Final Report

9/15/67

RI/FS at the 4th St. Site

Received 1/31/2001

RCRA — PACNW S

APPENDIX A

APPENDIX A
HISTORICAL DOCUMENTATION

APPENDIX A

Manufactured Gas Plants (MGPs), similar to the Citizens Gas Works, have been used since the 18th century to produce a combustible fuel for heating, cooking, and lighting. The first plant in Europe to actually make and distribute water gas was for public lighting in Dublin Ireland in 1830. This first plant made gas by passing steam across a bed of red hot coal or charcoal. Other systems used the same principal with steam being passed through a red hot iron pipe or a pipe filled with charcoal.

The original gas production systems consisted of a retort into which melted resin and oil were siphoned and decomposed, and a second retort filled with scrap iron and charcoal, into which water was introduced. The resulting water gas was used to flush out the oil and resin gas from the first retort. The production of gas continued to develop throughout the 1800s with the introduction of coal gas. Coal gas was manufactured through the thermal decomposition of volatile matter (coal or coke) in the absence of air (oxygen).

The first record of the practical application of water gas apparatus in the production of manufactured gas in America was in the Municipal Gas Light Company's works in New York City in 1884. The apparatus was composed of twin generators, and air preheaters and a common, brick mixing chamber. Air under natural draft entered from the bottom of a preheater, passed up through it, being preheated by the products of combustion, then to the side or bottom of the generator and up through the fuel bed, the products of combustion going to the top of the air heater, down through it and to the stack. During the run the steam was admitted to the top of the generator, was decomposed by passing down through the fuel bed and passed into the mixing chamber, where it was mixed with "a gas rich in carbon"(AGJ 1934).

In the mid 1870s under pressure from the infant electric industry, gas producers desired to produce gases of a higher candle power than was possible using standard water gas practices. A redesign of the process led builders to use not the standard externally heated, but an internally fired generator, and internally fired vaporizing and fixing chambers which were heated by the combustion of generator gases. During this time it was also realized that the value of gas lay not in its illuminating but in its heating value.

In 1874 the first combination generator-retort system began operation. In this process, water (blue) gas was produced and metered seperately from the oil gas. This allowed producers to better control the quality of the product by adjusting the combination of the lower BTU water gas and the higher BTU oil gas to attain the desired heating ability.

Professor Thaddius S.C. Lowe was the inventor of the most successful form of water gas equipment. His equipment permitted the economy of scale, flexibility of operation,

and adaptability to a variety of gas making materials. The list of material in Prof. Lowe's apparatus included generator fuels such as anthracite and bituminous coal, and a number of forms of coke. Carburants such as gas and fuel oils and oil refinery or natural gas were also used interchangeably (AGJ 1934).

The first units of Lowe's design consisted of a generator and a superheater. Primary air was furnished to the base of the generator containing the coal and heated secondary air was admitted at the base of the superheater to burn the generator gases produced during the blasting period. Oil was admitted at the top of the generator fire, vaporized and was fixed in the superheater in the presence of blue gas which was produced in the generator by steam passing up through the incandescent fuel bed. The first plants of the Lowe design were built in Baltimore, throughout Pennsylvania and in Utica, NY in 1874.

The last major change to the gas production process was introduced in 1889 when Lowe added a second superheater to provide a larger fixing surface. Throughout the 1890s and 1900s, changes where made not to improve upon the theory of gas production but to increase the efficiency of the process. Improvements included the installation of steam and airflow meters, and a change from manual to hydraulic operation of valves (1914) and controls operated electrically on a mechanical timer (1915).

Following manufacture, the gas proceeded through a series of condensers, scrubbers and purifiers. Inventors first believed that slow cooling of the gas allowed benzol hydrocarbons to be retained. In addition to the condensers, long foul mains were used to aid in cooling and the reduction of naphthalene. In fact it was the use of clay retorts which greatly reduced the amount of naphthalene because of the lower carbonizing temperatures.

In 1907 the invention of the Doherty washer cooler the system increased both operating efficiency and reduced costs of maintenance. In the washer gas enters from the bottom and passes through a series of wooden grids over which cooled water has been sprayed cooling the gas. While the gas undergoes cooling the removal of tars and sulfur impurities is also facilitated. In 1913 the Condon Scrubber stand pipe was added to the process. Ammonia liquor is sprayed into the stand pipes in such a manner that the hot gas leaving the carbonizing chambers must pass through a film. The liquor and tars drain down to a separator and the ammonia liquor is recycled back into the process. This process was common and widespread in the early part of the 20th century.

Improvements in the scrubbing process led to the P. and A. tar extractor with which gas was impinged at a high velocity on a plate surface. A principle of tar extraction used by water gas plants allowed the gas to pass through wood shavings with the cooled tar adhering to the shavings which were dumped or burned when saturated. The most advanced method of tar removal was the Cottrell Electrical Precipitator which employed a pulsating, high tension, direct current conducted through the flow of gas, in which the separation and precipitation of electrically charged particles occur. Commercial

installation of the Cottrell unit begin in 1924 and was widely used in "modernized" plants.

A number of undesirable by-products other than tar were formed during gas manufacture. Among these are ammonia, sulfur, cyanogens, and other light oils.

The first commercial apparatus for ammonia recovery a scrubber consisting of a tower filled with coke or excelsior, over which water was uniformly distributed. This method was found to be unsatisfactory and soon a wooden grid or tray scrubber was universally used. Although the tray scrubber design underwent little change, the method of distributing the water across the trays developed from a system of spray heads. In early models rotary scrubbers replaced the packed tower and they in turn were replaced by intensive grid scrubbers which employ the principal of recirculation of the wash liquor through the grids at a high rate of flow.

Light oils were not generally removed from the gas until approximately 1915 when the oils were removed from the carburetted water gas as well as coal gas. Light oil removal reduced the amount of naphthalene in the gas to almost nil. When light oils were not removed naphthalene scrubbers were a necessity. Naphthalene was removed by passing the gas through a series of wooden grids over which straw oil or other solvents were sprayed.

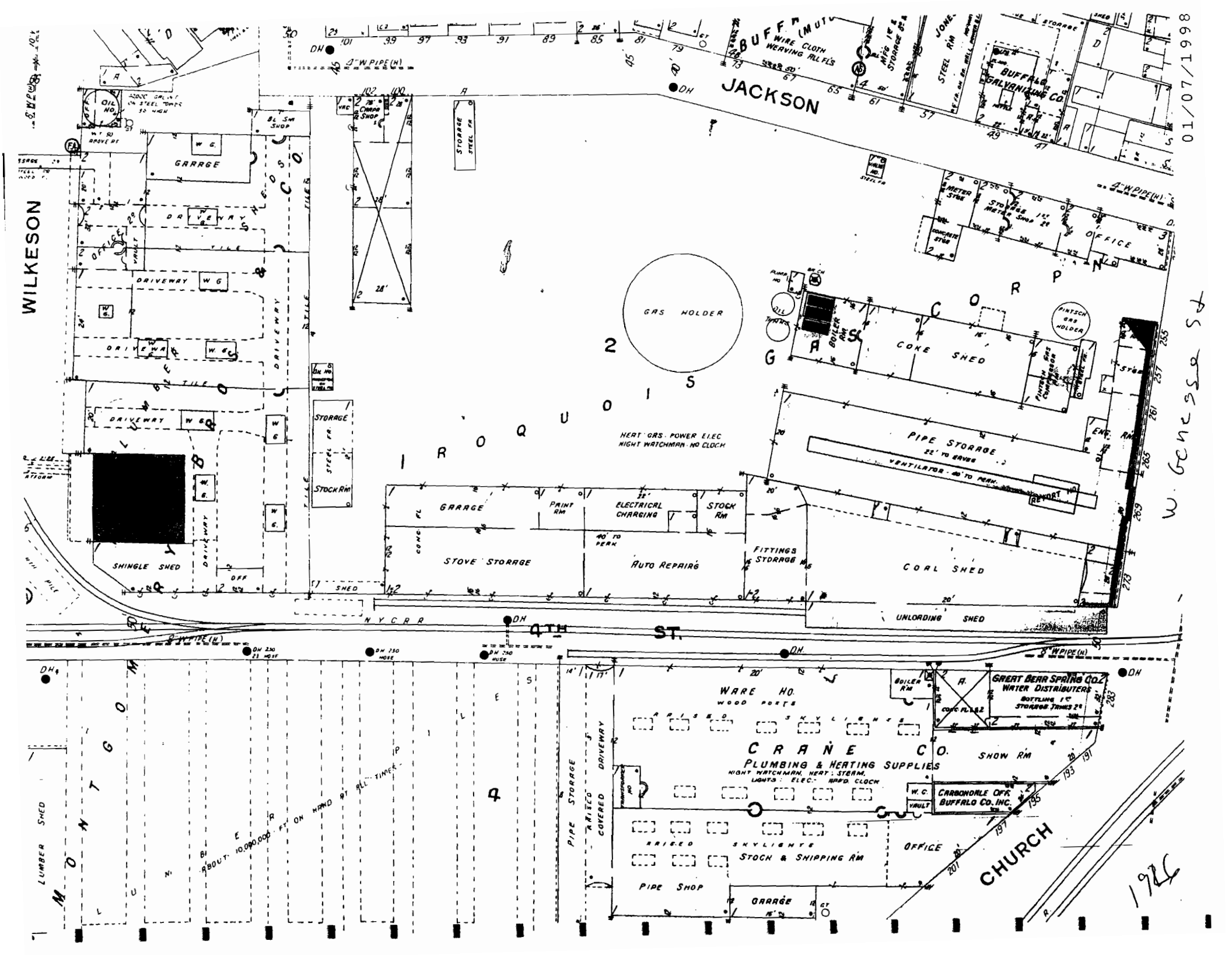
Few plant operators were concerned with the removal of cyanogens from the gas. This corrosive impurity was usually retained by liquid purification scrubbers, by hydrogen sulfide removal and it is partially adsorbed by the oxide used in the dry purification.

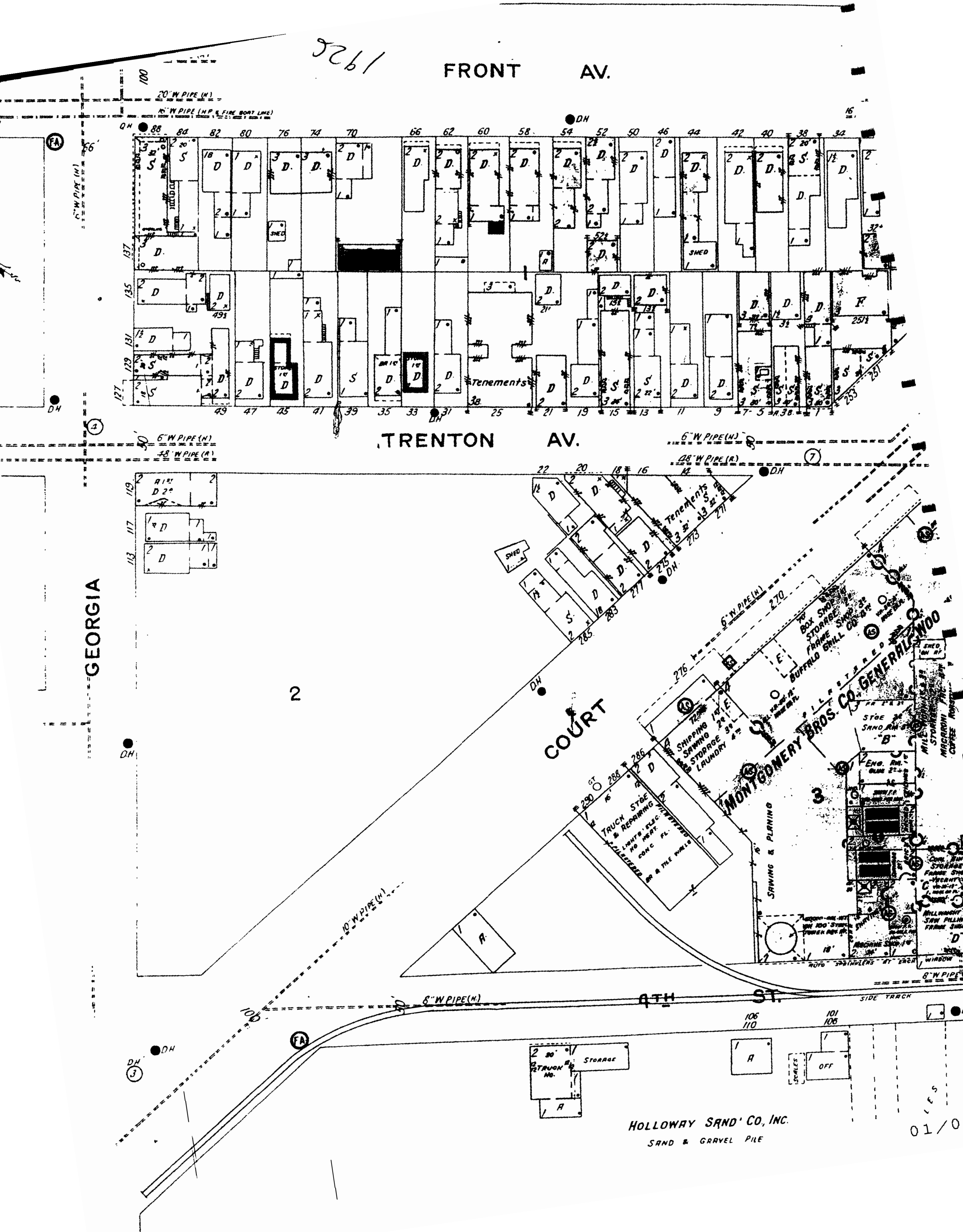
The last impurity to be removed from the gas was sulfur. Sulfur removal was accomplished by dry purification in boxes filled with iron oxide. In the early systems when candle power was important, carbon dioxide was considered to be a serious impurity and lime was used as the purifying agent, because it removed the carbon dioxide as well as the hydrogen sulfide. In the late 1880s the process was changed to the use of rusted iron borings (scrap) and wood shavings. Although some substitutions were made during the first and second world wars, the process changed little until the development of new oxides in about 1930. The newly manufactured materials such as activated iron oxide, iron hydroxide and a mix of precipitated ferric hydroxide with granulated blast furnace slag more than doubled the sulfur adsorption capacity of the system. When the purifier material had no more capacity for sulfur, the material was removed from the boxes and revivified by mixing it in the open air in order to allow the sulfur to react with the oxygen and dissociate from the iron complexes.

In approximately the 1920s the Koppers Company developed a process for the removal of sulfur by liquid purification. The gas was washed through a packed tower or absorber with a clear soda ash solution. The spent solution was then aerated and recirculated back through the system. The air containing hydrogen sulfide and cyanide

impurities was vented to the atmosphere or when odor control was a concern back into the system to reduce odor emissions.

Although the manufactured gas processes used by the Citizens Gas Works are uncertain, Figure 1.3 indicates that many of the typical gas production processes (oil gas, water gas, etc.) may have been used at the plant.


01/07/1998
JACKSON
WILKESON
MONTGOMERY
4TH ST.
CHURCH
W. Genesee St
BUFFALO GALVANIZING CO
WIRE CLOTH WEAVING ALL FLS
GARAGE
DRIVEWAY
SHINGLE SHED
STOCK RM
GAS HOLDER
COKE SHED
PINTSCH GAS HOLDER
PIPE STORAGE
VENTILATOR 40' TO PEAK
COAL SHED
UNLOADING SHED
HEAT GAS POWER ELEC
NIGHT WATCHMAN NO CLOCK
GARAGE
PAINT RM
ELECTRICAL CHARGING
STOCK RM
STOVE STORAGE
AUTO REPAIRS
FITTINGS STORAGE
NYCRA
WARE HO.
WOOD POSTS
CRANE CO.
PLUMBING & HEATING SUPPLIES
NIGHT WATCHMAN, HEAT: STEAM,
LIGHTS: ELEC: TIME CLOCK
SHOW RM
GREAT BEAR SPRING CO.
WATER DISTRIBUTERS
CARBONDALE OFF.
BUFFALO CO. INC.
RAISED SKYLIGHTS
STOCK & SHIPPING RM
OFFICE
PIPE SHOP
GARAGE
PIPE STORAGE
RAISED COVERED DRIVEWAY
LUMBER SHED
ABOUT 10,000,000 FT ON HAND AT ALL TIMES
OFFICE
METER STOR
STORAGE METER SHOP
CONCRETE STOR
OIL NO.
BL SM SHOP
CHEMO SHOP
STORAGE
STEEL FA
STEEL FIL
VAULT
W.C.
DH NO.
8" W PIPE (H)
4" W PIPE (H)
DH 250 FT HOSE
DH 230 FT HOSE


1926
FRONT AV.
TRENTON AV.
GEORGIA
COURT
4TH ST.
Tenements
SHED
MONTGOMERY BROS. CO. GENERAL WOO
BUFFALO GRILL CO.
BOX SHOP
SAWING & PLANING
SHIPPING 1st
SAWING 2nd
STORAGE 3rd
LAUNDRY 4th
TRUCK STGE & REPAIRING
MACHINE SHOP
MILLWRIGHT & SAW FILING
SIDE TRACK
HOLLOWAY SAND CO, INC.
SAND & GRAVEL PILE
STORAGE
TRUCK HO.
OFF
SCALES

1915
City Atlas

29

30

30

COURT

GEORGIA

AVE

STATE ST.

PARK

TERRACE

WHEELER

SLIP

Sturges Iron Works

Montgomery Iron Works

Bradley Fire Works Co.

Iron Foundry

Iron Foundry

Iron Foundry

Wooden Building

Chapel Pl.

Court Pl.

Crown

Wheeler

Slip

Terrace

Ave

St

Georgia

Court

Park

State St.

Niaga

Square

Ave

139

136

137

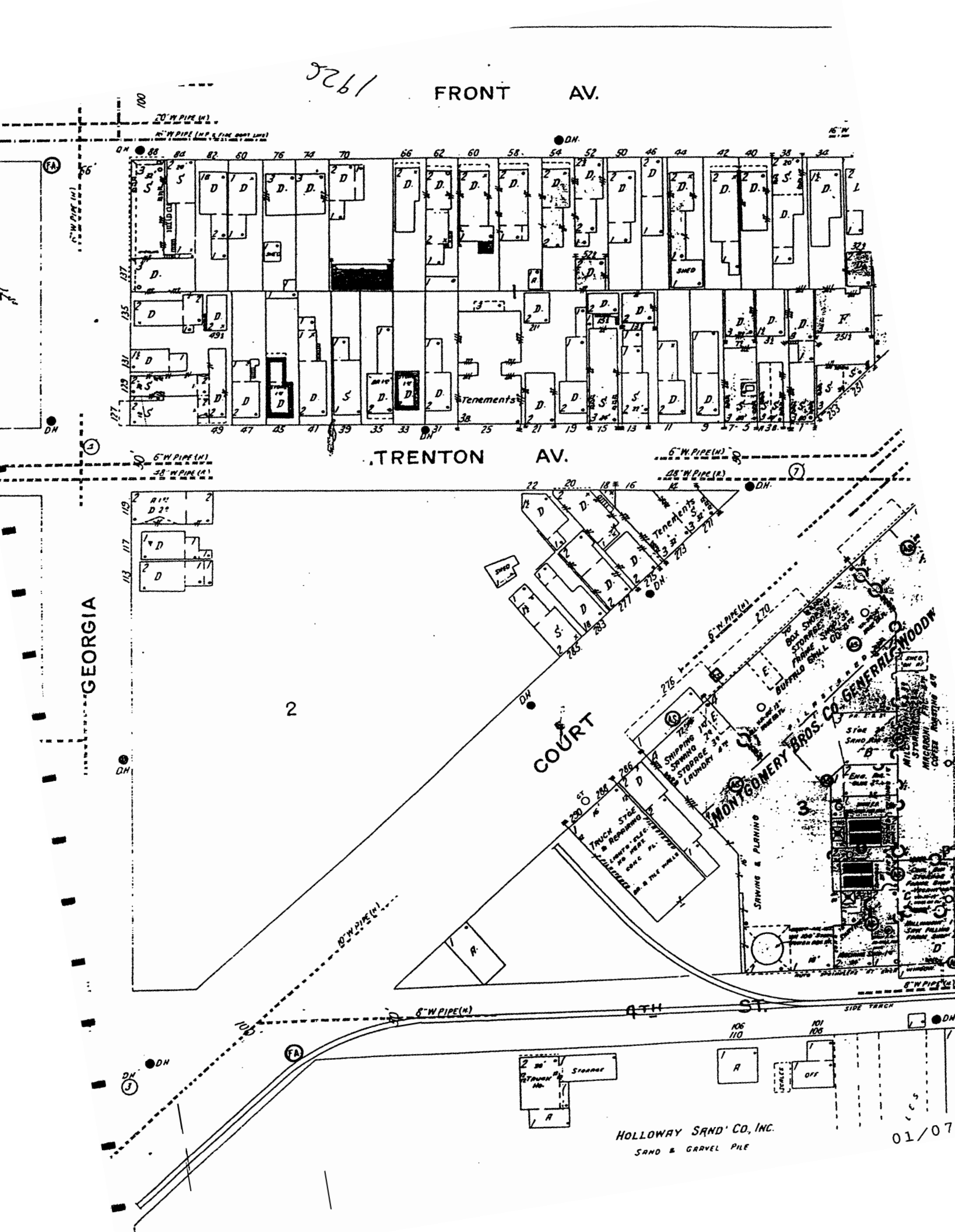
108

19

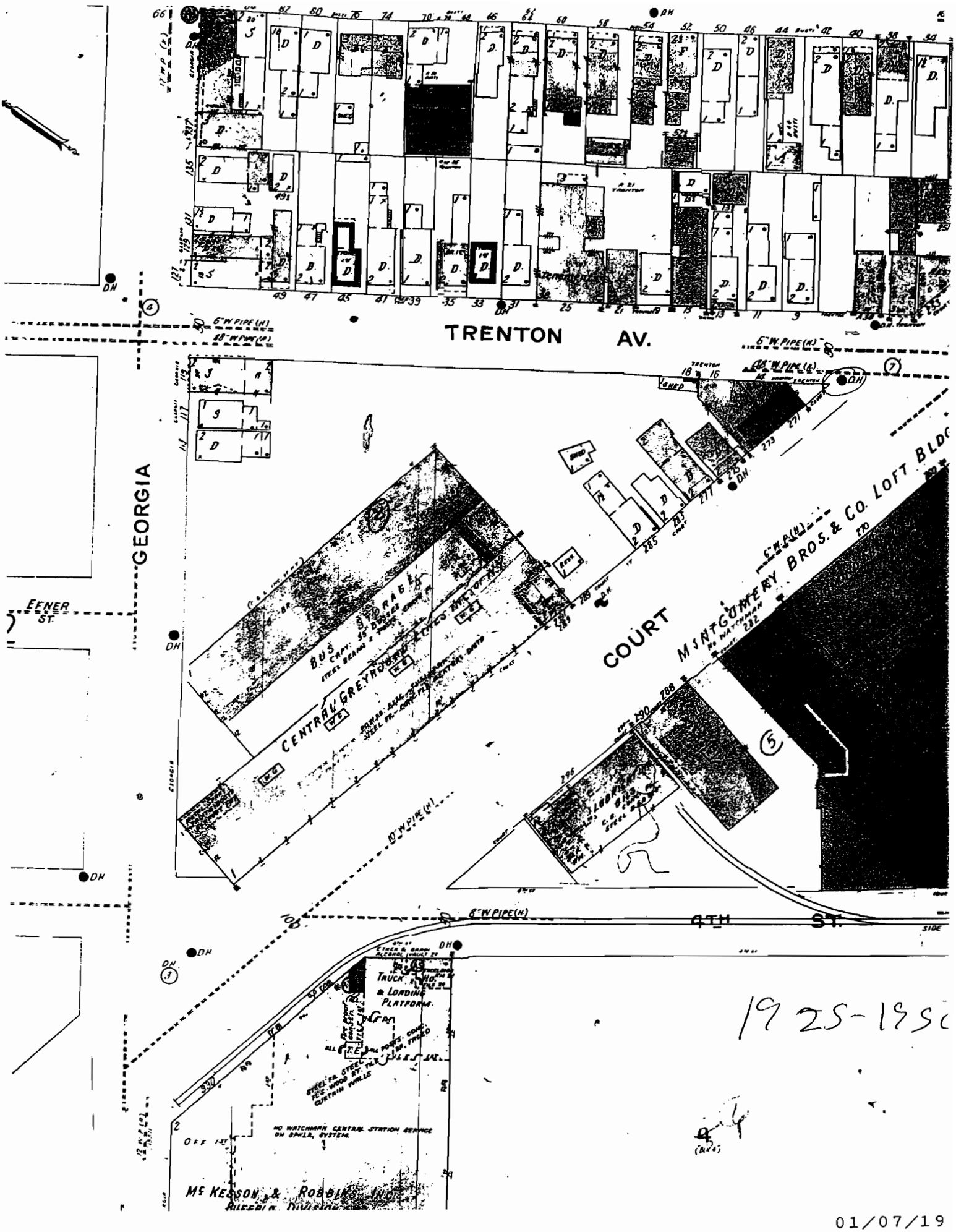
6

2

3


1926
FRONT AV.
TRENTON AV.
GEORGIA
COURT
Tenements
MONTGOMERY BROS. CO.
GENERAL WOODW
SAWING & PLANING
STORAGE
SHIPPING SPAWNING STORAGE LAUNDRY
BUFFALO GRILL
HOLLOWAY SAND CO, INC.
SAND & GRAVEL PILE
01/07

AVE.
6in.
20in.
6in.
ST.
ARK
TERRACE
50in.
COAL YARD
N.Y. C. R.R. Co.
JACKSON
ST.
ST.
5
6in.
6in.
24
12
2
T.
TOOL WORKS
G. Parr
PLANING
MILL
Lee,
Holland
& Co.
13
Wilkeson
PARINA
FLOUR
MILLS
Lee, Holland & Co.
LUMBER YARD
3
BUFFALO
GAS WORKS
16
GEORGE
CITY GAS WORKS
SOUTH
4in.
E.C. Morse
B. Small
BUFFALO ICE Co
27
26
G. Hutch
15
American
Glucose Co.
Fox & Holloway
14
L.H. & Co.
Lee, Holland & Co.
5
WILKESON
Buffalo Gas Co.
LUMBER YARD
Lee, Holland & Co.
MALT HO.
Fisher & Co.
4
C
Sheehan
H. Irons
Sherman
& Sheehan
GEORGIA ST.
CANAL
GEORGIA ST.
BELT LINE
STATION
Central
ock & Terminal R.R. Co.
M. Harring
ICE HOUSE
N.Y.C. R.R. Co.
F. Jeke
RAIL ROAD
HUDSON RIVER



1925-1950

01/07/19

APPENDIX B

APPENDIX B
BORING LOGS

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

Contractor:	SJB Services Inc.	BORING NO.	SB - 1
Driller:	Don Butzer		
Inspector:	George Hermance	PROJECT NAME: BURA - Fourth Street Site	Sheet 1 of 1
Rig Type:	CME 75	PROJECT NUMBER: 732260	Location: Inside Fenced Area
Method:	4.25-inch HSA/SS		
Observations		Weather: Sunny, 70 degrees	
Depth of Water			
River Elevation		Date/Time Start: 4/29/98 1015	
Top of Boring Elevation			
		Date/Time Finish: 4/29/98 1057	

PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.20		1		1-4	Brown topsoil to .5', Red Brick to 1', 1'-1.8' Dark Brown	4.8 ppm	Fill
	SS-1	2	1.8	5-4	Silty Clay, trace of C+D debris, moist, stiff,		
0.50		3		10-50/4	Dark brown to black, Silty fine Sand, some Clay, trace very	1.0 ppm	Fill
	SS-2	4	0.8		fine Gravel, moist, loose		
1.30		5		2-1	Mottled gray and brown, fine Sand and Silt, trace Gravel	15.9 ppm	Fill
	SS-3	6	1.2	1-1	(coal+slag), wet		Sample: SB01C
2.10		7		w-w	Mottled brown fine Sand and silt, wet, fill gravel changes to	14.6 ppm	Fill to 7'
	SS-4	8	1.7	2-4	black peat (.5' thick) then Silt and Clay at 7'		
1.00		9		2-4	Black Silt and fine Sand to 8.5', wet, then brown fine Sand	17.6 ppm	SM
	SS-5	10	1.5	5-4	and Silt with dark banding to 10'		
2.40		11		3-5	Brown fine Sand and Silt, some black sand partings, wet	28.1ppm	SM
	SS-6	12	1.7	9-13	Dilatent		Sample: SB01F
0.50		13		7-5	Brown fine Sand and Silt to 12.7', then light brown, red,	17.1 ppm	SM
	SS-7	14	1.8	4-50/.1	medium-fine Sand, some (+) Silt, trace fine Gravel, wet		
0.00		15		17-50/.3	Gray silty Clay, trace fine Sand, trace med.-fine Gravel, wet	10.6 ppm	CL
	SS-8	16	0.5		Top of Rock at 14.75'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

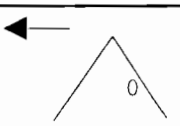
R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. SB - 2

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	of
Location:	Inside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	4/29/98 1300
Date/Time Finish	4/29/98 1346



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		5-26	Topsoil for .5' then broken concrete to 2'	10.4 ppm	Fill
	SS-1	2	1.2	15-12			
3.10		3		33-21	Concrete to 2.5', black Silty Sand with small pieces of coal	10.2 ppm	Fill
	SS-2	4	1.8	9-6	from 2'-3.5', broken concrete to 4'		
0.30		5		w-1	Black Silty fine Sand, trace Clay, brick, cement, wood, to	18.4 ppm	Fill to 4.5
					4.5', then GrayGreen fine Sand and Silt, trace fine Gravel,		
	SS-3	6	1.6	1-2	some black fine sand partings, wet		SM
0.10		7		1-2	Gray Green fine Sand and Silt, trace (-) fine Gravel (6'-7.3')		
					7.3'-7.8' Black SILT, trace fine Sand, some black partings	19.7 ppm	SM
					7.8'-8.0' Gray green fine SAND, some Silt, trace fine Gravel		Sample: SB02D
	SS-4	8	2.0	3-7	wet, dilatent		
1.00		9		3-5	Red to light brown fine SAND and SILT, uniform, wet	15.5 ppm	SM-SW
	SS-5	10	1.4	8-7			
0.60		11		4-3	Same as 8'-10' to 11', then red brown Silt and fine Sand,	30.3 ppm	SM-SC
	SS-6	12	1.4	4-7	trace (+) Clay, trace (-) fine Gravel, some banding, wet		Sample: SB02F
0.00		13		7-17	Red brown Sand and Clay, trace (+) Silt, trace fine Gravel,	30.9 ppm	SC
	SS-7	14	1.4	12-9	wet,		
0.50		15		8-14	Gray fine Sand and Silt, trace fine Gravel, trace Clay, wet	12.0 ppm	SM
	SS-8	16	1.3	50/.3	Top of Rock 15.3'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

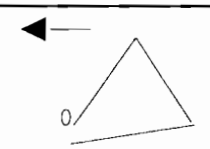
PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB - 3

Sheet 1 of 1

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Location:	Outside fenced area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	4/30/98 0837
Date/Time Finish	4/30/98 0854



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
6.50		1		3-9	Topsoil for .3', then .5' concrete, brick, sand, at .9' black	48 ppm	Fill
	SS-1	2	1.6	9-4	fine Sand, Gravel, Slag for .2', mottled brown and tan Sand		Strong odor
10.50		3		4-5	Wet broken concrete, slag, Sand, Auger refusal at 4'	78.9 ppm	Fill
	SS-2	4	1.0	50/.4	Move borhole to location outside fence		
1.30		5		3-2	Black Silt, fine Sand, Slag, Brick, coal, wood, moist,	82 ppm	Fill
	SS-3	6	1.3	2-2			
9.80		7		2-2	Black Silt and fine Sand, Wood at 7.5', Then black silty	477 ppm	Fill Sheen
	SS-4	8	1.2	2-2	Clay, wet		Sample: SB03D
3.70		9		2-2	Dark gray and black Silty Clay, mottled, wet,	79.1 ppm	Fill
	SS-5	10	0.5	2-3			Sheen
4.30		11		4-5	Brown and Gray, fine SAND and SILT, wet and dilatent	88 ppm	SM
	SS-6	12	1.3	8-8			Sample: SB03F
1.70		13		18-13	Gray brown fine SAND and SILT, wet, dilatent	67 ppm	SM
	SS-7	14	1.7	15-50/.3			
					Top of Rock at 14.8'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

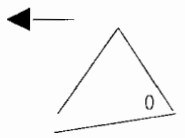
SUMMARY:

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB - 4

Contractor:	SJB Services Inc
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	4/30/98 1011
Date/Time Finish	4/30/98 1205



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		1-4	Topsoil for .5', Black cement, slag, brick, Sand and Silt,	21 ppm	Fill
	SS-1	2	1.6	5-8	moist		
60.00		3		10-10	Red brick and cement,	60 ppm	Fill
	SS-2	4	1.7	14-25			
206.00		5		49-50/.2	Brick and decayed concrete, fuel odor,wet	2500 ppm	Fill
	SS-3	6	0.8				
582.00		7		50/.2	Red and Tan brick, wet	1860 ppm	Fill Sheen
	SS-4	8	0.2				
303.00		9		48-50/.4	Red and Tan brick, wet, some gray sand between bricks	274 ppm	Fill Sheen
	SS-5	10	0.9				
66.30		11		48-50/.2	Red broken brick, gray sand nodules, partings, wet	284 ppm	Fill
	SS-6	12	0.8				Sample: SB04F
100.00		13		73-50/.4	Broken concrete and slag to 12.6', then .3' wood, seam of	1249 ppm	Fill
	SS-7	14	1.0		tar 12.9' to 12.92', then brokenand stained concrete		
1.70		15		7-14	14'-14.8' gray black fine Sand and Silt, wet, dilatent, odor,	228 ppm	SM-SC
					14.8'-15' Red Silty Clay, then Gray green fine Sand, little		
	SS-8	16	1.6	17-22	Silt, little (-) fine Gravel, wet		
3.10		17		33-47	Red brown and gray, gravelly fine Sand, trace (+) Silt, wet	370 ppm	GM Smeared product
	SS-9	18	2.0	28-38	hard,		
7.00		19		50/.1	Gravelly fine SAND, wet, hard,	NA	GM
	SS-10	20	0.1		Top of Rock at 19.1'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

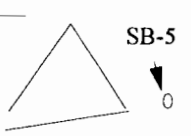
SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. SB - 5

Sheet 1 of 1

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	4/30/98 1435
Date/Time Finish	4/30/98 1550



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
2.10		1		3-13	black coal, Silt, Sand, trace brown fine Sand and Silt mixed	33.4 ppm	Fill
	SS-1	2	1.5	12-13	brick in shoe of spoon		
7.30		3		6-9	Brick, slag, cement, fine Sand, mixed fill, wet,	76.8 ppm	Fill Sheen
	SS-2	4	1.3	9-8			
23.10		5		3-17	Gray green medium to fine Sand, brick, .2' cement, brick,	1832 ppm	Fill Sheen
	SS-3	6	1.3	28-15	mixed after .2', wet, odor		
52.10		7		26-11	Red brick, tan brick, cement, black ash, wet, odor	390 ppm	Fill Sheen
	SS-4	8	1.0	6-4			
0.00		9		w-2	blackand brown mottled with blue spots, fine Sand and Silt	104 ppm	Fill Sheen
	SS-5	10	1.1	2-2	coal chunks, wet,		Sample: SB05E
15.00		11		2-5	Same as 8' - 10'	53 ppm	Fill Sheen
	SS-6	12	0.2	4-5			
0.00		13		3-5	Mottled black and gray Sitly Clay, brick at the bottom, shoe	122 ppm	Fill Sheen
	SS-7	14	1.2	8-7	covered with product.		
0.00		15		7-8	Dark gray to brown gravelly Sand, some Silt, wet, hard	78 ppm	GM Smeared
	SS-8	16	2.0	11-16			Product
0.00		17		48-48	Gray gravelly Sand, some Silt, hard, wet,	81 ppm	GM Smeared
	SS-9	18	1.3	50/.3			Product
0.00		19		50/.1	Gray gravelly Sand, some Silt, hard, wet,	NA	GM
	SS-10	20	0.1				

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

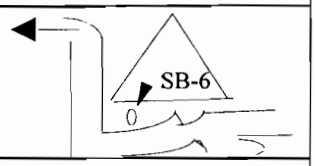
R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. SB - 6

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/1/98 0820
Date/Time Finish	5/1/98 0900



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		1-3	Brown topsoil then broken brick and coal, slag, tan brick,	12 ppm	Fill
	SS-1	2	1.0	4-10	Moist		
49.00		3		8-6	Black Silt and fine Sand, wood, dusty coal, strong odor,	125 ppm	Fill
	SS-2	4	2.0	4-4	moist		
0.00		5		1-1	Black silty fine Sand, coal dust, wood, laden with product	130 ppm	Fill
	SS-3	6	2.0	1-2			Sample: SB06C
50.00		7		2-1	Black, Fill, sand gravel wood, soaked with product, gray		Fill
	SS-4	8	1.5	2-2	Silty Clay at 7', wet		
0.00		9		w-w	Gray silty Clay, moist, soft, nodules of product throughout	66 ppm	ML Product
	SS-5	10	2.0	2-2			Sample: SB06 E
0.00		11		3-3	gray silty Clay to 10.3, then red brown fine Sand, Silt and	134 ppm	ML Smeared
	SS-6	12	1.6	3-2	some Clay, trace (-) fine Gravel, wet		Product
0.00		13		4-4	Red brown fine Sand, Silt, and Clay, trace (-) fine Gravel	88 ppm	SM-SC
	SS-7	14	1.5	50/.5	wet, soft		
					top of rock at 13.5'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

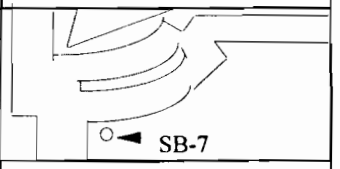
W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

Contractor:	SJB Services Inc.	BORING NO.	SB -7
Driller:	Don Butzer		
Inspector:	George Hermance	PROJECT NAME: BURA - Fourth Street Site	Sheet 1 of 1
Rig Type:	CME 75	PROJECT NUMBER: 732260	Location: Outside Fenced Area
Method:	4.25-inch HSA/SS		
Observations		Weather: Sunny, 70 degrees	
Depth of Water			
River Elevation		Date/Time Start: 5/1/98 0820	
Top of Boring Elevation			
		Date/Time Finish: 5/1/98 0900	



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)		
		0						
0.00		1		3-3	Topsoil for 5.', then Silty fine Sand as fill, coal dust, brick	23 ppm	Fill	
	SS-1	2	1.3	5-8	cement, slag, moist			
0.00		3		6-8	Red brick and cement for .2', mixed black and green sand	15 ppm	Fill	
	SS-2	4	1.5	8-8	to 3.5', some cement chunks, moist			
0.00		5		3-5	Black brokenslag, wood, cement, mixed cinders, wet	31 ppm	Fill	
	SS-3	6	1.2	3-3				
12.80		7		4-2	Brick, sand, wood, gravel, wet	357 ppm	Fill	Heavy Sheen
	SS-4	8	0.8	3-4				
		9		2-3	Gravel and slag to 9', then mottled brown Clayey Silt, trace	278 ppm	Fill	Heavy Sheen
	SS-5	10	1.2	8-8	(-) gravel, soft			
10.00		11		4-3	Green Silty Clay for .4', then fill, slag, gravel, sand, brick,		Fill	Free-Phase Product
	SS-6	12	1.3	1-2	very heavy amount of product			
15.00		13		4-2	Black fill with product, wet, brick, gravel, sand, some silty	2500 ppm	Fill	Free-Phase Product
	SS-7	14	1.3	1-4	clay			
0.00		15		4-2	No Recovery			
	SS-8	16	0.0	1-1				
		17		w-w	Black fill, Brick to 17.7', last .3' is stained medium to fine	2500 ppm	Fill	Free-Phase Product
	SS-9	18	2.0	31-43	Sand, some very fine Gravel, trace Silt, wet, hard			
50.00		19		4-5	Gray sandy Slit, trace (+) Clay, trace (-) fine Gravel, wet,		SM	Smeared Product
	SS-10	20	2.0	4-4	soft, sloppy,			
50.00		21		4-10	Gray Gravelly till, medium to fine Sand, some Silt, trace	2500 ppm	SW-SM	
	SS-11	22	1.5	10-50/.4	Clay, wet			Smeared Product
					Top of Rock at 21.9'			

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

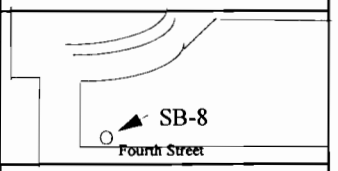
R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. SB - 8

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	East of sidwalk at 4th Street
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/1/98 1445
Date/Time Finish	5/1/98 1554



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		3-3	Black brown Silt and fine Sand, trace Clay, C+D debris,	24.2 ppm	Fill
	SS-1	2	2.0	3-4	Brick, cement, moist		
0.00		3		5-16	Black brown mottled Silty fine Sand, little (-) Clay, moist	25.3 ppm	Fill
	SS-2	4	2.0	7-7	some brick		
0.00		5		2-3	Same as 2'-4' to 4.5', then mottled gray and tan medium to	29.1 ppm	Fill
	SS-3	6	1.8	4-5	fine Sand, some Silt, trace Clay, trace coal pieces, moist		
0.00		7		3-4	Brown and tan medium to fine SAND and SILT, wet	11.1 ppm	SM
	SS-4	8	1.7	3-3	dilatent, no sheen		
0.00		9		w-1	Gray green SILT, little Clay, mottled, wet,	10.9 ppm	ML
	SS-5	10	1.7	1-1			
0.00		11		w-w	Gray green Silt and fine Sand, changes to gray fine Sand	30.5 ppm	SM
	SS-6	12	1.6	w-2	and Silt, wet		Sample: SB08F
0.00		13		4-3	Gray medium to fine Sand, some Silt, wet	27.5 ppm	SM
	SS-7	14	2.0	3-3			
		15		w-w	Gray Silt and fine Sand to 15', then Black brown Silt with	29.8 ppm	SM-Pt
	SS-8	16		2-2	peat, moist		
0.00		17		4-5	Peat to 17', then gray tan Silt, fine Sand, some Clay, wet,	29.1 ppm	Pt-SM
	SS-9	18	1.4	6-6	soft		
0.00		19		3-5	Gray tan fine SAND and SILT, trace fine Gravel, wet	14.6 ppm	SM
	SS-10	20	1.7	8-11	dilatent		Sample; SB08J
0.00		21		3-7	Red gray medium to fine Sand to 21', then red brown Silty	4.5 ppm	SP-CL
	SS-11	22	1.5	6-6	Clay, trace fine Gravel, moist		
0.00		23		7-10	Red SILT and very fine SAND, some Clay, trace fine		ML-SM
	SS-12	24	2.0	11-12	Gravel, wet, stiff		
0.00		25		2-50/.1	Same as 22'-24' to 24.6'		ML-SM
	SS-13	26	0.5		Top of Rock at 24.6'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

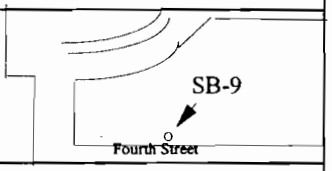
PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB - 9

Sheet 1 of 1

Contractor:	SJB.Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Location:	East of sidwalk at 4th Street
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/4/98 1000
Date/Time Finish	5/4/98 1205



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		5-5	Black brown topsoil for .5', then black brown Slity fine	0 ppm	Fill
	SS-1	2	0.9	4-3	Sand, with slag, medium fine Gravel, moist		
0.00		3		13-10	Black brown silty fill, brick, moist,	0 ppm	Fill
	SS-2	4	1.1	8-5			
0.00		5		2-3	Black, brown, red brick, slag, cement, cinders, moist	3.0 ppm	Fill
	SS-3	6	1.5	13-12			
0.00		7		50/.4	.2' of broken cement, moist	0.0 ppm	Fill
	SS-4	8	0.2				
0.00		9		50/.4	Broken concrete, broke through at 9.8'	0.0 ppm	Fill
	SS-5	10	0.4				
0.00		11		48-30	Wood, cement, rubble, moist	0.0 ppm	Fill
	SS-6	12	0.3	4-3			
0.00		13		6-6	Wood, broken cement, sand and silt, moist to 13', then	3.1 ppm	Fill Sample:
	SS-7	14	1.1	12-6	Gray Green Silty fine Sand, wet, dilatent, trace Clay, soft		SM SB09G
		15		18-10	No Recovery		
	SS-8	16	0.0	11-7			
0.00		17		3-3	Gray Silty fine Sand, trace (+) Clay, wet, soft dilatent to 17.2'	5 ppm	SM
	SS-9	18	2.0	4-8	then peat to 18'		Sample: SB091
0.00		19		9-9	Peat to 18.5', then red brown gray Clayey Silt, trace (-) fine	0.0 ppm	ML
	SS-10	20	1.5	8-8	Sand, wet, soft		
0.00		21		10-20	Red brown gray Slity Clay, trace coarse sand. wet dilatent	0.0 ppm	ML
	SS-11	22	0.5	15-33			
0.00		23		14-17	Red and gray Sandy Silt, some Clay in partings, wet	0.0 ppm	SM
	SS-12	24	2.0	17-20	dilatent		
0.00		25		9-18	Reddish gray Sandy Clay, some Silt, wet, trace (+) fine	0.0 ppm	SC
	SS-13	26	1.5	30-27	Gravel		
0.00		27		36-50/.3	Gray and tan Silty Sand, trace (-) fine Gravel, wet	0.0 ppm	SC
	SS-14	28	0.8		Top of Rock at 26.8'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

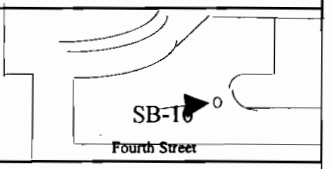
PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB - 10

Sheet 1 of 1

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Location:	East of sidwalk at 4th Street
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/4/98 1453
Date/Time Finish	5/4/98 1557



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		1-3	Topsoil then Black SILT and fine Sand as fill, coal dust,	8.8 ppm	Fill
	SS-1	2	1.0	9-12	Brick, gravel, moist		
0.00		3		5-4	Tan, brown and black medium to fine Sand, some Silt,	14.6 ppm	Fill
	SS-2	4	1.5	4-4	mottled, wet, all as fill		
0.00		5		3-3	Mottled brown, black and gray medium to fine Sand, some	35 ppm	Fill
	SS-3	6	1.5	3-4	Silt, trace Gravel, wet, more coarse Sand 5.8'-6'		
23.10		7		3-2	Black medium to fine Sand, little (-) Silt, wet, loose, odor	133 ppm	Fill
	SS-4	8	1.3	4-4			Sample: SB10D
		9		2-1	No recovery		
	SS-5	10	0.0	2-1			
0.00		11		2-1	Gray sandy Silt, trace (+) Clay, wet, soft, some wood, roots	32.2 ppm	ML
	SS-6	12	1.4	1-1			
0.00		13		1-3	Same as 10'- 12' to 13.6', then wood, then coarse to fine	50.3 ppm	ML-SP
	SS-7	14	1.5	5-9	Sand and fine Gravel, wet to 14'		Sample: SB10G
0.00		15		3-5	Red gray silty Clay, little (-) fine Sand, trace (-) fine gravel	27 ppm	CL
	SS-8	16	1.8	5-1	wet		
0.00		17		3-7	Red gray fine SAND and SILT, trace (+) fine Gravel, wet,	33.6 ppm	SM
	SS-9	18	1.8	12-12	soft, dilatent, last .2 is all gray		
0.00		19		3-11	Gray Sandy Silt, little (-) fine Gravel, wet	17 ppm	ML
	SS-10	20	1.0	30-40			
0.00		21		39-51	Gray medium to fine Sand, some medium to fine Gravel,	18 ppm	SM
	SS-11	22	1.0	52-34	trace (+) Silt, trace (-) Clay, wet Hard		
0.00		23		30-50/.2	Same as 20'-22'	10 ppm	SM
	SS-12	24	0.6		Top of Rock at 22.7'		
		25					
	SS-13	26					
		27					
	SS-14	28					

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB - 11

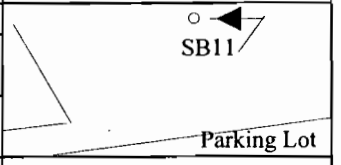
Contractor: SJB.Services Inc.
Driller: Don Butzer
Inspector: George Hermance
Rig Type: CME 75
Method: 4.25-inch HSA/SS

PROJECT NAME: BURA - Fourth Street Site
PROJECT NUMBER: 732260

Sheet 1 of 1
Location: East of sidwalk at 4th Street

Observations
Depth of Water
River Elevation
Top of Boring Elevation

Weather: Sunny, 70 degrees
Date/Time Start: 5/5/98 0850
Date/Time Finish: 5/5/98 0957



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		5-6	Brown Topsoil, Sandy Silt with debris to 1.1', then mixed	15.5 ppm	Fill
	SS-1	2	1.5	6-17	topsoil, brick, coal, cement , moist		
0.00		3		9-18	Mixed C+D debris, brick cement, with black Silty Clay, fine	13.4 ppm	Fill
	SS-2	4	1.4	8-4	Sand, moist fill		
0.00		5		5-3	Black and Dark green Silty Clay, wet, glass and broken	14.3 ppm	Fill
	SS-3	6	1.0	2-3	cement		
0.00		7		2-2	Stained black Silty Clay for .3', then mottled brown silty	13.1 ppm	Fill
	SS-4	8	1.0	1-2	Clay, trace (-) fine Sand		
0.00		9		3-3	Mottled black, brown, gray, Sandy Silt, trace Clay, wet, soft	21.2 ppm	SM
	SS-5	10	1.5	3-6	Black areas of sample are fine sand		Sample: SB11E
0.00		11		3-5	Brown fine Sand and Silt, trace(-) Clay, wet, dilatent	13.8 ppm	SM
	SS-6	12	0.7	5-8			
0.00		13		11-12	Brown gray fine Sand, some Silt, wet, dilatent	14.4 ppm	SM
	SS-7	14	1.4	12-13			
0.00		15		7-9	Brown and Tan fine Sand, some Silt, trace (-) Clay in	23.6 ppm	SM
	SS-8	16	1.2	12-10	partings, Last .2' is Red silty Clay, trace fine Gravel, wet		Sample SB11H
0.00		17		13-10	Reddish Gray fine Sand, some Silt, trace (-) Clay, trace fine	14.7 ppm	SM
	SS-9	18	1.2	10-22	Gravel, wet and dilatent in spots		
0.00		19		43-50/.2	Gray gravelly fine Sand, some Silt, trace (-) Clay, wet		SW
	SS-10	20	0.5		Top of Rock at 18.7'		
		21					
	SS-11	22					
		23					
	SS-12	24					
		25					
	SS-13	26					
		27					
	SS-14	28					

STANDARD PENETRATION
SS = SPLIT SPOON
ST = SHELBY TUBE
W = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

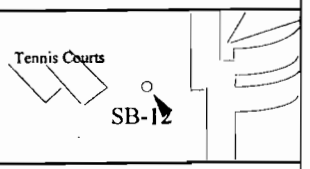
SUMMARY:

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB - 12

Contractor:	SJB Services Inc
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	East of sidwalk at 4th Street
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/5/98 0850
Date/Time Finish	5/5/98 0957



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		5-6	Brown sandy Silt, trace Clay, trace (-) fine Gravel, moist	22.1 ppm	Fill
	SS-1	2	1.0	12-4	Topsoil		
0.00		3		23-15	Brick, black brown Sandy Silt, moist, chunks of coal	28.3 ppm	Fill
	SS-2	4	1.1	50/.1			
0.00		5		11-11	Broken cement, some Silty Clay, wet no sheen	24.5 ppm	Fill
	SS-3	6	0.1	5-5			
0.00		7		2-3	Wet medium to fine Gravel as slag, small plug of Silty Clay	23.7 ppm	Fill
	SS-4	8	0.5	2-2	Wet, no sheen		
0.00		9		8-3	Dark brown Peat, some Silt, moist	11.8 ppm	Pt
	SS-5	10	1.0	2-3			
0.00		11		3-2	Peat with silt mixed throughout, Moist	14.4 ppm	Pt
	SS-6	12	1.3	2-2			
0.00		13		2-2	Same as 10'-12', more silt in bottom of spoon	28.0 ppm	Pt
	SS-7	14	1.5	2-2			
0.00		15		3-4	Peat to 14.2, then gray Sandy Silt, trace (+) Clay, roots,	168 ppm	Pt-SM
	SS-8	16	1.3	1-1	peat in nodules, wet, no sheen		
0.00		17		2-2	Gray Silty Clay with peat, roots, wood mixed in, last .2' is	184 ppm	CL
	SS-9	18	2.0	5-7	coarse to fine Sand, fine Gravel, with odor		Sample: SB12I
0.00		19		5-6	Red brown Clay, some Silt, to 18.5', then Gray silty fine	37 ppm	SM-CL
	SS-10	20	1.3	23-41	Sand, trace (+) Clay, trace (-) fine Gravel, wet, odor		Sample: SB12J
		21			Top of Rock at 19.5		
	SS-11	22					
		23					
	SS-12	24					
		25					
	SS-13	26					
		27					
	SS-14	28					

STANDARD PENETRATION

SS = SPLIT SPOON
ST = SHELBY TUBE
W = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

SUMMARY:

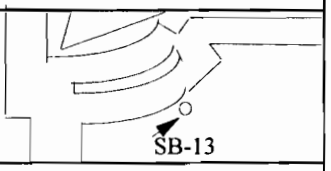
PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB -13

Sheet 1 of 1

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/6/98 0835
Date/Time Finish	5/6/98 0929



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)		
		0						
0.00		1		2-2	Topsoil for .5' then black Sandy Silt, trace (-) Clay, brick	4.3 ppm	Fill	
	SS-1	2	1.1	50/.2	slag, gravel, moist			
0.00		3		22-50/.2	No Recovery			
	SS-2	4	0.0					
30.90		5		9-5	Black fine Sand and Silt, trace wood, sheen on soil, strong	349 ppm	Fill	
	SS-3	6	1.0	8-7	odor, moist			
0.00		7		3-3	No Recovery			
	SS-4	8	0.0	4-5				
30.90		9		4-3	Mottled gray tan and black fine Sand, some silt, trace clay,	241 ppm	SM-SC	Free-Phase
	SS-5	10	1.6	2-5	trace roots, Napl in root bores	Sample	SB13E	Product
56.50		11		3-5	Gray sandy Silt, little Clay, moist to wet, to 10.5', then red	85 ppm	SM	Free-Phase
	SS-6	12	1.6	6-18	brown Clayey Silt, trace fine gravel, coated with NAPL			Product
0.00		13		15-15	Gray SILT and CLAY, soft, wet	377 ppm	CL	Free-Phase
	SS-7	14	1.1	13-29				Product
0.00		15		7-5	Gray Silty Clay, trace fine Gravel, soft, and sticky, wet	42.8 ppm	CL	Smeared
	SS-8	16	1.5	6-10		Sample	SB13HI	Product
0.00		17		13-50/.1	Same as 14'-16'	22.7 ppm		Smeared
	SS-9	18	0.6		Top of Rock at 16.6'			Product
		19						
	SS-10	20						
		21						
	SS-11	22						

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

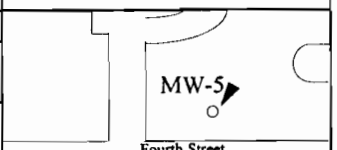
SUMMARY:

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. MW-5 (SB-14)

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/6/98 0835
Date/Time Finish	5/6/98 0929



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	COMMENTS (Well Construction)
		0					0.0'
0.00		1		8-11	Dark brown topsoil for .8', then black sandy fill with brick	0.0 ppm	
	SS-1	2	1.5	13-28	cement and stone	Fill	1.5'
0.00		3		38-24	Crushed stone, cement, brick	12.7 ppm	
	SS-2	4	1.2	50/.4		Fill	4.0'
513.00		5		4-4	Red brick for .2' then brown fine Sand and Silt for .6', then	2500 ppm	5.0'
	SS-3	6	1.8	3-4	black woody peat, bottom .2' is black Silty Clay, moist, odor	Fill, SM, Pt	
511.00		7		4-5	black woody peat for .2' then black stained Silty Clay, odor,	1120 ppm	
	SS-4	8	2.0	5-5	grades to sandy to 8' depth, partings of Sand, moist	CL-SC	
0.00		9		4-1	Gray Silty Clay to 8.3' then gray medium to fine Sand and	26.2 ppm	
	SS-5	10	1.4	1-1	Silt, wet, Dilatent.	CL-SM	
0.00		11		1-2	Gray fine Sand and Silt, wet, dilatent, peat in last .2'	30.2 ppm	
	SS-6	12	1.4	4-4	of the spoon	SM-Pt	
0.00		13		4-5	black and Gray Silty Clay, wet, changes to red gray Silty	12.1 ppm	
	SS-7	14	1.3	8-8	Clay at 13.8'	CL	
0.00		15		4-4	Red gray Silty Clay to 14.4', then red gray Sandy Silt, trace	0.0 ppm	
	SS-8	16	1.9	6-8	Clay, trace Gravel, wet	CL-SM	
0.00		17		21-24	Gray Sandy Silt, trace Gravel, trace Clay, wet, changes to	4.6 ppm	
	SS-9	18	1.6	28-17	fine Sand and Silt at 17'	SM	
		19		50/.4	No Recovery Auger Refusal at 19'		19.0'
	SS-10	20	0.0		Top of Rock at 18.4'		
					Samples collected: MW5C - 4'-6'; MW5I - 16'-18'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

2" ID Schedule 40 PVC Well Riser (5'-0.5')

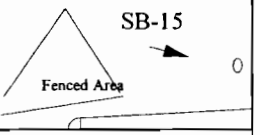
2" ID Schedule 40 PVC, 0.010" slotted Well Screen (19'-5.0')

Filter Sand (19.1'- 4.0')

Bentonite Chips (4 0'-1.5') Cement Bentonite Grout, Curb Box, and pad (1.5'-0.0')

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

Contractor:	SJB Services Inc.	BORING NO.	SB - 15
Driller:	Don Butzer		
Inspector:	George Hermance	PROJECT NAME: BURA - Fourth Street Site	Sheet 1 of 1
Rig Type:	CME 75	PROJECT NUMBER: 732260	Location: Outside Fenced Area
Method:	4.25-inch HSA/SS		
Observations		Weather: Sunny, 70 degrees	
Depth of Water			
River Elevation		Date/Time Start: 5/7/98 0928	
Top of Boring Elevation			
		Date/Time Finish: 5/7/98 1035	



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		4-3	Brown Clayey Topsoil for .8' then concrete and slag	0.0 ppm	Fill
	SS-1	2	1.1	10-12			
0.00		3		17-9	Cement for .3 then black white red broken slag, cement,	56.3 ppm	Fill
	SS-2	4	1.0	14-14	brick and wood, last .2' is wet		
0.00		5		18-7	Brown sloppy Silt and fine Sand , slag, gravel and stone,		Fill
	SS-3	6	0.3	3-5	wet no odor		
0.00		7		50/.3	No recovery		
	SS-4	8	0.0				
0.00		9		3-3	Gray brown fine Sand and Slit, trace (+) fine Gravel, trace	14.7 ppm	ML
	SS-5	10	0.8	5-9	(-) Clay, wet		
0.00		11		14-11	Same as 8' to 10', stone in shoe of the spoon	1.3 ppm	ML
	SS-6	12	0.3	11-11			
0.00		13		11-15	Gray brown fine Sand, Silt, trace (+) fine Gravel, wet, trace	15.9 ppm	SM
	SS-7	14	0.7	12-14	(-) Clay		Sample: SB15G
		15		13-18	Brown Gray Silt and fine Sand, little Clay, trace (+) fine	17.9 ppm	SM-SC
	SS-8	16	1.7	23-35	Gravel, wet		
0.00		17		31-33	Gray brown Silt and fine Sand, trace (+) Clay, trace (-)	40.2 ppm	SM-SC
	SS-9	18	1.5	35-50/.3	medium to fine Gravel, wet		Sample: SB15I
		19		50/0	No recovery Auger refusal at 18.5'		
	SS-10	20	0.0		Top of Rock at 18.5'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

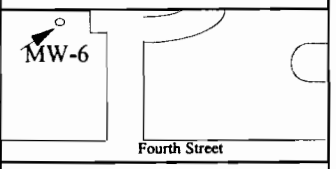
SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. MW-6 (SB-16)

Sheet 1 of 1

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Sunny, 70 degrees
Date/Time Start	5/7/98 1349
Date/Time Finish	5/8/98 1030



