AECOM
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Cleveland, OH 44114
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Project name:
CUY-Garfield Parkway Bridge

Project ref:
60717955

To:
Mr. Christopher J. Papp, P.E.
Park District Civil Engineer
Planning & Engineering Department
4101 Fulton Parkway
Cleveland, Ohio 44144

From:
Erik J. Bogen

Date:
February 16, 2024
Rev. September 19, 2024

CC:
Michael Woodring, P.E. (AECOM)

Memo

Subject: Mill Creek Culvert Geotechnical Exploration

Introduction

The following memorandum presents the results of the geotechnical exploration performed in support of the design of the Garfield Parkway culvert over Mill Creek and stream restoration. The geotechnical exploration was performed in accordance with the professional services agreement for this project executed September 21, 2023.

Project Understanding

The following summarizes our understanding of the proposed improvements based on the Stage 1 Submittal plans submitted to the Cleveland Metroparks December 22, 2023. The project site is located within the Garfield Park Reservation in Garfield Heights, Ohio at approximately latitude and longitude 41.431°, -81.602°.The focus of this project is the removal and partial reconstruction of the existing 22'x7' concrete box culvert conveying Mill Creek under Garfield Parkway. The outlet headwall and approximately 250 ft of the western end of the existing culvert will be completely removed with a restoration of the open stream channel. A new headwall will be constructed at the proposed new culvert outlet, approximately 50 ft west of Garfield Parkway. The existing box culvert upstream of the proposed new headwall will be removed and replaced using an open-cut. This will necessitate temporary removal of a 100-ft length of the existing Garfield Parkway roadway. After installation of the new box culvert and headwall are complete, the culvert will be backfilled and the Garfield Parkway pavement reconstructed.

Subsurface Exploration

A subsurface exploration was performed at the project site in support of design and construction of the proposed improvements. The exploration included three geotechnical soil borings performed in general accordance with the requirements of the Ohio Department of Transportation (ODOT) Specifications for Geotechnical Explorations (SGE). One boring (B-001-0-23) was drilled near the location of the proposed new headwall to a depth of 35 ft below existing grade, and two borings (B-002-0-23 and B-003-0-23) were drilled within the existing Garfield Parkway to depths of 7.5 ft below the top of existing pavement.

The borings were drilled on December 15, 2023 by AECOM's subcontractor, Ohio TestBor, Inc. The borings were drilled with a Diedrich D-50 rubber-tracked ATV-mounted drill rig using 2-1/4" inner-diameter hollow-stem augers. The borings drilled within the Garfield Parkway

Standard Penetration Test (SPT) samples were collected from boring B-001-0-23 at 2.5-ft interval in the upper 10 ft of the boring and at 5-ft intervals for the remainder of the boring. SPT samples were collected continuously starting at the bottom of the existing pavement and subbase. All SPT samples were each 18 inches in length and performed using an automatic hammer

with a weight of 140 lbs and a drop height of 30 inches. The hammer was calibrated on January 6, 2023 with a resulting energy ratio of 79.1%.

An AECOM geotechnical engineer was present on site during drilling operations to perform general oversight of the drilling subcontractor, log each of the soil borings, assign field classifications to each soil sample, and collect representative soil samples from the SPT split-spoon samplers. Each representative sample was placed in a glass jar and sealed.

Subsurface Conditions

The following sections summarize the subsurface conditions encountered at each of the soil boring locations.

Culvert Headwall

Boring B-001-0-23 was drilled at the location of the proposed culvert headwall. The ground surface at the location of the proposed culvert headwall was covered with grass and topsoil.

Fill soils were encountered immediately below the topsoil and extended to a depth around 12 ft below existing grade (approximate elevation 802 ft NAVD88). The fill soils largely consist of gravel with sand, silt, and clay (ODOT Class A-2-6) with a layer of silt and clay (A-6a) between 5 and 8 ft below existing grade. The A-2-6 soils had N60 values ranging from 4 to 17 with an average around 9 blows per foot (bpf) indicating a generally loose to medium dense compactness. A hand penetrometer reading taken on the sample of the A-6a fill soil was 0.25 tons per square foot (tsf) indicating a generally soft consistency.

Natural soil deposits were encountered from the base of the fill material to a depth around 32 ft below existing grade (approximate elevation 782 ft NAVD88). The natural soils included both gravel with sand (A-1-b) and gravel with sand, silt, and clay (A-2-6). N60 values within the natural sand and gravel soils ranged from 40 to greater than 100 bpf indicating a generally dense to very dense compactness.

