Speed Letter

Illinois Department of Transportation

Bureau of Bridges & Structures • 2300 S. Dirksen Parkway • Springfield, Illinois 62764

To: Holcomb Foundation Engineering Co.
393 Wood Road
Po Box 88
Carbondale, IL
62903-

Attention: Timothy J. Holcomb

Date: March 25, 2010	**Job No.:** P-97-010-07
SN: 096-0075	**Contract No.:** 74222
Route: FAP 821 (IL 15)	
Section: (18BY1)B-1	
County: Wayne	
Other:	

Subject: **Structure Geotechnical Report (SGR) Review**

We are Sending:

☐ Structure Geotechnical Report ☐ Foundation/Wall Design Details ☐ Settlement/Stability Analysis
☒ Approval ☐ Comments ☐ Special Provisions ☐

These Are:

☒ Approved As Submitted ☐ Approved Subject to Changes & Comments Below
☐ Returned for Revisions and Re-submittal ☐ For Your Use ☐ For Review and Comments
☐

Remarks:
Following our review of your SGR dated March 24, 2010, we approve the report as submitted for use in completing the final design plans and specifications.

If you have any questions or need further assistance, please contact Paul S. Guthrie at (217)-524-4681 or Riyad M. Wahab at (217)-522-2704

Copies To: Esi Consultants, Ltd.
Roger L. Driskell - District 7 Attn:Timothy S. Jackson

rmw/psg

By _____
For The Engineer of Bridges & Structures
12/23/09

Structure Geotechnical Report

FAP Route 821(Illinois Route #15)
Section (18BY1)B-1
Wayne County
Structure (Existing) 096-0007
Structure (Proposed) 096-0075
Contract: 74222
Job Number: P-97-010-07
PTB 148-25

Prepared By: Timothy J. Holcomb, P.E.
Holcomb Foundation Engineering Company
PO Box 88
Carbondale, Illinois 62903
618-529-5262
HFE File H-09038

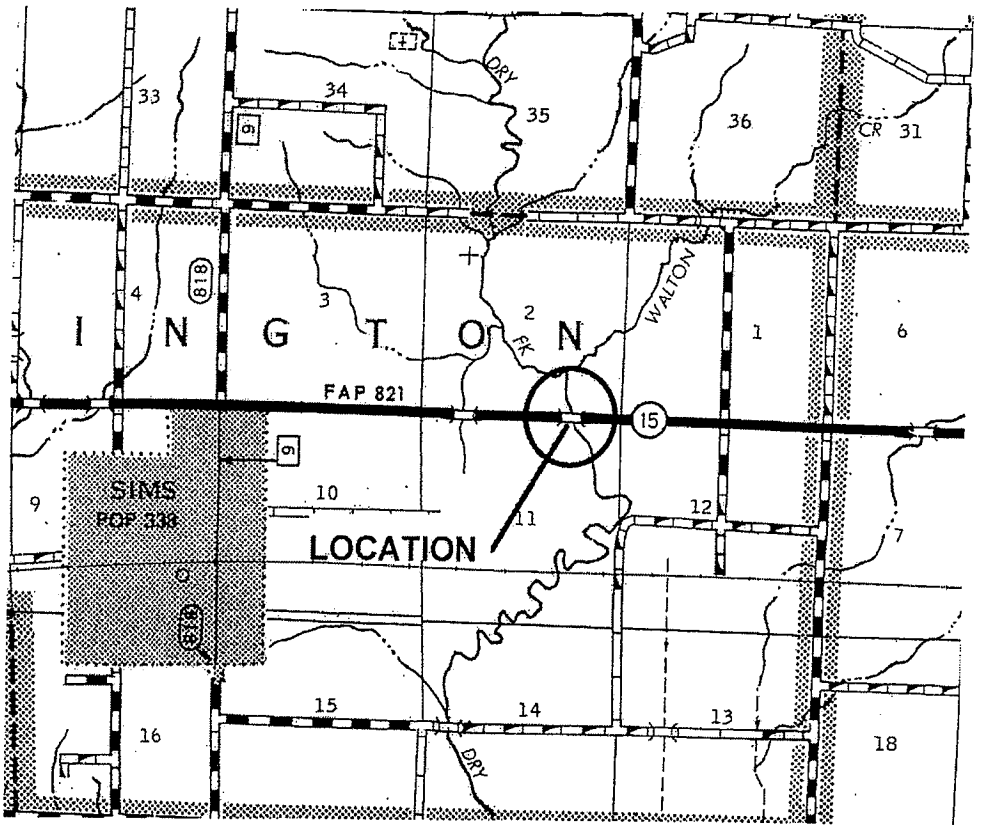
Date: March 24, 2010

Prepared For: ESI Consultants, LTD
753 Windsor Road
Charleston, Illinois 61920

Attachments: TSL Drawings
Subsurface Profile
Boring Logs
Site Classification
Slope Stability Analyses

1.0 Project Description and Proposed Structure Information

This structure is to consist of replacement of existing structure 096-0007 carrying US Route #15 over Dry Fork Creek in Wayne County, Illinois. This structure lies approximately two miles east of Sims on Route #15, between Sections 2 and 11 in Township 2 South, Range 6 East of the Third Principal Meridian in Wayne County.



The project includes construction of a three span structure with a length of 137' 0" back to back of abutments, and a width of 36' 0". The new structure will consist of a concrete deck at an approximate elevation of 405.5 resting on pile supported abutments and piers. The new structure will have 2:1 end slopes with a 20 foot berm on the east side of the streambed. The proposed streambed elevation is 385.1. Intermediate supports are 42' 9" east and west of the new abutments. This structure will be constructed using stage construction with one lane open to traffic.

2.0 Existing Information

The existing structure was constructed in 1922 and reconstructed in 1957. The original structure consisted of a two span reinforced concrete thru girder superstructure founded upon pile supported closed abutments and a solid wall pier on pile supported footings. In 1957, the structure was widened from 20 to 28 feet. The existing superstructure consists of continuous two span, 6 steel beams with a reinforced concrete slab and two pile bent supported approach slabs with no skew. The existing structure will be completely replaced.

3.0 Site Investigation, Subsurface Exploration, and Conditions

This structure lies in the Mt. Vernon Hill Country physiographic division, which generally consists of a thin mantle of loess overlying Illinoisan glacial drift and alluvium. The area in the vicinity of this structure has been influenced by Skillet Fork Creek alluvial deposits overlying shale and sandstone bedrock. Pennsylvanian deposits of shale, sandstone, coal, and limestone generally lie at relatively shallow depths in this area. The immediate site subsurface conditions consist of about one foot of asphalt and concrete pavement overlying about eight to fifteen feet of gray to brown silty clay to silty loam. Below these soils lies two to four feet of soft silty loam, that overlies brown mottled gray clay loam. The clay loam extends to depths ranging from about 34 to 39 feet, where a very stiff gray clay loam to sandy loam was encountered. Gray shale was encountered at about 69 feet in all of the soil borings.

A rock core cut in Boring #3 indicates the shale extends to about 73 feet in depth, where a gray sandstone was encountered. The sandstone extends down to at least the bottom of this soil boring.

Three soil borings were drilled at this structure, located as follows:

Boring #1	1245+62 (6.5' Left)
Boring #2	1246+30 (7.0' Right)
Boring #3	1247+28 (7.0' Right)

The upper silty clay to clay loam is firm to stiff, with unconfined compressive strengths ranging from 0.4 to 2.0 tons per square foot, averaging 1.2 tsf. Standard penetration test values range from 4 to 10 blows per foot. Moisture contents vary from 2 to 26 percent, averaging 19 percent. These upper soils appear to be in fair to good condition in relation to the stability of the bridge abutments.

The sandy loam encountered at 8.5 feet in Boring #1, and at 15 feet in Boring #2 is very soft, with unconfined compressive strengths ranging from 0.1 to 0.4 tons per square foot, averaging 0.3 tsf. Standard penetration test values range from 2 to 4 blows per foot. Moisture contents of 26 to 30 percent were encountered in the soft loam, averaging about 26 percent. These soils have a high settlement potential.

The clay loam encountered below about 10 to 20 feet at this site ranges from soft to stiff, with unconfined compressive strengths ranging from 0.1 to 1.7 tons per square foot, averaging 0.9 tsf. Standard penetration test values range from 2 to 13 blows per foot, averaging about 7 bpf. Moisture contents vary from 17 to 26 percent, averaging 22 percent. These soils have a moderate settlement potential.

The glacial till encountered at about 34 to 39 feet in depth is very dense, with standard penetration test values ranging from 21 to in excess of 100 blows per foot, averaging 41 bpf. Unconfined compressive strengths range from 0.8 to 7.9 tons per square foot, averaging 4.2 tsf. Moisture contents vary from 12 to 18 percent. The glacial till has a very low settlement potential.

The shale encountered at about 69 feet in depth is very dense, with standard penetration test values in excess of 100 blows per foot. The shale is estimated to have a very low settlement potential.

Ground water was encountered at the following elevations:

Boring No.	Upon Completion	After 72 Hours
1	387.8	389.4
2	N/M	N/M
3	392.9	391.9

N/M – Not Measured due to borehole drilled through bridge deck.

4.0 Geotechnical Evaluation

4.1 Settlement

Very little additional fill is anticipated at the approach abutments, due to the elevation of the new structure being about the same as the existing structure. On the east side of the new structure, the 20 foot berm will actually be constructed at a lower elevation than the existing soil currently in this area. Due to the subsoils supporting no more load than the current overburden loadings, we anticipate less than 0.25 inch of settlement at the end slopes. No remedial methods are recommended to limit the settlements at this location.

