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U.S. DEPARTMENT OF ENERGY

STRATEGIC PETROLEUM RESERVE
PROJECT MANAGEMENT OFFICE
NEW ORLEANS, LOUISIANA

Site Environmental Report

for

Calendar Year 1993

STRATEGIC PETROLEUM RESERVE

SITE

ENVIRONMENTAL REPORT

FOR

CALENDAR YEAR 1993

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ABBREVIATIONS AND ACRONYMS

ac	acre
adj	adjacent
ADM	Action Description Memorandum
AFFF	aqueous film forming foam
ARCO	Atlantic Richfield Company
As	arsenic
AST	above ground storage tanks
ASTM	American Standard Testing Methods
avg	average
bbl	barrel(s) (1 bbl = 42 gallons)
BC	Bayou Choctaw
BDL	Below Detectable Limit
BH	Big Hill
bldg	building
bls	below land surface
BM	Bryan Mound
BOD_5	five day biochemical oxygen demand
CAA	Clean Air Act
CAP	corrective action plan
°C	degrees celcius
CEQ	Council for Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESQG	conditionally exempt small quantity generator
Ci	Curies
cm	centimeter
CO	carbon monoxide
COD	chemical oxygen demand
COE	United States Army Corps of Engineers
CWA	Clean Water Act
CVN	Cavern
DA	United States Department of Agriculture
DMR	Discharge Monitoring Report
DO	dissolved oxygen
DOE	United States Department of Energy

DOT	United States Department of Energy
DPRP	Discharge Prevention and Response Plan
EA	environmental assessment
EIQ	Emissions Inventory Questionnaire
EIS	environmental impact statement
EPA	United States Environmental Protection Agency
ERT	Emergency Response Team
ESA	Endangered Species Act
ES&H	Environmental Safety & Health
°F	Degrees Fahrenheit
FE	Fossil Energy
F&WS	United States Fish and Wildlife Service
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding Of No Significant Impact
FRP	Facility Response Plan
ft	feet
GLO	General Land Office
gpd	gallons per day
ha	hectacre
HAP	Hazardous Air Pollutant
HPP	high pressure pump pad
H_g	mercury
HW	hazardous waste
ICW	Intracoastal Waterway
in	inch
kg	kilogram
km	kilometers
LA	Louisiana
lab	laboratory
LAC	Louisiana Administrative Code
lbs	pounds
LDEQ	Louisiana Department of Environmental Quality
LDHHR	Louisiana Department of Health and Human Resources
LWDPS	Louisiana Water Discharge Permit System
LDNR	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Development

LDWF	Louisiana Department of Wildlife and Fisheries
m/sec	meters per second
m	meters
m^3	cubic meters
MACT	maximum achievable control technology
maint	maintenance
max	maximum
mCi	millicuries
mg/l	milligrams per liter
mi	miles
min	minute
M&O	Management & Operations contractor
MMB	million barrels
MS	Mississippi
NAAQS	National Ambient Air Quality Standards
NE	northeast
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NPL	National Priority List (CERCLA)
NRC	National Response Center
NORM	naturally occurring radioactive material
NO_x	nitrogen oxide
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NSPS	New Source Performance Standards
NSR	New Source Review
NV	not a valid number or statistical meaning
NW	northwest
O&G	oil and grease
OPA	Oil Pollution Act
Ops	operations
OSPRA	Oil Spill Prevention and Response Act
OVA	organic vapor analyzer
P&A	plug and abandon

PCB	polychlorinated biphenyls
pCi	picocuries
pH	negative logarithm of the hydrogen ion concentration (acidic to basic on a scale of 0 to 14, 7 is neutral)
PM_{10}	Particulate Matter
PMO	Project Management Office
PPA	Pollution Prevention Act of 1990
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RCT	Railroad Commission of Texas
RPX	Recovery Pump Exercise
ROW	Right-of-Way
RQ	reportable quantity
RWIS	raw water intake structure
SAL	salinity
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
Se	selenium
SE	southeast
SIP	State Implementation Plan
SJ	St. James
SM	Sulphur Mines
SOC	Security Operations Center
SO_2	sulfur dioxide
SPCC	Spill Prevention Control and Countermeasures Plan
SPR	Strategic Petroleum Reserve
sq	square
SQG	small quantity generator
stn	station
STP	sewage treatment plant
S.U.	standard units
SW	southwest
TACB	Texas Air Control Board
TDH	Texas Department of Health

TDH&PT	Texas Department of Highways and Public Transportation
TDS	total dissolved solids
TNRCC	Texas Natural Resource Conservation Commission
TOC	total organic carbon
TPDES	Texas Pollution Discharge Elimination System
TPQ	Threshold Planning Quantity
tpy	tons per year
TSCA	Toxic Substance Control Act
TSD	treatment, storage, and disposal
TSS	total suspended solids
TTA	Tiger Team Assessment
TWC	Texas Water Commission
TX	Texas
UIC	Underground Injection Control
USDA	United States Department of Agriculture
UST	underground storage tank
USCG	United States Coast Guard
VOC	volatile organic compound
WH	West Hackberry
WI	Weeks Island
yd	yard

EXECUTIVE SUMMARY

This report, provided annually in accordance with DOE Order 5400.1, summarizes monitoring data collected to assess Strategic Petroleum Reserve (SPR) impacts on the environment. The report serves the public interest by documenting environmental conditions of the SPR.

Included in this report is a description of each site's environment, an overview of the SPR environmental program, and a recapitulation of special environmental activities and events associated with each SPR site during 1993. The active permits and the results of the environmental monitoring program (i.e., air, surface water, ground water, and water discharges) are discussed within each section by site. The quality assurance program is presented which includes results from laboratory and field audits and studies performed internally and by regulatory agencies.

No significant adverse environmental impact resulted from any SPR activities during 1993. Environmental areas of concern, such as potential ground water contamination, are fully addressed in the applicable section by site.

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1. INTRODUCTION

The creation of the Strategic Petroleum Reserve (SPR) was mandated by Congress in Title I Part B of the Energy Policy and Conservation Act (P.L. 94-163), of December 22, 1975. The SPR provides the United States with sufficient petroleum reserves to mitigate the effects of an oil supply interruption.

The SPR consists of five active Gulf Coast underground salt dome oil storage facilities (three in Louisiana and two in Texas), a marine terminal facility (in Louisiana), and an administrative facility (in Louisiana). A sixth storage facility, Sulphur Mines, has been decommissioned and sold. Figure 1-1 is a regional map showing the relative location of SPR facilities.

Four of the six storage sites were acquired with existing solution-mined caverns, three of which have had additional solution mining. The fifth site is a room and pillar salt mine, previously created by mechanical underground mining techniques and converted by the SPR to storage. The sixth storage site was created entirely by solution mining. Sulphur Mines, the smallest of the SPR sites, transferred its crude oil to Big Hill and West Hackberry in 1992 in preparation for the decommissioning and sale of the site in mid 1993. Real property was transferred to other sites where needed, or excessed.

The pipeline terminals currently used by the SPR are the ARCO Terminal (Texas City, Texas), the Phillips Docks and Jones Creek Tank Farm (Freeport, Texas), the Sunoco Pipeline Terminal (Nederland, Texas), the Capline and LOCAP Pipeline Terminal from LOOP (St. James, Louisiana), the Texas 22 to Lake Charles refineries and the SPR St. James Terminal. The sites are also capable of distributing crude oil via tank ships.

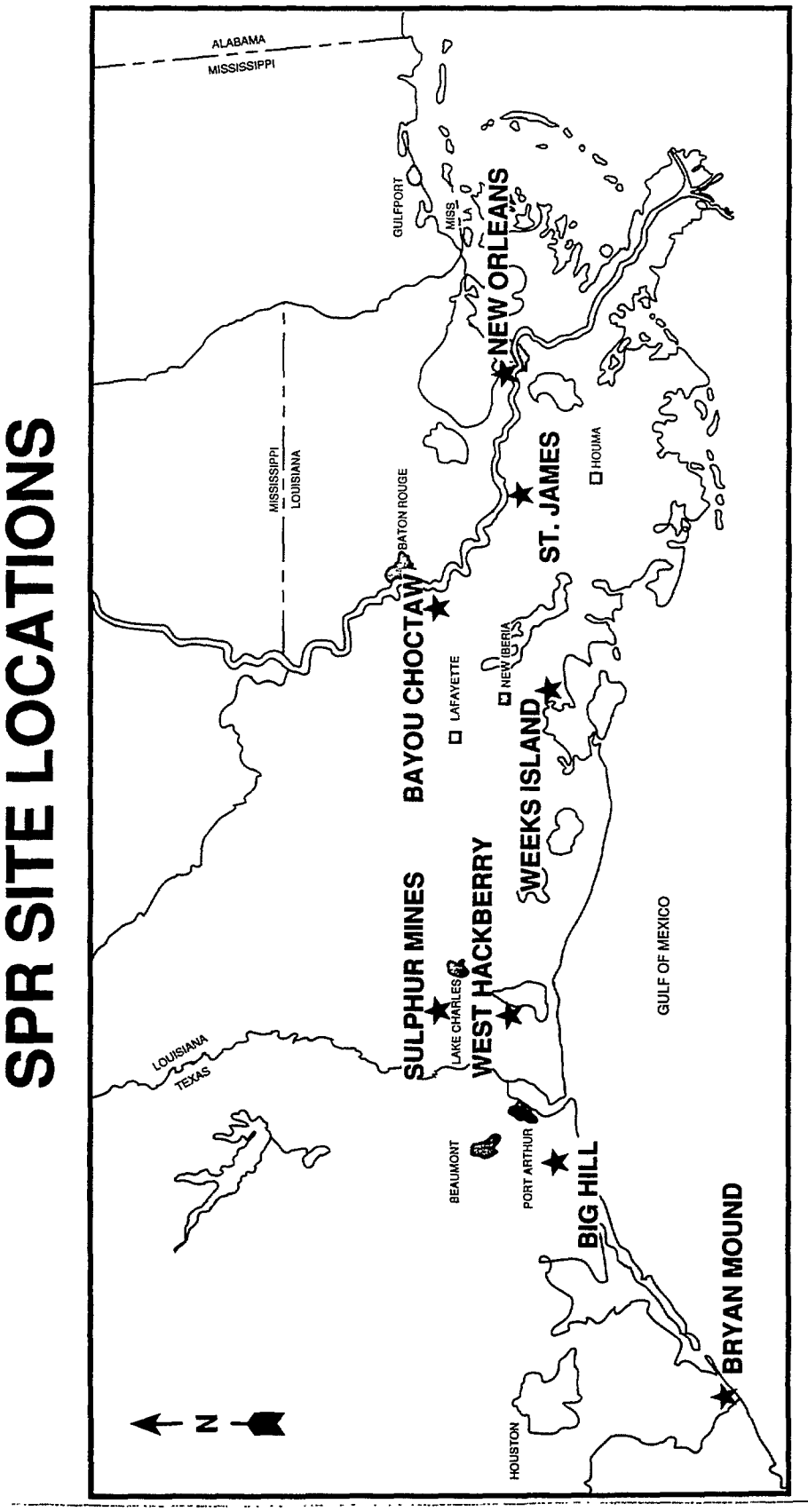

Figure 1-1. SPR Site Locations

Descriptions of the individual sites with photographs (Figures 1-2 through 1-8), follow. Figures 5-1 through 5-7 provide the site specific configurations.

1.1 BAYOU CHOCTAW

The Bayou Choctaw (BC) site is located on the west side of the Mississippi River 19.3 km (12 mi.) southwest of Baton Rouge in Iberville Parish, Louisiana (Figure 1-2). The site consists of a primary operational area and a brine disposal area occupying approximately 69 and 81 ha (168 and 200 ac) respectively. The area surrounding the site is rural, with a number of people living in small settlements along the nearby highways. The nearest communities are Addis, to the northeast, and Plaquemine, to the southeast. Baton Rouge, the Louisiana State Capitol and the major source of housing and services for the site, is within easy commuting distance.

The habitat surrounding the site is a freshwater swamp. Elevation ranges from approximately 1.5 to 3.0 m (five to ten ft) above sea level. Although there are no clear topographic expressions in the area, major surface subsidence has occurred creating substantial areas of bottomland hardwoods and swamp with interconnecting waterways. The site proper is normally dry and protected from spring flooding by the site's flood control levees and pumps. The collapse of a solution-mined cavern in 1954 resulted in the formation of a 4.9 hectare (12 acre) lake (Cavern Lake) on the north side of the site.

Bottomland hardwood forest and deciduous swamps are predominant at the Bayou Choctaw site. The vegetation at the site includes baldcypress, sweetgum, water tupelo (characteristic of lowland

Figure 1-2. Bayou Choctaw SPR Site

areas), bulltongue, and spikerushes. Water oak is also present but not abundant. The deciduous swamp is the most widespread habitat type found at the site. It provides resources for a large number of wildlife. Bird species common at Bayou Choctaw are herons, ibis, egrets, woodpeckers, wood duck, thrushes, American anhinga, and American woodcock. Raptors are commonly observed perching in the area. The southern bald eagle, an endangered species, has one nest within one mile of the Bayou Choctaw - St. James crude oil pipeline, and a second has been identified within the regional area of the site. Other endangered species of raptors may occasionally appear near the Bayou Choctaw facility or along its pipeline right-of-ways. Inhabitants of the bottomland forest and swamp include opossum, squirrels, nutria, mink, river otter, raccoon, swamp rabbit, white-tailed deer, and snakes. The American alligator, classified as 'threatened by similarity of appearance', is frequently found in and adjacent to the site.

The site is located near the intersection of several major bayous and waterways. The Intracoastal Waterway (Port Allen Canal) passes in a north-south direction one km (0.6 mi) west of the site. The Intracoastal Waterway extends to the north and then turns eastward through the Port Allen Canal to enter the Mississippi River at Baton Rouge. In the area of the site, the Intracoastal Waterway is part of Choctaw Bayou, a natural waterway. Smaller canals and bayous, such as Bayou Bourbeaux, the North-South Canal and the East-West Canal, enter the site area and continue to Bull Bay and the Intracoastal Waterway.

The Bayou Choctaw site will be used to store 11.4 million m^3 (72 MMB) of crude oil. Currently, there are six solution-mined caverns at this storage site. An existing cavern, Number 18, was expanded (solution mined) to enhance the overall storage capacity of the Bayou Choctaw SPR site. Raw water is provided from Cavern Lake. Brine is transported via pipeline to 12 brine disposal wells located approximately two miles south of

the site. There is a 91 cm (36 in) crude oil pipeline 58 km (36 mi) long that connects the site to the St. James Terminal.

1.2 BIG HILL

The Big Hill (BH) site is located in Jefferson County, Texas, approximately 109 km (68 mi) east of Houston, 37 km (23 mi) southwest of Port Arthur, and 14 km (9 mi) north of the Gulf of Mexico. Only small unincorporated communities are located near the site. The rural area around the site (Figure 1-3) is used primarily for rice farming, cattle grazing, and oil and gas production. The permanent work force is supplied in small part from the local area, with the remainder moving into the area or commuting from Beaumont or Port Arthur. During the construction phase, much of the transient skilled labor was brought in from Houston, Galveston, or Lake Charles. The site is situated on approximately 111 ha (275 ac) of land on the Big Hill salt dome. Surface elevations reach 10 m (35 ft) above sea level, the highest elevations in the region. The agricultural and pasture land uses around Big Hill are typical of the region.

Approximately one km (0.6 mi) south of the dome is the northern boundary of fresh to intermediate marsh which grades into brackish and saline marsh towards the Gulf of Mexico. The nearby waterways include Spindletop Ditch, approximately five km (three mi) south of the site, which connects to the Intracoastal Waterway located three km (two mi) further south and oriented in a northeast to southwest direction. Freshwater impoundments are located south of the site. Numerous sloughs, bayous, and lakes, including Willow Slough Marsh, Salt Bayou, Star Lake, and Clam Lake, connect with the Intracoastal Waterway. Natural ridges (cheniers) paralleling the coastline isolate the marsh from the Gulf of Mexico.

Figure 1-3. Big Hill SPR Site

Existing habitats in the vicinity of the site are related to agricultural use. There are petroleum-related industrial operations on and off the salt dome which have altered land use.

There are two ponds present on the eastern edge of the dome, one of which is located on the northeast corner of the site and the other just north of the site.

The upland habitat, which comprises the majority of the site, consists of many tall grasses such as bluestem, indiangrass, switchgrass, and prairie wildgrass. A few 150 year old live oak trees are present on site. Identified bird concentrations and rookeries are about five miles south and west of the site.

No rare, threatened or endangered species habitat is identified in the vicinity of the Big Hill site on the Texas Natural Resource Conservation Commission (TNRCC) Coastal Regional Spill Response Map. The paddlefish, a state regulated species, has been identified in Taylor Bayou in the vicinity of the oil pipeline crossing. Fauna typical in the area include coyote, pocket gophers, rabbits, raccoon, rodents, snakes, turtles, and numerous upland game birds and passerines. The nearby ponds and marsh south of the site provide excellent habitat for the American alligator. No known species that frequent the site are endangered or threatened. The McFaddin National Wildlife Refuge located south of the site provides important habitat for over-wintering waterfowl.

The Big Hill site is planned for the storage of 25.6 million m^3 (160 MMB) of crude oil in 14 caverns. Appurtenant facilities include a raw water intake structure 5 miles away on the Intracoastal Waterway with a 107 cm (48 in) pipeline extending to the site, a 107 cm (48 in) brine disposal pipeline extending

14.5 km (9 miles) onshore and 8 km (5 mi) offshore in the Gulf of Mexico, and a 91 cm (36 in) pipeline for transporting crude oil between the site and the Sunoco Terminal in Nederland, Texas. The brine pipeline has a series of brine diffuser nozzles which disperse and mix brine with receiving seawater.

1.3 BRYAN MOUND

The Bryan Mound (BM) site is located in Brazoria County, about 105 km (65 mi) due south of Houston, Texas, and five km (3 mi) south of Freeport, Texas, on the east bank of the Brazos River Diversion Channel, near the Gulf of Mexico. The area is highly industrialized, and includes several petrochemical related facilities. Approximately 50 percent of the area's population work in the local area, although many commute to work from outside the immediate vicinity.

The site occupies 202.3 ha (500 ac) in the southwest apex of a triangle formed by the Brazos River Diversion Channel, the old Brazos River, and the Intracoastal Waterway. A U.S. Army Corps of Engineers silt gate controls the flow of water between the Intracoastal Waterway and the Diversion Channel. A levee parallels the Diversion Channel in a southern direction from Freeport until due west of the site. The levee then turns east, bisecting the site.

Figure 1-4 shows the major water bodies near the site, Blue Lake to the north, and Mud Lake to the southeast. These water bodies generally define the mounded aspect of the Bryan Mound dome, which creates a surface expression in the terrain by rising approximately 5 meters (15 ft) above the surrounding wetlands. Although Blue Lake is within the protective triangle formed by the levee system (with excess rainwater drained off by two large pump stations operated by the city of Freeport) there is some drainage through culverts southward into the Intracoastal Waterway. Mud Lake, on the other hand, is connected by a slough to the Intracoastal Waterway.

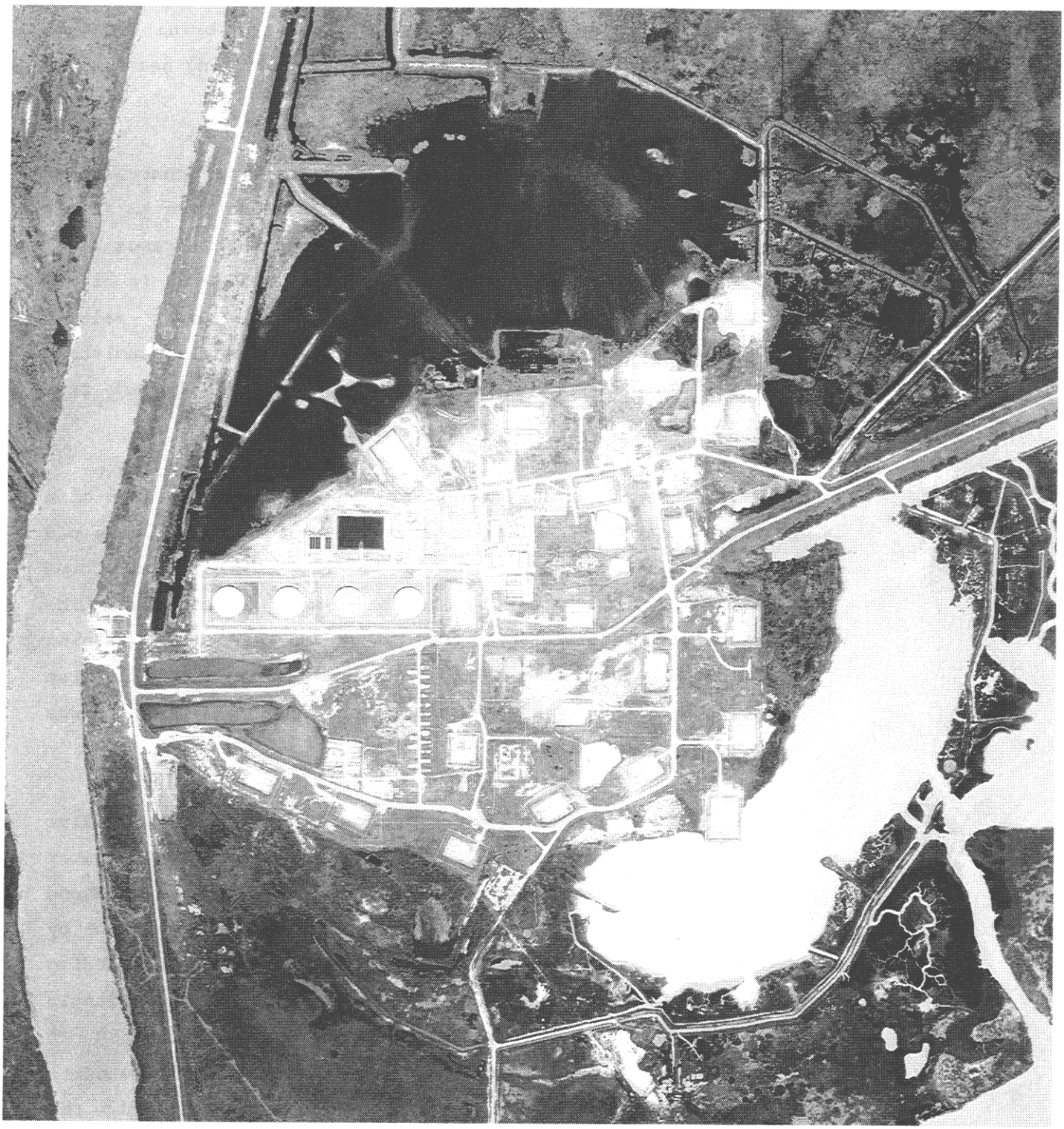

Figure 1-4. Bryan Mound SPR Site

The marsh and prairie areas surrounding Bryan Mound are typical of those found throughout this region of the Texas Gulf Coast. Brackish marshland dominates the low-lying portions of the site in all but the northern area, where the coastal prairie ecosystem extends along the levee paralleling the Brazos River Diversion Channel. The coastal prairie is covered with medium to very tall grasses which form a moderate to dense cover for wildlife. These grasses also occur in unmowed "natural" site areas. Those areas periodically inundated by tidal waters are dominated by cordgrass.

A diverse range of habitats is created by water bodies surrounding Bryan Mound. Marshes and tidal pools, such as Mud Lake and Bryan Lake, which connect with the Gulf of Mexico by way of the Intracoastal Waterway or the Brazos River, are ideal habitats for a variety of birds, aquatic life, and mammals. Migratory waterfowl, common egret, snowy egret, great blue heron, killdeer, least tern, and black-necked stilt (the latter two are Texas state-protected species), as well as nutria, raccoon, skunk, rattlesnakes, turtles, and frogs can be found on and in the area surrounding Bryan Mound. No federally endangered or threatened species are found on site; however, brown pelican, piping plover, and peregrine falcon inhabit nearby areas. Whooping cranes have been recorded occurring just across the Brazos River Diversion Channel to the southwest of the site.

Shrimp, crabs, trout, flounder, and redfish are abundant in Mud Lake during various seasons of the year. Black drum, mullet, gar, and blue crab are found in Blue Lake.

A total storage capacity of 35.9 million m^3 (226 MMB) of crude oil in 20 solution-mined caverns is planned for Bryan Mound. Appurtenant facilities include a 91 cm (36 in) brine disposal pipeline extending 22.4 km (13.9 mi) offshore and 4.5 km (2.8

miles) onshore into the Gulf of Mexico, a raw water intake structure adjacent to the site on the Brazos River Diversion Channel, two 76 cm (30 in) crude oil pipelines connecting the site to the Jones Creek Tank Farm 4.8 km (3 mi) northwest of the site, the Phillips docks 6.4 km (4 mi) northeast of the site, and the 102 cm (40 in), 73.6 km (46 mi) crude oil pipeline from the site to the ARCO refinery in Texas City. A series of brine diffuser nozzles, located at the end of the brine pipeline, disperse brine and mix with receiving sea water.

1.4 ST. JAMES TERMINAL

The St. James Terminal (SJ) consists of six aboveground storage tanks with a total capacity of 0.3 million m^3 (two MMB) and two tanker docks, as seen in Figure 1-5. The tank farm area occupies 42.5 ha (105 ac) and the docks occupy 19.4 ha (48 ac). The terminal has separate crude oil pipelines connecting it with Weeks Island and Bayou Choctaw. The site is located on the west bank of the Mississippi River, approximately halfway between New Orleans and Baton Rouge, Louisiana, and 3.1 km (1.9 mi) north of the town of St. James, on Louisiana Highway 18. The area around the site is rural with a number of people living in small settlements along Highway 18, the major thoroughfare in the area. Although some of the work force may commute from New Orleans or Baton Rouge, the majority of the workers are from the local labor pool. The terminal is bounded by the Texas and Pacific Railroad to the west, commercial facilities to the north and south, and the Mississippi River levee on the east between Louisiana Highway 18 and the river. The area adjacent to the Mississippi River at the St. James docks (the batture) is a freshwater wetland that is inundated during high water periods. Much of the land area surrounding the terminal is used for pasture and sugar cane cultivation.

Figure 1-5. St. James SPR Terminal

Per the Threatened and Endangered Species of Louisiana, Parish List (January 25, 1993), it is possible that the following two species could be present near the site or the Mississippi River: the pallid sturgeon (endangered) and the Arctic peregrine falcon (threatened). No federally endangered or threatened species are found on site, however, a southern bald eagle (endangered) was reported flying along the Mississippi River. Frogs, snakes, turtles, rabbits, raccoon, armadillo, muskrat, opossum, nutria, squirrels, egrets, ibis, and herons can be found on the site and in the surrounding areas.

1.5 SULPHUR MINES

The Sulphur Mines (SM) site, approximately 71 ha (175 ac), is located in Calcasieu Parish, 2.4 km (1.5 mi) west of the town of Sulphur, Louisiana (Figure 1-6). This site was decommissioned and sold in May 1993. The oil pipeline was sold and recovered as scrap metal. There has been considerable industrial activity on and near the site since the late 1800's. The greater part of the work force came from the town of Sulphur, with the remainder from outlying communities and the major urban area of Lake Charles. Four brine disposal wells are located in an area approximately 3.2 km (2.0 mi) southwest of the main site.

Due to the area land contours and differing terrain types, the site is divided into two operational areas, primary (administrative) and secondary (caverns). The secondary site area is bordered on the west, northeast, and north by water bodies. Most of these bodies of water are interconnected and drained by one creek flowing eastward from the site to Bayou D'Inde. A floodwater canal is located 0.4 km (0.25 mi) east of the site. Changes in elevation throughout the site are minor, with most of the site four to six m (15 to 20 ft) above sea level. The site proper is normally dry except in the spring season or during heavy rains when high waters sometimes flood portions of it.

Figure 1-6. Sulphur Mines SPR Site

The lowest elevations are over the center of the dome, where subsidence has occurred as a result of prior sulfur mining activity. Much of the surrounding area is covered with a mixed pine/hardwood forest.

Mammals on site and in the surrounding area include white-tailed deer, raccoon, fox squirrel, cottontail rabbit, opossum, striped skunk, armadillo, nutria, southern flying squirrel, white-footed mouse, and bobcat. Snakes, turtles, frogs, and toads can also be found. Crappie, largemouth bass, sunfish, gar, carp, bowfin, and catfish inhabit shallow ponds on the site. Many bird species including egrets, killdeer, herons, and migratory waterfowl are present. The American alligator, threatened by similarity of appearance, may be found on site. No other federally endangered or threatened species are found on site.

Sulphur Mines stored 4.1 million m^3 (26 MMB) of crude oil in five existing solution-mined caverns three of which form a single gallery. The site was connected to the Sunoco Terminal in Nederland by a 41 cm (16 in), 25.6 km (16 mi) crude oil pipeline and was connected to the West Hackberry 107 cm (42 in) line Gulf Intracoastal Waterway. The Sulphur Mines pipeline has been isolated from the West Hackberry pipeline as part of decommissioning the Sulphur Mines facility. Brine disposal was via injection into four brine disposal wells located approximately two miles (3.2 km) southwest of the site.

1.6 WEEKS ISLAND

The aboveground facility, shown in Figure 1-7, occupies approximately 3 ha (7 ac) and is located in Iberia Parish, Louisiana, about 22 km (14 mi) south of New Iberia. The surrounding area is sparsely populated. New Iberia, the closest major urban center, supplies the greater part of the labor force.

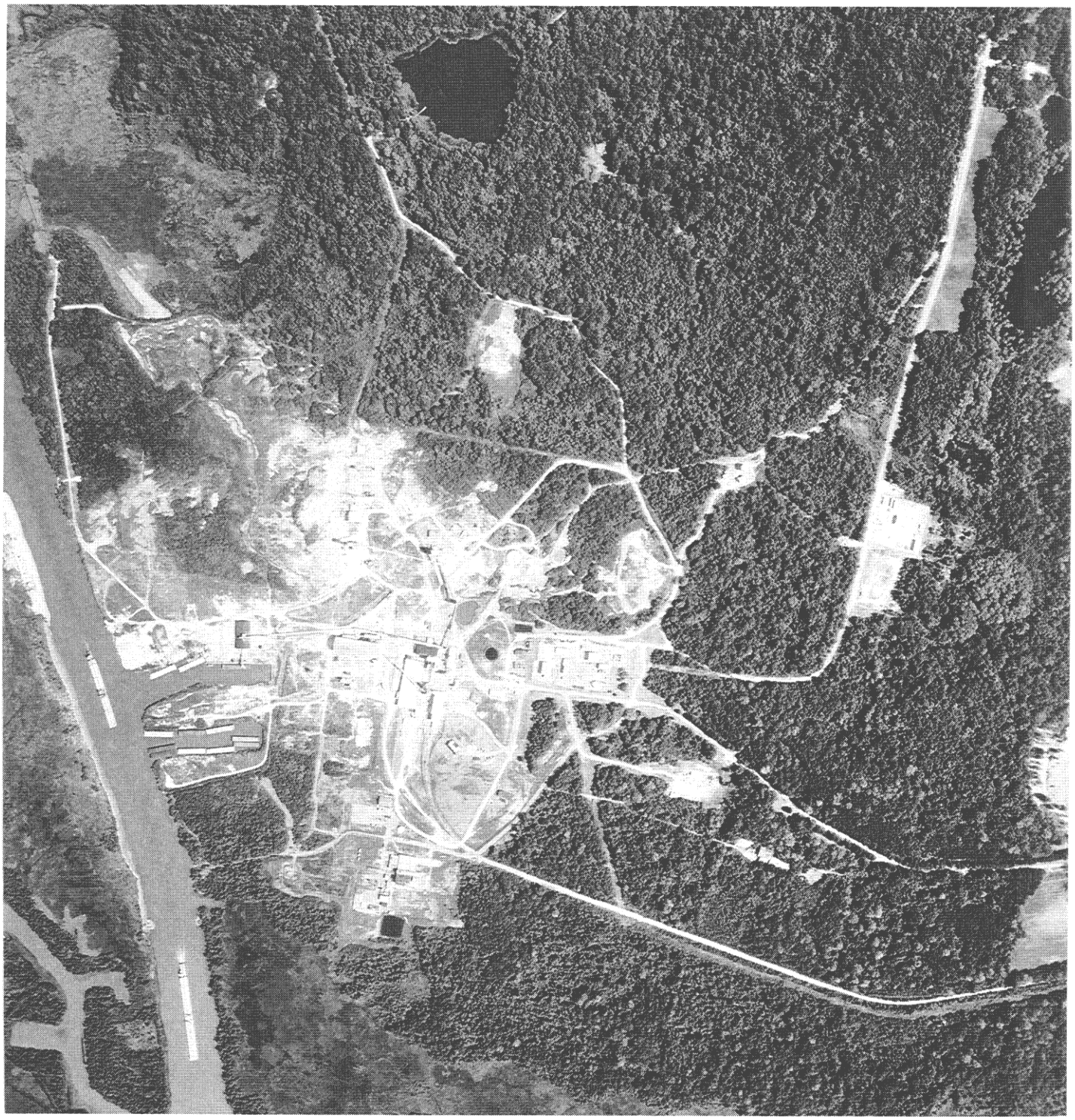

Figure 1-7. Weeks Island SPR Site

The major employment sectors within the parish are mineral production, manufacturing, construction, and agriculture. The Weeks Island (WI) salt dome borders Vermilion Bay, which opens to the Gulf of Mexico. The Weeks Island salt mine, developed in the early 1900's by room-and-pillar mining, operated continuously until 1981, at which time operations were moved to another part of the same dome. The land surface over the salt dome forms an "island" caused by domal upthrusting and includes the highest elevation, 52 m (171 ft) above sea level, in southern Louisiana. The area surrounding the island is a combination of marsh, bayous, manmade canals (including the Intracoastal Waterway), and bays contiguous with the Gulf of Mexico.

The Weeks Island site consists of a large mechanically excavated salt mine with 11.6 million m^3 (73 MMB) of crude oil storage capacity. In addition to normal site facilities, there is a 91 cm (36 in) 108 km (67 mi) long crude oil pipeline connecting the site to the St. James Terminal.

The vegetation communities on Weeks Island are diverse. Lowland hardwood species proliferate in the very fertile loam soil common at the higher elevations. The predominant tree species are oak, magnolia, and hickory, which extend down to the surrounding marsh. Pecan trees are also present. Gulls, terns, herons, and egrets are common in the marsh area.

Mink, nutria, river otter, and raccoon are the most common inhabitants of the intermediate marshes. Other mammals found at Weeks Island are opossum, bats, squirrels, swamp rabbit, bobcat, white-tailed deer, and coyote. Weeks Island is the home of one of the densest breeding populations of the Louisiana black bear, which has been listed as a threatened species by the U.S. Fish and Wildlife Service under authority of the Endangered Species Act. The endangered red wolf has been sighted in Vermilion Parish about 30 miles west.

Weeks Island and the surrounding wetlands are also frequented by a variety of endangered or threatened avian species, including the brown pelican, bald eagle, peregrine falcon, the piping plover, and least tern. The wetlands to the southwest of Weeks Island is a breeding area for least terns. The American alligator, occurs in the marshes adjacent to the site.

The water bodies surrounding Weeks Island provide a vast estuarine nursery ground for an array of commercially and recreationally important finfish and shellfish.

1.7 WEST HACKBERRY

The West Hackberry (WH) site is located in Cameron Parish 29 km (18 mi) southwest of Lake Charles, Louisiana, and 26 km (16 mi) north of the Gulf of Mexico. Cameron Parish is the largest and least populous parish in Louisiana. The local economy consists of fishing, shrimping, rice farming, and petroleum production. The work force at the site is derived from local residents of the Hackberry community, the towns of Sulphur and Lake Charles, in Calcasieu Parish, and from recent arrivals to the area.

The site is situated on 229 ha (565 ac) of land on top of the West Hackberry salt dome (Figure 1-8). The dome is covered by a distinct mounded overburden on its western portion, with elevations up to 6.5 m (21 ft), the highest elevation in Cameron Parish. The majority of the dome is approximately 1.5 m (five ft) above sea level. Two brine disposal well pads occupying approximately 2.5 ha (six ac) are located three km (1.9 mi) south of the site.

Figure 1-8. West Hackberry SPR Site

Waterways near the site include Calcasieu Lake and the Calcasieu Ship Channel approximately five km (three mi) to the east, and the Intracoastal Waterway approximately six km (four mi) north of the site. Black Lake, a brackish water lake, borders the dome on the northern and western sides. Numerous canals and natural waterways, including Black Lake Bayou, connect Black Lake to Alkali Ditch and then to the Intracoastal Waterway on the eastern side of the site. Black Lake Bayou, referred to locally as Kelso Bayou, continues wandering in a generally easterly direction from Black Lake, eventually connecting with the Calcasieu Ship Channel northeast of the town of Hackberry.

The western part of Cameron Parish consists of marshland with natural ridges extending in a generally east-west direction. These ridges, or cheniers, are stranded former beach lines which affect water flow through the marshes. The cheniers typically support grasses and trees. In many areas, lakes, bayous, and canals are concentrated so that the marsh may not seem to be a land mass, but rather a large region of small islands. Marshland closest to the coast generally has the highest salinity levels and lowest species diversity. Vegetation found on site and in the surrounding area of the West Hackberry facility is dominated by Chinese tallow, willow, various oak species, and numerous species of marsh and upland grasses. The marsh lands surrounding West Hackberry and its appurtenant facilities provides excellent habitat for a variety of wetland species. This area is predominantly brackish marsh with areas of submerged vegetation. Many wading birds, waterfowl, shore birds, seabirds, and diving birds frequent the area, in many cases breeding and nesting here. The American alligator is extremely common, breeding and nesting in this area. A variety of other reptiles, fish, shellfish, and mammals also frequent this area, in many cases breeding and reproducing. Oyster reefs occur in Calcasieu Lake with large

concentrations in West Cove near the brine disposal pipeline. Sport and commercial fishing takes place throughout this area for a variety of species, including fresh water and marine fish and shellfish.

Several species that are protected by the U.S. Fish and Wildlife Service under authority of the Endangered Species Act occur in the West Hackberry area. These include the southern bald eagle, Arctic peregrine falcon, and brown pelicans. These species also inhabit the lands through which the SPR pipelines pass.

Also inhabiting the area surrounding the West Hackberry site are snakes, egrets, herons, migratory waterfowl, red-tailed hawk, red fox, raccoon, nutria, opossum, rabbits, and white-tailed deer. Aquatic inhabitants of Black Lake include crabs, shrimp, drum, croaker, spot, sheepshead, mullet, gar, redfish, and catfish. No endangered or threatened species other than the alligator (threatened by similarity of appearance) have been identified on site.

