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PHASE II

CONTAMINATION ASSESSMENT/ REMEDIAL ACTIVITIES INVESTIGATIONWORK PIAN - GROUP J NAVAL AIR STATION PENSACOLA PENSACOLA, FLORIDA

Crash Crew Training Area (Site 3) Fuel Farm Pipeline Leak Area (Site 19)

April 1992

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 Crash Crew Training Area (Site 3) and the Fuel Farm Pipeline Leak (Site 19) located at the Naval Air Station (NAS) in Pensacola, Escambia County, Florida. This work plan has been prepared by Ecology and Environment, Inc., (E & E) for the Southern Division, U.S. Navy, Naval Facilities Engineering Command, under Contract No. N62467-88-C-0200. The work plan has been developed based on information and file documents provided by the Navy, and on information gathered by E & E during preliminary site inspections conducted during January 1989.

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

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

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

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

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

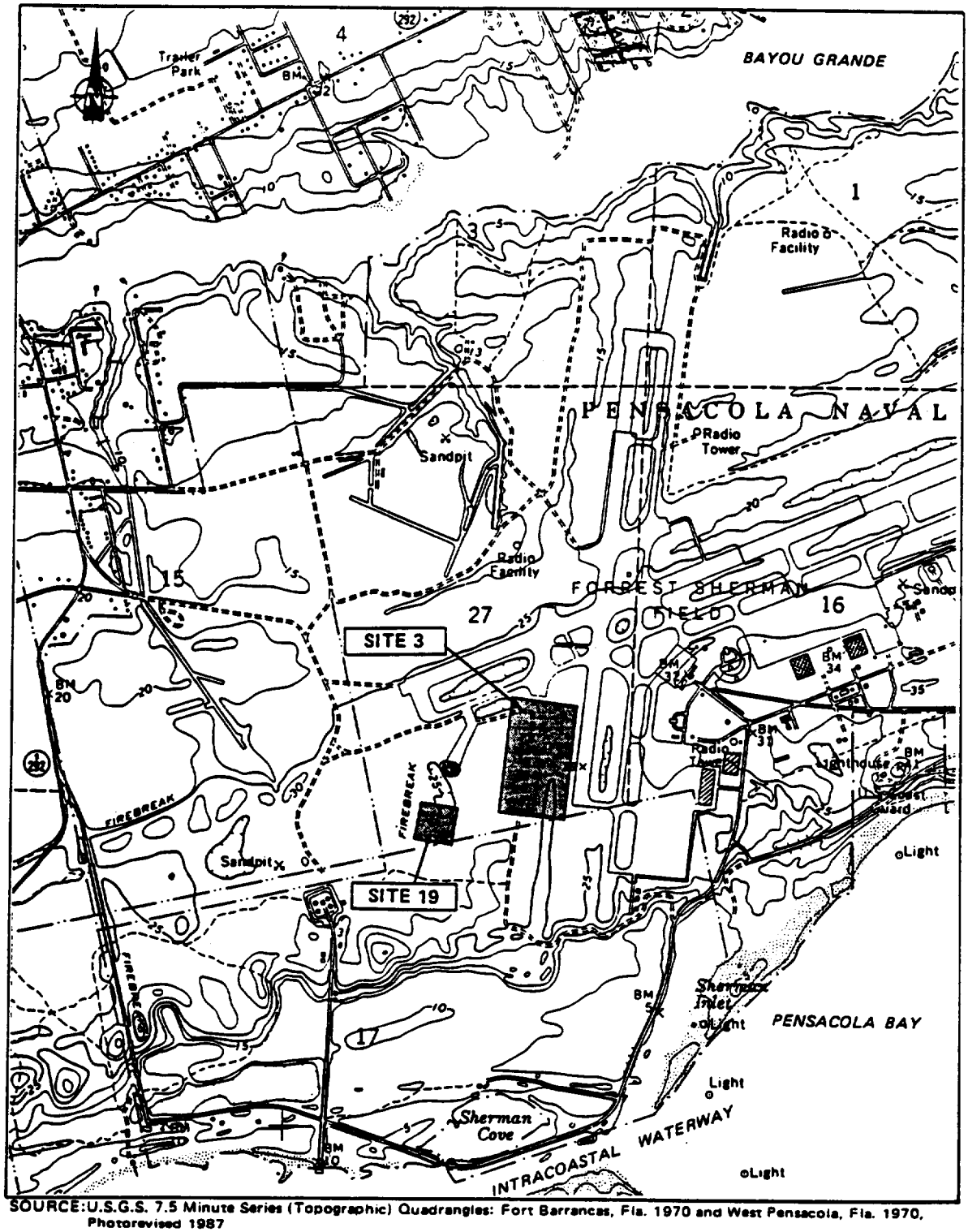
2. SITE DESCRIPTION

2.1 Site 3 — Crash Crew Training Area

The Crash Crew Training Area (Site 3) occupies an open area of land approximately 900 feet by 2,300 feet along the southwestern border of Forrest Sherman Field (see figures 2-1 and 2-2). The site is bounded to the east by aircraft runway [19]; to the north by a paved aircraft taxiway; to the west by a scattered brush and woods area: and to the south by an open field. An unimproved jeep trail runs north and south across the western portion of the site and connects with several other dirt roads. Four hundred feet west-southwest of Site 3 is NAS Pensacola Site 19, the Fuel Farm Pipeline Leak site.

Site 3 contains at least eight different burn areas. The two northernmost burn areas are currently being used for training exercises (see Figure 2-2). Several of the burn areas contain miscellaneous pieces of equipment including: a fuel trailer, a cockpit simulator, and other airplane parts. The equipment is used as part of the fire fighter training program. The surficial soil in each of the pits is blackened, and several pits have fuel stains and oily residue.

The site area topography is generally flat with site elevations ranging from 24 to 29 feet above mean sea level (HSL). The site is sandy and well drained; however, excess surface drainage flows into a shallow depression parallel to runway [19]. The depression is drained by two separate catch basin systems which are part of the stormwater drainage system for the airfield. One catch basin located near well GM22 drains to the north, and another catch basin located near well GM23 drains to the south (see Figure 2-2; Geraghty and Miller [G & M] 1984).



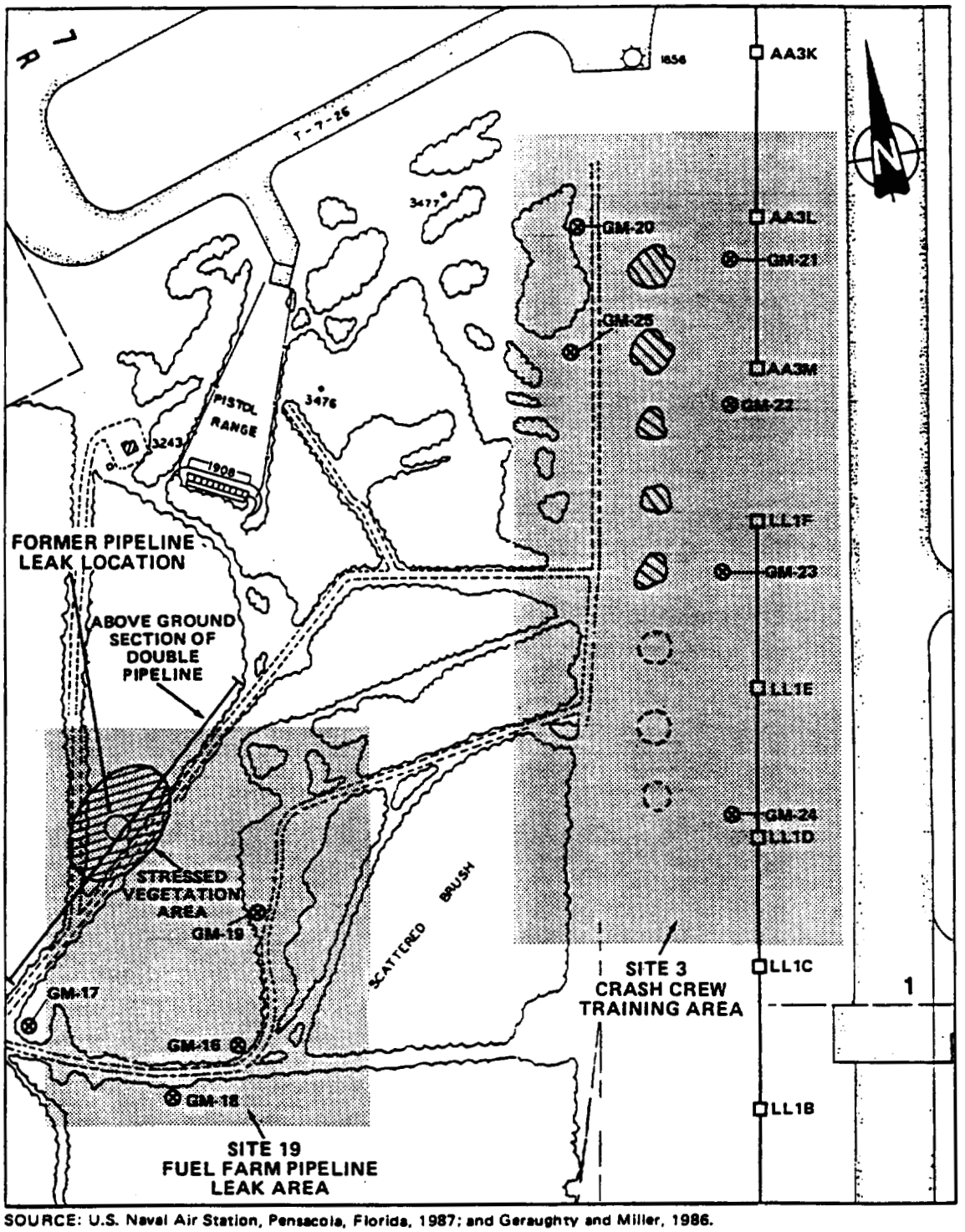
SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970, Photorevised 1987

SCALE

0 — ½ — 1 MILE

0 — .5 — 1 KILOMETER

Figure 2–1 LOCATION MAP – NAS PENSACOLA SITES 3 and 19



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

KEY:

- Existing Monitoring Well
- Burn Areas
- Possible Former Burn Areas
- Storm Drain Catch Basin

SCALE

0 200 400 600 800 FEET

Figure 2–2 SITE MAP NAS PENSACOLA, SITES 3 & 19

There are six monitoring wells (GM20, GM21, GM22, GM23, GM24, and GM25) located on site (see Figure 2-2). Each of the wells is completed to a depth of 11.5 feet and screened from approximately 9 to 11.5 feet (G & M 1984). A sand pack filter, installed in each well, extends from the bottom of the borehole to approximately 5 feet below land surface (BLS). The top of the sand pack is graded to a fine sand, and the remaining annulus is filled with cement grout. An aboveground protective security cover, set into the cement, was installed at each well.

2.2 Site 19 — Fuel Farm Pipeline Leak

The Fuel Farm Pipeline leak (Site 19) is located southwest of Forrest Sherman field, approximately 1,300 feet west of the southern portion of aircraft runway 36 (see figures 2-1 and 2-2). The pipeline leak occurred near the center of an aboveground section of double pipeline, which runs between the fuel farm tanks and the tank truck loading facility at Forrest Sherman Field. Surrounding the location of the leak is a stressed area of vegetation, measuring approximately 200 feet by 400 feet. As recently as 1983, no significant regrowth had taken place, and dead trees were still present at the site during E & E's preliminary reconnaissance (January 1989).

The site area measures approximately 850 feet by 1,000 feet (see Figure 2-2). Several jeep trails and unimproved roads traverse the site, one of which lies parallel to the aboveground pipeline. The site is generally flat with land surface elevations averaging approximately 27 to 28 feet above MSL. The soils are generally sandy and well drained.

In addition to the six shallow monitoring wells located on Site 3, four shallow monitoring wells (GM16, GM17, GM18, and GM19) are located in the immediate vicinity of Site 19 (see Figure 2-2). Each of the wells is completed to a depth of 11.5 feet and constructed as discussed in Section 2.1.1 (C & M 1984).

The area surrounding Site 19 consists of scattered brush and woods. The only building located in the immediate site vicinity is a naval base pistol range, which is approximately 1,300 feet north of the site.

Two ecologically sensitive marsh areas are located in the site area. One marsh area is located approximately 3,000 feet northwest of the site, and the second marsh area is located 2,000 feet south of the site (United States Geological Survey [USGS] 1970a). As discussed in Section 2.1.1, Site 3 is located approximately *400* feet east of Site 19.

3. SITE HISTORY

3.1 Site 3--Crash Crew Training Area

Site 3 has been used to train fire fighters for aircraft crash situations since 1955 (National Energy and Environmental Support Activity [NEESA] 1983). During training, approximately 30 to 50 gallons of fuel, which may include JP-4, JP-5, AVGAS, or lube oil is poured into unlined pits or on various pieces of equipment and ignited to simulate aircraft crash conditions. The fire is then extinguished using AFPF (aqueous film form foam), a solution which may contain any of several foaming agents used by the Navy (G & M 1984). NEESA has reported that as many as five training fires may be set at the site each week, using up to 250 gallons of fuel. It has been estimated, however, that 200 additional gallons of fuel per week are disposed of on site (NEESA 1983).

In June 1983, an Initial Assessment Study (IAS) of 29 sites on NAS Pensacola was completed by NEESA. In the IAS, Site 3 was evaluated based on historical records, field inspections, and personnel interviews. No soil or water samples were taken at the site; however, based on the data obtained during the study, the IAS team concluded that contamination at Site 3 was not sufficient to constitute a threat to human health or the environment. NEESA recommended no further study at the site. However, at a November 17, 1983, meeting between the Navy and the Florida Department of Environmental Regulation (FDER), Site 3 was reappointed to the list of sites to be investigated during a Verification Study.

In July 1984, G & M conducted a Verification Study of 18 sites on NAS Pensacola. Site 3 was included in this Verification Study. During the

Verification Study, 18 shallow soil borings were completed on site in an effort to determine whether free-floating product was present on the water table. In addition, six shallow monitoring wells were installed on Site 3 (G & M 1984).

Soil borings conducted at the site did not reveal any free product contamination. Groundwater samples collected from each of the six monitoring wells were analyzed for volatile organic compounds (VOCs). Three of the wells (GM20, GM21, and GM23) were found to contain low level concentrations of VOCs. Groundwater samples collected from monitoring wells GM20 and GM21 were found to contain chloroform (0.3 microgram per liter [µg/L] and 0.6 µg/L, respectively), 1,2-dichloroethane (1.0 µg/L and 2.0 µg/L, respectively), and 1,1,1-trichloroethane (1.1 µg/L and 1.0 µg/L, respectively). A sample collected from well GM21 was also found to contain 1,1-dichloroethane at a concentration of 11 µg/L. In addition, each of the three wells was found to contain methylene chloride at concentrations up to 6.2 µg/L (G & M 1984).

The Navy Civil Engineering Lab (NCEL), Port Hueneme, California, conducted a separate study of the site which included the collection and analysis of soil and groundwater samples (G & M 1984). The results of this study are presently unknown.

The Verification Study recommended that no further studies be conducted at the site (G & M 1984); consequently, Site 3 was not included in the Characterization Study.

On January 6, 1989, E & E conducted a preliminary site reconnaissance of Site 3 to establish the areas of possible contamination and to confirm the locations of the existing monitoring wells.

32 Site 19 — Fuel Farm Pipeline Leak

The Fuel Farm Pipeline Leak is reported to have occurred in 1958. The amount of fuel discharged was not measured; however, NEESA reported that more than 360,000 gallons of JP-4 fuel oil was discharged onto the

ground surface at the location shown in Figure 2-2. A separate section of the same report states that 860,000 gallons of fuel oil leaked onto the ground at the site (NEESA 1983).

During the June 1983 IAS conducted by NEESA, an investigation into the Fuel Farm Pipeline Leak (Site 19) was conducted. Investigation of Site 19 included a review of historical records, field inspections, and personnel interviews. NEESA concluded that further investigation at the site was warranted. The IAS recommended that an investigation be conducted regarding the possibility of free product floating on the groundwater at the site and that, if necessary, the feasibility of recovering this free product be determined (NEESA 1983).

During the Verification Study, G & M installed four shallow monitoring wells (GM16, GM17, GM18, and GM19) and completed 11 soil borings to investigate the possible presence of free product floating on the water table. Neither the monitoring wells nor the soil borings revealed the presence of free product; however, a fuel odor was detected in soil samples collected in the area of dead trees. No laboratory analysis was performed on either soil or groundwater samples during the Verification Study. G & M suggested that because the water table in the area of the spill is sometimes above land surface, most of the fuel was removed by evaporation and biodegradation during the 25-year period following the spill. No further study was recommended for the site (G & M 1984). However, FDER recommended that further investigation be conducted at Site 19, and it was included in the list of sites to be investigated during the Characterization Study (G & M 1986).

As part of the Characterization Study, the four monitoring wells (GM16, GM17, GM18, and GM19) installed during the Verification Study were sampled and analyzed for the presence of benzene, toluene, and xylene. Groundwater from monitoring wells GM16, GM18, and GM19 was found to contain extremely high concentrations of benzene (422 µg/L, 30 µg/L, and 146 µg/L, respectively). In addition, wells GM16 and GM19 were also found to contain elevated concentrations of xylene (818 µg/L and 577 µg/L, respectively; G & M 1986). Based on data collected from the

on-site monitoring wells, G & M calculated the shallow groundwater flov velocity to be approximately 130 feet per year (ft/yr), assuming the following parameters: porosity 0.20; hydraulic gradient, 0.004; and hydraulic conductivity, 120 gallons per day (gpd)/ft^2.

On January 6, 1989, E & E conducted a preliminary reconnaissance of Site 19 to locate areas of possible contamination and to confirm the locations of existing monitoring wells.

4. CLIMATOLOGY

NAS Pensacola is located in an area that typically experiences a mild, subtropical climate. This climate is a result of the latitude (approximately 30° North) and the stabilizing effect of the adjacent Gulf of Mexico (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 7 inches per month) and lowest during spring and fall (averaging 4 inches per month; Kennedy 1982). High intensity thunderstorms are common, producing as much as 3 to 4 inches of rainfall during a single hour. Because evaporation rates are also highest in the summer months, the potential recharge resulting from heavy summer rains is reduced. Spring and fall rains are generally less intense, but longer in duration, producing less surface runoff and higher rates of infiltration and net recharge.

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 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.

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 seminatural (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), Eydrocotyle bonariensis (beach pennywort), Ipomoea stolonifera (beach morning-glory), Coccoloba uvifera (sea grape), Ouercus geminata (twin live oak), and the stunted shrubs species'Yucca aloifolia (yucca), Opuntia, and Cereus. This community type has been ranked by the Florida Natural Areas Inventory (FNAI) as locally restricted and vulnerable to extinction due to developmental activities. This community type can have three to five distinct habitat types (Wolfe et al. 1988).

The sand pine scrub community is a more upland coastal community characterized by coastal dune formations from an older geologic age with

deep, fine, white sand substrate and the plants ~~Pinus clausa~~ (sand pine), Quercus spp. (scrub oak species, geminata, chanpanii, nyrtifolia, and inopina), Cladonia species, and Ceratiola ericoides (rosemary). This community type has been ranked by FNAI as imperiled statewide because of its rarity and because of its vulnerability to extinction due to some artificial or biological factor. This community type can have three to five distinct habitats (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. Flatwoods 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). Flatwoods communities also occupy areas of low depressions, 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; Uolfe ~~et al~~. 1988).

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

Freshwater Wetland Vegetation. Much of the geological material underlying the NAS Pensacola facility is deep, porous sand often

containing relatively impermeable clay lenses. In combination with high annual rainfall, this geologic condition causes the formation of small areas of perched groundwater. In areas with relatively steep slopes, groundwater seepage escapes into well-defined stream channels called steepheads as found near Site 30. In gently sloping areas, the presence of perched groundwater conditions results in the formation of wetland bogs, as found near Sherman Field. Wetland or seepage bogs are characterized by herbaceous plant species as described in the sections above for flatwoods and sandhill communities. Most of these communities and other vegetative communities east of Sherman Field have been considerably altered by base development 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 found large numbers of nesting osprey in the southwestern portions of the NAS Pensacola facility. Because of the large number and diversity of habitats found around the facility and considering that the survey was conducted during a predominantly non-mating season, it is likely that there are more species of birds using the facility and surrounding waters as feeding and nesting sites than have been found.

Reptiles and **Amphibians.** During the 1986 survey conducted by the Navy, only four out of a possible 30 species of reptiles and amphibians associated with the area were identified on the NAS Pensacola facility, none of which are endangered. A recent check of the FNAI files confirms that the presence of the gopher tortoise (Gopherus polyphemus) can most likely be found in suitable habitats on the western portions of the facility (see Appendix C). Most 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 **Wetlands.** 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. 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 Balodule beaudettei. Seagrass beds in the area surrounding the facility have not been historically mapped, and very little is known of their composition, locality, or areal extent. Grass beds of unknown species composition extending along the north shore of Pensacola Bay in the 1950s disappeared by 1961. An examination of historical aerial photographs (see Section 12) may elucidate past distributions of seagrasses.

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

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

Capitella spp., various spionids, and Haploscoloplos spp.) and bivalves (Anodontia alba and Tellina spp.) during most of the year. FDER samples collected along the wastewater treatment plant outfall show a drastic drop in species abundance and diversity close to the sewage outfall (Navy 1986). This indicates that the benthic community might have been negatively influenced by the sewage outfall.

Samples collected by the Navy (1986) indicate a low density yet moderate diversity of benthic infaunal organisms when compared to other estuarine systems within and around the turning basin. A complete comparison of the Navy's data cannot be made to other literature at this time because their data are not given in numbers per unit area. However, the Navy's data reveal that very few deep dwelling organisms reside in the areas around the turning basin, and a lack of deep dwelling benthic organisms 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 seven cartilaginous fish species (Cooley 1978). The 13 most abundant species were spot (Leiostomus xanthurus), pinfish (Lagodon rhomboides Atlantic c (M tus) gulf menhaden (Brevoortia patronus), bay anchovy (Anchoa mitchilli), longspine porgy (Stenotus caprinus), silver perch (Bairdiella chrysoura), southern hake (Urophycis floridana), inshore lizardfish (Synodus foetens), gafftopsail catfish (Bagre marinus), sand seatrout (Cynoscion arenarius), and spotted hake (Urophycis regia; Heil 1988).

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

Moderate densities of blue crab (Callinectes sapidus), shrimp (Penaeus duorarum, P. setiferus, and P. aztecus), and oysters (Crassostrea virginica) have been collected throughout Pensacola Bay (Heil 1989).

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

Sport and Commercial Fishing. A moderate amount of commercial fishing occurs in Escambia County, accounting for 2% of the total Florida landings for 1980 to 1985 (Navy 1986). The dominant finfish species in 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, blue crab, and squid. These data, as well as the Navy's data, also suggest that a significant tuna fishery may be developing in the Pensacola Bay area (0 pounds landed in 1983; 1,582 pounds in 1987).

Sport Fisheries data are not available from 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

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

Marine Mammals. Few mammals have been sighted within the area of the NAS 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. Manatees have been sighted irregularly, with one recent sighting in the area recorded by the Florida Natural Areas Inventory (FNAI) in October 1988. A goosebeaked whale (Ziphius cavirostris) was reported stranded on Santa Rosa Island, and a pilot whale (Globicephala macrorhynchus) was found stranded on a beach near Pensacola (Navy 1986).

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

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

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grounds. Complete biotic surveys may be necessary to determine the presence of threatened or endangered species and potential pathways of contamination to these species.

5.2 Site-Specific Biological Resources

Site 19 is located within a well developed area of pine trees maintained in semi-natural timbering conditions. This community type has a well developed overstory dominated by slash and loblolly pine species and an understory dominated by grasses and fire-tolerant shrubs. The habitat found on this site may support a diverse assemblage of fauna that would use the habitat for feeding, nesting, and as a migration corridor to other wooded sites in the vicinity.

Site 3 has been cleared of all native vegetation during the development of the runway system at Sherman Field. The only vegetation on the site at this time is cultivated grasses. To the west lies a well maintained stand of pine trees in semi-natural plantation condition. Fauna associated with this nearby community may use Site 3 for feeding and as a migration corridor to the wooded areas east of Sherman Field.

No aquatic habitats are found on either site. Bayou Grande and Pensacola Bay lie approximately 0.5 mile to the north and south, respectively.

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 Hexico by Santa Rosa Island and Perdido Key, both of which are barrier islands.

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

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

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

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

6.2 Site-Specific Surface Water Hydrology

No surface water bodies are located on sites 3 and 19 or in their immediate vicinity. The closest surface water system is a marsh, which is located approximately 0.25 mile south of Site 19. The nearest body of open water is Sherman Cove, which is located approximately 0.5 mile south of Site 19 (see Figure 2-1). Pensacola Bay lies approximately 0.5 mile to the south.

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 west of Chevalier Field. Seaward of the escarpment is a nearly level marine terrace with surface elevations of approximately 5 feet above 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, 1970b). Sandy soils occur throughout the NAS Pensacola area. As a result, most of the rainfall infiltrates directly into the subsurface. Consequently, there are few streams or surface water bodies on the peninsula.

7.1.2 Regional Hydrogeology

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

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unconsolidated to poorly indurated clastic deposits (Wagner et al. 1984). In this portion of Florida, the Surficial Aquifer constitutes an important source of water supply and is called the Sand-and-Gravel Aquifer (Southeastern Geological Society [SEGS] 1986). [Based on the total dissolved solids (TDS) content of groundvater from wells that tap the Sand-and-Gravel Aquifer in southern Escambia County (Clemens et al. 1989), the groundwater is classified as Class G-1 (FDER 1988b).] The sediments making up this aquifer belong to all or part of the Pliocene to Holocene 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 (Wilkins et al. 1985).

