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CONTAMINATION ASSESSMENT/ REMEDIAL ACTIVITIES INVESTIGATION WORK PLAN—GROUP G NAVAL AIR STATION PENSACOLA PENSACOLA, FLORIDA

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

July, 1990

Prepared for:

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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 of 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 of 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? vhich, 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 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 vork 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.

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2. SITE DESCRIPTION

2.1 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 to the east of the building. The entire area between the helicopter scrap yard and Building 780 is paved with concrete. The areas to the 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. There are no surface water bodies present in the immediate site vicinity, but Bayou Grande is located approximately 1,300 feet to the north of the site (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 to the 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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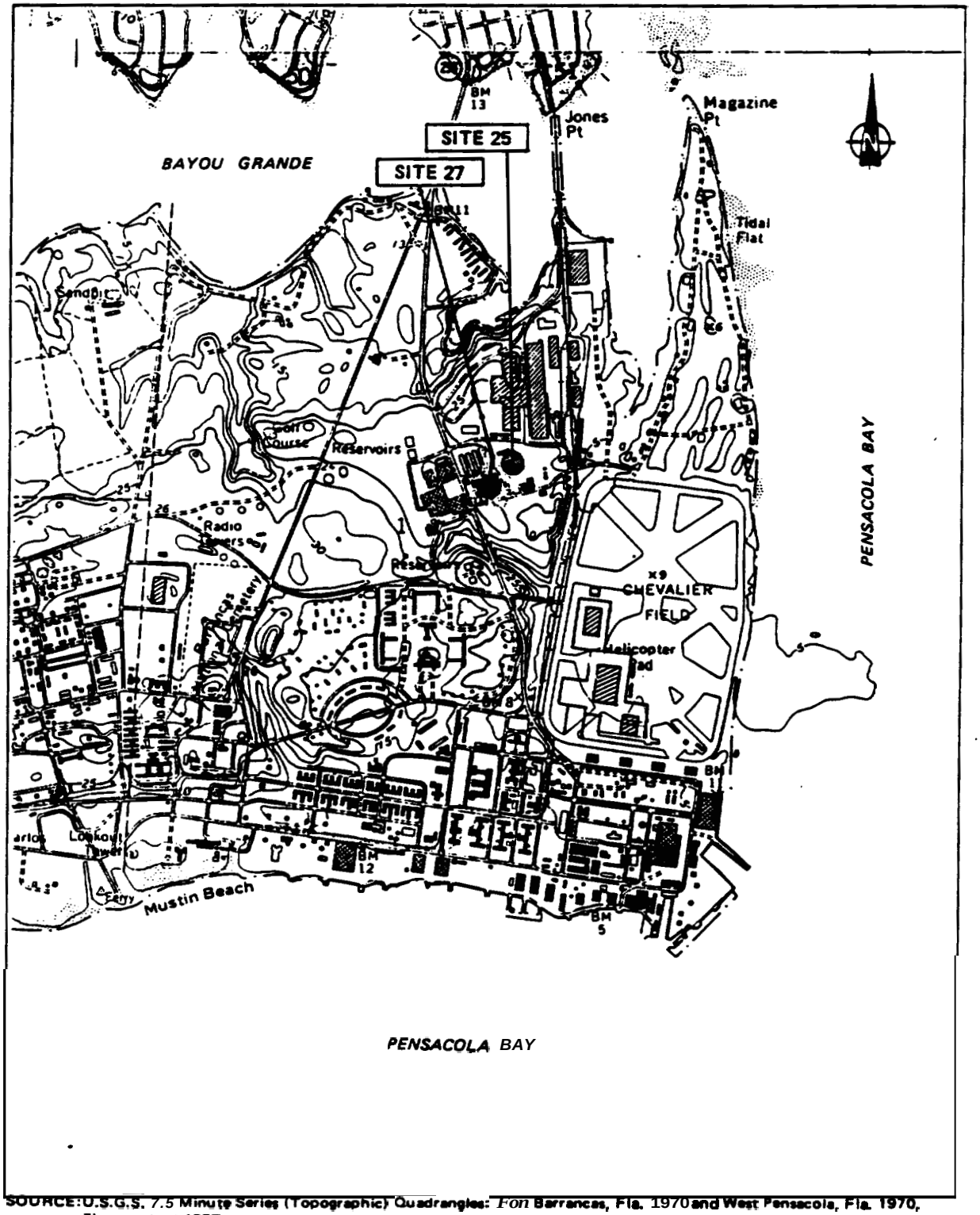


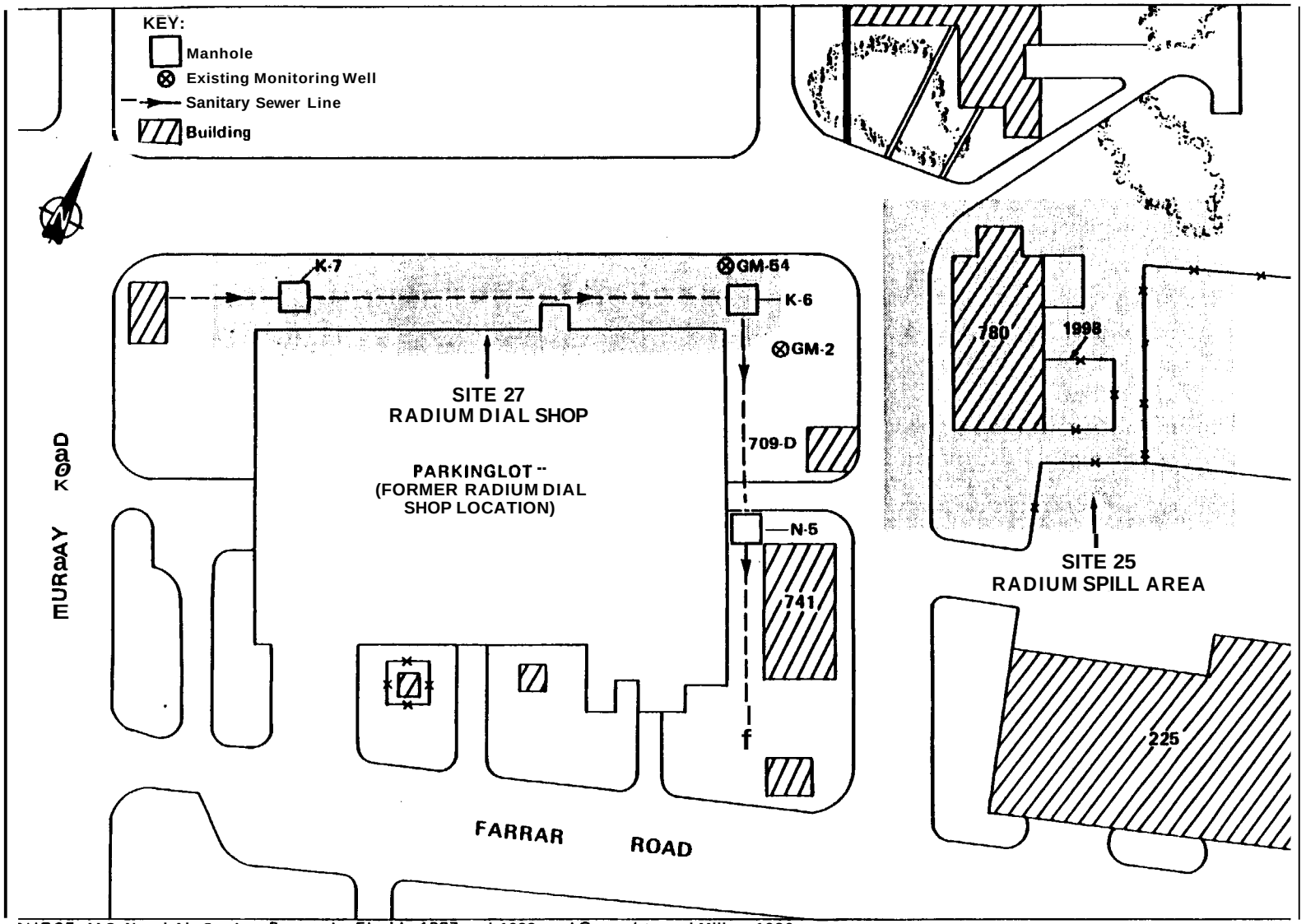
SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: *Fort* Barrancas, Fla. 1970 and West Pensacola, Fla. 1970, Photorevised 1987

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

2.2 Site 27 - Radium Mal Shop Sever

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 shovn 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 to the west of Site 27 across Hurray Road. Hanhole K-7, of the sanitary sewer, 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 mean sea level (HSL). The direction of surface drainage is generally to the north-northeast (Geraghty & Hiller, Inc. [G & M] 1986). In general, where exposed, the surface soils are sandy and well-drained.

Two 2-inch PVC monitoring wells (GH-2 and GM-54) are located near the northeast corner of the parking lot. Well GH-2 is screened from 17.7 to 20.2 feet and well GH-54 is screened from 109.5 to 114.5 feet (G & 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).

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Four other shallow monitoring wells are located in the site vicinity. Well GM-1 is located 200 feet northwest of Site 27 on Site 31 which is northwest of the parking lot. Well GM-2 is screened from 23.8 to 26.3 feet. Approximately 1,500 feet southeast of Site 27 are shallow wells GM-52, GM-55 and GM-58. 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).*

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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 Building 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 1970's (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.

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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 clean up operation is not known.

In June of 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 was not recommended.

3.2 Site 27 - Radium Dial Shop Sever

From the 1940's 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 re-painting 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 reworked 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).

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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 it's 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 drain pipe, portions of the linoleum floor covering, walls, and wooded 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 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

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the sever system associated vith the Radium Dial Shop. The site vas discussed during a meeting betveen 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 vas completed by G & H, which included findings and recommendations concerning Site 27. During the study, a monitor vell (GM-2) vas 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; hovever, chlorinated hydrocarbons vere found in concentrations as high as 29 ug/L as shovn in Table 3-1. Shallov monitoring vell GH-1 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 close proximity of Sites 31 and 27, and the fact that Site 27 is hydraulically dovngradient of the potential contamination sources on Site 31, the two sites vere grouped together for the verification study (G & M 1984). G & H recommended that a deep monitoring vell be installed adjacent to GH-2 to determine the vertical hydraulic gradient (G & M 1984).

In Harch 1986, a Characterization Study vas completed by G & M during which the proposed deep vell (GH-54) vas installed. This vell was sampled and no VOCs were detected. As shown on Table 3-1, shallow monitoring wells GX-52, GH-55 and GH-58 vere also installed and sampled as part of the Characterization Study. These wells are approximately 1,500 feet hydraulically dovngradient (to the southeast) of Site 27, hovever they are not directly associated to Site 27. G & M concluded that Site 27 did not pose an imminent hazard to human health or the environment and no further action vas recommended (G & H 1986).

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TABLE 3-1

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS
FOR SITES 25 AND 27 (ug/l (ppb))

Compounds Detected (EPA Methods 601 and 602)	Monitoring Well Number											
	GM-1		GM-2		GM-52		GM-54		GM-55		GM-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	--	3.1	--	N.A.	--	N.A.	--	N.A.	--	N.A.	--
1,2-dichloroethane	--	--	29	--	N.A.	--	N.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.	--	#.A.	210
Tetrachloroethene	0.4	--	0.6	--	N.A.	--	N.A.	--	N.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.	13

NOTES: V.S. = Verification Study, Geraghty and fliller, 1984
C.S. = characterization Study, Geraghty and fliller, 1986

KEY: -- = Not present above detection limits
N.A. = Not Applicable - wells were not installed at this date.

4. CLIMATOLOGY

The 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 (Wolfe ~~et al~~. 1988). The average annual temperature ranges from 55° Fahrenheit (F) in the winter to 81° F in the summer. Although the annual temperature range is fairly stable, actual daily values can be more extreme, ranging from less than 7° F in the winter to more than 102° F in the summer. Thunderstorms occur during approximately half of the days during the summer months and can cause a 10° to 20° F drop in temperature in only a few minutes (Wolfe ~~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 [seven] inches per month) and lowest during spring and fall (averaging [four] inches per month)([Kennedy 19821). High intensity thunderstorms are common, producing as much as three to four inches of rainfall during a single hour. Evaporation rates are also highest in the summer months, which reduces the potential recharge resulting from heavy summer rains. Spring and fall rains are generally less intense, but longer in duration, producing less surface runoff and higher rates of infiltration and net recharge.

Wind 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. However, the NAS Pensacola installation has approximately 3,500 acres in natural or semi-natural (plantation) condition, primarily in the western portion of the facility.

5.1 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 Uniuola paniculata (sea oats), Hydrocotyle bonariensis (beach pennywort), Ipomea 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 3 to 5 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 pine), Quercus spp. (scrub oak species, geminata, champanii, myrtifolia, and

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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 aan-made or biological factor. This community type can have 3 to 5 distinct habitats (Uolfe et al. 1988).

Two other community types may 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 vere verified with walk-through surveys and ground truthing by the Navy in March of 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

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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. (fetterbushes)(Wolfe 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 (Wolfe 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. The Navy recorded moderate size rookeries of the great blue heron, and

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found large numbers of nesting osprey in the southwestkn 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 all 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 aerial 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 of 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., Chaeto 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 the Florida Department of Environmental Regulation (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

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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 may have been negatively influenced by the sewage outfall.

Samples collected by the Navy (1986) indicate a lov density yet moderate diversity of benthic infuanal organisms vhen compared to other estuarine systems within and around the turning basin. A complete comparison of the Navy's data can not be made to other literature at this time because their data is not given in numbers per unit area. Eovcver, the Navy's data reveals that very few deep dwelling organisms reside in the areas around the turning basin, and a lack of deep dwelling benthic organisms may be an indication of a benthic community under stressed conditions (Luckenbach et al. 1988).

Fish and Shellfish. Early studies of Pensacola Bay have identified 180 bony fish species and 7 cartilaginous fish species (Cooley 1978). The 13 most abundant species were spot (Leiostomus xanthurus), pinfish (Lagodon rhonboides), atlantic croaker (Nicropogonias 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 vas highest in the more saline waters near the NAS Pensacola facility during spring and summer. In the less saline waters of East Bay, diversity vas 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 the blue crab (Callinectes sapidus), shrimp (Penaeus duorarum, P. setiferus, and P. aztecus), and oysters (Crassostrea virginica) have been collected throughout Pensacola Bay

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(Heil 1989). Shrimp are caught in greater abundances near NAS because of the higher salinities. Blue crabs and oysters are more readily caught in the East Bay area. In fact, the only legal shellfishing areas recognized by 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 the 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 1980-85 (Navy 1986). The dominant finfish species in terms of total weight 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, bluecrabs, and squid. this data, as well as the Navy's data, also suggests 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 in the state of Florida at this time due to the lack of a state saltwater fishing license (Heil 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 percent of all commercially valuable fish species are estuarine dependent during some phase of their life cycle. Shrimp, bluecrab 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 Pensacola 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. Hanatees have been sighted irregularly, with one recent sighting in the area recorded by the 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 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 (listed in 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). Host 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, as well as nesting and feeding animals on the facility grounds. Complete biotic surveys may be necessary to determine

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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 1/4-mile to the southeast. There. are no aquatic habitats 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 man-made 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 and b).

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.

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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 mean sea level (MSL). 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 MSL (USGS 1970a and b). 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 (SEGS 1986). 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 (Uilkins 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 6 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 one foot near surface water bodies to more than 20 feet in areas of higher elevation. In general, the direction of ground water 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 (G 6 M 1986) yielded hydraulic conductivity values ranging from 16 to 56 ft/day. Horizontal 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.

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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 composedof 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 semi-confining 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 the 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 below land surface 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

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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 vithin the main producing zone occurs under confined or semi-confined conditions. At one nested well location on NAS Pensacola (east of Building 648) the vater level elevation in a well open to the main producing zone is approximately 7 feet lover than that in an adjacent well open to the surficial zone (G 6 M 1986). This indicates that a significant downward hydraulic gradient exists betveen 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 (Vilkins 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). For the most part the entire sequence is poor to non-water bearing. However, relatively thin beds of sand exist within the unit which may yield small quantities of water. 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.

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7.1.2.3 Floridan Aquifer System

Immediately underlying the Intermediate System and occurring at a depth of approximately 1,500 feet below land surface at NAS Pensacola is the Floridan Aquifer System. The Floridan Aquifer in this area is comprised of the Middle to Lower 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 (Wagner ~~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 GM-54, 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 the immediate proximity of Sites 25 and 27 (see Figure 2-2). This well (GM-2) indicates that the water table in this area occurs approximately 14 feet below land surface. Another shallow well (GM-1) exists approximately 700 feet northwest of GM-2, 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 & 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

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from the installation of well GM-54, 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 semi-confining 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 below land surface in the site vicinity and consists of fine-grained quartz sand to a depth of at least 120 feet. Monitoring well GM-54 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 GM-54 is approximately 7 feet lower than that in well GU-2 (located 30 feet southeast of GM-54), 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, there exists a significant potential for downward groundwater flow from the surficial zone into the main producing zone.

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) is located approximately 1,300 feet southvest of Sites 25 and 27, is screened between 105 and 160 feet below land surface, 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 exists for wells open to the main producing zone to allow a determination of hydraulic gradient at NAS Pensacola.

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No aquifer test data exists for monitoring wells open to the main producing zone at NAS Pensacola. However, records on file with 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.

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8. PROJECT MANAGEMENT PLAN

The Generic Project Management Plan (GPMP), submitted to the Navy for approval, 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).

9. SITE MANAGEMENT PLAN

The Generic Site Management Plan (GSMP), submitted to the Navy for approval, 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 GSMP, 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.

