

# TERRA ASSOCIATES, Inc.

Consultants in Geotechnical Engineering, Geology  
and  
Environmental Earth Sciences

January 21, 2010  
Project No. T-6389

Ms. Diane Dunbar  
Friends of Lewis Park  
c/o NBHC  
3211 Beacon Avenue South, Suite #14  
Seattle, Washington 98114

Subject: Geologically Hazardous Areas Review  
Lewis Forest Park Restoration  
Golf Drive South  
Seattle, Washington

Dear Ms. Dunbar:

As requested, we have conducted a review of geologically hazardous areas for the Lewis Forest Park site. The location of the site is shown on the attached Figure 1. Our scope of work included a visual site reconnaissance, on-site exploration, and review of all available geologic documentation. Our study addresses geologic hazards as described in the City of Seattle Municipal Code. It also includes analysis of slope stability along three profiles on the existing slope. The results of these analyses are used to address potential erosion, steep slope, and landslide hazards as they relate to restoration of the park.

## SITE CONDITIONS

The site is a predominantly east-facing hillside with a narrow plateau along its western margin. The topographic information provided to us indicates the slope is approximately 50 to 80 feet high, with inclinations ranging between about 20 and 90 percent. The site is bordered to the west by Golf Drive South and 15th Avenue South, to the north by South Charles Street, and to the east and south by residential lots. At the toe of the slope exists a partially graded and gravel surfaced alleyway that provides access to the southern and northern most down-slope residences.

The northern quarter of the property has been reworked. This portion of the site is gently to moderately sloping. We observed two areas of fill or graded soil. One area observed consists of a circular berm creating a small interior depression. The second area, located at the transition to the steeper untouched southern three quarters of the site, ramps up to the south to a level pad separating upper and lower portions of the slope. Trees appear to have been thinned and the area stripped of nearly all previously existing undergrowth. Older growth Alder and Maple trees are scattered throughout the northern quarter with new plantings consisting of coniferous trees, bushes, shrubs and groundcover (hemlock, cedar, spruce, snow berry, rose, salal, and fern). Bark covered walking trails lined with tree limbs meander throughout this portion of the site. A semi-flexible, approximately one-inch diameter tightline pipe has been placed from the northern end of the site to a small water storage container, near the intersection of Golf Drive South, 15th Avenue South, and 14th Avenue South. Water spickets are attached at regular intervals.

The southern three quarters of the property varies in inclination and vegetation throughout. In general, vegetation consists of a thick to moderate growth of Maples with thick underbrush and groundcover. Underbrush consists mostly of holly, salal, Oregon grape, and wax myrtle. Groundcover consists almost entirely of ivy with scattered fern. We observed a small stand of Birch trees in the upper plateau portion of the slope near the southwest corner of the site. Blackberry and nettles were observed in the flatter lower portions of the slope toward the slopes toe. We observed the existing utility easements to be nearly void of shrubs or bushes. Based on City of Seattle Sewer cards, these utilities were installed in the mid 1920s. We also observed garbage, and occasional concrete debris littered throughout the southern three-quarters of the site.

We did not observe indications of deep-seated instability; however, portions of the slope have been subjected to shallow erosion, creep, and localized sloughing. These conditions are generally limited to the forest litter and relatively loose surficial soils mantling the underlying competent soils, and are commonly associated with natural weathering occurrences on steep slopes. All of the erosional features we observed on the steep slope appear to be a result of surface water runoff and shallow interflow from areas above the slope crest, and flatter areas above the toe of the slope.

## **GEOLOGIC CONDITIONS**

On December 10, 2009, we visited the site to perform a reconnaissance of the slope. On December 17, 2009, we revisited to perform our subsurface exploration. We excavated 4 test pits to depths ranging from about 8 feet to 8.5 feet and 6 hand augers to a maximum depth of 4 feet below the existing ground surface. Test pits were excavated at the top of the slope, along the flatter western margin of the site. In general, we observed loose to medium dense sand and silty sand. Test Pit TP-3 found uncontrolled fill, consisting of organics, ash, and charred bits, to a depth of 2 feet grading down slope to 3 feet below existing surface grade. Hand augers found topsoil and topsoil fill from three inches to two feet in thickness overlaying silty sand and silt. Silt is exposed in the cut face at the toe of the slope along the alleyway on the southern end of the site.

The native soils are generally moist below a depth of about three feet. We observed wet soils to a depth of about 4.5 feet in Test Pit TP-1. Soils in and around the area of TP-1 were wet enough that vibration during excavation was felt under foot. We did not observe indications of significant groundwater seepage on the slope; however, we observed the exposed silt soils at the southern half of the toe of the steep slope were wet, and sloughing in places. The wet conditions at this location appear to be from surface runoff from areas above, and possibly from seasonal perched groundwater following roots and emerging out the face of the cut toe of the slope.

The *Geologic Map of Seattle – a Progress Report, Seattle, Washington* by K.G. Troost, D.B. Booth, A.P. Wisher, and S.A. Shimel, 2005, maps the soils at the site as Advanced Outwash (Qva) resulting from mass wastage in the northern and majority of the site becoming landslide deposits in the southern margin. Lawton Clay (Qvlc) is the mapped geology at and beyond the toe of the slope. It is possible that due to their density and consistent grain size that the surficial sands were potentially deposited as a result of past landsliding however, the soils were void of organic and granular debris normally included in landslide debris.

Detailed descriptions of the subsurface conditions encountered in the test pits and hand augers are presented on the attached Test Pit and Hand Auger Logs in Appendix A. The approximate locations of the test pits and hand augers are shown on the attached Figure 2.

## **GEOLOGICALLY HAZARDOUS AREAS**

Section 20.09.020 (A)(1) of the City of Seattle Municipal Code (SMC) defines geologically hazardous areas as liquefaction-prone areas, landslide-prone areas (including steep slope areas), peat settlement-prone areas, seismic hazard areas, and volcanic hazard areas.

### **Liquefaction-Prone Areas**

Section 20.09.020 (A)(2) of the SMC defines liquefaction-prone areas as those areas “underlain by cohesionless soils of low density, usually in association with a shallow groundwater table, that lose substantial strength during earthquakes”.

Liquefaction is a phenomenon where there is a reduction or complete loss of soil strength due to an increase in pore water pressure induced by vibrations from a seismic event. Liquefaction mainly affects geologically recent deposits of fine-grained sands that are below the groundwater table. Soils of this nature derive their strength from intergranular friction. The generated water pressure or pore pressure essentially separates the soil grains and eliminates this intergranular friction; thus, eliminating the soil’s strength.

The soils we observed at the site consist of fine loose to medium dense sand becoming medium dense silty sand terminating in medium stiff silt. Due to the lack of subsurface groundwater within the fine grained sands and the cohesive nature of the underlying silt, it is our opinion that there is a minimal risk for soil liquefaction to occur at the site.

### **Landslide-Prone Areas**

Section 25.09.020 (A)(3)(a) of the SMC, defines landslide-prone areas as "...known landslide areas identified by documented history, or areas that have shown significant movement during the last ten thousand years or are underlain by mass wastage debris deposited during this period; or potential-landslide areas...". Potential-landslide areas include but are not limited to the following:

(b.)(1) "Those areas that are described as potential slide areas in "Seattle Landslide Study" (Shannon & Wilson, 2000 and 2003)."

(b.)(2) "Areas with indications of past landslide activity, such as landslide headscarps and sidescarps, hummocky terrain, areas with geologic conditions that can promote earth movement, and areas with signs of potential landsliding, such as springs, groundwater seepage, and bowed or backtilted trees."

"(b.)(5) "Slopes with an incline of 40 percent or more within a vertical elevation change of at least 10 feet."

The South Seattle Vicinity Map, Figure C-8 of the *Seattle Landslide Study* shows the site to be less than 100 feet south and west of the nearest recorded landslides. According to this study, the northern extent of the site is located within a landslide prone area with the entire site identified as having landslide potential.

During our site visit, we did not observe on-site indications of deep-seated instability, springs, or groundwater seepage on the steep slopes. As discussed, we observed relatively shallow erosional features and localized shallow sloughing or creep at isolated locations. Due to its geologic mapping, local landslide study, presence of shallow ground movement features, and slope inclinations, the site would be considered a landslide prone area pursuant to Items 1, 2, and 5.

### **Steep Slope Areas**

Section 20.09.020 (A) (4) of the SMC defines steep slope areas as those areas with slopes inclined at 40 percent or greater with in a vertical elevation change of at least 10 feet. The southern two thirds of the site is inclined at gradients generally greater than 40 percent and; therefore, meets requirements as stated in the SMC as a Steep Slope.

### ***Stability Analysis***

We performed our stability analyses using the computer program WINSTABL. The soil parameters used are shown on the attached analysis plots and output text in Appendix B. These parameters are based on field and laboratory data, and our past experience with similar soils. Analyses of the slope were performed along three section lines identified on the attached Figure 3 as Section A-A' through Section C-C'. Our analyses of these sections considered both static and pseudostatic (seismic) conditions for the existing slopes. A horizontal acceleration of 0.20g was used in the pseudostatic analysis to simulate slope performance under earthquake loading.

The lowest safety factors for each condition are presented in the following table:

| Section Analyzed | Minimum Safety Factors |              |
|------------------|------------------------|--------------|
|                  | Static                 | Pseudostatic |
| Section A-A'     | 1.57                   | 1.13         |
| Section B-B'     | 1.76                   | 1.30         |
| Section C-C'     | 2.16                   | 1.32         |

The results of the stability analyses indicate that acceptable factors of safety against global or deep-seated landslides occurring on the property are present under current conditions.

### **Peat Settlement-Prone Areas**

Section 20.09.020 (A)(5) of the SMC defines peat settlement-prone areas as those areas as delineated on Maps A1 through A26 of the Peat Settlement-prone Area Boundaries Maps. Based on review of the 2007 Peat Settlement-prone Area Boundaries Map A-14, the site is not located within a peat settlement-prone area.

### **Seismic Hazard Areas**

Section 20.09.020 (A)(6) of the SMC defines seismic hazard areas as liquefaction-prone areas and also include but are not limited to the following:

- (a.) "Areas of the City subject to ground shaking from seismic hazards that are addressed by the Building Code (SMC Title 22)."
- (b.) The Seattle Fault zone as delineated in Troost et al., 2005, the geologic map of Seattle, a progress report, U.S. Geological Survey, Open-file report 2005-1252 or as the Director determines is more accurately mapped by the U.S. Geological Survey, as set out in a Directors Rule."

The January 2007 Director's Report and Recommendation titled "Amendments to the Geologic Hazards Areas Designation of the Environmentally Critical Areas Regulations" states that the Seattle Fault Zone is to be considered a geologic hazard area. Based on review of the 2007 Seattle Fault Zone map by the Department of Planning and Development (DPD) for the City of Seattle, the site lies within the Seattle Fault Zone. Per, Exhibit A to the Geologic Hazard Areas Designation Ordinance, this fault is said to be a "5 to 7 km-wide east-west trending zone of south-dipping thrust faults, north-dipping backthrusts, and folds. This fault is an active fault, inferred to have been active during the Holocene epoch in the last 10,000 years". No historic earthquakes (within the last 150 years) have been caused by or associated with deformation or surface rupture along a fault or fold in Washington State.

Based on the soil and groundwater conditions we observed in our on-site explorations, and the results of our stability analysis, it is our opinion that the risk for severe damage resulting from seismically induced landslides, earth adjustments, and settlement is low.

### **Volcanic Hazard Areas**

Section 20.09.020 (A) (7) of the SMC defines volcanic hazard areas as, "...areas subject to inundation by lahars or related flooding resulting from volcanic activity to Mount Rainer, as delineated by the U.S. Geological Survey in Hoblitt, et al., 1998, *Volcano Hazards from Mount Rainer, Washington*, Revised 1998: U.S. Geological Survey Open-File Report 98-428, or as the Director determines are more accurately mapped by the U.S. Geological Survey, as set out in a Director's Rule".

The January 2007 Director's Report and Recommendation titled *Amendments to the Geologic Hazards Areas Designation of the Environmentally Critical Areas Regulations* states that the "based on the best available science review, lahars represent a known or suspected risk to Seattle...". Per, the Department of Planning and Developments Exhibit A to the Geologic Hazard Areas Designation Ordinance, dated January 31, 2007. "Mount Rainer represents the only active volcano that may pose a hazard to the City of Seattle from lahar activity". The report indicates that the City of Seattle will most likely be subject to secondary or "post-lahar sedimentation" impacts from a Case II lahar rather than direct damage. According to *Plate II of the Open-File Report* contained in the *Volcano Hazards from Mount Rainier, Washington* by Hoblitt et al., the site is within an area that is estimated to have an "annual probability of the deposition of 1 centimeter" of 0.1 to 0.02 percent.

Due to the unknown and unpredictable nature of a volcanic eruption and the relatively minor secondary effects posed to the site, it is our opinion that the volcanic hazard at the site is low.

### **Erosion Hazard Areas**

Due to existing erosion features, and classification as a landslide and steep slope hazard, it is our opinion that the site would also classify as an Erosion Hazard Area. We observed several areas of past and ongoing surficial erosion at the toe, along foot trails within the slope, and occasionally near the top of the slope. One area in particular has been improved using wooded terraces. This area is inclined at approximately 80 to 90 percent with no groundcover vegetation. Maple leaves are scattered across the surface. Wood limbs have been staked in place creating approximately eight terraces. Slight, but ongoing erosion of the surface organics and sandy topsoil is visible. Analysis using the Universal Soil Loss Equation indicates that under current conditions erosion results in the transport of approximately 2.5 tons of soil from the site per year of which approximately 30 percent is from the restored northern quarter of the site. The equation indicates that maintaining 75 percent or greater tree canopy and 70 percent or greater forest litter with managed undergrowth will aid in maintaining soil erosion losses to current levels.

In our opinion, proper implementation and maintenance of Best Management Practices (BMPs) for erosion and sediment control will adequately mitigate the erosion potential at the site. Restoration activity on the site involving removal of existing vegetation cover and possibly minor grading will need to consider implementing appropriate temporary erosion control measures to mitigate erosion in the short-term while the newly planted native vegetation establishes.

### **DISCUSSION**

Based on the results of our analysis of current site conditions, we conclude the property is stable with respect to mass movement of soil due to a deep-seated slope failure. Soil movement we observed was typically shallow slope creep and surface erosion involving only the near-surface soil horizon. In our opinion, site activities associated with restoration of native vegetation with minimal grading will not impact this current stability.

Ms. Diane Dunbar  
January 21, 2010

The existing forest litter and thick growth of ivy significantly reduces soil erosion. The old growth Maple trees at the site contribute to a majority of the forest litter. Their large leaves and wide reaching branches provide much needed rain droplet dampening lowering the slopes potential for soil loss. Based on our observation of the already restored northern quarter, we anticipate that remaining park native plant restoration will involve disturbance of the forest litter and removal of evasive species such as the existing ivy. Trees and underbrush will also be thinned allowing for planting of new evergreen trees and underbrush native to the northwest. In our opinion, this restoration would adequately protect the shallow soil horizon and maintain soil losses at their current level once established. However as noted above until firmly established, additional temporary ground cover elements may need to be implemented to reduce erosion in the short-term.

Restoration efforts should take place in small, inconsecutive areas so as not to disturb the entire slope at one time. New plantings should be allowed to firmly establish themselves, providing permanent erosion control, prior to beginning secondary portions. We recommend that clearing of evasive groundcover, underbrush, and thinning of larger trees be limited to dry weather days. Individual new plantings may be installed if soils are stabilized immediately after. Every effort must be made to limit the exposure of bare soils on the slope.

