

October 16, 2023

Three Leaf Partners  
504 W. Juneau Avenue  
Milwaukee, WI 53203

## Hartland Apartments: Perimeter Slope Maintenance & Inspection Plan

Three Leaf Partners in conjunction with design professionals from Payne & Dolan, GeoTest, and Insight Landscape Design have worked collaboratively throughout the design of this project to evaluate the existing conditions of the former Palmer Sand & Gravel property, design the planned improvements to ensure a greenspace buffer is maintained adjacent to the existing slopes, document the existing stability of the existing cut slopes and to have a procedure for future landowners and property managers to monitor, detect and mitigate surface or global instability of the existing perimeter slopes.

### Existing Conditions

The subject property consists of glacial deposits (primarily sand and gravel) that were mined from the 1930s to the 1960s. The property was owned and operated by Palmer Sand & Gravel and produced road gravel for the construction industry. The existing perimeter slopes along Hill Street, adjacent to the cemeteries and residential properties that front on W. Capitol Drive have remained unchanged since extraction activities ceased in the 1960s. The embankment associated with Palmer Drive was constructed in the 1970s and has remained unchanged since that time. The vegetation present on the slopes is a dense mix of trees, shrubs and ground cover plant material consistent with 50+ years of growth with very few places where the soils are completely bare and exposed. A storm sewer outfall on Hill Street, likely constructed in the 1980s, discharges onto the gravelly slope east of the Village's water tower. This discharge has resulted in surface erosion and scour, but not resulted in any significant failures of the Hill Street cut slope.

Due to the gravelly nature of the existing slopes and the presence of large cobbles in the glacial deposit, the soils have a very high infiltration rate. The combination of the very high infiltration rate, the high percentage of large cobbles, and the absence of groundwater, make the slopes very durable to surface erosion. The presence of a dense mix of trees, shrubs and ground cover on the slopes is evidence of the durability and stability of the perimeter slopes.

The details of the geotechnical investigation, global stability analysis, surface erosion sensitivity analysis, baseline slope inspection and baseline vegetation analysis are all attached as appendices to serve as a resource for landowners and property management professionals.

### Proposed Improvements

The building and ponds associated with the subject development have been cited in a manner that places them all outside of a theoretical 2:1 slope stability setback projected from the top of the existing

perimeter slopes to the proposed finished grade of the development. Additionally, the northern area of the sand and gravel pit will be raised approximately 20 feet and reduce the exposed heights of the perimeter slopes to reduce the possibilities of slope failure. Further, excess overburden material will be placed at the bottom of the existing perimeter slopes and serve as a toe buttress to further reduce the possibilities of slope failure. The toe buttressing also provides a level area (10:1) at the bottom of the perimeter slopes where gravels or cobbles that become dislodged will gather and serve as visual indicators of instability to aid monitoring and inspection efforts. These areas are outside of the mowed turf areas and in the unoccupied open space of the development.

### **Global Stability**

Using the laboratory results of the geotechnical investigation, slope stabilities analyzed at four locations with the resulting factor of safety determined to be 1.5 or higher. The USACOE Slope Stability Manual (EM 1110-2-1902, 31 Oct 03) Section 3-4 provide factor of safety guidance for new embankments and multi-stage loading conditions. A factor of safety of 1.5 was determined to be the most suitable for analyzing the global stability of the existing cut slope embankment for the subject property. The USACOE guide also provides unsatisfactory slope performance characteristics which include: shear failure, surface sloughing, excessive deformation, liquefaction and piping. A slope inspection form has been developed to assist with identification of these conditions during future inspections.

### **Surface Erosion**

Given the glacial deposits present on this site, the large concern for slope instability is surface erosion which can be identified easy thru routine visual inspections and occurs slowly and incrementally in these gravelly soils with large cobbles, high infiltration rates and the absence of groundwater. Surface erosion is anticipated to occur primarily as a result of uncontrolled and concentrated surface water runoff. A dense mix of vegetation is indicative of stable slopes not experiencing surface erosion.

A Hill Street public storm sewer outfall had eroded the existing perimeter slope beneath the pipe outfall. A corrective action plan has been developed for this condition and will be completed as part of the overall development of the property. It should be noted that the runoff energy from the pipe outfall is dissipated by the large cobbles in the glacial deposit and runoff infiltrated before the flows reach the existing floor of the gravel pit. The corrective action plan for this area is designed to fill the washout beneath the outfall with the native sand and gravel with large cobbles, place coir logs parallel to the slope with live stakes and brush mats to dissipate energy, and rip-rap the slope from the pipe outfall to the proposed top of the toe buttress

### **Monitoring & Inspections**

A baseline inspection has been completed for the perimeter slopes that documents their condition prior to the start of construction activities. The slope inspection aimed to identify any signs of global instability, surface erosion, and to document the trees and shrubs that are present as well as to identify any signs in the growth patterns that are indicative of instability. The findings of both further reinforce that the existing slopes are stable.

The inspection did identify a Village of Hartland storm sewer outfall on the south side of Hill Street and east of the water tower that has caused erosion to the slope below the outfall. The pipe was likely installed in the 1980s and the erosion has occurred incrementally since the time of initial construction. A corrective action plan has been developed to repair the slope and stabilize the outfall of the pipe.

It is recommended that a qualified professional perform a perimeter slope inspection every three years to identify any signs of slope instability and determine when correction actions are warranted. This would also include a review of the vegetation growth patterns.

Respectfully,

A handwritten signature in black ink, appearing to read "Craig Donze". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Craig Donze, PE PLS  
Payne & Dolan  
Engineering Manager

Cc: Ryan Amtmann, PE, Village of Hartland Engineer

### **Appendices**

Appendix A - Geotechnical Slope Stability Analysis, GeoTest, September 29, 2023

Appendix B – Slope Observations and Maintenance Manual, Insight Landscape Design, October 3, 2023

Appendix C – Master Grading Plan (Cut-Fill), Payne & Dolan, September 5, 2023

Appendix D – Slope Maintenance & Inspection Plan, Payne & Dolan, September 28, 2023

Appendix E – Slope Inspection and Maintenance Checklist, Payne & Dolan, October 3, 2023

Appendix F – Indicators of Slope Instability & Corrective Actions, Payne & Dolan, October 3, 2023

September 8, 2023



John Ford  
President  
Three Leaf Partners  
504 W. Juneau Avenue  
Milwaukee WI, 53203

Subject: Geotechnical Slope Stability Analysis  
Hartland Quarry Apartments  
700 W. Capitol Drive, Hartland, Wisconsin

Dear Mr. Ford,

GeoTest, Inc. (GeoTest) has prepared this slope stability analysis for the west, north, and southeast bluffs around the perimeter of the above-referenced property. This report describes the subsurface exploration, laboratory testing, and computer analysis services, and presents our conclusions regarding the slope stability of the perimeter bluffs.

### **Project Description**

Three Leaf Partners is proposing to develop the property located at 700 W. Capitol Drive in the Village of Hartland, Wisconsin. The location of the project is illustrated in Figure 1 in Appendix A. The boundaries of the combined 45-acre property are illustrated in Figure 2 in Appendix A.

The proposed development consists of eighteen separate buildings, including a single-story club house, two-story apartment buildings, and single-story garage buildings. The development will also include parking and drive paved areas and multiple stormwater management devices. The proposed development is illustrated in Figure 3 in Appendix A.

The perimeter bluffs currently have slopes steeper than 1h:1v, with many sections close to 0.75h:1v. The proposed development plan assumes the final slopes will be designed for effectively 2h:1v, with toe buttresses ranging from 4h:1v to 10h:1v.

### **Geotechnical Services Background**

GeoTest completed an initial slope stability analysis for seven selected bluff sections. That analysis (report dated July 17, 2023) concluded that the seven sections will have Factors of Safety ranging from 1.3 to 4.3, based on the preliminary site grading plans. GeoTest also completed a geotechnical subsurface investigation (report dated May 4, 2023). That investigation provided geotechnical design parameters and recommendations related to the construction of buildings, pavements, and stormwater management systems.



## **Scope of Work**

### **Geotechnical Subsurface Exploration**

To advance the slope stability analysis for the most critical bluff sections (along Palmer Drive and Hill Street, and adjacent to the two cemeteries), we initiated a geotechnical exploration program. The locations of the four cross-sections are illustrated on Figure 4 in Appendix A. The drilling scope consisted of four borings (B-1 through B-4) drilled to depths of 60 to 70 feet below the existing ground surface. The boring locations are also identified on Figure 4 in Appendix A.

The borings were drilled using conventional hollow-stem augers to avoid the introduction of drilling fluids into the soil profile. Soil samples were obtained at 5-foot intervals in the borings using split-barrel sampling procedures in general accordance with ASTM D1586. Representative portions of the samples were sealed in glass jars and returned to GeoTest for laboratory testing and classification.

Descriptive logs for each boring, which describe the method of drilling, sample types, sample depths, and observations regarding soil and groundwater conditions, were prepared at the time of sampling. These logs were utilized by a GeoTest geotechnical engineer as an aid to prepare the final logs included in Appendix B.

The ground surface elevations at the boring locations were interpolated from a preliminary topographic map produced by Payne & Dolan. Water level observations, if encountered, were noted on the field logs.

All drilling and sampling procedures are described in Appendix C.

### **Laboratory Testing**

The laboratory testing program consisted of water content testing on all boring samples. In addition, a GeoTest geotechnical engineer examined and visually classified each sample, based on texture and plasticity, in accordance with the Unified Soil Classification System (USCS). The engineer grouped soil samples into strata that are illustrated on the logs.

The notes included on the logs and charts describing the system of classification are included in Appendix B. All laboratory testing procedures are described in Appendix C.

The recovered soil samples will be retained for 60 days after the date of this report. Unless other instructions as to their disposition are received, they will be discarded at that point.

### Soil and Groundwater Conditions

The following narrative is a generalization of the subsurface conditions encountered at the borings. Soil conditions can vary in areas between the sampling locations. For a more-detailed description of the subsurface conditions encountered at each sampling location, please refer to the attached logs in Appendix B.

#### Soil Conditions

The predominant soil profile encountered at the borings (beneath surface topsoil) consisted of stratified layers of native sand and gravel soils with varying clay, silt, cobble, and boulder content. They were classified as SC, SC-SM, SM, SW-SM, and GW-GM. No cohesive (clay or silt) layers were encountered or observed at the borings.

The soils recovered in the borings were similar to the soils (bluff samples) recovered during the May geotechnical investigation.

Buried concrete rubble fill was encountered at the initial location of B-1 (east of Palmer Drive) that caused auger refusal and prompted moving west of Palmer Drive.

The predominant native granular soils generally exhibited medium to very dense relative densities, with N-values ranging from 15 to sampler refusal (greater than 50 for 6 inches). The N-values were the lowest (medium dense) to depths of 3 to 15 feet.

Typically, moisture contents are considered high if they are above 15% in granular soils and above 20% in cohesive soils. The moisture contents in the native granular soils ranged from 1.6% to 12.6%, with an average of 5.5%.

Based on the field and laboratory data, four soil types were selected, with different physical characteristics used in the slope stability analysis. These were defined as follows:

| <b>Name</b> | <b>Soil Density</b> | <b>Friction Angle</b> | <b>Description</b>           |
|-------------|---------------------|-----------------------|------------------------------|
| Soil 1      | 130 pcf             | 30 <sup>0</sup>       | Medium Dense Sand with Fines |
| Soil 2      | 135 pcf             | 32 <sup>0</sup>       | Very Dense Sand with Fines   |
| Soil 3      | 140 pcf             | 33 <sup>0</sup>       | Dense Sand and/or Gravel     |
| Soil 4      | 145 pcf             | 35 <sup>0</sup>       | Very Dense Sand and Gravel   |

The analyzed soil profiles consisting of these four generalized soil types are illustrated on the cross-sections included in Appendix D.

#### Groundwater Conditions

No free groundwater or perched water layers were encountered at the borings. These field observations were consistent with the laboratory testing.

### Analysis and Conclusions

Because of the relatively consistent nature of the soils observed during the May investigation and this additional analysis (granular soils), the additional slope stability analysis considered all field and laboratory data generated from both. The analysis was performed using STABLPRO 2015.4.5. The following table summarizes the results.

| Section | Factor of Safety | Representative Boring |
|---------|------------------|-----------------------|
| 1       | 2.4              | 1                     |
| 2       | 1.5              | 2                     |
| 3       | 1.7              | 3                     |
| 4       | 1.5              | 4                     |

*Note - The complete output reports and cross-sections for each section analysis are included in Appendix D.*

The above Factor of Safety (FOS) results were assessed by referencing the following section in the USACOE Slope Stability Manual:

*EM 1110-2-1902 31 Oct 03 -*

*3-4. Other Slopes*

*a. Factors of safety. Factors of safety for slopes other than the slopes of dams should be selected consistent with the uncertainty involved in the parameters such as shear strength and pore water pressures that affect the calculated value of factor of safety and the consequences of failure. When the uncertainty and the consequences of failure are both small, it is acceptable to use small factors of safety, on the order of 1.3 or even smaller in some circumstances. When the uncertainties or the consequences of failure increase, larger factors of safety are necessary. Large uncertainties coupled with large consequences of failure represent an unacceptable condition, no matter what the calculated value of the factor of safety. The values of factor of safety listed in Table 3-1 provide guidance but are not prescribed for slopes other than the slopes of new embankment dams. Typical minimum acceptable values of factor of safety are about 1.3 for end of construction and multistage loading, 1.5 for normal long-term loading conditions, and 1.1 to 1.3 for rapid drawdown in cases where rapid drawdown represents an infrequent loading condition. In cases where rapid drawdown represents a frequent loading condition, as in pumped storage projects, the factor of safety should be higher.*

The goal for this project is to create and maintain a minimum FOS of 1.5. The sections analyzed meet these criteria.

The proposed civil design creates minimum slopes of 2H:1V (theoretical) from the tops of each slope to the toes. The design incorporates toe buttresses that will serve to resist slope failures and provide a mid-level horizontal bench top to collect material that may erode from

the upper slope section that will not be remodeled. The proposed slopes of the toe buttresses (minimum 4h:1v) will provide increased FOS.

There are three slope areas that have visual erosion and a lack of vegetation. A fourth area will be removed during site grading. These areas are illustrated on the Photograph Log in Appendix A. A mitigation plan for these three slopes will be addressed in a vegetation management plan prepared by others. These areas will also be specifically targeted to receive additional fills at their buttresses to further reduce the exposed height of the existing slopes.

The USACOE guide also considers Unsatisfactory Slope Performance (Section 1.7), which includes: shear failure, surface sloughing, excessive deformation, liquefaction, and piping. There are several small areas of visible surface sloughing between sections 2 and 6. These areas will be evaluated to determine the source of the sloughing, which appears to be stormwater runoff from adjacent lands.

### **General Qualifications**

The services provided by GeoTest on this project were performed with the degree of skill and care typically performed by other members of the geotechnical engineering profession, practicing in this locale, at this time. No other warranty, expressed or implied, is given.

We appreciate the opportunity to provide geotechnical engineering services for this project. If you have any questions, or require any further assistance, please feel free to contact us.

Sincerely,

*Michael D. Frede, P.E.*

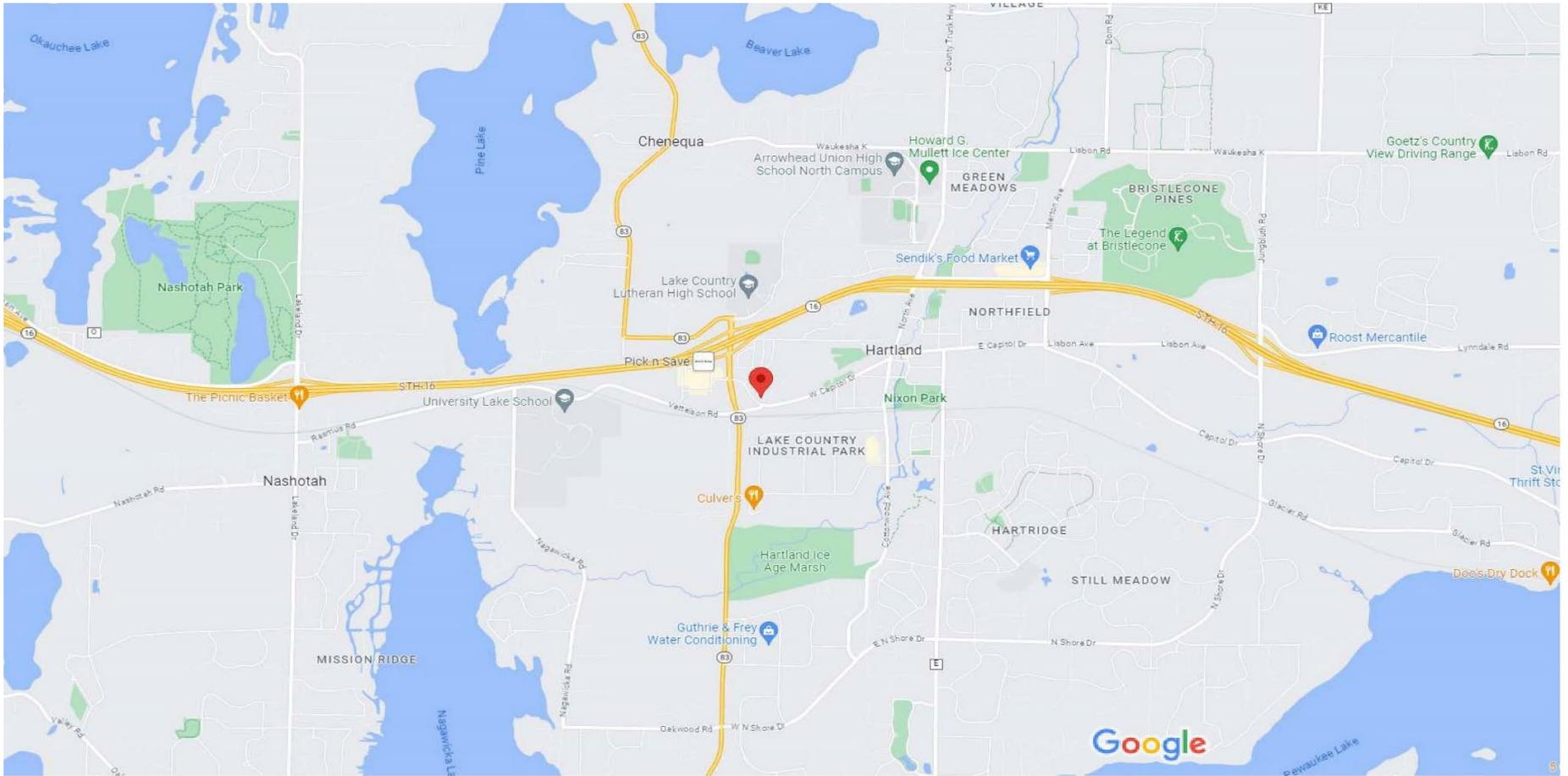
Michael D. Frede, P.E.  
Technical Director/Senior Engineer



## Appendix A

- Figure 1 – Site Location Diagram
- Figure 2 – Property Location Diagram
- Figure 3 – Proposed Development Diagram
- Figure 4 – Boring & Cross-Section Location Diagram
- Photographic Log





Map data ©2023 Google 2000 ft



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
Hartland, Wisconsin  
Waukesha County

**Project No.:** 7708  
**Date:** 4/29/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 1**  
**Site Location**  
**Diagram**



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
 Hartland, Wisconsin  
 Waukesha County

**Project No.:** 7708  
**Date:** 9/5/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 2**  
**Property Boundary**  
**Diagram**



JLA PROJECT NUMBER: W221013

**HARTLAND QUARRY DEVELOPMENT**  
Plan Commission Submittal

**PROGRESS DOCUMENTS**  
These documents reflect progress and are not and shall not be subject to public review or comment. These documents are for informational purposes only and shall not be used for any other purpose without the consent of JLA Architects.

DATE OF RELEASE: 09/26/2023

REVISIONS ON SCHEDULE:

| NO. | DATE | DESCRIPTION | BY |
|-----|------|-------------|----|
|     |      |             |    |

**ARCHITECTURAL SITE LAYOUT PLAN**

SHEET NUMBER:  
**ASP-100**



RENDERED ARCHITECTURAL SITE PLAN  
1" = 100' 0"



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
Hartland, Wisconsin  
Waukesha County

**Project No.:** 7708  
**Date:** 9/5/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 3**  
**Proposed**  
**Development**  
**Diagram**



**Project Name:** Hartland Quarry Apartments  
**Project Location:** 700 W. Capitol Drive  
 Hartland, Wisconsin  
 Waukesha County

**Project No.:** 7708  
**Date:** 9/5/23  
**Drawn By:** MDF  
**Scale:** NTS

**FIGURE 4**  
**Boring & Cross-**  
**Section Location**  
**Diagram**

### Photographic Log

|   |                       |   |                             |
|---|-----------------------|---|-----------------------------|
| <b>Project:</b><br>Hartland Quarry Apartments           |                       | <b>Client:</b><br>Three Leaf Partners   | <b>Project No.:</b><br>7708 |
| <b>Photo No.</b><br>1                                   | <b>Date</b><br>9-7-23 |  |                             |
| <b>Description:</b><br>Erosion area along Palmer Drive. |                       |   |                             |

|  |                       |  |  |
|--|-----------------------|--|--|
| <b>Photo No.</b><br>2  | <b>Date</b><br>9-7-23 |  |  |
| <b>Description:</b><br>Erosion area near the neighboring barn. |                       |  |  |

|   |                                       |                             |
|---|---------------------------------------|-----------------------------|
| <b>Project:</b><br>Hartland Quarry Apartments | <b>Client:</b><br>Three Leaf Partners | <b>Project No.:</b><br>7708 |
|---|---------------------------------------|-----------------------------|

|   |                       |  |
|---|-----------------------|--|
| <b>Photo No.</b><br>3   | <b>Date</b><br>9-7-23 |  |
| <b>Description:</b><br>Erosion area near the North Point Church Cemetery. |                       |  |

|   |                       |  |
|---|-----------------------|--|
| <b>Photo No.</b><br>4   | <b>Date</b><br>9-7-23 |  |
| <b>Description:</b><br>Erosion area north of the industrial area. |                       |  |



## Appendix B

- General Notes
- Boring Logs
  - B-1
  - B-2
  - B-3
  - B-4
- Legend
- Unified Soil Classification System (USCS)



## Drilling and Sampling Abbreviations:

|                                 |   |
|---------------------------------|---|
| <b>AD</b> Solid-Stem Auger      | <b>OS</b> Osterberg Sampler, 3-inch-O.D. Shelby Tube                                    |
| <b>AS</b> Auger Sample          | <b>PMT</b> Pressuremeter Test (In Situ)   |
| <b>BS</b> Bulk Sample           | <b>RD</b> Rotary Drilling   |
| <b>DD</b> Diamond Core Drilling | <b>SS</b> Split-Spoon Sampler, 1.375-inch-I.D., 2-inch-O.D.<br>(Unless otherwise noted) |
| <b>FT</b> Fish Tail             | <b>ST</b> Shelby Tube Sampler, 2-inch-O.D. (Unless otherwise noted)                     |
| <b>GP</b> Geoprobe              | <b>VS</b> Vane Shear  |
| <b>GS</b> Giddings Sampler      | <b>WOH</b> Weight of Hammer   |
| <b>HA</b> Hand-Auger Drilling   | <b>WS</b> Wash Sample   |
| <b>HS</b> Hollow-Stem Auger     |   |

Standard Penetration (“N”): Blows per foot of a 140-pound hammer falling 30 inches on a 2-inch-O.D. split-spoon sampler, except where otherwise noted.

## Water Level Measurement Abbreviations:

|                                       |                                  |                          |
|---------------------------------------|----------------------------------|--------------------------|
| <b>AAR</b> After Auger Removal        | <b>BCR</b> Before Casing Removal | <b>WS</b> While Sampling |
| <b>AB</b> After Boring                | <b>DCI</b> Dry Cave In           |                          |
| <b>ACR</b> After Casing Removal       | <b>WCI</b> Wet Cave In           |                          |
| <b>BAR</b> Before Auger Removal       | <b>WD</b> While Drilling         |                          |
| <b>BCI</b> Before Casing Installation | <b>WL</b> Water Level            |                          |

Water levels indicated on the boring logs are the levels measured in the boring at the times indicated. In relatively pervious soils, the observed water levels are considered a reliable indicator of groundwater positions. In relatively impervious soils, the accurate determination of groundwater elevations may not be possible, even after several days of observations. In this case, other indicators of groundwater position, such as sealed observation wells or piezometers, may be required.

