankton is primarily dominated by Calonoid copepods and benthic invertebrate larvae. This study is very limited by the fact that samples were collected with undefined methods and only during the early spring. This sampling protocol does not define population fluctuations that are characteristic of low population abundances commonly found in estuaries during the summer months. Examination of the zooplankton data results in the same conclusions. It should be pointed out that any contamination entering Pensacola Bay from either groundwater or surface water sources may be accumulated in the invertebrate larvae that predominate most estuarine water bodies.

Benthos. Marine soft-sediment communities are found adjacent to the northern, eastern, and southern areas of the NAS Pensacola facility in Pensacola Bay. Although no intensive benthic surveys were conducted along the perimeter of the facility, surveys at nearby sites by FDER and the Navy have described the benthic communities within Pensacola Bay as a whole. FDER collected benthic samples in most of Pensacola Bay and found that the sediments were dominated by polychaetes (Aricidea spp., Capitella spp., various spionids, and Eaploscoloplos spp.) and bivalves (Anodontia alba and Tellina spp.) during most of the year. FDER samples

collected along the wastewater treatment plant outfall show a drastic drop in species abundance and diversity close to the sewage outfall (Navy 1986). This indicates that the benthic community might have been negatively influenced by the sewage outfall.

Samples collected by the Navy (1986) indicate a low density yet moderate diversity of benthic infaunal organisms when compared to other estuarine systems within and around the turning basin. A complete comparison of the Navy's data cannot be made to other literature at this time because their data are not given in numbers per unit area. However, the Navy's data reveal that very few deep dwelling organisms reside in the areas around the turning basin, and a lack of deep dwelling benthic organisms nay be an indication of a benthic community under stressed conditions (Luckenbach et at. 1988).

Fish and Shellfish. Early studies of Pensacola Bay have identified 180 bony fish species and seven cartilaginous fish species (Cooley 1978). The 13 most abundant species were spot (Leiostomus xanthurus), pinfish (Lagodon rhomboides), Atlantic croaker (Micropogonias undulatus), gulf menhaden (Brevoortia patronus), bay anchovy (Anchoa mitchilli), longspine porgy (Stenotus caprinus), silver perch (Bairdiella chrysoura), southern hake (Urophycis floridana), inshore lizardfish (Synodus foetens), gafftopsail catfish (Bagre marinus), sand seatrout (Cynoscion arenarius), and spotted hake (Urophycis regia; Heil 1988).

Fish diversity was highest in the more saline waters near the NAS Pensacola facility during spring and summer. In the less saline waters of East Bay, diversity was lowest in summer and highest during the winter months. Fish population density was the highest in the more saline waters, with peaks throughout the summer (Cooley 1978).

Moderate densities of blue crab (Callinectes sapidus), shrimp (Penaeus duorarum, P setiferus, and P. aztecus), and oysters (C virginica) have been collected throughout Pensacola Bay (Heil 1989). Shrimp are caught in greater abundances near NAS Pensacola because of the higher salinities. Blue crabs and oysters are more readily caught

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in the East Bay area. In fact, the only legal shellfishing areas recognized by Florida Department of Natural Resources (FDNR) are in the East Bay area. Scallops (Aequipecten irradians) are collected only within grassbed areas. No information is available at this time on where scallops are collected by the general public and how many are removed. The nearest seagrass beds to the NAS facility are located in Big Lagoon along the southwest portion of the facility.

Sport and Commercial Fishing. A moderate amount of commercial fishing occurs in Escambia county, accounting for 2% of the total Florida landings for 1980 to 1985 (Navy 1986). The dominant finfish species in teras of total veight was the black mullet. The most economically important species of finfish was the red snapper. E & E examined the commercial landing data for Escambia County for 1987 and 1988 (Heil 1989) and found that the most important commercial species by weight were: black mullet (24% of county landings), brown shrimp (21%), vermillion snapper (19.5%) , red snapper (7.6%), porgies (4.7%), and amberjack *(4%).* Other less important commercial fish caught were Spanish mackerel, sand seatrout, black grouper, spotted seatrout, blue crab, and squid. These data, as well as the Navy's data, also suggest that a significant tuna fishery may be developing in the Pensacola Bay area (0 pounds landed in 1983; 1,582 pounds in 1987).

Sport Fisheries data is not available from the State of Florida at this time due to the lack of a state saltwater fishing license (Beil 1989). A telephone survey conducted by the U.S. Fish and Wildlife Service ranks the spotted seatrout as a primary fish species sought by fisherman in 1987. Following this species were: king mackerel, red drum, Spanish mackerel, groupers, red snapper, flounders, and sand seatrout. It is likely that the sport fishing catch equals or exceeds commercial landings for species sought by both interests (Navy 1986).

The estuarine system is a very important element in the life history of most of the commercial and sport fishing species sought. Between 65 and

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90% of all commercially valuable fish species are estuarine dependent during some phase of their life cycle. Shrimp, blue crab, and shellfish are known to release larvae that feed in and around estuaries until settlement. During early life history stages, the juveniles reside within seagrass beds or other protected habitats until maturity. Any contamination of the water or sediments around NAS Pensacola could be detrimental to fish and shellfish population structure or could be accumulated by the organisms residing near the facility.

Marine Mammals. Few mammals have been sighted within the area of the NAS Pcnsacola facility. Most of the 13 species of mammals reported for the northeastern Gulf of Mexico stay predominantly in Gulf waters. The Atlantic bottlenose dolphin (Tursiops truncatus), however, has been sighted regularly off the NAS Pensacola facility. Manatees have been sighted irregularly, with one recent sighting in the area recorded by FNAI in October 1988. A goosebeaked whale (Ziphius cavirostris) was reported stranded on Santa Rosa Island, and a pilot whale (Globicephala macrorhynchus) was found stranded on a beach near Pensacola (Navy 1986).

Although no surveys of marine mammals have been conducted, it can be assumed that they are quantitatively ranked as uncommon to common in abundance within the waters surrounding the NAS Pensacola facility.

Threatened and Endangered Species. A number of threatened and endangered species (see Appendix C) have been identified in the vicinity of the NAS Pensacola facility. Many rare, threatened, and endangered species are associated with the wetland or bog habitats found on NAS Pensacola. A total of 57 occurrences for six plant species were recorded in an inventory conducted by FNAI (1988b) of the NAS Pensacola facility (see Appendix C). Most of these plants were found in the area around Sherman Field and habitats to the west. Any site remediation and, more importantly, any assessment of environmental endangerment must consider the water level requirements of rare and endangered plant species, the foraging activities of birds in the waters surrounding the NAS Pensacola facility, and nesting and feeding animals on the facility grounds. Complete biotic surveys may be necessary to determine

the presence of threatened or endangered species and potential pathways of contamination to these species.

5.2 Site-Specific Biological Resources

The habitats on sites 25 and 27 have been considerably altered by NAS Pensacola activities. The sand pine scrub community has been replaced by asphalt parking lots, buildings, and concrete aprons. The creek on Site 30 lies approximately 0.25 mile southeast of this area. No aquatic habitats are associated with Site 25 or Site 27. Several *oak* trees are found north of Site 25; however, it is expected that few, if any, faunal species use these sites for feeding or nesting, but some species may use the sites as a migration corridor to other habitats in the area.

6. SURFACE WATER HYDROLOGY

6.1 General Occurrence and Significance of Surface Water

The NAS Pensacola facility is located on a coastal peninsula bounded by Bayou Grande to the north, Pensacola Bay to the south and east, and Big Lagoon to the southwest. Pensacola Bay and Big Lagoon are partially separated from the Gulf of Mexico by Santa Rosa Island and Perdido Key, both of which are barrier islands.

Surface soils consist primarily of permeable sands which allow rapid infiltration of precipitation. This direct infiltration limits stream formation and constitutes the major source of recharge to the underlying Sand-and-Gravel Aquifer.

There are no naturally occurring perennial streams on NAS Pensacola; however, there are approximately 10 naturally occurring intermittent streams and numerous artificial drainage pathways which include many stormwater outfalls. Discharge is mainly to the south into Pensacola Bay; however, some small intermittent streams discharge into Bayou Grande to the north from Sherman Field and Chevalier Field (USGS 1970a, 1970b).

The southwestern and northern portions of NAS Pensacola contain areas of freshwater wetlands. These are particularly sensitive areas formed by the intersection of the water table with the land surface. These systems are defined by and dependent upon a dynamic water-cycle, with periodic inundation and exposure corresponding to seasonal fluctuations in the water table.

The discharge of surface waters into Pensacola Bay, Bayou Grande, and the coastal wetland areas presents the potential for transport of contaminants into these systems. This could have a significant impact on seagrass and other sensitive plant communities, as well as on shell fishing, recreational fishing, and swimming in these coastal zones. Discharges, either through the surface water or groundwater, into wetland areas found on site could also have a significant impact on the biotic communities that are dependent on those habitats.

6.2 Site-Specific Surface Water Hydrology

No surface water bodies occur on or in the immediate vicinity of Site 27. The closest surface water body is a small unnamed creek and marshy area located 800 feet south of the site. This creek is proposed for sampling under the investigation of Site 30.

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7. PHYSIOGRAPHY AND HYDROGEOLOGY

7.1 Physiography and Regional Hydrogeology

7.1.1 Physiography

NAS Pensacola is located in the Gulf Coastal Lowlands Subdivision of the Coastal Plain Province physiographic division (Brooks 1981). The 5,800-acre facility is located on a peninsula bounded on the east and south by Pensacola Bay and Big Lagoon and on the north by Bayou Grande. The most prominent topographic feature on the peninsula is an escarpment or bluff which parallels the southern and eastern shorelines and on which Fort Barrancas was built. In the eastern portion of NAS Pensacola, the bluff runs north-south just to the west of Chevalier Field. Seaward of the escarpment is a nearly level marine terrace with surface elevations of approximately 5 feet above HSL. The central part of the peninsula, located landward of the escarpment, is a broad gently rolling upland area with surface elevations up to 40 feet HSL (USGS 1970a, 1970b). Sandy soils occur throughout the NAS Pensacola area. As a result, most of the rainfall infiltrates directly into the subsurface. Consequently, there are few streams or surface water bodies on the peninsula.

7.1.2 Regional Hydrogeology

There are three principal hydrogeologic units of importance which underlie the NAS Pensacola. These are, in descending order, the Surficial Aquifer, the Intermediate System, and the Floridian Aquifer System.

7.1.2.1 Surficial/Sand-and-Gravel Aquifer

The Surficial Aquifer occurs from land surface to a depth of approximately 300 feet at NAS Pensacola and consists of a sequence

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of unconsolidated to poorly indurated clastic deposits (Wagner et al. 1984). In this portion of Florida, the Surficial Aquifer constitutes an important source of water supply and is called the Sand-and-Gravel Aquifer (Southeastern Geological Society [SEGS] 1986). [Based on the total dissolved solids (TDS) content of groundwater from vells that tap the Sand-and-Gravel Aquifer in southern Escambia County (Clemens et al. 1989), the groundwater is classified as Class G l (FDER 1988b).] The sediments making up this aquifer belong to all or part of the Pliocene to Eolocene Series which, in this area, consist mainly of the Citronelle Formation overlain by a thin cover of marine terrace deposits. Given that the Sand-and-Gravel Aquifer is contiguous with land surface and recharge occurs principally by the direct infiltration of precipitation, the aquifer is particularly susceptible to contamination from surface sources. In the NAS Pensacola vicinity, the Sand-and-Gravel Aquifer is made up of three zones based on contrasting permeabilities. These zones are referred to as the surficial zone, the low permeability zone, and the main producing zone (Vilkins et al. 1985).

Surficial Zone. The surficial zone is contiguous with land surface and contains groundwater under water table or perched water table conditions. The results of numerous borings conducted at NAS Pensacola (G & M 1984, 1986) indicate that the surficial zone ranges in thickness between 40 and 70 feet and consists of tan and brown, fine- to medium-grained quartz sand. Depth to the water table within the surficial zone is variable depending on location and ranges from less than 1 foot near surface water bodies to more than 20 feet in areas of higher elevation. In general, the direction of groundwater flow is controlled by the topography and by discharge to surface water bodies. Consequently, shallow groundwater in the surficial zone moves toward areas of lower elevation and/or the nearest surface water body. Overall, the surficial zone has a high permeability. Numerous aquifer (slug) tests and laboratory permeability tests conducted on wells in or sediments from the surficial zone at NAS Pensacola yielded hydraulic conductivity values ranging from 16 to 56 ft/day (G & M 1986). Eorizontal groundwater flow velocities in the surficial zone will depend on site-specific hydraulic conductivities

and horizontal hydraulic gradients; however, velocities would generally be expected to be high.

Low Permeability Zone. Underlying the surficial zone is a zone of lower permeability sediments dominated by clay and silt-sized material. This zone is referred to as the low permeability zone. At NAS Pensacola, this zone is generally composed of gray to blue, sandy, silty, slightly fossiliferous (shelly) clay and clayey sand ranging in thickness from 8 to 40 feet (G & M 1984, 1986).

The results of laboratory permeability tests conducted on samples from this zone indicate that vertical hydraulic conductivities are low, ranging from 4.2×10^{-5} to 9.9×10^{-2} ft/day. Thus, the low permeability zone probably functions as a confining or semiconfining unit inhibiting the flow of groundwater between the surficial zone and the underlying main producing zone. The low permeability zone has been encountered in at least 16 borings at widely spread locations throughout NAS Pensacola (G & M 1984, 1986). Although additional boring or geophysical techniques would be required to confirm its presence at a given location, it is likely that this unit is ubiquitous at NAS Pensacola. Few, if any, wells are open to the low permeability zone at NAS Pensacola; thus, no information is available regarding groundwater flow direction.

Main Producing Zone. The bottom portion of the Sand-and-Gravel Aquifer is called the main producing zone and is composed mainly of sand and gravel interbedded with thin beds of silt and clay. The depth at which the main producing zone is encountered is somewhat variable, ranging from 60 to approximately 120 feet below land surface (BLS) at NAS Pensacola. This zone generally has the highest permeability characteristics due to thicker and more persistent sand and gravel beds, and is tapped by most of the major wells in the Pensacola area (Wilkins et al. 1985). NAS Pensacola has three supply wells which produce water from this zone; however, due to high iron content in the water, the wells are infrequently used (G & M 1986). The principal sources of water for NAS Pensacola are wells located at Corry Field, approximately

3 miles to the north. The thickness of the main producing zone can be highly variable; however, it is estimated to be up to about 100 feet at NAS Pensacola. Insufficient data exist for wells open to the main producing zone at NAS Pensacola to determine direction of groundwater flow within this zone; however, the flow direction is assumed to be generally southward under ambient conditions. Pumpage of the supply wells would locally cause groundwater in this zone to flow toward the wells.

As a result of the overlying low permeability zone, groundwater within the main producing zone occurs under confined or semiconfined conditions. At one nested well location on NAS Pensacola (east of Building 648), the water level elevation in a well open to the main producing zone is approximately 7 feet lower than that in an adjacent well open to the surficial zone (G & M 1986). This indicates that a significant downward hydraulic gradient exists between these two zones. Thus, a considerable potential exists for vertical groundwater flow from the surficial to the main producing zone at this location. It is not known to what extent this potential exists elsewhere at NAS Pensacola.

7.1.2.2 Intermediate System

The lower limit of the Sand-and-Gravel Aquifer coincides with the top of a regionally extensive and vertically persistent hydrogeologic unit of much lower permeability. This unit is referred to as the Intermediate System. In the vicinity of NAS Pensacola, the top of the Intermediate System generally lies within the sediments termed Miocene Coarse Clastics or corresponds to the top of the Upper Member of the Pensacola Clay and occurs at a depth of approximately 300 feet (Wilkins ~~et al.~~ 1985). In general, the Intermediate System consists of fine-grained sediments and functions as an effective confining unit which retards the exchange of water between the overlying Sand-and-Gravel Aquifer and the underlying Floridan Aquifer System (SEGS 1986). The entire sequence is primarily poor to non-water bearing. However, relatively thin beds of sand which may yield small quantities of water exist within the unit. In the NAS Pensacola area, the Intermediate System is approximately 1,100 feet thick and is composed of the lower portion of the Miocene

Coarse Clastics, the Upper Member of the Pensacola Clay, the Escambia Sand Member of the Pensacola Clay, and the Lower Member of the Pensacola Clay; all are of Miocene Age.

7.1.2.3 Floridan Aquifer System

Immediately underlying the Intermediate System and occurring at a depth of approximately 1,500 feet BLS at NAS Pensacola is the Floridan Aquifer System. The Floridan Aquifer in this area is comprised of the Middle to Laver Miocene Chickasawhay Limestone and undifferentiated Tampa Stage Limestone. Groundwater within the Floridan Aquifer in this area is highly mineralized and is not used for water supply (Uagner et al. 1984).

7.2 Site Hydrogeology

In the immediate vicinity of sites 25 and 27, the surficial zone of the Sand-and-Gravel Aquifer occurs from land surface to a depth of approximately 73 feet. The lithologic description of cuttings collected during the installation of monitoring well GM54, located between sites 25 and 27 (see Figure 2-2), indicates that this zone primarily consists of tan and brown, fine to medium-grained quartz sand. Only one shallow monitoring well open to the surficial zone exists in proximity to sites 25 and 27 (see Figure 2-2). This well (GM02) indicates that the water table in this area occurs approximately 14 feet BLS. Another shallow well (GM01) exists approximately 700 feet northwest of GM02, near the northeast corner of Building 648 and is associated with Site 31. Based on water level data collected from both of these wells (G 6 M 1984) the direction of groundwater flow is generally to the east toward an unnamed creek and Bayou Grande, and the horizontal hydraulic gradient is approximately 0.005. No aquifer tests have been conducted on wells open to the surficial zone in the immediate vicinity of sites 25 and 27. However, G & M (1986) reported results from tests on shallow wells located elsewhere on NAS Pensacola. Hydraulic conductivities ranged from 16 to 57 ft/day, and averaged approximately 30 ft/day. Assuming an effective porosity of 0.20, a groundwater flow velocity for the surficial zone in this area is estimated to be approximately 0.75 ft/day or 274 ft/year.

Immediately underlying the surficial zone in the vicinity of sites 25 and 27 and extending to a depth of approximately 105 feet is the low permeability zone of the Sand-and-Gravel Aquifer. Based on the cuttings from the installation of well GM54, this zone primarily consists of green to gray, sandy, clayey silt with some shell fragments. no monitoring wells open to the low permeability zone exist in the vicinity of sites 25 and 27; however, based on the lithology, this zone would be expected to function as a confining or semiconfining unit restricting the flow of groundwater between the surficial zone and the underlying main producing zone. the direction of groundwater flow within the low permeability zone is unknown.

The top of the main producing zone occurs at approximately 110 feet BLS in the site vicinity and consists of fine-grained quartz sand to a depth of at least 120 feet. Monitoring well GM54 is screened between 109.5 and 114.5 feet and is open to the upper portion of this zone. The water level elevation in well GM54 is approximately 7 feet lower than that in well GM02 (located 30 feet southeast of GM54), indicating a significant downward hydraulic gradient between the surficial zone and the main producing zone in this area (approximately 0.09; G & M 1984). Thus, depending on the vertical hydraulic conductivity of the low permeability zone at this site location, a significant potential for downward groundwater flow from the surficial zone into the main producing zone exists.

The direction of groundwater flow within the main producing zone at these sites is unknown; however, a generally southward flow is expected under ambient conditions. An NAS Pensacola supply well (Well No. 2), located approximately 1,300 feet southwest of sites 25 and 27, is screened between 105 and 160 feet BLS and thus is open to the main producing zone. This well is utilized by NAS Pensacola for backup water supply only during periods of peak demand. However, during these periods of pumping the direction of flow in the main producing zone would be directly toward the supply well. Insufficient data exist for wells open to the main producing zone to allow a determination of hydraulic gradient at NAS Pensacola.

No aquifer test data exist for monitoring wells open to the main producing zone at NAS Pensacola. However, records on file vith the Northwest Florida Water Management District (1985) indicate that Well No. 2 has a specific capacity of 21 gallons per minute per foot (gpm/ft) at a pumping rate of 650 gpm.

8. PROJECT PLAN

The Generic Project Management Plan (GPMP) defines the technical approach and schedule as well as the qualifications of personnel who will be directing and performing this Contamination Assessment/Remedial Activities Investigation. This work plan will incorporate and reference applicable technical and schedule sections, as appropriate, and will follow E & E's project management guidelines (see Section 22).

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9. SITE MANAGEMENT PLAN

The Generic Site Management Plan (GSHP) defines the management procedures for field activities on both the site and program level. The management and implementation of all field activities conducted as part of the Contamination Assessment/Remedial Activities Investigation of sites 25 and 27 will follow the GSHP and any updated versions. Data Quality Objectives (DQOs) and all applicable or relevant and appropriate requirements (ARARs) have been considered in developing the initial phases of fieldwork described here and will be updated and revised for any subsequent phases of fieldwork.

10. HEALTH AND SAFETY PLAN

A comprehensive General Health and Safety Plan (GHSP) and individual site-specific safety plans (SSPs) have been developed to provide readily available emergency information and preventative safety measures. The GHSP outlines health and safety procedures and protocols to be followed during all field investigations at each of the **[39]** sites on NAS Pensacola. The plan includes: standard operating procedures (e.g., site entry and decontamination); hazard communication and training (e.g., safety training, briefings, and documentation); safety equipment and instrumentation (e.g., monitoring and personnel protective equipment); hazard evaluation by contaminant class (e.g., metals and organics); and hazard evaluation for each task (e.g., drilling and sampling). The GHSP will be periodically updated, as required, during the course of this program.

In addition, the GHSP and the individual SSPs will define the toxicological properties and health hazards associated with each site. The SSP will include emergency action information pertinent to the safety of the field personnel and of the public (i.e., hospitals, ambulatory units, poison control centers, fire departments, and police/sheriff departments). The SSP will also identify first-aid and personal safety equipment and will provide recommended site security precautions. The GHSP and the SSP will comply with the Occupational Safety and Health Administration (OSHA) Guidelines for Eazardous Waste Operations (29 Code of Federal Regulations [CF'R) Section 1910).

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11. QUALITY ASSURANCE PROJECT PLAN

A Generic Quality Assurance Project Plan (GQAPP) has been prepared and submitted to the Navy. This comprehensive document will be referenced for all field and laboratory procedures for this program, and will be used to develop the Site-Specific Quality Assurance Plans (SQAPs).

The SQAP will provide site-specific quality assurance/quality control (QA/QC) measures used to obtain accurate and precise data for all site investigation activities. The SQAP will address all phases of the investigation from development of the initial sampling plan through verification and reporting of the analytical results. All of the QA/QC procedures described in the GQAPP and SQAP will be in accordance with. applicable professional technical standards, U. S. Environmental Protection Agency (EPA) requirements, and specific Navy goals and requirements for this project. All samples will collected, handled, packaged, preserved, and transported in accordance with the GQAPP and SQAP and with U.S. Navy and EPA procedures.

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12. AERIAL PHOTOGRAPH ANALYSIS

Prior to the initiation of fieldwork, E & E will examine all available aerial photographs of NAS Pensacola for past and present conditions, features, and developments which may have direct relevance to the fieldwork methodology. The aerial photograph analysis task will involve assembling and stereoscopically analyzing historical photographic imagery and topographic maps available for the site area. For the purpose of supporting the development of field investigation strategies, efforts will be made to obtain photographs of an appropriate scale that will allow for analysis of past and present surface conditions, drainage, and land use. Photographs showing the history of site activities will be analyzed to obtain information regarding the evolution of site features which might have affected hydrologic conditions. The historical perspective gained by studying aerial photographs will provide insight applicable to such tasks as field reconnaissance and monitoring well placement. In addition, the analysis of historical and current aerial photographs, performed in conjunction with geophysical investigation, will aid in the accurate determination of the extent of the formerly used area at the sites.

[Bold items enclosed in brackets denote changes to last version of document]

13. UTILITIES SURVEY

Prior to conducting any augering, boring, drilling, or excavation activities? E & E will locate all underground cables, pipes, utilities? or other obstructions which may become damaged or otherwise hinder fieldwork. The appropriate authorities (e.g., NAS Pensacola Public Works and Southern Bell) will be contacted to identify the location of all underground utilities in the site area. In addition? E & E will examine available maps and documents and conduct a metal detector survey on site to determine the presence of any other potentially hazardous subsurface features. If appropriate and applicable, other surface geophysical techniques may be used to locate deeper obstructions not readily detected with a metal detector. The locations of all underground utilities or obstructions will be marked with surveyors flags, day-glow paint, or by other methods as appropriate. This task may be conducted as part of the physical survey but will be considered a separate task for cost purposes.

14. FIELDWORK METHODOLOGY

Site 27 has been documented to be radioactively contaminated (see sections 2.2 and 3.2). However, the exact extent of removal of contaminated materials (e.g., soils and piping) is not well documented. Consequently, one of the investigative goals for this site is to learn more about the history of this site and the subsequent NEESA-RASO survey and removal actions. Ultimately, the concrete cap over manhole K-7 may have to be removed to allow access to the remainder of the sewer line in that area to check for residual radiation and/or contamination.

All field investigations in the vicinity of sites 25 and 27 will be performed as specified in Section 6.3 (Radiation Surveys) of the GQAPP.

14.1 Phase I--Field Screening

The primary objective of the Phase I field screening investigation is to effectively and efficiently focus the Site Characterization (Phase 11) and subsequent Extent Delineation (phases III and IV) studies. The field screening phase will employ a variety of field investigation techniques, including the collection of samples for laboratory analysis. However, the analysis of these samples will be subject to less rigorous QA/QC requirements, which reflect the "focusing" objective--rather than a formal contaminant quantification objective--of this phase. Each field screening task will utilize all existing information from preceding tasks, including aerial photograph analyses, to adjust the locations of the various surveys and sampling locations, thereby achieving optimum results. The objectives/advantages of the field screening methods are discussed in detail in Section 9.1 of the GQAPP.

14.1.1 Physical *survey*

14.1.1.1 Overall Physical Reconnaissance

Site 25 — A visual survey of the physical characteristics of Site 25 will be conducted as the initial step of the Phase I fieldwork. A thorough walkover of the radium spill area and the vicinity surrounding Building 780 will be conducted by the site investigation team. A preliminary survey of the site will be conducted with a radiation alert instrument to approximate the baseline radioactive level exposure of the field team. Particular attention will be given to locating the exact area in which the radium spill occurred.

The site area will be measured off in order to establish a grid area for later radiation and surface emission surveys as specified in sections 6.1.1 and 6.3.2 of the GQAPP, as well as defining the analytical screening sampling area. The southern and eastern borders of Site 25 are restricted by fenced areas, and access points to the proposed sampling areas located within the fences will be determined at this time.

Compound 1998, which is currently used as a storage area for scrapped helicopter parts, will be visually surveyed to locate staining of the concrete pad and potential surface vater drainage pathways. Areas where helicopter parts may require removal to provide access for sampling will be identified. All information gathered will be thoroughly documented in the site logbook and mapped for future reference.

Site 27 — A visual survey of the physical characteristics of Site 27 will be conducted as the initial step of the Phase I fieldwork sequence. A preliminary survey of the site will be conducted using a radiation alert instrument to gauge the baseline exposure of the field team. A thorough walkover of the Building 709 foundation and the areas adjacent to the former radium dial shop will be performed by the site

investigation team to locate pertinent site characteristics, including existing monitoring wells GM02 and GM54, manholes K-7, K-6, and N-5, drainage ditches, and surface water drainage patterns. The building foundation will be checked for staining and evidence of past spillage.

The Site 27 area will be measured, and a formal grid pattern will be established for later field surveys as described in Section 6.1.1 of the GQAPP. All site information obtained will be thoroughly documented in the site logbook and mapped.

14.1.1.2 Radiation Survey

Site 25 — A gamma scintillation detector will be used to perform an extensive radiation survey of the radium spill site. The detector will be passed over the site at ground level, and any areas having above normal gamma radioactivity will be recorded. The survey will be concentrated on a 25-foot by 25-foot area directly east of Building 780 and in Compound 1998, as this is the approximate vicinity in which the spill was documented to have occurred. A 5-foot center grid pattern will be used to cover the remaining site area.

The instruments will be calibrated as specified in Section 6.3 of the GOAPP, in an area away from the influence of the site. Table 6-1 of the GOAPP lists allowable radiation levels for field personnel as established by E & E standard protocol. All radiation levels will be documented in the logbook and mapped as detected during the survey.

Site 27 — An extensive radiation survey will be conducted over the foundation of former Building 709 (former radium dial shop location) and along the path of the sanitary drain line from manhole K-7 to N-5 (See Figure 14-1). A gamma scintillation detector survey will be conducted at ground level to locate areas with above background gamma radioactivity measurements. The survey will be conducted over the entire surface area of the building foundation and in a 100-foot-square area surrounding manholes K-7, K-6, and N-5. A grid based on 5-foot centers will be used to cover the rest of the ground surrounding the

drainage system. If the manhole covers can be removed, a gamma radiation survey will also be performed in the open manhole with a radiation alert instrument and a gamma scintillation counter.

All instruments will be checked for background levels as specified in Section 6.3 of the GOAPP. Table 6-1 of the GQAPP lists the E & E radiation action levels for exposure of the site investigation team. All radiation levels detected during the survey will be documented in the logbook.

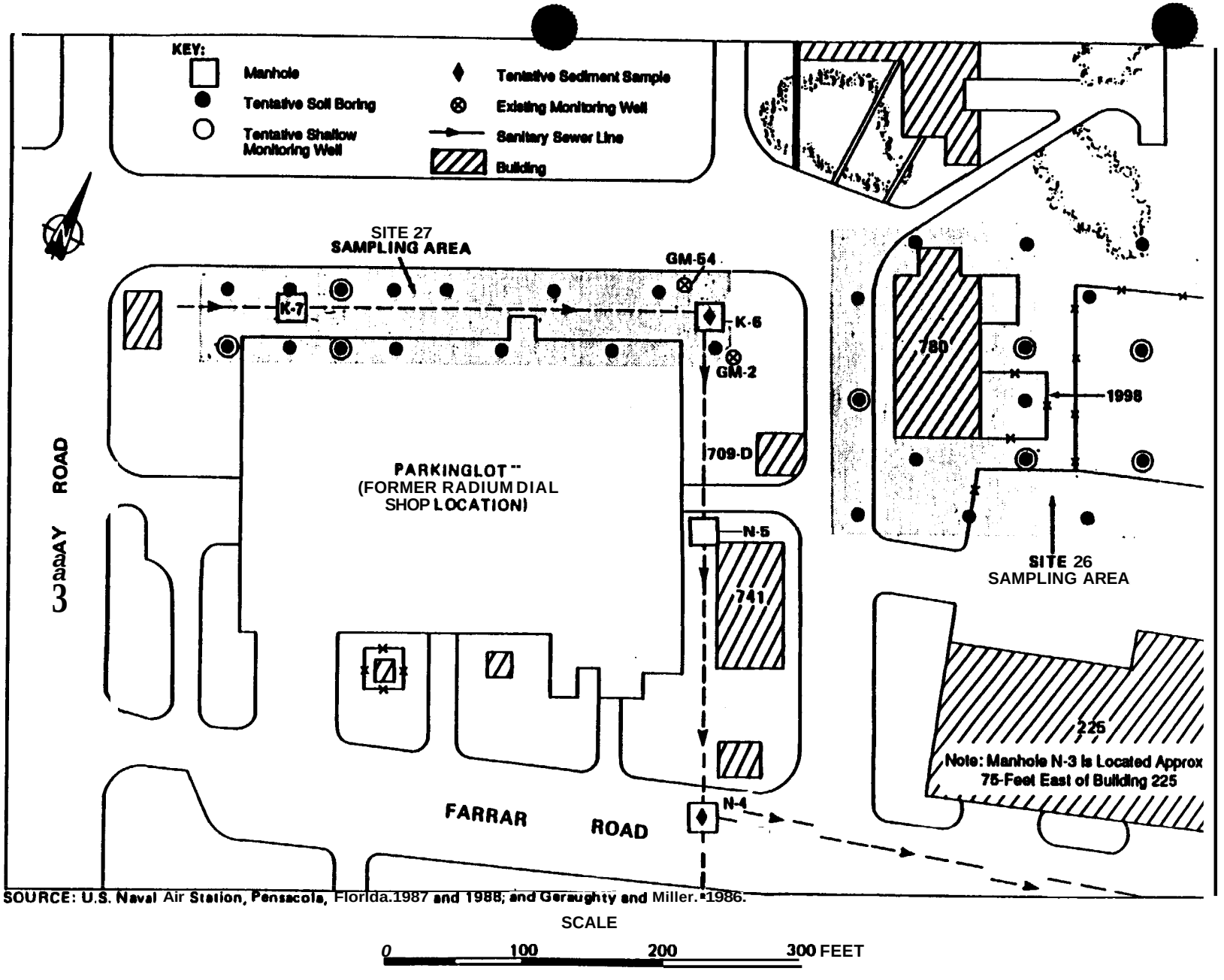
14.1.1.3 HNu/OVA Surface Emissions Survey [and Particulate Air Screening]

A surface emissions survey will be performed to locate any potential sources of volatile soil gases in the Site 25 and Site 27 vicinities. These surveys will be performed as outlined in Section 6.1.1 of the GOAPP.

Site 25 — A surface emissions survey will be conducted at the Radium Spill Area located at the eastern side of Building 780 and in the Compound 1998 area. Special attention will be given to areas where staining of the soil or concrete might have been visually identified. The survey will be conducted on 5-foot grid centers along the east side of the building and on 10-foot centers for the remaining sampling area (see Figure 14-1).

Station locations and detected concentrations will be recorded in the site logbook and mapped in detail. The information generated from this survey will be used as a factor in determining the need for formal air sampling at this site.

Preliminary air screening will be conducted with a particulate monitor, such as a Mini-Ram, to determine if the site represents a source of particulates in the air. The air [screening] will be conducted in accordance with Section 6.1.1 of the GQAPP.



SOURCE: U.S. Naval Air Station, Pensacola, Florida.1987 and 1988; and Geraughty and Miller. 1986.

Figure 14–1 TENTATIVE SOIL BORING AND TEMPORARY MONITORING WELL AND SEDIMENT SAMPLING LOCATIONS, SITES 25 AND 27 – PHASE I

Site 27 — A surface emissions survey will be performed across the exposed soil areas near the northern and eastern perimeters of the foundation from manhole K-7 to manhole N-5 of the sanitary sewer line. Special attention will be given to the sanitary sewer manholes. The survey will be conducted at 5-foot centers in the vicinity of the manholes and at 25-foot grid centers in the remaining sampling area (see Figure 14-1). In addition, a limited survey will be conducted on the foundation by checking for volatile emissions at cracks and joints and surface stains of other locations as appropriate.