4.2 Slope Stability

Due to the elevation of the existing structure being roughly the same as the proposed structure, we do not anticipate problems with the embankment stability. The seismic analysis has been determined using a peak horizontal ground acceleration of 0.093g. Stability analyses have been performed on both end slopes and determined the following factors of safety based upon the unconfined compressive strength tests:

Location	Analysis	Factor of Safety
East End Slope	Steady State	1.5
East End Slope	Seismic	1.2
West End Slope	Steady State	1.6
West End Slope	Seismic	1.1

These factors of safety appear acceptable for the proposed structure.

4.3 Seismic Considerations

Seismic Performance Zone (SPZ) = 2
Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.286
Design Spectral Acceleration at 0.2 sec. (S_{Ds}) = 0.687
Soil Site Class = D

4.4 Scour

Scour elevations have been determined for the piers as 13' for the 100 year flood, which results in estimated scour elevations as follows:

Design Scour	E. Abut.	Pier 1	Pier 2	W. Abut.
Elevation (ft.)	397.9	372.1	372.1	398.1

4.5 Mining Activity

The mine maps available from the State of Illinois Geological Survey indicate the site has not been undermined. No coal mining has been performed in Wayne County. Therefore, subsidence is not a concern at this location.

5.0 Foundation Evaluations and Design Recommendations

5.1 Bearing Capacity of Bridge Approaches

The approach footings require 2.0 ksf as maximum applied service bearing pressures per IDOT ABD 08.3. Data provided in the boring logs indicates the subsoils at each approach in the upper five feet of both of the approaches have bearing pressures in excess of 2.0 ksf. Due to the new approaches having about the same elevation as the existing abutments, we do not foresee problems with settlements at either approach. Therefore, ground improvement at both abutments does not appear necessary.

5.2 Foundation Recommendations

Both drilled piers and spread footings are not practical or economical alternatives for this structure. The subsoils do not have adequate strength for economical design of spread footings, and settlements would be extremely high. Drilled piers are not a cost effective alternative for the structure due to their depth and the difficulty of installing the piers at the intermediate bridge supports.

It is recommended the structure is supported upon steel H piling or metal shell concrete filled piles. Factored loadings for the abutments and piers have been tabulated using the following assumptions:

Abutments:	1500 kips	
Piers:	2000 kips	
Pile Cutoff Elev:	West Abutment –	400.12
	East Abutment –	399.88
	West Pier -	402.63
	East Pier -	402.54
Ground Surface At Pile:	398.1 (Abutments)	
	384.1 (Piers #1 and #2)	

Based upon the soil borings, the following soils at the corresponding elevations appear to be susceptible to liquefaction due to low unconfined compressive strengths or standard penetration test values, and were taken into account during the seismic design of the piles:

Boring No.	Liquefiable Subsoils (Elevation)
1	377.5-380.4
2	365.6-380.6
3	377.5-380.4

The subsoils at these locations consist of either loose sands or soft loamy soils that have the potential for liquefaction.

Due to the size of this structure and the estimated loadings, metal shell or H-piles appear feasible at this location for support of the axial bridge loadings. The piles should be sized and spaced according to current IDOT LRFD design policy in coordination with the pile tables enclosed. Once the necessary factored resistance available (Rf) is determined from the structural loadings, the nominal required bearing (Rn) and estimated pile lengths can be determined using these tables.

Pile Design Table

West Abutment – Boring No. 1

	Rn (kips)	Rf (kips)	Seismic Rf (kips)	Estimated Length (ft.)
Metal Shell 14" x 0.312" Walls*				
	167	92	21	31
	223	123	78	41
HP 12 x 63	270	149	67	41
	458	252	216	46
HP 14 x 73	321	177	83	41
	543	299	257	46

East Abutment – Boring No. 3

	Rn (kips)	Rf (kips)	Seismic Rf (kips)	Estimated Length (ft.)
Metal Shell 14" x 0.312" Walls*				
	247	136	104	44
	498	274	354	54
HP 12 x 63	408	224	208	54
HP 14 x 73	493	271	257	54

The following are estimated pile lengths and capacities for piles driven for piers in the stream bed for the intermediate piers:

Pile Lengths for Intermediate Pier #1 - Boring No. 2

	Rn (kips)	Rf (kips)	Seismic Rf (kips)	Estimated Length (ft.)
Metal Shell 14" x 0.312" Walls*				
	352	181	278	47
	394	204	320	57
HP 12 x 63	267	122	147	67
	446	228	353	70
HP 14 x 73	317	144	174	67
	549	282	440	70

Pile Lengths for Intermediate Pier #2 - Boring No. 2

	Rn (kips)	Rf (kips)	Seismic Rf (kips)	Estimated Length (ft.)
Metal Shell 14" x 0.312" Walls*				
	352	181	278	47
	394	204	320	57
HP 12 x 63	267	122	147	67
	446	228	353	70
HP 14 x 73	317	144	174	67
	549	282	440	70

* - Pile shoes are recommended for the 14 inch metal shell piles due to dense subsoils encountered near the bearing elevations.

Our experience in this area has been pile tip elevations have been seated at about three to four feet into the dense bedrock. However, the bearing capacity of the piles should be determined for each pile based upon the WSDOT driving formula.

A test pile is recommended at Pier #2 due to lack of a soil boring at this location.

5.3 Lateral Stability

The lateral stability of the proposed piles may be calculated using the following soil strength parameters:

Material Type	Depth** (Ft.)	Equivalent Skin Friction (PSF)	Phi Angle Degrees	Undrained Shear Strength (PSF)	Strain @ 50% of Peak Strength (E50)	Saturated Soil Unit Weight (PCF)	Static Soil Modulus Parameter k (pci)
2*	0-25	350	N/A	1200	0.010	125.0	500 PCI
1*	25-35	200	N/A	600	0.020	125.0	100 PCI
2*	35-70	870	N/A	4200	0.005	125.0	1000 PCI
9*	Below 70	980	N/A	10000	0.0005	130.0	2000 PCI

* 1 - Soft Clay, 2- Stiff Clay with free water, 3 - Stiff Clay without free water, 4 - Sand, 5 - Linear Interpolation (p-y curves), 6 - Hard Rock, 7 - Silt, 8 - API Sand, 9 - Weak Rock

** - Below abutment ground line elevations.

6.1 Underwater Structure Excavation Protection

Based upon the streambed flow elevation at the time of the soil borings (388.39), the high surface water elevation is estimated at approximately elevation 392.14, which is only about seven feet above the proposed streambed elevation of 385.1. Therefore, since this is less than ten feet in depth, underwater structure excavation protection may be used during construction of the intermediate piers. This includes diversion of water by sheet piles, timbers, concrete, or approved embankment material which are adequate to support the excavation are possible alternatives for this type of protection. The underwater structure excavation protection system is usually designed by an engineer retained by the contractor.

6.2 Temporary Soil Retention System

During construction it will be necessary to provide sheet piling at each existing abutment for stage construction. There is not adequate room at this site for temporary slopes, and mechanically stabilized slopes do not appear to be economically feasible for such a small project, since these usually require a specialty contractor. Geotextile walls are usually used in Stage 2 for retention of the fill adjacent to the driving lane, however there is little grade differential between the old and new construction. The area adjacent to the temporary stage construction lane is very limited. Therefore, ground improvement techniques and temporary construction slopes will not aid in stabilization of the side slopes due to the close proximity of the lane to the new culvert location. Preliminary plans require temporary sheet piling at both abutments. The sheet piles may be designed using the following soil parameters:

Soil Type	Cohesion (ksf)	Phi Angle (deg)	Sat Unit Wt. (PCF)	Moisture (%)
Silty Clay (0-12')	1.0	0	125.0	19
Clay Loam (12-35')	0.9	0	125.0	22

6.3 Existing Structure

The existing structure lies between the new bridge abutments, with a support near the middle of the streambed. Therefore, the existing supports do not interfere with construction of the new bridge, so they should not require removal prior to construction.

6.4 Backfill

Porous granular embankment (special) will be placed behind both abutments to facilitate drainage. Four inch perforated drains should allow any seepage water to drain out of these abutment backfill areas.

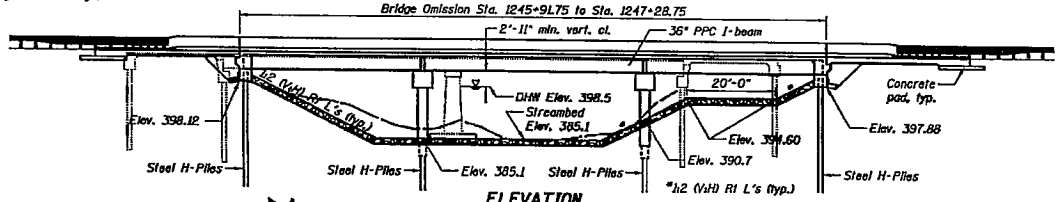
Timothy J. Holcomb, P.E.

B.M. - Cut square in the southwest corner of the bridge curb of structure 096-0007, elev. 405.27.

