PRELIMINARY SOILS INVESTIGATION
PROPOSED PARKING LOT EXPANSION
STAHL'S AUTOMOTIVE MUSEUM
56308 NORTH BAY DRIVE
CHESTERFIELD TOWNSHIP, MICHIGAN

STEINER ASSOCIATES
15735 NORWICH ROAD
LIVONIA, MICHIGAN 48154

APRIL 9, 2024
BY
McDOWELL & ASSOCIATES

McDowell & Associates
Geotechnical, Environmental & Hydrogeological Services • Materials Testing & Inspection
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April 9, 2024

Steiner Associates
15735 Norwich Road
Livonia, Michigan 48154

Job No. 24-112

Attention: Mr. Marvin Steiner

Subject: Preliminary Soils Investigation
Proposed Parking Lot Expansion
Stahl's Automotive Museum
56308 North Bay Drive
Chesterfield Township, Michigan

Dear Mr. Steiner:

In accordance with your request, we have made a Preliminary Soils Investigation at the subject project.

Field Work and Laboratory Testing

Five Test Pits, designated as TP-1 through TP-5, were performed at the subject property at the approximate locations shown on the Test Pit Location Plan which accompanies this report. The test pit locations were selected and field located by our engineer. The test pits were advanced to depths of about six feet (6') or eight feet (8') below the existing ground surface at the test pit locations. Topsoil was stripped from the vicinity of Test Pit TP-5 prior to arrival.

Soil descriptions, groundwater observations and the results of field and laboratory tests are to be found on the accompanying Logs of Test Pits, Gradation Curve sheets and summary sheet of Sieve Analysis results.

Test Pits TP-1 and TP-3 encountered three feet (3') and three feet three inches (3'3") of fill material consisting of brown or dark brown clayey soils with varying amounts of sand and stones and streaks of topsoil followed by apparent native soils consisting of brown sand and silt at Test Pit TP-1 or variegated silty clay at Test Pit TP-3, which continued to the termination depths of the test pits. The remaining test pits encountered apparent native soils consisting primarily of variegated clay continuing throughout the test pits depth with the exception of an area of sand and silt-type soils encountered between the surface topsoil and the clay-type soils at Test Pit TP-4.

Soil descriptions and depths shown on the test pit logs are approximate indications of change from one soil type to another and are not intended to represent an area of exact geologic change or stratification. Also, the site shows some signs of modification which could indicate fill and soil conditions different from those encountered at the test pit locations.

Following completion of the test pit excavations, Test Pits TP-1 and TP-3 were prepared for infiltration testing using double ring infiltrometers. Infiltration test preparation consisted of excavating a soil bench adjacent to the primary test pit excavation. On the benched soil, two double ring infiltrometers with open bottoms were installed at a depth of about two inches (2") into the soil bench. Extra care was exercised to maintain a good seal between the steel tubing and in-situ soils to prevent loss of test water. Following installation of the infiltrometers, a thin needle-punch geotextile filter was placed above the soil in the inner ring of each infiltrometer and the pipes were filled with about five inches (5") of potable water to initiate the "soak period". A representative soil sample was obtained at the test locations. Infiltration testing was not performed in TP-2, TP-4 and TP-5 due to shallow groundwater and/or surface water.

Once the appropriate soak period duration was maintained in each infiltrometer, the casings were refilled with potable water and the infiltration test was initiated. Throughout the course of testing, water level readings within the inner ring of the infiltrometers were obtained and recorded at specific time intervals. It should be noted that water level readings were taken to the nearest sixteenth of an inch (1/16"). Water level readings from each infiltration test may be found on the Test Pit Log sheets.

Laboratory tests for grain-size distribution were performed on the grab samples obtained from the infiltration test locations. Test results are provided on the accompanying Gradation Curve sheets.

Groundwater Conditions

Seepage water was observed either from the surface or from the upper three feet (3') of the soils within the test pits with the exception of Test Pit TP-1. It should be noted that short-term groundwater observations may not provide a reliable indication of the depth of the water table. In soils with significant fines content (clay and/or silt), this is due to the slow rate of infiltration of water into the borehole as well as the potential for water to become trapped in overlying layers of granular soils during periods of heavy rainfall. Water levels in granular soils fluctuate with seasonal and climatic changes as well as the amount of rainfall in the area immediately prior to the measurements. It should be expected that groundwater fluctuations could occur on a seasonal basis and that seams of water-bearing sands or silts could be found within the various clay strata at the site.

