APPENDIX B

Boring logs

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING GT-1
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 2-foot split spoons Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/5/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Pam Cox		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0 - 2	-	12/24	12	Asphalt				
	19	*8*	*4*	*7*		Gray GRAVEL (FILL)		--	0 6	
						Brownish yellow SILT, little Sand				
						(dry, medium dense)				
2	2	2 - 4	-	18/24	17			ML	0 8	
	3	*4*	*13*	*17*		@ 3' Light brown SAND, little Gravel				
						(dry, medium dense)				
4	3	4-8	-	22/24	25			SP	1.1	
	4	*10*	*15*	*27*						
6	4	6-8	-	23/24	57			SP	1	
	20	*26*	*31*	*38*						
8	5	8-10	-	24/24	45	similar (moist, dense)		SP	0 8	
	16	*18*	*27*	*13*						
9	6	10-12	-	24/24	48			SP	1.3	
	9	*23*	*25*	*27*						
10	7	12-14	-	24/24	60	grades to brownish yellow SAND,		SP	1.1	
	26	*38*	*22*	*25*		some Gravel (moist, dense)				
11	8	14-16	-	24/24	43			SP	1	
	11	*19*	*24*	*23*						
12	9	16-18	-	24/24	39			SP	0 6	
	11	*20*	*19*	*13*						
13	10	18-20	-	24/24	30			SP	0 5	
	14	*13*	*17*	*23*						
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING GT-2
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 2-foot split spoons Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/5/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale / Pam Cox		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-2	-	12/24	12	Asphalt				
	5	5	7	5		Moderate yellowish brown 10YR5/4 SAND, some gravel (dry)			1.7	
2	2	2-4	-	24/24	36				2.4	
	14	17	19	19		@ 3' CLAY, trace gravel				
4	3	4-8	-	24/24	62				2 4	
	6	24	38	51		@ 5' Moderate yellowish brown 10YR 5/4 SAND, some gravel (subrounded)				
6	4	6-8	-	23	57	Similar (moist, dense)			NL	
	20	26	31	38						
8	5	8-10	-	24/24	54	Similar (moist, dense)			1.4	
	15	30	24	36						
9	6	10-12	-	24/24	87	Brownish yellow SAND, some fine gravel (subrounded) (moist)			1.3	
	31	39	48	51						
10	7	12-14	-	24/24	43	Similar (moist, dense)			NL	
	7	21	22	30						
11	8	14-16	-	20/24	52	Similar (moist, dense)			1.1	
	16	21	31	25						
12	9	16-18	-	--/24	49	Brownish yellow SAND, little gravel (moist, dense)			0 9	
	25	24	25	29						
13	10	18-20	-	12/24	21	Similar (moist, medium dense)			0.2	
	10	11	10	12						
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-110
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/28/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		36/48		0-3" Asphalt Dusky brown 5YR2/2 SAND, trace gravel (subangular, subrounded) (moist, loose)			3 4	
4	2	4-8		43/48		Similar @ 4 5' grades to grayish brown 5YR 3/2			1.6	
8	3	8-12		43/48		Similar @ 9' grades to SAND, some gravel			5 3	
12	4	12-16		48/48		Similar			14 0	
16	5	16-20		48/48		grades to SAND, trace gravel			14 0	
20	6	20-24		24/48		Similar			4 6	
						Boring was terminated at 24'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-111
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/28/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Grout Riser [ ] Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		Grayish brown 5YR3/2 SAND and SILT, some gravel (moist, loose)			24 6	
						@ 15" Dusky yellow brown 10YR2/2 SAND, some gravel (subangular, sub-				
4	2	4-8		41/48		Similar			22.5	
8	3	8-12		48/48		Similar			3 8	
12	4	12-16		48/48		Similar			NL	
16	5	16-20		48/48		Similar			3 1	
20	6	20-21		12/12		Similar			1.3	
						Boring was terminated at 21'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-112
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/28/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Grout Riser [ ] Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		43/48		0-5" Asphalt Dark yellow brown 10YR4/2 SAND, some gravel (subangular, subrounded) (moist, loose) @ 16" SILTY CLAY, some gravel			3 8	
4	2	4-8		39/48		Similar @ 4.5' Dusky yellow brown 10YR2/2 SAND, some gravel (subangular, sub-rounded) (moist, loose) @ 6.5' SILT and CLAY, some gravel			30	
8	3	8-12		48/48		Similar @8 5' Dark yellowish orange 10YR6/6 SAND and SILT, some gravel (subangular-subrounded) (moist, loose) @10.5' CLAY, trace gravel (moist, stiff)			9 9	
12	4	12-16		42/48		Dark yellowish brown 10YR4/2 SAND and SILT, some gravel (subangular, subrounded) (moist, loose)			19.0	
16	5	16-20		43/48		Similar @ 17' lense of SILT and CLAY			3.1	
20	6	20-22		27.5/48		Similar			4.2	
						Boring was terminated at 22'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-113
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/28/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		36/48		0-4" Asphalt Dusky brown 5YR2/2 SAND, little gravel (subangular, subrounded) (moist, loose) @ 19"-5" lense of CLAY, some gravel			6	
4	2	4-8		30/48		Dark yellowish orange 10YR6/6 SAND, some gravel (subangular, subrounded) (moist, loose)			20 5	
8	3	8-12		20/48		Dusky brown 5YR 2/2 SAND and SILT, some gravel (subangular-subrounded) (moist, loose) @9' grades to SAND, some gravel			13.3	
12	4	12-16		31/48		Similar @ 13' SILT and CLAY, little gravel (subangular-subrounded) @ 14' SAND and SILT, little gravel (subangular, subrounded) (moist, loose)			16.0	
16	5	16-20		NL		Slough - Not Logged			NL	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-113b
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/29/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4								
4	2	4-8								
8	3	8-12								
12	4	12-16								
16	5	16-20		19/36		** Discrete sample from 16-20 feet* Dark yellowish brown 10YR6/6 SAND, some gravel			1.3	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-113c
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/29/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4								
4	2	4-8								
8	3	8-12								
12	4	12-16		28/36		** Discrete sample from 12-16 feet* Pale yellowish brown 10YR6/2 SAND (coarse), trace gravel (FILL)			9.6	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-114
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/28/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		42/48		0-3" Asphalt Moderate yellowish brown 5YR5/4 SAND, little gravel (subangular, subrounded) (moist, loose) (FILL)			8 1	
4	2	4-8		36/48		Moderate yellowish brown 5YR5/4 SAND (moist, loose)			0 5	
8	3	8-12		26/48		Similar			1.2	
12	4	12-14		24/24		Similar			1.0	
14	5	14-17		24/36		Similar			1	
16	6	17-20		28.5/36		Similar			1.2	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-115
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/29/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		41/48		0-7" Asphalt @7" Dusky brown 5YR2/2 GRAVEL (FILL) @ 17" Pale yellowish orange 10YR8/6 coarse SAND (subrounded, subangular) @ 20" - 9" layer of dark yellowish orange 10YR6/6 CLAY, little gravel @ 20" Grayish orange 10YR7/4 SAND			7.8	
4	2	4-8		48/48		some gravel Similar			1.1	
8	3	8-12		48/48		Similar @ 9.5' grades to coarse SAND and GRAVEL (moist)			1.1	
12	4	12-16		43/48		Similar			8 1	
16	6	16-20		12/48		Similar			1.1	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-116
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/29/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		42/48		0-9" Asphalt Moderate yellowish brown 10YR4/2 SAND and CLAY, little gravel @ 2' FILL (soil, clay, aggregate mix) with white calcium build-up			2 6	
4	2	4-8		37/48		Similar @ ~5' Dark yellowish orange 10YR6/6 CLAY, little gravel (soft) @~6' becomes coarse SAND with little gravel @~6.5' FILL (soil, clay, aggregate mix)			3 6	
8	3	8-12		36/48		Similar @~9' Grayish orange 10YR7/4 SAND, some gravel			1.0	
12	4	12-16		34/48		Similar @ 12 5' - 6" layer of FILL @ 13' very pale orange 10YR8/2 SAND			1.8	
16	5	16-18		24/24		Similar			1.4	
18	6	18-20		18/24		Similar			1.3	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-117
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/29/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		41/48		0-6" Asphalt Dark yellowish brown 10YR4/2 SAND some gravel (FILL) @~2.5' SAND @ 3' Dark yellowish brown 10YR4/2 CLAY and SILT			41.1	
4	2	4-8		5/48		Similar			6.9	
8	3	8-12		37/48		Dark yellowish orange 10YR6/6 SAND			5 0	
12	4	12-16		48/48		Similar			3.9	
16	6	16-20		39/48		Similar			12.0	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-118
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/30/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-4" Asphalt Moderate brown 5YR 3/4 SILT, little gravel (moist, loose) @ 14" moderate yellowish brown 10YR5/4 SAND, trace gravel @ 21" Moderate brown 10YR4/2 CLAY and SILT, trace gravel (soft) @ 32" grades to CLAY, trace gravel			90	
4	2	4-8		39/48		(moist, soft) @41" Moderate yellowish brown 10YR5/4 SILTY SAND, trace gravel (moist, loose) @4 5' Dark yellowish orange 10YR6/6 CLAY, trace gravel (wet, soft) @6' very pale orange SAND, trace gravel (moist, loose)			4 9	
8	3	8-12		48/48		Dark yellowish orange 10YR6/6 SAND trace gravel (moist, loose) @ 9 5' moderate yellowish brown 10YR5/4 CLAY (moist, stiff) @ 10' SAND, some gravel @ 11' grades to SAND, little gravel			1.0	
12	4	12-14 5		30/48		Similar			10 6	
14 5	5	14 5-17.5		36/48		Similar			1.7	
17.5	6	17.5-20		30/48		Similar			13 2	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-119
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/30/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		36/48		0-3" Dark yellowish brown 10YR2/2 SAND and SILT, some gravel (sub-angular, subrounded) (moist, loose) @ ~2' CLAY (moist, firm) slough and pieces of concrete			400	
4	2	4-8		48/48		Very pale orange 10YR8/2 SAND some gravel (subangular-subrounded) (moist, loose)			142	
8	3	8-12		48/48		Moderate yellowish brown 10YR5/4 SAND and SILT, some gravel (sub-angular-subrounded) (moist, loose) @ 9' similar with trace gravel			100.0	
12	4	12-16		43/48		Similar			20 0	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-120
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 11/30/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		32/48		Dusky yellowish brown 10YR 2/2 SILTY SAND, some fine gravel (subangular) (moist, medium dense)			469	
						@ 29" - 1" layer of very pale orange 10YR 8/2 CLAY (moist, stiff)				
4	2	4-8		32.5/48		@5' grades to very pale orange SAND some fine gravel (subangular, subrounded), (moist, loose)			3413	
8	3	8-12		48/48		@ 8.5' grades to little gravel @ 9' SAND, some gravel			2860	
12	4	12-16		48/48		@ 14 5' - 10" layer very pale orange 10YR 8/2 SAND and SILT, little gravel			1081	
16	5	16-20		48/48		@ 17.5' - 5" layer of SAND, little gravel			1145.0	
20	6	20-24		18/36		Similar			15.1	
						Boring was terminated at 24'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-121
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/1/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		30/48		Dark yellowish brown SILT and CLAY some gravel (subangular) (moist, loose)			344	
4	2	4-8		37/48		Similar @4 5' very pale orange 10YR 4/2 SAND, little gravel (moist, loose)			310	
8	3	8-12		34/48		Similar @ 9 5' Dark yellowish orange 10YR6/6 SAND, some gravel (subrounded) (moist, loose)			83	
12	4	12-15		34/48		Similar @ 13' - 1' layer of very pale orange 10YR 8/2 CLAY, black staining (wet, medium stiff) @ 14' Dark yellowish orange 10YR6/6			50.3	
15	5	15-18		15/48		SAND, little gravel			15	
18	5	18-20		24/24		Similar			5.4	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-122
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/1/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		32/48		0-6" Dusky yellowish brown 10YR 2/2 SILTY SAND, trace fine gravel (subangular) (moist, loose)			3 6	
						@3 5' grades to SAND (dry, loose)				
4	2	4-8		48/48		@4' grades to SAND, some fine gravel (subangular, subrounded)			4	
8	3	8-12		unk		Similar w/varying amounts of gravel			20.2	
						@ ~11' iron staining				
12	4	12-16		26/48		Similar			16	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-123
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/1/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		35/48		Dark yellowish orange 10YR 6/6 SILT and SAND, trace fine gravel (subrounded) (moist, loose) @ 9" Dark yellowish brown 10YR 4/2 CLAY, trace coarse gravel (subangular) (dry, very stiff) @ 25" grades to SAND, little gravel (damp, loose)			2 4	
4	2	4-8		48/48		@ 4 5' Dark yellowish orange 10Y 6/6 coarse SAND, some fine gravel (subrounded-subangular) (moist, loose)			1.7	
8	3	8-12		48/48		@ 8 5' Dark yellowish orange 10YR6/6 SAND and GRAVEL (subangular) (moist, loose)			0 9	
12	4	12-16		29/48		@ 13' Dark yellowish orange 10YR6/6 SAND, some fine gravel			1	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-124
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/1/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		41/48		Moderate yellowish brown 10YR5/4 SAND, some silt and gravel (sub-rounded, subangular) (moist, loose) @ 12" Dusky yellowish brown 10YR 2/2 SILT, some gravel (dry, loose) @ 14" becomes CLAY (medium stiff) *alternating layers of SILT, SAND, CLAY*			165	
4	2	4-8		48/48		Dusky yellowish brown 10YR2/2 SILT some gravel (dry, loose) @ 4 5' Very pale orange 10YR8/2 SAND, some gravel (moist, loose) @~6 5' grades to little gravel			121	
8	3	8-12		27/48		Similar @ 8.5' grades to some gravel @ ~9' SILTY CLAY, trace gravel @ ~9 5' SAND, some gravel			105	
12	4	12-16		48/48		Very pale orange 10YR8/2 SAND, some gravel (subangular, subrounded) (moist, loose)			8	
16	5	16-18		24/24		Similar			45.0	
18	6	18-20		24/24		Similar, SAND, trace gravel			110.0	
20	7	20-24		29/36		Similar			9 8	
						Boring was terminated at 24'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-125
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/1/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		Dusky yellowish brown 10YR 2/2 SILTY SAND, little gravel (subangular) (moist, loose)			260	
						@ 19" Dusky yellowish brown 10YR 2/2 CLAY (moist, stiff)				
						@ 36" Dark yellowish orange 10YR6/6 SAND, trace gravel				
4	2	4-8		48/48		grades to Very pale orange 10YR8/2			12.1	
8	3	8-12		35/48		Similar			54 8	
						@ 9.5' Dark yellowish orange 10YR6/6 SAND, some gravel (subangular) (moist, loose)				
12	4	12-16		48/48		grades to Very pale orange 10YR8/2 SAND, trace fine gravel (moist, loose)			27.5	
16	5	16-20		36/36		Similar			12.5	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-126
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		31/48		0-4" Dark yellowish orange 10YR 6/6 SAND and GRAVEL (subrounded) (moist, loose) @ 4" Dark yellowish brown 10YR 4/2 SILT and SAND, little gravel (subangular subrounded (moist, loose) @ 23" Very pale orange 10YR 8/2 SAND, some gravel (moist, loose)			13.2	
4	2	4-8		41/48		Similar			7	
8	3	8-12		40/48		Similar @8 5' Pale yellowish brown 10YR 6/2 SAND, some silt and gravel (subangular subrounded), (moist, loose) @ 9.5' grades to SILT and SAND, little gravel @ 10' Very pale orange 10YR 8/2 SAND, some gravel (moist, loose)			2	
12	4	12-16		NL/48		Similar			9	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-127
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/7/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		26/48		Dusky yellowish brown 10YR4/2 SILT and CLAY, some gravel (subrounded) (moist, soft)			307	
						@ 21" Very pale orange 10YR 8/2 SAND, some gravel (subangular, sub-rounded) (moist, loose)				
4	2	4-8		48/48		Similar			2.6	
8	3	8-12		42/48		Similar @8.5' grades to dark yellowish orange 10YR6/6 SAND, some gravel			8.5	
12	4	12-16		36/48		Very pale orange 10YR 8/2 SAND, some gravel (moist, loose)			2.3	
16	5	16-20		43/48		Similar (minor color variations)			20 0	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-128
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/7/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist:		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		40/48		0-3" Asphalt @3" Dusky brown SAND, trace gravel (subangular, subrounded) (moist, loose)			1	
4	2	4-8		37/48		Similar @ 4 5' grades to grayish brown 5YR 3/2			0 6	
8	3	8-12		17/48		Similar @ 9' grades to SAND, some gravel			0 7	
12	4	12-16		8/24		Similar			0.7 0.7	
16	5	16-20		17/24		Similar				
20	6	20-24		24/48		Similar			4 6	
						Boring was terminated at 24'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-129
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/1/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		37/48		Moderate yellowish brown 10YR5/4 SILT and CLAY, trace gravel (subrounded) (moist, loose)			0.2	
4	2	4-8		46/48		Similar, with some gravel @ 4 5' grades to very pale orange 10YR 8/2 SAND, some gravel (sub-angular) (moist, loose) @6 5' grades to dark yellowish orange @ 7' grades to trace gravel			0.1	
8	3	8-12		18/48		Similar @ 8 5' grades to SAND, some gravel			0.3	
12	4	12-16		23/24		Similar			0.2 0.1	
16	5	16-20		24/24		Similar (black precipitate on sides)				
20	6	20-24		24/48		Similar			4 6	
						Boring was terminated at 24'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-130
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/6/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		Moderate yellowish brown 10YR 5/4 SAND, some gravel (subrounded) (moist, loose) @ 4" SILT and CLAY, some gravel @ 20" grades to yellowish brown 10YR2/2 CLAY @ 31" SAND, some gravel			1.3	
4	2	4-8		48/48		Similar @ 6 5' grades to very pale orange 10YR8/2 SAND, little gravel (sub-rounded, subangular) (moist, loose)			0.8	
8	3	8-12		48/48		Similar @ 8 5' - 2" layer of SILT and CLAY, trace gravel becomes SAND, some gravel			1.8	
12	4	12-16		37/48		Similar @ 13' becomes SAND and GRAVEL layers of SAND with various amounts of gravel			4	
16	5	16-20		26/48		Similar			4.8	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-131
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/7/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		42/48		Moderate yellowish brown 10YR5/4 SILT and CLAY, some gravel (moist, loose) @ 13" CLAY, some silt and gravel @ 24" CLAY, trace gravel @ 38" SAND, some gravel			2.7	
4	2	4-8		45/48		Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose) @ 7' Moderate yellowish brown 10YR 5/4 CLAY, some silt, trace gravel			0 7	
8	3	8-12		36/48		Very pale orange 10YR 8/2 SAND some gravel (subrounded, subangular) (moist, loose)			1.1	
12	4	12-16		48/48		Similar @ 14' Dark yellowish orange 10YR 6/6 SAND, some gravel (subangular, subrounded) (moist, loose)			0.9	
16	5	16-20		8/48		Similar			0 8	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-132
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/7/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		38/48		Dark yellowish brown 10YR4/2 SILT and SAND, some gravel (moist, loose) @ 12" CLAY, some silt and gravel @ 30" Dark yellowish brown 10YR4/2 SILT and SAND, some gravel			11.5	
4	2	4-8		30/48		Similar @~4 5' Very pale orange 10YR8/2 SAND, some gravel (subrounded, sub-angular), (moist, loose)			0.7	
						Boring was terminated at 8'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-133
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/7/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		45/48		Moderate yellowish brown 10YR5/4 SILT and SAND, some gravel (sub-rounded, subangular) (moist, loose)			35	
4	2	4-8		48/48		Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose) @ 6.5' Dark yellowish orange 10YR6/6 SILT and SAND, some gravel (sub-rounded, subangular) (moist, loose)			7	
8	3	8-12		26/48		Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose) @ 9.5' grades to SAND and GRAVEL			15.6	
12	4	12-16		NL/48		Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose)			2.6	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-134
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/7/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		45/48		Moderate yellowish brown 10YR5/4 SILT and SAND, some gravel (sub-rounded, subangular) (moist, loose)			35	
4	2	4-8		48/48		Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose) @ 6 5' Dark yellowish orange 10YR6/6 SILT and SAND, some gravel (sub-rounded, subangular) (moist, loose)			7	
8	3	8-12		26/48		Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose) @ 9.5' grades to SAND and GRAVEL			15 6	
12	4	12-16		NL/48		Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose)			2.6	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-135
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/7/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		Dark yellowish orange 10YR6/6 SILT and SAND, little gravel (moist, loose) @ 5" grades to some gravel @ 14" Dusky brown 5YR2/2 CLAY, trace gravel (moist, very stiff) @ 25" CLAY, trace gravel (moist, soft) @ 35" Very pale orange 10YR8/2			5.9	
4	2	4-8		48/48		SAND, some gravel (moist, loose) Similar			0.5	
8	3	8-12		25/48		Similar			7.8	
						Boring was terminated at 12'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-136
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		41/48		0-4" Dark yellowish brown 10YR4/2 SILT, some gravel (subangular - subrounded), (moist, loose) @ 4" grades to SILT, some sand and gravel @ 24" lense of CLAY (stiff)			2	
4	2	4-8		37/48		Very pale orange 10YR8/2 SAND, some gravel (subangular-subrounded) (moist, loose)			2	
8	3	8-12		21/48		Similar			1.2	
						Boring was terminated at 12'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-137
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/9/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		37/48		0-6" Moderate yellowish brown 10YR 5/4 SILT and CLAY, trace gravel (subangular-subrounded), (moist) 6" lense of SILT, some sand and gravel @12" CLAY, trace gravel			6 2	
4	2	4-8		37/48		Similar			1.1	
						Boring was terminated at 8'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-138
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/1/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		3" Asphalt Grayish brown 5YR3/2 SILT and SAND trace gravel (moist, loose) @ 7" grades to some gravel @ 14" Dusky brown 5YR2/2 CLAY, trace gravel (moist, very stiff) @ 25" CLAY, trace gravel (moist, soft) @ 47" Dark yellowish orange 10YR6/6			4.6	
4	2	4-8		48/48		SAND, some gravel (moist, loose) Similar @ 6.5' grades to trace gravel			4 9	
8	3	8-12		37/48		Similar @ 9' - 10" layer of very pale orange 10YR8/2 SAND and GRAVEL (sub-rounded) (moist, loose) Very pale orange 10YR8/2 SAND, trace GRAVEL (moist, loose)			10	
12	4	12-16		48/48		Similar @ 13' Moderate yellowish brown 10YR 5/4 SAND and SILT , some gravel (moist, loose) @13 5' grades to SAND, some gravel			0.5	
16	5	16-20		30/36		Similar			0 6	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-139
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/3/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		44/48		0-2" Asphalt Dark yellowish brown 10YR4/2 SILT and SAND, little gravel (subrounded) (moist, loose) @ 29" Dusky brown 5YR2/2 CLAY, trace gravel (subangular) (moist, soft)			NL	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-140
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/3/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-3" Asphalt @ 3" Dark yellowish brown 10YR 4/2 SILTY SAND, trace gravel (subrounded) (moist, loose). alternate lenses of SILTY CLAY and SILTY SAND			1	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-141
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005 .	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/3/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		Dark yellowish orange 10YR6/6 SAND little gravel (subrounded, subangular) (moist, soft)			0.7	
						@ 15" Dark yellowish orange 10YR6/6 SILT and SAND				
						@ 28" Dark yellowish brown 10YR2/2 CLAY, trace fine gravel				
						@ 39" Very pale orange 10YR8/2 SAND				
4	2	4-8		22/48		some gravel (subrounded) *Similar with varying amounts of gravel*			0 4	
8	3	8-12		20/48		Similar			NL	
12	4	12-16		41/48		Similar			3.1	
						@ 14' Very pale orange 10YR8/2 SAND and GRAVEL				
						@ 14 5' grades to SAND, trace gravel				
16	5	16-20		20/36		Dark yellowish orange 10YR6/6 SAND, little gravel (subangular, subrounded), (moist, loose)			0 6	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-142
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 2 and 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/3/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		38/48		Dark yellowsh orange 10YR6/6 SILTY SAND, little gravel (subrounded, sub-angular) (moist, soft) @ 28" Dark yellowish brown 10YR4/2 SAND and SILT, trace fine gravel @ 34" -3" layer dark yellowish brown 10YR6/6 CLAY, trace gravel (moist, soft) @ 37" SAND and SILT, trace fine gravel			0 8	
4	2	4-8		42/48		Similar			1.7	
8	3	8-12		28/48		Similar			2.1	
12	4	12-16		23/48		Similar @ 14' Very pale orange 10YR8/2 SAND and GRAVEL @ 14 5' grades to SAND, trace gravel			2.7	
16	5	16-20		31/48		Dark yellowish orange 10YR6/6 SAND, little gravel (subangular, subrounded), (moist, loose)			6.1	
20	6	20-24		8/48					5 6	
24	7	24-26		23/48					4	
						Boring was terminated at 26'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-143
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/3/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Grout Riser [ ] Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		42/48		Dark yellowish orange 10YR 6/6 SAND and SILT, trace fine gravel (subrounded) (moist, loose) @ 33" - 6" lense of SILT, trace fine gravel (moist, loose) @ 39" Dusky yellowish brown CLAY trace fine gravel (subangular) (moist, medium stiff)			1.3	
4	2	4-8		42/48		Similar, becomes soft @5-5.5' Dusky yellowish orange 10YR 6/6 SILT and SAND, some fine gravel (subrounded) (moist, loose)			0 4	
8	3	8-12		48/48		Similar @ 8 5' Dark yelowish orange 10YR6/6 SAND, some gravel (subrounded, subangular), (moist, loose)			4.6	
12	4	12-16		48/48		Very pale orange 10YR 8/2 SAND, trace fine gravel (subrounded, sub-angular) (moist, loose)			2	
16	5	16-20		48/48		Very pale orange 10YR 8/2 SAND, some gravel (subrounded, subangular) (moist, loose)			10 0	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-144
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/6/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		43/48		0-5" Asphalt @ 5" Pale yellowish brown 10YR 6/2 SILT and SAND, some gravel (subrounded-subangular) (moist, loose)			1	
4	2	4-6		20/24		Similar @ 4.5' concrete @ 5.5' Pale yellowish brown 10YR 6/2 SILT and SAND, some gravel (subrounded-subangular) (moist, loose)			0 8	
						Boring was terminated at 6'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-144B
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Grout Riser [ ] Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		36/48		0-4" Asphalt @ 4" Moderate yellowish brown 10YR 5/4 SILT and SAND, some gravel (subangular), (moist, loose)			0 9	
4	2	4-8		33/48		Similar			0.5	
8	3	8-12		19/48		grades to SAND, some gravel (moist, loose)			0.7	
						Boring was terminated at 12'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-145
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/9/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-4" Asphalt @ 4" Mod. yellowish brown 10YR 5/4 SILT and CLAY, some gravel (sub-rounded, subangular), (moist, soft) @ 29" grades to SILT and SAND, some gravel (moist, loose)			5	
4	2	4-8		43/48		Similar @ 4 5' Cement @ 7' Dusky yellowish brown 10YR2/2 GRAVEL (moist, loose) - Oil Residue			4.5	
8	3	8-12		18/48		Moderate yellowish brown 10YR5/4 CLAY, trace grace (moist, soft)			3 2	
12	4	12-16		34/48		Moderate yellowish brown 10YR5/4 SAND, some gravel (Green Layer) (moist, loose) @ 12.7' CLAYEY waste @ 14.5' Moderate yellowish brown 10YR5/4 SAND and GRAVEL (wellrounded) (moist, loose)			10	
16	5	16-20		15/48		Dark yellowish orange 10YR6/6 SAND, some gravel (subangular, subrounded), (moist, loose)			0.8	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-146a
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		37/48		0-4" Asphalt @ 4" Dusky yellowish brown 10YR 2/2 SILT and SAND, some gravel (subangular), (moist, loose) @ 8" grades to SILT and CLAY @ 24" SAND, trace gravel			2.2	
4	2	4-8		30/48		Similar @ 5.5' Moderate yellowish brown 10 YR 5/4 CLAY, some gravel (moist, soft) @ 6' Moderate yellowish brown 10YR 5/4 SAND and GRAVEL (moist, loose)			0.5	
8	3	8-12		36/48		Similar @ 8 5' Very pale orange 10YR 8/2 SAND, some gravel (moist, loose)			1.1	
12	4	12-16		48/48		Similar @ 12.5' Moderate yellowish brown 10 YR 5/4 SAND, some gravel (moist, loose)			1	
						Bonng was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-146b
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-3" Asphalt @ 3" Pale yellowish brown 10YR4/2 SILT and SAND, some gravel (moist, loose) @ 8" Dark yellowish orange 10YR6/6 CLAY trace gravel (subrounded) (moist, soft) @ 3' Dark yellowish orange 10YR6/6			NL	
4	2	4-8		39/48		SAND, some gravel (moist, loose) @ 5' Dark yellowish orange 10YR6/6 CLAY trace gravel (subrounded) (moist, soft) @ 6.5' Dark yellowish orange 10YR6/6 SAND, some gravel (subrounded, subangular) (moist, loose)			NL	
						Boring was terminated at 8'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-146c
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		42/48		0-3" Asphalt @ 3" Grayish brown 5YR 3/2 SILT and SAND, some gravel (moist, loose) @ 9" Dark yellowish orange 10YR 6/6 CLAY, some gravel (subrounded) (moist, stiff) (alternating lenses of SAND and CLAY)			1.5	
4	2	4-8		34/48		Dark yellowish orange 10YR 6/6 SAND some gravel (subrounded, subangular) (moist, loose)			1.8	
						Boring was terminated at 8'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-147
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/6/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-4" Asphalt Pale yellowish brown 10YR2/2 SILT and SAND, some fine gravel (dry, loose) @ 9" Dark yellowish orange 10YR6/6 SAND, little gravel (moist, loose) @ 25" - 8" lense of CLAY, little gravel (moist, stiff) @ 33" - 9" lense of CLAY, trace gravel (moist, soft)			2.1	
4	2	4-8		40/48		@ 42" Dark yellowish orange 10YR 6/6 SAND, some gravel (damp, loose) Similar			0 6	
8	3	8-12		36/48		Similar @ 9.5' - 5" lense of dark yellowish orange 10YR6/6 SAND and GRAVEL			0 5	
12	4	12-16		36/48		Very pale orange 10YR8/2 SAND, some gravel (moist, loose)			3.8	
16	5	16-20		48/48		Similar			18 6	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-148
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 3" Asphalt Moderate yellowish brown 10YR5/4 SILTY SAND, little fine gravel (subangular) (moist, loose) 2" CLAY lense grades to dark yellowish orange 10YR			0 6	
4	2	4-8	--	30.5/48	--	6/6 SAND, trace fine gravel (moist, loose) Dark yellowish brown 10YR4/2 CLAY (moist, soft)			1	
8	3	8-11.5	--	25/42	--	@ 8.5' Yellowish brown 10YR4/2 SILTY SAND with trace fine gravel (subangular), (moist, loose)			0 6	
						Refusal at 11.5' bgs.				
						Boring was terminated at 11.5'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-149
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-3" Asphalt @ 3" Pale yellowish brown 10YR 6/2 SILT and SAND, trace fine gravel (subangular), (dry, loose) @ 14" - 3" lense of SILT (FILL) Similar to previous @ 19" - 7" lense of CLAY, trace gravel (moist, soft)			0 4	
4	2	4-8		48/48		Dark yellowish orange 10YR 6/6 SAND trace fine gravel (damp, loose)			0 5	
8	3	8-12		48/48		Similar @ 8.5' Grayish orange 10YR7/4 SAND, some gravel (moist, loose) @ 10 5' grades to SAND, trace gravel			0.6	
12	4	12-16		48/48		Similar @ 12 5' Dark yellowish orange 10YR 6/6 SAND, some silt and fine gravel (moist, loose) @14' Dark yellowish orange 10YR6/6 SAND, some fine gravel (moist, loose)			0 3	
16	5	16-20		25/36		Similar			0.2	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 150
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 3" Asphalt Dark yellowish orange 10YR 6/6 CLAY some silt, trace fine gravel (subrounded subangular) (moist, soft) @ 15" Moderate yellowish brown 10YR5/4 SAND, some gravel, little silt (moist, loose) @ 24" -10" lense of CLAY, trace gravel			0 8	
4	2	4-8	--	37/48	--	@ 34" Moderate yellowish brown 10YR5/4 SAND and SILT, some gravel (moist, loose) @ 37" grades to SAND, some gravel @ 5' Dark yellowish orange 10YR6/6 SAND, trace gravel (moist, loose4)			0 4	
8	3	8-12	--	7/48	--	Similar			1.8	
12	4	12-16	--	36/36	--	Similar			0.4	
16										
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 151
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 3" Asphalt Grayish brown 5YR3/2 SILTY SAND, trace gravel (subrounded) (moist, loose) @ 8" CLAY, trace gravel (moist, soft) @ 38" Dark yellowish brown 10YR5/4 SAND, some gravel (moist, loose)			1.5	
4	2	4-8	--	36/48	--	Similar @ 6.5' Dark yellowish orange 10YR6/6 CLAY (moist, soft)			0 9	
8	3	8-12	--	34/48	--	Dark yellowish orange 10YR6/6 SILTY SAND, some fine gravel (subrounded, subangular) (moist, loose) @ 9' grades to SAND and GRAVEL @ 10' grades to SAND, some gravel			2.7	
12	4	12-16	--	41/48	--	Similar @ 12.5' grades to SAND, trace gravel			1.3	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 152
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen ☒ Riser ☐ Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	–	48/48	–	0 - 3" Asphalt Grayish brown 5YR3/2 SILT and SAND, some gravel (subrounded) (dry, loose) @ 9" SILTY CLAY, some gravel (soft) @ 16" CLAY (moist, medium stiff) @ 23" CLAY, trace gravel (moist, soft) @ 29" very pale orange 10YR8/2 SAND some gravel (moist, loose)			2.5	
4	2	4-8	–	41/48	–	Similar @ 6.5' dark yellowish orange 10YR6/6 CLAY, trace gravel (moist, soft)			0 9	
8						Boring was terminated at 8'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 153
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	42/48	--	0 - 3" Asphalt Grayish brown 5YR2/2 SILT and CLAY, little gravel (subrounded) (moist, loose) @ 9" SILTY CLAY, some gravel (soft) @ 16" CLAY, little gravel (moist, soft) @ 34" Dark yellowish orange 10YR6/6 SAND, some gravel (moist, loose)			0 8	
4	2	4-8	--	43/48	--	Similar			0.7	
						Boring was terminated at 8'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 154
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/4/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 5" Asphalt Grayish brown 5YR3/2 SAND and SILT some fine gravel (subrounded) (moist, loose) lenses of SILT and CLAY				
4	2	4-8	--	35/48	--	@ 5' Dark yellowish orange 10YR6/6 SAND, some fine gravel (subrounded, subangular) (moist, loose)				
						Boring was terminated at 8'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 155
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/6/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 3" Asphalt Dark yellowish brown 10YR4/2 SILTY SAND, some gravel (moist, loose) @ 44" Moderate yellowish brown 10YR 5/4 SAND, some gravel (moist, loose)			24.1	
4	2	4-8	--	39/48	--	Moderate yellowish brown 10YR5/4 SAND, some silt and gravel (moist, loose) @~5 5' CLAY, some gravel (moist, soft)			46 2	
8	3	8-10.5	--	22/48		Dark yellowish brown 10YR4/2 SILTY SAND, little gravel (moist, loose) @ 8.5' SAND, some gravel (moist, soft) @ 9.5' SILTY SAND, some gravel			26 5	
10 5	4	10 5-12	--	7/48	--	Concrete @ 11' SAND, some gravel (moist, soft)			2 1	
12	5	12-16	--	43/48	--	Very pale orange 10YR8/2 SAND, some gravel (moist, loose) @ 13' Dark yellowish orange 10YR6/6 SAND, some gravel (moist, loose) @ 14 5' grades to trace gravel			3	
16	6	16-20	--	24/48	--	Similar			4.9	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 156
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/6/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 2" Asphalt Moderate yellowish brown 10YR5/4 CLAY and SILT, some gravel (moist soft) @ 37" - 7" lense of CLAY (moist, soft)			33 6	
4	2	4-8	--	36/48	--	Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose) @ ~6.5' - 4" lense of CLAY			1.4	
8	3	8-12	--	48/48	--	Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose)			2 6	
12	4	12-16	--	48/48	--	Similar @ 15' Dark yellowish orange 10YR6/6 SAND, some aggregate (subrounded, subangular) (moist, loose)			3.1	
16	5	16-20	--	23/36	--	Similar			3 4	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 157
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/6/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 4" Asphalt Pale yellowish brown 10YR6/2 SILTY SAND, some gravel (moist, loose) @ 10" Dark yellowish brown 10YR4/2 SAND, some silt and gravel (moist, loose) @ 26" CLAY, trace gravel (moist, stiff) @ 33" CLAY, little gravel (moist, soft)			27.2	
4	2	4-8	--	39/48	--	Very pale orange 10YR6/2 SAND, some gravel (subrounded, subangular) (moist, loose)			1.1	
8	3	8-12	--	38/48	--	Similar @ 9 5' CLAY and SILT, trace gravel (moist, soft)			3 9	
12	4	12-16	--	48/48	--	Pale yellowish brown 10YR6/2 SAND, trace gravel (subrounded) (moist, loose) @ ~13.5' Very pale orange 10YR8/2 SAND and GRAVEL (moist, loose) @ 15' Dark yellowish orange SAND, some gravel (subangular, subrounded) (moist, loose)			2.9	
16	5	16-20	--	20/36	--	Similar			3.8	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-158
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-6" Concrete @ 6" Pale yellowish brown 10YR 2/2 SILT, some sand and gravel (sub-angular, subrounded), (moist, loose) ~ 1' lense of SILTY CLAY, some gravel (moist, loose)			1	
4	2	4-8		37/48		Dark yellowish orange 10YR 6/6 SAND, some gravel (subrounded -subangular) (moist, loose)			0 7	
8	3	8-12		48/48		Similar			0.5	
12	4	12-16		40/48		Similar			0.7	
16	5	16-20		40/48		Similar			0.8	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-159
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/6/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		37/48		0-4" Asphalt Moderate yellowish brown 10YR5/4 SAND and SILT, some gravel (sub-angular, subrounded), (moist, loose) @ ~1' concrete @ 2.5' Very pale orange 10YR8/2 SAND and SILT, some gravel (FILL)			22.2	
4	2	4-8		10/48		Similar			10 8	
8	3	8-12		41/48		Similar with iron remnants @ 9' Moderate yellowish brown 10YR 5/4 SILT and CLAY, some gravel (moist, soft) @ 10' Very pale orange 10YR8/2 SAND, some gravel (subrounded, subangular) (moist, loose)			2 4	
12	4	12-16		22/48		Similar			1.4	
16	5	16-20		28/36		Similar			1.2	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-160
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		35/48		0-4" Asphalt Dark yellowish brown 10YR 4/2 CLAY and SILT, some gravel (moist, soft) @1' lense of SAND and GRAVEL (subangular, subrounded) alternate clay and sand lenses			0 5	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 161
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 2" Asphalt Dark yellowish brown 10YR4/2 CLAY little gravel (moist, stiff). @21" grades to dark yellowish orange 10YR 6/6 CLAY, trace fine gravel (moist, soft) @30" grades to dark yellowish orange SAND, some fine gravel (subangular, subrounded), (moist, loose)			0.4	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 162
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 3" Asphalt Pale yellowish brown 10YR6/2 SILT, some sand, little gravel (subangular). (moist, loose) @ 9" Dark yellowish brown CLAY trace fine gravel (moist, soft) @37" Dark yellowish orange 10YR6/6 SAND, some gravel (moist, loose)			0.9	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 163
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 5" Asphalt Pale yellowish brown 10YR6/2 SILT, some fine gravel Moderate yellowish brown CLAY some Silt (moist, soft) (lense of SILT, some gravel) @36" Dark yellowish orange 10YR6/6 SAND, some gravel (moist, loose)			0.6	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 164
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	–	48/48	–	0 - 3" Asphalt Pale yellowish brown 10YR6/2 SILT, some fine gravel @7" Dusky yellowish brown 10YR2/2 CLAY, some gravel (moist, soft) @32" Dark yellowish orange 10YR6/6 SAND, some fine gravel (moist, loose)			0.5	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB- 165
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4	--	48/48	--	0 - 3" Asphalt Pale yellowish brown 10YR6/2 SILT, some fine gravel @7" Dusky yellowish brown 10YR2/2 CLAY, some gravel (moist, soft) @34" Dark yellowish orange 10YR6/6 SAND, some fine gravel (moist, loose)			0.7	
						Boring was terminated at 4'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-166
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		48/48		0-4" Asphalt Pale yellowish brown 10YR 6/2 SILT, some sand, and gravel (subround subangular) (moist, loose) @ 11" grades to SAND and SILT, some gravel			5	
4	2	4-8		30/48		@ 5' Dark yellowish brown 10 YR 4/2 GRAVEL (subrounded, subangular) (moist, loose)			12.5	
8	3	8-12		35/48		Similar w/trace sand			1000	
12	4	12-16		19/48		@ 13' Very pale orange 10YR 8/2 SAND, some gravel (subrounded, subangular) (moist, loose)			800	
16	5	16-20		9/48		Similar			10.5	
						Boring was terminated at 20'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-167
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4								
4	2	4-8								
8	3	8-12								
12	4	12-16								
16	5	19-23		29/36		*Discrete sample from 19-23 feet Very pale orange 10YR 8/2 SAND, some gravel (subangular, subrounded)			1.2	
						Boring was terminated at 23'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-168
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen [=] Riser [ ] Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4								
4	2	4-8								
8	3	8-12								
12	4	12-16		23/36		*Discrete sample from 12-16 feet Dark yellowish orange 10YR6/6 SAND, some gravel (subangular, subrounded)			NL	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-169
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/8/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4								
4	2	4-8								
8	3	8-12								
12	4	12-16		13/36		*Discrete sample from 12-16 feet Dusky yellowish brown 10YR2/2 SAND and GRAVEL (subrounded)** ** *Heavily coated with organic sludge*			1.3	
						Boring was terminated at 16'				

