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ENGINEERING WORK PLAN
FOR BIOVENTING SYSTEM
7th STREET BX SERVICE STATION

EGLIN AIR FORCE BASE
FLORIDA

ENGINEERING-SCIENCE
ATLANTA, GEORGIA

JUNE 1992
FINAL

PREPARED FOR

HEADQUARTERS AIR FORCE SYSTEMS COMMAND
COMMAND CIVIL ENGINEER (HQS AFSC/DEV)
ANDREWS AIR FORCE BASE, MARYLAND 20334-5000

UNITED STATES AIR FORCE
AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE (AFCEE)
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INSTALLATION RESTORATION PROGRAM

ENGINEERING WORK PLAN
FOR BIOVENTING SYSTEM
7th STREET BX SERVICE STATION

AIR FORCE SYSTEMS COMMAND
EGLIN AIR FORCE BASE, FLORIDA

JUNE 22, 1992
FINAL

PREPARED BY

ENGINEERING-SCIENCE, INC.
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USAF CONTRACT NO. F33615-90-D-4014, DELIVERY ORDER NO.4
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ENVIRONMENTAL RESTORATION DIVISION (ESR)
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As part of an on-going Installation Restoration Program (IRP) at Eglin AFB, Florida a bioventing system will be constructed at the 7th Street BX Service Station. This is an Engineering Work Plan for installing the bioventing system. The objective of this bioventing system is to support on-going remediation efforts at the Service Station. Existing remedial system at the site includes a groundwater recovery and treatment system. This plan contains information concerning construction, installation, operation, maintenance, and monitoring of the bioventing system. The procedures to be employed for construction and specification are also included.

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PREFACE

This Engineering Work Plan provides information concerning the installation of the bioventing system at the 7th Street BX Service Station at Eglin AFB, Florida.

Engineering-Science, Inc., Atlanta, Georgia is contractor for this work. Mr. Ola A. Awosika, P.G., will be the primary responsible scientist performing the work.

The plan commences on February 6, 1992 and continues through December 31, 1992.

Mr. James F. Williams, PG, CGWP, United States Air Force AFCEE/ESR, Brooks AFB, Texas is the Technical Program Manager.

Approved:

Contract Program Manager

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SECTION 1
INTRODUCTION

This engineering work plan describes the tasks required to install, operate, and monitor a bioventing system at the 7th Street BX Service Station at Eglin Air Force Base (AFB), Florida. The procedures and specifications for performing the tasks described are also provided in this plan. In addition, requirements for sampling and laboratory analysis are also described. The location of this site is shown on Figure 1.1.

1.1 OBJECTIVE AND SCOPE OF WORK

The objective of the bioventing system at the 7th Street BX Service Station is to aid in expediting remediation efforts at the site. This objective was developed through evaluation of previous investigation results, current remediation efforts, and results of a bioventing pilot test at the site. Currently, a ground water recovery and treatment system is being operated at the site to address remediation of groundwater contamination. A significant portion of the soil at the site has been impacted by the release of gasoline into the subsurface at the site. Since the existing system is incapable of remediating soil contamination, a plan to consider the use of the bioventing remedial system to address this concern was implemented.

The scope of work for this project includes preparation of project scoping documents, construction and installation of the system, operation and maintenance for one year, and preparation of a report which summarizes the effectiveness of the system over the period of operation.

A summary of the background information on the site which initiated subsequent development of the remediation effort is provided in Section 2 of this plan.

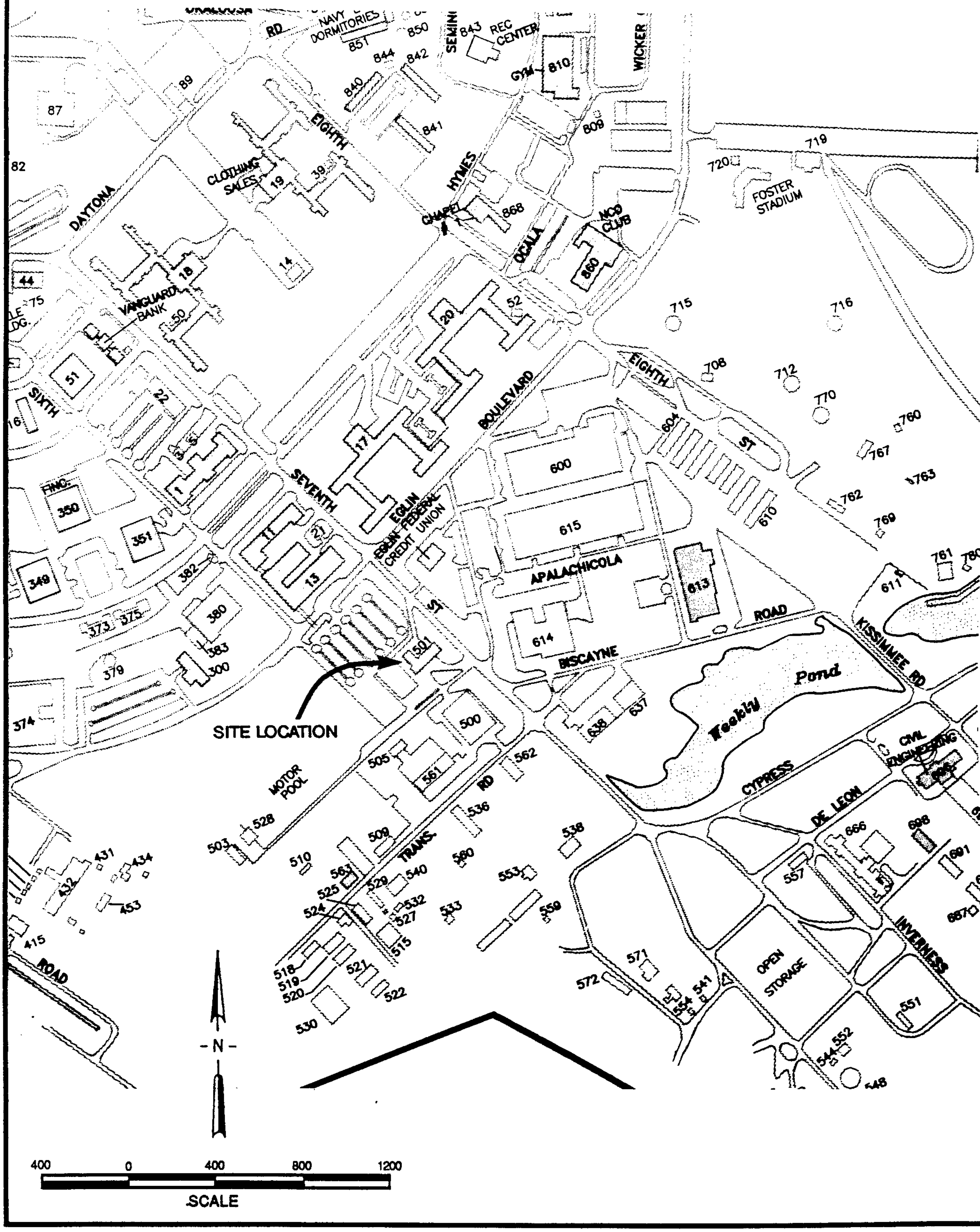
1.2 OVERVIEW OF BIOVENTING REMEDIAL SYSTEM

1.2.1 Remediation of Fuel-Contaminated Soils

Fuel contamination in soils generally presents a long-term source of groundwater contamination, and must be remediated to assure successful site cleanup. A variety of soil remediation options are now available for fuel-contaminated soils. Because fuel contaminated soil is not specifically listed as a hazardous waste, and is generally not ignitable, excavation and disposing of these soils in approved landfills has frequently been the most expedient remediation

EGLIN AFB

LOCATION OF 7th STREET BX SERVICE STATION



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option. Increased costs, increased restrictions on land disposal, and the risk of becoming a potentially responsible party in a future landfill remediation have made this option much less attractive.

Many sites with shallow soil contamination are now remediated by excavating soils and treating them above ground using thermal, chemical/physical, or biological processes. Low-temperature thermal desorption processes have proven very effective at rapidly removing fuels and chlorinated solvents from sands, silt, and clay soils. Removal rates of over 99 percent have been achieved at treatment costs of \$100 - \$150 per cubic yard given sufficient volume. In some states, fuel-contaminated soil can be used as base material for asphalt production. The costs of excavation, transportation, and processing for asphalt production are \$35 to \$50 per cubic yard. However, this option may not be appropriate for Eglin AFB soils.

Excavation is often impossible when contaminated soils lie beneath buildings, critical transportation corridors, or simply beyond the depth of safe and economical soil removal. At the 7th Street BX Service Station significant contamination has migrated beneath the Service area. Under these circumstances in situ remediation methods can be employed.

Technologies for in situ soils remediation include soils washing, thermal methods such as vitrification and steam stripping, soil venting, and enhanced biodegradation. Soil venting enhanced biodegradation (bioventing remedial system) has been selected for the 7th Street BX Service Station. A description of this method is provided below.

1.2.2 Enhanced Biodegradation Through Soil Venting

Over the past two decades a significant number of research studies and commercial projects have successfully used enhanced biodegradation to remediate contaminated groundwater (Lee, 1988). This more conventional form of bioremediation focuses on methods of providing oxygen and nutrients to indigenous bacteria to stimulate microbial consumption of fuel hydrocarbons in groundwater. Unfortunately, groundwater contamination if often a symptom of more prevalent soil contamination. Hinchee et al. (1988) provided a hypothetical case for a 1,000-gallon jet fuel spill occurring in the unsaturated zone. The authors estimated that in a fine, sandy soil, 962 gallons of the fuel would be partitioned in the soil, 25 gallons would vaporize in soil gas, and only 13 gallons would be available to dissolve in the groundwater. Clearly, in situ bioremediation is an incomplete process if it fails to address fuel residuals in the soil, which slowly release soluble compounds such as benzene, toluene, ethylbenzene, and xylenes (BTEX) into the groundwater. Since gasoline contain a large fraction of BTEX hydrocarbons the removal of fuel residuals from the soil is critical to groundwater remediation.

Attempts to remove or biodegrade fuel residuals from the vadose zone by flushing with nutrient- and oxygen-rich aqueous solutions have proven to be ineffective (Downey and Elliott, 1990, U.S. EPA, 1990). Research has shown that the flow of water through the unsaturated zone takes place in the large macropores of the soil, and often fails to contact fuel residuals which are trapped in the micropores (Wilson and Conrad, 1984). This limitation is particularly evident when fuels are spilled into dry soils. In the absence of soil moisture, fuels will move into the micropores and become occluded, resisting the future entrance of water into these pore spaces. The inaccessibility of fuel residuals to excessive water flushing was recently documented at a jet fuel spill in the POL area at Eglin AFB; over 190 pore volumes of nutrient- and oxygen-enriched water passed through highly permeable, sandy soils without any significant reduction in total petroleum hydrocarbon (TPH) soil concentrations (Hinchee and Downey, 1989).

The use of air as a medium to contact and remove volatile hydrocarbons has been extensively used in soil vapor extraction systems. Due to the tremendous viscosity and diffusivity advantages of air, soil vapor extraction has been more successful than water flushing in contacting fuel residuals trapped in soil micropores. Air is also 1,000 times more efficient than water at transferring oxygen to the subsurface to stimulate aerobic biodegradation of fuel residuals. A full-scale soil venting project was recently completed to remediate a 27,000-gallon jet fuel spill at Hill AFB in Utah. During this 18 month project, jet fuel residuals were reduced from an average TPH concentration of approximately 900 milligrams per kilogram (mg/kg) to less than 10 mg/kg. Monitoring of vented soil gas indicated that volatilization accounted for 60 percent of the removal, and biodegradation accounted for the remaining 40 percent (Hinchee and Miller, 1991). A bioventing pilot test recently completed by Engineering-Science, Inc. at a diesel fuel contaminated site confirmed the ability of deep soil venting (>60 feet) to supply oxygen to indigenous bacteria and to stimulate diesel fuel degradation.

A lack of oxygen generally limits the natural biodegradation of hydrocarbons by soil bacteria. Once oxygen is supplied by soil venting, natural bacteria multiply and thrive, using fuel hydrocarbons as their primary carbon source. Another factor influencing fuel biodegradation is the availability of basic nutrients such as nitrogen and phosphorous. Recent research at a bioventing demonstration at Tyndall AFB in Florida indicates that soils bacteria are able to recycle essential nutrients, and may also rely on nitrogenase bacteria to fix atmospheric nitrogen and introduce useful forms of nitrogen for fuel-degrading microbes (Miller, 1990). Nutrients that were added to the subsurface at the Hill AFB or Tyndall AFB sites produced little or no increase in biological activity when compared to no-nutrient controls. Biodegradation accounted for over 50 percent of the fuel removed from soils at the Tyndall AFB bioventing demonstration. Due to the similarities between Tyndall AFB and Eglin AFB soils, natural nutrients are expected to be adequate for bioventing at this site.

Adequate soil moisture must be available to sustain microbial populations. A column testing using soils from the Hill AFB site showed increasing fuel biodegradation as soil moisture was increased from 6 to 18 percent (by weight). However, at higher moisture levels, a reduction in air permeability could also limit oxygen supply. The warm, moist sands at Eglin AFB should provide an excellent environment for in situ biodegradation. Soil temperature was found to vary approximately 7°C at the Tyndall AFB site and summer biodegradation rates were approximately twice those occurring in winter.

1.3 PROJECT TEAM

The project team assigned to the bioventing system project, their responsibilities, and lines of authority are outlined below.

Name	Task Assigned
Scott Rowden, C. I. H.	Program Manager for Eglin AFB Projects
Ola Awosika, P. G.	Project Manager
Ed Grunwald, C. I. H.	Office Health and Safety Manager
Doug Downey, P. E.	Bioventing Task Manager
Patricia Williamson	Site Contact - U.S. Air Force

Oversight for project activities accomplished at Eglin AFB are provided by Mr. Scott Rowden who is responsible for coordinating the various Eglin AFB project activities accomplished by ES.

The project manager, Ola Awosika, is responsible for overall conduct of the project. Mr. Awosika is also responsible for enforcing the requirements of the project health and safety plan. Mr. Ed Grunwald is the office health and safety manager and will be responsible for updating and revising the project health and safety plan, as necessary. He will arrange for periodic field audits to ensure that the provisions of the health and safety plan are being enforced.

Mr. Downey will supervise construction and installation of the bioventing system and serve as the site health and safety officer and is responsible for assuring that the day-to-day bioventing activities are preformed in conformance with the project health and safety plan.

SECTION 2
SITE DESCRIPTION AND INVESTIGATION

2.1 SITE DESCRIPTION

The 7th Street BX Service Station is located near the intersection of 7th street and Eglin Boulevard on Eglin Main Base (Figure 1.1). The geographic coordinates for the site are 30° 28´ 49" N Latitude and 86° 29´ 53" W Longitude. The Service Station is bordered by a vehicle maintenance facility (Bldg 500) to the Southeast parking lot to the southwest and northwest and a small grass field to the northeast (Figure 2.1).

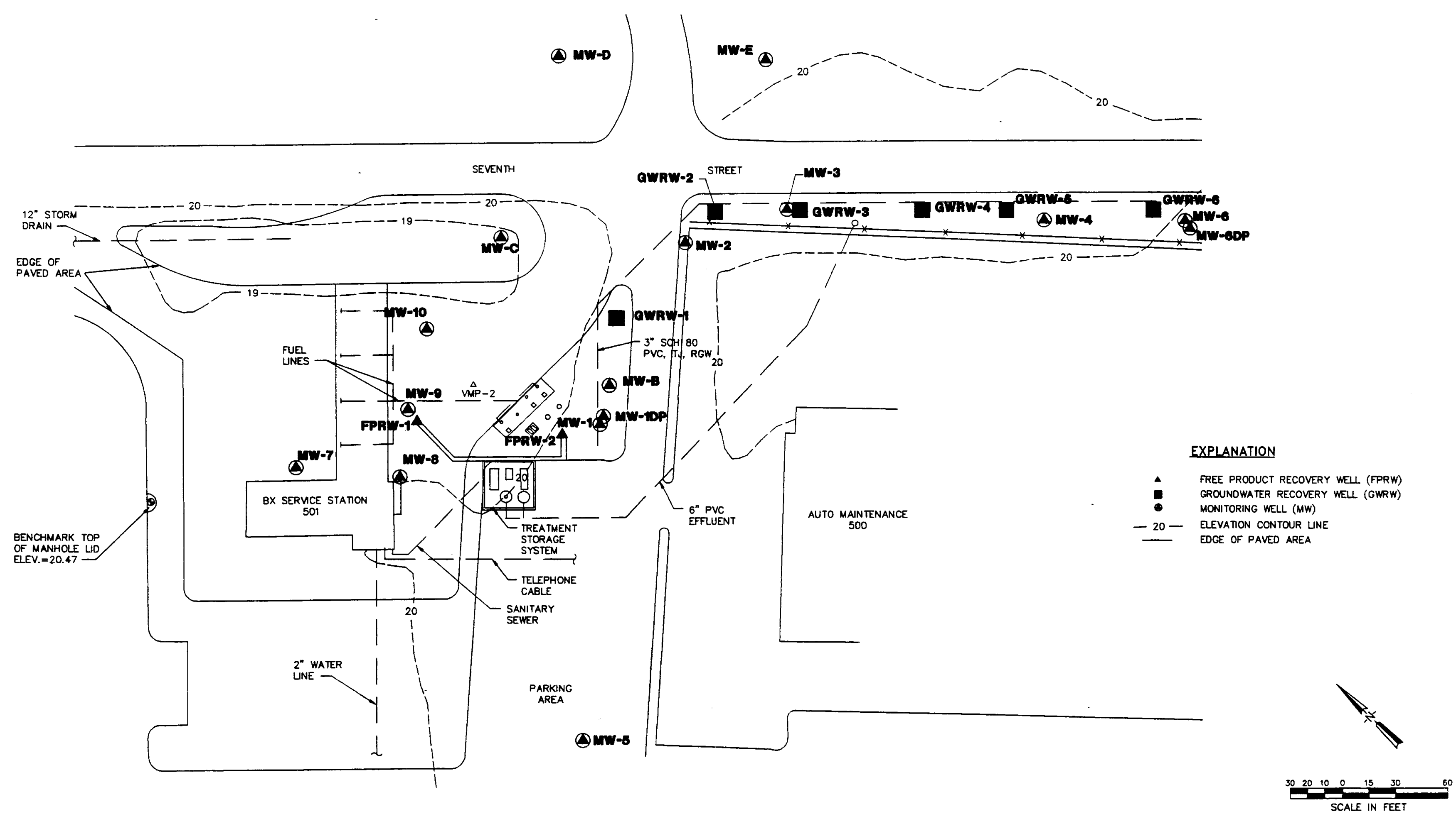
The 7th Street BX Gas Station is currently active and includes three active pump islands and a four bay car-care center which handles minor car maintenance and repair. The station has been in operation since 1955. The total area of the site is approximately 1 acre. The service station with a covered extension over the pump islands is the only building on site. The remaining portion of the site is covered by asphalt and concrete, with grass areas along portions of the site perimeter. The station currently, as well as in the past, utilizes underground tanks for fuel storage. A groundwater recovery and air stripper system currently exists on the gas station premises (Figure 2.1). This recovery and treatment system includes 6 groundwater recovery wells, 2 fuel recovery and groundwater recovery wells, and an air stripper treatment unit. The Service Station employs approximately 5 personnel.