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	(Well Construction)
							0.0'
		0					
0.00		1		3-4	Brown Silt and Fine Sand, trace Clay for .7', then Red Brick	0.0 ppm	1.0'
	SS-1	2	1.3	8-10	Black Sand and Silt, slag, cement.	Fill	
0.00		3		7-5	Dark brown fine Sand, some Silt, some Clay, trace (-) fine	0.0 ppm	
	SS-2	4	1.6	4-8	Gravel, glass, cement	Fill	
0.00		5		3-7	Tan medium to fine SAND, chunks of cement in shoe, wet	0.0 ppm	5.0'
	SS-3	6	1.4	17-19		Fill	
0.00		7		4-4	Tan medium to fine SAND for .4', then Black and gray Silty	0.0 ppm	
	SS-4	8	1.3	4-6	Clay for .8', last.1' is peat, wet, no odor, no sheen	SC-CL-Pt	8.0'
		9		1-2	No recovery		
	SS-5	10	0.0	1-2			10'
0.00		11		w-1	Gray CLAY, little Silt, moist, soft, trace roots, brown staining	0.0 ppm	
	SS-6	12	2.0	2-1		CL	
		13		w-8	Gray Silty Clay to 13' then coarse to fine Sand black for .1'		
	SS-7	14	1.8	10-5	then brown dilatent fine Sand and Silt, wet	CL	
0.00		15		3-4	Brown fine Sand and Silt for .5' then red brown Clay and	0.0 ppm	
	SS-8	16	1.5	7-13	Sand for .5' then red brown Silt and fine Sand, wet	SM-CL-SM	
0.00		17		7-11	Brown silt with .1' varves of red Clay, wet dilatent silt	0.0 ppm	
	SS-9	18	1.5	13-15	last.2' red Silty Clay, trace fine Gravel, stains around gravel	ML	
0.00		19		8-8	Gray Silty fine Sand, trace (+) medium to fine Gravel, wet	0.0 ppm	
	SS-10	20	1.5	24-50/.4	Auger refusal at 20'	SM	20'
					Top of Rock at 20'		
					Samples collected: SB16D - 6'-8'; SB16G - 12'-14'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

2" ID Schedule 40 PVC Well Riser (10'-0.5')

2" ID Schedule 40 PVC, 0.010" slotted Well Screen (20'-10.0')

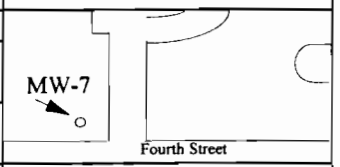
Filter Sand (20'- 8.0')

Bentonite Chips (8.0'-5.0')

Cement Bentonite Grout, Curb Box, and pad (1.0'-0.0')

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

Contractor:	SJB Services Inc.	BORING NO.	MW-7 (SB-17)
Driller:	Don Butzer		
Inspector:	George Hermance	PROJECT NAME	BURA - Fourth Street Site
Rig Type:	CME 75	PROJECT NUMBER	732260
Method:	4.25-inch HSA/SS	Sheet	1 of 1
Observations		Location:	Outside Fenced Area
Depth of Water		Weather	Sunny, 70 degrees
River Elevation		Date/Time Start	5/8/98 1156
Top of Boring Elevation		Date/Time Finish	5/8/98 1545



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	(Well Construction)
		0					
0.00		1		1-3	topsoil then Tan medium to fine Sand, salt and pepper	0.0 ppm	1.0'
	SS-1	2	2.0	4-4	Sand, slag moist, some Silt and Clay	Fill	2.0'
0.00		3		4-4	black sandy Slag to 2.5' then brown and tan fine Sand and	0.0 ppm	
	SS-2	4	1.7	5-6	Silt mixed with brick, cement, roots, moist	Fill	
0.00		5		4-4	Brown Tan medium to fine SAND, some Silt with brick to	0.0 ppm	5.0'
	SS-3	6	2.0	4-3	5.6', then black Silty fine Sand, trace(+) Clay, wood moist	Fill	
0.00		7		1-2	Mixed black tan and gray Sand, Silt and Clay, then.5' stiff	0.0 ppm	7.0'
	SS-4	8	1.3	2-3	black Clay, then mottled green Silty Clay, tr(+) fSand, moist	SC-SM	
0.00		9		w-w	Gray fine SAND and SILT, trace roots, wet dilatent	0.0 ppm	
	SS-5	10	1.7	w-2		SM	
0.00		11		1-1	Gray fine Sand and Silt, trace(-) Clay, Trace (-) roots, wet	0.0 ppm	
	SS-6	12	1.2	1-1	dilatent	SM	
0.00		13		2-2	Gray fine Sand and Silt to 13' then .4' of Peat, then .2' dark	0.0 ppm	
	SS-7	14	1.2	2-1	gray Clay, some Silt, wet	SM	
0.00		15		1-3	Grayish red Silt and fine Sand, little (-) Clay, wet, dilatent	0.0 ppm	
	SS-8	16	1.5	5-7		SM	
0.00		17		3-5	Reddish gray Silt and fine Sand, trace (-) very fine Gravel,	0.0 ppm	
	SS-9	18	2.0	7-4	wet, dilatent	SM	
0.00		19		6-10	Red gray Silt and fine Sand to 19.5' then red Silty Clay,	0.0 ppm	
	SS-10	20	1.6	5-Aug	trace fine Sand, trace very fine gravel, wet	SM	20'
0.00		21		4-50/.2	Gray silt and Clay, wet, stiff, Auger refusal at 20.7'	CL	20.7'
	SS-11	22	0.4		Top of rock at 20.7'		

Samples collected: MW07D - 6'-8'; MW07I - 16'-18'

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

2" ID Schedule 40 PVC Well Riser (7'-0.5')

2" ID Schedule 40 PVC, 0.010" slotted Well Screen (20'-7.0')

Filter Sand (20.7'- 5.0')

Bentonite Chips (5.0'-2 0') Cement Bentonite Grout, Curb Box, and pad (1.0'-0.0')

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. MW-8 (SB-18)

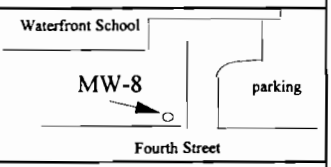
Contractor: SJB Services Inc.
Driller: Don Butzer
Inspector: George Hermance
Rig Type: CME 75
Method: 4.25-inch HSA/SS

PROJECT NAME: BURA - Fourth Street Site
PROJECT NUMBER: 732260

Sheet 1 of 1
Location: Outside Fenced Area

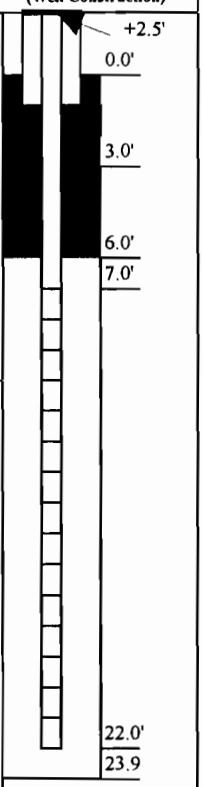
Observations
Depth of Water
River Elevation
Top of Boring Elevation

Weather: Sunny, 70 degrees
Date/Time Start: 5/11/98 0836
Date/Time Finish: 5/11/98 0955



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)
		0				
0.00		1		3-3	Brown topsoil for 1' then Black Sand and Silt, slag, concrete	0.0 ppm
	SS-1	2	1.8	4-3	red brick, moist	Fill
0.00		3		8-11	fill black slag, gray slag brick to 3', then brown Silty Clay	0.0 ppm
	SS-2	4	1.3	3-7	with fill intermixed	Fill
0.00		5		4-5	Black and gray Slag, silt, sand, wood, some medium to	0.0 ppm
	SS-3	6	1.2	3-3	fine sand, moist to wet	Fill
0.00		7		3-3	No Recovery	
	SS-4	8	0.0	3-4	Chunks of wood in spoon	
0.00		9		2-2	No Recovery	
	SS-5	10	0.0	2-2		
0.00		11		1-1	Gray Sandy Silt, little Clay, wet dilatent	0.0 ppm
	SS-6	12	2.0	1-1		SM
0.00		13		w-w	Same as 10'-12'	0.0 ppm
	SS-7	14	2.0	w-1		SM
0.00		15		4-7	Red brown Gray SILT and fine SAND, wet dilatent	0.0 ppm
	SS-8	16	1.8	8-10		SM
0.00		17		11-3	Tan , Gray SILT and fine SAND, wet dilatent	0.0 ppm
	SS-9	18	1.7	2-5		SM
0.00		19		w-1	Red brown Silt and fine Sand for 1' then red brown	0.0 ppm
	SS-10	20	2.0	3-3	Silty Clay with .1' thick laminae	SM-CL
0.00		21		5-13	Same as 18' to 20' to 20.8' thengray Silty fine Sand, little	0.0 ppm
	SS-11	22	2.0	13-10	fine Gravel, wet, hard	CL-SM
0.00		23		23-50/.4	Same as 20.8' -22 feet then to 23'	
	SS-12	24	0.5		Top of rock at 22.9'	

Samples collected: MW08F - 10'-12'; MW08I - 16'-18'



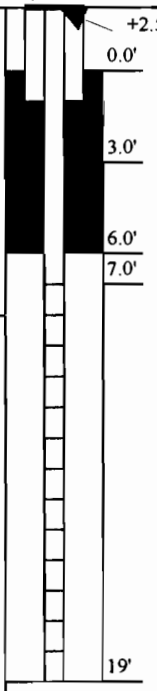
STANDARD PENETRATION
SS = SPLIT SPOON
ST = SHELBY TUBE
W = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

SUMMARY:
2" ID Schedule 40 PVC Well Riser (7'-+2.5')
2" ID Schedule 40 PVC, 0.010" slotted Well Screen (20'-7.0')
Filter Sand (20.7'- 5.0')
Bentonite Chips (5.0'-2.0') Cement Bentonite Grout, Curb Box, and pad (1.0'-0.0')

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

Contractor:	SJB Services Inc.	BORING NO.	MW-9 (SB-19)
Driller:	Don Butzer		
Inspector:	George Hermance	PROJECT NAME: BURA - Fourth Street Site	Sheet 1 of 1
Rig Type:	CME 75	PROJECT NUMBER: 732260	Location: Outside Fenced Area
Method:	4.25-inch HSA/SS		
Observations		Weather: Sunny, 70 degrees	South end of Waterfront School — MW-9
Depth of Water			
River Elevation		Date/Time Start: 5/11/98 1505	
Top of Boring Elevation			
		Date/Time Finish: 5/11/98 1459	

PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)
		0				+2.5' / 0.0'
0.00		1		1-3	Topsoil for 1' then black slag,coal brick in fine Sand and	0.0 ppm
	SS-1	2	2.0	5-6	Silt, moist	Fill
0.00		3		5-6	mixed fill, cement, black sand and silt, trace clay, coal,	0.0 ppm
	SS-2	4	1.4	3-4	moist	Fill
0.00		5		2-1	Black sandy fill to 5.5', then brown Sandy silt, trace Clay	0.0 ppm
	SS-3	6	1.5	1-1	moist to wet	Fill
0.00		7		w-1	Black Silt and Fine Sand, trace Clay, wood, gravel,	0.0 ppm
	SS-4	8	1.7	4-5	slag, coal, then tan fine Sand and Silt, wet dilatent	Fill
0.00		9		3-4	Red and gray Silt and fine Sand, wet, dilatent, trace Clay	0.0 ppm
	SS-5	10	1.7	7-5	in laminae, trace ine Gravel	SM
0.00		11		4-5	Same as 8' to 10'	0.0 ppm
	SS-6	12	1.5	6-9		SM
0.00		13		4-1	Same as 10'-12' to 12.6 then Red brown Silty Clay, trace	0.0 ppm
	SS-7	14	1.6	1-2	very fine Gravel, wet, soft	SM-CL
0.00		15		1-3	Red brown Silt and fine Sand, trace Clay, wet dilatent silt	0.0 ppm
	SS-8	16	1.5	5-7		SM
0.00		17		4-5	Grayish red Silt and fine Sand, wet, dilatent	0.0 ppm
	SS-9	18	2.0	5-5		SM
0.00		19		2-1	Gray red Silt and fine Sand, trace very fine Gravel, trace	0.0 ppm
	SS-10	20	0.8	50/.2	(-) Clay, wet Auger refusal at 19'	SM
					Top of rock at 19'	
					Samples collected: MW09D - 6'-8'; MW09H - 14'-16'	



STANDARD PENETRATION

SS = SPLIT SPOON
ST = SHELBY TUBE
W = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

SUMMARY:

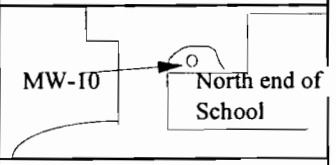
2" ID Schedule 40 PVC Well Riser (7'-+2.5')
2" ID Schedule 40 PVC, 0.010" slotted Well Screen (19'-7.0')
Filter Sand (20.7'- 5.0')
Bentonite Chips (5.0'-2.0') Cement Bentonite Grout, Curb Box, and pad (1.0'-0.0')

PARSONS ENGINEERING SCIENCE

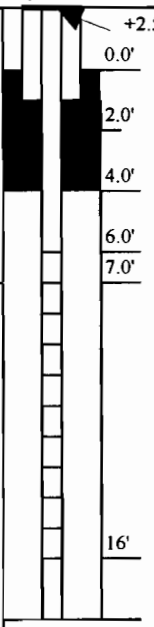
DRILLING RECORD

BORING NO. MW-10 (SB-20)

Contractor:	SJB Services Inc.
Driller:	
Inspector:	Dan Lipp
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Partly Cloudy, cold
Date/Time Start	11/13/98 0954
Date/Time Finish	11/13/98 1240



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)
		0				
0.00		1		3-5	Topsoil for 1', brown, dry	1.5 ppm
	SS-1	2	1.0	4-7		Fill
0.00		3		7-8	Brown, black topsoil, trace brick, trace fine gravel, trace	3.9 ppm
	SS-2	4	1.2	9-6	wood, dry	Fill
0.00		5		4-9	Dark brown fine sand and fine gravel, some concrete,	5.6 ppm
	SS-3	6	0.8	5-4	Moist	Fill
0.00		7		1-2	8" black Peat, then dark brown fine sand and fine gravel,	6.2 ppm
	SS-4	8	0.6	2-4	Trace clay, trace silt, wet at 7'	SM-CL
0.00		9		1-2	Gray Clay, some Silt, moist	6.1 ppm
	SS-5	10	1.5	2-3		SM
0.00		11		2-3	same as above from 10' to 11', 11' to 12' brown Clay, some	2.8 ppm
	SS-6	12	1.6	7-7	fine Sand and fine gravel, moist	SM
0.00		13		13-16	Brown Clay and Silt, trace fine gravel and sand.	3.5 ppm
	SS-7	14	2.0	14-16		SM-CL
0.00		15		8-10	Brown Clay, trace fine sand , some coarse gravel.	4.7 ppm
	SS-8	16	1.6	50-21		SM
0.00		17		9-9	Same as 14'-16'	18.5 ppm
	SS-9	18	15.0	50/3"		SM
0.00		19		50/0		
	SS-10	20	0.0		Auger refusal at 18'	
					Top of rock at 18'	
					Samples collected: MW101 -16'-18'; MW10D - 6'-8'	



STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

2" ID Schedule 40 PVC Well Riser (7'-+2.5')

2" ID Schedule 40 PVC, 0.010" slotted Well Screen (19'-7.0')

Filter Sand (20.7'- 5.0')

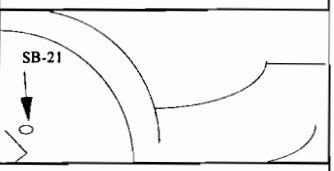
Bentonite Chips (5.0'-2.0') Cement Bentonite Grout, Curb Box, and pad (1.0'-0.0')

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. SB - 21

Contractor:	SJB Services Inc.
Driller:	Don Butzer
Inspector:	Dan Lipp
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Partly cloudy, cold
Date/Time Start	11/13/98 1350
Date/Time Finish	11/13/98 1530



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		12-12	Brown topsoil, trace brick, some caorse gravel	5.2 ppm	Fill
	SS-1	2	1.0				
0.00		3		6-7	Two inches red brick, then black medium to fine sand , trace	1.2 ppm	Fill
	SS-2	4	1.3	4-4	medium to fine gravel		
0.00		5		4-4	Black fine Sand , trace fine gravel, dry		Fill
	SS-3	6	0.8	6-6			
0.00		7		1-2	Black peat, trace fine gravel, moist	2.8 ppm	Pt
	SS-4	8	1.5	2-4			
0.00		9		4-3	Gray Silt and fine Sand, trace Clay	2.5 ppm	SM-ML
	SS-5	10	2.0	2-2			
0.00		11		wh-wh	Same as 8' to 10'	0.0 ppm	ML
	SS-6	12	1.0	wh-wh			
0.00		13		1-1	Same as 10' to 12'	6.5 ppm	ML
	SS-7	14	2.0	2-2			
		15		7-8	Gray Silt and Sand, trace clay, moist	8.5 ppm	ML
	SS-8	16	1.5	13-11			
0.00		17		7-9	Brown Silt and fine Sand , some very fine gravel	7.5 ppm	ML
	SS-9	18	2.0	13-10	Wet at 18'		
		19		13-6	Same as above to 19.5' , Refusal at 19.5'	10.5 ppm	
	SS-10	20	1.3	5-50/0	Top of Rock at 19.5'		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

Wh = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. SB - 22

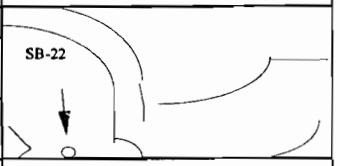
Contractor: SJB.Services Inc.
Driller:
Inspector: Dan Lipp
Rig Type: CME 75
Method: 4 25-inch HSA/SS

PROJECT NAME BURA - Fourth Street Site
PROJECT NUMBER 732260

Sheet 1 of 1
Location: Outside Fenced Area

Observations
Depth of Water
River Elevation
Top of Boring Elevation

Weather Partly cloudy, cold, Light Rain
Date/Time Start 11/16/98 0750
Date/Time Finish 11/16/98 0900



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		3-13	topsoil for the first foot	0.0 ppm	Fill
	SS-1	2		13-13	Brown fine sand, trace red brick, dry		
0.00		3		18-15	blabck fine sand , some fine gravel, dry	2.0 ppm	Fill
	SS-2	4	0.5	27-10			
0.00		5		4-6	Black fine sand, some gray silt. dry	4.2 ppm	Fill
	SS-3	6	1.3	6-6			
0.00		7		6-5	Black fine Sand , wet, has a sheen	15.0 ppm	Fill-Pt
	SS-4	8	1.0	5-5			
0.00		9		2-3	same as above some peat	9.5 ppm	Fill-Pt
	SS-5	10	1.5	4-4			
0.00		11		2-2	Dark brown peat, some black fine sand	7.5 ppm	Pt
	SS-6	12		2-2			
0.00		13		3-3	Gray Silt, trace peat, trace Clay	9.5 ppm	ML
	SS-7	14	2.0	3-3			
		15		wh-wh	Gray Clay, some Silt, moist	4.5 ppm	ML-CL
	SS-8	16	1.7	3-1			
0.00		17		wh-wh	Brown Silt and Clay, s0ome gray Silt, moist	6.2 ppm	ML-CL
	SS-9	18	2.0	2-5			
		19		7-12	Brown Silt and Clay, trace fine Sand	5.5 ppm	ML-CL
0.00	SS-10	20	1.5	10-10			
		21		20-36	Gray Silt and coarse gravel, Refusal at 21'	8.5 ppm	GM
0.00	SS-11	22	0.4	50/0	Top of Rock @ 21'		

STANDARD PENETRATION
SS = SPLIT SPOON
ST = SHELBY TUBE
Wh = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. SB - 23

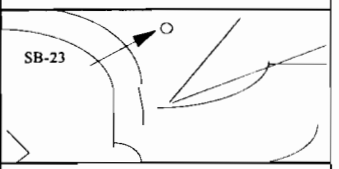
Contractor: SJB Services Inc.
Driller:
Inspector: Dan Lipp
Rig Type: CME 75
Method: 4.25-inch HSA/SS

PROJECT NAME: BURA - Fourth Street Site
PROJECT NUMBER: 732260

Sheet 1 of 1
Location: Outside Fenced Area

Observations
Depth of Water
River Elevation
Top of Boring Elevation

Weather: Partly cloudy, cold, Light Rain
Date/Time Start: 11/16/98 0915
Date/Time Finish: 11/16/98 1100



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
0.00		1		3-9	Topsoil and brick	2.0 ppm	Fill
	SS-1	2	1.0	12-12			
0.00		3		12-32	Balck sand, rock in shoe of spoon, dry	0.0 ppm	Fill
	SS-2	4	0.0	50/2			
0.00		5		5-5	gray fine sand some medium to fine gravel, trace fine brown	3.5 ppm	SM
	SS-3	6		9-10	sand, moist		
0.00		7		7-7	Brown fine Sand, dry	3.0 ppm	SM
	SS-4	8	1.0	9-10			
0.00		9		8-3	Gray and brown fine Sand and Silt, some medium to fine	4.5 ppm	SM
	SS-5	10	2.0	4-8	gravel.		
0.00		11		4-50/1	Same as above, refusal at 11'	5.5 ppm	SM
	SS-6	12	0.4				
					Top of Rock @ 10.6'		

STANDARD PENETRATION
SS = SPLIT SPOON
ST = SHELBY TUBE
Wh = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

SUMMARY:

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. UB-1

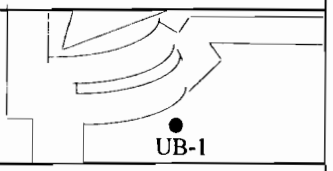
Contractor: SJB Services Inc.
Driller: Tony Jackebczak/ Ryan Easter
Inspector: George Hermance
Rig Type: CME 75
Method: 2.25-inch HSA/SS

PROJECT NAME BURA - Fourth Street Site
PROJECT NUMBER 732260

Sheet 1 of 1
Location: Outside Fenced Area

Observations
Depth of Water
River Elevation
Top of Boring Elevation

Weather Partly Cloudy, 65 degrees
Date/Time Start 8/25/99 0954
Date/Time Finish 8/25/99 1017



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
2.80		1			No Sample collected from 0 - 2 feet.		
		2	NA				
2.70		3		23-16	browm gray, brick, concrete, some Sand, trace (+) Silt, moist	9 ppm	Fill
	SS-1	4	0.9	12-12			
3.10		5		2-2	black gray silty Clay, trace Silt and fine Sand, moist	5.9 ppm	SM-CL
	SS-2	6	0.5	2-2			
2.80		7		2-2	dark brown peat with twigs, roots, some silt as lamina and	5.3 ppm	Pt
	SS-3	8	1.9	2-2	as a matrix.		
2.80		9		1-1	Peat to 8.4' then gray Silt and fine Sand, trace (+) Clay, wood,	8.7 ppm	ML-Pt
	SS-4	10	1.6	2-1	roots, moist		
2.80		11		1-1	Peat to 10.6', then gray fine Sand and Silt, trace (+) Clay,	9.1 ppm	Pt-ML
	SS-5	12	1.8	2-1	moist to wet		
2.80		13		w-w	gray fine Sand and Silt, trace (+) Clay, moist to almost wet,	15.2 ppm	SM-Pt
	SS-6	14	1.6	w-2	some pockets of Peat in the sample, trace (-) wood chunks		

STANDARD PENETRATION
SS = SPLIT SPOON
ST = SHELBY TUBE
W = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

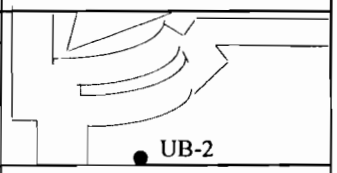
SUMMARY: Sample collected for analytical work is B-1 from 12-14 ft.
Invert of adjacent pipe is 12 ft.

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. UB - 2

Contractor:	SJB Services Inc.
Driller:	Tony Jackebczak/ Ryan Easter
Inspector:	George Hermance
Rig Type:	CME 75
Method:	2.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Partly Cloudy, 65 degrees
Date/Time Start	8/25/99 1040
Date/Time Finish	8/25/99 1101



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
		1			No Sample collected from 0 - 2 feet.		
		2	NA				
5.10		3		23-16	brown Silt and Sand to 3' then gray red silty Clay, trace very fine	7.8 ppm	SM-ML
	SS-1	4	1.6	12-12	Gravel, stiff moist.		
		5		1-2	red gray silty Clay to 4.8', black brown Peat to 5.6', dark gray	12.2 ppm	ML-CL-Pt
	SS-2	6	1.7	2-2	silty Clay with Peat to 6'		
0.80		7		w-1	gray fine Sand and Silt, trace (+) Clay, trace roots, moist to wet	6.7 ppm	ML-SM
	SS-3	8	1.7	1-1			
1.00		9		w-w	gray fine Sand and Silt, trace(-) Clay, moist to wet	8.7 ppm	SM-ML
	SS-4	10	1.7	1-2			
NR		11		w-1	gray fine Sand and Silt, trace(-) Clay, moist to wet		SM-ML
	SS-5	12	2.0	2-3			

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

Sample collected for analytical work is B-2 from 10-12 ft.

Invert of adjacent pipe is 12 ft.

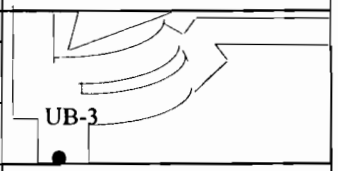
No NAPL observed.

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. UB - 3

Contractor:	SJB Services Inc.
Driller:	Tony Jackebczak/ Ryan Easter
Inspector:	George Hermance
Rig Type:	CME 75
Method.	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Partly Cloudy, 65 degrees
Date/Time Start	8/25/99 1323
Date/Time Finish	8/25/99 1340



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
		1			No Sample collected from 0 - 2 feet.		
		2	NA				
5.00		3		9-7	tan Sand and concrete, Gravel, trace red Clay, moist		SM
	SS-1	4	0.8	5-9			
4.60		5		5-7	gray fine Sand and Silt, wet, soft, black Peat last .2"		SM-ML-Pt
	SS-2	6	1.0	9-2			
0.00		7		3-2	Rock in Shoe of the Split Spoon		
	SS-3	8	0.0	2-2			
5.80		9		1-1	gray fine Sand and Silt,little (-) Clay, trace(-) roots, moist to wet		SM-ML
	SS-4	10	1.7	1-1	worm borrows		
1.00		11		w-1	gray fine Sand and Silt, trace(-) Clay, moist to wet, trace roots		SM-ML
	SS-5	12	1.6	2-1			

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

Sample collected for analytical work is UB-3 from 10-12 ft.

Invert of adjacent pipe is 12 ft.

No NAPL observed.

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. UB - 4

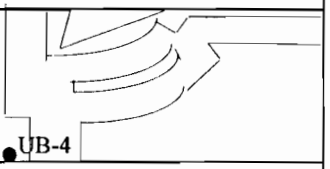
Contractor:	SJB.Services Inc.
Driller:	Tony Jackebczak/ Ryan Easter
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS

PROJECT NAME: BURA - Fourth Street Site
PROJECT NUMBER: 732260

Sheet 1 of 1
Location: Outside Fenced Area

Observations
Depth of Water
River Elevation
Top of Boring Elevation

Weather: Partly Cloudy, 65 degrees
Date/Time Start: 8/25/99 1350
Date/Time Finish: 8/25/99 1420



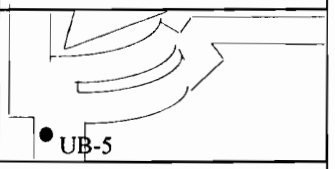
PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)
		0				
		1			No Samples collected from 0 - 2 feet. Auger to 1.3 ft. and	
		2	NA		encountered concrete cover for the weir in the swan trunk line.	
					Attempted two borings and check all nearby manholes to confirm	
					presence of the weir vault cover.	

STANDARD PENETRATION
SS = SPLIT SPOON
ST = SHELBY TUBE
W = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

SUMMARY: Auger refusal encountered on weir vault cover.
Invert of adjacent pipe is 12 ft.

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

Contractor:	SJB Services Inc.	BORING NO.	UB -5
Driller:	Tony Jackebczak/ Ryan Easter		
Inspector:	George Hermance	PROJECT NAME	BURA - Fourth Street Site
Rig Type:	CME 75	PROJECT NUMBER	732260
Method:	4.25-inch HSA/SS	Sheet	1 of 1
Observations		Location:	Outside Fenced Area
Depth of Water		Weather	Partly Cloudy, 65 degrees
River Elevation		Date/Time Start	8/25/99 1120
Top of Boring Elevation		Date/Time Finish	8/25/99 1142



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
		1			No Sample collected from 0 - 2 feet.		
		2	NA				
9.80		3		10-6	brown Sand to 2.8' then black fine Sand and Silt , trace Clay		SM-ML
	SS-1	4	1.1	5-5	NAPL (sheen) in shoe of spoon		
		5		3-2	black fine Sand and Silt, trace Clay, product sheen on last 1' of		SM-ML
	SS-2	6	1.4	2-2	sample, visible on shoe of spoon.		
8.40		7		2-2	brown Peat, moist, some fine Sand, trace (+) Silt, trace Gravel		Pt-SM
	SS-3	8	1.0	1-1			
13.00		9		1-1	brown Peat for .4', then gray fine Sand and Silt, trace (+) Clay		Pt-SM-ML
	SS-4	10	1.8	1-1	moist, soft, trace roots, no product visible.		
6.80		11		w-w	gray fine Sand and Silt, some Clay, trace (+) roots and wood,		SM-ML
	SS-5	12	1.4	w-2	moist to wet		

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

Sample collected for analytical work is B-5 from 10-12 ft.

Invert of adjacent pipe is 12 ft.

NAPL observed 4' to 6'.

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. UB - 6

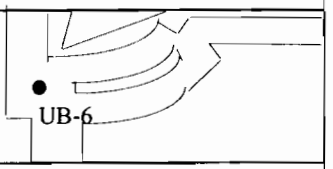
Contractor: SJB Services Inc.
Driller: Tony Jackebczak/ Ryan Easter
Inspector: George Hermance
Rig Type: CME 75
Method: 4.25-inch HSA/SS

PROJECT NAME: BURA - Fourth Street Site
PROJECT NUMBER: 732260

Sheet 1 of 1
Location: Outside Fenced Area

Observations
Depth of Water
River Elevation
Top of Boring Elevation

Weather: Partly Cloudy, 65 degrees
Date/Time Start: 8/25/99 1246
Date/Time Finish: 8/25/99 1300



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
		1			No Sample collected from 0 - 2 feet.		
		2	NA				
6.40		3		9-10	tan medium to fine Sand, wet, first 6" is black fill.	8 ppm	SW
	SS-1	4	1.3	4-13			
6.10		5		4-3	balck and gray fine Sand and Silt, moist to wet, Peat for last .2"	6.4 ppm	SM-Pt
	SS-2	6	1.3	2-2			
6.20		7		2-1	Peat	7.1 ppm	Pt
	SS-3	8	0.9	1-2			
4.50		9		1-1	Peat for 0.8', then gray fine Sand and Silt, wet	8 ppm	Pt-SM
	SS-4	10	1.0	1-1			
5.10		11		w-w	gray fine Sand and Silt, some Clay, moist, soft	7 ppm	SM-ML
	SS-5	12	1.3	w-7			

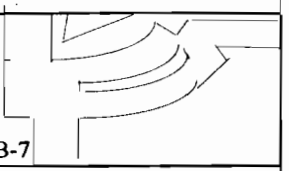
STANDARD PENETRATION
SS = SPLIT SPOON
ST = SHELBY TUBE
W = WOH = WEIGHT OF HAMMER
R = WOR = WEIGHT OF RODS

SUMMARY:
Sample collected for analytical work is UB-6 from 10-12 ft.
Invert of adjacent pipe is 12 ft.
No NAPL observed

PARSONS ENGINEERING SCIENCE
DRILLING RECORD

BORING NO. UB - 7

Contractor:	SJB Services Inc.
Driller:	Tony Jackebczak/ Ryan Easter
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Partly Cloudy, 65 degrees
Date/Time Start	8/25/99 1430
Date/Time Finish	8/25/99 1451



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
		1			No Sample collected from 0 - 2 feet.		
		2	NA				
		3		7-8	brown Silt and fine Sand, trace (+) fine Gravel, dry		SM
	SS-1	4	0.9	9-10			
0.50		5		7-4	brown Silt and fine Sand, trace (-) fine Gravel, dry to 4.5'		SM-CL
	SS-2	6	1.1	2-2	red brown silty Clay, wet, soft, brick color orange silt		
0.00		7		5-3	Rock in shoe of the spoon		
	SS-3	8	0.0	2-1			
0.50		9		w-1	gray fine Sand and Silt, trace Clay, trace (-) roots, moist to wet		SM-ML
	SS-4	10	1.2	1-1			
4.50		11		w-w	gray silty Clay, trace fine Sand, wet, soft		CL
	SS-5	12	2.0	1-1			

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

Sample collected for analytical work is UB-7 from 10-12 ft.

Invert of adjacent pipe is 12 ft.

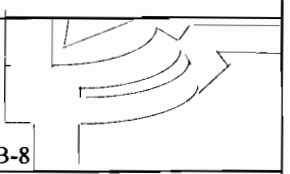
No NAPL observed.

PARSONS ENGINEERING SCIENCE

DRILLING RECORD

BORING NO. UB - 8

Contractor:	SJB Services Inc.
Driller:	Tony Jackebczak/ Ryan Easter
Inspector:	George Hermance
Rig Type:	CME 75
Method:	4.25-inch HSA/SS
PROJECT NAME	BURA - Fourth Street Site
PROJECT NUMBER	732260
Sheet	1 of 1
Location:	Outside Fenced Area
Observations	
Depth of Water	
River Elevation	
Top of Boring Elevation	
Weather	Partly Cloudy, 65 degrees
Date/Time Start	8/25/99 1534
Date/Time Finish	8/25/99 1549



PID Reading	Sample Code	Sample Depth	Rec. (ft)	SPT	FIELD IDENTIFICATION OF MATERIAL	COMMENTS (Headspace)	
		0					
		1			No Sample collected from 0 - 2 feet.		
		2	NA				
0.00		3		9-8	brick, sandy concrete, some Silt, loose moist		Fill
	SS-1	4	1.6	5-4			
0.00		5		3-1	brown, gray, tan, concrete, Sand, brick as fill		Fill
	SS-2	6	1.3	1-3			
0.00		7		4-8	same as above to 6.8', black gray silty fine Sand, trace (+)Clay,		Fill-SC
	SS-3	8	1.6	4-4	soft, wet		
0.00		9		2-2	gray fine Sand and Silt, trace Clay, trace roots, moist to wet		SM-ML
	SS-4	10	2.0	2-2			
0.00		11		1-1	gray fine Sand and Silt, trace Clay, trace roots, moist to wet		SM-ML
	SS-5	12	2.0	1-2			

STANDARD PENETRATION

SS = SPLIT SPOON

ST = SHELBY TUBE

W = WOH = WEIGHT OF HAMMER

R = WOR = WEIGHT OF RODS

SUMMARY:

Sample collected for analytical work is UB-8 from 10-12 ft.

Invert of adjacent pipe is 12 ft.

No NAPL observed.

APPENDIX C

APPENDIX C
GEOTECHNICAL REPORTS

SJB SERVICES, INC.
Contract Drilling and Testing

1951-1 Hamburg Turnpike
Buffalo, NY 14218
Phone: (716) 821-5911
Fax: (716) 821-0163

55 Oliver Street
Cohoes, New York 12047
Phone: (518) 238-1145
Fax: (518) 238-1249

P.O. Box 416 • 208 Le Fevre Road
Stockertown, PA 18083
Phone: (610) 746-2670
Fax: (610) 746-2669

TOLL FREE: 1-800-821-5911

Laboratory Test Report

PROJECT : MATERIAL TESTING : PARSON E.S.

CLIENT : PARSON E.S.

DATE : MAY 29, 1998

PROJECT NO.: SJB-T977
REPORT NO.: LTR-1

SAMPLE INFORMATION :
Sample No. 98-267 was collected by the Client and received at SJB Services, Inc. on May 12, 1998. Sample was identified as Parson E.S. sample number MW-6.

ASTM D-422 : Particle Size Analysis of Soils

Sieve Size	Percent Passing
1"	100.0
3/4"	99.0
1/2"	97.6
3/8"	96.7
1/4"	95.6
#4	94.6
#10	92.8
#20	91.5
#40	90.4
#100	81.3
#200	56.8

PERCENT COMPONENTS			
GRAVEL	SAND	SILT	CLAY
5.4%	37.8%	45.3%	11.5%

ASTM D-2216 : Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D-4318 : Liquid Limit, Plastic Limit, and Plasticity Index of Soils

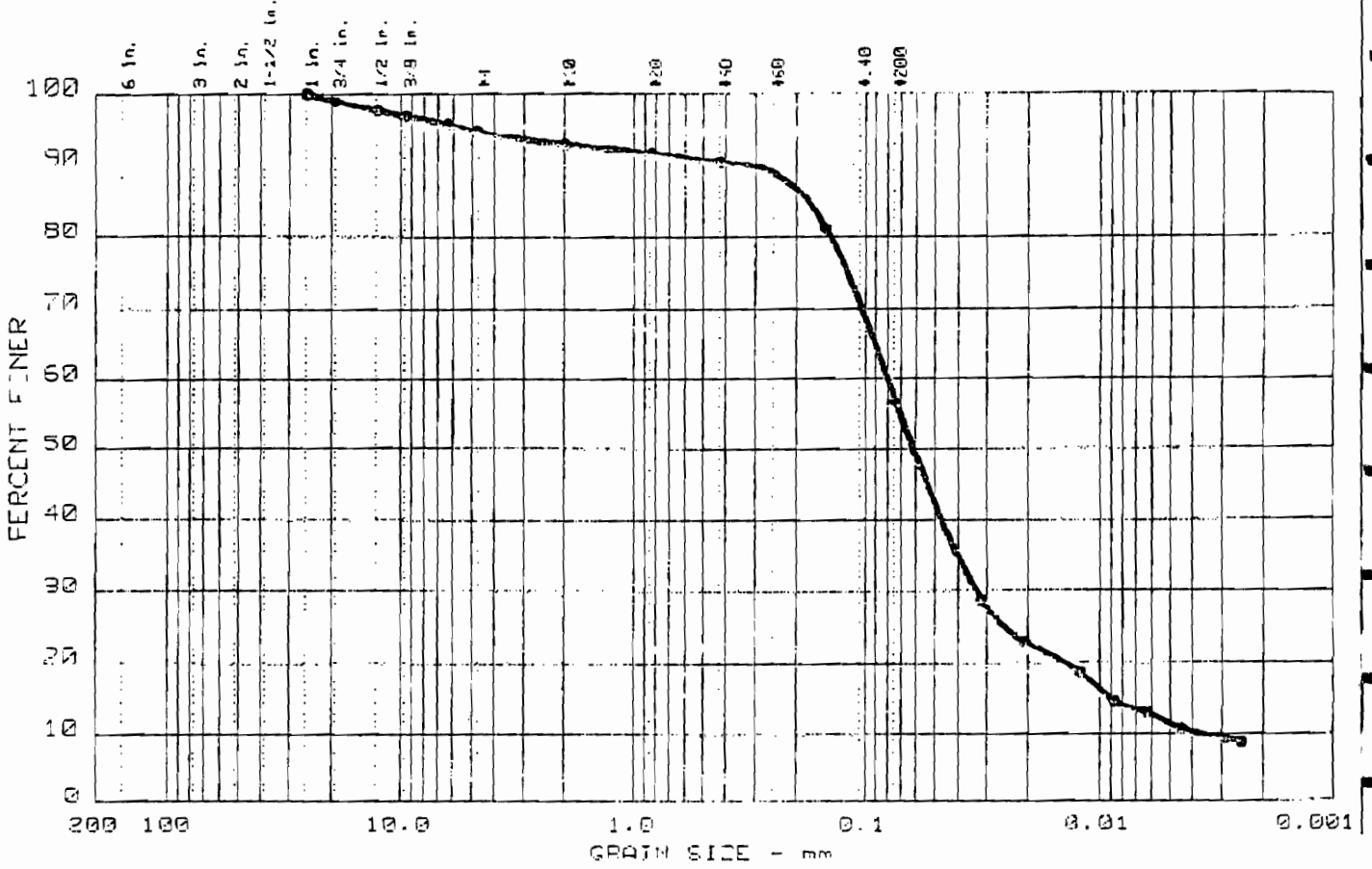
Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
25.7 %	19	19	NON PLASTIC

SJB Services, Inc.

Paul Gregorczyk
Laboratory Manager

Ray J. Kron
Testing Services Manager

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	5.4	37.8	45.3	11.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●	19	0	0.18	0.08	0.06	0.033	0.0089	0.0035	3.98	22.9

MATERIAL DESCRIPTION	USCS	AASHTO
● SILT & SAND, LITTLE CLAY, TRACE GRAVEL	ML	A-4(0.0)

Project No.: SJB-T977 : LTR-1
Project: MATERIAL TESTING : PARSON E.S.
● Location: MW-6

Date: MAY 29, 1998

GRAIN SIZE DISTRIBUTION TEST REPORT

SJB Services, Inc.

Remarks:
Collected by the Client and received at SJB on May 12, 1998.
SJB Sample ID# is 98-267

Figure No. _____

SJB SERVICES, INC.

Contract Drilling and Testing

1951-1 Hamburg Turnpike, Buffalo, NY 14218 — Phone: (716) 821-5911, Fax: (716) 821-0163
55 Oliver Street, Cohoes, New York 12047 — Phone: (518) 238-1145, Fax: (518) 238-1249
P.O. Box 416 • 208 Le Fevre Road, Stockertown, PA 18083 — Phone: (610) 746-2670, Fax: (610) 746 2669

TOLL FREE: 1-800-821-5911

Laboratory Test Report

PROJECT : MATERIAL TESTING : PARSON E.S.

CLIENT : PARSON E.S.

DATE : MAY 29, 1998

PROJECT NO.: SJB-T977
REPORT NO.: LTR-2

SAMPLE INFORMATION :
Sample No. 98-268 was collected by the Client and received at SJB Services, Inc. on May 12, 1998. Sample was identified as Parson E.S. sample number SB-7 : 8' - 10'.

ASTM D-422 : Particle Size Analysis of Soils

Sieve Size	Percent Passing
3/4"	100.0
1/2"	97.3
3/8"	94.0
1/4"	88.1
#4	85.0
#10	75.8
#20	69.1
#40	58.2
#100	26.4
#200	16.7

PERCENT COMPONENTS			
GRAVEL	SAND	SILT	CLAY
15.0%	68.3%	13.2%	3.5%

ASTM D-2216 : Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D-4318 : Liquid Limit, Plastic Limit, and Plasticity Index of Soils

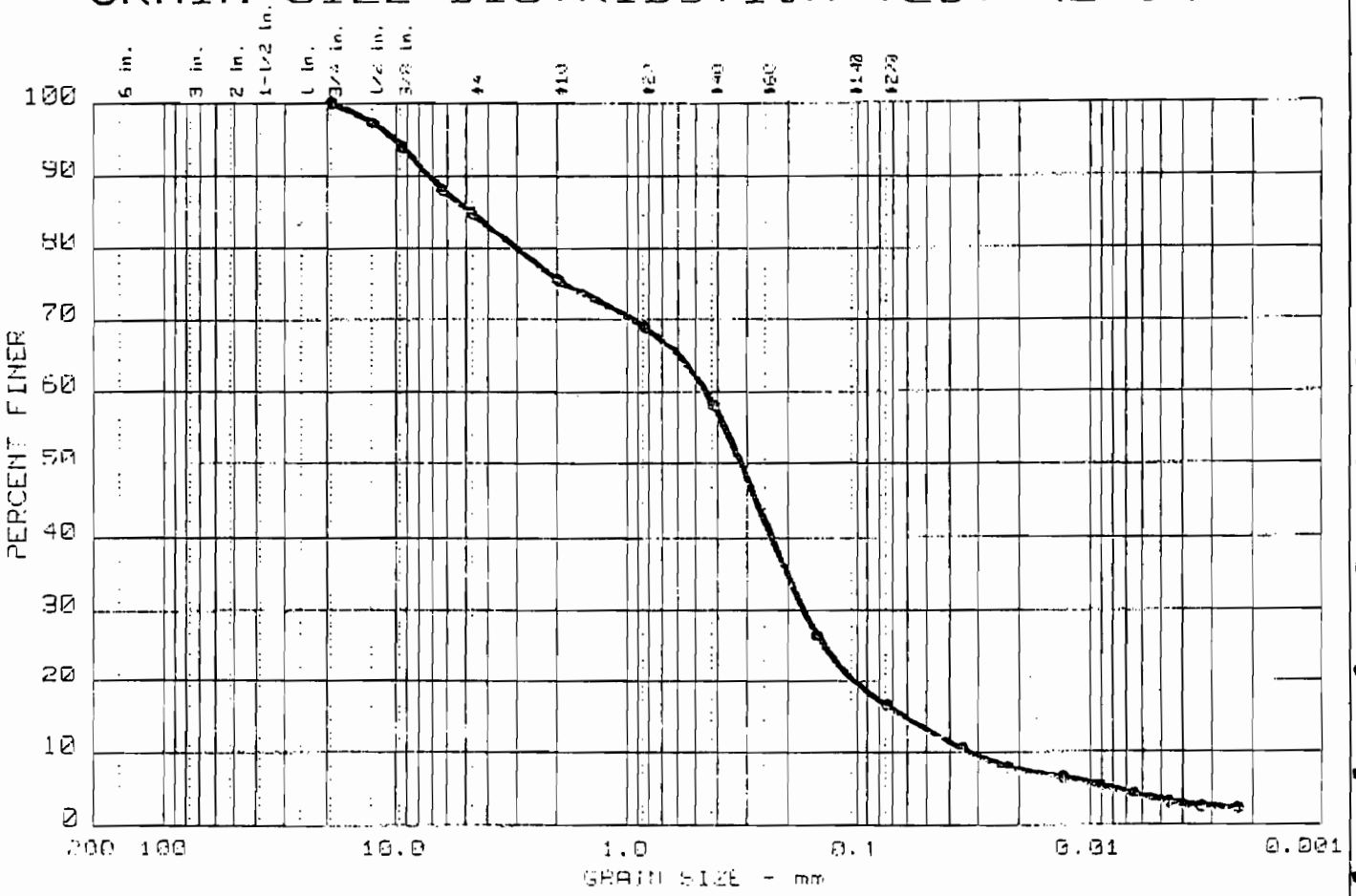
Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
23.9 %	unable to perform liquid limit,	NON PLASTIC	

SJB Services, Inc.

Paul Gregorczyk
Laboratory Manager

Ray J. Kron
Testing Services Manager

GRAIN SIZE DISTRIBUTION TEST REPORT



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
● S	0.0	15.0	60.3	13.2	9.5

	LL	PI	D_{95}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			4.73	0.45	0.32	0.171	0.0607	0.0322	2.01	14.0

MATERIAL DESCRIPTION	USCS	AASHTO
● SAND, LITTLE GRAVEL & SILT, TRACE CLAY	SM	A-2-4(0.0)

Project No.: SJB-T977 : LTR-2
Project: MATERIAL TESTING : PARSON E.S.
● Location: SB-7 : 8'-10'

Date: MAY 29, 1998

GRAIN SIZE DISTRIBUTION TEST REPORT

SJB Services, Inc.

Remarks:
Collected by the Client and received at SJB on May 12, 1998.
SJB Sample ID# is 98-268

Figure No. _____

APPENDIX D

APPENDIX D
WELL DEVELOPMENT RECORDS
AND
GROUNDWATER SAMPLE RECORDS

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-3*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*15.8* feet
Initial Static Water Level (TOC)	*4.79* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *15.81* - *4.79* x *0.16*

= *1.8* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 6.3 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	1 gallon	*6.9*	*58.2*	*1283*	*>200*	*Sheen*
	3 gallon	*6.97*	*57.7*	*1253*	*>200*	*Sheen*
	4.5 gallon	*6.94*	*57.3*	*1242*	*>200*	*Sheen*
	5.5 gallon	*7.01*	*57.9*	*1215*	*>200*	*Sheen*

odor

Comments: *Bailed and surged for over 6 gallons*

PARSONS ENGINEERING SCIENCE, INC.

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-4*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*15.8* feet
Initial Static Water Level (TOC)	*5.61* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *15.81* - *5.61* x *0.16*

= *1.6* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 6 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	0 gallon	*6.9*	*58.2*	*1283*	*>200*	*Sheen*
	2 gallon	*6.97*	*57.7*	*1253*	*>200*	*Sheen*
	4 gallon	*6.94*	*57.3*	*1242*	*>200*	*no Sheen*

Comments: *Well Bailed and surged to dry*

PARSONS ENGINEERING SCIENCE, INC.

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-5*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*17.7* feet
Initial Static Water Level (TOC)	*7.67* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *17.68* - *7.67* x *0.16*

= *1.6* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 5 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	0 gallon	*7.5*	*64.6*	*1232*	*>200*	*Odor*
	3 gallon	*7.92*	*66.9*	*965*	*>200*	*Odor*
	4 gallon	*7.6*	*63.5*	*1192*	*>200*	*Odor*

Comments: *Well Bailed and surged to dry*

PARSONS ENGINEERING SCIENCE, INC.

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-6*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*17.0* feet
Initial Static Water Level (TOC)	*3.51* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *17* - *3.51* x *0.16*

= *2.2* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 4.5 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	0 gallon	*7.6*	*65.1*	*673*	*>200*	
	3 gallon	*7.75*	*62.4*	*467*	*>200*	

Comments: *Well Bailed and surged to dry*

PARSONS ENGINEERING SCIENCE, INC.

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-7*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*19.4* feet
Initial Static Water Level (TOC)	*6.82* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *19.35* - *6.82* x *0.16*

= *2.0* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 7 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	0 gallon	*7.26*	*65.1*	*1013*	*>200*	
	3 gallon	*7.35*	*62.4*	*861*	*>200*	
	4 gallon	*7.35*	*62.4*	*925*	*>200*	
	5.5 gallon	*7.23*	*58.8*	*904*	*>200*	

Comments: *Well Bailed and surged to dry*

PARSONS ENGINEERING SCIENCE, INC.

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-8*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*23.1* feet
Initial Static Water Level (TOC)	*6.38* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *23.11* - *6.38* x *0.16*

= *2.7* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 9 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	1 gallon	*6.94*	*60.1*	*1326*	*>200*	
	3 gallon	*7.01*	*59.7*	*1288*	*>200*	
	6 gallon	*6.97*	*60.4*	*1392*	*>200*	
	8 gallon	*6.94*	*61.6*	*1420*	*>200*	

Comments: *Well Bailed and surged*

PARSONS ENGINEERING SCIENCE, INC.

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-9*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*21.0* feet
Initial Static Water Level (TOC)	*7.65* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *20.95* - *7.65* x *0.16*

= *2.1* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 8 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	0 gallon	*6.77*	*63.0*	*1360*	*>200*	
	2 gallon	*7.11*	*59.3*	*1145*	*>200*	
	4 gallon	*6.95*	*58.5*	*1334*	*>200*	
	6 gallon	*6.9*	*59.7*	*1424*	*>200*	
	8 gallon	*6.94*	*58.6*	*1325*	*>200*	

Comments: *Well Bailed and surged*

PARSONS ENGINEERING SCIENCE, INC.

WELL DEVELOPMENT LOG

Site Name *Bura 4th Street* Well *MW-10*

Date *5/14/98*

Samplers *GWH* Start Time

DJL

Total Well Depth (TOC)	*19.0* feet
Initial Static Water Level (TOC)	*9.4* feet
Well Diameter	*2.0* inches

Development Data

Method *Bailer Surge*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *19* - *9.4* x *0.16*

= *1.5* gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Total Volume of Water Removed 4.5 gallons

Total Time (minutes)	Volume Removed	pH	Temp. (F)	Conduct. (uS/cm)	Turbidity (NTU)	Comments
	0 gallon	*7.6*	*50.6*	*634*	*>200*	
	1 gallon	*7.28*	*56.3*	*631*	*>200*	
	3 gallon	*7.2*	*54.6*	*520*	*>200*	
	4.5 gallon	*7.17*	*56.6*	*495*	*>200*	

Comments: *Well Bailed and surged*

PARSONS ENGINEERING SCIENCE, INC.

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-3*

Date *5/15/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*15.8*
Initial Static Water Level (TOC)	*4.92*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *15.8* - *4.92* x *0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*7.18*
Temp. (F)	*67.1*
Spec. Cond. (uS/cm)	*1213*
Turbidity (NTU)	

Comments:

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-4*

Date *5/15/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*15.8*
Initial Static Water Level (TOC)	*5.66*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *15.81* - *5.66* x *0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*7.4*
Temp. (F)	*68*
Spec. Cond. (uS/cm)	*794*
Turbidity (NTU)	

Comments:

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-5*

Date *5/15/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*17.7*
Initial Static Water Level (TOC)	*7.58*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *17.68* - *7.58* x *0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*7.13*
Temp. (F)	*65*
Spec. Cond. (uS/cm)	*1428*
Turbidity (NTU)	

Comments:

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-6*

Date *5/15/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*17.0*
Initial Static Water Level (TOC)	*4*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *17 - 4 x 0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*7.32*
Temp. (F)	*65.6*
Spec. Cond. (uS/cm)	*885*
Turbidity (NTU)	

Comments:

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-7*

Date *5/15/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*19.4*
Initial Static Water Level (TOC)	*6.8*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *19.35* - *6.8* x *0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*7.35*
Temp. (F)	*62.1*
Spec. Cond. (uS/cm)	*973*
Turbidity (NTU)	

Comments:

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-8*

Date *5/15/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*23.1*
Initial Static Water Level (TOC)	*6.35*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *23.11* - *6.35* x *0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*6.99*
Temp. (F)	*65.1*
Spec. Cond. (uS/cm)	*1384*
Turbidity (NTU)	

Comments:

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-9*

Date *5/15/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*21.0*
Initial Static Water Level (TOC)	*7.65*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *20.95* - *7.65* x *0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*6.77*
Temp. (F)	*65.2*
Spec. Cond. (uS/cm)	*1503*
Turbidity (NTU)	

Comments:

WELL SAMPLING RECORD

Site Name *BURA 4th Street* Well *MW-10*

Date *11/18/98*

Samplers *George Hermance* Time

Daniel Lipp

Total Well Depth (TOC)	*19.0*
Initial Static Water Level (TOC)	*9.4*
Well Diameter (inches)	*2.0*

Purging Data

Method *Disposable Bailer*

Water Volume = (Total Depth of Well - Depth To Water) x Casing Volume per Foot

= *19 - 9.4 x 0.16*

= gallons

Casing Volumes (gal/ft.):					
2-inch	0.16	4-inch	0.64	8-inch	2.5
3-inch	0.36	6-inch	1.4	10 inch	4

Volume of Water Removed gallons

Sampling Data

Method *Disposable Bailer*

Parameters	Bottle	Pres.	Method
VOCs(BTEX)	*(2) 40ml vials*	*HCl*	*8020*
PAH/Phenols	*(2) 1l amber*		*8270*
Cyanide	*(1) 500ml HDPE*	*NaOH*	*335.2*

Field Parameters

pH	*7.17*
Temp. (F)	*56.6*
Spec. Cond. (uS/cm)	*495*
Turbidity (NTU)	

Comments:

APPENDIX E

APPENDIX E
SLUG TEST DATA

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-3**

Test Date: **05/19/98**

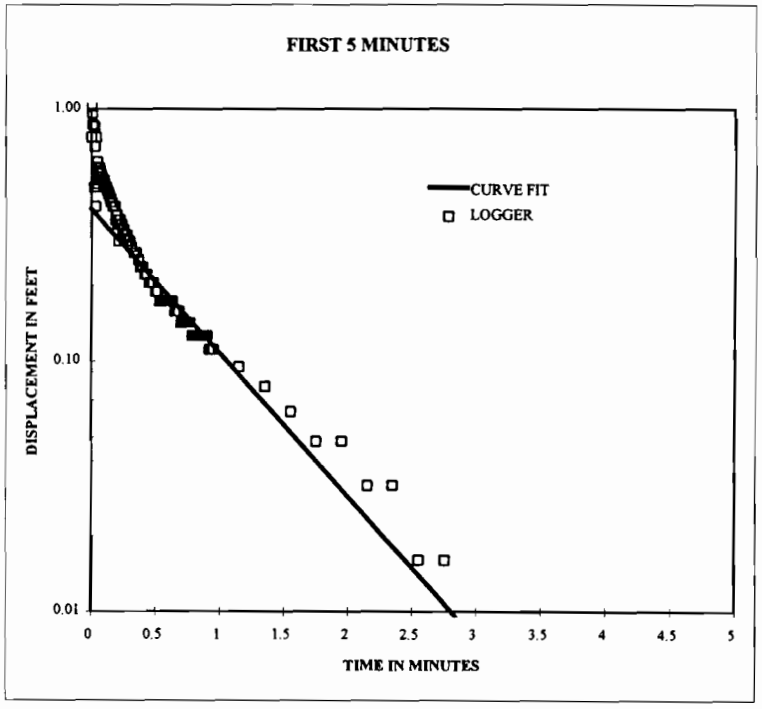
Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **Falling**

Hydraulic conductivity

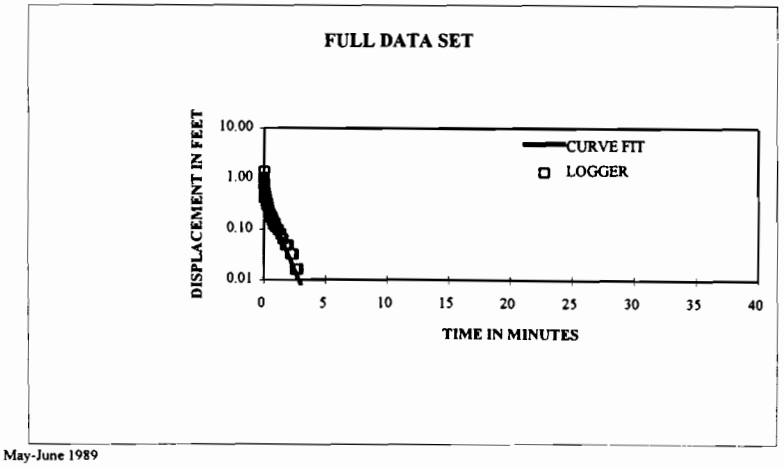
8.73E-04	cm/sec
1.72E-03	ft/min
2.47	ft/day

Casing stickup	1.90	feet
Static water level (from top of casing)	5.41	feet
Depth to bottom of screen (from ground level)	13.90	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	10.00	feet
Depth to "impermeable boundary"	15.00	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.40	feet
ΔH at time t (Y_t)	0.01	feet
Time	2.80	minutes



Bouwer-Rice Parameters

feet	cm		cm	
3.51	106.98	*SW*		
10.39	316.69	*H*	120.00	*L/Rw*
3.9	118.87	*Ts*	0.90	*H/D*
0.083	2.54	*Rw*	4.60	*A*
0.083	2.54	*Rc*	0.75	*B*
0.167	5.08	*DS*	4.60	*C*
10.00	304.80	*L*	2.58	*Ln[(D-H)/Rw]'*
11.49	350.22	*D*	2.58	*Ln[(D-H)/Rw]*
0.4	12.19	Y_o	3.54	equation (8)
0.01	0.30	Y_t	3.76	equation (9)
	168.00	*t (seconds)*	3.76	*Ln(Re/Rw)*
	1.00	*M*	8.7E-04	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989

Bouwer, H. and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976.

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-3**

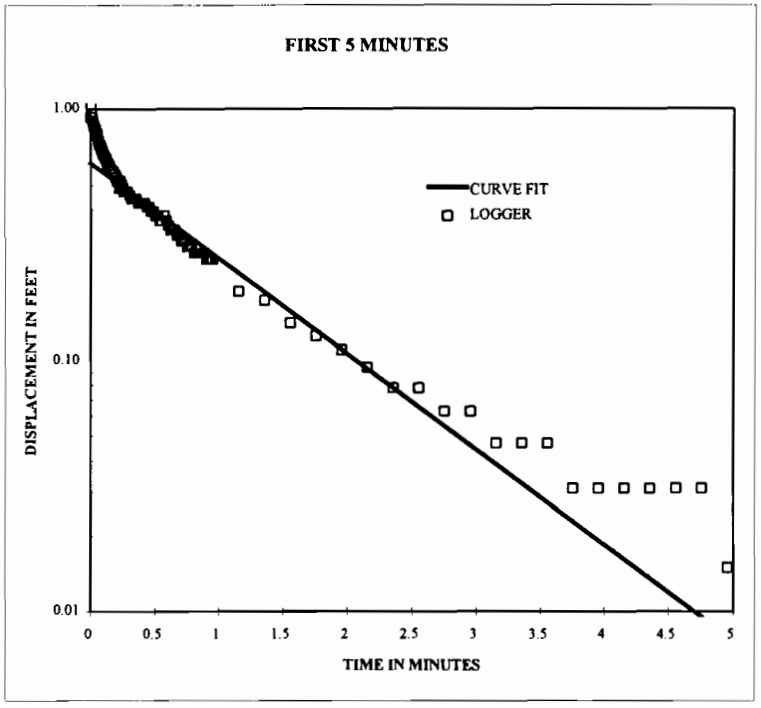
Test Date: **05/19/98**

Formation Tested: **Alluvial deposits**

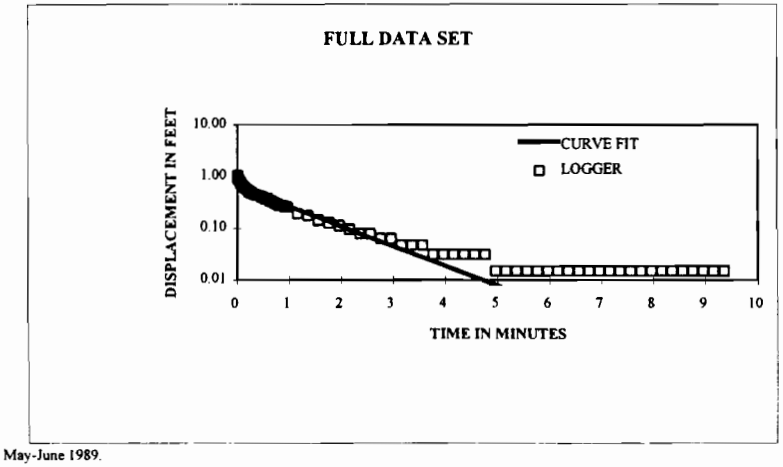
Rising (R) or Falling (F) Head Test: **r**

Hydraulic conductivity		
	5.79E-04	cm/sec
	1.14E-03	ft/min
	1.64	ft/day

Casing stickup	1.90	feet
Static water level (from top of casing)	5.41	feet
Depth to bottom of screen (from ground level)	13.90	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	10.00	feet
Depth to "impermeable boundary"	15.00	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.61	feet
ΔH at time t (Y_t)	0.01	feet
Time	4.70	minutes



Bouwer-Rice Parameters				
feet	cm		cm	
3.51	106.98	*SW*		
10.39	316.69	*H*	120.00	*L/Rw*
3.9	118.87	*Ts*	0.90	*H/D*
0.083	2.54	*Rw*	4.60	*A*
0.083	2.54	*Rc*	0.75	*B*
0.167	5.08	*DS*	4.60	*C*
10.00	304.80	*L*	2.58	*Ln[(D-H)/Rw]'*
11.49	350.22	*D*	2.58	*Ln[(D-H)/Rw]*
0.61	18.59	Y_0	3.54	equation (8)
0.01	0.30	Y_t	3.76	equation (9)
	282.00	*t (seconds)*	3.76	*Ln(Re/Rw)*
	1.00	*M*	5.8E-04	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

Bouwer, H. and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976.