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10. HEALTH AND SAFETY PLAN

A comprehensive General Health and Safety Plan (GESP) and individual site-specific safety plans (SSP) have been developed to provide readily available emergency information and preventative safety measures. The GESP, submitted to the Navy for approval, outlines health and safety procedures and protocols to be followed during all field investigations at each of the 37 sites on NAS Pensacola. The plan includes: standard operating procedures (site entry, decontamination, etc.); hazard communication and training (safety training, briefings, documentation, etc.); safety equipment and instrumentation (monitoring, personnel protective equipment, etc.); hazard evaluation by contaminant class (metals, organics, etc.); and hazard evaluation for each task (drilling, sampling, etc.). The GESP 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 (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 Hazardous Waste Operations (29 CFR 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 for approval. 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 (SQAP).

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 may 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 site.

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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 will 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.

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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, piping, etc.) 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 (Phase 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 Quality Assurance/Quality Control (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

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analysis, 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 walk-over 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 water 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 walk-over of the Building 709 foundation and the areas adjacent

[Bold items enclosed in brackets denote changes from original text]

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to the former radium dial shop will be performed by the site investigation team to locate pertinent site characteristics including existing monitoring wells GM-2 and GM-54, 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 Sections 6.1.1 and 6.3.2 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 radioactivity will be recorded. The survey will be concentrated on a 25 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 GQAPP, in an area away from the influence of the site. Table 6-1 of the GQAPP 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 Building of 709 (former radium dial shop location) and along the path of 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 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

[Bold items enclosed in brackets denote changes from original text]

manhole covers can be removed, a radiation survey will also be done 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 GQAPP. 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*

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 tbe GQAPP.

Site 25 — A surface emission 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 may 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.

[In addition, preliminary air screening will be conducted vith a particulate monitor, such as a Mini-Ram, to determine if the site represents a source of particulates in the air. The air sampling will be conducted in accordance vith Section 6.1.3 of the GQAPP.]

[Bold items enclosed in brackets denote *changes* from original text]

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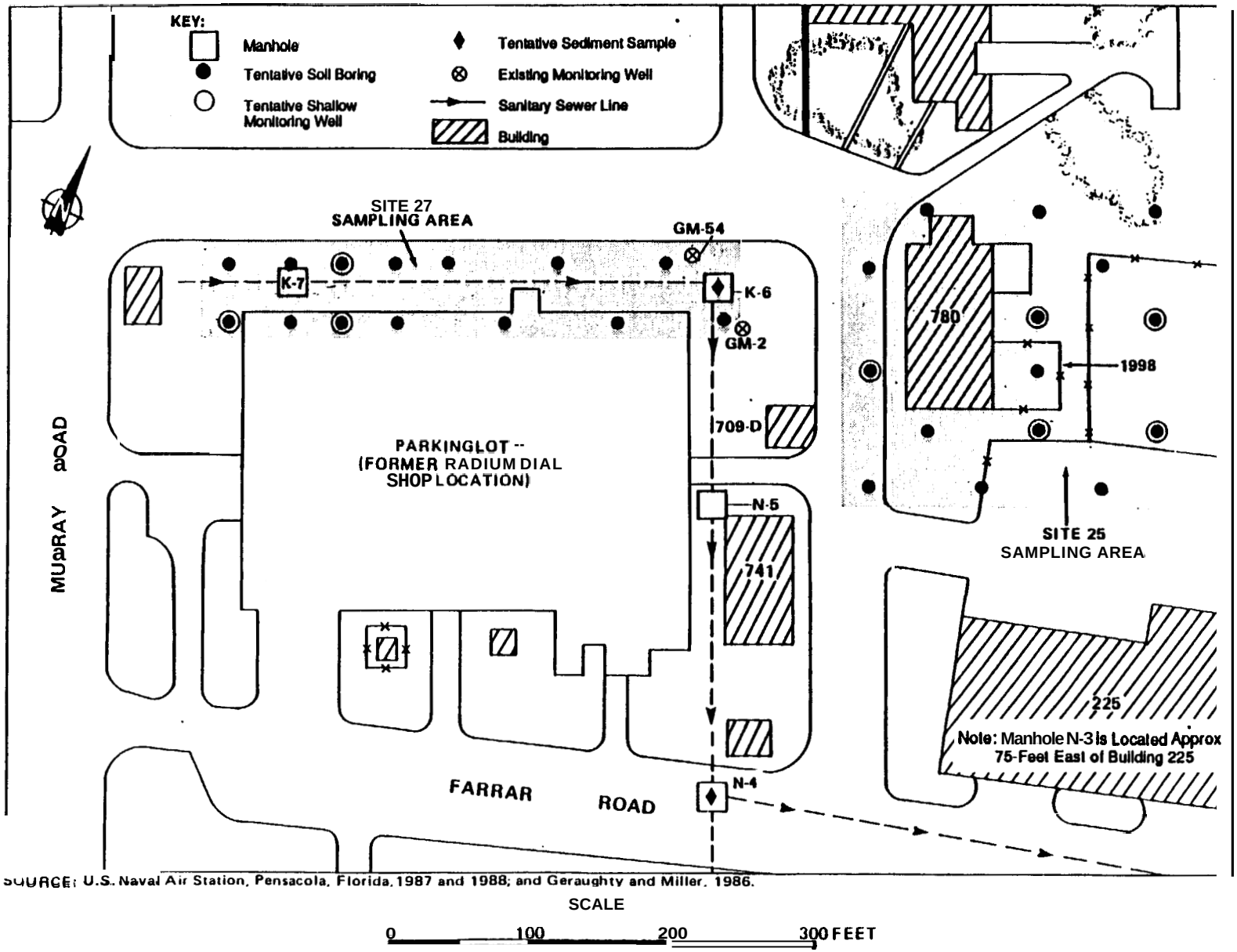

SOURCE: U.S. Naval Air Station, Pensacola, Florida, 1987 and 1988; and Geraughty and Miller, 1986.

SCALE

0 100 200 300 FEET

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

Site 27 -- A surface emission survey will be performed across the exposed soil areas near the northern and eastern perimeters of the foundation from manhole K-7 to 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, joints, 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.

[In addition, preliminary air screening will be conducted vith a particulate monitor, such as a Mini-Ram, to determine if the site represents a source of particulates in the air. The air sampling will be conducted in accordance vith Section 6.1.3 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 EM-34 survey, which has a greater depth of investigation, will be conducted only if an anomalous area has been defined with the EM-31 which appears to require further investigation.

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

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[Bold items enclosed in brackets denote changes from original text]

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 instruments sensitivity, 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 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 since 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, groundwater 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]**. Since 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 **sever]** 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 sever 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 boring locations at Site 27 (see Figure 14-1). Forty-five soil samples will be collected at Site 25, and forty-two 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 3 samples will be collected per borehole.

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

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

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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	lo. 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 dosignations are as follows:

A = Gross alpha, volatile organic 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 u d ketones, TCL base/neutral and acid extractable 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), u d alkalinity (water only).]

[b]Specific constituents encompassed by tho various chemical groups included within analytical suite A are identified in Tables 9-1 through 9-4 of tho 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 through 9-13 of the 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.

[f]Trip blanks will be analyzed for TCL volatile organics only.

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

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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 vells (GM-2 and GM-54)] will be [purged] and sampled in accordance with Section 6.8 of the GQAPP. Equipment decontamination will be conducted in accordance with GQAPP Section 6.10.

14.1.4. Hydrologic Assessment

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

Hydrologic 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 rational for placement of permanent monitoring wells during in Phases II and 111.

14.2 Phase II - Characterization

The primary objectives of the Phase II field investigation are as follows:

- To characterize the nature and magnitude of the full spectrum of potential site contaminants;
- 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;

[Bold items enclosed in brackets denote changes from original text]

- 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.]

[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.]

TABLE 14-2

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS—GROUP G

SITE 25

Medium	No. of samples	Dupli-cates	Trip Blanks[a]	Field Blanks	Rinsate Blank8	[Preservative Blanks[b]]	Total'	Analytica1 suito[c,d]
Soil	25	3	2	[1]	2	[1]	34 (10)	A C
Groundwater	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[t]	Analytical suite[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	[1]	4	[1]	[46](12)	

[a]Trip blanks will be analyzed for [Target] Compound List (TCL) volatile organic compounds 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 a5 follows:

A = Gross Alpha, Radium 226, TCL volatile organic compounds plus xylene and ketones, TCL base/neutral and acid extractable 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).

Table 14-2 (Cont.)

B = Total suspended solids, total Kjeldahl aitrogon, ammonia nitrogen, orthophosphate phosphorus, dissolved oxygon (in field), 5-day biological oxygen demand (BOD_5), and chorical oxygen demand (COD).

C = pH, alkalinity, percent moisture, grain size, BTU contont, 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 - Not required.]

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[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 compositing 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 GQAPP.

[14.2.3] Shallow Monitoring Well Installation and Development

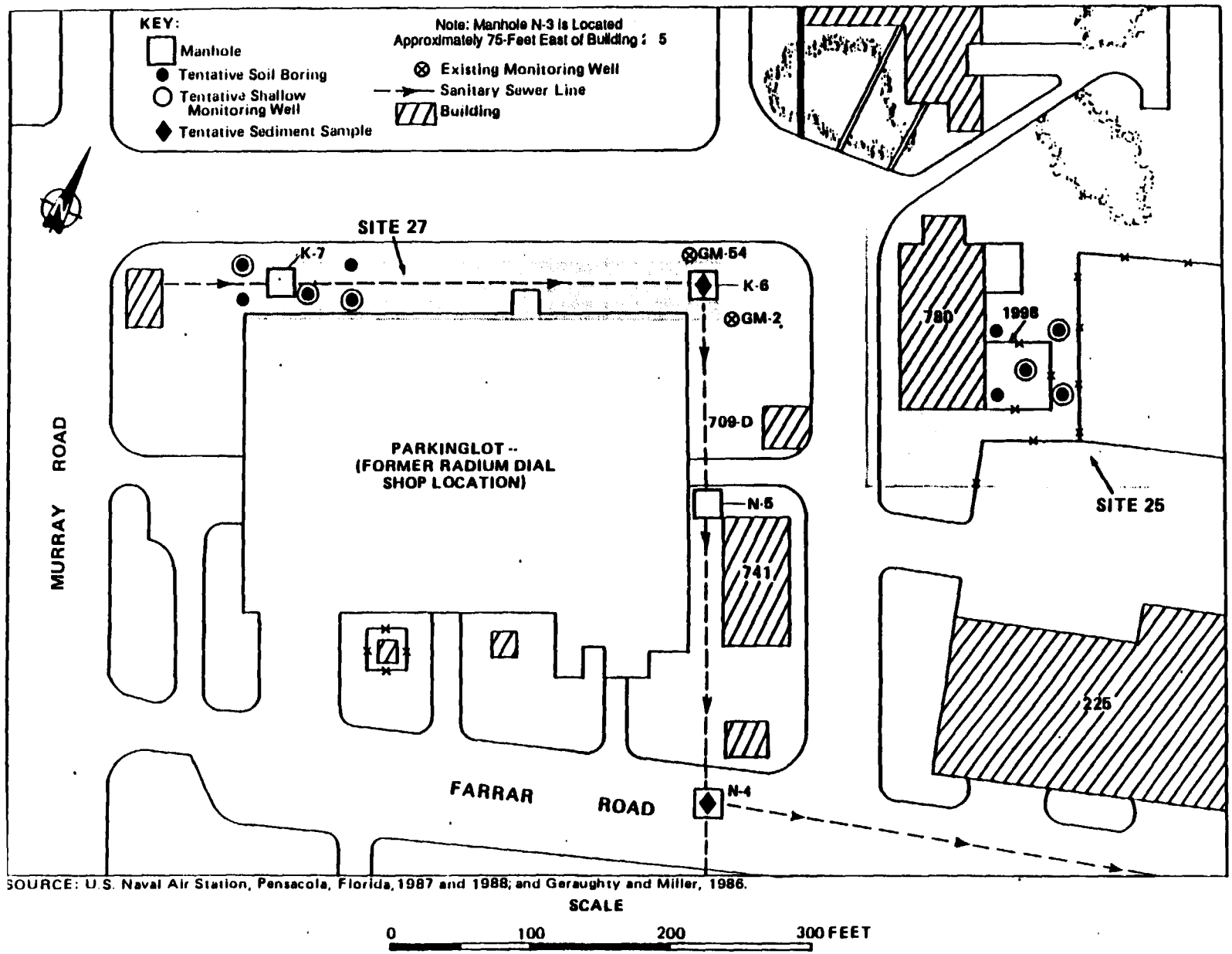
The actual number and locations of shallow monitoring wells to be installed will be based on the analytical results of Phase I. Three wells will be installed both at Site 25 and at Site 27, to proposed depths of 25 feet. Tentative well locations are shown in Figure 14-2. All wells will be installed using 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 number proposed. When and where possible and/or practical, additional monitoring wells will be installed during Phase II in order to expedite the overall investigation schedule.]

[14.2.4] Groundwater 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

[Bold items enclosed in brackets denote changes from original text]



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

Figure 14–2 TENTATIVE SOIL BORING AND SHALLOW MONITORING WELL AND SEDIMENT SAMPLING LOCATIONS, SITES 25 AND 27 – PHASE II

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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.]

14.3 Phase III -- Extent Delineation

Phase III tasks will be conducted based on the results of Phases I and II. Although the earlier phases are intended to identify and characterize the areas

[Bold items enclosed in brackets denote changes from original text]

and contaminants of priaary 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 shallov, 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 groundvater 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 Phase I and II findings.

14.3.4 Groundvater 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 well head survey to obtain top of casing elevations. Uater 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 lov 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, aquifer testing, etc., will be utilized as

[Bold items enclosed in brackets denote *changes* from original text]

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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 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 - Bxtent Delineation

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

- Soil Sampling;
- Shallow Monitoring Well Installation and Development;
- Intermediate and Deep Monitoring Well Installation and Development;
- Groundwater Sampling; and
- Hydrologic Assessment

14.5 Topographic Survey and Base Hap

Following the completion of Phases III and IV, a topographic survey of the Site 1 area will be conducted and a base map will be developed. Base map coverage, contour intervals, scale, and requirements for horizontal and vertical control will be established and approved by the Navy. The topographic base map will be developed for the requirements of remedial planning and will include the locations of surface features such as: roads, structures, nearby surface waters, monitoring wells, and above ground utilities. The location of subsurface utilities and drainage structures will be reflected on the base map as indicated on existing NAS Pensacola General Development and utilities maps, and/or as located during field investigations.

[Bold items enclosed in brackets denote changes from original text]

14.6 Field Quality Assurance/Quality Control

14.6.1 Documentation

Field activities and sample management will entail certain strict documentation requirements as described in Section 7.0 of the GQAPP.

14.6.2 Field QA/QC 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 6.12 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.

14.7 Decontamination and Waste Management Procedures

14.7.1 Decontamination Procedures

All equipment decontamination procedures for Site 1 will be performed in accordance with Section 6.10 of the GQAPP.

14.7.2 Waste Management Procedures

All water generated during monitoring well purging and development activities on Site 1 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.

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[Bold items enclosed in brackets denote changes from original text]

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 Generic Quality Assurance Project Plan (GQAPP) and Generic Site Management Plan (GSMP). 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 QSMP.

[Bold items enclosed in brackets denote changes from original text]

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. Two scenarios will be considered to assess the potential for off-site contamination, including:

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

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 phases of fieldwork described above.

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.

[**Bold** items enclosed in brackets denote **changes** from original text]

17. TREATABILITY STUDY

As indicated in Table 14-2, 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 Table 14-2, 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 from original text]

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 Feasibility Study (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 whether 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, groundwater, 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

[Bold items enclosed in brackets denote changes from original text]

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, ground water, 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 risks and potential future risks if no action is taken. Therefore, as part of this evaluation a reasonable maximum exposure scenario should be developed, which reflects 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.

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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 potential 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, retirement homes, etc.);
- Activities (recreational and/or occupational) which take place near the sites, and the estimated number of people involved;

[Bold items enclosed in brackets denote changes from original text]

- 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 FS 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 (i.e., hydrogeologists, chemists, risk assessors, etc.), the Navy, and the reviewing regulatory agencies (i.e., FDER and BPA) and that the goal of these tasks is to produce appropriate, sufficient, and high quality data to complete the baseline risk assessment.]

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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 workplan 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 and identify problems, and determihe 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.

[Bold items enclosed in brackets denote changes from original text]

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 consideration of 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 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,

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when comparing alternatives. 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 PS Report

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

20. REPORT

[Following the Phase I investigation, E & E will prepare a Phase I Data Report and Recommendat ons for each site. The purpose of his report is to summarize briefly 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 Phase II report will be produced. However, 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 Recommendations 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.]

E & E will prepare a 90% draft [for each of the above-described] reports, [which] summarizes the activities and results [of the inves'tigation tasks performed.] Upon receipt of comments [from] the Navy concerning the 90% draft reports, E & E will prepare a draft final report for the Navy and the Technical Review Committee (TRC) review. The TRC review comments will be incorporated into final reports. 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

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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.

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[Bold items enclosed in brackets denote changes from original text]

21. DOCUMENT REVISION

Periodic updating of all administrative documents (GQAPP, GSMP, GHSP, 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 GQAPP, GSMP, GHSP, and GPMP. Work plans will be revised after each phase of fieldwork, with Phases III and IV, 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.

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22. PROJECT MANAGEMENT

Project management will be an ongoing process .throughout this investigation. This process includes preparation of bi-weekly project status reports, coordination of schedules, mobilizations, and other project incidentals with the Navy, management of project staff, coordination with the E & E support groups (e.g., publications, 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.

[Bold items enclosed in brackets denote changes from original text]

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 **11**, **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 **(FFASMP).** The schedule **in** the FFASMP will **be** updated yearly.

