United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD R06-85/007
June 1985

EPA

Superfund
Record of Decision:

Triangle Chemical, TX

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA/ROD/R06-85/007	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE SUPERFUND RECORD OF DECISION Triangle Chemical, TX		5. REPORT DATE June 11, 1985
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency 401 M Street, S.W. Washington, D.C.		13. TYPE OF REPORT AND PERIOD COVERED Final ROD Report
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Triangle Chemical Company site is a 2.3 acre tract located on Texas State Highway 87, just north of the Bridge City, Texas city limits. The Triangle Chemical Company operated a chemical mixing and blending facility from the early 1970s until 1981. During the company's operating period, various types of industrial cleaning compounds, automobile brake fluid, windshield washer solvents, hand cleaners, and pesticides were produced. Raw materials and finished products were stored onsite in bulk surface storage tanks and 55-gallon drums. Currently, approximately 51,000 gallons of hazardous materials are stored in 12 above-ground storage tanks.

The selected remedial action includes: incineration and deep well injection of the tank and drum contents; decontamination of all onsite structures; offsite disposal of trash and debris; and mechanical aeration of contaminated soils to background levels. Total capital costs for the selected remedial alternative is estimated to be $385,000 with O&M costs approximately $500 per year.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Triangle Chemical, TX Contaminated Media: soil Key contaminants: VOCs, toluene		

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report) None	21. NO. OF PAGES 54
	20. SECURITY CLASS (This page) None	22. PRICE

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RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

SITE: Triangle Chemical Company, Inc., Texas State Highway 87, Bridge City Texas

DOCUMENTS REVIEWED

I have reviewed the following documents describing the analysis of cost-effectiveness of remedial alternatives for the Triangle Chemical Company site:

- Triangle Chemical Company Site Investigation, Roy F. Weston, Inc., September, 1984
- Triangle Chemical Company Feasibility Study, Roy F. Weston, Inc., March, 1985.
- Staff summaries and recommendations.

DESCRIPTION OF SELECTED REMEDY

° Storage tank and drum contents - offsite incineration, deep well injection.

° Storage tank sludges - offsite landfill.

° Onsite structures - decontaminate and leave onsite.

° Trash - offsite landfill.

° Contaminated soil - onsite mechanical aeration.

DECLARATION

Consistent with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and the National Contingency Plan (40 CFR Part 300), I have determined that the selected remedy for the Triangle Chemical Company site is a cost-effective remedy and provides adequate protection of public health, welfare and the environment. The State of Texas has been consulted and agrees with the approved remedy. In addition, the action will require future operation and maintenance activities to ensure the continued effectiveness of the remedy. These activities will be considered part of the approved action and eligible for Trust Fund monies for a period of 1 year.

I have also determined that the action being taken is appropriate when balanced against the availability of Trust fund monies for use at other sites. In addition, offsite destruction of liquids and secure disposition of solids is more cost-effective than other remedial action and is necessary to protect public health, welfare or the environment.

June 11, 1985
DATE

Dick Whittington, P.E.
Regional Administrator
Region VI

SUMMARY OF REMEDIAL ALTERNATIVE SELECTION

TRIANGLE CHEMICAL COMPANY

BRIDGE CITY, TEXAS

TABLE OF CONTENTS

RECORD OF DECISION
REMEDIAL ALTERNATIVE SELECTION

TRIANGLE CHEMICAL COMPANY
BRIDGE CITY, TEXAS

Site Location and Description

The Triangle Chemical Company site is a 2.3 acre tract located on Texas State Highway 87, approximately one-half mile north of its junction with State Highway 62 just north of the Bridge City, Texas city limits as shown in Figure 1. The site is bound on the north by a commercial property, on the south by a residence, on the east by Highway 87, and on the west by Coon Bayou, in an area that is projected to become increasingly urbanized in the next decade (Figure 2). The population of Bridge City is approximately 10,000 people. There are 15 houses and 50 mobile homes within 1/4 mile of the Triangle Chemical site.

Natural grade elevations at the site range from four to seven feet above mean sea level. The site is located in the 100-year floodplain as identified by the Federal Emergency Management Agency. However, the combination of frequently intense rainfall, gentle site slope, and poor drainage and tidal influences in the bayou system, which discharges into the Sabine River approximately three miles downstream, has resulted in inundation of the site once every 6 years.

Groundwater is a major part of the public and industrial water supply in the region and is furnished by the Chicot and Evangeline aquifers, which are hydrologically connected and considered a single unit called the Gulf Coast aquifer. The shallow water table normally lies about 6 feet below the ground surface. However, during periods of heavy rain the water table has risen to as high as 2 feet below the surface.

The site surface includes five buildings and thirty tanks, as seen in Figures 3 and 4. Twelve of the tanks currently contain hazardous liquids totalling 51,000 gallons. The buildings were used for office space, processing areas, and loading areas.

Site History

The Triangle Chemical Company operated a chemical mixing and blending facility from the early 1970's to 1981. During the company's operating period various types of industrial cleaning compounds, automobile brake fluid, windshield washer solvents, hand cleaners, and pesticides were produced. Raw materials and finished products were stored in bulk surface storage tanks and 55-gallon drums on the site.