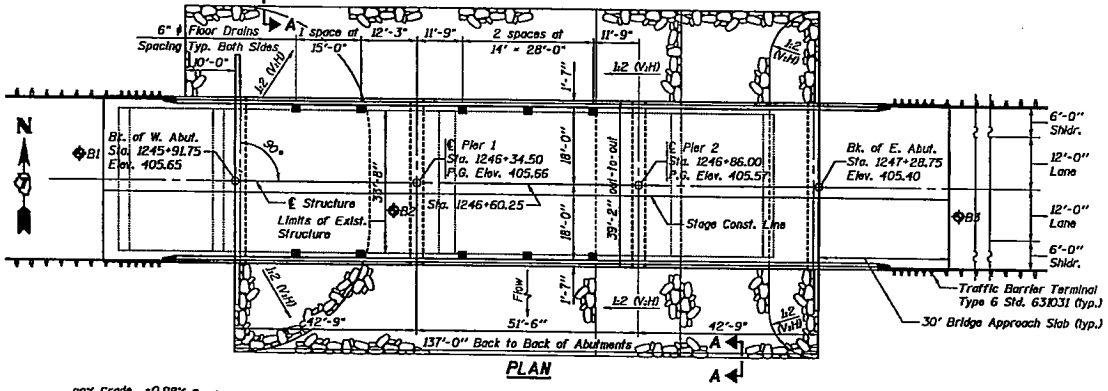
Structure 096-0007 was originally constructed in 1922, as SBI 15, Section 18B and reconstructed in 1957 as SBI 15, Section 18-BY-1. The original structure consisted of a two span reinforced concrete thru girder superstructure supported on pile supported closed abutments and a solid wall pier on pile supported footings. In 1957, the structure was widened from a 20' to a 28' roadway width. The superstructure consists of continuous two span, 6 steel beams with a reinforced concrete slab and two pile bent supported approach slabs with no skew. The existing structure shall be completely replaced. One lane of traffic is to be maintained using stage construction.

Salvage - No Salvage.

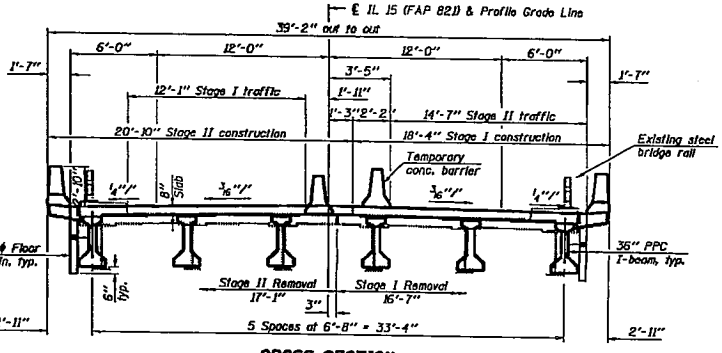
STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION



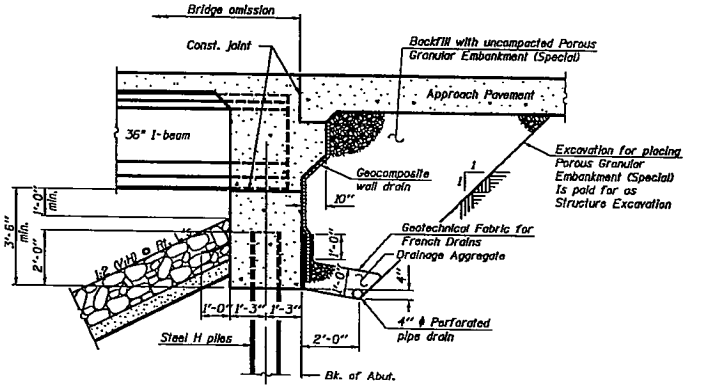
ELEVATION



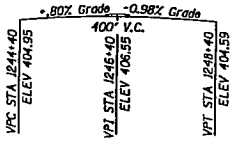
PLAN



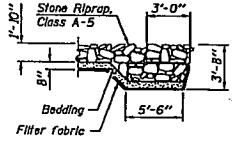
CROSS SECTION
(Looking East)



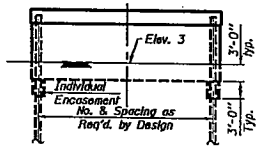
SECTION THRU INTEGRAL ABUTMENT
(Horiz. dim. ⊥ Rt. L's)



PROFILE GRADE
(Along ℄ IL Rte. 15)



SECTION A-A



PIER SKETCH

HIGHWAY CLASSIFICATION
FAP Rte. 821 - IL Rte. 15
Functional Class: Minor Arterial (Rural)
ADT: 3698 (2011); 4438 (2031)
ADTT: 340 (2011); 408 (2031)
DHV: 533
Design Speed: 60 m.p.h.
Posted Speed: 55 m.p.h.
Two-Way Traffic
Directional Distribution: 50%

DESIGN SPECIFICATIONS
2007 AASHTO LRFD Bridge Design Specifications, with 2008 Interims

LOADING HL-93
Allow 50#/sq. ft. for future wearing surface.

DESIGN STRESSES

FIELD UNITS
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

PRECAST PRESTRESSED UNITS
f'c = 6,000 psi
f'ci = 5,000 psi
F's = 270,000 psi (½" low relax. strands)
Fsi = 201,960 psi (½" low relax. strands)

SEISMIC DATA
Seismic Performance Zone (SPZ) =
Design Spectral Acceleration at 1.0 sec (SD1) =
Design Spectral Acceleration at 0.2 sec (SDS) =
Soil Site Class (S) =

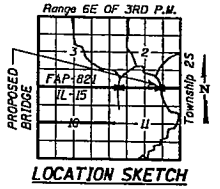
DESIGN SCOUR ELEVATION TABLE

Design Scour Elevation (ft.)	E. Abut.	Pier 1	Pier 2	W. Abut.
	397.9	372.1	377.7	398.1

WATERWAY INFORMATION

Drainage Area = 61.29 sq.mi. — Low Grade Elev. 401.6 @ Sta. 1237+00

Flood	Freq. Yr.	Q C.F.S.	Opening Sq. Ft. Exist.	Opening Sq. Ft. Prop.	Nat. H.W.E.	Head - Ft. Exist.	Head - Ft. Prop.	Headwater El. Exist.	Headwater El. Prop.
	10	4032	768	849	398.0	0.8	0.8	398.8	398.8
Design	50	6377	814	908	398.5	1.9	1.9	400.4	400.4
Base	100	7340	833	931	398.7	2.3	2.3	401.0	401.0
Overtopping	200	8408	861	967	398.9	2.8	2.8	401.7	401.7
Max. Calc.	500	-	-	-	-	-	-	-	-



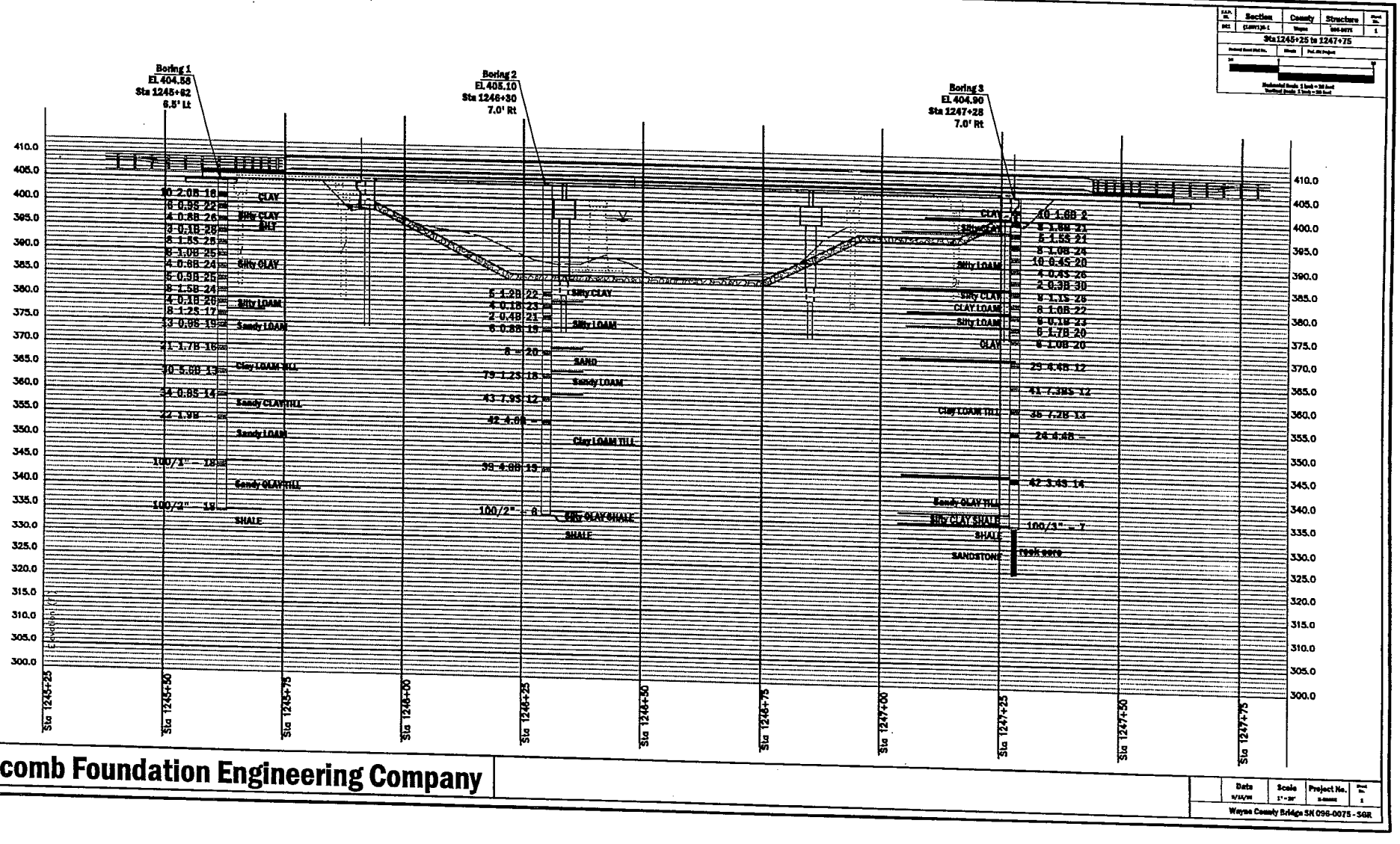
LOCATION SKETCH

GENERAL PLAN
IL ROUTE 15 OVER DRY FORK CREEK
F.A.P. RTE. 821 - SEC. (18BY1)B-1
WAYNE COUNTY
STATION 1246+42
STRUCTURE NO. 096-0075

