STRUCTURE GEOTECHNICAL REPORT
MANHATTAN-MONEE ROAD OVER
PRAIRIE CREEK TRIBUTARY
STATION 23+51.50
EX SN 099-0450, PR SN 099-0931
WILL COUNTY, ILLINOIS

For
Quigg Engineering Inc.
111 S. Wacker Drive, Suite 3910
Chicago, IL 60606

Submitted by
Wang Engineering, Inc.
1145 North Main Street
Lombard, IL 60148

Original Report: June 3, 2019
Revised Report: October 25, 2019

Technical Report Documentation Page

1. Title and Subtitle Structure Geotechnical Report, Manhattan-Monee Road over Prairie Creek Tributary		**2. Original Date:** June 3, 2019 **Revised Date:** October 25, 2019 **3. Report Type** ☒ SGR ☐ RGR ☐ Draft ☒ Final ☒ Revised
4. Route / Section / County/ District/ Region FAP 531/2018-063-CR&D/Will/ 1/ 1		**5. Contract** 62G85
6. PTB / Item No./Work Order 185-002/15	**7. Existing Structure Number(s)** 099-0450	**8. Proposed Structure Number(s)** 099-0931
9. Prepared by Wang Engineering, Inc. 1145 N Main Street Lombard, IL 60148	**Contributor(s)** Author: Mohammed Kothawala, P.E, DGE QA/QC: Corina Farez, P.G, P.E. PM: Mohammed Kothawala, P.E, DGE.	**Contact** (630) 953-9928 ext. 1036 mkothawala@wangeng.com
10. Prepared for Quigg Engineering Inc. 111 S. Wacker Drive, Suite 3910 Chicago, IL, 60606	**Design Engineer** Mr. Michael Okrent, P.E. Project Manager	**Contact** (312) 235-6783 MOkrent@QuiggEngineering.com

11. Abstract

The existing 6-foot wide by 4-foot high double-cell box culvert will be removed and replaced with a 12-foot wide and 5-foot high single-cell box culvert and out-to-out length of 48 feet that is 16.5 feet longer than existing one to accommodate new shoulders. The proposed culvert will have invert elevation of 673.15 and 673.10 feet at the upstream and downstream ends, respectively.

Beneath the pavement, the general lithologic profile encountered during the investigation includes up to 3 feet of loose to medium dense, brown gravelly silty loam and buried topsoil over up to 4 feet of medium stiff silty clay followed by stiff to hard silty clay. Groundwater was not observed during and at the end of drillings. Surface water was observed at upstream and downstream of culvert.

With about the 36 inches of unstable soils removal and replacement, it will be feasible to construct the culvert. Following the recommended treatment, the culvert barrel can be designed a factored resistance of 4, 000 psf. The long-term settlements are estimated to be 0.2 and 0.1 inches at the downstream and upstream widening portions, respectively with a differential settlement of about 0.1 inches or less.

We provided recommendations for the potential wingwall types including horizontal, precast apron end sections, cast-in-place T-type walls, and sheet pile walls. Global stability analyses for the wingwalls show FOS of 4.18 and 2.15 for the short-term and long-term conditions, respectively and meet the minimum required FOS of 1.5.

12. Path to archived file

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Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

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WILL COUNTY, ILLINOIS
FOR
QUIGG ENGINEERING INC.

1.0 INTRODUCTION

This report presents the results of our subsurface investigation, laboratory testing, geotechnical evaluations, and recommendations to support the removal and replacement of the culvert at the Manhattan Monee Road over the Prairie Creek Tributary at Station 23+51.50. The site is located about 330 feet east of South Kankakee Street in Will County, Illinois. On the USGS *Manhattan Quadrangle 7.5 Minute Series* map, the project site is generally located at SW ¼ of Section 14, Township 34N, Range 11E of the Third Principal Meridian. A *Site Location Map* is presented as Exhibit 1.

The purpose of this investigation was to characterize the site soil and groundwater conditions, perform geotechnical analyses, and provide recommendations for the design and construction of the proposed culvert replacement.

1.1 Proposed Structure

Based on *General Plan and Elevations* (GPE) drawing (Appendix D) dated October 25, 2019 and information provided by Quigg Engineering Inc (QEI), Wang Engineering, Inc. (Wang) understands the existing culvert will be replaced with new a 12-foot wide and 5-foot high concrete box culvert. The culvert will have an out-to-out length of 48 feet and invert elevations of 673.15 and 673.10 feet at the upstream and downstream section, respectively. The roadway profile grade will not be changed. The new culvert and wingwalls are proposed to be cast-in-place. The precast option will not be allowed due to the insufficient fill over the culvert top slab.

1.2 Existing Structure

The existing structure (SN 099-0450) is a double-cell reinforced concrete box culvert measuring 31.5-foot long by 15.0-foot wide. The cells are 6-foot wide and 4-foot high. The culvert carries one lane of traffic on each direction.

2.0 METHODS OF INVESTIGATION

The following sections outline the field and laboratory investigations performed by Wang.

2.1 Field Investigation

The field investigation consisted of two structure borings, designated as CB-01 and CB-02 drilled on both sides of Manhattan Monee Road. The borings were performed by Wang on April 19, 2019 from elevations of 679.75 and 670.72 to a depth of 30.0 feet below the ground surface (bgs). The as-drilled coordinates and elevations were obtained with a mapping-grade GPS unit. Stations and offsets were provided by QEI. As-drilled boring locations are presented in the *Boring Logs* (Appendix A) and the as-completed boring locations are shown in the *Boring Location Plan* (Exhibit 2).

Truck-mounted drilling rig, equipped with hollow stem augers, was used to advance and maintain open boreholes. Soil sampling was performed according to AASHTO T206, *"Penetration Test and Split Barrel Sampling of Soils."* The soil was sampled at 2.5-foot intervals to the boring termination depths. Soil samples collected from each sampling interval were placed in sealed jars and transported to the laboratory for further examination and laboratory testing.

Field boring logs, prepared and maintained by Wang geologists, include lithological descriptions, visual-manual soil (IDH Textural) classifications, results of Rimac and pocket penetrometer unconfined compressive strength tests (Q_u), and results of Standard Penetration Tests (SPT) recorded as blows per 6 inches of penetration.

Groundwater levels were measured while drilling and at completion of each boring. Each borehole was backfilled upon completion with soil cuttings and/or bentonite chips. The pavement surface was restored as close as possible to its original condition.

2.2 Laboratory Testing

The soil samples were tested in the laboratory for moisture content (AASHTO T265). Atterberg limit (AASHTO T89 and T90) and particle size analyses (AASHTO T88) were performed on a selected sample. Tested sample was classified according to the IDH classification system. Field visual descriptions of the soil samples were verified in the laboratory. Laboratory test results are shown in the *Boring Logs* (Appendix A) and in the *Laboratory Test Results* (Appendix B).

3.0 INVESTIGATION RESULTS

Detailed descriptions of the soil conditions encountered during the subsurface investigation are presented in the attached *Boring Logs* (Appendix A) and in the *Soil Profile* (Exhibit 3). Please note that strata contact lines represent approximate boundaries between soil types. The actual transition between soil types in the field may be gradual in horizontal and vertical directions.

3.1 Lithological Profile

Boring CB-01, drilled on the eastbound lane, encountered 3 inches of asphalt over 4 inches of concrete, followed by 5 inches of asphalt pavement. Boring CB-02 drilled on the westbound encountered 3 inches of asphalt over 9 inches of concrete. In descending order, the general lithologic succession encountered beneath the surface includes: 1) man-made ground (fill); 2) medium stiff silty clay; and 3) stiff to hard silty clay.

1) Man-made ground (fill)

Beneath the pavement, the borings encountered up to 3 feet of loose to medium dense, brown gravelly silty loam to loam fill. The unit has N values of 7 and 20 blows per foot and moisture content of 13 and 27%. Underneath the silty loam fill, Boring CB-02 revealed 3 feet of buried topsoil with unconfined compressive strength (Q_u) value of 1.0 tsf and moisture content value of 35%.

2) Medium stiff silty clay

At elevations of 673.6 and 676.5 (4 to 6 feet bgs), the borings encountered up to 4 feet of medium stiff, black to brown, and gray silt clay. The layer has Q_u values of 0.7 to 1.0 tsf and moisture content values of 28 to 44%. Laboratory index testing on a sample shows a liquid limit (L_L) value of 40% and plastic limit (P_L) value of 20%.