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

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

The results of laboratory permeability tests conducted on samples from this zone indicate that vertical hydraulic conductivities are low, ranging from 4.2×10^{-5} to 9.9×10^{-2} ft/day. Thus, the low permeability zone probably functions as a confining or semiconfining unit inhibiting the flow of groundwater between the surficial zone and the underlying main producing zone. The low permeability zone has been encountered in at least 16 borings at widely spread locations throughout NAS Pensacola (G & M 1984, 1986). Although additional boring or geophysical techniques would be required to confirm its presence at a given location, it is likely that this unit is ubiquitous at NAS Pensacola. Pew, 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 consists mainly of sand and gravel interbedded with thin beds of silt and clay. The depth at which the main producing zone is encountered is somewhat variable, ranging from 60 to approximately 120 feet BLS at NAS Pensacola. This zone generally has the highest permeability characteristics due to thicker and more persistent sand and gravel beds and is tapped by most of the major wells in the Pensacola area (Wilkins et al. 1985). NAS Pensacola has three supply wells which produce water from this zone; however, due to high iron content in the water, the wells are infrequently used (G & M 1986). The principal sources of water, for NAS Pensacola are wells located at Corry Field, approximately 3 miles to the north. The thickness of the

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

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

7.1.2.2 Intermediate System

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

Sand Hember of the Pensacola Clay, and the Lower Member of the Pensacola Clay; all are of Hiocene Age.

7.1.2.3 Floridan Aquifer System

Immediately underlying the Intermediate System and occurring at a depth of approximately 1,500 feet BLS at NAS Pensacola is the Floridan Aquifer System. The Floridan Aquifer in this area is composed of the Hiddle to Lower Hiocene 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 3 and 19, the surficial zone of the Sand-and-Gravel Aquifer probably occurs to a depth of about 50 feet BLS. Although no deep borings have been completed in the immediate vicinity of either site, data from numerous borings completed at various sites on NAS Pensacola indicate a general surficial zone thickness of approximately 50 feet. Furthermore, the surficial zone thickens toward the western portion of the base. G & H (1984) provides drilling logs for borings conducted on NAS Pensacola prior to the Verification Study. Included in this report is information concerning a group of borings (boring group 10) which were completed approximately 0.75 mile east of sites 3 and 19. The lithologic description of cuttings from boring group 10, indicates that the surficial zone primarily consists of tan and brown, fine- to medium-grained quartz sand. A total of 10 shallow monitoring wells, open to the surficial zone, have been installed during previous investigations at sites 3 and 19. These wells indicate that the water table generally occurs between 1 and 4 feet BLS. Based on water level data collected from monitoring wells at Site 3, the direction of groundwater flow is generally to the east. In comparison, water level data collected from wells located on Site 19 indicate that groundwater flow in the surficial zone is to the south-southeast. The horizontal hydraulic gradient is approximately 0.004 for both sites. Based on groundwater data collected at Site 19, G & H (1986) estimated a horizontal shallow ground-water flow velocity of 0.36 ft/day or 130

ft/yr. A flow velocity was not reported for Site 3; however, due to the proximity of the sites and the similarity in horizontal hydraulic gradient, it is presumed that horizontal flow velocities for groundwater at the two sites are approximately the same.

As stated above, data regarding lithologic zones deeper than 11.5 feet are not available for sites 3 and 19 or the immediate vicinity. Eowever, based on data collected from borings completed at other NAS Pensacola locations, it is assumed that the low permeability zone of the Sand-and-Gravel Aquifer occurs at approximately 50 feet and extends to a depth of approximately 100 feet BLS (G & M 1984). Based on reported lithologic data from boring group 10 (G & M 1984), this zone would be expected to function as a confining or semiconfining unit restricting the flow of groundwater between the surficial zone and the main producing zone which underlies the unit. The direction of groundwater flow within the low permeability zone is unknown.

Based on data from NAS Pensacola Supply Well No. 3 (approximately 1 mile east of both sites) and data from boring group 10, it is estimated that the top of the main producing zone occurs approximately 100 feet BLS in the site vicinity. 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. Insufficient data exist for wells open to the main producing zone to allow a determination of hydraulic gradient at NAS Pensacola.

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8. PROJECT MANAGEMENT PLAN

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

9. SITE MANAGEMENT PLAN

The Generic Site Management Plan (GSHP) defines the management procedures for field activities on both the site and program levels. The management and implementation of all field activities conducted as part of the Contamination Assessment/Remedial Activities Investigation of sites 3 and 19 will follow the GSHP and any updated versions. Data Quality Objectives (DQOs) and all applicable or relevant and appropriate requirements **(ARARs)** have been considered in developing the initial phases of fieldwork described here and will be updated and revised for any subsequent phases of fieldwork.

10. HEALTH AND SAFETY PLAN

A comprehensive General Health and Safety Plan (GESP) and individual site-specific safety plans (SSPs) have been developed to provide readily available emergency information and preventative safety measures. The GESP outlines health and safety procedures and protocols to be followed during all field investigations at each of the [39] sites on NAS Pensacola. The plan includes: standard operating procedures (e.g., site entry and decontamination); hazard communication and training (e.g., safety training, briefings, and documentation); safety equipment and instrumentation (e.g., monitoring and personnel protective equipment); hazard evaluation by contaminant class (e.g., metals and organics); and hazard evaluation for each task (e.g., drilling and sampling). The 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 (i.e., hospitals, ambulatory units, poison control centers, fire departments, and police/sheriff departments). The SSP will also identify first-aid and personal safety equipment and will provide recommended site security precautions. The GHSP and the SSP will comply with the Occupational Safety and Health Administration (OSHA) Guidelines for Hazardous Waste Operations (29 Code of Federal Regulations [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.. This comprehensive document will be referenced for all field and laboratory procedures for this program, and will be used to develop the Site-Specific Quality Assurance Plans (SQAPs).

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

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12. AERIAL PHOTOGRAPH ANALYSIS

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

13. UTILITIES SURVEY

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

14. FIELDWORK METHODOLOGY

14.1 Phase I — Field Screening

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

14.1.1 Physical Survey

14.1.1.1 Overall Physical Reconnaissance

A field reconnaissance survey will be conducted on and around sites 3 and 19. Available aerial photographs and maps will be used as guides in locating surface features. Visual inspections will be made regarding surface conditions, surface drainage patterns, areas of stressed vegetation, burn areas, and stained areas.

During the reconnaissance survey, the field team will identify areas that present the most suitable conditions for the establishment of grid survey baselines. The use of a grid system as part of Phase I field investigations is discussed in the following sections.

The reconnaissance survey team will utilize air monitoring equipment during walkovers conducted at sites 3 and 19, in accordance with Section 6.1.1 of the GQAPP. In the event that any [areas with readings above background] are located, the area(s) will be flagged and identified on a site map for future reference.

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

During the establishment of the geophysical survey grid network (discussed in Section 14.1.2), an emissions survey will be conducted using HNu and/or OVA air monitoring equipment. The survey will be conducted in accordance with Section 6.1.1 of the GQAPP. Measurements will be made at each established grid point, and readings will be recorded in the field logbook.

Preliminary air screening will be conducted with a particulate monitor, such as a Mini-Ram, to determine if the site represents a source of particulates in the air. The air [screening] will be conducted in accordance with Section 6.1.[1] of the GQAPP.

14.1.1.3 Habitat/Biota Survey

During the physical reconnaissance, an E & E biologist/ecologist will determine the on-site terrestrial and aquatic habitat and the surrounding habitats which may be affected by off-site contaminant migrations. During the walkover survey, rare, threatened, and endangered species and their potential habitats will be identified, and an evaluation will be made of general site conditions to support viable populations of plants and animals. A habitat/biota survey will be conducted for sites 3 and 19, as well as an evaluation of the literature.

14.1.2 Geophysical Survey

The site areas, site fringes, and surrounding local areas will require an electromagnetic terrain conductivity survey (EM-31) and magnetometer

survey. The surveys will be performed in accordance with field methodologies and data interpretation techniques discussed in Section 6.2 of the GOAPP.

The effort will initially require the set-up of a grid system over the study area. To accomplish this, at least two baseline transects will be established (providing an x and y axis) and flagged at 50-foot intervals. A transit survey instrument will be used to establish the baselines, and a Brunton compass and tape measure will be used to complete the grid system for the study area. The grid spacing will be based on 50-foot centers. The EM-31 and magnetometer surveys will be conducted by obtaining measurements at each 50-foot interval grid point.

The geophysical data will be used in conjunction with other background data obtained to identify: anomalous conditions in the site areas; water table conditions; the location of potential subsurface plumes; and the horizontal and vertical orientation of plumes, if located. Ultimately, the interpretation of these data will be a primary consideration in the development of a rationale for monitoring well placement strategies in phases I and 11.

14.1.3 Analytical Screening

14.1.3.1 Soil Beadspace Survey

Using the method described in Section 14.1.2, soil headspace survey grids, with 100-foot grid centers, will be established at sites 3 and 19. Soil headspace survey samples will be collected and composited for every 5-foot depth interval to the water table. The depth to water at each of the sites is assumed to be 5 feet; thus, it is projected that only one depth interval will be collected at each grid point. Samples will be collected using a portable drill rig with 4-inch-diameter solid stem augers. In those areas where it is impractical to use the portable drill rig, a hand-operated bucket auger will be employed. Soil headspace survey sample collection and screening will be conducted in

accordance with Section 6.4 of the GQAPP. The results of the soil headspace survey will aid in making final determinations on the soil and groundwater sampling locations.

14.1.3.2 Laboratory Analysis

Phase I sampling activities for sites 3 and 19 will include a soil headspace survey, the collection of soil samples, the installation of shallow temporary monitoring wells, and groundwater sampling. All of the samples will be analyzed in the laboratory for analytical screening parameters. The analytical screening program has been developed for the Phase I effort as a measure to efficiently and cost-effectively provide focus for subsequent phases of site characterization and contamination extent delineation. 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.

Soil — It is tentatively planned that composite soil samples will be collected at 33 locations on Site 3 and at 18 locations on Site 19 (see Figure 14-1). The results of the physical and soil headspace surveys will be used to adjust the final number and locations of samples. At each location, soils will be collected and composited over 5-foot intervals to the water table. Assuming the depth to water is approximately 5 feet BLS (G & M 1986), it is tentatively planned that a total of 33 soil samples will be collected at Site 3 and a total of 18 soil samples will be collected at Site 19. Samples will be collected using a portable drill rig with 4-inch-diameter solid stem augers. In those areas where it is impractical to use the portable drill rig, a hand-operated bucket auger will be employed. All sampling and equipment decontamination activities will be conducted between sampling intervals as discussed in sections 6.6 and 6.10 of the GQAPP.

Groundwater — Approximately 11 temporary stainless steel monitoring wells will be installed on Site 3 and approximately six will be installed on Site 19. The results of the physical survey and soil headspace surveys will be used to adjust the final number and locations of samples.

TABLE 14-1

PHASE I SAMPLING AND ANALYTICAL REQUIREMENTS—GROUP J

SITE 3

Medium	No. of Samples	Duplicates	Total	Analytical Suite[a,b]
Soil	33	2	35	A
Groundwater[d]	11	1	12	A
TOTAL	44	3	41	

Medium	No. of Samples	Dupli-cates	Trip Blanks	Field Blanks	Rinsate Blanks	Preservative Blanks[g]	Total	Analytical Suite[a,c]
Groundwater[e]	6	1	1	1	1	1	11	B

SITE 19

Medium	no. of Samples	Duplicates	Total	Analytical Suite[a,b]
Soil	18	1	19	A
Groundwater[d]	6	1	7	A
TOTAL	24	2	26	

Table 14-1 (Cont.)

Medium	No. of Samples	Dupli-cates	Trip Blanks[f]	Field Blanks	Rinsate Blanks	Preservative Blanks[g]	Total	Analytical Suite[a,c]
Groundwater[e]	4	1	1	1	1	1	9	B

[a]Analytical suite designations are as follows:

A = Volatile organic compounds, polynuclear aromatic hydrocarbons, phenols, perticides and total PCBs, total recoverable hydrocarbons, and metals (total, unfiltered).

B = Target Compound List (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).

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

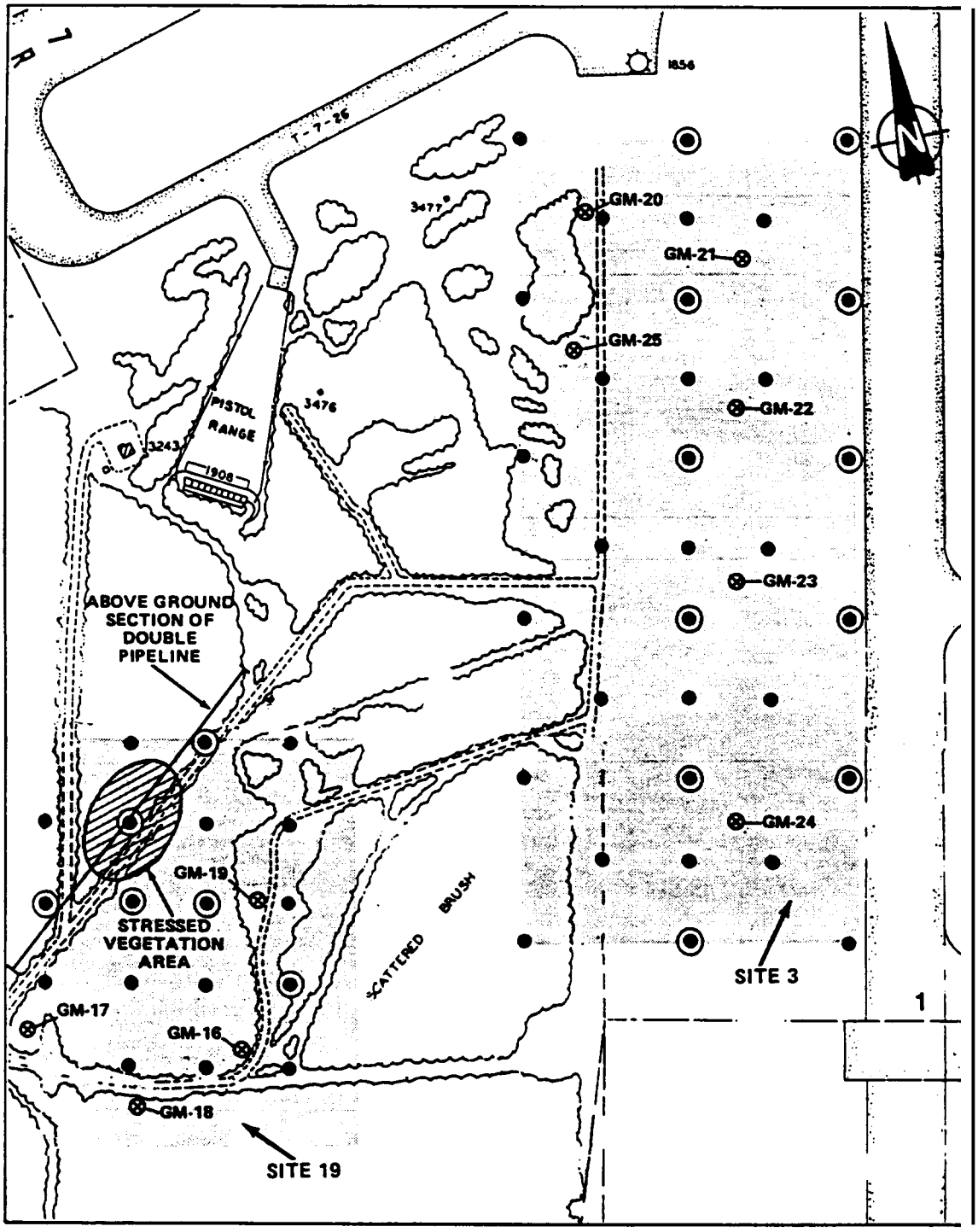
[c]Specific constituents encompassed by the various chemical groups included within analytical suite B are identified in Tables 9-5 through 9-13 of the GQAPP.

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

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

'Trip blanks will be analyzed for TCL volatile organic conpounds only.

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



SOURCE: U.S. Naval Air Station, Pensacola, Florida, 1987; and Geraghty and Miller 1984, 1986

SCALE 0 200 400 600 800 FEET

KEY:

- ● Tentativ Soil Boring
- ○ Tentative Temporary Monitoring Well
- ⊗ Existing Monitoring Well

Figure 14–1 TENTATIVE SOIL BORING AND TEMPORARY MONITORING WELL LOCATIONS, SITES 3 & 19 – PHASE I

Each temporary monitoring well will be constructed of stainless steel casing terminating in 5 feet of 0.01-inch slotted, stainless steel screen. The well casing will be placed in the corresponding soil sample borehole after the soil samples have been collected. Each well will be installed so that the well screen brackets the water table (i.e., the top of the screen extends slightly above the water level).

Each of the temporary monitoring wells will be developed as provided in Section 6.7.5 of the GQAPP, Each temporary monitoring well and the 10 existing monitoring wells will be purged and sampled in accordance with Section 6.8 of the GQAPP.

14.1.4 Eydrologic Assessment

The temporary wells and existing well network will be surveyed to obtain top of casing (TOC) elevations referenced to USGS datum or to a suitable established benchmark located within the vicinity of sites 3 and 19. Static water levels will be measured in each well to determine shallow groundwater flow direction and horizontal hydraulic gradient.

Hydrologic data collected during Phase I and geophysical and analytical screening data will all be evaluated, and evidence of lateral contaminant migration in shallow groundwater will be assessed. Conclusions drawn from these evaluations will form the basis for permanent monitoring well installations in phases II and 111.

14.2 Phase II--Characterization/Extent Delineation

This section of the Contamination Assessment/Remedial Activities Investigation Work Plan--Group J (Site 3, Crash Crew Training Area and Site 19, Fuel Farm Pipeline Leak), Naval Air Station Pensacola, Pensacola, Florida, has been entirely revised to reflect the results of the Phase I activities proposed in the original work plan document (June 1990). Prior to performance of Phase I activities on Group J (sites 3 and 19), Site 19 was transferred from the Naval Installation Restoration Program (IRP) to the Navy's Underground Storage Tank Program and therefore will no longer be addressed as part of this operable unit. Consequently, all Group J Phase II and subsequent activities detailed in

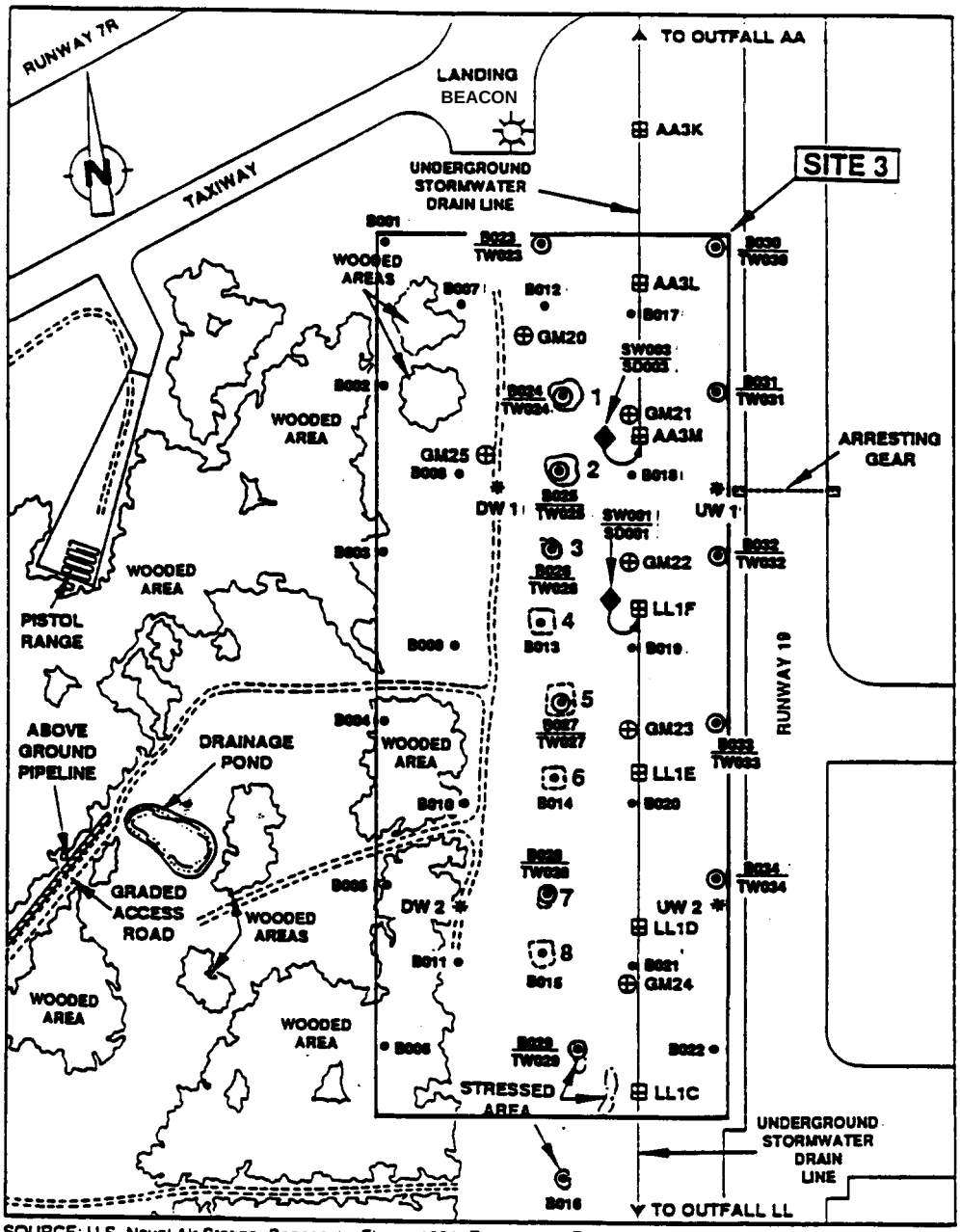
Section 14.2 through the remainder of this work plan are directed only toward Site 3. The original version (June 1990) of Section 14.2 of this work plan is presented in Appendix D. Figures 14-2 and 14-3 show the actual Phase I sampling locations and location designations. The results of the Phase I investigation of Site 3 are presented in E & E's Final Draft Interim Data Report, Contamination Assessment/Remedial Activities Investigation, Crash Crew Training Area (Site 3), Naval Air Station Pensacola, Pensacola, Florida, April 1992.

In general, the results of E & E's Phase I investigation of Site 3, reviewed in combination with those of previous investigations of the site (NEESA 1983; G & M 1984), indicated the following:

- On-site surface water and sediment in the Site 3 stormwater drainage system appear to have been impacted by metal and organic contaminant migration from the burn areas. Chromium and phenol concentrations exceeding the respective Florida Class III surface water quality standards/fresh water were detected in the on-site surface water samples. Metals, TRPHs, xylenes, and PAHs or phenols were detected at low to elevated concentrations in the on-site sediment samples.

- Phenols were detected at a concentration exceeding the Florida Class III Surface Water Quality Standard/Fresh Water in surface water at one of the Site 3 stormwater drainage system outfalls (outfall LL; see Figure 14-3). Trace to low levels of metals and one or more of the contaminant groups TRPHs, PAHs, and phenols were detected in sediments at the Site 3 stormwater drainage system outfalls (see Figure 14-3). These results suggest that off-site contaminant migration via the stormwater drainage system **may** be occurring; however, ambient and/or off-site contaminant sources may also be present.

- Elevated levels of metals (primarily lead), TRPHs, aromatic-type VOCs, PAHs, and phenols were detected in soil samples over large areas of the site. Only low levels of metals were detected: however, comparatively elevated total metals concentrations were detected in or near the burn areas. TRPHs were detected in most soil samples, with significantly elevated concentrations detected in the burn areas and the drainage swale area opposite and north of burn area 2 (soil borings B017 and B018; see Figure 14-2). Significantly elevated levels of one or more of the aromatic-type VOCs (toluene, ethylbenzene, or xylenes), PAHs, and phenols were detected in burn areas 1, 2, 4, 5,



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

SCALE

0 100 200 400 600 800 FEET

KEY:

= = = = Jeep Trail

Stormwater Catch Basin with Grate

AA3K/LL1C Stormwater Catch Basin Designation

Active Burn Area

Former Burn Area

1 Burn Area Number

Existing Permanent Shallow Monitoring Well

GM21 Permanent Monitoring Well Number

Particulate Air Screening Location

DW 1/UW 1 Particulate Air Screening Location Number (downwind/upwind)

Surface Water and Sediment Sample Location

SW001 Surface Water Sample Number

SD001 Sediment Sample Number

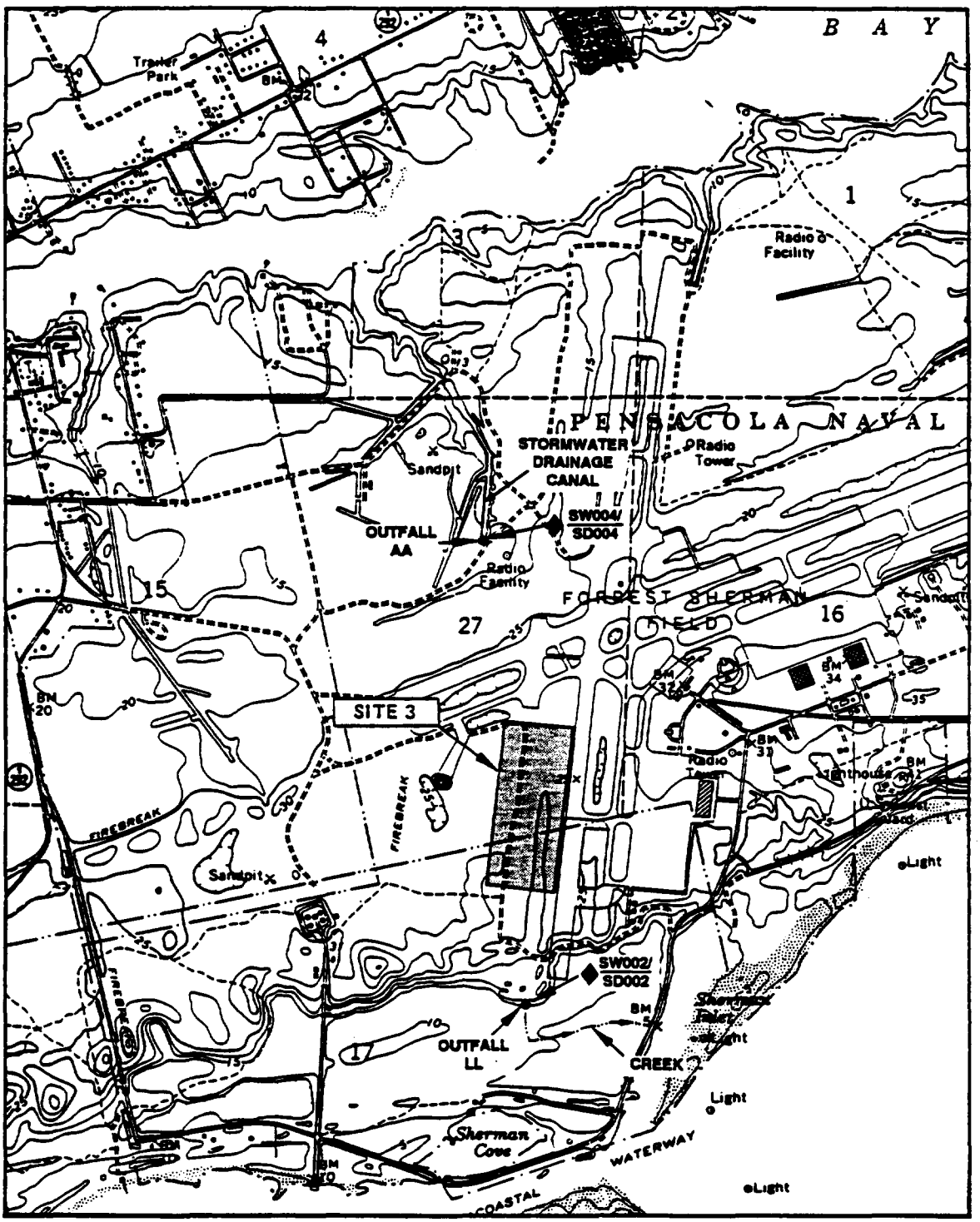
Soil Boring

Temporary Monitoring Well

B023 Soil Boring Number

TW023 Temporary Monitoring Well Number

Figure 14-2 PARTICULATE AIR SCREENING, ON-SITE SURFACE WATER AND SEDIMENT SAMPLING, SOIL BORING, AND TEMPORARY MONITORING WELL LOCATIONS— NAS PENSACOLA SITE 3 — PHASE I



SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas, Fla. 1970 and West Pensacola, Fla. 1970, Photorevised 1987; Ecology and Environment, Inc., 1991

KEY:

◆ Surface Water and Sediment Sample Location

SW001 Surface Water Sample Number

SD001 Sediment Sample Number

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 14-3 OFF-SITE SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS — NAS PENSACOLA SITE 3 — PHASE I

and 6 and in the drainage swale area opposite and north of burn area 2 (soil borings B017 and B018; see Figure 14-2). Significantly elevated phenols concentrations were also detected in burn area 3 and in the northeast corner of the site (soil borings B026 and B030; see Figure 14-2). The observed metals and organic distributions on the site strongly suggest that the burn areas on Site 3 are the sources of the observed soil contamination. It is possible that some phenols contamination detected in the northeast corner of the site and low levels of TRPH contamination detected along the periphery of the site may represent additional ambient and/or off-site sources.