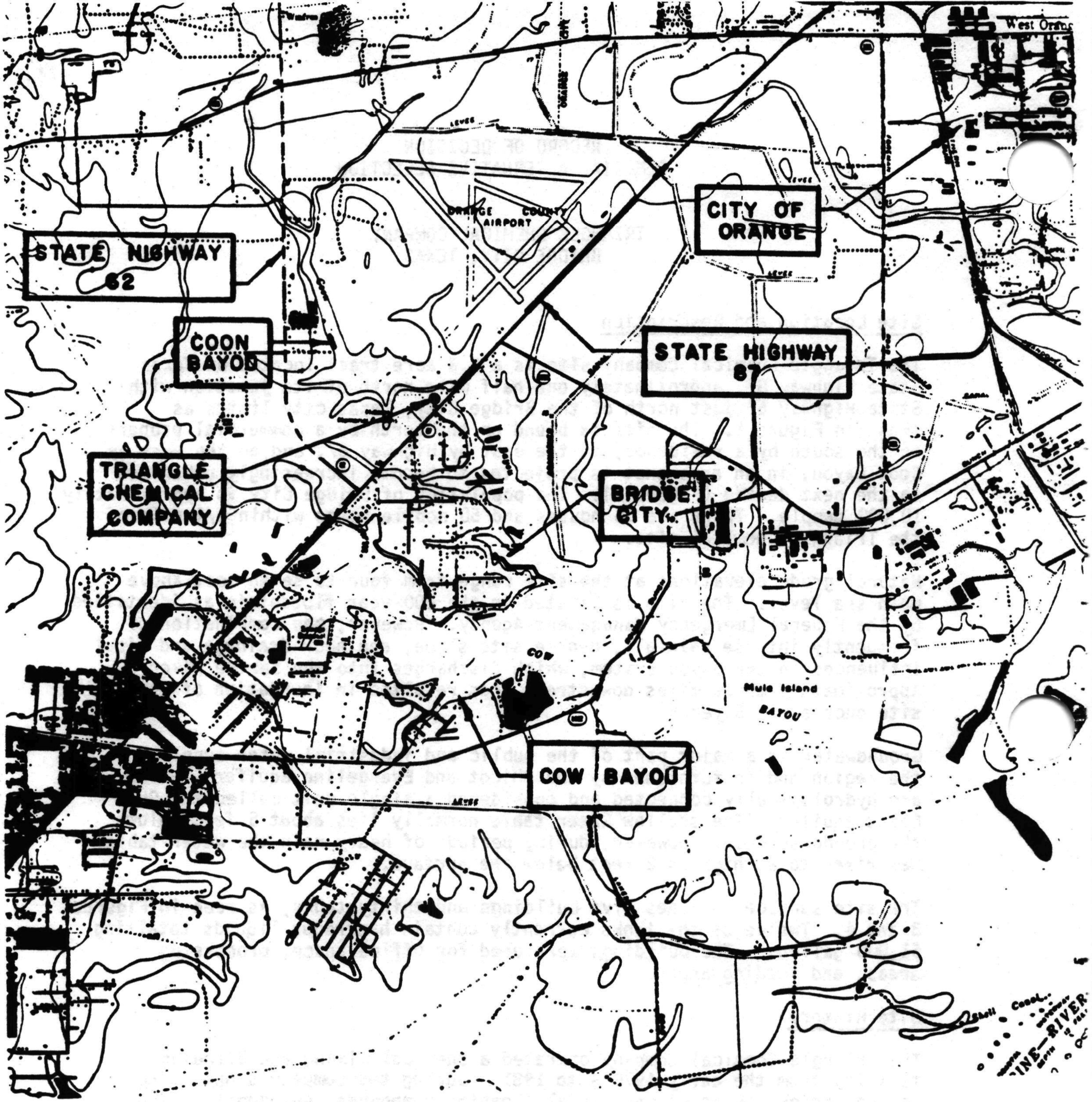


FIGURE 1
SITE VICINITY MAP

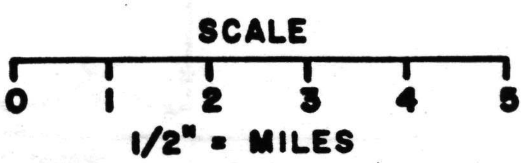


FIGURE 2
PROJECTED
REGIONAL LAND USE
1995

SOURCE: AREAWIDE WASTE TREATMENT
MANAGEMENT PLAN
SOUTHEAST TEXAS AREA 1978

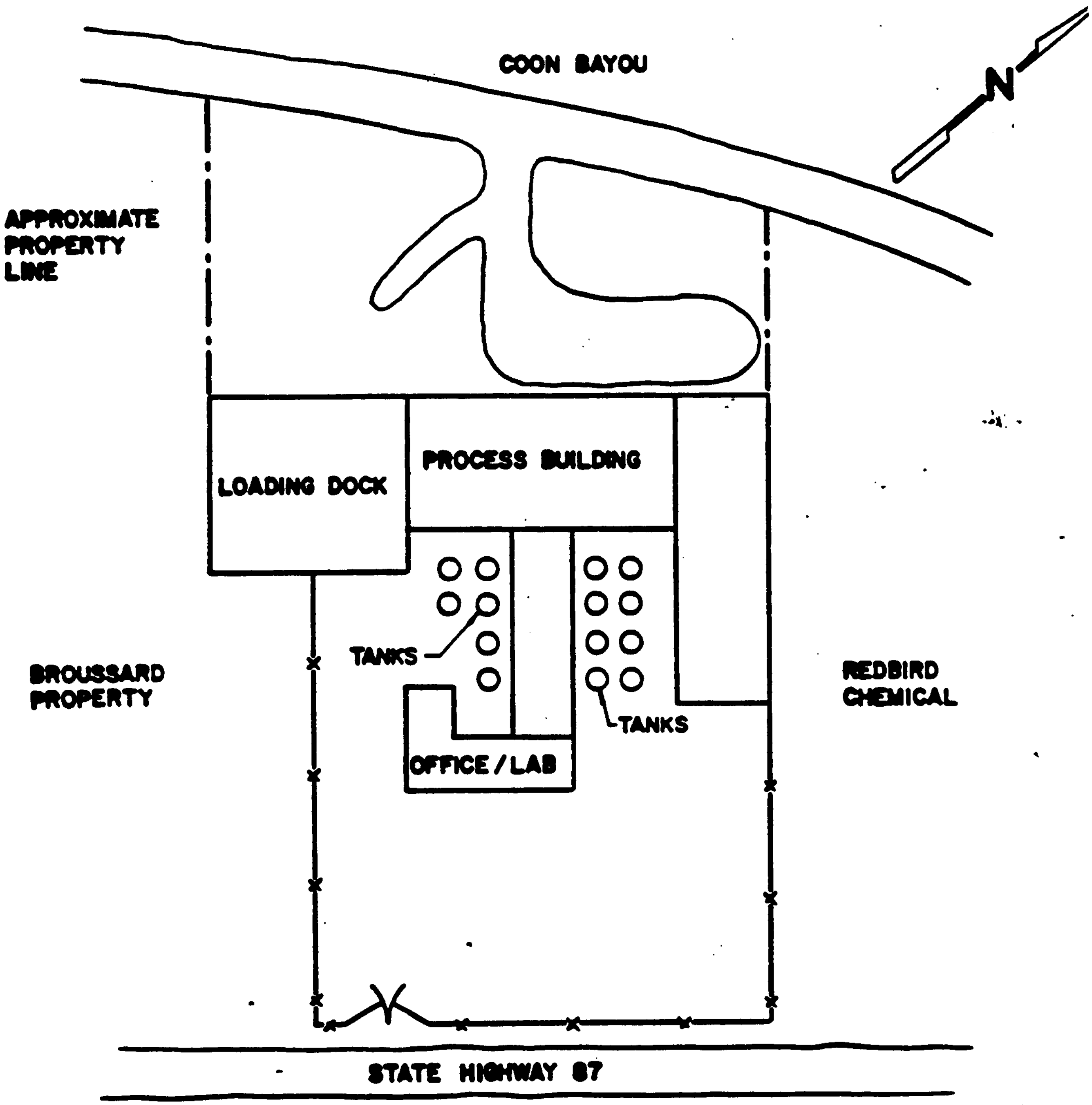
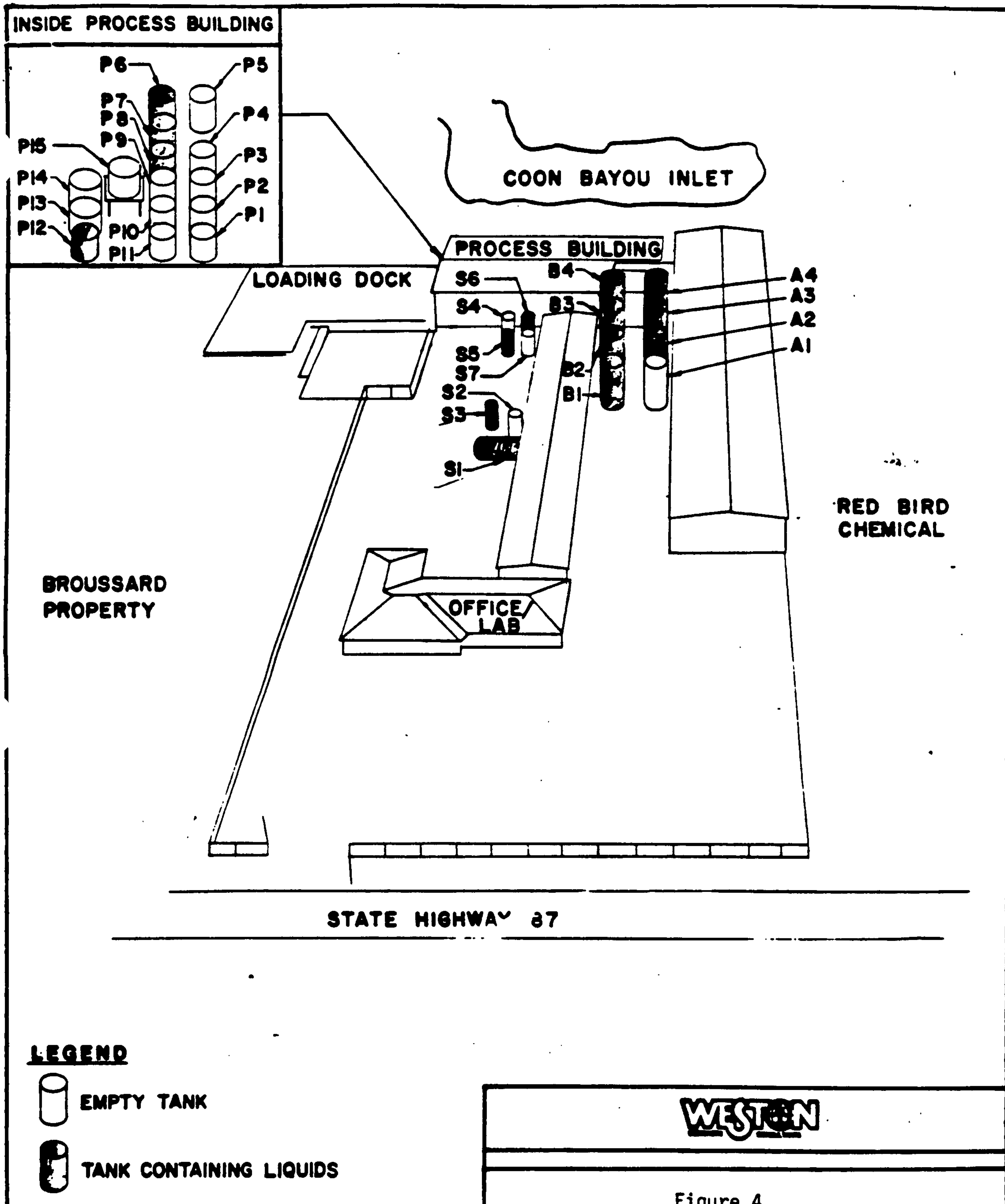


FIGURE 3
TRIANGLE CHEMICAL COMPANY
SITE MAP



WESTON

Figure 4

LOCATION OF PROCESS AND STORAGE TANKS TRIANGLE CHEMICAL COMPANY

During the latter period of plant operation, numerous fish kills in Coon Bayou were reported by the local residents. Documented fish kills near the site are listed in Table 1. Subsequent investigations by the Texas Department of Water Resources (TDWR) indicated that these fish kills could have been the result of discharges of hazardous materials from the site. In August 1981, TDWR acquired a temporary injunction against Triangle Chemical Company, calling for compliance with pollution control laws and prevention of further untreated discharges from the site.

In October 1981, TDWR found the site to be abandoned. Limited sampling of drums, spill areas, runoff areas, and Coon Bayou documented that hazardous materials were located onsite and were migrating offsite via stormwater runoff and direct discharge reinforcing the possibility that the fish kills could have been caused by hazardous material spills from the site. The drums stored onsite were noted to be in a deteriorated condition with some bulging and leaking.

After the Trustee in bankruptcy for the Triangle Chemical Company indicated that the company assets were insufficient to perform any necessary cleanup work at the site, the Environmental Protection Agency (EPA) initiated an Immediate Removal Action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) to deter public access to hazardous materials on the site in April 1982. This action consisted of: (1) building a six-foot high chain link and barbed wire fence around the material storage area, (2) posting warning signs around the site, and (3) constructing a drainage canal in front of the main drum storage area to prevent runoff from reaching Highway 87. The cost of this action was $8,082.25.

In August 1982, a Planned Removal Action was conducted to remove the drums and contaminated debris at the site. Under this action, the drums were staged and liquids were pumped to bulk transport trucks for offsite disposal. Empty drums were crushed and removed from the site along with contaminated trash and soil. The soil removal operations were limited to the drum staging and crushing area. The wastes removed from the site during this action were taken to an approved hazardous waste disposal site owned by Chemical Waste Management, Inc. in Port Arthur, Texas and included: 21,000 gallons of liquid, 350 cubic yards of contaminated soil and trash, and 1,095 55-gallon drums. The cost of this action was $74,755.25.

In July 1982, TDWR nominated the Triangle Chemical Company for inclusion on the National Priorities List. The site ranked high enough to be placed on the list and became eligible for remedial investigation/feasibility study (RI/FS) funding. In August 1983, a cooperative agreement between EPA and the State of Texas was approved, awarding $183,000 to conduct the studies. Roy F. Weston, Inc. of Houston, Texas was selected to conduct the RI/FS. The onsite activities for the remedial investigation were completed in April 1984 and the final report was received in September 1984. The Feasibility Study was initiated in August 1984 and completed in March 1985.

TABLE 1

DOCUMENTED FISH KILLS ON COON BAYOU

DATE	LOCATION	CAUSE	NO. FISH KILLED
03/27/76	Near SH 62 & Winfree Rd.	Low D.O.	No Count
09/06/77	Near Confluence of Cow Bayou	Low D.O.	10,000
10/24/77	Private Pond Adjacent to Coon Bayou & Hoo Hoo Rd.	Low D.O.	1,250
03/25/78	Between US 87 and Mouth of Coon Bayou	Low D.O.	1,000
05/05/78	Between US 87 and Mouth of Coon Bayou	Low D.O.	38
11/2/81	Near Hoo Hoo Rd. Bridge	Low D.O.	No Count
10/19/82	Private Pond 1 Mile Upstream From Plant	Low D.O.	No Count

In response to suspected unauthorized activities on the Triangle property, a third emergency action was undertaken to completely enclose the site with a six-foot chain link fence in March 1985.

Current Site Status

The site investigation performed at the Triangle Chemical Company generated substantial information concerning the regional geology, site geology and hydrogeology, and site geochemistry.

Regional stratigraphic information is presented in Table 2. Bridge City and Orange County are located in the southernmost surface exposure of the Beaumont Clay Formation, consisting primarily of interdistributary muds and distributary sands and silts of the Pleistocene Age. As seen in Figure 5, the soils at the site consist primarily of silty clays of the formation. The uppermost stratum is a dark brown, clayey silt containing some organics fiber, representing a weathered soil horizon of the Beaumont formation. Underlying the clayey silt is a silty clay containing trace fine sands. This soil layer was found to be stiff and moist during the site investigation.

Within the silty clay unit are lenses of light brown silt containing traces of clay and very fine sand. This silt is typically saturated and soft, varying in thickness from 2 feet to 5 feet across the site.

Adjacent to Coon Bayou, a light gray silty clay was identified underlain by a black silty clay containing a significant amount of organic fiber.

Groundwater elevations, monitored during the site investigation, indicate that shallow groundwater occurs across the site at depths of 2 to 6 feet below the surface. Fluctuations in the shallow water table elevation are associated with local weather conditions. During periods of heavy rainfall, the water table has been identified as high as 2 feet below the surface. Based on measured groundwater elevations, horizontal groundwater flow occurs in a northeasterly direction across the site and discharges into Coon Bayou. The influence of tidal variations on the water table elevation is not significant enough to effect overall groundwater flow.

As seen in Table 3, the onsite shallow groundwater is slightly contaminated. Because the maximum contaminant concentrations are well below the concentrations established by the National Drinking Water Standards and the Clean Water Act water quality criteria (Table 4 and 5, respectively), the groundwater does not present a significant threat to human health and the environment. It should be noted that the shallow groundwater is presently subject to future contamination from leaching of contaminants due to an elevated water table during severe rainfall events.

