Geotechnical Investigation Report

Gladwin City-County Transit Bus Maintenance Garage Addition
621 Weaver Court
Gladwin, Michigan

Prepared for

Gladwin City-County Transit

November 24, 2021

2211055

Prein&Newhof

Contents

1 INTRODUCTION

Prein&Newhof has performed a geotechnical investigation in connection with the proposed addition to the existing Gladwin City-County Transit bus maintenance garage in Gladwin, Michigan. The purpose of this investigation is to evaluate the soil conditions at the location of the proposed addition and to provide recommendations for the support of foundations, floor slabs and other proposed developments. Our work was performed in accordance with the scope of work outlined in our proposal dated September 30, 2021 and the terms of our Professional Services Agreement dated October 11, 2021.

2 PROPOSED CONSTRUCTION

Based on the information provided by Sidock Group, the proposed project will consist of a 2,800 square foot building addition to be constructed on the east side of the existing bus maintenance garage. The building is expected to consist of a single-story slab-on-grade pre-engineered building measuring approximately 80 feet (ft) in the north-south direction and 35 ft in the east-west direction.

We anticipate that the proposed building addition will employ steel framing supported on conventional column and wall footings, similar to the existing structure. Exterior walls are expected to consist of pre-fabricated metal panels. No specific information has been provided relative to structural loads. For purposes of this report, we assume that column and wall loads will not exceed about 200 kips and about 200 pounds per lineal foot, respectively.

We anticipate that finished grades for the building addition will match the existing facilities. Given the essentially flat topography at the site, we expect that exterior grades will remain essentially unchanged.

3 FIELD INVESTIGATION

Subsurface conditions at this site were explored by drilling two soil borings, designated SB-1 and SB-2, at the locations indicated in the Notes on the respective soil boring logs in the Appendix. The borings were drilled by Pearson Drilling Company under the observation of Prein & Newhof. Soil samples were obtained within each boring at regular depth intervals of 2.5 feet (ft.) within the upper 10 ft and at intervals of 5 ft below that depth. Samples were obtained using the Standard Penetration Test (SPT) method (ASTM D1586) whereby a 2-inch outside-diameter split-spoon sampler is driven into the soil in three successive 6-inch increments, with the number of blows for each increment being recorded. The number of blows required to drive the sampler the last 12 inches is defined as the Standard Penetration Resistance (N). Upon completion of soil drilling and sampling operations, the bore holes were backfilled with drill cuttings and capped with cold-patch.

The soil samples obtained at the site were visually classified in the field, sealed in glass jars and transported to our laboratory for further classification and testing. We will retain these soil samples for a period of 60 days after the date of this report, at which time we will dispose of the samples unless we are otherwise instructed.

Subsurface conditions at each boring location are shown on the Logs of Soil Boring in the Appendix. Definitions of the descriptions used on the boring logs are presented on the Soil Nomenclature and Terminology sheet in the Appendix.

4 SUBSURFACE CONDITIONS

Subsurface soil and groundwater conditions encountered in the borings are presented on the Logs of Soil Boring in the Appendix. Definitions of the descriptions used on the boring logs are presented on the Soil Nomenclature and Terminology sheet, also included in the Appendix. The stratification shown on the logs represents our interpretation of the soil conditions at the specific boring locations. Variations in subsoil conditions may occur between specific borings as well as between samples in any boring. Additionally, the stratigraphic lines represent our interpretation of the approximate boundaries between the soil types; however, the transition may be more gradual than what is shown.

The proposed building addition is scheduled to abut against the east wall of the bus maintenance garage building. Most of the proposed construction area is currently paved with asphalt, but there are also two narrow concrete approach slabs and a planter area abutting the east wall of the building. Most of the proposed construction area is paved with about 4 to 5 inches of asphalt over 4 to 5 inches of aggregate base. Localized concrete pavement and mulch/topsoil exist directly adjacent to the existing building. The thickness of these localized materials was not determined. At the location of SB-1, the existing pavement is underlain by 14.5 inches of sand fill and 14.5 inches of topsoil. These miscellaneous materials were not encountered in SB-2. In general, these soils are not considered suitable in their present condition for the support of footings or floor slabs but may be used for fill or landscaping purposes in non-structural areas.