The West Hackberry site will store 34.8 million m^3 (219 MMB) of crude oil in 22 solution-mined caverns. Brine is currently transported and disposed by injection into eight active brine disposal wells. The 91 cm (36 in), 42 km (26 mi) brine pipeline that goes to an area 11 km (seven mi) south of Holly Beach, Louisiana, in the Gulf of Mexico is currently out of service. Raw water is brought to the site via pipeline from the Intracoastal Waterway and crude oil is transported between the site and the Sunoco Terminal in Nederland, Texas, via a 107 cm (42 in), 66 km (42 mi) crude oil pipeline.

2. COMPLIANCE SUMMARY

General

The Strategic Petroleum Reserve (SPR) operates in conformance with requirements established by Federal and state statutes and regulations; Executive Orders; and Department of Energy (DOE) Orders. The SPR is responsible for establishing programs to ensure compliance with these requirements. The SPR was managed and operated by Boeing Petroleum Services, Inc., while under contract to DOE, through the first quarter of 1993. Since April 1, 1993, the SPR has been managed and operated by DynMcDermott Petroleum Operations Company. Compliance status in this year's report therefore reflects compliance activities conducted by DOE personnel, Boeing Petroleum Services, Inc., and DynMcDermott Petroleum Operations Company.

Regulatory

Several Federal, state, and local agencies are responsible for enforcing environmental regulations at SPR facilities. The principal regulatory agencies are the Environmental Protection Agency (EPA) Region VI, the Louisiana Department of Environmental Quality (LDEQ), the Louisiana Department of Natural Resources (LDNR), the Railroad Commission of Texas (RCT), The Army Corps of Engineers (COE), and the Texas Natural Resource Conservation Commission (TNRCC). These agencies issue permits, review compliance reports, inspect facilities and operations, and oversee compliance with applicable regulations.

DOE Orders/Directives

Phase I of the expanded baseline ground water surveillance field work, required by DOE Order 5400.1, was conducted in 1993 at all SPR sites. Phase II, including installation of ground water monitoring wells to verify potential contamination where indicated by the phase I conductivity and soil gas survey, will be performed as necessary in accordance with the ground water protection management program plan.

In 1993, the SPR implemented the expanded Fossil Energy (FE) requirement for the Environmental, Safety, and Health Management Plan by including environmental as part of the budget planning process.

This was an extensive task that was accomplished by the consolidated effort of Environmental, Safety, and Health; Operations and Maintenance; Engineering; Materiel; and other personnel. The final document, scheduled for completion in early 1994, is expected to reflect SPR environmental budgetary needs for core and project compliance activities over the next seven years

2.1 COMPLIANCE STATUS (JANUARY 1, 1993 THROUGH DECEMBER 31, 1993)

Much of the SPR's compliance program deals with meeting regulations under the Clean Water Act. The SPR sites have a total of 102 waste and storm water discharge monitoring stations. The SPR is also required to meet many of the requirements under the Clean Air Act and the Safe Drinking Water Act. Site waste management activities are conducted in accordance with the Resource Conservation and Recovery Act (RCRA). The SPR sites do not generate large quantities of hazardous waste and therefore typically operate as either Conditionally Exempt Small Quantity Generators (CESQG) in Texas, or Small Quantity Generators (SQG) in Louisiana (the smallest available category of generator in each state). The SPR sites do not treat, store, or dispose of hazardous wastes, and therefore are not RCRA permitted facilities. Each site is identified by an EPA generator number that is used to track the manifesting of hazardous waste for off-site treatment or disposal. None of the SPR sites are identified on the National Priority Listing (NPL) under CERCLA. No polychlorinated biphenyl (PCB), contaminated oils, or friable asbestos were found at the SPR sites in 1993.

The following sections highlight compliance activities at the seven SPR sites by environmental statute.

Clean Water Act (CWA)

The SPR sites comply with the CWA through permitting with the National Pollution Discharge Elimination System (NPDES) program

and following the Spill Prevention, Control and Countermeasures (SPCC) program, of which are both regulated by EPA.

The SPR submitted Form 1's of the NPDES permit renewal applications for the seven sites, cosigned by DOE and the M&O contractor to EPA in April 1993. Six NPDES permit renewal applications (the geographically distinct West Hackberry - Texas 22 meter station and the West Hackberry main site permit applications were combined) were reviewed and updated to reflect current conditions, and submitted in November 1993 as agreed to by DOE and EPA. The applications are expected to be processed to permits in 1994. No updated application was submitted for Sulphur Mines since this site was sold in May 1993.

Corresponding state permit renewal applications were processed for each site during 1993. LDEQ conducted permit renewal application visits of Bayou Choctaw, Weeks Island, and West Hackberry in 1993, and is expected to conduct a similar visit of St. James in 1994. These visits assisted LDEQ in understanding the configuration and operation of the SPR facilities for the purpose of writing effective permits, and benefited the SPR in understanding the philosophy and constraints under which LDEQ writes discharge permits. Draft permits for the LA Water Discharge Permit System for the West Hackberry and Weeks Island sites were received from LDEQ in 1993 and made available for public comment. Both are expected to be finalized in 1994. Bayou Choctaw should receive an LDEQ permit during early 1994. Big Hill and Bryan Mound submitted applications for discharge permit coverage from the Railroad Commission of Texas (RCT) in 1993. Bryan Mound received a RCT permit effective October 1993 and Big Hill is expected to receive its discharge permit from the RCT in 1994. Processing of state permit renewal applications is expected to be completed in 1994.

Each SPR site has an SPCC plan that addresses prevention and containment of oil spills. All the SPR spill plans are current in accordance with 40 CFR 112.

Pollution Prevention Act of 1990 (PPA)

A Pollution Prevention Plan was prepared for each site in accordance with the new storm water general permits and implemented by October 1, 1993. The EPA Storm Water Pollution Prevention Plan requirement was met by creating a multimedia document that consolidates the EPA requirement with the more general DOE required Pollution Prevention Plan and the related Waste Minimization and Solid Waste Management Plans, providing a single source for information on all of these related topics.

Clean Air Act (CAA)

The six SPR facilities comply with the applicable provisions of the CAA and State Implementation Plans (SIP). All of the SPR facilities are located in attainment areas for all National Ambient Air Quality Standards (NAAQS) pollutants with the exception of ozone. Weeks Island and West Hackberry are located in attainment areas for ozone; therefore, are regulated by the Prevention of Significant Deterioration (PSD) permitting program. Big Hill, Bryan Mound, and Bayou Choctaw are located in nonattainment areas for ozone. Therefore, the New Source Review (NSR) permitting program applies. St James is located in a transition area for ozone awaiting EPA determination. None of the SPR facilities are considered to be major sources during normal operations under PSD, NSR, and Title III hazardous air pollutant regulations. All of the facilities ensure that the provisions of the applicable state air permits are followed. There were no noncompliances or violation notices issued to the SPR facilities during 1993.

Due to gas buildup into the stored crude oil inventory and changes in the CAA and SIP, the air permits at all SPR sites are being reevaluated to incorporate new potential emissions

information and meet requirements. During 1993, Bryan Mound, which is in a severe nonattainment area for ozone, submitted an application to reflect changes in the emission levels from different sources; however, the total emission level from the facility did not change. In February 1994, West Hackberry, which is an attainment area for ozone, submitted a permit modification application after an inspection by LDEQ. LDEQ requested that a tank that was never installed, be removed from the permit. The application submitted included all of the emission sources to begin complying with the new Title V operating permit requirements. Review and update, with revisions as necessary, of the remaining sites is expected in 1994.

The LDEQ Form Order received in August 1990, has been determined by LDEQ to not apply to the SPR after the 1992 revision of the St. James air permit was submitted. The Order applies to facilities that emit more than 100 tons per year of VOC or NO_x St. James emits less than 100 tpy during normal operations. Emissions in excess of 100 tons per year will occur during drawdown and are allowed by LDEQ under a special variance.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

The SPR has not needed or been required to conduct emergency response activities pursuant to this act. DOE Order 5480.14 required all DOE-owned sites to evaluate compliance with CERCLA. DOE Phase I & II reports (similar to CERCLA's Preliminary Assessment and Site Investigation process) were completed in 1986 and 1987, respectively. The reports assessed each site for the potential presence of inactive hazardous waste sites, and recommended no further action under CERCLA. The DOE Phase I & II reports were submitted to EPA Region VI; and, all SPR sites were considered as No Further Remedial Action Plan sites to reflect the findings in the reports. All

SPR sites are classified as generators (small quantity or conditionally exempt small quantity) and have never operated hazardous waste treatment, storage, or disposal facilities. No hazardous substance releases have occurred.

Superfund Amendments and Reauthorization Act (SARA)

Reporting requirements under the Superfund Amendments and Reauthorization Act (SARA Title III, Tier Two) apply to the SPR and were completed. The 1992 SARA Title III, Tier Two report was completed and distributed, as required, by March 1, 1993 to the various state and local emergency planning committees, and local fire departments. Section 313 reporting under SARA (Form R) does not apply to the SPR since oil storage does not fall within the applicable Standard Industrial Classification (SIC) codes. EPA and DOE, however, have established a memorandum of understanding (MOU) to expand the Form R requirement to certain DOE facilities. Applicability of this MOU to the SPR is under review.

Safe Drinking Water Act (SDWA)

The SPR oil storage caverns and brine disposal wells are regulated by the SDWA. The EPA has given primacy under the SDWA to both Louisiana and Texas UIC programs, which regulate the underground hydrocarbon storage, related brine disposal, and brine and crude oil spill wastes. The SPR operates 25 salt water disposal wells in Louisiana, four of which were sold with the Sulphur Mines site during early 1993. The LDNR issued a Compliance Notice for Louisiana sites in 1993 regarding failure to annually file form OR-1, which identifies company officers. Form OR-1 was promptly completed and submitted on receipt of the Compliance Notice.

Bryan Mound, St. James, and West Hackberry are on local municipal water supplies. Big Hill, Sulphur Mines, and Weeks Island have on-site ground water wells for non potable use and use bottled water for drinking. Bayou Choctaw has a state

permitted potable water well noncommunity, nontransient public water supply building with distribution piping to all outlets, including water fountains. Funding (fiscal year 1994) has been provided to tie both the Big Hill and Weeks Island sites to local potable water systems in Winnie, TX, and Lydia, LA, respectively, reducing water quality testing requirements and eliminating the need for bottled water. No drinking water upgrades were planned for Sulphur Mines because that site was decommissioned and sold during 1993.

Findings from the brine pond ground water studies at West Hackberry and Bryan Mound indicate that ground water contamination from leaking brine ponds or buried piping has occurred at varying levels at both sites. The West Hackberry facility negotiated a corrective action plan (CAP) for a leaking brine pond with LDNR in February 1992. The CAP requires ground water recovery pumping, ground water monitoring, and submission of quarterly monitoring reports. In a March 23, 1993 letter, LDNR expressed concern with persistent pump failures and poor recovery rate at West Hackberry. LDNR met with DOE in April 1993, to discuss these issues. The SPR successfully identified and implemented a new recovery pump technology that produced sustained recovery in shallow and deep aquifers to LDNR satisfaction. The West Hackberry site's ground water monitoring program was inspected by LDNR and LDEQ in 1993 with no concerns identified. Affected ground waters at both sites are naturally brackish and not suited for domestic or agricultural use. This use limitation is a significant factor in determining whether future action is needed.

A phase I report on field work for a ground water baseline at all sites was finalized and issued in 1993. Field work consisted of using electrical conductivity and soil gas measurements as indicators of potential brine and oil contamination. A phase II verification survey is expected to be initiated in 1994.

Resource Conservation and Recovery Act (RCRA)

SPR wastes associated with underground hydrocarbon storage activities continue to be considered under the RCRA exclusion for drilling fluids, produced waters, and other wastes associated with the exploration, development, or production of crude oil, natural gas or geothermal energy. Other wastes generated at SPR facilities in conjunction with construction, operations and maintenance activities are considered for characterization under RCRA.

In 1993, the SPR manifested hazardous waste from the Big Hill, St. James, and West Hackberry SPR site for off site treatment/disposal. Hazardous waste was manifested from St. James and Weeks Island during the first quarter of 1994. The wastes consisted primarily of spent paint solvent, solvent contaminated oils, and gas cylinders. The SPR submitted notification forms of regulated waste activity to the EPA for all SPR sites. In 1993, accumulated monthly waste volumes exceeded the SQG generator threshold once at the Weeks Island and once at the St. James SPR sites. Subsequent to these exceedences, the sites applied for and received reinstatement of SQG status. The SPR is a registered generator and continues to coordinate actions with appropriate regulatory authorities.

The SPR has underground storage tanks (USTs) that are used for the storage of diesel and unleaded gasoline. There are two USTs at Bayou Choctaw, three at Big Hill, two at St. James, and two at Weeks Island, and all are registered under the corresponding state UST programs, as required. An in-line pressurized piping leak detection systems required for the Big Hill vehicle gasoline and diesel dispensing station will be installed in early 1994. The requirement for in-line pipe leak detection systems is unique to these two SPR USTs and is required by design due to internal submerged pumps and pressurized piping. Plans are underway to remove all SPR USTs in 1994 and replace them with above ground storage tanks.

USTs at Bayou Choctaw, Big Hill, St. James, and Weeks Island were tightness tested in December 1993, as required by state and Federal regulations. This activity brought all SPR USTs into the leak detection program consisting of monthly product inventory control and annual tank tightness testing. In addition to inventory control and tank tightness testing, the Big Hill program required annual integrity testing of pressurized piping unique to UST systems. This testing will not be completed until January, 1994.

Toxic Substances Control Act Construction (TSCA)

PCB's and friable asbestos construction materials were not found at SPR sites in 1993. The small amount of asbestos present on the SPR is nonfriable. All nonfriable asbestos (such as gaskets and insulation board) is disposed as it is taken out of service, in accordance with applicable solid waste regulations, at local municipal landfills. All liquid-filled electrical equipment used on the SPR is PCB free (under TSCA) due to Federal regulations prohibiting its use and previous actions to remove detectable PCBs. As a result of a Tiger Team audit finding, much of the SPR hydraulic equipment was and continues to be tested for presence of PCB as opportunity avails. To date no SPR hydraulic equipment has tested positive for PCBs.

National Environmental Policy Act (NEPA)

In 1992, the SPR issued a draft Environmental Impact Statement (EIS) on the proposed expansion of the SPR to a one billion barrel reserve. Public hearings on the draft EIS were conducted at five locations (Freeport and Port Arthur, TX, New Iberia, LA, and Hattiesburg and Pascagoula, MS) and the public review period was extended to July 1993. The EIS will also cover SPR routine activities such as maintenance work orders and service orders, precluding individual NEPA environmental reviews and categorization of each activity (10 CFR 1021 will

apply to non-routine). Finalization of this EIS is not yet scheduled.

The Environmental Assessment (EA) for the brine line replacement and diffuser relocation project at Bryan Mound was issued for public comment with comments received in 1992 and response to these comments provided in early 1993. As a result of the EA and these comments, a FONSI (Finding of No Significant Impact) was issued in 1993.

An EA for the use of herbicides along the SPR crude oil pipeline rights-of-way was begun in December 1992. This EA is expected to be completed after further expansion of the impact section, currently scheduled for 1994.

In 1993, an Action Description Memorandum (ADM) was developed for the gassy oil project to remove methane gas intrusion from the crude oil. The NEPA process will continue in 1994 when an EA is expected to be finished.

One hundred twenty-six projects were submitted for NEPA review action in 1993. All but one resulted in either a categorical exclusion from further NEPA action or had previously been covered under existing NEPA documentation.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

All pesticides and herbicides were used in accordance with manufacturers' recommendations. Restricted use pesticides were applied by licensed commercial applicators.

Endangered Species Act (ESA)

The SPR coordinated ESA requirements with the United States Fish & Wildlife Service (USF&WS) and other appropriate state agencies in conjunction with the Bryan Mound brine line replacement project Environmental Assessment. In 1992 and 1993, a survey of a construction right-of-way identified no

occurrences of the piping plover, an endangered species frequenting there, negating the need for related restrictions in the construction schedule. There were no ESA issues requiring action, and the construction permit from the Corps of Engineers (COE) was issued.

The Weeks Island site, along with neighboring facilities, is working with the USF&WS, U.S. Department of Agriculture (USDA), Louisiana Department of Wildlife and Fisheries (LDWF), and the Louisiana Nature Conservancy to prevent harm to the Louisiana black bear that occurs there and to ensure worker safety.

A southern bald eagle nest was identified in the general area near Bayou Choctaw. Its location will be considered in planning and permitting any SPR activity that might occur in the vicinity of the nest. The piping plover, brown pelican, and peregrine falcon have been identified in the vicinity of Bryan Mound.

National Historic Preservation Act (NHPA)

NHPA related activities were coordinated with appropriate State Historical Preservation Offices during NEPA activities. The Bryan Mound brine line EA, which was completed in 1993, included onshore and offshore historical site surveys that were conducted in 1992. No historical or cultural sites were found.

Oil Pollution Act (OPA) of 1990

Final regulations from EPA, the U. S. Coast Guard (USCG), and the Department of Transportation (DOT) regarding development of the response plans and implementation of OPA were not promulgated as required. DOT issued an interim final rule effective January 5 1993; the USCG issued an interim final rule February 5, 1993; just 13 days before the statutory deadline, and EPA issued a proposed rule with no effective date on February 17, 1993. Facility Response Plans (FRPs) were therefore prepared in accordance with DOT regulations for DOE

pipelines; with NVIC 7-92 (Navigation Vessel Inspection Circular) which is acceptable under the USCG interim final rule, for the St. James docks and, in accordance with statutory OPA requirements (EPA) for five sites and non-USCG portion of St. James. A single plan was prepared under NVIC 7-92 and OPA statutory requirements for St. James and distributed to the USCG and EPA. The SPR wrote and distributed seven separate FRPs for the six active sites and the off site crude oil pipelines. These plans were submitted as required to the EPA, DOT, and USCG on February 18, 1993, and fully implemented as required by August 18, 1993. The SPR received dated certifications of receipt of these plans from EPA (April 7, 1993), DOT (June 17, 1993), and USCG (March 23, 1993).

Parallel Texas legislation (Oil Spill Prevention Response Act) requiring operators in Texas to prepare Discharge Prevention and Response Plans (DPRPs) for each facility, were completed with submission of DPRPs to the General Land Office (GLO) in Texas for both Big Hill and Bryan Mound in August 1992. These DPRPs were subsequently fully implemented. Big Hill was inspected by the GLO in May 1993 resulting in certification by the GLO to continue operation under OSPRA.

Executive Order 11988, "Floodplain Management" and Executive Order 11990, "Protection of Wetlands."

The M&O contractor began training individuals under the new wetlands delineation guidance criteria as a precursor to developing detailed wetlands delineation maps for each SPR site.

Other Miscellaneous Compliance Activities

During 1993, coordination with regulatory agencies was conducted concerning CAA, CWA, SDWA, SARA, RCRA, ESA, and Executive Orders 11988 and 11990. No activity has been required relative to TSCA, FIFRA, NHPA, and CERCLA.

Coordination activities involved information gathering and interpretation of regulations to assure proper compliance.

2.2 MAJOR ENVIRONMENTAL ISSUES AND ACTIONS

General

All crude oil stored at the Sulphur Mines site was transferred to Big Hill and West Hackberry. The site was officially decommissioned in the first quarter of 1992, and sold on May 7, 1993. Information required for the transfer by 40 CFR 373 was provided, indicating that no known hazardous waste disposal areas exist on site. All SPR permits were canceled or transferred to the new owner, effective June 1993.

The SPR confirmed in 1993 that the crude oil stored at several sites presented environmental problems during large oil movements. One of the problems was high volatile organic compounds (VOC) emissions at storage tanks and docking facilities at both SPR and private terminals. Methane gas (non-regulated) from the salt dome has migrated into the stored crude oil. As the oil reaches atmospheric pressure in a vessel, the methane escapes from the oil stripping the regulated pollutants (VOC) from the oil and vents to the atmosphere. This is a natural phenomenon that occurs at oil production facilities but they are equipped with gas separating and collecting equipment. The SPR is in the process of procuring and installing equipment to separate and collect the gas to minimize VOC emissions. The second problem is elevated crude oil vapor pressures exceeding regulatory limits for storage in tanks. This is caused by relatively high storage temperatures in the caverns. The SPR is in the process of procuring and installing heat exchangers to cool the oil sufficiently so that the vapor pressures are within regulatory limits.

In 1993, a sinkhole was discovered at the Weeks Island site above the crude oil storage area. The SPR is in the process of

performing geotechnical analysis to determine the cause and impact of this sinkhole on the storage facility.

Tiger Team Assessments/Environmental Audits

The DOE Tiger Team visited the SPR during 1992, assessing all environmental programs in accordance with established protocol. In their final report, 84 findings (72 compliance findings and 12 best management practice findings) were identified in environmental media. A Corrective Action Plan (CAP) was prepared for each finding and approved by headquarters. The actions identified in the CAPs have been scheduled based on funding, and are tracked to completion. Fourteen of the 84 environmental findings have been closed. The schedule for completion of the corrective actions is identified in the SPR Corrective Action Plan.

During 1993, the SPR evaluated the existing Tiger Team findings and corrective action plans for the purpose of consolidating some of the corrective action to more efficiently correct the findings. This SPR rebaselining effort will reduce the 84 environmental findings and CAPs through closure and combination of similar open CAPs for the purpose of increasing the efficiency and cost effectiveness in closing them.

The M&O contractor's yearly environmental self-assessment was completed in February 1993. Findings from each previous self-assessment are tracked to completion in the Consolidated Corrective Action Plan (PMO) and the Master Action Tracking System (contractor). A new self-assessment plan, to be performed by site and New Orleans environmental groups, is in the process of being implemented.

Regulatory Inspections

The LDEQ Air Quality Division performed inspections of West Hackberry and St. James in 1993. Both inspections included review of records. At West Hackberry permitted sources that no

longer exist were discussed and addressed in the subsequent permit renewal. At St. James activities regarding tank seal gap measurements were evaluated and found to be in order.

Neither Texas site was visited by the Railroad Commission of Texas (RCT) regarding discharge permits in 1993. EPA did not perform water discharge permit inspections of any SPR site during this time period.

Big Hill was visited by the Texas General Land Office (GLO) as the result of a small spill into the Gulf Intracoastal Waterway in early 1993 reported by the SPR. The SPR successfully demonstrated that it was not the source of the spill. The TX GLO also visited Big Hill in 1993 as part of the site's successful certification inspection under the Oil Spill Prevention and Response Act.

Non-Routine Releases

In 1993, the seven SPR sites reported six oil spills and six brine spills in quantities greater than the one barrel (42 gallons) (see Section 3.4 for more details). Total volume of oil spilled in 1993 was 232 barrels and the total volume of brine spilled was 370 barrels. Oil spills are reported to the National Response Center (NRC) if they cause a film or sheen on navigable waters. A 2 gallon lubrication oil release to the Gulf Intracoastal Waterway at Big Hill was the only spill requiring notification of the NRC. State agencies require notification if an oil spill exceeds one bbl (LA) or five bbl (TX). Brine spills are reported if they may affect water quality. All of the specified oil and brine spills were reported to appropriate state agencies and immediately cleaned up, with no long term impacts observed.

Spills and releases have also declined significantly from 27 in 1990 to 13 and 14 in 1991 and 1992, respectively, and down to 12 in 1993. No long-term adverse environmental impact resulted from any spill or release.

2.3 SUMMARY OF PERMITS (JANUARY 1, 1993 THROUGH DECEMBER 31, 1993

General

Permits currently in effect include six NPDES permits, six CAA permits, 45 COE wetlands permits (Section 404 of CWA), and over 100 oil field pit, underground injection well, and mining permits. In addition, a number of corresponding state discharge and other state and local permits are in effect. The Sulphur Mines NPDES and air permits were transferred and canceled respectively, as of June 1993.

Permit Compliance

Routine compliance reports (monthly and quarterly NPDES Discharge Monitoring Reports (DMR)) were submitted to appropriate agencies in accordance with deadlines. Beginning in August 1993 responsibility for signature of these reports was transferred from the DOE Director of ES&H to the Senior DOE Representative at each site.

All air monitoring and reporting requirements have been conducted in accordance with the permit requirements. Quarterly VOC monitoring of all valves and pump seals in service continues to be performed at the Big Hill and Bryan Mound sites as required by the permits. VOC monitoring at the four Louisiana sites is not required by regulation or permits. An Emissions Inventory Questionnaire (EIQ) is submitted annually for the Bryan Mound site in accordance with the TNRCC regulations. The EIQ establishes the amount of air pollutants (VOC and other regulated pollutants) that were emitted by the various sources in the site and can be compared to the permitted limits. The other sites do not require EIQ

submission because their VOC emissions are below the regulatory limit for the ozone attainment classification in those areas.

Other routine environmental reports and notifications have been submitted as required by applicable codes and permits.

Noncompliances

Eighteen National Pollutant Discharge Elimination System (NPDES) permit noncompliances occurred out of a total of 9882 permit related analyses performed in 1993 (see Section 5.3 for more detail). These noncompliances involved permit exceedences at the sewage treatment plants and storm water outfalls, or were caused by sampling error, mechanical failures, and operator error. Exceeding permit limitations and failure to take a proper sample each resulted in 44% of the noncompliances, and mechanical failure resulted in the remaining 12% of the noncompliances. All noncompliances were of short duration and immediately resolved, causing no adverse environmental impact.

At Bryan Mound, a test was performed on one of the four crude oil storage tanks to determine the environmental, safety, and operational impact of the gassy oil on the tank seals. Material balance calculations indicated that the VOC emissions from the tank were much greater than was anticipated by using industry standard estimation methodologies (AP-42). The material balance emissions during the test were approximately eight times greater than permitted. The difference in emissions are not considered an increase since there was no change in the mode of operation. The only difference was the method in calculating these emissions; therefore, actual emissions did not change. The air permit for Bryan Mound requires submittal of a Quarterly Tank Emissions Report to the TNRCC. The TNRCC was notified of this emission issue through the quarterly report.

Notices of Violation (NOV)

During 1993, the SPR maintained a status of low risk to the environment. NOVs have declined significantly from 10 (all administrative) in 1990 to one in 1993. The single NOV in 1993 was due to a misunderstanding of data submitted to LDEQ. The LDEQ notified the SPR for failure to pay annual Naturally Occurring Radioactive Material (NORM) fees. The SPR did not pay the fee on initial notification because it had tested negative for NORM and submitted those results to LDEQ. The second notification was responded to by explaining that SPR sites are NORM negative and are hydraulically isolated from nearby NORM contaminated fields unrelated to and located outside of SPR areas of operation. LDEQ required no further action from the SPR.

3. ENVIRONMENTAL PROGRAM OVERVIEW

The environmental program is implemented by a prime contractor for the SPR on behalf of DOE (permittee). The environmental program is designed to support the SPR through tasks aimed at avoiding or minimizing adverse environmental effects from the SPR on surrounding lands, air, and water bodies.

The monitoring and inspection program, originally developed under guidance of the SPR Programmatic Environmental Action Report and Site Environmental Action Reports, now conforms with the monitoring program by DOE Order 5400.1. This program includes monitoring permitted NPDES outfalls and air emissions, conducting other required Federal and state inspections, and surveillance sampling and analysis of site-associated surface and ground water quality. This makes possible the assessment of environmental impacts and early detection of water quality degradation that may occur from SPR operations.

The results of the individual program areas such as air emissions monitoring and reporting, NPDES compliance, water quality monitoring, and ground water monitoring, for 1993 are discussed in sections 5 and 6.

3.1 ASSOCIATED PLANS AND PROCEDURES

Associated plans and procedures developed to support the SPR environmental program include group-specific Spill Contingency Plans with spill reporting procedures, and site-specific Spill Prevention, Control, and Countermeasures Plans. The Environmental Programs and Procedures Manual was revised September 1993. The Ground Water Protection Management Plan, Environmental Monitoring Plan, and Environmental Protection Implementation Plan were revised and implemented during 1993. Pollution Prevention Awareness, Waste Management, Waste Minimization, and Storm Water Pollution Prevention Plans were consolidated into the SPR Pollution Prevention Plan and implemented October 1993. Site specific Facility Response Plans, were prepared and implemented in 1993. Oil Discharge Prevention and Response Plans for Bryan Mound and Big Hill were prepared and implemented in early 1993. Compliance with Federal, state, and local laws, regulations, and permits has

procedures and by performing routine reviews and updates of those plans. Table 3-1 contains a comprehensive list of environmental plans and reports to monitor compliance with the various laws and regulations.

3.2 REPORTING

Proper operation of the SPR with respect to the environment involves several types of reports and reporting procedures. The basic reports are summarized briefly in this section.

3.2.1 Spill Reports

The spill contingency plans include procedures for reporting spills to the SPR contractor, DOE, and appropriate regulatory agencies. Specific reporting procedures are dependent upon several key factors including the quantity and type of material spilled, immediate and potential impacts of the spill, and spill location (e.g., wetland or water body). Any spill considered significant at the site is first verbally reported to site management and then to the SPR contractor management in New Orleans and the onsite DOE representative. These procedures contained in the Facility Response Plan have been simplified and condensed to a credit card-like document for attachment to identification badges and to a laminated placard for handy desk reference. Verbal notification and associated written follow-ons to the appropriate regulatory agencies occurs as required. Final written reports from the site are submitted after cleanup, unless otherwise directed by the DOE or appropriate regulatory agency.

3.2.2 Discharge Monitoring Reports

Wastewater discharges from SPR sites are authorized by EPA through the NPDES Program; through the LDEQ by the Louisiana Water Discharge Permitting System LWDPS; and through the Railroad Commission of Texas (RCT) by the Texas Pollution Discharge Elimination System (TPDES) Program. Depending on site specific permit requirements, discharge sample analyses are reported monthly (Big Hill, Bryan Mound, and West Hackberry) and quarterly (Bayou Choctaw, Saint James, and Weeks Island) to

the state agency and EPA. Included in each report is an explanation of the cause and actions taken to correct any noncompliance or bypass that may have occurred during the reporting period. Draft permits received during 1993 indicate that the states are reducing the frequency of testing and reporting for all SPR water discharge sources. In addition, Sulphur Mines reporting was eliminated during 1993 with the act of sale and permit transfers becoming effective in May and June respectively.

3.2.3 Other Reports

The SPR contractor provides several other reports to or on behalf of DOE. Federal, state, and local regulatory requirements are summarized in Table 3-1.

Table 3-1. Federal, State, and Local Regulatory Reporting Requirements

Regulation, Statute or Directive	Regulated Area	Enforcement Agency	Types of Required Permits, Applications, or Documentation	Routine Reporting Requirements
Clean Water Act as amended (FWPCA)	Wastewater Discharges	U.S. EPA, Region VI	NPDES Permit	Quarterly & monthly monitoring reports
		Louisiana Department of Environmental	Water Discharge Permit	Quarterly & monthly monitoring reports
		Texas Natural Resource Conservation Commission (TNRCC)	Water Discharge Permit	Monthly monitoring reports
	Spill Prevention, Control and Countermeasures (SPCC)	U.S. EPA, U.S. Coast Guard, U.S. Dept. of Transportation LDEQ,	SPCC Plan	Submit existing plan when spills on navigable waters exceed 1,000 gallons or occur two or more times in 1 year.
	Dredging, maintenance, and construction of oil and brine pipelines, and offshore structures. (Section 404 and 10)	U.S. Corps of Engineers (COE)	Maintenance Permit	Two week advance notice of work start, suspension, and end.
	Wildlife Refuges	U.S. Fish and Wildlife Service	Right-of-Way for Construction and Maintenance	None
Oil Pollution Act of 1990 (amendment of FWPCA)	Oil Spill Response	U.S. EPA, LDEQ, USCG, TNRCC	Facility Response Plan Oil Spill Response Certification	None
		U.S. Dept. of Transportation	Pipeline Response Plan	None
Oil Spill Prevention and Response Act of 1991	Oil Spill Response in Texas Coastal Zone	General Land Office	Oil Discharge Prevention and Response Plan	
			Discharge Prevention and Response Facility Cert.	Report spills of oil as required

Table 3-1 (Continued). Federal, State, and Local Regulatory Reporting Requirements

Regulation, Statute or Directive	Regulated Area	Enforcement Agency	Types of Required Permits, Applications, or Documentation	Routine Reporting Requirements
Safe Drinking Water Act	Cavern formation, well workovers, etc.	Louisiana Dept. of Natural Resources (LDNR). Office of Conservation, Underground Injection and Mining Division	Well Workover Permit (WH-1)	Well Workover Report .
			Cavern Inspection (29-M)	Annual Cavern Inspection Report
			Saltwater Disposal (UIC-10)	Annual Saltwater Disposal Well Report
			Cavern Integrity Test	Annual Cavern Integrity Report
		Railroad Commission of Texas (RCT)	Brine Injection Permit (H-10)	Annual Disposal/Injection Well Reports
			Oil Wells Integrity (W-10)	Annual Oil Well Status Report
			Cavern Integrity Test	Annual Cavern Integrity Tests Report
	Underground Storage Tanks	LDNR, TWC	Registration Number	None.
Clean Air Act	Control of hydrocarbon emissions from tanks, valves, and piping	LDEQ, TNRCC	Air Emissions Permit (1280-00015)	Annual Emissions Report
			Air Emissions Permit Special Requirement	Quarterly Tank Emissions report
Resource Conservation and Recovery Act	Haz. Waste generation and disposal	LDEQ	Annual Generators Report	Annual report to agency
			LA Notification of HW Activity	New Waste stream, Request ID or > 220 lb limit
			LA Uniform HW Manifest	Complete and submit form with disposal to state (twice)

Table 3-1 (Continued). Federal, State, and Local Regulatory Reporting Requirements

Regulation, Statute or Directive	Regulated Area	Enforcement Agency	Types of Required Permits, Applications, or Documentation	Routine Reporting Requirements
Resource Conservation and Recovery Act (continued)	Haz. Waste Generation and disposal	TNRCC	Texas Waste Codes Notification	Submit for new waste streams
			TX Uniform HW Manifest	Complete and submit form with disposal
	Used Oil Burned for Recovery	LDEQ, TNRCC	Uniform HW Manifest (Recycling)	Complete and submit form with disposal to state
	Nonhazardous Oil Field Waste Disposal	LDNR	Non-Haz. Oil Field Waste Shipping Control Ticket	Complete and submit form with disposal
			UIC-23 Form	Complete and submit with interstate shipping
		RCT	Minor Permit	Complete and submit for non-RCT permitted disposal facilities
			Non-Haz. Oil Field Waste Shipping Paper	Complete and submit form with disposal
	Municipal Wastes	LDEQ, TNRCC	Shipping Paper	Complete and submit form with disposal
	Industrial Wastes	LDEQ	Industrial Solid Waste Notification	Complete and submit form with new waste streams
			Industrial Solid Waste Generator Annual Report	Annual report
			Nonhazardous Special Waste Manifest	Complete and submit form with disposal
Superfund Amendment Reauthorization Act	Reporting of inventories of hazardous substances and materials stored on site	Louisiana Department of Public Safety and and Corrections, Texas Dept. of Health	Title III, Tier II	Annual Inventory Report
Pollution Prevention Act of 1990	Strategy to incorporate pollution prevention into ES&H goals.	EPA, DOE	Pollution Prevention Plan Waste Min. Plan, Waste Management Plan, Stormwater Pollution Prevention Plan	Annual Inspection and Update of Plan (re-write every 3 years)

Table 3-1 (Continued). Federal, State, and Local Regulatory Reporting Requirements

Regulation, Statute or Directive	Regulated Area	Enforcement Agency	Types of Required Permits, Applications, or Documentation	Routine Reporting Requirements
Toxic Substances Control Act	PCB Storage and Use Asbestos Toxic Chemicals	EPA	Plan	None
National Environmental Policy Act	Review of proposed projects for environmental considerations	U.S. Council on Environmental Quality (CEQ)	Environmental Impact Statements, Environmental Assessments	Only when not covered under other EIS or EA.
			Categorical Exclusions	For projects that require consent.
Miscellaneous State Environmental Regulation	Water withdrawal from coastal areas	Louisiana Dept. of Transportation	Water Rights Permit (Sulphur Mines only)	None
	Use of Salt Domes	LDNR	Permit for Use of Salt Domes for Hydrocarbon Storage	None
	Water withdrawal from coastal areas	TNRCC	Water Appropriation Permit	Annual Usage Report
Miscellaneous State Environmental Regulation	Pipeline Usage	RCT	Pipeline and Gathering System Certification (T-4C)	Annual Certification
	Storage of Oil in Underground Salt Domes	LDNR, RCT	Storage Permit	None
	Operation of Brine Ponds	LDNR, RCT	Operate and Maintain Permit	None
Miscellaneous Reports	Environmental Monitoring (5400.1)	DOE	Environmental Protection and Implementation Plan	Annual revision
	Environmental Monitoring (5400.1)	DOE	Ground Water Protection Management	Annual revision
	Environmental Monitoring (5400.1)	DOE	Environmental Monitoring Plan	Annual revision
	Environmental Monitoring (5400.1)	DOE	Annual Site Environmental Report	Annual revision
	Environmental Monitoring	DOE	Performance Indicator	Quarterly Report

Table 3-1 (Continued). Federal, State, and Local Regulatory Reporting Requirements

Regulation, Statute or Directive	Regulated Area	Enforcement Agency	Types of Required Permits, Applications, or Documentation	Routine Reporting Requirements
Miscellaneous Reports	Waste Management	DOE	Annual Report on Waste Generation and Waste Minimization Progress	Annual summary of all wastes
	Waste Management	DOE	Affirmative Procurement Report	Annual revision
	Waste Management	DOE	Waste Minimization/ Pollution Prevention Crosscut Plan	Annual
	Waste Management	LDEQ, TNRCC	Monthly Waste Inventory Form	Complete form for documentation
	Waste Management	LDEQ, TNRCC	Weekly Waste Inspections Form	Complete form for documentation (includes inspection)
	Pollution Prevention	DOE	SPR Pollution Prevention Plan	Annual revision
		DOE	ES&H Management Plan	Annual revision

3.3 ENVIRONMENTAL PERMITS

The active environmental permits, required by regulatory agencies to construct, operate and maintain the SPR, are discussed by site.

3.3.1 Bayou Choctaw

Table 3-2 lists the active permits at Bayou Choctaw. Individual work permits are received from the Louisiana Underground Injection Control Division of LDNR for each well workover performed. State inspectors regularly visit the site to observe SPR operations. A draft LWDPS discharge permit was received in September 1993 and administrative actions were completed by early December 1993. The finalized permit is anticipated for early 1994. An NPDES renewal application was forwarded to Region VI, USEPA in November 1993, which was accepted as administratively complete on January 3, 1994.