Depending on the final restoration plans, erosion measures such as terraces, wattling, contour brush-layering, and placement of jute or woven fabrics may be used. An interceptor drain in the flatter area along the toe of the slope may also be recommended. We recommend that no permanent, unmonitored, watering system be installed. Watering should be done by hand and should be limited to each individual planting. Motorized equipment traversing the slope during restoration should also be limited with most of the restoration work completed by hand labor when practical.

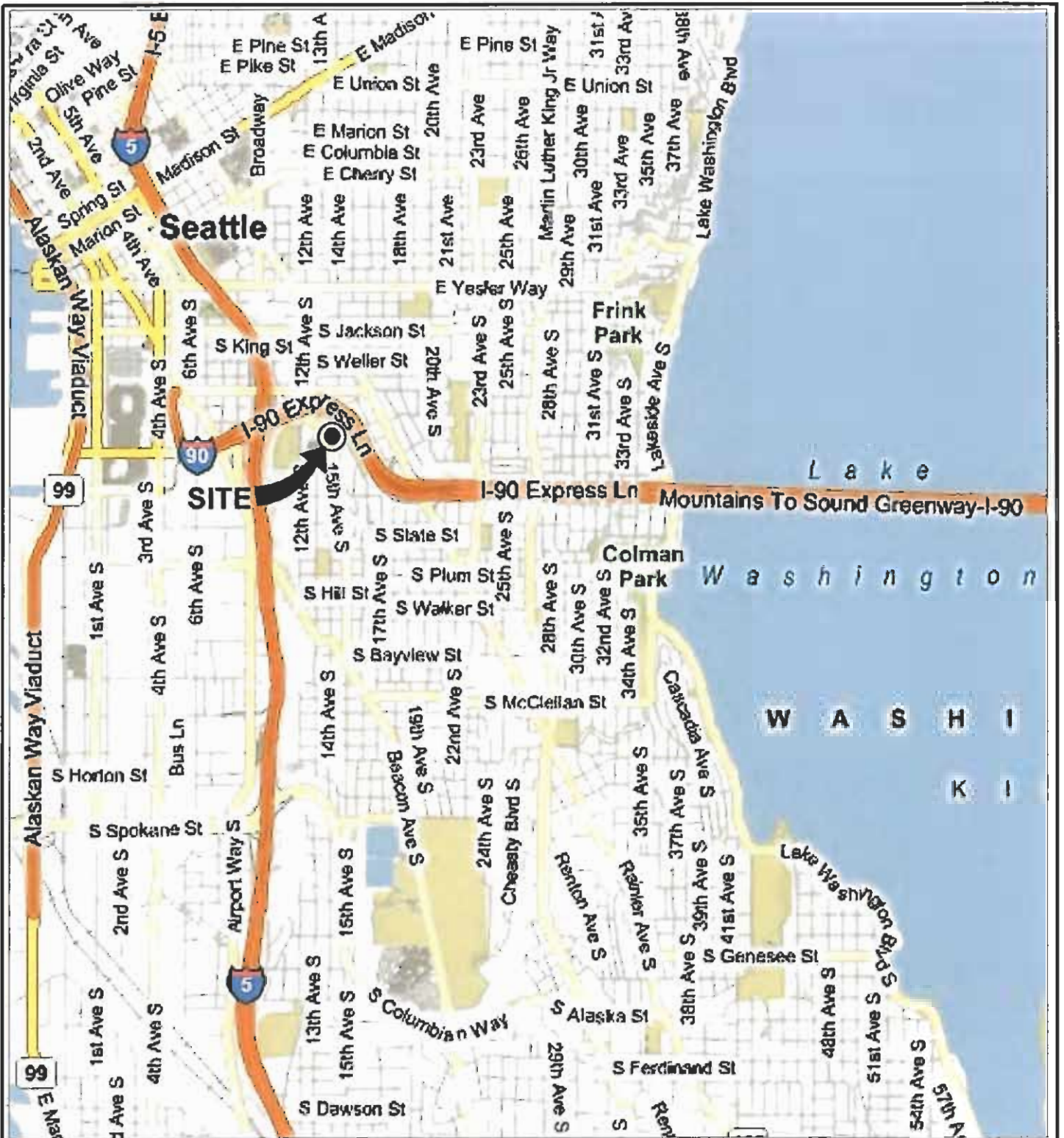
Terra Associates, Inc. looks forward to reviewing the proposed restoration plans once available. At that time, we will provide additional geotechnical recommendations for implementation. We trust the information presented is sufficient for your current needs. If you have any questions or require additional information, please call.

Sincerely yours,  
**TERRA ASSOCIATES, INC.**

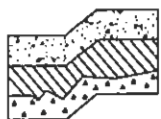
  
Jessica M. Moran, E.F.T.  
Staff Geotechnical Engineer

  
Theodore Schepper, P.E.  
Principal  
26742

- Encl:
- Figure 1 – Site Map
  - Figure 2 – Exploration Location Plan
  - Figure 3 – Cross Sections & Soils Map
  - Figure 4 – Geologic Hazard Areas Map
  - Appendix A – Unified Soils Classification System  
Test Pit & Hand Auger Logs  
Sieve Analyses
  - Appendix B – WINSTABL Output Data



REFERENCE: MICROSOFT MAPS ON LINE AT [WWW.BING.COM/MAPS](http://WWW.BING.COM/MAPS)



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and Environmental Earth Sciences

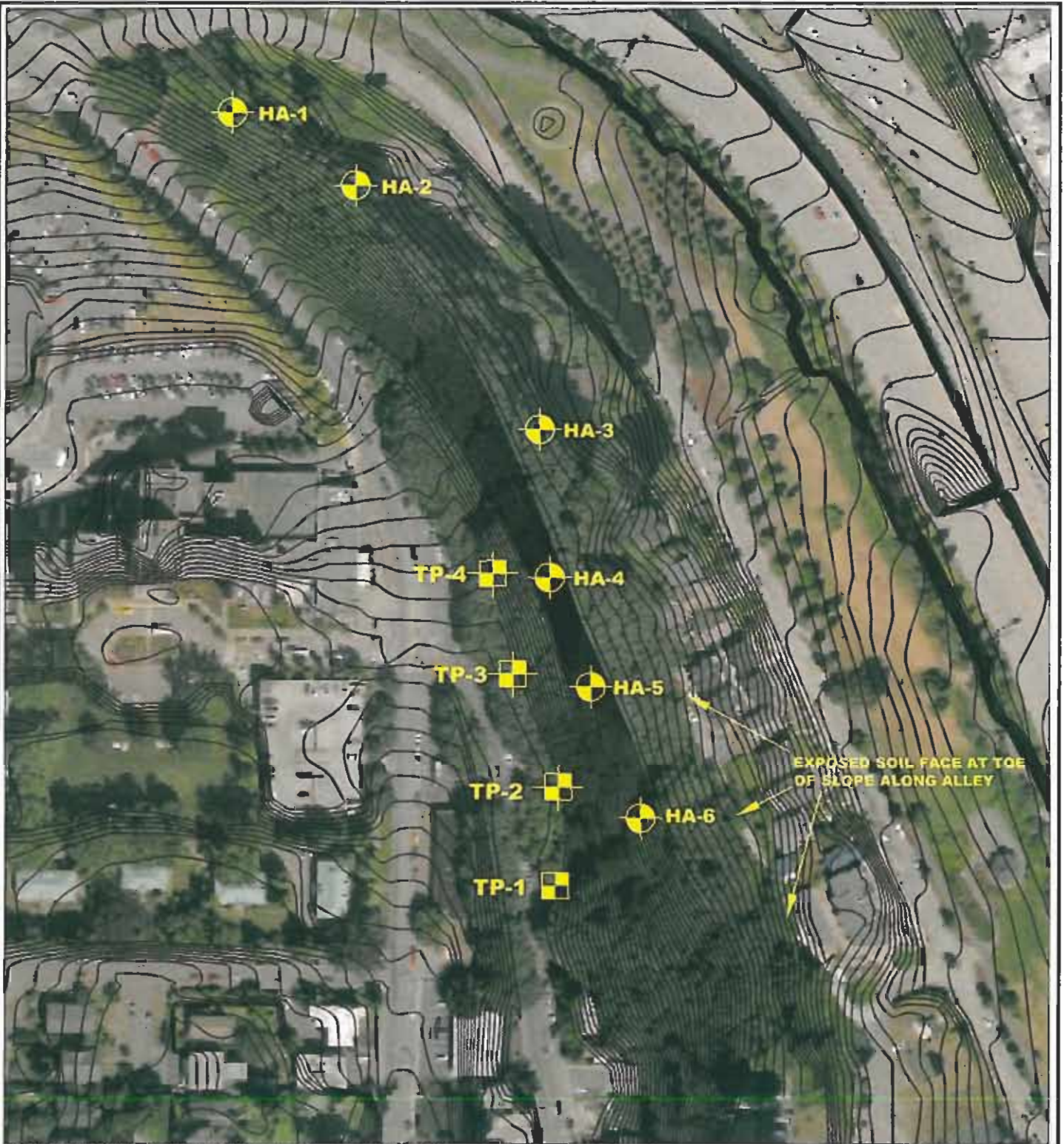
VICINITY MAP  
 LEWIS FOREST PARK RESTORATION  
 SEATTLE, WASHINGTON

Proj. No. T-6389



Date JAN 2010

Figure 1





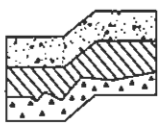
**NOTE:** THIS SITE PLAN IS A SCHEMATIC. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE. IT IS INTENDED FOR REFERENCE ONLY.

**LEGEND:**  **TP-1** APPROXIMATE TEST PIT LOCATION  
 **HA-1** APPROXIMATE HAND AUGER LOCATION



**REFERENCE:** SITE PLAN IS OVERLAY OF LIDAR CONTOURS, PROVIDED BY THE FRIENDS OF LEWIS FOREST PARK, ON AERIAL MAP FROM KING COUNTY IMAP ACCESSED ON DECEMBER 14, 2009

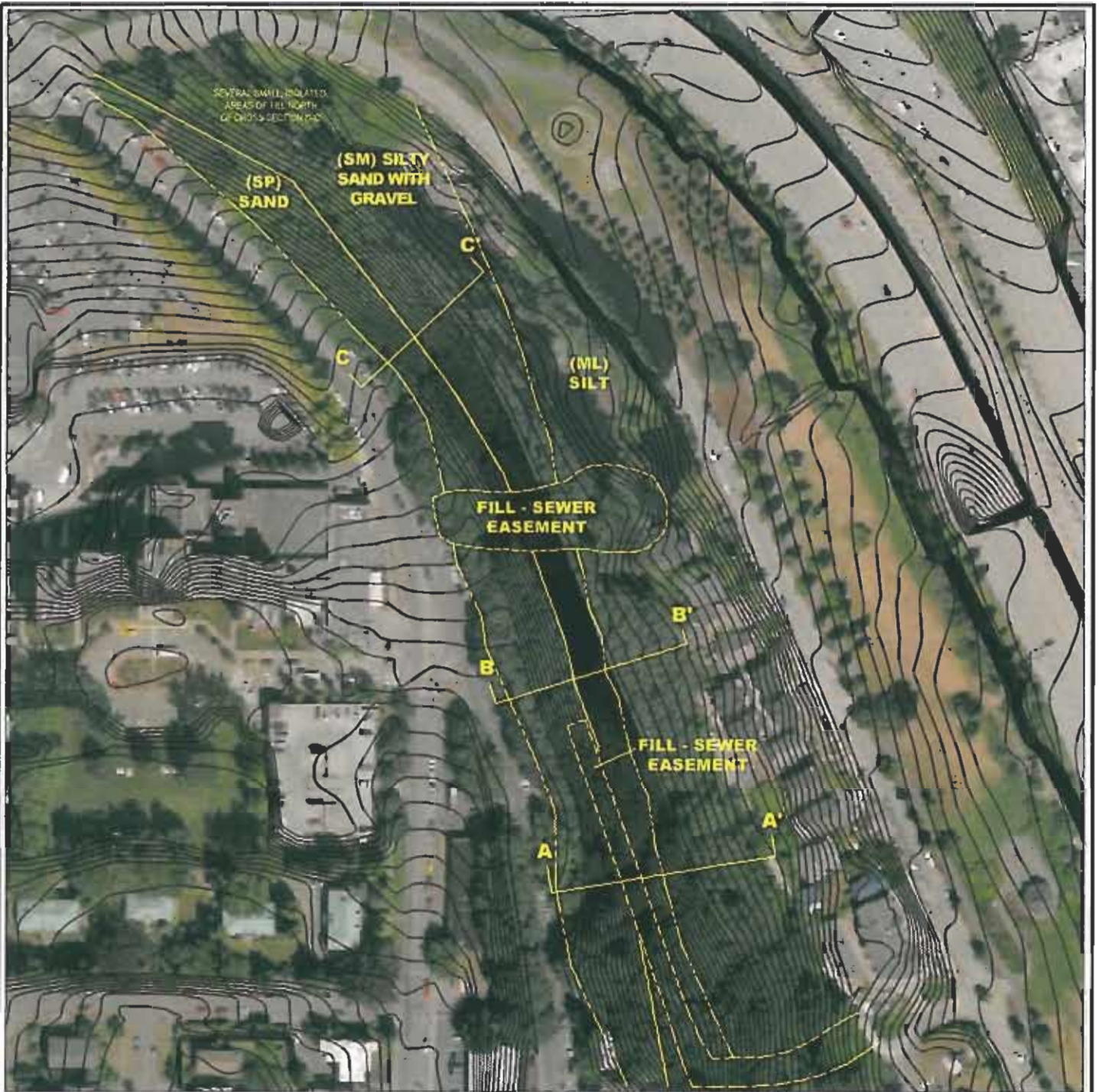
NOT TO SCALE



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and Environmental Earth Sciences

**EXPLORATION LOCATION PLAN  
 LEWIS FOREST PARK RESTORATION  
 SEATTLE, WASHINGTON**

|                 |               |          |
|-----------------|---------------|----------|
| Proj. No.T-6389 | Date JAN 2010 | Figure 2 |
|-----------------|---------------|----------|

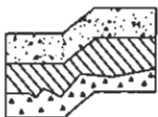


**NOTE:**

SOIL MAP IS APPROXIMATE. ELEVATIONS AND LOCATIONS ARE BASED ON DOCUMENT REVIEW, SITE OBSERVATIONS AND SHALLOW EXPLORATIONS. FILL LOCATIONS ARE APPROXIMATE, BASED ON SITE OBSERVATIONS AND CITY OF SEATTLE SEWER CARDS ON LINE. IT IS INTENDED FOR REFERENCE ONLY.