Sample locations and detected organic concentrations will be recorded in the site logbook and mapped in detail. The information generated from this survey will be used as a factor in determining the need for a formal air sampling program at this site.

Preliminary air screening will be conducted with a particulate monitor, such as a Mini-Ram, to determine if the site represents a source of particulates in the air. The air [screening] will be conducted in accordance with Section 6.1.1 of the GQAPP.

14.1.2 Geophysical *Survey*

A geophysical survey will be conducted for Site 25 only. Due to the density of cultural features in the Site 27 area, the use of geophysical survey instruments is not feasible and therefore will not be attempted.

At Site 25, an electromagnetic terrain conductivity (EM) survey will be conducted to characterize the subsurface conductivity of the site as a function of an induced magnetic field, following methods described in Section 6.2.2 of the GQAPP. The preliminary survey will be conducted using an EM-31. An *En-34* survey, which has a greater depth of investigation, will be conducted only if an anomalous area which appears to require further investigation has been defined with the EM-31.

At Site 25, this survey data will be used to establish the presence of any contamination plume associated with this site or due to migration

[Bold items enclosed in brackets denote changes to *last* version of document)

from Site 31 (which is located hydraulically upgradient and physically adjacent to Site 25). The proposed grid spacing for the EM-31 survey is anticipated to be 25 feet over the sampling area.

The magnetometer survey will be used to locate buried materials which have magnetic properties including drainage system piping, drums, cylinders, and tanks. As detailed in Section 6.2.3 of the GQAPP, a number of factors can influence the sensitivity of the instrument; therefore, the potential interferences associated with this instrument will be taken into account when establishing a grid pattern and analyzing the resulting survey data. A 25-foot center grid will be used for the survey of the radiation spill area and surrounding investigation area. All detected features will be mapped for future reference.

14.1.3 Analytical Screening

14.1.3.1 Laboratory Analyses

Sites 25 and 27 are considered to be potentially radioactive contamination sites because they are associated with the former radium dial shop facility. All samples collected at these sites will be screened in the field for radiation exposure levels. If a sample is statistically determined to be above background radiation levels, it will be sent to a laboratory prepared to accept and perform analyses on radioactive samples. All samples will be analyzed for gross alpha contamination to determine the presence of alpha emitters potentially associated with radium contamination.

Phase I will require the installation of temporary monitoring wells, groundvater sampling, and soil sampling. Site 27 will also require the collection of three sediment samples. All samples will be analyzed according to the analytical screening program developed for Phase I, as a measure to efficiently and cost-effectively prioritize contaminants for further investigation during later phases of the site characterization. Analytical screening is addressed in detail in Section 9.1 of the GQAPP.

Analytical requirements for samples collected in Phase I are shown in Table 14-1.

Sediment -- Two sediment samples are tentatively proposed to be collected from manhole access locations to the sever at Site 27, as shown on Figure 14-1. Because these manholes are located downstream from the primary discharge point of Building 709 (manhole K-7; see Figure 14-1), which has been found to contain radioactive contamination, other portions of the sewer may also be contaminated; therefore, sediment samples will be collected at manholes K-6 and N-4 or N-3 to confirm the presence or absence of any organic or radioactive contamination. In addition, the sewer outfall will be located, and one sediment sample will be collected. The samples will be obtained by lowering a jar or stainless steel sampling cup into the manholes and drawing the container across the bottom of the outfall to collect sediments that may have deposited out of the drainage system. The process will be repeated until enough sample volume is obtained for analysis. Each sample will be transferred to a clean sample container for shipment to the laboratory.

Soil -- Subsurface soil samples will be taken from 15 borings at Site 25 and 14 borings at Site 27 (see Figure 14-1). Forty-five soil samples will be collected at Site 25, and 42 soil samples will be collected at Site 27. Samples will be obtained by compositing soil over 5-foot intervals to the top of the water table. The depth to water is approximately 15 feet at sites 25 and 27; therefore, it is anticipated that three samples will be collected per borehole.

All soil sampling activities will be conducted in accordance with Section 6.6 of the GOAPP. All sampling equipment including augers, bowls, spoons, and trowels will be decontaminated between each soil sampling interval as specified in Section 6.10 of the GQAPP.

Groundwater -- Five temporary shallow monitoring wells will be installed at Site 25 and three at Site 27. The tentative locations of the shallow monitoring wells are shown on Figure 14-1. Temporary stainless steel

TABLE 14-1

PHASE I SAMPLING AND ANALYTICAL REQUIREMENTS-GROUP G

SITE 25

Medium	no. of Samples	Duplicates	Total	Analytical suite[a,b]
Sediment	3	1	4	A
Soil	45	2	47	A
Groundwater[d]	5	1	6	A
TOTAL	50	3	53	

SITE 27

Medium	No. of Samples	Duplicates	Total	Analytical Suite[a,b]
Soil	42	2	44	A
Groundwater[d]	3	1	4	A
TOTAL	45	3	48	

Medium	No. of Samples	Dupli-cates	Trip Blanks[f]	Field Blanks	Rinsate Blanks	Preservative Blanks[g]	Total.	Analytical Suite [a,c]
Groundwater[e]	2	1	1	1	1	1	7	B

Table 14-1 (Continued)

[a]Analytical suite designations are as follows:

A = Gross alpha, volatile orqanic compounds, polynuclear aromatic hydrocarbons, phenols, pesticides and total PCBs, total recoverable hydrocarbons, metals (total, unfiltered), and pH.

B = Gross Alpha, Radium 226, Target Compound List (TCL) volatile organic compounds plus xylene and ketones, TCL base/neutral and acid oxtractable organic compounds, TCL pesticides and PCBs, total recoverable hydrocarbons; TCL metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered], cyanide, total organic carbon, hardness (water only), and alkalinity (water only).

[b]Specific constituents encompassed by tho various chemical groups included within analytical suite A are identified in Tables 9-1 throuqh 9-4 of the Generic Quality Assurance Project Plan.

[c]Specific constituents encompassed by the various chemical groups included within analytical suite B are identified in Tables 9-5 throuqh 9-13 of tho GQAPP.

[d]Groundwater samples and analytical requirements shown are for Phase I temporary wells only.

[e]Groundwater samples and analytical requirements shown are for existing permanent monitoring wells.

'Trip blanks will be analysed for TCL volatile organics only.

[g]Preservative blanks will be analysed tor TCL volatile organic compounds, total recoverable hydrocarbons, total TCL metals, and cyanide.

monitoring wells will be installed in order to bracket the water table with 5 feet of 0.01-inch slotted screen.

The eight temporary wells and the two existing permanent wells (GM02 and GM54) will be purged and sampled in accordance with Section 6.8 of the GOAPP. Equipment decontamination will be conducted in accordance with GQAPP Section 6.10.

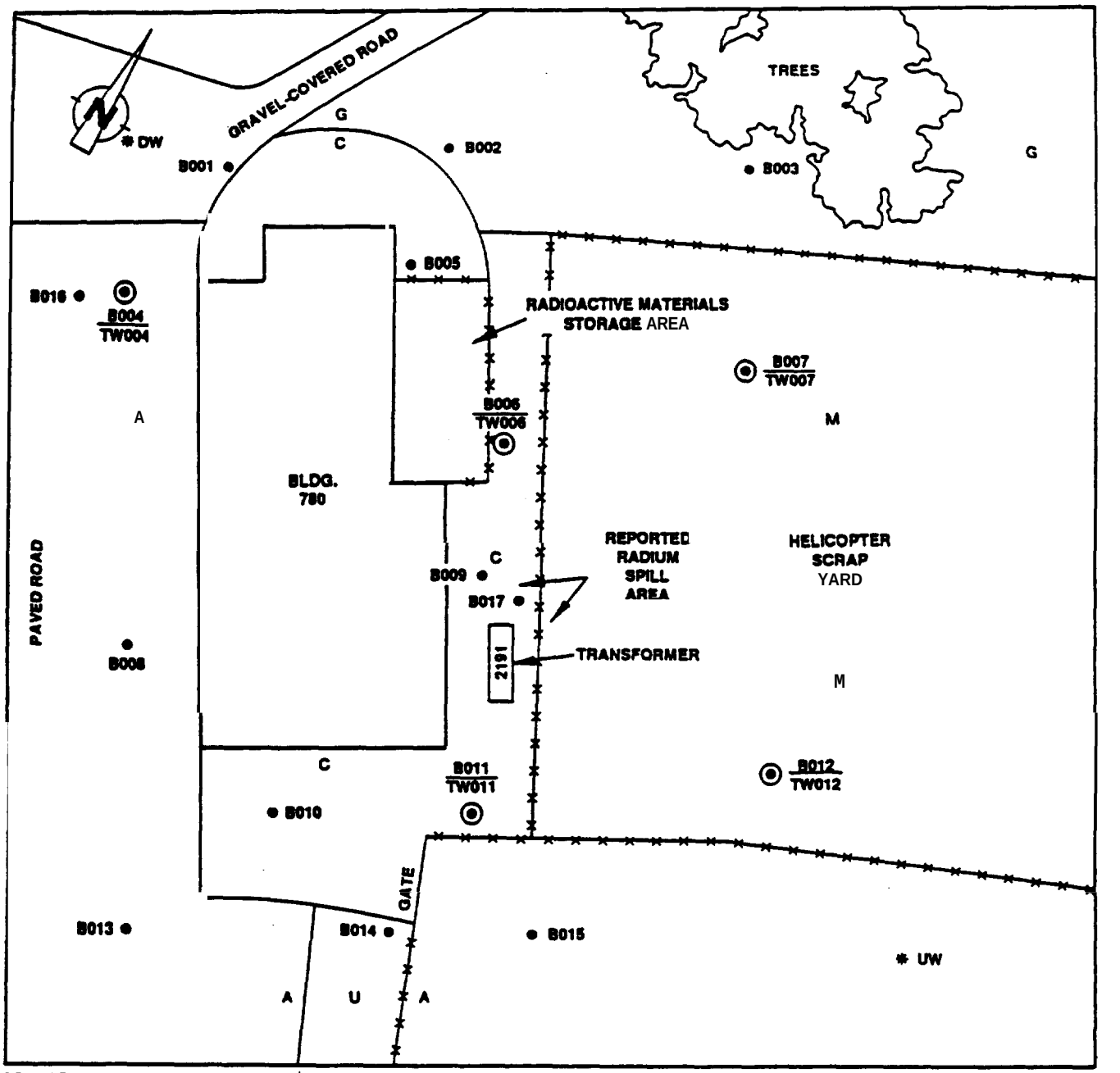
14.1.4 Hydrologic Assessment

The hydrologic assessment will consist of a wellhead elevation survey and water level measurements in the temporary monitoring wells and all existing nearby monitoring wells. One of the wellheads will be assigned an elevation based on an established benchmark in the Site 25 and Site 27 vicinities, and all other wellhead elevations will be referenced to this datum. Water levels will be precisely measured using a steel tape calibrated to hundredths of a foot in order to delineate the prevailing shallow groundwater flow direction and horizontal hydraulic gradient.

Eydrologic data gathered during the Phase I site characterization will be evaluated with respect to geophysical and analytical data to evaluate the potential for any lateral contamination migration and to formulate a rationale for placement of permanent monitoring wells during phases II and 111.

14.2 Phase II--Characterization/Extent Delineation

This section of the Contamination Assessment/Remedial Activities Investigation Work Plan--Group G (Site 25, Radium Spill Area; Site 27, Radium Dial Shop Sewer), Naval Air Station Pensacola, Pensacola, Florida, has been entirely revised to reflect the results of the Phase I activities proposed in the original work plan document (June 1990). The original version (June 1990) of Section 14.2 of this work plan is presented in Appendix D. Figures 14-2 and 14-3 show the actual Phase I sampling locations and location designations. The results of the Phase I investigation of sites 25 and 27 are presented, respectively, in E & E's Final Draft Interim Data Report, Contamination Assessment/ Remedial Activities Investigation, Radium Spill Area (Site 25), Naval



SOURCE: U.S. Naval Air Station, Pensacola, Florida 1991; Ecology and Environment, Inc. 1991

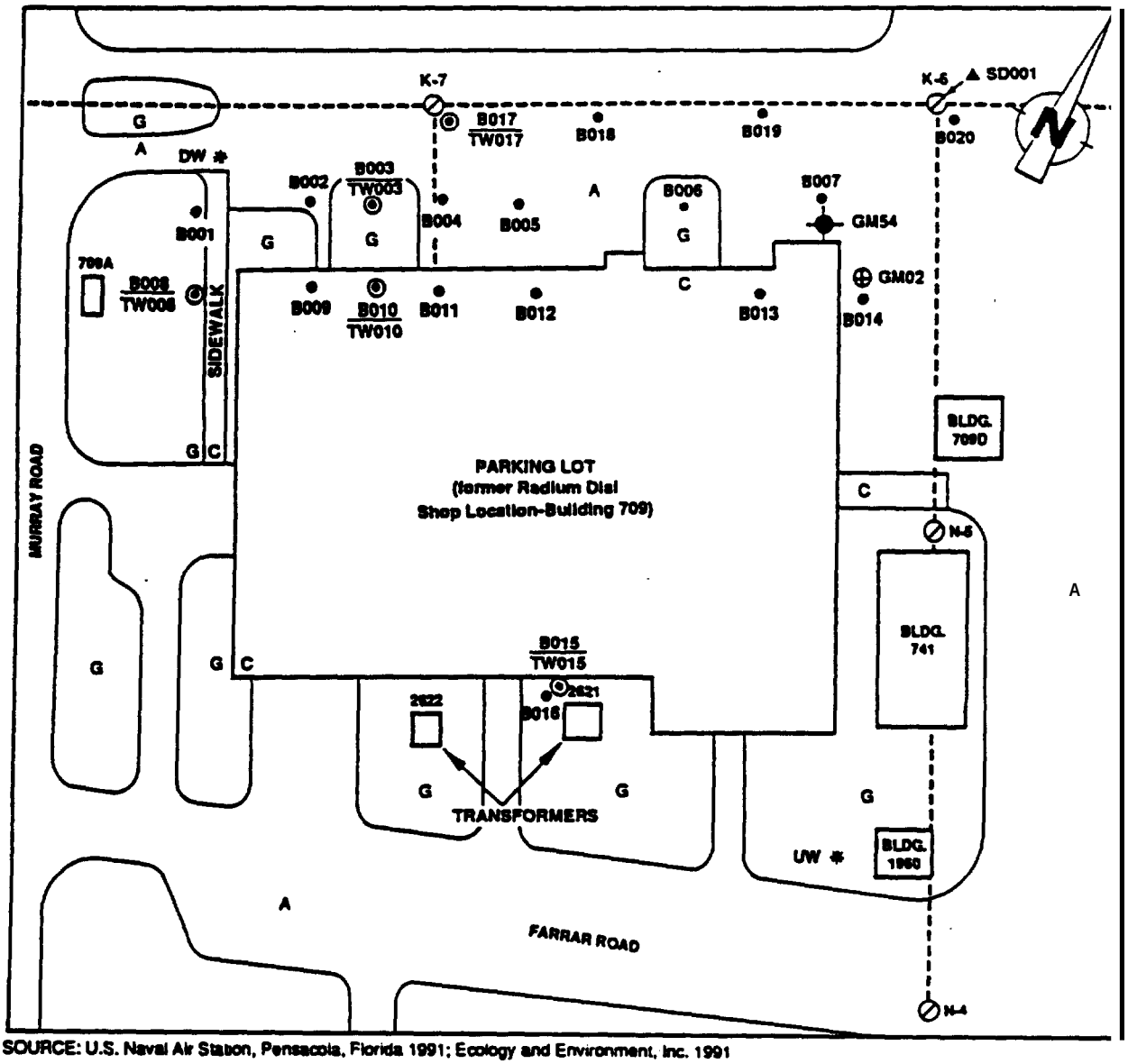
SCALE

0 50 100 FEET

KEY:

BLDG. 780	Building	U	Unpaved Area
	Trees	●	Soil Boring
—✕—✕—	Fence	○	Temporary Monitoring Well
A	Asphalt-Paved Area	B006	Soil Boring Number
C	Concrete-Paved Area	TW006	Temporary Monitoring Well Number
G	Grass-Covered Area	✱	Particulate Air Screening Location
M	Metal-Covered/Unpaved Area	DW/UW	Downwind/Upwind

Figure 14-2 PARTICULATE AIR SCREENING, SOIL BORING, AND TEMPORARY MONITORING WELL LOCATIONS - NAS PENSACOLA SITE 25 - PHASE I



SOURCE: U.S. Naval Air Station, Pensacola, Florida 1991; Ecology and Environment, Inc. 1991

SCALE

0 100 200 FEET

KEY:

A	Asphalt-Paved Area	GM02	Permanent Monitoring Well Number
C	Concrete-Paved Area	●	Soil Boring
G	Grass-Covered Area	○	Temporary Monitoring Well
⊘	Sanitary Sewer Manhole	B003	Soil Boring Number
K-7/N-4	Manhole Numbers	TW003	Temporary Monitoring Well Number
BLDG 709D	Building	*	Particulate Air Screening Location
⊕	Existing Permanent Shallow Monitoring Well	DW/UW	Downwind/Upwind
✦	Existing Permanent Deep Monitoring Well	▲	Sediment Sample
		SD001	Sediment Sample Number

Figure 14-3 PARTICULATE AIR SCREENING, SEDIMENT SAMPLE, SOIL BORING, AND TEMPORARY MONITORING WELL LOCATIONS NAS PENSACOLA SITE 27- PHASE I

Air Station Pensacola, Pensacola, Florida, April 1992; and E 6 E's Final Draft Interim Data Report, Contamination Assessment/Remedial Activities Investigation, Radium Dial Shop Sewer (Site 27), Naval Air Station Pensacola, Pensacola, Florida, April 1992.

In general, the results of E & E's Phase I investigation of sites 25 and 27, reviewed in combination with those of previous investigations of the site (NEESA-RASO 1983; G 6 M 1984, 1986; ABB 1991), indicated the following:

Site 25

- o A potential source of radiation contamination exists, possibly in the soil, in the area east of Building 780; however, the extent of the contamination, if it exists, is **unknown;**

- o Polychlorinated biphenyl (PCB) contamination is present in the area of transformer 2191; however, the extent of the contamination is unknown; and

- o Radium-226 contamination in the groundwater samples obtained from the surficial zone of the Sand-and-Gravel Aquifer may be associated with the former spill or with past and/or present radium dial stripping activities at Building 780.

Site 27

- o Elevated concentrations of radium-226, chromium, and lead, primarily in the near surface soils, were detected in the area between transformer 2621 and the southern edge of the Building 709 foundation at Phase I borings B015 and B016;

- o Elevated concentrations of radium-226, metals, total recoverable petroleum hydrocarbons (TRPHs), VOCs, poly-nuclear aromatic hydrocarbons (PAHs), and phenols were detected in Phase I borings B010 and B011 in the area where the former carburetor shop, degreaser, and cleaning tank were located;

- o Soil contamination does not appear to be present in the area north of Site 27 between buildings 645 and 743;

- o Groundwater samples obtained from the surficial zone of the Sand-and-Gravel Aquifer in the south-central portion of the site (Phase I temporary monitoring well TW015) exhibited concentrations of radium-226, chromium, and lead which

exceed the respective Florida primary drinking water standards, as well as an elevated level of 1,1-dichloroethane; and

- o Shallov groundwater samples collected in the north-central portion of the site (TW010) exhibited concentrations of arsenic and lead exceeding the respective Florida primary drinking water standards, as well as elevated levels of TRPHs, total xylenes, and phenols.

In light of the Phase I results summarized above, the objectives of the Phase II investigations of sites 25 and 27 will be as follows:

Site 25

- o Identify, to the greatest extent possible, the on-site sources of radium-226 and PCB contamination, additional off-site sources of contamination, and potential ambient sources of contamination in the site vicinity;
- o Fully characterize the nature/magnitude and delineate the overall extent of on-site soil and groundwater contamination; and
- o Initiate the Risk Assessment and Feasibility Study for the site.

A full-scale RI/FS will be warranted at Site 25--initially designated a "screening" site.

Site 27

- o Identify, to the greatest extent possible, the on-site sources of radium-226, metals, and organic contamination, additional off-site sources of contamination, and any potential ambient sources of contamination in the site vicinity;
- o Fully characterize the naturelmagnitude and delineate the overall extent of on-site soil and groundwater contamination; and
- o Initiate the Risk Assessment and Feasibility Study for the site.

To meet the above objectives, the Phase II investigations of sites 25 and 27 will include the following elements:

(Bold items enclosed in brackets denote changes to last version of document]

- Contaminant source survey;
- Soil sampling;
- Installation of shallow and intermediate monitoring wells;
- Collection of groundwater samples from all existing (Site 27 only) and newly installed wells;
- Eydrologic assessment; and
- Bngineering survey.

The specific scope of work associated with each of the above elements is described in sections 14.2.1 through 14.2.4. In developing the specific scopes of work, the Phase I and previous analytical results have been evaluated regarding all requirements of the CERCLA and Superfund Amendments and Reauthorization Act (SARA), as well as all other ARARs. For sites 25 and 27, these ARARs include:

- Resource Conservation and Recovery Act (RCRA);
- Clean Water Act (CWA);
- Safe Drinking Water Act (SDWA);
- 40 CFR Parts 264, 265, 270, and 271 (Corrective Action for Solid Waste Management Units at Eazardous Waste Management Facilities; Proposed Rule);
- Chapter 17-550, Florida Administrative Code (FAC; Drinking Water Standards, Monitoring, and Reporting); and
- Chapter 17-770, FAC (State Underground Petroleum Environmental Response).

Formal, quantitative air sampling will not be conducted during Phase II at sites 25 and 27 because no evidence that these sites represent a potential source of airborne volatile or particulate contaminants vas revealed by the Phase I surface emissions survey, particulate air screening, or fieldwork air monitoring activities. However, base-wide biota sampling will be conducted in conjunction with the investigation of operable units (OUs) 15, 16, and 17 (Bayou Grande Area, NAS Pensacola Wetlands, and Pensacola Bay Area, respectively.)

[Bold items enclosed in brackets denote changes to last version of document]

Based on the results of the activities identified above, during Phase II E & E will initiate the appropriate Risk Assessment and Feasibility Study activities. Risk Assessment activities will be directed toward identification of contaminants of concern as well as identification of data gaps that must be eliminated to support the eventual completion of a Baseline Risk Assessment for the sites. If no data gaps are identified, the Baseline Risk Assessment will be completed during Phase II.

Feasibility Study activities, required for sites 25 and 27, will be directed toward identification of data gaps that must be eliminated to support the eventual completion of a comprehensive Feasibility Study for the sites. If no data gaps are identified, the Feasibility Study will be completed during Phase II.

In addition, if warranted, E & E will evaluate the Phase II results to identify whether any interim remedial measures (IRMs) are required and, if so, to develop recommendations for implementation of these IRMs (see Section 14.2.5). IRMs will only be implemented following receipt of EPA approval.

All Phase II investigation activities and results will be discussed in a separate interim data report for each site structured in the required format of a formal draft remedial investigation (RI) report. This Phase II interim data report will provide a complete data synthesis incorporating the results of E & E's Phase I and Phase II investigations, as well as the results of previous investigations. The interim data report will specify whether additional Phase III assessment activities are required, or whether the formal draft RI report for the site can be prepared.

All Phase I investigation activities were completed in accordance with B 6 E's 1990 GOAPP for Contamination Assessments and Remedial Activities at NAS Pensacola. All Phase II investigation activities will be completed in accordance with the newly revised, updated 1992 version of this document. In this section (14.2), all references apply to the 1992 version of the GOAPP.

14.2.1 Contaminant Source Survey

A supplemental contaminant source survey will be performed at sites 25 and 27 to obtain a comprehensive understanding of potential additional contaminant source(s) in the site vicinities. At sites 25 and 27, the contaminant source surveys will include the following:

Site 25

- Identification of any current activities in Building 780 that may be impacting the site;
- Identification of any potential off-site and/or ambient sources of radium-226 groundwater contamination (this radionuclide was detected in the sample from potentially upgradient temporary well TW004); and
- Determination of whether any normal, daily, facility-specific and/or base-wide activities, such as aircraft operations, may have created potential, low-level, ambient sources of TRPE or other contamination.

Site 27

- Identification of the nature of materials that were stored in former radium paint room/equipment building formerly located south of Building 709;
- Identification of activities, materials used, and disposal methods in the former carburetor shop and degreaser area; and
- Determination of whether any normal, daily, facility-specific and/or base-wide activities, such as aircraft operations, may have created potential, low-level, ambient sources of TRPE or other contamination.

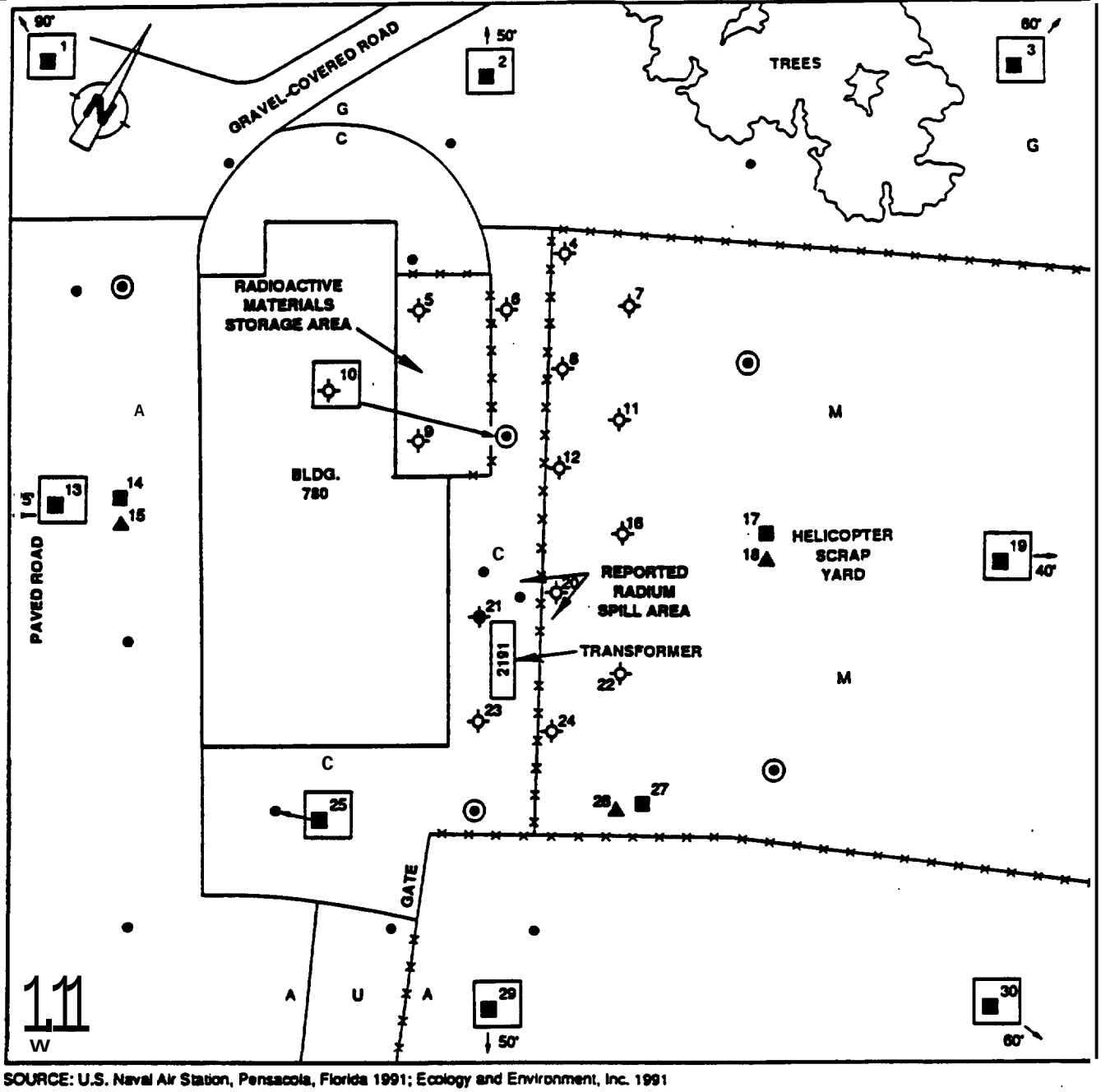
The survey will utilize existing information in NAS Pensacola files, previous investigative reports, and interviews with current and former employees of the NAS Pensacola facility. All background source survey work will be conducted in close communication with the facility Installation Restoration (IR) coordinator as the survey may need to access repositories and/or individuals at several locations among the various tenant commands.

14.2.2 Sampling and Analysis

Figure 14-4 shows the proposed Phase II soil boring and monitoring well locations for Site 25, and Figure 14-5 shows the proposed soil boring and monitoring well locations for Site 27. Tables 14-2 and 14-3 summarize the sampling and analytical requirements, including QA/QC samples, for the Phase II investigations of sites 25 and 27, respectively. Tables 14-4 and 14-5 provide the specific rationale for each proposed Phase II Site 25 soil boring and monitoring well location, respectively, and for the analytical suite associated with each proposed Phase II sampling location. Tables 14-6 and 14-7 provide the specific rationale for each proposed Phase II Site 27 soil boring and monitoring well location, respectively, and for the analytical suite associated with each proposed Phase II sampling location. (Groundwater samples to be collected from the two existing on-site wells and analyzed for suite A [see belov] are not included in rationale Table 14-7.)

The sample location reference numbers listed in tables 14-4 and 14-5 correspond to the location numbers on Figure 14-4, and the sample location reference numbers listed in tables 14-6 and 14-7 correspond to the location numbers on Figure 14-5. The analytical suite designations used in tables 14-4 through 14-7 correspond to the designations defined in tables 14-2 and 14-3.

It is proposed to sample the two Site 27 existing wells for analytical suite A and all Site 27 newly installed wells for the parameters indicated on Table 14-3 during Phase II to provide a uniform, time-synchronous perspective on Site 27 groundwater conditions. This perspective will be critical to properly evaluate the groundwater migration pathway. In addition, during Phase II field activities at NAS Pensacola site groups A through E, soil borings, shallow monitoring wells, and intermediate monitoring wells will be completed at three background locations across the base, and — together with the three existing on-base deep supply wells--sampled for analytical suite A. (Soil samples collected below the water table will be analyzed for Target Analyte List [TAL] metals.) These background locations will help provide a perspective regarding on-site occurrences of potential



SOURCE: U.S. Naval Air Station, Pensacola, Florida 1991; Ecology and Environment, Inc. 1991

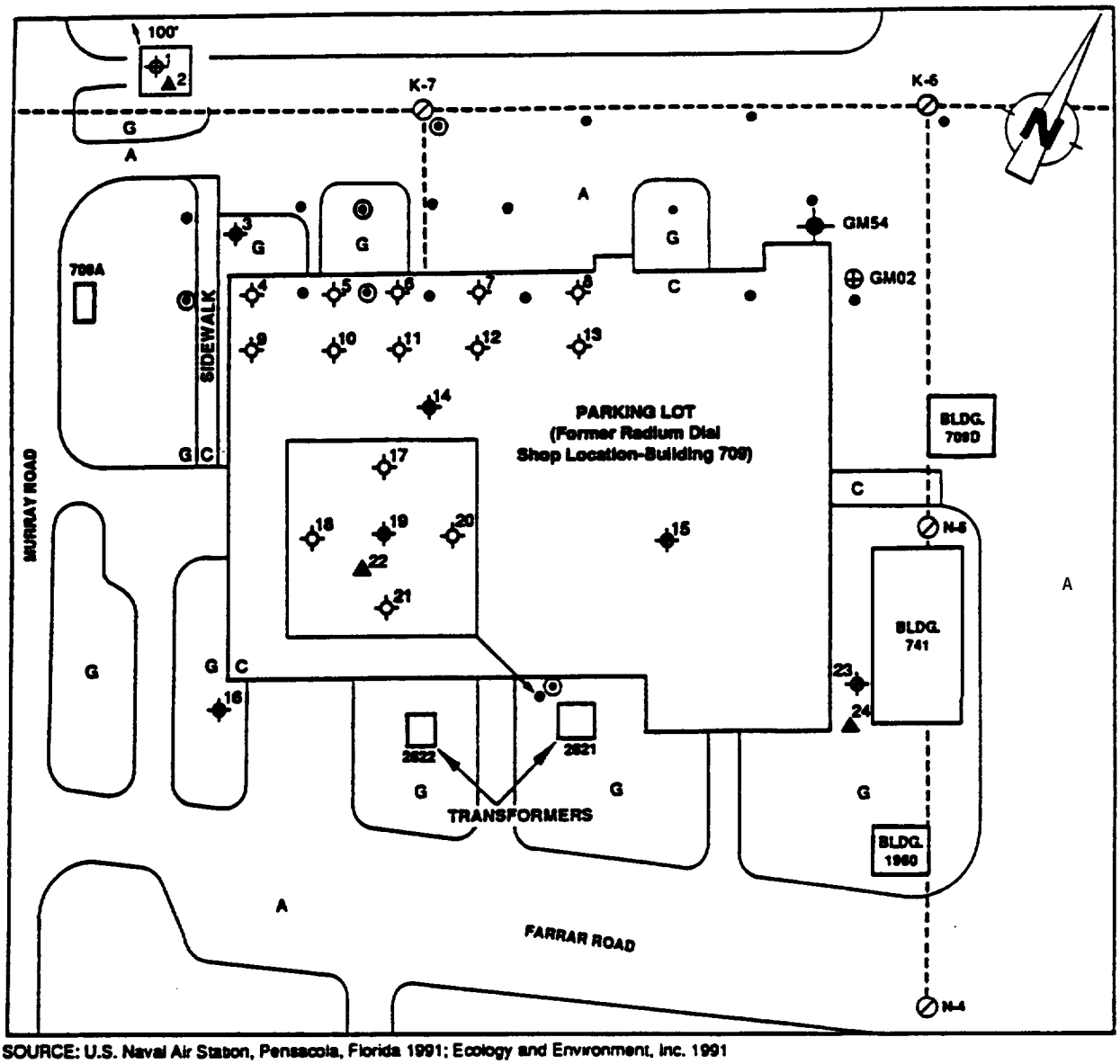
SCALE

0 50 100 FEET

KEY:

BLDG 780	Building	M	Metal-Covered/Unpaved Area	■	Proposed Phase II Shallow Monitoring Well
	Trees	U	Unpaved Area	▲	Proposed Phase II Intermediate Monitoring Well
	Fence	●	Phase I Soil Boring	30	Location Reference Number
A	Asphalt-Paved Area	○	Phase I Temporary Monitoring Well	40'	Approximate Distance and Direction to Location of Proposed Monitoring Well
C	Concrete-Paved Area		Proposed Phase II Soil Boring		
G	Grass-Covered Area		Proposed Phase II Soil Boring and Shallow Monitoring Well		

Figure 14-4 PROPOSED SOIL BORING AND MONITORING WELL LOCATIONS
NAS PENSACOLA SITE 25 — PHASE II



SOURCE: U.S. Naval Air Station, Pensacola, Florida 1991; Ecology and Environment, Inc. 1991

SCALE

0 — 100 — 200 FEET

KEY:

A	Asphalt-Paved Area	⊕	Existing Permanent Shallow Monitoring Well	⌖	Proposed Phase II Soil Boring
C	Concrete-Paved Area	✦	Existing Permanent Deep Monitoring Well	✦	Proposed Phase II Soil Boring and Shallow Monitoring Well
G	Grass-Covered Area	GM02	Permanent Monitoring Well Number	▲	Proposed Phase II Intermediate Monitoring Well
⊘	Sanitary Sewer Manhole	●	Phase I Soil Boring	24	Location Reference Number
K-7/N-4	Manhole Numbers	○	Phase I Temporary Monitoring Well	100'	Approximate Distance and Direction to Location of Proposed Monitoring Well
BLDG 709D	Building				

Figure 14-5 PROPOSED SOIL BORING AND MONITORING WELL LOCATIONS
NAS PENSACOLA SITE 27 — PHASE II

Table 14-2

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS
NAS PENSACOLA SITE 25

Medium	lo. of Samples[a]	Dupli-cates	Trip Blanks[b]	Preservative Blanks[b]	Field Blanks	Rinsate Blanks	Total[a]	Analytical suit.[c,d]
Soil[e]	15	2	1	NR[f]	NR	1	19	A
	60	6	NR	NR	NR	1	66	B
	(35)	NR	NR	NR	NR	--	35)	D
Groundwater[g]	8	1	1	1	1	1	13	A
	8	1	NR	NR	NR	NR	9	C
	(10)	NR	NR	NR	NR	NR	10)	E
TOTAL	91	10	2	1	1	3	107	
	(45)	NR	NR	NR	NR	NR	45)	

14[NASP]UH8000:T0480/1394/10

Key:

[a]The number of samples shown in parentheses will bo analyzed for tho additional parameters indicated.