2.2 GEOLOGY AND HYDROGEOLOGY

The topography at the site is relatively flat. Three predominant geologic features; The sands and gravel, Pensacola Clay and a series of limestone and dolomitic lithologies of the Floridan Aquifer underlie the 7th Street site. The sands and gravels extend to an approximate depth of 50 feet below land surface (bls). The underlying Pensacola Clay is approximately 280 feet thick in the area and extends to a depth of approximately 300 feet below land surface (USGS 1986 and 1988). A series of limestone and dolomite lithologies, the Tampa and Chickasawhay Formations underlie the Pensacola Clay. The Tampa and Chickasawhay Formations are characterized as vesicular limestone and dolomite. The Bucatunna Clay, a massive calcareous, fossiliferous clay of low permeability, in turn underlies these two carbonate formations in this area of the base. The Ocala Group, a permeable fossiliferous limestone, resides below the Bucatunna Clay. The Ocala Group, in turn, is underlain by the Claiborne Group, a series of limestones and

Figure 2.1

SITE LAYOUT MAP
7th STREET BX SERVICE STATION
EGLIN AFB



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shales of low permeability USGS 1986. Groundwater occurs in two primary aquifer systems at Eglin AFB; the surficial sand and gravel aquifer and the deep Floridan aquifer system. The sand and gravel aquifer is utilized primarily for irrigation purposes while the Floridan aquifer system serves as the primary source of drinking water for Eglin AFB and the surrounding municipalities.

The sand and gravel aquifer occurs under unconfined or water table conditions at the 7th Street site. Groundwater occurs in the surficial sand and gravel aquifer between 5 and 7 feet below land surface (bls) (Table 2.1). The generalized groundwater flow direction in the shallow sand and gravel aquifer is towards the south-southeast as indicated by past groundwater levels in the site monitoring wells. Water levels in the deep monitoring wells (screened 40-50 feet bls) indicate a downward vertical component of groundwater flow in the shallow sand and gravel aquifer. Results from a pumping test conducted during the recovery system installation indicate that the estimated transmissivity of the shallow sand aquifer is approximately 13,000 gallons per day per foot (Layne-Western 1987).

The lower boundary of the sand and gravel aquifer is formed by the Pensacola Clay, a low permeability unit that serves as a nearly impervious layer and effectively isolates the sand and gravel aquifer the Floridan aquifer system.

The depth to the top of the Floridan aquifer system is approximately 300 feet bls (ES 1989). The transmissivity of the aquifer ranges from 250 to 50,000 square feet per day (ES 1989). The Floridan Aquifer system in the area has minor karst features (ES 1989)

The Floridan aquifer system is divided into two aquifers in this portion of Eglin AFB. The Bucatunna Clay serves as a low permeability unit forming the Upper Floridan aquifer above and the Lower Floridan aquifer below. As the clay layer thickens to the south and west, the Lower Floridan aquifer approaches confined conditions (ES 1989).

Groundwater use in the area surrounding the 7th Street site consist of irrigation and drinking water supplies. Drinking water in the area is drawn from both the Floridan aquifer system and the sand and gravel aquifer. The nearest drinking water well (Eglin Base Well #5) is located approximately 400 feet northeast of the site in the Credit Union parking lot (ES 1992). Eglin Base Well #5 draws water from the Floridan aquifer system at a depth of 642 feet bls and serves as part of a blended system for Eglin Main Base.

Although the site topography is relatively flat, runoff from the site is believed to be high because asphalt and concrete cover the majority of the site. Evaporation is expected to be high in the region during the summer months (May - September), reducing the volume of site runoff. Two grass area along the perimeter of the site are local topographic lows and most likely receive runoff from the site. The site is located in the greater than 500 year floodplain (FEMA, 1985). The runoff volume

TABLE 2.1
WELL SURVEY DATA (25 JULY 1991)
7TH STREET BX SERVICE STATION
EGLIN AFB

Well	Horizontal North	Horizontal East	Marked Top of Casing[1]	Ground Elevation	Water Level Elevation (ft. MSL) Baseline	8/16/91	8/23/91	8/30/91
MW1	543747.7438	1370712.7400	20.74	20.60	14.60	15.16	13.74	13.56
MW1-DP	543749.3897	1370716.0000	22.67	20.54	14.33	13.97	13.67	13.49
MW2	543774.4214	1370818.0201	21.25	21.00	--	--	--	--
MW3	543741.6962	1370897.8900	21.25	20.97	14.22	13.50	13.21	12.64
MW4	543652.2800	1370986.1097	21.30	20.89	--	--	--	--
MW5	543481.4580	1370217.1793	21.02	19.27	14.57	16.11	15.82	15.79
MW6	543590.9498	1371047.6795	20.40	20.25	13.55	12.78	12.32	11.96
MW6-DP	543590.9498	1371047.6795	22.05	20.21	13.20	12.70	12.24	12.06
MW7	543858.2691	1370581.9703	19.40	19.74	14.94	14.55	14.20	14.03
MW8	543798.3970	1370613.3501	19.78	19.99	--	--	--	--
MW9	543831.1550	1370630.7802	19.25	19.70	--	--	--	--
MW10	543849.8109	1370673.8303	18.91	19.15	14.81	14.46	14.12	14.03
MWE	543811.1770	1370966.2202	21.39	20.34	14.58	13.58	13.24	12.90

(1) Top of 2 inch PVC casing (well riser)

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which flows into these areas then flows topographically downgradient via a storm sewer network and/or earthen ditches for approximately 1.6 miles to Choctawhatchee Bay.

There are no drinking water intakes located within 15 downstream miles of the site (ES 1991). Weekly Pond is hydraulically downgradient of the site. Because of the prevailing groundwater flow direction, Weekly Pond may have received hazardous constituents via groundwater and surface water discharge prior to the installation of the groundwater recovery/treatment system. Weekly Pond is not classified as a fishery because the water body is currently closed to fishing. Public access to the pond is not restricted.

2.3 PREVIOUS INVESTIGATION

In the fall of 1983, the Florida Department of Environmental Regulations (FDER) was notified of a fuel leak at the 7th Street BX Gas Station, which over a period of years had released an estimated 3600 gallons of unleaded gasoline into the subsurface environment (ES 1990). A remedial investigation and design effort conducted by Geraghty and Miller was initiated in the spring of 1985. Among the results from the remedial investigation, the presence of volatile and semivolatile organic compounds was detected in the shallow groundwater near the 7th Street site. Free fuel product was also discovered floating on top of the water table at the site. In addition, minor concentrations of chlorinated hydrocarbons were detected (ES 1990). The suspected sources of the free product plume were underground fuel storage tanks and broken and leaky pipe fittings near the pump bays. The 1985 Geraghty and Miller data indicated that two separate plumes may have existed near the 7th Street site: one plume located directly beneath the service station and a second plume located hydraulically downgradient of the service station and adjacent to the vehicle maintenance facility (Bldg. 500). Geraghty and Miller speculated that the source of the second plume may have been associated with the vehicle maintenance facility (ES 1990).

A groundwater recovery/treatment system and a free product recovery system were installed at the 7th Street site in the fall of 1987. Due to delays caused by various system modifications, the system did not begin operation until the fall of 1989. The system was designed to recover the free-floating fuel product and both contaminant plumes identified by Geraghty and Miller in 1985 (ES 1990). The recovered groundwater is treated utilizing an on-site air stripper system to remove the volatile organic compounds from the water. The treatment system effluent is subsequently discharged into a sanitary sewer. The system is currently regulated under FDER Final Order (ES 1990). ES was under contract to monitor and maintain the system.

Recent groundwater sampling results in July 1991 presented in Table 2.2 indicate a continued presence of BTEX compounds at high concentrations in the

TABLE 2.2
RESULTS OF BASELINE SAMPLING
JULY 19, 1991
7TH STREET BX SERVICE STATION
EGLIN AFB, FLORIDA

Parameter	Units	MCL Federal(2)	MCL Florida(3)	MW-1S	MW-1DP	MW-3	MW-5	MW-6S	MW-6DP	MW-8	MW-10	MW-E
Benzene	ug/L	5	1	7,140 **	ND	62.5 JN**	ND	ND	ND	1,190 **	4,650 **	ND
Toluene	ug/L	1,000	-	30,200 **	ND	45.6 JN	ND	ND	ND	10,500 **	4,590 **	ND
Ethylbenzene	ug/L	700	-	3,040 **	ND	7.5 JN	ND	ND	ND	6,730 **	563	ND
Xylenes	ug/L	10,000	-	18,910 **	ND	47.8 JN	ND	ND	ND	12,720 **	2,350	ND
Tric,Fl-Methane	ug/L	-	-	ND	ND	ND	20.5	ND	ND	ND	ND	ND
1,1-Dichloroethene	ug/L	7	7	ND	0.5 JN	ND	0.6 JN	0.5 JN	ND	ND	ND	0.5 JN
Chloromethane	ug/L	5	-	ND	3.2 U	3.2 U	2.4 U	2.3 U	ND	177 JN**	55 JN	2.8 U
Chloroform	ug/L	100 (1)	-	ND	ND	ND	ND	ND	1.1 U	ND	ND	ND
Trichloroethene	ug/L	5	3	ND	5.9 **	ND	ND	ND	3.7 **	ND	ND	ND
T-1,3-Dichloropropene	ug/L	-	-	ND	ND	2.2 JN	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	600 (1)	-	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	ug/L	15 *	50	9.3	ND	8.8	ND	6.5	ND	9.6	35.1 **	4.1
pH	-	NA	NA	6.01	6.71	6.58	5.35	5.75	5.56	6.44	6.78	6.97
Conductivity	umhos/cm	NA	NA	371	76	290	186	256	67	234	290	218

MCL - Maximum Contaminant Level
NA - Not Applicable
ND - Not Detected
J - Estimated value
(1) - Compound listed for regulation
(2) - USEPA "Drinking Water Regulations and Health Advisories," November 1991.
(3) - FDER "Drinking Water Standards, Monitoring and Reporting," April 1990.

* - Action level
** - Concentration exceeding MCL
N - Tentative identification. Presumptive evidence of presence of material
U - Undetected at and above this level

AT510/922J153/T-2-2.XLS

sand and gravel aquifer near the 7th Street site. The results indicate the high BTEX concentrations (>1000 μg/l) in three wells; MW-1, MW-7 and MW-10. These wells are located within the suspected source area. The sampling results also indicate the presence of chlorinated hydrocarbons in MW-1, MW-1DP, MW-3, MW-5, MW-6, MW-7, and MW-10. The vehicle maintenance facility located southeast of the site may be a potential source of these contaminants.

2.4 RECENT INVESTIGATION - BIOVENTING PILOT TEST

On October 7 and 8, 1991, representatives of the Air Force Center for Environmental Excellence (AFCEE) and Engineering-Science, Inc. conducted a series of diagnostic tests to determine the feasibility of using in-situ bioventing to remediate a fuel spill at the 7th Street Service Station on Eglin AFB, Florida. Three diagnostic tests were attempted during this 24-hour site visit. Two of the tests, an air permeability and initial soil gas analysis were completed. A third test to estimate in situ respiration rates was unsuccessful because the test extraction well was not located in fuel contaminated soils. The results of these tests and a recommended approach for full-scale remediation were included in a letter report (ES, 1991). Highlights of the tests and results are presented in the following sections.

2.4.1 Soil Gas Analysis

Well MW-1 was selected for soil gas extraction and analysis. This well was selected because it was the only monitoring well near the fuel spill that had open screen above the water table. After a 1 scfm vacuum pump was used to purge MW-1 for 10 minutes and draw in soil gas for analysis, no oxygen was detected in the extracted soil gas at Well MW-1. A carbon dioxide concentration of 14 percent was measured. This indicated that existing soil bacteria are consuming all available oxygen, and that contaminated soils beneath the asphalt paving are anaerobic. Data gathered indicated the addition of oxygen using a bioventing system will accelerate the natural biodegradation of the remaining fuel residuals.

2.4.2. In-situ Respiration Test

An in-situ respiration test was attempted using MW-1 first as an air injection point and then as a soil gas monitoring point. Fresh air was injected at a rate of 80 scfm for approximately 12 hours using the DR 404 Rotron® blower. After 12 hours of air injection the DR 404 Rotron® blower was removed from the well and a 1 scfm vacuum pump was used to purge the well and draw in surrounding soil gas. Oxygen levels were elevated to 21 percent after the air injection and the in-situ respiration test was initiated. At one hour intervals MW-1 was purged for one minute and air samples analyzed for oxygen and carbon dioxide.

Oxygen consumption was very slow at MW-1 and it did not appear that soils near this well contained sufficient contamination to provide a hydrocarbon source for natural bacteria. It was possible that the 12 hours of air injection forced hydrocarbon vapors away from MW-1 and removed the hydrocarbons vapors which existed near the well prior to the air injection. Similar tests at a jet fuel site at Tyndall AFB yielded average oxygen consumption rates of .004%/min, or 1500-2000 mg of total petroleum hydrocarbons per kg of soil per year. Although rates could not be measured at Eglin AFB due to the lack of a vapor monitoring well in the fuel contaminated soil, the report for the pilot study suggested it was reasonable to assume that Eglin AFB soils and bacterial populations will produce similar rates when enhanced by bioventing.

It was determined that full-scale remediation of the site can be achieved through a combination of free product recovery, groundwater depression and treatment using the existing air stripper, and in-situ bioventing to remove fuel contamination from soils beneath and adjacent to the asphalt pavement. ES recommended restoration of the free product recovery system to remove the final layer of fuels from the groundwater soil interface. In addition, ES recommended that the existing groundwater recovery system should be operated at the maximum capacity possible without jeopardizing air stripper efficiency. This will provide a maximum depression of the groundwater table and increase the ability of the bioventing system to circulate air through the capillary fringe and total contaminated soil profile.

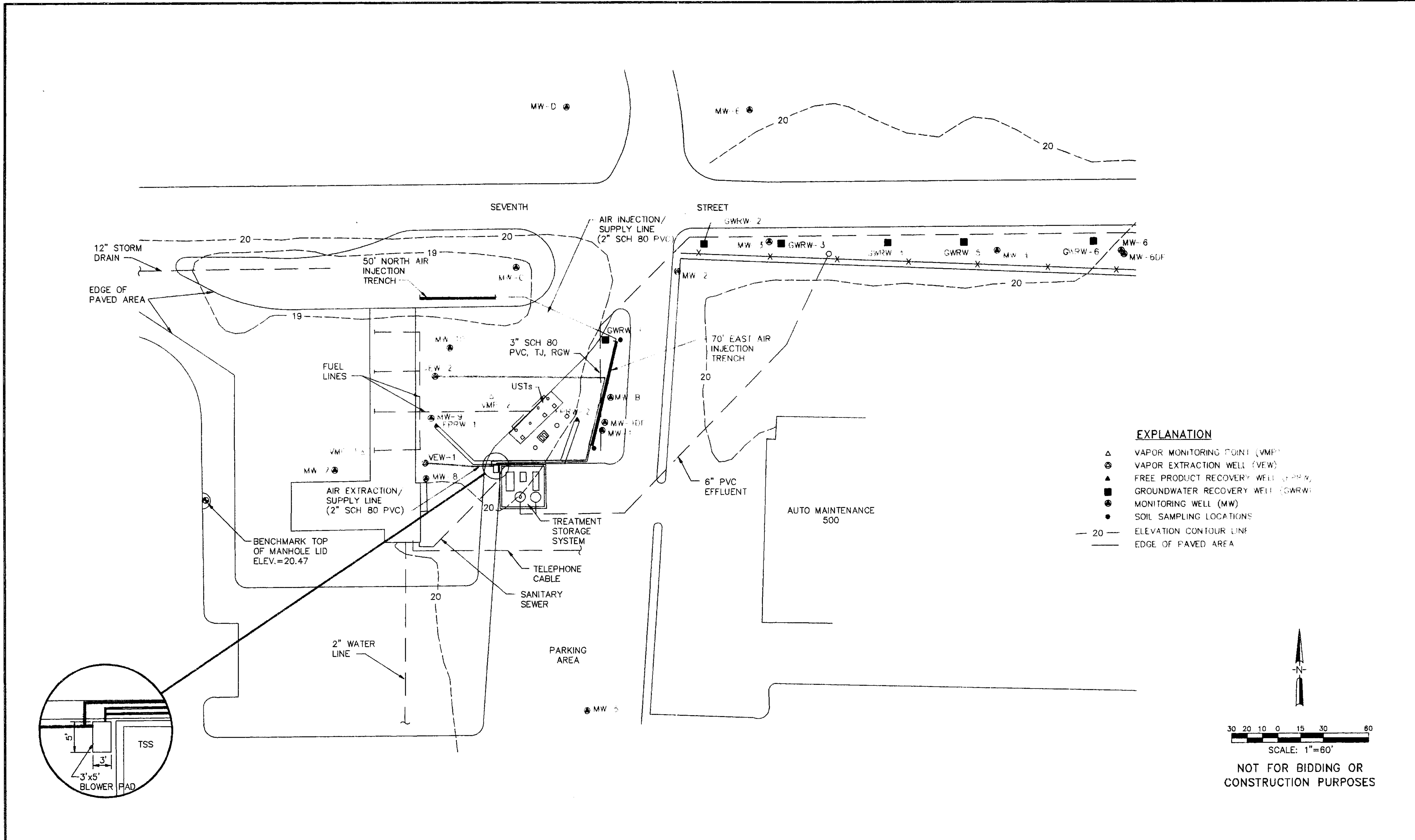
SECTION 3
BIOVENTING SYSTEM

3.1 DESCRIPTION

The proposed bioventing system is depicted on the bioventing system installation plan presented in Figure 3.1. The system is designated to operate at a flow rate that is sufficient to influence the entire contaminated volume but slow enough to optimize oxygen delivery without creating excess volatile emissions at the site. Based on the radius of influence measured during the pilot testing, a blower capable of operating at 80 scfm at a vacuum of 60″ H_2O will be installed. A Gast Model RJ 125 Q-50 or EG&G Rotron Model DR505 AX5B explosion proof or equivalent will be adequate for this application, and will provide additional capacity for recirculation of vapor-laden air.

