Document
4

PRELIMINARY
SITE ASSESSMENT
OF FIRE TRAINING AREA
LAREDO
INTERNATIONAL AIRPORT

TAC ENVIRONMENTAL CO.
276 AA MINES ROAD
LAREDO, TEXAS 78041

Mr. Carlos Rubenstein
Texas Natural Resource Conservation Commission
Region #15
813 E. Pike Blvd.
Weslaco, Texas 78596

Subject: Preliminary Assessment of the
Laredo International Airport Fire Training Pits

Dear Mr. Rubenstein:

Please find a copy of the Preliminary Site Assessment which we were asked by the City of Laredo to complete as a initial step. Further investigation, however, is needed to complete the assessment of the area. Please look over the report and let us know if you concur with our recommendations. All of the analyses that was completed is included in this report.

Sincerely,

TAC ENVIRONMENTAL CO.

Jesus Aguero, Manager TAC Environmental

Jerilyn K. Rich, REM, JBL Group, Inc.

TABLE OF CONTENTS

APPENDICES

PRELIMINARY SITE ASSESSMENT
OF FIRE TRAINING AREA
LAREDO INTERNATIONAL AIRPORT

DESCRIPTION OF SITE

The subject site is located on the north side of the Laredo International Airport grounds, just west of the airport runways and west of Daugherty Street. This area contains two known surface impoundments used for fire training practice pits. One fire training pit is covered and one is exposed. The exposed pit was the one used by the City of Laredo from 1975 to 1992. The City of Laredo used the pit for fire practice training once every quarter. Diesel and gasoline fuel were used as accelerants when the Laredo Fire Department used the pit (named as Fire Training Pit #1). The military also used Fire Training Pit #1 and Fire Training Pit #2, and used spent oil and gasoline as accelerants, although it is not known if other accelerants were also used. One 10,000 gallon tank which contained one large hole and several small holes, was removed from the Fire Training Pit #1 area.

On the north end of the Fire Training Pit #1, there is a valve and a short discharge area where possible contaminated storm water from rain water was discharged. Also, a possible line coming from the southeast to the pit, perhaps was used to fuel the fire training pit. Also, MoVac removed free product and water from the pit. Approximately 2,772 gallons of product and water were removed on 1/17/95.

SITE ACTIVITIES

During the removal of the 10,000 gallon tank, a test hole was excavated in the area of Fire Training Pit #2, the covered impoundment. The excavated was around

5.0' (feet) deep. Approximately 2.0' (feet) below the existing surface, there was a layer of black material from 1.5' (feet) to 2.0' (feet) in thickness, and then below that a brown, silty clay.

TAC Environmental was asked to complete a preliminary investigation of the sites soils in and near the fire training pits. The total of five (5) borings were made within and around the fire training pits. The soil borings were made to a depth of 5.0' (feet). Three (3) samples were taken per boring, one (1) at the surface, one (1) and 1.0' (foot) in depth, and the last sample at 5.0' (feet). (See Site Sketch for boring locations).

Samples were placed in VOA bottles, and immediately placed in a cooler containing ice packs, and then were shipped to CasChem Laboratories.

Borings No. 1, No. 2, and No. 4 indicated high levels of hydrocarbons present from the surface to the depth of 5.0' (feet). Borings No. 3 and No. 5, however, did not indicate the presence of hydrocarbons. The impacted soils are a brown silty clay with a plastic index believed to be greater than twelve. The average TPH (Total Petroleum Hydrocarbons) of the impacted soils determined from borings No. 1, No. 2, and No.4 is 6,615 mg/kg TPH.

SUMMARY

The preliminary site assessment did indicate the levels of hydrocarbons contamination to a depth of 5.0' (feet), and generally located the impacted soil areas in and throughout Fire Training Pit #1 and Pit #2, also at the discharge (north) end of Pit #1. However, the precise delineation was not defined vertically and only somewhat horizontally. Also, a TCLP analysis should be completed on the soils from

Training Pits No. 1 and No. 2. The analysis will determine if the soils contain hazardous components and possibly may make the soil a hazardous waste.

Obviously soils within the fire training pits need to be excavated and remediated. Upon completion of the TCLP analysis of the contaminated soils, a determination could then be made to excavate and treat the soils on site. Soils within the existing pits could be excavated to a depth of 7.0' (feet) to 8.0' (feet) in depth, within the boundaries of the pits.

RECOMMENDATIONS

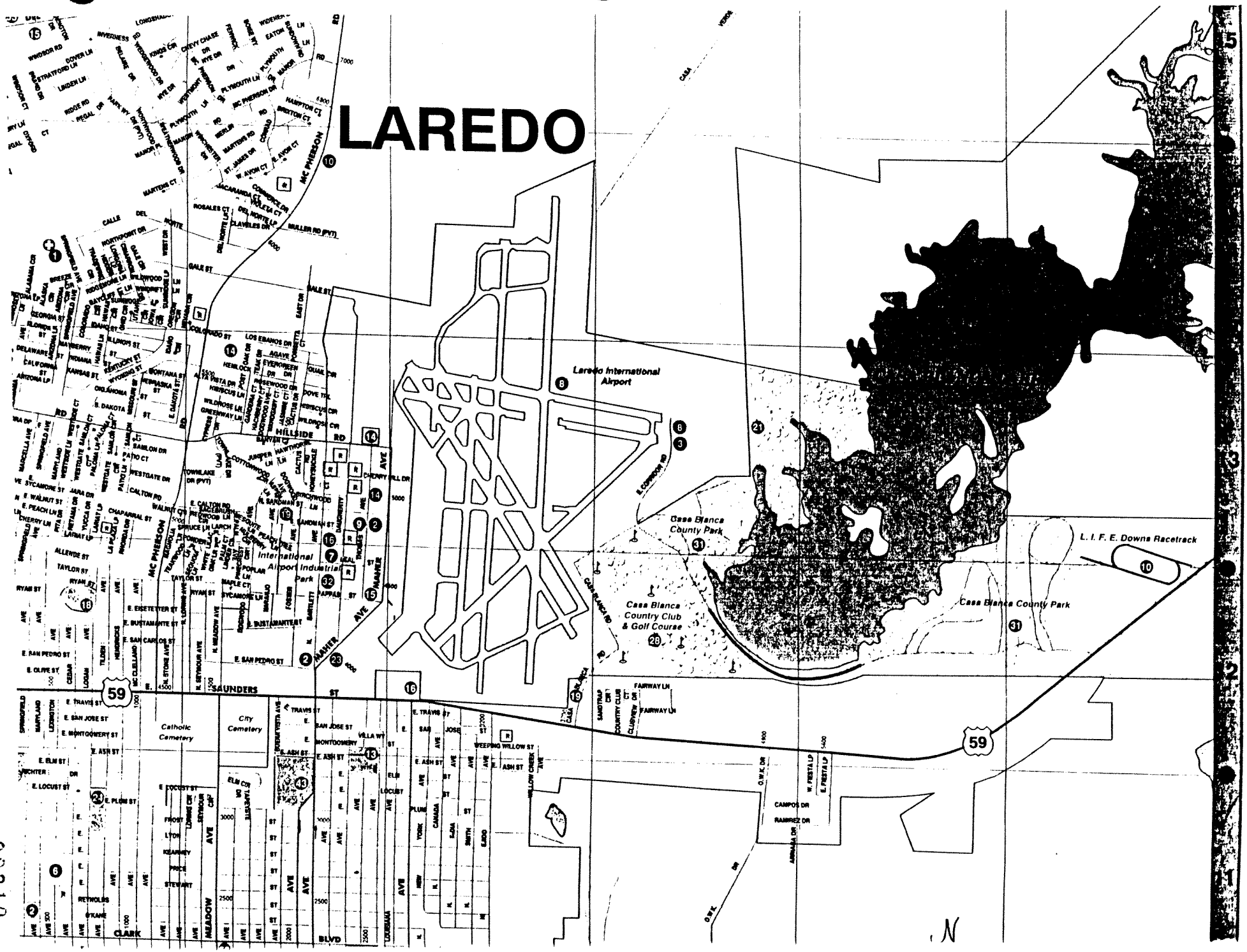
Initiate with instructing the laboratory to run a TCLP analysis in the impacted areas located at Borings No. 1, No. 2, and No. 4, with the minimum of one (1) complete TCLP analysis as a composite sample. Upon completion of the TCLP analysis, there is an option to remove and treat the soil from the impoundments to begin with the worst and obvious contaminated soils.