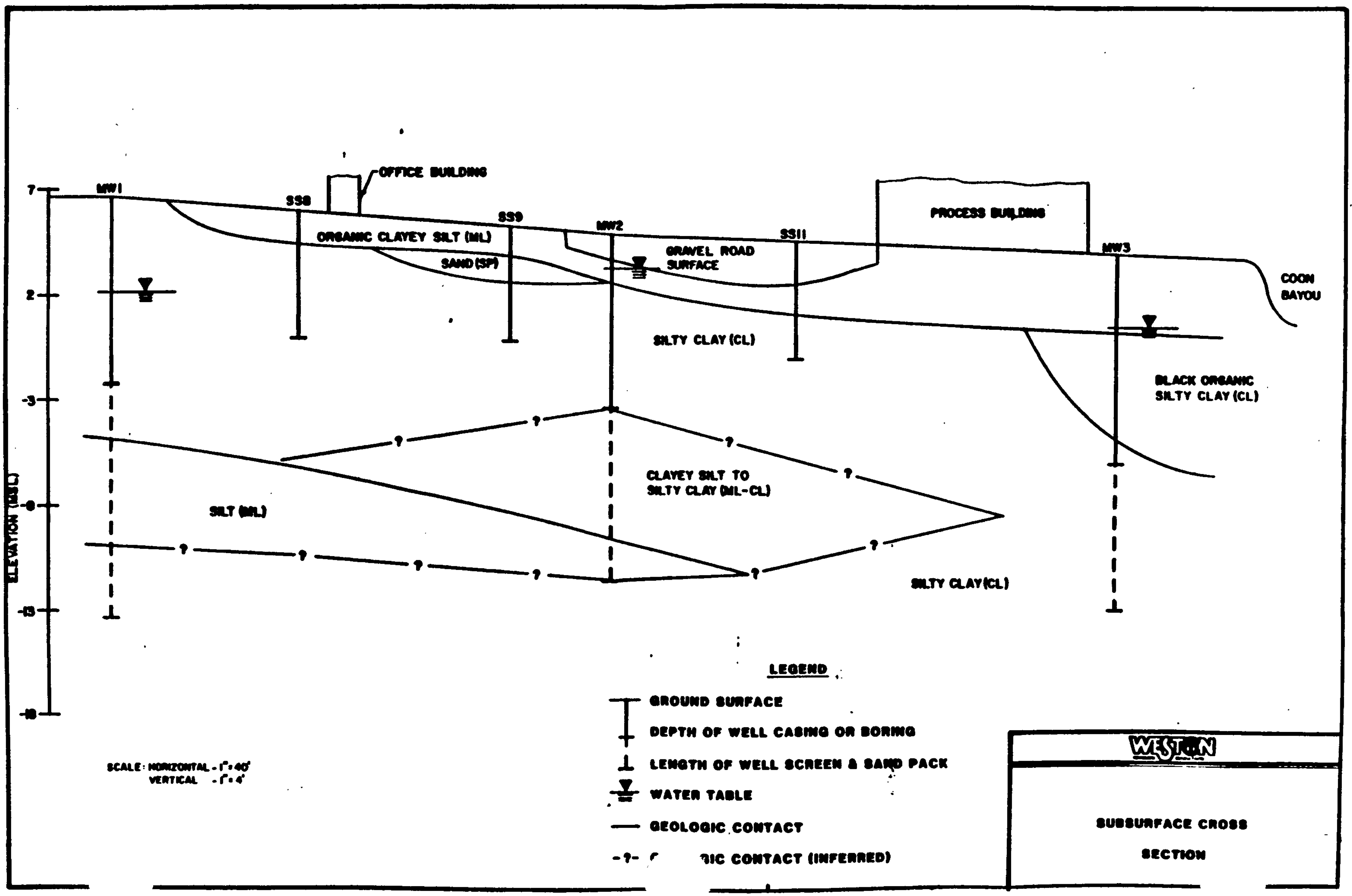
The site is located immediately adjacent to Coon Bayou, which is a tributary of the Cow Bayou and Sabine River drainage systems. There are no stream gauging stations in Coon Bayou, however, flow variability in Coon Bayou is similar to the variability of Cow Bayou, in which the flow ranges from 0 to 4,600 cubic feet per second (cfs), with an average of 101 cfs. Both bodies of water are influenced by tidal fluctuations; extremely high tides have, in some cases, temporarily reversed the flow in both bayous.

TABLE 2

STRATIGRAPHY OF THE TEXAS GULF COAST REGION

Era	System	Series	Stratigraphic Units			Hydrogeologic Units	Selected Faunal Markers	Remarks
Cenozoic	Quaternary	Holocene	Alluvium			Chicot aquifer		Quaternary System undifferentiated on sections.
		Pleistocene	Beaumont Clay					
			Montgomery Formation					
			Bentley Formation					
			Willis Sand					
	Tertiary	Pliocene	Goliad Sand			Evangeline aquifer		Goliad Sand overlapped east of Lavaca County.
		Miocene	Fleming Formation			Burkeville confining system	*Potamides matsoni* *Bigenerina nodosaria var. directa* *Bigenerina humblei* *Amphistegina sp.*	
			Oakville Sandstone			Jasper aquifer		Oakville Sandstone included in Fleming Formation east of Washington County.
			Surface	Catahoula Tuff or Sandstone	Subsurface: Upper part of Catahoula Tuff or Sandstone		*Discorbis nomada* *Discorbis gravelli* *Heterostegina sp.* *Marginulina idiomorpha*	Catahoula Tuff designated as Catahoula Sandstone east of Lavaca County.
					Subsurface: Anahuac Formation	Catahoula confining system (restricted)		Anahuac and "Frio" Formations may be Oligocene in age.
					Subsurface: "Frio" Formation		*Textularia mississippiensis*	
		Oligocene(?)	Surface: Frio Clay		Subsurface: Vicksburg Group equivalent	Not discussed as hydrologic units in this report.	*Textularia warreni*	Frio Clay overlapped or not recognized on surface east of Live Oak County.
		Eocene	Jackson Group	Whitsett Formation	Fashing Clay Member			Indicated members of Whitsett Formation apply to south-central Texas. Whitsett Formation east of Karnes County may be, in part or in whole, Oligocene in age.
					Calliham Sandstone Member or Tordilla Sandstone Member		*Marginulina cocoaensis*	
					Dubose Member			
					Deweesville Sandstone Member		*Textularia hockleyensis*	
					Conquista Clay Member		*Massilina pratti*	
					Dilworth Sandstone Member			
				Manning Clay			*Textularia dibollensis*	
				Wellborn Sandstone				
				Caddell Formation			*Nonionella cockfieldensis*	
			Claiborne Group	Yegua Formation			*Discorbis yeguaensis* *Eponides yeguaensis*	
				Cook Mountain Formation			*Ceratobulimina eximia*	
				Sparta Sand				
				Weches Formation				
				Queen City Sand				
				Reklaw Formation				
				Carrizo Sand				
			Wilcox Group					
		Paleocene	Midway Group					

FIGURE 5
SITE GEOLOGY



BLE 3
TRIAN\ .IEMICAL COMPANY
ANALYTICAL RESULTS
GROUNDWATERS

COMPOUND	UNIT OF CONCENTRATION	MW-1 WELL 1	MW-1D WELL 1-DUPLICATE	MW-2 WELL 2	MW-2D WELL 2-DUPLICATE	MW-3 WELL 3	FIELD BLANK	LAB BLANK	DETECTION LIMIT
Phenols	mg/l	NP	--	NP	NP	NP	NP	--	.005
pH		7.1	--	7.1	--	8.3	8.5	--	--
Chromium	mg/l	NP	--	NP	--	NP	NP	--	.05
Copper	mg/l	NP	--	NP	--	.06	NP	--	.03
Lead	mg/l	NP	--	NP	--	NP	NP	--	.50
Nickel	mg/l	NP	--	NP	--	.13	NP	--	.10
Silver	mg/l	NP	--	NP	--	NP	NP	--	.10
Zinc	mg/l	.05	--	.08	--	.10	NP	--	.05
TOC	mg/l	75.1	50.0	36.1	--	62.5	1.0	--	1.0
Specific Conductance	u mhos/cm	2,100	--	577	--	4,900	1.35	--	--
MBAS	mg/l	--	--	NP	--	--	NP	--	0.02
Oil & Grease-Infra Red	mg/l	--	--	NP	--	--	--	NP	0.2
Oil & Grease-Gravimetric	mg/l	--	--	NP	--	--	--	--	1.0
<u>Priority Pollutant Volatiles</u>*									
Methylene Chloride**	ug/l	25	--	26	--	25	29	22	10
<u>Priority Pollutant Base Neutrals</u>									
Di-n-Butyl Phthalate	ug/l	52	--	NP	--	NP	NP	--	10
Bis (2-Ethyl Hexyl) Phthalate	ug/l	50	--	NP	--	NP	NP	--	10
<u>Priority Pollutant Pesticides</u>									
Delta-BHC	ug/l	--	--	trace	--	--	--	--	2
<u>Priority Pollutant Acid Extractables</u>									
Pentachlorophenol	ug/l	--	--	10-20	--	--	NP	--	10

* MW-1 also had non-priority pollutant volatile present. Review of scan indicates substance to be 2-octanol. Approximately 50 ug/l.

** Chemical in analytical extraction process.

TABLE 4
U.S. EPA DRINKING WATER STANDARDS

STANDARD	CONSTITUENT	MAXIMUM CONCENTRATION mg/l
Primary Drinking Water	Arsenic	0.05
	Barium	1.0
	Cadmium	0.01
	Chromium	0.05
	Fluoride	1.4 - 2.4
	Lead	0.05
	Mercury	0.002
	Nitrate (as N)	10
	Selenium	0.01
	Silver	0.05
	Endrin	0.0002
	Lindane	0.004
	Methoxychlor	0.1
	Toxaphene	0.005
	2,4-D	0.1
	2,4,5-TP Silvex	0.01
Secondary Drinking Water	Chloride	250
	Color	15 color units
	Copper	1
	Corrosivity	Noncorrosive
	Foaming Agents	0.5
	Iron	0.3
	Manganese	0.05
	Odor	3 Threshold Odor Number
	pH	6.5 - 8.5
	Sulfate	250
	Total Dissolved Solids (TDS)	500
	Zinc	5

References: 40 CFR Parts 141 and 143.

TABLE 5

CLEAN WATER ACT
WATER QUALITY CRITERIA

Compound*	Water Quality Criteria Fish and Drinking Water	Water Quality Criteria Drinking Water Only
Diethylphthalate	350 mg/l	434 mg/l
Di-n-Butyl Phthalate	34 mg/l	44 mg/l
Pentachlorophenol	1.01 mg/l	1.01 mg/l

* Volatile organic compounds detected at Triangle Chemical Company

Data generated during the site investigation, presented in Table 6, shows that the surface water directly adjacent to the site is only slightly contaminated. Concentrations of contaminants detected are well below drinking water and Clean Water Act water quality standards. Therefore, contamination of surface waters from the site is not considered to be significant.

During the site investigation, several 55-gallon drums of chemical product were observed in a building on property owned by the Triangle Chemical Company, north of Redbird Chemical Company. These drums are in deteriorated condition, and pose a threat to human health due to direct contact with the public. Therefore, disposal of these drums is addressed as part of the remedial action at the site.

The results of the site investigation and supplemental sampling performed during the feasibility study indicate that approximately 51,000 gallons of hazardous materials are stored in 12 above ground storage tanks onsite. The analytical results of samples taken from these tanks are presented in Tables 7 and 8.

The results of the site investigation also indicate that soil contamination is restricted to past drum and tank storage areas onsite. Concentrations of metals detected are within the range of levels found to occur naturally in the soil in the area. Onsite soil contamination is extensive for volatile organics compounds (VOC), as seen in Figure 6, which illustrates the lateral and vertical extent of soil contamination of greater than 500 parts per million total volatile organics. Concentrations of specific volatile compounds found in the soil are listed in Table 9. A total of 1,900 cubic yards of contaminated soils are onsite; no contaminated soils were detected offsite.

The following conclusions were developed from the remedial investigation:

- Near surface soils on the site have been contaminated from migration of the waste materials through spills and leaks from drums and tanks.
- Groundwaters below the site are not significantly impacted by the facility.
- Surface waters in the vicinity of the site are not significantly impacted.
- Air quality at the site has not been measurably impacted.
- Tanks containing hazardous materials remain unsecured onsite.
- A large quantity of general refuse, a portion of which is potentially contaminated with chemical product, remains onsite.
- A drum storage area on Triangle Chemical Company's northern property remains unsecured.

