

Prepared for:
Illinois Department of
Transportation, District 2
819 Depot Avenue
Dixon, Illinois 61021

Structure Designer:
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Springfield, Illinois 62704
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Abbreviated Structure Geotechnical Report

F.A.U. Route 5118 (Linden Road)
Section (201-3)K & (4-1, 5)R
Winnebago County
Job No. P-92-111-06
Contract No. 64C62
PTB No. 141-004
Linden Road over I-39 SB (Ramp BD)
Structure No. 101-0216
Existing Structure No. None

Submitted August 2016; Rev Dec. 2016



Abbreviated Structure Geotechnical Report

Original Report Date: 8/17/2016 Proposed SN: 101-0216 Route: F.A.U.5118 (Linden Road)
Revised Date: 12/13/2016 Existing SN: None Section: (201-3)K & (4-1, 5)R
Geotechnical Engineer: Kipkoech Chepkoit County: Winnebago
Structural Engineer: Fehr Graham Contract: 64C62

Indicate the proposed structure type, substructure types, and foundation locations (attach plan and elevation drawing):

The new structure will be a single-span, 72" PPC IL Beam bridge. The substructures will consist of semi-integral abutments with spread footing bearing in rock. The TSL general plan and elevation drawing is attached.

The proposed Linden Road bridge will be constructed over proposed Ramp BD east of Ramp AD and west of existing SB I-39. Linden Road will be in service during construction of the proposed structure.

According to information provided by the structure designer, the estimated factored vertical load at the base of each abutment footing is estimated to be 2,616 kips.

Discuss the existing boring data, existing plans foundation information, new subsurface exploration and need for any additional exploration to be provided with SGR Technical Memo (attach all data and subsurface profile plot):

Logs of five borings drilled at the site were provided by IDOT District 2. Borings B-3 was drilled in March 2006. Borings B-1a through B-4a were drilled in March 2016. Locations of the borings are shown on the attached Boring Location Plan. The station and offset on the logs for B-3 is relative to a superseded alignment. Boring locations along the current Linden Road alignment are shown on the attached Subsurface Data Profile. The available boring data is sufficient to design the structure.

The subsurface condition is generally a thin layer of overburden on limestone bedrock. The overburden consists of silty loam, sandy loam, clay loam, and loam. The thickness of the overburden at the west and east abutments varies from approximately 7.5 to 9.5 feet and 6.5 to 10.5 feet, respectively. Weathered limestone on sound bedrock was encountered in most of the soil borings. The thickness of the weathered limestone at the west and east abutments varies from approximately 2.5 to 6.0 feet and 1.5 feet, respectively. Bedrock at the west and east abutment varies from El. 835.2 to 834.8 and El. 833.0 to 832.6, respectively. Rock cores were performed in all borings except at B-4a and varied in depth from 10 to 15 feet.

Underground coal mine information available from ISGS indicates that the project area has not been undermined.

Provide the location and maximum height of any new soil fill or magnitude of footing bearing pressure. Estimate the amount and time of the expected settlement. Indicate if further testing, analysis, and/or ground improvement/treatment is necessary:

The back of both abutments will be approximately 2 to 3 feet above existing ground. The maximum fill height in the vicinity of the bridge will be approximately 4 feet at the west approach of the bridge. The bridge footing's factored bearing pressure is estimated to be 6 to 12 ksf.

No long-term consolidation-type settlement is expected at this site. Up to 0.5 inches of immediate settlement may occur at the bridge cone and less than 0.25 inch at the bridge footing due to elastic compression of the rock.

Identify any new cuts or fill slope angles and heights. Estimate the factor of safety against slope failure. Indicate if further testing, analysis or ground improvement/treatment is necessary:

The maximum fill height in the vicinity of the bridge will be approximately 4 feet with 1V:4H side slopes. The maximum cut under the bridge will be approximately 26 feet.

A typically-configured 1V:2H bridge end slope with the toe offset 6 feet from the edge of shoulder would be excavated entirely within the limestone bedrock. The section through the bridge could also be configured to match the typical section along Ramp BD. The face of the abutments would be located approximately 14 to 22 feet behind the rock face.

Due to very favorable conditions at the base of the embankment, the factor of safety against slope failure can be assumed to exceed 1.5 without analysis.

