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NAS FORT WORTH
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FINAL WORK PLAN FOR SITE CHARACTERIZATION OF SANITARY SEWER SYSTEM NAS FORT WORTH TX

2/1/1997

INTERNATIONAL TECHNOLOGIES

File: 17G
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NAVAL AIR STATION FORT WORTH JRB CARSWELL FIELD TEXAS

ADMINISTRATIVE RECORD COVER SHEET

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HQ Air Force Center for Environmental Excellence

Final
Work Plan

Prepared for:

Site Characterization of Sanitary Sewer System
Naval Air Station Fort Worth Joint Reserve Base
Carswell Field, Texas

F41624-94-D8047-0039
Project No. 768579

February 1997

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FINAL
RCRA FACILITY INVESTIGATION
WORK PLAN
For
Site Characterization of Sanitary Sewer System

for
Naval Air Station Fort Worth
Fort Worth,Texas
Revision 1, February 1997

Approved: _____ Date 2/21/97
IT QA/QC Manager

Approved: _____ Date 2/21/97
IT Project Manager

Approved: _____ Date _____
TNRCC

Approved: _____ Date _____
AFCEE Team Chief

Contract No. F41624-94-D8047-0039

Final

Work Plan
RCRA Facility Investigation
Sanitary Sewer System
Naval Air Station Fort Worth
Joint Reserve Base, Carswell Field
Fort Worth, Texas

Prepared for:

Air Force Center for Environmental Excellence
Brooks Air Force Base, Texas
Contract No. F41624-94-D-8047
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Project No. 768579
Revision 1

February 1997

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List of Acronyms

AFB	Air Force
AFBCA	Air Force Base Conversion Agency
AFCEE	Air Force Center of Environmental Excellence
AGE	aerospace ground equipment
AOC	area of concern
ATSDR	Agency for Toxic Substances and Disease Registry
CAM	Continuous Automated Monitoring
cm/s	centimeters per second
COE	U.S. Army Corps of Engineers
COPC	chemical of potential concern
CWA	Clean Water Act
DCE	dichloroethylene
DOT	U.S. Department of Transportation
DQO	data quality objectives
EPA	U.S. Environmental Protection Agency
FSP	field sampling plan
gal/yr	gallons per year
gpd/ft	gallons per day/per foot
HSP	health and safety plan
ICM	interim corrective measure
IRP	Installation Restoration Program
IT	IT Corporation
JP-4	jet petroleum grade 4
lb/yr	pounds per year
m^3/kg	cubic meters per kilogram
MCL	maximum contaminant level
MEK	methyl ethyl ketone
mg/L	milligrams per liter
mg/kg-day	milligrams per kilogram per day

List of Acronyms *(continued)*

mgd	million gallons per day
MSC	media-specific concentration
msl	mean sea level
NAS Fort Worth	Naval Air Station Fort Worth
NCTCOG	North Central Texas Council of Governments
NDI	nondestructive investigation
NFA	no further action
OWS	oil/water separator
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
QAPP	quality assurance project plan
Radian	Radian Corporation
RAGS	Risk Assessment Guidance for Superfund
RCRA	Resource Conservation and Recovery Act
RFA	request for analysis
RfD	reference dose
RFI	RCRA Facility Investigation
SAC	Strategic Air Command
SAP	sampling and analysis plan
SVOC	semivolatile organic compounds
SWMU	solid waste management unit
TAC	Texas Administrative Code
TCA	trichloroethane
TCE	trichloroethylene
THI	target hazard index
TIC	tentatively identified constituents
TNRCC	Texas Natural Resource Conservation Commission
VOC	volatile organic compounds
WSA	Off-Site Weapons Storage Area

1.0 Introduction

IT Corporation (IT) has been contracted by the Air Force Center for Environmental Excellence (AFCEE) to prepare a Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) work plan and a quality program plan, evaluate existing information, obtain additional data as needed, and prepare an RFI report and an interim corrective measures (ICM) work plan for the sanitary sewer system at the Naval Air Station Fort Worth (NAS Fort Worth) Joint Reserve Base, Carswell Field, Texas. IT is performing this work under Contract F41624-94-D-8047, Delivery Order 39.

Chapter 2.0 describes the existing background physical and environmental setting for the facility and summarizes the operational history of the sanitary sewer system at the facility. The plan for data consolidation and site investigation is provided in Chapter 3.0. Chapter 4.0 describes the approach for the baseline human-health risk assessment. Chapter 5.0 outlines the reporting of the investigation results and Chapter 6.0 describes the project schedule. Chapter 7.0 outlines management of the project and Chapter 8.0 provides the list of references for this work plan.

The quality program plan includes a health and safety plan (HSP) and a sampling and analysis plan (SAP). The HSP is a project-specific and site-specific plan. The SAP consists of two volumes: the field sampling plan (FSP) and the quality assurance project plan (QAPP). The FSP describes the field and analytical methods to be used in the collection of additional site data. The QAPP documents the data quality objectives (DQO) and the quality assurance/quality control (QA/QC) procedures to be used in the performance of field and laboratory work.

Project Objectives. The objectives of this project are:

- Conduct a site investigation to obtain additional data necessary to adequately assess the potential soil and groundwater contamination from the sanitary sewer system (Solid Waste Management Unit [SWMU] 66) and to determine whether any release of contaminants has occurred. The data are to be sufficient to characterize environmental conditions of site groundwater and subsurface soil.

- In the process of obtaining site characterization data, obtain data needed for risk assessment and determine if a threat to human health exists.

- Consolidate data in an RFI report compliant with Texas Natural Resource Conservation Commission (TNRCC) regulations and procedures.
- Prepare an ICM work plan for the sanitary sewer system that identifies and evaluates candidate technologies and recommends an appropriate remedy, if remediation is warranted.
- Allow for property transfer of parcels through which the sanitary sewer passes.

2.0 Existing Site Information

2.1 Description of Site

NAS Fort Worth is located in north-central Texas in Tarrant County, 8 miles west of downtown Fort Worth (Figure 2-1). The NAS Fort Worth property, totaling 2,555 acres, consists of the main Base and two noncontiguous parcels. The main Base comprises 2,264 acres and is bordered by Lake Worth to the north, the West Fork of the Trinity River and Westworth Village to the east, Fort Worth to the northeast and southeast, White Settlement to the west and southwest, and Air Force Plant No. 4 to the west. The area surrounding NAS Fort Worth is mostly suburban, including the residential areas of the cities of Fort Worth, Westworth Village, and White Settlement. The sanitary sewer system is networked throughout the facility, primarily in the areas that are developed for industrial and residential purposes (Figure 2-2).

2.2 Environmental Setting

2.2.1 Climate

The climate in the Fort Worth region is subhumid with mild winters and hot, humid summers. The average annual precipitation is 31.5 inches, with the majority falling between April and October. The average annual temperature is 66 degrees Fahrenheit (°F). July is the hottest month with an average monthly temperature of 86°F, while January is the coldest month with an average monthly temperature of 45°F. Temperature changes are rapid and often change 20° to 30° in several hours. The average annual relative humidity is 63 percent.

Prevailing winds are primarily southerly from March through November and northerly from December through February; the average wind speed is 8 knots. Severe thunderstorms with wind speeds of 65 knots and hail storms are common. Climate conditions in summer make tornado formations possible, although there is more property damage each year due to hail than to tornadoes.

2.2.2 Sensitive Habitats

Sensitive habitats include those areas that can potentially restrict the reuse of the land, such as wetlands under the jurisdiction of the Clean Water Act (CWA), plant communities that are