TABLE (

TRIANGLE CHEMICAL COMPANY

ANALYTICAL RESULTS

SURFACE WATERS

COMPOUND	UNIT OF CONCENTRATION	B-1W INLET	B-1W-D INLET DUPLICATE	FIELD BLANK	DETECTION LIMIT
Phenols	mg/l	NF	--	--	.005
pH	mg/l	6.2	7.2	7.0	--
Chromium	mg/l	NF	--	NF	.05
Copper	mg/l	0.19	--	--	.03
Lead	mg/l	NF	--	NF	.5
Nickel	mg/l	NF	--	NF	.1
Silver	mg/l	NF	--	NF	.1
Zinc	mg/l	0.04	--	NF	.02
Priority Pollutant Base Neutrals					
Di-n-Butyl Phthalate	ug/l	22	38	13	10
Diethyl Phthalate	ug/l	NF	NF	13	10

TABLE 7

ANALYTICAL RESULTS OF TANK SAMPLING
DURING EMERGENCY RESPONSE ACTION
AUGUST, 1982

COMPOUND*	TANK NUMBER A2	A3	A4	B3	B4	21**
Trichloroethylene	2,351	—	—	—	16,000	69
1,1,2-Trichloroethane	13	—	—	—	401	—
Benzene	10	52	—	—	72	—
1,1,2,2-Tetrachloroethene	39	—	—	—	550	—
Toluene	620	733	412	—	3,400	711
Napthalene	1,112	4	—	—	6,285	58
Ethyl Benzene	—	132	77	—	20,000	82
2-Ethylhexyl Phthalate	—	—	—	—	220,000	309
1,2-Dichloroethane	—	—	—	—	710	—
2-Chloroethylvinyl Ether	—	—	—	—	2,000	—
1,4-Dichlorobenzene	—	—	—	—	5,561	—
1,2-Dichlorobenzene	—	—	—	—	43,500	—
N-Nitrosodiphenylamine	—	218	800	—	—	—
PCB (polychlorinated biphenyls)	—	75	—	—	—	—
Chromium	0.15	—	—	0.02	150	0.04
Copper	11	0.35	4.0	0.07	5.8	0.42
Lead	2.5	—	1.0	0.09	7.1	0.3
Nickel	0.5	0.2	0.03	1.3	0.3	0.06
Silver	0.2	—	—	—	—	—
Zinc	12.9	0.5	1.1	0.4	—	0.09
Mercury	—	—	—	—	0.003	—

* All concentrations of organic compounds expressed as parts per billion (ppb)
All concentrations of inorganic compounds (metals) expressed as parts per billion (ppb)

** Tank No. 21 was relabeled as S6 in this investigation.

TRIANGLE CHEMICAL COMPANY
ANALYTICAL RESULTS ON TANK CONTENTS

COMPOUND	UNIT OF CONCENTRATION	A2	A3	A4	B4	F6	F7	F8	F12	S3	S5	S6
Polychlorinated Biphenyls[1]	mg/l	NP	0.12[2]	NP	NP	NP	NP	NP	NP	NP	NP	NP
Endrin	mg/l	NP[3]	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Lindane	mg/l	NP[3]	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Methoxychlor	mg/l	NP[3]	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
Toxaphene	mg/l	NP[3]	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
2,4-D	mg/l	NP[3]	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
2,4,5-TP	mg/l	NP[3]	NP	NP	0.013	NP	NP	NP	NP	NP	NP	NP
Flashpoint	°F	100	NP	NP	100	125	130	NP	100	NP	115	100
Reactivity	—	NP'	NP	NP	NP	NP	NP	NP	NP	NP	NP	NP
pH	—	8.8	6.2	10.2	11.1	NOTE 4	NOTE 4	NOTE 4	10.9	9.6	8.7	9.0
Arsenic	mg/l	NP	NP	0.018	0.013	NOTE 5	0.010	0.026	0.019	0.009	NP	NOTE 5
Barium	mg/l	NP	NP	NP	NP	NOTE 5	NP	0.05	0.04	NP	NP	NOTE 5
Cadmium	mg/l	NP	NP	NP	0.06	NOTE 5	NP	NP	NP	NP	NP	NOTE 5
Chromium	mg/l	0.88	0.14	NP	69.0	NOTE 5	0.05	0.15	0.15	NP	0.28	NOTE 5
Lead	mg/l	1.4	2.6	0.32	2.8	NOTE 5	0.8	1.4	2.2	NP	1.4	NOTE 5
Mercury	mg/l	NOTE 6	NOTE 6	NP	NOTE 6	NOTE 5	NP	NP	0.315	NP	NOTE 6	NOTE 6
Selenium	mg/l	NP	NP	NP	NP	NOTE 5	NP	0.025	NP	NP	NP	NOTE 5
Silver	mg/l	NP	NP	NP	NP	NOTE 4	0.1	NP	0.1	NP	NP	NOTE 5
Bicarbonates	mg/l	4,400	92	NP	100	NOTE 4	NOTE 4	NOTE 4	40	4,400	440	560
Carbonates	mg/l	2,800	0	1,760	9,200	NOTE 4	NOTE 4	NOTE 4	13,600	2,800	100	140
Sulphur	%	NP	NP	NP	0.01	0.11	0.19	0.01	NP	NP	NP	NP
Chlorine	%	0.03	NP	NP	0.28	0.02	NP	0.01	NP	NP	NP	NP
Total Carbon	%	13.4	2.33	1.76	20.4	83	87.6	7.36	0.61	2.66	4.57	4.68
Halogens	%	0.03	NP	NP	0.28	0.02	NP	0.01	NP	NP	NP	NP
Hydrogen	%	10.9	11.7	11.0	10.6	11.9	11.6	10.7	10.6	11.0	10.2	10.1
Nitrogen	%	0.16	NP	0.03	0.13	NP	NP	0.02	NP	NP	0.02	NP
Ash	%	1.10	NP	0.02	1.3	NP	0.06'	3.3	3.8	0.30	0.10	0.08

TABLE 8 (CONT.)

TRIANGLE CHEMICAL COMPANY
ANALYTICAL RESULTS ON TANK CONTENTS

COMPOUND	UNIT OF CONCENTRATION	A2	A3	A4	B4	F6	F7	F8	F12	S3	S5	S6
Viscosity @ 38°C	Centistokes	1.0	1.5	0.9	4.0	1.5	1.8	2.4	0.9	1.0	1.5	1.5
Specific Gravity	—	1.0255	0.9960	1.000	1.0355	0.8611	0.8630	1.0295	1.029	1.0159	0.9800	0.9856
BTU/lb	—	NP	NP	NP	NP	10,240	19,060	NP	50	NP	NP	NP
Suspended Solids	mg/l	12	11	37	30	2,100[7]	47	5	816	82	59	9
Corrosivity	mm/yr	0.06	0.17	0.19	0.01	0.14	NP	NP	NP	0.10	0.02	0.16

1 Includes arochlor 1211, 1232, 1242, 1248, 1254, 1260, 1016

2 Represents arochlor 1242

3 None of EP Toxicity herbicides/pesticides were found. However, tank number A2 was found to contain 24 mg/l DDE, 40 mg/l DDD, 13 mg/l DDT.

4 High organic content prevents determination of accurate pH, carbonates, and bicarbonates.

5 Nature of samples prevent metals analysis using AA since samples ignite and melt holding apparatus. Similar problems were experienced with inductively coupled plasma analysis. Various nitric acid and freon extraction techniques were attempted, but did not produce adequate quality control data.

6 Nature of samples resulted in foaming during aspiration, and subsequent contamination of instrument during analyses.

7 Nature of sample caused glass fiber filter to dissolve. Results may not be accurate.

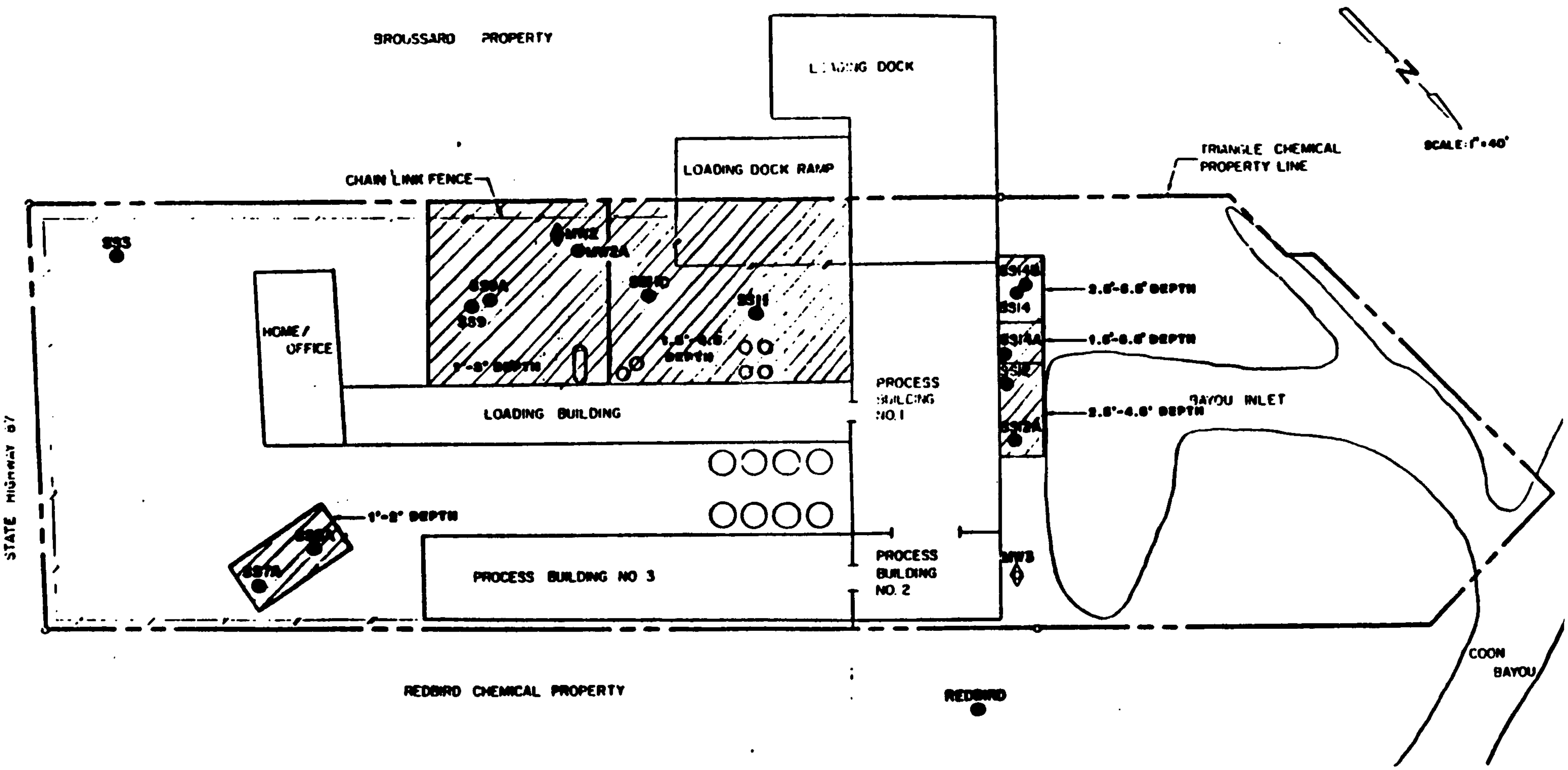


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Figure 6

LOCATION OF SOIL BORINGS/
SOIL ZONES WITH TOTAL V.O.C.
MEASUREMENTS > 500 P.P.M.

TABLE 9
TRIANGLE CHEMICAL COMPANY
ANALYTICAL RESULTS
SOILS

COMPOUND	UNIT OF CONCENTRATION	SC-1 SURFACE	SC-1 1'	SC-2 SURFACE	SC-2 1'	SC-3 SURFACE	SC-3 1'	SC-4 SURFACE	SC-4 1'	SS-4 SURFACE	SS-4 1'	DETECTION LIMIT	NATURALS IN SOILS AVE.	NATURALS IN SOILS RANGE
Phenols	ug/gm	NF	NF	NF	NF	NF	0.233	NF	0.051	0.086	NF	.005	--	--
pH	SU	8.1	7.7	8.3	7.9	8.3	8.3	8.1	7.6	7.6	7.0	--	--	--
Chromium	mg/kg	4.8	5.0	3.0	4.4	12.1	7.2	7.5	12.4	4.9	3.4	.05	200	5-1,000
Copper	mg/kg	11.5	10.0	7.2	7.6	14.1	10.7	8.5	10.2	9.1	5.2	.03	20	2-100
Lead	mg/kg	57.2	19.5	36.6	49.2	89.3	22.1	23.0	27.1	43.4	15.7	.5	10	2-200
Nickel	mg/kg	4.2	2.2	4.2	2.0	5.7	NF	4.9	6.3	NF	NF	.1	40	5-500
Silver	mg/kg	NF	NF	NF	NF	NF	NF	NF	NF	NF	NF	.1	--	--
Zinc	mg/kg	102	28.0	28.1	64.1	65.1	232	35.2	11.6	26.3	3.2	.02	50	10-300
<u>Priority Pollutant Base Neutrals</u>														
Di-m-Butyl- Phthalate	ug/mg	NF	NF	NF	NF	NF	NF	NF	23	NF	NF	10	--	--

* As per "Chemical Monitoring of Soils for Environmental Quality and Animal and Human Health", Dale E. Baker and Leon Chesmin, contribution to journal series of Agricultural Experiment Station.

