

**REPORT OF GEOTECHNICAL EXPLORATION**  
**(FINAL)**  
**WOO-75-7.00 LANDSLIDE EXPLORATION**

PID: 120414  
WOOD COUNTY, OHIO

October 10, 2025

Prepared for:

Ohio Department of Transportation, District 2

Bowling Green, Ohio

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Project/File:

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## Revision Schedule

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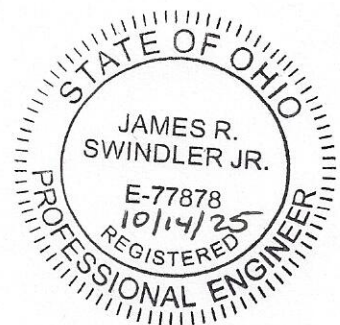
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## **Executive Summary**

A landslide is located along the west shoulder of Interstate Route (IR) 75 north of Cygnet where IR 75 crosses over Bays Road in Wood County. The landslide is occurring on a gently curved portion downhill from the southbound lanes. The landslide affects approximately 100 feet of the road. The Ohio Department of Transportation (ODOT) is planning to repair and stabilize the landslide. Stantec Consulting Services Inc. (Stantec) was contracted to perform the geotechnical exploration and provide design recommendations for the project.

Stantec advanced two borings to obtain geotechnical data for the proposed roadway improvements.

- One on the west shoulder of southbound IR 75 above the landslide.
- One near the toe of the landslide at the base of the embankment.

The surface materials encountered included approximately 4 inches of topsoil at the toe boring and 5 inches of asphalt underlain by approximately 13 inches of concrete in the roadway boring. Fine-grained soils with low to moderate plasticity were typically encountered beneath the surface materials. The fine-grained soils were classified as sandy silt (A-4a), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6). The soils were described as brown to gray, medium stiff to hard, and damp to wet. Groundwater was encountered in each boring at depths ranging from 6 feet (elevation 678.0 feet) in B-001-1-25 to 21.5 feet (elevation 680.5 feet) in B-001-0-25. In each boring, a thin layer of gravel and stone fragments (A-1-a) was encountered between the fine-grained soils described above and bedrock. The gravel and stone fragments were described as gray dolomite, dense, and moist. Bedrock at the site was described as dolomite and encountered at depths ranging from 28 feet (elevation 656.0 feet) in B-001-1-25 to 45.5 feet (elevation 656.5 feet) in B-001-0-25. The dolomite was described as dark gray to gray, moderately weathered, and highly to moderately fractured.

At the conclusion of field and laboratory testing for the project, it was determined that the landslide is a shallow embankment failure most likely caused by drainage travelling down the embankment and from the nearby culvert. The recommended remediation method is special benching as outlined in Section 806 of the ODOT Geotechnical Design Manual (GDM). Recommended material properties for each soil layer encountered are summarized in this report.



## **Acronyms / Abbreviations**

<b>Acronym / Abbreviation</b>	<b>Full Name</b>
ASTM	American Society for Testing and Materials
ER	Energy Ratio
CU	Consolidated Undrained
GDM	Geotechnical Design Manual
IR	Interstate Route
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
PSF	Pounds per Square Foot
PSI	Pounds per Square Inch
SGE	Specifications for Geotechnical Explorations
SPT	Standard Penetration Test
SR	State Route
TIMS	Traffic Information Mapping System
TSF	Tons per Square Foot
USDA	United States Department of Agriculture
UU	Unconsolidated Undrained



# 1 INTRODUCTION

A landslide is located along the west shoulder of Interstate Route (IR) 75 north of Cygnet where IR 75 crosses over Bays Road in Wood County. The landslide is occurring on a gently curved portion downhill from the southbound lanes. The landslide affects approximately 100 feet of the road.

The Ohio Department of Transportation (ODOT) is planning to repair and stabilize the landslide. Stantec Consulting Services Inc. (Stantec) was contracted to perform the geotechnical exploration and provide design recommendations for the project. Figure 1 shows the site vicinity.

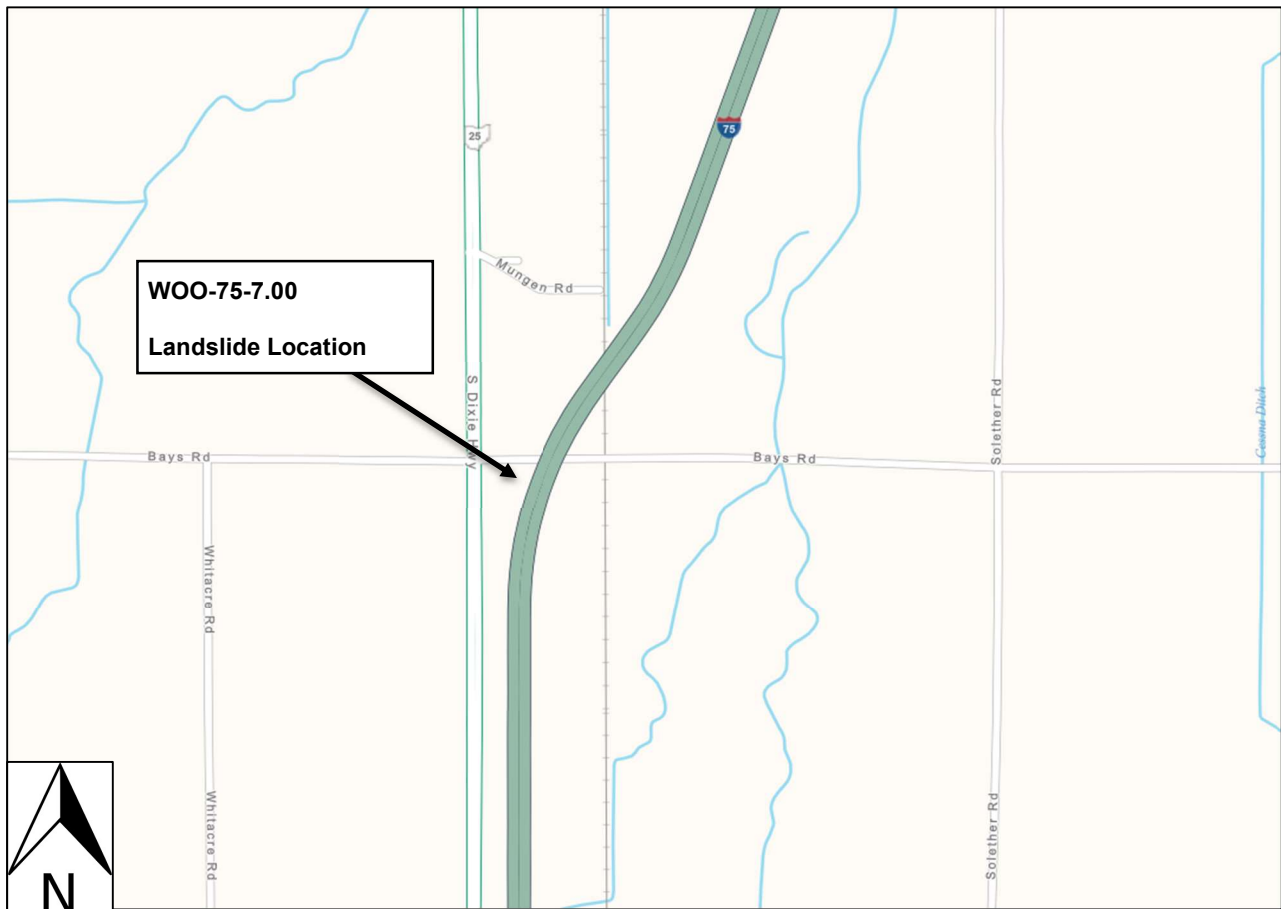


Figure 1: Site Vicinity (from ODOT Traffic Information Mapping System (TIMS, 2025))