This bioventing system has been designed to maximize the recirculation of vapor-laden air through site soils. Figure 3.2 illustrates the recommended conceptual design for this site. Two 4″ vapor extraction wells (VEWs) will draw oxygenated air into the site from all directions stimulating aerobic biodegradation. A dilution valve located on the vacuum side of the blower will be used to control flow rates and supply additional oxygen to the system. To control and reduce volatile organics in the extracted air stream and further enhance biodegradation of these volatiles, air removed from the soils would be reinjected at two locations; along the north edge of the asphalt using a 50 ft injection trench and along the east edge of the asphalt area near Well MW1 using a 70 ft. injection trench (Figure 3.1). The location for the injection trench will set up an air recirculation pattern in the northern half and eastern portion of the asphalt area away from the service station (see Figure 3.2). In addition, these injection trenches will allow for better air distribution and recirculation in the system. Minimal air will escape to the atmosphere because the flow gradient will pull air beneath the asphalt for multiple passes through the soil. To improve air permeability in this area, ES recommends that the grass island not receive artificial watering during the course of this treatability study. Two vapor monitoring points (VMPs) will be installed to evaluate the potential for in situ biodegradation over time at the site. These VMPs will be located within the area of known contamination as shown in Figure 3.1. The uptake of oxygen by soil bacteria and subsequent production of carbon dioxide are indicators of biodegradation which can be measured at these monitoring ports. To evaluate the effectiveness of this system, soil samples will be collected for analysis

Figure 3.1



NO.	DATE	REVISIONS	PROJECT NO. AT510
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0	4/1/92	DRAFT	

ENGINEERING SCIENCE
DESIGN · RESEARCH · PLANNING

ES

EGLIN AFB
7th STREET BX SERVICE STATION
FLORIDA

BIOVENTING SYSTEM
INSTALLATION PLAN

SCALE 1" = 60'
SHEET NO.
FILE NO. SITEMAP.DWG

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Figure 3.2

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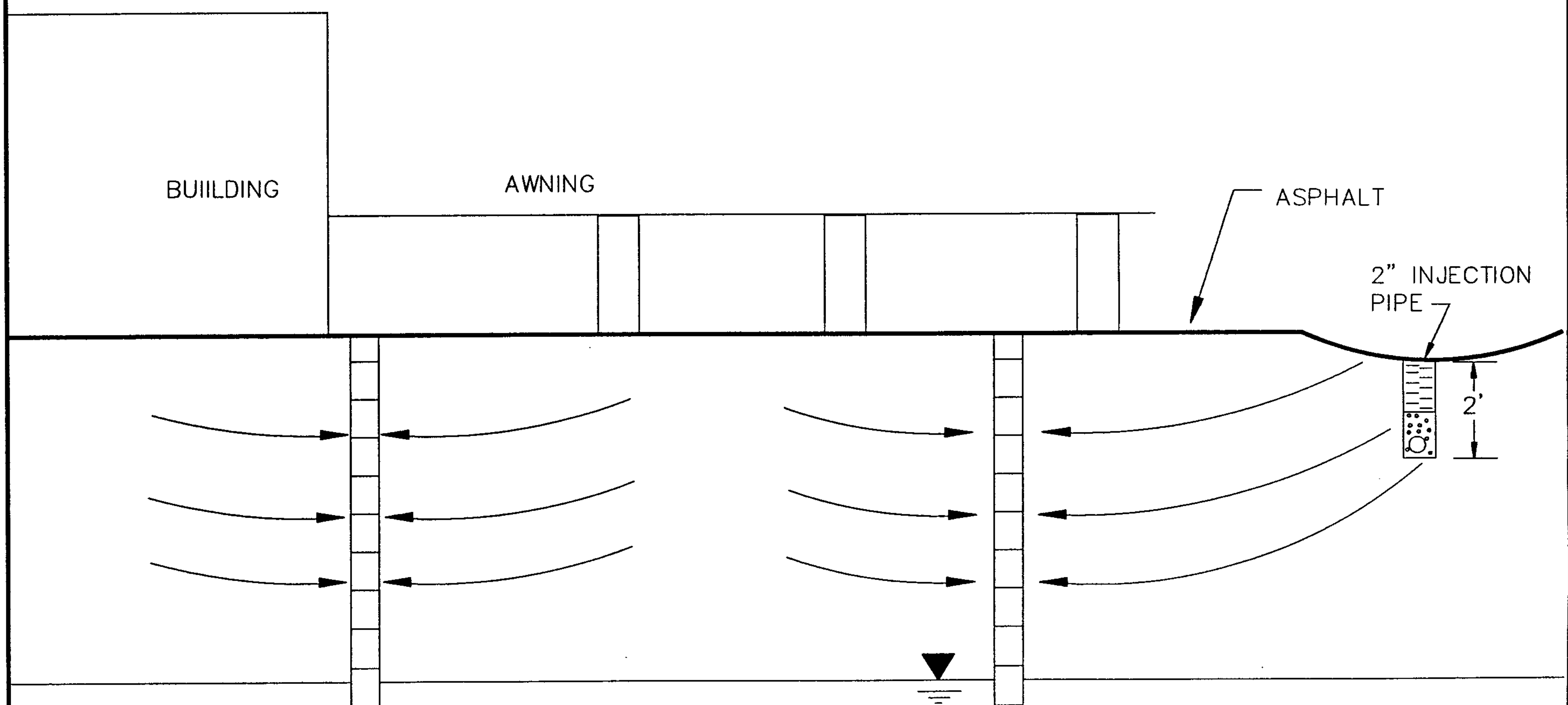
CONCEPTUAL CROSS-SECTION DESIGN FOR IN-SITU RECIRCULATION
7th STREET BX SERVICE STATION
EGLIN AFB, FLORIDA



ES ENGINEERING-SCIENCE

during installation of the system and after one year of operation of the system for comparison.

The objectives of this system will be to: 1) supply oxygen to contaminated soils; 2) reduce volatile emissions by recirculating extracted gases through in situ soil; and 3) create a flow gradient away from the existing service station to prevent vapor hazards.

3.2 PROCEDURES AND SPECIFICATIONS

This section present the procedures to be employed for performing construction activities for the bioventing system at the 7th Street Service Station. In addition, the specifications for the materials to be used in the construction of the system are also provided.

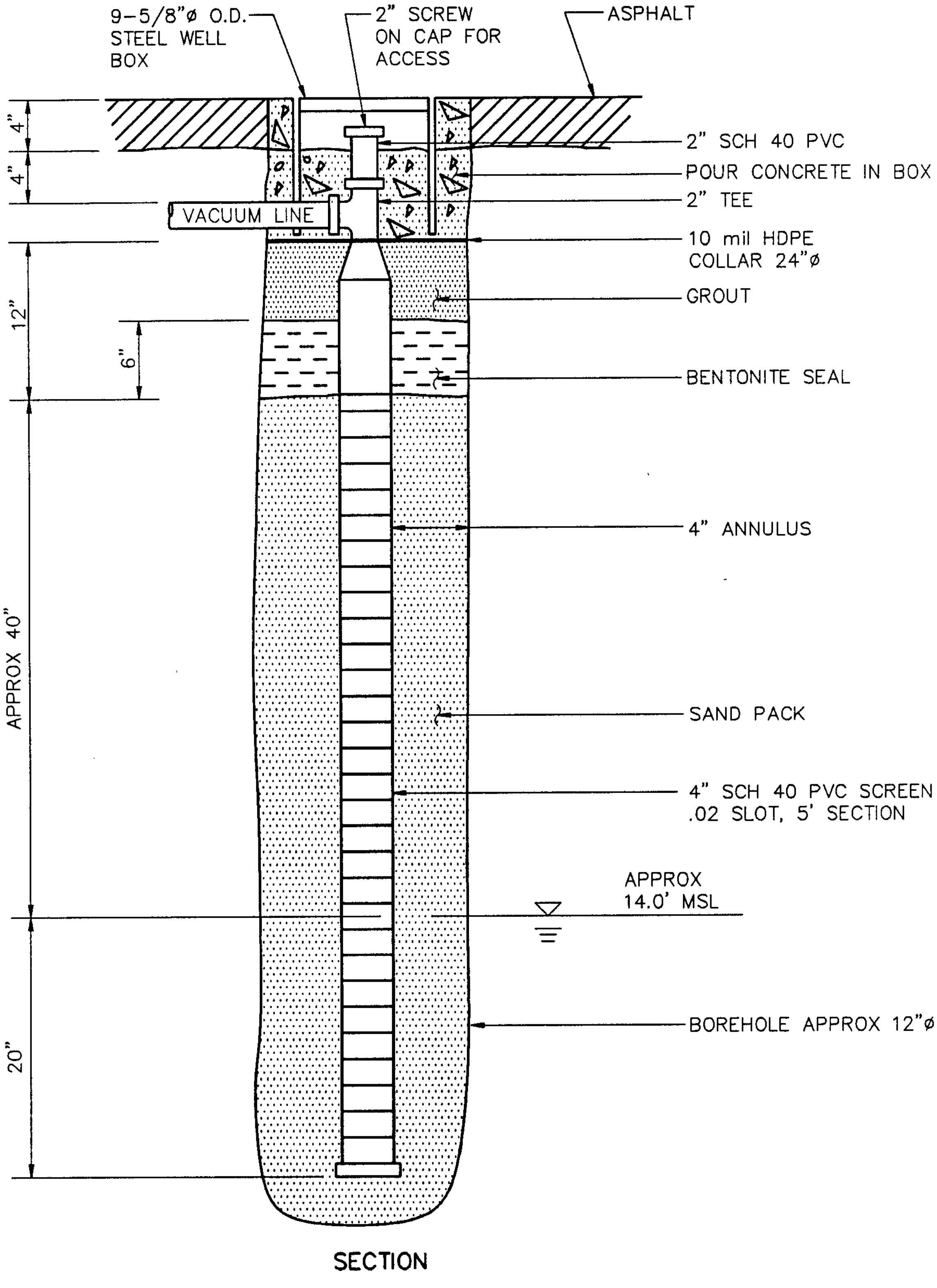
3.2.1 Drilling

Drilling work will be conducted to install the vapor extraction wells, vapor monitoring points and to enable collection of soil samples for chemical analyses. Hollow stem augering technique will be used for drilling the borings for wells followings procedures described below. A nominal six-inch internal diameter, continuous flight hollow stem auger will be used for drilling boreholes meant for both collection of soil samples for analyses and well installation. Hollow stem augering technique or hand augering technique will be used to drill boreholes designated solely for collection of soil samples for analyses. In this case, if the hollow stem augering technique is used, a nominal 3¼-inch ID, continuous flight auger will be used to drill the boreholes.

3.2.1.1 Borehole Installation; Sizes and Depths

The boreholes for the vapor extraction wells will be approximately 12-inches in diameter and advanced to a depth of approximately 7 ft. The wells in these boreholes will be installed at a depth of approximately 7 ft. (Figure 3.3). The wells will be constructed of 4-inch ID schedule 40 polyvinyl-chloride (PVC) casing and screen. The screen slot size will be 0.020-inch and the screen will be 5-ft section of PVC. At a maximum the borehole shall extend 20 ins. into the water table to accommodate the vapor extraction wells. The purpose for this is to allow bioventing to impact deeper soils as the water table drops. By construction time, it is anticipated that the water table at the site would be near its highest level. Water table fluctuation of about 1 to 2 ft. can be expected in this area. Current site hydrologic condition is indicative of lower water table i.e. the water table on January 13, 1992 was at a depth of about 6 to 10 ft bls. The water table can get as high as 4 ft. below ground surface at this site.

The boreholes for the vapor monitoring points will be approximately 12-inches in diameter and be completed to a depth of approximately 4 ft. or to about 1 ft. above the water table (Figure 3.4). The vapor monitoring points will be constructed



TYPICAL VAPOR EXTRACTION WELL (VEW)

N.T.S.

NOTE:
NOT FOR BIDDING OR CONSTRUCTION PURPOSES.

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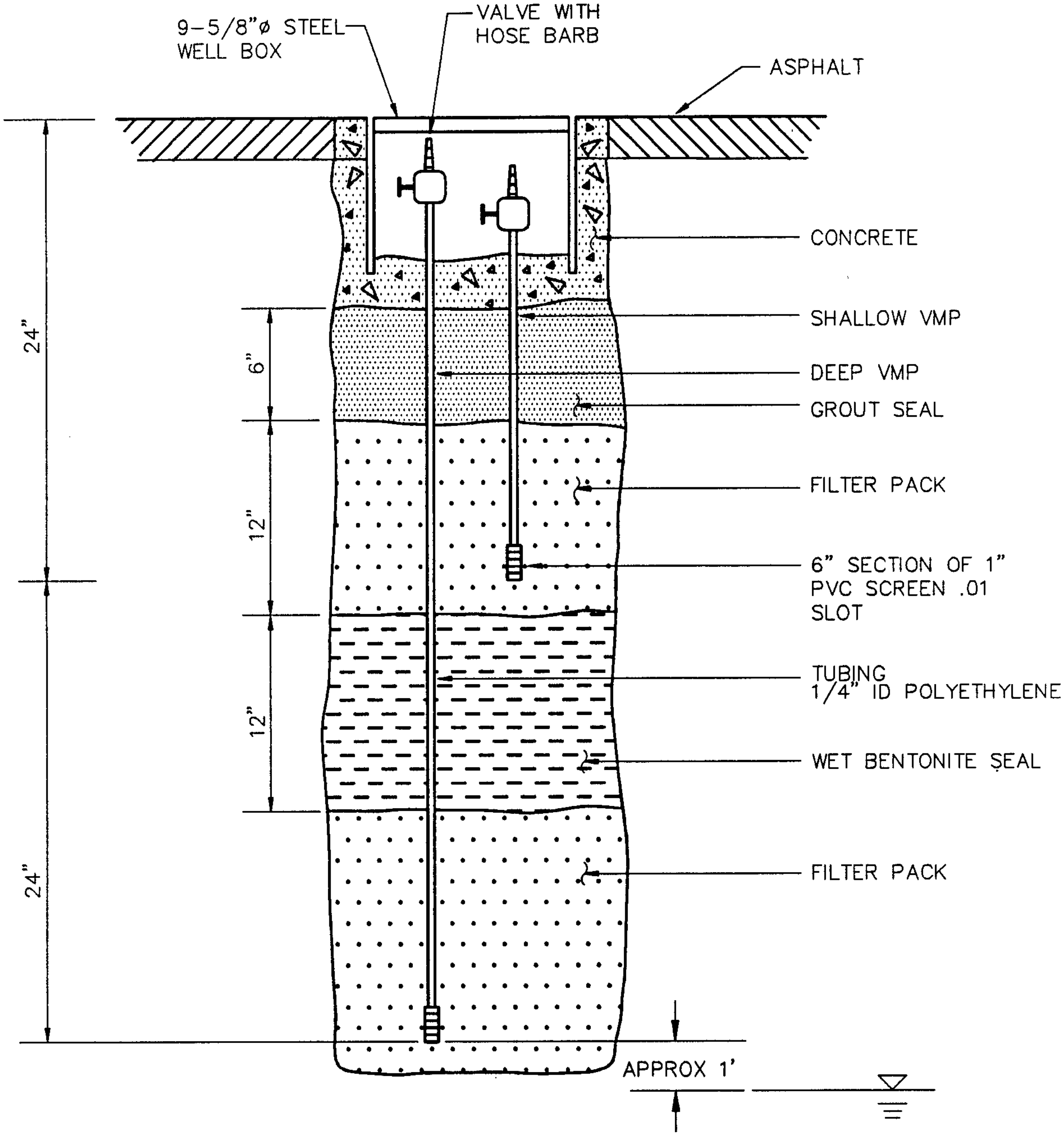

SECTION

TYPICAL VAPOR MONITORING POINT (VMP)

N.T.S.

NOTE
NOT FOR BIDDING
OR CONSTRUCTION
PURPOSES.