Groundwater was initially encountered in B-001-0-23 at a depth of 13 ft below existing grade (elevation 801 ft NAVD88) and was measured at a depth of 11 ft below existing grade (elevation 803 ft NAVD88) on boring completion. Groundwater levels should be expected to fluctuate throughout the year due to seasonal variation, rainfall, and/or snowmelt, but may be expected to roughly correspond with the natural water level of Mill Creek.

Garfield Parkway Pavement

The existing pavement of Garfield Parkway consists of 11 to 12 inches of asphalt with a sand and gravel subbase.

The subgrade soils in borings B-002-0-23 and B-003-0-23 are predominantly fine-grained soils, including both sandy silt (A-4a) and silt and clay (A-6a) with an interlayer of coarse and fine sand (A-3a) encountered from 4.7 to 6.0 ft below top of existing pavement in B-002-0-23. N60 values within the non-cohesive sandy silt and the coarse and fine sand ranged from 4 to 7 bpf with an average of 6 bpf indicating a generally very loose to loose compactness. Hand penetrometer readings in the cohesive sandy silt and the silt and clay soils ranged from 0.25 to 3.75 tsf with an average around 1.3 tsf indicating consistencies ranging from soft to very stiff with a stiff consistency on average.

Groundwater was not encountered in borings B-002-0-23 and B-003-0-23 at the time of drilling. However, potential for encounter of perched groundwater within the sand and gravel subbase or sand interlayers during and after rainfall and/or snowmelt exists and should be accounted for during construction.

Analysis and Recommendations

The following sections present our analysis and recommendations for geotechnical aspects of the design and construction of the proposed culvert replacement.

Subgrade Analysis

Subgrade analysis was performed for the project in accordance with ODOT Geotechnical Design Manual, Section 600 (formerly Geotechnical Bulletin 1). One subgrade analysis spreadsheet was prepared using data from borings B-002-0-23 and B-003-0-23. The subgrade analysis spreadsheets are included in **Attachment C**.

The majority of the subgrade for the replacement pavement is anticipated to consist of engineered fill for backfill of the replacement box culvert. The engineered fill should be placed and compacted in accordance with the requirements of ODOT Construction and Material Specifications (CMS) Item 203 – "Roadway Excavation and Embankment" and Item 611 – "Pipe Culverts, Sewers, Drains, and Drainage Structures." Existing subgrade soils to receive new pavement and base should be proof-rolled and improved as needed in accordance with the requirements of CMS Item 204 – "Subgrade Compaction and Proof Rolling." Existing subgrade that does not pass proof-roll may be improved by a 12-inch cut and replace with geogrid or a 18-inch cut and replace with geotextile only. Backfill for the cut-and-replaced section should conform to the requirements of CMS Item 703.16C, Type B. A design CBR value of 7 may be used for design of the replacement flexible pavement section, provided the above engineered fill and proof-roll requirements are performed as stated.

Cuvert Headwall Recommendations

Backfill behind the new culvert headwall should consist of pervious, granular material conforming to ODOT CMS Item 703.16.B and classified as Department Group Classifications A-1-a, A-1-b, A-3, A-3a, or A-2-4. Granular material classified as A-2-5, A-2-6, or A-2-7 should not be used as retaining wall backfill.

Earth loading parameters for retaining wall design are summarized in **Table 1** below:

Table 1: Retaining Wall Earth Loading Parameters

Material	Friction Angle (°)	Cohesion (psf)	Total Unit Weight (pcf)	Submerged Unit Weight (pcf)	Rankine Active Earth Pressure Coeff.	Rankine Passive Earth Pressure Coeff.
Retaining Wall Backfill	30	0	125	63	0.33	3.0
Existing Sand and Gravel Fill Soils	30	0	125	63	0.33	3.0
Natural Dense Sand and Gravel Soils	32	100	125	63	0.31	3.2

The culvert headwall should be founded on the undisturbed dense to very dense sand and gravel soils encountered around elevation 802 ft (NAVD88), and at or below a depth of 3.5 ft for frost protection. A nominal bearing capacity of 8,900 psf may be used for design of footings so constructed. Applying an LRFD resistance factor of 0.45 as specified in AASHTO LRFD Bridge Design Specifications Section 10.5.5, this results in a factored bearing capacity of 4,000 psf.

The natural dense sand and gravel soils Therefore, under a maximum bearing pressure of 4,000 psf, total settlements of less than 1 inch and differential settlements less than 1/2 inch are anticipated to occur immediately.