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TABLE 9 (continued)
TRIANGLE CHEMICAL COMPANY
ANALYTICAL RESULTS
VOLATILE ORGANICS IN SOILS

COMPOUND*	NW-2A 24"	SS-SA 14"	SS-9A 24"	SS-11C 6"	SS-11C 16"	SS-11C 32"	SS-12A 30"	SS-14A 18"	SS-14B 30"	REDBIRD 24"	TRIP BLANK	LAB BLANK
Priority Pollutant Volatiles												
Chlorobenzene	NF	NF	NF	NF	0.62	NF	NF	NF	NF	NF	NF	NF
1,2 Trans Dichloroethylene	NF	NF	NF	NF	0.13	NF	NF	NF	NF	NF	NF	NF
Ethylbenzene	NF	NF	NF	NF	NF	0.18	NF	NF	NF	NF	NF	NF
Non-Priority Pollutant Volatiles**												
Acetone	0.15	0.16	--	1.4	0.06	0.09	0.05	0.05	--	0.03	--	--
Carbon Disulfide	0.12	0.21	--	0.22			--	0.05	--	--	--	--
Furan	--	--	--	--	> 0.05	> 0.04	--	--	--	--	--	--
Tetrahydrofuran	--	0.07	--	0.11	--	0.04	--	0.04	--	--	--	--
Aldehyde C_4	--	--	--	0.32	--	--	--	--	--	--	--	--
Methylketone C_4	--	--	--	0.41	--	--	--	--	--	--	--	--
Aldehyde C_5	--	--	--	--	--	--	0.04	--	--	--	--	--
Methylketone C_5	0.09	0.12	--	9.7	--	0.04	--	--	--	--	--	--
Dioxane	--	--	--	0.26	0.22	0.04	--	--	--	--	--	--
Methylketone C_6	--	--	--	2.4	--	--	--	--	--	--	--	--
Methylketone C_7	--	--	--	22.0	--	--	--	--	--	--	--	--
Total Alcohol $> C_5$	--	--	--	1.3	--	--	--	--	--	--	--	--
Methylketone C_8	--	--	--	0.68	--	--	--	--	--	--	--	--
Alkylbenzenes $> C_8$	--	--	--	> 3.9	--	--	--	--	--	--	--	--
Hydrocarbons C_8	--	--	--		--	--	--	--	--	--	--	--
Total Acetates	--	--	--	--	--	--	--	--	--	0.33	--	--
Dichlorobenzene	--	--	--	--	0.11	0.04	--	--	--	--	--	--

Detection Limit - 0.1 μg/g

* All units in μg/g

** Concentrations reported are to be used as semi-quantification only

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The following target receptors were identified in the remedial investigation:

- Materials released onto the ground surface from the storage tanks would either percolate into the soil or flow into Coon Bayou. The risk to receptors via surface water migration has been documented by fish kills caused by past releases of similar materials that were stored in 55-gallon drums which were disposed of during a removal action in August 1982.

- A sudden release of materials in the tanks would also present a risk to persons living and working in the area and driving past the site due to volatile organics released to the atmosphere and direct contact with contaminated soil.

- The volatile organic compounds detected in the soils, several of which are suspected mutagens, teratogens, and carcinogens, could be released to the atmosphere during future development of the site affecting worker health and safety. Toxicity characteristics and routes of exposure for the volatile organic compounds found in the soil and tanks are listed in Table 10.

No significant migration of airborne contaminants onsite was detected during the remedial investigation.

Migration Pathways

Groundwater

The Triangle Chemical Company site is underlain by the Beaumont Formation, one of five formations that make up the Chicot Aquifer of the Texas Gulf Coast.

The Chicot Aquifer is the youngest aquifer in the coastal plain of Texas and includes the Willis Sand, Bentley Formation, Montgomery Formation, Beaumont Clay and Recent Alluvium. Recharge to the lower portions of the Chicot Aquifer occur at outcrops of the Willis, Bentley and Montgomery Formations, north of Orange County. The Willis Sand consists principally of reddish sands and gravel, silt and clay. The Willis Sand is not known to yield freshwater to wells in Orange County and contains slightly to moderately saline water. The Bentley and Montgomery Formations consist of a basal gravelly sand grading upward into finer sand, silt and clay. Much of the sediments of these formations are similar to the Willis Sand from which they were at least partly derived.

The deltaic coastwise plain of the Beaumont Clay forms the land surface of all of Orange County except along rivers and the coast where it is covered by Recent Alluvium. Much of the surface exposure of the Beaumont Clay in the northern part of the County is covered by fine sandy loam because of a greater proportion of sand near the base of the formation. Southward the Beaumont becomes progressively more clayey. While the Beaumont is generally described as consisting of clay it contains much sandy material which can be locally utilized for water supply. Sand beds in the Beaumont Clay yield freshwater to domestic and livestock wells in Orange County.

TABLE 10
TOXICITY DATA FOR SELECTED ORGANICS FOUND IN SOILS AND TANKS
AT TRIANGLE CHEMICAL COMPANY

	TOXICITY CHARACTERISTICS[4]			ROUTE OF EXPOSURE			
	CARGINOGEN	MUTAGEN	TERATOGEN	INHALATION	SKIN ABSORPTION	INGESTION	SKIN/EYE CONTACT
<u>SOILS</u>							
Acetone		X		X	X	X	X
Carbon Disulfide		X	X	X	X	X	X
Chlorobenzene	X			X	X	X	X
Dichlorobenzene	X			X		X	X
1,2-Dichloroethylene				X		X	X
Dioxane	X	X		X	X	X	X
Ethyl Benzene	X		X	X		X	X
Furan	X	X		X	X	X	X
Tetrahydrofuran	X	X		X		X	X
<u>TANKS</u>							
Benzene	X	X	X	X	X	X	X
Dichlorobenzene	X			X	X	X	X
Dichloroethane	X			X		X	X
Ethyl benzene	X		X	X		X	X
Napthalene	X			X	X	X	X
1,1,2,2-Tetrachloroethane	X	X		X	X	X	X
Toluene	X		X	X	X	X	X
1,1,2-Trichloroethane	X			X	X	X	X
Trichloroethylene	X	X	X	X		X	X

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The recent alluvium in bayous supplies small quantities of groundwater to temporary residences. Although the alluvium is capable of furnishing large quantities of groundwater, large scale development would induce or accelerate movement of saline water from the rivers into the aquifer, eliminating the potential for using the aquifer as a major resource.

As previously discussed, shallow groundwater is encountered between 2 and 6 feet below the surface of the site. Fluctuations in the shallow water table occur primarily due to local weather conditions, rising during periods of heavy rainfall and falling during drier periods. Although a tidal influence is seen in the water table, fluctuations due to this influence are not significant.

The remedial investigation confirmed minor contamination of the shallow groundwater. The fluctuations in the water table and heavy rainfalls associated with these fluctuations indicate that the observed groundwater contamination is due to periodic leaching of soils when the water table has risen. Based on the observed contamination, soil permeability (10^{-3} cm/sec), and direction of flow, it is possible that soil contaminants leached into the groundwater could impact Coon Bayou.

Surface Water

Surface water has been contaminated from the site from runoff during flood events and from leaking tanks and drums. Seventy-five percent of the site lies in the 100-year floodplain as designated by the Federal Emergency Management Agency, and portions of the site have been inundated at least once every six years. Potential exists for future contamination of surface water due to erosion and transport of contaminated soil and a release of contents from deteriorating onsite storage tanks.

Air

Results of the remedial investigation indicate that air quality in the area has not been adversely affected by the site. Volatile organic compounds were released from the soil surface after spills from tanks and drums on the site, but no contaminants were detected in the soil within one foot of the surface. Volatile organics were detected in soils 1 to 5 feet deep in concentrations as high as 500 ppm, and could be released suddenly during future site development. It is unlikely, however, that significant air quality degradaton will occur if the site surface remains undisturbed.

Enforcement

Potentially responsible parties (PRPs) for Triangle consist of the Triangle Estate which is currently in Chapter 7 Bankruptcy; approximately six companies and corporations that have either owned Traingle Chemical or were sister companies of Triangle operating from the same location; and officers of the companies and corporations associated with Triangle. None of the companies involved are solvent.

The State of Texas obtained an injunction against Triangle in August of 1981. This injunction required Triangle to comply with all pertinent rules and regulations. At the time of this injunction, Triangle was operating under Chapter 11 Bankruptcy rules. Approximately two months after the injunction, the Texas Department of Water Resources (TDWR) discovered that the facility had been abandoned.

In August 1982, EPA Region VI forwarded a cost recovery case development plan to Headquarters. This CERCLA cost recovery action was for monies expended in the emergency and planned removal actions begun in April 1982, and continuing through August 1982. This cost recovery action is pending in the bankruptcy court.

Due to the insolvency of the entities involved with Triangle, remedial action could not be obtained in a timely fashion through litigation. However, PRPs will be offered the opportunity to voluntarily implement the selected remedy.

Alternatives Evaluation

The feasibility study for the Triangle Chemical site was performed to determine what actions, if any, would be appropriate as part of a permanent remedy for the site. Several alternative remedial methods were developed to cost-effectively mitigate damage to, and provide adequate protection of public health, welfare and the environment from past and future releases of contaminants in storage tanks and soil currently onsite.

The National Contingency Plan, 40 CFR Part 300.68 (e) (2) states that "Source control remedial actions may be appropriate if a substantial concentration of hazardous substances remains at or near the area where they were originally located and inadequate barriers exist to retard migration of substances into the environment." In accordance with the plan, and based on the conclusions of the remedial investigation, a source control remedial action is necessary at the Triangle Chemical site.

The major threats to public health and the environment attributed to contaminants at the site are:

1. Direct contamination of groundwater

2. Rupture of storage tanks, releasing contaminants to the soil, surface water, and atmosphere.

3. Uncontrolled releases of volatile organic contaminants in the subsurface soils resulting from future developmental excavation.

Remedial Objectives

The feasibility study performed by Roy F. Weston Associates in March 1985 developed the following objectives based on the results of the remedial investigation:

- Remove and dispose of the contents of the storage tanks in an approved disposal facility, and decontaminate the tanks.

° Prevent significant degradation of the shallow groundwater.

° Prevent significant degradation of surface water.

° Reduce contamination in the soil to mitigate future impacts on human health, the environment, and site development.

° Remove and dispose of the trash in and around the buildings onsite.

At the time the facility was abandoned, 1,095 55-gallon drums used for storing raw materials and products were located on the site. Therefore, closure of the site must be in compliance with the Resource Conservation and Recovery Act (RCRA) 40 CFR 264.178, which states that "at closure, all hazardous wastes and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases and soil containing or contaminated with hazardous wastes or hazardous waste residues must be decontaminated or removed." The Permit Applicant's Guidance Manual for Hazardous Waste Land Treatment, Storage, and Disposal Facilities states that, at closure of a facility, soils are considered to be decontaminated when the concentrations of hazardous constituents are at background levels for soil in the area.

Criteria to measure the accomplishment of the objectives developed for the contaminated soil were established based on time-weighted average permissible exposure limits (TWA-PEL) and short term exposure limits (STEL) for volatile organic compounds identified in the soils and regulatory requirements for the closure of container storage facilities. These TWA-PEL's and STEL's are listed in Table 11. Appropriate levels of soil clean up based on these criteria were determined to be 100 ppm of total volatile organics, the most conservative STEL, and 25 ppm, the most conservative TWA-PEL. Based on the regulatory requirement for facility closure, the appropriate level of clean up would be background.

Clean up criteria were not established for the removal of the tank contents. Closure of the tanks will be done in strict accordance with 40 CFR 264.197, with appropriate decontamination of the tank interiors.

In accordance with Section 300.68 of the National Contingency Plan, several remedial methods were developed in the feasibility study to accomplish the objectives established for the permanent remedy at the site. Two methods were developed to dispose of the contents of the storage tanks, two methods to address the onsite structures, seven methods to address the onsite contaminated soil, and one method to address trash and debris on the site. A no-action alternative was also evaluated.