NOT TO SCALE



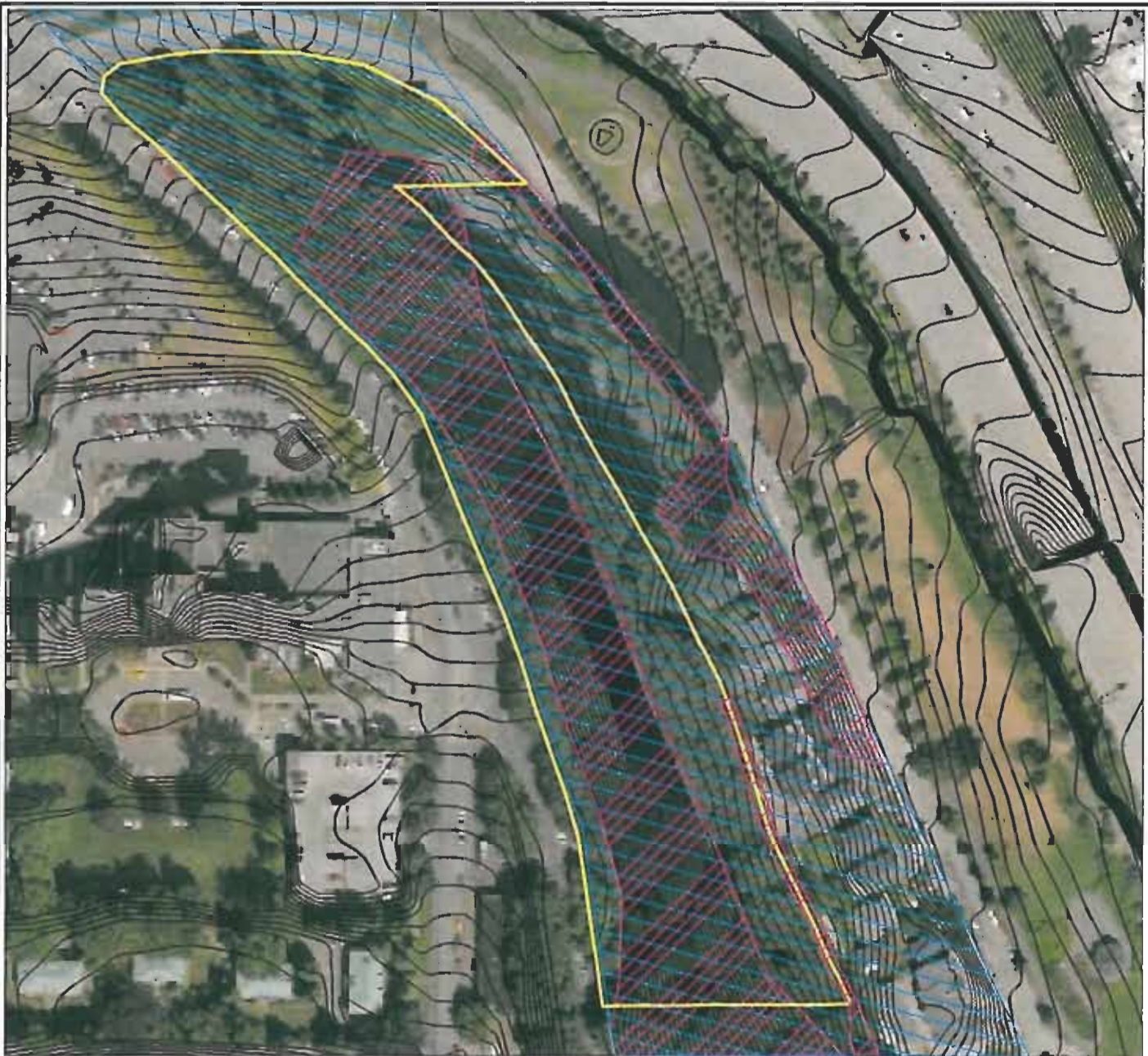
**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and  
 Environmental Earth Sciences




**CROSS-SECTIONS & SOILS MAP  
 LEWIS FOREST PARK RESTORATION  
 SEATTLE, WASHINGTON**

Proj. No.T-6389

Date JAN 2010

Figure 3

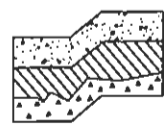


- LEGEND:**
-  APPROXIMATE STEEP SLOPE HAZARD AREAS
  -  APPROXIMATE LANDSLIDE HAZARD AREA
  -  APPROXIMATE PROPERTY BOUNDARY

- NOTES:**
1. AS A RESULT OF LANDSLIDE AND STEEP SLOPE HAZARDS, IT IS OUR OPINION THAT THE ENTIRE SITE WOULD ALSO BE CLASSIFIED AS AN EROSION HAZARD AREA.
  2. THIS MAP IS A SCHEMATIC AND FOR REFERENCE ONLY. ALL HAZARD AREAS ARE APPROXIMATE AND BASED ON SITE OBSERVATIONS AND THE PROVIDED LIDAR CONTOUR MAP.



NOT TO SCALE



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and Environmental Earth Sciences

**GEOLOGIC HAZARD AREAS  
 LEWIS FOREST PARK RESTORATION  
 SEATTLE, WASHINGTON**

|                  |               |          |
|------------------|---------------|----------|
| Proj. No. T-6389 | Date JAN 2010 | Figure 4 |
|------------------|---------------|----------|

**APPENDIX A**

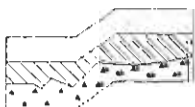
**UNIFIED SOILS CLASSIFICATION SYSTEM, TEST PIT &**

**HAND AUGER LOGS, AND SIEVE ANALYSES**

| MAJOR DIVISIONS                         |  | LETTER SYMBOL   | TYPICAL DESCRIPTION  |  |
|---|--|---|--|--|
| COARSE GRAINED SOILS                    | GRAVELS<br>More than 50% of coarse fraction is larger than No. 4 sieve | Clean Gravels (less than 5% fines)                                      | GW<br>Well-graded gravels, gravel-sand mixtures, little or no fines.   |  |
|   |  | Gravels with fines  | GP<br>Poorly-graded gravels, gravel-sand mixtures, little or no fines. |  |
|   |  |   | GM<br>Silty gravels, gravel-sand-silt mixtures, non-plastic fines.     |  |
|   |  | SANDS<br>More than 50% of coarse fraction is smaller than No. 4 sieve   | Clean Sands (less than 5% fines)                                       | GC<br>Clayey gravels, gravel-sand-clay mixtures, plastic fines.  |
|   | SW<br>Well-graded sands, gravelly sands, little or no fines.           |   |  |  |
|   | FINE GRAINED SOILS   | SILTS AND CLAYS<br>Liquid limit is less than 50%                        | Sands with fines   | SP<br>Poorly-graded sands or gravelly sands, little or no fines. |
|   |  |   |  | SM<br>Silty sands, sand-silt mixtures, non-plastic fines.        |
|   |  |   | SILTS AND CLAYS<br>Liquid limit is greater than 50%                    | SC<br>Clayey sands, sand-clay mixtures, plastic fines.           |
|   |  | ML<br>Inorganic silts, rock flour, clayey silts with slight plasticity. |  |  |
|   |  |   |  | CL<br>Inorganic clays of low to medium plasticity, (lean clay).  |
| OH<br>Organic clays of high plasticity. |  |   |  |  |
|   | OL<br>Organic silts and organic clays of low plasticity.               |   |  |  |
| MH<br>Inorganic silts, elastic.         |  |   |  |  |
|   | CH<br>Inorganic clays of high plasticity, fat clays.                   |   |  |  |
| HIGHLY ORGANIC SOILS                    |  | PT  | Peat.  |  |

### DEFINITION OF TERMS AND SYMBOLS

|              |  |   |  |
|--------------|--|---|--|
| COHESIONLESS | Density  | Standard Penetration Resistance in Blows/Foot | I 2" OUTSIDE DIAMETER SPLIT SPOON SAMPLER<br>T 2.4" INSIDE DIAMETER RING SAMPLER OR SHELBY TUBE SAMPLER<br>▼ WATER LEVEL (DATE)<br>Tr TORVANE READINGS, tsf<br>Pp PENETROMETER READING, tsf<br>DD DRY DENSITY, pounds per cubic foot<br>LL LIQUID LIMIT, percent<br>PI PLASTIC INDEX<br>N STANDARD PENETRATION, blows per foot |
|              | Very loose<br>Loose<br>Medium dense<br>Dense<br>Very dense       | 0-4<br>4-10<br>10-30<br>30-50<br>>50          |  |
| COHESIVE     | Consistency  | Standard Penetration Resistance in Blows/Foot |  |
|              | Very soft<br>Soft<br>Medium stiff<br>Stiff<br>Very stiff<br>Hard | 0-2<br>2-4<br>4-8<br>8-16<br>16-32<br>>32     |  |



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and  
 Environmental Earth Sciences

UNIFIED SOIL CLASSIFICATION SYSTEM  
 LEWIS FOREST PARK RESTORATION  
 SEATTLE, WASHINGTON

Proj. No. T-6389

Date JAN 2010

Figure A-1

# LOG OF TEST PIT NO. TP-1

FIGURE A-2

PROJECT NAME: Lewis Forest Park Restoration      PROJ. NO: T-6389      LOGGED BY: JMC  
 LOCATION: Seattle, Washington      SURFACE CONDS: Ivy, Leaves, Bark      APPROX. ELEV: \_\_\_\_\_  
 DATE LOGGED: December 17, 2009      DEPTH TO GROUNDWATER: N/A      DEPTH TO CAVING: N/A

| DEPTH (FT.) | SAMPLE NO. | DESCRIPTION   | CONSISTENCY/<br>RELATIVE DENSITY | W (%) | POCKET PEN. (TSF) | REMARKS |
|-------------|------------|---|----------------------------------|-------|-------------------|---------|
|             |            | Dark gray organics with sand and silt, moist. (TOPSOIL)   | Loose                            |       |                   |         |
|             | 1          | Brown mottled SAND with silt, occasional gravel, fine grained sand, wet. (SP-SM) Roots throughout | Loose                            | 12.7  |                   |         |
| 5           | 2          | Tan silty SAND, fine grained, moist. (SM) Some areas mottled.                                     | Medium Dense                     | 14.5  |                   |         |
|             | 3          | Grayish-brown SAND, fine grained with pockets of coarse grained sand, moist. (SP)                 | Medium Dense                     | 7.3   |                   |         |
| 10          |            | Terminated at 8 feet.<br>No groundwater seepage observed.   |                                  |       |                   |         |
| 15          |            |   |                                  |       |                   |         |

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and  
 Environmental Earth Sciences

# LOG OF TEST PIT NO. TP-2

FIGURE A-3

PROJECT NAME: Lewis Forest Park Restoration PROJ. NO: T-6389 LOGGED BY: JMC

LOCATION: Seattle, Washington SURFACE CONDS: Jvy. Leaves APPROX. ELEV: \_\_\_\_\_

DATE LOGGED: December 17, 2009 DEPTH TO GROUNDWATER: N/A DEPTH TO CAVING: N/A

| DEPTH (FT.) | SAMPLE NO. | DESCRIPTION   | CONSISTENCY/<br>RELATIVE DENSITY | W (%) | POCKET PEN. (TSF) | REMARKS |
|-------------|------------|---|----------------------------------|-------|-------------------|---------|
|             |            | Dark gray organics with sand and silt, moist. (TOPSOIL)                                     | Loose                            |       |                   |         |
|             | 1          | Mottled tan SAND, trace silt, occasional gravel, fine grained, moist. (SP) Roots to 3 feet. | Loose Becoming<br>Medium Dense   | 16.7  |                   |         |
| 5           | 2          | Areas of silty SAND. (SM)   |                                  | 14.1  |                   |         |
|             | 3          |   |                                  | 12.8  |                   |         |
| 10          |            | Terminated at 8 feet.<br>No groundwater seepage observed.                                   |                                  |       |                   |         |
| 15          |            |   |                                  |       |                   |         |

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and  
 Environmental Earth Sciences

# LOG OF TEST PIT NO. TP-3

FIGURE A-4

PROJECT NAME: Lewis Forest Park Restoration PROJ. NO: T-6389 LOGGED BY: JMC

LOCATION: Seattle, Washington SURFACE CONDS: Leaves & Bark APPROX. ELEV: \_\_\_\_\_

DATE LOGGED: December 17, 2009 DEPTH TO GROUNDWATER: N/A DEPTH TO CAVING: N/A

| DEPTH (FT.) | SAMPLE NO. | DESCRIPTION  | CONSISTENCY/<br>RELATIVE DENSITY | W (%) | POCKET PEN. (TSF) | REMARKS |
|-------------|------------|--|----------------------------------|-------|-------------------|---------|
|             |            | (4 inches BARK and LEAVES)<br>FILL: black organics, ash, charred bits, areas of reddish-brown silty sand, moist. (UNCONTROLLED FILL) | Loose                            |       |                   |         |
|             | 1          |  |                                  | 43.2  |                   |         |
|             |            | Dips Down Slope  |                                  |       |                   |         |
| 5           |            | Mottled brown SAND with trace silt, fine grained, moist. (SP)  | Medium Dense                     |       |                   |         |
|             | 2          |  |                                  | 7.5   |                   |         |
|             |            | Tan silty SAND, occasional cobble, fine grained, moist. (SM) Some areas mottled.   | Medium Dense                     |       |                   |         |
|             | 3          |  |                                  | 5.4   |                   |         |
|             | 4          |  |                                  | 7.2   |                   |         |
| 10          |            | Terminated at 8 feet.<br>No groundwater seepage observed.  |                                  |       |                   |         |
| 15          |            |  |                                  |       |                   |         |

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and  
 Environmental Earth Sciences



# LOG OF TEST PIT NO. TP-4

FIGURE A-5

PROJECT NAME: Lewis Forest Park Restoration PROJ. NO: T-6389 LOGGED BY: JMC

LOCATION: Seattle, Washington SURFACE CONDS: Ivy & Leaves APPROX. ELEV: \_\_\_\_\_

DATE LOGGED: December 17, 2009 DEPTH TO GROUNDWATER: N/A DEPTH TO CAVING: N/A

| DEPTH (FT.) | SAMPLE NO. | DESCRIPTION   | CONSISTENCY/<br>RELATIVE DENSITY   | W (%) | POCKET PEN. (TSF) | REMARKS |
|-------------|------------|---|------------------------------------|-------|-------------------|---------|
|             |            | Dark brown organics with sand and silt, moist.<br>(TOPSOIL)                             | Loose                              |       |                   |         |
|             | 1          | Tan SAND with trace silt, scattered gravel, fine grained,<br>wet. (SP) Roots to 3 feet. | Loose Becoming<br><br>Medium Dense | 25.6  |                   |         |
| 5           | 2          | Heavily mottled.  |                                    | 8.3   |                   |         |
|             | 3          | Includes charred or black stained areas.  |                                    | 14.4  |                   |         |
| 10          |            | Terminated at 8.5 feet.<br>No groundwater observed.                                     |                                    |       |                   |         |
| 15          |            |   |                                    |       |                   |         |

NOTE: This subsurface information pertains only to this test pit location and should not be interpreted as being indicative of other locations at the site.