3) Stiff to hard silty clay

At elevations of 669.3 and 672.7 feet (8 to 10 feet bgs), the borings encountered medium stiff to hard, black to gray, silty clay extending to the termination depths. The unit has Q_u values between 1.3 and 6.3 tsf and moisture content values between 16 and 21%.

3.2 Groundwater Conditions

Groundwater was not observed during and at the end of drilling.

4.0 FOUNDATION ANALYSIS AND RECOMMENDATIONS

Geotechnical evaluations and recommendations for the culvert and wingwalls are included in the following sections.

4.1 Scour Considerations

The design scour elevation should be taken at the bottom of the cutoff wall (IDOT 2012). To prevent local erosion, we recommend placing stone riprap or a concrete apron at the ends of the culvert. This will also prevent sediments from entering and accumulating in the culvert, minimize long-term maintenance, and provide protection to the stream bed at the interface.

4.2 Culvert Foundation

Based on our subsurface investigations, the soils at the base of the culvert are expected to be medium stiff silty clay with a Q_u value of 0.66 tsf and moisture content of 29% at the upstream portion and hard silty clay with a Q_u value of 4.3 tsf and moisture content of 20% at the downstream portion. Prior to placement of culvert, we recommend removing 36 inches of soils along the entire length of proposed culvert to elevation of 669.1 feet and replacing with granular soil as per IDOT District One "*Aggregate Subgrade Improvement*." Foundation can be designed using a factored bearing resistance of 4,000 psf. Before placing the aggregate fill, the base of the excavation should be underlain with geotextile fabric for ground stabilization in accordance with Section 210 of the IDOT Standard Specifications. For the estimating purposes, the removal and replacement can be considered along entire length of proposed culvert. The replacement material should extend a minimum of two feet beyond the edge of the box.

The soil at the culvert bearing level should be evaluated in the field to determine the actual undercut depth. The actual extent of the removal shall be determined in the field by a soil inspector at the time

of construction.

4.3 Wingwalls

Based on the TSL plan and information provided by QEI, we understand the wingwalls on both ends will be horizontal cantilever wingwalls with a length of 12 feet. The other wingwalls type suitable for this culvert include precast apron end sections, cast-in-place T-type or sheet pile walls.

Horizontal cantilever wingwalls should be designed based on the structural guidelines provided in Section 4.2 of the IDOT Culvert Manual (2017). Horizontal cantilever wingwalls should be founded at a minimum depth of 3.0 feet below the culvert invert elevations.

Foundation soils for the end sections are expected to be medium stiff silty clay at upstream end and hard silty clay at the downstream end. We recommend removing 12 inches of medium stiff soils to an elevation 669.1 feet and replacing with granular soil IDOT District One "*Aggregate Subgrade Improvements*." Following the recommended removal and replacement, the precast end section can be designed using a factored bearing resistance of 4,000 psf. The precast apron end sections should be as per IDOT Base sheet dated 2/17/2017 "*SCB-AES, Precast Concrete Box Culvert Apron End Section Details"* and constructed based on IDOT Standard Specifications.

For cast-in-place T-type wingwalls, the footings should be established at a depth such that they would be at least 4 feet below culvert barrel invert elevation. Footings will be established at elevations 669.1 and 669.2 feet. Based on the subsurface investigation results, stiff to hard silty clay is expected to be encountered at the footing elevations. The T-type wingwalls can be designed with a factored resistance of 4,000 psf and the information and typical sections shown in IDOT Section 4.4 (IDOT 2017).

For sheet pile walls, the design embedment depth of the walls should be in accordance with AASTHO LRFD 2017 Specifications using drained soil parameters provided in Tables 1 and 2 at the upstream and downstream ends, respectively. The design of the wall should ignore 3 feet of soil in front of the wall measured from the finished ground surface elevation in providing passive pressure due to the frost-heave condition. The water pressure should be added to the earth pressure if drainage is not provided. The simplified earth pressure distributions as per AASHTO LRFD Bridge Design Specifications can be used.

Table 1: Geotechnical Parameters for Design of Sheet Pile Wingwalls at the Upstream End
Reference Boring: CB-02

Soil Description (Layer)	Unit Weight, γ (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
New GRANULAR FILL Finished grade to EL 673.5 feet	120	0	30	0.33	3.00
M Stiff SILTY CLAY EL 673.5 to 669.5 feet	115	0	28	0.36	2.78
Stiff to Hard Silty Clay EL 669.5 to 649.8 feet	120	100	31	0.32	3.12

Table 2: Geotechnical Parameters for Design of Sheet Pile Wingwalls at the Downstream End
Reference Boring: CB-01

Soil Description (Layer)	Unit Weight, γ (pcf)	Drained Shear Strength Properties		Earth Pressure Coefficients	
		Cohesion (psf)	Friction Angle (°)	Active Pressure	Passive Pressure
New GRANULAR FILL Finished grade to EL 673.0 feet	120	0	30	0.33	3.00
M Stiff SILTY CLAY EL 673.0 to 670.0 feet	115	0	28	0.36	2.78
Stiff to Hard Silty Clay EL 670.0 to 650.7 feet	120	100	31	0.32	3.12

Design considerations should also include deflection control at the top of sheet pile wall. The estimated soil parameters that may be used to analyze deflection of the wall using COMP 624P, LPILE or any other programs are presented in Tables 3 and 4.

Table 3: Recommended Parameters for Lateral Load Analysis of Sheet Pile Wingwalls at the Upstream End
Reference Boring: CB-02

Soil Type (Layer)	Unit Weight γ (pcf)	Undrained Shear Strength, c_u (psf)	Estimated Friction Angle, Φ (°)	Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50} (%)
New GRANULAR FILL Finished grade to EL 673.5 feet	120	0	30	30	--
M Stiff SILTY CLAY EL 673.5 to 669.5 feet	115	700	0	100	1.0
Stiff to Hard Silty Clay EL 669.5 to 649.8 feet	120	2200	0	700	0.6

Table 4: Recommended Parameters for Lateral Load Analysis of Sheet Pile Wingwalls at the Downstream End
Reference Boring: CB-01

Soil Type (Layer)	Unit Weight γ (pcf)	Undrained Shear Strength, c_u (psf)	Estimated Friction Angle, Φ (°)	Estimated Lateral Soil Modulus Parameter, k (pci)	Estimated Soil Strain Parameter, ε_{50} (%)
New GRANULAR FILL Finished grade to EL 673.0 feet	120	0	30	30	--
M Stiff SILTY CLAY EL 673.0 to 670.0 feet	115	700	0	100	1.0
Stiff to Hard Silty Clay EL 670.0 to 650.7 feet	120	3500	0	1000	0.5

4.4 Settlement Evaluations

Following the recommended foundation soil treatment as described in Section 4.2, we estimate the foundation soils will experience settlement of about 0.2 inches at the downstream and 0.1 inches at the upstream widening portions of the culvert with the differential settlement of 0.1 inches or less. The settlement estimates are acceptable for the culvert structure.

4.5 Global Stability

The global stability of T-type wingwalls was analyzed based on the generalized soil profile described in Section 3.1 and estimated wingwall height of about 8.0 feet. We have performed global stability

analyses for the wingwalls at the critical location at the north end section with the weaker layer under both undrained (short-term) and drained (long-term) conditions. The analyses were performed with *Slide v6.0* and the results of the evaluations are provided in Appendix C. We estimate the wingwalls have undrained (short-term) and drained (long-term) FOS of 4.18 and 2.15, meeting the minimum FOS requirement of 1.5 (IDOT 2015).

4.6 Cast-In-Place or Precast Culvert Considerations

The results of the settlement indicate that both the cast-in-place and precast culvert options are appropriate and feasible at the site. Following the recommended treatment 0.5 inches will not cause excessive separation of the precast sections.

4.7 Stage Construction

Based on the project report and TSL Plan, the traffic will be detoured during construction. Culvert will be constructed in one stage.

5.0 CONSTRUCTION CONSIDERATIONS

5.1 Site Preparation

The existing vegetation, surface topsoil, pavement, and debris should be cleared and stripped where the culvert will be placed.

5.2 Excavation, Dewatering and Utilities

Excavations should be performed in accordance with local, state, and federal regulations. The potential effect of ground movements upon nearby roadways, structures, and utilities should be considered during construction. Any excavation that cannot be sloped 1:2 (V:H) should be properly shored with temporary sheet piling or temporary soil retention systems.

The groundwater was not observed during drilling. However, during our site visit, the surface water was observed in the ditches as well as in the culvert. Depending upon prevailing climate conditions and the time of the year when culvert construction take place, control runoff and maintenance of existing flows may require temporary water diversion and control. Any water that accumulates in open excavations by seepage or runoff should be immediately removed.