## **2 GEOLOGY AND OBSERVATIONS OF THE PROJECT**

### **2.1 GENERAL**

The *Physiographic Regions of Ohio Map* (Ohio Department of Natural Resources [ODNR], 1998) indicates that the project is located within the Woodville Lake-Plain Reefs of the Huron-Erie Lake Plains. The Woodville Lake-Plain Reefs are described as a lacustrine plain with low dunes and lake margin features, punctuated by more than 75 ancient bedrock reefs rising 10 to 40 feet above the level of the plain and ranging from 0.1 to 3.0 square miles. It also consists of oblong reefs that are highly draped with drift. The region has a very low relief (generally about 10 feet) with elevations of 600 to 775 feet.

### **2.2 SOIL GEOLOGY**

According to the *Quaternary Geology of Ohio Map* (ODNR, 1999), the project site is underlain by clay till (Hiram, Yorkshire, Lake tills) from the Late Wisconsinan era. These soils are lake-planed moraine, very flat, planed by waves in glacial lakes, and consist of small patches of sand, silt, or clay on the surface in many areas. The soil survey (*Web Soil Survey of Wood County, Ohio*, United States Department of Agriculture [USDA], 2025) indicates that the project site is underlain by soils from the Wauseon fine sandy loam. These soils are typically fine sandy loam, loamy fine sand, and clay loam. These soils are described as very poorly drained, with low to moderately high capacity of transmitting water. The *Ohio Geology Interactive Map* (ODNR, 2025) indicates that the project site consists of 0 to 20 feet of glaciated till.

### **2.3 BEDROCK GEOLOGY**

Bedrock mapping (*Ohio Geology Interactive Map*, ODNR, 2025) and *Descriptions of Geologic Map Units* (ODNR, 2011) indicate that the overburden soils at the project site are underlain by sedimentary rock of the Lockport Dolomite formation from the Silurian age. The Lockport Dolomite formation consists of dolomite with minor limestone, chert, and shale. The bedrock from this formation is described as bluish gray to gray and weathers reddish gray to gray. The diagnostic feature consists of fossiliferous dolomite and distinct planar to irregular bedding.

According to the *Ohio Mine Locator* (ODNR, 2025), there are nine mines within a 3-mile radius of the project site. Two historical industrial quarries lie about 2 miles northwest, five historical industrial quarries lie between 1.5 to 2.5 miles southeast of the project site, and two surface mines producing limestone are located about 3 miles north of the project site.

The *Karst Interactive Map* (ODNR, 2025) indicates there are no suspected karst features within a 10-mile radius of the project site.



## **2.4 HYDROLOGY**

Drainage from the site flows to a ditch located approximately 55 feet west of IR 75 near the toe of the embankment. No flow was observed in the ditch during field activity, but on review of topographic mapping it appears the ditch drains to the south along IR 75 to a basin located approximately 0.4 miles away from the site.

## **2.5 HYDROGEOLOGY**

The *Ohio Geology Interactive Map* shows that the site is underlain by the Lake Maumee Lacustrine Aquifer (sand and gravel aquifer), which has a yield of less than 5 gallons per minute. According to the Groundwater Resources of Wood County map (ODNR, 2025), the project site is in an area where wells with yields of 2 to 20 gallons per minute can be achieved.

A search was performed using the ODNR *Ohio Water Wells Map (2025)* to review the geology recorded on logs of water wells located near the project site. According to the map, 9 water wells have been drilled within a 0.5-mile radius of the project site. The well logs indicate that bedrock depth ranges from 8 to 29 feet. The bedrock encountered at these wells were described as limestone. The logs also indicate that static water depth in the area ranges from 1 to 25 feet.

## **2.6 SEISMIC**

A review of the seismic data available in the project vicinity was completed using the ODNR *Ohio Earthquake Epicenters Map (2025)*. Overall, Ohio has a relatively limited amount of seismic activity. Within a 5-mile radius of the project, there have been two earthquake epicenters with magnitudes of 2.0. The available data reviewed included events that occurred in Ohio from 1886 to present day.

## **2.7 SITE RECONNAISSANCE**

Stantec representatives visited the site on May 13, 2025, to record observations and mark borehole locations. The land surrounding the project site was described as primarily rural with some resident and business locations nearby. The pavement of IR 75 was observed to be in fair condition. Pavement cracks were observed in all south bound lanes. The landslide was observed to be a shallow embankment failure, with a failure surface estimated to be approximately 5 feet deep. At the time of the reconnaissance, the landslide was not impacting traffic on IR 75.



## **3 EXPLORATION**

### **3.1 HISTORIC EXPLORATION PROGRAMS**

The ODOT Transportation Information Maps System (TIMS) website provides documentation for two geotechnical explorations performed along IR 75 near the project site.

WOO-75-2.37 was an exploration for reconstruction of existing bridges along IR 75 over Jersey City Road drilled in 2013. The project consisted of 24 borings drilled to depths of 21.5 to 41.5 feet. Fill was encountered to depths of 17.0 to 18.5 feet at the abutments, 4.0 to 8.5 feet at the piers, and 3.0 to 10.0 feet in the roadway. The fill soils were described as sandy silt (A-4a), silt and clay (A-6a), silty clay (A-6b) and clay (A-7-6). Glacial till soils were typically encountered below the fill and were described as sandy silt (A-4a), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6). Bedrock was encountered at depths ranging from 11.0 to 57.0 feet for borings drilled at the adjacent land and the bridge. The bedrock was described as gray dolomite.

WOO-(25)(75)-5.20 was an exploration for the new alignment of IR 75 and SR 25 drilled in 1963. The project consisted of 103 borings drilled in existing and proposed alignments. The overburden soils were classified as gravel and stone fragments with sand and silt (A-2-4), coarse and fine sand (A-3a), silt (A-4a), sandy silt (A-4b), silt and clay (A-6a), silty clay (A-6b), elastic clay (A-7-5), and clay (A-7-6). The borings were shallow and terminated at the depths of 10.0. to 12.0 feet, thus bedrock information was not available.

### **3.2 PROJECT EXPLORATION PROGRAM**

Stantec advanced two borings to obtain geotechnical data for the proposed roadway improvements.

- One on the west shoulder of southbound IR 75 above the landslide.
- One near the toe of the landslide at the base of the embankment.