- Metals (primarily chromium and lead) and organic contamination are present in groundwater of the surficial zone of the Sand-and-Gravel Aquifer at levels exceeding federal and state standards or guidance concentrations. The highest levels of groundwater contaminants were detected primarily in the burn areas and drainage swale area opposite the burn areas in the northern third of the site; however, significant levels of metals or organic contamination were detected in several areas along the northern site boundary and near the southern site boundary.

- The Phase I analytical data clearly indicate that the burn areas are the primary sources of the groundwater contamination present on Site 3; however, additional localized sources of groundwater contamination may be present on or in the vicinity of Site 3. The Phase I results also indicate little off-site migration of contaminants within the surficial zone groundwater.

In light of the Phase I results summarized above, the objectives of the Phase II investigation of Site 3 will be as follows:

- Eliminate the primary long-term, continuing sources of groundwater contamination on the site;

- Identify, to the greatest extent possible, any additional on-site or off-site sources of contamination and potential ambient sources of contamination in the site vicinity;

- Determine the nature, magnitude, and extent of potential surface water and sediment contamination in the Site 3 stormwater drainage system and at the drainage system outfalls;

- Delineate the nature, magnitude, and lateral/vertical extents of known/suspected areas of soil and groundwater contamination; and

- Initiate the Risk Assessment and Feasibility Study for the site.

To meet the above objectives, the Phase II investigation of Site 3 will include the following elements:

- Interim remedial measure (IRM) design;
- Contaminant source survey;
- Surface water, sediment, and soil sampling;
- Installation of shallow and intermediate wells;
- Collection of groundwater samples from all existing and newly installed wells;
- Eydrologic assessment; and
- Engineering survey.

The specific scope of work associated with each of the above elements is described in sections 14.2.1 through 14.2.5. In developing the specific scopes of work, the Phase I analytical results and previous analytical results have been evaluated regarding all requirements of the CERCLA and Superfund Amendments and Reauthorization Act (SARA), as well as all other ARARs. For Site 3, these ARARs include:

- Resource Conservation and Recovery Act (RCRA);
- Clean Water Act (CWA);
- Safe Drinking Water Act (SDWA);
- 40 CFR Parts 264, 265, 270, and 271 (Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities; Proposed Rule);
- Chapter 17-3, Florida Administrative Code (FAC; Water Quality Standards);
- Chapter 17-301, FAC (Surface Waters of the State);
- Chapter 17-302, FAC (Surface Water Quality Standards);
- Chapter 17-550, FAC (Drinking Water Standards, Monitoring, and Reporting); and

- o Chapter 17-770, FAC (State Underground Petroleum Environmental Response).

Formal, quantitative air sampling will not be conducted during Phase II at Site 3 because no evidence that Site 3 represents a potential source of airborne volatile or particulate contaminants was revealed by the Phase I surface emissions survey, particulate air screening, or fieldwork air monitoring activities. Biota sampling also will not be conducted during Phase II because the potential contaminants of concern have not been sufficiently characterized. However, base-wide biota sampling will be conducted in conjunction with the investigation of operable units (OUs) 15, 16, and 17 (Bayou Grande Area, NAS Pensacola Wetlands, and Pensacola Bay Area, respectively).

Based on the results of the activities identified above, during Phase II E & E will initiate the appropriate Risk Assessment and Feasibility Study activities. Risk Assessment activities will be directed toward identification of contaminants of concern as well as identification of data gaps that must be eliminated to support the eventual completion of a Baseline Risk Assessment for the site. If no data gaps are identified, the Baseline Risk Assessment will be completed during Phase 11.

Feasibility Study activities, which will be required for Site 3, will be directed toward identification of data gaps that must be eliminated to support the eventual completion of a comprehensive Feasibility Study for the site. If no data gaps are identified, the Feasibility Study will be completed during Phase 11.

In addition, if warranted, E & E will evaluate the Phase II results to identify whether any additional IRMs are required and, if so, to develop recommendations for implementation of these IRMs (see Section 14.2.1). IRMs will only be implemented following receipt of EPA approval.

All Phase II investigation activities and results will be discussed in an interim data report structured in the required format of a formal draft remedial investigation (RI) report. This Phase II interim data report will provide a complete data synthesis incorporating the results

of E & E's Phase I and Phase II investigations, as well as the results of previous investigations. The interim data report will specify whether additional Phase III assessment activities are required or whether the formal draft RI report for the site can be prepared. All Phase I investigation activities were completed in accordance with E & E's 1990 GQAPP for Contamination Assessments and Remedial Activities at NAS Pensacola. All Phase II investigation activities will be completed in accordance with the newly revised, updated 1992 version of this document. In this section (14.2), all references apply to the 1992 version of the GQAPP.

14.2.1 Interim Remedial Measure Design

An IRM will be designed for Site 3 to address mitigation of the heavily contaminated soils in burn areas 1 through 6 as continuing sources of on-site contamination. Design and subsequent implementation of this IRM are required because Phase I investigation results clearly indicate that the burn area soils represent both primary current sources and long-term, continuing sources of Site 3 groundwater contamination. The IRM will only be implemented following receipt of EPA approval.

At a minimum, the IRM design will address all soils above the water table in burn areas 1 through 6. In developing the IRM design, various remediation alternatives for contaminated soils will be fully considered. These include excavation and on- or off-site incineration and/or on- or off-site disposal; land farming; excavation/electrochemical destruction; and/or ~~in situ~~ methods (e.g., air sparging and bioremediation). The evaluation of these alternatives will primarily consider the effectiveness, cost efficiency, and impact of each alternative on the overall Site 3 remedial program schedule.

During the field investigation, circumstances on site may require additional IRMs. IRMs will be initiated on a case-by-case basis and only following receipt of EPA approval. Rapid response will be emphasized. An additional IRM could involve the installation of security fences and warning signs; construction of berms, caps, and/or recovery and treatment systems; and removal of soil, sediment, and/or

drums. A detailed, explanatory report of any IRM(s) conducted will be developed by E 6 E and provided to the Navy and EPA.

14.2.2 Contaminant Source Survey

A supplemental contaminant source survey will be performed at Site 3 to obtain a comprehensive understanding of potential additional contaminant source(s) in the site vicinity. At Site 3, this survey will include the following:

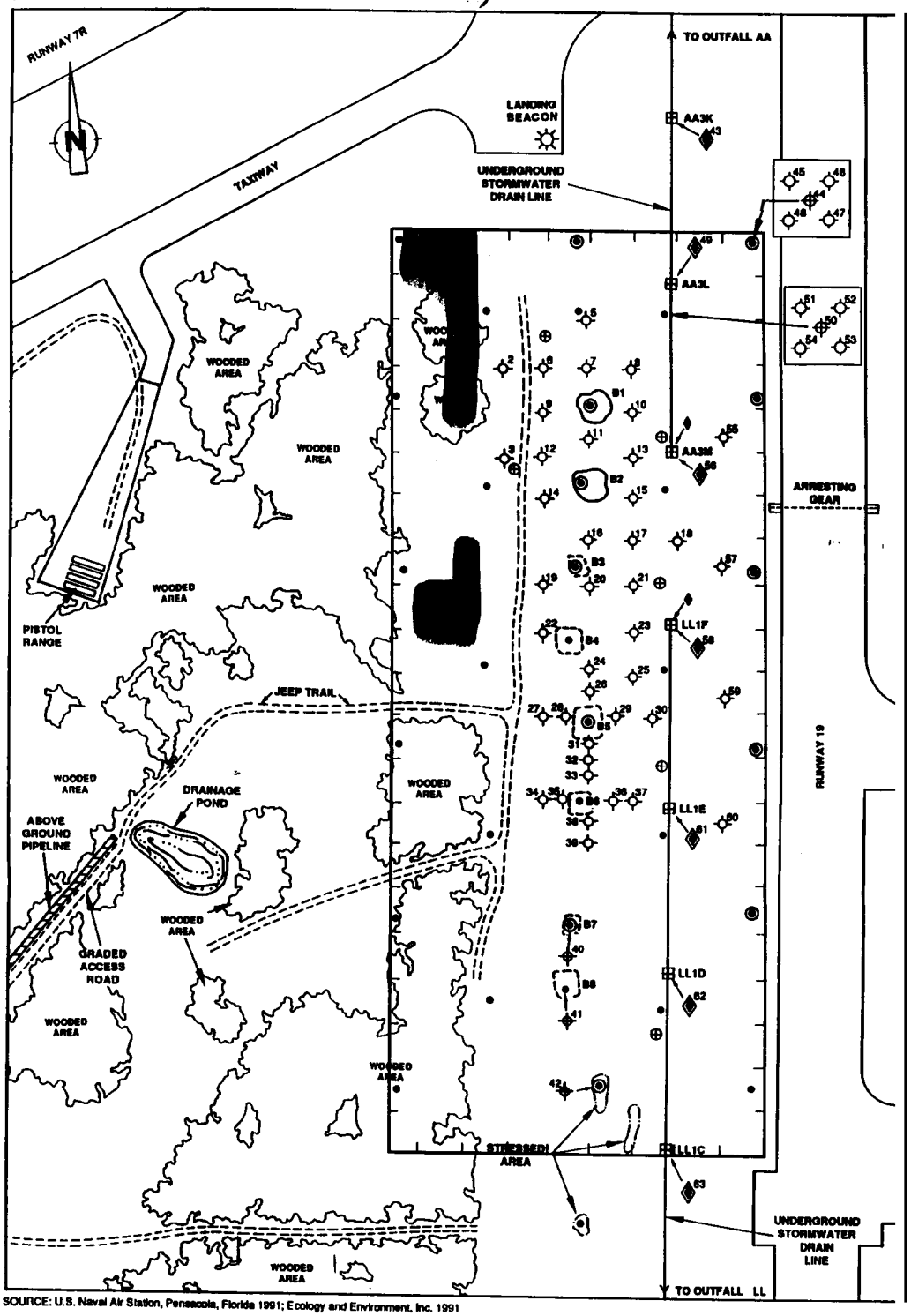
- Identification of any off-site and/or ambient sources that may be contributing contamination to off-site portions of the Site 3 stormwater drainage system and to the outfalls of this drainage system;
- Location of former and existing on-site underground utilities; and
- Determination of whether any normal, daily, facility-specific and/or base-wide activities, such as aircraft operations, may have created potential, low-level, ambient sources of TRPE or other contamination.

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

14.2.3 Sampling and Analysis

Figures 14-4, 14-5, and 14-6 show the proposed Phase II surface water and sediment sampling, soil boring, and monitoring well locations for Site 3. Table 14-2 summarizes the sampling and analytical requirements, including QA/QC samples, for the Phase II investigation of Site 3. Tables 14-3, 14-4, and 14-5 provide the specific rationale for each proposed Phase II surface water and sediment sample, soil boring, and monitoring well location, respectively, and for the analytical suite associated with each proposed Phase II sampling location. (Groundwater

[Bold i t w enclosed in brackets denote
changes to last version of document]



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

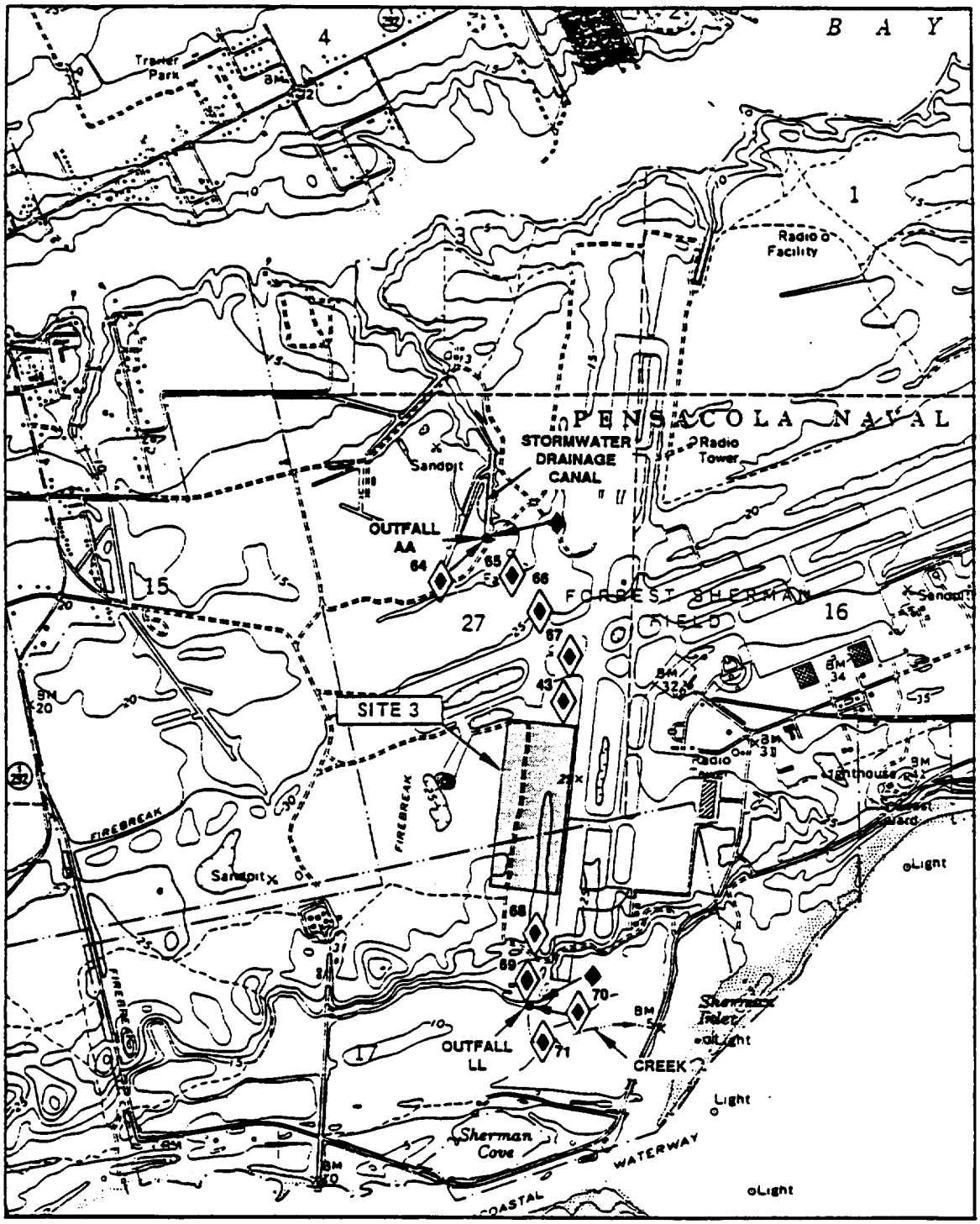
0 200 400 FEET

KEY:

- Jeep Trail
- Stormwater Catch Basin With Grate
- AA3K/LL1C Stormwater Catch Basin Designation
- Active Burn Area
- Former Burn Area
- B1 Burn Area Number
- Existing Permanent Shallow Monitoring Well
- Phase I Surface Water and Sediment Sample
- Phase I Soil Boring
- Phase I Temporary Monitoring Well
- Proposed Phase II Surface Water and Sediment Sample
- Proposed Phase II Soil Boring
- Proposed Phase II Soil Boring and Shallow Monitoring Well
- 37 Location Reference Number
- Under Water During Sampling Period

NOTE: Soil boring locations 45 through 48 and 51 through 54 are located 20 feet from soil boring/shallow well locations 44 and 50, respectively.

Figure 14-4 PROPOSED ON-SITE SURFACE WATER AND SEDIMENT SAMPLING AND SOIL BORING LOCATIONS — NAS PENSACOLA SITE 3 — PHASE II



SOURCE: U.S.G.S. 7.5 Minute Series (Topographic) Quadrangles: Fort Barrancas Fla. 1970 and West Pensacola, Fla. 1970. Photorevised 1987; Ecology and Environment, Inc., 1991

KEY:

♦ Phase I Surface Water and Sediment Sample

◊ Proposed Phase II Surface Water and Sediment Sample

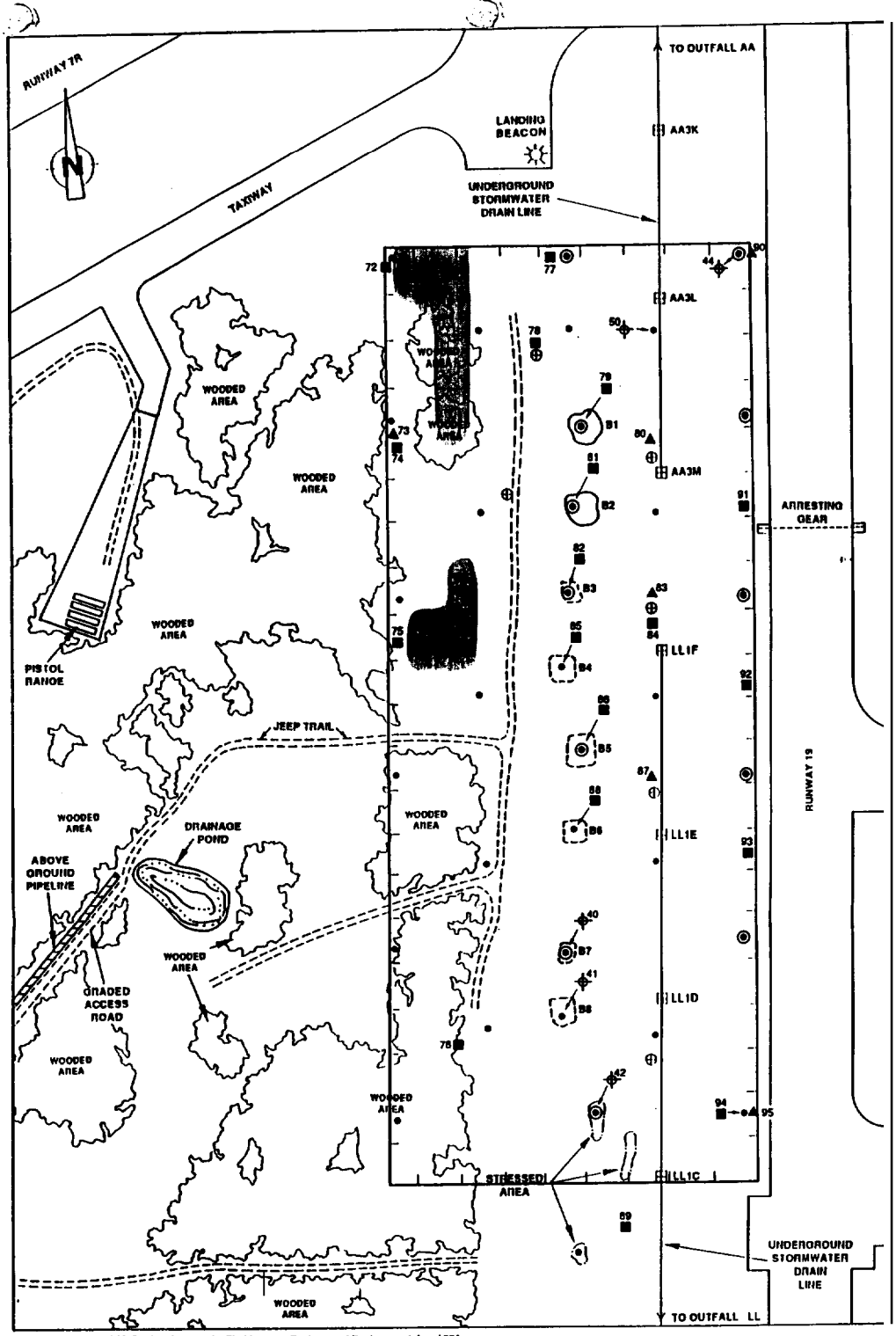
49 Location Reference Number

SCALE

0 ½ 1 MILE

0 .5 1 KILOMETER

Figure 14-5 PROPOSED OFF-SITE SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS — NAS PENSACOLA SITE 3 — PHASE II



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

SCALE

0 200 400 FEET

KEY:

=====	Jeep Trail	•	Phase I Soil Boring
▣	Stormwater Catch Basin With Grate	○	Phase I Temporary Monitoring Well
AA3K/LL1C	Stormwater Catch Basin Designation	⊕	Proposed Phase II Soil Boring and Shallow Monitoring Well
⬭	Active Burn Area	■	Proposed Phase II Shallow Monitoring Well
⬭	Former Burn Area	▲	Proposed Phase II Intermediate Monitoring Well
B1	Burn Area Number	91	Location Reference Number
⊕	Existing Permanent Shallow Monitoring Well		Under Water During Sampling Period

Figure 14-6 PROPOSED MONITORING WELL LOCATIONS — NAS PENSACOLA SITE 3 — PHASE II

Table 14-2

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS
NAS PENSACOLA SITE 3

Medium	No. of Samples[a]	Dupli-cates	Trip Blanks[b]	Preservative Blanks[b]	Field Blanks	Rinsate Blanks	Total[a]	Analytical Suite[c,d]
Surface Water	17	2	--	--	NR	2	21	A
	(1)	--	2	--	--	--	(1),2	D
	(2)	NR[e]	NR	NR	NR	NR	(2)	E
Sediment	17	2	--	NR	NR	2	21	A
	(1)	--	2	NR	NR	--	(1),2	D
	(2)	NR	NR	NR	NR	NR	(2)	F
Soil[f]	63	6	--	NR	NR	9	78	A
	75	8	NR	NR	NR	--	83	B
	24	2	NR	NR	NR	All	26	C
	(1)	--	9	NR	All	--	(1),9	D
	(36)	NR	NR	NR	NR	NR	(36)	F
Groundwater[g]	33	3	--	1	1	5	43	A
	(1)	--	5	--	--		(1),5	D
	(11)	NR	NR	NR	All	All	(11)	E
TOTAL	229	23	18	1	1	18	290	
	(51)	NR	NR	NR	NR	NR	(51)	

14[NASP]UH8000:T0481/1300/10

Key:

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

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

[c]Analytical suite designations are as follows:

A = TCL VOCs; TCL base-neutral/acid extractable organic coapounds (BNAs); TCL pesticides and polychlorinated biphenyls (PCBs); TRPHs; TAL metals (total [i.e., unfiltered] and dissolvod [i.e., millipore-filtered], water only): cyanido: gross alpha, beta, and gama radio-activity: total organic carbon: total Kjoldahl nitrogen (TKN; surface water and sediment only): grain size (sediment only); hardness (water only); and alkalinity (water only).

B = TRPHs, TCL VOCs, and TCL BNAs.

C = TRPHs and TCL BNAs.

D = Appendix IX VOCs, BNAs, dioxins, posticidos, PCBs, organophosphorus pesticides, herbicides, total wtals, cyanide, and sulfide.

E = Total suspended solids, TKN (groundwater only), ammonia nitrogon, orthophosphate phosphorus, dissolvod oxygon (in field), 5-day biological oxygen demand (BOD_5), and chemical oxygon demand (COD).

F = pH, alkalinity, percent moisture, grain size (soil only), BTU contont. ash contont, total organic halogens, sulfur, ignitability, and cation oxchango capacity (CEC).

[d]Specific constituents encompassed by tho various chemical groups included within tho above-listed analytical suitor are identified in tables 9-6 through 9-15 of tho GQAPP.

[e]NR = lot required.

[f]For Site 3, 54 boring locations X 3 dopth intervals = 162 samples.

[g]For Site 3, 4 existing wells + 19 now on-sit. wells (23 shallow and 6 intermediate) = 33 samples.