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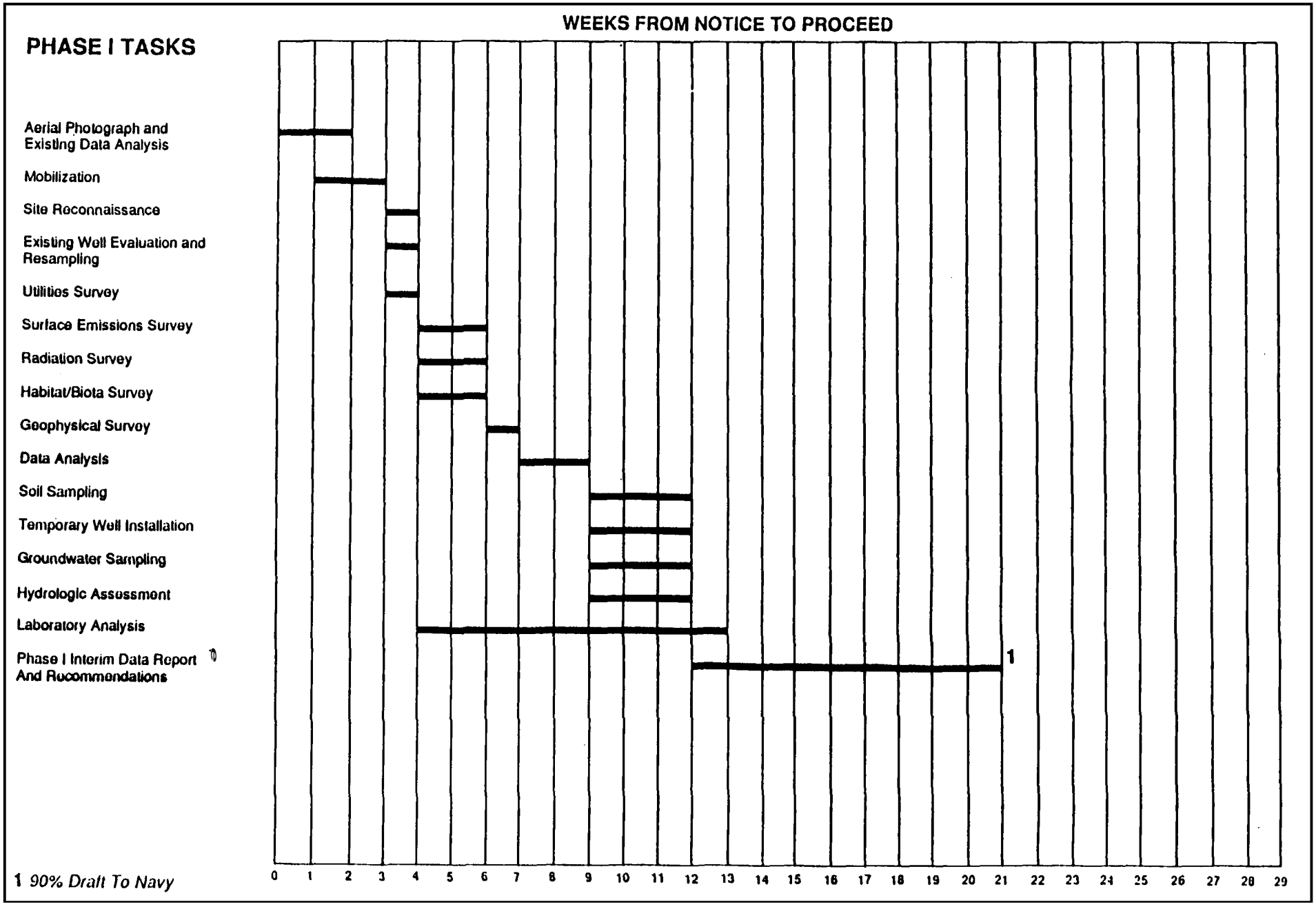

Figure 23-1 PHASE I PROJECT SCHEDULE -- GROUP G

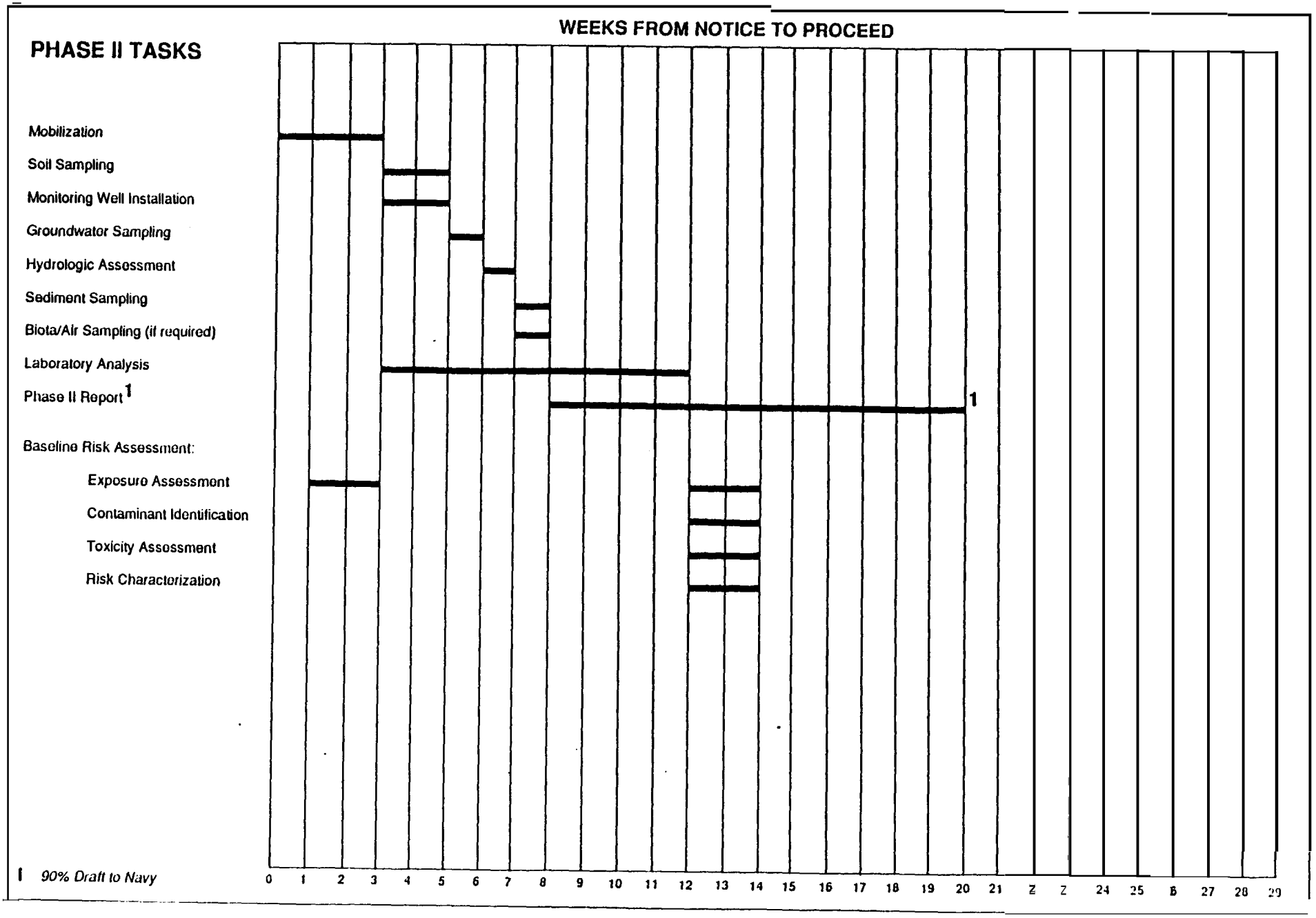

Figure 23-2 PHASE II PROJECT SCHEDULE -- GROUP G

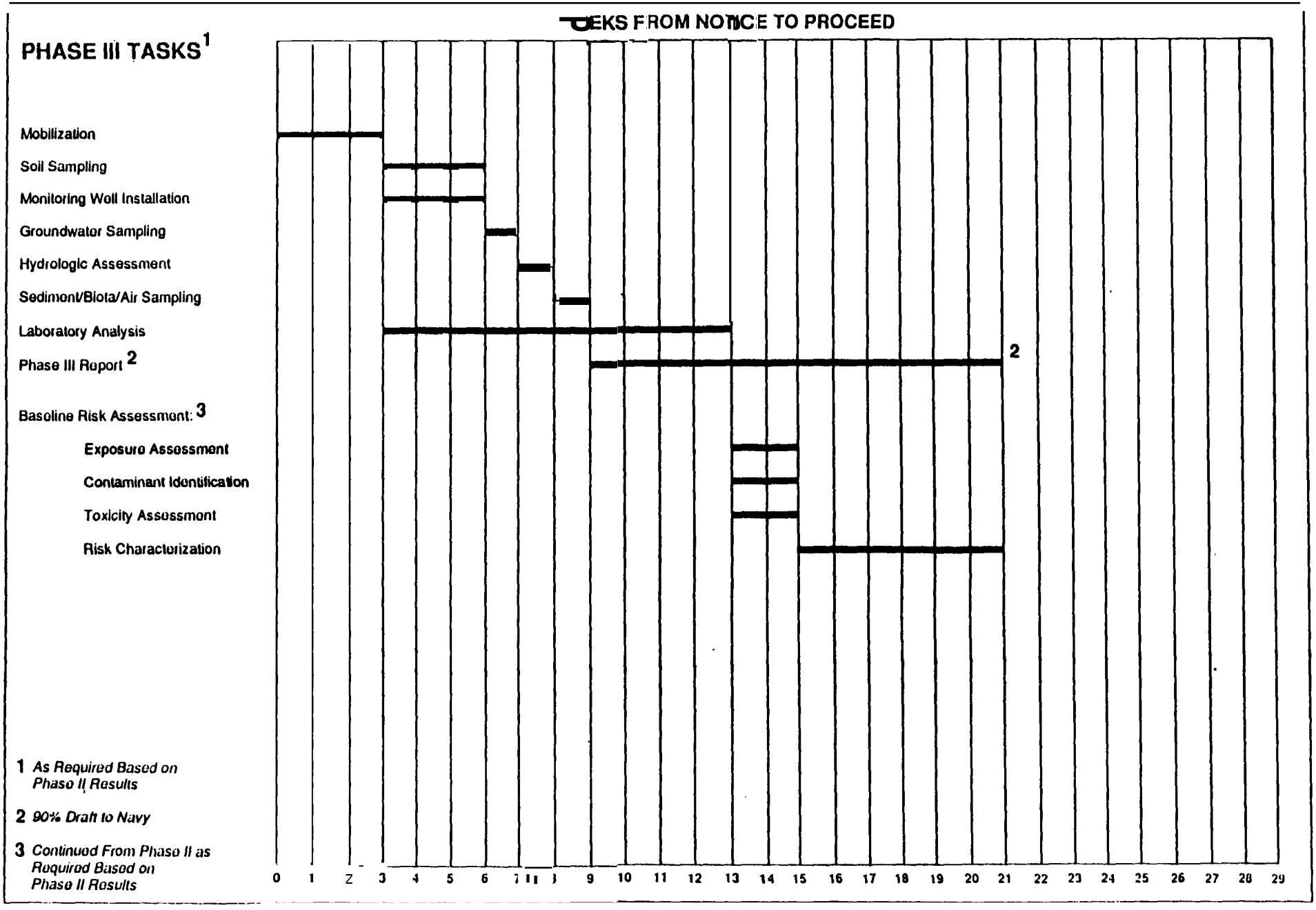

Figure 23-3 PHASE III PROJECT SCHEDULE -- GROUP G

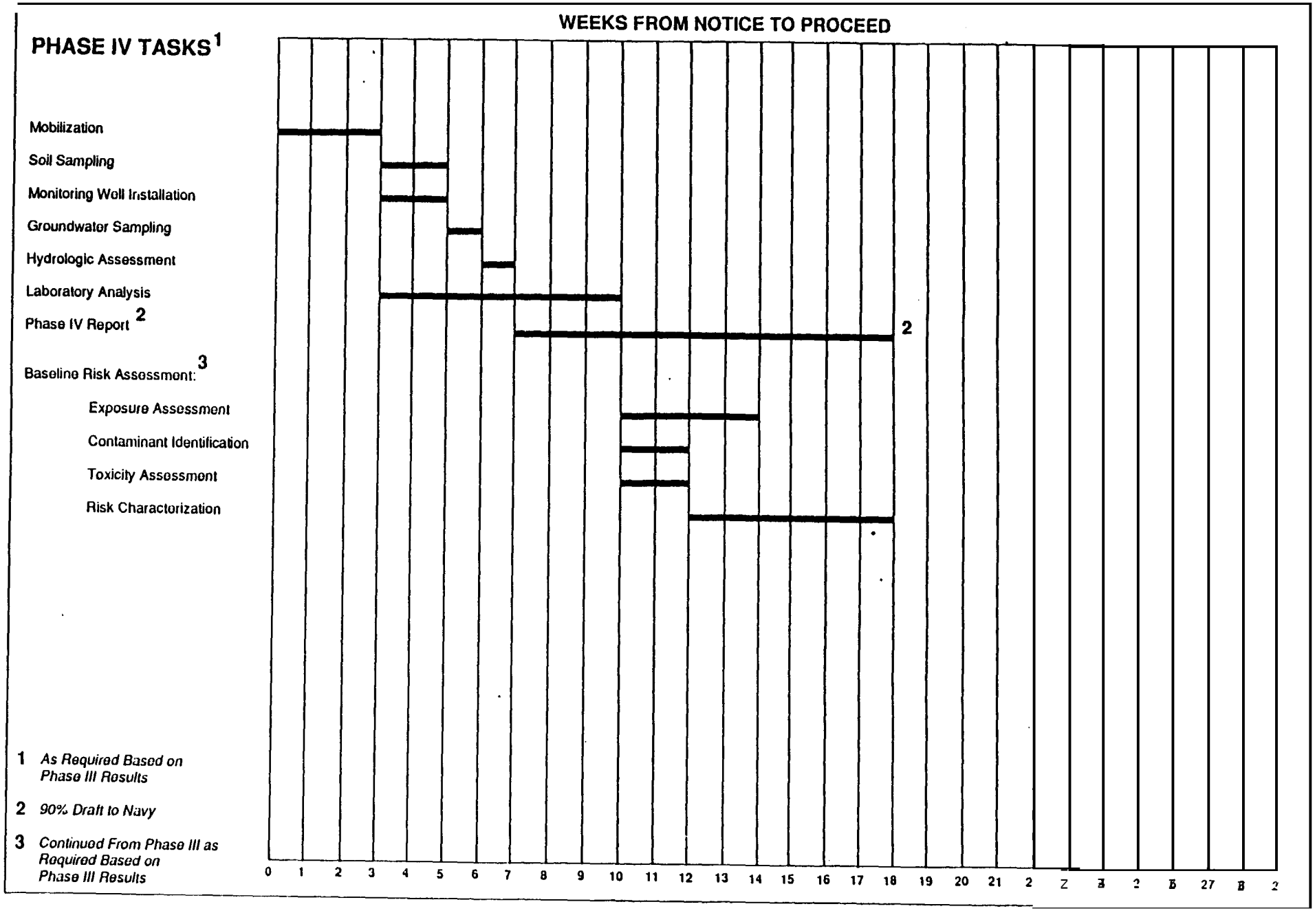

Figure 23-4 PHASE IV PROJECT SCHEDULE -- GROUP G

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APPENDIX A

SITE-SPECIFIC SAFETY PLAN

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SITE SAFETY PLAN

Version 988

A. GENERAL INFORMATION

Project Title: Site 25 - Radium Spill Area

Project No.: UH1102

TDD/Pan No.:

Project Manager: John Barksdale

Projoct Dir.: Rick Rudy

Location(s): Radium Spill Area in unknown location directly east of Building 780

Prepared by: Mary Miller

Dato Propared: 4-28-89

Approval by: Jackie Gillings MLM

Dato Approvod: 5-11-89

Site Safety Officer Review:

Dato Reviewed:

Scope/Objective of work: Field Screening will include physical surveys, radiation surveys, soil sampling, temporary well installation and groundwator sampling.

Proposed Dato of Field Activities: August 1989

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

Documentation/Summary:

Overall Chemical Hazard:	Sorious [ ] LOW [X]	Moderate [ ] Unknown [ ]
Overall Physical Hazard	Sorious [ ] LOW [ ]	Moderate [X] Unknown [ ]
Radioactive Hazard	Sorious [ ] LOW [ ]	Moderate [ ] Unknown [X]

B. SITE/WASTE CHARACTERISTICS

waste Type(s):

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

Characteristic(s):

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

Othor:

Physical Hazards:

Overhead [X]	Confined* Space [ ]	Below Grade [ ]	Trip/Fa11 [X]
Puncture [X]	Burn [ ]	Cut [X]	Splash [X]
Noise [X]	Other: Holicoptor debris located in compound 1998, vehicular traffic		

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

Site History/Description and Unusual Features (see Sampling Plan for detailed description): In 1978 a corroded drum containing radioactive waste broke open on tho concrete paved area east of Building 700. The spill was reported to have boon cleaned up. Tho exact location of tho spill is not known.

Locations of Chemicals/Wastes: Tho exact location is not known but is reported to be on tho paved area adjacent to Building 780 on tho east.

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

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

C. 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) Physical Surveys - Automobile hazards; debris pile--compound

2) Temporary Monitoring Well Installation - Using portable drill rig:

3) Soil Sampling - Using portable drill rig:

4) Decontamination Procedures - Usinq solvents.