O'BRIEN & GERE ENGINEERS, INC.	TEST BORING LOG	REPORT OF BORING SB-170
Client: GTEOSI Proj. Loc: Hicksville, New York File No.: 5816.009.005	Sampler: 4-foot acetate Hammer: 140 lbs - direct push	Page 1 of 1 Start Date: 12/9/00 End Date:
Boring Company: Environmental Probing, Inc. OBG Geologist: Eddy Teasdale		Screen = Riser Grout Sand Pack Bentonite

Depth Below Grade	No.	Depth (feet)	Blow /6"	Recovery /Penetr	"N" Value	Sample Description	Stratum Change General Description	USCS	Field Testing PID (ppm)	Field Testing Black Light
0	1	0-4		42/48		0 - 4" Asphalt Moderate yellowish brown 10YR5/4 SILT and SAND, some fine gravel @23" grades to SAND, some gravel @ 29" SILTY CLAY, some gravel (moist, loose)			50 4	
4	2	4-8		24/48		Similar @ ~5.5' Dusky yellowish brown 10YR 2/2 CLAY, some gravel (subrounded subangular)			25	
8	3	8-12		20/48		Similar			5 9	
12	4	12-16		27/48		@12.25' Dark yellowish orange 10YR 6/6 SAND, some gravel (moist, loose)			1.2	
16	5	16-20		17/48		Similar			1.1	
						Boring was terminated at 20'				

Appendix C

Air sampling analytical results (Revision 1)

GTEOSI - HICKSVILLE
File: 5816.029. reports

Galson Laboratories

6601 Kirkville Road
E. Syracuse, NY 13057-0369
Phone: (315) 432-5227
Fax: (315) 437-0571
www.galsonlabs.com

November 29, 2000

DOH ELAP# 11626

Ms. Pam Cox
O'Brien & Gere Engineers, Inc.
P.O. Box 4873
Syracuse, NY 13221

Client Account# 10864 Login# L66171

Dear Ms. Cox:

Enclosed are the analytical results of the samples received by our laboratory November 29, 2000.

Results in this report are based on the sampling data provided by the client. Unless otherwise requested, all samples will be discarded two weeks from the date of this report.

Please contact your client service representative, Nancy Ackerman at (888) 577-5227, extension 305, if you would like any additional information regarding this report.

Thank you for using Galson Laboratories.

Sincerely,

Galson Laboratories

F. Joseph Unangst
Laboratory Director

Enclosure(s)

Laboratories
6601 Kirkville Road
P.O. Box 369
E. Syracuse, NY 13057
Tel. (315) 437-7252 888-577-Labs (5227)
Fax: (315) 437-0571

Request For Industrial Hygiene Analysis

Company Name: O'Brien + Gere
Site Name: Hicksville, New York
Sampled By: PMC
Project #: 5816 005

nd Report to: Pam Cox
OBG
5000 Brittonfield Parkway
E. Syr.

Invoice to:

☐ Purchase order number ____ OBG PRICES
(or)
☐ Credit Card (type) ____ Card # ____ Exp Date ____
☐ Verbal Authorization ____

☐ Standard Turn-Around Time OR ☒ Rush: Date and Time Requested: 11/30/00 8 (am) pm
☒ Phone Results to: Cox Phone # (315-391-0020 ext.
☐ Fax Results to: ____ Fax # ( ) - -
☐ Email Results to: ____

PASSIVE

Sample Identification	Date Sampled	Sample Medium Catalog # / Lot #	Air Sample Volume (liters)*	Analysis Requested	Method Reference
#1	11/27/00	SK 9211 3m3520		PCE/TCE	
#2	↓	SK 9229		↓	
#3		SK 9214			
Blank	↓	—	~~1/2~~ 3	↓	

*For passive monitors please list time exposed in minutes. 18:30 - 7:35 am

Comments (Please list any known interferences present in sampling area): ____

Chain of Custody	Print Name	Signature	Date/Time
Relinquished by:	Pam Cox	P. M. Cox	11/28/0
Received by LAB.		Bruce Baptie	11/29 @ 10:30

Samples received after 3pm will be considered as next day's business.

LAB ORIGINAL

Galson Laboratories

LABORATORY ANALYSIS REPORT

Client : O'Brien & Gere Engineers, Inc.
Site : Hicksville, NY
Project No. : 5816.009

Date Sampled : 27-NOV-00
Date Received : 29-NOV-00
Date Analyzed : 29-NOV-00

Account No.: 10864
Login No. : L66171

Trichloroethylene

Sample ID	Lab ID	Time minutes	Front ug	Back ug	Total ug	ppm
#1	L66171-1	785	<8	<8	< 8	< 0.06
#2	L66171-2	785	<8	<8	< 8	< 0.06
#3	L66171-3	785	<8	<8	< 8	< 0.06
BLANK	L66171-4	NA	<8	<8	< 8	NA

Level of quantitation: 8 ug
Analytical Method : OVM 3M
OSHA PEL (TWA) : 100 ppm
Collection Media : OVM2-3520

Submitted by: AMW
Approved by : jal
Date : 29-NOV-00
QC by:
NYS DOH # : 11626

< -Less Than
> -Greater Than
NA -Not Applicable
mg -Milligrams
ug -Micrograms
ND -Not Detected
m3 -Cubic Meters
l -Liters
ppm -Parts per Million
kg -Kilograms
NS -Not Specified

Galson Laboratories

LABORATORY ANALYSIS REPORT

Client : O'Brien & Gere Engineers, Inc.
Site : Hicksville, NY
Project No. : 5816.009

Date Sampled : 27-NOV-00
Date Received : 29-NOV-00
Date Analyzed : 29-NOV-00

Account No.: 10864
Login No. : L66171

Tetrachloroethylene

Sample ID	Lab ID	Time minutes	Front ug	Back ug	Total ug	ppm
#1	L66171-1	785	<8	<8	< 8	< 0.05
#2	L66171-2	785	<8	<8	< 8	< 0.05
#3	L66171-3	785	<8	<8	< 8	< 0.05
BLANK	L66171-4	NA	<8	<8	< 8	NA

Level of quantitation: 8 ug
Analytical Method : OVM 3M
OSHA PEL (TWA) : 100 ppm
Collection Media : OVM2-3520

Submitted by: AMW
Approved by : jal
Date : 29-NOV-00
QC by:
NYS DOH # : 11626

< -Less Than
> -Greater Than
NA -Not Applicable
mg -Milligrams
ug -Micrograms
ND -Not Detected
m3 -Cubic Meters
l -Liters
ppm -Parts per Million
kg -Kilograms
NS -Not Specified

File 5516.009

Galson Laboratories

6601 Kirkville Road
E Syracuse, NY 13057-0369
Phone. (315) 432-5227
Fax: (315) 437-0571
www.galsonlabs.com

May 09, 2001

DOH ELAP# 11626

Ms. Pam Cox
O'Brien & Gere Engineers, Inc.
P.O. Box 4873
Syracuse, NY 13221

Client Account# 10864 Login# L70743

Dear Ms. Cox:

Enclosed are the analytical results of the samples received by our laboratory May 04, 2001.

Results in this report are based on the sampling data provided by the client. Unless otherwise requested, all samples will be discarded two weeks from the date of this report.

Please contact your client service representative, Nancy Ackerman at (888) 577-5227, extension 305, if you would like any additional information regarding this report.

Thank you for using Galson Laboratories.

Sincerely,

Galson Laboratories

FOR:

F. Joseph Unangst
Laboratory Director

Enclosure(s)

Galson
Laboratories
6601 Kirkville Road
P.O Box 369
E. Syracuse, NY 13057
Tel: (315) 437-7252 888-577-Labs (5227)
Fax: (315) 437-0571

Request For Industrial Hygiene Analysis

Company Name: O'Brie + Gere
Site Name: Hicksville
Sampled By: P. Cox
Project #: 5816.009

Report to: Pam Cox
O'Brien + Gere
5000 Brittonfield Pkwy
E. Syracuse

Invoice to:

☐ Purchase order number
☐ Credit Card (type) Card # Exp Date
☐ Verbal Authorization

☐ Standard Turn-Around Time OR ☒ Rush: Date and Time Requested: 5/9/01 am pm NOON
☒ Phone Results to: 437-6100 Phone # ( ) - ext.
☐ Fax Results to: Fax # ( ) -
☐ Email Results to:

Sample Identification	Date Sampled	Sample Medium Catalog # / Lot #	Air Sample Volume (liters)*	Analysis Requested	Method Reference
Front Office	5/1/01	RI 8954 3500 OVM	1380	PCE/TCE	3500
Middle	5/1/01	RI 9148	1380	PCE/TCE	3500
Back Bay	5/1/01	RI 9171	1380	PCE/TCE	3500
Blank	5/1/01	RI 9209	NA		
			5/4 JDA		NYSDOH 3/1-9 per Jeff to not 5/7/01 SSP

*For passive monitors please list time exposed in minutes. 5/1/01 9:05am — 5/2/01 8:05am

Comments (Please list any known interferences present in sampling area):

Chain of Custody	Print Name	Signature	Date/Time
Relinquished by:	P. Cox	P. M. Cox	5/4/01 8:9
Received by LAB.	M. Krause	M. Krause	5/4/01 8:00 am

Samples received after 3pm will be considered as next day's business.

Galson Laboratories

6601 Kirkville Road
E. Syracuse, NY 13057-0369
Phone (315) 432-5227
Fax: (315) 437-0571
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LABORATORY ANALYSIS REPORT

Client : O'Brien & Gere Engineers, Inc.
Site : Hicksville
Project No. : 5816.009

Date Sampled : 01-MAY-01
Date Received : 04-MAY-01
Date Analyzed : 08-MAY-01

Account No.: 10864
Login No. : L70743

Perchloroethylene

Sample ID	Lab ID	Time minutes	Total ug	Conc ug/m3
FRONT OFFICE	L70743-1	1380	0.88	22
MIDDLE	L70743-2	1380	4.5	112
BACK BAY	L70743-3	1380	6	149
BLANK	L70743-4	NA	<0.03	NA

Level of quantitation: 0.03 ug
Analytical Method : NYS DOH 311-9
OSHA PEL (TWA) : NA
Collection Media : OVM

Submitted by: SF
Approved by : jal
Date : 09-MAY-01
QC by:
NYS DOH # : 11626

< -Less Than
> -Greater Than
NA -Not Applicable
mg -Milligrams
ug -Micrograms
ND -Not Detected
m3 -Cubic Meters
l -Liters
ppm -Parts per Million
kg -Kilograms
NS -Not Specified

Galson Laboratories

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E. Syracuse, NY 13057-0369
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LABORATORY ANALYSIS REPORT

Client : O'Brien & Gere Engineers, Inc.
Site : Hicksville
Project No. : 5816.009

Date Sampled : 01-MAY-01
Date Received : 04-MAY-01
Date Analyzed : 08-MAY-01

Account No.: 10864
Login No. : L70743

Trichloroethylene

Sample ID	Lab ID	Time minutes	Total ug	ppm
FRONT OFFICE	L70743-1	1380	<8	< 0.03
MIDDLE	L70743-2	1380	<8	< 0.03
BACK BAY	L70743-3	1380	<8	< 0.03
BLANK	L70743-4	NA	<8	NA

Level of quantitation: 8 ug
Analytical Method : OVM 3M; GC/FID
OSHA PEL (TWA) : 100 ppm
Collection Media : OVM

Submitted by: SF
Approved by : jal
Date : 09-MAY-01
QC by:
NYS DOH #: 11626

< -Less Than
> -Greater Than
NA -Not Applicable
mg -Milligrams
ug -Micrograms
ND -Not Detected
m3 -Cubic Meters
l -Liters
ppm -Parts per Million
kg -Kilograms
NS -Not Specified

Galson Laboratories

6601 Kirkville Road
E Syracuse, NY 13057-0369
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Fax (315) 437-0571
www.galsonlabs.com

July 09, 2001

DOH ELAP# 11626

Ms. Pam Cox
O'Brien & Gere Engineers, Inc.
P.O. Box 4873
Syracuse, NY 13221

Client Account# 10864 Login# L72506

Dear Ms. Cox:

Enclosed is the revised report of the samples received by our laboratory June 29, 2001. As requested, we have reported results in ug/m3.

Results in this report are based on the sampling data provided by the client. Unless otherwise requested, all samples will be discarded two weeks from the date of this report.

Please contact your client service representative, Nancy Ackerman at (888) 577-5227, extension 305, if you would like any additional information regarding this report.

Thank you for using Galson Laboratories.

Sincerely,

Galson Laboratories

F. Joseph Unangst
Laboratory Director

Enclosure(s)

Galson Laboratories

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E Syracuse, NY 13057-0369
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Fax: (315) 437-0571
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LABORATORY ANALYSIS REPORT

Client : O'Brien & Gere Engineers, Inc.
Site : Hicksville, NY
Project No. : 5816.009

Date Sampled : 27-JUN-01
Date Received : 29-JUN-01
Date Analyzed : 07-JUL-01

Account No.: 10864
Login No. : L72506

Perchloroethylene

Sample ID	Lab ID	Time minutes	Total ug	Conc ug/m3
RC6272-FRONT	L72506-1	842	0.07	3
RG7600-CENTER	L72506-2	859	1.57	63
RG7558-BACK	L72506-3	860	2.12	84

Level of quantitation: 0.03 ug
Analytical Method : NYS DOH 311-9
OSHA PEL (TWA) : 100 ppm
Collection Media : OVM

Submitted by: SF
Approved by : jal
Date : 09-JUL-01
QC by:
NYS DOH # : 11626

< -Less Than
> -Greater Than
NA -Not Applicable
mg -Milligrams
ug -Micrograms
ND -Not Detected
m3 -Cubic Meters
l -Liters
ppm -Parts per Million
kg -Kilograms
NS -Not Specified

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E. Syracuse, NY 13057-0369
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Fax: (315) 437-0571
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LABORATORY ANALYSIS REPORT

Client : O'Brien & Gere Engineers, Inc.
Site : Hicksville, NY
Project No. : 5816.009

Date Sampled : 27-JUN-01
Date Received : 29-JUN-01
Date Analyzed : 06-JUL-01

Account No.: 10864
Login No. : L72506

Trichloroethylene

Sample ID	Lab ID	Time minutes	Total ug	Conc ug/m3
RC6272-FRONT	L72506-1	842	<5	< 190
RG7600-CENTER	L72506-2	859	<5	< 190
RG7558-BACK	L72506-3	860	<5	< 180

Level of quantitation: 5 ug
Analytical Method : OVM 3M; GC/FID
OSHA PEL (TWA) : 100 ppm
Collection Media : OVM

Submitted by: SF
Approved by : jal
Date : 09-JUL-01
QC by:
NYS DOH #: 11626

< -Less Than
> -Greater Than
NA -Not Applicable
mg -Milligrams
ug -Micrograms
ND -Not Detected
m3 -Cubic Meters
l -Liters
ppm -Parts per Million
kg -Kilograms
NS -Not Specified

APPENDIX D

Film badge analytical results

O'BR. & GERE ENG
ATTN CRAIG GABRIEL
5000 BRITTONFIELD PKWY
PO BOX 4873
EAST SYRACUSE NY 13057

LANDAUER®

Landauer, Inc. 2 Science Road Glenwood, Illinois 60425-1586
Telephone: (708)755-7000 Facsimile: (708)755-7016
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RADIATION DOSIMETRY REPORT

ACCOUNT NO.	SERIES CODE	ANALYTICAL WORK ORDER	REPORT DATE	DOSIMETER RECEIVED	REPORT TIME IN WORK DAYS	PAGE NO
146337		0035381386	01/02/01	12/18/00	10	1 OF 1

PARTICIPANT NUMBER	NAME / ID NUMBER / BIRTH DATE / SEX	DOSIMETER	USE	RADIATION QUALITY	DOSE EQUIVALENT (MREM) FOR PERIODS SHOWN BELOW: DEEP DDE	EYE LDE	SHALLOW SDE	QUARTERLY ACCUMULATED DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	YEAR TO DATE DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	LIFETIME DOSE EQUIVALENT (MREM): DEEP DDE	EYE LDE	SHALLOW SDE	RECORDS FOR YEAR	INCEPTION DATE (MM/YY)
FOR MONITORING PERIOD:					11/28/00			QTR 4			2000							
00000	CONTROL	P	CNTRL		M	M	M										2	07/95
		U	CNTRL				M											
90005		P	OWHBDY		M	M	M						NOTOTAL					
		U	OEXTRM				M						NOTOTAL					
90006		P	OWHBDY	P	M	M	1						NOTOTAL				1	
		U	OEXTRM				M						NOTOTAL					
90007		P	OWHBDY		M	M	M						NOTOTAL					
		U	OEXTRM				M						NOTOTAL					
90008		P	OWHBDY		M	M	M						NOTOTAL				1	
		U	OEXTRM				M						NOTOTAL					
90009		P	OWHBDY		M	M	M						NOTOTAL					
		U	OEXTRM				M						NOTOTAL					

M: MINIMAL REPORTING SERVICE OF 1 MREM

QUALITY CONTROL RELEASE: JS 1 - PR 7132 - RPT130 - N1 - 06056

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Appendix E

Data Validation Chemical and Radiological (Revision 1)

Chemical Data Validation

Contents

Executive summary

This Data Usability Summary Report (DUSR) addresses data quality for soil borings, one ground water sample and trip blanks collected at the Cantiague Rock Road (former Sylvania Electric Products Incorporated) Site in Hicksville, New York. Sample collection activities were conducted by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) in November and December 2000.

The environmental samples collected for this investigation were submitted to O'Brien & Gere Laboratories, Inc. of Syracuse, New York for analysis of volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), fluoride, metals, mercury, pH, and percent solids using New York State Department of Environmental Conservation (NYSDEC) Methods. The analytical data were evaluated by O'Brien & Gere using the quality assurance/quality control (QA/QC) criteria established in the NYSDEC ASP Methods and the *Supplement to the Approved Work Plan (Appendix C) Former Sylvania Electric Products Incorporated Facility, Cantiague Rock Road, Hicksville* (O'Brien & Gere 2000) as guidance. Excursions from the QA/QC criteria were qualified based on guidance provided in the following documents:

- *United States Environmental Protection Agency Region II Evaluation of Metals Data for the CLP 3/90* (USEPA 1992b), and
- *United States Environmental Protection Agency Region II Contract Laboratory Program (CLP) Organics Data Review, SOP No. HW-6, Revision #11* (USEPA 1996).

Overall, 100 percent of the PCB, metals and mercury data and approximately 96.6 percent of the VOC data were determined to be usable for qualitative and quantitative purposes. Therefore, the completeness objective of 90 percent, as stated in the QAPP, was met.

1. Introduction

1.1. Sample identification

The Data Usability Summary Report (DUSR) addresses the results of a data quality evaluation for soil boring and one ground water sample and trip blanks collected at the at the Cantiague Rock Road (former Sylvania Electric Products Incorporated) Site in Hicksville, New York. Sample collection activities were conducted by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) in November and December 2000.

The quantity and types of samples that were submitted for data validation are presented in Table 1-1 below.