The borings were marked and staked using the approximate location of the landslide provided by District 2. The boring on the roadway shoulder was marked with paint and the toe boring was staked and flagged with white ribbon. No survey was performed for the boring locations, so GPS coordinates for each boring location were determined using phone GPS capabilities. Elevations were determined using the existing topographic contour maps. A summary of these borings is shown in Table 1. Boring locations are shown on the geotechnical profile in Appendix A.



## WOO-75-7.00 Landslide Exploration

### 4 FINDINGS

Table 1. Boring Summary

Boring No.	Station (feet)	Offset (feet)	Alignment	Ground surface Elevation (feet)	Bottom of Boring Elevation (feet)	Boring Type
B-001-0-25	375+34	75 Lt.	IR 75	702.0	651.1	Landslide
B-002-0-25	375+34	126 Lt.	IR 75	684.0	648.7	Landslide

The borings were performed with a CME 45 track-mounted drill rig using 4¼-inch inside diameter (ID) hollow stem augers to advance the borings through soil. Standard Penetration Test (SPT) sampling was performed continuously until reaching coreable bedrock. The energy ratio (ER) of the CME 45 automatic hammer and drill rod system was measured to be over 90 percent on December 22, 2022. The depths and elevations of the SPTs with the corresponding  $N_{60}$ -values are shown on the boring logs in Appendix A.

The materials encountered were logged by a geotechnical engineer, with attention given to soil type, consistency, and moisture. The borings were checked for the presence of groundwater during drilling with the depth of water recorded. The borings were sealed with bentonite grout, then capped with asphalt cold patch for the boring performed in the roadway or auger cuttings for the boring performed at the toe of the embankment.

The soil samples obtained from the borings were returned to Stantec's geotechnical laboratory for visual classification and tested for water content. Engineering classification testing was performed on samples taken near proposed subgrade and samples reflecting each of the main soil horizons. The engineering classification tests conducted on the samples were sieve and hydrometer analysis (ASTM D 422) and Atterberg limits (ASTM D 4318). The samples were classified according to the ODOT classification method.

Two undisturbed Shelby tube samples were extruded in the laboratory, where one Unconsolidated Undrained (UU) triaxial compression test (ASTM D 2850) and one Consolidated Undrained (CU) triaxial compression test (ASTM D 4767) were performed. One rock core sample was subjected to unconfined compressive strength of rock core (UCR) testing (ASTM D 7012). Results from Stantec's laboratory program for soil index testing and rock compressive strength testing are shown on the boring logs and detailed laboratory reports are provided with the geotechnical profile in Appendix A.

## 4 FINDINGS

The surface materials encountered include approximately 4 inches of topsoil at the toe boring and 5 inches of asphalt underlain by approximately 13 inches of concrete in the roadway boring. Fine-grained soils with low to moderate plasticity were typically encountered beneath the surface materials.

Embankment fill was encountered below the roadway materials in B-001-0-25. The fill was classified as sandy silt (A-4a) or silt and clay (A-6a). The fill was described as gray to gray mottled with brown, stiff to very stiff (SPT  $N_{60}$  values ranging from 12 to 24 with an average of 18 blows per foot), damp to wet (moisture contents of 14 to 18 percent with an average of 16 percent), and having low to moderate plasticity



## **WOO-75-7.00 Landslide Exploration**

### **5 ANALYSIS AND RECOMMENDATIONS**

(plasticity indices (PI) of 5 to 12 with an average of 9). A UU triaxial test was performed at a depth of 6.2 to 6.7 feet in B-001-0-25, representing the embankment soil at the site. The test resulted in an undrained shear strength of 1.9 tons per square foot (tsf).

Glacial till was encountered below the embankment soil in B-001-0-25 and the topsoil in B-001-1-25. The till was classified as silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6). The soils were described as brown to gray, medium stiff to hard (SPT  $N_{60}$  values ranging from 6 to 53 with an average of 28 blows per foot), damp to wet (moisture contents of 12 to 33 percent with an average of 19 percent), and having moderate plasticity (PI of 11 to 21 with an average of 14). A three-point CU triaxial test was performed at depths from 6.0 to 7.9 feet in B-001-1-25, representing the glacial till at the site. The test resulted in a drained shear strength of 0 tsf at an angle of 28 degrees. The undrained portion of this test yielded poor results.

Ground water was encountered in each boring at depths ranging from 6 feet (elevation 678.0 feet) in B-001-1-25 to 21.5 feet (elevation 680.5 feet) in B-001-0-25 within the glacial till layer.

In each boring, a thin layer of gravel and stone fragments (A-1-a) was encountered between the fine-grained soils described above and bedrock. The gravel and stone fragments were described as gray, dense, and moist. The stone fragments were further described as weathered dolomite.

Bedrock at the site was described as dolomite and encountered at depths ranging from 28 feet (elevation 656.0 feet) in B-001-1-25 to 45.5 feet (elevation 656.5 feet) in B-001-0-25. The dolomite was described as dark gray to gray, moderately weathered, and highly to moderately fractured. One unconfined compressive strength of rock test was completed on the dolomite resulting in a compressive strength of 7,910 pounds per square inch (psi). Approximately 5 to 6 feet of dolomite was cored in each boring.

## **5 ANALYSIS AND RECOMMENDATIONS**

### **5.1 GENERAL**

The recommendations that follow are based on the information discussed in this report and the interpretation of the subsurface conditions encountered at the site during the fieldwork. If future design changes are made, Stantec should be notified so that such changes can be reviewed, and the recommendations amended as necessary.

These conclusions and recommendations are based on data and subsurface conditions from the borings advanced during this exploration using the degree of care and skill ordinarily exercised under similar circumstances by competent members of the engineering profession. No warranties can be made regarding the continuity of conditions.



## **5.2 LANDSLIDE DISCUSSION AND RECOMMENDATIONS**

At the conclusion of field and laboratory testing for the project, it was determined that the landslide is a shallow embankment failure most likely caused by drainage travelling down the embankment and from the nearby culvert. The recommended remediation method is special benching as outlined in Section 806 of the ODOT Geotechnical Design Manual (GDM). Recommended material properties for each soil layer encountered are summarized in Table 2. The properties were determined from laboratory testing or using estimates provided in Section 404 of the GDM. A summary of the calculations is provided in Appendix B.

*Table 2. Material Properties*

<b>Soil Type</b>	<b>Moist Unit Weight (pcf)</b>	<b>Saturated Unit Weight (pcf)</b>	<b>Drained Friction Angle (Deg)</b>	<b>Drained Cohesion (psf)</b>	<b>Undrained Friction Angle (Deg)</b>	<b>Undrained Cohesion (psf)</b>
Embankment Fill (Elevation 702.0 to 686.5 feet)	123	61	26	200	0	2,000
Glacial Till (Elevation 686.5 to 657.0 feet)	126	64	28	0	0	2,750



## **Appendix A Geotechnical Profile Drawings**



**PROJECT DESCRIPTION**

THIS PROJECT, WOO-75-07.00 IS THE EXPLORATION FOR INVESTIGATING A LANDSLIDE ALONG THE WEST SHOULDER OF INTERSTATE ROUTE (IR) 75 NORTH OF CYGNET IN WOOD COUNTY. THE LANDSLIDE IS OCCURRING ON A GENTLY CURVED PORTION DOWNHILL FROM THE SOUTHBOUND LANE. THE LANDSLIDE AFFECTS APPROXIMATELY 100 FEET OF THE ROAD.