Source: Ecology and Environment, Inc., 1992.

Table 14-3

RATIONALE FOR PROPOSED PHASE II SURFACE WATER AND SEDIMENT SAMPLE LOCATIONS AND ANALYSES NAS PENSACOLA SITE 3

Location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
49	SW SD	Hydraulically downgradiont of burn areas; TRPHs and phonols dotoctod in nearby Phase I soil samplo **S017.**	A	Characterize full spoctrum of potential contaminants.
56	SW SD	Hydraulically downgradiont of burn areas; TRPHs, VOCs, and phonols dotoctod in Phaso I surface water sample SW003 and metals, TRPHs, xylenes, and BNAs detected in Phaso I sediment samplo **SD003.**	A D E,F	Characteriro full spectrum of potential contaminants. Meet RCRA requirements. Support potential site remediation activities.
50	SW SD	Hydraulically downgradiont of burn areas; Chromium and VOCs detected in Phaso I surface water samplo **SW001** and metals, TRPHs, VOCs, and PAHs dotoctod in Phaso I sodimont samplo SD001.	A E,F	Characterize full spoctrum of potential contaminants. Support potential site remediation activities.
61	SW SD	Hydraulically downgradiont of burn areas; VOCs, VOC TICs, and BNA TICs dotectod in nearby existing shallow monitoring well samplo W023.	A	Characterize full spectrum of potential contaminants.
62	SW SD	Hydraulically downgradiont of burn areas; VOCs, VOC TICs, and BNA TICs.	A	Characteriro full spoctrum of potential contaminants.
63	SW SD	Hydraulically downgradient of burn areas and stressed area where xylenes and phonols detected in Phase I groundwater sample GW029 and TRPHs detected in corresponding Phase I soil samplo S029.	A	Characterize full spoctrum of potential contaminants.

14[NASP]UH8000:T0481/1301/7

Key at ond of table.

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

Table 14-3 (Cont.)

Location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
1,4	SW SD	Background control and oxtont delineation; wetland area not sampled during Phaao I investigation.	A	Charactoriro contaminant levels in site vicinity.
64	SW SD	Site 3 stormwater drainago systom outfall; nothing dotoctod in Phaao I surfaco wator sample SW004 but TRPHs and PAHs dotoctod in corroaponding Phaao I sediment sample SD004.	A	Characterize full spectrum of potontial sodimont contaminants and confirm absence of surfaco wator contamination at this location.
43, 65-67	m SD	Site 3 stormwater drainago systom M; delineate downatroam oxtont of surface wator and sediment contamination dotoctod at head of drainago systom on Site 3.	A	Charactoriro full spectrum of potontial contaminants.
68,69,71	m SD	Site 3 stormwater drainago systom LL; delineate downatroam oxtont of surfaco wator and sediment contamination dotoctod at head of drainago system on Site 3.	A	Characterize full spectrum of potontial contaminants.
70	SW SD	Site 3 stormwater drainago system outfall; nothing dotoctod in Phase I surface wator sample but phenols dotoctod in corroapondinq Phase I sediment sample SD002.	A	Characterize full spectrum of potontial sediment contaminants and confirm absence of surfaco wator contamination at this location.

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Key:

[a] SW = Surface wator; SD = rodimont.
[b] Specific parameters included within each analytical suite are diven in Table 14-2.

TRPHs = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.
BNAs = Base/neutral and acid extractable organic compounds.
RCRA = Resource Conservation and Recovery Act.
PAHs = Polynuclear aromatic hydrocarbons.
TICs = Tentatively identified compounds.

Source: Ecology and Environment, Inc., 1992.

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

Table 14-4

RATIONALE FOR PROPOSED PHASE II SOIL
SAMPLE LOCATIONS AND ANALYSES
NAS PENSACOLA SITE 3

Location Reference Number(s)	Sample Type(s)[a]	Location Rational.	Analytical Suito(s)[b]	Analytical Rationale
2,3,5-39, 55,57,59,60	AWT	Delineate magnitude and potential outer extent of contamination detected in Phase I burn areas 1 through 6 soil samples S013, S014, and S024 through S027.	A	Confirm absence of contamination in these areas or characterize full spectrum of potential contaminants
			B (Locations 6-13, 15-18, 20, 21, 23, 25, 26, 28-31, 33, 35, 36, 3a only)	TRPHs, VOCs, and BNAs are only concern here.
			D (Location 13, 0.5-2.5 foot only)	Meet RCRA requirements.
			F (Locations 3, 7, 13, 19, 21, 24, 27, 30, and 38 only)	Support potential site remediation planning activities.
40	AWT	Former burn area; confirm absence of soil contamination in Phase I roil sample S028.	A	Confirm absence of contamination in this area or characterize full spectrum of potential contaminants.
41	AWT	Former burn area; confirm contamination detected in Phase I soil sample S015 (TRPHs).	A	Characterize full spectrum of potential contaminants.
			F	Support potential site remediation planning activities.

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Key at end of table.

Table 14-4 (Cont.)

Location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
42		confirm contamination dotoctod in Phase I soil sample S029 (TRPHs); xylenes and phenols dotoctod in Phase I groundwater sample GW029.	A	Characterize full spectrum of potontial contaminants.
44,50	AWT	Confirm contamination (TRPHs and phenols) detected in Phase I soil samples S030 and S017.	A	Characterize full spectrum of potontial contaminants.
		(TRPHs and Phenols)	F	Support potontial site remediation planning activities.
45-48 51-54	AWT	Delineate potential lateral extent of contamination dotoctod in Phase I roil samples S030 and S017.	C	TRPHs and BNAs are only concern here.

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Key :

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

TRPHs = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.
BNAs = Base/neutral and acid extractable organic compounds.
RCRA = Resource Conservation and Recovery Act.

Source: Ecology and Environment, Inc., 1992.

Table 14-5

RATIONALE FOR PROPOSED PHASE II MONITORING WELL LOCATIONS AND GROUNDWATER SAMPLE ANALYSES NAS PENSACOLA SITE 3

Location Reference Number(s)[a]	Sample Type(s)[b]	Location Rationale	Analytical Suite(s)[c]	Analytical Rationale
72,74,75,76, 89,91,92,93,94	SGW	Delineate extent of groundwater contamination dotoctod across Site 3 during Phase I; proposed wells are hydraulically upgradient (locations 72 and 74), across gradient (locations 75 and 76), or downgradient (locations 89, 91, 92, 93, and 94) of Site 3 groundwater contamination detected during Phaso I investigation.	A	confirm absence of contamination or characterize full spoctrum of potontial contaminants.
40	SGW	Former burn area; confirm absence of groundwator contamination in Phaso I temporary well TW028.	A	confirm absence of groundwater contamination in this area or charactoriro full spoctrum of potontial contaminants.
41	SGW	Former burn area; determine presence and naturo of potontial groundwater contamination; high TRPHs dotoctod in Phaso I soil sample S015.	A	Characterize full spoctrum of potontial contaminants.
42	SGW	Stressed vegetation area; high xylenes and phenols detected in Phase I temporary well M 2 9.	A	Characterize full spoctrum of potontial contaminants.
			E	Support potontial site remediation planning activities.
44	SGW	Determine presence and naturo of potontial groundwator contamination; high phenols detected in Phase I soil sample S030.	A	Characterize full spectrum of potential contaminants.
50	SGW	Dotormino presence and nature of potontial groundwator contamination; high TRPHs and phenols dotoctod in Phaso I roil sample S017.	A	Characterize full spectrum of potontial contamination..
			E	support potontial site remediation planning activities.

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Key at end of table.

Table 14-5 (Cont.)

Location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
77	SGW	High metals concentrations dotoctod in Phaso I temporary well TW023.	A	Characterize full spectrum ot potontial contaminants.
			E	Support potontial site romodiation planning activitios.
78,84	SGW	Replace shallow wells OX20 and GM22 destroyed during site maintenance activities	A	Characterize full spectrum of potontial contarinants.
			E (Location 78 only)	Support potontial site romodiation planning activities.
79,81	SGW	Active burn areas; high load, VOCs, PAHs, and phenols dotoctod in Phaso I temporary wells TW024 and TW025.	A	Characterize full spectrum of potontial contaminants.
			D (Location 81 only)	Meet RCRA requirements.
			E	support potontial site remediation planning activitios.
82	SGW	Former burn area; high metals and xylenes dotoctod in Phaso I temporary well TW026.	A	Characterize full spectrum of potontial contaminants.
			E	support potontial site remediation planning activitios.
85	SGW	Former burn area; determine presence and nature of potontial groundwater contamination; high TRPHs, VOCs, and BNAs dotoctod in Phaso I soil sample S013.	A	Characterize full spectrum Of potontial contaminants.
			E	Support potontial site romodiation planning activitios.

14[NASP]UH8000:T0481/1303/7

Key at end of table.

Table 14-5 (Cont.)

Location Reference Number(s)	Sample Type(s)[a]	Location Rationale	Analytical Suite(s)[b]	Analytical Rationale
86	SGW	High metals, xylenes, and phenols dotoctod in Phase I temporary well TW027.	A	Characterize full spectrum of potontial contaminants.
			E	Support potontial site romodiation planning activitios.
88	SGW	Former burn area: determine presence and nature of potontial groundwator contamination: high TRPHs, VOCs, and BNAs dotoctod in Phase I soil samples S014 and S014D.	A	Charactoriro full spectrum of potential contaminants.
			E	Support potontial site romodiation planning activitios.
73,80,83, 87,90,95	IGW	Determine presence and nature of intormodiato depth groundwater contamination; proposed wells are upgradient (location 3 only) within or downgradient of areas of shallow groundwator contamination and are clustered with existing or proposed shallow wells.	A	Charactoriro full spectrum of potontial contaminants.
			E (location 83 only)	Support potontial site romodiation planning activitios.

14[NASP]UH8000:T0481/1303/7

Key:

[a]All four existing wells will also bo sampled during Phase II for analytical Suite A (see Table 14-2).
[b]SGW = Groundwater sample from shallow monitoring well; IGW = groundwater sample from intermediate monitoring well.
[c]Specific parameters included within each analytical suite are given in Table 14-2.

TRPHs = Total recoverable petroleum hydrocarbons.
VOCs = Volatile organic compounds.
BNAs = Base/neutral and acid extractable organic compounds.
PAHs = Polynuclear aromatic hydrocarbons.
RCRA = Resource Consorvation and Recovery Act.

Source: Ecology and Environment, Inc., 1992.

samples to be collected from the four existing on-site wells and analyzed for suite A [see below] are not included in the rationale table [see Table 14-51).

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

It is proposed to sample all existing wells and all newly installed wells for analytical suite A during Phase II to provide a uniform, time-synchronous perspective on Site 3 groundwater conditions. This perspective will be critical to properly evaluate the groundwater migration pathway. In addition, during Phase II field activities at NAS Pensacola site groups A through E, soil borings, shallow monitoring wells, and intermediate monitoring wells will be completed at three background locations across the base, and--together with the three existing on-base deep supply wells--sampled for analytical suite A. (Soil samples collected below the water table will be analyzed for Target Analyte List [TAL] metals). These background locations will help provide a perspective on the on-site occurrences of potential contaminants as well as aid in evaluating the impact of potential, base-wide ambient contaminant sources. The collection of these background soil and groundwater samples is discussed in the work plan for Group A--Site 1 (Sanitary Landfill; E & E 1991).

Table 14-2 indicates that one sample from each medium will be additionally analyzed for analytical suite D (Appendix IX parameters). It should be noted that for these samples, suite A analyses will be performed only for parameters not encompassed by Appendix IX (e.g., gross alpha, beta, and gamma radioactivity). Furthermore, Table 14-2 also indicates that trip blanks will not be analyzed for the full Appendix IX suite of parameters but only for Appendix IX VOCs. Finally, it should also be noted that the number of required trip'blanks shown on

Table 14-2 reflects the total number of trip blanks required to be collected for both the suite A and D samples.

As noted above, tables 14-3, 14-4, and 14-5 provide specific rationales for proposed Phase II sampling locations and analyses. Sampling locations were selected based on the Phase I results in accordance with one of the following criteria:

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

Sampling locations selected according to the first criterion are required to allow identification of the full spectrum of potential on-site contaminants as well as the maximum levels of occurrence. Locations selected according to the second criterion are required to delineate the distribution of contamination on site and in the site vicinity. Locations selected according to the third criterion are required to confirm that the extent of contamination has been completely delineated. The specific, detailed rationales provided in tables 14-3, 14-4, and 14-5 for each sampling location or group of locations meet one or more of the three general criteria defined above.

All three of the above criteria must be met to complete a Baseline Risk Assessment and Feasibility Study for the site. Furthermore, in most instances, meeting the above criteria requires that the collected samples be analyzed for the full suite of parameters in analytical suite A. Hovever, in some cases (e.g., extent delineation of TRPH and phenols contamination detected in isolated site area soil samples), a more limited analytical program (e.g., TRPHs and BNAs in soils) is warranted.

Finally, to support potential remediation planning activities for this site, selected samples from each medium also must be analyzed for those parameters which directly control the viability of various remedial alternatives (see analytical suites E and F, Table 14-2).

14.2.3.1 Surface Water and Sediment Sampling

During the Phase II investigation at Site 3, surface water and sediment samples will be collected at the 17 locations shown on figures 14-4 and 14-5. The combined surface water and sediment sampling locations are as follows: one sample from each of the two wet areas in the northeastern quarter of the site; one sample from each of the six stormwater catch basins located on Site 3; two samples in the stormwater drainage system south of Site 3; four samples in the stormwater drainage system north of the site; one sample at each of the two stormwater drainage system outfalls; and one sample in the intermittent stream 500 feet downstream of the southern stormwater drainage system outfall (outfall LL).

Surface water samples will be collected in accordance with Section 6.9.1 of the GQAPP. Surface water samples collected at locations in surface water bodies and in the stormwater drainage system shallower than 1 foot will be collected at the surface and, whenever possible, directly into the sampling container. If not possible, a glass or stainless steel beaker or similar sampling device will be used. Samples collected from water deeper than 1 foot will be collected within 1 foot of the bottom using a Kemmerer or similar sampling device. Surface water samples collected at the stormwater drainage system outfalls will be collected immediately adjacent to the discharge point. During collection of surface water samples, the'surface water pH, temperature, specific conductance, dissolved oxygen, turbidity, and water depth will be recorded in the field notebook. Equipment decontamination will be conducted in accordance with Section 6.10 of the GQAPP.

Sediment samples will be collected in accordance with Section 6.9.2 of the GQAPP. Sediment samples will be collected at a depth of surface to 0.5 foot below the surface with one of the following: a stainless steel trowel, a bucket-type mud auger, an Eckman dredge, or other coring device. Sediment samples collected at stormwater drainage system outfalls will be collected immediately adjacent to the discharge point. The composition of sediment materials retrieved will be recorded in the field notebook. Equipment decontamination activities will be conducted in accordance with Section 6.10 of the GQAPP.

The number and types of surface water and sediment field QA/QC samples to be collected during Phase II were determined in accordance with Section 11.1 of the GQAPP.

The 17 surface water and 17 sediment samples will be analyzed for the parameters included on Table 14-2 (see also Table 14-3).

14.2.3.2 Soil Sampling

During the Phase II soil boring and monitoring well installation (Section 14.2.3.2), soil samples will be collected at 54 locations across Site 3 (see Figure 14-4). At soil boring locations where a monitoring well will not be installed, soil borings will be completed using hollow-stem auger methods, and soil samples will be collected using split-spoon samplers in accordance with Section 6.6.2 of the GQAPP.

At each location, except as noted below, composite samples will be collected from each of the following depth intervals: 0 to 0.5 foot BLS, 0.5 foot to 2.5 feet BLS, 2.5 to 5 feet BLS, and then every 5-foot interval to the the water table. For the purpose of estimating sample numbers, the depth to the water table is assumed to be 5 feet BLS.

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

The 162 soil samples will be analyzed for the parameters included on Table 14-2 (see also Table 14-4).

14.2.3.3 Soil Boring Completion and Permanent Monitoring Well Installation and Development

A total of 29 permanent monitoring wells will be installed at Site 3. These wells will be located and designed to supplement the Phase I

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investigation results regarding the lateral and vertical extents of groundwater contamination. The number and target completion depths of these wells are as follows:

- Twenty-three shallow wells, each of which will be approximately 15 feet deep (two of these are proposed to replace existing damaged wells GM20 and GM22); and
- Six intermediate wells, each of which will be approximately 40 feet deep.

Figure 14-6 shows the locations of the proposed monitoring wells for each of the two depth intervals at Site 3, and Table 14-5 provides the rationale for each of the monitoring well locations, target depths, and corresponding sampling analytical requirements.

In order to detect the presence of any floating product at Site 3, the 23 shallow wells will be completed into the upper portion of the surficial zone of the Sand-and-Gravel Aquifer so that the well screen brackets the water table. These wells are expected to be approximately 15 feet deep. The intermediate wells will be installed to investigate the vertical extent of possible groundwater contaminants, particularly any dense nonaqueous phase liquids (DNAPLs) at Site 3. The six intermediate wells will be completed into the lower portion of the surficial zone immediately above the first confining/semiconfining unit. These intermediate wells are expected to be approximately 40 feet deep. Each of the six intermediate wells will be clustered with a shallow well to assist in delineating the vertical extent of any contamination at that location as well as to determine the vertical hydraulic gradients between the tvo monitored zones (see Figure 14-6).

The intermediate wells and the majority of the shallow wells will be installed using hollow-stem auger methods and constructed of 4-inch-diameter, flush-joint, threaded, polyvinyl chloride (PVC) casing terminating in 10 feet of 0.015-inch, factory-slotted screen.

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The shallow wells installed in burn areas 1 through 6 and 8 and in the stressed area near the southern site boundary (see Figure 14-6; locations 41, 42, 79, 81, 82, 84, 85, 86, and 88) will be constructed of 4-inch-diameter, flush-joint, threaded, PVC casing terminating in 10 feet of 0.015-inch, continuously-slotted, wire-wound screen to facilitate conversion of these wells into recovery wells if required for site remediation activities.

To prevent the potential downward migration of any shallow contaminants during drilling, intermediate wells at locations *80*, 83, 87, and 90 (see Figure 14-6) will be installed, using either hollow-stem auger or hydraulic rotary methods, through 8-inch-diameter, PVC surface casings. The surface casings will be grouted in place and allowed to set 24 hours prior to drilling the well borehole to the target depth, in accordance with Section 6.7.4 of the GQAPP. Intermediate well surface casings will be set at approximately 30 feet BLS. The intermediate wells installed through the surface casings will be constructed in the same manner as the shallow wells constructed with slotted well screens. All drilling and monitoring well construction will be conducted in accordance with sections 6.7.2 and 6.7.3 of the GQAPP. In addition, all Site 3 newly installed wells will be protected above surface grade with a steel surface casing and locking wellhead cover.

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

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

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

14.2.3.4 Groundvater Sampling

During Phase II at Site 3, groundwater samples will be collected from four existing on-site monitoring wells and 29 newly installed on-site monitoring wells (see Figure 14-6). Purging and sampling of each well will be conducted in accordance with sections 6.8.2 and 6.8.3 of the GQAPP, respectively. Equipment decontamination activities will be conducted in accordance with Section 6.10 of the GQAPP. The number and types of groundwater field QA/QC samples to be collected during Phase II were determined in accordance with Section 11.1 of the GQAPP.

The 33 groundwater samples will be analyzed for the parameters included on Table 14-2 (see also Table 14-5).

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

14.2.4 Eydrologic Assessment

The main objective of the Phase II hydrologic assessment is to further delineate the hydrogeologic character of the underlying aquifer at Site 3. Slug and short-term specific capacity tests, rather than a long-term aquifer pumping test, have been proposed for Phase II because the location and distribution of contaminants in the various zones of the underlying aquifer have not yet been precisely determined. The hydrologic assessment at Site 3 will include a wellhead elevation survey of all the newly installed permanent monitoring wells, static water level measurements in all the on-site wells and on-site and/or adjacent

surface water bodies, short-term specific capacity and/or slug tests on all the newly installed permanent wells, and measurement of stream flow at appropriate surface water locations.

All of the newly installed monitoring wells will be surveyed during the engineering survey (Section 14.2.5) and referenced to a USGS benchmark, in accordance with Section 6.7.6 of the GQAPP. In addition, staff gauges will be placed in all surface water bodies on site and will be surveyed relative to the same datum as the wells.

At Site 3, static water levels will be measured in all the existing and proposed on-site wells and in the on-site water bodies on at least four occasions: once during the sampling of the newly installed wells; once approximately two to four weeks after sampling to obtain an estimate of the short-term temporal variability in water levels; once during a low tidal phase: and once during a high tidal phase. The measurements taken during opposing tidal phases will be collected on the same day in order to accurately evaluate tidal influences on water level elevations at Site 3.

Limited aquifer testing will be conducted at Site 3 on all newly installed monitoring wells. This testing will consist primarily of performing short-term specific capacity tests on wells that are capable of sustaining a measurable yield. The specific capacity testing at Site 3 will be conducted during the development of the newly installed wells. The procedure for specific capacity testing involves measuring the initial static water level in the well and then withdrawing groundwater from the well at a constant rate for a designated period. The sustained water level during pumping is then noted, and the pump is turned off. The water level recovery in the well is then recorded continuously over time until the water level equilibrates to the initial static level. In addition to measuring drawdown in the developing well during the specific capacity testing, water levels will be measured in adjacent shallow and/or intermediate wells to determine the extent to which the respective, monitored zones may be hydraulically connected.

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

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

For all inland surface water bodies on Site 3 in which a flow is noted, velocity, discharge, and stream elevation data will be recorded at the same time that water levels are measured in the on-site monitoring wells. A rain gauge will be installed at or near the site and monitored regularly over the course of the fieldwork.

14.2.5 Engineering Survey

A comprehensive engineering survey will be conducted to accurately identify all site sampling locations and cultural and topographic features. All sampling and monitoring well locations will be identified both horizontally and vertically. In addition, any utilities, above-ground structures, and improvements (such as pavement) will be located. Any pertinent information found during the contaminant source survey (Section 14.2.2) will be incorporated into this survey. The survey also will delineate topographic variability using contour intervals of 2 feet.

All engineering survey information will be integrated with any existing computer-aided design (CAD) base maps so that all updated, site-related information can be precisely and efficiently added to the base map. The

development of a CAD base map will include the addition of previous data point locations (i.e., coordinates of latitude and longitude). The survey drawing will be produced in mylar and blueline copies; the CAD file for the drawing will be kept on diskette.

14.2.6 Report

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

14.3 Phase 111 —-Extent Delineation

Phase III tasks will be conducted, [if deemed necessary] based on the results of phases I and 11. Although the earlier phases are intended to identify and characterize areas and contaminants of primary concern as they extend laterally from Site 3, Phase III activities will be geared toward delineating the horizontal and vertical extents of contamination.

14.3.1 Biota Sampling

If deemed appropriate on the findings of phases I and 11, additional biota sampling may be conducted during Phase 111. If required, a separate biological sampling plan will be prepared. [However, base-vide biota sampling will be conducted as part of the investigation of OUs 15, 16, and 17.]

14.3.2 Soil Sampling

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

14.3.3 Shallow Monitoring Well Installation and Development

Additional shallow monitoring wells may be required to determine the horizontal extents of shallow groundvater contamination.

14.3.4 Intermediate and Deep Monitoring Well Installation and Development

The installation of additional monitoring wells into deeper zones of the aquifer may be required in order to assess horizontal and vertical hydraulic gradients, aquifer physical characteristics, and vertical

extent of contamination. The number of wells and their locations and depths are dependent upon the findings of phases I and 11.

14.3.5 Groundwater Sampling

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

14.3.6 Hydrologic Assessment

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

[14.3.7 Engineering Survey

A comprehensive engineering survey will be conducted to accurately identify all nev aite sampling locations. All sampling and monitoring well locations will be identified both horizontally and vertically. In addition, any improvements (such as pavement) will be located. All engineering *survey* information will be integrated with the existing Phase II computer-aided design *(CAD)* base maps so that all updated, siterelated information *can* be precisely and efficiently added to the base map. The survey drawing will be produced in mylar and blueline copies; the CAD file for the drawing will be kept on diskette.]

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

14.3.[8] 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 II, if any sampling is performed in Phase 11.

14.4 Phase IV--Extent Delineation

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

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

14.[5] Field Quality Assurance/Quality Control

14.[5].1 Documentation

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

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

Samples collected for laboratory analysis (both screening and non-screening) during all phases of fieldwork will require the preparation of field QA/QC samples as described in Section 11.1 of the GQAPP. The estimated numbers of required field QA/QC samples for phases I and II arc shown in tables 14-1 and 14-2.

14.[6] Decontamination and Vaste Management Procedures

14.[6].1 Decontamination Procedures

All equipment decontamination procedures for Site 3 will be performed in accordance with Section 6.10 of the GOAPP.

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

14.[6].2 Waste Management Procedures

[All investigation-derived waste handling will be performed in accordance vith Section 6.11 of the GQAPP and EPA's guidance for investigation-derived waste.] All water generated during monitoring well purging and development activities on Site 3 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 disposed of on site or 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 protective clothing and other disposable materials, will be containerized, labeled, and moved to a storage area on NAS Pensacola.

15. LABORATORY QUALITY ASSURANCE/QUALITY CONTROL

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

16. GROUNDWATER MODELING

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

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

E 6 E will use the two-dimensional analytical RANDOMWALK model (Prickett et al. 1981) to arrive at these estimates. E & E will calculate flow velocity field input data for the solute transport simulation from a simplified model based on Darcy's Law. E & E will utilize parameters including transmissivity, storativity, and hydraulic conductivity from the previous phases of fieldwork.

To obtain a prediction of plume extent without remediation, E & E will illustrate organic and inorganic simulations for the current time and for one, five, and 10 years into the future. Additional simulations will include different remedial pumping scenarios for both organic and inorganic contamination. E 6 E then will use information generated by these computer simulations for remedial alternative development. Other computer models that can be utilized to assess on-site groundwater conditions include: PLASM, a two-dimensional, finite-difference groundwater flow model; GWTRANS, a two-dimensional, finite-difference solute transport model; FEMWATER, a finite-element groundwater model; and FEMWASTE, a finite-element solute transport model.