Limitations

This geotechnical investigation was performed in accordance with the standard of care commonly used as state-of-practice in our profession. Specifically, our services have been performed in accordance with generally accepted principles and practices of the geological and geotechnical engineering profession. This warranty is in lieu of all other warranties, either express or implied.

The data presented herein represent the conditions encountered at the specific locations and at the specific times at which our exploration took place. It should be noted that variations in soil and rock stratigraphy and characteristics and groundwater conditions between exploration locations, that may become evident during construction, are possible.

The geotechnical information presented in this report is based on the data collected for this project. The geotechnical information presented in this report should not be used for other projects or purposes. Conclusions made from these data by others are their responsibility. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended. Background

information, design basis, and other data have been furnished to AECOM by third parties, which AECOM has used in preparing this report. AECOM has relied on this information as furnished.

Attachments

Attachment A – Soil Boring Location Plan

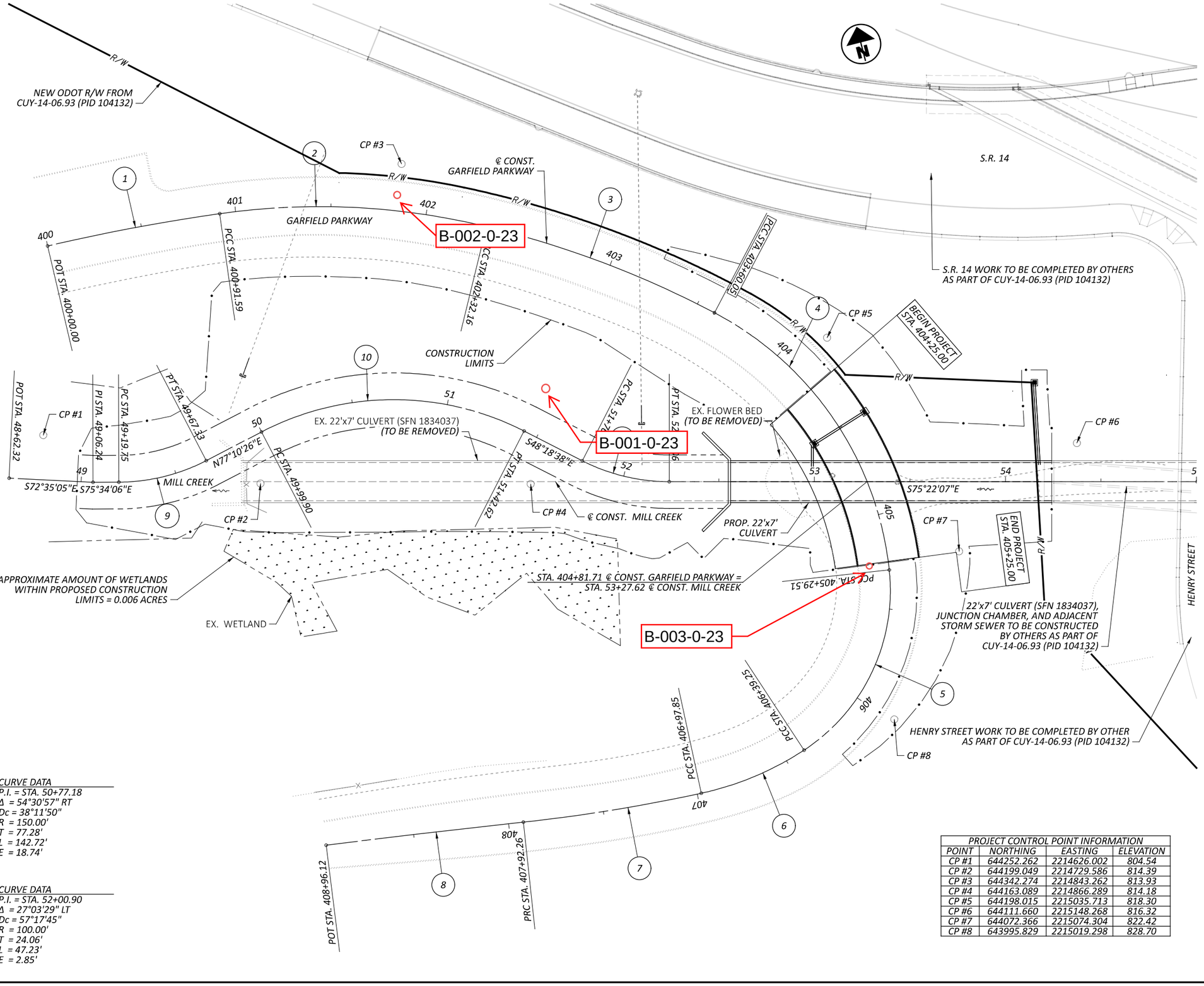
Attachment B – Soil Boring Logs

Attachment C – Subgrade Analysis (ODOT GDM Section 600)

