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1989 ANNUAL ENVIRONMENTAL REPORT FOR THE STRATEGIC PETROLEUM RESERVE

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DISCLAIMER

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ABBREVIATIONS AND ACRONYMS

ARCO	Atlantic Richfield Company
bbl	Barrel(s) (1bbl = 42 gallons)
BC	Bayou Choctaw
BH	Big Hill
BM	Bryan Mound
BOD_5	five day biochemical oxygen demand
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curies
cm	centimeter
COE	United States Army Corps of Engineers
DO	dissolved oxygen
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
ERT	Emergency Response Team
F&WS	United States Fish and Wildlife Service
ft	feet
in	inch
kg	kilogram
km	kilometers
LDEQ	Louisiana Department of Environmental Quality
LDHHR	Louisiana Department of Health and Human Resources
LDNP	Louisiana Department of Natural Resources
LDOTD	Louisiana Department of Transportation and Development
LDWF	Louisiana Department of Wildlife and Fisheries
m/sec	meters per second
mCi	millicuries
m	meters
m^3	cubic meters
mg/l	milligrams per liter
mi	miles
MMB	million barrels
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System

pH	negative logarithm of the hydrogen ion concentration (acidic to basic on a scale of 0 to 14, 7 is neutral)
ppt	parts per thousand
RCT	Railroad Commission of Texas
SARA	Superfund Amendments and Reauthorization Act
SJ	St. James
SM	Sulphur Mines
SPR	Strategic Petroleum Reserve
STP	Sewage Treatment Plant
S.U.	Standard units
TACB	Texas Air Control Board
TDH	Texas Department of Health
TDH&PT	Texas Department of Highways and Public Transportation
TDS	total dissolved solids
TOC	total organic carbon
TSS	total suspended solids
TWC	Texas Water Commission
UIC	Underground Injection Control
UST	underground storage tank
USCG	United States Coast Guard
VOC	volatile organic compound
WH	West Hackberry
WI	Weeks Island

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 as a management tool for mitigating such impacts, thus serving the public interest by ensuring environmentally sound operation 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 1989. The active permits and the results of the environmental monitoring program (i.e., air, surface water, groundwater, and water discharges) are discussed by site. The quality assurance program is presented which includes results from laboratory and field audits and studies performed internally and by regulatory agencies.

In general, no significant adverse environmental impact resulted from SPR activities during 1989, except for a brine release from a pipeline perforation south of the Bryan Mound site adversely affecting a small area of marsh vegetation which is recovering at this time. The SPR continues to maintain an overall excellent environmental record.

SUMMARY ASSESSMENT
ENVIRONMENTAL COMPLIANCE ACTIVITY

BACKGROUND AND OVERVIEW

The Strategic Petroleum Reserve (SPR) consists of six Gulf Coast underground salt dome oil storage complexes (four in Louisiana and two in Texas), a marine terminal facility (in Louisiana), and an administrative facility (in Louisiana). The SPR uses five sites with solution-mined caverns and a sixth underground mechanically excavated room-and-pillar salt mine. Additional space is being created by solution mining at the Big Hill site in Texas. These sites transfer stored crude oil to distribution facilities by pipeline for subsequent distribution. Approximately 584 million barrels of crude oil are now in storage. Storage capacity has been fully developed at five of the six storage sites, and storage capacity at Big Hill now exceeds 50 percent of design capacity. The SPR sites have a total of 73 wastewater and stormwater discharge monitoring stations.

COMPLIANCE SUMMARY

The SPR is regulated primarily under the jurisdiction of the Clean Water Act. Permits and compliance are discussed in the permit section. The SPR also operates under permits based on the Clean Air Act. Site activities are conducted in accordance with requirements of Part 105 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (National Contingency Plan) and the Resource Conservation and Recovery Act, however none of the SPR sites are treatment, storage or disposal (TSD) facilities. They are considered Conditionally Exempt Small Quantity Generator sites and do not require RCRA permits. There are no CERCLA remedial action activities at any site. No PCB's are stored or used at any SPR site.

In 1989, a total of 11 oil spills and 17 brine spills were experienced at SPR sites. Twenty four noncompliances with wastewater discharge permits were recorded for the 8,728 analyses performed in 1989. For this year, through May 1, 1990, nine oil spills, two brine spills, and 10 noncompliances have occurred. No long term environmental impacts were observed from the spills or noncompliances. Monitoring and a vegetation assessment continue at the site of a brine spill in 1989 at the Bryan Mound site.

CURRENT ISSUES AND ACTIONS

During 1989 and in the first four months of 1990, the SPR has continued, with three exceptions, to maintain an excellent environmental compliance record. A failure of the 36-inch brine disposal pipeline on June 22, 1989, at a point in a brackish salt marsh, one mile southeast of the Bryan Mound storage facility, resulted in moderate, short-term adverse environmental impact to approximately eight acres. Injury to vegetation from the brine spill ranged from severe to light. A monitoring plan was implemented immediately. Any necessary remedial actions will be taken following a final evaluation of natural recovery in the spring of 1990. At this time, two-thirds of the vegetation in the impacted area is clearly recovering naturally. The winter freeze did retard regrowth, however continued recovery has been apparent this spring. The pipeline was repaired and placed into service in September 1989. The SPR plans to apply for the necessary permit approvals to relocate the brine discharge to the 30-foot depth contour.

The second instance involved holding nine barrels of crude oil, contaminated with lead, past the pre-transport accumulation time permitted by 40 CFR 262.34, at the Bayou Choctaw site. The appropriate state regulatory agency was notified, but delays were being experienced in arranging for disposal. The contaminated oil was blanket oil obtained from the abandoned cavern of a previous landowner. It is not part of the SPR inventory. The contaminated oil was removed for incineration at an approved hazardous waste facility on November 27, 1989. Since then a single barrel of contaminated oil was disposed, well within requisite accumulation time limits.

The third instance involved failure to plug and abandon unused boreholes, coreholes, and cavern wells at Bayou Choctaw in accordance with the schedule submitted to the State of Louisiana. A revised schedule was submitted and approved by the state, and the plugging and abandonment was completed on December, 21, 1989.

A groundwater engineering and consulting firm, Geraghty and Miller, was awarded a contract to study and propose a solution for previously reported brine plumes at two SPR sites. It is not known at this time if the source of these plumes are from SPR operation, past or present, or from the industrial activities of previous owners. Regardless, steps are being taken to resolve this issue.

ENVIRONMENTAL PERMITS

Permits currently in effect include seven National Pollutant Discharge Elimination System (NPDES) permits, six air quality permits, 45 Corps of Engineers wetlands permits, and over 100 pit, underground injection, and mining permits. In addition, a number of corresponding state and local permits are in effect.

Environmental reports and notifications have been submitted routinely as required by applicable codes and permits. Six applications to renew NPDES permits are currently being processed by the U.S. Environmental Protection Agency (EPA). All operating permits are current, and the SPR is under no regulatory compliance orders or Notices of Violation, nor are there any outstanding lawsuits involving environmental issues at the SPR.

There is an issue between EPA and Department of Energy (DOE) regarding the signator as operator or co-operator on the NPDES permits. It is EPA's contention that the operating contractor sign the permit as operator. Assistance has been requested from Headquarters to resolve this issue. Resolution is expected either in the form of a DOE-EPA headquarters level agreement or a uniform DOE policy for operator designation on NPDES permits.

The SPR inventories of hazardous chemicals do not meet or exceed the CERCLA (SARA Title III) reporting thresholds.

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 minimize the effects of an oil supply interruption.

The SPR consists of six Gulf Coast underground salt dome oil storage complexes (four in Louisiana and two in Texas), a marine terminal facility (in Louisiana), and an administrative facility (in Louisiana). Figure 1-1 is a regional map showing the relative location of SPR facilities. Four of the sites were acquired with existing solution mined caverns and a fifth, room and pillar salt mine site, was acquired with storage previously created by mechanical underground mining techniques. The sixth storage site was created by solution mining. Some of these sites are being expanded by solution mining to create the mandated storage capacity.

The sites were originally constructed around three major inland pipeline systems capable of transporting U.S. and foreign crude oil from the Gulf Coast to refineries in the Midwest. The current inland pipeline terminals planned for use by the SPR are the ARCO Terminal (Texas City, Texas), the Sunoco Pipeline Terminal (Nederland, Texas), and the Capline Pipeline Terminal (St. James, Louisiana). The sites are also capable of distributing crude oil via tankships. The ARCO pipeline connecting the Bryan Mound site with the Texas City, Texas, docks and area refineries was completed in 1987. A second pipeline connecting the West Hackberry site to refineries in Lake Charles, Louisiana, and Beaumont - Port Arthur, Texas areas via the Texas 22 pipeline was completed in 1989. Access to additional dockage was completed in 1988 for the St. James Terminal with the installation of a short segment of pipeline connecting the nearby Shell Capline facility. An additional tie-in to the Koch pipeline has also been completed.

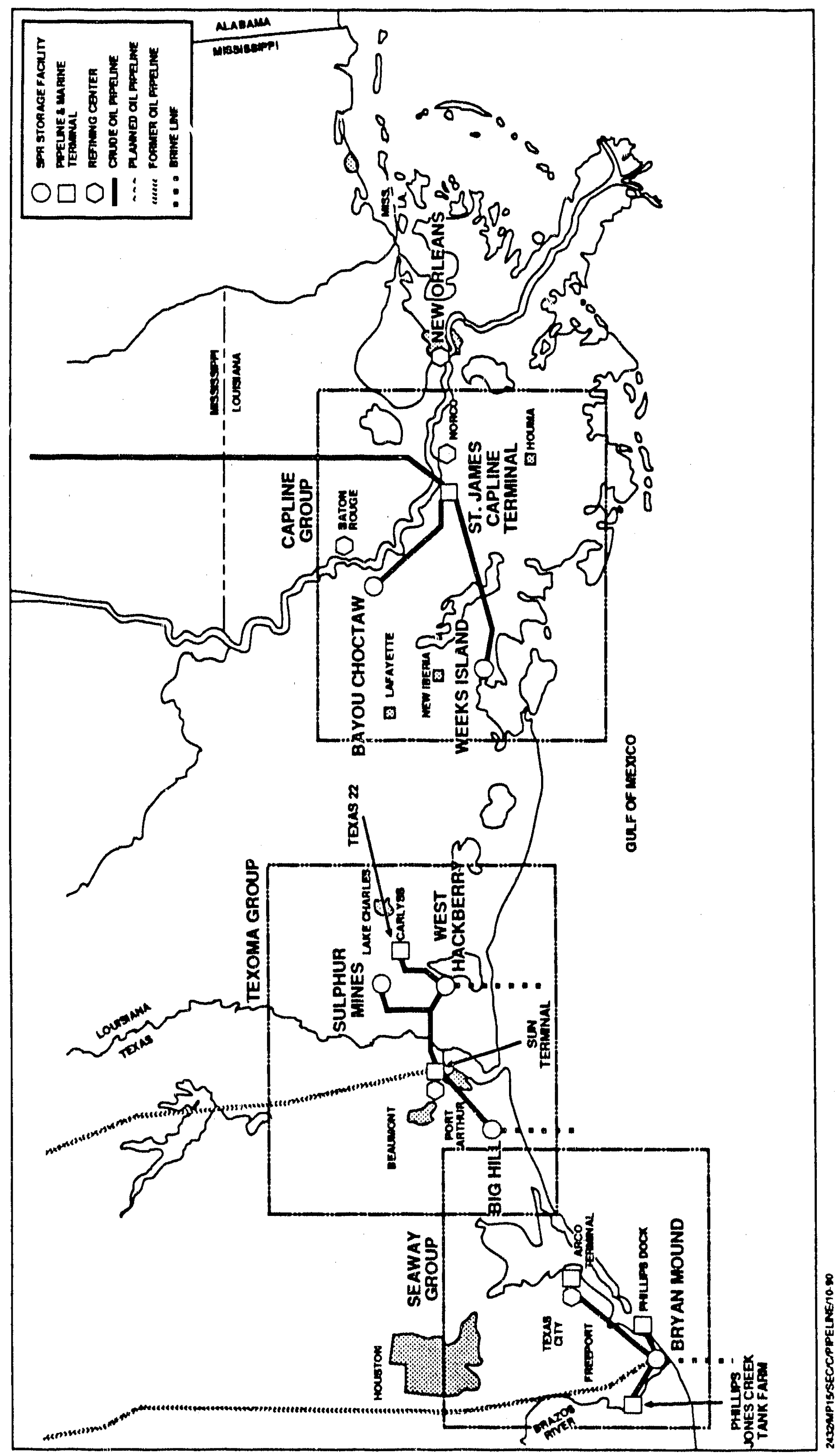


Figure 1-1. SPR Site Locations

Descriptions of the individual sites with photographs, follow. Figures 3-1 through 3-7 are the site specific layouts.

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 hectares (168 and 200 acres) 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 (5 to 10 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, tupelo (characteristic of lowland 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 Choctaware herons, ibis, egrets, woodpeckers, wood duck, thrushes, American anhinga, and American woodcock. Inhabitants of the bottomland forest and swamp include opossum, squirrels, nutria, mink, river otter, raccoon, swamp rabbit, white-tailed deer, American alligator, and snakes.

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 1 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 the North-South Canal and the East-West Canal, enter the site area and continue to Bull Bay and the Intracoastal Waterway.

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.

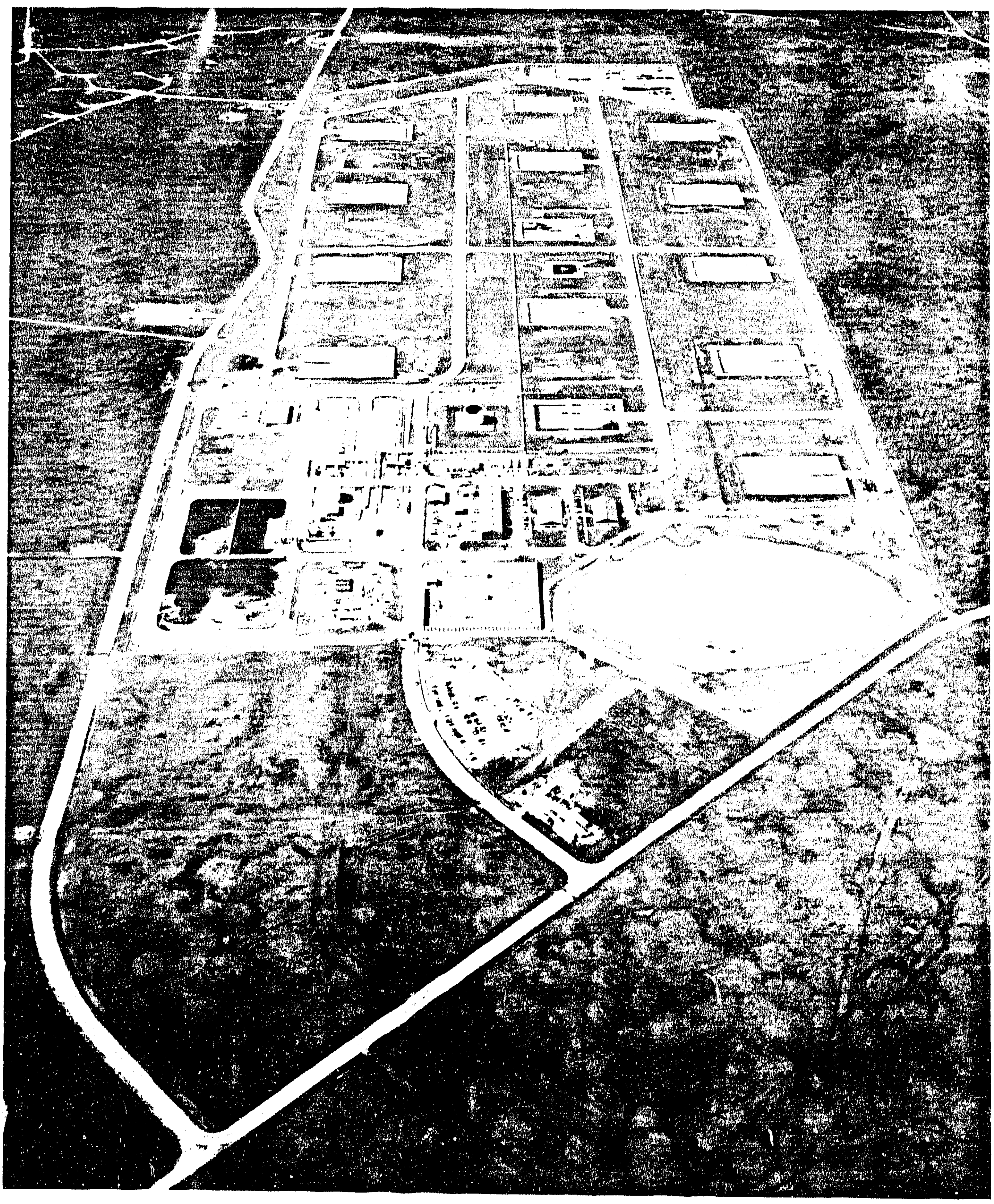


Figure 1-3. Big Hill SPR Site

The site is situated on approximately 111 hectares (275 acres) 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 (.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 (3 mi) south of the site, which connects to the Intracoastal Waterway located three km (2 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.

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 on SPR property.

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. Fauna typical in the area include coyote, rabbits, raccoon, rodents, snakes, turtles, and numerous upland game birds and passerines. The nearby ponds and marsh south of the site provide excellent alligator habitat. The McFaddin National Wildlife Refuge located south of the site provides important habitat for over wintering waterfowl.

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 are between 20 and 55 years of age and work in the local area, although many commute to work from outside the immediate vicinity.

The site occupies 237 hectares (586 acres) 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. The levees protecting the town of Freeport form a second 5.5 square km (3.5 sq mi) triangular pattern within the triangle formed by the rivers. A levee parallels the Diversion Channel in a southern direction from Freeport until due west of the site. The levee then turns east essentially 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 m (15 ft) above the surrounding wetlands. Although Blue Lake is within the protective triangle formed by the levee system (with excess rain water drained off

Figure 1-6 Bryan Mound SPR Site

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 directly connected with the Intracoastal Waterway.

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 seawater are dominated by cordgrasses.

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 state-protected species), as well as nutria, raccoon, skunk, rattlesnakes, turtles, and frogs can be found on and in the area surrounding Bryan Mound.

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.

1.4 ST. JAMES TERMINAL

The St. James Terminal (SJ) consists of six aboveground storage tanks and two tanker docks, as seen in Figure 1-5. The tank farm area occupies 42.5 hectares (105 acres) and the docks occupy 19.4 hectares (48 acres). 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 local labor pools.

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. Much of the land area surrounding the terminal is used for pasture and sugar cane cultivation. 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 hectares (175 acres), is located in Calcasieu Parish, 2.4 km (1.5 mi) west of the town of Sulphur, Louisiana (Figure 1-6). There has been considerable industrial activity on and near the site since the late 1800's. The greater part of the work force comes 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 on property owned by the Pittsburgh Plate

Glass Company approximately 3.5 km (2.2 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, northwest, 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 (1/4 m) 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. 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, alligator, 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.

1.6 WEEKS ISLAND

The aboveground facility, shown in Figure 1-7, occupies approximately three hectares (7 acres) 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. 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 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, raccoon, and alligator 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, black bear, and coyote. 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 population derives its economy from 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 hectares (565 acres) 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 nearly 6.5 m (21 ft), the highest point in Cameron Parish. The majority of the dome is approximately 1.5 m (5 ft) above sea level. Two brine disposal well pads occupying approximately 2.5 hectares (6 acres) are located 3 km (1.9 mi) south of the site.

Waterways near the site include Calcasieu Lake and the Calcasieu Ship Channel approximately 5 km (3 mi) to the east, and the Intracoastal Waterway approximately 6 km (4 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

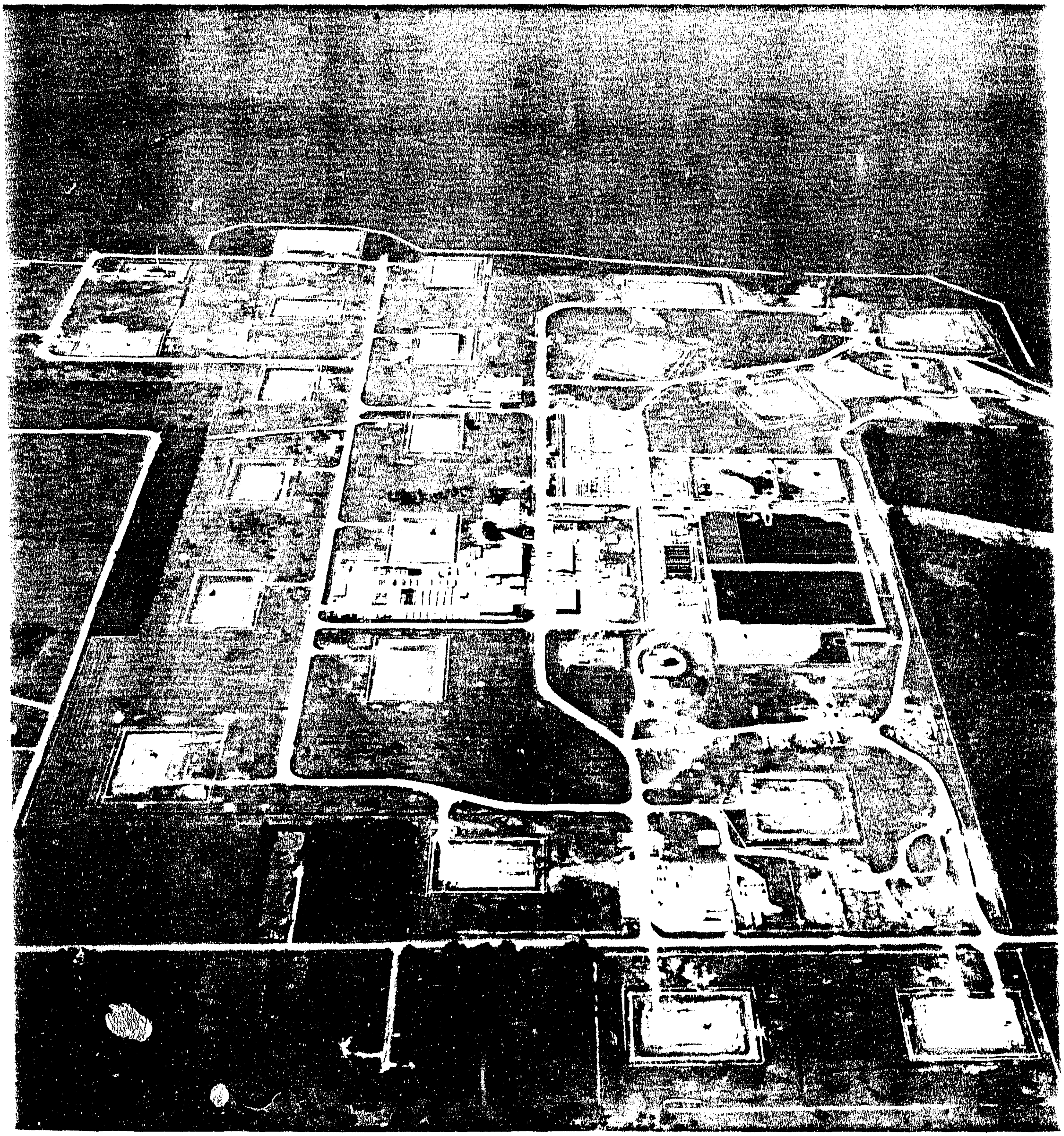


Figure 1-8. West Hackberry SPR Site

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. American alligator, snakes, egrets, herons, roseate spoonbill, migratory waterfowl, red-tailed hawk, red fox, raccoon, nutria, opossum, rabbits, and white-tailed deer inhabit the area surrounding the West Hackberry site. Aquatic inhabitants of Black Lake include crabs, shrimp, drum, croaker, spot, sheepshead, mullet, gar, redfish, and catfish.

2. PROGRAM OVERVIEW

The environmental program is implemented by a prime contractor for the SPR on behalf of the United States Department of Energy (DOE) (owner, operator, and environmental permit holder). 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 and water bodies.

The monitoring and inspection program was originally developed under guidance of the SPR Programmatic Environmental Action Report, Site Environmental Action Reports, and DOE Orders. This program includes monitoring permitted National Pollutant Discharge Elimination System (NPDES) outfalls and air emissions, conducting ocher required Federal and state inspections, and regular 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 quality monitoring and reporting, NPDES compliance, water quality monitoring, and ground water monitoring, for 1989 are discussed in section 3.

2.1 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, site-specific Spill Prevention, Control, and Countermeasures Plans, the Environmental Programs and Procedures Manual that includes a Solid Waste Management Plan, an Underground Injection Control Plan, and a Fugitive Emissions Monitoring Plan. Draft plans and procedures for groundwater protection, pollution prevention awareness, and waste minimization are under preparation and will be issued in 1990. Compliance with Federal, state, and local laws, regulations, and permits has been accomplished in part by implementation of these plans and procedures.

2.2 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, and Countermeasures 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.

ERT personnel from all sites participate in annual spill response training at the Lamar University Fire and Safety Institute. 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 special circumstances unique to each SPR site.

2.3 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.

2.3.1 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 waterbody). 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 contractor operating procedure 22OP-21 "Reporting of Spills," 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 to the appropriate regulatory agencies follows when necessary. Final written reports from the site are submitted after cleanup, unless otherwise directed by the DOE or appropriate regulatory agency.

2.3.2 Discharge Monitoring Reports

Wastewater discharges from SPR sites are authorized by the Environmental Protection Agency (EPA) through the NPDES Program. Depending on site specific permit requirements, discharge sample analyses are reported to the state and EPA monthly (Big Hill, Bryan Mound, and West Hackberry), and quarterly (Bayou Choctaw, Saint James, Sulphur Mines, and Weeks Island). Included in the report is an explanation of the cause and actions taken to correct any noncompliance or bypass.

2.3.3 Other Reports

The SPR contractor provides several other reports to or on behalf of DOE. These reports include:

a. Fugitive Air Emissions for Bryan Mound (quarterly);
b. Emission Inventory Questionnaire Status update for St. James Terminal, Sulphur Mines, and Weeks Island (annually);
c. Air Quality Construction Status Report for West Hackberry (semi-annually);
d. Permit Tracking System review and update (annually and quarterly);
e. Monthly Noncompliance and Spill Report with an annual summary for all sites;
f. Environmental Audit Reports for each site (annually);
g. Water Usage for Bryan Mound and Big Hill (annually);
h. Raw Water Usage and Brine Discharge Data for Big Hill, Bryan Mound and West Hackberry (monthly)
i. Monthly Environmental Compliance Report
j. Performance Indicator Program (monthly)

k. OMB Circular A-106 Environmental Project Plan (semi-annually)

l. Environmental Activity Report System (quarterly)

m. Environmental Compliance Issue Coordination DOE Order 5400.2A (annual)

n. Environmental Protection and Implementation Plan DOE Order 5400.1 (annual revision)

o. Annual Monitoring Report, H-10

p. Plug and Abandon Report (as needed)

q. Work Resume Report (as needed)

2.4 OIL SPILLS: RECAPITULATION

In 1989, the total amount of oil moved (received and transferred internally) was in excess of 3.6 million m^3 (22.8 MMB). The oil spills involving quantities in excess of 0.16 m^3 (one barrel) that occurred during 1989, both contained and uncontained, are presented in Table 2-1. Five crude oil spills were caused by equipment failures, two by operator error, three from faulty gaskets, and one by a flange fitting leak.

The total number of spills, total volume spilled, and the percent volume spilled of total volume moved are shown below for each year from 1982 through 1989.

Table 2-1. Number of 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

The total number of spills has generally declined since 1982. The percent spilled during 1989 is similar to that reported in the previous two years based on throughput. Approximately 80% of the oil spilled in 1989 was associated with one spill involving the failure of a flange gasket. Nine of the spills resulted in spillage of only 76 barrels of oil. No environmental damage occurred.

Table 2-2. 1989 Oil Spills

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
01/25/89	SM	0.48 m^3 (3 bbls)	Leaking vent valve allowed oil to leak from pig traps at valve station SM-4. Depressured pipeline and replaced valve. All oil contained to area around sump. Cleaned area using sorbent.
02/24/89	BH	0.32 m^3 (2 bbls)	BHT-10 overflowed due to open drain valves on meter prover (being drained). High level alarm on BHT-10 nonfunctional. Washed and vacuumed area.
04/03/89	BH	0.32 m^3 (2 bbls)	Hose slipped out of chain and fell from ring tank to pad during depressuring of 106A. Stopped source, picked up free oil with sorbent, removed, and replaced oiled gravel.
04/06/89	WH	0.95 m^3 (6 bbls)	Damaged gasket on north header. Replaced with flexitallic gasket. Valves closed to relieve pressure. High pressure pump pad drains plugged with sorbent. Earthen dike built. Areas washed and sorbent used.
04/08/89	BM	8-16 m^3 (50-100 bbls)	Mechanical failure of wellhaed lubricator during wirelining operation. Cut wireline and closed valves to stop spray. Washed and vacuumed immediate area. Scraped and removed oiled vegetation outside of well pad area. Small quantity entered Mud Lake and surrounding wetland. Oil removed using boom and sorbent.