Project Description

It is understood that the project will consist of constructing new pavement and overflow gravel parking areas to increase the existing parking lot area at the site. It is further understood that the use of rain garden/ detention for stormwater infiltration is being considered. It is anticipated that new parking lots will support mostly automobile traffic with occasional delivery and sanitation trucks. Based on the information provided to McDowell & Associates by Culver Development's representative, it appears that the new pavement area will be constructed with rigid pavement composed of 8" thick concrete underlain by 6" thick compacted 21AA crushed limestone and the overflow gravel parking area will be 16" thick compacted 21AA crushed limestone. A geotextile woven separation fabric was installed and covered with a layer of 21AA crushed limestone at the northwest section of the proposed overflow gravel parking lot.

Infiltration Recommendations

It is understood that the proposed stormwater management system consists of a rain garden extending roughly between four feet (4') to five feet (5') below the existing ground surface. To be suitable for infiltration, it is understood that Macomb County requires a minimum clearance between the invert of the stormwater management system and the seasonal high-water table of two feet (2'), and a minimum infiltration rate of 0.24 in/hr.

Infiltration tests were performed at depths of four feet (4') in Test Pits TP-1 and TP-3. The test in TP-1 resulted in unfactored infiltration rates of 0.11 in/hr and 0.22 in/hr. No noticeable infiltration was observed in TP-3. The apparent native soils encountered in TP-3 and the remaining test pits with the exception of TP-1 generally consisted of clay soils with seams of wet sand or silt. We would typically expect these clay-type soils to have permeabilities of less than $1.0x10^{-6}$ cm/s. These fine-grained soils impede downward movement of water and have a very slow rate of water transmission. For design purposes, it is suggested that a combined average infiltration rate for Test Pit TP-1as well as a factor of safety of two be considered. This would result in a design infiltration rate of 0.17 in/hr.

Based on the indications from the test pits, the existing site soils do not appear to be suitable for infiltration.

Groundwater Considerations

The subsoils at the site are generally expected to be moderately to highly susceptible to frost heaving due to silt content in the sand and clay-type soils. The laboratory tests indicated that the site clay soils have generally high moisture contents. Water in the pavement section is one of the pavement section failure mechanisms considering the presence of poorly drained, moderately slowly permeable subgrade soils at most of the site. It is recommended that pavements be properly graded to promote effective drainage of water and prevent the ponding of surface water in the low areas. A system of "stub drains" or one drain placed around the catch basin and backfilled with pea stone should be installed at any catch basin or manhole structures to drain any collection of surface water runoff and thus minimize the possibility of frost penetration and heave. The drain tile should be wrapped with a geotechnical filter fabric. Edge drains should be installed in watered landscaped areas or shallow groundwater areas (typically where groundwater is found to be within 18" of the planned pavement surface). These drains could be field determined during construction. Existing catch basins and manhole structures should be checked and repaired as needed.

Pavement Design

The soil conditions encountered in the test pits indicate that the subgrade consists of sand, clay, and fill soils. Moisture contents in the soils range from about 13.1% to 31.9%. Clay soils generally have low California Bearing Ratios (CBRs). We have considered a CBR of 3% and a modulus of subgrade reaction of about 100 pci. It appears the site soils are highly susceptible to frost heave with signs of over optimum moisture content.

Based on the project information provided and the results of field and laboratory tests, it appears that the fill and native non-organic soils at the test pits are suitable for the support of pavements if some

potential settlement can be tolerated. If some potential settlement cannot be tolerated, then all existing fill soils and native soft saturated soils should be removed, and properly installed and compacted engineered fill should be placed in the resulting excavations.

In the areas to be paved, any topsoil, loose soil, soft saturated soil, organic soil, or other objectionable materials should be removed and the subgrade thoroughly proof-compacted with heavy, rubber-tired equipment. If during the proof-compaction operation areas are found where the soils yield excessively, the yielding materials should be scarified, dried and recompacted or removed and replaced with similar material or clean coarse stone engineered fill. Undercutting and placement of clean crushed concrete or crushed stone with geogrid may be required in areas of unstable subgrade. After proof-compaction, the upper one foot (1') of the grade should be compacted to a minimum density of 95% of its maximum dry density as determined by the Modified Proctor Test (AASHTO T-180 or ASTM D-1557). Care should be taken to ensure compaction of fill soils required in the vicinity of manholes and/or catch basins.