Table 3-2. Active Permits at Bayou Choctaw

PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053040	EPA	NPDES	1/03/94	1/02/99	(1)
LAR00A280	EPA	NPDES*	12/31/92	12/31/97	(2)
WP0179	LDEQ (Disch.)	Water	7/22/83	7/21/88	(3)
1280-00015-000	LDEQ	Air	10/01/87	Open	
None	LDNR	Injection	1/11/83	Open	(4)
SDS-1	LDNR	Injection	9/09/77	Open	(5)
LMNOD-SP (Bayou Plaquemine) 17	COE	Constr. & Maintain	9/26/77	-	(6)
LMNOD-SP (Bull Bay) 3	COE	Constr. & Maintain	1/30/79	-	(7)
LMNOD-SP (Iberville Parish Wetlands) 7	COE	Constr. & Maintain	9/26/77	-	(8)
LMNOD-SP (Iberville Parish Wetlands) 10	COE	Constr. & Maintain	6/12/78	-	(9)
LMNOD-SP (Iberville Parish Wetlands) 17	COE	Constr. & Maintain	11/6/78	-	(10)
LMNOD-SP (Iberville Parish Wetlands) 31	COE	Constr. & Maintain	5/27/80	-	(11)
LMNOD-SP (Iberville Parish Wetlands) 102	COE	Constr. & Maintain	9/26/77	-	(12)

(1) Renewal application of 11/24/93 accepted as administratively complete on 1/3/94.
(2) NPDES* General Permit for Storm Water Associated with Industrial Activity effective 12/31/92; Notice of Intent made 9/30/92.
(3) Renewal submitted 11/9/87; No response from LDEQ. Application resubmitted. Follow-up LWDPS submission 10/92; accepted for review 10/1/92 Draft permit received 10/27/93 and administrative processing completed 1/4/94; awaiting finalized permit.
(4) Letter of financial responsibility to plug and abandon injection wells.
(5) Permit approved use of salt dome cavities for storage of liquid hydrocarbons.
(6) Maintain 36-inch crude oil pipeline.

(7) Maintain Bull Bay 24" brine disposal pipeline recorded with applicable Registrar of Deeds.
(8) Construct and maintain well pads (brine disposal wells).
(9) Enlarge existing well pads and construct access roads (brine disposal Wells 1, 2, & 3.)
(10) Construct and maintain access road to brine disposal well area.
(11) Construct and maintain well pad, levees, access road & appurtenances to cavern 102 and additional bank stabilization, warehouse pad and culvert per additions of 1983.
(12) Construct and maintain ring levee, drill site and appurtenances, Well 101.

COE - U.S. Army Corps of Engineers
EPA - Environmental Protection Agency
F&WS - U.S. Fish and Wildlife Service
LDEQ - Louisiana Department of Environmental Quality
LDNR - Louisiana Department of Natural Resources
LDOTD - Louisiana Department of Transportation and Development
TNRCC - Railroad Commission of Texas
TACB - Texas Air Control Board
TDH&PT - Texas Department of Highways and Public Transportation
TNRCC - Texas Natural Resource Convention Commission

3.3.2 Big Hill

Table 3-3 lists the active permits at Big Hill. The Big Hill site has an amendment to its TNRCC (former TNRCC) permit for appropriating additional state waters for the leaching, site utility, and fire protection systems. The permit requires a yearly report of water quantities used. In 1993, the site appropriated 0.66 million m^3 (532.88 acre-feet) of water from the Intracoastal Waterway exclusive of water for fire protection. This represents only 0.45% of the total allowable withdrawal for a year.

Big Hill provided the RCT with a complete renewal application, as required for an expiring TPDES water discharge permit. The RCT has been designated as lead agency for this program in Texas for the SPR sites. Also, an NPDES renewal application was forwarded to Region VI, EPA in November 1993, which was accepted as administratively complete on December 22, 1993.

3.3.3 Bryan Mound

Table 3-4 lists the active permits for the Bryan Mound site. The Bryan Mound site has a second TNRCC permit for

Table 3-3. Active Permits at Big Hill

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0092827	EPA	NPDES	12/22/93	12/21/98	(1)
TXR00B608	EPA	NPDES*	12/31/92	12/31/97	(2)
SWGCO-RP 16536 (01,02,03)	COE	Constr. & Maintain	01/11/84	-	(3)
P-7	F&WS	Constr.	07/31/86	07/31/88	(4)
		Operate	07/31/86	06/30/36	(5)
9256	TNRCC	Air	05/17/83	5/16/98	(6)
02937 & 02939	RCT	Operate	11/28/83	Open	(7)
P000226A & P000226B	RCT	Operate/ Maintain	09/19/84	Open	(8)
0048295	RCT	Operate	05/09/83	Open	(9)
0048320			06/23/83	Open	
02638	TNRCC	Water (Disch.)	03/27/89	03/26/94	(10)
4045A	TNRCC	Water(Use)	11/14/83	Open	(11)

(1) Renewal submitted 11/24/93 - accepted as administratively complete 12/22/93.
(2) NPDES* General Permit for Storm Water Associated with Industrial Activity effective 12/31/92; Notice of Intent made 9/30/92.
(3) Permits to construct and maintain RWIS, raw water 48" pipeline, brine disposal 48" pipeline, crude oil 36" pipeline. Maintenance dredging clause renewed as needed.
(4) Completion of raw water, brine disposal, and crude oil pipeline extended. Amended to install offshore pipeline by trenching.
(5) Completion of pipeline construction extended. (48" Brine Pipeline)
(6) While under construction.
(7) Valid until ownership changes, system changes, or other physical changes are made in the system.
(8) Permits to operate and maintain anhydrite and brine/oil pits.
(9) Permits to create, operate, and maintain an underground hydrocarbon storage facility consisting of 14 caverns.
(10) Corresponds to TX0092827 (EPA-NPDES). Renewal application submitted to RCT in December 1993 as required.
(11) Permit expires after consumption of 239,080 acre-feet of water or end of project.

the appropriation of state waters for the leaching program, site utility, and fire protection systems. The permit requires a yearly report of the quantity of water used. In 1993, the site used a total of 0.06 million m^3 (48.06 acre/feet) of water from the Brazos River Diversion Channel. A total of 147.08 million m^3 (119,236 acre-feet) of water has been appropriated to date for site activities which represents 32.5% of the total volume permitted.

A COE modification to permit 12347 (as amended) was obtained in 1993 for improvements to the RWIS maintenance dredging spoil area. A COE modification for the construction of the 24-inch diameter replacement brine line was issued for permit 12062. An expanded construction window was later issued for the beach crossing phase as a result of the piping plover survey.

Bryan Mound received a finalized (renewed) TPDES permit to discharge from the RCT in August (effective October 1, 1993). Also, an NPDES renewal application was forwarded to Region VI, EPA in November 1993, which was accepted as administratively complete on January 3, 1994.

Table 3-4. Active Permits at Bryan Mound

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0074012	EPA	NPDES	1/03/94	1/02/99	(1)
TXR00B609	EPA	NPDES*	12/31/92	12/31/97	(2)
SWGCO-RP-12347(01)	COE	Dredging	02/29/84	12/31/94	(3)
3-67-782 (Docket#)	RCT	Injection	08/21/78	Open	(4)
3-70-377 (Docket#)	RCT	Injection	12/18/78	Open	(4)
P001447	RCT	Operate	10/30/84	Open	(5)
P001448	RCT	Operate	10/30/84	Closed	(6)
3681A	TNRCC	Water	7/20/81	Open	(7)
UHS-004	RCT	Water	10/01/93	09/30/98	(8)
6176B	TNRCC	Air	2/23/87	02/22/02	
82-8475	TDH&PT	Constr.	01/01/83	Open	(9)
SWGCO-RP-11666	COE	Constr. & Maint.	10/15/77	-	(10)
SWGCO-RP-12112	COE	Constr. & Maint.	07/25/77	-	(11)
SWGCO-RP-12062	COE	Constr. & Maint.	10/10/78	-	(12)
SWGCO-RP-14114(01)	COE	Constr. & Maint.	05/18/85	-	(13)
SWGCO-RP-16177	COE	Constr. & Maint.	09/07/82	-	(14)

(1) Renewal submitted 11/24/93. Accepted as administratively complete 1/3/94.
(2) NPDES* General Storm Water permit effective 12/31/92; Notice of Intent sent 9/30/92.
(3) Maintenance dredging of raw water intake extended. (SWGCO-RP 12347 authorized constr. of RWIS)
(4) Approval of oil storage and salt disposal program.
(5) Authority to operate brine pond.
(6) Small brine pond closed August, 1989.
(7) Permit expires after consumption of 367,088 acre-feet of water or project ends.
(8) Corresponds with TX0074012 (EPA-NPDES). (Renewal submitted 1/30/89, RCT acted on permit in August, 1993; effective 10/1/93)
(9) Corresponds with SWGCO-RP-16177.
(10) for 30-inch crude oil pipeline to 3 miles SW from Freeport
(11) for 30-inch crude oil pipeline to 2 miles S from Freeport
(12) for 36-inch brine disposal pipeline & diffuser
Revision/amendment (01) approved construction of 24 inch replacement pipeline in January, 1993.
(13) general permit for pipeline crossings by directional drilling in navigable waters
(14) place an 8-inch water line (PVC, potable)

3.3.4 St. James

Table 3-5 lists the active permits at St. James Terminal. A maintenance notification was made to the COE regarding work commencing in 1993 on the pipeline and docks covered by permit LMNOD(Mississippi River)998.

An NPDES renewal application was forwarded EPA to Region VI, EPA in November 1993, which was accepted as administratively complete on January 3, 1994.

Table 3-5. Active Permits at St. James Terminal

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0054674	EPA	NPDES	1/03/94	1/02/99	(1)
LAR00A276	EPA	NPDES*	12/31/92	12/31/97	(2)
LMNOD-SP(Mississippi River)998	COE	Constr.& Maintain	03/20/78	-	(3)
WP 0929	LDEQ	Water (Disch.)	05/04/90	05/03/95	(4)
983	LDEQ	Air	07/25/78	Open	(5)

(1) Permit renewal submitted 11/24/93. Accepted as administratively complete 01/03/94.
(2) NPDES* General Storm Water permit; Notice of Intent made 9/30/92.
(3) Permit and all amendments recorded with Registrar of Deeds in St. James Parish. Maintenance dredging clause renewed as needed.
(4) LDEQ Water Permit renewal submitted.
(5) Requires annual operating report. (EIQ and permit being revised.)

3.3.5 Sulphur Mines

Table 3-6 lists the status of the Sulphur Mines site permits. The main site property was sold to a new owner in May 1993 and all permits affected by the sale were transferred or canceled effective June 1993.

The COE permit for the 16 inch diameter crude oil pipeline connecting to the West Hackberry 42-inch diameter crude oil pipeline was modified in 1993 to accommodate the maintenance of, and access for a valve station located south of the ICW. The modification also transferred ownership of the remaining line to accommodate recovery and abandonment operations. Disposal well permits remain active until plug and abandonment activities are completed and the appropriate reports made; anticipated for early 1994.

Table 3-6. Permit Status at Sulphur Mines

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0055786	EPA	NPDES	04/12/90	04/11/95	(1)
LAR00A277	EPA	NPDES*	12/31/92	12/31/97	(2)
NONE	LDEQ	Water (Disch.)	12/07/84	Open	(3)
1042	LDEQ	Air	09/26/78	Open	(4)
None	LDOTD	Water(Use)	01/01/90	Open	(5)
None	LDNR	Brine Injection	01/11/83	Open	(6)
SDS-6	LDNR	Brine Injection	07/20/78	Open	(7)
LMNOD-SP (LTCS)20	COE	Constr. & Maintain	07/24/78	-	(8)

(1) Permit transferred to new owner effective June 1993.
(2) NPDES* General Storm Water permit effective 12/31/92; Notice of Intent made 9/30/92. Coverage terminated July 27, 1993.
(3) LWDPS renewal sent 10/92; accepted for review 11/5/92; canceled effective June 1993.
(4) Requires annual operating report. Canceled May 1993.
(5) Water purchase agreement (renewed annually). Canceled May 1993.
(6) Letter of financial responsibility to close, plug, and abandon any and all injection wells.
(7) Approval for use of salt dome cavities for storage of liquid hydrocarbons. Canceled May 1993.
(8) For 20-inch pipeline. Modification submitted 8/13/85 for erosion control work on the Intracoastal Waterway. Recorded permit and amendments with applicable Parish Registrars of Deeds. Modified in 1993 for pipeline removal and abandonment and continued maintenance of structure south of ICW.

3.3.6 Weeks Island

The active permits for Weeks Island are listed in Table 3-7. A LWDPS renewal application was submitted to LDEQ and accepted for review on 7/24/92. A draft LWDPS permit was received in January 1994 and administrative processing is currently underway. An NPDES renewal application was forwarded to Region VI, EPA in November 1993, which was accepted as administratively complete on December 22, 1993.

Table 3-7. Active Permits at Weeks Island

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0056243	EPA	NPDES	12/22/93	12/21/98	(1)
LAR00A278	EPA	NPDES*	12/31/92	12/31/97	(2)
LMNOD-SP(Atchafalaya Floodway) 251	COE	Constr. Maintain	07/12/78	-	(3)
1105	LDEQ	Air	01/30/79	Open	(4)
SDS-8	LDNR	Injection	02/16/79	Open	(5)
WP1051	LDEQ	Water (Disch.)	01/17/87	01/16/92	(6)

(1) Renewal submitted 11/24/93. Accepted as administratively complete 12/22/93.
(2) NPDES* General Storm Water permit effective 12/31/92; Notice of Intent made 9/30/92.
(3) Recorded permit and amendments with applicable Parish Registrar of Deeds. Maintenance dredging clause renewed as needed.
(4) Requires annual operating report.
(5) Approval for use of salt dome cavities for storage of liquid hydrocarbons.

(6) Permit interpreted via LAC to expire 1/16/93; LWDPS renewal submitted for June 1992; accepted for review on 7/24/92. Draft permit received 1/10/94, currently processing.

3.3.7 West Hackberry

Active permits for West Hackberry are listed in Table 3-8. A concurrence for Nationwide Permit coverage was received from the COE for wetlands (footpath maintenance) work at the West Hackberry 42-inch crude line valve station #6. A concurrence for Nationwide Permit coverage was also received from the COE for security fence relocation work in wetlands adjacent to the main site. This work is to be performed in conjunction with erosion protection (rip-rap addition) maintenance work covered by permit LMNOD(Black Lake)43. Permit LMNOD(Black Lake)31 was modified to accommodate the deepening and lengthening of the boat slip access channel. This action involved Coastal Zone Management concurrence and spoil placement mitigation.

A state LWDPS draft (temporary) permit was received for West Hackberry in October. A finalized (renewal) permit is anticipated for early 1994. Also, an NPDES renewal application was forwarded to Region VI, EPA in November 1993, which was accepted as administratively complete on January 3, 1994.

Table 3-8. Active Permits at West Hackberry

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053031	EPA	NPDES	01/03/94	01/02/99	(1)
LAR00A279	EPA	NPDES*	12/31/92	12/31/97	(2)
LMNOD-SP (LTCS) 26	COE	Dredging	02/08/79	02/08/99	(3)
LMNOD-SP (Black Lk) 31	COE	Dredging	10/26/82	09/39/96	(4)
LMNOD-SP (Black Lk) 43	COE	Constr.& Maintain	07/26/84	-	(5)
LMNOD-SP (Gulf of Mexico) 2574	COE	Constr.& Maintain	08/11/80	-	(6)
LMNOD-SE (LTCS) 40	COE	Constr.& Maintain	05/25/88	-	(7)
LMNOD-SP (Cameron Parish Wetlands) 162	COE	Constr. & Maintain	03/09/78	-	(8)
None	LDNR	Injection	08/07/79	Open	(9)
971198-9	LDNR	Injection	10/06/83	Open	(10)
WP1892	LDEQ	Water (Disch.)	12/08/88	01/25/94	(11)
1048	LDEQ	Air	10/26/78	Open	(12)
SWGCO-RP-12342	COE	Constr. & Maint.	3/28/78	-	(13)
LMNOD-SP (Cameron Parish Wetlands) 152		Constr. & Maint.	3/16/78	-	(14)
LMNOD-SP (Cameron Parish Wetlands) 276		Constr. & Maint.	2/11/80	-	(15)

(1) Renewal submitted 11/24/93. Accepted as administratively complete 1/3/94.
(2) NPDES* General Storm Water permit effective 12/31/92; Notice of Intent made 9/30/92.
(3) Maintenance dredging for raw water intake.
(4) Maintenance dredging for fire water canal and extended boat slip access amendment of 1993.
(5) Construction of erosion control dike completed in 1986. Maintenance dredging open until 7/26/94; addition of rip-rap amendment of 1993 open until 1995.
(6) Amended to install parallel pipeline (05/29/86).
(7) Permit to construct and maintain 36" crude oil pipeline from site to Texoma/LC Meter Station.
(8) Permit to maintain 42" crude oil pipeline.
(9) Approval to create 16 additional salt dome cavities.
(10) Approval to construct and operate wells 117A and B.
(11) Includes Texoma/Lake Charles Meter Station-Outfall 004. Permit renewal submitted and accepted as complete on July 13, 1993; Draft (temporary) permit effective October 27 1993 with a 90 day period. Finalized permit anticipated for early 1994.
(12) Requires semi-annual status-of-construction report.
(13) For 42" crude oil pipeline crossings of waters & waterways
(14) For brine disposal wells, well pads, and brine disposal pipelines, (12", 20", & 24")
(15) For well pads, levees, and access roads (Wells 110, 111, 112, 113, 114, & 115)

3.4 WASTE MINIMIZATION PROGRAM

The waste minimization program was implemented to reduce the generation of all wastes including hazardous, and nonhazardous sanitary wastes. The most significant SPR-wide waste minimization accomplishments during 1993 were:

a) Consolidation and implementation of the SPR Pollution Prevention Plan including Pollution Prevention Awareness, Waste Management, Waste Minimization, and Storm Water Pollution Prevention
b) Implementation of the Recycled Laser Toner Cartridge Recycling Program
c) Collection of spent batteries and oil filters for recycling
d) Implementation of Exhibit 6.6, "General Environmental Regulations," for contracts with Waste Management Plan submittal requirements
e) Inspection and acquisition of services of another off-site hazardous waste incinerator

The SPR generated only RCRA hazardous and sanitary (nonhazardous industrial, nonhazardous oil field, and municipal) wastes. All SPR sites except Saint James Terminal and Weeks Island generated less than 220 lbs (100 Kg)of RCRA hazardous waste per month, thus maintaining Small Quantity Generator/ Conditionally Exempt Small Quantity Generator status throughout 1993. The generation of nickel cadmium batteries during a change out of the uninterrupted power supply at St. James Terminal and the generation of paint wastes during a major painting project at Weeks Island prompted one month deviations from the SQG status for those sites. RCRA hazardous waste generation (2376 kilograms) increased by 5.3 percent during 1993 when compared with 1992. Hazardous waste is incinerated off site.

Sanitary waste is disposed off site. Nonhazardous oil field waste was generated during the cleaning of oil tank five at St. James Terminal and mine drawdown out of a sump at Weeks Island.

Generation of sanitary waste (698.2 tons) increased by 8.1 per cent during 1993 when compared with 1992.

Paper, used oil burned for energy, antifreeze, and scrap metals are recycled off site. The amount of paper recycled (41.05 tons) decreased by 0.5 percent during 1993 when compared with 1992. Cardboard (2.74 tons) was recycled off site. Used oil burned for energy (85,705 gallons) increased by 887 percent during 1993 when compared with 1992.

Waste management training included hazardous waste handling, compliance, waste manifest completion and waste minimization components. This training is provided annually. Training covering 49 CFR hazardous materials transportation was also provided during 1993.

The Environmental Department staff distributed educational wheels on recycling to all employees. The SPR Pollution Prevention (formerly Waste Minimization) Interdepartmental Team conducted SPR-wide monthly conference calls to discuss pollution prevention topics, thus increasing its scope of activity. Pollution prevention information appeared in the SPR-wide publication, Wellspring, and in the ES&H Communiqué (a publication sent to site managers).

Interdepartmental meetings, including environmental representatives, were held to review product acquisitions. Efforts continue to search for new methods of pollution prevention.

3.5 TRAINING

Site Environmental and Emergency Response Team (ERT) personnel have received training in environmental plans and procedures. Site management personnel are knowledgeable of environmental procedures, spill reporting procedures, the group-specific Spill Contingency Plans, the site-specific Spill Prevention, Control, Countermeasures Plans, and Facility Response Plans and compliance awareness. Compliance awareness training is conducted by the individual site environmental specialists at

each of the SPR sites. During this training, site personnel learn about applicable regulatory requirements. NEPA, SARA Title III Tier Two, Hazardous Waste Handling, and Waste Manifest Form Completion training courses were provided during 1993. Several sessions of an environmental awareness course were provided to DOE and contractor management and staff in 1993.

ERT personnel from all sites participate in annual spill response refresher training currently provided by the Texas A&M University, Engineering Extension Service. Onsite training is also provided in spill cleanup and control. Site response personnel are trained to rapidly and effectively contain and cleanup oil, brine, and hazardous substance spills under the circumstances typical at each SPR site.

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4. ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

There are no radioactive process effluents from any SPR facility. The only radioactive materials at any SPR facility are sealed sources in certain field instruments.

4.1 SEALED SOURCES

A total of 78 nuclear density gauges (SGH Model Nos. 5190, 5191, and 5202) are located on pipelines within the Bayou Choctaw, West Hackberry, Sulphur Mines, and Bryan Mound sites. The gauges are used for monitoring fluid density changes (oil versus brine) in pipelines. Each gauge unit contains between 100 and 4000 millicuries (mCi) of cesium 137. Gauge wipe tests are performed every three years as required by the general license. The DOE is a general licensee under the manufacturer, Texas Nuclear. The Sulphur Mines gauges were returned to the manufacturer. No radiation leakage has been detected from any of the gauges to date.

4.2 NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)

In 1989, LA amended its radiation regulations to require a survey to determine the locations and contamination levels of NORM in the oil and gas industry. The M&O contractor has contracted for each of its sites to be surveyed, including the laydown yards where pipe is stored. A cursory inspection using a Geiger counter was conducted. This preliminary inspection revealed no NORM present. The contracted survey, conducted at all SPR sites and the commercial pipe yard where SPR piping is stored, was completed in early 1991. The results, no readings of elevated levels at any location, were submitted to the state as required. No future monitoring is anticipated due to the negative results of a NORM survey conducted in 1991.

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5. ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

A primary goal of DOE and the SPR contractor is to ensure that all SPR activities are conducted in accordance with sound environmental practices and the environmental integrity of the SPR sites, and their respective surroundings, is maintained.

Effective environmental surveillance monitoring (separate from discharge permit effluent compliance monitoring) provides a mechanism for assessing the impact of SPR activity on air, surface water, and ground water (section 6). Site monitoring programs were developed as management tools to provide the information necessary for limiting unwarranted environmental impacts, thus serving the public interest by ensuring environmentally sound operation of the SPR.

5.1 AIR QUALITY

The regulated air pollutants emitted by the SPR facilities are either hazardous in nature or have an impact on the ambient air quality (ozone). The non-hazardous pollutants that have an impact on air quality are non-methane/ethane volatile organic compounds (VOC), nitrous oxides (NOx), sulfur dioxides (SO2), carbon monoxide (CO), and particulate matter (PM10). The hazardous air pollutants (HAP) are benzene, toluene, ethylbenzene, and xylene. As crude oil, that was stored under pressure in caverns, is moved to surface facilities its individual components vaporize emitting VOCs and hazardous pollutants from such sources as valves, pumps seals, storage tanks, tankers, and brine ponds. These emissions do not occur from functional pressured systems such as the storage caverns. All of the facilities are equipped with emergency generators that emit NOx, SO2, CO, and PM10 in small quantities.

There are three types of air monitoring required at the SPR facilities. They are organic vapor release testing, emission inventory calculations, and tank seal inspections.

The two Texas facility permits (Big Hill and Bryan Mound) require that all valves and pump seals are screened for VOC leaks. This is done quarterly at both sites with an organic vapor analyzer (OVA). Currently, the Louisiana facility permits do not require this type of screening; however, it may be required with the new air permits due to an increase in the number of components required to be identified in the permits. In order to use more accurate calculation factors these components need to be screened for effectiveness in minimizing VOC releases.

The second type of monitoring is required by the Texas and Louisiana regulations. If a facility in a nonattainment area for ozone emits more than a certain amount of VOC, it must submit annual Emission Inventory Questionnaires (EIQ). These EIQs reflect the amount of pollutants emitted from the facility using industry acceptable calculations during a calendar year. Currently, the only facility required to submit an EIQ in 1993 was Bryan Mound because it is over the threshold of 10 tons per year.

The third type of monitoring is seal inspection of the internal and external floating roof tanks. St. James, Big Hill, and Bryan Mound have floating roof tanks that require inspection of the primary (every five years) and secondary (once a year with the exception of Big Hill that requires semi-annual) seals. The inspections involve checking the seals for visible tears, holes, or cumulative gaps that exceed a regulatory limit.

5.1.1 Bayou Choctaw

Bayou Choctaw, located in a severe nonattainment area for ozone, operated in accordance with all air quality regulatory requirements. Total emissions from the facility were calculated using method AP-42 (EPA, 1985) to be less than nine metric tons/year (10 tons/year) (a "nonsignificant facility" as noted in the air quality regulations for Louisiana). Nonsignificant facilities are exempt from emissions monitoring

requirements and EIQ submission. There were no major configuration changes which would have resulted in additional air emissions during 1993. The only monitoring required at Bayou Choctaw is visual inspection of the valves in crude oil service on the cavern pads to determine visual leaks. No air quality monitoring using actual monitoring equipment was required or conducted during 1993.

5.1.2 Big Hill

The Big Hill facility, located in a serious nonattainment area for ozone, operated in accordance with applicable air quality regulatory requirements and all conditions of the air quality permit. Quarterly monitoring of all valves and pump seals in crude oil service, as required by the permit, using an OVA, began in 1990 when crude oil fill was initiated. The secondary tank seals for the surge tank BHT-7, inspected semi-annually in accordance with State regulations, were within regulatory limits. An EIQ is not required at Big Hill because total VOC emissions all less than 10 tpy which is the regulatory limit for having to submit an EIQ. No other form of monitoring is required at Big Hill.

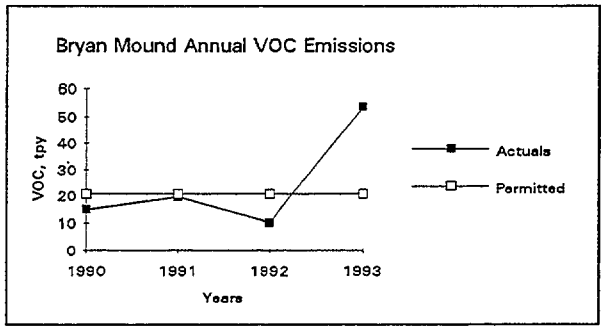
5.1.3 Bryan Mound

The Bryan Mound facility, located in a severe nonattainment area for ozone, operated in accordance with all air quality regulatory requirements throughout 1993. The ongoing quarterly fugitive emissions monitoring program, as required by the TNRCC permit, did not identify any leaking components for 1993. The air permit also requires that monthly calculations of the VOC emissions from the four internal floating roof tanks be submitted to the TNRCC quarterly. The permit requires that these calculations be done with AP-42 methodology which uses the true vapor pressures of the stored crude oil and its throughput for each storage tank. The VOC emissions from the four surge tanks using the permit required method (AP-42) were estimated at 1.29 metric tons (1.42 tons) during 1993. However in August 1993, a test performed using one of the surge tanks

to determine the capability of these tanks to control gassy oil identified a considerably higher emission rate. Using material balance, the VOC emissions for the test were 41.37 metric tons (46 tons). The difference in emission estimates is due to the gassy crude oil stored at the facility. The AP-42 methodology is not applicable to gassy crude oils as the test indicated.

Since the facility is permitted to emit 18.78 metric tpy (20.7 tpy) of VOC emissions, it has to submit an annual EIQ because it is over the threshold of 10 tpy. In 1993, Bryan Mound submitted its annual EIQ indicating total VOC emissions for 1992 to be 9.25 metric tpy (10.2 tpy). The estimated VOC emissions for the 1993 EIQ that will be submitted in 1994 is 48.99 metric tons (54 tons). The increase in emissions is due to the test performed on the surge tank. DOE plans to use the tanks only during emergency situations until the gassy oil can be degassed. Figure 5-1 shows the VOC air pollutants emitted from the site since monitoring for an annual EIQ was implemented. Even though the VOC emissions were higher than permitted, the site remained in compliance because the methodology used to calculate the emissions previously was required by the permit.

Figure 5-1



5.1.4 St. James Terminal

St. James Terminal, located in a transitional attainment area for ozone, operated in accordance with all air quality permit and regulatory requirements during 1993. The permitted emissions during stand-by are 27.2 metric tons per year of VOC (30 tons per year) with allowance to exceed 90.72 metric tons per year (100 tons) during drawdown. Yearly secondary seal gap measurements are the only type of monitoring required at St. James. The secondary seals on all six external floating roof tanks were within required limits. No air quality monitoring using actual monitoring equipment was required or conducted during 1993.

5.1.5 Sulphur Mines

Sulphur Mines operated in accordance with all air quality permit and regulatory requirements during 1993. Sulphur Mines was decommissioned in March 1992 with only a small amount of crude oil transferred during 1993 (<20,000 bbls). Hydrocarbon emissions, based on crude oil throughput, were well below levels cited in the (0.2 metric tons (440 pounds)/year for withdrawal mode of operation). No air quality monitoring with field equipment was required or conducted during 1993.

5.1.6 Weeks Island

Weeks Island is one of two SPR sites in an attainment area for ozone. The current air permit reflects the stand-by emissions at the site as 5.53 metric tpy (6.1 tpy) of VOC and 9.11 metric tpy of nitrous oxides (10.04 tpy). The site operated within these permitted limits. Air quality monitoring using actual monitoring equipment was neither required nor conducted during 1993. No other form of air monitoring is required at the site.

5.1.7 West Hackberry

West Hackberry, located in an ozone attainment area, operated in accordance with all air quality permit and regulatory requirements during 1993. Hydrocarbon emissions were well below the 50.4 metric tpy (55.4 tpy) permitted for filling

operations. An air permit modification will be submitted to LDEQ to reflect current operational conditions. The amount of allowable VOC emissions from the site is expected to increase to about 54.43 metric tpy (60 tpy). This is due to additional sources identified at the facility such as fugitive emissions during workovers and identification of additional valves, pump seals, and flanges. It is expected that these components will have to be screened for leaks to comply with new requirements. Due to the increase in VOC emissions, an annual EIQ will also prepared because the site will be over the threshold of 50 tpy (adjacent areas to nonattainment).

5.2 SURFACE WATER QUALITY MONITORING

During 1993, surface waters of the Bayou Choctaw, Big Hill, Bryan Mound, Sulphur Mines, and West Hackberry SPR sites were sampled and monitored for general water quality according to the SPR Environmental Monitoring Plan. Monitoring is conducted to provide early detection of surface water quality degradation resulting from SPR operations. It separate from, and in addition to, the water discharge permit monitoring program and is not required by any Federal or state regulatory agency. Monitoring was conducted at Sulphur Mines through May, after which the site was sold to Pittsburgh Plate Glass. Surface water quality monitoring was not conducted at St. James Terminal or Weeks Island because of the low potential to impact surface waters on these two sites. Table 5-1 identifies frequency of specific parameters measured at each SPR site for both DMR and surface water quality.

This year data are presented statistically by site in Tables 5-2 to Table 5-6 instead of graphically in figures. All observed values that were below detectable limit (BDL) were evaluated as one-half the BDL for statistical calculation purposes. In addition to the commonly used statistical methods, the coefficient of variation (CV) was incorporated to evaluate the data. The coefficient of variation is a mathematical tool used to quickly identify data sets with a high incidence of variation. Values approaching or exceeding 100% indicate that one standard deviation from the stated mean encompasses zero. Such occurrences invalidate the data from a statistical utility standpoint. The usefulness of this treatment is to draw attention to, or cull, highly variable data sets for further evaluation as to the source or cause of the variability. Extremely low values of CV indicate little or no variation which may be caused by a preponderance of measurements below the method limit of detectability. A quick cross-check for a data set with a low CV and a large quantity of BDLs would confirm that the measurements made were low throughout the year.

PHYSICO-CHEMICAL PARAMETERS	SAMPLE IDENTIFICATION AND FREQUENCY BY SITE																	
	DAILY						WEEKLY			MONTHLY							QTR	
	BC	BH	BM	SJ	~~SM~~	WH	BH	BM	~~SM~~	BC	BH	BM	SJ	SM	WI	WH	SJ	
pH	15, 17-20 101 HPP SWD1 SWD2 SWD3	003	101-116 1,2 4,5 TX-002	001		001 6-9, 11 101-117 HPP SOT		TX-003 & other storm water	001, 002 2,4, 6,7, HPP	001 002 A-F	001 002 004 A-G	001 A-J		A,B D-G	01A 01B 002	002 A-F 001 004	002 003	
SALINITY			001			001 HPP		TX-003+	002	A-F	A-G 001	A-J		A,B D-G		A-F		
TEMP.			001			001				A-F	A-G 001	A-J		A,B D-G		A-F		
TOTAL DISSOLVED SOLIDS						001	001	001								A-F		
TOTAL SUSPENDED SOLIDS						001	001 002	001.	004	001 002	004	002*			01B 002 003	002 A-F	002 003	
DISSOLVED OXYGEN		*** 001	001			001				A-F	A-G	A-J		A,B D-G	A-F			
BOD_5								001	004	001 002	004	002*			01B 002	002	002 003	
COD			TX-002									A-J						
OIL & GREASE	15, 17-20 101 HPP SWD1 SWD2 SWD3	001 003	001 101-116 1,2 4,5 TX-001	001		001 6-9 11 101-117 HPP		TX-003 & other storm water	2,4, 6,7, HPP						01A	004		
TOC		003		001		6-9 11 101-117 HPP SOT		001 TX-003 & other storm water		A-F	A-G	A-J TX-003 & other storm water		A,B D-G	E	A-C E-F 004		
METALS: As,Hg,Se												TX-003 & other storm water						
FECAL COLIFORM															01B 002	002		
RESIDUAL CHLORINE			TX-002															
FLOW	001 002 15, 17-20 101 HPP SWD1 SWD2 SWD3	001	TX-001, 002 001	001		001 HPP**	002 004**	TX-002*	001, 002, 2,4, 6,7, HPP			002*	002 003		01A 01B 002 003	002 004		

* Sampling performed twice per indicated period.
** Sampling performed 5 days/week.
***Sampling performed daily except weekends and holidays when injecting oxygen scavenger chemical

HPP: High Pressure Pump Pad
SWD: Salt Water Disposal (Injection Well)
SOT: Slop Oil Tank

Table 5-1. Physicochemical Parameters

NOTE: Water quality stations (lettered stations) are sampled for possible detection of any adverse environmental condition on and in the waters surrounding the SPR sites.

5.2.1 Bayou Choctaw

Samples were collected and analyzed monthly where possible for seven surface water monitoring stations. Monitoring stations A through G are identified in Figure 5-1. Parameters monitored include pH, salinity, temperature, dissolved oxygen (DO), oil and grease, and total organic compound (TOC) (Table 5-2). A discussion of each parameter follows.

5.2.1.1 Hydrogen Ion Activity (pH)

The annual median values of pH for all the monitored stations ranged from 7.0 to 7.6. This indicates a generally neutral to slightly basic waters. Fluctuations observed are attributed to environmental and seasonal factors such as variations in rainfall, temperature, and aquatic system flushing.

5.2.1.2 Salinity (SAL)

Average annual salinities remained low, less than 1.0 ppt at all stations during 1993 except B and C which averaged 2.6 and 1.2 ppt, respectively. Similar to last year, several spikes were observed throughout the year at stations B and C that could possibly be due to mitigation of offsite contamination, traces of historical contamination, or low water conditions where evaporation of concentrated dissolved salts occurs.

5.2.1.3 Temperature

Observed temperature ranged from 12.0° C in late winter to 32.0° C in mid summer. Temperature fluctuations were consistent among all stations and are attributed solely to meteorological conditions since Bayou Choctaw produces no thermal discharges.