**HISTORIC RECORDS**

ODOT TMS PROVIDES DOCUMENTATION FOR TWO GEOTECHNICAL EXPLORATIONS PERFORMED ALONG IR 75.

WOO-75-2.37 WAS AN EXPLORATION FOR RECONSTRUCTION OF EXISTING BRIDGES ALONG IR 75 OVER JERSEY CITY ROAD DRILLED IN 2013. THE PROJECT CONSISTED OF 24 BORINGS DRILLED TO DEPTHS OF 21.5 TO 41.5 FEET. FILL WAS ENCOUNTERED AT DEPTHS OF 17.0 TO 18.5 FEET AT THE ABUTMENTS, 4.0 TO 8.5 FEET AT THE PIERS, AND 3.0 TO 10.0 FEET IN THE ROADWAY. THE FILL SOILS WERE DESCRIBED AS SANDY SILT (A-4A), SILT AND CLAY (A-6A), SILTY CLAY (A-6B) AND CLAY (A-7-6). GLACIAL TILL SOILS WERE TYPICALLY ENCOUNTERED BELOW THE FILL. THE SOILS WERE DESCRIBED AS SANDY SILT (A-4A), SILT AND CLAY (A-6A), SILTY CLAY (A-6B), AND CLAY (A-7-6). BEDROCK WAS ENCOUNTERED AT DEPTHS RANGING FROM 11.0 TO 57.0 FEET FOR BORINGS DRILLED AT THE ADJACENT LAND AND THE BRIDGE. THE BEDROCK WAS DESCRIBED AS GRAY DOLOMITE.

WOO-(25)(75)-5.20 WAS AN EXPLORATION FOR THE NEW ALIGNMENT OF IR 75 AND SR 25 DRILLED IN 1963. THE PROJECT CONSISTED OF 103 BORINGS DRILLED IN EXISTING AND PROPOSED ALIGNMENTS. THE OVERBURDEN SOILS WERE CLASSIFIED AS COARSE AND FINE SAND (A-3A), GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT (A-2-4), SILT (A-4A), SANDY SILT (A-4B), SILT AND CLAY (A-6A), SILTY CLAY (A-6B), ELASTIC CLAY (A-7-5), AND CLAY (A-7-6). THE BORINGS WERE SHALLOW AND TERMINATED AT THE DEPTHS OF 10.0 TO 12.0 FEET, THUS BEDROCK INFORMATION WAS NOT AVAILABLE.

**GEOLOGY**

THE PROJECT IS LOCATED WITHIN THE WOODVILLE LAKE-PLAIN REEFS OF THE HURON-ERIE LAKE PLAINS. THE WOODVILLE LAKE-PLAIN REEFS ARE DESCRIBED AS LACUSTRINE PLAIN WITH LOW DUNES AND LAKE MARGIN FEATURES, PUNCTUATED BY MORE THAN 75 ANCIENT BEDROCK REEFS RISING 10 TO 40 FEET ABOVE THE LEVEL OF THE PLAIN AND RANGING FROM 0.1 TO 3.0 SQUARE MILES. IT ALSO CONSISTS OF OBLONG REEFS THAT ARE HIGHLY DRAPED WITH DRIFT. THE REGION HAS A VERY LOW RELIEF (GENERALLY ABOUT 10 FEET) WITH ELEVATIONS OF 600 TO 775 FEET.

THE GEOLOGY CONSISTS OF SEDIMENTARY ROCKS OF THE LOCKPORT DOLOMITE FROM THE SILURIAN AGE. THE LOCKPORT DOLOMITE GROUP CONSISTS OF DOLOMITE WITH MINOR LIMESTONE, CHERT AND SHALE. THE BEDROCK FROM THIS FORMATION IS DESCRIBED AS BLuish GRAY TO GRAY AND WEATHERS REDDISH GRAY TO GRAY. THE DIAGNOSTIC FEATURE CONSISTS OF FOSSILIFEROUS DOLOMITE AND DISTINCT PLANAR TO IRREGULAR BEDDING.

**RECONNAISSANCE**

STANTEC REPRESENTATIVES VISITED THE SITE ON MAY 13, 2025 TO OBSERVE THE SITE AND MARK BOREHOLE LOCATIONS. THE LAND SURROUNDING THE PROJECT SITE WAS DESCRIBED AS PRIMARILY RURAL, WITH SOME RESIDENTIAL AND BUSINESS LOCATIONS NEARBY. THE PAVEMENT OF IR 75 WAS OBSERVED TO BE IN FAIR CONDITION. PAVEMENT CRACKS WERE OBSERVED IN ALL SOUTH BOUND LANES. THE LANDSLIDE WAS OBSERVED TO BE A SHALLOW EMBANKMENT FAILURE, WITH A FAILURE SURFACE ESTIMATED TO BE APPROXIMATELY 5 FEET DEEP. AT THE TIME OF THE RECONNAISSANCE, THE LANDSLIDE WAS NOT IMPACTING TRAFFIC ON IR 75.

**SUBSURFACE EXPLORATION**

STANTEC ADVANCED TWO BORINGS TO OBTAIN GEOTECHNICAL DATA FOR THE PROPOSED ROADWAY IMPROVEMENTS.

- ONE ON THE WEST SHOULDER OF SOUTHBOUND IR 75 ABOVE THE LANDSLIDE.
- THE OTHER NEAR THE TOE OF THE LANDSLIDE AT THE BASE OF THE EMBANKMENT.

THE BORINGS WERE PERFORMED WITH A CME 45 TRACK-MOUNTED DRILL RIG USING 4 1/4-INCH INSIDE DIAMETER (ID) HOLLOW STEM AUGERS. THE STANDARD PENETRATION TEST (SPT) SAMPLING WAS PERFORMED CONTINUOUSLY UNTIL REACHING COREABLE BEDROCK. THE ENERGY RATIO (ER) OF THE CME 45 AUTOMATIC HAMMER AND DRILL ROD SYSTEM WAS MEASURED TO BE 90 PERCENT ON DECEMBER 22, 2022.

**EXPLORATION FINDINGS**

THE SURFACE MATERIALS ENCOUNTERED INCLUDE APPROXIMATELY 4 INCHES OF TOPSOIL AT THE TOE BORING AND 5 INCHES OF ASPHALT UNDERLAIN BY APPROXIMATELY 13 INCHES OF CONCRETE IN THE ROADWAY BORING. FINE-GRAINED SOILS WITH LOW TO MODERATE PLASTICITY WERE TYPICALLY ENCOUNTERED BENEATH THE SURFACE MATERIALS.