If the potential for more than normal settlement cannot be tolerated, then all existing fill and soft saturated native soils should be excavated from the parking lot areas and replaced with properly installed and compacted engineered fill. The excavation should extend at least six inches (6") outside the parking lot edges for every foot below the planned finished surface. The removal of the unsuitable soils should be done in the presence of a qualified soils engineer to provide reasonable assurance that no uncontrolled fill or saturated soils are left behind before the placement of the engineered fill. After the unsuitable soils have been removed, the excavation should be backfilled with compacted bank run sand, preferably consisting of MDOT Type I or II granular soils or MDOT 21AA crushed stone. If the bottom of the excavation is not sufficiently stable to install the bank run sand, then a layer of coarse stone fill such as MDOT 6AA or 1" x 3" crushed stone or crushed concrete with geogrid could be installed. Geotextile fabric should be placed between the coarse stone engineered fill material and any granular fill soils to minimize the amount of fines infiltrating into the coarse aggregate material. The granular MDOT Class I or II soils or MDOT 21AA crushed stone should be deposited in horizontal lifts not to exceed nine inches (9") in thickness with each lift being compacted uniformly to a minimum density of 95% of its maximum value as determined by the Modified Proctor Test (ASTM D-1557).

After the subgrade has been properly compacted and fill has been properly placed and compacted, the pavement section and gravel materials could be installed in accordance with the design plans

The stabilization procedures outlined above should result in reasonably stable parking lot. It should be recognized, however, that all pavements and unpaved roads and parking areas need repairs from time to time as a result of progressive yielding under repeated traffic loads for a prolonged period of time. Placing the new pavement and gravel materials over existing non-engineered fill soils may result in long-term differential settlement and some potential cracking of the pavement.

All paving operations should conform with any applicable Macomb County and city of Chesterfield specifications.

Closing

The evaluations and recommendations presented in this report have been formulated on the basis of reported or assumed data relating to the location, type, finished grades and traffic conditions for the proposed project. Any significant change in this data in the final design plans should be brought to our attention for review and evaluation with respect to the prevailing subsoil conditions.

Experience indicates that actual subsurface conditions at the site could vary from those found at the soil test pits made at specific locations. It is, therefore, essential that a qualified geotechnical engineering testing firm be retained to provide soils engineering services during the site preparation, excavation, earthmoving and paving phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations and to allow design changes in the event that subsurface conditions differ from those anticipated prior to the start of construction.

If we can be of any further service, please feel free to call.

Very truly yours,

McDOWELL & ASSOCIATES

David Quintal, M.S., P.E.
Geotechnical Engineer

Ihsan Aljawaheri, P.E.
Staff Engineer

IA:DQ/jb

Attachments: Test Pit Logs (5 pp)
Infiltration Test Logs (2 pp)
Gradation Curve Sheets (2 pp)
Sieve Analysis (1 p)
Test Pit Location Plan (1 p)

McDowell & Associates
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Ferndale, MI 48220
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Fax: (248) 399-2157

TEST PIT LOG REPORT

PROJECT: Stahl's Automotive Museum Parking Lot Expansion
REPORT NO.:
LOCATION: 56308 North Bay Drive - Chesterfield Township, Michigan
OUR JOB NO.: 24-112
CLIENT: Steiner Associates
CLIENT'S JOB NO.:

WEATHER: Sunny
TEMPERATURE RANGE: °F
DATE: 4/5/2024
TIME:

TEST PIT NO.: TP-1

DEPTH (in.)	SOIL	DEPTH (in.)	SOIL DESCRIPTION	HOUSEL BLOWS/6"
0'6"			Moist dark brown clayey TOPSOIL, fill	
1'0"		10"		
1'6"			Moist brown sandy silty CLAY with traces of pebbles and topsoil, fill	
2'0"				
2'6"				
3'0"				
3'6"		3'3"		
4'0"				7
4'6"				
5'0"				
5'6"			Moist brown fine SAND & clayey SILT with trace of pebbles M.C. 13.1%	
6'0"				
6'6"				
7'0"				
7'6"				
8'0"		8'0"		
8'6"				
9'0"				
9'6"				
10'0"				

No groundwater encountered .