17. TREATABILITY STUDY

As indicated in 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.

18. BASELINE RISK ASSESS —

As part of the Remedial Activities Investigation, a baseline risk assessment will be conducted to determine the level of effort required in the PS 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 concern to focus on in subsequent efforts in the risk assessment process. It may be useful at some of the NAS Pensacola sites to select "indicator chemicals" to represent the most toxic, persistent, and/or mobile substances among those identified that are most likely to contribute significantly to the overall risk posed by the site. Sometimes this indicator chemical can be selected to represent a "class" of chemicals (e.g., trichloroethylene to represent all volatiles).

18.2 Exposure Assessment

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

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

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

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

18.3 Toxicity Assessment

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

18.4 Risk Characterization

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

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

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

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- o Records of any environmental and/or health complaints regarding the sites; and
- o 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 (e.g., hydrogeologists, chemists, and risk assessors), the Navy, and the reviewing regulatory agencies (i.e., FDER and EPA) and that the goal of these tasks is to produce appropriate, sufficient, and high quality data to complete the baseline risk assessment.

19. FEASIBILITY STUDY

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

As part of the initial scoping activities of the FS, E 6 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 6 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 6 E will screen and develop applicable technologies for the remediation of any on-site contamination. In the process of screening applicable technologies, E 6 E will consider all ARARs, identify problems, and determine pathways of contamination using a receptor-oriented approach based on the threat to the public health, welfare, and the environment. In this summary, pathways will be outlined for each medium of concern. E & E then will identify applicable remedial technologies for each general response action such as contaminant removal, treatment, disposal, and so on. The identification of technologies will be based on technical selection criteria and E 6 E's engineering judgment.

19.2 Assessment of Applicable Remedial Technologies

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

19.3 Risk Assessment

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

19.4 Development and Evaluation of Remedial Action Alternatives

During the preceding task, remedial technologies will be assessed independently without considering 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 action alternatives, criteria including technical feasibility, environmental and public health, institutional impacts, and comparative costs will be considered.

19.5 Selection of Recommended Remedial Action Alternatives

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

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

19.6 Feasibility Study Report

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

20. REPORT

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

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

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

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

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

21. DOCUMENT REVISION

Periodic updating of all administrative documents (GOAPP, GSMP, GHSP, GPHP, and work plans) will be necessary due to changes in site conditions and/or program conditions or requirements. The schedules shown in the GPHP and GSHP indicate document revisions approximately every two months for the GOAPP, 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.

22. PROJECT MANAGEMENT

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

23. PROJECT SCHEDULE

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

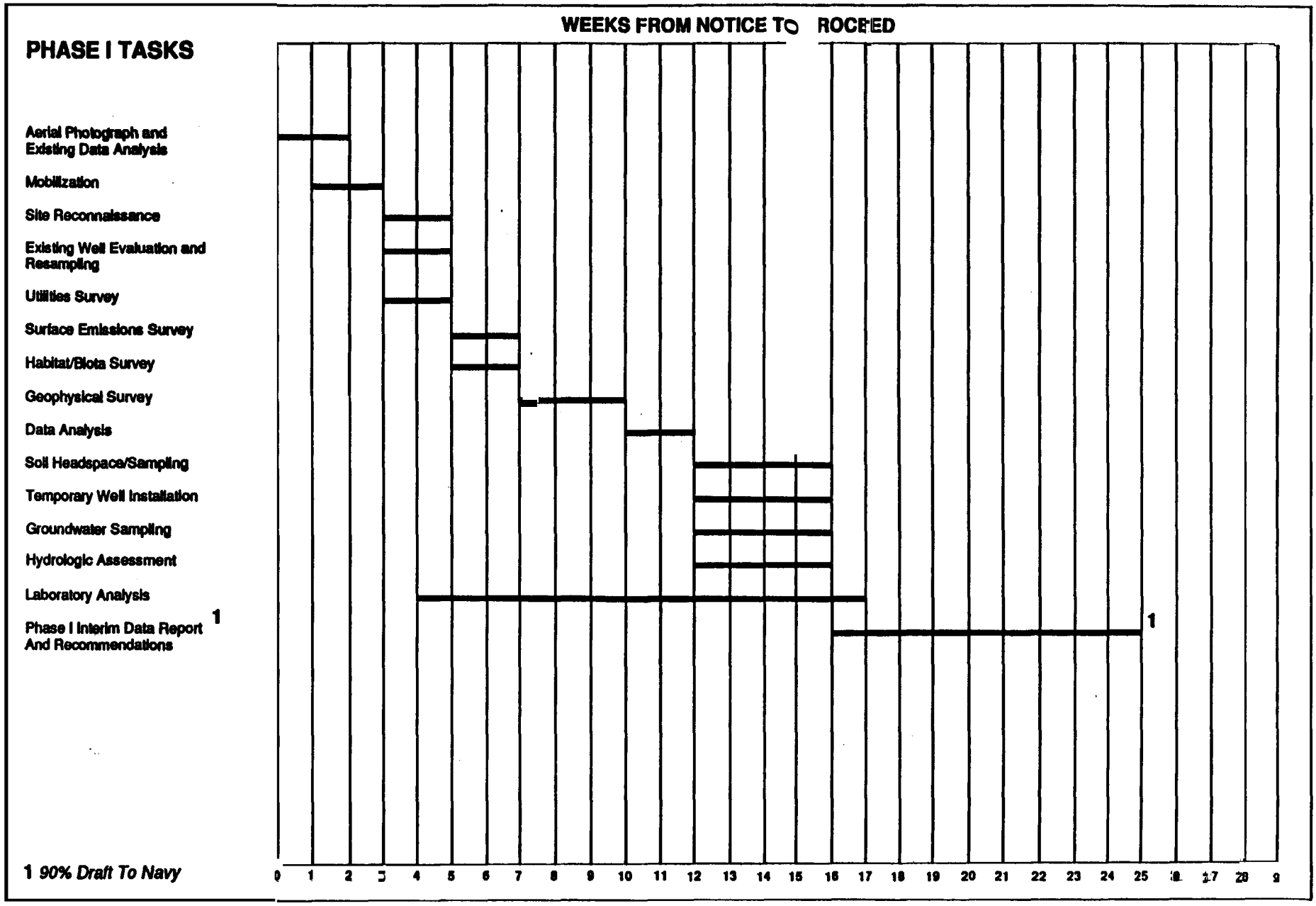

Figure 23-1 PHASE I PROJECT SCHEDULE -- GROUP J

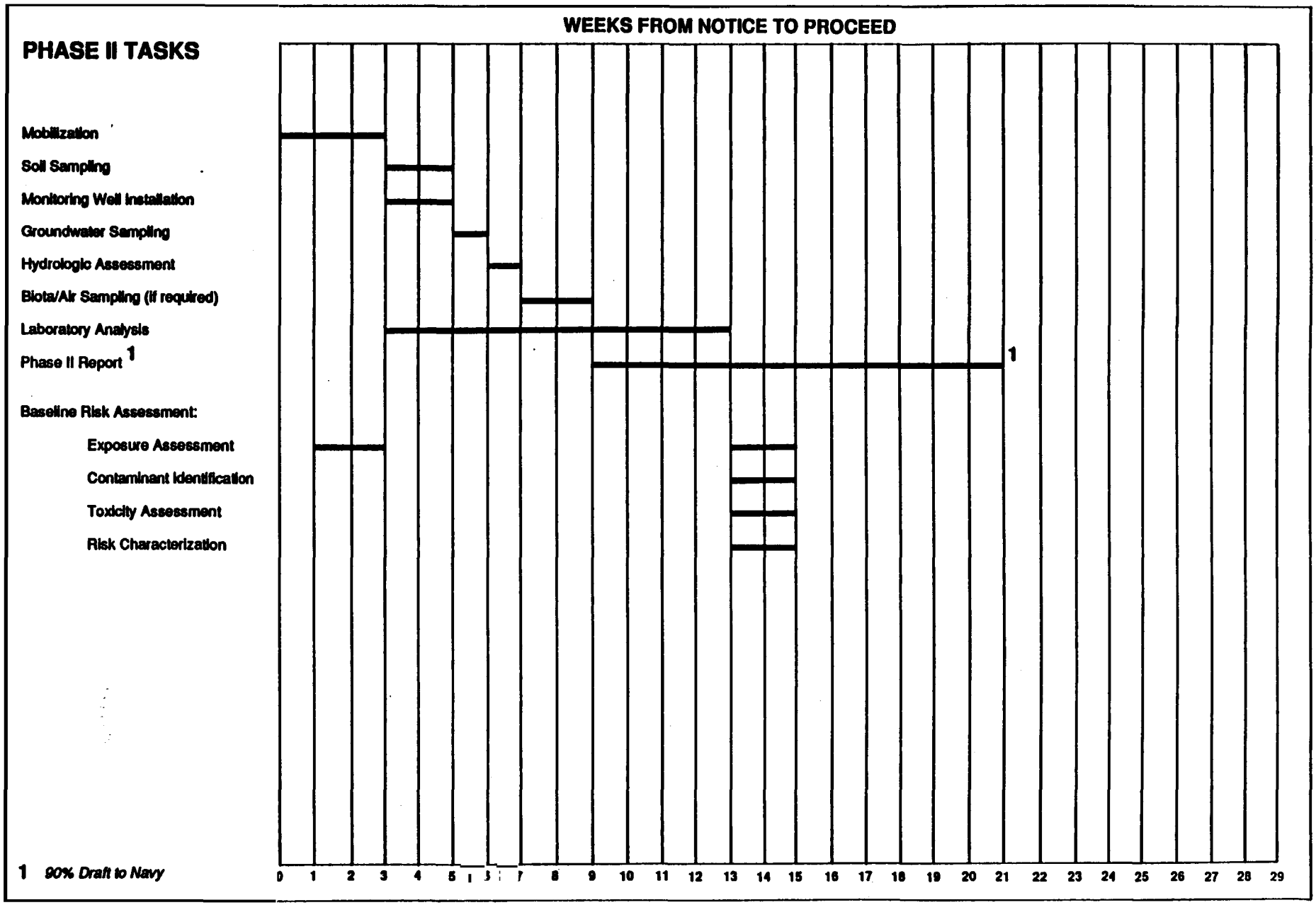

Figure 23-2 PHASE II PROJECT SCHEDULE -- GROUP J

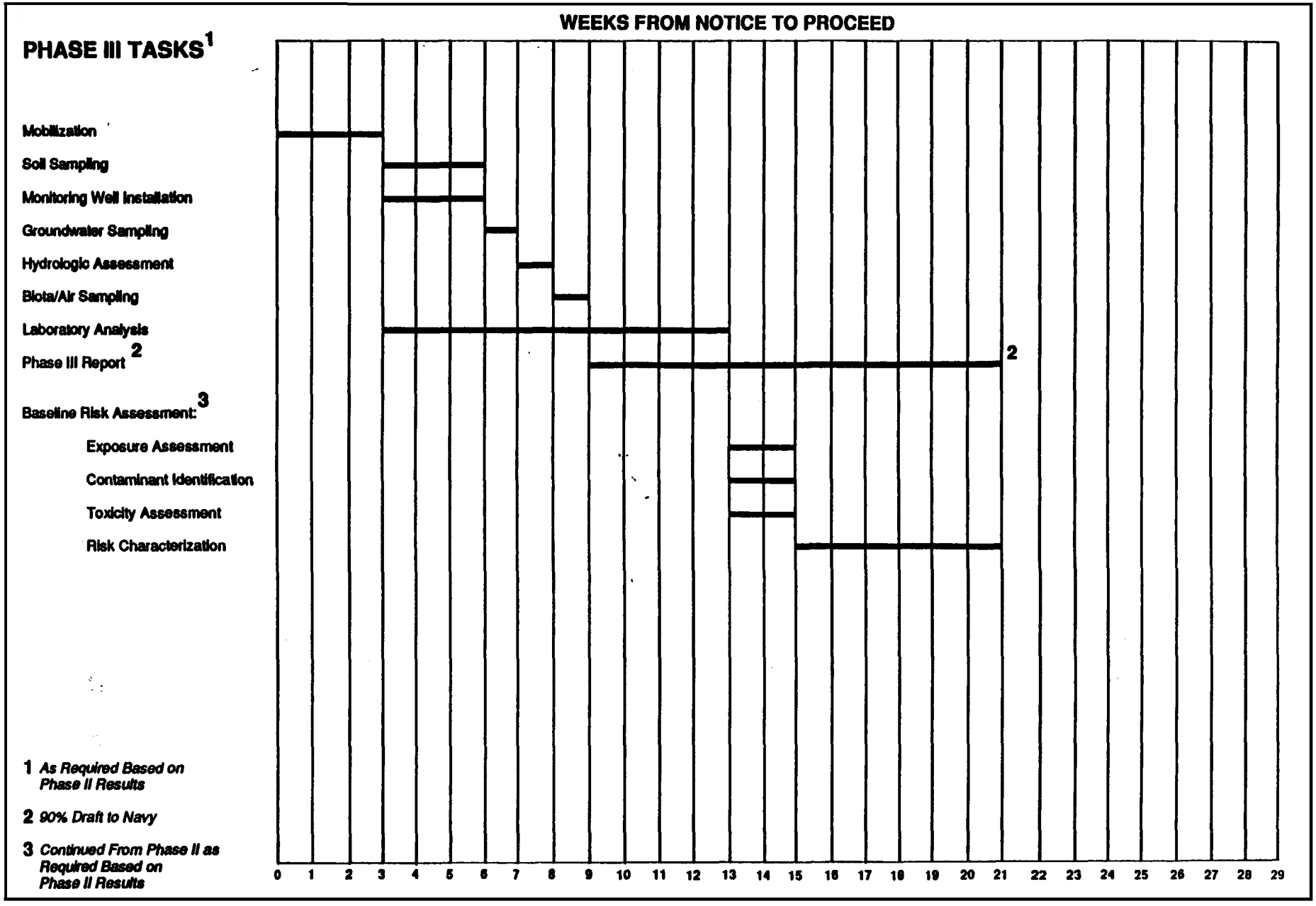

Figure 23-3 PHASE III PROJECT SCHEDULE – GROUP J

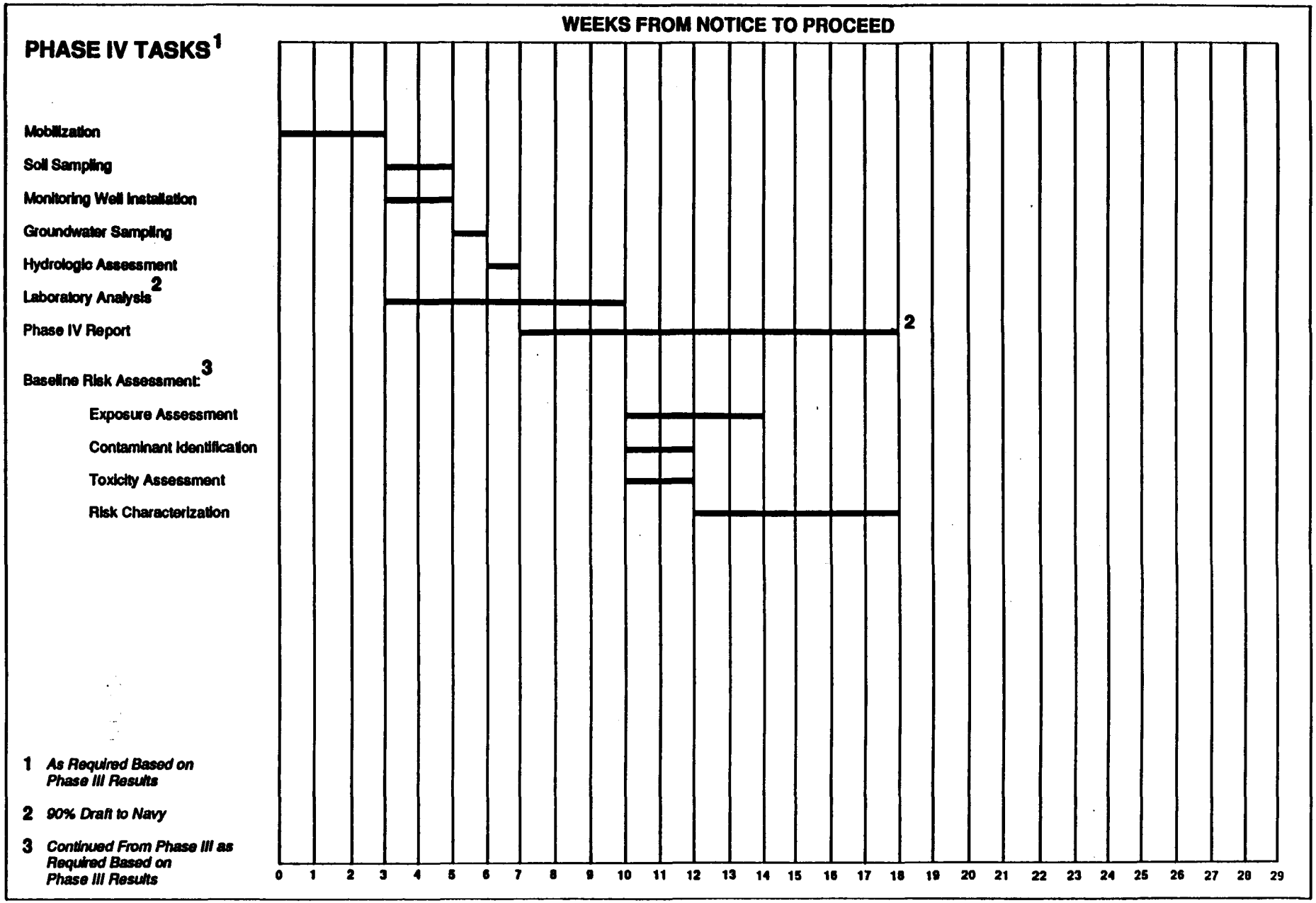

Figure 23-4 PHASE IV PROJECT SCHEDULE – GROUP J

24. REFERENCES

Barraclough, J. T. and 0. T. Marsh, 1962, Aquifers and Quality of Ground Water along the Gulf Coast of Western Florida: Florida Bureau of Geology, Report of Investigations 29.

Barraclough, J. T., 1967, Ground-water Features in Escambia and Santa Rosa Counties, Florida: Florida Geological Survey, Map Series No. 26.

Brooks, E. K., 1981, Physiographic Divisions of Florida: Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, Gainesville, Florida.

Carlisle, V. W., 1960, Soil Survey of Escambia County, Florida: Series 1955, No. 8, U.S. Department of Agriculture, Washington, D.C.

Coe, C. J., 1979, Geology of the Plio-Pleistocene Sediments in Escambia and Santa Rosa Counties, Florida: Florida State University, Master Thesis.

Coffin, J. E., 1982, Summary of Ground-water and Surface-water Data for City of Pensacola and Escambia County, Florida: U. S. Geological Survey Open-file Report 82-361.

Cooke, C. W., 1939, Scenery of Florida Interpreted by a Geologist: Florida Geological Survey, Bulletin No. 17.

_____, 1945, Geology of Florida: Florida Geological Survey, Bulletin No. 29.

Cooley, N. R., 1978, *An* Inventory of Estuarine Fauna in the Vicinity of Pensacola, Florida: Florida Marine Research Publications No. 31, Florida Department of Natural Resources, Marine Research Laboratory, St. Petersburg, Florida.

Driscoll, F.G., 1986, Groundwater and Wells, Second Edition: Johnson Division, St. Paul, Minnesota.

Ecology and Environment, Inc. (E 6 E), 1989, Generic Quality Assurance Project Plan, Contamination Assessments and Remedial Activities, Naval Air Station, Pensacola, Florida.

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

[_____, 1990, Generic Quality Assurance Project Plan, Contamination Assessments and Remedial Activities, Naval Air Station, Pensacola, Florida.]

[_____, 1991, Contamination Assessment/Remedial Activities Investigation Work Plan--Group A, Naval Air Station Pensacola, Pensacola, Florida.]

_____, 19[92]a, General Health and Safety Plan, Contamination Assessments and Remedial Activities, Naval Air Station, Pensacola, Florida.

_____, 19[92]b, General Project Management Plan, Contamination Assessments and Remedial Activities, Naval Air Station, Pensacola, Florida.

_____, 19[92c], General Site Management Plan, Contamination Assessments and Remedial Activities, Naval Air Station, Pensacola, Florida.

[_____, 1992d, Generic Quality Assurance Project Plan, Contamination Assessments and Remedial Activities, Naval Air Station, Pensacola, Florida.]

ERN-Southeast, Inc. (ERM), 1988, Draft Site Investigation Report NIRP Site 31 at Building 649, Naval Air Station, Pensacola, Florida.

Flood and Associates, Inc., 1978, South Escambia and Santa Rosa Counties, 201 Facilities Plan, City of Pensacola, Escambia and Santa Rosa Counties, City of Gulf Breeze, Santa Rosa Island Authority, and Santa Rosa County Beach Administration.

Florida Department of Environmental Regulation (FDER), 1988[a], Unpublished Harine Sediment Data from Pensacola Bay Sediment Study, 1985-1987, Tallahassee, Florida.

[_____, 1988b, Water Quality Standards, Classification of Groundwater Usage, Reclassification, Chapter 17.3-403, Florida Administrative Code.]

Florida Natural Areas Inventory (FNAI), 1988a, Special Plants and Animals List, Escambia County, Florida, Tallahassee, Florida.

_____, 1988b, Survey of Pensacola Naval Air Station and Outlying Bronson Field for Rare and Endangered Plants, Tallahassee, Florida.

Geraghty and Hiller, Inc. (G 6 M), 1984, Verification Study, Assessment of Potential Ground-water Pollution at Naval Air Station, Pensacola, Florida.

_____, 1986, Characterization Study, Assessment of Potential Ground-water Pollution at Naval Air Station, Pensacola, Florida.

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

_____, 1987a, Quarterly Report, Corrective Action Program, Wastewater Treatment Plant, NAS Pensacola, Florida.

_____, 1987b, Lithologic Logs, NAS Pensacola Wastewater Treatment Facility, Pensacola, Florida.

_____, 1988, Semi-Annual Report, Corrective-Action and Compliance-Monitoring Programs, Surge Pond Operation Permit, Wastewater Treatment Facility, Naval Air Station, Pensacola, Florida.

Green, K. Michael, 1989, personal communication, Navy Engineer in Charge.

Heil, D. C., 1989, personal communication, Florida Department of Natural Resources, Tallahassee, Florida.

Jacob, C. E. and H. H. Cooper Jr., 1940, Report on the Ground-water Resources of the Pensacola Area in Escambia County, Florida: U. S. Geological Survey, Open-file Report 400001.

Kennedy, L. R., 1982, Rainfall Summary for the Northwest Florida Water Management District: Water Resources Special Report 82-3.

Ketchen, H. G. and R. C. Staley, 1979, A Hydrographic Survey in Pensacola Bay, Florida State University, Department of Oceanography, Tallahassee, Florida.

Lohman, S. W., 1972, Ground-Water Hydraulics: U. S. Geological Survey Professional Paper 708, Washington, D.C.

Luckenbach, H. W., R. J. Diay, and L. C. Schaffner, 1988, Scientific Consultation and Analytical Services: Benthic Assessment Procedures. Project 5, Virginia Water Control Board, Gloucester Point, Virginia.

Marsh, O. T., 1966, Geology of Escambia and Santa Rosa Counties, Western Florida Panhandle: Florida Geological Survey, Bulletin 46, 140 p.

Husgrove, R. H., J. T. Barraclough, and O. T. Harsh, 1961, Interim Report on the Water Resources of Escambia and Santa Rosa Counties, Florida: Florida Geological Survey, Information Circular No. 30.

Musgrove, R. E., J. T. Barraclough, and R. G. Grantham, 1965, Water Resources of Escambia and Santa Rosa Counties, Florida: Florida Geological Survey, Report of Investigations No. *40*.

_____, 1966, Water Resources Records of Escambia and Santa Rosa Counties, Florida: Florida Geological Survey, Information Circular No. 50.

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

Naval Energy and Environmental Support Activity (NEESA), 1983, Initial Assessment Study of Naval Air Station, Pensacola, Florida. NEESA 13-015.

National Institute for Occupational Safety and Health Association (OSHA), 1985, Occupational Safety and Eealth Guidance Manual for Hazardous Waste Site Activities.

Northvest Florida Water Management District, 1981, Public Water Supply Systems in the Coastal Areas of Escambia, Santa Rosa, Bay, Okaloosa and Walton Counties: Northwest Florida Water Management District, Water Resources Special Report 81-3.

Pike, E., 1989, personal communication, NAS Pensacola Public Works Department.

Prickett, T. A., T. G. Naymik, and C. G. Lonnquist, 1981, A Random Walk Solute Transport Model for Selected Groundwater Quality Evaluations, Bulletin 654, Illinois State Water Survey, Champaign, Illinois.

Schropp, S. J., and E. L. Windom, 1988, A Guide to the Interpretation of Metals Concentrations in Estuarine Sediments, Florida Department of Environmental Regulation, Coastal Zone Management Section, Tallahassee, Florida.

Southeastern Geological Society (SEGS), 1986, Florida Eydrogeologic Units: Southeastern Geological Society Ad Hoc Committee on Florida Eydrostratigraphic Unit Definition (SEGS), Florida Geologic Survey, Special Publication No. 28.

Trapp, E, Jr., 1972, Availability of Ground Water for Public-Water Supply in the Pensacola Area, Florida - Interim Report, June 1971: U. S. Geological Survey, Open-File Report FL72002.

_____, 1973, Availability of Ground Water for Public-Water Supply in Central and Southern Escambia County, Florida - Interim Report, July 1973; U. S. Geological Survey, Open-File Report FL 72029.

_____, 1975, Eydrology of the Sand-and-Gravel Aquifer in Central and Southern Escambia County, Florida - Preliminary Report - November 1973: U. S. Geological Survey, Open-File Report FL74027.

_____, 1978, Preliminary Hydrologic Budget of the Sand-and-Gravel Aquifer under Unstressed Conditions, with a Section on Vater Quality Monitoring, Pensacola, Florida: U. S. Geological Survey, Water-Resources Investigations 77-96.

U.S. Environmental Protection Agency (EPA), 1984, Standard Operating Safety Guidelines.