BAYOU CHOCTAW

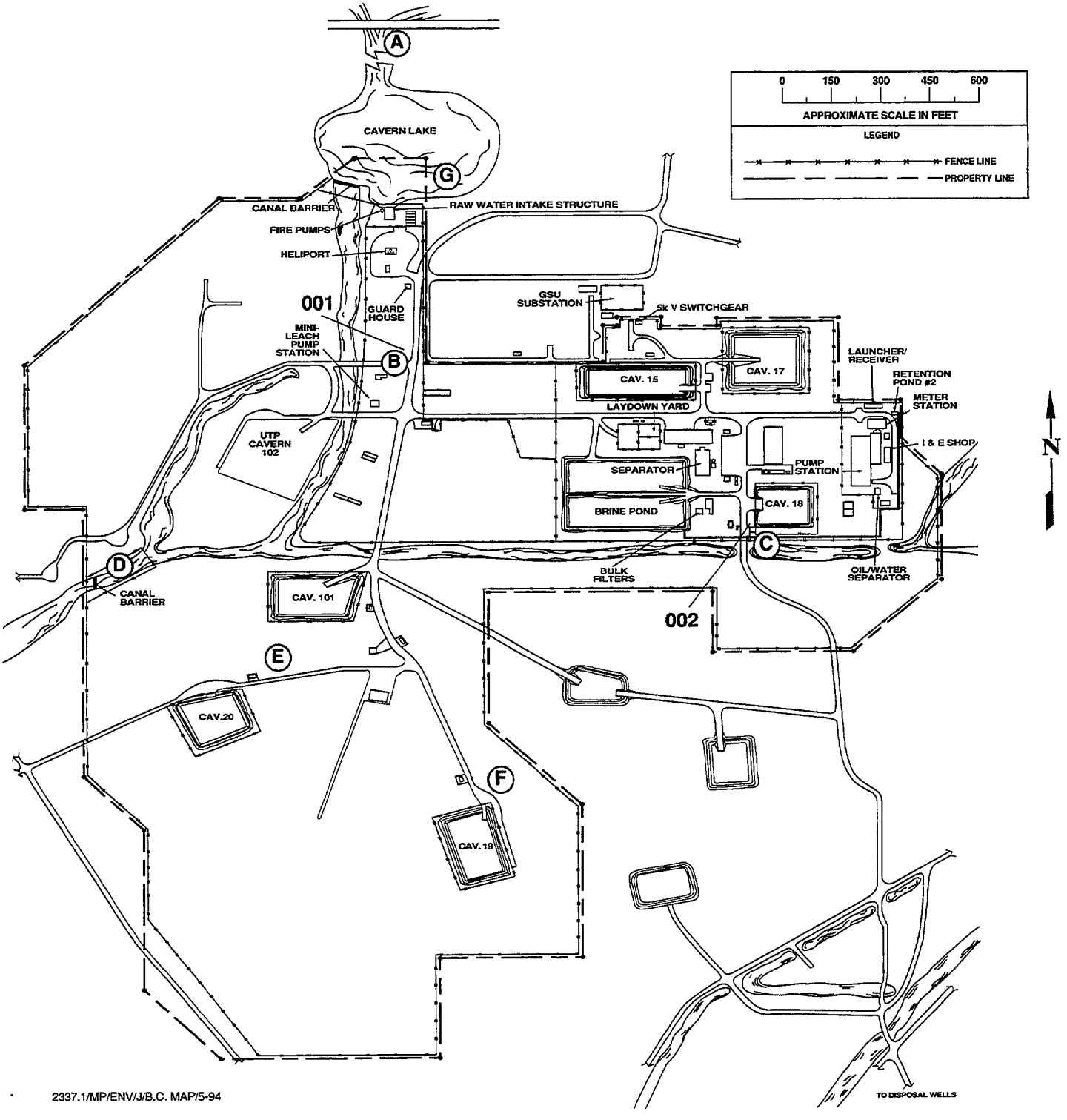


Figure 5-2

(Sheet 1 of 2). Bayou Choctaw Environmental Monitoring Stations

Discharge Monitoring Stations

001 Discharge from sewage treatment plant (administration building)

002 Discharge from sewage treatment plant (control building)

Stormwater Discharges

Stormwater and pump flush from pump pads

Stormwater runoff from well pads 15, 17-20, and 101

Water Quality Monitoring Stations

A Canal north of Cavern Lake at perimeter road bridge

B North-South Canal at bridge to caverns 10, 11, and 13

C East-West Canal at Intersection of road to brine disposal wells

D East-West Canal at cavern 10

E Wetland Area near well pad 20

F Wetland Area near well pad 19

G Near Raw Water Intake

Figure 5-2

(Sheet 2 of 2). Bayou Choctaw Environmental Monitoring Stations

Table 5-2. Data Summary for Bayou Choctaw Monitoring Stations

Bayou Choctaw

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
A								
pH	8	0	7.8	6.3	NV	7.4	NV	NV
Temperature	8	0	31.0	12.0	21.7	22.5	6.8	31.4
Salinity	8	8	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	8	8	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	8	0	7.1	1.3	3.5	3.5	1.8	51.8
Total Organic Carbon	8	0	9.7	3.0	6.1	5.9	2.1	35.0
B								
pH	11	0	7.6	6.8	NV	7.3	NV	NV
Temperature	11	0	30.0	14.0	21.5	22.0	5.4	25.3
Salinity	11	4	6.0	0.5	2.5	2.0	2.0	78.3
Oil & Grease	11	11	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	11	0	7.9	0.1	4.8	6.5	2.6	53.9
Total Organic Carbon	11	1	9.8	2.4	6.1	6.4	2.7	44.2
C								
pH	12	0	7.5	6.3	NV	7.1	NV	NV
Temperature	12	0	32.0	13.0	21.9	22.0	6.6	30.1
Salinity	12	8	4.0	0.5	1.2	0.5	1.1	95.3
Oil & Grease	12	12	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	9.2	2.4	4.5	3.9	1.9	42.5
Total Organic Carbon	12	0	13.6	4.4	9.4	10.5	3.4	35.8
D								
pH	12	0	8.1	6.3	NV	7.6	NV	NV
Temperature	12	0	31.0	12.0	21.7	23.0	6.7	30.8
Salinity	12	10	2.0	0.5	0.6	0.5	0.4	69.3
Oil & Grease	12	12	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	9.2	2.1	4.2	3.4	2.0	47.9
Total Organic Carbon	12	0	10.6	2.7	6.5	6.4	2.3	35.6

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

Table 5-2 (Continued). Data Summary for Bayou Choctaw Monitoring Stations

Bayou Choctaw

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
E								
pH	12	0	7.2	6.0	NV	6.9	NV	NV
Temperature	12	0	31.0	12.0	21.5	22.0	6.3	30.8
Salinity	12	12	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	12	12	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	6.6	0.7	3.6	3.3	2.1	58.8
Total Organic Carbon	12	0	9.0	3.2	6.1	5.6	1.7	27.3
F								
pH	12	0	7.7	6.6	NV	7.1	NV	NV
Temperature	12	0	32.0	13.0	22.1	22.0	6.4	28.9
Salinity	12	9	3.0	0.5	0.9	0.5	0.8	91.6
Oil & Grease	12	12	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	7.4	0.6	4.9	6.3	2.7	55.0
Total Organic Carbon	12	0	21.5	4.7	9.3	7.6	4.6	49.2
G								
pH	12	0	8.7	6.4	NV	7.3	NV	NV
Temperature	12	0	31.0	12.0	21.7	21.5	6.5	29.7
Salinity	12	12	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	12	12	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	9.7	1.1	5.5	4.4	2.8	51.1
Total Organic Carbon	12	0	13.7	2.3	7.2	6.3	3.5	48.7

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.

Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

5.2.1.4 Dissolved Oxygen (DO)

The consistency in DO observations suggests that SPR runoff and discharges do not significantly reduce the DO of receiving waters. Low levels below 2.0 mg/l observed at various times are attributed to high temperature and high organic loading resulting from Hurricane Andrew combined with low flow and minimal flushing typically observed in a wetland environment.

5.2.1.5 Oil and Grease

Oil and grease levels were below detectable levels (<5 mg/l) at all stations throughout 1993. The data favorably reflect continued good site housekeeping and effective site spill prevention, control, and response efforts.

5.2.1.6 Total Organic Carbon (TOC)

Average annual TOC concentrations ranged from 6.1 to 9.4 mg/l. High TOC readings correlate with high organic loading which is usually found in stagnant or sluggish water bodies of limited volume, such as an evaporating pool of water. No correlation was found between TOC and temperature; TOC did not appear to vary seasonally.

5.2.1.6 General Observations

Based on the above discussion, the following general observations are made regarding the quality of Bayou Choctaw surface waters.

a. The surrounding surface waters continue to have a relatively neutral to slightly basic pH.

b. The observed salinities remained generally low. Elevated salinities observed in 1993 were not attributed to SPR activity.

c. Temperature variations were due to seasonal changes since there are no thermal processes used at any SPR site.

d. Lower DO levels occasionally observed are attributed to high temperatures, high organic loading, and low flow and minimal flushing typically observed in backwater swamp areas.

e. Consistently low oil and grease levels observed indicate that site oil spills are effectively managed, minimizing any impact on the Bayou Choctaw environs.

5.2.2 Big Hill

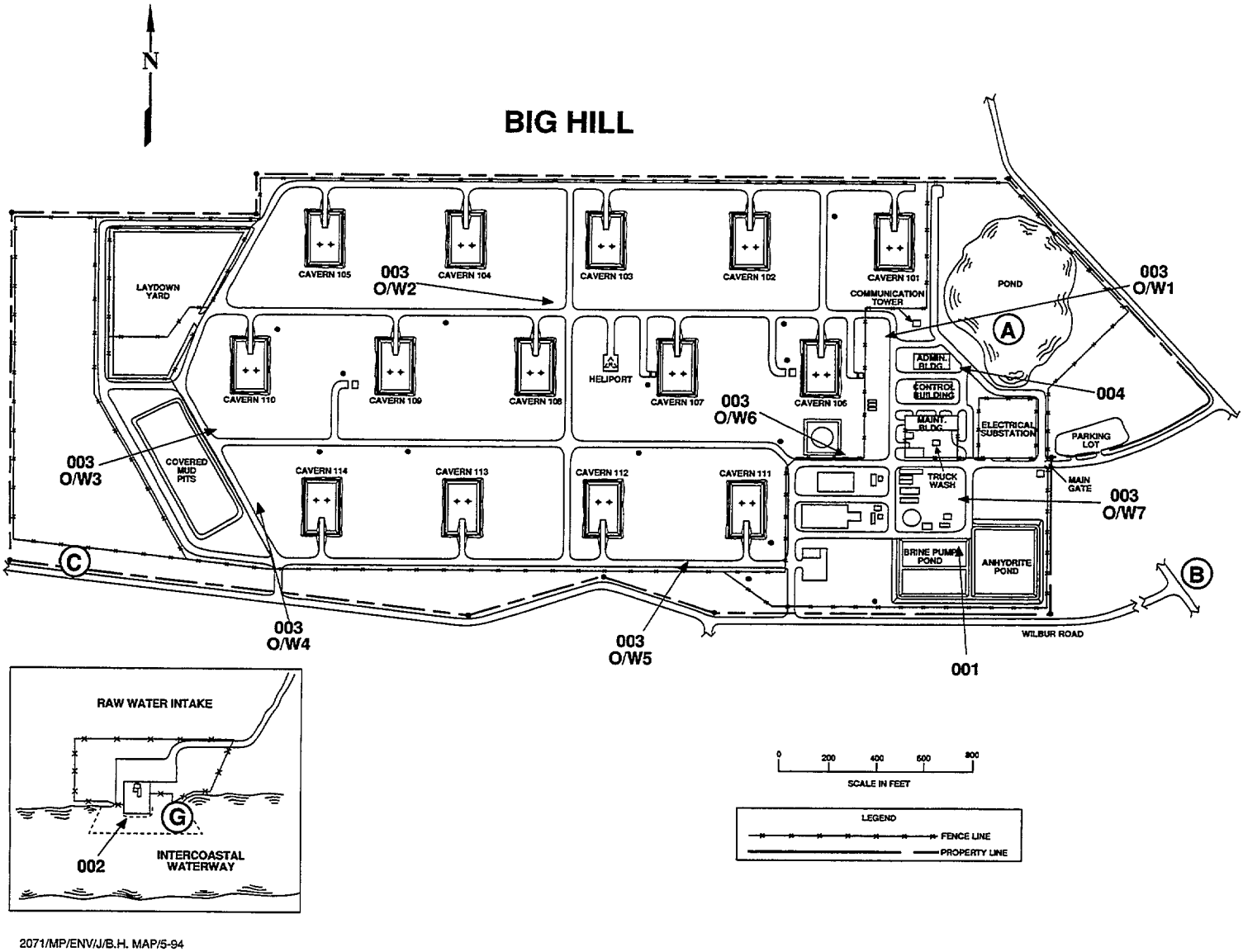
Monitoring stations were established at five locations (Figure 5-2) to assess site-associated surface water quality and to provide early detection of any surface water quality degradation that may result from SPR operations. Parameters including pH, temperature, salinity, oil and grease, dissolved oxygen, and total organic carbon were monitored (Table 5-3).

5.2.2.1 Hydrogen Ion Activity (pH)

The 1993 data show the pH of the site and surrounding surface waters remained between 6.0 and 8.4. The annual median values of pH for each of the monitored stations ranged from 6.8 to 7.6. No seasonal trend was observed, but pH increases were evident at the Gator Hole (station F), Pipkin Pond (E), Intracoastal Waterway (G), and the Wilber(C) ditch during periods of high or low temperatures and high TOC concentrations. These conditions are indicative of high primary productivity.

5.2.2.2 Salinity (SAL)

Annual average salinities were generally low, ranging from fresh on site to 4.9 ppt at the Intracoastal Waterway. It was observed that the further south the station location, the slightly higher the salinity. The fresh water environment evident at the STP pond and



2071/MP/ENV/J/B.H. MAP/5-94

Figure 5-3

(Sheet 1 of 2). Big Hill Environmental Monitoring Stations

Discharge Monitoring Stations

001 Brine disposal to Gulf of Mexico

002 Hydroclone and blowdown at raw water intake structure

003 Stormwater discharges

O/W1 Stormwater from well pads 101, 102, 106, 107

O/W2 Stormwater from well pads 103, 104, 105

O/W3 Stormwater from well pads 108, 109, 110

O/W4 Stormwater from well pads 113, 114

O/W5 Stormwater from well pads 111, 112

O/W6 Stormwater from BHT-7 (crude oil surge tank) diked area

O/W7 Stormwater from pump and meter pads

004 Discharge from sewage treatment plant (TNRCC only)

Water Quality Monitoring Stations

A Pond receiving effluent from site sewage treatment plant (STP)

C Wilber Road Ditch - southwest of site

E Pier at Pipkin Pond

F Culvert crossover (Gator Hole) on RWIS road

G RWIS at Intracoastal Waterway

Figure 5-3 (Sheet 2 of 2). Big Hill Environmental Monitoring Stations

Table 5-3. Data Summary for Big Hill Monitoring Stations

Big Hill

Station	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
A								
pH	12	0	7.7	6.2	NV	7.3	NV	NV
Temperature	12	0	35.0	12.0	21.5	22.0	7.3	34.1
Salinity	12	12	0.5	0.5	0.5	0.5	0.0	83.2
Oil & Grease	12	12	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	12	0	14.8	1.7	8.1	7.5	4.2	52.1
Total Organic Carbon	12	0	24.7	7.2	11.0	9.2	5.0	45.3
C								
pH	12	0	8.4	6.5	NV	7.0	NV	NV
Temperature	12	0	32.0	12.0	21.5	21.5	7.1	33.3
Salinity	12	6	3.6	0.5	1.5	0.7	1.2	83.2
Oil & Grease	12	12	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	12	0	19.0	2.4	9.2	8.1	5.5	60.1
Total Organic Carbon	12	0	23.0	10.9	15.9	15.7	3.4	21.2
E								
pH	12	0	7.8	6.0	NV	6.7	NV	NV
Temperature	12	0	28.0	10.0	19.8	19.5	6.4	32.2
Salinity	12	12	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	12	12	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	12	0	15.2	0.2	5.8	5.5	5.1	86.9
Total Organic Carbon	12	0	22.0	1.8	14.5	13.3	5.5	37.9
F								
pH	12	0	8.2	6.4	NV	7.0	NV	NV
Temperature	12	0	31.0	10.0	21.2	21.5	7.1	33.8
Salinity	12	7	13.0	0.5	3.1	0.5	4.4	141.6
Oil & Grease	12	12	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	12	0	13.4	0.2	6.8	8.5	4.4	65.2
Total Organic Carbon	12	0	21.8	7.0	15.3	14.8	4.6	29.9

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

Table 5-3 (Continued). Data Summary for Big Hill Monitoring Stations

Big Hill

Station	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
G								
pH	12	0	8.3	6.7	NV	7.5	NV	NV
Temperature	12	0	32.0	12.0	21.77	22.0	7.3	33.9
Salinity	12	3	13.0	0.5	4.9	2.6	4.8	98.1
Oil & Grease	12	12	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	12	0	17.8	4.6	10.4	10.3	5.0	48.1
Total Organic Carbon	12	0	19.6	2.5	11.4	11.1	5.2	45.5

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

(Station A) and the Pipkin pond (E) transitioned to brackish at the Gator Hole (F) and the Intracoastal Waterway (G). Marsh changes from fresh to intermediate regime were evident. A seasonal increase in salinity was observed in the fall at the Gator Hole and the Intracoastal Waterway stations which are located in a brackish water environment which is tidally affected. No salinities were observed that would indicate brine contamination through SPR activities. The coefficient of variation for salinity approached or exceeded 100% at the Gator Hole and the Intracoastal Waterway which indicates that salinity is highly variable at these locations.

5.2.2.3 Oil and Grease

Results for all stations at all times were below the detectable limit. No indicating crude oil from SPR activities was found at these stations during sampling episodes.

5.2.2.4 Temperature

Temperatures observed in 1993 ranged from 10.0 ^{0}C to 35.0 ^{0}C and exhibited the characteristics expected from seasonal meteorological changes. Temperature fluctuations were very similar among all stations.

5.2.2.4 Dissolved Oxygen (DO)

Dissolved oxygen was generally greatest in the spring and lowest in the summer and fluctuated with seasonal temperature changes. The widest range of DO fluctuation observed during 1993 was at the Wilber Road ditch; however, all stations exhibited wide fluctuations indicative of sluggish, shallow water environments. Lowest dissolved oxygen concentrations were observed in the summer when high temperatures and high organic loading in sluggish waters created an oxygen deficient environment for aquatic organisms. Highest dissolved oxygen concentrations were observed from February to May

in cooler algae-rich waters where oxygen is a by-product of primary productivity.

5.2.2.5 Total Organic Carbon (TOC)

Average annual TOC concentrations ranged from 11.0 to 15.9 mg/l. Elevated TOC levels were observed with high DO levels, such as found during algae blooms in spring and fall, and with low DO concentrations such as found in summer's warm sluggish water conditions that encourage biotic growth.

5.2.2.6 General Observations

Based on the above discussion, the following general observations are made regarding the quality of Big Hill surface waters.

a. The surrounding surface waters have a near neutral pH that varies with temperature and primary productivity in several locations.

b. Observed salinities were generally low and increased in natural fashion from fresh water at the site to intermediate brackish water regimes at the Intracoastal Waterway.

c. Surrounding surface waters were not impacted by SPR crude oil.

d. Temperature variations followed seasonal meteorological changes.

e. Dissolved oxygen and total organic carbon fluctuations were affected by seasonal meteorological changes, resultant changes in algal and biotic growth, and flow conditions.

5.2.3 Bryan Mound

Surface waters surrounding the Bryan Mound site were monitored throughout 1993. Blue Lake was sampled once monthly at seven stations. Mud Lake was sampled at three stations once monthly except during January, February, and March when low tides restricted access to the lake.

Specific surface water monitoring stations are identified in Figure 5-3. Stations A through C and E through G are located along the Blue Lake shoreline to monitor effects of site runoff. Station D, located farther away from the site in Blue Lake, serves as a control. Stations H and I are located along the Mud Lake shoreline to monitor effects of site runoff. Station J located, near the central point of the lake, serves as a control.

Specific parameters monitored in the Bryan Mound surface waters include pH, temperature, salinity, oil and grease, DO, and TOC.

5.2.3.1 Hydrogen Ion Activity (pH)

Observed 1993 pH data were generally neutral to slightly basic, indicative of natural waters devoid of carbon dioxide and generally hard in regard to mineral content. Marine and estuarine waters, such as those in Blue Lake and Mud Lake, typically have somewhat elevated H levels and high mineral content. The pH fluctuated directly with the rate of carbon dioxide uptake as related to low primary productivity (lower pH) during cool periods and high primary productivity (higher pH) during warm periods.

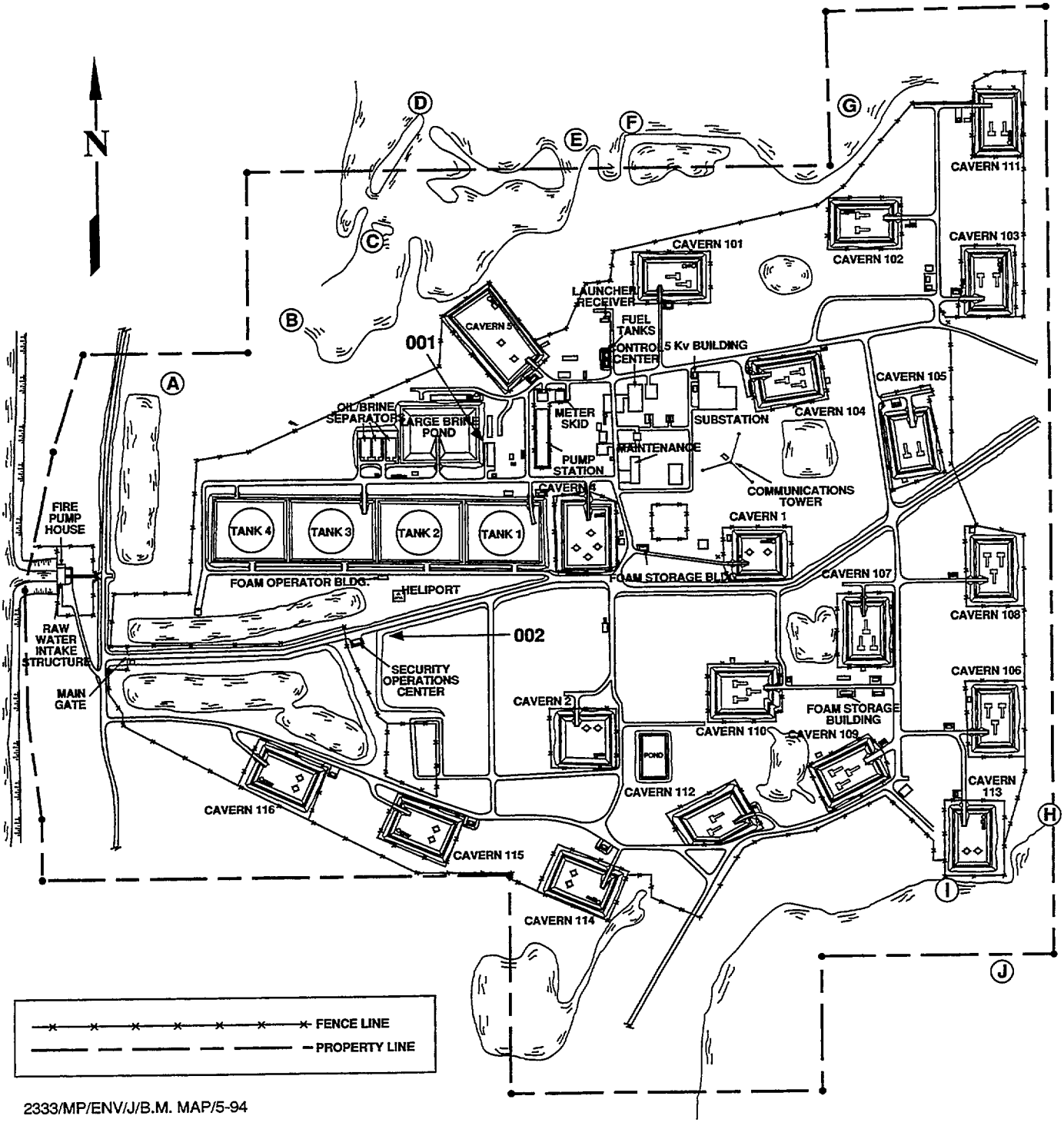


Figure 5-4

(Sheet 1 of 2). Bryan Mound Environmental Monitoring Stations

Discharge Monitoring Stations

001 Brine disposal

002 Discharge from the sewage treatment plant

Stormwater runoff from surge tank area (corresponds to TWC permit no. 02271 discharge 001)

Stormwater discharges

Stormwater runoff from well pads 1, 2, 4, 5, and 101-116

Stormwater runoff from the high-pressure pump pad

Water Quality Monitoring Stations

A Blue Lake

B Blue Lake

C Blue Lake

D Blue Lake - Control Point 1

E Blue Lake

F Blue Lake

G Blue Lake

H Mud Lake

I Mud Lake

J Mud Lake - Control Point 2

Figure 5-4 (Sheet 2 of 2). Bryan Mound Environmental Monitoring Stat

Table 5-4. Data Summary for Bryan Mound Monitoring Stations

Bryan Mound

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
A								
pH	11	0	9.5	8.0	NV	8.5	NV	NV
Temperature	11	0	31.0	10.0	23.2	24.0	7.1	30.6
Salinity	11	0	3.4	2.2	2.7	3.0	0.4	15.9
Oil & Grease	3	3	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	10	0	13.2	7.2	9.5	8.9	2.1	22.3
Total Organic Carbon	11	0	37.0	10.0	18.1	15.0	8.2	45.6
B								
pH	11	0	9.5	7.7	NV	8.6	NV	NV
Temperature	11	0	32.0	10.0	23.0	24.0	6.9	30.1
Salinity	11	0	3.3	2.3	2.8	2.9	0.4	13.1
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	10	0	15.0	5.1	9.4	8.9	2.8	29.9
Total Organic Carbon	11	0	33.9	11.6	18.1	14.1	7.3	40.4
C								
pH	11	0	9.5	7.6	NV	8.6	NV	NV
Temperature	11	0	32.0	10.0	22.7	22.0	6.8	30.0
Salinity	11	0	3.3	2.4	2.8	3.0	0.3	12.4
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	10	0	11.3	6.8	8.9	9.0	1.5	16.7
Total Organic Carbon	11	0	31.3	9.0	16.2	14.5	6.3	38.9
D								
pH	11	0	9.3	7.7	NV	8.6	NV	NV
Temperature	11	0	31.0	10.0	23.0	24.0	6.8	29.7
Salinity	11	0	3.5	2.4	2.8	2.9	0.4	13.3
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	10	0	12.0	7.9	9.5	9.4	1.4	15.0
Total Organic Carbon	11	0	30.2	8.0	15.6	14.8	6.1	39.3

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

Table 5-4 (Continued). Data Summary for Bryan Mound Monitoring Stations

Bryan Mound

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
E								
pH	11	0	9.3	7.8	NV	8.6	NV	NV
Temperature	11	0	31.0	11.0	22.4	22.0	6.6	29.6
Salinity	11	0	3.2	2.4	2.8	2.9	0.3	11.8
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	10	0	10.8	6.2	9.0	9.5	1.4	16.1
Total Organic Carbon	11	0	36.8	10.0	16.5	14.5	7.4	44.9
F								
pH	11	0	9.2	7.7	NV	8.6	NV	NV
Temperature	11	0	31.0	10.0	22.4	22.0	6.8	30.5
Salinity	11	0	3.3	2.4	2.8	3.0	0.3	11.7
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	10	0	18.2	6.7	9.9	9.5	3.2	32.1
Total Organic Carbon	11	0	36.6	6.0	16.0	15.2	7.7	47.7
G								
pH	10	0	9.2	7.7	NV	8.6	NV	NV
Temperature	10	0	31.0	10.0	21.5	21.0	6.6	30.7
Salinity	10	0	3.5	2.4	2.9	2.9	0.4	12.9
Oil & Grease	3	3	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	9	0	18.3	5.7	9.8	9.2	3.5	35.4
Total Organic Carbon	10	0	36.2	6.0	15.8	14.8	8.0	50.5
H								
pH	5	0	8.4	6.8	NV	7.8	NV	NV
Temperature	5	0	29.0	18.0	22.4	20.0	4.5	20.1
Salinity	5	1	24.6	0.5	11.6	10.6	8.8	76.7
Oil & Grease	2	2	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	4	0	8.5	4.6	6.9	7.2	1.7	24.0
Total Organic Carbon	5	0	6.4	3.4	4.7	4.4	1.2	26.1

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

Table 5-4 (Continued). Data Summary for Bryan Mound Monitoring Stations

Bryan Mound

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
I								
pH	5	0	8.5	7.1	NV	7.8	NV	NV
Temperature	5	0	29.0	18.0	22.0	20.0	4.5	20.6
Salinity	5	1	24.1	0.5	11.8	11.1	8.7	73.6
Oil & Grease	2	2	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	4	0	8.7	5.6	7.5	7.8	1.5	19.7
Total Organic Carbon	5	0	29.0	3.8	9.8	5.4	10.8	109.7
J								
pH	5	0	8.9	7.2	NV	8.1	NV	NV
Temperature	5	0	29.0	18.0	22.0	19.0	4.8	21.8
Salinity	5	0	23.5	2.2	12.0	11.4	8.0	66.7
Oil & Grease	2	2	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	4	0	10.6	3.5	7.1	7.2	3.1	43.7
Total Organic Carbon	5	0	33.9	4.8	11.6	5.9	12.6	108.2

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.

Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

There were no known pH inducing impacts resulting in any pH changes to Mud Lake during 1993, Minor pH fluctuations in the Bryan Mound surface waters appear to be the result of seasonal and tidal variations rather than site activity.

5.2.3.2 Salinity (SAL)

Observed salinity fluctuations ranged from 2.2 to 3.5 ppt in Blue Lake and 0.5 to 24.6 ppt in Mud Lake. Salinity fluctuation are attributed to meteorologically induced conditions rather than site operations, since salinities observed at control sample points 1 and 2 (sample sites D and J) were consistent with those found along the site shoreline. The wider salinity range in Mud Lake relative to Blue Lake are primarily attributed to the strong tidal and wind influence on the lake and its more direct link with the Gulf of Mexico.

5.2.3.3 Temperature

Temperatures observed in 1993 ranged from 10 ^{0}C to 32 ^{0}C and exhibited the characteristics expected from seasonal meteorological changes. Mud Lake remained warmer than Blue Lake in the winter and was slightly cooler than Blue Lake in the summer. The more moderate range of Mud Lake is attributed to stronger tidal movement.

5.2.3.4 Dissolved Oxygen (DO)

The DO levels in 1993 ranged between 3.5 to 18.3 mg/l. Fluctuations in DO levels were attributed to the inverse relationship between temperature and DO as well as seasonal fluctuations in primary organic productivity, and meteorological factors such as wind driven mixing. The DO ranges observed are considered beneficial to the aquatic organisms inhabiting these lakes.

5.2.3.5 Total Organic Carbon (TOC)

Average annual TOC data for 1993 ranged between 4.7 to 18.1 mg/l and was slightly lower in Mud Lake than Blue Lake; however TOC variability was consistently lower in Blue Lake than at I and J in Mud Lake. The higher variability in Mud Lake is attributed to greater tidal movement where organics are brought in and flushed out. The TOC levels observed in both lakes are indicative of healthy conditions and a stable oxygen demand.

5.2.3.6 General Observations

Based on the above discussions, the following general observations are made regarding the quality of Bryan Mound surface waters.

a. The observed pH was stable and predominantly neutral to slightly basic in Blue Lake and Mud Lake.

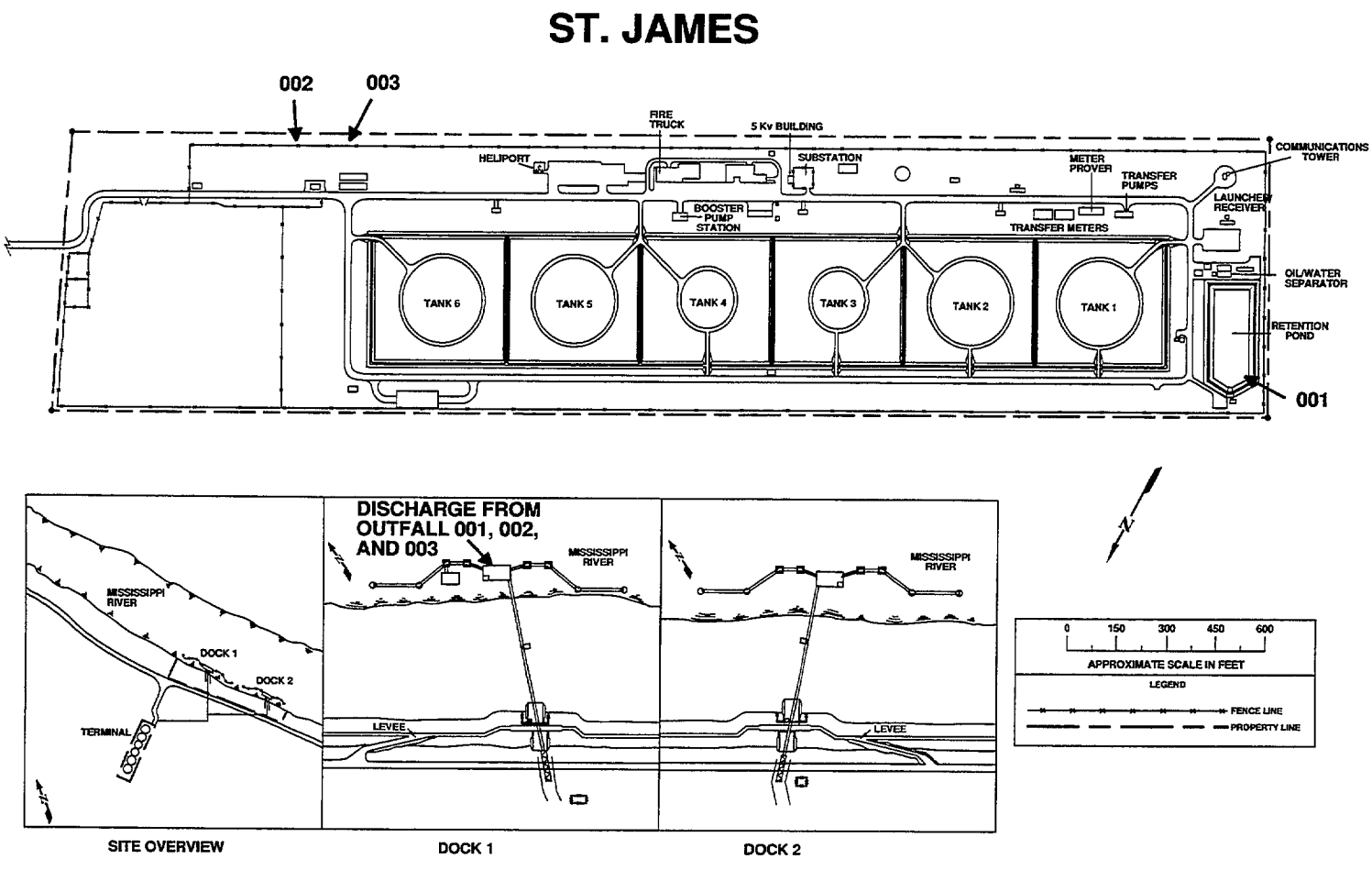
b. Salinity fluctuations during and among years are attributed to meteorologically induced conditions and previous industrial activity rather than site operations.

c. Levels of DO fluctuated with temperature and primary productivity.

d. Except for temperature, Mud Lake experiences more pronounced changes in water quality than Blue Lake. The more direct link of Mud Lake with the Gulf of Mexico and the frequent wind and tidal induced flushing are responsible for wider seasonal changes in water quality than observed in Blue Lake.

5.2.4 St. James Terminal

St. James Terminal is located in a low-lying agricultural area beyond the west levee of the Mississippi River. All precipitation is effectively drained westward from the terminal



2334/MP/ENV/J/ST. JAMES MAP/5-94

Figure 5-5

(Sheet 1 of 2). St. James Terminal Environmental Monitoring Stations

Discharge Monitoring Stations

001 Discharge from retention pond

002 Discharge from package sewage treatment plant

003 Discharge from package sewage treatment plant

There are no water quality monitoring stations at St. James.

Figure 5-5

(Sheet 2 of 2). St. James Terminal Environmental Monitoring Stations

and surrounding sugar cane fields by a series of ditches back to bottom land hardwood areas.

The two St. James docks are located on the west bank of the Mississippi River. They are curbed with all runoff pumped to the stormwater treatment system and retention pond. The site retention pond, which also collects stormwater runoff from the six crude oil storage tank containment areas, is discharged intermittently through outfall 001 (Figure 5-4) into the Mississippi River. Two wastewater treatment plants, which serve the site control and maintenance buildings, discharge as state outfalls 002 and 003 through outfall 001 into the Mississippi River.

At St. James, the Mississippi River has a large flow volume and rapid currents providing a strong assimilative capacity. The intermittent nature of discharges from site outfalls, the characteristic hydrographic features of the Mississippi River, and a state-conducted water quality monitoring program limit the value of a site-directed water quality monitoring program in the Mississippi River. There are no other surface waters located near the site.

5.2.5 Sulphur Mines

Samples were collected at six stations quarterly to monitor surface water quality. Monitoring stations are identified in Figure 5-5. Specific parameters monitored were pH, temperature, salinity, oil & grease, DO, and TOC (Table 5-5).

The Sulphur Mines site was decommissioned, and all crude oil was transferred to West Hackberry and Big Hill by early 1992. Surface waters were sampled in February and May, 1993, before the site was sold to Pittsburgh Plate Glass.