**Terra Associates, Inc.**  
 Consultants in Geotechnical Engineering  
 Geology and  
 Environmental Earth Sciences

**Hand Auger Log: HA-1**

| <b>DEPTH</b> | <b>DESCRIPTION</b>  | <b>MOISTURE CONTENT</b> |
|--------------|---|-------------------------|
| 0' - 8"      | Dark Gray/Brown organics with sand and silt, loose, moist (TOPSOIL)                                 | No sample collected     |
| 8" - 3'      | Reddish brown silty SAND with gravel, scattered cobbles, medium dense, moist (SM) mottled in places | @ -1', 11.8%            |

**Hand Auger Log: HA-2**

| <b>DEPTH</b> | <b>DESCRIPTION</b>   | <b>MOISTURE CONTENT</b> |
|--------------|--|-------------------------|
| 0' - 2'      | FILL: dark gray/brown organics with areas of reddish brown sand with silt, scattered gravel and cobbles, scattered glass, ceramic and aluminum garbage, loose, moist, numerous roots | @ -0.5', 29.3%          |

**Hand Auger Log: HA-3**

| <b>DEPTH</b> | <b>DESCRIPTION</b>   | <b>MOISTURE CONTENT</b> |
|--------------|--|-------------------------|
| 0' - 10"     | FILL: Dark Gray/Brown organics with sand and silt, scattered glass, ceramic and aluminum garbage, loose, moist | No sample collected     |
| 10" - 3'     | Reddish brown silty SAND with gravel, occasional cobble, medium dense, moist, (SM), roots throughout           | @ -2', 19.4%            |

**Hand Auger Log: HA-4**

| <b>DEPTH</b> | <b>DESCRIPTION</b>   | <b>MOISTURE CONTENT</b> |
|--------------|--|-------------------------|
| 0' - 1'      | FILL: Dark Gray/Brown organics with sand and silt, loose, moist (TOPSOIL)                                      | No sample collected     |
| 1' - 1.5'    | FILL: Mixture of topsoil and reddish brown sand with silt and scattered gravel, loose, moist (TOPSOIL & SP-SM) | No sample collected     |
| 1.5' - 2'    | Tan SILT with sand, medium stiff, moist (ML) mottled in places   | @ 1.5' 24.5%            |

Figure A-6

**Hand Auger Log: HA-5**

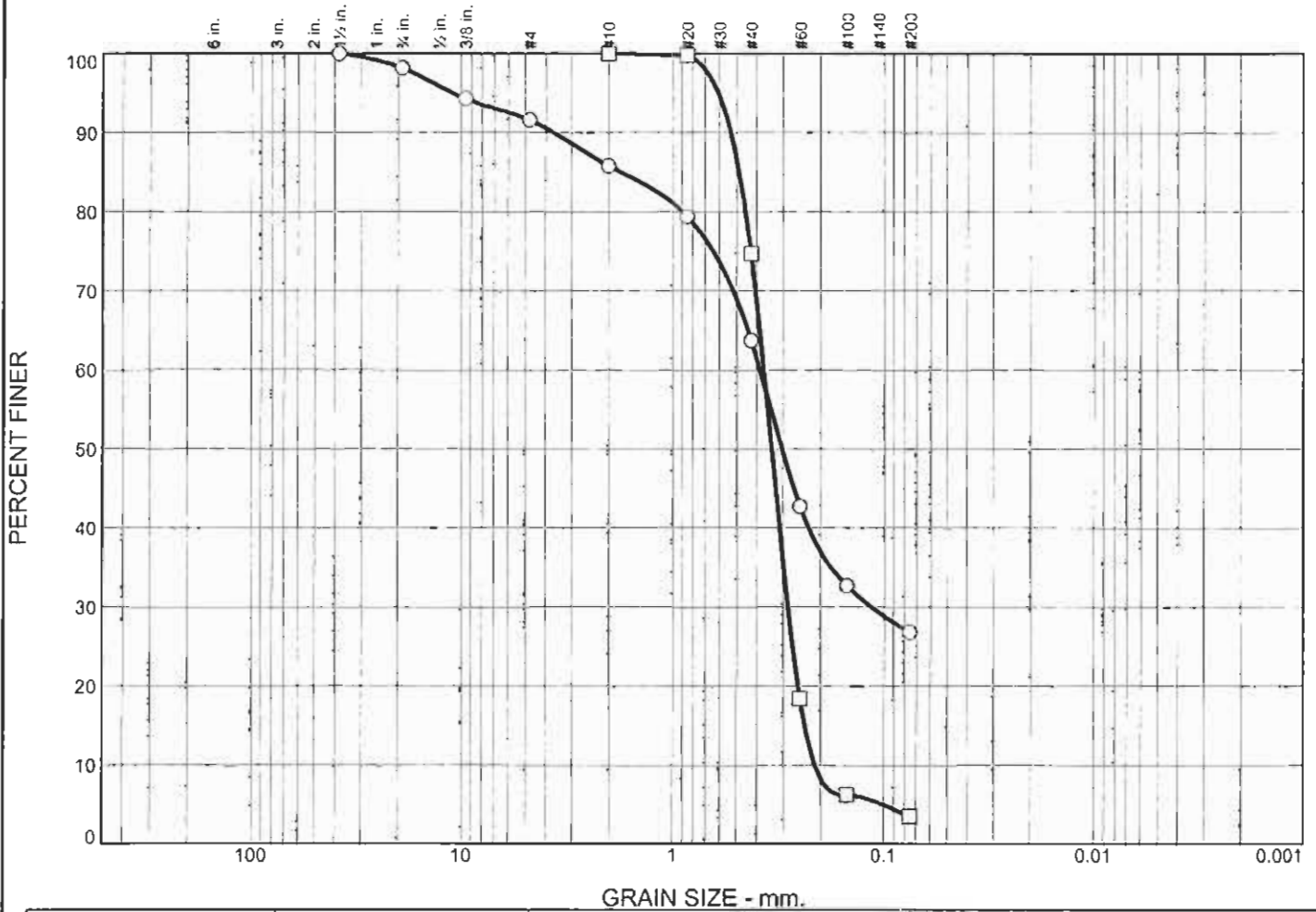
| <b>DEPTH</b> | <b>DESCRIPTION</b>  | <b>MOISTURE CONTENT</b> |
|--------------|---|-------------------------|
| 0' - 1'      | Dark Gray/Brown organics with sand and silt, loose, moist (TOPSOIL) | No sample collected     |
| 1' - 3.5'    | Tan SILT, some sand, medium stiff, moist (ML) mottled in places     | @ -2', 20.1%            |

**Haud Auger Log: HA-6**

| <b>DEPTH</b> | <b>DESCRIPTION</b>   | <b>MOISTURE CONTENT</b> |
|--------------|--|-------------------------|
| 0' - 3"      | Dark Gray/Brown organics with sand and silt, loose, moist (TOPSOIL)  | No sample collected     |
| 3" - 1.5'    | Reddish brown silty SAND, fine grained, loose, moist (SM)  | No sample collected     |
| 1.5' - 3'    | Tan SAND with trace silt and gravel, fine grained gravel and fine to coarse sand, medium dense, moist (SP) | @ -2', 10.9%            |

Figure A-7

# Particle Size Distribution Report



|   | % +3" | % Gravel |      | % Sand |        |      | % Fines |      |
|---|-------|----------|------|--------|--------|------|---------|------|
|   |       | Coarse   | Fine | Coarse | Medium | Fine | Silt    | Clay |
| ○ | 0.0   | 1.8      | 6.6  | 5.8    | 22.1   | 36.9 | 26.8    |      |
| □ | 0.0   | 0.0      | 0.0  | 0.0    | 25.3   | 71.2 | 3.5     |      |

|   | LL     | PL     | D <sub>85</sub> | D <sub>60</sub> | D <sub>50</sub> | D <sub>30</sub> | D <sub>15</sub> | D <sub>10</sub> | C <sub>c</sub> | C <sub>u</sub> |
|---|--------|--------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|
|   |        |        |                 |                 |                 |                 |                 |                 |                |                |
| □ | 0.4857 | 0.3693 | 0.3390          | 0.2843          | 0.2375          | 0.2129          | 1.03            | 1.73            |                |                |

| Material Description | USCS | AASHTO |
|----------------------|------|--------|
| ○ Silty SAND         | (SM) |        |
| □ SAND               | (SP) |        |

**Project No.** T-6389      **Client:** Friends of Lewis Forest Park  
**Project:** Lewis Forest Park Restoration  
 Golf Drive & 15th Avenue South, Seattle, Washington  
 ○ **Location:** Test Pit TP-1      **Depth:** -5 ft      **Sample Number:** 2  
 □ **Location:** Test Pit TP-2      **Depth:** -7.5 ft      **Sample Number:** 3

**Terra Associates, Inc.**  
**Kirkland, WA**

**Remarks:**

Figure A-8

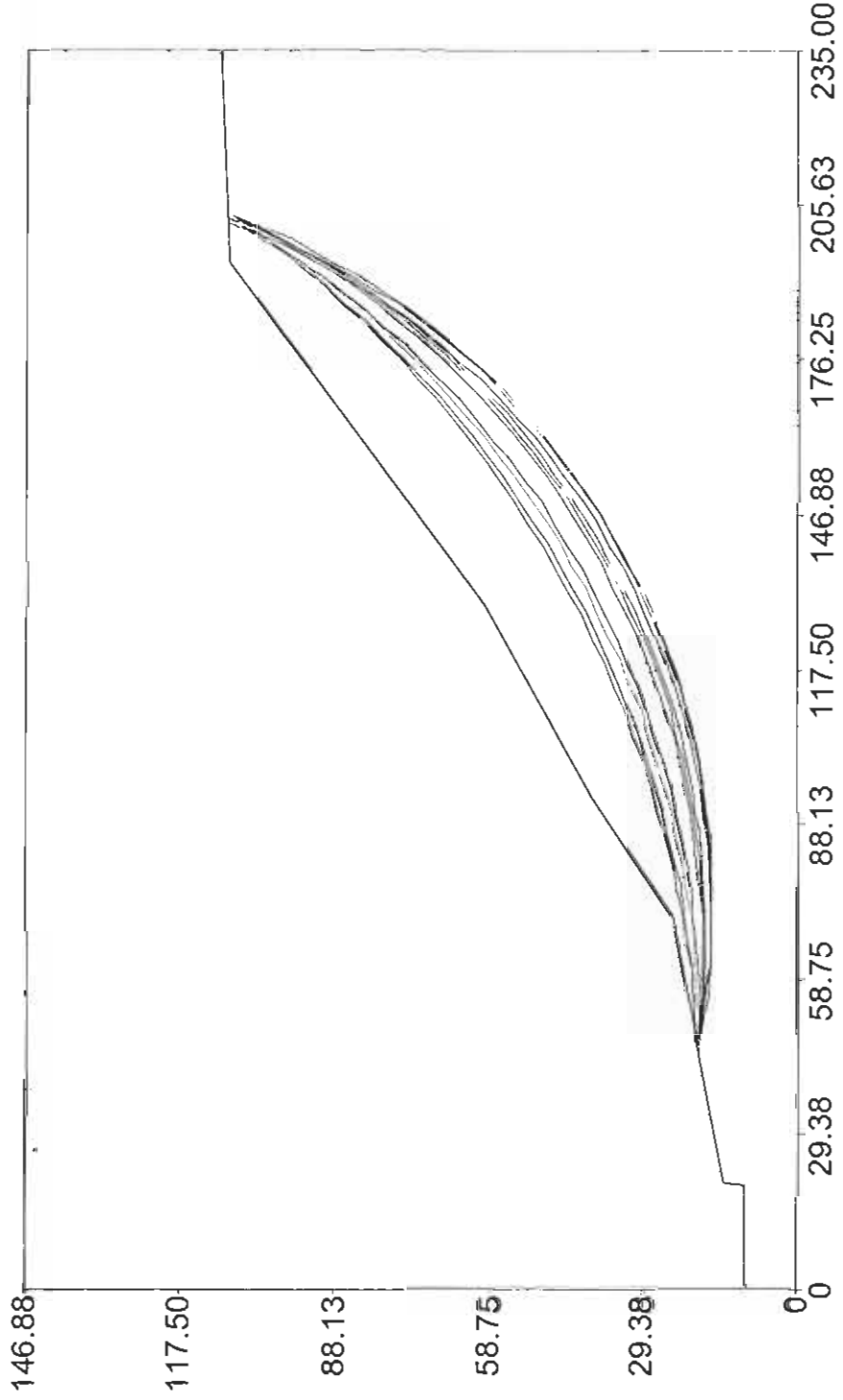
Tested By: JMC

Checked By: JMC

## **APPENDIX B**

### **WINSTABL OUTPUT DATA**

# Cross Section A-A'



# Safety Factors

|      |
|------|
| 1.57 |
| 1.57 |
| 1.58 |
| 1.58 |
| 1.58 |
| 1.58 |
| 1.60 |
| 1.61 |
| 1.61 |
| 1.61 |

Profile.out  
\*\* PCSTABL6 \*\*

by  
Purdue University

modified by  
Peter J. Bosscher  
University of Wisconsin-Madison

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

PROBLEM DESCRIPTION Cross Section A-A'

BOUNDARY COORDINATES

7 Top Boundaries  
7 Total Boundaries

| Boundary No. | X-Left (ft) | Y-Left (ft) | X-Right (ft) | Y-Right (ft) | Soil Type Below Bnd |
|--------------|-------------|-------------|--------------|--------------|---------------------|
| 1            | 0.00        | 10.00       | 20.00        | 10.00        | 3                   |
| 2            | 20.00       | 10.00       | 20.50        | 14.00        | 3                   |
| 3            | 20.50       | 14.00       | 70.50        | 24.00        | 3                   |
| 4            | 70.50       | 24.00       | 93.00        | 39.00        | 3                   |
| 5            | 93.00       | 39.00       | 130.00       | 60.00        | 2                   |
| 6            | 130.00      | 60.00       | 195.00       | 108.00       | 1                   |
| 7            | 195.00      | 108.00      | 235.00       | 110.00       | 1                   |

ISOTROPIC SOIL PARAMETERS

3 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             | 110.0                | 110.0                    | 0.0                      | 32.0                 | 0.00                 | 0.0                     | 0                 |
| 2             | 120.0                | 120.0                    | 100.0                    | 34.0                 | 0.00                 | 0.0                     | 0                 |
| 3             | 105.0                | 105.0                    | 1000.0                   | 30.0                 | 0.00                 | 0.0                     | 0                 |

Profile.out

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

25 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 45.00 ft.  
and X = 47.00 ft.