_____, 1985a, Guidance on Remedial Investigations under CERCLA, EPA, OSWER, HWERL; EPA report #540/6-85/002; NTIS ref #PB-85-268616; OSWER Directive 9355.0-06B, U.S. EPA, Cincinnati, Ohio.

_____, 1985b, Guidance on Feasibility Studies under CERCLA, EPA, OSWER, OWPE, EPA report #540/G-85/003; NTIS ref #PB-85-238-590; OSWER Directive 9355.0-05c, U.S. EPA, Washington, D.C.

_____, 1987a, Data Quality Objectives for Remedial Response Activities, OSWER Directive 9335.0-7B, U.S. EPA, Washington, D.C.

_____, 1987b, Compendium of Superfund Field Operations Methods, OSWER Directive 9355.0-14, EPA/540/P-87/00/a.

_____, 1988a, CERCLA Compliance with Other Laws Manual, Draft, OSWER Directive 9234.1-01, U.S. EPA, Washington, D.C.

_____, 1988b, Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA, Draft, OSWER Directive 9355.3-01 OERR # 68-01-7090 and 68-W8-0098, U.S. EPA, Washington, D.C.

U.S. Fish and Wildlife Service, 1987, Long Range Fish and Wildlife Section, Naval Air Station Pensacola and Outlying Field Bronson, Pensacola, Florida, USFWS Field Office, Panama City, Florida.

U.S. Geological Survey (USGS), 1970a, 7 1/2 Minute Topographic Map, Fort Barrancas, Florida Quadrangle.

_____, 1970b, 7 1/2 Minute Topographic Map, West Pensacola, Florida Quadrangle, Photorevised 1987.

U.S. Navy, 1986, U.S. Navy Gulf Coast Strategic Homeporting Environmental Impact Statement, Appendix IV, Pensacola, Florida. Southern Division, Naval Facilities Engineering Command, Charleston, South Carolina.

_____, 1987, General Development Map Nos. 1276829 to 1276839, U.S. Naval Air Station, Pensacola, Florida, Southern Division Naval Facilities Engineering Command, Charleston, South Carolina.

Wagner, J. R., 1982, Hydrogeology of the Northwest Florida Water Management District, in Ground Water in Florida - Proceedings of the First Annual Symposium on Florida Hydrogeology: Northwest Florida Water Management District, Public Information Bulletin 82-2.

_____, 1989, Hydrogeologic Framework of the Northwest Florida Water Management District.

Wagner, J. R., T. W. Allen, L. A. Clemens, and J. B. Dalton, 1984, Ambient Ground Water Honitoring Program - Phase 1: Northwest Florida Water Management District, DER Contract Number WM65.

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

Walton, W. C., 1970, Ground Water Resource Evaluation: McGraw-Hill Book Co., New York.

Water and Air Research, Inc. (WAR), 1986, Report of Collection and Analyses of Sediment, Water, and Elutriate Samples for Navy Gulf Coast Strategic Homeporting Project, Pensacola, Florida.

Wilkins, K. T., J. R. Wagner, and T. W. Allen, 1985, Hydrogeologic Data for the Sand-and-Gravel Aquifer in Southern Escambia County, Florida: Northwest Florida Water Management District, Technical File Report 85-2.

Wolfe, S. E., J. A. Reidenauer, and D. B. Means, 1988, An Ecological Characterization of the Florida Panhandle, U.S. Fish and Wildlife Service Biological Report 88(12); Minerals Management Service OCS Study\MMS 88-0063.

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

APPENDIX A

SITE-SPECIFIC SAFETY PLAN

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

ecology and environment, inc.

SITE SAFETY PLAN

Version 988

A. GENERAL INFORMATION

Project Title: Site 3-The Crash Crow Training Area Project No.: UH8000

TDD/Pan No.:

Project Manager: John Barksdale Project Dir.: Gerry Gallagher

Location(s): Crash Crow Training Area-Open area of land along tho southwestern border of Forrest Sherman Field

Prepared by: Dan Foss Date Proparod: 3/24/92

Approval by: Sybil Newchurch Data Approved: 3/26/92

Site Safety Officer Review: Date Reviewed:

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

Proposed Date of Field Activities: December 1992

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

Documentation/Summary:

Ovorall Chemical Hazard:	Serious	[ ]	Moderate	[1
	LOW	[X]	Unknown	[ ]
Ovorall Physical Hazard	Serious	[ ]	Moderate	[X]
	Low	[ ]	Unknown	[1

B. SITE/WASTE CHARACTERISTICS

Waste Type(s):

Liquid	X]	Solid	[X 1	Sludge	[ ]	Gas/Vapor	[X]

Characteristic s):

Flammable/ Ignitable	X]	Volatile	[X]	Corrosive	[ ]	Acutely Toxic	[ ]
Explosive	[X 1	Reactive	[ ]	Carcinogen	[X]	Radioactive*	[1

Other:

Physical Hazards:

Overhead	[X]	Confined* Space	[ ]	Below Grade	[ ]	Trip/Fall	[X]
Puncture	[ ]	Burn	[ ]	Cut	[ ]	Splash	[X]
Noise	[X]	Other:	Aircraft and vehicular traffic using Forrest Sherman Field, heat stress, cold stress				

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

Site History/Description and Unusual Features (see Sampling Plan for detailed description): Since 1955 site 3 was used to train firefighters. During training approximately 30-50 gallons of JP-4, JP-5, AVGAS or lube oil was poured into unlined pits and ignited to simulate aircraft crash conditions. An additional 200 gallons of fuel per week were disposed of on-site. Phase I soil borings contained low to elevated levels of TRPHs, VOCs, PAHs, and phonolr. Groundwater samples collected from temporary monitoring wells contained low to elevated levels of metals TRPHs, VOCs, PAHs, and phonolr.

Locations of Chemicals/Wastes: Subrurfaco

Estimated Volume of Chemicals/Wastes: Unknown

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) Surface Water and Sediment Sampling - Splash, personal contamination, slips, trips, falls, aircraft

2) Soil sampling - Personal contamination, overhead, noiao, aircraft

3) Monitoring well inatallation - Overhead, noise, aircraft

4) Groundwater aampling - splash, personal contamination, noise, aircraft

5) Docontamination procedures - Solvents, acid solutions

6) Physical surveys - Slips, trips, falls, noiao, aircraft

7) Hydrologic assessment - Splash, personal contamination, noise, aircraft

Chemical Hazard Evaluation:

Compound	PEL/TWA	Route of Exposure	Acute Symptoms	Odor Threshold	Odor Description
Hydrochloric Acid	5 ppm	Inh, Inq, Con.	Corroaivo	N/A	Acrid
Nitric Acid	2 ppm	Inh, Ing, Con.	Corroaivo	0.3 - 1 ppm	Acrid
Sulfuric Acid	1 mg/m^3	Inh, Ing, con.	Corrosive	N/A	Odorless
Sodium Hydroxide	2 mg/m^3	Inh, Ing, Con.	Corroaivo	N/A	Odorless
Isopropyl Alcohol	440 ppm	Inh, Ing, Con.	Drowsiness, Head	7.5 - 200 ppm	Rubbing Alcohol
Methylene Chloride	500 ppm	Inh, Ing, Con.	Vertigo,Chest Pain	214 ppm	Sweetish
Benzene	1 ppm	Inh, Ing, Con.	Naus, Dizzy,Vomit	Odorless	Odorless
Toluene	200 ppm	Inh, Ing, Con.	Fatigue, Head	0.2 ppm	Aromatic
Ethylbenzene	100 ppm	Inh,Ing,Con,Abs	Head,Vomit,Burns	0.1 ppm	Aromatic
Xylene	100 ppm	Inh,Ing,Con,Abs	Head,Naus,Cough	0.5 ppm	Aromatic
Lead	0.05 mg/m^3	Inh, Ing, Con.	Vomit, Diarrhea	N/A	N/A
Chromium	1 mg/m^3	Inh, Con.	Cough,Wheez,Head	N/A	N/A
Cadmium	0.2 mg/m^3	Inh, Con.	Head, Cough,Vomit	N/A	N/A
Diesel Fuel (JP5)	-	Inh, Ing, Con.	Vomit, Diarrhea	.082 ppm	Petroleum
Gasoline	300 ppm	Inh, Ing, Con.	Dizziness, Uncon.	5 ppm	Aromatic

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

D. SITE SAFETY WORK PLAN

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

Perimeter identified? [yes] Site secured? [yes]

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

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

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

	A	B	C	D
Task 1				X
Task 2				X
Task 3				X
Task 4				X
Task 5				X
Task 6				X
Task 7				X

(Expand if necessary)

Modifications: Modified level D with tyvok, neoprene gloves and boots, safety glasses, APR available when upgrade to level C is necessary based on OVA readings.

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

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

Air Monitoring (daily calibration unless otherwise noted):

Contaminant of Interest	Type of Sample (area, personal)	Monitoring Equipment	Frequency of Sampling
Volatile Organics	Aroa	OVA	Continuous
Radiation	Area	Mini-rad	Continuous
Explosive Gases	Aroa	O_2/Explosimeter	Continuous

(Expand if necessary)

Docontarination Solutions and Procedures for Equipment, Sampling Gear, etc.:

Alconox + tap water wash, tap wator rinao, two isopropanol rinses, organic-fro. water rinao, and air dry.

Teflon implements used for tho collection of samples for metals analyses will have a 13% nitric acid solution rinse after the tap water rinse followed by another tap water rinao, two isopropanol rinses, and air dry.

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

Decon Solution Monitoring Procoduros, if Applicable: Decontamination activities will bo performed in e well-ventilated area upwind of tho sampling zone.

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

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

Work Limitations (time of day, weather conditions, etc.) and Heat/Cold Stress Requirements: All fimldwork activities will be performed during daylight hours. Team members will break as needed to prevent 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 fieldwork waste materials will bo double bagged, drummed, labeled, and transported to designated location for final disposal by the Navy.

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

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

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

E. EMERGENCY INFORMATION

(Use supplemental sheets, if necessary)

LOCAL RESOURCES

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

Ambulance: On base: (904) 452-4130: Off base: 911

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

Poison Control Center:

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

Fire Department: 911

Airport:

U.S. Coast Guard: Emergency: (904) 453-8178; General Information: (904) 453-8202

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

Fed. Express: (800) 238-5355

Client Contact: U.S. Navy Southern Division, Engineer-In-Charge, Suzanne D. Sanborn: (003) 743-OS74

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

SITE RESOURCES

Site Emergency Evacuation Alarm Method: N/A

Water Supply Source: On site

Telephone Location, Number: To bo dotorrinod on site

Cellular Phone, if available: To bo dotorrinod on site

Radio:

Other: On-site warehouse number to bo dotorrinod

EMERGENCY CONTACTS

1. Dr. Raymond Harbison (Univ. of Florida) ..... (501) 221-0465 or (904) 462-3277, 3281
   Alachua, Florida (501) 370-0263 (24 hours)

2. Ecology and Environment, Inc., Safety Director
   Paul Jonmaire ..... (716) 684-0060 (office)
   (716) 655-1260 (homo)

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

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

MEDTOX HOTLINE

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

   What to report:

   - State: "this is an emergency."
   - Your name, region, and site.
   - Telephone number to reach 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 the information given to the 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 - homo # (716) 688-0004

EMERGENCY ROUTES

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

Directions to hospital (include map) from Site 3

NAS Dispensary - Follow San Carlos Road (turns into Radford Blvd.) to Duncan Road. Turn loft onto Duncan Road and follow it north to tho intersection with Turnor Stroot. Turn right on Turner Stroot. The NAS Dispensary is located on Turnor Stroot in Building 3600.

Baptist Hospital - Take Duncan Road (Navy Blvd.) north to exit tho base. Navy Blvd. becomes HWY 98 and curves to tho east. Follow Navy Blvd./Hwy. 98 east approx. 3 mi to Pace Blvd. Turn loft (north) on Pace Blvd. and proceed approx. 1 mi to Cervantes St. (Hwy. 90). Turn right on Cervantes/Hwy. 90 and follow this road for about 8 block8 and turn loft (north) onto E street. Tho hospital is about 6 blocks north on tho loft.

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

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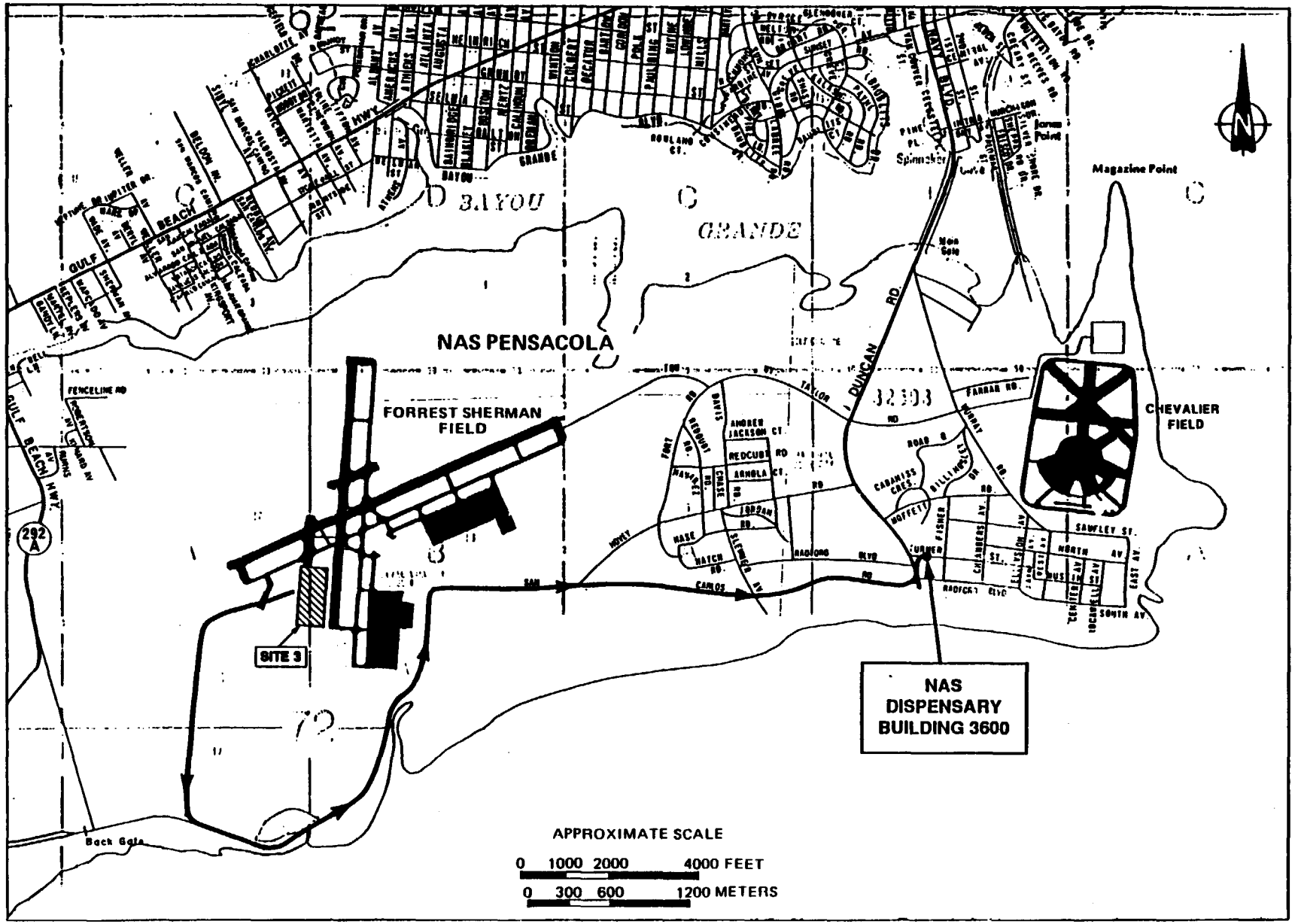
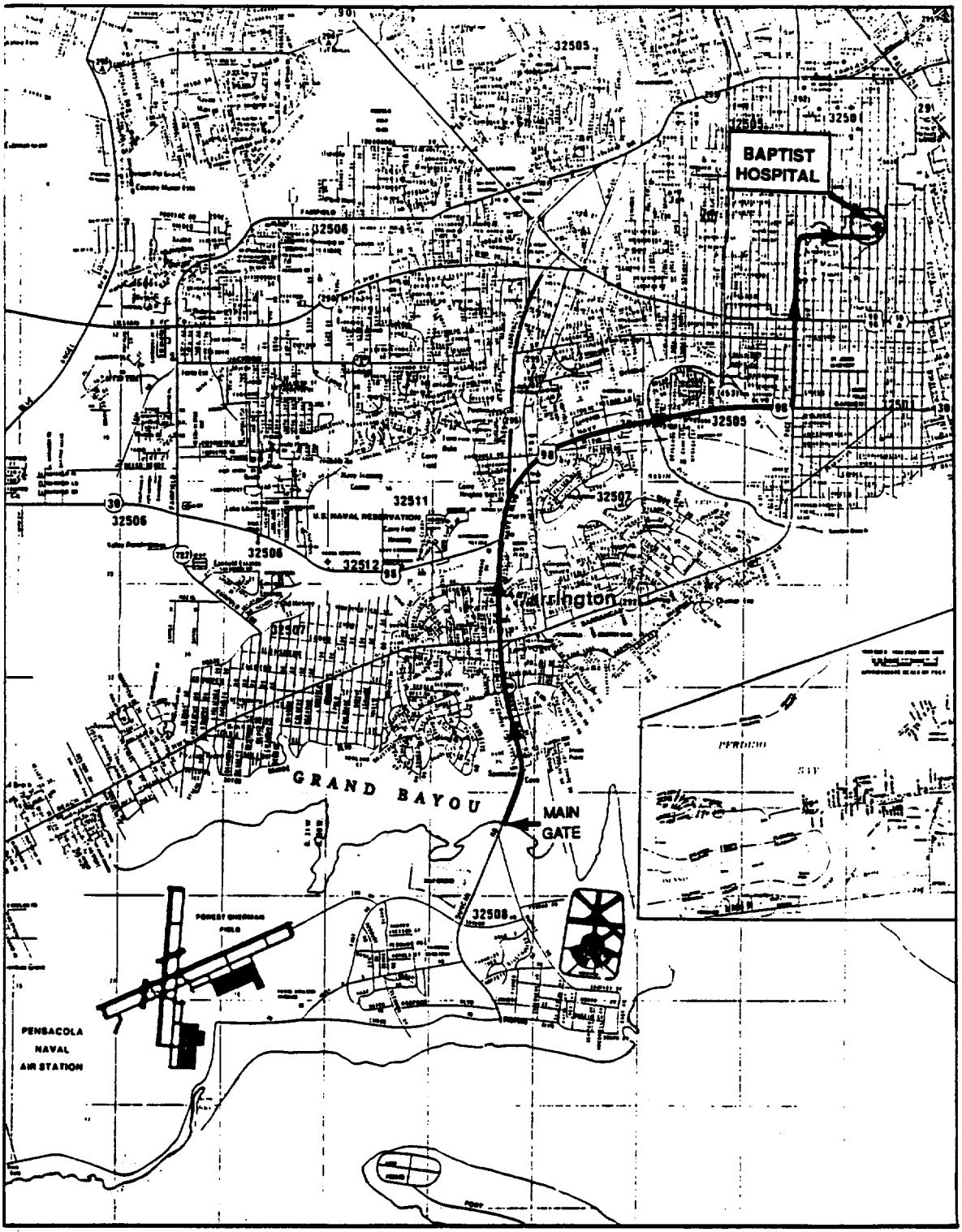


Figure A-1 LOCATION OF NAS DISPENSARY



SOURCE: Ecology and Environment, Inc., 1992

APPROXIMATE SCALE IN FEET

0 2000 4000 6000 8000

Figure A-2 LOCATION OF BAPTIST HOSPITAL

F. EQUIPMENT CHECKLIST

PROTECTIVE GEAR

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

INSTRUMENTATION	lo.
OVA	
THERMAL DESORDCR	
O2/EXPLOSIMETER W/CAL. KIT	X
PHOTOVAC TIP	
HNu (Probe 10.2 eV _____)	X
MAGNETOMETER	
PIPE LOCATOR	
WEATHER STATION	
DRAEGER PUMP, TUBES _____	
BRUNTON COMPASS	
MONITOX CYANIDE	
HEAT STRESS MONITOR	
NOISE EQUIPMENT _____	
PERSONAL SAMPLING PUMPS	
RADIATION EQUIPMENT	
DOCUMENTATION FORMS	
PORTABLE RATEMETER	
SCALER/RATEMETER	
NaI Prok	
ZnS Prok	
GM Pancake Probe	
GM Side Window Probe	
MICRO R METER	
ION CHAMBER	
ALERT DOSIMETER	
POCKET DOSIMETER	
MINI RAD	X
FIRST AID EQUIPMENT	
FIRST AID KIT	X
OXYGEN ADMINISTRATOR	
STRETCHER	
PORTABLE EYE WASH	X
BLOOD PRESSURE MONITOR	
FIRE EXTINGUISHER	X

DECON EQUIPMENT	No.
WASH TUBS	X
BUCKETS	X
SCRUB BRUSHES	X
PRESSURIZED SPRAYER	X
DETERGENT (Type _____)	
SOLVENT (Type _____)	
PWTIC SHEETIW	X
TARPS AND POLES	
TRASH BAGS	X
TRASH CANS	
MASKING TAPE	X
DUCT TAPE	X
PAPER TOWELS	X
FACE MWK	
FACE MWK SANITIZER	
FOLDING CHAIRS	
STEP LADDERS	
DISTILLED WATER	X
SAMPLING EQUIPMENT	
8 OZ. BOTTLES	X
HALF-GALLON BOTTLES	X
VOA BOTTLES	X
BAILER CORD	X
HAND BAILERS	X
THIEVING RODS WITH BULBS	
spoons	X
KNIVES	
FILTER PAPER	
PERSONAL SAMPLING PUMP SUPPLIES	

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

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ON-SITE SAFETY MEETING

Project _____ TDD/Pan _____

Date _____ Time _____ Job No. _____

Address _____

Specific Location _____

Type of Work _____

_____

SAFETY TOPICS PRESENTED

Protective Clothing/Equipment _____

_____

Chemical Hazards _____

_____

Radiation Hazards _____

_____

Physical Hazards _____

_____

Emergency Procedures _____

_____

Hospital/Clinic _____ Telephone _____

Hospital Address _____

Special Equipment _____

Other _____

Checklist

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

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

Name Printed	Signature

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

_____ (Site Safety Coordinator) _____ (Team Leader)

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ecology and environment, inc.	
Title: SOP-HEALTH AND SAFETY ON DRILLING RIG OPERATIONS	
Category: H 6 S, Training 2.7	Revised: JANUARY 1990
	Approved: H. Van Cleave

STANDARD OPERATING PROCEDURES
FOR
HEALTH AND SAFETY ON
DRILLING RIG OPERATIONS

REVISED: JANUARY 1990

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1 INTRODUCTION

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

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

2 OPERATION OF DRILLING EQUIPMENT BY E & E

2.1 RESPONSIBILITIES AND AUTHORITY OF SITE SAFETY OFFICER

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

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

2.2 RESPONSIBILITIES AND AUTHORITY OF E & E DRILLER

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

- Kill svitches tripped and operation verified;
- Chain guards in place:
- Belt guards in place:
- Belts set to proper tension (visual);
- Loose belts;
- Presence of any fluid leaks:
- Any damaged hoses, cables, ropes, chains;
- Control panel is clean:
- Control lever functions labeled;
- Pressure relief valves function:
- Cathead free of rust and grease;
- Cathead grooves less than 1/8 inch in depth;
- All tools in proper working order;
- Rig leveled and stabilized;
- Check for weld cracks in mast; and
- Safety hooks operational.

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

During the drilling operations, the following safety practices will be in effect:

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

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The Driller has authority to direct personnel within the area while drilling operations are in progress. Access to the hazardous area around the auger and borehole is restricted by the "super exclusion zone" delineated by the 4- by 8-foot sheet of plyvood centered over the borehole before drilling. A large hole cut in the plyvood allovs penetration of the augers. No personnel are allowed in this zone pad at any time vhile drilling is actively undervay.

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

2.3 RESPONSIBILITY AND AUTHORITY OF OTHER E 6 E PERSONNEL

E 6 E personnel vorking at a drilling site must act as support to the Drilling Team by providing any necessary support functions: however, it is important that personnel are careful not to interfere vith the drilling process. Personnel are restricted from approaching the "super exclusion zone" while drilling is undervay. If an E 6 E crew member recognizes an unsafe condition in the work area or on the rig, he should bring it to the attention of the sso and Team Leader, if it is not resolved in a timely manner. If conditions are still deemed to be hazardous, team members have the option to contact their Regional Safety Coordinator (RSC) or Corporate Eealth and Safety in Buffalo.

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

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

3 TRAINING REQUIREMENTS FOR SITE PERSONNEL

3.1 E 6 E SITE *SAFETY* OFFICER

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

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3.2 E 6 E DRILLER AND HELPER

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

3.3 OTHER E & E DRILLING PERSONNEL

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

3.4 SUBCONTRACT DRILLER AND OTHER SUBCONTRACT DRILLING PERSONNEL

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

4 SUPERVISION OF SUBCONTRACT DRILLERS

4.1 RESPONSIBILITIES AND AUTHORITY OF SITE SAFETY OFFICER

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

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

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

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

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The SSO's monitoring duties include calibration and setup of the appropriate monitoring devices, as specified in the SSP. At a minimum, this generally includes an O_2/explosimeter and realtime organic vapor monitoring capabilities (e.g., HNU, OVA). Noise monitoring, like heat stress monitoring, is employed where appropriate. If the SSO believes additional monitoring devices beyond the directive of the SSP should be employed (e.g., Rad Mini, Hini Ram), it is his or her responsibility to obtain this equipment with the cooperation of the RSC or the Corporate Health and Safety Group, from the nearest E 6 E office.

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

E 6 E personnel are forbidden from entering the "super exclusion zone" around the borehole while the rig is actively drilling. The SSO must not attempt to take air readings in or around the auger while in use, nor are cutting samples taken while the auger is in motion. An O_2/explosimeter should be set up if possible for unmanned (alarmed) operations at the rig using an extension hose to continuously draw samples from the borehole area during drilling operations.