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of ¼-inch ID polyethylene. The screen will be constructed of 1-inch ID Schedule 40 PVC, with a slot size of 0.010-inch. These points must be completed in contaminated soils to insure accurate measurement of biological degradation.

Boreholes for collection of soil samples for analysis will be approximately 6-inches or 12 inches in diameter depending on method used and advanced to depths of 4-8 ft. Two of these boreholes (VEWs boreholes) will extend to a minimum of 1 ft below current groundwater table to obtain samples to evaluate contaminant distribution in the soil.

3.2.1.2 Borehole Logging

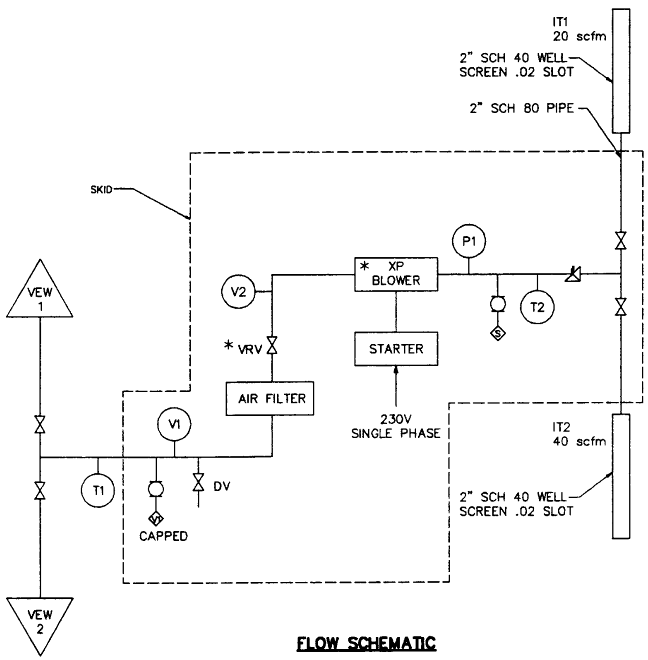
Soil samples will be collected for lithologic description as the borings are advanced. These samples will be collected using an 18-inch long, split spoon samples following Standard Penetration Test procedures (ASTM Method D-1586) where applicable. The samples will be collected at 2-ft. intervals to depths specified for each type of borehole drilled. Soils will be classified with respect to type, grain size, mineralogy (when pertinent), color, etc. The samples will also be checked for discoloration, odor, and presence of organic vapors. The presence of organic vapors will be tested by placing a portion of the sample in a bottle, sealing the bottle, then testing for the presence of organics in the headspace of the bottle using an organic vapor detector. Information gathered from these sampling efforts will be recorded on a boring log.

3.2.1.3 Borehole Abandonment

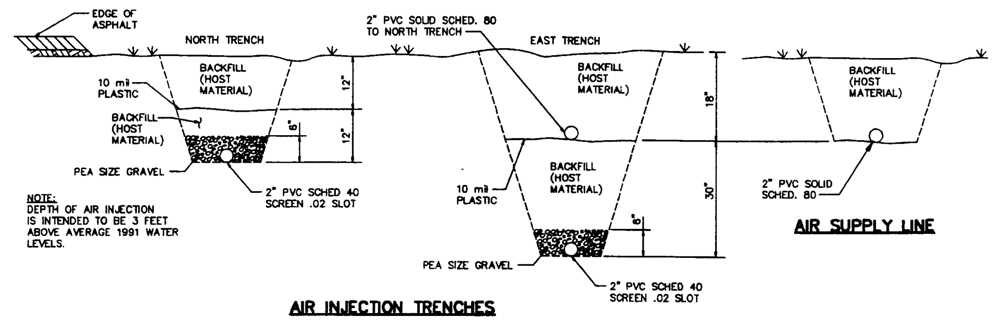
Boreholes not contaminated enough for completion as a monitoring well and those used solely for soil sample collection will be abandoned. Abandonment shall involve filling of each borehole with cement grout in the appropriate mixture discussed for "grouting". The grout will be placed in the hole from the bottom up in one continuous operation using a tremie pipe. The augers will be pulled gradually as the grout is placed.

3.2.2 Piping and Air Injection Trench Excavations

The bioventing system will also require two air injection trenches and air supply piping excavation. Locations of the proposed excavations are presented on Figure 3.1. A typical section of pipe and air injection trench is included in the site conceptual details for the Beioventing System on Figure 3.5. Excavations for piping and air injection trenches will include the removal of any material for the installation of system piping and will be constructed in accordance with OSHA regulations. Excavations for air supply pipe trench will not be performed greater than 18 inches over existing conduits for the recovery and treatment system unless site condition warrants laying of air supply pipe across but under conduit to maintain slope required. Where this conditon occurs extra care will be taken to undercut soil beneath conduit without making contact with conduit. If possible



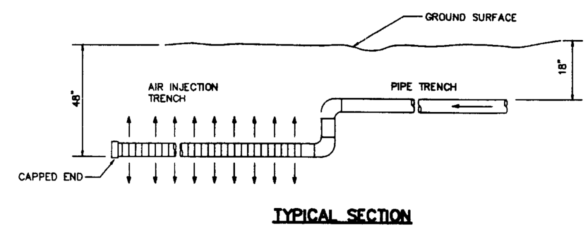
FLOW SCHEMATIC



NOTE:
DEPTH OF AIR INJECTION IS INTENDED TO BE 3 FEET ABOVE AVERAGE 1991 WATER LEVELS.

AIR INJECTION TRENCHES

AIR SUPPLY LINE



TYPICAL SECTION

TYPICAL SECTION OF AIR INJECTION TRENCHES AND PIPE TRENCH

LEGEND

IT – INJECTION TRENCH

(P) – PRESSURE GUAGE (0–100" H_2O)

(T) – TEMPERATURE GUAGE (T1 0–250°F) (T2 0–250°F)

– SAMPLE PORT

(V) – VACUUM GUAGE (0–100" H_2O)

VRV – VACUUM RELIEF VALVE (SET AT 70" H_2O)

– RELIEF VALVE

– AIR CONTROL VALVE

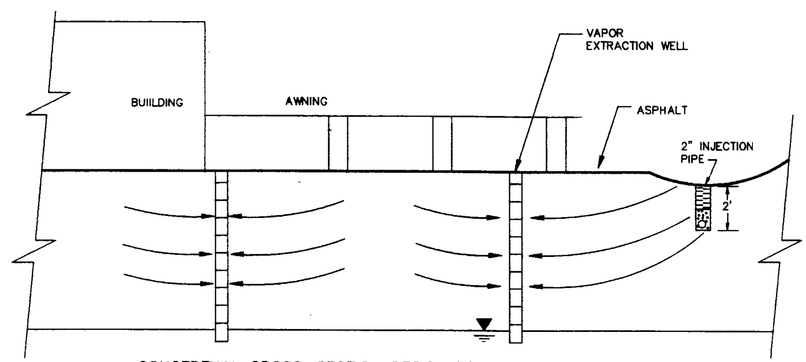
DV – DILUTION VALVE

*

BLOWER SPECS: GAST R5125-1 (2.5 HP) OR EG&G ROTRON MODEL DR505AX58 80 cfm AT 60" H_2O. EXPLOSION PROOF 2 HP SINGLE PHASE 115/230V. MAX AMPS – 11.5A AT 230V.

VACUUM RELIEF VALVE SPECS: GAST AG258 1 1/2" NPT, ADJUSTABLE 30 – 170 in. H_2O. 200 cfm MAX. SILENCER FOR RELIEF VALVE, AJ121D

FLOW SCHEMATIC FOR THE BIOVENTING SYSTEM



CONCEPTUAL CROSS-SECTION DESIGN FOR IN-SITU RECIRCULATION

NOTE:
NOT FOR BIDDING OR CONSTRUCTION PURPOSES.

NO.	DATE	REVISIONS	PROJECT NO. AT510.06	DATE
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DESIGN RESEARCH PLANNING

EGLIN AFB
7th STREET BX SERVICE STATION
Florida

CONCEPTUAL DETAILS
– MISCELLANEOUS

SCALE NONE
SHEET NO. 4
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3.2.2.1 Air Injection Trenches

Air injection trenches will be used to recirculate hydrocarbon vapors for treatment in the soil and to circulate additional oxygen to contaminated soils.

Trenches constructed for installing the air injection piping will be excavated to a maximum depth of three feet and one foot in width. The actual bottom of the trench will be determined by the on-site ES Engineer based on the stability of the undisturbed material. Sections of the trenches to be constructed are shown on Figure 3.5.

3.2.2.2 Auxiliary Piping Trenches

Excavations constructed for installing vacuum and recirculation piping will be excavated to a maximum of two feet. If foundation soil is soft, wet, unstable or does not afford solid foundation for pipe, the subcontractor will excavate 6" below pipe grade and backfill with approved material as specified below.

3.2.2.3 Photographs

Photographs of the trenching operations will be taken for documenting activities. Photographs will be stored in the ES project files and will be provide to AFCEE and EAFB.

3.2.2.4 Utilities

Prior to any excavation activities, the ES representative will meet with the base civil engineer and determine the location of all underground utilities in the proposed trenching areas. Utilities will be identified in the field and marked for identification purposes by the base Civil Engineering personnel. All appropriate digging permits will be obtained from the base before excavation activities are initiated.

3.2.3 Soil Sampling Procedures

3.2.3.1 Hand Auger or Split-Spoon Samples

During drilling operations, soil samples will be collected using a hand-auger or a split-spoon sampler. Hand auger will be used wherever possible. In areas where hand augering is not possible hollow stem augering with split-spoon sampling will be performed.

3.2.3.2 Location, Number and Depth of Soil Samples

A maximum of eight soil samples will be collected for laboratory analysis. Of these, two samples will be collected from each of the VEWs, preferably one sample at 1 ft. above the water table and a second sample at 1 ft. below the water table; one sample will be collected from each of the VMPs at a depth of 4-5 ft; and two samples, one at each end, of the east trench. Soil sampling locations as described are shown on Figure 3.1. Generally, soil samples will be collected by advancing a hand auger or split-spoon sampler at 2-ft depth interval.

Samples sent to the laboratory shall include at a minimum, two QA Samples; a duplicate soil sample and an equipment blank.

3.2.3.3 Sample Preparation, Custody and documentation

Split-spoon samples will be collected using hollow-stem augering techniques. Prior to the collection of each sample, the split spoon sampler will be decontaminated.

Sample collection is accomplished by placing the split spoon samplers at the designated sample collection point and advancing the sampler until the desired depth is attained. The split-spoon sampler is then removed from the borehole. After the sample is collected, the following procedure is used to remove the sample from split spoon:

- Remove the shoe from the split spoon.
- Place a small portion into a jar for headspace screening.
- For soil sample designated for analysis, place the remaining soil sample into a decontaminated stainless steel bowl and homogenize with a decontaminated stainless steel spoon.
- Place the homogenized sample in the appropriate precleaned sample container.
- Package the samples and place immediately on ice.

Where hand augering technique is employed, the sample will be collected in the auger bucket at depth of interest and brought up to the surface. All but the first bulleted sample collection procedures above will then be followed to expedite the sample collection effort.

All samples will be accompanied by a Chain-of-Custody Record. A Chain-of-Custody Record will accompany the sample from sample collection during shipment to the laboratory, and through the laboratory. The "remarks" column will be used to record specific considerations associated with sample acquisition such as: sample type, container type, sample preservation methods, and method number of analyses to be performed.

The laboratory will retain one file copy and the completed original will be returned to the project manager as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler to a laboratory or to an ES office.

Shipments will be sent by overnight express courier and a bill of lading will be used. Bills of lading will be retained as part of the permanent documentation. Other details on sample handling, packaging and shipment are provided in the Sampling and Analyses Plan (SAP) for this project.

3.2.3.4 Soil Headspace Screening

The soil samples collected during hand auger or split-spoon sampling will be screened for possible contamination visually and with an organic vapor analyzes (OVA). A portion of the sample will be tested for the presence of organic vapors by transferring the soil to a glass bottle immediately upon retrieval, filling the bottle to 3/4 full, capping the bottle with aluminium foil, waiting for approximately 5 minutes, and then inserting the probe of the organic vapor detector through the foil into the headspace. The readings obtained will be recorded on the drilling records. The samples will be examined for obvious signs of contamination including discoloration and odor. Any indications of contamination will be noted on the boring logs. The samples will be labeled and examined visually for lithologic description.

3.2.4 Extraction and Monitoring Well Construction

3.2.4.1 Well Casing

All VEWs will be constructed of new and decontaminated 4-inch ID Schedule 40 Polyvinyl-chloride (PVC) casing and screen (Figure 3.3). However, a reducer will be used to complete the VEWs just below the ground surface as a 2-inch well. The purpose for this is to allow for placement of an adaptor for monitoring equipment and for use in connecting to the vacuum line. A threaded 4-inch PVC bottom cap will be installed at the bottom of the well. A 9 5/8-inch OD metal box will be installed over each VEW for flush completion to the ground surface. Whenever possible air tight threaded fittings will be used. All PVC casing will be straight and plumb, and will conform to ASTM standards F-480-88A or National Sanitation Foundation Standard 14 (Plastic Pipe Section).

The PVC casing will be visually inspected by the on-site geologist prior to installation. Any section of PVC pipe that does not appear straight and in good condition will be rejected.

All VMPs will be constructed of new and decontaminated ¼-inch ID Polyethylene (Figure 3.4). The VMPs will be completed below the ground surface. A 9 5/8-inch OD metal box will be installed over each VMP for flush completion to ground surface.

3.2.4.2 Well Screen

The VEWs will each have a 5-ft section of PVC screen. The VMPs will each have a 6-inch section of PVC screen. Screens will be 4-inch ID for the VEWs and 1-inch ID for the VMPs and constructed of schedule 40 PVC factory-slotted screen. Screen slot size will be 0.020-inch for the VEWs and 0.010-inch for the VMPs. Screen intervals in the VEWs and VMPs are shown in Figure 3.3 and 3.4.

3.2.4.3 Filter Pack and Natural Pack

A filter pack will be emplaced in each VEW from the bottom of the borehole to a few inches above the top of the well screen. The filter pack will be tremied in the annular space using a 1.5-inch (minimum) diameter pipe. The tremie pipe will be lifted from the bottom of the hole at the same rate that the filter pack is set. The filter pack material will be clean, well rounded, and inert silica sand. Filter pack shall be No. 30-40 silica sand (or equivalent) in the VEWs. A filter pack will also be used for the VMPs and will be placed from the bottom of the borehole or the required depth below the screen to a minimum of 6-inches above the screen (Figure 3.4).

3.2.4.4 Bentonite Seal

A 6-inch thick wet bentonite seal will be emplaced directly above the filter pack in the VEWs. A 12-inch thick wet bentonite seal will be emplaced directly above the natural filter pack in the deep VMPs. Because of the shallow depth of the VEWs and VMPs the bentonite will be pumped into the annular space. A minimum of one hour will be allowed for hydration of the bentonite before installation of the grout seal. The bentonite must form a complete seal. The depths at which bentonite seals will be placed in the VMPs and VEWs are also shown in Figures 3.3 and 3.4.

3.2.4.5 Grout Seal/Grouting

A 6-inch grout seal will be emplaced above the bentonite seal in the VEWs, and above the natural pack in the shallow VMPs. The grout will be mixed in the following proportions:

- 94 pounds of neat Type I Portland (or API Class A) cement.
- 4 pounds of pure sodium bentonite powder.
- 6.5 gallons of potable water.

Because of the shallow depth of well completion the grout could be pumped or poured.

3.2.4.6 Surface Completion of VEWs and VMPs

Each of the VEWs and VMPs will be completed flush to the surface using a 9 5/8-inch OD metal box (See Figures 3.3 and 3.4).

The fittings that will be installed at the top of the VEWs and VMPs are also shown in Figures 3.3 and 3.4. These fitting include a valve with a hose barb for each VMP and a 2-inch Schedule 40 ID casing with a screw-on cap for access to each VEW.

3.2.5 Piping Construction

Air injection pipes and associated piping will be installed as shown in Figures 3.1 and 3.5. All pipe, fittings, couplings, and appurtenant items shall be new, free from defects or contamination, and will be standard products of the manufacturer.

3.2.5.1 Air Injection Piping

The purpose of the air injection pipes will be to recirculate hydrocarbon vapors and provide oxygen to the contaminated soils to the north and east end of the site. The pipe in the north trench will be laid in the bottom of the trench at an approximate depth of two feet. The pipe in the east trench will be installed at an approximate depth of three feet. All injection pipes will be constructed of 2-inch schedule 40 PVC screen with 0.02 slot. Screen lengths will be furnished in 10 foot flush threaded lengths. The PVC piping will be inspected by the on-site ES representative prior to installation. Any section of PVC pipe that does not appear in good condition will be rejected. All elbows, joints and fittings will be connected using standard PVC cements.

Backfill between the injection screen and the trench will consist of a gravel pack made up of pea size gravel. The gravel pack will be uniform in size and will be introduced uniformly across the screened interval. The gravel pack will extend approximately 4" above the top of the screened interval in the north trench and in the east trench as shown on Figure 3.5. A sheet of 10-mil PVC material will be laid on top of the gravel pack and overlain by natural backfill to the ground surface. Since the air injection piping will be located in low traffic areas the backfill will not be compacted.

3.2.5.2 Vacuum and Injection Line Piping

Vacuum and Injection Line Piping will be installed at the site as shown in Figure 3.1. All vacuum and injection line piping will be constructed of solid, 2-inch schedule 80 PVC pipe. All elbows, joints and fittings will be threaded and air tight.

Backfill material of auxiliary pipe trenches will consist of uncontaminated natural soil or equivalent material. In area of heavy traffic material will be placed in 6" layers and compacted by tamping. Backfilling of the pipe zone will be completed by hand with particular attention to the underside of pipe and pipe fittings. Backfill will be placed to provide a firm support along the full length of the pipe.