Table 2-2. 1989 Oil Spills (continued)

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
04/14/89	SJ	0.32 m^3 (2 bbls)	Loose bolts on 12" flange. Shut off source, opened 12" sump valve, tightened bolts, diked spill area. Washed and vacuumed spill area.
04/27/89	BC	0.4 m^3 (2.5 bbls)	Flow surge caused pressure surge valves to relieve. Valves reset automatically when pressure dropped. Valve on concrete ditch closed. Washed and vacuumed area.
05/20/89	WH	108.4 m^3 (682 bbls)	Faulty flange gasket on buried portion of line failed. Original gasket material was replaced. No new damage resulted. Oil flowed over wet barren clay preventing heavy penetration. Residual oil flushed to deluge pond.
05/26/89	WH	0.8 m^3 (5 bbls)	Tubing pulled away from fitting. Turned off supply valve. Fire monitor water was directed on the spray to knock it down. Estimate 2-5 gallons caused silver sheen on Black Lake.
05/28/89	WH	0.64 m^3 (4 bbls)	Tubing failed at fitting west side of meter skid run #1. Meter run #1 was depressured, leaking tubing was blocked. Oil was vacuumed and prevented from entering foam deluge drain with earthen barrier. Tubing and fittings were replaced.
09/07/89	BH	8 m^3 (50 bbls)	A loose stringer in cavern 112 is suspected for the release of oil into the anhydrite pond. Booms were deployed to isolate oil to corner of pond where it was vacuumed up.

2.5 BRINE SPILLS: RECAPITULATION

The SPR disposed of 94.6 million m^3 (591.0 MMB) of brine (saturated sodium chloride solution) during 1989. Approximately 94.0% of the brine was disposed in the Gulf of Mexico via the Big Hill (89.2%), Bryan Mound (2.7%), and West Hackberry (1.8%) and brine disposal pipelines. The remainder was disposed in saline aquifers via injection wells at the Bayou Choctaw (6.3%) and Sulphur Mines (less than 0.1%) sites, and at offsite disposal wells (less than 0.1%).

The brine spills involving quantities in excess of 0.16 m^3 (one bbl), both contained and uncontained, during 1989 are discussed in Table 2-2. Six spills were caused by corrosion/erosion of piping, one by a gasket/flange failure, two by operator error, and eight by equipment failures.

The total number of spills, total volume spilled, and percent volume spilled of total volume disposed are shown below for each year from 1982.

Table 2-3. 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	131,231.6 (825,512)	0.1395

One spill (corrosion/erosion of a brine pipeline) accounted for 99% of the brine spilled. Initially eight acres of marsh were affected. Subsequent monitoring has shown strong regrowth in most of the area in less than one year. With the exception of the above spill the number of spills increased slightly, while the volume (512 barrels) decreased. No significant long term adverse environmental impact was observed from any SPR brine spills as evidenced by subsequent surveys and water quality monitoring.

Table 2-4 1989 Brine Spills

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
01/15/89	BC	0.8 m^3 (5 bbls)	Overfilled frac tank during N_2 coil tubing operation. Stopped tubing operation. Washed and vacuumed area.
01/19/89	BC	0.32 m^3 (2 bbls)	Failure of N_2 coil tubing due to erosion. Spillage confined within dikes of brine disposal pad No. 3. Stopped tubing operation. Washed and vacuumed area.
04/10/89	BC	1.6 m^3 (10 bbls)	Hose pulled apart at coupling to frac tank during pigging of line. Operation shutdown. Hose replaced. Washed and vacuumed area.
04/19/89	WH	0.16 m^3 (1 bbl)	Erosion along bottom of pipeline. Wooden plug placed in line with stainless steel band placed around piping. Area around brine puddles was excavated. Washed and vacuumed area.
04/28/89	BC	0.24 m^3 (1.5 bbls)	Defective valve body gasket caused leak. Dropped pressure on line, opened valve in attempt to reseat. Visqueen used to collect leaking brine until valve was repaired.
05/01/89	BC	0.64 m^3 (4 bbls)	Slam retarder on 2320-CK check valve failed at brine manifold east side of HPP. Valve isolated. Visqueen and pump used to collect leaking brine.
05/08/89	BM	0.8 m^3 (5 bbls)	Small (approximate 1/2" diameter) holes were perforated in top of pipe to allow for gas testing prior to dewatering and demolition. Possible relief of air pressure in line caused brine to flow out of perforated holes. Installed plugs in perforated holes. Less than one barrel entered Blue Lake. Used fresh water to dilute brine.

Table 2-4. 1989 Brine Spills (continued)

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
06/22/89	BM	132,000 m^3 (825,000 bbls)	Corrosion/erosion phenomena along bottom of brine disposal line created perforations in line which allowed brine to escape. Brine line was taken out of service until repaired.
09/03/89	WH	5.1 m^3 (33 bbls)	Packing sleeve failed on WH pump 104 brine pump. Brine flowed into pad containment. Only one barrel overflowed onto barren clay and limestone. Washed and vacuumed area.
09/05/89	WH	4.8 m^3 (30 bbls)	Flange near cavern 113 was opened to provide line ventilation prior to cutting operations. Valve leaked brine through and drained out of open flange. Brine contained with earthern dike. Vacuumed and washed area.
09/21/89	WH	38.4 m^3 (240 bbls)	Corrosion/erosion of the brine return line east of administration building. Leakage minimal due to compacted clay around pipe. Washed and vacuumed area.
09/21/89	WH	1.3 m^3 (80 bbls)	Flange gasket failed near valve C11620-C3 on cavern 116. Brine contained in barren clay ditches where it was vacuumed. Gasket failure probably due to efforts to dislodge a salt plug in cavern piping. Replaced flange gasket.
09/27/89	WH	5.6 m^3 (35 bbls)	Pump packing gland failed releasing brine to low pressure pump pad #1 and to surrounding area. Washed and vacuumed brine. Replaced pump packing.
10/04/89	SM	1.6 m^3 (10 bbls)	Corrosion induced failure of underground 12" brine line east of low-pressure pump pad. Spill was contained in ditch. Repaired pipeline.
11/08/89	BM	0.32 m^3 (2 bbls)	Failure of 20" brine return/discharge line near brine disposal pump pad. Closed sluice gate at culvert and hand seated valves up and down stream. Flushed area with fresh water.

Table 2-4. 1989 Brine Spills (continued)

DATE	LOCATION	AMOUNT	CAUSE/CORRECTIVE ACTION
12/08/89	BH	0.48 m^3 (3 bbls)	Corrosion/erosion of "C" section in 106 B wellhead at the weld. Shut in and depressured wellhead to effect repair. Vacuumed brine from area.
12/08/89	BH	8 m^3 (50 bbls)	Erosion/corrosion of underground 20" brine return piping on well pad 106. Excavated piping to locate leaks. Replaced leaking section. Vacuumed spilled brine from excavation and well pad.

2.6 WASTEWATER DISCHARGE COMPLIANCE

In 1989, a total of 8,728 analyses were performed to monitor wastewater discharge quality from the SPR in accordance with NPDES and corresponding state permits. Although 24 noncompliances were reported (Tables 3-2, 3-4, 3-6, 3-8, 3-11, and 3-13), the SPR was in compliance with permit requirements for approximately 99.7% of the analyses performed. Four of the noncompliances involved site sewage treatment plants, eleven operator errors in failing to collect, analyze, or record samples, eight problems with brineline operation, one failure to sample a stormwater discharge.

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

2.7 PIPELINES

The SPR owns 325 miles of pipelines for transporting either crude oil, raw water, or brine. The crude oil lines tie each site into a terminal for distribution during a drawdown to refineries by pipeline, tanker, or barges. They also serve to fill the SPR with crude oil.

The raw water lines bring water to the sites for solution mining to create the caverns in the salt domes and during drawdown to displace the crude oil. The brine disposal pipelines either dispose of brine in saline underground aquifers or offshore in the Gulf of Mexico as allowed by permit. Brine discharges occur during solution mining, fill-refill, and to relieve pressures from cavern creep.

The pipelines are routinely inspected by designated pipeline crews, periodic overflights, coupon monitoring, pigging, and various testing including integrity flow tests and ultrasonic testing.

During 1989, a failure in the Bryan Mound brine line occurred approximately one mile south of the site spilling brine into the marsh. Eight acres of marsh were severely impacted. A recovery and monitoring program was established and implemented. The final report will be published in 1990. Further discussions on this incident are found in sections 2.5, 2.9, and 3.4.6. This was the only pipeline spill in 1989.

2.8 WASTE MINIMIZATION PROGRAM

A waste minimization program was created, documented, and implemented to prevent the generation of hazardous waste and apply treatment techniques to reduce volume, toxicity, and mobility of SPR generated waste.

2.9 SPECIAL ENVIRONMENTAL ACTIVITIES

Brief example of SPR activities are presented here and in the applicable site section.

During 1989, there was a major brine spill that prompted additional studies to assess and monitor impact. Weekly, monthly, and quarterly water quality monitoring, quarterly vegetation assessment, and interstitial soil water sampling will provide, along with aerial photographc interpretation, an evaluation of the initial impact and recovery. Based on this data, decisions will be made on what, if any, mitigation will be required in 1990.

The Environmental Survey of the SPR conducted by DOE Headquarters was completed in early 1988. The 29 findings were categorized as either lower level III or IV and not of an immediate threat to health or the environment. Eight of the findings were closed in 1989 bringing the total number closed to 19. Of the remaining 10, four are awaiting action from the Survey and Analysis team, three are scheduled for completion in FY'90, one in FY'91, FY'92, and FY'93 each. Actions pertaining to recently closed findings are discussed in section 3 under the site specific Other Significant Environmental Activity section.

The discharge from the Sulphur Mines water treatment system was added to the NPDES discharge permit.

Design modifications required to correct potable water system deficiencies were developed and implemented where necessary. Implementation of corrective actions, involving major plumbing system revisions at some sites, commenced in 1987. Completion has been delayed until 1990.

The Environmental Advisory Committee, whose purpose is to supplement existing BPS environmental and safety efforts by providing impartial assessments and advice to the operating management, public, and media relative to SPR management, programs, and policies, held quarterly meetings in 1989. Several recommendations were made by the committee. An example management, public, and media relative to SPR management, programs, and policies, held quarterly meetings in 1989. Several recommendations were made by the committee. An example of one such recommendation was to join the "One Call" notification centers. In 1989, DOE joined DOTTIE (Dial One Time to Inform Everyone) in Louisiana and TESS (Texas Excavation Safety System) in Texas. These systems notify members to mark underground pipelines (or utilities) prior to any excavation to prevent accidental rupture.

Project Directive 116, Storage and Maintenance of drummed materials at SPR facilities, continued being implemented in 1989 with participation of several BPS directorates. Improved methods for the purchase, control, storage, and disposal of drums and drummed materials have been incorporated into the procurement and property systems. The plan is scheduled to be fully implemented by 1990, with the exception of building covered drum storage areas presently budgeted for 1992.

An environmental assessment for decommissioning Sulphur Mines and expanding the Big Hill and Bayou Choctaw sites was completed in accordance with National Environmental Policy Act guidelines. The resulting impacts from these activities were evaluated and determined to be insignificant.

Nine barrels of lead contaminated crude oil from Bayou Choctaw were the only hazardous waste generated in 1989. It was disposed of at an approved hazardous waste facility for incineration.

All unused coreholes, boreholes, and caverns at Bayou Choctaw were plugged and abandoned. Appropriate notifications were sent to LDNR.

A major subcontract was let to address potential groundwater contamination on an expedited basis. An electromagnetic survey was conducted at West Hackberry and Bryan Mound. Underground

Three monitoring wells were installed around the Bayou Choctaw brine pond. Data from those wells will be used to determine contamination and what actions will be necessary in 1990.

At Sulphur Mines, a pilot study using an electrical conduction system was conducted to locate leaks of the brine pond liner. Several leaks were located and repaired.

The 1988 SARA Title III Tier II forms for all sites (including New Orleans) were submitted to the appropriate state emergency response committees, local emergency planning groups, and fire departments located near any of our sites or pipelines.

3. ENVIRONMENTAL PROGRAM

3.1 INTRODUCTION

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

3.1.1 Air Quality

During 1989, air emissions were monitored primarily through measurements and calculations from operating data. Volatile hydrocarbons from valves, pumps, tanks, tankers, and brine ponds are the predominant air emissions from SPR facilities. They are monitored for permit compliance at Big Hill and Bryan Mound using an organic vapor analyzer. The quantity of hydrocarbon emissions is generally dependent on the volume of oil throughput, with minimal emissions occurring during periods of static storage. Small amounts of hydrogen sulfide are released from some crude oils handled and stored by the SPR. Estimated emissions associated with the SPR were generally lower during 1989 as compared to 1982 through 1988 due to the reduction in fill activity. Actual throughput was monitored at Bryan Mound only and is discussed in the Bryan Mound section of this report. Dust emissions from most site roads have been mitigated through paving or application of dust control agents.

3.1.2 Surface Water Quality Monitoring

During 1989, the surface waters of the Bayou Choctaw, Bryan Mound, Sulphur Mines, and West Hackberry SPR sites were sampled and monitored for general water quality. This monitoring is separate from, and in addition to, the water discharge permit monitoring program and is not required by any Federal or state regulatory agency. 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. Surface water quality monitoring at Big Hill was initiated in the last half of 1989.

3.1.3 Water Discharge Permit Monitoring

The water discharge permit monitoring program fulfills the requirements of the EPA NPDES, and corresponding state 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 1989. These discharges are grouped as:

a. brine discharge to the Gulf of Mexico,
b. stormwater runoff from tank, well, and pump pads
c. effluent from package sewage treatment plants.

Parameters monitored varied by site and discharge. Table 3-1 identifies frequency of specific parameters measured at each SPR site. The variations in data are discussed by site following the water quality monitoring discussions.

3.1.4 Environmental Permits

The active environmental permits, required by regulatory agencies to construct and maintain the SPR, are discussed by site. The discussion of site permits includes the number and type of noncompliances (if any) experienced at each site during 1989.

3.1.5 Hydrology and Groundwater Monitoring

Groundwater monitoring is performed at Bayou Choctaw, Big Hill, Bryan Mound, and West Hackberry. Salinity, pH, and other indicator parameters are monitored depending upon the individual site, although well monitoring is not required by

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- 001 002	001		001 6-9, 11 101- 117 HPP SOT			001- 006	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			001 HPP				A-F	A-G	A-J		A,B D-G		A-F	
TEMP.		001	001			001				A-F	A-G	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									004	001 002	004	002*			01B 002	002	002 003
COD			TX- 001 1,2 4,5 101- 116									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			001- 003 005 006						01A	004	
TOC		003		001		6-9 11 101- 117 HPP SOT		001		A-F	A-G	A-J		A,B D-G	E	A-C E-F 004	
FECAL COLIFORM															01B 002	002	
RESIDUAL CHLORINE		004	TX- 002														
FLOW	001 002 15, 17- 20 101 HPP SWD1 SWD2 SWD3	001	TX- 001, 001	001		001 HPP**	002 004**	TX- 002*	001- 006			002*	002 003		01A 01B 002 003	002 004	

Sampling performed twice per indicated period.
** Sampling performed 5 days/week.

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

Table 3-1. 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.

any Federal or state regulations or permits. Monitor wells were installed at Bayou Choctaw in September of 1989. Initial data from these monitor wells indicate slightly brackish groundwater. The Bayou Choctaw monitoring wells will be monitored throughout 1990.

Background information is not available on the construction and installation of some of the existing monitoring wells which presents problems when interpreting data. The groundwater characteristics of each site are discussed within each site section.

3.1.6 Radioactivity

There are no radioactive process effluents from any SPR facility. Only sealed sources of radioactive material are in use.

A total of 132 SGH Model Nos. 5190, 5191, and 5202 nuclear density gauges 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 400 millicuries (mCi) of cesium 137. Gauge wipe tests are performed every three years as recommended by the manufacturer. No radiation leakage has been detected to date. The DOE is a general licensee under the manufacturer, Texas Nuclear.

Princeton Gamma Tech Model 100 sulfur analyzer is used in the St. James laboratory for analyzing sulfur concentrations in oil samples. The Bryan Mound instrument was not used in 1989 and will be excessed in 1990. The instrument at West Hackberry was excessed this year. The radioisotope within any analyzer contained 50 mCi of iron 55. No radiation leakage from any analyzer has been detected from semiannual wipe tests.

3.2 BAYOU CHOCTAW

The Bayou Choctaw site will be used to store 10.4 million m^3 (66 MMB) of crude oil. Currently, there are six solution-mined caverns at this storage site. An existing cavern, Number 18, is being expanded 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 58 km (36 mi), 91 cm (36 in) crude oil pipeline connecting the site to the St. James Terminal.

3.2.1 Air Quality

During 1989, Bayou Choctaw operated in accordance with air quality regulatory requirements. Total emissions from the facility were calculated using method AP-42 (EPA, 1985) to be less than nine metric tons (10 tons)/year (a "nonsignificant facility" as noted in the air quality regulations for Louisiana). Nonsignificant facilities are exempt from vapor monitoring requirements. There were no configurational changes which would have resulted in additional air emissions during 1989. Bayou Choctaw is located in a nonattainment area for ozone.

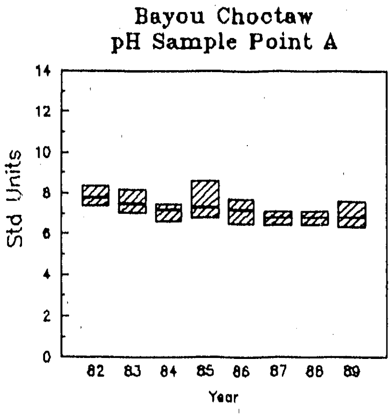
3.2.2 Surface Water Quality Monitoring

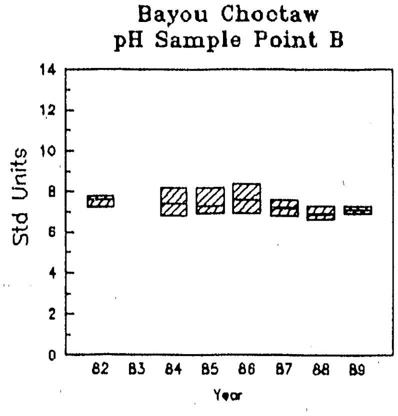
Samples collected once monthly at each monitoring station were used to monitor surface water quality. Specific monitoring stations are identified in Figure 3-1. Parameters monitored in the Bayou Choctaw surface waters included pH, salinity, total suspended solids (TSS), temperature, dissolved oxygen (DO), five day biochemical oxygen demand (BOD_5), and oil and grease. A discussion of each parameter follows. Years without data are shown as blank in the following graphs.

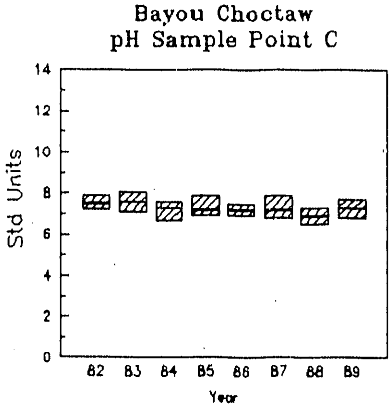
3.2.2.1 Hydrogen Ion Activity (pH)

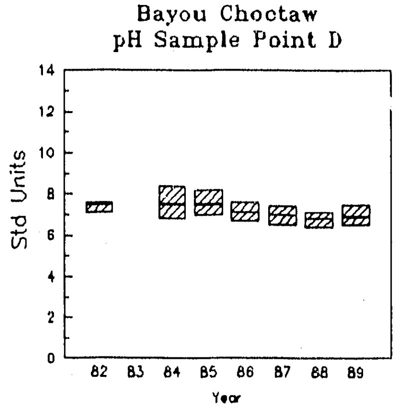
The hydrogen ion activity, or pH, remained essentially neutral (7.0) in most cases.

The 1982 through 1989 data have remained relatively constant in terms of median pH and range. The slight fluctuations observed are attributed to a variety of environmental and seasonal factors such as variations in rainfall or aquatic system flushing.

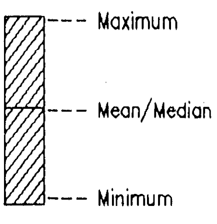








NOTE: Scale between stations changes to show long term variation with greater amplitude.



BAYOU CHOCTAW

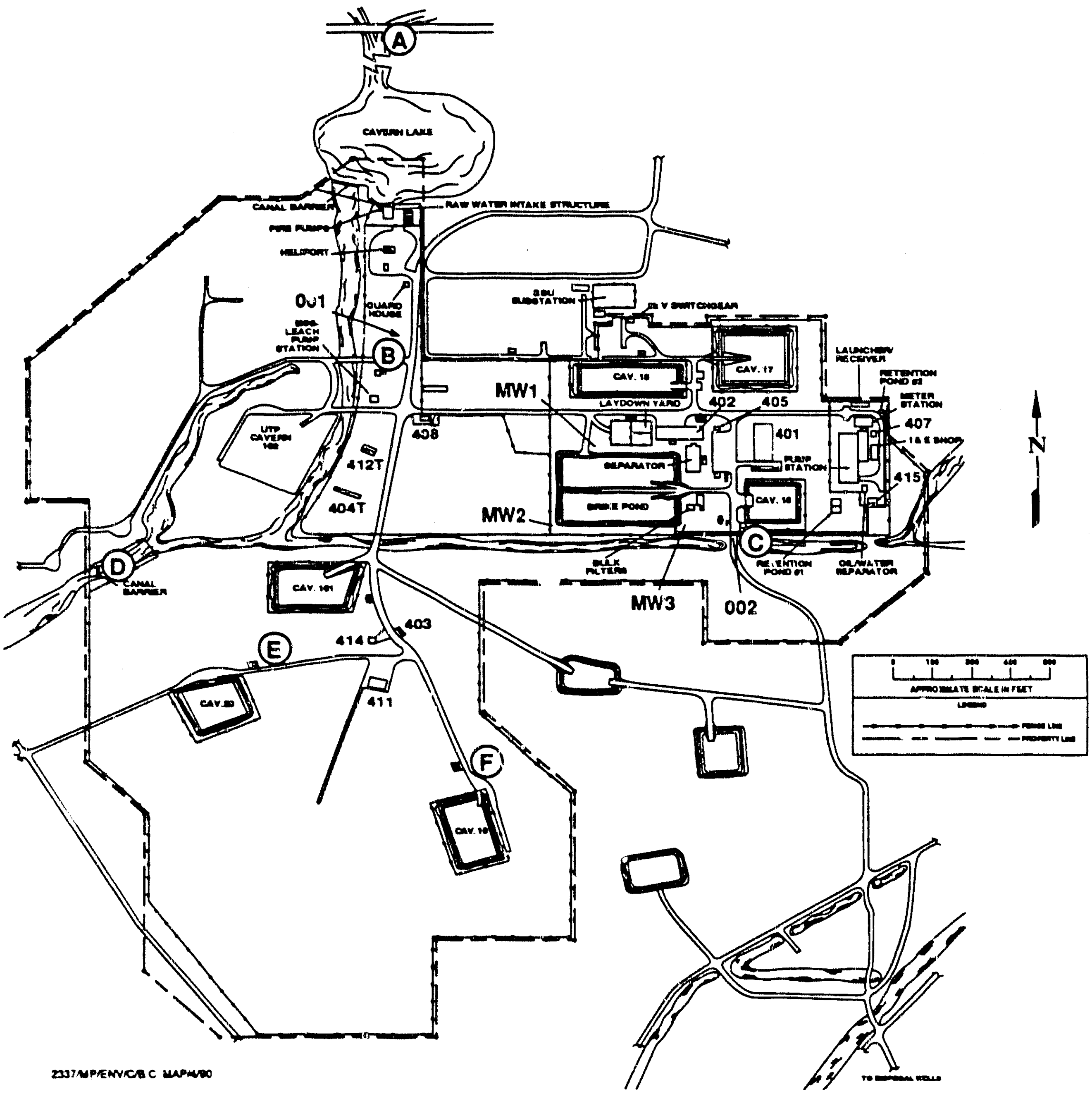


Figure 3-1 (Sheet 1 of 2). Bayou Choctaw Environmental Monitoring Stations

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

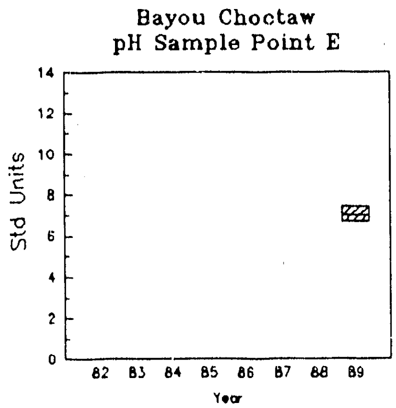
Water Quality Monitoring Stations

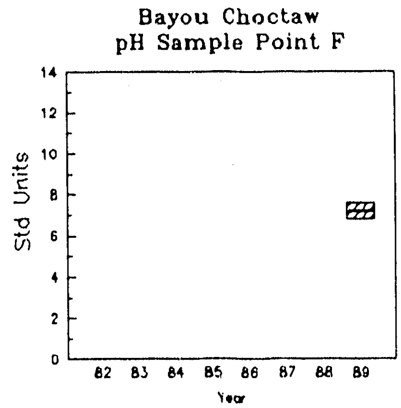
A	Canal north of Cavern Lake at perimeter road bridge
B	North-South Canal at bridge to caverns 10, 11, and 13
C	East-West Canal at Intersection of road to brine disposal wells
D	East-West Canal at cavern 10
E	Wetland Area near well pad 19
F	Wetland Area near well pad 20

Groundwater Monitoring Stations

MW1	North of brine pond
MW2	Southwest corner of brine pond
MW3	Southeast corner of brine pond

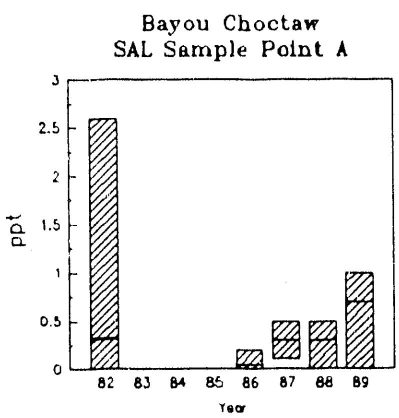
Figure 3-1 (Sheet 2 of 2). Bayou Choctaw Environmental Monitoring Stations

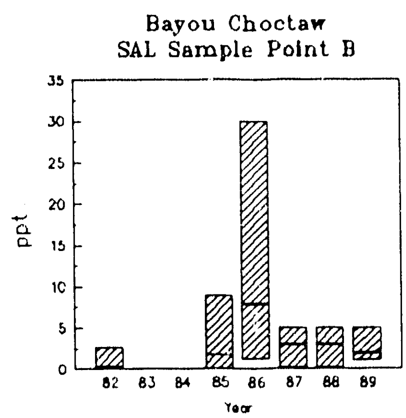


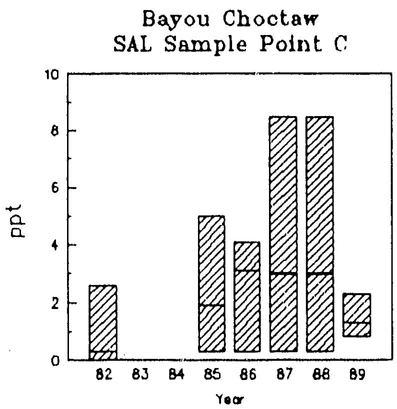


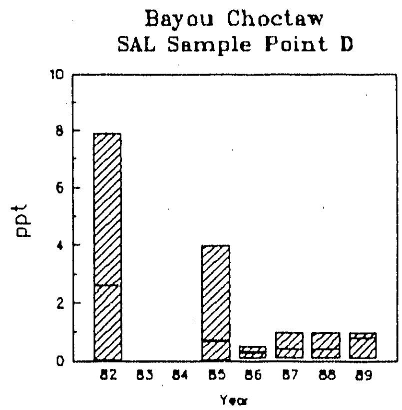
3.2.2.2 Salinity (SAL)

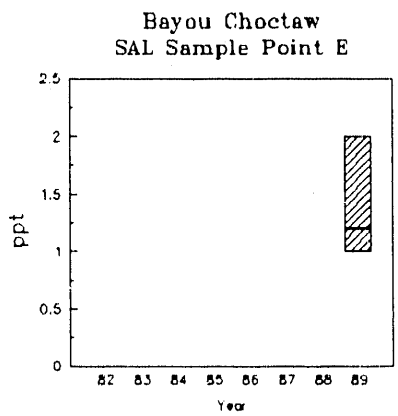
A slight increase in salinity was observed at Station A, which is the inlet to Cavern Lake and not influenced by site activities. Otherwise the overall salinity of the area is consistent with past data.