EMBANKMENT FILL WAS ENCOUNTERED BELOW THE ROADWAY MATERIALS IN B-001-0-25. THE FILL WAS CLASSIFIED AS SANDY SILT (A-4A) OR SILT AND CLAY (A-6A). THE FILL WAS DESCRIBED AS GRAY TO GRAY MOTTLED WITH BROWN, STIFF TO VERY STIFF, DAMP TO WET, AND HAVING LOW TO MODERATE PLASTICITY.

GLACIAL TILL WAS ENCOUNTERED BELOW THE EMBANKMENT SOIL IN B-001-0-25 AND THE TOPSOIL IN B-001-1-25. THE TILL WAS CLASSIFIED AS SILT AND CLAY (A-6A), SILTY CLAY (A-6B), AND CLAY (A-7-6). THE SOILS WERE DESCRIBED AS BROWN TO GRAY, MEDIUM STIFF TO HARD, DAMP TO WET, AND HAVING MODERATE PLASTICITY. GROUND WATER WAS ENCOUNTERED IN EACH BORING AT DEPTHS RANGING FROM 6 FEET (ELEVATION 678.0 FEET) IN B-001-1-25 TO 21.5 FEET (ELEVATION 680.5 FEET) IN B-001-0-25 WITHIN THE GLACIAL TILL LAYER.

IN EACH BORING, A THIN LAYER OF GRAVEL AND STONE FRAGMENTS (A-1-A) WAS ENCOUNTERED BETWEEN THE FINE-GRAINED SOILS DESCRIBED ABOVE AND BEDROCK. THE GRAVEL AND STONE FRAGMENTS WERE DESCRIBED AS GRAY, DENSE, AND MOIST. THE STONE FRAGMENTS WERE FURTHER DESCRIBED AS WEATHERED DOLOMITE.

BEDROCK AT THE SITE WAS DESCRIBED AS DOLOMITE AND ENCOUNTERED AT DEPTHS RANGING FROM 28 FEET (ELEVATION 656.0 FEET) IN B-001-1-25 TO 45.5 FEET (ELEVATION 656.5 FEET) IN B-001-0-25. THE DOLOMITE WAS DESCRIBED AS DARK GRAY TO GRAY, MODERATELY WEATHERED, AND HIGHLY TO MODERATELY FRACTURED.

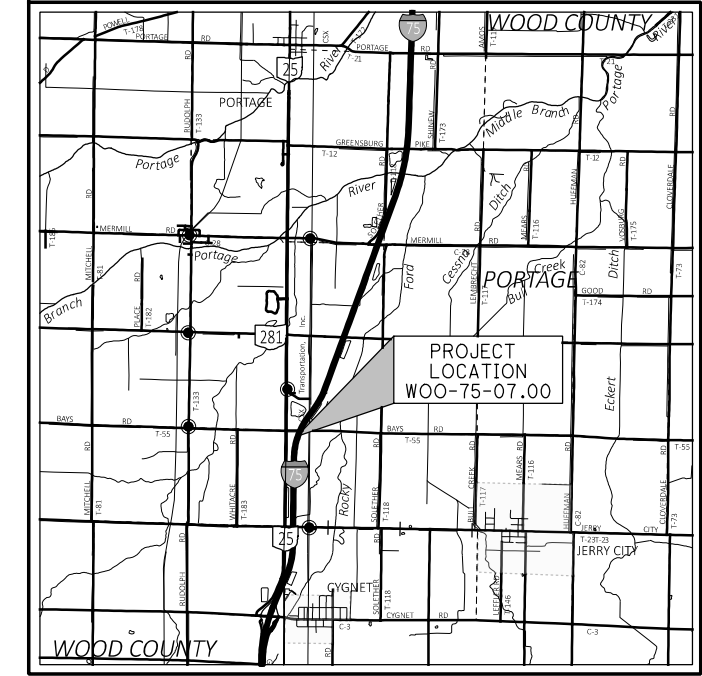
**SPECIFICATIONS**

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY 2025.

**AVAILABLE INFORMATION**

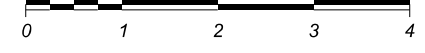
THE SOIL, BEDROCK, AND GROUNDWATER INFORMATION COLLECTED FOR THIS SUBSURFACE EXPLORATION THAT CAN BE CONVENIENTLY DISPLAYED ON THE SOIL PROFILE SHEETS HAS BEEN PRESENTED. GEOTECHNICAL REPORTS, IF PREPARED, ARE AVAILABLE FOR REVIEW ON THE OFFICE OF CONTRACT SALES WEBSITE.

LEGEND		ODOT CLASS	CLASSIFIED MECH./VISUAL	
DESCRIPTION				
GRAVEL AND STONE FRAGMENTS		A-1a	1	2
SANDY SILT		A-4a	1	2
SILT AND CLAY		A-6a	9	25
SILTY CLAY		A-6b	1	2
CLAY		A-7-6	2	3
		TOTAL	14	34
DOLOMITE		VISUAL		
PAVEMENT OR BASE = X = APPROXIMATE THICKNESS		VISUAL		
CONCRETE = X = APPROXIMATE THICKNESS		VISUAL		
TOPSOIL = X = APPROXIMATE THICKNESS		VISUAL		
PROJECT BORING LOCATION - PLAN VIEW.				
DRIVE SAMPLE AND/OR ROCK CORE BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.				
WC	INDICATES WATER CONTENT IN PERCENT.			
N <sub>60</sub>	INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.			
X/Y/Z	NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT): X= NUMBER OF BLOWS FOR FIRST 6 INCHES. Y= NUMBER OF BLOWS FOR SECOND 6 INCHES. Z= NUMBER OF BLOWS FOR THIRD 6 INCHES.			
W	INDICATES FREE WATER ELEVATION.			
TR	INDICATES TOP OF ROCK.			
SS	INDICATES A SPLIT SPOON SAMPLE.			
ST	INDICATES A SHELBY TUBE SAMPLE.			
Qu	INDICATES UNCONFINED COMPRESSIVE TEST (ROCK), ASTM D7012.			