Chemical Hazard Evaluation:

Compound	PEL/TWA	Route of Exposure	Acute Symptoms	Odor Threshold	Odor Description
Benzene	1.0 ppm	Inh,Ing,Derm,Eye	Dizz., Naus.	4.68 ppm	sweet
Isopropyl Alcohol	400 ppm	" "	Drous., Head,	7.5-200 ppm	rubbing alcohol
Nitric Acid	2 ppm	" "	corrosive	0.3 - 1 ppm	acrid
Radionuclids	**Half-Life**	**Typo of Radiation**	**Action Level**	**Route of Exposure**	**Acute Symptoms**
RA-226	1620 years	alpha, gamma	>2 mR/hr	Inhalation,	>200 rem,
			presence of HP	Ingestion	nausea, vomiting
			required		possible

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

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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? [yes] Site secured? [no 1

Work Areas Designated? [yes] Zone(s) of contamination Identified? [no]

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

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

	A	B	C	D
Task 1				X
Task 2				X
Task 3				X
Task 4				X

(Expand if necessary)

Modifications: Modified level D with tyvock, neoprene gloves and boots, safety glasses, APR available when level C upgrade is necessary

Action Levels for Evacuation of Work Zone Pending Reassessment of Conditions: See Allowable Radiation Dose Attachmont

- Level D: O_2 <19.5% or >25%, explosive atmosphere >10% LEL, organic vapors above background levels, particulates >_____ mg/m^3, other _____

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Contaainant of Interest	Type of Sample (area, personal)	Monitoring Equipment	Frequency of Sampling
VOC's	Area	OVA	Continuous
Radiation -- Exposure	Area	Micro-R-M	Continuous
Explosive Gases	Area	O_2/Explosimeter	Continuous
Radiation — Soil	Area	Gamma Scintill.	Survey

Personnel Decon Protocol: boot and glove wash - trisodium phosphate wash with clean water rinse. Expendables will be double bagged and drummed for disposal. Field personnel will take a hygienic shower, off-site, following each day's field wrk.

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

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

All drilling safety procedures will be strictly adhered to as outlined in Attachment A. Personnel will be scanned for radioactivity as part of the decontamination procedure.

Site Entry Procedures and Special Considerations: E & E's 'Buddy System" will be employed at all times during fieldwork activities. Personnel will exercise caution in the vicinity of Chevalier Field and along nearby roadways. If levels exeeding 5 mR/hr encountered team members will evacuate the sampling area, and contact the corporate health physics group to reassess the site.

Work Limitations (time of day, weather conditions, etc.) and Heat/Cold Stress Requirements:

All fieldwork activities will be performed during daylight hours. Team members will take breaks as necessary to avoid heat stress and replace fluids. Cooling vests may be 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 be double bagged, drummed, labeled and transported to a 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 worn during sample preservation with acids.

Team Member*	Responsibility
Team members to be determined	Team Leader
	Site Safety Officer/Sampler
	Geologist/Sampler

*All entries into exclusion sone 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 288.2 (19801.

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E. EMERGENCY INFORMATION

(Use supplorontal shoots, if necessary)

LOCAL RESOURCES

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

Ambulance On Base — 904-452-4138, Off Base -- 911

Hospital Emergency Room NAS Dispensary - 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 ASC 1-716-631-0360

Fed. Express 1-800-238-5355

Client Contact U.S. Navy Southern Division, Engineer-In-Charge, 1-803-743-0574

Site Contact NAS Ponsacola Enviromental Coordinator, W. Dewayne Ray -- 904-452-4515

*Baptist Hospital is prepared to handle radioactively contaminated personnel.

SITE RESOURCES

Site Erorgoncy Evacuation Alarm Method N/A

Water Supply Source On-sit.

Telephone Location, Number To bo dotorminod on-site

Collular Phone, if availablo N/A

Radio

Other On-sit. warehouse number to bo dotorminod

EMERGENCY CORACTS

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

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

3. Regional Office Contact ..... M.Miller.... 656-2854 (home)
   877-1978 (office)

4. Office Manager..... R.Rudy..... 893-7245 (home)

MEDTOX HOTLINE

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

   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
   b. Corporate Safety Director - Paul Jonmaire - home # (716) 655-1260
   c. Assistant Corp. Safety Officer - Steven Sherman - home # (716) 688-0004

EMERGENCY ROUTES

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

Directions to hospital (include map)

NAS Dispensary - Follow Murray Road south to Ellyson Avonuo. Turn right onto Ellyson Avonuo and continue tc it's intersection with Turner Stroot. Tho NAS Dispensary is located on tho northwest corner of tho intersection of Ellyson Avenue and Turner Stroot, in Building 625-A.

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. 3mi to Pace Blvd. Turn loft (north) on Pace Blvd. and proceed approx. lmi 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 Got Off-Sit. Emergency egress routes will bo located if emergency exit routes become blocked by construction, etc.

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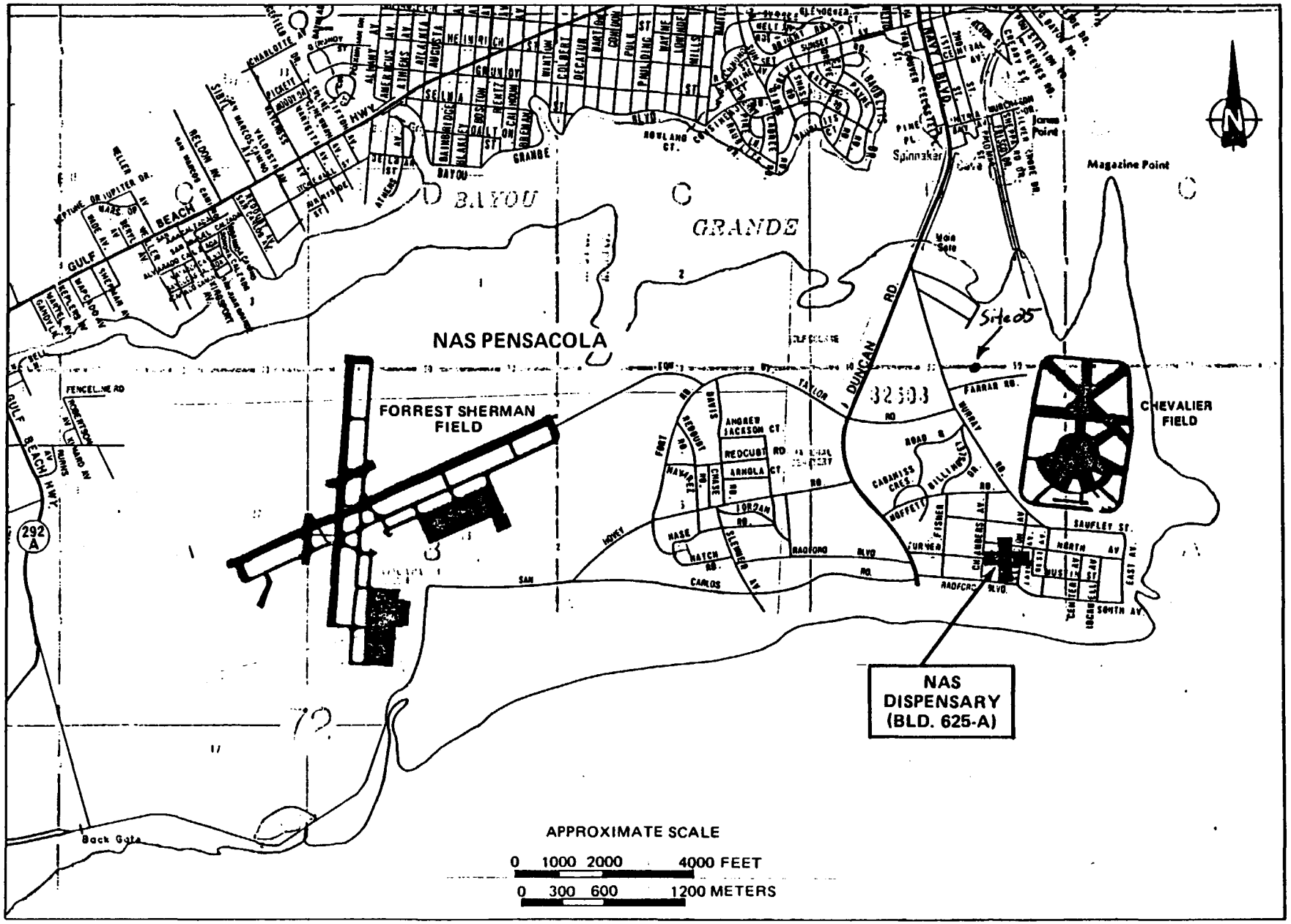

Figure 3–2 LOCATION OF NAS DISPENSARY

DRILL RIG SAFETY

* Hard hats must be worn.

* All team members must be know the procedure to shut the rig off and the location of the "kill" switch.

* when moving a rig off the road, pay attention to obstacles in route of travel. Walk the intended route first.

* Have someone guide the rig driver when clearance is at a minimum or when hazards are in close proximity.

* Set rig brakes and block the wheels when rig is set up at the desired drilling location.

* The mast must be lowered when the rig is moved.

* Always consider overhead wires to be live, watch for sagging lines and do not operate rig within 15 feet of overhead lines.

* Make sure the site, platforms and walkways are free of cbstructions.

* Make sure proper housekeeping is practiced around and on the rig at all times. Tools should be stored in a manner that permits convenient access and provides for adequate safety.

* Store gasoline in approved containers that have a spark arrestor and keep them clear of the drilling work area.

* Check rig equipment prior to starting work. Repair or replace faulty and worn items.

* Handle augers with care. Use proper lifting techniques when picking up samplers and augers. Use a tool hoist if possible and stay clear of rotating augers. Keep cables and ropes secured when not in use.

* Level and stabilize the drill rig prior to raising the mast.

* Watch for slippery ground when working in the area of the rig.

* All unattended boreholes must be properly covered.

* Do not drill during an electrical storm.

* Maintain a safe distance from the rig mechanisms during drive sampling and auger removal operations.

ECOLOGY AND ENVIRONMENT, INC.,

STANDARD OPERATING PROCEDURES FOR EMERGENCIES DUE TO HEAT AND HEAT STRESS MONITORING

Field operations during the summer months can create a variety of hazards to the employee. Heat cramps, heat exhaustion, and heat stroke can be experienced and, If not remedied, can threaten life or health. Therefore, It is Important that all employees be able to recognize symptoms of these conditions and be capable of arresting the problem as quickly as possible.

THE EFFECTS OF HEAT

As the result of normal oxidation processes within the body, a predictable amount of heat is generated. If the heat Is liberated as it is formed, there la no change In body temperature. If the heat is liberated 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 with the elimination of heat leads to its accumulation and thus to the elevation of body temperature. As a result, the person is said to have a fever. When such a condition exists, it produces a vicious cycle in which certain body processes speed up and generate additional heat. Then the body must eliminate not only the normal but also the addltlonal quantities of heat.

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 or a breeze strikes the body. additional heat is lost by convsctlon. However, when the temperature of the surroundlng air becomes equal to or rises above that of the body, all of the heat must be lost by vaporization of the moisture or sweat from the skin surface. As the air becomes more humid (contains mor-? moisture], vaporization from the skin slows down. Thus, on a day when the temperature Is 95 to 100°F, with high humidity and little or no breeze, conditions are ideal for the retentlon of heat within the body. It is on such a day or, more commonly, a succession of such days (a heat wave) that medical emergencies due to heat are likely to occur. Such emergencies are classified in three categories. heat cramps, heat exhaustlon, and heat stroke.

HEAT CRAMPS

Heat cramps usually affect people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat cramps also may result from drinking iced water or other drinks either too quickly or in too large a quantity.

Heat Cramp Symptoms. The symptoms of heat cramp are:

- Muscle cramps in legs and abdomen,
- Pain accompanying the cramps,
- Faintness, and
- Profuse perspiration.

Heat Cramp Emergency Care. Remove the patient to a cool place. Give him sips of liquids such as "Gatorade" or its equivalent. Apply manual pressure to the cramped muscle. Remove the patient to a hospital if there is any indication of a more serious problem.

HEAT EXHAUSTION

Heat exhaustion occurs in individuals working in hot environments. and may be associated with heat cramps. Heat exhaustion is caused by the pooling of blood in the vessels of the skin. The heat is transported from the interior of the body to the surface by the 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 lower extremities when an individual is in an upright position, may lead to an inadequate return of blood to the heart and eventually to physical collapse.

Heat Exhaustion Symptoms. The symptoms of heat exhaustion are:

- Weak pulse;
- Rapid and usually shallow breathing;
- Generalized weakness;
- Pale, clammy skin;
- Profuse parspiration;
- Dizziness;
- Unconsciousness; and
- Appearance of having fainted (the patient responds to the same treatment administered in cases of fainting).

Heat Exhaustion Emergency Care. Remove the patient to a cool place and remove as much clothing as possible. . 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 the patient for shock, and remove him to a medical facility if there is any indication of a more serious problem.

HEAT STROKE

Heat stroke is a profound disturbance of the heat-regulating mechanism, associated with high fever and collapse. Sometimes this condition results in convulsions, unconsciousness, and even death. Direct

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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% mortality rate. Alcoholics are extremely susccptible.

Heat Stroke Symptoms. The symptoms of heat stroke are:

- Sudden onset;
- Dry, hot, and flushed skin;
- Dilated pupils;
- Early loss of consciousness;
- Full and fast pulse;
- Breathing deep at first, later shallow and even almost absent;
- Muscle twitching, growing into convulsions; and
- Body temperature reaching 105 to 106°F or higher.

Heat Stroke Emergency Care. Remember that this Is a true emergency. Transportation to a medical facility should not be delayed. Remove the patient to a cool environment- if possible, and remove as much clothing as possible. Assure an open airway. Reduce body temperature promptly--preferably by wrapping in a wet sheet or else by dousing the body with water. if cold packs arc available, place them under the arms, around the 'neck, at the ankles, or at any place where blood vessels that lie close to the skin can be cooled. Protect the patient from injury during convulslons, especially from tongue biting.

AVOIDANCE 0F HEAT-RELATED EMERGENCIES

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 system. Without these electrolytes, body systems cannot function properly, thereby Increasing the represented health hazard. Therefore, when personnel are working In situations where the ambient temperatures and humidity are high--and especially In situations where protection Levels A B, and C are required--the site safety officer must:

- Assure that all employees drink plenty of fluids ("Gatorade" or its equivalent):
- Assure that frequent breaks are scheduled so overheating does not occur; and
- Revise work schedules, when 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).

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

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

One method of measuring the effectiveness of employees' rest-recovery regime is by monitoring the heart rate. The "Brouha guideline" is one such method:

- During a three-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 kart 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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Material Safety Data

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

ISOPROPYL ALCOHOL

PRODUCT' IDENTIFICATION;

Synonyms: ?-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 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 plentyof 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.q 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 MOSH-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, acetadehyde, 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, thea 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

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
May cause irritation of the nose and throat. Exposure to high concentrations has a narcotic effect, producing symptoms of drowsiness, headache, staggering, unconsciousness and possibly death.

Ingestion:
May cause drowsiness, unconsciousness, and death. Gastrointestinal pin, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (SAX Sixth Edition).

Skin Contact:
Has a defatting action of the skin that can cause irritation. May cause irritation with a stinging effect and burning sensation.

Eye Contact:
Vapors may irritate the eyes. Splashes may cause severe irritation. possible corneal burns and eye damage.

Chronic Exposure:
Prolonged contact with skin may cause mild imtation, dying, cracking, or contact dermatitis may develop.

Aggrevation of Pre-existing Conditions:
Persons with preexisting skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the 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:
Give water to drink. Induce vomiting if medical help not is immediately available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minuter Get medical attention if irritation develops or persists.

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)

Oral rat LD50: 5840 mg/kg. Skin rabbit LD50: 13 gm/kg. Inhalation rat LC50: 16000 ppm/8H. Mutation references cited Aquatic Toxicity rating TLm96: 1000-10 ppm.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
400 ppm (TWA).
-ACGIH Threshold Limit Value (TLV):
400 ppm (TWA); 500 ppm (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 a m. Please refer to the ACGIH document, 'Industrial Ventilation, A Manual of Recommended Practices', m a t recent edition, for details.

Personal Respirators: (NIOSH Approved)
If the TLV is exceeded a full facepiece chemical cartridge respirator may be worn, in general, up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

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 wonting with this material. Maintain eye wash fountain and quick-drench facilities in work area.

SECTION 7 Storage and Special Information

Protect against physical damage. Store in a cool, dry well-ventilated location, a n y from m y area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment.

Mallinckrodt
Material Safety Data

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Mallinckrodt, Inc., Science Products Division, P.O. Box M, Paris, KY 40361.

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 MEASURES

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 a 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 minuter 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 liquid.

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 oxides 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 mort substances, especially strong bases, metallic powders, carbides, hydrogen sulfide, turpentine, and combustible organics.

SECTION 4 Leak/Spill Disposal Information

Isolate or enclose the area of the leak or spill. Clean-up personnel should wear protective clothing rod 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 lit sizes: Neutralize with alkaline material, pick up with absorbent material (sand, earth, vermiculite) and dispose in 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.

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

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Corrosive! Inhalation of vapors a n auiicl breathing difficulties and lead to pneumonia and pulmonary edema, which may bo 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 b u m 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 a d may c a w 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 d w to the corrosive properties of the acid.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye disease may be more susceptible to tho 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 muse. 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 em control the emissions of the contaminant at its source, preventing dispersion clit into the general work area. Please refer to the ACGIH document. 'Industrial Ventilation, A Manual of Recommended Practices", m a t 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.

Mallinckrodt
Material Safety Data

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SULFURIC ACID 96%

PRODUCT IDENTIFICATION:

Synonyms Oil of Vitriol

Formula CAS No: 7664-93-9

Molecular Weight: 98.07

Chemical Formula: H_2SO_4

Hazardous Ingredients: Not applicable.

PRECAUTIONARY MEASURES

DANGER! 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.
Do not breathe mist.
Keep container closed.
Use only with adequate ventilation.
Wash thoroughly after handling.
This substance is classified as a POISON under the Federal Caustic Poison Act.

E S T

In all cases call a physician. 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. 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.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: Colorless, oily liquid.

Odor: Odorless.

Solubility: Infinite @ 20°C.