ESI CONSULTANTS, LTD
ILLINOIS DEPARTMENT OF PROFESSIONAL REGULATION REGISTRATION #184-001644

DRAWN BY: ADG CHECKED BY: DF DATE: 07-07-2009

SHEET NO. 1 OF 1 SHEETS	F.A.P. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
	821	(18BY1)B-1	WAYNE	1	1
		SN P-97-010-07	CONTRACT NO. 74222		
		FED. ROAD DIST. NO. _ ILLINOIS FED. AID PROJECT			



Holcomb Foundation Engineering Company

Date	Scale	Project No.
9/15/08	1" = 20'	

Wayne County Bridge SN 096-0075 - SGR

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 9/23/08

ROUTE FAP 821 DESCRIPTION Dry Fork LOGGED BY E. Sandschafer

SECTION (18BY1)B-1 LOCATION Sec 2 - SE 1/4, Sec 11 - NE 1/4, SEC. , TWP. 2 S, RNG. 6 E, 3 PM

COUNTY Wayne DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 096-0007
Station 1246+42

BORING NO. 1 W Abut
Station 1245+62
Offset 6.50ft Lt
Ground Surface Elev. 404.58 ft

Surface Water Elev. 388.39 ft
Stream Bed Elev. 385.16 ft

Groundwater Elev.:
First Encounter 369.6 ft
Upon Completion 387.8 ft
After 72 Hrs. 389.4 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				3" asphalt on 9 1/4" concrete pavement.
403.58				
				Stiff, damp, gray, CLAY.
	4			
	4 6	2.0 B	16	
400.08				
-5	2			Medium, damp, gray, SILTY CLAY.
	3 3	0.9 S	22	
	2			
	2 2	0.8 B	26	
396.28				
				Very soft, very damp, gray, SILT.
-10	0			
	0 3	0.1 B	28	
393.98				
				Medium to stiff, damp, brown/gray/red, SILTY CLAY.
	2			
	3 5	1.5 S	25	
-15	2			
	4 4	1.0 B	25	
	1			
	2 2	0.6 B	24	
-20	1			

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	2 3	0.9 B	25	Medium to stiff, damp, brown/gray/red, SILTY CLAY. *(continued)*
	1			
	3 5	1.5 B	24	
380.08				
-25	1			Very soft, very damp, gray mottled red, SILTY LOAM.
	2 2	0.1 B	26	
377.38				
	1			Stiff to medium, damp, red/gray/blue, SANDY LOAM.
	4 4	1.2 S	17	
-30	3			
	6 7	0.9 S	19	
370.08				
-35	3			Stiff, damp, gray, CLAY LOAM TILL.
	5 16	1.7 B	16	
-40	5			

Latitude W 88 deg 29.883 min, Longitude N 38 deg 22.271 min, Map Datum WGS 84

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 9/23/08

ROUTE FAP 821 DESCRIPTION Dry Fork LOGGED BY E. Sandschafer

SECTION (18BY1)B-1 LOCATION Sec 2 - SE 1/4, Sec 11 - NE 1/4, SEC., TWP. 2 S, RNG. 6 E, 3 PM

COUNTY Wayne DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 096-0007
Station 1246+42

BORING NO. 1 W Abut
Station 1245+62
Offset 6.50ft Lt
Ground Surface Elev. 404.58 ft

Surface Water Elev. 388.39 ft
Stream Bed Elev. 385.16 ft

Groundwater Elev.:
First Encounter 369.6 ft
Upon Completion 387.8 ft
After 72 Hrs. 389.4 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	11 19	5.6 B	13	Stiff, damp, gray, CLAY LOAM TILL. *(continued)*
360.08				
-45	5			Medium, damp, gray, SANDY LOAM.
359.08	11 23	0.8 S	14	Dark blue/black/brown, SANDY CLAY TILL.
355.08				
-50	5			Stiff, damp, gray, SANDY LOAM.
	10 12	1.9 B		
-55				
345.08				
-60	50/1"		18	

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	50/1" 50/0"			Very dense, very moist, blue marbled brown, SANDY CLAY TILL w/ many Sandstone fragments. *(continued)*
-65				
335.08				
-70	50/3" 50/1" 50/1"		7	Very dense, moist, gray, SANDY CLAY SHALE.
334.68				Extent of exploration.
-75				
-80				

Benchmark: BM 469 Cut square on bridge curb in SW corner of existing structure, Sta 1245+70, 15' Rt = 405.27' elevation. Provided by Program Development.

Latitude W 88 deg 29.883 min, Longitude N 38 deg 22.271 min, Map Datum WGS 84

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation

Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 9/25/08

ROUTE FAP 821 DESCRIPTION Dry Fork LOGGED BY E. Sandschafer

SECTION (18BY1)B-1 LOCATION Sec 2 - SE 1/4, Sec 11 - NE 1/4, SEC., TWP. 2 S, RNG. 6 E, 3 PM

COUNTY Wayne DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 096-0007
Station 1246+42

BORING NO. 2 Pier
Station 1246+30
Offset 7.00ft Rt
Ground Surface Elev. 405.10 ft

Surface Water Elev. 388.39 ft
Stream Bed Elev. 385.16 ft

Groundwater Elev.:
First Encounter 370.6 ft
Upon Completion N/A ft
After ____ Hrs. N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				3" asphalt on 6 7/8" concrete bridge deck. 404.30
				Air.
-5				
-10				
-15				
-20				385.20
				Stiff, damp, gray, SILTY CLAY. *(continued)*
	2			
	2 3	1.2 B	22	
				380.60
-25	2			Very soft to medium, very damp, gray, SILTY LOAM.
	2 2	0.1 B	23	
	0			
	0 2	0.4 B	21	
-30	1			
	3 3	0.8 B	19	
				370.60
-35	0			Loose, wet, gray, fined grained, SAND. *4% passing #200 sieve.*
	0 8		20	
				365.60
-40	15			Stiff, damp, gray, SANDY LOAM.

Latitude W 88 deg 29.870 min, Longitude N 38 deg 22.270 min, Map Datum WGS 84

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

BBS, from 137 (Rev. 8-99)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 9/25/08

ROUTE FAP 821 DESCRIPTION Dry Fork LOGGED BY E. Sandschafer

SECTION (18BY1)B-1 LOCATION Sec 2 - SE 1/4, Sec 11 - NE 1/4, SEC., TWP. 2 S, RNG. 6 E, 3 PM

COUNTY Wayne DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 096-0007
Station 1246+42

BORING NO. 2 Pier
Station 1246+30
Offset 7.00ft Rt
Ground Surface Elev. 405.10 ft

Surface Water Elev. 388.39 ft
Stream Bed Elev. 385.16 ft

Groundwater Elev.:
First Encounter 370.6 ft
Upon Completion N/A ft
After ____ Hrs. N/A ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	36	1.2	18	Stiff, damp, gray, SANDY LOAM. *(continued)*
	43	S		
				360.60
-45	8			Hard, damp, gray, CLAY LOAM TILL.
	15	7.9	12	
	28	S		
-50	6			
	16	4.6		
	26	B		
-55				
-60	9			
-65				
	16	4.6	13	Hard, damp, gray, CLAY LOAM TILL. *(continued)*
	23	B		
				335.60
-70	50/4"		6	Very dense, moist, gray, SILTY CLAY SHALE. 335.20
	50/1"			Extent of exploration.
	50/1"			
-75				Benchmark: BM 469 Cut square on bridge curb in SW corner of existing structure, Sta 1245+70, 15' Rt = 405.27' elevation. Provided by Program Development.
-80				

Latitude W 88 deg 29.870 min, Longitude N 38 deg 22.270 min, Map Datum WGS 84

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 9/22/08

ROUTE FAP 821 DESCRIPTION Dry Fork LOGGED BY E. Sandschafer

SECTION (18BY1)B-1 LOCATION Sec 2 - SE 1/4, Sec 11 - NE 1/4, SEC., TWP. 2 S, RNG. 6 E, 3 PM

COUNTY Wayne DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 096-0007
Station 1246+42

BORING NO. 3 E Abut
Station 1247+28
Offset 7.00ft Rt
Ground Surface Elev. 404.90 ft

Surface Water Elev. 388.39 ft
Stream Bed Elev. 385.16 ft

Groundwater Elev.:
First Encounter 377.4 ft
Upon Completion 392.9 ft
After 96 Hrs. 391.9 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
				4" asphalt on 10 1/4" concrete pavement.
				403.70
				Stiff, damp, red, CLAY.
	2			
	4 6	1.6 B	2	
				400.40
-5	3			Stiff, damp, gray marbled brown, SILTY CLAY.
	4 4	1.6 B	21	
				397.60
	1			Stiff to soft, very damp, red marbled gray, SILTY LOAM.
	2 3	1.5 S	21	
-10	1			
	4 4	1.0 B	24	
	3			
	5 5	0.4 S	20	
-15	1			
	2 2	0.4 S	26	
	1			
	1 1	0.3 B	30	
				385.40
-20	2			
				Stiff, damp, red mottled gray, SILTY CLAY. *(continued)*
	3 5	1.1 S	26	
				382.90
	1			Medium to stiff, damp, red marbled gray, CLAY LOAM.
	4 4	1.0 B	22	
				380.40
-25	1			Very soft, very damp, red marbled gray, SILTY LOAM.
	2 4	0.1 B	23	
	0			377.50
	2 4	1.7 B	20	Stiff to medium, damp, gray, CLAY.
-30	1			
	2 4	1.0 B	20	
				370.40
-35	9			Hard, damp, gray, CLAY LOAM TILL.
	14 15	4.4 B	12	
-40	8			