[b]Trip blank8 will be analyzed for Target Compound List (TCL) volatile organic compounds (VOCs) only. Preservative blanks will bo analyzed for TCL VOCs, total recoverable petroleum hydrocarbons (TRPHs), dissolved Target Analyte List (TAL) metals, and cyanide.

[c]Analytical suite designations are as follows:

A = TCL VOCs; TCL base-neutral/acid oxtractable organic compounds (BNAs); TCL pesticides, and polychlorinated biphenyls (PCBs); TRPHs; TAL metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered], water only): cyanide; gross alpha, beta, and gamma radioactivity: radium-226; total organic carbon: hardness (water only): and alkalinity (water only).

B = Gross alpha, beta, and gamma radioactivity: radium-226: and PCBs only.

C = Gross alpha, beta, and gamma radioactivity and radium-226 only.

D = pH, alkalinity, percent moisture, grain size, BTU content, ash content, total organic halogens, sulfur, ignitability, and cation exchange capacity.

E = Total suspended solids, total Kjeldahl nitrogen (TKN), ammonia nitrogen, orthophosphate phosphorus, dissolved oxygen (in field), 5-day biological oxygen demand (BOD_5), and chemical oxygen demand (COD).

[d]Specific constituents encompassed by tho various chemical groups included within tho above-listed analytical suites are identified in tables 9-5 through 9-13 of the GQAPP.

[e]15 boring locations X 5 depth intervals = 75 samples.

[f]NR = lot required.

[g]16 now wells (13 shallow and 3 intermediate) = 16 samples.

Source: Ecology and Environment, Inc., 1992.

[Bold items enclosed In brackets denote changes to last version of document]

Table 14-3

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS
NAS PENSACOLA SITE 27

Medium	lo. of Samples[a]	Dupli-cates	Trip Blanks[b]	Preservative Blanks[b]	Field Blanks	Rinsate Blanks	Total'	Analytical Suite[c,d]
Soil[e]	126	13	—	NR[f]	NR	5	144	A
	(1)	—	5	NR	NR	—	(1),5	B
	(30)	NR	NR	NR	NR	—	(30)	C
Groundwater[g]	12	1	—	1	2	2	18	A
	(1)	—	2	NR	NR	NR	(1),2	B
	(8)	NR	NR	NR	NR	—	(8)	D
TOTAL	138	14	7	1	2	7	169	
	(40)	NR	NR	NR	NR	NR	(40)	

14[NASP]UH8000:T0480/1395/10

Key:

[a]The number of samples shown in parentheses will bo analyzed for the additional parameters indicated.

[b]Trip blanks will be analyzed for Appendix IX volatile organic compounds (VOCs) only. Preservative blanks will be analyzed for Target Compound List (TCL) VOCs, total recoverable petroleum hydrocarbon. (TRPHs), dissolved Target Analyte List (TAL) metals, and cyanide.

[c]Analytical suite designations are as follows:

A = TCL VOCs; TCL base-neutral/acid extractable organic compounds (BNAs); TCL pesticides, and polychlorinated biphenyls (PCBs); TRPHs; TAL metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered], water only): cyanide; gross alpha, beta, and gamma radioactivity: radium-226 total organic carbon: hardness (water only); and alkalinity (water only).

B = Appendix IX VOCs, BAA., dioxins, pesticides, PCBs, organophosphorus pesticides, herbicides, total metals, cyanide, and sulfide.

C = pH, alkalinity, percent moisture, grain size, BTU content, ash contont. total organic halogens, sulfur, ignitability, and cation exchange capacity.

D = Total suspended solids, total Kjeldahl nitrogon (TKN), ammonia nitrogen, orthophosphate phosphorus, dissolved oxygen (in field), 5-day biological oxygen demand (BOD_5), and chemical oxygen demand (COD).

[d]Specific constituents encompassed by tho various chemical groups included within the above-listed analytical suites are identified in tables 9-5 throuqh 9-13 of the GQAPP.

[e]21 boring locations x 6 depth intervals = 126 samples.

[f]NR = lot required.

[g]2 existing wells + 10 new wells (7 shallow and 3 intermediate) = 12 samples.

Source: Ecology and Environment, Inc., 1992.

[Bold items enclosed in brackets denote changes to last version of document]

RATIONALE FOR PROPOSED PHASE II SOIL SAMPLE LOCATIONS AND ANALYSES NAS PENSACOLA SITE 25

location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
8	AWT	Dotormino presence or absence of contamination in this area.	A	Characterise full spectrum of potential contaminantm.
			D	Support potential site remediation planning activitiom.
20.21	AWT	Elevated levels of PCBs detected in Phamo I moil borings B009 and B017.	A	Characterise full spectrum of potential contaminants.
			D	Support potential site remediation planning activities.
4-1.9-12	AWT	Determine tho presence of potential moil contamination in areas not sampled during Phase I.	B	Radium-226 is of potential concern here. Some potential for PCB contamination exists here.
			D (locations 5, 10, and 11 only)	Support potential site remediation planning activitiom.
16,22,23,24	AUT	Delineate potential outer extent of contamination detected during tho Phamo I sampling.	B	PCB contamination is of definite concern here, and Radium-226 is of potential concern.
			D (location 24 only)	Support potential site remediation planning activitiom.

14[NASP]UH8000:T0480/1307/7

Key:

[a]AUT = Soil samples collected above water table at following intervals (BLS): 0-0.5, 0.5-2.5, 2.5-5, 5-10, 10-15 foot.
[b]Specific parameters included within each analytical suite are given in Table 14-2.

PCB = Polychlorinated biphenyl.

Source: Ecology and Environment, Inc., 1992.

[Bold items enclosed in brackets denote changes to last version of document]

RATIONALE FOR PROPOSED PHASE II MONITORING WELL LOCATIONS AND GROUNDWATER SAMPLE ANALYSES NAS PENSACOLA SITE 25

Location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
1,2,3, 13,19, 28,29,30	SGW	Delineate extent of groundwater contamination detected on Site 25 during Phase I. Locations 1 and 2 are potentially hydraulically upgradient and a11 others are hydraulically downgradiont of Phase I Site 25 contamination.	C E (locations 1 and 28 only)	Determine absence of contamination in thoro areas. Radium-226 and gross alpha, beta, and gamma only of concern here. Support potontial site romodiation planning activities.
14,17,21, 25.27	SGW	Determine presence and nature of potontial shallow groundwator contamination. All wells are hydraulically downgradiont of contamination detected on Site 25 during Phase I.	A E	Characterise full spectrum of potontial contaminants. Support potontial site romodiation planning activities.
15,18,26	IGW	Determine presence and nature of intermediate depth groundwater contamination. Proposed wells are located downgradiont of areas of shallow contamination and are clustered with proposed shallow wells.	A E	Characterise full spectrum of potontial contaminants. Support potontial site romodiation planning activitior.

14[NASP]UH8000:T0480/1341/7

Key:

[a]SGW = Oroundwator sample from shallow monitoring well;
IGW = Groundwater sample from intermediate monitoring well.
[b]Specific parameters included within each analytical suite are given in Table 14-2.

Source: Ecology and Environment, Inc., 1992.

[Bold items enclosed in brackets denote changes to last version of document]

RATIONALE FOR PROPOSED PHASE II SOIL SAMPLE LOCATIONS AND ANALYSES NAS PENSACOLA SITE 27

Location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
1,14,15, 16,23	AWT	Determine tho presence and nature of potential soil contamination in areas not sampled during Phase I.	A	Characterise full spectrum of potential contaminants.
			C (Location 14 only)	Support potential site romodiation planning activities.
3-13,17,18, 20,21	AWT	Delineate potential outer extent of contamination detected during Phase I soil sampling.	A	Characterise full spectrum of potential contaminants.
			C (location. 3, 5, and 10 only)	Support potential site romodiation planning activities.
19	AWT	Confirm contamination detected during Phase I soil sampling in boring 6016.	A	Characterise full spectrum of potential contaminants.
			B (0.5-2.5 foot)	Meet RCRA requirements.
			C	Support potential site romodiation planning activities.

14[NASP]UH6000:T0480/1330/7

Key:

[a]AWT = Soil samples collected above water table at following intervals (BLS): 0-0.5, 0.5-2.5, 2.5-5, 5-10, 10-15, 15-20 foot.
[b]Specific parameters included within each analytical suite are given in Table 14-3.

RCRA = Resource Consotvation and Recovery Act.

Source: Ecology and Environment, Inc., 1992.

[Bold items enclosed in brackets denote changes to last version of document]

RATIONALE FOR PROPOSED PHASE II MONITORING WELL LOCATIONS AND GROUNDWATER SAMPLE ANALYSES NAS PENSACOLA SITE 27

Location Reference Number(s)[a]	Sample Type(s)[b]	Location Rationale	Analytical Suite(s)[c]	Analytical Rational.
1,15,16,23	SGW	Delineate extent of groundvator contamination dotoctod on **site** 27 during Phaso I. Proposed wells either hydraulically upgradiont (Location 1) or across gradient (Locations 15, 16, and 23) of Phaso I Site 27 contamination.	A	Dotormino absence of contamination in these areas or characterize full spectrum of potential contaminants.
			D (locations 1 and 15 only)	Support potential **site** romodiation planning activities.
3	**SGW**	Delineate extent or identify **source** of shallow groundvator contamination dotoctod in Phaso I temporary monitoring well TW010 (metals, TRPHs, VOCs, phenols). Located hydraulically upgradiont from TW010.	A	Characterize full spectrum of potential contamination.
			D	Support potential **site** romodiation planning activities.
14	**SGW**	Dotormino presence and nature of potential shallow groundvator contamination. Well is located hydraulically downgradient of contamination dotoctod in Phaso I temporary monitoring well TW010.	A	Characterize full spectrum of potential contamination.
			D	Support potential **site** romodiation planning activitios.
19	**SGW**	Confirm nature and magnitude of groundwater contamination dotoctod in Phaso I temporary monitoring well TW015 (radium-226, gross alpha, metals, VOCs).	A	Characterize full spectrum **of** potential contamination.
			B	Hoot RCRA requirements.
			D	Support potential **site** romodiation planning activitios.

14[NASP]UH8000:T0480/1342/7

toy at end of table.

[Bold items enclosed in brackets denote changes to last version of document]

Table 14-7 (Cont.)

Location Reference Number(s)[a]	Sample Type(s)[b]	Location Rationale	Analytical Suite(s)[c]	Analytical Rationale
2,22,24	IGW	Determine presence and nature of intermediate groundwater contamination. Proposed wells are clustered with proposed shallow wells.	A	Characterize full spectrum of potential contaminants.
			D	support potential site remediation planning activities.

14[NASP]UH8000:T0480/1342/7

Key:

[a]The two existing wells GM02 and GM54 will also be sampled during Phase II for analytical suite A parameters.
[b]SGW = Groundwater sample from shallow monitoring well; IGW = groundwater sample from intermediate monitoring well.
[c]Specific parameters included within each analytical suites are given in Table 14-3.

TRPHs = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.
RCRA = Resource Conservation and Recovery Act.

Source: Ecology and Environment, Inc., 1992.

[Bold items enclosed in brackets denote changes to last version of document]

contaminants as well as aid in evaluating the impact of potential, base-wide ambient contaminant sources. The collection of these background soil and groundwater samples is discussed in the work plan for Group A--Site 1 (Sanitary Landfill; E & E 1991).

Table 14-3 indicates that one sample from each medium at Site 27 will be additionally analyzed for Appendix IX parameters (analytical suite B). It should be noted that for these samples, analytical suite A analyses will be performed only for parameters not encompassed by Appendix IX (e.g., gross alpha, beta, and gamma radioactivity). Furthermore, it should be noted that trip blanks for sites 25 and 27 will not be analyzed for full analytical suite A parameters, but only for VOCs (Appendix IX VOCs for Site 27 and Target Compound List [TCL] VOCs for Site 25). Finally, it should also be noted that the number of required trip blanks shown on tables 14-2 and 14-3 reflects the total number of trip blanks required for the entire sampling program for each site.

As noted above, tables 14-4 through 14-7 provide specific rationales for proposed Phase II sampling locations and analyses for each site. Sampling locations were selected based on the Phase I results in accordance with one of the following criteria:

- Area of known contamination,
- Area of potential contamination, or
- Known or suspected area of no contamination.

Sampling locations selected according to the first criterion are required to allow identification of the full spectrum of potential on-site contaminants as well as the maximum levels of occurrence. Locations selected according to the second criterion are required to delineate the distribution of contamination on site and in the site vicinity. Locations selected according to the third criterion are required to confirm that the extent of contamination has been completely delineated. The specific, detailed rationales provided in tables 14-4 through 14-7 for each sampling location or group of locations meet one or more of the three general criteria defined above.

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All three of the above criteria must be met to complete a Baseline Risk Assessment and Feasibility Study for the sites. Furthermore, in most instances, meeting the above criteria requires that the collected samples be analyzed for the full suite of parameters in analytical suite A. However, in some cases (e.g., evaluation of potential radium-226 and/or PCB contamination), a more limited analytical program is warranted.

Finally, to support potential remediation planning activities for these sites, selected samples from each medium also must be analyzed for those parameters which directly control the viability of various remedial alternatives (see analytical suites D and E [Table 14-2] and analytical suites C and D (Table 14-3].

14.2.2.1 Soil Sampling

All Phase II soil sampling, compositing, and lithologic logging will be performed in accordance with Section 6.6 of the GQAPP. Equipment decontamination will be performed in accordance with Section 6.10 of the GWP. The number and types of soil field QA/QC samples to be collected during Phase II were determined in accordance with Section 11.1 of the GQAPP.

At soil boring locations where a monitoring well will not be installed, soil borings will be completed using hollow-stem auger methods, and soil samples will be collected using split-spoon samplers in accordance with Section 6.6.2 of the GWP.

Site 25

During the soil boring and shallow monitoring well installation (Section 14.2.2.2), soil samples will be collected at 15 soil boring locations across Site 25 (see Figure 14-4). At each location, composite soil samples will be collected from each of the following depth intervals: 0 to 0.5 foot BLS, 0.5 foot to 2.5 feet BLS, 2.5 to 5 feet BLS, and then every 5-foot interval to the water table. For the purpose of estimating sample numbers, the depth to the water table is assumed to be 14 feet BLS across the site.

The 75 soil samples will be analyzed for the parameters indicated on Table 14-2 (see also Table 14-4).

Site 27

During the Phase II soil boring and monitoring well installation (Section 14.2.2.2), soil samples will be collected at 21 locations across Site 27 (see Figure *14-5).* At each location, composite soil samples will be collected from each of the following depth intervals: 0 to 0.5 foot BLS, 0.5 foot to 2.5 feet BLS, 2.5 to 5 feet BLS, and then every 5-foot interval to the water table. For the purpose of estimating sample numbers, the depth to the water table is assumed to be 16 feet BLS across the site.

The 126 soil samples will be analyzed for the parameters indicated on Table 14-3 (see also Table 14-6).

14.2.2.2 Soil Boring Completion and Permanent Monitoring Well Installation and Development

A total of 16 permanent monitoring wells will be installed at Site 25, and 10 will be installed at Site 27. These wells will be located and designed to supplement the Phase I investigation results regarding the lateral and vertical extents of groundwater contamination. The number and target completion depths of these wells are as follows:

Site 25:

- Thirteen shallow wells, each of which will be approximately 20 feet deep; and
- Three intermediate wells, each of which will be approximately 40 feet deep.

Site 27:

- Seven shallow wells, each of which will be approximately 20 feet deep; and
- Three intermediate wells, each of which will be approximately 40 feet deep.

Figures 14-4 and 14-5 show the locations of the proposed monitoring wells at each site, and tables 14-5 and 14-7 provide a detailed rationale for the selection of each of the monitoring well locations and target depths at each site.

In order to detect the presence of any floating product at sites 25 and 27, the shallow wells will be completed into the upper portion of the surficial zone of the Sand-and-Gravel Aquifer so that the well screen brackets the water table. At sites 25 and 27, the intermediate wells will be installed to investigate the vertical extent of possible groundwater contaminants, particularly any dense nonaqueous phase liquids (DNAPLs). The six intermediate wells will be completed into the lower portion of the surficial zone immediately above the first confining/semiconfining unit. Each of the intermediate wells will be clustered with a shallow well to assist in delineating the vertical extent of any contamination at that location as well as to determine the vertical hydraulic gradients between the monitored zones (see figures 14-4 and 14-5).

All of the shallow and intermediate wells on sites 25 and 27 will be installed using hollow-stem auger methods and constructed of 4-inch-diameter, flush-threaded PVC casing terminating in 10 feet of 0.015-inch, factory-slotted screen.

All drilling and finished monitoring well construction will be conducted in accordance with sections 6.7.2 and 6.7.3 of the GQAPP. In addition, all newly installed wells will be protected above surface grade with a steel surface casing and locking wellhead cover. In paved or heavily traveled areas, the wells will be protected at surface grade with a flush-mount security cover and locking cap.

In conjunction with the drilling of the well boreholes, continuous split-spoon samples will be collected to the target completion depth of each well in accordance with Section 6.7.2.3 of the GQAPP. At sites 25 and 27 where wells are constructed in clusters, split-spoon samples will only be collected during drilling of the deeper well borehole.

After installation, each of the new monitoring wells will be developed using a submersible pump and/or bailer in accordance with Section 6.7.5 of the GOAPP. Development waste will be contained in 55-gallon drums, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy (see also Section 14.6.2).

All drilling equipment will be decontaminated prior to use and between the installation of each well in accordance with Section 6.10 of the GQAPP. All borehole cuttings and drilling fluids will be stored in 55-gallon drums, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy (see also Section 14.6.2).

14223 Groundwater Sampling

Purging and sampling of each well will be performed in accordance with sections 6.8.2 and 6.8.3 of the GQAPP, respectively. Equipment decontamination activities will be performed in accordance with Section 6.10 of the GQAPP. The number and types of groundwater field QA/QC samples to be collected were determined in accordance with Section 11.1 of the GQAPP.

All shallow monitoring wells will be checked for floating and/or sinking immiscible hydrocarbons with an oil/water interface probe. All intermediate monitoring wells will be checked for sinking immiscible hydrocarbons with an oil/water interface probe.

Site 25

During Phase 11, groundwater samples will be collected from the 16 newly installed on-site monitoring wells at Site 25 (see Figure 14-4). The 16 groundwater samples will be analyzed for the parameters indicated on Table 14-2 (see also Table 14-5).

Site 27

During Phase 11, groundwater samples will be collected from the two existing wells and 10 newly installed on-site shallow monitoring wells at Site 27 (see Figure 14-5). The 12 groundwater samples will be

analyzed for the parameters indicated on Table 14-3 (see also Table 14-7).

14.2.3 Hydrologic Assessment

The main objective of the Phase II hydrologic assessment is to further delineate the hydrogeologic character of the underlying aquifer at sites 25 and 27. Slug and short-term specific capacity tests, rather than a long-term pump test, have been proposed for Phase II because the location and distribution of contaminants in the various zones of the underlying aquifer have not yet been precisely identified. The hydrologic assessment at sites 25 and 27 will include a wellhead elevation survey of all the newly installed permanent monitoring wells; static water level measurements in all the on-site wells and short-term specific capacity and/or slug tests on all the newly installed permanent wells.

All of the newly installed monitoring wells will be surveyed during the engineering survey (Section 14.2.4) and referenced to a USGS benchmark, in accordance with Section 6.7.6 of the GQAPP.

At sites 25 and 27, static water levels will be measured in all the existing and proposed on-site wells on at least four occasions: once during the sampling of the newly installed wells; once approximately two to four weeks after sampling to obtain an estimate of the short-term temporal variability in water levels; once during a low tidal phase; and once during a high tidal phase. The measurements taken during opposing tidal phases will be collected on the same day in order to accurately evaluate tidal influences on water level elevations at these sites.

Limited aquifer testing will be conducted on all newly installed monitoring wells. This testing will consist primarily of performing short-term specific capacity tests on wells that are capable of sustaining a measurable yield. The specific capacity testing at sites 25 and 27 will be conducted during the development of the newly installed wells. The procedure for specific capacity testing involves aeasuring the initial static water level in the well and then withdrawing groundwater from the well at a constant rate for a

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designated period. The sustained water level during pumping is then noted, and the pump is turned off. The water level recovery in the well is then recorded continuously over time until the water level equilibrates to the initial static level. In addition to measuring drawdown in the developing well during the specific capacity testing, water levels will be measured in adjacent shallow and/or intermediate monitoring wells to determine the extent to which the respective, monitored zones may be hydraulically connected.

Injection or withdrawal-type slug tests will be performed on nevly installed wells that are not capable of sustaining a measurable yield. The procedure for slug testing involves measuring the initial static water level in the well and then injecting or withdrawing a known volume from the well, using a solid stainless steel cylinder, to create an instantaneous change in water level. The water level is then recorded continuously over time until the water level equilibrates to the initial static level.

The purposes of the specific capacity and slug testing are to obtain site-specific, first estimate values for hydraulic conductivity (K), transmissivity (T), and groundwater flow velocity (V) for each of the monitored depth zones. During each of these tests, a calibrated tape and/or electronic data logger will be used to monitor and record the water levels in the well(s) being tested or observed.

A rain gauge will be installed at or near the sites and monitored regularly during the fieldwork.

14.2.4 Engineering *Survey*

A comprehensive engineering survey will be conducted to accurately identify all site sampling locations and cultural and topographic features. All sampling and monitoring well locations will be identified both horizontally and vertically. In addition, any utilities, above-ground structures, and improvements (such as pavement) will be located. Any pertinent information found during the contaminant source survey (Section 14.2.1) will be incorporated into this survey. The survey also

will delineate topographic variability using contour intervals of 2 feet.

All engineering survey information will be integrated with any existing computer-aided design (CAD) base maps so that all updated, site-related information can be precisely and efficiently added to the base map. The development of a CAD base map will include the addition of previous data point locations (i.e., coordinates of latitude and longitude). The survey drawing will be produced in mylar and blueline copies; the CAD file for the drawing will be kept on diskette.

14.2.5 Interim Remedial Measures

During the field investigation, circumstances on site may require IRMs. IRMs will be initiated on a case-by-case basis and only following receipt of EPA approval. Rapid response will be emphasized. An IRM could involve the installation of security fences and warning signs; construction of berms, caps, and/or recovery and treatment systems; and removal of soil, sediment, and/or drums. If an IRM is conducted, a detailed, explanatory report of the IRH will be developed by E & E and provided to the Navy and EPA.

14.2.6 Report

Refer to Section 20 of this work plan (revised April 1992) for a description of the Phase II report.

14.3 Phase III—Extent Delineation

Phase III tasks will be conducted, [if deemed necessary] based on the results of phases I and II. Although the earlier phases are intended to identify and characterize the areas and contaminants of primary concern, Phase III activities will be geared toward further delineation of horizontal and vertical extents of contamination.

14.3.1 Soil Sampling

Soil sampling will be conducted in conjunction with any new shallow, intermediate, or deep monitoring well installations.

14.3.2 Shallow Monitoring Well Installation and Development

Additional monitoring wells may be required to further delineate the horizontal extent of groundwater contamination.

14.3.3 Intermediate and Deep Monitoring Well Installation and Development

The installation of additional monitoring wells into deeper zones of the aquifer may be required in order to assess horizontal and vertical hydraulic gradients, aquifer physical characteristics, and vertical extent of contamination. The number of wells and their locations and depths are dependent upon the findings of phases I and II.

14.3.4 Groundwater Sampling

All wells installed in Phase III will be sampled, and the analytical requirements for the samples will be developed based on the results of previous phases. Monitoring wells installed prior to Phase III will be resampled as required.

14.3.5 Hydrologic Assessment

All wells installed during Phase III will require a wellhead survey to obtain top of casing (TOC) elevations. Water level measurements will be made for all site monitoring wells and nearby surface water bodies. Horizontal and vertical hydraulic gradients will be determined. Aquifer testing will be performed, as required, to determine aquifer physical characteristics. On sites where contamination is found in the surficial zone during phases I and/or 11, the low permeability zone will be further characterized during Phase III and any subsequent phases. It is intended that soil sample results, lithologic logs, isopach maps, Permeability testing and aquifer testing will be utilized as required to determine the lateral extent and/or continuity of the low permeability zone, as well as the degree to which hydraulic connection exists between the surficial zone and underlying main producing zone at each site.

[14.3.6 Engineering Survey

A comprehensive engineering survey will be conducted to accurately identify all new site sampling locations. All sampling and monitoring

[Bold items enclosed in brackets demote changes to last version of document]

well locations vill be identified both horizontally and vertically. In addition, any improvements (such as pavement) will be located. All engineering survey information will be integrated vith the existing Phase II computer-aided design *(CAD)* base maps so that all updated, site-related information *can* be precisely and efficiently added to the base map. The survey draving vill be produced in mylar and blueline copies; the CAD file for the draving will be kept on diskette.)

14.3.[7] Air Sampling

The need for formal air sampling during Phase III and the techniques to be employed are dependent upon the findings of phases I and 11.

14.4 Phase IV--Extent Delineation

The following tasks, if required, will be performed as a continuation of the effort to delineate the extent of contamination:

- Soil sampling;
- Shallow monitoring well installation and development;
- Intermediate and deep monitoring well installation and development;
- Groundwater sampling;
- Eydrologic assessment; [and
- Engineering Survey.]

14.[5] Field Quality Assurance/Quality Control

14.[5].1 Documentation

Field activities and sample management will entail certain strict documentation requirements as described in Section 7 of the GQAPP.

14.[5].2 Field Quality Assurance/Quality Control Samples

Samples collected for laboratory analysis (both screening and non-screening) during all phases of fieldwork will require the preparation of field QA/QC samples as described in Section [11.1] of the GQAPP. The

estimated numbers of required field QA/QC samples for phases I and II are shown in tables 14-1 and *14-2.*

14.[6] Decontamination and Waste Management Procedures

14.[6).1 Decontamination Procedures

All equipment decontamination procedures for sites 25 and 27 will be performed in accordance with Section 6.10 of the GQAPP.

14.[6].2 Waste Management Procedures

[All investigation-derived vaste handling vill be performed in accordance with Section 6.11 of the GQAPP and EPA's guidance for investigation-derived vaste.] All water generated during monitoring well purging and development activities on sites 25 and 27 will be discharged onto the ground surface away from the well or will be containerized, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy.

Any excess soil auger cuttings generated by soil boring or monitoring well installation activities will be containerized, labeled, and moved to a storage area on NAS Pensacola, as directed by the Navy.

Other investigation-derived wastes, such as potentially contaminated clothing and disposable materials, will be containerized, labeled, and moved to a storage area on NAS Pensacola.

15. LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

Laboratory QA/QC procedures are designed to ensure the accuracy, precision, completeness, representativeness, and comparability of all analytical data. Laboratory QA/QC has been addressed both in the GQAPP and GSHP. All phases of fieldwork will incorporate a different level of data quality and requisite laboratory QA/QC. These levels are discussed in detail in the GQAPP and GSHP.

16. GROUNDWATER MODELING

E & E will use the data generated in the previous field investigation phases to conduct limited computer modeling when applicable and appropriate. The following two scenarios will be considered to assess the potential for off-site contamination:

- Estimated future plume movement without any remedial action effects (i.e., no action); and
- Estimated total time periods required, for a total contaminant mass at variable pumping rates, to extract contaminants from the aquifer in order to meet previously established standards for drinking water (ARARs).

E & E will use the two-dimensional analytical RANDOMWALK model (Prickett et al. 1981) to arrive at these estimates. E & E will calculate flow velocity field input data for the solute transport simulation from a simplified model based on Darcy's Law. E & E will utilize parameters including transmissivity, storativity, and hydraulic conductivity from the previous phases of fieldwork.

To obtain a prediction of plume extent without remediation, E & E will illustrate organic and inorganic simulations for the current time and for one, five, and ten years into the future. Additional simulations will include different remedial pumping scenarios for both organic and inorganic contamination. E & E then will use information generated by these computer simulations for remedial alternative development. Other computer models that can be utilized to assess on-site groundwater conditions include: PLASM, a two-dimensional, finite-difference groundwater flow model; GWTRANS, a two-dimensional, finite-difference solute transport model; FEMWATER, a finite-element groundwater model; and FEMWASTE, a finite-element solute transport model.

17. TREATABILITY STUDY

As indicated in tables 14-2 and 14-3, a number of the analyses to be performed on the samples collected during phases II through IV are required in support of the treatability study. Characterization of samples in terms of parameters listed in tables 14-2 and 14-3, together with treatability tests, will provide the basic data required for the evaluation of physical, chemical, and biological remedial technologies. Some of the treatability tests that may be examined are incineration tests, solubility tests, soil leaching tests, and coagulation-flocculation jar tests.

[Bold items enclosed in brackets denote changes to last version of document]

18. BASELINE RISK ASSESSMENT

As part of the Remedial Activities Investigation, a baseline risk assessment will be conducted to determine the level of effort required in the FS for remedial actions. The baseline risk assessment will provide an evaluation of the potential threat to human health and the environment in the absence of any remedial action by providing the basis for determining vhether or not remedial action is necessary and the justification for performing any remedial actions.

The baseline risk assessment identifies and characterizes the toxicity and levels of hazardous substances present in the media of concern (e.g., air, groundvater, soil, surface water, sediment, or biota), the environmental fate and transport mechanisms within the media of concern (e.g., physical, chemical, biological degradation processes, and hydrogeological conditions), the potential human and environmental receptors, the potential exposure routes and the extent of actual or expected exposure, the extent of impact or threat (i.e., risk characterization), and the level or levels of uncertainty associated with all of the above. The complexity of the site will determine the level of effort required to conduct the baseline risk assessment. The conclusions of the baseline risk assessment will determine the level of effort required in the risk assessment to be conducted in the FS.

The baseline risk assessment can be divided into four tasks: contaminant identification? exposure assessment, toxicity assessment, and risk characterization.

18.1 Contaminant Identification

The main purpose of this step is to screen available information on the hazardous wastes present at the site and to identify contaminants of concern to focus on in subsequent efforts in the risk assessment process. It may be useful at some of the NAS Pensacola sites to select "indicator chemicals" to represent the most toxic, persistent, and/or mobile substances among those identified that are most likely to contribute significantly to the overall risk posed by the site. Sometimes this indicator chemical can be selected to represent a "class" of chemicals (e.g., trichloroethylene to represent all volatiles).

18.2 Exposure Assessment

In this subtask, actual or potential pathways are identified, populations potentially exposed are characterized, and the extent of exposure is determined. Identification of potential exposure pathways helps to conceptualize the migration of contaminants from an existing source to an existing or potential point of contact. An exposure pathway may be viewed as identifying four elements:

1) A source mechanism of chemical release into the environment;
2) An environmental transport medium (e.g., air, groundwater, or biota);
3) A point of potential contact with the medium of concern; and
4) An exposure route to the population from the contact point.

The purpose of this analysis is to provide decision makers with an understanding of both the current and potential future risks if no action is taken. Therefore, as part of this evaluation, a reasonable maximum exposure scenario should be developed to reflect the type(s) and extent(s) of exposures that could occur based on the expected future use of the site.

The final step in the exposure assessment is to integrate the information and develop a qualitative and/or quantitative estimate of the expected exposure levels resulting from the actual or potential release of contaminants from the site.

[Bold items enclosed in brackets denote *changes* to last version of document]

18.3 Toxicity Assessment

This step considers: (1) the types of adverse human or environmental effects associated with contaminant exposure; (2) the relationship between the magnitude of exposure(s) and the adverse effects; and (3) related uncertainties such as the evidence for a chemical's potential carcinogenicity in humans. Typically, this process relies heavily on existing toxicity information and rarely involves the development of new data on toxicity or dose-response relationships.

18.4 Risk Characterization

In the final stages of the baseline risk assessment, a characterization of the potentially adverse effects to human health or environment of each scenario derived is developed and summarized. By integrating information developed during the exposure and toxicity assessments, estimates of risk can be developed to include carcinogenic risks, noncarcinogenic risks, and environmental risks. To characterize environmental risks, the potential exposures to the surrounding ecological receptors must be identified, and the potential effects associated with such exposure(s) must be determined. Important factors to examine include disruptive effects to populations (plant and animal) and the extent of perturbations to the ecological community. In addition, the Integrated Risk Information System (IRIS) will be utilized.

The following data will be obtained for each site as part of the baseline risk assessment:

- Distance to the closest residence (on or off NAS Pensacola);
- Type of barrier, if any, to prevent access;
- Approximate population within 0.25 mile of the site (including NAS Pensacola);
- Sensitive land uses in the vicinity of the site (e.g., schools, hospitals, and retirement homes);
- Activities (recreational and/or occupational) which take place near the sites and the estimated number of people involved;

- Records of any environmental and/or health complaints regarding the sites; and
- Log of any actions taken by a health unit regarding health issues, complaints, and concerns.