Indicate at each substructure, the 100-year and 200-year total scour depths in the Hydraulics report, the non-granular scour depth reduction, the proposed ground surface, and the recommended foundation design scour elevations:

N/A

Determining the seismic soil site class, the seismic performance zone, the 0.2 and 1.0 second design spectral accelerations and indicate if that the soils are liquefiable:

The seismic Site Class is B, the SPZ is 1, SDS = 0.085g, and SD1 = 0.033g. The soils are not considered to be liquefiable for the design earthquake.

Confirm feasibility of the proposed foundation or wall type and provide design parameters. Attach a pile design table indicating feasible pile types, various nominal required bearings, factored resistances available and corresponding estimated lengths at locations where piles will be used. Provide factored bearing resistance and unit sliding resistance at various elevations and confirm no ground improvement/treatment is necessary where spread footings are proposed. Estimated top of rock elevations as well as preliminary factored unit side and tip resistance values shall be indicated when drilled shafts are proposed:

The bridge designer determined that a single-span PPC I-beam bridge is feasible with open abutments. The bottom of the abutment caps will be located within the weathered rock stratum, so driven pile foundations are not feasible. The site is well-suited for shallow spread footings bearing on rock.

Excavation will be required to remove the overburden and weathered limestone to install the spread footing on bedrock. Variation of sound bedrock elevation should be expected. Variation of up to 4 feet and 1.0 foot should be expected at the west and east abutments, respectively. Concrete should be used to bring low elevations to desired bearing elevation of the footing.

Geotechnical design parameters for spread footings bearing in limestone bedrock at El. 831.1 and El. 827.5 at west and east abutment, respectively, are listed below.

1. Nominal Bearing Resistance ----- 150 ksf
2. Bearing Resistance Factor ----- 0.45
3. Coefficient of friction between footing concrete and bedrock ----- 0.7
4. Sliding Resistance Factor ----- 1.0

The bottom of footings should be adjusted during construction to ensure a minimum embedment of 6 inches in non-weathered rock. The rock excavation should be made with near vertical sides at the plan dimensions to allow the sides and base of the embedded portion of the footing to be cast against undisturbed rock surfaces. In view of this the following statement need to be shown as a note on the plan as per IDOT Bridge Manual:

“The bottom of footing elevation(s) shall be adjusted to ensure a minimum embedment of 6 inches in non-weathered rock. The rock excavation shall be made with near-vertical sides at the plan dimensions to allow the sides and base of the embedded portion of the footing to be cast against undisturbed rock surface”.

Calculate the estimated water surface elevation and determine the need for cofferdams (type 1 or 2), and seal coat:

N/A

Assess the need for sheeting or soil retention or temporary construction slope and provide recommendation for other construction concerns:

The proposed structure will be staged to maintain traffic on the right half of existing Linden Road while the left half of the bridge is constructed. It is anticipated that the bridge will be constructed in a top-down sequence where the final excavation for the proposed Ramp BD roadway will be made after traffic is moved to the left half of the new bridge.

Excavation during the first phase will be limited to the base of the footings at the abutments and to slightly below the girders across the span. Near-vertical cuts of approximately 10 to 12 feet depth will be required at the abutments. Temporary sheet piling is not feasible due to the shallow bedrock. A Temporary Soil Retention System, in accordance with Article 522.07 of the Standard Specifications, should be specified at locations where laid back slopes are not possible.

Benchmark: Cut "□" south side of eastern base of 30 mph ramp sign located east of the ramp connecting I-39 NB to US 20 West (Ramp DA) 0.1 mile north of the centerline of Linden Road. Elev. 851.37, 42°-13'-06.37" N. 89°-00'-39.64" W.