Latitude W 88 deg 29.851 min, Longitude N 38 deg 22.268 min, Map Datum WGS 84

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

SOIL BORING LOG

Date 9/22/08

ROUTE FAP 821 DESCRIPTION Dry Fork LOGGED BY E. Sandschafer

SECTION (18BY1)B-1 LOCATION Sec 2 - SE 1/4, Sec 11 - NE 1/4, SEC., TWP. 2 S, RNG. 6 E, 3 PM

COUNTY Wayne DRILLING METHOD Hollow stem auger & split spoon HAMMER TYPE Auto 140#

STRUCT. NO. 096-0007
Station 1246+42

BORING NO. 3 E Abut
Station 1247+28
Offset 7.00ft Rt
Ground Surface Elev. 404.90 ft

Surface Water Elev. 388.39 ft
Stream Bed Elev. 385.16 ft

Groundwater Elev.:
First Encounter 377.4 ft
Upon Completion 392.9 ft
After 96 Hrs. 391.9 ft

DEPTH (ft)	BLOWS (/6")	UCS Qu (tsf)	MOIST (%)	Description
	16 25	7.3 BS	12	Hard, damp, gray, CLAY LOAM TILL. *(continued)*
-45	8			
	13 22	7.2 B	13	
-50	5			
	10 14	4.4 B		
-55				
345.40				
-60	9			
	16 26	3.4 S	14	Very stiff, damp, gray marbled blue, SANDY CLAY TILL. *(continued)*
344.30				
344.10				Gray, moist, fine grained, SAND.
				Very stiff, damp, gray marbled blue, SANDY CLAY TILL.
-65				
335.40				
-70	36			Very dense, moist, gray, SILTY CLAY SHALE.
334.60	50/2" 50/1"		7	Borehole continued with rock coring.
-75				
-80				

Latitude W 88 deg 29.851 min, Longitude N 38 deg 22.268 min, Map Datum WGS 84

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer)
The SPT (N value) is the sum of the last two blow values in each sampling zone (AASHTO T206)

Illinois Department of Transportation
Division of Highways
Illinois Department of Transportation

ROCK CORE LOG

Date 9/22/08

ROUTE FAP 821 **DESCRIPTION** Dry Fork **LOGGED BY** E. Sandschafer

SECTION (18BY1)B-1 **LOCATION** Sec 2 - SE 1/4, Sec 11 - NE 1/4, **SEC.**, **TWP.** 2 S, **RNG.** 6 E, 3 **PM**

COUNTY Wayne **CORING METHOD** Rotary, surf set diamond bit

STRUCT. NO. 096-0007
Station 1246+42

CORING BARREL TYPE & SIZE NW, conv dbl bbl, split inner

Core Diameter 2.06 in
Top of Rock Elev. 335.40 ft
Begin Core Elev. 334.60 ft

BORING NO. 3 E Abut
Station 1247+28
Offset 7.00ft Rt
Ground Surface Elev. 404.90 ft

	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Gray, slight to moderate weathering, SILTY CLAY SHALE. 334.60		B3C1	85	73	1.2	
332.20						
Gray, slightly weathered, SANDSTONE.						
Rock core B3C1 from 73.8' to 74.3' depth Qu = 234 tsf.	-75					
		B3C2	84	69	1.1	
Rock core B3C2 from 76.3' to 76.8' depth Qu = 464 tsf.						
324.60	-80					
Extent of exploration.						
Drilled additional 1' depth into Shale, no change in material.						
Benchmark: BM 469 Cut square on bridge curb in SW corner of existing structure, Sta 1245+70, 15' Rt = 405.27' elevation. Provided by Program Development.	-85					
	-90					

Color pictures of the cores Available on request
Cores will be stored for examination until 09/22/09
The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

BBS, form 138 (Rev. 8-99)

Field Rock Core Log a.xls

Field Rock Core Log

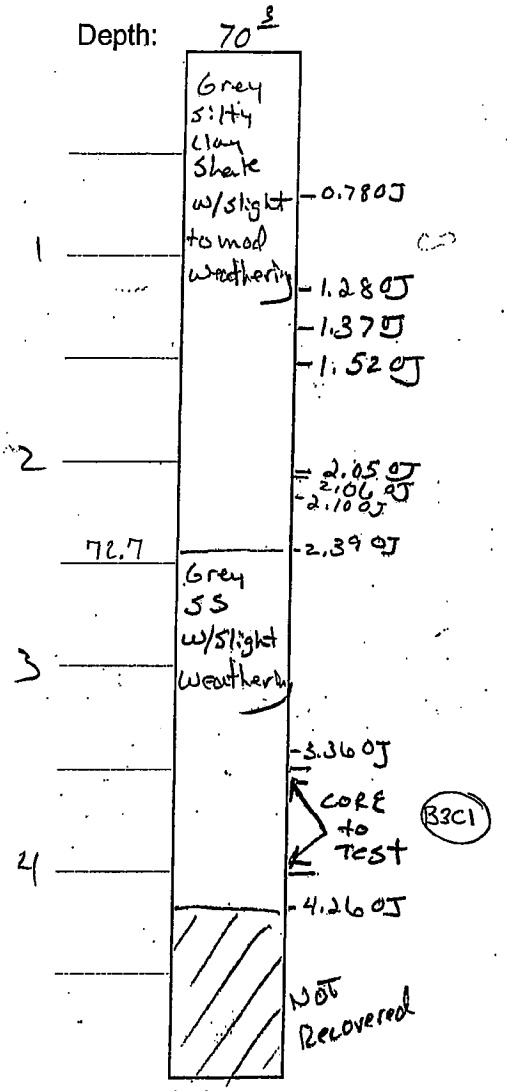
Date: 9-22-08

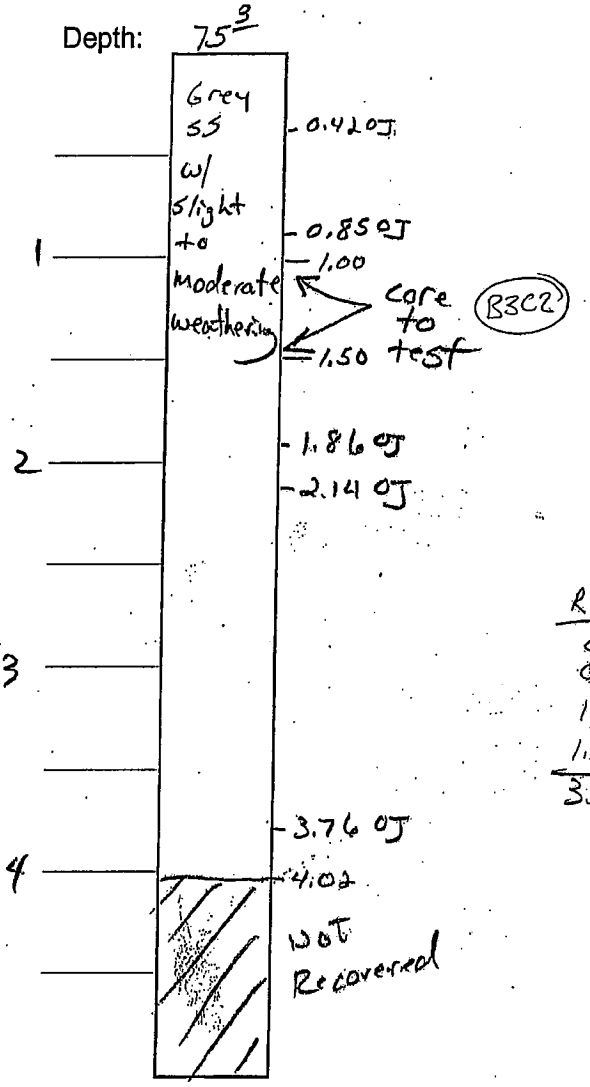
Structure #: 096-0007

Boring #: B3

Rock Core #: B3C1

Rock Core #: B3C2





RQD
0.78
0.49
0.54
0.94
2.90

RQD
0.40
0.41
1.00
1.64
3.45

Core Time: 5:55 (1.2 min/ft)

Recovery: 85.2%

RQD: 73%

Core Time: 5:27 (1.1 min/ft)

Recovery: 84%

RQD: 69%

Logged By: Eric Sandschafer

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
AASHTO Spectrum for 7% PE in 75 years
Latitude = 38.371140
Longitude = -088.497930
Site Class B
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.254	PGA - Site Class B
0.2	0.487	Ss - Site Class B
1.0	0.125	S1 - Site Class B

Conterminous 48 States
2007 AASHTO Bridge Design Guidelines
Spectral Response Accelerations SDs and SD1
Latitude = 38.371140
Longitude = -088.497930
As = FpgaPGA, SDs = FaSs, and SD1 = FvS1
Site Class D - Fpga = 1.29, Fa = 1.41, Fv = 2.30
Data are based on a 0.05 deg grid spacing.

