State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/6/99 Sampler: Type SS Dia. 51mm Water Elev. 271.56m
Date Completed 10/6/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset Sta 38+050, 0.00 m Surface Elev. 273.296m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
273.30	0														
273.20		5-9-27			TOPSOIL Very soft, light brown, decomposed SANDSTONE.	1	--	--	--	--	--	--	--	9	VISUAL
	1														
272.08		6-18-26			Very soft to medium hard, brown to gray, decomposed to weathered CLAY SHALE.	2	--	--	--	--	--	--	--	14	VISUAL
	2	12-19-33				3	--	--	--	--	--	--	--	14	VISUAL
	3	50/150				4	--	--	--	--	--	--	--	6	VISUAL
	4														
268.72		50/25				5	--	--	--	--	--	--	--	2	VISUAL
	5	RQD = 100%	1.55	0.00	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Hard, gray, slightly weathered, very fine grained SANDSTONE with massive bedding. Quality of rock considered excellent as per RQD.	Run 1									
267.17	6														
					TERMINATION DEPTH = 6.13 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/6/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/6/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. _____ Station & Offset Sta 38+250, 0.00 m Surface Elev. 267.140m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
267.14	0														
267.02		2-4-5			TOPSOIL Stiff to very stiff, reddish-brown CLAY (A-7-6), little to trace rock fragments, moist.	1	7	3	10	--	80 *	46	23	21	A-7-6
	1	4-11-16				2	3	4	2	--	90 *	48	19	16	A-7-6
265.31	2	7-19-30			Very soft to medium hard, reddish-brown, decomposed to highly weathered CLAY SHALE.	3	--	--	--	--	--	--	--	15	VISUAL
	3	30-39-50/127				4	--	--	--	--	--	--	--	12	VISUAL
	4														
	5	21-43-40				5	--	--	--	--	--	--	--	10	VISUAL
	6	50/76				6	--	--	--	--	--	--	--	--	VISUAL
261.04		RQD = 66%	1.45	0.08	Note: Auger refusal on bedrock at 6.10 meters. Began coring bedrock. soft, clay, highly weathered SILTY SHALE with indistinct to laminar bedding (fissile). Quality of rock for run 1 considered fair as per RQD.	Run 1									
260.25	7				Hard, gray, slightly weathered, fine grained SAND STONE with moderated to thick bedding.										
259.52					TERMINATION DEPTH = 7.62 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

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LOG OF BORING

Date Started 10/6/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/6/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. _____ Station & Offset Sta 38+600, 0.00 m Surface Elev. 265.397m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
265.40	0														
265.28		4-9-10			TOPSOIL Very stiff, light brown CLAY (A-7-6), little to trace sand, trace to no rock fragments, moist.	1	1	2	9	--	88 *	45	22	17	A-7-6
264.48	1	Shelby Tube			Very stiff, brown ELASTIC CLAY (A-7-5), trace rock fragments, moist.	ST	7	0	0	--	93 *	53	21	18	A-7-5
263.87		5-10-12			Very stiff, light brown CLAY (A-7-6), trace sand, moist.	3	0	0	6	--	94 *	43	21	18	A-7-6
263.11	2	50/102			Very soft to soft, brown, highly weathered, micaceous CLAY SHALE.	4	--	--	--	--	--	--	--	7	VISUAL
262.35	3	RQD = 36%	1.22	0.30	Note: Auger refusal on bedrock at 3.05 meters. Began coring bedrock Very soft to soft, brown, highly weathered CLAYSTONE with indistinct bedding.	Run 1									
	4				Note: Iron staining present throughout length of core.										
260.83					TERMINATION DEPTH = 4.57 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

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Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/7/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/7/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset Sta 38+815, 0.00 m Surface Elev. 261.779m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
261.78	0														
261.69		4-4-3			TOPSOIL Medium stiff, brown SILT AND CLAY (A-6a), some sand, little rock fragments, moist.	1	13	10	14	--	64 *	39	15	22	A-6a
260.71	1	12-50/76			Soft to medium hard, brown, decomposed to weathered SANDSTONE.	2	--	--	--	--	--	--	--	9	VISUAL
260.26		ROD = 68%	1.52	0.00	Note: Auger refusal on bedrock at 1.52 meters. Began coring bedrock.	Run 1									
	2				Hard, gray, slightly weathered, slightly micaceous, fine grained SANDSTONE with very thin to thin bedding. Note: Iron staining present from 1.52 to 1.65 meters. Quality of rock for Run 1 considered fair as per ROD.										
259.13															
258.73	3				Soft, gray, weathered, slightly micaceous SILTSTONE with indistinct to very thin bedding.										
					TERMINATION DEPTH = 3.05 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

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Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/7/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/7/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset Sta 38+972, 0.00 m Surface Elev. 261.520m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
261.52	0														
261.43		4-6-8			TOPSOIL Stiff, brown CLAY (A-7-6), trace sand, moist.	1	0	1	3	--	96 *	49	22	18	A-7-6
260.61	1	8-13-17			Very stiff to hard, brown SILTY CLAY (A-6b), little sand, trace rock fragments, moist.	2	8	6	7	--	79 *	39	17	12	A-6b
259.54	2	50/25			Note: No recovery for Sample 3.	3	--	--	--	--	--	--	--	--	VISUAL
		RQD = 79%	1.55	0.00	Note: Auger refusal on bedrock at 1.98 meters. Began coring bedrock.	Run 1									
	3				Hard, brown to light brown, slightly weathered, micaceous, fine grained SANDSTONE with thin to moderate bedding. Calcite cementation present from 1.98 to 2.07 meters (effervesces freely). Quality of rock considered fair as per ROD. Note: Calcite cementation present from 2.93 to 3.54 meters (effervesces freely with dilute HCl).										
257.98					TERMINATION DEPTH = 3.54 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
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Testing Laboratory

LOG OF BORING

Date Started 10/7/99 Sampler: Type SS Dia. 51mm Water Elev. 263.51m
Date Completed 10/7/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset Sta 39+311, 0.00 m Surface Elev. 263.810m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
263.81	0														
263.72		2-5-7			TOPSOIL Stiff to very stiff, brown CLAY (A-7-6), trace rock fragments, trace sand, moist.	1	0	0	2	--	98 *	60	31	21	A-7-6
	1	6-9-14				2	2	2	1	--	95 *	46	21	15	A-7-5
261.98	2	33-51			Very soft to soft, brown, decomposed CLAY SHALE.	3	--	--	--	--	--	--	--	6	VISUAL
		28-50/127				4	--	--	--	--	--	--	--	7	VISUAL
260.76	3	ROD = 29%	1.43	0.09	Note: Auger refusal on bedrock at 3.05 meters. Began coring bedrock Soft to very soft, brown, highly weathered CLAYSTONE with indisting bedding. Iron staining present throughout length of core Quality of rock considered poor as per ROD. Note: 127 mm thick, very fine grained sandstone seam at 3.26 meters. Note: 89 mm thick, very fine grained sandstone seam at 3.51meters.	Run 1									
	4														
259.24					TERMINATION DEPTH = 4.57 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/7/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/7/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset Sta 38+815, 0.00 m Surface Elev. 261.779m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
261.78	0														
261.69		4-4-3			TOPSOIL Medium stiff, brown SILT AND CLAY (A-6a), some sand, little rock fragments, moist.	1	13	10	14	--	64 *	39	15	22	A-6a
260.71	1	12-50/76			Soft to medium hard, brown, decomposed to weathered SANDSTONE.	2	--	--	--	--	--	--	--	9	VISUAL
260.26		RQD = 68%	1.52	0.00	Note: Auger refusal on bedrock at 1.52 meters. Began coring bedrock. Hard, gray, slightly weathered, slightly micaceous, fine grained SANDSTONE with very thin to thin bedding. Note: Iron staining present from 1.52 to 1.65 meters. Quality of rock for Run 1 considered fair as per RQD.	Run 1									
	2														
259.13					Soft, gray, weathered, slightly micaceous SILTSTONE with indistinct to very thin bedding.										
258.73	3				TERMINATION DEPTH = 3.05 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

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LOG OF BORING

Date Started 10/7/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/7/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset Sta 38+972, 0.00 m Surface Elev. 261.520m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
261.52	0														
261.43		4-6-8			TOPSOIL Stiff, brown CLAY (A-7-6), trace sand, moist.	1	0	1	3	--	96 *	49	22	18	A-7-6
260.61	1	8-13-17			Very stiff to hard, brown SILTY CLAY (A-6b), little sand, trace rock fragments, moist.	2	8	6	7	--	79 *	39	17	12	A-6b
259.54	2	50/25 RQD = 79%	1.55	0.00	Note: No recovery for Sample 3. Note: Auger refusal on bedrock at 1.98 meters. Began coring bedrock. Hard, brown to light brown, slightly weathered, micaceous, fine grained SANDSTONE with thin to moderate bedding. Calcite cementation present from 1.98 to 2.07 meters (effervesces freely). Quality of rock considered fair as per RQD. Note: Calcite cementation present from 2.93 to 3.54 meters (effervesces freely with dilute HCl).	3 Run 1	--	--	--	--	--	--	--	--	VISUAL
257.98	3				TERMINATION DEPTH = 3.54 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

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LOG OF BORING

Date Started 10/7/99 Sampler: Type SS Dia. 51mm Water Elev. 263.51m
Date Completed 10/7/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. _____ Station & Offset Sta 39+311, 0.00 m Surface Elev. 263.810m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
263.81	0														
263.72		2-5-7			TOPSOIL Stiff to very stiff, brown CLAY (A-7-6), trace rock fragments, trace sand, moist.	1	0	0	2	--	98 *	60	31	21	A-7-6
	1	6-9-14				2	2	2	1	--	95 *	46	21	15	A-7-5
261.98	2	33-51			Very soft to soft, brown, decomposed CLAY SHALE.	3	--	--	--	--	--	--	--	6	VISUAL
		28-50/127				4	--	--	--	--	--	--	--	7	VISUAL
260.76	3	RQD = 29%	1.43	0.09	Note: Auger refusal on bedrock at 3.05 meters. Began coring bedrock Soft to very soft, brown, highly weathered CLAYSTONE with indisting bedding. Iron staining present throughout length of core Quality of rock considered poor as per RQD. Note: 127 mm thick, very fine grained sandstone seam at 3.26 meters. Note: 89 mm thick, very fine grained sandstone seam at 3.51meters.	Run 1									
259.24	4														

TERMINATION DEPTH = 4.57 METERS

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/12/99 Sampler: Type SS Dia. 51mm Water Elev. 271.55m
Date Completed 10/12/99 Casing: Length ____ Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. ____ Station & Offset CR 16: Sta 50+405, 0.00 m Surface Elev. 271.856m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
271.86	0														
271.64					TOPSOIL										
		2-3-4			Medium stiff, brown SANDY SILT (A-4a), some clay, trace rock fragments, trace roots, moist.	1	3	10	24	37	26	27	5	17	A-4a
270.94	1	3-6-8			Stiff, brown CLAY (A-7-6), trace sand, moist.	2	0	3	5	--	92 *	41	16	20	A-7-6
270.33					Stiff, brown, SILT AND CLAY (A-6a), trace rock fragments, moist.	ST	10	0	0	--	90 *	32	11	10	A-6a
269.87	2	56/150			Very soft to soft, brown to gray, decomposed to highly weathered CLAY SHALE.	4	--	--	--	--	--	--	--	7	VISUAL
	3	56/150				5	--	--	--	--	--	--	--	7	VISUAL
	4														
267.28		50/51				6	--	--	--	--	--	--	--	3	VISUAL
	5	RQD = 82%	1.58	0.09	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Very soft, gray, highly weathered CLAYSTONE, with indistinct bedding. Quality of rock considered good as per RQD. Note: 150 mm thick sandy shale seam at 4.66 meters. Note: Color change to red at 5.18 meters.	Run 1									
265.61	6				TERMINATION DEPTH = 6.25 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/5/99 Sampler: Type SS Dia. 51mm Water Elev. 269.71m
Date Completed 10/5/99 Casing: Length ____ Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. ____ Station & Offset CR 16: Sta 50+588, 0.00 m Surface Elev. 270.012m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
270.01	0				BERM MATERIAL										
269.71		3-2-2			Soft to medium stiff, brown to gray SILT AND CLAY (A-6a), little sand, moist.	1	--	--	--	--	--	--	--	--	VISUAL
	1	2-2-4				2	0	3	14	--	83 *	35	14	22	A-6a
268.49	2	3-7-8			Stiff, brown CLAY (A-7-6), trace rock fragments, little sand, moist.	3	1	2	10	--	87 *	42	21	22	A-7-6
267.57		3-6-8			Stiff, brown to gray SILTY CLAY (A-6b), trace rock fragments, some sand, moist.	4	3	5	18	--	74 *	37	16	20	A-6b
266.81	3	5-8-20			Very stiff, reddish-brown CLAY (A-7-6), trace rock fragments, little sand, moist.	5	0	1	4	--	95 *	44	17	24	A-7-6
	4	8-1-18				6	0	0	0	--	100 *	44	16	24	A-7-6
	5														
264.37		50/51			Very soft, brown to gray, decomposed SANDSTONE, wet at 5.67 meters.	7	--	--	--	--	--	--	--	--	VISUAL
263.92	6	RQD = 82%	1.31	0.21	Note: Auger refusal on bedrock at 6.10 meters. Began coring bedrock. Hard, gray, slightly weathered, micaceous, fossiliferous fine grained SANDSTONE with thin to massive bedding.	Run 1									
262.61	7														
262.39					Very soft, gray, highly weathered CLAY SHALE with indistinct to laminar bedding (fissile). Note: 25 mm hard, gray, weathered limestone seam present at 7.56 meters. TERMINATION DEPTH = 7.62 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/5/99 Sampler: Type SS Dia. 51mm Water Elev. 270.35m
Date Completed 10/5/99 Casing: Length ____ Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. ____ Station & Offset CR 16: Sta 50+660, 0.00 m Surface Elev. 270.957m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
270.96	0														
270.50		1-2-2			BERM MATERIAL										
	1				Soft, brown SILT AND CLAY (A-6a), little sand, moist.	1	0	1	13	--	86 *	32	14	25	A-6a
269.89		Shelby Tube			Soft, brown CLAY (A-7-6), moist. (Shelby Tube Sample)	ST	6	0	0	--	94 *	54	25	25	A-7-6
269.28	2	4-6-9			Stiff, brown SILTY CLAY (A-6b), some sand, moist.	3	0	0	24	--	76 *	40	19	21	A-6b
268.37		14-23-28			Very soft, brown to reddish-brown, decomposed CLAY SHALE.	4	--	--	--	--	--	--	--	17	VISUAL
	3	25-49				5	--	--	--	--	--	--	--	13	VISUAL
	4														
		31-50/76				6	--	--	--	--	--	--	--	13	VISUAL
266.39	5	RQD = 17%	1.34	0.18	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Very soft, red, decomposed CLAY SHALE with indistinct bedding. Rock quality very poor as per RQD.	Run 1									
264.86	6				TERMINATION DEPTH = 6.10 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

ATH-33-30.981

ROADWAY/CULVERT SOIL PROFILE
BORING LOGS

DRAWN	REVIEWED	DATE	CALCULATED	CHECKED
E.D.S.	B.M.	03/22/00	W.I.N.	S.S.S.

PRIME ENGINEERING & ARCHITECTURE, INC.
COLUMBUS: (614) 457-2100 AKRON: (330) 666-5432

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/12/99 Sampler: Type SS Dia. 51mm Water Elev. 271.55m
Date Completed 10/12/99 Casing: Length ____ Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. ____ Station & Offset CR 16: Sta 50+405, 0.00 m Surface Elev. 271.856m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
271.86	0														
271.64		2-3-4			TOPSOIL Medium stiff, brown SANDY SILT (A-4a), some clay, trace rock fragments, trace roots, moist.	1	3	10	24	37	26	27	5	17	A-4a
270.94	1	3-6-8			Stiff, brown CLAY (A-7-6), trace sand, moist.	2	0	3	5	--	92 *	41	16	20	A-7-6
270.33					Stiff, brown, SILT AND CLAY (A-6a), trace rock fragments, moist.	ST	10	0	0	--	90 *	32	11	10	A-6a
269.87	2	56/150			Very soft to soft, brown to gray, decomposed to highly weathered CLAY SHALE.	4	--	--	--	--	--	--	--	7	VISUAL
	3	56/150				5	--	--	--	--	--	--	--	7	VISUAL
	4														
267.28		50/51				6	--	--	--	--	--	--	--	3	VISUAL
	5	ROD = 82%	1.58	0.09	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Very soft, gray, highly weathered CLAYSTONE, with indistinct bedding. Quality of rock considered good as per ROD. Note: 150 mm thick sandy shale seam at 4.66 meters. Note: Color change to red at 5.18 meters.	Run 1									
265.61	6				TERMINATION DEPTH = 6.25 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
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LOG OF BORING

Date Started 10/5/99 Sampler: Type SS Dia. 51mm Water Elev. 269.71m
Date Completed 10/5/99 Casing: Length Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset CR 16: Sta 50+588, 0.00 m Surface Elev. 270.012m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
270.01	0														
269.71					BERM MATERIAL										
		3-2-2			Soft to medium stiff, brown to gray SILT AND CLAY (A-6a), little sand, moist.	1	--	--	--	--	--	--	--	--	VISUAL
	1	2-2-4				2	0	3	14	--	83 *	35	14	22	A-6a
268.49					Stiff, brown CLAY (A-7-6), trace rock fragments, little sand, moist.										
	2	3-7-8				3	1	2	10	--	87 *	42	21	22	A-7-6
267.57															
		3-6-8			Stiff, brown to gray SILTY CLAY (A-6b), trace rock fragments, some sand, moist.	4	3	5	18	--	74 *	37	16	20	A-6b
	3														
266.81															
		5-8-20			Very stiff, reddish-brown CLAY (A-7-6), trace rock fragments, little sand, moist.	5	0	1	4	--	95 *	44	17	24	A-7-6
	4														
		8-1-18				6	0	0	0	--	100 *	44	16	24	A-7-6
	5														
264.37															
		50/51			Very soft, brown to gray, decomposed SANDSTONE, wet at 5.67 meters.	7	--	--	--	--	--	--	--	--	VISUAL
263.92	6														
		RQD = 82%	1.31	0.21	Note: Auger refusal on bedrock at 6.10 meters. Began coring bedrock. Hard, gray, slightly weathered, micaceous, fossiliferous fine grained SANDSTONE with thin to massive bedding.	Run 1									
	7														
262.61															
262.39					Very soft, gray, highly weathered CLAY SHALE with indistinct to laminar bedding (fissile). Note: 25 mm hard, gray, weathered limestone seam present at 7.56 meters. TERMINATION DEPTH = 7.62 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
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LOG OF BORING

Date Started 10/5/99 Sampler: Type SS Dia. 51mm Water Elev. 270.35m
Date Completed 10/5/99 Casing: Length Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset CR 16: Sta 50+660, 0.00 m Surface Elev. 270.957m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
270.96	0														
270.50		1-2-2			BERM MATERIAL Soft, brown SILT AND CLAY (A-6a), little sand, moist.	1	0	1	13	--	86 *	32	14	25	A-6a
269.89	1	Shelby Tube			Soft, brown CLAY (A-7-6), moist. (Shelby Tube Sample)	ST	6	0	0	--	94 *	54	25	25	A-7-6
269.28	2	4-6-9			Stiff, brown SILTY CLAY (A-6b), some sand, moist.	3	0	0	24	--	76 *	40	19	21	A-6b
268.37	3	14-23-28			Very soft, brown to reddish-brown, decomposed CLAY SHALE.	4	--	--	--	--	--	--	--	17	VISUAL
		25-49				5	--	--	--	--	--	--	--	13	VISUAL
	4	31-50/76				6	--	--	--	--	--	--	--	13	VISUAL
266.39	5	RQD = 17%	1.34	0.18	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Very soft, red, decomposed CLAY SHALE with indistinct bedding. Rock quality very poor as per RQD.	Run 1									
264.86	6				TERMINATION DEPTH = 6.10 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/14/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/14/99 Casing: Length Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset CR 21: Sta 3+074, 0.00 m Surface Elev. 294.580m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
294.58	0				ASPHALT										
294.06	1	4-4-4			Medium stiff, brown SILT AND CLAY (A-6a), some rock fragments, some sand, moist.	1	23	11	14	--	52 *	31	13	13	A-6a
293.36	2	1-2-2			Soft, brown SILT (A-4b), some clay, trace sand, moist.	2	0	0	2	65	33	29	8	28	A-4b
292.29	3	Shelby Tube			Very stiff, brown CLAY (A-7-6), little sand, trace rock fragments, moist.	ST	13	10	6	--	71 *	42	16	18	A-7-6
		3-8-10				4	5	3	7	--	85 *	43	22	23	A-7-6
290.92	4	55			Soft to medium hard, brown, decomposed to highly weathered SANDSTONE.	5	--	--	--	--	--	--	--	6	VISUAL
290.16	5	40-50/76			Very soft, brown to gray, highly weathered to decomposed CLAY SHALE.	6	--	--	--	--	--	--	--	7	VISUAL
	6	13-35-50/102				7	--	--	--	--	--	--	--	12	VISUAL
286.96	7	50/5"			Note: Auger refusal on bedrock at 7.62 meters. Began coring bedrock.	8	--	--	--	--	--	--	--	--	VISUAL
286.87	8	RQD = 8%	0.55	0.98	Soft, gray, highly weathered SILTY SHALE with indistinct to laminar bedding (fissile).	Run 1									
285.44	9				Very soft, gray, highly weathered CLAY SHALE, with indistinct to laminar bedding (fissile). Quality of rock considered very poor as per RQD. Note: 127 mm thick silty shale seam at 8.17 meters. Note: Most of the bedrock in Run 1 washed away during coring resulting in low recovery and RQD. TERMINATION DEPTH = 9.14 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
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LOG OF BORING

Date Started 10/14/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/14/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset CR 21: Sta 3+293, 0.00 m Surface Elev. 292.428m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
292.43	0				TOPSOIL										
292.28	1	1-2-2			Soft, brown SILT AND CLAY (A-6a), trace rock fragments, little sand, moist.	1	4	4	9	--	83 *	34	13	22	A-6a
291.36		5-7-10			Very stiff, brown CLAY (A-7-6), little rock fragments, trace sand, moist.	2A	18	6	4	--	72 *	41	13	14	A-7-6
291.06					Very soft to soft, brown, decomposed CLAY SHALE.	2B	--	--	--	--	--	--	--	11	VISUAL
	2	15-24-23				3	--	--	--	--	--	--	--	14	VISUAL
	3	8-30-54				4	--	--	--	--	--	--	--	12	VISUAL
	4	41-50/25				5	--	--	--	--	--	--	--	6	VISUAL
287.86	5	RQD = 52%	1.52	0.00	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Soft, gray, highly weathered CLAY SHALE with laminar bedding (fissile). Quality of rock considered fair as per RQD. Note: Iron staining present from 4.66 meters to 5.24 meters. Note: 0.40 meter thick hard, gray, weathered silty shale seam at 4.85 meters.	Run 1									
286.33	6				TERMINATION DEPTH = 6.10 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
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Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/15/99 Sampler: Type SS Dia. 51mm Water Elev. 279.92m
Date Completed 10/15/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset TR55: Sta 48+365 Surface Elev. 281.598m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
281.60	0				ASPHALT										
281.14					ROAD BASE										
280.84	1	31-19-14			Very stiff, brown SILT AND CLAY (A-6a) and rock fragments, little sand, moist.	1A	41	24	12	--	23 *	--	--	5	A-1-b
280.38		2-4-4			Medium stiff, brown CLAY (A-7-6), trace sand, moist.	1B	41	10	7	--	43 *	33	14	9	A-6a
279.62	2	2-4-4			Medium stiff, brown ELASTIC CLAY (A-7-5), trace to little rock fragments trace sand, moist.	2	0	1	2	--	98 *	43	23	23	A-7-6
	3	Sheby Tube				3	2	3	2	--	93 *	58	28	25	A-7-5
		15-48-27				ST	5	8	12	--	76 *	51	20	16	A-7-5
277.79	4				Very soft, brown, decomposed CLAY SHALE.	5	11	2	2	--	84 *	57	23	12	A-7-5
277.33					Medium hard, brown, highly weathered SANDSTONE.										
277.18		50/76			Note: Auger refusal on bedrock at 4.42 meters. Began coring	6	--	--	--	--	--	--	--	10	VISUAL
	5	RQD = 100%	1.68	0.00	bedrock Hard, brown, slightly weathered, micaceous, fine grained SANDSTONE with moderate to thick bedding. Iron staining present throughout length of core. Quality of rock considered excellent as per RQD. Note: Some very thin, carbonaceous laminations present from 5.06 to 6.10 meters. Bedding planes are weak along these laminations.	Run 1									
275.50	6				TERMINATION DEPTH = 6.10 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

ATH-33-30.981

ROADWAY/CULVERT SOIL PROFILE
BORING LOGS

DRAWN	REVIEWED	DATE	CALCULATED
E.D.S.	B.M.	03/22/00	W.I.N.
			CHECKED S.S.S.

PRIME ENGINEERING & ARCHITECTURE, INC.
COLUMBUS: (614) 457-2200 AKRON: (330) 666-5432

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/14/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/14/99 Casing: Length Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset CR 21: Sta 3+074, 0.00 m Surface Elev. 294.580m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
294.58	0				ASPHALT										
294.06	1	4-4-4			Medium stiff, brown SILT AND CLAY (A-6a), some rock fragments, some sand, moist.	1	23	11	14	--	52 *	31	13	13	A-6a
293.36	2	1-2-2			Soft, brown SILT (A-4b), some clay, trace sand, moist.	2	0	0	2	65	33	29	8	28	A-4b
292.29	3	Shelby Tube			Very stiff, brown CLAY (A-7-6), little sand, trace rock fragments, moist.	ST	13	10	6	--	71 *	42	16	18	A-7-6
		3-8-10				4	5	3	7	--	85 *	43	22	23	A-7-6
290.92	4	55			Soft to medium hard, brown, decomposed to highly weathered SANDSTONE.	5	--	--	--	--	--	--	--	6	VISUAL
290.16	5	40-50/76			Very soft, brown to gray, highly weathered to decomposed CLAY SHALE.	6	--	--	--	--	--	--	--	7	VISUAL
	6														
	7	13-35-50/102				7	--	--	--	--	--	--	--	12	VISUAL
286.96					Note: Auger refusal on bedrock at 7.62 meters. Began coring bedrock.										
286.87	8	50/51 RQD = 8%	0.55	0.98	Soft, gray, highly weathered SILTY SHALE with indistinct to laminar bedding (fissile).	8 Run 1	--	--	--	--	--	--	--	--	VISUAL
	9				Very soft, gray, highly weathered CLAY SHALE, with indistinct to laminar bedding (fissile). Quality of rock considered very poor as per RQD. Note: 127 mm thick silty shale seam at 8.17 meters. Note: Most of the bedrock in Run 1 washed away during coring resulting in low recovery and RQD.										
285.44					TERMINATION DEPTH = 9.14 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
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Division of Highways
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LOG OF BORING

Date Started 10/14/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/14/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset CR 24: Sta 3+293, 0.00 m Surface Elev. 292.428m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
292.43	0														
292.28		1-2-2			TOPSOIL Soft, brown SILT AND CLAY (A-6a), trace rock fragments, little sand, moist.	1	4	4	9	--	83 *	34	13	22	A-6a
291.36	1														
291.06		5-7-10			Very stiff, brown CLAY (A-7-6), little rock fragments, trace sand, moist.	2A	18	6	4	--	72 *	41	13	14	A-7-6
					Very soft to soft, brown, decomposed CLAY SHALE.	2B	--	--	--	--	--	--	--	11	VISUAL
	2	15-24-23				3	--	--	--	--	--	--	--	14	VISUAL
	3	8-30-54				4	--	--	--	--	--	--	--	12	VISUAL
	4	41-50/25				5	--	--	--	--	--	--	--	6	VISUAL
287.86		RQD = 52%	1.52	0.00	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Soft, gray, highly weathered CLAY SHALE with laminar bedding (fissile). Quality of rock considered fair as per RQD. Note: Iron staining present from 4.66 meters to 5.24 meters. Note: 0.40 meter thick hard, gray, weathered silty shale seam at 4.85 meters.	Run 1									
	5														
286.33	6														

TERMINATION DEPTH = 6.10 METERS

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

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Testing Laboratory

LOG OF BORING

Date Started 10/15/99 Sampler: Type SS Dia. 51mm Water Elev. 279.92m
Date Completed 10/15/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. _____ Station & Offset TR55: Sta 48+365 Surface Elev. 281.598m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
							Physical Characteristics								
281.60	0				ASPHALT										
281.14															
280.84		31-19-14			ROAD BASE	1A	41	24	12	--	23 *	--	--	5	A-1-b
	1				Very stiff, brown SILT AND CLAY (A-6a) and rock fragments, little sand, moist.	1B	41	10	7	--	43 *	33	14	9	A-6a
280.38		2-4-4			Medium stiff, brown CLAY (A-7-6), trace sand, moist.	2	0	1	2	--	98 *	43	23	23	A-7-6
279.62	2	2-4-4			Medium stiff, brown ELASTIC CLAY (A-7-5), trace to little rock fragments trace sand, moist.	3	2	3	2	--	93 *	58	28	25	A-7-5
	3	Sheby Tube				ST	5	8	12	--	76 *	51	20	16	A-7-5
		15-48-27				5	11	2	2	--	84 *	57	23	12	A-7-5
277.79	4				Very soft, brown, decomposed CLAY SHALE.										
277.33															
277.18		50/76 RQD = 100%	1.68	0.00	Medium hard, brown, highly weathered SANDSTONE. Note: Auger refusal on bedrock at 4.42 meters. Began coring bedrock Hard, brown, slightly weathered, micaceous, fine grained SANDSTONE with moderate to thick bedding. Iron staining present throughout length of core. Quality of rock considered excellent as per RQD. Note: Some very thin, carbonaceous laminations present from 5.06 to 6.10 meters. Bedding planes are weak along these laminations.	6 Run 1	--	--	--	--	--	--	--	10	VISUAL
	5														
	6														
275.50					TERMINATION DEPTH = 6.10 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/13/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/13/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset TR64: Sta 49+145, 0.00 m Surface Elev. 283.383m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
283.38	0														
283.26		2-2-4			TOPSOIL Medium stiff, brown SILTY CLAY (A-6b), some sand, moist.	1	0	0	21	--	79 *	39	20	19	A-6b
	1	Sheby Tube				ST	0	1	31	--	68 *	36	19	18	A-6b
281.86		4-6-8			Stiff, brown SANDY SILT (A-4a) and clay, moist.	3	0	0	32	22	46	27	9	22	A-4a
281.10	2														
280.70		3-6-50/127			Stiff, brown CLAY (A-7-6), trace rock fragments, trace sand, moist.	4	1	0	1	--	97 *	51	26	22	A-7-5
	3				Medium hard to hard, tan, weathered, very fine grained SANDSTONE with very thin to moderate bedding.										
		RQD = 14%	1.52	0.00	Note: Auger refusal on bedrock at 3.05 meters. Began coring bedrock.	Run 1									
279.51	4				Medium hard, gray, weathered CLAY SHALE with laminar bedding (fissile).										
278.81					Quality of Run 1 considered very poor as per RQD.										
					TERMINATION DEPTH = 4.57 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/13/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/13/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset TR64: Sta 49+270, 0.00 m Surface Elev. 295.329m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
295.33	0														
295.21		3-6-7			TOPSOIL Stiff, brown CLAY (A-7-6), trace sand, moist.	1	0	1	9	--	91 *	60	33	25	A-7-6
294.41	1														
		2-4-4			Medium stiff to stiff, brown ELASTIC CLAY (A-7-5), trace sand, moist.	2	0	0	4	--	96 *	75	45	31	A-7-5
		Shelby Tube				ST	0	0	1	--	99 *	57	23	30	A-7-5
	2	4-5-8				4	0	0	0	--	100*	57	27	31	A-7-5
292.43	3	4-6-8			Stiff to hard, brown CLAY (A-7-6), no to trace rock fragments, trace to and sand, moist.	5	1	0	1	--	98 *	44	16	28	A-7-6
	4	4-7-7				6	0	0	1	--	99 *	46	17	31	A-7-6
	5	3-5-6				7	0	0	3	--	96 *	45	18	29	A-7-6
		7-13-9				8	1	1	3	--	95 *	42	19	20	A-7-6
289.23	6	4-24-50/127			Very soft to soft, brown, decomposed to highly weathered CLAY SHALE.	9A	8	27	10	--	56 *	41	16	16	A-7-6
						9B	--	--	--	--	--	--	--	10	VISUAL
	7														
287.71		50/76			Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock.	10	--	--	--	--	--	--	--	5	VISUAL
	8	RQD = 98%	1.52	0.00	Hard, light gray, slightly weathered, micaceous, fine grained SANDSTONE with very thin to moderate bedding. Some iron staining present from 7.80 to 8.23 meters and from 8.81 to 9.14 meters. Note: Many to some very thin carbonaceous laminations present from 7.71 to 9.14 meters. Quality of rock for Run 1 considered excellent as per RQD.	Run 1									
286.19	9														
					TERMINATION DEPTH = 9.14 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

ATH-33-30.981

ROADWAY/CULVERT SOIL PROFILE
BORING LOGS

DRAWN	REVIEWED	DATE	CALCULATED
E.D.S.	B.M.	03/22/00	W.I.N.
			CHECKED S.S.S.

PRIME ENGINEERING & ARCHITECTURE, INC.
COLUMBUS (614) 457-2100 AKRON (330) 666-5432

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/13/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/13/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. _____ Station & Offset TR64: Sta 49+145, 0.00 m Surface Elev. 283.383m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
283.38	0														
283.26		2-2-4			TOPSOIL Medium stiff, brown SILTY CLAY (A-6b), some sand, moist.	1	0	0	21	--	79 *	39	20	19	A-6b
	1	Sheby Tube				ST	0	1	31	--	68 *	36	19	18	A-6b
281.86		4-6-8			Stiff, brown SANDY SILT (A-4a) and clay, moist.	3	0	0	32	22	46	27	9	22	A-4a
	2														
281.10		3-6-50/127			Stiff, brown CLAY (A-7-6), trace rock fragments, trace sand, moist.	4	1	0	1	--	97 *	51	26	22	A-7-5
280.70	3				Medium hard to hard, tan, weathered, very fine grained SANDSTONE with very thin to moderate bedding.										
		RQD = 14%	1.52	0.00	Note: Auger refusal on bedrock at 3.05 meters. Began coring bedrock.	Run 1									
279.51	4				Medium hard, gray, weathered CLAY SHALE with laminar bedding (fissile).										
278.81					Quality of Run 1 considered very poor as per RQD.										
					TERMINATION DEPTH = 4.57 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

State of Ohio
Department of Transportation
Division of Highways
Testing Laboratory

LOG OF BORING

Date Started 10/13/99 Sampler: Type SS Dia. 51mm Water Elev. m
Date Completed 10/13/99 Casing: Length 1.52m Dia. 83mm

Project: ATH-33-30.981
Project No.: 99043
Location: Athens County, Athens, Ohio

Boring No. Station & Offset TR64: Sta 49+270, 0.00 m Surface Elev. 295.329m

Elev. (m)	Depth (m)	Std. Pen./ RQD	Rec. (m)	Loss (m)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
295.33	0														
295.21		3-6-7			TOPSOIL Stiff, brown CLAY (A-7-6), trace sand, moist.	1	0	1	9	--	91 *	60	33	25	A-7-6
294.41	1	2-4-4			Medium stiff to stiff, brown ELASTIC CLAY (A-7-5), trace sand, moist.	2	0	0	4	--	96 *	75	45	31	A-7-5
		Shelby Tube				ST	0	0	1	--	99 *	57	23	30	A-7-5
	2	4-5-8				4	0	0	0	--	100*	57	27	31	A-7-5
292.43	3	4-6-8			Stiff to hard, brown CLAY (A-7-6), no to trace rock fragments, trace to and sand, moist.	5	1	0	1	--	98 *	44	16	28	A-7-6
	4	4-7-7				6	0	0	1	--	99 *	46	17	31	A-7-6
	5	3-5-6				7	0	0	3	--	96 *	45	18	29	A-7-6
	6	7-13-9				8	1	1	3	--	95 *	42	19	20	A-7-6
289.23		4-24-50/127				9A	8	27	10	--	56 *	41	16	16	A-7-6
	7				Very soft to soft, brown, decomposed to highly weathered CLAY SHALE.	9B	--	--	--	--	--	--	--	10	VISUAL
287.71	8	50/76 RQD = 98%	1.52	0.00	Note: Auger refusal on bedrock at 4.57 meters. Began coring bedrock. Hard, light gray, slightly weathered, micaceous, fine grained SANDSTONE with very thin to moderate bedding. Some iron staining present from 7.80 to 8.23 meters and from 8.81 to 9.14 meters. Note: Many to some very thin carbonaceous laminations present from 7.71 to 9.14 meters. Quality of rock for Run 1 considered excellent as per RQD.	10 Run 1	--	--	--	--	--	--	--	5	VISUAL
286.19	9				TERMINATION DEPTH = 9.14 METERS										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm (*Indicates silt & clay combined)

SUMMARY OF SOIL TEST DATA (GANNETT FLEMING)

BORING No.	Station & Offset	Depth From To	% AGG.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	% W.C.	ODOT Class
RA-1	29+505	0.00-0.61	FILL: MOTTLED BROWN SILTY CLAY WITH SAND AND ROCK FRAGMENTS							10	VISUAL
		1.22-1.83	BROWN SANDY SILT, SOME CLAY, LITTLE GRAVEL							15	VISUAL
		1.83-2.13	BROWN CLAY, SOME SILT, TRACE SAND							23	VISUAL
		2.13-2.44	0	0	0	41	59			25	A-7-6
		2.44-3.05	0	0	1	42	57			31	A-7-6
		4.11-4.42	BROWN/ORANGE BROWN AND GRAY SILTY CLAY W/ OXIDES AND FINE SAND							15	VISUAL
		4.42-4.57	BROWN/ORANGE BROWN AND GRAY SILTY CLAY W/ OXIDES AND FINE SAND							18	VISUAL
		5.64-6.25	BROWN/ORANGE BROWN AND GRAY SILTY CLAY W/ OXIDES AND FINE SAND							26	VISUAL
		7.16-7.43	GRAY SILTY CLAY/EXTREMELY WEATHERED SHALE							11	VISUAL
RA-2	29+515 5 M LEFT	0.00-0.61	FILL: BROWN/ORANGE BROWN SI. CLAY W/ SAND, GRAVEL, AND ROOT HAIRS.							9	VISUAL
		0.61-1.22	FILL: BROWN/ORANGE BROWN SI. CLAY W/ SAND, GRAVEL, AND ROOT HAIRS.							12	VISUAL
		1.22-1.52	FILL: BROWN/ORANGE BROWN SI. CLAY W/ SAND, GRAVEL, AND ROOT HAIRS.							16	VISUAL
		1.52-1.83	FILL: BROWN/ORANGE BROWN SI. CLAY W/ SAND, GRAVEL, AND ROOT HAIRS.							19	VISUAL
		1.83-2.44	FILL: BROWN/ORANGE BROWN SI. CLAY W/ SAND, GRAVEL, AND ROOT HAIRS.							22	VISUAL
		2.44-2.74	FILL: BROWN/ORANGE BROWN SI. CLAY W/ SAND, GRAVEL, AND ROOT HAIRS.							22	VISUAL
		2.74-3.05	0	0	16	83		33	17	23	A-6b
		4.11-4.42	9	3	17	29	41			21	A-6b
		4.42-4.57	MOTTLED DARK BROWN AND GRAY SILTY CLAY W/ SANDSTONE FRAGS.							14	VISUAL
		5.64-6.10	MOTTLED DARK BROWN AND GRAY SILTY CLAY W/ SANDSTONE FRAGS.							17	VISUAL
		7.16-7.43	GRAY DECOMPOSED CLAY SHALE							14	VISUAL
RA-3	29+550 5 M RIGHT	0.00-0.61	BROWN W/ LT. GRAY SI. CLAY W/ TR. SAND, OXIDES AND ROCK FRAGS.							19	VISUAL
		0.61-1.22	BROWN W/ LT. GRAY SI. CLAY W/ TR. SAND, OXIDES AND ROCK FRAGS.							18	VISUAL
		1.22-1.83	BROWN W/ LT. GRAY SI. CLAY W/ TR. SAND, OXIDES AND ROCK FRAGS.							14	VISUAL
		1.83-2.44	BROWN W/ LT. GRAY SI. CLAY W/ TR. SAND, OXIDES AND ROCK FRAGS.							19	VISUAL
		2.44-3.05	BROWN/ORANGE BROWN SILTY CLAY W/ TRACES OF FINE SAND AND OXIDES							24	VISUAL
		4.11-4.57	18	12	18	23	29			22	A-6a
		5.64-6.10	BROWN DECOMPOSED CLAY SHALE							10	VISUAL
		8.69-8.90	GRAY DECOMPOSED CLAY SHALE							12	VISUAL
RA-4	29+555	0.00-0.61	FILL: BROWN/LT. BROWN SI. CLAY AND SAND W/ GRAVEL AND ROCK FRAGS.							16	VISUAL
		0.61-1.22	13	6	10	70		38	19	15	A-6b
		1.22-1.83	27	6	12	21	34			14	A-6b
		1.83-2.44	BROWN AND GRAY TO GRAY SILTY CLAY							17	VISUAL
		2.44-2.74	BROWN AND GRAY SILT AND CLAY							26	VISUAL
		2.74-3.05	BROWN AND GRAY SILT AND CLAY WITH SAND SEAMS							26	VISUAL
		4.11-4.57	0	0	25	74		33	15	22	A-6a
		5.64-6.10	BROWN AND GRAY SILT AND CLAY, SOME SAND							17	VISUAL
		7.16-7.28	BROWN SILTY CLAY, SOME SAND, TRACE SANDSTONE FRAGMENTS							12	VISUAL
TR55-1	48+215	0.00-0.61	1	1	1	97		69	38	18	A-7-5
		0.61-1.22	RED/MAROON AND LIGHT BEIGE CLAY W/ TRACES OF SAND AND ROOT HAIR							10	VISUAL
		1.22-1.83	9	3	3	41	44			10	A-7-6
		1.83-2.44	LIGHT OLIVE/BEIGE SILTY CLAY W/ TRACES OF OXIDE STAINS							9	VISUAL
		2.44-3.05	RED/MAROON AND OLIVE SILTY CLAY W/ TRACES OF OXIDE STAINS							10	VISUAL
		4.11-4.42	RED/MAROON AND OLIVE SILTY CLAY W/ TRACES OF OXIDE STAINS							9	VISUAL
		4.42-4.57	RED/MAROON AND OLIVE SILTY CLAY W/ TRACES OF OXIDE STAINS							14	VISUAL
TR55-2	48+240	0.30-0.91	LIGHT OLIVE BROWN/BEIGE SILTY CLAY W/ SILTSTONE/SANDSTONE FRAGS.							7	VISUAL
		2.13-2.40	LIGHT BROWN/BEIGE EXTREMELY WEATHERED SILTSTONE/ARENACEOUS SHALE							9	VISUAL
		2.74-3.01	1	5	5	34	55			13	A-7-6
TR55-3	48+260	0.30-0.91	0	1	1	25	73			31	A-7-6
		0.91-1.52	7	2	3		88	42	21	30	A-7-6
		1.52-2.13	12	10	5	24	49			22	A-7-6
		2.13-2.44	1	4	4		90	48	20	18	A-7-6
		2.44-2.74	RED AND YELLOW SILTY CLAY WITH TRACES OF SAND							13	VISUAL
		2.74-3.01	LIGHT BROWN WEATHERED SILTSTONE/FINE GRAINED SANDSTONE							7	VISUAL
		4.11-4.32	LIGHT BROWN, HIGHLY WEATHERED SANDSTONE							5	VISUAL
TR55-4	48+280	0.30-0.91	0	1	1		88	63	34	36	A-7-6
		0.91-1.52	0	1	1	23	76			23	A-7-6
		1.52-2.13	2	2	2		94	42	21	18	A-7-6
		2.13-2.74	LIGHT YELLOWISH BROWN AND RED SILTY CLAY W/ TRACES OF SAND							20	VISUAL
		2.74-3.35	LIGHT YELLOWISH BROWN AND RED SILTY CLAY W/ TRACES OF SAND							17	VISUAL
		4.11-4.35	DARK GRAY WEATHERED ARENACEOUS SHALE							9	VISUAL
TR55-5	48+300	0.30-0.91	ORANGE BROWN W/ RED AND GRAY SILTY CLAY W/ OXIDES AND FINE SAND							26	VISUAL
		0.91-1.52	5	10	9	19	56			23	A-7-6
		1.52-2.13	OLIVE BROWN TO OLIVE SILTY CLAY W/ TRACES OF OXIDES							7	VISUAL
		2.13-2.74	OLIVE BROWN TO OLIVE SILTY CLAY W/ TRACES OF OXIDES							8	VISUAL
		4.11-4.25	GRAY, WEATHERED SHALE							4	VISUAL
		4.25-4.38	GRAY, WEATHERED SHALE							6	VISUAL
		5.64-5.88	GRAY, HIGHLY WEATHERED CLAY SHALE							9	VISUAL
		7.16-7.55	LT. BROWN SA. SILT W/ OXIDES (EXTREMELY WEATHERED SILTSTONE/SANDTONE)							11	VISUAL
TR64-1	49+180	0.00-0.61	FILL: BROWN/LIGHT BROWN TO BEIGE SILTY CLAY W/ OXIDES AND SAND							16	VISUAL
		0.61-1.22	FILL: BROWN/LIGHT BROWN TO BEIGE SILTY CLAY W/ OXIDES AND SAND							17	VISUAL
		1.22-1.52	FILL: ORANGE BROWN SILT AND SAND W/ TRACES OF OXIDES							17	VISUAL
		1.52-1.83	0	1	10	56	33	26	7	26	A-4b
		1.83-2.44	3	4	13	45	35			29	A-4a
		4.11-4.57	2	1	28	69		39	21	18	A-6b
		5.64-6.07	LT. BROWN W/ GRAY VERY SILTY CLAY/CLAYEY SILT W/ ROCK FRAGS.							16	VISUAL
		7.16-7.43	GRAY TO OLIVE GRAY SILTY CLAY AND SHALE							12	VISUAL