Existing Structure: None

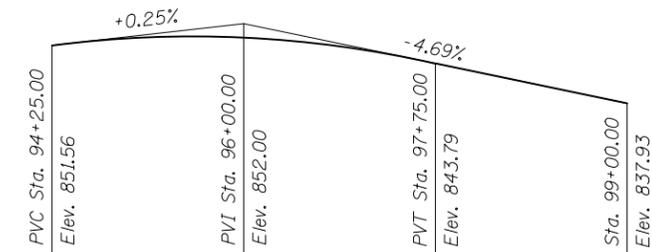
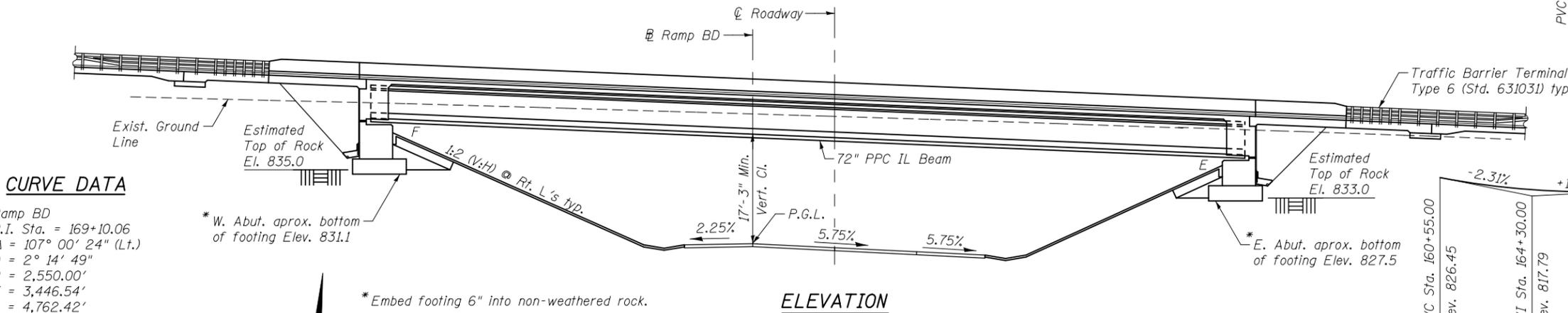
Stage Construction will be utilized to maintain one lane of traffic at all times. Stage I Traffic will be maintained on existing Linden Rd.

CURVE DATA

Ramp BD
 P.I. Sta. = 169+10.06
 $\Delta = 107^\circ 00' 24" (Lt.)$
 $D = 2^\circ 14' 49"$
 $R = 2,550.00'$
 $T = 3,446.54'$
 $L = 4,762.42'$
 $E = 1,737.32'$
 $SE = 5.75\%$
 P.C. Sta. = 134+63.52
 P.T. Sta. = 182+25.95

* W. Abut. approx. bottom of footing Elev. 831.1

* Embed footing 6" into non-weathered rock.