3.2.6 Decontamination Procedures

3.2.6.1 General Decontamination Procedures

All equipment and tools that will be used at the site will be cleaned as necessary prior to each use. This effort will help prevent possible sample contamination from the variety of sampling equipment, tools and machinery that will be available for use during the execution of the field work. Decontamination will be documented in field log book.

3.2.6.2 Drilling Equipment

The drilling rig will be decontaminated by steam cleaning, washing with a non-phosphate laboratory-grade detergent and rinsing with potable water before moving to perform drilling work. All other drilling equipment, including casing and well screens, will be decontaminated following the procedures mentioned below.

3.2.6.3 Sampling Equipment

All tools used for sampling, including split spoons, hand auger buckets, sample-cutting knives, stainless steel bowls, etc., will be decontaminated before each use. Decontamination will consist of a laboratory grade detergent (e.g.,Liquinox®) wash, potable water rinse, pesticide-grade methanol rinse, and high pressure liquid chromatography (HPLC) grade water rinse, followed by air-drying. When dry, the equipment shall be wrapped in aluminum foil until ready for use. In general, as much decontamination as possible will be done at a designated area, preferably a base wash rack. Decontamination fluids will be discharged into the base sewer system. Decontamination fluids resulting from on-site decontamination will be collected and transported to the designated area for disposal.

Decontamination will be conducted in a manner that will guard against cross-contamination of equipment. Equipment will be placed on clean plastic sheeting or on surfaces covered with aluminum foil. Personnel will wear clean vinyl gloves during decontamination of equipment.

All decontamination procedures performed during the course of the field work will be documented in the field logbook. Any deviation from these decontamination procedures will be noted.

3.2.7 Asphalt/Pavement Patching

This section includes the material and construction requirements necessary to repair any asphalt or pavement changed by construction of the bioventing system. Any asphalt or pavement to be removed will be saw cut along straight lines to provide a vertical surface abutting asphalt or pavement to remain.

3.2.7.1 Materials

The aggregate used for the base will match existing material. The aggregate will consist of clean, hard durable fragments or particles of stone crushed to conform to that of aggregate commonly used at Eglin AFB in area subject to loading by semi-tractor trailers and other heavy vehicles. Base material will be approved in advance by the Engineering-Science Representative.

The asphalt mix used to replace the excavated surface material will match the existing material. The mix will conform to mixes commonly used in the area for surfaces designed for fully loaded semi-tractor trailers. Mix shall be approved in advance by the Engineering-Science representative.

3.2.7.2 Aggregate and Asphalt Placement

Prior to placement of aggregate, the surface of the subgrade will be compacted to provide a firm surface. The aggregate will be placed in layer of not more than two inches (compacted) in thickness to match existing conditions. Aggregate will be place directly on the prepared subgrade or on the preceding layer of compacted aggregate by approved methods. Immediately after material has been placed, it will be compacted with a vibratory compactor of adequate size and then approve by the Engineering-Science representative prior to any additional covering.

The asphalt mix shall be placed in layers or lifts of not more than two inches (compacted) in thickness to match existing conditions. Asphalt shall be placed directly on the prepared base or on the preceding layer of compacted asphalt by approved methods. Immediately after material has been place, it shall be compacted with a vibratory compactor of adequate size and then approved by the on-site Engineering-Science representative prior to any additional covering. The edges of the repaired section shall meet the existing pavement in flush, vertical joints to prevent mixing of new and old asphalt.

3.2.8 Analytical Procedures

The analytical methods which will be used in evaluating contamination and contaminant removal are presented in the Sampling and Analysis Plan for this project. Only soil samples will be collected for analysis at the laboratory. These samples will be analyzed in accordance with the Florida DER approved QA Plan of Southwest Laboratories, Inc. (SWLO). The analyte of interest is total petroleum hydrocarbons (TPHs). The analytical method to be used by SWLO is EPA analytical method 418.1. In addition, four of the samples collected may be analyzed for BTEX compounds to help evaluate baseline condition at the start of the bioventing work. A request for this analyses may be made by AFCEE at the time the sampling work is performed.

3.2.9 Extraction Equipment

The vapor extraction (VE) unit to be used for the bioventing test is depicted in a flow diagram included in the site conceptual details provided on Figure 3.5. The unit consists of a vacuum blower, starter, air filter, flow control and air bleed valves, pressure and temperature gauges, flow indicator, and air sampling points. The following section describes the equipment and processes.

Based on the pilot test an extraction rate of 40 scfm produced a radius of influence of approximately 50 ft beneath the asphalt at the surface. Radius of influence, minimum oxygen supply requirements, and the area of contaminated soil were used for the full-scale system design.

3.2.9.1 Vacuum Blower

To create a vacuum in the subsurface, a vacuum blower will be used to remove air from the VEW. A blower capable of providing 80 standard cubic feet per minute (SCFM) at approximately 60 inches of water-column vacuum, respectively is required. A Gast Model RJ125Q-50 or EG&G Rotron Model DR505 AX5B or equivalent has been selected as the vacuum blower to be used on site. The blower is constructed of aluminum for explosion proof operation.

The blower is driven by an explosion-proof 2-2.5 horsepower electric motor. It is rated for continuous-duty service, full-voltage starting, and is suitable for outdoor locations. A 230-volt, three-phase, 60-cycle electrical power source will be required and is available at the existing air stripper. An explosion proof starter will be installed through which power from the source to the blower will be controlled.

3.2.9.2 Instrumentation

Piping connecting VEW to the air filter will consist of 2-inch-inside-diameter, schedule-40 PVC pipe and fittings. A 2-inch PVC header will be used to manifold the air flow from each VEW. Piping to the each header will be sloped towards VEW. Air velocity ports will be placed on each vapor extraction well before the air filter to measure air flow from VEW. Air velocity ports will also be located before each air injection screen to measure injection flow rates. A vacuum indicator and a temperature indicator are located in 1.5-inch-diameter galvanized pipe (V1 and T1 shown on Figure 4.4). A dilution valve is also installed in the 1.5-inch galvanized pipe to regulate the vacuum and flow rate in the VEW.

A water knock-out pot may be required if significant moisture condenses in the air filter unit. A knock-out pot will not be placed on the unit initially because it requires frequent maintenance. However, the blower configuration will allow the installation of a knock-out if required.

A particulate filter will be placed in-line between VEW and the blower to protect the blower. A pressure indicator will be installed after the filter to measure the pressure differential across the knock-out pot and the filter (V2 shown on Figure 3.6). A vacuum relief valve will also be provided between the filter and blower. If the filter becomes fouled, the vacuum relief valve will prevent damage to the piping and blower. A pressure indicator (0-100" H_20) and temperature indicators will be installed between the blower outlet and the discharge piping (P3 and T2 shown on Figure 3.6). The discharge piping will consist of steel and PVC piping.

A vapor-sampling point will be placed between the blower and the air injection piping (SP shown on Figure 3.6).

3.2.10 Regulatory Requirements and Permitting

All drilling, well installation, sampling trenching, and other Construction activities pursuant to installation of the bioventing system shall be conducted in strict accordance with applicable laws, rules and regulations. The base will be contacted for construction requirements to enable issuance of permits where applicable. Well installation permits will be obtained from the state by the drilling subcontractor. The state will also be contacted to assure that all permits required are obtained.

SECTION 4
SYSTEM OPERATION AND MONITORING

The bioventing system will be operated and maintained by ES for a period of one (1) year, after system start-up. This 1 year period of ES operation and maintenance includes an initial 5 day start up operation, followed by monthly site visits. Eglin AFB will designate personnel to receive basic maintenance training and observe operations during the initial 5-day start up. Operation and maintenance logs will be developed and used by ES and Eglin AFB personnel operating and maintaining the system

4.1 SYSTEM START UP

Start-up of the bioventing System will begin following installation of all system components and restoration of site to its pre-construction condition. During this time, ES will perform vacuum monitoring, and in-situ respiration tests in order to optimize long-term operations.

4.1.1 Vacuum Monitoring

During start-up of the system the vacuum pressure will be measured at the two vapor monitoring points and at the two vapor extraction wells. The vapor monitoring points are installed to insure adequate air flow through the contaminated soil volume. Based on bioventing pilot testing on the site, a flow of 40 cfm is expected to produce a radius of influence of approximately 50 ft beneath the asphalt. A radius of influence of only 20 ft is expected in the grass covered areas based on air injection tests at well MW-1. The radius of influence of the system will be compared to the radius of influence predicted from the pilot test data.

At the vapor extraction wells, vacuum gauges with a range of 0 to 100 inches of water column will be used to measure the resulting vacuum. A vacuum gauge with a range of 0 to 20 inches of water-column will be used to measure vacuum at the Pressure Monitoring Points (PMPs). The vacuum measurements will be taken manually by connecting, with tygon tubing, the magnehelic gauge to the hose barb on each vapor monitoring point (Figure 3.4)

Operating time for each test will be recorded from the time the blower is turned on. Vacuum at each VMP, and at each measurement location on the vapor extraction wells will be recorded at 1, 5, 10, 20, 30, 40, 50, and 60 minutes, and every 60 minutes thereafter for 8 hours. This data will be used to confirm radius of influence requirements and insure air flow throughout the contaminated soil volume.

4.1.2 Temperature Monitoring

Temperature will be measured at each of the locations shown on Figure 3.6 at the same time intervals as the vacuum measurements.

4.1.3 Oxygen and Carbon Dioxide Monitoring

Oxygen concentrations are an excellent indicator of soil gas movement and the exchange of soil gas from outer soils into the contaminated zone. In the absence of vacuum extraction, soil gases in contaminated areas are depleted of oxygen and build up high levels of carbon dioxide as a result of biological fuel consumption. As stagnant soil gas is removed by the VEW, new soil gas enters the soil volume from surrounding clean soils and from the atmosphere. The result is an increase in oxygen and a decrease in carbon dioxide.

Prior to initiating vacuum extraction at this site, oxygen and carbon dioxide concentrations will be measured at each vapor monitoring point. In highly contaminated soils, oxygen is often totally depleted and carbon dioxide is often in excess of 15 percent. This indicates that fuel has provided the primary carbon source for respiration and cell growth, and that bacteria are in an oxygen-limited environment. Once venting begins, oxygen from surrounding clean soils and from the atmosphere is drawn into the contaminated soils. This rise in oxygen can be measured in both individual vapor monitoring points and in the exhaust of the VEWs.

Both oxygen and carbon dioxide will be monitored with a specialized gas analyzer. This instrument includes an infra-red detector for carbon dioxide and an electrochemical cell for oxygen analysis, and is capable of measuring both compounds to within an accuracy of 0.2 percent. The instrument requires daily calibration with carbon dioxide gas mixed in laboratory grade nitrogen.

To determine the specific oxygen utilization rates for this fuel spill site, an in situ respiration test will be conducted. As soil bacteria consume fuel they utilize oxygen and produce carbon dioxide. Prior field research has shown that oxygen consumption provides the most accurate estimate of hydrocarbon degradation. Although carbon dioxide should provide an equivalent estimate of fuel biodegradation, natural sinks and sources of carbon dioxide in the soil carbonate cycle can mask carbon dioxide production associated with bacteria respiration.

Oxygen uptake in an uncontaminated background area will also be monitored throughout start-up. If oxygen levels remain relatively constant it will indicate that biological oxygen consumption of natural (nonfuel) organic carbon and abiotic oxygen consumption are not significant in these soils.

Oxygen utilization rates measured during start-up of the system will be used to estimate the rates at which gasoline fuel will be biodegraded at this site and optimize oxygen supply rates. Complete biological mineralization of fuel hydrocarbons (e.g., n-decane) can be described by the equation:

$$C_{10}H_{22} + 15.5\ O_2 \dashrightarrow 10\ CO_2 + 11\ H_2O$$

Approximately 3.5 grams of oxygen is required to mineralized 1 gram of fuel hydrocarbons to carbon dioxide. This ratio will actually underestimate fuel biodegradation because a third or more of the fuel hydrocarbons are used in cell production and not carbon dioxide production.

Based on this 3.5:1 ratio, the average oxygen utilization rate observed in contaminated soils, and soil bulk density and porosity values, the quantity of fuel biodegraded each day can be computed using the following relationship:

$$K_b = K_o\, A\, D_o\, R \times 1/100\% \times 1440\ \text{min/day}$$

where:

K_b = biodegradation rate mg/kg/day

K_o = oxygen utilization rate (%/min)

A = vol of air/kg soil = porosity/bulk density

D_o = density oxygen gas assumed to be 1330 mg/l

R = mass ratio of hydrocarbon to oxygen required for mineralization (1:3.5)

4.2 QUARTERLY MONITORING

In-situ respiration test will be performed on quarterly basis (4 times) for the first year of operation. The respiration test will include oxygen and carbon dioxide monitoring over a 40 to 60 hour period as described above (section 4.1.3). In addition vacuum monitoring may be performed at VMPs to assure system is operating within the range of design specification. During these visits, the operation of the system will be reviewed and maintenance of the system will be performed.

SECTION 5
REPORTING REQUIREMENTS AND DELIVERABLES

After start-up of the bioventing system ES will prepare a summary report that will document baseline conditions and start-up effort. This report will also include the analytical data for soil samples collected prior to system start up. System start-up information will include vacuum monitoring and in-situ respiration test data and analysis.

An operation and maintenance (O&M) manual will be prepared as part of this project to assist base personnel in system operation and maintenance. Included in this manual will be a detailed information concerning system operation, theory of operation, operating strategy, operating schedule, preventive maintenance and safety.

Monthly summary report will be prepared and submitted to AFCEE after each monthly visit. This report will include results of monthly check of oxygen, carbon dioxide and volatile organics. Monthly results will be used to monitor the quantity of fuel biodegraded and to adjust the system to minimize volatile organic emissions. Each quarter an in-situ respiration test will be performed to ensure that nutrients, moisture or oxygen are not limiting biodegradation. The results of this quarterly in-situ respiration test will be provided with the associated monthly report.

At the end of the first year of operation, a final report containing a complete evaluation of the system will be provided. This report will include:

- a summary of the operation and maintenance of the system, including repairs and any modifications made to system;
- results of all monthly and quarterly monitoring efforts;
- results of soil sampling work after one year of operation and comparison to baseline condition; and a
- complete evaluation of the effectiveness of the system.

Where appropriate, results will be presented in tabular and graphical format.

SECTION 6
SUBCONTRACTORS AND RESPONSIBILITIES

Engineering-Science will employ the services of four subcontractors during the construction and installation of the bioventing system: Griner Drilling Services, Inc., Choctaw Engineering Services, Southwest Laboratories, and Bearden Construction Incorporated. Griner Drilling services, Mobile, Alabama will provide drilling and excavation services including installation of wells and piping for the system. Choctaw Engineering Services, Ft. Walton Beach, Florida will provide surveying services if required. Bearden Construction Inc., Ft. Walton Beach, Florida will provide electrical services. Southwest Laboratories of Oklahoma will provide analytical laboratory services for sample analyses. Where applicable, subcontractors shall obtain and pay for all permits, licenses, and certificates required for performance of work.

SECTION 7
SCHEDULE

The overall schedule for completing the tasks described in this work plan is presented in Table 7.1.

TABLE 7.1
SCHEDULE FOR BIOVENTING SYSTEM REMEDIATION STUDY
7TH STREET BX SERVICE STATION

Task	Start/Completion Dates
Project Scoping Documents	
Submit Engineering Design Work Plan (Draft)	2 March 92
Submit Health and Safety Plan	2 March 1992
Submit Sampling and Analysis Plan (Draft)	30 March 1992
Submit Engineering Design Work Plan (Final)	1 May 1992
Submit Sampling and Analysis Plan (Final)	1 May 1992
Treatability Work	
Construction and Installation of System	1 thru 12 May 1992*
System Start-up	15 May 1992*
Field Sampling	1 thru 5 May 1992*
Report	
Bioventing System O&M Manual	30 August 1992*
Bioventing System Start-up Letter Report	30 July 1992*
Bioventing System Monthly Summary Report	TBD
Bioventing System Final Letter Report	1 September 1992*

TBD To be Determined

*Those dates may change depending on when the Work Plan is approved.

REFERENCES

REFERENCES

CH2M HILL 1991, Installation Restoration Program Stage 2-1 Remedial Investigation. Beale Air Force Base, Marysville, California.

Downey, D.C. and M.G. Elliott 1990, Performance of Selected In Situ Soil Decontamination Technologies: An Air Force Perspective. Environmental Progress.

Engineering-Science 1991, Letter Report for the Bioventing Diagnostic Work and Conceptual Design for the 7th Street Service Stations

Engineering-Science 1992, Memorandum to File, January 21, Subject: Eglin AFB drinking water wells.

Engineering-Science 1991, Air Stripper Engineering Work Plan for the 7th Street BX Service Stations

Engineering-Science 1990, Recovery and Treatment System Evaluation Letter Report

Engineering-Science 1989, Installation Restoration Program (IRP) Stage 3, Remedial Investigation/Feasibility Study, Eglin Air Force Base, Florida

Federal Emergency Management Agency 1985, Flood Insurance Rate Map, Okaloosa County, Panel No. 120173-0190D, July.

Geraghty and Miller 1985, Remedial Action Plan for 7th Street BX Station.