BORING No.	Station & Offset	Depth From To	% AGG.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	% W.C.	ODOT Class
TR64-2	49+195	0.00-0.61	FILL: BROWN/ORANGE BROWN SI. CLAY W/ SAND, GRAVEL AND OXIDE TRACES							12	VISUAL
		0.61-1.22	9	7	36	20	27			13	A-6a
		1.22-1.83	8	4	33	38	17		NP	11	A-4a
		1.83-2.44	17	7	6	41	29			11	A-4a
		2.44-3.05	LIGHT OLIVE BROWN AND ORANGE BROWN SILTY CLAY							13	VISUAL
		4.11-4.51	OLIVE TO GRAY SILTY CLAY (EXTREMELY WEATHERED SHALE)							15	VISUAL
TR64-3	49+215	0.30-0.69	LIGHT BROWN SILTY SAND W/ SANDSTONE FRAGMENTS							12	VISUAL
TR64-4	49+240	0.30-0.91	LIGHT ORANGE BROWN W/ LIGHT GRAY SILTY CLAY W/ TRACES OF OXIDES							19	VISUAL
		0.91-1.37	LIGHT ORANGE BROWN W/ LIGHT GRAY SILTY CLAY W/ TRACES OF OXIDES							10	VISUAL
		1.37-1.61	LIGHT OLIVE BROWN TO OLIVE SILTY CLAY							7	VISUAL
TR64-5	49+260	0.30-0.91	RED W/ ORANGE-BROWN AND GRAY SILTY CLAY W/ TRACES OF OXIDES							31	VISUAL
		0.91-1.52	0	1	2	30	66			28	A-7-6
		1.52-2.13	0	1	8		91	42	15	27	A-7-6
		2.13-2.74	RED W/ TRACE GRAY SILTY CLAY							26	VISUAL
		2.74-3.35	RED W/ TRACE GRAY SILTY CLAY							23	VISUAL
		4.11-4.52	GRAY CLAY, SOME SILT, TRACE SAND							12	VISUAL
RAW-2	1+365	0.00-0.61	MOTTLED RED, BROWN, AND LT. BROWN SI. CLAY W/ SANDSTONE FRAGS.							9	VISUAL
RAW-3	1+400	0.00-0.61	2	1	2		95	42	19	12	A-7-6
		0.61-1.13	MOTTLED GRAY W/ MAROON SI. CLAY W/ LIMESTONE NODULE FRAGMENTS							8	VISUAL
		1.22-1.31	GRAY W/ OLIVE BROWN SILTY CLAY							4	VISUAL
		1.83-1.95	GRAY WEATHERED ARENACEOUS SHALE							4	VISUAL
		2.44-2.68	GRAY WEATHERED ARENACEOUS SHALE							3	VISUAL
RAW-4	1+430	0.00-0.61	7	4	4	23	62			16	A-7-6
		0.61-1.22	FILL: GRAYISH BROWN SILTY CLAY, W/ BLACK AND GRAY SHALE FRAGS.							14	VISUAL
		1.22-1.58	1	2	3		94	45	20	11	A-7-6
		1.83-2.07	DARK OLIVE GRAY TO GRAY SILTY CLAY							8	VISUAL
		2.44-2.65	GRAY, EXTREMELY WEATHERED ARENACEOUS SHALE							7	VISUAL
RAW-5	1+470	0.00-0.61	FILL: BROWNISH GRAY SI. CLAY W/ SAND, GRAVEL, AND ORGANIC FIBERS							13	VISUAL
		0.61-1.22	FILL: BROWNISH GRAY SI. CLAY W/ SAND, GRAVEL, AND ORGANIC FIBERS							11	VISUAL
		1.22-1.83	FILL: BROWNISH GRAY SI. CLAY W/ SAND, GRAVEL, AND ORGANIC FIBERS							12	VISUAL
		1.83-2.19	0	2	4	30	64			12	A-7-6
		2.44-2.68	3	7	5		86	41	19	10	A-7-6
		4.11-4.29	OLIVE BROWN, WEATHERED SHALE							5	VISUAL
RAW-6	1+510 7 M RIGHT	0.00-0.61	25	9	13	20	33			12	A-7-6
		0.61-1.22	FILL: MOTTLED BROWN AND GRAY SI. CLAY W/ SAND AND ROCK FRAGMENTS							11	VISUAL
		1.22-1.83	26	7	8		59	41	19	15	A-7-6
		1.83-2.44	FILL: MOTTLED BROWN AND GRAY SI. CLAY W/ SAND AND ROCK FRAGMENTS							13	VISUAL
		2.44-3.05	FILL: MOTTLED BROWN AND GRAY SI. CLAY W/ SAND AND ROCK FRAGMENTS							11	VISUAL
RAW-8	1+400 15 M RIGHT	0.00-0.61	FILL: GRAY, OLIVE, AND RED SI. CLAY W/ SHALE FRAGS. AND ORGANICS							13	VISUAL
		0.61-1.22	2	1	3	28	66			19	A-7-6
		1.22-1.64	MOTTLED GRAY W/ BROWN TO DARK GRAY SILTY CLAY							11	VISUAL
		2.44-2.65	GRAY ARENACEOUS SHALE							8	VISUAL
RAW-9	1+450 15 M RIGHT	0.00-0.61	FILL: BROWN AND OLIVE BROWN SI. CLAY W/ TRACES OF ORGANIC FIBERS							13	VISUAL
		0.61-1.22	4	0	3		93	52	21	15	A-7-5
		1.22-1.83	OLIVE TO OLIVE AND DARK GRAY SILTY CLAY							11	VISUAL
		1.83-2.04	OLIVE TO OLIVE AND DARK GRAY SILTY CLAY							10	VISUAL
		2.44-2.56	OLIVE TO OLIVE AND DARK GRAY SILTY CLAY							9	VISUAL
RAW-10	1+495 23 M RIGHT	0.00-0.61	FILL: BROWN, OLIVE, AND GRAY SI. CLAY W/ SAND AND SHALE FRAGMENTS							14	VISUAL
		0.61-1.22	FILL: BROWN, OLIVE, AND GRAY SI. CLAY W/ SAND AND SHALE FRAGMENTS							9	VISUAL
		1.22-1.83	FILL: BROWN, OLIVE, AND GRAY SI. CLAY W/ SAND AND SHALE FRAGMENTS							8	VISUAL
		1.83-2.44	FILL: BROWN, OLIVE, AND GRAY SI. CLAY W/ SAND AND SHALE FRAGMENTS							14	VISUAL
		2.44-3.05	FILL: BROWN, OLIVE, AND GRAY SI. CLAY W/ SAND AND SHALE FRAGMENTS							15	VISUAL
		4.11-4.29	16	6	8	36	33			13	A-6a
		5.64-6.10	FILL: LT. BROWN/BROWN SI. CLAY, W/ ROCK FRAGS., SAND, AND ORGANICS							18	VISUAL
RBW-1	29+280 5M LEFT	0.00-0.52	FILL: BROWN AND GRAY SI. CLAY W/ SAND, GRAVEL, AND SHALE FRAGS.							8	VISUAL
		0.61-0.73	FILL: BROWN AND GRAY SI. CLAY W/ SAND, GRAVEL, AND SHALE FRAGS.							4	VISUAL
		1.22-1.83	40	7	11		43	31	10	9	A-4a
		2.44-3.05	4	4	7	37	49			16	A-6b
		4.11-4.54	LT. BROWN W/ TRACE GRAY SA. SILT AND CLAY W/ TRACES OF ROCK FRAGS.							12	VISUAL
		7.16-7.72	DARK GRAY, WEATHERED SHALE							9	VISUAL
RBW-2	29+330 7M LEFT	0.00-0.61	FILL: LIGHT BROWN SI. SAND W/ SANDSTONE FRAGMENTS AND GRAVEL							9	VISUAL
		0.61-1.22	FILL: BROWN AND GRAY SANDSTONE AND SHALE FRAGMENTS							7	VISUAL
		1.83-2.13	FILL: GRAY SHALE/CLAY SHALE FRAGMENTS							8	VISUAL
		2.13-2.44	23	13	10	20	34			17	A-6b
		2.44-2.53	FILL: BROWN AND GRAY, SI. SAND W/ SANDSTONE/CLAY SHALE FRAGS.							10	VISUAL
		4.11-4.41	6	4	10		81	39	18	22	A-6b
		4.42-4.57	BROWN SILTY CLAY W/ TRACES OF OXIDES							17	VISUAL
		5.64-5.91	4	6	17		73	40	17	15	A-6b
		7.16-7.37	VERY WEATHERED, ORANGE BROWN TO OLIVE AND GRAY SHALE/CLAY SHALE							13	VISUAL
		8.69-8.96	RED/MAROON AND GRAY, VERY WEATHERED SHALE/CLAY SHALE							12	VISUAL

ABBREVIATIONS

DK. = DARK
LT. = LIGHT
SI. = SILTY
SA. = SANDY
FRAGS. = FRAGMENTS

GANNETT FLEMING
SUITE 350
415 EXECUTIVE PARKWAY
WESTERVILLE, OHIO 43081

CALCULATED | CHECKED
DATE 4/21/01
REVIEWED
DRAWN MDH

STRUCTURAL FOUNDATION
SOIL PROFILE

ATH-33-30.981

24 APR 2001 12:15:30
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SUMMARY OF SOIL TEST DATA (GANNETT FLEMING)

BORING No.	Station & Offset	Depth From	Depth To	% AGG.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	% W.C.	ODOT Class
RBW-3	29+380 8M LEFT	0.00	0.61	FILL: MOTTLED BROWN/LT. BROWN, GRAY AND RED SI. CLAY, W/ ROCK FRAGS.							11	VISUAL
		0.61	1.22	FILL: MOTTLED BROWN/LT. BROWN, GRAY AND RED SI. CLAY, W/ ROCK FRAGS.							9	VISUAL
		1.22	1.52	FILL: MOTTLED BROWN/LT. BROWN, GRAY AND RED SI. CLAY, W/ ROCK FRAGS.							10	VISUAL
		1.52	1.83	25	5	5	66		38	16	13	A-6b
		1.83	2.44	FILL: MOTTLED BROWN/LT. BROWN, GRAY AND RED SI. CLAY, W/ ROCK FRAGS.							16	VISUAL
		2.44	3.05	FILL: MOTTLED BROWN/LT. BROWN, GRAY AND RED SI. CLAY, W/ ROCK FRAGS.							13	VISUAL
		4.11	4.42	LT. BROWN AND TRACE RED SI. CLAY W/ TRACES OF OXIDES							15	VISUAL
		4.42	4.57	5	9	3	83		55	25	28	A-7-5
		5.64	6.00	0	1	1	34	64			13	A-7-6
RBW-4	29+430 10M LEFT	0.00	0.61	34	13	12	20	21			9	A-6a
		0.61	1.00	FILL: MOTTLED BROWN/LT. BROWN AND BEIGE SI. CLAY W/ SAND AND GRAVEL							9	VISUAL
		1.22	1.46	FILL: MOTTLED BROWN/LT. BROWN AND BEIGE SI. CLAY W/ SAND AND GRAVEL							8	VISUAL
		1.83	1.95	OLIVE, EXTREMELY WEATHERED, SOFT SHALE							9	VISUAL
		2.44	2.56	RED/MAROON, EXTREMELY WEATHERED, SOFT SHALE							10	VISUAL
		2.56	2.68	OLIVE, SOFT WEATHERED SHALE							10	VISUAL
		4.11	4.57	GRAY, SOFT TO VERY SOFT WEATHERED SHALE							16	VISUAL
		5.64	5.79	OLIVE/OLIVE GRAY, SOFT TO MEDIUM HARD SHALE							11	VISUAL
RBW-5	29+470 10M LEFT	0.00	0.39	FILL: MOTTLED LT. BROWN/OLIVE SI. CLAY W/ SAND, ROCK FRAGS. AND WOOD							7	VISUAL
		0.61	1.22	LIGHT BROWN SILTY CLAY, SOME ROCK FRAGMENTS, LITTLE SAND							13	VISUAL
		1.22	1.52	7	3	33	56		31	12	21	A-6a
		1.52	1.83	7	6	31	27	29			22	A-6a
		1.83	2.13	POSS. FILL: BROWN W/ ORANGE BROWN SILT AND CLAY W/ SAND AND OXIDES							22	VISUAL
		2.13	2.44	2	7	40	26	25	25	5	18	A-4a
		2.44	2.74	6	0	0	50	40			19	A-4b
		2.74	3.05	GRAY SA. CLAY W/ TRACES OF SANDSTONE FRAGS.							19	VISUAL
		4.11	4.42	DARK GRAY SI. CLAY W/ SILT PARTINGS; TRACES OF MOLLUSK SHELLS							23	VISUAL
		4.42	4.73	DARK GRAY SI. CLAY W/ SILT PARTINGS; TRACES OF MOLLUSK SHELLS							18	VISUAL
		5.64	5.79	OLIVE GRAY AND GRAY SI. CLAY (EXTREMELY WEATHERED SHALE)							10	VISUAL

ABBREVIATIONS

DK. = DARK
LT. = LIGHT
SI. = SILTY
SA. = SANDY
FRAGS. = FRAGMENTS

GANNETT FLEMING
SUITE 350
4151 EXECUTIVE PARKWAY
WESTERVILLE, OHIO 43081

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SOIL PROFILE

ROADWAY / CULVERT SOIL

ATH-33-30.981

24 APR 2001 12:50
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US 33 MAINLINE BRIDGE OVERPASS
BORING LOCATIONS AND SOIL PROFILE

ATH-33-30.981

77/105

DRAWN MDH | REVIEWED | DATE 4/20/01 | CALCULATED | CHECKED

HORIZONTAL SCALE IN METERS
0 1500 20

EX. RAMP TO US 33 WEST
EX. RAMP TO US 33 EAST
EX. US 50 EAST
EX. US 50 WEST
EX. ALBANY ROAD
EX. FRUM ROAD

PT STA 0+915.931
PC STA 0+963
PT STA 0+966
PT STA 3+3
PCC STA 0+336.179
PT STA 29+517.748
ST STA 29+529.383
CS STA 29+409.383
PT STA 1+410.236
STA 29+610.
STA 29+610.
SLIP RAMP C =
SLIP RAMP C =
RAMP C =
3.600m RT

RBW-5
RA-1
RA-2
RA-3
RA-4

WESTBOUND

RBW-5: 7 80/.8; 13 11; 21 8; 18 7; 19 13; 18 30; 10 50/0.5; 50/0.2 66%; 70%

RA-1: 10 3-3-4-21; 50/0.2; 15 13-15-18-20; 23 4-2-4-5; 31 4-3-4-3; 15 3-5-5; 26 5-9-15; 11 28-50/0.4; 77%

RA-3: 19 5-6-7-8; 18 6-7-12-14; 14 8-9-12-19; 19 3-8-10-13; 24 4-4-5-8; 22 3-4-6; 10 45-50/0.2; 12 50/0.3; 49-50/.2; 50/0.3 50 %; 65 %

EASTBOUND

RA-2: 9 12-17-18-21; 12 17-14-9-7; 19 12-11-8-8; 22 3-5-8-8; 23 3-5-6-7; 21 5-9-9; 17 7-8-7; 14 34-50/0.4; 100 %; 44 %

RA-4: 16 7-7-11-13; 15 8-11-7-12; 14 9-7-9-7; 17 9-5-2-2; 26 3-4-4-4; 22 3-4-5; 17 5-8-7; 12 50/0.4 0 %; 25 %; 33 %; 92 %; 72 %

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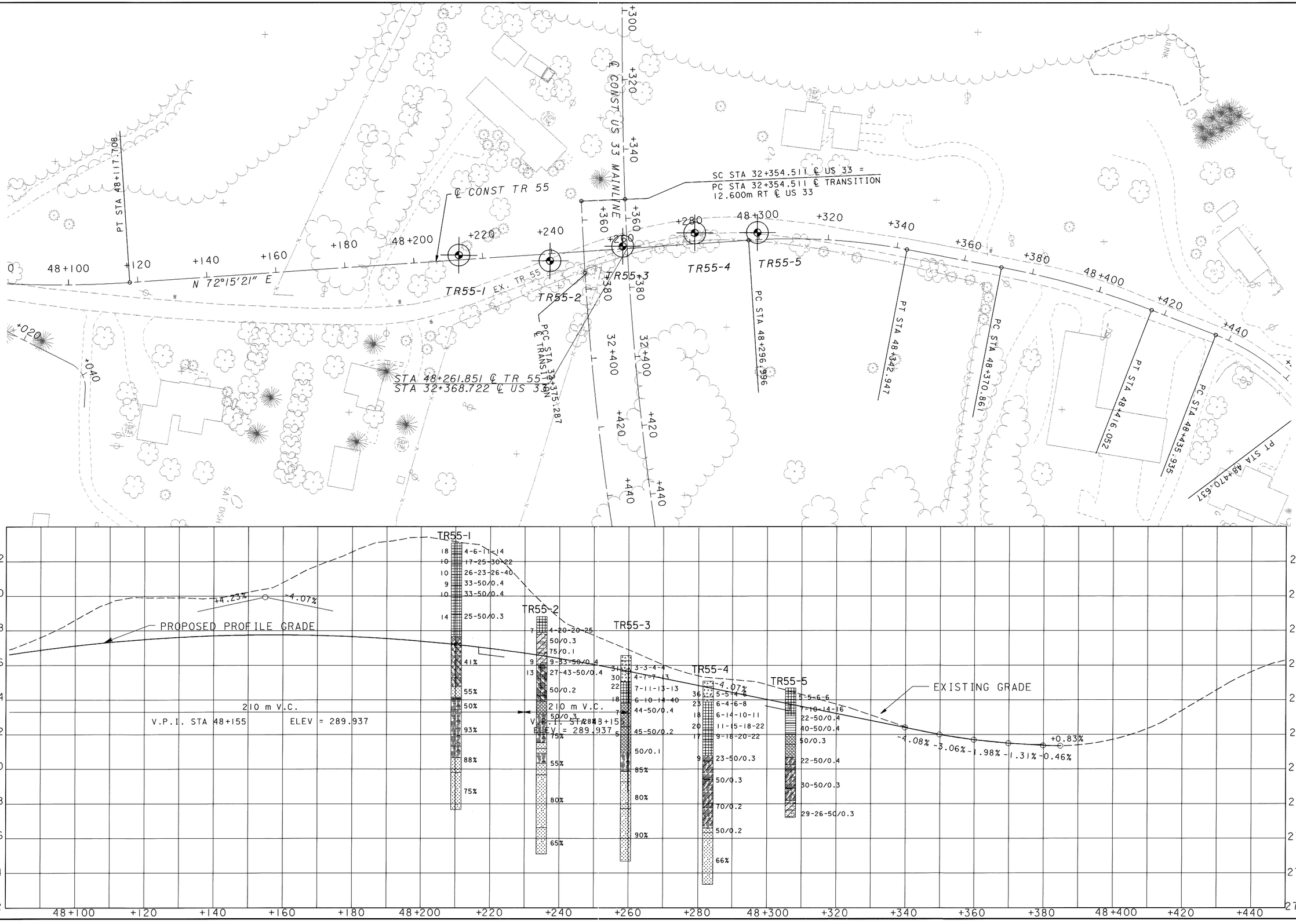

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DATE	4/20/01
CALCULATED	
CHECKED	

HORIZONTAL SCALE IN METERS

0 20

TR 55 BRIDGE OVERPASS
BORING LOCATIONS AND SOIL PROFILE

ATH-33-30.981

78/105

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EX.TR 64

EX.TR 65

PC STA 49+033.885

PT STA 49+057.767

PC STA 0+041.7

L S 78°22'29" E

49+000 +020 +040 +060 +080 49+100 +120 +140 +160 +180 49+200 +220 +240 +260 +280 49+300

35+300 +320 +340 +360 +380 35+400 +420

+060 +040 +020

TR64-1 TR64-2 TR64-3 TR64-4 TR64-5

+2.42 %

12

80 m V.C.

V.P.I. STA 49+070.000 ELEV = 290.576

+2.11% +4.40%

280 m V.C.

V.P.I. STA 49+260 ELEV = 298.936

TR64-1

16 4-5-7-7
17 6-9-11-14
26 3-3-3-3
29 2-2-3-2
SHELBY TUBE
16 7-10-14
16 17-27-50/0.4
12 21-50/0.4
50/0.1

TR64-2

12 6-17-17-20
13 12-11-7-7
11 5-5-21-31
13 7-30-40-38
13 14-28-40-36
15 17-39-50/0.3
50/0.3
53%

TR64-3

12 4-12-50/0.3
75/0.4
85%

TR64-4

19 4-4-6-7
10 11-20-50/0.5
7 20-50/0.3
50/0.4
54%
61%

TR64-5

31 4-2-3-5
28 8-6-11-14
27 6-6-8-10
26 6-10-14-16
23 5-9-14-15
SHELBY TUBE
12 18-35-50/.3
50/.4
75%
98%

296 294 292 290 288 286 284 282 280 278 276

49+000 +020 +040 +060 +080 49+100 +120 +140 +160 +180 49+200 +220 +240 +260 +280 49+300

0 20 HSOO HORIZONTAL SCALE IN METERS

DRAWN	REVIEWED	DATE	CALCULATED	CHECKED
MDH		4/20/01		

TR 64 BRIDGE OVERPASS
BORING LOCATIONS AND SOIL PROFILE

ATH-33-30.981

79/105

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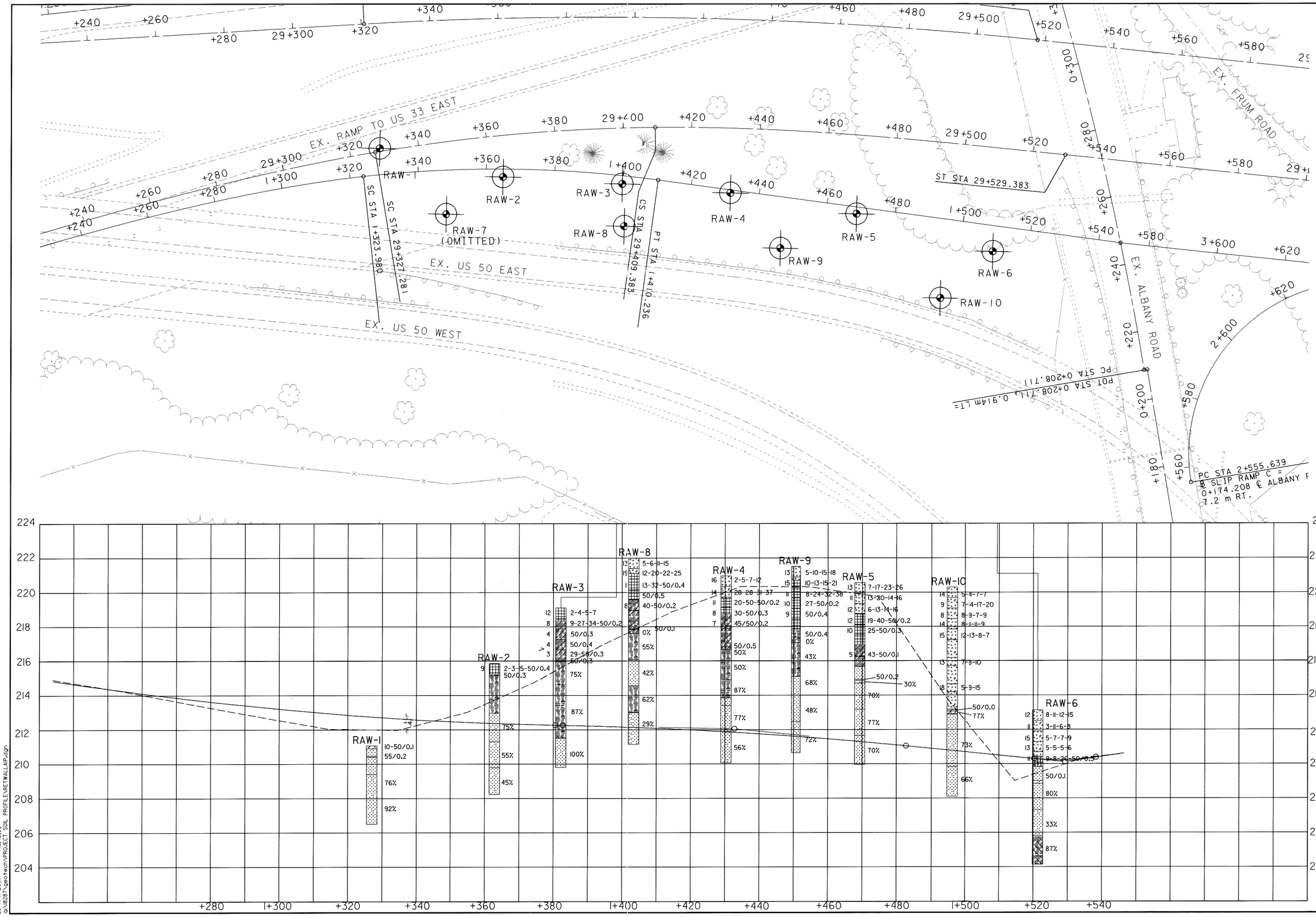

RAMP A RETAINING WALL
BORING LOCATIONS AND SOIL PROFILE

ATH-33-30.981

80/105

DRAWN	REVIEWED	DATE	CALCULATED	CHECKED
MDH		4/20/01		

HORIZONTAL SCALE IN METERS
0 10 20
1:500

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EX. RICHLAND AVE.

EX. RAMP TO US 33 WEST

EX. RAMP TO US 33 EAST

EX. US 50 WEST

EX. US 50 EAST

EX. ALBANY ROAD

EX. FRUM ROAD

RBW-1 RBW-2 RBW-3 RBW-4 RBW-5

PC STA 0+808.916
PC STA 29+320.877
PT STA 0+915.931
PC STA 0+936.365
PT STA 0+966.291
PT STA 0+404.688
3.353m LT.=
PCC STA 0+336.179
PT STA 29+517.748
ST STA 29+529.383
SC STA 1+323.980
SC STA 29+327.281
CS STA 29+409.383
PT STA 1+410

RBW-1
8 3-19-25-50/.2
4 50/0.4
9 11-10-11-10
16 21-31-17-17
12 18-28-50/0.4
50/0.1
9 38-50/0.2
50/0.3
50/0.2

RBW-2
9 4-6-8-21
7 9-14-10-9
25-12-10-9
17 25-16-14-12
10 50/0.3
22 5-7-15
15 53-50/0.4
13 35-50/0.2
12 61-50/0.4
75%
78%

RBW-3
11 15-25-24-27
9 13-50/0.4
13 5-10-11-14
16 8-8-9-12
13 5-10-9-13
28 13-11-16
13 20-47-50/0.2
50/0.4
50/0.3
50/0.1

RBW-4
9 8-14-21-13
9 11-19-50/0.3
8 9-50/0.3
9 50/0.4
10 49-50/0.3
16 9-26-43
11 50/0.5
50/0.1
50/0.1

RBW-5
7 10-30-50/0.3
13 9-8-9-11
21 3-4-14-25
18 3-4-3-9
19 4-6-7-11
18 7-10-20-25
10 50/0.5
50/0.2 66%
70%

218 216 214 212 210 208 206 204 202 200 198

+180 29+200 +220 +240 +260 +280 29+300 +320 +340 +360 +380 29+400 +420 +440 +460 +480 29+500 +520 +540

HORIZONTAL SCALE IN METERS
0 10 20
1:500

DRAWN	REVIEWED	DATE	CALCULATED	CHECKED
MDH		4/20/01		

RAMP B RETAINING WALL
BORING LOCATIONS AND SOIL PROFILE

ATH-33-30.981

81/105

23 APR 2001
I640+42
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Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm.

Boring No. RA-1 Station & Offset Surface Elev. 207.9 m Water Elev. 202.6 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
207.9		3-3-4-21	0.34	0.27	8 cm of Topsoil--fill-mottled brown silty clay w/ sand and rock/gravel fragments; slightly moist.	1								10	
207.3	1	50/0.2	0.00	0.06	qh=4.5+ kg/cm2	2									
206.7		13-15-18-20	0.27	0.34	qh=4.5+ kg/cm2	3								15	
206.1	2				qh=1.5+ kg/cm2										
205.8		4-2-4-5	0.30	0.30	Brown/orange brown and trace gray silty clay w/ traces of oxides and fine sand (CL); moist, medium stiff.	4	0	0	0	41	59	0	0	23	A-7-6
205.5	3	4-3-4-3	0.40	0.21	qh=0.5 kg/cm2	5	0	0	1	42	57	0	0	31	A-7-6
204.3	4				Traces of weathered sandstone and gravel noted at 3.7 meters.										
203.8		3-5-5	0.30	0.30	qh=2.25 kg/cm2	6								15	
202.3	5														
	6	5-9-15	0.24	0.37	qh=1.25 kg/cm2	7								26	
201.5	7				Gray silty clay/extremely weathered shale (CL); moist, hard. Slight laminations present. Auger refusal at 8.2 meters.										
200.8		28-50/0.4	0.24	0.03	qh=4.0 kg/cm2	8								11	
	8														
199.6					Interbedded gray, soft to medium hard shale (70%) and hard, light gray cemented										
199.1															

Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm.

Boring No. RA-1 Station & Offset Surface Elev. 207.9 m Water Elev. 202.6 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
					sandstone (30%); good rock quality.										
		77	1.98	0.15	qu=274.3 kg/cm2	9									
198.2	10				qu=50.8 kg/cm2										
197.4	11				Bottom of boring at 10.5 meters.										
	12														
	13														
	14														
	15														
	16														
	17														

GANNETT FLEMING
SUITE 350
4151 EXECUTIVE PARKWAY
WESTERVILLE, OHIO 43081

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FOUNDATION SOIL PROFILE
BORING LOGS

ATH-33-30.981

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Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm.

Boring No. RA-2 Station & Offset Surface Elev. 208.4 m Water Elev. 203.9 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
208.4		12-17-18-21	0.30	0.30	Fill-mottled brown to orange-brown silty clay w/ sand, gravel, and traces of root hairs; slightly moist to moist. Increase in moisture w/ traces of sandstone fragments and oxides below 1.5 m.	1								9	
207.8	1	17-14-9-7	0.46	0.15		2								12	
207.2					qh=4.5 kg/cm2										
206.9		12-11-8-8	0.46	0.15	qh=4.5+ kg/cm2	3								19	
206.6	2				qh=1.5 kg/cm2										
		3-5-8-8	0.40	0.21	qh=0.75 kg/cm2	4								22	
206.0					qh=0.75 kg/cm2										
205.7	3	3-5-6-7	0.40	0.21	Dark brown w/ trace gray silty clay w/ traces of fine sand and root fibers (CL); moist, medium stiff to stiff.	5	0	0	17		83	33	17	23	A-6b
	4														
204.3					qh=0.75 kg/cm2										
204.2	5	5-9-9	0.40	0.06	Mottled dark brown and gray silty clay w/ little sandstone fragments (CL); moist, very stiff.	6	9	3	17	29	41			21	A-6b
202.8	6	7-8-7	0.30	0.15	qh=3.5 kg/cm2	7								17	
	7														
201.4															
201.3		34-50/0.4	0.27		Gray silty clay w/ traces of sandstone fragments (CL); moist, hard. Auger refusal at 8.2 m.	8								14	
	8														
200.2		100	0.46		Hard light gray cemented sandstone; excellent rock quality. qu=362.2 kg/cm2	9									
199.8					Interbedded soft to medium hard gray shale										

Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm.

Boring No. RA-2 Station & Offset Surface Elev. 208.4 m Water Elev. 203.9 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10	44	1.31	0.37	and cemented hard light gray fine to medium grained sandstone; poor rock quality. qu= 591.3 kg/cm2 (note: Lost part of rock core sample back in boring - measured RQD is lower than in-situ value).	10									
198.1	11				Bottom of boring at 10.4 meters.										
	12														
	13														
	14														
	15														
	16														
	17														

GANNETT FLEMING
SUITE 350
4151 EXECUTIVE PARKWAY
WESTERVILLE, OHIO 43081

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FOUNDATION SOIL PROFILE
BORING LOGS

ATH-33-30.981

83/105

23 APR 2001 15:57:28
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Date Started 080299 Date Completed 080299 Sampler: Type Split Spoon Dia. 5 cm.

Boring No. RA-3 Station & Offset _____ Surface Elev. 209.5 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
209.5					12 cm. Gravel--Brown w/ trace light gray										
209.3		5-6-7-8	0.18	0.43	silty clay w/ traces of sandstone and shale fragments, sand and oxides (CL); moist,	1								19	
208.8	1	6-7-12-14	0.27	0.34	very stiff. qh=2.0 kg/cm2 Brown w/ trace light gray silty clay w/	2								18	
208.2		8-9-12-19	0.18	0.43	traces of sandstone and shale fragments, sand, and oxides (CL); moist, very stiff. qh=3.75 kg/cm2	3								14	
207.6	2	3-8-10-13	0.30	0.30	qh=4.0 kg/cm2 qh=3.0 kg/cm2	4								19	
207.0	3	4-4-5-8	0.46	0.15	Mottled brown and orange-brown silty clay w/ traces of fine sand and oxides (CL); moist, medium stiff. qh=3.0 kg/cm2	5								24	
205.5	4														
205.3		3-4-6	0.27	0.18	Grayish brown silty clay w/ traces of gray sandstone fragments and fine sand (CL); moist, medium stiff. qh=1.5 kg/cm2	6	18	12	18	23	29			22	A-6a
204.3	5				Very soft to soft brown shale.										
203.8	6	45-50/0.2	0.18	0.03		7								10	
202.8	7				Soft to very soft black shale.										
202.3		50/0.3	0.06	0.03		8								12	
201.2	8				Soft to very soft gray shale.										
200.8		49-50/0.2	0.15	0.06		9									

Date Started 080299 Date Completed 080299 Sampler: Type Split Spoon Dia. 5 cm.

Boring No. RA-3 Station & Offset _____ Surface Elev. 209.5 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10														
199.2		50/0.3	0.06	0.03		10									
199.1		50	0.12	0.08		11									
198.9	11				Light gray moderately hard, fine to medium grained sandstone w/ soft to medium gray arenaceous shale seams; fair rock quality. Limestone seam at 11.7 m. qu=406.2 kg/cm2										
198.9		65	1.40	0.12		12									
197.4	12				Bottom of boring at 12.1meters .										
	13														
	14														
	15														
	16														
	17														

GANNETT FLEMING
SUITE 350
4151 EXECUTIVE PARKWAY
WESTERVILLE, OHIO 43081

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FOUNDATION SOIL PROFILE
BORING LOGS

ATH-33-30.981

84/105

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Date Started 080299 Date Completed 080299 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RA-4 Station & Offset Surface Elev. 209.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
209.7		7-7-11-13	0.27	0.34	15 cm. of Topsoil--fill-mottled brown and light brown silty clay and sand w/ traces of gravel and rock fragments; brick/ concrete fragments noted above about 61 cm. qh=1.5 kg/cm2	1								16	
209.1	1	8-11-7-12	0.15	0.46	qh=4.5+ kg/cm2	2	13	6	10		71	38	19	15	A-6b
208.5		9-7-9-7	0.30	0.30	qh=4.25 kg/cm2	3	27	6	12	21	34			14	A-6b
207.9	2				qh=4.5+ kg/cm2										
207.6		9-5-2-2	0.09	0.52		4								17	
207.3					Brown and gray to gray silty clay (CL); moist to very moist, medium stiff [alluvium]. Predominantly brown w/ traces of gray sandstone fragments and oxides in sample #6. Stiff at sample #7.										
207.0	3	3-4-4-4	0.46	0.15		5								26	
					qh=1.5 kg/cm2										
	4				qh=1.0 kg/cm2										
205.6		3-4-5	0.40	0.06	qh=1.0 kg/cm2	6			25		75	33	15	22	A-6a
	5														
204.1		5-8-7	0.34	0.12	qh=1.75 kg/cm2	7								17	
	6														
203.0	7				Soft to very soft black shale; poor rock quality.										
202.6		50/0.4	0.12	0.00		8								12	
202.4		0	0.00	0.30		9									
202.1															
202.0	8				qu=26.4 kg/cm2										
201.8		25	0.30	0.91	Very soft brown-gray to gray shale; poor to very poor rock quality.	10									
200.9															

Date Started 080299 Date Completed 080299 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RA-4 Station & Offset Surface Elev. 209.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
200.6		33	0.18	0.12		11									
	10	92	1.49	0.03	Very soft, mottled brown and gray to gray arenaceous shale w/ limestone nodules; excellent rock quality (bottom 18 cm of rock sample is light gray sandstone). qu (sandstone) = 408.7 kg/cm2 note: RQD is misleadingly high, most of the shale sample is more like a hard soil.	12									
199.2															
199.1	11	72	1.46	0.06	Moderately hard to hard, fine to medium grained, light gray sandstone w/ isolated soft shale lenses and limestone nodules; thickly bedded; good rock quality.	13									
197.6	12				Bottom of boring at 12.2 meters.										
	13														
	14														
	15														
	16														
	17														

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Date Started 071699 Date Completed 071699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-1 Station & Offset Surface Elev. 292.9 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
292.9		4-6-11-14	0.18	0.43	5 cm Topsoil--red/maroon and light beige clay w/ traces of sand and root hairs (CH); slightly moist, very stiff to hard; predominantly red w/ trace yellow in sample #3. qh=4.5+ kg/cm2	1	1	1	1		97	69	38	18	A-7-5
292.3	1	17-25-30-22	0.46	0.15		2								10	
291.7		26-23-26-40	0.40	0.21	qh=4.0 kg/cm2	3	9	3	3	41	44			10	A-7-6
291.1	2	33-50/0.4	0.18	0.09	qh=4.5+ kg/cm2	4								9	
290.8					Light olive/beige silty clay w/ traces of										
290.5		33-50/0.4	0.24	0.03	oxide stains (CL); slightly moist, hard.	5								10	
290.2	3				qh=3.5 kg/cm2 Red/maroon and olive silty clay w/ traces of oxide stains (CL); slightly moist, hard; laminated structure.										
	4														
288.8		25-50/0.3	0.24	0.00	qh=4.5+ kg/cm2	6								14	
	5				Harder drilling below about 5.2 meters										
287.5	6				Interbedded gray and red/maroon soft shale w/ hard, white limestone and moderately hard sandstone lenses; limestone and sandstone lenses up to around 2" thick; poor rock quality.										
		41	1.98			7									
	7														
285.5					Indurated clay shale (0% RQD).										
	8														
284.9		55	1.22	0.30	Very soft, dark maroon/gray shale.	8									
284.6					Light brown, moderately hard, fine grained sandstone.										

Date Started 071699 Date Completed 071699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-1 Station & Offset Surface Elev. 292.9 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
284.0															
283.8		50	0.61		Soft to medium gray shale; fair rock quality.	9									
283.3	10				Mud seam with sandstone lenses noted at 9.1 meters deep; lost water circulation - core run cut short (0.6 meters)										
		93	1.98	0.15	Soft to moderately hard, gray arenaceous shale (83%) with moderately hard siltstone (17%) lenses; excellent rock quality.	10									
	11														
281.2	12				qu=200.2 kg/cm2										
280.5		88	1.52		Gray moderately hard to hard sandstone; dark striations evident in sample; good rock quality; massive bedding. qu=626.5 kg/cm2	11									
279.7	13														
	14														
278.6		75	2.13		qu=261.9 kg/cm2	12									
	15														
277.6					Bottom of boring @ 15.4 meters.										
	16														
	17														

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Date Started 071999 Date Completed 071999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-2 Station & Offset Surface Elev. 289.2 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
289.2					7.5 cm Asphalt--Light olive brown/beige silty clay w/ traces of siltstone/weathered shale fragments (CL); slightly moist, hard [residual soil].										
288.9		4-20-20-25	0.30	0.30		1								7	
288.3	1	50/0.3	0.00	0.09	Light brown/beige sandstone (fragments). [Extremely weathered bedrock]	2									
287.7		75/0.1	0.03	0.00		3									
287.4	2				Extremely weathered, very soft light brown/ beige siltstone/shale.										
287.1		9-33-50/0.4	0.40	0.03		4								9	
286.8					Red and light brown/beige silty clay/ extremely weathered shale (CL); slightly moist; hard soil/ soft to very soft rock.										
286.5	3	27-43-50/0.4	0.30	0.12		5	1	5	5	34	55			13	A-7-6
					qh=4.5+ kg/cm2										
285.1	4	50/0.2	0.03	0.03		6									
284.3	5				Medium to moderately hard, light brown/ beige, fine to medium grained sandstone (fragments).										
283.6		50/0.3	0.06	0.03		7									
283.6	6	28	0.12	0.34	Gray siltstone/ arenaceous shale; medium to poor rock quality.	8									
283.1	7	75	1.52		Soft to medium, gray arenaceous shale; fissile, fair rock quality.	9									
281.9					Medium to moderately hard, gray, fine grained sandstone, fair to good rock quality.										
281.6	8														
281.3		55	1.46	0.06	Soft to medium, gray arenaceous shale; fair RQD.	10									
280.7					Medium to moderately hard, gray fine grained sandstone w/ shale partings.										
280.4															

Date Started 071999 Date Completed 071999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-2 Station & Offset Surface Elev. 289.2 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
280.1					Light brown color below 8.8 meters.										
	10				Moderately hard, light brown, fine to medium grained sandstone; good rock quality, thickly bedded.										
	11	80	2.99	0.06		11									
277.9					Color change to gray below 11.2 meters; good to fair rock quality.										
277.0	12				qu=202.2 kg/cm2										
	13	65	1.52			12									
275.5	14				Bottom of boring at 13.7 meters.										
	15														
	16														
	17														

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Date Started 071799 Date Completed 071799 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-3 Station & Offset Surface Elev. 286.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
286.7					5 cm Asphalt--Probable fill-brown silty										
286.4		3-3-4-4	0.37	0.24	clay w/ traces of fine sand and oxides; moist. qh=2.25 kg/cm2	1	0	1	1	25	73			31	A-7-6
285.8	1	4-7-7-13	0.24	0.37	qh=2.75 kg/cm2	2	7	2	3	0	88	42	21	30	A-7-6
285.2	2	7-11-13-13	0.30	0.30	Red and yellow silty clay w/ traces of sand (CL); moist, very stiff. qh=2.75+ kg/cm2	3	12	10	5	24	49			22	A-7-6
284.6					qh=3.0 kg/cm2										
284.3		6-10-14-40	0.52	0.09	qh=4.5+ kg/cm2	4	1	4	4	0	90	48	20	18	A-7-6
284.0	3	44-50/0.4	0.27		Soft to medium siltstone/fine grained sandstone fragments.	5								7	
283.7	4				Medium hard light brown sandstone (fragments).										
282.6		45-50/0.2	0.18	0.03		6								5	
	5														
281.2					Gray sandstone (fragments sampled); spoon										
281.1	6	50/0.1	0.03	0.00	refusal.	7									
281.1					15 cm run to 5.8 m - Brown siltstone/fine grained sandstone recovered.										
280.9		85	1.62	0.06	Medium hard, gray arenaceous (sandy) shale; medium bedded, good rock quality.	8									
280.0	7				Medium to moderately hard gray, medium grained sandstone.										
279.7															
279.4	8	80	1.52		Medium to moderately hard brown sandstone; thickly bedded, excellent rock quality.	9									
277.9															

Date Started 071799 Date Completed 071799 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-3 Station & Offset Surface Elev. 286.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10														
276.2	11	90	2.99	0.06	Moderately hard gray sandstone; excellent rock quality, thickly bedded. qu=246.7 kg/cm2	10									
274.8	12				Bottom of boring @ 11.9 meters.										
	13														
	14														
	15														
	16														
	17														

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Date Started 071799 Date Completed 071799 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-4 Station & Offset Surface Elev. 285.0 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
285.0					5 cm Asphalt--Probable fill-red Clay w/										
284.7		5-5-4-6	0.37	0.24	traces of sandstone fragments and oxides; moist.	1	0	1	1		98	63	34	36	A-7-6
284.1	1				qh=2.25 kg/cm2										
283.8		6-4-6-8	0.30	0.30	qh=1.25 kg/cm2	2	0	1	1	23	76			23	A-7-6
283.5					Possible fill-mottled brown and red silty clay w/ traces of sand (CL); moist, stiff.										
	2	6-14-10-11	0.43	0.18	qh=4.5+ kg/cm2	3	2	2	2		94	42	21	18	A-7-6
282.9					qh=3.75 kg/cm2										
282.6		11-15-18-22	0.55	0.06		4								20	
282.3					Light yellowish brown and red silty clay w/ traces of sand (CL); slightly moist, hard. Dark maroon to gray seam around 3.7 m.										
	3	9-18-20-22	0.37	0.24	qh=4.5+ kg/cm2	5								17	
	4														
280.9		23-50/0.3	0.21	0.03		6								9	
280.7					Soft, gray to dark gray arenaceous shale.										
	5														
279.4		50/0.3	0.09			7									
	6														
	7														
277.8		70/0.2	0.06	0.00		8									
	8														
276.5															
276.4		50/0.2	0.06	0.00	Light brown, moderately hard, fine grained sandstone, massive light brown sandstone.	9									

Date Started 071799 Date Completed 071799 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-4 Station & Offset Surface Elev. 285.0 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
276.3															
275.2	10	66	2.29	0.76	Moderately hard, light gray fine grained sandstone; fair rock quality; clay seam at 11.4 m. qu = 117.1 kg/cm2 Note: Lifter in core barrel became binded in casing, resulting in core loss as sample was retrieved.	10									
	11														
273.3	12				Bottom of boring @ 11.7 meters.										
	13														
	14														
	15														
	16														
	17														

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Date Started 071699 Date Completed 071699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-5 Station & Offset Surface Elev. 284.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
284.7					7.5 cm Pavement--mottled orange-brown w/										
284.4					trace red and gray silty clay w/ traces of										
284.1		5-5-6-6	0.40	0.21	oxides and fine sand (CL); moist, stiff.	1									
283.7	1				qh=1.75 kg/cm2										
283.4		7-10-14-16	0.40	0.21	Light orange brown Clay w/ traces of oxides (CL);moist, very stiff.	2	5	10	9	19	56				A-7-6
283.1					qh=2.25 kg/cm2										
		22-50/0.4	0.27			3									
	2				Olive brown to olive silty clay w/ traces of oxides (CL); slightly moist, hard.										
282.5		40-50/0.4	0.21	0.06	qh=4.5+ kg/cm2	4									
282.1					qh=4.5+ kg/cm2										
281.9	3	50/0.3	0.06	0.03	Moderately hard sandstone rocks (fragments in sample).	5									
	4														
280.5		22-50/0.4	0.21	0.06		6									
280.4					Soft, weathered gray shale (fragments in sample).										
	5														
279.0		30-50/0.3	0.24	0.00		7									
	6														
278.0	7				Light brown, fine sandy silt w/ traces of oxides (SM); slightly moist, hard.										
277.5					[Extremely weathered siltstone/fine grained										
277.1		29-26-50/0.3	0.27	0.12	sandstone]	8									
	8				Bottom of boring @ 7.6 meters.										

Date Started 071699 Date Completed 071699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-1 Station & Offset Surface Elev. 286.1m Water Elev. 280.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
286.1		4-5-7-7	0.30	0.30	9 cm Topsoil--fill-mottled brown/light brown to beige silty clay w/ traces of oxides and sand; moist. qh=4.5+ kg/cm2	1								16	
285.4	1	6-9-11-14	0.40	0.21	qh=4.25 kg/cm2	2								17	
284.8					Fill: orange-brown silt and sand w/ traces										
284.5		3-3-3-3	0.40	0.21	of oxides; moist. qh=1.5 kg/cm2, w.c.= 17%	3	0	1	10	56	33	28	7	26	A-4b
284.2	2				qh=1.0 kg/cm2										
283.9		2-2-3-2	0.40	0.21	qh=0.5 kg/cm2	4	3	4	13	45	35			29	A-4a
283.6					Brownish gray silty clay w/ traces of wood and organic material(CL, OL); very moist, soft.										
	3	shelby tube	0.61			5									
	4														
282.1					Orange-brown and trace gray silty clay w/										
281.9		7-10-14	0.46		traces of fine sand (CL); moist, very stiff.	6								18	
281.2	5				qh=4.5 kg/cm2										
					Light brown w/ trace gray very silty clay/ clayey silt w/ weathered siltstone/ sandstone fragments (CL,ML); moist to very moist, hard.										
280.4															
	6	17-27-50/0.4	0.43		qh=2.75 kg/cm2	7								16	
279.3	7				Soft, gray to olive gray silty clay (CL) and shale.										
278.9		21-50/0.4	0.24	0.03	qh=4.5+ kg/cm2	8								12	
	8														
277.8		50/0.1	0.00	0.03	Bottom of boring @ 8.3 meters.	9									
277.8															

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Date Started 071699 Date Completed 071699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 55-5 Station & Offset Surface Elev. 284.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
284.7					7.5 cm Pavement--mottled orange-brown w/										
284.4					trace red and gray silty clay w/ traces of										
284.1		5-5-6-6	0.40	0.21	oxides and fine sand (CL); moist, stiff.	1									
283.7	1				qh=1.75 kg/cm2										
283.4		7-10-14-16	0.40	0.21	Light orange brown Clay w/ traces of oxides (CL);moist, very stiff.	2	5	10	9	19	56				A-7-6
283.1					qh=2.25 kg/cm2										
		22-50/0.4	0.27			3									
	2				Olive brown to olive silty clay w/ traces of oxides (CL); slightly moist, hard.										
282.5		40-50/0.4	0.21	0.06	qh=4.5+ kg/cm2	4									
282.1					qh=4.5+ kg/cm2										
281.9	3	50/0.3	0.06	0.03	Moderately hard sandstone rocks (fragments in sample).	5									
	4														
280.5		22-50/0.4	0.21	0.06		6									
280.4					Soft, weathered gray shale (fragments in sample).										
	5														
279.0		30-50/0.3	0.24	0.00		7									
	6														
278.0	7				Light brown, fine sandy silt w/ traces of oxides (SM); slightly moist, hard.										
277.5		29-26-50/ 0.3	0.27	0.12	[Extremely weathered siltstone/fine grained sandstone]	8									
277.1	8				Bottom of boring @ 7.6 meters.										

Date Started 071699 Date Completed 071699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-1 Station & Offset Surface Elev. 286.1 m Water Elev. 280.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
286.1		4-5-7-7	0.30	0.30	9 cm Topsoil--fill-mottled brown/light brown to beige silty clay w/ traces of oxides and sand; moist. qh=4.5+ kg/cm2	1								16	
285.4	1	6-9-11-14	0.40	0.21	qh=4.25 kg/cm2	2								17	
284.8															
284.5		3-3-3-3	0.40	0.21	Fill: orange-brown silt and sand w/ traces of oxides; moist. qh=1.5 kg/cm2, w.c.= 17%	3	0	1	10	56	33	28	7	26	A-4b
284.2	2				qh=1.0 kg/cm2										
283.9		2-2-3-2	0.40	0.21	qh=0.5 kg/cm2	4	3	4	13	45	35			29	A-4a
283.6	3	shelby tube	0.61		Brownish gray silty clay w/ traces of wood and organic material (CL, OL); very moist, soft.	5									
	4														
282.1															
281.9		7-10-14	0.46		Orange-brown and trace gray silty clay w/ traces of fine sand (CL); moist, very stiff.	6								18	
281.2	5				qh=4.5 kg/cm2										
280.4	6	17-27-50/ 0.4	0.43		Light brown w/ trace gray very silty clay/ clayey silt w/ weathered siltstone/ sandstone fragments (CL,ML); moist to very moist, hard. qh=2.75 kg/cm2	7								16	
279.3	7				Soft, gray to olive gray silty clay (CL) and shale.										
278.9		21-50/0.4	0.24	0.03	qh=4.5+ kg/cm2	8								12	
	8														
277.8		50/0.1	0.00	0.03	Bottom of boring @ 8.3 meters.	9									
277.8															

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-2 Station & Offset _____ Surface Elev. 287.1 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
287.1		6-17-17-20	0.15	0.46	Probable fill-mottled brown and orange brown silty clay w/ little to some sand, traces of oxides and gravel; slightly moist. qh=4.5+ kg/cm2	1								12	
286.5	1	12-11-7-7	0.37	0.24	Light orange brown w/ trace gray sandy silt (ML); slightly moist to moist medium dense. qh=1.5 kg/cm2	2	9	7	36	20	27			13	A-4a
285.9															
285.6		5-5-21-31	0.37	0.24		3	8	4	33	38	17			11	A-4a
285.3	2				Light olive brown and orange brown silty clay (CL); slightly moist, hard; laminated structure; olive brown in sample #5.										
		7-30-40-38	0.37	0.24		4	17	7	6	41	29			11	A-6a
284.7															
	3	14-28-40-36	0.61		qh=4.5+ kg/cm2	5								13	
	4														
283.1															
283.0		17-39-50/ 0.3	0.34	0.06	Olive to gray silty clay (CL); slightly moist, hard; [Extremely weathered shale]. qh=4.5+ kg/cm2	6								15	
	5														
281.6															
281.5		50/0.3	0.09		Light gray, medium hard sandstone (fragments).	7									
281.3	6				Light gray to gray, medium to moderately hard sandstone; fair rock quality, thickly bedded. qu=518.0 kg/cm2										
		53	1.68	0.15		8									
	7														
279.5															
	8				Bottom of boring @ 7.6 meters.										