Table 1-1. *Sample cross reference list*

Package ID	Date Collected	Client ID	Laboratory ID	Analysis Requested
OBG SDGs 7511, 7526, 7537, 7542	1/28/00	SB-110(3-4')	R6325	PCBs, Percent Solids
		SB-110(18-20')	R6326	VOCs, Percent Solids
		SB-110(20-21')	R6327	PCBs, Metals, Mercury, Percent Solids
		SB-110(21-22')	R6328	Percent Solids
		SB-111(0-4')	R6329	VOCs, Percent Solids
		SB-111(18')	R6330	PCBs, Metals, Mercury, Percent Solids
		SB-111(0-4')4'	R6331	PCBs, Percent Solids
		SB-111(0-4')2'	R6332	Percent Solids
		SB-112(4-8')	R6333	VOCs, Percent Solids
		SB-112(8-12')	R6334	Nickel, Percent Solids
		SB-112(2-3')	R6335	Percent Solids
		SB-112(0-4')	R6336	Nickel, Percent Solids
		SB-112(16-20')	R6337	PCBs, Metals, Mercury, pH, Percent Solids
		SB-113(0-4')	R6338	VOCs, Percent Solids
		SB-113(4-8')	R6339	Nickel, Percent Solids
		SB-113(12')	R6340	Nickel, Percent Solids
		SB-113(13.5-14')	R6341	Percent Solids

Table 1-1. *Sample cross reference list*

Package ID	Date Collected	Client ID	Laboratory ID	Analysis Requested
	11/29/00	SB-115(12-16')	R6453	VOCs, Percent Solids
		SB-115(8-12')	R6454	Nickel, Percent Solids
		SB-116(4-8')	R6455	VOCs, Percent Solids
		SB-116(16-20')	R6456	Nickel, Percent Solids
		SB-114(12')	R6457	Nickel, Percent Solids
		SB-114(4')	R6458	VOCs, Nickel, Percent Solids
		SB-114(20')	R6459	Metals, Mercury, Percent Solids
		SB-113B(16-20')	R6460	Metals, Mercury, Percent Solids
		SB-113C(12-16')	R6461	Metals, Mercury, Percent Solids
		SB-117(0-4')	R6462	VOCs, Percent Solids
		SB-117(12')	R6463	PCBs, Metals, Mercury, Percent Solids
	11/30/00	SB-118(17.5-20.0')	R6505	Percent Solids
		SB-118(4')	R6506	VOCs, Percent Solids
		SB-118(8-12')	R6507	PCBs, Metals, Mercury, pH, Percent Solids
		SB-120(12-16')	R6508	Nickel, pH, Percent Solids
		SB-120(4-8')	R6509	VOCs, Percent Solids
		SB-120(24')	R6510	VOCs, Percent Solids
		SB-119(0-4')	R6511	VOCs, Percent Solids
		SB-119(12-16'), MS/MSD	R6512	Nickel, Percent Solids
		SB-120D(12-16') Dup (SB-120 (12-16')	R6513	Nickel, Percent Solids
		Trip Blank A	R6514	VOCs
	12/1/00	SB-124(12-16')	R6527	Nickel, Percent Solids
		SB-124(0-4')	R6528	VOCs, Percent Solids
		SB-125(4')	R6529	VOCs, Metals, Mercury, Percent Solids
		SB-125(16-20')	R6530	VOCs, Percent Solids (On Hold)
		SB-125D(0-4') Dup (SB-125 (4'))	R6531	VOCs, Percent Solids
		SB-121(0-4')	R6532	VOCs, Percent Solids
		SB-121(18-20')	R6533	PCBs, Nickel, Percent Solids
		SB-122(12-16')	R6534	VOCs, Nickel, Percent Solids
		SB-123(0-4')	R6535	VOCs, Percent Solids
		SB-123(8-12')	R6536	Nickel, Percent Solids
		SB-129(2-3')	R6537	Nickel, pH, Percent Solids
		Trip Blank	R6538	VOCs*

Table 1-1. *Sample cross reference list*

Package ID	Date Collected	Client ID	Laboratory ID	Analysis Requested
OBG SDGs 7552, 7559	12/4/00	SB-148(8-11.5')	R6625	Nickel, Percent Solids
		SB-148(9')	R6626	Percent Solids
		SB-148(4-8')	R6627	VOCs, Percent Solids
		SB-149(6')	R6628	Nickel, Percent Solids
		SB-149(8-12')	R6629	VOCs, Percent Solids
		SB-150(1-2')	R6630	Nickel, Percent Solids
		SB-150(8-12')	R6631	VOCs, Percent Solids
		SB-151(1')	R6632	Percent Solids
		SB-151(1-2')	R6633	Nickel, Percent Solids
		SB-151(8-12')	R6634	VOCs, Percent Solids
		SB-151D(8-12') Dup (SB-151 (8-12'))	R6635	VOCs, Percent Solids
		SB-152(1-2')	R6636	PCBs, Metals, Mercury, Percent Solids
		SB-152(0-4')	R6637	VOCs, Percent Solids
		SB-152, 1'(8-14')	R6638	Percent Solids
		SB-153(0.5-2')	R6639	Nickel, Percent Solids
		SB-153(0-4')	R6640	VOCs, Percent Solids
		SB-153D(8-16') Dup (SB-153 (0.5-2'))	R6641	Nickel, Percent Solids
		SB-154(4-8')	R6642	Nickel, Percent Solids
		SB-154(0-4')	R6643	VOCs, Percent Solids
		SB-146A(1')	R6644	Nickel, Percent Solids
		SB-146A(0-4')	R6645	VOCs, Percent Solids
		SB-146B(0-4')	R6646	VOCs, Percent Solids
		SB-146B(1')	R6647	Nickel, Percent Solids
		SB-146C(2')	R6648	VOCs, Percent Solids
		SB-146C Dup (SB-146C (2'))	R6649	VOCs, Nickel, Percent Solids
		Trip Blank	R6690	VOCs
	12/3/00	SB-141(16-20')	R6650	PCBs, Metals, Mercury, pH, Percent Solids
		SB-141(12-16')	R6651	VOCs, Percent Solids
		SB-142(16-20')	R6652	VOCs, Percent Solids
		SB-142(8-12')	R6653	PCBs, Metals, Mercury, pH, Percent Solids
		SB-143(4-8')	R6654	PCBs, Metals, Mercury, pH, Percent Solids
		SB-143(16-20')	R6655	VOCs, Percent Solids
		SB-138(16-20')	R6656	Nickel, Percent Solids
		SB-138(8-12')	R6657	VOCs, Percent Solids
		SB-139(4')	R6658	VOCs, PCBs, Nickel, Percent Solids
		SB-140(4')	R6659	VOCs, PCBs, Nickel, Percent Solids
		Trip Blank	R6660	VOCs

Table 1-1. *Sample cross reference list*

Package ID	Date Collected	Client ID	Laboratory ID	Analysis Requested
OBG SDGs 7584, 7597, 7603, 7606	12/5/00	MW-1	R6837	Nickel, pH
	12/6/00	SB-147(16-20')	R6823	VOCs, Nickel, Percent Solids
		SB-155(4-8')	R6824	VOCs, Nickel, Percent Solids
		SB-157(12-16')	R6825	Nickel, Percent Solids
		SB-157(0-4')	R6826	VOCs, Percent Solids
		SB-156(0-4')	R6827	VOCs, Percent Solids
		SB-156D(16-20') Dup (SB-156 (4-8'))	R6828	pH, Percent Solids
		SB-156(4-8')	R6829	Nickel, pH, Percent Solids
		SB-144(0-4')	R6830	VOCs, Percent Solids
		SB-144D(16-20') Dup (SB-144 (5-6'))	R6831	PCBs, Percent Solids
		SB-144(6')	R6832	Percent Solids
		SB-144(5-6')	R6833	PCBs, Nickel, Percent Solids
		SB-159(8-12')	R6834	PCBs, Nickel, pH, Percent Solids
		SB-159(0-4')	R6835	VOCs, Percent Solids
		SB-130(16-20')	R6836	VOCs, Percent Solids
	12/7/00	SB-131(0-4')	R6894	VOCs, Percent Solids
		SB-131(4-8')	R6895	Metals, Mercury, pH, Percent Solids
		SB-131D(16-20'), MS/MSD	R6896	Metals, Mercury, Percent Solids
		SB-127(0-4')	R6897	VOCs, Nickel, pH, Percent Solids
		SB-133(0-4')	R6898	VOCs, Nickel, Percent Solids
		SB-133D(16-20') Dup (SB-133 (0-4'))	R6899	Nickel, Percent Solids
		SB-134(0-4')	R6900	VOCs, Percent Solids
		SB-134(12-16')	R6901	Nickel, Percent Solids
		SB-134D(16-20') Dup (SB-134 (12-16'))	R6902	Percent Solids
		SB-128(0-4')	R6903	VOCs, Nickel, Percent Solids
		SB-128D(16-20') Dup (SB-128 (0-4'))	R6904	VOCs, Percent Solids
		SB-132(1')	R6905	Percent Solids
		SB-135(8-12')	R6906	VOCs, Nickel, Percent Solids
		Trip Blank	R6907	VOCs*
	12/9/00	SB-145(20')	R6935	VOCs, PCBs, Nickel, pH, Percent Solids
		SB-145(8')	R6936	VOCs, PCBs, Nickel, pH, Percent Solids
		SB-145(12-16')	R6937	Fluoride, Percent Solids
		SB-169(12-16')	R6938	Percent Solids
		SB-170(16-20')	R6939	VOCs, Percent Solids

Table 1-1. *Sample cross reference list*

Package ID	Date Collected	Client ID	Laboratory ID	Analysis Requested
	12/8/00	SB-126(0-4'), MS/MSD	R6945	VOCs, Percent Solids
		SB-126(4-8'), MS/MSD	R6946	Nickel, Percent Solids
		SB-126(16-20'), MS/MSD	R6947	Percent Solids
		SB-160(0-4')	R6948	Percent Solids
		SB-161(0-4')	R6949	Percent Solids
		SB-162(0-4'), MS/MSD	R6950	Percent Solids
		SB-163(0-4')	R6951	Percent Solids
		SB-164(0-4')	R6952	Percent Solids
		SB-165(0-4')	R6953	Percent Solids
		SB-161D(16-20') Dup (SB-161 (0-4'))	R6954	Percent Solids
		SB-166(8-12')	R6955	VOCs, Metals, Mercury, Percent Solids
		SB-158(16-20')	R6956	VOCs, PCBs, Metals, Mercury, Percent Solids
		SB-158D(8-12') Dup (SB-158 (16-20'))	R6957	PCBs, Percent Solids
		SB-136(0-4'), MS/MSD	R6958	VOCs, Nickel, Percent Solids
		SB-137(0-4')	R6959	VOCs, Percent Solids
		Trip Blank A	R6960	VOCs*
		Trip Blank B	R6961	VOCs*

Note:
VOCs - volatile organic compounds
PCBs - polychlorinated biphenyls
TB – trip blank.
MS/MSD - matrix spike/matrix spike duplicate.

Metals include aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.

* Indicates that the trip blank was not listed on the chain-of-custody but was analyzed by the laboratory.

1.2. General considerations

Validation is a process of determining the suitability of a measurement system for providing useful analytical data. Although the term is frequently used in discussing methodologies, it applies to all aspects of the system and especially to samples, their measurement, and the actual data output. This report outlines deviations from the applicable QC criteria outlined in the following documents:

- NYSDEC. 1995. *Analytical Services Protocol (ASP),* October 1995 Revisions. Albany, New York.

- O'Brien & Gere Engineers, Inc. 2000. *Supplement to the Approved Work Plan (QAPP - Appendix C) Former Sylvania Electric Products Incorporated Facility, Cantiague Rock Road.* Syracuse, New York.

- APHA, AWWA, WPCF, 1992. *Standard Methods for the Examination of Water and Wastewater*, 18th Edition. Washington, D.C.

Excursions from the QA/QC criteria were qualified based on guidance provided in the following documents:

- *United States Environmental Protection Agency Region II Evaluation of Metals Data for the Contract Laboratory Program (CLP) 3/90* (USEPA 1992b), and

- *United States Environmental Protection Agency Region II Contract Laboratory Program (CLP) Organics Data Review, SOP No. HW-6, Revision #11* (USEPA 1996).

1.3. Analytical methods

The environmental samples collected for this investigation were submitted to O'Brien & Gere Laboratories, Inc. of Syracuse, New York for analysis of VOCs, PCBs, metals (consisting of aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc), mercury, fluoride, and pH using NYSDEC Methods and USEPA Methods. The analytical data generated for this investigation were evaluated by O'Brien & Gere using the QA/QC criteria established in the NYSDEC ASP Methods and the *Supplement to the Approved Work Plan (QAPP - Appendix C) Sylvania Electric Products Incorporated Facility, Cantiague Rock Road, Hicksville, New York* (O'Brien & Gere 2000) as guidance.

The methods used in this investigation are presented in Table 1-2.

Table 1-2. *Analytical method references*

Parameter	Method	Reference
VOCs	USEPA Method 8260B/ NYSDEC ASP Exhibit E	1
PCBs	USEPA Method 8082/ NYSDEC ASP Exhibit E	1
Metals *	USEPA Method 6010B/ NYSDEC ASP Exhibit E	1
Mercury	USEPA Method 7470A/ NYSDEC ASP Exhibit E	1
Fluoride	USEPA Method 340.2	1
pH**	USEPA Method 9040B	1
Percent Solids	USEPA Method 2540-G	2

Note:
1. NYSDEC. 1995. *Analytical Services Protocol (ASP) Methods,* October 1995 Revisions. Albany, New York.
2. APHA, AWWA, WPCF. 1992. *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, Washington, D.C.

* - Metals consist of aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc.
** - pH analyses were not evaluated during the validation process

The following chapters of this document address distinct aspects of the validation process. Chapter 2 lists the data QA/QC protocols used to validate the sample data. Specific QA/QC deviations and qualifications performed on the sample data are discussed in Chapter 3. Data completeness and usability are discussed in Chapter 4. Finally, the answers to the questions presented by the DUSR are presented in Chapter 5.

2. Data validation protocols

2.1. Sample analyses parameters

The validation of NYSDEC ASP analyses for this project used guidance presented in the QAPP (O'Brien & Gere 2000), and the analytical methodology, and the data validation guidelines referenced in Chapter 1 herein. The following QA/QC parameters were evaluated for the VOC analyses:

- Holding times, sample preservation, and percent solids,
- GC/MS tuning criteria,
- Initial and continuing calibration,
- Blank analysis,
- Surrogate recovery,
- MS/MSD analysis,
- Laboratory control sample (LCS) analysis,
- Internal standards performance,
- Field duplicate analysis,
- Analyte identification, quantitation, and reported detection limits,
- System performance, and
- Documentation completeness.

The following QA/QC parameters were evaluated for the PCB analyses:

- Holding times, sample preservation, and percent solids,
- GC performance,
- Analytical sequence,
- Initial and continuing calibration,
- Blank analysis,
- Surrogate recovery,
- MS/MSD analysis,
- LCS analysis,
- Field duplicate analysis,
- Analyte identification, quantitation, and reported detection limits,
- Cleanup efficiency verification,
- System performance, and
- Documentation completeness.

The following QA/QC parameters were evaluated for the metal, mercury, and fluoride analyses (where applicable):

- Holding times, sample preservation, and percent solids,
- Contract required detection limit (CRDL) standard analysis criteria,
- Initial and continuing calibration,
- Blank analysis,
- Inductively coupled plasma (ICP) interference check sample analysis,
- MS analysis,
- LCS analysis,
- Laboratory duplicate analysis,
- ICP serial dilution analysis,
- Field duplicate analysis,
- Verification of instrument parameters,
- Instrument detection limits,
- Linear ranges,
- Analyte quantitation, and reported detection limits, and
- Documentation completeness.

2.2. Data validation qualifiers

In accordance with the USEPA guidance, and using professional judgment, the following qualifiers are used in this data validation to qualify environmental samples:

"R" Indicates that the reporting limit or sample result has been determined to be unusable due to a major deficiency in the data generation process. The data should not be used for any qualitative or quantitative purposes.

"U" Indicates that the analyte was analyzed for, but was not detected. The sample quantitation limit is presented. This qualifier is also used in the validation process to signify that the detection limit of an analyte was raised due to blank contamination.

"J" Indicates that concentration of the result should be considered approximate. This qualifier is used when the data validation process identifies a deficiency in the data generation process. The laboratory also applies this qualifier when the analyte concentration was greater than the method detection limit (MDL) but less than the reported detection limit. In this case, during the validation process, the "J" flag was retained since the concentration is considered to be approximate.

The following guidelines are used regarding the assignment of qualifiers and the use of qualified data:

- The data quality evaluation results in only one qualifier for each analyte; in a case when several qualifiers are applicable to the same analyte; the cumulative effect of the various QA/QC excursions is employed in assigning the final data qualifiers.

- QA/QC excursions that do not result in the qualification of an analyte are not discussed, unless the situation observed through the validation process warrants noting.

- Qualifiers are applied to environmental samples. Trip blanks and MS/MSD samples are used to evaluate environmental samples and are not qualified due to detected excursions.

2.3. DUSR questions

The DUSR determines whether or not the data meet site specific criteria for data quality and use. The DUSR was developed by reviewing and evaluating the analytical data packages. During the course of this review the following questions were addressed:

1. Is the data package complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables?

2. Have all holding times been met?

3. Do all the QC data (blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data) fall within the protocol required limits and specifications?

4. Have all of the data been generated using established and agreed upon analytical protocols?

5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?

6. Have the correct data qualifiers been used?

The answers to the questions presented by the DUSR are presented in the following sections of the report and in the DUSR Summary section in Chapter 5

3. Data quality evaluation

3.1. Criteria

This chapter summarizes the QA/QC parameters, validation criteria, and qualifications performed on the sample data when the QA/QC parameters specified in Chapter 2 did not meet criteria. Samples that required qualification are described in the following sections, and are identified by the description documented on the sample chain-of-custody records.

3.1.1. Documentation completeness

The following chain-of-custody issues were detected during the validation process and were reported to the Project Manager.

- The chain-of-custody associated with samples collected 11/28/00 was incomplete. The dates of sample collection for samples SB-111 (0-4'), SB-111 (18'), SB-111 (0-4') 4', SB-111 (0-4') 2', SB-112 (4-8'), SB-112 (8-12'), SB-112 (2-3') and SB-112 (0-4') were not documented on the chain-of-custody. In addition, the times of sample collection for samples SB-112 (2-3') and SB-112 (0-4') were not documented on the chain-of-custody. The date of collection listed on the chain-of-custody for sample SB-111 (21-22') was 11/18/00. However, the laboratory noted that the date listed on the sample container was 11/28/00. The laboratory used the collection date for the above-mentioned samples as 11/28/00 based on the information listed on the sample bottles.

- The chain-of-custody associated with samples collected 11/28/00 was incomplete. The courier, Federal Express, was not listed on the accompanying After Hours Chain-of-Custody Laboratory form.

- The chain-of-custody associated with samples collected 12/7/00 was incomplete. The date of sample collection for samples SB-131 (4-8'), SB-131D (16-20') MS/MSD, SB-127 (0-4'), SB-133 (0-4'), SB-133D (16-20'), SB-134 (0-4'), SB-134 (12-16'), SB-134D (16-20'), SB-128 (0-4'), SB-128D (16-20'), and SB-132 (1') were not documented on the chain-of-custody. In addition, the time of sample collection for samples SB-131 (4-8') and SB-131D (16-20') MS/MSD were not documented on the chain-of-custody. The laboratory used the collection date for the above-mentioned samples as 12/7/00 based on the information listed on the sample bottles.

- The chain-of-custody associated with samples collected 12/8/00 was incomplete. The dates of sample collection for samples SB-126 (0-4') MS/MSD, SB-126 (4-8') MS/MSD, SB-126 (16-20') MS/MSD, SB-160 (0-4'), SB-161 (0-4'), SB-162 (0-4') MS/MSD, SB-163 (0-4'), and SB-164 (0-4') were not documented on the chain-of-custody. In addition, the times of sample collection for samples SB-126 (0-4') MS/MSD, SB-126 (4-8') MS/MSD, and SB-126 (16-20') MS/MSD were not documented on the chain-of-custody. The laboratory used the collection date for the above-mentioned samples as 12/8/00 based on the information listed on the sample bottles.

- The chain-of-custody associated with samples collected 12/8/00 was incomplete. The date of sample collection for samples SB-166 (8-12'), SB-158 (16-20'), SB-158D (8-12'), SB-136 (0-4') MS/MSD, and SB-137 (0-4') were not documented on the chain-of-custody. In addition, the time of sample collection for sample SB-136 (0-4') MS/MSD was not documented on the chain-of-custody. The laboratory used the collection date for the above-mentioned samples as 12/9/00 based on the information listed on the sample bottles.

The following method and analysis issue was detected during the validation process and was reported to the Project Manager.

- The laboratory indicated that a combination of the USEPA and NYSDEC ASP method quality control limits were used during the analysis of samples for this project. The laboratory used the NYSDEC ASP methods for calibration and instrument tuning. The USEPA methods were used for the remaining quality control requirements. As a result, either the laboratory control limits or the method control limits were used by the laboratory to evaluate the data. During the validation process, the limits used by the laboratory were also used by the validation team to evaluate the data.

3.2. VOC analyses

The QA/QC parameters presented in Section 2.1 for VOCs were applied to samples listed in Table 1-1. The following QA/QC parameters were found to meet validation criteria:

- Holding times, sample preservation, and percent solids,
- GC/MS tuning criteria,
- Initial calibration,
- MS/MSD analysis,
- Field duplicate analysis,
- Analyte identification and quantitation,
- System performance.

Deviations from QA/QC criteria presented in Section 2.1 are summarized below.

3.2.1. Continuing calibration

The percent difference (%D) for analytes in continuing calibrations analyzed for volatiles exceeded the method criterion. As a result of the continuing calibration excursions the results for analytes in samples associated with the calibrations were qualified as approximate (UJ) to indicate minor compromises in calibration linearity. The following table presents the calibration excursions:

Table 3-1. *Continuing calibration excursions for VOC analyses*

Continuing calibration ID	Analyte	Excursion	Affected samples	Action
MS2 12/13/00 0908	Bromomethane	36.8 %D	SB-127(0-4')	UJ
	Carbon tetrachloride	55.5 %D		
	Trans-1,3-dichloropropene	29.9 %D		
	Dibromochloromethane	26.0 %D		
	Bromoform	32.0 %D		
MS3 12/14/00 2120	Bromoform	28.0 %D	SB-126(0-4')	UJ
	1,1,2,2-Tetrachloroethene	44.8 %D	SB-158(16-20')	
			SB-136(0-4')	
			SB-137(0-4')	
			SB-145(8')	
			SB-135(8-12')	
MS2 12/15/00 0929	Bromomethane	30.7 %D	SB-166(8-12')	UJ
	Carbon tetrachloride	30.8 %D		
MS3 12/2/00	Vinyl chloride	28.5 %D	SB-110(18-20')	UJ
			SB-111(0-4')	
			SB-112(4-8')	
			SB-113(0-4')	
			SB-115(12-16')RE	
			SB-116(4-8')	
			SB-114(4')	
			SB-117(0-4')	
			SB-118(4')	
			SB-120(4-8')	
			SB-119(0-4')	
MS3 12/5/00	Vinyl chloride	26.9 %D	SB-120(24')	UJ
			SB-124(0-4')	
			SB-121(0-4')	

Note: %D indicates percent difference.

3.2.2. Blank analysis

Trip blanks are to be included in each cooler containing samples submitted for VOC analysis. Trip blanks were not included in the coolers containing samples submitted for VOC analysis, which were collected 11/28/00, 11/29/00, and 12/6/00. Therefore, sample contamination due to sample shipment issues was not evaluated for those samples.

Target analytes were detected in blanks analyzed for VOCs in this investigation. Samples that contained common laboratory contaminants at less than ten times the associated blank concentration and the remaining analytes at less than five times the associated blank concentration were qualified as undetected due to the blank contamination, as required by the USEPA Region II data validation guidelines. The blank excursions are summarized in the following table:

Table 3-2. *Blank excursions for VOC analyses*

Blank ID	Analyte	Detected Concentration	Affected Sample Results	Action
PB121400S1	Tetrachloroethene	1.4 µg/Kg	SB-145(20')	3U
			SB-170(16-20')	3U
			SB-131(0-4')	3U
PB121400S5	Acetone	4.9 µg/Kg	SB-126(0-4')	10U
			SB-158(16-20')	10U
			SB-136(0-4')	11U
			SB-137(0-4')	11U
			SB-145(8')	11U
			SB-135(8-12')	10U
	Methylene chloride	1.1 µg/Kg	SB-126(0-4')	8U
			SB-158(16-20')	6U
			SB-136(0-4')	3U
			SB-137(0-4')	3U
			SB-145(8')	7U
	Styrene	1.1 µg/Kg	SB-158(16-20')	3U
Trip Blank 12/3/00	Acetone	6.0 µg/L	SB-142(16-20')	34U
			SB-138(8-12')	15U
	Tetrachloroethene	1.0 µg/L	SB-138(8-12')	5U

Note: PB indicates preparation blank.

3.2.3. Surrogate recovery

The surrogate recovery was outside of the laboratory control limits for sample SB-142 (16-20') submitted for VOC analyses. Reanalysis confirmed the initial surrogate responses. As a result, the target analytes detected in the sample were qualified as approximate (UJ, J) to indicate biased low results based on the decreased response of the surrogate. The following table presents the target analytes qualified as a result of surrogate recovery excursion:

Table 3-3. *Surrogate excursions for VOC analyses*

Sample ID	Surrogate	Excursion	Affected analytes	Action
SB-142(16-20')	Dibromofluoromethane	61 %R	Target analytes	UJ, J

Note: %R indicates percent recovery.

3.2.4. LCS analysis

The laboratory recovery criteria for VOCs in LCS analyses were exceeded. As a result of the LCS excursions, the results in the associated samples were qualified as approximate (UJ) to indicate minor accuracy excursions. The following table presents the target analytes qualified as a result of the LCS excursions:

Table 3-4. *LCS excursions for VOC analyses*

LCS ID	Analyte	Excursion	Affected Sample	Action
L121300S9	Carbon tetrachlonde	53 %R	SB-127(0-4')	UJ
	Trans-1,3-dichloropropene	72 %R		
	Dibromochloromethane	69 %R		
	Bromoform	64 %R		
L121500S9	Carbon tetrachloride	66 %R, 58 %R	SB-166(8-12')	UJ
	Trans-1,3-dichloropropene	82 %R, 66 %R		

Note:
%R indicates percent recovery.

3.2.5. Internal standards performance

The recoveries for internal standards in samples analyzed for VOCs were lower than the validation control limits. Repeated analyses confirmed the internal standard excursions. In accordance with USEPA Region II data validation guidelines, the results for target analytes associated with internal standard area recoveries greater than 25 percent but less than the lower control limit were qualified as approximate (UJ, J) to indicate lower instrument response. The results for non-detected target analytes associated with internal standard area recoveries less than 25 percent were rejected (R) to indicate a major decrease in instrument response. The internal standard recovery excursions are summarized in the following table:

Table 3-5. *Internal standard area excursions for VOC analyses*

Sample ID	Internal standard	Excursion	Affected Analytes	Action
SB-147(16-20')	Fluorobenzene	26 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	31 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	26 %R	See affected analytes listed below	UJ
SB-133(0-4')	1,4-Difluorobenzene-d4	45 %R	See affected analytes listed below	UJ
SB-128(0-4')	Fluorobenzene	30 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	35 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	21 %R	See affected analytes listed below	(1)R
SB-134(0-4')	Fluorobenzene	27 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	28 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	21 %R	See affected analytes listed below	(1)R
SB-155(4-8')	Fluorobenzene	26 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	30 %R	See affected analytes listed below except Tetrachloroethene	UJ, J
	1,4-Difluorobenzene-d4	23 %R	See affected analytes listed below	(1)R
SB-155(4-8')DL	Chlorobenzene-d5	38 %R	Tetrachloroethene	J
SB-157(0-4')	Fluorobenzene	25 %R	See affected analytes listed below	UJ, J

Table 3-5. *Internal standard area excursions for VOC analyses*

Sample ID	Internal standard	Excursion	Affected Analytes	Action
	Chlorobenzene-d5	28 %R	See affected analytes listed below except Tetrachloroethene	UJ, J
	1,4-Difluorobenzene-d4	24 %R	See affected analytes listed below	(1)R
SB-157(0-4')DL	Chlorobenzene-d5	37 %R	Tetrachloroethene	J
SB-130(16-20")RE	Fluorobenzene	48 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	48 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	48 %R	See affected analytes listed below	UJ
SB-159(0-4')DL	Fluorobenzene	21 %R	See affected analytes listed below	(22)R, J
	Chlorobenzene-d5	22 %R	See affected analytes listed below	(5) R, J
	1,4-Difluorobenzene-d4	20 %R	See affected analytes listed below	(1) R
SB-156(0-4')	Fluorobenzene	45 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	45 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	39 %R	See affected analytes listed below	UJ
SB-148(4-8')RE	1,4-Difluorobenzene-d4	47 %R	See affected analytes listed below	UJ
SB-150(8-12')	1,4-Difluorobenzene-d4	47 %R	See affected analytes listed below	UJ
SB-134(0-4')	Fluorobenzene	45 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	42 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	35 %R	See affected analytes listed below	UJ
SB-152(0-4')RE	1,4-Difluorobenzene-d4	43 %R	See affected analytes listed below	UJ
SB-151D(8-12')	Fluorobenzene	40 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	37 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	31 %R	See affected analytes listed below	UJ
SB-153(0-4')	1,4-Difluorobenzene-d4	48 %R	See affected analytes listed below	UJ
SB-154(0-4')	Fluorobenzene	22 %R	See affected analytes listed below	(26)R
	Chlorobenzene-d5	21 %R	See affected analytes listed below	(7)R
	1,4-Difluorobenzene-d4	19 %R	See affected analytes listed below	(1)R
SB-146A(0-4')	1,4-Difluorobenzene-d4	43 %R	See affected analytes listed below	UJ
SB-146B(0-4')	1,4-Difluorobenzene-d4	46 %R	See affected analytes listed below	UJ
SB-146C(2')	1,4-Difluorobenzene-d4	38 %R	See affected analytes listed below	UJ
SB-142(16-20')RE	1,4-Difluorobenzene-d4	45 %R	See affected analytes listed below	UJ
SB-143(16-20')	1,4-Difluorobenzene-d4	49 %R	See affected analytes listed below	UJ
SB-138(8-12')	Fluorobenzene	40 %R	See affected analytes listed below	UJ, J
	Chlorobenzene-d5	39 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	35 %R	See affected analytes listed below	UJ
SB-111(0-4')	1,4-Difluorobenzene-d4	33 %R	See affected analytes listed below	UJ
SB-112(4-8')	1,4-Difluorobenzene-d4	44 %R	See affected analytes listed below	UJ
SB-116(4-8')	1,4-Difluorobenzene-d4	25 %R	See affected analytes listed below	UJ
SB-114(4')	1,4-Difluorobenzene-d4	45 %R	See affected analytes listed below	UJ
SB-120(4-8')	Chlorobenzene-d5	36 %R	See affected analytes listed below except Tetrachloroethene	UJ, J
	1,4-Difluorobenzene-d4	29 %R	See affected analytes listed below	UJ
SB-120(24')	Fluorobenzene	48 %R	See affected analytes listed below	UJ
	1,4-Difluorobenzene-d4	47 %R	See affected analytes listed below	UJ
SB-121(0-4')	Fluorobenzene	29 %R	See affected analytes listed below	UJ,J
	Chlorobenzene-d5	29 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	25 %R	See affected analytes listed below	UJ
SB-119(0-4')	1,4-Difluorobenzene-d4	41 %R	See affected analytes listed below	UJ
SB-124(0-4')	1,4-Difluorobenzene-d4	42 %R	See affected analytes listed below	UJ
SB-125D(0-4')	1,4-Difluorobenzene-d4	44 %R	See affected analytes listed below	UJ
SB-123 (0-4')RE	Fluorobenzene	32 %R	See affected analytes listed below	UJ,J
	Chlorobenzene-d5	29 %R	See affected analytes listed below	UJ, J
	1,4-Difluorobenzene-d4	26 %R	See affected analytes listed below	UJ

Table 3-5. *Internal standard area excursions for VOC analyses*

Sample ID	Internal standard	Excursion	Affected Analytes	Action

Note: DL - dilution analysis.
(1) indicates the number of rejected target analytes in the associated sample.