5.3 Filling and Backfilling

Fill used as embankment material and for replacement of any unstable or unsuitable soils encountered during construction should be pre-approved by the Engineer. The material used to backfill around and to a level at least 1 foot over the top of the culvert box, should be porous granular material conforming to the requirements specified in the Supplemental Specifications and Recurring Special Provisions, *Granular Backfill of Structures* (IDOT 2019).

5.4 Earthwork Operations

The required earthwork can be accomplished with conventional construction equipment. Moisture and traffic will cause deterioration of exposed subgrade soils. Precautions should be taken by the Contractor to prevent water erosion of the exposed subgrade. A compacted subgrade will minimize water runoff erosion.

Earth moving operations should be scheduled to not coincide with excessive cold or wet weather (early spring, late fall or winter). Any soil allowed to freeze or soften due to the standing water should be removed. Wet weather can cause problems with subgrade compaction.

It is recommended that an experienced geotechnical engineer be retained to inspect the exposed subgrade, monitor earthwork operations, and provide material inspection services during the construction phase of this project.

6.0 QUALIFICATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from the borings drilled at the locations shown on the boring logs and in Exhibit 2. This report does not reflect any variations that may occur between the borings or elsewhere on the site, variations whose nature and extent may not become evident until the course of construction. If changes are planned to the proposed improvements as described in this report, we should be timely informed so that our recommendations can be adjusted accordingly.

It has been a pleasure to assist Quigg Engineering Inc. and on this project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

WANG ENGINEERING, INC.

Mohammed Kothawala, P.E., DGE.
Geotechnical Department Manager

Corina T. Farez, P.G, P.E.
Vice President

Ramesh KC, EIT
Geotechnical Engineer

REFERENCES

AASHTO (2017) *LRFD Bridge Design Specificaitons*. Washington, D.C., American Asssociaiton of State Highway and Transportation Officials.

IDOT (2012) *Bridge Manual*. Illinois Department of Transportation.

IDOT (2015) *Geotechnical Manual*, Illinois Department of Transportation.

IDOT (2016) *Standard Specifications for Road and Bridge Construction.* Illinois Department of Transportation.

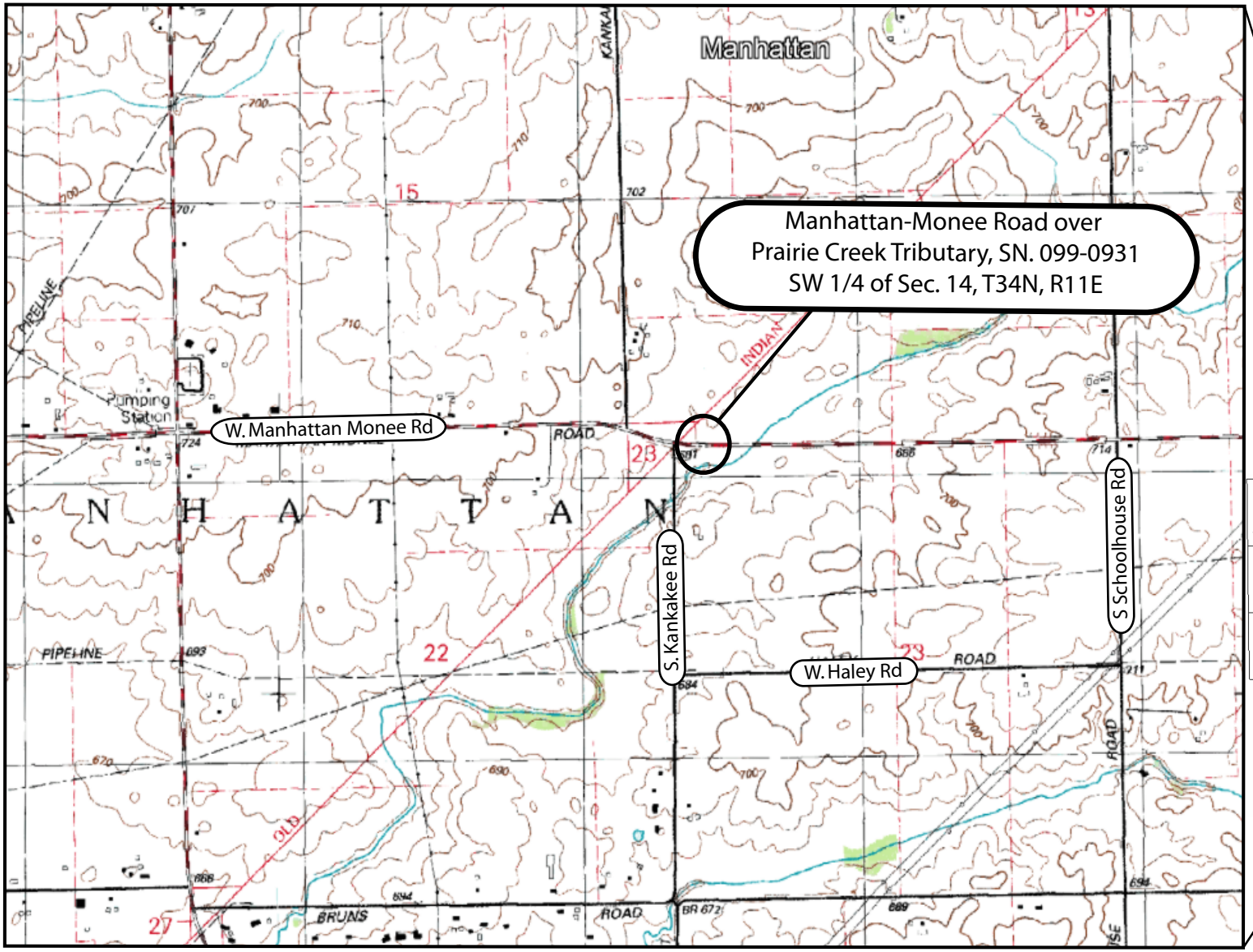
IDOT (2017) *Culvert Manual*. Illinois Department of Transportation.

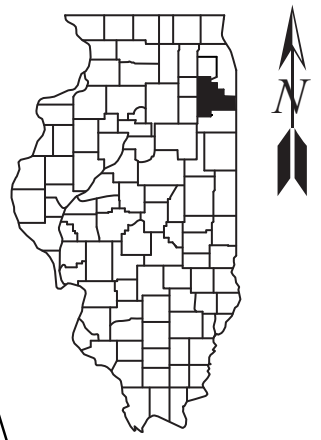
IDOT (2019) *Supplemental Specifications and Recurring Special Provisions.* Illinois Department of Transportation

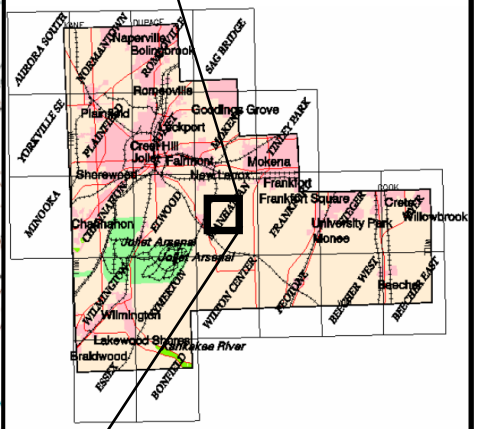
Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

EXHIBITS







Will County

Scale

0 0.5 1.0 Mile

SITE LOCATION MAP: MANHATTAN-MONEE ROAD OVER PRAIRIE CREEK TRIBUTARY, SN. 099-0931, WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 1	DRAWN BY: RKC CHECKED BY: M. Kothawala

Wang Engineering
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR QUIGG ENGINEERING, INC. 199-02-08

Legend

Boring Location

Scale

0 50 100 Feet

BORING LOCATION PLAN: MANHATTAN-MONEE ROAD OVER PRAIRIE CREEK TRIBUTARY, SN. 099-0931, WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL	EXHIBIT 2-1	DRAWN BY: RKC CHECKED BY: M. Kothawala

Wang Engineering
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR QUIGG ENGINEERING, INC. 199-02-08

Benchmark: CP 106, Iron rod at the north shoulder.
Northing: 1733208.132; Easting: 1092185.144
Elevation NGVD 88: 678.613

Existing Structure: S.N. 099-0450, year of construction unknown, consists of a double barrel reinforced concrete box culvert at 3 degree skew, with barrel dimensions of 4' tall by 6' wide. The culvert length is approximately 31'-6" out to out of headwalls. Proposed work consists of replacing the culvert with a single-cell concrete box culvert, 5' tall by 12' wide and 48' length out to out of headwalls, with the invert 1' below the flow line.