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-3 Station & Offset _____ Surface Elev. 288.7 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
288.7					5 cm Pavement										
288.4		4-12-50/0.3	0.30	0.09	Light brown silty sand w/ sandstone fragments (SM); slightly moist to moist, dense; [weathered fine grained sandstone.	1								12	
287.8	1														
		75/0.4	0.09	0.03	Sandstone fragments below 0.9 m.	2									
287.2															
	2				Light brown fine to medium grained, medium to moderately hard sandstone; fair to good rock quality, thick to massive bedding. qu=86.0 kg/cm2											
	3	75	2.59	0.46		3									
	4														
284.1															
	5				Bottom of boring @ 4.6 meters.										
	6														
	7														
	8														

GANNETT FLEMING
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Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-2 Station & Offset Surface Elev. 287.1m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
287.1		6-17-17-20	0.15	0.46	Probable fill-mottled brown and orange brown silty clay w/ little to some sand, traces of oxides and gravel; slightly moist. qh=4.5+ kg/cm2	1								12	
286.5	1	12-11-7-7	0.37	0.24	Light orange brown w/ trace gray sandy silt (ML); slightly moist to moist medium dense. qh=1.5 kg/cm2	2	9	7	36	20	27			13	A-4a
285.9															
285.6		5-5-21-31	0.37	0.24		3	8	4	33	38	17			11	A-4a
285.3	2				Light olive brown and orange brown silty clay (CL); slightly moist, hard; laminated structure; olive brown in sample #5.										
		7-30-40-38	0.37	0.24		4	17	7	6	41	29			11	A-6a
284.7					qh=4.5+ kg/cm2										
	3	14-28-40-36	0.61			5								13	
	4														
283.1															
283.0		17-39-50/ 0.3	0.34	0.06	Olive to gray silty clay (CL); slightly moist, hard; [Extremely weathered shale].	6								15	
					qh=4.5+ kg/cm2										
	5														
281.6															
281.5		50/0.3	0.09		Light gray, medium hard sandstone (fragments).	7									
281.3	6														
		53	1.68	0.15	Light gray to gray, medium to moderately hard sandstone; fair rock quality, thickly bedded. qu=518.0 kg/cm2	8									
	7														
279.5					Bottom of boring @ 7.6 meters.										
	8														

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-3 Station & Offset Surface Elev. 288.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
288.7					5 cm Pavement										
288.4		4-12-50/0.3	0.30	0.09	Light brown silty sand w/ sandstone fragments (SM); slightly moist to moist, dense; [weathered fine grained sandstone.	1								12	
287.8	1	75/0.4	0.09	0.03	Sandstone fragments below 0.9 m.	2									
287.2	2	75	2.59	0.46	Light brown fine to medium grained, medium to moderately hard sandstone; fair to good rock quality, thick to massive bedding. qu=86.0 kg/cm2	3									
	3														
	4														
284.1	5				Bottom of boring @ 4.6 meters.										
	6														
	7														
	8														

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-4 Station & Offset Surface Elev. 291.4 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
291.4					5 cm Pavement (tar and chip)										
291.1															
		4-4-6-7	0.43	0.18	Light orange-brown w/ light gray silty clay w/ traces of oxides (CL); moist, medium stiff to stiff. qh=2.25 kg/cm2	1								19	
290.5	1														
		11-20-50/ 0.5	0.37	0.09	qh=4.5+ kg/cm2	2								10	
290.2															
289.9					Light olive brown to olive silty clay (CL); slightly moist, hard.										
	2	20-50/0.3	0.21	0.03		3								7	
289.3															
		50/0.4	0.09	0.03		4									
289.0															
288.7					Medium to moderately hard light brown sandstone fragments; auger refusal at 2.7 m.										
	3														
		54	1.80	0.03	Medium to moderately hard light brown sandstone; fair rock quality, thick to massive bedding. Darker brown striations noted in core sample.	5									
	4														
286.8					qu=119.2 kg/cm2										
	5														
		61	2.13			6									
	6														
284.7															
	7				Bottom of boring @ 6.7 meters.										
	8														

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-5 Station & Offset Surface Elev. 293.8 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
293.8					5 cm Pavement--(tar and chip); fill-mottled brown silty clay w/ sand.										
293.5															
		4-2-3-5	0.30	0.30	Red w/ trace orange-brown and gray silty clay w/ trace oxides (CL); moist, soft. qh=1.25 kg/cm2	1								31	
293.1	1														
292.9		8-6-11-14	0.34	0.27	Red w/ trace gray silty clay (CL); moist, hard.	2	0	1	2	30	66			28	A-7-6
292.3					qh=3.75 kg/cm2										
	2	6-6-8-10	0.43	0.18	qh=2.25 kg/cm2	3	0	1	8		91	42	15	27	A-7-6
291.7															
		6-10-14-16	0.46	0.15	qh=2.5 kg/cm2	4								26	
291.1	3														
		5-9-14-15	0.40	0.21	qh=2.75 kg/cm2	5								23	
290.5															
290.2	4	shelby tube	0.37	0.24	Light olive brown to beige silty clay (CL); moist, hard.	6									
289.7															
		18-35-50/ 0.3	0.37	0.03		7								12	
	5														
288.4															
288.2		50/0.4	0.09	0.03	Light brown to beige, medium to moderately hard, fine to medium grained sandstone w/ dark brown striations/laminations; good to excellent rock quality; massivley bedded. qu=151.2 kg/cm2	8									
288.1	6														
		75	1.83			9									
	7														
286.3															
	8	98	1.58			10									

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Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-4 Station & Offset Surface Elev. 291.4 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
291.4					5 cm Pavement (tar and chip)										
291.1		4-4-6-7	0.43	0.18	Light orange-brown w/ light gray silty clay w/ traces of oxides (CL); moist, medium stiff to stiff. qh=2.25 kg/cm2	1								19	
290.5	1														
290.2		11-20-50/ 0.5	0.37	0.09	qh=4.5+ kg/cm2	2								10	
289.9					Light olive brown to olive silty clay (CL); slightly moist, hard.										
	2	20-50/0.3	0.21	0.03		3								7	
289.3															
		50/0.4	0.09	0.03		4									
289.0					Medium to moderately hard light brown sandstone fragments; auger refusal at 2.7 m.										
288.7	3														
	4	54	1.80	0.03	Medium to moderately hard light brown sandstone; fair rock quality, thick to massive bedding. Darker brown striations noted in core sample.	5									
286.8	5				qu=119.2 kg/cm2										
	6	61	2.13			6									
284.7	7				Bottom of boring @ 6.7 meters.										
	8														

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-5 Station & Offset Surface Elev. 293.8 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
293.8					5 cm Pavement--(tar and chip); fill-mottled brown silty clay w/ sand.										
293.5		4-2-3-5	0.30	0.30	Red w/ trace orange-brown and gray silty clay w/ trace oxides (CL); moist, soft. qh=1.25 kg/cm2	1								31	
293.1	1														
292.9		8-6-11-14	0.34	0.27	Red w/ trace gray silty clay (CL); moist, hard.	2	0	1	2	30	66			28	A-7-6
292.3	2	6-6-8-10	0.43	0.18	qh=3.75 kg/cm2	3	0	1	8		91	42	15	27	A-7-6
291.7		6-10-14-16	0.46	0.15	qh=2.25 kg/cm2 qh=2.5 kg/cm2	4								26	
291.1	3	5-9-14-15	0.40	0.21	qh=2.75 kg/cm2	5								23	
290.5															
290.2	4	shelby tube	0.37	0.24		6									
289.7		18-35-50/ 0.3	0.37	0.03	Light olive brown to beige silty clay (CL); moist, hard.	7								12	
	5														
288.4															
288.2	6	50/0.4	0.09	0.03	Light brown to beige, medium to moderately hard, fine to medium grained sandstone w/ dark brown striations/laminations; good to excellent rock quality; massivley bedded. qu=151.2 kg/cm2	8									
288.1		75	1.83			9									
	7														
286.3															
	8														
		98	1.58			10									

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-5 Station & Offset _____ Surface Elev. 293.8 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
284.7					Bottom of boring @ 9.2 meters.										
	10														
	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-5 Station & Offset Surface Elev. 293.8 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
284.7	10 11 12 13 14 15 16 17				Bottom of boring @ 9.2 meters.										

Date Started 073099 Date Completed 073099 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-1 Station & Offset Surface Elev. 211.3 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.3		10-50/0.1	0.09	0.09	Fill-gravel and topsoil 8 cm.	1									
210.7	1	55/0.2	0.00	0.06	Light brown, moderately hard sandstone fragments. Had to grind down to set core barrel.	2									
209.6	2 3	76	1.25	0.15	Light brown to gray, hard, medium to coarse sandstone; good to excellent rock quality, massive bedding; light gray below about 3.5 m. qu=154.8 kg/cm2	3									
208.2	4	92	1.52			4									
206.7	5 6 7 8				Bottom of boring @ 4.6 meters.										

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Date Started 073099 Date Completed 073099 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-1 Station & Offset Surface Elev. 211.3 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.3		10-50/0.1	0.09	0.09	Fill-gravel and topsoil 18 cm.	1									
210.7	1	55/0.2	0.00	0.06	Light brown, moderately hard sandstone fragments. Had to grind down to set core barrel.	2									
209.6	2	76	1.25	0.15	Light brown to gray, hard, medium to coarse sandstone; good to excellent rock quality, massive bedding; light gray below about 3.5 m. qu=154.8 kg/cm2	3									
208.2	3														
	4	92	1.52			4									
206.7	5				Bottom of boring @ 4.6 meters.										
	6														
	7														
	8														

Date Started 080599 Date Completed 080599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-2 Station & Offset Surface Elev. 216.2 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
216.2															
215.8		2-3-15-50/ 0.4	0.27	0.30	Mottled red and brown w/ trace light brown silty clay w/ traces of sandstone fragments (CL); moist, very stiff; gray shale noted in bottom of spoon. qh=2.25 kg/cm2	1								9	
215.6	1	50/0.3	0.03	0.06		2									
					Soft to medium hard gray arenaceous shale and fine grained sandstone/siltstone. Had to grind through bedrock to set core barrelat 2.9 meters.										
	2														
213.3	3														
		75	1.65	0.00	Light gray fine to medium grained, medium to moderately hard sandstone; thickly bedded, good to fair rock quality. qu=522.7 kg/cm2	3									
	4														
211.9					--trace of light brown color 4.3 m to 4.4 m deep										
211.6	5					4									
210.9		55	1.52		--trace of light brown color 5.3 m to 5.5 m deep										
	6														
210.1						5									
	7	45	1.40	0.12	--light brown sandstone with "poor" rock quality below 7.0 m (final 1.5 m core run appeared to have been disturbed during drilling).										
209.2															
208.6	8				Bottom of boring @ 7.6 meters.										

Date Started 080599 Date Completed 080599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-3 Station & Offset Surface Elev. 219.1m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
219.1		2-4-5-7	0.34	0.27	Mottled gray w/ trace maroon silty clay w/ traces of limestone nodule fragments (CL); moist, medium stiff. qh=4.5+ kg/cm2	1	2	1	2		95	42	19	12	A-7-6
218.5															
218.3	1	9-27-34-50/ 0.2	0.34	0.18	qh=4.5+ kg/cm2	2								8	
218.0					Gray w/ trace olive brown silty clay (CL); slightly moist, hard.										
217.9		50/0.3	0.09			3								4	
					Soft, gray arenaceous shale.										
217.2	2	50/0.4	0.06	0.06		4								4	
216.6		29-50/0.3	0.18	0.06		5								3	
216.0	3														
215.9		50/0.3	0.09			6									
					Light brown to gray, soft to moderately hard, arenaceous shale w/ limestone nodules and moderately hard to hard, fine to medium grained, light gray sandstone w/ dark striations; good rock quality, medium to thickly bedded.										
215.4	4														
		75	1.34	0.18	moderately hard shale 3.5 m to 4.3 m deep; light brown soft to medium shale in top 10 cm of core run.	7									
214.4	5														
	6	87	3.05			8									
212.7					qu=500.4 kg/cm2										
	7														
211.5															
211.3	8				Light gray, striated fine to medium grained, moderately hard sandstcne; excellent rock quality, thickly bedded.										
		100	1.52			9									

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Date Started 080599 Date Completed 080599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-2 Station & Offset Surface Elev. 216.2 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
216.2		2-3-15-50/ 0.4	0.27	0.30	Mottled red and brown w/ trace light brown silty clay w/ traces of sandstone fragments (CL); moist, very stiff; gray shale noted	1								9	
215.8															
215.6	1	50/0.3	0.03	0.06	in bottom of spoon. qh=2.25 kg/cm2	2									
	2				Soft to medium hard gray arenaceous shale and fine grained sandstone/siltstone. Had to grind through bedrock to set core barrel at 2.9 meters.										
213.3	3														
	4	75	1.65	0.00	Light gray fine to medium grained, medium to moderately hard sandstone; thickly bedded, good to fair rock quality. qu=522.7 kg/cm2	3									
211.9					--trace of light brown color 4.3 m to 4.4 m deep										
211.6	5														
210.9	6	55	1.52		--trace of light brown color 5.3 m to 5.5 m deep	4									
210.1	7	45	1.40	0.12		5									
209.2					--light brown sandstone with "poor" rock quality below 7.0 m (final 1.5 m core run appeared to have been disturbed during drilling).										
208.6	8				Bottom of boring @ 7.6 meters.										

Date Started 080599 Date Completed 080599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-3 Station & Offset Surface Elev. 219.1m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
219.1		2-4-5-7	0.34	0.27	Mottled gray w/ trace maroon silty clay w/ traces of limestone nodule fragments (CL); moist, medium stiff. qh=4.5+ kg/cm2	1	2	1	2		95	42	19	12	A-7-6
218.5															
218.3	1	9-27-34-50/ 0.2	0.34	0.18	qh=4.5+ kg/cm2	2								8	
218.0					Gray w/ trace olive brown silty clay (CL); slightly moist, hard.										
217.9		50/0.3	0.09			3								4	
					Soft, gray arenaceous shale.										
217.2	2	50/0.4	0.06	0.06		4								4	
216.6		29-50/0.3	0.18	0.06		5								3	
	3														
216.0		50/0.3	0.09			6									
215.9					Light brown to gray, soft to moderately hard, arenaceous shale w/ limestone nodules and moderately hard to hard, fine to medium grained, light gray sandstone w/ dark striations; good rock quality, medium to thickly bedded.										
215.4	4	75	1.34	0.18		7									
214.4	5				moderately hard shale 3.5 m to 4.3 m deep; light brown soft to medium shale in top 10 cm of core run.										
	6														
212.7	7	87	3.05			8									
					qu=500.4 kg/cm2										
211.5															
211.3	8				Light gray, striated fine to medium grained, moderately hard sandstone; excellent rock quality, thickly bedded.										
		100	1.52			9									

Date Started 080599 Date Completed 080599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-3 Station & Offset _____ Surface Elev. 219.1m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
209.8					Bottom of boring @ 9.3 meters.										
	10														
	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 080599 Date Completed 080599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-3 Station & Offset _____ Surface Elev. 219.1m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
209.8	10				Bottom of boring @ 9.3 meters.										
	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-4 Station & Offset _____ Surface Elev. 220.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
220.9															
		2-5-7-12	0.30	0.30	Fill-grayish brown silty clay w/ traces of black and gray shale fragments; moist. qh=3.25 kg/cm2	1	7	4	4	23	62			16	A-7-6
220.2	1														
		28-28-31-37	0.18	0.43	qh=2.5 kg/cm2	2								14	
219.6															
		20-50-50/ 0.2	0.24	0.12	Dark olive gray to gray silty clay (CL); slightly moist, hard; laminated structure. qh=4.5+ kg/cm2	3	1	2	3		94	45	20	11	A-7-6
219.0	2														
		30-50/0.3	0.15	0.09		4								8	
218.7															
218.4					Very soft to soft, gray arenaceous shale.										
		45-50/0.2	0.18	0.03		5								7	
	3														
	4														
216.7															
		50/0.5	0.09	0.06		6									
216.6															
		50	0.21			7									
216.4	5				Soft to medium, gray arenaceous shale; fair rock quality, medium bedding. --limestone nodules and lenses noted below about 4.6 meters.										
		50	1.43	0.09		8									
	6														
214.8					Moderately hard in and below sample #9.										
		87	1.52			9									
213.8	7				Medium to moderately hard, gray, fine grained sandstone/siltstone; thick to massive bedding; fair to good rock quality; isolated fissile lenses.										
213.3															
	8	77	1.31	0.21		10									
212.2					qu=277.6 kg/cm2										

GANNETT FLEMING
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FOUNDATION SOIL PROFILE
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Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-4 Station & Offset Surface Elev. 220.9 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
220.9		2-5-7-12	0.30	0.30	Fill-grayish brown silty clay w/ traces of black and gray shale fragments; moist. qh=3.25 kg/cm2	1	7	4	4	23	62			16	A-7-6
220.2	1	28-28-31-37	0.18	0.43	qh=2.5 kg/cm2	2								14	
219.6		20-50-50/0.2	0.24	0.12	Dark olive gray to gray silty clay (CL); slightly moist, hard; laminated structure. qh=4.5+ kg/cm2	3	1	2	3		94	45	20	11	A-7-6
219.0	2	30-50/0.3	0.15	0.09		4								8	
218.7					Very soft to soft, gray arenaceous shale.										
218.4		45-50/0.2	0.18	0.03		5								7	
	3														
	4														
216.7		50/0.5	0.09	0.06		6									
216.6		50	0.21		Soft to medium, gray arenaceous shale; fair rock quality, medium bedding.	7									
216.4	5														
		50	1.43	0.09	--limestone nodules and lenses noted below about 4.6 meters.	8									
214.8	6														
		87	1.52		Moderately hard in and below sample #9.	9									
213.8	7														
213.3					Medium to moderately hard, gray, fine grained sandstone/siltstone; thick to massive bedding; fair to good rock quality; isolated fissile lenses.										
	8														
		77	1.31	0.21		10									
212.2					qu=277.6 kg/cm2										

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-4 Station & Offset _____ Surface Elev. 220.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.8															
	10	56	1.83			11									
210.6					Hard, light brown, fine to medium grained sandstone w/ dark striations; isolated fissile lenses.										
210.0	11				Bottom of boring @ 10.9 meters.										
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-4 Station & Offset _____ Surface Elev. 220.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.8	10	56	1.83			11									
210.6	11				Hard, light brown, fine to medium grained sandstone w/ dark striations; isolated fissile lenses.										
210.0	12				Bottom of boring @ 10.9 meters.										
	13														
	14														
	15														
	16														
	17														

Date Started 072899 Date Completed 072899 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-5 Station & Offset _____ Surface Elev. 220.4 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
220.4		7-17-23-26	0.21	0.40	Fill: Mottled brownish gray silty clay w/ traces of sand, gravel, organic fibers and apparent coal pieces. qh=4.5 kg/cm2	1								13	
219.8	1	13-20-14-16	0.15	0.46	qh=4.5+ kg/cm2	2								11	
219.2		6-13-14-16	0.15	0.46	qh=2.75 kg/cm2	3								12	
218.7	2	19-40-50/0.2	0.21	0.15	Light brown/beige w/ trace orange silty clay w/ traces of oxides (CL); slightly moist, hard.	4	0	2	4	30	64			12	A-7-6
218.6		25-50/0.3	0.15	0.09	qh=3.0 kg/cm2 qh=4.5+ kg/cm2	5	3	7	5		85	41	19	10	A-7-6
218.0	3														
216.8	4				Olive brown, soft weathered shale.										
216.3		43-50/0.1	0.09	0.09		6								5	
215.5	5				Light gray, medium hard to moderately hard, fine grained sandstone.										
214.8		50/0.2	0.03	0.03		7									
214.7	6	30	0.15	0.18		8									
214.4	7	70	1.52		Olive and light gray sandstone below 5.8 m; soft to medium hard w/ shale/clay seams.	9									
212.9	8	77	1.49	0.03	Medium hard to moderately hard alternating gray to light brown, fine to medium grained sandstone; thickly to massive bedded below 7.3 m.	10									

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Date Started 072899 Date Completed 072899 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-5 Station & Offset Surface Elev. 220.4 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
220.4		7-17-23-26	0.21	0.40	Fill: Mottled brownish gray silty clay w/ traces of sand, gravel, organic fibers and apparent coal pieces. qh=4.5 kg/cm2	1								13	
219.8	1	13-20-14-16	0.15	0.46	qh=4.5+ kg/cm2	2								11	
219.2		6-13-14-16	0.15	0.46	qh=2.75 kg/cm2	3								12	
218.7	2	19-40-50/0.2	0.21	0.15	Light brown/beige w/ trace orange silty clay w/ traces of oxides (CL); slightly moist, hard.	4	0	2	4	30	64			12	A-7-6
218.6		25-50/0.3	0.15	0.09	qh=3.0 kg/cm2	5	3	7	5		85	41	19	10	A-7-6
218.0	3				qh=4.5+ kg/cm2										
216.8	4				Olive brown, soft weathered shale.										
216.3		43-50/0.1	0.09	0.09		6								5	
215.5	5				Light gray, medium hard to moderately hard, fine grained sandstone.										
214.8		50/0.2	0.03	0.03		7									
214.7	6	30	0.15	0.18		8									
214.4	7	70	1.52		Olive and light gray sandstone below 5.8 m; soft to medium hard w/ shale/clay seams.	9									
212.9	8	77	1.49	0.03	Medium hard to moderately hard alternating gray to light brown, fine to medium grained sandstone; thickly to massive bedded below 7.3 m.	10									

Date Started 072899 Date Completed 072899 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-5 Station & Offset _____ Surface Elev. 220.4 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.3	10	70	1.52		Dark striations below 8.8 m; predominantly light gray and moderately hard below 9.1 m.	11									
209.8	11				Bottom of boring @ 10.6 meters.										
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072899 Date Completed 072899 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-5 Station & Offset Surface Elev. 220.4 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.3	10	70	1.52		Dark striations below 8.8 m; predominantly light gray and moderately hard below 9.1m.	11									
209.8	11 12 13 14 15 16 17				Bottom of boring @ 10.6 meters.										

Date Started 080699 Date Completed 080699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-6 Station & Offset Surface Elev. 213.1m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
213.1					Fill-Mottled brown and gray silty clay w/ some sand and rock fragments; moist.										
		8-11-12-15	0.21	0.40	qh=3.25 kg/cm2	1	25	9	13	20	33			12	A-7-6
212.5	1	3-11-6-8	0.09	0.52	qh=1.75 kg/cm2	2								11	
211.9		5-7-7-9	0.34	0.27	qh=2.0 kg/cm2	3	26	7	8		59	41	19	15	A-7-6
211.3	2	5-5-5-6	0.21	0.40	qh=2.25 kg/cm2	4								13	
210.7					qh=1.75 kg/cm2										
210.4	3	9-8-20-50/ 0.5	0.34	0.27	Light brown silty sand w/ little sandstone fragments (SM); moist, medium dense.	5								11	
209.8	4				Medium to moderately hard, light brown, fine to medium grained sandstone; good rock quality.										
209.0		50/0.1	0.03			6									
208.9					qu=152.2 kg/cm2										
208.6	5	80	1.52			7									
207.2	6 7	33	0.70	0.82	Poor rock quality below 6.1m; possible cavity or soft mud seam from 6.7 m to 7.2 m.	8									
205.7	8	87	1.52		Marled maroon w/ trace gray and olive, soft to very soft shale; "good" rock quality; medium hard at top of interval. (RQD measurement misleading)	9									
204.6					qu=39.7 kg/cm2										

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Date Started 080699 Date Completed 080699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-6 Station & Offset Surface Elev. 213.1m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
213.1		8-11-12-15	0.21	0.40	Fill-Mottled brown and gray silty clay w/ some sand and rock fragments; moist. qh=3.25 kg/cm2	1	25	9	13	20	33			12	A-7-6
212.5	1	3-11-6-8	0.09	0.52	qh=1.75 kg/cm2	2								11	
211.9		5-7-7-9	0.34	0.27	qh=2.0 kg/cm2	3	26	7	8		59	41	19	15	A-7-6
211.3	2	5-5-5-6	0.21	0.40	qh=2.25 kg/cm2	4								13	
210.7					qh=1.75 kg/cm2										
210.4	3	9-8-20-50/ 0.5	0.34	0.27	Light brown silty sand w/ little sandstone fragments (SM); moist, medium dense.	5								11	
209.8	4				Medium to moderately hard, light brown, fine to medium grained sandstone; good rock quality.										
209.0		50/0.1	0.03			6									
208.9															
208.6	5	80	1.52		qu=152.2 kg/cm2	7									
	6														
207.2	7	33	0.70	0.82	Poor rock quality below 6.1m; possible cavity or soft mud seam from 6.7 m to 7.2 m.	8									
205.7	8	87	1.52		Marled maroon w/ trace gray and olive, soft to very soft shale; "good" rock quality; medium hard at top of interval. (RQD measurement misleading)	9									
204.6					qu=39.7 kg/cm2										

Date Started 080699 Date Completed 080699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-6 Station & Offset _____ Surface Elev. 213.1 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
204.1	10				Bottom of boring @ 9.0 meters.										
	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 080699 Date Completed 080699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-6 Station & Offset _____ Surface Elev. 213.1 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
204.1	10 11 12 13 14 15 16 17				Bottom of boring @ 9.0 meters.										

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-8 Station & Offset _____ Surface Elev. 222.0 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
222.0		5-6-11-15	0.24	0.37	Fill-mottled gray, olive and red silty clay w/ traces of organic fibers and shale fragments. qh=3.0 kg/cm2	1								13	
221.4					qh=1.0 kg/cm2										
221.1	1	12-20-22-25	0.30	0.30	Mottled gray w/ brown to dark gray silty clay (CL); slightly moist, hard.	2	2	1	3	28	66			19	A-7-6
220.8		13-32-50/ 0.4	0.27	0.15	qh=4.5+ kg/cm2	3								11	
220.2	2	50/0.5	0.06	0.09		4									
219.6	3 4	40-50/0.2	0.12	0.09	Medium, gray arenaceous shale.	5								8	
217.9		50/0.1	0.03	0.06	Soft, gray, arenaceous shale w/ limestone nodules; poor rock quality, thinly bedded.	6									
217.9		0	0.24			7									
217.6	5 6	55	1.52		Medium to moderatley hard, gray, arenaceous shale w/ limestone nodules; fair rock quality, medium bedding. qu=196.8 kg/cm2	8									
216.0	7	42	1.40	0.12	Gray, medium to moderately hard, fine grained sandstone w/ soft gray shale seams; limestone nodules below about 6.6 m; poor rock quality, medium to thick bedding.	9									
214.5	8	62	1.31	0.21	Medium, gray arenaceous shale and moderately hard to hard, light gray, fine to medium grained sandstone; fair rock quality, medium bedding; sandstone below about 7.9 m; mud seam at about 8.8 m.	10									

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Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-8 Station & Offset Surface Elev. 222.0 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
222.0		5-6-11-15	0.24	0.37	Fill-mottled gray, olive and red silty clay w/ traces of organic fibers and shale fragments. qh=3.0 kg/cm2	1								13	
221.4	1	12-20-22-25	0.30	0.30	qh=1.0 kg/cm2	2	2	1	3	28	66			19	A-7-6
221.1					Mottled gray w/ brown to dark gray silty clay (CL); slightly moist, hard.										
220.8		13-32-50/ 0.4	0.27	0.15	qh=4.5+ kg/cm2	3								11	
220.2	2	50/0.5	0.06	0.09		4									
219.6	3	40-50/0.2	0.12	0.09	Medium, gray arenaceous shale.	5								8	
	4														
217.9		50/0.1	0.03	0.06	Soft, gray, arenaceous shale w/ limestone nodules; poor rock quality, thinly bedded.	6									
217.9		0	0.24			7									
217.6	5	55	1.52		Medium to moderatley hard, gray, arenaceous shale w/ limestone nodules; fair rock quality, medium bedding. qu=196.8 kg/cm2	8									
	6														
216.0	7	42	1.40	0.12	Gray, medium to moderately hard, fine grained sandstone w/ soft gray shale seams; limestone nodules below about 6.6 m; poor rock quality, medium to thick bedding.	9									
214.5	8	62	1.31	0.21	Medium, gray arenaceous shale and moderately hard to hard, light gray, fine to medium grained sandstone; fair rock quality, medium bedding; sandstone below about 7.9 m; mud seam at about 8.8 m.	10									

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-8 Station & Offset Surface Elev. 222.0 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
213.0	10	29	1.83		Light gray, medium hard to moderately hard, fine to medium grained fissile sandstone w/ shale seams; poor rock quality, thin to medium bedding.	11									
211.2	11				Bottom of boring @ 10.9 meters.										
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-8 Station & Offset _____ Surface Elev. 222.0 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
213.0	10	29	1.83		Light gray, medium hard to moderately hard, fine to medium grained fissile sandstone w/ shale seams; poor rock quality, thin to medium bedding.	11									
211.2	11 12 13 14 15 16 17				Bottom of boring @ 10.9 meters.										

Date Started 072899 Date Completed 072899 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-9 Station & Offset _____ Surface Elev. 221.6 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
221.6		5-10-15-18	0.15	0.46	Probable fill-mottled brown and olive brown silty clay w/ traces of organic fibers; slightly moist. qh=4.5+ kg/cm2	1								13	
221.0					qh=4.5+ kg/cm2										
220.8	1	10-13-15-21	0.34	0.27	Olive to olive and dark gray silty clay (CL); slightly moist, hard.	2	4	0	3		93	52	21	15	A-7-5
220.3		8-24-32-38	0.27	0.34		3								11	
219.7	2	27-50/0.2	0.12	0.09	qh=4.5+ kg/cm2	4								10	
219.1	3	50/0.4	0.09	0.03		5								9	
217.9	4				Soft to medium, gray arenaceous shale.										
217.4		50/0.4	0.12			6									
217.3					Soft to medium, gray arenaceous shale w/ traces of limestone nodules; thickly bedded, poor rock quality.										
217.1	5	0	0.18			7									
216.1	6	43	1.40	0.12	qu=143.9 kg/cm2	8									
215.6															
215.2	7	68	1.46	0.06	Medium, fine to medium grained, gray sandstone; thickly bedded, fair to poor rock quality. -- medium to moderately hard below 7.6 m.	9									
214.1	8	48	1.52			10									

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Date Started 072899 Date Completed 072899 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-9 Station & Offset Surface Elev. 221.6 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
221.6		5-10-15-18	0.15	0.46	Probable fill-mottled brown and olive brown silty clay w/ traces of organic fibers; slightly moist. qh=4.5+ kg/cm2	1								13	
221.0															
220.8	1	10-13-15-21	0.34	0.27	qh=4.5+ kg/cm2	2	4	0	3		93	52	21	15	A-7-5
220.3		8-24-32-38	0.27	0.34	Olive to olive and dark gray silty clay (CL); slightly moist, hard.	3								11	
219.7	2	27-50/0.2	0.12	0.09	qh=4.5+ kg/cm2	4								10	
219.1		50/0.4	0.09	0.03		5								9	
	3														
217.9	4				Soft to medium, gray arenaceous shale.										
217.4		50/0.4	0.12			6									
217.3		0	0.18		Soft to medium, gray arenaceous shale w/ traces of limestone nodules; thickly bedded, poor rock quality.	7									
217.1	5														
		43	1.40	0.12		8									
216.1	6				qu=143.9 kg/cm2										
215.6															
215.2	7	68	1.46	0.06	Medium, fine to medium grained, gray sandstone; thickly bedded, fair to poor rock quality. -- medium to moderately hard below 7.6 m.	9									
214.1	8														
		48	1.52			10									

Date Started 072899 Date Completed 072899 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-9 Station & Offset Surface Elev. 221.6 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ ROD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
212.5	10	72	1.55	0.27	Light gray, moderately hard to hard, fine to medium grained sandstone; fair rock quality, thick to massive bedding. -- dark striations below 9.5 m.	11									
210.7	11				Bottom of boring @ 10.9 meters.										
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-10 Station & Offset Surface Elev. 220.2 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ ROD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
220.2															
219.6	1	5-4-7-7	0.24	0.37	Fill-mottled brown, olive and gray silty clay w/ trace to little fine sand and shale fragments; moist. qh=2.0 kg/cm2	1								14	
219.0	2	7-14-17-20	0.30	0.30	qh=4.5+ kg/cm2	2								9	
218.4		8-9-7-9	0.12	0.49		3								8	
218.1		8-11-11-9	0.15	0.46	-- black shale fragments noted in sample #4.	4								14	
217.8	3	12-13-8-7	0.24	0.37	qh=4.25 kg/cm2	5								15	
216.5	4				-- predominantly gray coloring below 3.7 m.										
216.1	5	7-8-10	0.21	0.24	qh=3.5 kg/cm2	6	16	6	8	36	33			13	A-6a
215.0					Probable fill-light brown to brown silty clay w/ traces of gray sandstone fragments, sand and organic fibers/oxides.										
214.6	6	5-9-15	0.30	0.15	qh=3.25 kg/cm2	7								18	
	7														
213.1		50/0.0	0.00		Marled olive brown and light gray, hard limestone; good rock quality, thin bedding.	8									
213.0		77	0.24			9									
212.8	8				Light brown w/ trace gray, medium to moderately hard, fine to medium grained sandstone; darker brown striations noted in sandstone; thick to massive bedding, fair to good rock quality. qu=96.6 kg/cm2										

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Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-10 Station & Offset Surface Elev. 220.2 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
220.2		5-4-7-7	0.24	0.37	Fill-mottled brown, olive and gray silty clay w/ trace to little fine sand and shale fragments; moist. qh=2.0 kg/cm2	1								14	
219.6	1	7-14-17-20	0.30	0.30	qh=4.5+ kg/cm2	2								9	
219.0		8-9-7-9	0.12	0.49		3								8	
218.4	2														
218.1		8-11-11-9	0.15	0.46	-- black shale fragments noted in sample #4.	4								14	
217.8	3	12-13-8-7	0.24	0.37	qh=4.25 kg/cm2	5								15	
216.5	4				-- predominantly gray ccloring below 3.7 m.										
216.1		7-8-10	0.21	0.24	qh=3.5 kg/cm2	6	16	6	8	36	33			13	A-6a
215.0	5				Probable fill-light brown to brown silty clay w/ traces of gray sandstone fragments, sand and organic fibers/oxides.										
214.6	6	5-9-15	0.30	0.15	qh=3.25 kg/cm2	7								18	
	7														
213.1		50/0.0	0.00		Marled olive brown and light gray, hard limestone; good rock quality, thin bedding.	8									
213.0		77	0.24			9									
212.8	8				Light brown w/ trace gray, medium to moderately hard, fine to medium grained sandstone; darker brown striations noted in sandstone; thick to massive bedding, fair to good rock quality. qu=96.6 kg/cm2										

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-10 Station & Offset Surface Elev. 220.2 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
210.7	10	73	2.74	0.30	-- fissile lenses noted in core run. qu=229.1kg/cm2	10									
209.7	11	66	1.62	0.11		11									
	12														
208.0	13				Bottom of boring @ 12.2 meters.										
	14														
	15														
	16														
	17														

Date Started 072999 Date Completed 072999 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RAW-10 Station & Offset _____ Surface Elev. 220.2 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ ROD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
		73	2.74	0.30		10									
210.7	10				-- fissile lenses noted in core run. qu=229.1 kg/cm2										
209.7	11	66	1.62	0.11		11									
	12														
208.0	13				Bottom of boring @ 12.2 meters.										
	14														
	15														
	16														
	17														

Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-1 Station & Offset _____ Surface Elev. 213.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
213.9		13-19-25-50/.2	0.43	0.09	Fill-mottled brown and gray silty clay w/ sand, gravel, and shale fragments; slightly moist.	1								8	
213.3	1	50/0.4	0.06	0.06		2								4	
212.8															
212.7	2	11-10-11-10	0.37	0.24	Probable fill-mottled red and gray silty clay w/ gray sandstone fragments; moist.	3	40	7	11		43	31	10	9	A-4a
211.4	3	21-31-17-17	0.34	0.27	Mottled red and gray w/ trace yellow silty clay w/ traces of oxides (CL); moist, hard. qh=3.5 kg/cm2	4	4	4	7	37	49			16	A-6a
210.2	4				Light brown w/ trace gray sandy silt and clay w/ traces of weathered sandstone fragments (ML, CL-ML); moist, very dense/ hard. qh=4.5 kg/cm2										
209.8	5	18-28-50/0.4	0.40	0.03		5								12	
208.4															
208.2	6	50/0.1	0.03	0.00	Soft to medium hard light brown, fine grained sandstone.	6									
207.2	7				Soft, dark gray weathered shale; laminated structure.										
206.7		38-50/0.2	0.21	0.34		7								9	
205.7	8				Soft to medium hard gray shale.										
205.2		50/0.3	0.09			8									

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Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-1 Station & Offset _____ Surface Elev. 213.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
213.9		13-19-25-50/.2	0.43	0.09	Fill-mottled brown and gray silty clay w/ sand, gravel, and shale fragments; slightly moist.	1								8	
213.3	1	50/0.4	0.06	0.06		2								4	
212.8					Probable fill-mottled red and gray silty clay w/ gray sandstone fragments; moist.										
212.7	2	11-10-11-10	0.37	0.24		3	40	7	11		43	31	10	9	A-4a
211.4	3	21-31-17-17	0.34	0.27	Mottled red and gray w/ trace yellow silty clay w/ traces of oxides (CL); moist, hard. qh=3.5 kg/cm2	4	4	4	7	37	49			16	A-6a
210.2	4				Light brown w/ trace gray sandy silt and clay w/ traces of weathered sandstone fragments (ML, CL-ML); moist, very dense/ hard.										
209.8	5	18-28-50/0.4	0.40	0.03	qh=4.5 kg/cm2	5								12	
208.4					Soft to medium hard light brown, fine grained sandstone.										
208.2	6	50/0.1	0.03	0.00		6									
207.2	7				Soft, dark gray weathered shale; laminated structure.										
206.7	8	38-50/0.2	0.21	0.34		7								9	
205.7					Soft to medium hard gray shale.										
205.2		50/0.3	0.09			8									

Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-1 Station & Offset _____ Surface Elev. 213.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10														
203.7		50/0.2	0.06	0.00	Bottom of boring @ 10.3 meters.	9									
203.6	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-2 Station & Offset _____ Surface Elev. 211.6 m Water Elev. 204.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.6		4-6-8-21	0.40	0.21	5 cm Topsoil--fill-light brown silty sand w/ sandstone fragments and gravel; slightly moist; cobbles/rock fragments at 1.5 m; gray shale fragments in sample #4.	1								9	
211.0	1	9-14-10-9	0.37	0.24	qh=3.25 kg/cm2	2								7	
210.4		25-12-10-9	0.00	0.61		3									
209.8	2	25-16-14-12	0.43	0.18	qh=3.25 kg/cm2, w.c.= 8%	4	23	13	10	20	34			17	A-6b
209.5					qh=4.5 kg/cm2										
209.2		50/0.3	0.09			5								10	
	3														
208.2					Fill-mottled red, brown and gray silty clay w/ sand and shale fragments; moist. Light orange-brown/beige at bottom of sample.										
207.5	4														
207.3		5-7-15	0.24	0.21	qh=1.5 kg/cm2	6	6	4	10		81	39	18	22	A-6b
207.0					qh=3.25 kg/cm2, w.c.= 17%										
	5				Brown silty clay w/ traces of oxides (CL); slightly moist, hard. Slightly laminated structure; orange-brown at bottom of sample.										
206.0		53-50/0.4	0.27		qh=4.5+ kg/cm2	7	4	6	17		73	40	17	15	A-6b
205.5	6				Very soft to soft, very weathered orange-brown to olive and gray arenaceous shale; laminated structure.										
	7														
204.4		35-50/0.2	0.18	0.03		8								13	
	8														
203.7					Very soft to soft red/maroon and gray, very weathered arenaceous shale.										
202.9		61-50/0.4	0.27			9								12	

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Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-2 Station & Offset Surface Elev. 211.6 m Water Elev. 204.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.6		4-6-8-21	0.40	0.21	5 cm Topsoil--fill-light brown silty sand w/ sandstone fragments and gravel; slightly moist; cobbles/rock fragments at 1.5 m; gray shale fragments in sample #4.	1								9	
211.0	1	9-14-10-9	0.37	0.24	qh=3.25 kg/cm2	2								7	
210.4		25-12-10-9	0.00	0.61		3									
209.8	2				qh=3.25 kg/cm2, w.c.= 8%										
209.5		25-16-14-12	0.43	0.18		4	23	13	10	20	34			17	A-6b
209.2		50/0.3	0.09		qh=4.5 kg/cm2	5								10	
	3														
208.2					Fill-mottled red, brown and gray silty clay w/ sand and shale fragments; moist. Light orange-brown/beige at bottom of sample.										
	4														
207.5															
207.3		5-7-15	0.24	0.21	qh=1.5 kg/cm2	6	6	4	10		81	39	18	22	A-6b
207.0	5				qh=3.25 kg/cm2, w.c.= 17%										
					Brown silty clay w/ traces of oxides (CL); slightly moist, hard. Slightly laminated structure; orange-brown at bottom of sample.										
206.0	6	53-50/0.4	0.27		qh=4.5+ kg/cm2	7	4	6	17		73	40	17	15	A-6b
205.5					Very soft to soft, very weathered orange-brown to olive and gray arenaceous shale; laminated structure.										
	7														
204.4		35-50/0.2	0.18	0.03		8								13	
	8														
203.7					Very soft to soft red/maroon and gray, very weathered arenaceous shale.										
202.9		61-50/0.4	0.27			9								12	

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-2 Station & Offset _____ Surface Elev. 211.6 m Water Elev. 204.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10														
201.4		75	0.30		Soft to medium hard gray arenaceous shale; good rock quality; medium to thickly bedded.	10									
201.1	11	78	1.46	0.06	Medium hard, gray arenaceous shale and siltstone/fine grained sandstone; good rock quality, medium to thickly bedded. qu=338.3 kg/cm2	11									
199.6	12				Bottom of boring @ 12.0 meters.										
	13														
	14														
	15														
	16														
	17														

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-2 Station & Offset Surface Elev. 211.6 m Water Elev. 204.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10														
201.4		75	0.30		Soft to medium hard gray arenaceous shale; good rock quality; medium to thickly bedded.	10									
201.1	11	78	1.46	0.06	Medium hard, gray arenaceous shale and siltstone/fine grained sandstone; good rock quality, medium to thickly bedded. qu=338.3 kg/cm2	11									
	12														
199.6					Bottom of boring @ 12.0 meters.										
	13														
	14														
	15														
	16														
	17														

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-3 Station & Offset Surface Elev. 209.6 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics: % Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
209.6		15-25-24-27	0.52	0.09	5 cm Topsoil--fill-mottled brown/light brown and gray to red silty clay w/ traces of brown sandstone and shale fragments; slightly moist to moist. qh=4.5+ kg/cm2	1								11	
209.0	1	13-50/0.4	0.21	0.06	qh=4.5+ kg/cm2	2								9	
208.4					qh=4.5+ kg/cm2, w.c.= 10%										
208.1		5-10-11-14	0.37	0.24	qh=3.75 kg/cm2	3	25	5	5		66	38	16	13	A-6b
207.8	2	8-8-9-12	0.37	0.24	qh=3.5 kg/cm2	4								16	
207.2		5-10-9-13	0.37	0.24	qh=2.5 kg/cm2	5								13	
	3														
206.0	4				Light brown and trace red silty clay w/ traces of oxides (CH); moist, very stiff. Slightly laminated structure.										
205.5		13-11-16	0.34	0.12	qh=2.5 kg/cm2, w.c.= 15%	6	5	9	3		83	55	25	28	A-7-5
205.4					qh=1.5 kg/cm2										
205.2	5				Mottled-orange-brown and red silty clay w/ traces of oxides (CL); moist, very stiff.										
204.1					Gray, silty clay (CL); slightly moist, hard. Slightly laminated, slickensided structure. [Very soft extrememly weathered shale]. qh=3.5 kg/cm2										
204.0	6	20-47-50/ 0.2	0.30	0.06		7	0	1	1	34	64			13	A-7-5
202.5	7	50/0.4	0.12	0.00	Red shale/hard silty clay (CL) seam noted in Sample #8	8									
200.9	8	50/0.3	0.03	0.06		9									

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FOUNDATION SOIL PROFILE
BORING LOGS

ATH-33-30.981

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Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-3 Station & Offset Surface Elev. 209.6 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
209.6		15-25-24-27	0.52	0.09	5 cm Topsoil--fill-mottled brown/light brown and gray to red silty clay w/ traces of brown sandstone and shale fragments;	1								11	
209.0	1	13-50/0.4	0.21	0.06	slightly moist to moist. qh=4.5+ kg/cm2	2								9	
					qh=4.5+ kg/cm2										
208.4															
208.1	2	5-10-11-14	0.37	0.24	qh=4.5+ kg/cm2, w.c.= 10%	3	25	5	5		66	38	16	13	A-6b
207.8					qh=3.75 kg/cm2										
	3	8-8-9-12	0.37	0.24	qh=3.5 kg/cm2	4								16	
207.2		5-10-9-13	0.37	0.24	qh=2.5 kg/cm2	5								13	
	4														
206.0					Light brown and trace red silty clay w/ traces of oxides (CH); moist, very stiff.										
205.5					Slightly laminated structure.										
205.4	5	13-11-16	0.34	0.12		6	5	9	3		83	55	25	28	A-7-5
205.2					qh=2.5 kg/cm2, w.c.= 15%										
					qh=1.5 kg/cm2										
					Mottled-orange-brown and red silty clay w/ traces of oxides (CL); moist, very stiff.										
204.1															
204.0	6	20-47-50/ 0.2	0.30	0.06	Gray, silty clay (CL); slightly moist, hard. Slightly laminated, slickensided structure. [Very soft extrememly weathered shale].	7	0	1	1	34	64			13	A-7-5
	7				qh=3.5 kg/cm2										
202.5		50/0.4	0.12	0.00	Red shale/hard silty clay (CL) seam noted in Sample #8	8									
	8														
200.9		50/0.3	0.03	0.06		9									

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-3 Station & Offset _____ Surface Elev. 209.6 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
200.2	10				Soft to medium hard arenaceous shale.										
199.4		50/0.1	0.03	0.00	Bottom of boring @ 10.2 meters.	10									
199.4	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-3 Station & Offset Surface Elev. 209.6 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
200.2	10				Soft to medium hard arenaceous shale.										
199.4	11	50/0.1	0.03	0.00	Bottom of boring @ 10.2 meters.	10									
	12														
	13														
	14														
	15														
	16														
	17														

Physical Characteristics

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-4 Station & Offset Surface Elev. 208.0 m Water Elev. 199.9 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
208.0															
	1	8-14-21-13	0.55	0.06	Fill-mottled brown/light brown and beige silty clay w/ sand and gravel/rock fragments. qh=2.75 kg/cm2	1	34	13	12	20	21			9	A-6a
207.4		11-19-50/ 0.3	0.27	0.12	qh=4.25 kg/cm2	2								9	
206.8		9-50/0.3	0.21	0.03		3								8	
206.5					Olive, extremely weathered soft shale.										
206.2	2	50/0.4	0.12	0.00	Red/maroon, extremely weathered soft shale.	4								9	
205.5		49-50/0.3	0.24	0.00		5								10	
205.2	3				Olive, soft weathered shale.										
204.0	4														
203.9		9-26-43	0.30	0.15	Gray, soft to very soft weathered shale.	6								16	
202.3	5														
202.2	6	50/0.5	0.12	0.03	Olive/olive gray soft to medium hard shale.	7								11	
200.8	7	50/0.1	0.03	0.00		8									
199.4	8	50/0.1	0.00	0.03	Bottom of boring @ 8.6 meters.	9									

Physical Characteristics

GANNETT FLEMING
SUITE 350
4151 EXECUTIVE PARKWAY
WESTERVILLE, OHIO 43081

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Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-4 Station & Offset Surface Elev. 208.0 m Water Elev. 199.9 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
208.0		8-14-21-13	0.55	0.06	Fill-mottled brown/light brown and beige silty clay w/ sand and gravel/rock fragments. qh=2.75 kg/cm2	1	34	13	12	20	21			9	A-6a
207.4	1	11-19-50/ 0.3	0.27	0.12	qh=4.25 kg/cm2	2								9	
206.8		9-50/0.3	0.21	0.03		3								8	
206.5					Olive, extremely weathered soft shale.										
206.2	2	50/0.4	0.12	0.00	Red/maroon, extremely weathered soft shale.	4								9	
205.5		49-50/0.3	0.24	0.00		5								10	
205.2	3				Olive, soft weathered shale.										
204.0	4														
203.9		9-26-43	0.30	0.15	Gray, soft to very soft weathered shale.	6								16	
	5														
202.3		50/0.5	0.12	0.03		7								11	
202.2	6				Olive/olive gray soft to medium hard shale.										
	7														
200.8		50/0.1	0.03	0.00		8									
	8														
199.4		50/0.1	0.00	0.03	Bottom of boring @ 8.6 meters.	9									
199.4															

Date Started 072199 Date Completed 072299 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-5 Station & Offset Surface Elev. 207.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
207.7		10-30-50/ 0.3	0.24	0.15	Fill-mottled light brown and olive silty clay w/ trace to little rock/sandstone and shale fragments, sand and wood. qh=2.75 kg/cm2	1								7	
207.1	1	9-8-9-11	0.52	0.09	qh=4.0 kg/cm2	2								13	
206.5					qh=2.0 kg/cm2										
206.2		3-4-4-5	0.30	0.30	Possible fill-brown w/ orange-brown silt and clay w/ little to some sand and oxides (ML,CL); moist, medium stiff to stiff. qh= 1.0 kg/cm2	3	7	3	33		56	31	12	21	A-6a
205.9	2				qh=1.5 kg/cm2										
205.6		3-4-3-9	0.46	0.15		4	2	7	40	26	25	25	5	18	A-4a
205.3					qh=2.5 kg/cm2										
205.0	3	4-6-7-11	0.43	0.18		5								19	
					Traces of sandstone fragments noted in sample #5. qh=1.0 kg/cm2										
204.1	4				Gray sandy clay w/ traces of sandstone fragments (CL); moist to very moist, stiff. qh=1.25 kg/cm2										
203.6		7-10-20-25	0.46	0.15	Dark gray silty clay w/ silt partings (CL); moist, very stiff to hard; mollusk shells noted in top part of sample. w.c.= 23% in top of sample.	6								18	
	5				qh=3.25 kg/cm2										
202.3					Olive gray and gray silty clay (CL); moist, hard [Extremely weathered shale].										
202.1	6	50/0.5	0.12	0.03		7								10	
	7														
200.6		50/0.2	0.06	0.00	Light gray to white, moderately hard to hard sandstone (calcareous) w/ seams of gray, soft to medium, arenaceous shale.	8									
200.6		66	0.15			9									
200.4	8	70	1.46	0.06		10									
198.9															

Date Started 072199 Date Completed 072299 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-5 Station & Offset Surface Elev. 207.7 m Water Elev.