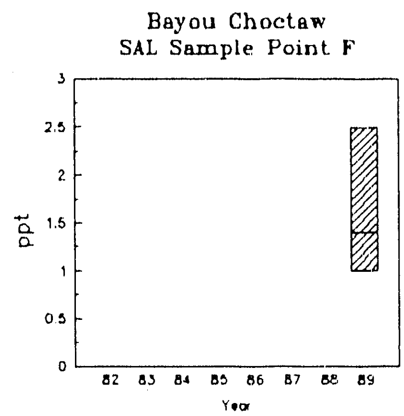






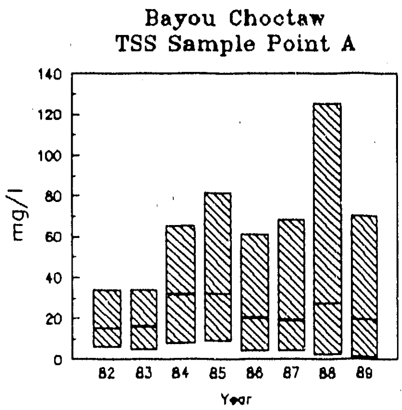


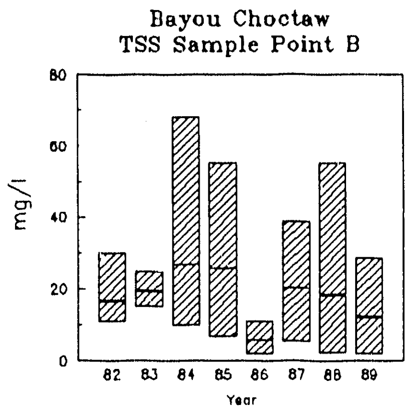




3.2.2.3 Total Suspended Solids (TSS)

No outfall at the site exceeded the permit limitation for TSS during 1989. TSS levels for 1989 were relatively consistent with those observed during previous years.


Bayou Choctaw
TSS Sample Point A
mg/l
Year
82 83 84 85 86 87 88 89


Bayou Choctaw
TSS Sample Point B
mg/l
Year
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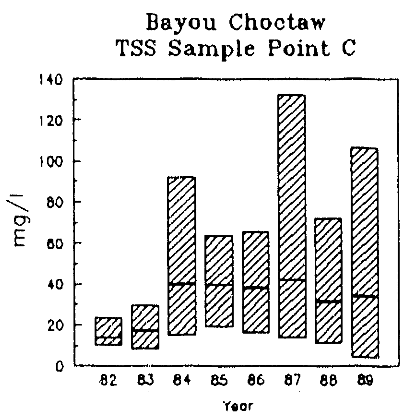
Bayou Choctaw
TSS Sample Point C
mg/l
Year
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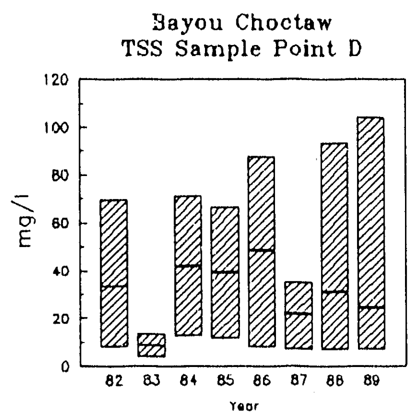
Bayou Choctaw
TSS Sample Point D
mg/l
Year
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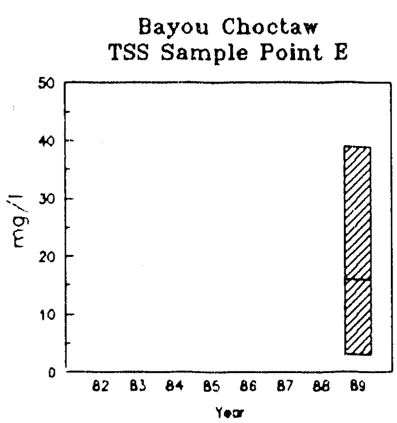
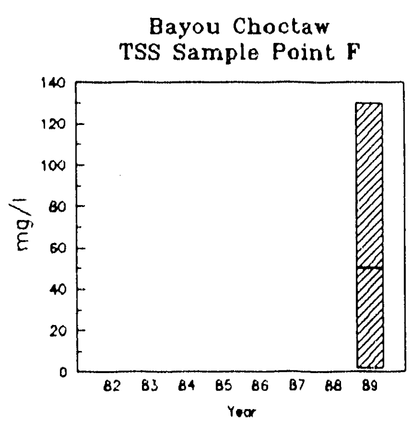
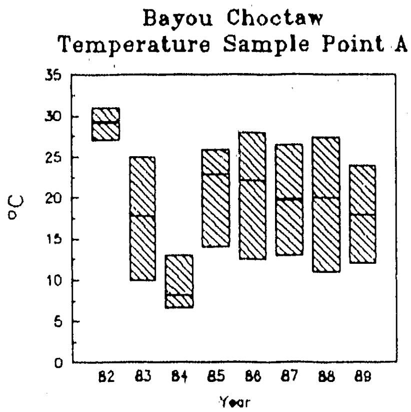
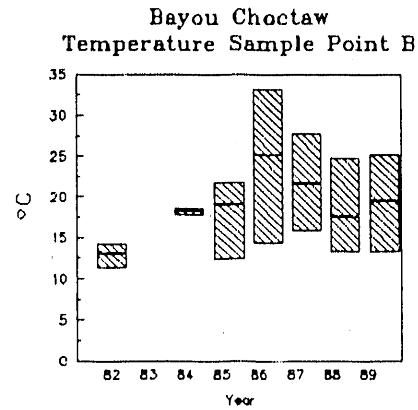

Bayou Choctaw
TSS Sample Point E
mg/l
Year
82 83 84 85 86 87 88 89

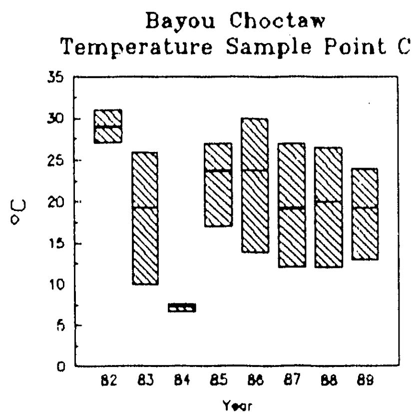

Bayou Choctaw
TSS Sample Point F
mg/l
Year
82 83 84 85 86 87 88 89

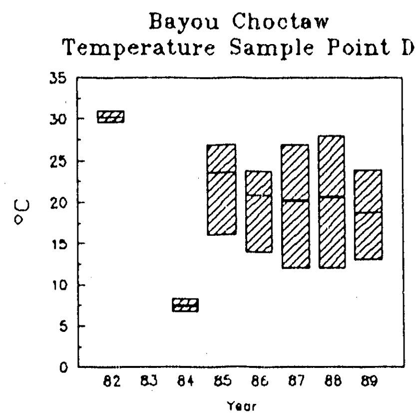
3.2.2.4 Temperature

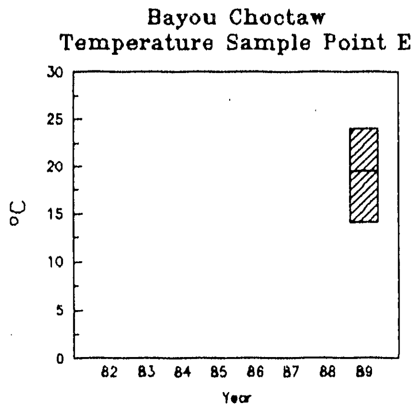
There was a slight decline in temperature observed at all monitoring stations. Temperature fluctuations are attributed solely to meteorological conditions since Bayou Choctaw produces no thermal discharges.

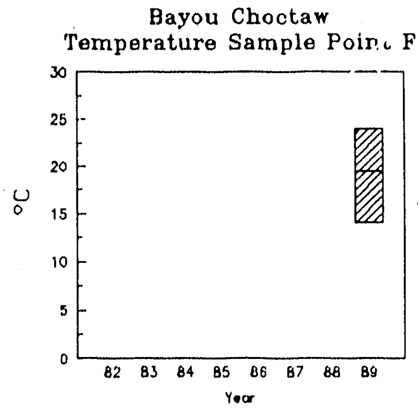






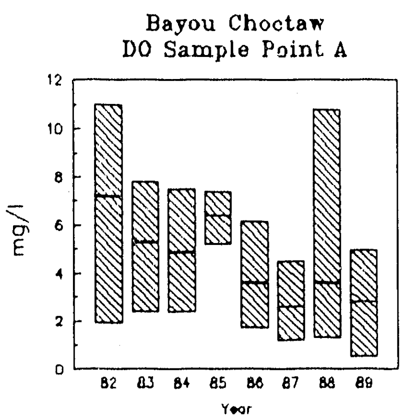


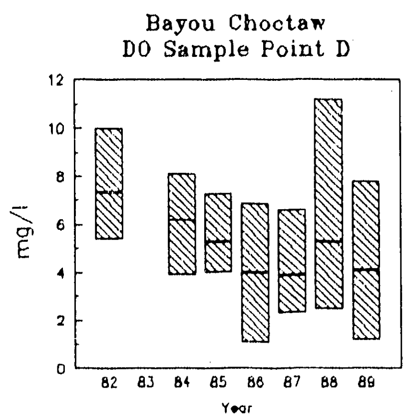


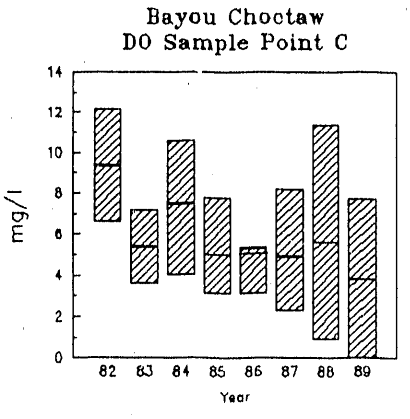


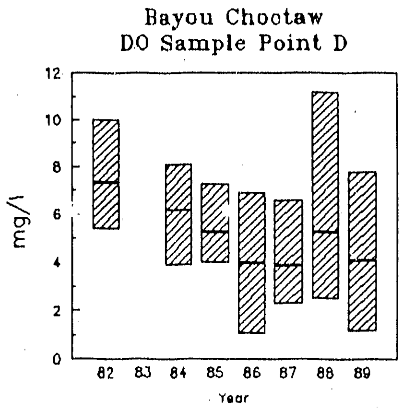
3.2.2.5 Dissolved Oxygen (DO)

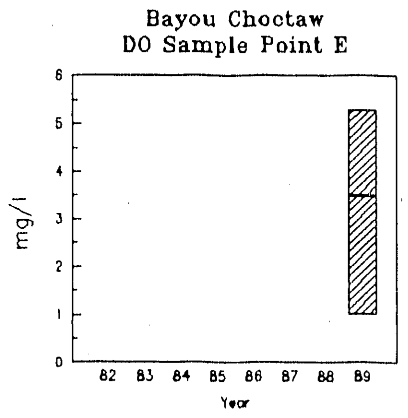
The consistency in DO observation suggests that SPR runoff and discharges do not significantly reduce the DO of receiving waters. Low levels observed at various times of the year are attributed to low flow and minimal flushing typically observed at times in a wetland environment.

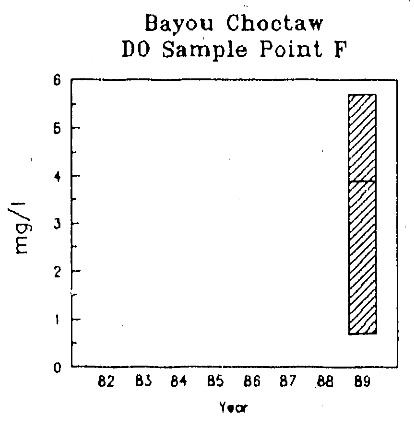






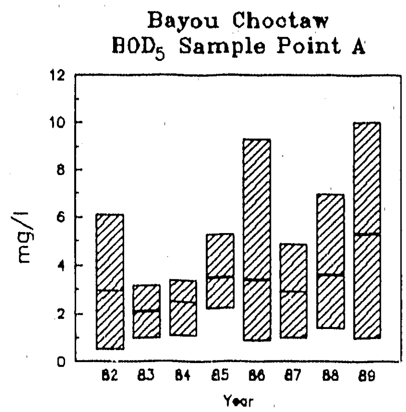


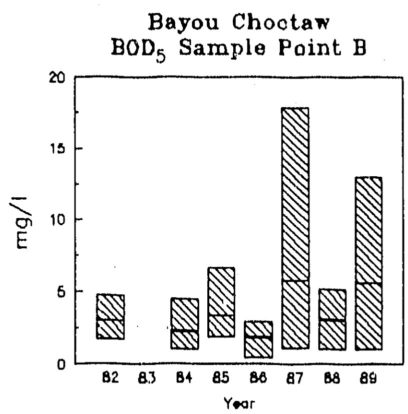


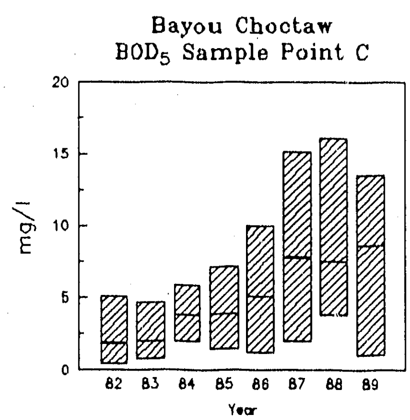


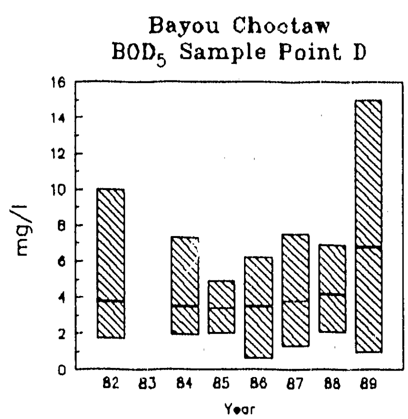
3.2.2.6 Biochemical Oxygen Demand (BOD_5)

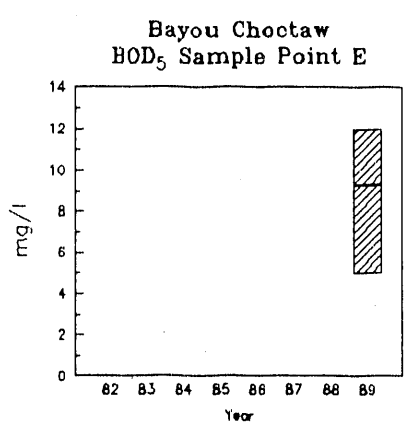
Ranges observed during previous years were similar to the 1989 data. Mean BOD_5 has shown a slight upward trend since 1982, but is still considered typical for the area. These data indicate general low organic loading in the Bayou Choctaw surface waters supporting the contention that the observed DO levels are not due to organic decomposition originating from an inefficient sewage treatment plant.

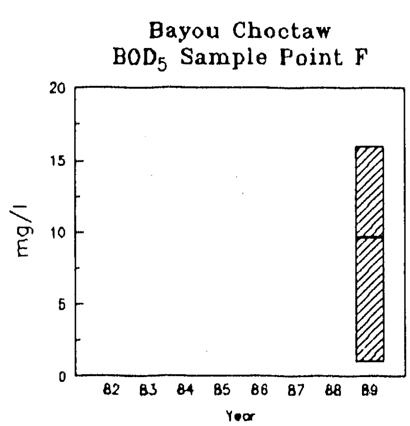

Bayou Choctaw
BOD_5 Sample Point A
mg/l
Year
82 83 84 85 86 87 88 89


Bayou Choctaw
BOD_5 Sample Point B
mg/l
Year
82 83 84 85 86 87 88 89


Bayou Choctaw
BOD_5 Sample Point C
mg/l
Year
82 83 84 85 86 87 88 89

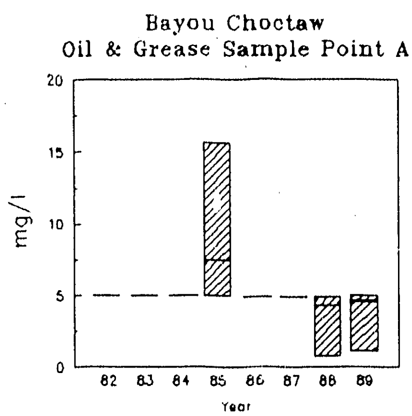

Bayou Choctaw
BOD_5 Sample Point D
mg/l
Year
82 83 84 85 86 87 88 89

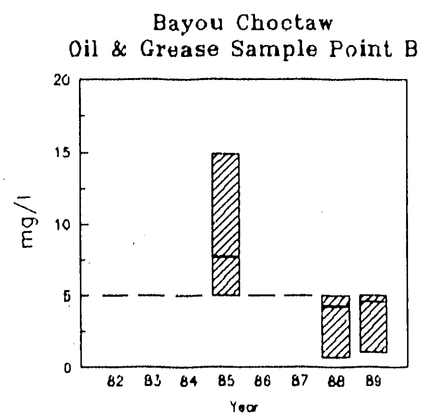

Bayou Choctaw
BOD_5 Sample Point E
mg/l
Year
82 83 84 85 86 87 88 89

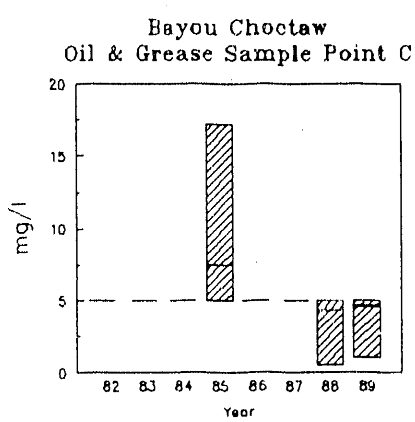

Bayou Choctaw
BOD_5 Sample Point F
mg/l
Year
82 83 84 85 86 87 88 89

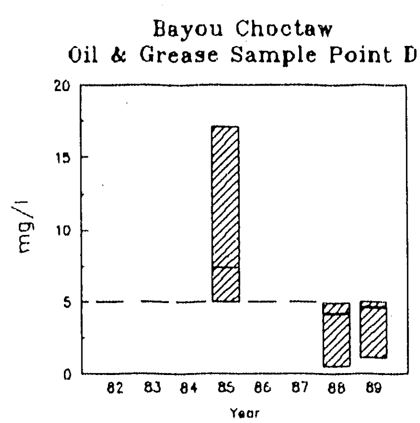
3.2.2.7 Oil and Grease

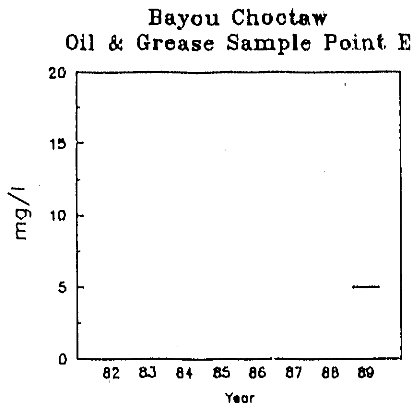
Oil and grease levels were below previously detectable levels (<5 mg/l) at all monitoring stations throughout 1989. These data are consistent with data collected since 1982 with the exception of 1985. Data prior to 1988 were obtained using "wet chemistry" methods which had a lower detection limit of 5.0 mg/l. Data for 1988 and 1989 were obtained using instrumentation with lower detection levels of 1 0 mg/l. The data favorably reflects continued good site housekeeping and effective site spill prevention, control, and response efforts.

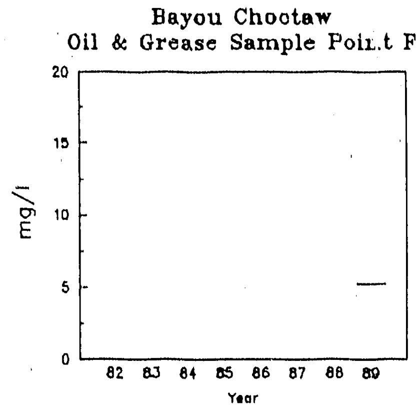












3.2.2.8 General Observations

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 pH.

b. The observed salinities were generally low. Those slightly elevated salinities observed were not attributed to SPR activity.

c. The moderately high TSS levels observed reflect ambient surface water conditions at Bayou Choctaw. Such conditions reduce the depth of the photic zone and may smother invertebrates. These conditions are not attributed to SPR operations, but rather appear indigenous to the area as demonstrated by consistently high TSS observations over an eight year period at both site and control stations.

d. The lower DO levels observed are attributed to low flow and minimal flushing. Typically observed in backwater swamp areas.

e. The consistently low BOD_5 and oil and grease levels observed since 1982 indicate that site oil spills and wastewater treatment plants are effectively managed, minimizing the impact on the Bayou Choctaw environs.

3.2.3 Water Discharge Permit Monitoring

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 and pump pads (containment areas).

Parameters for these discharge permits are described below.

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	flow	(report only)
	oil and grease	≤15 mg/l
	pH	6.0 - 9.0

A total of 621 analyses (7.7% for sewage and 92.2% for stormwater discharges) were conducted on permitted outfalls to monitor NPDES and state permit compliance during 1989. All four noncompliances (Table 3-2) in 1989 involved a failure to sample or analyze and were attributed to a temporary lab chemist employed at the site. A new permanent lab chemist is now employed at the site. A new procedure has been issued to improve STP operation. All other required analyses conducted on the site discharges were within permit limitations resulting in a 99.3% compliance level for 1989.

3.2.4 Active Permits

Table 3-3 lists the active permits at Bayou Choctaw. Individual work permits are received from the Louisiana Underground Injection Control Division for each well workover performed. State inspectors regularly visit the site to observe SPR operations.

OUTFALL LOCATION	PERMIT PARAMETER	VALUE / LIMIT	CAUSE
Storm water	ALL	______	Failure to obtain sample from well pad before discharge
002	pH	______ / 6.0 - 9.0 SU	NO DATA
002	pH	______ / 6.0 - 9.0 SU	NO DATA
002	TSS	______ / 20 mg/1	NO DATA

The three noncompliances at Bayou Choctaw outfall 002 were due to oversights of a temporary laboratory technician. There is no indication that the samples involved would have exceeded permit limitations.

Table 3-2. 1989 Noncompliances/Bypasses at Bayou Choctaw

PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053040 (NPDES)	EPA	NPDES	3/13/88	3/12/93	(1)
WP0179	LDEQ	Water (Disch.)	7/22/83	7/21/88	(1) (5)
1280-00015-000	LDEQ	Air	10/01/87	Open	
None	LDNR	Injection	1/11/83	Open	(2)
SDS-1	LDNR	Injection	9/09/77	Open	(8)
LMNOD-SP (Bayou Plaquemine)17	COE	Maint.	09/26/77	9/26/87	(3) (7)
LMNOD-SP (Bull Bay)3	COE	Constr. Maint.	01/30/79 1/30/79	01/29/82 09/26/87	(4), (6) (7)

(1) Renewal submitted (2/2/83 and 11/9/87).
(2) Letter of financial responsibility to plug and abandon injection wells.
(3) Maintain 36-inch crude oil pipeline.
(4) Dredge and maintain Bull Bay. 24" Brine Disposal Pipeline.
(5) No response from LDEQ. Application to be resubmitted.
(6) Recorded with applicable Registrar of Deeds.
(7) Maintenance clause of permit us being renewed.
(8) Permit approved use of salt dome cavities for storage of liquid Hydrocarbons

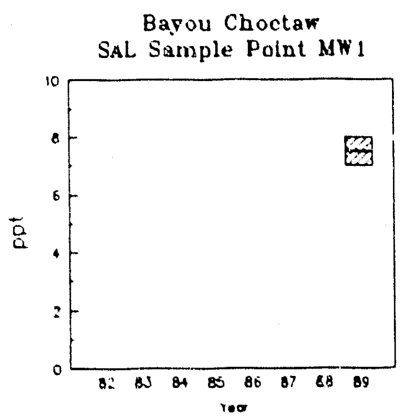
* COE - U.S. Army Corps of Engineers
EPA - Environmental Protection Agency
LDEQ - Louisiana Department of Environmental Quality
LDNR - Louisiana Department of Natural Resources

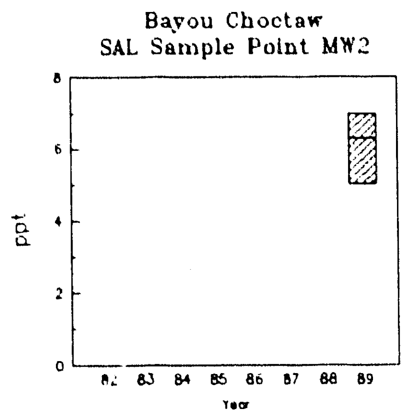
Table 3-3. Active Permits at Bayou Choctaw

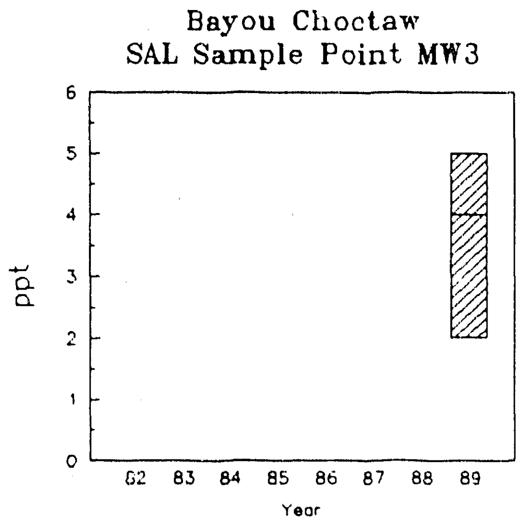
3.2.5 Groundwater

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 Atchafalaya clay. The interface of freshwater and saline water occurs at a depth of 122 to 150 m (400-500 ft) below the surface. Groundwater 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 installed at the Bayou Choctaw facility in September 1989. Initial sampling has indicated low salinity levels both upgradient and downgradient. Sampling will continue throughout 1990.







3.2.6 Other Significant Environmental Activity

Liquid samples (oil or brine, as found) from previously abandoned caverns 1, 2, 3, 8A, and 13, boreholes 1 and 2, and coreholes 5 and 9 were sampled, analyzed and determined to be nonhazardous. Cavern 10, which contained caustic brine with a high lead level in the oil/brine interface, was wireline sampled at ten depths. The nonhazardous caustic was determined to be confined to the interior of the casing pipe, connecting the surface to the cavern. This material was pumped to the brine pond for deep well injection. The lead contaminated interface oil (9 barrels) was incinerated offsite. All above-mentioned caverns and holes had not been used by DOE and in accordance with state approved plan were plugged and abandoned in 1989.

In response to the DOE headquarters survey and after brine pond refurbishment, three monitoring wells were installed to monitor brine pond integrity.

The Bayou Choctaw to St. James Terminal crude oil pipeline exhibited pressure fluctuations while the line was idle. These fluctuations were attributed to temperature changes and not to leakage, as originally suspected, after several tests and data review.

3.3 BIG HILL

The Big Hill site is planned for the storage of 25.4 million m^3 (160 MMB) of crude oil in 14 caverns. Appurtenant facilities include a raw water intake structure on the Intracoastal Waterway with a 107 cm (48 in) pipeline extending to the site, a 107 cm (48 in) brine disposal pipeline extending 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.

Drilling and construction commenced in 1983 at the site. Actual leaching (solution mining) of the oil storage caverns began in October 1987 and has continued.

3.3.1 Air Quality

The Big Hill facility operated in accordance with applicable air quality regulatory requirements and all conditions of the air quality permit. This included wetting plant roads with water and dust abatement chemicals to control fugitive dust emissions. Annual hydrocarbon emission monitoring as required by the permit will commence when actual crude oil storage (planned for October 1990) is initiated.

3.3.2 Surface Water Quality Monitoring

Beginning July 1989, selected locations were established as monitoring stations 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 such as pH, salinity, temperature, total organic carbon (TOC) or oil and grease, and dissolved oxygen (DO), were monitored. Initial data collected in 1989 will be incorporated with data collected in 1990 to establish trend information. Insufficient data has been collected to formulate any conclusions. However, observation of surrounding areas indicates that there has been no visible impact from SPR operations.

3.3.3 Water Discharge Permit Monitoring

Water discharges at Big Hill are regulated and enforced through the EPA NPDES permit program and the similar TWC discharge permit program. An NPDES renewal application was submitted in 1988 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, and stormwater from well pads and pump pads. Figure 3-2 shows the existing outfalls and the proposed water quality monitoring locations.

There were no discharges during 1989 from the hydroclone blowdown system or the sewage treatment plant. The sewage treatment plant is being retrofitted and will be brought on line in 1990. A vacuum truck service is hauling the sewage to the local community sewage treatment plant. Parameters for the two active discharges are described below.