- The analytes affected by internal standard fluorobenzene include: chloromethane, bromomethane, vinyl chloride, chloroethane, methylene chloride, acetone, 1,1-dichloroethene, carbon disulfide, 1,1-dichloroethane, trans-1,2-dichloroethene, cis-1,2-dichloroethene, chloroform, dibromofluoromethane, 1,2-dichloroethane, 2-butanone, 1,1,1-trichloroethane, carbon tetrachloride, bromodichloromethane, 1,2-dichloropropane, cis-1,3-dichloropropene, trichloroethene, benzene, trans-1,3-dichloropropene, 1,1,2-trichloroethane, 4-methyl-2-pentanone, toluene, and 2-hexanone.
- The analytes affected by internal standard chlorobenzene-d5 include: dibromochloromethane, tetrachloroethene, chlorobenzene, ethylbenzene, styrene, xylenes, and bromoform.
- The analyte affected by internal standard 1,4-difluorobenzene-d4 include: 1,1,2,2-tetrachloroethane.

3.2.6. Analyte reported detection limits

Dilutions were performed during the analysis of samples due to high concentrations of target analytes. For some samples, both the concentration from the diluted analysis (for those target analytes that exceeded calibration range) and the remaining results from the lowest dilution analysis were combined in the sample report. The analytes that were analyzed using one or more dilutions are summarized in the following table:

Table 3-6. *Sample reported from diluted VOC analyses*

Sample ID	Reason for dilution
SB-155(4-8')	High concentration of target analytes
SB-157(0-4')	
SB-156(0-4')	
SB-159(0-4')	
SB-127(0-4')	
SB-134(0-4')	
SB-145(8')	
SB-166(8-12')	
SB-139(4')	
SB-110(18-20')	
SB-111(0-4')	
SB-112(4-8')	
SB-116(4-8')	
SB-114(4')	
SB-117(0-4')	
SB-118(4')	
SB-120(4-8')	
SB-119(0-4')	
SB-124(0-4')	
SB-125(4')	
SB-125D(0-4')	
SB-121(0-4')	

The concentrations for target analytes from the dilution analyses for several samples did not compare well with the undiluted results. The sample result from the dilution analysis was reported. The following table summarizes the sample results from the dilution and undiluted analyses. Qualification of sample results was not performed since the discrepancies may have been the result of using two different sample vials during analysis or due to non-homogeneous sample aliquots.

Table 3-7. *Sample results from undiluted and diluted VOC analyses*

Sample ID	Target Analyte	Sample Results From Undiluted Analysis (µg/Kg)	Sample Results From Dilution Results (µg/Kg)
SB-155(4-8')	Tetrachloroethene	1100	380
SB-157(0-4')	Tetrachloroethene	330	100
SB-156(0-4')	Tetrachloroethene	3700	210
SB-133(0-4')	Tetrachloroethene	1400	780
SB-134(0-4')	Tetrachloroethene	9900	2500
SB145(8')	Tetrachloroethene	3800	160
SB-145(8')	Trichloroethene	490	52
SB-111(0-4')	Tetrachloroethene	5100	18000
SB-120(4-8')	Tetrachloroethene	13000	92000
SB-119(0-4')	Tetrachloroethene	5500	16000
SB-125(4')	Tetrachloroethene	69000	9600
SB-125D(0-4')	Tetrachloroethene	32000*	10000
SB-121(0-4')	Tetrachloroethene	46000*	9200

* Medium level analysis used.

The concentration of Tetrachloroethene in the initial and reanalysis of sample SB-130 (16-20') were not comparable. The results from a third analysis of the sample confirmed the re-analysis results but was performed outside of the holding time. Therefore the re-analysis results were reported for that sample.

3.3. PCB analyses

3.3.1. Criteria

The QA/QC parameters presented in Section 2.1 for were applied to samples listed in Table 1-1.

The following QA/QC parameters were found to meet validation criteria:

- Holding times, sample preservation, and percent solids,
- GC performance,
- Analytical sequence,
- Initial and continuing calibration,
- Surrogate recovery,
- Field duplicate analysis,
- Analyte identification, quantitation, and reported detection limits, and
- Cleanup efficiency verification.

Deviations from QA/QC criteria presented in Section 2.1 are summarized below.

3.3.2. Blank analysis

Although required by the QAPP, the instrument blanks generated during the PCB analysis were not included in the data packages. Therefore, instrument blanks were not evaluated during the validation process.

3.3.3. MS/MSD analysis

Although required by the QAPP at a frequency of 5 percent, MS/MSD samples were not collected for PCB analysis during this sampling event. Therefore, the accuracy and precision evaluation for matrix influences on target analytes was not performed during the validation process.

3.3.4. LCS analysis

The QAPP requires that the LCS spike contain Aroclors suspected to be present at the Site. Aroclor 1254 was detected in the samples collected for this sampling event. Aroclor 1254 was not included in the LCS spike solutions. Therefore, the instrument response for Aroclors 1016 and 1260 only were evaluated during the laboratory analysis since these Aroclors were included in the LCS spike solutions.

3.3.5. Analyte reported detection limits

Dilutions were performed during the analysis of samples due to high concentration of target analytes. The samples that were analyzed using one or more dilutions are summarized in the following table:

Table 3-8. *Analytes reported from diluted PCB analyses*

Analysis	Sample ID	Reason for dilution
PCBs	SB-144D(16-20') SB-144(5-6') SB-145(8') SB-152(1-2') SB-140(4')	High concentration of target analytes

3.4. Metals and mercury

3.4.1. Criteria

The QA/QC parameters presented in Section 2.1 for metals (consisting of aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc), mercury, and fluoride, were applied to samples listed in Table 1-1. The following QA/QC parameters were found to meet validation criteria:

- Holding times, sample preservation, and percent solids,
- CRDL standard analysis criteria,
- Initial and continuing calibration,
- Blank analysis,
- ICP interference check sample analysis,
- LCS analysis,
- Laboratory duplicate analysis,
- ICP serial dilution analysis,
- Verification of instrument parameters,
- Instrument detection limits,
- Linear ranges, and
- Analyte quantitation and reported detection limits.

Deviations from QA/QC criteria presented in Section 2.1 are summarized below.

3.4.2. MS analysis

The results for antimony in MS sample SB-131D (16-20') were less than the laboratory control limits. Post-digestion spikes were performed as required and met recovery criteria. In accordance with USEPA Region II data validation guidelines, when the sample concentrations were less than four times the spike concentrations, target analytes with MS recoveries that are greater than 10 percent but less than 200 percent were qualified as approximate (UJ, J) to indicate minor recovery excursions. The MS excursions are summarized in the following table:

Table 3-9. *MS excursions for metal analyses*

MS ID	Analyte	Excursion	Affected Sample Results	Action
SB-131D(16-20')	Antimony	49 %R, 49 %R	SB-166(8-12') SB-131(4-8') SB-110(20-21') SB-111(18') SB-112(16-20') SB-114(20') SB-113B(16-20') SB-113C(12-16') SB-117(12') SB-118(8-12') SB-125(4') SB-152(1-2') SB-141(16-20') SB-142(8-12') SB-143(4-8') SB-158(1-20') SB-131D(16-20')	UJ, J

Note: %R indicates percent recovery.

3.4.3. Field duplicate analysis

The field duplicate RPD requirement, which was specified in the QAPP (RPD less than 100 percent) was not met for nickel in the field duplicate pairs identified as SB-133 (0-4') and SB-133D (16-20'). As a result, the excursions detected results for nickel were qualified as approximate (J) in these samples. Additional qualifications of nickel data were not performed since RPD requirements were met for the other field duplicates collected.

4. Summary and data usability

This chapter summarizes the analytical data in terms of its completeness and usability. Data completeness is defined as the percentage of sample results that have been determined to be usable during the data validation process. Overall, 100 percent of the PCB, metals, mercury, and fluoride data and approximately 96.6 percent of the VOC data were complete and determined to be usable for qualitative and quantitative purposes.

The soil borings and one ground water sample collected at the Cantiague Rock Road (former Sylvania Electric Products Incorporated) Site in Hicksville, New York were evaluated based on QA/QC criteria established by NYSDEC ASP Methods as listed in Section 1-2, by the USEPA Region II guidelines and by the QAPP (O'Brien & Gere 2000) established for this project. Major deficiencies in the data generation process resulted in data being rejected, indicating that the data is considered unusable for either quantitative or qualitative purposes. Minor deficiencies in the data generation process resulted in some sample data being characterized as approximate. Identification of a data point as approximate indicates uncertainty in the reported concentration of the chemical, but not its assigned identity. The use of approximated analytical data for quantitative uses is consistent with the guidance presented in the *USEPA Risk Assessment Guidance for Superfund* (USEPA 1992a).

The following paragraphs present the adherence of the data to the precision, sensitivity, accuracy, representativeness, comparability, and completeness (PSARCC) parameters.

Precision is measured through the evaluation of field duplicate samples, laboratory duplicate, and MS/MSD samples. Although required by the QAPP at a frequency of 5 percent, field duplicates were not collected during the sampling event. Therefore, field collection precision was not evaluated during the validation process. None of the VOC, PCB, metal, mercury, and fluoride data were rejected due to precision excursions.

Sensitivity is established by reported detection limits that represent measurable concentrations of analytes which can be determined with a designated level of confidence. Sensitivity requirements with respect to reported detection limits were acceptable for the sample data in this project. Dilutions were performed for several analyses due to high target analytes present in the samples or matrix interference. Overall, with the exception of the dilution analyses used by the laboratory, the majority of the reported detection limits met the project requirements.

Matrix spike samples, internal standard recoveries, surrogate recoveries, LCS recoveries, and initial and continuing calibration criteria indicate the accuracy of the data. For the VOC analyses, 3.4 percent of the data were rejected due to internal standard recovery excursions. None of the PCB, metal, mercury, and fluoride data were rejected due to precision excursions.

Holding times, sample preservation, blank analysis, and compound identification and quantification are indicators of the representativeness of the analytical data. None of the VOC, PCB, metal, mercury, and fluoride data were rejected due to representativeness excursions.

Comparability is not compromised provided that the analytical methods did not change over time. A major component of comparability is the use of standard reference materials for calibration and QC. These standards are compared to other unknowns to verify their concentrations. Since standard analytical methods and reporting procedures were consistently used by the laboratory, the comparability criteria for the analytical data were met.

The completeness objective of 90 percent, as stated in the QAPP was met.

5. DUSR summary information

The DUSR was performed to determine whether or not the data meets Site specific criteria for data quality and use. The DUSR is developed by reviewing and evaluating the analytical data package. The following questions were addressed:

1. Is the data package complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables? *The QAPP required that NYSDEC ASP Category B deliverables be provided by the laboratory for each data package. With some exceptions, this requirement was met. The evaluation of the sample data could be completed using the information provided in the data packages provided by the laboratory.*

2. Have all holding times been met? *The holding times were met for the VOC, PCB, metal, mercury, and fluoride analyses.*

3. Do all the QC data (blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data) fall within the protocol required limits and specifications? *The laboratory used the method control limits during the analyses performed for this sampling event. QA/QC deviations and qualifications performed on the sample data are discussed in Chapter 3. Major excursions resulted in the rejection of 3.4 percent of the VOC data due to internal standard recoveries that were less than 25 percent.*

4. Have all of the data been generated using established and agreed upon analytical protocols? *The QAPP required that NYSDEC ASP methods be used in the analysis of samples collected for this sampling event. The laboratory used either NYSDEC ASP or USEPA method protocols for the analyses performed for this sampling event, which met data user and client needs.*

5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms? *The evaluation of the raw data confirmed the summary information provided in the data packages.*

6. Have the correct data qualifiers been used? *The laboratory applied the correct qualifiers to the sample data. The validation qualifiers were applied as required by USEPA Region II validation guidelines as listed in Chapter 1.*

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Radiological Data Validation

Contents

Executive summary

This report addresses data quality for soil samples collected at the former Sylvania Electric Products Incorporated facility in Hicksville, New York. Sample collection activities were conducted by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) from November 28, 2000 through December 9, 2000.

The environmental samples collected for this investigation were submitted to O'Brien & Gere Laboratories, Inc. (O'Brien & Gere Labs) of Syracuse, New York for radiochemistry analyses including gamma spectrometry; thorium 228, 230, and 232; and uranium 234, 235, and 238 using Los Alamos National Laboratory (LANL), United States Environmental Protection Agency (USEPA), and United States Department of Energy (USDOE) Methods. The analytical data generated for this investigation were evaluated by O'Brien & Gere using the quality assurance/quality control (QA/QC) criteria established in the methods as guidance. Excursions from the QA/QC criteria were qualified based on guidance provided in the USDOE *Guidance For Radiochemical Data Validation*, RD4, and the Science Applications International Corporation (SAIC) *Laboratory Data Validation Guidelines For Evaluating Radionuclide Analyzes*, 143-ARCS-92.01, Revision 05.

Since radium-226 is a gamma emitter that is interfered with by the presence of uranium-235, the results for isotope radium-226 were generated by O'Brien & Gere Engineers. The radium-226 results were calculated using the average of the results from the forth and fifth daughters, bismuth-214 and lead-214, respectively. The daughters were used to report radium-226 for the following reasons: the isotopes were assumed to be in equilibrium by the time of sample analysis, they have multiple emission lines, and they have comparable detection limits.

The results for isotope radium-226 were not reported by O'Brien & Gere's laboratory for environmental samples and field duplicates in the final data packages. Data validation was performed on the data provided by the laboratory. Qualifiers, which were applied to the laboratory results for bismuth-214 and lead-214 due to the analysis excursions, including laboratory control sample and field duplicate excursions, were transposed to the radium-226 results generated by O'Brien & Gere Engineers. Qualifiers resulting from blank contamination were only applied to the laboratory results of bismuth-214 and lead-214 as the result of the evaluation of the associated blanks analyzed by the laboratory.

Overall, 100 percent of the radiochemistry data were determined to be usable for qualitative and quantitative purposes.

1. Introduction

1.1. Sample identification

This report addresses the results of a data quality evaluation for soil samples collected at the former Sylvania Electric Products Incorporated facility in Hicksville, New York. Sample collection activities were conducted by O'Brien & Gere Engineers, Inc. (O'Brien & Gere) from November 28, 2000 through December 9, 2000.

The quantity and types of samples that were submitted for data validation are presented in Table 1-1 below.

Table 1-1. *Sample cross-reference list*

Package Identification	*Date Collected*	*Client ID*	*Laboratory ID*	*Analysis Requested*
7511	11/28/00	SB-110 (21-22)	R6328	Gamma
	11/28/00	SB-111 (0-4) ≈ 2'	R6332	Gamma
	11/28/00	SB-112 [2'-3']	R6335	Gamma
	11/28/00	SB-113 (13.5'-14')	R6341	Gamma, Alpha
	11/29/00	SB 115 (8-12')	R6454	Gamma
	11/29/00	SB 116 (16'-20')	R6456	Gamma
	11/29/00	SB-114 (20')	R6459	Gamma
	11/29/00	SB-113B (16'-20')	R6460	Gamma
	11/29/00	SB-113C (12'-16')	R6461	Gamma
	11/29/00	SB-117 (12')	R6463	Gamma
	11/30/00	SB-118 (17.5'-20.0')	R6505	Gamma
	11/30/00	SB-120 (12'-16')	R6508	Gamma, Alpha
	11/30/00	SB-119 (12'-16')	R6512	Gamma
	11/30/00	SB-120D (12'-16') [SB-120(12'-16')]	R6513	Gamma
	12/1/00	SB-124 (12'-16')	R6527	Gamma
	12/1/00	SB-125 (≈ 4')	R6529	Gamma
	12/1/00	SB-121 (18'-20')	R6533	Gamma

Table 1-1. *Sample cross-reference list*

Package Identification	Date Collected	Client ID	Laboratory ID	Analysis Requested
7511	12/1/00	SB-122 (12'-16')	R6534	Gamma
	12/1/00	SB-123 (8'-12')	R6536	Gamma
	12/1/00	SB-129 (2-3')	R6537	Gamma
	12/4/00	SB-148 (9')	R6626	Gamma
	12/4/00	SB-149 (6')	R6628	Gamma
	12/4/00	SB-150 (1'-2')	R6630	Gamma
	12/4/00	SB-151 (1')	R6632	Gamma, Alpha
	12/4/00	SB-152 1' (8"-14")	R6638	Gamma
	12/4/00	SB-153 (0.5'-2')	R6639	Gamma
	12/4/00	SB-153D (8-16') [SB-153(0.5'-2')]*	R6641	Gamma
	12/4/00	SB-154 (4'-8')	R6642	Gamma
	12/4/00	SB-146A (1')	R6644	Gamma
	12/4/00	SB-146B (1')	R6647	Gamma
	12/4/00	SB-146C (2')	R6648	Gamma
	12/3/00	SB-141 (16'-20')	R6650	Gamma
	12/3/00	SB-142 (8'-12')	R6653	Gamma
	12/3/00	SB-143 (4'-8')	R6654	Gamma
	12/3/00	SB-138 (16'-20')	R6656	Gamma
	12/3/00	SB-139 (4')	R6658	Gamma
	12/3/00	SB-140 (4')	R6659	Gamma
	12/6/00	SB-147 (16'-20')	R6823	Gamma
	12/6/00	SB-155 (4'-8')	R6824	Gamma
	12/6/00	SB-157 (12'-16')	R6825	Gamma
	12/6/00	SB-156 (4'-8')	R6829	Gamma
	12/6/00	SB-144 (6')	R6832	Gamma
	12/6/00	SB-159 (8'-12')	R6834	Gamma
	12/6/00	SB-130 (16'-20')	R6836	Gamma
	12/7/00	SB 131 (4'-8')	R6895	Gamma
	12/7/00	SB 127 (0'-4')	R6897	Gamma
	12/7/00	SB 133 (0'-4')	R6898	Gamma

Table 1-1. *Sample cross-reference list*

Package Identification	Date Collected	Client ID	Laboratory ID	Analysis Requested
7511	12/7/00	SB 134 (12'-16')	R6901	Gamma
	12/7/00	SB 134D (16'-20') [SB-134(12'-16')]*	R6902	Gamma
	12/7/00	SB 128 (0'-4')	R6903	Gamma
	12/7/00	SB-132 (≈1')	R6905	Gamma
	12/7/00	SB-135 (8-12)	R6906	Gamma
	12/9/00	SB-169 (12'-16')	R6938	Gamma
	12/9/00	SB-145 (12-16')	R6937	Gamma
	12/8/00	SB-126 (16'-20')	R6947	Gamma
	12/8/00	SB-126 (16'-20'), MS/MSD	R6947	Gamma
	12/8/00	SB-160 (0'-4')	R6948	Gamma
	12/8/00	SB-161 (0'-4')	R6949	Gamma
	12/8/00	SB-162 (0'-4')	R6950	Gamma
	12/8/00	SB-162 (0'-4'), MS/MSD	R6950	Gamma
	12/8/00	SB-163 (0'-4')	R6951	Gamma, Alpha
	12/8/00	SB-164 (0'-4')	R6952	Gamma
	12/8/00	SB-165 (0'-4')	R6953	Gamma
	12/8/00	SB-161D (16'-20') [SB-161(0'-4')]*	R6954	Gamma
	12/8/00	SB-166 (8'-12')	R6955	Gamma
	12/8/00	SB-158 (16'-20')	R6956	Gamma
	12/8/00	SB-136 (0'-4')	R6958	Gamma
	12/8/00	SB-137 (0'-4')	R6959	Gamma

Notes:
Gamma indicates Gamma Spectrometry.
Alpha indicates Alpha Spectrometry of thorium (isotopic) and uranium (isotopic).
MS/MSD indicates Matrix Spike/Matrix Spike Duplicate
* Indicates that field sampler identified blind field duplicate sample using false depth information.

1.2. General considerations

Validation is a process of determining the suitability of a measurement system for providing useful analytical data. Although the term is frequently used in discussing methodologies, it applies to all aspects of the system and especially to samples, their measurement, and the actual data output. Accordingly, for the samples and analyses addressed herein, this report outlines deviations from the applicable QC criteria outlined in the following documents:

- Los Alamos National Laboratory (LANL). 1995. *Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance*, LA-10300-M, Vol.II. Los Alamos, New Mexico.

- O'Brien & Gere Engineers, Inc. 2000. Supplement to the Approved Work Plan (QAPP – Appendix C), Former Sylvania Electric Products Incorporated Facility Cantiague Rock Road, Hicksville, New York. Syracuse, New York.

- United States Department of Energy (USDOE). 1990. Environmental Measurements Laboratory (EML) Procedures Manual, 27th Edition, Volume 1. New York, New York.

- United States Environmental Protection Agency (USEPA). 1980. *Prescribed Procedures for the Measurement of Radioactivity in Drinking Water*, EPA-600/4-80-032. Washington D.C.

Deviations from the QA/QC criteria were qualified based on guidance provided in the following documents:

- Science Applications International Corporation (SAIC). 1992. *Laboratory Data Validation Guidelines for Evaluating Radionuclide Analyzes*, 143-ARCS-92.01, Revision 05. Oak Ridge, Tennessee.

- USDOE. 1995. *Guidance for Radiochemical Data Validation*, RD4. Gaithersburg, Maryland.

1.3. Analytical methods

The environmental samples collected for this investigation were submitted to O'Brien & Gere Laboratories, Inc. of Syracuse, New York for radiochemistry analyses including gamma spectrometry, and alpha spectrometry (thorium 228, 230, and 232, and uranium 234, 235, and 238) using LANL, USDOE and USEPA Methods. The methods used in this investigation are presented in Table 1-2.

Table 1-2. *Analytical method references*

Parameter	*Method*	*Reference*
Gamma spectrometry	LANL ER-130 modified, 901.1 modified	1, 3
Thorium 228, 230, 232	EML TH-01 modified, 907.0	2, 3
Uranium 233/234, 235/236, 238	EML U-02 modified, 907.0	2, 3

Notes:
1. Los Alamos National Laboratory (LANL). 1995 Health and Environmental Chemistry: Analytical Techniques, Data Management, and Quality Assurance, LA-10300-M, Vol. II. Los Alamos, New Mexico.
2. United States Department of Energy (USDOE). 1990. *Environmental Measurements Laboratory (EML) Procedures Manual,* 27th Edition, Volume 1.New York, New York.
3. United States Environmental Protection Agency (USEPA). 1980. *Prescribed Procedures for the Measurement of Radioactivity in Drinking Water,* EPA-600/4-80-032. Washington D.C.

The following chapters of this document address distinct aspects of the validation process. Chapter 2 lists the data QA/QC protocols used to validate the sample data. Specific QA/QC deviations and qualifications performed on the sample data are discussed in Chapter 3. Data completeness and usability are discussed in Chapter 4. Chapter 5 presents the Data Usability Summary Report (DUSR) Summary Information. The samples submitted for gamma spectrometry analyses that were qualified as a result of blank excursions are summarized in Appendix A.

2. Data validation protocols

2.1. Sample analysis parameters

The validation of analyses for this project used guidance presented in the QAPP (O'Brien & Gere 2000), the analytical methodology, and the data validation guidelines referenced in Chapter 1 herein.

The following QA/QC parameters were evaluated for the radiochemistry (gamma spectrometry, alpha spectrometry) analyses (where applicable):

- Holding times and sample preservation,
- Calibration
- Blank analysis
- Tracer recovery (alpha spectrometry)
- Laboratory Control Sample (LCS)
- Matrix spike (MS) analysis
- Duplicate analysis
- Field duplicate analysis
- Radionuclide quantitation and detection evaluation
- Chemical separation specificity (alpha spectrometry)
- Target radionuclide list identification (gamma spectrometry)
- Tentatively identified radionuclides (gamma spectrometry)
- System performance
- Documentation completeness

Since radium-226 is a gamma emitter that is interfered with by the presence of uranium-235, the results for isotope radium-226 were generated by O'Brien & Gere Engineers. The radium-226 results were calculated using the average of the results from the forth and fifth daughters, bismuth-214 and lead-214, respectively. Bismuth-214 and lead-214 were used to report radium-226 for the following reasons: the isotopes were assumed to be in equilibrium by the time of sample analysis, they have multiple emission lines, and they have comparable detection limits.

The results for isotope radium-226 were not reported by O'Brien & Gere's laboratory for environmental samples and field duplicates in the final data packages. Data validation was performed on the laboratory data. Qualifiers which were applied to the laboratory results for bismuth-214 and lead-214 due to the analysis excursions, including laboratory control sample and field duplicate excursions, were transposed to the

radium-226 results generated by O'Brien & Gere Engineers. Qualifiers resulting from blank contamination were only applied to the laboratory results of bismuth-214 and lead-214 as the result of the evaluation of the associated blanks analyzed by the laboratory.

2.2. Data validation qualifiers

The following guidelines are used regarding the assignment of qualifiers and the use of qualified data:

- In a case when several qualifiers are applicable to the same analyte, the cumulative effect of the various QA/QC excursions is employed in assigning the final data qualifiers. For example, if a sample result is affected by blank contamination for which the "BU" qualifier is applied, but LCS excursions result in the qualification of the sample result as approximate (application of the "J" qualifier), the final data qualifier is the "BUJ" qualifier.

- QA/QC excursions which do not result in the qualification of an analyte, or which result in additional qualification of the analyte with the same qualifier, are not discussed.

- The use of approximated analytical data for quantitative uses is consistent with the guidance presented in the *USEPA Risk Assessment Guidance for Superfund* (USEPA 1992).

The following qualifiers have been used in this data validation.

"BU" This qualifier is applied when blank results are statistically evaluated and when the associated sample result is qualified as a result of the blank evaluation to indicate an approximate result. This qualifier can be interpreted as meaning that there is no statistical difference between the sample result and the blank result.

"J" An unusually uncertain result is assigned a J qualifier.

"JI" Indicates that the result should be considered approximate due to the presence of peak interference or radionuclides detected using three energy lines or less in the gamma spectrometry data.

2.3. Data Usability Summary Report (DUSR) questions

The DUSR determines whether or not the data meets site-specific criteria for data quality and use.

The DUSR was developed by reviewing and evaluating the analytical data packages. During the course of this review the following questions were addressed:

1. Is the data package complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables?
2. Have all holding times been met?
3. Do all the QC data: blanks, instrument tunings, calibration standards, calibration verifications, surrogate recoveries, spike recoveries, replicate analyses, laboratory controls and sample data fall within the protocol required limits and specifications?
4. Have all of the data been generated using established and agreed upon analytical protocols?
5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?
6. Have the correct data qualifiers been used?

The answers to the questions presented by the DUSR are presented in the following sections of the report and in the DUSR Summary section in Chapter 5.

3. Data quality evaluation

3.1. Summary

This chapter summarizes the QA/QC parameters, validation criteria, and qualifications applied to the sample data. It is organized and discusses observations on the basis of gamma spectrometry and alpha spectrometry, respectfully. It describes those parameters found to meet the validation criteria and identifies when the QA/QC parameters specified in Section 2 that did not meet criteria. Samples that required qualification are described in the following sections, and are identified by the description documented on the sample chain-of-custody records.

3.2. Gamma spectrometry analyses

3.2.1. Criteria

The QA/QC parameters presented in Section 2.1 for radiochemistry were applied to the environmental samples listed in Table 1-1. The following QA/QC parameters were found to meet validation criteria:

- Holding times and sample preservation,
- Calibration
- Radionuclide quantitation and detection evaluation
- System performance

3.2.2. Blank analysis

The blank results were evaluated using the following statistical approach: if the sample result minus the blank result was less than two times the quadratic sum of the sample and blank errors, the qualifier "BU" was applied to the sample result. The "two times" factor can be interpreted in terms of a confidence limit that the true sample result is greater than the true blank result. Assuming a Gaussian distribution for the errors, the two factor corresponds to a 99% confidence limit that the true sample result is greater than the true blank result. The samples qualified as a result of the statistical evaluation of the blank results are summarized in the table in Appendix A.

3.2.3. LCS analysis

The LCS results were evaluated using the following statistical approach: if the absolute value of the LCS recovery value minus the expected LCS recovery value was greater than two times the quadratic sum of the errors of the results, the qualifier "J" was applied to the sample result associated with the LCS analysis. The radionuclide radium-226, which was used to prepare the LCS samples, was used to represent the response of the remaining gamma spectrometry isotopes. The samples qualified as a result of the statistical evaluation of the LCS results are summarized in the following table:

Table 3-1. LCS evaluation for gamma spectrometry analyses

LCS ID	*Affected sample results*	*Action*
L121400S1D	SB-149 (6') SB-154 (4'-8') SB-146A (1') SB-146B (1') SB-141 (16'-20') SB-142 (8'-12') SB-143 (4'-8') SB-138 (16'-20) SB-140 (4')	J
L121400S1E	SB-147 (16-20') SB-155 (4'-8') SB-157 (12'-16') SB-156 (4'-8') SB-159 8'-12') SB-130 (16'-20') SB-131 (4'-8') SB-127 (0'-4') SB-134 (12'-16') SB 134D (16'-20') [SB-134(12'-16')]* SB-132 (=1') SB-135 (8-12)	J

Note:
Target analytes qualified for each affected sample include Actinium-228, bismuth-211, bismuth-212, bismuth-214, cesium-137, francium-223, lead-210, lead-211, lead-212, lead-214, potassium-40, protactinium-231, protactinium-234, protactinium-234m, radium-223, radium-224, thallium-208, thorium-227, thorium-231, thorium-234, uranium-235.

3.2.4. Matrix spike analysis

Matrix spike samples that were collected for this investigation were designated only for gamma spectrometry analysis. In accordance with gamma spectrometry methods, MS analysis is not performed for gamma spectrometry. The collection and designation of samples for MS analysis had no impact on the validation of the data.

3.2.5. Duplicate analysis

The duplicate results were evaluated using the following statistical approach: if the ratio of the absolute value of the difference between the duplicate results and the quadratic sum of the errors of the results, or

relative error ratio (RER), was greater than 3, the qualifier "J" was applied to the associated sample result. In the case that there was a result for one of the samples and the other was not detected, the minimum detectable concentration (MDC) was used from the non-detected result for the calculation.

Since the original duplicate results failed laboratory criteria, the laboratory repeated the duplicate analyses. The second set of duplicate samples also failed laboratory criteria. Both results were reported in the data package.

The samples qualified as a result of the statistical evaluation of the duplicate results are summarized in the following table:

Table 3-2. *Duplicate evaluation for gamma spectrometry analyses*

Duplicate ID	Radionuclide	RER	Affected sample results	Action
SB-126((16'-20') SB-162(0'-4')	Radium-224	3.5 7.0	SB-126(16'-20')	J
			SB-160(0'-4')	J
			SB-162(0'-4')	J
			SB-163(0'-4')	J
			SB-164(0'-4')	J
			SB-165(0'-4')	J
			SB-161D(16'-20')	J
			SB-166(8'-12')	J
			SB-136(0'-4')	J
			SB-137(0'-4')	J
			SB-145(12'-16')	J
			SB-169(12'-16')	J
			SB-161(0'-4')	J
			SB-158(16'-20')	J

Note: RER indicates relative error ratio.

3.2.6. Field duplicate analysis

The field duplicate results were evaluated using the following statistical approach: if the ratio of the absolute value of the difference between the duplicate results and the quadratic sum of the errors of the results, or relative error ratio (RER), was greater than 3, the qualifier "J" was applied to the field duplicate and the associated sample. In the case that

there was a result for one of the samples and the other was not detected, the minimal detectable concentration (MDC) was used from the non-detected result for the calculation.

