C. AJ 3/8/05 AJK

KANSAS DEPARTMENT OF TRANSPORTATION

MEMO TO: Jim L. Kowach, P.E.
Chief, Bureau of Design

ATTENTION: Ken Hurst, P.E.
Engineering Manager, State Bridge Office

FROM: Delmar L. Thompson, P.G. Regional Geologist, Lawrence

DATE: February 28, 2005

SUBJECT: Bridge Foundation Geology Report

RE: Project 63-75 K-7438-01
K-63 over Little Noxie Creek
Bridge No. 63-75-11.98(059)
Pottawatomie County

Three copies of the above report are attached to this memorandum. An Engineering Geology Bridge Sheet has been drawn on the Microstation Workstation. The file has been placed on the Design file server under the file name 74381198.dgn. Three copies of the drill sounding logs are attached to this report. If questions arise over the contents of this report, please contact the Lawrence Regional Geology Office.

LSI:AJG:RWH:DLT:rjc
Attachments
c: Bureau of Construction and Maintenance
District IV
Regional Geology Offices
Project File

BUREAU of MATERIALS and RESEARCH

GEOTECHNICAL UNIT
GEOLOGY SECTION

BRIDGE FOUNDATION GEOLOGY REPORT

63-75 K-7438-01
K-63 over Little Noxie Creek
Bridge No. 63-75-11.98(059)

Pottawatomie County

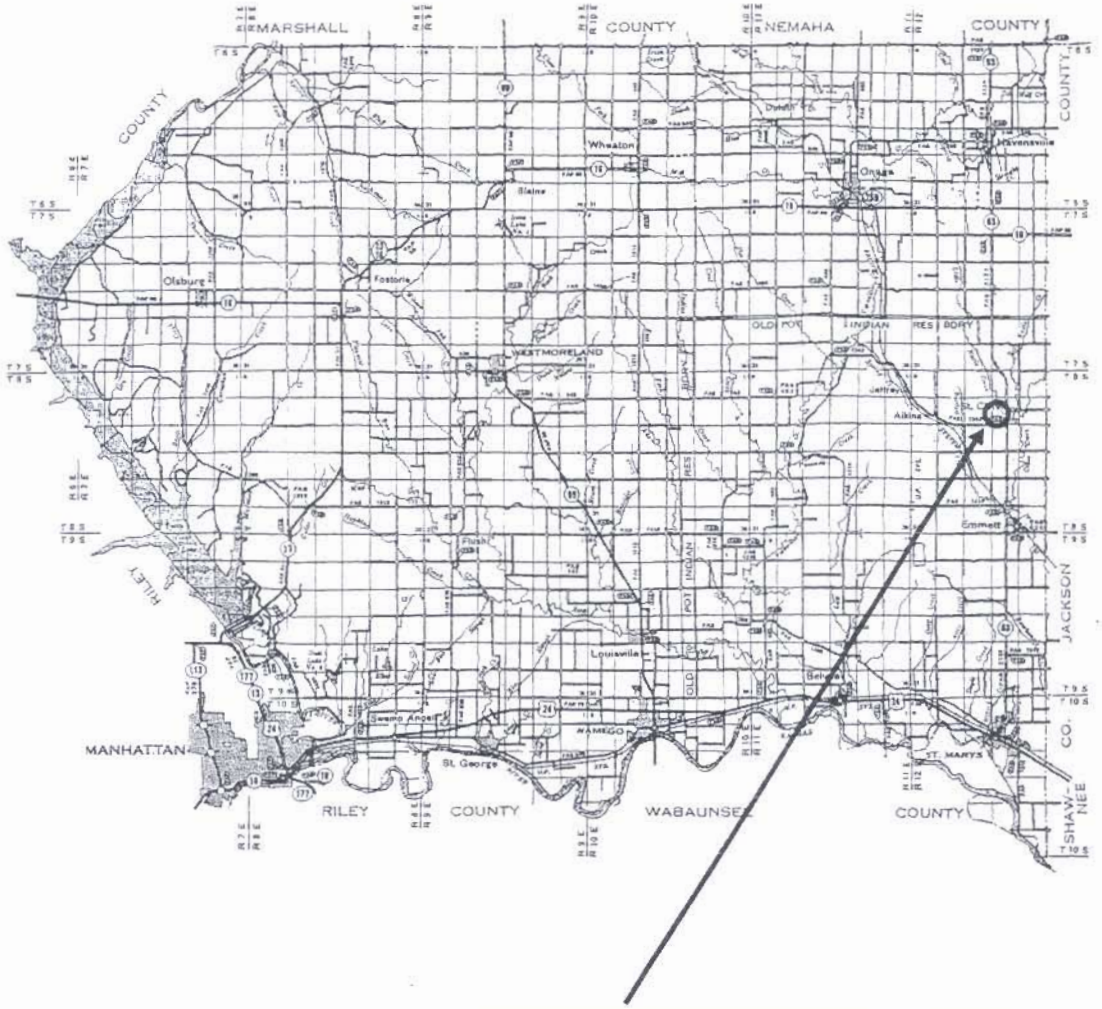
ROBERT W. HENTHORNE, P.G.
CHIEF GEOLOGIST