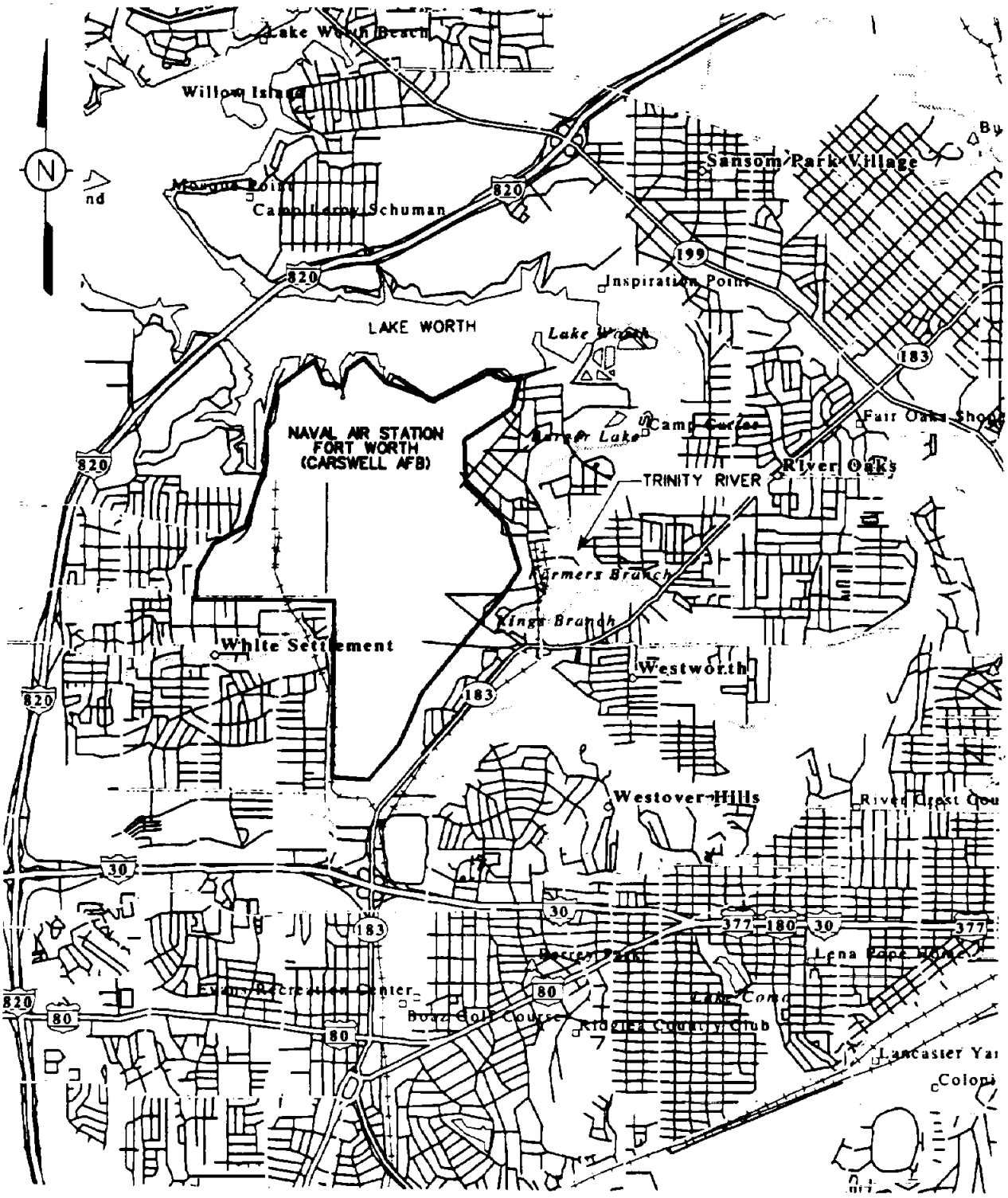

FIGURE 2-1
SITE LOCATION MAP

NAVAL AIR STATION FORT WORTH
FORT WORTH, TEXAS

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DRAWN BY K BLAIR	DATE LAST REV	ENGR CHCK BY W CARTER	DRAFT CHCK BY C TUMLIN
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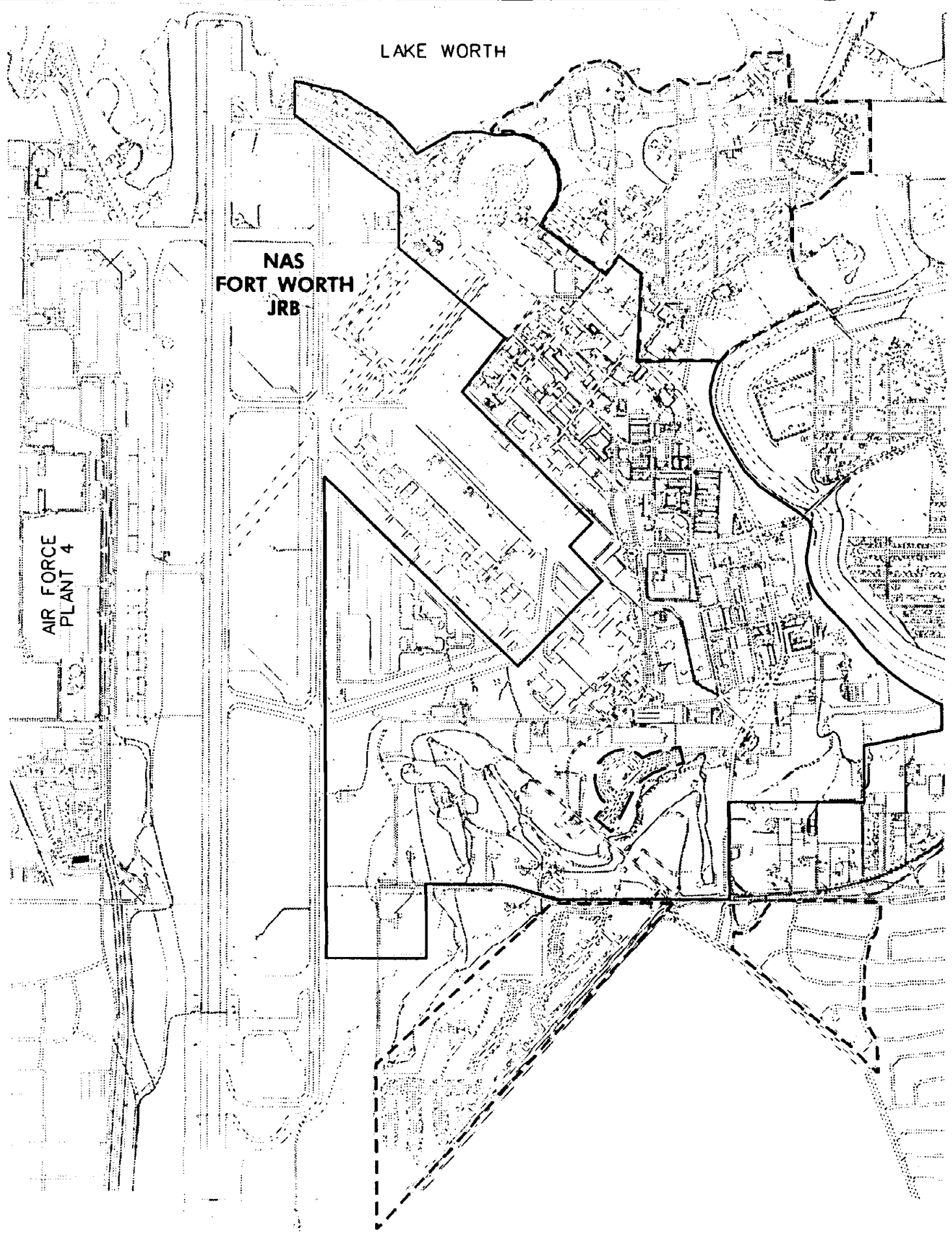

LEGEND

APPROXIMATE INDUSTRIAL BOUNDARY

APPROXIMATE RESIDENTIAL BOUNDARY

SCALE

0 1500 3000 FEET

FIGURE 2-2
SANITARY SEWER SYSTEM RFI
D. O. 39

NAS FORT WORTH JRB
TEXAS

INTERNATIONAL TECHNOLOGY CORPORATION

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designated as unusual or of limited distribution, and important seasonal use areas for wildlife (e.g., migration route, breeding areas, or crucial summer/winter habitat that are of agency concern). This includes areas associated with a protected species, or those areas critical to a species of population.

The shore of Lake Worth is considered a sensitive habitat due to its importance to migratory birds, including state- and federal-listed species. The Great Blue Heron rookeries by the Fort Worth Nature Center are sensitive nesting areas along the northern banks of Lake Worth. The birds are especially vulnerable to human intrusion during the nesting season. These rookeries are protected as sensitive wildlife areas by the Texas Department of Parks and Wildlife.

2.2.3 Wetlands

NAS Fort Worth has a total of 0.6 acres of jurisdictional wetlands designated by U.S. Army Corps of Engineers (COE), Fort Worth, Texas. Wetlands are defined by COE as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Areas that are periodically wet, but do not meet all three criteria (hydrophytic vegetation, hydric soils, and wetland hydrology), may still be jurisdictional wetlands subject to Section 404 of the federal CWA if they qualify as problem wetlands.

Drainage ditches are not considered as "waters of the United States" and are not classified as "jurisdictional" for protection under Section 404 of the CWA by the Fort Worth COE. Although water flows through Farmers Branch Creek and is found in various small ponds on the golf course, very little wetland vegetation is associated with these areas. Likewise, wetland vegetation along Lake Worth is infrequent and usually emergent when present. These areas do not support enough wetland cover to be classified as jurisdictional wetlands.

Jurisdictional wetland areas are found in the natural drainage stream southeast of Air Force Plant No. 4, totaling approximately 0.5 acre, and on the west side of the Off-Site Weapons Storage Area (WSA), totaling approximately 0.1 acre.

2.2.4 Surface Waters

NAS Fort Worth and all of Tarrant County are located within the Trinity River watershed. Surface water resources in the vicinity of the station include the West Fork and Kings Branch of the Trinity River, Farmers Branch Creek, Lake Worth, two ponds located in the golf course area, and one small pond in the WSA.

The amount of water the Trinity River receives is controlled by the watershed runoff from impervious areas during storms, by releases and overflows from the series of man-made reservoirs along the forks and tributaries by natural runoff, and by the discharge of effluent from sewage treatment plants. Lake Worth, a man-made reservoir on the West Fork of the Trinity River, is located north of NAS Fort Worth and is owned and operated by the City of Fort Worth. These waters are used for public water supply and recreation. Lake Worth covers an area of 3,558 acres and is 12 miles long. The lake has a conservation storage capacity of 38,130 acre-feet (or approximately 12.4 billion gallons).

Surface water is the main source of potable water in the vicinity of NAS Fort Worth. The City of Fort Worth Water Department is the primary supplier to the areas surrounding and including the station. Water from Farmers Branch Creek is used to irrigate the on-Base golf course. White Settlement and Sansom Park obtain water from 12 and 9 groundwater wells, respectively, but when required, they purchase surface water from Fort Worth to supplement their water supplies. NAS Fort Worth purchased 0.93 million gallons per day (mgd), 0.77 mgd, and 0.76 mgd of water from Forth Worth in 1989, 1990, and 1991, respectively.

Surface drainage at NAS Fort Worth is collected by the storm drainage system and routed into the sewer system, or as outfall into Lake Worth. An underground drainage culvert conducts surface runoff generated from areas west of the NAS Fort Worth eastward to Farmers Branch Creek.

The North Central Texas Council of Governments (NCTCOG) has implemented the Continuous Automated Monitoring (CAM) system. Two monitoring stations are located along the West Fork of the Trinity River, downstream from NAS Fort Worth. Current results of analyses of water from the first CAM station downstream from NAS Fort Worth showed that 100 percent of the

samples were below the criteria value of 5.5 milligrams per liter (mg/L) for dissolved oxygen, and that measure of acidity and alkalinity (pH) values range from 6.6 to 9.8 due to the presence of substantial attached algal communities. The U.S. Environmental Protection Agency (EPA) secondary drinking water standard for pH is a range from 6.5 to 8.5; this range is a guideline, not a requirement.

Storm water runoff from NAS Fort Worth that is not routed to the Base or city sewer system is discharged into Lake Worth. The outfall is permitted under the National Pollutant Discharge Elimination System and monitoring results document compliance with permit discharge limitations.

The water quality of Lake Worth is moderately hard, and contains slightly elevated salt levels during the warm summer season. Historically, Lake Worth has experienced problems with high sediment loads. Lake Worth was included in the 1990 Nonpoint Source Report for having known problems with sedimentation from agricultural and vacant lands. The sedimentation problems have been reduced by using Eagle Mountain Lake as a sediment trap.

The potential for contamination of surface water is present at several locations on NAS Fort Worth. Potential for migration of hazardous contaminants through the surface water is considered high, primarily due to the proximity of identified sites to the West Fork of the Trinity River, Farmers Branch Creek, and Lake Worth. In addition, shallow groundwater carrying dissolved contaminants may discharge to these surface waters.

2.2.5 Geography and Physiography

NAS Fort Worth is located within the Grand Prairie section of the Central Lowlands Physiographic Province. The area is characterized by broad terrace surfaces sloping gently eastward, interrupted by westward-facing escarpments. The topography of the station is fairly flat, except for areas near Farmers Branch Creek and the Trinity River. Elevations average 650 feet above mean sea level (msl) and range from 550 feet above msl in the east to 690 feet above msl in the southwest.

Soils in the area generally consist of the Aledo-Bolar-Sanger Association, which is defined as gently sloping to moderately steep, very shallow to deep, loamy and clayey soils on uplands.

The land uses west of NAS Fort Worth are predominantly residential and industrial. These include single-family residences, commercial centers, Air Force Plant No. 4, and an industrial complex in White Settlement.

The predominant development south of NAS Fort Worth is the commercial area located at the Interstate 30 and State Highway 183 interchange. This area includes a discount retail center, a regional shopping mall, and a convenience center.

Various types of residential development occur southeast of NAS Fort Worth, north of Interstate 30. South of River Oaks Boulevard and Roaring Springs Road are country club estates and upscale townhouses. Further south are middle- to upper-income, single-family housing, and multifamily units mixed with commercial office development. Single-family housing is also found on the eastern side of the NAS Fort Worth, from the Kings Branch housing tract north to Meandering Road.