Qualification of the native sample and the associated field duplicate sample, performed as a result of the statistical evaluation of the field duplicate results, are summarized in the following table:

Table 3-3. *Field duplicate evaluation for gamma spectrometry analyses*

Field Duplicate ID	Radionuclide	RER	Action
SB-120D (12'-16')/ SB-120(12'-16')	Actinium-228	3 85E-02	J
	Bismuth-214	5.46E-03	J
	Cesium-137	6 54E-06	J
	Lead-211	4.12E-01	J
	Lead-214	8 32	J
	Potassium-40	4.45E+01	J
	Protactinium-231	1.59E-01	J
	Protactinium-234	4 01E-01	J
	Protactinium-234m	4.34E+01	J
	Radium-224	5.71	J
	Thallium-208	3.73	J
	Thorium-231	4.11E-01	J
	Thorium-234	3.51E+03	J
SB-153D (8'-16')/ SB-153(0.5'-2')	Actinium-228	6.02E-01	J
	Bismuth-211	3.45E+01	J
	Bismuth-212	9.56E+00	J
	Bismuth-214	3.51E-03	J
	Cesium-137	4.00E-02	J
	Lead-211	5.35E-02	J
	Lead-214	4.92E-02	J
	Radium-223	3.75E-02	J
	Thorium-227	7.61E-03	J
	Thorium-231	3.31E-01	J
	Thorium-234	3.98E+01	J

Table 3-3. *Field duplicate evaluation for gamma spectrometry analyses*

Field Duplicate ID	Radionuclide	RER	Action
SB-134D (16'-20')/ SB-134(12'-16')	Actinium-228	4.76E-02	J
	Bismuth-212	3.33	J
	Bismuth-214	8.76E-01	
	Francium-223	3.08	
	Lead-210	3.23E+02	
	Lead-212	7.72E-01	
	Lead-214	3.82E+01	
	Potassium-40	4.56E+01	
	Protactinium-234	9.47E-01	
	Radium-224	5.05E-01	
	Thallium-208	3.54	
	Thorium-227	3 33	
	Uranium-235	5.42	
SB-161D (16'-20')/ SB-161(0'-4')	Bismuth-212	4.63	
	Bismuth-214	8.02	
	Cesium-137	9.20E-02	
	Francium-223	3.89E-01	
	Lead-210	3.35	
	Lead-211	6.25	
	Lead-212	5.29E-03	
	Protactinium-231	7.50E-01	
	Protactinium-234	5.93E-01	
	Protactinium-234m	6.61	
	Thallium-208	4.23E-02	
	Thorium-231	9.35E-02	

Note:
RER indicates relative error ratio.

3.2.7. Target radionuclide list identification

The radiochemical data generated for this investigation was evaluated for gamma peak interference. For this investigation, the gamma spectrometry data was corrected for uranium-235. In addition, radionuclides detected by gamma spectrometry with three or less energy lines include potassium-40, lead-210, bismuth-211, lead-211, bismuth-212, radium-224, protactinium-231, thorium-231, thorium-234, cesium-137, thallium-208, francium-223, and protactinium-234m. In the case that gamma peaks that interfere with the quantitation of the radionuclide of interest, or radionuclides detected using three energy lines or less are present, and correction was not performed, the result is qualified as "JI". Qualifiers applied to sample results as a result of gamma peak interference or energy line evaluation are summarized in the following table:

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB 110 (21-22)	Potassium-40	1.00E+01	JI
SB 110 (21-22)	Thorium-231	2.00E+00	JI
SB 110 (21-22)	Thorium-234	1.70E+01	JI
SB 110 (21-22)	Protactinium-234m	3.3E+01	JI
SB-111 (0-4') =2'	Potassium-40	1.30E+01	JI
SB-111 (0-4') =2'	Radium-224	7.30E+00	JI
SB-111 (0-4') =2'	Thallium-208	1.4E+00	JI
SB-111 (0-4') =2'	Thorium-231	5.30E+00	JI
SB-111 (0-4') =2'	Thorium-234	8.20E+01	JI
SB-112 (2'-3')	Bismuth-212	6.00E+00	JI
SB-112 (2'-3')	Potassium-40	9.70E+00	JI
SB-112 (2'-3')	Thallium-208	1.00E+00	JI
SB-112 (2'-3')	Protactinium-234m	1.20E+02	JI
SB-112 (2'-3')	Radium-224	6.00E+00	JI
SB-112 (2'-3')	Thorium-231	5.80E+00	JI
SB-112 (2'-3')	Thorium-234	6.30E+01	JI
SB-113 (13 5'-14')	Bismuth-212	5.70E+01	JI
SB-113 (13.5'-14')	Cesium-137	1.50E-01	JI
SB-113 (13.5'-14')	Thallium-208	1.30E+01	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-113 (13.5'-14')	Francium-223	1.30E+00	JI
SB-113 (13.5'-14')	Protactinium-234m	4.50E+02	JI
SB-113 (13.5'-14')	Potassium-40	1.40E+01	JI
SB-113 (13.5'-14')	Protactinium-231	3.10E+01	JI
SB-113 (13.5'-14')	Radium-224	5.50E+01	JI
SB-113 (13.5'-14')	Thorium-234	2.70E+02	JI
SB-115 (8'-12')	Potassium-40	7.60E+00	JI
SB-116 (16-20')	Cesium-137	1.20E-02	JI
SB-116 (16-20')	Potassium-40	5.40E+00	JI
SB-114(20')	Potassium-40	6.00E+00	JI
SB-113B (16'-20')	Potassium-40	4.30E+00	JI
SB-113C (12'-16')	Bismuth-212	1.00E+01	JI
SB-113C (12'-16')	Thallium-208	2.20E+00	JI
SB-113C (12'-16')	Protactinium-234m	1.30E+02	JI
SB-113C (12'-16')	Potassium-40	7.70E+00	JI
SB-113C (12'-16')	Radium-224	1.40E+01	JI
SB-113C (12'-16')	Thorium-231	4.90E+00	JI
SB-113C (12'-16')	Thorium-234	7.20E+01	JI
SB-117 (12')	Potassium-40	8.20E+00	JI
SB-117 (12')	Thallium-208	2.00E-01	JI
SB-117 (12')	Thorium-234	5.70E+00	JI
SB-118 (17.5'-20.0')	Potassium-40	8.10E+00	JI
SB-118 (17.5'-20.0')	Radium-224	4.70E+00	JI
SB-118 (17.5'-20.0')	Thallium-208	9.80E-02	JI
SB-118 (17.5'-20.0')	Thorium-234	5.60E+00	JI
SB-120 (12'-16')	Potassium-40	5.90E+00	JI
SB-120 (12'-16')	Protactinium-234m	1.40E+02	JI
SB-120 (12'-16')	Thorium-231	6.40E+00	JI
SB-120 (12'-16')	Thorium-234	8.00E+01	JI
SB-119 (12'-16')	Francium-223	7.60E-01	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-119 (12'-16')	Protactinium-234m	2.2E+02	JI
SB-119 (12'-16')	Potassium-40	8.90E+00	JI
SB-119 (12'-16')	Radium-224	1.10E+01	JI
SB-119 (12'-16')	Thorium-231	1.20E+01	JI
SB-119 (12'-16')	Thorium-234	1.60E+02	JI
SB-120D (12'-16')	Thallium-208	2.70E-01	JI
SB-120D (12'-16')	Protactinium-234m	6.10E+01	JI
SB-120D (12'-16')	Potassium-40	8.30E+00	JI
SB-120D (12'-16')	Thorium-234	4.00E+01	JI
SB-124 (12'-16')	Potassium-40	9.60E+00	JI
SB-124 (12'-16')	Thorium-234	9 30E+00	JI
SB-125 (=4')	Potassium-40	7.70E+00	JI
SB-125 (=4')	Thallium-208	2.60E-01	JI
SB-121 (18'-20')	Potassium-40	7.60E+00	JI
SB-121 (18'-20')	Thorium-234	1.30E+01	JI
SB-122 (12'-16')	Potassium-40	5.70E+00	JI
SB-123 (8'-12')	Potassium-40	5.90E+00	JI
SB-129 (2-3')	Thallium-208	6.40E-01	JI
SB-129 (2-3')	Protactinium-234m	7.10E+01	JI
SB-129 (2-3')	Potassium-40	8.40E+00	JI
SB-129 (2-3')	Thorium-231	3.60E+00	JI
SB-129 (2-3')	Thorium-234	4.10E+01	JI
SB-148 (9')	Potassium-40	7.20E+00	JI
SB-148 (9')	Thallium-208	9 80E-02	JI
SB-148 (9')	Radium-224	3.80E+00	JI
SB-148 (9')	Thorium-231	3.00E+00	JI
SB-148 (9')	Thorium-234	2 70E+00	JI
SB-149 (6')	Potassium-40	9.30E+00	JI
SB-149 (6')	Thallium-208	1 80E-01	JI
SB-150 (1'-2')	Bismuth-212	1.70E+00	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-150 (1'-2')	Potassium-40	9.40E+00	JI
SB-150 (1'-2')	Radium-224	2.10E+01	JI
SB-150 (1'-2')	Thallium-208	5.30E-01	JI
SB-150 (1'-2')	Thorium-234	9.40E+00	JI
SB-151 (1')	Bismuth-212	2.00E+01	JI
SB-151 (1')	Potassium-40	1.20E+01	JI
SB-151 (1')	Protactinium-231	7.50E+00	JI
SB-151 (1')	Thallium-208	5.20E+00	JI
SB-151 (1')	Protactinium-234m	5.90E+01	JI
SB-151 (1')	Radium-224	1.80E+02	JI
SB-151 (1')	Thorium-231	1.00E+01	JI
SB-151 (1')	Thorium-234	1.60E+01	JI
SB-152 1' (8"-14")	Bismuth-212	1.40E+01	JI
SB-152 1' (8"-14")	Potassium-40	9.80E+00	JI
SB-152 1' (8"-14")	Protactinium-231	4.00E+00	JI
SB-152 1' (8"-14")	Radium-224	1.40E+02	JI
SB-152 1' (8"-14")	Thorium-231	1.40E+01	JI
SB-152 1' (8"-14")	Thallium-208	4.20E+00	JI
SB-152 1' (8"-14")	Protactinium-234m	1.20E+02	JI
SB-152 1' (8"-14")	Thorium-234	7.70E+01	JI
SB-153 (0.5'-2')	Bismuth-212	4.90E+00	JI
SB-153 (0.5'-2')	Potassium-40	9.00E+00	JI
SB-153 (0.5'-2')	Radium-224	4.30E+01	JI
SB-153 (0.5'-2')	Thallium-208	1.20E+00	JI
SB-153 (0.5'-2')	Protactinium-234m	9.20E+01	JI
SB-153 (0.5'-2')	Thorium-234	5.70E+01	JI
SB-153D (8-16')	Bismuth-212	9.50E+00	JI
SB-153D (8-16')	Potassium-40	9.60E+00	JI
SB-153D (8-16')	Radium-224	7.80E+01	JI
SB-153D (8-16')	Cesium-137	1.40E-01	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-153D (8-16')	Thallium-208	2.30E+00	JI
SB-153D (8-16')	Protactinium-234m	1.20E+02	JI
SB-153D (8-16')	Thorium-231	3.40E+00	JI
SB-153D (8-16')	Thorium-234	2 80E+01	JI
SB-154 (4'-8')	Potassium-40	8.00E+00	JI
SB-154 (4'-8')	Radium-224	2.60E+00	JI
SB-154 (4'-8')	Thallium-208	2.10E-01	JI
SB-146A (1')	Potassium-40	9.50E+00	JI
SB-146A (1')	Radium-224	1.40E+01	JI
SB-146A (1')	Thallium-208	3.90E-01	JI
SB-146A (1')	Protactinium-234m	1.40E+01	JI
SB-146B (1')	Bismuth-212	1.70E+00	JI
SB-146B (1')	Thallium-208	2.60E-01	JI
SB-146B (1')	Protactinium-234m	1.20E+01	JI
SB-146B (1')	Potassium-40	8.00E+00	JI
SB-146B (1')	Radium-224	2.20E+00	JI
SB-146B (1')	Thorium-234	7.80E+00	JI
SB-146C (2')	Potassium-40	1.10E+01	JI
SB-146C (2')	Thallium-208	5.90E-01	JI
SB-146C (2')	Radium-224	1.90E+01	JI
SB-141 (16'-20')	Potassium-40	5.10E+00	JI
SB-141 (16'-20')	Radium-224	1.40E+00	JI
SB-142 (8'-12)	Potassium-40	8 40E+00	JI
SB-142 (8'-12)	Radium-224	2.90E+00	JI
SB-142 (8'-12)	Potassium-40	1.00E+01	JI
SB-142 (8'-12)	Thallium-208	1.60E-01	JI
SB-142 (8'-12)	Radium-224	1 80E+00	JI
SB-138 (16'-20)	Potassium-40	8.30E+00	JI
SB-138 (16'-20)	Thallium-208	1.20E-01	JI
SB-138 (16'-20)	Radium-224	1 50E+00	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-139 (4')	Potassium-40	8.70E+00	JI
SB-139 (4')	Radium-224	1.70E+01	JI
SB-139 (4')	Thorium-234	9.10E+00	JI
SB-139 (4')	Thallium-208	5.20E-01	JI
SB-139 (4')	Protactinium-234m	2.50E+01	JI
SB-140 (4')	Potassium-40	9.50E+00	JI
SB-140 (4')	Radium-224	7.30E+00	JI
SB-140 (4')	Protactinium-234m	1.30E+01	JI
SB-140 (4')	Thorium-234	2.90E+00	JI
SB-147 (16-20')	Potassium-40	6.10E+00	JI
SB-155 (4'-8')	Potassium-40	9.20E+00	JI
SB-155 (4'-8')	Thallium-208	2.70E-01	JI
SB-155 (4'-8')	Radium-224	8.30E+00	JI
SB-157 (12'-16')	Potassium-40	8.00E+00	JI
SB-157 (12'-16')	Radium-224	1.40E+00	JI
SB-156 (4'-8')	Potassium-40	6.90E+00	JI
SB-156 (4'-8')	Thallium-208	1.60E-01	JI
SB-156 (4'-8')	Radium-224	1.20E+00	JI
SB-144 (6')	Potassium-40	8.40E+00	JI
SB-144 (6')	Thallium-208	6.20E-01	JI
SB-144 (6')	Protactinium-234m	3.10E-01	JI
SB-159 (8'-12')	Potassium-40	6.80E+00	JI
SB-159 (8'-12')	Radium-224	1.00E+01	JI
SB-159 (8'-12')	Thallium-208	3.90E-01	JI
SB-159 (8'-12')	Thorium-234	2.70E+00	JI
SB-130 (16'-20')	Potassium-40	1.20E+01	JI
SB-130 (16'-20')	Radium-224	2.90E+00	JI
SB-131 (4'-8')	Potassium-40	9.60E+00	JI
SB-131 (4'-8')	Radium-224	1.80E+00	JI
SB-127 (0'-4')	Potassium-40	7.80E+00	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-127 (0'-4')	Thallium-208	2.20E-01	JI
SB-127 (0'-4')	Protactinium-234m	4.20E+01	JI
SB-127 (0'-4')	Thorium-234	2.20E+01	JI
SB-133 (0'-4')	Potassium-40	1 00E+01	JI
SB-133 (0'-4')	Radium-224	4.80E+00	JI
SB-133 (0'-4')	Thorium-231	4.50E+00	JI
SB-133 (0'-4')	Thallium-208	7.80E-01	JI
SB-133 (0'-4')	Protactinium-234m	1.10E+02	JI
SB-133 (0'-4')	Thorium-234	7 30E+01	JI
SB-134 (12'-16')	Potassium-40	6.00E+00	JI
SB-134 (12'-16')	Thallium-208	2 00E-01	JI
SB-134 (12'-16')	Radium-224	3.80E+00	JI
SB-134D (16'-20')	Potassium-40	7.30E+00	JI
SB-128 (0'-4')	Potassium-40	1.50E+01	JI
SB-128 (0'-4')	Thallium-208	4.70E-01	JI
SB-128 (0'-4')	Radium-224	2.60E+00	JI
SB-132 (=1')	Potassium-40	9.30E+00	JI
SB-132 (=1')	Thallium-208	2.90E-01	JI
SB-132 (=1')	Thorium-234	6.40E+00	JI
SB-135 (8-12)	Potassium-40	9 00E+00	JI
SB-135 (8-12)	Radium-224	1.70E+00	JI
SB-145 (12'-16')	Bismuth-212	1.00E+01	JI
SB-145 (12'-16')	Potassium-40	5 80E+00	JI
SB-145 (12'-16')	Thallium-208	3 60E+00	JI
SB-145 (12'-16')	Protactinium-234m	2 20E-03	JI
SB-145 (12'-16')	Protactinium-231	9 00E+00	JI
SB-145 (12'-16')	Thorium-234	1.20E+03	JI
SB-169 (12'-16')	Potassium-40	6.40E+00	JI
SB-169 (12'-16')	Thallium-208	6.10E-01	JI
SB-169 (12'-16')	Protactinium-234m	1 20E+02	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-169 (12'-16')	Thorium-231	7.10E+00	JI
SB-169 (12'-16')	Thorium-234	6.70E+01	JI
SB-126 (16'-20')	Potassium-40	8.10E+00	JI
SB-126 (16'-20')	Radium-224	5.50E+00	JI
SB-126 (16'-20')	Thorium-234	7.20E+00	JI
SB-160 (0'-4')	Potassium-40	9.10E+00	JI
SB-160 (0'-4')	Thallium-208	4.00E-01	JI
SB-160 (0'-4')	Radium-224	1.10E+01	JI
SB-161 (0'-4')	Potassium-40	1.00E+01	JI
SB-161 (0'-4')	Thallium-208	5.10E-01	JI
SB-162 (0'-4')	Potassium-40	1.20E+01	JI
SB-162 (0'-4')	Thallium-208	4.30E-01	JI
SB-162 (0'-4')	Radium-224	1.30E+01	JI
SB-163 (0'-4')	Potassium-40	8.60E+00	JI
SB-163 (0'-4')	Radium-224	4.80E+00	JI
SB-163 (0'-4')	Thorium-231	1.80E+01	JI
SB-163 (0'-4')	Thallium-208	3.70E-01	JI
SB-163 (0'-4')	Protactinium-234m	4.70E+2	JI
SB-163 (0'-4')	Thorium-234	2.60E+02	JI
SB-164 (0'-4')	Potassium-40	1.10E+01	JI
SB-164 (0'-4')	Thallium-208	3.80E-01	JI
SB-164 (0'-4')	Radium-224	2.70E+00	JI
SB-165 (0'-4')	Potassium-40	1.40E+01	JI
SB-165 (0'-4')	Radium-224	1.20E+01	JI
SB-165 (0'-4')	Thorium-234	7.50E+00	JI
SB-161D (16'-20')	Potassium-40	1.00E+01	JI
SB-161D (16'-20')	Radium-224	2.40E+00	JI
SB-161D (16'-20')	Thallium-208	3.80E-01	JI
SB-161D (16'-20')	Thorium-234	1.40E+01	JI
SB-166 (8'-12')	Lead-210	5.10E+00	JI

Table 3-4. *gamma spectrometry interference and energy lines evaluation*

Sample ID	Radionuclide	Sample Result	Qualifier
SB-166 (8'-12')	Radium-224	5 00E+01	JI
SB-166 (8'-12')	Thorium-231	1.70E+01	JI
SB-166 (8'-12')	Thallium-208	1.90E+00	JI
SB-166 (8'-12')	Protactinium-234m	3.10E+02	JI
SB-166 (8'-12')	Francium-223	3.00E+00	JI
SB-166 (8'-12')	Thorium-234	2.90E+02	JI
SB-158 (16'-20')	Potassium-40	8.00E+00	JI
SB-136 (0'-4')	Potassium-40	1.00E+01	JI
SB-136 (0'-4')	Radium-224	1.80E+01	JI
SB-136 (0'-4')	Thallium-208	4.50E-1	JI
SB-136 (0'-4')	Protactinium-234m	1.30E+02	JI
SB-136 (0'-4')	Thorium-231	4 80E+00	JI
SB-136 (0'-4')	Thorium-234	8.00E+01	JI
SB-137 (0'-4')	Potassium-40	9.30E+00	JI
SB-137 (0'-4')	Radium-224	4.00E+00	JI
SB-137 (0'-4')	Thorium-234	5.90E+00	JI

3.2.8. Tentatively identified radionuclides

Gamma spectra peaks in radionuclide analyses that are not isotopes are potentially tentatively identified radionuclides. These radionuclides are qualitatively identified by a radionuclide spectra library computer search and the identifications assessed by the data reviewer. Tentatively identified radionuclides were not required in this investigation.

3.3. Thorium 228, 230, 232, and uranium 233/234, 235/236, 238 by alpha spectrometry analyses

3.3.1. Criteria

The QA/QC parameters presented in Section 2.1 for radiochemistry were applied to the environmental samples listed in Table 1-1. The following QA/QC parameters were found to meet validation criteria:

- Holding times and sample preservation,
- Calibration
- LCS
- Duplicate analysis
- Chemical separation specificity
- System performance
- Documentation completeness

3.3.2. Blank analysis

The blank results were evaluated using the following statistical approach: if the sample result minus the blank result was less than two times the quadratic sum of the sample and blank errors, the qualifier "BU" was applied to the associated sample result. The "two times" factor can be interpreted in terms of a confidence limit that the true sample result is greater than the true blank result. Assuming a Gaussian distribution for the errors, the two factors correspond to a 99% confidence limit that the true sample result is greater than the true blank result. The statistical evaluation of the blank results are summarized in the following table:

Table 3-5. Blank evaluation for thorium/uranium analyses

Blank ID	Radionuclide	Blank Concentration ± Uncertainty (pCi)	Affected Sample Results	Action
PB013001S3	Thorium-228	4.4E-02 ± 5.1E-02	SB-120 (12-16')	BU

Note:
pCi indicates picocurries
Uncertainty indicates total propagated uncertainty, which includes counting error and non-counting error.
PB indicates method (preparation) blank.

3.3.3. Tracer recovery

The tracer recovery in sample SB-120 (12-16') was greater than the 50-100% recovery criteria. In accordance with the radiochemistry guidelines, results for the sample with a tracer recovery outside of the control limits were qualified as "J". The sample qualified due to tracer recovery excursions are summarized in the following table:

Table 3-6. *Tracer recovery evaluation for thorium/uranium analyses*

Sample ID	Analysis	Recovery	Action
SB-120 (12-16')	Thorium-230	111% R	J
	Thorium-232	111% R	J
	Thorium-228	J	J

Note:
% R indicates percent recovery.

3.3.4. Matrix spike analysis

MS analyses were performed on internal laboratory batch samples using alpha spectrometry analysis and were evaluated during the validation process.

3.3.5. Field duplicate analysis

There were no samples collected for alpha spectrometry field duplicate analysis. Therefore, field precision for samples collected and submitted for alpha spectrometry analysis was not evaluated during the validation process.

3.3.6. Radionuclide quantitation and detection evaluation

Although the minimum sample size used to provide representative subsampling for alpha spectrometry is 1.0 gram for solid samples, the laboratory used 0.1 grams for samples SB-113 (13.5'-14'), SB-120 (12'-16'), SB-151 (1'), and SB-163 (0'-4') that were analyzed for alpha spectrometry. The laboratory used the smaller sample size since the samples were suspected to contain high concentrations of radionuclides. As a result of the smaller sample size, the results reported for the affected samples were qualified as approximate (J). The samples qualified due to sample size are summarized in the following table:

Table 3-7. *Sample size evaluation for thorium/ uranium analyses.*

Sample ID	Analysis	Sample size	Action
SB-113(13.5'-14')	Thorium-228 Thorium-230 Thorium-232	Less than 1.0 gram	J J J
	Uranium-233/234 Uranium-235/236 Uranium-238	Less than 1.0 gram	J J J
SB-120(12'-16')	Thorium-2228 Thorium-230 Thorium-232	Less than 1.0 gram	J J J
	Uranium-233/234 Uranium-235/236 Uranium-238	Less than 1.0 gram	J J J
SB-151(1')	Thorium-228 Thorium-230 Thorium-232	Less than 1.0 gram	J J J
	Uranium-233/234 Uranium-235/236 Uranium-238	Less than 1.0 gram	J J J
SB-163(0'-4')	Thorium-228 Thorium-230 Thorium-232	Less than 1.0 gram	J J J
	Uranium-233/234 Uranium-235/236 Uranium-238	Less than 1 0 gram	J J J

4. Summary and data usability

This chapter summarizes the analytical data in terms of its completeness and usability. Data completeness is defined as the percentage of sample results that have been determined to be usable during the data validation process. Overall, 100 percent of the radiochemistry data were determined to be usable for qualitative and quantitative purposes.

The samples collected from the former Sylvania Electric Products Incorporated facility in Hicksville, New York were evaluated based on QA/QC criteria established by methods as listed in Section 1.3, by the data validation guidelines listed in Section 1.2, and by the QAPP (O'Brien & Gere 2000) established for this project. Major deficiencies in the data generation process would have resulted in data being rejected, indicating that the data are considered unusable for either quantitative or qualitative purposes. Minor deficiencies in the data generation process resulted in some sample data being characterized as unusually uncertain, approximate. Identification of a data point as approximate indicates uncertainty in the reported concentration of the chemical, but not its assigned identity.

The following paragraphs present the adherence of the data to the precision, sensitivity, accuracy, representativeness, comparability, and completeness (PSARCC) parameters.

Precision is measured through the evaluation of field duplicate samples and laboratory duplicate samples. For the radiochemistry analyses, none of the data were rejected due to precision excursions.

Sensitivity is established by reported detection limits that represent measurable concentrations of analytes that can be determined with a designated level of confidence. Sensitivity requirements were met for the sample data in this project.

Matrix spike samples and LCS recoveries indicate the accuracy of the data. For the radiochemistry analyses, none of the data were rejected due to accuracy excursions.

Holding times, sample preservation, blank analysis, and analyte identification and quantification are indicators of the representativeness of the analytical data. None of the radiochemistry data were rejected due to representativeness excursions.

Comparability is not compromised provided that the analytical methods did not change over time. A major component of comparability is the use of standard reference materials for calibration and QC. These standards are compared to other unknowns to verify their concentrations. Since standard analytical methods and reporting procedures were consistently used by the laboratory, the comparability criteria for the analytical data were met.

5. DUSR summary information

The DUSR was performed to determine whether or not the data meets site-specific criteria for data quality and use. The DUSR is developed by reviewing and evaluating the analytical data package. The following questions were addressed:

1. Is the data package complete as defined under the requirements for the NYSDEC ASP Category B or USEPA CLP deliverables?

The QAPP required that NYSDEC ASP Category B deliverables be provided by the laboratory for each data package. This requirement was met as it applies to the methods used by the laboratory for sample analysis. The evaluation of the sample data was completed using the information provided in the data packages provided by the laboratory.

2. Have all holding times been met?

The holding times were met for the radiochemistry analyses.

3. Do all the QC data: blanks, standards, spike recoveries, replicate analyses, and sample data fall within the protocol-required limits and specifications?

The laboratory used the laboratory control limits during the analyses performed for this sampling event. QA/QC deviations and qualifications performed on the sample data are discussed in Chapter 3. Major excursions were not detected for the radiochemistry data.

4. Have all of the data been generated using established and agreed upon analytical protocols?

The QAPP required that USEPA, LANL and USDOE methods are used in the analysis of samples collected for this sampling event. The laboratory used the required method protocols for the analyses performed for this sampling event, which met data user and client needs.

5. Does an evaluation of the raw data confirm the results provided in the data summary sheets and quality control verification forms?

The evaluation of selected raw data confirmed information provided in the data packages.

6. Have the correct data qualifiers been used?

The laboratory applied the correct qualifiers to the sample data. The validation qualifiers were applied as required by validation guidelines as listed in Section 1.