Hinchee, R.E., D.C. Downey, and E.J. Coleman 1988, Enhanced Bioreclamation, Soil Venting and Groundwater Extraction: A Cost Effectiveness and Feasibility Comparison. Proceedings of NWWA/API Conference on Petroleum Hydrocarbons and Organic Chemicals in Groundwater. Houston, TX

Hinchee, R.E. and D.C. Downey 1989, Enhanced Bioreclamation of Jet Fuels - A Full-Scale Test at Eglin AFB FL. Air Force Engineering and Services Laboratory Technical Report 88-78

Hinchee, R.E. and R.N. Miller 1991, Bioventing for In Situ Remediation of Jet Fuel. Proceedings of Air Force Environmental Restoration Technology Symposium. San Antonio, TX

Layne Western 1987 Daily Drilling logs for A-20 and 7th Street Sites

Lee, M.D. 1988 Biorestoration of Aquifers Contaminated with Organic Compounds. CRC Critical Reviews in Environmental Control. Vol. 18 p 29-89

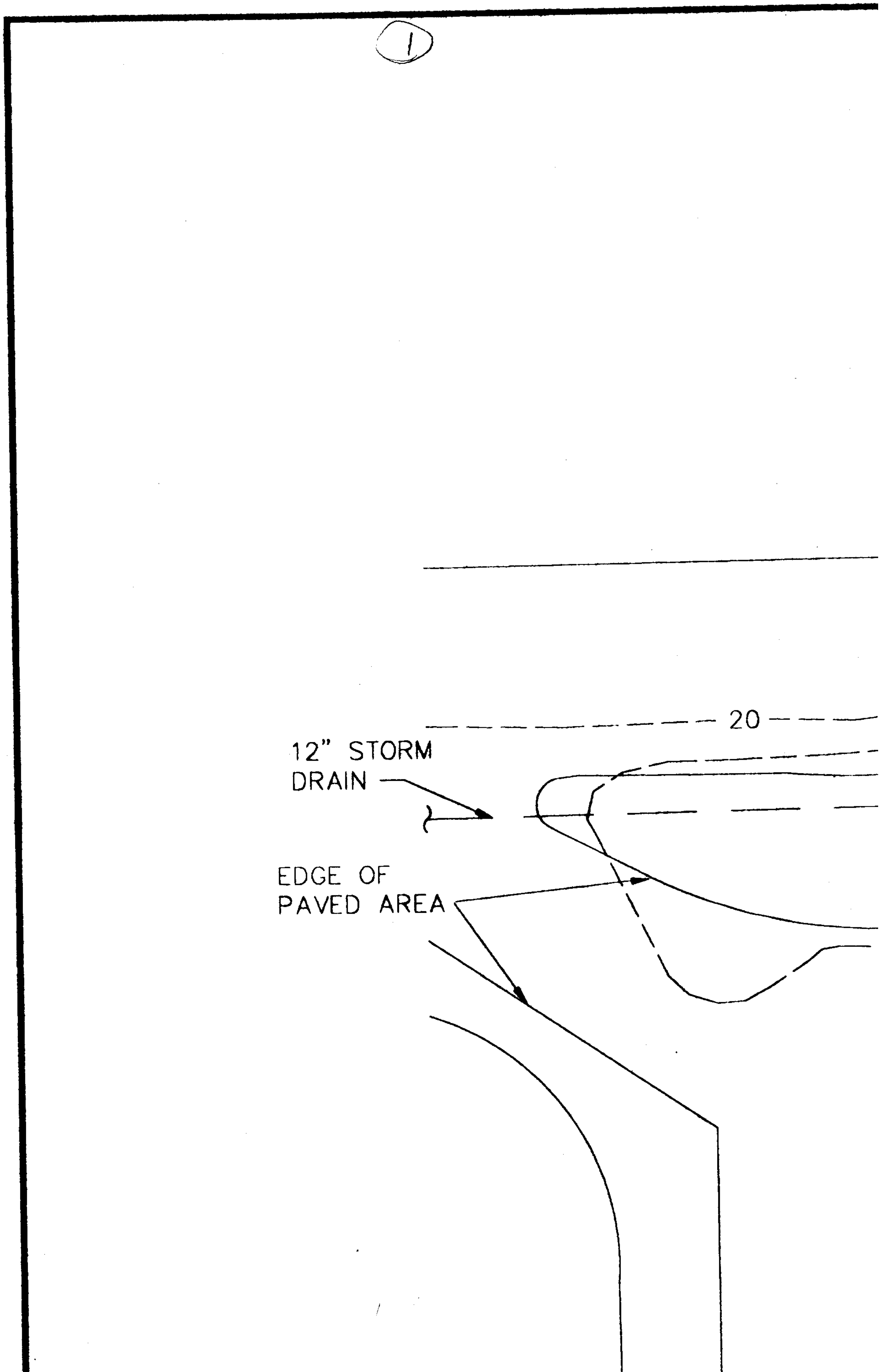
Miller, R.N. 1990, A Field Scale Investigation of Enhanced Petroleum Hydrocarbon Biodegradation in the Vadose Zone - Tyndall AFB FL Proceedings HWWA/API Petroleum Hydrocarbons and Organic Chemicals in Groundwater. pp 339-351. Houston, TX

U.S. EPA 1990, Enhanced Bioremediation Utilizing Hydrogen Peroxide as a Supplemental Source of Oxygen: A Laboratory and field Study. R.S. Kerr Laboratory. Submitted to the Center for Environmental Research Information (CERI) for Publication

U.S.G.S., 1986, Professional Paper 1403-B, Manuscript and Plate 25

U.S.G.S., 1988, Professional Paper 24030H, Manuscript and Plates 4 and 6

Wilson, J.S. and S.H. Conrad. 1984. Is Physical Displacement of Residual Hydrocarbons a Realistic Possibility in Aquifer Restoration. Proceedings of NWWA/API Conference on Petroleum Hydrocarbons in Groundwater, pp 274-297, Houston, TX



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12" STORM
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EDGE OF
PAVED AREA

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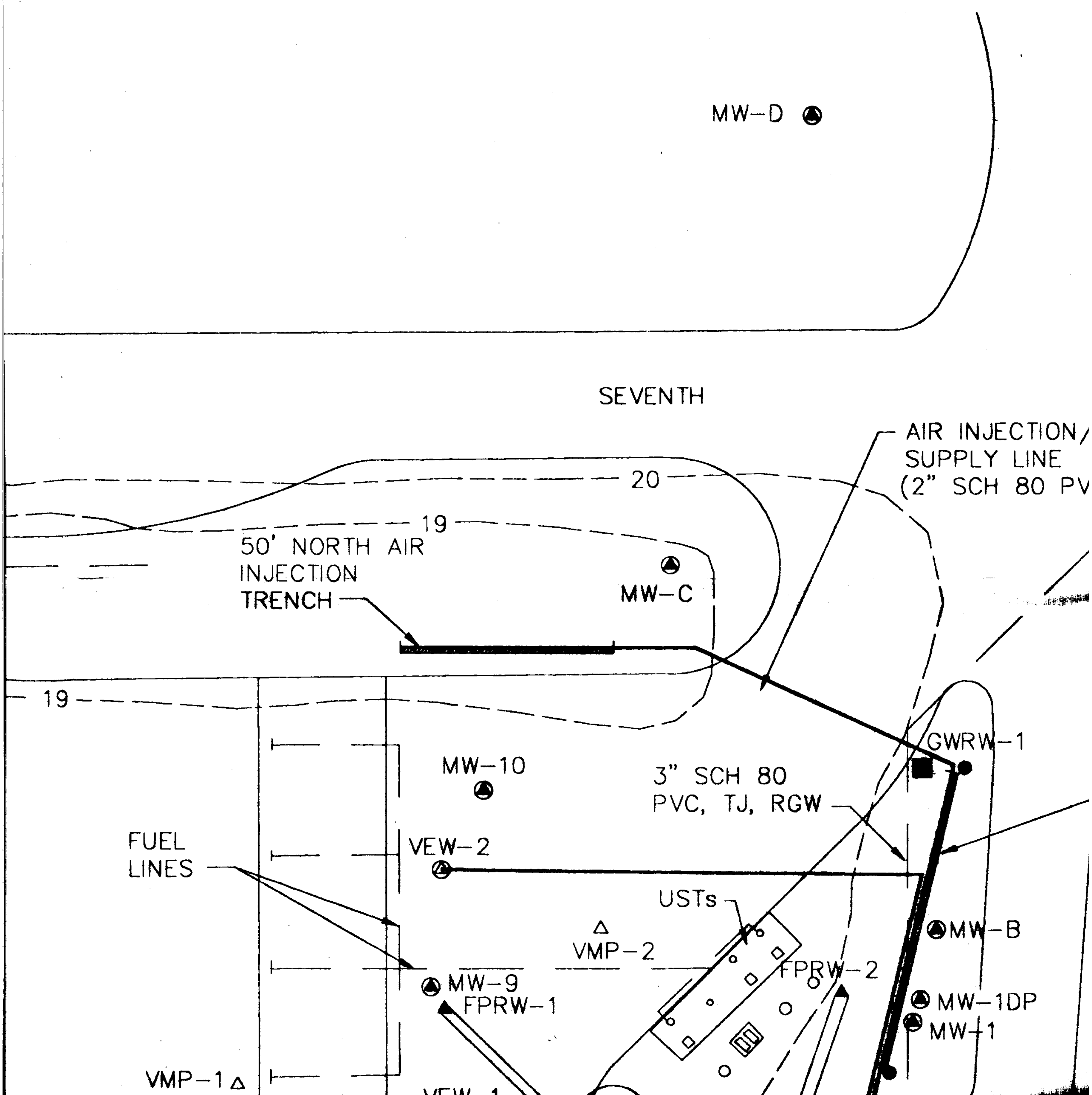
MW-D
SEVENTH
AIR INJECTION/
SUPPLY LINE
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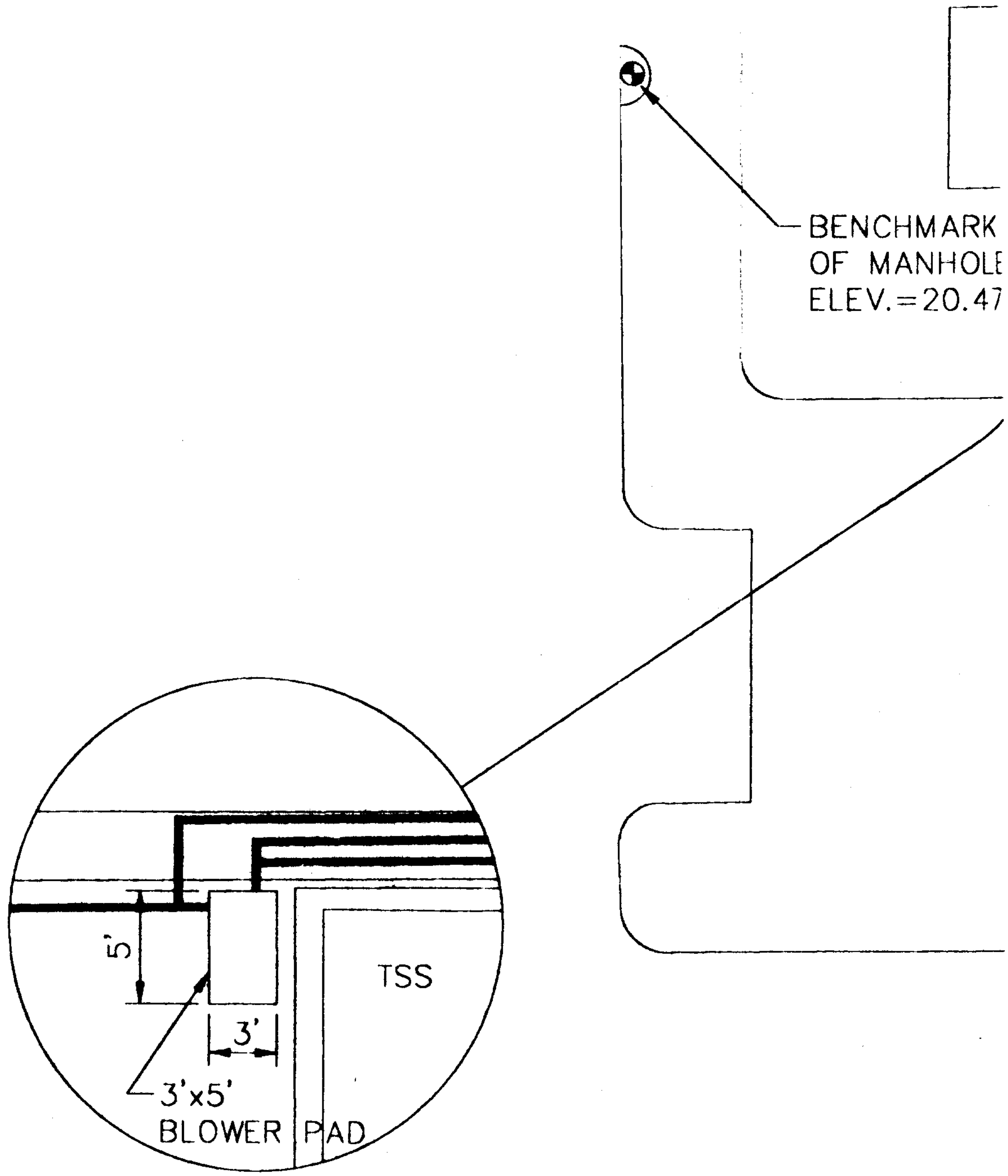
20
19
50' NORTH AIR
INJECTION
TRENCH
MW-C
19
GWRW-1
MW-10
3" SCH 80
PVC, TJ, RGW
FUEL
LINES
VEW-2
USTs
VMP-2
MW-B
MW-9
FPRW-1
FPRW-2
MW-1DP
MW-1
VMP-1
VEW-1



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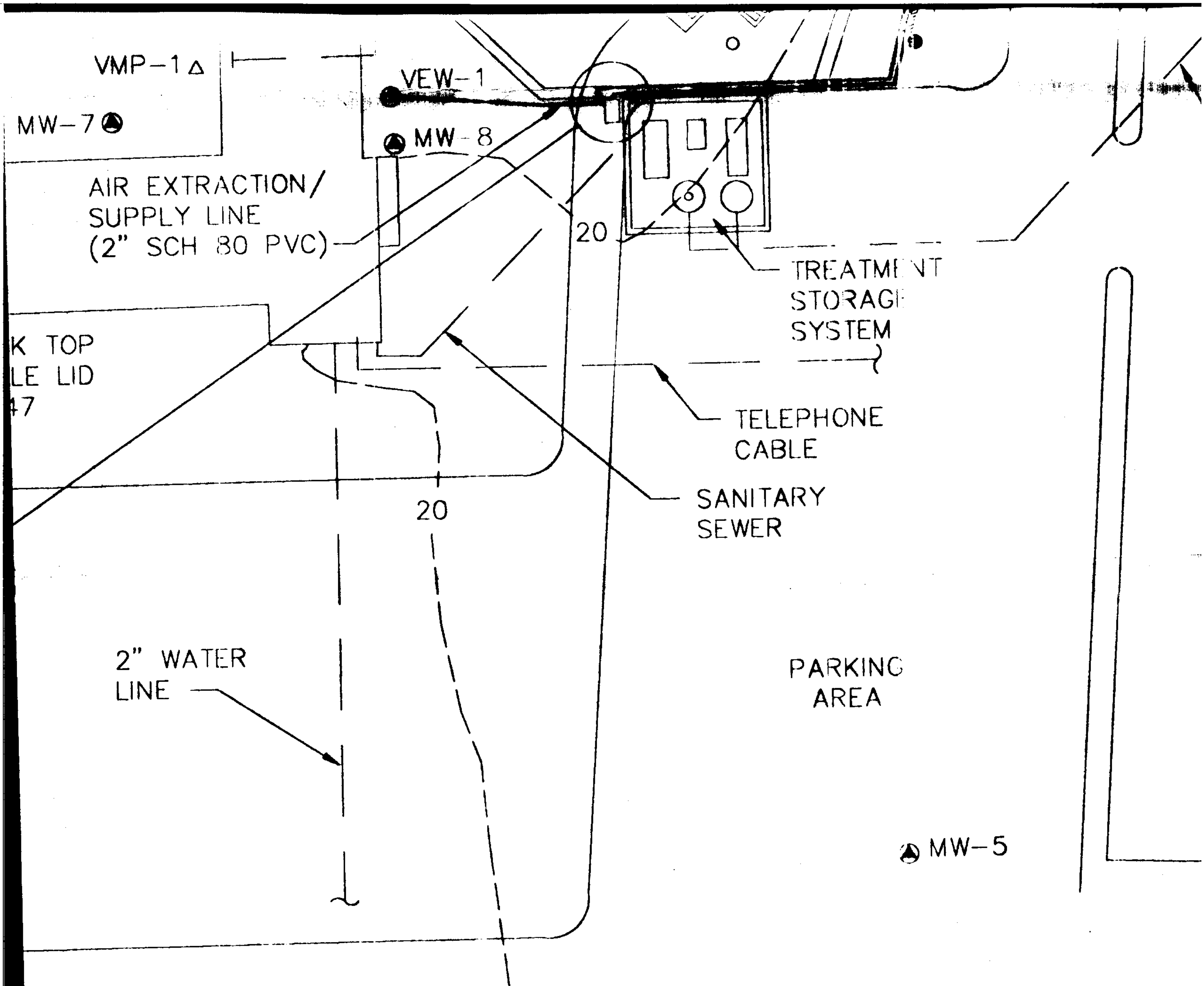