The results of the baseline risk assessment **may** indicate that the site poses little or no threat to human health or the environment. In such cases, the PS should be appropriately scaled down or eliminated. The results of the Remedial Activities Investigation and baseline risk assessment will serve as the primary basis of documenting a no further action decision.

It should be emphasized that all the tasks conducted as part of the baseline risk assessment will be performed on an interactive basis between the various disciplines required (e.g., hydrogeologists, chemists, and risk assessors), the Navy, and the reviewing regulatory agencies (i.e., FDER and EPA) and that the goal of these tasks is to produce appropriate, sufficient, and high quality data to complete the baseline .risk assessment.

19. FEASIBILITY STUDY

Further details on the specific tasks to be performed as part of the FS will be described in detail during the update of this work plan after the initial phases of the'fieldwork have been completed. However, it is anticipated that if contamination of some degree is identified on site, the general approach described below will be followed.

As part of the initial scoping activities of the FS, E & E will prepare a summary of field data collected during the RI to compare and evaluate the concentration of the contaminants of concern against the cleanup criteria developed. E & E will prepare a qualitative and quantitative summary of contamination for the scenarios identified during risk assessment evaluation. Results of this evaluation will serve as a basis for the screening of applicable remedial technologies for the development and evaluation of remedial action technologies.

19.1 Screening of Applicable Remedial Technologies

E & E will screen and develop applicable technologies for the remediation of any on-site contamination. In the process of screening applicable technologies, E & E will consider all ARARs, identify problems, and determine pathways of contamination using a receptor-oriented approach based on the threat to the public health, welfare, and the environment. In this summary, pathways will be outlined for each medium of concern. E & E then will identify applicable remedial technologies for each general response action such as contaminant removal, treatment, disposal, and so on. The identification of technologies will be based on technical selection criteria and E & E's engineering judgment.

19.2 Assessment of Applicable Remedial Technologies

During the assessment process, E & E will consider the relative applicability of each technology. In addition, criteria such as environmental, institutional, and public health impacts, and technical feasibility will be applied. A discussion of the applicable technologies will be provided for each general response action. The summary will include comments as appropriate concerning the reliability and implementability of the technology.

19.3 Risk Assessment

Based on the results of the baseline risk assessment conducted during the Remedial Activities Investigation, E & E will perform a detailed risk analysis to determine the acceptable levels of risk. This will allow the Navy to balance the increase in costs associated with each alternative against gains in safety. The risk analysis will include consideration of site contaminant toxicity, transport mechanisms, persistence in the environment, and impacts on human health and the environment.

19.4 Development and Evaluation of Remedial Action Alternatives

During the preceding task, remedial technologies will be assessed independently without considering potential advantages or disadvantages of technologies applied in combination. In this task, individual technologies will be assembled into remedial action alternatives for the site. During the assembly and evaluation of the action alternatives, criteria including technical feasibility, environmental and public health, institutional impacts, and comparative costs will be considered.

19.5 Selection of Recommended Remedial Action Alternatives

During this task, E & E will select a single remedial action alternative for the remediation of the site. The alternatives assembled during the preceding task will be compared using technical, environmental, and economic criteria. E & E will consider present worth of total costs, environmental effects, technical aspects, the extent to which alternatives comply with ARARs, community effects, and other factors.

E & E will apply these evaluation criteria uniformly to each alternative along with any additional criteria that may result from the Navy project coordination. E & E will discuss the selection of the chosen alternative by means of a statement of the relative advantages of the alternative over the other alternatives considered.

19.6 Feasibility Study Report

A draft and a final FS report will be provided to the Navy for review and comments.

20. REPORT

Following the Phase I investigation, E 6 E will prepare a Phase I Data Report for each site. The purpose of this report is to summarize the findings of Phase I and provide recommendations for the Phase II investigation; the Phase I interim report will not be a formal report. (In general, during the proposed multi-phase investigation process, formal reports will be generated only when little or no additional assessment work appears to be required.) Following the Phase I interim report, the work plans for the Phase II work will be updated accordingly. If the results of Phase II indicate that no further action is warranted, a formal [RI] report will be produced. Eowever, if the Phase II results indicate that additional investigation is required, the Phase II report will be produced as the Phase II Interim Data Report and will only briefly summarize the Phase II results and provide recommendations for the Phase III investigation. Thus, the Phase II interim report will not be a formal document. Following production of the Phase II interim report, the work plans for the Phase III work will be updated. [Once the Phase III work is complete, all results will be synthesized and presented in an RI report.

In addition, following any treatability studies and FS work, formal reports will be produced for these efforts. These reports will include detailed narratives associated with the respective tasks.

For all reports, B & B will prepare a 100% draft report for the Navy and Technical Review Committee (TRC) reviev. The TRC reviev comments will be incorporated into draft final reports which will be resubmitted to the TRC for final approval. The draft final report will then become final if no further comments are received from the TRC.]

[Bold items enclosed in brackets denote changes to last version of document]

Each report will be written as an independent document, complete in its own right, and fully supportive of the conclusions that it contains. Where appropriate, public participation issues will be summarized, as will interim remedial measures necessary to protect against continued degradation of conditions at the site(s). Information used in analyses, but supplemental to the analytical results, will be provided in a series of appendices.

Monthly progress reports during all field activities will be submitted to keep the Navy apprised of fieldwork status and site conditions. Current and planned activities as well as cost tracking will be provided.

21. DOCUMENT REVISION

Periodic updating of all administrative documents (GOAPP, GSHP, GESP, GPMP, and work plans) will be necessary due to changes in site conditions and/or program conditions or requirements. The schedules shown in the GPHP and GSHP indicate document revisions approximately every two months for the GOAPP, GSHP, GESP, and GPMP. Work plans will be revised after each phase of fieldwork, with phases III and TV, if required, fully developed after Phase II with separate cost estimations. Revised documents will undergo the same review process (e.g., Navy and TRC) as the original documents.

22. PROJECT MANAGEMENT

Project management will be an ongoing process throughout this investigation. This process includes preparation of biweekly project status reports, coordination of schedules, mobilizations, and other project incidentals vith the Navy, management of project staff, coordination with the E & E support groups (e.g., publications and laboratory), and ongoing project review by E & E technical managers and directors. These project management steps are described in detail in the GPMP submitted to the Navy.

23. PROJECT SCHEDULE

Figures 23-1, 23-2, 23-3, and 23-4 show the project schedules for phases I, 11, III, and IV, respectively. Given that the scopes of work for Phase II and beyond are dependent on the results of the preceding phases, the project schedules for phases II, 111, and IV are tentative. In addition, the length of time between phases is subject to the schedule in the Federal Facilities Agreement Site Hanagement Plan (FFA SMP). The schedule in the FFA SHP will be updated yearly.

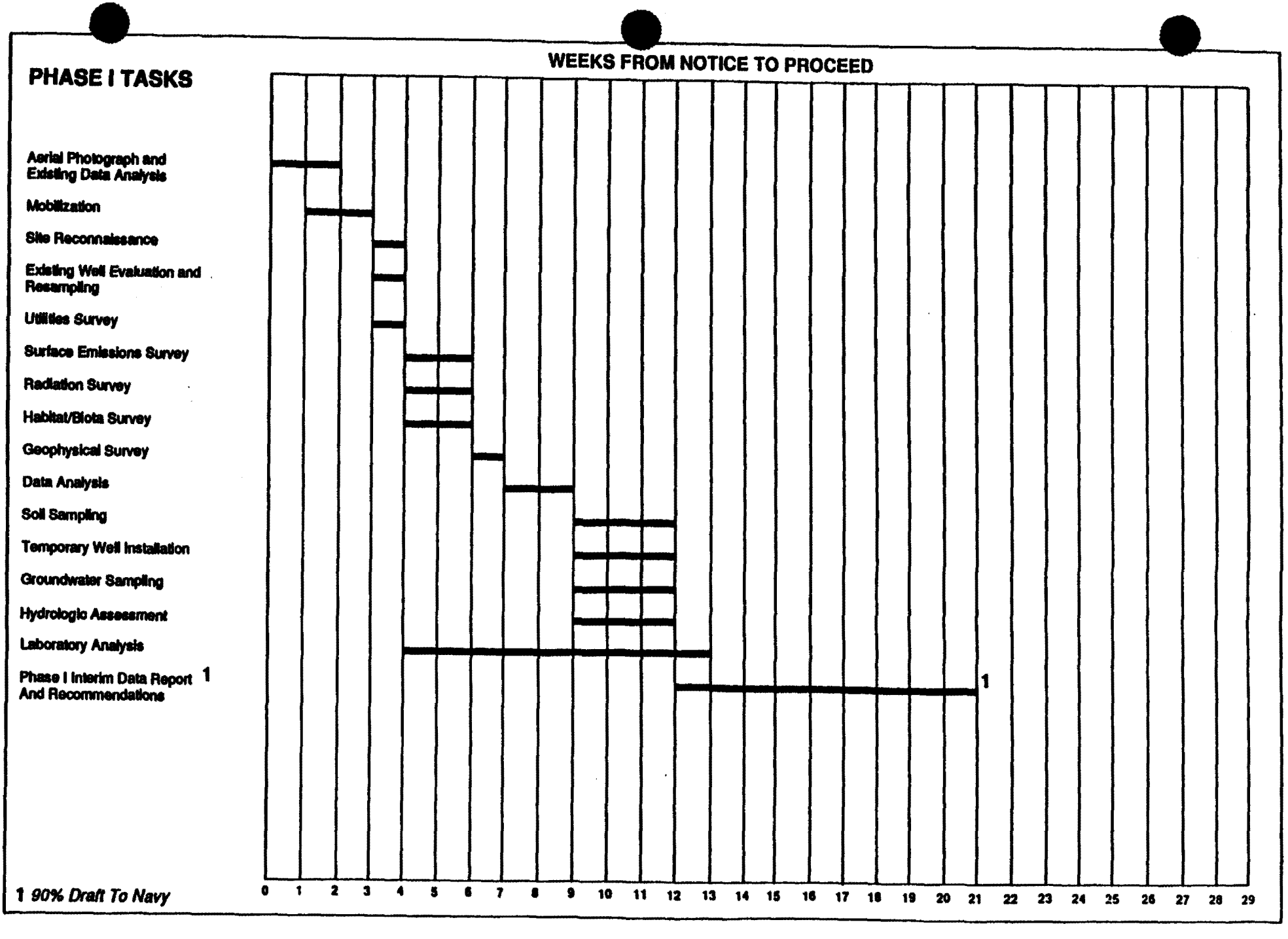

Figure 23-1 PHASE I PROJECT SCHEDULE -- GROUP G

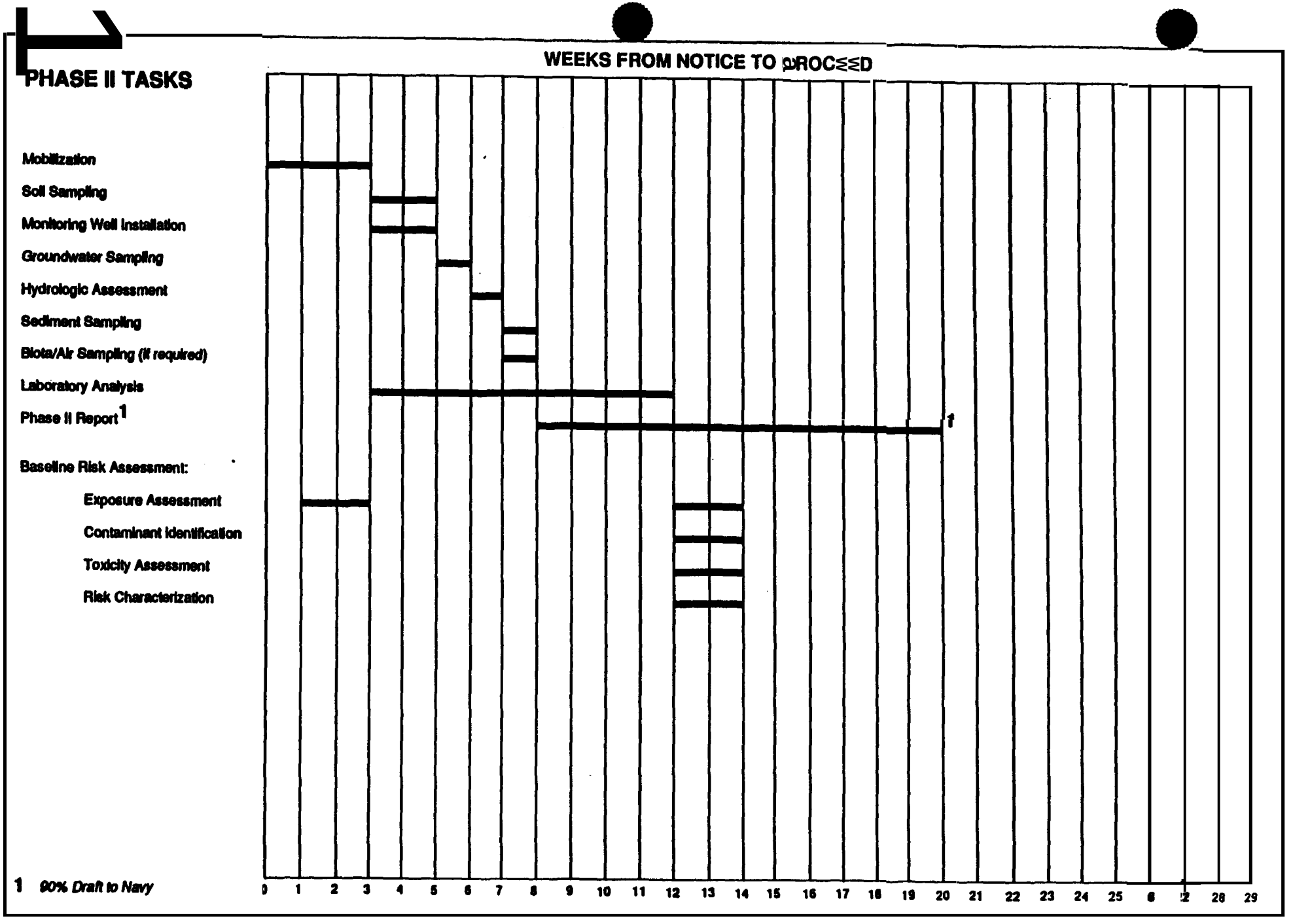

Figure 23-2 PHASE II PROJECT SCHEDULE -- GROUP G

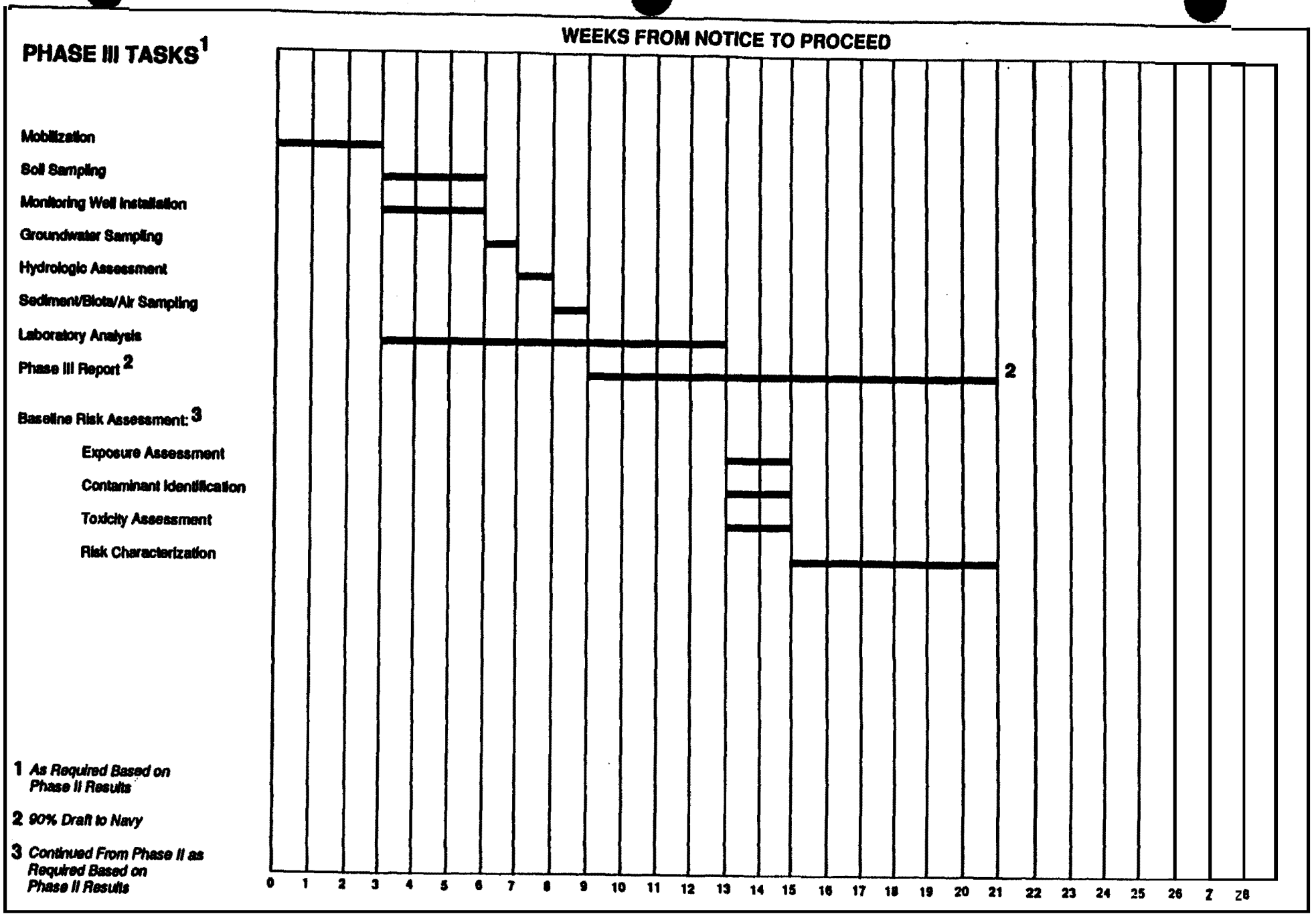

Figure 23-3 PHASE III PROJECT SCHEDULE -- GROUP G

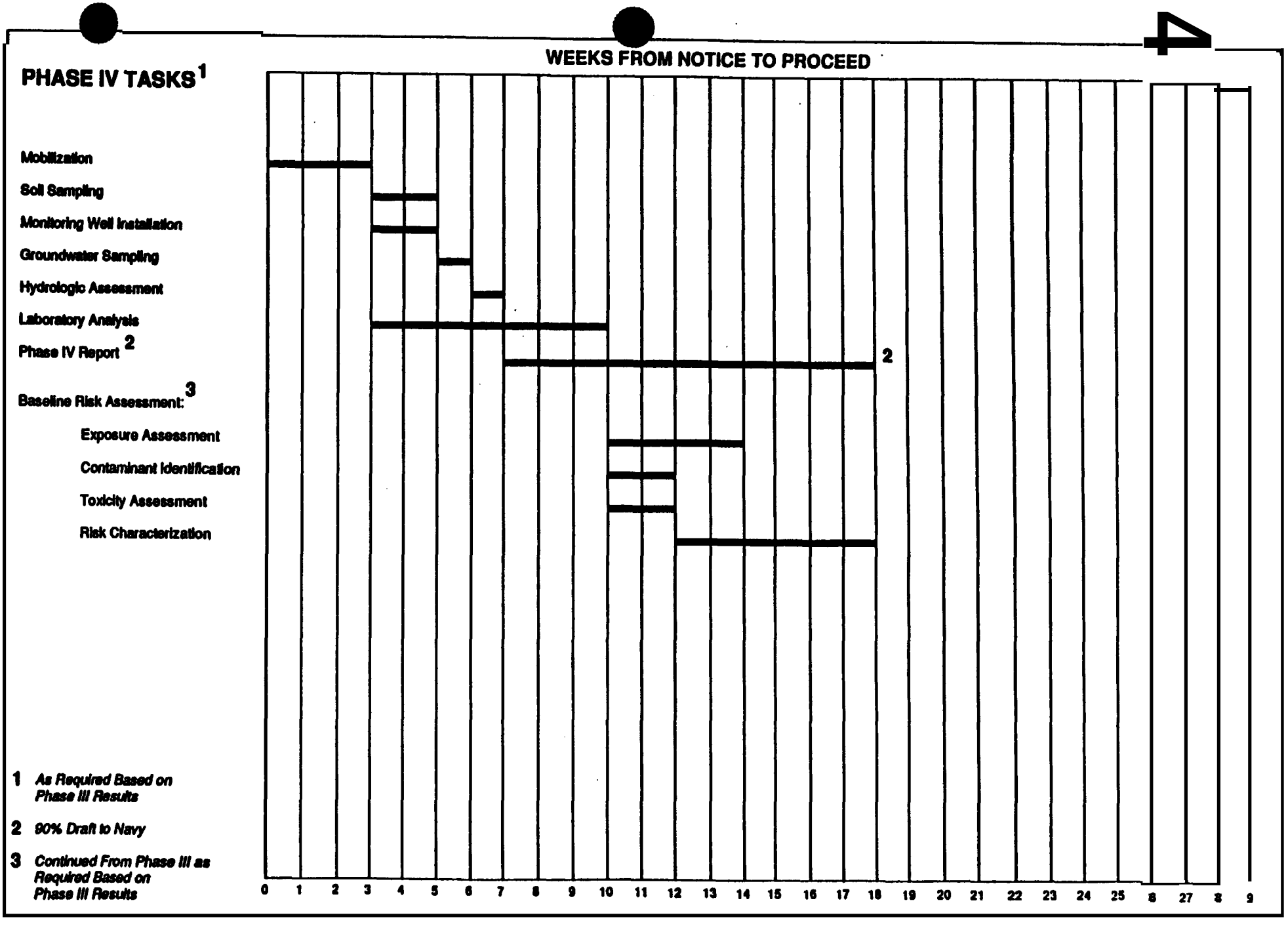

Figure 23-4 PHASE IV PROJECT SCHEDULE -- GROUP G

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APPENDIX A

SITE-SPECIFIC SAFETY PLAN

[Bold items enclosed in brackets denote **changes** to last version of document]

ecology and environment, inc.

SITE SAFETY PLAN

Version 988

A. GENERAL INFORMATION

Project Title: Site 25 - Radium Spill Area

Project lo.: UH8000

TDD/Pan lo.:

Project Manager: John Barksdale

Project Dit.: Gerry Gallagher

Location(s): Radium spill area in unknown location directly east of Building 780

Prepared by: Joe Fugitt

Date Prepared: 3-20-92

Approval by: Sybil Newchurch

Date Approved: 3-26-92

Site Safety Officer Review:

Date Reviewed:

Scope/Objective of Work: Field activities will include soil sampling, permanent monitoring well installation, groundwater sampling, physical surveys, and hydrologic asssessment.

Proposed Date of Field Activities: December 1992

Background Info: Complete: [X] Preliminary (No analytical data available) [ ]

Documentation/Summary:

Overall Chemical Hazard:	Serious [ ] Low [X]	Moderate [ ] Unknovn [ ]
Overall Physical Hazard	Serious [ ] Low [X]	Moderate [ ] Unknown [ ]
Radioactive Hazard	Serious [ ] Low [X]	Moderate [ ] Unknown [ ]

B. SITE/WASTE CHARACTERISTICS

Waste Type(s):

Liquid [X]	Solid [X]	Sludge [ ]	Gas/Vapor [X]

Characteristic(s):

Flammable/ Ignitable [ ]	Volatile [X]	Corrosive [ ]	Acutely Toxic [X]
Explosive [X]	Reactive [ ]	Carcinogan [X]	Radioactive* [X]

Other:

Physical Hazards:

Overhead [X]	Confined* Space [ ]	Below Grade [ ]	Trip/Fall [X]
Puncture [X]	Burn [ ]	Cut [X]	Splash [X]
Noise [X]	Other: Helicopter debris located in compound 1998. Vehicular traffic. Heat stress. Cold stress.		

*Requires completion of additional form and special approval from tho Corporate Health/Safety group. Contact RSC or HQ.

[HASP]UH8000:T0480:1

Site History/Description and Unusual Features (see Sampling Plan for detailed description): In 1978, a corroded drum containing radioactive waste broke open on the concrete paved area east of Building 780. Tho spill was reportedly cleaned up. Tho exact location of tho spill is not knovn. Phase I groundvator samples exhibited radium-226 contamination. Phase I soil samples exhibited PCB contamination in an area mast of Building 780.

Locations of **Chemicals/Wastes:** Tho exact location is not knovn but is reportedly on the paved area mast of and adjacent to Building 780.

Estimated Volume of Chemicals/Wastes: 25 gallons of radioactive waste from the radium paint stripping operations.

Site Currently in Operation Yes: [X] no: [ ]

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e. HAZARD EVALUATION

List Hazards *by* Task (i.e., drum sampling, drilling, etc.) and number them. (Task numbers are cross-referenced in Section D)

Physical Hazard Evaluation:

1) Soil sampling - Personal contamination, overhead, noise, automobilos
2) Monitoring well installation - Overhead, noise, automobiles
3) Groundwater sampling - Splash, personal contamination, automobilos
4) Decontamination procedures - Solvents, acid solutions
5) Physical surveys - slips, trips, falls, automobiles
6) Hydrologic assessment - Splash, personal contamination, automobiles

Chemical Hazard Evaluation:

Compound	PEL/TWA	Route of Exposure	Acute Symptoms	Odor Threshold	Odor Description
Nitric Acid	2 ppm	Inh, Ing, Con.	Corrosive	0.3 - 1 ppm	Acrid
Isopropyl Alcohol	440 ppm	Inh, Ing, Con.	Drowsiness, Head	7.5 - 200 ppm	Rubbing Alcohol
Benzene	1.0 ppm	Inh, Ing, Con.	Dizziness, Nausea	4.68 ppm	Sweet
PCB	0.001 mg/m^3	Inh, Ing, Con.	Skin Irritant	N/A	N/A

Radionuclide	Action Level	Route of Exposure	Acute Symptoms	Half-Life	Type of Radiation
Radium-226	72 mR/hr	Inh, Ing	Nausea, Vomit	1,620 years	Alpha, Gamma

Note: Complete and attach a Hazard Evaluation Sheet for ujor knovn contaminant.

D. SITE SAFETY WORK PLAN

Site Control: Attach map, use back of this page, or sketch of site showing hot zone, contamination reduction, zone, etc.

Perimeter identified? [ ] Site secured? [ ]

work Areas Designated? [ ] Zone(s) of Contamination Identified? [ ]

Personnel Protection (TLD badges required for all field personnel):

Anticipated Level of Protection (Cross-reference task numbers to Section C):

	A	B	C	D
Task 1			(X)	X
Task 2			(X)	X
Task 3				X
Task 4				X
Task 5				X
Task 6				X

(Expand if necessary)

Modifications: Modified level D with tyvek, neoprene gloves and boots, safety glasses, APR available when upgrade to level C is necessary based on gamma scintillation detector with 2" NaI probe. Tasks 3 and 6 will bo done in saranex coveralls.

Action Levels tor Evacuation of Work Zone Pending Reassessment of Condition.:

- Level D: O_2 <19.5% or >25%, explosive atmosphere >10% UL, organic vapors above background levels, particulates >____ mg/m^3, othor _____
- Level C: O_2 <19.5% or >25%, explosive atmosphere >25% LEL_3 (California-20%), unknown organic vapor (in breathing zone) >1 ppm, particulates >____ mg/m^3, othor _____
- Level B: O_2 <19.5% or >25%, explosive atmosphere >25% LEL_3 (California-20%), unknown organic vapors (in breathing zone) >5 ppm, particulates >____ mg/m^3, othor _____
- Level A: O_2 <19.5% or >25%, explosive atmosphere >25% LEL (California-20%), unknown organic vapors >500 ppm, particulates >____ mg/m^3, othor _____

Air Monitoring (daily calibration unless otherwise noted):

Contaminant of Interest	Type of Sample (area, personal)	Monitoring Equipment	Frequency of Sampling
Volatile Organics	Area	OVA	Continuous
Radiation-Soil	Area	Gamma Scintill	Survey
Explosive Gases	Area	O_2/Explosimeter	Continuous

Monitor for radioactive contamination, wipe. remonitor, rinse with wator or detergent and wator, if necessary, until no radiation eontarination persists. NOTE: Every effort will bo made to prevent generation of mixed waste. Alconox + tap wator wash, tap wator rinao, two isopropanol rinses, organic-free wator rinse and air dry. Teflon implements used for tho collection of samples for metals analyses will have a 108 nitric acid solution rinse after tho tap water rinse followed by another tap water rinao, two isopropanol rinses, and air dry.

[NASP]UH8000:T0480:1

Personnel Decon Protocol: boot and glove wash - Nconox + tap water wash with clean water rinse. Expendables will be double-bagged and drummed for disposal. Field personnel will take a hygienic shower off site, tollowing completion of each day's fieldwork.

Decon Solution Monitoring Procedures, if Applicable: Decontamination activities will be performed in a well-ventilated area upwind of tho sampling zone.

Special Site Equipment, Facilities, or Procedures (Sanitary Facilities and Lighting Must Meet 29 CFR 1910.120):

Site Entry Procedures and Spacial Considerations: E & E's "buddy system" will be employed at all times during fieldwork activities. Personnel will exercise caution in tho vicinity of nearby roadways. If above background radiation levels are encountered, team members will evacuate tho sampling area and contact tho corporate health physics group to reassess tho site.

Work Limitations (time of day. weather conditions, etc.) and Heat/Cold Stress Requirements: N l fieldwork activities will bo performed during daylight hours. Team members will break as needed to prevent heat stress and replace fluids. Cooling vests may bo used to prevent heat stress.

General Spill Control, if applicable: N/A

Investigation-Derived Material Disposal (i.e., expendables, decon waste, cuttings): All fieldwork waste materials will bo double bagged, drummed, labeled, and transported to designated location for final disposal by the Navy.

Sample Handling Procedures Including Protective Wear: During a11 handling of samples, all field team members will wear surgical gloves. Goggles will bo w r n during sample preservation with acids.

Team Member*	Responsibility
To bo determined.	Team Leader
	Site Safety Officer/Sampler
	Sampler
	Sampler

*All entries into exclusion zone require Buddy System use. All E & E field staff participate in medical monitoring program and have completed applicable training per 29 CFR 1910.120. Respiratory protection program meets requirements of 29 CFR 1910.134, and ANSI Z88.2 (1980).

- -

[NASP]UH8000:T0480:1

E EMERGENCY INFORMATION

(Use supplemental shoots, if necessary)

LOCAL RESOURCES

(Obtain a local telephone book from your hotel, if possible)

Ambulance: On base: (904) 452-4138; Off base: 911

Hospital Emergency Room: NAS Dispensary - Building 3600: (904) 452-2733: Baptist Hospital: (904) 434-4811 (Life Flight)

Poison Control Center:

Police (include local, county sheriff, state): 911

Fire Department: 911

Airport:

U.S. Coast Guard: Emergency: (904) 453-8178; General Info — tion: (904) 453-8282

Laboratory: E & E ASC: (716) 631-0360

Fed. Express: (BOO) 238-5355

Client Contact: U.S. Navy Southern Division, Engineer-In-Charge, Susanne D. Sanborn: (803) 743-0574

Site contact: NAS Pensacola Environmental Coordinator, Ron Joyner: (904) 452-4515

SITE RESOURCES

Site Emergency Evacuation Alarm Method: N/A

Water Supply Source: On site

Telephone Location, Number: To bo determined on site

Cellular Phone, if available: To be dotorminod on site

Radio:

Other: On-site warehouse number to be dotorminod

1. Dr. Raymond Harbison (Univ. of Florida) ..... (501) 221-0465 or (904) 462-3277, 3281
   Alachua, Florida (501) 370-8263 (24 hours)

2. Ecology and Environment, Inc., Safety Director
   Paul Jenmaire ..... (716) 684-8060 (office)
   (716) 655-1260 (home)

3. Regional Safety Coordinator - Sybil Southurch..... (904) 877-1978 (office
   (904) 878-2336 (home)

4. Regional Office Manager - Rick Rudy ..... (904) 877-1978 (office
   (904) 893-7245 (home)

MEDTOX HOTLINE

1. Twenty-four hour answering service: (501) 370-8263

   What to report:

   - stat.: "this is an emergency."
   - flour name, region, and site.
   - Telephone number to roach you.
   - Your location.
   - **Name of person injured or exposed.**
   - Nature of emergency.
   - Action taken.

2. A toxicologist, (Drs. Raymond Harbison or associate) will contact you. Repeat tho information given to tho answering service.

3. If a toxicologist does not return your call within 15 minutes, call tho following persons in order until contact is made:

   a. 24 hour hotline - (716) 684-8940
   b. Corporate Safety Director - Paul Jonnaire - home # (716) 655-1260
   c. Assistant Corp. Safety Officer - Steven Sherman - how # (716) 688-0084

EMERGENCY ROUTES

(NOTE: Field Team must Know Route(s) Prior to Start of Work)

Directions to hospital (include map) from site 25

MAS Dispensary - Follow Farrar Road west to Murray Road. Turn loft onto Murray Road. Follow Murray Road south to Moffett Road. Turn right onto Moffett Road and follow it west to Fisher Stroot. Turn loft onto Fisher Stroot. Follow Fisher Stroot south to Tumor Stroot: turn right onto Turner Stroot. Tho MAS Dispensary is located on Tumor Stroot in Building 3600.

Baptist Hospital - Take Duncan Road (Navy Blvd.) north to exit tho base. Navy Blvd. becomes Hwy 98 and curves to tho east. Follow Navy Blvd./Hwy. 98 east approx. 3 mi to Pace Blvd. Turn loft (north) on Pace Dlvd. and proceed approx. 1 mi to Cervantes St. (Hwy. 90). Turn right on Cervantes/Hwy. 90 and follow this road for about 8 blocks and turn loft (north) onto C street. Tho hospital is about 6 blocks north on tho loft.

Emergency Egress Routes to Get Off-Site Emergency egress routes will bo located if emergency exit routes become blocked by construction, etc.