Subsurface conditions below the existing pavement and miscellaneous materials described above are relatively uniform and can be summarized as follows:

Stratum 1 (Sand) The native soils encountered directly below the surficial soils described in the preceding paragraph consists predominantly of sand with trace to little silt, and trace of gravel extending to depths ranging from 18 to 19 ft below the surface. Relative densities of these soils range from very loose to medium dense with Standard Penetration N-values ranging from 2 to 20, with a median and average values of 7.

These materials are considered suitable for the direct support of light to moderate structural loads, provided that the conditioning procedures outlined in Sections 6.2 and 6.3 of this report are properly implemented.

Stratum 2 (Silty Clay) In SB-2, Stratum 1 soils are underlain by stiff silty clay that extends to depths explored. The unconfined compressive strength of the clay is approximately 4,000 pounds per square foot (psf). This material is also considered suitable for support of structural loads.

5 GROUNDWATER CONDITIONS

Groundwater level observations were made during and at completion of drilling. The observed groundwater level is 5.5 ft below the existing pavement surface at both boring locations. However, groundwater levels may to fluctuate as a result of seasonal variations in temperature, precipitation and snowmelt. Groundwater conditions at the time of construction may differ from those encountered in the borings.

6 EVALUATION AND RECOMMENDATIONS

6.1 General

As discussed in Section 4, above, most of the soils encountered during this investigation, are considered suitable for the support of conventional shallow foundations and floor slabs, if properly conditioned as discussed below.

6.2 Site Preparation, Earthwork and Backfill

Most of the proposed building expansion area is currently paved, although a narrow strip directly adjacent to the existing building includes a planter and some concrete slabs. In view of the essentially level nature of the site, we do not anticipate that any significant grade changes will be required for this project. At the beginning of site preparation operations, the existing pavement, surface vegetation, topsoil and miscellaneous fill should be stripped from the proposed building pad area. Topsoil and any other soil that is mixed with organic matter should either be disposed offsite or stockpiled on-site for later use for landscaping and/or site restoration purposes.

The existing fill and underlying buried topsoil encountered in SB-1 should be removed to its full depth and replaced with engineered fill. Since the extent of buried topsoil is not known, these unsuitable soil removal operations should be extended, as determined by a qualified geotechnical professional. In view of the loose to very loose nature of some of the existing soils, we recommend that the exposed surface be compacted with a vibratory roller to improve its load supporting capacity and provide more uniform subgrade conditions.

Although we do not anticipate any significant amount of engineered fill will be required to achieve design grades, any imported fill material that may be required should consist of granular material meeting the requirements of MDOT Class II. Any required fill or backfill should be placed in layers not exceeding 12 inches in thickness prior to compaction. The moisture content of the fill material should be properly controlled during compaction operations within a range of plus or minus 2 percent of the designated optimum value determined by the Modified Proctor Test (ASTM D1557). Within building and pavement areas, each layer of fill should be compacted so as to achieve a minimum density 95 percent of the maximum dry density as determined by Modified Proctor test. Frozen material should not be used as fill, nor should fill be placed on a frozen subgrade.

6.3 Foundation Recommendations

The bearing conditions resulting from the proper completion of the site preparation operations discussed in the preceding section are expected to be suitable for the direct support of conventional spread and strip footings. Based on the anticipated finished floor elevation, the soils at the estimated bottom of footing are expected to consist of sand. These soils are considered suitable for the direct support of conventional spread and strip footings. However, we recommend that the bottom of all footing excavations be compacted with a vibratory roller or plate compactor to improve the relative density and uniformity of the bearing soils.