Initial Screening of Alternatives

Section 300.68 (h) states that the following broad criteria should be used in the initial screening of alternatives (methods):

TABLE 11
PERMISSIBLE EXPOSURE LIMITS
FOR VOLATILE COMPOUNDS
FOUND AT TRIANGLE CHEMICAL COMPANY

	OSHA[1] TWA (PPM)	AOGIH[2] TWA (PPM)	AOGIH[3] STEL (PPM)
SOILS			
Acetone	1,000	750	1,000
Carbon Disulfide	--	10	--
Chlorobenzene	75	75	--
Dichlorobenzene	50-75	75	110
1,2-Dichloroethylene	200	200	250
Dioxane	100	25	100
Ethyl Benzene	100	100	125
Furan	--	--	--
Tetrahydrofuran	200	200	250
TANKS			
Benzene	1	10	25
Dichlorobenzene	50-75	75	110
Dichloroethane	100	200	250
Ethyl benzene	100	100	125
Napthalene	10	10	15
1,1,2,2-Tetrachloroethane	5	1	5
Toluene	200	100	150
1,1,2-Trichloroethane	10	10	20
Trichloroethylene	100	50	200

[1] OSHA TWA - Occupational Safety & Health Administration (OSHA) time weighted average.

[2] AOGIH TWA - American Conference of Governmental and Industrial Hygenists (AOGIH) time weighted average.

[3] AOGIH STEL - AOGIH short term exposure limit.

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(1) Cost. For each alternative, the cost of installing or implementing the remedial action must be considered, including operation and maintenance costs. An alternative that far exceeds (e.g. by an order of magnitude) the costs of other alternatives evaluated and that does not provide substantially greater public health or environmental benefit should usually be excluded from further consideration.

(2) Effects of the alternative. The effects of each alternative should be evaluated in two ways: (i) whether the alternative itself or its implementation has any adverse environmental effects; and (ii) for source control remedial actions, whether the alternative is likely to achieve adequate control of source material, or for offsite remedial actions, whether the alternative is likely to effectively mitigate and minimize the threat of harm to public health, welfare, or the environment. If an alternative has significant adverse effects, it should be excluded from further consideration. Only those alternatives that effectively contribute to protection of public health, welfare, or the environment should be considered further.

(3) Acceptable Engineering Practices. Alternatives must be feasible for the location and conditions of the release, applicable to the problem, and represent a reliable means of addressing the problem.

Each of the remedial methods was evaluated based on these criteria. The rationale for preference of remedial methods is outlined below.

Methods for Disposal of Tank Contents

1. Offsite incineration/deep well injection/solidification and offsite landfill

This method involves incineration of 32,100 gallons of ignitable liquids, deep well injection of 24,000 gallons of non-ignitable organic liquids, and solidification and offiste landfill disposal of 375 cubic yards of organic sludges. The method provides for destruction of more than half of the hazardous materials in the tanks, and minimizes the potential for direct contact with the sludges and materials that cannot be incinerated. There are several commercial incineration and injection facilities in the area, thereby reducing the risks associated with transporting hazardous materials. For these reasons, the method is retained.

2. Solidification and Offsite Landfilling of all Tank Contents

This method involves the use of inorganic solids to absorb the liquids and transform the waste into a dry soid material, which is transported to an offsite landfill for disposal. The method is significantly more costly than the incineration/deep well injection method without providing a commensurate increase in protection, and is therefore rejected.

Method for Disposal of Drums and Contents

1. Offsite incineration and deep well injection of contents/offsite landfill of empty drums

This is the only method developed for the disposal of 135 drums that are currently stored on the northern portion of Triangle Chemical Company's property. The contents can be bulked with similar liquids from the storage tanks and disposed of very cost-effectively.

Methods for Disposal of Contaminated Soils

1. Excavation of contaminated soil and disposal in an offsite landfill

This method is retained in the initial screening. This method involves removal of the contaminated soils, and the disposal of these soils in an approved landfill offsite. The site would then be backfilled and graded with clean soil. Human contact with the contaminated material and the potential for future groundwater contamination would be eliminated, thereby meeting all of the objectives for remedial action.

2. Excavation of contaminated soil and disposal in an onsite RCRA landfill

In this method, a RCRA approved hazardous materials landfill for disposal of contaminated soils would be constructed onsite. This method is rejected for the following reasons: (1) location of a landfill in the 100-year floodplain is not a recommended practice; (2) because the wastes would remain onsite, a continued threat of release of wastes will exist; (3) construction of a landfill will require demolition of the onsite structures; (4) extensive long-term maintenance and monitoring will be required; and (5) the costs are significantly higher than offsite transport and disposal with no additional health or environmental benefits.

3. In-Situ mechanical aeration of soils

Aeration of the soils is a physical decontamination method whereby the contaminated soils are exposed to the atmosphere and the volatile organic compounds are released under controlled conditions. Contamination is reduced to background levels in a short period of time, and capacity to manage wastes from other contaminated sites is created by not utilizing space at an offsite landfill. Post-closure activities associated with this method include groundwater monitoring and site maintenance. Also, this method is the least costly of all of the methods developed for soil remediation and will meet all of the objectives developed for the site. For these reasons, the method is retained for further evaluation.

4. In-Situ Forced Air Injection Aeration of Soils

This method may be technically infeasible for use with the type of soil found at the Triangle Chemical site. The clay soils will hinder the movement of air, thereby requiring extensive amount of time and electrical energy for adequate exposure of the subsurface soils and release of the volatile compounds to the atmosphere. Associated with these time and energy requirements are higher operating costs, making this method more costly than mechanical aeration while not providing a commensurate increase in protection. For these reasons, the method is eliminated from further consideration.

5. Encapsulation of Contaminated Soil

Construction of a protective cap over the site would provide adequate protection of the public from direct contact with the contaminated soil, as long as the cap is properly maintained and no future site development takes place. However, enscapsulation would not accomplish the objectives of preventing groundwater contamination and mitigating future impacts due to surface development, and would be difficult to maintain due to the location of the site.

By allowing contamination to remain in the soil, a significant potential for groundwater contamination will exist, and long-term groundwater monitoring will be required in order to detect an contaminant migration from the site. If contamination is detected, future remedial action addressing the groundwater may be required.

Capping the site will not eliminate the potential for uncontrolled releases of volatile organic compounds during future site development activities, thereby posing a serious health threat to future construction workers at the site.

Because the site is located in the 100-year floodplain of Coon Bayou, deterioration of the cap will be significant and long-term maintenance costs will be extremely high. A cap is infeasible along the bayou shoreline, where tidal action will cause continual cap erosion and exposure of contaminated soil.

For the reasons discussed above, encapsulation is rejected as a remedial method.

Disposal of Trash and Debris

1. Segregation and Disposal in an Offsite Landfill

Trash and debris will be separated into contaminated and uncontaminated material. The contaminated material will be disposed of in a RCRA-approved hazardous materials landfill. Over 95% of the material is non-hazardous, and will be buried in a sanitary landfill. All of the material will be removed from the site, eliminating the potential for direct contact.

Methods for Addressing Contaminated Buildings and Structures

1. Decontamination

Buildings will be steam cleaned and remain onsite. The rinsate will be collected and disposed of by deep well injection. The method is technically effective and will eliminate the risk of public exposure to contaminants. Also, it may be possible to salvage the prefabricated buildings after decontamination. The method is retained.

2. Demolition and Removal

Demolition and removal of the onsite structures is rejected because capital costs are significantly higher than the cost of decontamination, without a commensurate increase in benefits.

The comparative costs of each of these methods are listed in Table 12. The costs associated with excavation to 25 ppm and 100 ppm are listed for comparison of methods that would not attain full compliance of Federal regulations, but would provide adequate protection of public health based on established health criteria. For all soil alternatives that are not designed to reduce contamination to background levels, a total present worth of $75,800 must be added for site management and long-term monitoring. For example, the total present worth of site encapsulation (infiltration controls) with mechanical aeration including capital costs and operation and maintenance is $227,800.

Description of Remedial Action Plans

The alternative methods that were retained after the initial screening are combined into alternative remedial action plans for a permanent remedy at the site. Cost estimates and brief descriptions of the technical feasibility, implementability, and environmental effectiveness of each plan are listed in Table 13. Detailed descriptions of the methods included in each plan are given below.

The methods involving the disposal of onsite debris and storage tank contents and the decontamination of onsite structures are common to all of the alternative plans, and therefore need not be evaluated with each plan. For comparative purposes, the estimated costs of these methods are included in the total remedial plan estimates.

Disposal of Tank Contents and Decontamination of Tanks

Approximately 32,000 gallons of liquids and sludges in the onsite storage tanks are amenable to incineration based on laboratory analysis of flashpoint, organic content, and heat value. One commercial incinerator operates near the Triangle Chemical site, thereby reducing risk and cost associated with transporting hazardous materials.

TABLE 12

SUMMARY OF REMEDIAL ACTION METHOD COST ESTIMATES

REMEDIAL METHOD	TOTAL CAPITAL COST	MONITORING AND MAINTENANCE		TOTAL PRESENT WORTH
		ANNUAL	PRESENT WORTH*	
Tank Contents				
Solidify and Landfill All Contents	$151,000	--	--	$151,000
Deep Well Inject and Incinerate Liquids, Solidify and Landfill Sludges	118,000	--	--	118,000
Contaminated Soils				
Excavaton to Background Quality and Onsite Disposal	1,510,000	--	--	1,510,000
Excavation to 25 ppm Volatile Organics and Offsite Disposal	781,000	--	--	781,000
Excavation to 100 ppm Volatile Organics and Offsite Disposal	572,000	--	--	572,000
Excavation to Background Quality and Offsite Disposal	868,000	--	--	868,000
Mechanical Aeration for Volatile Organics Removal	62,000	--	--	62,000
Forced Air Injection for Volatile Organics Removal	173,000	--	--	173,000
Infiltration Controls with Excavation and Offsite Disposal	164,000	--	--	164,000
Infiltration Controls with Mechanical Aeration	152,000	--	--	152,000
Trash and Debris				
Segregation and Offsite Disposal	14,000	--	--	14,000
Buildings and Structures				
Demolition and Removal	614,000	--	--	6[illegible]0
Decontaminate and Remain Onsite	94,000	--	--	94,000

TABLE 12 (CONT.)

SUMMARY OF REMEDIAL ACTION METHOD COST ESTIMATES

REMEDIAL METHOD	TOTAL CAPITAL COST	MONITORING AND MAINTENANCE		TOTAL PRESENT WORTH
		ANNUAL	PRESENT WORTH*	
Drums and Contents				
Removal with Offsite Disposal	39,100**	--	--	39,100
Site Management				
Infiltration Control Method	26,000	5,300	49,800	75,800
All Other Methods	26,000	500	4,800	30,800

* Present worth values based on a discount rate of 10% over 30 years.

** Cost will vary according to most applicable disposal technology.

TABLE 13
SUMMARY OF ALTERNATIVE REMEDIAL ACTION PLANS
FOR TRIANGLE CHEMICAL COMPANY

PLAN	TECHNICAL FEASIBILITY	ENVIRONMENTAL EFFECTIVENESS	IMPLEMENTABILITY	CAPITAL COSTS	MONITORING/MAINTENANCE COSTS ANNUAL	MONITORING/MAINTENANCE COSTS PRESENT WORTH	TOTAL PRESENT WORTH
1. Disposal of Tank Contents and Trash, Decontamination of Structures, Excavation to Background Quality	Utilizes conventional technologies. Limits of contamination to background quality unproven.	Removes all wastes and contaminated materials from site. Air emissions during excavation and tank opening.	Requires 2 months. Perform during dry season.	$1,167,000	$500	$5,000	$1,172,500
2. Disposal of Tank Contents and Trash, Decontamination of Structures, Mechanical Aeration of Soils to Background Quality	Utilizes conventional technologies, except soil aeration method. Pilot study recommended prior to full implementation. Limits of contamination to background quality unproven.	Removes all wastes and reduces all contaminants to background levels. Air emissions during mechanical aeration of soils and tank opening.	Requires 2-3 months. Perform during dry season.	385,000	500	5,000	390,500
3. Disposal of Tank Contents and Trash, Decontamination of Structures, Excavation to 100 ppm Volatile Organics	Utilizes conventional technologies. Field determination of soil contaminant zone likely to be imprecise.	Some contaminated soils left onsite. Contamination below short-term exposure limits. Air emissions during excavation.	Requires 2 months. Perform during dry season	871,000	500	5,000	876,500

TABLE 13 (CONT.)