Location/Discharge	Parameter	Compliance Range
brine to Gulf	flow	0.27 million m^3/day
	velocity	$\geq$ 6.1 m/sec)
	oil and grease	$\leq$ 15 mg/l
	TDS	(report only)
	TSS	< 40 mg/l (TWC only)
	pH	6.0-9.0
	DO	detectable (when using O_2 scavenger)
stormwater	oil and grease	$\leq$ 15 mg/l
	TOC	$\leq$ 75 mg/l (EPA only)
	pH	6.0-9.0
sewage treatment plant (TWC only) (not in use)	flow	< 37.8 m^3/day
	BOD5	$\leq$ 45 mg/l and $\leq$ 0.38 kg/day
	TSS	$\leq$ 45 mg/l and $\leq$ 0.38 kg/day only)
	chlorine	$\geq$ 1.0 mg/l
	pH	6.0-9.0
hydroclone blowdown (not used)	flow	report
	TSS	report
	pH	6.0-9.0

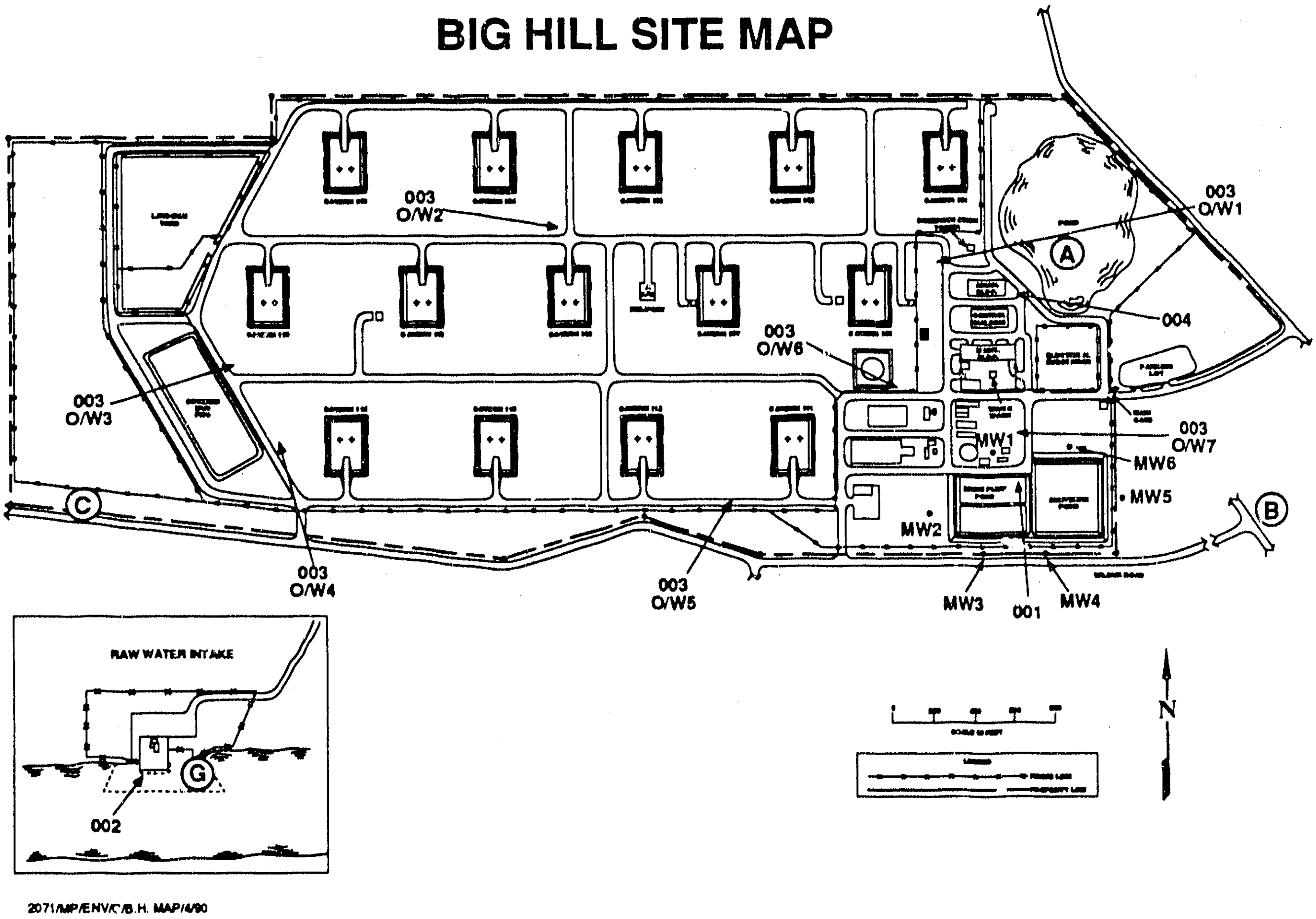


Figure 3-2 (Sheet 1 of 2). Big Hill Environmental Monitoring Stations

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 (TWC only)

Proposed Water Quality Stations

A Ten Acre Pond
B Pipkin's Cow Pond - southeast of site
C Wilber Road Ditch - southwest of site
D Reservoir and raw water & brine pipelines @ mile marker 03
E Reservoir and raw water & brine pipelines @ pole 47
F Culvert crossover (Gator Hole) on RWIS road
G RWIS at Intracoastal Waterway

Groundwater Monitoring Stations

MW1 North of brine pond
MW2 West of brine pond
MW3 South of brine pond
MW4 South of anhydrite pond
MW5 East of anhydrite pond
MW6 North of anhydrite pond

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

A total of 2551 analyses were performed to monitor NPDES and state discharge permit compliance during 1989. Brine discharges to the Gulf accounted for 56.2% of these analyses and analyses of stormwater accounted for 43.8%. There were 3 noncompliances during 1989 (Table 3-4) resulting in a 99.9% site compliance performance level.

3.3.4 Active Permits

Table 3-5 lists the active permits at Big Hill. The Big Hill site has submitted an amendment to its TWC 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 1989, the site appropriated 76.7 million m^3 (62,188 acre-feet) of water from the Intracoastal Waterway. This represents 20% of the total volume permitted.

3.3.5 Groundwater

The three major subsurface hydrological formations in the Big Hill area are the Chicot and Evangeline aquifers and the Burkville aquiclude. 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 at Big Hill 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.

Six monitoring wells were installed around the brine disposal pond system and were sampled for the first time in December 1987. Data collected for the past two years indicate a consistency between monitor wells. The wells are also consistent within each parameter indicating acceptable conditions between upgradient MW 1, 2, and 3 and downgradient

OUTFALL LOCATION	PERMIT PARAMETER	VALUE LIMIT	CAUSE
003	pH	9.3 & 9.5 / 9.0	Well pad drain leak-(since corrected) missing gaskets on Camlock caps
TWC 004	TSS	35 mg/l / 20 mg/l	Sewage treatment plant overload due to flushing activity for startup of new expansion unit. No sewage effluent in plant.
003	ALL	______	Failure to sample - wellpad drains left open during Hurricane Chantal

There was no evidence to indicate that the above noncompliances caused any adverse environmental impact.

Table 3-4. 1989 Noncompliances/Bypasses at Big Hill

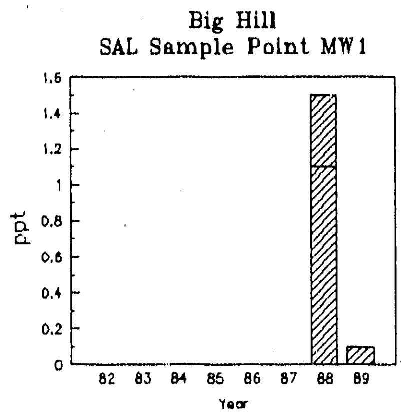
PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0092827	EPA	NYDES	01/18/88	01/17/94	(1)
SWGCO-RP 16536 (01,02,03)	COE	Constr. Maint.	01/11/84 01/11/84	01/11/94 Open	(2)
P-7	F&WS	Constr. Operate	07/31/86 07/31/86	07/31/88 06/30/2036	(3)
C-9256	TACB	Air	05/17/83	Open	(4)
02937-02939	RCT	Operate	11/28/83	Open	(5)
P000226A-P000226B	RCT	Operate/ Maintain	09/19/84	Open	(9)
0048295-0048320	RCT	Operate	05/09/83 06/23/83	Open Open	(6)
02638	TWC	Water (Disch.)	03/27/89	03/26/94	(7)
4045	TWC	Water (Use)	11/14/83	Open	(8)

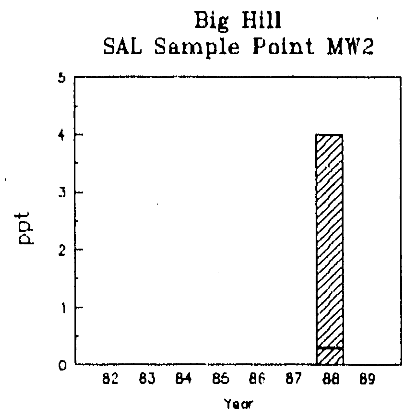
(1) Renewal submitted 9-23-88.
(2) Completion of raw water, brine disposal, and crude oil pipeline extended. Amended to install offshore pipeline by trenching.
(3) Completion of pipeline construction extended. (48" Brine Pipeline)
(4) While under construction.
(5) Valid until ownership changes, system changes, or other physical changes are made in the system.
(6) Permits to create, operate, and maintain an underground hydrocarbon storage facility consisting of 14 caverns.
(7) Corresponds to TX0092827. (EPA-NPDES)
(8) Permit expires after consumption of 239,080 acre-feet of water or end of project.
(9) Permits to operate and maintain anydrite and brine/oil pits.

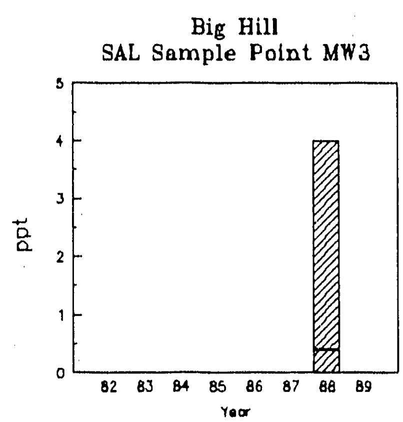
* F&WS - U.S. Fish and Wildlife Service
RCT - Railroad Commission of Texas
TACB - Texas Air Control Board
TWC - Texas Water Commission

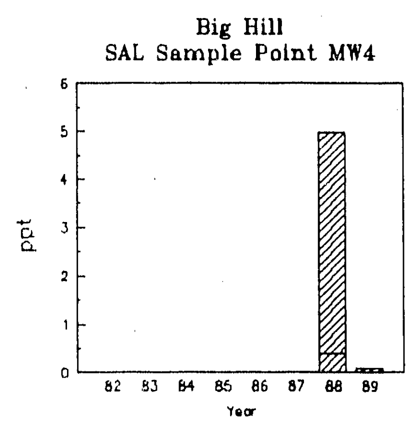
Table 3-5. Active Permits at Big Hill

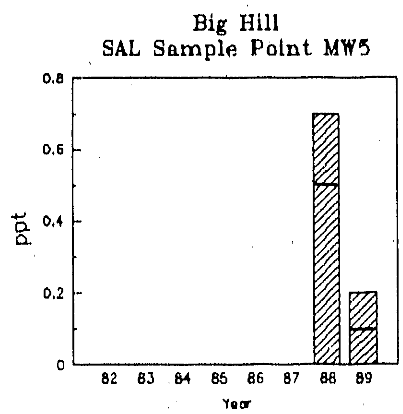
MW 4, 5, and 6 wells with no apparent leakage at the brine pond. Monitoring of these wells will continue so that a trend can be established.

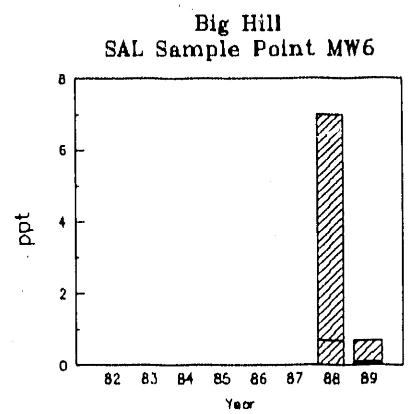












3.3.6 <u>Other Significant Environmental Activity</u>

The floating roof seals on the crude oil surge tank (BHT-7) were repaired and inspected. A report sent to the Texas Air Control Board (TACB) in lieu of agency inspection.

The use of brackish water as a fire fighting fluid, mentioned last year, was resolved by filling the fire water tank with fresh water. A project to increase the capacity of the "10 acre pond" for use as a fresh water source is in the approval stages. Brackish water would be used only as an emergency back-up.

3.4 BRYAN MOUND

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 20.1 km (12.5 mi) 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) crude oil pipeline from the site to the ARCO Refinery in Texas City.

3.4.1 Air Quality

The Bryan Mound facility, located in a nonattainment area for ozone, operated in accordance with all air quality regulatory requirements throughout 1989. The ongoing fugitive emissions monitoring program, as required by the TACB, includes monitoring for fugitive volatile organic compound (VOC) emissions from valves and seals on an annual basis using a VOC detector. The program includes monthly calculations of emissions based on crude oil throughput for each storage tank. No leaks of hydrocarbon vapors from valves or pump seals were detected during 1989. Hydrocarbon emissions from surge tanks were calculated at 2.1 metric tons (2.3 tons) during 1989, or 38% of the permitted limit (5.5 metric tons (6.1 tons) per year). A TACB inspection conducted during 1989 found no deficiencies in SPR air quality compliance.

3.4.2 Surface Water Quality Monitoring

The surface waters surrounding the Bryan Mound site were monitored throughout 1989. Blue Lake was sampled once monthly at each station. Mud Lake was sampled once monthly except during August and September when low tides restricted access to the lake.

Specific surface water monitoring stations are identified in Figure 3-3. 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 away from the shoreline in Mud Lake, serves as a control.

Specific parameters monitored in the Bryan Mound surface waters include pH, salinity, temperature, DO, and total organic carbon (TOC). The parameters are discussed below and compared to 1982 through 1988 monitoring data.

BRYAN MOUND SITE MAP

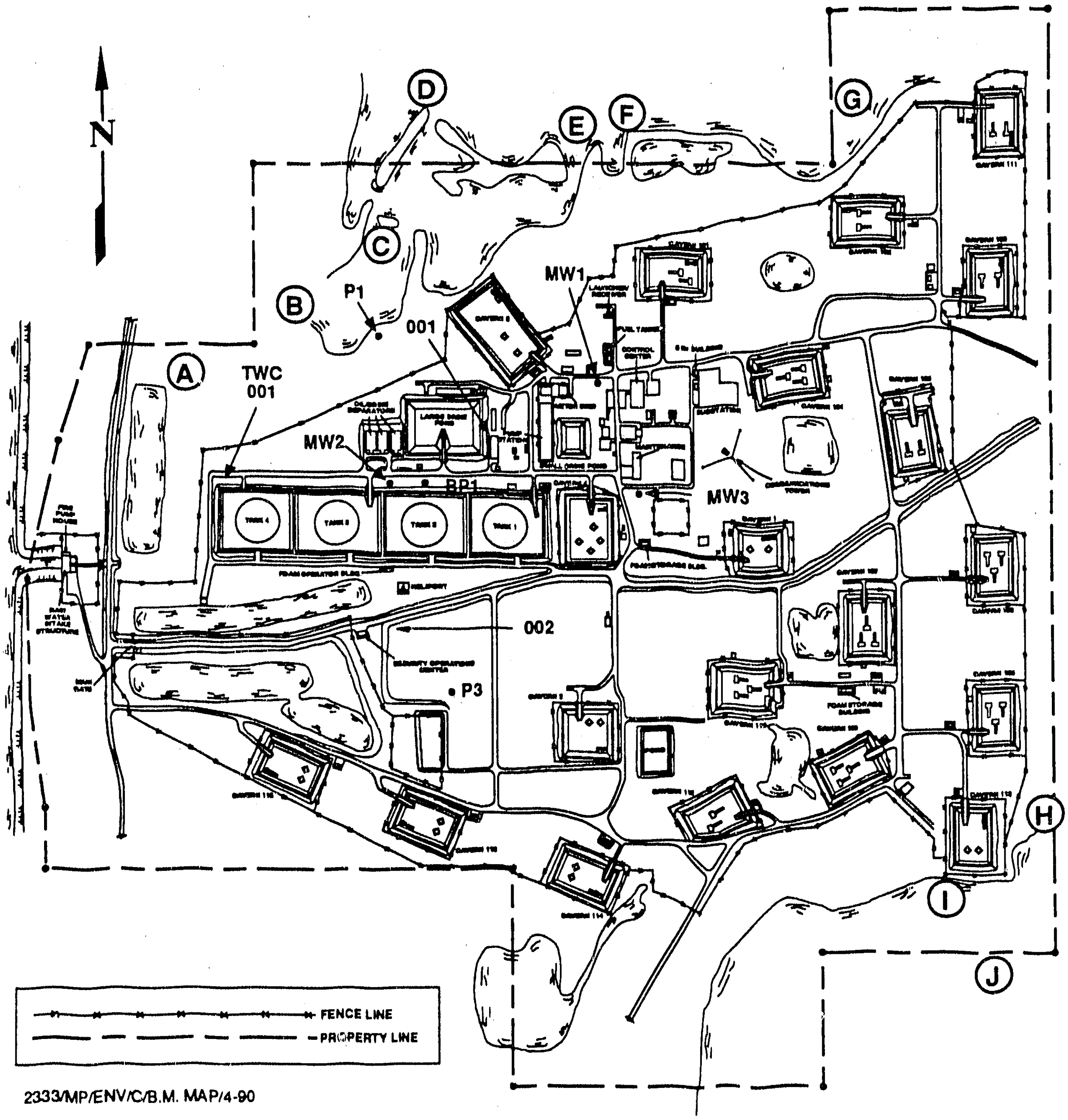


Figure 3-3 (Sheet 1 of 2). Bryan Mound Environmental Monitoring Stations

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

Groundwater Monitoring Stations

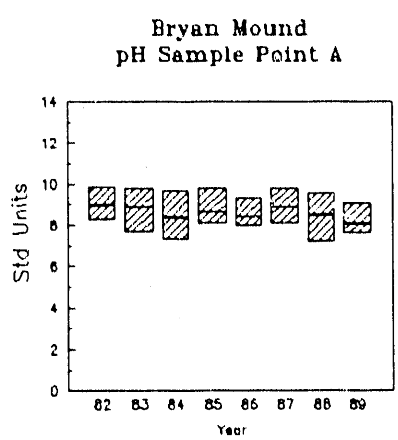
BP-1	South of brine pond
P1	Northwest of brine pond, between brine pond and Blue lake
P3	South of crude oil surge tanks
MW1	West of the control building
MW2	Southwest of the brine pond
MW3	South of the maintenance shop

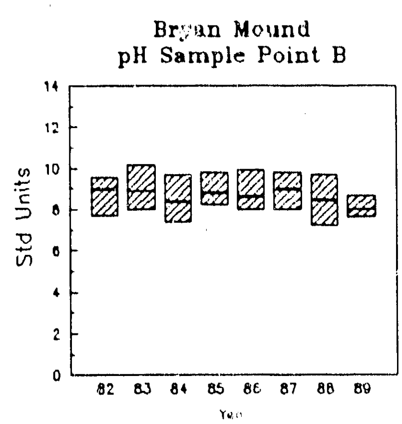
Figure 3-3 (Sheet 2 of 2). Bryan Mound Environmental Monitoring Stations

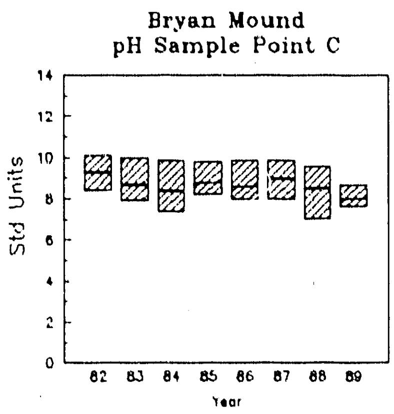
3.4.2.1 Hydrogen Ion Activity (pH)

pH data is relatively consistent with data from previous years. The consistently basic conditions indicate 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 pH levels and high mineral contents. The pH is believed to fluctuate 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.

There were no known pH inducing impacts resulting in any pH changes to Mud Lake during 1989 or previous years as indicated by these comparisons. Thus, minor pH fluctuations in the Bryan Mound surface waters appear to be the result of seasonal weather and tidal variations rather than site activity.






Bryan Mound
pH Sample Point C
Std Units
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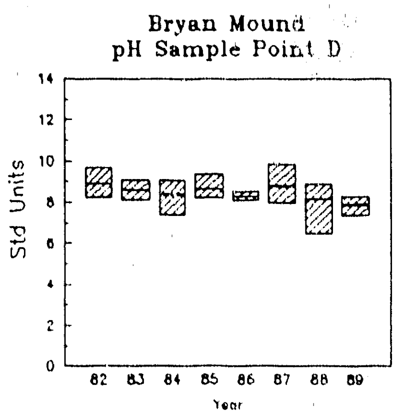
Year


Bryan Mound
pH Sample Point D
Std Units
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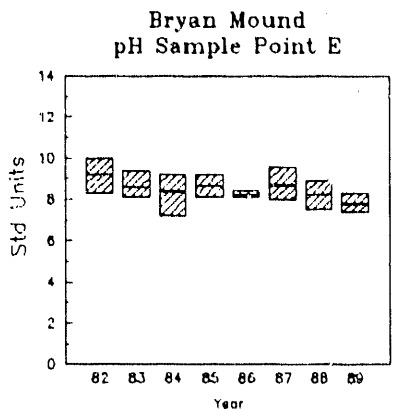
Year


Bryan Mound
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Std Units
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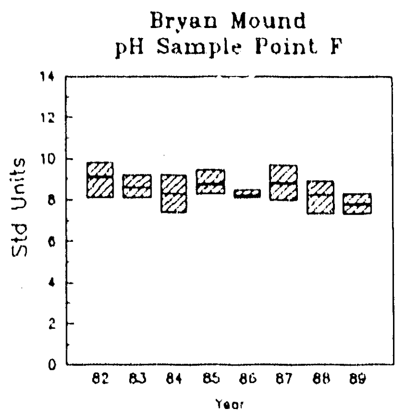
Year


Bryan Mound
pH Sample Point F
Std Units
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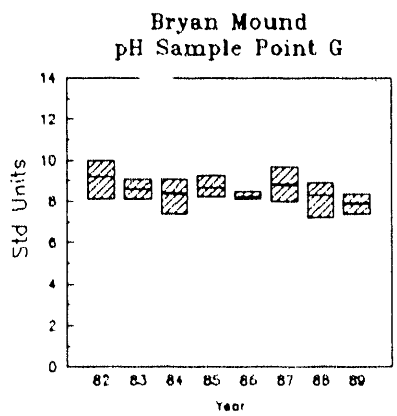
Year


Bryan Mound
pH Sample Point G
Std Units
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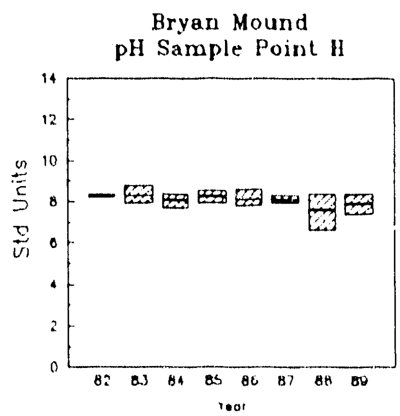
Year


Bryan Mound
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Std Units
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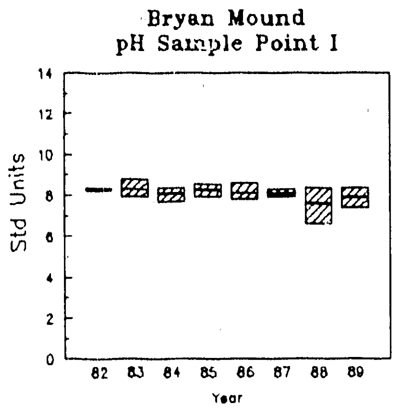
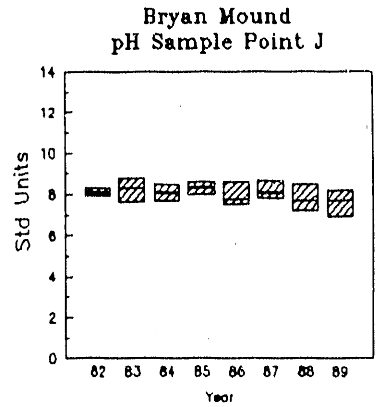
Year

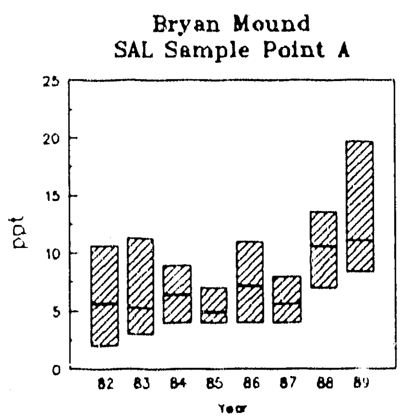


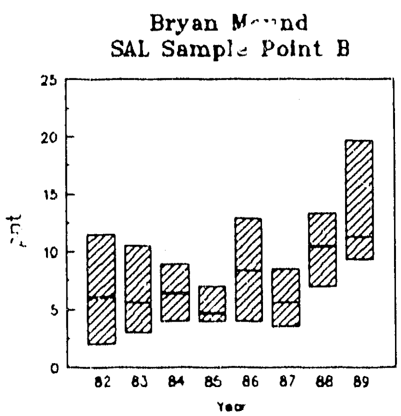


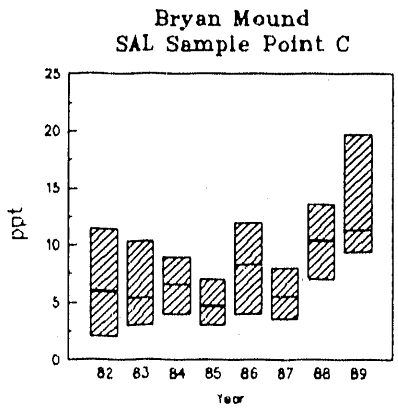
3.4.2.2 Salinity (SAL)

Salinity fluctuations in Blue Lake are attributed to meteorologically induced conditions rather than site operations, since salinities observed at control sample points were consistent with those found along the site shoreline.

Although there was a brine disposal pipeline failure in June of 1989, this event did not adversely affect Mud Lake. Mean salinities were at or below the midpoint since 1982. The larger salinity variations 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.



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ppt
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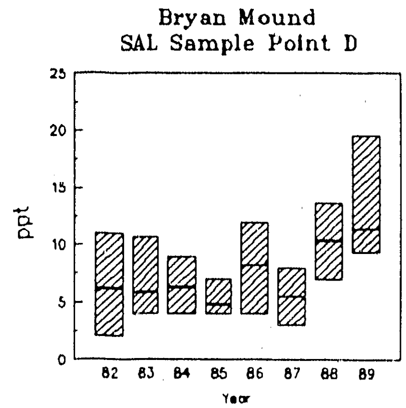
Bryan Mound
SAL Sample Point D
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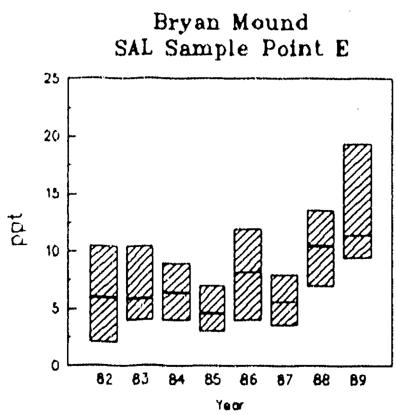
Bryan Mound
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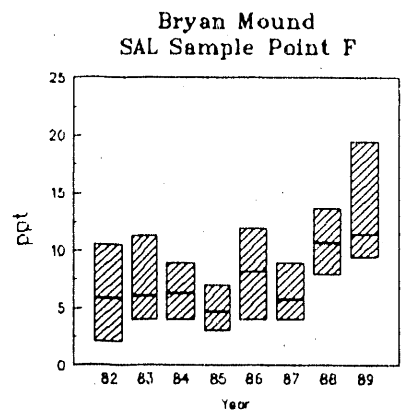
Bryan Mound
SAL Sample Point F
ppt
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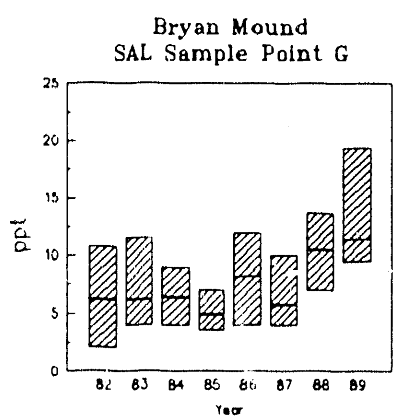
Bryan Mound
SAL Sample Point G
ppt
Year
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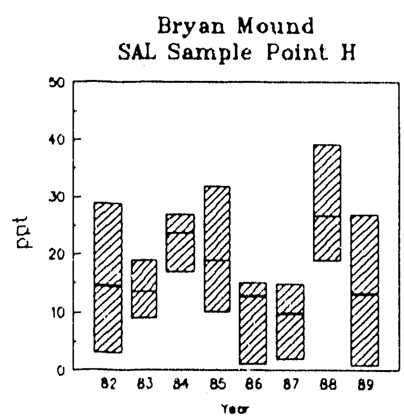
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ppt
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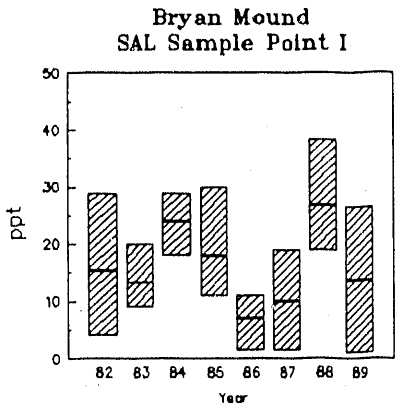
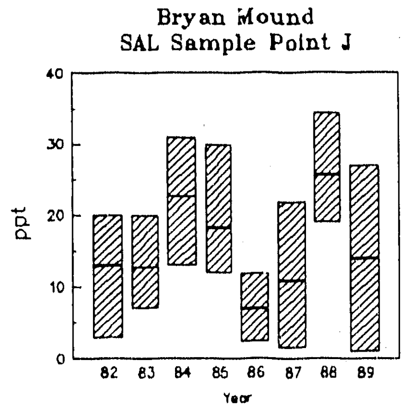
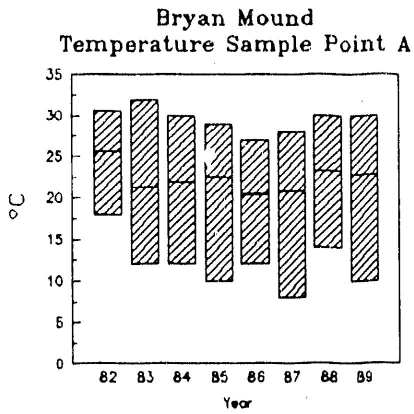
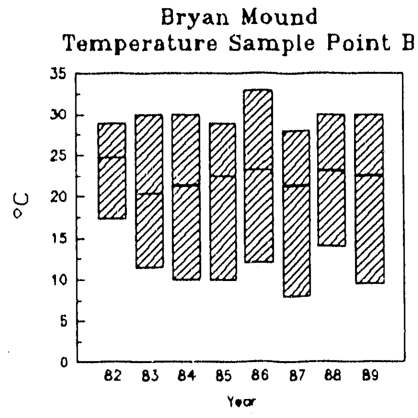




3.4.2.3 Temperature

Temperature data for 1989 was relatively consistent with data from previous years, which indicate fairly consistent temperatures with no influence from site operation.