CUY-GARFIELD PARKWAY BRIDGE

SCHEMATIC PLAN

HORIZONTAL SCALE IN FEET
0 12.5 25 50



1 *CURVE DATA*
P.I. = STA. 400+45.83
Δ = 05°02'46" RT
Dc = 05°30'33"
R = 1,040.00'
T = 45.83'
L = 91.59'
E = 1.01'

2 *CURVE DATA*
P.I. = STA. 401+62.74
Δ = 21°46'03" RT
Dc = 15°29'07"
R = 370.00'
T = 71.14'
L = 140.57'
E = 6.78'

3 *CURVE DATA*
P.I. = STA. 402+96.43
Δ = 14°05'29" RT
Dc = 11°01'06"
R = 520.00'
T = 64.27'
L = 127.89'
E = 3.96'

4 *CURVE DATA*
P.I. = STA. 404+52.27
Δ = 56°07'16" RT
Dc = 33°07'08"
R = 173.00'
T = 92.22'
L = 169.45'
E = 23.04'

5 *CURVE DATA*
P.I. = STA. 405+90.64
Δ = 62°52'42" RT
Dc = 57°17'45"
R = 100.00'
T = 61.13'
L = 109.74'
E = 17.21'

6 *CURVE DATA*
P.I. = STA. 406+68.88
Δ = 20°59'09" RT
Dc = 35°48'36"
R = 160.00'
T = 29.63'
L = 58.6'
E = 2.72'

7 *CURVE DATA*
P.I. = STA. 407+45.10
Δ = 06°04'40" RT
Dc = 06°26'16"
R = 890.00'
T = 47.25'
L = 94.41'
E = 1.25'

8 *CURVE DATA*
P.I. = STA. 408+44.19
Δ = 00°57'04" LT
Dc = 00°54'57"
R = 6,257.00'
T = 51.93'
L = 103.86'
E = 0.22'

9 *CURVE DATA*
P.I. = STA. 49+44.00
Δ = 27°15'28" LT
Dc = 57°17'45"
R = 100.00'
T = 24.25'
L = 47.57'
E = 2.90'

10 *CURVE DATA*
P.I. = STA. 50+77.18
Δ = 54°30'57" RT
Dc = 38°11'50"
R = 150.00'
T = 77.28'
L = 142.72'
E = 18.74'

11 *CURVE DATA*
P.I. = STA. 52+00.90
Δ = 27°03'29" LT
Dc = 57°17'45"
R = 100.00'
T = 24.06'
L = 47.23'
E = 2.85'

PROJECT CONTROL POINT INFORMATION

POINT	NORTHING	EASTING	ELEVATION
CP #1	644252.262	2214626.002	804.54
CP #2	644199.049	2214729.586	814.39
CP #3	644342.274	2214843.262	813.93
CP #4	644163.089	2214866.289	814.18
CP #5	644198.015	2215035.713	818.30
CP #6	644111.660	2215148.268	816.32
CP #7	644072.366	2215074.304	822.42
CP #8	643995.829	2215019.298	828.70

DESIGN AGENCY
AECOM
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DESIGNER KAA
REVIEWER MAW 11-20-23
PROJECT ID 119873
SHEET P.2 TOTAL P.20

MODEL: CLP_MILL_CREEK [Sheet] PAPERSIZE: 34x22 (in.) DATE: 12/20/2023 TIME: 3:17:47 PM USER: Brittney.Crandall
pw:\\aecom-na-pw.bentley.com:AECOM_DS20_NA_2019\Documents\60717955-CUY-Garfield Parkway Bridge\119873\400-Engineering\Roadway\Sheets\119873_GB001.dgn

PROJECT: MILL CREEK CULVERT	DRILLING FIRM / OPERATOR: OTB / JM	DRILL RIG: DIEDRICH D-50 (257)	STATION / OFFSET:
TYPE: CULVERT	SAMPLING FIRM / LOGGER: AECOM / EB	HAMMER: AUTOMATIC HAMMER	ALIGNMENT:
PID: SFN:	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 1/6/23	ELEVATION: 814.0 (MSL) EOB: 35.0 ft.
START: 12/15/23 END: 12/15/23	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.1	COORD: Not Recorded