PLAN	TECHNICAL FEASIBILITY	ENVIRONMENTAL EFFECTIVENESS	IMPLEMENTABILITY	CAPITAL COSTS	MONITORING/MAINTENANCE COSTS ANNUAL	MONITORING/MAINTENANCE COSTS PRESENT WORTH	TOTAL PRESENT WORTH
4. Disposal of Tank Contents and Trash, Decontamination of Structures, Mechanical Aeration of Soils to 100 ppm Volatile Organics	Utilizes conventional technologies, except soil aeration method. Pilot study recommended prior to full implementation. Field determination of soil contaminant zone likely to be imprecise.	Some contaminated soils left onsite. Contamination below exposure limits. Air emissions during excavation.	Requires 2-3 months. Perform during dry season.	377,000	500	5,000	382,000
5. Disposal of Tank Contents and Trash, Decontamination of Structures, Excavation of Soils to 25 ppm Volatile Organics	Same as 3	Same as 3 except contamination is below time weighted average exposure limit.	Same as 3	1,080,000	500	5,000	1,085,500
6. No Action	N/A	Does not accomplish site objectives, Inconsistent with land use projected for area. Potential for human exposure and threat to health and safety, potential for continued contaminant migration.	NA	NA	NA	NA	NA

Deep well injection is an appropriate disposal alternative for 24,000 gallons of non-ignitable liquids currently onsite. There are several facilities in the Gulf Coast Region which inject non-flammable, low solids waste into saline groundwaters 4,000 feet below the ground surface. This technology, although not destructive, will essentially eliminate potential human contact with the tank materials.

The sludges in the tanks would be solidified with an inorganic solid and landfilled at a permitted offsite landfill facility. Tanks would then be decontaminated by recirculating detergent water and rinsing. Final rinsate samples would be analyzed to certify that a tank would be decontaminated. Larger tanks would also be mechanically scoured, if necessary. All of the rinsate would be disposed of by deep well injection.

Trash and Debris Removal with Offsite Disposal

Offsite disposal is the only remedial action which is applicable to the site. Ninety-five percent of the trash is considered non-hazardous, and would be transported to a sanitary landfill in the area. That portion of the debris that is obviously stained would be considered hazardous, and will be disposed of in a RCRA approved hazardous materials landfill.

Decontamination of Onsite Structures

Decontamination would be accomplished by steam cleaning all floors, ceilings, walls, and internal structures. The rinsate would be collected and disposed of by deep well injection. Certification would be required to ensure that the buildings were decontaminated before any future use would be possible.

Offsite Disposal of Drums and Drum Contents

The materials which are currently stored on the Triangle Chemical Company property north of Redbird Chemical, will be analyzed and bulked with similar materials found in the onsite storage tanks. The materials will then be incinerated or deep well injected, as appropriate. The drums will be decontaminated, crushed, and disposed of in a RCRA approved landfill.

Differences in the alternative remedial action plans are attributed to the remedial methods developed as a permanent remedy for soil contamination at the site. Only the descriptions for the soils portion of each plan are given below. The complete plans include the selected remedial methods for the tank contents, drum and debris removal, and decontamination of the onsite structures.

Plan 1 - No Action

In accordance with Section 300.68 (g) of the National Contingency Plan (NCP), a no action alternative should be evaluated. This plan involves leaving the site conditions as they currently exist. Section 300.68 (h) (2) states that an alternative having significant adverse environmental effects or that does not effectively mitigate and minimize the threat of harm to public health welfare and the environment should be excluded from further consideration. The no action alternative would allow the site to continually pose a threat of: (1) a release of volatile organic contaminants in the soil to the atmosphere during future site development or flooding, (2) leaching of volatile organics into the groundwater during periods of heavy rainfall due to an elevated water table, (3) a release of tank contents causing extensive soil and surface water contamination, and (4) exposure of the public during unauthorized entry to the site. The risks to public health and the environment associated with the no action plan are unacceptable and the no action plan is rejected.

Plan 2 - Excavation and Offsite Landfill

Contaminated soils are limited to the areas onsite where releases from drums and tanks had occurred during and immediately after operation of the facility. The soils to be removed lie in a narrow band extending from about 1 foot below ground surface to just above the perched ground water table found at about six feet. A front end loader and a backhoe are required to excavate the soils and load trucks for offsite transport. A four-foot dike would be built to provide protection from the 100-year flood during the excavation period. Soils from the dike would be used as backfill after the contaminated soil is removed from the site. Excavated soils would be transported and disposed of in a RCRA approved double-lined landfill. Various levels of clean up were used for cost estimates based on (1) permissible exposure limits for several of the compounds identified in the soil and (2) regulatory requirements for facility closures. Volatilization of contaminants is expected to occur during excavation and transport. Thus soil being placed in a landfill may not be contaminated at the time of disposal. Because volatilization will be much more difficult to control during excavation than during aeration, excavation may result in an undesirable environmental effect at the site.

The pros and cons of this alternative are listed below:

Pros:

+ Equipment required is readily available in the area.
+ Utilizes conventional technology.
+ Removes contaminants from the site.
+ Only two months required for implementation.
+ Eliminates potential of future groundwater contamination.
+ Eliminates potential for release of volatiles during future site development.

Cons:

- Volatilization of contaminants will occur during excavation and transport.
- Very high cost due to requirement for double-lined landfill facility.
- Double-lined facility may not be readily available.

Plan 3 - In-Situ Mechanical Aeration

Contaminated soils will be exposed to the atmosphere under controlled conditions using a tractor with a disc harrow. Treatment consists of four-pass tilling of a six-inch soil layer. Treated layers will be excavated and stored in a diked area for use later as backfill. Soil sampling will be used to verify decontamination prior to excavation. Reduction of contaminant concentrations to background levels will take approximately 2 hours depending upon the ambient air temperature at the time of remedial action. Flood control structures will be built around the till area to control run-on, and provisions will be made to manage possible runoff from the 1-hour 25-year rainfall event. The material from the dike, native clays, will be used as final cover and grade material for the site. A groundwater monitoring program will be established to ensure that the groundwater will be adequately protected by the remedy. The existing monitoring wells will be supplementaed with one new shallow well at the north property boundary, downgradient of contaminated soil Area B. Air monitoring will be used to control the aeration operation. The areal extent of tilling can be varied to ensure that no offsite air quality degradation occurs.

Pros:

+ Least costly alternative to implement.
+ Volatilization can be monitored and remedy can be implemented under strictly controlled conditions.
+ Does not depend upon the availability of an approved double-lined facility.
+ Capacity at an offsite facility not consumed.
+ Potential for volatilization during future site development would be eliminated.
+ Risk due to transport of hazardous materials is eliminated.
+ Action can be completed within one month

Cons:

- Innovative technology; would require a pilot study.
- Background levels not set.
- Remedy would have to be implemented during dry season.

In the initial screening, the construction of an onsite RCRA approved landfill for the disposal of contaminated soils and trash was rejected. The cost of this construction was estimated to be $1,510,000. The expense involves the special construction requirements for floodplain protection and demolition of all onsite sturctures to provide enough area to build a landfill. Excavation of the soil to background levels and disposal at an approved offsite facility is estimated to cost $684,000. The costs of incineration and deep well injection of the tank contents must be added to each of these, and the cost of debris disposal and structure decontamination must be added to the offsite disposal alternative. The total cost of the onsite landfill alternative plan would be $1.63 million versus $1.17 million for the offsite disposal alternative.

Excavation of the soil to background levels and offsite disposal, in combination with the recommended actions for the structures, tank and drum contents, and onsite debris also complies with the applicable environmental laws and regulations. However, this is much more costly than the recommended alternative ($1.17 million versus $393,000) and does not offer a commensurate increase in benefits to human health and the environment. Also, because volatilization of the organic contaminants will occur during excavation and transport, it is likely that the soils will be effectively decontaminated prior to landfill disposal, and that landfill capacity could be better used for hazardous materials from other sites. Therefore, excavation and offsite disposal is not as cost-effective as mechanical aeration.

Excavation of soil to 100 ppm and 25 ppm would provide adequate protection of human health and the environment based on permissible exposure limits to contaminants found in the soil, but would not fully comply with applicable laws and regulations. The difference in cost between excavation to 100 ppm and excavation to background concentration is $296,000 ($1.17 million versus $876,000), and between excavation to 25 ppm and background levels is $86,500. However, groundwater monitoring would be required for a 30 year post-closure period, and future corrective actions may be required if contaminant migration via groundwater was detected. It would therefore appear that excavation to background would be more cost-effective than excavation to either 100 ppm or 25 ppm, when the potential for future groundwater actions at the site is considered.

Community Relations

Very little public interest has been expressed. The public notice period began on April 5, 1985 and ended on April 19, at which time the public comment period began. A public meeting was held in Orange, Texas on May 1. Five people attended the public meeting, and no statements were made. The public comment period ended on May 10, 1985; one comment was received during the peroid. The comment and a written response are included in the "Responsiveness Summary" section of this Record of Decision.

Consistency with Other Environmental Laws

It is EPA policy to give primary consideration to remedial actions that attain or exceed applicable and relevant standards of other Federal public health and environmental laws. The environmental laws which will have an impact on the proposed remedies for the Triangle Chemical site include:

1. The Resource Conservation and Recovery Act substantive requirements, 40 CFR Part 264, for closure of tanks and container storage facilities.

2. Executive Order 11988, Floodplain Management for sites located in flood plains.

3. Clean Water Act, water quality crietria for human health and drinking water.

4. Occupational Health and Safety Administration time weighted average-permissible exposure limits for air quality monitoring.

Closure of tanks and containers is regulated by the Resource Conservation and Recovery Act (RCRA) subparts I and J. Subpart I is the applicable regulation governing the closure of facilities in which hazardous materials were stored in containers. The subpart indicates that containers and soil containing or contaminated by hazardous wastes must be decontaminated or removed. The regulations in subpart J apply to facilities that use tanks to store hazardous wastes and state that, at closure, all hazardous wastes and residues must be removed from the tanks. RCRA also requires that offsite landfills used for disposal of hazardous wastes be double-lined, RCRA approved facilities. These requirements would also govern the construction of an onsite landfill. A brief description of all the applicable and relevant RCRA regulation is given in Table 14.

Executive Order 11988 applies to the protection of floodplains. The Triangle Chemical site is located in the 100-year floodplain. Therefore any onsite remedy should be designed with.consideration given to floodplain protection.

The Clean Water Act outlines water quality criteria for human health. These numerical standards are applied to address the issue of "how clean is clean" for the shallow groundwater at the site.

The Occupational Safety and Health Administration time weighted average-permissible exposure limit standards are applied to ensure that no degradation of offsite air quality will occur during remedial action.

TABLE 14
RCRA REGULATIONS APPLICABLE TO TRIANGLE CHEMICAL COMPANY

40 CFR REGULATION	DESCRIPTION OF REGULATION	APPLICABILITY TO TRIANGLE CHEMICAL	IMPACT ON CONTAMINANTS REMAINING ONSITE
264.18	Facilities located in 100-year flood plain must be designed, constructed, operated and maintained to prevent washout of any hazardous waste by a 100-year flood.	Parts of the site are inundated by 5 feet of water in a 100-year flood. Tidal surges may cause additional structural damage	No present flood protection. Tanks may need reinforcement, and contaminated areas may need to be diked.
264.50	A contingency plan to minimize hazards during an unplanned release must be developed by owners of a hazardous waste facility.	Liquids to be stored onsite are hazardous and ignitable.	A contingency plan would be required.
264.90	Facilities that treat, store, or dispose of hazardous waste must establish groundwater protection standards which may include long-term monitoring for 30 years.	Liquids to be stored onsite are hazardous. Hazardous wastes may remain in the soil.	Legal interpretations may require groundwater monitoring if hazardous wastes are left onsite.
264.178	Soils containing hazardous wastes and waste residues must be removed or decontaminated.	Hazardous wastes have been found in onsite soils.	Allowing wastes to remain onsite may be a violation of RCRA.