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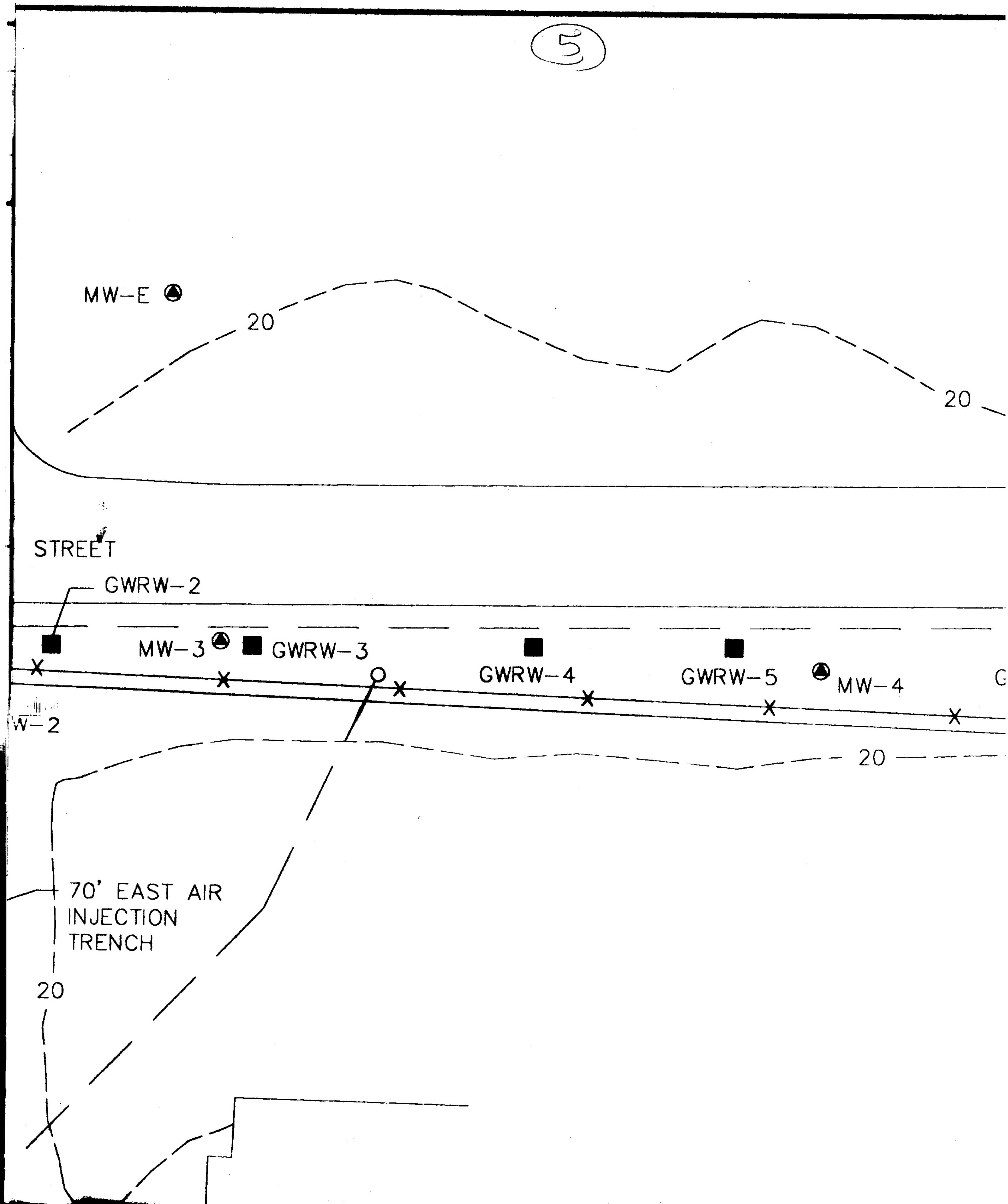
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70' EAST AIR
INJECTION
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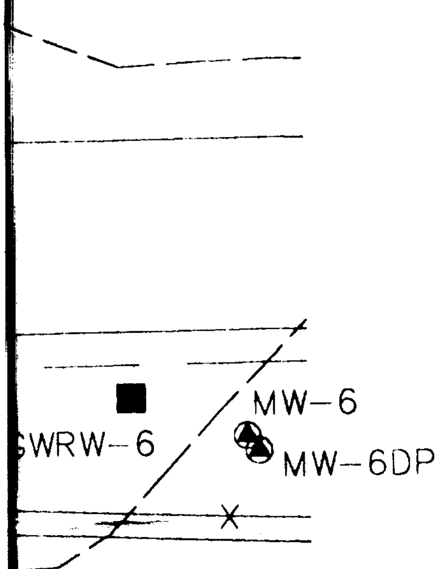
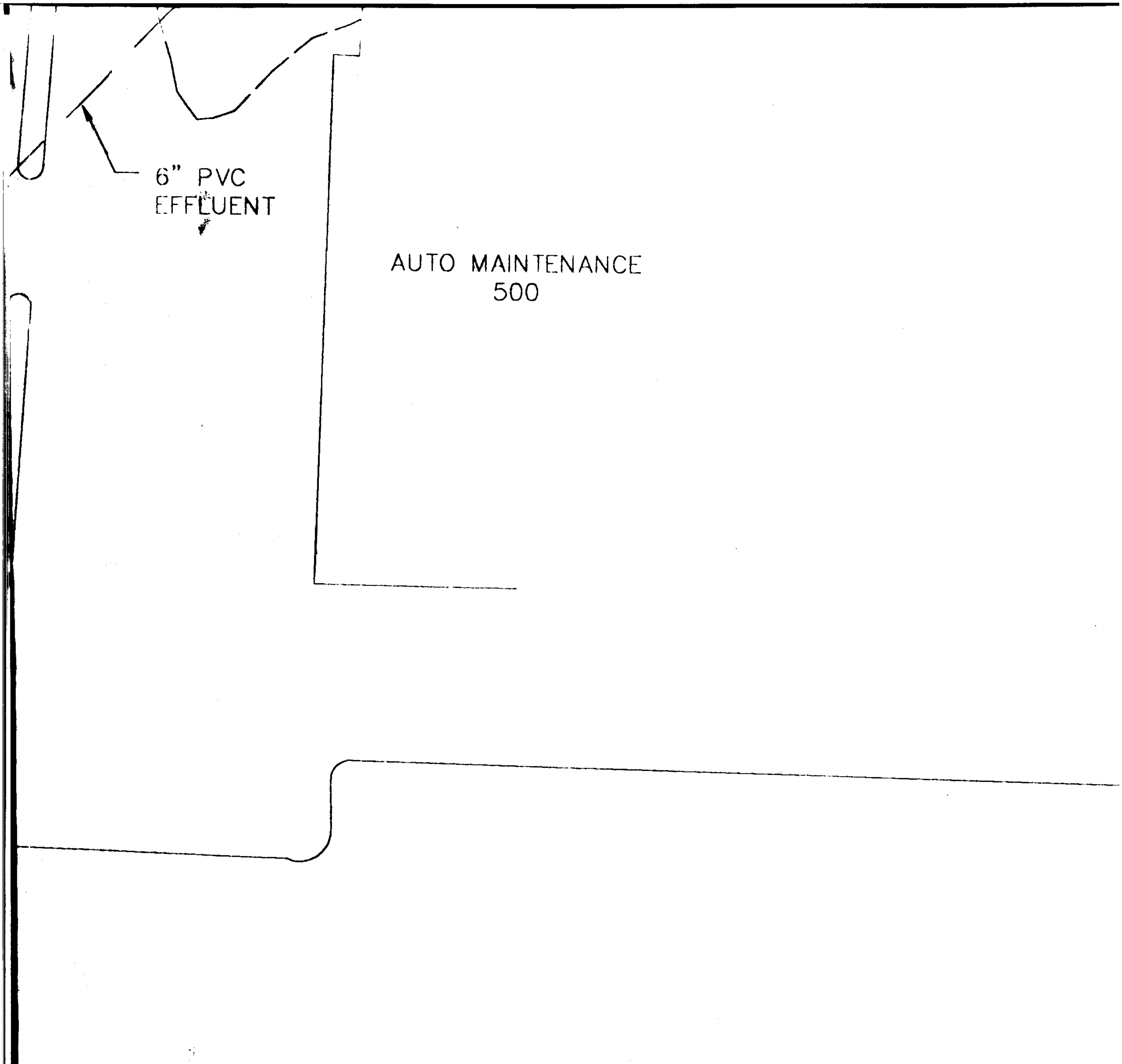
20

(6)



EXPLANATION

VAPOR MONITORING POINT (VMP)



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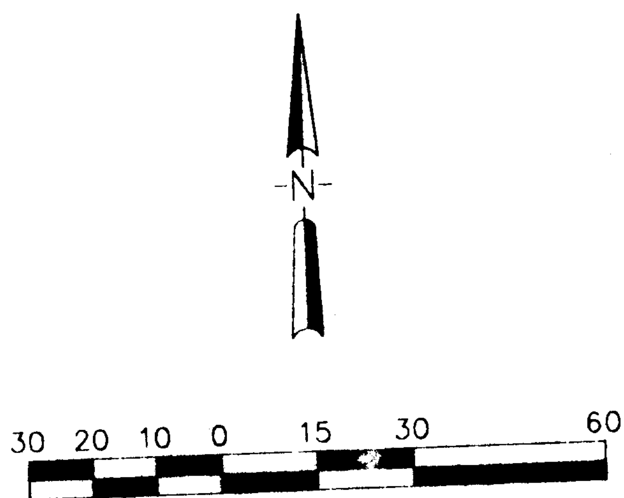
EGLIN AFB

7th STREET BX SERVICE STATIO

FLORIDA

EXPLANATION

- △ VAPOR MONITORING POINT (VMP)
- VAPOR EXTRACTION WELL (VEW)
- ▲ FREE PRODUCT RECOVERY WELL (FPRW)
- ■ GROUNDWATER RECOVERY WELL (GWRW)
- MONITORING WELL (MW)
- ● SOIL SAMPLING LOCATIONS
- — 20 — ELEVATION CONTOUR LINE
- ——— EDGE OF PAVED AREA



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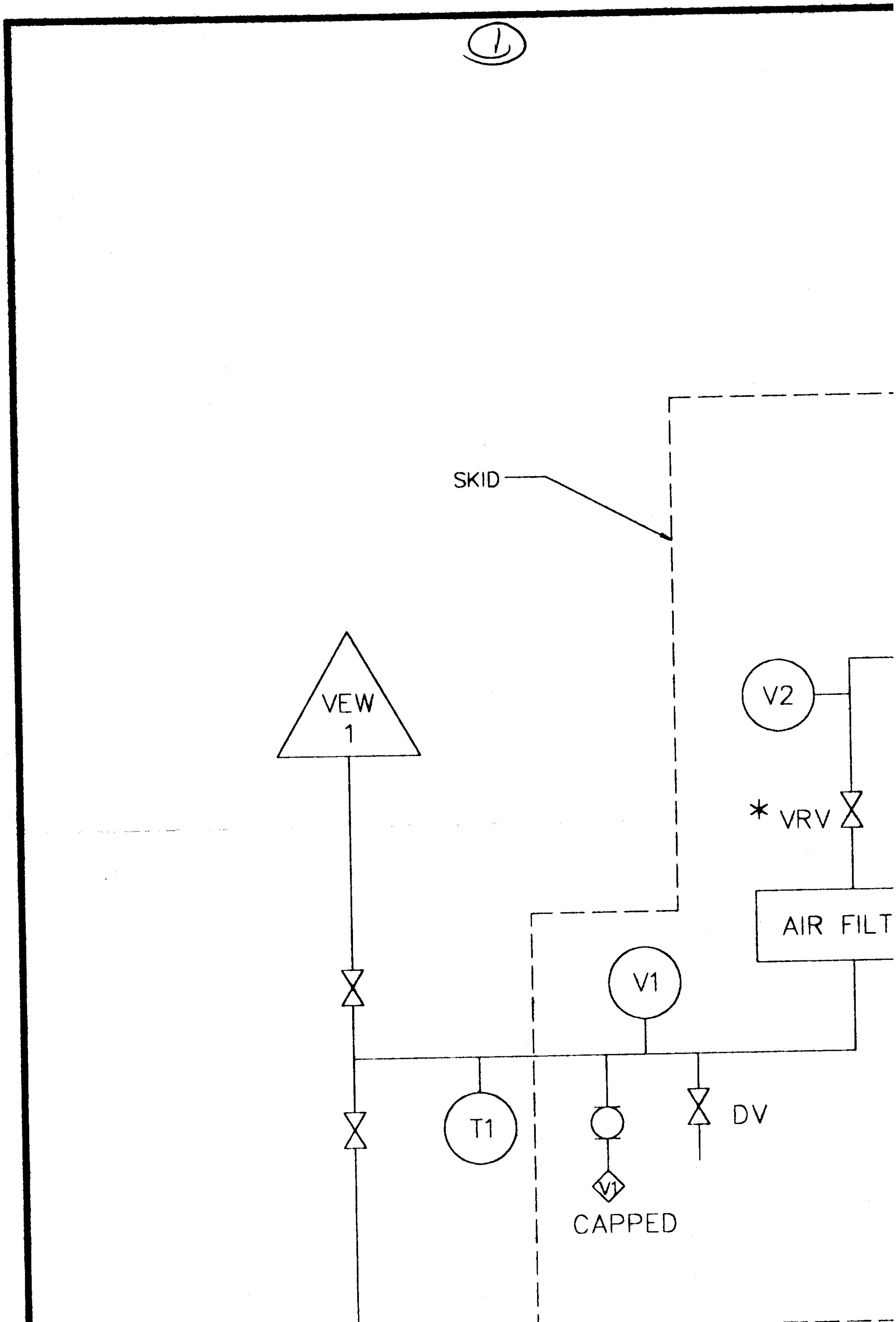
ATION	BIOVENTING SYSTEM INSTALLATION PLAN	SCALE 1" SHEET N FILE NO. SITEMA



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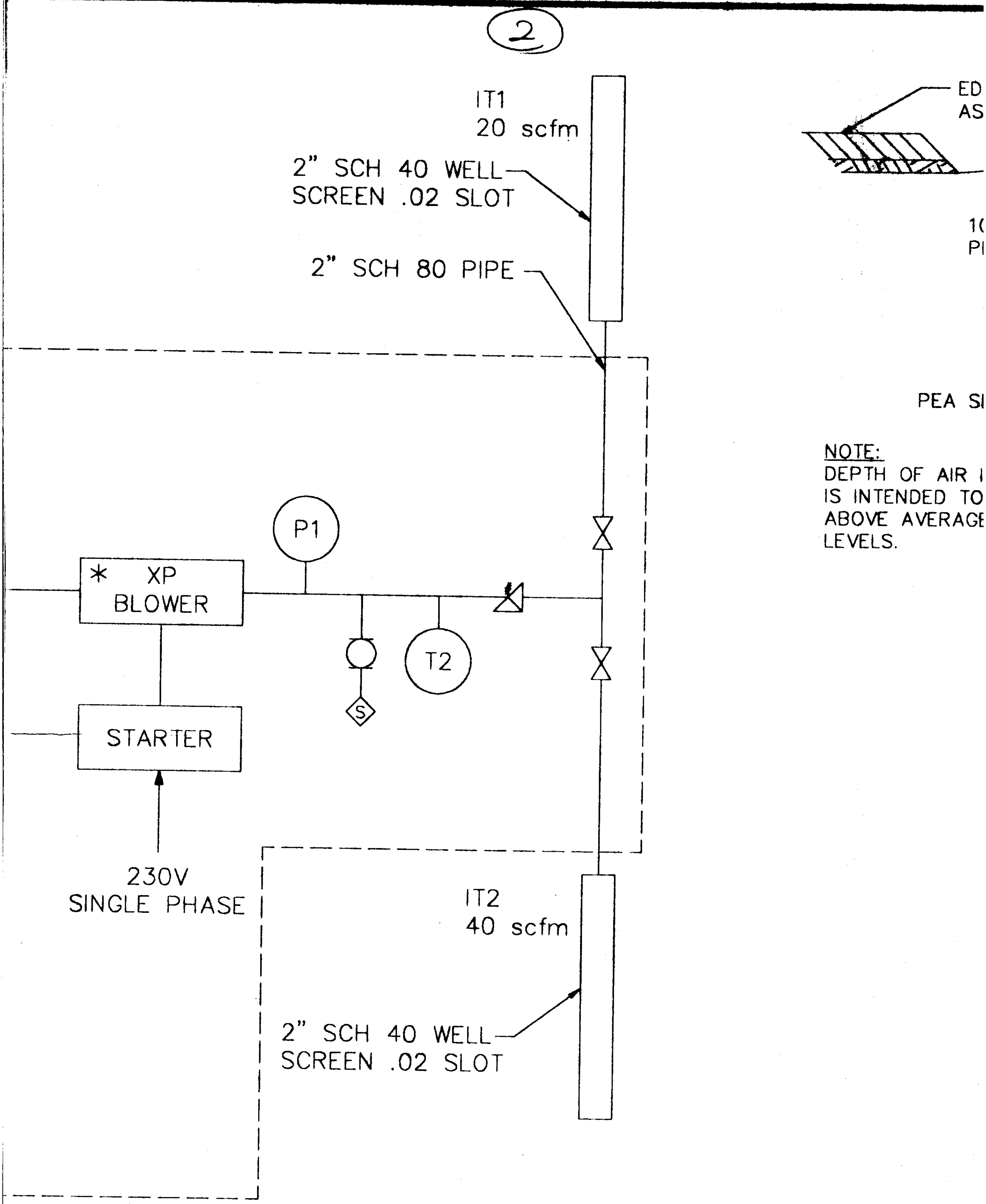
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40 scfm
2" SCH 40 WELL
SCREEN .02 SLOT

VIEW 2

FL

LEGEND

IT – INJECTION TRENCH

(P) – PRESSURE GUAGE (0–100" H_2O)

(T) – TEMPERATURE GUAGE
(T1 0–250°F)
(T2 0–250°F)

– SAMPLE PORT

(S)

(V) – VACUUM GUAGE
(0–100" H_2O)

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)W SCHEMATIC

*

) – AIR VELOCITY PORT

V – VACUUM RELIEF VALVE (SET AT 70" H_2O)

– RELIEF VALVE

– AIR CONTROL VALVE

– DILUTION VALVE

BLOWER SPECS: GAST R5125-1 (2.5 HP) OR EG&G ROTRON MODEL DR505AX5B 80 cfm AT 60" H_2O. EXPLOSION PROOF 2 HP SINGLE PHASE 115/230V. MAX AMPS – 11.5A AT 230V.