It is also recommended that a minimum of three (3) borings be completed to a maximum depth of 25.0' (feet) vertically, so the extent of the vertical contamination can be determined. Borings that encounter groundwater before ending at the depth of 25.0' (feet) should be developed into monitor wells. Soils should be continuously screened with a PID or OVM, and those readings recorded on Boring Logs.

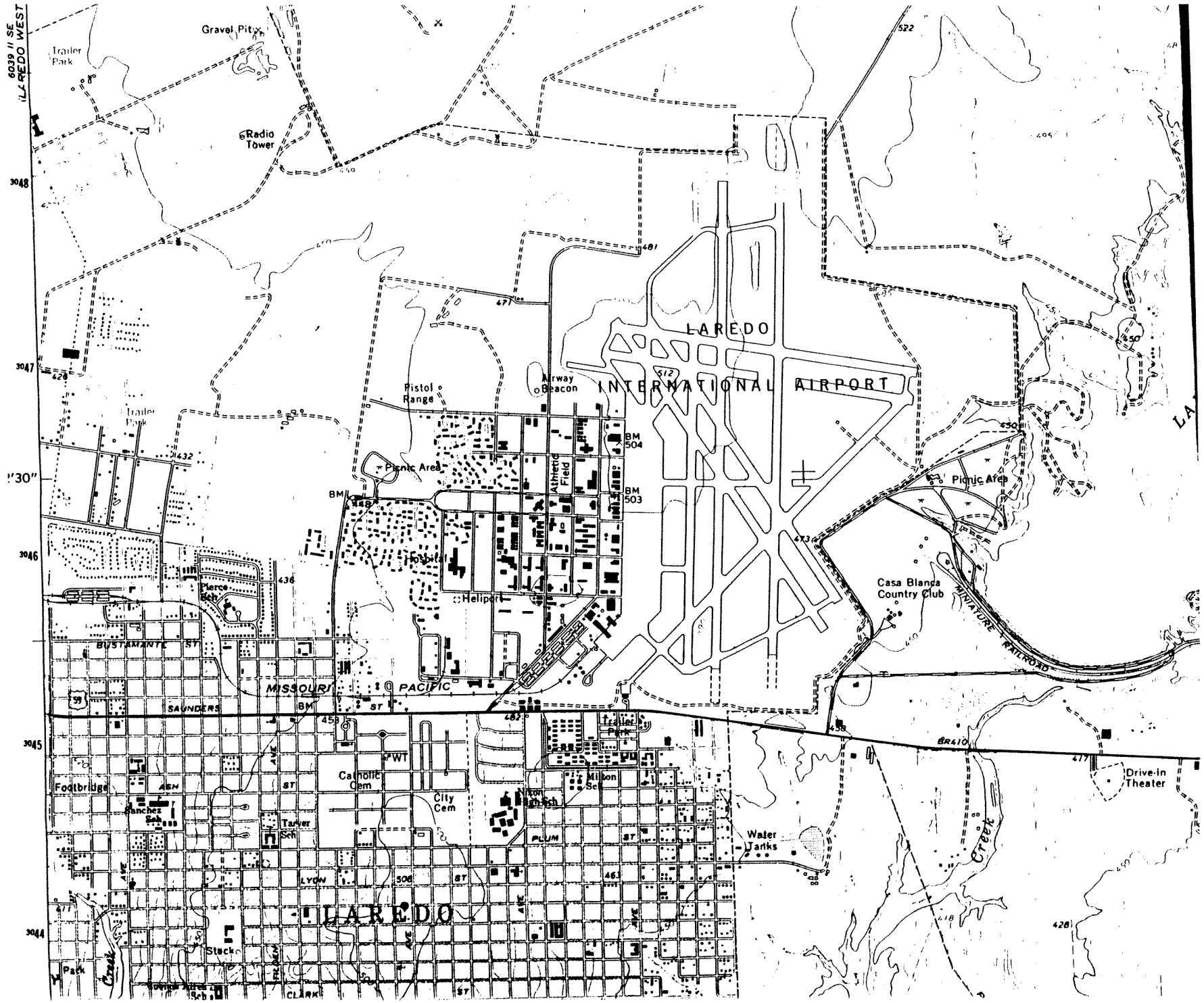
The minimum of three (3) monitor wells should be constructed upon encountering groundwater. The wells should be developed and sampled for BTEX and TPH, and depending on the TCLP analysis, other analysis could be required. Groundwater Gradient Maps, along with BTEX and TPH Isopachs should be completed to determine any groundwater impacted, if groundwater is encountered.

APPENDIX A

LOCATION MAP


LAREDO
Laredo International Airport
Casa Blanca County Park
Casa Blanca Country Club & Golf Course
L. I. F. E. Downs Racetrack
International Airport Industrial Park
Catholic Cemetery
City Cemetery
HILLSIDE RD
SAUNDERS ST
MC PHERSON
MAHER AVE
MARIEL
59
N