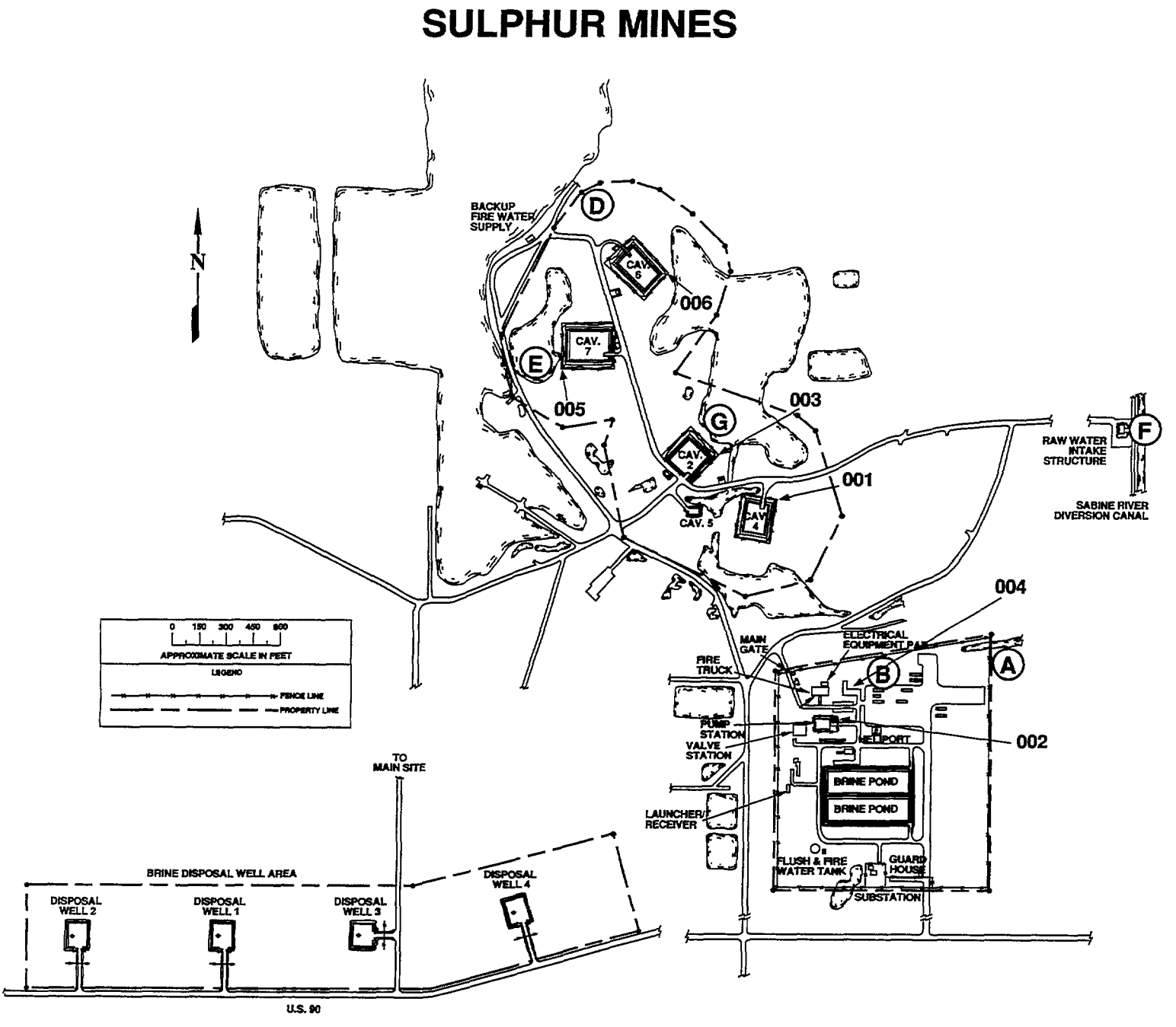


Figure 5-6

(Sheet 1 of 2). Sulphur Mines Environmental Monitoring Stations

Discharge Monitoring Stations

001 Discharge from sewage treatment plant

002 Storm water discharge from high pressure pump pad

Storm water discharge from well pads 2, 4, 6, and 7

Water Quality Monitoring Stations

A Drainage ditch at northeast corner of primary site

B Creek north of primary site

D Impoundment north of Cavern 6

E Impoundment west of Cavern 7

F Intake structure (Sabine Diversion Canal)

G Subsidence area

Figure 5-6 (Sheet 2 of 2). Sulphur Mines Environmental Monitoring Stations

Table 5-5. Data Summary for Sulphur Mines Stations

Sulphur Mines

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
A								
pH	2	0	7.1	6.5	NV	6.8	NV	NV
Temperature	2	0	21.4	18.0	19.7	19.7	2.4	12.2
Salinity	2	2	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	1	1	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	2	0	3.2	1.8	2.5	2.5	1.0	39.6
Total Organic Carbon	2	0	23.3	7.9	15.6	15.6	10.9	69.8
B								
pH	2	0	7.0	6.6	NV	6.8	NV	NV
Temperature	2	0	24.2	21.0	22.6	22.6	2.4	12.2
Salinity	2	2	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	1	1	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	2	0	5.9	1.5	3.7	3.7	3.1	84.1
Total Organic Carbon	2	0	10.5	5.3	7.9	7.9	3.7	46.5
D								
pH	1	0	7.2	7.2	NV	7.2	NV	NV
Temperature	1	0	25.4	25.4	25.4	25.4	NV	NV
Salinity	1	0	1.0	1.0	1.0	1.0	NV	NV
Oil & Grease	0							
Dissolved Oxygen	1	0	1.2	1.2	1.2	1.2	NV	NV
Total Organic Carbon	1	0	7.9	7.9	7.9	7.9	NV	NV
E								
pH	2	0	7.4	7.1	NV	7.2	NV	NV
Temperature	2	0	21.8	17.0	19.4	19.4	3.4	17.5
Salinity	2	1	1.0	0.5	0.7	0.7	0.0	0.0
Oil & Grease	1	1	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	2	0	6.9	1.5	4.2	4.2	3.8	90.9
Total Organic Carbon	2	0	8.0	6.9	7.4	7.4	0.8	10.4

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

Table 5-5 (Continued). Data Summary for Sulphur Mines Monitoring Stations

Sulphur Mines

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
F								
pH	2	0	7.1	6.5	NV	6.8	NV	NV
Temperature	2	0	25.8	18.0	21.9	21.9	5.5	25.2
Salinity	2	2	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	1	1	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	2	0	6.3	5.2	5.7	5.7	0.8	13.5
Total Organic Carbon	2	0	6.9	6.8	6.8	6.8	0.1	1.0
G								
pH	2	0	7.2	7.2	NV	7.2	NV	NV
Temperature	2	0	23.6	17.0	20.3	20.3	0.5	58.2
Salinity	2	2	0.5	0.5	0.5	0.5	0.0	0.0
Oil & Grease	1	1	2.5	2.5	2.5	2.5	NV	NV
Dissolved Oxygen	2	0	4.6	2.7	3.6	3.65	1.3	36.8
Total Organic Carbon	2	0	8.3	7.3	7.8	7.8	0.7	9.1

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

5.2.5.1 Hydrogen Ion Activity (pH)

The 1993 data show that pH of surrounding surface waters were near neutral and ranged from 6.5 to 7.4. Observed pH generally increased slightly in the spring.

5.2.5.2 Salinity (SAL)

Average annual salinity values were below detectable limits (less than 1.0 ppt) at all stations. Highest salinity (1.2 ppt) was observed at Station F, the Sabine Diversion Canal, which does not directly affect and is not effected by site run-off. There was no brine impact to surrounding waters from SPR activities.

5.2.5.3 Temperature

Sample station temperatures ranged from 17.0 ^{0}C to 25.8 ^{0}C and averaged from 19.4 ^{0}C to 25.4 ^{0}C. The range is conducive to supporting aquatic life. Fluctuations are attributed entirely to meteorological conditions since SPR activities did not produce thermal discharges.

5.2.5.4 Oil and Grease

Oil and Grease was tested only in January for all stations except D. All results were below detection limits (less than 5.0 mg/l). The data reflect effective spill prevention, control, and response efforts by the SPR and neighboring facilities.

5.2.5.5 Dissolved Oxygen (DO)

Dissolved oxygen ranged from 1.2 mg/l to 6.9 mg/l. Readings below 2.0 mg/l were taken at stations A, B, D, and E in the spring. Naturally sluggish, shallow water conditions and high biotic growth characteristic of these stations during warm weather created a high oxygen demand.

5.2.5.6 Total Organic Carbon (TOC)

Total organic carbon concentrations ranged from 5.3 mg/l to 23.3 mg/l. Concentrations were lower in the winter when algae and biotic growth was depressed by cooler temperatures. Concentrations were similar at all stations except A, a shallow drainage ditch where water flowed only during rainfall. Stagnant water at Station A and warm temperatures created a favorable environment for biotic growth. The low DO concentrations (1.8 mg/l) observed at this station is a result of these conditions.

5.2.5.7 General Observations

Based on the above discussion, the following general observations are made regarding the quality of Sulphur Mines surface waters.

a. Overall, pH remained relatively neutral.

b. Changes in water temperature were attributed to seasonal meteorological variation since the SPR had no thermal discharges.

c. The DO and TOC levels observed were attributed to natural factors such as temperature, algae and biotic growth, DO uptake and water flow.

d. Salinities observed were indicative of a freshwater wetland environment and exhibited no impact from SPR activities.

5.2.6 Weeks Island

The Weeks Island site is located on the Weeks Island salt dome approximately 30 m (100 ft) above sea level. The surrounding topography is of rather sharp relief with several small ponds located outside of SPR boundaries. None of the SPR outfalls discharge directly into these ponds. Other surface waters at this site are intermittent in nature, draining rapidly and

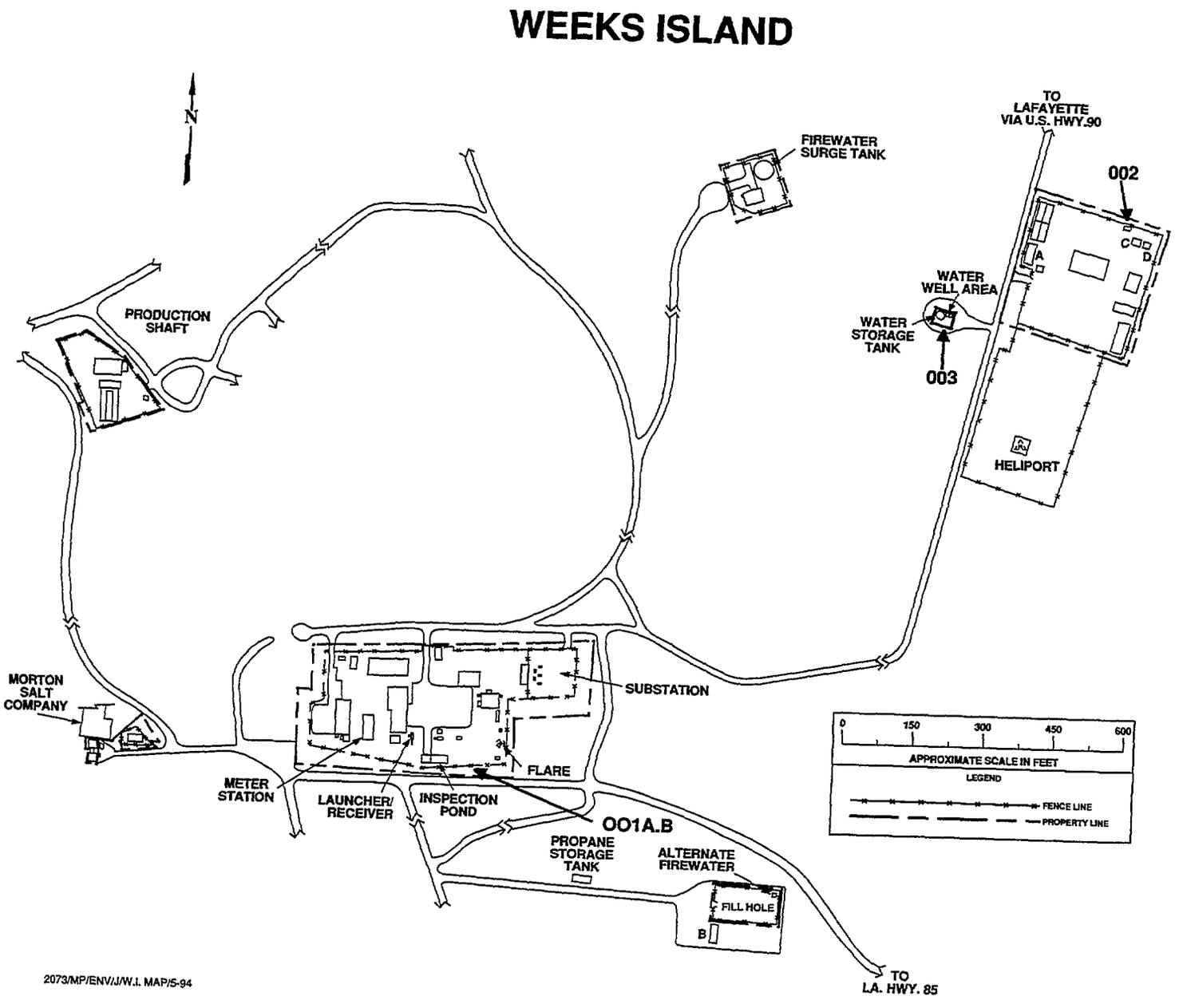


Figure 5-7
(Sheet 1 of 2). Weeks Island Environmental Monitoring Stations

Discharge Monitoring Stations

01A Storm water runoff

01B Discharge from sewage treatment plant

002 Discharge from sewage treatment plant

003 Discharge from iron removal system

004 Discharge from mine air dryer condensate

There are no water quality monitoring stations at Weeks Island

Figure 5-7 (Sheet 2 of 2). Weeks Island Environmental Monitoring Stations

thoroughly after any precipitation. The site outfalls (Figure 5-6) discharge small volumes into surface runoff at a substantial distance from receiving waters. The lack of potentially impacted DOS owned surface waters precludes the need for surface water quality monitoring at the Weeks Island site. Outfalls 004 and 01B are discharged with 01A through a single surface drain, similar to the St. James arrangement.

5.2.7 West Hackberry

In 1993, six surface water quality stations (Figure 5-7) were monitored monthly at West Hackberry. Specific parameters monitored include pH, temperature, salinity, DO, oil & grease, and TOC (Table 5-6).

5.2.7.1 Hydrogen Ion Activity (pH)

The pH of site and surrounding waters ranged between 5.8 and 9.3. Annual median values ranged from 7.1 to 8.5. Highest readings at all stations were observed during late fall and winter. Readings were consistently higher and exhibited less variability at station E than at other locations. Water sampled at station E is primarily phreatic (well water from the Hackberry community water supply) run-off from the site high-pressure pump pad. Surface water sampled at other stations was meteoric in origin. Fluctuations observed are attributed to environmental and seasonal factors such as variation in rainfall, temperature, algae and biotic growth, and aquatic system flushing.

5.2.7.2 Salinity (SAL)

Meteorological factors such as wind, tide, and rainfall contributed to the salinity variation observed in Black Lake and the Intracoastal Waterway. The broad salinity range observed in Black Lake (1.6 to 23.8 ppt) is more conducive to supporting euryhaline organisms and those with sufficient mobility to avoid salinity stresses that occur with such seasonal changes. Mean annual salinity

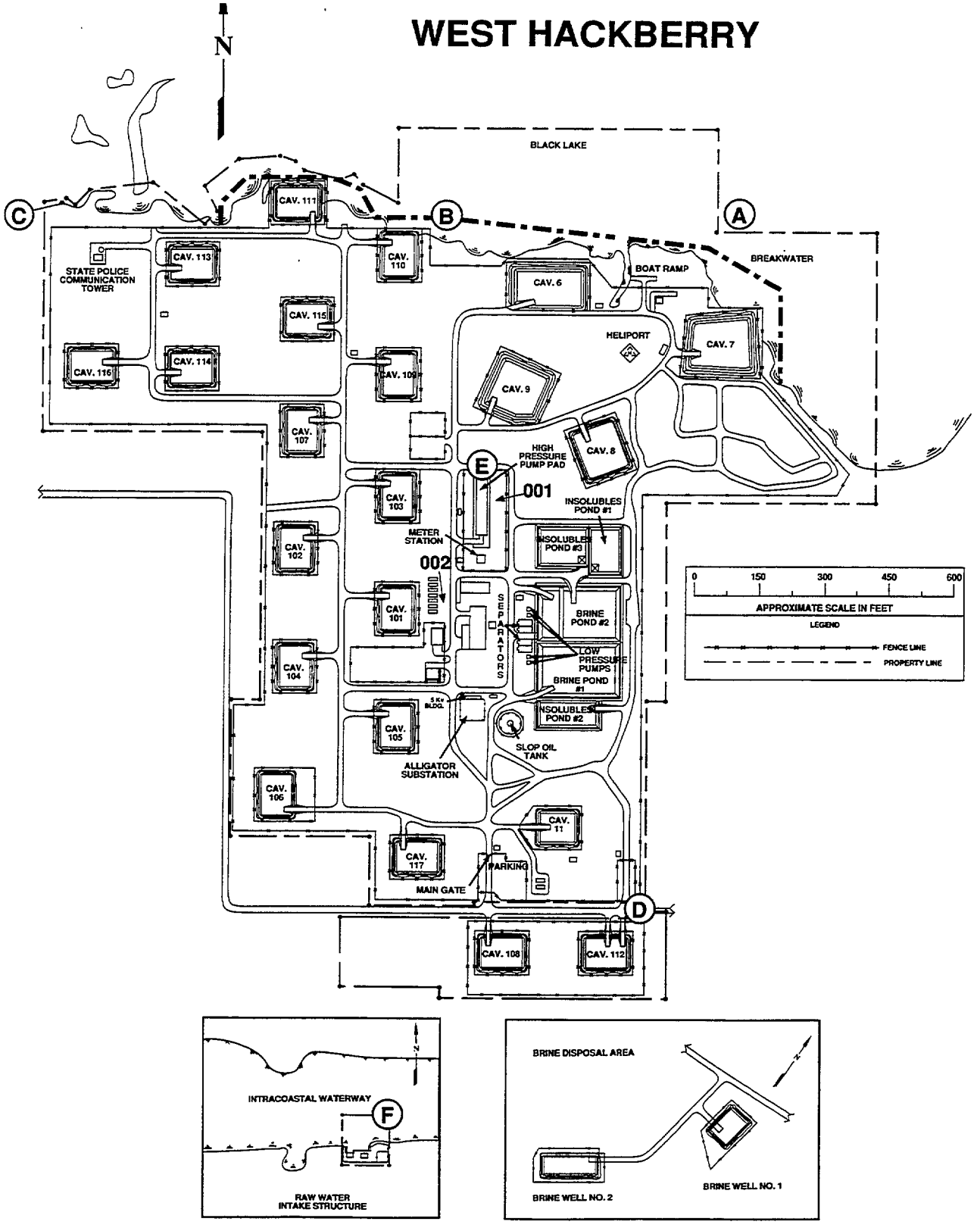


Figure 5-8

(Sheet 1 of 2). West Hackberry Environmental Monitoring Stations

Discharge Monitoring Stations

001 Brine disposal

002 Discharge from sewage treatment plant

003 Storm water and pump flush from high-pressure pump pad Storm water runoff from well pads 6-9, 11, and 101-117

004 Storm water from the Texoma/Lake Charles meter station

Water Quality Monitoring Stations

A Black Lake

B Black Lake

C Black Lake

D Southeast drainage ditch

E High-pressure pump pad

F Raw water intake structure (Intracoastal Waterway)

Figure 5-8

(Sheet 2 of 2). West Hackberry Environmental Monitoring Stations

Table 5-6. Data Summary for West Hackberry Monitoring Stations

West Hackberry

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
A								
pH	12	0	8.0	6.5	NV	7.1	NV	NV
Temperature	12	0	31.0	11.0	21.1	22.5	7.4	35.3
Salinity	12	0	23.8	1.6	7.4	4.8	6.2	83.8
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	14.8	5.6	9.4	9.0	2.8	29.7
Total Organic Carbon	12	0	10.2	2.1	7.8	8.1	2.2	27.9
B								
pH	12	0	8.1	6.4	NV	7.2	NV	NV
Temperature	12	0	30.0	11.0	21.3	23.0	7.4	34.9
Salinity	12	0	13.2	1.6	6.5	4.6	4.1	62.7
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	14.8	5.8	9.5	9.2	2.8	29.2
Total Organic Carbon	12	0	10.0	1.1	7.7	8.3	2.5	32.2
C								
pH	12	0	8.2	6.4	NV	7.3	NV	NV
Temperature	12	0	31.0	11.0	21.1	22.5	7.4	35.3
Salinity	12	0	13.2	1.6	6.6	4.6	4.04	61.7
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	1	14.5	5.8	9.4	8.6	2.8	29.4
Total Organic Carbon	12	0	23.1	1.0	9.0	8.8	5.0	55.2
D								
pH	12	0	8.5	7.2	NV	7.8	NV	NV
Temperature	12	0	30.0	12.0	21.1	20.5	6.5	31.5
Salinity	12	10	1.0	0.5	0.6	0.5	0.2	33.4
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	12.3	4.0	8.0	7.9	2.2	27.0
Total Organic Carbon	12	0	23.1	1.3	9.9	8.9	5.5	55.2

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.

Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

Table 5-6 (Continued). Data Summary for West Hackberry Monitoring Stations

West Hackberry

Station (Parameter)	Sample Size	BDL	Maximum	Minimum	Mean	Median	Standard Deviation	Coefficient of Variation
E								
pH	12	0	9.3	7.4	NV	8.4	NV	NV
Temperature	12	0	30.0	14.0	22.1	23.0	6.5	68.6
Salinity	12	2	3.5	0.5	1.5	1.0	1.0	68.6
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	2	12.5	6.1	8.4	8.0	1.7	19.7
Total Organic Carbon	12	0	15.5	0.5	3.7	4.0	2.1	58.4
F								
pH	12	0	7.8	5.8	NV	7.0	NV	NV
Temperature	12	0	32.0	12.0	21.7	20.0	7.2	33.1
Salinity	12	5	10.0	0.5	3.2	2.2	3.3	102.1
Oil & Grease	4	4	2.5	2.5	2.5	2.5	0.0	0.0
Dissolved Oxygen	12	0	14.0	4.2	8.4	7.8	2.8	33.8
Total Organic Carbon	12	1	15.5	0.5	7.9	7.7	3.7	47.0

Note: BDL = Number of samples that were below detectable limit.
NV = Not a valid number or statistical meaning.
Units: pH = SU; Temperature = deg. C; Salinity = ppt; Oil & Grease = mg/l; Dissolved Oxygen = mg/l; Total Organic Carbon = mg/l

observed for the Intracoastal Waterway (3.3 ppt) was lower than that of Black Lake (6.6 to 7.4 ppt). This is probably due to sampling methodology. Only surface samples were taken at all stations. The Intracoastal Waterway is deeper than shallow, well mixed Black Lake, and higher salinity water may have been present on the bottom of the waterway. Salinities observed at the two site ditch stations averaged less than 2.0 ppt, suggesting that brine contamination from site activities did not get off site.

5.2.7.3 Temperature

1993 data were consistent with observations at other sites and were indicative of regional climatic effects. No off-normal measurements were observed. Temperatures observed ranged from 11.0 ^{0}C to 32.0 ^{0}C and were generally consistent among stations.

5.2.7.4 Dissolved Oxygen

Observed DO levels in Black Lake and the Intracoastal Waterway are suitable for aquatic life and were generally higher (mean range: 7.5 to 9.5 mg/l) than that observed in ditches on site (8.0 mg/l mean for both stations). Greater surface area and water movement through currents and wave action provided greater aeration of the lake and waterway water. Water in the site ditch at station D was sluggish and stagnant between rain falls. Dissolved oxygen levels generally peaked in late spring and late fall in all water bodies.

5.2.7.5 Total Organic Carbon

Average annual TOC concentrations ranged from 0.5 to 23.1 mg/l. Peaks were observed during July and November in Black Lake and the Station D ditch on site and during January and March in the Intracoastal Waterway. These peaks do not coincide with peaks observed at Station E, the ditch that drains the high pressure pump pad. This

water of potable origin is not as rich in biomass as natural surface waters in other site ditches, Black Lake, and the Intracoastal Waterway. Consistently low TOC levels observed at Station E indicate that effluent from the pad did not contribute to TOC loading in the lake.

5.2.7.6 Oil and Grease

Observed oil and grease levels were below the detectable level (5 mg/l) at all stations throughout 1993. The data reflect effective spill prevention and housekeeping by the SPR.

5.2.7.7 General Observations

The following observations are made, based on the above discussion, concerning operational impacts on the West Hackberry aquatic environs.

a. pH and temperature remained fairly stable and were only affected by seasonal factors.

b. Runoff from the high pressure pump pad was of lower salinity than the Black Lake receiving waters. This demonstrates good housekeeping and prevention of brine releases.

c. Oil and grease levels were below the detectable limit at all stations throughout 1993 which is indicative of good housekeeping.

d. Dissolved oxygen levels in site ditches and receiving waters of Black Lake were consistently high and did not appear affected by site operations.

e. TOC at Station E which receives water from the high pressure pump pad remained well below permit limits and lower than that of natural receiving waters.

5.3 WATER DISCHARGE PERMIT MONITORING

The water discharge permit monitoring program fulfills the requirements of the EPA NPDES, and corresponding state TPDES and LWDPS programs. All SPR point source discharges are conducted in compliance with these Federal and state programs. SPR personnel regularly conducted point source discharges from all sites during 1993. These discharges are grouped as:

a. brine discharge to the Gulf of Mexico,
b. stormwater runoff from tank, well, and pump pads
c. rinse water from vehicles at specific locations draining to permitted outfalls.
d. effluent from package sewage treatment plants.

Corrective actions implemented to mitigate noncompliance recurrence included developing or modifying applicable procedures, retraining and certifying personnel, initiating special studies, and repairing faulty equipment.

In 1993, a total of 9,882 analyses were performed to monitor wastewater discharge quality from the SPR in accordance with NPDES and corresponding state permits. The SPR was in compliance with permit requirements for approximately 99.8% of the analyses performed. A total of 18 permit noncompliances were reported (Tables 5-9, 5-14, 5-16). during the calendar year (CY) 1993. Eight (44%) of the permit noncompliances experienced on the project were due to sampling, sample handling, or sampling related phenomena. Permit [parameter] excursions or exceedances also occurred 8 times or 44% of the noncompliances. The remaining 2 (12%) of the noncompliances resulted from problems with equipment (incubator) failure or piping failure allowing stormwater to leak-by causing an unauthorized discharge.

Parameters monitored varied by site and discharge. Table 5-1 identifies frequency of specific parameters measured at each

SPR site. The data measurement variations are discussed by site.

5.3.1 Bayou Choctaw

A total of 1100 measurements were performed on permitted outfalls and reporting stations to monitor NPDES and state permit compliance during 1993. There were no noncompliances in 1993; therefore, the site earned a perfect (100%) compliance level for 1993.

Most monitoring is related to water discharges regulated under the EPA (NPDES) permit and a corresponding permit issued by the Louisiana Department of Environmental Quality (LDEQ) Office of Water Resources. Discharges are from two package sewage treatment plants (STP), and stormwater runoff from well pads, pump pads (containment areas), and the site vehicle rinsing station.

Table 5-7. Parameters for the Bayou Choctaw Outfalls

Location/Discharge	Parameter	Compliance Range
sewage treatment plants	flow	(report only)
	BOD_5	<45 mg/l
	TSS	<45 mg/l
	pH	6.0 - 9.0
stormwater and vehicle rinsing	flow	(report only)
	oil and grease	<15 mg/l
	pH	6.0 - 9.0

A LWDPS permit renewal was submitted to LDEQ for the Bayou Choctaw facility in 1992, the draft permit was processed in 1993 final issuance and is anticipated early in 1994.

5.3.2 Big Hill

A total of 1661 measurements were performed to monitor NPDES and state discharge permit compliance during 1993. There were four noncompliances during 1993 (Table 5-9) resulting in a 99.8% site compliance performance level.

Water discharges at Big Hill are regulated and enforced through the EPA NPDES permit program and the similar TNRCC/RCT

discharge permit program (TPDES). An NPDES renewal application was submitted in 1988 and again in 1993 as required every five years. No significant changes were requested in the application. The discharges at the facility involve brine to the Gulf of Mexico, hydroclone blowdown into the Intracoastal Waterway, effluent from the sewage treatment plant, vehicle rinsing station, and stormwater from well pads and pump pads. Table 5-8 shows the existing outfalls. There were no discharges during 1993 from the hydroclone blowdown system.

Table 5-8. Parameters for the Big Hill Outfalls

Location/Discharge	Parameter	Compliance Range
brine to Gulf	flow	0.27 million m^3/day
	velocity	> 6.1 m/sec)
	oil and grease	< 15 mg/l
	TDS	(report only)
	TSS	< 40 mg/l (TNRCC only)
	pH	6.0 - 9.0 SU
	DO	detectable (when using O_2 scavenger)
stormwater and car wash	oil and grease	< 15 mg/l
	TOC	<75mg/l (EPA only)
	pH	6.0 - 9.0 SU
sewage treatment plant (TNRCC only)	flow	< 37.8 m^3/day
	BOD_5	< 65 mg/l
	TSS	< 65 mg/l
	chlorine	1.0 - 4.0 mg/l
	pH	6.0 - 9.0 SU
hydroclone blowdown (not used)	flow	report
	TSS	report
	pH	6.0 - 9.0 SU

A state water discharge permit renewal application was sent to the Railroad Commission of Texas and a finalized permit is anticipated for early 1994.

Table 5-9. Permit Noncompliances at Big Hill

Outfall Location	Permit Parameter	Value/ Limit	Cause
003	O&G	27.8/ 15	Contract lab results with no replicate indicated a high O&G value for a single stormwater discharge.

Table 5-9 (continued). Permit Noncompliances for Big Hill

Outfall Location	Permit Parameter	Value/ Limit	Cause
004	BOD_5	8.5/ 20.0	Two samples for the parameter BOD_5 taken during the monthly reporting period produced an average that exceeded the permitted limit. The high values are believed to have resulted from algae growth. The unit was taken out of service and disinfected.
001	no sample	-----	A discharge to the Gulf occurred which was sampled for O&G, however, the sample was not refrigerated. The test results therefore invalidated.
003	no sample	-----	A sample for a stormwater discharge was taken and the discharge approved. The pH measurement was not properly recorded resulting in the noncompliance.

5.3.3 Bryan Mound

A total of 3782 measurements were made on permitted outfalls for the purpose of monitoring NPDES and state discharge permit compliance during 1993. There were no noncompliances during 1993 resulting in a perfect (100%) site compliance performance level.

Water discharges at Bryan Mound are regulated and enforced through the EPA NPDES permit program and the similar TNRCC/RCT discharge permit program for state waters (TPDES). An NPDES renewal application was submitted during 1988 and again in 1993 as required every five years. No significant changes were requested in the application. The three permitted discharges are brine to the Gulf of Mexico; stormwater from the tank farm, well pads, and pump pads; and package sewage treatment plant effluent.

Table 5-10. Parameters for the Bryan Mound Outfalls

Location/Discharge	Parameter	Compliance Range
brine to Gulf (EPA only)	flow	0.17 million m^3/day
	velocity	> 6.1 m/sec
	oil and grease	<15 mg/l
	TDS	(report only)
	TSS	(report only)
	pH	6.0 - 9.0 SU
stormwater	flow	(report only)
	oil and grease	<15 mg/l
	TOC	<75 mg/l (EPA only)
	pH	6.0 - 9.0 RCT
	COD	<200 mg/l (RCT only)
	metals: As, Hg, Se	0.3 mg/l, 0.01 mg/l, 0.3 mg/l (RCT only)
sewage treatment plant	flow	<22.7 m^3/day (RCT only)
	BOD_5	<45 mg/l and <0.68 kg/day
	chlorine	1.0 - 4.0 mg/l
	pH	6.0 - 9.0 SU

5.3.4 St. James

A total of 81 measurements were performed on permitted outfalls to monitor NPDES and state discharge permit compliance. There were no noncompliances in 1993 giving the site a perfect (100%) compliance level.

Outfall 001 consists of stormwater from the site retention pond. Outfalls 002 and 003 are for the two site package sewage treatment plants. All three outfalls discharge through a common pipe to the Mississippi River.

Table 5-11. Parameters for the St. James Outfalls

Location/Discharge	Parameter	Compliance Range
retention pond	flow	(report only)
	oil and grease	<15 mg/l
	pH	6.0 - 9.0 SU
	TOC	<50 mg/l
sewage treatment plants	flow	(report only)
	BOD_5	<45 mg/l
	TSS	<45 mg/l
	pH	6.0 - 9.0 SU

5.3.5 Sulphur Mines

A total of 65 measurements were provided on permitted outfalls to monitor NPDES compliance during 1993 prior to permit transfer to the new owner in June 1993. The water system back

flush was not used in 1993. There was one noncompliance during 1993 (Table 5-13) resulting in a 98.5% compliance performance level. The site was decommissioned in 1992, the act of sale was completed in May 1993, and final permit transferals were effective in June 1993.

Table 5-12. Parameters for the Sulphur Mines Outfalls

Location/Discharge	Parameter	Compliance Range
stormwater	flow	(report only)
	oil and grease	<15 mg/l
	pH	6.0 - 9.0 SU
sewage treatment plant	flow	<5.6 m^3
	BOD_5	<45 mg/l
	TSS	<45 mg/l
	pH	6.0 - 9.0 SU
water treatment system back flush	flow	(report only)
	pH	6.0 - 9.0 SU
	salinity	(report only)

Table 5-13. Permit Noncompliances for Sulphur Mines

Outfall Location	Permit Parameter	Value/ Limit	Cause
002	no sample		The routine weekly sample for BOD_5 was taken and placed into the West Hackberry incubator. During the incubation period, equipment (incubator) failed invalidating the test results. A noncompliance resulted from the loss of data. Repairs were done on the incubator.

5.3.6 Weeks Island

A total of 196 measurements were performed on permitted outfalls to monitor NPDES compliance during 1993. There were two noncompliances in 1993 (Table 5-15). The site experienced a compliance performance level of 99.0%.

The water discharges at Weeks Island are regulated and enforced in accordance with the EPA NPDES permit program and the state water discharge program (LWDPS). There are separate outfalls (01B and 002) for each package sewage treatment plant. Outfall 01A handles all of the stormwater runoff collected in an on

site retention pond (Figure 5-7). There was no discharge from the iron removal unit (outfall 003) in 1993. The water condensing unit for the mine air (outfall 004) operated continuously in 1993.

An LWDPS permit renewal was submitted to LDEQ for the Weeks Island facility during 1992 with a draft permit being issued in January 1994. The NPDES permit was also renewed during 1993 as with all other SPR sites. In these renewals the Mine Air Condensate outfall (004) is being proposed for commingling with the 01A (Inspection Pond) discharge.

Table 5-14. Parameters for the Weeks Island Outfalls

Location/Discharge	Parameter	Compliance Range
stormwater	flow	(report only)
	oil and grease	<15 mg/l
	pH	6.0 - 9.0 SU
sewage treatment plant	flow	(report only)
	BOD_5	<45 mg/l
	TSS	<45 mg/l
	fecal coliform	<400 colonies/100 ml
	pH	6.0 - 9.0 SU
iron removal unit	flow	(report)
	TSS	<45 mg/l
mine air dryer condensate water	flow	(report)
	pH	6.0 - 9.0 SU
	TOC	(report)

Table 5-15. 1993 Noncompliances/Bypasses at Weeks Island

Outfall Location	Permit Parameter	Value/ Limit	Cause
002	no sample	------	The 002 STP was taken out of service for piping repairs in January. The plant was left open allowing rainfall entry resulting in a net discharge that month. No samples were obtained during the January reporting period. The plant was secured to preclude discharge until repairs were completed.
01A	Fecal Coliform	2000/ 400	The main site STP (01A) suffered a temporary hydraulic overload subsequent to a potable water system repair. Initial surge after repair upset the system. Subsequent samples indicated normal performance.

5.3.7 West Hackberry

A total of 2997 measurements were performed on permitted outfalls to monitor NPDES compliance during 1993. Permit noncompliances were identified on eleven occasions (Table 5-17). These eleven noncompliances, on a per analysis basis, resulted in a site compliance performance level of 99.6%.

The water discharges at the West Hackberry site are regulated and enforced in accordance with the EPA NPDES permit program and LDEQ's state water discharge program (LWDPS). The three categories of discharges and their parameters (Figure 5-8) at West Hackberry are brine disposal to the Gulf of Mexico; sewage treatment plant effluent; vehicle rinsing, station, and, stormwater runoff from well pads, and pump pads.

Table 5-16. Parameters for the West Hackberry Outfalls

Location/Discharge	Parameter	Compliance Range
brine to Gulf	flow	<0.17 million m^3/day
	velocity	>7.6 m/sec (25 ft/sec)
	oil and grease	<15 mg/l
	TSS	(report only)
	TDS	(report only)
	pH	6.0 - 9.0 SU
	DO	detectable (when using 0_2 scavenger)
sewage treatment plant	flow	(report only)
	BOD_5	<15 mg/l
	TSS	<45 mg/l
	fecal coliform	(report only)
	pH	6.0 - 9.0 SU
stormwater	flow	(report only)
	oil and grease	<15 mg/l
	TOC	<75 mg/l
	pH	6.0 - 9.0 SU

Table 5-17. 1993 Noncompliances/Bypasses at West Hackberry

Outfall Location	Permit Parameter	Value/ Limit	Cause
003	no sample(s)	-----	During the January reporting period a total of 5 separate stormwater discharges were documented from permitted outfalls that were not sampled as the result of discharge valves in the open position. Two outfalls were involved with separate rainfall events being experienced.
002	Fecal Coliform	1880/ 400	Routine sample indicated upset with STP. Chlorinating problem suspected.
002	BOD_5	20.6/ 15	During same incident, the Daily Max. Limit for BOD_5 was found to have been exceeded. The STP was believed to be upset and hydraulically overloaded.
002	BOD_5	20.6/ 10	Subsequent samples were not obtained to attempt to lower average BOD_5 and as a result Daily Average limit was also exceeded.
002	BOD_5	16.0/ 15	Results obtained from an outside lab indicated a 16.0 for BOD_5. Replicate samples were not obtained. The STP may have been hydraulically overloaded. The Daily Max. was exceeded.
002	BOD_5	16.0/ 10.0	Subsequent samples were not obtained to attempt to lower average BOD_5 and as a result Daily Average limit was also exceeded.

5.4 ENVIRONMENTAL OCCURRENCES

The majority of the non-routine releases of pollutants occur with the spillage into the environment of crude oil and brine from the SPR operations. Even though the SPR is considered to be in a stand-by mode, small quantities of crude oil and brine are moved throughout site equipment to maintain the facilities.

5.4.1 OIL SPILLS

There were six oil spills during 1993 totaling 232 barrels. One spill accounted for 200 barrels and was contained, recovered and returned to storage. No spills resulted in environmental damage.

In 1993, the total amount of oil moved (received and transferred internally) was approximately 5.2 million m^3 (32.95 MMB). The total number of crude oil spills, total volume spilled, and the percent volume spilled of total volume moved are shown in Table 5-18 for each year from 1982 through 1993.

Table 5-18. Number of Crude Oil Spills

Year	Total Spills	Volume Spilled m^3 (barrels)	Percent Spilled of Total Throughput
1982	24	847.0 (5,328)	0.00704
1983	21	380.9 (2,396)	0.00281
1984	13	134.8 (848)	0.00119
1985	7	85.4 (537)	0.00122
1986	5	1232.5 (7,753)	0.01041
1987	5	2.5 (16)	0.00002
1988	6	8.8 (55)	0.00001
1989	11	136.4 (858)	0.00004
1990	14	74.8 (467)	0.00003
1991	6	37.9 (237)	0.0004
1992	5	1.9 (12)	0.00006
1993	6	3.7 (232)	0.0007

The oil spills involving quantities in excess of 0.16 m^3 (1 bbl) that occurred during 1993, both contained and uncontained, are presented in Table 5-19. Oil spills in excess of one barrel are comparable to 1988 levels. No spills of oil

Table 5-19. 1993 Oil Spills

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
01/08/93	BM	32 m^3 (200 bbls)	An estimated 200 bbls of crude oil was released to the brine pond from CVN 112. The oil may have been released as a result of a brine string failure. The oil was contained on the brine pond and recovered.
03/15/93	SJ	0.32 m^3 (2 bbls)	An estimated 2 bbls of crude oil was lost during valve replacement at the oil manifold. The oil was contained and approximately 1.5 bbls were recovered. Contaminated soils and filter cloth were removed at a later date.
03/26/93	BH	0.008 m^3 (0.05 bbls)	An estimated 1 to 2 gallons of lube oil was lost to the ICW from the chain oiler reservoir of the traveling screens on the RWIS. Approximately 1 gallon was recovered. A sheen was produced on a navigable waterway.
05/06/93	BM	4.0 m^3 (25 bbls)	An estimated 25 bbls of crude oil was released from a buried flange on the Phillips Jones Creek Tank Farm from the BM 30" pipeline. The oil made its way to a stormwater retention area where 20.5 bbls were recovered. Some soils were affected and follow-up repairs indicated the failure of a weld joint at a flanged connection.
05/22/93	WH	0.48 m^3 (3 bbls)	An estimated 3 bbls of crude oil overflowed the cellar at WH CVN 107. The oil leakage was observed at the bolts on a Bradenhead flange. The contents of the cellar and the oil lost to the adjacent limestone covered pad floor were recovered after the leakage was stopped. The leak was traced to a failed downhole packer or bridge plug associated with the packer.
07/19/93	WH	0.32 m^3 (2 bbls)	Water infiltration into an abandoned and underground section of pipe near the HPP floated residual oil to the surface. 2 bbls were recovered during repairs consisting of flushing and concreting.

occurred during the months of February, April, June, August, September, October, November, and December.