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
					Bottom of boring @ 8.8 meters.										
	10														
	11														
	12														
	13														
	14														
	15														
	16														
	17														

GANNETT FLEMING
SUITE 350
4151 EXECUTIVE PARKWAY
WESTERVILLE, OHIO 43081

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1998 Year

Job. No. PID 18287 #17777 County ATHENS

Changes _____

Project Identification ATH-33-30.981

File No. DRS

CONSULTANT PROJECT

Begin Sta. 29+013 End Sta. 39+600

Name of Consultant Gannett Fleming

Name of Drilling Contractor Resource International

Contents of File Geotech Reports

Soil Profile Sheets and Structural Fdn. Sheets

Review Comments

Date of Report _____ No. of Tracings _____

Date Received _____ Filed with Year _____

Remarks Metric

FOUNDATION INVESTIGATION REPORT

T.R. 64 BRIDGE OVERPASS AT U.S. 33

for:

Ohio Department of Transportation, District 10

338 Muskingum Drive

Marietta, Ohio 45750-0658

GF Project No: 36151.250

January 2000

Gannett Fleming

Gannett Fleming

GANNETT FLEMING ENGINEERS
AND ARCHITECTS, P.C.
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January 19, 2000

Mr. George Collins, District Deputy Director
Ohio Department of Transportation, District 10
338 Mukingum Drive
Marietta, Ohio 45750-0658

Attn: Mr. Doug Briggs

Re: Foundation Investigation
ATH-33-30.981
T.R. 64 Overpass at U.S. 33
Athens, Ohio
G.F. No. 36151.250

Dear Mr. Briggs:

Here is a summary of our subsurface investigation for the aforementioned project. Based upon the present site plans, soil borings and an analysis of the encountered subsurface conditions, the following conclusions and recommendations have been developed.

- A deep foundation system consisting of driven piles can be installed in the embankment at the west abutment location. This should facilitate an "integral abutment" configuration. In order to establish the shortest bridge span, the embankment should be constructed utilizing imported granular fill to accommodate 2:1 grades. Based upon Boring TR-64-1, it appears as if the piles tips will bear on shale bedrock at about Elevation 278.9. During construction, a terminal driving resistance criteria should be established to determine axial load development and at which point the pile can be cut off. Given an HP 360 x 1.707 steel section and utilizing a steam hammer delivering 35,230 joules to the pile, a terminal driving resistance of 25 blows per 30 centimeters has been estimated for an allowable axial load of 400 kN.

- The western bridge pier can be designed to bear on a deep foundation system consisting of cast-in-place H-Pile elements. These elements should be placed in pre-drilled narrow diameter (500 mm) caissons excavated through the hard

residual soil to expose the sandstone. Based upon the soil boring drilled at this location, it appears as if the caisson excavations will extend to about Elevation 281. An allowable axial load of 450 kN is permissible for an appropriately constructed pile at this pier location. This was determined utilizing the soil parameters outlined in the following table.

Recommended PileDesign Parameters		
Depth/Stratum (meters)	Recommended Skin Friction (kPa)	Recommended Point Bearing (kPa)
0.0 to 0.8 Frost Depth/Fill	-	-
0.8 to 1.5 Light orange-brown and trace gray sandy silt with some clay	15.0	-
1.5 to 4.0 Light olive-brown and orange-brown silty clay	20.0	
4.0 to 5.5 Light olive-brown to beige silty clay [very weathered shale]	25.0	-
5.5 Light gray medium to moderately hard sandstone	-	3100.0

- The central and eastern bridge piers are presently located in areas where the mainline U.S. 33 roadway cuts are to be 2 to 5 meters deep. Based upon Borings TR-64-3 and TR-64-4, the final roadway subgrade elevations will be at the level where sandstone was encountered and cored. This material is suitable for the support of shallow spread foundations. It is recommended that these foundations be proportioned with a maximum gross allowable bearing pressure of 3100 kPa. It should be noted however, that the construction of these particular foundation elements will involve excavation through massive, moderately hard sandstone bedrock.

- The present plans indicate that the top of the east abutment will be located in a very slight (about 0.3 meters) cut below the existing T.R. 64 profile, near a cut/fill transition. At that location the naturally occurring soil is a red silty clay residual material derived from the Red Bed deposits prevalent across the region. Because these residual soils exhibit lower shear strengths and are notorious for slope stability problems, the design cut slope ratio in the overburden soil is 4:1. Presently, it is assumed that these slopes will be maintained in the immediate location of the proposed bridge, unless the natural materials are improved or replaced with compacted, engineered fill comprised of granular soil. When imported granular engineered fill soils are utilized in the immediate vicinity of the abutment location, the side slopes may be placed at 2:1 grades. Driven pile foundation elements bearing on the moderately hard sandstone bedrock are recommended for this location. As is the case with the west abutment

construction, a terminal driving resistance criteria should be established for construction purposes to determine axial load development and at which point the pile can be cut off. Given an HP 360 x 1.707 steel section and utilizing a steam hammer delivering 35,230 joules to the pile, a terminal driving resistance of 33 blows per 30 centimeters has been estimated for an allowable axial load of 500 kN. Based upon the subsurface information noted in Boring TR-64-5, it is estimated that a driven pile will extend to about Elevation 288.4.

- The abutments will have to act as relatively short retaining walls of approximately 1.0 to 1.5 meters in height, depending upon the depth of the bridge superstructure. If it is desired to minimize the span lengths, the east abutment may be placed in a location where the wall may effectively approach 3 to 3.5 meters in height. As a result, here will be lateral earth pressures generated against these abutments from the backfill supporting the approach slabs and road traffic. An active lateral pressure coefficient (K_a) of 0.33 should be utilized in conjunction with an estimated granular soil unit weight of 20.43 kN/m^3 (kilonewtons per cubic meter). If cohesive soil backfill is paced at the abutments, the K_a coefficient should be increased to 0.54. To help avert the build up of additional forces resulting from hydrostatic pressures, properly installed footing drains, backfilled with a free draining, open graded granular material, and/or weep holes should be incorporated into the abutment design. In addition, surface water infiltration should also be inhibited by compacting a layer of cohesive material (approximately 15 to 30 centimeters thick) above the granular backfill and by daylighting drains for the bridge superstructure away from the top of the abutment area.

The aforementioned recommendations are based upon proper construction and construction inspection to verify the subsurface conditions and assure the design is carried out in an appropriate manner. If there any questions concerning the content of this report, please contact this office.

Very truly yours,

GANNETT FLEMING ENGINEERS AND ARCHITECTS, P.C.

John R. Kenny, P.E.
Vice President
Manager, Ohio Office

Malcolm D. Hargraves, P.E.
Geotechnical Engineer

FOUNDATION INVESTIGATION REPORT
T.R. 64 BRIDGE OVERPASS at U.S. 33

Table of Contents

FOUNDATION INVESTIGATION REPORT
T.R. 64 BRIDGE OVERPASS at U.S. 33

1.0 INTRODUCTION AND SCOPE

1.1 Introduction

This structure foundation report presents the findings of the geotechnical investigation performed to characterize the subsurface conditions at the proposed site for the Township Route (T.R.) 64 overpass bridge at the new U.S. 33 highway, east of the T.R. 65 – T.R. 64 intersection in Alexander Township (Athens County), Ohio. This bridge overpass is part of the larger U.S. 33 Athens-Darwin project involving a new "Super-Two" highway corridor through southern Athens county and Meigs county in southeast Ohio. The purpose of this investigation was to determine the nature of the subsurface materials at the site, to assess their structural support capability, and to make recommendations relative to the design and construction of the structural foundations and earthwork for the project.

1.2 Scope

The scope of this investigation included a review of available geologic and soils data for the project area, a subsurface investigation consisting of five (5) soil test borings and associated rock coring, and an engineering analysis and evaluation of the subsurface conditions encountered at the site.

2.0 PROJECT CHARACTERISTCS

The proposed project is planned for the portion of T.R. 64, presently a two-lane, "tar-and-chip" paved roadway crossing the proposed U.S. 33 corridor just east of the T.R. 64 - T.R. 65 intersection in eastern Alexander Township. Current site plans and topographic information indicate that the existing alignment in the project area changes about 15 meters in elevation at a grade of approximately 14 percent. At the T.R. 64 - T.R. 65 intersection, the roadway is at approximately Elevation 289. The roadway dips as it approaches the proposed U.S. 33 main line corridor to a low point of about Elevation 285, then rises to about Elevation 302 at a point just east of the U.S. 33 corridor. It is suspected that the low point of the present T.R. 64 alignment could be located in an old drainage feature. Most of the natural slopes in the area are fairly mild, in the range of 5 horizontal to 1 vertical (5:1) or flatter. It is very likely that these mild slopes are due to the presence of the relatively low shear strength residual soils prevalent in the project area.

The proposed construction will involve erecting a bridge structure to carry T.R. 64 traffic over the new U.S. 33 and straightening the approach alignment of T.R. 64 in the vicinity of the new overpass structure. Presently the proposed bridge structure, as

depicted on the site plans, is a four-span structure about 80 to 85 meters in length, supporting travel lanes about 7.0 to 8.0 meters above the proposed U.S. 33 finished grades. The proposed roadway profile indicates that the western approach slab and bridge abutment will be supported on an embankment about 9.0 meters in height, while the eastern abutment and approach slab will be placed where the present ground surface will be subjected to a slight cut. The cut-fill scenario at the bridge location is due to the fact that the U.S. 33 mainline will require a relatively shallow fill of approximately 1.0 meter along the south-bound lanes and about a 5.0 meter cut on the north-bound lanes to establish the design grades.

3. 0 GEOLOGY and GENERALIZED SUBSURFACE CONDITIONS

3.1 Geology

The project lies in a region predominated by residual soils formed from Pennsylvanian aged sedimentary bedrock of the Marietta Plateau. Sandstone, siltstone, shale, clay shale/mudstone, along with occasional, deeper, thinly bedded coal seams of the Conemaugh and Monongahela formations dominate the bedrock profile along the proposed roadway corridor. In the immediate vicinity of the proposed bridge, there appears to be a mild expression of a very old, presently inactive drainage feature traversing the project site from northeast to southwest.

3.2 Subsurface Profile

Five (5) test borings were drilled for this investigation. The subsurface soil profile and groundwater conditions exposed in these borings are described in detail on the boring logs located in the appendix to this report. These boring logs indicate conditions at the particular locations and times the test bores were drilled. Some conditions, particularly groundwater levels, could change with time and periods of precipitation.

The soil borings encountered subsurface conditions along the proposed bridge alignment that varied from fill comprised of generally cohesive soils to residual soil materials. The residual materials were either silty clays derived from Red Bed (clay-shale, mudstone) deposits, very silty clay and silts derived from arenaceous shale and siltstone bedrock or silty sand derived from fine grained sandstone bedrock.

Borings TR-64-1 and TR-64-2, drilled near the base of the present slope, encountered fill and probable fill material to depths ranging from 0.6 meters to 2.1 meters below the present surface. The fill consisted of mottled brown/light brown to orange-brown silty clay to silt and sand with traces of oxide stains and gravel. Standard Penetration (N) values in this fill and probable fill varied widely from 5 to 34 blows per 30 centimeters (bpf), with the higher N-values occurring within about 1.0 meter of the surface. Below the fill soil, very moist, brownish gray silty clay with traces of wood and other organic material was encountered at Boring TR-64-1 and disclosed to a depth of about 3.7 meters. An N-value of 5 bpf was recorded in this soil, indicative of a soft subsurface condition. This material was not observed below the fill in Boring TR-64-2,

where medium dense (18 bpf), light orange-brown with trace gray sandy silt encountered and sampled to a depth of approximately 1.5 meters below the surface.

Very stiff to hard (24 to greater than 60 bpf), light olive brown and orange brown to orange-brown and trace gray silty clay to clayey silt became evident below about 1.5 to 4.0 meters deep in borings TR-64-1 and TR-64-2. These materials generally signified the top of the residual soil profile, and transitioned into the weathered arenaceous shale and siltstone bedrock, which became prominent below about 4.0 to 6.7 meters deep. Auger refusal occurred between 5.8 and 8.2 meters deep and a 1.8 meter rock core was obtained at boring TR-64-2. Light gray, medium, fine to medium grained sandstone was recovered from the coring activities and a Rock Quality Designation (RQD) of 53 percent, indicative of a fair rock quality, was measured in the sample.

The remaining borings, TR-64-3, TR-64-4, and TR-64-5, were drilled at successively higher points of elevation along the present roadway. Residual soil thicknesses in these borings ranged from about 0.3 meters at TR-64-3 to approximately 5.5 meters in TR-64-5, and were comprised of dissimilar materials. At Boring TR-64-3, the residual soil consisted of light brown silty sand with sandstone fragments. An N-value of greater than 50 bpf was recorded in this material, indicative of a very dense material. In Boring TR-64-4, medium stiff to stiff (10 bpf), light orange-brown with light gray silty clay was evident to about 1.2 meters deep. A transition to hard (greater than 50 bpf), light olive brown to olive silty clay was noted below the surficial soil and disclosed to the point of auger refusal. Boring TR-64-5 encountered residual soils derived from the Red Bed deposits consisting of red with trace orange-brown and trace gray silty clay to a depth of approximately 3.7 meters below the surface. The upper 0.8 meters of this material was in a soft (5 bpf) condition, while the remainder of this material exhibited a stiff to very stiff (14 to 29 bpf) consistency. These Red Bed residual soils were underlain by hard (greater than 50 bpf), light olive brown to beige silty clay.

Medium to moderately hard, light brown to beige, fine to medium grained sandstone with occasional striations was recovered in the rock core operations. RQD measurements of the core specimens ranged from 54 to 98 percent, denoting fair to excellent rock quality in the thickly to massively bedded sandstone formation.

3.3 Groundwater Conditions

Observations concerning groundwater were made during the drilling operations. Groundwater was noted in Boring TR-64-1 at 5.8 meters on the sampling tools as the boring was advanced and at 2.9 meters below the surface the next morning.

The observed groundwater level depends on normal variations in precipitation and surface runoff amounts. Fluctuations in groundwater can only be determined through observations made in bailed, cased holes, the construction of which was beyond the scope of this investigation.

4.0 FOUNDATION RECOMMENDATIONS

The following conclusions and recommendations have been developed based upon an analysis of the subsurface conditions encountered in this investigation and the present design details provided by ODOT. If there are changes to the current plans, the conclusions and recommendations outlined in this report should be reviewed by a representative of Gannett Fleming to determine if they need to be modified or if additional work is necessary.

4.1 Bridge Substructures

The soil borings and proposed grading plans indicate that the foundation structures will likely bear on three different materials, ranging from engineered fill to sandstone bedrock, based upon the particular substructure location and chosen method of construction. For this reason, the discussion of the foundation recommendations will be separated with respect to the subsurface conditions that particular substructure elements may have in common.

4.1.1 West Abutment – Shallow Spread Foundation

Present site plans and profiles for the T.R. 64 overpass show that the west approach to the bridge will require the construction of an embankment of up to 9.0 meters in height above the present T.R. 64 grade. It is presently planned to build this embankment out of the native materials available on the project site, a substantial portion of which are of somewhat marginal quality, necessitating the use of 3:1 slopes. In the event that imported, granular fill will be utilized for embankment construction, the fill slopes may be constructed with 2:1 finished grades. The embankment will be about 7.0 meters high at the proposed location of the abutment itself. As a result, the subsurface conditions must be evaluated for their suitability for earth structure and bridge substructure support.

Boring TR-64-1, drilled near the bottom of what appears to be a very old drainage feature, encountered approximately 2.1 meters of cohesive fill material comprised of silty clay, silt and sand. Although this fill was probably placed for the construction of the present T.R. 64, Gannett Fleming has not been presented with any compaction test records. For this reason, it is assumed that the fill was uncontrolled and is unsuitable for embankment and substructure support. This is because it is very likely that miscellaneous, uncontrolled fill has uncompacted or undercompacted lifts that can settle excessively and unpredictably.

Below this fill, very moist, soft, brownish gray silty clay with traces of wood and other organic material was observed and noted to about 4 meters below the surface. It is likely that this soft brownish gray, slightly organic soil is alluvium from the aforementioned drainage feature. Moisture contents in this material and deeper portions of the fill above it were on the order of 26 to 29 percent and a liquid limit (LL) of 28

percent was measured in material taken near this stratum. This scenario is usually an indication of a higher than desired stratum compressibility. As a consequence, this material is not deemed suitable for embankment and substructure support.

Suitable bearing material comprised of very stiff, orange-brown and trace gray silty clay was observed below about 4 meters deep. It is recommended that the existing fill and soft alluvium be undercut to expose this material before placing the new embankment fill. This will help minimize the likelihood of differential long-term settlement over the lifetime of the new embankment structure and help avoid unanticipated stresses in the proposed bridge due to added deflections at the abutment.

Once the properly constructed embankment fill is completed, the abutment may be constructed with either a shallow spread foundation or as a pile supported integral abutment. If a shallow spread foundation is the chosen option, the footing may be proportioned utilizing a bearing pressure of 96 kilopascals (kPa), assuming the footing is placed at the crest of the slope, allowing for frost depth (0.8 m). Recommended practice is to set the footing back from the edge of the slope at least 1.5 to 2.0 meters. If the footing is moved about 4.5 to 5.0 meters from the edge of the slope (roughly twice the width of the footing, assuming a width of about 2.5 meters) so that the slope effects are minimized, the allowable bearing pressure may be increased to 190 kPa. Moving the abutment away from the slope would increase the span lengths while the lower bearing pressures would increase the abutment footprint. Settlements associated with this option should be less than about 20 millimeters.

4.1.2 West Abutment – Driven Piles (Integral Abutment)

As an alternative to the shallow foundation, driven piles can be installed in the embankment. Utilizing this foundation type will help minimize the effect of the slope by transferring the structural loads to a deeper elevation. In addition, this facilitates shorter span lengths because the amount of set back necessary at the embankment crest can be reduced. Based upon Boring TR-64-1, it appears as if the piles tips will bear on shale bedrock at about Elevation 278.9. During construction, a terminal driving resistance criteria should be established to determine axial load development and at which point the pile can be cut off. Given an HP 360 x 1.707 steel section and utilizing a steam hammer delivering 35,230 joules to the pile, a terminal driving resistance of 25 blows per 30 centimeters has been estimated for an allowable axial load of 400 kN. This was determined utilizing the Engineering News pile driving formula.

4.1.3 Western Bridge Pier

Boring TR-64-2 encountered probable fill material similar to that noted in Boring TR-64-1 to a depth of about 0.6 meters below the surface, underlain by medium dense sandy silt to approximately 1.5 meters deep. Below the sandy silt material, a hard, light olive-brown and orange-brown silty clay was observed and sampled. This material exhibited a laminated structure characteristic of residual soils derived from fine grained sedimentary deposits. Sandstone bedrock was sampled at about 5.5 meters below the present surface grades. It is recommended that this material be utilized for structural

support. A deep foundation system consisting of H-Pile elements may be used at this location to carry the structural loads. These elements should be placed in pre-drilled narrow diameter (500 mm) caissons excavated through the hard residual soil to expose the sandstone. Based upon the soil boring drilled at this location, it appears as if the caisson excavations will extend to about Elevation 281. An allowable axial load of 450 kN is permissible for an appropriately constructed pile at this pier location. This was determined utilizing the soil parameters outlined in the following table.

Recommended PileDesign Parameters		
Depth/Stratum (meters)	Recommended Skin Friction (kPa)	Recommended Point Bearing (kPa)
0.0 to 0.8 Frost Depth/Fill	-	-
0.8 to 1.5 Light orange-brown and trace gray sandy silt with some clay	15.0	-
1.5 to 4.0 Light olive-brown and orange-brown silty clay	20.0	
4.0 to 5.5 Light olive-brown to beige silty clay [very weathered shale]	25.0	-
5.5 Light gray medium to moderately hard sandstone	-	3100.0

4.1.4 Central and Eastern Bridge Piers

The central and eastern bridge piers are presently located in areas where the mainline U.S. 33 roadway cuts are to be 2 to 5 meters deep. Based upon Borings TR-64-3 and TR-64-4, the final roadway subgrade elevations will be at the level where sandstone was encountered and cored. This material is suitable for the support of shallow spread foundations. It is recommended that these foundations be proportioned with a maximum gross allowable bearing pressure of 3100 kPa. It should be noted however, that the construction of these particular foundation elements will involve excavation through massive, moderately hard sandstone bedrock.

4.1.5 East Abutment (Integral Abutment)

The present plans indicate that the top of the east abutment will be located in a very slight (about 0.3 meters) cut below the existing T.R. 64 profile, near a cut/fill transition. This places the proposed bridge abutment about 6 to 7 meters above the U.S. 33 north bound lanes. At that point, the new T.R. 64 roadway subgrade will require approximately 1.5 meters of fill to achieve the planned profile elevation. Boring TR-64-5

encountered about 3.7 meters of red with trace orange-brown, to red with trace gray silty clay below the existing pavement and subgrade fill. Hard, light olive-brown to beige silty clay was encountered below the red silty clay soil to a depth of about 5.5 meters, at which point medium to moderately hard sandstone bedrock was observed.

The red silty clay soil is the residual material derived from the Red Bed deposits prevalent across the region. Because these residual soils exhibit lower shear strengths and are notorious for slope stability problems, the design cut slope ratio in the overburden soil is 4:1. Presently, it is assumed that these slopes will be maintained in the immediate location of the proposed bridge, unless the natural materials are improved or replaced with compacted, engineered fill comprised of granular soil. When granular engineered fill soils are utilized in the immediate vicinity of the abutment location, the side slopes may be placed at 2:1 grades, which should shorten the bridge span. If the abutment is to remain in the location as currently shown on the plans, it will be constructed on the face of the cut slope and will have to retain about 2.5 to 3 meters of soil and backfill required to achieve the T.R. 64 grades. If it is desired to place the abutment at the crest of the cut slope, the bridge span will have to be lengthened.

Driven pile foundation elements bearing on the moderately hard sandstone bedrock are recommended for this location, particularly if the abutment is to remain in its presently proposed location. As is the case with the west abutment construction, a terminal driving resistance criteria should be established for construction purposes to determine axial load development and at which point the pile can be cut off. Given an HP 360 x 1.707 steel section and utilizing a steam hammer delivering 35,230 joules to the pile, a terminal driving resistance of 33 blows per 30 centimeters has been estimated for an allowable axial load of 500 kN. Based upon the subsurface information noted in Boring TR-64-5, it is estimated that a driven pile will extend to about Elevation 288.4

4.2 Lateral Loads

The abutments will have to act as relatively short retaining walls of approximately 1.0 to 1.5 meters in height, depending upon the depth of the bridge superstructure. This assumes that the abutments are placed at the crest of the slopes. If it is desired to minimize the span lengths, the east abutment may be placed in a location where the wall will effectively be about 3 to 3.5 meters in height. As a result, there will be lateral earth pressures generated against these abutments from the backfill supporting the approach slabs and road traffic.

When designing for the lateral earth pressure loads, the engineer may assume that the top of the proposed abutment can translate sufficiently to allow "active" pressure development, particularly if integral abutments that must accommodate temperature movements are utilized. An active lateral pressure coefficient (K_a) of 0.33 should be utilized in conjunction with an estimated granular soil unit weight of 20.43 kN/m^3 (kilonewtons per cubic meter). If cohesive soil backfill is paced at the abutments, the K_a coefficient should be increased to 0.54. To help avert the build up of additional forces resulting from hydrostatic pressures, properly installed footing drains, backfilled with a free draining, open graded granular material, and/or weep holes should be incorporated

into the abutment design. In addition, surface water infiltration should also be inhibited by compacting a layer of cohesive material (approximately 15 to 30 centimeters thick) above the granular backfill and by daylighting drains for the bridge superstructure away from the top of the abutment area.

4.3 General Foundation Comments

All structural footings should be placed at a minimum depth of 1.2 meters or greater below the finished grades for frost protection and to satisfy ODOT requirements. If any soft, wet, organic or loose soil, or any old fill is encountered, the excavations should be extended downward so that the footings rest on competent soils.

All foundation bearing surfaces should be protected against freezing, the surface water and undue disturbance as the bearing soils will tend to soften or loosen and increase settlements in such cases. If at all possible, the footing concrete should be placed the same day that the excavation takes place. If this is not feasible, proper protection of the footing excavations should be provided. All footing excavations should be inspected to assure that adequate bearing is achieved before placing concrete for the foundations.

The cast-in-place pile excavations should be inspected to confirm the assumed subsurface conditions before placing concrete for the piles. The concrete for the piles should be placed immediately after the drilling and inspection takes place. Inspection of the piles should include recording the top and bottom elevations and a visual examination for plumbness, alignment and diameter.

Although it is not believed that the groundwater table will pose a problem, it is recommended that steel casing be available if groundwater seeps become evident. This will also help retain any of the material that may loosen during pier excavation. It is recommended that the concrete for the piers have a design slump of at least 15 centimeters in order to avoid arching of the concrete upon withdrawal of the temporary casing (if utilized). Furthermore, a positive head of concrete should be maintained above any groundwater (if encountered) during the withdrawal of the casing. These measures will preclude contamination of the pile concrete by groundwater and soil and safeguard the integrity of the cast-in-place piles.

5.0 EARTHWORK RECOMMENDATIONS

5.1 Site Preparation

All vegetation, topsoil, and other organic material or miscellaneous fill and debris should be removed from the construction areas prior to building or placing any fill on the site. After the completion of stripping operations, the exposed subgrade areas should be proofrolled with suitable heavy equipment, preferably a 180 to 270 kN loaded dump truck. Any soft yielding areas delineated by the proofrolling should be further undercut to firm soil. In the area where the west approach embankment is to be constructed, the stripping activities will involve an undercut of existing fill and soft alluvium to a depth of about 4.0 meters to expose firm material upon which the new embankment fill is to be placed.

This is necessary in order to minimize the possible settlements associated with the existing, potentially compressible materials and utilize the embankment as a structural support element for sustained abutment loads.

5.2 Excavation

Based upon the boring logs and the proposed grading plans, excavation for the west abutment (necessary undercutting), the west pier, and the east abutment should not be very difficult. The main issues at these locations will most likely be the need for temporary excavation bracing where the undercutting is deep or sufficient room to lay back the excavations is unavailable.

Difficulties can be expected in the areas of the central and eastern bridge piers, where fairly massive, moderately hard sandstone will have to be excavated to establish the U.S. 33 north bound lanes and the bearing elevations for the pier foundations. This sandstone appeared to be 1 to 2.5 meters in thickness above the bearing elevation in the pier foundation locations. The use of low power explosives may be necessary to attain the rough main line subgrade elevations and pneumatic tools, such as jack hammers, may be needed to excavate the bedrock in the structural foundations.

All temporary excavations for the installation of foundations, utilities, etc., should be properly laid back or braced in accordance with Occupational Safety and Health Administration (OSHA) requirements. In addition, existing underground utilities should be protected or rerouted as necessary in the proposed construction areas.

It is believed that the groundwater table at this site exists at a depth that should not present construction difficulties for a project of this type, particularly if construction is carried out during the dryer seasons of the year. Most of the water that may be encountered in shallow excavations at this site should be adequately controlled by conventional methods, such as positive gravity and/or pumping from sumps.

5.3 Embankment Fills

The embankment fill for the west abutment approach is to be placed at a 3:1 slope if it is to be constructed from the native soils of the area. A 2:1 slope is permissible if imported granular fill is used for the embankment construction. Material undercut from the existing roadway subgrade may be reused if it is sufficiently dried and free of deleterious materials (organics). Regardless of what material is utilized for embankment construction, any presently existing fill and soft alluvial soils must be undercut to expose suitable bearing material as outlined in Section 4.1.1 of this report before the embankment is constructed. It is recommended that the fill embankments be constructed in conjunction with the guidelines established in the Ohio Department of Transportation Construction and Material Specifications for embankment construction.

All fill should be placed in lifts of uniform thickness. For proper and timely construction of the fill, the soils should be placed at or near (within approximately 2 to 3 percent) the optimum moisture content as determined by the specified laboratory tests. Suitable equipment for either aerating or adding water should be available as the soil moisture and weather conditions dictate.

When placing soil backfill material immediately adjacent to any retaining walls, the compaction effort should be limited to that which is required to achieve 95 percent of the maximum Standard Proctor dry density. This measure should reduce the likelihood of excessive lateral earth pressures resulting from construction activities.

APPENDIX A
Boring Location Plan
Soil Boring Logs
Soil Profile

Date Started 071699 Date Completed 071699 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-1 Station & Offset _____ Surface Elev. 286.1 m Water Elev. 280.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
286.1		4-5-7-7	0.30	0.30	9 cm Topsoil--fill-mottled brown/light brown to beige silty clay w/ traces of oxides and sand; moist. qh= 4.5+ kg/cm2	1								16	
285.4	1	6-9-11-14	0.40	0.21	qh=4.25 kg/cm2	2								17	
284.8															A-4b
284.5		3-3-3-3	0.40	0.21	Fill: orange-brown silt and sand w/ traces of oxides; moist. qh=1.5 kg/cm2, w.c.= 17%	3	0	1	10	56	33	28	7	26	
284.2	2				qh=1.0 kg/cm2										A-4a
283.9		2-2-3-2	0.40	0.21	qh=0.5 kg/cm2	4	3	4	13	45	35			29	
283.6	3	shelby tube	0.61		Brownish gray silty clay w/ traces of wood and organic material (CL, OL); very moist, soft.	5									
	4														
282.1															
281.9		7-10-14	0.46		Orange-brown and trace gray silty clay w/ traces of fine sand (CL); moist, very stiff.	6								16	
281.2	5				qh=4.5 kg/cm2										
					Light brown w/ trace gray very silty clay/ clayey silt w/ weathered siltstone/ sandstone fragments (CL,ML); moist to very moist, hard.										
280.4	6	17-27-50/ 0.4	0.43		qh=2.75 kg/cm2	7								16	
	7														
279.3					Soft, gray to olive gray silty clay (CL) and shale.										
278.9		21-50/0.4	0.24	0.03	qh=4.5+ kg/cm2	8								12	
	8														
277.8		50/0.1	0.00	0.03	Bottom of boring @ 8.3 meters.	9									
277.8															

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-2 Station & Offset _____ Surface Elev. 287.1 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
287.1		6-17-17-20	0.15	0.46	Probable fill-mottled brown and orange brown silty clay w/ little to some sand, traces of oxides and gravel; slightly moist. qh=4.5+ kg/cm2	1								12	
286.5	1	12-11-7-7	0.37	0.24	Light orange brown w/ trace gray sandy silt (ML); slightly moist to moist medium dense. qh=1.5 kg/cm2	2	9	7	36	20	27			13	A-4a
285.9															
285.6		5-5-21-31	0.37	0.24		3	8	4	33	38	17			11	A-4a
285.3	2				Light olive brown and orange brown silty clay (CL); slightly moist, hard; laminated structure; olive brown in sample #5.										
		7-30-40-38	0.37	0.24		4	17	7	6	41	29			11	A-6a
284.7	3	14-28-40-36	0.61		qh=4.5+ kg/cm2	5								13	
	4														
283.1															
283.0		17-39-50/ 0.3	0.34	0.06	Olive to gray silty clay (CL); slightly moist, hard; [Extremely weathered shale]. qh=4.5+ kg/cm2	6								15	
	5														
281.6															
281.5		50/0.3	0.09		Light gray, medium hard sandstone (fragments).	7									
281.3	6														
	7	53	1.68	0.15	Light gray to gray, medium to moderately hard sandstone; fair rock quality, thickly bedded. qu=518.0 kg/ cm2	8									
279.5	8				Bottom of boring @ 7.6 meters.										

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-3 Station & Offset _____ Surface Elev. 288.7 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
288.7					5 cm Pavement										
288.4		4-12-50/0.3	0.30	0.09	Light brown silty sand w/ sandstone fragments (SM); slightly moist to moist, dense; [weathered fine grained sandstone.	1	0	0	0	0	0	0	0	0	0
287.8	1	75/0.4	0.09	0.03	Sandstone fragments below 0.9 m.	2	0	0	0	0	0	0	0	0	0
287.2	2	75	2.59	0.46	Light brown fine to medium grained, medium to moderately hard sandstone; fair to good rock quality, thick to massive bedding. qu=86.0 kg/cm2	3									
	3														
	4														
284.1	5				Bottom of boring @ 4.6 meters.										
	6														
	7														
	8														

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-4 Station & Offset _____ Surface Elev. 291.4 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
291.4					5 cm Pavement (tar and chip)										
291.1		4-4-6-7	0.43	0.18	Light orange-brown w/ light gray silty clay w/ traces of oxides (CL); moist, medium stiff to stiff. qh=2.25 kg/cm2	1								19	
290.5	1														
290.2		11-20-50/ 0.5	0.37	0.09	qh=4.5+ kg/cm2	2								10	
289.9		20-50/0.3	0.21	0.03	Light olive brown to olive silty clay (CL); slightly moist, hard.	3								7	
	2														
289.3		50/0.4	0.09	0.03		4									
289.0					Medium to moderately hard light brown sandstone fragments; auger refusal at 2.7 m.										
288.7	3														
	4	54	1.80	0.03	Medium to moderately hard light brown sandstone; fair rock quality, thick to massive bedding. Darker brown striations noted in core sample.	5									
286.8	5				qu=119.2 kg/cm2										
	6	61	2.13			6									
284.7	7				Bottom of boring @ 6.7 meters.										
	8														

Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-5 Station & Offset _____ Surface Elev. 293.8 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
293.8					5 cm Pavement--(tar and chip); fill-mottled										
293.5					brown silty clay w/ sand.										
		4-2-3-5	0.30	0.30	Red w/ trace orange-brown and gray silty	1								31	
293.1	1				clay w/ trace oxides (CL); moist, soft.										
292.9					qh=1.25 kg/cm2										A-7-6
		8-6-11-14	0.34	0.27	Red w/ trace gray silty clay (CL); moist,	2	0	1	2	30	66			28	
292.3					hard.										A-7-6
	2	6-6-8-10	0.43	0.18	qh=3.75 kg/cm2	3	0	1	8		91	42	15	27	
291.7					qh=2.25 kg/cm2										
		6-10-14-16	0.46	0.15	qh=2.5 kg/cm2	4								26	
291.1	3														
		5-9-14-15	0.40	0.21	qh=2.75 kg/cm2	5								23	
290.5															
290.2		shelby tube	0.37	0.24		6									
	4														
289.7					Light olive brown to beige silty clay (CL);										
		18-35-50/ 0.3	0.37	0.03	moist, hard.	7								12	
	5														
288.4															
288.2		50/0.4	0.09	0.03	Light brown to beige, medium to moderately	8									
288.1	6				hard, fine to medium grained sandstone w/										
					dark brown striations/laminations; good to										
		75	1.83		excellent rock quality; massivley bedded	9									
	7				qu=151.2 kg/cm2										
286.3															
	8														
		98	1.58			10									

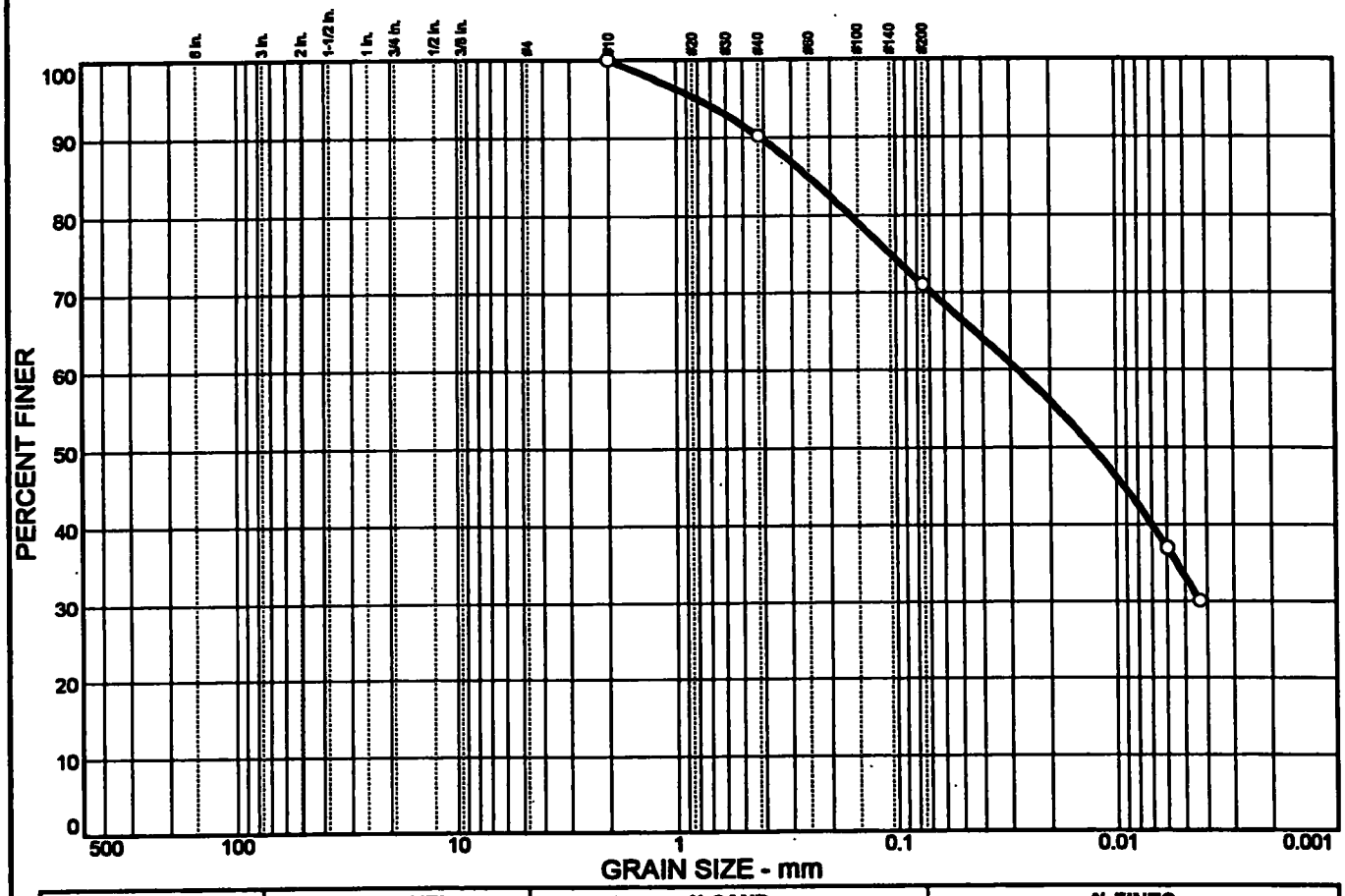
Date Started 071599 Date Completed 071599 Sampler: Type Split Spoon Dia. 5 cm

Boring No. TR 64-5 Station & Offset _____ Surface Elev. 293.8 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
284.7					Bottom of boring @ 9.2 meters.										
	10														
	11														
	12														
	13														
	14														
	15														
	16														
	17														

APPENDIX B
Laboratory Test Data

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	9.8	19.2	37.7	33.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	90.2		
#200	71.0		

* (no specification provided)

Soil Description

Lean clay with sand

Atterberg Limits

PL= 17 LL= 33 PI= 16

Coefficients

D_{85}= 0.252 D_{60}= 0.0278 D_{50}= 0.0128
D_{30}= 0.0043 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-6(9)

Remarks

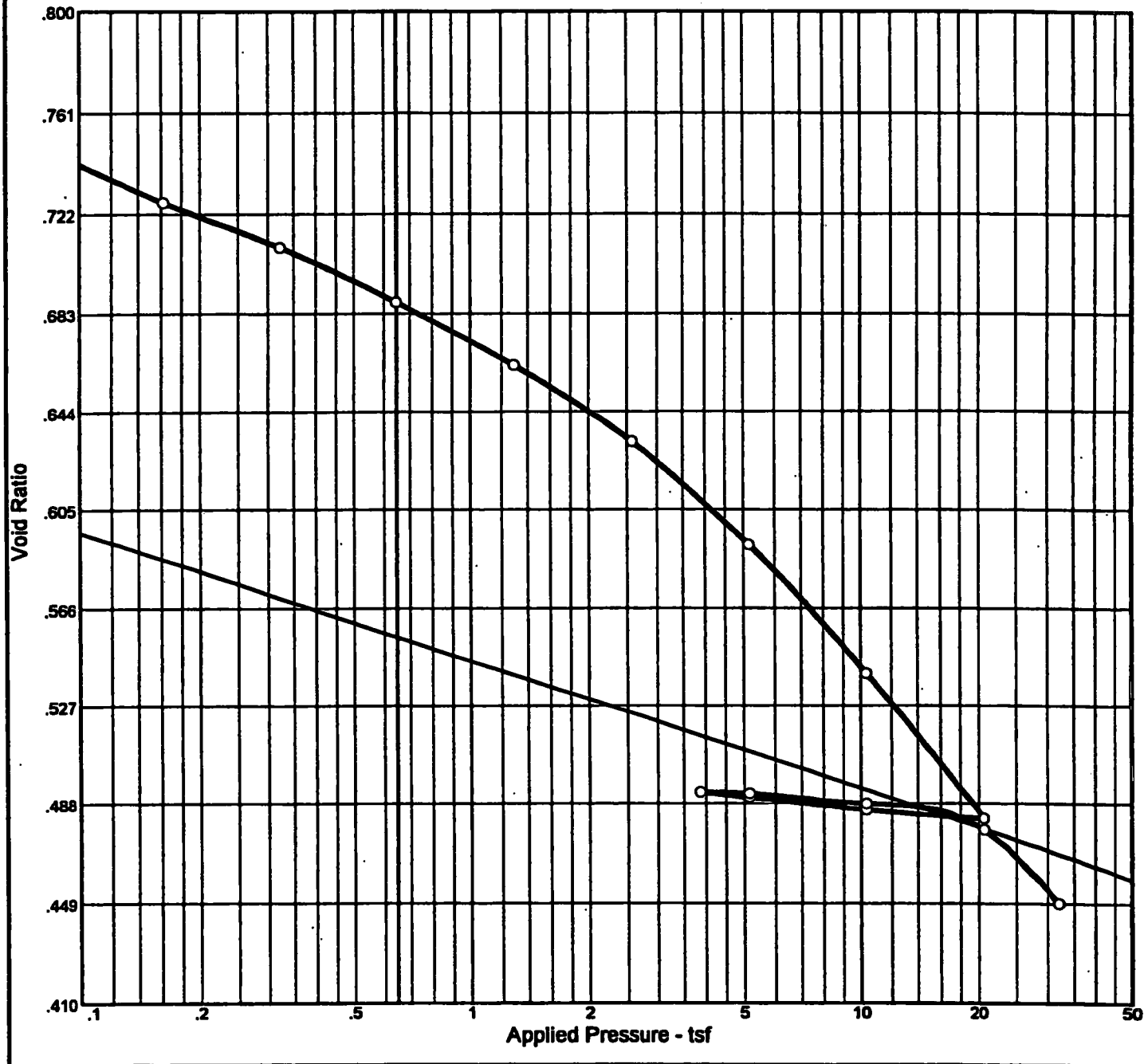
moisture content= 24.7%

Sample No.: TR64-1 **Source of Sample:** **Date:** 12/3/99
Location: **Elev./Depth:** 8.0'-10.0'

DODSON-STILSON, INC.

Client: Prime Engineering
Project: Athens Rte. 33 Bypass
Project No: 9921-3168.00 **Plate**

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	USCS	AASHTO	Initial Void Ratio
Saturation	Moisture							
91.1 %	24.7 %	98.2	33	16	2.74	CL	A-6(9)	0.741

MATERIAL DESCRIPTION

Lean clay with sand

Project No. 99213168.00 **Client:** Prime Engineering

Project: Athens Rte. 33 Bypass

Location: press tube

Remarks:
TR 64-1

CONSOLIDATION TEST REPORT

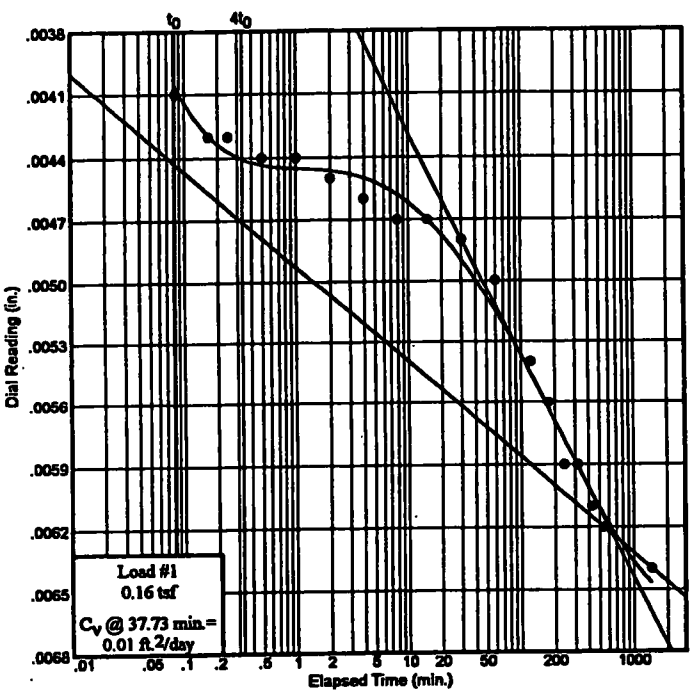
DODSON-STILSON, INC.