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-4**

Test Date: **05/19/98**

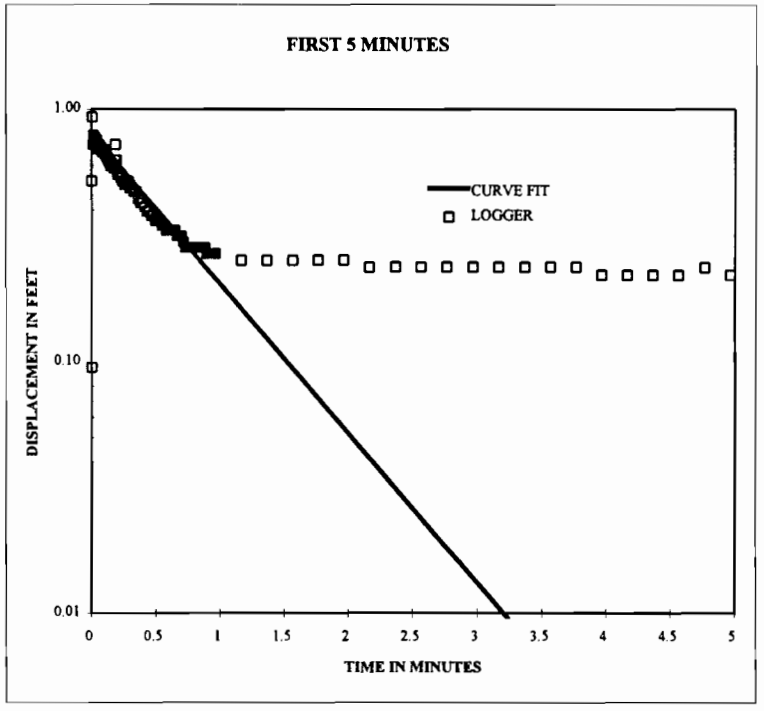
Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **Falling**

Hydraulic conductivity

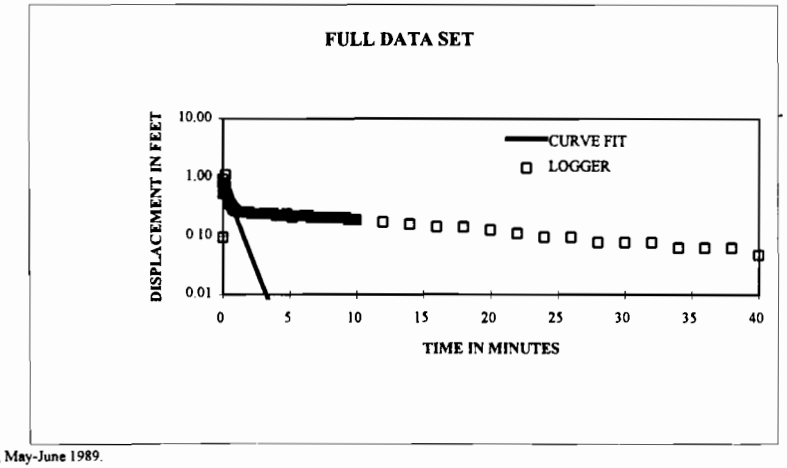
5.88E-04	**cm/sec**
1.16E-03	**ft/min**
1.67	**ft/day**

Casing stickup	**1.90**	feet
Static water level (from top of casing)	**6.01**	feet
Depth to bottom of screen (from ground level)	**13.90**	feet
Boring diameter	**8.00**	inches
Casing diameter	**2.00**	inches
Screen diameter	**2.00**	inches
Screen length	**10.00**	feet
Depth to "impermeable boundary"	**15.00**	feet
Estimated ratio of Kh/Kv	**1.00**	
Porosity of filter pack	**0.30**	
ΔH at time zero (Y_0)	**0.80**	feet
ΔH at time t (Y_t)	**0.01**	feet
Time	**3.20**	minutes



Bouwer-Rice Parameters

feet	cm		cm	
4.11	125.27	*SW*		
9.79	298.40	*H*	29.37	*L/Rw*
3.9	118.87	*Ts*	0.90	*H/D*
0.333	10.16	*Rw*	2.35	*A*
0.083	2.54	*Rc*	0.34	*B*
0.167	5.08	*DS*	1.90	*C*
9.79	298.40	*L*	1.19	*Ln[(D-H)/Rw]'*
10.89	331.93	*D*	1.19	*Ln[(D-H)/Rw]*
0.8	24.38	Y_0	2.39	equation (8)
0.01	0.30	Y_t	2.56	equation (9)
	192.00	*t (seconds)*	2.39	*Ln(Re/Rw)*
	1.00	*M*	5.9E-04	equation (5)
	0.30	*n*		



Bouwer, Herman 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

Bouwer, H. and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976.

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-4**

Test Date: **05/19/98**

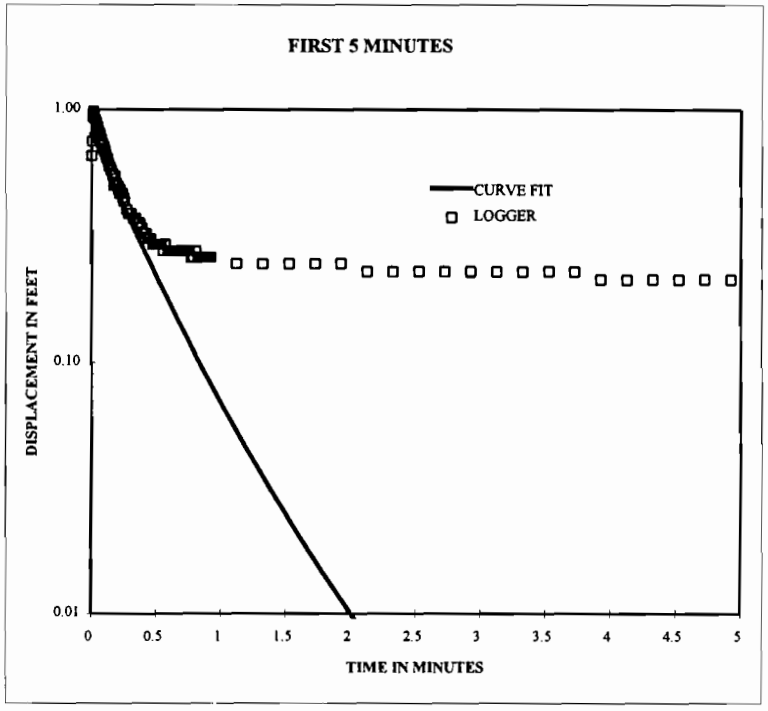
Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **rising**

Hydraulic conductivity

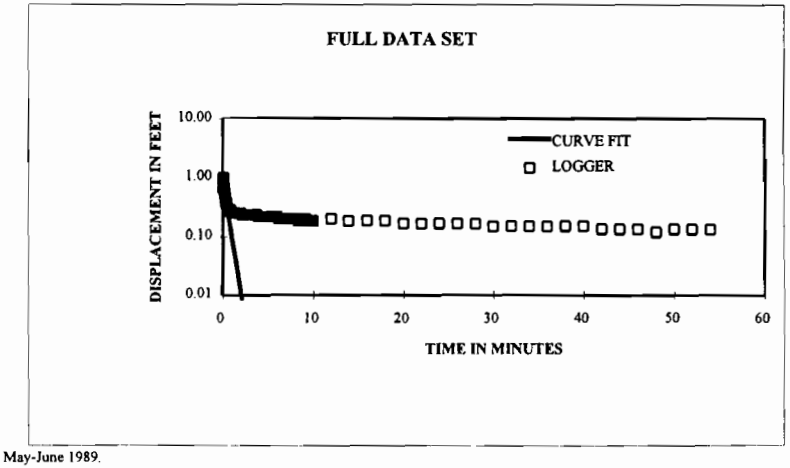
9.42E-04	cm/sec
1.85E-03	ft/min
2.67	ft/day

Casing stickup	1.90	feet
Static water level (from top of casing)	6.01	feet
Depth to bottom of screen (from ground level)	13.90	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	10.00	feet
Depth to "impermeable boundary"	15.00	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.80	feet
ΔH at time t (Y_t)	0.01	feet
Time	2.00	minutes



Bouwer-Rice Parameters

feet	cm		cm	
4.11	125.27	*SW*		
9.79	298.40	*H*	29.37	*L/Rw*
3.9	118.87	*Ts*	0.90	*H/D*
0.333	10.16	*Rw*	2.35	*A*
0.083	2.54	*Rc*	0.34	*B*
0.167	5.08	*DS*	1.90	*C*
9.79	298.40	*L*	1.19	*Ln[(D-H)/Rw]'*
10.89	331.93	*D*	1.19	*Ln[(D-H)/Rw]*
0.8	24.38	Y_o	2.39	equation (8)
0.01	0.30	Y_t	2.56	equation (9)
	120.00	*t (seconds)*	2.39	*Ln(Re/Rw)*
	1.00	*M*	9.4E-04	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

Bouwer, H. and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976.

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-5**

Test Date: **5/19/98**

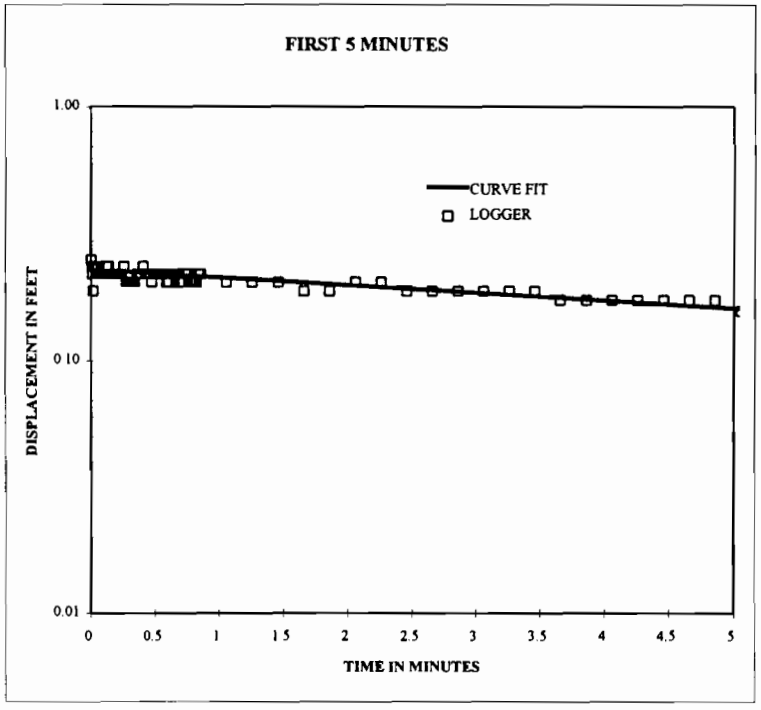
Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **falling**

Hydraulic conductivity

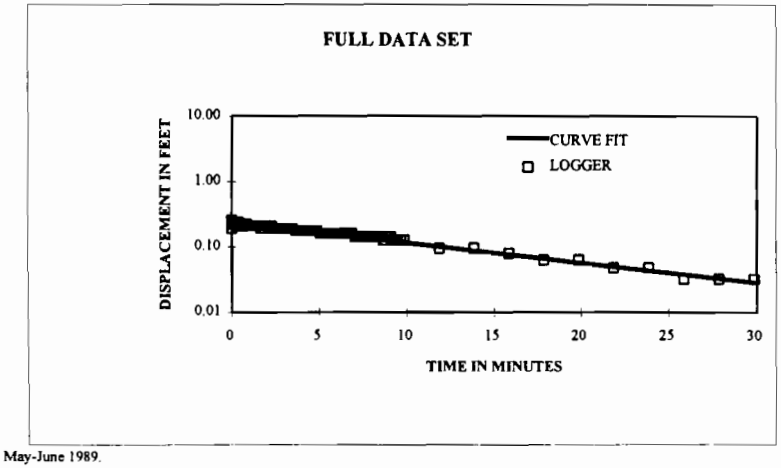
2.91E-05	cm/sec
5.73E-05	ft/min
0.08	ft/day

Casing stickup	0.00	feet
Static water level (from top of casing)	7.63	feet
Depth to bottom of screen (from ground level)	19.00	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	14.00	feet
Depth to "impermeable boundary"	19.10	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.23	feet
ΔH at time t (Y_t)	0.04	feet
Time	25.00	minutes



Bouwer-Rice Parameters

feet	cm		cm	
7.63	232.56	*SW*		
11.37	346.56	*H*	34.11	*L/Rw*
5	152.40	*Ts*	0.99	*H/D*
0.333	10.16	*Rw*	2.50	*A*
0.083	2.54	*Rc*	0.36	*B*
0.167	5.08	*DS*	2.10	*C*
11.37	346.56	*L*	-1.20	*Ln[(D-H)/Rw]'*
11.47	349.61	*D*	-1.20	*Ln[(D-H)/Rw]*
0.23	7.01	Y_0	2.69	equation (8)
0.04	1.22	Y_t	2.68	equation (9)
	1500.00	*t (seconds)*	2.68	*Ln(Re/Rw)*
	1.00	*M*	2.9E-05	equation (5)
	0.30	*n*		



Bouwer, Herman 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

Bouwer, H. and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976.

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-5**

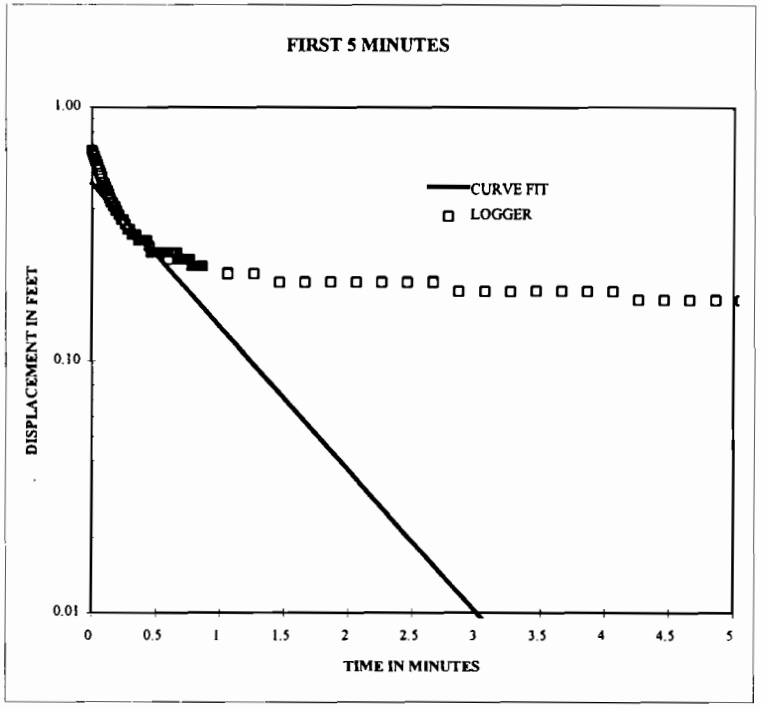
Test Date: **5/19/98**

Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **Rising**

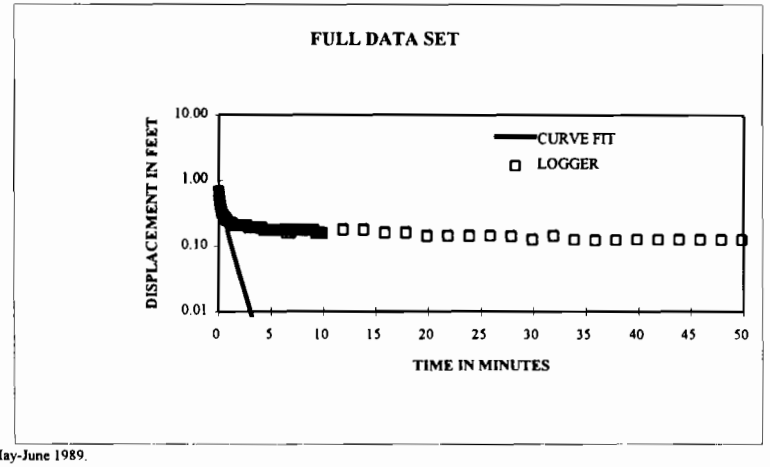
Hydraulic conductivity	5.42E-04	cm/sec
	1.07E-03	ft/min
	1.54	ft/day

Casing stickup	0.00	feet
Static water level (from top of casing)	7.63	feet
Depth to bottom of screen (from ground level)	19.00	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	14.00	feet
Depth to "impermeable boundary"	19.10	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.50	feet
ΔH at time t (Y_t)	0.01	feet
Time	3.00	minutes



Bouwer-Rice Parameters

feet	cm		cm	
7.63	232.56	*SW*		
11.37	346.56	*H*	34.11	*L/Rw*
5	152.40	*Ts*	0.99	*H/D*
0.333	10.16	*Rw*	2.50	*A*
0.083	2.54	*Rc*	0.36	*B*
0.167	5.08	*DS*	2.10	*C*
11.37	346.56	*L*	-1.20	*Ln[(D-H)/Rw]'*
11.47	349.61	*D*	-1.20	*Ln[(D-H)/Rw]*
0.5	15.24	Y_0	2.69	equation (8)
0.01	0.30	Y_t	2.68	equation (9)
	180.00	*t (seconds)*	2.68	*Ln(Re/Rw)*
	1.00	*M*	5.4E-04	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

Bouwer, H. and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976.

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-6**

Test Date: **05/19/98**

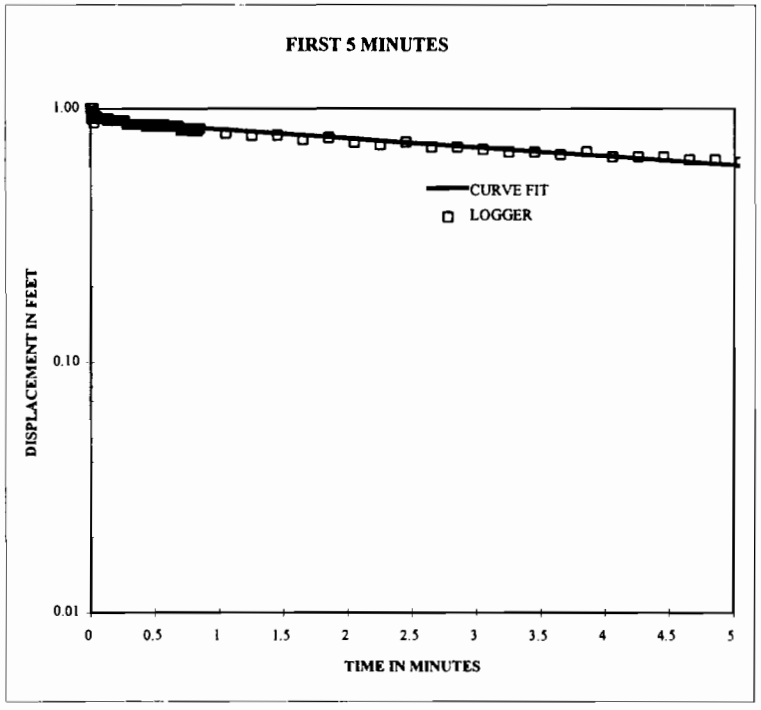
Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **Falling**

Hydraulic conductivity

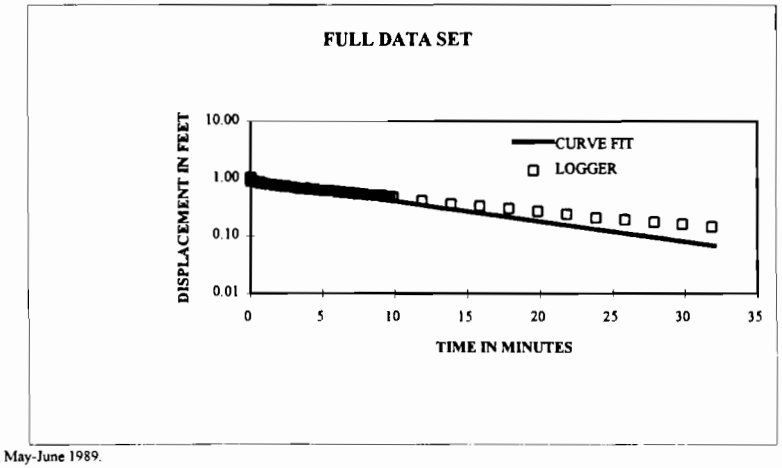
5.77E-05	cm/sec
1.14E-04	ft/min
0.16	ft/day

Casing stickup	0.00	feet
Static water level (from top of casing)	4.15	feet
Depth to bottom of screen (from ground level)	20.00	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	10.00	feet
Depth to "impermeable boundary"	20.01	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.90	feet
ΔH at time t (Y_t)	0.60	feet
Time	5.00	minutes



Bouwer-Rice Parameters

feet	cm		cm	
4.15	126.49	*SW*		
15.85	483.11	*H*	120.00	*L/Rw*
10	304.80	*Ts*	1.00	*H/D*
0.083	2.54	*Rw*	4.60	*A*
0.083	2.54	*Rc*	0.75	*B*
0.167	5.08	*DS*	4.60	*C*
10.00	304.80	*L*	-2.12	*Ln[(D-H)/Rw]'*
15.86	483.41	*D*	-2.12	*Ln[(D-H)/Rw]*
0.9	27.43	Y_0	4.26	equation (8)
0.6	18.29	Y_t	4.03	equation (9)
	300.00	*t (seconds)*	4.03	*Ln(Re/Rw)*
	1.00	*M*	5.8E-05	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

Bouwer, H. and R.C. Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976.

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-6**

Test Date: **05/19/98**

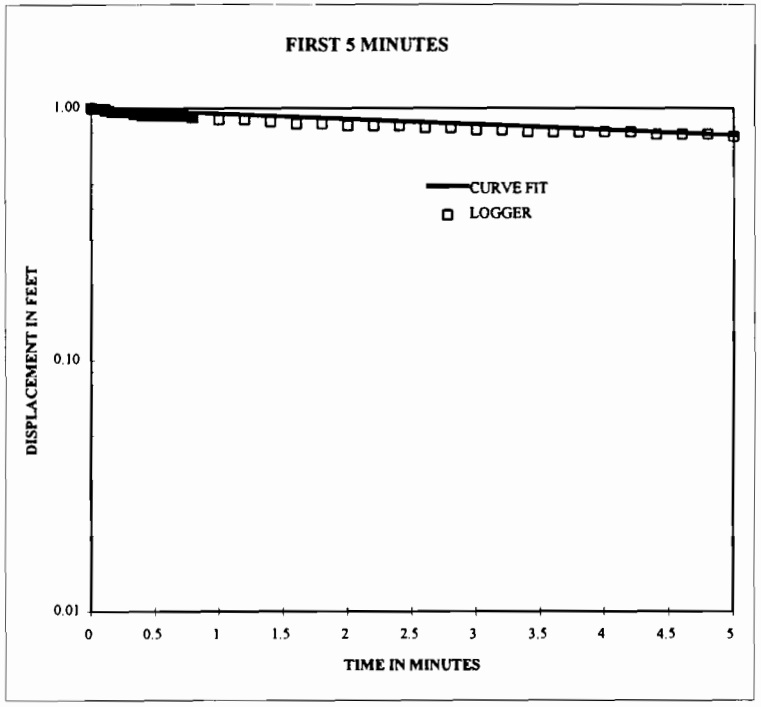
Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **Rising**

Hydraulic conductivity

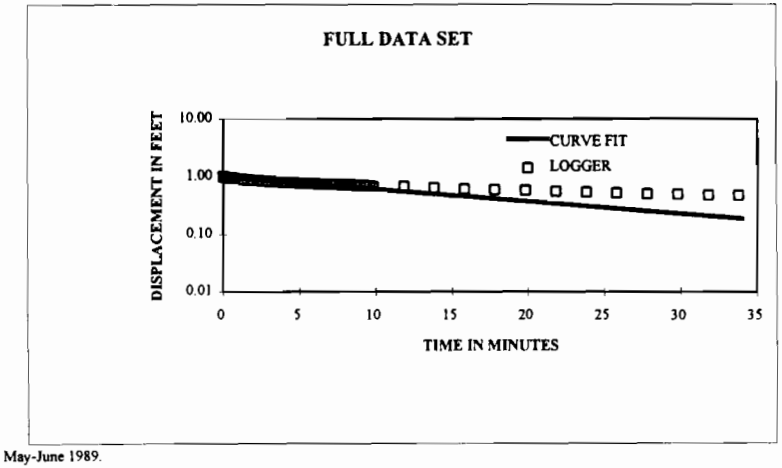
3.54E-05	cm/sec
6.96E-05	ft/min
0.10	ft/day

Casing stickup	0.00	feet
Static water level (from top of casing)	4.15	feet
Depth to bottom of screen (from ground level)	20.00	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	10.00	feet
Depth to "impermeable boundary"	20.01	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	1.00	feet
ΔH at time t (Y_t)	0.78	feet
Time	5.00	minutes



Bouwer-Rice Parameters

feet	cm		cm	
4.15	126.49	*SW*		
15.85	483.11	*H*	120.00	*L/Rw*
10	304.80	*Ts*	1.00	*H/D*
0.083	2.54	*Rw*	4.60	*A*
0.083	2.54	*Rc*	0.75	*B*
0.167	5.08	*DS*	4.60	*C*
10.00	304.80	*L*	-2.12	*Ln[(D-H)/Rw]'*
15.86	483.41	*D*	-2.12	*Ln[(D-H)/Rw]*
1	30.48	Y_0	4.26	equation (8)
0.78	23.77	Y_t	4.03	equation (9)
	300.00	*t (seconds)*	4.03	*Ln(Re/Rw)*
	1.00	*M*	3.5E-05	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

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Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-7**

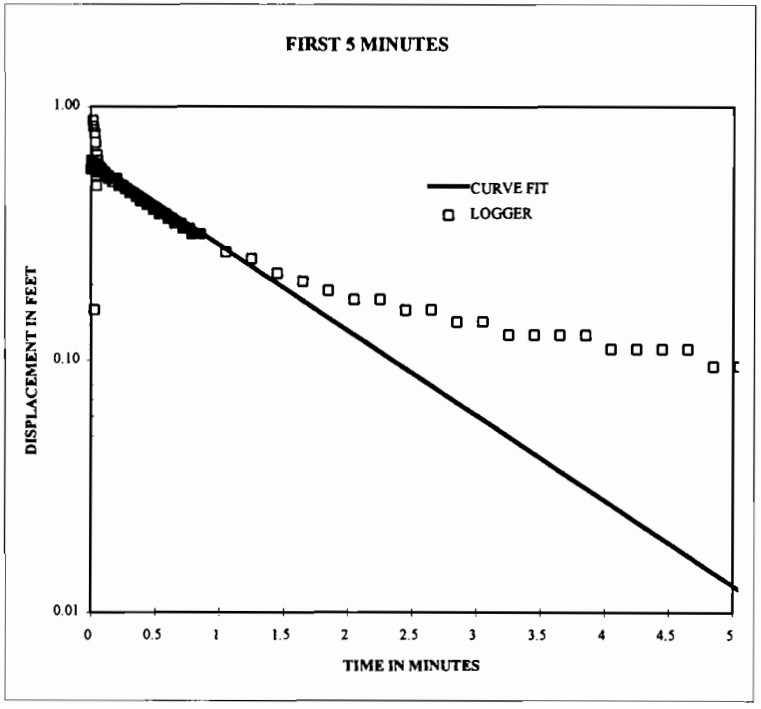
Test Date: **5/18/98**

Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **Falling**

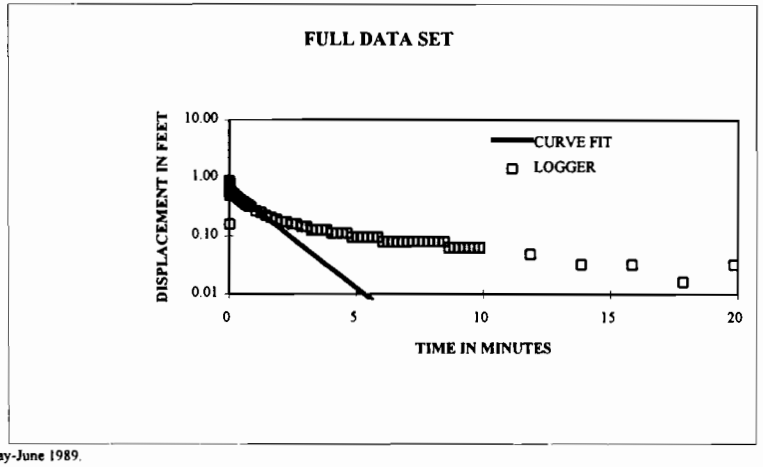
Hydraulic conductivity	**2.99E-04**	**cm/sec**
	5.89E-04	**ft/min**
	0.85	**ft/day**

Casing stickup	**0.00**	feet
Static water level (from top of casing)	**6.78**	feet
Depth to bottom of screen (from ground level)	**19.35**	feet
Boring diameter	**8.00**	inches
Casing diameter	**2.00**	inches
Screen diameter	**2.00**	inches
Screen length	**13.00**	feet
Depth to "impermeable boundary"	**20.00**	feet
Estimated ratio of Kh/Kv	**1.00**	
Porosity of filter pack	**0.30**	
ΔH at time zero (Y_0)	**0.62**	feet
ΔH at time t (Y_t)	**0.10**	feet
Time	**2.35**	minutes



Bouwer-Rice Parameters

feet	cm		cm	
6.78	206.65	*SW*		
12.57	383.13	*H*	37.71	*L/Rw*
6.35	193.55	*Ts*	0.95	*H/D*
0.333	10.16	*Rw*	2.70	*A*
0.083	2.54	*Rc*	0.38	*B*
0.167	5.08	*DS*	2.30	*C*
12.57	383.13	*L*	0.67	*Ln[(D-H)/Rw]'*
13.22	402.95	*D*	0.67	*Ln[(D-H)/Rw]*
0.62	18.90	Y_0	2.62	**equation (8)**
0.1	3.05	Y_t	2.75	**equation (9)**
	141.00	*t (seconds)*	2.75	*Ln(Re/Rw)*
	1.00	*M*	3.0E-04	**equation (5)**
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update" Ground Water vol. 27, no. 3, May-June 1989.

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Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-7**

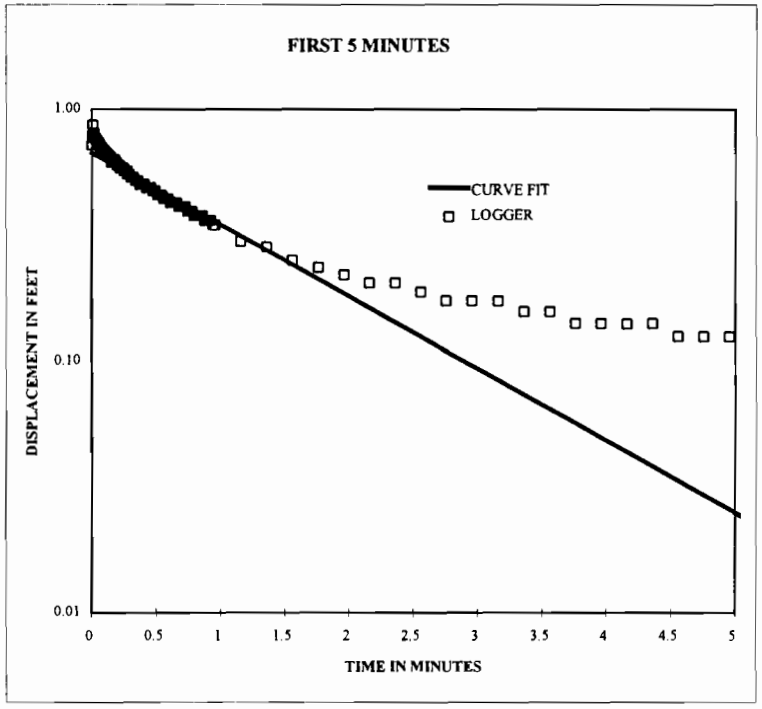
Test Date: **5/18/98**

Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **Rising**

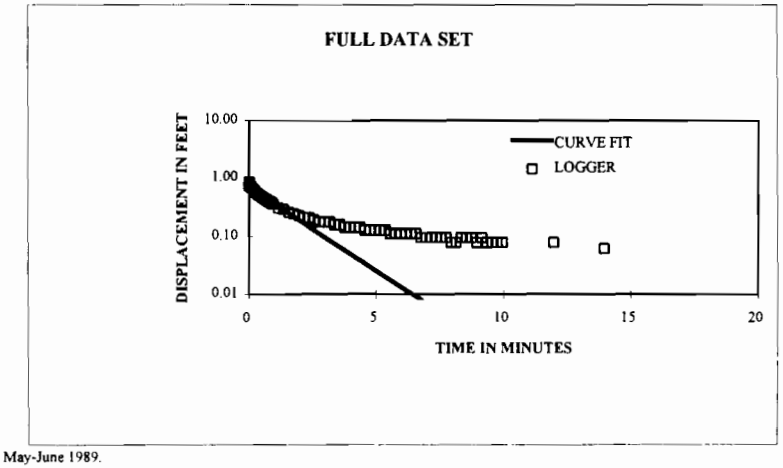
Hydraulic conductivity	**2.53E-04**	**cm/sec**
	4.98E-04	**ft/min**
	0.72	**ft/day**

Casing stickup	**0.00**	feet
Static water level (from top of casing)	**6.76**	feet
Depth to bottom of screen (from ground level)	**19.35**	feet
Boring diameter	**8.00**	inches
Casing diameter	**2.00**	inches
Screen diameter	**2.00**	inches
Screen length	**13.00**	feet
Depth to "impermeable boundary"	**20.00**	feet
Estimated ratio of Kh/Kv	**1.00**	
Porosity of filter pack	**0.30**	
ΔH at time zero (Y_0)	**0.67**	feet
ΔH at time t (Y_t)	**0.18**	feet
Time	**2.00**	minutes



Bouwer-Rice Parameters

feet	cm		cm	
6.76	206.04	*SW*		
12.59	383.74	*H*	37.77	*L/Rw*
6.35	193.55	*Ts*	0.95	*H/D*
0.333	10.16	*Rw*	2.70	*A*
0.083	2.54	*Rc*	0.38	*B*
0.167	5.08	*DS*	2.30	*C*
12.59	383.74	*L*	0.67	*Ln[(D-H)/Rw]'*
13.24	403.56	*D*	0.67	*Ln[(D-H)/Rw]*
0.67	20.42	Y_o	2.62	equation (8)
0.18	5.49	Y_t	2.75	equation (9)
	120.00	*t (seconds)*	2.75	*Ln(Re/Rw)*
	1.00	*M*	2.5E-04	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol 27, no. 3, May-June 1989.

Bouwer, H. and R C Rice. 1976. A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells". Water Resources Research. vol 12, no. 3, June 1976

Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-8**

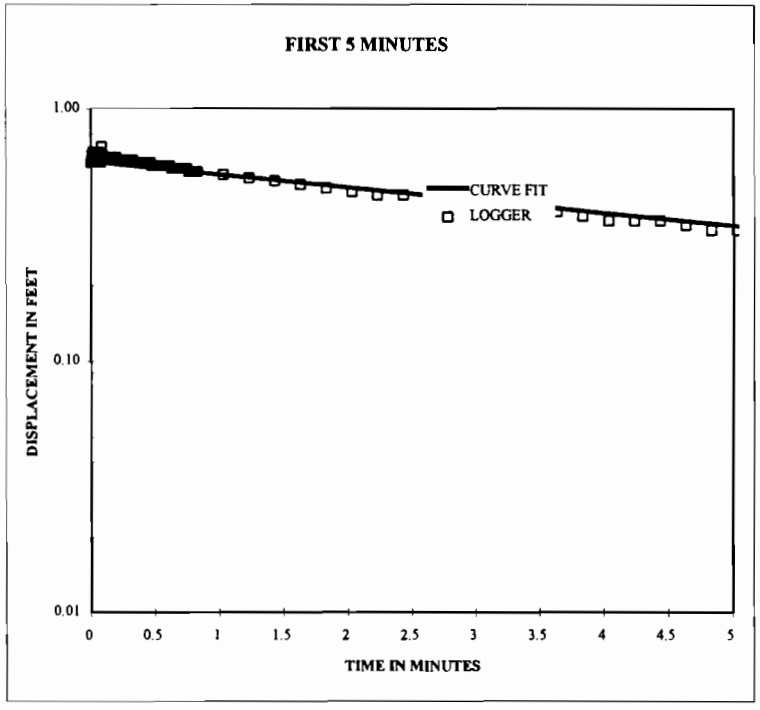
Test Date: **5/19/98**

Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **RISING**

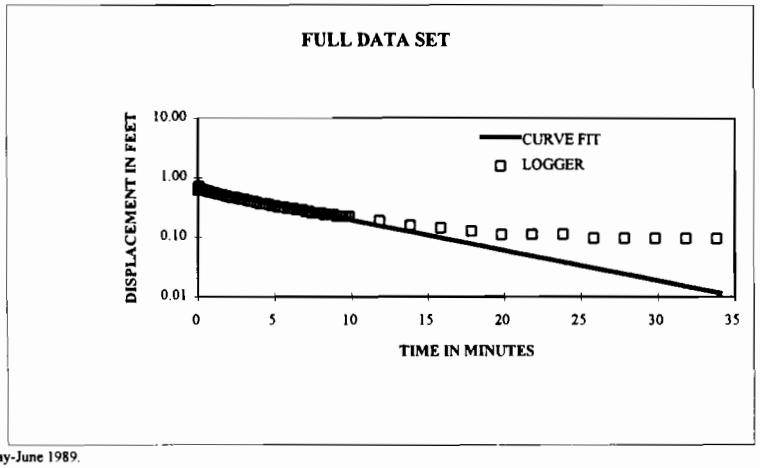
Hydraulic conductivity	5.73E-05	cm/sec
	1.13E-04	ft/min
	0.16	ft/day

Casing stickup	2.50	feet
Static water level (from top of casing)	6.99	feet
Depth to bottom of screen (from ground level)	22.00	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	15.00	feet
Depth to "impermeable boundary"	22.50	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.62	feet
ΔH at time t (Y_t)	0.09	feet
Time	16.50	minutes



Bouwer-Rice Parameters

feet	cm		cm	
4.49	136.86	*SW*		
17.51	533.70	*H*	180.00	*L/Rw*
7	213.36	*Ts*	0.97	*H/D*
0.083	2.54	*Rw*	5.65	*A*
0.083	2.54	*Rc*	1.00	*B*
0.167	5.08	*DS*	6.20	*C*
15.00	457.20	*L*	1.79	*Ln[(D-H)/Rw]'*
18.01	548.94	*D*	1.79	*Ln[(D-H)/Rw]*
0.62	18.90	Y_0	4.05	equation (8)
0.09	2.74	Y_t	4.16	equation (9)
	990.00	*t (seconds)*	4.16	*Ln(Re/Rw)*
	1.00	*M*	5.7E-05	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989.

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Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-9**

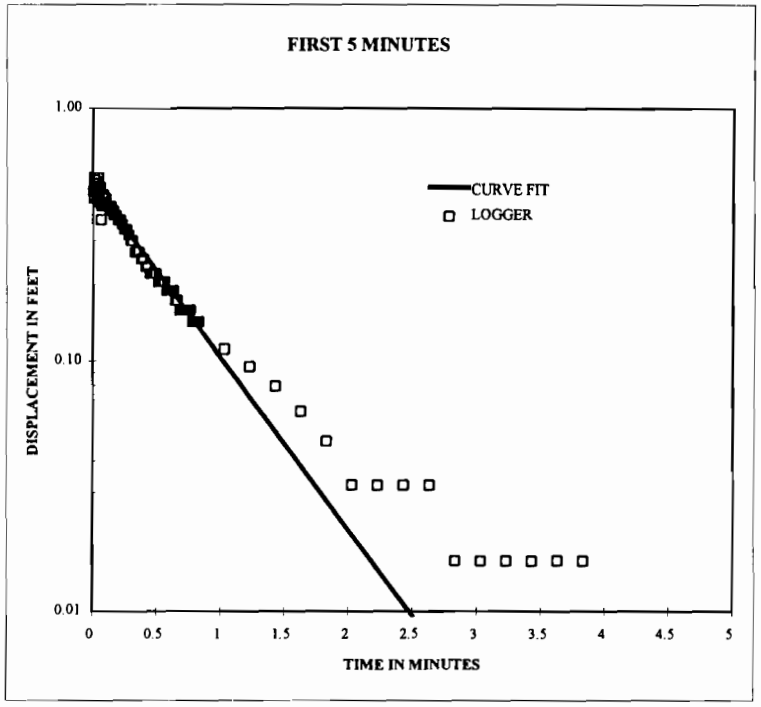
Test Date: **05/19/98**

Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **falling**

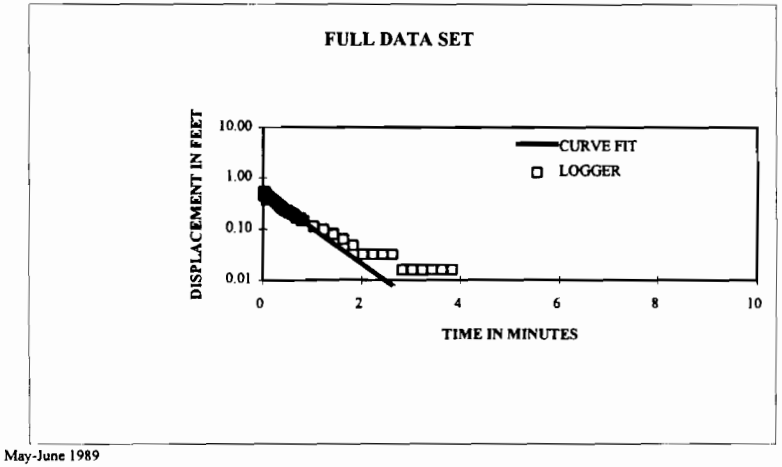
Hydraulic conductivity	9.22E-04	cm/sec
	1.81E-03	ft/min
	2.61	ft/day

Casing stickup	2.50	feet
Static water level (from top of casing)	7.71	feet
Depth to bottom of screen (from ground level)	19.00	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	12.00	feet
Depth to "impermeable boundary"	19.20	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.50	feet
ΔH at time t (Y_t)	0.01	feet
Time	2.60	minutes



Bouwer-Rice Parameters

feet	cm		cm	
5.21	158.80	*SW*		
13.79	420.32	*H*	144.00	*L/Rw*
7	213.36	*Ts*	0.99	*H/D*
0.083	2.54	*Rw*	5.07	*A*
0.083	2.54	*Rc*	0.80	*B*
0.167	5.08	*DS*	5.30	*C*
12.00	365.76	*L*	0.88	*Ln[(D-H)/Rw]'*
13.99	426.42	*D*	0.88	*Ln[(D-H)/Rw]*
0.5	15.24	Y_0	3.92	equation (8)
0.0082	0.25	Y_t	3.97	equation (9)
	156.00	*t (seconds)*	3.97	*Ln(Re/Rw)*
	1.00	*M*	9.2E-04	equation (5)
	0.30	*n*		



Bouwer, Herman. 1989. "The Bouwer and Rice Slug Test - An Update". Ground Water vol. 27, no. 3, May-June 1989

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Client: **Buffalo Urban Renewal Agency**

Project: **Fourth Street Site**

Project No.: **732260**

Well No.: **MW-9**

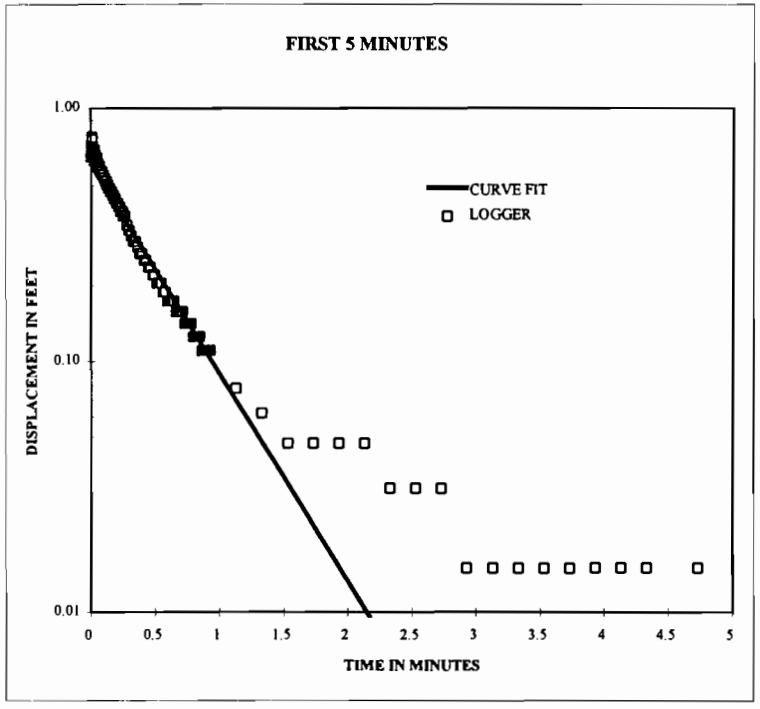
Test Date: **05/19/98**

Formation Tested: **Alluvial deposits**

Rising (R) or Falling (F) Head Test: **rising**

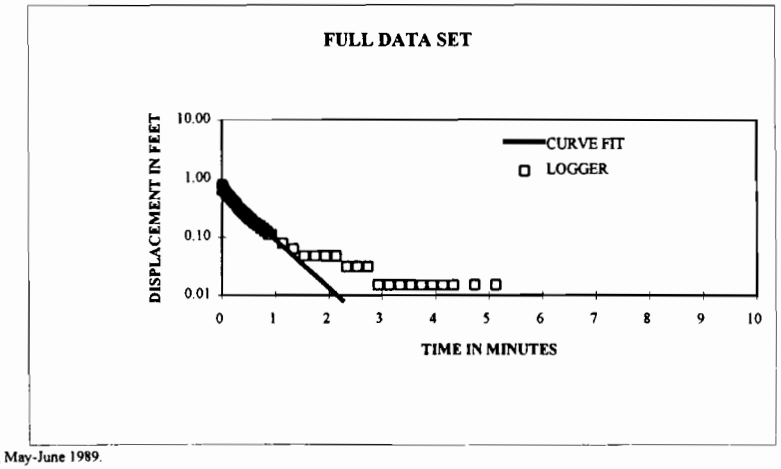
Hydraulic conductivity	1.11E-03	cm/sec
	2.19E-03	ft/min
	3.15	ft/day

Casing stickup	2.50	feet
Static water level (from top of casing)	7.71	feet
Depth to bottom of screen (from ground level)	19.00	feet
Boring diameter	8.00	inches
Casing diameter	2.00	inches
Screen diameter	2.00	inches
Screen length	12.00	feet
Depth to "impermeable boundary"	19.20	feet
Estimated ratio of Kh/Kv	1.00	
Porosity of filter pack	0.30	
ΔH at time zero (Y_0)	0.60	feet
ΔH at time t (Y_t)	0.01	feet
Time	2.25	minutes



Bouwer-Rice Parameters

feet	cm		cm	
5.21	158.80	*SW*		
13.79	420.32	*H*	144.00	*L/Rw*
7	213.36	*Ts*	0.99	*H/D*
0.083	2.54	*Rw*	5.07	*A*
0.083	2.54	*Rc*	0.80	*B*
0.167	5.08	*DS*	5.30	*C*
12.00	365.76	*L*	0.88	*Ln[(D-H)/Rw]'*
13.99	426.42	*D*	0.88	*Ln[(D-H)/Rw]*
0.6	18.29	Y_0	3.92	equation (8)
0.0082	0.25	Y_t	3.97	equation (9)
	135.00	*t (seconds)*	3.97	*Ln(Re/Rw)*
	1.00	*M*	1.1E-03	equation (5)
	0.30	*n*		



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APPENDIX F

APPENDIX F
LABORATORY ANALYTICAL DATA
AND
DATA VALIDATION REPORT

DATA VALIDATION REPORT

Prepared For:

BUFFALO URBAN RENEWAL AGENCY (BURA)

Fourth Street Site
Buffalo, New York

Prepared By:

PARSONS ENGINEERING SCIENCE, INC.

180 Lawrence Bell Drive, Suite 100
Williamsville, New York 14221
Phone: (716) 633-7074
Fax: (716) 633-7195

July 1998

PARSONS

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DATA VALIDATION SUMMARY

Groundwater, soil boring, and surface soil samples were collected from the BURA - Fourth Street site from April 29, 1998 through May 15, 1998. Analytical results from these samples were validated and reviewed by Parsons Engineering Science, Inc. (Parsons ES) for usability with respect to the following requirements:

- Work Plan;
- USEPA SW-846 analytical methodologies;
- NYSDEC Analytical Services Protocol (ASP); and
- USEPA Region II Standard Operating Procedures (SOP) in "CLP Organic Data Review and Preliminary Review," SOP No. HW-6, Revision #8, January 1992, and "Evaluation of Metals Data for the CLP Based on SOW 3/90," SOP No. HW-2, Revision #11, January 1992.

The analytical laboratory for this project was Severn Trent Envirotest Laboratories (STL). This laboratory is certified by the New York State Department of Health under the Environmental Laboratory Approval Program (ELAP) to perform analyses in accordance with the NYSDEC ASP.

1.1 LABORATORY DATA PACKAGES

The laboratory data package turnaround time, defined as the time from sample receipt by the laboratory to receipt of the analytical data packages by Parsons ES, was 50 days on average for groundwater and soil samples.

The data packages received from STL were paginated, complete, and overall were of good quality. Comments on specific quality control (QC) and other requirements are discussed in detail in the attached data validation reports which are summarized by sample media in Section 2.

1.2 SAMPLING AND CHAIN-OF-CUSTODY

Groundwater samples were collected, properly preserved, shipped under a chain-of-custody (COC) record, and received at STL within three days of sampling. Soil samples were collected, properly preserved, shipped under a COC record, and received at STL within one to two days of sampling. All samples were received intact and in good condition at STL.

1.3 LABORATORY ANALYTICAL METHODS

Groundwater and soil samples were collected from the Fourth Street site and analyzed for the volatiles benzene, toluene, ethylbenzene, and total xylenes (BTEX); polynuclear aromatic hydrocarbons (PAHs); phenols; and cyanide. In addition to these analytical parameters, certain surface soil samples were analyzed for total organic carbon (TOC). Summaries of issues concerning these laboratory analyses are presented in Subsections 1.3.1 through 1.3.4. The data qualifications resulting from the data validation review and statements on the laboratory analytical precision, accuracy, representativeness, completeness, and comparability (PARCC) are discussed for each analytical method in Section 2. The laboratory data were reviewed and qualified with the following validation flags:

"U" - not detected at the value given,

"UJ" - estimated and not detected at the value given,

"J" - estimated at the value given,

"N" - presumptive evidence at the value given, and

"R" - unusable value.

The validated laboratory data were tabulated and are presented by media in Attachment A.

1.3.1 BTEX

The groundwater and soil samples collected from the Fourth Street site were analyzed for target compound list BTEX using the USEPA SW-846 8020 analytical method. Certain reported results for the BTEX samples were qualified as estimated due to noncompliant surrogate recoveries, MS/MSD precision and accuracy, and field duplicate precision. Certain reported sample BTEX results were considered unusable and qualified "R" due to poor surrogate recoveries. Therefore, the BTEX analyses were 98.6 to 100% complete for the groundwater and soil data presented by STL and PARCC requirements were met overall.

1.3.2 PAHs and Phenols

The groundwater and soil samples collected from the Fourth Street site were analyzed for PAHs and phenols using the USEPA SW-846 8270 analytical method. Certain reported results for the PAHs and phenols samples were qualified as estimated due to noncompliant sample holding times, surrogate recoveries, instrument calibrations, internal standard sample responses, sample result identification, and field duplicate precision. Certain reported sample PAH results were considered unusable and qualified "R" due to poor surrogate recoveries. Therefore, the PAHs and phenols analyses were 93.9 to 100% complete for the groundwater and soil data presented by STL and PARCC requirements were met overall.

1.3.3 Cyanide

The groundwater and soil samples collected from the Fourth Street site were analyzed for cyanide using the USEPA SW-846 9010 analytical method. Certain reported results for the cyanide samples were qualified as estimated due to noncompliant matrix spike recoveries. All of the cyanide data were considered usable and 100% complete for the groundwater and soil data presented by STL and PARCC requirements were met overall.

1.3.4 TOC

Certain soil samples collected from the Fourth Street site were analyzed for TOC using the USEPA approved Lloyd Kahn analytical method. All calibrations, laboratory blanks, holding times, matrix spikes, duplicates, and control samples were reviewed for compliance. All of these analytical parameters for these samples were considered usable and 100% complete for the data presented by STL and PARCC requirements were met overall.

SECTION 2

DATA VALIDATION REPORTS

2.1 GROUNDWATER

Data review has been completed for data packages generated by STL containing groundwater samples collected from the Fourth Street site. The specific samples contained in these data packages, the analyses performed, and a usability summary are presented in Table 2.1-1. All of these samples were properly preserved, shipped under a COC record, and received intact by the analytical laboratory. The validated laboratory data are presented in Attachment A-1.

Data validation was performed for all samples in accordance with the most current editions of the USEPA Region II SOPs and the NYSDEC ASP for organic and inorganic data review. This data validation and usability report is presented by analysis type.

2.1.1 BTEX

The following items were reviewed for compliancy in the BTEX analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) precision and accuracy;
- Matrix spike blank (MSB) recoveries;
- Laboratory method blank and trip blank contamination;
- Gas Chromatograph (GC) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Field duplicate precision;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols.

Usability

All BTEX sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The BTEX data presented by STL were 100% complete and all BTEX data were considered usable and valid. The validated BTEX laboratory data are tabulated and presented in Attachment A-1. This table presents the most representative BTEX data for a sample location resulting from validation.

For example, sample MW09 was reanalyzed at a secondary dilution (MW09DL) since the benzene concentration exceeded instrument calibration ranges during the original analysis of this sample. Therefore, the validated result from the diluted sample for benzene was considered compliant and representative of the sample. This result was reported for the sample in the validated laboratory data table presented in Attachment A-1.

2.1.2 PAHs and Phenols

The following items were reviewed for compliancy in the PAHs and phenols analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- MS/MSD precision and accuracy;
- MSB recoveries;
- Laboratory method blank and contamination;
- Gas Chromatograph/Mass Spectrometer (GC/MS) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Internal standard area counts and retention times;
- Field duplicate precision;
- Quantitation Limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of initial and continuing calibrations.

Initial and Continuing Calibrations

All initial calibration compounds were compliant with a minimum relative response factor (RRF) of 0.05 and a maximum relative standard deviation (%RSD) of 30 % with the exception of 2,4-dintrophenol (46.96%), 4,6-dinitro-2-methylphenol (31.53%), and pentachlorophenol (30.66%) which were outside the QC limit for % RSD only for the initial calibration associated with all groundwater samples. The positive sample results for these noncompliant compounds were considered estimated and qualified "J" for these affected samples.

All continuing calibration compounds were compliant with a minimum RRF of 0.05 and a maximum percent difference (%D) of $\pm$ 25% with the exception of 2,4-dinitrophenol (-84.5%), 4-nitrophenol (-33.6%) and 4,6-dinitro-2-methyphenol (-53.1%) which were outside the QC limit for %D only for the continuing calibration associated with all groundwater samples. The sample results for these noncompliant compounds were considered estimated with positive results qualified "J" and nondetected results qualified "UJ" for the affected samples.

Usability

All PAH and phenols sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The PAH and phenols data presented by STL were 100% complete with all data considered usable and valid. The validated PAH and phenols laboratory data are tabulated and presented in Attachment A-1.

2.1.3 Cyanide

The following items were reviewed for compliancy in the cyanide analysis:

- Custody documentation;
- Holding times;
- Initial and continuing calibration verifications;
- Initial and continuing calibration, and laboratory preparation blank contamination;
- Matrix spike recoveries;
- Laboratory duplicate precision;

- Field duplicate precision;
- Laboratory control sample;
- Sample result verification and identification;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols.

Usability

All cyanide sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The cyanide data presented by STL were 100% complete and all data were considered valid and usable. The validated cyanide laboratory data are tabulated and presented in Attachment A-1.

2.2 SOIL

Data review has been completed for data packages generated by STL containing soil boring and surface soil samples collected from the Fourth Street site. The specific samples contained in these data packages, the analyses performed, and a usability summary are presented in Table 2.2-1. All of these samples were properly preserved, shipped under a COC record, and received intact by the analytical laboratory. The validated laboratory data are presented in Attachment A-2.

Data validation was performed for all samples in accordance with the most current editions of the USEPA Region II SOPs and the NYSDEC ASP for organic and inorganic data review. This data validation and usability report is presented by analysis type.

2.2.1 BTEX

The following items were reviewed for compliancy in the BTEX analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) precision and accuracy;

- Matrix spike blank (MSB) recoveries;
- Laboratory method blank and field blank contamination;
- Gas Chromatograph (GC) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Field duplicate precision;
- Quantitation limits; and
- Data completeness;

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of surrogate recoveries, MS/MSD precision and accuracy, and field duplicate precision.

Surrogate Recoveries

All sample surrogate recoveries were within QC limits with the exception of those sample surrogate recoveries summarized in Table 2.2-2. Since these recoveries fell below QC limits, all results for these samples were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ". However, nondetected BTEX results for sample SS03 were considered unusable and qualified "R" since at least one surrogate recovery fell below 10%.

MS/MSD Precision and Accuracy

All of the MS/MSD precision results (relative percent difference; RPD) and accuracy results (percent recovery; % R) were within QC limits for spiked sample analyses with the exception of those precision and accuracy results summarized in Table 2.2-3. Validation qualification was not warranted for the unspiked samples SB01C, SB13E, SB09G, SB09I, and MW05C since matrix effects were not confirmed and sample surrogate recoveries were compliant for these unspiked samples. However, noncompliant precision and/or accuracy results for the spiked analyses of SS02 and OFFSS03 confirmed the presence of matrix effects since surrogate recoveries for the unspiked samples SS02 and OFFSS03 were also noncompliant. Therefore, BTEX results for these samples were considered estimated with positive results qualified "J" and nondetected results qualified "UJ".

Field Duplicate Precision

Samples SB13HIDUP, SS01DUP, and MW08FDUP were collected as the field duplicate samples of SB13HI, SS01, and MW08F, respectively. All reported results for these duplicate pairs were acceptable with the exception of the reported results for

benzene (160 and 30 µg/kg), ethylbenzene (100 and 25 µg/kg), and total xylenes (140 and 39 µg/kg) for the field duplicates SB13HI and SB13HIDUP, respectively. Therefore, these results were considered estimated and qualified "J".

Usability

All BTEX sample results were considered usable following data validation with the exception of the nondetected BTEX results for sample SS03 due to a poor surrogate recovery.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness and comparability. The BTEX data presented by STL were 98.6% complete. The validated BTEX laboratory data are tabulated and presented in Attachment A-2. This table presents the most representative BTEX data for a sample location resulting from validation.

For example, samples SB11H, MW06G, MW07I, SS01, SS01DUP, SS02, SS03, SS04, SS05, MW08FDUP, OFFSS04, OFFSS05, OFFSS06, OFFSS07, SB02D, and SB08F were reanalyzed due to low surrogate recoveries. The reanalyzed samples also experienced low surrogate recoveries confirming the presence of matrix interferences in these samples with the exception of SB02D and SB08F. Therefore, results from the original analysis of these samples with the exception of SB02D and SB08F were considered representative of the sample and reported in the validated laboratory data table in Attachment A-2. Results from the reanalysis of samples SB02D and SB08F were reported in this table.

Samples MW09H and SB06E were diluted and reanalyzed due to low surrogate recoveries and exceedances in calibration ranges for various compounds. Therefore, results from the reanalysis of these samples were reported in the validated laboratory data table in Attachment A-2.

It was noted that the benzene concentration reported for sample SB-10G exceeded instrument calibration ranges. Since this sample was not reanalyzed, this result was considered estimated and qualified "J".

2.2.2 PAHs and Phenols

The following items were reviewed for compliancy in the PAHs and phenols analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;

- MS/MSD precision and accuracy;
- MSB recoveries;
- Laboratory method blank and field blank contamination;
- GC/MS instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Internal standard area counts and retention times;
- Field duplicate precision;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of holding times, surrogate recoveries, MS/MSD precision and accuracy, MSB recoveries, blank contamination, sample result identification, initial calibration and continuing calibrations, internal standard responses, and field duplicate precision.