## Gradation Description and Terminology:

Coarse-grained granular soils have more than 50% of their dry weight retained on a #200 sieve (0.074 mm); they include boulders, cobbles, gravel, sand, and combinations thereof. Fine-grained soils have less than 50% of their dry weight retained on a #200 sieve. Fine-grained granular soils are non-cohesive, and include silt; fine-grained cohesive soils include silty clay, and clay.

| Major Component of Sample | Size Range                             | Description of Components Present in Sample | Percent of Dry Weight |
|---------------------------|--|---|-----------------------|
| Boulders                  | Over 8" (200 mm)                       | Trace                                       | <5                    |
| Cobbles                   | 8" to 3" (200 to 75 mm)                | Few   | 5 - 10                |
| Gravel                    | 3" to #4 sieve (75 to 4.76 mm)         | Little                                      | 15 - 25               |
| Sand                      | #4 to #200 sieve (4.76 to 0.074 mm)    | Some  | 30 - 45               |
| Silt                      | Passing #200 sieve (0.074 to 0.005 mm) |   |                       |
| Clay                      | Smaller than 0.005 mm                  |   |                       |

### Consistency of Cohesive Soils

| Unconfined Compressive Strength, Qu, tsf | Consistency |
|--|-------------|
| <0.25                                    | Very Soft   |
| 0.25 - 0.49                              | Soft        |
| 0.50 - 0.99                              | Firm        |
| 1.00 - 1.99                              | Stiff       |
| 2.00 - 3.99                              | Very Stiff  |
| >4.00                                    | Hard        |

### Relative Density of Granular Soils

| N, Blows per 12 inches | Relative Density |
|------------------------|------------------|
| 0 - 3                  | Very Loose       |
| 4 - 9                  | Loose            |
| 10 - 29                | Medium Dense     |
| 30 - 49                | Dense            |
| 50 - 80                | Very Dense       |
| >80                    | Extremely Dense  |



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-1  
 Page: 1 of 3

Drilling Start Date: 8/11/23  
 Drilling End Date: 8/11/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 60  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1007  
 Location (Lat, Long): 43.10481, -88.35907

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               |  | SOIL/ROCK VISUAL DESCRIPTION | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|--|------------------------------|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 0          |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 0.00'      |           |             |             |             |               | (0.00') Topsoil: 6 inches of Sandy Topsoil   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 0.50'      |           |             |             |             |               | (0.50') Clayey SAND (SC); mostly fine-coarse grained sand, few fine-coarse gravel, few silt, little clay, well-graded, medium dense, slightly moist, brown   | 6.4                          |                      |                   |              |               |                       |                |                           |                                       | 1005           |
| 3.00'      |           |             |             |             |               | (3.00') Silty, Clayey SAND and gravel (SC-SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, little clay, well-graded, dense, slightly moist, brown, occasional cobbles | 6                            |                      |                   |              |               |                       |                |                           |                                       | 1000           |
| 9.50'      |           |             |             |             |               |  | 9.5                          |                      |                   |              |               |                       |                |                           |                                       | 995            |
| 14.00'     |           |             |             |             |               |  | 1.6                          |                      |                   |              |               |                       |                |                           |                                       | 990            |
| 22.00'     |           |             |             |             |               | (22.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, few clay, well-graded, very dense, slightly moist, brown, occasional cobbles        | 2.2                          |                      |                   |              |               |                       |                |                           |                                       | 985            |
| 27.00'     |           |             |             |             |               |  | 2.7                          |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-1  
 Page: 2 of 3

|   |   |
|---|---|
| Drilling Start Date: 8/11/23              | Boring Depth (ft): 60                     |
| Drilling End Date: 8/11/23                | Boring Diameter (in): 6.0                 |
| Drilling Company: PTS                     | Sampling Method(s): Split Spoon           |
| Drilling Method: Hollow Stem Auger        | DTW During Drilling (ft): N/A             |
| Drilling Equipment: CME55/Geoprobe 7822DT | DTW After Drilling (ft): N/A              |
| Driller: Brian Szydzik/Jed Vela           | Ground Surface Elev. (ft): 1007           |
| Logged By: Michael Frede                  | Location (Lat, Long): 43.10481, -88.35907 |

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               |  | SOIL/ROCK VISUAL DESCRIPTION | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|--|------------------------------|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 25         |           |             |             |             |               | (22.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, few clay, well-graded, very dense, slightly moist, brown, occasional cobbles    |                              |                      |                   |              |               |                       |                |                           |                                       | 980            |
|            |           |             |             |             |               | (26.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders |                              |                      |                   |              |               |                       |                |                           |                                       | 975            |
| 30         |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 970            |
|            |           |             |             |             |               |  |                              | 3.9                  |                   |              |               |                       |                |                           |                                       | 965            |
| 35         |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 960            |
|            |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 40         |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 45         |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 50         |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-1  
 Page: 3 of 3

|   |   |
|---|---|
| Drilling Start Date: 8/11/23              | Boring Depth (ft): 60                     |
| Drilling End Date: 8/11/23                | Boring Diameter (in): 6.0                 |
| Drilling Company: PTS                     | Sampling Method(s): Split Spoon           |
| Drilling Method: Hollow Stem Auger        | DTW During Drilling (ft): N/A             |
| Drilling Equipment: CME55/Geoprobe 7822DT | DTW After Drilling (ft): N/A              |
| Driller: Brian Szydzik/Jed Vela           | Ground Surface Elev. (ft): 1007           |
| Logged By: Michael Frede                  | Location (Lat, Long): 43.10481, -88.35907 |

| DEPTH (ft) | LITHOLOGY   | WATER LEVEL | COLLECT     |             |               |  | SOIL/ROCK VISUAL DESCRIPTION | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|---|-------------|-------------|-------------|---------------|--|------------------------------|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |   |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 50         | Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders |             |             |             |               | (26.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders | 3.4                          |                      |                   |              |               |                       |                |                           | 955                                   |                |
| 55         |   | SS          | 50          |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 950            |
| 60         |   |             | SS          | 50          | 0.10          |  |                              |                      |                   |              |               |                       |                |                           | 945                                   |                |
| 65         |   |             |             |             |               | (60.00') Boring terminated   |                              |                      |                   |              |               |                       |                |                           | 940                                   |                |
| 70         |   |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           | 935                                   |                |
| 75         |   |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-2  
 Page: 1 of 3

|   |   |
|---|---|
| Drilling Start Date: 8/8/23               | Boring Depth (ft): 70                     |
| Drilling End Date: 8/8/23                 | Boring Diameter (in): 6.0                 |
| Drilling Company: PTS                     | Sampling Method(s): Split Spoon           |
| Drilling Method: Hollow Stem Auger        | DTW During Drilling (ft): N/A             |
| Drilling Equipment: CME55/Geoprobe 7822DT | DTW After Drilling (ft): N/A              |
| Driller: Brian Szydzik/Jed Vela           | Ground Surface Elev. (ft): 1025           |
| Logged By: Michael Frede                  | Location (Lat, Long): 43.10544, -88.35778 |

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               |              | SOIL/ROCK VISUAL DESCRIPTION   | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|--------------|--|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD% |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 0          |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       | 1025           |
| 0.00'      |           |             |             |             |               |              | (0.00') Topsoil: 4 inches of Sandy Topsoil   |                      |                   |              |               |                       |                |                           |                                       |                |
| 0.50'      |           |             |             |             |               |              | (0.50') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, well-graded, medium dense, slightly moist, brown, occasional cobbles             | 6.3                  |                   |              |               |                       |                |                           |                                       |                |
| 7          | SS        |             | 7           | 0.80        | 15            |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 8          |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 5          | SS        |             | 5           | 0.70        | 19            |              |  | 5.9                  |                   |              |               |                       |                |                           |                                       | 1020           |
| 9          |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 10         |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 10         | SS        |             | 11          | 0.70        | 30            |              |  | 4.5                  |                   |              |               |                       |                |                           |                                       | 1015           |
| 13         |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 17         |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 15         | SS        |             | 50          |             |               |              | (13.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders |                      |                   |              |               |                       |                |                           |                                       | 1010           |
| 20         |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 20         | SS        |             | 5           | 0.40        | 50            |              |  | 5.5                  |                   |              |               |                       |                |                           |                                       | 1005           |
| 50         |           |             |             |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 25         | SS        |             | 50          |             |               |              |  |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-2  
 Page: 2 of 3

Drilling Start Date: 8/8/23  
 Drilling End Date: 8/8/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1025  
 Location (Lat, Long): 43.10544, -88.35778

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               |  | SOIL/ROCK VISUAL DESCRIPTION  | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|--|---|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%   |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 25         |           |             |             |             |               | (13.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders |   |                      |                   |              |               |                       |                |                           |                                       | 1000           |
| 27         |           |             | SS          | 19          | 0.20          | 59   |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 30         |           |             |             | 27          |               |  |   | 8.6                  |                   |              |               |                       |                |                           |                                       | 995            |
| 32         |           |             |             | 32          |               |  |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 35         |           |             |             |             |               | (31.00') Silty SAND (SM); mostly fine-coarse grained sand, few fine-coarse gravel, little silt, well-graded, dense, slightly moist, brown  |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 35         |           |             | SS          | 10          | 0.30          | 33   |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 38         |           |             |             | 15          |               |  |   | 10.2                 |                   |              |               |                       |                |                           |                                       | 990            |
| 40         |           |             |             | 18          |               |  |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 40         |           |             | SS          | 16          | 1.00          | 44   |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 42         |           |             |             | 21          |               |  |   | 4.4                  |                   |              |               |                       |                |                           |                                       | 985            |
| 43         |           |             |             | 23          |               |  |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 45         |           |             | SS          | 8           | 0.70          | 70   | (42.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown |                      |                   |              |               |                       |                |                           |                                       |                |
| 48         |           |             |             | 20          |               |  |   | 4.9                  |                   |              |               |                       |                |                           |                                       | 980            |
| 50         |           |             |             | 50          |               |  |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 50         |           |             | SS          | 50          |               |  |   |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-2  
 Page: 3 of 3

Drilling Start Date: 8/8/23  
 Drilling End Date: 8/8/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1025  
 Location (Lat, Long): 43.10544, -88.35778

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               |   | SOIL/ROCK VISUAL DESCRIPTION   | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|---|--|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%  |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 50         |           |             |             |             |               | (42.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown |  |                      |                   |              |               |                       |                |                           |                                       | 975            |
| 55         |           |             | SS          | 11          | 0.80          | 37  | (51.00') Well-graded SAND with silt and gravel (SW-SM); mostly fine-coarse grained sand, little fine-coarse gravel, few silt, dense, slightly moist, brown                                     | 9.6                  |                   |              |               |                       |                |                           |                                       | 970            |
| 60         |           |             | SS          | 16          | 0.30          | 50  | (57.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders | 8.9                  |                   |              |               |                       |                |                           |                                       | 965            |
| 65         |           |             | SS          | 50          | 0.10          |   |  | 2.3                  |                   |              |               |                       |                |                           |                                       | 960            |
| 70         |           |             | SS          | 22          | 0.30          | 50  |  | 5                    |                   |              |               |                       |                |                           |                                       | 955            |
| 75         |           |             |             |             |               | (70.00') Boring terminated  |  |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-3  
 Page: 1 of 3

Drilling Start Date: 8/9/23  
 Drilling End Date: 8/9/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10538, -88.35464

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               | SOIL/ROCK VISUAL DESCRIPTION               | Moisture Content (%)  | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|--|---|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) |  |   |                   |              |               |                       |                |                           |                                       |                |
| 0          |           |             |             |             |               | (0.00') Topsoil: 5 inches of Sandy Topsoil |   |                   |              |               |                       |                |                           |                                       |                |
| 0.50       |           |             | SS          | 5           | 0.80          | 15   | (0.50') Silty, Clayey SAND (SC-SM); mostly fine-coarse grained sand, few fine-coarse gravel, little silt, little clay, well-graded, medium dense, slightly moist, brown                                     | 4.6               |              |               |                       |                |                           |                                       | 1020           |
| 3.00       |           |             | SS          | 5           | 1.20          | 33   | (3.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, well-graded, dense, slightly moist, brown, occasional cobbles and boulders                    | 6                 |              |               |                       |                |                           |                                       | 1015           |
| 15.00      |           |             | SS          | 15          |               | 41   |   |                   |              |               |                       |                |                           |                                       | 1010           |
| 18.00      |           |             | SS          | 7           | 0.70          | 41   |   | 8.1               |              |               |                       |                |                           |                                       | 1005           |
| 20.00      |           |             | SS          | 5           | 1.00          | 39   | (20.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders | 6.3               |              |               |                       |                |                           |                                       | 1000           |
| 25.00      |           |             | SS          | 10          | 0.80          | 58   |   | 3.8               |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-3  
 Page: 2 of 3

Drilling Start Date: 8/9/23  
 Drilling End Date: 8/9/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10538, -88.35464

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               |   | SOIL/ROCK VISUAL DESCRIPTION   | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|---|--|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%  |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 25         |           |             |             |             |               |   |  |                      |                   |              |               |                       |                |                           |                                       | 995            |
|            |           |             |             |             |               | (20.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders |  |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             | SS          | 50          |               |   |  |                      |                   |              |               |                       |                |                           |                                       |                |
| 30         |           |             |             |             |               | (30.00') Well-graded SAND with silt and gravel (SW-SM); mostly fine-coarse grained sand, little fine-coarse gravel, few silt, dense, slightly moist, brown  |  |                      |                   |              |               |                       |                |                           |                                       | 990            |
|            |           |             | SS          | 17          | 0.20          | 48  |  | 4.3                  |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 22          |               |   |  |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 26          |               |   |  |                      |                   |              |               |                       |                |                           |                                       | 985            |
| 35         |           |             |             |             |               |   |  |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             | SS          | 18          | 0.50          | 43  |  | 3.1                  |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 20          |               |   |  |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 23          |               |   |  |                      |                   |              |               |                       |                |                           |                                       | 980            |
| 40         |           |             |             |             |               |   |  |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             | SS          | 17          | 0.80          | 36  | (41.00') Silty SAND with gravel (SM); mostly fine-coarse grained sand, little fine-coarse gravel, little silt, well-graded, dense, slightly moist, brown | 3.4                  |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 15          |               |   |  |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 21          |               |   |  |                      |                   |              |               |                       |                |                           |                                       | 975            |
| 45         |           |             |             |             |               |   |  |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             | SS          | 16          | 0.20          | 50  |  | 2.6                  |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 50          |               |   |  |                      |                   |              |               |                       |                |                           |                                       | 50             |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-3  
 Page: 3 of 3

|   |   |
|---|---|
| Drilling Start Date: 8/9/23               | Boring Depth (ft): 70                     |
| Drilling End Date: 8/9/23                 | Boring Diameter (in): 6.0                 |
| Drilling Company: PTS                     | Sampling Method(s): Split Spoon           |
| Drilling Method: Hollow Stem Auger        | DTW During Drilling (ft): N/A             |
| Drilling Equipment: CME55/Geoprobe 7822DT | DTW After Drilling (ft): N/A              |
| Driller: Brian Szydzik/Jed Vela           | Ground Surface Elev. (ft): 1022           |
| Logged By: Michael Frede                  | Location (Lat, Long): 43.10538, -88.35464 |

| DEPTH (ft) | LITHOLOGY  | WATER LEVEL | COLLECT     |             |               |   | SOIL/ROCK VISUAL DESCRIPTION | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|--|-------------|-------------|-------------|---------------|---|------------------------------|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |  |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 50         | Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders |             |             |             |               | (49.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, well-graded, very dense, slightly moist, brown, occasional cobbles and boulders |                              |                      |                   |              |               |                       |                |                           |                                       | 970            |
| 55         |  | SS          | 27          | 0.60        | 56            |   | 6.2                          |                      |                   |              |               |                       |                |                           |                                       |                |
|            |  |             | 22          |             |               |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |  |             | 34          |             |               |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 60         |  | SS          | 10          | 0.70        | 52            |   | 5.3                          |                      |                   |              |               |                       |                |                           |                                       |                |
|            |  | 28          |             |             |               |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |  | 24          |             |             |               |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 65         | SS   | 13          | 0.20        | 50          | 4.2           |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |  | 50          |             |             |               |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 70         | SS   | 19          | 0.30        | 50          | 6             |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |  | 50          |             |             |               |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |  |             |             |             |               | (70.00') Boring terminated  |                              |                      |                   |              |               |                       |                |                           |                                       | 950            |
| 75         |  |             |             |             |               |   |                              |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-4  
 Page: 1 of 3

Drilling Start Date: 8/10/23  
 Drilling End Date: 8/10/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10332, -88.35357

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               | SOIL/ROCK VISUAL DESCRIPTION  | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|---|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 0          |           |             |             |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 8          | SS        |             | 8           | 0.70        | 28            | (0.50') Silty SAND (SM); mostly fine-coarse grained sand, few fine-coarse gravel, little silt, well-graded, medium dense, slightly moist, brown, occasional cobbles                         | 12.6                 |                   |              |               |                       |                |                           |                                       | 1020           |
| 18         |           |             | 10          |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 5          | SS        |             | 5           | 0.80        | 14            |   | 10.4                 |                   |              |               |                       |                |                           |                                       |                |
| 6          |           |             | 6           |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 8          |           |             | 8           |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 10         | SS        |             | 4           | 0.60        | 15            |   | 8.9                  |                   |              |               |                       |                |                           |                                       |                |
| 5          |           |             | 5           |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 10         |           |             | 10          |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 15         | SS        |             | 9           | 0.70        | 29            |   | 9.2                  |                   |              |               |                       |                |                           |                                       |                |
| 14         |           |             | 14          |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 15         |           |             | 15          |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 20         | SS        |             | 13          | 0.40        | 28            | (20.00') Well-graded SAND with silt and gravel (SW-SM); mostly fine-coarse grained sand, little fine-coarse gravel, few silt, dense, slightly moist, brown, occasional cobbles and boulders | 8.7                  |                   |              |               |                       |                |                           |                                       |                |
| 14         |           |             | 14          |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 20         |           |             | 19          | 0.30        | 44            |   | 1.6                  |                   |              |               |                       |                |                           |                                       |                |
| 21         |           |             | 21          |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |
| 23         |           |             | 23          |             |               |   |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-4  
 Page: 2 of 3

Drilling Start Date: 8/10/23  
 Drilling End Date: 8/10/23  
 Drilling Company: PTS  
 Drilling Method: Hollow Stem Auger  
 Drilling Equipment: CME55/Geoprobe 7822DT  
 Driller: Brian Szydzik/Jed Vela  
 Logged By: Michael Frede

Boring Depth (ft): 70  
 Boring Diameter (in): 6.0  
 Sampling Method(s): Split Spoon  
 DTW During Drilling (ft): N/A  
 DTW After Drilling (ft): N/A  
 Ground Surface Elev. (ft): 1022  
 Location (Lat, Long): 43.10332, -88.35357

| DEPTH (ft) | LITHOLOGY | WATER LEVEL | COLLECT     |             |               |  | SOIL/ROCK VISUAL DESCRIPTION | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|-----------|-------------|-------------|-------------|---------------|--|------------------------------|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |           |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 25         |           |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 995            |
|            |           |             |             |             |               | (20.00') Well-graded SAND with silt and gravel (SW-SM); mostly fine-coarse grained sand, little fine-coarse gravel, few silt, dense, slightly moist, brown, occasional cobbles and boulders    |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             | SS          | 12          | 0.30          | 50   |                              | 4.7                  |                   |              |               |                       |                |                           |                                       |                |
| 30         |           |             |             | 50          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             |             |               | (32.00') Silty SAND (SM); mostly fine-coarse grained sand, few fine-coarse gravel, little silt, well-graded, dense, slightly moist, brown  |                              |                      |                   |              |               |                       |                |                           |                                       | 990            |
|            |           |             | SS          | 15          | 0.40          | 43   |                              | 2.7                  |                   |              |               |                       |                |                           |                                       |                |
| 35         |           |             |             | 18          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 25          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 985            |
|            |           |             | SS          | 14          | 0.50          | 45   |                              | 2.9                  |                   |              |               |                       |                |                           |                                       |                |
| 40         |           |             |             | 15          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 30          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 980            |
|            |           |             | SS          | 9           | 0.80          | 47   |                              | 3.5                  |                   |              |               |                       |                |                           |                                       |                |
| 45         |           |             |             | 20          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             | 27          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |           |             |             |             |               | (46.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders |                              |                      |                   |              |               |                       |                |                           |                                       | 975            |
|            |           |             | SS          | 15          | 0.30          | 50   |                              | 7.2                  |                   |              |               |                       |                |                           |                                       |                |
| 50         |           |             |             | 50          |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



Client: Three Leaf Partners  
 Project: Hartland Quarry Apts, #7708  
 Address: 700 W. Capitol Drive, Hartland, WI

**BORING LOG**  
 Boring No. B-4  
 Page: 3 of 3

|   |   |
|---|---|
| Drilling Start Date: 8/10/23              | Boring Depth (ft): 70                     |
| Drilling End Date: 8/10/23                | Boring Diameter (in): 6.0                 |
| Drilling Company: PTS                     | Sampling Method(s): Split Spoon           |
| Drilling Method: Hollow Stem Auger        | DTW During Drilling (ft): N/A             |
| Drilling Equipment: CME55/Geoprobe 7822DT | DTW After Drilling (ft): N/A              |
| Driller: Brian Szydzik/Jed Vela           | Ground Surface Elev. (ft): 1022           |
| Logged By: Michael Frede                  | Location (Lat, Long): 43.10332, -88.35357 |

| DEPTH (ft) | LITHOLOGY   | WATER LEVEL | COLLECT     |             |               |  | SOIL/ROCK VISUAL DESCRIPTION | Moisture Content (%) | Dry Density (pcf) | Liquid Limit | Plastic Limit | Plasticity Index (PI) | #200 Sieve (%) | Pocket Penetrometer (tsf) | Unconfined Compressive Strength (tsf) | ELEVATION (ft) |
|------------|---|-------------|-------------|-------------|---------------|--|------------------------------|----------------------|-------------------|--------------|---------------|-----------------------|----------------|---------------------------|---------------------------------------|----------------|
|            |   |             | Sample Type | Blow Counts | Recovery (ft) | N Value RQD%   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 50         | Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders |             |             |             |               | (46.00') Well-graded GRAVEL with silt and sand (GW-GM); mostly fine-coarse grained gravel, some fine-coarse sand, few silt, very dense, slightly moist, brown, occasional cobbles and boulders |                              |                      |                   |              |               |                       |                |                           |                                       | 970            |
| 55         |   | SS          | 12          | 0.50        | 67            |  | 5.2                          |                      |                   |              |               |                       |                |                           |                                       |                |
|            |   |             | 17          |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |   |             | 50          |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 60         |   | SS          | 20          | 0.50        | 52            |  | 5.3                          |                      |                   |              |               |                       |                |                           |                                       |                |
|            |   | 19          |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |   | 33          |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 65         |   |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 960            |
|            |   | SS          | 50          |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 955            |
| 70         |   |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       | 950            |
|            |   | SS          | 18          | 0.30        | 50            | 5  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |   | 50          |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |
|            |   |             |             |             |               | (70.00') Boring terminated   |                              |                      |                   |              |               |                       |                |                           |                                       |                |
| 75         |   |             |             |             |               |  |                              |                      |                   |              |               |                       |                |                           |                                       |                |

NOTES:



## BORING AND WELL LOG LEGEND

|  |  |  |  |
|--|--|--|--|
|  | <p><b>SURFACE</b><br/>         ASPHALT<br/>         CONCRETE<br/>         FILL<br/>         TOPSOIL<br/>         AIR<br/>         ICE</p> <p><b>USCS</b><br/>         Well-graded GRAVEL (GW)<br/>         Poorly graded GRAVEL (GP)<br/>         Silty GRAVEL (GM)<br/>         Clayey GRAVEL (GC)<br/>         Silty, Clayey GRAVEL (GC-GM)<br/>         Well-graded GRAVEL with silt (GW-GM)<br/>         Poorly graded GRAVEL with silt (GP-GM)<br/>         Well-graded GRAVEL with clay (GW-GC)<br/>         Poorly graded GRAVEL with clay (GP-GC)<br/>         Well-graded SAND (SW)<br/>         Poorly graded SAND (SP)<br/>         Silty SAND (SM)<br/>         Clayey SAND (SC)<br/>         Silty, Clayey SAND (SC-SM)<br/>         Well-graded SAND with silt (SW-SM)<br/>         Poorly graded SAND with silt (SP-SM)<br/>         Well-graded SAND with clay (SW-SC)<br/>         Poorly graded SAND with clay (SP-SC)<br/>         SILT (ML)<br/>         Lean CLAY (CL)<br/>         Silty CLAY (CL-ML)<br/>         Organic SOIL (OL)<br/>         Elastic SILT (MH)<br/>         Fat CLAY (CH)<br/>         Organic SOIL (OH)<br/>         Organic SOIL (OL/OH)<br/>         PEAT (PT)<br/>         BEDROCK<br/>         IGNEOUS Rock<br/>         METAMORPHIC Rock<br/>         SEDIMENTARY Rock<br/>         WATER</p> <p><b>Non-USCS</b><br/>         Gravel<br/>         Sand<br/>         Silt<br/>         Clayey Silt<br/>         Silt &amp; Clay<br/>         Clay &amp; Silt<br/>         Silty Clay<br/>         Clay<br/>         Boulders<br/>         Cobbles<br/>         Peastone<br/>         Glacial Till<br/>         Iron Ore<br/>         Wood<br/>         Peat<br/>         Saprolite<br/>         Ash<br/>         Waste</p> |  | <p><b>Volume Descriptors</b><br/>         Trace = &lt;5%<br/>         Few = 5-10%<br/>         Little = 15-25%<br/>         Some = 30-45%<br/>         Mostly = &gt;=50%</p> <p><b>Water Levels</b><br/>  Water Level During Drilling<br/>  Water Level at End of Drilling/in Completed Well</p> <p><b>Well/Boring Completion</b><br/>         Cap<br/>         Riser<br/>         Screen<br/>         End Plug<br/>         Annular Seal<br/>         Sanitary Seal (Bentonite Slurry/Chips/Pellets/Powder, Other)<br/>         Filter Pack (Sand, Gravel, Other)<br/>         Backfill</p> <p><b>Sample Type</b><br/>  GR Grab<br/>  EN Encore<br/>  SS Split Spoon<br/>  SH Shelby Tube<br/>  CO Core Barrel<br/>  DP Direct Push<br/>  ID Lab Sample and ID</p> <p><b>NOTES:</b><br/>         - The boring was backfilled with soils cuttings and bentonite chips upon completion.<br/>         - The stratification lines represent approximate boundaries between soil types<br/>         - The elevations are considered accurate to 1/2 foot.</p> |
|--|--|--|--|

# Unified Soil Classification System (USCS)



| Major Divisions  |  | Group symbols                                 | Typical Names   | Laboratory classification criteria   |   |   |  |
|--|--|---|---|--|---|---|--|
| Coarse-grained soils<br>(More than half of material is larger than No. 200 sieve size) | Gravels<br>(More than half of coarse fraction is larger than No. 4 sieve size) | GW  | Well-graded gravels, gravel-sand mixtures, little or no fines                               | Determine percentages of sand and gravel from grain-size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows:<br>Less than 5 percent . . . . . GW, GP, SW, SP<br>More than 12 percent . . . . . GM, GC, SM, SC<br>5 to 12 percent . . . . . Borderline cases requiring dual symbols | $C_u = \frac{D_{60}}{D_{10}}$ greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 |   |  |
|  |  | GP  | Poorly graded gravels, gravel-sand mixtures, little or no fines                             |  | Not meeting all gradation requirements for GW   |   |  |
|  |  | GM  | d   |  | Silty gravels, gravel-sand-silt mixtures  | Atterberg limits below "A" line or P.I. less than 4   |  |
|  |  |   | u   |  |   | Atterberg limits above "A" line or P.I. greater than 7  |  |
|  | GC   | Clayey gravels, gravel-sand-clay mixtures     | Above "A" line with P.I. Between 4 and 7 are borderline cases requiring use of dual symbols |  |   |   |  |
|  | Sands<br>(More than half of coarse fraction is smaller than No. 4 sieve size)  | Clean sands<br>(Little or no fines)           | SW  |  | Well-graded sands, gravelly sands, little or no fines   | $C_u = \frac{D_{60}}{D_{10}}$ greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ between 1 and 3 |  |
|  |  |   | SP  |  | Poorly graded sands, gravelly sands, little or no fines   | Note meeting all gradation requirements for SW  |  |
|  |  | SM  | d   |  | Silty sand, sand-silt mixtures  | Atterberg limits below "A" line or P.I. less than 4   |  |
|  |  |   | u   |  |   | Atterberg limits above "A" line or P.I. greater than 7  |  |
|  |  | SC  | Clayey sands, sand-clay mixtures  |  | Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols  |   |  |
| Fine-grained soils<br>(More than half of material is smaller than No. 200 sieve size)  |  | Silt and clays<br>(Liquid limit less than 50) | ML  | Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity   |   |   |  |
|  | CL   |   | Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays        |  |   |   |  |
|  | OL   |   | Organic silts and organic silty clays of low plasticity                                     |  |   |   |  |
|  | Silt and clays<br>(Liquid limit greater than 50)                               | MH  | Inorganic silts, micaceous or diatomaceous fine sandy or silty soil, elastic silts          |  |   |   |  |
|  |  | CH  | Inorganic clays of high plasticity, fat clays   |  |   |   |  |
|  |  | OH  | Organic clays of medium to high plasticity, organic silts                                   |  |   |   |  |
|  | Highly organic soils   | Pt  | Peat and other highly organic soils   |  |   |   |  |



## Appendix C

- Drilling Procedures
- Sampling Procedures
- Laboratory Procedures



## **Hand-Auger Drilling (HA)**

A sampling device is driven into the soil to the desired sample depth by a sledge hammer. After extracting the sample, the hole is advanced by a hand auger until the next sampling depth is reached. The manual driving of the sampler, especially into cohesive soils, may result in some sample disturbance. However, there are some situations where this method is the only viable option.