Footings for the proposed building be designed on the basis of a net allowable soil bearing pressure of 2,000 psf. All strip footings should be at least 16 inches in width and isolated spread footings should be at least 24 inches in their smallest plan dimension even if this results in a bearing pressure that is less than the allowable value indicated above. All footing excavations be checked and tested in the field by a qualified geotechnical professional to verify that adequate soil bearing conditions are achieved, compatible with the recommendations outlined in this report.

Exterior footings should extend to a minimum depth of 3.5 ft. below the exposed finished grade for protection against frost penetration. Interior footings not exposed to freezing temperatures during or after construction should preferably be established at shallower depths, provided that suitable bearing conditions are present. If foundations are to be constructed during periods of freezing temperatures, they should be extended below the frost penetration depth or insulated for protection against freezing temperatures. Furthermore, footings should not be constructed on frozen soil.

If adjacent footings are founded at different levels, they should be designed and constructed so that the least lateral distance between them is equal to or greater than the difference in their bearing elevation. To achieve a change in the elevation of a strip footing, the footing should be gradually stepped at a grade not steeper than two units horizontal to one unit vertical.

Care should be exercised when performing excavations and footing construction adjacent to the existing building to avoid undermining or otherwise disturbing the existing foundations. In general the new foundations should be constructed at the same depth as adjacent footings to prevent undermining.

If foundation construction is properly completed, post-construction settlement for the new building addition is estimated to be within normal tolerances of 1 inch total and ½ inch differential. However, the magnitude of differential settlement between the new and existing portions of the building may approach the same magnitude as total settlement. Accordingly, we recommend that new portions of the building be structurally separated from the existing buildings to allow for independent movement.

6.4 Groundwater Control

As indicated in an earlier section of this report, groundwater was noted in the borings drilled during the field investigation at a depth of 5.5 ft below the existing parking lot grade. However, groundwater levels can fluctuate with seasonal variations and following periods of prolonged precipitation and may be different at the time of construction.

In general, we anticipate that any groundwater seepage or accumulations of surface runoff in construction excavations should be controllable during construction by open pumping from prepared sumps extending into the clay soils. Any resulting discharge from these operations and any other surface runoff should be diverted away from excavations, toward on-site detention areas or existing ditches or storm sewers.

We recommend that subdrains be installed along the perimeter of the building at footing level to prevent groundwater from infiltrating and collecting under the floor slabs. The subdrain system should be connected to a storm sewer and a sump or other effective means for collecting and discharging subsurface water and prevent its accumulation under floor slabs.

6.5 Floor Slabs

In general, the subgrade resulting from the proper completion of site preparation operations outlined in a preceding section of this report is considered suitable for the direct support of interior floor slabs/pavement. Floor slabs, including slabs subject to vehicular traffic, may be designed using an estimated subgrade modulus of subgrade reaction (k) of 150 pounds per square inch per inch.

We recommend that a minimum of 6 inches of free-draining granular soil, meeting the requirements of MDOT Class II, be used under floor slabs. A vapor barrier should also be provided under the granular material to reduce moisture infiltration into the interior of the building.

6.6 Closing Remarks and Limitations

The recommendations submitted are based on the available soil information and data regarding the proposed construction provided by Sidock Group, plus any assumptions stated herein. The geotechnical engineer should be kept apprised of the progress of the design of this project and any items that deviate from the stated understanding and/or assumptions indicated in this report should be brought to our attention for review and evaluation.

Experience indicates that soil conditions at a site could vary from those generalized on the basis of soil borings. Therefore, we recommend that a qualified geotechnical engineer be involved in construction monitoring and testing services during the earthwork and foundation installation phases of the proposed project. This is to observe compliance with the design concepts, specifications and recommendations. Field monitoring also allows design changes to be made in a timely manner in the event that subsurface conditions differ from those anticipated prior to the start of construction.

This report is intended for specific use in the design and construction of the proposed building addition and other site planned site improvements, as described in this report. This geotechnical study has been conducted in a manner consistent with the level of care ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions. The findings, recommendations, and opinions contained herein have been developed in accordance with generally accepted practice in the fields of foundation engineering, soils mechanics, and engineering geology. No other representations, expressed or implied, and no warranty or guarantee is included or intended in this report.