Holding Times

All samples were within the holding time requirements for extraction and analysis with the exception of SB09G, 09I, 10G, 10I, 11E, 11H, 12I, 12J, OFFSS01, 02, 03, 04, 05, 06, 07, SS01, 01DUP, 02, 03, 04, 05, MW09D, 09H, 08F, 08FDUP, and 08I which exceeded the five day extraction technical holding time requirement by one to two days. Therefore, all results for these samples were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ".

Surrogate Recoveries

All sample surrogate recoveries were compliant and within QC acceptance limits with the exception of those summarized in Table 2.2-4. Validation qualification was not warranted for those samples where only one base-neutral and/or acid surrogate was noncompliant. However, all base-neutral and/or acid fraction sample results were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ" for those samples where at least two base-neutral and/or acid surrogates fell below QC limits. Nondetected base-neutral and/or acid sample results were considered unusable and qualified "R" for those samples where at least one base-neutral and/or acid surrogate recovered less than 10%.

MSB Recoveries and MS/MSD Precision and Accuracy

All of the MSB recoveries and the MS/MSD precision results (RPD) and accuracy results (%R) were within the QC limits with the exception of those summarized in Table 2.2-5. Validation qualification was not warranted for the unspiked samples due to these noncompliances because matrix effects were not confirmed present for these unspiked samples which yielded compliant surrogate recoveries and internal standard responses.

Blank Contamination

Field equipment blanks and laboratory method blanks associated with soil samples contained PAHs and phenols at concentrations summarized in Table 2.2-6. Therefore, all associated sample results with concentrations greater than the validation action concentration were acceptable and reported unqualified. However, all associated sample results with concentrations less than the validation action concentration were considered not detected and qualified "U".

As a result, the presence of contaminants in these blanks may be indicative of sample contamination from the laboratory and/or field practices. Sample results were qualified with a "B" by the laboratory for those cases where the associated laboratory method blank also contained the target compound, and therefore, was considered a laboratory artifact.

Sample Result Identification

All positive sample results were confirmed present, verified with instrument raw data, and within retention time windows. However, the detected 2-methylphenol result for sample SB03F was considered tentatively identified at an estimated concentration and qualified "JN" since the mass spectrum of this compound for this sample indicated a poor match quality with the reference standard.

Initial and Continuing Calibrations

All initial calibrations were compliant with a minimum relative response factor (RRF) of 0.05 and a maximum relative standard deviation (%RSD) of 30% with the exception of those compounds summarized in Table 2.2-7. The positive sample results for these noncompliant compounds were considered estimated and qualified "J" for the affected samples.

All continuing calibration compounds were compliant with a minimum RRF of 0.05 and a maximum %D of ± 25% with the exception of those compounds summarized in Table 2.2-8 which were outside the ± 25% QC limit. The sample results for these noncompliant compounds were considered estimated with positive results qualified "J" and nondetected results qualified "UJ" for the affected samples.

Internal Standards

All internal standard (IS) responses and retention times were within specified QC ranges based on associated calibration standards (i.e., sample's area count within -50% to +100% and retention times within ±0.5 minutes of the standard) with the exception of the ISs summarized in Table 2.2-9. Therefore, positive sample results were considered estimated, possibly biased high, and qualified "J" for those compounds associated with those noncompliant ISs which exceeded QC acceptance ranges for the affected samples. Sample results were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ" for those compounds associated with those noncompliant ISs which fell below QC acceptance ranges for the affected samples.

Field Duplicate Precision

Samples SB13HIDUP, SS01DUP, and MW08FDUP were collected as the field duplicate samples of SB13HI, SS01, and MW08F, respectively. All reported results for these duplicate pairs were acceptable with the exception of the reported results for naphthalene (1400 and 310 µg/kg), acenaphthene (2100 and 81 µg/kg), fluorene (2400 and 170 µg/kg), phenanthrene (24,000 and 1400 µg/kg), anthracene (7800 and 400 µg/kg), fluoranthene (21,000 and 2300 µg/kg), pyrene (18,000 and 2600 µg/kg), benzo(a) anthracene (11,000 and 1700 µg/kg), chrysene (8800 and 1700 µg/kg), benzo(b) fluoranthene (15,000 and 2900 µg/kg), benzo(k) fluoranthene (4900 and 1000 µg/kg), benzo(a) pyrene (10,000 and 2200 µg/kg), indeno (1,2,3-cd) pyrene (3500 and 1000 µg/kg), dibenz(a, h) anthracene (1000 and 270 µg/kg), and benzo(g,h,i)perylene (3200 and 1100 µg/kg) for the field duplicates SS01 and SS01DUP, respectively. Therefore, the reported results for these compounds in these samples were considered estimated with positive results qualified "J".

Usability

All PAH and phenol sample results were considered usable following data validation with the exception of the nondetected PAH results for samples MW05I, MW06G, SB15G, and SS04 due to poor surrogate recoveries.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness and comparability. The PAH and phenols data presented by STL were 93.9% complete. The validated PAH and phenols laboratory data are tabulated and presented in Attachment A-2. This table presents the most representative PAH and phenols data for a sample location resulting from validation.

For example, samples SB03D, 03F, 06C, 06E, 13E, SS01, 01DUP, and 05 were diluted and reanalyzed due to various sample concentrations exceeding instrument calibration ranges and/or noncompliant internal standard responses during the original

analysis. Therefore, results from the diluted analysis were reported in the validated laboratory data table in Attachment A-2 for these samples where initial sample concentrations exceeded instrument calibration ranges and/or noncompliant internal standard responses were experienced.

In addition, sample SS03 was reanalyzed due to noncompliant internal standard responses during the original analysis. Reanalysis of this sample confirmed the presence of matrix interferences with similar noncompliant internal standard responses. Therefore, results from the original analysis of SS03 were reported in the validated laboratory data table.

It was noted that the field blank ONFB01 was contaminated at the laboratory. Therefore, all results for this sample were considered unusable and qualified "R".

2.2.3 Cyanide

The following items were reviewed for compliance in the cyanide analysis:

- Custody documentation;
- Holding times;
- Initial and continuing calibration verifications;
- Initial and continuing calibration, laboratory preparation, and field blank contamination;
- Matrix spike recoveries;
- Laboratory duplicate precision;
- Field duplicate precision;
- Laboratory control sample;
- Sample result verification and identification;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of matrix spike recoveries.

Matrix Spike Recoveries

All the MS recoveries were within the 75-125% control limits and have concentrations less than four times the spiking concentration with the exception of the recovery for cyanide (68%) associated with soil samples collected 4/29/98 through 5/1/98.

All sample results for cyanide where the recovery fell below the QC limit were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ".

Usability

All cyanide sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The cyanide data presented by STL were 100% complete and all cyanide data were considered valid and usable. The validated cyanide laboratory data are tabulated and presented in Attachment A-2.

TABLE 2.1-1
SUMMARY OF SAMPLE ANALYSES AND USABILITY
GROUNDWATER - FOURTH STREET

SAMPLE ID	MATRIX	SAMPLE DATE	BTEX	PAHs PHENOLS	CYANIDE
TB	WATER	5/15/98	OK		
MW03	WATER	5/15/98	OK	OK	OK
MW04	WATER	5/15/98	OK	OK	OK
MW05	WATER	5/15/98	OK	OK	OK
MW06	WATER	5/15/98	OK	OK	OK
MW07	WATER	5/15/98	OK	OK	OK
MW08	WATER	5/15/98	OK	OK	OK
MW08DUP	WATER	5/15/98	OK	OK	OK
MW09	WATER	5/15/98	OK	OK	OK
		TOTAL SAMPLES:	9	8	8

NOTES: OK - Sample analysis considered valid and usable.

TABLE 2.2-1
SUMMARY OF SAMPLE ANALYSES AND USABILITY
SOIL - FOURTH STREET

SAMPLE ID	MATRIX	SAMPLE DATE	BTEX	PAHs/ PHENOLS	CYANIDE	TOC	FOOTNOTES
SB01C	SOIL	4/29/98	OK	OK	OK		
SB01F	SOIL	4/29/98	OK	OK	OK		
SB02D	SOIL	4/29/98	OK	OK	OK		
SB02F	SOIL	4/29/98	OK	OK	OK		
SB03D	SOIL	4/30/98	OK	OK	OK		
SB03F	SOIL	4/30/98	OK	OK	OK		
SB04F	SOIL	4/30/98	OK	OK	OK		
SB05E	SOIL	4/30/98	OK	OK	OK		
SB06C	SOIL	5/1/98	OK	OK	OK		
SB06E	SOIL	5/1/98	OK	OK	OK		
SB08F	SOIL	5/1/98	OK	OK	OK		
SB08J	SOIL	5/1/98	OK	OK	OK		
FB01	WATER	5/1/98	OK	OK	OK		
SB09G	SOIL	5/4/98	OK	OK	OK		
SB09I	SOIL	5/4/98	OK	OK	OK		
SB10G	SOIL	5/4/98	OK	OK	OK		
SB10D	SOIL	5/4/98	OK	OK	OK		
SB11E	SOIL	5/5/98	OK	OK	OK		
SB11H	SOIL	5/5/98	OK	OK	OK		
SB12I	SOIL	5/5/98	OK	OK	OK		
SB12J	SOIL	5/5/98	OK	OK	OK		

TABLE 2.2-1 (CONTINUED)

SUMMARY OF SAMPLE ANALYSES AND USABILITY

SOIL - FOURTH STREET

SAMPLE ID	MATRIX	SAMPLE DATE	BTEX	PAHs/ PHENOLS	CYANIDE	TOC	FOOTNOTES
SB13HI	SOIL	5/6/98	OK	OK	OK		
SB13HIDUP	SOIL	5/6/98	OK	OK	OK		
SB13E	SOIL	5/6/98	OK	OK	OK		
MW05C	SOIL	5/6/98	OK	OK	OK		
MW05I	SOIL	5/6/98	OK	NO	OK		2
SB15G	SOIL	5/7/98	OK	NO	OK		2
SB15I	SOIL	5/7/98	OK	OK	OK		
MW06D	SOIL	5/7/98	OK	OK	OK		
MW06G	SOIL	5/7/98	OK	NO	OK		2
FB02	WATER	5/7/98	OK	OK	OK		
MW07D	SOIL	5/8/98	OK	OK	OK		
MW07I	SOIL	5/8/98	OK	OK	OK		
MW09D	SOIL	5/11/98	OK	OK	OK		
MW09H	SOIL	5/11/98	OK	OK	OK		
MW08F	SOIL	5/11/98	OK	OK	OK		
MW08FDUP	SOIL	5/11/98	OK	OK	OK		
MW08I	SOIL	5/11/98	OK	OK	OK		
ONFB01	WATER	5/12/98	OK	OK	OK		
SS01	SOIL	5/12/98	OK	OK	OK		
SS01DUP	SOIL	5/12/98	OK	OK	OK		
SS02	SOIL	5/12/98	OK	OK	OK		

TABLE 2.2-1 (CONTINUED)

SUMMARY OF SAMPLE ANALYSES AND USABILITY

SOIL - FOURTH STREET

SAMPLE ID	MATRIX	SAMPLE DATE	BTEX	PAHs/ PHENOLS	CYANIDE	TOC	FOOTNOTES
SS03	SOIL	5/12/98	NO	OK	OK		1
SS04	SOIL	5/12/98	OK	NO	OK		2
SS05	SOIL	5/12/98	OK	OK	OK		
OFFSS01	SOIL	5/13/98	OK	OK	OK	OK	
OFFSS02	SOIL	5/13/98	OK	OK	OK	OK	
OFFSS03	SOIL	5/13/98	OK	OK	OK	OK	
OFFSS04	SOIL	5/13/98	OK	OK	OK	OK	
OFFSS05	SOIL	5/13/98	OK	OK	OK	OK	
OFFSS06	SOIL	5/13/98	OK	OK	OK	OK	
OFFSS07	SOIL	5/13/98	OK	OK	OK	OK	
		TOTAL SAMPLES:	52	52	52	7	

NOTES: OK - Sample analysis considered usable and valid.
NO - Sample analysis has noncompliance(s) resulting in unusable data. See appropriate footnote.

FOOTNOTES:

1 - Poor BTEX sample surrogate recoveries. Reanalysis OK.

2 - Poor PAH sample surrogate recoveries.

TABLE 2.2-2

BTEX SURROGATE RECOVERY OUTLIERS
SOIL - FOURTH STREET

SAMPLE ID	BFB %R	QC LIMIT
SB02D	61	67-120
SB06E	36	67-120
SB08F	47	67-120
SB11H	37	67-120
SB11HRE	65	67-120
MW06G	54	67-120
MW06GRE	60	67-120
MW07I	42	67-120
MW07IRE	64	67-120
SS01	12	67-120
SS01RE	10	67-120
SS01DUP	41	67-120
SS01DUPRE	39	67-120
SS02	48	67-120
SS02RE	44	67-120
SS03	9	67-120
SS03RE	52	67-120
SS04	47	67-120
SS04RE	56	67-120
SS05	28	67-120
SS05RE	25	67-120
MW08FDUP	37	67-120
MW08FDUPRE	53	67-120
MW08I	62	67-120
MW09D	65	67-120
MW09H	46	67-120
OFFSS03	52	67-120
OFFSS04	20	67-120
OFFSS04RE	27	67-120
OFFSS05	36	67-120
OFFSS05RE	50	67-120
OFFSS06	20	67-120
OFFSS06RE	29	67-120
OFFSS07	48	67-120
OFFSS07RE	54	67-120

NOTES: BFB = 4-Bromofluorobenzene
%R = Percent recovery

TABLE 2.2-3

BTEX MATRIX SPIKE/MATRIX SPIKE DUPLICATE OUTLIERS
SOIL - FOURTH STREET

					QC LIMITS	
SAMPLE ID	COMPOUND	MS %R	MSD %R	RPD	%R	RPD
SB13E	Ethylbenzene	*	*	32		0-21
	Total Xylenes	*	*	22		0-21
SB09G	Ethylbenzene	62	54	*	63-137	
SB09I	Benzene	35	60	53	63-135	0-22
	Toluene	32	54	52	63-147	0-24
	Ethylbenzene	29	48	49	63-137	0-21
	Total Xylenes	31	28	*	53-147	
SS02	Benzene	*	61	*	63-135	
	Toluene	50	47	*	63-147	
	Ethylbenzene	39	37	*	63-137	
	Total Xylenes	39	37	*	63-147	
OFFSS03	Toluene	57	58	*	63-147	
	Ethylbenzene	53	56	*	63-137	

NOTES: MS/MSD = Matrix spike/matrix spike duplicate

% R = percent recovery
RPD = Relative percent difference
* = %R or RPD within QC limits.

TABLE 2.2-4
PAH AND PHENOL SAMPLE SURROGATE RECOVERY OUTLIERS
SOIL - FOURTH STREET

SAMPLE ID	NBZ %R	FBP %R	TPH %R	PHL %R	2FP %R	2CP %R	DCB %R	TBP %R
SB01C	*	29	*	*	*	*	*	*
SB02DDL	*	17	*	*	*	*	19	*
SB03DDL	*	20	*	*	*	*	*	*
SB03D	*	19	*	*	*	*	19	*
SB12I	*	29	*	*	*	*	*	*
SB13E	*	*	*	*	*	*	14	*
SB13EDL	*	*	*	*	*	*	15	*
MW05I	*	18	*	*	*	*	6	*
SB15G	*	27	*	*	*	*	9	*
SB15I	*	21	*	*	*	*	10	*
MW06G	*	12	*	*	*	*	8	*
MW07I	*	*	*	*	*	*	12	*
MW07D	*	28	*	*	*	*	*	*
SB09G	*	25	*	*	*	*	*	*
MW09H	*	15	*	*	*	*	10	*
SS04	*	*	*	22	*	*	6	13

SURROGATE ID	QC LIMITS
NBZ = Nitrobenzene-d5	23-120
FBP = 2-Fluorobiphenyl	30-115
TPH = Terphenyl-d14	18-137
PHL = Phenol-d5	24-113
2FP = 2-Fluorophenol	25-121
2CP = 2-Chlorophenol-d4	20-130
DCB = 1, 2-Dichlorobenzene - d4	20-130
TBP = 2, 4, 6-Tribromophenol	19-122

NOTES: %R = Percent recovery
* = %R within QC limits

TABLE 2.2-5

PAH AND PHENOL MSB AND MS/MSD OUTLIERS
SOIL - FOURTH STREET

					QC LIMITS	
SAMPLE ID	COMPOUND	MS %R	MSD %R	RPD	%R	RPD
SBSPK69	Pentachlorophenol	110	N/A	N/A	17-109	
SBSPK77	4-Nitrophenol	120	N/A	N/A	11-114	
SB02F	4-Nitrophenol	131	115	*	11-114	
	Pentachlorophenol	119	121	*	17-109	
SB08J	Pentachlorophenol	*	110	*	17-109	
SB091	Pyrene	27	26	*	35-142	
SS02	Phenol	*	*	59		0-35
	2-Cholorophenol	*	*	57		0-50
	1, 4-Dichlorobenzene	*	*	39		0-27
	N-Nitroso-Di-N-Propylamine	*	*	53		0-38
	1, 2, 4-Trichlorobenzene	*	*	39		0-23
	4-Chloro-3-Methylphenol	*	*	62		0-33
	Acenaphthene	*	*	57		0-19
	2, 4-Dinitrotoluene	*	*	49		0-47
	Pentachlorophenol	*	*	73		0-47
	Pyrene	16	*	158	35-142	0-36
OFF2203	1, 2, 4-Trichlorobenzene	*	*	24		0-23
	Acenaphthene	*	*	26		0-19
	Pyrene	*	*	42		0-36

NOTES: MSB = Matrix spike blank
MS/MSD = Matrix spike/Matrix spike duplicate
%R = Percent recovery
RPD = Relative percent difference
* = %R or RPD with QC limits.

TABLE 2.2-6

DETECTED PAHS AND PHENOLS IN BLANKS
SOIL - FOURTH STREET

BLANK ID	COMPOUNDS	CONCENTRATION (µg/kg)	VALIDATION ACTION CONCENTRATION [1]	AFFECTED SAMPLES
FB01	Naphthalene Phenanthrene	1 µg/L 1 µg/L	5 µg/L 5 µg/L	Samples collected from 4/29/98 through 5/1/98
FB02	Naphthalene	2 µg/L	10 µg/L	Samples collected from 5/4/98 through 5/8/98
SBLK92	Phenol	65	325	All soil samples collected on 5/11/98 and 5/12/98
SBLK94	2-Methylphenol	150	750	All soil samples collected on 5/13/98

NOTES: (1) - Defined as 10 times the blank concentration for common semivolatile contaminants (phthalate esters) and 5 times the blank concentration for all other semivolatile contaminants.

TABLE 2.2-7

PAH AND PHENOL INITIAL CALIBRATION OUTLIERS
SOIL - FOURTH STREET

INITIAL CALIBRATION DATE	COMPOUND	%RSD [1]	AFFECTED SAMPLES
5/6/98	4,6-dinitro-2-methylphenol Pentachlorophenol	35.09 35.63	FB01, SB01F, 02D,02F, 04F, FB02
5/15/98	2,4-dinitrophenol	45.85	SB01C, 03D, 03DDL, 03F, 03FDL, 05E, 06C, 06CDL, 06E, 06EDL, 08F, 08J
5/15/98	2, 4-dinitrophenol 4, 6-dinitro-2-methylphenol	46.96 31.53	All samples collected 5/4/98 through 5/8/98
6/2/98	2, 4-dinitrophenol	38.29	SS03RE, 01DL, 05DL, 01DUP, 01DUPDL
6/2/98	2,4-dinitrophenol 4,6-dinitro-2-methylphenol	51.32 42.24	MW08F, 08FDUP, 08I, 09D, 09H, SS01, 02, 03, 04, 05, all samples collected 5/13/98

NOTES: [1] - Relative Standard Deviation.

TABLE 2.2-8

PAH AND PHENOL CONTINIUNG CALIBRATION OUTLIERS
SOIL - FOURTH STREET

CONTINUING CALIBRATION DATE	COMPOUND	%D (1)	AFFECTED SAMPLES
5/15/98	2,4-Dinitrophenol	33.5	SB08F, 08J, 06C, 06E
5/16/98	2,4-Dinitrophenol	-52.9	SB01C, 03D, 03F, 05E
5/18/98	2,4-Dinitrophenol 4,6-Dinitro-2-Methylphenol	47.9 26.4	SB03DDL, 03FDL, 06CDL, 06EDL
5/13/98	2,4-Dinitrophenol	45.9	FB02
5/16/98	4-Nitrophenol Benzo(g,h,i)Perylene	-26.4 26.1	SB13EDL
6/3/98	4, 6-Dinitro-2-Methylphenol	-25.7	SS01, 02, 03, 04, 05, MW09D, All samples collected 5/13/98
6/15/98	2,4-Dinitrophenol 4-Nitrophenol Pentachlorophenol	38.9 29.3 29.8	SS01DUP, 01DUPDL

NOTES: (1) - Percent Difference.

TABLE 2.2-9

PAH AND PHENOL INTERNAL STANDARD (IS) OUTLIERS
SOIL - FOURTH STREET

Sample ID	IS 1 Area	IS 2 Area	IS 3 Area	IS 4 Area	IS 5 Area	IS 6 Area
SB06E	*	*	*	*	*	2111886
SS03RE	*	*	*	*	*	440162
SS01DUP	*	*	*	*	*	311510
SS02	*	*	*	*	*	927644
SS01	*	*	*	*	1088455	572723
SS03	*	*	*	*	*	1092014
OFFSS03	*	*	*	*	*	1032846

INTERNAL STANDARD	QC LIMITS
IS1 = 1,4-Dichlorobenzene-d4	
IS2 = Naphthalene-d8	
IS3 = Acenaphthene-d10	
IS4 = Phenanthrene-d10	
IS5 =Chrysene-d12	1173801-4695204 FOR SS01
IS6 = Perylene-d12	518058-2072232 for SB06E 494620-1978478 for SS03RE 408906-1635622 for SS01DUP 1114523-4458092 for SS02, 01, 03 and OFFSS03

NOTES: * - Internal standard response within QC limits.

ATTACHMENT A
VALIDATED LABORATORY DATA

ATTACHMENT A-1
VALIDATED GROUNDWATER DATA

BURA 4TH STREET VALIDATED GROUNDWATER ANALYTICAL SDG: PE721		SAMPLE ID: LAB ID: SOURCE: SDG: MATRIX: SAMPLED: VALIDATED:	MW-03 186721-03 STL PE721 WATER 05/15/98 07/03/98	MW-04 186721-02 STL PE721 WATER 05/15/98 07/03/98	MW-05 186721-06 STL PE721 WATER 05/15/98 07/03/98	MW-06 186721-08 STL PE721 WATER 05/15/98 07/03/98	MW-07 186721-07 STL PE721 WATER 05/15/98 07/03/98	MW-08 186721-05 STL PE721 WATER 05/15/98 07/03/98	MW-08DUP 186721-09 STL PE721 WATER 05/15/98 07/03/98	MW-09 186721-04 STL PE721 WATER 05/15/98 07/03/98	TRIP BLANK 186721-01 STL PE721 WATER 05/15/98 07/03/98
CAS NO	COMPOUND	UNITS:									
	BTEX										
71-43-2	Benzene	ug/l	1.5	0.7 J	4	0.5 J	1 U	1 U	1 U	1900	1 U
108-88-3	Toluene	ug/l	1 U	1 U	1.9	1.1	1 U	1 U	1 U	2.4	1 U
100-41-4	Ethylbenzene	ug/l	1 U	2.7	13	1 U	1 U	1 U	1 U	41	1 U
1330-20-7	Xylenes, total	ug/l	1 U	7.9	2.8	1.3	1 U	1 U	1 U	44	1 U
BTEX	Total BTEX	ug/l	1.5	11.3	21.7	2.9	ND	ND	ND	1987.4	ND
	PAHs										
91-20-3	Naphthalene	ug/l	10 U	10 U	4 J	11 U	10 U	11 U	10 U	10 U	
208-96-8	Acenaphthylene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
83-32-9	Acenaphthene	ug/l	2 J	10 U	10 U	11 U	10 U	11 U	10 U	7 J	
132-64-9	Dibenzofuran	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
86-73-7	Fluorene	ug/l	1 J	10 U	10 U	11 U	10 U	11 U	10 U	2 J	
85-01-8	Phenanthrene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
120-12-7	Anthracene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
206-44-0	Fluoranthene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
129-00-0	Pyrene	ug/l	1 J	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
56-55-3	Benzo(a)anthracene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
218-01-9	Chrysene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
205-99-2	Benzo(b)fluoranthene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
207-08-9	Benzo(k)fluoranthene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
50-32-8	Benzo(a)pyrene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
193-39-5	Indeno(1,2,3-cd)pyrene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
53-70-3	Dibenz(a,h)anthracene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
191-24-2	Benzo(g,h,i)perylene	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
PAHs	Total PAHs	ug/l	13	ND	4	ND	ND	ND	ND	9	
	PHENOLS										
108-95-2	Phenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	42	
95-57-8	2-Chlorophenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
95-48-7	2-Methylphenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
106-44-5	4-Methylphenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
88-75-5	2-Nitrophenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
105-67-9	2,4-Dimethylphenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
120-83-2	2,4-Dichlorophenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
59-50-7	4-Chloro-3-methylphenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
88-06-2	2,4,6-Trichlorophenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
95-95-4	2,4,5-Trichlorophenol	ug/l	10 U	10 U	10 U	11 U	10 U	11 U	10 U	10 U	
51-28-5	2,4-Dinitrophenol	ug/l	25 UJ	25 UJ	25 UJ	28 UJ	25 UJ	28 UJ	25 UJ	25 UJ	
100-02-7	4-Nitrophenol	ug/l	25 UJ	25 UJ	25 UJ	28 UJ	25 UJ	28 UJ	25 UJ	25 UJ	
534-52-1	4,6-Dinitro-2-methylphenol	ug/l	25 UJ	25 UJ	25 UJ	28 UJ	25 UJ	28 UJ	25 UJ	25 UJ	
87-86-5	Pentachlorophenol	ug/l	25 U	25 U	25 U	28 U	25 U	28 U	25 U	25 U	
PHENOLS	Total Phenols	ug/l	ND	ND	ND	ND	ND	ND	ND	42	
	INORGANICS										
57-12-9	Cyanide	ug/l	85	10 U	11	10 U	10 U	10 U	10 U	13	

ATTACHMENT A-2
VALIDATED SOIL DATA

BURA
4TH STREET
VALIDATED SOIL ANALYTICAL DATA
SDG: PE141

		SAMPLE ID:	MW-5C	MW-5I	MW-06D	MW-06G	MW-07D	MW-07I	SB-09G	SB-09I	SB-10D	SB-10G
		DEPTH:	4-6'	16-18'	6-8'	12-14'	6-8'	16-18'	12-14'	16-18'	6-8'	12-14'
		LAB ID:	186319-04	186319-05	186319-09	186319-10	186375-01	186375-02	186141-01	186141-02	186141-04	186141-03
		SOURCE:	STL	STL	STL	STL	STL	STL	STL	STL	STL	STL
		SDG:	PE141	PE141	PE141	PE141	PE141	PE141	PE141	PE141	PE141	PE141
		MATRIX:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		SAMPLED:	05/06/98	05/06/98	05/06/98	05/06/98	05/08/98	05/06/98	05/04/98	05/04/98	05/04/98	05/04/98
		VALIDATED:	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98
CAS NO.	COMPOUND	UNITS:										
	BTEX											
71-43-2	Benzene	ug/Kg	340 U	1.1 U	1.3 U	1.3 UJ	1.4 U	1.3 UJ	0.8 J	1.4 U	6.2 U	85 J
108-88-3	Toluene	ug/Kg	340 U	1.1 U	1.3 U	1.3 UJ	1.4 U	1.3 UJ	1.4	1.4 U	6.2 U	0.8 J
100-41-4	Ethylbenzene	ug/Kg	340 U	1.1 U	1.3 U	1.3 UJ	1.4 U	1.3 UJ	1.3 U	1.4 U	6.2 U	1.4 U
1330-20-7	Xylenes, total	ug/Kg	430	1.1 U	1.3 U	1.3 UJ	1.4 U	1.3 UJ	1.8	1.4 U	31	7.2
BTEX	Total BTEX	ug/Kg	430	ND	ND	ND	ND	ND	4	ND	31	93
	PAHs											
91-20-3	Naphthalene	ug/Kg	660	R	430 U	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
208-96-8	Acenaphthylene	ug/Kg	450 U	R	430 U	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
83-32-9	Acenaphthene	ug/Kg	450 U	R	430 U	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
132-64-9	Dibenzofuran	ug/Kg	450 U	R	430 U	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
86-73-7	Fluorene	ug/Kg	450 U	R	430 U	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
85-01-8	Phenanthrene	ug/Kg	120 J	R	170 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
120-12-7	Anthracene	ug/Kg	450 U	R	430 U	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
206-44-0	Fluoranthene	ug/Kg	140 J	R	270 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
129-00-0	Pyrene	ug/Kg	130 J	R	230 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
56-55-3	Benzo(a)anthracene	ug/Kg	76 J	R	150 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
218-01-9	Chrysene	ug/Kg	69 J	R	140 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
205-99-2	Benzo(b)fluoranthene	ug/Kg	73 J	R	150 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
207-08-9	Benzo(k)fluoranthene	ug/Kg	450 U	R	47 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
50-32-8	Benzo(a)pyrene	ug/Kg	55 J	R	120 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
193-39-5	Indeno(1,2,3-cd)pyrene	ug/Kg	450 U	R	54 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
53-70-3	Dibenz(a,h)anthracene	ug/Kg	450 U	R	430 U	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
191-24-2	Benzo(g,h,i)perylene	ug/Kg	450 U	R	43 J	R	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
PAHs	Total PAHs	ug/Kg	1323	R	1374	R	ND	ND	ND	ND	ND	ND
	PHENOLS											
108-95-2	Phenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
95-57-8	2-Chlorophenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
95-48-7	2-Methylphenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
106-44-5	4-Methylphenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
88-75-5	2-Nitrophenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
105-67-9	2,4-Dimethylphenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
120-83-2	2,4-Dichlorophenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
59-50-7	4-Chloro-3-methylphenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
88-06-2	2,4,6-Trichlorophenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
95-95-4	2,4,5-Trichlorophenol	ug/Kg	450 U	380 U	430 U	420 U	450 U	430 U	420 UJ	480 UJ	410 UJ	460 UJ
51-28-5	2,4-Dinitrophenol	ug/Kg	1100 U	960 U	1100 U	1100 U	1100 U	1100 U	1100 UJ	1200 UJ	1000 UJ	1100 UJ
100-02-7	4-Nitrophenol	ug/Kg	1100 U	960 U	1100 U	1100 U	1100 U	1100 U	1100 UJ	1200 UJ	1000 UJ	1100 UJ
534-52-1	4,6-Dinitro-2-methylphenol	ug/Kg	1100 U	960 U	1100 U	1100 U	1100 U	1100 U	1100 UJ	1200 UJ	1000 UJ	1100 UJ
87-86-5	Pentachlorophenol	ug/Kg	1100 U	960 U	1100 U	1100 U	1100 U	1100 U	1100 UJ	1200 UJ	1000 UJ	1100 UJ
PHENOLS	Total Phenols	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	INORGANICS											
57-12-9	Cyanide	mg/Kg	1.3 U	1.1 U	1.3 U	1.3 U	1.3 U	1.3 U	1.2 U	1.4 U	1.2 U	1.4 U
SOLIDS	Percent Solids	%	74.5	87.2	77.6	78.8	73.6	77.2	79.1	69.9	81.3	73.2

BURA
4TH STREET
VALIDATED SOIL ANALYTICAL DATA
SDG: PE141

CAS NO.	COMPOUND	UNITS:	SB-11E 8-10' 186141-05 STL PE141 SOIL 05/05/98 07/03/98	SB-11H 14-16' 186141-06 STL PE141 SOIL 05/05/98 07/03/98	SB-12I 16-18' 186141-07 STL PE141 SOIL 05/05/98 07/03/98	SB-12J 18-20' 186141-08 STL PE141 SOIL 05/05/98 07/03/98	SB-13E 8-10' 186319-03 STL PE141 SOIL 05/06/98 07/03/98	SB-13HI 14-18' 186319-01 STL PE141 SOIL 05/06/98 07/03/98	SB-13HI-DUP 14-18' 186319-02 STL PE141 SOIL 05/06/98 07/03/98	SB-15G 12-14' 186319-06 STL PE141 SOIL 05/07/98 07/03/98	SB-15I 16-18' 186319-07 STL PE141 SOIL 05/07/98 07/03/98	FB-02 186319-08 STL PE141 WATER 05/07/98 07/03/98 ug/L
	BTEX											
71-43-2	Benzene	ug/Kg	1.2 U	1.2 UJ	13000	180	1900	160 J	30 J	1.1 U	1.1 U	1 U
108-88-3	Toluene	ug/Kg	1.2 U	1.2 UJ	370	5.8	1900	3.3 J	5 U	1.1 U	1.2	1 U
100-41-4	Ethylbenzene	ug/Kg	1.2 U	1.2 UJ	5900	240	11000	100 J	25 J	1.1 U	1.1 U	1 U
1330-20-7	Xylenes, total	ug/Kg	1.2 U	1.2 UJ	14000	540	17000	140 J	39 J	1.1 U	2.1	1 U
BTEX	Total BTEX	ug/Kg	ND	ND	33270	965.8	31800	403.3	94	ND	3.3	ND
	PAHs											
91-20-3	Naphthalene	ug/Kg	400 UJ	400 UJ	810 J	910 J	4800	180 J	160 J	R	370 UJ	2 J
208-96-8	Acenaphthylene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	830	370 U	370 U	R	370 UJ	10 U
83-32-9	Acenaphthene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	650	370 U	370 U	R	370 UJ	10 U
132-64-9	Dibenzofuran	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	430	370 U	370 U	R	370 UJ	10 U
86-73-7	Fluorene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	1200	370 U	370 U	R	370 UJ	10 U
85-01-8	Phenanthrene	ug/Kg	44 J	400 UJ	440 UJ	360 UJ	4300	370 U	370 U	R	370 UJ	10 U
120-12-7	Anthracene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	1200	370 U	370 U	R	370 UJ	10 U
206-44-0	Fluoranthene	ug/Kg	52 J	400 UJ	440 UJ	360 UJ	1600	370 U	370 U	R	370 UJ	10 U
129-00-0	Pyrene	ug/Kg	41 J	400 UJ	440 UJ	380 UJ	2500	370 U	370 U	R	370 UJ	10 U
56-55-3	Benzo(a)anthracene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	920	370 U	370 U	R	370 UJ	10 U
218-01-9	Chrysene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	780	370 U	370 U	R	370 UJ	10 U
205-99-2	Benzo(b)fluoranthene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	630	370 U	370 U	R	370 UJ	10 U
207-08-9	Benzo(k)fluoranthene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	210 J	370 U	370 U	R	370 UJ	10 U
50-32-8	Benzo(a)pyrene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	870	370 U	370 U	R	370 UJ	10 U
193-39-5	Indeno(1,2,3-cd)pyrene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	260 J	370 U	370 U	R	370 UJ	10 U
53-70-3	Dibenz(a,h)anthracene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	R	370 UJ	10 U
191-24-2	Benzo(g,h,i)perylene	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	290 J	370 U	370 U	R	370 UJ	10 U
PAHs	Total PAHs	ug/Kg	137	ND	810	910	21470	180	160	R	ND	2
	PHENOLS											
108-95-2	Phenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
95-57-8	2-Chlorophenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
95-48-7	2-Methylphenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
106-44-5	4-Methylphenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
88-75-5	2-Nitrophenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
105-67-9	2,4-Dimethylphenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
120-83-2	2,4-Dichlorophenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
59-50-7	4-Chloro-3-methylphenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
88-06-2	2,4,6-Trichlorophenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
95-95-4	2,4,5-Trichlorophenol	ug/Kg	400 UJ	400 UJ	440 UJ	360 UJ	410 U	370 U	370 U	370 U	370 U	10 U
51-28-5	2,4-Dinitrophenol	ug/Kg	990 UJ	990 UJ	1100 UJ	910 UJ	1000 U	940 U	930 U	930 U	920 U	25 UJ
100-02-7	4-Nitrophenol	ug/Kg	990 UJ	990 UJ	1100 UJ	910 UJ	1000 U	940 U	930 U	930 U	920 U	25 U
534-52-1	4,6-Dinitro-2-methylphenol	ug/Kg	990 UJ	990 UJ	1100 UJ	910 UJ	1000 U	940 U	930 U	930 U	920 U	25 U
87-86-5	Pentachlorophenol	ug/Kg	990 UJ	990 UJ	1100 UJ	910 UJ	1000 U	940 U	930 U	930 U	920 U	25 U
PHENOLS	Total Phenols	ug/Kg	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	INORGANICS											
57-12-9	Cyanide	mg/Kg	1.2 U	1.2 U	1.3 U	1.1 U	1.2 U	1.1 U	1.1 U	1.1 U	1.1 U	10 U
SOLIDS	Percent Solids	%	84.2	84	74.6	92.1	81.6	89.3	89.6	90.3	91.1	

BURA 4TH STREET VALIDATED SOIL ANALYTICAL DATA SDG: PE525		SAMPLE ID: DEPTH: LAB ID: SOURCE: SDG: MATRIX: SAMPLED: VALIDATED:	MW-08F 10-12' 186525-10 STL PE525 SOIL 05/11/98 07/03/98	MW-08FDUP 10-12' 186525-11 STL PE525 SOIL 05/11/98 07/03/98	MW-08I 16-18' 186525-12 STL PE525 SOIL 05/11/98 07/03/98	MW-09D 6-8' 186525-08 STL PE525 SOIL 05/11/98 07/03/98	MW-09H 14-16' 186525-09 STL PE525 SOIL 05/11/98 07/03/98	SS-01 0-0.5 186525-02 STL PE525 SOIL 05/12/98 07/03/98	SS-01DUP 0-0.5 186525-03 STL PE525 SOIL 05/12/98 07/03/98	SS-02 0-0.5 186525-04 STL PE525 SOIL 05/12/98 07/03/98	SS-03 0-0.5 186525-05 STL PE525 SOIL 05/12/98 07/03/98	SS-04 0-0.5 186525-06 STL PE525 SOIL 05/12/98 07/03/98	SS-05 0-0.5 186525-07 STL PE525 SOIL 05/12/98 07/03/98	ONFB01 186525-01 STL PE525 WATER 05/12/98 07/03/98
CAS NO.	COMPOUND	UNITS:												ug/L
	BTEX													
71-43-2	Benzene	ug/Kg	1.3 U	1.3 UJ	1.2 UJ	3.3 J	230	1.2 UJ	1.2 UJ	1.1 UJ	1.2 UJ	1.3 UJ	1.3 UJ	1 U
108-88-3	Toluene	ug/Kg	1.3 U	1.3 UJ	1.1 J	1.3 UJ	5.9 U	1.2 UJ	1.2 UJ	1.1 UJ	1.2 UJ	1.3 UJ	1.3 UJ	1 U
100-41-4	Ethylbenzene	ug/Kg	1.3 U	1.3 UJ	1.2 UJ	1.3 UJ	190	1.2 UJ	1.2 UJ	1.1 UJ	1.2 UJ	1.3 UJ	1.3 UJ	1 U
1330-20-7	Xylenes, total	ug/Kg	1.3 U	1.3 UJ	1.2 UJ	1.3 UJ	150	1.2 UJ	1.2 UJ	1.1 UJ	1.2 UJ	1.3 UJ	1.3 UJ	1 U
BTEX	Total BTEX	ug/Kg	ND	ND	1.1	3.3	570	ND	ND	ND	ND	ND	ND	ND
	PAHs													
91-20-3	Naphthalene	ug/Kg	430 UJ	430 UJ	390 UJ	330 J	400 UJ	1400 J	310 J	130 J	56 J	R	280 J	R
208-96-8	Acenaphthylene	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	440 J	350 J	380 UJ	410 UJ	R	150 J	R
83-32-9	Acenaphthene	ug/Kg	430 UJ	430 UJ	390 UJ	400 J	400 UJ	2100 J	81 J	150 J	410 UJ	R	360 J	R
132-64-9	Dibenzofuran	ug/Kg	430 UJ	430 UJ	390 UJ	260 J	400 UJ	1800 J	100 J	110 J	410 UJ	R	320 J	R
86-73-7	Fluorene	ug/Kg	430 UJ	430 UJ	390 UJ	520 J	400 UJ	2400 J	170 J	180 J	410 UJ	58 J	440 J	R
85-01-8	Phenanthrene	ug/Kg	430 UJ	430 UJ	390 UJ	1600 J	400 UJ	24000 J	1400 J	1500 J	150 J	180 J	4700 J	R
120-12-7	Anthracene	ug/Kg	430 UJ	430 UJ	390 UJ	720 J	400 UJ	7800 J	400 J	390 J	410 UJ	48 J	1000 J	R
206-44-0	Fluoranthene	ug/Kg	430 UJ	430 UJ	390 UJ	1100 J	400 UJ	21000 J	2300 J	1400 J	240 J	250 J	6300 J	R
129-00-0	Pyrene	ug/Kg	430 UJ	430 UJ	390 UJ	1300 J	400 UJ	18000 J	2600 J	1700 J	300 J	56 J	5900 J	R
56-55-3	Benzo(a)anthracene	ug/Kg	430 UJ	430 UJ	390 UJ	850 J	400 UJ	11000 J	1700 J	990 J	240 J	200 J	3100 J	R
218-01-9	Chrysene	ug/Kg	430 UJ	430 UJ	390 UJ	700 J	400 UJ	8800 J	1700 J	840 J	250 J	120 J	2700 J	R
205-99-2	Benzo(b)fluoranthene	ug/Kg	430 UJ	430 UJ	390 UJ	610 J	400 UJ	15000 J	2900 J	1300 J	620 J	120 J	5100 J	R
207-08-9	Benzo(k)fluoranthene	ug/Kg	430 UJ	430 UJ	390 UJ	250 J	400 UJ	4900 J	1000 J	330 J	230 J	66 J	920 J	R
50-32-8	Benzo(a)pyrene	ug/Kg	82 J	59 J	390 UJ	510 J	400 UJ	10000 J	2200 J	730 J	490 J	R	2700 J	R
193-39-5	Indeno(1,2,3-cd)pyrene	ug/Kg	430 UJ	430 UJ	390 UJ	200 J	400 UJ	3500 J	1000 J	390 J	430 J	R	1200 J	R
53-70-3	Dibenz(a,h)anthracene	ug/Kg	430 UJ	430 UJ	390 UJ	64 J	400 UJ	1000 J	270 J	98 J	110 J	R	380 J	R
191-24-2	Benzo(g,h,i)perylene	ug/Kg	430 UJ	430 UJ	390 UJ	150 J	400 UJ	3200 J	1100 J	380 J	410 J	R	860 J	R
PAHs	Total PAHs	ug/Kg	82	59	ND	9564	ND	1E+05	19581	10618	3526	1098	36410	R
	PHENOLS													
108-95-2	Phenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
95-57-8	2-Chlorophenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
95-48-7	2-Methylphenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
106-44-5	4-Methylphenol	ug/Kg	430 UJ	430 UJ	390 UJ	59 J	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
88-75-5	2-Nitrophenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
105-67-9	2,4-Dimethylphenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
120-83-2	2,4-Dichlorophenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
59-50-7	4-Chloro-3-methylphenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
88-06-2	2,4,6-Trichlorophenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
95-95-4	2,4,5-Trichlorophenol	ug/Kg	430 UJ	430 UJ	390 UJ	420 UJ	400 UJ	400 UJ	390 UJ	380 UJ	410 UJ	430 UJ	430 UJ	R
51-28-5	2,4-Dinitrophenol	ug/Kg	1100 UJ	1100 UJ	980 UJ	1100 UJ	990 UJ	990 UJ	970 UJ	960 UJ	1000 UJ	1100 UJ	1100 UJ	R
100-02-7	4-Nitrophenol	ug/Kg	1100 UJ	1100 UJ	980 UJ	1100 UJ	990 UJ	990 UJ	970 UJ	960 UJ	1000 UJ	1100 UJ	1100 UJ	R
534-52-1	4,6-Dinitro-2-methylphenol	ug/Kg	1100 UJ	1100 UJ	980 UJ	1100 UJ	990 UJ	990 UJ	970 UJ	960 UJ	1000 UJ	1100 UJ	1100 UJ	R
87-86-5	Pentachlorophenol	ug/Kg	1100 UJ	1100 UJ	980 UJ	1100 UJ	990 UJ	990 UJ	970 UJ	960 UJ	1000 UJ	1100 UJ	1100 UJ	R
PHENOLS	Total Phenols	ug/Kg	ND	ND	ND	59	ND	ND	ND	ND	ND	ND	ND	R
	INORGANICS													
57-12-9	Cyanide	mg/Kg	1.2 U	1.3 U	1.1 U	2.9	1.2 U	1.4	1.6	1.6	7.2	1.3 U	1.3 U	10 U
SOLIDS	Percent Solids	%	76.8	77.6	85.4	79	84.2	84.1	86.5	87.4	82.2	78	77.2	

BURA
4TH STREET
VALIDATED SOIL ANALYTICAL DATA
SDG: PE597

CAS NO.	COMPOUND	UNITS:	SAMPLE ID:	OFFSS01	OFFSS02	OFFSS03	OFFSS04	OFFSS05	OFFSS06	OFFSS07
			DEPTH:	0-0 5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'	0-0.5'
			LAB ID:	186597-01	186597-02	186597-03	186597-04	186597-05	186597-06	186597-07
			SOURCE:	STL	STL	STL	STL	STL	STL	STL
			SDG:	PE597	PE597	PE597	PE597	PE597	PE597	PE597
			MATRIX:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			SAMPLED:	05/13/98	05/13/98	05/13/98	05/13/98	05/13/98	05/13/98	05/13/98
			VALIDATED:	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98	07/03/98
	BTEX									
71-43-2	Benzene	ug/Kg		1.1 U	1.2 U	1.2 UJ	1.3 UJ	1.3 UJ	1.2 UJ	1.2 UJ
108-88-3	Toluene	ug/Kg		1.1 U	1.2 U	1.2 UJ	1.3 UJ	1.3 UJ	1.2 UJ	1.2 UJ
100-41-4	Ethylbenzene	ug/Kg		1.1 U	1.2 U	1.2 UJ	1.3 UJ	1.3 UJ	1.2 UJ	1.2 UJ
1330-20-7	Xylenes, total	ug/Kg		1.1 U	1.2 U	1.2 UJ	1.3 UJ	1.3 UJ	1.2 UJ	1.2 UJ
BTEX	Total BTEX	ug/Kg		ND	ND	ND	ND	ND	ND	ND
	PAHs									
91-20-3	Naphthalene	ug/Kg		300 J	390 UJ	91 J	440 UJ	440 UJ	160 J	50 J
208-96-8	Acenaphthylene	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	120 J	390 UJ
83-32-9	Acenaphthene	ug/Kg		330 J	85 J	200 J	440 UJ	440 UJ	230 J	130 J
132-64-9	Dibenzofuran	ug/Kg		250 J	58 J	110 J	440 UJ	440 UJ	170 J	79 J
86-73-7	Fluorene	ug/Kg		320 J	97 J	190 J	440 UJ	440 UJ	270 J	160 J
85-01-8	Phenanthrene	ug/Kg		2400 J	810 J	1500 J	96 J	300 J	2500 J	1300 J
120-12-7	Anthracene	ug/Kg		650 J	210 J	450 J	440 UJ	71 J	650 J	370 J
206-44-0	Fluoranthene	ug/Kg		2500 J	780 J	1900 J	150 J	380 J	2800 J	1500 J
129-00-0	Pyrene	ug/Kg		2300 J	770 J	1700 J	140 J	370 J	2700 J	1600 J
56-55-3	Benzo(a)anthracene	ug/Kg		1500 J	440 J	1200 J	74 J	210 J	1800 J	960 J
218-01-9	Chrysene	ug/Kg		1300 J	410 J	1000 J	76 J	210 J	1600 J	850 J
205-99-2	Benzo(b)fluoranthene	ug/Kg		2000 J	470 J	1600 J	96 J	250 J	2500 J	1000 J
207-08-9	Benzo(k)fluoranthene	ug/Kg		560 J	160 J	520 J	440 UJ	92 J	650 J	290 J
50-32-8	Benzo(a)pyrene	ug/Kg		1200 J	350 J	990 J	69 J	190 J	1600 J	730 J
193-39-5	Indeno(1,2,3-cd)pyrene	ug/Kg		420 J	190 J	400 J	44 J	120 J	560 J	390 J
53-70-3	Dibenz(a,h)anthracene	ug/Kg		120 J	53 J	110 J	440 UJ	440 UJ	190 J	100 J
191-24-2	Benzo(g,h,i)perylene	ug/Kg		300 J	170 J	310 J	440 UJ	110 J	430 J	310 J
PAHs	Total PAHs	ug/Kg		16450	5053	12271	745	2303	18930	9819
	PHENOLS									
108-95-2	Phenol	ug/Kg		380 UJ	69 J	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
95-57-8	2-Chlorophenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
95-48-7	2-Methylphenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
106-44-5	4-Methylphenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
88-75-5	2-Nitrophenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
105-67-9	2,4-Dimethylphenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
120-83-2	2,4-Dichlorophenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
59-50-7	4-Chloro-3-methylphenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
88-06-2	2,4,6-Trichlorophenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
95-95-4	2,4,5-Trichlorophenol	ug/Kg		380 UJ	390 UJ	390 UJ	440 UJ	440 UJ	410 UJ	390 UJ
51-28-5	2,4-Dinitrophenol	ug/Kg		960 UJ	970 UJ	980 UJ	1100 UJ	1100 UJ	1000 UJ	970 UJ
100-02-7	4-Nitrophenol	ug/Kg		960 UJ	970 UJ	980 UJ	1100 UJ	1100 UJ	1000 UJ	970 UJ
534-52-1	4,6-Dinitro-2-methylphenol	ug/Kg		960 UJ	970 UJ	980 UJ	1100 UJ	1100 UJ	1000 UJ	970 UJ
87-86-5	Pentachlorophenol	ug/Kg		960 UJ	970 UJ	980 UJ	1100 UJ	1100 UJ	1000 UJ	970 UJ
PHENOLS	Total Phenols	ug/Kg		ND	69	ND	ND	ND	ND	ND
	INORGANICS									
57-12-9	Cyanide	mg/Kg		1.1 U	1.1 U	1.2 U	1.3 U	1.3 U	1.1 U	1.2 U
SOLIDS	Percent Solids	%		87.3	86.5	85.5	75.9	76 5	81	85.6
7440-44-0	Total Organic Carbon	mg/Kg		34800	29200	35800	53900	49600	57500	60100

BURA
4TH STREET
VALIDATED SOIL ANALYTICAL DATA
SDG: PE948

CAS NO	COMPOUND	UNITS	SB-01C 4-6' 185948-01 STL PE948 SOIL 04/29/98 07/03/98	SB-01F 10-12' 185948-02 STL PE948 SOIL 04/29/98 07/03/98	SB-02D 6-8' 185948-03 STL PE948 SOIL 04/29/98 07/03/98	SB-02F 10-12' 185948-04 STL PE948 SOIL 04/29/98 07/03/98	SB-03D 6-8' 185948-05 STL PE948 SOIL 04/30/98 07/03/98	SB-03F 10-12' 185948-06 STL PE948 SOIL 04/30/98 07/03/98	SB-04F 10-12' 185948-07 STL PE948 SOIL 04/30/98 07/03/98	SB-05E 8-10' 185948-08 STL PE948 SOIL 04/30/98 07/03/98	SB-06C 4-6' 185988-01 STL PE948 SOIL 05/01/98 07/03/98
	BTEX										
71-43-2	Benzene	ug/Kg	1.2 U	1.2 U	1.3 U	1.2 U	3600	850	1.3 U	310 U	1800
108-88-3	Toluene	ug/Kg	1.2 U	1.2 U	1.3 U	1.2 U	1100 U	340	1.3 U	310 U	400 U
100-41-4	Ethylbenzene	ug/Kg	1.2 U	1.2 U	1.3 U	1.2 U	7900	440	1.3 U	260 J	19000
1330-20-7	Xylenes, total	ug/Kg	1.2 U	1.2 U	1.3 U	1.2 U	6500	940	3	380	9500
BTEX	Total BTEX	ug/Kg	ND	ND	ND	ND	18000	2570	3	640	30300
	PAHs										
91-20-3	Naphthalene	ug/Kg	310 J	400 U	430 U	400 U	41000	41000	430 U	1800	58000
208-96-8	Acenaphthylene	ug/Kg	120 J	400 U	430 U	400 U	860 J	7000	430 U	230 J	1200
83-32-9	Acenaphthene	ug/Kg	330 J	400 U	430 U	400 U	12000	1600 J	430 U	590	11000
132-64-9	Dibenzofuran	ug/Kg	350 J	400 U	430 U	400 U	8600	6100	430 U	570	1100
86-73-7	Fluorene	ug/Kg	480	400 U	430 U	400 U	9800	6800	430 U	1100	7300 J
85-01-8	Phenanthrene	ug/Kg	2600	400 U	430 U	400 U	30000	26000	430 U	2800	30000
120-12-7	Anthracene	ug/Kg	810	400 U	430 U	400 U	7500	9400	430 U	640	9100 J
206-44-0	Fluoranthene	ug/Kg	2200	400 U	430 U	400 U	17000	15000	60 J	1500	19000
129-00-0	Pyrene	ug/Kg	1700	400 U	430 U	400 U	13000	11000	83 J	1400	29000
56-55-3	Benzo(a)anthracene	ug/Kg	1100	400 U	430 U	400 U	9200	6200	430 U	690	11000
218-01-9	Chrysene	ug/Kg	1000	400 U	430 U	400 U	7600	5600	430 U	620	9400 J
205-99-2	Benzo(b)fluoranthene	ug/Kg	930	400 U	430 U	400 U	8600	6000	430 U	570	9200 J
207-08-9	Benzo(k)fluoranthene	ug/Kg	340 J	400 U	430 U	400 U	3600	2000	430 U	230 J	2700
50-32-8	Benzo(a)pyrene	ug/Kg	780	400 U	430 U	400 U	8100	5300	430 U	600	9300 J
193-39-5	Indeno(1,2,3-cd)pyrene	ug/Kg	350 J	400 U	430 U	400 U	4100	3200	430 U	280 J	3000
53-70-3	Dibenz(a,h)anthracene	ug/Kg	110 J	400 U	430 U	400 U	1100 J	680 J	430 U	87 J	900
191-24-2	Benzo(g,h,i)perylene	ug/Kg	290 J	400 U	430 U	400 U	3100	2700	430 U	280 J	780
PAHs	Total PAHs	ug/Kg	13800	ND	ND	ND	185160	155580	143	13987	211980
	PHENOLS										
108-95-2	Phenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	2000 U	430 U	420 U	540 U
95-57-8	2-Chlorophenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	2000 U	430 U	420 U	540 U
95-48-7	2-Methylphenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	270 JN	430 U	420 U	540 U
106-44-5	4-Methylphenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	350 J	430 U	420 U	540 U
88-75-5	2-Nitrophenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	2000 U	430 U	420 U	540 U
105-67-9	2,4-Dimethylphenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	730 J	430 U	420 U	540 U
120-83-2	2,4-Dichlorophenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	2000 U	430 U	420 U	540 U
59-50-7	4-Chloro-3-methylphenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	2000 U	430 U	420 U	540 U
88-06-2	2,4,6-Trichlorophenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	2000 U	430 U	420 U	540 U
95-95-4	2,4,5-Trichlorophenol	ug/Kg	410 U	400 U	430 U	400 U	2900 U	2000 U	430 U	420 U	540 U
51-28-5	2,4-Dinitrophenol	ug/Kg	1000 UJ	1000 U	1100 U	1000 U	7300 UJ	5100 UJ	1100 U	1100 UJ	1300 UJ
100-02-7	4-Nitrophenol	ug/Kg	1000 U	1000 U	1100 U	1000 U	7300 U	5100 U	1100 U	1100 U	1300 U
534-52-1	4,6-Dinitro-2-methylphenol	ug/Kg	1000 U	1000 U	1100 U	1000 U	7300 U	5100 U	1100 U	1100 U	1300 U
87-86-5	Pentachlorophenol	ug/Kg	1000 U	1000 U	1100 U	1000 U	7300 U	5100 U	1100 U	1100 U	1300 U
PHENOLS	Total Phenols	ug/Kg	ND	ND	ND	ND	ND	1350	ND	ND	ND
	INORGANICS										
57-12-9	Cyanide	mg/Kg	1.1 UJ	1.1 UJ	1.2 UJ	1.1 UJ	4.2 J	1.1 UJ	1.2 UJ	1.2 UJ	46.3 J
SOLIDS	Percent Solids	%	81.4	83.1	77.6	83	57.3	82	77.5	79.4	62.5

BURA 4TH STREET VALIDATED SOIL ANALYTICAL DATA SDG. PE948		SAMPLE ID: DEPTH: LAB ID: SOURCE: SDG: MATRIX: SAMPLED: VALIDATED:	SB-06E 8-10' 185988-02 STL PE948 SOIL 05/01/98 07/03/98	SB-08F 10-12' 185988-04 STL PE948 SOIL 05/01/98 07/03/98	SB-08J 20-22' 185988-05 STL PE948 SOIL 05/01/98 07/03/98	FB-01 185988-03 STL PE948 WATER 05/01/98 07/03/98
CAS NO.	COMPOUND	UNITS:				ug/L
	BTEX					
71-43-2	Benzene	ug/Kg	960	1.2 U	1.2 U	1 U
108-88-3	Toluene	ug/Kg	7.2	1.2 U	1.2 U	1 U
100-41-4	Ethylbenzene	ug/Kg	5800	1.2 U	1.2 U	1 U
1330-20-7	Xylenes, total	ug/Kg	6700	1.2 U	1.2 U	1 U
BTEX	Total BTEX	ug/Kg	13467	ND	ND	ND
	PAHs					
91-20-3	Naphthalene	ug/Kg	10000	420 U	400 U	1 J
208-96-8	Acenaphthylene	ug/Kg	150 J	420 U	400 U	11 U
83-32-9	Acenaphthene	ug/Kg	1400	420 U	400 U	11 U
132-64-9	Dibenzofuran	ug/Kg	180 J	420 U	400 U	11 U
86-73-7	Fluorene	ug/Kg	1100	420 U	400 U	11 U
85-01-8	Phenanthrene	ug/Kg	3300	420 U	400 U	1 J
120-12-7	Anthracene	ug/Kg	1100	420 U	400 U	11 U
206-44-0	Fluoranthene	ug/Kg	1400	420 U	400 U	11 U
129-00-0	Pyrene	ug/Kg	2100	420 U	400 U	11 U
56-55-3	Benzo(a)anthracene	ug/Kg	910	420 U	400 U	11 U
218-01-9	Chrysene	ug/Kg	880	420 U	400 U	11 U
205-99-2	Benzo(b)fluoranthene	ug/Kg	890 J	420 U	400 U	11 U
207-08-9	Benzo(k)fluoranthene	ug/Kg	280 J	420 U	400 U	11 U
50-32-8	Benzo(a)pyrene	ug/Kg	1300 J	420 U	400 U	11 U
193-39-5	Indeno(1,2,3-cd)pyrene	ug/Kg	610 J	420 U	400 U	11 U
53-70-3	Dibenz(a,h)anthracene	ug/Kg	100 J	420 U	400 U	11 U
191-24-2	Benzo(g,h,i)perylene	ug/Kg	850 J	420 U	400 U	11 U
PAHs	Total PAHs	ug/Kg	26550	ND	ND	2
	PHENOLS					
108-95-2	Phenol	ug/Kg	440 U	420 U	400 U	11 U
95-57-8	2-Chlorophenol	ug/Kg	440 U	420 U	400 U	11 U
95-48-7	2-Methylphenol	ug/Kg	440 U	420 U	400 U	11 U
106-44-5	4-Methylphenol	ug/Kg	440 U	420 U	400 U	11 U
88-75-5	2-Nitrophenol	ug/Kg	440 U	420 U	400 U	11 U
105-67-9	2,4-Dimethylphenol	ug/Kg	440 U	420 U	400 U	11 U
120-83-2	2,4-Dichlorophenol	ug/Kg	440 U	420 U	400 U	11 U
59-50-7	4-Chloro-3-methylphenol	ug/Kg	440 U	420 U	400 U	11 U
88-06-2	2,4,6-Trichlorophenol	ug/Kg	440 U	420 U	400 U	11 U
95-95-4	2,4,5-Trichlorophenol	ug/Kg	440 U	420 U	400 U	11 U
51-28-5	2,4-Dinitrophenol	ug/Kg	1100 UJ	1000 UJ	990 UJ	26 U
100-02-7	4-Nitrophenol	ug/Kg	1100 U	1000 U	990 U	26 U
534-52-1	4,6-Dinitro-2-methylphenol	ug/Kg	1100 U	1000 U	990 U	26 U
87-86-5	Pentachlorophenol	ug/Kg	1100 U	1000 U	990 U	26 U
PHENOLS	Total Phenols	ug/Kg	ND	ND	ND	ND
	INORGANICS					
57-12-9	Cyanide	mg/Kg	1.2 UJ	1.2 UJ	1.1 UJ	10 U
SOLIDS	Percent Solids	%	76.4	80.3	84.3	

DATA VALIDATION REPORT

Prepared For:

BUFFALO URBAN RENEWAL AGENCY (BURA)

Fourth Street Site
Buffalo, New York

Prepared By:

PARSONS ENGINEERING SCIENCE, INC.