Each Surface Terminates Between X = 202.00 ft.  
and X = 204.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

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 Bishop Method \* \*

Failure Surface Specified By 39 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.50       | 19.20       |
| 2         | 51.50       | 19.24       |
| 3         | 56.50       | 19.41       |
| 4         | 61.49       | 19.73       |
| 5         | 66.47       | 20.18       |
| 6         | 71.43       | 20.77       |
| 7         | 76.38       | 21.50       |
| 8         | 81.30       | 22.37       |
| 9         | 86.20       | 23.37       |
| 10        | 91.07       | 24.50       |
| 11        | 95.91       | 25.77       |
| 12        | 100.71      | 27.18       |
| 13        | 105.46      | 28.72       |
| 14        | 110.18      | 30.38       |
| 15        | 114.84      | 32.18       |
| 16        | 119.46      | 34.11       |
| 17        | 124.01      | 36.16       |
| 18        | 128.51      | 38.34       |
| 19        | 132.95      | 40.65       |
| 20        | 137.32      | 43.07       |
| 21        | 141.63      | 45.62       |
| 22        | 145.86      | 48.28       |
| 23        | 150.01      | 51.06       |



|    |        | Profile.out |
|----|--------|-------------|
| 24 | 154.09 | 53.96       |
| 25 | 158.09 | 56.96       |
| 26 | 162.00 | 60.08       |
| 27 | 165.82 | 63.30       |
| 28 | 169.55 | 66.63       |
| 29 | 173.19 | 70.06       |
| 30 | 176.73 | 73.59       |
| 31 | 180.17 | 77.22       |
| 32 | 183.51 | 80.94       |
| 33 | 186.75 | 84.75       |
| 34 | 189.88 | 88.65       |
| 35 | 192.90 | 92.63       |
| 36 | 195.81 | 96.70       |
| 37 | 198.60 | 100.85      |
| 38 | 201.28 | 105.07      |
| 39 | 203.27 | 108.41      |

Circle Center At X = 47.6 ; Y = 199.6 and Radius, 180.4

\*\*\* 1.572 \*\*\*

Failure Surface Specified By 40 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.00       | 19.10       |
| 2         | 50.98       | 18.64       |
| 3         | 55.97       | 18.34       |
| 4         | 60.97       | 18.20       |
| 5         | 65.97       | 18.22       |
| 6         | 70.96       | 18.40       |
| 7         | 75.95       | 18.74       |
| 8         | 80.93       | 19.24       |
| 9         | 85.88       | 19.91       |
| 10        | 90.82       | 20.73       |
| 11        | 95.72       | 21.71       |
| 12        | 100.59      | 22.85       |
| 13        | 105.42      | 24.15       |
| 14        | 110.20      | 25.60       |
| 15        | 114.94      | 27.20       |
| 16        | 119.62      | 28.96       |
| 17        | 124.24      | 30.86       |
| 18        | 128.80      | 32.92       |
| 19        | 133.29      | 35.12       |
| 20        | 137.71      | 37.46       |
| 21        | 142.04      | 39.94       |
| 22        | 146.30      | 42.57       |
| 23        | 150.47      | 45.33       |
| 24        | 154.55      | 48.22       |
| 25        | 158.53      | 51.24       |
| 26        | 162.42      | 54.39       |
| 27        | 166.20      | 57.66       |
| 28        | 169.87      | 61.06       |
| 29        | 173.43      | 64.57       |
| 30        | 176.88      | 68.19       |
| 31        | 180.21      | 71.92       |
| 32        | 183.41      | 75.76       |
| 33        | 186.49      | 79.70       |

|    |        | Profile.out |
|----|--------|-------------|
| 34 | 189.44 | 83.73       |
| 35 | 192.26 | 87.86       |
| 36 | 194.95 | 92.08       |
| 37 | 197.50 | 96.38       |
| 38 | 199.90 | 100.76      |
| 39 | 202.17 | 105.22      |
| 40 | 203.68 | 108.43      |

Circle Center At x = 62.8 ; Y = 173.2 and Radius, 155.1

\*\*\* 1.573 \*\*\*

Failure Surface Specified By 40 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.00       | 19.10       |
| 2         | 50.97       | 18.56       |
| 3         | 55.96       | 18.18       |
| 4         | 60.95       | 17.96       |
| 5         | 65.95       | 17.91       |
| 6         | 70.95       | 18.02       |
| 7         | 75.94       | 18.30       |
| 8         | 80.92       | 18.74       |
| 9         | 85.89       | 19.34       |
| 10        | 90.83       | 20.11       |
| 11        | 95.74       | 21.04       |
| 12        | 100.62      | 22.13       |
| 13        | 105.46      | 23.39       |
| 14        | 110.26      | 24.80       |
| 15        | 115.00      | 26.36       |
| 16        | 119.70      | 28.09       |
| 17        | 124.33      | 29.96       |
| 18        | 128.90      | 31.99       |
| 19        | 133.41      | 34.17       |
| 20        | 137.83      | 36.49       |
| 21        | 142.18      | 38.96       |
| 22        | 146.45      | 41.57       |
| 23        | 150.62      | 44.32       |
| 24        | 154.71      | 47.20       |
| 25        | 158.69      | 50.22       |
| 26        | 162.58      | 53.36       |
| 27        | 166.36      | 56.64       |
| 28        | 170.03      | 60.03       |
| 29        | 173.58      | 63.55       |
| 30        | 177.02      | 67.18       |
| 31        | 180.34      | 70.92       |
| 32        | 183.53      | 74.77       |
| 33        | 186.60      | 78.72       |
| 34        | 189.53      | 82.77       |
| 35        | 192.33      | 86.91       |
| 36        | 194.99      | 91.15       |
| 37        | 197.51      | 95.47       |
| 38        | 199.88      | 99.87       |
| 39        | 202.11      | 104.34      |
| 40        | 203.99      | 108.45      |

Circle Center At x = 65.0 ; Y = 169.8 and Radius, 151.9

Profile.out

\*\*\* 1.575 \*\*\*

Failure Surface Specified By 40 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 45.50       | 19.00       |
| 2         | 50.50       | 18.89       |
| 3         | 55.50       | 18.93       |
| 4         | 60.50       | 19.11       |
| 5         | 65.49       | 19.43       |
| 6         | 70.46       | 19.90       |
| 7         | 75.43       | 20.51       |
| 8         | 80.37       | 21.27       |
| 9         | 85.29       | 22.17       |
| 10        | 90.18       | 23.21       |
| 11        | 95.04       | 24.39       |
| 12        | 99.86       | 25.71       |
| 13        | 104.64      | 27.18       |
| 14        | 109.38      | 28.78       |
| 15        | 114.06      | 30.51       |
| 16        | 118.70      | 32.38       |
| 17        | 123.28      | 34.39       |
| 18        | 127.80      | 36.52       |
| 19        | 132.26      | 38.79       |
| 20        | 136.65      | 41.18       |
| 21        | 140.97      | 43.71       |
| 22        | 145.21      | 46.35       |
| 23        | 149.38      | 49.12       |
| 24        | 153.46      | 52.00       |
| 25        | 157.46      | 55.01       |
| 26        | 161.37      | 58.12       |
| 27        | 165.18      | 61.35       |
| 28        | 168.90      | 64.69       |
| 29        | 172.53      | 68.14       |
| 30        | 176.05      | 71.68       |
| 31        | 179.47      | 75.33       |
| 32        | 182.78      | 79.08       |
| 33        | 185.98      | 82.92       |
| 34        | 189.07      | 86.85       |
| 35        | 192.04      | 90.87       |
| 36        | 194.90      | 94.98       |
| 37        | 197.64      | 99.16       |
| 38        | 200.25      | 103.42      |
| 39        | 202.74      | 107.76      |
| 40        | 203.08      | 108.40      |

Circle Center At X = 51.8 ; Y = 191.5 and Radius, 172.6

\*\*\* 1.577 \*\*\*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) | Profile.out |
|-----------|-------------|-------------|-------------|
| 1         | 46.00       | 19.10       |             |
| 2         | 50.96       | 18.49       |             |
| 3         | 55.94       | 18.04       |             |
| 4         | 60.93       | 17.76       |             |
| 5         | 65.93       | 17.64       |             |
| 6         | 70.93       | 17.70       |             |
| 7         | 75.93       | 17.92       |             |
| 8         | 80.91       | 18.31       |             |
| 9         | 85.88       | 18.87       |             |
| 10        | 90.83       | 19.59       |             |
| 11        | 95.75       | 20.48       |             |
| 12        | 100.64      | 21.53       |             |
| 13        | 105.49      | 22.75       |             |
| 14        | 110.29      | 24.12       |             |
| 15        | 115.05      | 25.66       |             |
| 16        | 119.75      | 27.36       |             |
| 17        | 124.40      | 29.22       |             |
| 18        | 128.98      | 31.22       |             |
| 19        | 133.48      | 33.39       |             |
| 20        | 137.92      | 35.70       |             |
| 21        | 142.27      | 38.16       |             |
| 22        | 146.54      | 40.76       |             |
| 23        | 150.72      | 43.51       |             |
| 24        | 154.80      | 46.39       |             |
| 25        | 158.79      | 49.41       |             |
| 26        | 162.67      | 52.56       |             |
| 27        | 166.44      | 55.84       |             |
| 28        | 170.11      | 59.24       |             |
| 29        | 173.65      | 62.77       |             |
| 30        | 177.08      | 66.41       |             |
| 31        | 180.38      | 70.17       |             |
| 32        | 183.55      | 74.03       |             |
| 33        | 186.59      | 78.00       |             |
| 34        | 189.50      | 82.07       |             |
| 35        | 192.27      | 86.23       |             |
| 36        | 194.90      | 90.49       |             |
| 37        | 197.38      | 94.82       |             |
| 38        | 199.72      | 99.25       |             |
| 39        | 201.90      | 103.74      |             |
| 40        | 203.94      | 108.31      |             |
| 41        | 204.00      | 108.45      |             |

Circle Center At X = 66.8 ; Y = 166.7 and Radius, 149.0

\*\*\* 1.580 \*\*\*

Failure Surface Specified By 39 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 47.00       | 19.30       |
| 2         | 51.99       | 19.55       |
| 3         | 56.98       | 19.93       |
| 4         | 61.95       | 20.43       |
| 5         | 66.91       | 21.07       |

|    |        | Profile.out |
|----|--------|-------------|
| 6  | 71.86  | 21.83       |
| 7  | 76.78  | 22.72       |
| 8  | 81.67  | 23.73       |
| 9  | 86.54  | 24.87       |
| 10 | 91.38  | 26.13       |
| 11 | 96.18  | 27.52       |
| 12 | 100.95 | 29.03       |
| 13 | 105.68 | 30.66       |
| 14 | 110.36 | 32.41       |
| 15 | 115.00 | 34.28       |
| 16 | 119.58 | 36.27       |
| 17 | 124.12 | 38.38       |
| 18 | 128.59 | 40.60       |
| 19 | 133.01 | 42.94       |
| 20 | 137.37 | 45.39       |
| 21 | 141.67 | 47.95       |
| 22 | 145.89 | 50.62       |
| 23 | 150.05 | 53.40       |
| 24 | 154.14 | 56.28       |
| 25 | 158.15 | 59.27       |
| 26 | 162.08 | 62.36       |
| 27 | 165.93 | 65.55       |
| 28 | 169.69 | 68.84       |
| 29 | 173.38 | 72.22       |
| 30 | 176.97 | 75.70       |
| 31 | 180.47 | 79.27       |
| 32 | 183.88 | 82.92       |
| 33 | 187.20 | 86.66       |
| 34 | 190.42 | 90.49       |
| 35 | 193.54 | 94.40       |
| 36 | 196.55 | 98.39       |
| 37 | 199.47 | 102.45      |
| 38 | 202.28 | 106.58      |
| 39 | 203.46 | 108.42      |

Circle Center At X = 39.8 ; Y = 213.9 and Radius, 194.8

\*\*\* 1.582 \*\*\*

Failure Surface Specified By 39 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.50       | 19.20       |
| 2         | 51.49       | 19.55       |
| 3         | 56.47       | 20.02       |
| 4         | 61.43       | 20.62       |
| 5         | 66.38       | 21.33       |
| 6         | 71.31       | 22.17       |
| 7         | 76.22       | 23.12       |
| 8         | 81.10       | 24.20       |
| 9         | 85.95       | 25.39       |
| 10        | 90.78       | 26.71       |
| 11        | 95.57       | 28.14       |
| 12        | 100.33      | 29.68       |
| 13        | 105.04      | 31.34       |
| 14        | 109.72      | 33.12       |
| 15        | 114.35      | 35.01       |

|    |        | Profile.out |
|----|--------|-------------|
| 16 | 118.93 | 37.01       |
| 17 | 123.46 | 39.12       |
| 18 | 127.94 | 41.35       |
| 19 | 132.36 | 43.68       |
| 20 | 136.73 | 46.12       |
| 21 | 141.03 | 48.66       |
| 22 | 145.27 | 51.31       |
| 23 | 149.45 | 54.06       |
| 24 | 153.55 | 56.91       |
| 25 | 157.59 | 59.86       |
| 26 | 161.55 | 62.91       |
| 27 | 165.44 | 66.06       |
| 28 | 169.25 | 69.30       |
| 29 | 172.97 | 72.63       |
| 30 | 176.62 | 76.05       |
| 31 | 180.18 | 79.56       |
| 32 | 183.66 | 83.15       |
| 33 | 187.04 | 86.83       |
| 34 | 190.34 | 90.59       |
| 35 | 193.54 | 94.43       |
| 36 | 196.65 | 98.35       |
| 37 | 199.66 | 102.34      |
| 38 | 202.58 | 106.40      |
| 39 | 203.97 | 108.45      |

Circle Center At X = 34.6 ; Y = 223.8 and Radius, 204.9

\*\*\* 1.596 \*\*\*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.00       | 19.10       |
| 2         | 50.92       | 18.21       |
| 3         | 55.87       | 17.51       |
| 4         | 60.84       | 16.98       |
| 5         | 65.83       | 16.63       |
| 6         | 70.83       | 16.46       |
| 7         | 75.83       | 16.47       |
| 8         | 80.82       | 16.66       |
| 9         | 85.81       | 17.03       |
| 10        | 90.78       | 17.58       |
| 11        | 95.73       | 18.31       |
| 12        | 100.64      | 19.21       |
| 13        | 105.53      | 20.29       |
| 14        | 110.37      | 21.55       |
| 15        | 115.16      | 22.98       |
| 16        | 119.89      | 24.58       |
| 17        | 124.57      | 26.35       |
| 18        | 129.18      | 28.29       |
| 19        | 133.72      | 30.39       |
| 20        | 138.17      | 32.66       |
| 21        | 142.55      | 35.08       |
| 22        | 146.83      | 37.66       |
| 23        | 151.02      | 40.39       |
| 24        | 155.10      | 43.27       |
| 25        | 159.08      | 46.30       |

|    |        | Profile.out |
|----|--------|-------------|
| 26 | 162.95 | 49.46       |
| 27 | 166.71 | 52.77       |
| 28 | 170.34 | 56.21       |
| 29 | 173.84 | 59.77       |
| 30 | 177.22 | 63.46       |
| 31 | 180.45 | 67.27       |
| 32 | 183.55 | 71.19       |
| 33 | 186.51 | 75.23       |
| 34 | 189.32 | 79.36       |
| 35 | 191.98 | 83.60       |
| 36 | 194.49 | 87.92       |
| 37 | 196.83 | 92.34       |
| 38 | 199.02 | 96.83       |
| 39 | 201.04 | 101.41      |
| 40 | 202.90 | 106.05      |
| 41 | 203.76 | 108.44      |

Circle Center At X = 73.0 ; Y = 155.3 and Radius, 138.9

\*\*\* 1.605 \*\*\*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 47.00       | 19.30       |
| 2         | 51.92       | 18.41       |
| 3         | 56.87       | 17.69       |
| 4         | 61.84       | 17.16       |
| 5         | 66.83       | 16.81       |
| 6         | 71.83       | 16.64       |
| 7         | 76.83       | 16.66       |
| 8         | 81.82       | 16.86       |
| 9         | 86.81       | 17.24       |
| 10        | 91.77       | 17.80       |
| 11        | 96.72       | 18.55       |
| 12        | 101.63      | 19.47       |
| 13        | 106.51      | 20.58       |
| 14        | 111.34      | 21.86       |
| 15        | 116.12      | 23.32       |
| 16        | 120.85      | 24.96       |
| 17        | 125.51      | 26.76       |
| 18        | 130.11      | 28.74       |
| 19        | 134.62      | 30.88       |
| 20        | 139.06      | 33.18       |
| 21        | 143.41      | 35.65       |
| 22        | 147.67      | 38.27       |
| 23        | 151.82      | 41.05       |
| 24        | 155.88      | 43.98       |
| 25        | 159.82      | 47.06       |
| 26        | 163.65      | 50.27       |
| 27        | 167.35      | 53.63       |
| 28        | 170.93      | 57.12       |
| 29        | 174.39      | 60.73       |
| 30        | 177.70      | 64.48       |
| 31        | 180.88      | 68.34       |
| 32        | 183.91      | 72.31       |
| 33        | 186.80      | 76.39       |

|    |        | Profile.out |
|----|--------|-------------|
| 34 | 189.54 | 80.58       |
| 35 | 192.12 | 84.86       |
| 36 | 194.54 | 89.24       |
| 37 | 196.80 | 93.70       |
| 38 | 198.89 | 98.24       |
| 39 | 200.82 | 102.85      |
| 40 | 202.58 | 107.53      |
| 41 | 202.87 | 108.39      |