## **Solid-Stem Auger Drilling (AD)**

Continuous flight augers are turned and hydraulically advanced by a truck- or track-mounted unit to create a borehole. In solid-stem auger drilling, casing and drilling mud are not typically used to maintain an open borehole.

## **Hollow-Stem Auger Drilling (HS)**

Continuous flight augers having open stems are used to advance the borehole. The open stem allows the sampling tool to be used without removing the augers from the borehole. Hollow-stem augers maintain an open borehole during the sampling operations. This sampling method is not appropriate for geotechnical investigation beneath the water table, especially in granular soils.

## **Rotary Drilling (RD)**

Various cutting bits, in conjunction with circulating drilling fluid, are used to advance the borehole. Surface casing is used to maintain sidewall stability in the top several meters of the borehole, and to facilitate the circulation of the drilling fluid into the mud tank.

## **Diamond Core Drilling (DD)**

A double-tube or triple-tube core barrel with a diamond bit cuts an annular space around a cylinder of rock or cemented material. When the coring has proceeded to the desired core run length, the core is broken off and the sample is retained by a core catcher just above the diamond bit. Samples recovered by this procedure are placed in sturdy core boxes in sequential order.

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### **Auger Sampling (AS)**

Soil samples are obtained as cuttings from the auger flights as they are lifted from the borehole. Auger samples provide a general indication of subsurface conditions; however, they do not provide undisturbed samples, nor do they provide samples from specific depths. Due to the possible loss of soil components, or the mixing of soil components from various elevations, auger samples may not be representative of in-situ soil conditions.

### **Split-Barrel Sampling (SS) - ASTM Standard D-1586-84**

A 2-inch-O.D. split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer free-falling 30 inches. The first 6 inches of penetration is usually considered a seating drive. The Standard Penetration Resistance value is the number of blows of the hammer over the final 12 inches of driving. This value provides an indication of the in-place relative density of granular soils. The indication should be considered qualitative, since many variables such as drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies can significantly affect the Standard Penetration Resistance value. A representative portion of the soil sample is recovered from the split-barrel sampler, placed in a sample jar, and delivered to our laboratory for further examination and possible testing.

### **Shelby Tube Sampling Procedure (ST) - ASTM Standard D-1587-83**

A 2- or 3-inch-diameter thin-walled seamless steel tube having a sharp cutting edge is hydraulically pushed into the soil to obtain a relatively undisturbed sample. This procedure is generally used for cohesive soils. The Shelby tubes are carefully handled to minimize sample disturbance, and delivered to a laboratory where the soil is extruded from the tube, examined, and tested.

# Soil Sampling Methods

American Society for Testing and Materials

## ASTM 1586

### Standard Method for Penetration Test and Split-Barrel Sampling of Soils<sup>1</sup>

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of the last revision. A number in parentheses indicates the year of the last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

This method has been approved for use by agencies of the Department of Defense and for listing in the DOD Index of Specifications and Standards.

#### 1. Scope

1.1 This method describes the procedure, generally known as the Standard Penetration (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

#### 2. Applicable Documents

##### 2.1 ASTM Standards:

D2487 Test Method for Classification of Soils for Engineering Purposes<sup>2</sup>

D2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)<sup>2</sup>

D4220 Practice for Preserving and Transporting Soil Samples<sup>2</sup>

#### 3. Descriptions of Terms Specific to This Standard

3.1 anvil—that portion of the drive-weight assembly while the hammer strikes and through which the hammer energy passes into the drill rods.

3.2 cathead—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by succes-

sively tightening and loosening the rope turns around the drum

3.3 drill rods—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.4 drive-weight assembly—a device consisting of the hammer, hammer fall guide, the anvil, any hammer drop system.

3.5 hammer—that portion of the drive-weight assembly consisting of the  $140 \pm 2$  lb ( $63.5 \pm 1$  kg) impact weight which is successfully lifted and dropped to provide the energy that accomplishes the sampling and penetration.

3.6 hammer drop system—that portion of the drive-weight assembly by which the operator accomplishes the lifting and dropping of the hammer to produce the blow.

3.7 hammer fall guide—that part of the drive-weight assembly used to guide the fall of the hammer.

3.8 N-value—the blowcount representation of the penetration resistance of the soil. The N-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.9  $\Delta N$ —the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.10 number of rope turns—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer; divided by  $360^\circ$  (see Fig. 1).

3.11 sampling rods—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.12 SPT—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

#### 4. Significance and Use

4.1 This method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or N-value, and the engineering behavior of earthworks and foundation are available.

#### 5. Apparatus

5.1 Drilling Equipment—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be suitable for advancing a borehole in some subsurface conditions.

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<sup>1</sup>This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D1586-58T. Last previous edition D1586-67 (1974).

<sup>2</sup>Annual Book of ASTM Standards, Vol 04.08.

5.1.1 Drag, Chopping and Fishtail Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advance-ment drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharging bits are permitted.

5.1.2 Roller-Cone Bits, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advance-ment drilling methods if the drilling fluid discharge is deflected.

5.1.3 Hollow-Stem Continuous Flight Augers, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 Solid, Continuous Flight, Bucket and Hand Augers, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave into the sampler or sampling rods during the sampling.

5.2 Sampling Rods--Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of a parallel wall "A" rod (a steel rod which has an outside diameter of 1 5/8 in. (41.2 mm) and an inside diameter of 1 1/8 in. (28.5 mm)).

NOTE 1--Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the N-values to depths of at least 100 ft. (30 m).

5.3 Split-Barrel Sampler--The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1 3/8 in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sampler retainer basket is permitted, and should also be noted on the penetration record if used.

NOTE 2--Both theory and available test data suggest that N-values may increase 10 to 30% when liners are used.

#### 5.4 Drive-Weight Assembly:

5.4.1 Hammer and Anvil--The hammer shall weigh  $140 \pm 2$  lb ( $63.5 \pm 1$  kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of hammer assembly with an internal anvil is encouraged.

NOTE 3--It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 Hammer Drop System--Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of the sampler while re-engaging and lifting the hammer.

5.5 Accessory Equipment--Accessories such as labeled, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

### 6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft. (1.5 m) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

### 7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-kg) hammer and count the number of blows applied in

each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

7.2.3 There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance", or the "N-value". If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6 in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5 kg) hammer and allows it to drop  $30 \pm 1.0$  in. (0.76 m  $\pm$  25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2 1/4 rope turns on the cathead may be used during the performance of the penetration test,

as shown in Fig. 1.

NOTE 4—The operator should generally use either 1 3/4 of 2 1/4 rope turns, depending upon whether or not the rope comes off the top (1 3/4 turns) or the bottom (2 1/4 turns) of the cathead. It is generally known and accepted that 2 3/4 or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76 m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15 m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the jar for each stratum and note its location in the sampler barrel.

## 8. Report

8.1 Drilling information shall be recorded in the filed and shall include the following:

- 8.1.1 Name and location of job,
- 8.1.2 Names of crew,
- 8.1.3 Type and make of drilling machine,
- 8.1.4 Weather conditions,
- 8.1.5 Date and time of start and finish of boring,
- 8.1.6 Boring number and location (station and coordinates, if available and applicable),
- 8.1.7 Surface evaluation, if applicable
- 8.1.8 Method of advancing and cleaning the boring,
- 8.1.9 Method of keeping boring open,
- 8.1.10 Depth of water surface and

drilling depth at time of a noted loss of drilling fluid, and time and date when reading or notation was made,

8.1.11 Location of strata changes,

8.1.12 Size of casing, depth of cased portion of boring,

8.1.13 Equipment and method of driving sampler,

8.1.14 Type of sampler and length and inside diameter of barrel (note use of liners),

8.1.15 Size, type and section length of the sampling rods, and

8.1.16 Remarks.

8.2 Data obtained for each sample shall be recorded in the field and shall include the following:

8.2.1 Sample depth and, if utilized, the sample number,

8.2.2 Description of soil,

8.2.3 Strata changes within sample,

8.2.4 Sampler penetration and recovery lengths, and

8.2.5 Number of blows per 6-in. (0.15 m) or partial increment.

## 9. Precision and Bias

9.1 Variations in N-values of 100% or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller N-values in the same soil can be reproduced with coefficient or variation of about 10%.

9.2 The use of faulty equipment, such as extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in N-values obtained between operator-drill rig systems.

9.3 The variability in N-values produced by different drill rigs and operators may be reduced by measuring the part of the hammer energy delivered into the drilling rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value adjustment is currently under development.

ASTM Designation: D 1595

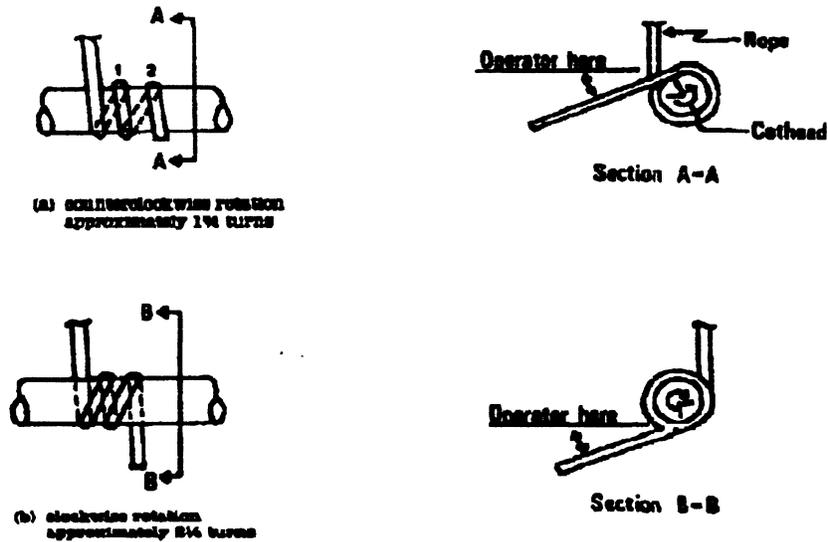
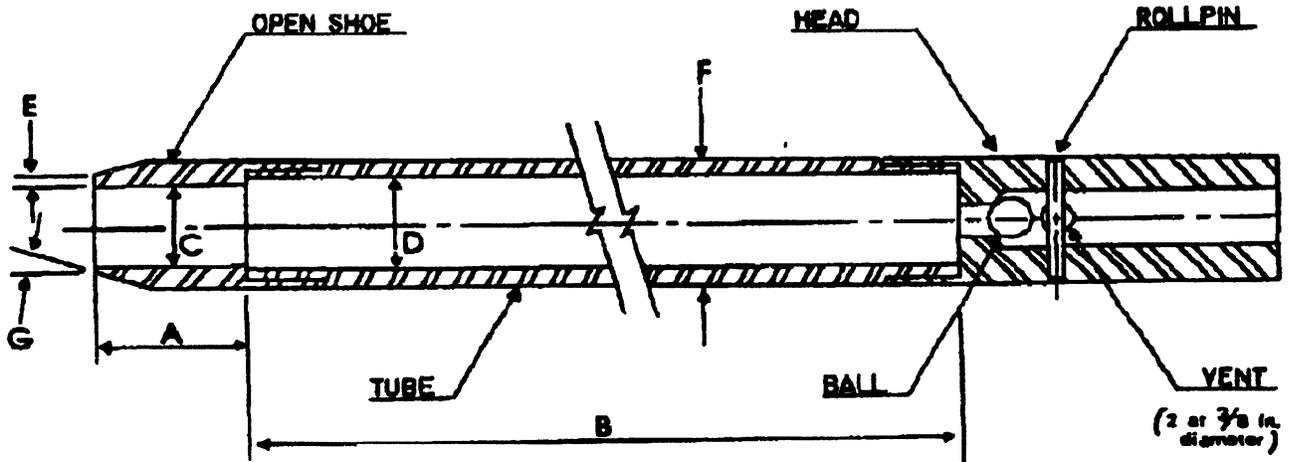


FIG. 1 Definitions of the number of rope turns and the angle for (a) counterclockwise rotation and (b) clockwise rotation of the cathead



- |  |  |
|--|--|
| A = 1.0 to 2.0 in. (25 to 50 mm)                 | E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)             |
| B = 18.0 to 30.0 in. (0.457 to 0.762 m)          | F = 2.00 ± 0.05 - 0.00 in. (50.8 ± 1.3 - 0.0 mm) |
| C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)          | G = 16.0° to 23.0°                               |
| D = 1.50 ± 0.05 - 0.00 in. (38.1 ± 1.3 - 0.0 mm) |  |

The 1 1/2 in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

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This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 1916 Race St., Philadelphia, PA 19103.

### **Water Content ( $W_c$ )**

The water content of a soil is determined by weighing a moist soil sample, drying it in an oven for approximately 24 hours, and reweighing the sample to determine the moisture loss. The water content is the ratio of the weight of water in the soil to the weight of the dry soil. Water content is typically expressed as a percentage.

### **Calibrated Hand Penetrometer ( $Q_p$ )**

In the calibrated hand penetrometer test, the unconfined compressive strength of a soil is estimated to a maximum value of 4.5 tons per square foot (tsf) by measuring the resistance of the soil sample to penetration by a spring-calibrated plunger. The hand penetrometer test device has been carefully calibrated by its manufacturer with the results of numerous unconfined compressive strength tests. This test provides a quick, simple, and low-cost testing procedure from which soil strength can be estimated.

### **Unconfined Compression Test ( $Q_u$ )**

In the unconfined compression strength test, an undisturbed cylinder of soil is loaded axially until the soil fails to carry additional load, or until 20% strain has been reached, whichever occurs first. The undrained shear strength of a cohesive soil is usually considered to equal half of the unconfined compressive strength.

### **Dry Density ( $\gamma_d$ )**

The dry density of a soil is the weight of dry soil in a unit volume. The soil's total unit weight is typically calculated by weighing a cylinder of soil, and dividing the weight by the cylinder's volume as calculated by measuring the cylinder's height and diameter at several locations. The soil's dry density is then determined by correcting the cylinder's weight to account for its water content measured as described above. Use of this value is often made when estimating the degree of compaction of a soil.

### **Classification of Samples**

Soil samples are classified on the basis of their texture and plasticity in accordance with the Unified Soil Classification System (USCS). The two-letter designator in parentheses following each soil description on the boring logs represents the applicable unified classification. If the designator is capitalized, the classification has been confirmed by the appropriate index testing. If the designator is lower-case, the classification has been visually estimated.

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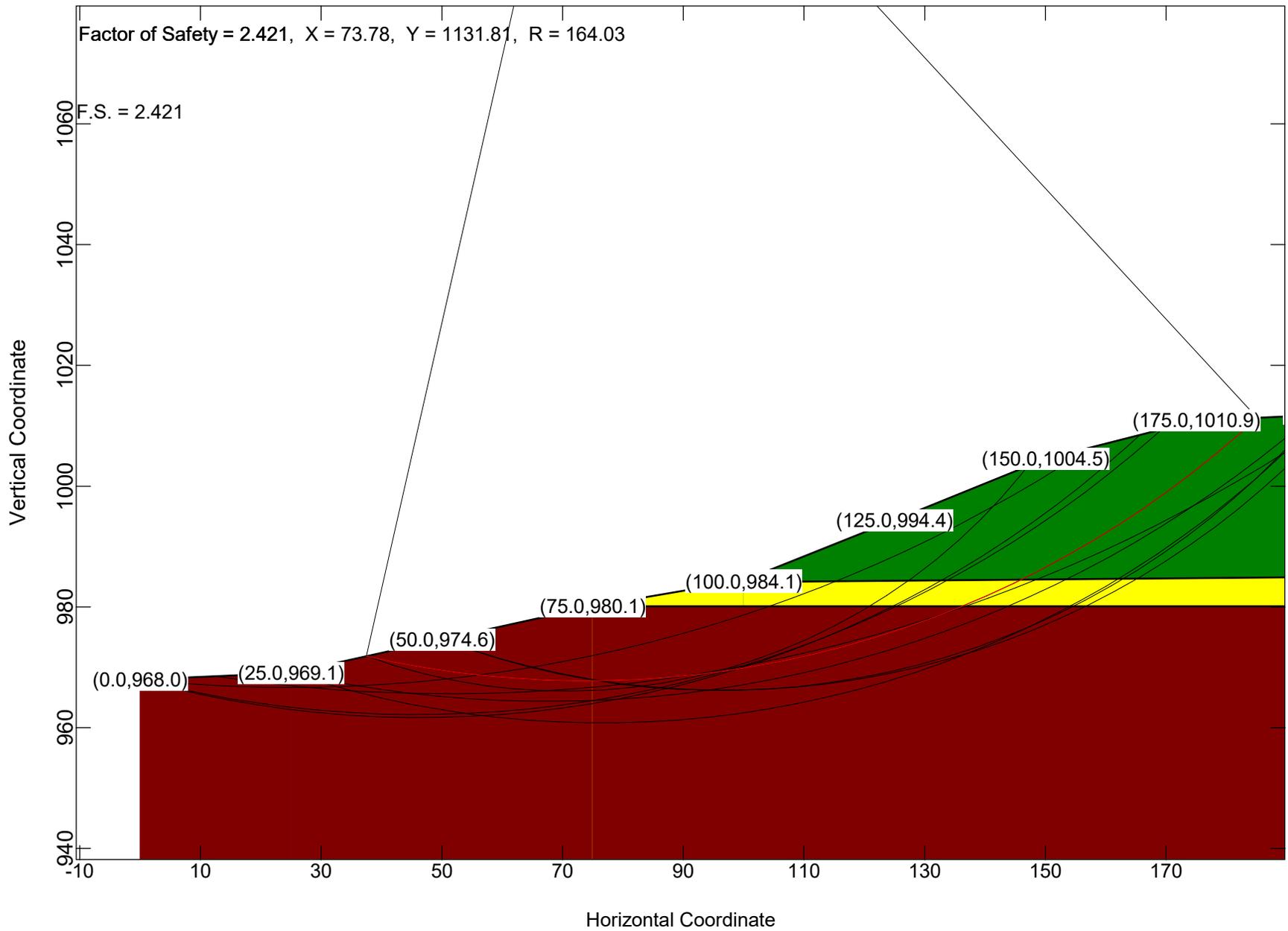


## Appendix D

- Slope Stability Analyses
  - Section 1 (B-1)
  - Section 2 (B-2)
  - Section 3 (B-3)
  - Section 4 (B-4)



# SECTION 1



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

--Slope Stability Analysis--  
Simplified Janbu, Simplified Bishop  
or Spencer Method of Slices

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 1c.sl4d  
Name of output file : Hartland Quarry - Section 1c.sl4o  
Name of plot output file : Hartland Quarry - Section 1c.sl4p

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Time and Date of Analysis  
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Date: September 05, 2023 Time: 18:05:02

1

PROBLEM DESCRIPTION Section 1c - After Grading

BOUNDARY COORDINATES

8 Top Boundaries  
10 Total Boundaries

| Boundary<br>No. | X-Left<br>ft. | Y-Left<br>ft. | X-Right<br>ft. | Y-Right<br>ft. | Soil Type<br>Below Bnd |
|-----------------|---------------|---------------|----------------|----------------|------------------------|
|-----------------|---------------|---------------|----------------|----------------|------------------------|

|    |        |         |        |         |   |
|----|--------|---------|--------|---------|---|
| 1  | 0.00   | 967.98  | 25.00  | 969.08  | 4 |
| 2  | 25.00  | 969.08  | 50.00  | 974.60  | 4 |
| 3  | 50.00  | 974.60  | 75.00  | 980.12  | 4 |
| 4  | 75.00  | 980.12  | 100.00 | 984.41  | 2 |
| 5  | 100.00 | 984.41  | 125.00 | 994.36  | 1 |
| 6  | 125.00 | 994.36  | 150.00 | 1004.49 | 1 |
| 7  | 150.00 | 1004.49 | 175.00 | 1010.86 | 1 |
| 8  | 175.00 | 1010.86 | 200.00 | 1012.00 | 1 |
| 9  | 100.00 | 984.12  | 200.00 | 985.00  | 2 |
| 10 | 75.00  | 980.12  | 200.00 | 980.12  | 4 |

1

#### ISOTROPIC SOIL PARAMETERS

##### 4 Type(s) of Soil

| Soil Type No. | Total Unit Wt. pcf | Saturated Unit Wt. pcf | Cohesion Intercept psf | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant psf | Piez. Surface No. |
|---------------|--------------------|------------------------|------------------------|----------------------|----------------------|-----------------------|-------------------|
| 1             | 130.0              | 0.0                    | 0.0                    | 30.0                 | 0.00                 | 0.0                   | 0                 |
| 2             | 135.0              | 0.0                    | 0.0                    | 32.0                 | 0.00                 | 0.0                   | 0                 |
| 3             | 140.0              | 0.0                    | 0.0                    | 33.0                 | 0.00                 | 0.0                   | 0                 |
| 4             | 145.0              | 0.0                    | 0.0                    | 35.0                 | 0.00                 | 0.0                   | 0                 |

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.  
and X = 50.00 ft.

Each Surface Terminates Between X = 125.00 ft.  
and X = 200.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial  
Failure Surfaces Examined. They Are Ordered - Most Critical  
First.

\* \* Safety Factors Are Calculated By The Modified Janbu Method \* \*

Failure Surface Specified By 33 Coordinate Points

| Point<br>No. | X-Surf<br>ft. | Y-Surf<br>ft. |
|--------------|---------------|---------------|
| 1            | 37.50         | 971.84        |
| 2            | 42.39         | 970.81        |
| 3            | 47.31         | 969.93        |
| 4            | 52.26         | 969.20        |
| 5            | 57.23         | 968.62        |
| 6            | 62.21         | 968.19        |
| 7            | 67.20         | 967.91        |
| 8            | 72.20         | 967.79        |
| 9            | 77.20         | 967.81        |
| 10           | 82.20         | 967.99        |
| 11           | 87.19         | 968.33        |
| 12           | 92.16         | 968.81        |
| 13           | 97.12         | 969.45        |
| 14           | 102.06        | 970.23        |
| 15           | 106.97        | 971.17        |
| 16           | 111.85        | 972.26        |
| 17           | 116.70        | 973.49        |
| 18           | 121.50        | 974.87        |
| 19           | 126.26        | 976.40        |
| 20           | 130.97        | 978.07        |
| 21           | 135.63        | 979.89        |
| 22           | 140.24        | 981.84        |
| 23           | 144.78        | 983.94        |
| 24           | 149.25        | 986.17        |
| 25           | 153.65        | 988.54        |



|    |     |          |          |          |          |          |          |          |          |          |
|----|-----|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 26 | 4.1 | 0.99E+04 | 0.00E+00 |
| 27 | 4.5 | 0.11E+05 | 0.00E+00 |
| 28 | 1.2 | 0.28E+04 | 0.00E+00 |
| 29 | 3.3 | 0.78E+04 | 0.00E+00 |
| 30 | 0.8 | 0.18E+04 | 0.00E+00 |
| 31 | 3.7 | 0.83E+04 | 0.00E+00 |
| 32 | 4.3 | 0.91E+04 | 0.00E+00 |
| 33 | 4.3 | 0.81E+04 | 0.00E+00 |
| 34 | 4.2 | 0.71E+04 | 0.00E+00 |
| 35 | 4.1 | 0.60E+04 | 0.00E+00 |
| 36 | 4.0 | 0.49E+04 | 0.00E+00 |
| 37 | 0.5 | 0.56E+03 | 0.00E+00 |
| 38 | 3.4 | 0.30E+04 | 0.00E+00 |
| 39 | 3.8 | 0.20E+04 | 0.00E+00 |
| 40 | 2.9 | 0.47E+03 | 0.00E+00 |

-----

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 12.50      | 968.53     |
| 2         | 17.45      | 967.83     |
| 3         | 22.42      | 967.23     |
| 4         | 27.39      | 966.72     |
| 5         | 32.37      | 966.31     |
| 6         | 37.36      | 966.00     |
| 7         | 42.36      | 965.78     |
| 8         | 47.36      | 965.65     |
| 9         | 52.36      | 965.63     |
| 10        | 57.36      | 965.70     |
| 11        | 62.35      | 965.86     |
| 12        | 67.35      | 966.12     |
| 13        | 72.33      | 966.48     |
| 14        | 77.31      | 966.93     |
| 15        | 82.28      | 967.48     |
| 16        | 87.24      | 968.13     |
| 17        | 92.19      | 968.87     |
| 18        | 97.11      | 969.71     |
| 19        | 102.03     | 970.64     |
| 20        | 106.92     | 971.66     |
| 21        | 111.79     | 972.78     |
| 22        | 116.65     | 973.99     |
| 23        | 121.47     | 975.30     |
| 24        | 126.27     | 976.69     |
| 25        | 131.05     | 978.18     |
| 26        | 135.79     | 979.77     |
| 27        | 140.50     | 981.44     |

|    |        |         |
|----|--------|---------|
| 28 | 145.18 | 983.20  |
| 29 | 149.82 | 985.05  |
| 30 | 154.43 | 987.00  |
| 31 | 159.00 | 989.03  |
| 32 | 163.53 | 991.14  |
| 33 | 168.02 | 993.35  |
| 34 | 172.46 | 995.64  |
| 35 | 176.86 | 998.01  |
| 36 | 181.21 | 1000.47 |
| 37 | 185.52 | 1003.02 |
| 38 | 189.77 | 1005.64 |
| 39 | 193.98 | 1008.35 |
| 40 | 198.13 | 1011.14 |
| 41 | 199.32 | 1011.97 |