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January 1999

PARSONS

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SECTION 1

DATA VALIDATION SUMMARY

Groundwater and soil boring samples were collected from the BURA - Fourth Street site from November 13, 1998 through November 18, 1998. Analytical results from these samples were validated and reviewed by Parsons Engineering Science, Inc. (Parsons ES) for usability with respect to the following requirements:

- Work Plan;
- USEPA SW-846 analytical methodologies;
- NYSDEC Analytical Services Protocol (ASP); and
- USEPA Region II Standard Operating Procedures (SOP) in "CLP Organic Data Review and Preliminary Review," SOP No. HW-6, Revision #8, January 1992, and "Evaluation of Metals Data for the CLP Based on SOW 3/90," SOP No. HW-2, Revision #11, January 1992.

The analytical laboratory for this project was Severn Trent Envirotest Laboratories (STL). This laboratory is certified by the New York State Department of Health under the Environmental Laboratory Approval Program (ELAP) to perform analyses in accordance with the NYSDEC ASP.

1.1 LABORATORY DATA PACKAGES

The laboratory data package turnaround time, defined as the time from sample receipt by the laboratory to receipt of the analytical data packages by Parsons ES, was 35 days on average for groundwater and soil samples.

The data packages received from STL were paginated, complete, and overall were of good quality. Comments on specific quality control (QC) and other requirements are discussed in detail in the attached data validation reports which are summarized by sample media in Section 2.

1.2 SAMPLING AND CHAIN-OF-CUSTODY

Groundwater and soil samples were collected, properly preserved, shipped under a chain-of-custody (COC) record, and received at STL within one day of sampling. All samples were received intact and in good condition at STL.

1.3 LABORATORY ANALYTICAL METHODS

Groundwater and soil samples were collected from the Fourth Street site and analyzed for the volatiles benzene, toluene, ethylbenzene, and total xylenes (BTEX); polynuclear aromatic hydrocarbons (PAHs); phenols; and cyanide. Summaries of issues concerning these laboratory analyses are presented in Subsections 1.3.1 through 1.3.3. The data qualifications resulting from the data validation review and statements on the laboratory analytical precision, accuracy, representativeness, completeness, and comparability (PARCC) are discussed for each analytical method in Section 2. The laboratory data were reviewed and may be qualified with the following validation flags:

"U" - not detected at the value given,

"UJ" - estimated and not detected at the value given,

"J" - estimated at the value given,

"N" - presumptive evidence at the value given, and

"R" - unusable value.

The validated laboratory data were tabulated and are presented by media in Attachment A.

1.3.1 BTEX

The groundwater and soil samples collected from the Fourth Street site were analyzed for target compound list BTEX using the USEPA SW-846 8020 analytical method. Certain reported results for the BTEX samples were qualified as estimated due to noncompliant surrogate recoveries and field duplicate precision. Therefore, the BTEX analyses were 100% complete and usable for the groundwater and soil data presented by STL and PARCC requirements were met overall.

1.3.2 PAHs and Phenols

The groundwater and soil samples collected from the Fourth Street site were analyzed for PAHs and phenols using the USEPA SW-846 8270C analytical method. Certain reported results for the PAHs and phenols samples were qualified as estimated due to noncompliant instrument calibrations. Therefore, the PAHs and phenols analyses were 100% complete and usable for the groundwater and soil data presented by STL and PARCC requirements were met overall.

1.3.3 Cyanide

The groundwater and soil samples collected from the Fourth Street site were analyzed for cyanide using the USEPA SW-846 9010 analytical method. Certain reported results for the cyanide samples were qualified as estimated due to noncompliant matrix spike recoveries, laboratory control sample recoveries, and field duplicate precision. All of the cyanide data were considered usable and 100% complete for the groundwater and soil data presented by STL and PARCC requirements were met overall.

SECTION 2

DATA VALIDATION REPORTS

2.1 GROUNDWATER

Data review has been completed for data packages generated by STL containing groundwater samples collected from the Fourth Street site. The specific samples contained in these data packages, the analyses performed, and a usability summary are presented in Table 2.1-1. All of these samples were properly preserved, shipped under a COC record, and received intact by the analytical laboratory. The validated laboratory data are presented in Attachment A-1.

Data validation was performed for all samples in accordance with the most current editions of the USEPA Region II SOPs and the NYSDEC ASP for organic and inorganic data review. This data validation and usability report is presented by analysis type.

2.1.1 BTEX

The following items were reviewed for compliancy in the BTEX analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) precision and accuracy;
- Matrix spike blank (MSB) recoveries;
- Laboratory method blank and trip blank contamination;
- Gas Chromatograph (GC) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Field duplicate precision;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols.

Usability

All BTEX sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The BTEX data presented by STL were 100% complete and all BTEX data were considered usable and valid. The validated BTEX laboratory data are tabulated and presented in Attachment A-1.

2.1.2 PAHs and Phenols

The following items were reviewed for compliancy in the PAHs and phenols analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- MS/MSD precision and accuracy;
- MSB recoveries;
- Laboratory method blank and contamination;
- Gas Chromatograph/Mass Spectrometer (GC/MS) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Internal standard area counts and retention times;
- Field duplicate precision;
- Quantitation Limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of surrogate recoveries, MS/MSD precision and accuracy, and initial and continuing calibrations.

Surrogate Recoveries

All sample surrogate recoveries were within QC limits with the exception of the acid surrogate 2,4,6-tribromophenol which exceeded the QC limit 10-123% for samples

MW10 (124%) and MW110 (134%). Validation qualification was not warranted for these samples since only one acid surrogate was noncompliant.

MS/MSD Precision and Accuracy

All of the MS/MSD precision results (relative percent difference; RPD) and accuracy results (percent recovery; %R) were within QC limits for spiked analyses with the exception of the high MS/MSD recoveries for pentachlorophenol (147% and 121%, respectively: QC limit 9-103%) and the precision results for 1,4-dichlorobenzene (29%; QC limit 0-28%) and 1,2,4-trichlorobenzene (36%; QC limit 0-28%) associated with the spiked analyses of MW10. Validation qualification of the unspiked sample MW10 was not warranted due to these noncompliances since pentachlorophenol was not detected and internal standard responses were compliant.

Initial and Continuing Calibrations

All initial calibration compounds were compliant with a minimum relative response factor (RRF) of 0.05 and a maximum relative standard deviation (%RSD) of 30 % with the exception of 2,4-dintrophenol (52.63%), 4,6-dinitro-2-methylphenol (39.98%), and pentachlorophenol (31.90%) which were outside the QC limit for % RSD only for the initial calibration associated with all groundwater samples. The positive sample results for these noncompliant compounds were considered estimated and qualified "J" for these affected samples.

All continuing calibration compounds were compliant with a minimum RRF of 0.05 and a maximum percent difference (%D) of $\pm$ 25% with the exception of pentachlorophenol (34.0%) which was outside the QC limit for %D only for the continuing calibration associated with all groundwater samples. The sample results for this noncompliant compound was considered estimated with positive results qualified "J" and nondetected results qualified "UJ" for the affected samples.

Usability

All PAH and phenols sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The PAH and phenols data presented by STL were 100% complete with all data considered usable and valid. The validated PAH and phenols laboratory data are tabulated and presented in Attachment A-1.

2.1.3 Cyanide

The following items were reviewed for compliancy in the cyanide analysis:

- Custody documentation;
- Holding times;
- Initial and continuing calibration verifications;
- Initial and continuing calibration, and laboratory preparation blank contamination;
- Matrix spike recoveries;
- Laboratory duplicate precision;
- Field duplicate precision;
- Laboratory control sample;
- Sample result verification and identification;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of matrix spike recoveries, laboratory control sample recoveries, and field duplicate precision.

Matrix Spike and Laboratory Control Sample Recoveries

Cyanide recoveries during matrix spike and laboratory control sample analyses were noncompliant (128%; QC limit 75-125% for matrix spike analysis, and 128%; QC limit 90-110% for laboratory control sample analysis). Therefore, positive cyanide results were considered estimated, possibly biased high, and qualified "J".

Field Duplicate Precision

Sample MW110 was collected as the field duplicate of MW10. All reported results for this duplicate pair were acceptable with the exception of the reported cyanide results 51 and 140 µg/L, respectively. Therefore, these results were considered estimated and qualified "J" due to poor field duplicate precision.

Usability

All cyanide sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The cyanide data presented by STL were 100% complete and all data were considered valid and

usable. The validated cyanide laboratory data are tabulated and presented in Attachment A-1.

2.2 SOIL

Data review has been completed for data packages generated by STL containing soil boring samples collected from the Fourth Street site. The specific samples contained in these data packages, the analyses performed, and a usability summary are presented in Table 2.2-1. All of these samples were properly preserved, shipped under a COC record, and received intact by the analytical laboratory. The validated laboratory data are presented in Attachment A-2.

Data validation was performed for all samples in accordance with the most current editions of the USEPA Region II SOPs and the NYSDEC ASP for organic and inorganic data review. This data validation and usability report is presented by analysis type.

2.2.1 BTEX

The following items were reviewed for compliancy in the BTEX analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) precision and accuracy;
- Matrix spike blank (MSB) recoveries;
- Laboratory method blank and field blank contamination;
- Gas Chromatograph (GC) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Field duplicate precision;
- Quantitation limits; and
- Data completeness;

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of surrogate recoveries and field duplicate precision.

Surrogate Recoveries

All sample surrogate recoveries were within QC limits with the exception of those sample surrogate recoveries summarized in Table 2.2-2. Since these recoveries fell below QC limits, all results for these samples were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ".

Field Duplicate Precision

Sample SB22HIDUP was collected as the field duplicate sample of SB22HI. All reported results for this duplicate pair were acceptable with the exception of the reported results for benzene (33 and 65 µg/kg, respectively). Therefore, these results were considered estimated and qualified "J".

Usability

All BTEX sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness and comparability. The BTEX data presented by STL were 100% complete and usable. The validated BTEX laboratory data are tabulated and presented in Attachment A-2. This table presents the most representative BTEX data for a sample location resulting from validation.

For example, samples MW10D, SB21D, and SB23C were reanalyzed due to low surrogate recoveries. The reanalyzed samples also experienced low surrogate recoveries confirming the presence of matrix interferences in these samples. Therefore, results from the original analysis of these samples were considered representative of the sample and reported in the validated laboratory data table in Attachment A-2.

Samples SB22HI and SB22HIDUP were diluted and reanalyzed due to low surrogate recoveries and exceedances in calibration ranges for various compounds. Therefore, results from the reanalysis of these samples were reported in the validated laboratory data table in Attachment A-2.

It was noted that sample SB21D contained a percent solid content of 36.4% (i.e., sample contained mostly water). Therefore, sample results were considered estimated with positive results qualified "J" and nondetected results qualified "UJ".

2.2.2 PAHs and Phenols

The following items were reviewed for compliancy in the PAHs and phenols analysis:

- Custody documentation;

- Holding times;
- Surrogate recoveries;
- MS/MSD precision and accuracy;
- MSB recoveries;
- Laboratory method blank and field blank contamination;
- GC/MS instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Internal standard area counts and retention times;
- Field duplicate precision;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of surrogate recoveries, MS/MSD precision and accuracy, MSB recoveries, and initial calibration and continuing calibrations.

Surrogate Recoveries

All sample surrogate recoveries were compliant and within QC acceptance limits with the exception of the high 2,4,6-tribromophenol acid surrogate recovery for sample SB22D (126%; QC limit 19-122%). Validation qualification was not warranted for this sample where only one acid surrogate was noncompliant.

MSB Recoveries and MS/MSD Precision and Accuracy

All of the MSB recoveries and the MS/MSD precision results (RPD) and accuracy results (%R) were within the QC limits with the exception of the high MSB and MS/MSD recoveries for pentachlorophenol (140% and 138%/131%, respectively; QC limit 17-109%). Validation qualification was not warranted for the unspiked soil samples due to these noncompliances because matrix effects were not confirmed present for the soil samples which yielded compliant surrogate recoveries and internal standard responses.

Initial and Continuing Calibrations

All initial calibrations were compliant with a minimum relative response factor (RRF) of 0.05 and a maximum relative standard deviation (%RSD) of 30% with the exception of those compounds summarized in Table 2.2-3. The positive sample results for these noncompliant compounds were considered estimated and qualified "J" for the affected samples.

All continuing calibration compounds were compliant with a minimum RRF of 0.05 and a maximum %D of ± 25% with the exception of those compounds summarized in Table 2.2-4 which were outside the ± 25% QC limit. The sample results for these noncompliant compounds were considered estimated with positive results qualified "J" and nondetected results qualified "UJ" for the affected samples.

Usability

All PAH and phenol sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness and comparability. The PAH and phenols data presented by STL were 100% complete and usable. The validated PAH and phenols laboratory data are tabulated and presented in Attachment A-2. This table presents the most representative PAH and phenols data for a sample location resulting from validation.

For example, sample SB22D was diluted and reanalyzed due to the concentration of phenanthrene exceeding instrument calibration ranges during the original analysis. Therefore, the phenanthrene result from the diluted analysis was reported in the validated laboratory data table in Attachment A-2 for this sample.

It was noted that sample SB21D contained a percent solids content of 36.4% (i.e., sample contained mostly water). Therefore, sample results were considered estimated with positive results qualified "J" and nondetected results qualified "UJ".

2.2.3 Cyanide

The following items were reviewed for compliance in the cyanide analysis:

- Custody documentation;
- Holding times;
- Initial and continuing calibration verifications;
- Initial and continuing calibration, laboratory preparation, and field blank contamination;
- Matrix spike recoveries;
- Laboratory duplicate precision;
- Field duplicate precision;
- Laboratory control sample;

- Sample result verification and identification;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols.

Usability

All cyanide sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The cyanide data presented by STL were 100% complete and all cyanide data were considered valid and usable. The validated cyanide laboratory data are tabulated and presented in Attachment A-2.

It was noted that sample SB21D contained a percent solids content of 36.4% (i.e., sample contained mostly water). Therefore, sample results were considered estimated with positive results qualified "J" and nondetected results qualified "UJ".

TABLE 2.1-1
SUMMARY OF SAMPLE ANALYSES AND USABILITY
GROUNDWATER - FOURTH STREET

SAMPLE ID	MATRIX	SAMPLE DATE	BTEX	PAHs/ PHENOLS	CYANIDE
TB	WATER	11/18/98	OK		
MW10	WATER	11/18/98	OK	OK	OK
MW110	WATER	11/18/98	OK	OK	OK
		TOTAL SAMPLES:	3	2	2

NOTES: OK - Sample analysis considered valid and usable.

TABLE 2.2-1
SUMMARY OF SAMPLE ANALYSES AND USABILITY
SOIL - FOURTH STREET

SAMPLE ID	MATRIX	SAMPLE DATE	BTEX	PAHs/ PHENOLS	CYANIDE
MW10D	SOIL	11/13/98	OK	OK	OK
MW10I	SOIL	11/13/98	OK	OK	OK
SB21D	SOIL	11/13/98	OK	OK	OK
SB21J	SOIL	11/13/98	OK	OK	OK
SB22HI	SOIL	11/16/98	OK	OK	OK
SB22HIDUP	SOIL	11/16/98	OK	OK	OK
SB22D	SOIL	11/16/98	OK	OK	OK
SB23C	SOIL	11/16/98	OK	OK	OK
SB23F	SOIL	11/16/98	OK	OK	OK
		TOTAL SAMPLES:	9	9	9

NOTES: OK - Sample analysis considered usable and valid.

TABLE 2.2-2

BTEX SURROGATE RECOVERY OUTLIERS
SOIL - FOURTH STREET

SAMPLE ID	BFB %R	QC LIMIT
MW10D	41	67-120
SB21D	31	67-120
SB22HI	57	67-120
SB22HIDUP	44	67-120
MW10DRE	59	67-120
SB21DRE	10	67-120
SB23C	59	67-120
SB23CRE	60	67-120

NOTES: BFB = 4-Bromofluorobenzene
%R = Percent recovery

TABLE 2.2-3

PAH AND PHENOL INITIAL CALIBRATION OUTLIERS
SOIL - FOURTH STREET

INITIAL CALIBRATION DATE	COMPOUND	%RSD [1]	AFFECTED SAMPLES
11/6/98	2,4-dinitrophenol	52.63	All Samples
	4,6-dinitro-2-methylphenol	39.98	
	Pentachlorophenol	31.90	

NOTES: [1] - Relative Standard Deviation.

TABLE 2.2-4

PAH AND PHENOL CONTINIUNG CALIBRATION OUTLIERS
SOIL - FOURTH STREET

CONTINUING CALIBRATION DATE	COMPOUND	%D [1]	AFFECTED SAMPLES
11/30/98	Pentachlorophenol	37.1	All samples except SB22DDL
12/1/98	Pentachlorophenol	34.0	SB22DDL

NOTES: [1] - Percent Difference.

ATTACHMENT A
VALIDATED LABORATORY DATA

BURA 4TH STREET VALIDATED GROUNDWATER DATA SDG 195482		SAMPLE ID: LAB ID. SOURCE SDG: MATRIX: SAMPLED: VALIDATED:	MW10 195482-01 STL 195482 WATER 11/18/98 12/27/98	Dup of MW10 MW110 195482-02 STL 195482 WATER 11/18/98 12/27/98	TB 195482-03 STL 195482 WATER 11/18/98 12/27/98
CAS NO	COMPOUND	UNITS.			
	BTEX				
71-43-2	Benzene	ug/l	0 5 J	0 6 J	1 U
108-88-3	Toluene	ug/l	1 U	0 5 J	1 U
100-41-4	Ethylbenzene	ug/l	1 U	1 U	1 U
1330-20-7	Xylenes, total	ug/l	1 U	1 U	1 U
	Total BTEX		0.5	1.1	ND
	PAHs				
91-20-3	Naphthalene	ug/l	10 U	10 U	
208-96-8	Acenaphthylene	ug/l	10 U	10 U	
83-32-9	Acenaphthene	ug/l	10 U	10 U	
132-64-9	Dibenzofuran	ug/l	10 U	10 U	
86-73-7	Fluorene	ug/l	10 U	10 U	
85-01-8	Phenanthrene	ug/l	10 U	10 U	
120-12-7	Anthracene	ug/l	10 U	10 U	
206-44-0	Fluoranthene	ug/l	10 U	10 U	
129-00-0	Pyrene	ug/l	10 U	10 U	
56-55-3	Benzo(a)anthracene	ug/l	10 U	10 U	
218-01-9	Chrysene	ug/l	10 U	10 U	
205-99-2	Benzo(b)fluoranthene	ug/l	10 U	10 U	
207-08-9	Benzo(k)fluoranthene	ug/l	10 U	10 U	
50-32-8	Benzo(a)pyrene	ug/l	10 U	10 U	
193-39-5	Indeno(1,2,3-cd)pyrene	ug/l	10 U	10 U	
53-70-3	Dibenz(a,h)anthracene	ug/l	10 U	10 U	
191-24-2	Benzo(g,h,i)perylene	ug/l	10 U	10 U	
	Total PAHs		ND	ND	
	PHENOLs				
108-95-2	Phenol	ug/l	10 U	10 U	
95-57-8	2-Chlorophenol	ug/l	10 U	10 U	
95-48-7	2-Methylphenol	ug/l	10 U	10 U	
106-44-5	4-Methylphenol	ug/l	10 U	10 U	
88-75-5	2-Nitrophenol	ug/l	10 U	10 U	
105-67-9	2,4-Dimethylphenol	ug/l	10 U	10 U	
120-83-2	2,4-Dichlorophenol	ug/l	10 U	10 U	
59-50-7	4-Chloro-3-methylphenol	ug/l	10 U	10 U	
88-06-2	2,4,6-Trichlorophenol	ug/l	10 U	10 U	
95-95-4	2,4,5-Trichlorophenol	ug/l	10 U	10 U	
51-28-5	2,4-Dinitrophenol	ug/l	25 U	25 U	
100-02-7	4-Nitrophenol	ug/l	25 U	25 U	
534-52-1	4,6-Dinitro-2-methylphenol	ug/l	25 U	25 U	
87-86-5	Pentachlorophenol	ug/l	25 UJ	25 UJ	
	Total Phenols		ND	ND	
	INORGANICS				
57-12-9	Cyanide	ug/l	140 J	51 J	

ATTACHMENT A-2
VALIDATED SOIL DATA

BURA 4TH STREET VALIDATED SOIL ANALYTICAL DATA SDG: 195271/195326		SAMPLE ID DEPTH: LAB ID: SOURCE: SDG: MATRIX. SAMPLED. VALIDATED	MW10D 6-8' 195271-01 STL 195271/195 SOIL 11/13/98 12/26/98	MW10I 16-18' 195271-02 STL 195271/195 SOIL 11/13/98 12/26/98	SB21D 6-8' 195271-03 STL 195271/195 SOIL 11/13/98 12/26/98	SB21J 18-20' 195271-04 STL 195271/195 SOIL 11/13/98 12/26/98	SB22D 6-8' 195326-03 STL 195271/195 SOIL 11/16/98 12/26/98	SB22HI 14-18' 195326-01 STL 195271/195 SOIL 11/16/98 12/26/98	Dup of SB22HI SB22HIDUP 14-18' 195326-02 STL 195271/195 SOIL 11/16/98 12/26/98	SB23C 4-6' 195326-04 STL 195271/195 SOIL 11/16/98 12/26/98	SB23F 10-12' 195326-05 STL 195271/195 SOIL 11/16/98 12/26/98
CAS NO	COMPOUND	UNITS.									
	BTEX										
71-43-2	Benzene	ug/kg	1 4 UJ	1 1 U	1 9 J	40	1.3 U	65 J	33 J	1 J	22
108-88-3	Toluene	ug/kg	1 4 UJ	1 1 U	2 7 UJ	6 U	1 1 J	7.1 U	7.2 U	1.2 UJ	15
100-41-4	Ethylbenzene	ug/kg	1.4 UJ	1 1 U	2.7 UJ	160	4 1	11	6 8 J	1.2 UJ	1 2 U
1330-20-7	Xylenes, total	ug/kg	1.4 UJ	1 1 U	2 7 UJ	180	9 8	16	14	1.2 UJ	8 4
	Total BTEX		ND	ND	1.9	380	15	92	53 8	1	45 4
	PAHs										
91-20-3	Naphthalene	ug/kg	410 U	370 U	930 UJ	170 J	500	550 U	480 U	390 U	140 J
208-96-8	Acenaphthylene	ug/kg	410 U	370 U	930 UJ	400 U	56 J	550 U	480 U	390 U	400 U
83-32-9	Acenaphthene	ug/kg	410 U	370 U	930 UJ	400 U	740	550 U	480 U	390 U	400 U
132-64-9	Dibenzofuran	ug/kg	410 U	370 U	930 UJ	400 U	720	550 U	480 U	390 U	400 U
86-73-7	Fluorene	ug/kg	410 U	370 U	930 UJ	400 U	1200	550 U	480 U	390 U	400 U
85-01-8	Phenanthrene	ug/kg	410 U	370 U	930 UJ	400 U	4600	550 U	480 U	390 U	56 J
120-12-7	Anthracene	ug/kg	410 U	370 U	930 UJ	400 U	1400	550 U	480 U	390 U	400 U
206-44-0	Fluoranthene	ug/kg	410 U	370 U	930 UJ	400 U	2600	550 U	480 U	390 U	44 J
129-00-0	Pyrene	ug/kg	410 U	370 U	110 J	400 U	2700	550 U	480 U	390 U	42 J
56-55-3	Benzo(a)anthracene	ug/kg	410 U	370 U	140 J	400 U	1400	550 U	480 U	390 U	400 U
218-01-9	Chrysene	ug/kg	410 U	370 U	93 J	400 U	1200	550 U	480 U	390 U	400 U
205-99-2	Benzo(b)fluoranthene	ug/kg	410 U	370 U	100 J	400 U	1200	550 U	480 U	390 U	400 U
207-08-9	Benzo(k)fluoranthene	ug/kg	410 U	370 U	930 UJ	400 U	390 J	550 U	480 U	390 U	400 U
50-32-8	Benzo(a)pyrene	ug/kg	410 U	370 U	930 UJ	400 U	1100	550 U	480 U	390 U	400 U
193-39-5	Indeno(1,2,3-cd)pyrene	ug/kg	410 U	370 U	930 UJ	400 U	390 J	550 U	480 U	390 U	400 U
53-70-3	Dibenz(a,h)anthracene	ug/kg	410 U	370 U	930 UJ	400 U	110 J	550 U	480 U	390 U	400 U
191-24-2	Benzo(g,h,i)perylene	ug/kg	410 U	370 U	930 UJ	400 U	330 J	550 U	480 U	390 U	400 U
	Total PAHs		ND	ND	443	170	20636	ND	ND	ND	282
	PHENOLs										
108-95-2	Phenol	ug/kg	410 U	370 U	930 UJ	400 U	440 U	550 U	480 U	390 U	400 U
95-57-8	2-Chlorophenol	ug/kg	410 U	370 U	930 UJ	400 U	440 U	550 U	480 U	390 U	400 U
95-48-7	2-Methylphenol	ug/kg	410 U	370 U	930 UJ	400 U	440 U	550 U	480 U	390 U	400 U
106-44-5	4-Methylphenol	ug/kg	410 U	370 U	930 UJ	400 U	62 J	550 U	480 U	390 U	400 U
88-75-5	2-Nitrophenol	ug/kg	410 U	370 U	930 UJ	400 U	440 U	550 U	480 U	390 U	400 U
105-67-9	2,4-Dimethylphenol	ug/kg	410 U	370 U	930 UJ	400 U	63 J	550 U	480 U	390 U	400 U
120-83-2	2,4-Dichlorophenol	ug/kg	410 U	370 U	930 UJ	400 U	440 U	550 U	480 U	390 U	400 U
59-50-7	4-Chloro-3-methylphenol	ug/kg	410 U	370 U	930 UJ	400 U	400 U	550 U	480 U	390 U	400 U
88-06-2	2,4,6-Trichlorophenol	ug/kg	410 U	370 U	930 UJ	400 U	440 U	550 U	480 U	390 U	400 U
95-95-4	2,4,5-Trichlorophenol	ug/kg	410 U	370 U	930 UJ	400 U	440 U	550 U	480 U	390 U	400 U
51-28-5	2,4-Dinitrophenol	ug/kg	1000 U	930 U	2300 UJ	1000 U	1100 U	1400 U	1200 U	980 U	1000 U
100-02-7	4-Nitrophenol	ug/kg	1000 U	930 U	2300 UJ	1000 U	1100 U	1400 U	1200 U	980 U	1000 U
534-52-1	4,6-Dinitro-2-methylphenol	ug/kg	1000 U	930 U	2300 UJ	1000 U	1100 U	1400 U	1200 U	980 U	1000 U
87-86-5	Pentachlorophenol	ug/kg	1000 UJ	930 UJ	2300 UJ	1000 UJ	1100 UJ	1400 UJ	1200 UJ	980 UJ	1000 UJ
	Total Phenols		ND	ND	ND	ND	62	ND	ND	ND	ND
	INORGANICS										
57-12-9	Cyanide	MG/KG	1.4 U	1.1 U	2.7 UJ	1.2 U	1.3 U	1 4 U	1 4 U	1.2 U	1 2 U
SOLIDS	Percent Solids	%	72.6	90.4	36.4	83	76.1	70 5	69 6	84 8	82 9

DATA VALIDATION REPORT

Prepared For:

BUFFALO URBAN RENEWAL AGENCY (BURA)

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October 1999

PARSONS

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SECTION 1

DATA VALIDATION SUMMARY

Soil boring samples were collected from the BURA - Fourth Street site on August 25, 1999. Analytical results from these samples were validated and reviewed by Parsons Engineering Science, Inc. (Parsons ES) for usability with respect to the following requirements:

- Work Plan;
- USEPA SW-846 analytical methodologies;
- NYSDEC Analytical Services Protocol (ASP); and
- USEPA Region II Standard Operating Procedures (SOP) in "CLP Organic Data Review and Preliminary Review," SOP No. HW-6, Revision #8, January 1992, and "Evaluation of Metals Data for the CLP Based on SOW 3/90," SOP No. HW-2, Revision #11, January 1992.

The analytical laboratory for this project was Severn Trent Envirotest Laboratories (STL). This laboratory is certified by the New York State Department of Health under the Environmental Laboratory Approval Program (ELAP) to perform analyses in accordance with the NYSDEC ASP.

1.1 LABORATORY DATA PACKAGES

The laboratory data package turnaround time, defined as the time from sample receipt by the laboratory to receipt of the analytical data packages by Parsons ES, was 26 days on average for the soil samples.

The data packages received from STL were paginated, complete, and overall were of good quality. Comments on specific quality control (QC) and other requirements are discussed in detail in the attached data validation report which is presented in Section 2.

1.2 SAMPLING AND CHAIN-OF-CUSTODY

Soil samples were collected, properly preserved, shipped under a chain-of-custody (COC) record, and received at STL within three days of sampling. All samples were received intact and in good condition at STL.

1.3 LABORATORY ANALYTICAL METHODS

Soil samples were collected from the Fourth Street site and analyzed for the volatiles benzene, toluene, ethylbenzene, and total xylenes (BTEX) and polynuclear aromatic

hydrocarbons (PAHs). Summaries of issues concerning these laboratory analyses are presented in Subsections 1.3.1 through 1.3.2. The data qualifications resulting from the data validation review and statements on the laboratory analytical precision, accuracy, representativeness, completeness, and comparability (PARCC) are discussed for each analytical method in Section 2. The laboratory data were reviewed and may be qualified with the following validation flags:

"U" - not detected at the value given,

"UJ" - estimated and not detected at the value given,

"J" - estimated at the value given,

"N" - presumptive evidence at the value given, and

"R" - unusable value.

The validated laboratory data were tabulated and are presented in Attachment A.

1.3.1 BTEX

The soil samples collected from the Fourth Street site were analyzed for BTEX using the USEPA SW-846 8021B analytical method. Certain reported results for the BTEX samples were qualified as estimated due to noncompliant surrogate recoveries and field duplicate precision. Therefore, the BTEX analyses were 100% complete and usable for the soil data presented by STL and PARCC requirements were met overall.

1.3.2 PAHs

The soil samples collected from the Fourth Street site were analyzed for PAHs using the USEPA SW-846 8270C analytical method. Certain reported results for the PAH samples were qualified as estimated due to noncompliant sample surrogate recoveries. Therefore, the PAH analyses were 100% complete and usable for the soil data presented by STL and PARCC requirements were met overall.

SECTION 2

DATA VALIDATION REPORT

2.1 SOIL

Data review has been completed for data packages generated by STL containing soil samples collected from the Fourth Street site. The specific samples contained in these data packages, the analyses performed, and a usability summary are presented in Table 2.1-1. All of these samples were properly preserved, shipped under a COC record, and received intact by the analytical laboratory. The validated laboratory data are presented in Attachment A.

Data validation was performed for all samples in accordance with the most current editions of the USEPA Region II SOPs and the NYSDEC ASP for organic and inorganic data review. This data validation and usability report is presented by analysis type.

2.1.1 BTEX

The following items were reviewed for compliancy in the BTEX analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- Matrix spike/matrix spike duplicate (MS/MSD) precision and accuracy;
- Matrix spike blank (MSB) recoveries;
- Laboratory method blank and trip blank contamination;
- Gas Chromatograph (GC) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Field duplicate precision;
- Quantitation limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of surrogate recoveries and field duplicate precision.

Surrogate Recoveries

All sample surrogate recoveries were within QC limits with the exception of those sample surrogate recoveries summarized in Table 2.1-2. Since these recoveries fell below QC limits, all results for these samples were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ".

Field Duplicate Precision

Sample DUPE was collected as the field duplicate sample of UB002. All reported results for this duplicate pair were acceptable with the exception of the reported results for benzene, toluene, and total xylenes. Therefore, these results were considered estimated with positive results qualified "J" and nondetected results qualified "UJ".

Usability

All BTEX sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The BTEX data presented by STL were 100% complete and all BTEX data were considered usable and valid. The validated BTEX laboratory data are tabulated and presented in Attachment A.

2.1.2 PAHs

The following items were reviewed for compliancy in the PAH analysis:

- Custody documentation;
- Holding times;
- Surrogate recoveries;
- MS/MSD precision and accuracy;
- MSB recoveries;
- Laboratory method blank contamination;
- Gas Chromatograph/Mass Spectrometer (GC/MS) instrument performance;
- Sample result verification and identification;
- Initial and continuing calibrations;
- Internal standard area counts and retention times;

- Field duplicate precision;
- Quantitation Limits; and
- Data completeness.

These items were considered compliant and acceptable in accordance with the validation protocols with the exception of surrogate recoveries.

Surrogate Recoveries

All sample surrogate recoveries were within QC limits with the exception of those surrogate recoveries summarized in Table 2.1-3. Since at least two base-neutral sample surrogate recoveries fell below QC limits, all PAH results for these samples were considered estimated, possibly biased low, with positive results qualified "J" and nondetected results qualified "UJ".

Usability

All PAH sample results were considered usable following data validation.

Summary

The quality assurance objectives for measurement data included considerations for precision, accuracy, representativeness, completeness, and comparability. The PAH data presented by STL were 100% complete with all data considered usable and valid. The validated PAH laboratory data are tabulated and presented in Attachment A.

TABLE 2.1-1
SUMMARY OF SAMPLE ANALYSES AND USABILITY
SOIL - FOURTH STREET

SAMPLE ID	MATRIX	SAMPLE DATE	BTEX	PAHs
TB001	WATER	8/25/99	OK	
UB001	SOIL	8/25/99	OK	OK
UB002	SOIL	8/25/99	OK	OK
UB003	SOIL	8/25/99	OK	OK
UB005	SOIL	8/25/99	OK	OK
UB006	SOIL	8/25/99	OK	OK
UB007	SOIL	8/25/99	OK	OK
UB008	SOIL	8/25/99	OK	OK
DUPE	SOIL	8/25/99	OK	OK
		TOTAL SAMPLES:	9	8

NOTES: OK - Sample analysis considered usable and valid.

TABLE 2.1-2

BTEX SURROGATE RECOVERY OUTLIERS
SOIL - FOURTH STREET

SAMPLE ID	BFB %R	QC LIMIT
UB003	45	67-120
UB008	35	67-120
UB002	45	67-120
UB003RE	36	67-120
UB008RE	40	67-120
UB002RE	38	67-120

NOTES: BFB = 4-Bromofluorobenzene
%R = Percent recovery

TABLE 2.1-3

PAH SURROGATE RECOVERY OUTLIERS
SOIL - FOURTH STREET

SAMPLE ID	NBZ %R	FBP %R	TPH %R	DCB %R
DUPE	*	24	*	27
UB001	*	19	*	29
UB002	*	19	*	24
UB003	*	30	*	28
UB005	*	33	*	38
UB006	*	22	*	32
UB007	*	32	*	25
UB008	*	26	*	23

SURROGATE	QC LIMITS
NBZ = Nitrobenzene-d5	38 - 141%
FBP = 2-Fluorobiphenyl	45 - 150%
TPH =Terphenyl-d14	47 - 200%
DCB = 1,2-Dichlorobenzene-d4	56 - 189%

NOTES: %R = Percent recovery.
* = Percent recovery within QC limits.

ATTACHMENT A
VALIDATED LABORATORY DATA

BURA 4TH STREET Validated Soil Analytical Data SDG: 206975		SAMPLE ID: LOCATION: DEPTH: LAB ID: SOURCE: SDG: MATRIX: SAMPLED: VALIDATED:	UB001 B1 12-14' 206975-04 STL 206975 SOIL 08/25/99 10/15/99	UB002 B2 10-12' 206975-03 STL 206975 SOIL 08/25/99 10/15/99	UB002-DUP B2 10-12' 206975-06 STL 206975 SOIL 08/25/99 10/15/99	UB003 B3 10-12' 206975-08 STL 206975 SOIL 08/25/99 10/15/99	UB005 B5 10-12' 206975-05 STL 206975 SOIL 08/25/99 10/15/99	UB006 B6 10-12' 206975-05 STL 206975 SOIL 08/25/99 10/15/99	UB007 B7 10-12' 206975-02 STL 206975 SOIL 08/25/99 10/15/99	UB008 B8 10-12' 206975-01 STL 206975 SOIL 08/25/99 10/15/99	TB001 TRIP BLANK 206975-10 STL 206975 WATER 08/25/99 10/15/99
CAS NO.	COMPOUND	UNITS:									ug/L
	BTEX										
71-43-2	Benzene	ug/Kg	400	2.8 J	130 J	1.3 UJ	1.3 U	4.7 J	100	1.2 UJ	1 U
108-88-3	Toluene	ug/Kg	5.1 J	12 J	6.4 UJ	1 J	2.1	7 U	6.4 U	4.6 J	1 U
100-41-4	Ethylbenzene	ug/Kg	4.3 J	1.3 UJ	6.4 U	1.3 UJ	2.3	7 U	3.6 J	1.2 UJ	1 U
1330-20-7	Xylenes, total	ug/Kg	20	0.9 J	14 J	1.3 UJ	5.5	14	13	1.2 UJ	1 U
	Total BTEX	ug/Kg	429.4	15.3	144	1	9.9	18.7	116.6	4.6	ND
	PAHs										
91-20-3	Naphthalene	ug/Kg	490 UJ	50 J	170 J	440 UJ	100 J	470 UJ	420 UJ	410 UJ	
91-57-6	2-Methylnaphthalene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	140 J	470 UJ	420 UJ	410 UJ	
91-58-7	2-Chloronaphthalene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
83-32-9	Acenaphthene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
86-73-7	Fluorene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	46 J	470 UJ	420 UJ	410 UJ	
85-01-8	Phenanthrene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	480 J	470 UJ	420 UJ	410 UJ	
120-12-7	Anthracene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	48 J	470 UJ	420 UJ	410 UJ	
206-44-0	Fluoranthene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
129-00-0	Pyrene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	86 J	470 UJ	420 UJ	410 UJ	
56-55-3	Benzo(a)anthracene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
218-01-9	Chrysene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
205-99-2	Benzo(b)fluoranthene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
207-08-9	Benzo(k)fluoranthene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
50-32-8	Benzo(a)pyrene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
193-39-5	Indeno(1,2,3-cd)pyrene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
53-70-3	Dibenz(a,h)anthracene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
191-24-2	Benzo(g,h,i)perylene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
208-96-8	Acenaphthylene	ug/Kg	490 UJ	420 UJ	430 UJ	440 UJ	440 UJ	470 UJ	420 UJ	410 UJ	
	Total PAHs	ug/Kg	ND	50	170	ND	ND	ND	ND	ND	

APPENDIX G

APPENDIX G
DETAILED RISK ASSESSMENT

APPENDIX G
HUMAN HEALTH RISK ASSESSMENT

G.1 INTRODUCTION

A human health risk assessment was performed to provide an estimate of current and future human health risks associated in the absence of remedial action. The results of the risk assessment were used to assist in establishing preliminary remediation goals (PRGs) for remedial action, if required. Constituents of potential concern (COPCs) identified in this human health screening were evaluated in accordance with federal USEPA, USEPA Region II, and NYSDOH guidance for the evaluation of potential human health effects from Site-related media (USEPA 1989; NYSDOH 1998). The risk assessment process included the following major steps:

- Data Evaluation and Identification of COPCs (Subsection G.3)
- Exposure Assessment (Subsection G.4)
- Toxicity Assessment (Subsection G.5)
- Risk Characterization and Uncertainty Analysis (Subsections G.6 and G.7)

These steps are discussed in this section. Potential sources of chemical constituents, exposure pathways, and receptors are described in this section and illustrated in the conceptual site model (CSM) presented in Figure G.1 (see Section 6.4).

G.2 DATA EVALUATION AND IDENTIFICATION OF COPCs

G.2.1 Data Evaluation

The following media were quantitatively addressed: (1) surface soil and (2) mixed surface and subsurface soil. Groundwater data were compiled and evaluated in the screening process (identification of COPCs). As discussed in Section G.2, however, groundwater was not quantitatively evaluated because of the lack of receptors.

After combining analytical data and eliminating those analytes not detected in any samples in a particular medium (soil or groundwater), the analytical data were evaluated on the basis of quality, with respect to sample quantitation limits, laboratory qualifiers and codes, and blanks. Data selected for use in the evaluation included unqualified data and those data with qualifiers that indicated uncertainties in concentrations, but not in constituent identification ("J" values). Analytical data with an "R" (rejected) qualifier were not retained for use in the evaluation. Also not selected were data with qualifiers indicating that the analyte was detected in a laboratory blank at a level below the 10-times or 5-times rule for organics (for common laboratory contaminants and other compounds, respectively) or below the 5-times rule for pesticides and inorganics (USEPA 1989). The sample location map

resulting from the sampling effort is provided in Section 2, Figure 2.1. Statistical summaries of the onsite soil and groundwater data are provided in Attachment G.1.

The NYSDOH defines surface soil as those soils which are present at a depth of 0 to 0.5 ft. The surface soil interval is used to evaluate current receptors. For the assessment of potential future exposure scenarios, a mixed surface and subsurface soil interval is evaluated. The choice of interval was based on the assumption that development could result in the excavation and redistribution of subsurface soils onto the surface, resulting in surface soil strata which is a mixture of current surface and subsurface soils. For future receptors, a depth of 0 to 12 ft is assessed.

The following depths and locations for soil samples were compiled and evaluated:

0 to 0.5 ft - This data set is considered onsite surface soil and is evaluated for exposure by current and future receptors. Future receptor exposure assumes that redistribution of soil due to excavation activities will not occur. A total of 4 to 5 surface soil samples were compiled (depending on the constituent) in the data statistical analysis. The statistical data summary table is provided in Attachment G.1, Table G.1-1.

0 to 12 ft - This data set is considered onsite mixed surface and subsurface soil and is evaluated for exposure to future receptors. Future receptor exposure assumes that redistribution of soil due to excavation activities will occur. A total of 26 to 27 surface and subsurface soil samples were compiled (depending on the constituent) in the data statistical analysis. The statistical data summary table is provided in Attachment G.1, Table G.1-2.

0 to 22 ft - This data set includes all samples analyzed at all depths. The data is provided for informational purposes only since it was not quantitatively evaluated. A total of 39 to 43 surface and subsurface soil samples were compiled (depending on the constituent) in the data statistical analysis. The statistical data summary table is provided in Attachment G.1, Table G.1-3.

BACKGROUND SAMPLES (0 to 0.5 ft) - This data set includes analyzed samples located in the area surrounding the Site (see Section 4, Figure 4.2 for locations). Two times the mean concentration of these samples is used as the representative background screening concentration (USEPA 1998a). This data was not further evaluated quantitatively. A total of 7 surface soil samples were compiled in the data statistical analysis. The statistical data summary table is provided in Attachment G.1, Table G.1-4.

MW-8 AND -9 - These two soil samples are located offsite and were collected to evaluate potential offsite sources of contamination. The data is provided for comparison purposes only, and is not evaluated in the screening process or in the quantitative risk assessment. The data summary table is provided in Attachment G.1, Table G.1-5.

The following locations for groundwater samples were compiled and evaluated:

ONSITE SAMPLES - These groundwater samples are located onsite and are compared to regulatory screening criteria as described in Section 5.3.2. These data are not further evaluated quantitatively (Section G.2). A total of 6 groundwater samples were compiled in the data statistical analysis. The data summary table is provided in Attachment G.1, Table G.1-6.

MW-8 AND -9 - These groundwater samples are located offsite and were collected to evaluate potential sources of contamination. The data is provided for comparison purposes only. This data is not evaluated in the screening process or in the quantitative risk assessment. The data summary table is provided in Attachment G.1, Table G.1-7.

G.2.2 Constituent screening

For those chemical constituents detected, site-specific screening was performed using NYSDEC TAGM (1994), NYSDEC Ambient Water Quality Standards and Guidance Values (1998), and NYSDOH (1992) values. Chemicals present in samples were compiled for each medium of concern and were screened to identify COPCs. The results of the screening (described below) are presented in Attachment G.2, and a summary of the COPCs identified for each soil interval is provided in Table G.1. Groundwater was not quantitatively evaluated (Section G.2), and the groundwater screening results are presented in Attachment G.2 and summarized below.

The human health screening was conducted as follows:

1. **Comparison to criteria:** A comparison of maximum onsite concentrations to available human health criteria was completed as the first step in the screening process. Soil constituents were screened against TAGM soil cleanup values (1994). Site-specific organic carbon content was used to derive site-specific TAGM values (Attachment G.2, Table G.2-1). Groundwater constituents were compared to NYSDEC class GA groundwater standards (1998) and NYSDOH public drinking water standards (maximum contaminant levels, MCLs) (1992).
2. **Background Screening:** Inorganic constituents (cyanide) in soil were screened against two times the background mean concentration (personal communication, USEPA Region II, 1998). The 0-0.5 ft offsite soil samples were considered to be representative of background conditions. No comparison of background concentrations was conducted for the Site groundwater samples.
3. **Identification of COPCs**: Soil analytes not eliminated during the screening process are considered COPCs and are quantitatively evaluated. The COPCs in soil are listed in Table G.1. Groundwater analytes not eliminated using the screening process are presented in Attachment G.2 and are not evaluated quantitatively due to the lack of a complete exposure pathway to identified receptors (Figure G.1).

Soil screening results are presented in Attachment G.2, Tables G.2-2 through G.2-3. A summary of the results (COPCs identified) is presented in Table G.1. In surface soil, five SVOCs and cyanide were identified as COPCs. In subsurface soil, two VOCs, seven SVOCs,

and cyanide were identified as COPCs. These COPCs are further evaluated in the quantitative risk assessment.

Results of the groundwater screening (comparison to criteria) are presented in Attachment G.2, Table G.2-4. Two sets of criteria were compared to the maximum detected concentrations in onsite groundwater samples. The first set of criteria used was the NYSDEC class GA groundwater standards (NYSDEC 1998). These values are derived in order to protect receptors exposed to freshwater groundwater as well as to establish levels that are not considered hazardous due to migration of contaminants from groundwater to surface water bodies. In groundwater, benzene, ethylbenzene, and total xylenes exceeded these criteria.

The second set of criteria used was the NYSDOH drinking water standards (NYSDOH 1992). These values are state-designated maximum contaminant levels (MCLs) for any drinking water source. These values are considered protective for human consumption of drinking water. In groundwater, ethylbenzene, and total xylenes exceeded their respective MCL values. The total organic contaminant concentration, however, did not exceed the MCL designated for total organic constituent concentration in drinking water. There was no MCL listed for cyanide. Thus, a comparison to groundwater concentrations was not completed for cyanide.

G.3 EXPOSURE ASSESSMENT

The objective of the exposure assessment is to estimate the type and magnitude of potential exposure to the COPCs identified following the methodology discussed in Section G.3.2. An exposure pathway is considered complete only when all of the following four elements is present:

- A contaminant source;
- A mechanism for release, retention, or transport of a chemical in a given medium;
- A point of human contact with the medium (i.e., exposure point); and
- A plausible receptor and route of exposure at the exposure point.

A CSM was developed to identify the source of chemical constituents and the potential receptors and pathways of exposure (Figure G.1). The CSM provides an overall assessment of the primary and secondary sources and the corresponding release mechanisms and impacted media. The CSM also identifies potential receptors and associated pathways of exposure to impacted media.

The primary source of detected chemical constituents, including BTEX, PAHs, and cyanide, is waste resulting from past activities involving the manufacture, storage, and distribution of manufactured gas. The probable release mechanism(s) for the chemical constituents to soil include deposition onto surface soil, infiltration and percolation through the soil into the subsurface soil, and subsurface release through gas holders, buried tanks, or other former MGP structures. The primary onsite media impacted by the MGP, therefore, are

surface and subsurface soil. Under various end-use scenarios, chemical constituents may migrate from surface soil to subsurface soil via infiltration and percolation, and/or chemical constituents in subsurface soil may be excavated and redistributed onto the surface to become mixed with surface soil.

The potential secondary release mechanisms from soil include the generation of fugitive dust and the volatilization of chemical constituents from soil, resulting in air (dust and vapors) being considered a secondarily impacted medium. Routes identified for exposure to chemical constituents include inhalation of chemical constituents in air (dust and vapors) as well as direct contact with soil via ingestion and dermal contact.

Consistent with USEPA's Risk Assessment Guidance for Superfund (RAGS) (USEPA 1989), current and reasonably foreseeable future land-use scenarios were considered. Current and reasonably foreseeable future land-use scenarios were based on the Site description provided in Section 1 of this report. Specifically, the Site is located in the City of Buffalo, Erie County, New York (see Figure 1.1). It consists of an area of undeveloped property where previous environmental investigations have indicated the presence of free product in the shallow subsurface. Previous environmental investigations have indicated that contamination is present in an area encompassing approximately 0.25 acres.

Current land use at the Site and the immediate vicinity is institutional (elementary school), commercial and recreational. A portion of the Site is currently a paved parking area with planted islands, although the majority of the Site is covered by soil with vegetative cover. Current surface soils (0 to 0.5 ft) were used to assess potential exposure of current receptors. In addition, the 0 to 0.5 ft interval was used to evaluate a potential onsite worker if future excavation does not occur.

Potential (future) land-use scenarios include industrial/commercial or residential. Given the history of the area, these land-use scenarios are appropriate. Mixed surface and subsurface soils are evaluated for future receptors to account for potential excavation and redistribution of soils during the "hypothetical" future redevelopment.

Groundwater was also evaluated in the screening process (Section G.3). Chemical constituents may impact groundwater via leaching or partitioning from the subsurface soil. According to the USGS Water-Resources Investigations Report 88-4076, the Site is located in an area that contains an unconfined aquifer. These aquifers are typically sand and gravel with saturated zones usually less than 10 feet in thickness. Groundwater in the vicinity is not used as a potable drinking water supply, and no primary aquifers are located within two miles of the Site. In addition, the concentrations of most chemical constituents detected in groundwater are below NYSDEC Ambient Water Quality values, indicating that partitioning from soil to groundwater has been limited (see Attachment G.2 for results of groundwater screening). However, because groundwater flow is in the direction of Lake Erie (approximately 1500 feet east Fourth Street), groundwater was evaluated in the screening process, but potential exposure of hypothetical future receptors was not quantitatively evaluated. Given the distance to Lake Erie, however, concentrations of Site-related

constituents in groundwater are expected to decrease below acceptable levels prior to discharge to the lake.

Current receptors include current school employees, school students, and adolescent trespassers; potential future receptors include industrial/commercial workers, construction workers, and onsite residents. A detailed discussion of the current and future receptors is provided in Section 5.4.1.

G.3.1 Potential Receptors

The following potential receptors were identified.

G.3.1.1 Current Adolescent Receptors

Given the absence of substantial fencing, it is likely that adolescents and students at the Waterfront School may access portions of the Site during the school day. Therefore, these receptors may be exposed to surface soils, with potentially complete exposure pathways including incidental ingestion, dermal contact, inhalation of fugitive dust, and inhalation of volatiles from soil.

G.3.1.2 Current School Employees

Current workers are defined as individuals that are employed at or near the Site (at the Waterfront School) and have unlimited access to Site media. Currently, onsite workers include school employees that utilize the parking area. The current workers (school employees) are assumed to be potentially exposed daily (5-day work week) to Site media. Current school employees are assumed to be exposed to surface soil (0 to 0.5 feet in depth). Incidental ingestion of soil, dermal contact with soil, inhalation of fugitive dust from soil, and inhalation of volatiles from soil are potential pathways for exposure.

G.3.1.3 Future Industrial/Commercial Workers

Future workers are defined as individuals that will potentially be employed at an industrial or commercial facility, and will have unlimited access to Site media. Future workers are assumed to be potentially exposed daily (5-day workweek) to Site media.

Given that potential workers are the most likely future receptors, potential risks resulting from exposure to soils were evaluated for both a non-excavation (0 to 0.5 ft) and an excavation (0 to 12 ft) scenario. Incidental ingestion of soil, dermal contact with soil, inhalation of fugitive dust from soil, and inhalation of volatiles from soil are potential pathways for exposure to soil.

G.3.1.4 Hypothetical Future Construction Workers

In addition to the workers described above, construction workers may also be exposed to Site soils in the future. The difference between industrial/commercial workers and construction workers is that construction workers have the potential to be more highly

exposed than other workers, but over a shorter period of time (i.e., the duration of the construction activity).

Exposure to soils at a depth of 0 to 12 ft is expected when standard commercial/industrial or residential development occurs. A depth of 12 feet is considered to be reasonable for standard development. Incidental ingestion of soil, dermal contact with soil, inhalation of fugitive dust from soil, and inhalation of volatiles from soil are potential exposure pathways.

G.4.1.5 Hypothetical Future Residents (Adult and Child)

Hypothetical future residents are defined as individuals that reside onsite and have unlimited access to Site media. The residents are assumed to be exposed to Site media on a daily basis. Both an adult and child resident were considered in the risk assessment.

Hypothetical future residents were assumed to be exposed to mixed surface soil (0 to 12 ft) which would result following residential development. Incidental ingestion of soil, dermal contact with soil, inhalation of fugitive dust from soil, and inhalation of volatiles from soil are potential pathways for exposure to soil.

G.3.2 Estimation of Intake

Two types of exposure estimates are currently used for CERCLA-type risk assessments: reasonable maximum exposure (RME) and central tendency (CT). The RME is defined as the highest exposure that could reasonably be expected to occur for a given exposure pathway, and is intended to account for both uncertainty in the chemical concentration and variability in the exposure parameters (such as exposure frequency or averaging time). The CT, which is meant to characterize a more average exposure, is evaluated for comparison purposes and is based on mean exposure parameters.

The following general equation will be used to quantify exposure to potential receptors:

$$\text{Intake} = \frac{C * CR * EF * ED}{BW * AT}$$

Where:

C	=	Chemical Concentration in Soil (mg/kg)
CR	=	Contact Rate (amount/unit time: mg/d soil)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (days: equal to ED for noncarcinogen(s) and 70 years for carcinogens)

Details of the exposure assumptions and parameters that are used to evaluate exposure in are listed in Attachment G.3. The site-specific particulate emission factor (PEF) and volatilization factors (VFs) used for each chemical in the soil inhalation exposure scenario are provided in Attachment G.3, Tables G.3-3 and G.3-4 (USEPA 1996). The primary sources for the RME and CT exposure factors are as follows:

- USEPA 1989: Risk Assessment Guidance for Superfund, Volume I (RAGS)
- USEPA 1991a: Supplemental Guidance, Standard Default Exposure Factors
- USEPA 1992a: Dermal Exposure Assessment, Principles and Applications
- USEPA 1993a: Superfund's Standard Default Exposure for the Central Tendency and Reasonable Maximum Exposure
- USEPA 1995a: Supplemental Guidance to RAGS: Region 4 Bulletins. Human Health Risk Assessment
- USEPA 1997. Exposure Factors Handbook

These referenced sources are used to calculate pathway-specific intake factors for all potential pathways.

As detailed in Attachment G.3, most of the exposure assumptions used in the risk assessment are default values from the above sources. The site-specific exposure assumptions used in the risk assessment are discussed below and listed in Attachment G.3, table G.3-1:

1. Current Adolescent Trespasser
    - Exposure frequency of 250 days/year (RME) reflects exposure 5 days/week for 50 weeks (2 weeks away from home for vacation). This receptor is assumed to be exposed during the school day. The CT exposure frequency of 100 days/year reflects exposure 2 days/week for 50 weeks. The exposure duration for both the RME and CT evaluations is 10 years.
    - Skin surface area of 4,400 cm^2 (RME) and 3,350 cm^2 (CT) reflects 25% of total body surface area for a 13-year old adolescent. USEPA (1992a) recommends that, for soil contact scenarios, a value of 25% is appropriate to represent exposure of the hands, legs, arms, neck and head.
    - The assumed exposure time for the inhalation pathway is 4 hours for the RME scenario and 2 hours for the CT scenario and the body weight of the adolescent receptor is assumed to be 45 kg.
    - An inhalation rate of 0.83 m^3/hr is assumed for the receptor (20 m^3/day ÷ 24 hr/day).
2. Current School Employee
    - Exposure frequency of 200 days/year (RME) reflects exposure 5 days/week for 40 weeks (2 weeks away from home for vacation as well as 10 weeks for summer

vacation when school is not in session). The CT exposure frequency of 100 days/year reflects 2.5 days/week for 40 weeks (the employee may only contact non-paved soil half of the time). The exposure duration is a total of 25 years for the RME evaluation and 5 years for the CT evaluation.

- Skin surface area of 5,800 cm^2 (RME) and 5,000 cm^2 (CT) for the adult school employee reflects 25% of total body surface area.
- The assumed exposure time for the inhalation pathway is 2 hours for the RME scenario and 1 hour for the CT scenario. The body weight of the receptor is 70 kg.
- An inhalation rate of 0.83 m^3/hr is assumed for the receptor (20 m^3/day ÷ 24 hr/day).

3. Future Industrial/Commercial Worker

   - Exposure frequency of 250 days/year (RME) reflects exposure 5 days/week for 50 weeks (2 weeks away from home for vacation). The CT exposure frequency is 234 days/year (USEPA, 1993a). The exposure duration is a total of 25 years for the RME evaluation and 5 years for the CT evaluation.
   - Skin surface area of 5,800 cm^2 (RME) and 5,000 cm^2 (CT) for the future worker reflects 25% of total body surface area.
   - The assumed exposure time for the inhalation pathway is 8 hours for both the RME and CT scenarios. The body weight of the receptor is 70 kg.
   - An inhalation rate of 2.5 m^3/hr is assumed for the worker. This value assumes that all of a workers daily inhalation rate of 20 m^3/day will occur during the 8-hour workday (20 m^3/day ÷ 8 hours/workday).

4. Future Construction Worker

   - The exposure parameters for the future construction worker are the same as the future industrial worker with the exception of the exposure duration and ingestion rate. The future construction worker exposure duration assumes 1 year for the RME and CT and an ingestion rate of 480 mg/day for the RME scenario and 100 mg/day for the CT exposure scenario.

5. Future Adult and Child Resident

   - Exposure frequency of 350 days/year (RME) reflects exposure 7 days/week for 50 weeks (2 weeks away from home for vacation). The CT exposure frequency of 175 days/year reflects exposure 7 days/week for 25 weeks. The exposure duration is a total of 30 years for the RME evaluation (6 years as a child and 24 years as an adult) and 9 years for the CT evaluation (6 years as a child and 3 years as an adult).

- Skin surface area of 5,800 cm^2 (RME) and 5,000 cm^2 (CT) for the adult and 2,300 cm^2 (RME) and 1,980 cm^2 (CT) for the child (6-year-old child) reflects 25% of total body surface area for these receptors.
- The assumed exposure time for the inhalation pathway is 24 hours for both the RME and CT scenarios. The body weight of the receptors are assumed to be 70 kg for the adult and 15 kg for the child.

G.3.3 Exposure Point Concentrations

Exposure point concentrations (EPCs) are the concentrations of chemicals in a given medium to which a hypothetical receptor may be exposed at a specific location known as the "exposure point." Exposure point concentrations can be based on analytical data obtained from onsite sampling, or they may be estimated through modeling. The exposure point concentrations for oral and dermal pathways are equal to the representative concentrations for media. Exposure point concentrations for exposure to particulates and volatiles generated from soil are modeled based on the most recent methodology provided by USEPA (USEPA 1996).

In assessing the possible exposures of hypothetical or actual receptors to Site chemical constituents, an exposure-point concentration (EPC) must be calculated for each chemical in each medium. EPCs are the chemical concentrations at the point at which a receptor will be exposed. The EPCs are used to quantify current and future exposure scenarios.

For soil, under both current and hypothetical future exposure scenarios, the exposure point concentrations were estimated from the RI analytical data. The statistical analysis of the analytical data is presented in Attachment G.1. The Risk Assessment Guidance for Superfund (RAGS) manual emphasizes determining reasonable maximum estimates of exposure (EPCs). The reasonable maximum exposure (RME) and central tendency (CT) evaluations both use the EPCs in the risk estimate. For soil samples, data were assumed to be log-normally distributed. The EPC for soil was determined to be the lesser of the log-normal 95% UCL and the maximum detected concentration.

To calculate the 95% UCL of the arithmetic mean for log-normally distributed data, the data were first transformed using the natural logarithm function [ln(x)]. The arithmetic mean and standard deviation of the transformed data were calculated, and the H-statistic determined or extrapolated (Gilbert 1987). The 95% UCL is calculated as follows for transformed data:

$$95\%\text{UCL} = e^{(\bar{x}+0.5s^2+sH/\sqrt{n-1})}$$

Where:

95% UCL = 95% upper confidence limit of mean,

e	=	constant (base of the natural log, equal to 2.718),
$\bar{x}$	=	arithmetic mean of the transformed data,
s	=	standard deviation of the transformed data,
H	=	H-statistic (from Gilbert 1987, or extrapolated),
n	=	number of samples.

The results of these statistical analyses are presented in the data statistical summary tables in Attachment G.1.

G.4 TOXICITY ASSESSMENT

The objective of the toxicity assessment is to weigh available evidence regarding the potential for particular chemical constituents to cause adverse effects in exposed individuals and to provide, where possible, an estimate of the relationship between the extent of exposure to a contaminant and the increased likelihood and/or severity of adverse effects.

The most recent available toxicity data was used to calculate carcinogenic and noncarcinogenic risks. This includes the Integrated Risk Information System (IRIS; USEPA 1998b) updates and Health Effects Assessment Summary Tables (HEAST; USEPA 1995b). In addition, provisional and surrogate toxicity factors were included in the assessment where available and appropriate. Toxicity values used in the risk assessment are provided in Attachment G.3, Table G.3-2.

To assess toxicity via the dermal absorption route of intake, intake resulting in absorbed dose is compared to a toxicity value representing absorbed dose. To convert intake from administered to absorbed dose, the intake factor is adjusted by a dermal absorption factor (1% for organics and 0.1% for inorganics). To convert administered dose toxicity factors (oral) to absorbed dose toxicity factors, the oral toxicity factors are adjusted by oral absorption factors. Oral absorption efficiencies (percent absorbed by the gastrointestinal tract following oral intake) were identified for each COPC and are used to modify toxicity values as follows:

- For carcinogens, the oral slope factor is divided by the oral absorption efficiency to derive an adjusted slope factor.
- For noncarcinogens, the oral reference dose is multiplied by the oral absorption efficiency to derive an adjusted reference dose.