[NASP]UH8000:T0480:1

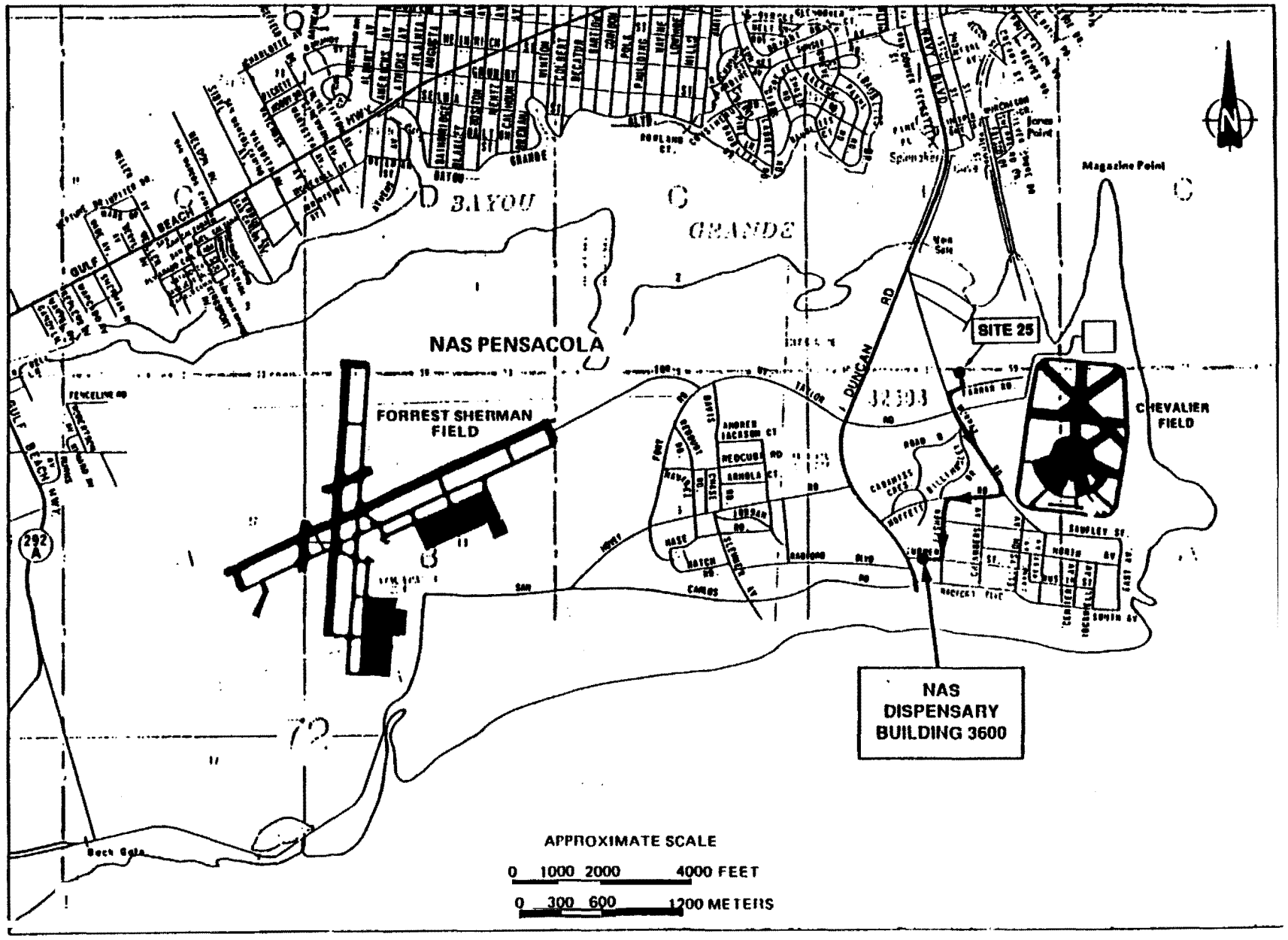
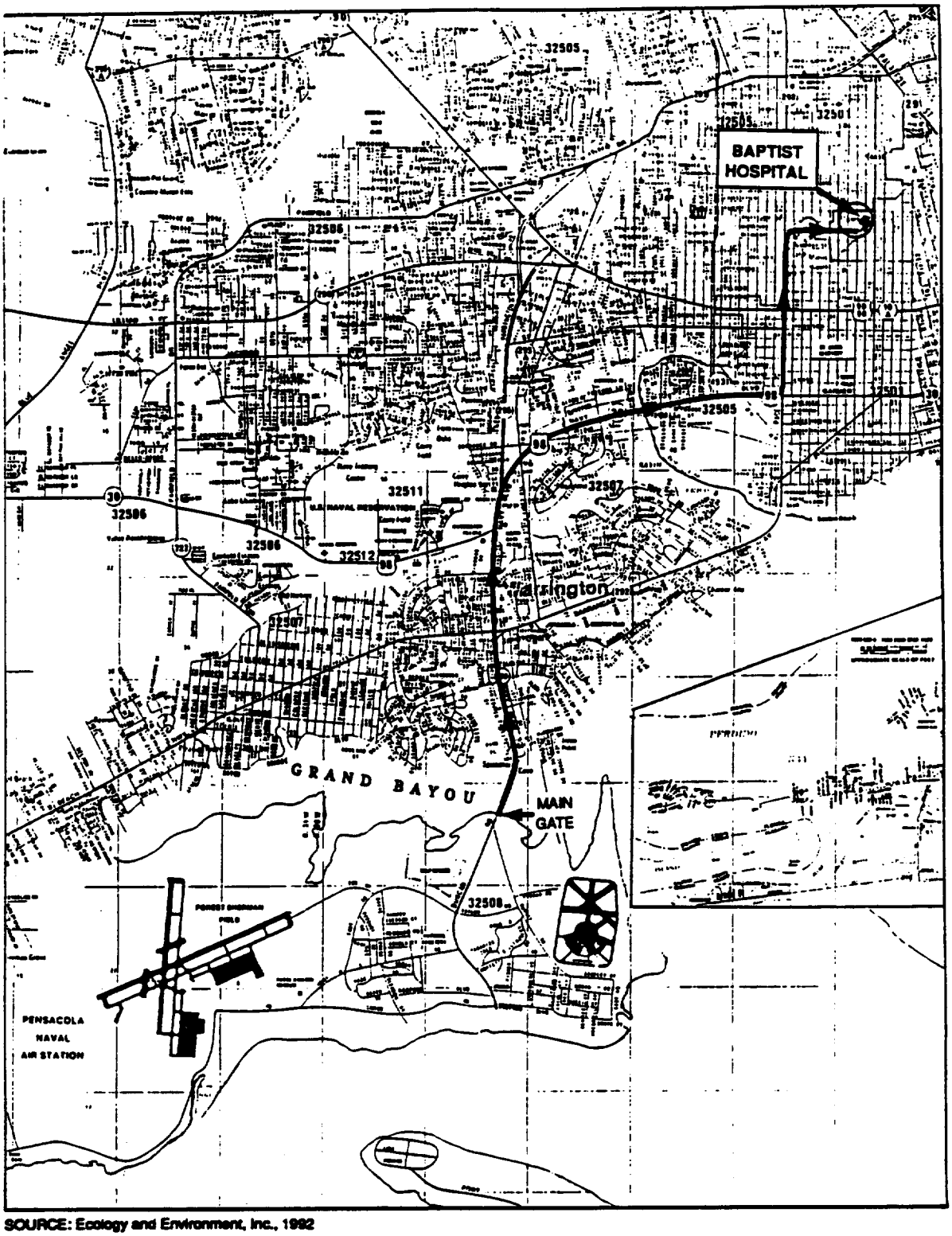


Figure A-1 LOCATION OF NAS DISPENSARY



SOURCE: Ecology and Environment, Inc., 1992

APPROXIMATE SCALE IN FEET

0 2000 4000 6000 8000

Figure A-2 LOCATION OF **BAPTIST** HOSPITAL

F. EQUIPMENT CHECKLIST

PROTECTIVE GEAR

Level A	No.	Level B	No.
SCBA		SCBA	
SPARE AIR TANKS		SPARE AIR TANKS	
ENCAPSULATING SUIT (Type _____)		PROTECTIVE COVERALL (Type _____)	
SURGICAL GLOVES		RAIN SUIT	
NEOPRENE SAFETY BOOTS		BUTYL APRON	
BOOTIES		SURGICAL GLOVES	
GLOVES (Type _____)		GLOVES (Type _____)	
OUTER WORK GLOVES		OUTER WORK GLOVES	
HARD HAT		NEOPRENE SAFETY BOOTS	
CASCADE SYSTEM		BOOTIES	
5-MINUTE ESCAPE COOLING VEST		HARD HAT WITH FACE SHIELD	
		CASCADE SYSTEM	
		MANIFOLD SYSTEM	

Level C		Level D	
ULTRA-TWIN RESPIRATOR		ULTRA-TWIN RESPIRATOR (Available)	X
POWER AIR PURIFYING RESPIRATOR		CARTRIDGES (Type GMC-H _____)	
CARTRIDGES (Type _____)		5-MINUTE ESCAPE MASK (Available)	
5-MINUTE ESCAPE MASK		PROTECTIVE COVERALL (Type Tyvek _____)	X
PROTECTIVE COVERALL (Type _____)		RAIN SUIT	
RAIN SUIT		NEOPRENE SAFETY BONDS	
BUTYL APRON		BOOTIES	X
SURGICAL GLOVES		WORK GLOVES	
GLOVES (Type _____)		HARD HAT WITH FACE SHIELD	X
OUTER WORK GLOVES		SAFETY GLASSES	X
NEOPRENE SAFETY BOOTS			
HARD HAT WITH FACE SHIELD			
BOOTIES			
HARDHAT			

INSTRUMENTATION	No.	DECON EQUIPMENT	No.
OVA		WASH TUBS	X
THERMAL DESORBER		BUCKETS	X
O2/EXPLOSIMETER W/CAL. KIT	X	SCRUB BRUSHES	X
PHOTOVAC TIP		PRESSURIZED SPRAYER	X
HNu (Probe 10.2 eV)	X	DETERGENT (Type)	
MAGNETOMETER		SOLVENT (Type)	
PIPE LOCATOR		PLASTIC SHEETING	X
WEATHER STATION		TARPS AND POLES	
DRAEGER PUMP, TUBES		TRASH BAGS	X
BRUNTON COMPASS		TRASH CANS	
MONITOX CYANIDE		MASKING TAPE	X
HEAT STRESS MONITOR		DUCT TAPE	X
NOISE EQUIPMENT		PAPER TOWELS	X
PERSONAL SAMPLING PUMPS		FACE MASK	
		FACE MASK SANITIZER	
		FOLDING CHAIRS	
		STEP LADDERS	
RADIATION EQUIPMENT		DISTILLED WATER	X
DOCUMENTATION FORMS			
PORTABLE RATEMETER			
SCALER/RATEMETER		SAMPLING EQUIPMENT	
NaI Probe		8 OZ. BOTTLES	X
ZnS Probe		HALF-GALLON BOTTLES	X
GM Pancake Probe		VOA BOTTLES	X
GM Side Window Probe		BAILER CORD	X
MICRO R METER		HAND BAILERS	X
ION CHAMBER		THIEVING RODS WITH BULBS	
ALERT DOSIMETER		SPOONS	X
POCKET DOSIMETER		KNIVES	
MINI RAD	X	FILTER PAPER	
FIRST AID EQUIPMENT		PERSONAL SAMPLING PUMP SUPPLIES	
FIRST AID KIT	X		
OXYGEN ADMINISTRATOR			
STRETCHER			
PORTABLE EYE WASH	X		
BLOOD PRESSURE MONITOR			
FIRE EXTINGUISHER	X		

	No .	MISCELLANEOUS (Cont.)	NO.
TOOL KIT	X		
HYDRAULIC JACK			
LUG WRENCH			
TOW CHAIN			
VAN CHECK OUT			
Gas			
Oil			
Antifreeze			
Battery			
Windshield Wash			
Tire Pressure			
		SHIPPING EQUIPMENT	
MISCELLANEOUS		COOLERS	X
PITCHER PUMP		PAINT CANS WITH LIDS, 7 CLIPS EACH	
SURVEYOR'S TAPE		VERMICULITE	X
100 FIBERGLASS TAPE		SHIPPING LABELS	X
300 NYLON ROPE		DOT LABELS: "DANGER"	
NYLON STRING		"UP"	
SURVEYING FLAGS		"INSIDE CONTAINER COMPLIES ..."	
FILM		"HAZARD GROUP"	
WHEEL BARROW		STRAPPING TAPE	X
BUNG WRENCH		BOTTLE LABELS	X
SOIL AUGER		BAGGIES	X
PICK		CUSTODY SEALS	X
SHOVEL		CHAIN-OF-CUSTODY FORMS	X
CATALYTIC HEATER		FEDERAL EXPRESS FORMS	X
PROPANE GAS		CLEAR PACKING TAPE	X
BANNER TAPE			
SURVEYING METER STICK			
CHAINING PINS & RING			
TABLES			
WEATHER RADIO			
BINOCULARS			
MAGAPHONE			

ecology and environment, inc.

ON-SITE SAFETY MEETING

Project _____ TDD/Pan _____

Date _____ Time _____ Job No. _____

Address _____

,Specific Location _____

Type of Work _____

_____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment _____

_____

Chemical Hazards _____

_____

Radiation Hazards _____

Physical Hazards _____

_____

Emergency Procedures _____

_____

Hospital/Clinic _____ Telephone _____

Hospital Address _____

Special Equipment _____

Other _____

Checklist

1. Emergency information reviewed? _____ and made familiar to a11 team members? _____
2. Route to nearest hospital driven? _____ and its location known to a11 team members? _____
3. Site safety plan readily available and its location known to all team members? _____

Meeting shall be attended by a11 personnel who will be working within the exclusion area. Daily informal update meetings will be held when site tasks and/or conditions change.

ATTENDEES

(Expand on back of sheet if necessary)

Name Printed	Signature

Meeting Conducted by: _____ (Print) _____ (Signature)

_____ (Site Safety coordinator) _____ (Team Leader)

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ecology and environment, inc.

SITE SAFETY PLAN

Version 988

A. GENERAL INFORMATION

Project Title: Site 27 - Radium Dial Shop Sewer

Project No.: UH8000

TDD/Pan No. :

Project Manager: John Barksdale

Project Dir.: Gerry Gallagher

Location(s): Foundation of Building 709 and sewer line connecting to manhole K-7

Prepared by: Joe Fugitt

Dato Proparod: 3/20/92

Approval by: Sybil Newchurch

Date Approved: 3/26/92

Site Safety Officer Review:

Date Reviewed:

Scope/Objective of Work: Field activities will include moil sampling, permanent monitoring well installation, groundwater sampling, physical surveys, and hydrologic assessment

Proposed Dato of Field Activities: December 1992

Background Info: Complete: [X] Preliminary (No analytical data available) [ ]

Documentation/Summary:

Overall Chemical Hasard:	Serious [ ] Low [X]	Moderate [ ] Unknown [ ]
Overall Physical Hasard	Serious [ ] Low [ ]	Moderate [X] Unknown [ ]
Radioactive Hazard	Serious [ ] Low [X]	Moderate [ ] Unknown [ ]

B. SITE/WASTE CHARACTERISTICS

Waste Type(s):

Liquid [X]	Solid [X]	Sludge [ ]	Gas/Vapor [X]

Characteristic(s):

Flammable/ Ignitable [X]	Volatile [X]	Corrosive [ ]	Acutely Toxic [ ]
Explosive [X]	Reactive [ ]	Carcinogen [X]	Radioactive* [X]

Other:

Physical Hazards:

Overhead [X]	Confined* Space [ ]	Below Grade [X]	Trip/Fall [X]
Puncture [X]	burn [1	Cut [X]	Splash [X]
Noise [X]	Other: Vehicular traffic in site area. Heat/cold stress.		

*Requires completion of additional form and special approval from tho Corporato Health/Safety group. Contact RSC or HQ.

[NASP]UH8000:T0480:2

Site History/Description and Unusual Features (see Sampling Plan for detailed description): Previous to 1976, Building 709 was used to rework radium dials. Tho building was dismantled in 1976, and tho drain pipe was found to be radioactively contaminated. It was capped with concrete and loft in place. Phase I soil samples colloctod south of tho Building 709 foundation exhibited olovatod concentrations of radium-226, chromium, and load. soil samples colloctod in tho area of tho former carburetor shop exhibited olovatod radium-226, metals, TRPHs, VOCs, PAHs, and phenols. Phase I groundwater samples exhibited olovatod concentrations of metals (arsonic, chromium, and load), radium-226, TRPHs, total xylenes, phonola, and 1,1-dichloroethane.

Locations of Chemicals/Wastes: Radioactive contaminants have boon found in drain pipe adjacent to manhole K-7.

Estimated Volume of Chemicals/Wastes: Approximately 1,500 gallons per year of cleaning solution contaminated with radium was dumped down tho drains in Building 709.

Site Currently in Operation Yes: [ ] no: [X]

---

e. HAZARD EVALUATION

List Hazards by Task (i.e., drum sampling, drilling, etc.) and number them. (Task numbers are cross-referenced in Section D)

Physical Hazard Evaluation:

1) Soil sampling - Personal contamination, overhead, noise, automobiloa

2) Monitoring well installation - Overhead, noise, automobiles

3) Groundwater sampling - Splash, personal contamination, automobiloa

4) Decontamination procedures - Solvents, acid solutions

5) Physical surveys - Slips, trips, falls, automobiloa

6) Hydrologic assessment - Splash, personal contamination, automobiles

Chemical Hazard Evaluation:

Compound	PEL/TWA	Route of Exposure	Acute Symptoms	Odor Threshold	Odor Description
Nitric Acid	2 ppm	Inh, Ing, Con	Corrosive	0.3 - 1 ppm	Acrid
Isopropyl Alcohol	440 ppm	Inh, Ing, Con	Drowsiness, Head	7.5 - 200 ppm	Rubbing Alcohol
Benzene	1 ppm	Inh, Ing, Con	Dizziness, Nausea	4.68 ppm	Sweet aromatic
Hydrogen Cyanide	4.7 ppm	Inh	Weak, Head	0.00027 ppm	Bitter almond
1,1-Dichloroethane	100 ppm	Inh, Ing, Con	Nausea, Vomit	5 ppm	Sweet
Arsenic	0.010 mg/m^3	Inh, Ing, con	Head, Dizziness	N/A	N/A
Chromium	1 mg/m^3	Inh. Ing, Con	Nausea, Fever	N/A	N/A
Lead	0.050 mg/m^3	Inh, Ing, Con	Head, Voaft	N/A	N/A
Phenols	5 ppm	Inh, Ing, Con	Vomit, Diarrhea	0.05 ppm	Sweet, pungent
Xylene	100 ppm	Inh, Ing, Con	Eye irritant	0.5 ppm	Aromatic

Radionuclide	Action Level	Route of Exposure	Acute Symptoms	Half-Life	Type of Radiation
Radium-226	>2mR/hr	Inh, Ing	Nausea, Vomit	1,620 years	Alpha, gamma

Note: Complete and attach a Hazard Evaluation Sheet for major known contaminant.

[NASP]UH8000:T0480:2

D. SITE SAFETY WORK PLAN

Site Control: Attach map, use back of this page, or sketch of site showing hot tone, contamination reduction, zone, etc.

Perimeter identified? [ ] Site secured? [ ]

Work Areas Designated? [ ] Zone(s) of Contamination Identified? [ ]

Personnel Protection (TLD badges required for all field personnel):

Anticipated Level of Protection (Cross-reference task numbers to Section C):

	A	B	C	D
Task 1			(X)	X
Task 2			(X)	X
Task 3				X
Task 4				X
Task 5				X
Task 6				X

(Expand if necessary)

Modifications: Modified level D with tyvok, neoprene gloves and boots, safety glasses, APR available when upgrade to level C is necessary based on gamma scintillator. Tasks 3 and 6 will bo performed in Saranex.

Action Levels for Evacuation of Work Zone Pending Reassessment of Conditions:

- Level D: O_2 <19.5% or >25%, explosive atmosphere >10% LEL, organic vapors above background levels, particulates > _____ mg/m^3, other _____
- Level C: O_2 <19.5% or >25%, explosive atmosphere >25% LEL (California-20%), unknown organic vapor (in breathing tone) >1 ppm, particulates > _____ mg/m^3, other _____
- Level B: O_2 <19.5% or >25%, explosive atmosphere >25% LEL (California-2081, unknown organic vapors (in breathing zone) >5 ppm, particulates > _____ mg/m^3, other _____
- Level A: O_2 <19.5% or >25%, explosive atmosphere >25% LEL (California-2081, unknown organic vapors >500 ppm, particulates > _____ mg/m^3, other _____

Air Monitoring (daily calibration unless otherwise noted):

Contaminant of Interest	Type of Sample (area, personal)	Monitoring Equipment	Frequency of Sampling
Volatile Organics	Area	OVA	Continuous
Radiation	Area	Gamma Scin. w/2-NaI probe	Continuous
Explosive Gases	Area	O_2/Explosimeter	Continuous

Decontamination solutions and Procedures for Equipment, Sampling Gear, etc.:

Monitor for radioactive contamination. wipe, remonitor, rinse with vator or detergent, if necessary, until no radiation contamination persists. Note: Every effort will be made not to generate mixed waste.

Alconox + tap water wash, tap water rinse, two isopropanol rinses, organic-free vator rinse, and air dry.

Teflon implements used for tho collection of samples for metals analyses will have a 10% nitric acid solution rinse after tho tap vator rinse followed by another tap vator rinse, tvo isopropanol rinses, and air dry.

[NASP]UH8000:T0480:2

Personnel Decon Protocol: Boot and glove wash - Alconox + tap water wash with clean water rinse. Expendables will bo double-bagged and drummed for disposal. Field personnel vill take a hygienic shower 02f site, following completion of each day's fieldwork.

Decon solution Monitoring Procedures, if Applicable: Decontamination activities will bo performed in a well-ventilated area upwind of the sampling zone.

Special Site Equipment, Facilities, or Procedures (Sanitary Facilities and Lighting Must Meet 29 CFR 1910.120):

Site Entry Procedures and Special Considerations: E & E's "buddy system" will bo employed at a11 times during fieldwork activities. Personnel vill exercise caution in tho vicinity 02 nearby roadways. If above background radiation levels are encountered, team members vill evacuate tho sampling area and contact tho corporato health physics group to reassess tho site.

work Limitations (time of day, weather conditions, etc.) and Heat/Cold Stress Requirements: All fieldwork activities will bo performed during daylight hours. Team members will break as needed to prevent heat stress and replace fluids. Cooling vests may bo used to prevent heat stress.

General Spill Control, if applicable: N/A

Investigation-Derived Material Disposal (i.e., expendables, decon waste, cuttings): All fieldwork vasto materials vill bo double bagged, drummed, labeled, and transported to designated location for final disposal by the Navy

Sample Handling Procedures Including Protective Wear: During all handling of samples, all field team members vill wear surgical gloves. Goggles vill bo worn during sample preservation vith acids.

Team Member*	Responsibility
To bo determined.	Team Leader
	Site Safety Officer/Sampler
	Geologist/Sampler
	Sampler

*All entries into exclusion zone require buddy system use. All E & E field staff participate in medical monitoring program and have completed applicable training per 29 CFR 1910.120. Respiratory protection program meets requirements of 29 CFR 1910.134, and ANSI 200.2 (1980).

[NASP]UH8000:T0480:2

E. EMERGENCY INFORMATION

(Use supplemental sheets, if necessary)

LOCAL RESOURCES

(obtain a local telephone book from your hotal, if possible)

Ambulance: On base: (904) 452-4138: Off base: 911

Hospital Emergency ROOD: NAS Dispensary - Building 3600: (904) 452-2733; Baptist Hospital: (904) 434-4811 (Life Flight)

Poison Control Center:

Police (include local, **county sheriff, state):** 911

Fire Department: 911

Airport:

U.S. Coast Guard: Emergency: (904) 453-8178; General Information: (904) 453-8282

Laboratory: E & E MC: (716) 631-0360

Fed. Express: (800) 238-5355

Client Contact: U.S. navy Southern Division, Enpinoor-In-Chargo, Suzanne D. Sanborn: (803) 743-0574

Site Contact: NAS Pensacola Environmental Coordinator. Ron Joyner: (904) 452-4515

SITE RESOURCES

Site Emergency Evacuation Alarm Method: N/A

Water Supply Source: On site

Telephone Location, Number: To bo dotorminod on site

Cellular Phone, if available: To bo determined on site

Radio :

Other: On-sit. warehouse number to bo determined

EMERGENCY CONTACTS

1. Dr. Raymond Harbison (Univ. of Florida) ..... (501) 221-0465 or (904) 462-3277, 3281
   Alachua, Florida (501) 370-8263 (24 hours)

2. Ecology and Environment, Inc., Safety Director
   Paul Jonmaire ..... (716) 684-8060 (office)
   (716) 655-1260 (homo)

3. Regional Safety Coordinator - Sybil Nowchurch..... (904) 877-1978 (office)
   (904) 878-2336 (home)

4. Regional Office Manager - Rick *Rudy* ..... (904) 877-1978 (office)
   (904) 893-7245 (home)

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   What to report:

   - State: "this is an emergency."
   - Your name, region, and site.
   - Telephone number to roach you.
   - Your location.
   - Name of person injured or exposed.
   - Nature of emergency.
   - Action taken.

2. A toxicologist, (Drs. Raymond Harbison or associate) will contact you. Repeat tho information given to tho answering service.

3. If a toxicologist does not return your call within 15 minutes, call tho following persons in order until contact is made:

   a. 24 hour hotline - (716) 684-8940
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   c. Assistant Corp. Safety Officer - Steven Sherman - homo # (716) 688-0084

EMERGENCY ROUTES

(NOTE: Field Teams must Know Route(s) Prior to Start of Work)

Directions to hospital (include up) from Site 27

NAS Dispensary - Follow Farrar Road mat to Hurray Road. Turn loft onto Murray Road. Follow Hurray Road south to Moffett Road. Turn right onto Moffett Road and follow it west to Fisher Stroot. Turn left onto Fisher Stroot. Follow Fisher Stroot south to Turnor Stroot. Turn right loft on Turnor Stroot. Tho NAS Dispensary is located on Turner Stroot in Building 3600.

Baptist Hospital - Take Duncan Road (Navy Blvd.) north to exit tho base. Navy Blvd. becomes HWY 98 and curves to the east. Follow Navy Blvd./Hwy. 98 east approx. 3 mi to Pace Blvd. Turn loft (north) on Pace Blvd. and proceed approx. 1 mi to Cervantes St. (Hwy. 90). Turn right on Cervantes/Hwy. 90 and follow this road for about 8 blocks and turn loft (north) onto E street. Tho hospital is about 6 blocks north on tho loft.

Emergency Egress Routes to Get Off-Site Emergency egress routoa will bo located if emergency exit routoa become blocked by construction, etc.

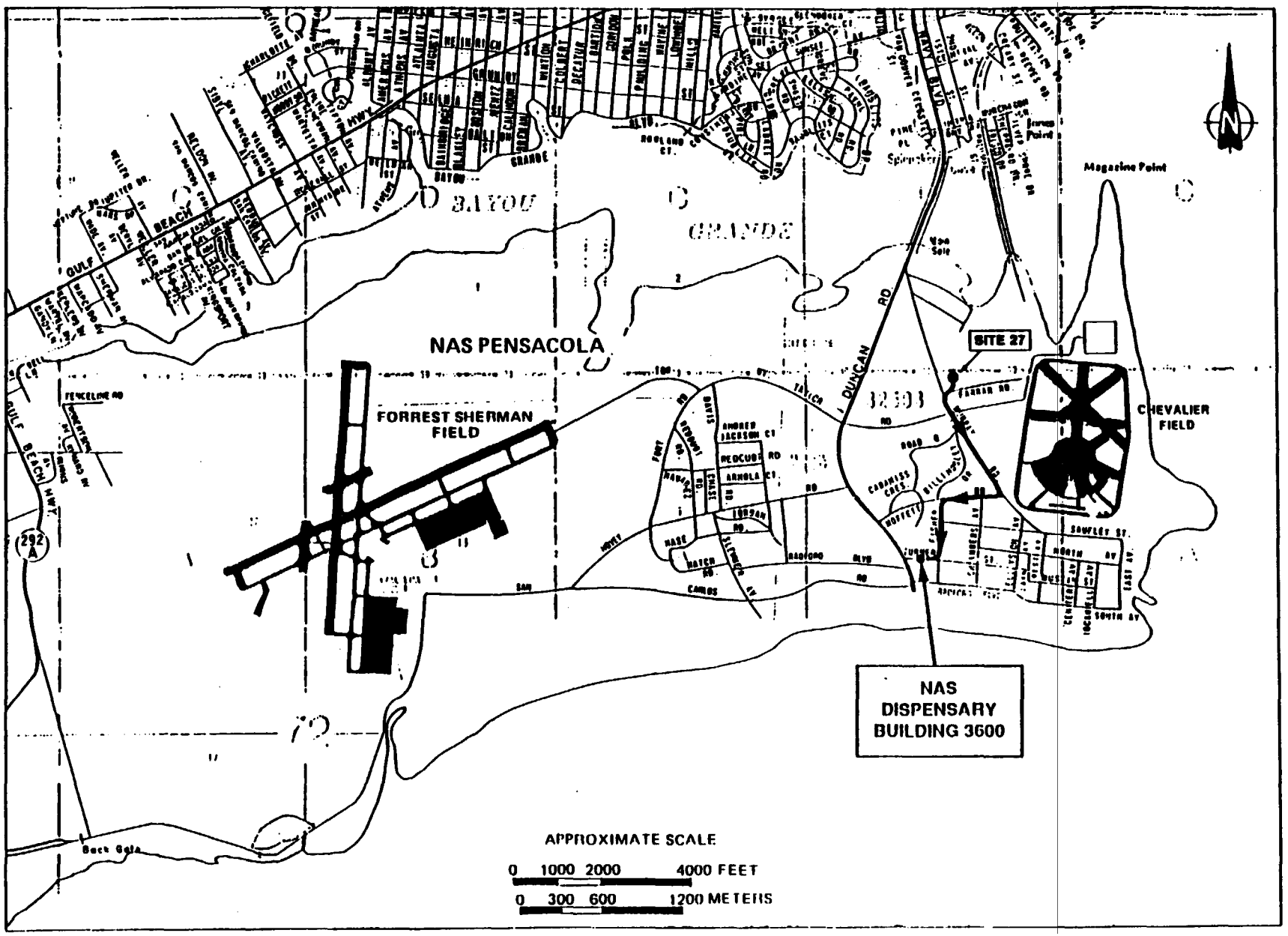

Figure 2.3 LOCATION OF NAS DISPENSARY

F. EQUIPMENT CHECKLIST

Level A	NO.	Level B	NO.
SCBA		SCBA	
SPARE AIR TANKS		SPARE AIR TANKS	
ENCAPSULATING SUIT (Type _____)		PROTECTIVE COVERALL (Type _____)	
SURGICAL GLOVES		RAIN SUIT	
NEOPRENE SAFETY BOOTS		BUTYL APRON	
BOOTIES		SURGICAL GLOVES	
GLOVES (Type _____)		GLOVES (Type _____)	
OUTER WORK GLOVES		OUTER WORK GLOVES	
HARD HAT		NEOPRENE SAFETY BOOTS	
CASCADE SYSTEM		BOOTIES	
5-MINUTE ESCAPE COOLING VEST		HARD HAT WITH FACE SHIELD	
		CASCADE SYSTEM	
		MANIFOLD SYSTEM	
Level C		**Level D**	
ULTRA-TWIN RESPIRATOR		ULTRA-TWIN RESPIRATOR (Available)	X
POWER AIR PURIFYING RESPIRATOR		CARTRIDGES (Type GMC-H _____)	
CARTRIDGES (Type _____)		5-MINUTE ESCAPE MASK (Available)	
5-MINUTE ESCAPE MASK		PROTECTIVE COVERALL (Type Tyvek _____)	X
PROTECTIVE COVERALL (Type _____)		RAIN SUIT	
RAIN SUIT		NEOPRENE SAFETY BONDS	
BUTYL APRON		BOOTIES	X
SURGICAL GLOVES		WORK GLOVES	
GLOVES (Type _____)		HARD HAT WITH FACE SHIELD	X
OUTER WORK GLOVES		SAFETY GLASSES	X
NEOPRENE SAFETY BOOTS			
HARD HAT WITH FACE SHIELD			
BOOTIES			
HARDHAT			

INSTRUMENTATION	No.	DECON EQUIPMENT	No.
OVA		WASH TUBS	X
THERMAL DESORBER		BUCKETS	X
O2/EXPLOSIMETER W/CAL. KIT	X	SCRUB BRUSHES	X
PHOTOVAC TIP		PRESSURIZED SPRAYER	X
HNu (Probe 10.2 eV)	X	DETERGENT (Typo)	
MAGNETOMETER		SOLVENT (Type)	
PIPE LOCATOR		PLASTIC SHEETING	X
WEATHER STATION		TARPS AND POLES	
DRAEGER PUMP, TUBES		TRASH BAGS	X
BRUNTON COMPASS		TRASH CANS	
MONITOX CYANIDE		MASKING TAPE	X
HEAT STRESS MONITOR		DUCT TAPE	X
NOISE EQUIPMENT		PAPER TOWELS	X
PERSONAL SAMPLING PUMPS		FACE MASK	
		FACE MASK SANITIZER	
		FOLDING CHAIRS	
		STEP LADDERS	
RADIATION EQUIPMENT		DISTILLED WATER	X
DOCUMENTATION FORMS			
PORTABLE RATEMETER			
SCALER/RATEMETER		SAMPLING EQUIPMENT	
NaI Probe		8 OZ. BOTTLES	X
ZnS Probe		HALF-GALLON BOTTLES	X
OH Pancake Probe		VOA BOTTLES	X
OH lido Window Probe		BAILER CORD	X
MICRO R METER		HAND BAILERS	X
ION CHAMBER		THIEVING RODS WITH BULBS	
ALERT DOSIMETER		SPOONS	X
POCKET DOSIMETER		KNIVES	
MINI RAD	X	FILTER PAPER	
FIRST AID EQUIPMENT		PERSONAL SAMPLING PUMP SUPPLIES	
FIRST AID KIT	X		
OXYGEN ADMINISTRATOR			
STRETCHER			
PORTABLE EYE WASH	X		
BLOOD PRESSURE MONITOR			
FIRE EXTINGUISHER	X		

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VAN EQUIPMENT	No.	MISCELLANEOUS (Cont.)	No.
TOOL KIT	X		
HYDRAULIC JACK			
LUG WRENCH			
TOW CHAIN			
VAN CHECK OUT			
Gas			
Oil			
Antifreeze			
Battery			
Windshield Wash			
Tire Pressure			
		SHIPPING EQUIPMENT	
MISCELLANEOUS		COOLERS	X
PITCHER PUMP		PAINT CANS WITH LIDS, 7 CLIPS EACH	
SURVEYOR'S TAPE		VERMICULITE	X
100 FIBERGLASS TAPE		SHIPPING LABELS	X
300 NYLON ROPE		DOT LABELS: "DANGER"	
NYLON STRING		"UP"	
SURVEYING FLAGS		"INSIDE CONTAINER COMPLIES ..."	
FILM		"HAZARD GROUP"	
WHEEL BARROW		STRAPPING TAPE	X
BUNG WRENCH		BOTTLE LABELS	X
SOIL AUGER		BAGGIES	X
PICK		CUSTODY SEALS	X
SHOVEL		CHAIN-OF-CUSTODY FORMS	X
CATALYTIC HEATER		FEDERAL EXPRESS FORMS	X
PROPANE GAS		CLEAR PACKING TAPE	X
BANNER TAPE			
SURVEYING METER STICK			
CHAINING PINS & RING			
TABLES			
WEATHER RADIO			
BINOCULARS			
MAGAPHONE			

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ON-SITE SAFETY MEETING

Project _____ TDD/Pan _____

Date _____ Time _____ Job No. _____

Address _____

Specific Location _____

Type of Work _____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment _____

Chemical Hazards _____

Radiation Hazards _____

Physical Hazards _____

Emergency Procedures _____

Hospital/Clinic _____ Telephone _____

Hospital Address _____

Special Equipment _____

Other _____

Checklist

1. Emergency information reviewed? _____ and made familiar to all team members? _____
2. Route to nearest hospital driven? _____ and its location known to all team members? _____
3. Site safety plan readily available and its location known to all team members? _____

Meeting shall be attended by all personnel who will be working within the exclusion area. Daily informal update meetings will be held when site tasks and/or conditions change.