Traffic will be detoured during construction.

No salvage.

Precast alternate is not allowed.

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge
Design Specifications, 8th Edition

LOADING HL-93

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

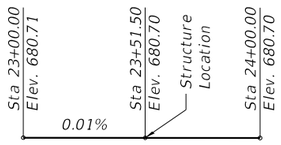
DESIGN STRESSES

FIELD UNITS

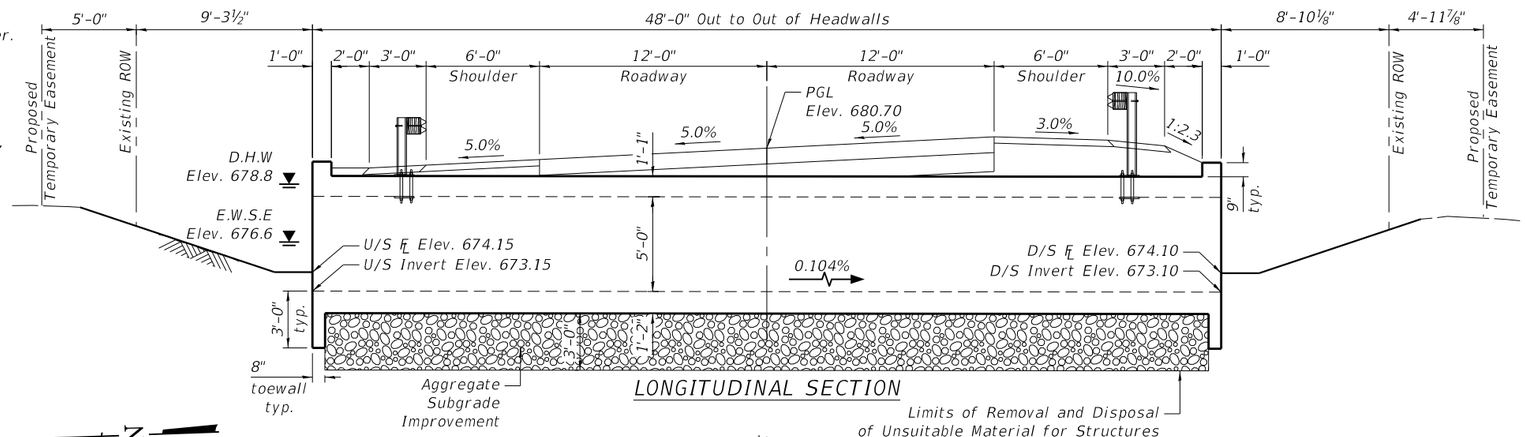
f'c = 3,500 psi
fy = 60,000 psi (Reinforcement)

HORIZONTAL CURVE DATA

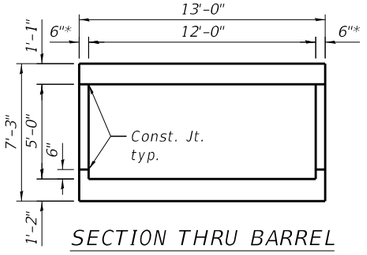
PI STA. = 22+34.15
(N = 1,733,179.4420,
E = 1,091,914.2846)
Δ = 13° 58' 42" (LT)
D = 2° 58' 19"
R = 1,927.90'
T = 236.35'
L = 470.35'
E = 14.43'
P.C. STA. = 19+97.81
(N = 1,733,231.3114,
E = 1,091,683.7000)
P.T. STA. = 24+68.15
(N = 1,733,184.8077,
E = 1,092,150.5702)



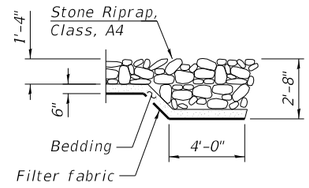
PROFILE GRADE
(Along ℄ Manhattan-Monee Rd)



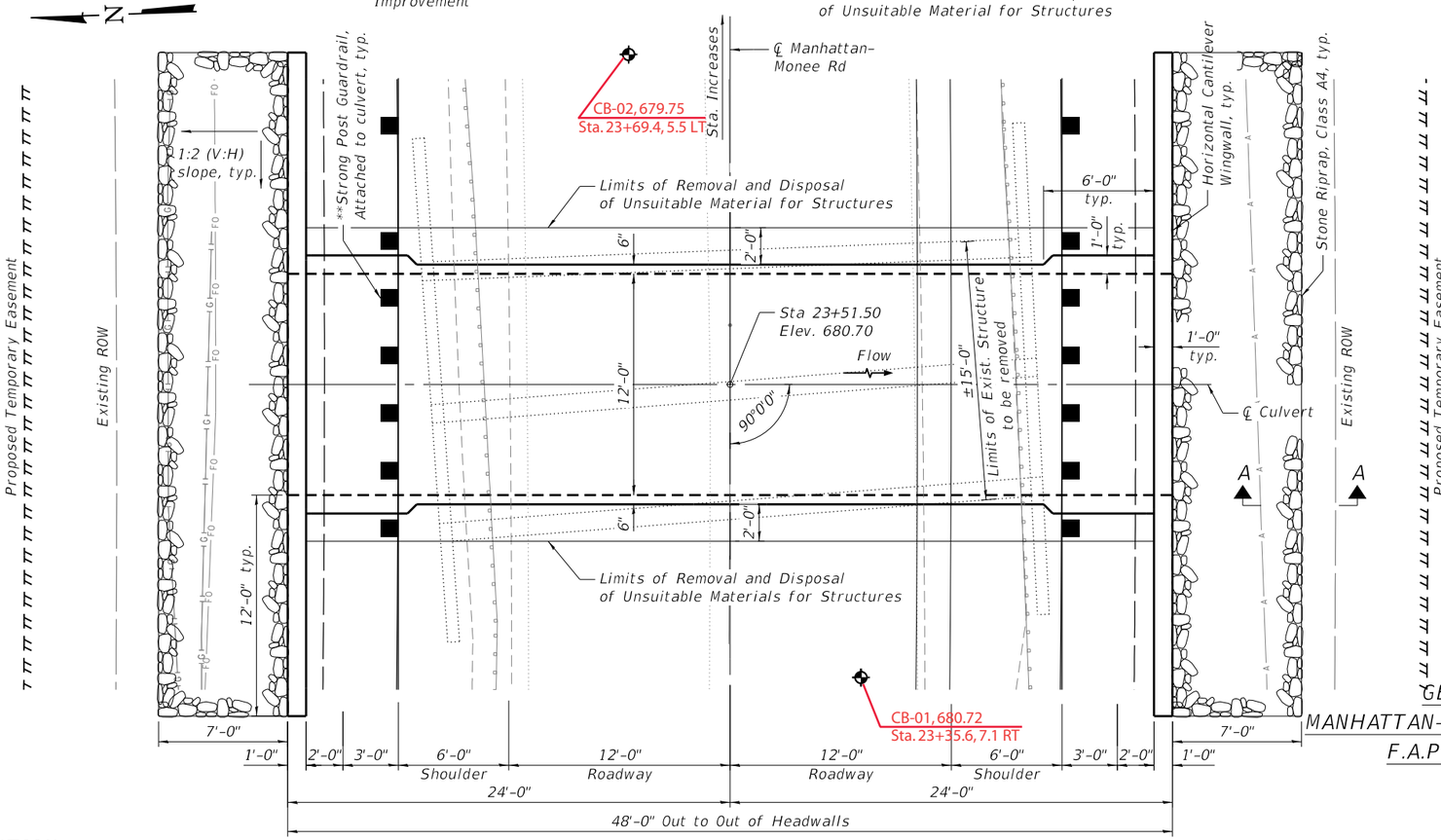
LONGITUDINAL SECTION



SECTION THRU BARREL
(Along ℄ Manhattan-Monee Rd)
* Thickness at U/S & D/S end is 12"

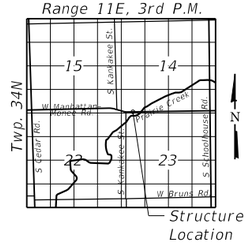


SECTION A-A



PLAN
⌖ - Soil Boring Locations

** Guardrail payitems and quantities provided in roadway plans.



LOCATION SKETCH

WATERWAY INFORMATION

Drainage Area = 8.4 sq. mi. Low Grade Elev. = 680.20 @ Sta. 35+06.10

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	47	47	48	678.3	0.3	0.2	678.6	678.5
Design	50	163	47	48	678.8	0.8	0.8	679.6	679.6
Base	100	230	47	48	679.1	1.1	0.8	680.2	679.9
Overtopping		270	47	48	679.4	1.1	0.8	680.2	680.2
Max. Calc.	500	275	47	48	679.5	1.2	0.9	680.7	680.4