Public/recreational land uses occur north of the NAS Fort Worth, surrounding Lake Worth. Public access along the southern shore of Lake Worth is currently restricted due to NAS Fort Worth activities. A fish hatchery, YMCA camp, and private recreation lands are located along the West Fork of the Trinity River, northeast of the NAS Fort Worth.

2.2.6 Regional Geology

Quaternary alluvium is found at the surface through most of the NAS Fort Worth area. The alluvium consists of floodplain and fluvial terrace deposits of gravel, sand, silt, and clay that occur as a veneer on the eroded surface of Upper Cretaceous strata. The Quaternary alluvium found throughout the area was deposited by the Trinity River in terrace deposits along the river valley banks as a result of changing sea level during the Pleistocene and Holocene (Recent) Epochs. Reworking and deposition of these deposits by the ancestral and present Trinity River has created a series of "terraced" river alluvium deposits of varying elevations placed by the river at various elevations due to its corresponding level influence by sea level changes during Quaternary continental glaciation.

Previous drilling activities at NAS Fort Worth indicate that the alluvial deposits vary in thickness from less than 10 feet to approximately 50 feet in thickness and generally thicken in an east to

southeastern direction toward the Trinity River. The irregular thickness of the alluvium is due to depositional events, stream channeling, and erosion. In general, silt and clay with varying amounts of sand and gravel occur at the land surface down to depths of 5 to 10 feet. Underlying the silt and clay is a sand and gravel unit that normally increases in grain size with increasing depth. The sand deposits are fine- to coarse-grained, tan to rust in color, and composed predominantly of quartz grains. Gravel is mostly limestone and fossilized limestone shell fragments ranging in size from fine to cobbles. The gravels were deposited as channel lag deposits on the scoured upper surface of the underlying Cretaceous strata.

Underlying the Quaternary alluvium are the Cretaceous-aged Goodland and Walnut Formations. Both formations consist of interbedded, fossiliferous, hard limestone and calcareous shale. The rock is fractured and there is considerable jointing and flaking, which gives the limestone a fractured appearance. These strata are generally dry, although small amounts of water are occasionally present in the shale and clay units (Radian Corporation [Radian], 1991).

The Cretaceous-age strata have a regional dip to the southeast. The surface elevation of the Cretaceous strata surface varies considerably across the area of the Naval Air Station due to erosion of the Trinity River and its ancient stream course. The Goodland and Walnut Formations have been removed by erosion of the Trinity River to the west of NAS Fort Worth and along the erosional valley of the Trinity River to the north and the east of the site. The locally irregular topography of the top of the bedrock is characteristic of an erosional surface modified by fluvial processes, which is characterized by the variable nature and thickness of the overlying sequence of Quaternary alluvial sediments.

Underlying the Goodland and Walnut Formations is the Cretaceous-aged Paluxy Formation. Regionally, the Paluxy Formation is divided into upper and lower sand members by a shale unit. The sands in the upper part of the Paluxy are reported to be fine-grained with shale interbeds. The lower sand member generally consists of two separate and distinct sand strata, but the individual sand beds do not maintain constant thickness or lithology over long distances. The lower part of the Paluxy Formation generally consists of coarse-grained sand that grades upward into fined-grained sand with variable amounts of shale and limestone. The Paluxy Formation thickness ranges from 140 to 190 feet, averaging 160 feet in Tarrant County (Radian, 1991).

The Paluxy Formation is exposed along the southern shore of Lake Worth at the northern boundary of the facility and along the erosional channel of the Trinity River. The Paluxy Formation either is aerially exposed or is in contact with overlying Quaternary alluvium where the Goodland and Walnut Formations have been removed by erosion.

2.2.7 Hydrogeology

Three hydrogeologic units exist beneath NAS Fort Worth that are relevant to subsurface conditions. From the shallowest to the deepest, they are: (1) the Quaternary alluvium aquifer containing unconfined groundwater associated with the Trinity River alluvial terrace deposits; (2) an aquitard of predominantly dry limestone of the Goodland and Walnut Formations; and (3) an aquifer in the Paluxy Formation. The groundwater investigation will be within the Quanternary alluvium aquifer.

The Quaternary alluvial groundwater is found under unconfined conditions at NAS Fort Worth. Low permeability is typical of the alluvium because of the large amounts of clay and silt. However, there are zones of greater permeability in the saturated sands and gravels of former channel deposits. Recharge to the water-bearing sediments is local, from rainfall and infiltration from stream channels and drainage ditches. The direction of groundwater flow is generally controlled either by bedrock topography or discharge zones at primary or secondary streams. Previous reports indicate that the groundwater flow in these sediments across the facility is generally toward Farmers Branch Creek or eastward toward the Trinity River located at the eastern boundary of the facility. Quaternary alluvium river channel deposits at the western boundary of NAS Fort Worth had a measured hydraulic conductivity of 2.9×10^{-1} from a 1991 pump test (Radian, 1991). Groundwater leakage may occur to the underlying Paluxy Formation in areas where the Walnut Formation aquitard is significantly thinned by erosion or eroded away.

The unconfined groundwater found in the Quaternary alluvium is generally separated from the underlying Paluxy Aquifer by the low permeability limestones and calcareous shales where the Goodland and Walnut Formations are present. The aquitard is composed of moist clay and shale layers interbedded with dry limestone beds.

Vertical hydraulic conductivity of the competent Walnut Formation was measured on core samples collected during the Air Force Plant No. 4 RFI. The calculated logarithmic mean of the

hydraulic conductivity values is 7.0 x 10^{-10} centimeters per second (cm/s). Hydrographs from paired upper zone Quaternary alluvium and Paluxy Formation monitoring wells indicate there is little flow from the overlying alluvial aquifer to the Paluxy Formation in those areas where the Walnut Formation is not deeply eroded. In those areas where erosion has cut into the Walnut Formation, the potential exists for downward migration of recharge to the Paluxy (Kuniasky, et al., 1996).

The Paluxy Aquifer is the shallowest Cretaceous-aged aquifer underlying NAS Fort Worth. In the area, water in the uppermost part of the Paluxy Formation would occur under confined conditions beneath the Goodland and Walnut Formations, except where these units have been eroded away. However, extensive groundwater pumping in the Fort Worth area, including the Cities of White Settlement and Samson Park, has lowered the Paluxy Aquifer potentiometric surface below the top of the formation, resulting in unconfined conditions.

Recharge to the Paluxy Aquifer occurs where the formation crops out. The Paluxy Formation crops out west of Air Force Plant No. 4, and north of NAS Fort Worth in the bed of Lake Worth. Lake Worth is a major recharge area for the aquifer and creates a potentiometric high in its vicinity. Regional groundwater flow is southeastward in direction of the regional dip. Transmissivities in the Paluxy Aquifer range from 1,263 to 13,808 gallons per day per foot (gpd/ft), and average 3,700 gpd/ft (Radian, 1991).

2.3 Site History and Operations

2.3.1 Ownership

The facility known as NAS Fort Worth was originally a modest dirt runway built to service an aircraft manufacturing plant located where Air Force Plant No. 4 is now located. When it was established in 1942, the installation was referred to as the Tarrant Field Airdrome and was originally under the jurisdiction of the Gulf Coast Army Air Field Training Command. The Strategic Air Command (SAC) assumed control of the installation in 1946 and the NAS Fort Worth served as headquarters of the Eighth Air Force. At that time, the 7th Bomber Wing became the NAS Forth Worth host unit. NAS Fort Worth was renamed Carswell Air Force Base (AFB) in 1948 in honor of Fort Worth native, Major Horace S. Carswell.

In 1951, Headquarters 19 Air Division was located at Carswell AFB, where it remained until September 1988. The Air Combat Command assumed control of NAS Fort Worth in 1992 with the disestablishment of SAC. On October 1, 1994, the U.S. Navy assumed responsibility for the facility and the name changed from Carswell AFB to NAS Fort Worth Joint Reserve Base, referred to in this document as NAS Fort Worth.

The Air Force Base Conversion Agency (AFBCA) is currently the on-site responsible party for Installation Restoration Program (IRP) sites and the RCRA Part B permit holder for SWMUs. The AFBCA operating location is tasked with coordinating closure activities, maintaining a caretaker force, and serving as an Air Force liaison supporting NAS Fort Worth property disposal and interim leases. AFBCA will remain the on-site responsible party for areas outside the 301 Tactical Fighter Wing area until the disposal of all NAS Fort Worth properties is complete (Jacobs Engineering, 1995).

2.3.2 Operation

Before the construction of the initial airfield facilities in 1942, the area now occupied by NAS Fort Worth was pasture land and woods. The majority of the NAS Fort Worth property was acquired in the 1940s with most of the property acquired from the city of Fort Worth in 1941. Additional property, including most of the south Base, the hospital area, and the WSA, was acquired during the 1950s. Kings Branch and south Base residential areas were acquired in 1960. Several miscellaneous additional properties totaling less than 10 acres have been acquired since 1970 (Jacobs Engineering, 1995).

After 1941, the former Carswell AFB mission was as a bomber training base. Wastes have been generated and disposed of at NAS Fort Worth since the beginning of industrial operations in 1942. The major industrial operations at NAS Fort Worth included: maintenance of jet engines, aerospace ground equipment, fuel systems, weapons systems, and hydraulic systems; maintenance of general and special purpose vehicles; aircraft corrosion control; and nondestructive inspection activities (Jacobs Engineering, 1995).

Waste oils generally refer to lubricating fluids, such as crankcase oils and synthetic turbine oils. Hydraulic fluids have also been included in this category. Recoverable fuels refer to fuel drained from aircraft tanks and vehicles, such as jet petroleum grade 4 (JP-4) and MOGAS (gasoline).

Spent solvents and cleaners refer to liquid used for degreasing and general cleaning of aircraft, aircraft systems, electronic components, and vehicles. This category includes PD-680 and various chlorinated organic compounds, such as carbon tetrachloride, trichloroethylene (TCE), and 1,1,1-trichloroethane (TCA).

Specific types of solvents used by the Air Force have changed over the years. In the 1950s, carbon tetrachloride was in common use. Its use was replaced by TCE about 1960. Since then, TCE and 1,1,1-TCA have been commonly used; however, TCE usage has decreased in favor of 1,1,1-TCA. Today, PD-680 Type II, 1,1,1-TCA, and TCE are used.

Waste paint solvents or thinners and strippers are generated by corrosion control activities. Typical thinners include isobutyl acetate, toluene, methyl ethyl ketone (MEK), isopropanol, naphtha, and xylene. Paint strippers generally contain such compounds as methylene chloride, toluene, ammonium hydroxide, and phenolics (CH2M Hill, 1996).

All of these operations generated waste materials, primarily oils, recoverable fuels, spent solvents, and cleaners. Most waste oils, recovered fuels, spent solvents and cleaners were either burned at fire training areas on NAS Fort Worth, reused on NAS Fort Worth, or processed through the Defense Property Disposal Office. An undetermined amount of these materials were discharged to the sanitary sewer system at NAS Fort Worth (Jacobs Engineering, 1995).