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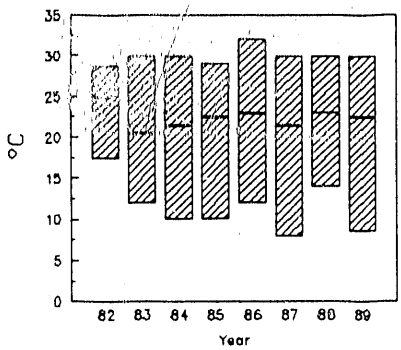
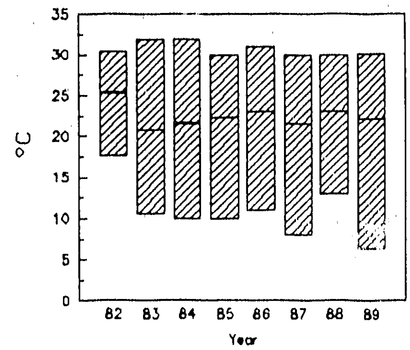
Temperature Sample Point C



Bryan Mound
Temperature Sample Point D



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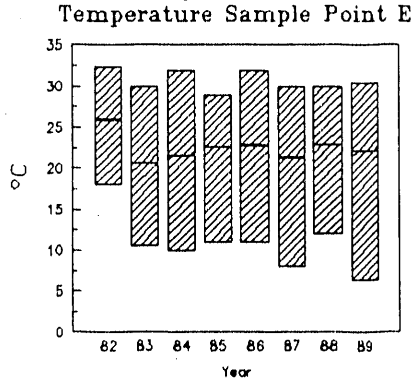
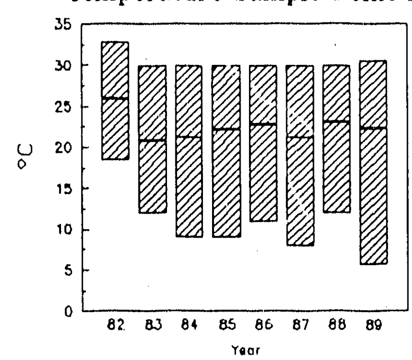
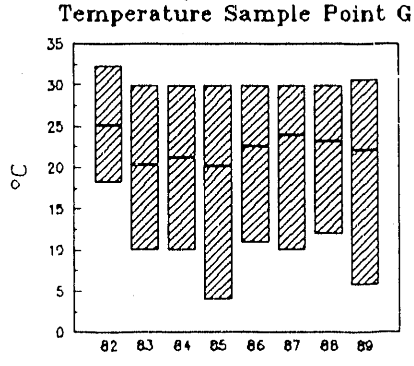
Temperature Sample Point E



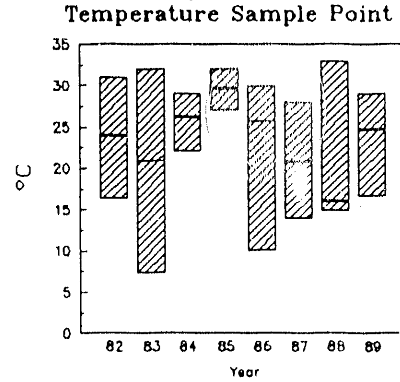
Bryan Mound
Temperature Sample Point F

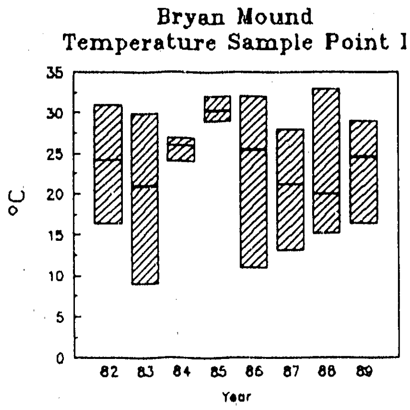


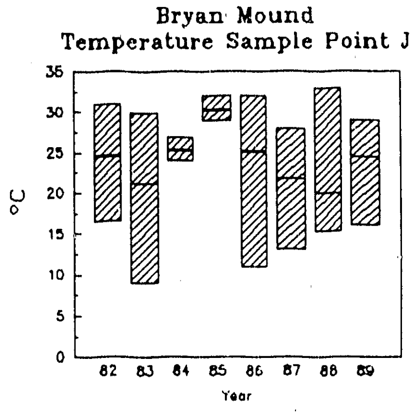
Bryan Mound
Temperature Sample Point G



Bryan Mound
Temperature Sample Point H

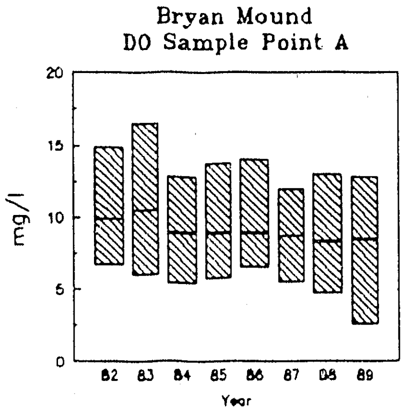


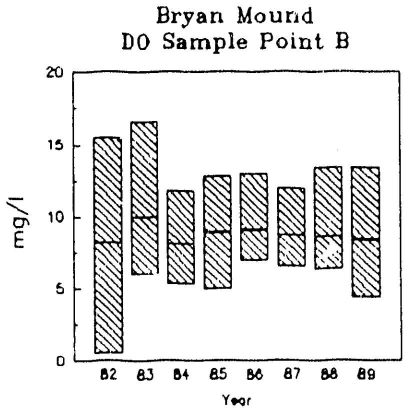


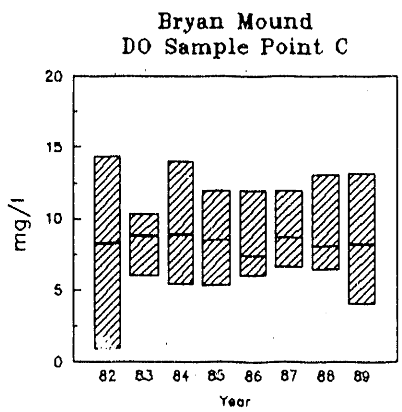


3.4.2.4 Dissolved Oxygen (DO)

The DO levels in 1989 were consistent with that observed since 1982. The DO ranges observed are considered beneficial to the aquatic organisms inhabiting these lakes. 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.



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DO Sample Point C
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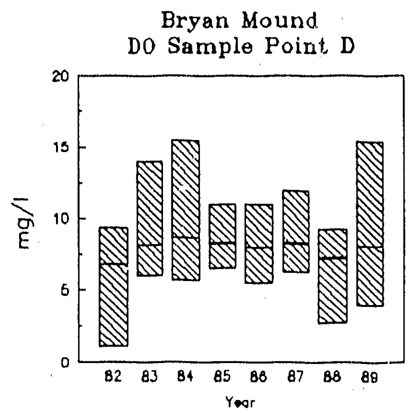
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DO Sample Point D
mg/l
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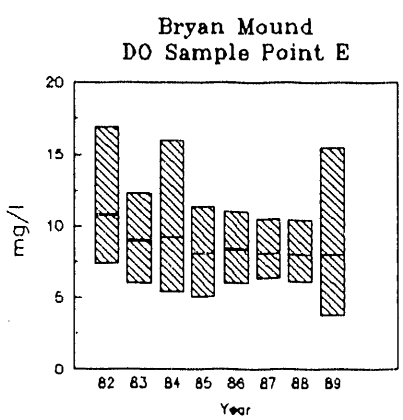
Year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DO Sample Point E
mg/l
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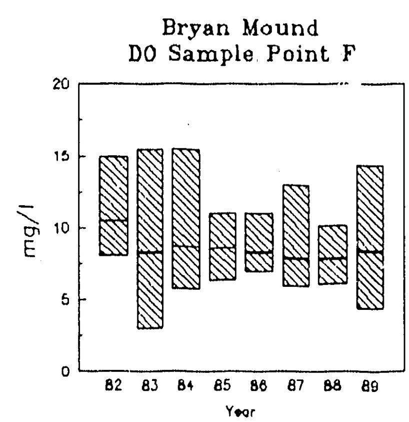
Year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mg/l
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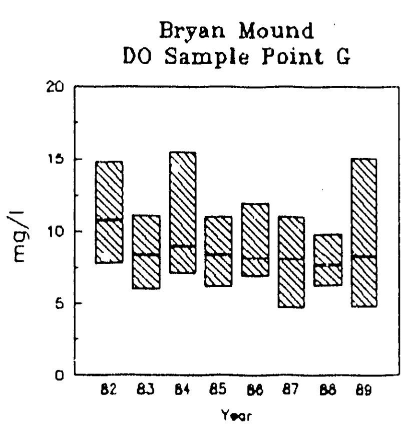
Year


Bryan Mound
DO Sample Point G
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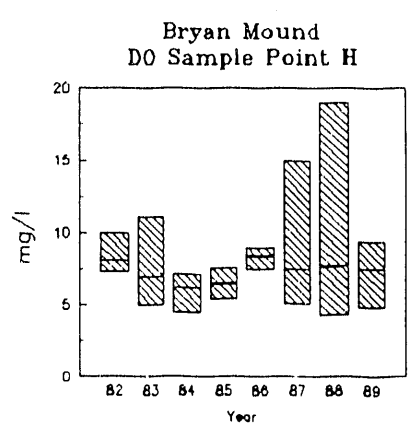
Year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DO Sample Point H
mg/l
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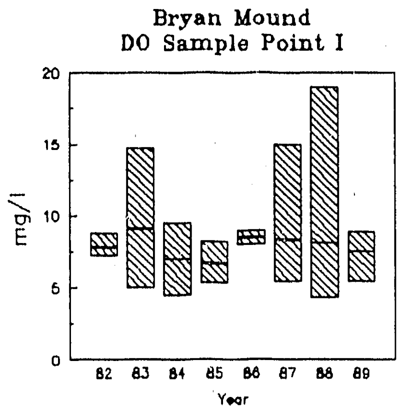
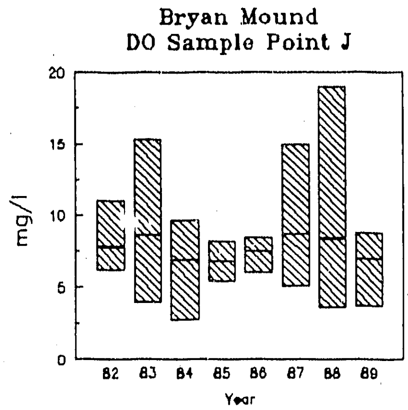
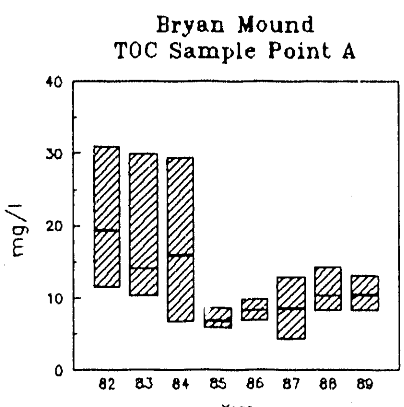
Year

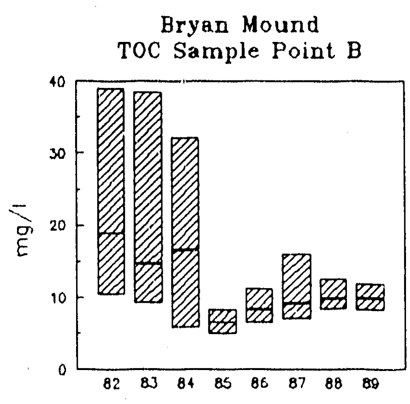


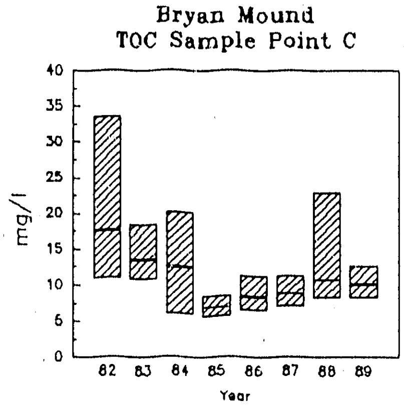


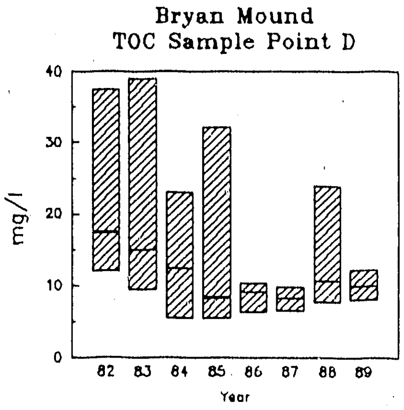
3.4.2.5 Total Organic Carbon (TOC)

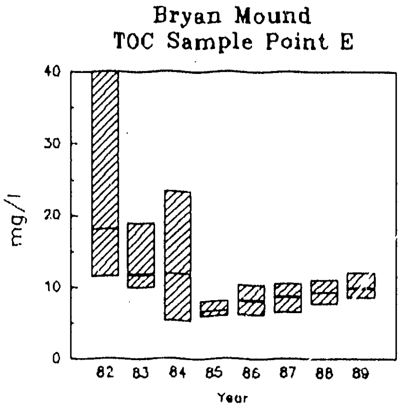
TOC data for 1989 is relatively consistent with data collected from previous years. The TOC concentration in Blue Lake remained low during 1989. The elevated concentrations attributed to natural phytoplankton blooms from 1982 through 1984 were not observed in subsequent years. The TOC concentration in Mud Lake remained low also. The low TOC levels observed in both lakes are consistent with healthy conditions and a stable oxygen demand.

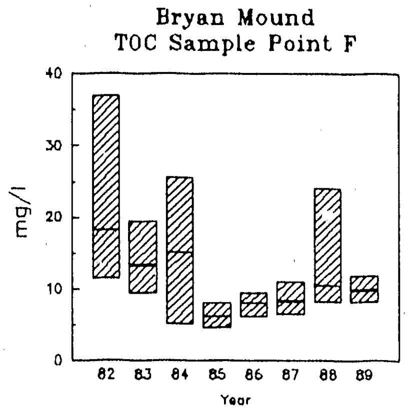


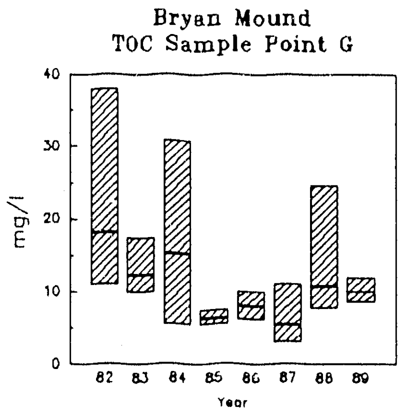


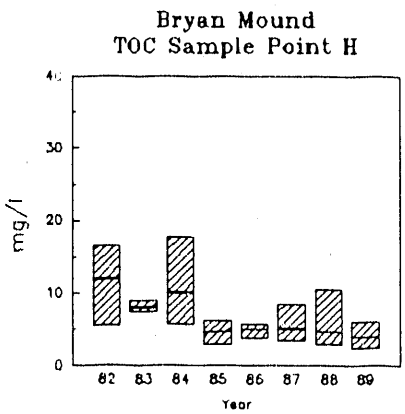

Bryan Mound
TOC Sample Point C
mg/l
Year
82 83 84 85 86 87 88 89

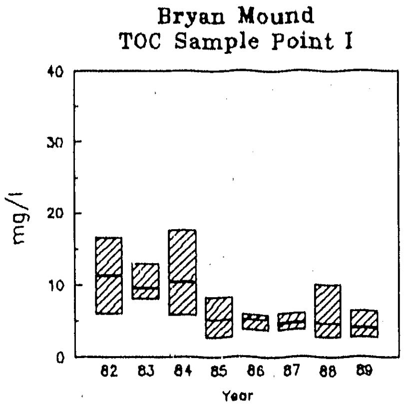

Bryan Mound
TOC Sample Point D
mg/l
Year
82 83 84 85 86 87 88 89

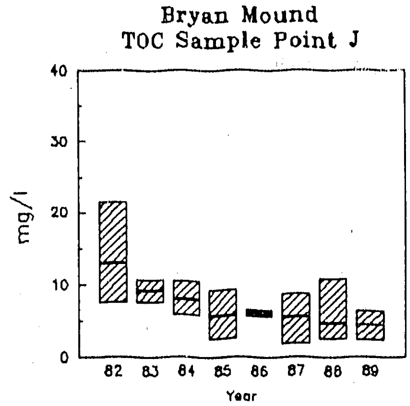

Bryan Mound
TOC Sample Point E
mg/l
Year
82 83 84 85 86 87 88 89


Bryan Mound
TOC Sample Point F
mg/l
Year
82 83 84 85 86 87 88 89


Bryan Mound
TOC Sample Point G
mg/l
Year
82 83 84 85 86 87 88 89


Bryan Mound
TOC Sample Point H
mg/l
Year
82 83 84 85 86 87 88 89





3.4.2.6 Additional Water Quality Monitoring

Visual surveys of adjacent water bodies were performed periodically to monitor those climatic events and environmental perturbations that may affect the SPR either directly or by association. Survey findings for 1989 were negative.

3.4.2.7 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 in Blue Lake and Mud Lake. This is consistent with the observed characteristic alkalinity and relative water hardness data from previous years.

b. Salinity levels in Mud Lake were generally consistent with that observed during previous years. Salinity fluctuations during and among years are attributed to meteorologically induced conditions rather than site operations.
Two tropical storms in 1989 appear to have had no major measurable adverse affects on either lake.

c. Levels of TOC and DO remained moderate and fairly constant throughout the year. These data indicate stable continued primary production.

d. 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 dramatic seasonal changes in water quality.

3.4.3 Water Discharge Permit Monitoring

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

Parameters for the three discharges are described below.

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
stormwater	flow	(report only)
	oil and grease	≤15 mg/l
	TOC	≤75 mg/l (EPA only)
	pH	6.0 - 9.0
	COD	≤200 mg/l (TWC only)
sewage treatment plant	flow	≤22.7 m^3/day (TWC only)
	BOD_5	≤45 mg/l and ≤0.68 kg/day
	TSS	≤45 mg/l and ≤0.68 kg/day
	chlorine	≥ 1.0 mg/l
	pH	6.0 - 9.0

A total of 1,524 analyses were performed on permitted outfalls for the purpose of monitoring NPDES and state discharge permit compliance during 1989. The brine discharges to the Gulf of Mexico accounted for 21% of these analyses. Other analyses were performed on stormwater and pump pad discharges (76%) and sewage treatment plant discharges (3%). There were three noncompliances during 1989 (Table 3-6) resulting in a 99.9% site compliance performance level.

3.4.4 Active Permits

Table 3-7 lists the active permits for the Bryan Mound site. The Bryan Mound site has a second TWC permit for 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 1989, the site appropriated 1.07 million m^3 (865.1 acre-feet) of water from the Brazos River Diversion Channel. A total of 146.96 million m^3 (119,142 acre-feet) of water has been appropriated to date for site activities which represents 32.4% of the total volume permitted.

3.4.5 Groundwater

The Chicot and Evangeline Aquifers are fresh and slightly saline in the Bryan Mound area. Fresh water for Brazoria County is obtained from the upper portions of the Chicot Aquifer.

Over the salt dome, fresh water is thought to occur in the upper 24 m (79 ft) with slightly saline water from a depth of 24 to approximately 69 m (79 to 226 ft). However, the wells drilled on site for rig water are all brackish.

The sampling of two existing monitoring wells, P1 and P3 began in April of 1988. Installation and sampling of two additional monitoring wells, BP1 and BP2 began in December of 1988. Three new monitoring wells (MW1, MW2, and MW3) were installed in August of 1989. BP2, crushed by a bulldozer, is out of service.

OUTFALL LOCATION	PERMIT PARAMETER	VALUE LIMIT	CAUSE
Stormwater	O&G	________	No Data - exceeded sample holding time
002	TSS	63.5 mg/l 45.0 mg/l	Unstable STP operation
001	ALL	________	Failure to sample
002	Flow	________	Stuck toilet caused STP to exceed allowed discharge flow rate
001	Low Nozzle Exit Velocity	________	Intermittent/low flow caused by leak resulted in a failure to maintain the required nozzle exit velocity. Discrepancy identified during integrity flow test.

STP = Sewage Treatment Plant

There is/was no evidence to indicate that the above noncompliances resulted in any significant adverse environmental impact.

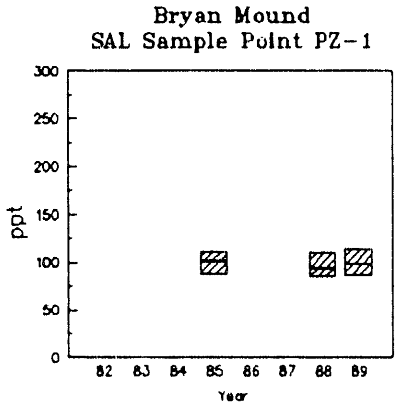
Table 3-6. 1989 Noncompliances/Bypasses at Bryan Mound

PERMIT NUMBER	ISSUING* AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
TX0074012	EPA	NYPDES	02/02/89	02/01/94	(1)
SWGCO-RP-12347(1)	COE	Dredging	02/29/84	12/31/94	(2)
3-67-782 (Docket#)	RCT	Injection	08/21/78	Open	(3)
P001447	RCT	Operate	10/30/84	Open	(5)
P001448	RCT	Operate	10/30/84	Closed	(4)
3-70-377 (Docket#)	RCT	Injection	12/18/78	Open	(3)
3681A	TWC	Water	07/20/81	Open	(6)
02271	TWC	Water	02/05/90	02/04/95	(7)
R-6176B	TACB	Air	02/23/87	Open	
82-8475	TDH&PT	Constr.	01/01/83	Open	(8)

(1) Renewal submitted 9/7/88.
(2) Maintenance dredging of raw water intake extended.
(3) Approval of oil storage and salt disposal program.
(4) Small brine pond closed August, 1989.
(5) Authority to operate brine pond.
(6) Permit expires after consumption of 367,088 acre-feet of water or project ends.
(7) Corresponds with TX0074012. (EPA-NPDES)
(8) Corresponds with SWGCO-RP-16177.

* TDH&PT - Texas Department of Highways and Public Transportation

Table 3-7. Active Permits at Bryan Mound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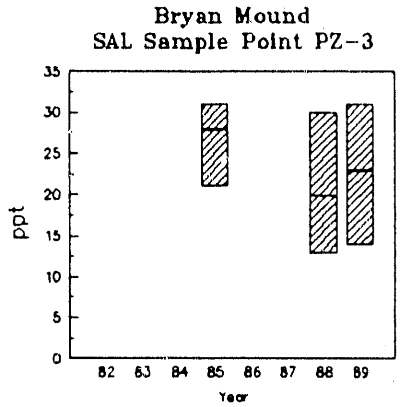
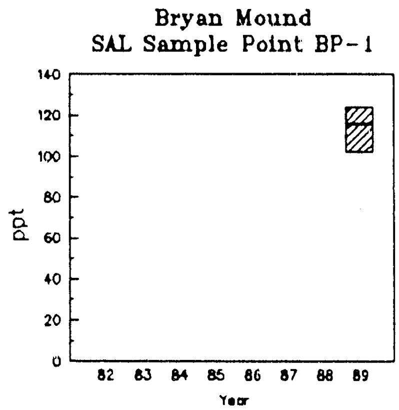
SAL Sample Point PZ-1
ppt
300
250
200
150
100
50
0
82 83 84 85 86 87 88 89
Year


Bryan Mound
SAL Sample Point PZ-3
ppt
35
30
25
20
15
10
5
0
82 83 84 85 86 87 88 89
Year


Bryan Mound
SAL Sample Point BP-1
ppt
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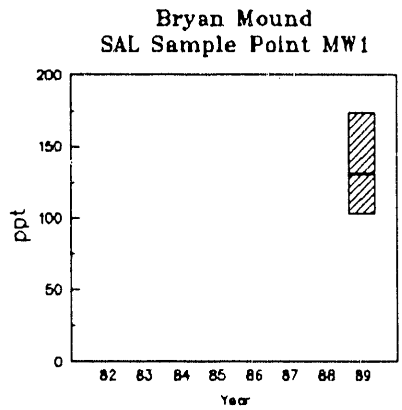
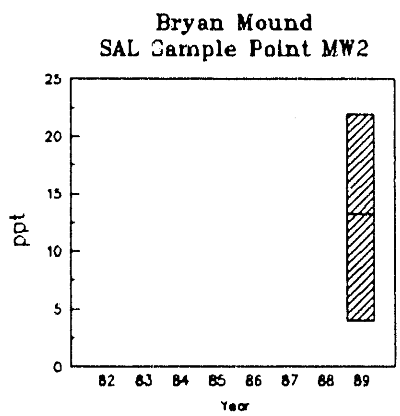
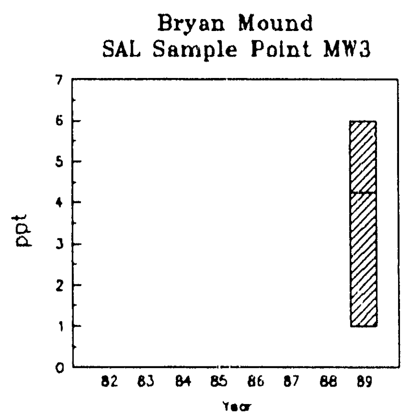
120
100
80
60
40
20
0
82 83 84 85 86 87 88 89
Year


Bryan Mound
SAL Sample Point MW1
ppt
200
150
100
50
0
82 83 84 85 86 87 88 89
Year


Bryan Mound
SAL Sample Point MW2
ppt
25
20
15
10
5
0
82 83 84 85 86 87 88 89
Year


Bryan Mound
SAL Sample Point MW3
ppt
7
6
5
4
3
2
1
0
82 83 84 85 86 87 88 89
Year

3.4.6 Other Significant Environmental Activity

A leak in the Bryan Mound brine disposal line was identified during a flow integrity test in June. About eight acres of coastal salt marsh was damaged. Soil, surface and ground water, and vegetation sampling and analysis was initiated immediately and will continue into 1990. Significant recovery from the salt damage due to natural hydrological events was apparent at the end of 1989.

Dye tests performed in 1987 on well pad 113 were effective in locating dike leaks which impaired stormwater retention capabilities. The high density polyethylene liner installed at well pad 113 will be maintained and replaced in 1991, at which time the well pad will be permanently repaired.

3.5 **ST. JAMES TERMINAL**

The St. James Terminal has six aboveground storage tanks (total capacity 0.3 million m^3 or two MMB) and two tanker docks. The terminal has separate crude oil pipelines connecting it with Weeks Island and Bayou Choctaw.

3.5.1 Air Quality

St. James Terminal operated in accordance with all air quality permit and regulatory requirements during 1989. Hydrocarbon emissions were well below the levels projected in the Emission Inventory Questionnaire (866 metric tons/year for loading operations and 541 metric tons/year for unloading operations). Seals on all six external floating roofs were visually inspected during 1989 and were in compliance with state air quality regulations. St. James is located in a nonattainment area for ozone.

3.5.2 Surface Water Quality Monitoring

St. James Terminal is located in a low-lying agricultural area beyond the west levee of the Mississippi River. All precipitation is effectively drained from the terminal and surrounding sugar cane fields by a series of ditches.

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 3-4) 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.

3.5.3 Water Discharge Permit Monitoring

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 are through a common pipe to the Mississippi River.

Parameters for the outfalls are described below.