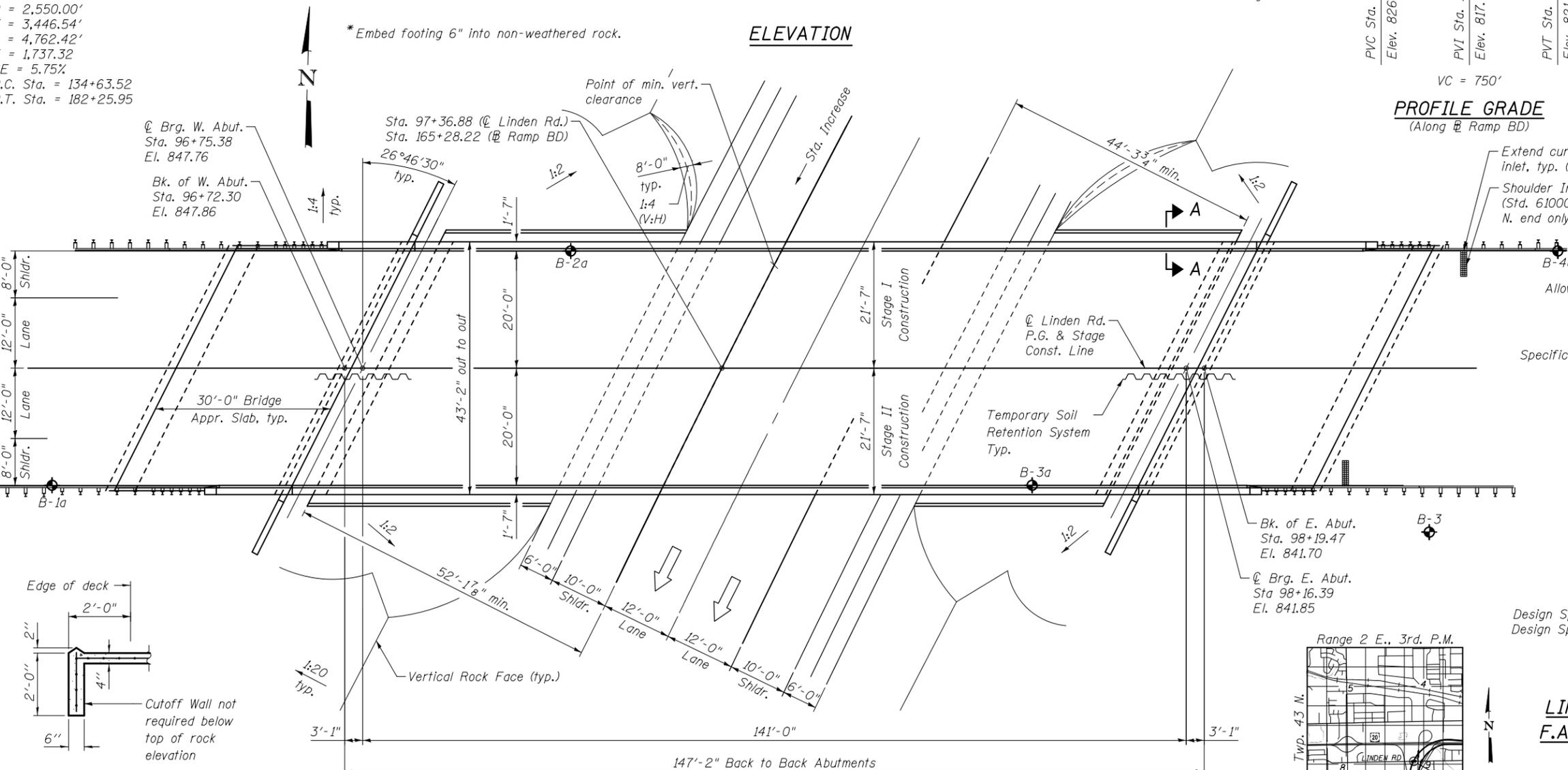
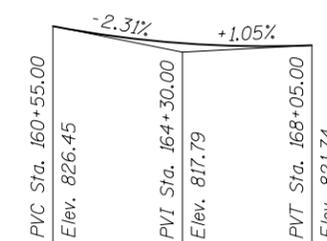
VC = 350'
PROFILE GRADE
 (Along Linden Rd.)

HIGHWAY CLASSIFICATION

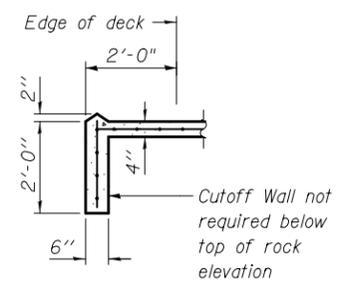
F.A.U. Rte. 5118 - Linden Road
 Functional Class: Minor Arterial
 ADT: 6650 (2013); 18,000 (2040)
 ADTT: 330 (2013); 900 (2040)
 DHV: 1805 (2040)
 Design Speed: 45 m.p.h.
 Posted Speed: 45 m.p.h.
 Two-Way Traffic
 Directional Distribution: 50:50

F.A.I. Rte. 39 - I-39 SB (Ramp BD)
 Functional Class: Interstate
 ADT: 10,000 (2013); 28,000 (2040)
 ADTT: 4200 (2013); 11,700 (2040)
 DHV: 2250 (2040)
 Design Speed: 70 m.p.h.
 Posted Speed: 65 m.p.h.
 One-Way Traffic

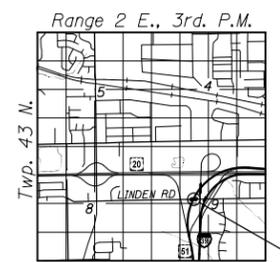
VC = 750'
PROFILE GRADE
 (Along Ramp BD)



SECTION A-A



PLAN



LOCATION SKETCH

LOADING HL-93

Allow 50#/sq. ft. for future wearing surface.