2.3.3 Results of Previous Site Investigations

In 1984, the IRP was initiated at NAS Fort Worth and began with a program records search conducted by CH2M Hill, Inc. Since 1984, Air Force IRP studies have been conducted by several contractors, and have focused on the identification and characterization of waste disposal areas and SWMU identified in the installation's RCRA Part B permit.

Pursuant to the Defense Base Closure and Realignment Act of 1990, NAS Fort Worth was selected for closure and associated property disposal during Round II Base Closure Commission deliberations. This announcement initiated the closure and began disposal and reuse planning activities.

The ongoing IRP is under a Defense-State Memorandum of Agreement, which is a financial reimbursement agreement between the U.S. Department of Defense (DOD) and the State of Texas. NAS Fort Worth does have a Hazardous Waste Part B permit issued by the Texas Natural Resources Conservation Commission (TNRCC) in February 1991 that establishes requirements and procedures for investigating RCRA SWMUs. Most NAS Fort Worth IRP sites are also SWMUs and are regulated under this permit.

The sanitary sewer system was designated as SWMU 66 in a RCRA Facility Assessment (RFA) report by EPA (A.T. Kearney, 1989). The RFA reported the sanitary sewer system collects sanitary wastewater as well as some industrial wastewater from NAS Fort Worth facilities, including the Visual Information Center Work Station Waste Accumulation Areas (SWMU 13). The report indicated that other industrial activities that discharged waste to the sanitary sewer system include:

- Aerospace ground equipment (AGE) maintenance shop at Building 1414 (1,800 pounds per year [lb/yr] aircraft soap)
- Battery shop at Building 1410 (500 gallons per year [gal/yr] of neutralized electrolyte)
- Fuel systems shop at Building 1048 (300 gal/yr of JP-4)
- Nondestructive investigation (NDI) laboratory at Building 1414 (500 gal/yr of film development chemicals)
- Jet engine test cell at Building 1015 (350 gal/yr of JP-4, 225 gal/yr of oil and hydraulic fluid)
- Wash rack at Building 29 (15,000 gal/yr of PD-680, 5,000 gal/yr of aircraft soap)
- AGE maintenance shop at Building 1628 (100 gal/yr of PD-680)
- Wash rack at Building 18 (9,000 gal/yr of PD-680, 3,100 gal/yr of aircraft soap)

The wastewater collected by the sanitary sewer system is discharged into the City of Fort Worth publicly-owned treatment works. The sanitary sewer system has been in operation since the Base was activated in 1942.

NAS Fort Worth currently has 19 IRP sites. A Phase I records search conducted in 1984 identified 15 sites requiring further evaluation. Subsequent IRP investigations and other Base activities have identified an additional four sites. Thirteen of these sites are also RCRA SWMUs. The east area groundwater site is suspected of being contaminated due to the presence of the IRP sites, but is not currently considered as a unique site. This IRP site is the responsibility of the adjacent Air Force Plant No. 4 and is not a NAS Fort Worth IRP site. The TCE plume is managed under the Federal Facilities Agreement for Air Force Plant No. 4, which is a National Priorities List site (Jacob Engineering, 1995).

An investigation of 11 oil/water separators (OWS) at NAS Forth Worth was performed to assess contamination at the OWSs and evaluate the condition and future use of the OWSs. The report indicated that two of the separators, located at Building 1015 (SWMU 47) and Building 1194 (SWMU No. 35), were connected to the sanitary sewer system. The separator at Building 1064, was reported to be connected to the storm sewer system and the unit at Building 38 was connected to a french drain and discharged to an unnamed stream (area of concern (AOC) No. 14). The discharge connections of the remaining seven OWSs investigation was not reported (Law Environmental, Inc., 1995). An investigation of the sanitary sewer system in 1994 indicated that most of the OWSs at the facility did discharge diffluent through the sanitary sewer system (Carter and Burgess, 1994). Of the 21 OWSs connected to the sanitary sewer system at NAS Fort Worth, five OWSs have been submitted for no further action (NFA) status with TNRCC. NFA status will be achieved for the five OWSs after completion of a pending background study for metal concentration in soil. The OWSs are located at Buildings 1060, 1064, 1145, 1643, and 4210 (CH2M Hill, 1996).

Shallow and deep soil samples were collected at the 11 units and analyzed for volatile organic compounds (VOC) by EPA Method SW8240 and for RCRA metals (except mercury) by EPA Method SW6010/7000. No analyses for semivolatile organic compounds (SVOC) were performed, but organic odors were detected during sampling activities. No groundwater samples were collected during the Law Environmental investigation.

None of the soil samples analyzed contained volatile organics above Texas Risk Reduction Standards. Soils in the immediate area of each of the 11 OWSs, however, were contaminated with metals concentrations exceeding Texas Risk Reduction Standards (Law Environmental, Inc., 1995).

3.0 Plan of Investigation

This section of the work plan defines the scope of work to be performed during the investigation phase of the RFI. Because limited data exists on the nature and extent of contamination associated with the sanitary sewer system, only activities associated with the collection of analytical data for completion of the RFI report are addressed. These investigation activities include collection of soil sample (surface/near surface and subsurface), groundwater, and surface water. Investigations will be conducted along (1) the industrial complex, (2) the sanitary sewer system in the north/south sanitary sewer segment, and (3) sanitary sewer systems in the residential areas (southwest housing, southeast housing, northern housing, and Bureau of Prisons Hospital).

For this investigation, areas of NAS Fort Worth have been divided into residential and industrial areas. Residential areas of NAS Fort Worth have not been associated with industrial practices and generation of wastes associated with U.S. Air Force operations that would have impacted the sanitary sewer system with industrial contaminants. For this investigation, residential areas of NAS Fort Worth shown on Figure 2-2 will have limited investigation of soil and groundwater to verify the absence of industrial contaminants for the RFI and to allow the eventual transfer of property by the U. S. Air Force. Industrial areas of NAS Fort Worth are designated to receive a more thorough investigation of the sanitary sewer system for releases of effluent to the soil and groundwater. Investigation of the sewer line owned by the City of Fort Worth running from west to east across the facility is limited to where the NAS Fort Worth sanitary sewer line ties into the City of Fort Worth line.

Connected to the sanitary sewer system network and included in this investigation are 24 OWSs as shown on Table 3-1. This table identifies the location of the OWS (building number), whether the OWS is a SWMU or AOC, and its capacity, age, and effluent connection. Previous investigations of some of the OWSs had been performed before and additional data will be collected during this investigation where data gaps have been identified. The OWSs have been included in this investigation to determine if effluent from the OWSs may have been released to soil or groundwater.

TABLE 3-1

OIL/WATER SEPARATOR SAMPLING LOCATIONS
SANITARY SEWER SYSTEM RFI
NAS Fort Worth
Project No. 768579

Building Number	AOC/ SWMU #	Previous Soil Investigation	Type	Capacity (gallons)	Year of Installation	Outlet
1015	SWMU 47	YES	A	1,500	1967	Sanitary Sewer
1027	SWMU 44	YES	A	1,500	1985	Sanitary Sewer
1060	AOC 11	YES	A	750	1985	Sanitary Sewer
1064	AOC 10	YES	A	18,000	1988	Sanitary Sewer
1101	N/D	NO	A	4,000	N/D	Sanitary Sewer
1145	AOC 13	YES	A	1,500	1982	Sanitary Sewer
1190	SWMU 52	YES	A	2,000	NA	Sanitary Sewer
1191	SWMU 37	YES	A	500	1982	Sanitary Sewer
1194	SWMU 35	YES	A	2,000	1983	Sanitary Sewer
1194	N/D	NO	A	2,000	1983	Sanitary Sewer
1320	SWMU 61	NO	A	400	1960	Sanitary Sewer
1414	SWMU 41	YES	B	1,000	1970	Sanitary Sewer
1423	N/D	NO	A	2,700	1983	Sanitary Sewer
1602	N/D	NO	A	18,524	1994	Sanitary Sewer
1628	SWMU 7	NO	A	1,000	1981	Sanitary Sewer
1643	N/D	NO	A	2,000	1982	Sanitary Sewer
1655	N/D	NO	A	550	1991	Sanitary Sewer
1656	N/D	NO	B	18,524	1989	Sanitary Sewer
3358	N/D	NO	B	N/D	N/D	Sanitary Sewer
4146	N/D	NO	A	1,000	1983	Sanitary Sewer
4205	N/D	NO	A	550	1984	Sanitary Sewer
4210	AOC 12	YES	A	3,500	1985	Sanitary Sewer
4217	N/D	NO	B	N/D	N/D	Sanitary Sewer
4160	N/D	NO	B	N/D	1984	Sanitary Sewer

Legend:

A - Oil/Water Separator
B - Grit/Oil Interceptor
N/D - Not Determined

The investigation includes collection of soil (surface and subsurface), groundwater, and surface water samples for analyses. Table 3-2 presents a summary of proposed samples to be collected as well as analytical parameters. A detailed discussion regarding sample locations and analytical parameters is provided in the FSP.

The investigative methods and rationale specifies the investigative approach to identify potential environmental impact to soil and groundwater from the sanitary sewer system. Coordination of field investigation activities based on investigation results will be conducted with the designated AFCEE representative. The investigation approach will be conducted as follows:

- Collection of soil samples will be performed along the sanitary sewer from areas of greatest potential for release of hazardous materials into the environment, which includes the industrial sector of the sanitary sewer and OWSs. Collection will also be conducted of subsurface soil samples by direct-push technology near each manhole, major bend (i.e., exceeding 45°), and at 250-foot intervals along sanitary sewer sections in the industrial complex of the NAS Fort Worth and along sanitary sewer lines downstream from the industrial complex. Analytical data will determine where concentrations of VOCs, SVOCs, and metals exceed PQLs or background concentrations. Additional assessment of the lateral extent of the impacted soil will be recommended where contaminants determined to be released from the sewer system exceed the PQLs or background concentrations..

- Where field screening observations indicate contamination, soil samples will be submitted for fast turnaround time analysis for VOCs, TPHs, and metals (optional). Rapid turnaround analysis will be used to determine if additional investigation of soils will be recommended for the specific area.

- Where soil samples confirm the concentration of a contaminant exceeds media-specific concentration (MSC), then recommendations will be made for additional investigation of the soil and groundwater in the specific area.

- Suggestions for the relocation of monitoring wells to assess groundwater conditions at areas where soil contamination exceeds MSCs may be made to the designated AFCEE field representative.