Circle Center At X = 51.3 ; Y = 1225.5 and Radius, 259.8

\*\*\* 2.549 \*\*\*

1

Failure Surface Specified By 38 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 25.00      | 969.08     |
| 2         | 29.89      | 968.05     |
| 3         | 34.81      | 967.14     |
| 4         | 39.75      | 966.36     |
| 5         | 44.71      | 965.71     |
| 6         | 49.68      | 965.18     |
| 7         | 54.66      | 964.79     |
| 8         | 59.66      | 964.52     |
| 9         | 64.65      | 964.38     |
| 10        | 69.65      | 964.38     |
| 11        | 74.65      | 964.50     |
| 12        | 79.65      | 964.75     |
| 13        | 84.63      | 965.13     |
| 14        | 89.60      | 965.64     |
| 15        | 94.56      | 966.28     |
| 16        | 99.51      | 967.04     |
| 17        | 104.42     | 967.94     |
| 18        | 109.32     | 968.96     |
| 19        | 114.19     | 970.11     |
| 20        | 119.02     | 971.38     |
| 21        | 123.82     | 972.77     |

|    |        |         |
|----|--------|---------|
| 22 | 128.59 | 974.29  |
| 23 | 133.31 | 975.94  |
| 24 | 137.99 | 977.70  |
| 25 | 142.62 | 979.59  |
| 26 | 147.20 | 981.59  |
| 27 | 151.73 | 983.71  |
| 28 | 156.20 | 985.95  |
| 29 | 160.61 | 988.31  |
| 30 | 164.96 | 990.77  |
| 31 | 169.24 | 993.35  |
| 32 | 173.46 | 996.04  |
| 33 | 177.60 | 998.84  |
| 34 | 181.67 | 1001.74 |
| 35 | 185.67 | 1004.75 |
| 36 | 189.58 | 1007.86 |
| 37 | 193.42 | 1011.07 |
| 38 | 194.17 | 1011.73 |

Circle Center At X = 67.4 ; Y = 1157.6 and Radius, 193.3

\*\*\* 2.564 \*\*\*

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 974.60     |
| 2         | 54.71      | 972.92     |
| 3         | 59.48      | 971.42     |
| 4         | 64.30      | 970.11     |
| 5         | 69.18      | 968.98     |
| 6         | 74.09      | 968.04     |
| 7         | 79.03      | 967.29     |
| 8         | 84.00      | 966.73     |
| 9         | 88.98      | 966.36     |
| 10        | 93.98      | 966.19     |
| 11        | 98.98      | 966.21     |
| 12        | 103.98     | 966.41     |
| 13        | 108.96     | 966.81     |
| 14        | 113.93     | 967.41     |
| 15        | 118.86     | 968.19     |
| 16        | 123.77     | 969.16     |
| 17        | 128.63     | 970.32     |
| 18        | 133.45     | 971.67     |
| 19        | 138.21     | 973.20     |

|    |        |         |
|----|--------|---------|
| 20 | 142.91 | 974.91  |
| 21 | 147.53 | 976.80  |
| 22 | 152.09 | 978.87  |
| 23 | 156.56 | 981.11  |
| 24 | 160.94 | 983.52  |
| 25 | 165.22 | 986.10  |
| 26 | 169.40 | 988.84  |
| 27 | 173.47 | 991.74  |
| 28 | 177.43 | 994.80  |
| 29 | 181.27 | 998.00  |
| 30 | 184.98 | 1001.35 |
| 31 | 188.56 | 1004.84 |
| 32 | 192.01 | 1008.46 |
| 33 | 194.91 | 1011.77 |

Circle Center At X = 96.0 ; Y = 1096.2 and Radius, 130.0

\*\*\* 2.585 \*\*\*

1

Failure Surface Specified By 34 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 974.60     |
| 2         | 54.72      | 972.95     |
| 3         | 59.50      | 971.48     |
| 4         | 64.33      | 970.19     |
| 5         | 69.21      | 969.08     |
| 6         | 74.12      | 968.15     |
| 7         | 79.06      | 967.40     |
| 8         | 84.03      | 966.83     |
| 9         | 89.01      | 966.44     |
| 10        | 94.01      | 966.24     |
| 11        | 99.01      | 966.23     |
| 12        | 104.01     | 966.40     |
| 13        | 108.99     | 966.75     |
| 14        | 113.97     | 967.29     |
| 15        | 118.91     | 968.01     |
| 16        | 123.83     | 968.91     |
| 17        | 128.71     | 970.00     |
| 18        | 133.55     | 971.26     |
| 19        | 138.34     | 972.70     |
| 20        | 143.07     | 974.32     |
| 21        | 147.74     | 976.11     |

|    |        |         |
|----|--------|---------|
| 22 | 152.34 | 978.07  |
| 23 | 156.86 | 980.20  |
| 24 | 161.30 | 982.49  |
| 25 | 165.66 | 984.95  |
| 26 | 169.92 | 987.56  |
| 27 | 174.08 | 990.34  |
| 28 | 178.14 | 993.26  |
| 29 | 182.08 | 996.33  |
| 30 | 185.91 | 999.55  |
| 31 | 189.62 | 1002.90 |
| 32 | 193.20 | 1006.39 |
| 33 | 196.65 | 1010.01 |
| 34 | 198.35 | 1011.92 |

Circle Center At X = 96.9 ; Y = 1101.7 and Radius, 135.5

\*\*\* 2.618 \*\*\*

Failure Surface Specified By 35 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 0.00       | 967.98     |
| 2         | 4.98       | 967.51     |
| 3         | 9.97       | 967.15     |
| 4         | 14.96      | 966.89     |
| 5         | 19.96      | 966.74     |
| 6         | 24.96      | 966.68     |
| 7         | 29.96      | 966.74     |
| 8         | 34.95      | 966.89     |
| 9         | 39.95      | 967.15     |
| 10        | 44.93      | 967.51     |
| 11        | 49.91      | 967.98     |
| 12        | 54.88      | 968.55     |
| 13        | 59.83      | 969.22     |
| 14        | 64.77      | 969.99     |
| 15        | 69.70      | 970.87     |
| 16        | 74.60      | 971.85     |
| 17        | 79.48      | 972.93     |
| 18        | 84.34      | 974.11     |
| 19        | 89.17      | 975.40     |
| 20        | 93.98      | 976.78     |
| 21        | 98.75      | 978.26     |
| 22        | 103.50     | 979.84     |
| 23        | 108.21     | 981.52     |

|    |        |         |
|----|--------|---------|
| 24 | 112.88 | 983.29  |
| 25 | 117.52 | 985.17  |
| 26 | 122.11 | 987.13  |
| 27 | 126.67 | 989.20  |
| 28 | 131.18 | 991.35  |
| 29 | 135.64 | 993.61  |
| 30 | 140.06 | 995.95  |
| 31 | 144.43 | 998.38  |
| 32 | 148.74 | 1000.90 |
| 33 | 153.01 | 1003.52 |
| 34 | 157.22 | 1006.22 |
| 35 | 157.48 | 1006.40 |

Circle Center At X = 25.0 ; Y = 1207.6 and Radius, 241.0

\*\*\* 2.672 \*\*\*

1

Failure Surface Specified By 39 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 25.00      | 969.08     |
| 2         | 29.77      | 967.59     |
| 3         | 34.59      | 966.24     |
| 4         | 39.44      | 965.04     |
| 5         | 44.33      | 963.99     |
| 6         | 49.25      | 963.09     |
| 7         | 54.19      | 962.34     |
| 8         | 59.15      | 961.73     |
| 9         | 64.13      | 961.28     |
| 10        | 69.12      | 960.98     |
| 11        | 74.12      | 960.83     |
| 12        | 79.12      | 960.83     |
| 13        | 84.12      | 960.98     |
| 14        | 89.11      | 961.28     |
| 15        | 94.09      | 961.74     |
| 16        | 99.05      | 962.34     |
| 17        | 104.00     | 963.10     |
| 18        | 108.91     | 964.00     |
| 19        | 113.80     | 965.05     |
| 20        | 118.66     | 966.25     |
| 21        | 123.47     | 967.60     |
| 22        | 128.24     | 969.09     |
| 23        | 132.97     | 970.73     |

|    |        |         |
|----|--------|---------|
| 24 | 137.64 | 972.51  |
| 25 | 142.26 | 974.43  |
| 26 | 146.81 | 976.48  |
| 27 | 151.31 | 978.68  |
| 28 | 155.73 | 981.01  |
| 29 | 160.08 | 983.47  |
| 30 | 164.36 | 986.06  |
| 31 | 168.55 | 988.79  |
| 32 | 172.66 | 991.63  |
| 33 | 176.68 | 994.61  |
| 34 | 180.61 | 997.70  |
| 35 | 184.45 | 1000.91 |
| 36 | 188.18 | 1004.23 |
| 37 | 191.82 | 1007.66 |
| 38 | 195.34 | 1011.21 |
| 39 | 195.91 | 1011.81 |

Circle Center At X = 76.6 ; Y = 1125.9 and Radius, 165.1

\*\*\* 2.684 \*\*\*

Failure Surface Specified By 38 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 0.00       | 967.98     |
| 2         | 4.86       | 966.80     |
| 3         | 9.75       | 965.76     |
| 4         | 14.67      | 964.85     |
| 5         | 19.60      | 964.07     |
| 6         | 24.56      | 963.42     |
| 7         | 29.54      | 962.91     |
| 8         | 34.52      | 962.54     |
| 9         | 39.52      | 962.29     |
| 10        | 44.52      | 962.19     |
| 11        | 49.52      | 962.22     |
| 12        | 54.51      | 962.38     |
| 13        | 59.50      | 962.68     |
| 14        | 64.48      | 963.12     |
| 15        | 69.45      | 963.69     |
| 16        | 74.40      | 964.39     |
| 17        | 79.33      | 965.23     |
| 18        | 84.24      | 966.20     |
| 19        | 89.11      | 967.31     |
| 20        | 93.96      | 968.54     |

|    |        |         |
|----|--------|---------|
| 21 | 98.77  | 969.91  |
| 22 | 103.54 | 971.40  |
| 23 | 108.27 | 973.02  |
| 24 | 112.95 | 974.78  |
| 25 | 117.59 | 976.65  |
| 26 | 122.17 | 978.65  |
| 27 | 126.69 | 980.78  |
| 28 | 131.16 | 983.03  |
| 29 | 135.57 | 985.39  |
| 30 | 139.90 | 987.88  |
| 31 | 144.17 | 990.48  |
| 32 | 148.37 | 993.20  |
| 33 | 152.49 | 996.03  |
| 34 | 156.54 | 998.96  |
| 35 | 160.50 | 1002.01 |
| 36 | 164.38 | 1005.17 |
| 37 | 168.18 | 1008.42 |
| 38 | 169.24 | 1009.39 |

Circle Center At X = 45.9 ; Y = 1147.0 and Radius, 184.8

\*\*\* 2.714 \*\*\*

1

Failure Surface Specified By 37 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 0.00       | 967.98     |
| 2         | 4.84       | 966.72     |
| 3         | 9.71       | 965.60     |
| 4         | 14.61      | 964.62     |
| 5         | 19.54      | 963.78     |
| 6         | 24.49      | 963.08     |
| 7         | 29.46      | 962.52     |
| 8         | 34.45      | 962.10     |
| 9         | 39.44      | 961.83     |
| 10        | 44.44      | 961.70     |
| 11        | 49.44      | 961.71     |
| 12        | 54.43      | 961.86     |
| 13        | 59.42      | 962.16     |
| 14        | 64.41      | 962.60     |
| 15        | 69.37      | 963.18     |
| 16        | 74.32      | 963.90     |
| 17        | 79.24      | 964.77     |

|    |        |         |
|----|--------|---------|
| 18 | 84.14  | 965.77  |
| 19 | 89.01  | 966.92  |
| 20 | 93.84  | 968.20  |
| 21 | 98.64  | 969.62  |
| 22 | 103.39 | 971.18  |
| 23 | 108.09 | 972.87  |
| 24 | 112.75 | 974.69  |
| 25 | 117.35 | 976.65  |
| 26 | 121.89 | 978.74  |
| 27 | 126.37 | 980.96  |
| 28 | 130.79 | 983.30  |
| 29 | 135.14 | 985.77  |
| 30 | 139.41 | 988.36  |
| 31 | 143.61 | 991.08  |
| 32 | 147.73 | 993.91  |
| 33 | 151.77 | 996.86  |
| 34 | 155.72 | 999.92  |
| 35 | 159.58 | 1003.10 |
| 36 | 163.35 | 1006.38 |
| 37 | 165.62 | 1008.47 |

Circle Center At X = 46.5 ; Y = 1136.7 and Radius, 175.0

\*\*\* 2.764 \*\*\*

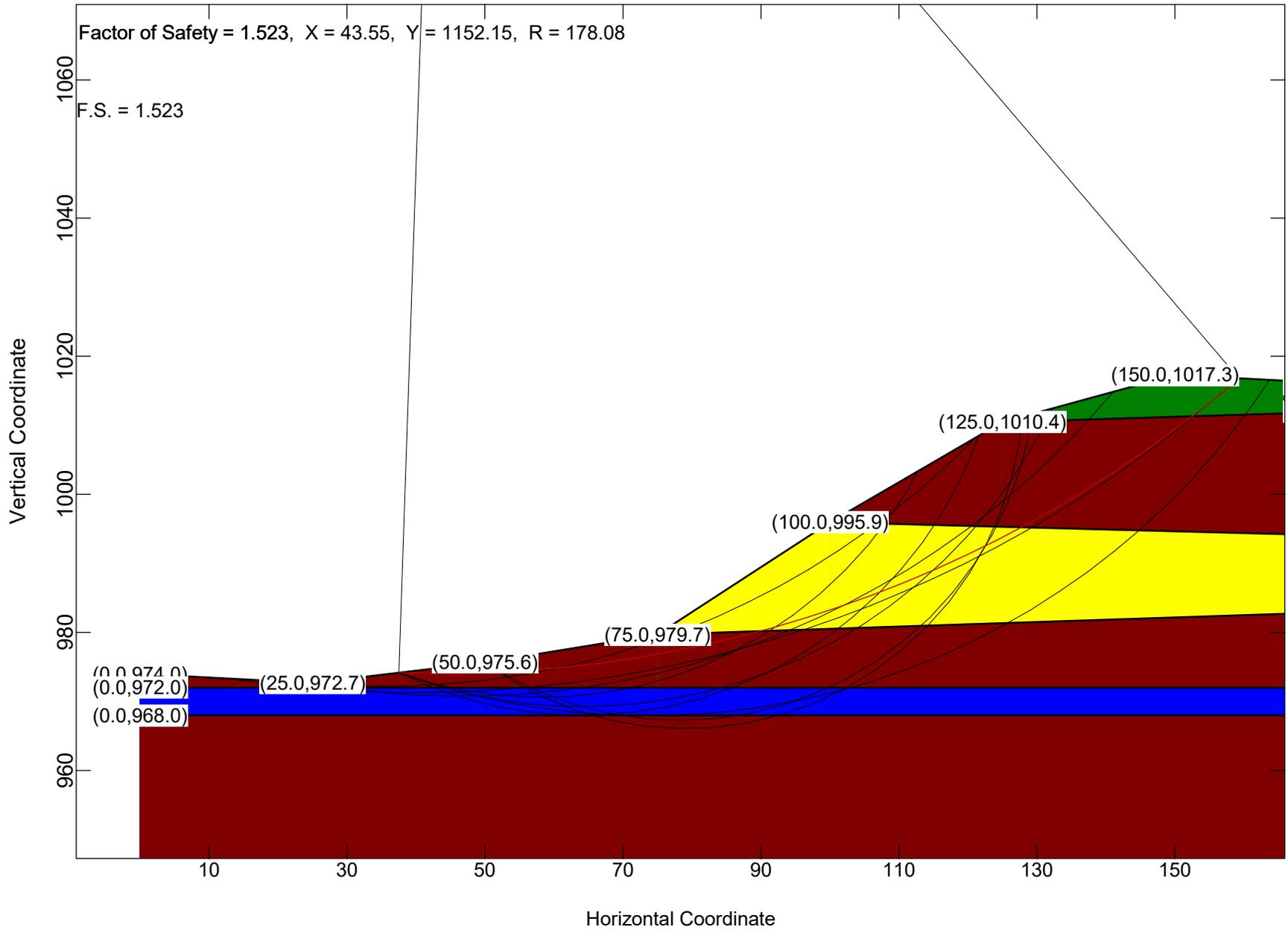
Failure Surface Specified By 26 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 971.84     |
| 2         | 42.25      | 970.26     |
| 3         | 47.07      | 968.93     |
| 4         | 51.95      | 967.85     |
| 5         | 56.88      | 967.02     |
| 6         | 61.84      | 966.45     |
| 7         | 66.83      | 966.13     |
| 8         | 71.83      | 966.07     |
| 9         | 76.83      | 966.27     |
| 10        | 81.81      | 966.72     |
| 11        | 86.76      | 967.42     |
| 12        | 91.67      | 968.38     |
| 13        | 96.52      | 969.60     |
| 14        | 101.30     | 971.05     |
| 15        | 106.00     | 972.76     |
| 16        | 110.61     | 974.70     |



-  
-  
-  
-  
-  
S 1113.20 +  
-  
-  
-  
-  
-  
1335.84 +  
-  
-  
-  
F 1558.48 +  
-  
-  
-  
-  
T 1781.12 +

# SECTION 2



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

--Slope Stability Analysis--  
Simplified Janbu, Simplified Bishop  
or Spencer Method of Slices

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2c.sl4d  
Name of output file : Hartland Quarry - Section 2c.sl4o  
Name of plot output file : Hartland Quarry - Section 2c.sl4p

-----

Time and Date of Analysis

-----

Date: September 05, 2023 Time: 17:16:57

1

PROBLEM DESCRIPTION Section 2c- After Grading

BOUNDARY COORDINATES

7 Top Boundaries  
12 Total Boundaries

| Boundary No. | X-Left ft. | Y-Left ft. | X-Right ft. | Y-Right ft. | Soil Type Below Bnd |
|--------------|------------|------------|-------------|-------------|---------------------|
|--------------|------------|------------|-------------|-------------|---------------------|

|    |        |         |        |         |   |
|----|--------|---------|--------|---------|---|
| 1  | 0.00   | 974.00  | 25.00  | 972.70  | 4 |
| 2  | 25.00  | 972.70  | 50.00  | 975.63  | 4 |
| 3  | 50.00  | 975.63  | 75.00  | 979.70  | 4 |
| 4  | 75.00  | 979.70  | 100.00 | 995.94  | 2 |
| 5  | 100.00 | 995.94  | 125.00 | 1010.44 | 4 |
| 6  | 125.00 | 1010.44 | 150.00 | 1017.28 | 1 |
| 7  | 150.00 | 1017.28 | 175.00 | 1016.00 | 1 |
| 8  | 125.00 | 1010.44 | 175.00 | 1012.00 | 4 |
| 9  | 100.00 | 995.94  | 175.00 | 994.00  | 2 |
| 10 | 75.00  | 979.70  | 175.00 | 983.00  | 4 |
| 11 | 0.00   | 972.00  | 175.00 | 972.00  | 3 |
| 12 | 0.00   | 968.00  | 175.00 | 968.00  | 4 |

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

| Soil Type No. | Total Unit Wt. pcf | Saturated Unit Wt. pcf | Cohesion Intercept psf | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant psf | Piez. Surface No. |
|---------------|--------------------|------------------------|------------------------|----------------------|----------------------|-----------------------|-------------------|
| 1             | 130.0              | 0.0                    | 0.0                    | 30.0                 | 0.00                 | 0.0                   | 0                 |
| 2             | 135.0              | 0.0                    | 0.0                    | 32.0                 | 0.00                 | 0.0                   | 0                 |
| 3             | 140.0              | 0.0                    | 0.0                    | 33.0                 | 0.00                 | 0.0                   | 0                 |
| 4             | 145.0              | 0.0                    | 0.0                    | 35.0                 | 0.00                 | 0.0                   | 0                 |

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.  
and X = 50.00 ft.

Each Surface Terminates Between X = 100.00 ft.  
and X = 175.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial  
Failure Surfaces Examined. They Are Ordered - Most Critical  
First.

\* \* Safety Factors Are Calculated By The Modified Janbu Method \* \*

Failure Surface Specified By 28 Coordinate Points

| Point<br>No. | X-Surf<br>ft. | Y-Surf<br>ft. |
|--------------|---------------|---------------|
| 1            | 37.50         | 974.17        |
| 2            | 42.50         | 974.07        |
| 3            | 47.50         | 974.11        |
| 4            | 52.50         | 974.29        |
| 5            | 57.49         | 974.61        |
| 6            | 62.46         | 975.07        |
| 7            | 67.43         | 975.67        |
| 8            | 72.37         | 976.41        |
| 9            | 77.30         | 977.29        |
| 10           | 82.19         | 978.31        |
| 11           | 87.06         | 979.46        |
| 12           | 91.89         | 980.75        |
| 13           | 96.68         | 982.17        |
| 14           | 101.43        | 983.73        |
| 15           | 106.14        | 985.42        |
| 16           | 110.79        | 987.24        |
| 17           | 115.40        | 989.20        |
| 18           | 119.94        | 991.28        |
| 19           | 124.43        | 993.49        |
| 20           | 128.85        | 995.82        |
| 21           | 133.21        | 998.27        |
| 22           | 137.49        | 1000.85       |
| 23           | 141.70        | 1003.55       |



|          |     |          |          |          |          |          |          |          |          |
|----------|-----|----------|----------|----------|----------|----------|----------|----------|----------|
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 15       | 4.8 | 0.70E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 16       | 3.3 | 0.54E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 17       | 1.4 | 0.25E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 18       | 4.7 | 0.87E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 19       | 4.7 | 0.94E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 20       | 4.6 | 0.99E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 21       | 4.5 | 0.10E+05 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 22       | 4.5 | 0.11E+05 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 23       | 0.6 | 0.14E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 24       | 2.7 | 0.64E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 25       | 1.1 | 0.26E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 26       | 4.4 | 0.94E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 27       | 4.3 | 0.84E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 28       | 4.2 | 0.72E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 29       | 4.1 | 0.61E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 30       | 4.1 | 0.49E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 31       | 0.1 | 0.12E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 32       | 2.5 | 0.23E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 33       | 1.3 | 0.93E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 34       | 3.9 | 0.16E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 35       | 1.5 | 0.14E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |

-----

Failure Surface Specified By 27 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
|-----------|------------|------------|

|    |        |         |
|----|--------|---------|
| 1  | 25.00  | 972.70  |
| 2  | 29.94  | 971.92  |
| 3  | 34.91  | 971.34  |
| 4  | 39.89  | 970.97  |
| 5  | 44.89  | 970.80  |
| 6  | 49.89  | 970.83  |
| 7  | 54.88  | 971.06  |
| 8  | 59.86  | 971.49  |
| 9  | 64.82  | 972.13  |
| 10 | 69.75  | 972.97  |
| 11 | 74.64  | 974.01  |
| 12 | 79.49  | 975.24  |
| 13 | 84.28  | 976.67  |
| 14 | 89.01  | 978.30  |
| 15 | 93.67  | 980.11  |
| 16 | 98.25  | 982.11  |
| 17 | 102.75 | 984.30  |
| 18 | 107.15 | 986.67  |
| 19 | 111.46 | 989.21  |
| 20 | 115.65 | 991.93  |
| 21 | 119.74 | 994.81  |
| 22 | 123.70 | 997.86  |
| 23 | 127.54 | 1001.06 |
| 24 | 131.24 | 1004.42 |
| 25 | 134.81 | 1007.93 |
| 26 | 138.23 | 1011.58 |
| 27 | 141.03 | 1014.83 |

Circle Center At X = 46.6 ; Y = 1093.9 and Radius, 123.2

\*\*\* 1.544 \*\*\*

1

Failure Surface Specified By 24 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.23      | 972.55     |
| 3         | 47.06      | 971.25     |
| 4         | 51.96      | 970.27     |
| 5         | 56.92      | 969.63     |
| 6         | 61.91      | 969.31     |
| 7         | 66.91      | 969.33     |

|    |        |         |
|----|--------|---------|
| 8  | 71.90  | 969.67  |
| 9  | 76.85  | 970.35  |
| 10 | 81.75  | 971.35  |
| 11 | 86.57  | 972.68  |
| 12 | 91.29  | 974.33  |
| 13 | 95.90  | 976.28  |
| 14 | 100.36 | 978.54  |
| 15 | 104.66 | 981.08  |
| 16 | 108.79 | 983.91  |
| 17 | 112.71 | 987.00  |
| 18 | 116.43 | 990.35  |
| 19 | 119.91 | 993.94  |
| 20 | 123.15 | 997.75  |
| 21 | 126.12 | 1001.77 |
| 22 | 128.83 | 1005.97 |
| 23 | 131.24 | 1010.35 |
| 24 | 132.21 | 1012.41 |

Circle Center At X = 64.2 ; Y = 1044.5 and Radius, 75.3

\*\*\* 1.547 \*\*\*

Failure Surface Specified By 22 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 975.63     |
| 2         | 54.32      | 973.11     |
| 3         | 58.86      | 971.02     |
| 4         | 63.59      | 969.38     |
| 5         | 68.45      | 968.21     |
| 6         | 73.40      | 967.50     |
| 7         | 78.39      | 967.28     |
| 8         | 83.38      | 967.55     |
| 9         | 88.33      | 968.29     |
| 10        | 93.18      | 969.51     |
| 11        | 97.89      | 971.19     |
| 12        | 102.41     | 973.32     |
| 13        | 106.71     | 975.87     |
| 14        | 110.74     | 978.83     |
| 15        | 114.47     | 982.16     |
| 16        | 117.85     | 985.84     |
| 17        | 120.87     | 989.83     |
| 18        | 123.49     | 994.09     |
| 19        | 125.68     | 998.58     |

|    |        |         |
|----|--------|---------|
| 20 | 127.43 | 1003.27 |
| 21 | 128.72 | 1008.10 |
| 22 | 129.30 | 1011.62 |

Circle Center At X = 78.2 ; Y = 1019.0 and Radius, 51.7

\*\*\* 1.629 \*\*\*

1

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 12.50      | 973.35     |
| 2         | 17.45      | 972.66     |
| 3         | 22.42      | 972.11     |
| 4         | 27.41      | 971.70     |
| 5         | 32.40      | 971.42     |
| 6         | 37.40      | 971.29     |
| 7         | 42.40      | 971.29     |
| 8         | 47.39      | 971.44     |
| 9         | 52.39      | 971.72     |
| 10        | 57.37      | 972.14     |
| 11        | 62.34      | 972.70     |
| 12        | 67.29      | 973.40     |
| 13        | 72.22      | 974.24     |
| 14        | 77.12      | 975.21     |
| 15        | 82.00      | 976.32     |
| 16        | 86.84      | 977.56     |
| 17        | 91.65      | 978.94     |
| 18        | 96.41      | 980.46     |
| 19        | 101.13     | 982.10     |
| 20        | 105.81     | 983.88     |
| 21        | 110.43     | 985.78     |
| 22        | 115.00     | 987.81     |
| 23        | 119.51     | 989.97     |
| 24        | 123.96     | 992.26     |
| 25        | 128.34     | 994.66     |
| 26        | 132.65     | 997.19     |
| 27        | 136.89     | 999.84     |
| 28        | 141.06     | 1002.60    |
| 29        | 145.15     | 1005.48    |
| 30        | 149.15     | 1008.48    |
| 31        | 153.07     | 1011.58    |
| 32        | 156.91     | 1014.79    |