Each of the six spills experienced during 1993 had different causative factors. These factors varied from sump overflow to failure of gaskets or pipe flange failure, to loss of oil during routine valve maintenance. No trend is readily apparent from this year's data.

5.4.2 BRINE SPILLS

During 1993 there were six brine spills totaling 370 barrels. None of the brine spilled resulted in environmental damage. No long term adverse environmental impact was observed from any SPR brine spills as evidenced by subsequent surveys and water quality monitoring.

The SPR disposed of 5.23 million m^3 (32.69 MMB) of brine (mostly saturated sodium chloride solution, some discharges were of lower salinities than normally attributed to brine) during 1993. Approximately 82.5% of the brine was disposed in the Gulf of Mexico via the Big Hill (53.5% of the total), and Bryan Mound (29.0% of the total) brine disposal pipelines. The remainder was disposed in saline aquifers via injection wells at the Bayou Choctaw (9.7% of the total), and West Hackberry (7.8% of the total) sites. In 1993, no disposal of saltwater occurred at the West Hackberry off-shore pipeline or the saltwater disposal wells at the Sulphur Mines site and less than 0.1% of the total was disposed at permitted offsite disposal wells.

The total number of spills, total volume spilled, and percent volume spilled of total volume disposed are shown in Table 5-20 for each year from 1982 on.

The brine spills involving quantities in excess of 0.16 m^3 (1 bbl), both contained and uncontained, during 1993 are described in Table 5-21. Corrosion/erosion has been the leading causal factor for brine spills over the past few years. Other types of failures (gasket/flange/other equipment) have contributed somewhat. The second major factor is operator error.

Table 5-20. Number of Brine Spills

Year	Total Spills	Volume Spilled m^3 (barrels)		Percent Spilled of Total Disposed
1982	43	443.8	(2,792)	0.0005
1983	44	259.4	(1,632)	0.0002
1984	17	314.0	(1,975)	0.0003
1985	16	96,494.8	(607,000)	0.1308
1986	7	275.6	(1,734)	0.0017
1987	22	96.5	(608)	0.0003
1988	12	93.8	(586)	0.0001
1989	17	31,231.6	(825,512)	0.1395
1990	12	11,944.3	(74,650)	0.0170
1991	7	1,156.8	(7,230)	0.004
1992	9	48.0	(302)	0.003
1993	6	59.2	(370)	0.001

However, during 1993 only one of the six spills is attributable to operator/contractor error. The remaining spills were the result of failures of pipes or valves and two incidents involving overflows from excessive rainfall. Four of the six spills accounted for less than 52 barrels of the brine released in 1993. A brine line failure at the Bryan Mound facility and a ruptured fire line leak occurring at the West Hackberry site constituted the remainder of the spilled volume. As provided in Table 5-20, over the period 1982 to 1993, CY '93 experienced the least number of spill incidents and the second lowest overall volume, which was attributed to attention to detail and quick site response.

Table 5-21. 1993 Brine Spills

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
1/27/93	WH	2.28 m^3 (14.3 bbls)	An estimated 600 gallons of brine was released to ground water through Recovery Well P5-S. The discharge hose for the well was placed below the level of the brine pond thereby allowing a siphon to begin. The situation, noted during routine tests, was remedied and the well pumped until ambient conditions were reached 1 week later.

Table 5-21 (Continued). 1993 Brine Spills

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
2/03/93	BM	32.0 m^3 (200 bbls)	An estimated 200 bbls of brine was released to a freshwater pond adjacent to the brine line ROW behind CVN 114. Approximately 1250 sq. yd. was impacted. The area was flushed and vacuumed recovering an estimated 140 bbls. Additional flows to the Gulf may have leaked at this location during the month of January 1993; however, an integrity test of Jan. 7, 1993 indicated integrity at that time.
4/08/93	WH	2.08 m^3 (13 bbls)	An estimated 13 bbls of salty stormwater was released from the south insolubles pond. The release resulted from excessive rainfall combined with pump failure/ stoppage. The release was an overflow to a ditch leading offsite. The release had a salinity of 8.0 ppt; an O&G of 1.1 mg/l; and a TOC of 5.5 mg/l. A siphon was initiated to the brine pond and the release was stopped.
6/21/93	WH	3.2 m^3 (20 bbls)	An estimated 20 bbls of salty water overflowed south insolubles pond #2 as a result of excessive short term rainfall. 3 working pumps and a siphon started into the brine pond could not maintain sufficient freeboard. The overflow occurred along the east side of the pond and ceased when the rainfall diminished and pumping lowered the water level in the pond.
7/15/93	WH	19.0 m^3	An estimated 119 bbls of saltwater (sal. 12-14 ppt) was lost from a (119 bbls) rupture in an underground fire line. This portion of the line was isolated and repairs scheduled. Heavy rainfall diluted the release and freestanding water was vacuumed and placed into the brine pond.
11/22/93	BM	0.6 m^3	An estimated 4 bbls of brine leaked from a 1/4 inch diameter rupture in (4 bbls)the onshore portion of the brineline. The leak was discovered within 18 minutes of commencing the flow. Appropriate notifications were made, impacts assessed, and the line has been repaired and returned to service. The low volume did not require written follow-up reporting to the RCT.

5.5 SARA TITLE III REPORTING REQUIREMENTS

To fulfill requirements set forth in the Emergency Planning and Community Right-To-Know Act of 1986, the SPR submitted SARA Title III Tier Two forms for 1993, for each site. Tables 5-22 through 5-28 list chemical name, maximum daily value (lbs) for regulatory specified ranges, and location of hazardous chemicals on the SPR above Threshold Planning Quantity (TPQ) or 10,000 lbs. for sites in Texas.

There were no extremely hazardous substances in excess of the TPQ in 1993 negating the possibility of reportable releases. The SPR Sulphur Mines site, sold in May 1993, was not reported under SARA because there were no hazardous chemicals above the TPQ on site. Offsite SPR pipelines containing crude oil were reported separately from SPR sites (Table 5-28 and 5-29).

Table 5-22.

LOUISIANA SARA TITLE III TIER TWO SUMMARY AT BAYOU CHOCTAW

Chemical Name/Category	*Max Daily Amount (lbs)	Location
AFFF, (butylcarbitol)	10,000 - 99,999	Foam deluge bldg & storage bldg
Ammonium bisulfite	10,000 - 99,999	Adj to brine pond
Bromotrifluoromethane (Halon 1301)	1,000 - 9,999	Control room in ops bldg
Crude oil, petroleum flammable and combustible liq	1 billion > 1 billion	Six underground storage caverns in salt dome & site piping
Diesel fuel	1,000 - 9,999	Fuel station, flood pump & generators near exit, water pumps near NW entrance
Gasoline	10,000 - 99,999	Fuel station near SW exit, emergency generator at disposal wells
Oil, flammable and combustible	1,000 - 9,999	Flammable stg bldg and maintenance bldg
Paint, flammable or combustible	1,000 - 9,999	Flammable storage bldg maintenance bldg
Sodium hydroxide	100 - 999	Ops. laydown yd

*Reporting range specified by LA SARA Title III Tier Two Reporting Requirement

Table 5-23.
TEXAS SARA TITLE III TIER TWO SUMMARY AT BIG HILL

Chemical Name/Category	*Max Daily Amount (lbs)	Location
Ammonium bisulfite	10,000 - 99,999	Near brine pond
Crude oil, petroleum, flammable and combustible liq	1 billion > 1 billion	Fourteen underground storage caverns in the dome, surge tank, and site piping
Diesel fuel	10,000 - 99,999	Fuel station & RWIS
Gasoline	10,000 - 99,999	Fuel station
Oil, flammable and combustible	10,000 - 99,999	Warehouse, lab & RWIS

*Reporting range specified by Texas SARA Title III Tier Two Reporting Requirement

Table 5-24
TEXAS SARA TITLE III TIER TWO SUMMARY AT BRYAN MOUND

Chemical Name/Category	*Max Daily Amount (lbs)	Location
AFFF (butylcarbitol)	100,000 - 999,999	Fire systems around site, foam bldg, laydown & excess yd
Crude oil, petroleum, flammable and combustible liq	1 billion > 1 billion	Twenty underground storage caverns, 4 surge tanks & site piping
Diesel fuel	10,000 - 99,999	Fuel station & RWIS
Gasoline	10,000 - 99,999	Fuel station
Oil, flammable and combustible	10,000 - 99,999	Laydown yd, flammable storage bldg, & warehouse
Paints, flammable or combustible	10,000 - 99,999	Flammable storage bldg

*Reporting range specified by Texas SARA Title III Tier Two Reporting Requirement

Table 5-25.
LOUISIANA SARA TITLE III TIER TWO SUMMARY AT ST. JAMES TERMINAL

Chemical Name/Category	*Max Daily Amount (lbs)	Location
AFFF (butylcarbitol)	10,000 - 99,999	Fire truck bay, fire systems on main site & dock
Bromotrifluoromethane (Halon 1301)	100 - 999	Control room in ops
Compound, tree/weed killing liq, poison B	1,000 - 9,999	Laydown area
Compressed gas (except helium, neon, argon, krypton, xenon)	100 - 999	Lab, meter station, inside & outside of ops bldg
Crude oil, petroleum flammable and combustible liq	100,000,000 - 499,999,999	Six storage tanks & site piping
Diesel fuel	10,000 - 99,999	Fuel station in laydown area, dock fire pumps, site emergency gen, & fire pump near fuel station
Gasoline	10,000 - 99,999	Fuel station in maint bldg area
Hazardous waste, liq or solid N.O.S.	1,000 - 9,999	Laydown yd & satellite areas
Oil, flammable and combustible	1,000 - 9,999	Flammable storage bldg, lab, & flammable storage cabinet on side of ops bldg
Paint, flammable or combustible	1,000 - 9,999	Flammable storage bldg & paint shed near laydown area
Potassium bicarbonate	1,000 - 9,999	Fire truck bay in maint bldg
Propane or liquefied petroleum gas supplied as pressurized	1,000 - 9,999	Lab, fire pumps, flammable shed near laydown area
Thinner, flammable and combustible	1,000 - 9,999	Flammable storage bldg
Visco 1152, biocide	1,000 - 9,999	West end of main site

*Reporting range specified by LA SARA Title III Tier Two Reporting Requirement

Table 5-26.
LOUISIANA SARA TITLE III TIER TWO SUMMARY AT WEEKS ISLAND

Chemical Name/Category	*Max Daily Amount (lbs)	Location
AFFF (butylcarbitol)	10,000 - 99,999	Fire equipment at maint & foam storage bldg
Bromotrifluoromethane (Halon 1301)	10,000 - 99,999	Control room in ops bldg & mine service shaft
Cement	1,000 - 9,999	Flammable storage bldg
Compressed gas (except helium, neon, argon, krypton, xenon)	1,000 - 9,999	Lab, meter station, inside & outside of ops bldg
Crude oil, petroleum, flammable and combustible liquid	1 billion > 1 billion	One underground storage cavern in salt dome & site piping
Diesel fuel	10,000 - 99,999	Fuel station in laydown area, fire storage area, production shaft area, & main site near emergency generator
Gasoline	10,000 - 99,999	Fuel station in laydown area
Hazardous waste, liquid or solid, N.O.S.	1,000 - 9,999	Laydown yd & satellite areas
Insecticide, liquid, N.O.S.	1,000 - 9,999	Laydown yd & storage bldg
Methylethylketone	100 - 999	Laydown area
Mineral spirits	100 - 999	Flammable stg bldg
Oil, flammable and combustible	1,000 - 9,999	Laydown yd, flammable storage bldg, & main maintenance bldg
Paint, flammable or combustible	1,000 - 9,999	Laydown yd paint shed & flammable storage bldg
Phosphoric acid	100 - 999	Laydown yd drum rack&shed
Potassium bicarbonate	1,000 - 9,999	Fire truck area
Propane or liq petroleum gas	10,000 - 99,999	Fill site rd, main site

*Reporting range specified by LA SARA Title III Tier Two Reporting Requirement

Table 5-26. (Continued).
LOUISIANA SARA TITLE III TIER TWO SUMMARY AT WEEKS ISLAND

Chemical Name/Category	*Max Daily Amount (lbs)	Location
Silica, crystalline quartz	100 - 999	Construction site
Thinner, flammable and combustible	1,000 - 9,999	Flammable storage bldg

*Reporting range specified by LA SARA Title III Tier Two Reporting Requirement

Table 5-27.
LOUISIANA SARA TITLE III TIER TWO SUMMARY AT WEST HACKBERRY

Chemical Name/Category	*Max Daily Amount (lbs)	Location
AFFF (butylcarbitol)	50,000,000 - 99,999,999	Foam storage bldg & site fire systems
Ammonium bisulfite, solution	1,000 - 9,999	West of brine pond
Antifreeze compound, liquid	1,000 - 9,999	Property yd
Bromotrifluoromethane (Halon 1301)	1,000 - 9,999	Control room & lab
Compound, tree or weed killing liq.	1,000 - 9,999	Pipeline bldg
Crude oil, petroleum, flammable and combustible liq	1 billion > 1 billion	Twenty two underground storage caverns in salt dome & site piping
Diesel fuel	1,000 - 9,999	Site fuel station & workover rig yd
Gasoline	10,000 - 99,999	Site fuel station & pipeline bldg
Oil, flammable and combustible	1,000 - 9,999	Warehouse, property yd & flammable storage bldg
Paint, flammable or combustible	1,000 - 9,999	Flammable storage & warehouse bldg
Propane or liquefied petroleum gas supplied as pressurized	10,000 - 99,999	Maint bldg, motor control at Lake Charles meter station, & fire training area
Thinner, flammable & combustible	1,000 - 9,999	Flammable storage bldg

*Reporting range specified by LA SARA Title III Tier Two Reporting Requirement

Table 5-28.
LOUISIANA SARA TITLE III TIER TWO SUMMARY IN OFFSITE PIPELINES

Chemical Name/Category	Max Daily Amount (lbs)	Location
Crude oil, petroleum, flammable and combustible liq	1,000,000 - 9,999,999	Offsite pipeline in Ascension Parish, LA
Crude oil, petroleum, flammable and combustible liq	50,000,000 - 99,999,999	Offsite pipeline in Assumption Parish, LA
Crude oil, petroleum, flammable and combustible liq	1,000,000 - 9,999,999	Offsite pipelines in Calcasieu Parish, LA
Crude oil, petroleum, flammable and combustible liquid	10,000,000 - 49,999,999	Offsite pipelines in Cameron Parish, LA
Crude oil, petroleum flammable and combustible liquid	1,000,000 - 9,999,999	Offsite piping in Iberia Parish, LA
Crude oil, petroleum flammable and combustible liq	100,000,000 - 499,999,999	Offsite pipeline in Iberville Parish, LA
Crude oil, petroleum, flammable and combustible liq	10,000,000 - 49,999,999	Offsite pipeline in St. Martin Parish, LA
Crude oil, petroleum, flammable and combustible liq	10,000,000 - 49,999,999	Offsite pipeline in St. Mary Parish, LA
Crude oil, petroleum flammable and combustible liq	10,000,000 - 49,999,999	Offsite pipelines in St. James Parish, LA

*Reporting range specified by LA SARA Title III Tier Two Reporting Requirement

Table 5-29.
TEXAS SARA TITLE III TIER TWO SUMMARY IN OFFITE PIPELINES

Chemical Name/Category	*Max Daily Amount (lbs)	Location
Crude oil, petroleum, flammable and combustible liq	50,000,000 - 99,999,999	Offsite pipelines in Brazoria County, TX
Crude oil, petroleum, flammable and combustible liq	10,000,000 - 49,999,999	Offsite pipeline in Galveston County, TX
Crude oil, petroleum, flammable and combustible liq	10,000,000 - 49,999,999	Offsite pipeline in Jefferson County, TX (Big Hill)
Crude oil, petroleum, flammable and combustible liq	1,000,000 - 9,999,999	Offsite pipeline in Jefferson County, TX (West Hackberry)
Crude oil, petroleum, flammable and combustible liq	10,000,000 - 49,999,999	Offsite pipeline in Orange County, TX

*Reporting range specified by Texas SARA Title III Tier Two Reporting Requirement

adj - adjacent
AFFF - Aqueous Film Forming Foam
avg - average
bldg - building
lbs - pounds
maint - maintenance
max - maximum
NE - northeast
NW - northwest
ops - operations
SW - southwest
lab - laboratory
RWIS - raw water intake structure
yd - yard

6. HYDROLOGY AND GROUND WATER MONITORING

Ground water monitoring is performed at Bayou Choctaw, Big Hill, Bryan Mound, and West Hackberry. Salinity and the presence of hydrocarbons are monitored although ground water monitoring is not required by any Federal or state regulations or permits at Bayou Choctaw, Big Hill, and Bryan Mound. Monitoring is required at West Hackberry in accordance with a monitoring plan agreed upon by DOE and the LDNR. West Hackberry ground water monitoring and recovery activities were reported quarterly to the LDNR in 1993.

In 1991, studies directed toward characterizing ground water contamination at West Hackberry and Bryan Mound were completed. In the *Contamination Assessment Report and Corrective Action Plan* for Bryan Mound, no recovery action was advised for brine contamination due to soil characteristics. In the West Hackberry *Contamination Assessment Report and Remedial Alternatives Analysis*, additional recovery wells and brine pond repair or replacement were advised.

In a two-phase study, all sites except decommissioned Sulphur Mines were surveyed (Phase I) in December 1992 for possible brine and hydrocarbon ground water contamination. The results of this study were presented in the *Final Report on Baseline Hydrogeological Screening Surveys Strategic Petroleum Reserve Sites Louisiana and Texas*. The report was reviewed in 1993 for implementation of Phase II activities, verification of contamination. Phase II will begin in 1994.

Ground water data collected for the past five years are presented where available. Ground water characteristics of each site are discussed within each site section.

6.1 BAYOU CHOCTAW

The Plaquemine Aquifer is the main source of fresh water for the site and several surrounding municipalities. It is located approximately 18 m (60 ft) below the surface and extends to a depth of 150 to 182 m (500-600 ft). The upper 18 m (60 ft) of sediments in the aquifer consist of predominantly Atchafalaya clay. The interface of freshwater and saline water occurs at a depth of 122 to 150 m (400-500 ft) below the surface. Ground water in the Plaquemine Aquifer communicates with the Mississippi River, flowing away from it during the high river stage and towards the river in the low stage.

Three monitoring wells (MW1, MW2, and MW3) were installed at the Bayou Choctaw facility in 1989, and a fourth (MW4) in 1990 (Figure 6-1). These wells were drilled roughly 30 feet below land surface (bls) to monitor the brine pond and not the deeper Plaquemine Aquifer.

Ground water salinities observed at all four wells (Figure 6-2) are above ambient for a fresh water environment and are presumably elevated by past and possibly present brine handling activities.

All four wells exhibit seasonal salinity fluctuations that are affected by rainfall. Highest salinities have usually occurred in late winter and early spring, and lowest salinities have been observed in late spring and early fall.

In addition to rainfall, surface brine spills may have also affected ground water salinities observed in these shallow wells. The salinity range observed at well MW3 is much greater than that of the other three wells. Ground water surface piezometric data of the wells show that ground water movement is to the southeast. A 1992 brine spill on the nearby low pressure pump pad north of the well may have elevated the salinity in that area. Its movement was captured by MW3.

Long-term salinity trends have been established which, examined within the context of the southeastern ground water movement, assist in identifying possible areas or sources of contamination. Wells MW1 and MW2 exhibit a slight increase in salinity. Both wells are situated upgradient of the brine pond area, with respect to ground water movement. The source of contamination may be residual from a historical activity that occurred northwest of the pond. The 1992 study suggested a large area of brine contaminated ground water and a smaller area of highly mineralized ground water exist north west of these wells as indicated by elevated conductivity measurements. However, this could be a result of soil conductivity. Although it captures the most saline ground water, MW3 is slowly decreasing in salinity over time. The brine pond appears to be a prime source of contamination for MW3; however, waning brine contamination from a spill in this area in 1992 or decreased use of the brine pond could result in decreasing salinity. Despite frequent fluctuations, there is no salinity trend observed at well MW4. This well is situated away from and down gradient of the brine pond and higher salinity well MW3. Future ground water samples will be evaluated for increasing salinity.

Future ground water data, including that of the all-sites survey, and on-going inspections of the brine pond and site piping will assist in determining if contamination does exist from SPR activities.

In 1993, four water wells were plugged and abandoned at Bayou Choctaw in accordance with Louisiana Department of Transportation and Development (LDOTD) requirements. These wells include one 12-inch non-SPR industrial water well west of the brine pond, one 4-inch rig well at brine disposal well pad 3, and two 4-inch rig wells at brine disposal well pad 2.

BAYOU CHOCTAW

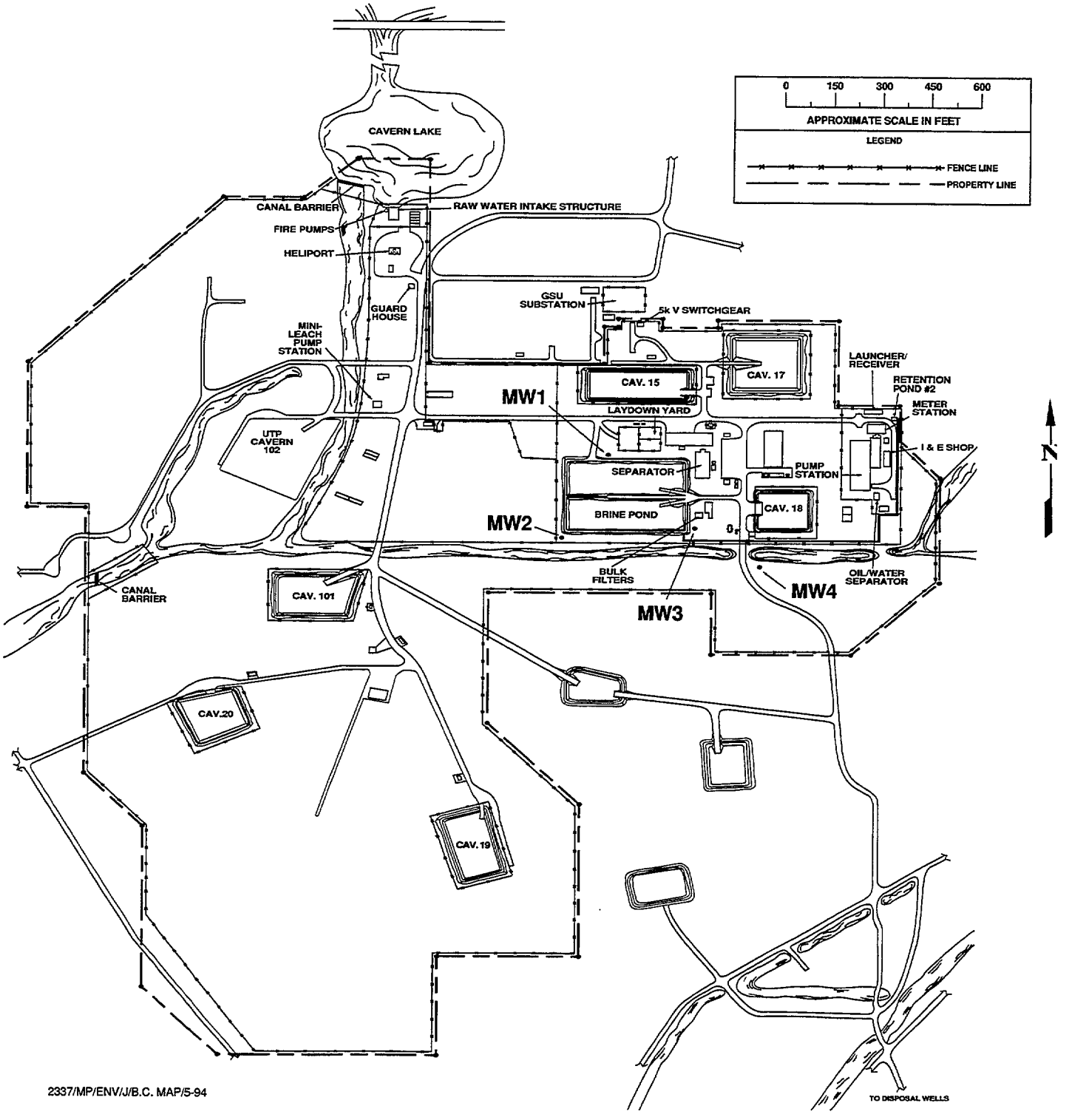


Figure 6-1. Bayou Choctaw Ground Water Monitoring Wells

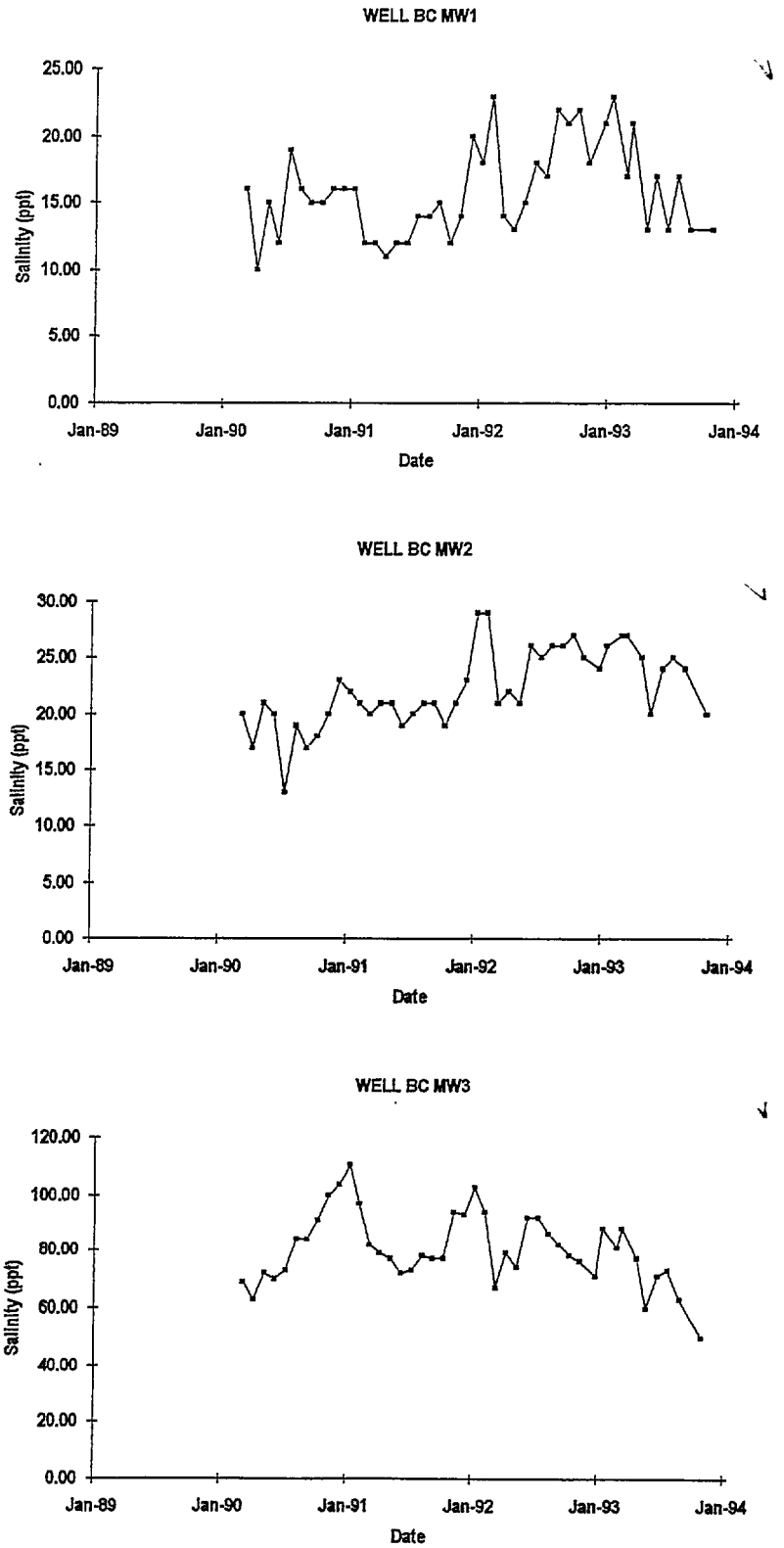


Figure 6-2. Bayou Choctaw Groundwater Monitoring Well Salinities

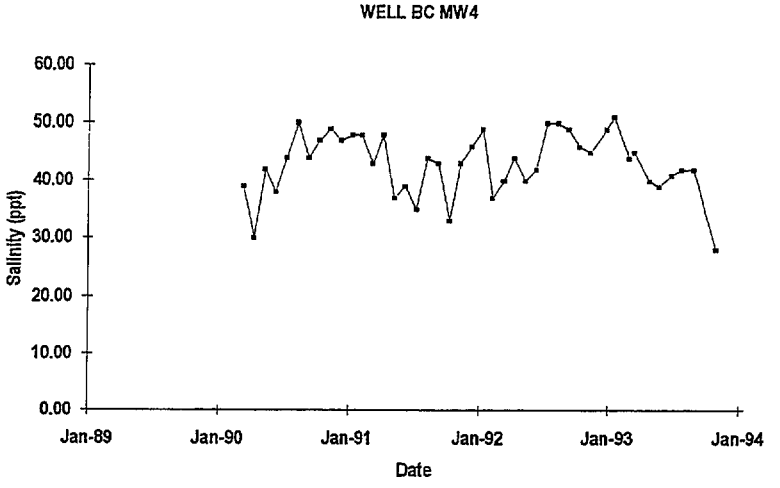


Figure 6-2. Bayou Choctaw Groundwater Monitoring Well Salinities

6.2 BIG HILL

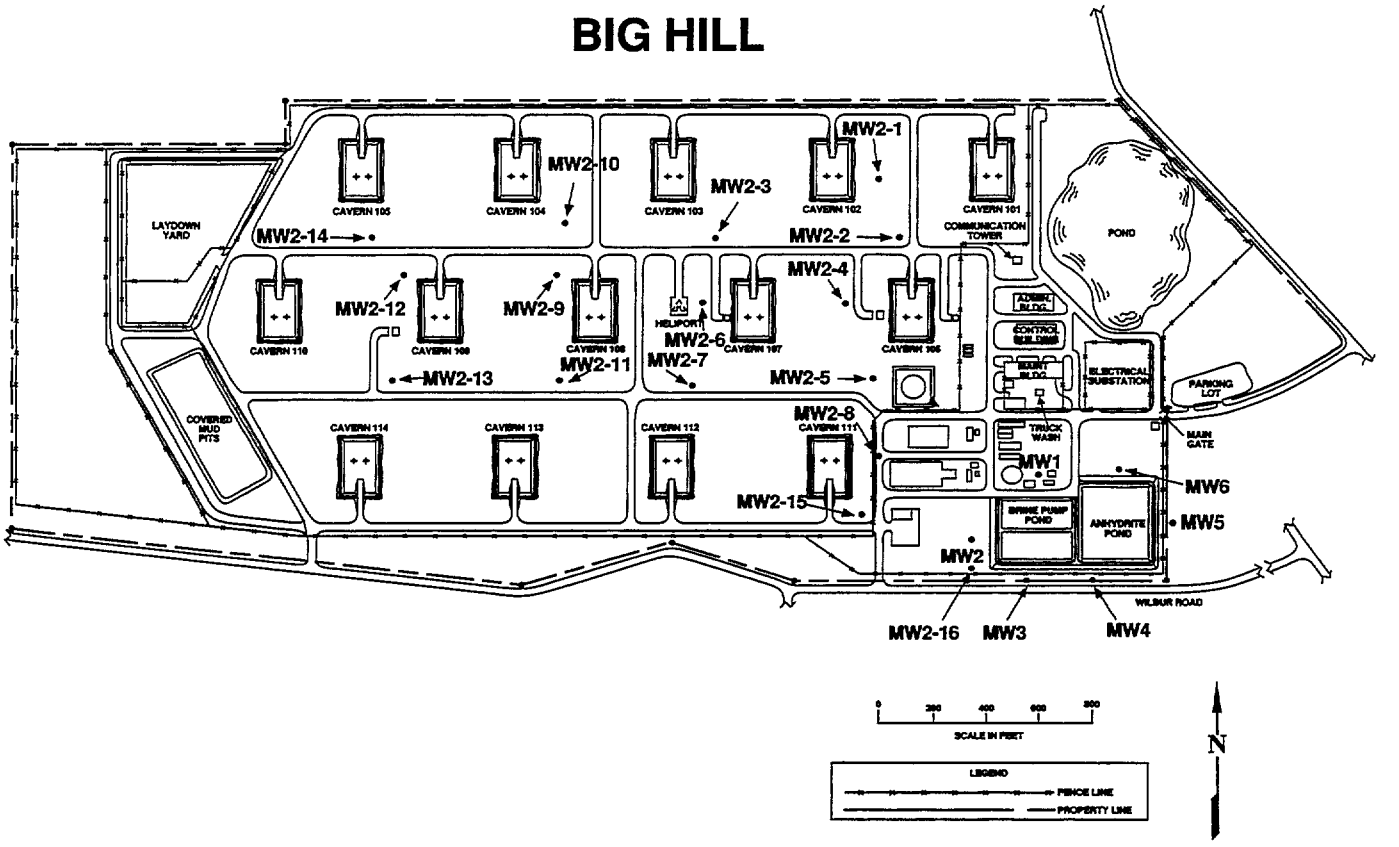
The three major subsurface hydrological formations in the Big Hill area are the Chicot and Evangeline aquifers and the Burkville aquitard. The major source of fresh water is the Chicot Aquifer which is compressed over the Big Hill salt dome. Fresh water in the upper Chicot Aquifer is limited from near the surface to a depth of -30 m (-98 ft) mean sea level.

The town of Winnie uses fresh water from the upper Chicot Aquifer. Beaumont and Port Arthur draw fresh water from the lower Chicot Aquifer.

Sampling of six monitoring wells (wells MW1 to MW6) around the brine disposal pond system (Figure 6-3) began in 1987. The system is composed of a three Hypalon-lined ponds, of which two are concrete lined with an underdrain contained within a slurry wall. Salinity data collected from the six wells for the past five years indicate a consistency among them. Salinity of ground water from all wells remained at or below the detection limit (1.0 ppt) of the salinity meter used (Figure 6-4). All observed values that are below detection limit were evaluated as one-half the BDL for statistical calculations. Observed salinity changes are too low to indicate contamination.

Monthly sampling of 16 2-inch brine piping leak detection monitoring wells (wells MW2-1 to MW2-16) began in 1991. Unlike those around the brine pond, these smaller wells were installed adjacent to buried brine piping on site to detect brine should it be released from the piping. (Figure 6-3). The wells are roughly 15 feet deep and do not intercept an aquifer. As a result, one has remained dry and the remainder have yielded very little water. Salinities at 15 of the wells ranged from 0 to 3.5 ppt in 1993, with most monthly readings remaining below 1.5 ppt. Only ground water from well MW2-15, east of Cavern 111, yielded salinities of 3.5 to 14.0 ppt. Elevated salinities in the clay are attributed to a past piping failure

adjacent to that location. Observed salinities at this location decreased from a 1992 maximum of 25.5 ppt.