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

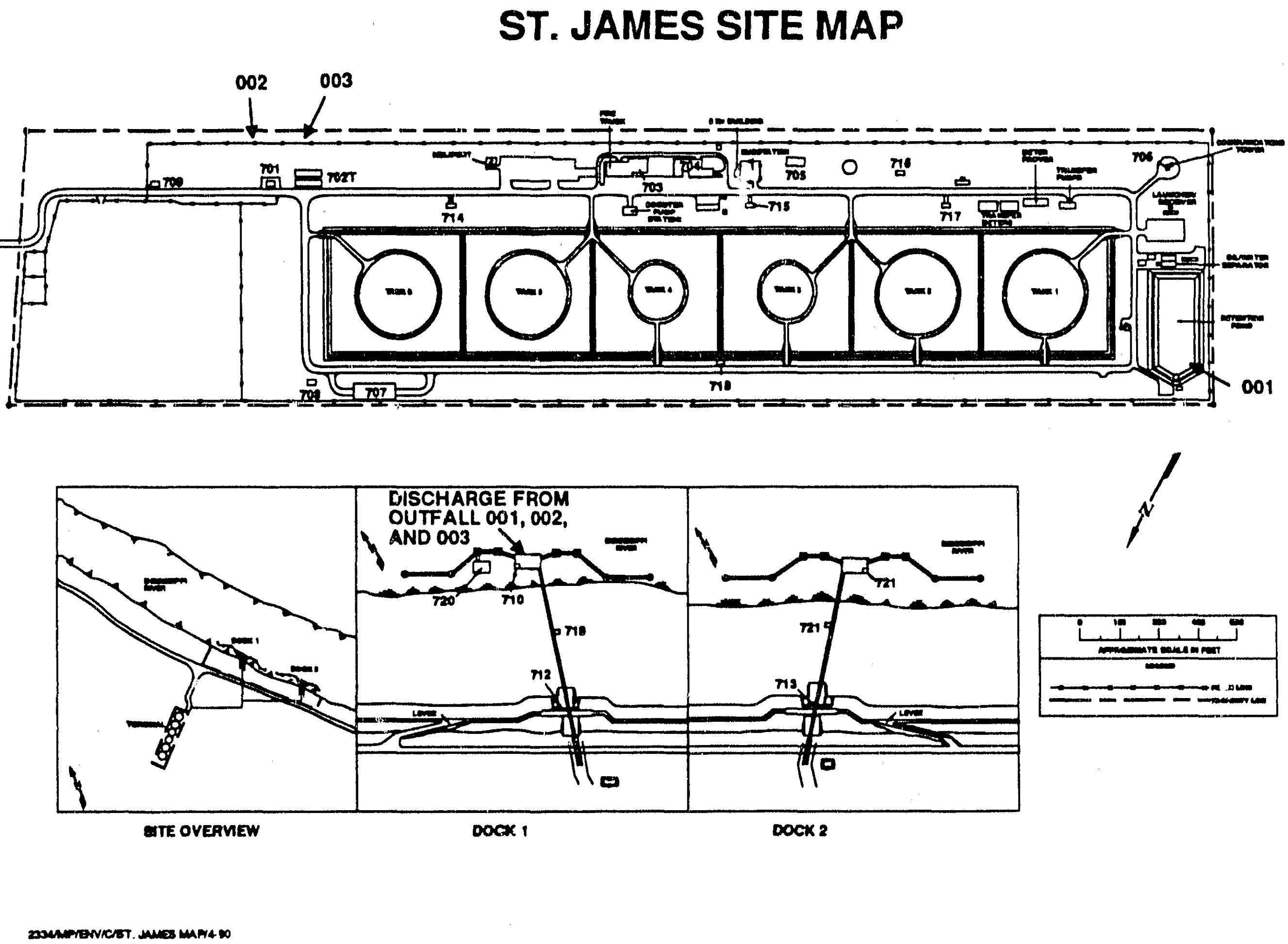


Figure 3-4 (Sheet 1 of 2). St. James Terminal Environmental Monitoring Stations

Discharge Monitoring Stations

001	Discharge from retention pond
002	Discharge from package sewage treatment plant
003	Discharge from package sewage treatment plant

Figure 3-4 (Sheet 2 of 2). St. James Terminal Environmental Monitoring Stations

A total of 72 analyses (42% for stormwater and 58% for sewage effluent discharges) were performed on permitted outfalls to monitor NPDES and state discharge permit compliance. There were four noncompliances in 1989 (Table 3-8) giving the site a 98.2% compliance level.

3.5.4 Active Permits

Table 3-9 lists the active permits at St. James Terminal.

3.5.5 Groundwater

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.

3.5.6 Other Significant Environmental Activity

Several minor corrective actions were completed by late 1989. Vapor plugs were installed in the crude oil tank sample tubes to minimize the emission of volatile organic vapors and replacement of the floating room vapor seals progressed during the year with completion scheduled for 1990.

3.6 **SULPHUR MINES**

Sulphur Mines stores 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 is connected to the Sunoco Terminal in Nederland by a 41 cm (16 in), 25.6 km (16 mi) crude oil pipeline which connects to the West Hackberry 107 cm (42 in) line at the Gulf Intracoastal Waterway. Brine disposal is via injection into four brine disposal wells located approximately two miles (3.2 km) southwest of the site.

3.6.1 Air Quality

Sulphur Mines operated in accordance with all air quality permit and regulatory requirements during 1989. No configurational or

OUTFALL LOCATION	PERMIT PARAMETER	VALUE LIMIT	CAUSE
001	TOC	________	No Data
001	TOC	________	No Data
001	O&G	________	No Data
002	pH	5.8 SU 6.0 - 9.0	Low pH in sewage treatment plant. Cause not known.

All outfall 001 noncompliances at St. James were due to oversights of a temporary laboratory technician. There is no indication that the samples involved would have exceeded permit limitations.

Table 3-8. 1989 Noncompliances/Bypasses at Saint James

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0054674	EPA	NPDES	07/11/90	07/10/95	
LMNOD-SP (Mississippi River) 998	COE	Maint.	03/20/78	03/20/88	(1)
WP 0929	LDEQ	Water (Disch.)	09/26/84	09/26/89	(3)
983	LDEQ	Air	07/25/78	Open	(2)

(1) Permit and all amendments recorded with Registrar of Deeds in St. James Parish.
(2) Requires annual operating report.
(3) LDEQ Air Permit renewal submitted.

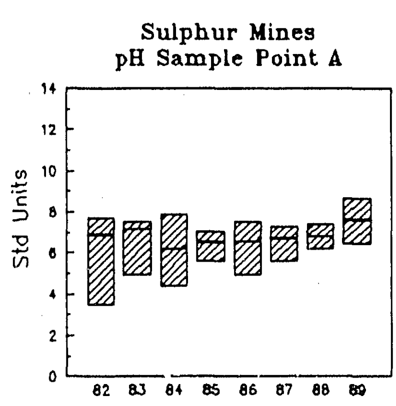
Table 3-9. Active Permits at St. James Terminal operational changes affecting emission rates occurred at Sulphur Mines. Hydrocarbon emissions, based on crude oil throughput, were well below levels in the Emissions during 1989. Inventory Questionnaire (0.2 metric tons (440 pounds)/year for standby (static) mode of operation). No air quality monitoring using actual monitoring equipment was required or conducted during 1989. This SPR site is located in a nonattainment area for ozone.

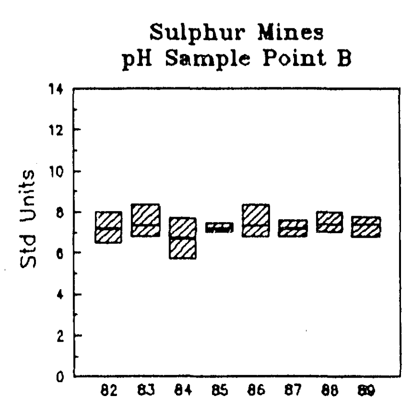
3.6.2 Surface Water Quality Monitoring

Samples collected once monthly at each monitoring station were used to monitor surface water quality. Specific monitoring stations are identified in Figure 3-5. Station C was not monitored during 1989 due to access problems associated with construction activities by an adjacent land owner. Specific parameters monitored in the Sulphur Mines surface waters were pH, salinity, TSS, temperature, oil and grease, and DO. These data are summarized and compared to data collected since 1982.

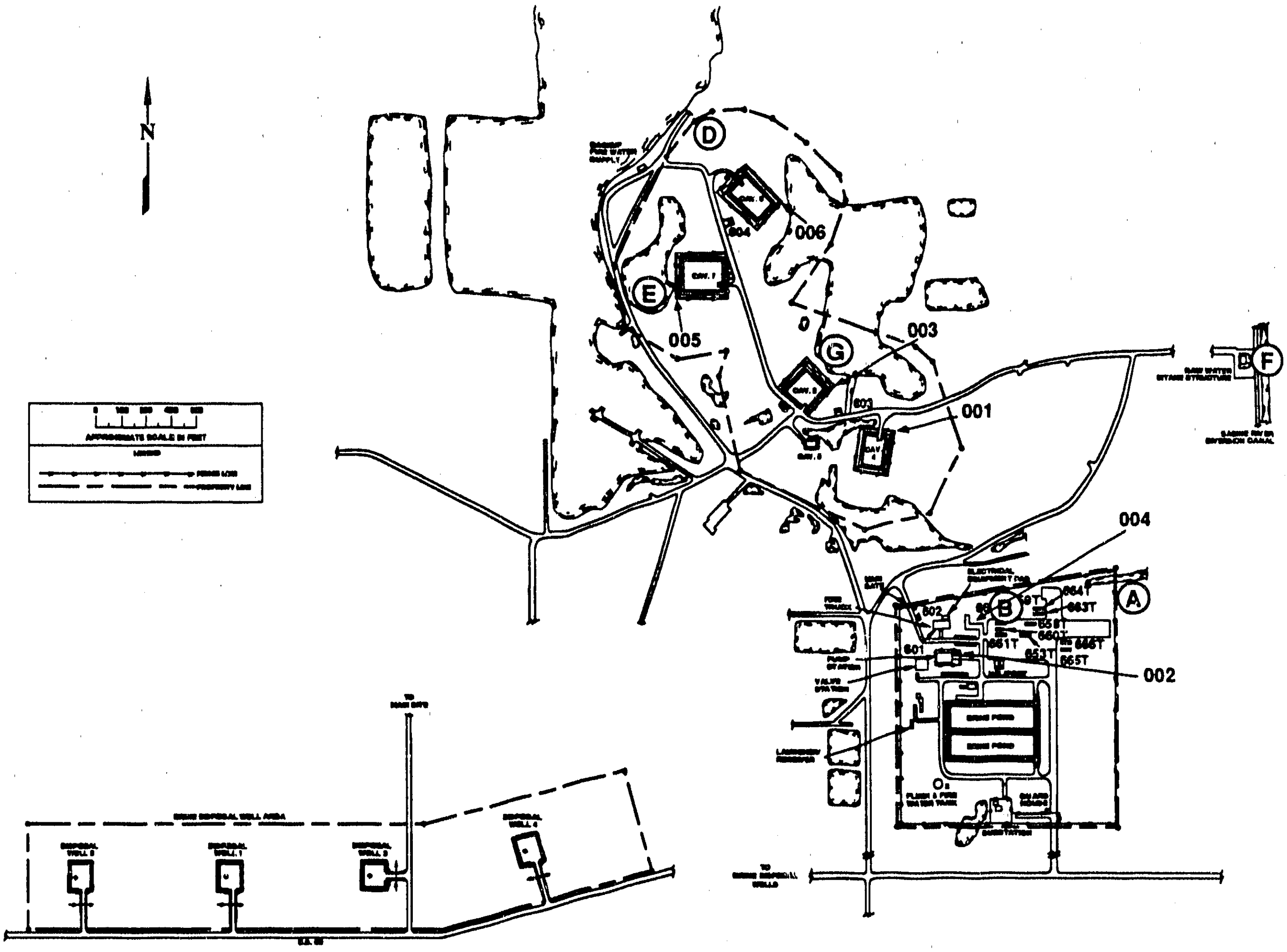
3.6.2.1 Hydrogen Ion Activity (pH)

1989 pH data was consistent with corresponding data from previous years.





SULPHUR MINES SITE MAP



2335/MP/ENV/C/B.H. MAP/4/90

Figure 3-5 (Sheet 1 of 2). Sulphur Mines Environmental Monitoring Stations

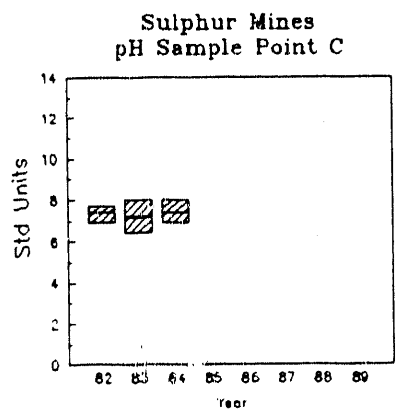
Discharge Monitoring Stations

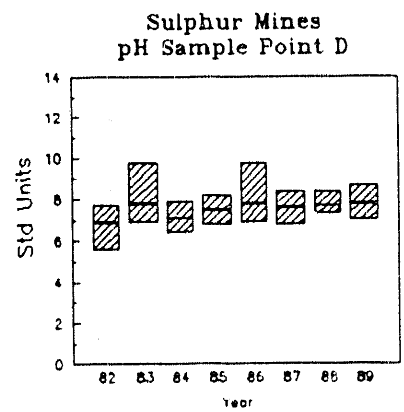
001	Stormwater runoff from well pad 4
002	Stormwater runoff from pump station
003	Stormwater runoff from well pad 2
004	Discharge from sewage treatment plant
005	Stormwater runoff from well pad 7
006	Stormwater runoff from well pad 6

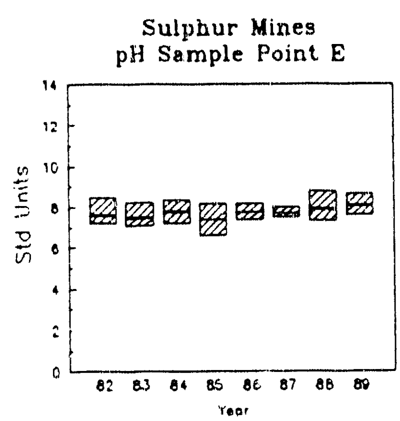
Water Quality Monitoring Stations

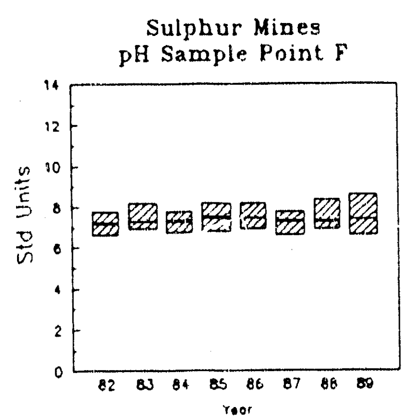
A	Drainage ditch at northeast corner of primary site
B	Creek north of primary site
C	Subsidence area (pump) replaced with G
D	Impoundment north of Cavern 6
E	Impoundment west of Cavern 7
F	Intake structure
G	Subsidence area

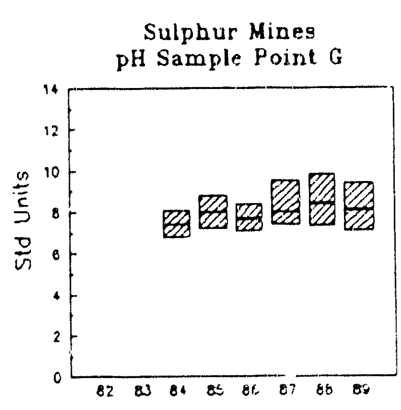
Figure 3-5 (Sheet 2 of 2). Sulphur Mines Environmental Monitoring Stations


Sulphur Mines
pH Sample Point C
Std Units
Year


Sulphur Mines
pH Sample Point D
Std Units
Year

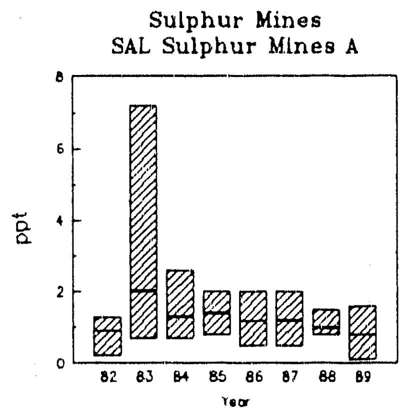

Sulphur Mines
pH Sample Point E
Std Units
Year

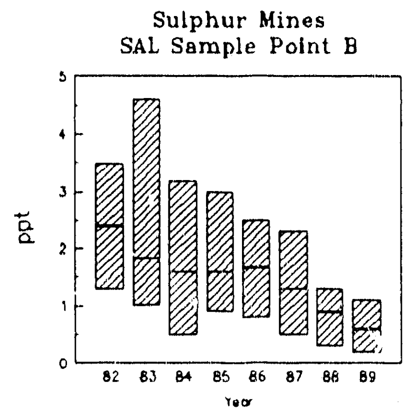

Sulphur Mines
pH Sample Point F
Std Units
Year

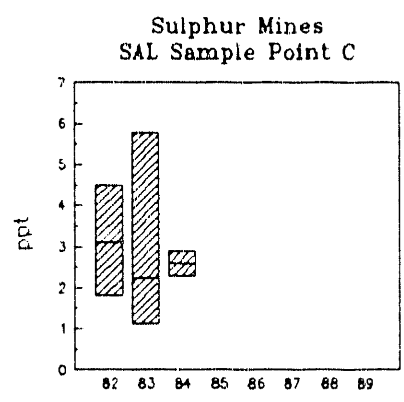

Sulphur Mines
pH Sample Point G
Std Units
Year

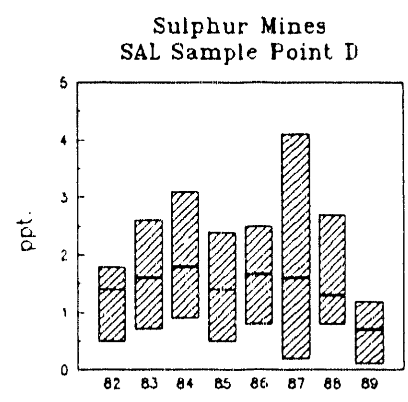
3.6.2.2 Salinity (SAL)

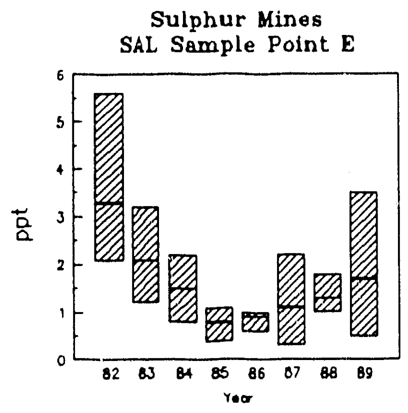
1989 salinity was consistent with overall salinities from previous years with a continuing slight decline observed at sample points B and G.

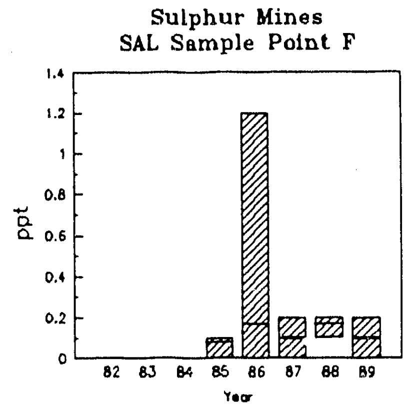


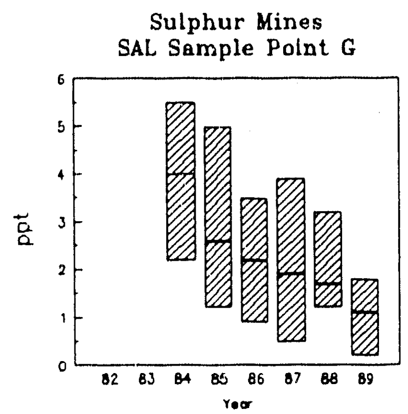






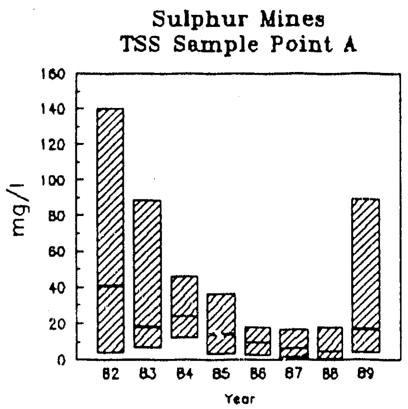


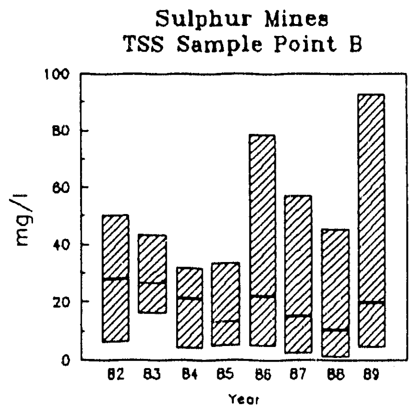


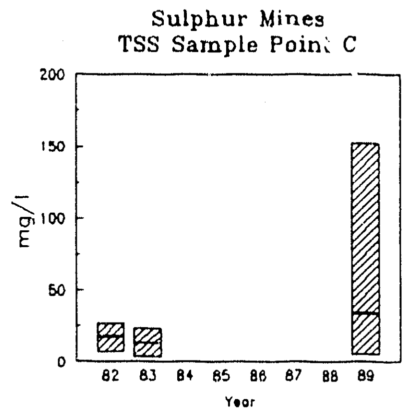


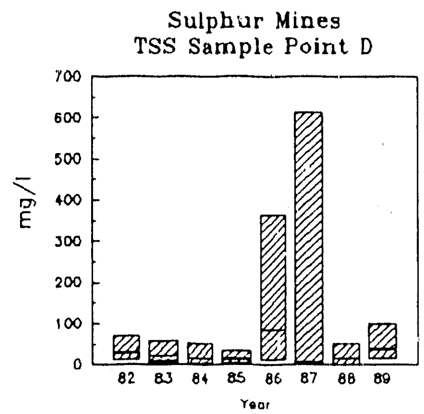
3.6.2.3 Total Suspended Solids (TSS)

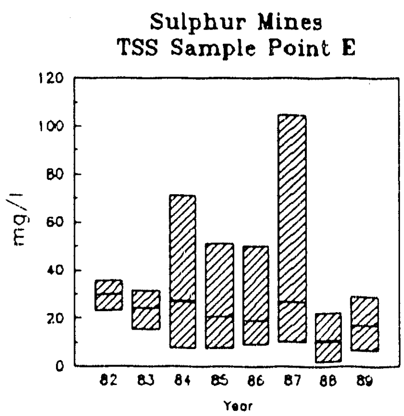
1989 TSS data was consistent with data from previous years. All site point source discharges were within permit limitations for TSS throughout 1989. The generally high and variable TSS levels observed in the surrounding waters are not attributed to any point source discharge from the site.

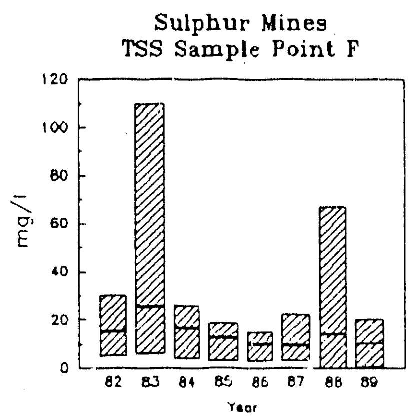

Sulphur Mines
TSS Sample Point A
mg/l
Year
82 83 84 85 86 87 88 89


Sulphur Mines
TSS Sample Point B
mg/l
Year
82 83 84 85 86 87 88 89


Sulphur Mines
TSS Sample Point C
mg/l
Year
82 83 84 85 86 87 88 89


Sulphur Mines
TSS Sample Point D
mg/l
Year
82 83 84 85 86 87 88 89

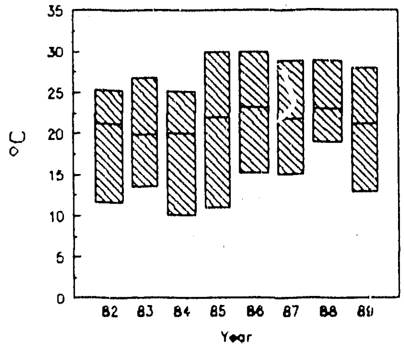

Sulphur Mines
TSS Sample Point E
mg/l
Year
82 83 84 85 86 87 88 89


Sulphur Mines
TSS Sample Point F
mg/l
Year
82 83 84 85 86 87 88 89

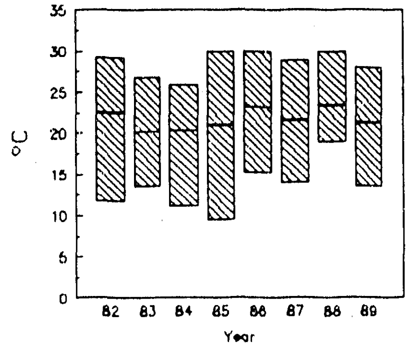
3.6.2.4 Temperature

The sample temperatures of the Sulphur Mines surface waters were generally conducive to supporting aquatic life throughout 1989. 1989 temperature data was comparable to data from previous years.

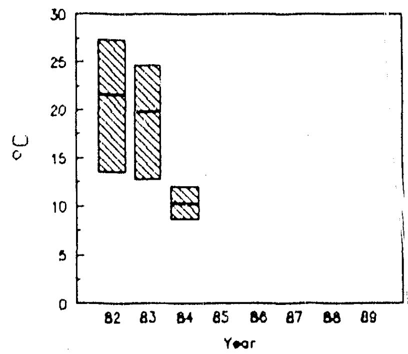
Sulphur Mines
Temperature Sample Point A



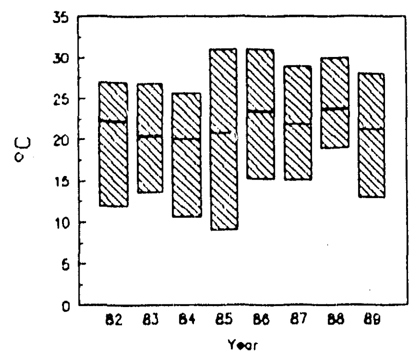
Sulphur Mines
Temperature Sample Point B

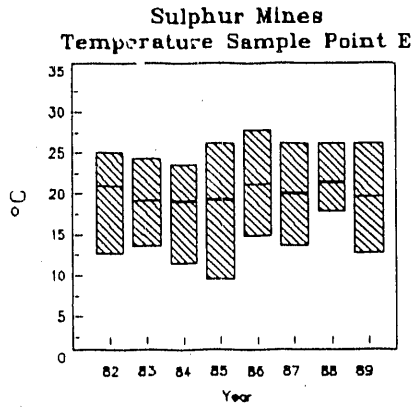


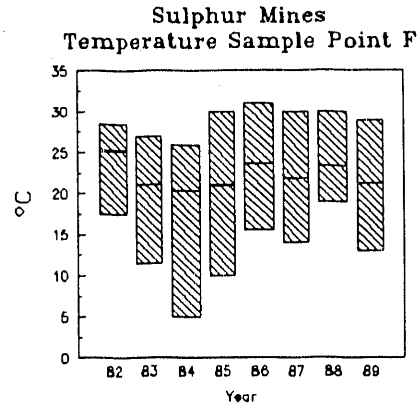
Sulphur Mines
Temperature Sample Point C



Sulphur Mines
Temperature Sample Point D

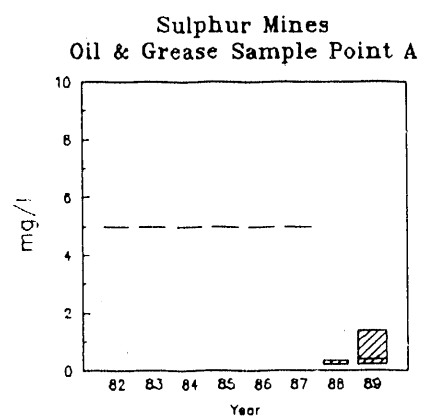


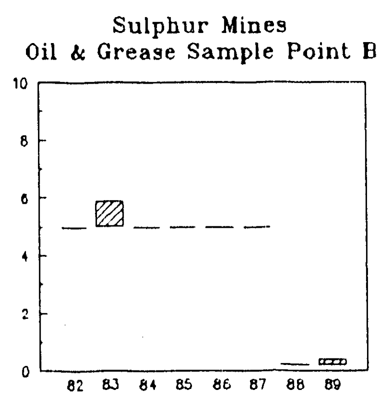




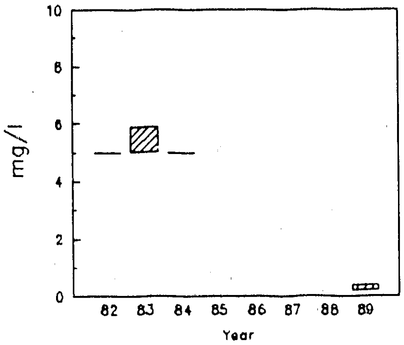
3.6.2.5 Oil and Grease

Oil and Grease levels were less than 5 mg/l at all monitoring stations throughout 1989. These data reflect favorably on the site spill prevention, control, and overall good housekeeping during 1989. These results are consistent with that collected during previous years. In 1988 and 1989 a more discrete analytical method was used enabling the SPR to have lower detection limits instead of the normal <5 mg/l.