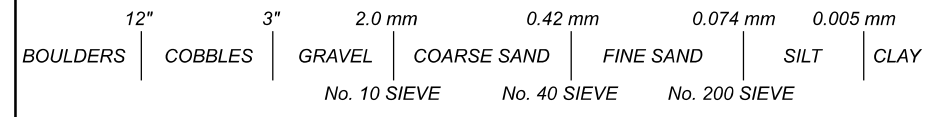


LOCATION MAP

SCALE IN MILES



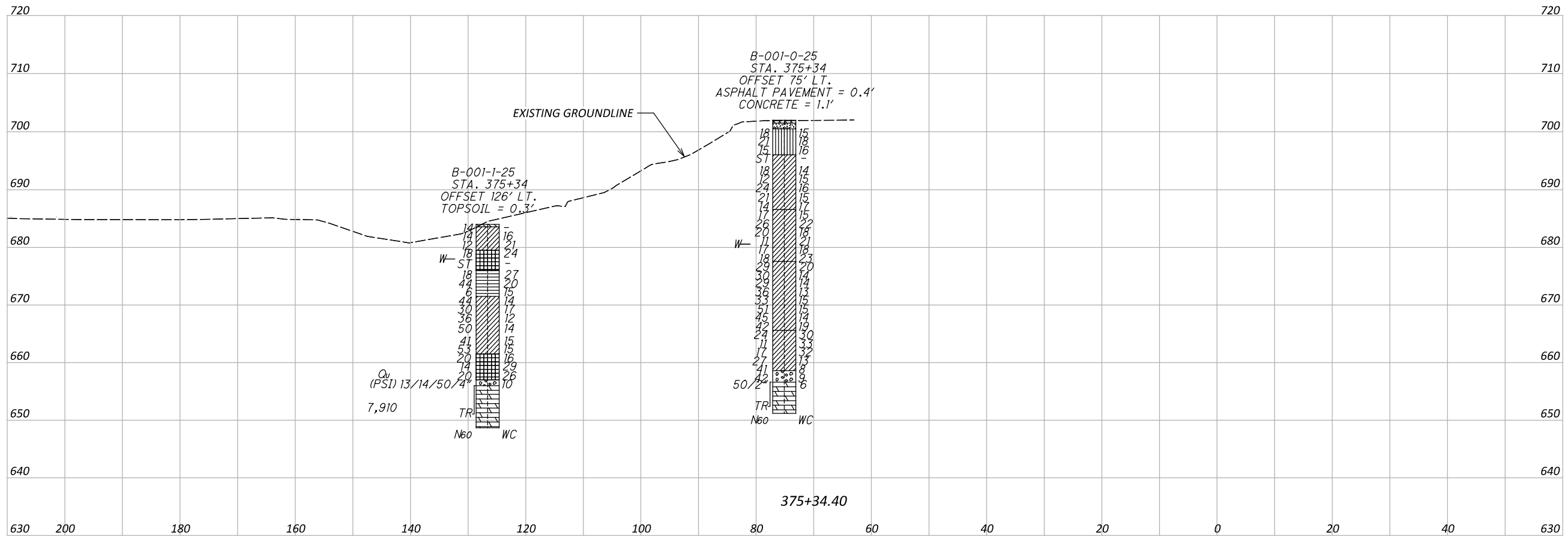
**PARTICLE SIZE DEFINITIONS**



- RECON.** - JAS & NU 05/13/2025
- DRILLING** - DC & JAS 05/21-05/22/2025
- DRAWN** - MJ 10/2025
- REVIEWED** - JRS 10/10/2025

DESIGN AGENCY  
  
 10200 Alliance Road,  
 Suite 300  
 Cincinnati, OH 45242  
 (513) 842-6200  
 DESIGNER  
 MSJ  
 REVIEWER  
 JRS 10-10-25  
 PROJECT ID  
 120414  
 SUBSET TOTAL  
 0 0  
 SHEET TOTAL  
 P.1 9





GEOTECHNICAL PROFILE - LANDSLIDE  
 CROSS SECTION STA. 375+34.40



DESIGNER  
**MSJ**

REVIEWER  
**JRS 10-10-25**

PROJECT ID  
**120414**

SUBSET	TOTAL
0	0
SHEET	TOTAL
P.3	9



B-001-0-25



Run #:	Depth	Recovery	RQD
NQ2-1	45.9'	50.4"/60.0" 84%	0.0"/60.0" 0%
WOO-75-7.00 PID: 120414			



B-001-1-25



Run #:	Depth	Recovery	RQD
NQ2-1	29.5'	21.6"/21.6"	100%
NQ2-2	31.3'	48.0"/48.0"	100%
WOO-75-7.00 PID: 120414			
		4.8"/21.6"	22%
		15.6"/48.0"	33%

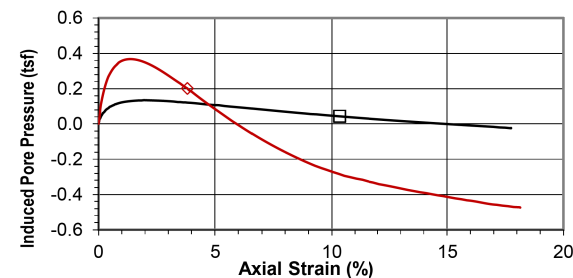
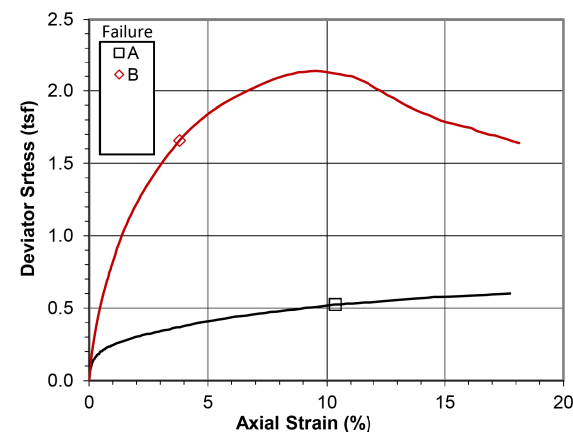
### Consolidated Undrained Triaxial Compression

ASTM D 4767

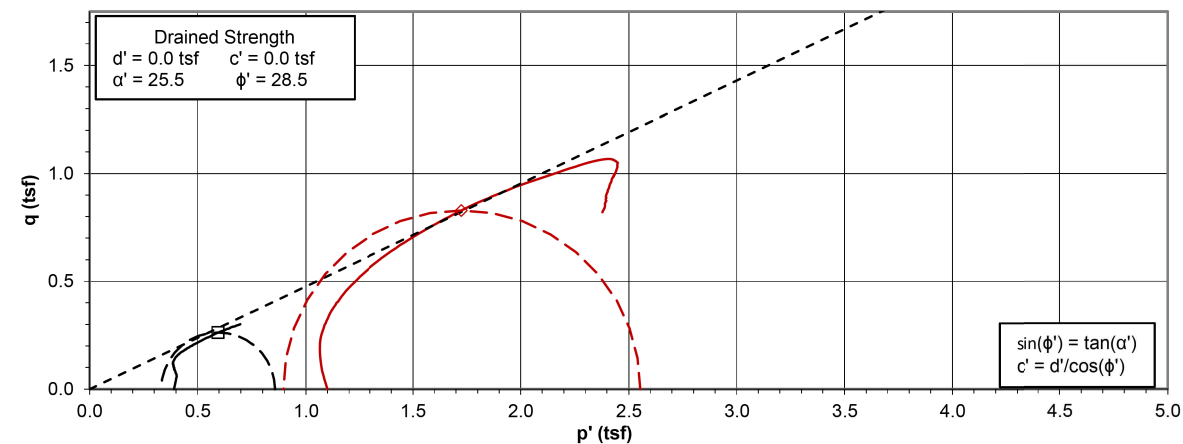
Project Name WOO-75-7.00

Project 175578434  
 Set ID 700

Test	Lab ID	Source	Description	Gs	LL	PL	PI
A	700	B-001-1-25, 6.0'-6.5'	Sandy Lean Clay (CL), brown, moist, firm	2.75			
B	700	B-001-1-25, 7.4'-7.9'	Lean Clay (CL), brown, moist, firm	2.75			