The scope or purpose of this geotechnical evaluation does not specifically or by implication provide an environmental assessment of the proposed site.

Respectfully Submitted,

Prein & Newhof

Fernando Souto, P.E.

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cc: Tim Miller, Sidock Group

Appendix

Soil Boring Logs

Soil Nomenclature, General

Prein&Newhof
Engineers • Surveyors • Environmental • Laboratory
3355 Evergreen Drive NE Grand Rapids, Michigan 49525
Telephone : (616) 364-8491 Fax : (616) 364-6955

LOG OF SB-1

DESCRIPTION :	Gladwin City Bus Maintenance Garage Building		
LOCATION :	Gladwin, MI		
WATER ENCOUNTERED AT :	5.5'	PROJECT NO. : 2211055	INSPECTOR : Scott Cathey
WATER AFTER COMPLETION :	20.0'	DRILLING CONTRACTOR: Pearson Drilling Company	DRILLER : John Birgy
START DATE : 11-16-2021	CHECKED BY : Fernando Souto, P.E.	DRILL RIG : Truck Mounted 4.25" HSA	BORING METHOD : SPT
		SURFACE ELEVATION : -	TOTAL DEPTH : 20.0'

SAMPLE	PENETRATION (BLOWS/6")	STD. PEN. N-VALUE	MOISTURE (%)	DRY DENSITY (PCF)	UNCONF. COMP. STRENGTH (PSF)	PID READING (PPM)	DEPTH (FT.)	SUBSURFACE PROFILE	ELEVATION (FT.)
							0.3'	ASPHALT (4")	
							0.7'	AGGREGATE BASE (4")	
SS-1	2 5 4	9					2.3'	FILL: Loose brown FINE to MEDIUM SAND with trace silt (SP-FILL)	
							3.5'	TOPSOIL: Loose dark brown to black FINE to MEDIUM SAND with little silt	
SS-2	3 3 3	6					5	Loose brown FINE to MEDIUM SAND with trace silt (SP) [wet]	
							6.0'		
SS-3	2 1 for 12	2						Very loose brown FINE to COARSE SAND with trace silt, trace gravel (SW) [wet]	
SS-4	4 1 2	3					10		
							12.0'		
SS-5	5 8 12	20					15	Medium dense light brown FINE to MEDIUM SAND with trace to little silt (SP) [wet]	
							19.0'		
SS-6	10 4 5	9					20	Loose light brown CLAYEY SAND with little silt (SC) [wet]	
							20.0'	END OF BORING	
							25		
							30		

NOTES : Boring backfilled with soil and cold patch.
Boring drilled 35' East of Northeast corner of existing building.

Prein&Newhof
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LOG OF SB-2

DESCRIPTION :	Gladwin City Bus Maintenance Garage Building
LOCATION :	Gladwin, MI
PROJECT NO. :	2211055
INSPECTOR :	Scott Cathey
DRILLING CONTRACTOR:	Pearson Drilling Company
DRILLER :	John Birgy
DRILL RIG :	Truck Mounted 4.25" HSA
BORING METHOD :	SPT
SURFACE ELEVATION :	-
TOTAL DEPTH :	20.0'
WATER ENCOUNTERED AT :	5.5'
WATER AFTER COMPLETION :	20.0'
START DATE :	11-16-2021
CHECKED BY :	Fernando Souto, P.E.