M.C. = Moisture Content

FIELD REPRESENTATIVE: Ihsan Aljawaheri, P.E.

jb

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TEST PIT LOG REPORT

PROJECT: Stahl's Automotive Museum Parking Lot Expansion **REPORT NO.:**

LOCATION: 56308 North Bay Drive - Chesterfield Township, Michigan **OUR JOB NO.:** 24-112

CLIENT: Steiner Associates **CLIENT'S JOB NO.:**

WEATHER: Sunny **TEMPERATURE RANGE:** °F

DATE: 4/5/2024 **TIME:**

TEST PIT NO.: TP-2

DEPTH (in.)	SOIL	DEPTH (in.)	SOIL DESCRIPTION	HOUSEL BLOWS/6"
0'6"				
1'0"		0'8"	Moist dark brown clayey TOPSOIL	
1'6"				4
2'0"			Very moist variegated silty CLAY with traces of sand and pebbles and wet silty sand seams M.C. 31.9%	
2'6"				
3'0"		3'0"		
3'6"				
4'0"				8
4'6"			Moist variegated silty CLAY with traces of sand and pebbles M.C. 24.6%	
5'0"				
5'6"				
6'0"		6'0"		
6'6"				
7'0"				
7'6"				
8'0"				
8'6"				
9'0"				
9'6"				
10'0"				

Water seepage encountered at 2'0".

M.C. = Moisture Content

FIELD REPRESENTATIVE: Ihsan Aljawaheri, P.E.

jb

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TEST PIT LOG REPORT

PROJECT: Stahl's Automotive Museum Parking Lot Expansion **REPORT NO.:**

LOCATION: 56308 North Bay Drive - Chesterfield Township, Michigan **OUR JOB NO.:** 24-112

CLIENT: Steiner Associates **CLIENT'S JOB NO.:**

WEATHER: Sunny **TEMPERATURE RANGE:** °F

DATE: 4/5/2024 **TIME:**

TEST PIT NO.: TP-3

DEPTH (in.)	SOIL	DEPTH (in.)	SOIL DESCRIPTION	HOUSEL BLOWS/6"
0'6"		0'4"	Moist dark brown clayey TOPSOIL	
1'0"				
1'6"				
2'0"			Moist dark brown silty CLAY with sand and stones, fill	
2'6"				
3'0"		3'0"		
3'6"				
4'0"				6
4'6"			Moist variegated silty CLAY with sand and traces of pebbles M.C. 21.6%	
5'0"				
5'6"				
6'0"		6'0"		
6'6"				
7'0"				
7'6"				
8'0"				
8'6"				
9'0"				
9'6"				
10'0"				

Water seepage from surface.

M.C. = Moisture Content

FIELD REPRESENTATIVE: Ihsan Aljawaheri, P.E.

jb

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Fax: (248) 399-2157

TEST PIT LOG REPORT

PROJECT: Stahl's Automotive Museum Parking Lot Expansion
REPORT NO.:
LOCATION: 56308 North Bay Drive - Chesterfield Township, Michigan
OUR JOB NO.: 24-112
CLIENT: Steiner Associates
CLIENT'S JOB NO.:

WEATHER: Sunny
TEMPERATURE RANGE: °F
DATE: 4/5/2024
TIME:

TEST PIT NO.: TP-4

DEPTH (in.)	SOIL	DEPTH (in.)	SOIL DESCRIPTION	HOUSEL BLOWS/6"
0'6"			Moist dark brown clayey TOPSOIL	
1'0"		10"		
1'6"		1'6"	Very moist brown SAND & SILT with trace of pebbles M.C. 15.9%	
2'0"				6
2'6"				
3'0"				
3'6"			Very moist to moist variegated silty CLAY with traces of sand and pebbles M.C. 25.5%	8
4'0"				
4'6"				
5'0"				
5'6"				
6'0"		6'0"		
6'6"				
7'0"				
7'6"				
8'0"				
8'6"				
9'0"				
9'6"				
10'0"				

Water seepage encountered at 10".

M.C. = Moisture Count

jb

FIELD REPRESENTATIVE: Ihsan Aljawaheri, P.E.