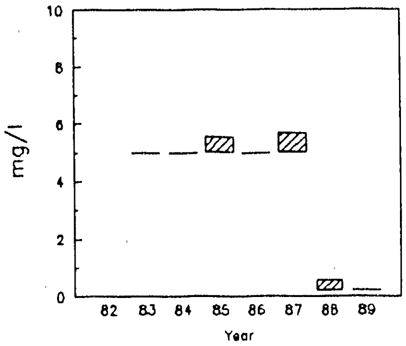




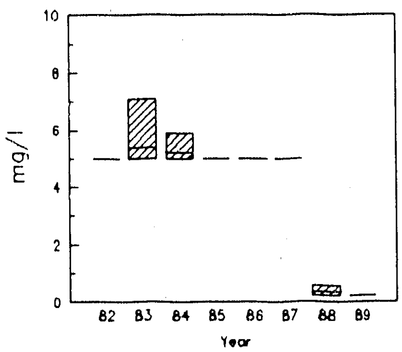
Sulphur Mines
Oil & Grease Sample Point C



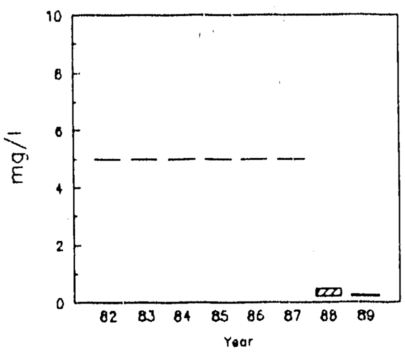
Sulphur Mines
Oil & Grease Sample Point D



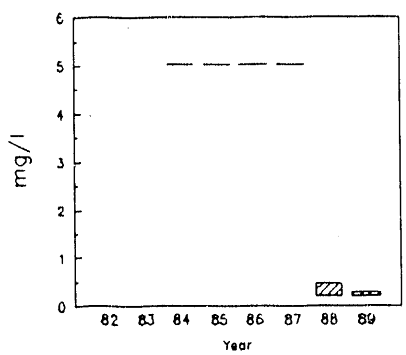
Sulphur Mines
Oil & Grease Sample Point E



Sulphur Mines
Oil & Grease Sample Point F

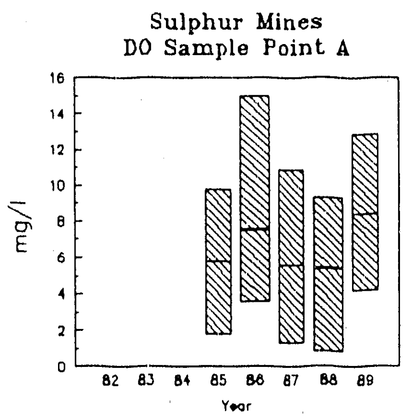


Sulphur Mines
Oil & Grease Sample Point G



3.6.2.6 Dissolved Oxygen (DO)

Dissolved oxygen monitoring was performed only at station A throughout 1989. This station is located in a relatively stagnant drainage ditch that receives effluent from the site package sewage treatment plant. The sewage plant operated in compliance throughout 1989. High DO levels are attributed to increased flushing caused by high rainfall.



3.6.2.7 General Observations

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

a. Overall, pH continues to be relatively neutral.

b. Changes in water temperature observed during years since 1982 are attributed to seasonal meteorological variation since the SPR has no thermal discharges.

c. The DO levels observed since 1985 have been relatively consistent, with only a sight deviation in 1986, and are attributed to natural factors as well as low BOD_5 levels in effluent from the site sewage treatment plant.

d. Stations Band G have shown a steady decline in salinity suggesting a general reduction of salinity when compared to previous levels and the years of industrial activity in the area.

3.6.3 Water Discharge Permit Monitoring

The six water discharge points at Sulphur Mines are regulated through the EPA NPDES program. Five of the discharges are stormwater runoff from the well and pump pads (outfalls 001, 002, 003, 005, and 006). The sixth (outfall 004) is the effluent from the sewage treatment plant.

Parameters for stormwater and wastewater discharges are described below.

Location/Discharge	Parameter	Compliance Range
stormwater	flow	(report only)
	oil and grease	≤15 mg/l
	pH	6.0 - 9.0
sewage treatment plant	flow	≤5.6 m^3/day
	BOD_5	≤45 mg/l
	TSS	≤45 mg/l
	pH	6.0 - 9.0

A total of 112 analyses were conducted on permitted outfalls to monitor NPDES compliance during 1989. Approximately 57% of the analyses performed were for monitoring stormwater runoff and 43% for sewage treatment plant effluent analyses. There were no noncompliances during 1989 resulting in a compliance performance level of 100%.

3.6.4 Active Permits

Table 3-10 lists the active permits at Sulphur Mines. The brine disposal wells are routinely exercised, and all state underground injection control certifications are current. State inspectors regularly visit the site to observe underground injection operations.

3.6.5 Groundwater

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.

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

(1) Renewal submitted 8/13/85 for erosion control work on the Intracoastal Waterway. Recorded permit and amendments with applicable Parish Registrars of Deeds.
(2) Third round renewal submitted April 12, 1990.
(3) Requires annual operating report.
(4) Water purchase agreement (renewed annually).
(5) Letter of financial responsibility to close, plug, and abandon any and all injection wells.
(6) Approval for use of salt dome cavities for storage of liquid hydrocarbons.
(7) Permit submitted to LDEQ. State never responded. EPA NPDES renewal notification sent to LDEQ. Still no response from state.

* LDOTD - Louisiana Department of Transportation and Development

Table 3-10. Active Permits at Sulphur Mines

There are no groundwater monitoring wells on the Sulphur Mines site.

3.6.6 Other Significant Environmental Activity

Water collecting in the brine pond underdrain system was monitored at weekly intervals. The pH was relatively constant (range 5.5 to 6.3). Salinity levels averaged 129.6 ppt and ranged between 8.0 and 201 0 ppt. The high salinities were caused by leaks in the pond liners. The south pond was repaired in 1989, the north pond is scheduled for repair in mid 1990.

The brine pond is intermittently filled with fresh water. The underdrain system, along with repairs to the pond lining, prevents contamination of the soil beneath the brine pond. The Sulphur Mines site is due to be decommissioned in November, 1992.

3.7 WEEKS ISLAND

The Weeks Island site consists of a large mechanically excavated (room and pillar type) 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-inch) 108 km (67 mi) long crude oil pipeline connecting the site to the St. James Terminal.

3.7.1 Air Quality

Weeks Island operated in accordance with all air quality permit and regulatory requirements during 1989. No significant configurational or operational changes affecting emission rates occurred at the facility. Hydrocarbon emissions, based on throughput, were well below levels shown in the Emissions Inventory Questionnaire (i.e., 0.2, 0.6, and 0.8 metric tons (440, 1320 and 1760 pounds) per year for filling, withdrawal and recirculation operations respectively). Air quality monitoring using actual monitoring equipment was neither required nor conducted during 1989.

3.7.2 Surface Water Quality Monitoring

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. None of the SPR outfalls discharge directly into these ponds. Other surface waters at this site are intermittent in nature, draining rapidly and thoroughly after any precipitation. The site outfalls (Figure 3-6) discharge small volumes into surface runoff at a substantial distance from receiving waters. The lack of potentially impacted surface waters precludes the need for surface water quality monitoring at the Weeks Island site.

3.7.3 Water Discharge Permit Monitoring

The water discharges at Weeks Island are regulated and enforced in accordance with the EPA NPDES permit program. There are separate outfalls (01B and 002) for each package sewage treatment plant. Outfall 01A handles of stormwater runoff collected in an onsite retention pond. There was no discharge from the iron removal unit (outfall 003) in 1989.

The various parameters for the monthly samples of all discharge points are listed below with their maximum limits.

Location/Discharge	Parameter	Compliance Range
stormwater	flow	(report only)
	oil and grease	$\leq$15 mg/l
	pH	6.0 - 9.0
sewage treatment plant	flow	(report only)
	BOD_5	$\leq$45 mg/l
	TSS	$\leq$45 mg/l
	fecal coliforms	$\leq$400 colonies/100 ml
	pH	6.0 - 9.0
iron removal unit	flow	(report)
	TSS	$\leq$45 mg/l

A total of 144 analyses (83% for sewage and 17% for stormwater discharges) were conducted on permitted outfalls to monitor NPDES compliance during 1989. There were three noncompliances in 1989 (Table 3-11). The site experienced a compliance performance level of 98%.

WEEKS ISLAND SITE MAP

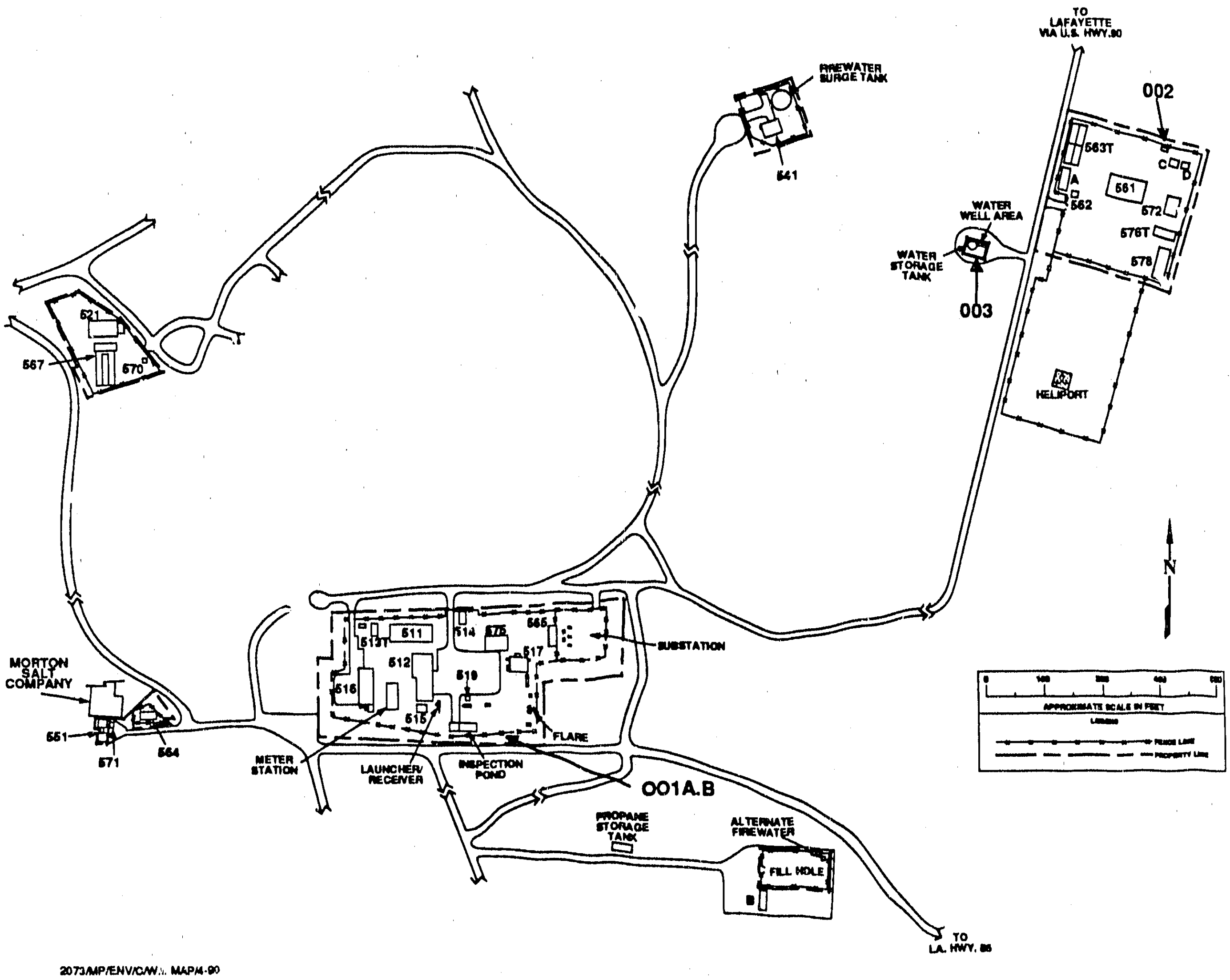


Figure 3-6 (Sheet 1 of 2). Weeks Island Environmental Monitoring Stations

Discharge Monitoring Stations

01A	Stormwater runoff
01B	Discharge from sewage treatment plant
002	Discharge from sewage treatment plant
003	Discharge from iron removal system

Figure 3-6 (Sheet 2 of 2). Weeks Island Environmental Monitoring Stations

OUTFALL LOCATION	PERMIT PARAMETER	VALUE LIMIT	CAUSE
001A	Oil & Grease	________	No Data
001B	TSS	________	No Data
002	TSS	________	No Data

All noncompliances at WI were due to oversights of a temporary laboratory technician. There is no indication that the samples involved would have exceeded permit limitations.

Table 3-11. 1989 Noncompliances/Bypasses at Weeks Island

3.7.4 Active Permits

The active permits for Weeks Island are listed in Table 3-12.

3.7.5 Groundwater

The Chicot formation is the principal aquifer in the Weeks Island area. The aquifer surface is at approximately 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 groundwater monitoring stations at Weeks Island.

3.7.6 Other Significant Environmental Activity

The investigation initiated in 1987 continued for determining the source of brine which is accumulating in the storage area of the mine. This involved dewatering the mine at the fill hole and disposing the collected brine at an approved offsite facility. Preliminary results indicate the brine source is probably from the hydrostatic test waters from the crude oil pipeline to the site and not from outside the mine. A project to condition the mine air and remove moisture was initiated in 1988 and will be completed in 1990.

3.8 WEST HACKBERRY

The West Hackberry site will store 34.8 million m^3 (219 MMB) of crude oil in 22 solution-mined caverns. Brine is transported and disposed either by injection into eight active brine disposal wells located approximately 3 km (2 mi) southeast of the site or to the Gulf of Mexico through a 91 cm (36 in), 42 km (26 mi) pipeline at an area 11 km (7 mi) south of Holly Beach, LA. A series of brine diffuser nozzles are operated to promote brine dispersion. 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 via a 107 cm (42 in), 66 km (42 mi) crude oil pipeline.

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0056243	EPA	NPDES	10/14/87	10/13/92	(1)
LMNOD-SP (Atchafalaya Floodway) 251	COE	Maint.	07/12/78	07/11/88	(2)
1105	LDEQ	Air	01/30/79	Open	(3)
SDS-8	LDNR	Injection	02/16/79	Open	(4)
None	LDEQ	Water (Disch.)	01/17/87	1/16/92	

(1) Renewal submitted 9/25/87.
(2) Recorded permit and amendments with applicable Parish Registrar of Deeds. Maintenance clause being renewed.
(3) Requires annual operating report.
(4) Approval for use of salt dome cavities for storage of liquid hydrocarbons.

Table 3-12. Active Permits at Weeks Island

3.8.1 Air Quality

West Hackberry operated in accordance with all air quality permit and regulatory requirements during 1989. According to throughput and AP-42 computations, hydrocarbon emissions were well below the 50.4 metric tons (55.4 tons) permitted for filling operations. Air quality monitoring using actual monitoring equipment was neither required nor conducted during 1989. There were no construction or configurational changes which would have resulted in additional emissions during 1989. The facility is located in a nonattainment area for ozone.

3.8.2 Surface Water Quality Monitoring

West Hackberry surface water quality was monitored by sampling once monthly at each station throughout 1989. Specific monitoring stations are identified in Figure 3-7. Specific parameters monitored in the West Hackberry surface waters include pH, salinity, TSS, temperature, TOC, and oil and grease. TOC was monitored only at station E corresponding to the NPDES permit requirement regarding stormwater discharges. Each parameter is discussed in the following sections.

3.8.2.1 Hydrogen Ion Activity (pH)

1989 data is generally consistent with data from previous years. Natural waters low in, or devoid of, carbon dioxide are medium hard to hard, with regard to mineral content, and characteristically have a slightly high pH. Some compounds, such as hydrogen cyanide and hydrogen sulfide, increase in toxicity with the degree of dissociation, resulting in increasing aquatic toxicity with reduced pH. A mildly high pH is beneficial to aquatic life and consistent with an environmentally sound ecosystem.

WEST HACKBERRY SITE MAP

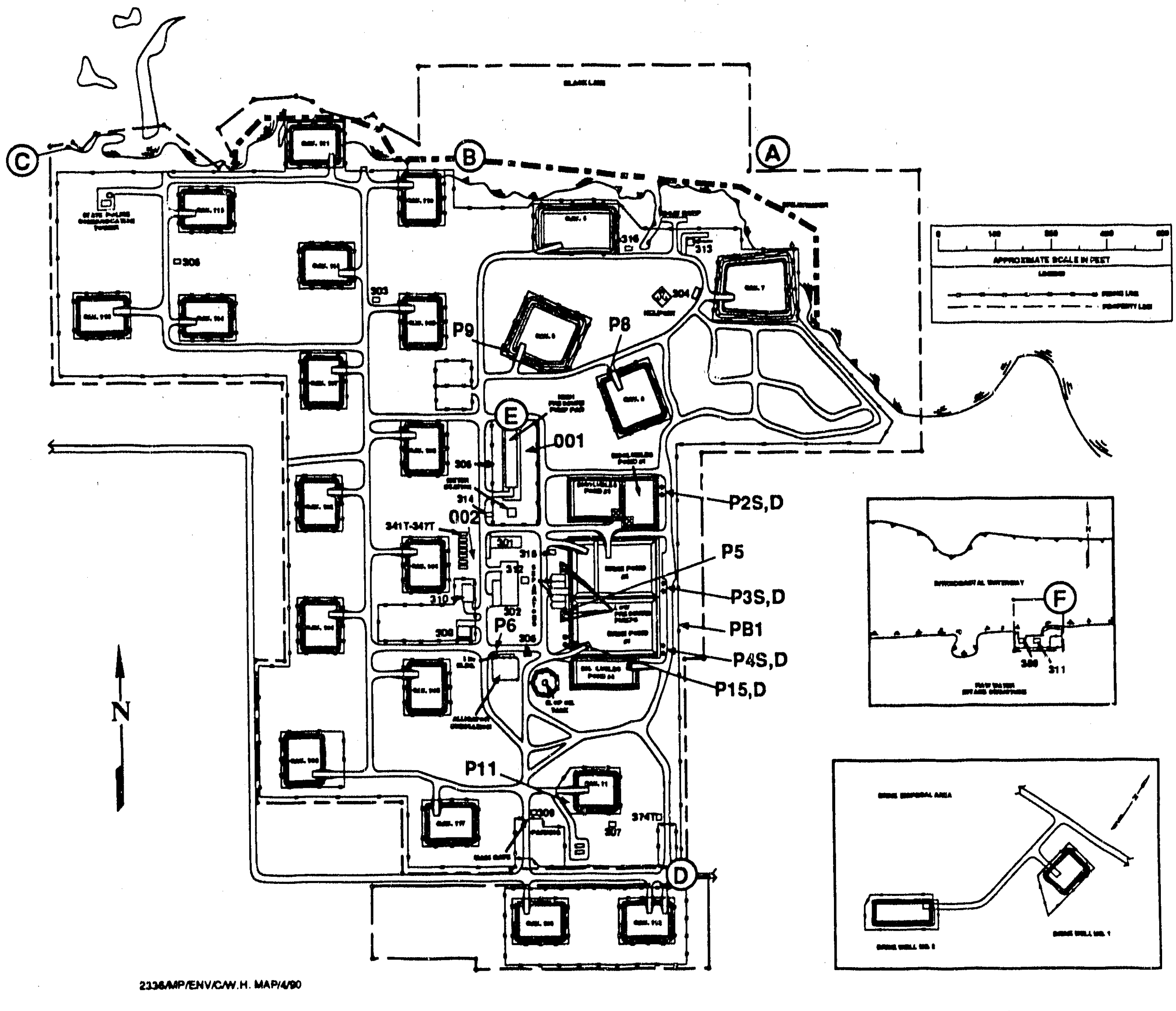


Figure 3-7 (Sheet 1 of 2). West Hackberry Environmental Monitoring Stations

Discharge Monitoring Stations

001	Brine disposal
002	Discharge from sewage treatment plant
003 (State)	Stormwater and pump flush from high-pressure pump pad
	Stormwater runoff from well pads 6-9, 11, and 101-117
004	Stormwater from the Texoma/Lake Charles meter station

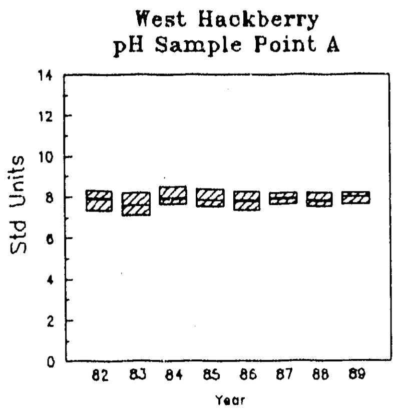
Water Quality Monitoring Stations

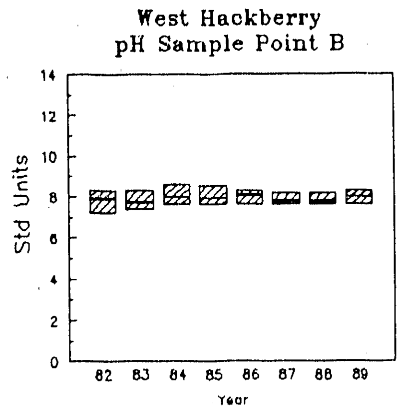
A	Black Lake
B	Black Lake
C	Black Lake
D	Southeast dainage ditch
E	High-pressure pump pad
F	Raw water intake structure

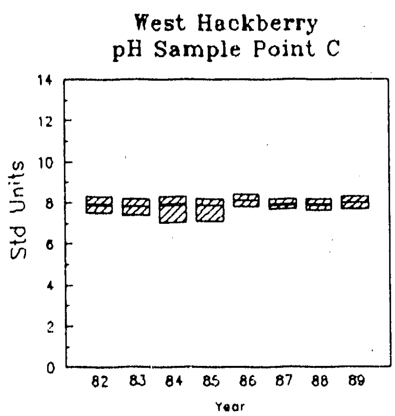
Groundwater Monitoring Stations

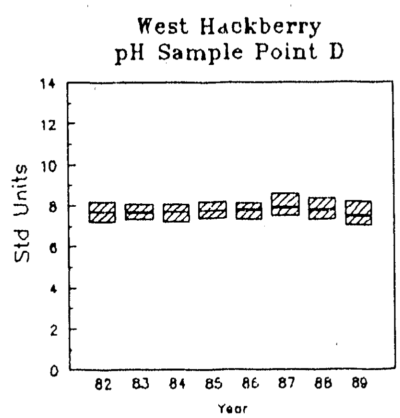
PB1	East of brine pond #1 - out of service
P8	North of cavern 8
P9	South of cavern 9
P11	West of cavern 11
P1S, D	Southwest of brine pond
P2S, D	Northeast of anhydrite pond
P3S, D	Northeast of brine pond
P4S, D	Southeast of brine pond
P5	Northwest of brine pond
P6	Northwest of site electrical substation

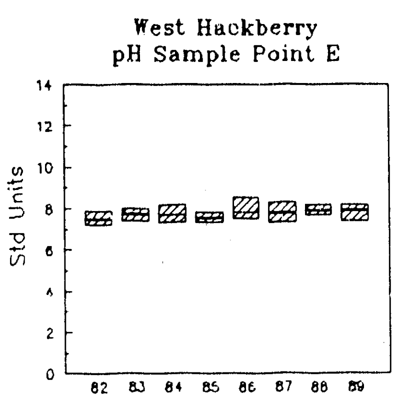
Figure 3-7 (Sheet 2 of 2). West Hackberry Environmental Monitoring Stations

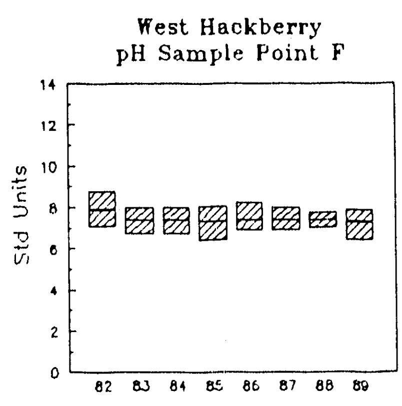

West Hackberry
pH Sample Point A
Std Units
14
12
10
8
6
4
2
0
82 83 84 85 86 87 88 89
Year


West Hackberry
pH Sample Point B
Std Units
14
12
10
8
6
4
2
0
82 83 84 85 86 87 88 89
Year


West Hackberry
pH Sample Point C
Std Units
14
12
10
8
6
4
2
0
82 83 84 85 86 87 88 89
Year


West Hackberry
pH Sample Point D
Std Units
14
12
10
8
6
4
2
0
82 83 84 85 86 87 88 89
Year

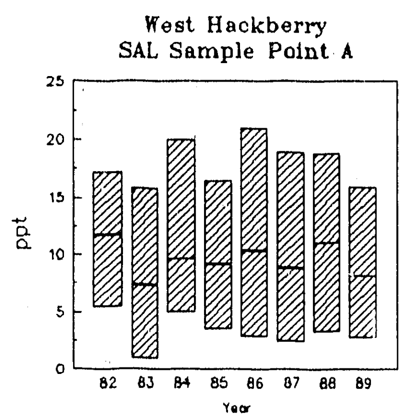

West Hackberry
pH Sample Point E
Std Units
14
12
10
8
6
4
2
0
82 83 84 85 86 87 88 89
Year

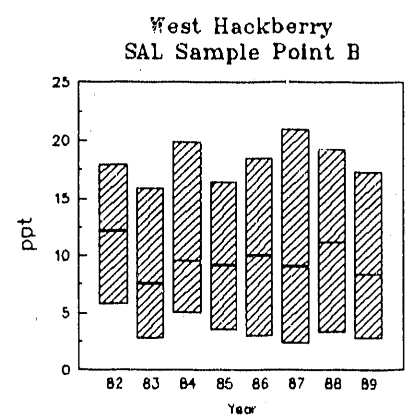

West Hackberry
pH Sample Point F
Std Units
14
12
10
8
6
4
2
0
82 83 84 85 86 87 88 89
Year

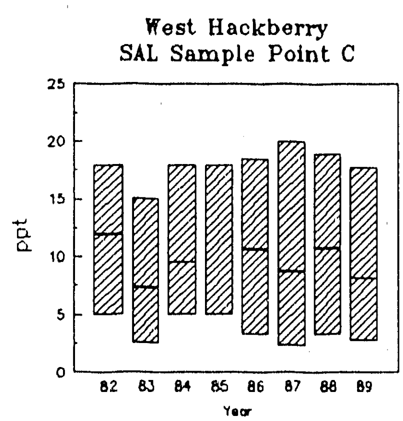
3.8.2.2 Salinity (SAL)

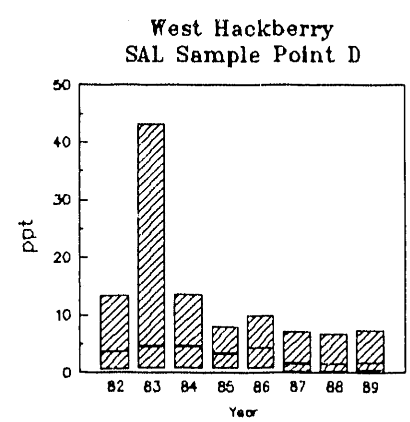
The salinity of Black Lake exhibited a slight decline possibly attributed to tropical storms during the year, with all other data being consistent with previous years.

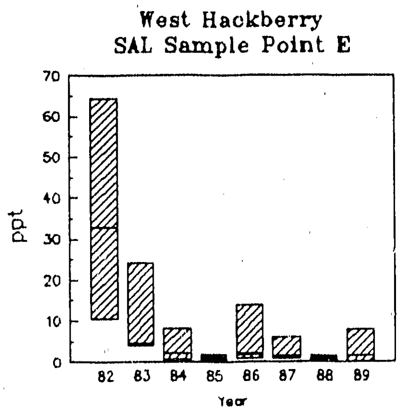
Wind, tide, and rainfall contributed to the salinity variation in Black Lake. The broad salinity range observed in Black Lake is more conducive to supporting euryhaline organisms or those with sufficient mobility to avoid salinity stresses with such seasonal changes.