TABLE 14 (CONT.)

40 CFR REGULATION	DESCRIPTION OF REGULATION	APPLICABILITY TO TRIANGLE CHEMICAL	IMPACT ON CONTAMINANTS REMAINING ONSITE
264.191	Owners which treat or store hazardous wastes in tanks must conform to tank design standards which define structural integrity.	Liquids to be stored onsite are hazardous.	Existing tanks are of unknown structural integrity and may need to be modified.
264.192	Tanks used to store corrosive hazardous liquids must be equipped with an inner liner or other corrosion inhibition system.	Some liquids to be stored onsite are corrosive.	Tanks have no known liners or corrosion inhibition systems and must be modified.
264.192	Storage of hazardous liquids in tanks requires an inspection schedule to assess tank conditions which includes at least weekly spot checks for signs of leakage.	Liquids to be stored onsite are hazardous	Weekly tank inspections significantly increase site management costs.

TABLE 14 (CONT.)

40 CFR REGULATION	DESCRIPTION OF REGULATION	APPLICABILITY TO TRIANGLE CHEMICAL	IMPACT ON CONTAMINANTS REMAINING ONSITE
264.197	Ignitable liquids must be separated and managed with respect to extreme heat or pressure, uncontrolled toxic mists, and uncontrolled flammable fumes.	Some liquids to be stored onsite are ignitable.	Compliance with management regulations may require costly monitoring instrumentation.
265.198	Ignitable liquids must be stored in tanks which comply with requirements of the National Fire Protection Association.	Some liquids to be stored on-site are ignitable.	Compliance may require costly construction of tank storage area dikes and proper drainage systems.
Permit applicants Guidance Manual for hazardous waste land treatment storage, and disposal facilities.	Agency considers contamination to be removed when the concentrations of hazardous constituents in the soil are at background levels.	Sets criteria for soil cleanup	Required for full compliance with Federal Environmental Regulations and Guidance.

Recommended Alternative

Section 300.68 (j) of the National Contingency Plan states that "The appropriate extent of remedy shall be determined by the lead agency's selection of the remedial alternatives which the agency determines is cost-effective (i.e. the lowest cost alternative that is technologically feasible and reliable and which effectively mitigates and minimizes damage to and provides adequate protection of public health, welfare or the environment)."

To this end, incineration and deep well injection of the tank and drum contents, decontamination of all onsite structures, offsite disposal of trash and debris, and mechanical aeration of the contaminated soils is the recommended remedial action for the Triangle Chemical site. Schematic drawings of the mechanical aeration method of this alternative are presented in Figures 7 and 8. This alternative complies with the closure requirements for tanks (40 CFR 264 subpart J) and container storage facilities (40 CFR 264 subpart I). This alternative is also the lowest cost alternative that will comply with all applicable and relevant Federal environmental laws and regulations. Decontamination of the soil to background levels would effectively mitigate the potential for future groundwater contamination.

Operation and Maintenance

Post closure monitoring and maintenance will be required for any remedial plan selected for the Triangle Chemical site, although post-closure activities will be more extensive for alternatives in which wastes remain onsite. For all plans, post closure activities will include vegetation control, fence repair, and quarterly groundwater monitoring from existing monitoring wells to verify that the groundwater is not impacted by remedial construction. For plans that do not clean up contaminated soils to background levels, additional groundwater monitoring and site surface maintenance will be necessary for a period of up to 30 years.

Operation and maintenance for the recommended alternative will involve landscaping and fence repair at the site, groundwater monitoring from the three existing onsite monitoring wells, and construction of an additional shallow monitoring well at the site boundary directly downgradient of soil contamination Area B. Groundwater monitoring will be performed for a period of 5 years. If no significant contamination is detected in the monitoring wells by the end of this period, the remedy will be considered effective and further monitoring will not be required. If significant contamination is detected during the monitoring period, corrective measures will be evaluated.

Annual operation and maintenance costs for the recommended alternative is estimated to be $500 and the present worth is estimated to be $5000.

Schedule

Approve Remedial Action	June, 1985
Award Cooperative Agreement for Design	June, 1985
Award Cooperative Agreement for Construction	June, 1985

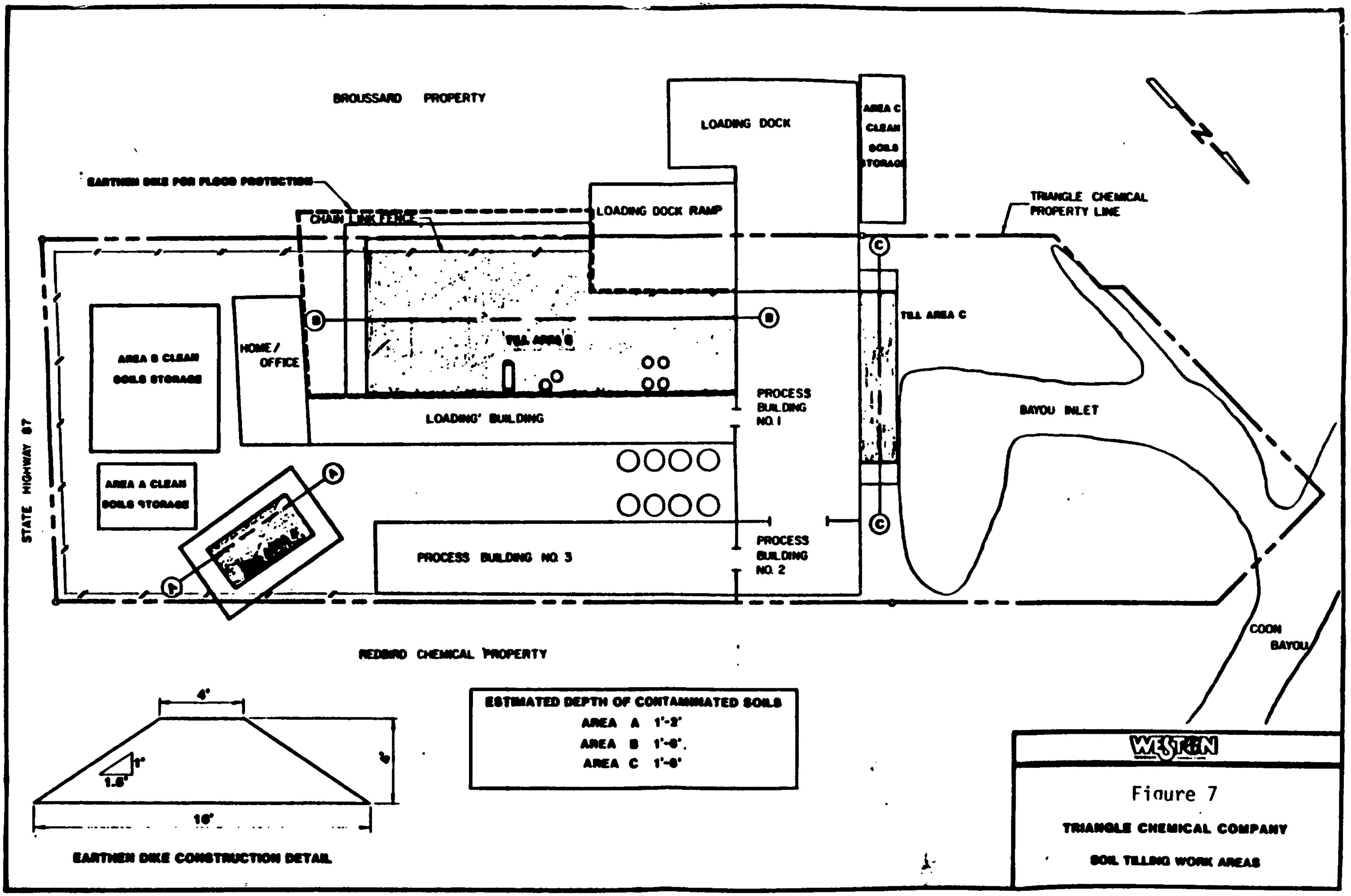
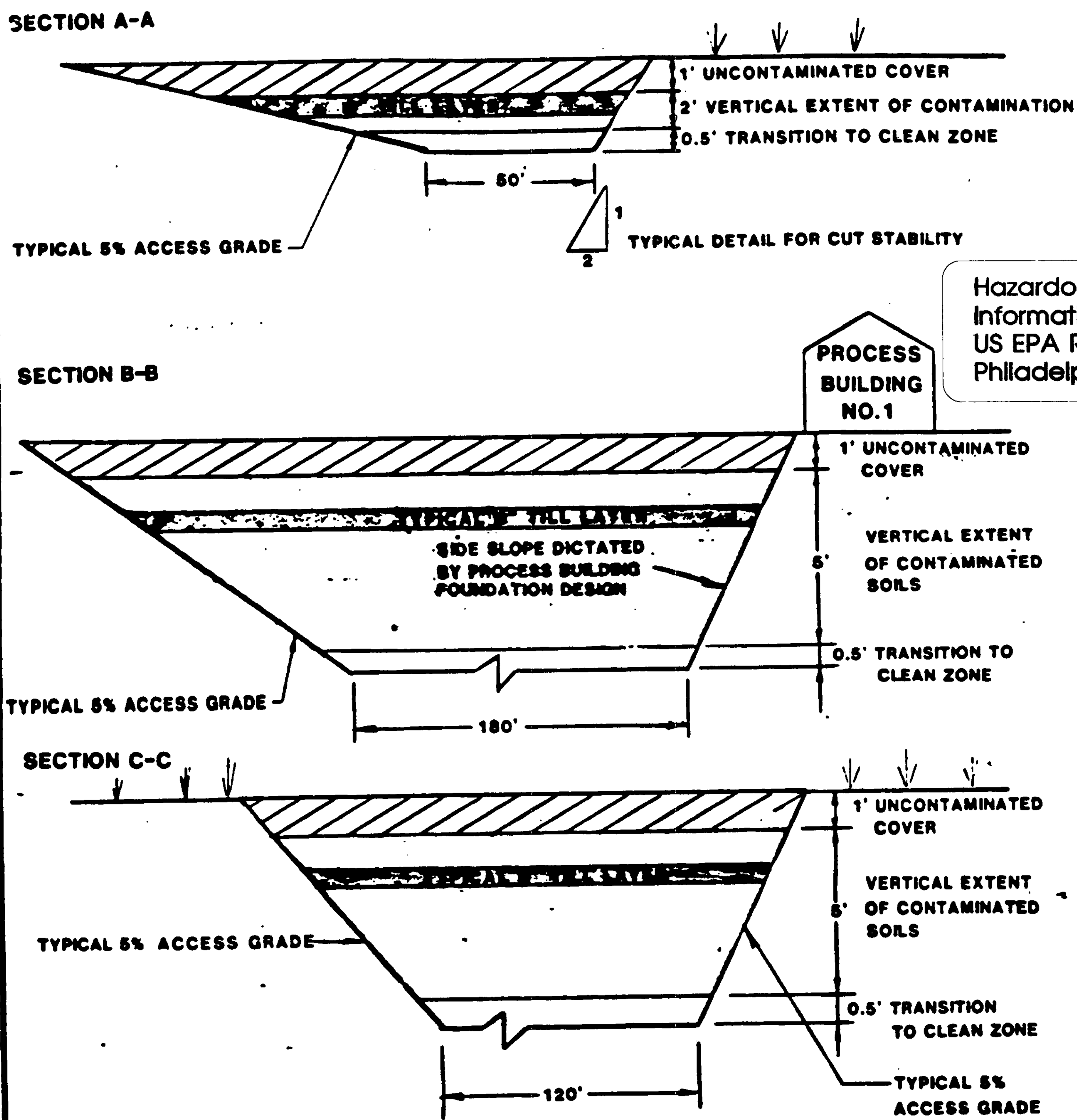


Figure 7

TRIANGLE CHEMICAL COMPANY

SOIL TILLING WORK AREAS



LEGEND

NOTE: VERTICAL SCALE EXAGGERATED TO SHOW CONSTRUCTION DETAIL

UNCONTAMINATED COVER

TILL ZONE

VEGETATION

WESTON

Figure 8

TRIANGLE CHEMICAL COMPANY

SOIL TILLING SECTION VIEWS