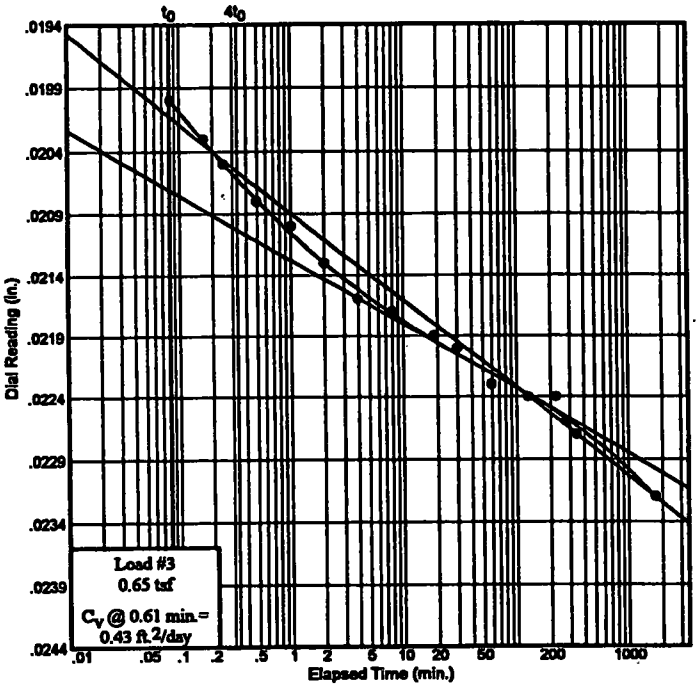
Plate

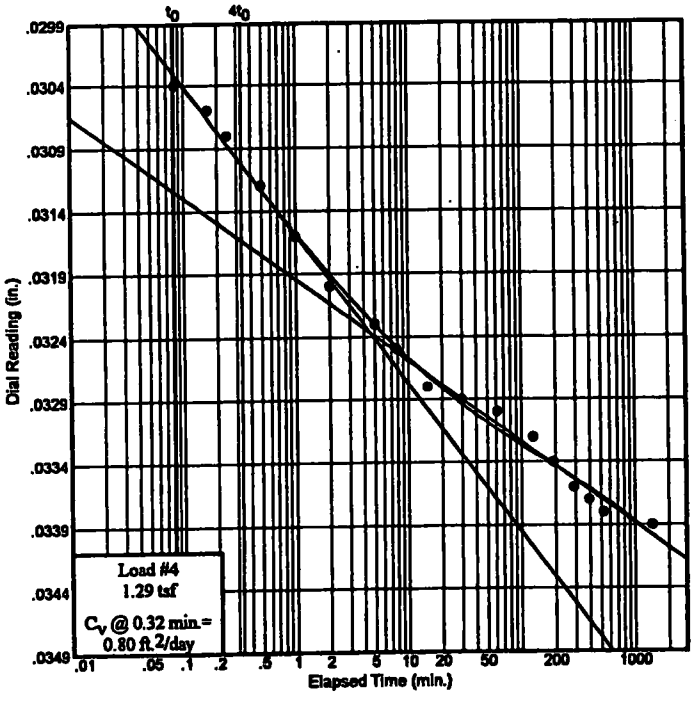
Dial Reading vs. Time

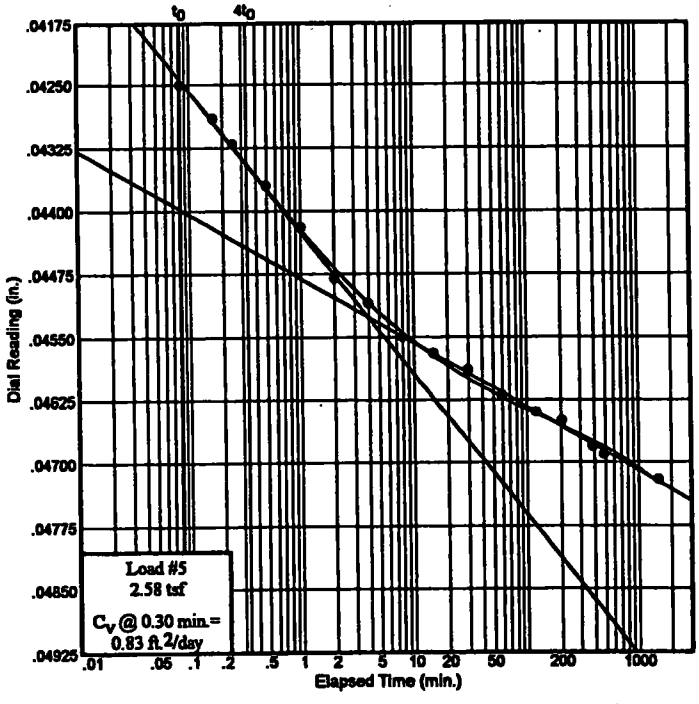
Project No.: 99213168.00
Project: Athens Rte. 33 Bypass

Location: press tube









Dial Reading vs. Time

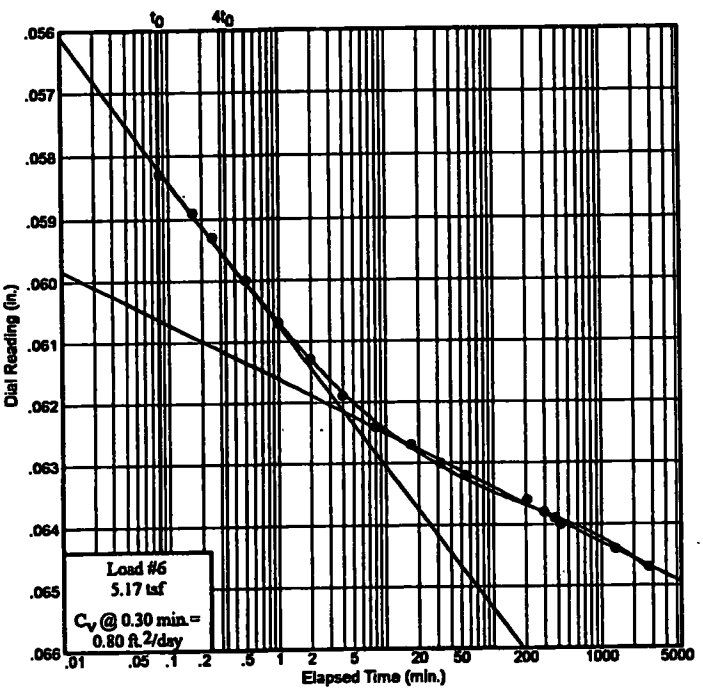
DODSON-STILSON, INC.

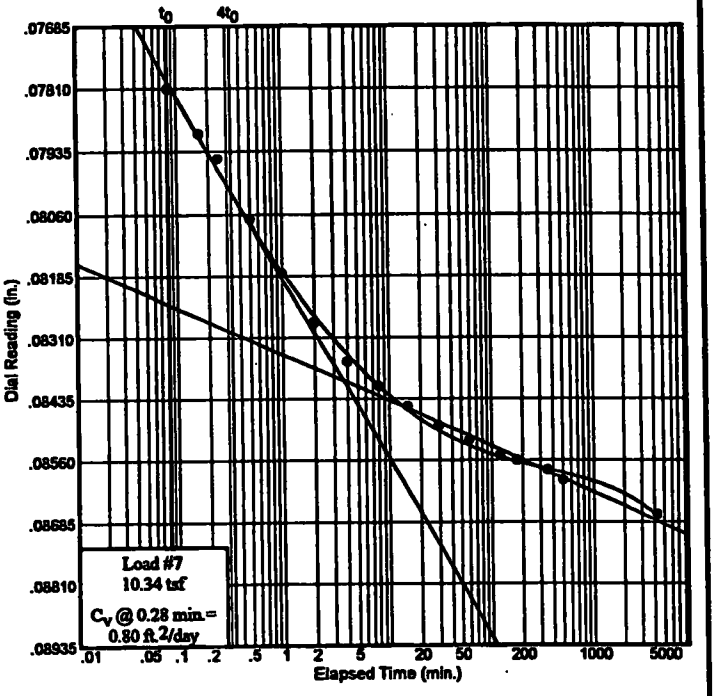
Plate

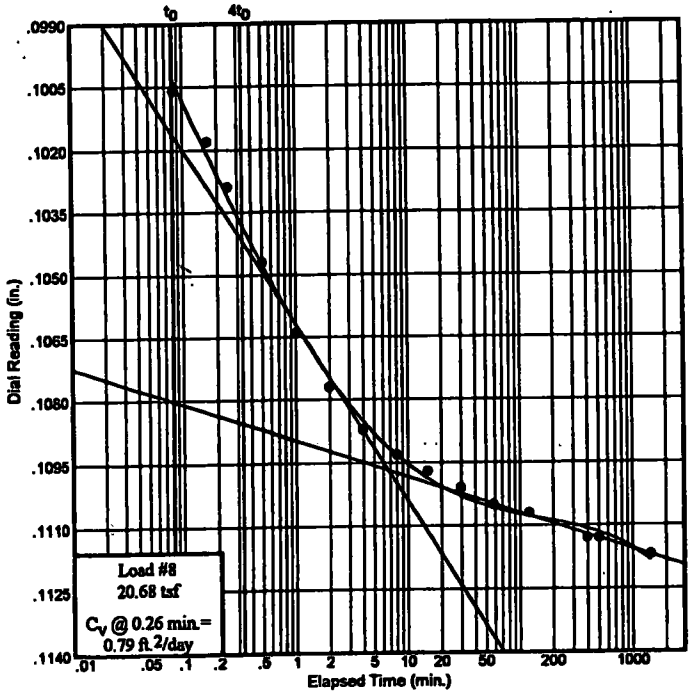
Dial Reading vs. Time

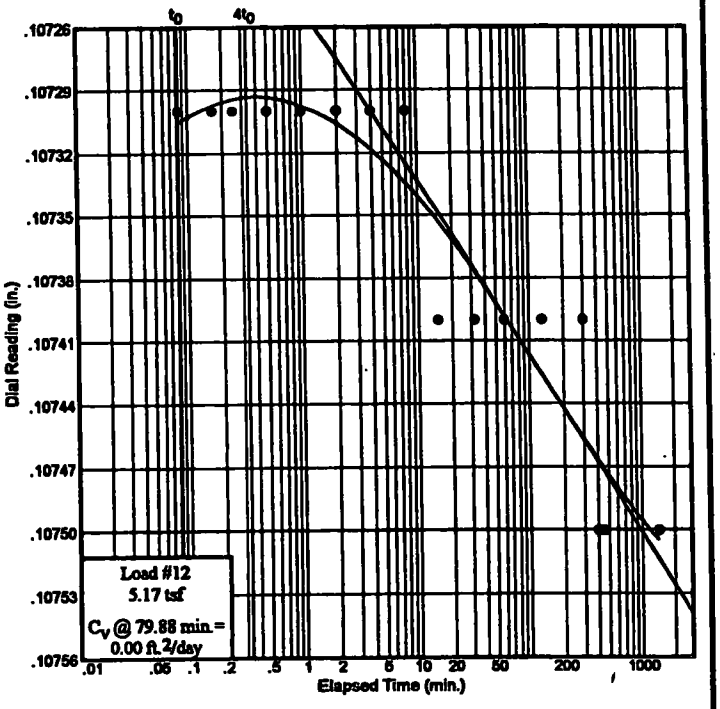
Project No.: 99213168.00
Project: Athens Rte. 33 Bypass

Location: press tube









Dial Reading vs. Time

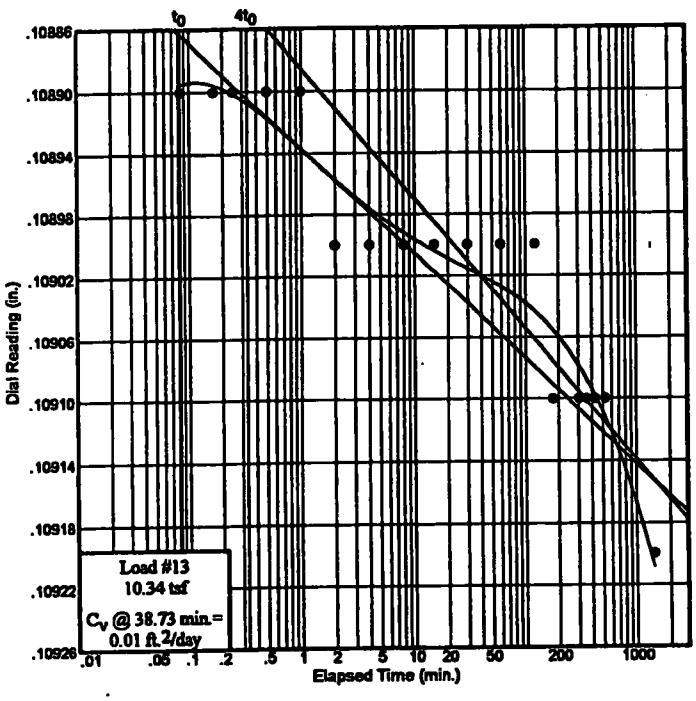
DODSON-STILSON, INC.

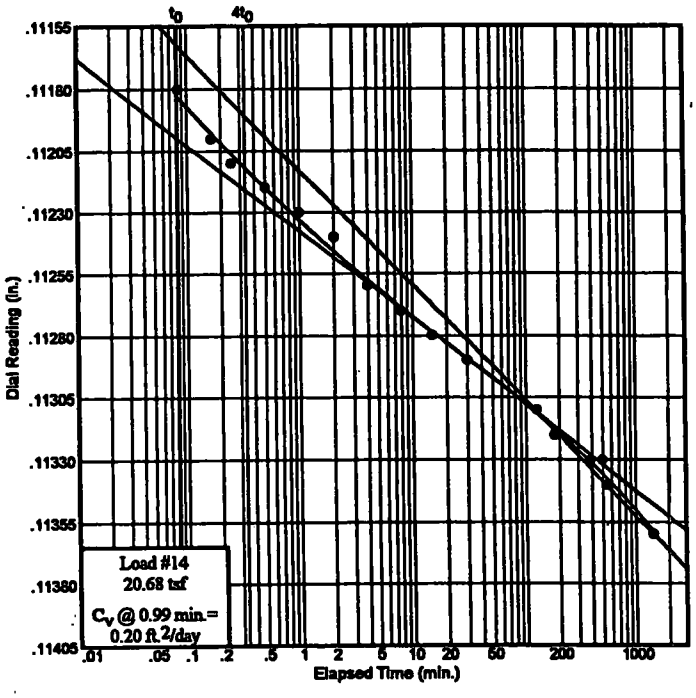
Plate

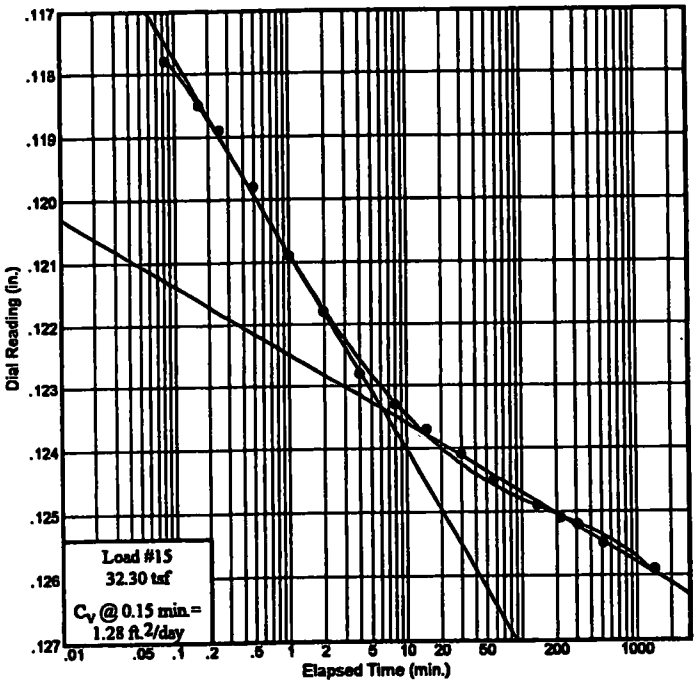
Dial Reading vs. Time

Project No.: 99213168.00
Project: Athens Rte. 33 Bypass

Location: press tube







Dial Reading vs. Time

DODSON-STILSON, INC.

Plate

APPENDIX C
Foundation Summary Table

FOUNDATION SUMMARY TABLE

SUMMARY OF T.R. 64 FOUNDATION DESIGN RECOMMENDATIONS

Substructure Unit	Proposed Bottom of Footing Elevation	Bearing Stratum	Applicable Core Borings	Average % Core Recovery	Average % RQD	Allowable Foundation Pressure	Pile Type Size	Pile Tip Reinforcement	Allowable Axial Pile Load Per Pile	Driving Method	Estimated Pile Tip Elevation	Estimated Footing Width, B	Coefficient of Friction
West Abutment Sta. 49+169.0 #	291.5	Weathered Gray Shale	TR 64-1	N/A	N/A	N/A	HP 310 x 1.079	N/A	400 kN	refusal or terminal set *	278.9	N/A	N/A
West Pier Sta. 49+191.4	286.3	Sandstone	TR 64-2	92	53	N/A	HP 310 x 1.079	N/A	500 kN	pre-drill to depth	280.8	N/A	N/A
Central Pier Sta. 49+218.2	286.1	Sandstone	TR 64-3	85	75	3100 kPa	N/A	N/A	N/A	N/A	N/A	3.0 m	0.7
East Pier Sta. 49+243.8	286.6	Sandstone	TR 64-4	99	58	3100 kPa	N/A	N/A	N/A	N/A	N/A	3.0 m	0.7
East Abutment Sta. 49+266.4	293.4	Sandstone	TR 64-5	100	87	N/A	HP 310 x 1.079	N/A	500 kN	refusal	288.4	N/A	N/A

* Terminal Driving Resistance at West Abutment based upon the use of a steam hammer delivering 35,230 joules of input energy to the pile is 25 blows per 30 centimeters.

@ Abutments are to be constructed above imported granular fill embankments/improved slopes constructed with 2:1 grades. Otherwise the slopes at the east and west abutments are 4:1 and 3:1, respectively.

All station locations are for preliminary purposes only.

FOUNDATION INVESTIGATION REPORT

RAMP B RETAINING WALL AT U.S. 33 AND ALBANY ROAD

for:

Ohio Department of Transportation, District 10

338 Muskingum Drive

Marietta, Ohio 45750-0658

GF Project No: 36151.230

January 2000

Gannett Fleming

Gannett Fleming

GANNETT FLEMING ENGINEERS
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www.gannettfleming.com

January 11, 2000

Mr. George Collins, District Deputy Director
Ohio Department of Transportation, District 10
338 Mukingum Drive
Marietta, Ohio 45750-0658

Attn: Mr. Doug Briggs

Re: Foundation Investigation
ATH-33-30.981
Ramp B Retaining Wall at U.S. 33 and Albany Road
Athens, Ohio
G.F. No. 36151.230

Dear Mr. Briggs:

Here is a summary of our subsurface investigation for the aforementioned project. Based upon the present site plans, soil borings and an analysis of the encountered subsurface conditions, the following conclusions and recommendations have been developed.

- A traditional reinforced concrete retaining wall is to be supported on foundation elements extending through the existing entrance ramp fill to the hard residual soil and soft weathered bedrock encountered in the borings 1.5 to 4.6 meters below the fill. A double row of small diameter drilled piers extending about 1.0 meter into the bearing materials will be used. These piers are to be tied together below a pier cap that functions as the footing for the wall and proportioned with a gross allowable bearing pressure of 475 kPa. These piers will also be subjected to uplift or tension loads in response to the imposed overturning moments. To determine the necessary embedment for tension resistance, a side shear of 22.5 kPa has been estimated for piers installed in the very stiff to hard alluvium encountered at Boring RBW-5. This side shear increases to 35 kPa when the piers are installed in the hard residual soil and very soft bedrock encountered in Borings RBW-1 through RBW-4. Based upon the use of a granular backfill, an active lateral pressure coefficient (K_a) of 0.28 is to be utilized in conjunction with an estimated granular soil unit weight of 20.43 kN/m^3 (Kilonewtons per cubic meter). Should the cohesive in-situ soils be utilized for backfill, the K_a value is to be increased to 0.5. In addition, surface water infiltration should also be inhibited by compacting a layer of cohesive material (approximately 15 to 30 centimeters thick) above the granular backfill.

- A reinforced earth retaining system is also an option for this wall. In the opinion of this writer, a system such as this is preferable to a traditional cantilevered wall in an

environment where potential differential settlement is a concern. The inherent flexibility of a mechanically stabilized wall allows such a system to accommodate the likely differential settlement that can occur after the main embankment fill surcharges the existing ramp. Based upon the use of a granular material, an active lateral pressure coefficient (K_a) of 0.28 is to be utilized in conjunction with an estimated granular soil unit weight of 20.43 kN/m^3 (Kilonewtons per cubic meter). The bearing/leveling subgrade for the wall is to be undercut to a depth of 0.9 to 1.0 meter below the proposed bearing elevation and backfilled with a well compacted, well graded granular material such as ODOT No. 304 stone. In the area of the existing culvert location, the existing soft fill and alluvial materials encountered in the foundation excavation have to be removed to expose stiff to very stiff soils. Based upon the boring at this location, this will involve an undercut of up to roughly 3 meters. Once the gravel trench has been constructed, the leveling pad may be proportioned utilizing a gross allowable bearing pressure of 190 kPa. A subgrade reaction modulus of 27 N/cm^3 (Newtons per cubic centimeter) and a sliding friction coefficient equal to 0.55 has been estimated for design purposes.

- The proposed U.S. 33 northbound embankment will require up to roughly 10.0 meters of fill, 3.0 to 4.0 meters of which will be above the present entrance ramp embankment. The present embankment exhibited some slope instability that became a source of concern with respect to the proposed construction and a computer-aided slope stability analysis was performed to determine if the proposed surcharge would overload the present embankment slope and initiate a failure. An estimate of the in-situ soil strength parameters was obtained from the slip area and used to model the slope supporting the probable surcharge. From this analysis, it is believed that a minimum F.S. of 1.5 will be realized. It appears as if the slip area has been repaired. However, because Gannett Fleming was not involved during the design or construction of the slip repair, recommendations regarding this issue are outlined in Section 4.1 of this report.

The aforementioned recommendations are based upon proper construction and construction inspection to verify the subsurface conditions and assure the design is carried out in an appropriate manner. If there any questions concerning the content of this report, please contact this office.

Very truly yours,

GANNETT FLEMING ENGINEERS AND ARCHITECTS, P.C.

John R. Kenny, P.E.
Vice President
Manager, Ohio Office

Malcolm D. Hargraves, P.E.
Geotechnical Engineer

cc: Mr. Jeffrey B. Koehn, M-E Companies

FOUNDATION INVESTIGATION REPORT
RAMP B RETAINING WALL at U.S. 33 and ALBANY ROAD

Table of Contents

FOUNDATION INVESTIGATION REPORT
RAMP B at U.S. 33 and ALBANY ROAD

1.0 INTRODUCTION AND SCOPE

1.1 Introduction

This structure foundation report presents the findings of the geotechnical investigation performed to characterize the subsurface conditions at the proposed site for the new U.S. 33 northbound lanes and entrance ramp from the Albany Road–Richland Avenue intersection in Athens, Ohio. This entrance ramp is part of the larger U.S. 33 Athens-Darwin project involving a new "Super-Two" highway corridor through southern Athens county and Meigs county in southeast Ohio. The purpose of this investigation was to determine the nature of the subsurface materials at the site, to assess their structural support capability, and to make recommendations relative to the design and construction of the structural foundations and earthwork for the project.

1.2 Scope

The scope of this investigation included a review of available geologic and soils data for the project area, a subsurface investigation consisting of five (5) soil test borings and associated rock coring, and an engineering analysis and evaluation of the subsurface conditions encountered at the site.

2.0 PROJECT CHARACTERISTCS

U.S. 33 is currently configured as a four–lane, divided, limited access highway carrying traffic around Athens, Ohio. This highway also carries traffic from U.S. 50 and S.R. 32. At the intersection with Richland Avenue and Albany Road, U.S. 33 narrows to a two-lane configuration as it continues in a southerly direction toward Pomeroy, Ohio, while the U.S. 50/S.R. 32 traffic is maintained with a four-lane configuration as an overpass above the U.S. 33 exit ramp and Albany Road. Present topographic information and site plans indicate that the proposed construction site has fairly substantial relief in the project vicinity, changing approximately 10 to 12 meters in elevation with moderately wooded slopes as steep as 1 vertical to 1 horizontal (1:1). A comparison of the current topographic information to older USGS maps of the area indicate that the present day four-lane alignment required cuts on the order of 15 to 18 meters to establish the subgrade elevations. Some of this excavated material was probably reused as fill for the present entrance ramp embankment for northbound U.S. 33 traffic access to the present by-pass. This embankment ranges up to roughly 12 to 14 meters in height with slopes as steep as about 2:1.

A topographic map of the immediate area depicts a slip in this embankment adjacent to the ramp. This slip, approximately 27 meters long and 56 meters wide, occurred where the ramp was relatively high and where deeper fill appeared to have been placed during the ramp

construction. In addition to the slip area, a relatively large culvert, roughly 2.0 meters in diameter, crosses below the ramp near the U.S. 33-Richland Avenue intersection.

Proposed for construction is a retaining wall, approximately 180 to 200 meters long, providing a grade separation and transition between the present entrance ramp from the Richland Avenue-Albany Road intersection and the proposed embankment for the U.S. 33 mainline northbound lanes. Proposed profiles indicate that the embankment is to range from 1.0 to nearly 10.0 meters in height, which implies that the proposed wall will need to be up to 10.0 meters tall, depending upon the chosen grades and space constraints in the wall area.

3. 0 GEOLOGY and GENERALIZED SUBSURFACE CONDITIONS

3.1 Geology

The project lies in a region predominated by residual soils formed from Pennsylvanian aged sedimentary bedrock of the Marietta Plateau. Sandstone, siltstone, shale, clay shale/mudstone, along with occasional, deeper, thinly bedded coal seams of the Conemaugh formation dominate the bedrock profile along the proposed roadway corridor. In the specific location of the proposed wall and mainline embankment, a transition zone between the residual soils of the more rugged higher elevations and alluvium associated with a localized drainage stream is evident, along with human placed fill related to earlier construction activities.

3.2 Subsurface Profile

Five (5) test borings were drilled for this investigation. The subsurface soil profile and groundwater conditions exposed in these borings are described in detail on the boring logs located in the appendix to this report. These boring logs indicate conditions at the particular locations and times the test bores were drilled. Some conditions, particularly groundwater levels, could change with time and periods of precipitation.

The soil borings generally encountered fill comprised of mottled olive, brown, beige, red and gray silty clay and weathered mudstone, clay shale, and sandstone fragments to depths ranging from 1.1 to 4.6 meters below the present ground surface. Standard Penetration (N) values in this material varied widely from 7 to greater than 50 blows per 30 centimeters (bpf), indicative of a generally unpredictable soil consistency.

Below the fill, residual soil comprised of mottled red and gray, and brown to light brown with trace red silty clay or silty sand was observed and sampled. N-values in these materials generally ranged from 22 to greater than 50 bpf, indicative of a very stiff to hard consistency. Where residual soils were not evident, weathered bedrock comprised of soft orange-brown to olive and gray arenaceous shale was encountered. A notable exception was in Boring RBW-5, where very stiff to hard gray sandy clay underlain by dark gray silty clay alluvium was observed below the fill.

Rock coring techniques were used in Borings RBW-2 and RBW-5. Medium to moderately hard, gray arenaceous shale and siltstone/fine grained sandstone to light gray/white

hard calcareous sandstone with shale seams was recovered in the respective borings. Rock Quality Designation (RQD) measurements ranged from 66 to 78 percent in the recovered samples, reflective of a fair to good rock quality.

3.3 Groundwater Conditions

Observations concerning groundwater were made during the drilling operations. The following table summarizes the levels at which groundwater was measured in each of the borings where observed prior to the rock coring activities.

Groundwater Levels (m)	
Boring Number	Noted on Drilling Rods
RBW-2	7.3
RBW-4	8.1

The groundwater level depends on normal variations in precipitation and surface runoff amounts. Fluctuations in groundwater can only be determined through observations made in bailed, cased holes, the construction of which was beyond the scope of this investigation.

4.0 FOUNDATION RECOMMENDATIONS

The following conclusions and recommendations have been developed based upon an analysis of the subsurface conditions encountered in this investigation and the present design details provided by ODOT. If there are changes to the current plans, the conclusions and recommendations outlined in this report should be reviewed by a representative of Gannett Fleming to determine if they need to be modified or if additional work is necessary.

Two wall type alternatives shall be considered in this section of the report. The first wall type is a traditional, cantilever concrete retaining wall. The second wall type is a mechanically stabilized, reinforced earth retaining system, the effectiveness of which strongly depends upon the backfill material and embankment material chosen for the U.S. 33 northbound lanes. In addition to the wall types, the global stability of the proposed alignment was initially examined to determine if the existing ramp embankment might be compromised.

4.1 Concrete Retaining Wall

The soil borings encountered fill to depths ranging from 1.5 to 4.6 meters in depth along the length of the proposed wall. This fill was most probably placed as part of the present ramp embankment construction and as part of the backfill associated with the culvert crossing at the bottom of the ramp. Compaction records regarding the placement of this fill were not available for review. Consequently, it is assumed that the material was placed in an uncontrolled manner, and should not be utilized for structural support of a relatively rigid, concrete wall system. The

reason is that uncontrolled fills may settle unpredictably, due to the compression of undercompacted or uncompacted areas within the soil mass and result in excessive deflection, differential settlement, and possibly induce unanticipated stresses in the proposed wall structure. Because of concerns with excessive deflection and differential settlement associated with an uncontrolled fill, it is recommended to extend the wall foundations through this fill to the hard residual soil and soft weathered bedrock encountered in the borings below the fill.

A double row of small diameter drilled piers extending about 1.0 meter into the bearing materials will be used. These piers will be tied together below a pier cap that functions as the footing for the wall and must be proportioned with a gross allowable bearing pressure of 475 kPa. These piers will also be subjected to uplift or tension loads in response to the imposed overturning moments. To determine the necessary embedment for tension resistance, a side shear of 22.5 kPa has been estimated for piers installed in the very stiff to hard alluvium encountered at Boring RBW-5. This side shear increases to 35 kPa when the piers are installed in the hard residual soil and very soft bedrock encountered in Borings RBW-1 through RBW-4. A factor of safety equal to 3 has been utilized in the tension capacity estimates.

The primary loads on the retaining wall will be horizontal forces derived from lateral earth pressures associated with the new U.S. 33 embankment. When designing for the lateral earth pressure loads, it is assumed that the top of the proposed wall can translate sufficiently to allow "active" pressure development. Based upon the use of a granular backfill, an active lateral pressure coefficient (K_a) of 0.28 should be utilized in conjunction with an estimated granular soil unit weight of 20.43 kN/m^3 (Kilonewtons per cubic meter). Should the cohesive in-situ soils be utilized for backfill, the K_a value increases to 0.5. To help avert the build up of additional forces resulting from hydrostatic pressures, properly installed footing drains, backfilled with a free draining, open graded granular material, and/or weep holes must be incorporated into the wall design. In addition, surface water infiltration should also be inhibited by compacting a layer of cohesive material (approximately 15 to 30 centimeters thick) above the granular backfill.

4.2 Mechanically Stabilized Earth Retaining Wall

An alternative to the concrete wall is a mechanically stabilized earth retaining wall. As is the case for the traditional concrete wall, the primary loads on the retaining wall will be from lateral earth pressures associated with the new U.S. 33 embankment surcharge. In order for a reinforced earth system to mobilize the shear strength between the reinforcing strips (or geogrid as the case may be) and the soil, the wall will have to yield, resulting in the formation of "active" pressures. Based upon the use of a granular backfill in the zone of reinforcement, an active lateral pressure coefficient (K_a) of 0.28 must be utilized in conjunction with an estimated granular soil unit weight of 20.43 kN/m^3 (Kilonewtons per cubic meter). Appropriate measures for drainage and prevention of surface water infiltration as mentioned in the previous section will also be incorporated in the design. The bearing/leveling subgrade for the wall should be undercut to a depth of 0.9 to 1.0 meter below the proposed bearing elevation and backfilled with a well compacted, well graded granular material such as ODOT No. 304 stone. In the area of the existing culvert location between approximately Station 29+450 and 29+460, the existing soft fill and alluvial materials encountered in the foundation excavation should be removed to expose stiff to very stiff soils. Based upon the boring at this location, this will involve an undercut of up

to roughly 3 meters. Adequate bearing conditions in this undercut area should be verified by a qualified geotechnical professional. Once the gravel trench has been constructed, the leveling pad may be proportioned utilizing a gross allowable bearing pressure of 190 kPa. A subgrade reaction modulus of 27 N/cm^3 (Newtons per cubic centimeter) and an ultimate sliding friction coefficient equal to 0.55 has been estimated for design purposes. A factor of safety equal to 1.5 against a sliding failure should be utilized in the design.

In the opinion of this writer, a mechanically stabilized earth retaining system is preferable to a traditional cantilevered wall in an environment where potential differential settlement is a concern. The inherent flexibility of a mechanically stabilized wall allows such a system to accommodate the likely differential settlement that can occur after the main embankment fill surcharges the existing ramp. The use of a reinforced earth wall will also reduce the necessary undercutting or pier installation outlined for the concrete wall system.

4.3 Embankment Stability

The proposed U.S. 33 northbound embankment will require up to roughly 10.0 meters of fill, 3.0 to 4.0 meters of which will be above the present entrance ramp embankment. As mentioned previously, the present embankment exhibited some slope instability that became a source of concern with respect to the proposed construction. For this reason, a computer-aided slope stability analysis was performed to determine if the proposed surcharge would overload the present embankment slope and initiate a failure.

Using an old topographic map depicting the initial slip, the shear strength parameters of the existing fill soils were back-calculated with the computer program. A phi angle of 23 degrees and a cohesion of 0.47 kPa were obtained from this process. These values were inserted into the program modeling the proposed surcharge. From this it was determined that a minimum factor of safety (F.S.) equal to about 1.54 is probable, assuming that the failure surface is forced into a surcharge given no shear strength characteristics. Generally a F.S. equal to 1.5 is the required value for global slope stability. Since the imposed surcharge will be a real material with some shear strength, it is believed that the recommended F.S. of 1.5 will be realized.

The slope appears to have been repaired where the failure occurred, however Gannett Fleming did not design nor was Gannett Fleming present during the repair operations. As a result, this company can neither confirm nor deny that the failure was repaired appropriately. To properly repair the slope and to protect against future instability, the existing embankment material should be removed to expose competent material below the slip surface and replaced with compacted, engineered fill as outlined in the Ohio Department of Transportation (ODOT) Construction and Material Specification Manual. As part of this repair the new compacted material must be appropriately benched into the competent in-situ soils to engage the replacement material with the natural soils. In addition, it is likely that erosion due to the drainage stream located at the toe of the slope adversely affected the present embankment where the aforementioned slip occurred. For this reason it is recommended that some form of rock channel protection, such as ODOT Type D or Type C stone, be placed at the existing embankment toe.

4.4 General Foundation Comments

All structural footings should be placed at a minimum depth of 0.8 meters or greater below the finished grades for frost protection. If any soft, wet, organic or loose soil, or any old fill is encountered, the excavations should be extended downward so that the footings rest on competent soils.

All foundation bearing surfaces should be protected against freezing, the surface water and undue disturbance as the bearing soils will tend to soften or loosen and increase settlements in such cases. If at all possible, the footing concrete should be placed the same day that the excavation takes place. If this is not feasible, proper protection of the footing excavations should be provided. All footing excavations should be inspected by a qualified geotechnical professional to assure that adequate bearing is achieved before placing concrete for the foundations.

Drilled pier excavations should be inspected to confirm the assumed subsurface conditions before placing concrete for the drilled piers. The concrete for the piers should be placed immediately after the drilling and inspection takes place. Inspection of the drilled piers should include recording the top and bottom elevations and a visual examination for plumbness, alignment and diameter.

Although it is not believed that the groundwater table will pose a problem, it is recommended that steel casing be available if groundwater seeps become evident. This will also help retain any of the material that may loosen during pier excavation. It is recommended that the concrete for the piers have a design slump of at least 15 centimeters in order to avoid arching of the concrete upon withdrawal of the temporary casing (if utilized). Furthermore, a positive head of concrete should be maintained above any groundwater (if encountered) during the withdrawal of the casing. These measures will preclude contamination of the pier concrete by groundwater and soil and safeguard the integrity of the piers.

5.0 EARTHWORK RECOMMENDATIONS

5.1 Site Preparation

Site preparation operations should consist of removing any vegetation, topsoil, and other organic material or loose miscellaneous fill and debris from the construction areas. After the completion of undercutting operations, the exposed subgrade areas should be proofrolled with suitable heavy equipment, preferably a 180 to 270 kN loaded dump truck. Any soft yielding areas delineated by the proofrolling may need to be undercut or otherwise stabilized as recommended by the geotechnical engineer prior to placing the new embankment material.

5.2 Excavation

Based upon the boring logs and the proposed grading plans, the wall foundations for the concrete retaining wall will have to be excavated through fill and into hard residual soil or soft

weathered bedrock. Exceptions will probably occur in the areas around Boring RBW-5, where encounters with softer fill and alluvium are likely to occur. In the event the stabilized earth wall system is chosen, the major excavation and undercutting should occur around the present culvert in the softer materials, and excavation through harder materials should be minimized. If the drilled piers are installed for the concrete wall, some difficulty may be encountered, however the hard soils/soft rock generally appear to accommodate removal without unusual effort.

All temporary excavations for the installation of foundations, utilities, etc., should be properly laid back or braced in accordance with Occupational Safety and Health Administration (OSHA) requirements. Where the excavation occurs around the present culvert, temporary bracing will probably be required in the soft fill and alluvial soils observed at this location.

It is believed that the groundwater table generally occurs at a depth that should not present construction difficulties for a project of this type, particularly if construction is carried out during the dryer seasons of the year. Exceptions will probably occur at the present culvert location where drainage from an active stream may encroach upon the wall excavation during brief periods of intense precipitation. Consequently, the contractor should have a means of channeling the flow away from the excavation. In the remaining areas of the wall, most of the water that may be encountered in shallow excavations at this site should be adequately controlled by conventional methods.

5.3 Fills

It is recommended that the fill embankments be constructed in conjunction with the guidelines established in the Ohio Department of Transportation Construction and Material Specifications for embankment construction. When placing soil material immediately adjacent to the retaining wall, the compaction effort should be limited to that which is required to achieve 95 percent of the maximum Standard Proctor dry density. This measure should reduce the likelihood of excessive lateral earth pressures resulting from construction activities.

APPENDIX A
Boring Location Plan
Soil Boring Logs
Soil Profile

Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-1 Station & Offset _____ Surface Elev. 213.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
213.9		13-19-25-50/.2	0.43	0.09	Fill-mottled brown and gray silty clay w/ sand, gravel, and shale fragments; slightly moist.	1								8	
213.3	1	50/0.4	0.06	0.06		2								4	
212.8															
212.7	2	11-10-11-10	0.37	0.24	Probable fill-mottled red and gray silty clay w/ gray sandstone fragments; moist.	3								9	
211.4	3	21-31-17-17	0.34	0.27	Mottled red and gray w/ trace yellow silty clay w/ traces of oxides (CL); moist, hard. qh=3.5 kg/cm2	4	40	7	11		43	31	10	16	A-4a
210.2	4				Light brown w/ trace gray sandy silt and clay w/ traces of weathered sandstone fragments (ML, CL-ML); moist, very dense/ hard.										
209.8	5	18-28-50/0.4	0.40	0.03	qh=4.5 kg/cm2	5	4	4	7	37	49			12	A-6a
208.4															
208.2	6	50/0.1	0.03	0.00	Soft to medium hard light brown, fine grained sandstone.	6									
207.2	7				Soft, dark gray weathered shale; laminated structure.										
206.7	8	38-50/0.2	0.21	0.34		7								9	
205.7					Soft to medium hard gray shale.										
205.2		50/0.3	0.09			8									

Date Started 072099 Date Completed 072099 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-1 Station & Offset _____ Surface Elev. 213.9 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10														
203.7		50/0.2	0.06	0.00	Bottom of boring @ 10.3 meters.	9									
203.6	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-2 Station & Offset _____ Surface Elev. 211.6 m Water Elev. 204.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
211.6		4-6-8-21	0.40	0.21	5 cm Topsoil--fill-light brown silty sand w/ sandstone fragments and gravel; slightly moist; cobbles/rock fragments at 1.5 m; gray shale fragments in sample #4.	1								9	
211.0	1	9-14-10-9	0.37	0.24	qh=3.25 kg/cm2	2								7	
210.4		25-12-10-9	0.00	0.61		3									
209.8	2														A-6b
209.5		25-16-14-12	0.43	0.18	qh=3.25 kg/cm2, w.c.= 8%	4	23	13	10	20	34			17	
209.2		50/0.3	0.09		qh=4.5 kg/cm2	5								10	
	3														
208.2	4				Fill-mottled red, brown and gray silty clay w/ sand and shale fragments; moist. Light orange-brown/beige at bottom of sample.										
207.5															A-6b
207.3		5-7-15	0.24	0.21	qh=1.5 kg/cm2	6	6	4	10		81	39	18	22	
207.0	5				qh=3.25 kg/cm2, w.c.= 17%										
					Brown silty clay w/ traces of oxides (CL); slightly moist, hard. Slightly laminated structure; orange-brown at bottom of sample.										
206.0	6	53-50/0.4	0.27		qh=4.5+ kg/cm2	7	4	6	17		73	40	17	15	A-6b
205.5					Very soft to soft, very weathered orange-brown to olive and gray arenaceous shale. Laminated structure.										
	7														
204.4		35-50/0.2	0.18	0.03		8								13	
	8														
203.7					Very soft to soft red/maroon and gray, very weathered arenaceous shale.										
202.9		61-50/0.4	0.27			9								12	

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-2 Station & Offset _____ Surface Elev. 211.6 m Water Elev. 204.2 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10														
201.4		75	0.30		Soft to medium hard gray arenaceous shale; good rock quality; medium to thickly bedded.	10									
201.1	11	78	1.46	0.06	Medium hard, gray arenaceous shale and siltstone/fine grained sandstone; good rock quality, medium to thickly bedded. qu=338.3 kg/cm2	11									
199.6	12				Bottom of boring @ 12.0 meters.										
	13														
	14														
	15														
	16														
	17														

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-3 Station & Offset _____ Surface Elev. 209.6 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
209.6		15-25-24-27	0.52	0.09	5 cm Topsoil--fill-mottled brown/light brown and gray to red silty clay w/ traces of brown sandstone and shale fragments; slightly moist tomoist. qh=4.5+ kg/cm2	1								11	
209.0	1	13-50/0.4	0.21	0.06		2								9	
					qh=4.5+ kg/cm2										
208.4					qh=4.5+ kg/cm2, w.c.= 10%										A-6b
208.1		5-10-11-14	0.37	0.24		3	25	5	5		66	38	16	13	
207.8	2				qh=3.75 kg/cm2										
		8-8-9-12	0.37	0.24	qh=3.5 kg/cm2	4								16	
207.2	3	5-10-9-13	0.37	0.24	qh=2.5 kg/cm2	5								13	
206.0	4				Light brown and trace red silty clay w/ traces of oxides (CH); moist, very stiff. Slightly laminated structure.										
205.5															A-7-5
205.4		13-11-16	0.34	0.12	qh=2.5 kg/cm2, w.c.= 15%	6	5	9	3		83	55	25	28	
205.2	5				qh=1.5 kg/cm2										
					Mottled-orange-brown and red silty clay w/ traces of oxides (CL); moist, very stiff.										
204.1															
204.0	6	20-47-50/ 0.2	0.30	0.06	Gray, silty clay (CL); slightly moist, hard. Slightly laminated, slickensided structure. [Very soft extrememly weathered shale].	7	0	1	1	34	64			13	A-7-5
	7				qh=3.5 kg/cm2										
202.5		50/0.4	0.12	0.00	Red shale/hard silty clay (CL) seam noted in Sample #8	8									
	8														
200.9		50/0.3	0.03	0.06		9									

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-3 Station & Offset _____ Surface Elev. 209.6 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
200.2	10				Soft to medium hard arenaceous shale.										
199.4		50/0.1	0.03	0.00	Bottom of boring @ 10.2 meters.	10									
	11														
	12														
	13														
	14														
	15														
	16														
	17														

Date Started 072199 Date Completed 072199 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-4 Station & Offset _____ Surface Elev. 208.0 m Water Elev. 199.9 m

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
208.0		8-14-21-13	0.55	0.06	Fill-mottled brown/light brown and beige silty clay w/ sand and gravel/rock fragments. qh=2.75 kg/cm2	1	34	13	12	20	21			9	A-6a
207.4	1	11-19-50/ 0.3	0.27	0.12	qh=4.25 kg/cm2	2								9	
206.8		9-50/0.3	0.21	0.03		3								8	
206.5					Olive, extremely weathered soft shale.										
206.2	2	50/0.4	0.12	0.00	Red/maroon, extremely weathered soft shale.	4								9	
205.5		49-50/0.3	0.24	0.00		5								10	
205.2	3				Olive, soft weathered shale.										
204.0	4														
203.9		9-26-43	0.30	0.15	Gray, soft to very soft weathered shale.	6								16	
	5														
202.3															
202.2	6	50/0.5	0.12	0.03	Olive/olive gray soft to medium hard shale.	7								11	
	7														
200.8		50/0.1	0.03	0.00		8									
	8														
199.4		50/0.1	0.00	0.03	Bottom of boring @ 8.6 meters.	9									
199.4															

Date Started 072199 Date Completed 072299 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-5 Station & Offset _____ Surface Elev. 207.7 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
207.7		10-30-50/ 0.3	0.24	0.15	Fill-mottled light brown and olive silty clay w/ trace to little rock/sandstone and shale fragments, sand and wood. qh=2.75 kg/cm2	1								7	
207.1	1	9-8-9-11	0.52	0.09	qh=4.0 kg/cm2	2								13	
206.5					qh=2.0 kg/cm2										A-6a
206.2		3-4-4-5	0.30	0.30		3	7	3	33		56	31	12	21	
205.9	2				Possible fill-brown w/ orange-brown silt and clay w/ little to some sand and oxides (ML,CL); moist, medium stiff to stiff. qh= 1.0 kg/cm2										A-4a
205.6		3-4-3-9	0.46	0.15		4	2	7	40	26	25	25	5	18	
205.3					qh=1.5 kg/cm2										
205.0	3	4-6-7-11	0.43	0.18	qh=2.5 kg/cm2	5								19	
204.1	4				Traces of sandstone fragments noted in sample #5 qh=1.0 kg/ cm2										
203.6					Gray sandy clay w/ traces of sandstone fragments (CL); moist to very moist, stiff. qh=1.25 kg/cm2										
	5	7-10-20-25	0.46	0.15	Dark gray silty clay w/ silt partings (CL); moist, very stiff to hard; mollusk shells noted in top part of sample. w.c.= 23% in top of sample.	6								18	
202.3					qh=3.25 kg/cm2										
202.1	6	50/0.5	0.12	0.03	Olive gray and gray silty clay (CL); moist, hard. [Extremely weathered shale]	7								10	
	7														
200.6		50/0.2	0.06	0.00	Light gray to white, moderately hard to hard sandstone (calcareous) w/ seams of gray, soft to medium, arenaceous shale.	8									
200.6		66	0.15			9									
200.4	8														
		70	1.46	0.06		10									
198.9															

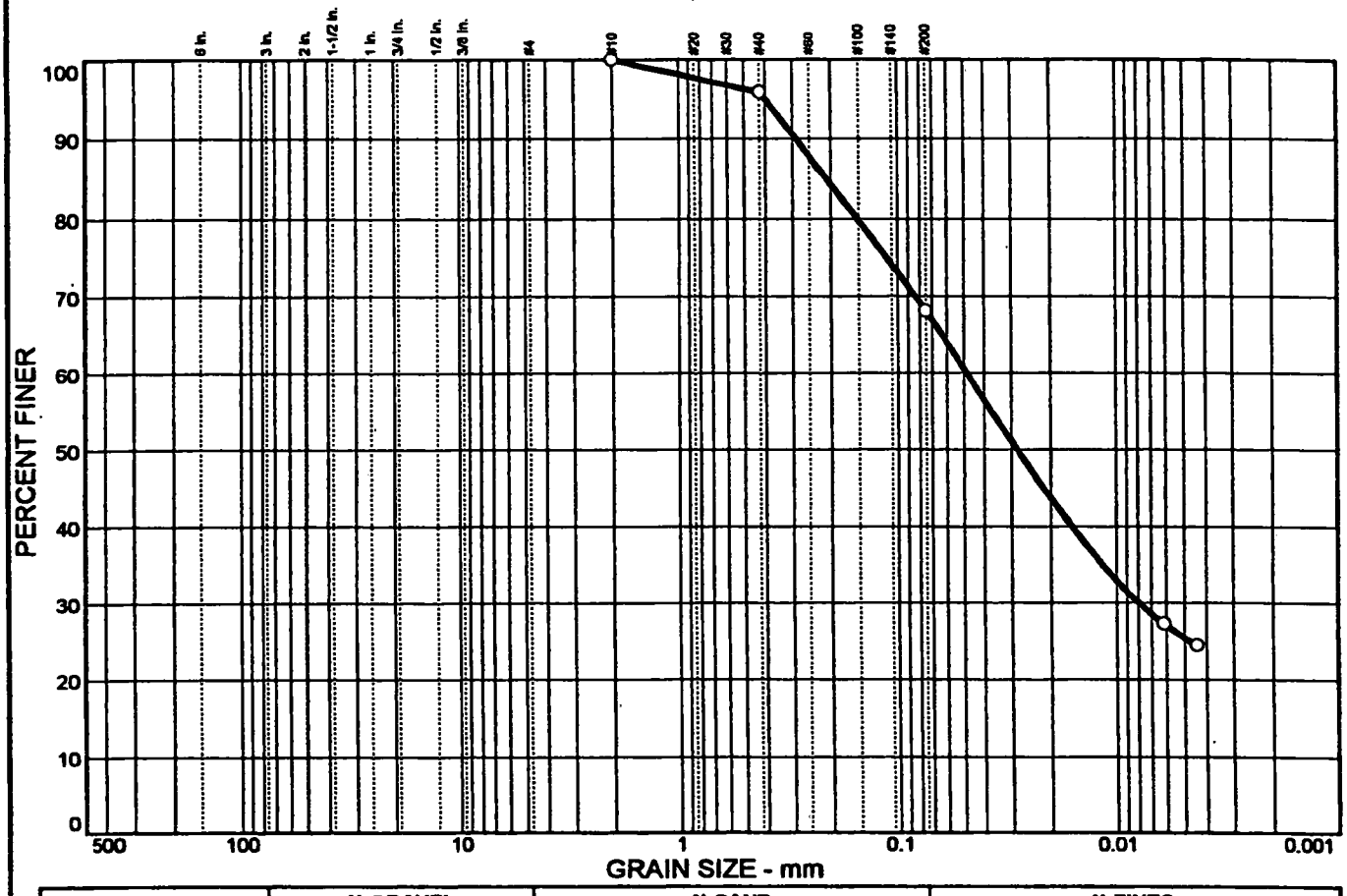
Date Started 072199 Date Completed 072299 Sampler: Type Split Spoon Dia. 5 cm

Boring No. RBW-5 Station & Offset _____ Surface Elev. 207.7 m Water Elev. _____

Elev. (m.)	Depth (m.)	Std. Pen./ RQD	Rec. (m.)	Loss (m.)	Description	Sample No.	Physical Characteristics								
							% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class.
	10				Bottom of boring @ 8.8 meters.										
	11														
	12														
	13														
	14														
	15														
	16														
	17														

APPENDIX B
Laboratory Test Data
Global Slope Stability Analysis

Particle Size Distribution Report



% COBBLES	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	4.1	27.8	42.6	25.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#10	100.0		
#40	95.9		
#200	68.1		

* (no specification provided)

Soil Description

Sandy lean clay

Atterberg Limits

PL= 15 LL= 27 PI= 12

Coefficients

D_{85}= 0.208 D_{60}= 0.0482 D_{50}= 0.0282
D_{30}= 0.0079 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL AASHTO= A-6(6)

Remarks

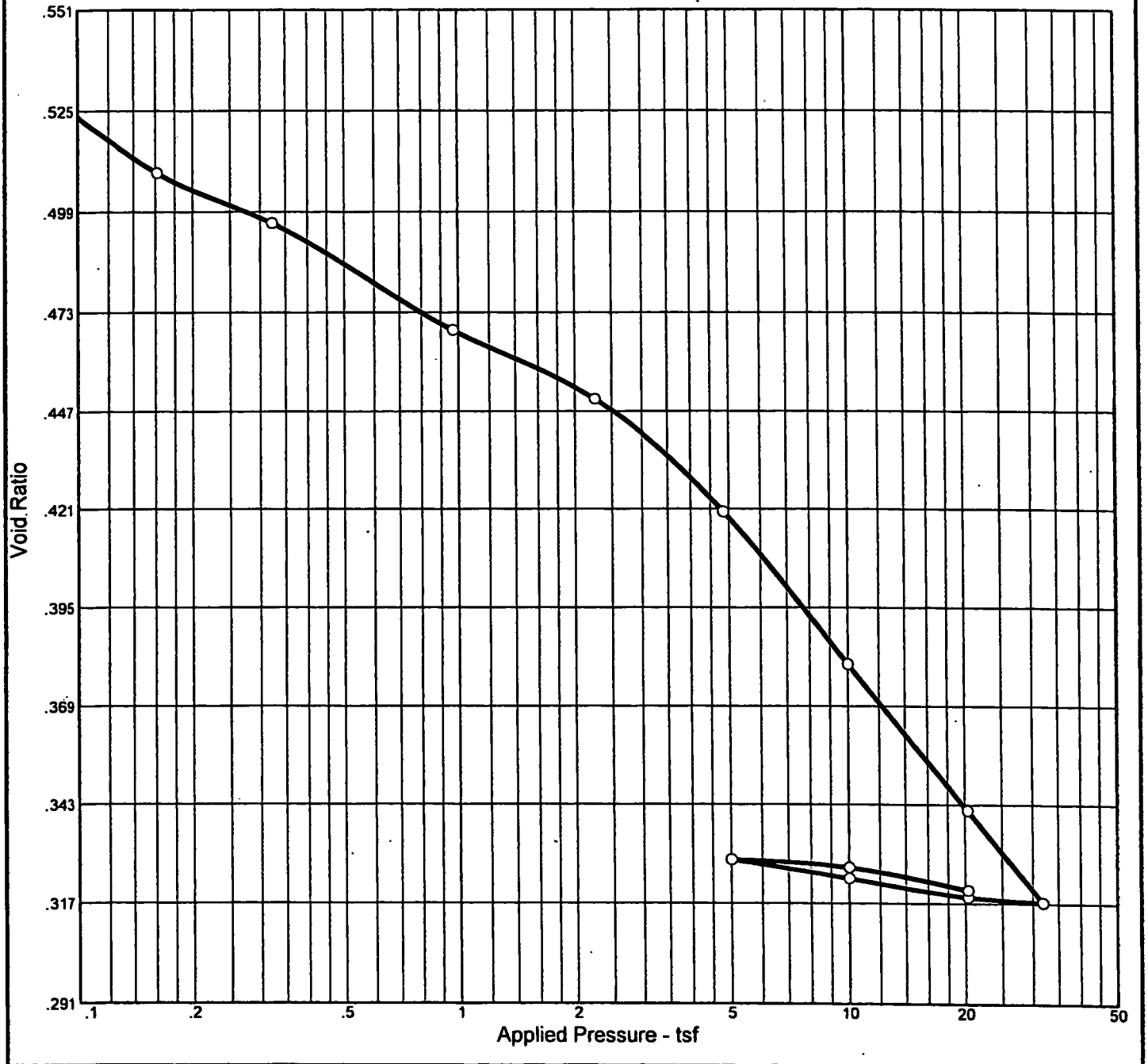
moisture content= 20.6%

Sample No.: RBW-5 **Source of Sample:** **Date:** 12/3/99
Location: press tube **Elev./Depth:** 8.0'-10.0'

DODSON-STILSON, INC.