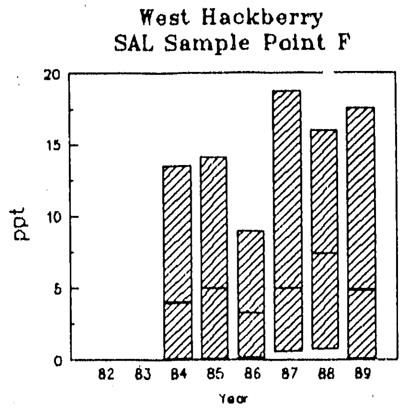






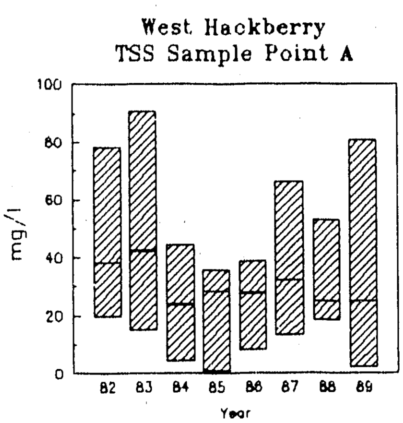


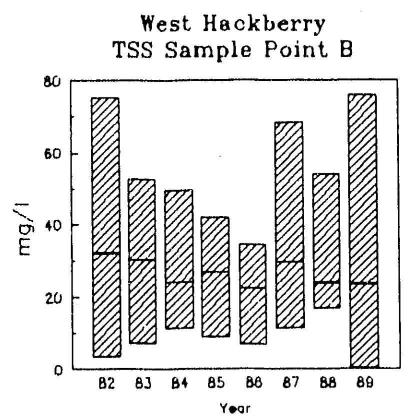


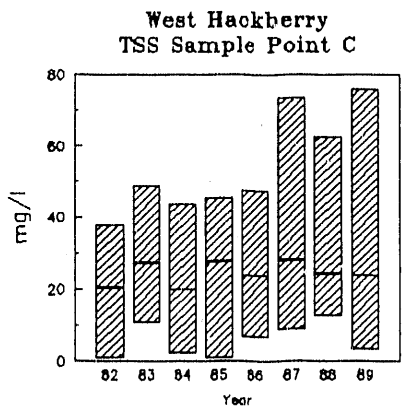


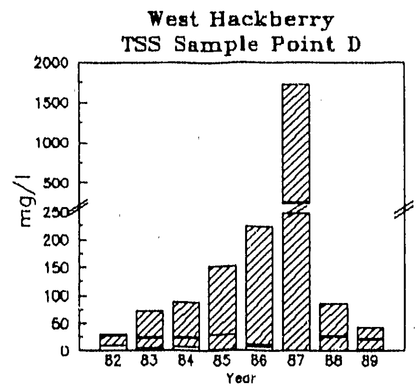
3.8.2.3 Total Suspended Solids (TSS)

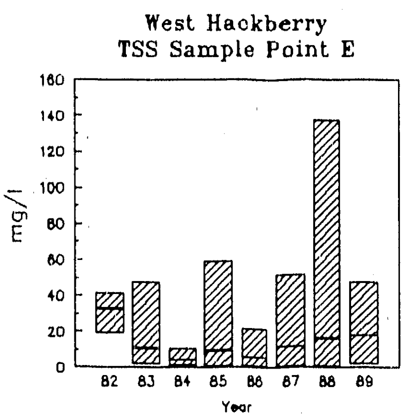
It appears that the high pressure pump pad does not significantly contribute to the levels of suspended solids in the lake. TSS fluctuations at Station F (on the Intracoastal Waterway) is expected for a high traffic, shallow waterway. The 1989 TSS observations were generally similar to previous year's data suggesting that occurrence of relatively high TSS levels are typical for this water body.

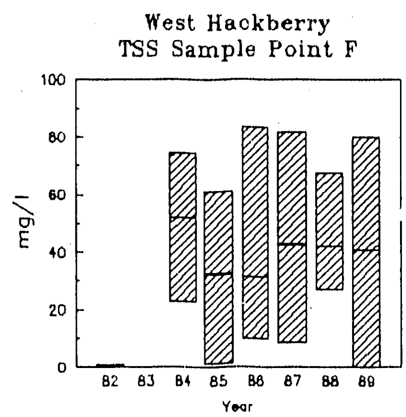








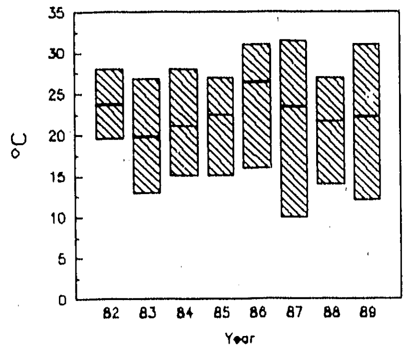




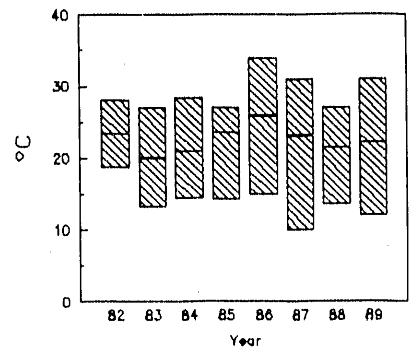
3.8.2.4 Temperature

1989 data was consistent with observations at other sites indicative of regional climatic effects.

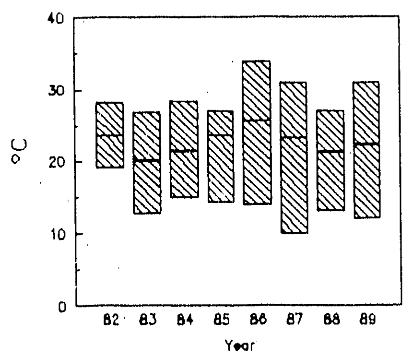
West Hackberry
Temperature Sample Point A



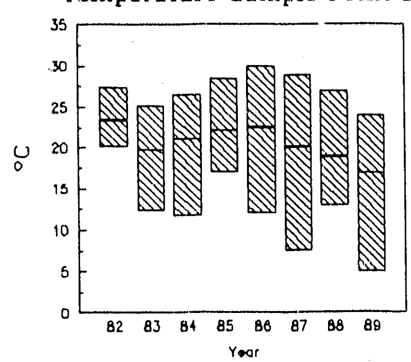
West Hackberry
Temperature Sample Point B



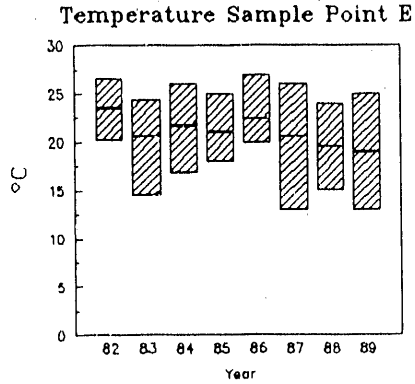
West Hackberry
Temperature Sample Point C



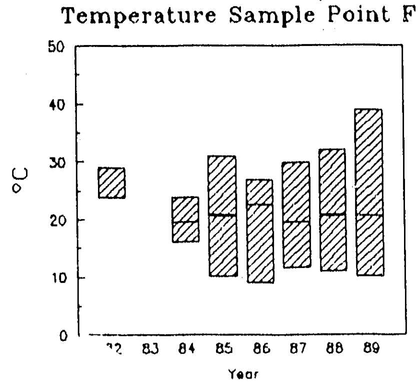
West Hackberry
Temperature Sample Point D



West Hackberry
Temperature Sample Point E

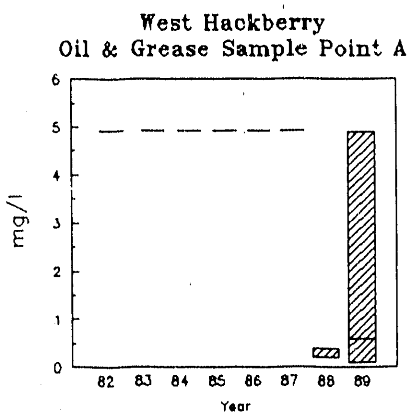


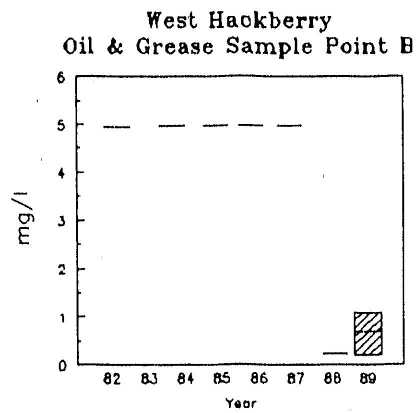
West Hackberry
Temperature Sample Point F

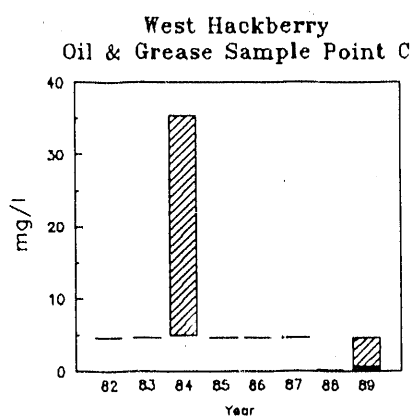


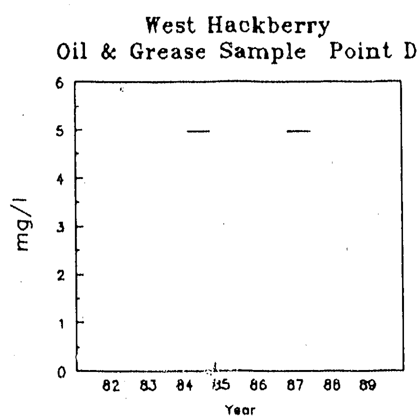
3.8.2.5 Oil and Grease

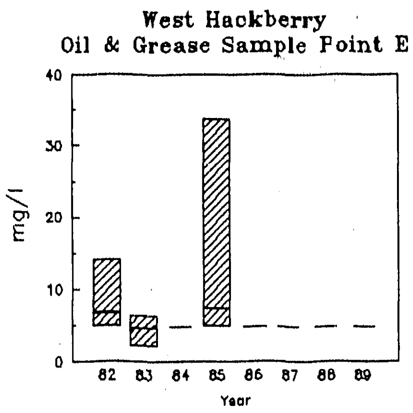
Oil and grease levels were below the previously detectable levels (<5 mg/l) at all stations throughout 1989. New instrumentation has allowed lower detection limits. These data are generally consistent with oil and grease data collected since 1982. Data from 1988 and 1989 were analyzed using an infrared method which gives detection limits below 5 mg/l.

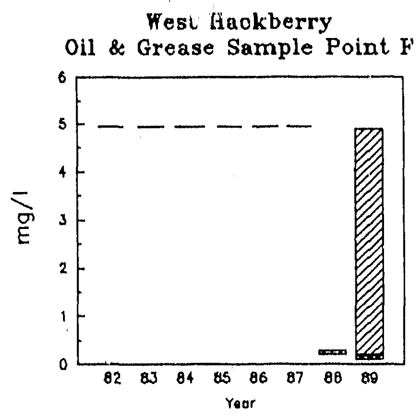






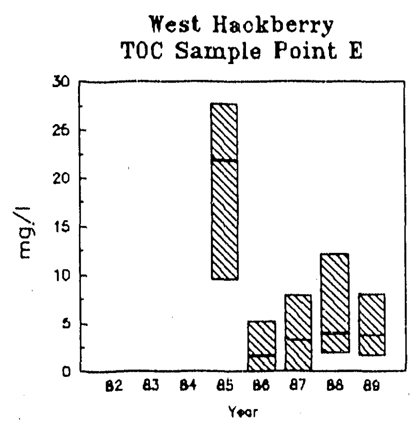






3.8.2.6 Total Organic Carbon (TOC)

TOC is an NPDES permit required parameter for discharges from the high-pressure pump pads and adjacent stormwater discharges. The low levels indicate that effluent from the pad did not contribute to TOC loading in the lake. These TOC levels are generally consistent with the three previous years, indicating a relatively low and insignificant level.



3.8.2.7 General Observations

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

a. pH remained fairly stable and consistent with previous years.
b. Runoff from the high pressure pump pad was of lower salinity than the Black Lake receiving waters. This demonstrates continuing good control of brine leaks and spills observed since 1982.
c. TSS levels have fluctuated widely at all stations since 1982. High levels of TSS in Black Lake did not appear to be related to site discharges or runoff, but to natural phenomena.
d. Oil and grease levels were <5 mg/l in Black Lake throughout 1989.
e. TOC remained well below permit limits.

3.8.3 Water Discharge Permit Monitoring

The water discharges at the West Hackberry site are regulated and enforced in accordance with the EPA NPDES permit program. The Louisiana Stream Control Commission (currently the Office of Water Resources in LDEQ) authorized discharge of stormwater and sanitary wastewater effluents.

The three categories of discharges at West Hackberry are brine disposal, sewage treatment plant effluent, and stormwater runoff from well and pump pads. The various parameters for these discharges are listed below with their maximum limits.

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
	DO	detectable (when using O_2 scavenger)

Location/Discharge	Parameter	Compliance Range
sewage treatment plant	flow	(report only)
	BOD_5	≤15 mg/l
	TSS	≤45 mg/l
	fecal coliform	(report only)
	pH	6.0 - 9.0
stormwater	flow	(report only)
	oil and grease	≤15 mg/l
	TOC	≤75 mg/l
	pH	6.0 - 9.0

A total of 3,700 analyses were conducted on permitted outfalls to monitor NPDES compliance during 1989. Discharges from the sewage treatment plant and brine disposal pipeline accounted for 1.4% and 25.4% respectively of total analyses performed. The majority of the analyses (73.2%) involved well and pump pad runoff.

Permit noncompliances were identified on five occasions (Table 3-13). These 1989 noncompliances, on a per analysis basis, resulted in a site compliance performance level of 99.9%.

3.8.4 Active Permits

Active permits for West Hackberry are listed in Table 3-14.

3.8.5 Groundwater

There are three shallow aquifers found in the vicinity of the West Hackberry site. The Chicot Aquifer, which flows closest to the surface in the Hackberry area, contains predominantly fresh water with salinity increasing with proximity to the coast. The Evangeline Aquifer flows under the Chicot and the Jasper Aquifer.

The majority of the groundwater 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 in some areas. The fresh/saline water interface is approximately 200 m (700 ft) below the surface.

OUTFALL LOCATION	PERMIT PARAMETER	VALUE LIMIT	CAUSE
001	DO	0	Adjustment of oxygen scavenger resulted in momentary loss of DO
001	Oil & Grease		No Sample*
001	All		No Sample*
001	All		No Sample*
001	All		No Sample*

* Causes have been attributed to operations failing to a catch a sample over a weekend, failing to notify the lab before starting up of the brineline, failing to follow established sampling procedures or catching the sample at the wrong sample point.

Table 3-13. 1989 Noncompliances/Bypasses at West Hackberry

PERMIT NUMBER	ISSUING AGENCY	PERMIT TYPE	EFFECTIVE DATE	EXPIRATION DATE	COMMENTS
LA0053031	EPA	NPDES	08/22/89	08/21/94	(8)
LMNOD-SP (LTCS)26	COE	Dredging	02/08/79	02/08/99	(1)
LMNOD-SP (Black Lk)31	COE	Dredging	10/26/82	05/15/97	(2)
LMNOD-SP (Black Lk)43	COE	Constr. Maint.	07/26/84 07/26/94	07/25/87 Open	(3)
LMNOD-SP (Gulf of Mexico)2574	COE	Constr. Maint.	08/11/80 08/11/80	08/11/90 Open	(4)
LMNOD-SE (LTCS) 40	COE	Constr. Maint.	05/25/88 05/25/88	06/30/91 Open	(10)
LMNOD-SP (Cameron Parish Wetlands) 162	COE	Maint.	03/09/78	03/09/88	(11)
None	LDNR	Injection	08/07/79	Open	(5)
971198-9	LDNR	Injection	10/06/83	Open	(6)
WP1892	LDEQ	Water (Use)	12/08/88	12/09/93	(8) (9)
1048	LDEQ	Air	10/26/78	Open	(7)

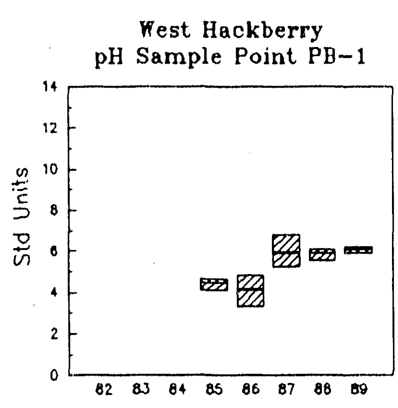
(1) Maintenance dredging for raw water intake.
(2) Maintenance dredging for fire water canal.
(3) Maintenance of erosion control dike completed in 1986.
(4) Amended to install parallel pipeline. (05/29/86)
(5) Approval to create 16 additional salt dome cavities.
(6) Approval to construct and operate wells 117A and B.
(7) Requires semi-annual status-of-construction report.
(8) Renewal submitted 4/6/89. Dates based on previous permit.
(9) Includes Texoma/Lake Charles Meter Station-Outfall 004.
(10) Permit to construct and maintain 36" crude oil pipeline from site to Texoma/LC Meter Station.
(11) Permit to maintain 42" crude oil pipeline being renewed.

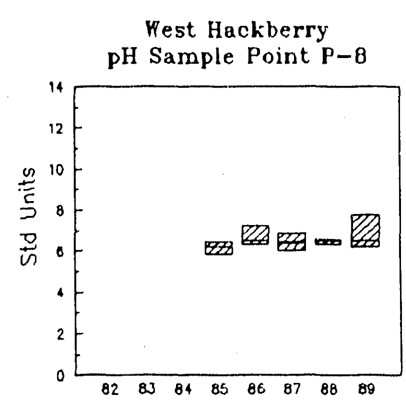
Table 3-14. Active Permits at West Hackberry

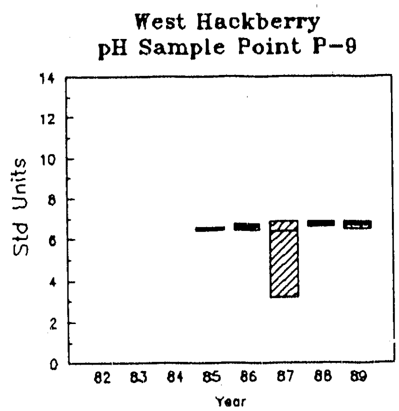
There are 13 monitoring wells (Figure 3-7) on the West Hackberry site. Four of these monitoring wells have been sampled monthly since 1982. Eight monitoring wells were installed in 1988 and two were installed in 1989. One of the original four monitoring wells (PB1) was plugged and abandoned in 1989 due to a casing failure. Well logs and background information on construction and installation are lacking for the other three wells installed prior to 1982.

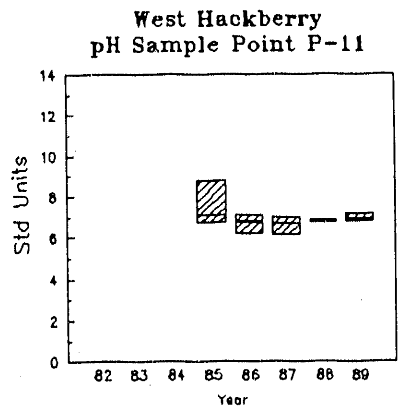
Continous pump downs (evacution) of wells P1-S and P3-S (wells were relatively consistent) exhibited a slight decrease in salinity. P5 exhibited an increase in salinity toward the end of 1989. Continued pump down should eventually result in a reduction of groundwater salinity. Additional wells planned for 1990 should provide additional information on the source of the salinity and provide remediation alternatives.

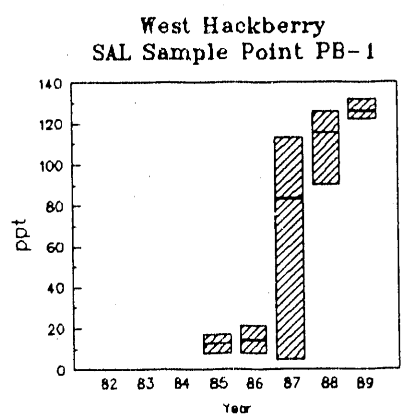
pH and salinity remained fairly low and consistent in wells P8 and P9, a drop in salinity along with an approach to neutral pH was found in P11.

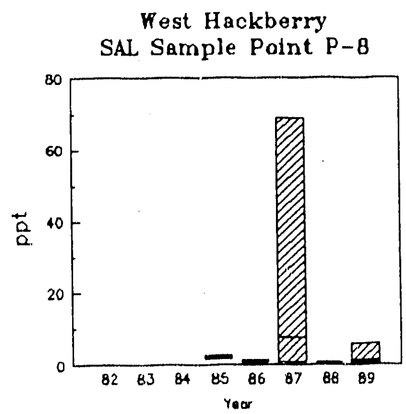


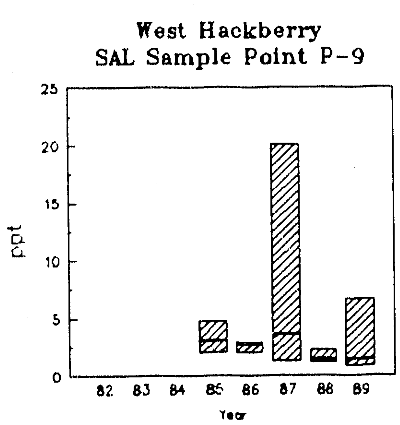


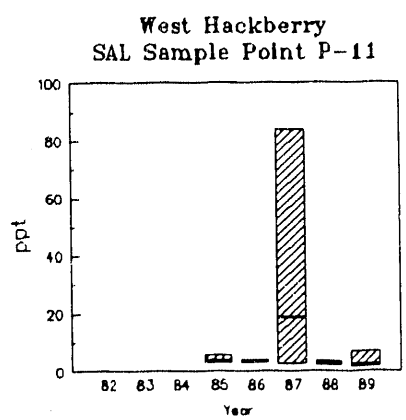

West Hackberry
pH Sample Point P-9
Std Units
0
2
4
6
8
10
12
14
82 83 84 85 86 87 88 89
Year

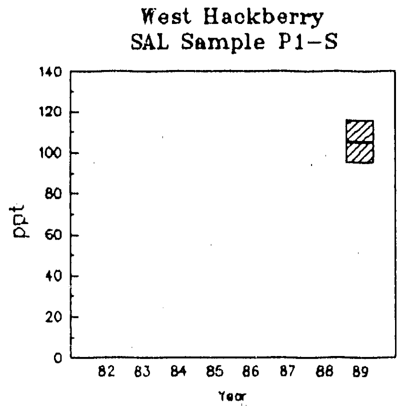

West Hackberry
pH Sample Point P-11
Std Units
0
2
4
6
8
10
12
14
82 83 84 85 86 87 88 89
Year

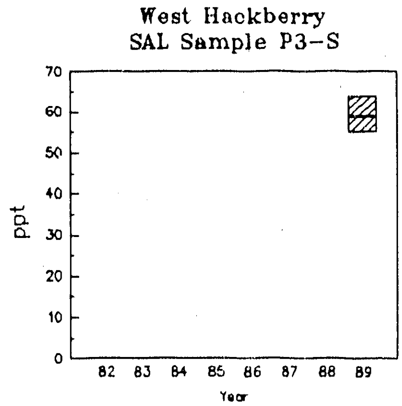

West Hackberry
SAL Sample Point PB-1
ppt
0
20
40
60
80
100
120
140
82 83 84 85 86 87 88 89
Year

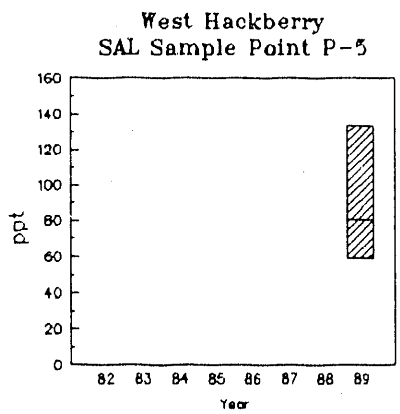

West Hackberry
SAL Sample Point P-8
ppt
0
20
40
60
80
82 83 84 85 86 87 88 89
Year


West Hackberry
SAL Sample Point P-9
ppt
0
5
10
15
20
25
82 83 84 85 86 87 88 89
Year


West Hackberry
SAL Sample Point P-11
ppt
0
20
40
60
80
100
82 83 84 85 86 87 88 89
Year







3.8.6 Other Significant Environmental Activity

Drum inventory has been reduced and a drum storage area established. Used oil is sent to a recycler to avoid disposal cost and generation of waste.

With the onset of oxygen scavenger use, brine sampling for DO was initiated on the brine disposal pipeline at the pumps and downstream at the site property line to ensure that dissolved oxygen levels remained detectable at the outfall.

3.9 CONCLUSION

The only significant environmental event resulting from SPR activities in 1989 was the Bryan Mound brine disposal line failure (section 3.4.6). Observations throughout the year on the spill area has shown recovery. The SPR continues to maintain an excellent overall environmental record at all facilities.

4. QUALITY ASSURANCE

The SPR sites undergo periodic evaluation throughout the year in the form of 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 all 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 annual audits and audits at select sites by state and federal environmental agencies.

4.1 FIELD QUALITY CONTROL

All field environmental monitoring and surveillance activities are performed in accordance with standard procedures contained in the BPS Environmental Programs and Procedures Manual. These procedures include maintenance of chain-of-custody, collection of QC samples, and field documentation. BPS site operations personnel are routinely trained in the implementation of these procedures.

4.2 EPA DISCHARGE MONITORING REPORT QUALITY ASSURANCE STUDY

The EPA entered the ninth year of its Discharge Monitoring Report Quality Assurance (DMR-QA) program. Through this program EPA provides analytical laboratories of major NPDES dischargers blind samples of permit parameters for analysis. Due to budgetary constraints EPA narrowed its 1989 list of participants in the DMR-QA program. The SPR was removed from the list apparently due to erroneous classification of Big Hill, Bryan Mound, and West Hackberry as minor discharges. These facilities should be reinstated as participants by 1991.

4.3 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 Waste Water Laboratories (EPA-600/4-79-019). This program focuses on the use of analyses of field and laboratory spikes, standard recoveries, split samples, and blanks at regular intervals to determine the accuracy and precision of analyses. Duplicate analyses and matrix spikes are performed on every tenth sample, of each analysis type, using the methods listed in Table 4-1. Several hundred of these quality assurance analyses were performed in addition to the 1989 discharge compliance 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 has developed software for the Hewlett-Packard 41CX handheld computer to allow rapid and exact determinations of accuracy and precision without the necessity of quality control chart preparation. Accuracy and precision data was generated for the West Hackberry and Bryan Mound labs with the Big Hill lab just entering into the SPR QA Program. The listing below summarizes the QA data by site.

TEST TYPE	SITE	N	$STD.DEV._{Avg}$
Accuracy	WH	1626	7.891
	BM	1155	7.746
Precision	WH	443	26.140
	BM	1101	10.063

N = Number of determinations through 1989
$STD.DEV._{Avg.}$ = Cumulative Average Standard Deviations

(Statistical data was not available for Big Hill and Bayou Choctaw due to staffing limitations and site commissioning activities.)

Standard Deviation is used to monitor changes in the accuracy and precision of specific analyses at specific sites. A trend

7 analysis is applied to this Standard Deviation Data (per the EPA Handbook for Analytical Quality Control) to identify degradation of accuracy and precision. Identification of a trend 7 error, or a tendency towards this error, causes the chemist to examine procedures, instrumentation, and reagents for the source of error.

During 1989, regulatory and DOE auditors examined the SPR laboratories' precision and accuracy data and found this data, the program, and methodology in order.

4.3 ENVIRONMENTAL AUDITS

In addition to federal and state regulatory agency audits, the M&O contractor conducts an annual environmental audit at each site. Each audit is performed over a two to three-day period followed by an outbriefing with site management and preparation of a formal audit report with specific recommendations as appropriate. Audit areas include environmental records, laboratory procedures and records, site housekeeping, operating procedures, training, environmental response equipment, and permit regulatory compliance. A general field inspection of the site environs is also conducted to assess the general site conditions, changes attributable to site impacts, and the effects of planned and proposed site construction modifications.

The 1989 environmental audit at each SPR site showed the overall implementation and execution of the SPR Environmental Program to be outstanding. Findings reported during 1989 by those state and federal regulatory agencies that performed compliance inspections were consistent with SPR findings. Such positive findings are attributed to the high level of environmental awareness exhibited among all site personnel and the emphasis SPR management has placed on fulfilling the intent and conditions of the SPR Environmental Program.

Internal audits are conducted in accordance with a detailed audit check list which addresses the pertinent aspects of all environmental programs and activities. Additional audits were conducted in 1989 by the EPA, COE, TACB, RCT, LDEQ, LDNR, TDH, USCG, and DOE.

SPR WASTEWATER LABORATORY ANALYTICAL METHODOLOGY

Analysis Determination	Method	Source*	Description
Biochemical Oxygen Demand (BOD_5)	507 405.1	SM-16 EPA	5 Day, 20°C 5 Day, 20°C
Chemical Oxygen Demand (COD)	410.4	EPA	Colorimetric Instrument
Fecal Coliform	909C	SM-16	Membrane Filter
Residual Chlorine	330.4	EPA	Titrimetric
Oil & Grease	413.1 503A	EPA SM-16	Separatory Funnel Extraction Separatory Funnel Extraction
Total Organic Carbon (TOC)	415.1 505B	EPA SM-16	Combustion/Oxidation Combustion/Oxidation
Dissolved Oxygen (DO)	360.1 360.2 421B	EPA EPA SM-16	Membrane Electrode (Field) Winkler Method (Lab) Electrometric
Hydrogen Ion Conc. (pH)	150.1 423	EPA SM-16	Electrometric Electrometric
Total Dissolved Solids (TDS)	160.1 209A	EPA SM-16	Gravimetric, 180°C Gravimetric, 180°C
Total Suspended Solids (TSS)	160.2 209B	EPA SM-16	Gravimetric, 103-105°C Gravimetric, 103-105°C

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

SM-16 = American Public Health Association, et al., Standard Methods for the Examination of Water and Wastewater, 16th Ed., 1985.

Table 4-1

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