2-YR Q = 24 C.F.S

KEITH W. BENTING
STATE OF ILLINOIS
4777
DECATUR, ILLINOIS
LICENSED STRUCTURAL ENGINEER

Keith W. Benting, Illinois S.E. 081-004777 Date
Expires 11/30/2020

GENERAL PLAN AND ELEVATION
MANHATTAN-MONEE RD. OVER PRAIRIE CREEK TRIB.
F.A.P RTE. 531 SEC. 2018-063-CR&D
WILL COUNTY
STATION 23+51.50
S.N. 099-0931

BORING LOCATION PLAN: MANHATTAN-MONEE ROAD OVER PRAIRIE CREEK TRIBUTARY, SN. 099-0931, WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL | EXHIBIT 2-2 | DRAWN BY: N. Balakumaran | CHECKED BY: M. Kothawala

Wang Engineering
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR QUIGG ENGINEERING, INC. | 199-02-08

QUIGG ENGINEERING INC

USER NAME = MOkrent		DESIGNED - AWM		REVISED -	
		CHECKED - KWB		REVISED -	
PLOT SCALE = 8:0.0000 ':" / in.		DRAWN - LC		REVISED -	
PLOT DATE = 10/25/2019		CHECKED - MC		REVISED -	

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

GENERAL PLAN AND ELEVATION
STRUCTURE NO. 099-0931
SHEET S1 OF S4 SHEETS

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
531	2018-063-CR&D	WILL	88	47
		CONTRACT NO. 62G85		
		ILLINOIS	FED. AID PROJECT	

MODEL: Default
FILE NAME: S:\2018\18IL042-AES PH2 IDOT D1-PTB 185-02\WO15-62G85-Manhattan_Monee\CADD\CADD Sheets\16-ID162G85-sht-S1_General Plan.dgn
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Wang Engineering
1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

APPENDIX A

Wang Engineering

BORING LOG LEGEND

Relative Drilling Resistance		
RDR	**Term**	**Criter**
1	Very Easy	No chatter, very little resistance, very fast and steady drill advance
2	Easy	No chatter, some resistance, fast and steady drill advance rate
3	Moderate	Some chatter, firm drill resistance, moderate advance
4	Hard	Frequent chatter, variable drill resistance, slow advance rate
5	Very Hard	Constant chatter, variable and very slow drill advance, nearly refusal

Proportional Terms (%)	
Trace	1-10
Little	10-20
Some	20-35
And	35-50

Coarse Gradation	
Boulder	>200mm
Cobble	200mm to 75mm
Gravel	75mm to 2mm

Relative Density of Non-Cohesive Soils	
N-Blows/12 inches	**Relative Density Term**
0-3	Very Loose
4-9	Loose
10-29	Medium Dense
30-49	Dense
50-80+	Very Dense

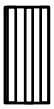
Soil Moisture Conditions	
Term	**Appearance and Feel**
Dry	Soil sample looks and feels powdery or dusty; no indication of moisture. Free-running granular soils.
Damp	Cohesive soils cannot be molded easily without adding water. Granular soil may not flow very easily.
Moist	Soil is near the optimum moisture content. Cohesive soils are near the plastic limit. Soil changes color slightly when exposed to air for a short period.
Wet	One may feel a high degree of moisture, yet no free water is visible. Water may become visible if the sample is squeezed. Cohesive soil appears weak and sticks to and/or stains hands. Granular soils tend to cohere.
Saturated	Applied to granular soils that have free surface water; water drains freely from the sample.

Consistency of Cohesive Soils	
Unconfined Compressive Strength Qu, tsf	**Consistency Term**
<0.25	Very Soft
0.25-0.49	Soft
0.50-0.99	Medium Stiff
1.00-1.99	Stiff
2.00-3.99	Very Stiff
>4.00	Hard

Rock Quality Designation (RQD)	
0-25%	Very Poor
25-50%	Poor
50-75%	Fair
75-90%	Good
90-100%	Excelent

Sample Type Symbols


Split Spoon (SS)


Shelby Tube (ST)


No Recovery (NR)


In-situ Vane Shear Test


Auger Cuttings


Geoprobe


Rock Core

Drill Rig:
TMR = Truck Mouted Rig
ATV = All Terrain Vehicle Rig
[--%] = SPT Hammer Efficiency

SPT = Standard Penetration Test
Q_u = Unconfined Compressive Strength Test
P = Pocket Penetrometer
S = Shear failure (Rimac)
B = Bulge failure (Rimac)
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
N-Value (N-Blows/12 inches) is the sum of the second and the third SPT values

05/14/2018 (V05)

Wang Engineering
wangeng@wangeng.com
1145 North Main Street
Lombard, IL 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG CB-01

WEI Job No.: 199-02-08

Client: **Quigg Engineering Inc.**
Project: **Manhattan-Monee Culverts Replacement**
Location: **Will County, Illinois**

Datum: NAVD 88
Elevation: 680.72 ft
North: 1733179.23 ft
East: 1092017.58 ft
Station: 23+35.6
Offset: 7.1 RT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	680.5	3-inch thick ASPHALT						
	680.1	--PAVEMENT--						
	679.7	4-inch thick CONCRETE						
		--PAVEMENT--						
		5-inch thick ASPHALT						
		--PAVEMENT--						
		Medium dense, brown, gravelly SILTY LOAM; damp						
		--RDR 2--						
	676.5	Medium stiff, orangish brown and gray SILTY CLAY, trace gravel; wet	5		2	2 3 3	NR	
		--RDR 2--			3	2 1 2	0.66 B	28
	672.7	Very stiff to hard, brown and gray SILTY CLAY, trace gravel; damp to moist						
		--RDR 2--	10		4	2 3 5	4.26 B	20
					5	3 7 11	6.31 B	19
			15		6	3 6 10	3.20 B	19
					7	6 7 10	5.00 B	16
			20		8	4 5 7	4.18 B	17
			25		9	3 6 9	4.84 B	17
					10	5 7 9	4.59 B	18
					11	2 5 7	2.87 B	18
	650.7	Boring terminated at 30.00 ft	30		12	4 6 8	2.62 B	18
			35					
			40					

GENERAL NOTES

Begin Drilling: **04-19-2019** Complete Drilling: **04-19-2019**
Drilling Contractor: **Wang Testing Services** Drill Rig: **B57 TMR [100%]**
Driller: **N&A** Logger: **E. Yim** Checked by: **J. Rowells**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **DRY**
At Completion of Drilling: **DRY**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

WANGENGINC 1990208.GPJ WANGENG.GDT 5/20/19

Wang Engineering
wangeng@wangeng.com
1145 North Main Street
Lombard, IL 60148
Telephone: 630-953-9928
Fax: 630-953-9938

BORING LOG CB-02

WEI Job No.: 199-02-08

Client: **Quigg Engineering Inc.**
Project: **Manhattan-Monee Culverts Replacement**
Location: **Will County, Illinois**

Datum: NAVD 88
Elevation: 679.75 ft
North: 1733190.61 ft
East: 1092051.85 ft
Station: 23+69.4
Offset: 5.5 LT

Profile	Elevation (ft)	SOIL AND ROCK DESCRIPTION	Depth (ft)	Sample Type / recovery	Sample No.	SPT Values (blw/6 in)	Qu (tsf)	Moisture Content (%)
	679.5	3-inch thick ASPHALT --PAVEMENT--						
	678.8							
	678.5	9-inch thick CONCRETE --PAVEMENT--						
		3-inch thick, medium stiff, black SILTY CLAY, trace gravel; wet --FILL--			1	2 3 4	0.82 B	27
	676.8	Loose, brown, gravelly SILTY LOAM to LOAM; damp --FILL--			2	1 3 3	1.00 P	35
		Stiff, black SILTY CLAY LOAM, trace gravel; wet --BURIED TOPSOIL--	5					
	673.6	Medium stiff, black, organish brown and gray SILTY CLAY, trace gravel; wet --RDR 2--			3	2 1 2	0.98 B	44
		--L_L(%)=40, P_L(%)=20-- --%Gravel=0.4-- --%Sand=10.6-- --%Silt=53.9-- --%Clay=35.0--	10		4	3 1 2	0.66 B	29
	669.3	Stiff to hard, orange, brown and gray SILTY CLAY, trace gravel; damp to wet --RDR 2 to 3-- --sand lenses--			5	2 3 5	1.89 B	21
			15		6	3 6 8	4.02 B	16
					7	3 6 7	2.87 B	18
			20		8	3 4 7	3.61 B	18
			25		9	4 5 6	4.43 B	18
					10	4 5 8	1.56 B	19
					11	4 5 5	1.31 B	17
	649.8	Boring terminated at 30.00 ft	30		12	3 5 7	1.97 B	17
			35					
			40					

GENERAL NOTES

Begin Drilling: **04-19-2019** Complete Drilling: **04-19-2019**
Drilling Contractor: **Wang Testing Services** Drill Rig: **B57 TMR [100%]**
Driller: **N&A** Logger: **E. Yim** Checked by: **J. Rowells**
Drilling Method: **2.25" HSA; boring backfilled upon completion**

WATER LEVEL DATA

While Drilling: **DRY**
At Completion of Drilling: **DRY**
Time After Drilling: **NA**
Depth to Water: **NA**

The stratification lines represent the approximate boundary between soil types; the actual transition may be gradual.