Table 3-2

Summary Table of all Soil and Water[a] Samples
Sanitary Sewer RFI Field Sampling Plan
NAS Fort Worth
Project No. 768579

Parameter	Analytical Method	Matrix	Number of Field samples	Field Duplicate 10%	Matrix Spike 5%	Matrix Spike Duplicate 5%	Material Blank 1 per source/ matrix	Equip. Rinsate 1 per Day	Trip Blank 1 per VOA cooler	Total No. of Samples	Combined Total No. of Water/Soil Samples
Volatiles	SW8260	Soil	424	42	21	21	2	30	60	600	
		Water	44	4	2	2	2	20	20	94	
		Combined									694
Semivolatiles	SW8270	Soil	464	46	23	23	2	30	0	588	
		Water	44	4	2	2	2	20	0	74	
		Combined									662
RCRA Metals	SW6010/7000	Soil	424	42	21	21	2	30	0	540	
		Water	44	4	2	2	2	20	0	74	
		Combined									614
Pest/PCB[b]	SW8080	Soil	262	26	13	13	2	30	0	346	
		Water	0	0	0	0	0	0	0	0	
		Combined									346
Nitrate[c]	EPA 300.0	Water	14	1	1	1	2	5	0	24	24
Sulfate[c]	EPA 300.0	Water	14	1	1	1	2	5	0	24	24
TDS	EPA 160.1	Water	14	1	0	0	0	0	0	15	15
Volatiles[d]	SW8240 (48 hr. TAT)	Soil	60	6	3	3	2	30	30	134	134
TPH-Gasoline[e]	SW8015M (48 hr. TAT)	Soil	60	6	3	3	2	30	0	104	104
TPH-Jet Fuel[f]	SW8015M (48 hr. TAT)	Soil	60	6	3	3	2	30	0	104	104
RCRA Metals	SW6010/7000 (48 hr. TAT)	Soil	43	4	2	2	2	30	0	83	83
Biotechnical	See Table 3-5 in	Soil	12	1	0	0	1	1	0	15	
	Field Sampling Plan	Water	10	1	0	0	1	1	0	13	
		Combined									28
Geotechnical	See Table 3-6	Soil	12	0	0	0	0	0	0	12	12
Field Parameters	See Table 3-7 in Field Sampling Plan	Soil	10	1	0	0	0	0	0	11	
		Water	14	1	0	0	0	0	0	15	
		Combined									26

[a] Groundwater and surface water.
[b] Pest/PCB QC water samples collected in 1 liter glass, no preservative (hold time = 7 day preext., 40 day postext.)
[c] Nitrate and Sulfate to be collected in the same bottle
[d] Volatile QC water samples: collected in 3 * 40 ml glass amber vials, preserved in HCL with 14 day hold time
[e] TPH Gasoline QC water samples: collected in 3 * 40 ml glass amber vials, preserved in HCL with 14 day hold time
[f] TPH- Jet Fuel QC water samples: collected in 2 * 1 liter glass amber, no preser. with 7 day hold time

3.1 Surface Soil Investigation

3.1.1 Field Procedures

Surface soil samples will be collected to evaluate potential surface contamination. The surface soil samples will be discrete grab samples collected from 0 to 2 foot in depth. The surface soil samples will be collected at selected sanitary sewer system manholes and OWS locations at residential and industrial areas of NAS Fort Worth to confirm if there have been releases from the sanitary sewer to surface soils. Surface soil samples will be collected at selected subsurface soil sample locations to determine if the sanitary sewer effluent had impacted the surface soils. Manholes of the sanitary sewer system and surface soils at OWSs are selected as locations because the higher potential of a surface release of effluent from the sanitary sewer system at these structures. At OWS locations, surface soil samples, will be collected, along with sub-surface soil samples to determine distribution of contaminants and identify exposure pathways. Soil samples will be collected alongside of the OWSs that are accessible to sampling equipment. Where previous investigation of OWS soils has occurred, soil samples will be collected to fill data gaps.

The number and location of soil samples is based on potential releases of contaminants from the sanitary sewer system onto the surface. Industrialized areas of the Base have a higher density of sample locations than residential areas. The surface soil samples will be collected in residential areas to verify the absence of contaminant above background levels so that residential areas can be cleared for transfer. Surface soils in industrialized areas will be collected to determine if past management practices of the sanitary sewer system has impacted these soils.

Surface soil samples will be collected at locations specified in the FSP. Soil samples will be collected in protective sleeves to minimize organic compound volatilization as the soil sample is recovered. The sample tubes will be driven into the ground with a direct-push soil rig or manually in a California modified shoe.

Criteria for selection of surface/surface soil sample locations are listed as follows:

- Sample collection will be performed in areas with greatest potential for release of hazardous materials into environment (e.g., industrial facility locations).
- Samples will be collected at manhole locations along sections of sewer line down stream from industrialized areas to determine if sanitary sewer system effluent impacted surface soils.
- A representative number of surface soil samples will be collected at residential areas to verify there has been no unacceptable release of contaminants.
- Collection of analytical data for use in calculating human health risks to verify if TNRCC risk reduction standards for both NAS Forth Worth residential and industrial areas have been met.

When this work plan is published, an investigation will be in progress to collect and assess background conditions of soil and groundwater at NAS Forth Worth. This data will be used where available to establish soil background concentrations necessary for completion of the risk assessment.

3.1.2 Laboratory Methods

Surface soil samples will be analyzed by EPA Methods SW8260 for VOCs, SW8270 for SVOCs, and SW6010/7000 for RCRA metals. Selected surface samples from the industrial complex and residential areas will also be analyzed by EPA Method SW8080 for pesticides and polychlorinated biphenyls (PCB).

3.2 Subsurface Soil Investigation

3.2.1 Subsurface Soil Investigation Field Procedures

Soil borings will be installed along each of the three sanitary sewer system segments using direct-push soil probe methods. Subsurface soil samples will then be collected in protective sleeves to minimize organic compound volatilization as the soil sample is recovered.

Criteria for the subsurface soil sampling locations are as follows:

- Collection from areas of greatest potential for release of hazardous materials into the environment: industrial sector of the sanitary sewer and OWSs, where industrial activity was maximized and the greatest potential exists for releases of effluent to subsurface soils surrounding the system.

- Collection near each manhole, major bend (i.e., exceeding 45°), and at 250-foot intervals along sanitary sewer sections in the industrial complex of the NAS Fort Worth and along sanitary sewer lines downstream from the industrial complex. The industrialized area of the NAS Fort Worth is predominantly where wash racks, maintenance shops, and repair facilities were located near the flight apron area.

- Collection where residential sewers discharge into interceptors ; limited data acquisition is justified because of the low probability of discharge of regulated materials to the sanitary sewer system from residential areas.

- Collection of analytical data for use in calculating human health risks to verify TNRCC risk reduction standards for both residential and industrial areas have been met.

Soil probe sampling locations will be at every manhole, every 250 straight section of sewer, at every bend exceeding 45°, and at every OWS and lift station along the sanitary sewer system within the industrial complex of NAS Forth Worth. The industrial complex at NAS Forth Worth has a higher density of proposed sample locations than either the northern and southern residential areas because a small portion of the materials used in the industrial complex, such as fuels, hydraulic oil, paint strippers, and solvents, were discharged into to the sanitary sewer system. Residential areas require limited subsurface soil sampling due to the low probability of regulated material being released from households to the sanitary sewer system. The subsurface soil samples will be collected in the residential areas to verify the absence of contaminant greater than background levels so that residential areas can be cleared for real property transfer. Sub-surface soils in industrial areas will be collected and analyzed to determine if past management practices of the sanitary sewer system has impacted these soils.

Sample depth will depend on whether there is a known groundwater plume below the location being sampled. If there is a known plume, the sample will be collected 2 feet above the

groundwater table. If there is no known plume, the sample will be collected immediately above the groundwater table. The elevation of the groundwater table will be calculated based on historic and seasonal data. The purpose of obtaining the subsurface soil sample immediately above the water table where there is no known groundwater contamination is to investigate the point-specific soils below the sewer component and the capillary fringe, which may contain groundwater that has been transported from another contaminant source. Depths will be determined prior to boring from groundwater elevation maps and sewer line elevation. Soil boring locations will be located as close to the edge of each sanitary sewer line as possible without unreasonable risk of puncturing the line as determined by the accuracy of the utility field location.

3.2.2 Subsurface Soil Investigation Lab Methods

Subsurface soil samples will be submitted for analysis using EPA Methods SW8260 for VOCs, SW8270 for SVOCs, and SW6010/7000 for RCRA metals. At locations where surface soil samples are collected, subsurface soil samples will also be analyzed by EPA Method SW8080 for pesticides and PCBs.

Subsurface samples will also be collected for geotechnical and biotechnical analyses. Geotechnical and biotechnical sample locations will be chosen near the conclusion of subsurface soil sampling at the industrial area. The decision will be for six geotechnical and six biotechnical soil probes. The locations will be made in the field by the principal investigator and coordinated with the AFCEE field representative. Locations will be chosen from geographic areas showing the highest levels of contamination from field screening during the subsurface investigation, and not from the zones of highest contamination.

Each geotechnical soil sample will be tested for dry bulk density, effective porosity, organic content, intrinsic permeability, and water content. The biotechnical soil samples will be analyzed for ammonium (EPA Method 350.2), phosphate (EPA Method 365.1), total Kjeldahl nitrogen (EPA Method 351.3), moisture content (EPA 160.3), and pH (SW 9045).

3.3 Groundwater

3.3.1 Groundwater Investigation Field Procedures

Groundwater samples will be collected from permanent monitoring wells installed at sampling locations specified in the FSP. Criteria for the groundwater sampling are as follows:

- Collection of groundwater samples at industrialized sections of the sanitary sewer, such as oil/water separators. The industrialized area of NAS Fort Worth has the greatest potential for the release of contaminants from the sanitary sewer system into the soil and groundwater.

- Collection of groundwater from monitoring wells installed at selected sanitary sewer system manholes in industrialized areas of NAS Fort Worth to determine if materials discharged to the sewer system in the area have been released to the groundwater from that part of the sewer.

- Collection of groundwater at monitoring wells installed by manholes located downstream of potential release areas. This is to determine if migration from a sanitary sewer system release has impacted the system downstream from the potential release area, through fluid movement through the sewer and its trench, and the groundwater downgradient of the potential release area.

- Selection of monitoring well locations to intercept groundwater along mapped flow paths downstream of industrialized segments of the sanitary sewer system. Evaluation of existing monitoring well analytical data or resampling of these wells for additional analytical parameters will be used to fill data gaps.

- Groundwater samples collected from areas of known groundwater plumes, such as the Air Force Plant No. 4 plume, will be evaluated for the presence of previously identified contaminants along with other analytes. Groundwater samples from the northern lobe of the Air Force Plant No. 4 plume in the flight operations area will be collected and analyzed to determine if solvents (other than trichloroethylene/ dichloroethylene [TCE/DCE]), metals, and SVOCs have been released to the groundwater from the sanitary sewer system.

The number and location of groundwater samples is based on potential releases of contaminants from the sanitary sewer at the industrial complex of NAS Fort Worth because of past discharge of fuels, hydraulic oils, paint strippers, and solvents to the sanitary sewer system through shop drains. Groundwater samples will not be collected at residential areas due to the low probability

of regulated material being released from households to the sanitary sewer system and into the environment.