Period (sec)	Sa (g)	
0.0	0.359	As - Site Class D
0.2	0.687	SDs - Site Class D
1.0	0.286	SD1 - Site Class D

IDOT Global Site Classification

Structure No. SN 096-0007

Date: 9/8/2009

Boring No.	ds/(di/N)	di	ds/(di/Su)	di	ds/(di/Nch)	di
1	21	100	859	47.5	100	52.5
2	43	100	2805	32.4	54	67.6
3	19	100	847	57.5	45	42.5
Sum:	83	300	4511	137.4	137.4	162.6
Average:	**28**		**1313**		**67**	
Site Classification	**D**		**D**		**C**	

IDOT Site Classification

Structure No. Wayne Co SN 096-0007 Boring No. 1

Date: 9/8/2009 Elev. @ Pt. of Fixity 393

Layer Elevation	Thickness(di)	N (avg)	Su (avg)	Nch (avg)	di/N	di/Su	di/Nch
392.58							
	12.5	6	1100		2.0833	0.011364	
380.08							
	2.7	4	100		0.6750	0.027	
377.38							
	7.3	11	1050		0.6636	0.006952	
370.08							
	25	27	2500		0.9259	0.01	
345.08							
	10	100		100	0.1000		0.1
335.08							
	42.5	100		100	0.4250		0.425
292.58							
	100			Sum-	di/N	4.873 di/Su	0.055 di/Nch 0.525

		Site Class
ds/(di/N) =	21	D
ds/(di/Su)	858.7	E
ds/(di/Nch)	100	C

IDOT Site Classification

Structure No. Wayne Co SN 096-0007 Boring No. 2

Date: 9/8/2009 Elev. @ Pt. of Fixity 373

Layer Elevation	Thickness(di)	N (avg)	Su (avg)	Nch (avg)	di/N	di/Su	di/Nch
373							
	2.4	6	800		0.4000	0.003	
370.6							
	5	8		8	0.6250		0.625
365.6							
	5	79	1200		0.0633	0.004167	
360.6							
	25	41	5700		0.6098	0.004386	
335.6							
	62.6	100		100	0.6260		0.626
273							
	100			Sum-	di/N	2.324 di/Su	0.012 di/Nch 1.251

		Site Class
ds/(di/N) =	43	D
ds/(di/Su)	2804.6	C
ds/(di/Nch)	54	C

IDOT Site Classification

Structure No. Wayne Co SN 096-0007 Boring No. 3

Date: 9/8/2009 Elev. @ Pt. of Fixity 393

Layer Elevation	Thickness(di)	N (avg)	Su (avg)	Nch (avg)	di/N	di/Su	di/Nch
392.9							
	7.5	5	366		1.5000	0.020492	
385.4							
	5	8	1050		0.6250		0.625
380.4							
	2.9	6	100		0.4833	0.029	
377.5							
	7.1	6	1350		1.1833	0.005259	
370.4							
	25	32	5825		0.7813	0.004292	
345.4							
	10	42	3400		0.2381	0.002941	
335.4							
	42.5	100		100	0.4250		0.425
292.9							
	100			Sum-	di/N 5.236	di/Su 0.062	di/Nch 1.050

		Site Class
ds/(di/N) =	19	D
ds/(di/Su)	847.0	E
ds/(di/Nch)	45	C

XSTABL File: 9038W01 9-08-09 14:39

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2005      *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.207                96 - 1992  *
*****************************************
```

Problem Description : Wayne Co. SN 096-0075 West Abut. SS

SEGMENT BOUNDARY COORDINATES

---

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	105.4	45.0	105.4	1
2	45.0	105.4	59.0	94.6	2
3	59.0	94.6	79.0	94.6	2
4	79.0	94.6	81.2	93.5	2
5	81.2	93.5	98.0	85.1	3
6	98.0	85.1	166.0	85.1	3
7	166.0	85.1	180.8	92.5	3
8	180.8	92.5	184.8	94.5	2
9	184.8	94.5	192.1	98.1	1
10	192.1	98.1	199.6	105.6	1
11	199.6	105.6	250.0	105.6	1

7 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	184.8	94.5	250.0	94.5	2
2	180.8	92.5	250.0	92.5	3
3	.0	80.0	250.0	80.0	4
4	.0	80.0	150.0	65.6	6
5	150.0	65.6	250.0	70.0	5
6	150.0	65.6	250.0	60.1	6
7	.0	73.0	250.0	55.1	7

ISOTROPIC Soil Parameters

---

7 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	800.0	.00	.000	.0	1
2	125.0	125.0	100.0	.00	.000	.0	1
3	125.0	125.0	600.0	.00	.000	.0	1
4	125.0	125.0	700.0	.00	.000	.0	1
5	125.0	125.0	1700.0	.00	.000	.0	1
6	125.0	125.0	800.0	.00	.000	.0	1
7	125.0	125.0	1900.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	85.00
2	250.00	85.00

BOUNDARIES THAT LIMIT SURFACE GENERATION HAVE BEEN SPECIFIED

LOWER limiting boundary of 1 segments:

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)
1	.0	35.0	250.0	35.0

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

1500 trial surfaces will be generated and analyzed.

30 Surfaces initiate from each of 50 points equally spaced along the ground surface between x = 90.0 ft
and x = 175.0 ft

Each surface terminates between x = 185.0 ft
and x = 250.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

15.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined
within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface
is specified by 9 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	145.51	85.10
2	157.44	76.01
3	171.41	70.55
4	186.35	69.14
5	201.09	71.88
6	214.52	78.57
7	225.59	88.70
8	233.45	101.47
9	234.61	105.60

**** Simplified BISHOP FOS = 1.583 ****

****
** **
** Out of the 1500 surfaces generated and analyzed by XSTABL, **
** 1 surfaces were found to have MISLEADING FOS values. **
** **
****

The following is a summary of the TEN most critical surfaces

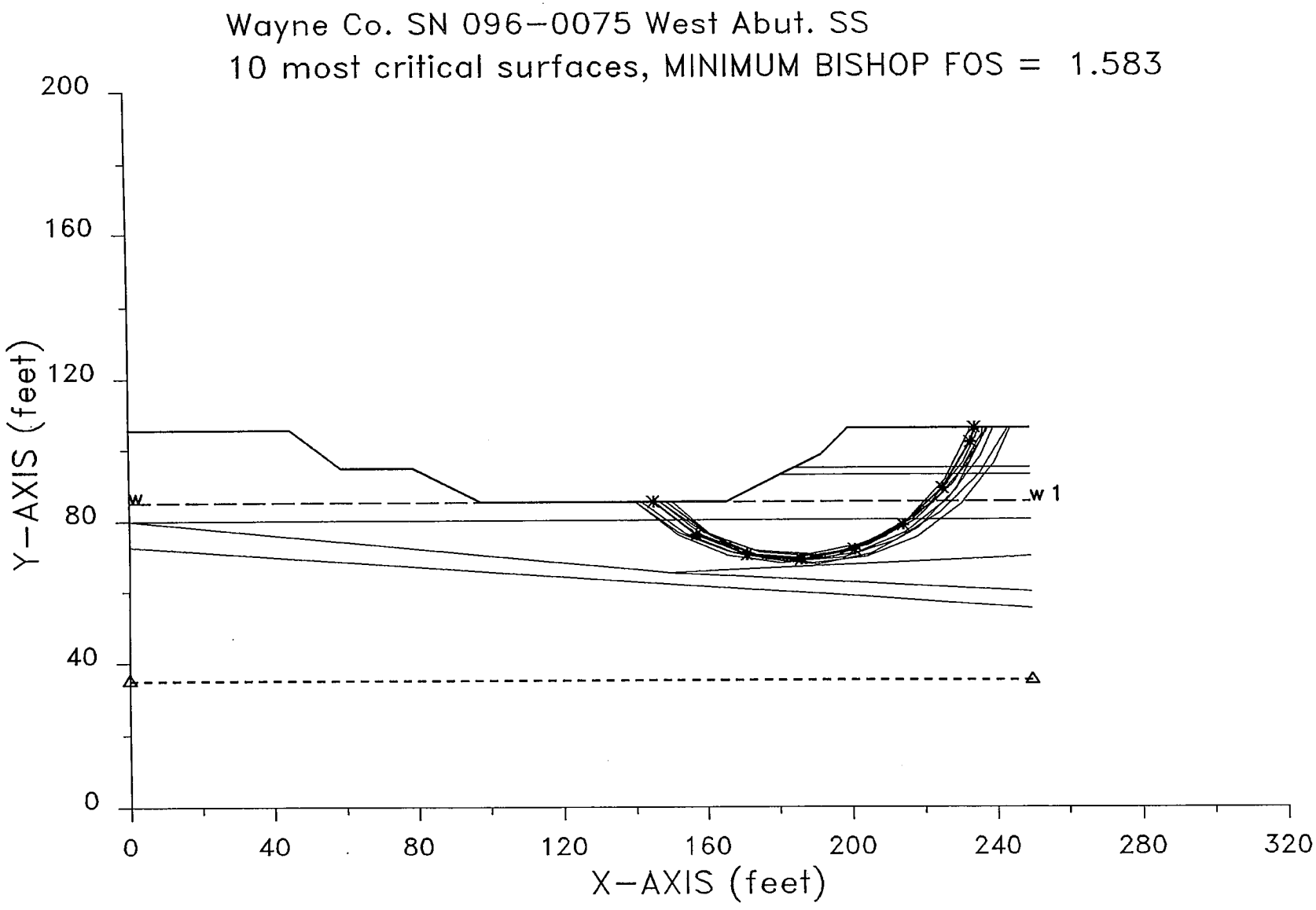
9038W01

Problem Description : Wayne Co. SN 096-0075 West Abut. SS

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.583	183.92	123.15	54.06	145.51	234.61	3.988E+06
2.	1.584	185.99	127.26	58.45	145.51	239.76	4.486E+06
3.	1.584	181.55	127.05	58.83	140.31	235.90	4.591E+06
4.	1.589	184.29	120.80	51.45	147.24	233.26	3.693E+06
5.	1.592	188.71	118.16	50.36	150.71	237.04	3.712E+06
6.	1.592	186.52	123.99	54.05	148.98	237.07	3.908E+06
7.	1.594	185.37	133.34	64.84	142.04	243.94	5.276E+06
8.	1.598	190.29	126.95	58.80	148.98	244.66	4.595E+06
9.	1.599	185.42	127.81	57.28	147.24	237.83	4.185E+06
10.	1.599	181.87	132.14	62.77	140.31	238.38	4.909E+06

* * * END OF FILE * * *

9038W01 9-08-09 14:39



XSTABL File: 9038W03 9-08-09 14:44

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2005      *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.207                96 - 1992  *
*****************************************
```