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TEST PIT LOG REPORT

PROJECT: Stahl's Automotive Museum Parking Lot Expansion
REPORT NO.:
LOCATION: 56308 North Bay Drive - Chesterfield Township, Michigan
OUR JOB NO.: 24-112
CLIENT: Steiner Associates
CLIENT'S JOB NO.:

WEATHER: Sunny
TEMPERATURE RANGE: °F
DATE: 4/5/2024
TIME:

TEST PIT NO.: TP-5

DEPTH (in.)	SOIL	DEPTH (in.)	SOIL DESCRIPTION	HOUSEL BLOWS/6"
0'6"				
1'0"				
1'6"			Very moist variegated silty CLAY with traces of sand and pebbles M.C. 23.0%	4
2'0"				
2'6"				
3'0"				
3'6"				
4'0"		4'0"		
4'6"				
5'0"			Moist variegated silty CLAY with traces of sand and pebbles	9
5'6"				
6'0"		6'0"		
6'6"				
7'0"				
7'6"				
8'0"				
8'6"				
9'0"				
9'6"				
10'0"				

Water seepage from the surface.

M.C. = Moisture Content

jb

FIELD REPRESENTATIVE: Ihsan Aljawaheri, P.E.

Cased Borehole Infiltration Test Log

McDowell & Associates

Test Pit #: 1

Job Number: 24-112
Project: Infiltration Study - Parking Lot Expansion
Location: 56308 North Bay Drive - Chesterfield Township, Michigan

Date: 4/5/2024
Weather: Temperature > 32 degrees
Ground Elv.: N/A

Soil Stratigraphy:

See test pit log for soil and groundwater conditions

Groundwater Depth: Not Encountered

Pipe Installation #1

Soil Depth: 4'
Inner Pipe Dia.: 6"
Outer Pipe Dia. 10"
Embedment: 2"
Stick-up: 5"

Pipe Installation #2

Soil Depth: 4'
Inner Pipe Dia.: 6"
Outer Pipe Dia. 10"
Embedment: 2"
Stick-up: 5"

Pipe Distance: 3'6"

Soak Period (Pipe #1)

Start Date: 4/5/2024
Notes:
Time: 30 min Water Drop: 0.75 inches
Notes:
Time: 30 min Water Drop: 0.50 inches
Notes:

Soak Period (Pipe #2)

Start Date: 4/5/2024
Notes:
Time: 30 min Water Drop: 0.50 inches
Notes:
Time: 30 min Water Drop: 0.38 inches
Notes:

Test Period (Pipe #1)

Time: 30 min Water Drop: 0.25 inches
Notes:
Time: 30 min Water Drop: 0.25 inches
Notes:
Time: 30 min Water Drop: 0.19 inches
Notes:
Time: 30 min Water Drop: 0.19 inches
Notes:
Time: Water Drop: inches

Notes: Average of last 4 readings = 0.22 inches in 30 mins
Unfactored infiltration rate = 0.44 inches per hour

Test Period (Pipe #2)

Time: 30 min Water Drop: 0.19 inches
Notes:
Time: 30 min Water Drop: 0.13 inches
Notes:
Time: 30 min Water Drop: 0.06 inches
Notes:
Time: 30 min Water Drop: 0.06 inches
Notes:
Time: Water Drop: inches

Notes: Average of last 4 readings = 0.11 inches in 30 mins
Unfactored infiltration rate = 0.22 inches per hour

Cased Borehole Infiltration Test Log

McDowell & Associates

Test Pit #: 3

Job Number: 24-112
Project: Infiltration Study - Parking Lot Expansion
Location: 56308 North Bay Drive - Chesterfield Township, Michigan

Date: 4/5/2024
Weather: Temperature > 32 degrees
Ground Elv.: N/A

Soil Stratigraphy:

See test pit log for soil and groundwater conditions

Groundwater Depth: Water seepage from the surface

Pipe Installation #1

Soil Depth: 4'
Inner Pipe Dia.: 6"
Outer Pipe Dia. 10"
Embedment: 2"
Stick-up: 5"

Pipe Installation #2

Soil Depth: 4'
Inner Pipe Dia.: 6"
Outer Pipe Dia. 10"
Embedment: 2"
Stick-up: 5"

Pipe Distance: 2'

Soak Period (Pipe #1)

Start Date: 4/5/2024
Notes:
Time: 30 min Water Drop: 0.00 inches
Notes:
Time: Water Drop: inches
Notes:

Soak Period (Pipe #2)

Start Date: 4/5/2024
Notes:
Time: 30 min Water Drop: 0.00 inches
Notes:
Time: Water Drop: inches
Notes:

Test Period (Pipe #1)

Time: Water Drop: inches
Notes:
Time: Water Drop: inches
Notes:
Time: Water Drop: inches
Notes:
Time: Water Drop: inches
Notes:
Time: Water Drop: inches