Boiling Point: ca. 310°C (590°F)

Melting Point: ca. -14°C (6°F).

Specific Gravity: 1.84

Vapor Density (Air =1): < 0.3 @ 25°C (77°F)

Vapor Pressure (mm Hg): 1 @ 146°C (250°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. Reacts with most metals releasing flammable, potentially explosive hydrogen gas.

Explosion:
Not combustible, but substance is a strong oxidizer and its heat of reaction with reducing agents or combustibles may cause ignition.

Fire Extinguishing Media:
Dry chemical, 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.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Toxic fumes of oxides of sulfur. Will react with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to generate carbon dioxide gas, and with cyanides and sulfides to form poisonous hydrogen cyanide and hydrogen sulfide respectively.

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Water, bases, organic material, halogens, metal acetylides, oxides and hydrides, strong oxidizing and reducing agents and many other reactive substances.

SECTION 4 Leak/Spill Disposal Information

Dike and cover leaking or spilled liquid with dirt, vermiculite, kitty-litter or other inert absorbent. Cover spill with sodium bicarbonate or soda ash and mix. Clean-up personnel require protective clothing and respiratory protection from vapors and mists. Neutralized waste may be containerized and disposed in a RCRA approved waste disposal facility. Flush area of spill with dilute soda ash solution and discard to sewer.

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

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health 3 flammability: 0 Reactivity: 2 Other: Water reactive

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Inhalation produces damaging effects on the mucous membnnes and upper respiratory tract. May cause lung edema. Symptoms may include irritation of the nose and throat, and labored breathing.

Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat, and stomach, leading to death. Can cause sore throat, vomiting. diarrhea.

Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur.

Eye Contact:
Corrosive. Splashes can cause blurred vision, redness, pain and severe tissue burns.

Chronic Exposure:
Long-term exposure to mist or vapors may cause damage to teeth.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory lunction may be more susceptible to the effects of the substance.

B. FIRST AID

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

Ingestion:
If swallowed, D-O NOT induce vomiting. Give large quantities of water or milk if available. Call a physician immediately. Never give anything by mouth to an unconscious person.

Skin Exposure:
In caw of contact, immediately flush skin with plenty of water lor at least 15 minutes while removing contaminated clothing and shoes. Call a physician.

Eye Exposure:
Wash eyes with plenty of water lor at kut IS minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

C. TOXICITY DATA (RTECS, 1982)

Oral rat LD50: 2140 mg/kg. Inhalation Guinea Pig LC50: 18 mg/m^3.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:

-OSHA Permissible Exposure Limit (PEL):
1 mg/m^3 (TWA).
-ACGIH Threshold Limit Value (TLV):
1 mg/m^3 (TWA).

Ventilation System:
A system of local and/or general exhaust b recommended lo 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, lor details.

Personal Respirators: (NIOSH Approved)
If the TLV b exceeded a lull faceplece chemical cartridge respirator may be worn. In general, up lo 100 times the TLV or the maximum use concentration specified by the respintor supplier, whichever b less. Alternatively, a supplied air full faceplece respirator or airlined hood may be worn.

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

Eye Protection:
Use chemical safety goggles and/or a lull face shield where splashing b 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

Store in a cool, dry, ventilated storage area with acid resistant floors and pod drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it lor other purposes. When diluting, always add the acid lo water; never odd water lo the acid.

HAZARD EVALUATION OF CHEMICALS

Chemical Name: Benzene

Date:

CAS **Number:** 7143-2

REFERENCES CONSULTED: NIOSH/OSHA Pocket Guide

CHEMICAL **PROPERTIES:** (Synonyms: Benzol, cyclohexatriene, coal tar naptha)

Chemical Formula: C_6H_6

Molecular Weight: 78.08

Physical State: Liquid

Solubility (H_2O): 820 ppm

Boiling Point: 176°F

Flash Point: 12°F

Vapor Pressure/Density: 75 mm/2.8

Freezing Point: 42°F

Specific Gravity: 0.877

Odor/Odor Threshold: 1.5 - 5 ppm

Flammable **Limits:** 7.1%, 0.3%

Incompatabilities: Strong oxidizers, zinc in presence of steam, chlorine trifluoride, ozone, sulfuric acid, potassium, chromic anhydride

BIOLOGICAL **PROPERTIES:**

TLV-TWA: 10 ppm

Odor Characteristics: Aromatic

Route of Exposure: Inhalation, ingestion, direct contact, skin nbsorption

PEL: 1 ppm - 5 ppm ceiling

IDLH: 2000 ppm

Human: Carcinogen

Rat/Mouse: Csrcinogen

HANDLING RECOMMENDATIONS: (**Personal** protective measures)

Impermeable protective clothing, gloves, **and** boots; eye protection; respirator **required** at 1 ppm; SCBAs required **et 10** ppm

HEALTH HAZARDS **AND** FIRST **AID:**

If in eyes, wash immediately with large amounts **of** water; if on skin, wash with **soap** (mild detergent) and water; move person to fresh sir; perform artificial respiration **if** breathing stopped; if swallowed, do not **induce** vomiting, remove by gastric lavage and catharsis

SYMPTOMS:

Acute: Excitation, euphoria, headache, **drowsiness,** dizziness, vomiting, delirium, unconsciousness, blurred vision, tremors, **shallow** respiration

Chronic: Headache, anorexia, drowsiness, nervousness, pallor, anemia, bleeding under skin and eyes, reduced clotting ability, possibly leukemia, liver and kidney damage

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Radium 226 Date

DOT Name/U.N. No. Radioactive Material Job No.

UN Number UN 2910/UN 2982

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other: NCRP65, 10 CFR 20

Handbook of Chemistry and Physics

Chemical Properties: (Synonyms:)

Chemical Formula Ra-226 (elemental) Molecular Weight 226

Physical state solid Solubility (H_2O) N/A Boiling Point N/A

flrh Point N/A Vapor Pressure/Density 5.5 Freezing Point N/A

Specific Gravity N/A Odor/Odor Threshold N/A Flammable Limits N/A

Radiological Properties: Alpha, gamma emitter, half-life = 1620 Years, radon daughters emit alpha, beta, and gamma rays, direct daughter product is Radon 222.

Biological Properties:

DAC $3x10^{-10}$ uCi/mL MPC $4x10^{-10}$ uCi/mL (water) (air) MPC $3x10^{-10}$ uCi/mL

ran Human Aquatic Rat/Mouse

Route of Exposure Inhalation, ingestion, dermal, external radiation hazard

Carcinogen X Teratogen X Mutagen X

Handling Recommendations: (Personal protective measures)

Protective clothing, respirators if airborn particulates are 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:

None immediate. decomtaminate personnel prior to transportand notify emergency personnel. Flush wounds with water.

Symptoms: Acute: None immediate. Above 200 rem - nausea, vomiting may may appear within hours. LD_{50} - 350 rem

Chronic: Lung cancer, skin injury, osteogenic sarcoma.

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Chemical Fact Sheet* Version 3

1,1,2,2-TETRACHLOROETHANE

ie information in this sheet applies to workplace exposure resulting from processing, manufacturing, storing or handling and is not designed for the population at large, Any generalization kyond occupational exposures should not be made. The best industria hygiene practice is Lo maintain concentrations of all chemicals at levels as low as is practical.

Chemical Names: Acetylene tetrachloride, dichloro-2,2-dichloroethane, tetrachloroethane, sym-tetrachloroethane; CAS 79-34-5.

Trade Names: Acetosal, Bonoform, Cellon, Westron, TCE and others.

Uses: Primary use is as an intermediate in the production of trichloroethylene, also used as solvent for fats, oils, resins, paints, varnish, weed killers, insecticides and many others.

PHYSICAL INFORMATION

Appearance: Clear, colorless or pale yellow liquid.

Odor: Sweetish, like chloroform. Minimum Detectable by Odor: 5 ppm.

Behavior in Water: Only slightly soluble, sinks.

HEALTH HAZARD INFORMATION

OSHA Standard: Average 8 hour exposure - 5 ppm.

NIOSH Recommended Limit: Reduce exposure to the lowest feasible level.

ACGIH Recommended Limit: Average 8 hour exposure - 1 ppm.

Short Term Exposure:

Inhalation: Exposure of 116 ppm For 20 minutes has caused dizziness and vomiting. At 260 ppm for 10 minutes, irritation of nose and throat were felt in addition, At 335 ppm for 10 minutes, rapid fatigue was also experienced. These symptoms generally disappear when exposure stops. Large accidental exposures have resulted in death,

Skin: Absorption through skin is possible. Significant skin absorption may occur to produce toxic effects. Earliest and most common symptom io tremors of hands, followed by skin irritation, numbness and effects listed above. Death has occurred from a combination of inhalation and skin absorption,

Eyes: Irritation and tearing.

Ingestion: Abdominal pain, nausea, and vomiting followed by similar symptoms as inhalation. As little as 3 ml (1/10 liq. oz.) may cause unconsciousness.

Long Term Exposure:

Symptoms may include nervousness, loss of appetite, constipation, tremors, fatigue, dizziness, nausea, vomiting and headache. nay result in long lasting liver damage. These symptoms have been reported after prolonged exposure to 75 ppm.

Tetrachloroethane at high levels has caused liver cancer in mice. Whether it causes cancer in humans is unknown.

*Prepared by the Bureau of Toxic Substance Assessment, New York State Department of Health. For an explanation of the terms and abbreviations used, see "Toxic Substances: How Toric is Toxic" available from the New York State Department of Health.

EMERGENCY AND FIRST AID INSTRUCTIONS

Inhalation: Move person to fresh air. Give artificial respiration or oxygen, as required. Seek medical attention.

Skin: Remove soaked clothing. Wash affected area with soap and water for at least 5 minutes. Seek medical attention.

Eyes: Wash eyes with lots of water. Seek medical attention,

Ingestion: Seek medical attention immediately.

Note to Physician: Expired air or blood analysis may be helpful in determining severity of exposure. Give special attention to neurological and liver function screening tests. Alcoholism may be a predisposing factor.

FIRE AND EXPLOSION INFORMATION

General: Not flammable except under conditions listed below.

REACTIVITY

to Avoid: Reacts violently with sodium, potassium, nitrates and 2,4-dinitrophenyl disulfide; flammable gas given *off* when heated with strong alkalies such as potassium hydroxide.

Conditions to Avoid: Breakdown in tbe presence of heat. light or moisture may yield chemically active and toxic *gases* such as hydrogen chloride, phosgene, carbon dioxide and carbon monoxide.

PROTECTIVE MEASURES

Storage and Handling: Keep container closed; store in a *cool*, dry, dark area with adequate ventilation.

Engineering Controls: Provide adequate ventilation. Have eyewash stations available.

Protective Clothing (Should not be substituted for proper handling and engineering controls): Rubber or neoprene protective clothing, gloves and goggles.

Protective Equipment: For any detectable levels use a supplied-air respirator ulth an auxiliary self-contained breathing apparatus, both with a full facepiece and operated in a positive pressure mode or a self-contained breathing apparatus uith a full facepiece operated in a positive pressure mode. For escape from a contaminated area use a gas mask with an organic vapor canister or an escape-type self-contained breathing apparatus.

Miscellaneous: Do not wear contact lenses when handling this material.

PROCEDURES FOR SPILLS AND LEAKS

Get all workers out *of* the spill area. Put on respirator and other protective clothing. Spread wad or other absorbent material mer liquid to absorb it. Shovel into buckets. take to a safe place in the open air. For final disposal contact *your* regional office of the New York state Department of Environmental Conservation.

For more information:
Contact the Industrial Hygienist or Safety Officer at your worksite or the New York State Department of Health, Bureau *of* Toxic Substance Assessment, 2 University Place, *Albany*, New York 12203.

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SITE SAFETY PLAN

Version 988

A. GENERAL INFORMATION

Project Title: Site 27 - Radium Dial Shop Sewer Project No.: UH1102

TDD/Pan No.:

Projoct Manager: John Barksdale Projoct Dir. : Rick Rudy

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

Proparod by: Mary Miller Date Proparod: 4-20-09

Approval by: Jackie Gillings MLM Date Approved: 5-11-89

Site Safety Officer Review: _____ Date Reviewed: _____

Scope/Objective of Work: Field Screening will include physical surveys, radiation survey, soil sampling, sediment sampling, temporary well installation and groundwater sampling.

Proposed Date of Field Activities: August 1989

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

Documentation/Summary:

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

B. SITE/WASTE CHARACTERISTICS

Waste Type(s):

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

Characteristic(s):

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

Other: _____

Physical Hazards:

Overhead [X]	Confined* Space [ ]	Below Grade [X]	Trip/Fall [X]
Puncture [X]	Burn [ ]	Cut [X]	Splash [X]
Noise [X]	Other: Vehicular traffic in site area, excavation equipment		

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

Site History/Description and Unusual Features (see Sampling Plan for detailed description): Previous to 1976 Building 709 was used to rework radium dials. The building was dismantled in 1976 and tho drainpipo was found to be radioactively contaminated. It was capped with concrete and left in place.

Locations of Chemicals/Wastes: Radioactive contaminants have boon found in drainpipe adjacent to manhole K7

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

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

C. HAZARD EVALUATION

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

Physical Hazard Evaluation:

1) Physical Surveys - Automobile hazards;

2) Temporary Monitoring Well Installation - using portable drill rig;

3) Soil sampling - Using portablm drill rig;

4) Decontamination Procedures - Using solvents.

Chemical Hazard Evaluation:

Compound	PEL/TWA	Route of Exposure	Acute Symptoms	Odor Threshold	odor Description
Isopropyl Alcohol	400 ppm	Inh,Ing,Derm,Eye	drowsiness,head.	7.5-200 ppm	rubbing alcohol
Nitric Acid	2 ppm	Inh,Ing,Derm,Eye	corrosive	0.3-1 ppm	acrid
Benzene	1 ppm	Ing,Derm, Inh	Dizz., Naus	4.68 ppm	sweet aromatic
HCN	10 ppm	Inh.	Weak., Head.	0.00027 ppm	bitter almond

Radionuclide	Half-Life	Typo of Radiation	Action Level	Route of Exposure	Acute Symptoms
RA-226	1620 years	alpha, gamma	>2 mR/hr presence of HP required	Inhalation, Ingestion	>200 rem nausea, vomiting possiblo

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

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D. SITE SAFETY WORK PLAN

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

Perimeter identified? [yes] Site secured? [no]

Work Areas Designated? [yes] Zone(s) of Contamination Identified? [no]

Personnel Protection (TLD badges required for a11 field personnel):

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

	A	B	C	D
Task 1				X
Task 2				X
Task 3				X
Task 4				X

Action Levels for Evacuation of work Zone Pending Reassessment of Conditions: See Allowable Radiation Dose Attachment

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

Air Monitoring (daily calibration unless otherwise noted):

contaminant of Interest	Typo of Sample (area, personal)	Monitoring Equipment	Frequency of Sampling
VOC's	Area	OVA	Continuous
Radiation -- Exposure	Area	Micro-R-Meter	Continuous
Explosivo Gases	Area	O_2/Explosimeter	Continuous
Radiation -- Survey	Area	Gamma Scin.	Survey
HCN gas	Porsonnel	Monitox	Continuous

Decontamination Solutions and Procedures for Equipment, Sampling Gear, otc.:
Monitor for radioactive contamination/wipe/remonitor/rinse with water or detergent, if necessary. until no radiation contarination persists/Trisodium phosphate wash, tap water rinse, isopropanol rinse, distilled water rinse, isopropanol rinse, and final distilled water rinse. Note: Every effort will be made not to generate mixed waste.

Personnel Decon Protocol: Boot and glove wash - trisodium phosphate wash with clean water rinse. Expendables will be double bagged and drummed for disposal. Field personnel will take a hygienic shower, off-sit., following each day's field work.

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

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

All drilling safety procedures will bo strictly adhered to as outlined in Attachment A. If background radiatior levels are exceeded in tho soil samples, tho drainpipe will be excavated to determine tho source area.

Site Entry Procedures and Special Considerations: E & E's "Buddy System" will bo employed at all times during fioldwork activities. Personnel will exercise caution in tho vicinity of Chevalier Field and along nearby roadways. If levels exeeding 5 mR/hr are encountered team members will 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 fioldwork activities will bo performed during daylight hours. Team members will take breaks as necessary tc avoid heat stress and replace fluids. Cooling vests ray bo used to prevent heat stress.

General spill Control, if applicable: N/A

Investigation-Derived Material Disposal (i.e., expendables, decon waste, cuttings):

All fioldwork waste materials will bo double baggod, drummed, labeled and transported to a designated location for final disposal by the Navy.

Sample Handling Procoduros Including Protective Wear:

During a11 handling of samples, a11 field team members will wear surgical gloves. Goggles will bo worn during sample preservation with acids.

Team Member*	Responsibility
Team members to be determined	Team Leader
	Site Safety Officer/Sampler
	Geologist/Sampler

*All entries into exclusion zone require Buddy System use. All E & E fiold staff participate in nodical 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).

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E. EMERGENCY INFORMATION

(Use supplemental shoats, if necessary)

LOCAL RESOURCES

(Obtain A local telephone book from your hotol, if possibla.)

Ambulance On Base -- 904-452-4138, Off Base -- 911

Hospital Emergency Room NAS Dispensary - 904-452-2733, Baptist Hospital 904-434-4811 (Life Flight)'

Poison Control Center

Police (include local, county shaciff. state) 911

Fire Department 911

Airport

U.S. Coast Guard Emergency - 904-453-8178, General Information 904-453-8282

Laboratory E & E ASC 1-716-631-0360

Fed. Express 1-800-238-5355

Cliant Contact U.S. Navy Southern Division, Enginoer-In-Chargo, 1-803-743-0574

Site Contact NAS Pensacola Enviromental Coordinator, W. Dewayne Ray -- 904-452-4515

*Baptist Hospital is prepared to handle radioactively contaminated porsonnol.