If an appropriate oral absorption efficiency value was not identified, the following default values were used: 80 percent for VOCs, 50 percent for SVOCs, and 20 percent for inorganics (USEPA 1995a). Administered dose toxicity values are used for oral and inhalation routes of toxicity. For the evaluation of carcinogenic PAHs, USEPA guidance (USEPA 1993b) was consulted for toxicity equivalency factors (TEFs) based on the toxicity of benzo(a)pyrene. Those COPCs that are not quantitatively addressed are qualitatively addressed in the uncertainty section.

Attachement G.4 provides toxicity profiles for the COPCs. The toxicity profiles discuss the physical and chemical properties, fate and transport, and toxicity associated with each COPC.

G.4.1 Noncarcinogens

For many noncarcinogenic toxicity effects, protective mechanisms may exist that must be overcome before an adverse effect is manifested. As a result, a range of exposures, from zero to some finite threshold value, may be tolerated by an organism without any expression of adverse effects. In developing toxicity values to evaluate noncarcinogenic effects, the USEPA approach is to identify the upper bound of this tolerance range (i.e., the maximum subthreshold level). For most chemicals, this level can only be estimated, so uncertainty factors and modifying factors are applied to this estimated level in order to derive a reference dose (RfD) for evaluation of noncarcinogens (USEPA 1989).

An RfD reported as an intake (in mg/kg-day) is the toxicity value used most often in evaluating noncarcinogenic effects. Reference concentrations (RfCs), reported as a concentration in air (in mg/m^3), are used to evaluate noncarcinogenic effects via the inhalation route.

RfDs are developed and verified by USEPA and are defined as "an estimate of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime" (USEPA 1989). RfDs are usually based on the highest concentration of a chemical tested at which no adverse effects were demonstrated in animal experiments (the NOAEL, or no observed adverse effect level). Occasionally, RfDs are based on human epidemiological data, most often from occupational health studies. To calculate an RfD, the NOAEL is divided by uncertainty and modifying factors. If a NOAEL is not available for a chemical, a LOAEL (lowest observed adverse effect level) may be divided by additional factors for use as an RfD (USEPA 1989).

RfDs/RfCs are reported with their associated uncertainty factors (UFs). UFs generally consist of multiples of 10, with each factor representing a specific area of uncertainty inherent in the extrapolation from available data. The use of UFs helps to ensure that the potential for adverse noncarcinogenic effects is not underestimated, even for sensitive subpopulations, during the derivation of RfDs/RfCs.

G.4.2 Carcinogens

For human health risk assessment, USEPA subscribes to the "nonthreshold" theory of carcinogenesis, which proposes that there is essentially no level of exposure to a carcinogen that does not pose a finite probability of generating a carcinogenic response. This theory assumes that a small number of molecular events can evoke changes in a single cell that may lead to uncontrolled cellular proliferation and eventually to cancer (USEPA 1989). Therefore, no dose is thought to be risk free and, in evaluating cancer risk, an effect threshold cannot be estimated. As a result, USEPA takes a probabilistic approach to the evaluation of the carcinogenicity of chemicals. This two-step evaluation includes the assignment of a weight-

of-evidence classification to each chemical based on: (1) strength of evidence that it is a human carcinogen; and (2) calculation of a slope factor for those chemicals that are possible, probable, or known human carcinogens (USEPA 1989).

The USEPA weight-of-evidence classification system characterizes a chemical's carcinogenicity based on the availability of animal, human, and other supportive data. A chemical is assigned to one of the following classes, based on the strength of evidence that a chemical produces carcinogenic effects in humans (USEPA 1989):

- Group A - Human Carcinogen. This category indicates that there is sufficient evidence from epidemiological studies to demonstrate carcinogenicity in humans.
- Group B - Probable Human Carcinogen. This category is subdivided into Group B1 and Group B2:

  Group B1 indicates limited data are available suggesting carcinogenicity in humans.

  Group B2 indicates there is sufficient evidence of carcinogenicity in animals and inadequate or no evidence in humans.
- Group C - Possible Human Carcinogen. This category indicates that there is limited evidence of carcinogenicity in animals and inadequate or no evidence in humans.
- Group D - Not Classifiable. This category indicates that there is inadequate or no data by which to classify a chemical as a human carcinogen.
- Group E - Evidence of Human Noncarcinogenicity. This category indicates there is no evidence of carcinogenicity in an adequate number of studies.

The slope factor (SF) is a plausible upper-bound estimate of the probability of a carcinogenic response per unit intake of a chemical over a lifetime. It is usually the upper 95th percent confidence limit of the slope of the dose-response curve and is expressed as the reciprocal of the chemical intake (in mg) per kg of body weight per day $[(mg/kg\text{-}bw\text{-}day)^{-1}]$ or [kg-bw-day/mg]. The SF is used to estimate an upper-bound lifetime probability of an individual developing cancer as a result of exposure to a particular level of a potential carcinogen. SFs are accompanied by the weight-of-evidence classification to indicate the strength of the evidence that the chemical is a human carcinogen (USEPA 1989).

SFs are reported either as "risk per unit dose" $[(mg/kg\text{-}day)^{-1}]$ or as a "unit risk." Unit risk expresses risk from a substance per concentration of that substance in the medium where human contact occurs. For example, inhalation SFs are usually reported as risk per unit concentration in air $[(\mu g/m^3)^{-1}]$.

G.5 RISK CHARACTERIZATION

To characterize potential noncarcinogenic effects, comparisons were made between projected intakes of substances and toxicity values. To characterize potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure were estimated from projected intakes and chemical-specific dose-response information. Major assumptions, scientific judgments, and to the extent possible, estimates of the uncertainties embodied in the risk assessment are also presented.

For each COPC having available toxicity values, a cancer risk and hazard quotient (HQ) estimate were presented. Attachment G.3 presents the cumulative cancer risk and Hazard Index (HI = sum of all HQs for a given pathway and receptor) estimates derived for each receptor, pathway, and chemical at each site. A summary of the derived risks and hazards are presented in Table G.2.

G.5.1 Carcinogenic Effects

Carcinogenic risk is expressed as a probability of developing cancer as a result of lifetime exposure. For a given chemical and route of exposure, carcinogenic risk is calculated as follows:

Oral risk = exposure intake (administered dose) x oral slope factor (administered dose)

Inhalation risk = exposure intake (administered dose) x inhalation unit risk factor (administered dose)

Dermal risk = intake (absorbed dose) x oral slope factor (absorbed dose)

For simultaneous exposure to several carcinogens, USEPA assumes that the risks are additive. That is to say:

$$RiskT = Risk1 + Risk2 + ... + Riski$$

Where:

RiskT = the total cancer risk, expressed as a unitless probability, and

Risk*i* = the risk estimate for the *i*th substance

Addition of the carcinogenic risks is valid when the following assumptions are met:

- Doses are low.
- No synergistic or antagonistic interactions occur.
- Background risks are assumed to be additive.

USEPA's target range for carcinogenic risk associated with Superfund sites is one-in-ten thousand (1E-04) to one-in-one million (1E-06). That is, the receptor risk due to the Site should not exceed this target range. Those COPCs that are identified during the risk

characterization as contributing significantly (individual cancer risk of 1 x 10^{-6}) to a receptor with a cumulative cancer risk of 1 x 10^{-4} or greater are identified as COCs. The cumulative cancer risk is defined as the summation of the risks associated with all media and all pathways of exposure. The COCs were then discussed in an uncertainty analysis to determine whether they should be considered final COCs. A summary of the carcingenic risks and hazard indices are presented in Table 5.2.

G.5.1.1 Derived Carcinogenic Risk for the Current Receptors

Table G.2 presents a summary of the carcinogenic risks derived for current receptors exposed to chemical constituents in surface soil in the 0 to 0.5 ft depth interval. The carcinogenic risk calculation tables are presented in Attachment G.3. The total receptor risks derived were 6 x 10^{-5} (RME) for the current school employee and 4 x 10^{-5} (RME) for the current adolescent trespasser. Both of these total receptor risks fall below the target of 1 x 10^{-4}, indicating that remedial action is not warranted for the protection of current receptors from potential carcinogenic risks. Carcinogenic chemicals of concern (COC), therefore, were not identified for current receptors.

G.5.1.2 Derived Carcinogenic Risk for Future Receptors

Table G.2 presents a summary of the carcinogenic risks derived for future receptors exposed to chemical constituents in soil in the 0 to 0.5 ft. and the 0 to 12 ft. interval. The carcinogenic risk calculation tables are presented in Attachment G.3. The total receptor risks for the RME exposure scenario were 7 x 10^{-5} for the future industrial/commercial worker (surface soil exposure), 3 x 10^{-5} for the future industrial worker (mixed surface and subsurface soil exposure), 3 x 10^{-6} for the future construction worker and 9 x 10^{-5} for the future resident (combined child and adult). All of these total receptor risks fall below the target of 1 x 10^{-4}, indicating that remedial action is not warranted for the protection of future receptors from potential carcinogenic risks. Carcinogenic chemicals of concern (COC), therefore, were not identified for future receptors.

G.5.2 Noncarcinogenic Effects

The potential for noncarcinogenic effects is evaluated by comparing an exposure level or intake (chronic daily intake or CDI) over a specified time period with a reference dose derived for a similar exposure period. This ratio is termed the Hazard Quotient (HQ). In other words, the hazard quotient equals the intake divided by the reference value, or:

- Oral HQ = exposure intake (administered dose)/oral RfD (administered dose)
- Inhalation HQ = intake (administered dose)/inhalation RfC (administered dose)
- Dermal HQ = intake (absorbed dose)/oral RfD (absorbed dose)The HQ assumes that there is a level of exposure (i.e., RfD or RfC) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level exceeds the threshold (i.e., if HQ exceeds unity), there may be concern for potential noncancer effects.

To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) approach has been developed by the EPA. This approach assumes that simultaneous subthreshold exposures to several chemicals could result in an adverse health effect. The HI is calculated as follows:

- Hazard Index (HI) = HQ1 + HQ2 + ... + HQ*i*

Where:

- Hq*i* = the hazard quotient for the *i*th toxicant

It should be noted that exposure intake is taken to mean "chronic" exposure. Chronic exposure is defined as exposure that occurs over the majority of a life span.

According to USEPA (1989) guidance for noncarcinogens, it is appropriate to derive HI values based on target organ effects, instead of a cumulative HI, if necessary. Given that noncarcinogens are additive only for their specific target organs, target organ HIs are appropriate for a more complete evaluation of potential effects of exposed receptors.

Calculation of an HI in excess of 1 indicates the potential for adverse health effects. Indices greater than 1 will be generated any time intake for any of the COPCs exceeds its RfD or RfC. However, if there are two or more chemicals involved, it is possible to generate an HI greater than 1, even if none of the individual chemical intakes or concentrations exceed their respective RfDs or RfCs. If a particular COPC was determined to contribute significantly (HQ of 0.1 or greater) to a receptor HI of 1 or greater, it was identified as a COC. The cumulative HI is defined as the summation of the hazards associated with all media and all exposure pathways.

G.5.2.1 Derived Noncarcinogenic Risk for Current Receptors

Table 5.2 presents a summary of the noncarcinogenic hazard index derived for current receptors exposed to chemical constituents in soil in the 0 to 0.5 ft. depth interval. The noncancer calculation tables are presented in Attachment G.3. The total receptor HIs were 0.0003 (RME) for the current school employee and 0.0006 (RME) for the current adolescent trespasser. Both of these total receptor risks fall below the target of 1, indicating that remedial action is not warranted for the protection of current receptors from potential noncarcinogenic risks. Noncarcinogenic chemicals of concern (COC), therefore, were not identified for current receptors.

G.5.2.2 Derived Noncarcinogenic Risk for Future Receptors

Table 5.2 presents a summary of the noncarcinogenic hazard indices derived for future receptors exposed to chemical constituents in soil in the 0 to 0.5 ft. and the 0 to 12 ft. intervals. The noncancer risk calculation tables are presented in Attachment G.3. The total receptor HIs for the RME exposure scenario were 0.0004 for the future industrial/commercial worker (surface soil exposure), 0.1 for the future industrial/commercial worker (mixed surface and subsurface soil exposure), and 0.8 for the future resident (combined child and adult). The

derived hazard indices did not exceed the target of 1 for any future receptors, indicating that remedial action is not warranted for the protection of future receptors from potential noncarcinogenic risks. Noncarcinogenic chemicals of concern (COC), therefore, were not identified for future receptors.

G.6 UNCERTAINTY ASSESSMENT

The discussion of uncertainties was developed for the following risk assessment steps: data evaluation, exposure assessment, toxicity assessment, and risk characterization.

G.6.1 Data Evaluation

The sampling data collected at any site are inevitably a limited subset of the nearly unlimited quantity of data that potentially could be collected; as such, they may result in an underestimation or overestimation of risk. In addition, given that the objective of the RI sampling was to define the nature and extent of chemical constituents, samples were not collected randomly and may be biased toward overestimation of chemical concentrations.

Uncertainty in contaminant identification is considered low because sampling protocol generally targets appropriate analytes based on historical information and guidance. Reasonable certainty is also assumed because of the sample data validation and quality assurance/quality control (QA/QC) procedures applied to sample analysis and data evaluation.

G.6.2 Exposure Assessment

Factors that can contribute to uncertainty in the exposure assessment include identification and evaluation of exposure pathways, assumptions for scenario development, intake parameters, and derivation of exposure point concentrations.

The identification of potential exposure pathways and receptors is based on site-specific reasonable current use and hypothetical future land use. To the extent possible, site-specific receptors are identified and exposure parameters tailored to these receptors are identified to minimize uncertainty in the exposure scenarios.

Values assumed for exposure parameters (e.g., inhalation rate and exposure frequencies) used in calculations for intakes are based primarily on USEPA guidance. These assumptions may result in underestimating or overestimating the intakes calculated for specific receptors, depending on the accuracy of the assumptions relative to actual conditions and uses. In the case of dermal exposure, there is uncertainty associated with the conversion from an administered intake to an absorbed intake because of uncertainty associated with the conversion factors.

G.6.3 Toxicity Assessment

Uncertainty is inherent in the toxicity values used to characterize the carcinogenic and noncarcinogenic risks. This chemical-specific uncertainty is incorporated into the toxicity value during its development. For example, an uncertainty factor may be applied for

interspecies and intrahuman variability, for extrapolation from subchronic to chronic exposures, and/or for epidemiological data limitations. The toxicity values used in the risk assessment may overestimate or underestimate risk depending on how each toxicity value was derived.

Toxicity values may not be available for some COPCs, thereby precluding their inclusion in the quantitative risk evaluation. The resulting risk estimation excludes these chemical-specific risks from the calculation, and may underestimate the total risk.

Because toxicity information is limited for many chemicals, toxicity numbers from similar or related chemicals are sometimes substituted. The use of surrogate toxicity values may underestimate or overestimate risk. For some chemicals, analytical results may not distinguish between different isomers or forms of a chemical although available toxicity information does, or vice versa. The absence of isomer specific toxicity values or isomer specific analytical results for some chemicals may tend to underestimate or overestimate risks. No surrogate compounds were used in this risk assessment.

PAHs were identified as COPCs in soils and were evaluated quantitatively. Toxicity values associated with the carcinogenic PAHs are derived using Toxicity Equivalency Factors (TEF), which compare carcinogenic potency of a given congener to benzo(a)pyrene. The use of TEF values to derive toxicity values for the carcinogenic PAHs may overestimate or underestimate the risk associated with the given congener, based on the accuracy of the TEF value used in the evaluation.

Methodology for the derivation of toxicity values for the assessment of dermal exposure is not available, therefore, dermal toxicity values are estimated by adjusting oral toxicity values (see Section 3.5 for methodology discussion). The assumptions made to derive the dermal toxicity values (i.e., use of a default oral absorption factor when a chemical-specific factor is not available) may overestimate or underestimate risk.

G.6.4 Risk Characterization

Some of the procedures used and uncertainties inherent in the human health assessment process may tend to underestimate or overestimate potential risk. Assumptions built into this risk assessment, such as the conservative assumptions for the exposure scenarios, tend to overestimate rather than underestimate potential risks. The assumption of additivity of effects for both carcinogenic and noncarcinogenic effects may result in an overestimation or an underestimation of risk. The assumption of additivity does not allow for potential synergistic or antagonistic effects of various chemicals.

The assumption that contamination is assumed to remain constant over time also results in an overestimation or underestimation of the derived risks. Fate and transport mechanisms, which would result in the degradation and loss of some COPCs from the environment, may not be considered in the exposure evaluation for the future receptors, thereby resulting in an overestimation of risk. Conversely, the degradation of certain chemicals (i.e.,

trichloroethylene) may result in the generation of chemicals with equal or higher potencies (i.e., vinyl chloride), thereby resulting in an underestimation of risk. Given that none of the chemicals identified as COPCs are expected to degrade to more toxic compounds, this issue should not impact the results of the risk assessment. The primary COPCs identified for the Site are PAHs and benzene, which are not expected to significantly degrade to either less toxic or more toxic compounds.

G.7 CONCLUSIONS

Constituents identified in soils and groundwater were evaluated in a screening process to identify COPCs at the Fourth Street Site located in Buffalo, NY. The risk assessment evaluated potential exposure of current and future receptors to soils (Figure 5.1). A quantitative analysis of the carcinogenic and noncarcinogenic risks from COPCs identified in soils to these receptors was consequently conducted. Results of the risk assessment demonstrated that, in the absence of any remedial action, risks to potential receptors are very low. Both the calculated carcinogenic and noncarcinogenic risks fell below the USEPA threshold values.

Groundwater was evaluated in the screening process, but potential exposure of hypothetical future receptors was not quantitatively evaluated. Groundwater in the vicinity is not used as a potable drinking water supply, and no primary aquifers are located within two miles of the Site. Although the groundwater medium was not evaluated quantitatively, it is being evaluated as a medium of concern during the feasibility study. A comparison to NYSDEC Class GA standards was conducted to determine potentially impacted areas (see Section 6).

APPENDIX G
RISK ASSESSMENT

ATTACHMENT G.1
DATA SUMMARY TABLES

Table G.1-1
BURA - Fourth Street Site
Statistical Summary

Media: Surface Soil (0-0.5 ft)

Analyte	CAS No.	Freq of Detect	Units	Min Detect	Max Detect	Log Mean	Log 95% UCL	EP Conc [1]
Acenaphthene	83-32-9	3 / 4	mg/kg	1.50E-01	2.10E+00	3.90E-01	1.59E+02	2.10E+00
Acenaphthylene	208-96-8	2 / 4	mg/kg	1.50E-01	4.40E-01	2.25E-01	6.41E-01	4.40E-01
Anthracene	120-12-7	4 / 5	mg/kg	4.80E-02	7.80E+00	4.96E-01	1.39E+04	7.80E+00
Benzo(a)anthracene	56-55-3	5 / 5	mg/kg	2.00E-01	1.10E+01	1.10E+00	4.43E+03	1.10E+01
Benzo(a)pyrene	50-32-8	4 / 4	mg/kg	4.90E-01	1.00E+01	1.76E+00	5.56E+03	1.00E+01
Benzo(b)fluoranthene	205-99-2	5 / 5	mg/kg	1.20E-01	1.50E+01	1.49E+00	3.18E+04	1.50E+01
Benzo(g,h,i)perylene	191-24-2	4 / 4	mg/kg	3.80E-01	3.20E+00	8.09E-01	5.66E+01	3.20E+00
Benzo(k)fluoranthene	207-08-9	5 / 5	mg/kg	6.60E-02	4.90E+00	4.69E-01	8.26E+02	4.90E+00
Chrysene	218-01-9	5 / 5	mg/kg	1.20E-01	8.80E+00	9.03E-01	5.17E+03	8.80E+00
Dibenz(a,h)anthracene	53-70-3	4 / 4	mg/kg	9.80E-02	1.00E+00	2.53E-01	4.91E+01	1.00E+00
Dibenzofuran	132-64-9	3 / 4	mg/kg	1.10E-01	1.80E+00	3.38E-01	1.68E+02	1.80E+00
Fluoranthene	206-44-0	5 / 5	mg/kg	2.40E-01	2.10E+01	1.62E+00	1.05E+05	2.10E+01
Fluorene	86-73-7	4 / 5	mg/kg	5.80E-02	2.40E+00	2.96E-01	6.98E+01	2.40E+00
Indeno(1,2,3-cd)pyrene	193-39-5	4 / 4	mg/kg	3.90E-01	3.50E+00	9.16E-01	9.05E+01	3.50E+00
Naphthalene	91-20-3	4 / 4	mg/kg	5.60E-02	1.40E+00	2.31E-01	7.42E+02	1.40E+00
Phenanthrene	85-01-8	5 / 5	mg/kg	1.50E-01	2.40E+01	1.36E+00	8.18E+05	2.40E+01
Pyrene	129-00-0	5 / 5	mg/kg	5.60E-02	1.80E+01	1.25E+00	4.56E+06	1.80E+01
Cyanide	57-12-9	3 / 5	mg/Kg	1.60E+00	7.20E+00	1.51E+00	2.63E+01	7.20E+00
Percent Solids	SOLIDS	5 / 5	%	7.72E+01	8.74E+01	8.22E+01	8.71E+01	8.71E+01

(1) Exposure point concentrations = lesser of log 95% UCL vs max detected value.

Table G.1-2
BURA - Fourth Street Site
Statistical Summary

Media: Subsurface Soil (0-12 ft) Excludes MW-08 and MW-09

Analyte	CAS No.	Freq of Detect	Units	Min Detect	Max Detect	Log Mean	Log 95% UCL	EP Conc [1]
Benzene	71-43-2	8 / 27	mg/kg	1.00E-03	3.60E+00	5.18E-03	3.50E+01	3.60E+00
Ethylbenzene	100-41-4	7 / 27	mg/kg	4.10E-03	1.90E+01	6.00E-03	7.06E+02	1.90E+01
Toluene	108-88-3	5 / 27	mg/kg	1.10E-03	1.90E+00	3.50E-03	1.65E+00	1.65E+00
Xylenes, total	1330-20-7	11 / 27	mg/kg	3.00E-03	1.70E+01	8.40E-03	1.06E+03	1.70E+01
Acenaphthene	83-32-9	11 / 26	mg/kg	1.50E-01	1.20E+01	4.36E-01	1.75E+00	1.75E+00
Acenaphthylene	208-96-8	10 / 26	mg/kg	5.60E-02	7.00E+00	2.74E-01	6.42E-01	6.42E-01
Anthracene	120-12-7	12 / 27	mg/kg	4.80E-02	9.40E+00	5.09E-01	3.15E+00	3.15E+00
Benzo(a)anthracene	56-55-3	16 / 27	mg/kg	7.60E-02	1.10E+01	5.33E-01	3.92E+00	3.92E+00
Benzo(a)pyrene	50-32-8	14 / 26	mg/kg	5.50E-02	1.00E+01	5.52E-01	3.70E+00	3.70E+00
Benzo(b)fluoranthene	205-99-2	16 / 27	mg/kg	7.30E-02	1.50E+01	5.32E-01	4.42E+00	4.42E+00
Benzo(g,h,i)perylene	191-24-2	13 / 26	mg/kg	4.30E-02	3.20E+00	3.57E-01	9.34E-01	9.34E-01
Benzo(k)fluoranthene	207-08-9	14 / 27	mg/kg	4.70E-02	4.90E+00	3.31E-01	1.06E+00	1.06E+00
Chrysene	218-01-9	16 / 27	mg/kg	6.90E-02	9.40E+00	4.84E-01	3.31E+00	3.31E+00
Dibenz(a,h)anthracene	53-70-3	11 / 26	mg/kg	8.70E-02	1.10E+00	2.34E-01	4.07E-01	4.07E-01
Dibenzofuran	132-64-9	11 / 26	mg/kg	1.10E-01	8.60E+00	3.69E-01	1.14E+00	1.14E+00
Fluoranthene	206-44-0	18 / 27	mg/kg	4.40E-02	2.10E+01	6.48E-01	1.42E+01	1.42E+01
Fluorene	86-73-7	12 / 27	mg/kg	5.80E-02	9.80E+00	4.55E-01	2.23E+00	2.23E+00
Indeno(1,2,3-cd)pyrene	193-39-5	13 / 26	mg/kg	5.40E-02	4.10E+00	3.92E-01	1.24E+00	1.24E+00
Naphthalene	91-20-3	14 / 26	mg/kg	5.60E-02	5.80E+01	6.25E-01	1.84E+01	1.84E+01
Phenanthrene	85-01-8	17 / 27	mg/kg	4.40E-02	3.00E+01	7.70E-01	2.96E+01	2.96E+01
Pyrene	129-00-0	19 / 27	mg/kg	4.10E-02	2.90E+01	5.90E-01	1.67E+01	1.67E+01
2,4-Dimethylphenol	105-67-9	2 / 27	mg/kg	6.30E-02	7.30E-01	2.33E-01	3.27E-01	3.27E-01
2-Methylphenol	95-48-7	1 / 27	mg/kg	2.70E-01	2.70E-01	2.35E-01	2.95E-01	2.70E-01
4-Methylphenol	106-44-5	2 / 27	mg/kg	6.20E-02	3.50E-01	2.26E-01	3.06E-01	3.06E-01
Cyanide	57-12-9	5 / 27	mg/Kg	1.60E+00	4.63E+01	9.30E-01	2.52E+00	2.52E+00
Percent Solids	SOLIDS	27 / 27	%	3.64E+01	8.74E+01	7.60E+01	8.18E+01	8.18E+01

(1) Exposure point concentrations = lesser of log 95% UCL vs max detected value.

Table G.1-3
BURA - Fourth Street Site
Statistical Summary

Media: All Soil (0-depth) Excludes MW-08 and MW-09

Analyte	CAS No.	Freq of Detect	Units	Min Detect	Max Detect	Log Mean	Log 95% UCL
Benzene	71-43-2	15 / 43	mg/kg	8.00E-04	1.30E+01	5.29E-03	9.80E+00
Ethylbenzene	100-41-4	12 / 43	mg/kg	4.10E-03	1.90E+01	5.00E-03	3.48E+01
Toluene	108-88-3	11 / 43	mg/kg	8.00E-04	1.90E+00	2.61E-03	1.83E-01
Xylenes, total	1330-20-7	19 / 43	mg/kg	1.80E-03	1.70E+01	7.30E-03	6.63E+01
Acenaphthene	83-32-9	11 / 39	mg/kg	1.50E-01	1.20E+01	3.41E-01	8.82E-01
Acenaphthylene	208-96-8	10 / 39	mg/kg	5.60E-02	7.00E+00	2.50E-01	4.31E-01
Anthracene	120-12-7	12 / 40	mg/kg	4.80E-02	9.40E+00	3.80E-01	1.35E+00
Benzo(a)anthracene	56-55-3	16 / 40	mg/kg	7.60E-02	1.10E+01	3.93E-01	1.57E+00
Benzo(a)pyrene	50-32-8	14 / 39	mg/kg	5.50E-02	1.00E+01	3.99E-01	1.50E+00
Benzo(b)fluoranthene	205-99-2	16 / 41	mg/kg	7.30E-02	1.50E+01	3.85E-01	1.60E+00
Benzo(g,h,i)perylene	191-24-2	13 / 39	mg/kg	4.30E-02	3.20E+00	2.98E-01	5.71E-01
Benzo(k)fluoranthene	207-08-9	14 / 40	mg/kg	4.70E-02	4.90E+00	2.85E-01	6.13E-01
Chrysene	218-01-9	16 / 40	mg/kg	6.90E-02	9.40E+00	3.68E-01	1.37E+00
Dibenz(a,h)anthracene	53-70-3	11 / 39	mg/kg	8.70E-02	1.10E+00	2.25E-01	3.20E-01
Dibenzofuran	132-64-9	11 / 39	mg/kg	1.10E-01	8.60E+00	3.05E-01	6.49E-01
Fluoranthene	206-44-0	18 / 40	mg/kg	4.40E-02	2.10E+01	4.48E-01	3.70E+00
Fluorene	86-73-7	12 / 40	mg/kg	5.80E-02	9.80E+00	3.53E-01	1.05E+00
Indeno(1,2,3-cd)pyrene	193-39-5	13 / 39	mg/kg	5.40E-02	4.10E+00	3.18E-01	6.94E-01
Naphthalene	91-20-3	18 / 39	mg/kg	5.60E-02	5.80E+01	4.65E-01	4.36E+00
Phenanthrene	85-01-8	17 / 40	mg/kg	4.40E-02	3.00E+01	5.03E-01	6.26E+00
Pyrene	129-00-0	19 / 40	mg/kg	4.10E-02	2.90E+01	4.21E-01	3.91E+00
2,4-Dimethylphenol	105-67-9	2 / 43	mg/kg	6.30E-02	7.30E-01	2.22E-01	2.74E-01
2-Methylphenol	95-48-7	1 / 43	mg/kg	2.70E-01	2.70E-01	2.24E-01	2.59E-01
4-Methylphenol	106-44-5	2 / 43	mg/kg	6.20E-02	3.50E-01	2.18E-01	2.63E-01
Cyanide	57-12-9	5 / 43	mg/Kg	1.60E+00	4.63E+01	7.92E-01	1.46E+00
Percent Solids	SOLIDS	43 / 43	%	3.64E+01	9.21E+01	7.81E+01	8.23E+01

Table G.1-4
BURA - Fourth Street Site
Statistical Summary

Media: Surface Soil (0-0.5 ft) - Offsite Background Samples

Analyte	CAS No.	Freq of Detect	Units	Min Detect	Max Detect	Log Mean	2X Mean
Acenaphthene	83-32-9	5 / 7	mg/kg	8.50E-02	3.30E-01	1.87E-01	3.75E-01
Acenaphthylene	208-96-8	1 / 7	mg/kg	1.20E-01	1.20E-01	1.88E-01	3.75E-01
Anthracene	120-12-7	6 / 7	mg/kg	7.10E-02	6.50E-01	3.02E-01	6.05E-01
Benzo(a)anthracene	56-55-3	7 / 7	mg/kg	7.40E-02	1.80E+00	5.77E-01	1.15E+00
Benzo(a)pyrene	50-32-8	7 / 7	mg/kg	6.90E-02	1.60E+00	4.86E-01	9.71E-01
Benzo(b)fluoranthene	205-99-2	7 / 7	mg/kg	9.60E-02	2.50E+00	7.09E-01	1.42E+00
Benzo(g,h,i)perylene	191-24-2	6 / 7	mg/kg	1.10E-01	4.30E-01	2.44E-01	4.87E-01
Benzo(k)fluoranthene	207-08-9	6 / 7	mg/kg	9.20E-02	6.50E-01	2.91E-01	5.82E-01
Chrysene	218-01-9	7 / 7	mg/kg	7.60E-02	1.60E+00	5.29E-01	1.06E+00
Dibenz(a,h)anthracene	53-70-3	5 / 7	mg/kg	5.30E-02	1.90E-01	1.30E-01	2.61E-01
Dibenzofuran	132-64-9	5 / 7	mg/kg	5.80E-02	2.50E-01	1.40E-01	2.79E-01
Fluoranthene	206-44-0	7 / 7	mg/kg	1.50E-01	2.80E+00	9.83E-01	1.97E+00
Fluorene	86-73-7	5 / 7	mg/kg	9.70E-02	3.20E-01	1.99E-01	3.98E-01
Indeno(1,2,3-cd)pyrene	193-39-5	7 / 7	mg/kg	4.40E-02	5.60E-01	2.33E-01	4.65E-01
Naphthalene	91-20-3	4 / 7	mg/kg	5.00E-02	3.00E-01	1.54E-01	3.08E-01
Phenanthrene	85-01-8	7 / 7	mg/kg	9.60E-02	2.50E+00	8.31E-01	1.66E+00
Pyrene	129-00-0	7 / 7	mg/kg	1.40E-01	2.70E+00	9.45E-01	1.89E+00
Phenol	108-95-2	1 / 7	mg/kg	6.90E-02	6.90E-02	1.75E-01	3.49E-01
Percent Solids	SOLIDS	7 / 7	%	7.59E+01	8.73E+01	8.25E+01	NA
Total Organic Carbon	7440-44-0	7 / 7	mg/Kg	2.92E+04	6.01E+04	4.43E+04	NA

Table G.1-5
BURA - Fourth Street Site
Statistical Summary

Media: Subsurface Soil (6-16 ft) - MW-08 and MW-09

Analyte	CAS No.	Freq of Detect	Units	Min Detect	Max Detect	Mean
Benzene	71-43-2	2 / 5	mg/kg	3.30E-03	2.30E-01	1.17E-01
Ethylbenzene	100-41-4	1 / 5	mg/kg	1.90E-01	1.90E-01	1.90E-01
Toluene	108-88-3	1 / 5	mg/kg	1.10E-03	1.10E-03	1.10E-03
Xylenes, total	1330-20-7	1 / 5	mg/kg	1.50E-01	1.50E-01	1.50E-01
Acenaphthene	83-32-9	1 / 5	mg/kg	4.00E-01	4.00E-01	4.00E-01
Anthracene	120-12-7	1 / 5	mg/kg	7.20E-01	7.20E-01	7.20E-01
Benzo(a)anthracene	56-55-3	1 / 5	mg/kg	8.50E-01	8.50E-01	8.50E-01
Benzo(a)pyrene	50-32-8	3 / 5	mg/kg	5.90E-02	5.10E-01	2.50E-01
Benzo(b)fluoranthene	205-99-2	1 / 5	mg/kg	6.10E-01	6.10E-01	6.10E-01
Benzo(g,h,i)perylene	191-24-2	1 / 5	mg/kg	1.50E-01	1.50E-01	1.50E-01
Benzo(k)fluoranthene	207-08-9	1 / 5	mg/kg	2.50E-01	2.50E-01	2.50E-01
Chrysene	218-01-9	1 / 5	mg/kg	7.00E-01	7.00E-01	7.00E-01
Dibenz(a,h)anthracene	53-70-3	1 / 5	mg/kg	6.40E-02	6.40E-02	6.40E-02
Dibenzofuran	132-64-9	1 / 5	mg/kg	2.60E-01	2.60E-01	2.60E-01
Fluoranthene	206-44-0	1 / 5	mg/kg	1.10E+00	1.10E+00	1.10E+00
Fluorene	86-73-7	1 / 5	mg/kg	5.20E-01	5.20E-01	5.20E-01
Indeno(1,2,3-cd)pyrene	193-39-5	1 / 5	mg/kg	2.00E-01	2.00E-01	2.00E-01
Naphthalene	91-20-3	1 / 5	mg/kg	3.30E-01	3.30E-01	3.30E-01
Phenanthrene	85-01-8	1 / 5	mg/kg	1.60E+00	1.60E+00	1.60E+00
Pyrene	129-00-0	1 / 5	mg/kg	1.30E+00	1.30E+00	1.30E+00
4-Methylphenol	106-44-5	1 / 5	mg/kg	5.90E-02	5.90E-02	5.90E-02
Cyanide	57-12-9	1 / 5	%	2.90E-03	2.90E-03	2.90E-03

Table G.1-6
BURA - Fourth Street Site
Statistical Summary

Media: Groundwater (excludes MW-08 and MW-09)

Analyte	CAS No.	Freq of Detect	Units	Min Detect	Max Detect	Mean
Benzene	71-43-2	5 / 6	mg/l	5.00E-04	4.00E-03	1.30E-03
Ethylbenzene	100-41-4	2 / 6	mg/l	2.70E-03	1.30E-02	2.95E-03
Toluene	108-88-3	3 / 6	mg/l	5.00E-04	1.90E-03	8.33E-04
Xylenes, total	1330-20-7	3 / 6	mg/l	1.30E-03	7.90E-03	2.25E-03
Acenaphthene	83-32-9	1 / 6	mg/l	2.00E-03	2.00E-03	4.58E-03
Fluorene	86-73-7	1 / 6	mg/l	1.00E-03	1.00E-03	4.42E-03
Naphthalene	91-20-3	1 / 6	mg/l	4.00E-03	4.00E-03	4.92E-03
Pyrene	129-00-0	1 / 6	mg/l	1.00E-03	1.00E-03	4.42E-03
Cyanide	57-12-9	3 / 6	mg/l	1.10E-02	1.40E-01	4.18E-02

Table G.1-7
BURA - Fourth Street Site
Statistical Summary

Media: Groundwater - Offsite samples MW-08 and MW-09

Analyte	CAS No.	Freq of Detect	Units	Min Detect	Max Detect	Mean
Benzene	71-43-2	1 / 2	mg/l	1.90E+00	1.90E+00	9.50E-01
Ethylbenzene	100-41-4	1 / 2	mg/l	4.10E-02	4.10E-02	2.08E-02
Toluene	108-88-3	1 / 2	mg/l	2.40E-03	2.40E-03	1.45E-03
Xylenes, total	1330-20-7	1 / 2	mg/l	4.40E-02	4.40E-02	2.23E-02
Acenaphthene	83-32-9	1 / 2	mg/l	7.00E-03	7.00E-03	6.25E-03
Fluorene	86-73-7	1 / 2	mg/l	2.00E-03	2.00E-03	3.75E-03
Phenol	108-95-2	1 / 2	mg/l	4.20E-02	4.20E-02	2.38E-02
Cyanide	57-12-9	1 / 2	mg/l	1.30E-02	1.30E-02	9.00E-03

ATTACHMENT G.2
DATA SCREENING TABLES

Table G.2-1
NYSDEC Soil Cleanup Levels (TAGM) [1] Adjusted for TOC Content
BURA - Fourth Street Site

Constituent	Reported TAGM Soil Cleanup Levels[2]	Adjusted TAGM Cleanup Levels					
		K_{oc}	Groundwater Standards/Criteria C_w (ppb)	Allowable Soil Concentration C_s (ppm)	Soil Cleanup Objectives to Protect GW Quality (ppm)[4]	Adjusted TAGM Soil Cleanup Objective (ppm)	
Chemical - units in mg/kg							
Volatiles							
Benzene	6.00E-02	8.30E+01	7.00E-01	2.66E-03	2.66E-01	2.66E-01	
Ethylbenzene	5.50E+00	1.10E+03	5.00E+00	2.52E-01	2.52E+01	2.52E+01	
Toluene	1.50E+00	3.00E+02	5.00E+00	6.87E-02	6.87E+00	6.87E+00	
Xylenes, total	1.20E+00	2.40E+02	5.00E+00	5.50E-02	5.50E+00	5.50E+00	
Semi-Volatiles							
Acenaphthene	5.00E+01	4.60E+03	2.00E+01	4.21E+00	4.21E+02	5.00E+01	(a)
Acenaphthylene	4.10E+01	2.06E+03	2.00E+01	1.88E+00	1.88E+02	5.00E+01	(a)
Anthracene	5.00E+01	1.40E+04	5.00E+01	3.21E+01	3.21E+03	5.00E+01	(a)
Benzo(a)anthracene	2.44E-01	1.38E+06	2.00E-03	1.26E-01	1.26E+01	2.24E-01	(b)
Benzo(a)pyrene	6.10E-02	5.50E+06	2.00E-03	5.04E-01	5.04E+01	6.10E-02	(b)
Benzo(b)fluoranthene	1.10E+00	5.50E+05	2.00E-03	5.04E-02	5.04E+00	5.04E+00	
Benzo(g,h,i)perylene	5.00E+01	1.60E+06	5.00E+00	3.66E+02	3.66E+04	5.00E+01	(a)
Benzo(k)fluoranthene	1.10E+00	5.50E+05	2.00E-03	5.04E-02	5.04E+00	5.04E+00	
Chrysene	4.00E-01	2.00E+05	2.00E-03	1.83E-02	1.83E+00	1.83E+00	
Dibenz(a,h)anthracene	1.40E-02	3.30E+07	5.00E+01	7.56E+04	7.56E+06	1.40E-02	(b)
Dibenzofuran	6.20E+00	1.23E+03	5.00E+00	2.82E-01	2.82E+01	2.82E+01	
2,4-Dimethylphenol	NS	--	--	--	--	NS	
Fluoranthene	5.00E+01	3.80E+04	5.00E+01	8.70E+01	8.70E+03	5.00E+01	(a)
Fluorene	5.00E+01	7.30E+03	5.00E+01	1.67E+01	1.67E+03	5.00E+01	(a)
Indeno(1,2,3-cd)pyrene	3.20E+00	1.60E+06	2.00E-03	1.47E-01	1.47E+01	1.47E+01	
2-Methylphenol	1.00E+02	1.50E+01	5.00E+00	3.44E-03	3.44E-01	3.44E-01	
4-Methylphenol	1.00E-01	1.70E+01	5.00E+01	3.89E-02	3.89E+00	3.89E+00	
Naphthalene	1.30E+01	1.30E+03	1.00E+01	5.95E-01	5.95E+01	5.00E+01	(a)
Phenanthrene	5.00E+01	4.37E+03	5.00E+01	1.00E+01	1.00E+03	5.00E+01	(a)
Pyrene	5.00E+01	1.33E+04	5.00E+01	3.04E+01	3.04E+03	5.00E+01	(a)
Phenol	3.00E-02	2.70E+01	1.00E+00	1.24E-03	1.24E-01	1.24E-01	
Inorgancs							
Cyanide	NS	--	--	--	--	NS	

Notes:

NS No Standard (Cleanup Level value) for this analyte.

(1) TAGM = Technical and Administrative Guidance Memorandum, 1994.
NYSDEC = New York State Department of Environmental Conservation
TOC = Total Organic Carbon

(2) TAGM Soil Cleanup Levels based on 1% TOC (1994)

(3) TAGM Soil Cleanup Levels based on 4.58% TOC (site specific TOC) using the equation $Cs = f \times Cw \times Koc$
Cs = Soil Cleanup Objective (unless otherwise indicated in TAGM)
f = soil organic carbon content (TOC)
Cw = Groundwater Standards/Criteria from TAGM (1994)
Koc = partition coefficient from TAGM (1994)

(4) Soil Cleanup Objctive = Cs x Correction Factor (CF)
CF = 100 per TAGM # 4046 (1994)

(a) Per TAGM #4046 (1994), Individual Semi-Volatiles Soil Cleanup Objective must be < 50 ppm.

(b) Soil Cleanup Objective based on USEPA Human Health Carcinogens (TAGM 1994).

Table G.2-2
Surface Soil (0-0.5 ft) Screening Against Soil Cleanup Levels (TAGM) [1] and Background
BURA - Fourth Street Site

Constituent	NYSDEC [2] Adjusted TAGM Soil Cleanup Levels	Surface Soil (0-0.5 ft)			
		Maximum Detected Concentration	2X Mean[3] Background (0-0.5 ft)	Retained as COPC[4] Y/N	Criteria for Exclusion as COPC
Chemical - units in mg/kg					
Semi-Volatiles					
Acenaphthene	5.00E+01	2.10E+00	NA	N	TAGM
Acenaphthylene	5.00E+01	4.40E-01	NA	N	TAGM
Anthracene	5.00E+01	7.80E+00	NA	N	TAGM
Benzo(a)anthracene	2.24E-01	1.10E+01	NA	Y	--
Benzo(a)pyrene	6.10E-02	1.00E+01	NA	Y	--
Benzo(b)fluoranthene	5.04E+00	1.50E+01	NA	Y	--
Benzo(g,h,i)perylene	5.00E+01	3.20E+00	NA	N	TAGM
Benzo(k)fluoranthene	5.04E+00	4.90E+00	NA	N	TAGM
Chrysene	1.83E+00	8.80E+00	NA	Y	--
Dibenz(a,h)anthracene	1.40E-02	1.00E+00	NA	Y	--
Dibenzofuran	2.82E+01	1.80E+00	NA	N	TAGM
Fluoranthene	5.00E+01	2.10E+01	NA	N	TAGM
Fluorene	5.00E+01	2.40E+00	NA	N	TAGM
Indeno(1,2,3-cd)pyrene	1.47E+01	3.50E+00	NA	N	TAGM
Naphthalene	5.00E+01	1.40E+00	NA	N	TAGM
Phenanthrene	5.00E+01	2.40E+01	NA	N	TAGM
Pyrene	5.00E+01	1.80E+01	NA	N	TAGM
Inorganics					
Cyanide	NS	7.20E+00	ND	Y	--

Notes:
- NS No Standard (Cleanup Level value) for this analyte.
- NA Not appropriate because the background screening is completed for inorganic constituents only.
- ND Not detected.
- (1) TAGM = Technical and Administrative Guidance Memorandum, 1994.
- (2) New York State Department of Environmental Conservation Adjusted TAGM Soil Cleanup Levels from Table J.2-1
- (3) Background screening only applies to inorganic analytes.
- (4) COPC = Chemical of Potential Concern; analyte was retained if the maximum concentration exceeded the TAGM soil cleanup level, if a TAGM soil cleanup level was not available, or if the maximum concentration exceeded 2X the background mean (for inorganics only).

Table G.2-3
Subsurface Soil (0-12 ft) Screening Against Soil Cleanup Levels (TAGM) [1] and Background
BURA - Fourth Street Site

Constituent	NYSDEC [2] Adjuusted TAGM Soil Cleanup Levels	Surface Soil (0-12 ft) Maximum Detected Concentration	2X Mean [3] Background (0-0.5 ft)	Retained as COPC [4] Y/N	Criteria for Exclusion as COPC
Chemical - units in mg/kg					
Volatiles					
Benzene	2.66E-01	3.60E+00	NA	Y	--
Ethylbenzene	2.52E+01	1.90E+01	NA	N	TAGM
Toluene	6.87E+00	1.90E+00	NA	N	TAGM
Xylenes, total	5.50E+00	1.70E+01	NA	Y	--
Semi-Volatiles					
Acenaphthene	5.00E+01	1.20E+01	NA	N	TAGM
Acenaphthylene	5.00E+01	7.00E+00	NA	N	TAGM
Anthracene	5.00E+01	9.40E+00	NA	N	TAGM
Benzo(a)anthracene	2.24E-01	1.10E+01	NA	Y	--
Benzo(a)pyrene	6.10E-02	1.00E+01	NA	Y	--
Benzo(b)fluoranthene	5.04E+00	1.50E+01	NA	Y	--
Benzo(g,h,i)perylene	5.00E+01	3.20E+00	NA	N	TAGM
Benzo(k)fluoranthene	5.04E+00	4.90E+00	NA	N	TAGM
Chrysene	1.83E+00	9.40E+00	NA	Y	--
Dibenz(a,h)anthracene	1.40E-02	1.10E+00	NA	Y	--
Dibenzofuran	2.82E+01	8.60E+00	NA	N	TAGM
2,4-Dimethylphenol	NS	7.30E-01	NA	Y	--
Fluoranthene	5.00E+01	2.10E+01	NA	N	TAGM
Fluorene	5.00E+01	9.80E+00	NA	N	TAGM
Indeno(1,2,3-cd)pyrene	1.47E+01	4.10E+00	NA	N	TAGM
2-Methylphenol	3.44E-01	2.70E-01	NA	N	TAGM
4-Methylphenol	3.89E+00	3.50E-01	NA	N	TAGM
Naphthalene	5.00E+01	5.80E+01	NA	Y	--
Phenanthrene	5.00E+01	3.00E+01	NA	N	TAGM
Pyrene	5.00E+01	2.90E+01	NA	N	TAGM
Inorganics					
Cyanide	NS	4.63E+01	ND	Y	--

Notes:

NS No Standard (Cleanup Level value) for this analyte.

NA Not appropriate because the background screening is completed for inorganic constituents only.

ND Not detected.

(1) TAGM = Technical and Administrative Guidance Memorandum, 1994.

(2) New York State Department of Environmental Conservation
Adjusted TAGM Soil Cleanup Levels from Table J.2-1

(3) Background screening only applies to inorganic analytes.

(4) COPC = Chemical of Potential Concern; analyte was retained if the maximum concentration exceeded the TAGM soil cleanup level, if a TAGM soil cleanup level was not available, or if the maximum concentration exceeded 2X the background mean (for inorganics only).

Table G.2-4
Groundwater Comparison to NYSDEC Criteria and NYS MCLs[1,2]
BURA - Fourth Street Site

Constituent	Groundwater Criteria				
	Maximum Detected Concentration	NYSDEC Class GA Criteria[3] (mg/L)	Exceed Criteria? Y/N	New York State MCL[4] (mg/L)	Exceed MCL? Y/N
Chemical - units in mg/L					
Volatiles					
Benzene	4.00E-03	1.00E-03	Y	5.00E-03	N
Ethylbenzene	1.30E-02	5.00E-03	Y	5.00E-03	Y
Toluene	1.90E-03	5.00E-03	N	5.00E-03	N
Xylenes	7.90E-03	5.00E-03	Y	5.00E-03	Y
Semi-Volatiles					
Acenaphthene	2.00E-03	2.00E-02	N	5.00E-02	N
Fluorene	1.00E-03	5.00E-02	N	5.00E-02	N
Naphthalene	4.00E-03	1.00E-02	N	5.00E-02	N
Pyrene	1.00E-03	5.00E-02	N	5.00E-02	N
Total Organics:	3.48E-02	NA	NA	1.00E-01	N
Inorganics					
Cyanide	1.40E-01	2.00E-01	N	NS	NA

Notes:
NS No Standard and/or MCL (Groundwater Criteria) for this analyte
ND not detected
NA not applicable
(1) New York State Department of Environmental Conservation
(2) New York State Maximum Contaminant Levels (Title 10, Chapter I, Part 5)
(3) Freshwater Groundwater Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations (TOGS 1.1.1; June 1998)
(4) MCLs for Public Water Systems (Drinking Water Standards, Title 10 Chapter I, Part 5, December 1992)
0.005 ppm for POCs (principle organic compounds) and 0.05 ppm for UOCs (unspecified organic contaminants)

ATTACHMENT G.3
HHRA TABLES

Table G.3-1
Exposure Assumptions Used for Human Health Risk Assessment
Current and Future Receptors
BURA - Fourth Street Site

			Soil															
			Worker**				Trespasser				Adult Resident				Child Resident			
Factors		Units	RME	Ref	CT	Ref	RME	Ref	CT	Ref	RME	Ref	CT	Ref	RME	Ref	CT	Ref
Body Wt. (BW)	BW	kg	70	1,5	70	1, 5	45	1, 5	45	1,5	70	1, 5	70	1,5	15	2,5	15	2,5
Exposure Duration (ED)	ED	yr.	25	5,6	5	5,6	10	2,5	10	5	24	5,6	7	5	6	5,6	2	5
Exposure Frequency (EF)	EF	d/yr.	250	1,2,5,6	234	5	250	7	100	7	350	1,2,5,6	175	4	350	1,2,5,6	175	4
Exposure Time (ET)	ET	hr/d	8	1	8	1	4	1	2	1	24	1	24	1	24	1	24	1
Adherence Factor Soil to Skin (AF)	AF	mg/cm^2	1	4,6	0.2	4,6	1	4,6	0.2	4,6	1	4,6	0.2	4,6	1	4, 6	0.2	4,6
Skin Surface Area Available for Contact (SA)	SA	cm^2	5,800	4a	5,000	4a	4,400	4a	3,350	4a	5,800	4a	5,000	4a	2,300	4a	1,980	4a
Ingestion Rate (IR_o)	IRo	mg/d	100	1,5	50	5	100	1,5	50	5	100	1,5	50	5	200	5	100	5
Inhalation Rate (IR_i)	IRi	m^3/hr	2.5	6	2.5	6	0.83	6	0.83	6	0.83	6	0.83	6	0.625	6	0.625	6
Fraction Ingested from Contaminated Sources (FI)	FI	unitless	1.0	1, 6	1.0	1, 6	1.0	1, 6	1.0	1,6	1.0	1, 6	1.0	1,6	1.0	1,6	1.0	1,6
Absorption Factor (ABSo), organics	ABSo	unitless	1%	6	1%	6	1%	6	1%	6	1%	6	1%	6	1%	6	1%	6
Absorption Factor (ABSi), inorganics	ABSi	unitless	0.10%	6	0.10%	6	0.10%	6	0.10%	6	0.10%	6	0.10%	6	0.10%	6	0.10%	6

Note:

** - These values represent an industrial worker, for school employees, the exposure frequency is 200 days/year (RME) and 100 days/year (CT). The exposure time is 2 hr/day (RME) and 1 hr/day (CT).
For construction workers, the ED = 1 year (RME and CT) and the IRo = 480 mg/day for RME and 100 mg/day for CT.
Ingestion rate, IR, is expressed in mg/day for soil and l/day for groundwater.
References:
(1) EPA 1989 - RAGS
(2) EPA 1991a - Supplemental Guidance to RAGS
(3) EPA 1997 - Exposure Factors Handbook
(4) EPA 1992a - Dermal Guidance
(5) EPA 1993a - Region VIII Guidance for the RME and CT
(6) EPA 1995a - Region IV Supplemental Guidance
(7) Best Professional Judgement -
a - Reflects exposure of 25% of the total body surface area.

Table G.3-2
Chemical-Specific Toxicity and Exposure Values Used for Human Health Risk Assessment[1]
BURA - Fourth Street Site

COPCs[2]	CAS Number	Toxicity Values									Exposure Values
		Toxicity Class[3]	CAG Group[4]	OSF[5]	ORfD[6]	OABS[7]	DRfD[8]	DSF[9]	RfC[10]	IUR[11]	DABS[12]
Volatiles											
Benzene	71-43-2	NC,C	A	2.90E-02	3.00E-03	9.50E-01	2.85E-03	3.05E-02	6.00E-03	8.30E-06	1.00E-02
Xylenes	1330-20-7	NC,C	D	--	2.00E+00	9.00E-01	1.80E+00	--	--	--	1.00E-02
Semi-Volatiles											
Benzo(a)anthracene	56-55-3	C	B2	7.30E-01	--	5.00E-01	--	1.46E+00	--	8.80E-05	1.00E-02
Benzo(a)pyrene	50-32-8	C	B2	7.30E+00	--	5.00E-01	--	1.46E+01	--	8.80E-04	1.00E-02
Benzo(b)fluoranthene	205-99-2	C	B2	7.30E-01	--	5.00E-01	--	1.46E+00	--	8.80E-05	1.00E-02
Chrysene	218-01-9	C	B2	7.30E-03	--	5.00E-01	--	1.46E-02	--	8.80E-07	1.00E-02
Dibenz(a,h)anthracene	53-70-3	C	B2	7.30E+00	--	5.00E-01	--	1.46E+01	--	8.80E-04	1.00E-02
2,4-Dimethylphenol	105-67-9	NC	NR	--	2.00E-02	5.00E-01	1.00E-02	--	--	--	1.00E-02
Naphthalene	91-20-3	NC	D	--	4.00E-02	5.00E-01	2.00E-02	--	3.00E-03	--	1.00E-02
Inorganics											
Cyanide	57-12-5	NC	D	--	2.00E-02	5.00E-01	1.00E-02	--	--	--	1.00E-03

Notes:
1. All values from IRIS if available. HEAST used if IRIS values unavailable.
2. Chemicals of Potential Concern.
3. Toxicity Class: C - Carcinogen, NC - Noncarcinogen, NR = Not Reported.
4. CAG - EPA Carcinogen Assessment Group. NR - Not Reported.
5. OSF - oral slope factor.
6. ORfD - oral reference dose.
7. OABS - oral absorption factors from appropriate ATSDR Profiles (ATSDR 1988 - 1994) or default values (see text).
8. DRfD - dermal RfD = oral RfD x oral absorption factor.
9. DSF - dermal SF = oral SF/oral absorption factor.
10. RfC - inhalation reference concentration.
11. IUR - inhalation unit risk.
12. DABS - dermal absorption factor according to EPA Region IV, 11/95.

Table G.3-3
Calculation of Soil Particulate Emission Factor[(1)]
BURA - Fourth Street Site

CONSTANTS:					
Inverse of mean conc at center of square source (Q/C)	see below	g/m^2-s per kg/m^3	(2,3)	Particulate emission factor (PEF) =	$meters^3/kg$
Fraction of vegetative cover (V) =	0.50	unitless	(2)		
Mean annual wind speed (Um) =	4.69	meters/sec	(2)	Q/C x (3600s/h/(0.036 x (1-V) x (Um/Ut)^3 x F(x))	
Equivalent threshold value of wind speed at 7 m (Ut) =	11.32	meters/sec	(2)		
Function dependent on Um/Ut from Cowherd (1985)	0.194	unitless	(2)		

Notes:

1. USEPA 1996: Soil Screening Guidance
2. Use site-specific or default values from USEPA 1996b.
3. Default values for a site in Hartford and resultant PEF values as follows:

	Q/C	PEF
0.5 acres =	71.35	1.03E+09

Table G.3-4
Calculation of Soil Volatilization Factor[1]
BURA - Fourth Street Site

Constituent	Koc[4] (cm^3/g)	H[4] (atm-m3/mol)	H[4] dimensionless	Dw[4] (cm^2/s)	Di[4] (cm2/sec)	Kd[4] (cm^3/g)	Da[4] (cm^2/s)	Volatilization Factor (m^3/kg)
Benzene	5.89E+01	5.55E-03	2.28E-01	9.80E-06	8.80E-02	5.89E-01	1.42E-03	3.45E+03
Xylenes (total)	3.86E+02	6.73E-03	2.76E-01	8.75E-06	7.80E-02	3.86E+00	2.78E-04	7.79E+03

CONSTANTS:	Inverse of the mean conc at the center of a square source (Q/C), g/m^2-s per kg/m^3 =	71.35	Default for 0.5-acre site in Hartford
	Exposure interval (T), s =	9.50E+08	(5)
	Bulk densitey (ρ_b), g/cm^3 =	1.50	(5)
	Air -filled soil porosity (0a), Lair/Lsoil =	0.28	(5)
	Total soil porosity (n), Lpore/Lsoil =	4.30E-01	(5)
	Water-filled soil porosity (0w), Lwater/Lsoil =	0.150	(5)
	Soil particle density (ρ_s), g/cm^3 =	2.650	(5)
	Conversion factor (CF), m^2/cm^2 =	1E-04	(5)
INPUT VARIABLES:	Organic carbon partition coef. (Koc), cm^3/g =	chem-spec	
	Henry's Law constant (H), atm-m^3/mol =	chem-spec	
	Diffusivity in water (Dw), cm2/s =	chem-spec	
	Organic carbon content (foc), g/g =	0.010	Site-specific
	Gas diffusivity (Di), cm^2/sec =	chem-spec	
INTERMEDIATE STEPS:	Soil-water partition coefficient (Kd), cm^3/g =	chem-spec	(Koc × foc)
	Apparent diffusivity (Da), cm^2/s =	chem-spec	$[(0a^{10/3}*Di*H' + 0w^{10/3}*Dw)/n^2)/(\rho_b*Kd + 0w + 0a*H'))]$
OUTPUT:	Volatilization Factor (VF), m^3/kg =	chem-spec	Q/C x ((3.14 x Da x T)^0.5/(2 x ρ_b x Da)) x 10^{-4} (m^2/cm^2)

Notes:

1. USEPA, 1996: Soil Screening Guidance
2. Chemical Abstract Service.
3. Chemical class: v -- volatile; s -- semivolatile; p -- pesticide/pcb; x -- dioxin; and m -- metal.
4. Chemical specific factors from Soil Screening Guidance, if available. Other sources include Groundwater Chemicals Desk Reference, Volumes 1 and 2, Montgomery et al; The Merck Index, Eleventh Edition; and Fate and Exposure Data, Volumes 1 - 5 (Howard, et al, Lewis Publishers); Envirofate Database (Chemical Information System).
5. Default values from USEPA, 1996.

Table G.3-5
BURA - Fourth Street Site
Current School Employee
Ingestion of Surface Soil (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current School Employee	
	RME[1]	CT[1]
Intake Rate (IR), mg/day	100	50
Fraction Ingested (FI), unitless	1	1
Exposure Frequency (EF), days/yr	200	100
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATC)

RME CIF = 2.80E-07
CT CIF = 1.40E-08

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATN)

RME NIF = 7.83E-07
CT NIF = 1.96E-07

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] OSF (kg-d/mg)	Toxicity Values[6] ORfD (mg/kg-d)	Cancer Risk[7] RME	% of Total	Cancer Risk[7] CT	% of Total	Hazard Quotient[8] RME	% of Total	Hazard Quotient[8] CT	% of Total
Semi-Volatiles												
Benzo(a)anthracene	1.10E+01	1.10E+01	7.30E-01	--	2.2E-06	08%	1.1E-07	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	7.30E+00	--	2.0E-05	73%	1.0E-06	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	7.30E-01	--	3.1E-06	11%	1.5E-07	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	7.30E-03	--	1.8E-08	<1%	9.0E-10	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	7.30E+00	--	2.0E-06	07%	1.0E-07	07%	--	--	--	--
Inorganics												
Cyanide	7.20E+00	7.20E+00	--	2.00E-02	--	--	--	--	2.8E-04	100%	7.0E-05	100%

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	3E-05	1E-06	3E-04	7E-05

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day) / (Reference Dose, mg/kg-day).

Table G.3-6
BURA - Fourth Street Site
Current School Employee
Dermal Exposure to Surface Soil (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current School Employee	
	RME[1]	CT[1]
Skin Surface Area (SA), cm^2/event	5,800	5,000
Soil-to-Skin Adherance (AF), mg/cm^2	1	0.2
Exposure Frequency (EF), events/yr	200	100
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATC)
RME CIF = 1.62E-05
CT CIF = 2.80E-07
Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATN)
RME NIF = 4.54E-05
CT NIF = 3.91E-06

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg)		Toxicity Values[6] DSF (kg-d/mg)	DRfD (mg/kg-d)	DABS (unitless)	Cancer Risk[7] RME	% of Total	CT	% of Total	Hazard Quotient[8] RME	% of Total	CT	% of Total
	RME	CT											
Semi-Volatiles													
Benzo(a)anthracene	1.10E+01	1.10E+01	1.46E+00	--	1.00E-02	2.6E-06	08%	4.5E-08	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	1.46E+01	--	1.00E-02	2.4E-05	73%	4.1E-07	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	1.46E+00	--	1.00E-02	3.6E-06	11%	6.1E-08	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	1.46E-02	--	1.00E-02	2.1E-08	<1%	3.6E-10	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	1.46E+01	--	1.00E-02	2.4E-06	07%	4.1E-08	07%	--	--	--	--
Inorganics													
Cyanide	7.20E+00	7.20E+00	--	1.00E-02	1.00E-03	--	--	--	--	3.3E-05	100%	2.8E-06	100%

Cancer Risk		Hazard Index	
RME	CT	RME	CT
3E-05	6E-07	3E-05	3E-06

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless) / (Reference Dose, mg/kg-day).