Circle Center At X = 73.9 ; Y = 153.2 and Radius, 136.5

\*\*\* 1.605 \*\*\*

Failure Surface Specified By 41 Coordinate Points

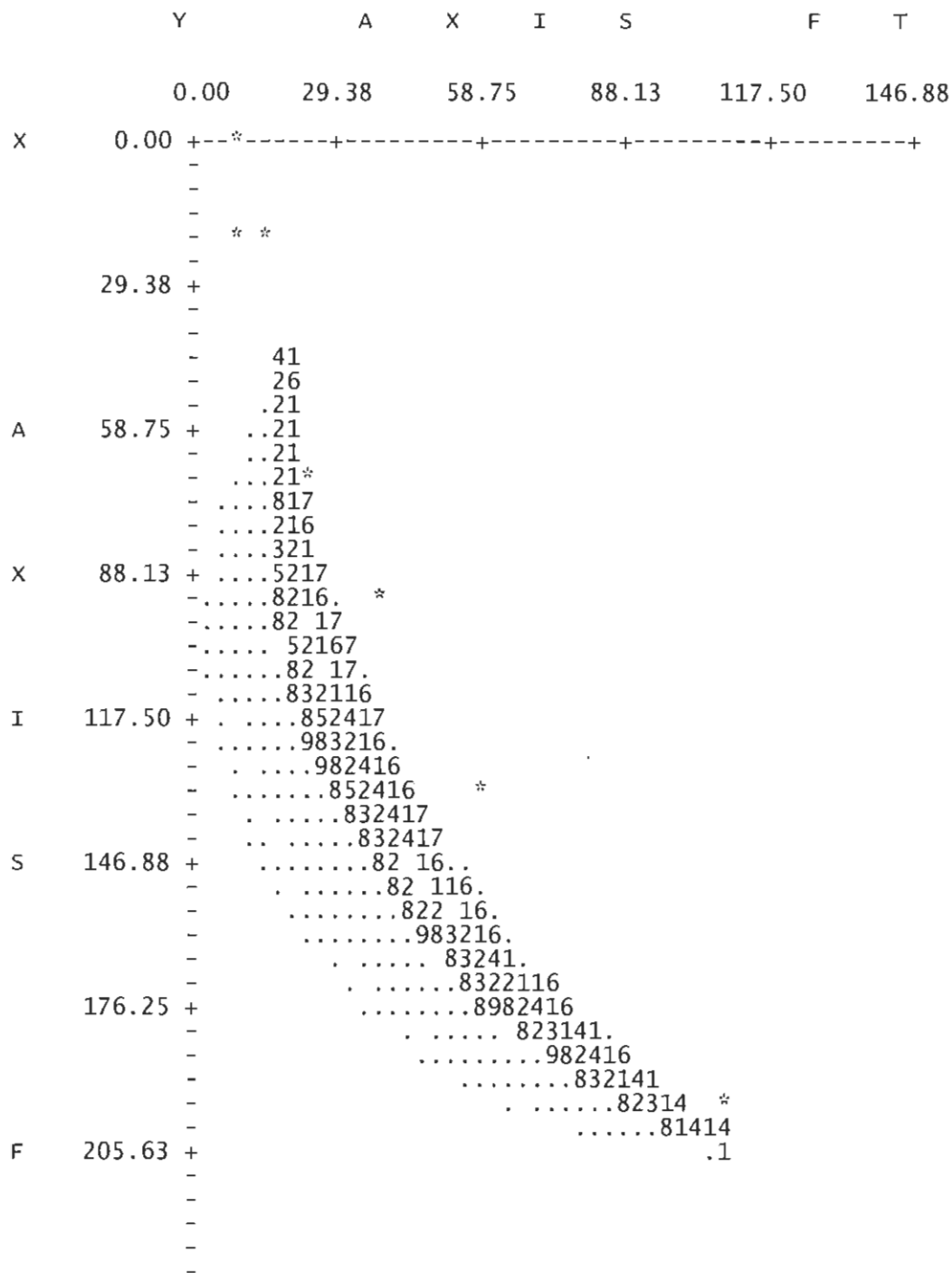
| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 45.00       | 18.90       |
| 2         | 49.93       | 18.08       |
| 3         | 54.89       | 17.44       |
| 4         | 59.87       | 16.98       |
| 5         | 64.86       | 16.69       |
| 6         | 69.86       | 16.59       |
| 7         | 74.86       | 16.65       |
| 8         | 79.85       | 16.90       |
| 9         | 84.84       | 17.33       |
| 10        | 89.80       | 17.93       |
| 11        | 94.74       | 18.71       |
| 12        | 99.65       | 19.66       |
| 13        | 104.52      | 20.79       |
| 14        | 109.35      | 22.09       |
| 15        | 114.13      | 23.56       |
| 16        | 118.85      | 25.20       |
| 17        | 123.51      | 27.01       |
| 18        | 128.11      | 28.98       |
| 19        | 132.63      | 31.11       |
| 20        | 137.07      | 33.41       |
| 21        | 141.43      | 35.86       |
| 22        | 145.70      | 38.46       |
| 23        | 149.87      | 41.22       |
| 24        | 153.94      | 44.12       |
| 25        | 157.91      | 47.16       |
| 26        | 161.76      | 50.34       |
| 27        | 165.50      | 53.66       |
| 28        | 169.12      | 57.11       |
| 29        | 172.62      | 60.69       |
| 30        | 175.98      | 64.39       |
| 31        | 179.21      | 68.20       |
| 32        | 182.31      | 72.13       |
| 33        | 185.26      | 76.17       |
| 34        | 188.07      | 80.30       |
| 35        | 190.72      | 84.54       |
| 36        | 193.23      | 88.87       |
| 37        | 195.58      | 93.28       |
| 38        | 197.77      | 97.77       |
| 39        | 199.80      | 102.34      |
| 40        | 201.66      | 106.98      |
| 41        | 202.16      | 108.36      |



Profile.out

Circle Center At X = 70.4 ; Y = 157.1 and Radius, 140.5

\*\*\* 1.610 \*\*\*

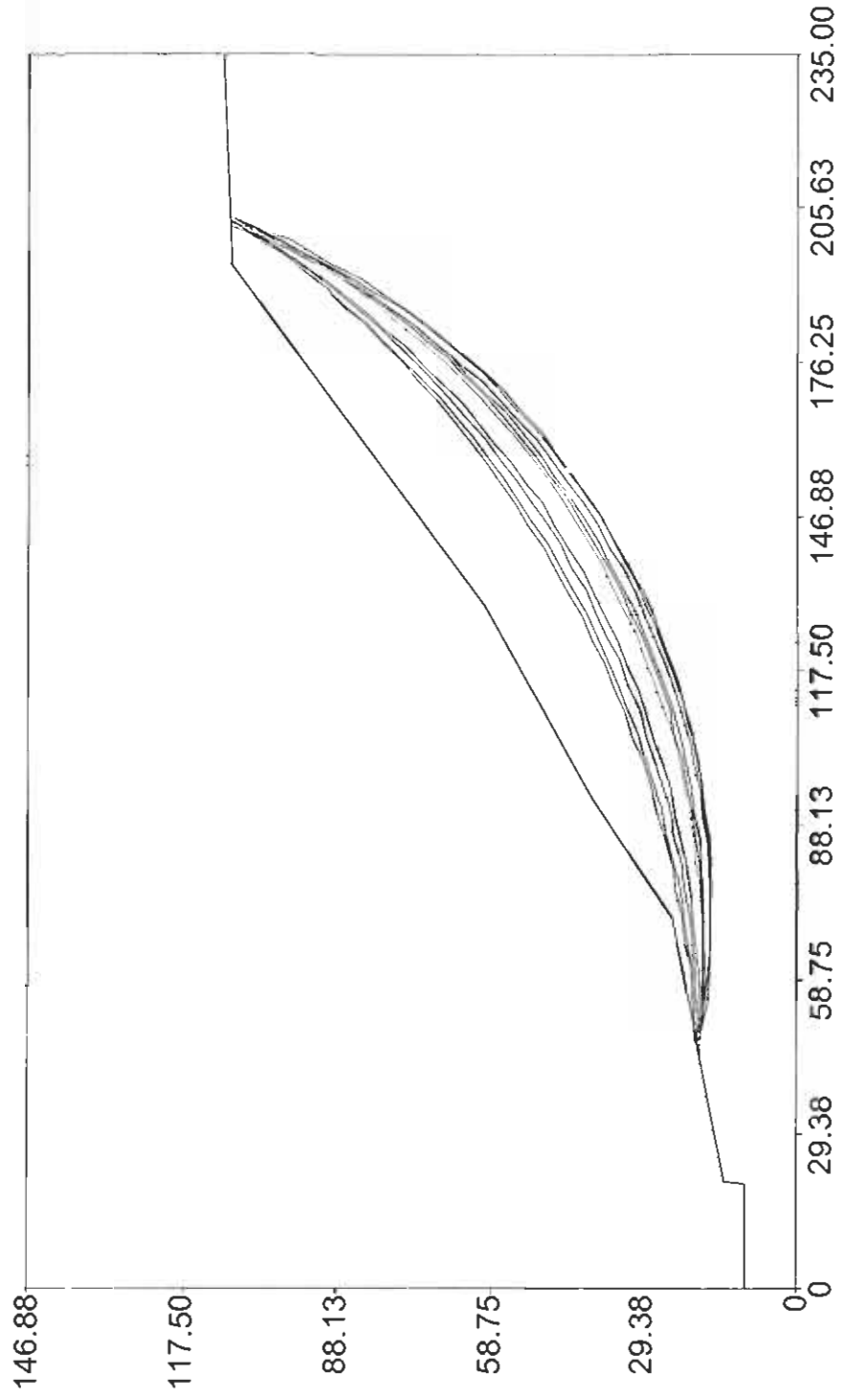


T 235.00 +

Profile.out

\*

Cross Section A-A' (0.2g)



Safety Factors

|      |
|------|
| 1.13 |
| 1.13 |
| 1.13 |
| 1.13 |
| 1.13 |
| 1.14 |
| 1.15 |
| 1.15 |
| 1.15 |
| 1.16 |

Profile.out  
\*\* PCSTABL6 \*\*

by  
Purdue University

modified by  
Peter J. Bosscher  
University of Wisconsin-Madison

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

PROBLEM DESCRIPTION Cross Section A-A'

BOUNDARY COORDINATES

7 Top Boundaries  
7 Total Boundaries

| Boundary No. | X-Left (ft) | Y-Left (ft) | X-Right (ft) | Y-Right (ft) | Soil Type Below Bnd |
|--------------|-------------|-------------|--------------|--------------|---------------------|
| 1            | 0.00        | 10.00       | 20.00        | 10.00        | 3                   |
| 2            | 20.00       | 10.00       | 20.50        | 14.00        | 3                   |
| 3            | 20.50       | 14.00       | 70.50        | 24.00        | 3                   |
| 4            | 70.50       | 24.00       | 93.00        | 39.00        | 3                   |
| 5            | 93.00       | 39.00       | 130.00       | 60.00        | 2                   |
| 6            | 130.00      | 60.00       | 195.00       | 108.00       | 1                   |
| 7            | 195.00      | 108.00      | 235.00       | 110.00       | 1                   |

ISOTROPIC SOIL PARAMETERS

3 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             | 110.0                | 110.0                    | 0.0                      | 32.0                 | 0.00                 | 0.0                     | 0                 |
| 2             | 120.0                | 120.0                    | 100.0                    | 34.0                 | 0.00                 | 0.0                     | 0                 |
| 3             | 105.0                | 105.0                    | 1000.0                   | 30.0                 | 0.00                 | 0.0                     | 0                 |

Profile.out

A Horizontal Earthquake Loading Coefficient  
of 0.200 Has Been Assigned

A Vertical Earthquake Loading Coefficient  
of 0.000 Has Been Assigned

Cavitation Pressure = 0.0 psf

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

25 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 5 Points Equally Spaced  
Along The Ground Surface Between X = 45.00 ft.  
and X = 47.00 ft.

Each Surface Terminates Between X = 202.00 ft.  
and X = 204.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation  
At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

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 Bishop Method \* \*

Failure Surface Specified By 40 Coordinate Points

| Point<br>No. | X-Surf<br>(ft) | Y-Surf<br>(ft) |
|--------------|----------------|----------------|
| 1            | 46.00          | 19.10          |
| 2            | 50.98          | 18.64          |
| 3            | 55.97          | 18.34          |
| 4            | 60.97          | 18.20          |
| 5            | 65.97          | 18.22          |
| 6            | 70.96          | 18.40          |
| 7            | 75.95          | 18.74          |
| 8            | 80.93          | 19.24          |
| 9            | 85.88          | 19.91          |
| 10           | 90.82          | 20.73          |
| 11           | 95.72          | 21.71          |
| 12           | 100.59         | 22.85          |
| 13           | 105.42         | 24.15          |

|    |        | Profile.out |
|----|--------|-------------|
| 14 | 110.20 | 25.60       |
| 15 | 114.94 | 27.20       |
| 16 | 119.62 | 28.96       |
| 17 | 124.24 | 30.86       |
| 18 | 128.80 | 32.92       |
| 19 | 133.29 | 35.12       |
| 20 | 137.71 | 37.46       |
| 21 | 142.04 | 39.94       |
| 22 | 146.30 | 42.57       |
| 23 | 150.47 | 45.33       |
| 24 | 154.55 | 48.22       |
| 25 | 158.53 | 51.24       |
| 26 | 162.42 | 54.39       |
| 27 | 166.20 | 57.66       |
| 28 | 169.87 | 61.06       |
| 29 | 173.43 | 64.57       |
| 30 | 176.88 | 68.19       |
| 31 | 180.21 | 71.92       |
| 32 | 183.41 | 75.76       |
| 33 | 186.49 | 79.70       |
| 34 | 189.44 | 83.73       |
| 35 | 192.26 | 87.86       |
| 36 | 194.95 | 92.08       |
| 37 | 197.50 | 96.38       |
| 38 | 199.90 | 100.76      |
| 39 | 202.17 | 105.22      |
| 40 | 203.68 | 108.43      |