3348/FG/ENV/J/B.H. MAP/5-94

Figure 6-3. Big Hill Ground Water Monitoring Wells

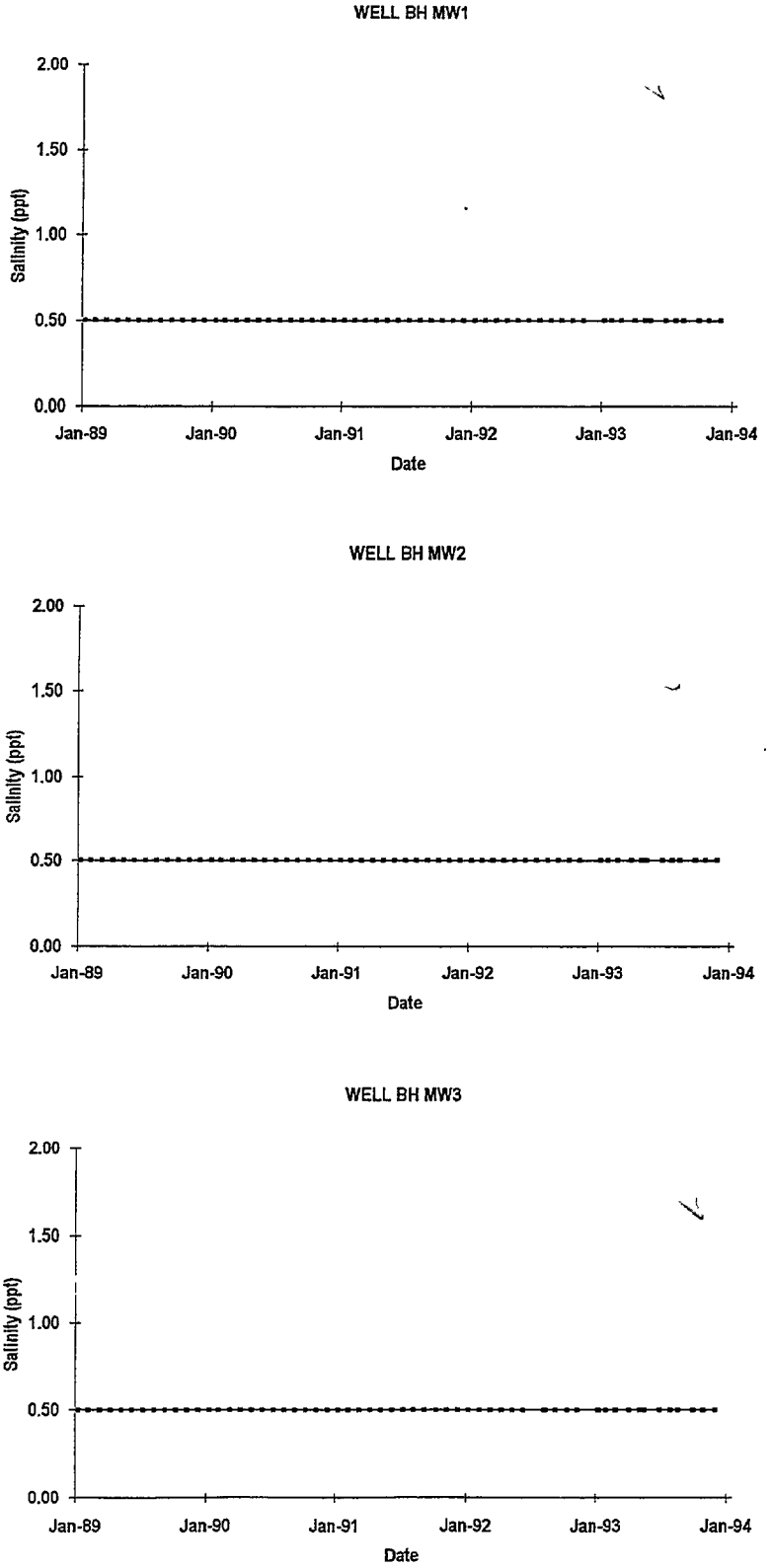
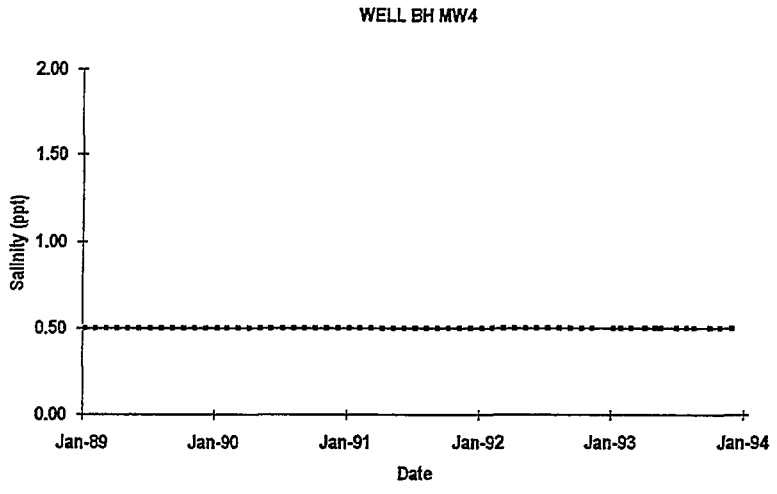
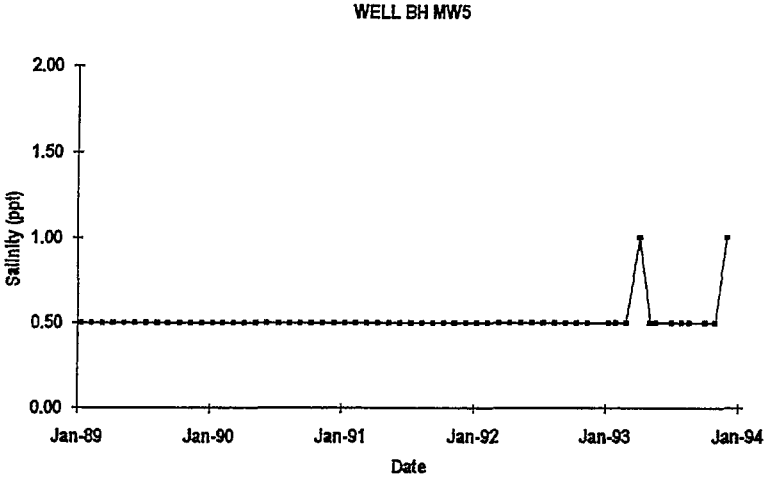


Figure 6-4. Big Hill Ground Water Monitoring Well Salinities





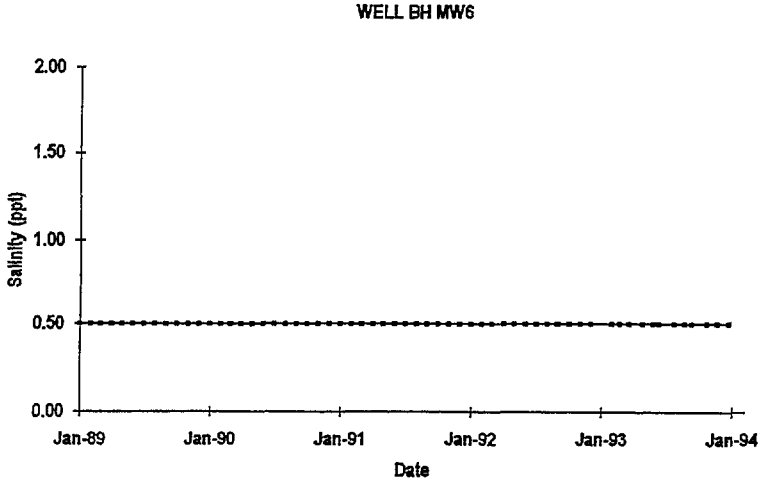


Figure 6-4. (continued) Big Hill Groundwater Monitoring Well Salinities

6.3 BRYAN MOUND

The site monitoring wells installed in 20 and 50 foot bls zones have disclosed that no fresh water exists over the salt dome. Monitoring well salinities ranged from 4.1 to 134.0 ppt in 1993. However, the Chicot and Evangeline Aquifers are fresh to slightly saline in the Bryan Mound area and fresh water for Brazoria County is obtained from the upper portions of the Chicot.

Fifteen monitoring wells were drilled at Bryan Mound in four phases between 1981 and 1990 (Figure 6-5). Sampling began shortly after installation. Wells BP1D, BP2S, and PZ2S are out of service due to casing damage.

A 1991 study determined that site ground water movement in the shallow zone was in the northerly direction toward Blue Lake while that of the deep zone was in the southeasterly direction toward Mud Lake. The aquifers exhibit a very low average linear velocity ranging from 2.5 to 3.3 ft/yr due to the clay content of the water bearing strata and very low hydraulic gradients. This characteristic reduces the risk of contaminating potable aquifers of the salt dome.

Three areas exhibiting high ground water salinity attributable to SPR operations have been located. The first area stretches from the present (and a past) brine pond eastward to the brine pump pads and to the site of a small demolished brine pond. The second area lies southeast of the security operations center (SOC), and the third lies south of the maintenance building.

High salinities observed at shallow monitor wells PZ1S, MW1S, and BP1S since their installation may be attributed to brine pond activity. A large brine pond with a 36 mil flexible Hypalon (chlorosulfonated polyethylene) membrane was constructed in 1978. The liner leaked, and the pond was renovated with new Hypalon and concrete in 1982. High ground

water salinity in the pond area and to the north and east could be the result of previous or continued leakage from the pond or from adjacent buried piping. Salinities of deep complements to wells PZ1S and BP1S (PZ1D and BP1D) are much lower and considered ambient for the site. They indicate no contamination of the deep zone around the present pond and no communication with the shallow zone.

Salinity of deep zone well MW1D (complement to shallow zone well MW1S) is greater than that of any shallow well and much greater than any other deep well. This well may be in a brine plume that extends northward from the site of the small brine pond demolished in 1989. The high salinity of the deep well may also indicate upgradient communication of the two zones in that area.

An anhydrite disposal area used during construction and leaching phases of the site may be the source of contamination intercepted by wells MW5S and PZ3S near the SOC. A contamination source in the area near the maintenance building is not identified and probably pre-dates the SPR activity.

Brine contamination is not evident at the northwest corner of the site. Shallow zone monitor wells MW3S and MW4S near the southwest corner and west of the brine pond, respectively, and deep zone monitor wells PZ1D, BP1D, and MW4D north and west of the brine pond exhibit lower salinities than wells to the east and south.

Wide salinity fluctuations observed in Figure 6-6 graphs are due to changing sampling methodology. Observed salinity was directly related to the degree of well purging prior to sampling. Consistent purging methodology was instituted in September 1993.

Elevated ground water salinities observed in both zones in the brine pond and pump pad area remain constant overall, despite

fluctuations encountered. High salinities observed in the shallow zone near the SOC and in both zones near the maintenance building appear to be increasing slightly. Low salinities observed in uncontaminated deep and shallow zones at the northwest corner of the site remain constant.

Future sampling of piezometric elevations and additional ground water chemical analyses may provide trending and greater understanding of ground water movement and SPR influence on water quality.

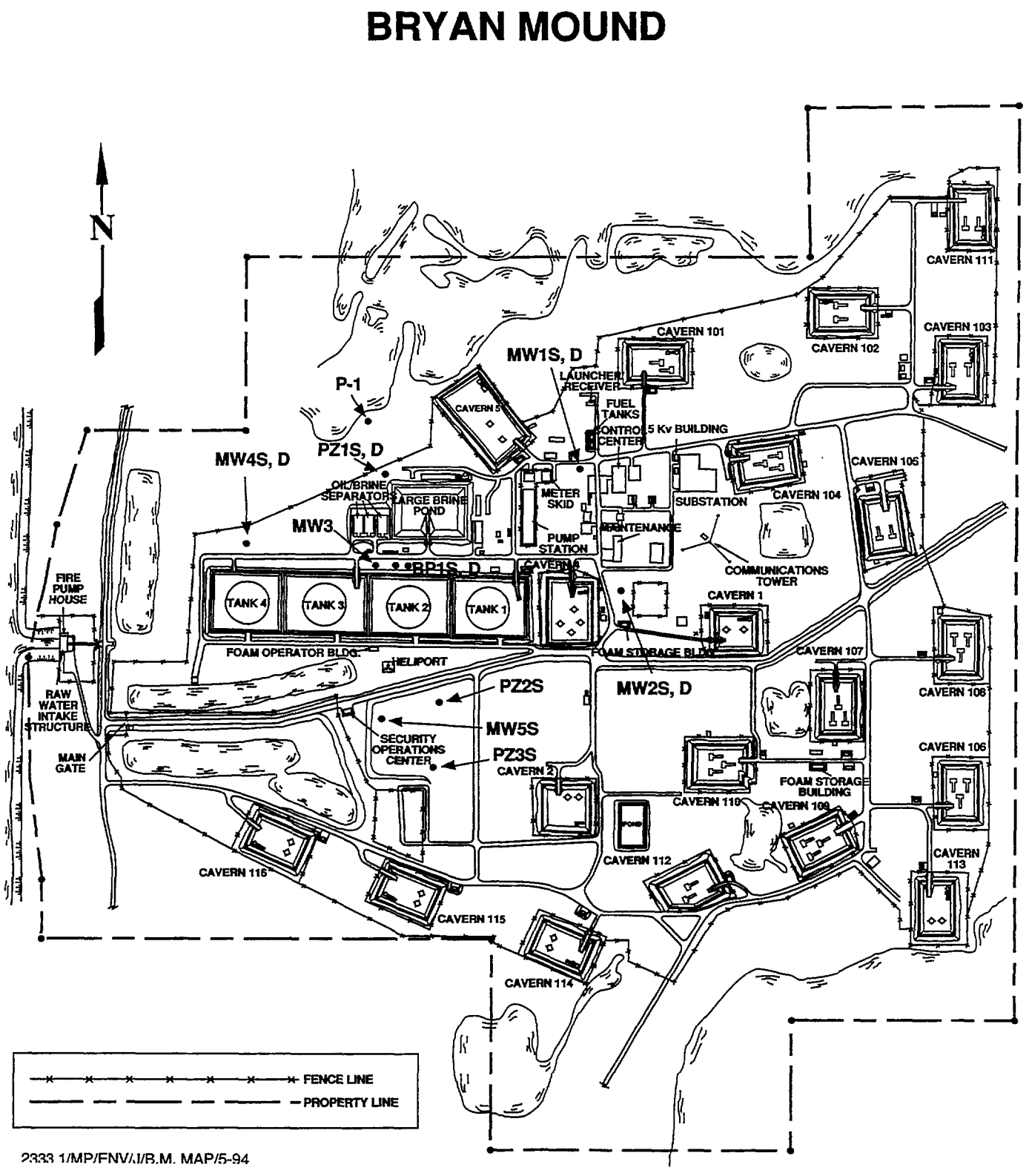


Figure 6-5. Bryan Mound Ground Water Monitoring Wells

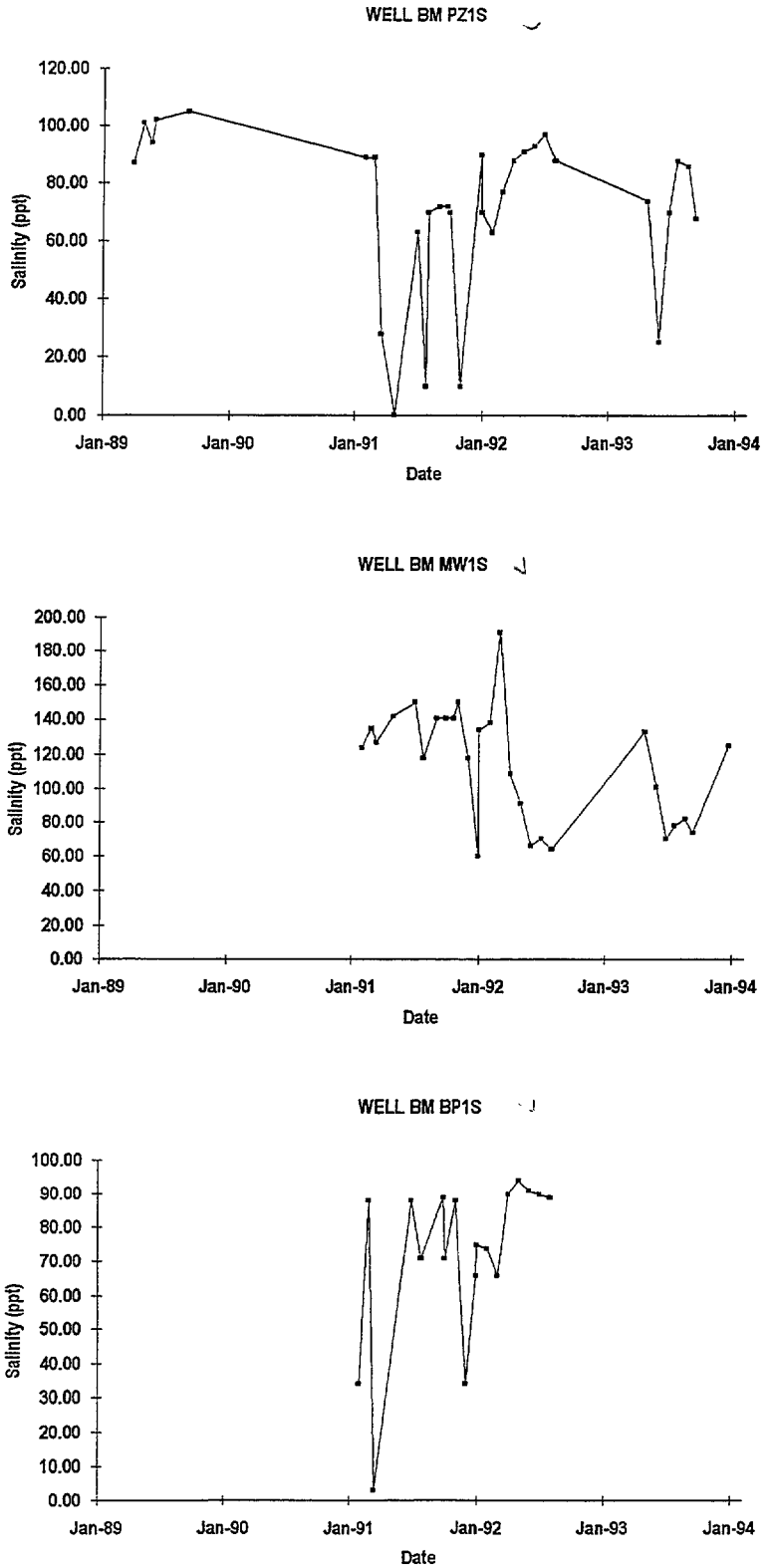


Figure 6-6. Bryan Mound Groundwater Monitoring Well Salinities

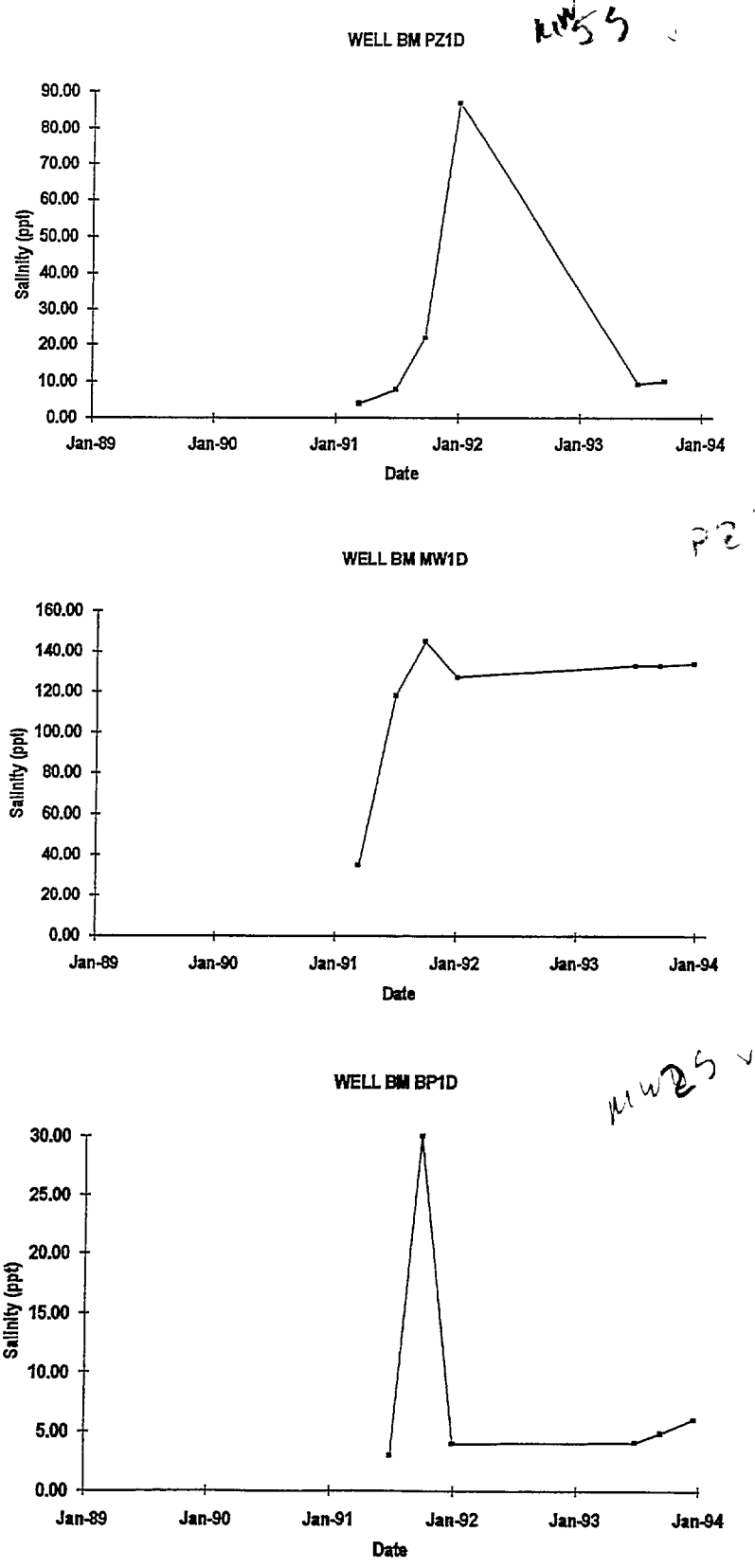


Figure 6-6 (continued). Bryan Mound Groundwater Monitoring Well Salinities

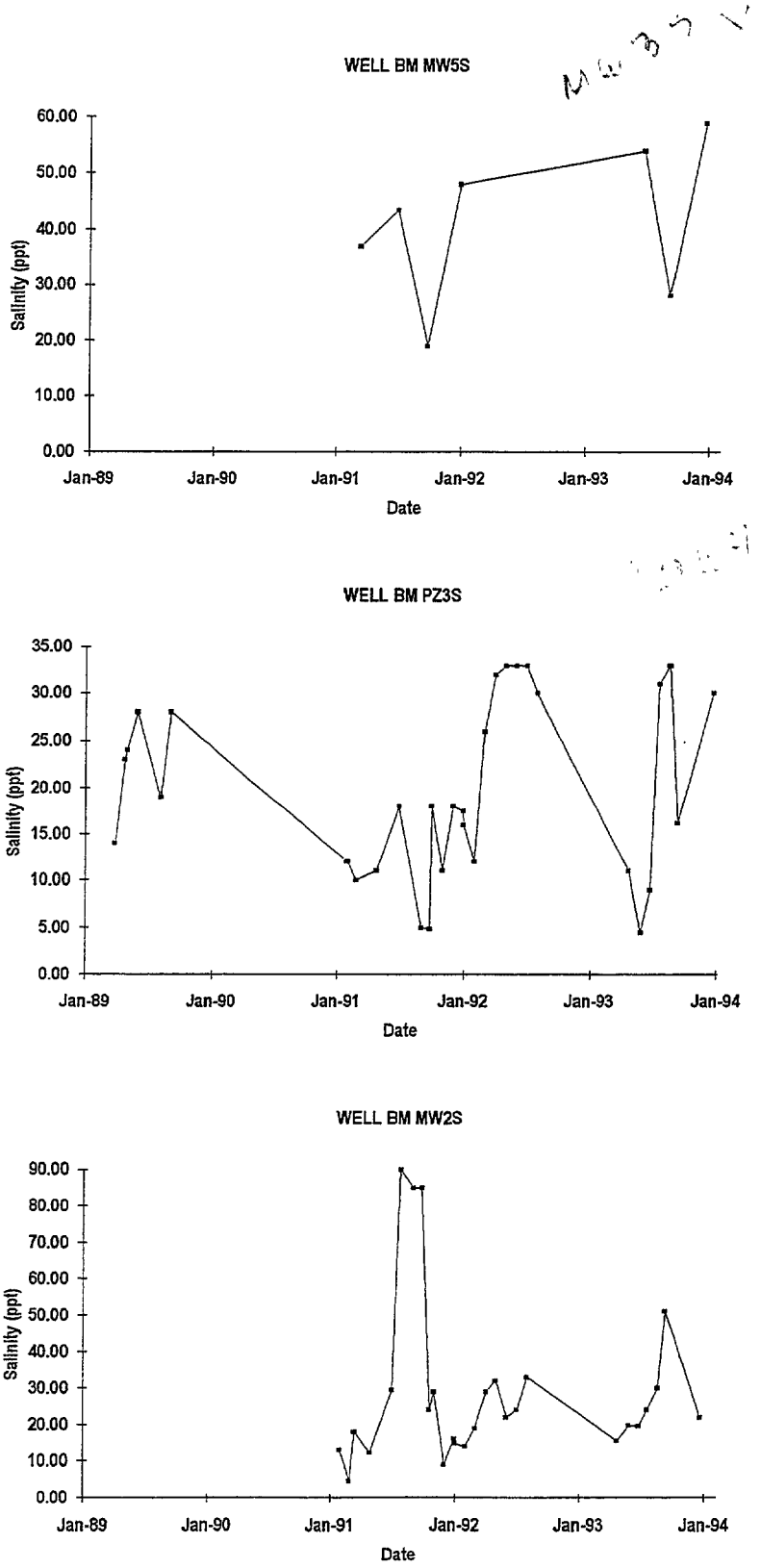
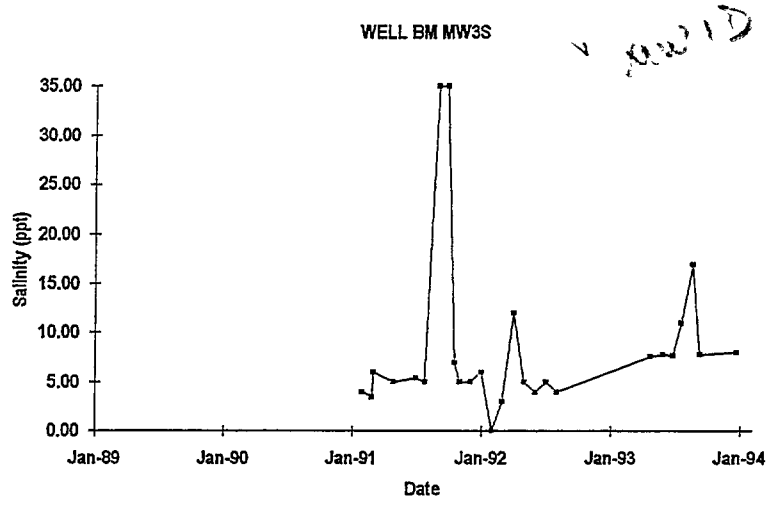


Figure 6-6 (continued). Bryan Mound Groundwater Monitoring Well Salinities



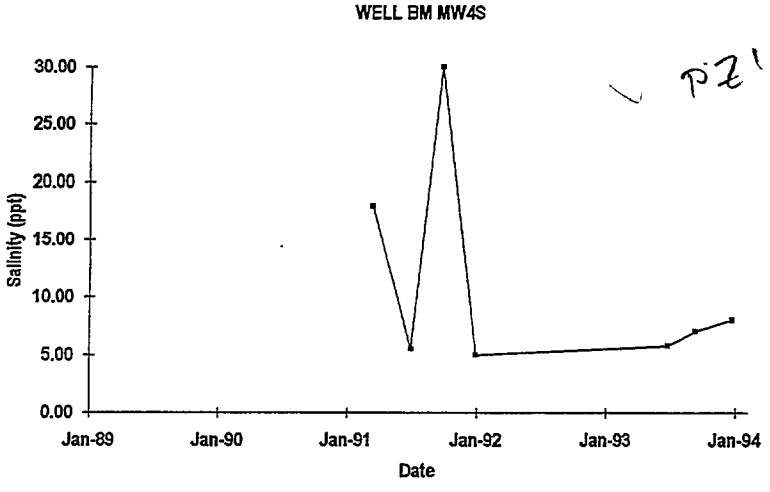


Figure 6-6 (continued). Bryan Mound Groundwater Monitoring Well Salinities

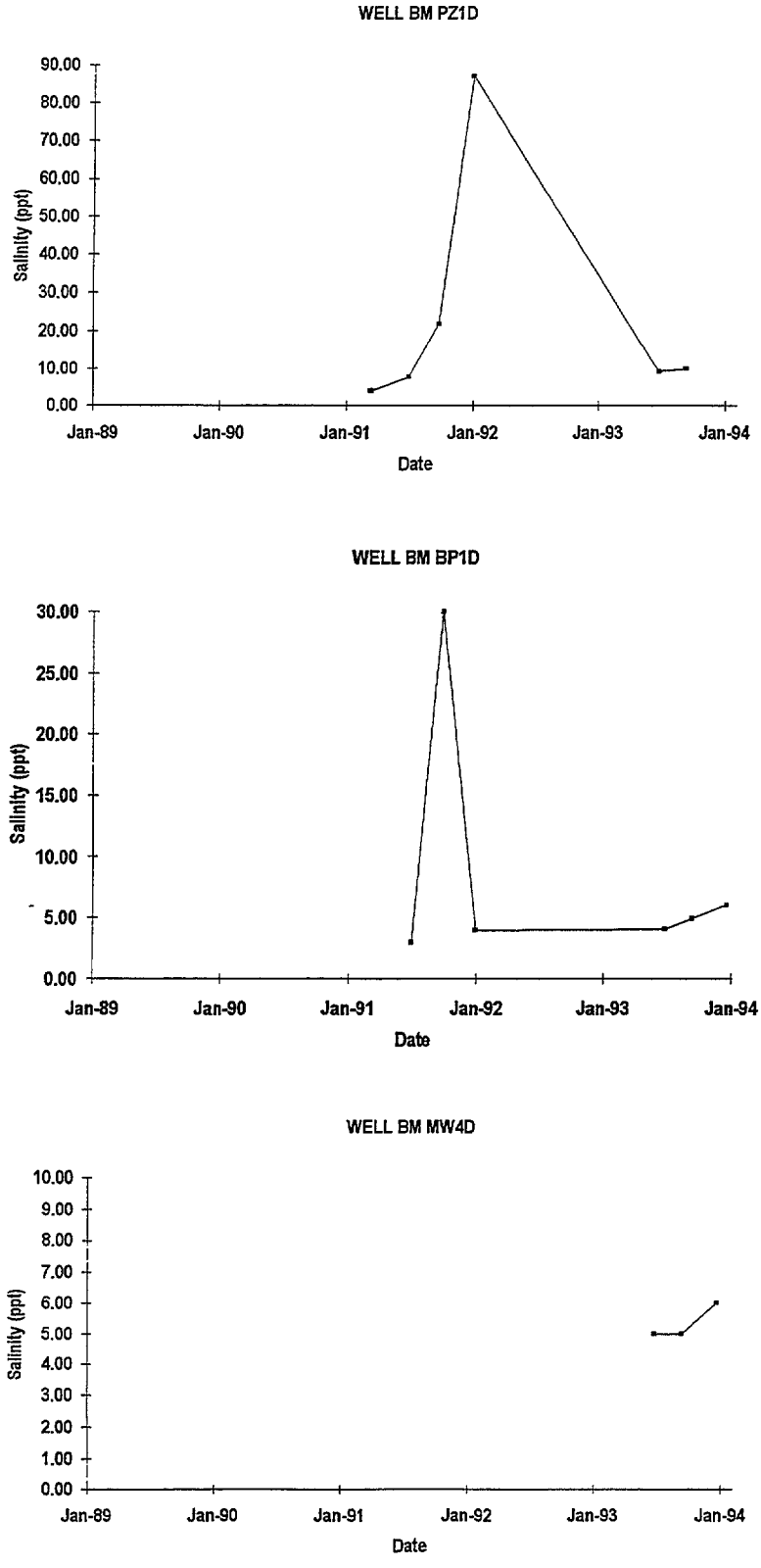


Figure 6-6 (continued). Bryan Mound Groundwater Monitoring Well Salinities

6.4 ST. JAMES

The Chicot Aquifer is the principal regional aquifer at St. James. The upper strata of the Chicot Aquifer is in direct hydrologic contact with the Mississippi River. Most of the ground water contained in this aquifer is slightly brackish. In the St. James area only the uppermost units contain fresh water.

No ground water monitoring wells have been installed at the St. James site due to the absence of brine and chronic crude oil spillage. There is no evidence of leakage; however, data from the ground water contamination survey will be examined, and any areas of potential contamination will be verified in 1994.

6.5 SULPHUR MINES

The main aquifers in the vicinity of Sulphur Mines are the Chicot, Evangeline, and Jasper. The Chicot Aquifer provides a fresh water source for public and industrial use to the towns of Hackberry, Lake Charles, and Sulphur. The Evangeline and Jasper aquifers are saline. The Evangeline Aquifer is used for salt water disposal in the Lake Charles area. No ground water monitoring wells were installed for brine or hydrocarbon contamination on the Sulphur Mines site, and due to its sale in May 1993, no ground water brine and hydrocarbon contamination survey was performed.

6.6 WEEKS ISLAND

The Chicot formation is the principal aquifer in the Weeks Island area. The aquifer surface is approximately at sea level near Weeks Island and slopes slightly northwest towards a cone of depression attributed to heavy withdrawals in the Lake Charles area. The fresh water sand layers provide water for the local area.

There are no ground water monitoring wells at Weeks Island. There has been no evidence that site activities have compromised ground water integrity; however, attention has been

focused on a sink hole on Morton property that may potentially affect crude oil storage.

The sink hole is located east of the mine's crude oil fill hole and has grown in the past year. Its volume and depth have been monitored closely from the surface, and seismic tests have been performed to characterize soil below the hole at the dome interface. With assistance from Sandia Laboratories, a study is underway to determine if there is communication between the mine and the sink hole.

Phase I results of the 1992 ground water brine and hydrocarbon contamination survey of the entire site by ECT have been scrutinized, and areas identified as potentially contaminated will be examined in 1994.

with the exception of deep zone wells P1D and P4D on west and east sides of the brine pond, respectively, where salinities exceeded that of all other wells.

A brine plume extends east-northeastward through the shallow zone from the southwest corner of the brine pond, and its saline ground water is captured by six recovery wells. Wells P1S and P5S intercept the plume on the west side of the pond, wells RW1S and RW2S on the south side, and P3S and P4S on the east side. Wide salinity fluctuations of data depicted were caused by salinity stratification in the wells and oscillating cones of depression. Prior to mid-1993, submersible recovery well pumps ran intermittently and could not develop stable cones of depression and resultant stable salinities. One high salinity peak in January 1993 in Well P5S was caused by a brief siphoning of brine from the pond into the well. When pumping was resumed, the rapid decrease in salinity indicated that the loss into the well had limited effect.

A decreasing salinity trend was observed for wells P1S, P5S, and RW1S along the western side of the pond. A slight increasing salinity trend was observed for wells RW2S, P3S, and P4S along the eastern half of the pond. With ground water movement to the east, it is expected that wells on the west side of the pond will capture more fresh, uncontaminated ground water from the west as the source of brine contamination decreases. This response may be delayed to the east.

No deep zone plume has been identified despite high salinities at recovery wells P1D and P4D. Brine sources captured by these two wells may be different from each other. Salinities of deep zone recovery wells RW1D and RW2D near high salinity P1D and well P3D on the east side of the pond were near ambient conditions (generally less than 3 ppt). Wells RW3D, RW4D, and RW5D are situated closer to high salinity deep well P4D, and their salinities increased during 1993 or remained above ambient (roughly 2.1 to 19.7 ppt annual average). It appears

6.7 WEST HACKBERRY

The Chicot Aquifer, which flows closest to the surface in the Hackberry area, contains predominantly fresh water with salinity increasing with proximity to the Gulf of Mexico. The majority of the ground water pumping from the Chicot Aquifer takes place in the Lake Charles area. The pumping is so great that a cone of depression has been created which has reversed the flow direction to the north. The fresh/saline water interface is approximately 200 m (700 ft) below ground surface. Zones contaminated and monitored at West Hackberry are near the surface, the shallow zone at roughly 20 feet bls and the deep zone at roughly 50 feet bls.

A 1991 study identified the brine pond as a source of ground water contamination. As a result, the brine pond was cleaned, and cracks in the walls and floor were grouted to repair the leak rate.

Eleven monitoring wells and 15 recovery wells (Figure 6-7) were installed on the West Hackberry site in five phases. Well logs and background information on construction and installation are lacking for wells installed in 1982, but are available for wells constructed later. All wells are used to monitor or control brine contamination beneath the brine pond system. Salinity data gathered over the past five years at all wells are depicted in Figure 6-8.

Ground water recovery at the brine pond has improved over the past four years. Although recovery began in 1989, overall brine recovery performance was poor through mid-1993 due to frequent pump failure. In August and September 1993, failure-prone submersible pumps were replaced with reliable surface-activated reciprocating pumps.

Observed recovery well salinities have revealed a complex picture of ground water contamination beneath the brine pond. Salinities were greater in the shallow zone than the deep zone

that the elevated deep zone salinities are confined around wells P1D and P4D.

Shallow monitoring wells P8, P9, and P11 at caverns 8, 9, and 11, respectively, are located away from the vicinity of the brine pond ground water contamination plume and represent ambient ground water conditions. These wells exhibited little change over the past five years. During 1993, only well P8 showed a notable (1.3 ppt average) increase in salinity. The brine source has not been determined. Salinities observed at well P11 are decreasing after exhibiting a temporary increase due to a brackish water leak from an adjacent fire water system two years ago.

Shallow zone monitoring wells P2S, P6S, P12S, and P13S, and deep zone monitoring wells P2D, P6D, P12D, P13D, and MW1D are nearer the brine pond, and, with the exception of wells P12S and P13S, intercept ambient ground water. Well P12S is the only downgradient monitoring point in the shallow zone brine plume extending eastward from the brine pond. Its salinity has decreased slightly since sampling began in 1992. Over the past two years, salinity at well P13S has increased slightly, possibly from residual localized contamination from a nearby brineline leak in 1992.

Cones of depression were created in both zones as a result of successful ground water recovery. The differences in shallow and deep zone potentiometric surfaces and the rapid lowering of the piezometric heads during pumping indicate that the two zones are confined.

Continued ground water recovery, sampling, and testing will disclose trends and may determine sources of contamination.