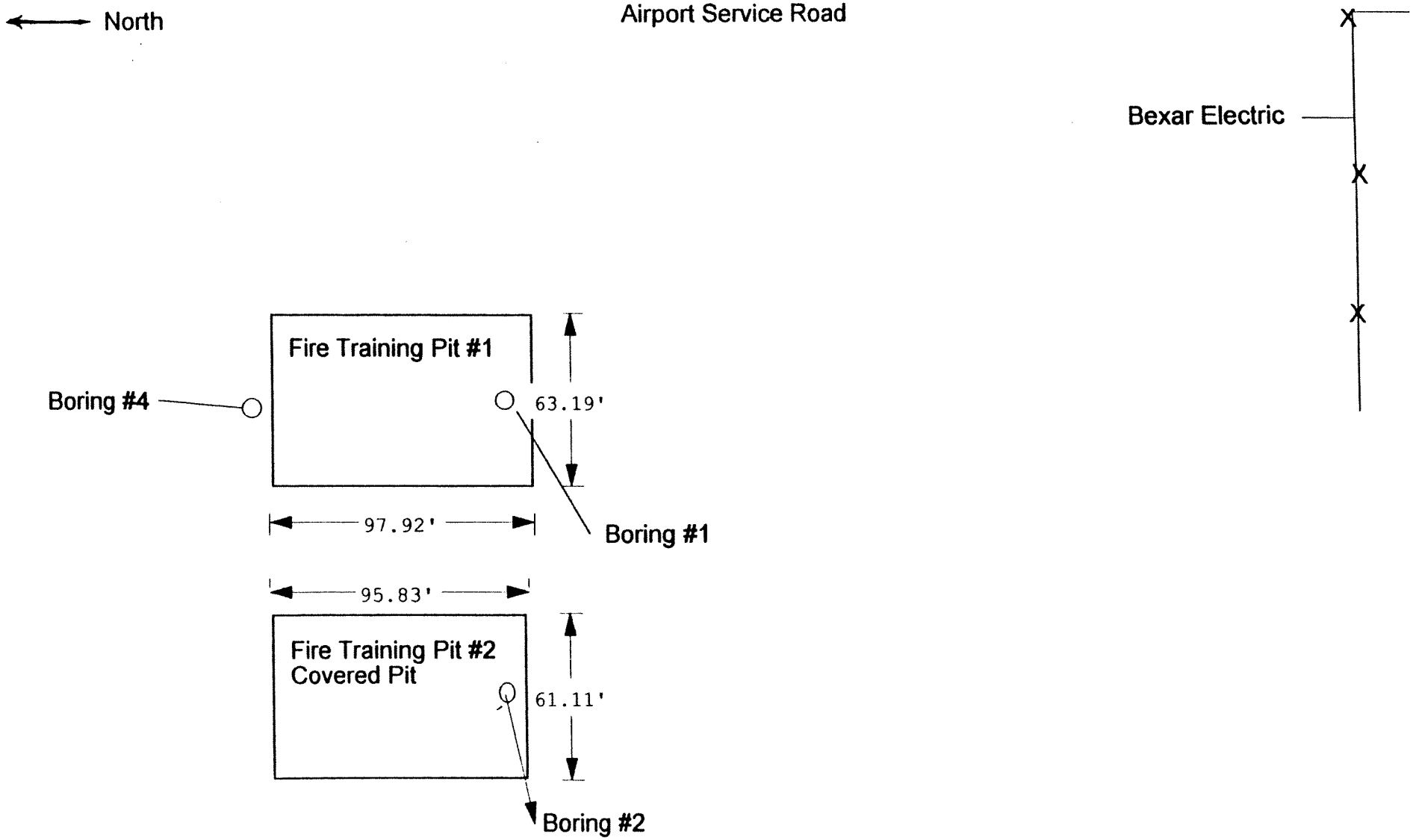
00310


6039 II SE
LAREDO WEST
Gravel Pit
Trailer Park
Radio Tower
LAREDO
INTERNATIONAL AIRPORT
Pistol Range
Airway Beacon
Athletic Field
Picnic Area
Heliport
BM 504
BM 503
Casa Blanca Country Club
MINIATURE RAILROAD
MISSOURI PACIFIC
BUSTAMANTE ST
SAUNDERS ST
Pierce Sch
Footbridge
Sanchez Sch
Tarver Sch
Catholic Cem
City Cem
Nixon Sch
Milton Sch
Trailer Park
Water Tanks
Drive-in Theater
BR410
LYON ST
PLUM ST
Stacks
Park
Creek
3048
3047
3046
3045
3044
'30"

00311

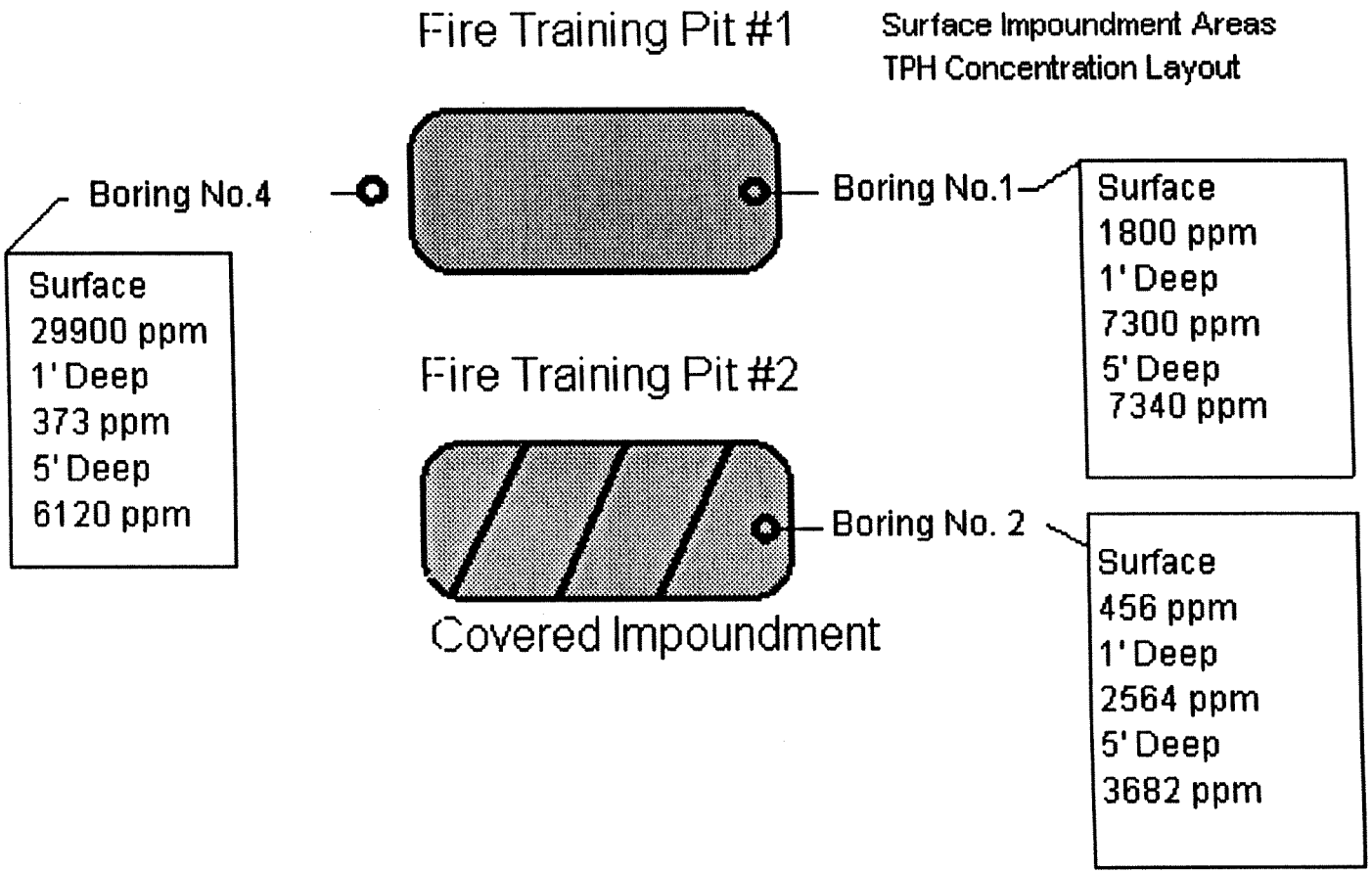
APPENDIX B

SITE MAP



TAC Environmental

Tac Environmental Company
Laredo Airport Fire Training
Surface Impoundment Areas
TPH Concentration Layout