SITE RESOURCES

Site Emergency Evacuation Alarm Method N/A

Water Supply Source On-site

Telephone Location, Number To be dotarminod on-sit.

Cellular Phone, if availablo N/A

Radio

Other On-site warehouse number to be 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 Environnant, Inc., Safety Director
   Paul Jonmaire ..... (716) 684-8060 (office)
   (716) 655-1260 (home)

3. Rogional Offica Contact ..... M.Miller.... 656-2854 (home)
   877-1978 (office)

4. Offica Manager ..... R.Rudy..... 893-7245 (home)

MEDTOX HOTLINE

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

   What to report:

   - State: 'this is an emergency."
   - Your name, region, and site.
   - Telephone number to roach you.
   - Your location.
   - Nan of person injurod 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 toxfcologist 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 Jonmaire - home # (716) 655-1260
   c. Assistant Corp. Safety Officer - Steven Sherman - homo # (716) 688-0084

(.On: Field Team must Know Route(.) Prior to Start of Work)

Directions to hospital (include map)

Dispensary - Follow Murray Road south to Ellyson Avonuo. Turn right onto Ellyson Avonuo and continuo to it's intersection with Turner Street. The NAS Dispensary is located on tho northwest corner of tho intersection of Ellyson Avonuo and Turner Stroot, in Building 625-A.

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. 3mi to Pace Blvd. Turn loft (north) on Pace Blvd. and proceed approx. lmi 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 Got Off-Sit. Emergency egress routes will bo located if emergency exit routes become blocked by construction, otc.

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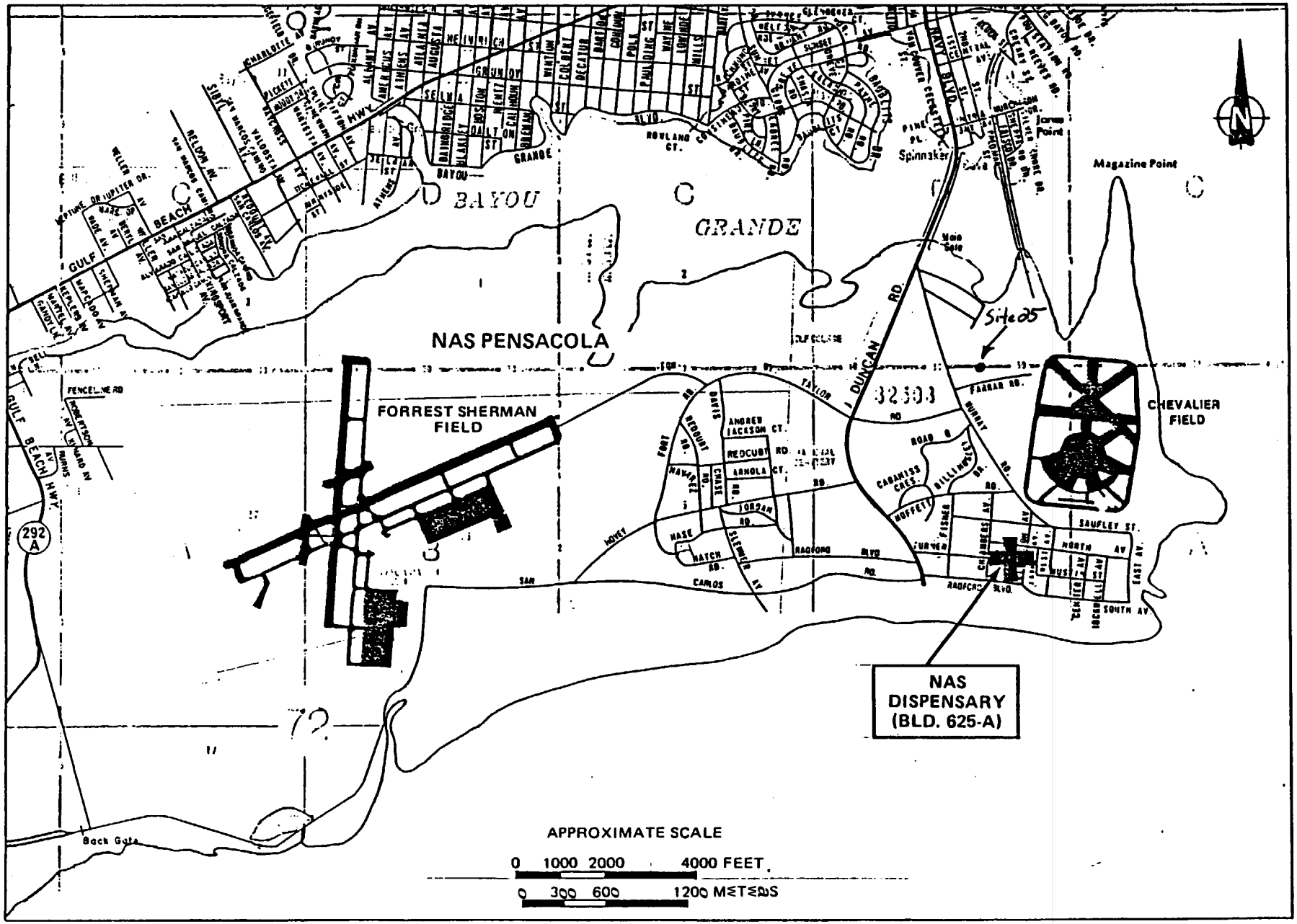

Figure 3–2 LOCATION OF NAS DISPENSARY

MAXIMUM ALLOWABLE RADIATION DOSE
TO INVESTIGATION PERSONNEL

Part of Body	Per Calendar Quarter	Per Year
Whole *body*, head and trunk, gonad., blood forming organs, lenses of eyes	1 rem	4 rem
Skin of 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 WILL BE TRAINED IN E & 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

DRILL RIG SAFETY

* Hard hats must be worn.
* All team members must be know the procedure to shut the rig off and the location of the "kill" switch.
* When moving a rig off the road, pay attention to obstacles in route of travel. Walk the intended route first.
* Have someone guide the rig driver when clearance is at a minimum or when hazards are in close proximity.
* Set rig brakes and block the wheels when rig is set up at the desired drilling location.
* The mast must be lowered when the rig is moved.
* Always consider overhead wires to be live, watch for sagging lines and do not operate rig within 15 feet of overhead lines.
* Make sure the site, platforms and walkways are free of obstructions.
* Make sure proper housekeeping is practiced around and on the rig at all times.. Tools should be stored in a manner that permits convenient access and provides for adequate safety.
* Store gasoline in approved containers that have a spark arrestor and keep them clear of the drilling work area.
* Check rig equipment prior to starting work. Repair or replace faulty and worn items.
* Handle augers with care. Use proper lifting techniques when p'icking up samplers and augers. Use a tool hoist if possible and stay clear of rotating augers. Keep cables and ropes secured when not in use.
* Level and stabilize the drill rig prior to raising the mast.
* Watch for slippery ground when working in the area of the rig.
* All' unattended boreholes must be properly covered.
* Do not drill during an electrical storm.
* Maintain a safe distance from the rig mechanisms during .drive sampling and auger removal operations.

ECOLOGY AND ENVIRONMENT, INC.,
STANDARD OPERATING PROCEDURES FOR
EMERGENCIES DUE TO HEAT AND HEAT STRESS MONITORING

Field operations during the summer months can create a variety of hazards to the employee. Heat cramps. heat exhaustion. and heat stroke can be experienced and. If not remedied. can threaten life or health. Therefore, It is important that all employees be able to recognize symptoms of these conditions and be capable of arresting the problem as quickly as possible.

THE EFFECTS OF HEAT

As the result of normal oxidation processes within the body, a predictable amount of heat is generated. If the heat is liberated as it is formed, there is no change in body temperature. If the heat is liberated 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 with the elimination of heat leads to its accumulation and thus to the elevation of body temperature. As a result, the person is said to have a fever. When such a condition exists, it produces a vicious cycle in which certain body processes speed up and generate additional heat. Then the body must eliminate riot only the normal but also the additional quantities of heat.

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 or a breeze strikes the body, additional heat is lost by convection. However, when 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 or sweat from the skin surface. As the air becomes more humid (contains more moisture), vaporization from the skin slows down. Thus, on a day when the temperature is 95 to 100°F, with high humidity and little or no breeze, conditions are ideal for the retention of heat within the body. It is on such a day or. more commonly, a succession of such days (a heat wave) that medical emergencies due to heat are likely to occur. Such emergencies are classified in three categories: heat cramps, heat exhaustion, and heat stroke.

HEAT CRAMPS

Heat cramps usually affect people who work in hot environments and perspire a great deal. Loss of salt from the body causes very painful cramps of the leg and abdominal muscles. Heat cramps also may result from drinking iced water or other drinks either too quickly or in too large a quantity.

<u>Heat Cramp Symptoms.</u> The symptoms of heat cramp are:

- Muscle cramps in legs and abdomen,
- Pain accompanying the cramps,
- Faintness, and
- Profuse perspiration.

Heat Cramp Emergency Care. Remove the patient to a cool place. Give him sips of liquids such as "Gatorade" or its equivalent. Apply manual pressure to the cramped muscle, Remove the patient to a hospital If there is any indication of a more serious problem.

HEAT EXHAUSTION

Heat exhaustion occurs in individuals working in hot environments, and may be associated with heat cramps. Heat exhaustion is caused by the pooling of blood in the vessels of the skin, The heat is transported from the interior of the body to the surface by the 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 lower extremities when an individual is in an upright position, may lead to an inadequate return of blood to the heart and eventually to physical collapse.

Heat Exhaustion Symptoms. The symptoms of heat exhaustion are:

- Weak pulse;
- Rapid and usually shallow breathing;
- Generalized weakness;
- Pale, clammy skin;
- Profuse perspiration;
- Dizziness;
- Unconsciousness; and
- Appearance of having fainted (the patient responds to the same treatment administered in cases of fainting).

Heat Exhaustion Emergency Care. Remove the patient to a cool place and remove as much clothing as possible. 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 the patient for shock, and remove him to a medical facility if there is any indication of a more serious problem.

HEAT STROKE

Heat stroke is a profound disturbance of the heat-regulating mechanism, associated with 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% mortality rate. Alcoholics are extremely susceptible.

Heat Stroke Symptoms. The symptoms of heat stroke are:

- Sudden onset;
- Dry, hot, and flushed skin;
- Dilated pupils;
- Early loss of consciousness;
- Full and fast pulse;
- Breathing deep at first, later shallow and even almost absent;
- Muscle twitching, growing into convulsions; and
- Body temperature reaching 105 to 106°F or higher.

Heat Stroke Emergency Care. Remember that this is a true emergency. Tranrportrtion to a medical facility should not be delayed. Remove the patient to a cool environment if possible, and remove as much clothing as possible. Assure an open airway. Reduce body temperature promptly — preferably by wrapping in a wet sheet or else by dousing the body with water. If cold packs are available, place them under the arms, around the neck, at the ankles, or at any place where blood vessels that lie close to the skin can be cooled. Protect the patient from injury during convulsions, especially from tongue biting.

AVOIDANCE OF HEAT-RELATED EMERGENCIES

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 system. Without these electrolytes, body systems cannot function properly, thereby increasing the represented health hazard. Therefore, when personnel are working in situations where the ambient temperatures and humidity are high--and especially in situations where protection Levels A B, and C are required — the site safety officer must:

- Assure that all employees drink plenty of fluids ("Gatorade" or its equivalent):
- Assure that frequent breaks are scheduled so overheating does not occur; and
- Revise work schedules, when 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).

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If protective clothing must be worn, especially Levels A and E, the suggested guidelines for ambient temperature and maximum wearing time per excursion are:

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

One method of measuring the effectiveness of employees' rest-recovary regime Is by monitoring the heart rate. The "Brouha guideline" Is one such method:

a During a three-mlnuta 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 mlnute.

a 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.

Mallinckrodt
Material Safety Data

Emergency Phone Number: 314-982-5000

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

ISOPROPYL ALCOHOL

PRODUCT IDENTIFICATION:

Synonyms: 2-propanol; KC-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 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.
Wuh thoroughly after handling.
Amid 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 minuter. 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:
Todc 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 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 dear 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

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
May cause irritation of the nose and throat. Exposure to high concentrations has a narcotic effect, producing symptoms of drowsiness, headache, staggering, unconsciousness and possibly death.

Ingestion:
May cause drowsiness, unconsciousness, and death. Gastrointestinal pain, cramps, nausea, vomiting, and diarrhea may also result. The single lethal dose for a human adult = about 250 mls (SAX Sixth Edition).

Skin Contact:
Has a defatting action of the skin that can cause irritation. May cause irritation with a stinging effect and burning sensation.

Eye Contact:
Vapors may irritate the eyes. Splashes may cause severe irritation. possible corneal burns and eye damage.

Chronic Exposure:
Prolonged contact with skin may cause mild irritation, drying, cracking, or contact dermatitis may develop.

Aggravation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the 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:
Give water to drink. Induce vomiting if medical help not is immediately available. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Exposure:
Remove any contaminated clothing. Wash skin with soap or mild detergent and water for at least 15 minutes. Get medical attention if irritation develops or persists.

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

C. TOXICITY DATA (RTECS, 1982)

Oral rat LD50: 5840 mg/kg. Skin rabbit LDJO 13 gm/kg. Inhalation rat LC50: 16000 ppm/8H. Mutation references cited Aquatic Toxicity rating TLm96: 1000-10 ppm.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
-OSHA Permissible Exposure Limit (PEL):
400 ppm (TWA).
-ACGIH Threshold Limit Value (TLV):
400 ppm (TWA); 500 ppm (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 a full facepiece chemical cartridge respirator may be worn, in general, up to the maximum use concentration specified by the respirator supplier. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

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 quickdrench facilities in work area.

SECTION 7 Storage and Special Information

Protect against physical damage. Store in a cool, dry well-ventilated location. away from any area where the fire hazard may be acute. Outside or detached storage is preferred. Separate from oxidizing materials. Containers should be bonded and grounded for transfers to avoid static sparks. Storage and use areas should be No Smoking areas. Use non-sparking type tools and equipment.

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NITRIC ACID, 70%

PRODUCT IDENTIFICATION:

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

Formula CAS No: 7697-37-2

Molecular Weight: 63.00

Chemical Formula: HNO_3

Hazardous Ingredients: Not Applicable

SURES

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

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

EMERGENCY/FIRST AID

In case of contact, immediately flush skin or eyes with plenty of water for at least IS 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 ill cases tall a physician.
SEE SECTION 5.

DOT Hazard Class: Oxidizer

SECTION 1 Physical Data

Appearance: Clear, colorless to slightly yellow liquid.

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 oxides 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 Leak/Spill Disposal Information

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.

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 thb substance.

B. FIRST AID

Iohalatloo:
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 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 pknty 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 b 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 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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SULFURIC ACID 96%

PRODUCT IDENTIFICATION:

Synonyms: Oil of Vitriol

Formula CAS No.: 7664-93-9

Molecular Weight: 98.07

Chemical Formula: H_2SO_4

Hazardous Ingredients: Not applicable.

PRE(ITI(

DANGER! CORROSIVE. LIQUID
CAUSE **SEVERE BURNS TO** BODY TISSUE. AY BE FATAL
It **SWALLOWED. HARMFUL** It ALED INHALATION MAY
CAUSE LUNG DAMAGE.

Do **not get in** eyes, on skin, or on clothing.
Do not t it.
Keep container **closed.**
Use only with n
it **thoroughly** after ha
This substance is classified as a POISON under the Federal C
i Act.

EMERGENCY/ !

In all cases call e i In case of contact, **immediately** flush **skin** or yes with plenty of water **for at l 15** te
If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water. Never give ng l c an unconscious person. If inhaled, remove to fresh **air.** If not breathing, *give* artificial respiration. If i is difficult, **give oxygen.**
SEE **SECTION 5.**

DOT Hazard **Class:** *Corrosive* **Material**

SECTION 1 Physical Data

Appearance: Colorless, oily liquid.

Odor: Odorless.

Solubility: Infinite @ 20°C.

Boiling Point ca. 310% (590°F)

Melting Point: ca. -14°C **(6°F).**

Specific **Gravity:** 1.84

Vapor **Density (Air=1): < 03 @ 25°C (77°F)**

Vapor Pressure (mm Hg): I **@ 146°C (250°F).**

Evaporation Rate: **No information found**

SECTION 2 Fire and Explosion Information

Fire:
Not combustible, but substance b a **stror g oxidizer and its heat of reaction** with reducing agents or combustibles may cause ignition. Reacts with m a t metals releasing flammable, **potentially explosive hydrogen gas.**

Explosion:
Not combustible, but substance is a **strong oxidizer and its** b u t **of reaction** with **reducing** agents or combustibles may cause ignition.

Fire Extinguishing Media:
Dry chemical, foam or carbon dioxide. Wmar **spray** maybe **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.

SECTION 3 Reactivity Data

Stability:
Stable under ordinary conditions of use and storage.

Hazardous Decomposition Products:
Toxic fumes *of* oxides of sulfur. **Will react** with water or steam to produce toxic and corrosive fumes. Reacts with carbonates to **generate carbon** dioxide **gas,** and with cyanides and sulfides to **form poisonous hydrogen cyanide and hydrogen sulfide respectively.**

Hazardous Polymerization:
Will **not occur.**

Incompatibilities:
Water, bases, organic material, halogens, metal acetylides, oxides and hydrides, strong oxidizing and reducing agents and many other reactive substances.

SECTION 4 Leak/Spill Disposal Information

Dike and cover leaking or spilled liquid with dirt, vermiculite, kitty-litter or other inert absorbent. Cover spill with sodium bicarbonate or soda ash and mix. Clean-up personnel require protective clothing and respiratory protection from vapors and mists. Neutralized waste may be containerized and disposed in a RCRA approved waste disposal facility. Flush area of spill with dilute soda ash solution and discard to sewer.