References

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Attachment A

Evaluation of blank results for gamma spectrometry

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
Prep Blank ID	**PB120500S1**			
SB 110 (21-22)	Actinium-228	4.00E-01	1.10E+01	BU
SB 110 (21-22)	Bismuth-211	7.80E-01	4.50E+00	BU
SB 110 (21-22)	Bismuth-212	8.80E-01	7.70E+00	BU
SB 110 (21-22)	Bismuth-214	1.80E-01	2.30E+01	BU
SB 110 (21-22)	Cesium-137	4.30E-02	4.10E+00	BU
SB 110 (21-22)	Francium-223	6.80E-03	-4.90E+00	BU
SB 110 (21-22)	Lead-210	1.10E+00	1.10E+01	BU
SB 110 (21-22)	Lead-211	-3 30E-01	-3.80E+01	BU
SB 110 (21-22)	Lead-214	1.50E-01	1.10E+00	BU
SB 110 (21-22)	Protactinium-231	1.30E-01	-6.00E+00	BU
SB 110 (21-22)	Protactinium-234	3 30E-02	7.90E+00	BU
SB 110 (21-22)	Radium-223	1.60E-02	7.00E+00	BU
SB 110 (21-22)	Radium-224	1.40E+00	2.40E+01	BU
SB 110 (21-22)	Thallium-208	7.30E-02	-4.20E+00	BU
SB 110 (21-22)	Thorium-227	4.90E-02	-8.10E+00	BU
SB-111 (0-4') =2'	Bismuth-211	2.20E+00	4.50E+00	BU
SB-111 (0-4') =2'	Bismuth-212	3.60E+00	7.70E+00	BU
SB-111 (0-4') =2'	Bismuth-214	9.60E-01	2.30E+01	BU
SB-111 (0-4') =2'	Cesium-137	7.50E-02	4.10E+00	BU
SB-111 (0-4') =2'	Francium-223	2.20E-01	-4.90E+00	BU
SB-111 (0-4') =2'	Lead-210	4.30E-01	1.10E+01	BU
SB-111 (0-4') =2'	Lead-211	-1.00E+00	-3.80E+01	BU
SB-111 (0-4') =2'	Protactinium-231	2.80E+00	-6.00E+00	BU
SB-111 (0-4') =2'	Protactinium-234	-2.90E-01	7.90E+00	BU
SB-111 (0-4') =2'	Protactinium-234m	1.40E+00	-1.20E+02	BU
SB-112 (2'-3')	Bismuth-211	1.90E+00	4.50E+00	BU
SB-112 (2'-3')	Bismuth-214	8.10E-01	2.30E+01	BU
SB-112 (2'-3')	Cesium-137	8.00E-02	4.10E+00	BU
SB-112 (2'-3')	Francium-223	5.10E-02	-4.90E+00	BU
SB-112 (2'-3')	Lead-210	-1.60E-01	1.10E+01	BU
SB-112 (2'-3')	Lead-211	-4.10E-01	-3.80E+01	BU
SB-112 (2'-3')	Lead-214	8.10E-01	1.10E+00	BU
SB-112 (2'-3')	Protactinium-231	2.50E+00	-6.00E+00	BU
SB-112 (2'-3')	Protactinium-234	-2.90E-01	7.90E+00	BU
SB-112 (2'-3')	Radium-223	5.40E-01	7.00E+00	BU
SB-113 (13.5'-14')	Bismuth-211	1.80E+00	4.50E+00	BU
SB-113 (13.5'-14')	Bismuth-214	5.40E-01	2.30E+01	BU
SB-113 (13.5'-14')	Lead-210	-3.50E+00	1.10E+01	BU
SB-113 (13.5'-14')	Lead-211	-1.90E+00	-3.80E+01	BU
SB-113 (13.5'-14')	Lead-214	6.30E-01	1.10E+00	BU
SB-113 (13.5'-14')	Protactinium-234	-1.60E+00	7.90E+00	BU
SB-113 (13.5'-14')	Thorium-231	8.50E+00	4.00E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
Prep Blank ID	**PB120700S1**			
SB-115 (8'-12')	Actinium-228	5.60E-01	1.10E+01	BU
SB-115 (8'-12')	Bismuth-211	7.00E-01	1.20E+00	BU
SB-115 (8'-12')	Bismuth-212	3.50E-01	5.20E+00	BU
SB-115 (8'-12')	Bismuth-214	2 00E-01	1.70E+00	BU
SB-115 (8'-12')	Francium-223	4.30E-02	-1.10E+01	BU
SB-115 (8'-12')	Lead-210	7.00E-01	7.00E+01	BU
SB-115 (8'-12')	Lead-211	-6.10E-02	1.20E+01	BU
SB-115 (8'-12')	Lead-212	1.30E-01	6.10E+00	BU
SB-115 (8'-12')	Lead-214	3.20E-02	4.40E-01	BU
SB-115 (8'-12')	Protactinium-231	2.40E-01	4.20E+01	BU
SB-115 (8'-12')	Protactinium-234	8 30E-02	1.20E+00	BU
SB-115 (8'-12')	Protactinium-234m	4.60E+00	2.00E+02	BU
SB-115 (8'-12')	Radium-223	-1.30E-02	3.10E+00	BU
SB-115 (8'-12')	Radium-224	8.20E-01	6.80E+01	BU
SB-115 (8'-12')	Thallium-208	7.20E-02	1.70E+00	BU
SB-115 (8'-12')	Thorium-227	-1.50E-02	9.20E-01	BU
SB-115 (8'-12')	Thorium-231	8.50E-02	4.60E+00	BU
SB-115 (8'-12')	Thorium-234	3.30E-01	1.30E+01	BU
SB-115 (8'-12')	Uranium-235	8.20E-02	1.20E+00	BU
SB-116 (16-20')	Actinium-228	3.00E-01	1.10E+01	BU
SB-116 (16-20')	Bismuth-211	6.90E-01	1.20E+00	BU
SB-116 (16-20')	Bismuth-212	5.30E-01	5.20E+00	BU
SB-116 (16-20')	Bismuth-214	2.60E-01	1.70E+00	BU
SB-116 (16-20')	Cesium-137	1.80E-02	9.00E-01	BU
SB-116 (16-20')	Francium-223	7.90E-02	-1.10E+01	BU
SB-116 (16-20')	Lead-210	2.00E+00	7.00E+01	BU
SB-116 (16-20')	Lead-211	4.00E-02	1.20E+01	BU
SB-116 (16-20')	Lead-212	2.30E-01	6.10E+00	BU
SB-116 (16-20')	Protactinium-231	3.80E-01	4.20E+01	BU
SB-116 (16-20')	Protactinium-234	3.10E-02	1.20E+00	BU
SB-116 (16-20')	Protactinium-234m	3.50E+00	2.00E+02	BU
SB-116 (16-20')	Radium-223	1.10E-01	3.10E+00	BU
SB-116 (16-20')	Radium-224	2.40E+00	6.80E+01	BU
SB-116 (16-20')	Thallium-208	9.10E-02	1.70E+00	BU
SB-116 (16-20')	Thorium-227	1.70E-02	9.20E-01	BU
SB-116 (16-20')	Thorium-231	2.40E-01	4 60E+00	BU
SB-116 (16-20')	Thorium-234	2.30E+00	1.30E+01	BU
SB-114(20')	Actinium-228	3.00E-01	1.10E+01	BU
SB-114(20')	Bismuth-211	7.00E-01	1.20E+00	BU
SB-114(20')	Bismuth-212	3.90E-01	5.20E+00	BU
SB-114(20')	Bismuth-214	2.30E-01	1.70E+00	BU
SB-114(20')	Cesium-137	-1.10E-02	9.00E-01	BU
SB-114(20')	Francium-223	-6.20E-03	-1.10E+01	BU
SB-114(20')	Lead-210	2.10E+00	7.00E+01	BU
SB-114(20')	Lead-211	5.60E-02	1.20E+01	BU
SB-114(20')	Lead-212	2.70E-01	6.10E+00	BU
SB-114(20')	Protactinium-231	1.20E-01	4.20E+01	BU
SB-114(20')	Protactinium-234	2.20E-02	1.20E+00	BU
SB-114(20')	Protactinium-234m	1.60E+00	2.00E+02	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-114(20')	Radium-223	8.70E-02	3.10E+00	BU
SB-114(20')	Radium-224	2.90E+00	6.80E+01	BU
SB-114(20')	Thallium-208	1.10E-01	1.70E+00	BU
SB-114(20')	Thorium-227	2.50E-02	9.20E-01	BU
SB-114(20')	Thorium-231	8.30E-02	4.60E+00	BU
SB-114(20')	Thorium-234	1.40E+00	1.30E+01	BU
SB-114(20')	Uranium-235	5.10E-02	1.20E+00	BU
SB-113B (16'-20')	Actinium-228	2.40E-01	1.10E+01	BU
SB-113B (16'-20')	Bismuth-211	1.70E-01	1.20E+00	BU
SB-113B (16'-20')	Bismuth-212	4.50E-01	5.20E+00	BU
SB-113B (16'-20')	Bismuth-214	1 10E-01	1.70E+00	BU
SB-113B (16'-20')	Cesium-137	-1.90E-02	9.00E-01	BU
SB-113B (16'-20')	Francium-223	6.40E-02	-1.10E+01	BU
SB-113B (16'-20')	Lead-210	-1.30E-01	7.00E+01	BU
SB-113B (16'-20')	Lead-211	1.50E-02	1.20E+01	BU
SB-113B (16'-20')	Lead-212	1.60E-01	6.10E+00	BU
SB-113B (16'-20')	Lead-214	5.90E-02	4 40E-01	BU
SB-113B (16'-20')	Protactinium-231	-1.90E-01	4.20E+01	BU
SB-113B (16'-20')	Protactinium-234	7.40E-02	1.20E+00	BU
SB-113B (16'-20')	Protactinium-234m	9.70E+00	2.00E+02	BU
SB-113B (16'-20')	Radium-223	-1.40E-02	3.10E+00	BU
SB-113B (16'-20')	Radium-224	6.20E-01	6.80E+01	BU
SB-113B (16'-20')	Thallium-208	7.10E-02	1.70E+00	BU
SB-113B (16'-20')	Thorium-227	-1.90E-02	9.20E-01	BU
SB-113B (16'-20')	Thorium-231	2.30E-01	4.60E+00	BU
SB-113B (16'-20')	Thorium-234	5.50E+00	1.30E+01	BU
SB-113C (12'-16')	Bismuth-211	3.80E+00	1.20E+00	BU
SB-113C (12'-16')	Cesium-137	9.10E-02	9.00E-01	BU
SB-113C (12'-16')	Francium-223	1.40E-01	-1.10E+01	BU
SB-113C (12'-16')	Lead-210	1.30E+00	7.00E+01	BU
SB-113C (12'-16')	Lead-211	-3 50E+00	1.20E+01	BU
SB-113C (12'-16')	Protactinium-231	5.30E+00	4.20E+01	BU
SB-113C (12'-16')	Protactinium-234	-2.40E-01	1.20E+00	BU
SB-113C (12'-16')	Radium-223	1.10E+00	3.10E+00	BU
SB-117 (12')	Actinium-228	5.50E-01	1.10E+01	BU
SB-117 (12')	Bismuth-211	8.80E-01	1.20E+00	BU
SB-117 (12')	Bismuth-212	4.10E-01	5.20E+00	BU
SB-117 (12')	Bismuth-214	2.80E-01	1.70E+00	BU
SB-117 (12')	Cesium-137	1.40E-02	9.00E-01	BU
SB-117 (12')	Francium-223	-2.00E-01	-1.10E+01	BU
SB-117 (12')	Lead-210	2.60E+00	7.00E+01	BU
SB-117 (12')	Lead-211	5.40E-01	1.20E+01	BU
SB-117 (12')	Protactinium-231	1.00E-01	4.20E+01	BU
SB-117 (12')	Protactinium-234	2 60E-02	1.20E+00	BU
SB-117 (12')	Protactinium-234m	7.40E+00	2.00E+02	BU
SB-117 (12')	Radium-223	1.40E-01	3.10E+00	BU
SB-117 (12')	Radium-224	2.40E+00	6.80E+01	BU
SB-117 (12')	Thorium-227	1.10E-01	9.20E-01	BU
SB-117 (12')	Thorium-231	1.70E-01	4.60E+00	BU
SB-118 (17.5'-20.0')	Actinium-228	2.20E-01	1.10E+01	BU
SB-118 (17.5'-20.0')	Bismuth-211	8.00E-01	1.20E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-118 (17.5'-20.0')	Bismuth-212	5.90E-01	5.20E+00	BU
SB-118 (17.5'-20.0')	Bismuth-214	3.30E-01	1.70E+00	BU
SB-118 (17.5'-20.0')	Cesium-137	2.60E-02	9.00E-01	BU
SB-118 (17.5'-20.0')	Francium-223	-3.60E-02	-1.10E+01	BU
SB-118 (17.5'-20.0')	Lead-210	1.50E+00	7.00E+01	BU
SB-118 (17.5'-20.0')	Lead-211	6 00E-02	1.20E+01	BU
SB-118 (17.5'-20.0')	Lead-214	2.80E-01	4 40E-01	BU
SB-118 (17.5'-20.0')	Protactinium-231	-4.40E-01	4 20E+01	BU
SB-118 (17.5'-20.0')	Protactinium-234	-1.70E-01	1.20E+00	BU
SB-118 (17.5'-20.0')	Protactinium-234m	7.70E+00	2.00E+02	BU
SB-118 (17.5'-20.0')	Radium-223	-3.10E-02	3.10E+00	BU
SB-118 (17.5'-20.0')	Thallium-208	9.80E-02	1.70E+00	BU
SB-118 (17.5'-20.0')	Thorium-227	2.80E-01	9.20E-01	BU
SB-118 (17.5'-20.0')	Thorium-231	2.10E-01	4.60E+00	BU
SB-118 (17.5'-20.0')	Uranium-235	1.60E-01	1.20E+00	BU
SB-120 (12'-16')	Actinium-228	3.60E-01	1.10E+01	BU
SB-120 (12'-16')	Bismuth-211	5.00E-01	1.20E+00	BU
SB-120 (12'-16')	Bismuth-212	4.50E-01	5.20E+00	BU
SB-120 (12'-16')	Bismuth-214	1.20E-01	1.70E+00	BU
SB-120 (12'-16')	Cesium-137	1.30E-02	9.00E-01	BU
SB-120 (12'-16')	Francium-223	-4.60E-01	-1.10E+01	BU
SB-120 (12'-16')	Lead-210	5.20E+00	7.00E+01	BU
SB-120 (12'-16')	Lead-211	-7.00E-01	1.20E+01	BU
SB-120 (12'-16')	Lead-212	3.40E-01	6.10E+00	BU
SB-120 (12'-16')	Lead-214	-1.70E+03	4 40E-01	BU
SB-120 (12'-16')	Protactinium-231	-1.30E-01	4.20E+01	BU
SB-120 (12'-16')	Protactinium-234	-9.90E-03	1.20E+00	BU
SB-120 (12'-16')	Radium-223	-5.00E-02	3.10E+00	BU
SB-120 (12'-16')	Radium-224	1.70E+00	6.80E+01	BU
SB-120 (12'-16')	Thallium-208	8.70E-02	1.70E+00	BU
SB-120 (12'-16')	Thorium-227	1.20E-01	9.20E-01	BU
SB-119 (12'-16')	Actinium-228	6.80E-01	1.10E+01	BU
SB-119 (12'-16')	Bismuth-211	6.80E-01	1.20E+00	BU
SB-119 (12'-16')	Bismuth-212	3.90E-01	5.20E+00	BU
SB-119 (12'-16')	Bismuth-214	3.00E-01	1.70E+00	BU
SB-119 (12'-16')	Cesium-137	-8.60E-03	9.00E-01	BU
SB-119 (12'-16')	Lead-210	-4.70E-02	7.00E+01	BU
SB-119 (12'-16')	Lead-211	-6.10E-01	1.20E+01	BU
SB-119 (12'-16')	Lead-214	2.80E-01	4 40E-01	BU
SB-119 (12'-16')	Protactinium-231	1.10E+00	4 20E+01	BU
SB-119 (12'-16')	Protactinium-234	-1.00E+00	1.20E+00	BU
SB-119 (12'-16')	Radium-223	1.60E-02	3 10E+00	BU
SB-119 (12'-16')	Thallium-208	2.40E-01	1.70E+00	BU
SB-119 (12'-16')	Thorium-227	1.00E+00	9.20E-01	BU
SB-120D (12'-16')	Actinium-228	1.10E+00	1.10E+01	BU
SB-120D (12'-16')	Bismuth-211	7.10E-01	1.20E+00	BU
SB-120D (12'-16')	Bismuth-212	1.00E+00	5.20E+00	BU
SB-120D (12'-16')	Bismuth-214	2.00E-01	1.70E+00	BU
SB-120D (12'-16')	Cesium-137	1.40E-02	9.00E-01	BU
SB-120D (12'-16')	Francium-223	-1.90E-01	-1.10E+01	BU
SB-120D (12'-16')	Lead-210	3.40E+00	7.00E+01	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-120D (12'-16')	Lead-211	-1.80E-01	1.20E+01	BU
SB-120D (12'-16')	Lead-214	2.60E-01	4.40E-01	BU
SB-120D (12'-16')	Protactinium-231	-1.70E-01	4.20E+01	BU
SB-120D (12'-16')	Protactinium-234	9.30E-02	1.20E+00	BU
SB-120D (12'-16')	Radium-223	1.20E-01	3.10E+00	BU
SB-120D (12'-16')	Radium-224	1.60E+00	6 80E+01	BU
SB-120D (12'-16')	Thorium-227	2.20E-01	9.20E-01	BU
SB-120D (12'-16')	Thorium-231	2.50E+00	4.60E+00	BU
SB-124 (12'-16')	Actinium-228	8.70E-02	1.10E+01	BU
SB-124 (12'-16')	Bismuth-211	1.10E+00	1.20E+00	BU
SB-124 (12'-16')	Bismuth-212	9.10E-01	5.20E+00	BU
SB-124 (12'-16')	Bismuth-214	2.90E-01	1.70E+00	BU
SB-124 (12'-16')	Cesium-137	-1.00E-02	9.00E-01	BU
SB-124 (12'-16')	Francium-223	-6.30E-02	-1.10E+01	BU
SB-124 (12'-16')	Lead-210	1.00E+00	7.00E+01	BU
SB-124 (12'-16')	Lead-211	4.80E-02	1.20E+01	BU
SB-124 (12'-16')	Lead-212	2.20E-01	6 10E+00	BU
SB-124 (12'-16')	Lead-214	3.70E-01	4.40E-01	BU
SB-124 (12'-16')	Protactinium-231	-1.90E-01	4.20E+01	BU
SB-124 (12'-16')	Protactinium-234	-2.80E-02	1.20E+00	BU
SB-124 (12'-16')	Protactinium-234m	1.70E+01	2.00E+02	BU
SB-124 (12'-16')	Radium-223	-4.60E-02	3.10E+00	BU
SB-124 (12'-16')	Radium-224	2.30E+00	6.80E+01	BU
SB-124 (12'-16')	Thallium-208	6.20E-02	1.70E+00	BU
SB-124 (12'-16')	Thorium-227	3.80E-01	9.20E-01	BU
SB-124 (12'-16')	Thorium-231	2.60E-01	4.60E+00	BU
SB-125 (=4')	Actinium-228	7.20E-01	1.10E+01	BU
SB-125 (=4')	Bismuth-211	1.40E+00	1.20E+00	BU
SB-125 (=4')	Bismuth-212	7.80E-01	5.20E+00	BU
SB-125 (=4')	Cesium-137	-1.20E-03	9.00E-01	BU
SB-125 (=4')	Francium-223	-4.70E-02	-1.10E+01	BU
SB-125 (=4')	Lead-210	-9.30E-01	7.00E+01	BU
SB-125 (=4')	Lead-211	-1.60E-01	1.20E+01	BU
SB-125 (=4')	Protactinium-231	1.80E+00	4.20E+01	BU
SB-125 (=4')	Protactinium-234	-8 30E-02	1.20E+00	BU
SB-125 (=4')	Protactinium-234m	3.30E+00	2.00E+02	BU
SB-125 (=4')	Radium-223	1.70E-01	3 10E+00	BU
SB-125 (=4')	Radium-224	1.60E+00	6.80E+01	BU
SB-125 (=4')	Thorium-227	2.40E-01	9.20E-01	BU
SB-125 (=4')	Thorium-231	3 60E-01	4.60E+00	BU
SB-125 (=4')	Thorium-234	1.20E+00	1.30E+01	BU
SB-125 (=4')	Uranium-235	9.90E-02	1.20E+00	BU
SB-121 (18'-20')	Actinium-228	2.10E-01	1.10E+01	BU
SB-121 (18'-20')	Bismuth-211	3.70E-01	1.20E+00	BU
SB-121 (18'-20')	Bismuth-212	3.80E-01	5.20E+00	BU
SB-121 (18'-20')	Bismuth-214	3 40E-01	1.70E+00	BU
SB-121 (18'-20')	Cesium-137	1.50E-02	9.00E-01	BU
SB-121 (18'-20')	Francium-223	-2.40E-02	-1.10E+01	BU
SB-121 (18'-20')	Lead-210	-9.30E-02	7.00E+01	BU
SB-121 (18'-20')	Lead-211	-7.90E-01	1.20E+01	BU
SB-121 (18'-20')	Lead-212	2.00E-01	6.10E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-121 (18'-20')	Lead-214	1.30E-01	4.40E-01	BU
SB-121 (18'-20')	Protactinium-231	5.40E-01	4.20E+01	BU
SB-121 (18'-20')	Protactinium-234	-3.80E-01	1.20E+00	BU
SB-121 (18'-20')	Protactinium-234m	1.90E+01	2.00E+02	BU
SB-121 (18'-20')	Radium-223	4.00E-02	3.10E+00	BU
SB-121 (18'-20')	Radium-224	1.80E+00	6.80E+01	BU
SB-121 (18'-20')	Thallium-208	5.00E-02	1.70E+00	BU
SB-121 (18'-20')	Thorium-227	2.20E-01	9 20E-01	BU
SB-121 (18'-20')	Thorium-231	1.60E+00	4.60E+00	BU
SB-122 (12'-16')	Actinium-228	3.80E-01	1.10E+01	BU
SB-122 (12'-16')	Bismuth-211	4.30E-01	1.20E+00	BU
SB-122 (12'-16')	Bismuth-212	5.40E-01	5.20E+00	BU
SB-122 (12'-16')	Bismuth-214	2.00E-01	1.70E+00	BU
SB-122 (12'-16')	Cesium-137	-1.70E-02	9.00E-01	BU
SB-122 (12'-16')	Francium-223	-2.10E-02	-1.10E+01	BU
SB-122 (12'-16')	Lead-210	1.00E+00	7.00E+01	BU
SB-122 (12'-16')	Lead-211	2.10E-01	1.20E+01	BU
SB-122 (12'-16')	Lead-212	1.90E-01	6.10E+00	BU
SB-122 (12'-16')	Lead-214	1.50E-01	4.40E-01	BU
SB-122 (12'-16')	Protactinium-231	1.50E-01	4.20E+01	BU
SB-122 (12'-16')	Protactinium-234	3 50E-02	1.20E+00	BU
SB-122 (12'-16')	Protactinium-234m	5 00E+00	2.00E+02	BU
SB-122 (12'-16')	Radium-223	5 30E-02	3.10E+00	BU
SB-122 (12'-16')	Radium-224	1.20E+00	6.80E+01	BU
SB-122 (12'-16')	Thallium-208	8.20E-02	1.70E+00	BU
SB-122 (12'-16')	Thorium-227	6.90E-02	9.20E-01	BU
SB-122 (12'-16')	Thorium-231	1.70E-01	4.60E+00	BU
SB-122 (12'-16')	Thorium-234	1.40E+00	1.30E+01	BU
SB-122 (12'-16')	Uranium-235	7.40E-02	1.20E+00	BU
SB-123 (8'-12')	Actinium-228	5.10E-01	1.10E+01	BU
SB-123 (8'-12')	Bismuth-211	8.90E-01	1.20E+00	BU
SB-123 (8'-12')	Bismuth-212	7.40E-01	5.20E+00	BU
SB-123 (8'-12')	Bismuth-214	3.20E-01	1.70E+00	BU
SB-123 (8'-12')	Cesium-137	-2.50E-02	9.00E-01	BU
SB-123 (8'-12')	Francium-223	1.20E-03	-1.10E+01	BU
SB-123 (8'-12')	Lead-210	6.90E-01	7.00E+01	BU
SB-123 (8'-12')	Lead-211	-3.60E-01	1.20E+01	BU
SB-123 (8'-12')	Lead-212	2.20E-01	6.10E+00	BU
SB-123 (8'-12')	Lead-214	3.10E-01	4.40E-01	BU
SB-123 (8'-12')	Protactinium-231	-3.90E-01	4.20E+01	BU
SB-123 (8'-12')	Protactinium-234	2.00E-01	1.20E+00	BU
SB-123 (8'-12')	Protactinium-234m	7.30E+00	2.00E+02	BU
SB-123 (8'-12')	Radium-223	1.00E-01	3.10E+00	BU
SB-123 (8'-12')	Radium-224	1.30E+00	6.80E+01	BU
SB-123 (8'-12')	Thallium-208	4.40E-02	1.70E+00	BU
SB-123 (8'-12')	Thorium-227	2.50E-01	9.20E-01	BU
SB-123 (8'-12')	Thorium-231	-3.50E-01	4.60E+00	BU
SB-123 (8'-12')	Thorium-234	1.00E+00	1.30E+01	BU
SB-123 (8'-12')	Uranium-235	-1.10E-01	1.20E+00	BU
SB-129 (2-3')	Bismuth-211	1.60E+00	1.20E+00	BU
SB-129 (2-3')	Bismuth-212	1.90E+00	5.20E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-129 (2-3')	Cesium-137	8.90E-02	9.00E-01	BU
SB-129 (2-3')	Francium-223	3.40E-01	-1.10E+01	BU
SB-129 (2-3')	Lead-210	2.10E+00	7.00E+01	BU
SB-129 (2-3')	Lead-211	-6.20E-01	1.20E+01	BU
SB-129 (2-3')	Protactinium-231	-2.40E-02	4.20E+01	BU
SB-129 (2-3')	Protactinium-234	-6.50E-03	1.20E+00	BU
SB-129 (2-3')	Radium-223	3.60E-01	3.10E+00	BU
SB-129 (2-3')	Radium-224	2.90E+00	6.80E+01	BU
SB-129 (2-3')	Thorium-227	4.60E-01	9.20E-01	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
Prep Blank ID	**PB121400S1D**			
SB-148 (9')	Actinium-228	2.30E-01	1.30E+01	BU
SB-148 (9')	Bismuth-211	8.60E-01	-1.10E+01	BU
SB-148 (9')	Bismuth-212	4.20E-01	8 10E+00	BU
SB-148 (9')	Cesium-137	9.20E-03	-3.50E-01	BU
SB-148 (9')	Francium-223	-2 70E-01	-2.60E+00	BU
SB-148 (9')	Lead-210	2.80E+00	-5.00E+01	BU
SB-148 (9')	Lead-211	-2.80E-01	-4.40E+01	BU
SB-148 (9')	Protactinium-231	-4.60E-01	-6.30E+00	BU
SB-148 (9')	Protactinium-234	1.60E-01	5.70E+00	BU
SB-148 (9')	Protactinium-234m	5.20E+00	-5.30E+01	BU
SB-148 (9')	Radium-223	6.90E-02	9.70E+00	BU
SB-148 (9')	Thorium-227	1.40E-01	-3.40E+00	BU
SB-149 (6')	Bismuth-211	1.10E+00	-1.10E+01	BU
SB-149 (6')	Bismuth-212	3.20E-01	8.10E+00	BU
SB-149 (6')	Cesium-137	-8.60E-03	-3 50E-01	BU
SB-149 (6')	Francium-223	9.50E-03	-2.60E+00	BU
SB-149 (6')	Lead-210	7.40E-01	-5.00E+01	BU
SB-149 (6')	Lead-211	1.70E-01	-4.40E+01	BU
SB-149 (6')	Protactinium-231	-5 00E-02	-6.30E+00	BU
SB-149 (6')	Protactinium-234	-1.00E-01	5.70E+00	BU
SB-149 (6')	Protactinium-234m	7.10E-01	-5.30E+01	BU
SB-149 (6')	Radium-223	1.50E-02	9.70E+00	BU
SB-149 (6')	Radium-224	1.40E+00	-1.40E+01	BU
SB-149 (6')	Thorium-227	2.10E-01	-3.40E+00	BU
SB-149 (6')	Thorium-231	2.00E-01	4.50E+00	BU
SB-149 (6')	Thorium-234	4 90E-01	-1.20E+01	BU
SB-149 (6')	Uranium-235	1.00E-01	1.50E+00	BU
SB-150 (1'-2')	Bismuth-211	1.90E+00	-1.10E+01	BU
SB-150 (1'-2')	Cesium-137	1.80E-02	-3.50E-01	BU
SB-150 (1'-2')	Francium-223	-1.70E-01	-2.60E+00	BU
SB-150 (1'-2')	Lead-210	2.20E+00	-5.00E+01	BU
SB-150 (1'-2')	Lead-211	1.00E-02	-4.40E+01	BU
SB-150 (1'-2')	Protactinium-231	-2.00E-01	-6.30E+00	BU
SB-150 (1'-2')	Protactinium-234	2.00E-01	5.70E+00	BU
SB-150 (1'-2')	Protactinium-234m	1.30E+01	-5.30E+01	BU
SB-150 (1'-2')	Radium-223	5 40E-01	9.70E+00	BU
SB-150 (1'-2')	Thorium-227	5.90E-01	-3.40E+00	BU
SB-150 (1'-2')	Thorium-231	1.90E-02	4.50E+00	BU
SB-151 (1')	Bismuth-211	2.60E+00	-1.10E+01	BU
SB-151 (1')	Cesium-137	1.20E-02	-3.50E-01	BU
SB-151 (1')	Francium-223	-5.20E-01	-2.60E+00	BU
SB-151 (1')	Lead-210	2.10E+00	-5.00E+01	BU
SB-151 (1')	Lead-211	-8.50E-01	-4.40E+01	BU
SB-151 (1')	Protactinium-234	6.00E-01	5.70E+00	BU
SB-152 1' (8"-14")	Bismuth-211	2.50E+00	-1.10E+01	BU
SB-152 1' (8"-14")	Cesium-137	6.40E-02	-3.50E-01	BU
SB-152 1' (8"-14")	Francium-223	-5.10E-01	-2.60E+00	BU
SB-152 1' (8"-14")	Lead-210	5.10E-01	-5.00E+01	BU
SB-152 1' (8"-14")	Lead-211	-5.90E-01	-4.40E+01	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-152 1' (8"-14")	Protactinium-234	2.80E-01	5.70E+00	BU
SB-153 (0.5'-2')	Bismuth-211	1.80E+00	-1.10E+01	BU
SB-153 (0.5'-2')	Cesium-137	7.10E-02	-3 50E-01	BU
SB-153 (0.5'-2')	Francium-223	-3.30E-01	-2.60E+00	BU
SB-153 (0.5'-2')	Lead-210	1.00E+00	-5 00E+01	BU
SB-153 (0.5'-2')	Lead-211	-9.10E-01	-4.40E+01	BU
SB-153 (0.5'-2')	Protactinium-231	1.40E+00	-6.30E+00	BU
SB-153 (0.5'-2')	Protactinium-234	3.40E-01	5.70E+00	BU
SB-153 (0.5'-2')	Thorium-231	3.00E+00	4 50E+00	BU
SB-153D (8-16')	Bismuth-211	2.30E+00	-1.10E+01	BU
SB-153D (8-16')	Francium-223	-1.30E-01	-2.60E+00	BU
SB-153D (8-16')	Lead-210	-4 60E+00	-5.00E+01	BU
SB-153D (8-16')	Lead-211	-1.10E+00	-4.40E+01	BU
SB-153D (8-16')	Protactinium-231	2.80E+00	-6.30E+00	BU
SB-153D (8-16')	Protactinium-234	3.30E-01	5.70E+00	BU
SB-154 (4'-8')	Bismuth-211	6.70E-01	-1.10E+01	BU
SB-154 (4'-8')	Bismuth-212	5.30E-01	8.10E+00	BU
SB-154 (4'-8')	Cesium-137	-1.10E-02	-3.50E-01	BU
SB-154 (4'-8')	Francium-223	-8.30E-02	-2.60E+00	BU
SB-154 (4'-8')	Lead-210	1.70E+00	-5.00E+01	BU
SB-154 (4'-8')	Lead-211	1.00E-01	-4.40E+01	BU
SB-154 (4'-8')	Protactinium-231	-1.50E-01	-6.30E+00	BU
SB-154 (4'-8')	Protactinium-234	1.00E-01	5.70E+00	BU
SB-154 (4'-8')	Protactinium-234m	3.50E+00	-5.30E+01	BU
SB-154 (4'-8')	Radium-223	-4.80E-03	9.70E+00	BU
SB-154 (4'-8')	Thorium-227	2.00E-01	-3 40E+00	BU
SB-154 (4'-8')	Thorium-231	1.50E-01	4.50E+00	BU
SB-154 (4'-8')	Thorium-234	8.40E-01	-1.20E+01	BU
SB-154 (4'-8')	Uranium-235	9.30E-02	1.50E+00	BU
SB-146A (1')	Bismuth-211	1.70E+00	-1.10E+01	BU
SB-146A (1')	Bismuth-212	1.40E+00	8.10E+00	BU
SB-146A (1')	Cesium-137	1.10E-02	-3.50E-01	BU
SB-146A (1')	Francium-223	-9 20E-02	-2.60E+00	BU
SB-146A (1')	Lead-210	6.00E-01	-5 00E+01	BU
SB-146A (1')	Lead-211	-4.00E-01	-4.40E+01	BU
SB-146A (1')	Protactinium-231	-6 00E-01	-6 30E+00	BU
SB-146A (1')	Protactinium-234	8.70E-02	5.70E+00	BU
SB-146A (1')	Radium-223	4 00E-01	9.70E+00	BU
SB-146A (1')	Thorium-227	4.70E-01	-3.40E+00	BU
SB-146A (1')	Thorium-231	2.80E-01	4.50E+00	BU
SB-146A (1')	Thorium-234	4.70E+00	-1.20E+01	BU
SB-146A (1')	Uranium-235	1.20E-01	1.50E+00	BU
SB-146B (1')	Bismuth-211	1.20E+00	-1.10E+01	BU
SB-146B (1')	Cesium-137	6.50E-02	-3.50E-01	BU
SB-146B (1')	Francium-223	2.50E-03	-2.60E+00	BU
SB-146B (1')	Lead-210	-1.30E-01	-5.00E+01	BU
SB-146B (1')	Lead-211	4.50E-01	-4.40E+01	BU
SB-146B (1')	Protactinium-231	-2.20E-01	-6.30E+00	BU
SB-146B (1')	Protactinium-234	-3.90E-02	5.70E+00	BU
SB-146B (1')	Radium-223	1.50E-01	9.70E+00	BU
SB-146B (1')	Thorium-231	3.80E-01	4.50E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-146B (1')	Uranium-235	2 10E-01	1.50E+00	BU
SB-146C (2')	Bismuth-211	1.40E+00	-1.10E+01	BU
SB-146C (2')	Bismuth-212	1.10E+00	8 10E+00	BU
SB-146C (2')	Cesium-137	4.50E-02	-3.50E-01	BU
SB-146C (2')	Francium-223	-9.40E-02	-2.60E+00	BU
SB-146C (2')	Lead-210	1.90E+00	-5.00E+01	BU
SB-146C (2')	Lead-211	1.10E-01	-4.40E+01	BU
SB-146C (2')	Lead-212	1.70E+00	-8.70E-02	BU
SB-146C (2')	Protactinium-231	9.00E-01	-6.30E+00	BU
SB-146C (2')	Protactinium-234	-2.90E-02	5.70E+00	BU
SB-146C (2')	Protactinium-234m	8.10E+00	-5.30E+01	BU
SB-146C (2')	Radium-223	4 30E-01	9.70E+00	BU
SB-146C (2')	Thorium-227	4.10E-01	-3.40E+00	BU
SB-146C (2')	Thorium-231	-4.10E-02	4 50E+00	BU
SB-146C (2')	Thorium-234	2.80E+00	-1.20E+01	BU
SB-146C (2')	Uranium-235	4.60E-01	1.50E+00	BU
SB-141 (16'-20')	Actinium-228	3.70E-01	1.30E+01	BU
SB-141 (16'-20')	Bismuth-211	4.30E-01	-1.10E+01	BU
SB-141 (16'-20')	Bismuth-212	4.40E-01	8.10E+00	BU
SB-141 (16'-20')	Bismuth-214	1.70E-01	-3.70E+00	BU
SB-141 (16'-20')	Cesium-137	-6.50E-03	-3.50E-01	BU
SB-141 (16'-20')	Francium-223	8.80E-02	-2.60E+00	BU
SB-141 (16'-20')	Lead-210	-5 40E-01	-5.00E+01	BU
SB-141 (16'-20')	Lead-211	-2.20E-01	-4.40E+01	BU
SB-141 (16'-20')	Lead-214	1.50E-01	-3.70E+00	BU
SB-141 (16'-20')	Protactinium-231	-1.10E-01	-6.30E+00	BU
SB-141 (16'-20')	Protactinium-234	-5.50E-02	5.70E+00	BU
SB-141 (16'-20')	Protactinium-234m	4 50E-01	-5.30E+01	BU
SB-141 (16'-20')	Radium-223	-7.80E-02	9.70E+00	BU
SB-141 (16'-20')	Thallium-208	6.00E-02	-4.70E-01	BU
SB-141 (16'-20')	Thorium-227	1.40E-01	-3.40E+00	BU
SB-141 (16'-20')	Thorium-231	2.90E-01	4.50E+00	BU
SB-141 (16'-20')	Thorium-234	-4.40E-01	-1.20E+01	BU
SB-141 (16'-20')	Uranium-235	-7.10E-04	1.50E+00	BU
SB-142 (8'-12)	Bismuth-211	1.20E+00	-1.10E+01	BU
SB-142 (8'-12)	Bismuth-212	3.30E-01	8.10E+00	BU