33            159.19        1016.81

Circle Center At X = 39.7 ; Y = 1150.8 and Radius, 179.5

\*\*\*        1.639        \*\*\*

Failure Surface Specified By 23 Coordinate Points

| Point<br>No. | X-Surf<br>ft. | Y-Surf<br>ft. |
|--------------|---------------|---------------|
| 1            | 25.00         | 972.70        |
| 2            | 29.99         | 972.36        |
| 3            | 34.99         | 972.23        |
| 4            | 39.99         | 972.30        |
| 5            | 44.98         | 972.59        |
| 6            | 49.95         | 973.08        |
| 7            | 54.90         | 973.79        |
| 8            | 59.82         | 974.69        |
| 9            | 64.70         | 975.81        |
| 10           | 69.52         | 977.13        |
| 11           | 74.28         | 978.64        |
| 12           | 78.98         | 980.36        |
| 13           | 83.60         | 982.27        |
| 14           | 88.14         | 984.37        |
| 15           | 92.58         | 986.66        |
| 16           | 96.93         | 989.13        |
| 17           | 101.16        | 991.79        |
| 18           | 105.29        | 994.62        |
| 19           | 109.29        | 997.62        |
| 20           | 113.16        | 1000.78       |
| 21           | 116.90        | 1004.10       |
| 22           | 120.49        | 1007.58       |
| 23           | 121.01        | 1008.13       |

Circle Center At X = 35.7 ; Y = 1091.7 and Radius, 119.5

\*\*\*        1.644        \*\*\*

Failure Surface Specified By 22 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.08      | 972.16     |
| 3         | 46.81      | 970.54     |
| 4         | 51.66      | 969.31     |
| 5         | 56.59      | 968.49     |
| 6         | 61.57      | 968.07     |
| 7         | 66.57      | 968.06     |
| 8         | 71.56      | 968.46     |
| 9         | 76.49      | 969.27     |
| 10        | 81.34      | 970.48     |
| 11        | 86.08      | 972.08     |
| 12        | 90.67      | 974.07     |
| 13        | 95.08      | 976.43     |
| 14        | 99.28      | 979.14     |
| 15        | 103.24     | 982.18     |
| 16        | 106.95     | 985.54     |
| 17        | 110.36     | 989.19     |
| 18        | 113.47     | 993.11     |
| 19        | 116.24     | 997.28     |
| 20        | 118.66     | 1001.65    |
| 21        | 120.71     | 1006.21    |
| 22        | 121.50     | 1008.41    |

Circle Center At X = 64.2 ; Y = 1029.0 and Radius, 60.9

\*\*\* 1.671 \*\*\*

Failure Surface Specified By 22 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 975.63     |
| 2         | 54.17      | 972.87     |
| 3         | 58.60      | 970.56     |
| 4         | 63.25      | 968.70     |
| 5         | 68.05      | 967.33     |
| 6         | 72.98      | 966.46     |
| 7         | 77.96      | 966.09     |
| 8         | 82.96      | 966.24     |
| 9         | 87.92      | 966.89     |
| 10        | 92.78      | 968.05     |
| 11        | 97.51      | 969.69     |

|    |        |         |
|----|--------|---------|
| 12 | 102.03 | 971.81  |
| 13 | 106.32 | 974.38  |
| 14 | 110.33 | 977.37  |
| 15 | 114.01 | 980.76  |
| 16 | 117.32 | 984.51  |
| 17 | 120.24 | 988.57  |
| 18 | 122.72 | 992.91  |
| 19 | 124.75 | 997.48  |
| 20 | 126.30 | 1002.23 |
| 21 | 127.36 | 1007.11 |
| 22 | 127.82 | 1011.21 |

Circle Center At X = 79.1 ; Y = 1015.0 and Radius, 49.0

\*\*\* 1.705 \*\*\*

1

Failure Surface Specified By 19 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.28      | 972.69     |
| 3         | 47.16      | 971.60     |
| 4         | 52.11      | 970.91     |
| 5         | 57.10      | 970.62     |
| 6         | 62.10      | 970.74     |
| 7         | 67.07      | 971.25     |
| 8         | 71.99      | 972.17     |
| 9         | 76.81      | 973.48     |
| 10        | 81.52      | 975.18     |
| 11        | 86.07      | 977.25     |
| 12        | 90.44      | 979.68     |
| 13        | 94.59      | 982.46     |
| 14        | 98.52      | 985.56     |
| 15        | 102.17     | 988.97     |
| 16        | 105.54     | 992.66     |
| 17        | 108.61     | 996.62     |
| 18        | 111.34     | 1000.80    |
| 19        | 112.69     | 1003.30    |

Circle Center At X = 58.2 ; Y = 1032.5 and Radius, 61.9

\*\*\* 1.723 \*\*\*

Failure Surface Specified By 30 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.25      | 972.60     |
| 3         | 47.06      | 971.25     |
| 4         | 51.94      | 970.13     |
| 5         | 56.86      | 969.24     |
| 6         | 61.81      | 968.58     |
| 7         | 66.79      | 968.15     |
| 8         | 71.79      | 967.94     |
| 9         | 76.79      | 967.97     |
| 10        | 81.78      | 968.24     |
| 11        | 86.76      | 968.73     |
| 12        | 91.71      | 969.45     |
| 13        | 96.61      | 970.41     |
| 14        | 101.47     | 971.58     |
| 15        | 106.27     | 972.99     |
| 16        | 111.00     | 974.61     |
| 17        | 115.65     | 976.45     |
| 18        | 120.21     | 978.51     |
| 19        | 124.67     | 980.77     |
| 20        | 129.02     | 983.24     |
| 21        | 133.25     | 985.91     |
| 22        | 137.35     | 988.77     |
| 23        | 141.31     | 991.81     |
| 24        | 145.13     | 995.04     |
| 25        | 148.79     | 998.44     |
| 26        | 152.30     | 1002.01    |
| 27        | 155.63     | 1005.74    |
| 28        | 158.79     | 1009.61    |
| 29        | 161.76     | 1013.63    |
| 30        | 163.74     | 1016.58    |

Circle Center At X = 73.6 ; Y = 1075.7 and Radius, 107.8

\*\*\* 1.752 \*\*\*

0.00      223.80      447.60      671.41      895.21      1119.01

|   |         |   |        |        |        |        |          |
|---|---------|---|--------|--------|--------|--------|----------|
| X | 0.00    | + | -----+ | -----+ | -----+ | -----+ | **-----+ |
|   |         | - |        |        |        |        | .**      |
|   |         | - |        |        |        |        | .2*      |
|   |         | - |        |        |        |        | .41*     |
|   |         | - |        |        |        |        | .0*      |
|   |         | - |        |        |        |        | ***      |
|   | 223.80  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| A | 447.60  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| X | 671.41  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| I | 895.21  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| S | 1119.01 | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   | 1342.81 | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| F | 1566.61 | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |

T 1790.41 +

=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

--Slope Stability Analysis--  
Simplified Janbu, Simplified Bishop  
or Spencer Method of Slices

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 2c.sl4d  
Name of output file : Hartland Quarry - Section 2c.sl4o  
Name of plot output file : Hartland Quarry - Section 2c.sl4p

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Time and Date of Analysis

-----

Date: September 05, 2023 Time: 17:16:57

1

PROBLEM DESCRIPTION Section 2c- After Grading

BOUNDARY COORDINATES

7 Top Boundaries  
12 Total Boundaries

| Boundary No. | X-Left ft. | Y-Left ft. | X-Right ft. | Y-Right ft. | Soil Type Below Bnd |
|--------------|------------|------------|-------------|-------------|---------------------|
|--------------|------------|------------|-------------|-------------|---------------------|

|    |        |         |        |         |   |
|----|--------|---------|--------|---------|---|
| 1  | 0.00   | 974.00  | 25.00  | 972.70  | 4 |
| 2  | 25.00  | 972.70  | 50.00  | 975.63  | 4 |
| 3  | 50.00  | 975.63  | 75.00  | 979.70  | 4 |
| 4  | 75.00  | 979.70  | 100.00 | 995.94  | 2 |
| 5  | 100.00 | 995.94  | 125.00 | 1010.44 | 4 |
| 6  | 125.00 | 1010.44 | 150.00 | 1017.28 | 1 |
| 7  | 150.00 | 1017.28 | 175.00 | 1016.00 | 1 |
| 8  | 125.00 | 1010.44 | 175.00 | 1012.00 | 4 |
| 9  | 100.00 | 995.94  | 175.00 | 994.00  | 2 |
| 10 | 75.00  | 979.70  | 175.00 | 983.00  | 4 |
| 11 | 0.00   | 972.00  | 175.00 | 972.00  | 3 |
| 12 | 0.00   | 968.00  | 175.00 | 968.00  | 4 |

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

| Soil Type No. | Total Unit Wt. pcf | Saturated Unit Wt. pcf | Cohesion Intercept psf | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant psf | Piez. Surface No. |
|---------------|--------------------|------------------------|------------------------|----------------------|----------------------|-----------------------|-------------------|
| 1             | 130.0              | 0.0                    | 0.0                    | 30.0                 | 0.00                 | 0.0                   | 0                 |
| 2             | 135.0              | 0.0                    | 0.0                    | 32.0                 | 0.00                 | 0.0                   | 0                 |
| 3             | 140.0              | 0.0                    | 0.0                    | 33.0                 | 0.00                 | 0.0                   | 0                 |
| 4             | 145.0              | 0.0                    | 0.0                    | 35.0                 | 0.00                 | 0.0                   | 0                 |

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft. and X = 50.00 ft.

Each Surface Terminates Between X = 100.00 ft. and X = 175.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial  
Failure Surfaces Examined. They Are Ordered - Most Critical  
First.

\* \* Safety Factors Are Calculated By The Modified Janbu Method \* \*

Failure Surface Specified By 28 Coordinate Points

| Point<br>No. | X-Surf<br>ft. | Y-Surf<br>ft. |
|--------------|---------------|---------------|
| 1            | 37.50         | 974.17        |
| 2            | 42.50         | 974.07        |
| 3            | 47.50         | 974.11        |
| 4            | 52.50         | 974.29        |
| 5            | 57.49         | 974.61        |
| 6            | 62.46         | 975.07        |
| 7            | 67.43         | 975.67        |
| 8            | 72.37         | 976.41        |
| 9            | 77.30         | 977.29        |
| 10           | 82.19         | 978.31        |
| 11           | 87.06         | 979.46        |
| 12           | 91.89         | 980.75        |
| 13           | 96.68         | 982.17        |
| 14           | 101.43        | 983.73        |
| 15           | 106.14        | 985.42        |
| 16           | 110.79        | 987.24        |
| 17           | 115.40        | 989.20        |
| 18           | 119.94        | 991.28        |
| 19           | 124.43        | 993.49        |
| 20           | 128.85        | 995.82        |
| 21           | 133.21        | 998.27        |
| 22           | 137.49        | 1000.85       |
| 23           | 141.70        | 1003.55       |



|          |     |          |          |          |          |          |          |          |          |
|----------|-----|----------|----------|----------|----------|----------|----------|----------|----------|
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 15       | 4.8 | 0.70E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 16       | 3.3 | 0.54E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 17       | 1.4 | 0.25E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 18       | 4.7 | 0.87E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 19       | 4.7 | 0.94E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 20       | 4.6 | 0.99E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 21       | 4.5 | 0.10E+05 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 22       | 4.5 | 0.11E+05 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 23       | 0.6 | 0.14E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 24       | 2.7 | 0.64E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 25       | 1.1 | 0.26E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 26       | 4.4 | 0.94E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 27       | 4.3 | 0.84E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 28       | 4.2 | 0.72E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 29       | 4.1 | 0.61E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 30       | 4.1 | 0.49E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 31       | 0.1 | 0.12E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 32       | 2.5 | 0.23E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 33       | 1.3 | 0.93E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 34       | 3.9 | 0.16E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 35       | 1.5 | 0.14E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |

-----

Failure Surface Specified By 27 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
|-----------|------------|------------|

|    |        |         |
|----|--------|---------|
| 1  | 25.00  | 972.70  |
| 2  | 29.94  | 971.92  |
| 3  | 34.91  | 971.34  |
| 4  | 39.89  | 970.97  |
| 5  | 44.89  | 970.80  |
| 6  | 49.89  | 970.83  |
| 7  | 54.88  | 971.06  |
| 8  | 59.86  | 971.49  |
| 9  | 64.82  | 972.13  |
| 10 | 69.75  | 972.97  |
| 11 | 74.64  | 974.01  |
| 12 | 79.49  | 975.24  |
| 13 | 84.28  | 976.67  |
| 14 | 89.01  | 978.30  |
| 15 | 93.67  | 980.11  |
| 16 | 98.25  | 982.11  |
| 17 | 102.75 | 984.30  |
| 18 | 107.15 | 986.67  |
| 19 | 111.46 | 989.21  |
| 20 | 115.65 | 991.93  |
| 21 | 119.74 | 994.81  |
| 22 | 123.70 | 997.86  |
| 23 | 127.54 | 1001.06 |
| 24 | 131.24 | 1004.42 |
| 25 | 134.81 | 1007.93 |
| 26 | 138.23 | 1011.58 |
| 27 | 141.03 | 1014.83 |

Circle Center At X = 46.6 ; Y = 1093.9 and Radius, 123.2

\*\*\* 1.544 \*\*\*

1

Failure Surface Specified By 24 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.23      | 972.55     |
| 3         | 47.06      | 971.25     |
| 4         | 51.96      | 970.27     |
| 5         | 56.92      | 969.63     |
| 6         | 61.91      | 969.31     |
| 7         | 66.91      | 969.33     |

|    |        |         |
|----|--------|---------|
| 8  | 71.90  | 969.67  |
| 9  | 76.85  | 970.35  |
| 10 | 81.75  | 971.35  |
| 11 | 86.57  | 972.68  |
| 12 | 91.29  | 974.33  |
| 13 | 95.90  | 976.28  |
| 14 | 100.36 | 978.54  |
| 15 | 104.66 | 981.08  |
| 16 | 108.79 | 983.91  |
| 17 | 112.71 | 987.00  |
| 18 | 116.43 | 990.35  |
| 19 | 119.91 | 993.94  |
| 20 | 123.15 | 997.75  |
| 21 | 126.12 | 1001.77 |
| 22 | 128.83 | 1005.97 |
| 23 | 131.24 | 1010.35 |
| 24 | 132.21 | 1012.41 |

Circle Center At X = 64.2 ; Y = 1044.5 and Radius, 75.3

\*\*\* 1.547 \*\*\*

Failure Surface Specified By 22 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 975.63     |
| 2         | 54.32      | 973.11     |
| 3         | 58.86      | 971.02     |
| 4         | 63.59      | 969.38     |
| 5         | 68.45      | 968.21     |
| 6         | 73.40      | 967.50     |
| 7         | 78.39      | 967.28     |
| 8         | 83.38      | 967.55     |
| 9         | 88.33      | 968.29     |
| 10        | 93.18      | 969.51     |
| 11        | 97.89      | 971.19     |
| 12        | 102.41     | 973.32     |
| 13        | 106.71     | 975.87     |
| 14        | 110.74     | 978.83     |
| 15        | 114.47     | 982.16     |
| 16        | 117.85     | 985.84     |
| 17        | 120.87     | 989.83     |
| 18        | 123.49     | 994.09     |
| 19        | 125.68     | 998.58     |

|    |        |         |
|----|--------|---------|
| 20 | 127.43 | 1003.27 |
| 21 | 128.72 | 1008.10 |
| 22 | 129.30 | 1011.62 |

Circle Center At X = 78.2 ; Y = 1019.0 and Radius, 51.7

\*\*\* 1.629 \*\*\*

1

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 12.50      | 973.35     |
| 2         | 17.45      | 972.66     |
| 3         | 22.42      | 972.11     |
| 4         | 27.41      | 971.70     |
| 5         | 32.40      | 971.42     |
| 6         | 37.40      | 971.29     |
| 7         | 42.40      | 971.29     |
| 8         | 47.39      | 971.44     |
| 9         | 52.39      | 971.72     |
| 10        | 57.37      | 972.14     |
| 11        | 62.34      | 972.70     |
| 12        | 67.29      | 973.40     |
| 13        | 72.22      | 974.24     |
| 14        | 77.12      | 975.21     |
| 15        | 82.00      | 976.32     |
| 16        | 86.84      | 977.56     |
| 17        | 91.65      | 978.94     |
| 18        | 96.41      | 980.46     |
| 19        | 101.13     | 982.10     |
| 20        | 105.81     | 983.88     |
| 21        | 110.43     | 985.78     |
| 22        | 115.00     | 987.81     |
| 23        | 119.51     | 989.97     |
| 24        | 123.96     | 992.26     |
| 25        | 128.34     | 994.66     |
| 26        | 132.65     | 997.19     |
| 27        | 136.89     | 999.84     |
| 28        | 141.06     | 1002.60    |
| 29        | 145.15     | 1005.48    |
| 30        | 149.15     | 1008.48    |
| 31        | 153.07     | 1011.58    |
| 32        | 156.91     | 1014.79    |

33            159.19        1016.81

Circle Center At X = 39.7 ; Y = 1150.8 and Radius, 179.5

\*\*\*        1.639        \*\*\*

Failure Surface Specified By 23 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 25.00      | 972.70     |
| 2         | 29.99      | 972.36     |
| 3         | 34.99      | 972.23     |
| 4         | 39.99      | 972.30     |
| 5         | 44.98      | 972.59     |
| 6         | 49.95      | 973.08     |
| 7         | 54.90      | 973.79     |
| 8         | 59.82      | 974.69     |
| 9         | 64.70      | 975.81     |
| 10        | 69.52      | 977.13     |
| 11        | 74.28      | 978.64     |
| 12        | 78.98      | 980.36     |
| 13        | 83.60      | 982.27     |
| 14        | 88.14      | 984.37     |
| 15        | 92.58      | 986.66     |
| 16        | 96.93      | 989.13     |
| 17        | 101.16     | 991.79     |
| 18        | 105.29     | 994.62     |
| 19        | 109.29     | 997.62     |
| 20        | 113.16     | 1000.78    |
| 21        | 116.90     | 1004.10    |
| 22        | 120.49     | 1007.58    |
| 23        | 121.01     | 1008.13    |

Circle Center At X = 35.7 ; Y = 1091.7 and Radius, 119.5

\*\*\*        1.644        \*\*\*

Failure Surface Specified By 22 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.08      | 972.16     |
| 3         | 46.81      | 970.54     |
| 4         | 51.66      | 969.31     |
| 5         | 56.59      | 968.49     |
| 6         | 61.57      | 968.07     |
| 7         | 66.57      | 968.06     |
| 8         | 71.56      | 968.46     |
| 9         | 76.49      | 969.27     |
| 10        | 81.34      | 970.48     |
| 11        | 86.08      | 972.08     |
| 12        | 90.67      | 974.07     |
| 13        | 95.08      | 976.43     |
| 14        | 99.28      | 979.14     |
| 15        | 103.24     | 982.18     |
| 16        | 106.95     | 985.54     |
| 17        | 110.36     | 989.19     |
| 18        | 113.47     | 993.11     |
| 19        | 116.24     | 997.28     |
| 20        | 118.66     | 1001.65    |
| 21        | 120.71     | 1006.21    |
| 22        | 121.50     | 1008.41    |

Circle Center At X = 64.2 ; Y = 1029.0 and Radius, 60.9

\*\*\* 1.671 \*\*\*

Failure Surface Specified By 22 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 975.63     |
| 2         | 54.17      | 972.87     |
| 3         | 58.60      | 970.56     |
| 4         | 63.25      | 968.70     |
| 5         | 68.05      | 967.33     |
| 6         | 72.98      | 966.46     |
| 7         | 77.96      | 966.09     |
| 8         | 82.96      | 966.24     |
| 9         | 87.92      | 966.89     |
| 10        | 92.78      | 968.05     |
| 11        | 97.51      | 969.69     |

|    |        |         |
|----|--------|---------|
| 12 | 102.03 | 971.81  |
| 13 | 106.32 | 974.38  |
| 14 | 110.33 | 977.37  |
| 15 | 114.01 | 980.76  |
| 16 | 117.32 | 984.51  |
| 17 | 120.24 | 988.57  |
| 18 | 122.72 | 992.91  |
| 19 | 124.75 | 997.48  |
| 20 | 126.30 | 1002.23 |
| 21 | 127.36 | 1007.11 |
| 22 | 127.82 | 1011.21 |

Circle Center At X = 79.1 ; Y = 1015.0 and Radius, 49.0

\*\*\* 1.705 \*\*\*

1

Failure Surface Specified By 19 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.28      | 972.69     |
| 3         | 47.16      | 971.60     |
| 4         | 52.11      | 970.91     |
| 5         | 57.10      | 970.62     |
| 6         | 62.10      | 970.74     |
| 7         | 67.07      | 971.25     |
| 8         | 71.99      | 972.17     |
| 9         | 76.81      | 973.48     |
| 10        | 81.52      | 975.18     |
| 11        | 86.07      | 977.25     |
| 12        | 90.44      | 979.68     |
| 13        | 94.59      | 982.46     |
| 14        | 98.52      | 985.56     |
| 15        | 102.17     | 988.97     |
| 16        | 105.54     | 992.66     |
| 17        | 108.61     | 996.62     |
| 18        | 111.34     | 1000.80    |
| 19        | 112.69     | 1003.30    |

Circle Center At X = 58.2 ; Y = 1032.5 and Radius, 61.9

\*\*\* 1.723 \*\*\*

Failure Surface Specified By 30 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 974.17     |
| 2         | 42.25      | 972.60     |
| 3         | 47.06      | 971.25     |
| 4         | 51.94      | 970.13     |
| 5         | 56.86      | 969.24     |
| 6         | 61.81      | 968.58     |
| 7         | 66.79      | 968.15     |
| 8         | 71.79      | 967.94     |
| 9         | 76.79      | 967.97     |
| 10        | 81.78      | 968.24     |
| 11        | 86.76      | 968.73     |
| 12        | 91.71      | 969.45     |
| 13        | 96.61      | 970.41     |
| 14        | 101.47     | 971.58     |
| 15        | 106.27     | 972.99     |
| 16        | 111.00     | 974.61     |
| 17        | 115.65     | 976.45     |
| 18        | 120.21     | 978.51     |
| 19        | 124.67     | 980.77     |
| 20        | 129.02     | 983.24     |
| 21        | 133.25     | 985.91     |
| 22        | 137.35     | 988.77     |
| 23        | 141.31     | 991.81     |
| 24        | 145.13     | 995.04     |
| 25        | 148.79     | 998.44     |
| 26        | 152.30     | 1002.01    |
| 27        | 155.63     | 1005.74    |
| 28        | 158.79     | 1009.61    |
| 29        | 161.76     | 1013.63    |
| 30        | 163.74     | 1016.58    |

Circle Center At X = 73.6 ; Y = 1075.7 and Radius, 107.8

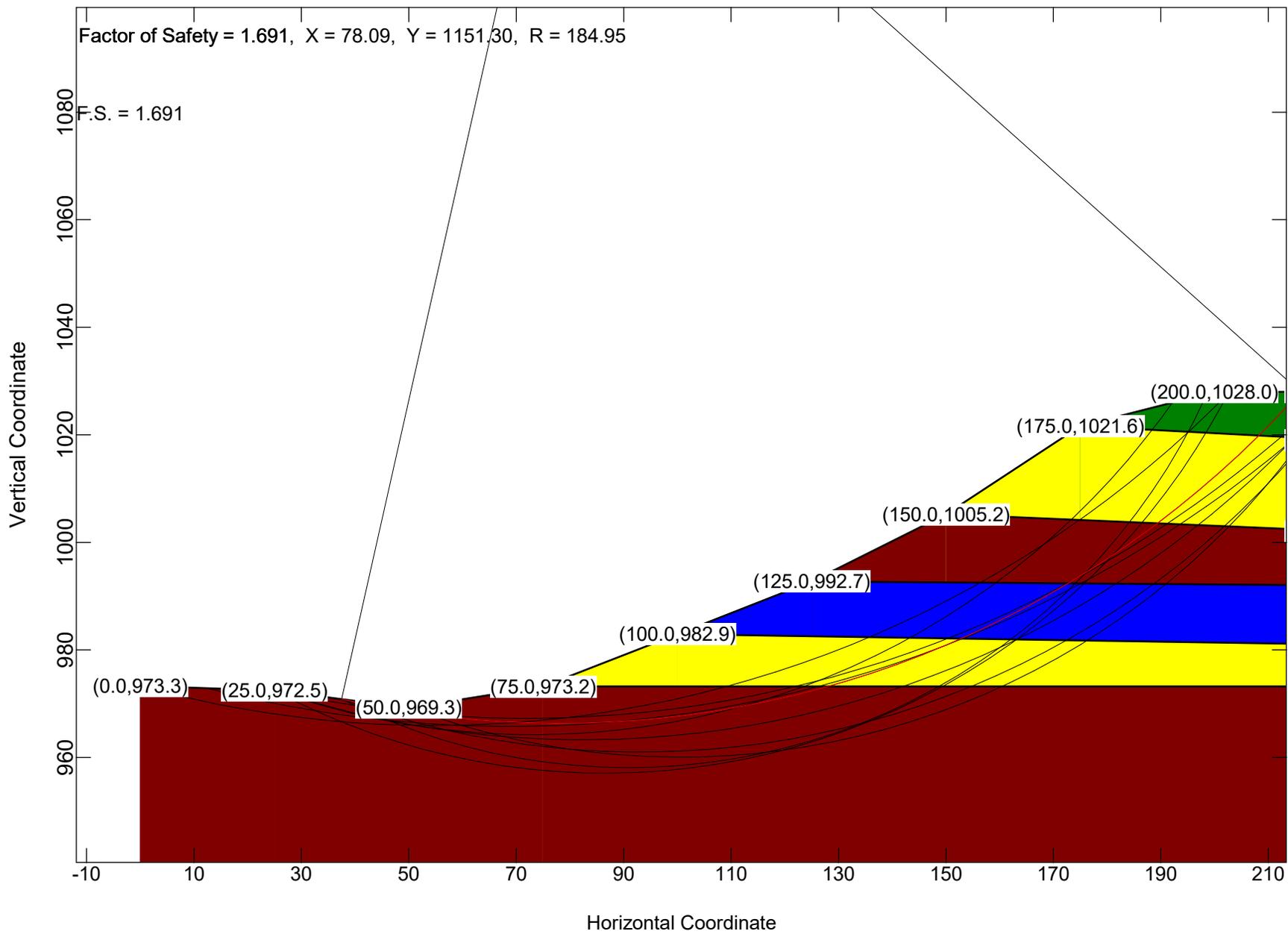
\*\*\* 1.752 \*\*\*

0.00      223.80      447.60      671.41      895.21      1119.01

|   |         |   |        |        |        |        |          |
|---|---------|---|--------|--------|--------|--------|----------|
| X | 0.00    | + | -----+ | -----+ | -----+ | -----+ | **-----+ |
|   |         | - |        |        |        |        | .**      |
|   |         | - |        |        |        |        | .2*      |
|   |         | - |        |        |        |        | .41*     |
|   |         | - |        |        |        |        | .0*      |
|   |         | - |        |        |        |        | ***      |
|   | 223.80  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| A | 447.60  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| X | 671.41  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| I | 895.21  | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| S | 1119.01 | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   | 1342.81 | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
| F | 1566.61 | + |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |
|   |         | - |        |        |        |        |          |

T 1790.41 +

# SECTION 3



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

--Slope Stability Analysis--  
Simplified Janbu, Simplified Bishop  
or Spencer Method of Slices

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 3c.sl4d  
Name of output file : Hartland Quarry - Section 3c.sl4o  
Name of plot output file : Hartland Quarry - Section 3c.sl4p

-----  
Time and Date of Analysis  
-----

Date: September 05, 2023 Time: 18:33:43

1

PROBLEM DESCRIPTION Section 3c - After Grading

BOUNDARY COORDINATES

9 Top Boundaries  
14 Total Boundaries

| Boundary<br>No. | X-Left<br>ft. | Y-Left<br>ft. | X-Right<br>ft. | Y-Right<br>ft. | Soil Type<br>Below Bnd |
|-----------------|---------------|---------------|----------------|----------------|------------------------|
|-----------------|---------------|---------------|----------------|----------------|------------------------|

|    |        |         |        |         |   |
|----|--------|---------|--------|---------|---|
| 1  | 0.00   | 973.30  | 25.00  | 972.46  | 4 |
| 2  | 25.00  | 972.46  | 50.00  | 969.25  | 4 |
| 3  | 50.00  | 969.25  | 75.00  | 973.21  | 4 |
| 4  | 75.00  | 973.21  | 100.00 | 982.92  | 2 |
| 5  | 100.00 | 982.92  | 125.00 | 992.74  | 3 |
| 6  | 125.00 | 992.74  | 150.00 | 1005.22 | 4 |
| 7  | 150.00 | 1005.22 | 175.00 | 1021.61 | 2 |
| 8  | 175.00 | 1021.61 | 200.00 | 1028.00 | 1 |
| 9  | 200.00 | 1028.00 | 225.00 | 1028.00 | 1 |
| 10 | 175.00 | 1021.61 | 225.00 | 1019.00 | 2 |
| 11 | 150.00 | 1005.22 | 225.00 | 1002.00 | 4 |
| 12 | 125.00 | 992.74  | 225.00 | 992.00  | 3 |
| 13 | 100.00 | 982.92  | 225.00 | 981.00  | 2 |
| 14 | 75.00  | 973.21  | 225.00 | 973.21  | 4 |

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

| Soil Type No. | Total Unit Wt. pcf | Saturated Unit Wt. pcf | Cohesion Intercept psf | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant psf | Piez. Surface No. |
|---------------|--------------------|------------------------|------------------------|----------------------|----------------------|-----------------------|-------------------|
| 1             | 130.0              | 0.0                    | 0.0                    | 30.0                 | 0.00                 | 0.0                   | 0                 |
| 2             | 135.0              | 0.0                    | 0.0                    | 32.0                 | 0.00                 | 0.0                   | 0                 |
| 3             | 140.0              | 0.0                    | 0.0                    | 33.0                 | 0.00                 | 0.0                   | 0                 |
| 4             | 145.0              | 0.0                    | 0.0                    | 35.0                 | 0.00                 | 0.0                   | 0                 |

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft.  
and X = 50.00 ft.