DESIGN SPECIFICATIONS

2014 AASHTO LRFD Bridge Design Specifications, 7th Edition with 2015 & 2016 Interims

DESIGN STRESSES

FIELD UNITS

$f'_c = 3,500$ psi
 $f'_c = 4,000$ psi (Superstructure Concrete)
 $f_y = 60,000$ psi (Reinforcement)

PRECAST PRESTRESSED UNITS

$f'_c = 8,500$ psi
 $f'_{ci} = 7,000$ psi
 $f_{pu} = 270,000$ psi (0.6" ϕ low lax. strands)
 $f_{pbt} = 202,300$ psi (0.6" ϕ low lax. strands)

SEISMIC DATA

Seismic Performance Zone (SPZ) = 1
 Design Spectral Acceleration at 1.0 sec. (S_{D1}) = 0.033 g
 Design Spectral Acceleration at 0.2 sec. (S_{D5}) = 0.085 g
 Soil Site Class = B

GENERAL PLAN

LINDEN ROAD OVER I-39 SB (RAMP BD)
F.A.I. RTE. 39 SEC. (201-3)K & (4-1,5)R
WINNEBAGO COUNTY
STATION 97+36.88
STRUCTURE NO. 101-0216

FILE NAME: \\s0101-0216\1010216-001-1a1.dgn

FEHR GRAHAM
 ENGINEERING & ENVIRONMENTAL
 ILLINOIS DESIGN FIRM NO. 184-003525

USER NAME = cconnor
 DESIGNED - CME
 CHECKED - MCB
 PLOT SCALE = 2114.000001 '1' / in.
 DRAWN - CFC
 PLOT DATE = 12/12/2016
 CHECKED - MCB

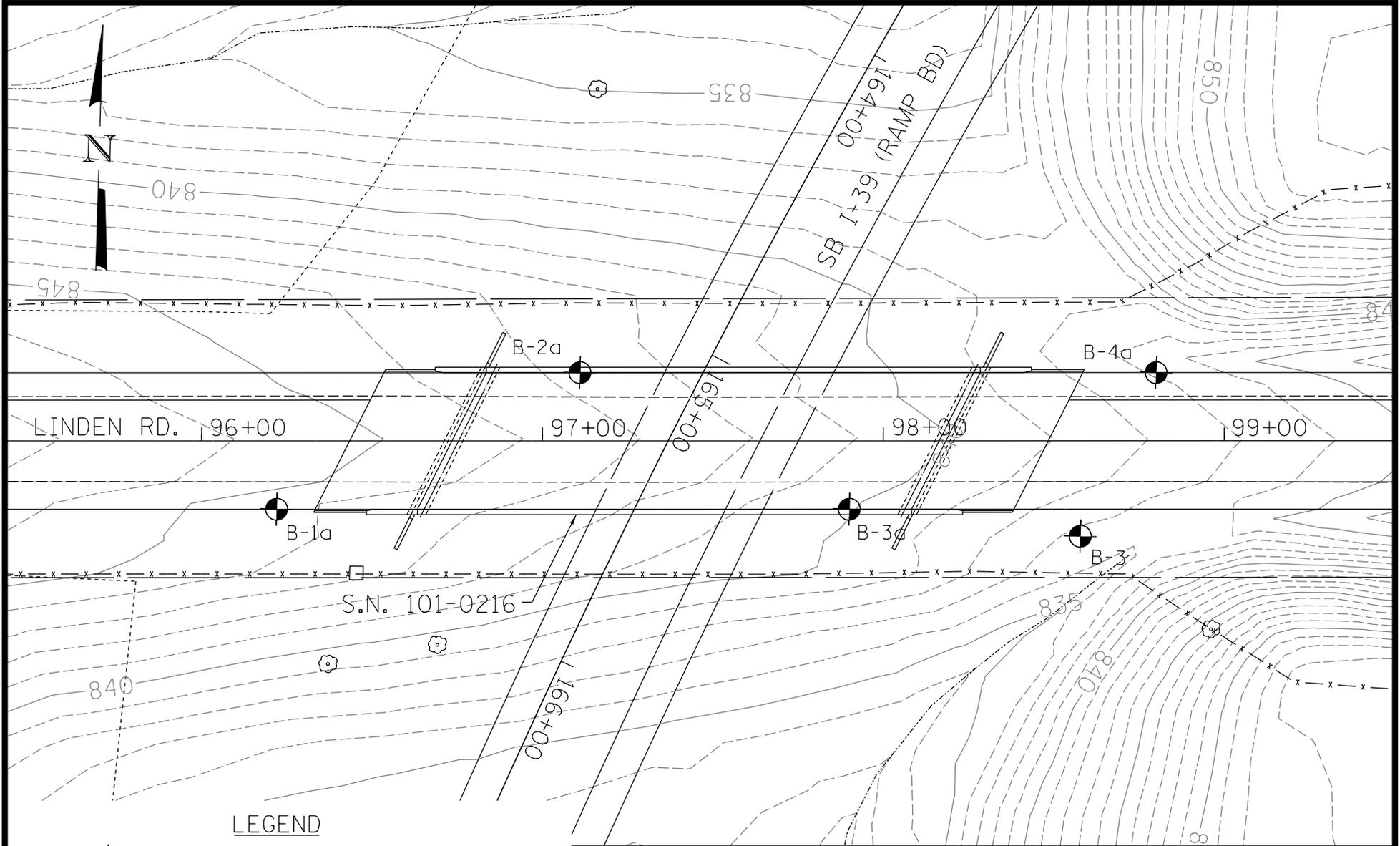
DESIGNED - CME
 CHECKED - MCB
 REVISIONS:

REVISIONS:
 REVISIONS:
 REVISIONS:
 REVISIONS:

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SHEET NO. 1 OF 2 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
39	(201-3)K & (4-1,5)R	WINNEBAGO		
CONTRACT NO. 64C62				
ILLINOIS FED. AID PROJECT				



LEGEND

 B-3a BORING LOCATION

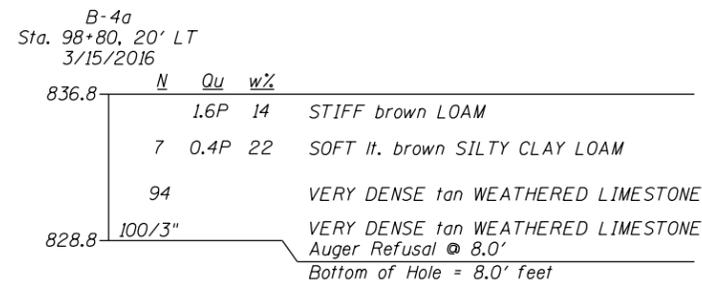
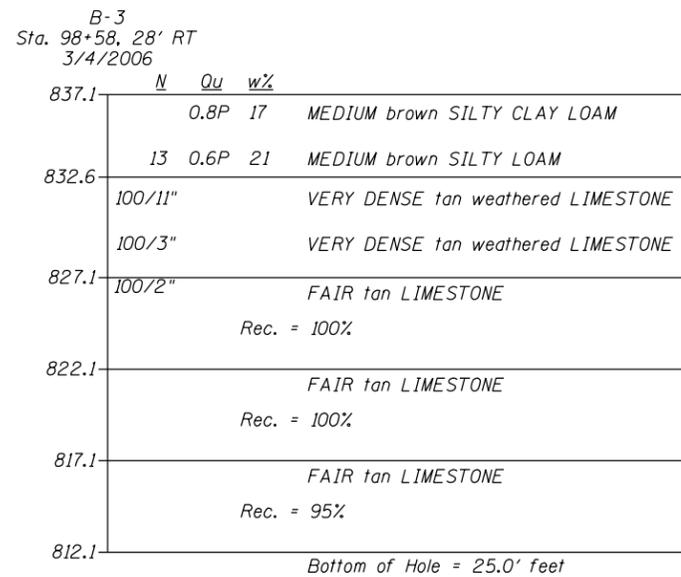
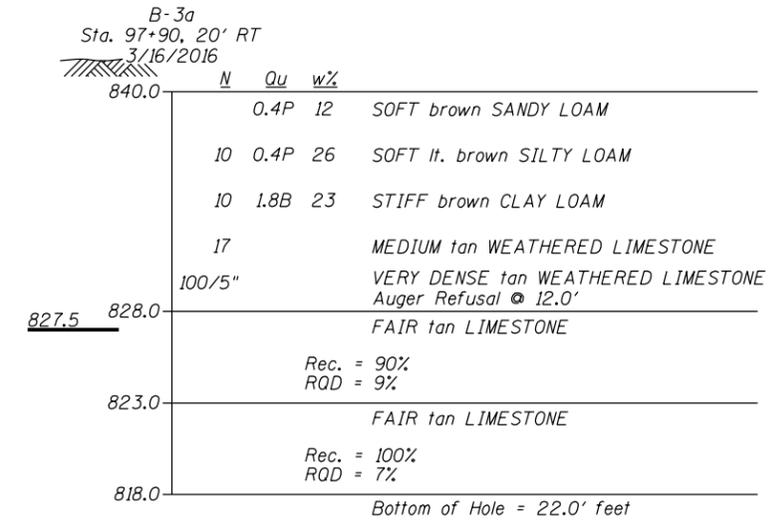
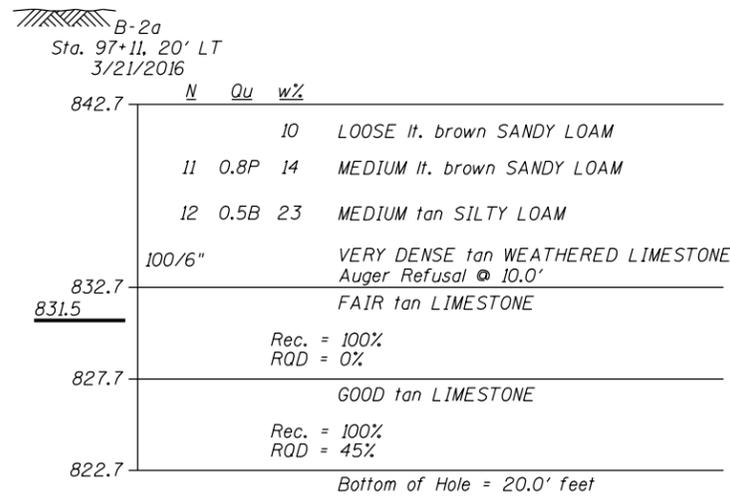
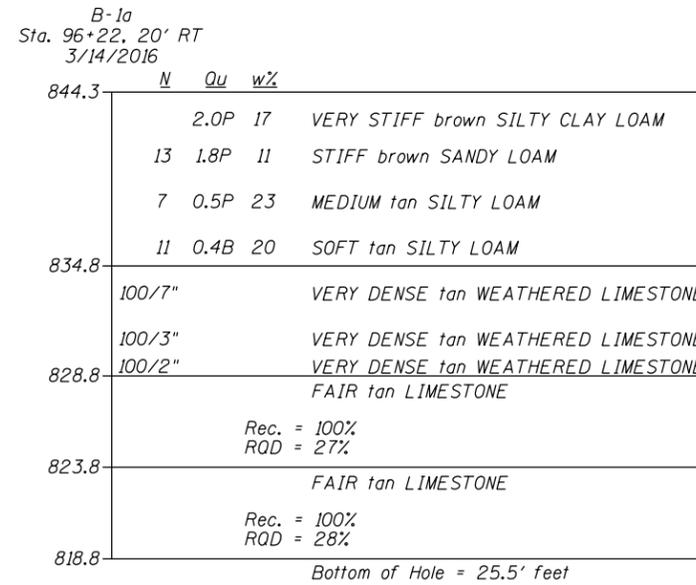