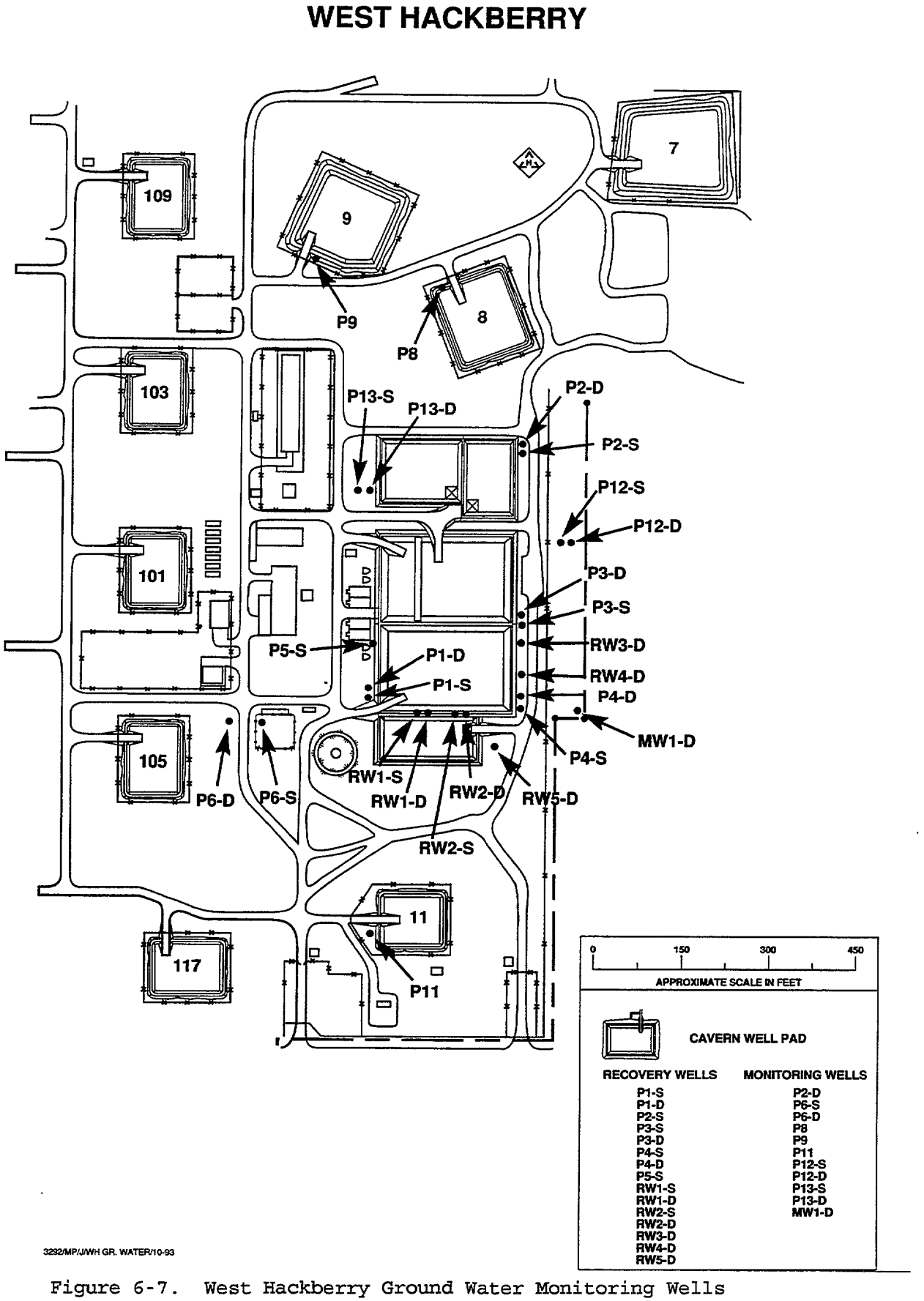


Figure 6-7. West Hackberry Ground Water Monitoring Wells

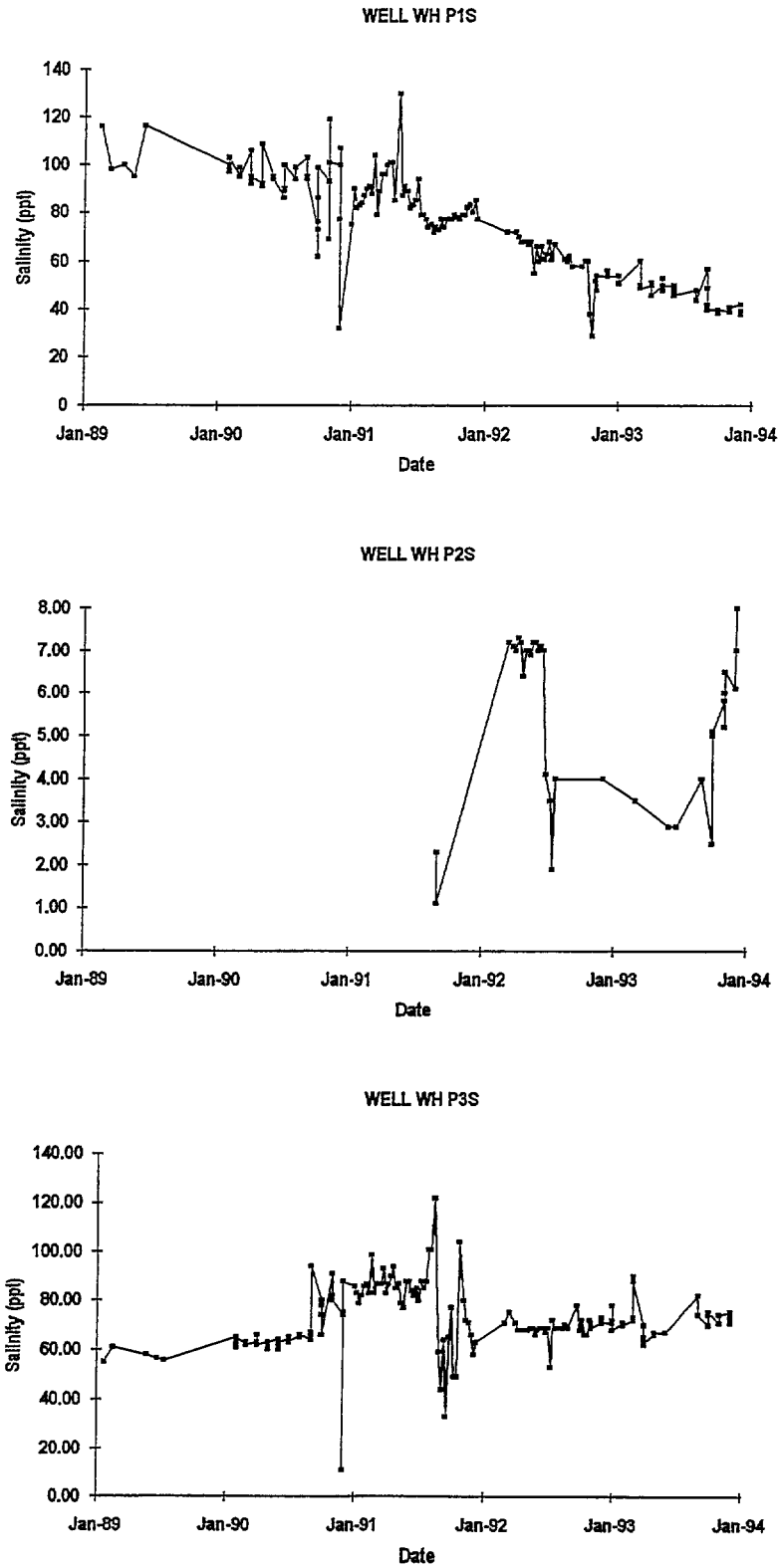
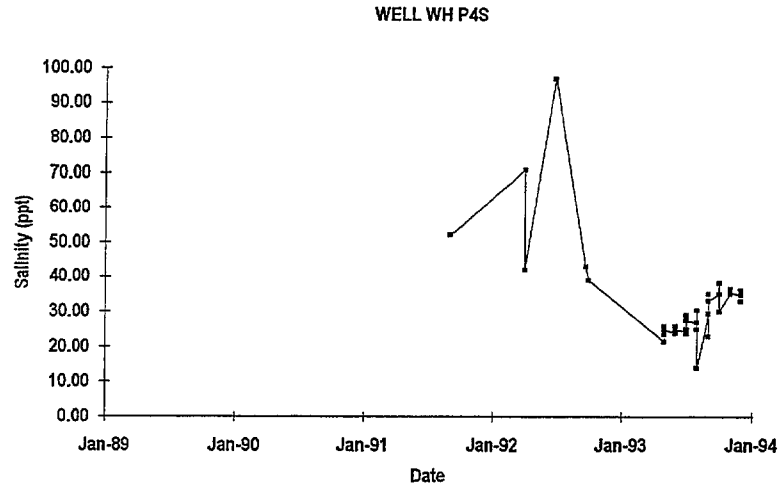
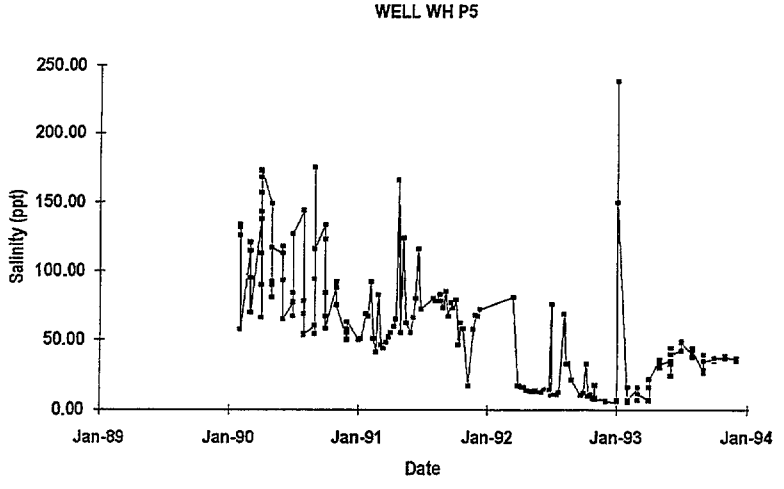


Figure 6-8. West Hackberry Ground Water Monitoring Well Salinities





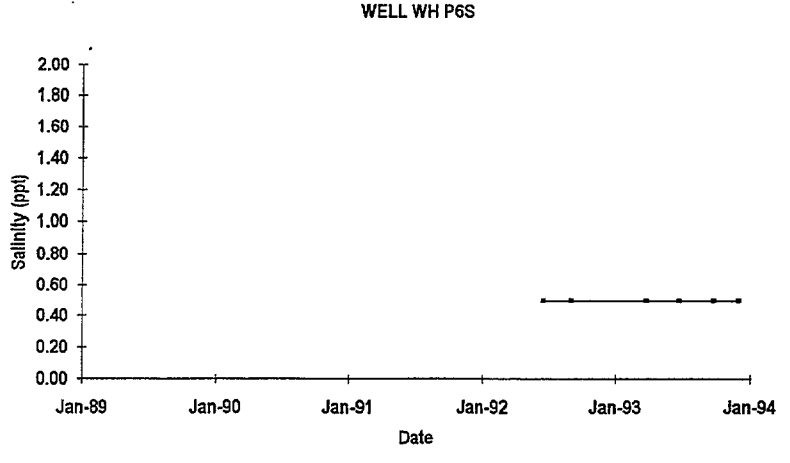
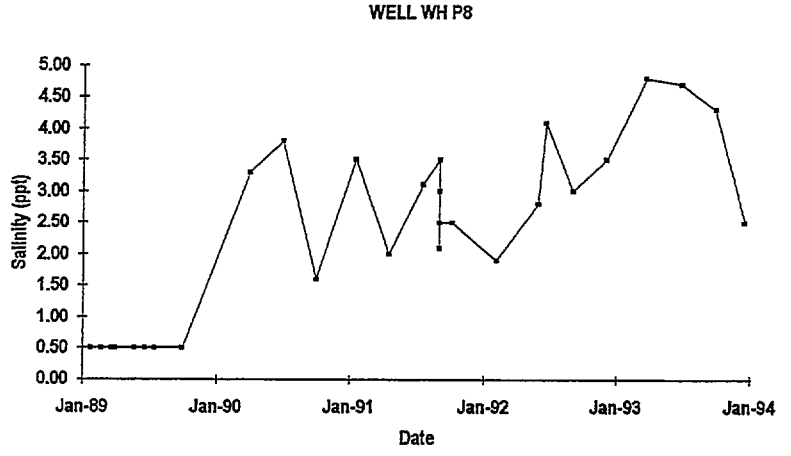
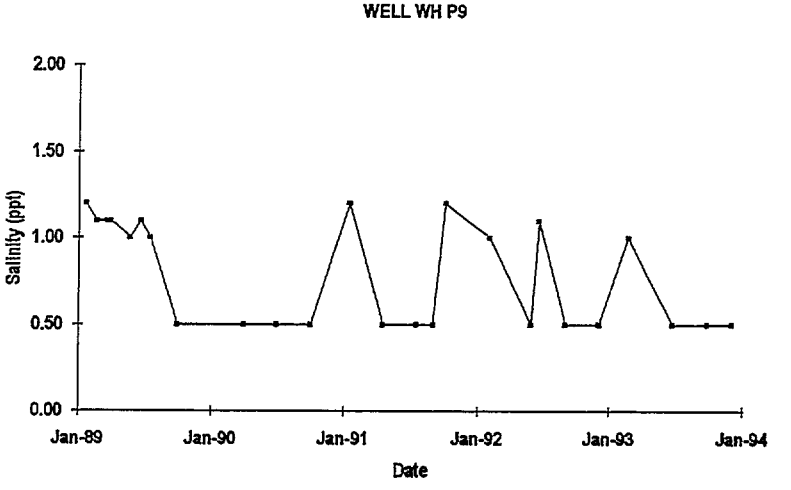
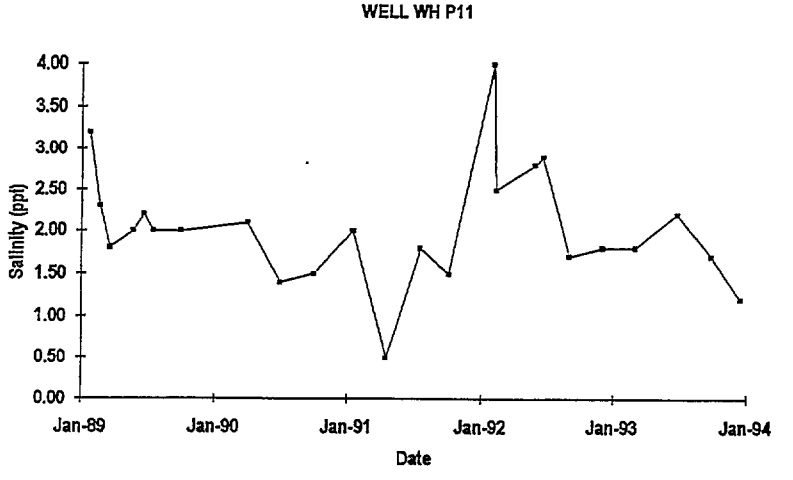


Figure 6-8 (continued). WH Ground Water Well Salinities







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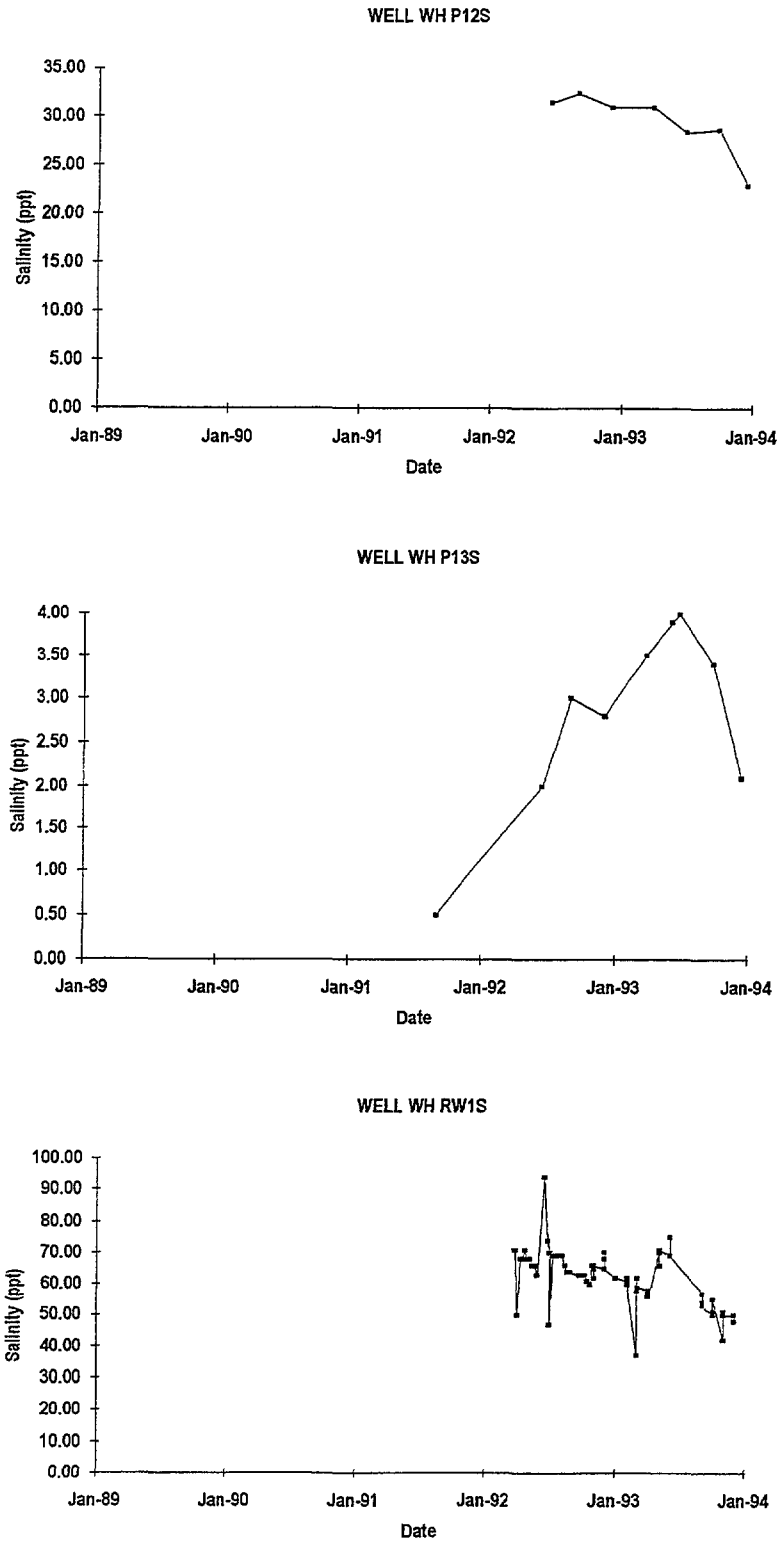
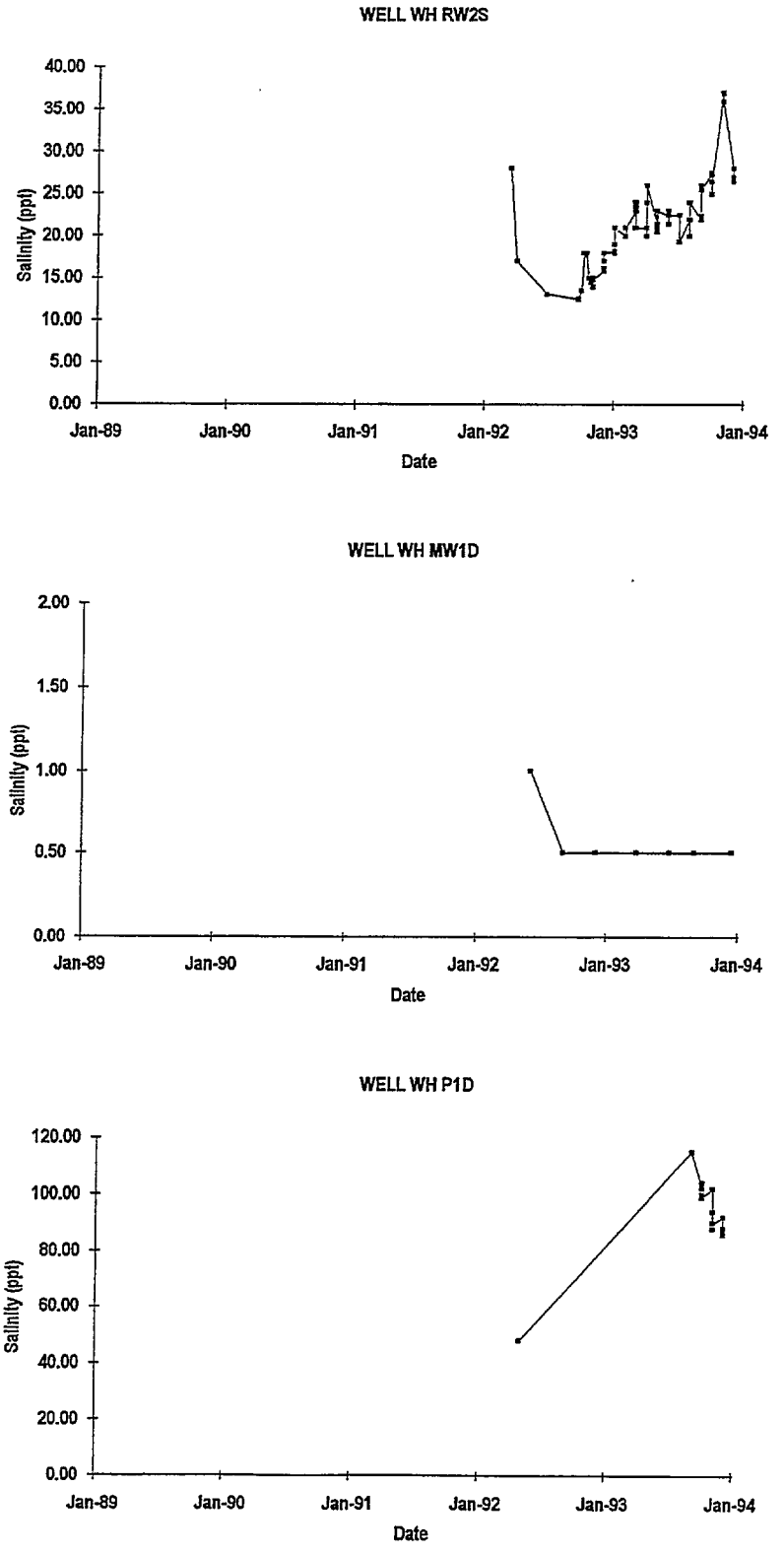


Figure 6-8 (continued). WH Ground Water Monitoring Well Salinities



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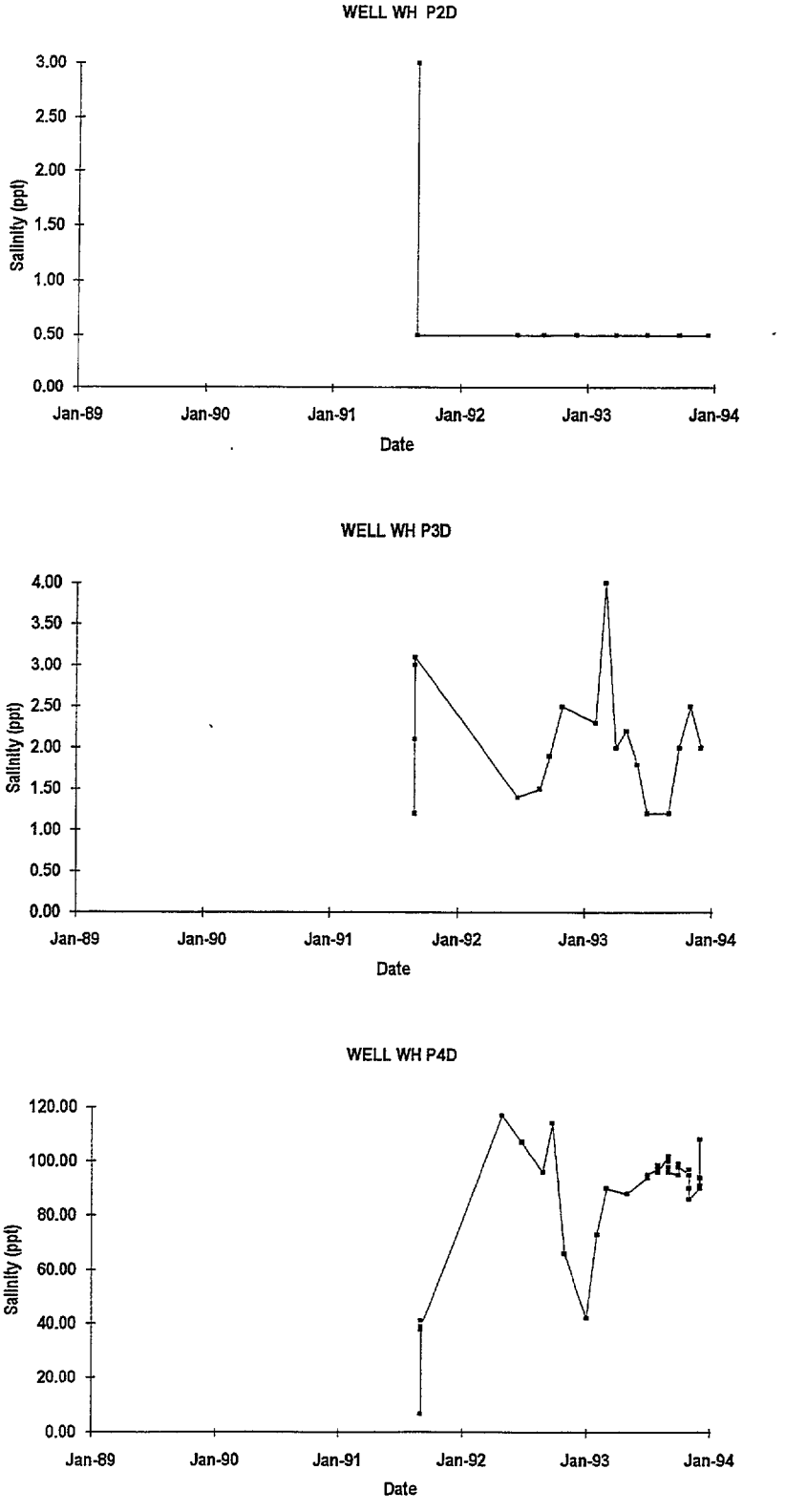

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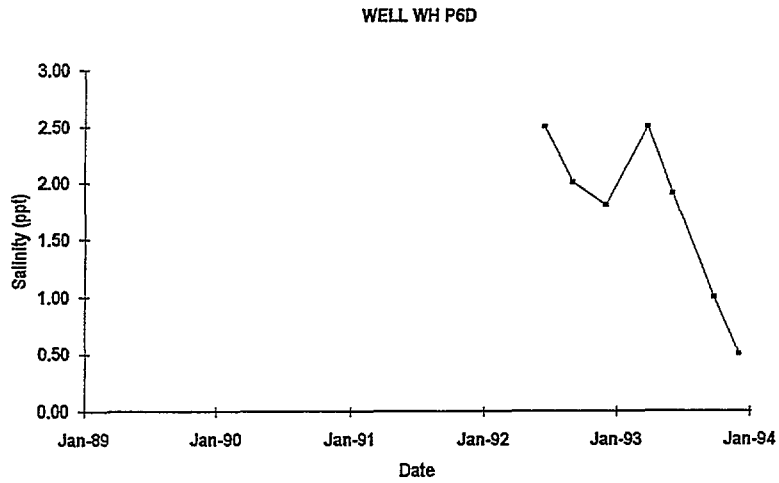

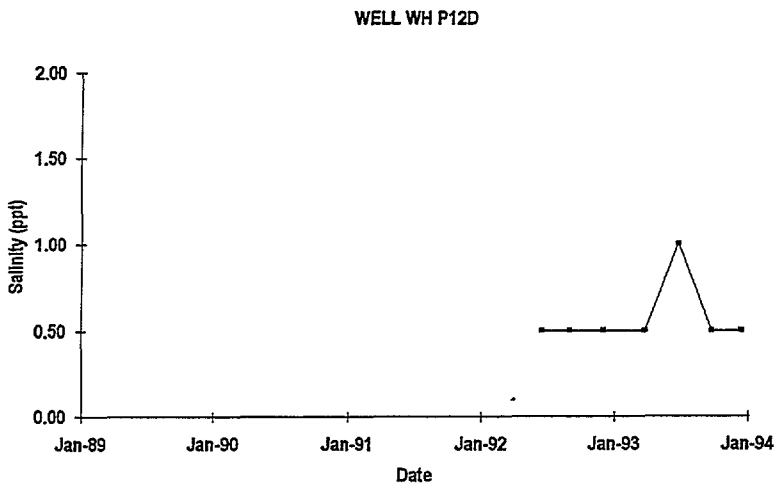

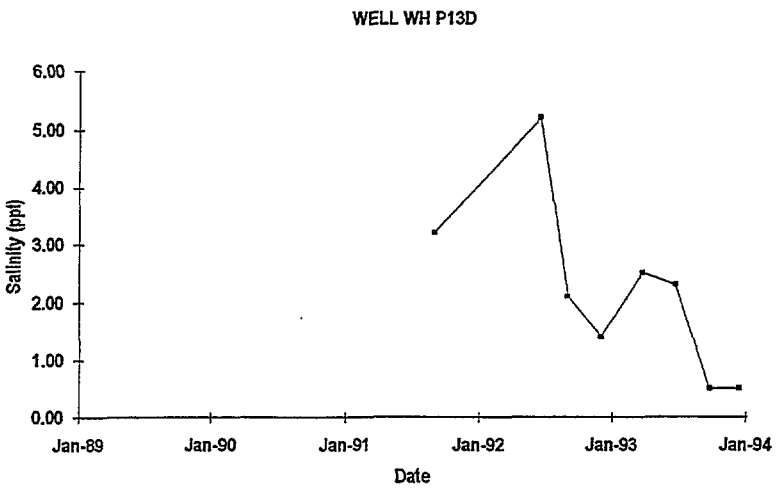

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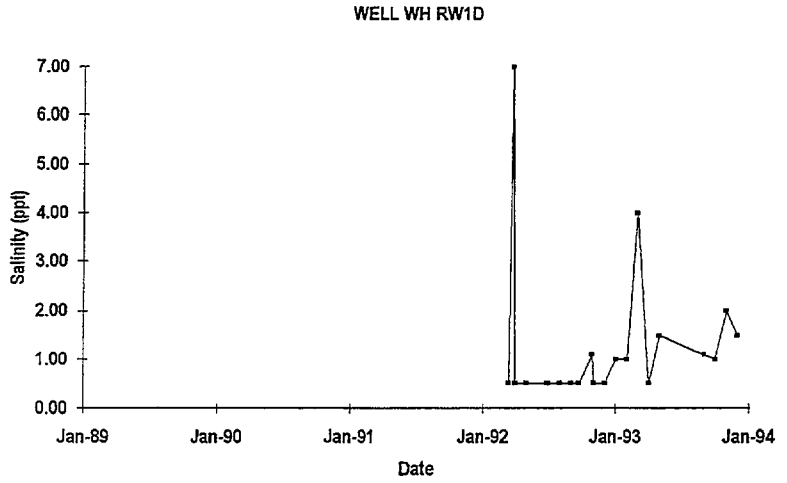

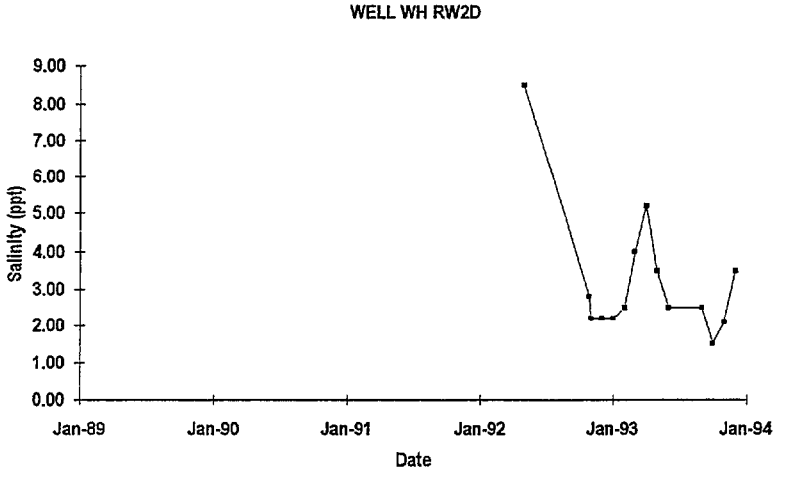

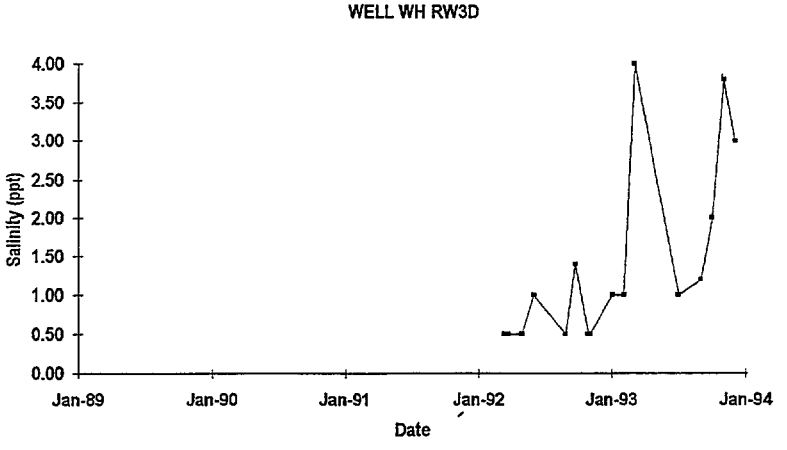

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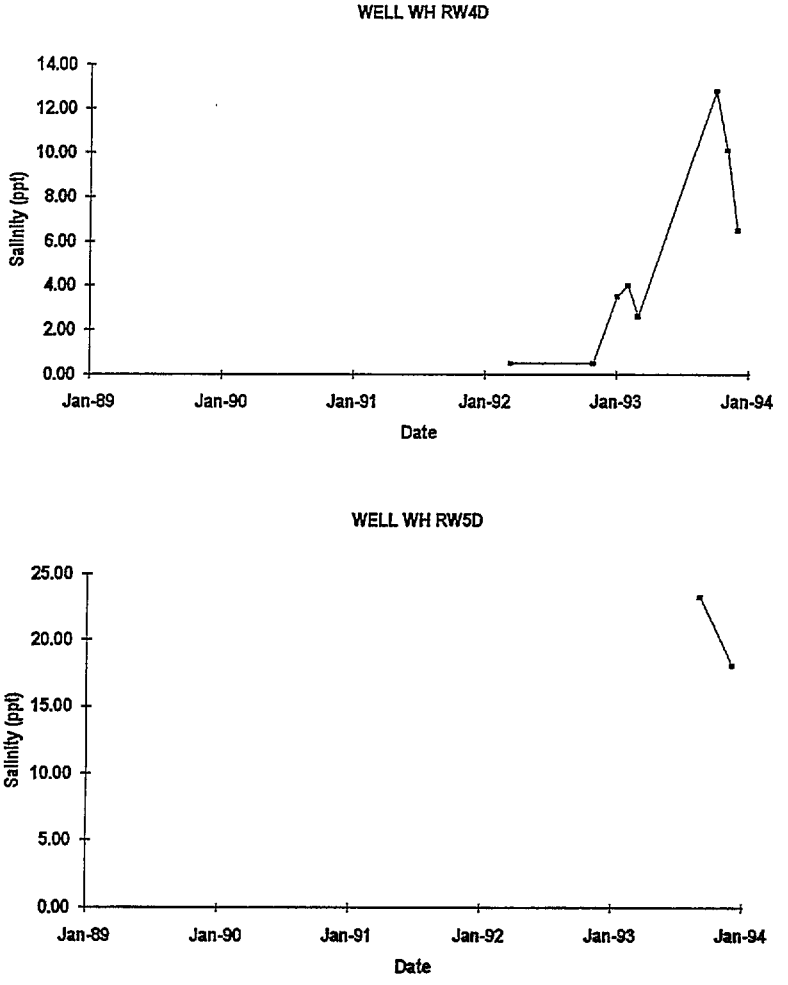

Figure 6-8 (continued). WH Ground Water Monitoring Well Salinities

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7. QUALITY ASSURANCE

The SPR sites undergo periodic evaluation throughout the year in the form of yearly internal audits as well as audits by outside Federal and state agencies. The structured laboratory quality assurance program has continued through the systematic application of acceptable accuracy and precision criteria at SPR laboratories. Compliance with this and other environmental program requirements was reviewed and evaluated at each site by means of the M&O contractor's triennial self-assessments and audits at select sites by state and Federal environmental agencies.

7.1 FIELD QUALITY CONTROL

All field environmental monitoring and surveillance activities are performed in accordance with standard procedures contained in the contractor's draft Laboratory Programs and Procedures Manual and the "Environmental Monitoring Plan." These procedures include maintenance of chain-of-custody, collection of quality control (QC) samples, and field documentation.

7.2 EPA DISCHARGE MONITORING REPORT QUALITY ASSURANCE STUDY

The EPA entered the 13th year of its Discharge Monitoring Report Quality Assurance (DMR-QA) program. Through this program EPA ensures verifiable and consistent data generation by providing analytical laboratories of major NPDES dischargers blind samples of permit parameters for analysis. The Big Hill, Bryan Mound, and West Hackberry sites, classified as major dischargers, participated in the study in 1993.

7.3 SPR LABORATORY ACCURACY AND PRECISION PROGRAM

The SPR laboratory quality assurance program is based on the *U.S. EPA Handbook for Analytical Quality Control in Water and Wastewater Laboratories.* This program focuses on the use of solvent or standard and method blanks, check standards, and for instrumental methods, final calibration blanks and final calibration verification standards with each analytical batch to verify quality control. Additionally, replicate and spiked samples are analyzed at a 10% frequency to determine precision and accuracy, respectively. Analytical methodology is based on

the procedures listed in Table 7-1. Several hundred of these quality assurance analyses were performed in addition to the 1993 discharge compliance and water quality analyses to verify the continuing high quality of SPR laboratory data.

The EPA quality control document advocates use of quality control charts to maintain and evaluate accuracy and precision data. The SPR uses a computer program to allow rapid and exact determinations of accuracy and precision without the necessity of manual quality control chart preparation.

Standard deviation from the mean is used to monitor changes in the accuracy and precision of specific analyses at each site. A Trend 7 analysis is applied to this standard deviation data (per the *EPA Handbook for Analytical Quality Control*) to identify changes in accuracy and precision. Identification of a trend 7 error, or a tendency towards it, causes the chemist to examine procedures, instrumentation, and reagents for the source of error.

Table 7-1. SPR WASTEWATER ANALYTICAL METHODOLOGY

Parameter	Method	Source*	Description
Biochemical Oxygen Demand	5210(B)	SM-17	5 Day, 20°C
	405.1	EPA-1	5 Day, 20°C
Chemical Oxygen Demand	D1252-88(B)		ASTM Micro Spectrophotometric Proc.
	410.4	EPA-1	Colorimetric, Manual
	5220(D)	SM-17	Closed Reflux, Colorimetric
Fecal Coliform Method	Part III-C-2		EPA-2 Direct Membrane Filter
	9222(D)	SM-17	Membrane Filter Procedure
Residual Chlorine	4500-Cl(G)	SM-17	DPD Colorimetric
	330.5	EPA-1	Spectrophotometric, DPD
	8021	Hach	DPD Method
Oil & Grease	413.1	EPA-1	Gravimetric, Separatory Funnel Extraction
	5520(B)	SM-17	Partition - Gravimetric
Total Organic Carbon	415.1	EPA-1	Combustion or Oxidation
	D4839-88	ASTM	Persulfate - UV Oxidation, IR
	5310(C)	SM-17	
	D2579(A)	ASTM	Combustion - IR
	5310 (B)	SM-17	
Dissolved Oxygen	D888-87(D)	ASTM	Membrane Electrode
	360.1	EPA-1	Membrane Electrode
	360.2	EPA-1	Winkler Method
	4500-O(C)	SM-17	Winkler Method
	4500-O(G)	SM-17	Membrane Electrode
Hydrogen Ion Conc. (pH)	D1293-84(A&B)		ASTM Electrometric
	150.1	EPA-1	Electrometric
	4500-H^+(B)	SM-17	Electrometric
Total Dissolved Solids	160.1	EPA-1	Gravimetric, 180°C
	2540(C)	SM-17	Gravimetric, 180°C
Total Suspended Solids	160.2	EPA-1	Gravimetric, 103-105°C
	2540(D)	SM-17	Gravimetric, 103-105°C
Salinity	D4542-85	ASTM	Refractometric

EPA-1 = U.S. Environmental Protection Agency, Methods for Chemical Analysis of Water and Wastes, Document No. EPA - 600/4-79-020, March 1983.

SM-17 = American Public Health Association, et al., Standard Methods for the Examination of Water and Wastewater, 17th Ed., 1989.

EPA-2 = U.S. EPA, Microbiological Methods for Monitoring the Environment: Water and Wastes, Document No. EPA-600/8-78-017, December 1978.

ASTM = American Society for Testing and Materials, Annual Book of Standards, Section 11 - Water, Volumes 11.01 and 11.02, 1990.

Hach = Hach Company, Hach Water Analysis Handbook, 2nd Ed., 1992

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