WANGENGINC 1990208.GPJ WANGENG.GDT 5/20/19

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1145 North Main Street
Lombard, Illinois 60148
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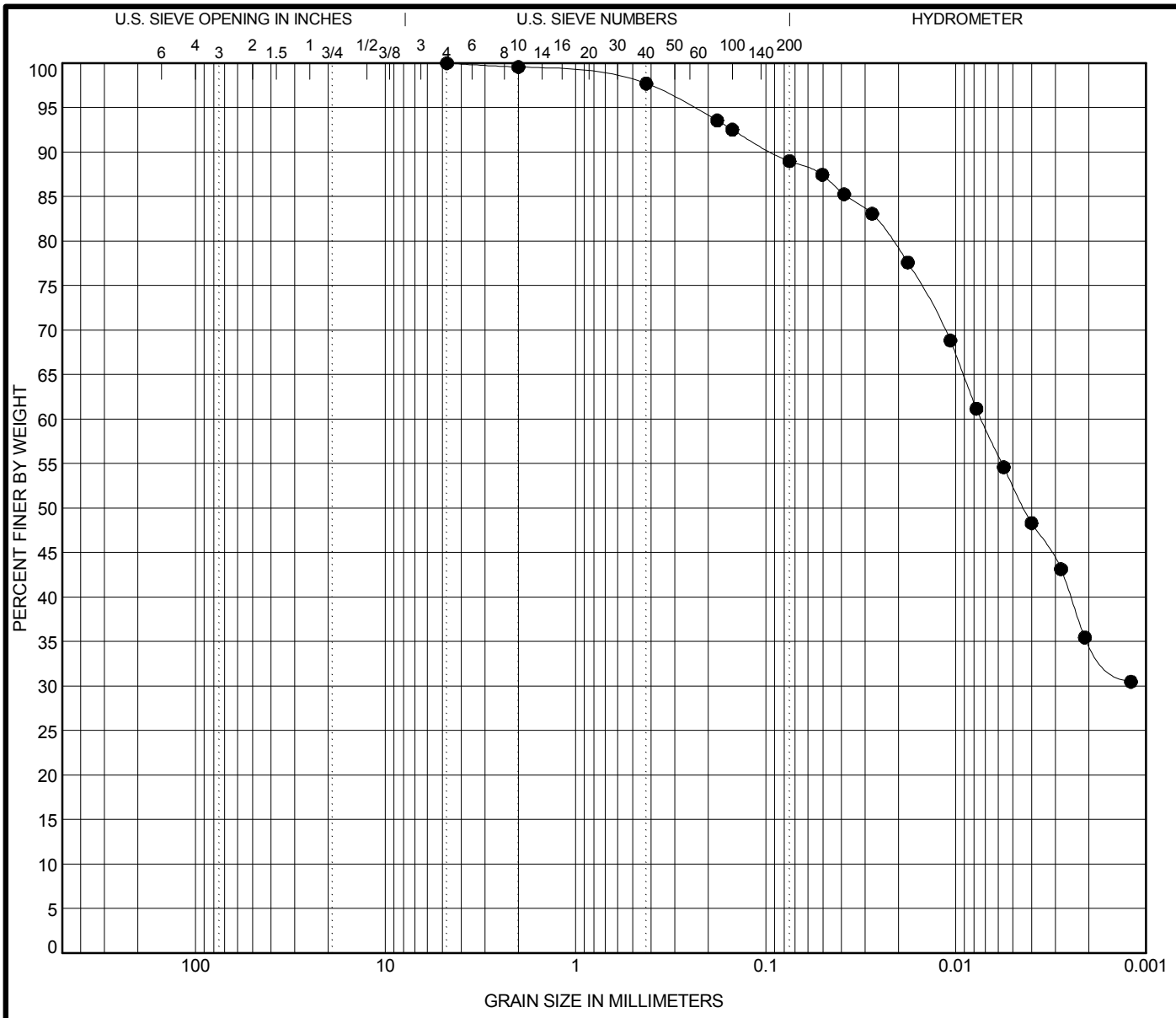
APPENDIX B



COBBLES	GRAVEL	SAND		SILT AND CLAY
		coarse	fine	

Specimen Identification		IDH Classification	LL	PL	PI	Cc	Cu
● **CB-02#4**	**8.5 ft**	**Silty Clay**	**40**	**20**	**20**		

Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
● **CB-02#4**	**8.5 ft**	**4.75**	**0.007**			**0.4**	**10.6**	**53.9**	**35.0**

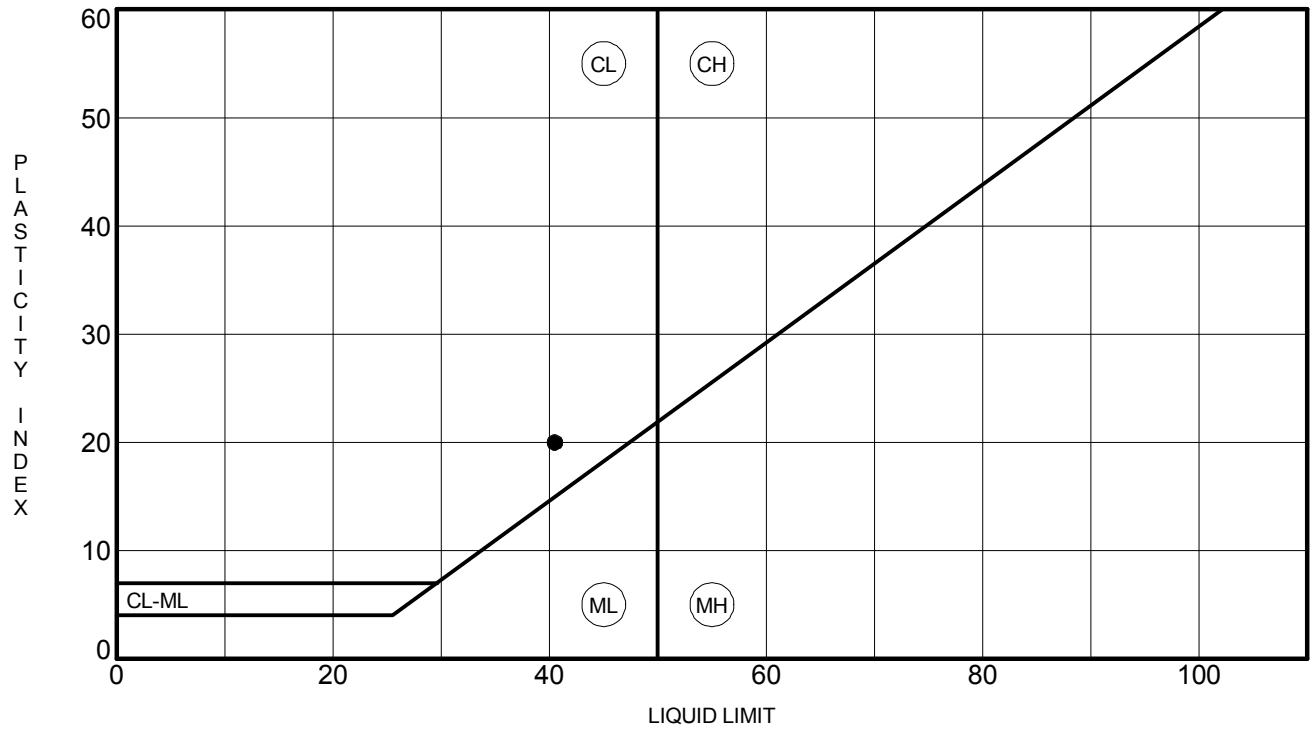
Wang Engineering, Inc.
1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