Problem Description : Wayne Co. SN 096-0075 West Abut. EQ

SEGMENT BOUNDARY COORDINATES

---

11 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	105.4	45.0	105.4	1
2	45.0	105.4	59.0	94.6	2
3	59.0	94.6	79.0	94.6	2
4	79.0	94.6	81.2	93.5	2
5	81.2	93.5	98.0	85.1	3
6	98.0	85.1	166.0	85.1	3
7	166.0	85.1	180.8	92.5	3
8	180.8	92.5	184.8	94.5	2
9	184.8	94.5	192.1	98.1	1
10	192.1	98.1	199.6	105.6	1
11	199.6	105.6	250.0	105.6	1

7 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	184.8	94.5	250.0	94.5	2
2	180.8	92.5	250.0	92.5	3
3	.0	80.0	250.0	80.0	4
4	.0	80.0	150.0	65.6	6
5	150.0	65.6	250.0	70.0	5
6	150.0	65.6	250.0	60.1	6
7	.0	73.0	250.0	55.1	7

ISOTROPIC Soil Parameters

---

7 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	125.0	125.0	800.0	.00	.000	.0	1
2	125.0	125.0	100.0	.00	.000	.0	1
3	125.0	125.0	600.0	.00	.000	.0	1
4	125.0	125.0	700.0	.00	.000	.0	1
5	125.0	125.0	1700.0	.00	.000	.0	1
6	125.0	125.0	800.0	.00	.000	.0	1
7	125.0	125.0	1900.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	85.00
2	250.00	85.00

A horizontal earthquake loading coefficient
of .093 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

BOUNDARIES THAT LIMIT SURFACE GENERATION HAVE BEEN SPECIFIED

LOWER limiting boundary of 1 segments:

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)
1	.0	35.0	250.0	35.0

A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.

1500 trial surfaces will be generated and analyzed.

30 Surfaces initiate from each of 50 points equally spaced
along the ground surface between x = 90.0 ft
and x = 175.0 ft

Each surface terminates between x = 185.0 ft
and x = 250.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

15.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	138.57	85.10
2	150.84	76.47
3	164.64	70.59
4	179.36	67.72
5	194.36	67.98
6	208.97	71.36
7	222.56	77.71
8	234.53	86.75
9	244.34	98.10
10	248.48	105.60

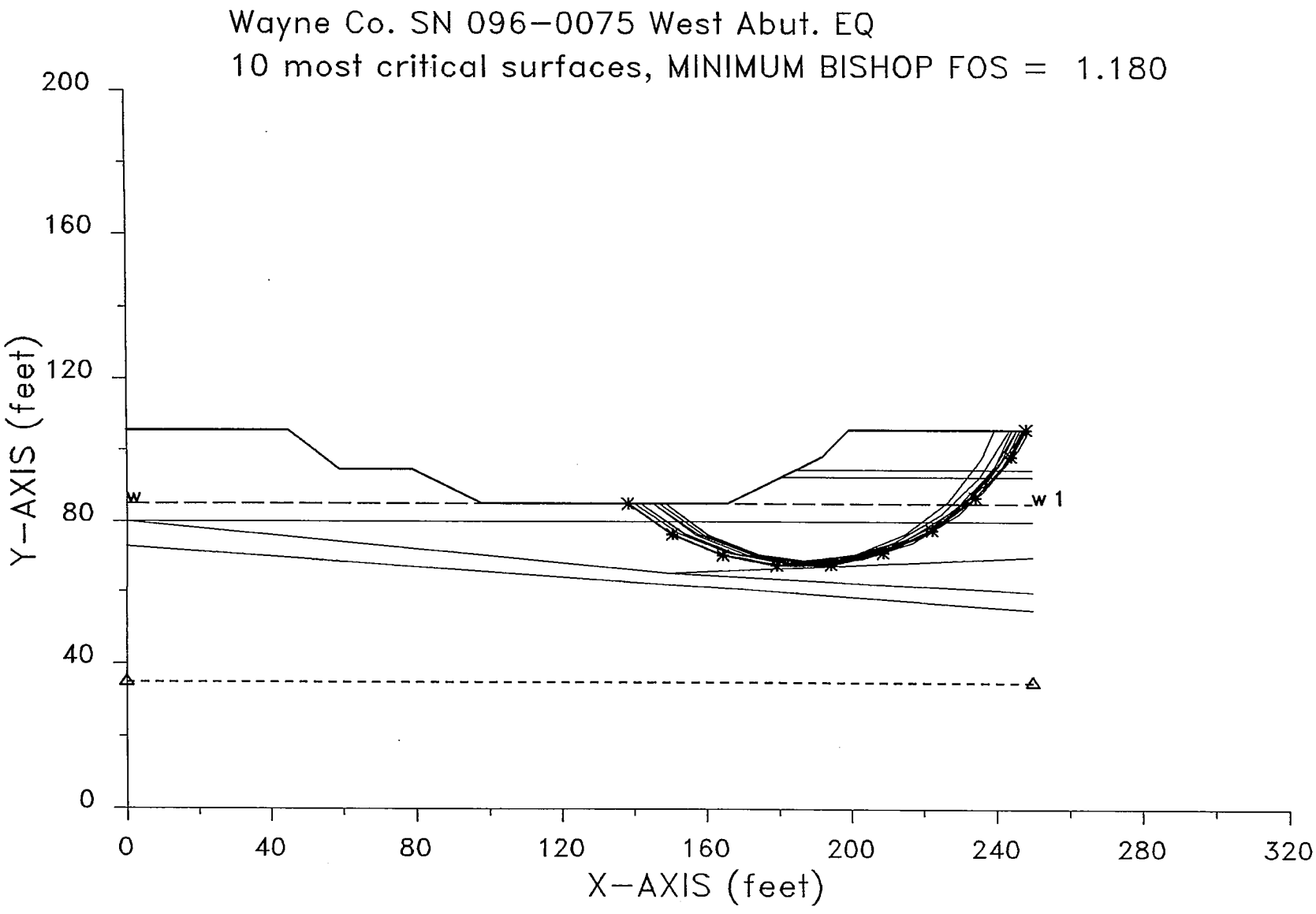
**** Simplified BISHOP FOS = 1.180 ****

The following is a summary of the TEN most critical surfaces

9038W03
Problem Description : Wayne Co. SN 096-0075 West Abut. EQ

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.180	185.64	138.99	71.55	138.57	248.48	6.223E+06
2.	1.187	184.84	138.44	70.61	138.57	246.91	6.056E+06
3.	1.187	186.66	140.48	72.22	140.31	249.45	6.197E+06
4.	1.191	186.82	137.06	68.60	142.04	247.44	5.726E+06
5.	1.196	190.29	131.64	63.40	147.24	248.06	5.132E+06
6.	1.197	185.37	133.34	64.84	142.04	243.94	5.276E+06
7.	1.199	188.06	133.38	64.36	145.51	245.94	5.137E+06
8.	1.201	190.53	129.07	60.49	148.98	245.90	4.741E+06
9.	1.202	190.29	126.95	58.80	148.98	244.66	4.595E+06
10.	1.207	185.99	127.26	58.45	145.51	239.76	4.486E+06

* * * END OF FILE * * *


Wayne Co. SN 096-0075 West Abut. EQ
10 most critical surfaces, MINIMUM BISHOP FOS = 1.180
Y-AXIS (feet)
200
160
120
80
40
0
w
w 1
0
40
80
120
160
200
240
280
320
X-AXIS (feet)

XSTABL File: 9038E11 9-08-09 15:59

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*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2005      *
*   Interactive Software Designs, Inc.  *
*        Moscow, ID 83843, U.S.A.       *
*                                       *
*          All Rights Reserved          *
*                                       *
*  Ver. 5.207                 96 - 1992 *
*****************************************
```

Problem Description : Wayne Co. SN 096-0075 East Abut. SS

SEGMENT BOUNDARY COORDINATES

---

7 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	85.1	68.0	85.1	4
2	68.0	85.1	84.8	93.5	3
3	84.8	93.5	87.0	94.6	2
4	87.0	94.6	107.0	94.6	2
5	107.0	94.6	113.4	97.8	2
6	113.4	97.8	121.0	105.4	1
7	121.0	105.4	150.0	105.4	1

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	113.4	97.8	150.0	97.8	2
2	84.8	93.5	150.0	93.5	3
3	68.0	85.1	150.0	85.1	4
4	.0	80.6	150.0	80.6	5
5	.0	65.6	150.0	80.0	6
6	.0	60.6	150.0	73.0	7

ISOTROPIC Soil Parameters

---

7 Soil unit(s) specified

Soil Unit	Unit Weight Moist	Unit Weight Sat.	Cohesion Intercept	Friction Angle	Pore Pressure Parameter	Pore Pressure Constant	Water Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Ru	(psf)	No.
1	125.0	125.0	1600.0	.00	.000	.0	1
2	125.0	125.0	1000.0	.00	.000	.0	1
3	125.0	125.0	300.0	.00	.000	.0	1
4	125.0	125.0	1000.0	.00	.000	.0	1
5	125.0	125.0	100.0	.00	.000	.0	1
6	125.0	125.0	1000.0	.00	.000	.0	1
7	125.0	125.0	3400.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	85.00
2	150.00	85.00

BOUNDARIES THAT LIMIT SURFACE GENERATION HAVE BEEN SPECIFIED

LOWER limiting boundary of 1 segments:

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)
1	.0	35.0	150.0	35.0

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

1500 trial surfaces will be generated and analyzed.

30 Surfaces initiate from each of 50 points equally spaced along the ground surface between x = 10.0 ft
and x = 80.0 ft

Each surface terminates between x = 90.0 ft
and x = 150.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

15.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	62.86	85.10
2	76.25	78.35
3	90.91	75.18
4	105.90	75.80
5	120.25	80.16
6	133.05	87.99
7	143.46	98.79
8	147.19	105.40

**** Simplified BISHOP FOS = 1.458 ****