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

Ensure compliance with local, state and federal regulations.

NFPA Ratings: Health 3 F nability: 0 Reactivity: 2 Other: **Water reactive**

SECTION S Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Inhalation produces damaging effects on the mucous membranes and upper respiratory tract. May cause lung edema. Symptoms may include irritation of the nose and throat, and labored breathing.

Ingestion:
Corrosive. Swallowing can cause severe burns of the mouth, throat. and stomach, leading to death. Can cause sore throat, vomiting. diarrhea.

Skin Contact:
Corrosive. Symptoms of redness, pain, and severe burn can occur.

Eye **Contact:**
Corrosive. Splashes can cause blurred vision, redness, pain and severe tissue burns.

Chronic Exposure:
Long-term exposure to mist or vapors may cause damage to teeth.

Aggrevation of Pre-existing Conditions:
Persons with pre-existing skin disorders or eye problems or impaired respiratory function may be more susceptible to the effects of the 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:
If swallowed, DO NOT induce vomiting. Give large quantities of water or milk if available. Call a physician immediately. Never give anything by mouth to an unconscious person.

Skin **Exposure:**
In case of contact, immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Call a physician.

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

C. TOXICITY DATA (RTECS, 1982)

Oral rat LD50: 2140 mg/kg. Inhalation Guinea Pig LC50: 18 mg/m^3.

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Airborne Exposure **Limits:**
-OSHA Permissible Exposure Limit (PEL):
1 mg/m^3 (TWA).
-ACGIH Threshold Limit Value (TLV):
1 mg/m^3 (TWA).

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 a full facepiece chemical cartridge respirator may be worn, in general, up to 100 times the TLV or the maximum use concentration specified by the respirator supplier, whichever is less. Alternatively, a supplied air full facepiece respirator or airlined hood may be worn.

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 rnd Specinl Information

Store in a mol, dry, ventilated storage area with acid resistant floors and good drainage. Protect from physical damage. Keep out of direct sunlight and away from heat, water, and incompatible materials. Do not wash out container and use it for other purposes. When diluting, always add the acid to water, never add water Io the acid.

HAZARD EVALUATION OF CHEMICALS

Chemical Name: Benzene

Date:

CAS Number: 71-43-2

REFERENCES CONSULTED: NIOSH/OSHA Pocket Guide

CHEMICAL PROPERTIES: (Synonyms: Benzol, cyclohexatriene, coal tar naptha)

Chemical Formula: C_6H_6

Molecular Weight: 78.08

Physical State: Liquid

Solubility (H_2O): 820 ppm

Boiling Point: 176°F

Flash Point: 12°F

Vapor Pressure/Density: 75 mm/2.8

Freezing Point: 42°F

Specific Gravity: 0.877

Odor/Odor Threshold: 1.5 - 5 ppm

Flammable Limits: 7.1%, 0.3%

Incompatabilities: Strong oxidizers, zinc in presence of steam, chlorine trifluoride, ozone, sulfuric acid, potassium, chromic anhydride

BIOLOGICAL PROPERTIES:

TLV-TWA: 10 ppm

Odor Characteristics: Aromatic

Route of Exposure: Inhalation, ingestion, direct contact, skin absorption

PEL: 1 ppm - 5 ppm ceiling

IDLH: 2000 ppm

Human: Carcinogen

Rat/Mouse: Carcinogen

HANDLING RECOMMENDATIONS: (Personal protective measures)

Impermeable protective clothing, gloves, and boots; eye protection; respirator required at 1 ppm; SCBAs required at 10 ppm

HEALTH HAZARDS AND FIRST AID:

If in eyes, wash immediately with large amounts of water; if on skin, wash with soap (mild detergent) and water; move person to fresh air; perform artificial respiration if breathing stopped; if swallowed, do not induce vomiting, remove by gastric lavage and catharsis

SYMPTOMS:

Acute: Excitation, euphoria, headache, drowsiness, dizziness, vomiting, delirium, unconsciousness, blurred vision, tremors, shallow respiration

Chronic: Headache, anorexia, drowsiness, nervousness, pallor, anemia, bleeding under skin and eyes, reduced clotting ability, possibly leukemia, liver and kidney damage

ecology and environment, inc.

HAZARD EVALUATION OF CHEMICALS

Chemical Name Radium 226 Date

DOT Name/U.N. No. Radioactive Material Job No.

UN Number UN 2910/UN 2982

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other: NCRP65, 10 CFR 20

Handbook of Chemistry and Physics

Chemical Properties: (Synonyms:)

Chemical Formula Ra-226 (elemental) Molecular Weight 226

Physical State solid Solubility (H_2O) N/A Boiling Point N/A

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

Specific Gravity N/A Odor/Odor Threshold N/A Flammable Limits N/A

Radiological Properties: Alpha, gamma emitter, half-life = 1620 years, radon daughters emit alpha, beta, and gamma rays, direct daughter product is Radon 222.

Biological Properties:

DAC $3x10^{-10}$ uCi/mL MPC $4x10^{-10}$ uCi/mL (water) (air) MPC $3x10^{-10}$ uCi/mL

IDLH Human Aquatic Rat/Mouse

Route of Exposure Inhalation, ingestion, dermal, external radiation hazard

Carcinogen X Teratogen X Mutagen X

Handling Recommendations: (Personal protective measures)

Protective clothing, respirators if airborn particulates are 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:

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

Health Hazards and First Aid:

None immediate, decomtaminate personnel prior to transportand notify emergency personnel. Flush wounds with water.

Symptoms: Acute: None immediate. Above 200 rem - nausea, vomiting may may appear within hours. LD_{50} - 350 rem

Chronic: Lung cancer, skin injury, osteogenic sarcoma.

Chemical Fact Sheet* Version 3

1,1,2,2-TETRACHLOROETHANE

The information in this sheet applies to workplace exposure resulting from processing, manufacturing, storing or handling and is not designed for the population at large. Any generalization beyond occupational exposures should not be made. The best industrial hygiene practice is to maintain concentrations of all chemicals at levels as low as is practical.

Chemical Names: Acetylene tetrachloride, dichloro-2,2-dichloroethane, tetrachloroethane, sym-tetrachloroethane; CAS 79-34-5.

Trade Names: Acetosal, Bonoform, Cellon, Westron, TCE and others.

Uses: Primary use is as an intermediate in the production of trichloroethylene, also used as solvent for fats, oils, resins, paints, varnish, weed killers, insecticides and many others.

PHYSICAL INFORMATION

Appearance: Clear, colorless or pale yellow liquid,

Odor: Sweetish, like chloroform. **Minimum Detectable by Odor:** 5 ppm.

Behavior in Water: Only slightly soluble, sinks.

HEALTH HAZARD INFORMATION

OSHA Standard: Average 8 hour exposure - 5 ppm.

NIOSH Recommended Limit: Reduce exposure to the lowest feasible level.

ACGIH Recommended Limit: Average 8 hour exposure - 1 ppm.

Short Term Exposure:

Inhalation: Exposure of 116 ppm for 20 minutes has caused dizziness and vomiting. At 260 ppm for 10 minutes, irritation of nose and throat were felt in addition. At 335 ppm for 10 minutes, rapid fatigue was also experienced. These symptoms generally disappear when exposure stops. Large accidental exposures have resulted in death.

Skin: Absorption through skin is possible. Significant skin absorption may occur to produce toxic effects. Earliest and most common symptom is tremors of hands, followed by skin irritation, numbness and effects listed above. Death has occurred from a combination of inhalation and skin absorption.

Eyes: Irritation and tearing.

Ingestion: Abdominal pain, nausea, and vomiting followed by similar symptoms as inhalation. As little as 3 ml (1/10 liq. oz.) may cause unconsciousness.

Long Term Exposure:

Symptoms may include nervousness, loss of appetite, constipation, tremors, fatigue, dizziness, nausea, vomiting and headache. May result in long lasting liver damage. These symptoms have been reported after prolonged exposure to 75 ppm.

Tetrachloroethane at high levels has caused liver cancer in rice. Whether it causes cancer in humans is unknown.

*Prepared by the Bureau of Toxic Substance Assessment, New York State Department of Health. For an explanation of the terms and abbreviations used, see "Toxic Substances: How Toxic is Toxic" available from the New York State Department of Health.

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EMERGENCY AND FIRST AID INSTRUCTIONS

Inhalation: Move person to fresh air. Give artificial respiration or oxygen, as required. Seek medical attention.

Skin: Remove soaked clothing. Wash affected area with soap and water for at least 5 minutes, Seek medical attention.

Eyes: Wash eyes with lots of water, Seek medical attention,

Ingestion: Seek medical attention immediately,

Note to Physician: Expired air or blood analysis may be helpful in determining severity of exposure. Give special attention to neurological and liver function screening tests. Alcoholism may be a predisposing factor.

FIRE AND EXPLOSION INFORMATION

General: lot flammable except under conditions listed below,

REACTIVITY

Materials to Avoid: Reacts violently with sodium, potassium, nitrates and 2,4-dinitrophenyl disulfide; flammable gas given off when heated with strong alkalies such as potassium hydroxide,

Conditions to Avoid: Breakdown in the presence of heat, light or moisture may yield chemically active and toxic gases such as hydrogen chloride, phosgene, carbon dioxide and carbon monoxide.

PROTECTIVE MEASURES

Storage and Handling: Keep container closed; store in a cool, dry, dark area with adequate ventilation,

Engineering Controls: Provide adequate ventilation. Have eyewash stations available.

Protective Clothing (Should not be substituted for proper handling and engineering controls): Rubber or neoprene protective clothing, gloves and goggles.

Protective Equipment: For any detectable levels use a supplied-air respirator with an auxiliary self-contained breathing apparatus, both with a full facepiece and operated in a positive pressure mode or a self-contained breathing apparatus with a full facepiece operated in a positive pressure mode. For escape from a contaminated area use a gas mask with an organic vapor canister or an escape-type self-contained breathing apparatus.

Miscellaneous: Do not wear contact lenses when handling this material.

PROCEDURES FOR SPILLS AND LEAKS

Get all workers out of the spill area. Put on respirator and other protective clothing. Spread sand or other absorbent material over liquid to absorb it. Shovel into buckets, take to a safe place. Place in the open air. For final disposal contact your regional office of the New York State Department of Environmental Conservation,

For more information:
Contact the Industrial Hygienist or Safety Officer at your worksite or the New Yock State Department of Health, Bureau of Toxic Substance Assessment, 2 University Place, Albany, New York 12203.

Chemical Pact Sheet* Version 3

HYDROGEN CYANIDE

The information in this sheet applies to workplace exposure resulting from processing, manufacturing, storing or handling and is not designed for the population at large. Any generalization beyond occupational exposures should not be made. The best industrial hygiene practice is to maintain concentrations of all chemicals at levels as low as is practical.

Chemical Names: Hydrogen cyanide, hydrocyanic acid, HCN, prussic acid; CAS 74-90-8.

Trade Names: Blausaure, Aero Liquid HCN and others.

Uses: Used as a fumigant**; used in electroplating, metallurgy and photographic processes; rued in the synthesis of resin monomers, acrylates, wthacrylates, hexamethylenediamine and acrylonitrile.

PHYSICAL INFORMATION

Appearance: Because its boiling point is near room temperature, hydrogen cyanide may be a colorless gas or colorless liquid. It is also sold as a water solution at a strength of 2% (USP) and commercial strengths of 5% to 10%.

Odor: Sweetish, like bitter almonds. **Minimum Detectable by Odor:** 1 ppm.

Evaporation: Liquid evaporates at room temperature. Vaporizes rapidly above 26°C (80°F).

Behavior in Water: Very soluble.

HEALTH HAZARD INFORMATION

OSHA Standard: Average 8 hour exposure — 10 ppm.

NIOSH Recommended Limit: 4.7 ppm.

ACGIH Recommended Limit: 10 ppm.

Short Term Exposure:

Inhalation: At less than 20 ppm, exposure to hydrogen cyanide ray produce headache, dizziness, nausea and vomiting. Concentrations greater than 50 ppm may cause difficulty in breathing, rapid tbrobbing of the heart, paralysis, unconsciousness, respiratory arrest or death. 30 minutes exposure to 135 ppm may cause death. 270 ppm has caused immediate death.

Skin: Hydrogen cyanide is readily absorbed tbrough the skin. Symptoms are similar to above.

Eyes: Hydrogen cyanide is irritating to the eye and rapidly absorbed.

Ingestion: Symptoms are similar to above. Death has resulted from ingestion of 570 mg/kg or 1.4 oz. for a 150 pound person.

Long Term Exposure:

Itching scarlet rash, red bumps, severe nose itch leading to bleeding, and possibly holes in the nose, may result from long term exposure to hydrogen cyanide. Headache, nausea, vomiting, weakness and enlarged thyroid gland have also been reported at exposures from 4 to 12 ppm. Most of these symptoms disappear after exposure stops.

**A permit may be required when used for this purpose. For more information, contact the New York State Department of Environmental Conservation, Bureau of Pesticides Management.

*Prepared by the Bureau of Toxic Substance Assessment, New York State Department of Health. For an explanation of the terms and abbreviations used, see "Toxic Substances: How Toxic is Toxic" available from the New York State Department of Health.

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EMERGENCY AND FIRST AID INSTRUCTIONS

Inhalation: Hove person to fresh air. Administer artificial respiration and oxygen as required. NIOSH recommends that ampules of amyl nitrate be available wherever hydrogen cyanide is in use. Whenever symptoms appear break ampule into cloth and hold under nose for 15 seconds. Repeat after 15 seconds. Seek medical attention immediately.

Skin: Remove all contaminated clothing. Wash with soap and large amounts of water for at least 15 minutes. Seek medical attention.

Eyes: Wash with water at least 15 minutes. Seek medical attention,

Ingestion: Use amyl nitrate as above, give artificial respiration and oxygen as required. Get immediate medical attention.

to Physician: Blood CN level,tests may be useful. Break amyl nitrate ampule in cloth and hold under nose for 15 seconds. Repeat at 15 second intervals. Additional treatment 10 ml of 3% sodium thiosulfate intravenously within 2 minutes followed by 50 ml of 25%.

FIRE AND EXPLOSION INFORMATION

General: Hydrogen cyanide is a dangerous fire hazard. It burns in air with a blue flame. Ignites at -17°C (0°F).

Explosive Limits: Upper -- 41%, Lower -- 6%.

Extinguisher: Use dry chemical, carbon dioxide or alcohol foam. Fight fire from far away.

REACTIVITY

General: After long standing, liquid hydrogen cyanide polymerizes to form a dark brown explosive powder.Moisture and alkalies (like lye, potassium hydroxide) speed up thrs coaction,

PROTECTIVE MEASURES

Storage and Handling: Protect containers against physical damage. Store outdoors, if possible, or indoors in standard combustible liquid storage room or cabinet, away from sources of ignition.

Engineering Controls: Provide adequate ventilation to keep levels below recommendation.

Protective Clothing (Should not be substituted for proper handling and engineering controls): Long rubber gloves, aprons and impervious clothing should be worn if contact with hydroge cyanide is likely.

Protective Equipment: For levels up to 40 ppm use a supplied-air respirator or a self-contained breathing apparatus. Far up to 50 ppm use a supplied-air respirator vith full facepiece, a self-contained breathing apparatus with a full facepiece, a supplied-ai respirator operated in continuous-flow mode or a gas mask vith full faceprece and a canister providinq protection against hydroqen cyanide. Far levels greater than 50 ppm c use in areas of unknown concentrations use a self-contained breathing apparatus wrth a full facepiece operated in a positive pressure mode or a combination Type C supplied-air respirator with an auxiliary self-contained breathrnq apparatus, both with full facepiece and operated in a positive pressure mode. par escar from a contaminated area use a gas mask with a canister providing protection against hydroqen cyanide or an escape self-contained breathinq apparatus. par fie ——— use a self-contained breathing apparatus with a full faceprece operated in a positive pressure mode.

PROCEDURES FOR SPILLS AND LEAKS

Waste solution8 of bydrogen cyanide should be destroyed by alkaline chlorination or alkaline reaction with ferrous sulfate. For final disposal contact your regional office of the New York State Department of Environmental Conservation.

For more information:

Contact the Industrial Hygienist or Safety Officer at your worksite or the New York State Department of Health, Bureau of Toxic Substance Assessment, 2 University Place, Albany, New Yotk 12203.

APPENDIX B

SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

[Bold items enclosed in brackets denote changes from original text]

Section 1.0 — Title Page

Work Plan Group: G
Site No.: 25
Site Name: Radium Spill Area

Prepared by: Mary L. Hiller
Ecology and Environment, Inc.
1203 Governor's Square Boulevard, Suite 401
Tallahassee, Florida 32301

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

E & E QA/QC Director or Assistant QA/QC Director: T. Yeates/R. Short

E & E ASC Director: A. Clifton

E & E QA/QC Project Officer: A. Schuessler

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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 HNu/OVA Surface Emission Survey
- X Radiation Survey
- ___ Habitat/Biota Survey
- ___ Asbestos Survey (in Rubble)
- X Hydrologic Assessment

Geophysical Survey (check all that apply):

- X Electromagnetic Conductivity:
  - X EM-31
  - X EH-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 : Planned Number of Samples ___
- X Laboratory Analyses:

PLANNED NUMBER OF SAMPLES		CATEGORIES OF ANALYSES
Surface Water	___	X Volatile Organic Compounds
Sediment	___	X Polynuclear Aromatic Hydrocarbons
Soil'	45	X Phenols
Groundwater	5	___ Chlorinated Eerbicides
Duplicates	3	___ Carbamates
Trip Blanks	___	X Pesticides/Polychlorinated Biphenyls
Field Blanks	___	X Total Recoverable Hydrocarbons
Rinsate Blanks	___	X Metals
Other		X Gross Alpha

Section 3.0 -- Project Summary (Continued)

Phase II -- Characterization

PLANNED NUMBER OF SAMPLES

Surface Water	___	Air	___	Duplicates	4
Sediment	___	Biota:		Trip Blanks	3
Soil	25	Flora	___	Field Blanks	3
Groundwater	3	Fauna	___	Rinsate Blanks	3

CATEGORIES OF ANALYSES

- X Purgeable Aromatics
- X Purgeable Halocarbons
- X Base/Neutral Extractables
- X Acid Extractables
- ___ Polynuclear Aromatic Hydrocarbons
- X Pesticides
- X Polychlorinated Biphenyls
- X Total Recoverable Hydrocarbons
- X Metals
- X Cyanide

Additional analytical categories are identified below:

- X Gross Alpha
- X Total Organic Carbon
- X Hardness (water only)
- 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 Grain Size
- X BTU Content
- X Ash Content
- X Total Halogens
- X Sulfur
- X Ignitability
- X Cation Exchange Capacity

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.