Each Surface Terminates Between X = 175.00 ft.  
and X = 225.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation. The Angle Has Been Restricted Between The Angles Of -45.0 And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial Failure Surfaces Examined. They Are Ordered - Most Critical First.

\* \* Safety Factors Are Calculated By The Modified Janbu Method \* \*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 970.85     |
| 2         | 42.39      | 969.82     |
| 3         | 47.31      | 968.92     |
| 4         | 52.25      | 968.16     |
| 5         | 57.21      | 967.53     |
| 6         | 62.19      | 967.03     |
| 7         | 67.17      | 966.67     |
| 8         | 72.17      | 966.44     |
| 9         | 77.17      | 966.35     |
| 10        | 82.17      | 966.39     |
| 11        | 87.17      | 966.57     |
| 12        | 92.16      | 966.88     |
| 13        | 97.14      | 967.33     |
| 14        | 102.10     | 967.91     |
| 15        | 107.05     | 968.62     |
| 16        | 111.98     | 969.47     |
| 17        | 116.88     | 970.46     |
| 18        | 121.75     | 971.57     |
| 19        | 126.60     | 972.82     |
| 20        | 131.40     | 974.19     |
| 21        | 136.17     | 975.70     |



|    |     |          |          |          |          |          |          |          |          |          |
|----|-----|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 14 | 5.0 | 0.95E+04 | 0.00E+00 |
| 15 | 2.9 | 0.59E+04 | 0.00E+00 |
| 16 | 2.1 | 0.45E+04 | 0.00E+00 |
| 17 | 4.9 | 0.11E+05 | 0.00E+00 |
| 18 | 4.9 | 0.12E+05 | 0.00E+00 |
| 19 | 4.9 | 0.13E+05 | 0.00E+00 |
| 20 | 4.9 | 0.13E+05 | 0.00E+00 |
| 21 | 3.2 | 0.90E+04 | 0.00E+00 |
| 22 | 1.6 | 0.45E+04 | 0.00E+00 |
| 23 | 1.4 | 0.40E+04 | 0.00E+00 |
| 24 | 3.4 | 0.10E+05 | 0.00E+00 |
| 25 | 4.8 | 0.15E+05 | 0.00E+00 |
| 26 | 4.7 | 0.15E+05 | 0.00E+00 |
| 27 | 4.7 | 0.16E+05 | 0.00E+00 |
| 28 | 4.4 | 0.15E+05 | 0.00E+00 |
| 29 | 0.2 | 0.72E+03 | 0.00E+00 |
| 30 | 2.6 | 0.90E+04 | 0.00E+00 |
| 31 | 2.0 | 0.72E+04 | 0.00E+00 |
| 32 | 4.5 | 0.16E+05 | 0.00E+00 |
| 33 | 4.5 | 0.17E+05 | 0.00E+00 |
| 34 | 4.4 | 0.17E+05 | 0.00E+00 |
| 35 | 4.3 | 0.17E+05 | 0.00E+00 |
| 36 | 0.2 | 0.88E+03 | 0.00E+00 |
| 37 | 2.3 | 0.88E+04 | 0.00E+00 |
| 38 | 1.8 | 0.67E+04 | 0.00E+00 |
| 39 | 4.2 | 0.15E+05 | 0.00E+00 |
| 40 | 4.1 | 0.14E+05 | 0.00E+00 |
| 41 | 4.0 | 0.12E+05 | 0.00E+00 |
| 42 | 0.2 | 0.64E+03 | 0.00E+00 |
| 43 | 3.7 | 0.10E+05 | 0.00E+00 |
| 44 | 3.9 | 0.97E+04 | 0.00E+00 |
| 45 | 3.0 | 0.68E+04 | 0.00E+00 |
| 46 | 0.7 | 0.15E+04 | 0.00E+00 |
| 47 | 3.7 | 0.66E+04 | 0.00E+00 |
| 48 | 3.6 | 0.48E+04 | 0.00E+00 |
| 49 | 0.2 | 0.22E+03 | 0.00E+00 |
| 50 | 3.3 | 0.28E+04 | 0.00E+00 |
| 51 | 3.4 | 0.13E+04 | 0.00E+00 |
| 52 | 1.0 | 0.72E+02 | 0.00E+00 |

-----

Failure Surface Specified By 39 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 25.00      | 972.46     |
| 2         | 29.75      | 970.88     |
| 3         | 34.54      | 969.47     |

|    |        |         |
|----|--------|---------|
| 4  | 39.38  | 968.23  |
| 5  | 44.27  | 967.15  |
| 6  | 49.18  | 966.24  |
| 7  | 54.13  | 965.50  |
| 8  | 59.10  | 964.93  |
| 9  | 64.08  | 964.53  |
| 10 | 69.07  | 964.30  |
| 11 | 74.07  | 964.24  |
| 12 | 79.07  | 964.36  |
| 13 | 84.06  | 964.65  |
| 14 | 89.04  | 965.11  |
| 15 | 94.00  | 965.74  |
| 16 | 98.94  | 966.54  |
| 17 | 103.84 | 967.51  |
| 18 | 108.71 | 968.64  |
| 19 | 113.54 | 969.95  |
| 20 | 118.32 | 971.42  |
| 21 | 123.04 | 973.05  |
| 22 | 127.71 | 974.85  |
| 23 | 132.31 | 976.80  |
| 24 | 136.85 | 978.91  |
| 25 | 141.30 | 981.18  |
| 26 | 145.68 | 983.60  |
| 27 | 149.97 | 986.16  |
| 28 | 154.17 | 988.87  |
| 29 | 158.27 | 991.73  |
| 30 | 162.28 | 994.73  |
| 31 | 166.18 | 997.86  |
| 32 | 169.97 | 1001.12 |
| 33 | 173.64 | 1004.51 |
| 34 | 177.19 | 1008.03 |
| 35 | 180.63 | 1011.66 |
| 36 | 183.93 | 1015.41 |
| 37 | 187.11 | 1019.28 |
| 38 | 190.15 | 1023.25 |
| 39 | 192.09 | 1025.98 |

Circle Center At X = 73.2 ; Y = 1109.7 and Radius, 145.4

\*\*\* 1.714 \*\*\*

1

Failure Surface Specified By 44 Coordinate Points

| Point<br>No. | X-Surf<br>ft. | Y-Surf<br>ft. |
|--------------|---------------|---------------|
|--------------|---------------|---------------|

|    |        |         |
|----|--------|---------|
| 1  | 25.00  | 972.46  |
| 2  | 29.89  | 971.43  |
| 3  | 34.81  | 970.51  |
| 4  | 39.74  | 969.70  |
| 5  | 44.69  | 969.01  |
| 6  | 49.66  | 968.43  |
| 7  | 54.64  | 967.97  |
| 8  | 59.63  | 967.63  |
| 9  | 64.62  | 967.40  |
| 10 | 69.62  | 967.29  |
| 11 | 74.62  | 967.30  |
| 12 | 79.62  | 967.42  |
| 13 | 84.61  | 967.66  |
| 14 | 89.60  | 968.01  |
| 15 | 94.58  | 968.49  |
| 16 | 99.54  | 969.07  |
| 17 | 104.50 | 969.77  |
| 18 | 109.43 | 970.59  |
| 19 | 114.34 | 971.52  |
| 20 | 119.23 | 972.57  |
| 21 | 124.09 | 973.73  |
| 22 | 128.93 | 975.00  |
| 23 | 133.73 | 976.38  |
| 24 | 138.50 | 977.88  |
| 25 | 143.24 | 979.49  |
| 26 | 147.94 | 981.20  |
| 27 | 152.59 | 983.03  |
| 28 | 157.20 | 984.96  |
| 29 | 161.77 | 987.00  |
| 30 | 166.28 | 989.15  |
| 31 | 170.75 | 991.40  |
| 32 | 175.16 | 993.75  |
| 33 | 179.51 | 996.21  |
| 34 | 183.81 | 998.76  |
| 35 | 188.05 | 1001.42 |
| 36 | 192.22 | 1004.17 |
| 37 | 196.33 | 1007.02 |
| 38 | 200.37 | 1009.97 |
| 39 | 204.34 | 1013.01 |
| 40 | 208.24 | 1016.14 |
| 41 | 212.07 | 1019.36 |
| 42 | 215.82 | 1022.66 |
| 43 | 219.49 | 1026.06 |
| 44 | 221.49 | 1028.00 |

Circle Center At X = 71.9 ; Y = 1182.1 and Radius, 214.8

\*\*\* 1.723 \*\*\*

Failure Surface Specified By 46 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 0.00       | 973.30     |
| 2         | 4.84       | 972.04     |
| 3         | 9.71       | 970.90     |
| 4         | 14.60      | 969.87     |
| 5         | 19.52      | 968.96     |
| 6         | 24.45      | 968.17     |
| 7         | 29.41      | 967.50     |
| 8         | 34.38      | 966.95     |
| 9         | 39.36      | 966.52     |
| 10        | 44.35      | 966.21     |
| 11        | 49.35      | 966.02     |
| 12        | 54.35      | 965.95     |
| 13        | 59.35      | 966.00     |
| 14        | 64.34      | 966.17     |
| 15        | 69.33      | 966.46     |
| 16        | 74.32      | 966.87     |
| 17        | 79.29      | 967.40     |
| 18        | 84.25      | 968.05     |
| 19        | 89.19      | 968.82     |
| 20        | 94.11      | 969.71     |
| 21        | 99.01      | 970.71     |
| 22        | 103.88     | 971.83     |
| 23        | 108.72     | 973.07     |
| 24        | 113.54     | 974.43     |
| 25        | 118.31     | 975.90     |
| 26        | 123.06     | 977.49     |
| 27        | 127.76     | 979.19     |
| 28        | 132.42     | 981.00     |
| 29        | 137.03     | 982.92     |
| 30        | 141.60     | 984.96     |
| 31        | 146.12     | 987.10     |
| 32        | 150.58     | 989.35     |
| 33        | 154.99     | 991.71     |
| 34        | 159.34     | 994.18     |
| 35        | 163.63     | 996.75     |
| 36        | 167.86     | 999.42     |
| 37        | 172.02     | 1002.19    |
| 38        | 176.11     | 1005.06    |
| 39        | 180.14     | 1008.03    |
| 40        | 184.09     | 1011.09    |
| 41        | 187.96     | 1014.25    |

|    |        |         |
|----|--------|---------|
| 42 | 191.76 | 1017.50 |
| 43 | 195.48 | 1020.84 |
| 44 | 199.12 | 1024.27 |
| 45 | 202.67 | 1027.79 |
| 46 | 202.88 | 1028.00 |

Circle Center At X = 54.8 ; Y = 1173.7 and Radius, 207.7

\*\*\* 1.816 \*\*\*

1

Failure Surface Specified By 40 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 970.85     |
| 2         | 42.01      | 968.69     |
| 3         | 46.60      | 966.72     |
| 4         | 51.28      | 964.95     |
| 5         | 56.02      | 963.37     |
| 6         | 60.83      | 962.00     |
| 7         | 65.69      | 960.83     |
| 8         | 70.60      | 959.87     |
| 9         | 75.54      | 959.11     |
| 10        | 80.51      | 958.57     |
| 11        | 85.50      | 958.24     |
| 12        | 90.50      | 958.11     |
| 13        | 95.50      | 958.20     |
| 14        | 100.49     | 958.50     |
| 15        | 105.46     | 959.02     |
| 16        | 110.41     | 959.74     |
| 17        | 115.32     | 960.67     |
| 18        | 120.19     | 961.80     |
| 19        | 125.01     | 963.15     |
| 20        | 129.76     | 964.69     |
| 21        | 134.45     | 966.44     |
| 22        | 139.06     | 968.38     |
| 23        | 143.58     | 970.51     |
| 24        | 148.01     | 972.83     |
| 25        | 152.33     | 975.34     |
| 26        | 156.55     | 978.03     |
| 27        | 160.65     | 980.90     |
| 28        | 164.62     | 983.93     |
| 29        | 168.46     | 987.14     |
| 30        | 172.16     | 990.50     |

|    |        |         |
|----|--------|---------|
| 31 | 175.72 | 994.01  |
| 32 | 179.12 | 997.67  |
| 33 | 182.37 | 1001.47 |
| 34 | 185.45 | 1005.41 |
| 35 | 188.37 | 1009.47 |
| 36 | 191.10 | 1013.66 |
| 37 | 193.66 | 1017.95 |
| 38 | 196.04 | 1022.35 |
| 39 | 198.23 | 1026.85 |
| 40 | 198.57 | 1027.63 |

Circle Center At X = 90.9 ; Y = 1076.3 and Radius, 118.2

\*\*\* 1.826 \*\*\*

Failure Surface Specified By 47 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 12.50      | 972.88     |
| 2         | 17.36      | 971.69     |
| 3         | 22.24      | 970.61     |
| 4         | 27.14      | 969.63     |
| 5         | 32.07      | 968.77     |
| 6         | 37.01      | 968.01     |
| 7         | 41.97      | 967.37     |
| 8         | 46.94      | 966.83     |
| 9         | 51.92      | 966.40     |
| 10        | 56.91      | 966.08     |
| 11        | 61.91      | 965.88     |
| 12        | 66.91      | 965.78     |
| 13        | 71.91      | 965.80     |
| 14        | 76.90      | 965.92     |
| 15        | 81.90      | 966.16     |
| 16        | 86.89      | 966.50     |
| 17        | 91.87      | 966.96     |
| 18        | 96.83      | 967.53     |
| 19        | 101.79     | 968.20     |
| 20        | 106.73     | 968.99     |
| 21        | 111.64     | 969.88     |
| 22        | 116.54     | 970.88     |
| 23        | 121.42     | 971.99     |
| 24        | 126.27     | 973.21     |
| 25        | 131.09     | 974.54     |
| 26        | 135.88     | 975.97     |

|    |        |         |
|----|--------|---------|
| 27 | 140.64 | 977.50  |
| 28 | 145.36 | 979.15  |
| 29 | 150.05 | 980.89  |
| 30 | 154.69 | 982.74  |
| 31 | 159.30 | 984.69  |
| 32 | 163.86 | 986.74  |
| 33 | 168.37 | 988.89  |
| 34 | 172.83 | 991.15  |
| 35 | 177.25 | 993.50  |
| 36 | 181.61 | 995.94  |
| 37 | 185.91 | 998.48  |
| 38 | 190.16 | 1001.12 |
| 39 | 194.35 | 1003.85 |
| 40 | 198.48 | 1006.67 |
| 41 | 202.54 | 1009.59 |
| 42 | 206.54 | 1012.59 |
| 43 | 210.47 | 1015.68 |
| 44 | 214.33 | 1018.85 |
| 45 | 218.12 | 1022.11 |
| 46 | 221.84 | 1025.46 |
| 47 | 224.54 | 1028.00 |

Circle Center At X = 68.7 ; Y = 1191.9 and Radius, 226.1

\*\*\* 1.838 \*\*\*

1

Failure Surface Specified By 45 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 25.00      | 972.46     |
| 2         | 29.77      | 970.97     |
| 3         | 34.58      | 969.61     |
| 4         | 39.43      | 968.38     |
| 5         | 44.31      | 967.28     |
| 6         | 49.21      | 966.31     |
| 7         | 54.14      | 965.48     |
| 8         | 59.10      | 964.78     |
| 9         | 64.06      | 964.22     |
| 10        | 69.05      | 963.79     |
| 11        | 74.04      | 963.50     |
| 12        | 79.03      | 963.34     |
| 13        | 84.03      | 963.31     |
| 14        | 89.03      | 963.43     |

|    |        |         |
|----|--------|---------|
| 15 | 94.03  | 963.68  |
| 16 | 99.01  | 964.06  |
| 17 | 103.98 | 964.58  |
| 18 | 108.94 | 965.23  |
| 19 | 113.88 | 966.02  |
| 20 | 118.79 | 966.94  |
| 21 | 123.68 | 967.99  |
| 22 | 128.54 | 969.18  |
| 23 | 133.36 | 970.49  |
| 24 | 138.15 | 971.94  |
| 25 | 142.89 | 973.52  |
| 26 | 147.59 | 975.22  |
| 27 | 152.25 | 977.05  |
| 28 | 156.85 | 979.01  |
| 29 | 161.39 | 981.09  |
| 30 | 165.88 | 983.29  |
| 31 | 170.31 | 985.62  |
| 32 | 174.67 | 988.06  |
| 33 | 178.97 | 990.62  |
| 34 | 183.19 | 993.30  |
| 35 | 187.34 | 996.09  |
| 36 | 191.41 | 998.99  |
| 37 | 195.40 | 1002.00 |
| 38 | 199.31 | 1005.12 |
| 39 | 203.14 | 1008.34 |
| 40 | 206.87 | 1011.66 |
| 41 | 210.51 | 1015.09 |
| 42 | 214.06 | 1018.61 |
| 43 | 217.52 | 1022.23 |
| 44 | 220.87 | 1025.94 |
| 45 | 222.63 | 1028.00 |

Circle Center At X = 82.4 ; Y = 1147.8 and Radius, 184.5

\*\*\* 1.839 \*\*\*

Failure Surface Specified By 43 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 970.85     |
| 2         | 42.22      | 969.21     |
| 3         | 46.99      | 967.71     |
| 4         | 51.81      | 966.36     |
| 5         | 56.66      | 965.16     |

|    |        |         |
|----|--------|---------|
| 6  | 61.55  | 964.11  |
| 7  | 66.47  | 963.21  |
| 8  | 71.41  | 962.46  |
| 9  | 76.38  | 961.87  |
| 10 | 81.36  | 961.43  |
| 11 | 86.35  | 961.15  |
| 12 | 91.35  | 961.01  |
| 13 | 96.35  | 961.04  |
| 14 | 101.34 | 961.22  |
| 15 | 106.33 | 961.55  |
| 16 | 111.31 | 962.03  |
| 17 | 116.27 | 962.67  |
| 18 | 121.20 | 963.47  |
| 19 | 126.11 | 964.41  |
| 20 | 130.99 | 965.51  |
| 21 | 135.83 | 966.76  |
| 22 | 140.64 | 968.15  |
| 23 | 145.39 | 969.69  |
| 24 | 150.10 | 971.38  |
| 25 | 154.75 | 973.22  |
| 26 | 159.34 | 975.19  |
| 27 | 163.87 | 977.31  |
| 28 | 168.33 | 979.57  |
| 29 | 172.72 | 981.96  |
| 30 | 177.04 | 984.49  |
| 31 | 181.27 | 987.15  |
| 32 | 185.42 | 989.94  |
| 33 | 189.48 | 992.86  |
| 34 | 193.45 | 995.90  |
| 35 | 197.32 | 999.06  |
| 36 | 201.09 | 1002.34 |
| 37 | 204.77 | 1005.74 |
| 38 | 208.33 | 1009.25 |
| 39 | 211.78 | 1012.86 |
| 40 | 215.12 | 1016.58 |
| 41 | 218.35 | 1020.40 |
| 42 | 221.45 | 1024.32 |
| 43 | 224.18 | 1028.00 |

Circle Center At X = 93.1 ; Y = 1122.8 and Radius, 161.8

\*\*\* 1.880 \*\*\*

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 969.25     |
| 2         | 54.71      | 967.57     |
| 3         | 59.47      | 966.05     |
| 4         | 64.29      | 964.71     |
| 5         | 69.15      | 963.53     |
| 6         | 74.05      | 962.52     |
| 7         | 78.97      | 961.68     |
| 8         | 83.93      | 961.02     |
| 9         | 88.91      | 960.52     |
| 10        | 93.90      | 960.21     |
| 11        | 98.89      | 960.06     |
| 12        | 103.89     | 960.10     |
| 13        | 108.89     | 960.30     |
| 14        | 113.88     | 960.68     |
| 15        | 118.84     | 961.24     |
| 16        | 123.79     | 961.96     |
| 17        | 128.71     | 962.86     |
| 18        | 133.59     | 963.93     |
| 19        | 138.44     | 965.18     |
| 20        | 143.23     | 966.58     |
| 21        | 147.98     | 968.16     |
| 22        | 152.67     | 969.90     |
| 23        | 157.29     | 971.80     |
| 24        | 161.85     | 973.87     |
| 25        | 166.33     | 976.09     |
| 26        | 170.73     | 978.46     |
| 27        | 175.04     | 980.99     |
| 28        | 179.26     | 983.67     |
| 29        | 183.39     | 986.49     |
| 30        | 187.41     | 989.45     |
| 31        | 191.33     | 992.56     |
| 32        | 195.14     | 995.80     |
| 33        | 198.84     | 999.17     |
| 34        | 202.41     | 1002.66    |
| 35        | 205.86     | 1006.28    |
| 36        | 209.18     | 1010.02    |
| 37        | 212.37     | 1013.87    |
| 38        | 215.42     | 1017.83    |
| 39        | 218.34     | 1021.90    |
| 40        | 221.11     | 1026.06    |
| 41        | 222.30     | 1028.00    |