APPENDIX C

SUMMARY OF ANALYSIS

LAREDO INTERNATIONAL AIRPORT
"FORMER FIRE TRAINING FACILITY"
Preliminary Soil Assessment
of Fire Training Pits

SAMPLE LOCATION	BENZENE ug/kg	TOLUENE ug/kg	ETHYL BENZENE ug/kg	XYLENES ug/kg	BTEX ug/kg	TPH mg/kg
BORING #1- SURFACE	<2	8.01	<2	<6	8.01 (<18.01)	1800
BORING #1- 1' DEEP	5.51	5.71	<2	<6	11.22 (<19.22)	7300
BORING #1- 5' DEEP	<40	<40	112	173	285 (<365)	7340
BORING #2- SURFACE	<4	<4	57.4	80.9	138.3 (<146.3)	456
BORING #2- 1' DEEP	<2	<2	<2	<6	(<12)	2564
BORING #2- 5' DEEP	<2	<2	<2	<6	(<12)	3682
BORING #3- SURFACE	<2	<2	<2	<6	(<12)	(<10)
BORING #3- 1' DEEP	<2	<2	<2	<6	(<12)	(<10)
BORING #3- 5' DEEP	<2	<2	<2	<6	(<12)	(<10)
BORING #4- SURFACE	<2	<2	<2	<6	(<12)	29900
BORING #4- 1' DEEP	<2	<2	<2	<6	(<12)	373
BORING #4- 5' DEEP	<2	<2	<2	<6	(<12)	6120
BORING #5- SURFACE	<2	<2	<2	<6	(<12)	(<10)
BORING #5- 1' DEEP	<2	<2	<2	<6	(<12)	(<10)
BORING #5- 5' DEEP	<2	<2	<2	<6	(<12)	(<10)

APPENDIX D
LABORATORY RESULTS

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OH 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#1 COMPOSITE B-1/SURFACE

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:00

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503463					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY	WEIGHT	
	BENZENE	<2	ug/kg	2 ug/kg	03/08/95
	TOLUENE	8.01	ug/kg	2 ug/kg	03/08/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/08/95
	XYLENES	<6	ug/kg	6 ug/kg	03/08/95
	TOTAL PETROLEUM HYDROCARBONS	1,800	mg/kg	30 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:12:53

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#2 COMPOSITE B-1/1'DOWN

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:10

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503464			DRY WEIGHT		
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95				
	BENZENE	5.51	ug/kg	2 ug/kg	03/08/95
	TOLUENE	5.71	ug/kg	2 ug/kg	03/08/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/08/95
	XYLENES	<6	ug/kg	6 ug/kg	03/08/95
	TOTAL PETROLEUM HYDROCARBONS	7,300	mg/kg	90 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:13:23

#2 CO

00319

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/16/95

Laboratory Analysis Report

Client ID: 7129
Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#3 COMPOSIT B-1/5'DOWN

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:22

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations: *BTEX:MATRIX INTERFERENCE*

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503465					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY WEIGHT		
	BENZENE	<40	ug/kg	40 ug/kg	03/13/95
	TOLUENE	<40	ug/kg	40 ug/kg	03/13/95
	ETHYLBENZENE	112	ug/kg	40 ug/kg	03/13/95
	XYLENES	173	ug/kg	120 ug/kg	03/13/95
	TOTAL PETROLEUM HYDROCARBONS	7,340	mg/kg	30 mg/kg	03/10/95

DATE REPORTED:03/16/95 TIME REPORTED:10:29:31

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129
Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#7 COMPOSITE B-2/SURFACE

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:32

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations: 2X TFT LOW MATIRX INTERFERENCE

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503471					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY	WEIGHT	
	BENZENE	<4	ug/kg	4 ug/kg	03/10/95
	TOLUENE	<4	ug/kg	4 ug/kg	03/10/95
	ETHYLBENZENE	57.4	ug/kg	4 ug/kg	03/10/95
	XYLENES	80.9	ug/kg	12 ug/kg	03/10/95
	TOTAL PETROLEUM HYDROCARBONS	456	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:16:21

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#8 COMPOSITE B-2/1'DOWN

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:34

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503469					
	BETX(8020)TPH(9071,418.1)		DRY	WEIGHT	
	BETX CAL.02-24-95				
	BENZENE	<2	ug/kg	2 ug/kg	03/10/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/10/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/10/95
	XYLENES	<6	ug/kg	6 ug/kg	03/13/95
	TOTAL PETROLEUM HYDROCARBONS	2,564	mg/kg	30 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:14:54

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129
Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#9 COMPOSITE B-2/5'DOWN

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:38

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations: RUN 2X TFT LOW

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503470					
	BETX(8020)TPH(9071,418.1)		DRY	WEIGHT	
	BETX CAL.02-24-95				
	BENZENE	<2	ug/kg	2 ug/kg	03/10/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/10/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/10/95
	XYLENES	<6	ug/kg	6 ug/kg	03/10/95
	TOTAL PETROLEUM HYDROCARBONS	3,682	mg/kg	30 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:15:44

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#10 COMPOSITE B-3/SURFACE

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:41

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503472					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY WEIGHT		
	BENZENE	<2	ug/kg	2 ug/kg	03/10/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/10/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/10/95
	XYLENES	<6	ug/kg	6 ug/kg	03/10/95
	TOTAL PETROLEUM HYDROCARBONS	<10	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:17:03

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#4 COMPOSITE B-4/SURFACE

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:25

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations: RAN 2X TFT LOW

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503466					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY	WEIGHT	
	BENZENE	<2	ug/kg	2 ug/kg	03/10/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/10/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/10/95
	XYLENES	<6	ug/kg	6 ug/kg	03/10/95
	TOTAL PETROLEUM HYDROCARBONS	29,900	mg/kg	300 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:13:45

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#11 COMPOSITE B-3/1'DOWN

Comment:

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:43

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503473					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY WEIGHT		
	BENZENE	<2	ug/kg	2 ug/kg	03/10/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/10/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/10/95
	XYLENES	<6	ug/kg	6 ug/kg	03/10/95
	TOTAL PETROLEUM HYDROCARBONS	<10	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:17:30

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#12 COMPOSITE B-3/5'DOWN

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:47

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503474					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY WEIGHT		
	BENZENE	<2	ug/kg	2 ug/kg	03/10/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/10/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/10/95
	XYLENES	<6	ug/kg	6 ug/kg	03/10/95
	TOTAL PETROLEUM HYDROCARBONS	<10	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:18:18

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#5 COMPOSITE B-4/1'DOWN

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:28

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503467					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY WEIGHT		
	BENZENE	<2	ug/kg	2 ug/kg	03/08/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/08/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/08/95
	XYLENES	<6	ug/kg	6 ug/kg	03/08/95
	TOTAL PETROLEUM HYDROCARBONS	373	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:14:21

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/16/95

Laboratory Analysis Report

Client ID: 7129
Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#6 COMPOSITE B-4/5'DOWN