The SSO has the ultimate authority over the Subcontractor with regard to vhethcr vork practices meet the requirements of the SSP. Shutdown of vork or restriction of personnel are options available to the SSO. The SSO should hold informal site safety briefings at the start of both field vork and daily vork shifts throughout the course of the project. Although E 6 E contractually requires Subcontractors to provide properly trained and outfitted staff, the SSO should verify verbally at the start-up meeting that the field staff has necessary respiratory approval and OSEA-mandated training, especially on hazardous waste sites. Site safety briefing topics, as well as attendees, will be recorded in the site safety log.

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

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

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

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

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

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

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

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

4.2 RESPONSIBILITIES AND AUTHORITY OF OTHER E & E PERSONNEL

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

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

B 6 E personnel are forbidden from approaching augers during drilling. Activities at the borehole, such as sampling, require that equipment be stopped.

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5.1.1 General Drilling Site Safety Checklist

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

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

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

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

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

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

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

5.1.2 Rotary and Core Drilling

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

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

  - Rods and bit should be open and clear.

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

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

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

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

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

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

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

- Drill rods should not be braked while being lowered into the hole with chuck jaws.

- Drill rods should not be held or lowered into the hole with pipe wrenches.

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

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

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

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

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

5.1.3 Cathead Usage

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

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

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

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

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

- Never wrap the rope from the cathead (or any other rope, wire rope, or cable on the drill rig) around a hand, vrist, arm, foot, ankle, leg, or any other part of the body.

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

- Do not use more rope wraps than are required to hoist a load.

- Do not leave a cathead unattended with the rope wrapped on the drum.

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

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

- The cathead Operator must be able to operate the cathead standing on a level surface with sound, firm-footing conditions, without distraction or disturbance.

5.1.4 Continuous-Flight or Hollow-Stem Augers

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

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

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

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

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

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

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in vire diameter, fatigue, corrosion, damage from heat, improper weaving, jamming, crushing, bird caging, kinking, core protrusion, and damage to lifting hardware. All related equipment must conform to standards as established by the American Iron and Steel Institute Wire Rope Users Hanual. Wire ropes should be replaced when insoection indicates excessive damage according to the Wire Rope-Users Hanual. All vire ropes which have not been used for a period of 1 month or more should be thoroughly inspected before being returned to service.

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

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

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

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

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

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

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

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

- Minimize shock loading on a wire rope--apply loads smoothly and ateadily.

- Avoid sudden loading in cold weather.

- Never use frozen ropes.

- Protect wire rope from sharp corners or edges.

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

- Clutches and brakes on hoists should be periodically tested.

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

- Always wear gloves when handling wire rope.

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

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

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6 REFERENCES

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

Diedrich D-50 Safety Manual.

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

Wire Rope Users Manual, American Iron and Steel Institute.

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Title: SOP-Beat Stress Monitoring	
Category: E 6 S, TRAINING 2.8	Revised: JANUARY 1990
	Approved: H. Van Cleave

STANDARD OPERATING PROCEDURE
FOR
EMERGENCIES DUE TO HEAT AND HEAT STRESS HONITORING

REVISED JANUARY *1990*

Prepared by

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1 INTRODUCTION

Field operations present a variety of hazards to the employee. During hot days or vhen vearing protective clothing, heat stress can be experienced and, if not remedied, can threaten the health or life of field personnel. Therefore, it is important that all employees are able to recognize the symptoms of heat stress as well as perform first aid without delay.

2 SCOPE

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

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

3 OBJECTIVES

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

4 EFFECTS OF HEAT

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

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

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

4.1 BEAT CRAMPS

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

4.1.1 Symptoms

The symptoms of heat cramps include the folloving:

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

4.1.2 Emergency Care

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

4.2 HEAT EXHAUSTION

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

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

4.2.1 Symptoms

The symptoms of heat exhaustion are as follovs:

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

4.2.2 Emergency Care

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

4.3 HEAT STROKE

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

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4.3.1 Symptoms

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

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

4.3.2 Emergency Care

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

5 PREVENTION OF HEAT STRESS

Please note that in the case of heat cramps or heat exhaustion, Gatorade or its equivalent is suggested as part of the treatment regime. The reason for this type of liquid refreshment is that such beverages will return much-needed electrolytes to the body's system. Vithout these electrolytes, body systems cannot function properly, and the represented health hazard will be increased. Therefore, when personnel are vorking in situations vhere the ambient temperatures and humidity are high, and especially in situations vhera levels A, B, and C of protective apparel are required, the SSO must follov the procedures listed belov:

- Ensure that frequent breaks are scheduled so that overheating is less likely to occur:
- 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); and
- Cooling vests should be worn if available.
- NOTE: Taking salt tablets is NOT currently recommended.

5.1 GUIDELINES FOR USE OF PROTECTIVE CLOTHING

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

Ambient Temperature (°F)	Maximum Wearing Time per Excursion (min)
Above 90	1
85 to 90	30
80 to 85	60
70 to 80	90
60 to 70	120
50 to 60	180

5.2 HEARTRATE MONITORING

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

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

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

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5.3 HONITORING PERSONNEL BODY TEHPERATURE AND BLOOD PRESSURE

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

5.4 HONITORING THE WORK AREA FOR EEAT STRESS CONDITIONS

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

6 DECONTAMINATION

As in other medical emergencies, decontamination should proceed as normally as possible without contributing unduly to the victim's stress or injury. At a minimum, the protective clothing should be removed as he or she is taken from the hazardous zone. The "buddy system" is always in effect and backup personnel should be available at the decontamination station to either suit up and assist in extraction or to help decontaminate and undress the victim. If other serious injuries or more life-threatening conditions exist, and the victim cannot be disrobed or decontaminated completely, the victim (or contaminated portions) should be wrapped in plastic (or other protective material) for his or her own safety as well as the safety of ambulance and hospital personnel. Carefully avoid action that vould result in the victim's being further overheated.

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MALLINCKRODT

Material Safety Data Sheet

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Emergency Telephone Number: 314-982-5000

HYDROCHLORIC ACID, 37%

PRODUCT IDENTIFICATION:

Synonym **Muriatic acid**

Formula CAS No.: 7647-01-0

Molecular Weight: 36.46 (HCl)

Chemical **Formula: HCl**

Hazardous Ingredients: **Hydrogen** chloride

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.
Avoid breathing mist.
Use only **with** adequate ventilation.
Wash thoroughly after handling.
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 minutes. **If swallowed, DO** NOT INDUCE VOMITING!
Give large quantities of water or milk **if** available. Never **give** anything by **mouth** to an **unconscious** person. If inhaled, remove to fresh air. If not breathing, **give** artificial respiration. If breathing is **difficult,** give oxygen. In all cases call a **physician.**
SEE SECTION 1.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: Clear, colorless fuming liquid.

Odor: Pungent odor of hydrogen chloride.

Solubility: Infinite in water with slight evolution of heat.

Boiling Point: 53°C (127°F); Azeotrope (20.2%) boils at 109°C (228°F)

Melting Point: -74°C (-101°F)

Specific Gravity: 1.18

Vapor Density (Air=1): No information found.

Vapor Pressure (mm Hg): **190 @ 25°C (77°F)**

Evaporation **Rate:** No information found.

SECTION 2 Fire and Explosion Information

Fire:
Can react with metals to release flammable hydrogen gas.

Explosion:
Not considered to be an explosion hazard.

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

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.** Containers **may burst when heated.**

Hazardous Decomposition Products:
When heated to decomposition, emits toxic hydrogen chloride fumes and will react with water or steam to produce heat and toxic and corrosive fumes.

Hazardous Polymerization:
Will **not occur.**

Incompatibilities:
A strong mineral acid, concentrated hydrochloric acid is highly **reactive with strong bases, metals, metal oxides, hydroxides, amines, carbonates and other alkaline materials. Incompatible with materials such as cyanides, sulfides, sulfites, and formaldehyde.**

SECTION 4 Leak/Spill Disposal Information

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

Reportable Quantity (RQ)(CWA/CERCLA) :5000 lbs.

Ensure compliance with local, state and federal regulations.

AD

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

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Corrosive! Inhalation of vapors can cause coughing, choking, **inflamation of the nose, throat, and upper respiratory tract.** Inhalation of higher concentrations may cause lung damage.

Ingestion:
Corrosive! Swallowing hydrochloric r i d can cause immediate p i n **and burns of the mouth, throat,** esophagus and **gastrointestinal** tract. May cause **nausea,** vomiting, and diarrhea.

Skin Contact:
Corrosive! Can cause redness, pain, and **severe** skin burns. Concentrated solutions cause deep ulcers and discolor skin.

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 d concentrated vapors may cause erosion **of teeth. Long term** exposures **seldom occur due** to the corrosive **properties** d **the** acid.

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

B. FIRST AID

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

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

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

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

C. TOXICITY DATA (RTECS, 1986)

Oral rat LD50: 900 mg/kg (Hydrochloric acid concentrated) Mutation references cited.

SECTION 6 Occupational Control Measures

Airborne Exposure Limits:
- OSHA Permissible **Exposure** Limit (PEL): 5 ppm Ceiling
- ACGIH **Threshold** Limit Value (TLV): 5 ppm Ceiling

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 Recommen 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:
Rubber or neoprene gloves and additional protection including impervious boots, apron, or coveralls, as needed in areas of unusual exposure to prevent skin contact.

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

SECTION 7 Storage and Special Information

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

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Material Safety Data

Emergency Phone Number: 314-982-5000

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ISOPROPYL ALCOHOL

PRODUCT IDENTIFICATION;

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

Formula CAS No.: 67-63-0

Molecular Weight: 60.10

Chemical Formula: $(CH_3)_2CHOH$

Hazardous Ingredients: Not applicable.

PRECAUTIONARY MEASURES

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

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

EMERGENCY/FIRST AID

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

SEE SECTION 5

DOT Hazard Class: **Flammable** Liquid

SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility: Infinite in water.

Boiling Point: 82°C (180°F).

Melting Point: -89°C (-128°F).

Specific **gravity:** 0.79

Vapor Density (Air=1): 2.1

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

Evaporation Rate: **(n-BUAC = 1)** 2.83

SECTION 2 Fire and Explosion Information

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

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

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

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

SECTION 3 Reactivity Data

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

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

Hazardous Polymerization:
Will not occur.

Incompatibilities:
Heat, flame, strong oxidizers, 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, 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.

reduce, reuse, recycle and environment

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

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ISOPROPYL ALCOHOL

PRODUCT IDENTIFICATION:

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

Formula CAS **No.: 67-63-0**

Molecular Weight: 60.10

Chemical Formula: **$(CH_3)_2$ CHOH**

Hazardous Ingredients: Not applicable.

PRECAUTIONARY MEASURES

WARNING! FLAMMABLE LIQUID. HARMFUL 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 **ill** medical help **is not** immediately available. Never *give* **anything** by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, **give** oxygen. In **case** of contact, **immediately** flush skin or eyes with plenty of water for at **least** 15 minutes. In all cases call **a physician.**
SEE SECTION 5.

DOT Hazard **Class: Flammable** Liquid

SECTION 1 Physical Data

Appearance: Clear, colorless liquid.

Odor: Rubbing alcohol.

Solubility. Infinite in water.

Boiling Point: 82°C (180°F).

Melting Point: **-89°C (-128°F).**

Specific gravity: 0.79

Vapor Density (Air-1): 2.1

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

Evaporation Rate: **(n-BUAC = 1)** 2.83

SECTION 2 Fire and Explosion Information

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

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

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

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

SECTION 3 Reactivity Data

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

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

Hazardous Polymerization:
Will not **occur.**

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

SECTION 4 Leak/Spill Disposal Information

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

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

Protect Our Environment

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

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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 minutes. If swallowed, DO NOT INDUCE VOMITING! Give large quantities of water or milk if available. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Oxidizer

SECTION 1 Physical Data

Appearance: Clear, colorless to slightly yellow 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.

AD

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

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

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

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

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

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

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

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

B. FIRST AID

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

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

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

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

C. TOXICITY DATA (RTECS, 1982)

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

SECTION 6 Occupational Control Measures

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

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

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

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

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

SECTION 7 Storage and Special Information

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

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Emergency Phone Number: 314-982-5000

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SODIUM HYDROXIDE

PRODUCT IDENTIFICATION:

Synonyms: Caustic soda; lye; sodium hydroxide solid; sodium hydrate

Formula CAS No.: 1310-73-2

Molecular Weight: 40.00

Chemical Formula: NaOH

Hazardous Ingredients: None.

PRECAUTIONARY MEASURES

DANGER! MAY BE FATAL IF SWALLOWED. CAUSES SEVERE BURNS.

Do not get in eyes, on skin, or on clothing.
Avoid breathing dust.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.
This substance is classified as a POISON under the Federal Caustic Poison Act.

EMERGENCY/FIRST AID

If swallowed, do NOT induce vomiting. Give large quantities of water. Never give anything by mouth to an unconscious person. Call a physician immediately. In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes. In all cases call a physician.
SEE SECTION 5.

DOT Hazard Class: Corrosive Material

SECTION 1 Physical Data

Appearance: White, deliquescent pellets.

Odor: Odorless.

Solubility: 111g/100 g of water.

Boiling Point: 1390°C (2534°F)

Melting Point: 318°C (604°F)

Specific Gravity (water=1): 213

Vapor **Density** (Air-1): No information found.

Vapor Pressure (mm Hg): **Negligible.**

Evaporation Rate: No information found.

SECTION 2 Fire and Explosion Information

Fire:
Not considered to **be** a fire hazard. Hot or molten material can **react violently with water.**
Can react with certain metals, such as aluminium, to generate flammable hydrogen gas.

Explosion:
Not considered to **be** an **explosion hazard.**

Fire **Extinguishing Media:**
Use any means **suitable** for extinguishing surrounding fire.
Adding water to caustic solution generates large amounts of heat.

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. Very hygroscopic. Can slowly pick** up moisture from air and **react** with carbon dioxide from air to form sodium carbonate.

Hazardous Decomposition Products:
Sodium oxide.

Hazardous Polymerization:
This substance does not polymerize.

Incompatibilities:
Contact with water, **acids,** flammable liquids, and organic halogen compounds, **especially trichloroethylene,** may cause fire or explosion. Contact with nitromethane and other similar nitro compounds causes formation **of shock-sensitive** salts. **Contact with** metals such as aluminum, tin, **and** zinc causes formation of flammable hydrogen **gas.**

SECTION 4 Leak/Spill Disposal Information

This is a test limit. **1000°C.** Clean-up personnel require protective **clothing** and respiratory protection from dust. Sweep, scoop or pick up spilled material. **Avoid** dusting. **Collected waste may be transferred** to a closed, **preferably** metal, container **and sent** to a RCRA-approved **waste disposal** facility. Do **not** flush to **the** sewer. Caution! **Floor and** other surfaces may be slippery. **Do not** contact with water. Neutralize traces with dilute acid.

Ensure compliance with local, state and federal regulations.

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

SECTION 5 Health Hazard Information

A. EXPOSURE / HEALTH EFFECTS

Inhalation:
Severe irritant. Effects from inhalation of dust or mist vary from mild irritation to serious damage of the upper respiratory tract, depending on severity of exposure. Severe pneumonitis may occur.

Ingestion:
Corrosive! Swallowing may cause severe burns of mouth, throat, and stomach. Severe scarring of tissue and death may result.

Skin Contact:
Corrosive! Contact of skin can cause irritation or severe burns and scarring with greater exposures.

Eye Contact:
Corrosive! May cause irritation of eyes, and with greater exposures, severe burns with possibly blindness resulting.

Chronic Exposure:
Prolonged contact with dilute solutions or dust has a destructive effect upon tissue.

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

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

Eye **Exposure:**
Wash eyes **with** plenty of water **lor** at least 15 minuter, lifting lower and upper eyelids **occasionally. Get** medical attention immcdiatcly.

C. TOXICITY DATA (RTECS, 1982)

No **LD50/LC50** information found relating to normal routes of occupational exposure. Irritation data: Skin, rabbit: 50 **mg/24H Severe** Eye, rabbit: 50 **mg/24H Severe**

SECTION 6 Occupational Control Measures

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

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 **dust/mist** respirator with chemical **goggles** may be worn, **in general,** up to ten times the **TLV. Consu** respirator ruppIkr **for limitations.** Alternatively, a **supplied air full** faceplece **respirator or** airlined hood may be worn.

Skin Protection:
Wear impervious protective clothing, including **boon, 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. Protect** from physical damage. Store in a cool, dry, ventilated area **away** from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse.

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Material Safety Data

Emergency Phone Number: **314-982-5000**

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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.

EMERGENCY/FIRST AID

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: a.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, a d 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-Utter or other inert absorbent. Cover **spill** with sodium bicarbonate **or soda ash** and mix. Clean-up personnel q u i r e 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 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.

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:
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 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 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 and Special Information

Store in a cool, 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 to the acid.

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Benzene Date 3/23/92

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

CAS Number 71-43-2

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other:

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

Chemical Properties: (Synonyms: Benzol, Benzole, Cyclohexatriene

Chemical Formula C_6H_6 Molecular Weight 78

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

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

Specific Gravity 0.879 Odor Characteristic 4.68 ppm Flammable Limits 1.3-7.1%

Incompatabilities strong oxidizers, chlorine, bromine

Biological Properties:

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

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

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

Carcinogen Human - suspected Teratogen Mutagen Experimental

Radiological Properties:

Handling Recommendations: (Personal protoctivo measures)

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

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

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

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

Chronic: Anorexia, drowsiness, anomia, bleeding under skin, reduced blood clotting; liver, kidney, bono marrow damage, leukemia

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Cadmium Date 3/23/92

DOT Name/U.N. No. 2570 Job No. UH8000

CAS Number 7440-43-9

References Consulted (circle):

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

Toxic and Hazardous Safety Manual Other:

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

Chemical Properties: (Synonyms:)

Chemical Formula Cd Molecular Weight 112.4

Physical State solid Solubility (H2O) Inrolublo Boiling Point 1409° F

Flash Point N/A Vapor Pressure/Density 0 n Freezing Point 610° F

Specific Gravity 8.65 Odor Characteristic --- Flammable Limits

Incompatabilities Strong oxidizers

Biological Proportios:

TLV-TWA — PEL 0.2 mg/m^3 Odor/Odor Threshold Odorless

IDLH 50 mg/m^3 Human --- Aquatic --- Rat/Mouse ---

Route of Exposure Inhalation, Ingestion

Carcinogen X Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Monitoring Recommendations:

Mini-Ram

Disposal/Waste Treatment:

Health Hazards and First Aid:

Large quantities of water, induce vomiting, medical attontion: remove to fresh air, medical attontion immediately

Symptoms: Acute: irritation of nose and throat, coughing, chest pain, nausea, vomiting, dissiness, chills, stomach distress, diarrhea

Chronic: loss of smell, liver damage, kidney damage, cancer

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HAZARD EVALUATION OF CHEMICALS

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

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

CAS Number 7440-47-3

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other: SAX, Aldrich

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

Chemical Properties: (Synonyms: chromic Oxide, soluble chromic salts)

Chemical Formula Cr Molecular Weight 52

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

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

Specific Gravity 7.14 odor Characteristic Flammable Limits

Incompatabilities Strong oxidizers

biological Properties:

TLV-TWA 0.5 mg/m^3 PEL 1 mg/m^3 Odor/Odor Threshold

IDLW N/A Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion

Carcinogen Teratogen Mutagen

Radiological Proportios:

Handling Recommendations: (Personal protective measures)

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

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

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

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

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

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HAZARD EVALUATION OF CHEMICALS

Chemical Name: Diesel Fuel Date: 3/23/92

DOT Name/U.N. No.: 1993 Job No.: UH8000

CAS Number: _____

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other: _____

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

Chemical Properties: (Synonyms: JP5, Jot Fuel, Diesel Oil, Fuel Oil #2)

Chemical Formula: CHx (mixture of hydrocarbons) Molecular Weight: varies

Physical State: liquid Solubility (H2O): unsoluble Boiling Point: 340°F- 675°F

Flash Point: 100 F- 136 F Vapor Pressure/Density: N/A Freezing Point: N/A

Specific Gravity: 0.879 Odor Characteristic: 0.082 ppm Flammable Limits: _____

Incompatabilities: Strong oxidizers

Biological Properties:

TLV-m: — PEL: — Odor/Odor Threshold: petroleum odor

IDLH: — Human: _____ Aquatic: _____ Rat/Mouse: _____

Route of Exposure: Inhalation, Ingestion, Dermal

Carcinogen: possible Teratogen: _____ Mutagen: _____

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impervious clothing, neoprene gloves and boots, APR at high concentrations

Monitoring Recommendations:

OVA or HNu with 10.2 eV probe.

Disposal/Waste Treatment:

Health Hazards and First Aid:

wash skin upon contact: do not induce vomiting if ingested. Seek medical attontion.

Symptoms: Acute: vomiting, diarrhea, pulmonary edema

Chronic: paeumonia, respiratory paralysis, CNS depressant

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Ethyl Benzene Date 3/23/92

DOT Name/U.N. No. 1175 Job No. UH8000

CAS Number 100-41-4

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other:

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

Chemical Proportiom: (Synonyms: Ethylbenzol, Phenylethane)

Chemical Formula $CH_3CH_2C_6H_5$ Molecular Weight 106.2

Physical State liquid Solubility (H2O) 0.01% Boiling Point 277°F

Flash Point 55°F Vapor Pressure/Density 10 mm Freezing Point -139°F

Specific Gravity 0.87 Odor Characteristic 0.1 ppm Flammable Limits

Incompatabilities Strong oxidizers

Biological Proportiom:

TLV-TWA 100 ppm PEL 100 ppm Odor/Odor Threshold aromatic. oily

IDLH 2000 ppm Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion

Carcinogen Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Tyvek or saranex coveralls; APR in dusty/ windy conditions or known high concontrationa.

Monitoring Recommendations:

OVA or 10.2 ev probe on HNu.

Disposal/Waste Treatment:

Health Hazards and First Aid:

IMG: seek medical attontion: INH: move to fresh air, seek medical attontion: DER: wash promptly with soap and water.

Symptoms: Acute: irritation of eyes, nose, throat, akin: weakness; dizziness; drowsiness; unconsciousness

Chronic: akin rash, inflammation. dermatitis

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Gasoline Date 3/23/92

DOT Name/U.N. No. 1203 Job No. UH8000

CAS Number 8006-61-9

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other: PAX

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

Chemical Properties: (Synonyms: Petrol, Motor spirits)

Chemical Formula CHx(Mixture of Hydrocarbons) Molecular Weight

Physical State liquid solubility (H2O) insoluble Boiling Point 39°F- 204°F

Flash Point -50°F Vapor Pressure/Density Freezing Point N/A

Specific Gravity <1 Odor Characteristic 5 ppm Flammable Limits 1.3-6.0%

Incompatabilities Strong oxidizers

Biological Properties:

TLV-TWA 300 ppm PEL 300 ppm Odor/Odor Threshold aromatic

IDLH Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion, Dermal

Carcinogen X Toratogon Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Monitoring Recommendations:

Combustible gas/O_2 meter- lined filter to prevent leaded gasoline from contaminating the elements, and OVA/ HNu.

Disposal/Waste Treatment:

Health Hazards and First Aid:

INH: remove to fresh air, administer O_2 if needed. ING: seek medical attention.

Symptoms: Acute: dizziness, unconsciousness, hyperemia

Chronic: CNS depression, dermatitis

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Lead Date 3/23/92

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

CAS Number 7439-92-1

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other:

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

Chemical Properties: (Synonyms: Plumbum)

Chemical Formula Pb Molecular Weight 207.2

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

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

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

Incompatabilities Strong oxidizers, hydrogen peroxide, acids

Biological Properties:

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

IDLH 700 mg/m3 Human Aquatic Rat/Mouse

Route of Exposure Inhalation, Ingestion, Dermal

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

Radiological Properties:

Handling Recommendations: (Personal protective measures)

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

Monitoring Recommendations:

Disposal/Waste Treatment:

Health Hazards and First Aid:

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

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

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

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Methylene Chloride Data 3/23/92

DOT Name/U.N. lo. 1593 Job lo. UH8000

CAS Number 75-09-2

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other:

Rad Health Handbook NCRP 65 10 CFR 20 Handbook of Chemistry and Physic8

Chemical Properties: (Synonyms: Dichloromethane, Methylene Dichloride)

Chemical Formula CH_2Cl_2 Molecular Weight

Physical State Liquid Solubility (H2O) Slightly Boiling Point 104°F

Flash Point Vapor Pressure/Density 350 mm Hg Freezing Point -142°F

Specific Gravity 1.33 Odor Characteristic Like chloroform Flammable Limits

Incompatabilities

Biological Proportios:

TLV-TWA 50 ppm PEL 500 ppm Odor/Odor Threshold Sweet, pleasant/160 ppm

IDLH 5,000 ppm Human Aquatic Rat/Mouse

Route of Exposure Oral, inh, ing, derm

Carcinogen Human/animal Teratogen Mutagen Experimental

Radiological Proportios:

N/A

Handling Recommendations: (Personal protective measures)

Tyvek, gloves (PVA, Viton); any detectable concentrations-SCBA: no APR cartridge available

Monitoring Recommendations:

OVA continuously

Disposal/Waste Treatment:

Health Hazards and First Aid:

Inh: move to fresh air, APR if necessary; Eye/skin: flush with water for 15 minutes, wash skin vith soap/water; Ing: seek medical attontion

Symptoms: Acute: Mental contusion. light-headedness, nausea/vomiting, headache, staggering, unconsciousness, irritation of eyes/resp/skin, skin burns

chronic: Heart palpitations, malaise, death

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Toluene Date 3/23/92

DOT Name/U.N. No. 1294 Job lo. UH8000

CAS Number 108-88-3

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other:

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

Chemical Properties: (Synonyms: Methyl benzene, Toluol, Phenyl methane)

Chemical Formula C_7H Molecular Weight 92

Physical State Colorless Liquid Solubility (H2O) 0.05g/100 H_2O Boiling Point 231°F

Flash Point 40°F Vapor Pressure/Density 22mm Freezing Point -139°F

Specific Gravity 0.8669 Odor Characteristic 0.2ppm Flammable Limits 1.32 - 7.1%

Incompatabilities Strong Oxidizers, HNO_3, H_2SO_4, O_2, Peroxides, Heat

Biological Properties:

TLV-TWA 100 ppm PEL 200 ppm Odor/Odor Threshold Benzene-Like

IDLH 2,000 ppm Human IHL TCLD - 200 ppm Aquatic 96:100-10 ppm Rat/Mouse 4000 ppm

Route of Exposure Inhalation, Ingestion, Dermal Contact, Eye (Ocular)

Carcinogen Experimental Teratogen Experimental Mutagen Experimental

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impervious clothing, Viton gloves, faceshield respirator w/organic vapor cartridge up to 1000 ppm, >1000 ppm use APR with chemical cartridge; 2000 ppm-SCBA

Monitoring Recommendations:

Disposal/Waste Treatment:

Concentrated: incineration; dilute discharge to municipal sewer after primary treatment, incineration for dilute organic mixture

Health Hazards and First Aid:

Flush area with water and wash with soap; move to fresh air if inhaled; if swallowed, do not induce vomiting. contact physician immediately.