Analyte	Hedia	Hethod 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/M	N/M
Polychlorinated Biphenyls	S/W	--	N/M	N/M	N/M	N/M
Total Recoverable Hydrocarbons	S/W	EPA 418.1				
Phenols	S/W	--	N/M	N/M	N/M	N/M
Arsenic	S/W	--	N/M	N/M	N/M	N/M
Cadmium	S/W	--	N/M	N/M	N/M	N/M
Chromium	S/W	--	N/M	N/M	N/M	N/M
Copper	S/W	--	N/M	N/M	N/M	N/M
Lead	S/W	--	N/M	N/M	N/M	N/M
Nickel	S/W	--	N/M	N/M	N/M	N/M
Silver	S/W	--	N/M	N/M	N/M	N/M
Zinc	S/W	--	N/M	N/M	N/M	N/M
Gross Alpha	S/W	EPA 900	N/M	N/M	N/M	N/M
Laboratory Analyses						
Volatile Halogenated Hydrocarbons	S/W	EPA 8010/601	N/M	N/M	N/M	N/M
Volatile Aromatic Hydrocarbons	S/W	EPA 8020/602	N/M	N/M	N/M	N/M
Gross Alpha	S/W	-- /EPA 900	N/M	N/M	N/M	N/M
Radium 226	S/W	-- /EPA 903.1	N/M	N/M	N/M	N/M
TCL Purgeables + xylenes	S/W	EPA 8240/624	N/M	N/M	N/M	N/M
TCL BNAs	S/W	EPA 8270/625	N/M	N/M	N/M	N/M
TCL Pesticides & PCBs	S/W	EPA 8080/608	N/M	N/M	N/M	N/M
Total Recoverable Hydrocarbons	S/W	EPA 418.1	N/M	N/M	N/M	N/M
TCL Metals:						
Aluminum	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Antimony	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Arsenic	S/W	EPA 7060/206.2	N/M	N/M	N/M	N/M
Barium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Beryllium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Boron	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Cadmium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Calcium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Chromium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Cobalt	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Copper	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Iron	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Lead	S/W	EPA 7421/239.2	N/M	N/M	N/M	N/M

Analyte	Media	Method No.	A	P	C	DL
Magnesium	S/W	EPA 6010/200.7	N/H	N/M	N/H	N/M
Manganese	S/W	EPA 6010/200.7	N/H	N/M	N/H	N/M
Hercury	S/W	EPA 74711245.1	N/H	N/M	N/H	N/M
Nickel	S/W	EPA 6010/200.7	N/H	N/M	N/M	N/M
Selenium	S/W	EPA 7740/270.2	N/H	N/H	N/H	N/M
Silver	S/W	EPA 6010/200.7	N/H	N/M	N/H	N/M
Sodium	S/W	EPA 6010/200.7	N/H	N/H	N/M	N/M
Thallium	S/W	EPA 7841/279.2	N/H	N/H	N/H	N/M
Vanadium	S/W	EPA 6010/200.7	N/M	N/H	N/M	N/M
Zinc	S/W	EPA 6010/200.7	N/M	N/M	N/H	N/M
Cyanide	S/W	EPA 90101335.2	N/M	N/H	N/M	N/M
TOC	S/W	EPA 9060/415.1	N/M	N/M	N/M	N/M
Hardness	W	EPA 130.2	N/H	N/M	N/M	N/M
Alkalinity	W	EPA 310.1	N/H	N/M	N/M	N/M
Total Suspended Solids	W	EPA 160.2	N/M	N/H	N/M	N/M
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/H	N/M	N/M
Orthophosphate Phosphorus	S/W	EPA 365.2	N/H	N/M	N/M	N/M
5-day Biological Oxygen Demand	W	SM 507	N/H	N/M	N/H	N/
Chemical Oxygen Demand	W	EPA 410.4	N/M	N/M	N/M	N/h
pH	W	EPA 150.1	N/M	N/H	N/H	N/M
Percent Moisture	S	ASTH D-2216-80	N/M	N/H	N/M	N/M
Grain Size	S	ASTH D-422-63	N/H	N/M	N/H	N/M
BTU Content	S	ASTH D-2015-77	N/H	N/M	N/H	N/M
Ash Content	S	ASTH D-482	N/H	N/M	N/M	N/H
Total Halogens	S	ASTH D-808-81	N/H	N/H	N/M	N/M
		EPA 325.3	N/H	N/H	N/M	N/M
Sulfur	S	ASTH D-129-64	N/H	N/H	N/H	N/H
Ignitability	S/W	EPA 1010	N/H	N/H	N/H	N/H
Cation Exchange Capacity	S	EPA 9081	N/M	N/M	N/M	N/M
Field Parameters						
pH	W	Field	N/M	N/M	N/H	N/M
Specific Conductance	W	Field	N/H	N/H	N/H	N/M
Temperature	W	Field	N/H	N/M	N/H	N/H
Dissolved Oxygen	W	EPA 360.1	N/H	N/H	N/H	N/H

Notes: S = Soil and/or sediment
W = Groundwater and/or surface vater
N/M = No Hodifications from GQAPP

.*
With the exception of Total Recoverable Eydrocarbons and Gross Alpha, the laboratory screening analyses do not have EPA method numbers.

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Section 6.0 -- Fieldwork 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

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 below:

Radiometric analyses will be conducted by an outside laboratory.

Section 10.0 — Data Reduction, Validation, and Reporting

Data reduction, validation, and reporting procedures are presented in Section 10.0 of the GQAPP. Hodifications to these procedures 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. Hodifications to these procedure's are described below:

No Hodifications

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 Modifications

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 1.0 -- Title Page

Work Plan Group: G
Site No.: 27
Site Name: Radium Dial Shop Sewer

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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 HNu/OVA Surface Emission Survey
- X Radiation Survey
- ___ Habitat/Biota Survey
- ___ Asbestos Survey (in Rubble)
- X Hydrologic Assessment

Geophysical Survey (check all that apply):

- ___ Electromagnetic Conductivity:
  - ___ EM-31 ___ EM-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 : Planned Number of Samples ___
- X Laboratory Analyses:

PLANNED NUMBER OF SAMPLES		CATEGORIES OF ANALYSES
Surface Water	___	X Volatile Organic Compounds
Sediment	1	X Polynuclear Aromatic Hydrocarbons
Soil	42	X Phenols
Groundwater	3	___ Chlorinated Herbicides
Duplicates	4	___ Carbamates
Trip Blanks	___	X Pesticides/Polychlorinated Biphenyls
Field Blanks	___	X Total Recoverable Hydrocarbons
Rinsate Blanks	___	X Metals
Other	___	X Gross Alpha

Section 3.0 — Project Summary (Continued)

Phase II — Characterization

PLANNED NUMBER OF SAMPLES

Surface Water	___	Air	___	Duplicates	5
Sediment	1	Biota:		Trip Blanks	4
Soil	25	Flora	___	Field Blanks	4
Groundwater	5	Fauna	___	Rinsate Blanks	4

CATEGORIES OF ANALYSES

- X Purgeable Aromatics
- X Purgeable Halocarbons
- X Base/Neutral Extractables
- X Acid Extractables
- ___ Polynuclear Aromatic Hydrocarbons
- X Pesticides
- X Polychlorinated Biphenyls
- X Total Recoverable Eydrocarbons
- X Metals
- X Cyanide

Additional analytical categories are identified below:

- X Gross Alpha
- X Total Organic Carbon
- X Eardness (water only)
- 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 Grain Size
- X BTU Content
- X Ash Content
- X Total Halogens
- X Sulfur
- X Ignitability
- X Cation Exchange Capacity

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
Pield 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.

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 Hydrocarbons	S/W	EPA 418.1				
Phenols	S/W	--	N/M	N/M	N/M	N/M
Arsenic	S/W	--	N/M	N/M	N/M	N/M
Cadmium	S/W	--	N/M	N/M	N/M	N/M
Chromium	S/W	--	N/M	N/M	N/M	N/M
Copper	S/W	--	N/M	N/M	N/M	N/M
Lead	S/W	--	N/M	N/M	N/H	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/M	N/H	N/H
Gross Alpha	S/W	EPA 900	N/M	N/M	N/M	N/M
Laboratory Ana						
Volatile Halogenated Hydrocarbons	S/W	EPA 8010/601	N/H	N/M	N/M	N/H
Volatile Aromatic Hydrocarbons	S/W	EPA 8020/602	N/H	N/M	N/M	N/M
Gross Alpha	S/W	-- /EPA 900	N/H	N/M	N/H	N/M
Radium 226	S/W	-- /EPA 903.1	N/H	N/M	N/H	N/M
TCL Purgeables + xylenes	S/W	EPA 8240/624	N/M	N/M	N/M	N/M
TCL BNAs	S/W	EPA 8270/625	N/M	N/M	N/M	N/M
TCL Pesticides & PCBs	S/W	EPA 8080/608	N/H	N/M	N/H	N/M
Total Recoverable Hydrocarbons	S/W	EPA 418.1	N/H	N/M	N/H	N/M
TCL Metals:						
Aluminum	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Antimony	S/W	EPA 6010/200.7	N/M	N/H	N/M	N/M
Arsenic	S/W	EPA 7060/206.2	N/M	N/H	N/M	N/M
Barium	S/W	EPA 6010/200.7	N/H	N/M	N/M	N/M
Beryllium	S/W	EPA 6010/200.7	N/M	N/H	N/M	N/M
Boron	S/W	EPA 6010/200.7	N/M	N/H	N/H	N/M
Cadmium	S/W	EPA 6010/200.7	N/H	N/H	N/H	N/M
Calcium	S/W	EPA 6010/200.7	N/H	N/M	N/M	N/M
Chromium	S/W	EPA 6010/200.7	N/H	N/M	N/M	N/M
Cobalt	S/W	EPA 6010/200.7	N/H	N/H	N/M	N/M
Copper	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Iron	S/W	EPA 6010/200.7	N/H	N/M	N/M	N/
Lead	S/W	EPA 7421/239.2	N/M	N/M	N/H	N/M

Analyte	Media	Method No.	A	P	C	DL
Magnesium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Manganese	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Mercury	S/W	EPA 7471/245.1	N/M	N/M	N/M	N/M
Nickel	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Selenium	S/W	EPA 7740/270.2	N/M	N/M	N/M	N/M
Silver	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Sodium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Thallium	S/W	EPA 7841/279.2	N/M	N/M	N/M	N/M
Vanadium	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Zinc	S/W	EPA 6010/200.7	N/M	N/M	N/M	N/M
Cyanide	S/W	EPA 9010/335.2	N/M	N/M	N/M	N/M
TOC	S/W	EPA 9060/415.1	N/M	N/M	N/M	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/M	N/M	N/M
Total Kjeldahl Nitrogen	S/W	EPA 351.3	N/M	N/M	N/M	N/M
Nitrogen-Ammonia	S/W	EPA 350.2	N/M	N/M	N/M	N/M
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/M	N/M
Chemical Oxygen Demand	W	EPA 410.4	N/M	N/M	N/M	N/M
pH	W	EPA 150.1	N/M	N/M	N/M	N/M
Percent Moisture	S	ASTM D-2216-80	N/M	N/M	N/M	N/M
Grain Size	S	ASTM D-422-63	N/M	N/M	N/M	N/M
BTU Content	S	ASTM D-2015-77	N/M	N/M	N/M	N/M
Ash Content	S	ASTM D-482	N/M	N/M	N/M	N/M
Total Halogens	S	ASTM D-808-81	N/M	N/M	N/M	N/M
		EPA 325.3	N/M	N/M	N/M	N/M
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/M
Cation Exchange Capacity	S	EPA 9081	N/M	N/M	N/M	N/M
Field Parameters						
pH	W	Field	N/M	N/M	N/M	N/M
Specific Conductance	W	Field	N/M	N/M	N/M	N/M
Temperature	W	Field	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
W = Groundwater and/or surface water
N/M = No Modifications from GQAPP

* With the exception of Total Recoverable Hydrocarbons and Gross Alpha, the laboratory screening analyses do not have EPA method numbers.

Section 6.0 -- Fieldwork 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

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 belov:

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 below:

Radiometric analyses will be conducted by an outside laboratory.

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 Modifications

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 Modifications

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 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 from original text]

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	Statu. FGFWFC(or FDA)	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 topminnow	P	SSC		Salt, fresh, 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)	Swamps, marshos, ponds
~~Caretta caretta caretta~~	Loggerhead turtle	M ?	T	T	Marine, coastal
Chelonia mydas mydas	Green turtle	M ?	E	E	Marine, coastal
Dermochelys coriacea	Loathocback turtlo	M	E	E	Marine, coastal
Drymarchon corais couperi	Eastern indigo snake	P	T	T	Open areas near water
Eretmochelys imbricata	Hawksbill turtlo	M ?	E	E	Marine, coastal
Gopherus polyphemus	Gopher tortoise	P	SSC	UR 1	Sandy coastal plains
Graptemys pulchra	Alabama map turtle	U	SSC		Swamps, streams, marshes, ponds
Lepidochelys kempi	Atlantic ridley	M ?	E	E	Marine, coastal
Rana areolata aesopus	Florida gopher frog	P	SSC	UR 2	Sand hill communities
Macroclemys temmincki	Alligator snapping turtlo	SR	SSC	UR 2	Swamps, marshos, ponds
MAMMALS					
Mustela viron lutensis	Florida mink	U		UR 2	Terrestrial habitats
Peromyscus polionotus trissyllepsis	Perdido Key beach mouse	N/A	T	E	Beach dunes
Trichechus manatus latirostris	West Indian manatee	M	E	E	Atlantic and Gulf coasts
Ursus americanus floridanus	Florida black boar	N/A	T	UR 2	Titi swamps

Appendix C (Cont).

Scientific Name	Common Name	Base statu.	statu. FGFWFC(or FDA)	USFWS	Habitat
BIRDS					
Charadrius melodus	Piping Plover	P	T	T	Opon dry, sandy beaches
Charadrius alexandrinus	Snowy plover	P	T	UR 2	Opon dry, sandy beaches
Dendroida dominica stoddardi	Stoddard's yellow-throated warbler	P-U		UR 2	Wooded habitats
Dendroica kirtlandii	Kirtland's warbler	U	E	E	Wooded habitats
Haematopus palliatus	American oystercatcher	U	SSC		Coastal habitats
Egretta rufescens	Reddish egret	P-U	SSC	UR 2	Freshwater/coastal wetlands
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 wetlands
Falco peregrinus tundrius	Arctic peregrine falcon	M	E	T	Winters on coasts
Falco sparverius paulus	Southeastern kestrel	R	T	UR 2	open pine forests, clearings
Haematopus palliatus	American oystercatcher	P-U	SSC		Open coastal beaches
Haliaeetus leucocephalus	Bald eagle	P-U	T	E	Pine forests/coastal habitat
Pandion haliaetus	Osprey	R	SSC		Near wator
Pelecanus occidentalis	Brown pelican	R	SSC	AC	Mangrove trees, coasts
Picoides borealis	Red-cockaded woodpecker	P-u	T	E	Cavity nests/old pine stands
Vermivora bachmanii	Bachmann's warbler	U	E	E	Wooded habitats
Campephilus principalis	Ivory-bi1led woodpecker	U	E	E	Wooded habitats
Sterna antillarum	Least tern	U	T		Coastal habitats
Mycteria americana	Wood stork	U	E	E	Freshwater/coastal wetlands
Rostrhamus sociabilis	Snail kite	U	E	E	Freshwater/coastal wet1ands
INVERTEBRATES					
Copris gopheri	Scarab beetle	P		UR 2	Associated w/Gopher Tortoise

Appendix C (Coat.)

Scientific Name	Common Name	Base Status	statu. FGFWFC(or FDA)	USFWS	Habitat
PLANTS					
Chrysopsis gossypina cruiseana	Cruise's goldon-artor	P	E	UR 1	Coastal dunes
Drosera intermedia	Spoon-leaved sundew	R	T		Aquatic habitats
Epigaea repens	Trailing arbutus	U	E		Dry, acid, sandy soil
Kalmia latifolia	Mountain laurel	U	T		Rich, moist, shady woods
Lilaeopsis carolinensis	Carolina lilaeopsis	R		UR 2	
Lilium iridollae	Panhandle lily	U	E	u R 2	Black, mucky soils
Pinguicula planifolia	Chapman's buttorwoct	U	RE	UR 2	
Polygonella macrophylla	Large-leaved jointweed	R	T	UR 1	Sand pino-oak rcrub
Rhododendron austrinum	Orange azalea	U	E	UR 5	Moist, woody habitats
Sarracenia leucophylla	White-top pitchorplant	R	E		Open acid bogs
Sarracenia rubra	Sweet pitchorplant	U	E	UR 2	Acid bogs/slash pine woods
Stewartia malacodnedron	Silky camellia	U	E		Slopes of woodod ravines

E = Endangered
T = Threatened
UR 1 = Under review, Lor 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 rpocios, but taxa has proven to bo more widespread than was previously believed and/or those 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 the 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 the NAS Pensacola facility.