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:30

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503468					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY	WEIGHT	
	BENZENE	<2	ug/kg	2 ug/kg	03/13/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/13/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/13/95
	XYLENES	<6	ug/kg	6 ug/kg	03/13/95
	TOTAL PETROLEUM HYDROCARBONS	6,120	mg/kg	30 mg/kg	03/10/95

DATE REPORTED:03/16/95 TIME REPORTED:10:29:40

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129
Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#13 COMPOSITE B-5/SURFACE

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:15:55

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503475					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY WEIGHT		
	BENZENE	<2	ug/kg	2 ug/kg	03/09/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/09/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/09/95
	XYLENES	<6	ug/kg	6 ug/kg	03/09/95
	TOTAL PETROLEUM HYDROCARBONS	<10	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:18:51

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#14 COMPOSITE B-5/1'DOWN

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:16:00

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503476					
	BETX(8020)TPH(9071,418.1) BETX CAL.02-24-95		DRY	WEIGHT	
	BENZENE	<2	ug/kg	2 ug/kg	03/08/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/08/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/08/95
	XYLENES	<6	ug/kg	6 ug/kg	03/08/95
	TOTAL PETROLEUM HYDROCARBONS	<10	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:20:07

CASCHEM LABORATORIES, INC.
1712 IRA TURPIN WAY NE
CANTON, OHIO 44705-1415
Phone (216) 588-TEST FAX:(216) 588-8412

03/14/95

Laboratory Analysis Report

Client ID: 7129

Sample ID:CITY OF LAREDO
Sample Matrix: SOIL
Sample Description:
#15 COMPOSITE B-5/5'DOWN

JESSIE AQUERO
TAC ENVIRONMENTAL COMPANY
276 AA MINES ROAD
LAREDO TX 78043

Comment:

Purchase Order No.:

Date Sampled:03-08-95
Time Sampled:16:07

Date Received:03/09/95 Time Received:12:15

Discrepancies or Deviations:

Lab Number	Test Description	Result	Unit	LOD	TEST DATE
9503477					
	BETX(8020)TPH(9071,418.1)		DRY	WEIGHT	
	BETX CAL.02-24-95				
	BENZENE	<2	ug/kg	2 ug/kg	03/08/95
	TOLUENE	<2	ug/kg	2 ug/kg	03/08/95
	ETHYLBENZENE	<2	ug/kg	2 ug/kg	03/08/95
	XYLENES	<6	ug/kg	6 ug/kg	03/08/95
	TOTAL PETROLEUM HYDROCARBONS	<10	mg/kg	10 mg/kg	03/10/95

DATE REPORTED:03/14/95 TIME REPORTED:12:20:23

APPENDIX E

BORING LOGS

Laredo Airport/City of Laredo Fire Training
Surface Impoundments
Boring Log
Boring No. 1

Boring #1

— Surface

Black Silty Clay/Wet w/ Odor

— 1.0'

Same/Less Wet

— 5.0'

Same/Dryer

Laredo Airport/City of Laredo Fire Training
Surface Impoundments

Boring #2

Boring Log Boring No. 2

— Surface

Dark Brown Silty/Dry No Smell

— 1.0'

Dark Brown/Black/Hard Clay

— 5.0'

Boring #3

Laredo Airport/City of Laredo Fire Training
Surface Impoundments

Boring Log Boring No. 3

– Surface

Dark Brown/Hard Clay
No Odor

– 1.0'

Greenish Brown/Hard Clay
No Odor

Greenish Brown/Hard Clay
No Odor

– 5.0'

Laredo Airport/City of Laredo Fire Training
Surface Impoundments

Boring #4

Boring Log Boring No. 4

— Surface

Very Black/Hard Clay
w/Odor

— 1.0'

Black Clay/Hard
W/Odor

Black/Brown Hard Clay/ w/Odor

— 5.0'

Laredo Airport/City of Laredo Fire Training
Surface Impoundments

Boring #5

Boring Log Boring No. 5

– Surface

Dark Brown Silty Clay
Wet/ No Odor

– 1.0'

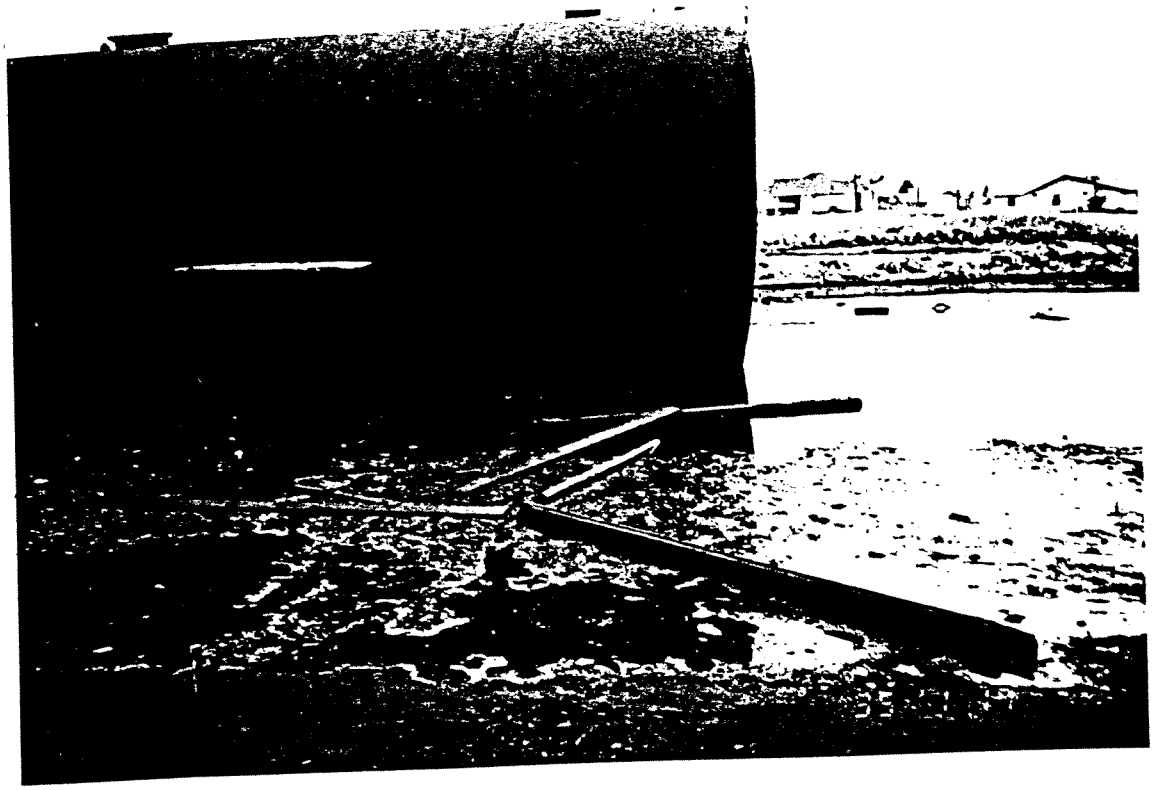
Light Brown/Hard Rocky
Clay/ No Odor

Same/ No Odor

– 5.0'