GRAIN SIZE DISTRIBUTION

Project: Manhattan-Monee Culverts Replacement

Location: Will County, Illinois

Number: 199-02-08



Specimen Identification		LL	PL	PI	Fines	IDH Classification
● **CB-02#4**	**8.5 ft**	**40**	**20**	**20**	**89**	**Silty Clay**

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1145 N Main Street
Lombard, IL 60148
Telephone: 630 953-9928
Fax: 630 953-9938

ATTERBERG LIMITS' RESULTS

Project: Manhattan-Monee Culverts Replacement

Location: Will County, Illinois

Number: 199-02-08

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1145 North Main Street
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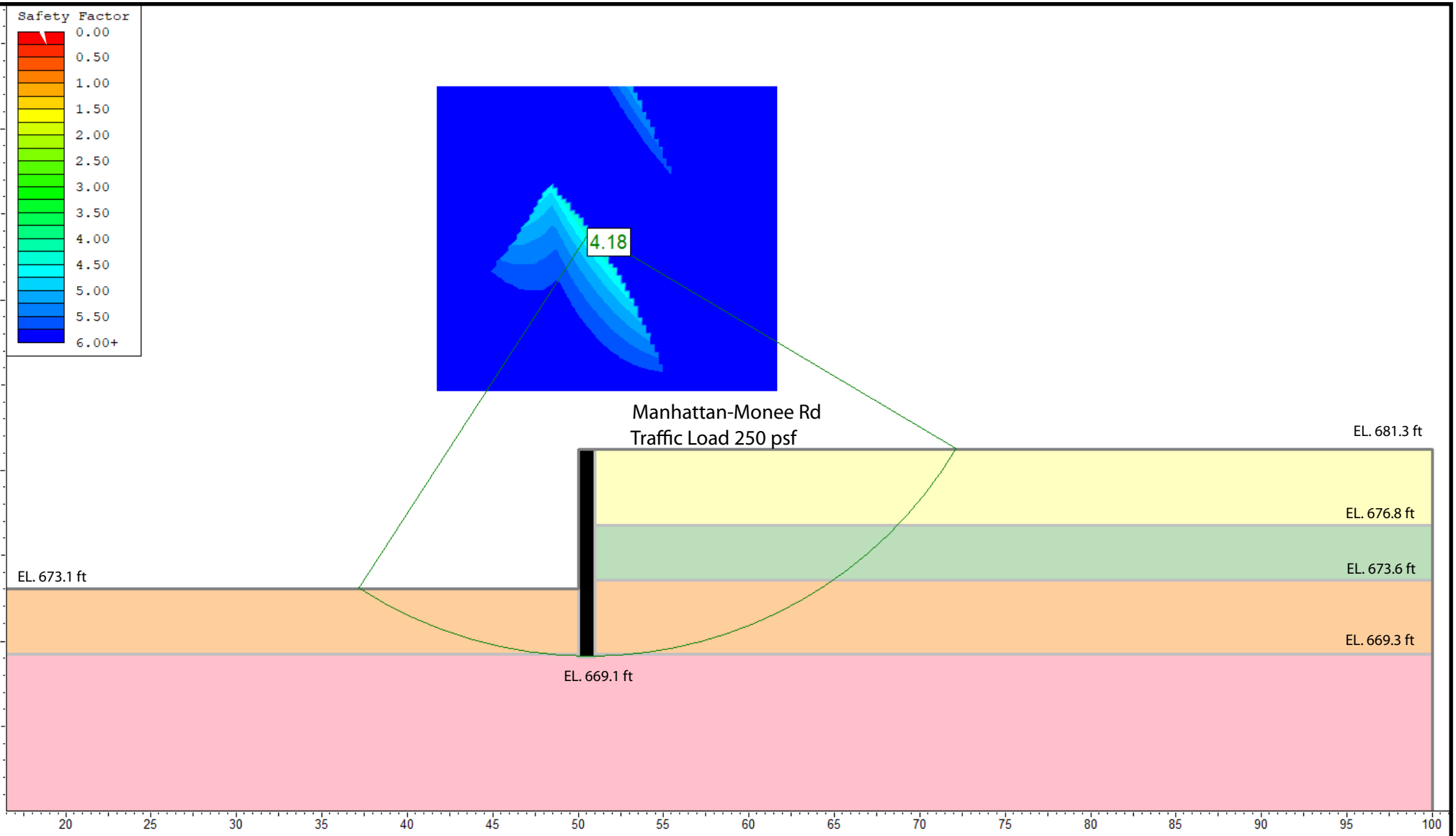
www.wangeng.com

APPENDIX C



Undrained Analysis, Upstream End Wingwall, Ref Boring: CB-02

Layer ID	Description	Total Unit Weight (pcf)	Undrained Cohesion (psf)	Undrained Friction Angle (degrees)
1	Loose SI Loam to Loam Fill	115	0	30
2	Stiff SI CL Loam	120	1000	0
3	Medium Stiff SI Clay	115	700	0
4	Stiff to V Stiff SI Clay	120	2200	0

GLOBAL STABILITY ANALYSIS: MANHATTAN-MONEE ROAD OVER PRAIRIE CREEK TRIBUTARY, SN. 099-0931, WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-1 | DRAWN BY: RKC | CHECKED BY: N. Balakumaran

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Lombard, IL 60148
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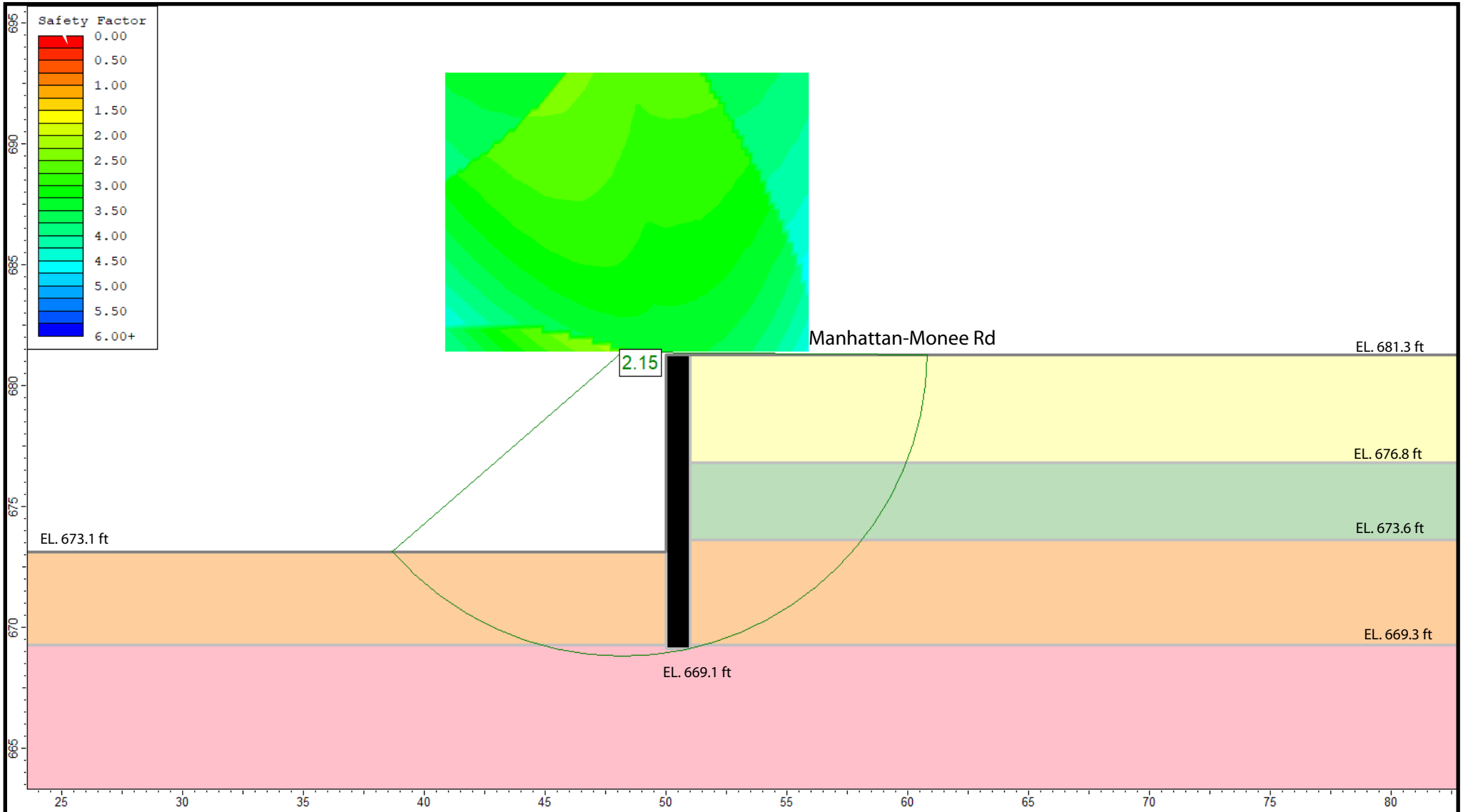
FOR QUIGG ENGINEERING, INC. | 199-02-08