Table G.3-7
BURA - Fourth Street Site
Current School Employee
Inhalation of Resuspended Surface Soil Particulate Contaminants (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current School Employee RME[1]	Current School Employee CT[1]
Inhalation Rate (IR), m^3/hr	2.5	2.5
Exposure Time (ET), hrs/day	2	1
Exposure Frequency (EF), days/yr	200	100
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 1.40E-02

CT CIF = 6.99E-04

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 3.91E-02

CT NIF = 9.78E-03

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR ($m^3/\mu g$)	Toxicity Values[6] RfC (mg/m^3)	PEF[7] (m^3/kg)	Cancer Risk[8] RME	Cancer Risk % of Total RME	Cancer Risk CT	Cancer Risk % of Total CT	Hazard Quotient[9] RME	Hazard Quotient % of Total RME	Hazard Quotient CT	Hazard Quotient % of Total CT
Semi-Volatiles													
Benzo(a)anthracene	1.10E+01	1.10E+01	8.80E-05	--	1.03E+09	4.6E-11	08%	2.3E-12	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	8.80E-04	--	1.03E+09	4.2E-10	73%	2.1E-11	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	8.80E-05	--	1.03E+09	6.2E-11	11%	3.1E-12	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	8.80E-07	--	1.03E+09	3.7E-13	<1%	1.8E-14	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	8.80E-04	--	1.03E+09	4.2E-11	07%	2.1E-12	07%	--	--	--	--
Inorganics													
Cyanide	7.20E+00	7.20E+00	--	--	1.03E+09	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	6E-10	3E-11	NC	NC

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,; calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,; calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Particulate Emission Factor (PEF) = 1.03E+09 (EPA 1996, site specific calculations).
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, $m^3/\mu g$ * 3500 kg-μg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-μg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

NC - Not calculable due to lack of toxicity or other chemical-specific information.

Table G.3-8
BURA - Fourth Street Site
Current Trespasser
Ingestion of Surface Soil (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current Trespasser RME[1]	CT[1]
Intake Rate (IR), mg/day	100	50
Fraction Ingested (FI), unitless	1	1
Exposure Frequency (EF), days/yr	250	100
Exposure Duration (ED), yrs	10	10
Body Weight (BW), kg	45	45
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	3,650	3,650
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATC)

RME CIF = 2.17E-07
CT CIF = 4.35E-08

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATN)

RME NIF = 1.52E-06
CT NIF = 3.04E-07

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] OSF (kg-d/mg)	Toxicity Values[6] ORfD (mg/kg-d)	Cancer Risk[7] RME	% of Total	Cancer Risk[7] CT	% of Total	Hazard Quotient[8] RME	% of Total	Hazard Quotient[8] CT	% of Total
Semi-Volatiles												
Benzo(a)anthracene	1.10E+01	1.10E+01	7.30E-01	--	1.7E-06	08%	3.5E-07	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	7.30E+00	--	1.6E-05	73%	3.2E-06	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	7.30E-01	--	2.4E-06	11%	4.8E-07	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	7.30E-03	--	1.4E-08	<1%	2.8E-09	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	7.30E+00	--	1.6E-06	07%	3.2E-07	07%	--	--	--	--
Inorganics												
Cyanide	7.20E+00	7.20E+00	--	2.00E-02	--	--	--	--	5.5E-04	100%	1.1E-04	100%

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	2E-05	4E-06	5E-04	1E-04

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day) / (Reference Dose, mg/kg-day).

Table G.3-9
BURA - Fourth Street Site
Current Trespasser
Dermal Exposure to Surface Soil (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current Trespasser RME[1]	CT[1]
Skin Surface Area (SA), cm^2/event	4,400	3,350
Soil-to-Skin Adherance (AF), mg/cm^2	1	0.2
Exposure Frequency (EF), events/yr	250	100
Exposure Duration (ED), yrs	10	10
Body Weight (BW), kg	45	45
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	3,650	3,650
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATC)
RME CIF = 9.57E-06
CT CIF = 5.83E-07
Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATN)
RME NIF = 6.70E-05
CT NIF = 4.08E-06

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] DSF (kg-d/mg)	DRfD (mg/kg-d)	DABS (unitless)	Cancer Risk[7] RME	% of Total	CT	% of Total	Hazard Quotient[8] RME	% of Total	CT	% of Total
Semi-Volatiles													
Benzo(a)anthracene	1.10E+01	1.10E+01	1.46E+00	--	1.00E-02	1.5E-06	08%	9.4E-08	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	1.46E+01	--	1.00E-02	1.4E-05	73%	8.5E-07	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	1.46E+00	--	1.00E-02	2.1E-06	11%	1.3E-07	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	1.46E-02	--	1.00E-02	1.2E-08	<1%	7.5E-10	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	1.46E+01	--	1.00E-02	1.4E-06	07%	8.5E-08	07%	--	--	--	--
Inorganics													
Cyanide	7.20E+00	7.20E+00	--	1.00E-02	1.00E-03	--	--	--	--	4.8E-05	100%	2.9E-06	100%
						Cancer Risk				**Hazard Index**			
						RME		**CT**		**RME**		**CT**	
						2E-05		**1E-06**		**5E-05**		**3E-06**	

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless) / (Reference Dose, mg/kg-day).

Table G.3-10
BURA - Fourth Street Site
Current Trespasser
Inhalation of Resuspended Surface Soil Particulate Contaminants (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current Trespasser RME[1]	CT[1]
Inhalation Rate (IR), m^3/hr	0.83	0.83
Exposure Time (ET), hrs/day	4	2
Exposure Frequency (EF), days/yr	250	100
Exposure Duration (ED), yrs	10	10
Body Weight (BW), kg	45	45
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	3,650	3,650

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)
RME CIF = 7.22E-03
CT CIF = 1.44E-03

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)
RME NIF = 5.05E-02
CT NIF = 1.01E-02

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	PEF[7] (m^3/kg)	Cancer Risk[8] RME	% of Total	Cancer Risk[8] CT	% of Total	Hazard Quotient[9] RME	% of Total	Hazard Quotient[9] CT	% of Total
Semi-Volatiles													
Benzo(a)anthracene	1.10E+01	1.10E+01	8.80E-05	--	1.03E+09	2.4E-11	08%	4.7E-12	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	8.80E-04	--	1.03E+09	2.1E-10	73%	4.3E-11	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	8.80E-05	--	1.03E+09	3.2E-11	11%	6.4E-12	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	8.80E-07	--	1.03E+09	1.9E-13	<1%	3.8E-14	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	8.80E-04	--	1.03E+09	2.1E-11	07%	4.3E-12	07%	--	--	--	--
Inorganics													
Cyanide	7.20E+00	7.20E+00	--	--	1.03E+09	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	3E-10	6E-11	NC	NC

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen.; calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen.; calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Particulate Emission Factor (PEF) = 1.03E+09 (EPA 1996, site specific calculations).
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

NC - Not calculable due to lack of toxicity or other chemical-specific information.

Table G.3-11
BURA - Fourth Street Site
Current/Future Worker
Ingestion of Surface Soil (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current Worker RME[1]	CT[1]
Intake Rate (IR), mg/day	100	50
Fraction Ingested (FI), unitless	1	1
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATC)

RME CIF = 3.49E-07
CT CIF = 3.27E-08

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATN)

RME NIF = 9.78E-07
CT NIF = 4.58E-07

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] OSF (kg-d/mg)	Toxicity Values[6] ORfD (mg/kg-d)	Cancer Risk[7] RME	% of Total	Cancer Risk[7] CT	% of Total	Hazard Quotient[8] RME	% of Total	Hazard Quotient[8] CT	% of Total
Semi-Volatiles												
Benzo(a)anthracene	1.10E+01	1.10E+01	7.30E-01	--	2.8E-06	08%	2.6E-07	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	7.30E+00	--	2.6E-05	73%	2.4E-06	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	7.30E-01	--	3.8E-06	11%	3.6E-07	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	7.30E-03	--	2.2E-08	<1%	2.1E-09	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	7.30E+00	--	2.6E-06	07%	2.4E-07	07%	--	--	--	--
Inorganics												
Cyanide	7.20E+00	7.20E+00	--	2.00E-02	--	--	--	--	3.5E-04	100%	1.6E-04	100%

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	3E-05	3E-06	4E-04	2E-04

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day) / (Reference Dose, mg/kg-day).

Table G.3-12
BURA - Fourth Street Site
Current/Future Worker
Dermal Exposure to Surface Soil (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current Worker RME[1]	CT[1]
Skin Surface Area (SA), cm^2/event	5,800	5,000
Soil-to-Skin Adherance (AF), mg/cm^2	1	0.2
Exposure Frequency (EF), events/yr	250	234
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATC)
RME CIF = 2.03E-05
CT CIF = 6.54E-07
Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATN)
RME NIF = 5.68E-05
CT NIF = 9.16E-06

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] DSF (kg-d/mg)	DRfD (mg/kg-d)	DABS (unitless)	Cancer Risk[7] RME	% of Total	CT	% of Total	Hazard Quotient[8] RME	% of Total	CT	% of Total
Semi-Volatiles													
Benzo(a)anthracene	1.10E+01	1.10E+01	1.46E+00	--	1.00E-02	3.3E-06	08%	1.1E-07	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	1.46E+01	--	1.00E-02	3.0E-05	73%	9.6E-07	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	1.46E+00	--	1.00E-02	4.4E-06	11%	1.4E-07	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	1.46E-02	--	1.00E-02	2.6E-08	<1%	8.4E-10	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	1.46E+01	--	1.00E-02	3.0E-06	07%	9.6E-08	07%	--	--	--	--
Inorganics													
Cyanide	7.20E+00	7.20E+00	--	1.00E-02	1.00E-03	--	--	--	--	4.1E-05	100%	6.6E-06	100%

Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
4E-05	1E-06	4E-05	7E-06

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless) / (Reference Dose, mg/kg-day).

Table G.3-13
BURA - Fourth Street Site
Current/Future Worker
Inhalation of Resuspended Surface Soil Particulate Contaminants (0-0.5 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Current Worker RME[1]	CT[1]
Inhalation Rate (IR), m^3/hr	2.5	2.5
Exposure Time (ET), hrs/day	8	8
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 6.99E-02

CT CIF = 1.31E-02

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 1.96E-01

CT NIF = 1.83E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	PEF[7] (m^3/kg)	Cancer Risk[8] RME	% of Total	Cancer Risk[8] CT	% of Total	Hazard Quotient[9] RME	% of Total	Hazard Quotient[9] CT	% of Total
Semi-Volatiles													
Benzo(a)anthracene	1.10E+01	1.10E+01	8.80E-05	--	1.03E+09	2.3E-10	08%	4.3E-11	08%	--	--	--	--
Benzo(a)pyrene	1.00E+01	1.00E+01	8.80E-04	--	1.03E+09	2.1E-09	73%	3.9E-10	73%	--	--	--	--
Benzo(b)fluoranthene	1.50E+01	1.50E+01	8.80E-05	--	1.03E+09	3.1E-10	11%	5.8E-11	11%	--	--	--	--
Chrysene	8.80E+00	8.80E+00	8.80E-07	--	1.03E+09	1.8E-12	<1%	3.4E-13	<1%	--	--	--	--
Dibenz(a,h)anthracene	1.00E+00	1.00E+00	8.80E-04	--	1.03E+09	2.1E-10	07%	3.9E-11	07%	--	--	--	--
Inorganics													
Cyanide	7.20E+00	7.20E+00	--	--	1.03E+09	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	3E-09	5E-10	NC	NC

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen.; calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen.; calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Particulate Emission Factor (PEF) = 1.03E+09 (EPA 1996, site specific calculations).
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

NC - Not calculable due to lack of toxicity or other chemical-specific information.

Table G.3-14
BURA - Fourth Street Site
Future Worker
Ingestion of Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Worker RME[1]	CT[1]
Intake Rate (IR), mg/day	100	50
Fraction Ingested (FI), unitless	1	1
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATC)

RME CIF = 3.49E-07

CT CIF = 3.27E-08

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATN)

RME NIF = 9.78E-07

CT NIF = 4.58E-07

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] OSF (kg-d/mg)	Toxicity Values[6] ORfD (mg/kg-d)	Cancer Risk[7] RME	Cancer Risk[7] % of Total	Cancer Risk[7] CT	Cancer Risk[7] % of Total	Hazard Quotient[8] RME	Hazard Quotient[8] % of Total	Hazard Quotient[8] CT	Hazard Quotient[8] % of Total
Volatiles												
Benzene	3.60E+00	3.60E+00	2.90E-02	3.00E-03	3.6E-08	<1%	3.4E-09	<1%	1.2E-03	66%	5.5E-04	66%
Xylene	1.70E+01	1.70E+01	–	2.00E+00	–	–	–	–	8.3E-06	<1%	3.9E-06	<1%
Semi-Volatiles												
Benzo(a)anthracene	3.92E+00	3.92E+00	7.30E-01	–	1.0E-06	08%	9.4E-08	08%	–	–	–	–
Benzo(a)pyrene	3.70E+00	3.70E+00	7.30E+00	–	9.4E-06	75%	8.8E-07	75%	–	–	–	–
Benzo(b)fluoranthene	4.42E+00	4.42E+00	7.30E-01	–	1.1E-06	09%	1.1E-07	09%	–	–	–	–
Chrysene	3.31E+00	3.31E+00	7.30E-03	–	8.4E-09	<1%	7.9E-10	<1%	–	–	–	–
2,4-Dimethylphenol	3.27E-01	3.27E-01	–	2.00E-02	–	–	–	–	1.6E-05	<1%	7.5E-06	<1%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	7.30E+00	–	1.0E-06	08%	9.7E-08	08%	–	–	–	–
Naphthalene	1.84E+01	1.84E+01	–	4.00E-02	–	–	–	–	4.5E-04	25%	2.1E-04	25%
Inorganics												
Cyanide	2.52E+00	2.52E+00	–	2.00E-02	–	–	–	–	1.2E-04	07%	5.8E-05	07%

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	1E-05	1E-06	2E-03	8E-04

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day) / (Reference Dose, mg/kg-day).

Table G.3-15
BURA - Fourth Street Site
Future Worker
Dermal Exposure to Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Worker RME[1]	Future Worker CT[1]
Skin Surface Area (SA), cm^2/event	5,800	5,000
Soil-to-Skin Adherance (AF), mg/cm^2	1	0.2
Exposure Frequency (EF), events/yr	250	234
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATC)
RME CIF = 2.03E-05
CT CIF = 6.54E-07
Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATN)
RME NIF = 5.68E-05
CT NIF = 9.16E-06

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] DSF (kg-d/mg)	DRfD (mg/kg-d)	DABS (unitless)	Cancer Risk[7] RME	% of Total	CT	% of Total	Hazard Quotient[8] RME	% of Total	CT	% of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	3.05E-02	2.85E-03	1.00E-02	2.2E-08	<1%	7.2E-10	<1%	7.2E-04	56%	1.2E-04	56%
Xylene	1.70E+01	1.70E+01	--	1.80E+00	1.00E-02	--	--	--	--	5.4E-06	<1%	8.6E-07	<1%
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	1.46E+00	--	1.00E-02	1.2E-06	08%	3.7E-08	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	1.46E+01	--	1.00E-02	1.1E-05	75%	3.5E-07	75%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	1.46E+00	--	1.00E-02	1.3E-06	09%	4.2E-08	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	1.46E-02	--	1.00E-02	9.8E-09	<1%	3.2E-10	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	1.00E-02	1.00E-02	--	--	--	--	1.9E-05	01%	3.0E-06	01%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	1.46E+01	--	1.00E-02	1.2E-06	08%	3.9E-08	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	2.00E-02	1.00E-02	--	--	--	--	5.2E-04	41%	8.4E-05	41%
Inorganics													
Cyanide	2.52E+00	2.52E+00	--	1.00E-02	1.00E-03	--	--	--	--	1.4E-05	01%	2.3E-06	01%

Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
1E-05	5E-07	1E-03	2E-04

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless) / (Reference Dose, mg/kg-day).

Table G.3-16
BURA - Fourth Street Site
Future Worker
Inhalation of Resuspended Subsurface Soil Particulate Contaminants (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Worker RME[1]	CT[1]
Inhalation Rate (IR), m^3/hr	2.5	2.5
Exposure Time (ET), hrs/day	8	8
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 6.99E-02

CT CIF = 1.31E-02

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 1.96E-01

CT NIF = 1.83E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	PEF[7] (m^3/kg)	Cancer Risk[8] RME	Cancer Risk[8] % of Total	Cancer Risk[8] CT	Cancer Risk[8] % of Total	Hazard Quotient[9] RME	Hazard Quotient[9] % of Total	Hazard Quotient[9] CT	Hazard Quotient[9] % of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	1.03E+09	7.1E-12	<1%	1.3E-12	<1%	4.0E-07	09%	3.7E-07	09%
Xylenes	1.70E+01	1.70E+01	--	--	1.03E+09	--	--	--	--	--	--	--	--
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	8.80E-05	--	1.03E+09	8.2E-11	08%	1.5E-11	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	8.80E-04	--	1.03E+09	7.7E-10	74%	1.4E-10	74%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	8.80E-05	--	1.03E+09	9.2E-11	09%	1.7E-11	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	8.80E-07	--	1.03E+09	6.9E-13	<1%	1.3E-13	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	--	1.03E+09	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	8.80E-04	--	1.03E+09	8.5E-11	08%	1.6E-11	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	3.00E-03	1.03E+09	--	--	--	--	4.1E-06	91%	3.8E-06	91%
Inorganics													
Cyanide	2.52E+00	2.52E+00	--	--	1.03E+09	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	1E-09	2E-10	4E-06	4E-06

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,: calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,: calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Particulate Emission Factor (PEF) = 1.03E+09 (EPA 1996, site specific calculations).
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

NC - Not calculable due to lack of toxicity or other chemical-specific information.

Table G.3-17
BURA - Fourth Street Site
Future Worker
Inhalation of Volatiles from Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Worker RME[1]	Future Worker CT[1]
Inhalation Rate (IR), m^3/hr	2.5	2.5
Exposure Time (ET), hrs/day	8	8
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	25	5
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	9,125	1,825

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 6.99E-02

CT CIF = 1.31E-02

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 1.96E-01

CT NIF = 1.83E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	VF[7] (m^3/kg)	Cancer Risk[8] RME	Cancer Risk[8] % of Total	Cancer Risk[8] CT	Cancer Risk[8] % of Total	Hazard Quotient[9] RME	Hazard Quotient[9] % of Total	Hazard Quotient[9] CT	Hazard Quotient[9] % of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	3.45E+03	2.1E-06	100%	4.0E-07	100%	1.2E-01	100%	1.1E-01	100%
Xylene	1.70E+01	1.70E+01	--	--	7.79E+03	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	**2E-06**	**4E-07**	**1E-01**	**1E-01**

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,: calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,: calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Volatilization Factor (VF) = 3.46E+03 (EPA 1996f, site specific calculations), Section 4.
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg)
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-hr
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

Table G.3-18
BURA - Fourth Street Site
Future Construction Worker
Ingestion of Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Construction Worker RME[1]	CT[1]
Intake Rate (IR), mg/day	480	100
Fraction Ingested (FI), unitless	1	1
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	1	1
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	365	365
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATC)

RME CIF = 6.71E-08

CT CIF = 1.31E-08

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATN)

RME NIF = 4.70E-06

CT NIF = 9.16E-07

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] OSF (kg-d/mg)	Toxicity Values[6] ORfD (mg/kg-d)	Cancer Risk[7] RME	% of Total	Cancer Risk[7] CT	% of Total	Hazard Quotient[8] RME	% of Total	Hazard Quotient[8] CT	% of Total
Volatiles												
Benzene	3.60E+00	3.60E+00	2.90E-02	3.00E-03	7.0E-09	<1%	1.4E-09	<1%	5.6E-03	66%	1.1E-03	66%
Xylene	1.70E+01	1.70E+01	--	2.00E+00	--	--	--	--	4.0E-05	<1%	7.8E-06	<1%
Semi-Volatiles												
Benzo(a)anthracene	3.92E+00	3.92E+00	7.30E-01	--	1.9E-07	08%	3.7E-08	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	7.30E+00	--	1.8E-06	75%	3.5E-07	75%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	7.30E-01	--	2.2E-07	09%	4.2E-08	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	7.30E-03	--	1.6E-09	<1%	3.2E-10	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	2.00E-02	--	--	--	--	7.7E-05	<1%	1.5E-05	<1%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	7.30E+00	--	2.0E-07	08%	3.9E-08	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	4.00E-02	--	--	--	--	2.2E-03	25%	4.2E-04	25%
Inorganics												
Cyanide	2.52E+00	2.52E+00	--	2.00E-02	--	--	--	--	5.9E-04	07%	1.2E-04	07%

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	2E-06	5E-07	9E-03	2E-03

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day) / (Reference Dose, mg/kg-day).

Table G.3-19
BURA - Fourth Street Site
Future Construction Worker
Dermal Exposure to Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Construction Worker	
	RME[1]	CT[1]
Skin Surface Area (SA), cm^2/event	5,800	5,000
Soil-to-Skin Adherance (AF), mg/cm^2	1	0.2
Exposure Frequency (EF), events/yr	250	234
Exposure Duration (ED), yrs	1	1
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[2] (ATN), days	365	365
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATC)
RME CIF = 8.11E-07
CT CIF = 1.31E-07
Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATN)
RME NIF = 5.68E-05
CT NIF = 9.16E-06

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg)		Toxicity Values[6] DSF (kg-d/mg)	DRfD (mg/kg-d)	DABS (unitless)	Cancer Risk[7] RME	% of Total	CT	% of Total	Hazard Quotient[8] RME	% of Total	CT	% of Total
	RME	CT											
Volatiles													
Benzene	3.60E+00	3.60E+00	3.05E-02	2.85E-03	1.00E-02	8.9E-10	<1%	1.4E-10	<1%	7.2E-04	56%	1.2E-04	56%
Xylene	1.70E+01	1.70E+01	--	1.80E+00	1.00E-02	--	--	--	--	5.4E-06	<1%	8.6E-07	<1%
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	1.46E+00	--	1.00E-02	4.6E-08	08%	7.5E-09	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	1.46E+01	--	1.00E-02	4.4E-07	75%	7.1E-08	75%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	1.46E+00	--	1.00E-02	5.2E-08	09%	8.4E-09	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	1.46E-02	--	1.00E-02	3.9E-10	<1%	6.3E-11	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	1.00E-02	1.00E-02	--	--	--	--	1.9E-05	01%	3.0E-06	01%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	1.46E+01	--	1.00E-02	4.8E-08	08%	7.8E-09	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	2.00E-02	1.00E-02	--	--	--	--	5.2E-04	41%	8.4E-05	41%
Inorganics													
Cyanide	2.52E+00	2.52E+00	--	1.00E-02	1.00E-03	--	--	--	--	1.4E-05	01%	2.3E-06	01%

Cancer Risk		Hazard Index	
RME	CT	RME	CT
6E-07	9E-08	1E-03	2E-04

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless) / (Reference Dose, mg/kg-day).

Table G.3-20
BURA - Fourth Street Site
Future Construction Worker
Inhalation of Resuspended Subsurface Soil Particulate Contaminants (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Construction Worker	
	RME[1]	CT[1]
Inhalation Rate (IR), m^3/hr	2.5	2.5
Exposure Time (ET), hrs/day	8	8
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	1	1
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	365	365

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 2.80E-03

CT CIF = 2.62E-03

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 1.96E-01

CT NIF = 1.83E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	PEF[7] (m^3/kg)	Cancer Risk[8] RME	Cancer Risk[8] % of Total	Cancer Risk[8] CT	Cancer Risk[8] % of Total	Hazard Quotient[9] RME	Hazard Quotient[9] % of Total	Hazard Quotient[9] CT	Hazard Quotient[9] % of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	1.03E+09	2.8E-13	<1%	2.6E-13	<1%	4.0E-07	09%	3.7E-07	09%
Xylenes	1.70E+01	1.70E+01	–	–	1.03E+09	–	–	–	–	–	–	–	–
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	8.80E-05	–	1.03E+09	3.3E-12	08%	3.1E-12	08%	–	–	–	–
Benzo(a)pyrene	3.70E+00	3.70E+00	8.80E-04	–	1.03E+09	3.1E-11	74%	2.9E-11	74%	–	–	–	–
Benzo(b)fluoranthene	4.42E+00	4.42E+00	8.80E-05	–	1.03E+09	3.7E-12	09%	3.4E-12	09%	–	–	–	–
Chrysene	3.31E+00	3.31E+00	8.80E-07	–	1.03E+09	2.8E-14	<1%	2.6E-14	<1%	–	–	–	–
2,4-Dimethylphenol	3.27E-01	3.27E-01	–	–	1.03E+09	–	–	–	–	–	–	–	–
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	8.80E-04	–	1.03E+09	3.4E-12	08%	3.2E-12	08%	–	–	–	–
Naphthalene	1.84E+01	1.84E+01	–	3.00E-03	1.03E+09	–	–	–	–	4.1E-06	91%	3.8E-06	91%
Inorganics													
Cyanide	2.52E+00	2.52E+00	–	–	1.03E+09	–	–	–	–	–	–	–	–

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	4E-11	4E-11	4E-06	4E-06

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,: calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,: calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Particulate Emission Factor (PEF) = 1.03E+09 (EPA 1996, site specific calculations).
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3.
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

NC - Not calculable due to lack of toxicity or other chemical-specific information.

Table G.3-21
BURA - Fourth Street Site
Future Construction Worker
Inhalation of Volatiles from Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Construction Worker	
	RME[1]	CT[1]
Inhalation Rate (IR), m^3/hr	2.5	2.5
Exposure Time (ET), hrs/day	8	8
Exposure Frequency (EF), days/yr	250	234
Exposure Duration (ED), yrs	1	1
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	365	365

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 2.80E-03

CT CIF = 2.62E-03

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 1.96E-01

CT NIF = 1.83E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

	EP Conc[5] (mg/kg)		Toxicity Values[6]			Cancer Risk[8]				Hazard Quotient[9]			
Constituent	RME	CT	IUR (m^3/µg)	RfC (mg/m^3)	VF[7] (m^3/kg)	RME	% of Total	CT	% of Total	RME	% of Total	CT	% of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	3.45E+03	8.5E-08	100%	7.9E-08	100%	1.2E-01	100%	1.1E-01	100%
Xylene	1.70E+01	1.70E+01	--	--	7.79E+03	--	--	--	--	--	--	--	--

	Cancer Risk		Hazard Index	
	RME	CT	RME	CT
PATHWAY SUMS:	8E-08	8E-08	1E-01	1E-01

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,: calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,: calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Volatilization Factor (VF) = 3.46E+03 (EPA 1996f, site specific calculations), Section 4.
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

Table G.3-22
BURA - Fourth Street Site
Hypothetical Future Adult Resident
Ingestion of Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Adult Resident RME[1]	CT[1]
Intake Rate (IR), mg/day	100	50
Fraction Ingested (FI), unitless	1	1
Exposure Frequency (EF), days/yr	350	175
Exposure Duration (ED), yrs	24	7
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	8760	2555
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATC)

RME CIF = 4.70E-07

CT CIF = 3.42E-08

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATN)

RME NIF = 1.37E-06

CT NIF = 3.42E-07

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] OSF (kg-d/mg)	Toxicity Values[6] ORfD (mg/kg-d)	Cancer Risk[7] RME	Cancer Risk[7] % of Total	Cancer Risk[7] CT	Cancer Risk[7] % of Total	Hazard Quotient[8] RME	Hazard Quotient[8] % of Total	Hazard Quotient[8] CT	Hazard Quotient[8] % of Total
Volatiles												
Benzene	3.60E+00	3.60E+00	2.90E-02	3.00E-03	4.9E-08	<1%	3.6E-09	<1%	1.6E-03	66%	4.1E-04	66%
Xylene	1.70E+01	1.70E+01	--	2.00E+00	--	--	--	--	1.2E-05	<1%	2.9E-06	<1%
Semi-Volatiles												
Benzo(a)anthracene	3.92E+00	3.92E+00	7.30E-01	--	1.3E-06	08%	9.8E-08	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	7.30E+00	--	1.3E-05	75%	9.3E-07	75%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	7.30E-01	--	1.5E-06	09%	1.1E-07	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	7.30E-03	--	1.1E-08	<1%	8.3E-10	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	2.00E-02	--	--	--	--	2.2E-05	<1%	5.6E-06	<1%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	7.30E+00	--	1.4E-06	08%	1.0E-07	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	4.00E-02	--	--	--	--	6.3E-04	25%	1.6E-04	25%
Inorganics												
Cyanide	2.52E+00	2.52E+00	--	2.00E-02	--	--	--	--	1.7E-04	07%	4.3E-05	07%

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	2E-05	1E-06	2E-03	6E-04

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day) / (Reference Dose, mg/kg-day).

Table G.3-23
BURA - Fourth Street Site
Hypothetical Future Adult Resident
Dermal Exposure to Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Adult Resident RME[1]	CT[1]
Skin Surface Area (SA), cm^2/event	5,800	5,000
Soil-to-Skin Adherance (AF), mg/cm^2	1	0.2
Exposure Frequency (EF), events/yr	350	175
Exposure Duration (ED), yrs	24	7
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	8,760	2,555
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATC)
RME CIF = 2.72E-05
CT CIF = 6.85E-07
Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATN)
RME NIF = 7.95E-05
CT NIF = 6.85E-06

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] DSF (kg-d/mg)	Toxicity Values[6] DRfD (mg/kg-d)	Toxicity Values[6] DABS (unitless)	Cancer Risk[7] RME	Cancer Risk[7] % of Total	Cancer Risk[7] CT	Cancer Risk[7] % of Total	Hazard Quotient[8] RME	Hazard Quotient[8] % of Total	Hazard Quotient[8] CT	Hazard Quotient[8] % of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	3.05E-02	2.85E-03	1.00E-02	3.0E-08	<1%	7.5E-10	<1%	1.0E-03	56%	8.7E-05	56%
Xylene	1.70E+01	1.70E+01	--	1.80E+00	1.00E-02	--	--	--	--	7.5E-06	<1%	6.5E-07	<1%
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	1.46E+00	--	1.00E-02	1.6E-06	08%	3.9E-08	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	1.46E+01	--	1.00E-02	1.5E-05	75%	3.7E-07	75%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	1.46E+00	--	1.00E-02	1.8E-06	09%	4.4E-08	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	1.46E-02	--	1.00E-02	1.3E-08	<1%	3.3E-10	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	1.00E-02	1.00E-02	--	--	--	--	2.6E-05	01%	2.2E-06	01%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	1.46E+01	--	1.00E-02	1.6E-06	08%	4.1E-08	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	2.00E-02	1.00E-02	--	--	--	--	7.3E-04	41%	6.3E-05	41%
Inorganics													
Cyanide	2.52E+00	2.52E+00	--	1.00E-02	1.00E-03	--	--	--	--	2.0E-05	01%	1.7E-06	01%

Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
2E-05	5E-07	2E-03	2E-04

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless) / (Reference Dose, mg/kg-day).

Table G.3-24
BURA - Fourth Street Site
Hypothetical Future Adult Resident
Inhalation of Resuspended Subsurface Soil Particulate Contaminants (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Adult Resident RME[1]	CT[1]
Inhalation Rate (IR), m^3/hr	0.83	0.83
Exposure Time (ET), hrs/day	24	24
Exposure Frequency (EF), days/yr	350	175
Exposure Duration (ED), yrs	24	7
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	8,760	2,555

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 9.36E-02

CT CIF = 1.36E-02

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 2.73E-01

CT NIF = 1.36E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	PEF[7] (m^3/kg)	Cancer Risk[8] RME	% of Total	Cancer Risk[8] CT	% of Total	Hazard Quotient[9] RME	% of Total	Hazard Quotient[9] CT	% of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	1.03E+09	9.5E-12	<1%	1.4E-12	<1%	5.5E-07	09%	2.8E-07	09%
Xylenes	1.70E+01	1.70E+01	–	–	1.03E+09	–	–	–	–	–	–	–	–
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	8.80E-05	–	1.03E+09	1.1E-10	08%	1.6E-11	08%	–	–	–	–
Benzo(a)pyrene	3.70E+00	3.70E+00	8.80E-04	–	1.03E+09	1.0E-09	74%	1.5E-10	74%	–	–	–	–
Benzo(b)fluoranthene	4.42E+00	4.42E+00	8.80E-05	–	1.03E+09	1.2E-10	09%	1.8E-11	09%	–	–	–	–
Chrysene	3.31E+00	3.31E+00	8.80E-07	–	1.03E+09	9.2E-13	<1%	1.3E-13	<1%	–	–	–	–
2,4-Dimethylphenol	3.27E-01	3.27E-01	–	–	1.03E+09	–	–	–	–	–	–	–	–
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	8.80E-04	–	1.03E+09	1.1E-10	08%	1.7E-11	08%	–	–	–	–
Naphthalene	1.84E+01	1.84E+01	–	3.00E-03	1.03E+09	–	–	–	–	5.7E-06	91%	2.8E-06	91%
Inorganics													
Cyanide	2.52E+00	2.52E+00	–	–	1.03E+09	–	–	–	–	–	–	–	–

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	1E-09	2E-10	6E-06	3E-06

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,: calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,: calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Particulate Emission Factor (PEF) = 1.03E+09 (EPA 1996, site specific calculations).
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg). Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day). Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

NC - Not calculable due to lack of toxicity or other chemical-specific information.

Table G.3-25
BURA - Fourth Street Site
Hypothetical Future Adult
Inhalation of Volatiles from Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Adult RME[1]	Future Adult CT[1]
Inhalation Rate (IR), m^3/hr	0.83	0.83
Exposure Time (ET), hrs/day	24	24
Exposure Frequency (EF), days/yr	350	175
Exposure Duration (ED), yrs	24	7
Body Weight (BW), kg	70	70
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	8,760	2,555

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 9.36E-02

CT CIF = 1.36E-02

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 2.73E-01

CT NIF = 1.36E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	VF[7] (m^3/kg)	Cancer Risk[8] RME	Cancer Risk[8] % of Total	Cancer Risk[8] CT	Cancer Risk[8] % of Total	Hazard Quotient[9] RME	Hazard Quotient[9] % of Total	Hazard Quotient[9] CT	Hazard Quotient[9] % of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	3.45E+03	2.8E-06	100%	4.1E-07	100%	1.7E-01	100%	8.3E-02	100%
Xylene	1.70E+01	1.70E+01	--	--	7.79E+03	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	**3E-06**	**4E-07**	**2E-01**	**8E-02**

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,: calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,: calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Volatilization Factor (VF) = 3.46E+03 (EPA 1996f, site specific calculations), Section 4.
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

Table G.3-26
BURA - Fourth Street Site
Hypothetical Future Child Resident
Ingestion of Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Child Resident RME[1]	CT[1]
Intake Rate (IR), mg/day	200	100
Fraction Ingested (FI), unitless	1	1
Exposure Frequency (EF), days/yr	350	175
Exposure Duration (ED), yrs	6	2
Body Weight (BW), kg	15	15
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	2,190	730
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATC)

RME CIF = 1.10E-06
CT CIF = 9.13E-08

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(IR * FI * EF * ED * CF) / (BW * ATN)

RME NIF = 1.28E-05
CT NIF = 3.20E-06

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] OSF (kg-d/mg)	Toxicity Values[6] ORfD (mg/kg-d)	Cancer Risk[7] RME	Cancer Risk[7] % of Total	Cancer Risk[7] CT	Cancer Risk[7] % of Total	Hazard Quotient[8] RME	Hazard Quotient[8] % of Total	Hazard Quotient[8] CT	Hazard Quotient[8] % of Total
Volatiles												
Benzene	3.60E+00	3.60E+00	2.90E-02	3.00E-03	1.1E-07	<1%	9.5E-09	<1%	1.5E-02	66%	3.8E-03	66%
Xylene	1.70E+01	1.70E+01	--	2.00E+00	--	--	--	--	1.1E-04	<1%	2.7E-05	<1%
Semi-Volatiles												
Benzo(a)anthracene	3.92E+00	3.92E+00	7.30E-01	--	3.1E-06	08%	2.6E-07	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	7.30E+00	--	3.0E-05	75%	2.5E-06	75%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	7.30E-01	--	3.5E-06	09%	2.9E-07	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	7.30E-03	--	2.6E-08	<1%	2.2E-09	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	2.00E-02	--	--	--	--	2.1E-04	<1%	5.2E-05	<1%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	7.30E+00	--	3.3E-06	08%	2.7E-07	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	4.00E-02	--	--	--	--	5.9E-03	25%	1.5E-03	25%
Inorganics												
Cyanide	2.52E+00	2.52E+00	--	2.00E-02	--	--	--	--	1.6E-03	07%	4.0E-04	07%

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	4E-05	3E-06	2E-02	6E-03

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day) / (Reference Dose, mg/kg-day).

Table G.3-27
BURA - Fourth Street Site
Hypothetical Future Child Resident
Dermal Exposure to Subsurface Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Child Resident RME[1]	Child Resident CT[1]
Skin Surface Area (SA), cm^2/event	2,300	1,980
Soil-to-Skin Adherance (AF), mg/cm^2	1	0.2
Exposure Frequency (EF), events/yr	350	175
Exposure Duration (ED), yrs	6	2
Body Weight (BW), kg	15	15
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[2] (ATN), days	2,190	730
Conversion Factor (CF), kg/mg	1.00E-06	1.00E-06

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATC)
RME CIF = 1.26E-05
CT CIF = 3.62E-07

Noncarcinogenic Intake Factor (NIF), kg/kg-day =
(SA * SK * EF * ED * CF) / (BW * ATN)
RME NIF = 1.47E-04
CT NIF = 1.27E-05

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] DSF (kg-d/mg)	Toxicity Values[6] DRfD (mg/kg-d)	DABS (unitless)	Cancer Risk[7] RME	Cancer Risk[7] % of Total	Cancer Risk[7] CT	Cancer Risk[7] % of Total	Hazard Quotient[8] RME	Hazard Quotient[8] % of Total	Hazard Quotient[8] CT	Hazard Quotient[8] % of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	3.05E-02	2.85E-03	1.00E-02	1.4E-08	<1%	4.0E-10	<1%	1.9E-03	56%	1.6E-04	56%
Xylene	1.70E+01	1.70E+01	--	1.80E+00	1.00E-02	--	--	--	--	1.4E-05	<1%	1.2E-06	<1%
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	1.46E+00	--	1.00E-02	7.2E-07	08%	2.1E-08	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	1.46E+01	--	1.00E-02	6.8E-06	75%	2.0E-07	75%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	1.46E+00	--	1.00E-02	8.1E-07	09%	2.3E-08	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	1.46E-02	--	1.00E-02	6.1E-09	<1%	1.7E-10	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	1.00E-02	1.00E-02	--	--	--	--	4.8E-05	01%	4.1E-06	01%
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	1.46E+01	--	1.00E-02	7.5E-07	08%	2.1E-08	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	2.00E-02	1.00E-02	--	--	--	--	1.4E-03	41%	1.2E-04	41%
Inorganics													
Cyanide	2.52E+00	2.52E+00	--	1.00E-02	1.00E-03	--	--	--	--	3.7E-05	01%	3.2E-06	01%

Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
9E-06	3E-07	3E-03	3E-04

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen, calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen, calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless * Slope Factor, kg-day/mg).
8. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, kg/kg-day * Absorption Factor, unitless) / (Reference Dose, mg/kg-day).

Table G.3-28
BURA - Fourth Street Site
Hypothetical Future Child Resident
Inhalation of Resuspended Subsurface Soil Particulate Contaminants (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Child Resident RME[1]	Child Resident CT[1]
Inhalation Rate (IR), m^3/hr	0.625	0.625
Exposure Time (ET), hrs/day	24	24
Exposure Frequency (EF), days/yr	350	175
Exposure Duration (ED), yrs	6	2
Body Weight (BW), kg	15	15
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	2,190	730

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 8.22E-02

CT CIF = 1.37E-02

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 9.59E-01

CT NIF = 4.79E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	PEF[7] (m^3/kg)	Cancer Risk[8] RME	Cancer Risk % of Total RME	Cancer Risk CT	Cancer Risk % of Total CT	Hazard Quotient[9] RME	Hazard Quotient % of Total RME	Hazard Quotient CT	Hazard Quotient % of Total CT
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	1.03E+09	8.3E-12	<1%	1.4E-12	<1%	1.9E-06	09%	9.7E-07	09%
Xylenes	1.70E+01	1.70E+01	--	--	1.03E+09	--	--	--	--	--	--	--	--
Semi-Volatiles													
Benzo(a)anthracene	3.92E+00	3.92E+00	8.80E-05	--	1.03E+09	9.6E-11	08%	1.6E-11	08%	--	--	--	--
Benzo(a)pyrene	3.70E+00	3.70E+00	8.80E-04	--	1.03E+09	9.1E-10	74%	1.5E-10	74%	--	--	--	--
Benzo(b)fluoranthene	4.42E+00	4.42E+00	8.80E-05	--	1.03E+09	1.1E-10	09%	1.8E-11	09%	--	--	--	--
Chrysene	3.31E+00	3.31E+00	8.80E-07	--	1.03E+09	8.1E-13	<1%	1.4E-13	<1%	--	--	--	--
2,4-Dimethylphenol	3.27E-01	3.27E-01	--	--	1.03E+09	--	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	4.07E-01	4.07E-01	8.80E-04	--	1.03E+09	1.0E-10	08%	1.7E-11	08%	--	--	--	--
Naphthalene	1.84E+01	1.84E+01	--	3.00E-03	1.03E+09	--	--	--	--	2.0E-05	91%	1.0E-05	91%
Inorganics													
Cyanide	2.52E+00	2.52E+00	--	--	1.03E+09	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	1E-09	2E-10	2E-05	1E-05

Notes:
1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen.; calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen.; calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Particulate Emission Factor (PEF) = 1.03E+09 (EPA 1996, site specific calculations).
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg). Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day). Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

NC - Not calculable due to lack of toxicity or other chemical-specific information.

Table G.3-29
BURA - Fourth Street Site
Hypothetical Future Child
Inhalation of Volatiles from Soil (0-12 ft)
Exposure Assumptions and Risk Calculations

EXPOSURE ASSUMPTIONS:[4]	Future Child RME[1]	Future Child CT[1]
Inhalation Rate (IR), m^3/hr	0.625	0.625
Exposure Time (ET), hrs/day	24	24
Exposure Frequency (EF), days/yr	350	175
Exposure Duration (ED), yrs	6	2
Body Weight (BW), kg	15	15
Avging Time, Carc[2] (ATC), days	25,550	25,550
Avging Time, Noncarc[3] (ATN), days	2,190	730

INTAKE FACTOR CALCULATIONS

Carcinogenic Intake Factor (CIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATC)

RME CIF = 8.22E-02
CT CIF = 1.37E-02

Noncarcinogenic Intake Factor (NIF), m^3/kg-day =
(IR * ET * EF * ED) / (BW * ATN)

RME NIF = 9.59E-01
CT NIF = 4.79E-01

CARCINOGENIC AND NONCARCINOGENIC RISK CALCULATIONS:

Constituent	EP Conc[5] (mg/kg) RME	EP Conc[5] (mg/kg) CT	Toxicity Values[6] IUR (m^3/µg)	Toxicity Values[6] RfC (mg/m^3)	VF[7] (m^3/kg)	Cancer Risk[8] RME	% of Total	Cancer Risk[8] CT	% of Total	Hazard Quotient[9] RME	% of Total	Hazard Quotient[9] CT	% of Total
Volatiles													
Benzene	3.60E+00	3.60E+00	8.30E-06	6.00E-03	3.45E+03	2.5E-06	100%	4.2E-07	100%	5.8E-01	100%	2.9E-01	100%
Xylene	1.70E+01	1.70E+01	--	--	7.79E+03	--	--	--	--	--	--	--	--

	Cancer Risk RME	Cancer Risk CT	Hazard Index RME	Hazard Index CT
PATHWAY SUMS:	**2E-06**	**4E-07**	**6E-01**	**3E-01**

Notes:

1. RME = Reasonable maximum exposure, CT = Central tendency.
2. Averaging time, carcinogen,: calculated as 70 years (average lifetime) times 365 days per year.
3. Averaging time, noncarcinogen,: calculated as exposure duration (in years) times 365 days per year.
4. See Section 5
5. EPC = Exposure point concentration. The EPC for RME was used to assess both RME and CT exposure.
6. See Section 5
7. Volatilization Factor (VF) = 3.46E+03 (EPA 1996f, site specific calculations), Section 4.
8. Cancer Risk = (Chemical Concentration, mg/kg * Carcinogenic Intake Factor, m^3/kg-day * Inhalation Unit Risk, m^3/µg * 3500 kg-µg-day/mg-m^3) / (Particulate Emission Factor (PEF), m^3/kg).
   Includes conversion from IUR to inhalation slope factor = 3500 kg-µg-day/mg-m^3
9. Hazard Quotient = (Chemical Concentration, mg/kg * Noncarcinogenic Intake Factor, m^3/kg-day) / (Particulate Emission Factor, m^3/kg * Reference Concentration, mg/m^3 * 2/7 m^3/kg-day).
   Includes conversion from RfC to inhalation reference dose = 2/7 m^3/kg-day.

ATTACHMENT G.4
CHEMICAL PROFILES

NOTES ON THE PROFILES

(1) The physical and chemical properties described in the profiles impact fate and transport as follows:

Highly-soluble chemicals can be rapidly leached from wastes and soils and are generally mobile in groundwater. Solubilities can range from less than 1 mg/L to totally miscible, with most common organic chemicals falling between 1 mg/L and 1,000,000 mg/L [1]. The water solubility of chemicals may become enhanced in the presence of organic solvents, which may be of concern for mixed wastes.

Volatilization of a chemical from surface water will depend partly on its vapor pressure and water solubility. Highly water-soluble chemicals generally have lower volatilization rates from water unless they also have high vapor pressures. Vapor pressure, a relative measure of the volatility of chemicals in their pure state, ranges from roughly 0.001 to 760 millimeters of mercury (mm Hg) for liquids. The Henry's Law Constant, which combines vapor pressure with solubility, is more appropriate than vapor pressure alone for estimating releases from water to air. Chemicals with Henry's Law Constants greater than 10^{-3} atmospheres - cubic meter per mole (atm-m^3/mole) may readily volatilize from water, particularly if they have a density which is less than that for water and do not bind tightly to organic material. Chemicals with values ranging from 10^{-3} to 10^{-5} are associated with moderate volatilization, while chemicals with values less than 10^{-5} will only volatilize from water to a limited extent [1].

Specific gravity, as used in the profiles, refers to the ratio of the density of a given chemical to the density of pure water, normally at defined temperatures. An organic chemical present in groundwater with a density greater than the ambient water, which is present in an amount sufficient to form a separate phase, tends to sink to the lowest portions of the aquifer. Conversely, a chemical with a density less than the groundwater, which is present in an amount sufficient to form a separate phase, tends to spread out along the upper portions of the aquifer.

The organic carbon partition coefficient (K_{OC}) reflects the propensity of a chemical to sorb to organic matter found in soil. The normal range of K_{OC} values is 1 to 10^7 milliliters per gram (mL/g), with higher values indicating greater sorption potential. Chemicals which have a strong tendency to sorb to organic matter (i.e., chemicals with high K_{OC} values) will move more slowly in the environment than chemicals with low K_{OC} values.

(2) The half-life values included in the profiles are estimates based on abiotic and/or biotic degradation processes only, and do not account for the transport of a chemical between environmental compartments, unless otherwise specified [2]. Additionally, estimates

are based on specified conditions such as soil type and chemical concentration. Therefore, the half-life ranges presented are not necessarily representative of a chemical's actual persistence within a particular environmental medium. The actual ranges of half-lives of chemicals which are mobile will probably be shorter than indicated in the case of permeable soils. Chemicals which are not mobile and are present at very high concentrations may actually have longer half-lives then indicated.

(3) A short half-life for degradation of a given chemical in a given medium does not guarantee that the health or environmental threat will be eliminated in a short period of time. It simply means that the chemical is likely to be modified within a relatively short time frame. The products of degradation vary tremendously, and some may be as toxic or more toxic than the starting material. A detailed description of the environmental degradation pathways for each chemical in each of the many types of media is beyond the scope of these profiles.

(4) Specific Gravity given at X/Y°C, where X = temperature of the chemical and Y = the temperature of the reference water.

(5) Abbreviations: NA = not applicable, ND = no data.

(6) There are no environmental half-life values for elements (metals) since they do not degrade.

(7) Abbreviations in Toxicity Section: RfD = oral reference dose; RfC = inhalation reference concentration; NOEL = no observed effect level; NOAEL = no observed adverse effect level; LOAEL = lowest observed adverse effect level; LEL = lowest effect level; FEL = frank effect level.

(8) The toxicity values presented were up-to-date at the time of preparation. However, current values should be obtained from the USEPA's Integrated Risk Information System (IRIS).

REFERENCES

1. Lyman, W.J., Rechl, W.G. and Rosenblatt, D.H., 1982. Handbook of Chemical Property Estimation Methods: Environmental Behavior of Organic Compounds. McGraw Hill Book Company. New York.

2. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.

BENZENE

CAS NUMBER

71-43-2

COMMON SYNONYMS

None.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 1,791 mg/L [1]
Vapor Pressure: 95.19 mm Hg at 25°C [1]

Henry's Law Constant: 5.43 x 10^{-3} atm-m^3/mole (temperature not given) [1]

Specific Gravity: 0.879 at 15/5°C [2]

Organic Carbon Partition Coefficient: 31 - 143 [1]

FATE DATA: HALF-LIVES

Soil: 5 - 16 days [3]

Air: 2.09 - 20.9 days [3]

Surface Water: 5 - 16 days [3]

Groundwater: 10 days to 2 years [3]

NATURAL SOURCES

Crude oil, volcanoes, forest fires, plants [1].

ARTIFICIAL SOURCES

Gasoline, fuel oils, chemical industry, coke ovens, mining, manufacturing, cigarette smoke [1].

FATE AND TRANSPORT

Benzene will rapidly volatilize from surface soil and water. That which does not volatilize from permeable surface and subsurface soils will be highly to very highly mobile, and can be expected to leach to nearby groundwater which is not protected by a confining layer. It is fairly soluble, and will be carried with the groundwater to discharge points. It may be subject to biodegradation in soils, shallow groundwater, and surface water. Benzene will not be expected to significantly adsorb to sediment, bioconcentrate in aquatic organisms, or hydrolyze. Photodegradation may be a significant removal mechanism in surface waters

which are not conducive to microbial degradation. Benzene will undergo significant photodegradation in air, but may be washed out with rain [1].

HUMAN TOXICITY

General. Benzene is absorbed into the body following ingestion, inhalation, and dermal contact, and must undergo metabolic transformation to exert its toxic effects. Metabolism occurs primarily in the liver, and to a lesser extent in the bone marrow [4]. The primary targets of benzene toxicity are the central nervous system and the blood [4,5]. Benzene is genotoxic to humans and the USEPA has placed it in weight-of-evidence cancer Group A, indicating that it is a human carcinogen [6].

Oral Exposure. A chronic oral RfD for benzene is currently under review by the USEPA [6], but a provisional value has been provided. A provisional value of 0.003 mg/kg-day is based on a LOAEL of 8 mg/kg-day for hematological and immunological effects in a subchronic study in mice [7]. Benzene is readily absorbed following oral exposure. The lowest reported fatal dose in humans is 50 mg/kg [5]. Acute oral LD_{50} values in animals include 930 to 5600 mg/kg in rats, 2000 mg/kg in dogs and 4700 mg/kg in mice [4,5]. Data regarding the ingestion of benzene in humans are limited to acute overexposure. Ingestion of 2 ml (29 mg/kg) has resulted in depression of the central nervous system, while ingestion of 10 ml (143 mg/kg) has been fatal [5]. The cause of death was usually respiratory arrest, central nervous system depression or cardiac collapse [4]. In animals, longer-term oral exposure has resulted in toxic effects on the blood (cytopenia: decrease in various cellular elements of the blood) and the immunological system (decreased white blood cells) [4]. There is no evidence that oral exposure to benzene causes effects on reproduction and development, but studies in animals suggest that benzene may affect fetal development [4]. There is no information regarding carcinogenic effects in humans following oral exposure to benzene, but studies in animals indicate that benzene ingestion causes cancer in various regions of the body [4]. An oral Slope Factor of 0.029 $(mg/kg/day)^{-1}$ is based on an increase in the incidence of leukemia in occupationally-exposed workers [6]. The oral Slope Factor was extrapolated from the inhalation data.

Inhalation Exposure. A chronic inhalation RfC for benzene is currently under review by the USEPA [6], but a provisional value has been provided. A provisional value of 0.006 mg/m^3 is based on a NOAEL of 5.7 mg/m^3 for hematopoetic effects in a subchronic study in mice [8]. Benzene is readily absorbed following inhalation exposure. The lowest reported fatal concentration in humans is 6380 mg/m^3 for a 5 minute exposure [5]. Acute inhalation LC_{50} values in rats ranged from 10,000 ppm for 7 hours to 13,700 ppm for 4 hours [4,5]. Most of the available data regarding benzene exposure involve workers exposed in the workplace. The acute effects of benzene exposure involve the central nervous system. Brief exposure to concentrations of 700 to 3000 ppm can cause drowsiness, dizziness, headaches and unconsciousness, and exposure to concentrations of 10,000 to 20,000 ppm can result in death

[4]. In most cases, the effects will end when exposure ceases. The hematopoietic system is the primary target of toxicity following long-term exposure: exposure for several months to years results in pancytopenia (reduction in red blood cells, platelets and white blood cells), while continued exposure for many years results in anemia or leukemia. The lowest concentration resulting in the hematological effects is approximately 10 to 50 ppm [5]. Benzene has been shown to cause chromosomal aberrations in bone marrow and lymphocytes in workers exposed to concentrations > 100 ppm [5]. Chromosomal damage has been found in animals at concentrations as low as 1 ppm [5]. Benzene is not known to be teratogenic (cause birth defects) in humans, but has been found to cause various problems in the developing fetus of animals (low birth weight, delayed bone formation) [4,5]. Occupational exposure to benzene has resulted in leukemia in exposed workers [4,5]. An inhalation Unit Risk of 8.3×10^{-6} $(ug/m^3)^{-1}$ is based on the incidence of leukemia in occupationally-exposed workers [6].

Dermal Exposure. Dermal exposure to benzene may cause redness and dermatitis [4,5]. Systemic effects have not been reported following dermal exposure to benzene.

REFERENCES

1. Howard, P.H., 1990. Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Vol. II: Solvents. Lewis Publishers, Inc. Chelsea, Michigan. 546 pp.

2. Merck, 1989. The Merck Index. Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

3. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.

4. ATSDR, 1991. Toxicological Profile for Benzene (Draft). Agency for Toxic Substances and Disease Registry. USPHS/USEPA. October 1991.

5. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 2. Cambridge, MA. July 1989.

6. USEPA, 1998. Integrated Risk Information System (IRIS). Data base. Online. October, 1998.

7. USEPA, 1997a. Risk Assessment Issue Paper for: Derivation of a Provisional Chronic Oral RfD for Benzene. 96-021/07-02-96. Provided by USEPA Superfund Technical Support Center. July 17, 1997.

8. USEPA, 1997b. Risk Assessment Issue Paper for: Derivation of a Provisional Chronic Inhalation RfC for Benzene. 96-021/07-02-96. Provided by USEPA Superfund Technical Support Center. July 17, 1997.

CYANIDE

CAS NUMBER

57-12-5

COMMON SYNONYMS

None noted.

ANALYTICAL CLASSIFICATION

Inorganic (wet chemistry).

PHYSICAL AND CHEMICAL DATA

Note: Data is for hydrogen cyanide (HCN).

Water Solubility: miscible [1]
Vapor Pressure: 264.3 mm Hg at)°C [1]

Henry's Law Constant: 5.1 x 10^{-2} atm-m^3/mole [1]

Specific Gravity: 0.6884 at 20°C (liquid) [1]

Organic Carbon Partition Coefficient: ND

FATE DATA: HALF-LIVES

Soil: ND
Air: ND

Surface Water: ND

Groundwater: ND

NATURAL SOURCES

Fruits, roots, and leaves of numerous plants [1].

ARTIFICIAL SOURCES

Vermicidal fumigants; insecticides; rodenticides; metal polishes; electroplating solutions; metallurgical processes [1,2].

FATE AND TRANSPORT

Cyanides may be found in the environment bound with organic and/or inorganic cations. The fate and transport of cyanide, therefore, is dependent upon the properties of the cyanide-bound material. Any discussion attempting to encompass all properties of cyanide-bound materials is beyond the scope of this assessment.

Cyanides may occur in soils as hydrogen cyanide, alkali metal salts, or immobile metallocyanide complexes. The fate of cyanides in soil will be largely dependent upon pH conditions of that soil. Volatilization of hydrogen cyanide from surface soils is expected to be a primary removal mechanism for soils having a pH of 9.2 or less. Though cyanide typically does not sorb strongly to soils (or organic matter therein), leaching to unprotected groundwaters is not expected to be significant due to the probability of cyanide fixation by trace metals found in soils, or transformation of cyanide via microbial action. However, if the initial cyanide loading proves toxic to soil-based microorganisms, leaching to groundwater may be expected. In water, cyanide occurs most commonly in the form of hydrogen cyanide. Hydrogen cyanide is removed from water primarily by volatilization. The rate of volatilization is also pH-dependent, with more rapid volatilization occurring at lower pH values [1].

Although simple metal cyanides and hydrogen cyanide are not expected to bioconcentrate in aquatic organisms, concentrations of simple metal cyanides have been detected in the tissues of fish exposed to waters containing silver and copper metal complexes. There is, as well, no evidence of biomagnification through trophic levels. Adsorption to suspended solids and sediments in waters will occur, but is expected to be a minor pathway in comparison to volatilization and biodegradation. [1]

Atmospheric concentrations of cyanide will exist almost exclusively as hydrogen cyanide, though small amounts of metal cyanides may exist associated with particulate matter. Given the relatively slow degradation rate of hydrogen cyanide in the atmosphere, this material has the potential to be transported for long distances. The most important removal mechanism for hydrogen cyanide in the atmosphere is via reaction with photochemically-produced hydroxyl radicals. Removal of hydrogen cyanide via either dry or wet deposition is expected to be a negligible mechanism. Metal cyanides (as particulates) will, however, be subject to deposition via gravitational settling and/or rainfall washout. [1]

HUMAN TOXICITY

General. Cyanide is highly toxic to humans following all routes of exposure. Cyanide acts by inhibiting enzymes that are needed to use oxygen efficiently, resulting in respiratory arrest. The major targets of cyanide toxicity are the central nervous system, the lungs and the heart [1]. Cyanide is not mutagenic and has been placed in weight-of-evidence cancer Group D, indicating that it is not classifiable as to human carcinogenicity [3].

Oral Exposure. A chronic oral RfD of 0.02 mg/kg/day is based on the NOAEL of 10.8 mg/kg/day for weight loss, thyroid effects and nervous system effects in a chronic study in rats [3]. Cyanide is readily absorbed following oral exposure. Acute oral LD_{50} values ranged from 2.7 to 11 mg/kg in rats, 2.34 to 2.70 mg/kg in rabbits and 4.3 mg/kg in mice [1,2]. In humans, an average fatal dose of 1.52 mg/kg has been calculated based on case reports of intentional or accidental poisonings. The lowest reported fatal dose in humans was

0.56 mg/kg [1]. Acute oral poisoning results in effects on the gastrointestinal system (vomiting), the heart (atrial fibrillation, shallow pulse, inaudible heart sounds), kidneys (increased protein output) and nervous system (tremors, stupor, coma). These effects have occurred at doses above 15 mg/kg [1]. Similar effects have been found in animals. Information regarding potential effects of cyanide on reproduction and development in humans are not available, but studies in animals indicate that effects on development may result following oral exposure [1]. Cyanide is not known to cause cancer in humans or animals following any route of exposure, therefore, an oral slope factor is not available [3].

Inhalation Exposure. A chronic inhalation RfC is not available for cyanide [3]. Cyanide is readily absorbed following inhalation exposure. Acute inhalation LC_{50} values vary according to duration of exposure: in rats, values ranged from 3,417 ppm (10 seconds) to 142 ppm (60 minutes), and in rabbits, values ranged from 2,200 ppm (45 seconds) to 208 ppm (35 minutes) [1]. In humans, an average fatal concentration is estimated to be 546 ppm for a 10-minute exposure. Exposure to 110 to 135 ppm for greater than an hour can be life-threatening, while exposure to 18-36 ppm for the same time period may not cause any effects [1]. Acute exposures to approximately 6 ppm and above may result in effects on the respiratory system (dyspnea, nasal irritation), cardiovascular system (chest pain, heart palpitations), gastrointestinal system (abdominal pain, nausea, vomiting), and nervous system (lightheadedness, breathlessness, numbness, headaches, and, at higher concentrations, coma). Chronic inhalation exposure of workers to comparable concentrations results in effects similar to those reported following acute exposure. Information regarding the potential effects of cyanide on reproduction and development are not available in humans or animals [1]. Cyanide is not known to cause cancer in humans or animals following any route of exposure, therefore, an inhalation unit risk is not available [3].