SCALE IN FEET



BORING LOCATION PLAN

LINDEN RD. OVER SB I-39 (RAMP BD)
S.N. 101-0216
WINNEBAGO COUNTY, ILLINOIS



LEGEND

N Standard Penetration Test N (blows/ft)
 Qu Unconfined Strength (tsf)
 w% Natural Moisture Content (%)

DD  Water Surface Elevation Encountered in Boring
 DD = during drilling
 Oh = at completion
 24h = 24 hours after completion

 Approximate Finish Grade
 Bottom of Footing

FILE NAME =	USER NAME =	DESIGNED - RGC	REVISED
		CHECKED - JLD	REVISED
	PLOT SCALE =	DRAWN - EJM	REVISED
	PLOT DATE = 10/13/16	CHECKED - JLD	REVISED

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

SUBSURFACE DATA PROFILE
STRUCTURE NO. 101-0216

SHEET NO. 1 OF 1 SHEETS

F.A.I. RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
39	(201-3)K & (4-1.5)R	WINNEBAGO		
CONTRACT NO.				
ILLINOIS FED. AID PROJECT				



SOIL BORING LOG

ROUTE FAI 39 DESCRIPTION P92-075-05 Soil Survey, I-39 @ Bypass 20, south edge of Rockford LOGGED BY W. Garza

SECTION (201-3) K LOCATION , SEC. , TWP. , RNG.