Notes: No noticeable infiltration in 30 min soak period

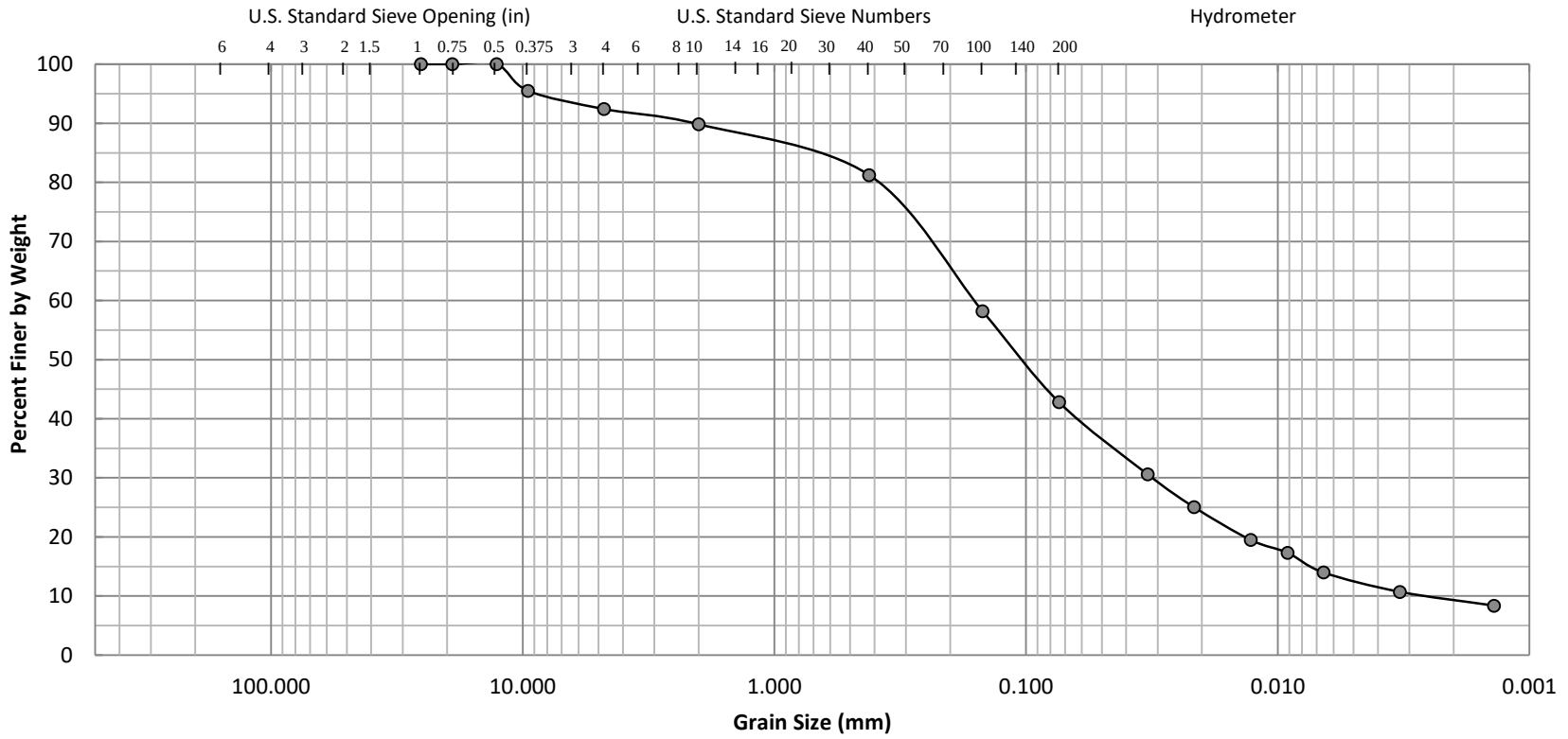
Test Period (Pipe #2)

Time: Water Drop: inches
Notes:
Time: Water Drop: inches
Notes:
Time: Water Drop: inches
Notes:
Time: Water Drop: inches
Notes:
Time: Water Drop: inches