Groundwater samples will generally not be collected from areas where groundwater plumes are known to exist from previous investigations and remedial efforts. These areas include the Air Force Plant No. 4 plume extending through the flight line area and eastward along White Settlement Road, the area downgradient of the petroleum, oils, and lubricants area, and the area downgradient of the Base Service Station (Building 1518). However, groundwater samples will be collected from the northern lobe of the Air Force Plant No. 4 plume in the flight operations area to determine if solvents other than TCE/DCE, metals, and SVOCs have been released to the groundwater.

The lack of data available on groundwater conditions associated with the sanitary sewer system directs this investigation toward the limited use of groundwater monitoring wells for gathering the most data for a large sewer system with limited available resources. The use of groundwater monitoring wells is necessary to produce the quality of groundwater required for the investigation. The monitoring wells will allow for the groundwater collection techniques required to assess for releases of all regulated materials to the groundwater contained in the effluent from the sanitary sewer system. Monitoring well locations have been selected for the evaluation of the groundwater quality of the sanitary sewer system and the immediate area. The location of the monitoring wells will be published in a separate document after agreement of all parties has been made on specific well location. Procedures for the installation of permanent monitoring wells and sampling procedures and methods are provided in the FSP.

Groundwater samples will also be collected from monitoring wells installed on the downgradient side of each sanitary sewer system component being investigated.

Soil boring data from the area will be used to assist in determining the depth to groundwater and the stratigraphy at the location necessary for construction of the well. Field parameters will be measured and recorded during monitoring well development and purging. Low flow sampling techniques will be utilized for collection of groundwater samples and are specified in the FSP.

Results of an investigation will be published by others under Air Force contract that assesses groundwater background conditions at NAS Fort Worth. These results will be used to aid in establishing groundwater background concentrations necessary for completion of the risk assessment.

3.3.2 Groundwater Investigation Lab Methods

Groundwater samples will be collected and submitted for analysis using EPA Methods SW8260 for VOCs, SW8270 for SVOCs, and SW6010/7000 for RCRA metals.

Near the conclusion of the investigation at the industrial area, biotechnical sample locations will be chosen. Locations will be selected in areas sharing the highest levels of contamination from field screening during the investigation. The final sample locations will be selected in the field by the principal investigator and coordinated with the AFCEE field representative. It is anticipated that six groundwater samples will be collected and tested for biotechnical parameters. The biotechnical water samples will be analyzed for nitrate (EPA Method 300), sulfate (EPA Method 300), total dissolved solids (EPA Method 160.1), methane (RSK SOP-175), and alkalinity (EPA Method 310.1).

Groundwater field parameters will be measured during collection of samples from both temporary well points and permanent monitoring wells that have been installed. Parameters to be measured in the field include pH, temperature, conductivity, dissolved oxygen, turbidity, and redox potential.

For consideration of corrective measures evaluations of impacted groundwater, if permanent monitoring wells are installed during this investigation, selected groundwater samples will be tested for biotechnical parameters. Selected groundwater samples will be collected and analyzed for nitrate (EPA Method 300), sulfate (EPA Method 300), total dissolved solids (EPA Method 160.1), methane (RSK SOP-175), and alkalinity (EPA Method 310.1).

3.4 Surface Water

3.4.1 Surface Water Investigation Field Procedures

Surface water samples will be collected at surface springs downstream of sanitary sewer system facilities. The surface water samples will be collected to determine if effluent has been released from the sanitary sewer system and is impacting surface water. The samples will be collected with standard surface water sampling equipment. A sample will be collected upstream and downstream of the suspected release points.

3.4.2 Surface Water Investigation Lab Methods

Surface water samples will be analyzed using EPA Methods SW8260 for VOCs, SW8270 for SVOCs, SW6010/7000 for RCRA metals, nitrate (EPA 300), sulfate (EPA 300), total dissolved solids (SW160.1), and alkalinity (EPA 310.1).

3.5 Additional Site Characterization

An IT risk assessment specialist will conduct a site review area during the course of the field investigation to verify possible contaminant pathways for ecological and human receptors. The results of this review will be included in the final RFI report.

3.6 Waste Management

Wastes that may be generated during the RFI site investigation include: (1) purged groundwater, (2) decontamination water, (3) drill cuttings, (4) expendable protective clothing (Tyvek), and (5) general trash. Modifications to the planned waste management may be made if field observations or waste attributes change. The general waste management approach is presented in this subsection; the detailed approach is included in the FSP.

Purged groundwater generated during well point purging and decontamination water generated during decontamination of sampling equipment will be contained on-site in labeled 55-gallon U.S. Department of Transportation (DOT) drums. All investigation-derived wastes will be classified in accordance with 30 Texas Administrative Code (TAC), Section 335, Subchapter R, for proper waste disposal. The water will be tested for VOCs, SVOCs, and RCRA metals and the analytical results reviewed to classify the water to determine its disposal options. If treatment

is permitted, the water will be pumped through activated carbon for treatment and contained in a tank for testing prior to discharge to the sanitary sewer. The analytical results will be provided to NAS Fort Worth personnel for review and approval before discharge to the NAS Fort Worth sanitary sewer. After its use, sample of the activated carbon will be obtained and submitted to the carbon vendor for analysis and proper classification of spent activated carbon identified for disposal. If acceptable by the vendor, the activated carbon will be shipped to the vendor for regeneration/recycling.

Drill cuttings from soil probe and drilling activities will be contained in drums or roll-off containers, which will be labeled and kept at the site in a designated location until analytical data are received. The Air Force will consult with TNRCC prior to disposal of soil cuttings that are contaminated in excess of Risk Reduction Standard 1. Contaminated soils will be characterized according to TNRCC rules and regulations and disposed of at an appropriate licensed landfill.

Disposal of protective clothing and trash will be disposed as noncontaminated refuse.

Waste disposal activity will be coordinated with NAS Fort Worth authorities and they are responsible for signing all transportation manifests as the "generator." Any hazardous waste disposal will be at a site selected by NAS Fort Worth authorities. All waste management practices will follow the guidelines established by the TNRCC.

4.0 Risk Assessment

The baseline human-health risk assessment will be consistent with the guidance set forth in the 40 Texas Risk Reduction Rules (30 TAC 335 Subchapter S) and with EPA guidance, including *Risk Assessment Guidance for Superfund (RAGS), Volume 1, Human Health Evaluation Manual* and *Exposure Factors Handbook* (EPA, 1991).

4.1 Select Contaminants of Concern

Soils collected during the site study will be analyzed for VOCs, SVOCs, RCRA metals, and pesticides/PCBs. Knowledge of process and professional judgement will be used to select the potential Phase 1B analytes, and to review the results of the Phase 1A investigation to remove contaminants from further consideration as appropriate. Retained analytes detected in at least one or more samples, for the purposes of risk assessment, will be considered to be tentatively identified constituents (TIC). All TICs will be retained as chemicals of potential concern (COPC) unless:

- They are not detected in exceedance of health-based levels.
- They are detected infrequently (i.e., in fewer than 5 percent of total samples for a medium) and are not expected to be presented based on site/process knowledge.
- They are naturally-occurring compounds (i.e., inorganics) and are detected at levels less than statistically developed background concentrations.

In addition, a consideration of additional factors will be applied, including:

- Mobility and persistence of contaminants with a view toward eliminating contaminants that are immobile from further fate and transport modeling, and eliminating contaminants that will naturally degrade or attenuate relatively quickly
- Chemicals that are essential nutrients.

The objective of the screening process is to identify chemicals in soils at the site that contribute significantly to risks calculated for probable soil and groundwater exposure scenarios and to eliminate inappropriate COPCs from further consideration. Accomplishing this will eliminate constituents that are demonstrably not "risk drivers." The use of health-based screening levels

and the rejection of infrequently detected constituents during COPC identification is available under Risk Reduction Standard 3 with TNRCC approval. Any COPC that are eliminated in the risk assessment will be fully explained and justified. Chemicals exceeding maximum contaminant levels (MCL) or other ARARs will be included, regardless of other screening criteria. Also, a direct comparison to background (upper threshold limits) or PQLs will be performed.

4.2 Exposure Assessment

The exposure assessment will be used to characterize actual and potential exposure, at the present time and in the future, and to determine the concentration levels over time and space in each environmental medium at the location where humans may come in contact with the COPCs. The primary components of an exposure assessment include a characterization of the exposure setting, a pathway analysis, and identification of appropriate exposure scenarios, and an estimation of exposure.

4.2.1 Identification of Exposure Pathways

According to EPA and TNRCC risk methodology, exposure of people can occur only if the exposure pathway is complete. Potential migration pathways at the NAS Fort Worth sanitary sewer system include air transport of vapors and particulate from COPC-contaminated soil, surface water transport via potential effluent release to surface water, and transport to the groundwater by infiltration of effluent from the sanitary sewer.

To determine which pathways are complete, and to eliminate incomplete pathways from further evaluation, the transport pathway analysis will assess the potential pathway a chemical takes from a source. The exposure pathway analysis will assess the potential pathway a chemical takes from a source to a receptor describing the source(s), location(s), and type(s) of environmental releases with population location(s) and activity pattern(s). For the NAS Fort Worth sanitary sewer system site assessment, exposure pathway analysis will entail the identification of the following essential elements:

- Source(s) and mechanism(s) of chemical release to the environment
- Transport medium (e.g., air, soil) with the potential to spread contamination
- Exposure point, i.e., a point of potential human contact with the contaminated medium that will make maximum use of local demographic information

- Exposure route (e.g., ingestion, inhalation, or direct dermal contact) at the exposure point.

- Ecological impacts will be considered. Human health PRGs will be developed, and then tested to determine whether they are sufficiently protective of ecological receptors.

Summary charts of the exposure pathways illustrating potential contaminant pathways from their source to potential receptors will be completed, including a rationale for the selection or exclusion of each pathway.

4.2.2 Quantification of Exposure Concentrations

For those constituents retained as COPCs, exposure concentrations at the identified receptors arriving through completed pathways will be quantified. This quantification is typically accomplished by contaminant fate and transport modeling; however, straightforward analytical calculations may be used when input variables are limited in number. An example would be calculating contaminant transport through the vadose (i.e., unsaturated) zone to groundwater. More complex numerical models can be applied appropriately to fully describe degradation and attenuation, e.g., modeling contaminant migration in groundwater.

4.2.3 Exposure Intake Variables

Exposure intake values such as contact rates (ingestion or inhalation rates), exposure frequency and duration, and body weight will be developed using default values utilized by TNRCC or EPA.

4.2.4 Toxicity Assessment

An assessment of toxicity for all COPCs will be made. The hierarchy of information specified in the Risk Reduction Rules is as follows:

(1) EPA's Integrated Risk Information System (IRIS) (EPA, 1993a)

(2) Health Effects Assessment Summary Tables (HEAST) (EPA, 1993b)

(3) EPA Criteria Documents

(4) Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profiles

(5) Other scientifically valid published sources.