COUNTY Winnebago DRILLING METHOD Hollow Stem Auger HAMMER TYPE CME-45 Automatic

STRUCT. NO. Station	DEPTH H	BLOW S	UCS Qu	MOIST T	Surface Water Elev. <u>N/A</u> ft	Stream Bed Elev. <u>N/A</u> ft	GROUNDWATER ELEV.: First Encounter _____ ft	Upon Completion _____ ft	After _____ Hrs. _____ ft	DEPTH H	BLOW S	UCS Qu	MOIST T
	(ft)	(/6")	(tsf)	(%)						(ft)	(/6")	(tsf)	(%)
MEDIUM brown SILTY CLAY LOAM			0.8 P	17									
	834.60												
MEDIUM brown SILTY LOAM		3 4 6	0.6 P	21									
	832.60												
									812.10	-25			
VERY DENSE tan weathered LIMESTONE		30											
	830.60	100/11"											
VERY DENSE tan weathered LIMESTONE		100/3"											
	827.10									-30			
Box #9 Time: 6 minutes FAIR tan LIMESTONE 100% Recovery		100/2"											
	822.10									-35			
Time: 7 minutes FAIR tan LIMESTONE 100% Recovery													
	817.10									-40			

The Unconfined Compressive Strength (UCS) Failure Mode is indicated by (B-Bulge, S-Shear, P-Penetrometer) **FIGURE 2**
 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
IDOT

ROCK CORE LOG

Date 3/21/16

ROUTE FAI 39 & FAP 301 DESCRIPTION P92-111-06 Proposed I-39 SB Ramp bridge over Linden Road LOGGED BY W. Garza

SECTION (201-3)K & 4-1.5)K LOCATION , SEC., TWP., RNG.

COUNTY Winnebago CORING METHOD _____

CORING BARREL TYPE & SIZE

STRUCT. NO. _____ Core Diameter 2 in
Station _____ Top of Rock Elev. 835.70 ft
Begin Core Elev. 832.70 ft

BORING NO. B-2a. Latitude 42° 13' 00.99"
Station 97+11 Longitude -89° 00' 45.12"
Offset 20.00ft Lt Northing 2,023,693.4158
Ground Surface Elev. 842.70 ft Easting 2,609,215.8380

DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
832.70	1	100	0	1.6	
827.70	2	100	45	1.8	490.0
822.70					
-20					
-25					
-30					

Dolomite: buff-white, severely fractured in 1" - 3" segments, micritic, pitted and pocked. 832.70

Dolomite: as above, medium bedded, with occasional severe pocking visible. t.s.f.: 827.0 to 826.5 and 824.4 to 823.8

End of Boring

Northing and Easting were calculated using the ILHP-WF coordinate system

Color pictures of the cores _____

Cores will be stored for examination until _____

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)



ROUTE FAI 39 & FAP 301 DESCRIPTION P92-111-06 Proposed I-39 SB Ramp bridge over Linden Road LOGGED BY W. Garza

SECTION (201-3)K & 4-1,5)K LOCATION , SEC. , TWP. , RNG.

COUNTY Winnebago CORING METHOD _____

STRUCT. NO. _____ Core Diameter 2 in
Station _____ Top of Rock Elev. 833.00 ft
Begin Core Elev. 828.00 ft

BORING NO. B-3a. Latitude 42° 13' 00.63"
Station 97+90 Longitude -89° 00' 44.00"
Offset 20.00ft Rt Northing 2,023,658.1150
Ground Surface Elev. 840.00 ft Easting 2,609,300.5764

CORING BARREL TYPE & SIZE _____

CORING BARREL TYPE & SIZE	DEPTH (ft)	CORE (#)	RECOVERY (%)	R.Q.D. (%)	CORE TIME (min/ft)	STRENGTH (tsf)
Dolomite: buff-white, micritic, pitted and pocked throughout, mostly fractured in 1" to 3" segments. t.s.f.: 824.3 to 823.0	828.00	1	90	10	1.6	497.0
Dolomite: as above, fractured likewise t.s.f.: 819.6 to 819.3	823.00	2	100	6	1.6	302.0
End of Boring	818.00					

Northing and Easting were calculated using the ILHP-WF coordinate system

Color pictures of the cores _____

Cores will be stored for examination until _____

The "Strength" column represents the uniaxial compressive strength of the core sample (ASTM D-2938)