EXPLORATION ID B-001-0-23

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
TOPSOIL	814.0																		
LOOSE, BROWN, **GRAVEL WITH SAND, SILT, AND CLAY**, FILL, MOIST TO WET	813.0	1	2 2 2	5	83	SS-1	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	-	
		2																	
		3																	
		4	1 2 1	4	56	SS-2	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	-	
	808.5	5																	
SOFT, GRAYISH BROWN, **SILT AND CLAY**, FILL, MOIST TO WET		6																	
		7	1 2 2	5	83	SS-3	0.25	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
	806.0	8																	
MEDIUM DENSE, MOTTLED BROWN AND GRAY, **GRAVEL WITH SAND, SILT, AND CLAY**, POSSIBLE FILL, MOIST TO WET		9	4 5 8	17	56	SS-4	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	-	
		10																	
▽ 803.0		11																	
	802.0	12																	
DENSE, GRAY, **GRAVEL WITH SAND**, LITTLE SILT, LITTLE CLAY, WET		13																	
W 801.0		14	8 12 18	40	33	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	-	
		15																	
	797.0	16																	

PID:	SFN:	PROJECT: MILL CREEK CULVERT	STATION / OFFSET:	START: 12/15/23	END: 12/15/23	PG 2 OF 2	B-001-0-23

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
VERY DENSE, GRAY, **GRAVEL WITH SAND, SILT, AND CLAY**, WET	797.0	18																	
		19	26 50	-	83	SS-6	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	-	
		20																	
		21																	
		22																	
		23																	
		24	27 50	-	100	SS-7	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	-	
		25																	
		26																	
		27																	
		28																	
		29	29 40 47	115	67	SS-8	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	-	
		30																	
		31																	
	782.0	32																	
SHALE, GRAY, DECOMPOSED TO SEVERELY WEATHERED.		33																	
		34	20 39 42	107	100	SS-9	-	-	-	-	-	-	-	-	-	-	Rock (V)	-	
	779.0	EOB 35																	

NOTES: SAND AND GRAVEL HEAVING IN AUGERS AT 13 FT; AUGERS FLUSHED WITH WATER.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: BACKFILLED WITH SOIL CUTTINGS

PROJECT: MILL CREEK CULVERT	DRILLING FIRM / OPERATOR: OTB / JM	DRILL RIG: DIEDRICH D-50 (257)	STATION / OFFSET:
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: AECOM / EB	HAMMER: AUTOMATIC HAMMER	ALIGNMENT:
PID: SFN:	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 1/6/23	ELEVATION: 814.0 (MSL) EOB: 7.5 ft.
START: 12/15/23 END: 12/15/23	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.1	COORD: Not Recorded

EXPLORATION ID B-002-0-23

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 814.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
12" ASPHALT	813.0																		
SAND AND GRAVEL BASE	812.5																		
MEDIUM STIFF, BROWN, **SANDY SILT**, TRACE GRAVEL, MOIST		1	3 4 4	11	89	SS-1	0.75	-	-	-	-	-	-	-	-	-	A-4a (V)	-	
@ 3.0' - BECOMES WITH GRAY MOTTLING		2	2 2 3	7	72	SS-2	0.50	-	-	-	-	-	-	-	-	-	A-4a (V)	-	
@ 3.8' - 1" COARSE AND FINE SAND SEAM	809.3	3				SS-3A	0.25	-	-	-	-	-	-	-	-	-	A-4a (V)	-	
VERY LOOSE, BROWN, **COARSE AND FINE SAND**, SOME SILT, MOIST	808.0	4	2 1 2	4	44	SS-3B	-	-	-	-	-	-	-	-	-	-	A-3a (V)	-	
LOOSE, BROWN, **SANDY SILT**, LITTLE GRAVEL, MOIST @ 6.3' - 1-1/2" GRAVEL OBSTRUCTED SAMPLER	806.5	5 6 7	2 2 3	7	22	SS-4	-	-	-	-	-	-	-	-	-	-	A-4a (V)	-	
		EOB																	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