Symptoms: Acute: Dissiness, fatigue, nausea, headache, vomiting, irritates eyes, dries skin

Chronic: Bono marrow, depression, defatting of skin, dermatitis, kidney and/or liver damage if ingested

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HAZARD EVALUATION OF CHEMICALS

Chemical Name Xylene Date 3/23/92

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

CAS Number 1330-73-8

References Consulted (circle):

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

Toxic and Hazardous Safety Manual ACGIH Other:

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

Chemical Properties: (Synonyms: Dimethylbenzene, Xylol)

Chemical Formula C_8H_{10} Molecular Weight 106

Physical State Colorless Liquid Solubility (H2O) Boiling Point 292°F

Flash Point 77°F Vapor Pressure/Density 3.7 Freezing Point -12°F

Specific Gravity 0.06 Odor Characteristic 0.5 ppm Flammable Limits 1.0% - 7.0%

Incompatabilities Strong oxidizers, strong acid, heat, peroxide

Biological Properties:

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

IDLU 1,000 ppm Human IHL TCL 0-200 ppm Aquatic Rat/Mouse IHL LD_{50} - 500 ppm/4HC

Route of Exposure Inhale, skin

Carcinogen Experimental Teratogen Mutagen

Radiological Properties:

Handling Recommendations: (Personal protective measures)

Impervious clothing, PVC gloves, faceshield, avoid prolonged contact. Respirator w/organic vapor cartridge up to 5,000 ppm; >10,000 ppm use SCM

monitoring Recommendations:

Disposal/Waste Treatment:

OSHA standard 29 CFR 1910. 106 applies

Health Hazards and First Aid:

Skin - wash w/soap and water; eyes - flush w/water; remove to trash air if overcome

Symptoms: Acute: Eye and mucous membrane irritant, CNS depressant, ingestion causes gastrointestinal upset

Chronic: More severe than above, hyperplasia of bono marrow

APPENDIX B

SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

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

Section 10 — Title Page

Work Plan Group: J
Site No. : 3
Site Name: Crash Crew Training Area

Prepared by: Dan Foss
Ecology and Environment, Inc.
1203 Governor's Square Blvd., Suite 401
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Prepared for: Department of the Navy
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive, P.O. Box 10068
Charleston, South Carolina 29411-0068
Contract Number N62467-88-C-0200

Signature Approvals:

B 6 B Project Manager: _____
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E 6 E ASC Director: _____
A. Clifton

B & E QA/QC Project Officer: _____
M. Meredith

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Section 3.0 — Project Summary

Work Plan Group: J

Site No.: 3

Site Name: Crash Crew Training Area

Site Description: A complete site description and history are presented in sections 2.0 and 3.0 of the attached work plan.

Phase I — Field Screening

Physical Survey (check all that apply):

X Overall Physical Reconnaissance
X OVA Surface Emission Survey
___ Radiation Survey
X Habitat/Biota Survey
X Hydrologic Assessment

Geophysical Survey (check all that apply):

X Electromagnetic Conductivity:
X EM-31 ___ EM-34
X Magnetometry
___ Very Low Frequency
___ Ground Penetrating Radar
___ Seismic Refraction
___ Seismic Reflection

Analytical Screening (check all that apply):

___ Field Analyses
X Soil Headspace Analyses: Planned number of samples 160
___ Soil Gas Analyses
X Laboratory Analyses:

PLANNED NUMBER OF SAMPLES

Surface Water	___
Sediment	___
Soil	33
Soil Gas	___
Groundwater	12
Duplicates	3
Soil Gas Duplicates	___
Trip Blanks	___
Field Blanks	___
Preservative Blanks	___

Rinsate Blanks ___

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Halocarbons
___ Base/Neutral Extractables
___ Acid Extractables
X Volatile Organic Compounds
X Polynuclear Aromatic Hydrocarbons
X Phenols
___ Dioxins
___ Organophosphorus Pesticides
___ Herbicides

X Pesticides
X Polychlorinated Biphenyls
X Total Recoverable Petroleum Hydrocarbons
X Metals
___ Cyanide

Phase II--Characterization

PLANNED NUMBER OF SAMPLES

Surface Water	17
Sediment	17
Soil	162
Soil Gas	___
Groundwater	33
Duplicates	23
Soil Gas Duplicates	___
Trip Blanks	18
Field Blanks	1
Preservative Blanks	1
Rinsate Blanks	18

CATEGORIES OF ANALYSES

___ Purgeable Aromatics
___ Purgeable Halocarbons
X Base/Neutral Extractables
X Acid Extractables
X Volatile Organic Compounds
___ Polynuclear Aromatic Eydrocarbons
___ Phenols
X Dioxins
X Organophosphorus Pesticides
X Herbicides

X Pesticides
X Polychlorinated Biphenyls
X Total Recoverable Petroleum Hydrocarbons

X Metals
X Cyanide

Additional analytical categories are identified below:

X Gross Alpha
X Gross Beta
X Gamma Scan
X Total Organic Carbon
X Grain Size
X Alkalinity
X Total Suspended Solids (water only)
X Total Kjeldahl Nitrogen
X Ammonia Nitrogen
X Orthophosphate Phosphorus
X Dissolved Oxygen (in field)
X 5-day Biological Oxygen Demand
X Chemical Oxygen Demand

X pH
X Percent Moisture
X Hardness (water only)
X BTU Content
X Ash Content
X Total Organic Halogens
X Sulfur
X Ignitability
X Cation Exchange Capacity
X Sulfide

Section 4.0 — Project Organization and Responsibility

The overall organizational structure for this site is discussed in Section 4.0 of the GQAPP. Site-specific designated personnel and their responsibilities are listed below:

Site Manager:
Team/Task Leader(s): To Be Determined
Field Support Personnel:

Biographies for those personnel listed above which are not included in the GQAPP are included in Appendix A of this document.

Section 5.0 — QA/QC Objectives for Measurement Data

Criteria for reporting the accuracy, precision, and completeness of data are presented in Section 5.0 of the GQAPP. Detection limits for screening and quantitative analyses are presented in Section 9.0 of the GQAPP. Procedures used to assess data accuracy, precision, and completeness are presented in Section 14.0 of the GQAPP. All analytes (including field parameters), sample media, and method numbers relevant to the investigation of this site are listed in the following table, which also identifies any modifications to the accuracy (A), precision (P), completeness (C), and detection limit (DL) criteria specified in the above-referenced GQAPP sections.

Section 6.0 -- Fieldwork and Sampling Procedures

Fieldwork and sampling procedures are presented in Section 6.0 of the GQAPP. Hodifications to these procedures are described below:

No Hodifications

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 Petroleum Hydrocarbons	S/W	EPA 418.1	N/M	N/M	N/M	TBD
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/H	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
Laboratory Analyses						
Gross Alpha	S/W	EPA 900	N/M	N/M	N/M	N/M
Gross Beta	S/W	EPA 900	TBD	TBD	TBD	TBD
Gamma Scan	S/W	EPA 901.1	TBD	TBD	TBD	TBD
TCL Purgeables + xylene	S/W	EPA 8240/624	N/M	N/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
Dioxins	S/W	EPA 8280	TBD	TBD	TBD	TBD
Organophosphorus Pesticides	S/W	EPA 8140	N/M	N/M	N/M	N/M
Herbicides	S/W	EPA 8150 (modified)/509B	N/M	N/M	N/M	N/M
Total Recoverable Petroleum Hydrocarbons	S/W	EPA 418.1	N/M	N/M	N/M	N/M
TAL Metals:						
Aluminum	S/W	EPA 6010	N/M	N/M	N/M	N/M
Antimony	S/W	EPA 6010	N/M	N/M	N/M	N/M
Arsenic	S/W	EPA 7060	N/M	N/M	N/M	N/M
Barium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Beryllium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Boron	S/W	EPA 6010	N/M	N/M	N/M	N/M
Cadmium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Calcium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Chromium	S/W	EPA 6010	N/M	N/M	N/M	N/M

Analyte	Media	Hethod No.	A	P	C	DL
Cobalt	S/W	EPA 6010	N/M	N/M	N/M	N/M
Copper	S/W	EPA 6010	N/M	N/H	N/M	N/M
Iron	S/W	EPA 6010	N/H	N/H	N/M	N/M
Lead	S/W	EPA 7421	N/H	N/H	N/M	N/M
Hagnesium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Manganese	S/W	EPA 6010	N/M	N/M	N/M	N/M
Mercury	S/W	EPA 7471/7470	N/M	N/M	N/M	N/M
Nickel	S/W	EPA 6010	N/M	N/M	N/M	N/H
Selenium	S/W	EPA 7740	N/M	N/M	N/M	N/M
Silver	S/W	EPA 6010	N/M	N/H	N/M	N/M
Sodium	S/W	EPA 6010	N/M	N/M	N/M	N/M
Thallium	S/W	EPA 7841	N/M	N/M	N/M	N/M
Tin	S/W	EPA 282.2	N/M	N/M	N/M	N/M
Vanadium	S/W	EPA 6010	N/H	N/H	N/M	N/H
Zinc	S/W	EPA 6010	N/H	N/M	N/H	N/M
Cyanide	S/W	EPA 9010/335.2	N/M	N/H	N/H	N/M
Sulfide	S/W	EPA 376.1	N/M	N/M	N/M	N/M
TOC	S/W	EPA 415.1	N/M	N/M	N/M	N/M
Hardness	W	EPA 130.2	N/M	N/M	N/M	N/H
Alkalinity	W	EPA 310.1	N/H	N/H	N/H	N/M
Total Suspended Solids	W	EPA 160.2	N/M	N/M	N/H	N/M
Total Kjeldahl Nitrogen	S/W	EPA 351.3	N/M	N/M	N/H	N/H
Nitrogen-Ammonia	S/W	EPA 350.2	N/M	N/M	N/M	N/H
Orthophosphate Phosphorus	S/W	EPA 365.2	N/M	N/M	N/H	N/H
5-day Biological Oxygen Demand	W	SM 507	N/M	N/H	N/H	N/M
Chemical Oxygen Demand	W	EPA 410.4	N/H	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	ASTH D-422-63	N/M	N/H	N/M	N/M
BTU Content	S	ASTM D-2015-77	N/M	N/M	N/H	N/M
Ash Content	S	ASTH D-482	N/M	N/M	N/H	N/M
Total Organic Halogens	S	ASTM D-808-81	TBD	TBD	TBD	TBD
		EPA 325.3	TBD	TBD	TBD	TBD
Sulfur	S	ASTM D-129-64	N/M	N/M	N/M	N/H
Ignitability	S/U	EPA 1010	N/M	N/M	N/M	N/M
Cation Exchange Capacity	S	EPA 9081	75-125	35	95%	100mg/kg

Analyte	Media	Method No.	A	P	C	DL
Field Parameters						
pH	W	150.1	N/M	N/M	N/M	N/M
Specific Conductance	W	120.1	N/M	N/M	N/M	N/H
Temperature	W	170.1	N/M	N/M	N/M	N/M
Dissolved Oxygen	W	EPA 360.1	N/M	N/M	N/M	N/M

Notes: S = Soil and/or sediment
W = Groundwater and/or surface water
N/M = No modifications from GQAPP
TBD = To be determined.

*With the exception of total recoverable petroleum hydrocarbons, the laboratory screening analyses do not have EPA method numbers.

Section 7.0 — Sample Custody

Sample custody procedures are presented in Section 7.0 of the GOAPP. Modifications to these procedures are described below:

No Hodifications

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:

No Modifications

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 main enance 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. Uodifications 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. Uodifications 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 GOAPP are listed below; biographies for these site personnel are presented on the following pages.

To Be Determined

APPENDIX C

THREATENED AND ENDANGERED FLORA AND FAUNA ASSOCIATED WITH NAS PENSACOLA

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

APPENDIX C
THREATENED AND ENDANGERED FLORA AND FAUNA OBSERVED OR LIKELY TO OCCUR WITHIN THE NAS PENSACOLA FACILITY OR NEARBY

Scientific Name	Coma Bar	Base * Status	Status FGFWFC(or FDA)	Status USFWS	Habitat
FISHES					
Acipenser oxyrhynchus	Atlantic sturgeon	M	SSC	UR 2	Gulf coast, estuarine
Ammocrypta asprella	Crystal darter	U	T	UR 2	Fresh water
Etheostoma histrio	Harelquin darter	U	SSC		Fresh water
Fundulus jenkinsi	Salt marsh 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, marshes, ponds
Caretta caretta caretta	Loggerhead turtle	M ?	T	T	Marine, coastal
Chelonia mydas mydas	Green turtle	M ?	E	E	Marine, coastal
Dermochelys coriacea	Leatherback turtle	M	E	E	Marine, coastal
Drymarchon corais coupori	Eastern indigo snake	P	T	T	Open areas near water
Eretmochelys imbricata	Hawksbill turtle	M ?	E	E	Marine, coastal
Gophorus 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 turtle	SR	SSC	UR 2	Swamps, marshes, ponds
MAMMALS					
Mustela vison 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	N	E	E	Atlantic and Gulf coasts
Ursus americanus floridanus	Florida black bear	N/A	T	UR 2	Titi swamps

Appendix C (Cont).

Scientific Name	Common Name	Base * Status	Status FGFWFC(or FDA)	Status USFWS	Habitat
BIRDS					
Charadrius melodus	Piping Plover	P	T	T	Open dry, sandy beaches
Charadrius alexandrinus	Snowy plover	P	T	UR 2	Open 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
Egrotta rufescens	Reddish egret	P-u	SSC	UR 2	Freshwater/coastal wetlands.
Egrotta caerulea	Little blue heron	P-U	SSC		Freshwater/coastal wetlands
Egrotta 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 water
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-billed 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 wetlands
INVERTEBRATES					
Copris gophori	Scarab beetle	P		UR 2	Associated w/Gopher Tortoise

Appendix C (Cont.)

Scientific Name	Cown Name	Base Status	Status FGFWFC(or FDA)	Status USFWS	Habitat
PLANTS					
Chrysopsis gossypina cruiseana	Cruise's goldon-astor	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	UR 2	Black, mucky soils
Pinguicula planifolia	Chapman's buttorwort	U	RE	UR 2	
Polygonella macrophylla	Large-leaved jointweed	R	T	UR 1	Sand pino-oak scrub
Rhododendron austrinum	Orange azalea	U	E	UR 5	Moist, woody habitats
Sarracenia leucophylla	White-top pitcherplant	R	E		Open acid bogs
Sarracenia rubra	Sweet pitcherplant	U	E	UR 2	Acid bogs/slash pine woods
Stewartia malacodnedron	Silky camellia	U	E		Slopes ot wooded ravines

E = Endangered
T = Threatened
UR 1 = Under roviow, for Federal listing with substantial evidence in existence indicating at least some degree of biological vulnerability and/or throat.
UR 2 = Under roviow, insufficient biological data available.
UR 5 = Candidate species, 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.

Base * = Status of species on tho NAS Pensacola facility.
R = Resident.
M = Migrant.
SR = Suspected resident.
P = Possible resident duo to available habitat; survey required.
U = Unknown, survey required.
N/A = not expected to occur on tho NAS Pensacola facility.

[APPENDIX D

JUNE 1990 SECTION 14.2--CHARACTERIZATION]

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

14.2 Phase II -- Characterization

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

- 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;
- To support the preliminary identification, screening, and evaluation data requirements of potential remedial alternatives.

The actual Phase II sampling locations, especially with respect to the Phase I locations, will primarily be a function of how uniform the Phase I results were with respect to contaminant type, magnitude, and distribution across the site.

Phase II investigation of sites 3 and 19 will involve the collection of soil 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 analytical requirements for Phase II samples are provided in Table 14-2.

During the Phase II investigations of sites 3 and 19, which are 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.

TABLE 14-2

PHASE II SAMPLING AND ANALYTICAL REQUIREMENTS—GROUP J

SITE 3

Medium	No. of Samples	Dupli-cates	Trip Blanks[a]	Field Blanks	Rinsate Blanks	Preservative Blanks[b]	Total*	Analytical Suite[c,d]
soil.	27	3	2	1	2	1	36 (6)	A C
Groundwater	5	1	1	NR	1	NR	8 (2)	A B
TOTAL	32	4	3	1	3	1	44(8)	

SITE 19

Medium	No. of Samples	Dupli-cates	Trip Blanks[a]	Field Blanks	Rinsate Blanks	Preservative Blanks[b]	Total*	Analytical Suite
soil	15	2	1	1	1	1	21 (6)	A C
Qroundwator	3	1	1	NR	1	NR	6 (2)	A B
TOTAL	18	3	2	1	2	1	27(8)	

[a]Trip blanks will bo analyzed for Target Compound List (TCL) volatile organic compounds only.

[b]Preservative blanks will bo analyzed for TCL volatile organic corpounda, total recoverable hydrocarbons, total TCL metals, and cyanide.

[c]Analytical suite designations are as follows:

A = TCL volatile organic compounds plus xylene and ketones, TCL base/neutral and acid oxtractablo organic compounds, TCL pesticides and PCBs, total recoverable hydrocarbons, TCL metals (total [i.e., unfiltered] and dissolved [i.e., millipore-filtered]), cyanide, total organic carbon, hardness (water only), and alkalinity (water only).

B = total suspended solids, total Kjeldahl nitrogon, ammonia nitrogen, orthophosphate phoaphorus, dissolved oxygen (in field), 5-day biological oxygmn dmrand (BOD_5), and chemical oxygon dmmand (COD).

C = pH, alkalinity, percent moisture, grain size, BTU content, ash eontont, 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 arm identified in Tables 9-5 through 9-13 of tho Generic Quality Assurance Projmct Plan.

*The number of samples shown in parentheses will be analyzed for thm additional parameters indicated.

NR = Uot required.

14.2.1 Biota Sampling

The need for formal biological sampling will be based on the results of the Phase I habitat/biota survey and analytical screening results. If biological sampling is required, a separate biological sampling plan will be prepared which outlines sample locations, sampling methodologies, analytical parameters, etc.

14.2.2 Soil Sampling

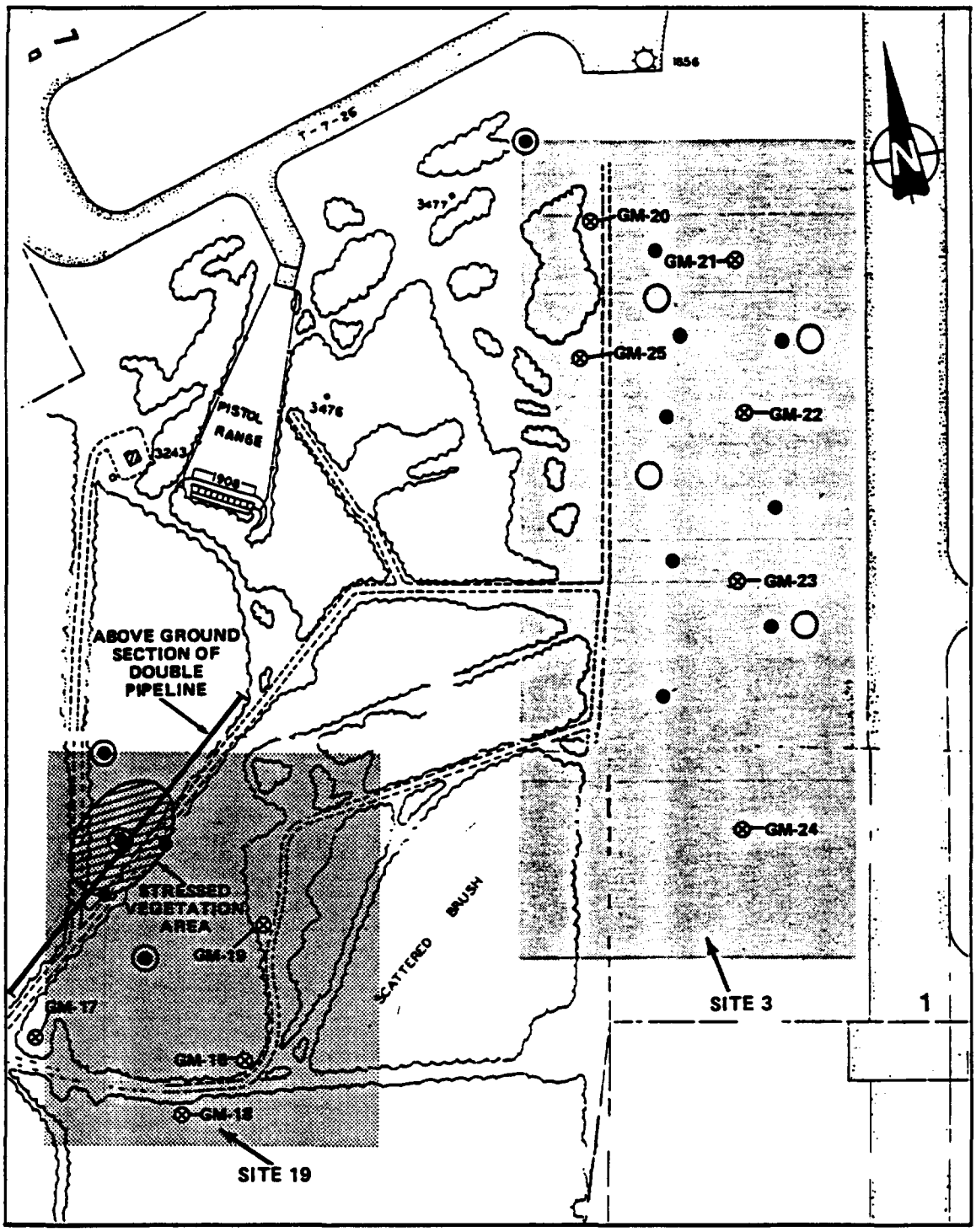
Tentative locations and numbers of soil samples for Phase II are presented in Figure 14-2. The actual number of soil samples and their locations will be determined based on the results of Phase I. For planning purposes, three soil samples are assumed at each boring location. Figure 14-2 presents nine tentative boring locations for Site 3 and five tentative boring locations for Site 19. Consequently, a total of 27 soil samples are projected for Site 3 and a total of 15 soil samples are projected for Site 19.

Soil samples will be collected in discrete intervals using a split-spoon sampler powered by a drill rig. A composite soil sample will be collected for each of the following depth intervals: 0 to 0.5 feet, 0.5 to 2.5 feet, then every 2.5 feet to the water table assumed to be at 5 feet. All sampling, compositing, and lithologic logging will be performed in accordance with sections 6.6 and 6.7 of the GOAPP.

Equipment decontamination will be performed between soil sampling intervals as discussed in Section 6.10 of the GQAPP. A detailed discussion of split-spoon soil sampling procedures is provided in Section 6.7.2.3 of the GQAPP.

14.2.3 Shallow Monitoring Well Installation and Development

Tentative locations for each of the eight Phase II monitoring wells are presented in Figure 14-2. Five new shallow monitoring wells will be installed on Site 3 and three new shallow monitoring wells will be installed on Site 19. As with the soil samples proposed for Phase 11, exact sampling locations will depend upon the Phase I Field Screening results.



SOURCE: U.S. Naval Air Station, Pensacola, Florida, 1987

KEY:

- ● Tentative Soil Boring
- ○ Tentative Shallow Monitoring Well
- ⊗ Existing Monitoring Well

Figure 14 – 2 TENTATIVE SOIL BORING AND SHALLOW MONITORING WELL LOCATIONS SITES 3 & 19 – PHASE II

Shallow monitoring wells will be installed using the hollow stem auger method described in Section 6.7.2.1 of the GQAPP. Each of the shallow monitoring wells will be installed to a depth of approximately 15 feet and will be constructed using two-inch PVC casing, and will bracket the water table with 10 feet of 0.01-inch slotted screen. A detailed discussion of standard monitoring well construction practices is provided in Section 6.7.3 of the GQAPP. All equipment used in monitoring well installation will be decontaminated as discussed in Section 6.10 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 the eight newly installed shallow monitoring wells on sites 3 and 19. During Phase II, a total of 5 groundwater samples will be collected from Site 3 and a total of 3 groundwater samples will be collected from Site 19. Prior to sample collection each well will be purged using the methods described in Section 6.8.1 and 6.8.2 of the GQAPP. Samples will be collected according to the methods provided in Section 6.8.3 of the GQAPP.

14.2.5 Hydrologic Assessment

Well head elevations will be surveyed for all newly installed monitoring wells. Water levels will be measured in all wells following procedures described in Section 14.1.4 of this work plan.

Limited aquifer testing will be conducted on all newly installed and existing monitoring wells. These will consist primarily of performing short-duration specific capacity tests during the development of the newly installed monitoring wells and slug or specific capacity on the

existing monitoring wells. Specific capacity and slug tests are particularly useful for deriving first estimates of aquifer hydraulic properties (i.e., hydraulic conductivity, transmissivity).

The advantages of conducting specific capacity tests in conjunction with well development is that the test itself does not generate additional potentially contaminated water, which requires disposal. Slug testing does not generate any potentially contaminated water.

Physical and chemical aquifer data collected during Phase II will be evaluated to determine lateral contaminant migration characteristics. A plan for deep well installation will be developed based on the findings of phases I and 11.

14.2.6 Air Sampling

Formal air sampling will be performed only as required based on the results of the Phase I surface emissions survey and particulate air sampling, and the Phase I shallow soil sampling. If formal air sampling is necessary, sampling will be conducted in accordance with procedures outlined in Section 6.1 of the GQAPP.