Client: Prime Engineering
Project: Athens Rte. 33 Bypass
Project No: 9921-3168.00 **Plate**

CONSOLIDATION TEST REPORT



Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (tsf)	P_c (tsf)	C_c	C_r	Initial Void Ratio
Saturation	Moisture									
100.0 %	20.6 %	110.6	27	12	2.7		2.82	0.12	0.01	0.523

MATERIAL DESCRIPTION	USCS	AASHTO
	CL	A-6

Project No. 99213168 **Client:** Prime Engineering

Project: Athens 33

Source: **Sample No.:** RBW-5 **Elev./Depth:** 8.0'-10.0'

Remarks:
Silty Clay

CONSOLIDATION TEST REPORT

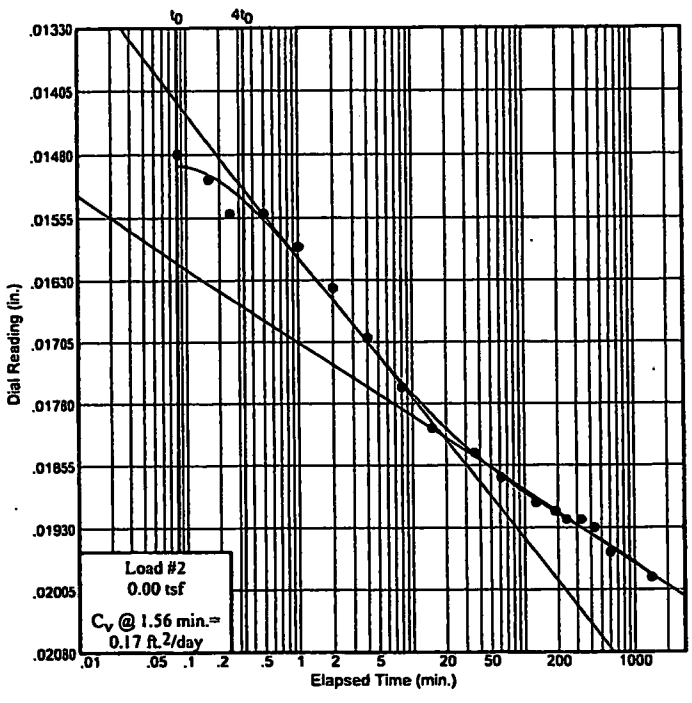
DODSON-STILSON, INC.

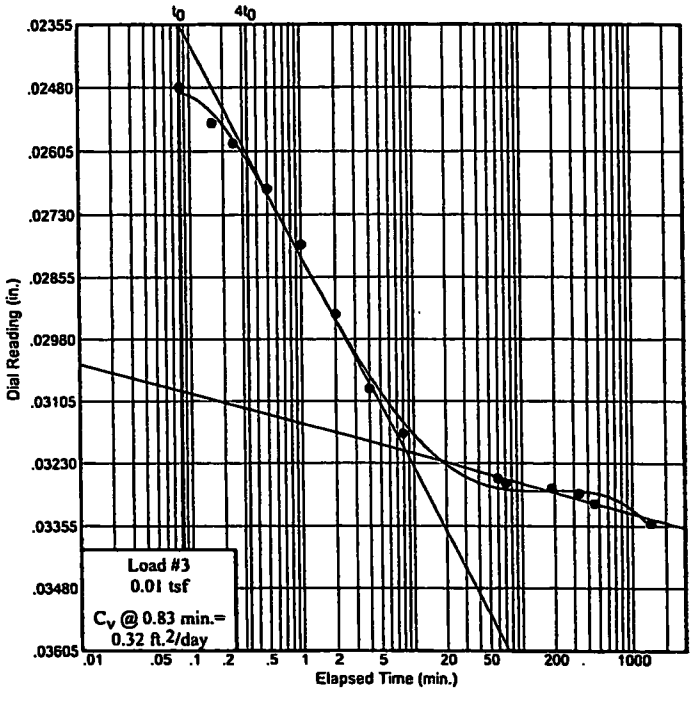
Plate

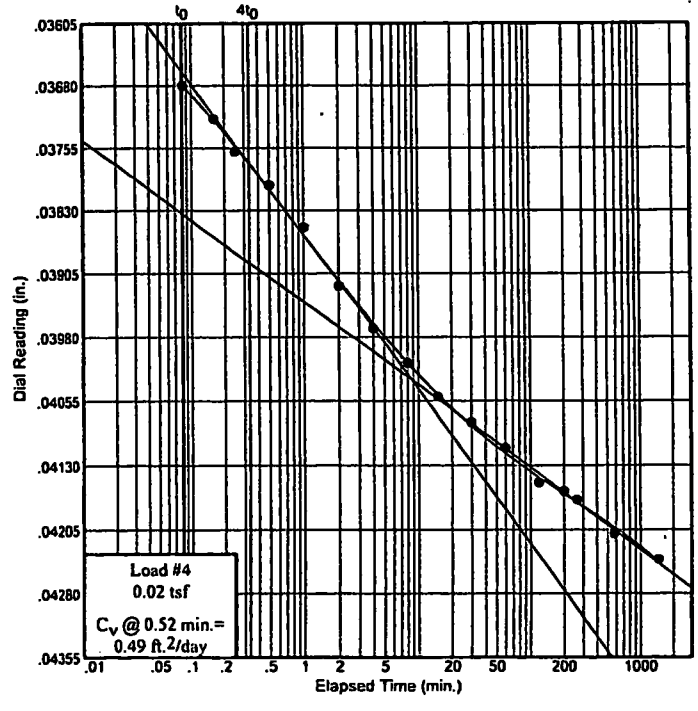
Dial Reading vs. Time

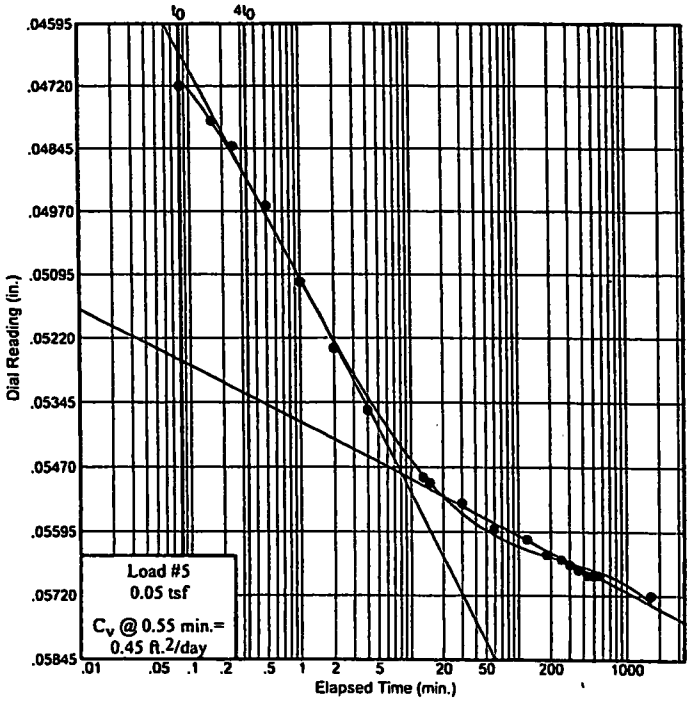
Project No.: 99213168
Project: Athens 33

Source: Sample No.: RBW-5 Elev./Depth: 8.0'-10.0'









Dial Reading vs. Time

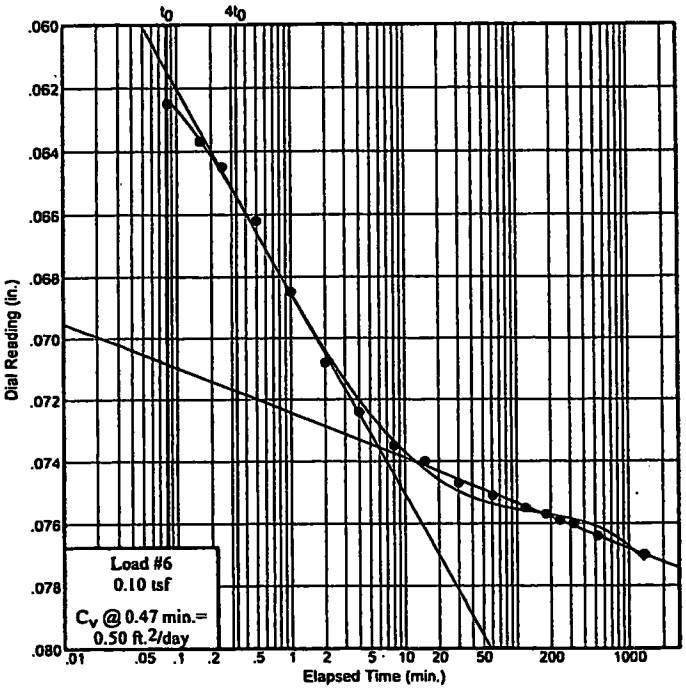
DODSON-STILSON, INC.

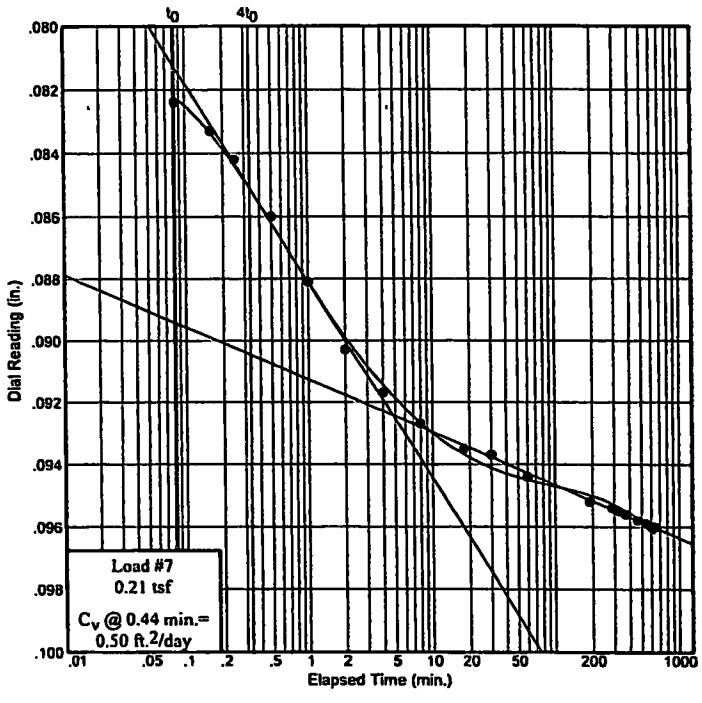
Plate

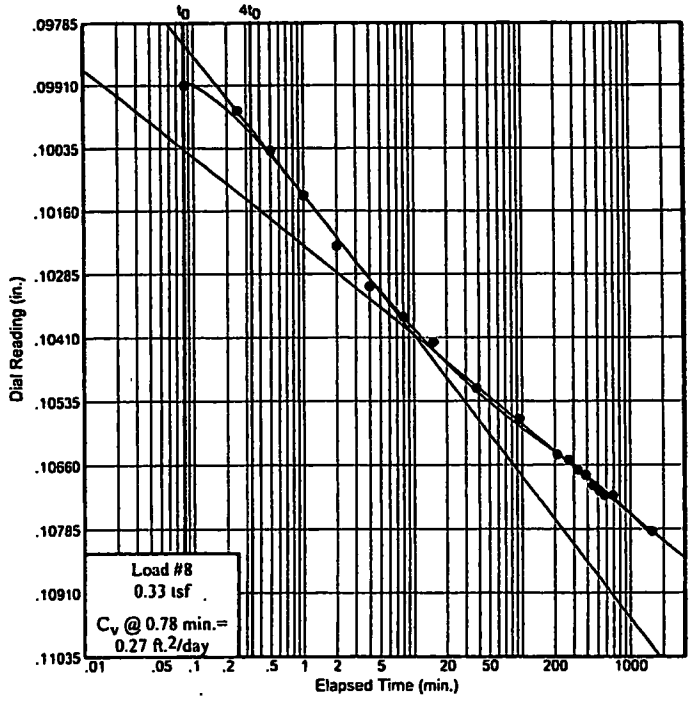
Dial Reading vs. Time

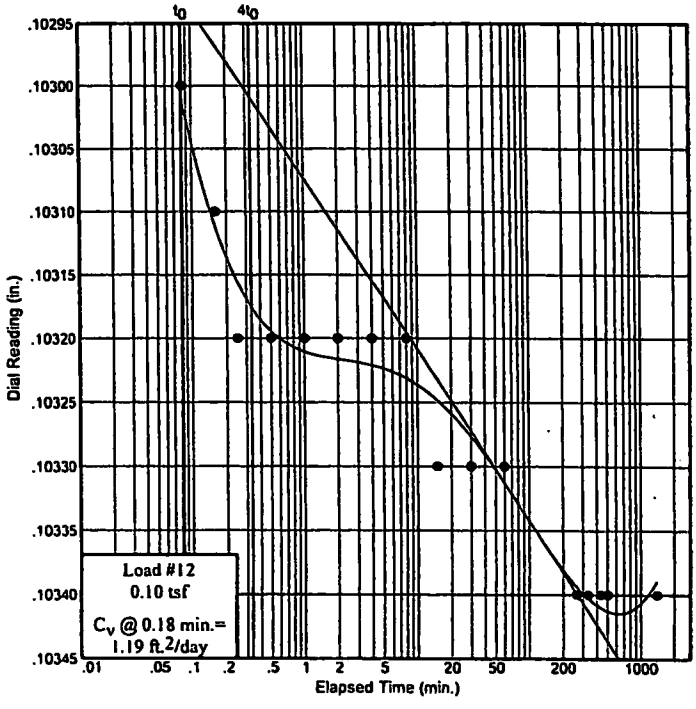
Project No.: 99213168
Project: Athens 33

Source: Sample No.: RBW-5 Elev./Depth: 8.0'-10.0'









Dial Reading vs. Time

DODSON-STILSON, INC.

Plate

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REAME (ROTATIONAL EQUILIBRIUM ANALYSIS OF MULTILAYERED EMBANKMENTS)
COPYRIGHT, CIVIL ENGINEERING SOFTWARE CENTER (MARCH 1994 VERSION)
UNIVERSITY OF KENTUCKY, LEXINGTON, KY 40506

INPUT FILE NAME -RAMPBSUR.DAT

TITLE -RAMP B RETAINING WALL - W/ SURCHARGE FROM ROADWAY FILL
(6 FT. EMBANKMENT FILL NOT GIVEN SHEAR STRENGTH)

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1     SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 5

NO. OF POINTS ON BOUNDARY LINE 1 = 8
 1  X COORD.=-100            Y COORD.= 14
 2  X COORD.= 0              Y COORD.= 14
 3  X COORD.= 22             Y COORD.= 6
 4  X COORD.= 84             Y COORD.= 6
 5  X COORD.= 128            Y COORD.= 24
 6  X COORD.= 136            Y COORD.= 42
 7  X COORD.= 198            Y COORD.= 48
 8  X COORD.= 300            Y COORD.= 48

NO. OF POINTS ON BOUNDARY LINE 2 = 2
 1  X COORD.= 162            Y COORD.= 57
 2  X COORD.= 162            Y COORD.= 55

NO. OF POINTS ON BOUNDARY LINE 3 = 2
 1  X COORD.= 136            Y COORD.= 58
 2  X COORD.= 136            Y COORD.= 56

NO. OF POINTS ON BOUNDARY LINE 4 = 5
 1  X COORD.= 136            Y COORD.= 58
 2  X COORD.= 162            Y COORD.= 57
 3  X COORD.= 188            Y COORD.= 55
 4  X COORD.= 198            Y COORD.= 53
 5  X COORD.= 300            Y COORD.= 53

NO. OF POINTS ON BOUNDARY LINE 5 = 13
 1  X COORD.=-100            Y COORD.= 29
 2  X COORD.= 0              Y COORD.= 29
 3  X COORD.= 14             Y COORD.= 27
 4  X COORD.= 22             Y COORD.= 24
 5  X COORD.= 23             Y COORD.= 24
 6  X COORD.= 30             Y COORD.= 27
 7  X COORD.= 53             Y COORD.= 32
 8  X COORD.= 104            Y COORD.= 57
 9  X COORD.= 114            Y COORD.= 58
 10 X COORD.= 136            Y COORD.= 58
 11 X COORD.= 136            Y COORD.= 64
 12 X COORD.= 198            Y COORD.= 64
 13 X COORD.= 300            Y COORD.= 64

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
```

```
 1        +0.000      -0.364      +0.000      +0.409      +2.250      +0.097
          +0.000
 2    +99999.000
 3    +99999.000
 4        -0.038      -0.077      -0.200      +0.000
 5        +0.000      -0.143      -0.375      +0.000      +0.429      +0.217
          +0.490      +0.100      +0.000 +99999.000      +0.000      +0.000

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 3

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 0
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1

FOR ZONE 1     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8

RADIUS DECREMENT FOR ZONE 2 = 0
NO. OF CIRCLES FOR ZONE 2 = 10
ID NO. FOR FIRST CIRCLE FOR ZONE 2 = 1
NO. OF BOTTOM LINES FOR ZONE 2 = 2

FOR ZONE 2     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8
FOR ZONE 2     LINE SEQUENCE 2
LINE NO.= 3    BEG. NO.= 2    END NO.= 1

RADIUS DECREMENT FOR ZONE 3 = 0
NO. OF CIRCLES FOR ZONE 3 = 0
ID NO. FOR FIRST CIRCLE FOR ZONE 3 = 1
NO. OF BOTTOM LINES FOR ZONE 3 = 2

FOR ZONE 3     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8
FOR ZONE 3     LINE SEQUENCE 2
LINE NO.= 2    BEG. NO.= 2    END NO.= 1
UNIT WEIGHT OF WATER= 62.4

SOIL NO.       COHESION       FRIC. ANGLE    UNIT WEIGHT
 1              10             23             125
 2              10             23             125
 3              10             23             125
 4              .0001          0              135

NO SEEPAGE
USE GRID
NO. OF SLICES= 20
NO. OF ADD. RADII= 3
ANALYSIS BY MODIFIED SPENCER METHOD (MTHD=4)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 20       Y COORD.= 140
POINT 2 X COORD.= 20       Y COORD.= 64
POINT 3 X COORD.= 100      Y COORD.= 64

X INCREMENT= 4                Y INCREMENT= 4
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
```

NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES
AND CONVERGE INDICATES HOW MANY FACTORS OF SAFETY NOT CONVERGED

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING	CONVERGE
20	140	1	1	127.577	2.433	0	0
20	124.8	1	1	112.591	2.621	0	0
20	109.6	1	1	97.670	3.049	0	0
20	94.40001	1	1	82.850	3.845	0	0
20	79.20001	1	1	68.199	5.338	0	0
20	64.00002	1	1	53.825	8.835	0	0
40	140	1	1	132.197	2.079	0	0
40	124.8	1	1	117.799	2.134	0	0
40	109.6	1	1	103.514	2.191	0	0
40	94.40001	1	1	88.400	2.203	0	0
40	79.20001	1	1	73.200	2.306	0	0
40	64.00002	1	1	58.000	2.613	0	0
60	140	1	1	124.016	1.595	0	0
60	124.8	1	1	112.391	1.689	0	0
60	109.6	1	1	101.714	1.840	0	

60	94.40001	1	1	88.400	1.911	0
0						
60	79.20001	1	1	73.200	1.914	0
0						
60	64.00002	1	1	58.000	1.939	0
0						
80	140	1	1	112.872	1.653	0
0						
80	124.8	1	1	99.959	1.644	0
0						
80	109.6	1	1	87.782	1.672	0
0						
80	94.40001	1	1	76.693	1.761	0
0						
80	79.20001	1	1	67.230	1.961	0
0						
80	64.00002	1	1	55.196	2.262	0
0						
100	140	1	1	104.403	2.088	0
0						
100	124.8	1	1	90.288	2.055	0
0						
100	109.6	1	1	76.588	2.050	0
0						
100	94.40001	1	1	63.575	2.107	0
0						
100	79.20001	1	1	51.767	2.312	0
0						
100	64.00002	1	1	42.190	2.325	0
1						

AT POINT (60 140) RADIUS 124.016

THE MINIMUM FACTOR OF SAFETY IS 1.595

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES
AND CONVERGE INDICATES HOW MANY FACTORS OF SAFETY NOT CONVERGED

CENTER X CONVERGE COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING
60	140	1	1	124.016	1.595	0
0						
64	140	1	1	121.606	1.563	0
0						
68	140	1	1	119.281	1.571	0
0						
64	144	1	1	124.852	1.558	0
0						
64	148	1	1	128.141	1.555	0
0						
64	152	1	1	131.469	1.553	0
0						
64	156	1	1	134.833	1.552	0
0						
64	160	1	1	138.232	1.553	0
0						
68	156	1	1	132.740	1.567	0
0						
60	156	1	1	137.011	1.540	0
0						
56	156	1	1	139.270	1.611	0
0						
60	160	1	1	140.357	1.539	0
0						
60	164	1	1	143.736	1.539	0
0						
64	160	1	1	138.232	1.553	0
0						
56	160	1	1	142.562	1.595	0
0						
61	160	1	1	139.818	1.542	0
0						
59	160	1	1	140.901	1.536	0
0						
58	160	1	1	141.450	1.557	0
0						
59	161	1	1	141.739	1.536	0
0						

59	162	1	1	142.580	1.536	0
0						
59	163	1	1	143.422	1.536	0
0						
59	164	1	1	144.267	1.536	0
0						
60	163	1	1	142.888	1.539	0
0						
58	163	1	1	143.962	1.549	0
0						

AT POINT (59 163) RADIUS 143.422

THE MINIMUM FACTOR OF SAFETY IS 1.536

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	BOTTOM TAN	BOTTOM SHEAR	INTERSLICE FORCE NORMAL	INTERSLICE FORCE SHEAR	RESISTING FORCE	DRIVING FORCE	THRUST HEIGHT
					0.000E+00				0.000
1	1	6.754	-0.232	0.741E+03	0.129E+04	0.366E+03	0.117E+04	-.530E+03	1.743
2	1	0.223	-0.206	0.456E+02	0.137E+04	0.388E+03	0.715E+02	-.303E+02	1.751
3	1	6.976	-0.179	0.184E+04	0.432E+04	0.123E+04	0.287E+04	-.108E+04	2.684
4	1	6.976	-0.129	0.250E+04	0.794E+04	0.225E+04	0.388E+04	-.109E+04	3.685
5	1	6.976	-0.079	0.303E+04	0.118E+05	0.336E+04	0.467E+04	-.835E+03	4.598
6	1	1.848	-0.048	0.875E+03	0.128E+05	0.365E+04	0.135E+04	-.149E+03	4.821
7	1	5.128	-0.024	0.270E+04	0.158E+05	0.448E+04	0.415E+04	-.229E+03	5.361
8	1	6.976	0.018	0.435E+04	0.198E+05	0.563E+04	0.668E+04	0.286E+03	5.929
9	1	6.976	0.067	0.502E+04	0.236E+05	0.671E+04	0.773E+04	0.123E+04	6.369
10	1	6.976	0.116	0.559E+04	0.269E+05	0.763E+04	0.864E+04	0.239E+04	6.705
11	1	6.976	0.166	0.606E+04	0.293E+05	0.831E+04	0.943E+04	0.374E+04	6.944
12	1	6.976	0.218	0.644E+04	0.306E+05	0.870E+04	0.101E+05	0.522E+04	7.089
13	1	6.976	0.271	0.674E+04	0.308E+05	0.875E+04	0.107E+05	0.681E+04	7.144
14	1	4.014	0.314	0.398E+04	0.303E+05	0.861E+04	0.641E+04	0.466E+04	7.139
15	1	2.963	0.343	0.292E+04	0.297E+05	0.843E+04	0.474E+04	0.372E+04	7.118
16	1	7.037	0.385	0.658E+04	0.273E+05	0.777E+04	0.108E+05	0.939E+04	6.993

17	1	6.916	0.446	0.585E+04	0.241E+05	0.686E+04	0.983E+04	0.961E+04
6.730								
18	1	6.976	0.512	0.512E+04	0.203E+05	0.577E+04	0.884E+04	0.956E+04
6.252								
19	1	6.976	0.585	0.425E+04	0.163E+05	0.464E+04	0.757E+04	0.893E+04
5.434								
20	1	1.132	0.630	0.601E+03	0.157E+05	0.446E+04	0.109E+04	0.134E+04
5.255								
21	1	5.845	0.671	0.390E+04	0.112E+05	0.317E+04	0.721E+04	0.923E+04
4.670								
22	1	6.976	0.754	0.365E+04	0.624E+04	0.177E+04	0.703E+04	0.949E+04
3.784								
23	1	7.050	0.857	0.244E+04	0.250E+04	0.709E+03	0.493E+04	0.696E+04
2.396								
24	4	6.903	0.979	0.629E-03	0.195E-02	0.000E+00	0.135E-02	0.250E+04
0.000								
		SUM					0.140E+06	0.911E+05

AT CENTER (59.000, 163.000) WITH RADIUS 143.422 AND SEISMIC COEFF. 0.00
FROM MODIFIED SPENCER METHOD, DEL ANGLE = 0.277 AND FACTOR OF SAFETY IS 1.536

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INPUT FILE NAME -RAMPBSUR.DAT

TITLE -RAMP B RETAINING WALL - W/ SURCHARGE FROM ROADWAY FILL
(9 FT. EMBANKMENT NOT GIVEN SHEAR STRENGTH)

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0

CASE NO. 1 SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 5

NO. OF POINTS ON BOUNDARY LINE 1 = 8
1 X COORD.=-100 Y COORD.= 14
2 X COORD.= 0 Y COORD.= 14
3 X COORD.= 22 Y COORD.= 6
4 X COORD.= 84 Y COORD.= 6
5 X COORD.= 128 Y COORD.= 24
6 X COORD.= 136 Y COORD.= 42
7 X COORD.= 198 Y COORD.= 48
8 X COORD.= 300 Y COORD.= 48

NO. OF POINTS ON BOUNDARY LINE 2 = 2
1 X COORD.= 162 Y COORD.= 57
2 X COORD.= 162 Y COORD.= 55

NO. OF POINTS ON BOUNDARY LINE 3 = 2
1 X COORD.= 136 Y COORD.= 58
2 X COORD.= 136 Y COORD.= 56

NO. OF POINTS ON BOUNDARY LINE 4 = 5
1 X COORD.= 136 Y COORD.= 58
2 X COORD.= 162 Y COORD.= 57
3 X COORD.= 188 Y COORD.= 55
4 X COORD.= 198 Y COORD.= 53
5 X COORD.= 300 Y COORD.= 53

NO. OF POINTS ON BOUNDARY LINE 5 = 13
1 X COORD.=-100 Y COORD.= 29
2 X COORD.= 0 Y COORD.= 29
3 X COORD.= 14 Y COORD.= 27
4 X COORD.= 22 Y COORD.= 24
5 X COORD.= 23 Y COORD.= 24
6 X COORD.= 30 Y COORD.= 27
7 X COORD.= 53 Y COORD.= 32
8 X COORD.= 104 Y COORD.= 57
9 X COORD.= 114 Y COORD.= 58
10 X COORD.= 136 Y COORD.= 58
11 X COORD.= 136 Y COORD.= 67
12 X COORD.= 198 Y COORD.= 67
13 X COORD.= 300 Y COORD.= 67

LINE NO. AND SLOPE OF EACH SEGMENT ARE:

```
 1        +0.000      -0.364      +0.000      +0.409      +2.250      +0.097
          +0.000
 2    +99999.000
 3    +99999.000
 4        -0.038      -0.077      -0.200      +0.000
 5        +0.000      -0.143      -0.375      +0.000      +0.429      +0.217
          +0.490      +0.100      +0.000 +99999.000      +0.000      +0.000

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 3

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 0
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1

FOR ZONE 1     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8

RADIUS DECREMENT FOR ZONE 2 = 0
NO. OF CIRCLES FOR ZONE 2 = 10
ID NO. FOR FIRST CIRCLE FOR ZONE 2 = 1
NO. OF BOTTOM LINES FOR ZONE 2 = 2

FOR ZONE 2     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8
FOR ZONE 2     LINE SEQUENCE 2
LINE NO.= 3    BEG. NO.= 2    END NO.= 1

RADIUS DECREMENT FOR ZONE 3 = 0
NO. OF CIRCLES FOR ZONE 3 = 0
ID NO. FOR FIRST CIRCLE FOR ZONE 3 = 1
NO. OF BOTTOM LINES FOR ZONE 3 = 2

FOR ZONE 3     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8
FOR ZONE 3     LINE SEQUENCE 2
LINE NO.= 2    BEG. NO.= 2    END NO.= 1
UNIT WEIGHT OF WATER= 62.4

SOIL NO.       COHESION       FRIC. ANGLE    UNIT WEIGHT
 1              10             23             125
 2              10             23             125
 3              10             23             125
 4              .0001          0              135

NO SEEPAGE
USE GRID
NO. OF SLICES= 20
NO. OF ADD. RADII= 3
ANALYSIS BY MODIFIED SPENCER METHOD (MTHD=4)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 20       Y COORD.= 140
POINT 2 X COORD.= 20       Y COORD.= 64
POINT 3 X COORD.= 100      Y COORD.= 64

X INCREMENT= 4                Y INCREMENT= 4
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
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NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES
AND CONVERGE INDICATES HOW MANY FACTORS OF SAFETY NOT CONVERGED

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING	CONVERGE
20	140	1	1	127.577	2.433	0	0
20	124.8	1	1	112.591	2.621	0	0
20	109.6	1	1	97.670	3.049	0	0
20	94.40001	1	1	82.850	3.845	0	0
20	79.20001	1	1	68.199	5.338	0	0
20	64.00002	1	1	53.825	8.835	0	0
40	140	1	1	132.197	2.006	0	0
40	124.8	1	1	117.799	2.090	0	0
40	109.6	1	1	103.514	2.191	0	0
40	94.40001	1	1	88.400	2.203	0	0
40	79.20001	1	1	73.200	2.306	0	0
40	64.00002	1	1	58.000	2.613	0	0
60	140	1	1	124.016	1.517	0	0
60	124.8	1	1	112.391	1.617	0	0
60	109.6	1	1	101.714	1.775	0	

60	94.40001	1	1	88.400	1.872	0
60	79.20001	1	1	73.200	1.914	0
60	64.00002	1	1	58.000	1.939	0
80	140	1	1	112.872	1.529	0
80	124.8	1	1	99.959	1.534	0
80	109.6	1	1	87.782	1.575	0
80	94.40001	1	1	76.693	1.679	0
80	79.20001	1	1	67.230	1.897	0
80	64.00002	1	1	55.196	2.262	0
100	140	1	1	104.403	1.832	0
100	124.8	1	1	90.288	1.811	0
100	109.6	1	1	76.588	1.821	0
100	94.40001	1	1	63.575	1.896	0
100	79.20001	1	1	51.767	2.122	0
100	64.00002	1	1	42.190	1.832	0

AT POINT (60 140) RADIUS 124.016

THE MINIMUM FACTOR OF SAFETY IS 1.517

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES
AND CONVERGE INDICATES HOW MANY FACTORS OF SAFETY NOT CONVERGED

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING CONVERGE
60	140	1	1	124.016	1.517	0
64	140	1	1	121.606	1.481	0
68	140	1	1	119.281	1.481	0
72	140	1	1	117.047	1.485	0
68	144	1	1	122.589	1.476	0
68	148	1	1	125.936	1.472	0
68	152	1	1	129.321	1.469	0
68	156	1	1	132.740	1.468	0
68	160	1	1	136.191	1.468	0
68	164	1	1	139.671	1.469	0
72	160	1	1	134.239	1.485	0
64	160	1	1	138.232	1.460	0
60	160	1	1	140.357	1.455	0
56	160	1	1	142.562	1.511	0
60	164	1	1	143.736	1.453	0
60	168	1	1	147.146	1.452	0
60	172	1	1	150.586	1.451	0
60	176	1	1	154.052	1.452	0
64	172	1	1	148.607	1.460	0

56	172	1	1	152.643	1.471	0
0						
61	172	1	1	150.083	1.454	0
0						
59	172	1	1	151.093	1.450	0
0						
58	172	1	1	151.605	1.448	0
0						
57	172	1	1	152.122	1.456	0
0						
58	173	1	1	152.463	1.448	0
0						
58	174	1	1	153.323	1.448	0
0						
58	175	1	1	154.185	1.448	0
0						
59	174	1	1	152.817	1.450	0
0						
57	174	1	1	153.834	1.445	0
0						
56	174	1	1	154.350	1.466	0
0						
57	175	1	1	154.693	1.445	0
0						
57	176	1	1	155.554	1.445	0
0						
58	175	1	1	154.185	1.448	0
0						
56	175	1	1	155.206	1.464	0
0						

AT POINT (57 175) RADIUS 154.693

THE MINIMUM FACTOR OF SAFETY IS 1.445

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	BOTTOM TAN	BOTTOM SHEAR	INTERSLICE FORCE NORMAL	INTERSLICE FORCE SHEAR	RESISTING FORCE	DRIVING FORCE	THRUST HEIGHT
					0.000E+00				0.000
1	1	6.863	-0.201	0.772E+03	0.124E+04	0.376E+03	0.114E+04	-.454E+03	1.730

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  2    1   0.368 -0.176 0.777E+02 0.136E+04 0.413E+03 0.114E+03 -.420E+02
1.745
  3    1   7.231 -0.150 0.197E+04 0.428E+04 0.130E+04 0.287E+04 -.927E+03
2.720
  4    1   7.231 -0.103 0.267E+04 0.784E+04 0.238E+04 0.388E+04 -.883E+03
3.752
  5    1   7.231 -0.055 0.323E+04 0.117E+05 0.354E+04 0.467E+04 -.588E+03
4.695
  6    1   0.940 -0.029 0.452E+03 0.122E+05 0.369E+04 0.654E+03 -.435E+02
4.809
  7    1   6.291 -0.006 0.341E+04 0.156E+05 0.474E+04 0.494E+04 -.633E+02
5.468
  8    1   7.231  0.038 0.473E+04 0.198E+05 0.599E+04 0.684E+04 0.615E+03
6.047
  9    1   7.231  0.085 0.546E+04 0.236E+05 0.716E+04 0.793E+04 0.161E+04
6.504
 10    1   7.231  0.133 0.608E+04 0.270E+05 0.817E+04 0.887E+04 0.281E+04
6.860
 11    1   7.231  0.181 0.659E+04 0.295E+05 0.893E+04 0.968E+04 0.419E+04
7.122
 12    1   7.231  0.231 0.700E+04 0.310E+05 0.939E+04 0.104E+05 0.569E+04
7.290
 13    1   7.231  0.283 0.732E+04 0.313E+05 0.948E+04 0.110E+05 0.729E+04
7.368
 14    1   1.325  0.314 0.137E+04 0.312E+05 0.946E+04 0.207E+04 0.151E+04
7.373
 15    1   5.906  0.341 0.594E+04 0.303E+05 0.920E+04 0.907E+04 0.714E+04
7.357
 16    1   4.094  0.380 0.390E+04 0.293E+05 0.888E+04 0.603E+04 0.521E+04
7.299
 17    1   3.137  0.409 0.284E+04 0.283E+05 0.858E+04 0.444E+04 0.407E+04
7.221
 18    1   7.231  0.452 0.596E+04 0.254E+05 0.771E+04 0.945E+04 0.940E+04
6.896
 19    1   7.231  0.516 0.506E+04 0.221E+05 0.670E+04 0.824E+04 0.902E+04
6.277
 20    1   4.402  0.572 0.260E+04 0.200E+05 0.607E+04 0.433E+04 0.508E+04
5.687
 21    1   2.829  0.609 0.239E+04 0.179E+05 0.542E+04 0.405E+04 0.496E+04
5.457
 22    1   7.231  0.663 0.534E+04 0.124E+05 0.376E+04 0.926E+04 0.119E+05
4.699
 23    1   7.231  0.748 0.412E+04 0.743E+04 0.225E+04 0.743E+04 0.101E+05
3.554
 24    1   3.955  0.823 0.167E+04 0.518E+04 0.157E+04 0.313E+04 0.442E+04
2.602
 25    4   3.276  0.875 0.301E-03 0.260E+04 0.790E+03 0.579E-03 0.257E+04
2.374
 26    4   7.231  0.960 0.694E-03 -.732E-03 0.000E+00 0.139E-02 0.260E+04
0.000
           SUM                                          0.140E+06 0.972E+05

AT CENTER (   57.000,   175.000) WITH RADIUS    154.693 AND SEISMIC
COEFF.  0.00
FROM MODIFIED SPENCER METHOD, DEL ANGLE = 0.294 AND FACTOR OF SAFETY IS
1.445
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INPUT FILE NAME -RAMPBSUR.DAT

TITLE -RAMP B RETAINING WALL - W/ SURCHARGE FROM ROADWAY FILL
(9 FT. EMBANKMENT FILL GIVEN SHEAR STRENGTH)

NO. OF STATIC AND SEISMIC CASES- 1

NO. OF NONCIRCULAR SLIP SURFACES= 0


CASE NO. 1     SEISMIC COEFFICIENT= 0

NO. OF BOUNDARY LINES= 5

NO. OF POINTS ON BOUNDARY LINE 1 = 8
 1  X COORD.=-100            Y COORD.= 14
 2  X COORD.= 0              Y COORD.= 14
 3  X COORD.= 22             Y COORD.= 6
 4  X COORD.= 84             Y COORD.= 6
 5  X COORD.= 128            Y COORD.= 24
 6  X COORD.= 136            Y COORD.= 42
 7  X COORD.= 198            Y COORD.= 48
 8  X COORD.= 300            Y COORD.= 48

NO. OF POINTS ON BOUNDARY LINE 2 = 2
 1  X COORD.= 162            Y COORD.= 57
 2  X COORD.= 162            Y COORD.= 55

NO. OF POINTS ON BOUNDARY LINE 3 = 2
 1  X COORD.= 136            Y COORD.= 58
 2  X COORD.= 136            Y COORD.= 56

NO. OF POINTS ON BOUNDARY LINE 4 = 5
 1  X COORD.= 136            Y COORD.= 58
 2  X COORD.= 162            Y COORD.= 57
 3  X COORD.= 188            Y COORD.= 55
 4  X COORD.= 198            Y COORD.= 53
 5  X COORD.= 300            Y COORD.= 53

NO. OF POINTS ON BOUNDARY LINE 5 = 13
 1  X COORD.=-100            Y COORD.= 29
 2  X COORD.= 0              Y COORD.= 29
 3  X COORD.= 14             Y COORD.= 27
 4  X COORD.= 22             Y COORD.= 24
 5  X COORD.= 23             Y COORD.= 24
 6  X COORD.= 30             Y COORD.= 27
 7  X COORD.= 53             Y COORD.= 32
 8  X COORD.= 104            Y COORD.= 57
 9  X COORD.= 114            Y COORD.= 58
 10 X COORD.= 136            Y COORD.= 58
 11 X COORD.= 136            Y COORD.= 67
 12 X COORD.= 198            Y COORD.= 67
 13 X COORD.= 300            Y COORD.= 67

LINE NO. AND SLOPE OF EACH SEGMENT ARE:
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```
 1        +0.000      -0.364      +0.000      +0.409      +2.250      +0.097
          +0.000
 2    +99999.000
 3    +99999.000
 4        -0.038      -0.077      -0.200      +0.000
 5        +0.000      -0.143      -0.375      +0.000      +0.429      +0.217
          +0.490      +0.100      +0.000 +99999.000      +0.000      +0.000

MIN. DEPTH OF TALLEST SLICE= 0
NO. OF RADIUS CONTROL ZONES= 3

RADIUS DECREMENT FOR ZONE 1 = 0
NO. OF CIRCLES FOR ZONE 1 = 0
ID NO. FOR FIRST CIRCLE FOR ZONE 1 = 1
NO. OF BOTTOM LINES FOR ZONE 1 = 1

FOR ZONE 1     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8

RADIUS DECREMENT FOR ZONE 2 = 0
NO. OF CIRCLES FOR ZONE 2 = 10
ID NO. FOR FIRST CIRCLE FOR ZONE 2 = 1
NO. OF BOTTOM LINES FOR ZONE 2 = 2

FOR ZONE 2     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8
FOR ZONE 2     LINE SEQUENCE 2
LINE NO.= 3    BEG. NO.= 2    END NO.= 1

RADIUS DECREMENT FOR ZONE 3 = 0
NO. OF CIRCLES FOR ZONE 3 = 0
ID NO. FOR FIRST CIRCLE FOR ZONE 3 = 1
NO. OF BOTTOM LINES FOR ZONE 3 = 2

FOR ZONE 3     LINE SEQUENCE 1
LINE NO.= 1    BEG. NO.= 1    END NO.= 8
FOR ZONE 3     LINE SEQUENCE 2
LINE NO.= 2    BEG. NO.= 2    END NO.= 1
UNIT WEIGHT OF WATER= 62.4

SOIL NO.       COHESION       FRIC. ANGLE    UNIT WEIGHT
 1              10             23             125
 2              10             23             125
 3              10             23             125
 4              0              38             135

NO SEEPAGE
USE GRID
NO. OF SLICES= 20
NO. OF ADD. RADII= 3
ANALYSIS BY MODIFIED SPENCER METHOD (MTHD=4)
NUMBER OF FORCES (NFO)= 0
SOFT SOIL NUMBER (SSN)= 0
INPUT COORD. OF GRID POINTS 1,2,AND 3

POINT 1 X COORD.= 20       Y COORD.= 140
POINT 2 X COORD.= 20       Y COORD.= 64
POINT 3 X COORD.= 100      Y COORD.= 64

X INCREMENT= 4                Y INCREMENT= 4
NO. OF DIVISIONS BETWEEN POINTS 1 AND 2= 5
```

NO. OF DIVISIONS BETWEEN POINTS 2 AND 3= 4
ONLY F. S. AT EACH CENTER WILL BE PRINTED
SLICES WILL BE SUBDIVIDED

AUTOMATIC SEARCH WILL FOLLOW AFTER GRID

FACTORS OF SAFETY BASED ON GRID

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES
AND CONVERGE INDICATES HOW MANY FACTORS OF SAFETY NOT CONVERGED

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING	CONVERGE
20	140	1	1	127.577	2.433	0	0
20	124.8	1	1	112.591	2.621	0	0
20	109.6	1	1	97.670	3.049	0	0
20	94.40001	1	1	82.850	3.845	0	0
20	79.20001	1	1	68.199	5.338	0	0
20	64.00002	1	1	53.825	8.835	0	0
40	140	1	1	132.197	2.040	0	0
40	124.8	1	1	117.799	2.121	0	0
40	109.6	1	1	103.514	2.191	0	0
40	94.40001	1	1	88.400	2.203	0	0
40	79.20001	1	1	73.200	2.306	0	0
40	64.00002	1	1	58.000	2.613	0	0
60	140	1	1	124.016	1.552	0	0
60	124.8	1	1	112.391	1.645	0	0
60	109.6	1	1	101.714	1.797	0	

60	94.40001	1	1	88.400	1.890	0
0						
60	79.20001	1	1	73.200	1.914	0
0						
60	64.00002	1	1	58.000	1.939	0
0						
80	140	1	1	112.872	1.591	0
0						
80	124.8	1	1	99.959	1.583	0
0						
80	109.6	1	1	87.782	1.611	0
0						
80	94.40001	1	1	76.693	1.705	0
0						
80	79.20001	1	1	67.230	1.918	0
0						
80	64.00002	1	1	55.196	2.262	0
0						
100	140	1	1	104.403	1.956	0
0						
100	124.8	1	1	90.288	1.913	0
0						
100	109.6	1	1	76.588	1.902	0
0						
100	94.40001	1	1	63.575	1.957	0
0						
100	79.20001	1	1	51.767	2.167	0
0						
100	64.00002	1	1	42.190	2.806	0
0						

AT POINT (60 140) RADIUS 124.016

THE MINIMUM FACTOR OF SAFETY IS 1.552

FACTORS OF SAFETY BASED ON SEARCH

IN THE FOLLOWING TABLE WARNING INDICATES HOW MANY TIMES THE
MAXIMUM RADIUS IS LIMITED BY THE END POINTS OF GROUND LINES
AND CONVERGE INDICATES HOW MANY FACTORS OF SAFETY NOT CONVERGED

CENTER X COORDINATE	CENTER Y COORDINATE	NO. OF CIRCLE TOTAL	CRITIC.	RADIUS	LOWEST F.S.	WARNING CONVERGE
60	140	1	1	124.016	1.552	0
64	140	1	1	121.606	1.520	0
68	140	1	1	119.281	1.524	0
64	144	1	1	124.852	1.515	0
64	148	1	1	128.141	1.512	0
64	152	1	1	131.469	1.511	0
64	156	1	1	134.833	1.511	0
64	160	1	1	138.232	1.512	0
68	156	1	1	132.740	1.522	0
60	156	1	1	137.011	1.501	0
56	156	1	1	139.270	1.569	0
60	160	1	1	140.357	1.501	0
60	164	1	1	143.736	1.501	0
64	160	1	1	138.232	1.512	0
56	160	1	1	142.562	1.554	0
61	160	1	1	139.818	1.503	0
59	160	1	1	140.901	1.498	0
58	160	1	1	141.450	1.517	0
59	161	1	1	141.739	1.498	0

59 159 1 1 140.064 1.505 0
0

AT POINT (59 160) RADIUS 140.901

THE MINIMUM FACTOR OF SAFETY IS 1.498

SUMMARY OF SLICE INFORMATION FOR MOST CRITICAL SLIP SURFACE

SL. NO.	SOIL NO.	SLICE WIDTH	BOTTOM TAN	BOTTOM SHEAR	INTERSLICE FORCE NORMAL	INTERSLICE FORCE SHEAR	RESISTING FORCE	DRIVING FORCE	THRUST HEIGHT
					0.000E+00				0.000
1	1	0.838	-0.268	0.115E+02	0.162E+02	0.469E+01	0.178E+02	-.441E+01	0.233
2	1	6.297	-0.240	0.747E+03	0.132E+04	0.382E+03	0.115E+04	-.537E+03	1.690
3	1	0.703	-0.213	0.155E+03	0.158E+04	0.458E+03	0.237E+03	-.103E+03	1.735
4	1	6.431	-0.186	0.183E+04	0.453E+04	0.131E+04	0.278E+04	-.109E+04	2.670
5	1	7.134	-0.136	0.272E+04	0.850E+04	0.246E+04	0.412E+04	-.122E+04	3.751
6	1	7.134	-0.085	0.330E+04	0.128E+05	0.369E+04	0.496E+04	-.942E+03	4.725
7	1	2.300	-0.051	0.116E+04	0.141E+05	0.408E+04	0.174E+04	-.202E+03	5.013
8	1	4.834	-0.025	0.270E+04	0.171E+05	0.493E+04	0.404E+04	-.237E+03	5.542
9	1	7.134	0.017	0.468E+04	0.215E+05	0.620E+04	0.701E+04	0.280E+03	6.150
10	1	7.134	0.068	0.540E+04	0.256E+05	0.739E+04	0.810E+04	0.130E+04	6.617
11	1	7.134	0.119	0.599E+04	0.290E+05	0.839E+04	0.904E+04	0.257E+04	6.971
12	1	7.134	0.171	0.648E+04	0.316E+05	0.913E+04	0.985E+04	0.402E+04	7.216
13	1	7.134	0.225	0.687E+04	0.330E+05	0.954E+04	0.105E+05	0.563E+04	7.357
14	1	7.134	0.281	0.717E+04	0.331E+05	0.958E+04	0.112E+05	0.733E+04	7.396
15	1	3.360	0.323	0.345E+04	0.327E+05	0.945E+04	0.544E+04	0.406E+04	7.381
16	1	3.774	0.353	0.383E+04	0.318E+05	0.920E+04	0.609E+04	0.492E+04	7.337
17	1	6.226	0.396	0.599E+04	0.297E+05	0.858E+04	0.965E+04	0.860E+04	7.184
18	1	0.909	0.428	0.835E+03	0.293E+05	0.847E+04	0.136E+04	0.129E+04	7.151
19	1	7.134	0.466	0.611E+04	0.258E+05	0.746E+04	0.101E+05	0.102E+05	6.776
20	1	7.134	0.536	0.524E+04	0.218E+05	0.630E+04	0.890E+04	0.998E+04	6.106
21	1	6.823	0.612	0.411E+04	0.178E+05	0.515E+04	0.721E+04	0.878E+04	5.019
22	1	0.312	0.654	0.264E+03	0.175E+05	0.507E+04	0.472E+03	0.599E+03	4.986

```
 23    1    7.134   0.701 0.546E+04 0.111E+05 0.320E+04 0.998E+04 0.131E+05
4.111
 24    1    7.134   0.800 0.424E+04 0.516E+04 0.149E+04 0.813E+04 0.113E+05
3.091
 25    1    4.836   0.896 0.208E+04 0.190E+04 0.550E+03 0.419E+04 0.605E+04
2.941
 26    4    2.298   0.960 0.119E+04 0.118E+04 0.341E+03 0.248E+04 0.238E+04
2.732
 27    4    7.134   1.055 0.167E+04 0.134E-02 0.000E+00 0.365E+04 0.361E+04
0.000
           SUM                                                 0.152E+06 0.102E+06

AT CENTER (    59.000,    160.000) WITH RADIUS     140.901 AND SEISMIC
COEFF.   0.00
FROM MODIFIED SPENCER METHOD, DEL ANGLE = 0.282 AND FACTOR OF SAFETY IS
1.498
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DESIGN SUMMARY TABLES
Retaining Wall Design Recommendations
Foundation Design Recommendation

SUMMARY TABLE I

SUMMARY OF RAMP B RETAINING WALL DESIGN RECOMMENDATIONS

Lateral Earth Pressure Coefficients (Gravel Backfill)		
K_i	Coefficient	Equivalent Fluid Pressure
K_a (Active)	0.28	5.72 kPa/m depth
K_o (At Rest)	0.44	8.98 kPa/m depth
K_p (Passive)	3.57	72.93 kPa/m depth

Lateral Earth Pressure Coefficients (Silty Clay / In-situ Soil Backfill)		
K_i	Coefficient	Equivalent Fluid Pressure
K_a (Active)	0.49	9.24 kPa/m depth
K_o (At Rest)	0.65	12.26 kPa/m depth
K_p (Passive)	2.04	38.49 kPa/m depth

When utilizing the aforementioned pressure coefficients, the granular backfill must occupy a zone between the wall and a line extending upward and away from the base of the wall at a 45°angle.