Name Printed	Signature

Meeting Conducted by: _____ (Print) _____ (Signature)

_____ (Site Safety Coordinator) _____ (Team Leader)

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STANDARD OPERATING PROCEDURES FOR HEALTH AND SAFETY ON DRILLING RIG OPERATIONS

REVISED: JANUARY 1990

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1 INTRODUCTION

This document is meant to be used in conjunction vith E 6 E SOPs for field operations and hazardous vaste site operations, and incorporates by reference all the safety precautions required therein. It specifically addresses the functions and responsibilities of personnel working on or around drilling operations.

E & E personnel are frequently required to vork in the field vith drill rigs, taking soil and rock samples, installing piezometers, and monitoring wells. Two general situations discussed separately are the supervision of Subcontract Drillers by E & E, and the direct operation of E 6 E's ovn drill rig by our personnel.

2 OPERATION OF DRILLING EQUIPMENT BY E 6 E

2.1 RESPONSIBILITIES AND AUTHORITY OF SITE SAFETY OFFICER

The duties of the Site Safety Officer (SSO) on drilling sites are the same as in other types of operations vith the exception of the increased emphasis on the hazards unique to drilling work. This section details specific drilling concerns of an SSO.

E & E personnel are restricted from the borehole area during active drilling. When E 6 E personnel are doing drilling; they will be restricted from the borehole area by means of a "super exclusion zone" delineated by placing a 4- by 8-foot sheet of plyvood over the borehole.

2.2 RESPONSIBILITIES AND AUTHORITY OF E & E DRILLER

At the beginning of each vork day, the E & E driller must inspect the rig to ensure the folloving components have been properly inspected, maintained, or replaced, or procedures have been performed:

- Kill switches tripped and operation verified;
- Chin guards in place:
- Belt guards in place;
- Belts set to proper tension (visual);
- Loose belts:
- Presence of any fluid leaks;
- Any damaged hoses, cables, ropes, chains:
- Control panel is clean:
- Control lever functions labeled:
- Pressure relief valves function;
- Cathead free of rust and grease:
- Cathead grooves less than 118 inch in depth;
- All tools in proper vorking order;
- Rig leveled and stabilized;
- Check for veld cracks in mast; and
- Safety hooks operational.

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The Driller will report items needing attention to the SSO: however, it is the Driller's responsibility to make sure that these items are corrected prior to drilling.

During the drilling operations, the folloving safety practices vill be in effect:

- All wheels will be blocked.
- Rig will be leveled using jacks or stabilizers.
- Rig engine will be in neutral when not actively turning augers.
- Plywood (or suitable substitute material) "super exclusion zone" pad will be in place over borehole.
- Rig engine key will be properly labeled.
- Rig equipment will be kept in an orderly manner within drilling work zone.
- All equipment will be properly lubricated.
- Tools will be used only for their intended purpose.
- Safety glasses, hearing protection will be vorn vhen hammers are operated.
- Jaws of all wrenches will be clean and free of mud to prevent slippage.
- All lift hooks will have jaw clasps.
- Fire extinguisher will be staged at rear of rig.
- Big will not be moved when mast is in raised position.
- Cables and ropes will be tied back or secured on stabilizer posts.
- All unattended drill holes will be covered.
- Check for overhead obstructions when raising rig mast, boom will not be raised vithin 25 feet of overhead utilities.
- No refueling will be permitted while equipment is running.

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The Driller has authority to direct personnel vithin the area vhile drilling operations are in progress. Access to the hazardous area around the auger and borehole is restricted by the "super exclusion zone" delineated by the 4- by 6-foot sheet of plywood centered over the borehole before drilling. A large hole cut in the plywood allovs penetration of the augers. No personnel are alloved in this zone pad at any time while drilling is actively underway.

Housekeeping around the rig is the responsibility of the Driller, but all team members must participate in this effort as well.

23 RESPONSIBILITY AND AUTHORITY OF *OTHER* E & E PERSONNEL

E & E personnel vorking at a drilling site must act as support to the Drilling Team by providing any necessary support functions; however, it is important that personnel are careful not to interfere vith the drilling process. Personnel are restricted from approaching the "super exclusion zone" vhile drilling is undernay. If an E & E crew member recognizes an unsafe condition in the vork area or on the rig, he should bring it to the attention of the SSO and Team Leader, if it is not resolved in a timely manner. If conditions are still deemed to be hazardous, team members have the option to contact their Regional Safety Coordinator (RSC) or Corporate Health and Safety in Buffalo.

It is the responsibility of all E & E personnel to carry their issued nondisposable gear, including hard hat, face shield, respirator, steel-toed boots, eyepiece inserts, safety glasses, and appropriate outernear for the expected climate.

All personnel should be aware of emergency facilities, egress routes, urd special medical conditions of their team members. As vith all E & E field vork, the buddy system is to be enforced.

3 TRAINING REQUIREMENTS FOR SITE PERSONNEL

31 E & E SITE SAFETY OFFICER

In addition to Basic Health and Safety Training and other OSHA mandated training, first aid, CPR, and necessary training in field monitoring of personnel, an SSO should have previously vorked as a team member on field drilling projects in order to have a vorking knovledge of the drill rig and its inherently hazardous natura. Where monitoring instrumentation is to be used, the SSO must be properly trained prior to field vork. The SSO must have an understanding of the hazards of heat and cold stress, their associated symptoms, and proper vork modifications to protect field staff from potential injury.

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3.2 E & E DRILLER AND HELPER

The E 6 E driller and helper shall have taken and passed the basic 40-hour Health and Safety Training as prescribed by E 6 E and mandated by OSHA. They shall also meet the other minimum requirements for field vork including medical approvals and respirator fit test. Based on previous experience and training, the Driller will be critiqued by the E & E Drilling Team upon employment vith E 6 E, by performing various types of drilling. This review will be the basis for determining whether additional training or apprenticeship will be required before alloving this employee to act as Driller. An existing E 6 E employee shall have a minimum of 1 year experience as a Driller's Eelper on an assortment of field projects before he or she can be reviewed for advancement to the position of Driller. If a Driller is uninvolved in drilling efforts for 1 year or more, he or she will be required to act as a Driller's Helper on a project, as well as receive rig-specific training on the equipment, before being permitted to act as a Driller again. The Driller's Helper position requires prior attendance at a drilling training school program. Following successful completion of such a course, the Driller's Helper will be observed on sites for a period of approximately 6 months, during which time he or she will vork on several drilling projects performing assorted types of drilling. The E & E Drilling Team will determine, based on these field observations, whether additional training is required for this individual.

3.3 OTHER E 6 E DRILLING PERSONNEL

All E 6 E personnel shall have taken the basic 40-hour Eealth and Safety Training course. Field personnel must meet medical and respiratory fit test requirements established by E & E and OSHA, as well.

3.4 SUBCONTRACT DRILLER *AND* OTHER SUBCONTRACT DRILLING PERSONNEL

Subcontract Drillers and their support personnel must, at a minimum, have passed basic 40-hour Eealth and Safety Training as prescribed by OSHA 29 CFR1910.120. Th 9 shall be medically approved and trained to use the level(s) of respiratory protection required onsite. Certification of training by the Subcontractor shall be required as a deliverable included in E 6 E's contractual documentation. This training shall be verbally verified and logged onsite by the SSO or Team Leader before starting vork.

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4 SUPERVISION OF SUBCONTRACT DRILLERS

4.1 RESPONSIBILITIES AND AUTHORITY OF SITE SAFETY OFFICER

The responsibilities of the SSO at a drilling site where subcontracted drillers are used include the folloving: rig inspections, personnel monitoring, and personnel protection.

A rig inspection starts vith, but is not limited to, verifying each item on the folloving checklist:

- The mast must be located at least 25 feet from any overhead or underground utility lines.
- The location and operation of operational and unencumbered kill switches must be reiterated to all site personnel.
- Outriggers, stabilizers, or jacks are in place, and the rig is level.
- A geophysical survey (electromagnetic or ground-penetrating radar) or a reliable site history must be obtained to verify absence of buried obstacles, tanks, or drums.
- A first aid kit and filled eyewash must be readily available.
- A fire extinguisher should be charged to the proper pressure and staged at rear of rig during drilling.
- The condition of ropes, chains, and cables must be checked.
- A lifeline or safety belt must be available if mast climbing is necessary.
- The Site Safety Plan (SSP) must be posted vith emergency phone list and map of hospital route.
- A "super exclusion zone" must be established around the borehole, using a 4- by 8-foot sheet of plywood. This defined area will be entered during active drilling only by the Driller, except in emergency situations.

If any of these items need replacement or repair, the SSO must make necessary arrangements and later verify that repair or replacement is sufficient before actual drilling begins. Working together, the SSO and the driller should verify that the rig has been checked against the Operator's checklist.

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The SSO's monitoring duties include calibration and setup of the appropriate monitoring devices, as specified in the SSP. At a minimum, this generally includes an O_2/explosimeter and realtime organic vapor monitoring capabilities (e.g., HNU, OVA). Noise monitoring, like heat stress monitoring, is employed vhere appropriate. If the SSO believes additional monitoring devices beyond the directive of the SSP should be employed (e.g., Rad Mini, Hini Ram), it is his or her responsibility to obtain this equipment with the cooperation of the RSC or the Corporate Health and Safety Group, from the nearest E & E office.

It is the responsibility of the SSO to ensure that all safety equipment is in good working order. Day-to-day operations, as well as calibration data, must be recorded in the equipment log or SSO log. Adequate supplies such as breathing air, drinking liquids, and calibration gas must be maintained.

E & E personnel are forbidden from entering the "super exclusion zone" around the borehole while the rig is actively drilling. The SSO must not attempt to take air readings in or around the auger vhile in use, nor are cutting samples taken vhile the auger is in motion. An O_2/explosimeter should be set up if possible for unmanned (alarmed) operations at the rig using an extension hose to continuously drav samples from the borehole area during drilling Operations.

The SSO has the ultimate authority over the Subcontractor vith regard to whether vork practices meet the requirements of the SSP. Shutdovn of work or restriction of personnel are options available to the SSO. The SSO should hold informal site safety briefings at the start of both field work and daily vork shifts throughout the course of the project. Although E & E contractually requires Subcontractors to provide properly trained and outfitted staff, the SSO should verify verbally at the start-up meeting that the field staff has necessary respiratory approval and OSHA-mandated training, especially on hazardous waste sites. Site safety briefing topics, as well as attendees, will be recorded in the site safety log.

If the SSO has reason to believe either E & E or Subcontractor personnel are under the influence of alcohol or drugs, or are othervise ill before or during work onsite, he or she should consider restricting those team members from site vork. Personnel arriving for work requiring level C protection vho are not cleanly shaved may also be restricted at the discretion of the SSO.

The folloving is a list of basic topics to be covered at site safety meetings:

- Personnel responsibilities;
- Planned investigation and presumed potential hazards;
- Levels of protection, monitoring plan, and equipment;
- Emergency scenario plans, including kill switch use;

- o Location and operation of kill svitches, fire extinguisher, and first aid kit;
- o Heat and cold stress hazards;
- o "Super exclusion zone" around borehole; and
- o Warnings to Subcontractors about hazards of climbing the mast vithout safaty belt and other equipment.

Because heat stress is a constant threat during warm weather, the SSO is responsible for determining vhether conditions are unsuitable for work. Where vorkers cannot vork vith the assistance of vork modifications, cooling vests, and other cooling means, the SSO may decide that vork should not continue. The need for vorker monitoring through blood pressure and oral temperature checks will be determined by the SSO vith assistance from the RSC and Buffalo Health and Safety staff, if necessary.

The SSO will be responsible for shutdovn of the drilling operation if electrical storms are in the site area.

No refueling operations will be performed until rig engines are shut down. Motor fuels should be stored and dispensed from spring-loaded, OSHA/FM-approved gas *cans* constructed of metal or polyethylene.

The SSO should ensure and document that no boreholes are left open or unfilled after drilling equipment is moved. In instances where a hole must be left open and unattended, suitable barricades, or the equivalent, will be staged around the hole to prevent personnel and equipment from falling in.

4.2 RESPONSIBILITIES AND AUTHORITY OF OTHER E 6 E PERSONNEL

All E & E personnel on site are required to follov the terms of the SSP and the direction of the SSO. Because the SSO cannot be in all places at all times, the crew should observe the subcontractors and condition of their equipment at all times, and report immediately to the Team Leader and SSO any safety-related issues that are unresolved. Included are such details as dressout, site functions, and decontamination. It is important that the SSO be involved so that proper log entries can be made.

B & E, as policy, does not provide safety equipment or monitoring instrumentation to subcontractors. Some projects, hovevcr, may be set up so that E & E personnel and subcontractors share the same expendable supplies.

E & E personnel are forbidden from approaching augers during drilling. Activities at the borehole, such as sampling, require that equipment be stopped.

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5 GENERAL DRILLING SITE SAFETY CHECKLISTS

5.1 SAFETY CHECKLISTS FOR SPECIFIC TYPES OF DRILLING ACTIVITIES

5.1.1 General Drilling Site Safety Checklist

- All E & E drilling personnel will have read and understood the terms of the E 6 E drilling SOP.
- Obvious or questionable safety conditions that arise during daily inspection of the rig and its components will be cause for vork interruption.
- Only approved Drillers will remain in proximity to the borehole during drilling, and an approximate 4- by 8-foot "super exclusion area" will be established around the moving auger at all times. No personnel, except the Driller and the Driller's Helper, will enter this zone during drilling. The SSO will issue warnings to those personnel who breach this zone.
- Continuous O_2/explosimeter monitoring at borehole using remote sampling hose will exist at all times.
- All field team members will be briefed on planned drilling operations and possible problems before work begins on day 1. All will be shown the location and operation of "kill switches," vhich will be operationally checked each morning.
- Fire extinguisher(s) will be staged next to the rig before drilling and refueling operations.
- Welding and cutting activities will only be performed avay from ignition sources at a distance approved by the sso or Team Leader.
- Appropriate personnel protective equipment (based on hazards associated with assumed well contaminants) will be worn as directed by the sso and the SSP. At a minimum, steel-toed boots, hard hats, and face shields will be worn during any active drilling.
- Outrigger stabilizers must be in place before drilling commences, and the rig must also be leveled.
- The drill rig mast must be horizontal during movement of rig and should not be erected within 25 feet of overhead lines.

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- Electrical storms within hearing range of the job site will signal work termination until the SSO and Team Leader notify personnel otherwise.

- The local utilities should be contacted prior to drilling so that their lines can be located and flagged. Situations of close proximity may involve isolating utility lines (i.e.' shutdown and inerting of gas lines).

- When buried drums or other material are suspected, a full survey of the drilling zone is required using appropriate instrumentation prior to ground breaking.

- Only trained, experienced staff who have studied proper drilling methods and served as a Helper under an experienced Driller will operate the cathead.

- Only properly licensed staff will drive the drill rig. A daily safety check of the vehicle, following E 6 E protocol, will be carried out by the driver.

- Climbing on the vertical mast is not permitted by E & E staff. Because the boom is not equipped with a ladder, it should be lowered for repairs.

512 Rotary and Core Drilling

The following precautionary measures should be taken during rotary and core drilling:

- Rotary drilling tools should be safety checked prior to drilling:

  - Rods and bit should be open and clear.

  - Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.

  - Drill rod chuck jaws should be checked periodically and replaced when necessary.

  - The capacities of hoists and sheaves should be checked against the anticipated veight of the drill rod string, in addition to other expected hoisting loads.

  - All hoses to and from the pump should be checked for properly installed couplings; couplings should be secured vith locking devices on "quick connect" fittings or wire on "Chicago-Style" couplings.

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- Hoses should be inspected daily for deterioration and leakage, and replaced if needed.

o Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting, and lowering of drill rods:

- Only the Operator of the drill rig should brake or set a manual chuck so that rotation (of the chuck) will not occur before removing the wrench from the chuck.

- Drill rods should not be braked vhile being lovered into the hole vi th chuck jaws.

- Drill rods should not be held or lovered into the hole vith pipe vrenches.

- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods vi th hands or a wrench.

- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled dovn before breaking the first tool joint.

- When drill rods are hoisted from the hole, they should be cleaned for safe handling vith rubber or other suitable rod viper. Do not use your hands to clean drilling fluids from drill rods.

- If work must progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted, cover panels strong enough to hold drill rig personnel.

- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage, or lay the rods down. As previously stated, hardhats, steel-coed boots, safety glasses, and work gloves are to be worn during such work, vith impervious gear and respiratory protection added as required by the SSP.

5.1.3 Cathead Usage

o Keep the cathead clean and free of rust, oil, and grease. If it becomes rusty, clean vith a vire brush.

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- Check the cathead periodically, vhen the engine is not running, for rope vear grooves. If a rope groove forms to a depth greater than 1/8 inch (3 mm), the cathead should be replaced.

- Always use a clean, dry, sound rope. A wet or oily rope may "grab" the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.

- Should the rope "grab" the cathead or othervise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel, including the Operator, to rapidly back avay and stay clear. If the rope "grabs" the cathead and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the Operator can turn off the drill rig engine and initiate other appropriate actions to release the tools. The Operator should carefully vatch the suspended tools, quickly backing away after turning off the engine.

- Chemicals *can* cause deterioration of the rope that may not be visibly detectable, thus the rope should alvays be protected from *any chemical* contact.

- Never vrap the rope from the cathead (or *any* other rope, vire rope, or cable on the drill rig) around a hand, vrist, am, foot, ankle, leg, or any other part of the body.

- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum vhen driving samplers, casing, or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead vith each hammer blow as the sampler or other drilling tool advances into the ground.

- Do not use mort rope vraps than are required to'hoist a load.

- Do not leave a cathead unattended vith the rope vrapped on the drum.

- Position all other hoist lines to prevent contact vith the operating cathead rope.

- When using the cathead and rope for driving or back-driving, make sure that all threaded connections are tight, vhile staying as far avay as possible from the hammer impact point.

- The cathead Operator must be able to operate the cathead standing on a level surface vith sound, firm-footing conditions, vithout distraction or disturbance.

5.1.4 Continuous-Flight or Hollow-Stem Augers

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low RPM.
- Apply an adequate amount of dovn pressure before rotation to seat the auger head belov the ground surface.
- Check auger flights for nicks or burrs that could catch clothing during rotation, and file them dovn.
- Vatch the auger head while slovly engaging the clutch or rotation control, and start rotation. Stay clear of the auger.
- Slovly rotate the auger and auger head vhile continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about 1 foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control, and repeat the starting process.
- An auger guide should be considered to facilitate the starting of a straight hole through hard ground or pavement.
- The Operator and tool handler should establish a system of responsibility for the various activities required for auger drilling, such as connecting and disconnecting auger sections and inserting and removing the auger fork. The Operator must ensure that the tool handler is well avay from the auger column and that the auger fork is removed before starting rotation.
- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger vith your hands, a vrench, or any other tool during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section vhen hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.

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- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger.

- Use a long-handled shovel to move auger cuttings avay from the auger. Never use your hands or feet to move cuttings avay from the auger.

- Do not use hands to clean rotating augers when removing augers from the ground.

- The use of vire line hoists, vire rope, and hoisting hardvare should conform to stipulations developed by the American Iron and Steel Institute Wire Rope Users Manual.

5.1.5 Use of Wire Line Hoists, Vire Rope, and Hoisting Equipment

- All vire ropes and fittings should be visually inspected during vve and thoroughly inspected at least once a veek for abrasion, broken vires, vear, reduction in rope diameter, reduction in vire diameter, fatigue, corrosion, damage from heat, improper veaving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardvare. All related equipment must conform to standards as established by the American Iron and Steel Institute Wire Rope Users Hanual. Vire ropes should be replaced vhen inspection indicates excessive damage according to the Wire Rope Users Manual. All vire ropes vhich have not been used for a period of 1 month or more should be thoroughly inspected before being returned to service.

- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer's inatructions and loaded according to the manufacturer's specifications.

- If a ball-bearing type hoisting svivel is used to hoist drill rods, svivcl bearings should be inspected and lubricated daily to ensure that the svivel freely rotates under load.

- If a rod slipping device is used to hoist drill rods, do not drill through or rotate drill rods through the slipping device, and do not hoist the drill rod column higher than one-half the mast height above the top of the mast (derrick). Do not hoist a rod column with loose tool joints and do not make up, tighten, or loosen tool joints vhilc the rod column is being supported by a rod slipping device. If drill rods should slip back into the borehole, do not attempt to brake the fall of the rods vith hands or by tensioning the slipping device.

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- Host sheaves on exploration drill rigs are stationary with a single part line. The number of parts of line should never be increased without first consulting with the manufacturer of the drill rig.

- Wire ropes must be properly matched with each sheave--if the rope is too large, the sheave will pinch the vire rope—if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger wire ropes.

- Use tool handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool handling hoists to pull objects avay from the drill rig; however, drills may be roved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.

- When stuck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.

- When attempting to free a mired vehicle or drill carrier, use only a winch on the front or rear of the vehicle, and stay as far as possible away from the vire rope. Do not attempt to use tool hoists to pull out a mired vehicle or drill rig carrier.

- Minimize shock loading on a vire rope—apply loads smoothly and steadily.

- Avoid sudden loading in cold weather.

- Never use frozen ropes.

- Protect vire rope from sharp corners or edges.

- Do not operate the rig vith damaged or faulty guides, rollers, sheave bearings, or latches on safety hooks.

- Clutches and brakes on hoists should be periodically tested.

- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.

- Always vear gloves when handling wire rope.

- Polloving the installation of a new vire rope, first lift a light load to allow the wire rope to adjust.

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- Never carry out hoisting operations when weather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Never hoist a load over the head, body, or feet of personnel.
- Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement of vire ropes should conform to the drill rig manufacturer's specifications.

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6 REFERENCES

Health and safety sections of the following operation manuals are incorporated by reference in this SOP:

Diedrich D-50 Safety Manual.

Drilling Safety Guide, Diamond Core Drill Manufacturers Association and National Drilling Contractors Association.

Wire Rope Users Manual, American Iron and Steel Institute.

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STANDARD OPERATING PROCEDURE
FOR
EMERGENCIES DUB TO HEAT AND HEAT STRESS MONITORING

REVISED JANUARY 1990

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1 INTRODUCTION

Field operations present a variety of hazards to the employee. During hot days or vhen vearing protective clothing, heat stress can be experienced and, if not remedied, can threaten the health or life of field personnel. Therefore, it is important that all employees are able to recognize the symptoms of heat stress as well as perform first aid vithout delay.

2 SCOPE

This standard operating procedure (SOP) describes the symptoms and treatment for the three classical types of heat stress presented here in ascending order of severity: heat cramps, heat exhaustion, and heat stroke. Field personnel should take immediate action to prevent a less severe form of heat stress from escalating into one requiring hospital treatment.

In addition, this SOP recommends vays *to* avoid heat stress, such as frequent rest periods, carefully timed excursions in protective clothing, and monitoring heartrate and body temperature. The Site Safety Officer (SSO) has overall responsibility for seeing that these guidelines are followed in the field. However, each individual must be cautious vhen working in conditions vherr heat stress is possible.

3 OBJECTIVES

The prevention of heat stress is of paramount importance for field personnel, particularly vhen they must vear heavy or confining protective clothing. The SSO must ensure that all personnel monitor themselves for possible heat stress, and know what to do in a heat emergency. For example, a person vho recognizes the symptoms of heat stroke *can* provide lifesaving first-aid to another, while medical assistance is summoned.

4 EFFECTS OF HEAT

Normal oxidation processes within the body produce a predictable amount of heat. If the heat is liberated as it is formed, there is no change in body temperature. If the heat is liberated slightly more rapidly, the body cools to a point at which the production of heat is accelerated and the excess is available to bring the body temperature back to normal.

Interference vith the elimination of heat luds to its accumulation and thus to the elevation of body temperature. As a result, the person is said to have a fever. Such a condition produces a cycle in which certain body processes speed up and generate additional heat. Then the body must eliminate not only the normal but also the additional quantities of heat.

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Heat produced within the body is brought to the surface largely by the bloodstream and escapes to the cooler surroundings by conduction and radiation. If air movement such as a breeze strikes the body, additional heat is lost by convection. However, vhen the temperature of the surrounding air becomes equal to or rises above that of the body, all of the heat must be lost by vaporization of the moisture (sveat) from the skin surface. As the air becomes more humid (contains more moisture), vaporization from the skin slovs down. Thus, on a day vhen the temperature is 95°F to 100°F, vith high humidity and little or no breeze, heat is retained vithin the body. It is on such a day or, more commonly, after a succession of such days (a heat vave) that medical emergencies due to heat are likely to occur. Such emergencies are classified in three categories: heat cramps, heat exhaustion, and heat stroke.

4.1 HEAT CRAMPS

Heat cramps usually affect people vho vork in hot environments and perspire a great deal. Loss of salt from the body causes painful cramps of the leg, arm, or abdominal muscles. Heat cramps also may result from drinking iced vater or other drinks either too quickly or in too large a quantity. Eut cramps generally occur during work, but may appear hours later in some cases.

4.1.1 Symptoms

The symptoms of heat cramps include the folloving:

- o Muscle cramps in legs, arms, or abdomen;
- o Pain accompanying the cramps;
- o Profuse perspiration; and
- o Faintness.

4.1.2 Emergency Care

Place the victim in a cool location, observing safety and decontamination considerations (see Section 6) if the victim is coming from the hot zone. Give the person sips of vater or an electrolyte liquid such as Gatorade or its equivalent. Apply manual pressure to the cramped muscle. The victim should not require medical treatment but be alert for any indication of a more serious problem.

4.2 HEAT EXHAUSTION

Heat exhaustion occurs in individuals vorking in hot environments and may be associated vith heat cramps. Heat exhaustion is caused by the pooling of blood in the vessels of the skin. The heat is

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transported from the interior of the body to the surface by blood. The blood vessels in the skin become dilated and a large amount of blood is pooled in the skin. This condition, plus the blood pooled in the lover extremities vhen an individual is in an upright position, may lead to an inadequate return of blood to the heart and eventually to physical collapse.

4.2.1 Symptoms

The symptoms of heat exhaustion are as follows:

- o Pale clammy skin,
- o Profuse perspiration,
- o Generalized weakness,
- o Dizziness,
- o *V u k* pulse,
- o Rapid and usually shallov breathing,
- o Unconsciousness, and
- o Appearance of having fainted (the patient will respond to the same treatment that is administered in cases of fainting).

4.2.2 Emergency Care

Place the victim in a cool location and remove as much clothing as possible while observing proper decontamination procedures. Administer cool water, Gatorade, or its equivalent. If possible, fan the patient continually to remove heat by convection, but do not allow chilling or overcooling. Treat for shock, and take the victim to a medical facility if there is any indication of a more serious problem.

4.3 EBAT STROKE

Heat stroke is a profound disturbance of the heat-regulating mechanism, associated vith high fever and collapse. Sometimes this condition results in convulsions, unconsciousness, and even death. Direct exposure to sun, poor air circulation, poor physical condition, and advanced age (over 40) bear directly on the tendency to heat stroke. It is a serious threat to life and carries a 20-percent mortality rate. Alcoholics are extremely susceptible.

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4.3.1 Symptoms

Folloving are the symptoms of heat stroke (note the absence of perspiration):

- o Dry, hot, and flushed skin;
- o Sudden onset:
- o Full and fast pulse:
- o Dilated pupils:
- o Early loss of consciousness:
- o Body (core) temperature's exceeding 105°F;
- o Muscle twitching, growing into convulsions; and
- o Bruthing deeply at first, later shallovly or even almost absent.

4.3.2 Emergency Care

Remember that this is a true emergency, therefore, transportation to a medical facility should not be delayed. In the meantime, place the victim in a cool environment and remove as much clothing as, possible. Ensure an open airvay. Reduce body temperature promptly, preferably by vrapping the victim in a vet sheet or dousing the body vith vater. If cold packs are available, place them under the arms, around the neck, on the ankles, or any place vhere blood vessels located close to the skin can be cooled. 'Protect the victim from injury during convulsions, especially *tongue* biting.

5 PREVENTION OF HEAT STRESS

Please note that in the case of heat cramps or heat exhaustion, Gatorade or its equivalent is suggested as part of the treatment regime. The reason for this type of liquid refreshment is that such beverages will return much-needed electrolytes to the body's system. Without these electrolytes, body systems cannot function properly, and the represented health hazard will be increased. Therefore, vhen personnel are vorking in situations vhere the ambient temperatures and humidity are high, and especially in situations vhere levels A, B, and C of protective apparel are required, the SSO must follov the procedures listed below:

- o Ensure that all employees have sufficient quantities of fluids (Gatorade or its equivalent). Personnel should prepare ahead of time for field vork in heat stress environments by consuming extra fluids;

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- Ensure that frequent breaks are scheduled so that overheating is less likely to occur;
- Revise vork schedules, vhen necessary, to take advantage of the cooler parts of the day (i.e., 5:00 a.m. to 1:00 p.m., and 6:00 p.m. to nightfall); and
- Cooling vests should be vorn if available.
- NOTE: Taking salt tablets is NOT currently recommended.

5.1 GUIDELINES FOR USE OF PROTECTIVE CLOTHING

If protective clothing must be worn, especially levels A and B, the suggested guidelines for ambient temperature and maximum wearing time per excursion are as follows:

Ambient Temperature (°F)	Maximum Wearing Time per Excursion (min)
Above 90	15
85 to 90	30
80 to 85	.60
70 to 80	90
60 to 70	120
SO to 60	180

5.2 HEARTRATE MONITORING

One method of measuring the effectiveness of an employee's rest-recovery regime is by monitoring the heartrate. The "Brouha guideline" is one such method:

- During a 3-minute period, count the pulse rate for the last 30 seconds of the first minute, the last 30 seconds of the second minute, and the last 30 seconds of the third minute.
- Double the count.

If the recovery pulse rate during the last 30 seconds of the first minute is at 110 beats/minute or less and the deceleration between the first, second, and third minutes is at least 10 beats/minute, the work-recovery regime is acceptable. If the employee's rate is above that specified, a longer rest period is required, accompanied by an increased intake of fluids.

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5.3 HONITORING PERSONNEL BODY TEMPERATURE AND BLOOD PRESSURE

When personnel are in respiratory protective gear for extended periods, or when air temperatures are very high, the monitoring of body temperature and blood pressure is another way of checking for symptoms of heat stress. Careful adherence to existing medical guidelines could identify an individual vho nag not have fully stabilized and therefore, is not ready to continue working in the hot zone.

5.4 MONITORING THE WORK AREA FOR HEAT STRESS CONDITIONS

Air temperature and relative humidity are the two most important measurements for determining tha likelihood that a heat stress situation will occur. The reading can be achieved using both a dry and vet bulb thermometer.

6 DECONTAMINATION

As in other medical emergencies, decontamination should proceed as normally as possible vithout contributing unduly to the victim's stress or injury. At a minimum, the protective clothing should be removed as he or she is taken from the hazardous zone. The "buddy system" is always in effect and backup personnel should be available at the decontamination station to either suit up and assist in extraction or to help decontaminate and undress the victim. If other serious injuries or more life-threatening conditions exist, and the victim cannot be disrobed or decontaminated completely, the victim (or contaminated portions) should be wrapped in plastic (or other protective material) for his or her ovn safety as well as the safety of ambulance and hospital personnel. Carefully avoid action that vould result in the victim's being further overheated.

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Mallinckrodt, Inc., Science Products Division, P O. Box M, Puis. KY 43061.

NITRIC ACID, 70%

PRODUCT IDENTIFICATION:

Synonyms: Aqua Fortis; Azotic Acid; Nitric Acid 70%

Formula CAS No.: 7697-37-2

Molecular Weight: 63.00

Chemical Formula: HNO_3

Hazardous Ingredients: Not Applicable

PRECAUTIONARY SUR

DANGER! STRONG OXIDIZER. CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE. CORROSIVE. LIQUID AND MIST CAUSE SEVERE BURNS TO ALL BODY **TISSUE. MAY BE** FATAL **IF SWALLOWED. HARMFUL** IF **INHALED. INHALATION** MAY **CAUSE LUNG DAMAGE.**

Do **not get in eyes, on** skin, or on **clothing.**
Avoid breathing mist.
Use only with adequate ventilation.
Wash thoroughly after **handling.**
Keep **from contact** with clothing **and** other combustible materials.
Do **not** store near combustible materials.
Store in tightly closed container.
Remove and wash contaminated clothing promptly.
This substance is classified as a POISON under the Federal Caustic **Poison Act.**

EMERGENCY/FIRST AID

In **case** of contact, immediately flush skin or eyes with plenty of **water** for at least 15 minutes. If swallowed, DO NOT INDUCE VOMITING! **Give** large quantities of water or milk **if** available. Never **give** anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, **give** artificial respiration. If breathing is difficult, give **oxygen. In all** cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Oxidizer

SECTION 1 Physical Data

Appearance: Clear, **colorless** to slightly yellow squid.

Odor: Suffocating acrid.

Solubility: Infinite in water.

Boiling Point: 122°C (252°F)

Melting Point: -34°C (-29°F)

Specific Gravity: 1.41

Vapor **Density (Air=1):** 2-3 approximately

Vapor **Pressure** (mm Hg): 62 **@ 20°C (68°F)**

Evaporation Rate: NO **Information** found.