by
Rocky Crow, P.G

Delmar Thompson, P.G.
Regional Geologist

February 2005

PROJECT LOCATION



63-75 K-7438-01
K-63 over Little Noxie Creek
Bridge No. 63-75-11.98(059)
Pottawatomie County

INTRODUCTION

This report provides geologic information regarding the replacement of the bridge K-63 over Little Noxie Creek. It is located 11.98 miles north of the junction of US-24 and K-63 at St. Marys.

General

The K-63 bridge crosses over Little Noxie Creek, which is a tributary to Big Noxie Creek. Topographically, the project area includes a steep bluff to the south of the bridge. The Little Noxie Creek has cut into the bluff exposing bedrock along a steep face. Little Noxie Creek has migrated south over time and filled the valley with alluvium creating a floodplain in which the north approach is built upon.

Further investigations and analysis of the core drill sounding have indicated the geologic units should be named as presented in this report which differ from the names presented in the Geology Report for the same project.

GEOLOGIC FOUNDATION MATERIAL

MANTLE

The soil mantle is classified as all unconsolidated material above bedrock. Most of the mantle is composed of alluvium and fill for the existing bridge. Alluvial deposits are comprised of brown silty clay, with traces of sand and gravel. Thickness of the soil mantle varies across the site. At Abutment 1 the average thickness is 4.0 ft., thinning to approximately 0.5 ft. near the stream channel, and thickening to nearly 25.0 ft. at Abutment 2.

BEDROCK

Lower Permian Series
Gearyan Stage
Council Grove Group
Foraker Limestone Formation

Long Creek Limestone Member

The remnant of the Long Creek Limestone Member is present only at Abutment 1. It is a weathered, shaly limestone and is 3.9 ft. thick.

Hughes Creek Shale Member

The Hughes Creek Shale Member is a limy shale, with colors ranging from gray to dark gray and also including greenish and maroon tones. It contains thin, sporadic limestone stringers. The maximum thickness cored at the bridge site was 31.9 ft.

Americus Limestone Member

The upper 7.5 ft. of the "Americus" is a shaly, weathered limestone that is quite porous and boxworked. The lower 8.0 ft. of this unit is a limy siltstone to a shaly limestone containing occasional thin gypsum veins and nodules. Due to the weathered and porous nature of the Americus Member, it is not considered as competent footing material for drilled shafts. Total thickness of this unit at the bridge site is 15.5 ft.

Lower Permian Series
Gearyan Stage
Admire Group
Janesville Shale Formation

Hamlin Shale Member

The upper 4.8 ft of the Hamlin Member is a limy, blue-gray to gray fossiliferous shale which contains sporadic pinkish-white gypsum nodules. A dark gray, 1.2 ft. thick limestone is found below it. This thin limestone is slightly shaly and coarse grained. The lowermost portion of the "Hamlin" is a limy shale, dark gray in color containing fossil debris and occasional, thin gypsum beds. Total thickness of the "Hamlin" is 10.2 ft.

Five Point Limestone Member

The Five Point Limestone Member is a gray, shaly, fossiliferous limestone. It is 5.9 ft. thick. It contains thin shale layers and abundant Brachiopod fossils. It will be suitable foundation material for drilled shafts.