SUMMARY TABLE II

SUMMARY OF FOUNDATION DESIGN RECOMMENDATIONS

Wall/Foundation Type	Bearing Stratum	Allowable Side Shear	Allowable Point Bearing	Allowable Axial Pile Load Per Pile	Installation Method	Pile Tip Reinforcement	Allowable Bearing Pressure	Modulus of Subgrade Reaction	Coefficient of Friction
M.S.E. w/ Spread Foundation	Gravel filled trench / gray sandy clay	N/A	N/A	N/A	N/A	N/A	190 kPa	27 N/cm	0.58
Concrete Wall on drilled piers	Weathered Shale/Hard Residual Silty Clay	35 kPa	475 kPa	N/A	Pre-drilled H-Piles or small diameter drilled pier	N/A	N/A	N/A	N/A

RESOURCE
INTERNATIONAL
ENGINEERING CONSULTANTS

PRELIMINARY SUBSURFACE INVESTIGATION REPORT

ATH/MEG-033-30.980/0.000
North Section, from Station 29+534 to 44+134
Athens County, Ohio

Prepared For:

Sverdrup Associates, Inc.
50 West Broad Street, Suite 1700
Columbus, Ohio 43214

Prepared By:

Resource International, Inc.
281 Enterprise Drive
Westerville, Ohio 43081

RI# W-7139

May, 1998

WORLDWIDE PROFESSIONAL SERVICES ORGANIZATION

RESOURCE INTERNATIONAL
Engineering Consultants

Civil Engineering
Surveying and Mapping
Testing Laboratories
Geotechnical/Environmental
Environmental Drilling
Construction Management
System Design and
Software Development

May 22, 1998

Mr. Terry Winebrenner, P.E.
Sverdrup Associates, Inc.
50 West Broad Street, Suite 1700
Columbus, Ohio 43214

Re: **Preliminary Subsurface Investigation**
ATH/MEG-033-30.980/0.000
PID 17974
North Section, from Station 29+534 to 34+134
RI #W-7139

Dear Mr. Winebrenner:

We are pleased to submit this preliminary subsurface investigation report for the north section of the referenced project, ATH/MEG-033-30.980/0.000. In order to expedite the delivery of the subsurface investigation report for this project, the report has been divided into four (4) parts, north, south, north-central, and south-central. Engineering logs have been prepared and are attached to this report along with results of laboratory testing. Full size plan and profile sheets are being prepared, and will be submitted as a single submission for the entire project. For reference purposes, half-size plan and profile sheets for this section are being included in this submittal.

If you have any questions concerning the subsurface investigation or this report, please call.

Sincerely,

RESOURCE INTERNATIONAL, INC.

Christopher Merklin, P.E.
Director - Geotechnical Engineering

G. Philip Hall, P.E.
Vice President

TABLE OF CONTENTS

1.0 INTRODUCTION

This report is a presentation of the subsurface investigation performed for ATH/MEG-033-30.980/0.000 - north section. The north section limits, for the purpose of this report, are between Stations 29+534 and 34+134.

The subject project is the design of a "super two" lane highway system linking the four-lane existing portion of USR 33 at Athens with the existing four-lane portion of USR 33 at Darwin. The total project length is 19.858 kilometers. The northern two-thirds of the alignment is within Athens County, traversing Athens, Alexander and Lodi Townships. The southern one-third (of the alignment) is within Bedford Township in Meigs County.

1.1 EXISTING LAND USAGE

The land usage along the entire alignment is generally described as alternating forest and pasture with very few cultivated fields. Typically, the valleys and steeply sloping hills are tree covered, and the flatter sidehills and hilltops are pasture. The field observations along Corridor A, as presented in the Geologic Study performed for Feasible Corridors A and B, are indicative of the land usage along the alignment in this northern section. Because of the relief, the area is well drained with creeks at the bottom of every valley and drainage paths down the sides of most of the hills. Drainage paths are easily identifiable by the erosion of the easily erobable surficial red clays and/or mudstone/shale. The alignment is traversed several times, typically along ridge tops, by county and township roads, with rural residences and farms scattered throughout.

The steep slopes and flatter hilltops show evidence of movement which is very common for this area. Many of the pastures exibit hummocky terrain. Many signs of predominantly small surficial slumps have been observed on the steep slopes and near the valley bottoms, along creek beds. Much of the exposed red soils and rock (red beds) in the valleys and on the slopes show evidence of severe decomposition from erosion.

Coal mines are common in southeast Ohio. It was determined in the Geologic Study that there are one abandoned underground mine and three reclaimed strip mines within the Feasible Study Corridors, none of which are present within this northern section of the alignment.

1.2 SITE GEOLOGY

Both Athens County and Meigs County lie entirely within the unglaciated section of the Allegheny Plateau. The area is maturely dissected, well-drained and is characterized by steep-sides, "V" shaped valleys and narrowly rounded hilltops.

Elevations along the alignment range from approximately 200 meters at the southern most portion, at Darwin, to approximately 300 meters in the northern portion.

The uplands are covered with a thin layer of residual soils; soils formed in place by the disintegration and decomposition of rocks and the consequent weathering of the mineral materials. Soils consist predominantly of sands and clays, very similar to the shales, mudstones, and sandstones on which they lie. The transition to bedrock is very subtle, and in most cases, not clearly identifiable, unless the parent rock is sandstone, siltstone, or limestone.

Soils in the valleys are generally described as colluvial (consisting of alluvial in part) soils overlying residual soils. Colluvial soils (colluvium) are loose and incoherent deposits typically found at the foot of a slope or cliff, brought there chiefly by gravity. Alluvial soils (Alluvium) are (intermixed) water-laid deposits. Typically, soils in the valley run deeper than on the slopes and hilltops, however, the soils are similar to those on the hills, consisting predominantly of sand and clay, and the transition to bedrock is equally difficult to identify.

Both Athens and Meigs Counties, along the alignment, are comprised of bedrock of Pennsylvania Age. The rock strata in this area of southeastern Ohio dips gently to the east-southeast at a rate of approximately 6 meters per kilometer. The top of the Conemaugh formation is estimated to be between elevations 260 and 270 meters at the north end of the alignment. It slopes downward to the east-southeast until it is entirely below any influence on the subject alignment at approximately Station 40+250.

The bedrock was deposited under regular succession of varying environmental conditions that were repeated many times. As a result, the rocks show a definite succession of strata representing one sequence of changing sedimentary conditions. A sequence of strata matching one depositional cycle is termed a cyclothem. Cyclothems are typically associated with unstable shelf or interior basin conditions in which alternate marine transgressions and regressions occur. The non-marine sediments occur in the lower half of the cyclothem and the marine sediments in the upper half. In Ohio, each cyclothem is usually defined as the series between a coal-to-coal interval. The lithology of the rocks that comprise the Pennsylvania System in Ohio consist of alternating clay, coal, shale, limestone and sandstone beds. These beds lack a real persistence and vary greatly in thickness over a short distance.

1.2.1 CONEMAUGH FORMATION

The literature defines the upper boundary of the Conemaugh Formation as the top of the Upper Freeport No. 7 coal and the lower boundary being the base of the No.

8 Pittsburgh coal. The lithology of the Conemaugh consists of sandstone, sandy shale, shale, limestone, coal, under-clay and varicolored claystones (clay-shales, mudstones, etc.) referred to as "Red beds". Bedded marine shales and some thin marine limestone are present in the lower part of the series, whereas the upper part contains only non-marine strata, including abundant red calcareous claystones. Coal seams of minable thickness occur throughout the study area. The Conemaugh Formation has a reported thickness of approximately 108 meters.

1.2.2 MONONGAHELA FORMATION

The Monongahela Formation overlies the Conemaugh Formation. Its lower boundary is defined as the base of the No. 8 Pittsburgh coal and the upper limit is the top of the No. 1 Waynesburg coal bed. The lithology of the Monongahela Formation is similar to the upper portion of the Conemaugh Formation. The most significant difference is the occurrence of minable coal beds in the Monongahela in contrast to the thin coal beds of the Conemaugh only available by strip mining.

The Monongahela Formation is approximately 76 meters thick. A full thickness above drainage is displayed in Lodi and Bedford Townships. Athens and Alexander Townships show only parts of the Monongahela Series above drainage.

1.3 CUT/FILL SECTIONS

The entire alignment will be constructed on alternating, massive cuts (hilltops) and fills (valleys). The cut and fill sections projected for the north section are presented in Table 1 (based on centerline profiles).

Table 1: Cut/Fill Sections

Begin Station	End Station	Earthwork	Maximum Depth (Cut or Fill)
29+600	30+196	Cut	24 meters
30+196	30+248	Fill	1 meter
30+248	30+634	Cut	35 meters
30+634	30+885	Fill	18 meters
30+885	31+056	Cut	21 meters
31+056	31+366	Fill	24 meters
31+366	31+497	Cut	11 meters
31+497	31+906	Fill	42 meters

31+906	31+962	Cut	7 meters
31+962	32+290	Fill	32 meters
32+290	32+420	Cut	11 meters
32+420	33+283	Fill	36 meters
33+283	33+322	Cut	3 meters
33+322	33+866	Fill	25 meters
33+866	33+970	Cut	9 meters
33+970	34+204	Fill	19 meters

2.0 SUBSURFACE INVESTIGATION

Forty (40) engineering test borings, designated B-1 through B-40, were planned for the north section. At the time of this report, all borings except B-40 have been drilled. B-40 will be drilled as soon as access is granted by the landowner (Brad Harter).

The boring locations were specified (station and offset) by representatives of Resource International, Inc. (RI), based on the horizontal and vertical alignment current in December, 1997. It is noted that both the horizontal and vertical alignments have changed since the development and execution of this boring plan, thus, many of the borings extend to awkward depths and/or are located well off the alignment. The boring locations were converted to Project Coordinates and field located by representatives of Sverdrup Associates (Sverdrup), Canter Surveying, with the use of Global Positioning Satelite (GPS). Borings in cut sections were drilled along the alignment and left and/or right of centerline (within the proposed backslopes) to identify the soil and rock conditions in the cut sections and at the proposed subgrade. Borings in fill sections were drilled to a depth equivalent to the height of the proposed embankment or spoon refusal in bedrock, whichever was shallower.

All but four (4) of the borings in the north section were drilled with either a truck-mounted or ATV-mounted rotary drilling rig, utilizing hollow-stem continuous flight augers to advance the holes in soil. The remaining four (4) borings were advanced with a Geoprobe Model 4220, a vehicle-mounted, hydraulically-powered machine that utilizes static force and percussion to advanced a 122-centimeter long by 5.1-centimeter diameter soil sampler.

Where borings extended into the bedrock (after encountering split-spoon sample refusal), a double tube diamond bit core barrel (both wireline and conventional

equipment) was used to core (the bedrock). Coring produced NX-sized (5.3-centimeter diameter) cores, from which the type of rock and its geological characteristics were determined.

For the borings advanced using a truck mounted rig, Standard Penetration testing was performed at 0.46 to 1.52-meter intervals. The Standard Penetration Test (ASTM D 1586) is conducted by using a 63.5-kilogram hammer falling 76.0 centimeters to drive a 5.1-centimeter O.D. split-barrel sampler 45.0 centimeters. Driving resistance is recorded on the boring logs in terms of blows per 15-centimeter interval of the driving distance. The second and third intervals are added to obtain the number of blows per 30 centimeters. Standard Penetration blow counts aid in determining soil properties applicable in embankment and roadway design.

A nominal 7.6-centimeter diameter shelby tube, or thin-walled sampler, was employed (ASTM D-1587) to obtain undisturbed samples from borings B-14, B-22, B-26, B-30, and B-36. The shelby tube is hydraulically pressed into the subsurface soils to obtain an undisturbed sample.

Soil samples obtained from the drilling operation were preserved in jars (drill rig boreholes) or sealed tubes (geoprobe boreholes), tested for natural moisture content (ASTM 2216), and visually classified in the laboratory. Representative soil samples were tested in the laboratory to determine the following properties:

- Liquid Limit, Plastic Limit	(AASHTO T89, T90)
- Gradation	(AASHTO T 88)
- Unconfined Compressive Strength (of Cohesive Soils)	(AASHTO T 208)
- (Wet) Unit Weight	(EM 1110-2-1906)
- One-Dimensional Consolidation Properties	(AASHTO T 216)

The tests performed are necessary to classify existing soils according to the Ohio Department of Transportation (ODOT) Classification System and to infer engineering properties of importance in determining pavement, embankment, and backslope design and construction recommendations. Results of the laboratory testing are presented in Appendices C and D.

A majority of the cohesive soil samples obtained with the drill rigs were tested to determine their unconfined compressive strengths by means of a hand penetrometer. These values are reported on the boring logs in kilopascals (kPa). The unconfined compressive strength of cohesive soils is used to estimate their undrained shear strength. It is noted that split-spoon samples are considered to be disturbed samples, and the laboratory determination of their shear strengths may vary slightly from undisturbed conditions.

Rock cores were logged in the field and visually classified in the laboratory. They were analyzed to identify the type of rock, color, minerals, bedding planes and other geological and mechanical features of interest in this project. The Rock Quality Designation (RQD) for each type of rock was calculated according to the equation:

$$RQD = \frac{\Sigma \text{segments equal or longer than 10.2 centimeters}}{\text{Core Run Length}} \times 100$$

The RQD aids in estimating the general quality of the rock and is used in conjunction with other parameters to designate the quality of the rock mass. Unconfined compressive strength of intact rock cores segments (ASTM D 2938) were performed on representative samples to identify their strength and hardness.

3.0 SUBSURFACE PROFILE

Interpreted engineering logs have been prepared from field geologist's logs, visual examination of samples, and laboratory testing. Classification follows the current ODOT Specifications for Subsurface Investigation. The following is a generalization of what was found in the test borings.

Soil drilled along the alignment is generally between 1.0 and 5.0 meters thick, averaging approximately 3.0 meters thick. The transition to bedrock is not easily discernable where the surface rock is shale, clay-shale, or mudstone, which accounts for at least 75% of this section. Where sandstone, limestone, or siltstone is the surface rock, transition (to rock) was easily discernable and typically shallower. The soils are almost exclusively cohesive, described as reddish brown clay (silty clay, sandy clay) of medium to high plasticity. The soils are predominantly classified as ODOT A-7-6 as well as A-6a, A-6b, and very little A-4a. It is noted that fill, described as native soils mixed with construction debris, was encountered in the top 5.0 meters of B-29 (above elevation 262.7 meters). However, since the alignment was shifted in the vicinity of CR 21, the area represented by B-29 is no longer within the limits of the pavement.

Many soil properties, including soil consistency and shear strength (of cohesive samples), are primarily derived from Standard Penetration blow counts. The Standard Penetration blow counts recorded during the drilling process ranged from 2 blows per 30 centimeters to refusal, increasing with depth. Generally speaking, soils encountered from the ground surface to 1.5 meters± are desribed as soft to stiff, below 1.5 meters±, soils are very stiff to hard. Split-spoon refusal, defined as obtaining in excess of 50 blows with less than 15 centimeters of penetration, was encountered in virtually every boring in the transitional material (hard indurated clay/very soft bedrock).

Laboratory testing indicates that the natural moisture contents of the soil encountered to a depth of 1.5 meters± are typically at to well above their corresponding plastic limits. However, because of the highly plastic nature of the clays encountered, the moisture contents do not approach the soils' corresponding liquid limits. Below the surficial 1.5 meters±, moisture contents typically decrease, down to typically less than 10% in the transitional material.

3.1 Bedrock

Bedrock was cored when encountered in any proposed cut section above the proposed completion depth of the test boring. If bedrock was encountered above the completion depth in any boring drilled in a proposed fill section, the boring was terminated on the top of bedrock (defined as split-spoon refusal). Much of the bedrock encountered consisted of shale, clay-shale, or mudstone, predominantly in poor condition. The mudstone and some of the shale was frequently slickensided and deteriorated when exposed to water. As mentioned above, where these bedrocks were encountered, the rock condition was typically so poor that it was difficult to identify the transition from soil to rock. Interbeds of sandstone, limestone, and (very little) siltstone were also encountered, some massive, near the central and southern portions of this section (from Station 30+470 to 34+400).

In the cut section between stations 29+600 and 30+634, bedrock was encountered in all borings above the proposed grade. Most of the bedrock consists of poor quality (soft and broken) shale and mudstone. A few limestone and sandstone interbeds were encountered above the proposed grade, none of which was greater than 1.0 meter thick.

In the cut section between stations 30+885 and 31+056, sandstone bedrock was encountered in B-16 very near the ground surface at approximately elevation 282 meters. The sandstone, described as brown, medium, medium-grained, slightly weathered, and highly broken (possibly "poker chipped"), extends to elevation 272.4 meters±. A 1.0-meter thick, soft, weathered, arenaceous shale interbed is present between eleavations 273.4 and 274.4 meters±. Similar shale was again encountered between elevations 272.4 and 269.8 meters±. This shale is underlain by gray, moderately hard, slightly broken limestone, extending to elevation 266.2 meters± (at or near the proposed grade). Soft, varigated, mudstone was encountered near the proposed grade, extending to the bottom of B-16 (elevation 258.5 meters).

Similar to the previous cut section, massive sandstone was encountered close to the ground surface in B-20, between stations 31+366 and 31+497. This sandstone was encountered over the full height of the proposed 11.0-meter cut, extending well below the proposed grade.

In the cut sections between 31+906 and 31+962 and between 32+290 and 32+420, soft (to medium), poor quality shales and mudstones were predominantly encountered in B-24 and B-27 above the proposed grade. Massive sandstone, similar to that encountered in B-20, was encountered just above the proposed grade in B-24 and well below the proposed grade in B-27.

A small cut of about 3.0 meters is proposed between stations 33+283 and 33+322. B-34, the closest boring to this area, encountered 1.8 meters of soil (reddish brown silty clay) overlying weathered sandstone bedrock which extends below the proposed grade.

In the cut section between stations 33+866 and 33+970, B-38 encountered weathered sandstone very near the ground surface, extending to the proposed grade near elevation 288 meters. The sandstone is underlain by soft shale, clay-shale, and mudstone. It is noted that B-38 is located well right of the alignment since the alignment was shifted, however, it is on the same ridge, and the soil and rock conditions are considered to be representative.

3.2 Groundwater

With the exception of the Hocking River Valley, groundwater in Athens and Meigs Counties is scarce at best. Few pearched lenses of groundwater was encountered during the drilling process in the northern section within the soil. It was impossible to identify groundwater in the rock sections since water was being used during the coring process. Groundwater for the area can be found in alternating layers of shale and thin sandstone with yields of less than 1.0 gallon per minute.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Data obtained from the drilling and testing program have been used to develop preliminary pavement, embankment, and backslope recommendations for the soils and bedrock encountered along the alignment. These parameters have been used to provide guidelines for the design of the pavement systems for the subject roadway which are discussed in the following paragraphs. It is noted that these recommendations are preliminary. Additional subsurface investigations will be performed to verify these recommendations along a finalized alignment.

4.1 Pavement Design

Because of the extensive earthwork necessary for this project, very little soil will remain in-place, in its current condition, as a pavement subgrade soil. Subgrades in most of the cut sections will be bedrock. The soils are almost exclusively

cohesive, described as reddish brown clay (silty clay, sandy clay) of medium to high plasticity. The shales and mudstone deteriorate to a highly plastic clay when exposed to weathering (water) as well. Therefore, it is recommended that pavement designs be based on a Group Index value of 16. The corresponding and design California Bearing Ratio (CBR) is approximately 4, and the equivalent Subgrade Resilient Modulus, M_R, is 4800 psi (this value is left in English units since the current L&D manual presents it that way for use in a correlation chart).

Where bedrock is encountered in the subgrade, the rock shall be cut an additional 0.5 to 0.6 meters below the surface of the subgrde, depending on the pavement type, for the cross section width of the roadway between points 0.3 meters beyond the shoulders.

4.2 Embankment Design

Massive embankment fills are proposed at the locations presented in Table 1. The largest fill section is 42 meters, between stations 31+497 and 31+906. To estimate the settlement of the "in-situ" soils (and rock) due to the weight of the embankment, one-dimensional consolidation tests were performed on undisturbed samples procurred from B-14 (station 30+736), B-26 (station 32+154), and B-30 (station 32+719). The results of these tests (See Appendix F) were employed to verify the compressibility parameters of the soils along the alignment in the valleys. A worst case settlement, within the foundation soils alone, was determined beneath the centerline of the proposed highway at the maximum fill section at station 31+670. In this analysis, the top 3.0 meters was modeled as a normally consolidated clay, and the underlying mudstone was modeled as a pre-consolidated clay. The total settlement caused by the consolidation of the "in-situ" subsoils is estimated to be between 0.6 and 0.8 meters. Additional settlements can be expected within the embankment itself, on the order of 0.3 to 0.5 meters.

Total settlement on the order of 1.0 meter± for such an embankment is not considered out of the ordinary. The foundation soils and the fill soils will be predominantly clayey, therefore, the time-rate of settlement will be slow. However, the construction process for such an embankment will be slow as well, and the embankment will like sit idle for a period of time before paving. In any case, the use of settlement plates is recommended to monitor the settlement of the soils in the larger embankments. Because of the notorious instability of the soils and rock in this area, the use of inclinometers is recommended to monitor the stability of these larger embankments as well. In the final design stage, it is recommended that further analysis be performed on the embankment slope-stability.

The earthwork design of all fill sections (and cut sections) shall follow ODOT's *Location and Design Manual* (1995, or latest, edition). The maximum (steepest) recommended unreinforced slope for the embankments is 2:1 (horizontal:vertical).

4.3 Backslope Design

The study area is considered to be highly susceptible to slope movements due to the lithology, topography and amount of rainfall. Problems of instability typically occur where the red shales and claystones (mudstones) are the thickest. Much of the bedrock encountered consisted of (red) shale, clay-shale, or mudstone, predominantly in poor condition. The mudstone and some of the shale was frequently slickensided and deteriorated when exposed to water. As mentioned above, where these bedrocks were encountered, the rock condition was typically so poor that it was difficult to identify the transition from soil to rock.

Many small slumps and rock falls were observed during field reconnaissance, most (slumps) of which are identified on the plans. A large slump was observed left of the alignment, in the vicinity of stations 32+600 to 32+700. The terrain is typically hummocked, indicating movement. The most common forms of landslides in southeastern Ohio are rock falls, where the soft shale bedrock is weathered out from underneath blocky sanstone or limestone, and rotational slumps.

Based on the soil and rock encountered in the proposed cut sections, backslope recommendations are presented below in Table 2, applying to both left and right backslopes as applicable.

Table 2: Backslope Recommendations

Cut Section	Maximum Cut	Recommended Backslope
29+600 to 30+196	24 meters	2:1 to daylight
30+248 to 30+634	35 meters	2:1 to daylight
30+885 to 31+056	21 meters	2:1 to 3.0-meter bench at elevation 275 (bottom of sandstone), 1:1 to top of sandstone, 2:1 to daylight
31+366 to 31+497	11 meters	1:1 to top of sandstone bedrock, 2:1 to daylight
31+906 to 31+962	7 meters	2:1 to daylight
32+290 to 32+420	11 meters	2:1 to daylight
33+283 to 33+322	3 meters	2:1 to daylight
33+866 to 33+970	9 meters	1:1 to the top of bedrock (sandstone), 2:1 to daylight

The top 5.0 (vertical) meters of all backslopes should be considered soil and laid back at a 2:1 slope.

Due to the lithologic character of the rock formations in this area, most of the cut slopes will be mixed-faced, consisting of various rock types. Differential weathering of the various rock types must be considered in the design of the cut slope. This is especially true where sandstone is overlying a less resistant shale. Because the shale weathers at a faster rate than the overlying sandstone, the sandstone may be left unsupported and subject to rock falls. Rock falls occur routinely in this area. Consequently, it is recommended that at least a 3-meter wide bench be constructed behind the roadway ditch to allow temporary accumulation of talus and rock fall material.

It is expected that blasting will be required for cuts in the limestone and sandstone bedrock. It is expected that the shales (and mudstone), even in an unweathered condition can be removed using standard ripping methods. We expect that even the upper, weathered sandstone can also be removed by ripping, due to the friable nature of the weathered sandstone.

It is recommended that sidehill benches be cut in the rock slopes which are greater than 15 meters high. Past experience has shown that these benches act to collect rock falls as well as minimize erosion of the exposed surface. The benches interrupt the velocity of runoff water washing down the slope and thus minimizes the erosion. Typically, these benches do not significantly increase hillside stability.

4.4 Construction Considerations

All site work shall conform to the latest ODOT Construction and Materials Specifications (January, 1997), including that all excavation and embankment preparation and construction should follow ODOT Item 200 (Earthwork).

Where existing structures will be razed, all foundations, floor slabs, basements, wells, and/or cistern walls shall be removed to a minimum of 0.3 meters below the grade of the surrounding area. All basements or cavities left by structure removal shall be filled to the level of the surrounding ground. For those areas within the vicinity of construction, the fill shall be compacted in accordance with the specifications provided in ODOT's Specifications.

Prior to beginning excavation, grading, and/or embankment operations across the site, all necessary clearing and grubbing shall be completed. Topsoil, organic deposits, unsuitable fill materials (as determined by a soils engineer or an experienced soils technician), and/or existing pavement sections should be stripped away from proposed pavement areas prior to excavation. In constructing

the embankments, if topsoil is encountered at the ground surface of the existing subgrade within 1.22 meters of the proposed subgrade elevation, the topsoil (and any other unsuitable material, as determined by the site soils engineer) should be stripped off and stockpiled. In areas where greater than 1.22 meters of fill is to be placed, the excavation is dependent on the soil conditions at the time of construction. In particular, if dry conditions exist, the topsoil will provide adequate stability, and can remain in place. If wet conditions exist, and excessive moisture contents are present, this topsoil will not provide adequate stability, and will require removal. Where a new pavement is to be constructed on an embankment which is less than 0.9 meters over an existing pavement, the existing pavement must be removed.

The proposed subgrade surfaces should be proofrolled prior to placing engineered fill. A soils engineer or an experienced soils technician should be present during proofrolling to determine if soft soils exist. When employing proofrolling to determine the soils that will require stabilization, the proposed profile of the roadway must be considered. A greater amount of subgrade deformation is acceptable at the base of an embankment than along sections of the subgrade where the roadway will be constructed at the existing grade.

The highway construction will cut through the Conemaugh and Monongahela Formations. Therefore, we expect the predominant rock fill to consist of weathered shale and sandstone. It is our opinion that colluvium and residual soil, sandstone and most of the shale will be suitable for embankment fill material. It is recommended that the cut material available for fill be classified. The sandstone and limestone are best suited for fill. This is followed by the green and gray shale, colluvium and residual soils. The "Red Bed" shales and claystones are the least suitable for fill soil due to their rapid slaking and deterioration into a plastic unstable clay soil. This "Red Bed" shale should be wasted whenever possible. Alternatively, special precautions and flatter slopes must be used if this red shale is used as fill.

Special design and construction techniques are recommended even when the gray and green, more stable shale is used for embankment fill. This shale requires the addition of water and special handling in order to construct a stable embankment fill. Even with special precautions, however, the stability of subgrades in shale deteriorates with time. Shallow sloughing is common in 2:1 embankment slopes formed in shale, therefore, it is recommended that limitations be placed on the use of shale in embankment construction. It is recommended that shale not be allowed within the upper 0.6 meter of embankment fill. A 0.6 meter cap of soil will minimize weathering and deterioration of the underlying shale. Further limitations are recommended if the "Red Bed" shale must be used in embankment fill. The shale should be broken into pieces no larger than 150 millimeters of the initial pass of the compactor and should be broken into pieces smaller than 50

millimeters following compaction. The shale should be compacted at a range of moisture varying from optimum to 3% wetter than optimum. Past experience has shown "Red Bed" fill will perform better when compacted wetter than optimum, due to swelling. It has been found that less swelling occurs in the fill when it is compacted at a moisture content wetter than optimum.

When employed as embankment fill, excavated bedrock shall be placed in lifts not to exceed 0.9 meters. When rock and other embankment material are excavated at the same time, the rock shall be incorporated into the outer portions of the embankment as rock fill and the other material shall be incorporated into the inner portion as rolled embankment. The top 0.6 meters of all embankments shall be constructed of material other than excavated bedrock.

Due to the steeply sloping topography, sidehill fills would be expected. It is critical that benches be cut into the hillside where the toe of the new slope starts on an existing slope. This bench should cut into the hillside wide enough to accommodate construction equipment. Wherever possible, benching should "key" into the underlying bedrock. Drains intercepting seepage would be installed in the back of the benches as dictated by site conditions. Landslide activity is common in areas of sidehill cut and fill operations. Consequently, landslides can be expected to occur if sidehill fills are improperly constructed.

Individual stability analyses should be performed in the final investigation for the sidehill fill areas.

Groundwater is does not occur in large quantities over the length of the alignment. A static water table is not expected within the depths of cuts for the proposed roadway. However, perched groundwater is expected in the more permeable sandstone beds of the Conemaugh and Monongahela Formations. This is especially true where the more permeable sandstone is directly underlain by a relatively impervious shale. Also, groundwater should be expected along the overburden/shale interface during wet weather. Horizontal drains may be needed on intermediate benches and along the roadway ditch line to lower the perched water table and minimize seepage emerging on the cut slopes. The need for horizontal drains will largely be controlled by the dip of the bedrock at the individual cut. As previously indicated, the regional dip of the rock is approximately 6 meters per kilometer to the east-southeast. Drains are used to dewater cut slopes when the rock is dipping toward the cut. Horizontal drains are usually not necessary when the rock dips away from the highway cut.

5.0 LIMITATIONS OF STUDY

Our recommendations for this project were developed utilizing soil and bedrock

information obtained from the test borings that were made at the proposed site. At this time we would like to point out that soil borings only depict the soil and bedrock conditions at the specific locations and time at which they were made. The conditions at other locations on the site may differ from those occurring at the boring locations.

The conclusions and recommendations herein have been based upon the available soil and bedrock information and the preliminary design details furnished by a representative of the owner of the proposed project. Any revision in the plans for the proposed construction from those anticipated in this report should be brought to the attention of the soils engineer to determine whether any changes in the foundation or earthwork recommendations are necessary. If deviations from the noted subsurface conditions are encountered during construction, they should also be brought to the attention of the soils engineer.

The scope of our services does not include any environmental assessment or investigation for the presence or absence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the site studied. Any statements in this report or on the test boring logs regarding odors, staining of soils, or other unusual conditions observed are strictly for the information of our client.

Our professional services have been performed, our findings obtained, and our recommendations prepared in accordance with generally accepted Geotechnical engineering principles and practices. Resource International is not responsible for the conclusions, opinions, or recommendations made by others based upon the data included herein.

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-1
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 12/15/97
Date Finished: 12/15/97
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 144770.015
Easting: 634241.813
Elevation: 209.6 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				Brown SILTY CLAY, some coarse to fine sand, little organics, trace fine gravel (Topsoil). Moist.			
SS-1	6 3 5	56	1.0	Brown and gray SILT and CLAY, some fine to coarse sand, some fine gravel. Stiff. Moist. -SS-1: ODOT A-6b (7); qh = 96 kPa	22	36	18
SS-2	3 4 5	100		Brown and gray to red CLAY, some to little silt, little coarse to fine sand, trace fine gravel. Stiff. Moist. -SS-2: qh = 144 kPa	25		
SS-3	7 7 7	89	2.0	-SS-3: qh = 239 kPa	22		
SS-4	5 5 6	83		-SS-4: qh = 168 kPa	26		
			3.0	Bottom of Boring = 3.0 meters			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-2
Sheet: 1 of 4
Completion Depth: 25.0 m

Date Started: 12/15/97
Date Finished: 12/16/97
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 144646.477
Easting: 634282.292
Elevation: 235.8 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				Brown SILTY CLAY, some organics, some coarse to fine sand, trace fine gravel (Topsoil). Moist.			
				0.1			
SS-1	2 2 3	33		Red CLAY, little silt, trace fine gravel, trace coarse and fine sand. Medium stiff. Moist. -SS-1: qh = 48 kPa	37		
			1.0				
SS-2A	4			-SS-2A: ODOT A-7-6 (20); qh = 72 kPa	36	74	23
SS-2B	11 17			Brownish-gray CLAYEY SILT, little fine sand. Very stiff to hard. Moist. -SS-2B: qh = 383 kPa			
SS-3	14 26 28	100	2.0		13		
				2.6			
SS-4	50/13cm	28	3.0	Brownish-gray to reddish-brown INDURATED CLAY/WEATHERED MUDSTONE. Hard soil/very soft bedrock.	10		
			4.0				
SS-5	50/5cm	11			23		

NOTES:

SAMPLE TYPE
SS - 5 1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-2
Project: ATH/MEG-33-30.980/0.000
Sheet: 2 of 4
Project Number: W-7139
Completion Depth: 25.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
				Brown weathered SANDSTONE. Very soft bedrock.			
SS-6	50/8cm	17	5.8				
RC-1			6.0	SHALE; gray, medium hard to soft, slightly weathered, highly broken, fissile, arenaceous. -Siltstone lens (soft) from 5.8 m to 6.1 m			
				-RC-1: Recovery = 90% -Core Loss = 15 cm -RQD = 0%			
			7.0	-Siltstone lens (soft) from 7.0 m to 7.2 m			
RC-2							
			8.0	-RC-2: Recovery = 100% -No Core Loss -RQD = 0%			
				-highly crumbled from 8.5 m to 8.8 m			
RC-3			9.0				
				-RC-3: Recovery = 85% -Core Loss = 21 cm -RQD = 0%			
			10.0				
			10.2				
RC-4				SHALE; gray and maroon stained to dark gray, soft, highly broken, slightly jointed, with several slickensides. -RC-4: Recovery = 85% -Core Loss = 59 cm -RQD = 0%			
			11.0				
RC-5							

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-2
Sheet: 3 of 4
Completion Depth: 25.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			12.0	-RC-5: Recovery = 75% -Core Loss = 38 cm -RQD = 0%			
RC-6			13.0	-RC-6: Recovery = 25% -Core Loss = 94 cm -RQD = 0%			
RC-7			14.0	-RC-7: Recovery = 0% -Core Loss = 150 cm -RQD = 0%			
RC-8				-RC-8: Recovery = 80% -Core Loss = 16 cm -RQD = 13%			
RC-9			15.0	-limestone lens (medium to moderately hard) from 15.1 m to 15.4 m			
				15.5 SILTSTONE; gray, medium hard, highly broken, micaceous, argillaceous.			
			16.0	-RC-9: Recovery = 100% -No Core Loss -RQD = 0%			
RC-10				16.6 SHALE; gray to dark gray, soft, highly broken, highly fissile, carbonaceous.			
			17.0	-qr (@ 16.9 m) = 31.05 MPa			
				-RC-10: Recovery = 90% -Core Loss = 15 cm -RQD = 0%			
RC-11			18.0				

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-2
Sheet: 4 of 4
Completion Depth: 25.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			19.0	-slightly jointed, several slickensides from 18.9 m to 20.3 m -RC-11: Recovery = 94% -Core Loss = 9 cm -RQD = 0%			
RC-12			20.0	-RC-12: Recovery = 80% -Core Loss = 30 cm -RQD = 0%			
			21.0				
RC-13			21.2	SILTSTONE; gray to greenish-gray, medium hard, highly broken, arenaceous, micaceous.			
			22.0	-RC-13: Recovery = 90% -Core Loss = 15 cm -RQD = 0%			
RC-14			23.0	SANDSTONE; brown and gray, medium to moderately hard, slightly broken, medium grained, micaceous.			
				-RC-14: Recovery = 100% -No Core Loss -RQD = 29%			
			24.0	-qr (@ 23.6 m) = 33.26 MPa			
RC-15				-RC-15: Recovery = 90% -Core Loss = 8 cm -RQD = 20%			
			25.0	Bottom of Boring = 25.0 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-3
Sheet: 1 of 3
Completion Depth: 17.0 m

Date Started: 2/5/98
Date Finished: 2/5/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 144458.422
Easting: 634437.611
Elevation: 252.2 m**

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 5 38	89		Dark brown coarse to fine SANDY SILT, little clay, little organics (Topsoil). Moist. 0.1	30		
SS-2	7 9 15	44		Brown SILTY CLAY, some coarse to fine sand. Hard. Moist. 0.5	17		
			1.0	Light brown coarse to fine SANDY CLAY, some silt, trace fine gravel. Very stiff. Moist. 1.1			
SS-3	20 20 25	61		Brown SILTY CLAY, trace coarse to fine sand, trace fine gravel. Hard. Moist.	9		
SS-4	10 12 24	61	2.0		9		
SS-5	14 21 24	67	3.0		10		
			4.0				
RC-1				SHALE; gray, soft, highly broken, slightly weathered. 4.3 4.4			

NOTES: ** Elevation is approximate.

SAMPLE TYPE
SS - 5 1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion ▼ N/A* m
After 24 Hrs ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-3
Project: ATH/MEG-33-30.980/0.000
Sheet: 2 of 3
Project Number: W-7139
Completion Depth: 17.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-2			5.0	LIMESTONE; dark gray, medium hard to moderately hard, highly broken, slightly jointed, fine crystalline. -RC-1: Recovery = 60% -Core Loss = 18 cm -RQD = 0%			
RC-3			5.5	-RC-2: Recovery = 44% -Core Loss = 43 cm -RQD = 0%			
			6.0	MUDSTONE; mottled purple, gray, and brown, very soft, crumbled to highly broken. -RC-3: Recovery = 50% -Core Loss = 60 cm -RQD = 0%			
RC-4			7.0	-RC-4: Recovery = 75% -Core Loss = 15 cm -RQD = 0%			
RC-5			7.3	MUDSTONE; mottled red, gray, and purple, very soft, massive to slightly massive.			
			8.0	-RC-5: Recovery = 100% -Core Loss = 6 cm -RQD = 96%			
RC-6			9.0	-RC-6: Recovery = 95% -Core Loss = 8 cm -RQD = 61%			
			10.0				
RC-7			11.0	-RC-7: Recovery = 100% -No Core Loss			

NOTES:

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WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-3
Sheet: 3 of 3
Completion Depth: 17.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				-RQD = 65%			
				11.9			
RC-8			12.0	MUDSTONE; mottled red, gray, and purple, soft, highly broken to slightly massive.			
				-RC-8: Recovery = 53% -Core Loss = 42 cm -RQD = 0%			
RC-9			13.0				
				-RC-9: Recovery = 95% -Core Loss = 3 cm -RQD = 21%			
RC-10							
			14.0				
				-RC-10; Recovery = 99% -Core Loss = 2 cm -RQD = 76%			
RC-11			15.0				
				-RC-11: Recovery = 100% -No Core Loss -RQD = 18%			
			16.0				
				16.4			
RC-12				SANDSTONE; gray, moderately hard, slightly massive, medium to fine grained, slightly carbonaceous.			
			17.0	-RC-12: Recovery = 90% -Core Loss = 6 cm -RQD = 71%			
				17.0			
				Bottom of Boring = 17.0 meters			

NOTES:

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-4
Sheet: 1 of 5
Completion Depth: 30.2 m

Date Started: 12/17/97
Date Finished: 12/18/97
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 144471.272
Easting: 634340.311
Elevation: 249.5 m**

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				5 cm - Asphalt (0.1)			
				8 cm - Sand and gravel base (0.3)			
SS-1	11 4 3	44		Reddish-brown CLAY, some silt, trace coarse to fine sand, trace fine gravel. Medium stiff to hard. Moist.	7		
			1.0				
SS-2	3 3 4	67			24		
SS-3	3 5 7	67	2.0	-SS-3: ODOT A-7-6 (18)	20	51	20
SS-4	7 14 21	56			13		
			3.0	(3.0) Reddish-brown INDURATED CLAY/WEATHERED MUDSTONE. Hard soil/very soft bedrock.			
			4.0				
SS-5	50/13cm	28		-sandstone encountered at 4.1 m			

NOTES: ** Elevation is approximate.

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion ▽ N/A * m
After 24 Hrs ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-4
Project: ATH/MEG-33-30.980/0.000
Sheet: 2 of 5
Project Number: W-7139
Completion Depth: 30.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-6	13 17 22	100	6.0	-SS-6: ODOT A-7-6 (12)	13	42	23
			7.0				
SS-7	20 42 50/13cm	100			12		
			8.0				
SS-8	27 50/13cm	33	9.0		11		
			10.0				
SS-9	50/13cm	11		Gray highly weathered SHALE. Hard soil/very soft bedrock.	13		
			10.2				
RC-1			11.0	SHALE; gray to red, soft, highly broken, highly to slightly jointed, with several slickensides.			

NOTES: ** Elevation is approximate.

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-4
Sheet: 3 of 5
Completion Depth: 30.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-2				-RC-1: Recovery = 75% -Core Loss = 15 cm -RQD = 0%			
			12.0				
				-RC-2: Recovery = 73% -Core Loss = 40 cm -RQD = 7%			
			13.0				
RC-3							
			14.0	-RC-3: Recovery = 85% -Core Loss = 23 cm -RQD = 22%			
RC-4							
			15.0				
				-RC-4: Recovery = 72% -Core Loss = 42 cm -RQD = 0%			
			16.0				
RC-5							
			17.0	-RC-5: Recovery = 100% -No Core Loss -RQD = 12%			
					17.7		
RC-6				SHALE; gray, medium hard, highly broken to slightly massive.			
			18.0				
				-RC-6: Recovery = 90%			

NOTES: ** Elevation is approximate.

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281 ENTERPRISE DRIVE
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-4
Sheet: 4 of 5
Completion Depth: 30.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				-Core Loss = 10 cm -RQD = 0%			
RC-7							
			19.0	-RC-7: Recovery = 83% -Core Loss = 10 cm -RQD = 0%			
RC-8							
			20.0	-RC-8: Recovery = 92% -Core Loss = 12 cm -RQD = 47% -qr (@ 20.4 m) = 46.80 MPa			
RC-9			21.0				
				-RC-9: Recovery = 95% -Core Loss = 8 cm -RQD = 43%			
			22.0				
RC-10							
			23.0	-RC-10: Recovery = 100% -No Core Loss -RQD = 27%			
					23.3		
				SILTSTONE; gray, medium hard, highly broken, micaceous.			
RC-11					23.9		
			24.0	SHALE; reddish-brown and purple, soft to medium hard, highly broken, with periodic slickensides.			
				-RC-11: Recovery = 70% -Core Loss = 47 cm -RQD = 0%			
			25.0				

NOTES: ** Elevation is approximate.

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-4
Project: ATH/MEG-33-30.980/0.000
Sheet: 5 of 5
Project Number: W-7139
Completion Depth: 30.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-12			26.0				
			27.0	-RC-12: Recovery = 98% -Core Loss = 6 cm -RQD = 0%			
			28.0				
RC-13				LIMESTONE; brown and gray, moderately hard, highly broken, highly jointed, fine crystalline. (28.3)			
			29.0	SANDSTONE; gray, moderately hard, highly broken, micaceous, fine grained. (28.9)			
			30.0	-RC-13: Recovery = 100% -No Core Loss -RQD = 0%			
				Bottom of Boring = 30.2 meters (30.2)			

NOTES: ** Elevation is approximate.