Dermal Exposure. The average fatal dose of cyanide in humans following dermal exposure was estimated to be 100 mg/kg [1]. Acute dermal LD_{50} values in rabbits ranged from 1.0 to 8.93 mg/kg [1]. Toxic effects observed following dermal exposure are similar to those following other routes of exposure [1].

ECOLOGICAL TOXICITY

General. Cyanide is a highly lethal, but short-lived noncumulative poison. No evidence was found of either cyanide bioaccumulation or biomagnification [4]. Hydrogen cyanide is the most common and the most toxic of the cyanides. The environmental chemistry of cyanide is complex, with cyanide gas (HCN) and ionic cyanide (CN^-) representing the toxic chemical forms.

Vegetation. Cyanide seldom remains biologically available in soils because it is either complexed by trace metals, metabolized by various microorganisms, or lost through volatilization. In plants, elevated cyanide concentrations inhibit respiration [5]. Some plant species, such as arrowgrass (*Triglochin* sp.) wind wild cherry (*Prunus*), are natural producers

of cyano compounds and will have inherent high concentrations of these compounds in their tissues.

Aquatic. Cyanide in aquatic systems exists as simple hydrocyanic acid; as water-soluble alkali metal salts, such as potassium cyanide and sodium cyanide; and as metallocyanide complexes of variable stability [4]. Cyanide toxicity increases with decreasing pH and dissolved oxygen. Cyanide concentrations in the range from 50 to 100 µg/L have proven to eventually fatal to many sensitive fishes and levels above 200 µg/L probably are rapidly fatal to most fish species [6].

The 96-hour LC_{50} of cyanide for bluegill was 56.0 to 227.0 µg/L and the maximum toxicant concentration was 9.3 to 19.8 µg/L [5]. The 96-hour LC_{50} of cyanide for juvenile and adult fathead minnows was 117.0 to 157.0 µg/L and 121.0 to 129.0 µg/L, respectively [7]. During chronic exposure, cyanide inhibited spawning in bluegill at 5.0 µg/L and reduced growth rate in fathead minnows at 35.0 µg/L [5]. The federal chronic freshwater quality criterion for cyanide is 5.2 µg/L [8]. The Ohio aquatic life habitat and water supply standard for cyanide is 12.0 µg/L for warmwater and modified warmwater habitats [9].

Wildlife. Cyanide is acutely toxic to birds and mammals in very small concentrations. Cyanide biomagnification in the food chain has not been reported, possibly due to rapid detoxification of sublethal doses by most species, and death at higher doses [5]. In mallards, a single oral dose of cyanide of 0.53 mg/kg body weight produced no deaths, but an LC_{50} result was produced at 1.43 mg/kg body weight [5]). In rabbits, a single oral dose of 10.0 to 15.0 mg/kg body wight produced a 100 percent kill in 14 to 30 minutes [5].

REFERENCES

1. ATSDR, 1991. Toxicological Profile for Cyanide. Draft. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. October 1991.

2. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 4. Cambridge, MA. July 1989.

3. USEPA, 1999. Integrated Risk Information System (IRIS). Data base. Online. January, 1999.

4. Snyder, B.D. and J.L. Snyder, 1984. Feasibility of Using Oil Shale Wastewater for Waterfowl Wetlands. U.S. Fish and Wildlife Service. FWS/OBS-84/01.

5. Eisler, R., 1991. Cyanide Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. Contaminant Hazard Reviews, Report 23, Biological Report 85 (1.23). U.S. Department of Interior, Fish and Wildlife Service, Washington, D.C.

6. USEPA, 1976. Quality Criteria for Water. Office of Water and Hazardous Materials. Washington, D.C.

7. Engineering-Science, Inc., 1991. Waste Site Investigation for Alcoa Massena Operation, Comprehensive Biota Sampling Program Report. Volume XII. Liverpool, NY.

8. USEPA, 1991. Water Quality Criteria Summary. Washington, D.C.

9. OEPA, 1991. Ohio Water Quality Standards. Ohio Administrative Code-Title 3734-Chapter 1. Ohio Environmental Protection Agency.

2,4-DIMETHYLPHENOL

CAS NUMBER

105-67-9

COMMON SYNONYMS

m-Xylenol

ANALYTICAL CLASSIFICATION

Semi-volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 6200 mg/L at 25°C [1]
Vapor Pressure: 0.098 mm Hg at 25°C [1]

Henry's Law Constant: 6.3×10^{-7} atm-m^3/mole at 8°C [1]

Specific Gravity:1.036 at 20/4°C [2]

Organic Carbon Partition Coefficient: 425 [1]

FATE DATA: HALF-LIVES

Soil: 1 - 7 days [3]
Air: 1.19 - 11.9 hours [3]

Surface Water: 1 - 7 days [3]

Groundwater: 2 - 14 days [3]

NATURAL SOURCES

Coal; tea; tobacco; marijuana; and Siberian pines [1]

ARTIFICIAL SOURCES

Coal processing/refining; manufacture of plastics, resins, pharmaceuticals, insecticides, fungicides, disinfectants, solvents, etc; asphalt and roadway runoff; domestic sewage; gasoline and diesel exhausts; and tobacco smoke [1]

FATE AND TRANSPORT

When released in water, 2,4-dimethylphenol will degrade principally due to biological action (with a half-life of hours to days). Photolysis may occur in clear surface waters, while oxidation by alkyl peroxy radicals may be important in humic waters. Because of the low Henry's Law constant, volatilization from water would not be a significant transport process. A low log bioconcentration factor (1.18) indicates a low potential for bioconcentration in aquatic organisms. 2,4-Dimethylphenol will adsorb moderately to

soils, and will biodegrade in several days. Releases to the atmosphere involve the reaction of vapor-phase 2,4-dimethylphenol with photochemically-produced hydroxyl radicals (daylight) or nitrate radicals (nighttime); atmospheric washout, via rainfall, is also an effective removal process [1].

HUMAN TOXICITY

General. Information regarding the toxicity of 2,4-dimethylphenol is limited to two short-term oral studies in mice [4] and an oral LD_{50} study in rats [5]. There is no information regarding the potential effects of 2,4-dimethylphenol on reproduction, development or cancer following any route of exposure. 2,4-Dimethylphenol has not been placed in a weight-of-evidence cancer group by the USEPA [4].

Oral Exposure. A chronic oral RfD of 0.02 mg/kg/day is based on a NOAEL of 50 mg/kg/day for clinical signs (lethargy, prostration, ataxia) and hematological changes in a subchronic study in mice [4]. 2,4-Dimethylphenol is absorbed following oral exposure, but the extent of absorption is not known. An acute oral LD_{50} of 3200 mg/kg is reported for rats [5]. Ingested 2,4-dimethylphenol has not been reported to be fatal to humans. Two short-term (14 day and 90 day) studies in rats reported clinical effects (described above) at 250 mg/kg/day [4]. In the 90-day study, hematological effects (lower mean red blood cell volume and hemoglobin) were also reported at 250 mg/kg/day [4]. An oral Slope Factor for cancer is not available for 2,4-dimethylphenol [4].

Inhalation Exposure. No useful information was located regarding inhalation exposure to 2,4-dimethylphenol in humans or animals.

Dermal Exposure. 2,4-Dimethylphenol appears to be a cocarcinogen following dermal exposure [6]. Its role as a primary carcinogen is not clear.

REFERENCES

1. Howard, P.H., 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. I: Large Production and Priority Pollutants. Lewis Publishers, Inc. Chelsea, MI. 574 pp.

2. Verschueren, K., 1983. Handbook of Environmental Data on Organic Chemicals. Second Edition. Van Nostrand Reinhold Company, New York.

3. Howard, O.H., Boething, R.S., Jarvis, W.F., Meylan, W.M., Michalenko, E.M. 1991. Handbook of Environmental Degradation Rates. Lewis Publishers, Inc. Chelsea, Michigan. 574 pp.

4. USEPA, 1999. Integrated Risk Information System (IRIS). Data base. Online. January, 1999.

5. National Institute for Occupation Safety and Health, 1991. Registry of Toxic Effects of Chemical Substances (RTECS), Volume I-III. United States Department of Health and Human Services. Cincinnati, OH.

6. Sittig, M., 1985. Handbook of Toxic and Hazardous Chemicals and Carcinogens. Second Edition. Noyes Publications. Park Ridge, New Jersey.

NAPHTHALENE
2-METHYLNAPHTHALENE

GENERAL

There is relatively little information available on 2-methylnaphthalene as compared to naphthalene. Therefore, all information below refers to naphthalene unless explicitly stated otherwise.

CAS NUMBERS

Naphthalene	91-20-3
2-Methylnaphthalene	91-57-6

COMMON SYNONYMS

Naphthalene: Naphthene, Tar Camphor.
2-Methylnaphthalene: Beta-methylnaphthalene

ANALYTICAL CLASSIFICATION

Semi-Volatile Organic.

PHYSICAL AND CHEMICAL DATA

	Naphthalene	2-Methylnaphthalene
Water Solubility (mg/L at 20°C) [1]	31.7	ND
Vapor Pressure (mm Hg at 25°C) [1]	0.087	ND
Henry's Law Constant (atm-m^3/mole) [1]	4.6×10^{-4}	ND
Specific Gravity (20/4°C) [1]	1.145	1.0058
Organic Carbon Partition Coefficient [1]	933	ND

FATE DATA: HALF-LIVES (HRS)

Soil: 16.6 to 48 days [2]
Air: 2.96 to 29.6 hours [2]
Surface Water: 12 hours to 20 days [2]
Groundwater: 1 to 288 days [2]

NATURAL SOURCES

Crude oil; natural, uncontrolled combustion (i.e., forest fires) [3,4].

ARTIFICIAL SOURCES

Naphthalene: Petroleum refining, mothball use and manufacture, coal tar distillation, pitch fumes, chemical intermediate (i.e., phthalic anhydride manufacture), vehicle emissions, combustion processes (i.e., refuse combustion), tobacco smoke, and oil spillage [3,4].

2-Methylnaphthalene: Synthesis of organic compounds such as insecticides, and release from gasoline due to its use as an additive [1,5].

FATE AND TRANSPORT

Naphthalene's sorption to soil ranges from low to moderate, depending upon the organic carbon content of the soil, and will leach rapidly through sandy soils. Volatilization from the uppermost soil layer will be important, but will lessen in importance with soil depth. In addition, volatilization from moisture-saturated soil is not expected to be important. Biodegradation is expected to be rapid in soils previously contacted with other polycyclic aromatic hydrocarbons (PAHs), but slow in "virgin" soils [3].

Volatilization, photolysis, sorption (to suspended solids, sediments, etc.), and biodegradation are the primary removal mechanisms for naphthalene in waters. The actual predominant mechanisms change with variations in several factors (i.e., water flow rate, level of sediments/suspended soils, water clarity, etc.) In addition, biodegradation rates of naphthalene in water vary with changes in concentration of naphthalene (higher concentrations yield higher rates), "virgin" versus oil-polluted water (quicker in oil-polluted waters), actual pollution site (more rapid biodegradation in sediments than waters), aerobic versus anaerobic conditions (no biodegradation in anaerobic conditions), and so on. Bioconcentration in aquatic organisms is expected to be moderate, except for accelerated bioconcentration in organisms lacking an aryl hydroxylase enzyme system (i.e. phytoplankton, snails, mussels). Naphthalene in the atmosphere reacts during daylight hours with hydroxyl radicals, and during nighttime hours with nitrate radicals. Photolysis is also expected in the atmosphere [3].

HUMAN TOXICITY

General. The breakdown of red blood cells is the primary health concern for humans exposed to naphthalene. Human deaths following ingestion have occurred [1]. The USEPA has placed naphthalene in weight-of-evidence Group D, indicating that it is not classifiable as to human carcinogenicity [6]. The USEPA does not currently provide any toxicity values for 2-methylnaphthalene [6,7].

Oral Exposure. Both the chronic and subchronic RfDs for naphthalene of 0.04 mg/kg/day are based on a NOAEL of 100 mg/kg/day for decreased mean terminal body weight observed in a subchronic oral study in rats [7]. Clinical evidence indicates that naphthalene is absorbed by humans in significant quantities via the oral route. The oral

LD_{50} reported for naphthalene in rats ranges from 2,200 to 2,400 mg/kg in rats [1]. The oral LD_{50} reported for 2-methylnaphthalene in rats is 1,630 mg/kg [5]. Lethal doses of naphthalene in humans have ranged from as low as 74 mg/kg to as high as 574 mg/kg [1]. Ocular damage has been documented in humans and animals following oral exposure [1]. Symptoms of intoxication include: nausea, vomiting, headache, diaphoresis, hematuria, hemolytic anemia, fever, central nervous system depression, hepatic necrosis, jaundice, convulsions, and coma [1,2,8]. Administration of 300 mg/kg/day to pregnant mice resulted in a decrease in the number of live pups per litter [1].

Inhalation Exposure. An inhalation RfC of 0.003 mg/m^3 is reported for naphthalene based on a LOAEL for nasal effects in a chronic study in mice [6]. Clinical reports suggest that inhaled naphthalene may be absorbed in sufficient quantity to produce adverse health effects in humans; however, no quantitative absorption data were located for humans or animals. One study, on rats, reported a NOAEL of 78 ppm for a 4-hour exposure. Symptoms and effects of inhalation exposure in humans include: headache, nausea, vomiting, abdominal pain, malaise, confusion, anemia, jaundice, and renal disease. No information was found regarding developmental and reproductive effects [1].

Dermal Exposure. Limited evidence in human infants indicated that hemolytic anemia may have resulted from dermal exposure to an unknown quantity of naphthalene. A NOAEL of 2,500 mg/kg was reported for rats. Naphthalene is a mild dermal and ocular irritant [1].

REFERENCES

1. ATSDR, 1990. Toxicological Profile for Naphthalene and 2-Methylnaphthalene. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. December 1990.

2. Howard, P.H.; Boethling, R.S.; Jarvis, W.F.; Meylan, W.M.; and Michalenko, E.M.; 1991. Handbook of Environmental Degradation Rates. Lewis Publishers, Inc. Chelsea, MI. 725 pp.

3. Howard, P.H., 1989. Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Vol. I: Large Production and Priority Pollutants. Lewis Publishers, Inc. Chelsea, MI. 574 pp.

4. Merck, 1989. The Merck Index. Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

5. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 4. Cambridge, MA. July 1989.

6. USEPA, 1999. Integrated Risk Information System (IRIS). On-line data base. January, 1999.

7. USEPA, 1995. Health Effects Assessment Summary Tables (HEAST). Office of Emergency and Remedial Response. May 1995.

8. National Institute for Occupation Safety and Health, 1991. Registry of Toxic Effects of Chemical Substances (RTECS), Volume I-III. United States Department of Health and Human Services. Cincinnati, OH.

POLYCYCLIC AROMATIC HYDROCARBONS

GENERAL

Polycyclic aromatic hydrocarbons (PAHs) are a large group of chemicals formed during the incomplete combustion of organic materials. There are over one hundred PAHs, and they are found throughout the environment in air, water, and soil. Seven of the 15 PAHs addressed in this profile are classified as probable human carcinogens [1,2].

CAS NUMBERS

Acenaphthene	83-32-9	Chrysene	218-01-9
Acenaphthylene	208-96-8	Dibenzo(a,h)anthracene	53-70-3
Anthracene	120-12-7	Fluoranthene	206-44-0
Benzo(a)anthracene	56-55-3	Fluorene	86-73-7
Benzo(a)pyrene	50-32-8	Indeno(1,2,3-cd)pyrene	193-39-5
Benzo(b)fluoranthene	205-99-2	Phenanthrene	85-01-8
Benzo(g,h,i)perylene	191-24-2	Pyrene	129-00-00
Benzo(k)fluoranthene	207-08-9		

COMMON SYNONYMS

Polynuclear aromatic hydrocarbons, PNAs, PAHs.

ANALYTICAL CLASSIFICATION

Semivolatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: insoluble to 3.93 mg/L [1]
Vapor Pressure: negligible to very low at 25°C [1]

Henry's Law Constant: 6.95×10^{-8} to 1.45×10^{-3} atm-m^3/mole [1]

Specific Gravity: approximately 0.9 to 1.4 at 0 to 27°C [1]

Organic Carbon Partition Coefficient (K_{oc}): 2.5×10^3 to 5.5×10^6 [1]

FATE DATA: HALF-LIVES

Soil: 12.3 days to 5.86 years [3]
Air: 0.191 hours to 2.8 days [3]

Surface Water: 0.37 hours to 1.78 years [3]

Groundwater: 24.6 days to 10.4 years [3]

NATURAL SOURCES

Volcanoes, forest fires, crude oil, and oil shale [1].

ARTIFICIAL SOURCES

Motor vehicles and other petroleum fuel engines, wood-burning stoves and fireplaces, furnaces, cigarette smoke, industrial smoke or soot, and charcoal-broiled foods [1].

FATE AND TRANSPORT

Because the physical and chemical properties of PAHs vary substantially depending on the specific compounds in question, the fate and transport characteristics vary. Thus, the following discussion is presented in very general terms. Some fate characteristics are roughly correlated with molecular weight; so the compounds are grouped as follows [1]:

- Low molecular weight: acenaphthene, acenaphthylene, anthracene, fluorene, and phenanthrene;
- Medium molecular weight: fluoranthene and pyrene; and
- High molecular weight: benzo(a)anthracene, benzo(b)fluoranthene, benzo-(k)fluoranthene, benzo(g,h,i)perylene, benzo(a)pyrene, chrysene, dibenzo-(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

PAHs are present in the atmosphere in the gaseous phase and sorbed to particulates. They may be transported great distances, and are subject to photodegradation as well as wet or dry deposition [1].

PAHs in surface water are removed by volatilization, binding to particulates and sediments, bioaccumulation, and sorption onto aquatic biota. The low molecular weight PAHs have Henry's Law constants in the range of 10^{-3} to 10^{-5} atm-m^3/mole, and would therefore be expected to undergo significant volatilization; medium molecular weight PAHs have constants in the 10^{-6} range; and high molecular weight PAHs have constants in the range of 10^{-5} to 10^{-8}. Half-lives for volatilization of benzo(a)anthracene and benzo(a)pyrene from water have been estimated to be greater than 100 hours. It has been reported that lower molecular weight PAHs could be substantially removed by volatilization under conditions of high temperature, shallow depth, and high wind. For example, anthracene was found to have a half-life for volatilization of 18 hours in a stream with moderate current and wind. In an estuary, volatilization and adsorption are the primary removal mechanisms for medium and high molecular weight PAHs, whereas volatilization and biodegradation are the major mechanisms for low molecular weight compounds. PAHs can bioaccumulate in plants and animals, but are subject to extensive metabolism by high-trophic-level consumers, indicating that biomagnification is not significant [1].

Potential mobility in soil is related to the organic carbon partition coefficient (K_{oc}). The low molecular weight PAHs have K_{oc} values in the range of 10^3 to 10^4, which indicates a moderate potential to be adsorbed to organic material. Medium molecular weight compounds have values on the order of 10^4, while high molecular weight compounds have values in the 10^5 to 10^6 range. The latter compounds, then, have a much greater tendency to adsorb and resist movement through soil. Volatilization of the lower molecular weight compounds from soil may be substantial. However, some portion of PAHs in soil may be transported to groundwater, and then move laterally in the aquifer, depending on soil/water conditions [1].

HUMAN TOXICITY

General. Ingestion of, inhalation of, or dermal contact with PAHs by laboratory animals has been shown to produce tumors. Reports in humans show that individuals exposed by inhalation or dermal contact for long periods of time to mixtures of PAHs and other compounds can also develop cancer. However, the relationship of exposure to any individual PAH with the onset of cancer in humans is not clear [1]. The available RfDs and weight-of-evidence groups for the PAHs addressed in this profile are presented in Table 1. The available slope factors are presented below. No other toxicity values were available [2,4].

Oral Exposure. Indirect evidence suggests that benzo(a)pyrene may not be readily absorbed following oral exposure in humans. On the other hand, absorption in rats appears to be rapid and efficient. Whether or not there is actually a significant difference between humans and rats in the capacity to absorb benzo(a)pyrene is questionable. It should be noted that the degree of uptake is highly dependent on the vehicle of administration. A NOAEL of 150 mg/kg/day was determined for gastrointestinal, hepatic, and renal effects in rats following acute oral exposure to benzo(a)pyrene or benzo(a)anthracene. LOAELs in the range of 40 to 160 mg/kg/day were determined for developmental and reproductive effects in mice following acute oral exposure to benzo(a)pyrene [1]. An oral slope factor of 7.3 $(mg/kg/day)^{-1}$ for benzo(a)pyrene is based on tumors detected in the forestomachs of rats and mice in various diet studies [2].

Inhalation Exposure. The USEPA does not currently provide inhalation RfCs for any of the PAHs [2,4]. Pure PAH aerosols appear to be well absorbed from the lungs of animals. However, PAHs adsorbed to various particles appear to be poorly absorbed, if at all. The latter are most likely to be removed from the lungs by mucociliary clearance and subsequent ingestion. Lung cancer in humans has been strongly associated with long-term inhalation of coke-oven emissions, roofing-tar emissions, and cigarette smoke, all of which contain mixtures of carcinogenic PAHs. It has been estimated that

the 8-hour time-weighted average exposure to PAHs in older coke plants was approximately 22 to 33 mg/m^3 [1]. An inhalation slope factor of 8.8×10^{-4} $(ug/m^3)^{-1}$ is reported for benzo(a)pyrene [15].

Dermal Exposure. Limited *in vivo* evidence exists that PAHs are at least partially absorbed by human skin. An *in vitro* study with human skin indicated that 3% of an applied dose of benzo(a)pyrene was absorbed after 24 hours. Studies in mice indicated that at least 40% of an applied dose of benzo(a)pyrene was absorbed after 24 hours. The carcinogenic PAHs as a group cause various noncancerous skin disorders in humans and animals. Substances containing mixtures of PAHs have been linked to skin cancers in humans. Studies in laboratory animals have demonstrated the ability of benz(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene to induce skin tumors [1].

ECOLOGICAL TOXICITY

General. The molecular weight of the individual PAHs affects their mobility and solubility in the environment, with lower weight compounds generally being more volatile and soluble than higher weight compounds, which have strong sorption properties. In aquatic environments, PAH partitioning in sediments occurs in an equilibrium process, with a potential for localized occurrences of high levels of dissolved PAHs [5,6]. PAHs can bioaccumulate in plants and animals, but do not biomagnify in food chains. Inter- and intraspecies responses to carcinogenic PAHs are variable, and some PAHs tend to inhibit the carcinogenicity of other compounds in mammals [7]. A variety of adverse effects on aquatic and terrestrial animals has been observed.

Vegetation. Plants absorb PAHs from soils through their root systems, and can translocate them to above ground parts. Lower weight PAHs are absorbed more readily than other PAHs [7]. Airborne deposition of particulate PAHs, and the subsequent adsorption to the skins of fruits and vegetables, accounts for reported higher PAH concentrations in aboveground versus underground plant parts. Soil concentrations of benzo(a)pyrene typically may reach 1,000 mg/kg; concentrations for total PAHs typically exceed benzo(a)pyrene concentrations by at least one order of magnitude. PAH concentrations in vegetation typically range from 20 to 1,000 µg/kg [6]. Some plants biocentrate PAHs in their oily parts (e.g., seeds) above levels in surrounding soils, but this does not appear to be typical [6]. In limited studies on PAHs in plants, phytotoxic effects were rare; photosynthetic inhibition in algae has been documented [7,6]. Some vascular plants catabolize benzo(a)pyrene [6], and PAHs synthesized by plants may act as growth hormones [7,8]. Plants may serve as a pathway for exposure of higher-order consumers to toxic levels of PAHs.

Aquatic Life. Most PAHs in aquatic environments tend to sorb to sediments, and sediment-associated PAHs have accounted for up to 77 percent of the steady-state body

burden in benthic amphipods [7]. Absorption and assimilation of PAHs vary widely among species and according to the specific compound. Crustaceans and fish appear better able to assimilate, metabolize, and eliminate PAHs than do molluscs and polychaetes [7,8]. Fish appeared to detoxify benzo(a)pyrene as quickly as it was absorbed in water-only exposures [9]. Little potential for biomagnification through aquatic food chains exists, and bioconcentration factors range widely. A 2- to 3-day exposure BCF of 485 was reported for anthracene in fathead minnows, and a 24-hour BCF of 12 was reported for benzo(a)pyrene in bluegill [7].

Toxic effects of PAHs in fish include liver, thyroid, gonad, and skin tumors. Phenanthene has an LC_{50} of 370 µg/L in grass shrimp, and benz(a)anthracene has an LC_{87} of 1,000 µg/L in bluegill [7]. In the Black River, Ohio, where sediment PAH levels were 10,000 times those in a control location, brown bullheads showed elevated concentrations of lower molecular weight PAHs in their livers and a higher incidence of liver tumors [5,7,8]. Dissolved fluorene introduced into pond waters resulted in reduced growth in bluegill at 0.12 mg/L, and in increased vulnerability to predation at 1.0 mg/L [7].

There are no promulgated federal or state aquatic life water quality criteria for any of the PAHs, though the USEPA has proposed a chronic criterion of 6.3 µg/L and an acute criterion of 30 µg/L for phenanthrene in fresh waters [10,11].

Wildlife. PAH toxicity studies in animals are mostly confined to laboratory experiments. Many PAHs can produce tumors in skin and epithelia tissues in all animal species tested, with malignancies induced by microgram acute exposures. Some carcinogenic PAHs can pass across skin, lungs, intestines, and placenta in mammals. Target organs are diverse, and the tissue affected is dependent on the compound and method of exposure. For example, dietary benzo(a)pyrene caused leukemia, lung adenoma, and stomach tumors in mice. Ancillary tissue damage may accompany carcinomas [7]. Selective effects based on age and gender of the receptor have also been observed [8,12,9,13]. Mammals do not tend to accumulate PAHs, which is likely due to the rapid metabolism of these compounds. For example, the biological half-life of benzo(a)pyrene in rat blood and liver was 5 to 10 minutes [7].

There is a scarcity of data on PAHs that are not carcinogenic [14]. Many chemicals, including other PAHs, modify the carcinogenic actions of PAHs in laboratory animals. Inhibitors of PAH-induced tumors include selenium, vitamins A and E, flavones, and ascorbic acid [7]. LD_{50} values also range widely: acute oral LD_{50} values for rodents range from 50 mg/kg body weight for benzo(a)pyrene to 700 mg/kg for phenanthrene, to 2,000 mg/kg for fluoranthene. Chronic oral carcinogenicity values for rodents include 40 mg/kg for benzo(b)fluoranthene, 72 mg/kg for benzo(k)fluoranthene, and 99 mg/kg for chrysene [7].

In a study on mallards, no mortality or visible toxic effects were observed over 7 months during which birds were fed diets containing 4,000 mg/kg PAHs, though heptatic changes were observed. Sax [9] reports that single oral doses of 250 ppm benzo(a)pyrene were not acutely toxic to ducks or chickens.

REFERENCES

1. ATSDR, 1990. Toxicological Profile for Polycyclic Aromatic Hydrocarbons. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. NTIS No. PB91-181537. December 1990.

2. USEPA, 1999. Integrated Risk Information System (IRIS). On-line data base. January, 1999.

3. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.

4. USEPA, 1995. Health Effects Assessment Summary Tables (HEAST). Office of Emergency and Remedial Response. May 1995.

5. Cura, J.J., B. Potocki, and M.L. Soczek, 1992. Distribution of PAH Compounds in Aquatic Biota. Superfund Risk Assessment in Soil Contamination Studies, ASTM STP 1158.K. Hoddinott and D. Knowles, eds. American Society for Testing and Materials. Philadelphia.

6. Edwards, N.T., 1983. Polycyclic Aromatic Hydrocarbons (PAHs) in the Terrestrial Environment-A Review. Journal of Environmental Quality 12(4):427-441.

7. Eisler, R., 1987. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates, A Synopsis. Biological Report 85(1.11), Contaminant Hazard Reviews Report 11. U.S. Fish and Wildlife Service, Laurel, Maryland.

8. Micromedex, Inc., 1992. Tomes Plus System. Toxicology, Occupational Medicine and Environmental Services. Volume 14. Denver, Colorado.

9. Sax, N.I. (ed.), 1985a. Benzo(a)pyrene. Dangerous Properties of Industrial Materials Report. January/February 1985, pp. 42-49.

10. USEPA, 1991. Water Quality Criteria Summary. Washington, D.C.

11. OEPA, 1991. Ohio Water Quality Standards. Ohio Administrative Code, Title 3745-Chapter 1. Ohio Environmental Protection Agency.

12. Sax, N.I. (ed.), 1984. Chrysene. Dangerous Properties of Industrial Materials Report. July/August 1984. pp. 83-100.

13. Sax, N.I. (ed.), 1985b. Benzo(k)fluoranthene. Dangerous Properties of Industrial Materials Report. January/February 1985, pp. 37-39.

14. USEPA, 1980. Ambient Water Quality Criteria for Polycyclic Aromatic Hydrocarbons. EPA 440/5-80-069.

15. USEPA, 1995. Supplemental Guidance to RAGS: Region 4 Bulletins. Human Health Risk Assessment. November 1995.

XYLENES

CAS NUMBER

1330-20-7

COMMON SYNONYMS

Xylene.

Note: There are three isomers (forms) of xylene: ortho, meta, and para, also known as 1,2-, 1,3-, and 1,4-xylene, respectively.

ANALYTICAL CLASSIFICATION

Volatile organic.

PHYSICAL AND CHEMICAL DATA

Water Solubility: 146 - 175 mg/L at 25°C [1]
Vapor Pressure: 6.6 - 8.7 mm Hg at 25°C [1]

Henry's Law Constant: 5.1 x 10^{-3} to 7.7 x 10^{-3} atm-m^3/mole at 25°C [2]

Specific Gravity: 0.880 at 20/4°C (*o*-xylene) [3]

Organic Carbon Partition Coefficient: 25.4 - 204 [1]

FATE DATA: HALF-LIVES

Soil: 1 - 4 weeks [4]
Air: 2.6 hours - 1.8 days [4]

Surface Water: 1 - 4 weeks [4]

Groundwater: 2 weeks - 1 year [4]

NATURAL SOURCES

All three isomers of xylene occur in petroleum. 1,2-Xylene is found additionally in coal tar, forest fire products, and plants [1].

ARTIFICIAL SOURCES

Gasoline, fuel oils, and their combustion products. Petroleum refining, chemical industry; aerosols of paints, varnishes, and shellacs. Wood-burning stoves and fireplaces [1].

FATE AND TRANSPORT

Xylenes are moderately mobile in soil and may leach to groundwater where they are known to persist for several years despite evidence of biodegradation in both soil and groundwater. The dominant removal process in surface water is volatilization, but this is

not a rapid process. Some adsorption to sediment will occur. Once released to the atmosphere, xylenes will undergo photochemical degradation at a moderate rate [1].

HUMAN TOXICITY

General. The primary target of xylenes toxicity is the central nervous system [2,5]. Xylenes are considered to be nongenotoxic. The USEPA has placed xylenes in weight-of-evidence cancer Group D, indicating that they are not classifiable as to human carcinogenicity [6].

Oral Exposure. A chronic oral RfD of 2 mg/kg/day is based on a NOAEL of 250 mg/kg/day for hyperactivity, decreased body weight and increased male mortality in a chronic study in rats [6]. Acute oral LD_{50} values for xylenes ranged from 3523 to 8600 mg/kg in rats and 5251 to 5627 mg/kg in mice [2,5]. Death in humans has been reported following the ingestion of xylenes, but the fatal dose is not known [2]. Reports of the ingestion of xylenes in humans are generally lacking. In animals, oral exposure to xylenes results in effects on the liver (increased liver enzymes and weight), the kidenys (increased kidney weight), and the nervous system (impairment of visual function, hyperactivity) [4]. Information is not available regarding the effects of ingested xylene on reproduction or development in humans, and the results of developmental studies in animals are inconclusive [2]. There is no conclusive evidence that oral exposure to xylenes causes cancer in humans or animals, therefore, an oral slope factor is not available [6].

Inhalation Exposure. An inhalation RfC for mixed xylenes is considered non-verifiable by the USEPA [7]. Xylenes are readily absorbed following inhalation exposure. Acute inhalation LC_{50} values of 6350 to 6700 ppm (4-hour exposure) were reported in rats for mixed xylenes [2]. LC_{50} values for the separate isomers are comparable to the mixture. Cause of death was usually respiratory failure and/or sudden ventricular fibrillation. In humans, inhalation of approximately 10,000 ppm xylenes has been fatal [2]. Exposure of humans to 90 ppm xylene has produced impairment of reaction time, manual coordination and body balance [5]. Brief exposure to concentrations of 200 ppm has caused irritation of the eyes, nose and throat. and exposure to concentrations above 200 ppm has resulted in nausea, vomiting, abdominal pain and loss of appetite [5]. Long-term high-level occupational exposure to xylenes (> 200 ppm) has resulted in central nervous system effects, incoordination, nausea, vomiting, and abdominal pain [5]. Studies in laboratory animals suggest that xylenes have a relatively low chronic toxicity. Some data in animals suggest possible kidney and liver impairment with high level inhalation exposures (>1000 ppm) [5]. Information regarding the effects of xylenes on human reproduction and development are not available, but teratogenicity, fetotoxicity, and maternal toxicity have been observed in animals [2,5]. Xylenes have been found to cross the human placenta, therefore, there is sufficient reason for concern for pregnant women

who are exposed to xylenes [2,5]. It is not known whether inhaled xylenes cause cancer in humans or animals, therefore, an inhalation unit risk is not available [6].

Dermal Exposure. Acute dermal LD_{50} values in rabbits of 14.1 ml/kg and greater than 5.0 ml/kg are reported for m-xylene and mixed xylenes, respectively [5]. Xylene is a skin irritant and causes redness, defatting and dryness. Vesicles may form following prolonged skin contact [2,5].

ECOLOGICAL TOXICITY

General. Xylenes are not a priority pollutant because they have low acute and chronic toxicity. Xylenes move through the soil/groundwater system when present at low concentrations, dissolved in water and adsorbed on soil, or as a separate organic phase resulting from a spill of significant quantities. Xylenes readily volatilize from water, are moderately adsorbed on soil, and have a moderate potential for bioaccumulation [8]. No information on biomagnification of xylenes was available in the technical literature.

Vegetation. Nearly all xylenes (98.8 percent) are expected to be sorbed into the soil. For the portion of xylenes in the gaseous phase of soil (0.5 perc[illegible] the soil/air pores up to the ground surface and removal by wind will [illegible]ss pathway [8]. Review of the technical literature did not produce inform[illegible]n regarding the phytotoxic effects of xylenes.

Aquatic Life. The half-life of xylenes in surface water has been calculated as 2.6 to 11.2 days [9]. Under normal environmental conditions, xylenes are not expected to undergo hydrolysis because they contain no hydrolyzable functional groups [8]. The LC_{50} value for freshwater fish was approximately 30 mg/L [9]. The 96-hour LC_{50} values for fathead minnows were 26.7 mg/L in soft water and 28.8 mg/L in hard water [10]. The 96-hour LC_{50} for bluegills was 20.9 mg/L in soft water [10]. There are no federal or state water quality standards established to protect aquatic life [11].

Wildlife. Xylenes are considered to be of low acute and chronic toxicity to birds and mammals [12]. No changes were found in rats, guinea pigs, dogs, and monkeys continuously exposed to 80 ppm for 127 days, nor in rats exposed to 700 ppm for 130 days [8]. Japanese quail showed no signs of toxicity at oral concentrations of 5,000 to 20,000 ppm (approximately 600 to 2,400 mg/kg body weight) [9]. Mallard eggs were immersed in xylene (10%) for 30 seconds and no significant effects on embryonic weight and length were observed when compared to controls [13]. Arthur D. Little, Inc. [8] reported an oral LD_{50} for rats at 4,300 mg/kg.

REFERENCES

1. Howard, P.H., 1990. Handbook of Environmental Fate and Exposure Data For Organic Chemicals, Vol. II: Solvents. Lewis Publishers, Inc. Chelsea, Michigan. 546 pp.

2. ATSDR, 1990. Toxicological Profile for Total Xylenes. Agency for Toxic Substances and Disease Registry. USPHS/USEPA. December 1990.

3. Merck, 1989. The Merck Index. Eleventh Edition. Merck & Company, Inc. Rahway, NJ.

4. Howard, P.H., R.S. Boethling, W.F. Jarvis, W.M. Meylan, and E.M. Michalenko, 1991. Handbook of Environmental Degradation Rates. Lewis Publishers. Chelsea, Michigan.

5. Arthur D. Little, Inc., 1989. The Installation Restoration Program Toxicology Guide. Volume 2. Cambridge, MA. July 1989.

6. USEPA, 1999. Integrated Risk Information system (IRIS). Data base. Online. January, 1999.

7. USEPA, 1995. Health Effects Assessment Summary Tables (HEAST). Office of Emergency and Remedial Response. May, 1995.

8. Arthur D. Little, Inc., 1985. The Installation Restoration Program Toxicology Guide. Volume 1. Cambridge, MA.

9. CH2M Hill, Inc., 1989. Preliminary Endangerment Assessment for Lowry Landfill. Prepared for USEPA. Denver, Colorado.

10. Sax, N.I. (ed.), 1984. Dangerous Properties of Industrial Materials. 6th ed. Van Nostrand Reinhold, New York. p 2728.

11. USEPA, 1991. Water Quality Criteria Summary. Washington, D.C.

12. Clement Associates, Inc., 1985. Chemical, Physical, and Biological Properties of Compounds Present a Hazardous Waste Sites. Prepared for USEPA. September 27, 1985.

13. Micromedex, Inc., 1992. Tomes Plus System. Toxicology, Occupational Medicine and Environmental Series. Volume 14. Denver, Colorado.

APPENDIX H

APPENDIX H

REMEDIAL ALTERNATIVE COST ESTIMATES

BURA
Fourth Street Site
SOIL/GROUNDWATER ALTERNATIVES
ALTERNATIVE 1 - Limited Action

CAPITAL COSTS

Item	Unit	Quantity	Unit Cost	Total Cost
1. Deed Restriction by Property Owner	LS	1	$10,000	$10,000
2. Construction of Security Fence	LF	1,830	$20	$36,600
3. Subtotal Capital Costs				$46,600
4. Engineering, Design, and Construction Oversight (10%)				$4,660
5. Contingencies (20%)				$9,320
6. TOTAL CAPITAL COSTS				**$61,000**

ANNUAL OPERATING AND MAINTENANCE COSTS

Item	Unit	Quantity	Unit Cost	Total Cost
1. Annual Site Inspection, Administration, and Reporting	LS	1	$4,000	$4,000
2. Short-Term Groundwater Monitoring, Annually for Five Years				
a. Field effort (labor, materials, and equipment)	HRS	16	$50	$800
b. Sample analyses	TEST	10	$500	$5,000
c. Data analysis and reporting	HRS	20	$80	$1,600
Subtotal				$7,400
3. Present Worth of Site Inspection, Administration, and Reporting [PW O&M=(P/A, 4%, 30) * Site Inspection Annual O&M]				$69,168
4. Present Worth of Groundwater Monitoring [PW O&M=(P/A, 4%, 5) * Groundwater Monitoring Annual O&M]				$32,943
5. TOTAL O&M PRESENT WORTH				**$100,000**
PRESENT WORTH OF ALTERNATIVE [PW=Total Capital Costs + Total O&M Present Worth]				**$160,000**

BURA
Fourth Street Site
SOIL/GROUNDWATER ALTERNATIVES
ALTERNATIVE 2 - Containment

CAPITAL COSTS

Item	Unit	Quantity	Unit Cost	Total Cost
1. Deed Restriction by Property Owner	LS	1	$10,000	$10,000
2. Placement of Asphalt Cap Onsite				
a. One 12-inch lift of clean fill for grading purposes	CY	4,700	$10	$47,000
b. Asphalt cap	SY	14,000	$25	$350,000
3. Subtotal Capital Costs				$407,000
4. Engineering, Design, and Construction Oversight (15%)				$61,050
5. Contingencies (20%)				$81,400
6. TOTAL CAPITAL COSTS				**$550,000**

ANNUAL OPERATING AND MAINTENANCE COSTS (annual groundwater monitoring for five years)

Item	Unit	Quantity	Unit Cost	Total Cost
1. Annual Site Inspection, Administration, and Reporting	**LS**	**1**	**4000**	**4000**
2. Cap Maintenance	HRS	30	$50	$1,500
3. Short-Term Groundwater Monitoring, Annually for Five Years				
a. Field effort (labor, materials, and equipment)	HRS	16	$50	$800
b. Sample analyses	TEST	10	$500	$5,000
c. Data analysis and reporting	HRS	20	$80	$1,600
Subtotal				$7,400
4. Present Worth of Site Inspection, Administration, Reporting [PW O&M=(P/A, 4%, 30) * Site Inspection Annual O&M]				$69,168
5. Present Worth of Cap Maintenance [PW O&M=(P/A, 4%, 30) * Cap Maintenance]				$25,938
6. Present Worth of Groundwater Monitoring [PW O&M=(P/A, 4%, 5) * Groundwater Monitoring Annual O&M]				$32,943
7. TOTAL O&M PRESENT WORTH				**$130,000**
PRESENT WORTH OF ALTERNATIVE [PW=Total Capital Costs + Total O&M Present Worth]				**$680,000**

ANNUAL OPERATING AND MAINTENANCE COSTS (semi-annual groundwater monitoring for thirty years)

Item	Unit	Quantity	Unit Cost	Total Cost
1. Annual Site Inspection, Administration, and Reporting	LS	1	$4,000	$4,000
2. Cap Maintenance	HRS	30	$50	$1,500
3. Short-Term Groundwater Monitoring, Annually for Five Years				
a. Field effort (labor, materials, and equipment)	HRS	32	$50	$1,600
b. Sample analyses	TEST	20	$500	$10,000
c. Data analysis and reporting	HRS	40	$80	$3,200
Subtotal				$14,800
4. Present Worth of Site Inspection, Administration, Reporting [PW O&M=(P/A, 4%, 30) * Site Inspection Annual O&M]				$69,168
5. Present Worth of Cap Maintenance [PW O&M=(P/A, 4%, 30) * Cap Maintenance]				$25,938
6. Present Worth of Groundwater Monitoring [PW O&M=(P/A, 4%, 30) * Groundwater Monitoring Annual O&M]				$255,922
7. TOTAL O&M PRESENT WORTH				**$350,000**
PRESENT WORTH OF ALTERNATIVE [PW=Total Capital Costs + Total O&M Present Worth]				**$900,000**

BURA
Fourth Street Site
SOIL/GROUNDWATER ALTERNATIVES
ALTERNATIVE 3A
Source Removal to One Foot Below Water Table

CAPITAL COSTS

Item	Unit	Quantity	Unit Cost	Total Cost
1. Construction of Dewatering Pad				
a. Berms	LF	400	$3	$1,200
b. 40-mil HDPE liner	SF	10,100	$2	$20,200
c. Sump pump	EA	1	$1,000	$1,000
d. Storage tank	EA	1	$2,000	$2,000
2. Removal of Soil to 1 foot below water table				
a. Removal of soil for 1:3 side slopes	CY	4,300	$10	$43,000
b. Excavation	CY	27,000	$10	$270,000
c. Stockpiling and dewatering	CY	3,000	$3	$9,000
3. Pre-treatment of Water				
a. Filtration and activated carbon system	LS	1	$50,000	$50,000
b. Sump pump	EA	1	$1,000	$1,000
c. Labor	HRS	168	$50	$8,400
4. Offsite Management of Materials				
a. Management of water at local POTW	1000 GAL	196.62	$8	$1,573
b. Transport & management of excavated soil (assumed 10% haz)	CY	2,700	$100	$270,000
c. Transport & management of excavated soil (assumed 90% non-haz)	CY	24,300	$55	$1,336,500
5. Replacement of Excavation Areas with Clean Fill	CY	27,000	$10	$270,000
6. Placement of Asphalt Cover Onsite				
a. One 12-inch lift of clean fill for grading purposes	CY	4,700	$10	$47,000
b. Asphalt cover	SY	14,000	$19	$266,000
7. Subtotal Capital Costs				$2,572,473
8. Engineering, Design, and Construction Oversight (10%)				$257,247
9. Contingencies (20%)				$514,495
10. TOTAL CAPITAL COSTS				**$3,300,000**

ANNUAL OPERATING AND MAINTENANCE COSTS

Item	Unit	Quantity	Unit Cost	Total Cost
1. Annual Site Inspection, Administration, Reporting	HRS	48	$60	$2,880
2. Cover Maintenance	HRS	20	$50	$1,000
3. Short-Term Groundwater Monitoring, Annually for Five Years				
a. Field effort (labor, materials, and equipment)	HRS	16	$50	$800
b. Sample analyses	TEST	10	$500	$5,000
c. Data analysis and reporting	HRS	20	$80	$1,600
Subtotal				$7,400
4. Present Worth of Site Inspection, Administration, Reporting [PW O&M=(P/A, 4%, 30) * Site Inspection Annual O&M]				$49,801
5. Present Worth of Cover Maintenance [PW O&M=(P/A, 4%, 30) * Cover Maintenance]				$17,292
6. Present Worth of Groundwater Monitoring [PW O&M=(P/A, 4%, 5) * Groundwater Monitoring Annual O&M]				$32,943
7. TOTAL O&M PRESENT WORTH				**$100,000**
PRESENT WORTH OF ALTERNATIVE [PW=Total Capital Costs + Total O&M Present Worth]				**$3,400,000**

BURA
Fourth Street Site
SOIL/GROUNDWATER ALTERNATIVES
ALTERNATIVE 3B
Source Removal to One Foot Below Deepest PRG Exceedances

CAPITAL COSTS

Item	Unit	Quantity	Unit Cost	Total Cost
1. Construction of Dewatering Pad				
a. Berms	LF	400	$3	$1,200
b. 40-mil HDPE liner	SF	10,100	$2	$20,200
c. Sump pump	EA	1	$1,000	$1,000
d. Storage tank	EA	1	$2,000	$2,000
2. Removal of Soil to 1 foot below Deepest PRG Exceedances				
a. Removal of soil for 1:3 side slopes	CY	11,000	$10	$110,000
b. Excavation	CY	40,000	$10	$400,000
c. Stockpiling and dewatering	CY	15,500	$3	$46,500
3. Pre-treatment of Water				
a. Filtration and activated carbon system	LS	1	$50,000	$50,000
b. Sump pump	EA	1	$1,000	$1,000
c. Labor	HRS	504	$50	$25,200
4. Offsite Management of Materials				
a. Management of water at local POTW	1000 GAL	1,028.81	$8	$8,230
b. Transport & management of excavated soil (assumed 10% haz)	CY	4,000	$100	$400,000
c. Transport & management of excavated soil (assumed 90% non-haz)	CY	36,000	$55	$1,980,000
5. Replacement of Excavation Areas with Clean Fill	CY	40,000	$10	$400,000
6. Placement of Asphalt Cover Onsite				
a. One 12-inch lift of clean fill for grading purposes	CY	4,700	$10	$47,000
b. Asphalt cover	SY	14,000	$19	$266,000
7. Subtotal Capital Costs				$3,733,930
8. Engineering, Design, and Construction Oversight (10%)				$373,393
9. Contingencies (20%)				$746,786
10. TOTAL CAPITAL COSTS				**$4,900,000**

ANNUAL OPERATING AND MAINTENANCE COSTS

Item	Unit	Quantity	Unit Cost	Total Cost
1. Annual Site Inspection, Administration, and Reporting	HRS	48	$60	$2,880
2. Cover Maintenance	HRS	20	$50	$1,000
3. Short-Term Groundwater Monitoring, Annually for Five Years				
a. Field effort (labor, materials, and equipment)	HRS	16	$50	$800
b. Sample analyses	TEST	10	$500	$5,000
c. Data analysis and reporting	HRS	20	$80	$1,600
Subtotal				$7,400
4. Present Worth of Site Inspection, Administration, Reporting [PW O&M=(P/A, 4%, 30) * Site Inspection Annual O&M]				$49,801
5. Present Worth of Cover Maintenance [PW O&M=(P/A, 4%, 30) * Cover Maintenance]				$17,292
6. Present Worth of Groundwater Monitoring [PW O&M=(P/A, 4%, 5) * Groundwater Monitoring Annual O&M]				$32,943
7. TOTAL O&M PRESENT WORTH				**$100,000**
PRESENT WORTH OF ALTERNATIVE [PW=Total Capital Costs + Total O&M Present Worth]				**$5,000,000**

BURA Fourth Street Site
SUMMARY OF UNIT COSTS

	Unit Cost	Unit	Source
1. Deed restriction	LS	$10,000	Experience
2. Construction of security fence	LF	$20	Means 1999
3. Site inspection, administration, and reporting	HR	$60	Experience
4. Groundwater monitoring			
a. Field effort	HR	$50	Experience
b. Lab analysis	SAMPLE	$500	Experience
c. Data analysis and reporting	HR	$80	Experience
5. Vegetative cover			
a. Fill	CY	$10	Experience
b. Topsoil	CY	$15	Experience
c. Seeding	ACRE	$2,200	Means 1999
6. Asphalt cap*	SY	$25	Experience
7. Construction of dewatering pad			
a. Berms	LF	$3	Experience
b. 40-mil HDPE liner	SF	$2	Experience
c. Sump pump	EA	$1,000	Means 1999
d. Storage tank	EA	$2,000	Means 1999
8. Excavation	CY	$10	Experience
9. Stockpiling and dewatering	CY	$3	Experience
10. Pre-treatment system (filtration and carbon)	LS	$50,000	Experience
11. Operation of system	HR	$50	Experience
12. Offsite management of water	1000 GAL	$8	Vendor (Buffalo Sewer Authority)
13. Transport and disposal in hazardous waste landfill	CY	$100	Vendor
14. Transport and disposal in non-hazardous waste landfill	CY	$50	Vendor
15. Asphalt cover (asphalt cap without geotextile or geomembrane)	SY	$19	Experience

*includes 2" top course, 4-6" binder course, 6" gravel, geotextile, geomembrane, and 6" fill

BURA FOURTH STREET SITE
ASSUMPTIONS FOR SOIL/GROUNDWATER ALTERNATIVE 1
LIMITED ACTION

GENERAL

The cost estimates include both capital and operating and maintenance expenses. The present worth for each alternative was estimated assuming a project life of 30 years and a 4% discount rate based on current interest and inflation rates. In the development of construction cost estimates, unit costs were obtained from vendor quotations, standard cost estimating documents (Means), or extensive Parsons ES experience with similar projects. Vendor quotes were obtained for key unit costs whenever possible. Unit costs are presented in Table 1.

CAPITAL COSTS

Item 1 - Deed Restrictions

Assumed to be a lump sum of $10,000 to cover negotiations and limited legal fees.

Item 2 - Construction of Security Fence

Assumed a security fence 1,830 long in order to enclose the area of where DNAPL was observed and where groundwater monitoring is to take place. The fence would be a six-foot high chain-link industrial fence.

ANNUAL O&M COSTS

Item 1 - Annual Inspection, Administration, Reporting

Assumed quarterly site inspections (4 hours), preparation of quarterly reports and

associated paperwork (4 hours), and administration performed quarterly (4 hours).

(12 hours) (4 times per year) = 48 hours at $60 per hour = $2,880

Assumed a lump sum of $1,000 per year for fence maintenance.

Total = $3,880 ≈ $4,000

Item 2 - Short-term Groundwater Monitoring

1. Assumed that five wells would require two people one day to purge and sample at $50 an hour: (2 people)(1 day)(8 hours/day) = 16 hours

2. Assumed a total of five monitoring points and five quality control samples taken in conjunction with the groundwater samples. Quality control samples would consist of: 1 duplicate (DUP), 1 matrix spike (MS), 1 matrix spike duplicate (MSD), 1 equipment blank (EB), and 1 trip blank (TB). Assumed laboratory analyses to be $500 per sample for target parameters.

BURA FOURTH STREET SITE
ASSUMPTIONS FOR SOIL/GROUNDWATER ALTERNATIVE 2 CONTAINMENT/TREATMENT

GENERAL

The cost estimates include both capital and operating and maintenance expenses. The present worth for each alternative was estimated assuming a project life of 30 years and a 4% discount rate based on current interest and inflation rates. In the development of construction cost estimates, unit costs were obtained from vendor quotations, standard cost estimating documents (Means), or extensive Parsons ES experience with similar projects. Vendor quotes were obtained for key unit costs whenever possible. Unit costs are presented in Table 1.

CAPITAL COSTS

Item 1 - Deed Restrictions

Assumed to be a lump sum of $10,000.

Item 2 - Construction of Security Fence

Assumed a security fence 1,830 long in order to enclose the area of where DNAPL was observed and where groundwater monitoring is to take place. The fence would be a six-foot high, chain-link industrial fence.

Item 3 - Placement of Asphalt Cap Onsite

1. Assumed that an extra 12-inch lift of clean fill would be required for grading purposes:

   127,000 SF x 1 ft. = 127,000 cubic feet = 4,704 CY

2. Assumed a cover area equal to the area of excavation: 127,000 SF, or 14,000 SY.

ANNUAL O&M COSTS

Item 1 - Annual Inspection, Administration, Reporting

Assumed quarterly site inspections (4 hours), preparation of quarterly reports and

associated paperwork (4 hours), and administration performed quarterly (4 hours).

(12 hours) (4 times per year) = 48 hours at $60 per hour = $2,880

Assumed a lump sum of $1,000 per year for fence maintenance.

Total = $3,880 ≈ $4,000

Item 2 - Cap Maintenance

Assumed that 30 hours per year at $50 per hour would be required for maintenance of the asphalt cap.

Item 3 - Short-term Groundwater Monitoring

1. Assumed that five wells would require two people one day to purge and sample at $50 an hour: (2 people)(1 day)(8 hours/day) = 16 hours

2. Assumed a total of five monitoring points and five quality control samples taken in conjunction with the groundwater samples. Quality control samples would consist of: 1 duplicate (DUP), 1 matrix spike (MS), 1 matrix spike duplicate (MSD), 1 equipment blank (EB), and 1 trip blank (TB). Assumed laboratory analyses to be $500 per sample for target parameters.

BURA FOURTH STREET SITE
ASSUMPTIONS FOR SOIL/GROUNDWATER ALTERNATIVE 3
SOURCE REMOVAL
OPTION A - EXCAVATION TO ONE FOOT BELOW WATER TABLE
OPTION B - EXCAVATION TO ONE FOOT BELOW PRG EXCEEDANCES

GENERAL

The cost estimates include both capital and operating and maintenance expenses. The present worth for each alternative was estimated assuming a project life of 30 years and a 4% discount rate based on current interest and inflation rates. In the development of construction cost estimates, unit costs were obtained from vendor quotations, standard cost estimating documents (Means), or extensive Parsons ES experience with similar projects. Vendor quotes were obtained for key unit costs whenever possible. Unit costs are presented in Table 1.

CAPITAL COSTS

Item 1 - Construction of Dewatering Pad

Assumed construction of a 100' x 100' dewatering pad with 400 feet of berms, a 110' x 110' layer of 40-mil HDPE liner, a sump pump, and a storage tank.

Item 2 - Removal of Soil to:

Option A: 1 foot below the water table

1. Estimated that 4,300 CY of soil would have to be removed to achieve 1:3 side slopes for excavation.

2. The following excavation areas are based on drawing boundary lines halfway between a sample with a PRG exceedance and a "clean" sample. The excavation depths are one foot below the deepest PRG exceedance in an area.

	area	depth of water table	excavation depth	volume
Area 1	21,000 SF	8 ft.	9 ft.	189,000 cu. ft.
Area 2	13,550 SF	8 ft.	9 ft.	121,950 cu. ft.
Area 3	20,350 SF	7 ft.	8 ft.	162,800 cu. ft.
Area 4	8,750 SF	0.5 ft.	1.5 ft.	13,125 cu. ft.
Area 5	11,140 SF	8 ft.	9 ft.	100,238 cu. ft.
Area 6	15,300 SF	8 ft.	9 ft.	137,700 cu. ft.

Total Volume = 724,813 cu. ft. ≈ 27,000 CY

3. Assumed that all of the soil excavated from below the water table would require dewatering:

	area	excavation depth - depth to water table	volume
Area 1	21,000 SF	9-8 = 1 ft.	21,000 cu. ft.
Area 2	13,550 SF	9-8 = 1 ft.	13,550 cu. ft.
Area 3	20,350 SF	8-7 = 1 ft.	20,350 cu. ft.
Area 5	11,140 SF	9-8 = 1 ft.	11,140 cu. ft.
Area 6	15,300 SF	9-8 = 1 ft.	15,300 cu. ft.

Total Volume = 81,340 cu. ft. ≈ 3,000 CY

Option B: 1 foot below deepest PRG exceedances

1. Estimated that 11,000 CY of soil would have to be removed to achieve 1:3 side slopes for excavation.

2. The following excavation areas are based on drawing boundary lines halfway between a sample with a PRG exceedance and a "clean" sample. They are also based on the extent of observed DNAPL. The excavation depths are one foot below the deepest PRG exceedance in an area or the greatest depth at which DNAPL was observed.

	area	depth of PRG exceedance	excavation depth	volume
Area 1	21,000 SF	10 ft.	11 ft.	231,000 cu. ft.
Area 2	13,550 SF	*	9 ft.	121,950 cu. ft.
Area 3	20,350 SF	12 ft.	13 ft.	264,550 cu. ft.
Area 4	8,750 SF	0.5 ft.	1.5 ft.	13,125 cu. ft.
Area 5	11,140 SF	14 ft. (DNAPL)	14 ft.	155,925 cu. ft.
Area 6	15,300 SF	18 ft. (DNAPL)	18 ft.	275,400 cu. ft.

* no PRG exceedances in this area, so 1 foot below the water table was used.

Total Volume = 1,061,950 cu. ft. ≈ 40,000 CY

3. Assumed that all of the soil excavated from below the water table would require dewatering:

	area	excavation depth - depth to water table	volume
Area 1	21,000 SF	11-8 = 3 ft.	63,000 cu. ft.
Area 2	13,550 SF	9-8 = 1 ft.	13,550 cu. ft.
Area 3	20,350 SF	13-7 = 6 ft.	122,100 cu. ft.
Area 5	11,140 SF	14-8 = 6 ft.	66,840 cu. ft.
Area 6	15,300 SF	18-8 = 10 ft.	153,000 cu. ft.

Total Volume = 418,490 cu. ft. ≈ 15,500 CY

Item 3 - Pre-treatment of Water

1. Assumed a lump sum of $50,000 for a pre-treatment system consisting of filtration and activated carbon units.

2. Assumed a $1000 sump pump for pumping the water into the pre-treatment system.

3. Assumed that excavation would take place for three weeks, so pre-treatment of water would occur during the same time: (21 days) x (24 hours) = 504 hours.

Item 4 - Offsite Management of Materials

1. Assumed that the soil excavated from below the water table is completely saturated and that the porosity of the soil is equal to that of silty sand and gravel: 29% (average porosity).

   Option A:

   Volume of water = wet volume x porosity x 7.4805 gal/cu. ft.

   = (81,340 cu. ft.) x (0.29) x 7.4805 gals per cubic foot = 176,454 gallons

   Option B:

   Volume of water = wet volume x porosity x 7.4805 gal/cu. ft.

   = (418,490 cu. ft.) x (0.29) x 7.4805 gals per cubic foot = 907,849 gallons

   Option A:

   Assumed that groundwater would be infiltrating the excavation area at a rate of 2 gpm (based on modeling results) during the excavation period of seven days:

   Volume of water = 2 gpm x 60 min/hr. x 24 hrs./day x 7 days = 20,160 gallons

   Total volume of water = 119,097 + 20,160 = 139,257 gallons

   Option B:

   Assumed that groundwater would be infiltrating the excavation area at a rate of 4 gpm (based on modeling results) during the excavation period of three weeks:

Volume of water = 4 gpm x 60 min/hr. x 24 hrs./day x 21 days = 120,960 gallons

Total volume of water = 430,940 + 120,960 = 551,900 gallons

2. Assumed that 10% of the excavated materials would be hazardous and be transported to an offsite hazardous waste landfill and that the remaining 90% would be non-hazardous and be transported to an offsite non-hazardous waste landfill.

Item 5 - Replacement of Excavation Areas with Clean Fill

Assumed that a volume of clean fill equal to the amount excavated would be imported.

Item 6 - Placement of Asphalt Cover Onsite

1. Assumed that an extra 12-inch lift of clean fill would be required for grading purposes:

   (127,000 SF) x 1 ft. = 127,000 cubic feet = 4,704 CY $\approx$ 4,700 CY

2. Assumed that an asphalt cover (asphalt cap without a geotextile or a geomembrane) would be sufficient because most, if not all, of the soil containing PRG exceedances would be removed. Assumed a cover area larger than the area of excavation (same area presented in Alternative 2 and shown in Figure 8.1): 127,000 SF, or 14,000 SY.

ANNUAL O&M COSTS

Item 1 - Annual Inspection, Administration, Reporting

Assumed quarterly site inspections (4 hours), preparation of quarterly reports and associated paperwork (4 hours), and administration performed quarterly (4 hours).

(12 hours) (4 times per year) = 48 hours

Item 2 - Cover Maintenance

Assumed that 20 hours per year at $50 per hour would be required for maintenance of the asphalt cover.

Item 3 - Short-term Groundwater Monitoring

1. Assumed that five wells would require two people one day to purge and sample at $50 an hour: (2 people)(1 day)(8 hours/day) = 16 hours

2. Assumed a total of five monitoring points and five quality control samples taken in conjunction with the groundwater samples. Quality control samples would

consist of: 1 duplicate (DUP), 1 matrix spike (MS), 1 matrix spike duplicate (MSD), 1 equipment blank (EB), and 1 trip blank (TB). Assumed laboratory analyses to be $500 per sample for target parameters.