PROJECT: MILL CREEK CULVERT	DRILLING FIRM / OPERATOR: OTB / JM	DRILL RIG: DIEDRICH D-50 (257)	STATION / OFFSET:	EXPLORATION ID B-003-0-23
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: AECOM / EB	HAMMER: AUTOMATIC HAMMER	ALIGNMENT:	
PID: SFN:	DRILLING METHOD: 2.25" HSA	CALIBRATION DATE: 1/6/23	ELEVATION: 826.0 (MSL) EOB: 7.5 ft.	PAGE 1 OF 1
START: 12/15/23 END: 12/15/23	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79.1	COORD: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 826.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
11" ASPHALT	825.1																		
SAND AND GRAVEL BASE	824.5	1																	
VERY STIFF, BROWN AND GRAY, **SANDY SILT**, SOME GRAVEL, FILL, DAMP	823.0	2	8 9 10	25	100	SS-1	2.75	-	-	-	-	-	-	-	-	-	A-4a (V)	-	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, FILL, DAMP	821.5	3 4	4 5 6	15	78	SS-2	3.75	-	-	-	-	-	-	-	-	-	A-6a (V)	-	
STIFF, GRAY, **SANDY SILT**, LITTLE GRAVEL, MOIST		5	3 2 3	7	67	SS-3	1.00	-	-	-	-	-	-	-	-	-	A-4a (V)	-	
@ 6.0' - BECOMES MEDIUM STIFF, MOIST TO WET, BROWNISH GRAY	818.5	6 7 EOB	2 1 2	4	67	SS-4	0.75	-	-	-	-	-	-	-	-	-	A-4a (V)	-	

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED ASPHALT PATCH; BACKFILLED WITH SOIL CUTTINGS

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Design Manual Section 600

CUY-14

Garfield Parkway Mill Creek Culvert

AECOM

Prepared By: Erik Bogen
Date prepared: Tuesday, January 2, 2024

1300 East 9th Street
Suite 500
Cleveland, OH 44114

216-622-2300

NO. OF BORINGS: 2

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-002-0-23	GARFIELD PKWY				Diedrich D-50 (257)	79	0.0	-1.5	1.5 C
2	B-003-0-23	GARFIELD PKWY				Diedrich D-50 (257)	79	0.0	-1.5	1.5 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.6 2/11/2022

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.5	3.0	0.0	1.5	11		0.75								10	A-4a	8			HP		18"	12"
	002-0	SS-2	3.0	4.5	1.5	3.0	7		0.5								10	A-4a	8			HP			861 Geogrid
	23	SS-3B	4.5	6.0	3.0	4.5	4										8	A-3a	0						
		SS-4	6.0	7.5	4.5	6.0	7	4									10	A-4a	8						
2	B	SS-1	1.5	3.0	0.0	1.5	25		2.75								10	A-4a	8						
	003-0	SS-2	3.0	4.5	1.5	3.0	15		3.75								14	A-6a	10						
	23	SS-3	4.5	6.0	3.0	4.5	7		1								10	A-4a	8						
		SS-4	6.0	7.5	4.5	6.0	4	4	0.75								10	A-4a	8						

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.6 2/11/2022

PID:

County-Route-Section: CUY-14
No. of Borings: 2

Geotechnical Consultant: AECOM
Prepared By: Erik Bogen
Date prepared: 1/2/2024

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	14''

Excavate and Replace Stabilization Options	
Global Geotextile Override(N60L):	18''
Override(HP):	24''
Global Geogrid Override(N60L):	12''
Override(HP):	18''

Design CBR	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	25%	HP ≤ 0.5	13%
$N_{60} < 12$	75%	0.5 < HP ≤ 1	38%
$12 \leq N_{60} < 15$	0%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	13%	HP > 2	25%
M+	0%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