West Branch Shale Member

The upper 4.2 ft. of this unit is a dark gray, limy, gypsiferous shale. Below this, 1.7 ft. of shaly limestone is found. An additional 0.7 ft. of dark gray shale was cored, but the total thickness of this unit was not ascertained.

FOUNDATION RECOMMENDATIONS

ABUTMENT FOUNDATIONS

PILE FOOTINGS

We recommend the design of pile footings for the abutments of the proposed bridge. It is recommended that point bearing H-pile be used at each location. At both Abutments, the H-pile will be founded in the Hughes Creek Shale Member. To insure that a minimum of 15 ft. of pile is in place after cutoff, pre-drilling will be required for the Abutment 1. Once the piles are set in the pre-drilled holes, each pile should be driven to bearing at elevations listed in table below. Due to variations in the Hughes Creek Shale Member, Piles will likely achieve bearing higher than the planned pile tip elevations. If the piles achieve bearing at a higher elevation, further

driving should cease to avoid damaging the pile. --(See Pile Note below) Pile footings should be designed for loads no greater than 9 ksi or 55 tons for 10x42 H-pile.

The following table lists the suggested design pile tip elevations for the abutment and pier foundations of the proposed structure:

PILE FOOTING DESIGN
ABUTMENT AND PIERS

K-63 over Noxie Creek
Br. No. 63-75-11.98(059)

Location	Centerline Station	Pre-drill Elevation	Pile Tip Elevation
Abutment 1	637+85	1076.80	1071.82
Abutment 2	639+36	N/A	1064.10

The following note should be placed in the Construction Plans:

Pile Note:

It should be understood that pile tip elevations are based on interpolations from power auger and core hole soundings. During construction, elevations may vary from those listed above. Some cut off should be expected.

PIER FOUNDATIONS

DRILLED SHAFT OPTION

Drilled Shafts are an option for the piers at this bridge location. Excavations for drilled shafts will need to be cased. Stream water flow and water movement in the silty clay and gravel zones in the mantle could cause caving and collapse of the excavation walls. If water is percolating through bedrock material at a high rate, a wet pour may be required. Permanent casing will be required for drilled shafts and will be set into the Hughes Creek Shale Member. Permanent casing elevations are given below and are intended to protect the drilled shafts from flood scour damage.

If the piers are to be supported with drilled shafts, it is critical that the bottom socket be clean and relatively flat. Allow no loose material within the footing when the footing is considered ready to pour. Elevations for drilled shafts are set in competent material of the Five Point Limestone Member and are given in the table below.

The following chart provides casing and footing elevations based on a 3 ft. diameter shaft by means of an analysis by the Shaft 5.0 program using a service load of 81.5 tons per shaft as provided by the bridge designer. This combined with the weight of the drilled shaft (22 tons), will result in a total design load of 103.5 tons per shaft. The Shaft 5.0 program, with a safety factor of 3, indicates that a single 3 ft. diameter drilled shaft will achieve a total allowable load of 168.8. Should a different size shaft be designed, the Geology Section should be notified so we may ensure that desirable elevations are obtained.

Special Note:

The Hamlin Member reacts severely when exposed to water, losing a high percentage of its strength in a very short period of time. Because skin friction is critical it is recommended that once the excavation is complete, place the reinforcing steel and concrete in less than 4 hours to minimize the exposure time of the shale.

DRILLED SHAFT DESIGN

K-63 over Little Noxie Creek
Bridge No. 63-75-11.98(059)

Location	Station	Elevation Top of Bedrock	Bottom of Permanent Casing	Elevation Base of Footing	Footing Material
Pier 1	638+35	1065.96	1059.0	1033.0	Five Point Limestone
Pier 2	638+86	1068.0	1059.0	1033.0	Five Point Limestone

INVESTIGATIVE CORE HOLE

If the drilled shaft option is chosen, an investigative core hole will be required for both piers of the proposed structure on the center column.

SPREAD FOOTING OPTION

We recommend Spread footings to support the pier columns of the proposed structure. If spread footings are chosen, they should be placed in firm shaly limestone of the Americus Limestone member for all locations. The maximum design bearing pressure for spread footings

for this proposed structure should not exceed 10 tsf. The recommended bottom footing elevations for spread footing design are listed in the table below.