Circle Center At X = 62.8 ; Y = 173.2 and Radius, 155.1

\*\*\* 1.129 \*\*\*

Failure Surface Specified By 39 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.50       | 19.20       |
| 2         | 51.50       | 19.24       |
| 3         | 56.50       | 19.41       |
| 4         | 61.49       | 19.73       |
| 5         | 66.47       | 20.18       |
| 6         | 71.43       | 20.77       |
| 7         | 76.38       | 21.50       |
| 8         | 81.30       | 22.37       |
| 9         | 86.20       | 23.37       |
| 10        | 91.07       | 24.50       |
| 11        | 95.91       | 25.77       |
| 12        | 100.71      | 27.18       |
| 13        | 105.46      | 28.72       |
| 14        | 110.18      | 30.38       |
| 15        | 114.84      | 32.18       |
| 16        | 119.46      | 34.11       |
| 17        | 124.01      | 36.16       |
| 18        | 128.51      | 38.34       |
| 19        | 132.95      | 40.65       |
| 20        | 137.32      | 43.07       |
| 21        | 141.63      | 45.62       |
| 22        | 145.86      | 48.28       |

|    |        | Profile.out |
|----|--------|-------------|
| 23 | 150.01 | 51.06       |
| 24 | 154.09 | 53.96       |
| 25 | 158.09 | 56.96       |
| 26 | 162.00 | 60.08       |
| 27 | 165.82 | 63.30       |
| 28 | 169.55 | 66.63       |
| 29 | 173.19 | 70.06       |
| 30 | 176.73 | 73.59       |
| 31 | 180.17 | 77.22       |
| 32 | 183.51 | 80.94       |
| 33 | 186.75 | 84.75       |
| 34 | 189.88 | 88.65       |
| 35 | 192.90 | 92.63       |
| 36 | 195.81 | 96.70       |
| 37 | 198.60 | 100.85      |
| 38 | 201.28 | 105.07      |
| 39 | 203.27 | 108.41      |

Circle Center At X = 47.6 ; Y = 199.6 and Radius, 180.4

\*\*\* 1.129 \*\*\*

Failure Surface Specified By 40 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.00       | 19.10       |
| 2         | 50.97       | 18.56       |
| 3         | 55.96       | 18.18       |
| 4         | 60.95       | 17.96       |
| 5         | 65.95       | 17.91       |
| 6         | 70.95       | 18.02       |
| 7         | 75.94       | 18.30       |
| 8         | 80.92       | 18.74       |
| 9         | 85.89       | 19.34       |
| 10        | 90.83       | 20.11       |
| 11        | 95.74       | 21.04       |
| 12        | 100.62      | 22.13       |
| 13        | 105.46      | 23.39       |
| 14        | 110.26      | 24.80       |
| 15        | 115.00      | 26.36       |
| 16        | 119.70      | 28.09       |
| 17        | 124.33      | 29.96       |
| 18        | 128.90      | 31.99       |
| 19        | 133.41      | 34.17       |
| 20        | 137.83      | 36.49       |
| 21        | 142.18      | 38.96       |
| 22        | 146.45      | 41.57       |
| 23        | 150.62      | 44.32       |
| 24        | 154.71      | 47.20       |
| 25        | 158.69      | 50.22       |
| 26        | 162.58      | 53.36       |
| 27        | 166.36      | 56.64       |
| 28        | 170.03      | 60.03       |
| 29        | 173.58      | 63.55       |
| 30        | 177.02      | 67.18       |
| 31        | 180.34      | 70.92       |
| 32        | 183.53      | 74.77       |

|    |        | Profile.out |
|----|--------|-------------|
| 33 | 186.60 | 78.72       |
| 34 | 189.53 | 82.77       |
| 35 | 192.33 | 86.91       |
| 36 | 194.99 | 91.15       |
| 37 | 197.51 | 95.47       |
| 38 | 199.88 | 99.87       |
| 39 | 202.11 | 104.34      |
| 40 | 203.99 | 108.45      |

Circle Center At X = 65.0 ; Y = 169.8 and Radius, 151.9

\*\*\* 1.131 \*\*\*

Failure Surface Specified By 40 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 45.50       | 19.00       |
| 2         | 50.50       | 18.89       |
| 3         | 55.50       | 18.93       |
| 4         | 60.50       | 19.11       |
| 5         | 65.49       | 19.43       |
| 6         | 70.46       | 19.90       |
| 7         | 75.43       | 20.51       |
| 8         | 80.37       | 21.27       |
| 9         | 85.29       | 22.17       |
| 10        | 90.18       | 23.21       |
| 11        | 95.04       | 24.39       |
| 12        | 99.86       | 25.71       |
| 13        | 104.64      | 27.18       |
| 14        | 109.38      | 28.78       |
| 15        | 114.06      | 30.51       |
| 16        | 118.70      | 32.38       |
| 17        | 123.28      | 34.39       |
| 18        | 127.80      | 36.52       |
| 19        | 132.26      | 38.79       |
| 20        | 136.65      | 41.18       |
| 21        | 140.97      | 43.71       |
| 22        | 145.21      | 46.35       |
| 23        | 149.38      | 49.12       |
| 24        | 153.46      | 52.00       |
| 25        | 157.46      | 55.01       |
| 26        | 161.37      | 58.12       |
| 27        | 165.18      | 61.35       |
| 28        | 168.90      | 64.69       |
| 29        | 172.53      | 68.14       |
| 30        | 176.05      | 71.68       |
| 31        | 179.47      | 75.33       |
| 32        | 182.78      | 79.08       |
| 33        | 185.98      | 82.92       |
| 34        | 189.07      | 86.85       |
| 35        | 192.04      | 90.87       |
| 36        | 194.90      | 94.98       |
| 37        | 197.64      | 99.16       |
| 38        | 200.25      | 103.42      |
| 39        | 202.74      | 107.76      |
| 40        | 203.08      | 108.40      |



Profile.out  
Circle Center At X = 51.8 ; Y = 191.5 and Radius, 172.6

\*\*\* 1.132 \*\*\*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.00       | 19.10       |
| 2         | 50.96       | 18.49       |
| 3         | 55.94       | 18.04       |
| 4         | 60.93       | 17.76       |
| 5         | 65.93       | 17.64       |
| 6         | 70.93       | 17.70       |
| 7         | 75.93       | 17.92       |
| 8         | 80.91       | 18.31       |
| 9         | 85.88       | 18.87       |
| 10        | 90.83       | 19.59       |
| 11        | 95.75       | 20.48       |
| 12        | 100.64      | 21.53       |
| 13        | 105.49      | 22.75       |
| 14        | 110.29      | 24.12       |
| 15        | 115.05      | 25.66       |
| 16        | 119.75      | 27.36       |
| 17        | 124.40      | 29.22       |
| 18        | 128.98      | 31.22       |
| 19        | 133.48      | 33.39       |
| 20        | 137.92      | 35.70       |
| 21        | 142.27      | 38.16       |
| 22        | 146.54      | 40.76       |
| 23        | 150.72      | 43.51       |
| 24        | 154.80      | 46.39       |
| 25        | 158.79      | 49.41       |
| 26        | 162.67      | 52.56       |
| 27        | 166.44      | 55.84       |
| 28        | 170.11      | 59.24       |
| 29        | 173.65      | 62.77       |
| 30        | 177.08      | 66.41       |
| 31        | 180.38      | 70.17       |
| 32        | 183.55      | 74.03       |
| 33        | 186.59      | 78.00       |
| 34        | 189.50      | 82.07       |
| 35        | 192.27      | 86.23       |
| 36        | 194.90      | 90.49       |
| 37        | 197.38      | 94.82       |
| 38        | 199.72      | 99.25       |
| 39        | 201.90      | 103.74      |
| 40        | 203.94      | 108.31      |
| 41        | 204.00      | 108.45      |

Circle Center At X = 66.8 ; Y = 166.7 and Radius, 149.0

\*\*\* 1.134 \*\*\*

Failure Surface Specified By 39 Coordinate Points

Profile.out

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 47.00       | 19.30       |
| 2         | 51.99       | 19.55       |
| 3         | 56.98       | 19.93       |
| 4         | 61.95       | 20.43       |
| 5         | 66.91       | 21.07       |
| 6         | 71.86       | 21.83       |
| 7         | 76.78       | 22.72       |
| 8         | 81.67       | 23.73       |
| 9         | 86.54       | 24.87       |
| 10        | 91.38       | 26.13       |
| 11        | 96.18       | 27.52       |
| 12        | 100.95      | 29.03       |
| 13        | 105.68      | 30.66       |
| 14        | 110.36      | 32.41       |
| 15        | 115.00      | 34.28       |
| 16        | 119.58      | 36.27       |
| 17        | 124.12      | 38.38       |
| 18        | 128.59      | 40.60       |
| 19        | 133.01      | 42.94       |
| 20        | 137.37      | 45.39       |
| 21        | 141.67      | 47.95       |
| 22        | 145.89      | 50.62       |
| 23        | 150.05      | 53.40       |
| 24        | 154.14      | 56.28       |
| 25        | 158.15      | 59.27       |
| 26        | 162.08      | 62.36       |
| 27        | 165.93      | 65.55       |
| 28        | 169.69      | 68.84       |
| 29        | 173.38      | 72.22       |
| 30        | 176.97      | 75.70       |
| 31        | 180.47      | 79.27       |
| 32        | 183.88      | 82.92       |
| 33        | 187.20      | 86.66       |
| 34        | 190.42      | 90.49       |
| 35        | 193.54      | 94.40       |
| 36        | 196.55      | 98.39       |
| 37        | 199.47      | 102.45      |
| 38        | 202.28      | 106.58      |
| 39        | 203.46      | 108.42      |

Circle Center At X = 39.8 ; Y = 213.9 and Radius, 194.8

\*\*\* 1.137 \*\*\*

Failure Surface Specified By 39 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.50       | 19.20       |
| 2         | 51.49       | 19.55       |
| 3         | 56.47       | 20.02       |
| 4         | 61.43       | 20.62       |
| 5         | 66.38       | 21.33       |

|    |        | Profile.out |
|----|--------|-------------|
| 6  | 71.31  | 22.17       |
| 7  | 76.22  | 23.12       |
| 8  | 81.10  | 24.20       |
| 9  | 85.95  | 25.39       |
| 10 | 90.78  | 26.71       |
| 11 | 95.57  | 28.14       |
| 12 | 100.33 | 29.68       |
| 13 | 105.04 | 31.34       |
| 14 | 109.72 | 33.12       |
| 15 | 114.35 | 35.01       |
| 16 | 118.93 | 37.01       |
| 17 | 123.46 | 39.12       |
| 18 | 127.94 | 41.35       |
| 19 | 132.36 | 43.68       |
| 20 | 136.73 | 46.12       |
| 21 | 141.03 | 48.66       |
| 22 | 145.27 | 51.31       |
| 23 | 149.45 | 54.06       |
| 24 | 153.55 | 56.91       |
| 25 | 157.59 | 59.86       |
| 26 | 161.55 | 62.91       |
| 27 | 165.44 | 66.06       |
| 28 | 169.25 | 69.30       |
| 29 | 172.97 | 72.63       |
| 30 | 176.62 | 76.05       |
| 31 | 180.18 | 79.56       |
| 32 | 183.66 | 83.15       |
| 33 | 187.04 | 86.83       |
| 34 | 190.34 | 90.59       |
| 35 | 193.54 | 94.43       |
| 36 | 196.65 | 98.35       |
| 37 | 199.66 | 102.34      |
| 38 | 202.58 | 106.40      |
| 39 | 203.97 | 108.45      |

Circle Center At X = 34.6 ; Y = 223.8 and Radius, 204.9

\*\*\* 1.147 \*\*\*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 46.00       | 19.10       |
| 2         | 50.92       | 18.21       |
| 3         | 55.87       | 17.51       |
| 4         | 60.84       | 16.98       |
| 5         | 65.83       | 16.63       |
| 6         | 70.83       | 16.46       |
| 7         | 75.83       | 16.47       |
| 8         | 80.82       | 16.66       |
| 9         | 85.81       | 17.03       |
| 10        | 90.78       | 17.58       |
| 11        | 95.73       | 18.31       |
| 12        | 100.64      | 19.21       |
| 13        | 105.53      | 20.29       |
| 14        | 110.37      | 21.55       |
| 15        | 115.16      | 22.98       |

|    |        | Profile.out |
|----|--------|-------------|
| 16 | 119.89 | 24.58       |
| 17 | 124.57 | 26.35       |
| 18 | 129.18 | 28.29       |
| 19 | 133.72 | 30.39       |
| 20 | 138.17 | 32.66       |
| 21 | 142.55 | 35.08       |
| 22 | 146.83 | 37.66       |
| 23 | 151.02 | 40.39       |
| 24 | 155.10 | 43.27       |
| 25 | 159.08 | 46.30       |
| 26 | 162.95 | 49.46       |
| 27 | 166.71 | 52.77       |
| 28 | 170.34 | 56.21       |
| 29 | 173.84 | 59.77       |
| 30 | 177.22 | 63.46       |
| 31 | 180.45 | 67.27       |
| 32 | 183.55 | 71.19       |
| 33 | 186.51 | 75.23       |
| 34 | 189.32 | 79.36       |
| 35 | 191.98 | 83.60       |
| 36 | 194.49 | 87.92       |
| 37 | 196.83 | 92.34       |
| 38 | 199.02 | 96.83       |
| 39 | 201.04 | 101.41      |
| 40 | 202.90 | 106.05      |
| 41 | 203.76 | 108.44      |

Circle Center At X = 73.0 ; Y = 155.3 and Radius, 138.9

\*\*\* 1.154 \*\*\*

Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 47.00       | 19.30       |
| 2         | 51.92       | 18.41       |
| 3         | 56.87       | 17.69       |
| 4         | 61.84       | 17.16       |
| 5         | 66.83       | 16.81       |
| 6         | 71.83       | 16.64       |
| 7         | 76.83       | 16.66       |
| 8         | 81.82       | 16.86       |
| 9         | 86.81       | 17.24       |
| 10        | 91.77       | 17.80       |
| 11        | 96.72       | 18.55       |
| 12        | 101.63      | 19.47       |
| 13        | 106.51      | 20.58       |
| 14        | 111.34      | 21.86       |
| 15        | 116.12      | 23.32       |
| 16        | 120.85      | 24.96       |
| 17        | 125.51      | 26.76       |
| 18        | 130.11      | 28.74       |
| 19        | 134.62      | 30.88       |
| 20        | 139.06      | 33.18       |
| 21        | 143.41      | 35.65       |
| 22        | 147.67      | 38.27       |
| 23        | 151.82      | 41.05       |

|    |        | Profile.out |
|----|--------|-------------|
| 24 | 155.88 | 43.98       |
| 25 | 159.82 | 47.06       |
| 26 | 163.65 | 50.27       |
| 27 | 167.35 | 53.63       |
| 28 | 170.93 | 57.12       |
| 29 | 174.39 | 60.73       |
| 30 | 177.70 | 64.48       |
| 31 | 180.88 | 68.34       |
| 32 | 183.91 | 72.31       |
| 33 | 186.80 | 76.39       |
| 34 | 189.54 | 80.58       |
| 35 | 192.12 | 84.86       |
| 36 | 194.54 | 89.24       |
| 37 | 196.80 | 93.70       |
| 38 | 198.89 | 98.24       |
| 39 | 200.82 | 102.85      |
| 40 | 202.58 | 107.53      |
| 41 | 202.87 | 108.39      |