Circle Center At X = 100.5 ; Y = 1103.3 and Radius, 143.2

\*\*\* 1.885 \*\*\*

Failure Surface Specified By 43 Coordinate Points

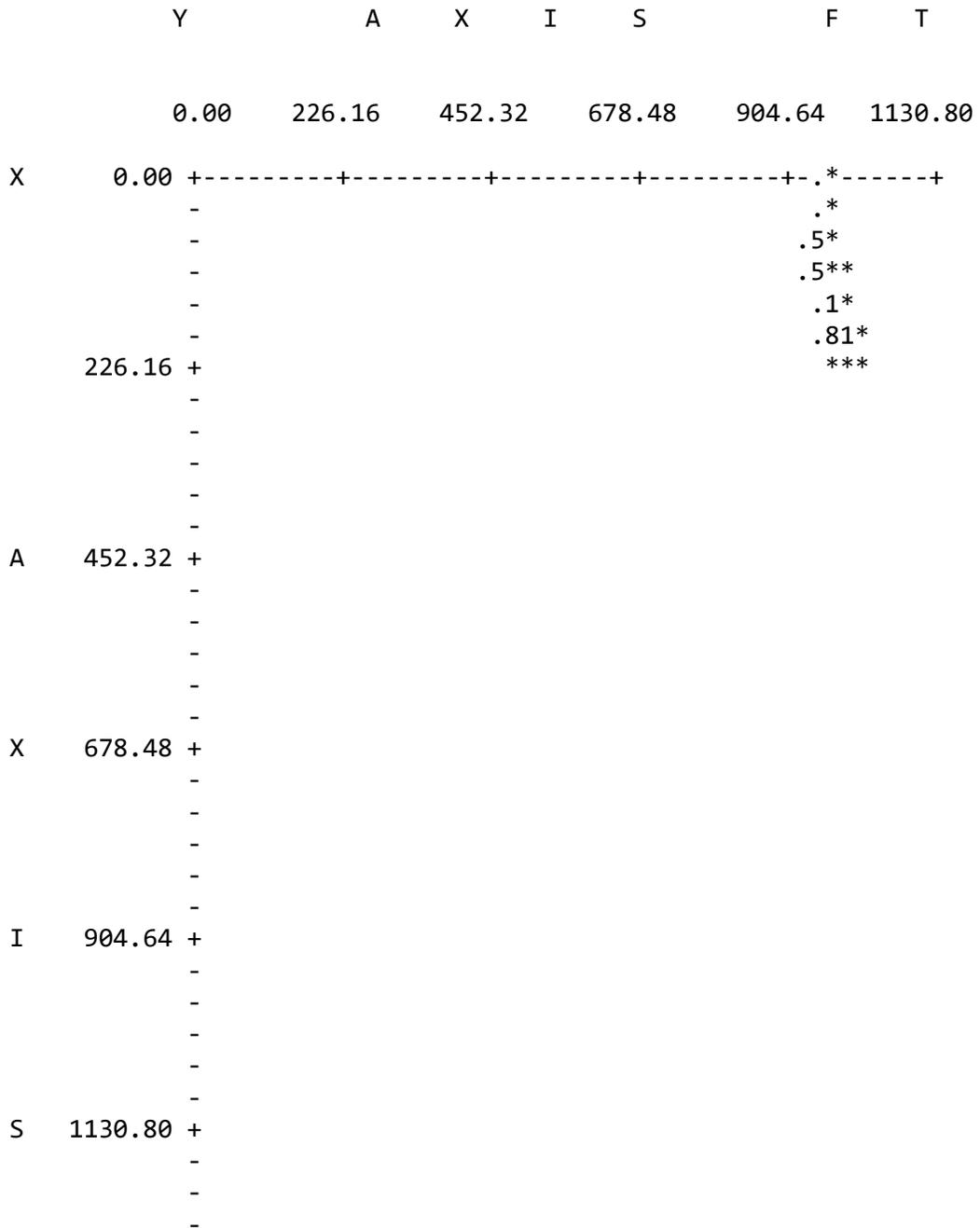
| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 25.00      | 972.46     |
| 2         | 29.46      | 970.19     |
| 3         | 33.99      | 968.09     |
| 4         | 38.61      | 966.17     |
| 5         | 43.30      | 964.43     |
| 6         | 48.05      | 962.86     |
| 7         | 52.85      | 961.48     |
| 8         | 57.71      | 960.29     |
| 9         | 62.60      | 959.28     |
| 10        | 67.54      | 958.46     |
| 11        | 72.50      | 957.83     |
| 12        | 77.48      | 957.39     |
| 13        | 82.47      | 957.14     |
| 14        | 87.47      | 957.08     |
| 15        | 92.47      | 957.21     |
| 16        | 97.46      | 957.54     |
| 17        | 102.43     | 958.05     |
| 18        | 107.38     | 958.76     |
| 19        | 112.30     | 959.65     |
| 20        | 117.18     | 960.73     |
| 21        | 122.02     | 962.00     |
| 22        | 126.80     | 963.45     |
| 23        | 131.53     | 965.09     |
| 24        | 136.19     | 966.90     |
| 25        | 140.77     | 968.89     |
| 26        | 145.28     | 971.06     |
| 27        | 149.70     | 973.39     |
| 28        | 154.03     | 975.89     |
| 29        | 158.26     | 978.56     |
| 30        | 162.38     | 981.39     |
| 31        | 166.40     | 984.37     |
| 32        | 170.29     | 987.51     |
| 33        | 174.06     | 990.79     |
| 34        | 177.71     | 994.21     |
| 35        | 181.22     | 997.77     |
| 36        | 184.59     | 1001.46    |
| 37        | 187.82     | 1005.28    |
| 38        | 190.90     | 1009.22    |
| 39        | 193.82     | 1013.28    |
| 40        | 196.59     | 1017.44    |
| 41        | 199.20     | 1021.71    |
| 42        | 201.64     | 1026.07    |

43            202.63        1028.00

Circle Center At X = 86.5 ; Y = 1087.6 and Radius, 130.6

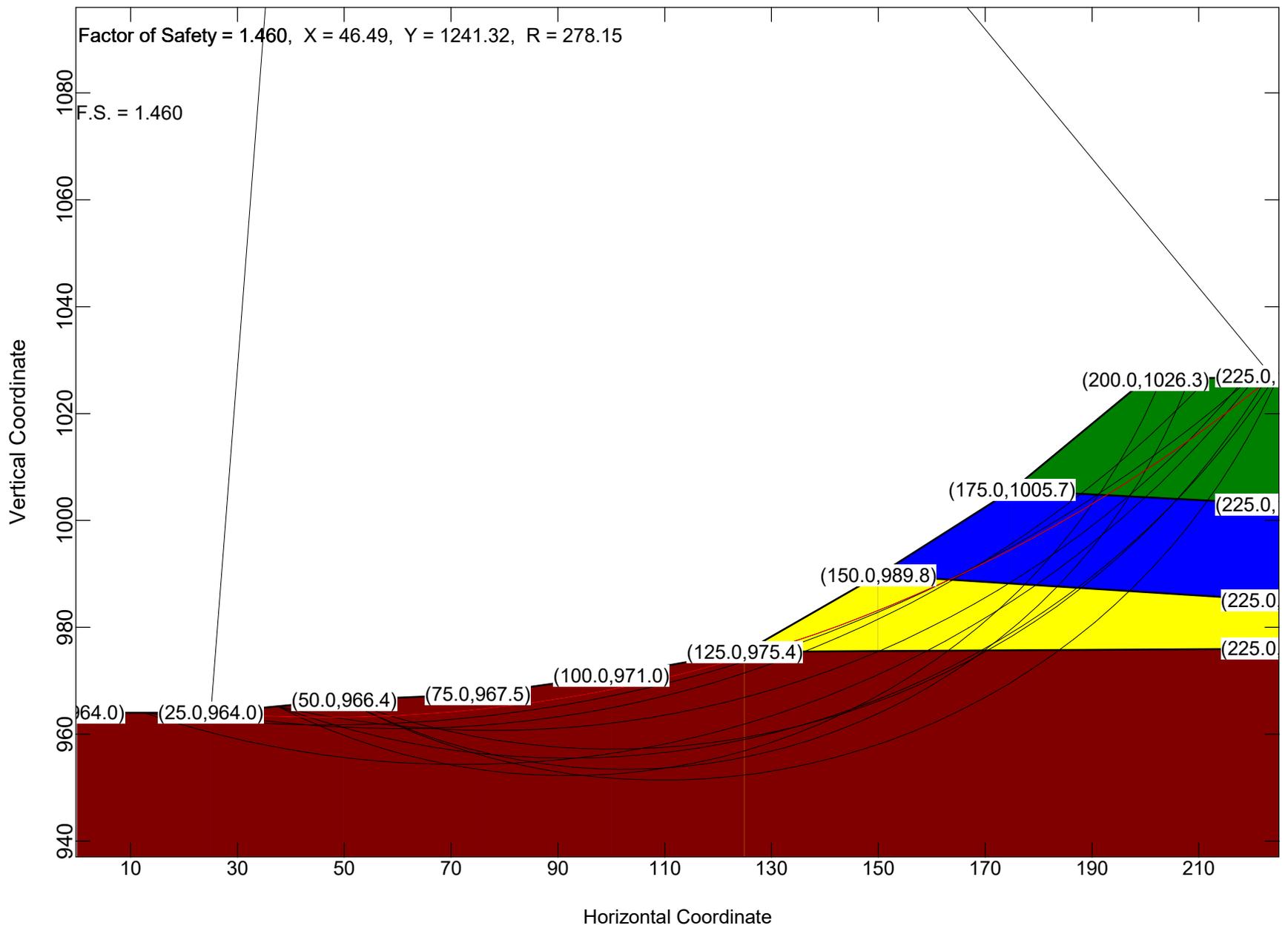
\*\*\*        1.904        \*\*\*

1



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1356.96 +  
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F 1583.12 +  
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T 1809.28 +

# SECTION 4



=====

STABLPro for Windows, Version 2015.4.5

Upgraded from:  
FHWA-PCSTABLE

Serial Number : 179981068

--Slope Stability Analysis--  
Simplified Janbu, Simplified Bishop  
or Spencer Method of Slices

=====

This program is licensed to :

GeoTest, Inc.  
West Allis, WI, USA

Path to file locations : C:\Ensoft\Hartland Quarry\  
Name of input data file : Hartland Quarry - Section 4c.sl4d  
Name of output file : Hartland Quarry - Section 4c.sl4o  
Name of plot output file : Hartland Quarry - Section 4c.sl4p

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Time and Date of Analysis

-----

Date: September 05, 2023 Time: 14:07:39

1

PROBLEM DESCRIPTION Section 4c - After Grading

BOUNDARY COORDINATES

9 Top Boundaries  
12 Total Boundaries

| Boundary No. | X-Left ft. | Y-Left ft. | X-Right ft. | Y-Right ft. | Soil Type Below Bnd |
|--------------|------------|------------|-------------|-------------|---------------------|
|--------------|------------|------------|-------------|-------------|---------------------|

|    |        |         |        |         |   |
|----|--------|---------|--------|---------|---|
| 1  | 0.00   | 964.00  | 25.00  | 964.00  | 4 |
| 2  | 25.00  | 964.00  | 50.00  | 966.38  | 4 |
| 3  | 50.00  | 966.38  | 75.00  | 967.48  | 4 |
| 4  | 75.00  | 967.48  | 100.00 | 970.99  | 4 |
| 5  | 100.00 | 970.99  | 125.00 | 975.42  | 4 |
| 6  | 125.00 | 975.42  | 150.00 | 989.75  | 2 |
| 7  | 150.00 | 989.75  | 175.00 | 1005.66 | 3 |
| 8  | 175.00 | 1005.66 | 200.00 | 1026.34 | 1 |
| 9  | 200.00 | 1026.34 | 225.00 | 1027.00 | 1 |
| 10 | 175.00 | 1005.66 | 225.00 | 1011.00 | 3 |
| 11 | 150.00 | 989.75  | 225.00 | 985.00  | 2 |
| 12 | 125.00 | 975.42  | 225.00 | 976.00  | 4 |

1

#### ISOTROPIC SOIL PARAMETERS

4 Type(s) of Soil

| Soil Type No. | Total Unit Wt. pcf | Saturated Unit Wt. pcf | Cohesion Intercept psf | Friction Angle (deg) | Pore Pressure Param. | Pressure Constant psf | Piez. Surface No. |
|---------------|--------------------|------------------------|------------------------|----------------------|----------------------|-----------------------|-------------------|
| 1             | 130.0              | 0.0                    | 0.0                    | 30.0                 | 0.00                 | 0.0                   | 0                 |
| 2             | 135.0              | 0.0                    | 0.0                    | 32.0                 | 0.00                 | 0.0                   | 0                 |
| 3             | 140.0              | 0.0                    | 0.0                    | 33.0                 | 0.00                 | 0.0                   | 0                 |
| 4             | 145.0              | 0.0                    | 0.0                    | 35.0                 | 0.00                 | 0.0                   | 0                 |

1

A Critical Failure Surface Searching Method, Using A Random Technique For Generating Circular Surfaces, Has Been Specified.

50 Trial Surfaces Have Been Generated.

10 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 0.00 ft. and X = 50.00 ft.

Each Surface Terminates Between X = 175.00 ft. and X = 225.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation

At Which A Surface Extends Is Y =900.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

Restrictions Have Been Imposed Upon The Angle Of Initiation.  
The Angle Has Been Restricted Between The Angles Of -45.0  
And 0.0 deg.

1

Following Are Displayed The Ten Most Critical Of The Trial  
Failure Surfaces Examined. They Are Ordered - Most Critical  
First.

\* \* Safety Factors Are Calculated By The Modified Janbu Method \* \*

Failure Surface Specified By 44 Coordinate Points

| Point<br>No. | X-Surf<br>ft. | Y-Surf<br>ft. |
|--------------|---------------|---------------|
| 1            | 25.00         | 964.00        |
| 2            | 29.99         | 963.66        |
| 3            | 34.98         | 963.41        |
| 4            | 39.98         | 963.25        |
| 5            | 44.98         | 963.17        |
| 6            | 49.98         | 963.19        |
| 7            | 54.98         | 963.30        |
| 8            | 59.97         | 963.50        |
| 9            | 64.97         | 963.78        |
| 10           | 69.95         | 964.16        |
| 11           | 74.93         | 964.63        |
| 12           | 79.90         | 965.18        |
| 13           | 84.86         | 965.83        |
| 14           | 89.80         | 966.56        |
| 15           | 94.73         | 967.39        |
| 16           | 99.65         | 968.30        |
| 17           | 104.55        | 969.30        |
| 18           | 109.43        | 970.39        |
| 19           | 114.29        | 971.56        |
| 20           | 119.13        | 972.82        |
| 21           | 123.94        | 974.17        |
| 22           | 128.73        | 975.61        |
| 23           | 133.49        | 977.13        |





|          |     |          |          |          |          |          |          |          |          |
|----------|-----|----------|----------|----------|----------|----------|----------|----------|----------|
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 32       | 2.2 | 0.21E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 33       | 4.6 | 0.48E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 34       | 4.6 | 0.54E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 35       | 1.9 | 0.24E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 36       | 2.7 | 0.35E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 37       | 4.5 | 0.64E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 38       | 4.5 | 0.67E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 39       | 0.1 | 0.13E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 40       | 4.3 | 0.70E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 41       | 4.4 | 0.77E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 42       | 4.3 | 0.82E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 43       | 4.3 | 0.85E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 44       | 4.2 | 0.89E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 45       | 1.5 | 0.33E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 46       | 1.9 | 0.42E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 47       | 0.7 | 0.16E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 48       | 4.1 | 0.81E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 49       | 4.1 | 0.66E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 50       | 4.0 | 0.50E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 51       | 4.0 | 0.35E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 52       | 3.9 | 0.19E+04 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |
| 53       | 2.8 | 0.42E+03 | 0.00E+00 |
| 0.00E+00 |     |          |          |          |          |          |          |          |          |

-----  
Failure Surface Specified By 42 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 965.19     |
| 2         | 42.39      | 964.16     |
| 3         | 47.31      | 963.26     |
| 4         | 52.25      | 962.50     |
| 5         | 57.21      | 961.87     |
| 6         | 62.19      | 961.38     |
| 7         | 67.18      | 961.02     |
| 8         | 72.17      | 960.80     |
| 9         | 77.17      | 960.71     |
| 10        | 82.17      | 960.76     |
| 11        | 87.17      | 960.95     |
| 12        | 92.16      | 961.27     |
| 13        | 97.14      | 961.73     |
| 14        | 102.10     | 962.32     |
| 15        | 107.05     | 963.05     |
| 16        | 111.97     | 963.92     |
| 17        | 116.87     | 964.91     |
| 18        | 121.74     | 966.04     |
| 19        | 126.58     | 967.31     |
| 20        | 131.38     | 968.70     |
| 21        | 136.14     | 970.23     |
| 22        | 140.86     | 971.88     |
| 23        | 145.53     | 973.66     |
| 24        | 150.16     | 975.57     |
| 25        | 154.72     | 977.60     |
| 26        | 159.24     | 979.76     |
| 27        | 163.69     | 982.03     |
| 28        | 168.07     | 984.43     |
| 29        | 172.39     | 986.95     |
| 30        | 176.64     | 989.59     |
| 31        | 180.82     | 992.33     |
| 32        | 184.92     | 995.20     |
| 33        | 188.94     | 998.17     |
| 34        | 192.88     | 1001.25    |
| 35        | 196.73     | 1004.44    |
| 36        | 200.50     | 1007.73    |
| 37        | 204.17     | 1011.12    |
| 38        | 207.75     | 1014.61    |
| 39        | 211.23     | 1018.20    |
| 40        | 214.62     | 1021.88    |
| 41        | 217.90     | 1025.65    |
| 42        | 218.88     | 1026.84    |

Circle Center At X = 77.8 ; Y = 1144.2 and Radius, 183.5

\*\*\* 1.606 \*\*\*

## Failure Surface Specified By 46 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 12.50      | 964.00     |
| 2         | 17.46      | 963.39     |
| 3         | 22.44      | 962.88     |
| 4         | 27.42      | 962.46     |
| 5         | 32.41      | 962.14     |
| 6         | 37.40      | 961.91     |
| 7         | 42.40      | 961.77     |
| 8         | 47.40      | 961.74     |
| 9         | 52.40      | 961.79     |
| 10        | 57.40      | 961.95     |
| 11        | 62.39      | 962.19     |
| 12        | 67.38      | 962.53     |
| 13        | 72.36      | 962.97     |
| 14        | 77.33      | 963.50     |
| 15        | 82.29      | 964.13     |
| 16        | 87.24      | 964.85     |
| 17        | 92.18      | 965.67     |
| 18        | 97.09      | 966.58     |
| 19        | 101.99     | 967.58     |
| 20        | 106.87     | 968.67     |
| 21        | 111.73     | 969.86     |
| 22        | 116.56     | 971.14     |
| 23        | 121.37     | 972.51     |
| 24        | 126.15     | 973.98     |
| 25        | 130.90     | 975.53     |
| 26        | 135.62     | 977.17     |
| 27        | 140.31     | 978.91     |
| 28        | 144.97     | 980.73     |
| 29        | 149.59     | 982.64     |
| 30        | 154.17     | 984.64     |
| 31        | 158.72     | 986.73     |
| 32        | 163.22     | 988.90     |
| 33        | 167.68     | 991.16     |
| 34        | 172.10     | 993.50     |
| 35        | 176.47     | 995.92     |
| 36        | 180.80     | 998.43     |
| 37        | 185.07     | 1001.02    |
| 38        | 189.30     | 1003.69    |
| 39        | 193.47     | 1006.44    |
| 40        | 197.60     | 1009.27    |

|    |        |         |
|----|--------|---------|
| 41 | 201.66 | 1012.18 |
| 42 | 205.68 | 1015.17 |
| 43 | 209.63 | 1018.23 |
| 44 | 213.52 | 1021.36 |
| 45 | 217.36 | 1024.57 |
| 46 | 220.00 | 1026.87 |

Circle Center At X = 46.9 ; Y = 1224.3 and Radius, 262.6

\*\*\* 1.621 \*\*\*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 966.38     |
| 2         | 54.71      | 964.70     |
| 3         | 59.47      | 963.18     |
| 4         | 64.29      | 961.84     |
| 5         | 69.15      | 960.66     |
| 6         | 74.05      | 959.65     |
| 7         | 78.98      | 958.82     |
| 8         | 83.93      | 958.16     |
| 9         | 88.91      | 957.67     |
| 10        | 93.90      | 957.36     |
| 11        | 98.90      | 957.22     |
| 12        | 103.90     | 957.26     |
| 13        | 108.89     | 957.48     |
| 14        | 113.88     | 957.86     |
| 15        | 118.85     | 958.43     |
| 16        | 123.79     | 959.16     |
| 17        | 128.71     | 960.07     |
| 18        | 133.59     | 961.15     |
| 19        | 138.43     | 962.41     |
| 20        | 143.22     | 963.83     |
| 21        | 147.97     | 965.41     |
| 22        | 152.65     | 967.17     |
| 23        | 157.27     | 969.08     |
| 24        | 161.82     | 971.16     |
| 25        | 166.29     | 973.39     |
| 26        | 170.68     | 975.78     |
| 27        | 174.99     | 978.32     |
| 28        | 179.20     | 981.02     |
| 29        | 183.32     | 983.85     |
| 30        | 187.33     | 986.83     |

|    |        |         |
|----|--------|---------|
| 31 | 191.24 | 989.95  |
| 32 | 195.04 | 993.21  |
| 33 | 198.72 | 996.59  |
| 34 | 202.28 | 1000.10 |
| 35 | 205.71 | 1003.74 |
| 36 | 209.01 | 1007.49 |
| 37 | 212.18 | 1011.35 |
| 38 | 215.22 | 1015.33 |
| 39 | 218.11 | 1019.41 |
| 40 | 220.86 | 1023.59 |
| 41 | 222.90 | 1026.94 |

Circle Center At X = 100.3 ; Y = 1099.9 and Radius, 142.7

\*\*\* 1.657 \*\*\*

1

Failure Surface Specified By 43 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 25.00      | 964.00     |
| 2         | 29.94      | 963.22     |
| 3         | 34.90      | 962.56     |
| 4         | 39.87      | 962.02     |
| 5         | 44.85      | 961.60     |
| 6         | 49.84      | 961.30     |
| 7         | 54.84      | 961.12     |
| 8         | 59.84      | 961.05     |
| 9         | 64.84      | 961.11     |
| 10        | 69.83      | 961.29     |
| 11        | 74.82      | 961.59     |
| 12        | 79.81      | 962.00     |
| 13        | 84.78      | 962.54     |
| 14        | 89.73      | 963.20     |
| 15        | 94.67      | 963.97     |
| 16        | 99.59      | 964.86     |
| 17        | 104.49     | 965.87     |
| 18        | 109.36     | 967.00     |
| 19        | 114.20     | 968.24     |
| 20        | 119.02     | 969.60     |
| 21        | 123.79     | 971.08     |
| 22        | 128.53     | 972.67     |
| 23        | 133.24     | 974.37     |
| 24        | 137.89     | 976.18     |

|    |        |         |
|----|--------|---------|
| 25 | 142.51 | 978.11  |
| 26 | 147.08 | 980.15  |
| 27 | 151.59 | 982.29  |
| 28 | 156.06 | 984.54  |
| 29 | 160.47 | 986.90  |
| 30 | 164.82 | 989.37  |
| 31 | 169.11 | 991.93  |
| 32 | 173.33 | 994.60  |
| 33 | 177.50 | 997.37  |
| 34 | 181.59 | 1000.24 |
| 35 | 185.62 | 1003.21 |
| 36 | 189.57 | 1006.27 |
| 37 | 193.45 | 1009.43 |
| 38 | 197.25 | 1012.68 |
| 39 | 200.97 | 1016.01 |
| 40 | 204.61 | 1019.44 |
| 41 | 208.17 | 1022.95 |
| 42 | 211.64 | 1026.55 |
| 43 | 211.73 | 1026.65 |

Circle Center At X = 59.9 ; Y = 1169.5 and Radius, 208.4

\*\*\* 1.713 \*\*\*

Failure Surface Specified By 44 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 965.19     |
| 2         | 42.22      | 963.54     |
| 3         | 46.99      | 962.05     |
| 4         | 51.81      | 960.71     |
| 5         | 56.67      | 959.51     |
| 6         | 61.56      | 958.48     |
| 7         | 66.48      | 957.59     |
| 8         | 71.42      | 956.87     |
| 9         | 76.39      | 956.30     |
| 10        | 81.37      | 955.88     |
| 11        | 86.37      | 955.63     |
| 12        | 91.37      | 955.53     |
| 13        | 96.37      | 955.59     |
| 14        | 101.36     | 955.81     |
| 15        | 106.35     | 956.18     |
| 16        | 111.32     | 956.71     |
| 17        | 116.27     | 957.40     |

|    |        |         |
|----|--------|---------|
| 18 | 121.20 | 958.25  |
| 19 | 126.10 | 959.25  |
| 20 | 130.96 | 960.40  |
| 21 | 135.79 | 961.71  |
| 22 | 140.57 | 963.16  |
| 23 | 145.31 | 964.77  |
| 24 | 149.99 | 966.53  |
| 25 | 154.61 | 968.44  |
| 26 | 159.17 | 970.48  |
| 27 | 163.67 | 972.68  |
| 28 | 168.09 | 975.01  |
| 29 | 172.43 | 977.48  |
| 30 | 176.70 | 980.09  |
| 31 | 180.88 | 982.83  |
| 32 | 184.98 | 985.70  |
| 33 | 188.98 | 988.70  |
| 34 | 192.88 | 991.82  |
| 35 | 196.69 | 995.07  |
| 36 | 200.38 | 998.43  |
| 37 | 203.98 | 1001.91 |
| 38 | 207.46 | 1005.50 |
| 39 | 210.82 | 1009.20 |
| 40 | 214.07 | 1013.00 |
| 41 | 217.19 | 1016.91 |
| 42 | 220.19 | 1020.91 |
| 43 | 223.06 | 1025.00 |
| 44 | 224.36 | 1026.98 |

Circle Center At X = 92.0 ; Y = 1113.9 and Radius, 158.4

\*\*\* 1.763 \*\*\*

1

Failure Surface Specified By 40 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 966.38     |
| 2         | 54.48      | 964.15     |
| 3         | 59.05      | 962.13     |
| 4         | 63.71      | 960.31     |
| 5         | 68.44      | 958.69     |
| 6         | 73.24      | 957.29     |
| 7         | 78.09      | 956.10     |
| 8         | 83.00      | 955.13     |

|    |        |         |
|----|--------|---------|
| 9  | 87.94  | 954.37  |
| 10 | 92.91  | 953.84  |
| 11 | 97.90  | 953.52  |
| 12 | 102.90 | 953.43  |
| 13 | 107.90 | 953.56  |
| 14 | 112.89 | 953.90  |
| 15 | 117.85 | 954.47  |
| 16 | 122.79 | 955.26  |
| 17 | 127.69 | 956.27  |
| 18 | 132.54 | 957.49  |
| 19 | 137.33 | 958.92  |
| 20 | 142.05 | 960.57  |
| 21 | 146.69 | 962.42  |
| 22 | 151.25 | 964.47  |
| 23 | 155.71 | 966.73  |
| 24 | 160.07 | 969.18  |
| 25 | 164.32 | 971.82  |
| 26 | 168.44 | 974.65  |
| 27 | 172.44 | 977.65  |
| 28 | 176.30 | 980.83  |
| 29 | 180.01 | 984.18  |
| 30 | 183.57 | 987.69  |
| 31 | 186.98 | 991.35  |
| 32 | 190.21 | 995.16  |
| 33 | 193.28 | 999.11  |
| 34 | 196.17 | 1003.19 |
| 35 | 198.87 | 1007.40 |
| 36 | 201.39 | 1011.72 |
| 37 | 203.71 | 1016.15 |
| 38 | 205.84 | 1020.67 |
| 39 | 207.76 | 1025.29 |
| 40 | 208.22 | 1026.56 |

Circle Center At X = 102.5 ; Y = 1066.4 and Radius, 113.0

\*\*\* 1.784 \*\*\*

Failure Surface Specified By 43 Coordinate Points

| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 50.00      | 966.38     |
| 2         | 54.45      | 964.10     |
| 3         | 58.99      | 962.00     |
| 4         | 63.61      | 960.08     |

|    |        |         |
|----|--------|---------|
| 5  | 68.30  | 958.35  |
| 6  | 73.05  | 956.81  |
| 7  | 77.87  | 955.45  |
| 8  | 82.73  | 954.29  |
| 9  | 87.63  | 953.32  |
| 10 | 92.57  | 952.55  |
| 11 | 97.54  | 951.97  |
| 12 | 102.53 | 951.60  |
| 13 | 107.52 | 951.42  |
| 14 | 112.52 | 951.44  |
| 15 | 117.52 | 951.65  |
| 16 | 122.50 | 952.07  |
| 17 | 127.46 | 952.68  |
| 18 | 132.40 | 953.50  |
| 19 | 137.29 | 954.50  |
| 20 | 142.15 | 955.70  |
| 21 | 146.95 | 957.09  |
| 22 | 151.69 | 958.68  |
| 23 | 156.37 | 960.45  |
| 24 | 160.97 | 962.40  |
| 25 | 165.49 | 964.53  |
| 26 | 169.93 | 966.85  |
| 27 | 174.26 | 969.33  |
| 28 | 178.50 | 971.99  |
| 29 | 182.63 | 974.82  |
| 30 | 186.64 | 977.80  |
| 31 | 190.53 | 980.94  |
| 32 | 194.29 | 984.24  |
| 33 | 197.91 | 987.68  |
| 34 | 201.40 | 991.26  |
| 35 | 204.74 | 994.98  |
| 36 | 207.93 | 998.83  |
| 37 | 210.97 | 1002.80 |
| 38 | 213.85 | 1006.89 |
| 39 | 216.56 | 1011.09 |
| 40 | 219.10 | 1015.40 |
| 41 | 221.47 | 1019.80 |
| 42 | 223.66 | 1024.30 |
| 43 | 224.85 | 1027.00 |