SB-142 (8'-12)	Cesium-137	3.80E-02	-3.50E-01	BU
SB-142 (8'-12)	Francium-223	-5.50E-03	-2.60E+00	BU
SB-142 (8'-12)	Lead-210	1.20E+00	-5 00E+01	BU
SB-142 (8'-12)	Lead-211	-7.60E-02	-4.40E+01	BU
SB-142 (8'-12)	Protactinium-231	-1.70E-01	-6.30E+00	BU
SB-142 (8'-12)	Protactinium-234	6.60E-02	5.70E+00	BU
SB-142 (8'-12)	Protactinium-234m	6.50E+00	-5.30E+01	BU
SB-142 (8'-12)	Radium-223	1.60E-01	9.70E+00	BU
SB-142 (8'-12)	Thorium-227	1.80E-01	-3.40E+00	BU
SB-142 (8'-12)	Thorium-231	-1.40E-02	4.50E+00	BU
SB-142 (8'-12)	Thorium-234	1.80E+00	-1.20E+01	BU
SB-142 (8'-12)	Uranium-235	2.10E-01	1.50E+00	BU
SB-143 (4'-8')	Actinium-228	4.40E-01	1.30E+01	BU
SB-142 (8'-12)	Bismuth-211	1.00E+00	-1.10E+01	BU
SB-143 (4'-8')	Bismuth-212	5.70E-01	8.10E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-143 (4'-8')	Cesium-137	6 30E-03	-3.50E-01	BU
SB-143 (4'-8')	Francium-223	1.50E-01	-2.60E+00	BU
SB-143 (4'-8')	Lead-210	1.30E+00	-5.00E+01	BU
SB-143 (4'-8')	Lead-211	-7.30E-01	-4.40E+01	BU
SB-143 (4'-8')	Protactinium-231	-4.80E-01	-6.30E+00	BU
SB-143 (4'-8')	Protactinium-234	1.90E-01	5.70E+00	BU
SB-143 (4'-8')	Protactinium-234m	5.40E-01	-5.30E+01	BU
SB-143 (4'-8')	Radium-223	1.30E-01	9.70E+00	BU
SB-143 (4'-8')	Thallium-208	1.10E-01	-4.70E-01	BU
SB-143 (4'-8')	Thorium-227	2.10E-01	-3 40E+00	BU
SB-143 (4'-8')	Thorium-231	4.30E-01	4.50E+00	BU
SB-143 (4'-8')	Thorium-234	2.40E-02	-1.20E+01	BU
SB-138 (16'-20)	Bismuth-211	6.80E-01	-1 10E+01	BU
SB-138 (16'-20)	Bismuth-212	4.20E-01	8 10E+00	BU
SB-138 (16'-20)	Bismuth-214	1.60E-01	-3 70E+00	BU
SB-138 (16'-20)	Cesium-137	3.90E-03	-3.50E-01	BU
SB-138 (16'-20)	Francium-223	1.10E-03	-2.60E+00	BU
SB-138 (16'-20)	Lead-210	-1.00E+00	-5.00E+01	BU
SB-138 (16'-20)	Lead-211	1.20E-01	-4 40E+01	BU
SB-138 (16'-20)	Protactinium-231	2.00E-01	-6.30E+00	BU
SB-138 (16'-20)	Protactinium-234	1.80E-01	5.70E+00	BU
SB-138 (16'-20)	Protactinium-234m	1.80E+00	-5 30E+01	BU
SB-138 (16'-20)	Radium-223	1.40E-01	9.70E+00	BU
SB-138 (16'-20)	Thorium-227	2.00E-01	-3.40E+00	BU
SB-138 (16'-20)	Thorium-231	-2.10E-02	4.50E+00	BU
SB-138 (16'-20)	Thorium-234	1.40E+00	-1.20E+01	BU
SB-138 (16'-20)	Uranium-235	9.40E-02	1.50E+00	BU
SB-139 (4')	Bismuth-211	1.60E+00	-1.10E+01	BU
SB-139 (4')	Bismuth-212	1.40E+00	8.10E+00	BU
SB-139 (4')	Cesium-137	3.90E-03	-3.50E-01	BU
SB-139 (4')	Francium-223	-5.00E-02	-2.60E+00	BU
SB-139 (4')	Lead-210	6.90E-01	-5.00E+01	BU
SB-139 (4')	Lead-211	-6.10E-01	-4.40E+01	BU
SB-139 (4')	Lead-212	1.00E+00	-8.70E-02	BU
SB-139 (4')	Protactinium-231	2.20E-01	-6.30E+00	BU
SB-139 (4')	Protactinium-234	2.40E-01	5.70E+00	BU
SB-139 (4')	Radium-223	4.20E-01	9.70E+00	BU
SB-139 (4')	Thorium-227	5.00E-01	-3 40E+00	BU
SB-139 (4')	Thorium-231	1.20E+00	4.50E+00	BU
SB-140 (4')	Bismuth-211	1.70E+00	-1.10E+01	BU
SB-140 (4')	Bismuth-212	1.10E+00	8.10E+00	BU
SB-140 (4')	Cesium-137	2.60E-02	-3.50E-01	BU
SB-140 (4')	Francium-223	-3.60E-02	-2.60E+00	BU
SB-140 (4')	Lead-210	1.20E+00	-5.00E+01	BU
SB-140 (4')	Lead-211	2.20E-01	-4 40E+01	BU
SB-140 (4')	Protactinium-231	-3 10E-01	-6 30E+00	BU
SB-140 (4')	Protactinium-234	-2 10E-01	5.70E+00	BU
SB-140 (4')	Radium-223	1.50E-01	9.70E+00	BU
SB-140 (4')	Thallium-208	2 50E-01	-4.70E-01	BU
SB-140 (4')	Thorium-227	2 90E-01	-3 40E+00	BU
SB-140 (4')	Thorium-231	1.30E-01	4 50E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-140 (4')	Uranium-235	8.20E-02	1.50E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
Prep Blank ID	**PB121400S1E**			
SB-147 (16-20')	Actinium-228	9.60E-02	1.10E+00	BU
SB-147 (16-20')	Bismuth-211	4.80E-01	-7.00E+00	BU
SB-147 (16-20')	Bismuth-212	1.30E-01	4.90E+01	BU
SB-147 (16-20')	Bismuth-214	1.20E-01	2.30E+00	BU
SB-147 (16-20')	Cesium-137	6 10E-03	3.90E-01	BU
SB-147 (16-20')	Francium-223	-1.20E-01	-5 40E+00	BU
SB-147 (16-20')	Lead-210	-1.70E-01	3.80E+01	BU
SB-147 (16-20')	Lead-211	2.40E-01	1.80E+01	BU
SB-147 (16-20')	Lead-212	9.10E-02	2.40E+00	BU
SB-147 (16-20')	Lead-214	1.70E-01	-1.20E+00	BU
SB-147 (16-20')	Protactinium-231	1.60E-01	2.00E+01	BU
SB-147 (16-20')	Protactinium-234	1.90E-02	1.50E+00	BU
SB-147 (16-20')	Protactinium-234m	1.70E+00	6.60E+01	BU
SB-147 (16-20')	Radium-223	1.00E-01	-3.40E+00	BU
SB-147 (16-20')	Radium-224	5.20E-01	-1.20E+01	BU
SB-147 (16-20')	Thallium-208	6.40E-02	2.40E+00	BU
SB-147 (16-20')	Thorium-227	4.90E-02	-9.90E+00	BU
SB-147 (16-20')	Thorium-231	-1.70E-02	-9.70E+00	BU
SB-147 (16-20')	Thorium-234	-1.50E-01	-5.30E+00	BU
SB-147 (16-20')	Uranium-235	-2.10E-02	2.50E+00	BU
SB-155 (4'-8')	Bismuth-211	1.50E+00	-7.00E+00	BU
SB-155 (4'-8')	Bismuth-212	9.90E-01	4.90E+01	BU
SB-155 (4'-8')	Cesium-137	-5.90E-03	3.90E-01	BU
SB-155 (4'-8')	Francium-223	-5.20E-03	-5.40E+00	BU
SB-155 (4'-8')	Lead-210	-1.90E+00	3.80E+01	BU
SB-155 (4'-8')	Lead-211	-2.90E-01	1.80E+01	BU
SB-155 (4'-8')	Protactinium-231	3.30E-01	2.00E+01	BU
SB-155 (4'-8')	Protactinium-234	1.80E-01	1.50E+00	BU
SB-155 (4'-8')	Protactinium-234m	2 10E+00	6.60E+01	BU
SB-155 (4'-8')	Radium-223	6.00E-02	-3.40E+00	BU
SB-155 (4'-8')	Thorium-227	2.30E-01	-9.90E+00	BU
SB-155 (4'-8')	Thorium-231	-1.80E-01	-9.70E+00	BU
SB-155 (4'-8')	Thorium-234	1.20E+00	-5.30E+00	BU
SB-155 (4'-8')	Uranium-235	7.40E-02	2.50E+00	BU
SB-157 (12'-16')	Actinium-228	1.70E-01	1.10E+00	BU
SB-157 (12'-16')	Bismuth-211	7.00E-01	-7.00E+00	BU
SB-157 (12'-16')	Bismuth-212	3.30E-01	4.90E+01	BU
SB-157 (12'-16')	Bismuth-214	2.10E-01	2.30E+00	BU
SB-157 (12'-16')	Cesium-137	8 00E-03	3.90E-01	BU
SB-157 (12'-16')	Francium-223	-7.40E-02	-5.40E+00	BU
SB-157 (12'-16')	Lead-210	2.40E+00	3 80E+01	BU
SB-157 (12'-16')	Lead-211	5.20E-01	1.80E+01	BU
SB-157 (12'-16')	Lead-212	1.70E-01	2.40E+00	BU
SB-157 (12'-16')	Protactinium-231	-4.90E-02	2.00E+01	BU
SB-157 (12'-16')	Protactinium-234	-5 60E-02	1.50E+00	BU
SB-157 (12'-16')	Protactinium-234m	2.10E+00	6.60E+01	BU
SB-157 (12'-16')	Radium-223	4.00E-02	-3.40E+00	BU
SB-157 (12'-16')	Thallium-208	1.00E-01	2.40E+00	BU
SB-157 (12'-16')	Thorium-227	1.20E-01	-9.90E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-157 (12'-16')	Thorium-231	-1.10E-02	-9.70E+00	BU
SB-157 (12'-16')	Thorium-234	5 70E-01	-5.30E+00	BU
SB-157 (12'-16')	Uranium-235	2.40E-02	2.50E+00	BU
SB-156 (4'-8')	Bismuth-211	9 40E-01	-7.00E+00	BU
SB-156 (4'-8')	Bismuth-212	5.30E-01	4.90E+01	BU
SB-156 (4'-8')	Cesium-137	-1.60E-02	3.90E-01	BU
SB-156 (4'-8')	Francium-223	-1.70E-01	-5.40E+00	BU
SB-156 (4'-8')	Lead-210	-1.80E-01	3.80E+01	BU
SB-156 (4'-8')	Lead-211	-2.40E-01	1.80E+01	BU
SB-156 (4'-8')	Protactinium-231	-6.50E-02	2.00E+01	BU
SB-156 (4'-8')	Protactinium-234	-1.30E-01	1.50E+00	BU
SB-156 (4'-8')	Protactinium-234m	8.10E+00	6 60E+01	BU
SB-156 (4'-8')	Radium-223	1.20E-01	-3.40E+00	BU
SB-156 (4'-8')	Thorium-227	1.20E-01	-9.90E+00	BU
SB-156 (4'-8')	Thorium-231	7.40E-01	-9.70E+00	BU
SB-156 (4'-8')	Thorium-234	8.70E-01	-5.30E+00	BU
SB-156 (4'-8')	Uranium-235	1.60E-01	2.50E+00	BU
SB-144 (6')	Bismuth-211	1.20E+00	-7.00E+00	BU
SB-144 (6')	Bismuth-212	1.60E+00	4.90E+01	BU
SB-144 (6')	Cesium-137	1.90E-02	3.90E-01	BU
SB-144 (6')	Francium-223	-1.40E-02	-5.40E+00	BU
SB-144 (6')	Lead-210	-3.00E-01	3.80E+01	BU
SB-144 (6')	Lead-211	-5.80E-01	1.80E+01	BU
SB-144 (6')	Protactinium-231	4.20E-01	2 00E+01	BU
SB-144 (6')	Protactinium-234	4.20E-01	1.50E+00	BU
SB-144 (6')	Radium-223	5.00E-01	-3 40E+00	BU
SB-144 (6')	Radium-224	1.90E-01	-1.20E+01	BU
SB-144 (6')	Thorium-231	1.40E+00	-9.70E+00	BU
SB-144 (6')	Thorium-234	1.60E-01	-5.30E+00	BU
SB-159 (8'-12')	Bismuth-211	2.90E-01	-7.00E+00	BU
SB-159 (8'-12')	Bismuth-212	5.80E-01	4 90E+01	BU
SB-159 (8'-12')	Bismuth-214	7.80E-02	2.30E+00	BU
SB-159 (8'-12')	Cesium-137	2 20E-02	3.90E-01	BU
SB-159 (8'-12')	Francium-223	-1.50E-01	-5.40E+00	BU
SB-159 (8'-12')	Lead-210	8.20E-01	3.80E+01	BU
SB-159 (8'-12')	Lead-211	-3.70E-01	1.80E+01	BU
SB-159 (8'-12')	Lead-214	1.00E-01	-1.20E+00	BU
SB-159 (8'-12')	Protactinium-231	-3.90E-01	2.00E+01	BU
SB-159 (8'-12')	Protactinium-234	2.10E-02	1.50E+00	BU
SB-159 (8'-12')	Protactinium-234m	5 20E+00	6.60E+01	BU
SB-159 (8'-12')	Radium-223	2.50E-01	-3.40E+00	BU
SB-159 (8'-12')	Thorium-227	4.10E-01	-9.90E+00	BU
SB-159 (8'-12')	Thorium-231	9 20E-02	-9.70E+00	BU
SB-159 (8'-12')	Uranium-235	2.30E-01	2.50E+00	BU
SB-130 (16'-20')	Actinium-228	5.80E-01	1.10E+00	BU
SB-130 (16'-20')	Bismuth-211	9.80E-01	-7.00E+00	BU
SB-130 (16'-20')	Bismuth-212	6.50E-01	4.90E+01	BU
SB-130 (16'-20')	Cesium-137	3 40E-02	3.90E-01	BU
SB-130 (16'-20')	Francium-223	1.60E-02	-5.40E+00	BU
SB-130 (16'-20')	Lead-210	1.00E+00	3.80E+01	BU
SB-130 (16'-20')	Lead-211	-1.70E-01	1.80E+01	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-130 (16'-20')	Protactinium-231	-6 10E-01	2.00E+01	BU
SB-130 (16'-20')	Protactinium-234	-2.50E-02	1.50E+00	BU
SB-130 (16'-20')	Protactinium-234m	6.20E+00	6.60E+01	BU
SB-130 (16'-20')	Radium-223	3.80E-02	-3.40E+00	BU
SB-130 (16'-20')	Thallium-208	6.10E-02	2.40E+00	BU
SB-130 (16'-20')	Thorium-227	5.30E-01	-9.90E+00	BU
SB-130 (16'-20')	Thorium-231	-1.50E-01	-9.70E+00	BU
SB-130 (16'-20')	Thorium-234	1.80E+00	-5.30E+00	BU
SB-130 (16'-20')	Uranium-235	1.30E-01	2.50E+00	BU
SB-131 (4'-8')	Bismuth-211	1.30E+00	-7.00E+00	BU
SB-131 (4'-8')	Bismuth-212	7.40E-01	4.90E+01	BU
SB-131 (4'-8')	Cesium-137	6.80E-04	3.90E-01	BU
SB-131 (4'-8')	Francium-223	6 00E-03	-5.40E+00	BU
SB-131 (4'-8')	Lead-210	-3.50E-02	3.80E+01	BU
SB-131 (4'-8')	Lead-211	-5.10E-01	1.80E+01	BU
SB-131 (4'-8')	Lead-214	2.10E-01	-1.20E+00	BU
SB-131 (4'-8')	Protactinium-231	-2.50E-01	2.00E+01	BU
SB-131 (4'-8')	Protactinium-234	-4.00E-02	1.50E+00	BU
SB-131 (4'-8')	Protactinium-234m	8.10E-01	6.60E+01	BU
SB-131 (4'-8')	Radium-223	1.40E-01	-3.40E+00	BU
SB-131 (4'-8')	Thallium-208	1.00E-01	2 40E+00	BU
SB-131 (4'-8')	Thorium-227	2.50E-01	-9.90E+00	BU
SB-131 (4'-8')	Thorium-231	1.80E-02	-9.70E+00	BU
SB-131 (4'-8')	Thorium-234	4 10E-01	-5.30E+00	BU
SB-131 (4'-8')	Uranium-235	3.10E-02	2.50E+00	BU
SB-127 (0'-4')	Bismuth-211	1.20E+00	-7.00E+00	BU
SB-127 (0'-4')	Bismuth-212	1.20E+00	4.90E+01	BU
SB-127 (0'-4')	Bismuth-214	2.70E-01	2.30E+00	BU
SB-127 (0'-4')	Cesium-137	2.10E-02	3.90E-01	BU
SB-127 (0'-4')	Francium-223	-9.00E-02	-5.40E+00	BU
SB-127 (0'-4')	Lead-210	1.10E+00	3.80E+01	BU
SB-127 (0'-4')	Lead-211	3.00E-01	1.80E+01	BU
SB-127 (0'-4')	Lead-214	2.90E-01	-1.20E+00	BU
SB-127 (0'-4')	Protactinium-231	7.90E-03	2.00E+01	BU
SB-127 (0'-4')	Protactinium-234	6.30E-02	1.50E+00	BU
SB-127 (0'-4')	Radium-223	9.70E-02	-3.40E+00	BU
SB-127 (0'-4')	Radium-224	1.20E+00	-1.20E+01	BU
SB-127 (0'-4')	Thorium-227	2.60E-01	-9.90E+00	BU
SB-127 (0'-4')	Thorium-231	1.20E+00	-9.70E+00	BU
SB-133 (0'-4')	Bismuth-211	2.20E+00	-7.00E+00	BU
SB-133 (0'-4')	Bismuth-212	3.00E+00	4.90E+01	BU
SB-133 (0'-4')	Bismuth-214	1.50E-01	2.30E+00	BU
SB-133 (0'-4')	Cesium-137	7.70E-02	3.90E-01	BU
SB-133 (0'-4')	Francium-223	3.60E-01	-5 40E+00	BU
SB-133 (0'-4')	Lead-210	1.90E-01	3.80E+01	BU
SB-133 (0'-4')	Lead-211	2.00E-01	1.80E+01	BU
SB-133 (0'-4')	Protactinium-231	1.20E+00	2.00E+01	BU
SB-133 (0'-4')	Protactinium-234	-5.50E-01	1.50E+00	BU
SB-133 (0'-4')	Radium-223	2.90E-01	-3 40E+00	BU
SB-134 (12'-16')	Actinium-228	3.60E-01	1.10E+00	BU
SB-134 (12'-16')	Bismuth-211	7.60E-01	-7.00E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-134 (12'-16')	Bismuth-212	2.50E-01	4 90E+01	BU
SB-134 (12'-16')	Cesium-137	7.00E-03	3.90E-01	BU
SB-134 (12'-16')	Francium-223	-2 20E-01	-5.40E+00	BU
SB-134 (12'-16')	Lead-210	1.70E+00	3.80E+01	BU
SB-134 (12'-16')	Lead-211	5 80E-02	1.80E+01	BU
SB-134 (12'-16')	Protactinium-231	-4.00E-01	2.00E+01	BU
SB-134 (12'-16')	Protactinium-234	-7.50E-02	1.50E+00	BU
SB-134 (12'-16')	Protactinium-234m	1.40E+00	6.60E+01	BU
SB-134 (12'-16')	Radium-223	5.00E-02	-3.40E+00	BU
SB-134 (12'-16')	Thorium-227	1.70E-01	-9.90E+00	BU
SB-134 (12'-16')	Thorium-231	-6.60E-02	-9.70E+00	BU
SB-134 (12'-16')	Thorium-234	3.70E-01	-5 30E+00	BU
SB-134 (12'-16')	Uranium-235	5 00E-02	2.50E+00	BU
SB-134D (16'-20')	Actinium-228	1.20E-02	1.10E+00	BU
SB-134D (16'-20')	Bismuth-211	4.50E-01	-7.00E+00	BU
SB-134D (16'-20')	Bismuth-212	-1.50E-01	4.90E+01	BU
SB-134D (16'-20')	Bismuth-214	2.40E-01	2.30E+00	BU
SB-134D (16'-20')	Cesium-137	-1.40E-02	3.90E-01	BU
SB-134D (16'-20')	Francium-223	-1.40E-02	-5.40E+00	BU
SB-134D (16'-20')	Lead-210	7.60E-01	3 80E+01	BU
SB-134D (16'-20')	Lead-211	2.40E-02	1.80E+01	BU
SB-134D (16'-20')	Lead-212	1.60E-01	2.40E+00	BU
SB-134D (16'-20')	Lead-214	1.60E-01	-1.20E+00	BU
SB-134D (16'-20')	Protactinium-231	-6.20E-01	2.00E+01	BU
SB-134D (16'-20')	Protactinium-234	-3 10E-01	1.50E+00	BU
SB-134D (16'-20')	Protactinium-234m	4.00E+00	6.60E+01	BU
SB-134D (16'-20')	Radium-223	-1.10E-02	-3.40E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-134D (16'-20')	Radium-224	1.70E+00	-1.20E+01	BU
SB-134D (16'-20')	Thallium-208	8.10E-02	2 40E+00	BU
SB-134D (16'-20')	Thorium-227	3 50E-01	-9.90E+00	BU
SB-134D (16'-20')	Thorium-231	-3.50E-01	-9.70E+00	BU
SB-134D (16'-20')	Thorium-234	4.00E-01	-5.30E+00	BU
SB-134D (16'-20')	Uranium-235	9.90E-02	2.50E+00	BU
SB-128 (0'-4')	Bismuth-211	3.60E+00	-7.00E+00	BU
SB-128 (0'-4')	Bismuth-212	2.30E+00	4.90E+01	BU
SB-128 (0'-4')	Cesium-137	6.90E-03	3.90E-01	BU
SB-128 (0'-4')	Francium-223	-1.30E-01	-5.40E+00	BU
SB-128 (0'-4')	Lead-210	1.10E+00	3.80E+01	BU
SB-128 (0'-4')	Lead-211	-8.20E-02	1.80E+01	BU
SB-128 (0'-4')	Protactinium-231	1.60E+00	2.00E+01	BU
SB-128 (0'-4')	Protactinium-234	-2.70E-01	1.50E+00	BU
SB-128 (0'-4')	Protactinium-234m	1.10E+01	6.60E+01	BU
SB-128 (0'-4')	Radium-223	-2.20E-02	-3.40E+00	BU
SB-128 (0'-4')	Thorium-231	8.70E-01	-9.70E+00	BU
SB-128 (0'-4')	Thorium-234	1.40E+00	-5.30E+00	BU
SB-132 (=1')	Bismuth-211	1.80E+00	-7.00E+00	BU
SB-132 (=1')	Bismuth-212	1.30E+00	4.90E+01	BU
SB-132 (=1')	Cesium-137	3.20E-02	3.90E-01	BU
SB-132 (=1')	Francium-223	-2.90E-02	-5.40E+00	BU
SB-132 (=1')	Lead-210	5.50E-01	3.80E+01	BU
SB-132 (=1')	Lead-211	2.90E-02	1.80E+01	BU
SB-132 (=1')	Protactinium-231	4.20E-01	2.00E+01	BU
SB-132 (=1')	Protactinium-234	-1.30E-01	1.50E+00	BU
SB-132 (=1')	Protactinium-234m	1.10E+01	6.60E+01	BU
SB-132 (=1')	Radium-223	1.20E-01	-3.40E+00	BU
SB-132 (=1')	Radium-224	1.40E+00	-1.20E+01	BU
SB-132 (=1')	Thorium-227	2.10E-01	-9.90E+00	BU
SB-132 (=1')	Thorium-231	4.30E-01	-9.70E+00	BU
SB-135 (8-12)	Bismuth-211	1.20E+00	-7.00E+00	BU
SB-135 (8-12)	Bismuth-212	4.00E-01	4.90E+01	BU
SB-135 (8-12)	Bismuth-214	2.30E-01	2.30E+00	BU
SB-135 (8-12)	Cesium-137	1.60E-02	3.90E-01	BU
SB-135 (8-12)	Francium-223	-5.30E-02	-5.40E+00	BU
SB-135 (8-12)	Lead-210	1.90E+00	3.80E+01	BU
SB-135 (8-12)	Lead-211	-8.40E-03	1.80E+01	BU
SB-135 (8-12)	Lead-214	2.70E-01	-1.20E+00	BU
SB-135 (8-12)	Protactinium-231	5.50E-01	2.00E+01	BU
SB-135 (8-12)	Protactinium-234	-8.60E-02	1.50E+00	BU
SB-135 (8-12)	Protactinium-234m	3.30E+00	6 60E+01	BU
SB-135 (8-12)	Radium-223	1.10E-01	-3 40E+00	BU
SB-135 (8-12)	Thallium-208	1.50E-01	2.40E+00	BU
SB-135 (8-12)	Thorium-231	-1.60E-01	-9.70E+00	BU
SB-135 (8-12)	Thorium-234	9.80E-01	-5.30E+00	BU
SB-135 (8-12)	Uranium-235	1.10E-01	2.50E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
Prep Blank ID	**PB121400S1F**			
SB-145 (12'-16')	Bismuth-211	7.20E-01	-1.90E-01	BU
SB-145 (12'-16')	Bismuth-214	2.50E-01	8.00E+00	BU
SB-145 (12'-16')	Cesium-137	-3.60E-03	3.10E+00	BU
SB-145 (12'-16')	Francium-223	-3.70E+00	5.40E+00	BU
SB-145 (12'-16')	Lead-210	-8.50E+01	5.20E+00	BU
SB-145 (12'-16')	Lead-211	-2.00E+00	-1.70E+01	BU
SB-145 (12'-16')	Lead-214	3 70E-01	7.70E-01	BU
SB-145 (12'-16')	Radium-224	1.80E+01	-6.30E+00	BU
SB-145 (12'-16')	Thorium-231	1.20E+00	-1.70E+00	BU
SB-169 (12'-16')	Bismuth-211	4.20E-01	-1.90E-01	BU
SB-169 (12'-16')	Bismuth-212	1.50E+00	2.30E+01	BU
SB-169 (12'-16')	Bismuth-214	2.50E-01	8 00E+00	BU
SB-169 (12'-16')	Cesium-137	8 80E-02	3.10E+00	BU
SB-169 (12'-16')	Francium-223	-5.10E-01	5 40E+00	BU
SB-169 (12'-16')	Lead-210	-1.30E+01	5.20E+00	BU
SB-169 (12'-16')	Lead-211	-1.50E+00	-1.70E+01	BU
SB-169 (12'-16')	Lead-212	1.10E+00	2.10E+00	BU
SB-169 (12'-16')	Lead-214	1.40E-01	7.70E-01	BU
SB-169 (12'-16')	Protactinium-231	9.90E-01	3.40E+00	BU
SB-169 (12'-16')	Protactinium-234	4.50E-01	-5.60E+00	BU
SB-169 (12'-16')	Radium-223	5.10E-01	1.00E+01	BU
SB-169 (12'-16')	Radium-224	7.90E+00	-6.30E+00	BU
SB-126 (16'-20')	Bismuth-211	1.30E+00	-1.90E-01	BU
SB-126 (16'-20')	Bismuth-212	1.30E+00	2.30E+01	BU
SB-126 (16'-20')	Bismuth-214	2 80E-01	8.00E+00	BU
SB-126 (16'-20')	Cesium-137	1.90E-02	3.10E+00	BU
SB-126 (16'-20')	Francium-223	-1.50E-04	5.40E+00	BU
SB-126 (16'-20')	Lead-210	1.50E-01	5.20E+00	BU
SB-126 (16'-20')	Lead-211	1.70E-01	-1.70E+01	BU
SB-126 (16'-20')	Protactinium-231	-1.90E+00	3.40E+00	BU
SB-126 (16'-20')	Protactinium-234	-2 40E-01	-5.60E+00	BU
SB-126 (16'-20')	Protactinium-234m	5.80E+00	4.10E+02	BU
SB-126 (16'-20')	Radium-223	1.60E-01	1.00E+01	BU
SB-126 (16'-20')	Thallium-208	1.20E-01	-2.50E+00	BU
SB-126 (16'-20')	Thorium-227	1.40E+00	2.90E+00	BU
SB-126 (16'-20')	Thorium-231	3.80E-01	-1.70E+00	BU
SB-126 (16'-20')	Uranium-235	5.30E-01	1.70E+00	BU
SB-160 (0'-4')	Bismuth-211	1.60E+00	-1.90E-01	BU
SB-160 (0'-4')	Bismuth-212	1.60E+00	2.30E+01	BU
SB-160 (0'-4')	Bismuth-214	3.90E-01	8.00E+00	BU
SB-160 (0'-4')	Cesium-137	5.00E-02	3.10E+00	BU
SB-160 (0'-4')	Francium-223	-1.50E-01	5.40E+00	BU
SB-160 (0'-4')	Lead-210	-2.00E+00	5.20E+00	BU
SB-160 (0'-4')	Lead-211	3.50E-01	-1.70E+01	BU
SB-160 (0'-4')	Protactinium-231	6.80E-01	3.40E+00	BU
SB-160 (0'-4')	Protactinium-234	2.70E-01	-5.60E+00	BU
SB-160 (0'-4')	Protactinium-234m	5.30E+00	4.10E+02	BU
SB-160 (0'-4')	Radium-223	2.50E-01	1.00E+01	BU
SB-160 (0'-4')	Thorium-231	6.10E-01	-1.70E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-160 (0'-4')	Thorium-234	9.90E+00	9.90E+01	BU
SB-161 (0'-4')	Bismuth-211	2.20E+00	-1.90E-01	BU
SB-161 (0'-4')	Bismuth-212	1.60E+00	2.30E+01	BU
SB-161 (0'-4')	Cesium-137	2.10E-02	3.10E+00	BU
SB-161 (0'-4')	Francium-223	-2.00E-01	5.40E+00	BU
SB-161 (0'-4')	Lead-210	-3.00E-01	5.20E+00	BU
SB-161 (0'-4')	Lead-211	-4 80E-01	-1.70E+01	BU
SB-161 (0'-4')	Lead-212	1.40E+00	2.10E+00	BU
SB-161 (0'-4')	Protactinium-231	1.30E+00	3 40E+00	BU
SB-161 (0'-4')	Protactinium-234	1.10E-01	-5.60E+00	BU
SB-161 (0'-4')	Protactinium-234m	2.00E+01	4.10E+02	BU
SB-161 (0'-4')	Radium-223	1.50E-01	1.00E+01	BU
SB-161 (0'-4')	Radium-224	1.50E+00	-6.30E+00	BU
SB-161 (0'-4')	Thorium-231	1.20E+00	-1.70E+00	BU
SB-161 (0'-4')	Thorium-234	1.40E+01	9.90E+01	BU
SB-162 (0'-4')	Bismuth-211	2.10E+00	-1.90E-01	BU
SB-162 (0'-4')	Bismuth-212	1.70E+00	2.30E+01	BU
SB-162 (0'-4')	Cesium-137	7.90E-02	3.10E+00	BU
SB-162 (0'-4')	Francium-223	-7.70E-02	5.40E+00	BU
SB-162 (0'-4')	Lead-210	3.60E-01	5.20E+00	BU
SB-162 (0'-4')	Lead-211	-1.80E-02	-1.70E+01	BU
SB-162 (0'-4')	Lead-214	7.70E-01	7.70E-01	BU
SB-162 (0'-4')	Protactinium-231	1.30E+00	3.40E+00	BU
SB-162 (0'-4')	Protactinium-234	2.80E-01	-5.60E+00	BU
SB-162 (0'-4')	Protactinium-234m	2.10E+00	4.10E+02	BU
SB-162 (0'-4')	Radium-223	3.50E-02	1.00E+01	BU
SB-162 (0'-4')	Thorium-231	-2.30E-01	-1.70E+00	BU
SB-162 (0'-4')	Thorium-234	3 10E+00	9.90E+01	BU
SB-162 (0'-4')	Uranium-235	5 40E-02	1.70E+00	BU
SB-163 (0'-4')	Bismuth-211	1.50E+00	-1.90E-01	BU
SB-163 (0'-4')	Bismuth-212	1.50E+00	2.30E+01	BU
SB-163 (0'-4')	Bismuth-214	4.20E-01	8.00E+00	BU
SB-163 (0'-4')	Cesium-137	-7.00E-03	3.10E+00	BU
SB-163 (0'-4')	Francium-223	1.00E+00	5.40E+00	BU
SB-163 (0'-4')	Lead-210	-2.00E+00	5.20E+00	BU
SB-163 (0'-4')	Lead-211	-6.70E-02	-1.70E+01	BU
SB-163 (0'-4')	Protactinium-231	-2.20E-01	3.40E+00	BU
SB-163 (0'-4')	Protactinium-234	7.40E-01	-5.60E+00	BU
SB-163 (0'-4')	Radium-223	4.00E-02	1.00E+01	BU
SB-163 (0'-4')	Thorium-227	-2.10E-02	2.90E+00	BU
SB-164 (0'-4')	Bismuth-211	2.30E+00	-1.90E-01	BU
SB-164 (0'-4')	Bismuth-212	9.50E-01	2.30E+01	BU
SB-164 (0'-4')	Cesium-137	-1.20E-02	3.10E+00	BU
SB-164 (0'-4')	Francium-223	1.50E-01	5.40E+00	BU
SB-164 (0'-4')	Lead-210	-2.30E-02	5.20E+00	BU
SB-164 (0'-4')	Lead-211	1.50E-01	-1.70E+01	BU
SB-164 (0'-4')	Protactinium-231	1.20E+00	3.40E+00	BU
SB-164 (0'-4')	Protactinium-234	6.00E-01	-5 60E+00	BU
SB-164 (0'-4')	Protactinium-234m	2.30E+00	4.10E+02	BU
SB-164 (0'-4')	Radium-223	2.20E-01	1.00E+01	BU
SB-164 (0'-4')	Thorium-231	-8.00E-01	-1.70E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-164 (0'-4')	Thorium-234	1.40E+00	9 90E+01	BU
SB-164 (0'-4')	Uranium-235	1.30E-01	1.70E+00	BU
SB-165 (0'-4')	Bismuth-211	2 70E+00	-1.90E-01	BU
SB-165 (0'-4')	Bismuth-212	1.50E+00	2.30E+01	BU
SB-165 (0'-4')	Cesium-137	4.10E-02	3.10E+00	BU
SB-165 (0'-4')	Francium-223	-1.90E-01	5.40E+00	BU
SB-165 (0'-4')	Lead-210	1.10E+00	5.20E+00	BU
SB-165 (0'-4')	Lead-211	6.50E-01	-1.70E+01	BU
SB-165 (0'-4')	Protactinium-231	1.70E+00	3.40E+00	BU
SB-165 (0'-4')	Protactinium-234	1.40E-01	-5.60E+00	BU
SB-165 (0'-4')	Protactinium-234m	3.10E+00	4.10E+02	BU
SB-165 (0'-4')	Radium-223	2.10E-01	1.00E+01	BU
SB-165 (0'-4')	Thallium-208	4.60E-01	-2.50E+00	BU
SB-165 (0'-4')	Thorium-231	7.40E-01	-1.70E+00	BU
SB-165 (0'-4')	Uranium-235	4.20E-01	1.70E+00	BU
SB-161D (16'-20')	Bismuth-211	2.20E+00	-1.90E-01	BU
SB-161D (16'-20')	Bismuth-212	1.90E+00	2.30E+01	BU
SB-161D (16'-20')	Cesium-137	-6 50E-03	3.10E+00	BU
SB-161D (16'-20')	Francium-223	-2.70E-01	5.40E+00	BU
SB-161D (16'-20')	Lead-210	2.30E+00	5.20E+00	BU
SB-161D (16'-20')	Lead-211	-1.40E-01	-1.70E+01	BU
SB-161D (16'-20')	Protactinium-231	6.90E-01	3.40E+00	BU
SB-161D (16'-20')	Protactinium-234	3.80E-01	-5.60E+00	BU
SB-161D (16'-20')	Protactinium-234m	2.10E+01	4.10E+02	BU
SB-161D (16'-20')	Radium-223	3.80E-01	1.00E+01	BU
SB-161D (16'-20')	Thorium-227	2.10E-01	2.90E+00	BU
SB-161D (16'-20')	Thorium-231	1.40E+00	-1.70E+00	BU
SB-166 (8'-12')	Bismuth-211	9.30E-03	-1.90E-01	BU
SB-166 (8'-12')	Bismuth-212	5.40E+00	2.30E+01	BU
SB-166 (8'-12')	Bismuth-214	3.20E-01	8.00E+00	BU
SB-166 (8'-12')	Cesium-137	4.90E-02	3.10E+00	BU
SB-166 (8'-12')	Lead-211	-2.40E+00	-1.70E+01	BU
SB-166 (8'-12')	Lead-214	1.10E-01	7.70E-01	BU
SB-166 (8'-12')	Potassium-40	4.60E+00	1.90E+02	BU
SB-166 (8'-12')	Protactinium-231	1.30E+00	3.40E+00	BU
SB-166 (8'-12')	Protactinium-234	1.90E+00	-5.60E+00	BU
SB-166 (8'-12')	Radium-223	1.40E-01	1.00E+01	BU
SB-158 (16'-20')	Bismuth-211	8.90E-01	-1.90E-01	BU
SB-158 (16'-20')	Bismuth-212	1.20E+00	2.30E+01	BU
SB-158 (16'-20')	Bismuth-214	2.70E-01	8.00E+00	BU
SB-158 (16'-20')	Cesium-137	1.80E-02	3.10E+00	BU
SB-158 (16'-20')	Francium-223	-6 10E-02	5.40E+00	BU
SB-158 (16'-20')	Lead-210	1.60E+00	5.20E+00	BU
SB-158 (16'-20')	Lead-211	-3.00E-01	-1.70E+01	BU
SB-158 (16'-20')	Lead-214	2.50E-01	7.70E-01	BU
SB-158 (16'-20')	Protactinium-231	1.70E-01	3.40E+00	BU
SB-158 (16'-20')	Protactinium-234	-1.30E-01	-5.60E+00	BU
SB-158 (16'-20')	Protactinium-234m	3.90E+00	4.10E+02	BU
SB-158 (16'-20')	Radium-223	9.30E-02	1.00E+01	BU
SB-158 (16'-20')	Radium-224	6.90E-01	-6 30E+00	BU
SB-158 (16'-20')	Thallium-208	1.10E-01	-2.50E+00	BU