```
**********************************************************************
**                                                                  **
**  Out of the   1500 surfaces generated and analyzed by XSTABL,    **
**        7 surfaces were found to have MISLEADING FOS values.      **
**                                                                  **
**********************************************************************
```

The following is a summary of the TEN most critical surfaces

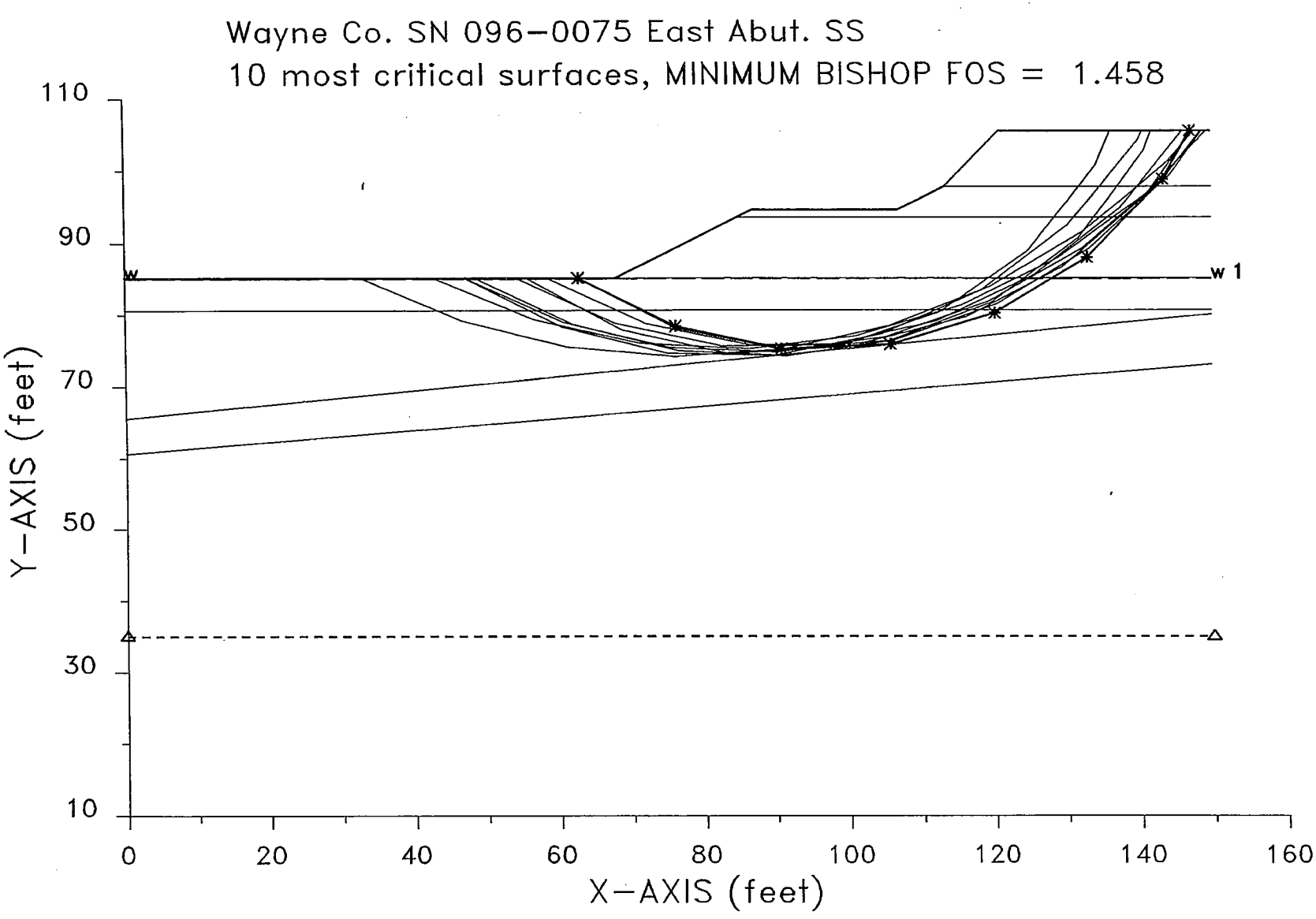
Problem Description : Wayne Co. SN 096-0075 East Abut. SS

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.458	95.99	134.17	59.20	62.86	147.19	2.840E+06

9038E11

2.	1.490	86.52	153.75	79.14	47.14	148.73	4.290E+06
3.	1.507	92.93	140.65	65.32	58.57	147.53	3.318E+06
4.	1.511	84.12	140.96	66.99	47.14	140.71	3.393E+06
5.	1.517	88.02	128.22	53.88	55.71	136.30	2.458E+06
6.	1.527	94.07	128.45	53.42	62.86	141.89	2.498E+06
7.	1.546	89.65	143.61	68.37	54.29	146.19	3.575E+06
8.	1.561	87.94	149.85	75.78	48.57	148.85	4.390E+06
9.	1.601	83.44	162.94	87.79	42.86	149.47	5.036E+06
10.	1.606	77.42	169.75	95.66	32.86	147.82	5.600E+06

* * * END OF FILE * * *


Wayne Co. SN 096-0075 East Abut. SS
10 most critical surfaces, MINIMUM BISHOP FOS = 1.458
w 1
Y-AXIS (feet)
X-AXIS (feet)
110
90
70
50
30
10
0
20
40
60
80
100
120
140
160

XSTABL File: 9038E13 9-08-09 16:01

```
*****************************************
*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
*        Copyright (C) 1992 - 2005      *
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*        Moscow, ID 83843, U.S.A.       *
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*                                       *
*  Ver. 5.207                 96 - 1992 *
*****************************************
```

Problem Description : Wayne Co. SN 096-0075 East Abut. EQ

SEGMENT BOUNDARY COORDINATES

---

7 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	85.1	68.0	85.1	4
2	68.0	85.1	84.8	93.5	3
3	84.8	93.5	87.0	94.6	2
4	87.0	94.6	107.0	94.6	2
5	107.0	94.6	113.4	97.8	2
6	113.4	97.8	121.0	105.4	1
7	121.0	105.4	150.0	105.4	1

6 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	113.4	97.8	150.0	97.8	2
2	84.8	93.5	150.0	93.5	3
3	68.0	85.1	150.0	85.1	4
4	.0	80.6	150.0	80.6	5
5	.0	65.6	150.0	80.0	6
6	.0	60.6	150.0	73.0	7

ISOTROPIC Soil Parameters

---

7 Soil unit(s) specified

Soil Unit	Unit Weight Moist	Unit Weight Sat.	Cohesion Intercept	Friction Angle	Pore Pressure Parameter	Pore Pressure Constant	Water Surface

No.	(pcf)	(pcf)	(psf)	(deg)	Ru	(psf)	No.
1	125.0	125.0	1600.0	.00	.000	.0	1
2	125.0	125.0	1000.0	.00	.000	.0	1
3	125.0	125.0	300.0	.00	.000	.0	1
4	125.0	125.0	1000.0	.00	.000	.0	1
5	125.0	125.0	100.0	.00	.000	.0	1
6	125.0	125.0	1000.0	.00	.000	.0	1
7	125.0	125.0	3400.0	.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 8 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	85.00
2	68.00	85.00
3	84.80	93.50
4	87.00	94.60
5	107.00	94.60
6	113.40	97.20
7	115.00	100.00
8	150.00	100.00

A horizontal earthquake loading coefficient
of .093 has been assigned

A vertical earthquake loading coefficient
of .000 has been assigned

BOUNDARIES THAT LIMIT SURFACE GENERATION HAVE BEEN SPECIFIED

LOWER limiting boundary of 1 segments:

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)
1	.0	35.0	150.0	35.0

A critical failure surface searching method, using a random
technique for generating CIRCULAR surfaces has been specified.

1500 trial surfaces will be generated and analyzed.

30 Surfaces initiate from each of 50 points equally spaced
along the ground surface between x = 10.0 ft
and x = 80.0 ft

Each surface terminates between x = 90.0 ft
and x = 150.0 ft

Unless further limitations were imposed, the minimum elevation
at which a surface extends is y = .0 ft

15.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 8 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	62.86	85.10
2	76.25	78.35
3	90.91	75.18
4	105.90	75.80
5	120.25	80.16
6	133.05	87.99
7	143.46	98.79
8	147.19	105.40

**** Simplified BISHOP FOS = 1.083 ****

The following is a summary of the TEN most critical surfaces

Problem Description : Wayne Co. SN 096-0075 East Abut. EQ

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.083	95.99	134.17	59.20	62.86	147.19	2.840E+06
2.	1.093	86.52	153.75	79.14	47.14	148.73	4.290E+06
3.	1.120	92.93	140.65	65.32	58.57	147.53	3.318E+06
4.	1.125	84.12	140.96	66.99	47.14	140.71	3.393E+06
5.	1.142	71.40	184.24	111.03	21.43	149.32	6.786E+06
6.	1.147	87.94	149.85	75.78	48.57	148.85	4.390E+06
7.	1.149	88.02	128.22	53.88	55.71	136.30	2.458E+06
8.	1.150	89.65	143.61	68.37	54.29	146.19	3.575E+06
9.	1.150	94.07	128.45	53.42	62.86	141.89	2.498E+06
10.	1.154	77.42	169.75	95.66	32.86	147.82	5.600E+06

* * * END OF FILE * * *

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