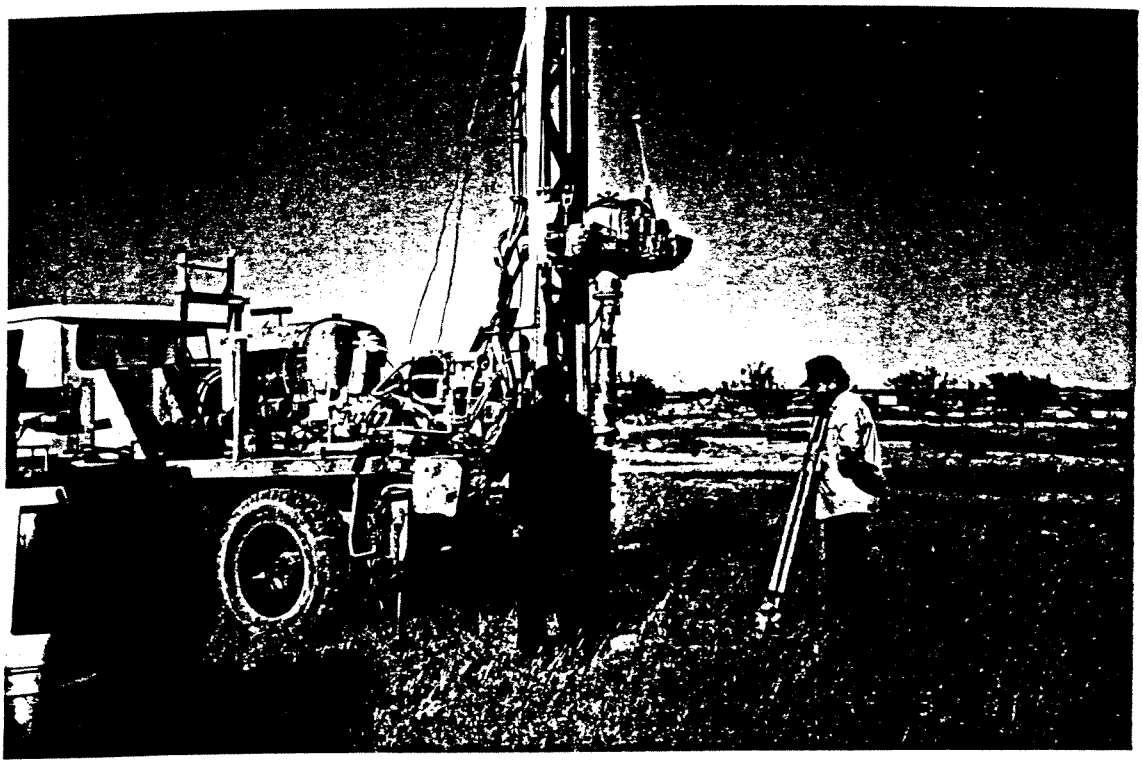
APPENDIX F
PHOTOGRAPHS

PHOTOGRAPH NO. 1: VIEW OF PIT NO. 1 AND THE 10,000 GALLON TANK AND THE LARGE OPENING IN THE TANK. ALSO, VIEW OF ACCELLERANTS ON THE CONTAMINATED GROUND.



PHOTOGRAPH NO. 2: ALTERNATE VIEW OF PIT NO. 1.

PHOTOGRAPH NO. 3: VIEW OF PIT NO. 1 AND THE TANK, VIEWING NORTH, NORTHWEST. PIT NO. 2, THE COVERED PIT IS TO THE WEST OF PIT NO. 1.



PHOTOGRAPH NO. 4: VIEW OF DRILLING PROCESS OF BORINGS DONE TO CHECK FOR EXTENT OF THE CONTAMINATION.

APPENDIX G
CHAIN OF CUSTODIES

CasChem Laboratories Incorporated
1712 - 11th Street N.E.
Canton, OH 44705
216-588-TEST
800-800-6052
(FAX) 216-588-8412

CHAIN OF CUSTODY FORM

Project # | Project Name & Address: (Circle) Canton

Samplers (Signature):

Customer Name and Address:

Sta. #	Date	Time	Comp	Grab	Station Location	No. of Containers	Analytical Method: TPH (418.1)	BTEX	TPH (8015) GRO	LEAD	PNA	TPH (8015) DRO	Remarks	Lab #
#1	3/3/95	3pm			B-1 / surface	1	X	X						
#2	3/3/95	3:15			B-1 / 5' down	1	X	X						
#3	3/3/95	3:30	X		B-1 / 5' down	1	X	X						
#4	3/3/95	3:35	X		B-4 / surface	1	X	X						
#5	3/3/95	3:40	X		B-4 / 1' down	1	X	X						
#6	3/3/95	3:45	X		B-4 / 5' down	1	X	X						
#7 (#8)	3/3/95	3:50	X		B-2 / 1' down	1	X	X						
#8 (#9)	3/3/95	3:55	X		B-2 / 5' d	1	X	X						
#9 (#7)	3/3/95	3:30	X		B-2 / surface	1	X	X						
#10	3/3/95	3:40	X		B-3 / surface	1	X	X						
#11	3/3/95	3:45	X		B-3 / 1' down	1	X	X						
#12	3/3/95	3:50	X		B-3 / 5' down	1	X	X						

Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)	Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)
	3/3/95 6pm				
Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)	Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)

Relinquished by: (Sig.)	Date/Time	Received for Lab by:	Date/Time	Sample Containers Cleaned by:	Date

Special Notes: Please fax results to JBL Enterp (330) 477 3009

Containers & Mailers Assembled by: | Date

00344

CUSTOMER: KEEP PINK COPY. RETURN WHITE AND CANARY COPIES WITH SAMPLES

CasChem Laboratories Incorporated

1712 - 11th Street N.E.
Canton, OH 44705

CHAIN OF CUSTODY FORM

216-588-TEST
800-800-6052
(FAX) 216-588-8412

Project # | Project Name & Address: City of Canton Training Center

Samplers (Signature):

Customer Name and Address: TNT Environmental Co 216 A N Main St

Sta. #	Date	Time	Comp	Grab	Station Location	No. of Containers	Analytical Method: TPH (418.1)	BTEX	TPH (8015) GRO	LEAD	PNA	TPH (8015) DRO	Remarks	Lab #
#13	3/8/95	3:30	X		3-5 / Surface	1	X	X						
#14	3/8/95	4:00	X		BS 1' down	1	X	X						
#15	3/8/95	4:30	X		BS 5' down	1	X	X						

Relinquished by: (Sig.)	Date/Time	Received by:(Sig.)	Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)
[signature]	3/8/95 - 6PM				
Relinquished by: (Sig.)	Date/Time	Received by:(Sig.)	Relinquished by: (Sig.)	Date/Time	Received by: (Sig.)

Relinquished by: (Sig.)	Date/Time	Received for Lab by:	Date/Time	Sample Containers Cleaned by:	Date

Special Notes:

Containers & Mailers Assembled by: | Date

CUSTOMER: KEEP PINK COPY, RETURN WHITE AND CANARY COPIES WITH SAMPLES

00345

APPENDIX H
QA/QC PLAN

QA/QC PLAN FOR INVESTIGATION & SAMPLING OF SOILS AND GROUNDWATER

INTRODUCTION

JBL GROUP, INC., is a professional consulting firm which provides hydrogeologic, engineering, microbiologic, and related testing services for comprehensive abatement and remediation of groundwater and environmental contamination.