Slope factors and reference doses (RfD) will be utilized in the risk calculations for those COPCs for which published information is available. If published values are not available from the hierarchy of sources, toxicity values may be developed by such alternate means as the use of surrogate chemicals that do have available toxicity data. The bases for the selection of the surrogates include: (1) chemical class, (2) toxicity characteristics, (3) metabolic and pharmacokinetic characteristics, and (4) structure-activity relationships. It is typically assumed that the known activity of one compound may be used to estimate the activity of another structurally-related compound for which specific toxicological data are lacking.

4.3 Risk Characterization and Calculation of Remediation Goals

Information obtained from the exposure and toxicity assessments will be integrated to estimate the potential human-health risk to current and future receptors. Given the appropriate land use scenario, the risk calculations will be compared with TNRCC criteria used to judge unacceptable risk (i.e., 10^{-6} excess lifetime cancer risk for carcinogens [current exposures] or 10^{-4} [potentiometric future exposures], and a target hazard index of 1 for systemic toxicants [current or potentiometric future exposures]. A consideration of aggregate risk posed by the COPC will be included in the risk characterization.

4.3.1 Risk Characterization

The magnitude and types of risks resultant from conditions at the site depend on the nature, duration, and frequency of exposure to COPC, and the characteristics of the exposed populations. Cancer risk is stated in terms of excess cancer cases attributed to exposure to the suspected carcinogen at the estimated chronic daily intake.

Noncarcinogenic risk estimates are determined by dividing chronic daily intake levels for each noncarcinogen by the appropriate RfD. The resulting ratio is the hazard quotient.

The sum of the hazard quotients for individual constituents is termed the total hazard index. If this ratio is less than or equal to 1.0, no adverse health effects are anticipated from the predicted

chronic daily intake level. If the ratio is greater than 1.0, the predicted chronic daily intake level could potentially cause adverse health effects. This determination is imprecise because the derivation of the RfD involves the use of multiple uncertainty factors. The potential for adverse health effects for a mixture of constituents having a hazard index in excess of 1.0 will be evaluated on a case-by-case basis.

4.3.2 Derivation of Remediation Goals

Preliminary remediation goals (PRG) will be developed by employing the methodology detailed in the Texas Risk Reduction Rules and *Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals)* (EPA, 1991), also abbreviated as RAGS Part B.

Determination of PRGs for Surface Soils. Under commercial/industrial land use, the risk of the contaminant from surface soil is assumed to be due to direct ingestion, inhalation of volatiles from the soil, and inhalation of particulates from the soil, and is calculated for an adult worker only. Pursuant to the Risk Reduction Rules, the definition of surface soil for purposes of evaluating potential exposure at commercial/industrial sites is assumed to be limited to the depth interval of 0 to 2 feet below grade as detailed at 31 TAC, 335.559(g).

The PRGs for surface soils (i.e., soils to 2 feet in depth from the surface) are established by first calculating carcinogenic PRGs using the methodology outlined in RAGS Part B as follows.

Once the PRG based on carcinogenic effects has been determined by the previously discussed methodology, a PRG must also be calculated based on noncarcinogenic toxic effects. This calculation is accomplished by employing Equation 7 from RAGS Part B (Commercial/Industrial Soil-Noncarcinogenic Effects) as follows: parameters, definitions, and values are identical to those previously listed for the "carcinogenic effects" equation. Three additional parameters for this equation are:

- Target hazard index (THI) (unitless), for which the default value is 1
- RfD_o, which is the oral chronic reference dose (milligrams per kilogram per day [mg/kg-day]), for which the value is chemical-specific

- RfD_i, which is the inhalation reference dose (mg/kg-day), for which the value is chemical-specific.

Equation 7

$$C(\text{mg/kg, risk-based}) = \frac{THI \times BW \times AT \times 365\,\text{days/yr}}{EF \times ED \times [((1/RfD_0 \times 10^{-6}\,\text{kg/mg} \times IR_{soil}) + ((1/RfD_i \times IR_{air} \times [1/VF + 1/PEF]))]}$$

Parameters	Definition (units)	Value
C	chemical concentration in soil (mg/kg)	-----
TR	target excess individual lifetime cancer risk (unitless)	10^{-6}
SF_i	inhalation cancer slope factor ((mg/kg-day)$^{-1}$)	chemical-specific
SF_o	oral cancer slope factor ((mg/kg-day)$^{-1}$)	chemical-specific
BW	body weight (kg)	site-specific
AT	averaging time (yr)	site-specific
EF	exposure frequency (days/yr)	site-specific
ED	exposure duration (yr)	site-specific
IR_{soil}	ingestion rate	50 mg/day
IR_{air}	inhalation rate	20 m^3/day
VF	soil-to-air volatilization factor (cubic meters per kilogram [m^3/kg])	chemical-specific
PEF	particulate emission factor (m^3/kg)	site-specific

Once the PRGs for both carcinogenic effects and for non-carcinogenic effects has been calculated, the lowest (i.e., most restrictive) of the two values is chosen as the PRG.

Determination of PRGs for Subsurface Soils. PRGs for subsurface soils will be determined with regard to a different exposure pathway than that for surface soils. Whereas surface soils are assumed to pose a potential direct human ingestion/inhalation exposure pathway, in the case of subsurface soil, the pathway is assumed to be a mechanism of contaminant leaching to groundwater, which then poses a contact, inhalation, or ingestion pathway via water supply wells.

As directed in the Risk Reduction Rules at 30 TAC §335.563(I)(2)(A), determinations of maximum residual concentrations that are protective of human health and the environment are based on fate and transport evaluation of contaminant migration. The process is summarized as follows:

- A groundwater PRG is calculated or a maximum contaminant level (MCL) is employed to establish maximum allowable concentrations of each contaminant in groundwater.

- Groundwater hydrology is applied to establish the maximum concentration of each contaminant in leachate in order for the groundwater not to have contaminant concentrations in excess of the various contaminant PRGs.

- A contaminant fate and transport evaluation is conducted to "back-model" the allowable concentration of each contaminant in soils in order for the groundwater not to have contaminant concentrations in excess of any of the contaminant PRGs.

- The resultant maximum allowable concentration is then employed as the cleanup criteria for subsurface soils.

4.3.3 Assessment of Uncertainties

A qualitative evaluation of uncertainties associated with the risk assessment will be conducted by evaluating the impact of uncertainties in each of the input parameters predicted to have high impact on the calculated risk. This evaluation will cost-effectively be accomplished by using the upper and lower values for each variable in the risk assessment calculations to determine the sensitivity of the estimated risks and hazards to uncertain input parameters. The calculated risks are characteristically insensitive to all but a very few input parameters. This qualitative treatment will be used to determine whether the uncertainty in the calculated risks is "low," "medium," or "high" according to EPA guidance.

5.0 Reporting

5.1 RCRA Facility Investigation Report

Existing reports describing investigation activities at the OWSs will be reviewed for the objective of preparing a RFI report. Interviews of knowledgeable persons such as regulatory agency personnel and current and former NAS Fort Worth personnel will also be conducted to supplement the reports if available information is incomplete and if personnel are available for interview. Existing aerial photographs, maps, and other sources of information will be reviewed if available and potentially beneficial.

Data available from a soil and groundwater background study, quarterly groundwater monitoring/sampling events, and previous site investigations with acceptable quality assurance/quality control criteria will be incorporated to fill data gaps of the sanitary sewer system for completion of the RFI.

After the available data have been evaluated, including field characterization data from the planned sanitary sewer system investigation, a report will be prepared that compiles and evaluates the information. The primary objective of the RFI report will be to compile all existing data, evaluate the data by current TNRCC regulations, and present conclusions as to the need for remedial or other actions. The risk assessment will be part of the report that will be a "stand-alone" document; it will contain all pertinent data from previous investigations as well as this one.

A preliminary outline of the report is shown in Figure 5-1. The outline follows the guidelines specified by TNRCC for a comprehensive site assessment report and for a risk assessment.

5.2 Interim Corrective Measures Work Plan

An ICM work plan will be prepared if remediation is recommended in the RFI report. The plan will follow the TNRCC guidance for Risk Reduction Standards for each specific area based on current and future land use and evaluate at least two remedial alternatives that incorporate the technologies most feasible for a site. The plan will be based upon the results of the RFI,

RCRA Facility Investigation Report

1. Executive Summary
2. Introduction
   a. Purpose of Investigation
   b. Background and Previous Investigations
      i. Site Description
      ii. Previous Investigations
   c. Report Organization
3. Field Techniques and Analytical Methods
   a. Soil
      i. Assessment Approach and Methods
         (1) Field Procedures
         (2) Lab Methods
   b. Groundwater
      i. Assessment Approach and Methods
         (1) Field Procedures
         (2) Lab Methods
   c. Surface Water
      i. Assessment Approach and Methods
         (1) Field Procedures
         (2) Lab Methods
   d. Surveying
4. Nature and Extent of Contamination surface and Subsurface Soils
      i. Near-surface Soils
         (1) Organic Constituents
         (2) Inorganic Constituents
      ii. Subsurface Soils
         (1) Organic Constituents
         (2) Inorganic Constituents
   a. Groundwater
         (1) Organic Constituents
         (2) Inorganic Constituents
   b. Surface Water
   c. Quality Assurance/Quality Control
      i. QC Approach and Summary
      ii. Laboratory Matrix QC Sample Results
5. Fate and Transport
   a. Sources and Types of Contaminants
   b. Potential Routes of Migration
   c. Environmental Reaction of the Chemicals of Concern
6. Risk Assessment
   a. Identification of Chemicals of Concern
   b. Exposure Assessment
      i. Exposure Setting Characterization
         (1) Site Conditions
         (2) Land Use
         (3) Water Use
      ii. Potentially Exposed Populations

Figure 5-1
Preliminary RCRA Facility Investigation Report Outline, NAS Fort Worth, Texas

iii. Exposure Pathway Analysis
c. Exposure Point Concentration
d. Estimation of Chemical Intake
e. Toxicity Assessment
f. Risk Characterization
g. Uncertainty Analysis
h. Special Considerations
i. Proposed Cleanup Levels
j. Compliance Point

7. Summary and Conclusions
   a. Summary
      i. Nature and Extent of Contamination
      ii. Fate and Transport
      iii. Risk Assessment Conclusions
   b. Conclusions
      i. Data Limitations
      ii. Recommendations for Interim Corrective Measures Plan
8. Photographic Documentation
9. Quality Assurance/Quality Control Procedures
10. References

Appendices
A. Boring/Probe Logs
B Soil Analytical Data
C. Soil Sample Chain of Custody Forms
D. Monitoring Well Diagrams
E. Groundwater Analytical Data
F. Groundwater Chain of Custody Forms
G. Surface Water Analytical Data
H. Surface Water Chain of Custody Forms
I. Waste Management and Disposition