SECTION 2 Fire and Explosion Information

Fire:
Not combustible, but **substance** is a strong oxidizer and its **heat** of **reaction** with **reducing** agents or combustibles **may** cause ignition. Can **react with** metals to **release** flammable hydrogen **gas.**

Explosion:
Reacts explosively with combustible organic or readily oxidizable **materials** such **as:** alcohols, turpentine, charcoal, organic **refuse, metal powder, hydrogen sulfide,** etc.

Fire Extinguishing Media:
If involved in a **fire,** use water spray.

Special Information:
Increases the flammability of combustible, organic and readily oxidizable materials. In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with **full** facepiece operated in the pressure demand or other positive pressure **mode.**

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and **storage. Containers** may burst when heated.

Hazardous Decomposition Products:
When heated to decomposition, emits toxic nitrogen odder **fumes** and hydrogen nitrate. Will react with **water or steam** to **produce** heat and toxic and **corrosive fumes.**

Hazardous Polymerization:
Will not occur.

Incompatibilities:
A dangerously **powerful** oxidizing **agent,** concentrated nitric acid **is** incompatible with **most** substances, **especially** strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

SECTION 4 I

Isolate or enclose the area of the **leak** or spill. Clean-up personnel should **wear** protective clothing and respiratory equipment suitable for **toxic** or **corrosive fluids** or vapors. Small Spills: Flush with water and neutralize with alkaline material (soda ash, lime, etc.). **Sewer** with **excess water. Larger spills** and lot **sizes:** Neutralize with alkaline material, pick up with absorbent material (sand, earth, **vermiculite) and** dispose in a RCRA-approved waste **facility** or **sewer** the neutralized slurry with **excess** water if local ordinances **allow.** Provide forced **ventilation** to **dissipate fumes.**

Reportable Quantity **(RQ)(CWA/CERCLA)** :1000 **lbs.**

Ensure compliance with local, state and federal **regulations.**

AD

NFPA Ratings: Health: 3 Flammability: 0 Reactivity: 0 Other: Oxidizer

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Corrosive! Inhalation of vapors can cause breathing difficulties and lead to pneumonia and pulmonary edema, which may be fatal. Other symptoms may include coughing, choking, and irritation of the nose, throat, and respiratory tract.

Ingestion:
Corrosive! Swallowing nitric acid can cause immediate pain and burns of the mouth, throat, esophagus and gastrointestinal tract.

Skin Contact:
Corrosive! Can cause redness, pain, and severe skin burns. Concentrated solutions cause deep ulcers and stain skin a yellow or yellow-brown color.

Eye Contact:
Corrosive! Vapors are irritating and may cause damage to the eyes. Splashes may cause severe burns and permanent eye damage.

Chronic Exposure:
Long-term exposure to concentrated vapors may cause erosion of teeth. Long term exposures seldom occur due to the corrosive properties of the acid.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to the effects of this substance.

B. FIRST AID

Inhalation:
Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Call a physician.

Ingestion:
DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention immediately.

Eye Exposure:
Wash eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1982)

Inhalation (Rat) LC50: 244 ppm
(NO_2)/30M

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
2 ppm (TWA)
-ACGIH Threshold Limit Value (TLV):
2 ppm (TWA); 4ppm (STEL)

Ventilation System:
A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, "Industrial Ventilation, A Manual of Recommended Practices", most recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded, wear a supplied air, full-facepiece respirator, airlined hood, or self-contained breathing apparatus. Nitric acid is an oxidizer and should not come in contact with cartridges and cannisters that contain oxidizable materials, such as activated charcoal.

Skin Protection:
Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls to prevent skin contact.

Eye Protection:
Use chemical safety goggles and/or a full face shield where splashing is possible. Contact lenses should not be worn when working with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect from physical damage and direct sunlight. Isolate from incompatible substances. Protect from moisture.

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ISOPROPYL ALCOHOL

PRODUCT IDENTIFICATION:

Synonyms: 2-propanol; sec-propyl alcohol; isopropanol

Formula CAS No.: 67-63-0

Molecular Weight: 60.10

Chemical Formula: $(CH_3)_2CHOH$

Hazardous Ingredients: Not applicable.

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL IF SWALLOWED OR INHALED. AFFECTS CENTRAL NERVOUS SYSTEM. CAUSES IRRITATION.

Keep away from heat, sparks and flame.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly after handling.
Avoid contact with eyes, skin and clothing.

EMERGENCY/FIRST AID

If swallowed, give water to drink. Induce vomiting if medical help is not immediately available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.

SEE SECTION 5.

DOT Hazard Class: Flammable Liquid

SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility: Infinite in water.

Boiling Point: 82°C (180°F).

Melting Point: -89°C (-128°F).

Specific gravity: 0.79

Vapor Density (Air = 1): 2.1

Vapor Pressure (mm Hg): 33 @ 20°C (68°F)

Evaporation Rate: (n-BUAC = 1) 2.83

SECTION 2 Fire and Explosion Information

Fire:
Flammable Liquid
Flashpoint: 12°C (53°F). (closed cup).
Autoignition temperature: 399°C (750°F).
Flammable limits in air, % by volume:
lel: 2.0, uel: 12.0.

Explosion:
Above flash point, vapor-air mixtures are explosive within flammable limits noted above. Contact with strong oxidizers may cause fire or explosion.

Fire Extinguishing Media:
Water spray, dry chemical, alcohol foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information:
In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode. Water may be used to flush spills away from exposures and to dilute spills to non-flammable mixtures. Vapors can flow along surfaces to distant ignition source and flash back.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Heat and sunlight can contribute to instability.

Hazardous Decomposition Products:
Toxic gases and vapors such as carbon monoxide may be released in a fire involving isopropyl alcohol.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Heat, flame, strong oxidizers, acetaldehyde, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, oleum and perchloric acid.

SECTION 4 Leak/Spill Disposal Information

Remove all sources of ignition. Ventilate area of leak or spill. Clean-up personnel require protective clothing and respiratory protection from vapors. Small spills may be absorbed on paper towels and evaporated in a fume hood. Allow enough time for fumes to clear hood, then ignite paper in a suitable location away from combustible materials. Contain and recover liquid for reclamation when possible. Larger spills and lot sizes can be collected as hazardous waste and atomized in a suitable RCRA approved combustion chamber, or absorbed with vermiculite, dry sand, earth or similar material for disposal as hazardous waste in a RCRA approved facility.

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

Ma 'odi
Material Safety Data

Emergency Phone Number: 314-982-5000

Mallinckrodt provides the information contained herein in good faith but makes no representation as to its comprehensiveness or accuracy. Individuals receiving this information must exercise their independent judgment in determining its appropriateness for a particular purpose.

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ISOPROPYL ALCOHOL

PRODUCT IDENTIFICATION:

Synonyms: 2-propanol; sec-propyl alcohol; isopropanol

Formula CAS No.: 67-63-0

Molecular Weight: 60.10

Chemical Formula: $(CH_3)_2$ CHOH

Hazardous Ingredients: **Not** applicable.

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL IC SWALLOWED OR INHALED. AFFECTS CENTRAL NERVOUS **SYSTEM. CAUSES IRRITATION.**

Keep away from but, sparks and name.
Keep container closed.
Use with adequate ventilation.
Avoid breathing vapor.
Wash thoroughly **after** handling.
Avoid contact with eyes, **skin** and clothing.

EMERGENCY/FIRST AID

If swallowed, **give** water to drink. Induce vomiting if medical help is not immediately available. Never give **anything** by mouth lo an unconscious person. If Inhaled, remove to fresh air. **If** not **breathing, give** artificial respiration. If breathing **is** difficult, give oxygen. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. **In** all cases call **a** physician.
SEE SECTION 5.

DOT Hazard Clare Flammable Liquid

emergency and preventative

SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility: Infinite in water.

Boiling Point: 82°C **(180°F).**

Melting Point: -89°C **(-128°F).**

Specific **gravity:** 0.79

Vapor Density (Air-1): 21

Vapor Pressure (mmHg): **33 @ 20°C (68°F)**

Evaporation Rate: (n-BUAC = 1) 2.83

SECTION 2 Fire and Explosion Information

Fire:
Flammable Liquid
Flashpoint: **12°C** (53°F). (closed cup).
Autoignition temperature: **399°C** (750°F).
Flammable limits in air, % by volume:
lel: 2.0; uel: 12.0.

Explosion:
Above flash point, vapor-air mixtures are **explosive** within flammable limits **noted above.** Contact with strung oxidizers may cause fire or explosion.

Fire Extinguishing Medlr:
Water spray, dry chemical, **alcohol** foam, or carbon dioxide. Water spray may be used to keep fire exposed containers cool.

Special Information:
In the event of a fire, **wear** lull protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure **mode.** Water may be used to flush spills **away from exposures** and to dilute **spills to non-flammable** mixtures. Vapors can flow abng surfaces to **distant ignition** source and flash **back.**

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage. Heat and sunlight **can** contribute to **instability.**

Hazardous Decomposition Products:
Toxic gases and vapors such as carbon monoxide may be released in a fire **involving isopropyl alcohol.**

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Heat, flame, strong oxidizers, acetadehyde, chlorine, ethylene oxide, hydrogen-palladium combination, hydrogen peroxide-sulfuric acid combination, potassium tert-butoxide, hypochlorous acid, isocyanates, nitroform, phosgene, deum and perchloric acid.

SECTION 4 Leak/Spill Disposal Information

Remove all **sources** of ignition. Ventilate area of kak or **spill.** Clean-up personnel require protective clothing and respiratory protection from vapors. Small **spills may be** absorbed on paper towels and evaporated in a fume hood. **Allow enough** time lor fumes to **clear** hood, then ignite paper in a suitable location away from combustible materials. **Contain** and **recover** liquid lor reclamation when possible. Larger spills **and lot** sizes can **be** collected **as** hazardous waste and atomized in a suitable RCRA approved combustion chamber, or **absorbed with** vermiculite, dry and, earth or similar material lor disposal as **hazardous** waste in a RCRA approved facility.

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health: 1 Flammability: 3 Reactivity: 0

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Arsonic Date 3/26/92

DOT Name/U.N. No. 1558 Job No. UH8000

CAS Number 7784-42-1

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic rad Hazardous Safety Manual **ACGIH** Other:

Rad Health Handbook **NCRP** 65 10 **CFR** 20 Handbook of Chemistry **and** Physics

Chemical Properties: (**Synonyms:** **Arsenia**)

Chemical Formula As Molecular Weight 14.9

Physical State Solid solubility (**H2O**) Insoluble soiling Point Sublimes

Flash Point N/A Vapor Pressure/Density 0 **mm** Freezing Point N/A

Specific Gravity 5.13 Odor Characteristic N/A Flammable Limits Non

Incompatabilities **STRONG OXIDIZERS, BROMINE AZIDE, HYDROGEN GAS**

Biological Properties:

TLV-TWA **0.002 mg/m^3** **PEL** **0.010 mg/m^3** Odor/Odor Threshold Odorless

IDLH **100 mg/m^3** Human Aquatic Rat/Mouse

Route **of** Exposure Inh, Abs, Ing, Con

Carcinogen Yes Toratogen **Mutagen**

Handling Recommendations: (**Personal** protective measures)

Tyvek and safety glasses with full-face respirator available tor upgrade.

Monitoring Recommendations:

Continuous **Mini-Ram**

Disposal/Waste Treatment:

Health Hazards and First Aid:

Eye: wash immediately; skin: wash immediately; Swallow: immediate medical attontion - irritation from exposure requires immediate medical attontion.

Symptoms: Acute: **Headache**, dizziness, nausea, vomiting, convulsions

Chronic: Coma

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Benzene Date 3/23/92

DOT Name/U.N. No. 1114 Job No. UH8000

CAS Number 71-43-2

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Pandbook of Chemistry and Physics

Chemical Properties: (Synonyms: Benzol, Benzole, Cyclohexatriene)

Chemical formula C_6H_6 Molecular Weight 78

Physical State Liquid Solubility (H2O) Slightly Boiling Point 176°F

Flash Point 12°F Vapor Pressure/Density 75 mm Freezing Point 42°F

Specific Gravity 0.879 Odor Characteristic 4.60 ppm Flammable Limits 1.3-7.1%

Incompatabilities strong oxidizers, chlorine, bromine

Biological Properties:

TLV-TWA 10 ppm PEL 1 ppm Odor/Odor Threshold Aromatic

IDLH 100/CNS Human Aquatic Rat/Mouse 50/24H

Route of Exposure Inhalation, ingestion, eye (ocular), dermal absorption

Carcinogen Human - suspected Teratogen Mutagen Experimental

Radiological Properties:

Handling Recommendations: (Personal protective measures)

10 ppm use SCBA. Use protective clothing: excel-viton; good-neoprene, saranax; poor-butyl, natural rubber for gloves. Avoid skin/eye contact

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

Do not induce vomiting or give water or milk: get medical attmntion immediately, remove to fresh air, give artificial respiration if needed, medical attention, flush with watmr, rinse/wash skin with soap and water thoroughly

Symptoms: Acute: Skin irritant, CNS depressant, mostly IHL, initial excitation followed by headache, dizziness, vomiting, delirium, severe exposure may see tremors, blurred vision, shallow respiration, convulsions

Chronic: Anorexia, drowsiness, anemia, bleeding under skin, reduced blood clotting: liver, kidney, bone marrow damage, leukemia

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Chromium (hexavalent) Date 3/23/92

DOT Name/U.N. no. Job No. UH8000

CAS Number 7440-47-3

References Consulted (circle):

NIOSH/OSHA Pocket Quid. Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH other: SAX, Aldrich

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Chromic oxide, soluble chromic salts)

Chemical Formula Cr Molecular Weight 52

Physical State solid Solubility (H2O) insoluble Boiling Point 4788°F

Flash Point N/A vapor Pressure/Density 0 mm Freezing Point 3452°F

Specific Gravity 7.14 Odor Characteristic Flammable Limits

Incompatabilities Strong oxidizers

Biological Properties:

TLV-TWA 0.5 mg/m^3 — PEL a^3 — Odor/Odor Threshold

IDLH N/A Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion

Carcinogen Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

APR: any detectable limit- SCBA. Wear gloves and booties. Prevent skin/eye contact.

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING: give large amounts of water, induce vomiting, immediate medical attention. INH: move to fresh air, CPR if necessary, immediate medical attention. DER: Rinse with large amounts of water.

Symptoms: Acute: Contact dermatitis; irritation of mucous membranes and upper respiratory tract, coughing, wheezing, headache, fever, nausea, vomiting.

Chronic: Carcinogen, liver and kidney damage, bronchitis, ulceration of skin, lung cancer.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name 1,1-dichloroethane Date 3/23/92

DOT Name/U.N. lo. 2362 Job No. UH8000

CAS Number 75-34-3

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Ethylene dichloride)

Chemical Formula CHCl2CH3 Molecular Weight 91.96

Physical State Liquid Solubility (H2O) 0.8% Boiling Point 135 °F

Flash Point 22 F Vapor Pressure/Density 230 mm Freezing Point -32.3°F

Specific Gravity 1.253 Odor Charactristic 5 ppm Flammable Limits 6.2

Incompatabilities Strong oxidisers, caustics. chemically active metals

Biological Properties:

TLV-TWA 100 ppm PEL 100 ppm Odor/Odor Threshold Sweet

IDLH 4,000 ppm Human Aquatic Rat/Mouse 400 mg/kg

Route of Exposure Inhalation, contact, ingestion, eye (occular)

Carcinogen X Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Disposable coveralls (Saranex), full face mask, impermeable gloves, respirators with organic cartridges

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

Ingestion - induce vomiting. Contact - flush with copious amounts of water. Get medical attention.

Inhalation- remove to fresh air.

Symptoms: Acute: Nausea, vomiting, drunkenness, CNS depression, corneal injury, chemical burns.

Chronic: Liver & kidney damage.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Hydrogen Cyanide Date 3/23/92

DOT Name/U.N. no. 1051 Job lo. UH8000

CAS Number 74-90-8

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. 11)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Formonitrile, Hydrocyanic acid, Prussic acid)

Chemical Formula HCN Molecular Weight 27.0

Physical State liquid/ gas Solubility (H2O) miscible Boiling Point 78° F

Flash Point 0 °F Vapor Pressure/Density 630 mm Freezing Point 8 °F

Specific Gravity 0.69 odor Characteristic Flammable Limits Class 1A

Incompatabilities Acids, oxidizers, amines, sodium hydroxide, calcium hydroxide, sodium carbonate, water

Biological Properties:

TLV-TWA 1.7 ppm PEL 4.7 ppm Odor/Odor Threshold bitter, almond-like

IDLH 50 ppm Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion, Dermal

Carcinogen --- Teratogen --- Mutagen ---

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Monitoring Recommendations:

OVA only. The Ionizing potential for HCN is 13.60 eV, so an HNu would be ineffective.

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING: Give water, induce vomiting, medical attention immediately; INH: move to fresh air, medical attention; DER: wash with soap and water promptly.

Symptoms: Acute: stomach distress, vomiting, diarrhea, black stool, headache, dizziness, metallic taste

Chronic: Muscle weakness, joint/muscle pain, insomnia, coma, death

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Lead Data 3/23/92

DOT Name/U.N. No. 2291 Job No. UH8000

CAS Number 7439-92-1

References Consultad (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. If)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Plumbum)

Chemical Formula Pb Molecular Weight 207.2

Physical State solid solubility (H2O) insoluble Boiling Point 3164 F

Flash Point N/A vapor Pressure/Density 0 mm Freezing Point N/A

Specific Gravity 11.34 Odor Characteristic N/A Flammable Limits N/A

Incompatabilities Strong oxidizers, hydrogen peroxide, acids

Biological Properties:

TLV-TWA .100 mg/m3 PEL .050 mg/m3 Odor/Odor Threshold N/A

IDLH 700 mg/m3 Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion, Dermal

Carcinogen — Teratogen — Mutagen —

Radiological Properties:

Handling Recommendations: (Personal protective measures)

5 mg/m^3 high efficiency particulate respirator; other concentrations- SCBA; avoid skin contact or ingestion.

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

ING: Give water, induce vomiting, medical attantion immediately; INH: move to fresh air, radical attention; DER: wash vith soap and water promptly.

Symptoms: Acute: stomach distress, vomiting, diarrhea, black stool, headache, dizziness, metallic taste

Chronic: muscle weakness, joint/muscle pain, insomnia, coma, death

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HAZARD EVALUATION OF CHEMICALS

Chemical Name PCBs Date 3/23/92

DOT Name/U.N. No. UN2315 Job No. UH8000

CAS Number 1336-36-3

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toric and Hazardous Safety Manual ACGIH Other: Chemtex data

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Proportior: (Synonyms: Aroclor 1254, 1221, 1232, 1241, 1245, etc.)

Chemical Formula $C_{12}H_5C_{12}$ (Approx) Molecular Weight 326

Physical State Liquid Solubility (H2O) Insoluble Boiling Point 617° to 691°F

Flash Point 431.3°F Vapor Pressure/Density 0.001 mm Freezing Point -2°F

Specific Gravity 1.3 - 1.8 odor Characteristic Flammable Limits

Incompatabilities strong oxidizers

Biological Proportior:

TLV-TWA 1.0 $\mu g/m^3$ PEL 0.5 mg/m^3 Odor/Odor Threshold mild hydrocarbon

IDLH 5 mg/m^3 Human Aquatic Rat/Mouse

Route of Exposure

Carcinogen X Teratogen Mutagen Suspect

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impermeable clothing, gloves, face shields. Use neoprene, butyl rubber, saranex.

Monitoring Recommendations:

Disposal/Waste Treatment:

Store contaminated clothing in closed container until discarded or laundered.

Health Hazards and First Aid:

Skin or eye contact - flush with water for at least 15 minutes.

Symptoms: Acute: Irritates eyes and skin; jaundice, dark urine; chloracne; nausea; voriting.

Chronic: Liver damage.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Phenol Date 3/23/92

DOT Name/U.N. lo. 1671 Job No. UH8000

CAS Number 108-95-2

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Chemical Properties: (Synonyms: Carbolic Acid, Phonic Acid, Phenyl Hydroxide)

Chemical Formula C_6H_5OH Molecular Weight 94.11

Physical State Solid/Liquid Solubility (H2O) 95 Boiling Point 359°F

Flash Point 175°F Vapor Pressure/Density 40 mm Freezing Point

Specific Gravity 1.06 Odor Characteristic .05 ppm Flammable Limits

Incompatabilities Strong oxidizers, calcium hypochlorite, aluminum chloride acid

Biological Properties:

TLV-TWA 5 ppm PEL 5 ppm Odor/Odor Threshold Sweet, pungent, aromatic

IDLH 250 ppm Human Aquatic Rat/Mouse

Route of Exposure Inh, eye, derm, ing,

Carcinogen Suspect Teratogen Experimental Mutagen Experimental

Handling Recommendations: (Personal protective measures)

APR: Dusty/windy condition or known high concontration of >1 but <5 ppm; SCBA >5 ppm Tyvek and gloves (Neoprene - 10 hours, Butyl - 8 hours)

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

Inh: move to fresh air, APR if necessary; Eye/skin: flush with water for 15 minutes/wash skin with soap and water; Ing: do not induce vomiting--instead, give milk, egg white, or water, and seek medical attention.

Symptoms: Acute: Vomiting, difficulty swallowing, diarrhea, loss of appetite, headache, fainting, dizziness, dark urine, skin rash/whitening of color

Chronic: Liver or kidney damage, eye damage/blindness, circulatory collapse, paralysis, convulsions, coma

[FS]FO5000:60

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Radium 226 Date 3/23/92

DOT Name/U.N. No. 2910/ 2912 Job No. UH8000

CAS Number: Radioactive Material

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and **Hazardous** Safety **Manual** **ACGIH** Other: NCRP65

Rad Health Handbook **NCRP** 65 10 CFR 20 Handbook of Chemistry and **Physics**

Chemical Properties: (Synonyms:)

Chemical Formula Ra 226 **Molecular Weight** 226

Physical State solid **Solubility (H2O)** insoluble **Boiling Point** N/A

Flash Point N/A **Vapor Pressure/Density** 5.5 mm **Freezing Point** N/A

Specific Gravity N/A **Odor Characteristic** N/A **Flammable Limits** N/A

Incompatabilities

Biological Properties:

DAC 3×10^{-10} uCi/mL **MPC** 4×10^{-10} uCi/mL (water) **MPC** 3×10^{-10} uCi/mL (air)

IDLH **Human** **Aquatic** **Rat/Mouse**

Route of Exposure Inhalation, Ingestion, Dermal

Carcinogen -X- Teratogen -X- Mutagen -X-

Radiological Properties:

Alpha, **gamma** emitter, half-life = 1620 years. Radon daughters emit alpha, beta and gamma rays; direct daughter product **is** Radon 222.

Handling Recommendations: (Personal protective measures)

Respirators if airborn particulates arm generated. Health physicist required for external radiation above **2 mR/hour.**

Monitoring **Recommendations:**

Survey ratemeter with alpha probes (GM or ZnS); Micro-R-Meter for **gamma** radiation. TLD badges, pocket dosimeters.

Disposal/Waste Treatment:

Disposal of radioactive waste depends on quantity, activity and form of waste. Disposal at **LLRW** disposal facility **if required.**

Health Hazards and First Aid:

IMG & INH: Decontaminate **personnel** prior to transport; medical attention immediately;

DER: wash **with** soap and water **promptly.**

Symptoms: Acute: stomach distress, vomiting, diarrhea, black stool, headache, dissiness, metallic **taste (above 200 rem)**

Chronic: Lung **cancer, skin** injury, osteogenic sarcoma

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HAZARD EVALUATION OF CHEMICALS

Chemical Name: Xylene Date: 3/23/92

DOT Name/U.N. No.: 1307 Job No.: UH8000

CAS Number: 1330-73-8

References Consulted (circle):

NIOSH/OSHA Pocket Guide Verschueren Merck Index Hazardline Chris (Vol. II)

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physics

Chemical Properties: (Synonyms: Dimethylbenzene, Xylol)

Chemical Formula: C_8H_{10} Molecular Weight: 106

Physical State: Colorless Liquid Solubility (H2O): Boiling Point: 292°F

Flash Point: 77°F Vapor Pressure/Density: 3.7 Freezing Point: -12°F

Specific Gravity: 0.86 Odor Characteristic: 0.5 ppm Flammable Limits: 1.01 - 7.01

Incompatabilities: Strong oxidisers, strong acid, heat, peroxide

Biological Properties:

TLV-TWA: 100 ppm PEL: 100 ppm Odor/Odor Threshold: Aromatic

IDLH: 1,000 ppm Human: IHL TCL 0-200 ppm Aquatic: Rat/Mouse: $IHL\ LD_{50}$ ppm/4HC - 500

Route of Exposure: Inhale, skin

Carcinogen: Experimental Teratogen: Mutagen:

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impervious clothing, PVC gloves, faceshield, avoid prolonged contact. Respirator w/organic vapor cartridge up to 5,000 ppm; >10,000 ppm use SCBA

Monitoring Recommendations:

Disposal/Waste Treatment:

OSHA standard 29 CFR 1910. 106 applies

Health Hazards and First Aid:

Skin - wash w/soap and water; eyes - flush w/water; remove to fresh air if overcome

Symptoms:

Acute: Eye and mucous membrane irritant, CNS depressant, ingestion causes gastrointestinal upset

Chronic: More severe than above, hyperplasia of bono marrow

MAXIMUM ALLOWABLE RADIATION DOSE
TO INVESTIGATION PERSONNEL

Part of Body	Per Calendar Quarter	Per Year
Whole body, head and trunk, gonads, blood forming organs, lenses of eyes	1 rem	4 rem
Skin ot whole body	6 rem	24 rem
Hands, Forearms, Feet and ankles	15 rem	60 rem

Source: E & E 1989

NOTE: Values represent 80% of Federal dose standards per 10 CFR 20.101.

ALL PERSONNEL USING RADIATION MONITORING EQUIPMENT UILL BE TRAINED IN E 6 E's 40 HOUR PROGRAM.

ACTION LEVELS:

≤ 2 mR/Hour - Continuous Monitoring

> 2 mR/Hour - Health Physicist present on-site

> 5 mR/Hour - Exposure time will be limited based on radiation levels

APPENDIX B

SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

[Bold **items** enclosed in brackets denote **changes** to last version of document]

Section 1.0 -- Title Page

Vork Plan Group: G
Site No.: 25
Site Name: Radium Spill Area

Prepared by: Joseph P. Fugitt
Ecology and Environment, Inc.
1203 Governor's Square Blvd., Suite 401
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Prepared for: Department of the Navy
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive, P.O. Box 10068
Charleston, South Carolina 29411-0068
Contract Number N62467-88-C-0200

Signature Approvals:

E & E Project Manager: _____
J. Barksdale

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K. Walker

E & E ASC Director: _____
A. Clifton

E & E QA/QC Project Officer: _____
M. Meredith

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Section 3.0 — Project Summary

Work Plan Group: G

Site No.: 25

Site Name: Radium Spill Area

Site Description: A complete site description and history are presented in sections 2.0 and 3.0 of the attached work plan.

Phase I — Field Screening

Physical Survey (check all that apply):

- X Overall Physical Reconnaissance
- X OVA Surface Emission Survey
- X Radiation Survey
- ___ Habitat/Biota Survey
- X Hydrologic Assessment

Geophysical Survey (check all that apply):

- X Electromagnetic Conductivity:
  - X EM-31 X EM-34
- X Magnetometry
- ___ Very Low Frequency
- ___ Ground Penetrating Radar
- ___ Seismic Refraction
- ___ Seismic Reflection

Analytical Screening (check all that apply):

- ___ Field Analyses
- ___ Soil Eeadspace Analyses: Planned number of samples ____
- ___ Soil Gas Analyses
- X Laboratory Analyses:

PLANNED NUMBER OF SAMPLES

Surface Water	___	Duplicates	3
Sediment	___	Soil Gas Duplicates	___
Soil	45	Trip Blanks	___
Soil Gas	___	Field Blanks	___
Groundwater	5	Preservative Blanks	___
		Rinsate Blanks	___

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Ealocarbons
___ Base/Neutral Extractables
___ Acid Extractables
_X_ Volatile Organic Compounds
_X_ Polynuclear Aromatic Hydrocarbons
_X_ Phenols
___ Dioxins
___ Organophosphorus Pesticides
___ Herbicides

_X_ Pesticides
_X_ Polychlorinated Biphenyls
_X_ Total Recoverable Petroleum Hydrocarbons
_X_ Metals
___ Cyanide
_X_ Gross Alpha

Phase II--Characterization

PLANNED NUMBER OF SAMPLES

Surface Water	___
Sediment	___
Soil	75
Soil Gas	___
Groundwater	16
Duplicates	10
Soil Gas Duplicates	___
Trip Blanks	2
Field Blanks	1
Preservative Blanks	1
Rinsate Blanks	3

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Ealocarbons
X Base/Neutral Extractables
X Acid Extractables
X Volatile Organic Compounds
___ Polynuclear Aromatic Eydrocarbons
___ Phenols
___ Dioxins
___ Organophosphorus Pesticides
___ Eerbicides

X Pesticides
X Polychlorinated Biphenyls
X Total Recoverable Petroleum Eydrocarbons
X Metals
X Cyanide

Additional analytical categories are identified below:

X Gross Alpha
X Gross Beta
X Gamma Scan
X Total Organic Carbon
X Grain Size
X Alkalinity
X Total Suspended Solids (water only)
X Total Kjeldahl Nitrogen
X Ammonia Nitrogen
X Orthophosphate Phosphorus
X Dissolved Oxygen (in field)
X 5-day Biological Oxygen Demand
X Chemical Oxygen Demand
X Radium-226

X pH
X Percent Moisture
X Hardness (water only)
X BTU Content
X Ash Content
X Total Organic Ealogens
X Sulfur
X Ignitability
X Cation Exchange Capacity
___ Sulfide

Section 4.0 -- Project Organization and Responsibility

The overall organizational structure for this site is discussed in Section 4.0 of the GQAPP. Site-specific designated personnel and their responsibilities are listed below:

Site Manager:
Team/Task Leader(s): To Be Determined
Field Support Personnel:

Biographies for those personnel listed above which are not included in the GQAPP are included in Appendix A of this document.

Section 5.0 — QA/QC Objectives for Measurement Data

Criteria for reporting the accuracy, precision, and completeness of data are presented in Section 5.0 of the GQAPP. Detection limits for screening and quantitative analyses are presented in Section 9.0 of the GQAPP. Procedures used to assess data accuracy, precision, and completeness are presented in Section 14.0 of the GQAPP. All analytes (including field parameters), sample media, and method numbers relevant to the investigation of this site are listed in the following table, which also identifies any modifications to the accuracy (A), precision (P), completeness (C), and detection limit (DL) criteria specified in the above-referenced GQAPP sections.

Section 6.0 -- Pieldvork and Sampling Procedures

Fieldwork and sampling procedures are presented in Section 6.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Analyte	Media	Method No.	A	P	C	DL
Laboratory Screening Analyses						
Volatile Organic Compounds	S/W	--	N/M	N/M	N/M	N/M
Polynuclear Aromatic Hydrocarbons	S/W	--	N/M	N/M	N/M	N/M
Pesticides	S/W	--	N/M	N/M	N/H	N/M
Polychlorinated Biphenyls	S/W	--	N/M	N/M	N/H	N/M
Total Recoverable Petroleum Hydrocarbons	S/W	EPA 418.1	N/M	N/H	N/H	TBD
Phenols	S/W	--	N/M	N/H	N/M	N/M
Arsenic	S/W	--	N/M	N/M	N/M	N/H
Cadmium	S/W	--	N/M	N/M	N/H	N/M
Chromium	S/W	--	N/M	N/M	N/H	N/M
Copper	S/W	--	N/M	N/M	N/H	N/M
Lead	S/W	--	N/M	N/M	N/M	N/M
Nickel	S/W	--	N/M	N/M	N/H	N/M
Silver	S/W	--	N/M	N/M	N/M	N/M
Zinc	S/W	--	N/M	N/H	N/H	N/H
Gross Alpha	S/W	EPA 900	N/M	N/M	N/M	N/M
aboratory Analyses						
Radium-226	S/W	EPA 903.1	N/M	N/H	N/H	N/M
Gross Alpha	S/W	EPA 900	N/M	N/M	N/H	N/M
Gross Beta	S/W	EPA 900	TBD	TBD	TBD	TBD
Gamma Scan	S/W	EPA 901.1	TBD	TBD	TBD	TBD
TCL Purgeables + xylene	S/W	EPA 8240/624	N/M	N/H	N/H	N/M
TCL BNAs	S/W	EPA 8270/625	N/H	N/M	N/H	N/M
TCL Pesticides & PCBs	S/W	EPA 8080/608	N/M	N/M	N/H	N/H
Total Recoverable Petroleum Eydrocarbons	S/W	EPA 418.1	N/M	N/M	N/M	N/M
TAL Metals:						
Aluminum	S/W	EPA 6010	N/M	N/H	N/H	N/M
Antimony	S/W	EPA 6010	N/H	N/M	N/M	N/M
Arsenic	S/W	EPA 7060	N/H	N/M	N/M	N/M
Barium	S/W	EPA 6010	N/M	N/H	N/M	N/M
Beryllium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Boron	S/W	EPA 6010	N/H	N/M	N/H	N/M
Cadmium	S/W	EPA 6010	N/M	N/H	N/H	N/M
Calcium	S/W	EPA 6010	N/M	N/H	N/H	N/M
Chromium	S/W	EPA 6010	N/M	N/H	N/H	N/M

Analyte	Media	Method No.	A	P	C	DL
Cobalt	S/W	EPA 6010	N/M	N/M	N/M	N/M
Copper	S/W	EPA 6010	N/M	N/M	N/H	N/H
Iron	S/W	EPA 6010	N/M	N/M	N/H	N/M
Lead	S/W	EPA 7421	N/M	N/M	N/M	N/M
Magnesium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Manganese	S/W	EPA 6010	N/M	N/M	N/H	N/H
Mercury	S/W	EPA 7471/7470	N/H	N/H	N/M	N/H
Nickel	S/W	EPA 6010	N/M	N/M	N/M	N/H
Selenium	S/W	EPA 7740	N/H	N/M	N/H	N/H
Silver	S/W	EPA 6010	N/M	N/M	N/M	N/M
Sodium	S/W	EPA 6010	N/M	N/M	N/H	N/H
Thallium	S/W	EPA 7841	N/M	N/M	N/M	N/M
Tin	S/W	EPA 282.2	N/M	N/M	N/M	N/H
Vanadium	S/W	EPA 6010	N/M	N/M	N/H	N/M
Zinc	S/W	EPA 6010	N/M	N/H	N/H	N/M
Cyanide	S/W	EPA 9010/335.2	N/M	N/M	N/M	N/M
TOC	S/W	EPA 415.1	N/M	N/H	N/H	N/M
Hardness	W	EPA 130.2	N/M	N/M	N/M	N/M
Alkalinity	W	EPA 310.1	N/M	N/M	N/M	N/M
Total Suspended Solids	W	EPA 160.2	N/M	N/H	N/M	N/H
Total Kjeldahl Nitrogen	S/W	EPA 351.3	N/M	N/H	N/M	N/M
Nitrogen-Ammonia	S/W	EPA 350.2	N/M	N/M	N/M	N/H
Orthophosphate Phosphorus	S/W	EPA 365.2	N/M	N/M	N/H	N/M
5-day Biological Oxygen Demand	W	SM 507	N/H	N/M	N/H	N/M
Chemical Oxygen Demand	W	EPA 410.4	N/M	N/H	N/M	N/M
pH	W	EPA 150.1	N/M	N/H	N/H	N/H
Percent Hoisture	S	ASTH D-2216-80	N/M	N/H	N/H	N/H
Grain Size	S	ASTH D-422-63	N/M	N/M	N/H	N/H
BTU Content	S	ASIH D-2015-77	N/M	N/M	N/M	N/M
Ash Content	S	ASTH D-482	N/M	N/M	N/H	N/M
Total Organic Halogens	S	ASTH D-808-81	TBD	TBD	TBD	TBD
		EPA 325.3	TBD	TBD	TBD	TBD
Sulfur	S	ASTH D-129-64	N/H	N/M	N/M	N/M
Ignitability	S/W	EPA 1010	N/M	N/H	N/M	N/M
Cation Exchange Capacity	S	EPA 9081	75-125	35	95%	100mg/kg

Analyte	Media	Method No.	A	P	C	DL
Field Parameters						
pH	W	150.1	N/M	N/H	N/M	N/M
Specific Conductance	W	120.1	N/M	N/M	N/M	N/M
Temperature	W	170.1	N/M	N/M	N/M	N/H
Dissolved Oxygen	W	EPA 360.1	N/M	N/M	N/M	N/M

Notes: S = Soil and/or sediment
W = Groundwater and/or surface water
N/M = No modifications from GQAPP
TBD = To be determined.