This QA/QC Plan documents investigative procedures for accurate and consistent collection of groundwater and environmental data with an emphasis on environmental impacts resulting from inadvertent losses of petroleum products. The specific quality control procedures outlines are based upon the Groundwater Monitoring Technical Environmental Guidance Document (EPA/530/SW-86/055), and Practical Guide to Groundwater Sampling (EPA/600/2-85/104).

SAMPLE SITE SELECTION

Selection of Monitor Well Locations

In general, many of the samples collected by JBL GROUP, INC., are from monitor wells. Various criteria is used to determine the selection of the sampling site. These include areas where losses are suspected to have occurred, or near structures that are subject to leaks or failure. Additional monitor wells will be installed in areas from the suspected contamination areas to delineate the contaminant plumes. This would include placement of monitor wells upgradient, downgradient, and outside the perimeter of the contaminant plumes.

Selection of Surface Water Locations

Surface waters are usually sampled when groundwater is being discharged from a site into a nearby surface water body such as a pond, stream, or ditch. When surface waters are sampled, samples will be collected at or near the point of discharge into the surface water body. A determination then can be made whether the discharged water is contaminating the surface water body.

SAMPLING PROCEDURES

Drilling Methods

Drilling Equipment Decontamination

Prior to commencing work, drilling equipment is cleaned to avoid introduction of foreign materials onto the site. The equipment subject to decontamination may include augers, drilling tools, sampling tools, and the rig itself. Material used to construct the wells, casing and screens are also decontaminated prior to installation. The methods used are site and parameter specific, and are outlined below:

Detergent Wash - using trisodiumphosphate or Alconox type detergent with clean water

Chemical Wash - using water super surfactant solvent; EFFF or Hazcleanser with clean water rinse

Water Rinse - a distilled water rinse is used to remove chemical or detergent residue. In the case of a contaminant which is water soluble, a clean water rinse may be sufficient without other methods.

Steam cleaning - when contaminants are easily volatilized or persistent residues need to be removed. Steam cleaning is particularly useful when cleaning large or bulky equipment such as drilling rigs, augers, etc.

Decontamination and rinse water is generally disposed of on site. Collection and disposal of decontaminated water is required. The water is containerized and stored on site while waste characterization and proper disposal is arranged.

SOIL BORINGS

Soil borings are advanced with a rotary auger drilling rig using hollow stem or solid stem augers. The augers are turned into the soil in five foot sections. Continuous

auger flights move soils cuttings from the drill bit to the surface. This procedure, using hollow augers, produces affectively a cased open hole to the end of the drill string, to facilitate sampling or other testing. When using solid augers, the auger must be removed to provide an open uncased hole for sampling, well installation, or other activities.

Other drilling methods which may be used include hand auguring and excavation with shovels, post hole diggers, or other manual methods. Hand boring methods are useful when soil types and conditions permit easy penetration to the required depth. Hand methods normally are not used for soil borings below the water table.

Following completion of borings, the bore hole is plugged by various methods. Normally drill cuttings are hauled and disposed of properly off site. After completion of the borings, bore holes are plugged with soil bentonite mixtures, or bentonite and/or cement grout. As required, contaminated drill cuttings are containerized and stored on site. The materials are characterized and properly disposed of.

MONITOR WELL INSTALLATION

Monitor wells are installed by auger drilling methods. Drilling equipment consists of B40 and B50 or other typical rotary auger rigs. The rig is used to drill a string of continuous flight augers into the ground to create a bore hole. The selected well casing is installed in the open hole by one of two methods.

The primary method of well installation is used with hollow stem augers. The augers are again drilled to total depth providing a cased open hole. The well casing is placed inside the hollow auger to the required depth and the augers removed. As the augers are pulled , the well remains at the required depth and natural material can collapse around the screen. Gravel or sand pack, is required, is placed through the augers during removal. The rate of filter pack application is matched to the rate of auger withdrawal so that uniform filter zone is created. The filter pack is placed up to one to two feet above the screen to provide isolation from the well seal materials. The annular space is backfilled by approved methods which can include bentonite or a low permeability grout. Grout, when required, can consist of various mixtures of cement, and/or bentonite. Grout is generally tremied through the augers during removal. Well

sealing and grouting methods are designated based on the soil and groundwater conditions in the boring.

The secondary method is used with solid augers. The augers are drilled to total depth and withdrawn from the hole. The specified well casing and screen is placed in the bore hole and pushed or driven to the proper depth. The annular space between casing and the bore hole can be backfilled with native soil or a low permeability mixture of cement and/or bentonite.

Well materials are selected based on the geologic conditions and groundwater sampling goals for each well. Casing types can consist of stainless steel and PVC. Both threaded coupled or flush threaded joints are used. Well screens consist of stainless steel continuous slot wire wound or PVC sawed slot construction. Stainless steel materials are typically used when free product are expected, while PVC materials are used for all other applications. Wells completed above grade are protected by a steel outer casing with a manhole with a hinged lockable cover. The outer casing is set in concrete which is shaped to promote drainage away from the well. Wells which are finished flush with the existing grade are set in a sealable casting which is cemented to the existing surface. Inside the casing the well is sealed with an expandable locking plug. Concrete pads where wells are placed in asphalt or concrete are 2.0' x 2.0'. All other areas, concrete pads are 4.0' x 4.0'.

Following installation, the wells are developed to remove fines from within the well and the aquifer material adjacent to the screen. This is done so that the produced water is sediment free and to provide good hydraulic connections with the aquifer. Well development methods include pumping and bailing, over surging and swabbing.

Vertical Sampling of Aquifers

Several methods are available for vertically sampling the aquifer. The choice of any given method is dictated by the specific conditions and objective of a particular investigation.

Two options are available using hollow stem augers. The first method utilized is a screened auger. In this method the augers penetrate to any required depth and a water

sample is obtained, using a clean stainless steel bailer. The second hollow stem method involved the use of a plugged lead auger. The auger string is inserted to total depth, which is determined on a site specific basis. A stainless steel screen (3 to 5 feet in length), and two (2) inch stainless steel casing are placed inside the augers to the top of the plug, which is removed, and the augers are withdrawn. As the augers are removed, the formation materials collapse about the well screen. The temporary well is then developed using any of the techniques described previously. This is called a piezometer.

The method using solid stem augers is similar to the second hollow stem method, except that the augers are removed from the boring and the screen and casing are driven to a total depth.

After completing sampling, the in-place well screen is pulled to the desired interval and redeveloped. Intervals are generally selected so that three (3) to five (5) feet of every nine (9) feet are sampled. The sampling interval and screen length can varied to provided sampling of greater or lesser portion of the aquifer.

Preliminary Preparation For Sampling

All sampling events to be conducted will be scheduled with the analyzing laboratory to make sure the laboratory can accept the samples. The laboratory will be informed of the approximate number of samples to be collected and the tentative date and the time of sample arrival.

Prior to the sampling trip any equipment which will be used shall be cleaned, calibrated, and in good working order. The sample bottle supply will also be verified to ensure containers are available.