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-5
Sheet: 1 of 3
Completion Depth: 16.1 m

Date Started: 12/24/97
Date Finished: 12/26/97
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 144354.317
Easting: 634389.372
Elevation: 260.4 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				5 cm - Asphalt (0.1)			
				7 cm - Sand and gravel base (0.2)			
SS-1	9 12 19	100		Brown SILTY CLAY, some coarse to fine sand, little to some fine gravel, trace coarse gravel (Fill). Hard to very stiff. Moist.	13		
			1.0				
SS-2	7 14 15	100		-trace asphalt in SS-2	9		
				(1.8)			
SS-3	28 36 49	78	2.0	Brown weathered SANDSTONE. Very soft bedrock.			
				(2.6)			
SS-4	20 32 49	100	3.0	Brown and reddish-brown MUDSTONE. Hard soil/very soft bedrock.			
			4.0				
SS-5	24 45 50/13cm	100					

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion ... N/A* m
After 24 Hrs ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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281 ENTERPRISE DRIVE
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-5
Project: ATH/MEG-33-30.980/0.000
Sheet: 2 of 3
Project Number: W-7139
Completion Depth: 16.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-6	50/8cm	17		-change in color to brownish-gray			
			6.0				
			7.0				
SS-7	50/8cm	17					
			8.0				
SS-8	34 50/8cm	56	9.0				
			10.0				
SS-9	44 50/5cm	44		-change in color to reddish-brown			
			11.0				

NOTES:

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-5
Sheet: 3 of 3
Completion Depth: 16.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-10	49 50/5cm	44	12.0				
			13.0				
SS-11	50/13cm	28					
			14.0				
RC-1				MUDSTONE; reddish-brown, very soft, highly broken. -RC-1: Recovery = 33% -Core Loss = 20 cm -RQD = 0%			
RC-2				-RC-2: Recovery = 83% -Core Loss = 5 cm -RQD = 0%			
RC-3			15.0	-RC-3: Recovery = 80% -Core Loss = 30 cm -RQD = 20%			
			16.0				
				16.1 Bottom of Boring = 16.1 meters			

NOTES:

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281 ENTERPRISE DRIVE
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-6
Sheet: 1 of 5
Completion Depth: 27.1 m

Date Started: 1/28/98
Date Finished: 1/29/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 144366.744
Easting: 634339.381
Elevation: 249.5 m**

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 2 2	44		Brown SILT, some fine sand, little organics, little clay (Topsoil). Moist. 0.1	22		
SS-2	2 2 2	89	1.0	Reddish brown to brownish gray CLAY, little silt, trace fine gravel, trace coarse to fine sand. Soft to very stiff. Moist. -SS-2: ODOT A-7-6 (20)	31	61	20
SS-3	4 4 5	44			25		
SS-4	5 8 10	33	2.0		16		
SS-5	6 8 11	61	3.0		11		
			4.0		4.0		
SS-6	11 13 25	50		Brown fine SAND, some clay, little silt, little coarse sand, trace coarse gravel. Dense. Moist. -SS-6: ODOT A-3a	17	NP	NP

NOTES: ** Elevation is approximate.

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion N/A* m
After 24 Hrs ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-6
Project: ATH/MEG-33-30.980/0.000
Sheet: 2 of 5
Project Number: W-7139
Completion Depth: 27.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			6.0				
				5.2 Red and purple INDURATED CLAY/MUDSTONE. Hard soil/very soft bedrock.			
SS-7	20 50/15cm	61	6.0		12		
			7.0				
SS-8	18 25 50/13cm	94			14		
			8.0				
SS-9 RC-1	50/8cm	0	9.0	8.8 MUDSTONE; gray to red, soft to medium hard, highly broken, nonbedded.			
				-RC-1: Recovery = 67% -Core Loss = 46 cm -RQD = 33%			
			10.0				
RC-2							
			11.0	-RC-2: Recovery = 75% -Core Loss = 38 cm -RQD = 0%			

NOTES: ** Elevation is approximate.

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281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-6
Project: ATH/MEG-33-30.980/0.000
Sheet: 3 of 5
Project Number: W-7139
Completion Depth: 27.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-3			12.0	-RC-3: Recovery = 85% -Core Loss = 23 cm -RQD = 22%			
			13.0				
RC-4				-RC-4: Recovery = 60% -Core Loss = 12 cm -RQD = 0%			
RC-5			14.0	-RC-5: Recovery = 95% -Core Loss = 6 cm -RQD = 29%			
RC-6			15.0	-RC-6: Recovery = 100% -No Core Loss -RQD = 0% -gray soft CLAY-SHALE @ 15.8-16.1 m			
			16.0				
RC-7			17.0	-RC-7: Recovery = 90% -Core Loss = 15 cm -RQD = 20%			
RC-8			18.0	SHALE; gray, soft to medium hard, highly broken, fissile, slightly arenaceous.	17.8		

NOTES: ** Elevation is approximate.

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WESTERVILLE, OHIO 43081
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-6
Sheet: 4 of 5
Completion Depth: 27.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			19.0	-RC-8: Recovery = 100% -No Core Loss -RQD = 20% -qr (@ 19.0 m) = 14.20 MPa			
RC-9			20.0	-RC-9: Recovery = 93% -Core Loss = 11 cm -RQD = 27%			
RC-10			21.0	-RC-10: Recovery = 89% -Core Loss = 13 cm -RQD = 27%			
			22.0				
RC-11				22.1 MUDSTONE; red and gray, soft, highly broken, nonbedded. -RC-11: Recovery = 100% -No Core Loss -RQD = 0%			
RC-12				-RC-12: Recovery = 95% -Core Loss = 2 cm -RQD = 0%			
RC-13			23.0	-RC-13: Recovery = 83% -Core Loss = 20 cm -RQD = 36%			
RC-14			24.0	-RC-14: Recovery = 68% -Core Loss = 26 cm -RQD = 0%			
RC-15			25.0				

NOTES: ** Elevation is approximate.

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
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REPORT OF SOIL EXPLORATION

Client Sverdrup Associates, Inc.
Project ATH/MEG-33-30.980/0.000
Project Number W-7139

Boring Number B-6
Sheet 5 of 5
Completion Depth 27.1 m

SAMPLE NO	BLOWS PER 16cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				-RC-15: Recovery = 76%			
				-Core Loss = 19 cm			
RC-16				-RQD = 0%			
			26.0				
				-RC-16: Recovery = 87%			
				-Core Loss = 16 cm			
				-RQD = 0%			
RC-17							
			27.0	-RC-17: Recovery = 100%			
				-No Core Loss			
				-RQD = 50%			
				27.1			
				Bottom of Boring = 27.1 meters			

NOTES: * Elevation is approximate.

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-7
Sheet: 1 of 7
Completion Depth: 41.1 m

Date Started: 12/29/97
Date Finished: 12/29/97
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 144228.912
Easting: 634432.009
Elevation: 269.5 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				3 cm - Asphalt (0.0)			
				8 cm - Sand and gravel base (0.1)			
SS-1	5 8 12	100		Mottled brown and gray CLAY, some coarse to fine sand, little silt, trace fine gravel. Very stiff to hard. Moist to damp.	19		
			1.0				
SS-2	6 9 14	67		-SS-2: ODOT A-7-6 (17)	17	53	25
SS-3	13 22 30	67	2.0		13		
				(2.3) Brown CLAYEY SILT, little coarse to fine sand. Hard. Damp.			
SS-4	8 22 29	100	3.0		9		
			4.0	(4.1)			
SS-5	36 50/3cm	22		Reddish-brown highly weathered MUDSTONE. Hard soil/very soft bedrock.			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: N/A* m
After 24 Hrs: N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-7
Sheet: 2 of 7
Completion Depth: 41.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-6	47 50/3cm	28	6.0				
				6.4 Gray weathered SHALE. Hard soil/very soft bedrock.			
SS-7	50/8cm	17	7.0				
			8.0				
SS-8	50/13cm	28	9.0				
			10.0				
SS-9	50/3cm	6					
				10.7 MUDSTONE; gray to red, soft, highly broken, with periodic slickensides from 14.3 m to 19.8 m.			
RC-1			11.0	-qr (@ 11.3 m) = 25.32 MPa			

NOTES:

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30,980/0.000
Project Number: W-7139
Boring Number: B-7
Sheet: 3 of 7
Completion Depth: 41.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			12.0	-RC-1: Recovery = 100% -No Core Loss -RQD = 19%			
			13.0				
RC-2							
			14.0	-RC-2: Recovery = 60% -Core Loss = 36 cm -RQD = 0%			
RC-3							
			15.0	-RC-3: Recovery = 100% -No Core Loss -RQD = 30%			
RC-4							
			16.0	-RC-4: Recovery = 70% -Core Loss = 64 cm -RQD = 5%			
			17.0				
RC-5							
			18.0				

NOTES:

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-7
Sheet: 4 of 7
Completion Depth: 41.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			19.0	-RC-5: Recovery = 94% -Core Loss = 15 cm -RQD = 39%			
RC-6			20.0	-RC-6: Recovery = 80% -Core Loss = 31 cm -RQD = 11%			
			21.0				
RC-7				-RC-7: Recovery = 100% -No Core Loss -RQD = 0%			
RC-8			22.0	-RC-8: Recovery = 71% -Core Loss = 26 cm -RQD = 9%			
				22.4			
RC-9			23.0				
			24.0	-RC-9: Recovery = 70% -Core Loss = 81 cm -RQD = 36%			
			25.0				

NOTES:

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-7
Sheet: 5 of 7
Completion Depth: 41.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-10			26.0	-RC-10: Recovery = 86% -Core Loss = 36 cm -RQD = 35%			
			27.0				
RC-11			28.0	-RC-11: Recovery = 52% -Core Loss = 53 cm -RQD = 60%			
RC-12			29.0	-RC-12: Recovery = 100% -No Core Loss -RQD = 0%			
RC-13				-RC-13: Recovery = 40% -Core Loss = 45 cm -RQD = 15%			
RC-14			30.0				
			31.0	-RC-14: Recovery = 90% -Core Loss = 30 cm -RQD = 35%			

NOTES:

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
WESTERVILLE, OHIO 43081
(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-7
Project: ATH/MEG-33-30.980/0.000
Sheet: 6 of 7
Project Number: W-7139
Completion Depth: 41.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			32.0				
			33.0	33.1			
RC-15				CLAY-SHALE; red to gray, soft, highly broken.			
			34.0				
				-RC-15: Recovery = 100% -No Core Loss -RQD = 30%			
			35.0				
			36.0				
RC-16				-RC-16: Recovery = 80% -Core Loss = 16 cm -RQD = 0%			
				36.9			
RC-17			37.0	SHALE; gray, soft, slightly broken, fissile, arenaceous.			
			38.0	-Siltstone (medium hard) lens from 37.9 m to 38.5 m -RC-17: Recovery = 99% -Core Loss = 2 cm -RQD = 64%			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-7
Project: ATH/MEG-33-30.980/0.000
Sheet: 7 of 7
Project Number: W-7139
Completion Depth: 41.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			39.0				
RC-18			40.0				
				40.8			
			41.0	SILTSTONE; gray, soft to medium hard, slighlty broken, micaceous.			
				41.1			
				Bottom of Boring = 41.1 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-8
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 2/11/98
Date Finished: 2/11/98
Drilled By: S.B.

DRILLING AND SAMPLING INFORMATION

Northing: 144196.170
Easting: 634325.107
Elevation: 248.8 m

Boring Method: Geoprobe
Hammer Weight: N/A
Hammer Drop: N/A

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
GS-1		100		Brown SILTY CLAY, little coarse to fine sand, trace organics, trace fine gravel (Topsoil). Moist. 0.1			
GS-2		100			28		
				Reddish brown SILTY CLAY, some fine sand, trace coarse sand, trace fine gravel. Moist.			
			1.0				
GS-3		100			15	40	21
			2.0	-GS-3: ODOT A-6b (9)			
				2.6			
GS-4		100		Brownish gray weathered CLAY-SHALE. Hard soil/very soft bedrock.			
			3.0	3.0			
				Bottom of Boring = 3.0 meters			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-9
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 2/11/98
Date Finished: 2/11/98
Drilled By: S.B.

DRILLING AND SAMPLING INFORMATION

Northing: 144201.968
Easting: 634290.591
Elevation: 241.5 m

Boring Method: Geoprobe
Hammer Weight: N/A
Hammer Drop: N/A

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
GS-1		100		Brown SILTY CLAY, some coarse to fine sand, trace organics, trace fine gravel (Topsoil). Moist.			
GS-2		100		Reddish brown CLAY, some silt, little fine gravel, trace coarse sand. Moist. -GS-2: ODOT A-7-6 (19)	20	55	20
			1.0				
GS-3		100		Red INDURATED CLAY/MUDSTONE. Hard soil/very soft bedrock.	14		
			2.0				
GS-4		100					
GS-5		100					
			3.0	Bottom of Boring = 3.0 meters			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-10
Sheet: 1 of 3
Completion Depth: 18.0 m

Date Started: 1/16/98
Date Finished: 1/16/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143998.933
Easting: 634291.974
Elevation: 255.8 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 2 3	56		Brown CLAYEY SILT, little organics, trace coarse to fine sand (Topsoil). Moist. 0.2			
SS-2	2 3 3	39	1.0	Brown SILTY CLAY, little to some coarse to fine sand, trace to little fine gravel. Medium stiff. Moist. 1.1	30 23		
SS-3	4 6 6	56		Mottled brown, red, and purple CLAY, some silt, trace coarse to fine sand. Stiff to hard. Moist. -SS-3: ODOT A-7-6 (17)	25	49	21
SS-4	4 10 11	78	2.0		18		
SS-5	9 11 22	83	3.0	3.0	13		
				Brown and purple weathered MUDSTONE. Hard soil/very soft bedrock.			
			4.0				
SS-6	21 29 44	67			9		

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion ▽ N/A* m
After 24 Hrs ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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281 ENTERPRISE DRIVE
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-10
Project: ATH/MEG-33-30.980/0.000
Sheet: 2 of 3
Project Number: W-7139
Completion Depth: 18.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-7	50/13cm	28	6.0		7		
			7.0				
SS-8	50/10cm	17			9		
			8.0				
				8.8			
RC-1			9.0	MUDSTONE; red to red and gray, very soft to soft, highly broken.			
				-RC-1: Recovery = 84% -Core Loss = 27 cm -RQD = 32%			
			10.0				
RC-2				-RC-2: Recovery = 95% -Core Loss = 3 cm -RQD = 35%			
			11.0				
RC-3							

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-10
Sheet: 3 of 3
Completion Depth: 18.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				-RC-3: Recovery = 97% -Core Loss = 3 cm -RQD = 38%			
			12.0				
RC-4				-RC-4: Recovery = 44% -Core Loss = 78 cm -RQD = 15%			
			13.0				
				13.4 MUDSTONE; red, soft, slightly massive, with sporadic slickensides.			
RC-5				-RC-5: Recovery = 80% -Core Loss = 30 cm -RQD = 56%			
			14.0				
				14.9			
RC-6			15.0	MUDSTONE, gray, soft, slightly to highly broken.			
				-RC-6: Recovery = 90% -Core Loss = 17 cm -RQD = 43%			
			16.0				
RC-7				-qr (@ 16.7m) = 1.06 MPa			
			17.0				
				-RC-7: Recovery = 87% -Core Loss = 18 cm -RQD = 0%			
			18.0	18.0 Bottom of Boring = 18.0 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-11
Sheet: 1 of 5
Completion Depth: 32.0 m

Date Started: 1/8/98
Date Finished: 1/8/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143860.636
Easting: 634270.350
Elevation: 273.7 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				Brown CLAYEY SILT, some organics, some coarse to fine sand (Topsoil). Moist.			
				0.1			
SS-1	2 2 4	44		Mottled brown and gray SILTY CLAY, some coarse to fine sand, trace fine gravel. Medium stiff to stiff. Moist.	18		
			1.0				
SS-2	4 5 4	56			16		
				1.8			
SS-3	9 11 21	28	2.0	Reddish-brown coarse to fine SAND, little coarse to fine gravel (weathered sandstone fragments), trace clayey silt. Dense. Damp to moist.	12		
				2.6			
SS-4	5 10 24	56	3.0	Mottled brown and gray CLAY, little silt, little fine to coarse sand, trace fine gravel. Hard. Moist. -SS-4: ODOT A-7-6 (19)	19	53	23
				3.5			
				Gray CLAY-SHALE. Hard soil/very soft bedrock.			
			4.0				
SS-5	34 50/13cm	56			18		

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion — N/A * m
After 24 Hrs ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client Sverdrup Associates, Inc.
Project ATH/MEG-33-30.980/0.000
Project Number W-7139

Boring Number B-11
Sheet 2 of 5
Completion Depth 32.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-6	40 50/10cm	61	6.0		14		
SS-7	49 50/10cm	56	7.0				
			8.0				
SS-8	50/10cm	22					
RC-1			9.0	MUDSTONE; gray to reddish-brown, soft, highly weathered, highly broken.			
			10.0	-RC-1: Recovery = 100% -No Core Loss -RQD = 13%			
				-siltstone (medium to moderately hard) lens from 10.3 m to 10.5 m			
RC-2				SHALE; gray, soft, highly broken, fissile.			
			11.0				
				SANDSTONE; gray, medium hard, highly			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-11
Project: ATH/MEG-33-30.980/0.000
Sheet: 3 of 5
Project Number: W-7139
Completion Depth: 32.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			12.0	broken, fine grained. -RC-2: Recovery = 94% -Core Loss = 15 cm -RQD = 9%			
				12.2 SHALE; reddish-brown, soft, highly broken, slightly jointed, fissile, slightly arenaceous, with sporadic slickensides.			
			13.0				
RC-3							
			14.0				
			15.0	-RC-3: Recovery = 90% -Core Loss = 30 cm -RQD = 12%			
			16.0				
				16.1 LIMESTONE; gray, medium to moderately hard, slightly broken, fine to medium crystalline.			
RC-4							
			17.0	17.0 MUDSTONE; gray to red, soft, highly broken, slightly jointed, slightly arenaceous, calcareous.			
				-RC-4: Recovery = 86% -Core Loss = 14 cm -RQD = 38%			
			18.0				

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-11
Sheet: 4 of 5
Completion Depth: 32.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				18.6			
				MUDSTONE; reddish-gray, soft, highly broken.			
RC-5			19.0	-RC-5: Recovery = 63% -Core Loss = 44 cm -RQD = 0%			
			20.0				
RC-6				-RC-6: Recovery = 75% -Core Loss = 15 cm -RQD = 0%			
RC-7			21.0	-RC-7: Recovery = 86% -Core Loss = 15 cm -RQD = 0%			
RC-8			22.0				
			23.0	-RC-8: Recovery = 95% -Core Loss = 12 cm -RQD = 28%			
				-slickenside @ 23.6 m			
			24.0				
RC-9				24.2 SHALE; reddish-gray, soft to medium hard, highly broken, fissile, highly arenaceous.			
			25.0	-RC-9: Recovery = 96% -Core Loss = 6 cm			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-11
Sheet: 5 of 5
Completion Depth: 32.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				-RQD = 17%			
				25.7			
RC-10				MUDSTONE; red, soft, highly broken.			
			26.0	-RC-10: Recovery = 73% -Core Loss = 26 cm -RQD = 26% -qr (@ 26.2m) = 4.97 MPa			
RC-11							
			27.0				
				-RC-11: Recovery = 78% -Core Loss = 45 cm -RQD = 0%			
			28.0				
RC-12							
			29.0	-RC-12: Recovery = 83% -Core Loss = 31 cm -RQD = 30%			
			30.0	30.0			
RC-13				LIMESTONE; gray, medium to moderately hard, slightly massive, slightly jointed, medium crystalline. -qr (@ 30.5m) = 67.97 MPa -RC-13: Recovery = 100% -No Core Loss -RQD = 77%			
			31.0	31.0 SHALE; gray, soft, slightly broken, slightly fissile.			
			32.0	Bottom of Boring = 32.0 meters 32.0			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-12
Sheet: 1 of 3
Completion Depth: 18.0 m

Date Started: 1/14/98
Date Finished: 1/15/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143867.047
Easting: 634210.694
Elevation: 289.7 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				Brown CLAYEY SILT, some organics, little coarse to fine sand (Topsoil). Moist. 0.1			
SS-1	4 8 19	50		Reddish-brown fine SAND, some silt, trace clay, trace coarse sand, trace fine gravel. Medium dense. Moist.	17		
			1.0	1.0			
SS-2	29 50/8cm	28		Reddish-brown weathered SANDSTONE. Soft bedrock.	9		
SS-3	46 50/5cm	39	2.0		8		
SS-4	44 50/8cm	44	3.0		8		
			4.0				
SS-5 RC-1	50/8cm	17		SANDSTONE; brown to reddish-gray, 4.3	6		

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: N/A * m
After 24 Hrs: ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-12
Sheet: 2 of 3
Completion Depth: 18.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				medium to moderately hard, broken, coarse to medium grained.			
			5.0	*-RC-1: Recovery = 80%* *-Core Loss = 30 cm* *-RQD = 48%*			
RC-2			6.0	*-RC-2: Recovery = 76%* *-Core Loss = 36 cm* *-RQD = 24%*			
			7.0				
RC-3							
				7.9			
			8.0	*SANDSTONE; brown, soft, highly broken, slightly argillaceous, medium grained.* *-RC-3: Recovery = 90%* *-Core Loss = 18 cm* *-RQD = 7%*			
			9.0				
				9.1			
RC-4				*SANDSTONE; gray, medium to moderately hard, highly broken, medium to coarse grained.*			
			10.0				
				-RC-4: Recovery = 98% *-Core Loss = 6 cm* *-RQD = 28%*			
				10.8			
			11.0	*SHALE; gray, soft, broken to slightly broken, fissile, slightly arenaceous.*			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-12
Project: ATH/MEG-33-30.980/0.000
Sheet: 3 of 3
Project Number: W-7139
Completion Depth: 18.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			12.0	-qr (@ 11.9 m) = 32.03 MPa			
RC-5			13.0	-RC-5: Recovery = 98% -Core Loss = 5 cm -RQD = 50%			
			14.0	-qr (@ 14.3 m) = 7.45 MPa -coal seam from 14.4 m to 14.6 m			
RC-6			15.0	LIMESTONE; gray, medium hard, slightly broken, slightly jointed, coarse crystalline.	14.9		
			16.0	-RC-6: Recovery = 96% -Core Loss = 6 cm -RQD = 38%			
RC-7				MUDSTONE; dark gray, soft, highly broken.	16.4		
			17.0	-RC-7: Recovery = 91% -Core Loss = 14 cm -RQD = 0%			
			18.0	LIMESTONE; gray, medium hard, highly broken, slightly jointed, medium crystalline. Bottom of Boring = 18.0 meters	17.7 18.0		

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-13
Sheet: 1 of 2
Completion Depth: 6.1 m

Date Started: 1/20/98
Date Finished: 1/20/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143700.873
Easting: 634267.449
Elevation: 255.4 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 2 4	44		Brown coarse to fine SANDY SILT, some clay, little organics (Topsoil). Moist.	25		
			0.1				
SS-2	2 3 3	50		Brown CLAY, some silt, little fine gravel, trace coarse to fine sand. Medium stiff to stiff. Moist. -SS-1: qh = 120 kPa -SS-2: qh = 96 kPa	27		
			1.0				
SS-3	3 5 9	44		-SS-3: ODOT A-7-6 (19); qh = 215 kPa	23	53	20
			1.8				
SS-4	3 6 9	89	2.0	Mottled red and gray to red CLAY, some silt, trace fine sand, trace fine gravel. Very stiff to hard. Moist to damp. -SS-4: qh = 263 kPa	19		
SS-5	11 14 20	72	3.0	-SS-5: qh = 431+ kPa	15		
			4.0				
SS-6	14 27 44	94		-SS-6: ODOT A-6b (13); qh = 431+ kPa	12	39	18

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client Sverdrup Associates, Inc.
Project ATH/MEG-33-30.980/0.000
Project Number W-7139

Boring Number B-13
Sheet 2 of 2
Completion Depth 6.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-7	25 50/13cm	61	6.0	-SS-7: qh = 431+ kPa	11		
			6.1	Bottom of Boring = 6.1 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-14
Sheet: 1 of 2
Completion Depth: 7.3 m

Date Started: 1/20/98
Date Finished: 1/20/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143601.720
Easting: 634280.038
Elevation: 240.5 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 2 4	33		Brown coarse to fine SANDY SILT, some clay, little organics (Topsoil). Moist. 0.1	30	35	21
ST-2				Brown to reddish-brown CLAYEY SILT, little coarse to fine sand, trace fine gravel. Medium stiff. Moist. 0.4 -SS-1: ODOT A-6a (10); qh = 120 kPa	21	35	17
SS-3	4 5 7	89	1.0	Mottled brown, red, and purple SILT and CLAY, some to trace fine to coarse sand, trace to little fine gravel. Stiff to hard. Moist to damp. -ST-2: ODOT A-6b (9); qu = 91 kPa; uw = 19.28 kN/m3 -SS-3: qh = 144 kPa	21		
SS-4	6 9 26	44	2.0	-SS-4: qh = 239 kPa	18		
SS-5	13 15 27	89	3.0	-SS-5: ODOT A-6b (13); qh = 431+ kPa 3.0 Mottled brown, red, and purple INDURATED CLAY/WEATHERED MUDSTONE. Hard soil/very soft bedrock.	13	39	17
SS-6	29 42 50/10cm	78	4.0		9		

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
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(614) 885-1959

REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-14
Sheet: 2 of 2
Completion Depth: 7.3 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-7	28 42 50/10cm	89	6.0		10		
			7.0				
SS-8	50/10cm	22					
				7.3			

Bottom of Boring = 7.3 meters

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-15
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 1/20/98
Date Finished: 1/20/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143465.374
Easting: 634311.724
Elevation: 266.0 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 16cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 3 3	89		Brown coarse to fine SANDY SILT, some clay, little organics (Topsoil). Moist. 0.2	26	35	21
AS-2	3 2 3	0	1.0	Brown CLAYEY SILT, some fine sand, little fine gravel, trace coarse sand. Medium stiff. Moist. -SS-1: ODOT A-6a (6); qh = 144 kPa 1.1	22		
SS-3	6 7 11	78		Mottled red, brown and gray SILTY CLAY, little coarse to fine sand, trace fine gravel. Very stiff. Moist to damp. -SS-3: qh = 287 kPa	18		
SS-4	7 10 12	67	2.0	-SS-4: qh = 431+ kPa	10		
SS-5	7 10 16	67		-SS-5: qh = 431+ kPa	13		
			3.0	Bottom of Boring = 3.0 meters 3.0			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-16
Sheet: 1 of 4
Completion Depth: 25.0 m

Date Started: 2/8/98
Date Finished: 2/9/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143358.495
Easting: 634337.739
Elevation: 283.4 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 4 8	83		Brown SILTY SAND, little clay, trace organics (Topsoil). Moist.			
			0.1				
SS-2	8 10 17	78		Brown CLAYEY SILT, some fine sand, little coarse sand, trace fine gravel. Stiff. Moist.	27		
			0.4				
			1.0	Brown weathered SANDSTONE. Very soft bedrock.			
			1.1				
SS-3	50/13cm	80		SANDSTONE; brown, medium hard, highly broken, medium to coarse grained, slightly weathered.			
SS-4	50/8cm	100	2.0				
RC-1			3.0				
			4.0	-RC-1: Recovery = 95% -Core Loss = 9 cm -RQD = 20%			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: N/A * m
After 24 Hrs: ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-16
Sheet: 2 of 4
Completion Depth: 25.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-2			6.0	-RC-2: Recovery = 84% -Core Loss = 24% -RQD = 0%			
RC-3			7.0	-RC-3: Recovery = 92% -Core Loss = 12% -RQD = 25% -qr (@ 7.3 m) = 12.36 MPa			
RC-4			9.0	-RC-4: Recovery = 98% -Core Loss = 6 cm -RQD = 5%			
			9.0	SHALE; gray, very soft to soft, highly broken, fissile, weathered, arenaceous.			
			10.0	SANDSTONE; brown, medium hard, highly broken, weathered. -loss of fluid circulation @ 10.2 meters			
RC-5			10.1				
			11.0	SHALE; gray, medium hard to soft, highly broken, arenaceous, fissile, slightly weathered.			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-16
Project: ATH/MEG-33-30.980/0.000
Sheet: 3 of 4
Project Number: W-7139
Completion Depth: 25.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			12.0				
				-RC-5: Recovery = 100% -No Core Loss -RQD = 11%			
			13.0				
				13.6 LIMESTONE; gray, moderately hard, fine crystalline, slightly broken, slightly jointed.			
RC-6			14.0				
				-RC-6: Recovery = 100% -No Core Loss -RQD = 47% -qr (@ 14.6 m) = 43.20 MPa			
			15.0				
RC-7				-gray shale lens from 15.5-15.8 m			
			16.0	-RC-7: Recovery = 88% -Core Loss = 15 cm -RQD = 0%			
RC-8							
			17.0	-RC-8: Recovery = 100% -No Core Loss -RQD = 0%			
RC-9				17.2 MUDSTONE; variegated gray, red, and brown, soft to very soft, highly broken, nonbedded, slickensides.			
			18.0	-RC-9: Recovery = 100% -No Core Loss -RQD = 0%			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-16
Sheet: 4 of 4
Completion Depth: 25.0 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-10			19.0	-RC-10: Recovery = 85% -Core Loss = 22 cm -RQD = 13%			
RC-11			20.0	-RC-11: Recovery = 76% -Core Loss = 36 cm -RQD = 8% -limestone lens from 21.0-21.1 m			
RC-12			22.0	-RC-12: Recovery = 99% -Core Loss = 2 cm -RQD = 0%			
RC-13			23.0	-brown from 22.9 to 25.0 meters			
			24.0	-RC-13: Recovery = 96% -Core Loss = 6 cm -RQD = 0%			
RC-14			25.0	-RC-14: Recovery = 83% -Core Loss = 25 cm -RQD = 0%			
			25.0	Bottom of Boring = 25.0 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-17
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 1/21/98
Date Finished: 1/21/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143271.048
Easting: 634359.023
Elevation: 265.3 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	4 3 4	67		Brown CLAYEY SILT, little organics, little coarse to fine sand (Topsoil). Moist. 0.1	31	40	25
SS-2	2 4 9	44	1.0	Brown to mottled brown and red CLAYEY SILT, some to trace coarse to fine sand, little fine gravel. Medium stiff. Moist. -SS-1: ODOT A-6b (6); qh = 168 kPa -SS-2: qh = 192 kPa	19		
SS-3	15 26 40	10		-SS-3: qh = 431+ kPa	10		
SS-4	17 33 42	78	2.0	-SS-4: qh = 431+ kPa 2.5	9		
SS-5	19 35 50/10cm	89	3.0	Red highly weathered SHALE. Hard soil/very soft bedrock. -SS-5: qh = 431+ kPa 3.0	10		
				Bottom of Boring = 3.0 meters			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion - Dry m
After 24 Hrs ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-18
Sheet: 1 of 2
Completion Depth: 5.9 m

Date Started: 1/21/98
Date Finished: 1/21/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143164.168
Easting: 634385.038
Elevation: 248.4 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 4 4	67		Brown CLAYEY SILT, some coarse to fine sand, little organics (Topsoil). Moist. 0.1	18		
SS-2	4 7 11	83	1.0	Brown SILTY CLAY, some fine sand, trace coarse sand, trace coarse to fine gravel. Stiff to very stiff. Moist. -SS-1: qh = 96 kPa -SS-2: ODOT A-6b (8); qh = 287 kPa 1.1	17	34	17
SS-3	12 14 17	33		Reddish-brown CLAY, some silt, trace coarse to fine sand, trace fine gravel. Hard. Moist. -SS-3: qh = 431+ kPa	10		
SS-4	8 13 19	44	2.0		9		
SS-5	8 14 21	39	3.0	-SS-5: qh = 431+ kPa	10		
SS-6	16 18 26	44	4.0	-SS-6: ODOT A-7-6 (16); qh = 431+ kPa	16	46	18

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-18
Sheet: 2 of 2
Completion Depth: 5.9 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
SS-7	16 50/5cm	33		Gray CLAYEY SILT, some coarse to fine sand. Hard. Damp.	8		
			5.6				
			5.9	Bottom of Boring = 5.9 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-19
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 1/21/98
Date Finished: 1/21/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 143018.423
Easting: 634420.512
Elevation: 267.5 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	3 3 4	83		Brown coarse to fine SANDY SILT, some organics, little clay (Topsoil). Moist. (0.1)	24	26	17
SS-2	2 3 4	22		Brown fine SANDY SILT, some clay, trace coarse sand, trace fine gravel. Medium stiff. Moist. (0.4)	13		
				-SS-1: ODOT A-4a (5); qh = 144 kPa			
SS-3	4 7 7	61	1.0	Brown fine SAND, some silty clay, little fine to coarse gravel (sandstone fragments), trace coarse sand. Loose. Moist. (1.1)	20		
				-SS-2: ODOT A-3a			
SS-4	4 11 15	50	2.0	Brown SILTY CLAY, some coarse to fine sand, trace coarse to fine gravel. Stiff to hard. Moist to damp.	17		
				-SS-3: qh = 311 kPa			
				-SS-4: qh = 431+ kPa			
SS-5	14 27 37	67		-SS-5: qh = 335 kPa	8		
			3.0	Bottom of Boring = 3.0 meters (3.0)			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-20
Sheet: 1 of 4
Completion Depth: 23.2 m

Date Started: 1/22/98
Date Finished: 1/22/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 142927.172
Easting: 634468.453
Elevation: 285.7 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	4 4 4	28		Dark brown coarse to fine SANDY SILT, some organics, little clay (Topsoil). Moist.	78		
SS-2	4 6 6	56	1.0	Dark brown to reddish brown SILTY CLAY, trace coarse to fine sand, trace fine gravel. Medium stiff. Moist. (0.1 – 1.1)	27		
SS-3	8 28 50/13cm	56		Brown highly weathered SANDSTONE. Hard soil/very soft bedrock.	12		
SS-4	50/13cm	22	2.0	SANDSTONE; brown, soft to medium hard, slightly massive to slightly broken, slightly jointed, coarse grained. (2.0 – 3.0)	8		
RC-1			3.0				
			4.0	-RC-1: Recovery = 99% -Core Loss = 3 cm -RQD = 55%			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: N/A* m
After 24 Hrs: ▼ N/A m
* Wash water used during the drilling process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

RESOURCE INTERNATIONAL, INC.
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-20
Project: ATH/MEG-33-30.980/0.000
Sheet: 2 of 4
Project Number: W-7139
Completion Depth: 23.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			6.0				
RC-2			6.0				
			7.0	-RC-2: Recovery = 95% -Core Loss = 15 cm -RQD = 70%			
			8.0				
RC-3			9.0				
			10.0	-RC-3: Recovery = 86% -Core Loss = 43 cm -RQD = 44%			
			11.0				

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-20
Sheet: 3 of 4
Completion Depth: 23.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				-qr (@ 11.4m) = 24.14 MPa			
RC-4			12.0	-RC-4: Recovery = 100% -No Core Loss -RQD = 32%			
			13.0	13.1 SHALE; black to gray, very soft to medium hard, highly broken, fissile, arenaceous.			
			14.0				
RC-5			15.0	-highly carbonaceous from 14.8m to 15.1m -RC-5: Recovery = 67% -Core Loss = 46 cm -RQD = 9%			
			16.0	16.2			
RC-6				LIMESTONE; gray to dark gray, medium to moderately hard, slightly broken, fine to medium crystaline. -RC-6: Recovery 100% -Core Loss = 48 cm			
			17.0	-RQD = 48%			
RC-7				-RC-7: Recovery = 80% -Core Loss = 31 cm			
			18.0	-RQD = 54%			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-20
Sheet: 4 of 4
Completion Depth: 23.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				18.6			
RC-8			19.0	MUDSTONE; gray to reddish-gray, soft, highly broken to slightly broken, with rare slickensides.			
				-RC-8: Recovery = 100% -No Core Loss -RQD = 0%			
RC-9			20.0				
			21.0	-RC-9: Recovery = 78% -Core Loss = 33 cm -RQD = 26%			
RC-10			22.0				
				-RC-10: Recovery = 62% -Core Loss = 57 cm -RQD = 61%			
			23.0				
				23.2			

Bottom of Boring = 23.2 meters

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-21
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 1/26/98
Date Finished: 1/26/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 142824.097
Easting: 634467.811
Elevation: 263.9 m

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 16cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 3 3	33		Brown fine SANDY SILT, little clay, trace organics (Topsoil). Moist. 0.1			
SS-2	2 2 3	61		Brown CLAYEY SILT, some fine sand, little coarse sand, trace fine gravel. Medium stiff. Moist. 0.5 -SS-1: ODOT A-6a (5)	22 25	32	18
SS-3	4 4 7	39	1.0	Mottled brown, gray, and red CLAY and SILT, some fine sand, trace coarse sand, trace fine gravel. Medium stiff to very stiff. Moist. -SS-3: ODOT A-6a (9)	21	32	19
SS-4	4 7 9	56	2.0		21		
SS-5	12 40 50/8cm	77	3.0	2.7 Variegated brown and purple INDURATED CLAY/MUDSTONE. Hard soil/very soft bedrock. 3.0	11		

Bottom of Boring = 3.0 meters

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-22
Sheet: 1 of 2
Completion Depth: 6.1 m

Date Started: 2/11/98
Date Finished: 2/11/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 142690.484
Easting: 634502.391
Elevation: 236.5 m**

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	3 3 3	56		Brown fine SANDY SILT, little organics, trace clay (Topsoil). Moist. 0.2	27		
ST-2		100		Brown SILTY CLAY, some fine sand, little fine gravel, trace organics. Medium stiff. Moist. 0.4	8		
			1.0	Brown fine to coarse SAND, some fine gravel (sandstone fragments). Moist. -ST-2: Visual ODOT A-3a 1.1			
SS-3	4 5 10	50		Brown CLAY, little fine sand, little to some silt, trace coarse sand, trace fine gravel. Very stiff. Moist. -SS-3: ODOT A-7-6 (17)	22	47	16
ST-4		67	2.0	-ST-4: ODOT A-7-6 (17); uw = 21.05 KN/m3 2.6	17	47	17
SS-5	7 14 17	67	3.0	Varigated red, brown, and gray INDURATED CLAY/MUDSTONE. Hard soil/very soft bedrock.			
			4.0				
SS-6	21 50/13cm	100					

NOTES: ** Elevation is approximate.

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion --- Dry m
After 24 Hrs ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

RESOURCE INTERNATIONAL, INC.
281 ENTERPRISE DRIVE
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(614) 885-1959

REPORT OF SOIL EXPLORATION

Client Sverdrup Associates, Inc.
Project ATH/MEG-33-30.980/0.000
Project Number W-7139

Boring Number B-22
Sheet 2 of 2
Completion Depth 6.1 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			6.0				
SS-7	46 50/5cm	88	6.0				
				6.1 Bottom of Boring = 6.1 meters			

NOTES: ** Elevation is approximate.

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-23
Sheet: 1 of 1
Completion Depth: 2.3 m

Date Started: 2/2/98
Date Finished: 2/2/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 142508.316
Easting: 634544.673
Elevation: 268.0 m**

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	3 3 5	39		Brown CLAYEY SILT, some coarse to fine sand, little organics (Topsoil). Wet. 0.1	38		
SS-2	2 2 3	50	1.0	Dark brown CLAY, some silt, trace coarse to fine sand, trace fine gravel. Medium stiff to very stiff. Wet to moist. -SS-2: ODOT A-7-6 (17)	27	51	23
SS-3	5 7 12	44		-SS-3: Mottled red and brown 1.8	17		
SS-4	12 47 50/3cm	77	2.0	Brown highly weathered SHALE. Hard soil/very soft bedrock. 2.3	11		
				Bottom of Boring = 2.3 meters			

NOTES: ** Elevation is approximate.

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion ▽ Dry m
After 24 Hrs ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-24
Sheet: 1 of 4
Completion Depth: 21.9 m

Date Started: 1/30/98
Date Finished: 2/1/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 142435.444
Easting: 634562.410
Elevation: 288.6 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 3 5	56		Dark brown SILT, some clay, little organics, trace fine sand (Topsoil). Moist. 0.1	41		
SS-2	4 11 21	89		Red to brown SILTY CLAY, little coarse to fine sand, trace fine gravel. Medium stiff to hard. Moist.	13		
			1.0	1.0			
SS-3	25 50/13cm	62		Brown INDURATED CLAY/CLAY-SHALE. Hard soil/very soft bedrock.	8		
SS-4	13 50/10cm	100	2.0		12		
				2.7			
RC-1			3.0	SHALE; brownish gray, soft to medium hard, highly broken. 3.1			
				SANDSTONE; brown to gray, medium hard to moderately hard, highly broken. 3.5			
				MUDSTONE; brown, soft, highly broken.			
			4.0	-RC-1: Recovery = 88% -Core Loss = 22 cm -RQD = 24%			
				4.5			

NOTES:

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: N/A * m
After 24 Hrs: ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-24
Sheet: 2 of 4
Completion Depth: 21.9 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-2				SHALE; brown and gray, soft, arenaceous, highly broken.			
				4.8			
			5.0	SHALE; gray, soft, highly weathered, highly broken, fissile.			
				-RC-2: Recovery = 100% -No Core Loss -RQD = 12%			
			6.0				
				6.1			
RC-3				SANDSTONE; gray to brown, soft to moderately hard, fine to coarse grained, slightly broken.			
			7.0				
				-qr (@ 7.3 m) = 12.79 MPa			
				-RC-3: Recovery = 97% -Core Loss = 9 cm -RQD = 43%			
			8.0				
			9.0				
RC-4				-loss of circulation @ 9.45 m			
			10.0				
				-jointed @ 10.4 m -RC-4: Recovery = 100% -No Core Loss -RQD = 50%			
			11.0				

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Boring Number: B-24
Project: ATH/MEG-33-30.980/0.000
Sheet: 3 of 4
Project Number: W-7139
Completion Depth: 21.9 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			12.0				
RC-5			13.0	-RC-5: Recovery = 96% -Core Loss = 12 cm -RQD = 33%			
				13.7 SHALE; gray, soft, highly broken, arenaceous, fissile.			
			14.0				
			15.0				
RC-6				15.8 LIMESTONE; gray, medium hard to moderately hard, highly broken, slightly jointed. -RC-6: Recovery = 100% -No Core Loss -RQD = 9%			
			16.0				
RC-7			17.0				
				-RC-7: Recovery = 96% -Core Loss = 6 cm -RQD = 36%			
			18.0				

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-24
Sheet: 4 of 4
Completion Depth: 21.9 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-8							
			19.0	-RC-8: Recovery = 85% -Core Loss = 16 cm -RQD = 22%			
				19.3			
RC-9				CLAY-SHALE; gray, very soft, highly broken.			
				-RC-9: Recovery = 69% -Core Loss = 15 cm -RQD = 0%			
				19.8			
RC-10			20.0	MUDSTONE; variegated gray, red, and brown, very soft, highly broken.			
				-Recovery = 92% -Core Loss = 12 cm -RQD = 0%			
			21.0				
				21.3			
RC-11				SHALE; gray, soft, highly broken, highly jointed, arenaceous, rare slickensides. -RC-11: Recovery = 45% -Core Loss = 34 cm -RQD = 0%			
				21.9			
				Bottom of Boring = 21.9 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-25
Sheet: 1 of 1
Completion Depth: 3.0 m

Date Started: 2/2/98
Date Finished: 2/2/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 142382.975
Easting: 634575.181
Elevation: 272.0 m**

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 3 3	89		Brown SANDY SILT, little clay, little organics (Topsoil). Moist. 0.1	25		
SS-2	3 3 4	83		Brown to reddish-brown SILTY CLAY, some coarse to fine sand, little fine gravel. Medium stiff. Moist. -SS-2: ODOT A-6a (5)	16	26	14
			1.0	1.1			
SS-3	4 6 8	56		Brown fine to coarse SANDY CLAY, some silt, trace coarse to fine gravel. Stiff. Moist.	13		
				1.8			
SS-4	4 7 13	61	2.0	Brown to gray SILTY CLAY, little coarse to fine sand, trace fine gravel. Very stiff. Moist.	20		
				2.4			
SS-5	8 23 27	72	3.0	Gray CLAY-SHALE. Very soft bedrock. 3.0	12		
				Bottom of Boring = 3.0 meters			

NOTES: ** Elevation is approximate.

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-26
Sheet: 1 of 2
Completion Depth: 5.8 m

Date Started: 2/11/98
Date Finished: 2/11/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 142223.628
Easting: 634613.966
Elevation: 250.0 m**

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 3 3	78	0.1	Brown SILTY CLAY, some fine sand, little organics, trace fine gravel (Topsoil). Moist.	20		
ST-2		100		Brown SILTY CLAY, some fine sand, trace to little fine gravel, trace coarse sand. Medium stiff to stiff. Moist.	23	36	14
			1.0	-ST-2: ODOT A-6b			
SS-3	2 2 4	56		-SS-3: Visual ODOT A-6b	23		
SS-4	4 5 8	39	2.0		23		
			2.4				
SS-5	6 9 19	33	3.0	Red to brown CLAY, little silt, trace fine sand, trace fine gravel, trace coarse sand. Very stiff to hard. Moist to damp.	17		
			4.0				
SS-6	10 21 29	78		-SS-6: ODOT A-7-6 (15)	14	44	18

NOTES: ** Elevation is approximate.

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: Dry m
After 24 Hrs: ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-26
Sheet: 2 of 2
Completion Depth: 5.8 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
			5.0				
				5.3 Gray weathered SHALE. Hard soil/very soft bedrock.			
SS-7	50/8cm	100		5.8 Bottom of Boring = 5.8 meters			

NOTES: ** Elevation is approximate.

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-27
Sheet: 1 of 4
Completion Depth: 19.2 m

Date Started: 1/30/98
Date Finished: 1/30/98
Drilled By: J.T.

DRILLING AND SAMPLING INFORMATION

Northing: 142050.402
Easting: 634644.425
Elevation: 292.6 m

Boring Method: 9.5 cm HSA/RC
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	3 6 13	67		Brown SILTY CLAY, little coarse to fine sand, little organics, trace fine gravel (Topsoil). Moist.	22		
			0.1				
SS-2	19 21 24	100		Red SILTY CLAY, some coarse to fine sand. Very stiff to hard. Moist to damp. -SS-2: ODOT A-6a (5)	16	34	21
			1.0				
SS-3	50/5cm	100		Light gray INDURATED CLAY/weathered CLAY-SHALE. Hard soil/very soft bedrock.	10		
SS-4	50/10cm	100	2.0		12		
SS-5	50/13cm	100	3.0				
			4.0				
SS-6	50/0cm	0					
			4.5				

NOTES:

SAMPLE TYPE
SS - 6 1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion: N/A* m
After 24 Hrs: ▼ N/A m
* Wash water used during the coring process.

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-27
Sheet: 2 of 4
Completion Depth: 19.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-1			5.0	MUDSTONE; brown and red, soft, highly broken, slightly jointed, rare slickensides.			
				-RC-1: Recovery = 91% -Core Loss = 14 centimeters -RQD = 27%			
RC-2			6.0				
			7.0	-RC-2: Recovery = 50% -Core Loss = 76 centimeters -RQD = 0%			
RC-3			8.0	-changing to gray in RC-3			
				-RC-3: Recovery = 100% -No Core Loss -RQD = 24%			
				SHALE; gray, soft, highly broken, arenaceous. 8.6 / 8.9			
			9.0	SANDSTONE; gray, moderately hard, medium to fine grained, highly broken. 9.2			
RC-4				SHALE; gray, moderately hard, arenaceous, slightly broken.			
				-RC-4: Recovery = 100% -No Core Loss -RQD 54%			
			10.0	10.1			
				MUDSTONE; gray, soft to moderately hard, slightly broken.			
				10.7			
RC-5			11.0	SANDSTONE; gray to brown, soft, slightly massive, medium to fine grained.			
				-RC-5: Recovery = 100%			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-27
Sheet: 3 of 4
Completion Depth: 19.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
				-No Core Loss -RQD = 69%			
				11.8			
			12.0	MUDSTONE; gray, soft, highly broken.			
				12.1			
RC-6				SANDSTONE; brown to gray, medium hard, medium to fine grained, massive.			
			13.0				
				-RC-6: Recovery = 100% -No Core Loss -RQD = 58%			
RC-7							
			14.0				
				-RC-7: Recovery = 100% -No Core Loss -RQD = 88%			
			15.0				
RC-8							
				-RC-8: Recovery = 100% -No Core Loss -RQD = 27%			
			16.0				
				-qr (@ 16.1 meters) = 18.52 MPa			
RC-9							
			17.0				
				-RC-9: Recovery = 100% -No Core Loss -RQD = 95%			
			18.0				

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139
Boring Number: B-27
Sheet: 4 of 4
Completion Depth: 19.2 m

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
RC-10				-RC-10: Recovery = 100% -No Core Loss -RQD = 63%			
			19.0				
			19.2	Bottom of Boring = 19.2 meters			

NOTES:

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REPORT OF SOIL EXPLORATION

Client: Sverdrup Associates, Inc.
Project: ATH/MEG-33-30.980/0.000
Project Number: W-7139

Boring Number: B-28
Sheet: 1 of 1
Completion Depth: 4.3 m

Date Started: 2/3/98
Date Finished: 2/3/98
Drilled By: M.F.

DRILLING AND SAMPLING INFORMATION

Northing: 141999.229
Easting: 634701.289
Elevation: 279.5 m**

Boring Method: 9.5 cm HSA
Hammer Weight: 63.5 kg
Hammer Drop: 76 cm

SAMPLE NO	BLOWS PER 15cm	PERCENT RECOVERY	DEPTH	SOIL DESCRIPTION	MOISTURE CONTENT	ATTERBERG LL	ATTERBERG PL
SS-1	2 2 3	56		Brown CLAYEY SILT, some coarse to fine sand, little organics (Topsoil). Moist. 0.1	27		
SS-2	2 2 8	22	1.0	Brown SILTY CLAY, little coarse to fine sand, trace fine gravel. Medium stiff to stiff. Moist.	21		
SS-3	3 4 6	61			31		
SS-4	17 20 50/10cm	56	2.0	Brown coarse to fine SANDY SILT, little clay, trace fine gravel. Hard. Moist. 1.8	15		
SS-5	9 11 37	100	3.0	-SS-5: ODOT A-4a (5)	17	NP	NP
			4.0				
SS-6	50/3cm	100		Brown weathered SANDSTONE. Very soft bedrock. 4.1 4.3	7		

Bottom of Boring = 4.3 meters

NOTES: ** Elevation is approximate. NP = non-plastic sample.

SAMPLE TYPE
SS - 5.1cm OD Split Spoon
GS - Geoprobe Sample
ST - Shelby Tube
RC - Rock Core
AS - Auger Sample

GROUND WATER READING
At Completion - Dry m
After 24 Hrs ▼ N/A m

BORING METHOD
HSA - Hollow Stem Augers
SFA - Solid Flight Augers
MD - Mud Drilling
WD - Wash Drilling
RC - Rock Coring