*With the exception of total recoverable petroleum hydrocarbons, the laboratory screening analyses do not have EPA method numbers.

Section 7.0 -- Sample Custody

Sample custody procedures are presented in Section 7.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 8.0 — Calibration Procedures and Frequency

Calibration procedures and frequency are presented in Section 8.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 9.0 -- Analytical Procedures

Screening and quantitative analytical procedures are presented in Section 9.0 of the GQAPP. Site-specific accuracy, precision, completeness, and detection limit criteria are presented in Section 5.0 of this SQAPP. Hodifications to any other of the analytical procedures are described below:

No Hodifications

Section 10.0 — Data Reduction, Validation, and Reporting

Data reduction, validation, and reporting procedures are presented in Section 10.0 of tht GOAPP. Hodifications to thtse proctdures are described below:

No Hodifications

Section 11.0 -- Internal Quality Control checks

Internal quality control check procedures are presented in Section 11.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 12.0 -- Performance and System Audits

Performance and system audit procedures are presented in Section 12.0 of the GQAPP. Specific audits planned for this site investigation are listed below:

Audit Type	Frequency/Date	Description
	To Be Determined	

Section 13.0 — Preventive Maintenance

Preventive maintenance procedures are presented in Section 13.0 of the GQAPP. Modifications to these procedures are described below:

No Hodifications

Section 14.0 — Procedures Used to Assess Accuracy, Precision, and Completeness of Data

Procedures used to assess the accuracy, precision, and completeness of data are presented in Section 14.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 15.0 — Corrective Action

Corrective action procedures are presented in Section 15.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 16.0 — Quality Assurance Reports to Management

Quality assurance report procedures are presented in Section 16.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Appendix A — Additional Personnel Biographies

Personnel assigned to this site investigation whose biographies do not appear in the GQAPP are listed below; biographies for these site personnel are presented on the following pages.

To Be Determined

Section 10 — Title Page

Work Plan Group: G
Site No.: 27
Site Name: Radium Dial Shop Sewer

Prepared by: Joseph F. Fugitt
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Signature Approvals:

E & B Project Manager: _____
J. Barksdale

B & B Regional QA/QC Coordinator: _____
K. Walker

E & E ASC Director: _____
A. Clifton

B & B QA/QC Project Officer: _____
M. Meredith

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Section 3.0 — Project Summary

Work Plan Group: G

Site No.: 27

Site Name: Radium Dial Shop Sewer

Site Description: A complete site description and history are presented in sections 2.0 and 3.0 of the attached work plan.

Phase I--Field Screening

Physical Survey (check all that apply):

- X Overall Physical Reconnaissance
- X OVA Surface Emission Survey
- X Radiation Survey
- ___ Habitat/Biota Survey
- X Hydrologic Assessment

Geophysical Survey (check all that apply):

- ___ Electromagnetic Conductivity:
  - ___ EM-31 ___ En-34
- ___ Magnetometry
- ___ Very Low Frequency
- ___ Ground Penetrating Radar
- ___ Seismic Refraction
- ___ Seismic Reflection

Analytical Screening (check all that apply):

- ___ Field Analyses
- ___ Soil Headspace Analyses: Planned number of'samples ___
- ___ Soil Gas Analyses
- X Laboratory Analyses:

PLANNED NUMBER OF SAMPLES

Surface Vater	___	Duplicates	4
Sediment	1	Soil Gas Duplicates	___
Soil	42	Trip Blanks	___
Soil Gas	___	Field Blanks	___
Groundwater	3	Preservative Blanks	___
		Rinsate Blanks	___

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Halocarbons
___ Base/Neutral Extractables
___ Acid Extractables
_X_ Volatile Organic Compounds
_X_ Polynuclear Aromatic Eydrocarbons
_X_ Phenols
___ Dioxins
___ Organophosphorus Pesticides
___ Berbicides

_X_ Pesticides
_X_ Polychlorinated Biphenyls
_X_ Total Recoverable Petroleum Bydrocarbons

_X_ Metals
___ Cyanide
_X_ Gross Alpha

Phase II--Characterization

PLANNED NUMBER OF SAMPLES

Surface Water	___
Sediment	___
Soil	126
Soil Gas	___
Groundvater	12
Duplicates	14
Soil Gas Duplicates	___
Trip Blanks	7
Field Blanks	2
Preservative Blanks	1
Rinsate Blanks	7

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Halocarbons
X Base/Neutral Extractables
X Acid Extractables
X Volatile Organic Compounds
___ Polynuclear Aromatic Hydrocarbons
X Phenols
X Dioxins
X Organophosphorus Pesticides
X Herbicides

X Pesticides
X Polychlorinated Biphenyls
X Total Recoverable Petroleum Hydrocarbons

X Metals
X Cyanide

Additional analytical categories are identified below:

X Gross Alpha
X Gross Beta
X Gamma Scan
X Total Organic Carbon
X Grain Size
X Alkalinity
X Total Suspended Solids (water only)
X Total Kjeldahl Nitrogen
X Ammonia Nitrogen
X Orthophosphate Phosphorus
X Dissolved Oxygen (in field)
X 5-day Biological Oxygen Demand
X Chemical Oxygen Demand
X Radium-226

X pH
X Percent Hoisture
X Hardness (water only)
X BTU Content
X Ash Content
X Total Organic Halogens
X Sulfur
X Ignitability
X Cation Exchange Capacity
X Sulfide

Section 4.0 — Project Organization and Responsibility

The overall organizational structure for this site is discussed in Section 4.0 of the GQAPP. Site-specific designated personnel and their responsibilities are listed below:

Site Manager:
Team/Task Leader(s): To Be Determined
Field Support Personnel:

Biographies for those personnel listed above which are not included in the GQAPP are included in Appendix A of this document.

Section 5.0 — QA/QC Objectives for Measurement Data

Criteria for reporting the accuracy, precision, and completeness of data are presented in Section 5.0 of the GQAPP. Detection limits for screening and quantitative analyses are presented in Section 9.0 of the GQAPP. Procedures used to assess data accuracy, precision, and completeness are presented in Section 14.0 of the GQAPP. All analytes (including field parameters), sample media, and method numbers relevant to the investigation of this site are listed in the following table, which also identifies any modifications to the accuracy (A), precision (P), completeness (C), and detection limit (DL) criteria specified in the above-referenced GQAPP sections.

Section 6.0 — Pieldvork and Sampling Procedures

Pieldvork and sampling procedures are presented in Section 6.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Analyte	Media	Method No.	A	P	C	DL
Laboratory Screening Analyses*						
Volatile Organic Compounds	S/W	--	N/M	N/M	N/H	N/M
Polynuclear Aromatic Bydrocarbons	S/W	--	N/M	N/M	N/H	N/M
Pesticides	S/W	--	N/M	N/H	N/M	N/H
Polychlorinated Biphenyls	S/W	--	N/H	N/M	N/M	N/M
Total Recoverable Petroleum Rydrocarbons	S/W	EPA 418.1	N/H	N/M	N/M	TBD
Phenols	S/W	--	N/H	N/M	N/H	N/M
Arsenic	S/W	--	N/H	N/M	N/H	N/H
Cadmium	S/W	--	N/H	N/M	N/M	N/M
Chromium	S/W	--	N/H	N/M	N/M	N/H
Copper	S/W	--	N/M	N/M	N/M	N/H
Lead	S/W	--	N/M	N/M	N/M	N/H
Nickel	S/W	--	N/M	N/M	N/M	N/M
Silver	S/W	--	N/H	N/M	N/H	N/M
Zinc	S/W	--	N/M	N/M	N/M	N/M
Gross Alpha	S/W	EPA 900	N/M	N/H	N/M	N/M
Laboratory Analyses						
Radium-226	S/W	EPA 903.1	N/M	N/M	N/H	N/M
Gross Alpha	S/W	EPA 900	N/M	N/H	N/H	N/H
Gross Beta	S/W	EPA 900	TBD	TBD	TBD	TBD
Gamma Scan	S/W	EPA 901.1	TBD	TBD	TBD	TBD
TCL Purgeables + xylene	S/W	EPA 8240/624	N/M	N/M	N/H	N/H
TCL BNAs	S/W	EPA 8270/625	N/M	N/M	N/M	N/H
TCL Pesticides & PCBs	S/W	EPA 8080/608	N/M	N/H	N/H	N/H
Dioxins	S/W	EPA 8280	TBD	TBD	TBD	TBD
Organophosphorus Pesticides	S/W	EPA 8140	N/M	N/M	N/M	N/M
Rerbicides	S/W	EPA 8150 (modified)/509B	N/M	N/H	N/M	N/M
Total Recoverable Petroleum Rydrocarbons	S/W	EPA 418.1	N/M	N/M	N/H	N/H
Phenols	S	EPA *8040*	N/M	N/M	N/H	N/M
TAL Hetals:						
Aluminum	S/W	EPA 6010	N/M	N/H	N/M	N/M
Antimony	S/W	EPA 6010	N/M	N/M	N/M	N/M
Arsenic	S/W	EPA 7060	N/M	N/M	N/M	N/M
Barium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Beryllium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Boron	S/W	EPA 6010	N/H	N/M	N/M	N/H
Cadmium	S/W	EPA 6010	N/H	N/H	N/M	N/H
Calcium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Chromium	S/W	EPA 6010	N/M	N/M	N/H	N/H

Analyte	Media	Method No.	A	P	C	DL
Cobalt	S/W	EPA 6010	N/M	N/M	N/H	N/M
Copper	S/W	EPA 6010	N/M	N/H	N/H	N/H
Iron	S/W	EPA 6010	N/M	N/H	N/H	N/M
Lead	S/W	EPA 7421	N/M	N/M	N/H	N/M
Magnesium	S/W	EPA 6010	N/M	N/M	N/M	N/H
Manganese	S/W	EPA 6010	N/M	N/M	N/M	N/H
Mercury	S/W	EPA 7471/7470	N/M	N/M	N/M	N/M
Nickel	S/W	EPA 6010	N/M	N/M	N/M	N/H
Selenium	S/W	EPA 7740	N/M	N/M	N/H	N/M
Silver	S/W	EPA 6010	N/M	N/M	N/M	N/M
Sodium	S/W	EPA 6010	N/H	N/M	N/H	N/M
Thallium	S/W	EPA 7841	N/M	N/H	N/M	N/H
Tin	S/W	EPA 282.2	N/M	N/H	N/M	N/M
Vanadium	S/W	EPA 6010	N/M	N/M	N/H	N/M
Zinc	S/W	EPA 6010	N/M	N/H	N/H	N/M
Cyanide	S/W	EPA 9010/335.2	N/M	N/H	N/M	N/H
Sulfide	S/W	EPA 376.1	N/M	N/M	N/M	N/H
TOC	S/W	EPA 415.1	N/M	N/H	N/H	N/H
Hardness	W	EPA 130.2	N/M	N/M	N/M	N/M
Alkalinity	W	EPA 310.1	N/M	N/M	N/M	N/M
Total Suspended Solids	W	EPA 160.2	N/M	N/H	N/M	N/H
Total Kjeldahl Nitrogen	S/W	EPA 351.3	N/M	N/H	N/M	N/M
Nitrogen-Ammonia	S/W	EPA 350.2	N/M	N/M	N/M	N/H
Orthophosphate Phosphorus	S/W	EPA 365.2	N/M	N/M	N/M	N/M
5-day Biological Oxygen Demand	W	SM 507	N/M	N/M	N/H	N/H
Chemical Oxygen Demand	W	EPA 410.4	N/M	N/M	N/M	N/M
pH	W	EPA 150.1	N/M	N/H	N/H	N/H
Percent Moisture	S	ASTM D-2216-80	N/M	N/M	N/M	N/H
Grain Size	S	ASTH D-422-63	N/M	N/H	N/H	N/M
BTU Content	S	ASTH D-2015-77	N/M	N/M	N/H	N/H
Ash Content	S	ASTH D-482	N/M	N/M	N/M	N/M
Total Organic Halogens	S	ASTH D-808-81	TBD	TBD	TBD	TBD
		EPA 325.3	TBD	TBD	TBD	TBD
Sulfur	S	ASTM D-129-64	N/M	N/M	N/M	N/M
Ignitability	S/W	EPA 1010	N/M	N/M	N/M	N/H
Cation Exchange Capacity	S	EPA 9081	75-125	35	95%	100mg/kg

Analyte	Media	Method No.	A	P	C	DL
Field Parameters						
pH	W	150.1	N/H	N/M	N/M	N/H
Specific Conductance	W	120.1	N/H	N/M	N/M	N/H
Temperature	W	170.1	N/M	N/M	N/M	N/M
Dissolved Oxygen	W	EPA 360.1	N/M	N/M	N/M	N/M

Notes: S = Soil and/or sediment
V = Groundwater and/or surface water
N/M = No modifications from GQAPP
TBD = To be determined.

*With the exception of total recoverable petroleum hydrocarbons, the laboratory screening analyses do not have EPA method numbers.

Section 7.0 — Sample Custody

Sample custody procedures are presented in Section 7.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 8.0 -- Calibration Procedures and Frequency

Calibration procedures and frequency are presented in Section 8.0 of the GQAPP. Modifications to these procedures are described below:

No Modifications

Section 9.0 — Analytical Procedures

Screening and quantitative analytical procedures are presented in Section 9.0 of the GQAPP. Site-specific accuracy, precision, completeness, and detection limit criteria are presented in Section 5.0 of this SQAPP. Modifications to any other of the analytical procedures are described belov:

No Xodifications

Section 10.0 — Data Reduction, Validation, and Reporting

Data reduction, validation, and reporting procedures are presented in Section 10.0 of the GQAPP. Modifications to these procedures are described below:

No Xodifications

Section 11.0 — Internal Quality Control Checks

Internal quality control check procedures are presented in Section 11.0 of the GQAPP. Modifications to these procedures are described below:

No Xodifications

Section 12.0 — Performance and System Audits

Performance and system audit procedures are presented in Section 12.0 of the GQAPP. Specific audits planned for this site investigation are listed below:

Audit Type	Frequency/Date	Description
	To Be Determined	

Section 13.0 — Preventive Maintenance

Preventive maintenance procedures are presented in Section 13.0 of the GQAPP. Modifications to these procedures are described below:

No Hodifications

Section 14.0 — Procedures Used to Assess Accuracy, Precision, and Completeness of Data

Procedures used to assess the accuracy, precision, and completeness of data are presented in Section 14.0 of the GOAPP. Hodifications to these procedures are described below:

No Modifications

Section 15.0 — Corrective Action

Corrective action procedures are presented in Section 15.0 of the GOAPP. Modifications to these procedures are described below:

No Modifications

Section 16.0 — Quality Assurance Reports to Management

Ouality assurance report procedures are presented in Section 16.0 of the GOAPP. Hodifications to these procedures are described below:

No Hodifications

Appendix A — Additional Personnel Biographies

Personnel assigned to this site investigation whose biographies do not appear in the GQAPP are listed below; biographies for these site personnel are presented on the following pages.

To Be Determined

APPENDIX C

THREATENED AND ENDANGERED FLORA AND FAUNA ASSOCIATED WITH NAS PENSACOLA

[Bold items enclosed in brackets denote changes to last version of document]

APPENDIX C
THREATENED AND ENDANGERED FLORA AND FAUNA OBSERVED OR LIKELY TO OCCUR WITHIN THE NAS PENSACOLA FACILITY OR NEARBY

Scientific Name	Common Name	Base * Status	Status FGFWFC(or FDA)	Status USFWS	Habitat
FISHES					
Acipenser oxyrhynchus	Atlantic sturgeon	M	SSC	UR 2	Gulf coast, estuarine
Ammocrypta asprella	Crystal darter	U	T	UR 2	Fresh water
Etheostoma histrio	Harelquin darter	U	SSC		Fresh water
Fundulus jenkinsi	Salt marsh topninnow	P	SSC		Salt, frorh, brackish waters
Lepisosteus spatula	Alligator gar	U	SSC		Brackish, fresh, salt water
Moxostoma carinatum	River redhorse	U	SSC		Fresh water
AMPHIBIANS AND REPTILES					
Alligator mississippiensis	American Alligator	R	SSC	T(S/A)	Swanpr, marshes, ponds
Caretta caretta caretta	Loggerhead turtle	M ?	T	T	Marine, coastal
Chelonia mydas mydas	Green turtle	M ?	E	E	Marine, coastal
Dermochelys coriacea	Leatherback turtle	n	E	E	Marine, coastal
Drymarchon corais couperi	Eastern indigo snake	P	T	T	Open areas near water
Eretmochelys imbricata	Hawksbill turtle	M ?	E	E	Marine, coastal
Gopherus polyphemus	Gopher tortoise	P	SSC	UR 1	Sandy coastal plains
Graptemys pulchra	Alabama nap turtle	U	SSC		Swamps, streams, marshes, ponds
Lepidochelys kempi	Atlantic ridley	M ?	E	E	Marine, coastal
Rana areolata aesopus	florid. gopher frog	P	SSC	UR 2	Sand hill communities
Macroclemys temmincki	Alligator snapping turtle	SR	SSC	UR 2	Swamps, marshes, ponds
MAMMALS					
Mustela vison lutensis	florid. mink	U		UR 2	Terrestrial habitats
Peromyscus polionotus trissyllepsis	Perdido Key beach mouse	N/A	T	E	Beach dunes
Trichechus manatus latirostris	Wort Indian manatee	M	E	E	Atlantic and Gulf coasts
Ursus americanus floridanus	florid. black boor	N/A	T	UR 2	Titi swamps

Appendix C (Coat).

Scientific Name	Common Name	Base * Status	status FGFWFC(or FDA)	USFWS	Habitat
BIRDS					
Charadrius melodus	Piping Plover	P	T	T	Open dry, randy beaches
Charadrius alexandrinus	Snowy plover	P	T	UR 2	Open dry, randy beaches
Dendroida dominica atoddardi	Stoddard's yellow-throated warbler	P-U		UR 2	Wooded habitats
Dendroica kirtlandii	Kirtland's warbler	U	E	E	Wooded habitatr
Haematopus palliatus	American oystercatcher	U	SSC		Coastal habitats
Egrotta rufescens	Reddish egret	P-U	SSC	UR 2	Freshwater/coastal wotlands
Egretta caerulea	Little blue heron	P-u	SSC		Freshwater/coastal wetlands
Egretta thula	Snowy egret	P-u	SSC		Freshwater/coastal wetlands
Grus canadensis pratensis	Florida sandhill crane	U	T		Freshwater wotlands
Falco peregrinus tundrius	Arctic peregrine falcon	M	E	T	Winters on coasts
Falco sparverius paulus	Southeastern kestrel	I	T	UR 2	Open pine forests, clearings
Haematopus palliatus	American oystercatcher	P-U	SSC		Opon coastal beaches
Haliaeetus leucocephalus	Bald eagle	P-u	T	E	Pine forests/coastal habitat
Pandion haliaetus	Osprey	I	SSC		Near water
Pelecanus occidentalis	Brown pelican	R	SSC	AC	Mangrove trees, coasts
Picoides borealis	Red-cockaded woodpockor	P-u	T	E	Cavity nests/old pine stands
Vermivora bachmanii	Bachmann's warbler	U	E	E	Wooded habitat.
Campephilus principalis	Ivory-billed woodpockor	U	E	E	Wooded habitatr
Sterna antillarum	Least torn	U	T		Coastal habitats
Mycteria americana	Wood stork	U	E	e	Freshwater/coastal wetlands
Rostrhamus sociabilis	Snail kite	U	E	E	Freshwater/coastal wetlands
INVERTEBRATES					
Copris gopheri	Scarab beetle	P		UR 2	Associated w/Gopher Tortoise

Appendix C (Coat.)

Scientific Name	Common Name	Base * Status	Status FGFWFC(or FDA)	USFWS	Habitat
PLANTS					
Chrysopsis gorrypina cruiseana	Cruise's golden-aster	P	E	UR I	Coastal dunes
Drosera intermedia	Spoon-leaved sundew	R	t		Aquatic habitats
Epigaea repens	Trailing arbutus	U	E		Dry, acid, randy roil
Kalmia latifolia	Mountain laurel	U	T		Rich, moist, shady woods
Lilaeopsis carolinensis	Carolina lilaeopsis	R		UR 2	
Lilium iridollae	Panhandle lily	U	C	UR 2	Black, mucky soils
Pinguicula planifolia	Chapman's buttorwort	U	RE	UR 2	
Polygonella macrophylla	Large-leaved jointweed	R	T	UR I	Sand pine-oak scrub
Rhododendron austrinua	Orange azalea	U	E	UR 5	Moist. woody habitats
Sarracenia leucophylla	Whit.-top pitchorplant	R	E		Open acid bogs
Sarracenia rubra	Sweet pitchorplant	U	C	UR 2	Acid bogs/slash pine woods
Stewartia malacodnadron	Silky camellia	U	C		Slopes of wooded ravines

C = Endangorod
T = Threatened
UR 1 = Under review, for Federal listing with substantial evidence in existence indicating at least some degree of biological vulnerability and/or throat.
UR 2 = Under review, insufficient biological data available.
UR 5 = Candidate species, but taxa has proven to bo more widespread than was previously believed and/or thoro species that are not subject to any identifiable throat.
FDA = Florida Department of Agriculture.
FGFWFC = Florida Game and Freshwater Fish Commission.
USFWS = U.S. Fish and Wildlife Service.

Appendix C (Cont.)

Base *	=	Status of species on tho NAS Pensacola facility.
R	=	Resident.
M	=	Migrant.
SR	=	Suspected resident.
P	=	**Possible** resident duo to **available** habitat; survey required.
U	=	Unknown, survey required.
N/A	=	Not expected to occur on tho WAS Pensacola facility.

[APPENDIX D

JUNE 1990 *SECTION* **14.2--CHARACTERIZATION]**

[Bold items enclosed in brackets denote
changes to **last** version of **document]**

14.2 Phase II - Characterization

The primary objectives of the Phase II field investigation are as follows:

- o To characterize the nature and magnitude of the full spectrum of potential site contaminants;
- o To confirm and validate the contaminant distributions indicated by the Phase I analytical screening results by collecting and analyzing samples under full-scale CERCLA-type QA/QC requirements;
- o To support the preliminary identification, screening, and evaluation data requirements of potential remedial alternatives;

Phase II investigation of each site will involve the collection of soil, sediment, and groundwater samples. Additional permanent, shallow monitoring wells will be installed. Air sampling will be conducted only if warranted by the results of Phase I efforts. In addition, limited aquifer testing will be performed.

The Phase II investigation of sites 25 and 27 is proposed to involve the collection of soil, groundwater and sediment samples. Permanent shallow monitoring wells will be installed as required with respect to Phase I analytical data. Limited aquifer testing will be performed on newly installed and existing monitoring wells. Air sampling will be conducted if deemed appropriate based on Phase I analytical data. The analytical requirements for Phase II sampling can be found in Table 14-2.

During the Phase II investigation of Site 27, which is covered by RCRA requirements, at least one sample per contaminated medium will also be analyzed for Appendix IX parameters (40 CFR, Part *264).* These samples will be collected from the area of highest contamination for each medium as determined during the Phase I investigation. Additional Appendix IX samples may be required depending on the extent of contamination detected.

[Bold items enclosed in brackets denote
changes to last version of **document]**

TABLE 14-2

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS—GROUP G

SITE 25

Medium	Ao. of Samples	Dupli-cates	Trip Blanks.	Field Blanks	Rinsate Blanks	[Preservative blanks[b]]	Total*	Analytical Suite[c,d]
Soil	25	3	2	[1]	2	[1]	34 (10)	A C
Groundwat.r	3	1	1	[NR]	1	[NR]	[6] (1)	A B
TOTAL	28	4	3	[1]	3	[1]	[40](11)	

SITE 27

Medium	No. of Samples	Dupli-cates	Trip Blanks[a]	Field Blanks	Rinsate Blanks	[Preservative Blanks[b]]	Total*	Analytical Suit-[c,d]
Soil	25	3	2	[1]	2	[1]	34 (10)	A C
Groundwater	[3]	1	1	[NR]	1	[NR]	[6] (1)	A B
Sediment	[3]	1	1	[NR]	1	[NR]	[6] (1)	A C
TOTAL	31	5	4	[11	4	[1]	[46](12)	

[a]Trip blanks will be analyzed for [Target] Compound List (TCL) volatile organic compound. only.

[[b]Preservative blanks will be analyzed for TCL volatile organic compounds, total recoverable hydrocarbons, total TCL metals, and cyanide.]

[c]Analytical suite designations are as follows:

A = Gross Alpha, Radium 226, TCL volatile organic conpounda plus xylene and kotonoa, TCL base/neutral and acid extractable organic conpounda, TCL pesticides and PCBs, total recoverable hydrocarbons, TCL metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered]), cyanide, total organic carbon, hardness (water only), and alkalinity (water only).

D = Total suspended solids, total Kjeldahl nitrogon, ammonia nitrogen, orthophosphate phosphorus, dissolved oxygen tin field), 9-day biological oxygon demand (BOD_5), and chemical oxygon demand (COD).

C = pH, alkalinity, percent moisture, grain size, BTU content, ash contont, total organic halogens, sulfur, ignitability, and cation exchange capacity.

[d]Specific constituents encompassed by tho various chemical groups included within tho above-listed analytical suites are identified in Tables 9-5 through 9-13 of tho Generic Quality Assurance Project Plan.

*Tho number of samples shown in parentheses will bo analyzed for tho additional parameters indicated.

[NR = lot required.]

14.2.1 Biota Sampling

The need for formal biological sampling will be based on the results of the Phase I habitat/biota survey and analytical screening results. If biological sampling is required, a separate biological sampling plan will be prepared which outlines sample locations, sampling methodologies, analytical parameters, etc.

14.2.2 Soil Sampling

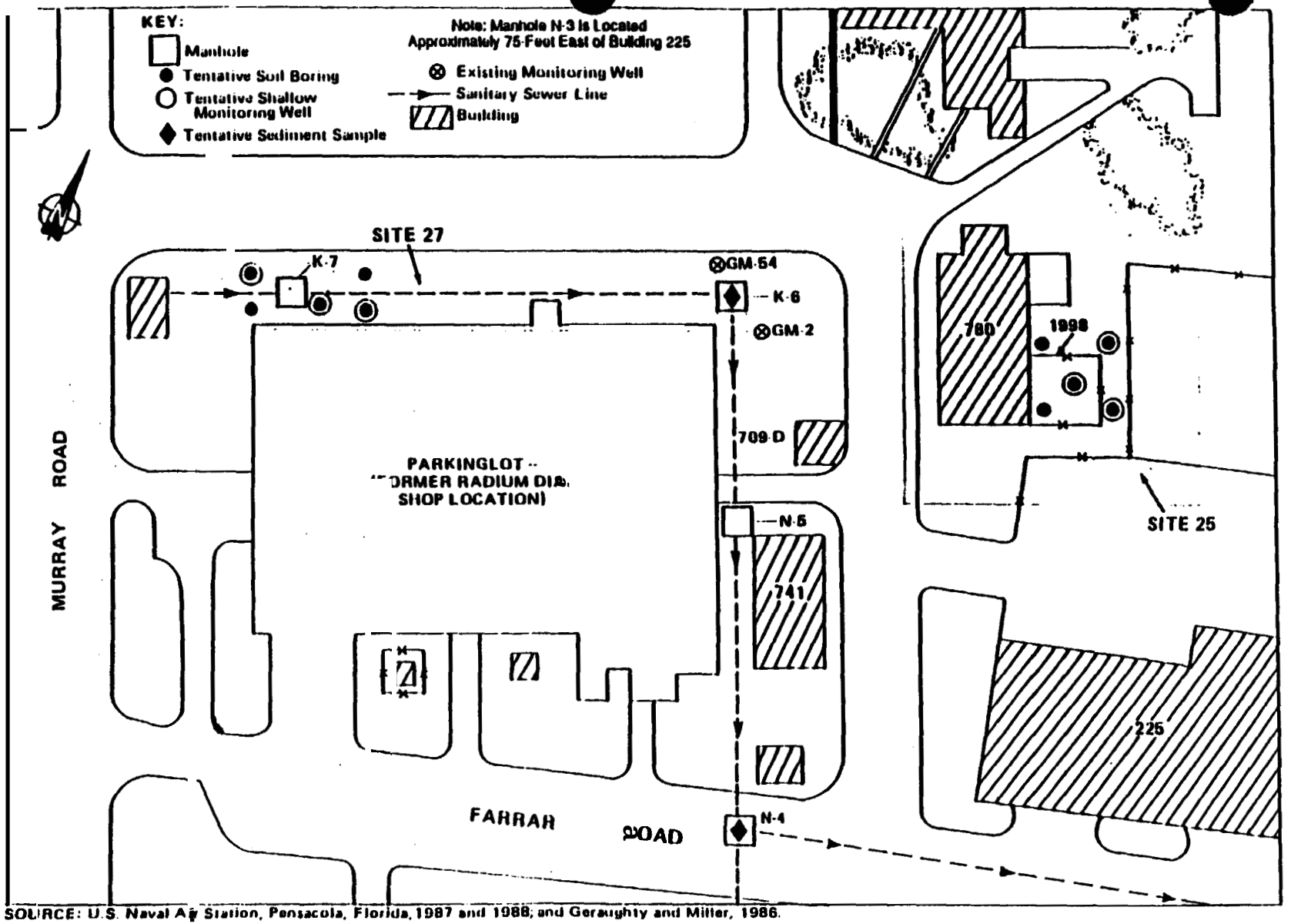
The actual numbers and locations of soil samples will be determined based on the results of Phase I analysis. A total of 25 soil samples will be collected at each site. Tentative sampling locations are shown in Figure 14-2. Samples will be collected by cornpositing the following depth intervals: 0 to 0.5 feet, 0.5 to 2.5 feet, then every 2.5 feet to the water table or to a maximum of 10 feet. Intervals deeper than 10 feet will be sampled only if contamination is indicated during Phase I.

For the purpose of calculating sample numbers, the depth to the water table is assumed to be 15 feet at sites 25 and 27. The total number of proposed samples and the analytical parameters are shown in Table 14-2. Samples will be conducted as outlined in 6.6.2 of the GOAPP.

14.2.3 Shallow Monitoring Well Installation and Development

The actual number and locations of shallow monitoring wells to be installed will be based on the analytical results of Phase I. Three wells will be installed both at Site 25 and at Site 27, to proposed depths of 25 feet. Tentative well locations are shown in Figure 14-2. All wells will be installed using the hollow stem auger drilling method as outlined in Section 6.7.2 of the GQAPP. All shallow monitoring wells are anticipated to be installed to a depth of 25 feet and will be constructed of 2-inch PVC with 10 feet of 0.10-inch screen bracketing the water table. Details on well construction can be found in Section 6.7.3 of the GQAPP.

Depending on the results obtained during Phase I, the delineation of the extent of shallow groundwater contamination may be possible during Phase II by the installation of a few monitoring wells in addition to the



SOURCE: U.S. Naval Air Station, Pensacola, Florida, 1987 and 1988; and Geraughty and Miller, 1986.

SCALE

0 100 200 300 FEET

Figure 14–2 TENTATIVE SOIL BORING AND SHALLOW MONITORING WELL AND SEDIMENT SAMPLING LOCATIONS, SITES 25 AND 27 – PHASE II

number proposed. When and where possible and/or practical, additional monitoring wells will be installed during Phase 11 in order to expedite the overall investigation schedule.

14.2.4 Groundvater Sampling

Groundwater samples will be collected from all new shallow monitoring wells after well development. Samples will be collected as outlined in sections 6.8 and 6.10 of the GQAPP. The temperature, pH, and specific conductance of the groundwater from each well will be measured in the field.

14.2.5 Hydrologic Assessment

A well head elevation survey will be conducted on each of the new monitoring wells as previously described in Section 14.1.4 of this work plan. Water levels will be measured in all new and existing wells to determine the shallow groundwater flow and horizontal and vertical hydraulic gradients.

In addition, limited aquifer testing will be performed consisting of short-term specific capacity tests conducted during well development and/or slug testing. These tests are useful in deriving first estimates of aquifer hydraulic properties. Aquifer testing will be conducted in conjunction with well development to decrease the amount of potentially contaminated groundwater that must be disposed of.

Hydrologic and analytical data will be used to evaluate the lateral migration of contaminants and plan the locations of deep wells, if needed, in subsequent phases of the site characterization.

14.2.6 Sediment Sampling

Two sediment samples are tentatively proposed to be collected from manhole access locations to the sewer at Site 27, as shown on Figure 14-2. In addition, the sewer outfall will be located and one sediment sample will be collected. The sediment samples will be collected as described in Section 14.1.3.1 for the Phase I sediment samples. A summary of analytical parameters can be found in Table 14-2.

14.2.7 Air Sampling

Formal air sampling will be performed in Phase II as deemed appropriate based on Phase I surface emission surveys and particulate air sampling, and the Phase I shallow soil sampling.