Field sampling kits will be inspected to be sure that all items necessary are present. A standard sampling kit will contain the following items:

* a teflon squirt bottle with methanol or acetone
* alconox/TSP soap
* a sufficient supply of distilled water for rinsing

* disposable gloves
* a waterproof pen
* an appropriate amount of sample containers and labels
* the proper purging and sampling device
* nylon rope
* ice packs and cooler
* appropriate site and safety manuals
* organic full face mask
* safety glasses

Sample Collection

Soil Sampling Procedures

Soil samples are taken during drilling with hollow stem augers by split barrel sampling methods. The split barrel sampler is a two (2) inch O.D. divided tube sampling device 18 to 24 inches in length. The sampler is driven into undisturbed soil in advance of the augers. The sampler is driven using a 140 hammer with a 30 inch free fall. The hammer blows are recorded for each of three 6 inch increments. The blows for the final two increments are summed and described at the standard penetration "N", which is a measure of the relative density of cohesionless soils. The sample is retrieved, opened and an intact sample of the soil strata is provided. The soils are classified and

also contained, preserved, and shipped as outlined previously.

Decontaminated procedures are site and parameter specification are outlined in the decontamination section. Decontamination of sampling tools is done prior to the start and between each sampling event.

Sampling frequency is normally specified based on the objectives of each investigation. Typically for split barrel sampling the interval is at 2.5 feet to the water table then at two foot intervals thereafter. On deeper borings where uniform soils are encountered, the interval may be extended as the depth increases. Grab samples are collected at preselected intervals or at locations as site conditions warrant.

Water Sampling Procedures

Prior to monitor well purging and sampling, the water level in each well will be measured. The electronic tape or wetted tape method will be used for measurement. Once static water levels are known, the volume of water in the wells will be determined for well purging.

Prior to the collection of a groundwater sample, the standing water in the well casing will be purged to ensure that a representative sample of the formation water is collected for analysis. Samples will not be collected before a minimum of three well volumes have been evacuated or before specific conductance has established. To ensure that the groundwater sample is collected from the zone to be monitored, a maximum of five (5) well volumes will be bailed dry and then sampled within 24 hours.

Once a well has been properly purged, samples will be collected in the following manner:

1. Rinse a clean teflon or stainless steel bailer at least five times with a sample water.

2. Transfer the sample into the vial, filling the vial to overflowing, and avoiding turbulence and bubbling as much as possible. Water should

stand above the top of the vial forming a convex meniscus. Carefully but quickly slip the cap onto the vial and tighten. Once the cap is tightly in place, invert the vial and gently tap against your hand to assure there are no bubbles inside. If bubbles are present, open the vial, and repeat the process.

3. Collect a duplicate sample.

4. Label the sample vials. Labels will include the project number, sample identification number, preservatives, date and time of sample collection, type of analysis required, and the name of the sampler.

5. Fill out the chain-of-custody form, include preservation techniques in the remarks section.

6. Check to make sure the vial caps are tight, then place the labeled sample and duplicate on ice immediately.

7. Transport the sample set, in a cooler on ice, back to the office for shipment to the analyzing laboratory, maintaining the chain-of-custody.

If it is necessary to obtain samples for water quality analysis from wells with in-place plumbing (purge wells or domestic wells for example), samples will be collected from the most pump-proximal cold water tap available. The system will be allowed to flush until temperature or conductivity has stabilized. Flow will be reduced to approximately 500ml/minute, (a stream about the width of a pencil), or less for sample collection. The method for sample collection will follow those previously stated.

Surface water blank shall be collected in accordance with the above mentioned methodology. Care will be exercised to allow for minimum disturbance of bottom sediment.

One equipment blank will be collected for each sample set. The blank sample will be collected at a random time. during the work period. The blank will be collected by filling the decontaminated sampling device with distilled or deionized water. Collect

a sample of the water utilizing the already described methods.

Sample Preservation and Handling

Soil sample preservation will be provided by immediately placing the containerized samples on ice in a darkened environment, typically in a cooler, to cool the sample to approximately four degrees Celsius, approximately 40 degrees F.

Water samples to be analyzed for dissolved inorganic parameters will be filtered and preserved in the field. They will be preserved by acidifying the samples with the samples with the appropriate acid (either nitric or sulfuric) to lower sample pH to less than two (2), and cooling to four degrees Celsius. Water samples to be analyzed for volatile organics may be preserved in the field with hydrochloric acid, sodium azide, or mercuric chloride.

Acid preservation will be done in a well ventilated area. The tip of the acid bottle will not be allowed to come in contact with sample. If it does, the tip will be flushed five (5) times with distilled water and twice with acid before the next sample is acidified. Samples will remain on ice or be refrigerated at approximately four degrees Celsius until they are analyzed.

After samples have been collected, sample sets will be sent to the laboratory as quickly as possible in sealed coolers packed with fresh ice and chain-of-custody documentation.

Measures to Avoid Cross-Contamination of Samples

To avoid cross-contamination during soil sampling decontamination procedures discussed in the section under Drilling Equipment Decontamination will be followed between each sample interval.

To avoid cross-contamination during well water sampling the following guidelines will be followed. Upon arrival at a site the bailer to be used to collect water samples will be rinsed with methanol or acetone, then scrubbed with alconox soap and thoroughly rinsed with tap water, followed by a thorough rinse of desalt water. If water quality data are available for the site the least contaminated well will be sampled first, followed by

the wells suspected to be most contaminated.

Between the collection of each sample, the bailer will be scrubbed with alconox soap, followed by a tap water and distilled water rinse. The nylon rope used on the bailer will be replaced. After completion of the round of sampling of the site, the equipment will be decontaminated as previously described.

In case where teflon tubing is used, the tubing will be washed with a solution of tri-sodium phosphate (TSP), and tap water followed by a rinse with a minimum of one gallon of distilled water. The tubing will also be rinsed with at least three liters of sample water prior to sample collection.

METHODS FOR DETERMINING AQUIFER PARAMETERS

Hydraulic Gradient

The hydraulic gradient is calculated by dividing the difference in the static groundwater elevations by the horizontal distance between the same wells.

Horizontal Hydraulic Conductivity

The rising-head falling-head slug test developed by Bouwer and Rice (1976), is generally used to estimate the hydraulic conductivity of an aquifer with a single well. The wells can be partially penetrating and partially screened, perforated, or otherwise open. The test is initiated by causing an instantaneous change in the water level in a monitor well or piezometer through the introduction or removal of a solid cylinder of known volume. The change in water levels is recorded utilizing a pressure transducer and displayed on a sensor display. The sensor display converts voltage output from the pressure transducer to the water level in feet above the transducer.

The method of interpreting the water levels versus time data that arises from the test in based upon the Thies equation which described the relationship between the inflow into the bore hole and the drawdown. An automated numerical algorithm developed by Kemblowski and Klein is utilized to process the slug test data.

Transmissivity

Aquifer transmissivity and storativity are generally determined by performing a pump test. The general set-up procedure is to install a production well five (5) feet from a permanent monitor well and the second temporary observation well fifty feet from the production well.

The production well is pumped at a constant discharge rate, while drawdowns are recorded in the pumping well and adjacent wells with digital electronic water level sensing devices at specified time intervals. Discharge from the pumping well is direct so as to avoid aquifer recharge to the test area. The test is allowed to run for a minimum of four hours at constant discharge rate. upon completion of the pumping period, recover in the observation wells is monitored for a minimum of thirty minutes or until recovery to static water level is reached.

The method of interpreting the drawdown data versus time and/or distance is based on techniques developed by Theis, or those modified for. The Theis method, such as Cooper and Jacob (1946), Hantush (1964), Neuman (1974), or Kahn (1982).