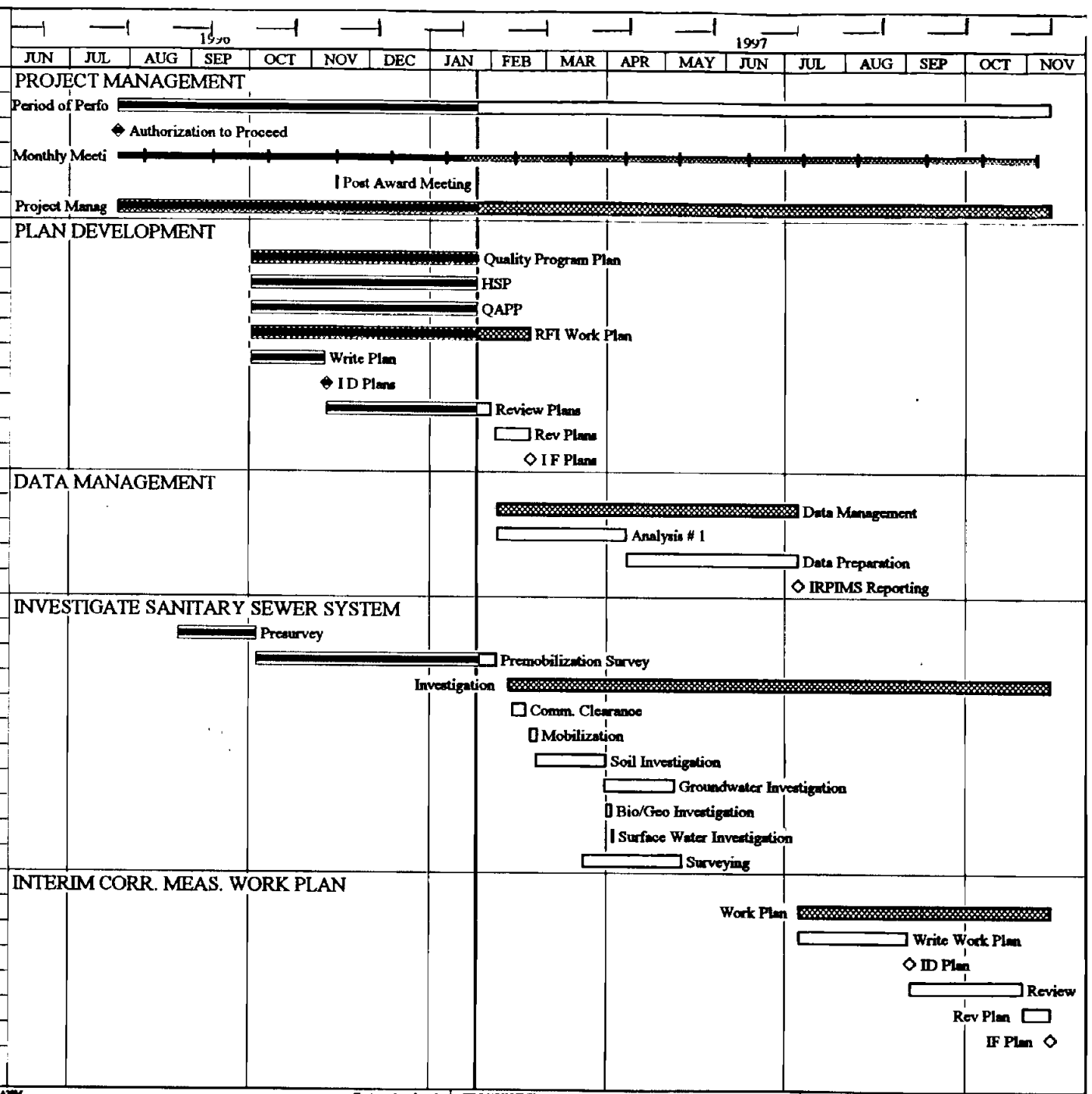
Figure 5-1 (Continued)
Preliminary RCRA Facility Investigation Report Outline, NAS Fort Worth, Texas

including the contaminants of concern and the remedial action objectives resulting from a risk-based analysis of the analytical results.

6.0 Schedule

The project schedule is shown on Figure 6-1.

ACTIVITY ID	EARLY START	EARLY FINISH	REM. DUR
PROJECT MANAGEMENT			
SI10000000	26JUL96A	12NOV97	208
SI10000001	26JUL96A		0
SI60100000	26JUL96A	6NOV97	10
SI60102000	14NOV96A	14NOV96A	0
SI60200000	26JUL96A	12NOV97	208
PLAN DEVELOPMENT			
SI10200000	2OCT96A		0
SI10201000	2OCT96A		0
SI10202000	2OCT96A		0
SI10300000	2OCT96A	20FEB97	19
SI10300005	2OCT96A	7NOV96A	0
SI10300010		8NOV96A	0
SI10300020	9NOV96A	31JAN97	5
SI10300030	3FEB97	20FEB97	14
SI10300040		20FEB97	0
DATA MANAGEMENT			
SI30000000	4FEB97	7JUL97	110
SI20201000	4FEB97	10APR97	48
SI30100000	11APR97	7JUL97	62
SI30200000	8JUL97	7JUL97	0
INVESTIGATE SANITARY SEWER SYSTEM			
SI70100000	26AUG96A	4OCT96A	0
SI70200000	5OCT96A	3FEB97	6
SI70300000	10FEB97	12NOV97	198
SI70300500	12FEB97	18FEB97	5
SI70301000	21FEB97	24FEB97	2
SI70302000	24FEB97	31MAR97	26
SI70303000	31MAR97	5MAY97	26
SI70304000	1APR97	3APR97	3
SI70305000	4APR97	4APR97	1
SI70306000	20MAR97	9MAY97	37
INTERIM CORR. MEAS. WORK PLAN			
SI80000000	8JUL97	12NOV97	92
SI80100000	8JUL97	1SEP97	40
SI80200000		2SEP97	0
SI80300000	3SEP97	29OCT97	41
SI80400000	30OCT97	12NOV97	10
SI80500000		12NOV97	0



Plot Date 21FEB97
Data Date 25JAN97
Project Start 28FEB96
Project Finish 31MAR97

(c) Primavera Systems, Inc.

Inactive
Activity Bar/Early Dates
Critical Activity
Progress Bar
Milestone/Flag Activity

A99M

Sheet 1 of 1

CONTRACT F41624-94-D-8047 DO 0039
RCRA Facility Investigation
PROJECT SCHEDULE - 768579

SUMMARY LEVEL
SUMMARY ACTIVITY

Date	Revision	Checked	Approved

Figure 6-1

7.0 Project Management

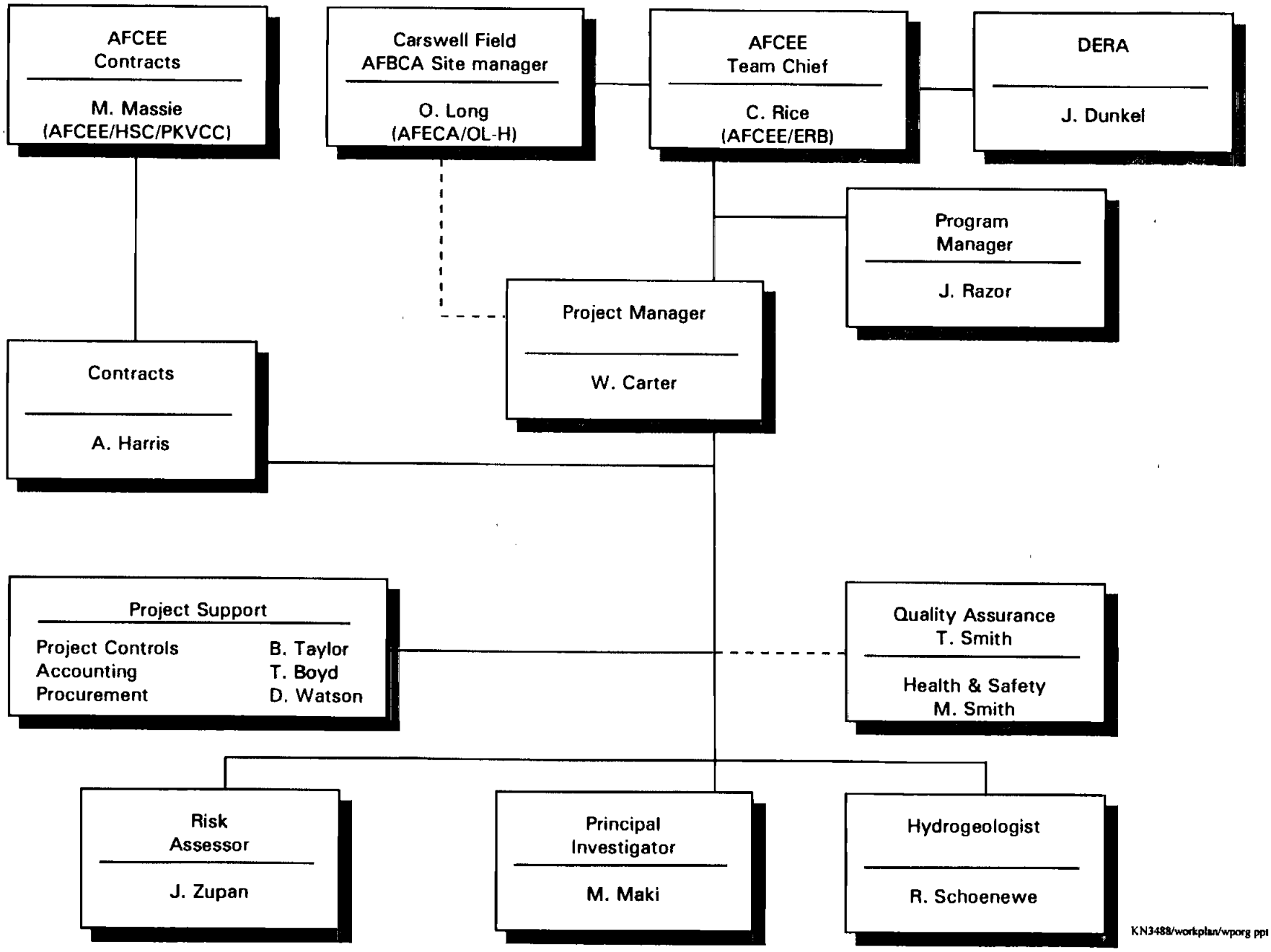
The objectives of this RFI are to:

- Complete RFI tasks in accordance with this work plan, the FSP, HSP, and QAPP.
- Communicate to the technical compliance, scheduled and actual program, and budgetary status of the project as appropriate with project participants (AFBCA, AFCEE, TNRCC).
- Complete and issue an RFI report and ICM plan as appropriate.

This task includes coordinating among other RFI project participants, as well as tracking schedules and budgets and preparing monthly status reports to AFCEE. Preparation of project information, forecasting, and updating of schedules and budgets will also be done under this task.

A more detailed description of project organization and responsibility is provided in Section 3.0 of the QAPP. The project organization is shown on Figure 7-1.

Figure 3-1. Project Organization - NAS Fort Worth (Project No. 768579)



8.0 References

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ADMINISTRATIVE RECORD

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