Notes: No noticeable infiltration in 30 min soak period

McDowell & Associates

Gradation Curve



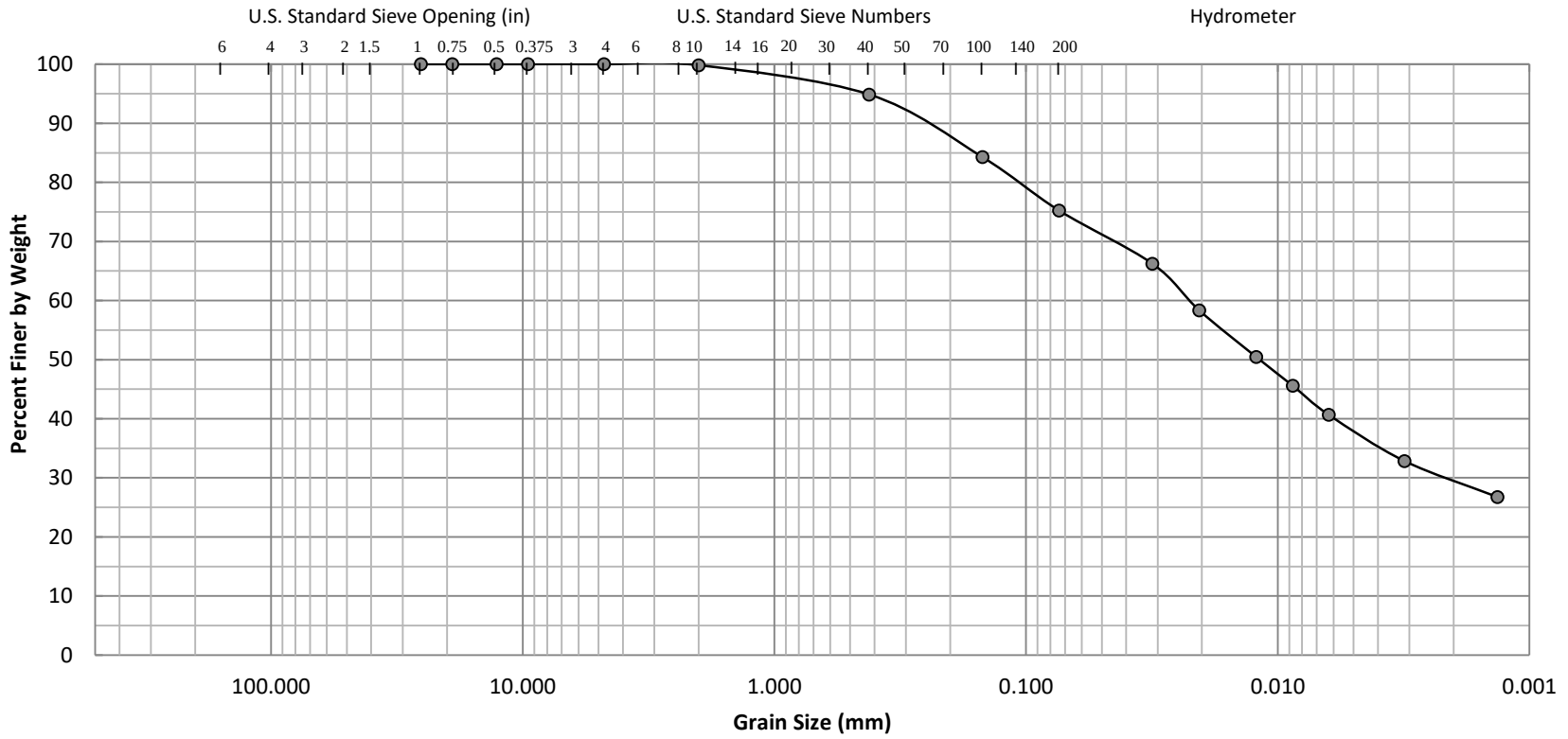
Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Sample #	Elev. Or Depth	Classification	Nat wc %	LL	PL	PI
#1		Brown SILT and Fine SAND with	13.1			
		traces of clay and gravel				

Preliminary Soils Investigation
Stahl's Automotive Museum Parking Lot
56308 North Bay Drive
Chesterfield Township, Michigan
M&A Job No. 24-112

McDowell & Associates

Gradation Curve



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Sample #	Elev. Or Depth	Classification	Nat wc %	LL	PL	PI
#3		Variegated silty CLAY with	21.0			
		little fine sand				