SPREAD FOOTING DESIGN

K-63 over Little Noxie Creek
Br. No. 63-75-11.98(059)

Location	Station	Elevation Top of Bedrock at Centerline	Elevation Base of Footing
Pier 1	638+35	1065.96	1054.5
Pier 2	638+86	1068.0	1054.5

If the designer chooses spread-footing foundations, the following notes should be included in the Construction Plans:

Note:

FOUNDATION INSPECTION

Please contact the Lawrence Regional Geology Office when construction begins on the pier foundations so that our personnel may observe the bedrock at the design bearing elevations.

Spread Footings:

"All excavation below the top of rock or the top of footing within 1.0 m of the edge of the footing will be done by hand equipment only, no machine rock excavation is allowed below the top of the footing. Cut the rock to neat lines shown on the plans. Do not use side forms but cast the concrete against the rock. Allow no loose material within the footing when the footing is considered ready to pour. If the material at the bottom of the footing does not match the material shown on the geology sheet do not precede until the regional geologist reviews the site".

"For all bridge spread footing locations, drill a 40-50 mm hole 1.5-m deep in the presence of the Engineer to verify the quality and soundness of the material below the footing. For footings less than 10 m^2 drill one hole in the center of the footing and for footings greater than 10 m^2 drill one hole at each corner".

"When the material in the sides of the footing is shale, do not allow water to pond in the footing excavation pit. Many Kansas shale members weather quickly in the presence of water. Once the excavation in shale is complete, place the reinforcing steel and concrete in less than 24 hours to minimize the exposure time of the shale. If the water cannot be cut off, then seal coarse of Grade 25 concrete may be used to encase the bottom of the footing. Consult the State Bridge

Office before attempting a seal coarse. If water is persistent, then tremie the concrete to the seal course. Do not allow the concrete to be placed on or through water where mixing or washing of the concrete can occur. Do not allow concrete to be placed if water is moving through the footing".

Backfill the spread footing excavation with crushed stone to within one meter of the top of bedrock and then fill with commercial grade concrete.

LATERALLY LOADED PILE

Design parameters for laterally loaded pile using a 3.0 ft. diameter shaft are as follows:

Mantle: N/A

Shale: Hughes Creek Shale Member
Qu=3.0
NPPY=3 GAM1=0.071 kfc

YP (I,J)	PP (I,J)
0.0	0.0000
0.005	5.035 k/ft
0.071	8.991 k/ft

Limestone: Americus Limestone Member

Qu= 23.65 tsf
NPPY = 3 , GAM1 = 0.145 kcf

YP (I,J)	PP (I,J)
0.0000	0.0000
0.0012	56.76 k/ft
0.0072	70.95 k/ft

Shale: Hamlin Shale Member

Qu= 33 tsf
NPPY = 3 , GAM1 = 0.152 kcf

YP (I,J)	PP (I,J)
0.0000	0.0000
0.0210	55.44 k/ft
0.0610	99.000 k/ft

Limestone: Five Point Limestone Member

Qu= 61 tsf
NPPY = 3 , GAM1 = 0.155 kcf

YP (I,J)	PP (I,J)
0.0000	0.0000
0.0012	146.400 k/ft
0.0072	183.000 k/ft

Shale: West Branch Shale Member

Qu= 55 tsf
NPPY = 3 , GAM1 = 0.145 kcf

YP (I,J)	PP (I,J)
0.0000	0.0000
0.0210	92.400 k/ft
0.0610	165.000 k/ft

HYDROLOGY

According to the power auger soundings the ground water was found above the mantle-bedrock contact approximately at elevation 1067.8. All material below this elevation may be considered saturated. Dewatering equipment will be required.

INVESTIGATIVE PROCEDURES

One core drill sounding, and six power auger soundings were utilized to investigate the geologic setting at this project site. Select samples of the cores were submitted for unconfined compression testing. Results of these tests and the logs of the soundings are included with this report.

ACKNOWLEDGMENTS

Thanks to Neil Croxton, Regional Geologist, Bob Bergman, ET Senior, Rob Vervynck, ET Senior, Ryan Salber, ET, John Jackson, ET, Sean Nordlund, ETA, and Joe Bork, ETA, for their assistance in the completion of the fieldwork for this bridge foundation investigation.