Drained Analysis, Upstream End Wingwall, Ref Boring: CB-02

Layer ID	Description	Total Unit Weight (pcf)	Drained Cohesion (psf)	Drained Friction Angle (degrees)
1	Loose SI Loam to Loam Fill	115	0	30
2	Stiff SI CL Loam	120	100	30
3	Medium Stiff SI Clay	115	0	28
4	Stiff to V Stiff SI Clay	120	100	31

GLOBAL STABILITY ANALYSIS: MANHATTAN-MONEE ROAD OVER PRAIRIE CREEK TRIBUTARY, SN. 099-0931, WILL COUNTY, ILLINOIS

SCALE: GRAPHICAL | APPENDIX C-2 | DRAWN BY: RKC | HECKED BY: N. Balakumaran

Wang Engineering
1145 N. Main Street
Lombard, IL 60148
www.wangeng.com

FOR QUIGG ENGINEERING, INC. | 199-02-08

Wang Engineering

1145 North Main Street
Lombard, Illinois 60148
Phone (630) 953-9928
www.wangeng.com

APPENDIX D

Benchmark: CP 106, Iron rod at the north shoulder.
Northing: 1733208.132; Easting: 1092185.144
Elevation NGVD 88: 678.613

Existing Structure: S.N. 099-0450, year of construction unknown, consists of a double barrel reinforced concrete box culvert at 3 degree skew, with barrel dimensions of 4' tall by 6' wide. The culvert length is approximately 31'-6" out to out of headwalls. Proposed work consists of replacing the culvert with a single-cell concrete box culvert, 5' tall by 12' wide and 48' length out to out of headwalls, with the invert 1' below the flow line.

Traffic will be detoured during construction.

No salvage.

Precast alternate is not allowed.

DESIGN SPECIFICATIONS

2017 AASHTO LRFD Bridge Design Specifications, 8th Edition

LOADING HL-93

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

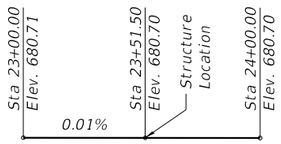
DESIGN STRESSES

FIELD UNITS

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

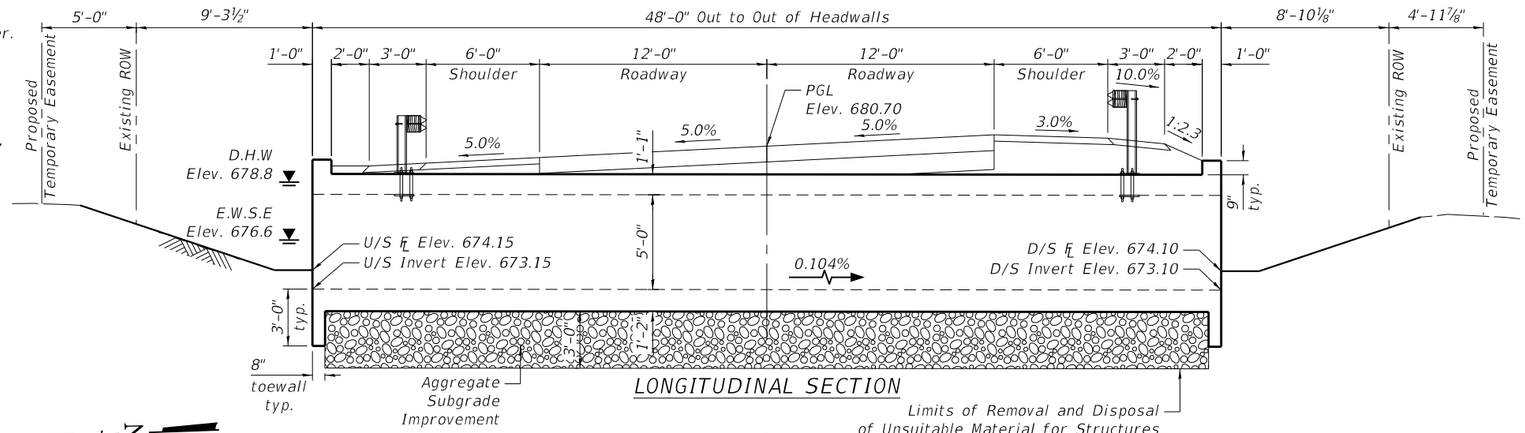
HORIZONTAL CURVE DATA

PI STA. = 22+34.15
(N = 1,733,179.4420,
E = 1,091,914.2846)
Δ = 13° 58' 42" (LT)
D = 2° 58' 19"
R = 1,927.90'
T = 236.35'
L = 470.35'
E = 14.43'
P.C. STA. = 19+97.81
(N = 1,733,231.3114,
E = 1,091,683.7000)
P.T. STA. = 24+68.15
(N = 1,733,184.8077,
E = 1,092,150.5702)



PROFILE GRADE

(Along ℄ Manhattan-Monee Rd)

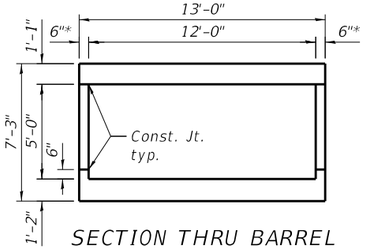


LONGITUDINAL SECTION

PLAN

℄ - Soil Boring Locations

*** Guardrail payitems and quantities provided in roadway plans.*



SECTION THRU BARREL

(Along ℄ Manhattan-Monee Rd)
** Thickness at U/S & D/S end is 12"*

SECTION A-A

STATION 23+51.50
BUILT ____ BY
STATE OF ILLINOIS
F.A.P RT. 531
SEC. 2018-063-CR&D
LOADING HL-93
STR. NO. 099-0931

NAME PLATE

See Std. 515001

LOCATION SKETCH

WATERWAY INFORMATION

Drainage Area = 8.4 sq. mi. Low Grade Elev. = 680.20 @ Sta. 35+06.10

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	47	47	48	678.3	0.3	0.2	678.6	678.5
Design	50	163	47	48	678.8	0.8	0.8	679.6	679.6
Base	100	230	47	48	679.1	1.1	0.8	680.2	679.9
Overtopping		270	47	48	679.4	1.1	0.8	680.2	680.2
Max. Calc.	500	275	47	48	679.5	1.2	0.9	680.7	680.4

2-YR Q = 24 C.F.S

KEITH W. BENTING
STATE OF ILLINOIS
4777
DECATUR, ILLINOIS
LICENSED STRUCTURAL ENGINEER

Keith W. Benting, Illinois S.E. 081-004777 Date
Expires 11/30/2020

GENERAL PLAN AND ELEVATION
MANHATTAN-MONEE RD. OVER PRAIRIE CREEK TRIB.
F.A.P RTE. 531 SEC. 2018-063-CR&D
WILL COUNTY
STATION 23+51.50
S.N. 099-0931

QUIGG ENGINEERING INC

USER NAME = MOkrent	DESIGNED - AWM	REVISED -	STATE OF ILLINOIS DEPARTMENT OF TRANSPORTATION	GENERAL PLAN AND ELEVATION STRUCTURE NO. 099-0931
	CHECKED - KWB	REVISED -		
PLOT SCALE = 8:0.0000 ':' / in.	DRAWN - LC	REVISED -		SHEET S1 OF S4 SHEETS
PLOT DATE = 10/25/2019	CHECKED - MC	REVISED -		

F.A.P RTE.	SECTION	COUNTY	TOTAL SHEETS	SHEET NO.
531	2018-063-CR&D	WILL	88	47
		CONTRACT NO. 62G85		
		ILLINOIS	FED. AID PROJECT	

MODEL: Default
FILE NAME: S:\2018\18IL042-AES PH2 IDOT D1-PTB 185-02\WO15-62G85-Manhattan_Monee\CADD\CADD Sheets\16-1D162G85-sht-S1_General Plan.dgn
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