Attachment A

Blank evaluation for gamma spectrometry analyses

Client ID	Radionuclide	Sample Result pCi/g	Blank Result pCi	Qualifier
SB-158 (16'-20')	Thorium-227	4.10E-02	2.90E+00	BU
SB-158 (16'-20')	Thorium-231	-1.30E-01	-1.70E+00	BU
SB-158 (16'-20')	Thorium-234	2.20E+00	9.90E+01	BU
SB-158 (16'-20')	Uranium-235	1.90E-01	1.70E+00	BU
SB-136 (0'-4')	Bismuth-211	2.30E+00	-1.90E-01	BU
SB-136 (0'-4')	Bismuth-212	1.30E+00	2.30E+01	BU
SB-136 (0'-4')	Cesium-137	9.30E-02	3.10E+00	BU
SB-136 (0'-4')	Francium-223	-6.10E-01	5.40E+00	BU
SB-136 (0'-4')	Lead-210	-1.80E+00	5.20E+00	BU
SB-136 (0'-4')	Lead-211	-4.80E-01	-1.70E+01	BU
SB-136 (0'-4')	Protactinium-231	2.20E+00	3.40E+00	BU
SB-136 (0'-4')	Protactinium-234	5.50E-01	-5.60E+00	BU
SB-136 (0'-4')	Radium-223	2.10E-01	1.00E+01	BU
SB-137 (0'-4')	Bismuth-211	2.60E+00	-1.90E-01	BU
SB-137 (0'-4')	Bismuth-212	1.60E+00	2.30E+01	BU
SB-137 (0'-4')	Cesium-137	-2.70E-02	3.10E+00	BU
SB-137 (0'-4')	Francium-223	-1.50E-01	5.40E+00	BU
SB-137 (0'-4')	Lead-210	9.90E-01	5.20E+00	BU
SB-137 (0'-4')	Lead-211	1.20E+00	-1.70E+01	BU
SB-137 (0'-4')	Protactinium-231	2.30E+00	3.40E+00	BU
SB-137 (0'-4')	Protactinium-234	-8.20E-02	-5.60E+00	BU
SB-137 (0'-4')	Protactinium-234m	9.50E+00	4.10E+02	BU
SB-137 (0'-4')	Radium-223	2.50E-02	1.00E+01	BU
SB-137 (0'-4')	Thallium-208	3.20E-02	-2.50E+00	BU
SB-137 (0'-4')	Thorium-231	3.10E-01	-1.70E+00	BU
SB-137 (0'-4')	Uranium-235	5.40E-01	1.70E+00	BU

APPENDIX F

Memorandum (Interpretation of Radiochemistry Data)

O'Brien & Gere Laboratories, Inc.

MEMORANDUM

To:	J. Banikowski	**Date:**	February 16, 2001
From:	W. H. Hayes	**File:**	G:\HAYES\Misc\GTE Rad Interpret.wpd
Re:	Interpretation of Radiochemistry Data	**cc:**	MS, MNP

Data have been reported from samples collected from the GTE - Sylvania Site in Hicksville, NY. Certain information should be understood while reviewing and interpreting the reported data. The purpose of this memo is to clarify a few of these points.

Gamma Spectrometry

Monitoring Objective

Activities are measured from photon emitting isotopes which are incorporated within the sample matrices. At the site in question, the principle radiological concerns are isotopes from the uranium, thorium, and actinium series of isotopes (see attachments). In chemically unprocessed radiological contaminants, these chains (series') should have an established equilibrium between parents and progeny. Further, in naturally occurring materials, the comparative fraction of uranium-235, should be about 0.72% of total uranium by mass. The actinium series should be expected to be in equilibrium with the U-235 parent.

Based on previous monitoring and process knowledge, it has been determined that radiological materials at the site were chemically processed; and, therefore, one may expect the series' of interest not to be in equilibrium. One finds elevated lower chain daughters not supported by parents or, conversely, parent and upper chain isotopes not supported by lower chain daughters.

Clean-up criteria have been principally established based on the determination of activities of the following isotopes:

Uranium-238	Uranium Series	parent
Radium-226	Uranium Series	lower chain daughter
Uranium-235	Actinium Series	parent
Thorium-232	Thorium Series	parent

Measurement Problems

The above isotopes may be fairly accurately interpolated from gamma spectrometry data, but, in several cases, may not necessarily or accurately be measured directly. For example, the decay of thorium-232 and uranium-238 do not yield any significant gamma emissions. Further, radium-226 emits a 186 KeV gamma when it decays, and this emission is the only energy for its gamma decay. The problem this poses is that uranium-235 also emits a 186 KeV gamma; and, therefore, interferes with the measurement of radium-226. Because uranium-235 gamma decays have several other emission energies, the interference from radium-226 on its quantification may be measured and corrected.

Reporting Conventions

Data are reported from the laboratory based on the activities measured for each reported isotope regardless of the fact that it is understood that individual isotopic results may be biased as a result of the presence of other isotopes. Results are reported as measured based on the energy and efficiency calibrations applied to the measurement system. Interpretation of data is left to the client. A certain level of understanding of gamma spectrometry data limitations is assumed. Some guidance to be used for this interpretation is attached.

Data Interpretation

Uranium-238 - As previously stated, uranium-238 is not a gamma emitter. As illustrated in the attached uranium series decay chart, its first daughter is thorium-234, which has a half-life of 24.1 days. Its second daughter is protactinium-234m, which has a half-life of 1.17 minutes.

Because the site is no longer in operation as a nuclear fuel fabrication facility, both daughters should be in equilibrium (equal activity with the parent uranium-238). Thorium-234 has gamma emissions at 63 and 93 KeV; protactinium-234m has a principle gamma emission at 1001 KeV. Either daughter could be used for interpolating uranium-238 activity. Each has its pros and cons. The gamma abundance (gammas/disintegration) for thorium-234 is higher than that observed for protactinium-234m - 4% compared with 0.6% - so the detection level for thorium-234 is lower. Conversely, though, there exists several interferences with measurements made at the emission energies from thorium-234. Almost nothing interferes with the protactinium-234m emission energy.

We, therefore, recommend that the reported protactinium-234m activities be used for interpolating the uranium-238 activities unless the Pa-234m activities are less than their detection levels. If their activities are less than detection levels, the Th-234 activities should be used for interpolating uranium-238 activities.

Thorium-232 - As also previously stated, thorium-232 is not a gamma emitter. As illustrated in the attached thorium series decay chart, its first daughter is radium-228, which has a half-life of 6.7 years. Its second daughter is actinium-228, which has a half-life of 6.13 hours. Because radium-228 is also not a gamma emitter, the actinium-228 emissions should be used for interpolating thorium-232 activities. Ac-228 has several emission lines and few interferences.

Uranium-235 - This isotope is a gamma emitter; has several emission lines; and can be fairly accurately quantified by gamma spectrometry directly.

Radium-226 - This isotope is a gamma emitter, but, as was previously discussed, is interfered with by the presence of uranium-235. The forth daughter of radium-226 is bismuth-214, and the fifth daughter is lead-214. All daughters between radium-226 and lead 214 have very short half-lives, so it may be accurately assumed that daughters are in equilibrium. In addition, all samples were allowed to set in their sealed counting vessels at least 21 days from the time they were dried and ground until they were counted. Therefore, we can attest with much assurance that Pb-214 and Bi-214 were in equilibrium with Ra-226. In that Pb-214 and Bi-214 have multiple emission lines, may be quantified fairly accurately, and have about equal detection levels, we recommend that the average of these two isotopes be used to quantify radium-226. If a conservative approach is deemed desirable, the higher of the lead or bismuth-214 could be used.

Other Considerations

Based on conversations about the interpretation of the data or how the data might be viewed, it became apparent that an understanding about how results are calculated might be necessary. Though the actual calculation is considerably more complicated than what is presented here, the following generally represents how results are calculated from observed data:

$$Activity(pCi/g) = \frac{\gamma\ counts}{2.22 * counttime * abundance * eff * mass}$$

where:	γ counts	=	observed gamma counts at a given energy
	2.22	=	conversion from dpm to pCi
	count time	=	minutes counted
	abundance	=	γ counts/disintegration for a given isotope's emission
	eff	=	efficiency (γ counts/γ emissions) for a given detector at a given energy
	mass	=	grams of sample aliquot counted

A question arose in conversations about the data that went like this. Hypothetically, if a sample had an observed result based on direct measurement of Ra-226 of 10 pCi/g and had observed results for Bi-214 and Pb-214 of 1.0 pCi/g, it is understood that Bi-214 and Pb-214 are more reliable at interpolating the Ra-226 result than the direct Ra-226 measurement. Therefore, it would be assumed that the Ra-226 activity is 1.0 pCi/g. Again, the high bias for the direct measurement of Ra-226 is caused by the U-235 interference. Therefore, if only 1.0 pCi/g of the Ra-226 result really is from Ra-226, does that mean that 9.0 pCi/g are from U-235?

The answer is no. The explanation comes from the abundance term in the above equation. The abundance for the 186 KeV peak from Ra-226 is 4%. The abundance for the 186 KeV peak from U-235 is 54%. Therefore, in simplistic terms, the 9 pCi/g over reporting of Ra-226 activity in our hypothetical example may have been caused by the presence of only 0.67 pCi/g of U-235 being misclassified.

$$0.67\ pCi/g = 9\ pCi/g * \frac{.04}{.54}$$

The above calculation is, again, not nearly this simplistic, but the example illustrates the point.

Conclusion

We recommend that the above assumptions, as stated in the Data Interpretation section, be used for reporting radiological monitoring data from this site.

Uranium Series (4n + 2)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{238}_{92}U$	Uranium I	4.51×10^{9}y	4.15 (25%) 4.20 (75%)	---	---
$^{234}_{90}Th$	Uranium X_1	24.1d	---	0.103 (21%) 0.193 (79%)	0.063c‡ (3.5%) 0.093c (4%)
$^{234}_{91}Pa^{m}$	Uranium X_2	1.17m	---	2.29 (98%)	0.765 (0.30%) 1.001 (0.60%)
99.87% | 0.13% → $^{234}_{91}Pa$	Uranium Z	6.75h	---	0.53 (66%) 1.13 (13%)	0.100 (50%) 0.70 (24%) 0.90 (70%)
$^{234}_{92}U$	Uranium II	2.47×10^{5}y	4.72 (28%) 4.77 (72%)	---	0.053 (0.2%)
$^{230}_{90}Th$	Ionium	8.0×10^{4}y	4.62 (24%) 4.68 (76%)	---	0.068 (0.6%) 0.142 (0.07%)
$^{226}_{88}Ra$	Radium	1602y	4.60 (6%) 4.78 (95%)	---	0.186 (4%)
$^{222}_{86}Rn$	Emanation Radon (Rn)	3.823d	5.49 (100%)	---	0.510 (0.07%)
$^{218}_{84}Po$	Radium A	3.05m	6.00 (~100%)	0.33 (~0.019%)	---
99.98% | 0.02% → $^{214}_{82}Pb$	Radium B	26.8m	---	0.65 (50%) 0.71 (40%) 0.98 (6%)	0.295 (19%) 0.352 (36%)
$^{218}_{85}At$	Astatine	~2s	6.65 (6%) 6.70 (94%)	? (~0.1%)	---
$^{214}_{83}Bi$	Radium C	19.7m	5.45 (0.012%) 5.51 (0.008%)	1.0 (23%) 1.51 (40%) 3.26 (19%)	0.609 (47%) 1.120 (17%) 1.764 (17%)
99.98% | 0.02% → $^{214}_{84}Po$	Radium C'	164μs	7.69 (100%)	---	0.799 (0.014%)
$^{210}_{81}Tl$	Radium C"	1.3m	---	1.3 (25%) 1.9 (56%) 2.3 (19%)	0.296 (80%) 0.795 (100%) 1.31 (21%)
$^{210}_{82}Pb$	Radium D	21y	3.72 (.000002%)	0.016 (85%) 0.061 (15%)	0.047 (4%)
$^{210}_{83}Bi$	Radium E	5.01d	4.65 (.00007%) 4.69 (.00005%)	1.161 (~100%)	---
~100% | .00013% → $^{210}_{84}Po$	Radium F	138.4d	5.305 (100%)	---	0.803 (0.0011%)
$^{206}_{81}Tl$	Radium E"	4.19m	---	1.571 (100%)	---
$^{206}_{82}Pb$	Radium G	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{206}_{82}Pb$ (4n + 2).....4(51) + 2 = 206

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from Table of Isotopes and USNRDL-TR-802.

Thorium Series (4n)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{232}_{90}Th$	Thorium	1.41×10^{10}y	3.95 (24%) 4.01 (76%)	---	---
$^{228}_{88}Ra$	Mesothorium I	6.7y	---	0.055 (100%)	---
$^{228}_{89}Ac$	Mesothorium II	6.13h	---	1.18 (35%) 1.75 (12%) 2.09 (12%)	0.34c‡ (15%) 0.908 (25%) 0.96c (20%)
$^{228}_{90}Th$	Radiothorium	1.910y	5.34 (28%) 5.43 (71%)	---	0.084 (1.6%) 0.214 (0.3%)
$^{224}_{88}Ra$	Thorium X	3.64d	5.45 (6%) 5.68 (94%)	---	0.241 (3.7%)
$^{220}_{86}Rn$	Emanation Thoron (Tn)	55s	6.29 (100%)	---	0.55 (0.07%)
$^{216}_{84}Po$	Thorium A	0.15s	6.78 (100%)	---	---
$^{212}_{82}Pb$	Thorium B	10.64h	---	0.346 (81%) 0.586 (14%)	0.239 (47%) 0.300 (3.2%)
$^{212}_{83}Bi$	Thorium C	60.6m	6.05 (25%) 6.09 (10%)	1.55 (5%) 2.26 (55%)	0.040 (2%) 0.727 (7%) 1.620 (1.8%)
64.0% $^{212}_{84}Po$	Thorium C'	304ns	8.78 (100%)	---	---
36.0% $^{208}_{81}Tl$	Thorium C''	3.10m	---	1.28 (25%) 1.52 (21%) 1.80 (50%)	0.511 (23%) 0.583 (86%) 0.860 (12%) 2.614 (100%)
$^{208}_{82}Pb$	Thorium D	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{232}_{90}Th$ (4n).....4(58) = 232

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Lederer, C. M., Hollander, J. M., and Perlman, I., Table of Isotopes (6th ed.; New York: John Wiley & Sons, Inc., 1967) and Hogan, O. H., Zigman, P. E., and Mackin, J. L., Beta Spectra (USNRDL-TR-802 [Washington, D.C.: U.S. Atomic Energy Commission, 1964]).

Actinium Series (4n + 3)*

Nuclide	Historical name	Half-life	Major radiation energies (MeV) and intensities†		
			α	β	γ
$^{235}_{92}U$	Actinouranium	7.1×10^8y	4.37 (18%) 4.40 (57%) 4.58c‡ (8%)	---	0.143 (11%) 0.185 (54%) 0.204 (5%)
$^{231}_{90}Th$	Uranium Y	25.5h	---	0.140 (45%) 0.220 (15%) 0.305 (40%)	0.026 (2%) 0.084c (10%)
$^{231}_{91}Pa$	Protoactinium	3.25×10^4y	4.95 (22%) 5.01 (24%) 5.02 (23%)	---	0.027 (6%) 0.29c (6%)
$^{227}_{89}Ac$	Actinium	21.6y	4.86c (0.18%) 4.95c (1.2%)	0.043 (~99%)	0.070 (0.08%)
98.6% 1.4%					
$^{227}_{90}Th$	Radioactinium	18.2d	5.76 (21%) 5.98 (24%) 6.04 (23%)	---	0.050 (8%) 0.237c (15%) 0.31c (8%)
$^{223}_{87}Fr$	Actinium K	22m	5.44 (~0.005%)	1.15 (~100%)	0.050 (40%) 0.080 (13%) 0.234 (4%)
$^{223}_{88}Ra$	Actinium X	11.43d	5.61 (26%) 5.71 (54%) 5.75 (9%)	---	0.149c (10%) 0.270 (10%) 0.33c (6%)
$^{219}_{86}Rn$	Emanation Actinon (An)	4.0s	6.42 (8%) 6.55 (11%) 6.82 (81%)	---	0.272 (9%) 0.401 (5%)
$^{215}_{84}Po$	Actinium A	1.78ms	7.38 (~100%)	0.74 (~.00023%)	---
~100% .00023%					
$^{211}_{82}Pb$	Actinium B	36.1m	---	0.29 (1.4%) 0.56 (9.4%) 1.39 (87.5%)	0.405 (3.4%) 0.427 (1.8%) 0.832 (3.4%)
$^{215}_{85}At$	Astatine	~0.1ms	8.01 (~100%)	---	---
$^{211}_{83}Bi$	Actinium C	2.15m	6.28 (16%) 6.62 (84%)	0.60 (0.28%)	0.351 (14%)
0.28% 99.7%					
$^{211}_{84}Po$	Actinium C'	0.52s	7.45 (99%)	---	0.570 (0.5%) 0.90 (0.5%)
$^{207}_{81}Tl$	Actinium C''	4.79m	---	1.44 (99.8%)	0.897 (0.16%)
$^{207}_{82}Pb$	Actinium D	Stable	---	---	---

*This expression describes the mass number of any member in this series, where n is an integer.
Example: $^{207}_{82}Pb$ (4n + 3).....4(51) + 3 = 207

†Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series.

‡Complex energy peak which would be incompletely resolved by instruments of moderately low resolving power such as scintillators.

Data taken from: Table of Isotopes and USNRDL-TR-802.

Nuclide Name	Nuclide Type	Half Life	Key Line?	Energy (keV)	% Abn
K-40	natural	1.28E+09Y	*	1460.81	10.67
CS-137	fission	30.07Y	*	661.66	85.12
TL-208	natural	1.41E+10Y		277.35	6.31
			*	583.19	84.50
				860.56	12.42
PB-210	natural	1600.00Y	*	46.54	4.25
BI-211	natural	7.04E+08Y	*	351.06	12.91
PB-211	natural	7.04E+08Y	*	404.85	3.78
				832.01	3.52
BI-212	natural	1.41E+10Y	*	727.33	6.58
PB-212	natural	1.41E+10Y		74.82	10.41
				77.11	17.50
				87.09	6.10
			*	238.63	43.30
				300.09	3.28
BI-214	natural	1600.00Y	*	609.31	46.40
				768.36	4.94
				934.06	3.03
				1120.29	15.10
				1238.11	5.78
				1377.67	4.00
				1407.98	2.15
				1509.23	2.11
				1729.59	2.92
				1764.49	15.40
				1847.42	2.11
PB-214	natural	1600.00Y		74.81	4.80
				77.11	8.00
				87.09	2.80
				241.98	7.43
				295.22	19.30
			*	351.93	37.60
FR-223	natural	3.28E+04Y	*	50.10	38.70
				79.72	9.10
				234.81	3.00
RA-223	natural	3.28E+04Y		81.07	15.20
				83.79	25.20
				94.56	8.75
				144.23	3.22
				154.21	5.62
			*	269.46	13.70
				323.87	3.93
RA-224	natural	1.41E+10Y	*	240.99	4.10
RA-226	natural	1600.00Y	*	186.21	3.59
TH-227	natural	3.28E+04Y		50.10	8.60
				85.43	2.08
				88.47	3.40
			*	235.97	12.30
				256.25	7.00
				300.00	2.66
				329.85	2.70

Nuclide Name	Nuclide Type	Half Life	Key Line?	Energy (keV)	% Abn
AC-228	natural	1.41E+10Y		93.35	3.19
				129.07	2.42
				209.25	3.89
				270.24	3.46
				328.00	2.95
				338.32	11.27
				463.01	4.40
				794.95	4.25
			*	911.20	25.80
				964.77	4.99
				968.97	15.80
				1588.19	3.22
PA-231	natural	3.28E+04Y		300.07	2.46
			*	302.65	2.90
TH-231	natural	7.04E+08Y	*	84.22	6.60
PA-234	natural	4.47E+09Y		94.65	14.40
				98.43	23.30
				111.30	5.44
				131.30	18.00
			*	152.72	6.00
				226.90	10.00
				569.30	11.80
				880.50	10.20
				883.24	9.60
				925.00	7.80
				926.72	7.20
				946.00	13.40
PA-234M	natural	4.47E+09Y	*	1001.03	0.84
TH-234	natural	4.47E+09Y	*	63.29	4.80
				92.59	5.58
U-235	natural	7.04E+08Y		89.60	6.00
				93.35	11.00
				105.60	2.40
			*	143.76	10.98
				163.36	5.08
				185.71	57.20
				205.31	5.01