Specimen	A	B
Initial Specimen Conditions		
Average Height (in)	5.949	5.755
Average Diameter (in)	2.892	2.857
Moist Unit Weight (pcf)	124.5	130.7
Moisture Content (%)	23.4	22.2
Dry Unit Weight (pcf)	100.9	107.0
Void Ratio	0.698	0.602
Degree of Saturation (%)	92.0	101.5
Consolidated Specimen Conditions		
Moist Unit Weight (pcf)	130.7	130.4
Moisture Content (%)	21.6	21.9
Dry Unit Weight (pcf)	107.5	107.0
Void Ratio	0.594	0.601
Degree of Saturation (%)	100.0	100.0
Eff. Con. Stress, $\sigma'_3$ (tsf)	0.392	1.099
At Drained Failure		
Max. Eff. Prin. Stress Ratio		
Axial Strain (%)	10.339	3.810
Deviator Stress (tsf)	0.525	1.657
Induced Pore Press. (tsf)	0.044	0.201
Minor Eff. Stress, $\sigma'_3$ (tsf)	0.332	0.895
Major Eff. Stress, $\sigma'_1$ (tsf)	0.857	2.553
Eff. Stress Ratio, $\sigma'_1/\sigma'_3$	2.581	2.851
$p'$ (tsf)	0.594	1.724
$q$ (tsf)	0.262	0.829



Comments Classification data from SS-4 in B-001-1-25: A-7-6 (9)  
 %GR = 8, %CS = 2, %FS = 32, %SI = 14, %CL = 44  
 LL = 41, PL = 20, PI = 21

Reviewed By KG

### Unconsolidated Undrained Triaxial Compression

ASTM D 2850

Project Name WOO-75-7.00  
 Source B-001-0-25, 6.2'-6.7'  
 Description Lean Clay with Gravel (CL), dark brown, moist, firm  
 Specimen Type Intact

Project No. 175578434  
 Lab ID 670  
 Test ID 670-A

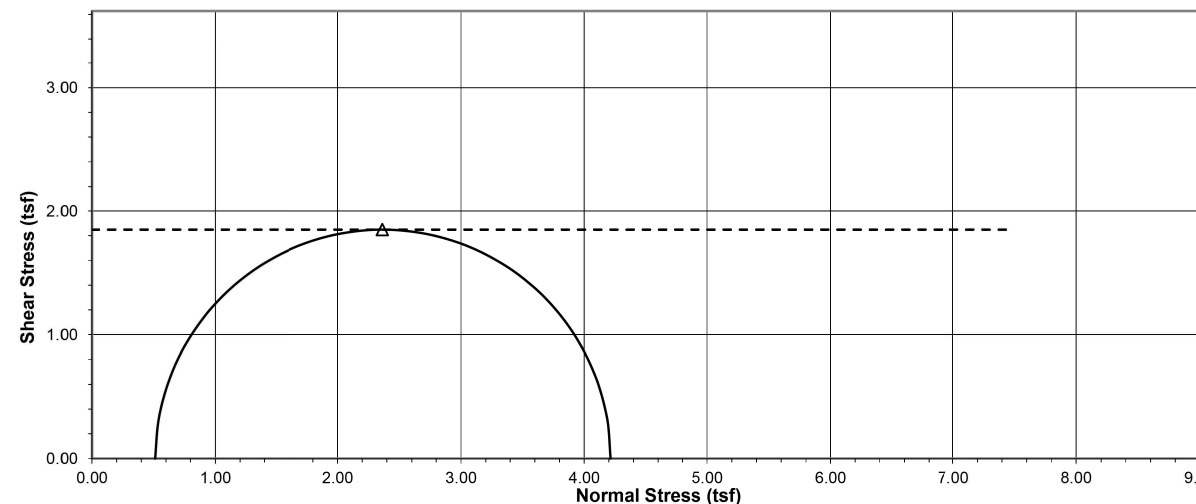
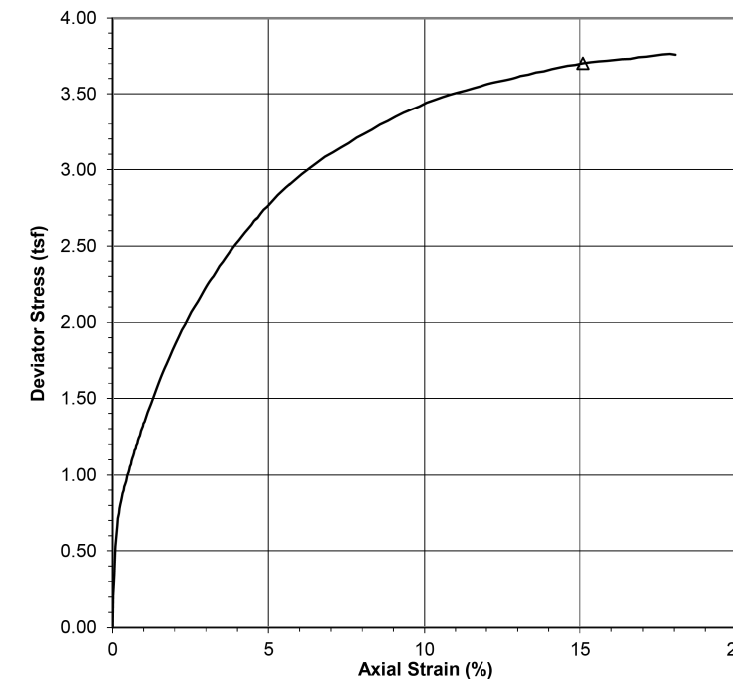
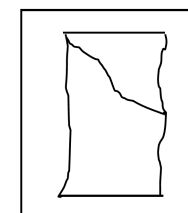
Date Received 06/02/2025  
 Date Tested 06/26/2025

Specific Gravity 2.72 Liquid Limit \_\_\_\_\_  
 ASTM D 854, Dry Plastic Limit \_\_\_\_\_  
 Plasticity Index \_\_\_\_\_

Target Test Parameters  
 Nominal Chamber Pressure (psi) 7.5  
 Actual Axial Strain Rate of Test (%/min) 1.001

At Unconsolidated Undrained Failure  
 Failure Criterion: 15% Axial Strain  
 Axial Strain (%) 15.10  
 Deviator Stress (tsf) 3.702  
 Minor Principal Stress,  $\sigma_3$  (tsf) 0.512  
 Major Principal Stress,  $\sigma_1$  (tsf) 4.214  
 Undrained Shear Strength,  $S_u$  (tsf) 1.851

Failure Sketch



Comments Classification data from SS-5 in B-001-0-25: A-6a (8)  
 %GR = 5, %CS = 7, %FS = 19, %SI = 31, %CL = 38  
 LL = 30, PL = 18, PI = 12