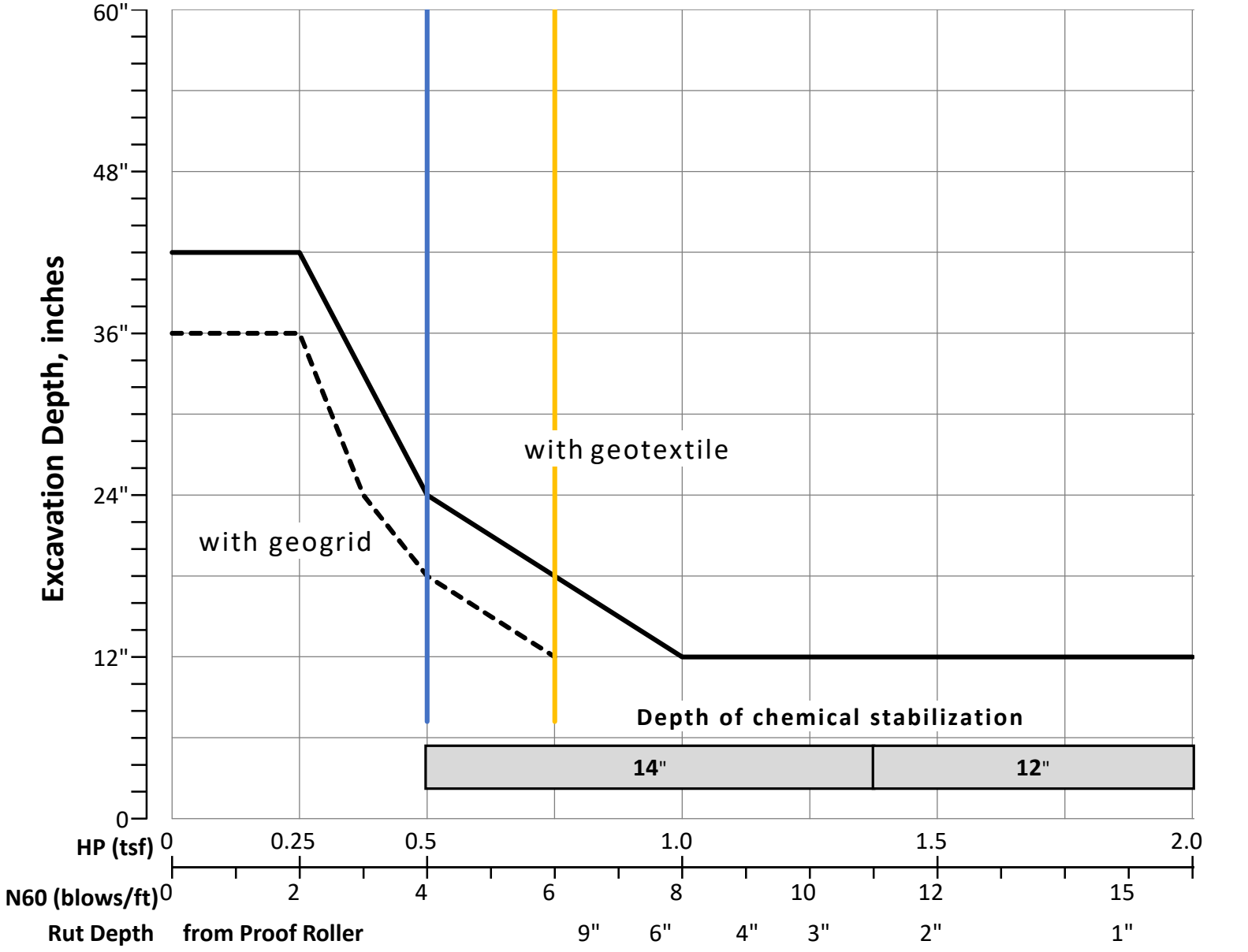
% Proposed Subgrade Surface	
Unstable & Unsuitable	50%
Unstable	50%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	10	4	1.58	0	0	0	0	0	0	0	10	7
Maximum	25	4	3.75	0	0	0	0	0	0	0	14	10
Minimum	4	4	0.50	0	0	0	0	0	0	0	8	0

Classification Counts by Sample

ODOT Class	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	0	1	6	0	0	1	0	0	0	0	0	8
Percent	0%	0%	0%	0%	0%	0%	0%	0%	13%	75%	0%	0%	13%	0%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	88%									13%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	3	0	0	1	0	0	0	0	0	4
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	75%	0%	0%	25%	0%	0%	0%	0%	0%	100%

Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
1.58	0.50	☑ HP
4.00	6.00	☑ N60L

Average HP
Average N_{60L}

The subgrade analysis workbook consists of five worksheets. Each worksheet functions independently. In all of the worksheets the fields are color coded as follows:

- Every yellow highlighted field indicates a field to be entered by the user.
- Every salmon field is to indicate a problem/issue.
- Every gray or green field is a heading/informational field.

IMPORTANT: The sequence of filling out the data needs to be followed as outlined below:

1. Cover Sheet: this worksheet is designed for the purpose of entering the project information. Enter all the following fields:

County-Route-Section	This includes the county, route, section number assigned to the project.
PID	the Project Identification Number
Project Description	See Cover Sheet for list of example details
Geotechnical Consultant	The Geotechnical Consultant performing the analysis.
Prepared By	The preparer of the subgrade analysis
Date prepared	The date the analysis is performed.
Contact Information	Name, address, telephone #, and email address
No. of Borings	Enter the total number of borings within the alignment that is being analyzed.