Preliminary Soils Investigation
Stahl's Automotive Museum Parking Lot
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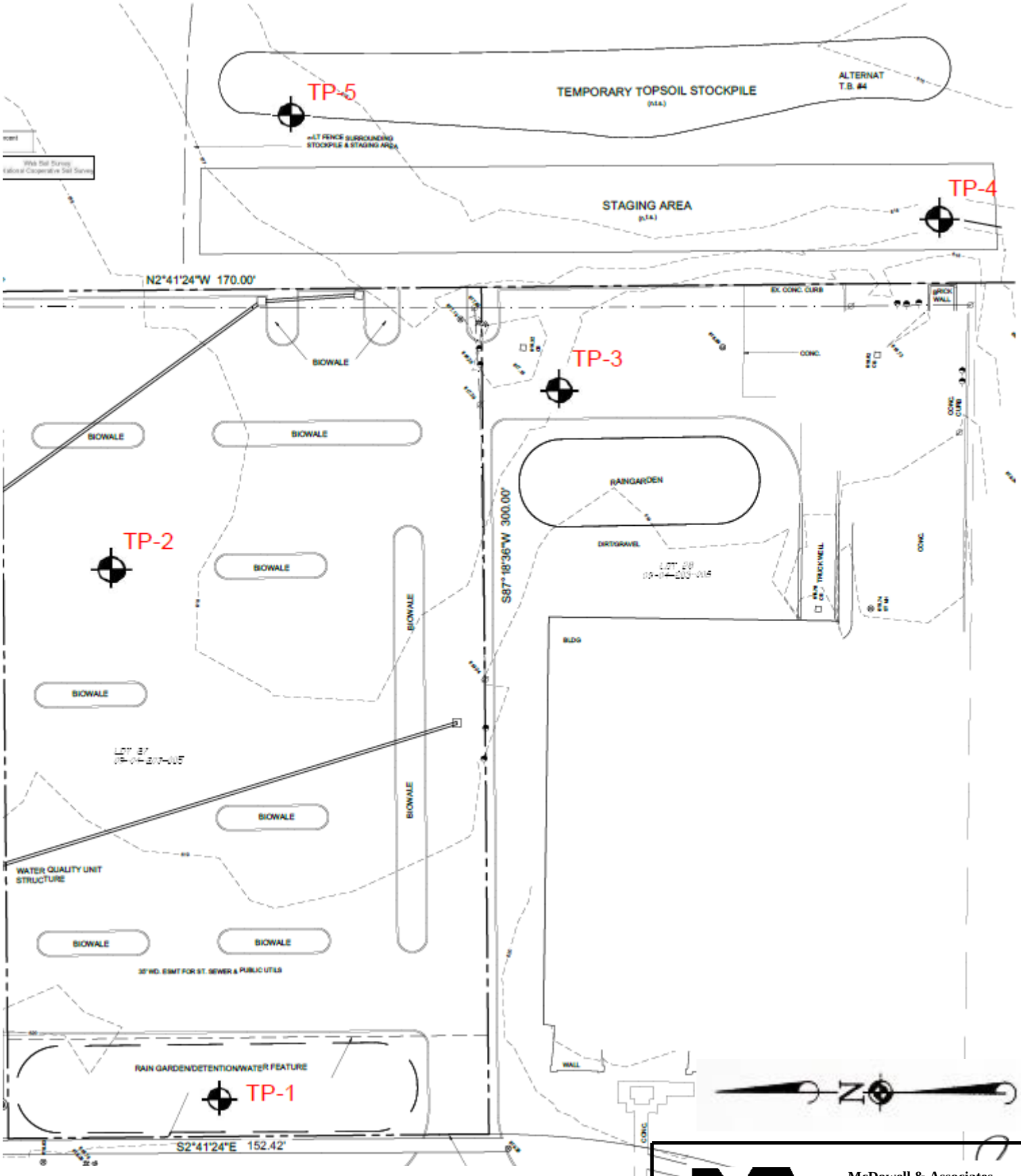
Chesterfield Township, Michigan
M&A Job No. 24-112

Job No. 24-112

SIEVE ANALYSIS SUMMARY

Boring	Sample	% Passing #4 Sieve	% Passing #10 Sieve	% Passing #40 Sieve	% Passing #100 Sieve	% Passing #200 Sieve
4	A	100.0	99.5	90.1	61.5	41.0



Note: Base drawing prepared by Mason Browns Associates, LLC

LEGEND

Test Pit Locations, 1 through 5:
Performed April 5, 2024

McDowell & Associates
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Soil Boring Location Plan

Job No. 24-112