SAMPLE	PENETRATION (BLOWS/6")	STD. PEN. N-VALUE	MOISTURE (%)	DRY DENSITY (PCF)	UNCONF. COMP. STRENGTH (PSF)	PID READING (PPM)	DEPTH (FT.)	SYMBOL	SUBSURFACE PROFILE	ELEVATION (FT.)
							0.5'		ASPHALT (5")	
							0.9'		AGGREGATE BASE (5")	
SS-1	4 3 5	8							Loose brown FINE to MEDIUM SAND with trace silt and gravel (SP) [wet below 5.5']	
SS-2	1 2 3	5					5			
SS-3	2 1 3	4					6.5'		Very loose brown FINE to COARSE SAND with trace silt and little fine gravel (SW) [wet]	
SS-4	1 4 6	10					8.5' / 10		Loose brown FINE to MEDIUM SAND with trace silt and trace to little gravel (SP) [wet]	
SS-5	2 2 4	6					15			
SS-6	2 2 4	6			4000*		18.0' / 20		Stiff brown SILTY CLAY with trace to little sand (CL) [wet]	
							20.0'		END OF BORING	
							25			
							30			

NOTES : Boring backfilled with soil and cold patch.
*Pocket Penetrometer
Boring drilled 4' East, 1' South of Southeast corner of existing building.

SOIL NOMENCLATURE AND TERMINOLOGY

DRILLING & SAMPLING DESIGNATIONS:

SS :	Split Spoon Sample (per ASTM D 1586)	HSA :	Hollow Stem Auger
LS :	Split Spoon Sample with 3" Liner Insert	SSA :	Solid Stem Auger
ST :	Shelby Tube Sample - 3" O.D., unless otherwise noted	RB :	Rock Bit (NX; BX; AX)
AS :	Auger Sample	PP :	Pocket Penetrometer Value
BS :	Bulk Sample	VS :	Vane Shear Value
		PM :	Pressuremeter test - in situ

STANDARD PENETRATION TEST (ASTM D-1586): A 2-inch OD, 1⅜-inch ID split barrel sampler is driven into undisturbed soil by means of repeating blows from a 140-pound hammer falling 30 inches. The sampler is driven three successive 6-inch increments; the total number of blows required for the final 12 inches of penetration is termed the Standard Penetration Resistance (N).

GRADATION DESCRIPTION & TERMINOLOGY:

Granular Soils (coarse-grained) have more than 50% of their dry weight retained on a #200 sieve; they are described as: *Boulders*, *Cobbles*, *Gravel* or *Sand*. Fine-Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are described as: *Clays* or *Clayey Silts* if they are cohesive, and *Silts* if they are non-cohesive. In addition to gradation, granular soils are defined based on their relative density; fine grained soils are further defined based on their strength or *consistency*, and on their *plasticity*.

Major Soil Component		Gradation Range
Boulders		Over 12 inches (305mm)
Cobbles		12 inches to 3 inches (305mm to 76mm)
Gravel	Coarse	3 inches to ¾ inches (76mm to 19mm)
	Fine	¾ inches to #4 sieve (19mm to 4.75mm)
Sand	Coarse	#4 sieve to #10 sieve (4.75mm to 2.00mm)
	Medium	#10 sieve to #40 sieve (2.00mm to 0.425mm)
	Fine	#40 sieve to #200 sieve (0.425mm to 0.074mm)
Silt		Passing #200 sieve (0.074mm) to 0.005mm
Clay		Smaller than 0.005mm

Descriptive Term(s) (of Minor Soil Constituents)	Percent of Dry Weight
Trace	1-10
Little	10-20
Some	20-35
And	35-50

CONSISTENCY OF COHESIVE SOILS:

Unconfined Comp Strength, Qu (tsf)	Consistency
<0.25	Very Soft
0.25 – 0.50	Soft
0.50 – 1.00	Medium (firm)
1.00 – 2.00	Stiff
2.00 – 4.00	Very Stiff
4.00 – 8.00	Hard
>8.00	Very Hard

RELATIVE DENSITY OF GRANULAR SOILS:

N - Blows/ft.	In-Situ Density
0 - 4	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
50 +	Very Dense

WATER LEVEL MEASUREMENT:

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. It should be noted that groundwater levels observed during drilling in predominantly cohesive soils are not necessarily indicative of the static groundwater level. This is due to the relatively low permeability of clay soils and the tendency of drilling operations to temporarily seal off natural paths of groundwater migration into the borehole. Additionally, fluctuations in groundwater levels should be anticipated with seasonal variations and following periods of heavy or prolonged precipitation.