Circle Center At X = 109.5 ; Y = 1077.2 and Radius, 125.8

\*\*\* 1.806 \*\*\*

| Point<br>No. | X-Surf<br>ft. | Y-Surf<br>ft. |
|--------------|---------------|---------------|
| 1            | 12.50         | 964.00        |
| 2            | 17.26         | 962.48        |
| 3            | 22.07         | 961.09        |
| 4            | 26.90         | 959.83        |
| 5            | 31.77         | 958.69        |
| 6            | 36.67         | 957.68        |
| 7            | 41.59         | 956.81        |
| 8            | 46.54         | 956.06        |
| 9            | 51.50         | 955.45        |
| 10           | 56.48         | 954.97        |
| 11           | 61.47         | 954.62        |
| 12           | 66.46         | 954.41        |
| 13           | 71.46         | 954.32        |
| 14           | 76.46         | 954.37        |
| 15           | 81.46         | 954.55        |
| 16           | 86.45         | 954.87        |
| 17           | 91.43         | 955.31        |
| 18           | 96.39         | 955.89        |
| 19           | 101.34        | 956.60        |
| 20           | 106.27        | 957.44        |
| 21           | 111.18        | 958.41        |
| 22           | 116.05        | 959.52        |
| 23           | 120.90        | 960.75        |
| 24           | 125.71        | 962.10        |
| 25           | 130.49        | 963.59        |
| 26           | 135.22        | 965.20        |
| 27           | 139.91        | 966.94        |
| 28           | 144.55        | 968.80        |
| 29           | 149.14        | 970.78        |
| 30           | 153.67        | 972.89        |
| 31           | 158.15        | 975.11        |
| 32           | 162.57        | 977.45        |
| 33           | 166.92        | 979.91        |
| 34           | 171.21        | 982.48        |
| 35           | 175.43        | 985.17        |
| 36           | 179.57        | 987.96        |
| 37           | 183.64        | 990.87        |
| 38           | 187.63        | 993.88        |
| 39           | 191.54        | 997.00        |
| 40           | 195.37        | 1000.22       |
| 41           | 199.11        | 1003.54       |
| 42           | 202.75        | 1006.96       |
| 43           | 206.31        | 1010.47       |
| 44           | 209.77        | 1014.08       |
| 45           | 213.14        | 1017.78       |
| 46           | 216.41        | 1021.56       |

|    |        |         |
|----|--------|---------|
| 47 | 219.57 | 1025.44 |
| 48 | 220.69 | 1026.89 |

Circle Center At X = 72.1 ; Y = 1142.7 and Radius, 188.4

\*\*\* 1.951 \*\*\*

Failure Surface Specified By 41 Coordinate Points

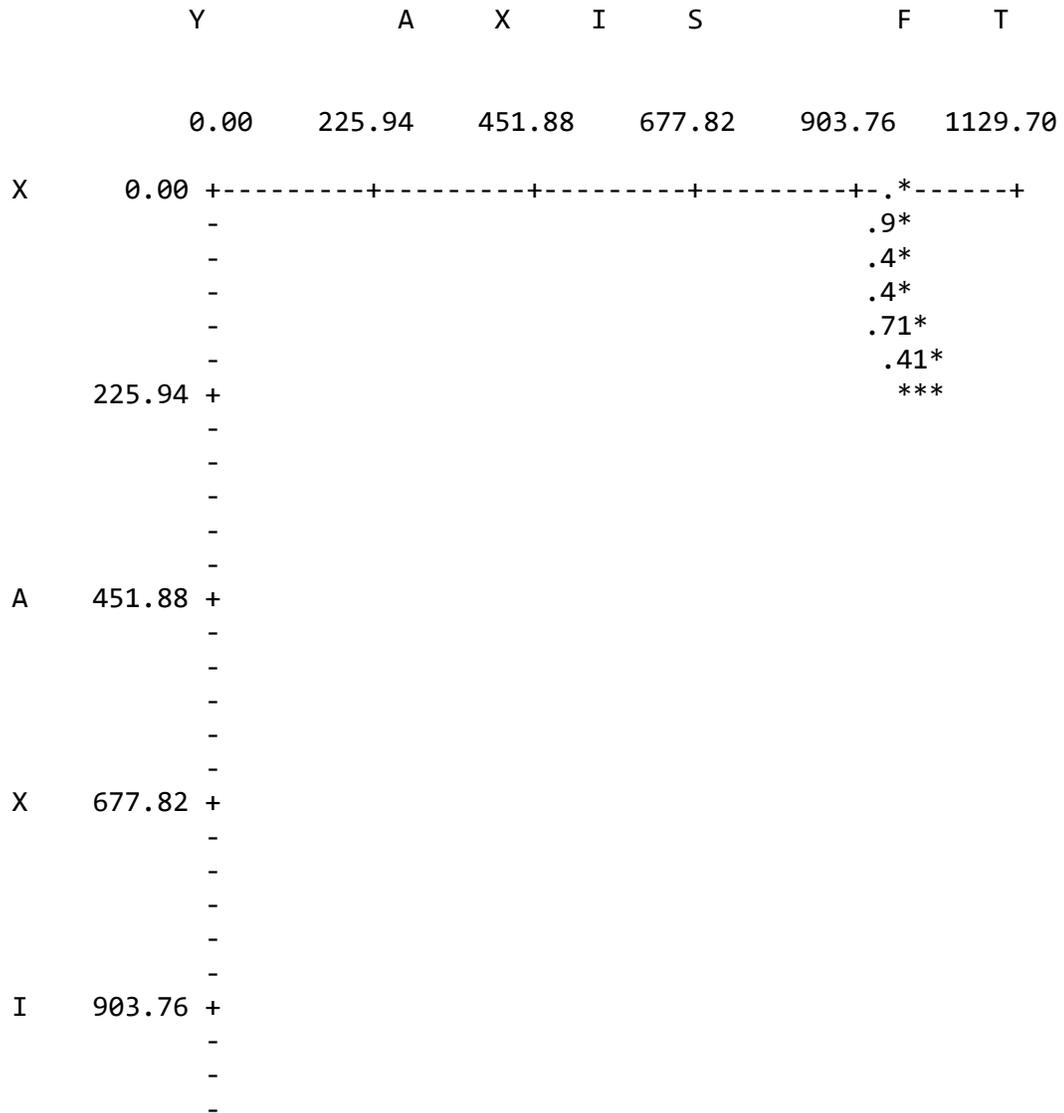
| Point No. | X-Surf ft. | Y-Surf ft. |
|-----------|------------|------------|
| 1         | 37.50      | 965.19     |
| 2         | 42.01      | 963.03     |
| 3         | 46.60      | 961.05     |
| 4         | 51.27      | 959.27     |
| 5         | 56.02      | 957.68     |
| 6         | 60.82      | 956.30     |
| 7         | 65.68      | 955.11     |
| 8         | 70.58      | 954.13     |
| 9         | 75.52      | 953.35     |
| 10        | 80.48      | 952.77     |
| 11        | 85.47      | 952.40     |
| 12        | 90.47      | 952.25     |
| 13        | 95.47      | 952.29     |
| 14        | 100.46     | 952.55     |
| 15        | 105.44     | 953.01     |
| 16        | 110.39     | 953.68     |
| 17        | 115.32     | 954.56     |
| 18        | 120.20     | 955.64     |
| 19        | 125.03     | 956.92     |
| 20        | 129.81     | 958.40     |
| 21        | 134.52     | 960.07     |
| 22        | 139.16     | 961.94     |
| 23        | 143.71     | 964.01     |
| 24        | 148.18     | 966.26     |
| 25        | 152.54     | 968.69     |
| 26        | 156.81     | 971.30     |
| 27        | 160.96     | 974.09     |
| 28        | 164.99     | 977.05     |
| 29        | 168.89     | 980.17     |
| 30        | 172.67     | 983.45     |
| 31        | 176.30     | 986.89     |
| 32        | 179.78     | 990.47     |
| 33        | 183.12     | 994.20     |
| 34        | 186.30     | 998.06     |

|    |        |         |
|----|--------|---------|
| 35 | 189.31 | 1002.05 |
| 36 | 192.16 | 1006.16 |
| 37 | 194.83 | 1010.39 |
| 38 | 197.32 | 1014.72 |
| 39 | 199.63 | 1019.15 |
| 40 | 201.76 | 1023.68 |
| 41 | 202.91 | 1026.42 |

Circle Center At X = 91.8 ; Y = 1072.6 and Radius, 120.3

\*\*\* 2.004 \*\*\*

1



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-  
S 1129.70 +  
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1355.64 +  
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F 1581.58 +  
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-  
-  
T 1807.52 +

## Hartland Quarry Slope Observations and Maintenance Manual

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Project Name: Hartland Quarry

Project Number: L23-043

Date: October 3<sup>rd</sup>, 2023      Time: 7:30 am

Present at site: InSite landscape Design -Michael Davis,

General:

During the site visit on the morning of the 3<sup>rd</sup>, several observations were made.

1. While conducting field observations, initially the entire rim of the quarry was walked and visually inspected, and in general, at the top of slope, there are very few places where it is completely bare and exposed. And of those unvegetated slopes, it was noticed to contain a great deal of aggregate at the surface. The overall site has heavy, dense diverse mix of overall cover. It contains trees, understory shrubs and ground cover plant material.





2. Some of the plant material observed:

- |  |   |
|--|---|
| ○ <i>Celtis occidentalis</i>             | ○ <i>Aronia melanocarpa</i> var. <i>elata</i> |
| ○ <i>Juglans nigra</i>                   | ○ <i>Ceanothus americanus</i>                 |
| ○ <i>Ostrya virginiana</i>               | ○ <i>Diervilla lonicera</i>                   |
| ○ <i>Populus deltoides</i>               | ○ <i>Rhus glabra</i>                          |
| ○ <i>Malus ioensis</i>                   | ○ <i>Rubus occidentalis</i>                   |
| ○ <i>Prunus serotina</i>                 | ○ <i>Vaccinium angustifolium</i>              |
| ○ <i>Betula alleghaniensis</i>           |   |
| ○ <i>Alnus incana</i> var. <i>rugosa</i> | ○ <i>Schizachyrium scoparium</i>              |
| ○ <i>Juglans cinerea</i>                 | ○ <i>Andropogon gerardii</i>                  |
| ○ <i>Prunus virginiana</i>               | ○ <i>Agastache foeniculum</i>                 |
|  | ○ <i>Silphium laciniatum</i>                  |
| ○ <i>Pinus strobus</i>                   | ○ <i>Rudbeckia subtomentosa</i>               |
| ○ <i>Thuja occidentalis</i>              | ○ <i>Lupinus perennis</i>                     |
| ○ <i>Pinus banksiana</i>                 | ○ <i>Anemone canadensis</i>                   |
| ○ <i>Picea glauca</i>                    | ○ <i>Fragaria virginiana</i>                  |

3. While conducting field observations at the rim of the quarry there appeared to be no real glaring evidence of active erosion trenches or ditches was discovered on the quarry site. Erosion ditches are created when (a lot of) water meets relatively loose moraine material, gravel and/or soil. The water entrains this material: First an erosion groove is formed, then an erosion gully and then an erosion ditch. It is important to maintain the dense plant material at the rim or top of the slope of the site.
4. While conducting field observations at the bottom of the slopes there did not appear to be evidence to concentrated debris and sediment transportation of an active erosion ditch from the slopes above, leaving a pile of sediment or wash out on the quarry floor.

The following are more specific observations of 4 potential areas of concern.

|   |                       |   |                             |
|---|-----------------------|---|-----------------------------|
| <b>Project:</b><br>Hartland Quarry Apartments           |                       | <b>Client:</b><br>Three Leaf Partners   | <b>Project No.:</b><br>7708 |
| <b>Photo No.</b><br>1                                   | <b>Date</b><br>9-7-23 |  |                             |
| <b>Description:</b><br>Erosion area along Palmer Drive. |                       |   |                             |

While conducting field observations at the slope identified in aerial photo #1 was observed to show no real signs of slope erosion, landslide, and instability in loess; instead, there was dense multilayer vegetation and large pieces of stone and a piece of equipment.



|  |                       |  |
|--|-----------------------|--|
| <b>Photo No.</b><br>2  | <b>Date</b><br>9-7-23 |  |
| <b>Description:</b><br>Erosion area near the neighboring barn. |                       |  |

While conducting field observations at the slope identified in aerial photo #2. This adjacent to the Jackson property at 431 Street. Prior to inspecting we obtained permission to walk the top of the slope on Mrs. Jackson's property. Among the things observed was that there is a storm drain outfall from Hill Street that is one of the reasons for the base spot in this area. It was observed to show no real signs of slope erosion that would need to be addressed at this time as is not causing, instability in loess or a landslide. In other areas there were signs of plant material lost and a few fallen trees which could indicate some erosion, but no significant signs of channeling of water or concentrated flow that would indicate the start of a groove in the down slope.



|   |                       |   |                             |
|---|-----------------------|---|-----------------------------|
| <b>Project:</b><br>Hartland Quarry Apartments                             |                       | <b>Client:</b><br>Three Leaf Partners   | <b>Project No.:</b><br>7708 |
| <b>Photo No.</b><br>3   | <b>Date</b><br>9-7-23 |  |                             |
| <b>Description:</b><br>Erosion area near the North Point Church Cemetery. |                       |   |                             |

While conducting field observations at the slope identified in aerial photo #3. This area of concern is adjacent to the North Point Church off of Capitol Drive. It was observed to show some areas of bare ground with empty patches lacking vegetation. There was an abundance of exposed aggregate ranging from small pebble size to larger boulders being exposed. The aggregate appears to be helping hold the slope together and preventing erosion. No real signs of slope erosion, landslide, and instability in loess.

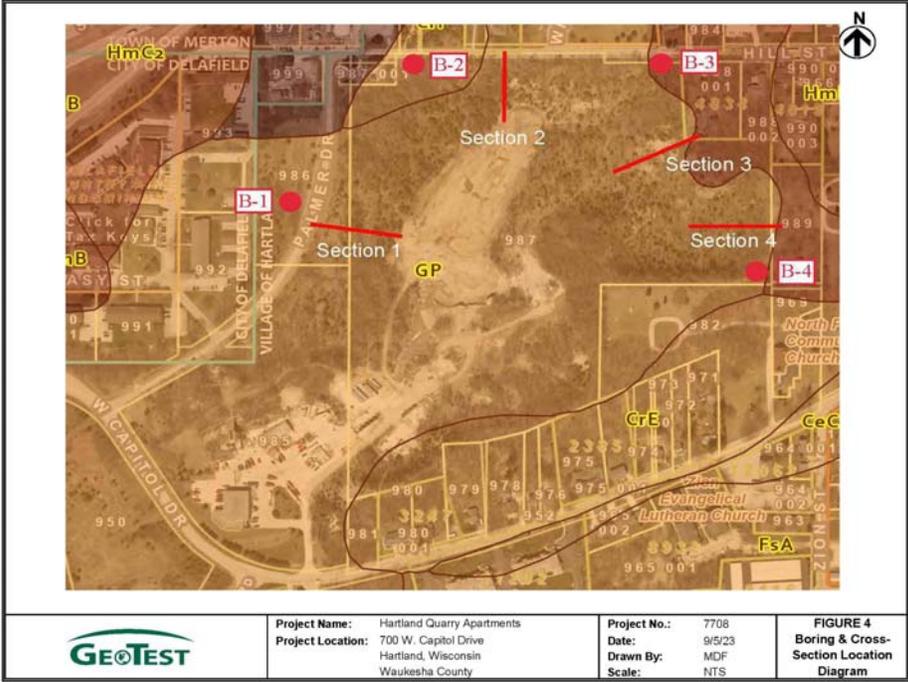


|  |                       |  |
|--|-----------------------|--|
| <b>Photo No.</b><br>4  | <b>Date</b><br>9-7-23 |  |
| <b>Description:</b><br><br><b>Erosion area north of the industrial area.</b> |                       |  |

While conducting field observations at the slope identified in aerial photo #4. This area of concern is located on the north western part of the parcel off of Palmer Drive, south of photo #1. It was observed to show some areas of bare ground with empty patches lacking vegetation. There was an abundance of exposed aggregate ranging from small pebble size to larger cobble sized rocks. The areas are noticeable and larger but the slope is holding itself together and there is not real evidence of erosion or slope instability.



Another section that was inspected (#5) while conducting field observations was approximately the midpoint of the norther parcel boundary along Hill Street. (approximately near the label Section 2 on the figure 4 diagram below) There is very little room at the top of slope and the guardrail along Hill Street. Also, there are several wind fall trees which could indicate erosion. But upon closer inspection there is really not much evidence of slope erosion or instability. Consistence with other areas, there was dense multilayer vegetation.



All of these areas should be inspected on a routine with a written and photographic report. It is recommended that it be done annually after the winter melt and spring rains.

While conducting further field observations at the rim of the Hartland Quarry, there was one area of concern that showed signs of channeling of water or concentrated flow that had a definite groove in the down slope. This is a stormwater outfall pipe that comes from an inlet along Hill Street. Please refer to the photos below.



Per the photos above, it was observed to show some areas of bare ground with empty patches lacking vegetation. There is a definite channel being worn directly from the storm water outfall. The pipe and outfall have been in place for many years and limited among of erosion and channeling is a positive sign that the down slope is generally stable. There was an abundance of exposed aggregate ranging from small pebble size to larger cobble sized rocks and some modest boulders along with many mature trees and understory plant material. This combination is why the down slope is holding itself together as well as it is. However, this is an area of concern and steps should be taken to prevent further erosion.

Attached is a pipe outfall plan to be implemented. A combination of multiple strategies is recommended. Biodegradable, pre-seeded erosion control blankets should be installed with bio-stakes along with some erosion control understory plant material plugs and livestock, woody plant material cut in and install withing the matting adjacent to both sides of the channel. The central channel should have rip rap down the slope of the channel with coir logs. This multi-faceted approach will ensure the current conditions do not exacerbate but yet improve the current existing conditions.



| NO. | REVISION DESCRIPTION | DATE |
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**HARTLAND APARTMENTS**  
 700 W. CAPITOL DRIVE  
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**THREE LEAF PARTNERS**  
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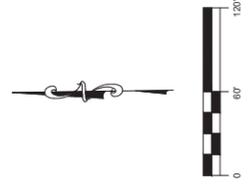
**SLOPE MAINTENANCE & INSPECTION PLAN**

**SHEET TITLE**

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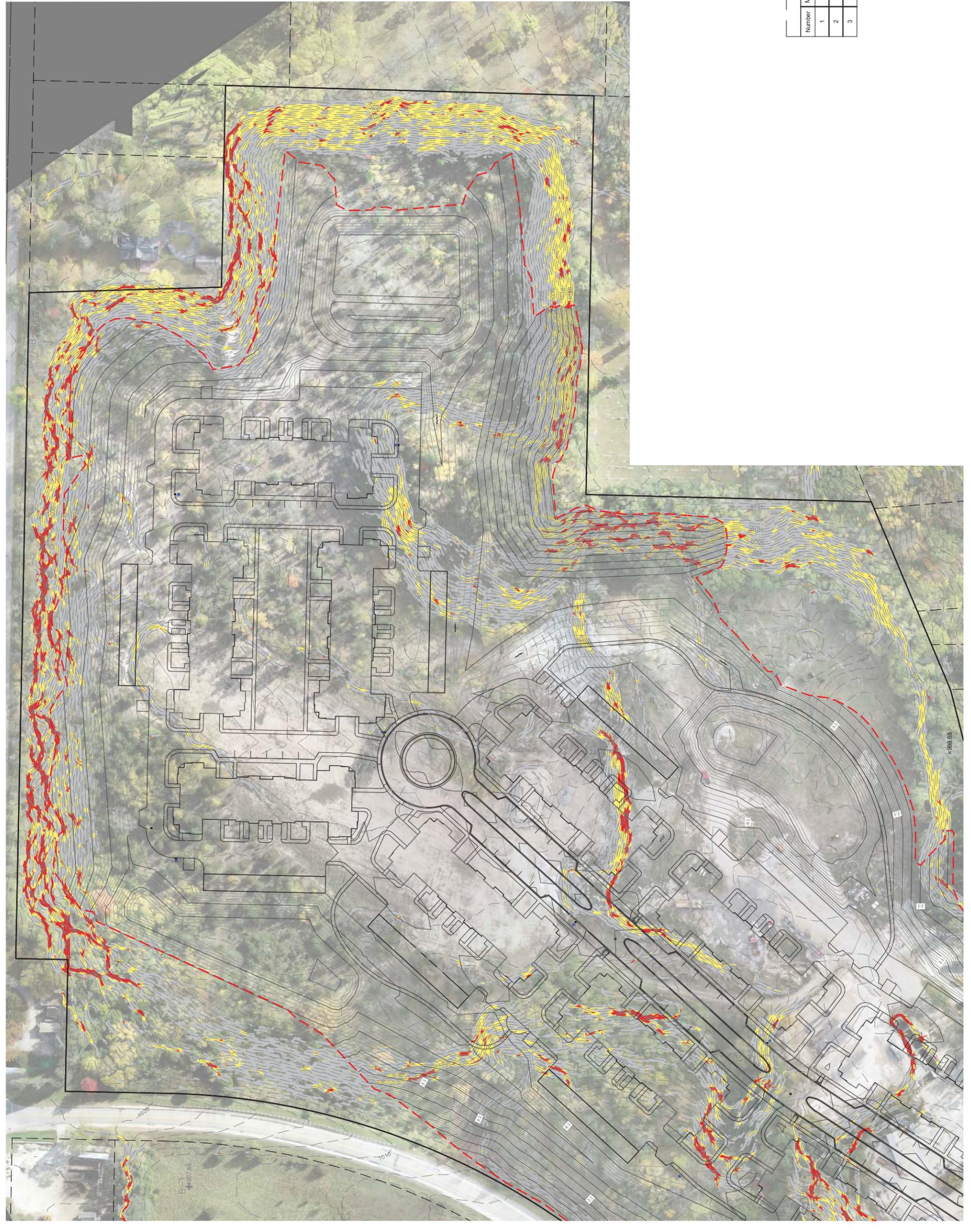
**PRELIMINARY  
 NOT FOR  
 CONSTRUCTION**



Slopes Table

| Number | Minimum Slope | Maximum Slope | Color  |
|--------|---------------|---------------|--------|
| 1      | 40.00%        | 66.67%        | Grey   |
| 2      | 66.67%        | 100.00%       | Yellow |
| 3      | 100.00%       | 100000.00%    | Red    |

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## Indicators of Slope Instability

**Rill Erosion** – micro channels of erosion caused by water runoff on bare soil, generally becomes gully erosion if not treated.



Monitor: .5" to 4" in depth – Determine source of periodic runoff and divert.

Immediate Corrective Action: greater than 6" in depth – plant vegetation to minimize and protect the soil from future scouring.

**Gully Erosion** – “U” or “V” shaped channels with periodic flow that occur due to untreated rills. Typically occurring at concentrated flow areas. The product of rills that are deeper than 1'. If not corrected prior to, immediate action must be taken to determine the runoff source, divert and increase the amount of vegetation or trees in the area. In extreme cases, rolled erosion mat may be necessary.



**Vegetative Bare Spots** – areas that have been previously vegetated begin to develop open/dead areas; this can lead to increased erosion due to lack of root structure.



Monitor: Small area of vegetation is needed – plant vegetation as necessary to minimize erosion

Immediate Corrective Action: Area has continued to grow, and erosion is occurring – use Live Stakes (as shown below) to eliminate the erosion in the area.

**Freeze/Thaw Erosion** –Showing up primarily in ice formations on side slopes. Possible areas could be near concentrated snow storage areas on Hill Street and Palmer Drive.



Monitor: small area of ice formation on slope – monitor the area through the Spring

Immediate Corrective Action: the area has grown and large cracks have formed – determine the source and divert runoff.

**Rock/Slides (Dry-ravel)** – similar to that of a landslide, in this slope failure, material, ranging from large boulders to small gravel marbles, will be found breaking from the top of the slope towards the toe of the slope



Monitor: Small marbles and gravel – seed, fertilize and mulch the area

Immediate Corrective Action: large boulders have broken away from the slope – determine if a rip-rap/rock blanket is necessary, extreme cases may require a retaining wall to hold the slope.

**Excessive sediment in swales** – dry-ravel erosion cause slides from top of slope to toe, many times to the swale basin.

Monitor: determine the source of the sediment

Immediate Corrective Action: Remove sediment from swale to ensure proper drainage is occurring

## Corrective Actions

Rilling & Gullies – The first step is always to determine the source of the runoff and divert it. Vegetation would be the next step so root structures can grow and hold the soil together. The most serious would be to apply a rolled erosion product.



Vegetative Bare Spots – Vegetative re-planting is the earliest step that can be taken to decrease the size/amount of bare spots. Live Stakes, mentioned above, have shown their ability to minimize erosion due to their strong roots.

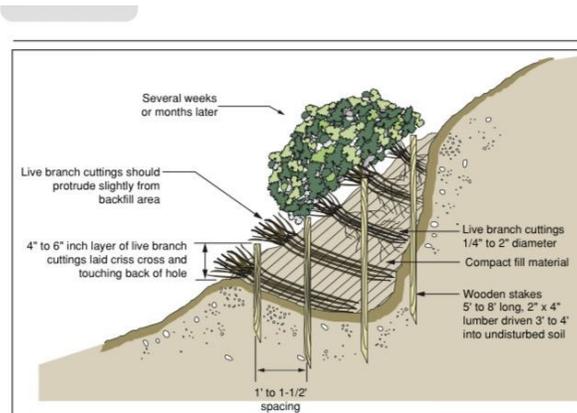


Figure 17—Typical branchpacking. (Lewis 2000)

Pipe Discharge areas causing rilling/gullies – rip rap may be necessary to treat this area

Dry-ravel – treatments include, seed, fertilizer and mulch, rip rap/rock blankets, bioengineered soil or in extreme cases a retaining wall may be needed.