2. Boring Logs Entry Worksheet: this worksheet has a programming code that will run in the background every time the sheet is activated and will make the sheet unresponsive for less than a minute. The code is designed to read the total number of borings from the cover sheet and generate the needed number of fields.
    a. All yellow highlighted fields are user's entry.
    b. ODOT has developed a text table export from gINT *(GB 1 Borings Log Entry Tab)* that will allow for copy and paste of all highlighted fields with the exception of proposed subgrade elevation. The designer must provide a proposed subgrade elevation in order for the spreadsheet to function properly.
    c. The Cut/Fill field is a calculated field that, based on the difference between the boring elevation and the proposed subgrade elevation, will highlight the cell either gray and adds the letter "C" to the end in a cut situation or highlights the cell in light purple and adds the letter "F" to the end in a fill situation.
    d. Every duplicate boring ID will be highlighted in salmon background and red text.
    e. **IMPORTANT**: <u>After</u> entering all the borings' information, the user must click "Add Subgrade Analysis Entry Fields" button. This will generate all the required fields in the "Subgrade Analysis" Worksheet.

3. Subgrade Analysis Worksheet:
    a. The boring number and boring ID is read from the "Boring Logs Entry Worksheet" excluding every boring that has six feet or more of fill.
    b. All yellow highlighted fields are to be entered by the user and salmon highlighted fields indicates a problem or issue.
    c. Every sample that has a Sulfate Content greater than or equal to 3000 will be highlighted in light salmon background. Every sample that has a Sulfate Content greater than or equal to 8000 will be highlighted in darker salmon background. Refer to Section 605 of the Geotechnical Design Manual for the latest guidance regarding high sulfate soils.

d. Unsuitable/Unstable:

i. Unsuitable samples that are within 3 feet of the top of subgrade will be highlighted with salmon background and the class will be showing in this field.

ii. Unstable Samples that are within 3 feet of top of subgrade will be highlighted with salmon background and text to indicate the problem as follows:

Criterion	Stabilization Need Check	Text displayed in the field
A-1-a, A-1-b, A-3, or A-3a Soil Class	No Stabilization is needed	
HP ≥ 1.875	No Stabilization is needed	
$N_{60} \geq 15$	No Stabilization is needed	
$1.875 \geq HP \geq 1.5$ and $M_c \geq$ Opt. M_c+3	Unstable Subgrade	HP & Mc
$15 \geq N_{60} \geq 12$ and $M_c \geq$ Opt. M_c+3	Unstable Subgrade	N_{60} & Mc
HP ≤ 1.5	Unstable Subgrade	HP
$N_{60} \leq 12$	Unstable Subgrade	N_{60}

iii. The field is formulated to check for HP first and check for N_{60} second.

e. Excavate and Replace (Item 204) is going to be calculated based on the subgrade depth for each sample indicating an unsuitable or unstable problem.

f. Recommendation:

i. Geotextile Option is calculated and rounded to a multiple of 3 inches based on the subgrade depth for every sample indicating an unsuitable or unstable problem.

ii. GEOGRID Option is only offered in case of unstable subgrade problem and if the geotextile option indicates the need to excavate greater than 12 inches.

PLEASE NOTE: The Problem, Excavate & Replace, and Recommendation Fields are the responsibility of the Designer. These fields are being enhanced to attempt to capture the ODOT philosophy regarding the subgrade stabilization chart, but are considered still under development. If there are discrepancies between the spreadsheet output and the stabilization chart - the chart governs in conjunction with engineering judgement. Please contact Steve Taliaferro at stephen.taliaferro@dot.ohio.gov if you have any questions.

PLEASE NOTE: It is the Designer's responsibility to identify the most representative data when samples have been separated into multiple specimen (say 1.5 to 2.3 feet and 2.3 to 3.0 feet). The spreadsheet is not capable at this time of addressing this issue within a direct data export from gINT.

4. Results Summary:
All fields in this sheet are password protected and are either calculated or read from the other worksheets.

5. Graph Worksheet:
This worksheet is designed to read the average N_{60L} and the average HP from the Cover Sheet and plot a blue line for Average HP and orange line for Average N_{60L} on GDM Figure 600-1 – Subgrade Stabilization. The Override Table can be used to enter HP and/or N_{60L} values that are different than the calculated averages. The Override values will change the global undercut recommendation in the Results Summary.