Reviewed KG

DESIGN AGENCY



**Stantec**  
 10200 Alliance Road,  
 Suite 300  
 Cincinnati, OH 45242  
 (513) 842-8200

DESIGNER

MSJ

REVIEWER

JRS 10-10-25

PROJECT ID

120414

SUBSET TOTAL

0 0

SHEET TOTAL

P.8 9

### Uniaxial Compressive Strength of Intact Rock Core Specimens

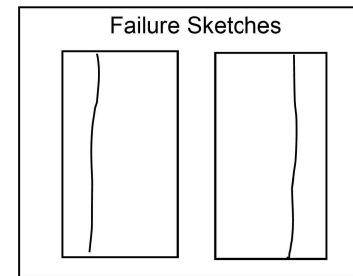
ASTM D 7012, Method C

Project Name WOO-75-7.00 Project Number 175578434  
 Lithology Dolostone, gray, medium strong Lab ID UCR-714  
 Hole Number B-001-1-25 Depth (ft) 31.8'-32.2' Date Received 06/02/2025  
 Temperature (°C) 23 Moisture Condition As Prepared, Moist Date Tested 06/16/2025  
 Side Planeness N/A Height (in) 4.954 Wet Unit Weight (pcf) 180.4  
 Perpendicularity N/A Diameter (in) 1.994 Dry Unit Weight (pcf) N/A  
 End Planeness N/A Area (in<sup>2</sup>) 3.124 Moisture Content (%) N/A  
 Parallelism N/A  
 Dimensions were not confirmed.

Loading Rate (lbf/sec) 141  
 Peak Load (lbf) 24716

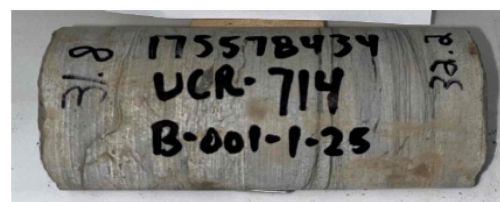
Failure Type Shear

Compressive Strength (psi) 7910  
 Compressive Strength (psf) 1139040  
 Compressive Strength (tsf) 570



Comments Fragile nature of specimen inhibited preparation, required capping of ends with Hydro-Stone.  
Dimensional tolerances were not confirmed.

CORE PREP



POST TEST



Reviewed By REL



DESIGNER	MSJ
REVIEWER	JRS 10-10-25
PROJECT ID	120414
SUBSET	TOTAL
0	0
SHEET	TOTAL
P.9	9

## **Appendix B Material Parameter Derivations**

### Material Property Estimation Using N<sub>60</sub> Values

#### B-001-0-25

Top Depth	Bot Depth	Avg SPT Depth	Blows 1st	Blows 2nd	Blows 3rd	N-value	Hammer Eff. (%)	N <sub>60</sub>	ODOT Class.	Unit Weight (pcf)	S <sub>u</sub> (psf)
1.5	3	2.5	13	5	7	12	90	18	A-4a	122	2250
3	4.5	4	8	6	8	14	90	21	A-4a	125	2625
4.5	6	5.5	4	4	6	10	90	15	A-4a	122	1875
8	9.5	9	6	5	7	12	90	18	A-6a	122	2250
9.5	11	10.5	3	3	5	8	90	12	A-6a	120	1500
11	12.5	12	6	8	8	16	90	24	A-6a	125	3000
12.5	14	13.5	5	6	8	14	90	21	A-6a	125	2625
14	15.5	15	2	3	6	9	90	14	A-6a	122	1687.5
15.5	17	16.5	3	5	6	11	90	17	A-6a	122	2062.5
17	18.5	18	7	8	9	17	90	26	A-6a	125	3187.5
18.5	20	19.5	5	6	7	13	90	20	A-6a	125	2437.5
20	21.5	21	2	2	5	7	90	11	A-6a	120	1312.5
21.5	23	22.5	4	4	7	11	90	17	A-6a	122	2062.5
23	24.5	24	2	4	8	12	90	18	A-6a	122	2250
24.5	26	25.5	6	8	11	19	90	29	A-6a	128	3562.5
26	27.5	27	4	7	13	20	90	30	A-6a	128	3750
27.5	29	28.5	3	7	12	19	90	29	A-6a	128	3562.5
29	30.5	30	5	11	13	24	90	36	A-6a	130	4500
30.5	32	31.5	3	9	13	22	90	33	A-6a	128	4125
32	33.5	33	12	16	18	34	90	51	A-6a	135	6375
33.5	35	34.5	8	13	17	30	90	45	A-6a	135	5625
35	36.5	36	8	12	16	28	90	42	A-6a	132	5250
36.5	38	37.5	7	7	9	16	90	24	A-6a	125	3000
38	39.5	39	3	3	4	7	90	11	A-6a	120	1312.5
39.5	41	40.5	3	5	6	11	90	17	A-6a	122	2062.5
41	42.5	42	6	7	11	18	90	27	A-6a	125	3375

Recommended For Analysis			
Soil Layer	Total Unit Wt (pcf)	Su (psf)	c' (psf)
Embankment (1.5-15.5)	123	2000	200
Till (15.5-43.0)	126	2750	0

B-001	Water Depth	21.5 ft
	Unit Weight Water	62.4 pcf

#### B-001-1-25

Top Depth	Bot Depth	Avg SPT Depth	Blows 1st	Blows 2nd	Blows 3rd	N-value	Hammer Eff. (%)	N <sub>60</sub>	ODOT Class.	Unit Weight (pcf)	S <sub>u</sub> (psf)
0	1.5	1	2	4	5	9	90	14	A-6a	122	1687.5
1.5	3	2.5	2	4	5	9	90	14	A-6a	122	1687.5
3	4.5	4	3	4	4	8	90	12	A-6a	120	1500
4.5	6	5.5	5	6	6	12	90	18	A-7-6	122	2250
8	9.5	9	4	5	7	12	90	18	A-6b	122	2250
9.5	11	10.5	9	12	17	29	90	44	A-6b	132	5437.5
11	12.5	12	2	2	2	4	90	6	A-6b	115	750
12.5	14	13.5	10	13	16	29	90	44	A-6a	132	5437.5
14	15.5	15	4	9	11	20	90	30	A-6a	128	3750
15.5	17	16.5	6	12	12	24	90	36	A-6a	130	4500
18	19.5	19	5	10	23	33	90	50	A-6a	135	6187.5
19.5	21	20.5	11	14	13	27	90	41	A-6a	132	5062.5
21	22.5	22	10	14	21	35	90	53	A-6a	135	6562.5
22.5	24	23.5	6	6	7	13	90	20	A-7-6	125	2437.5
24	25.5	25	4	3	6	9	90	14	A-7-6	122	1687.5
25.5	27	26.5	3	6	7	13	90	20	A-7-6	125	2437.5

Recommended For Analysis			
Soil Layer	Total Unit Wt (pcf)	Su (psf)	c' (psf)
Till (0.0-27.0)	126	2750	0

B-001-1	Water Depth	6 ft
---------	-------------	------