VACUUM RELIEF VALVE SPECS: GAST AG258 1 1/2" NPT, ADJUSTABLE 30 – 170 in. H_2O. 200 cfm MAX. SILENCER FOR RELIEF VALVE, AJ121D

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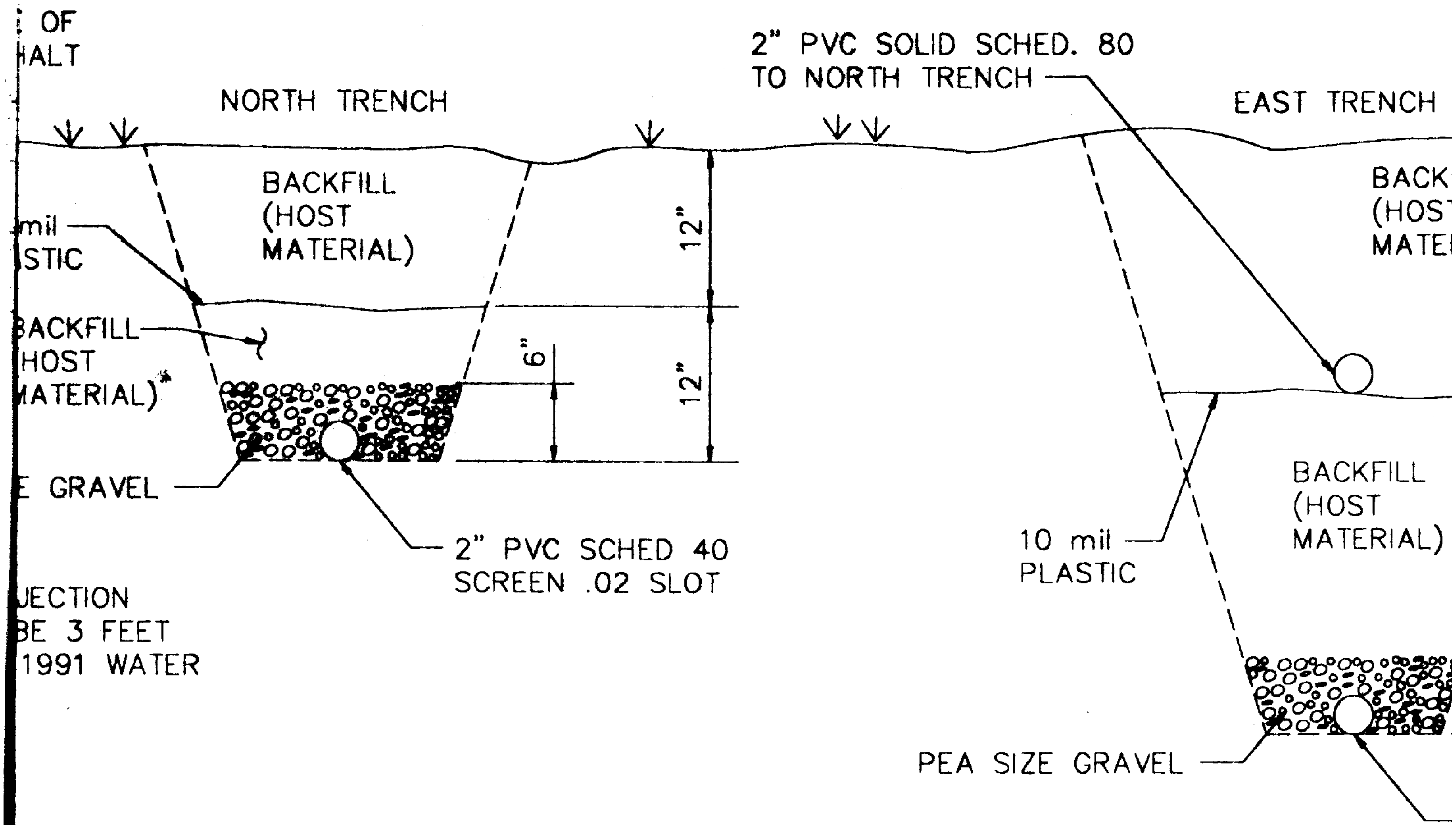
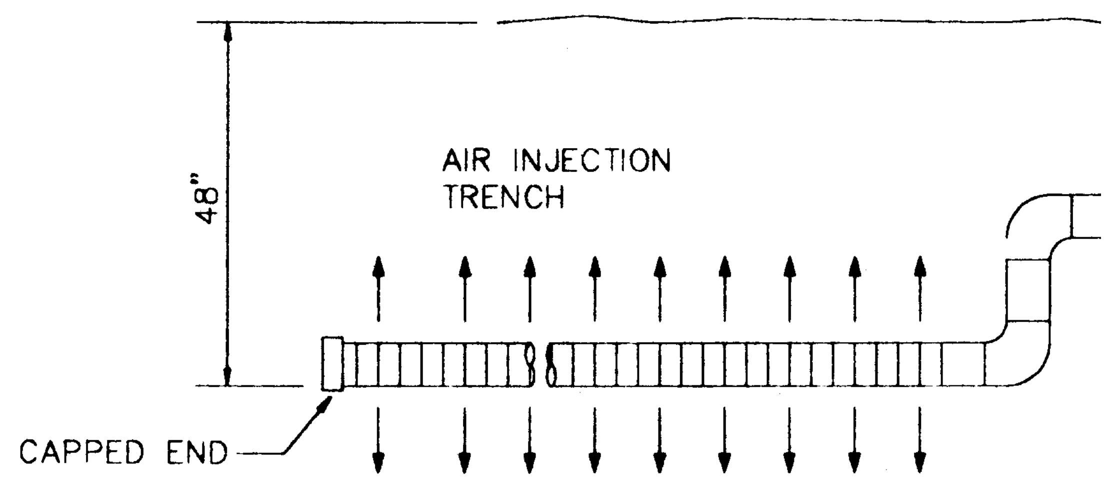


AIR INJECTION TRENCHES



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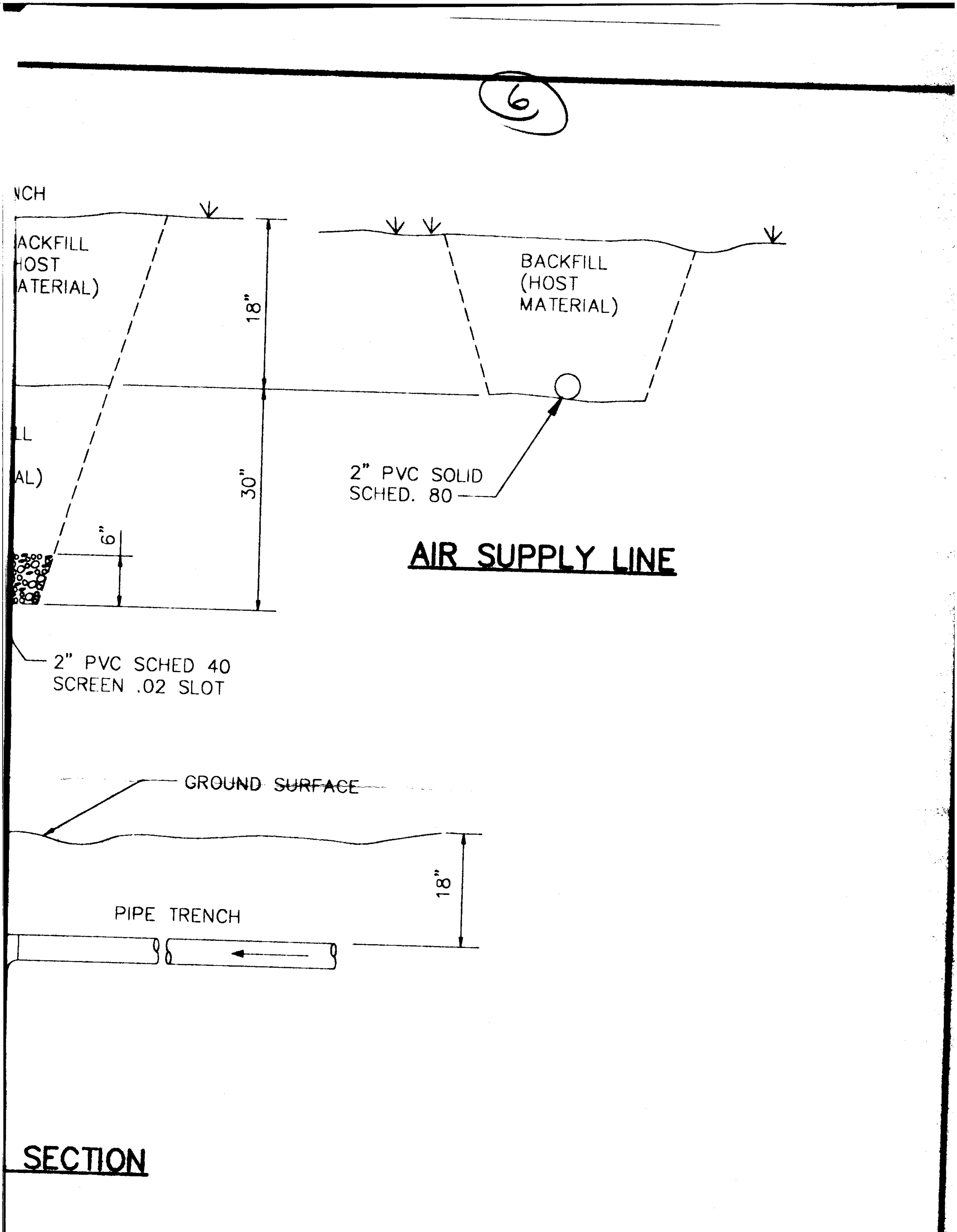
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AL)
30"
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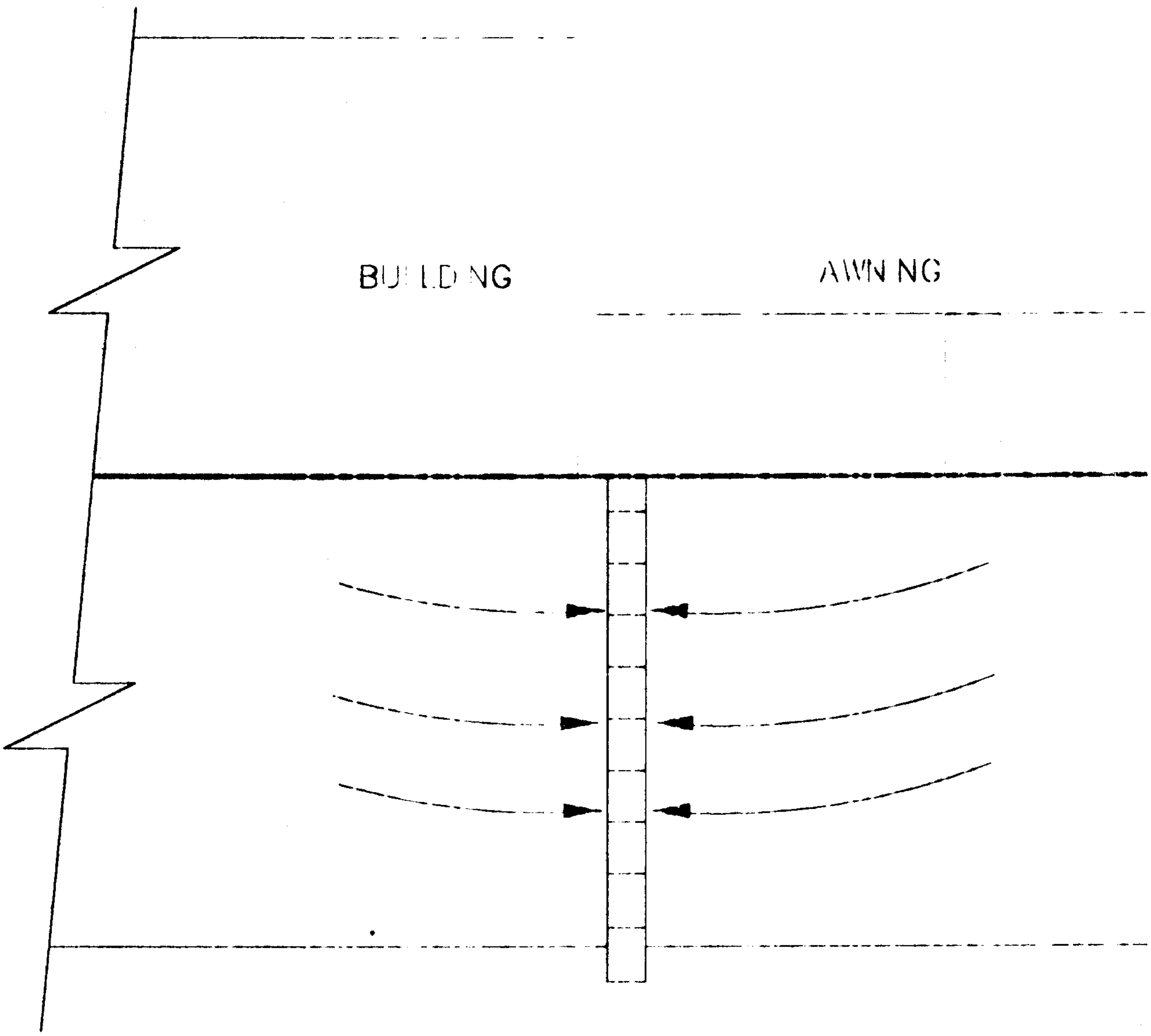
2" PVC SCHED 40
SCREEN .02 SLOT
BACKFILL
(HOST
MATERIAL)
2" PVC SOLID
SCHED. 80
AIR SUPPLY LINE
GROUND SURFACE
18"
PIPE TRENCH
SECTION

TYPICAL SECTION OF AIR INJECTION



CONCEPTUAL CROSS-SECTION D

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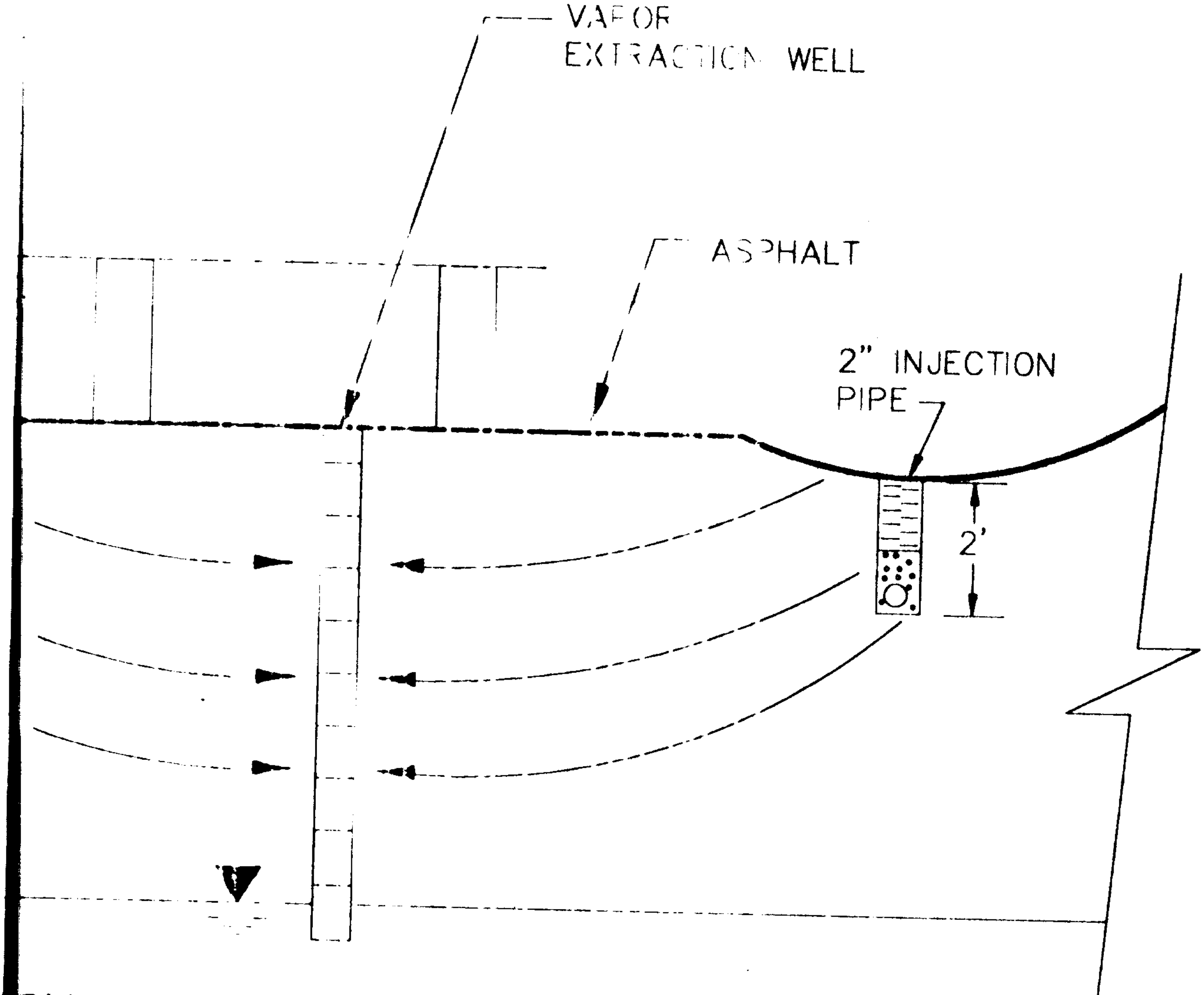
EGLIN AFB
7th STREET BX SERVICE STATIC
Florida

TRENCHES AND PIPE TRENCH



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