Circle Center At X = 73.9 ; Y = 153.2 and Radius, 136.5

\*\*\* 1.155 \*\*\*

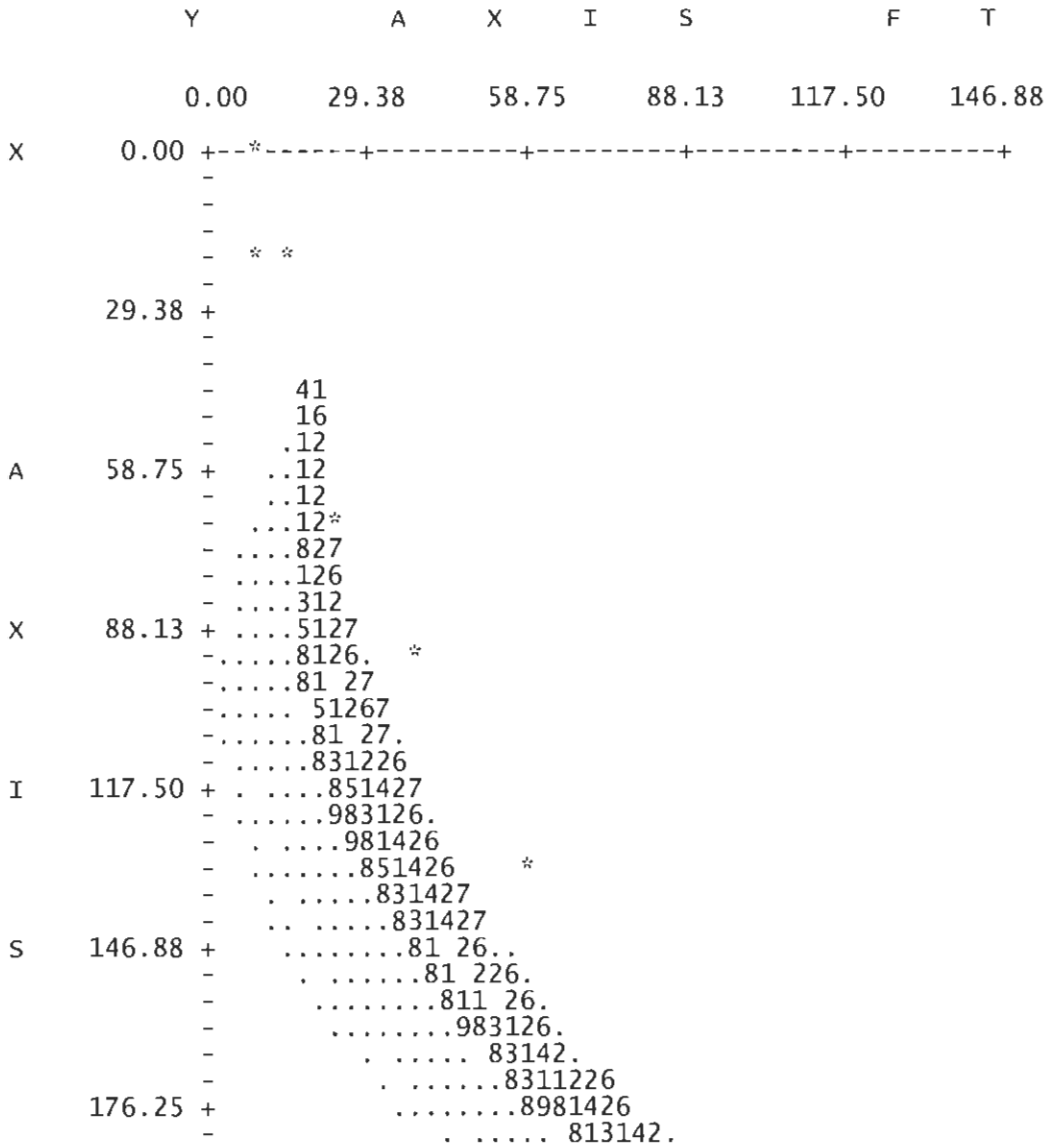
Failure Surface Specified By 41 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 45.00       | 18.90       |
| 2         | 49.93       | 18.08       |
| 3         | 54.89       | 17.44       |
| 4         | 59.87       | 16.98       |
| 5         | 64.86       | 16.69       |
| 6         | 69.86       | 16.59       |
| 7         | 74.86       | 16.65       |
| 8         | 79.85       | 16.90       |
| 9         | 84.84       | 17.33       |
| 10        | 89.80       | 17.93       |
| 11        | 94.74       | 18.71       |
| 12        | 99.65       | 19.66       |
| 13        | 104.52      | 20.79       |
| 14        | 109.35      | 22.09       |
| 15        | 114.13      | 23.56       |
| 16        | 118.85      | 25.20       |
| 17        | 123.51      | 27.01       |
| 18        | 128.11      | 28.98       |
| 19        | 132.63      | 31.11       |
| 20        | 137.07      | 33.41       |
| 21        | 141.43      | 35.86       |
| 22        | 145.70      | 38.46       |
| 23        | 149.87      | 41.22       |
| 24        | 153.94      | 44.12       |
| 25        | 157.91      | 47.16       |
| 26        | 161.76      | 50.34       |
| 27        | 165.50      | 53.66       |
| 28        | 169.12      | 57.11       |
| 29        | 172.62      | 60.69       |
| 30        | 175.98      | 64.39       |
| 31        | 179.21      | 68.20       |

|    |        | Profile.out |
|----|--------|-------------|
| 32 | 182.31 | 72.13       |
| 33 | 185.26 | 76.17       |
| 34 | 188.07 | 80.30       |
| 35 | 190.72 | 84.54       |
| 36 | 193.23 | 88.87       |
| 37 | 195.58 | 93.28       |
| 38 | 197.77 | 97.77       |
| 39 | 199.80 | 102.34      |
| 40 | 201.66 | 106.98      |
| 41 | 202.16 | 108.36      |

Circle Center At X = 70.4 ; Y = 157.1 and Radius, 140.5

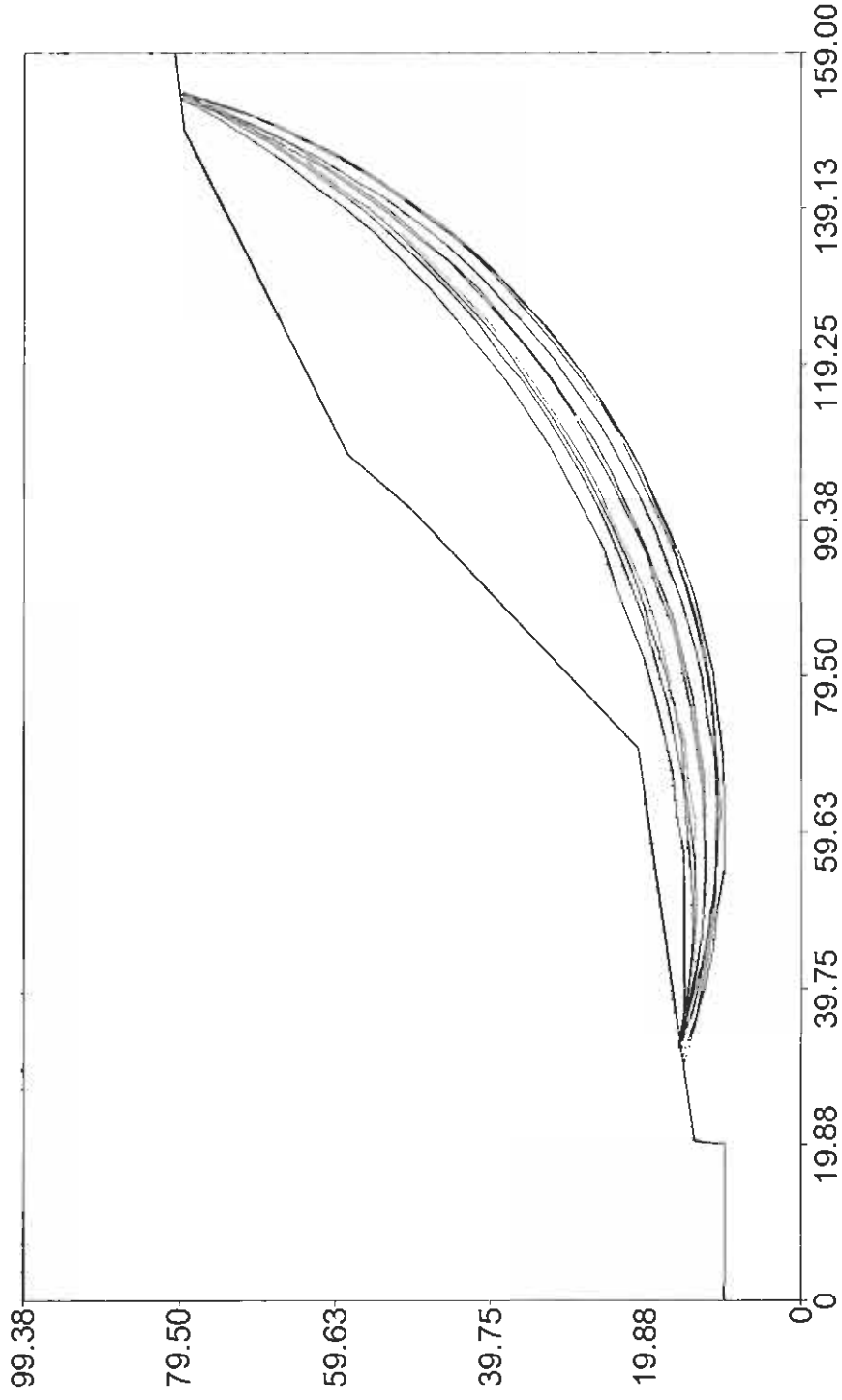
\*\*\* 1.158 \*\*\*



```

Profile.out
.....981426
.....831142
. ....81314 *
.....81414
F 205.63 + .1
-
-
-
-
-
-
-
T 235.00 + *
```

# Cross Section B-B'



# Safety Factors

|      |
|------|
| 1.76 |
| 1.76 |
| 1.77 |
| 1.77 |
| 1.77 |
| 1.78 |
| 1.79 |
| 1.79 |
| 1.81 |
| 1.82 |



Profile.out  
\*\* PCSTABL6 \*\*

by  
Purdue University

modified by  
Peter J. Bosscher  
University of Wisconsin-Madison

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

PROBLEM DESCRIPTION Cross Section B-B'

BOUNDARY COORDINATES

8 Top Boundaries  
8 Total Boundaries

| Boundary No. | X-Left (ft) | Y-Left (ft) | X-Right (ft) | Y-Right (ft) | Soil Type Below Bnd |
|--------------|-------------|-------------|--------------|--------------|---------------------|
| 1            | 0.00        | 10.00       | 20.00        | 10.00        | 3                   |
| 2            | 20.00       | 10.00       | 20.50        | 14.00        | 3                   |
| 3            | 20.50       | 14.00       | 70.50        | 21.00        | 3                   |
| 4            | 70.50       | 21.00       | 79.00        | 29.00        | 3                   |
| 5            | 79.00       | 29.00       | 101.00       | 50.00        | 2                   |
| 6            | 101.00      | 50.00       | 108.00       | 58.00        | 1                   |
| 7            | 108.00      | 58.00       | 149.00       | 79.00        | 1                   |
| 8            | 149.00      | 79.00       | 159.00       | 80.00        | 1                   |

ISOTROPIC SOIL PARAMETERS

3 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             | 110.0                | 110.0                    | 0.0                      | 32.0                 | 0.00                 | 0.0                     | 0                 |
| 2             | 120.0                | 120.0                    | 100.0                    | 34.0                 | 0.00                 | 0.0                     | 0                 |
| 3             | 105.0                | 105.0                    | 1000.0                   | 30.0                 | 0.00                 | 0.0                     | 0                 |

Profile.out

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

25 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 5 Points Equally Spaced Along The Ground Surface Between X = 30.00 ft.  
and X = 33.00 ft.

Each Surface Terminates Between X = 152.00 ft.  
and X = 154.00 ft.

Unless Further Limitations were Imposed, The Minimum Elevation At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

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 Bishop Method \* \*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.50       | 15.54       |
| 2         | 36.43       | 14.71       |
| 3         | 41.39       | 14.11       |
| 4         | 46.38       | 13.72       |
| 5         | 51.38       | 13.57       |
| 6         | 56.38       | 13.63       |
| 7         | 61.37       | 13.92       |
| 8         | 66.34       | 14.44       |
| 9         | 71.29       | 15.18       |
| 10        | 76.19       | 16.14       |
| 11        | 81.05       | 17.32       |
| 12        | 85.85       | 18.71       |
| 13        | 90.59       | 20.32       |
| 14        | 95.24       | 22.15       |
| 15        | 99.81       | 24.17       |
| 16        | 104.29      | 26.41       |
| 17        | 108.66      | 28.84       |
| 18        | 112.91      | 31.46       |
| 19        | 117.05      | 34.28       |
| 20        | 121.05      | 37.27       |
| 21        | 124.91      | 40.45       |
| 22        | 128.63      | 43.79       |

|    |        | Profile.out |
|----|--------|-------------|
| 23 | 132.19 | 47.30       |
| 24 | 135.60 | 50.96       |
| 25 | 138.83 | 54.77       |
| 26 | 141.89 | 58.73       |
| 27 | 144.77 | 62.82       |
| 28 | 147.46 | 67.03       |
| 29 | 149.96 | 71.36       |
| 30 | 152.27 | 75.80       |
| 31 | 153.98 | 79.50       |

Circle Center At X = 52.4 ; Y = 124.8 and Radius, 111.3

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

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.50       | 15.54       |
| 2         | 36.44       | 14.78       |
| 3         | 41.41       | 14.23       |
| 4         | 46.40       | 13.91       |
| 5         | 51.40       | 13.81       |
| 6         | 56.40       | 13.93       |
| 7         | 61.39       | 14.26       |
| 8         | 66.36       | 14.82       |
| 9         | 71.30       | 15.60       |
| 10        | 76.20       | 16.59       |
| 11        | 81.05       | 17.80       |
| 12        | 85.84       | 19.23       |
| 13        | 90.57       | 20.86       |
| 14        | 95.22       | 22.70       |
| 15        | 99.78       | 24.74       |
| 16        | 104.25      | 26.99       |
| 17        | 108.61      | 29.42       |
| 18        | 112.87      | 32.05       |
| 19        | 117.00      | 34.87       |
| 20        | 121.00      | 37.86       |
| 21        | 124.87      | 41.03       |
| 22        | 128.60      | 44.36       |
| 23        | 132.17      | 47.86       |
| 24        | 135.59      | 51.51       |
| 25        | 138.84      | 55.31       |
| 26        | 141.92      | 59.24       |
| 27        | 144.83      | 63.31       |
| 28        | 147.55      | 67.51       |
| 29        | 150.08      | 71.82       |
| 30        | 152.43      | 76.24       |
| 31        | 153.97      | 79.50       |

Circle Center At X = 51.2 ; Y = 127.0 and Radius, 113.2

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

Failure Surface Specified By 31 Coordinate Points

Profile.out

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.50       | 15.54       |
| 2         | 36.45       | 14.85       |
| 3         | 41.43       | 14.38       |
| 4         | 46.42       | 14.13       |
| 5         | 51.42       | 14.09       |
| 6         | 56.42       | 14.27       |
| 7         | 61.41       | 14.66       |
| 8         | 66.37       | 15.28       |
| 9         | 71.30       | 16.10       |
| 10        | 76.19       | 17.14       |
| 11        | 81.03       | 18.39       |
| 12        | 85.81       | 19.85       |
| 13        | 90.53       | 21.52       |
| 14        | 95.17       | 23.39       |
| 15        | 99.72       | 25.45       |
| 16        | 104.18      | 27.72       |
| 17        | 108.53      | 30.17       |
| 18        | 112.78      | 32.81       |
| 19        | 116.90      | 35.64       |
| 20        | 120.91      | 38.64       |
| 21        | 124.77      | 41.81       |
| 22        | 128.50      | 45.14       |
| 23        | 132.07      | 48.63       |
| 24        | 135.50      | 52.28       |
| 25        | 138.76      | 56.07       |
| 26        | 141.85      | 60.00       |
| 27        | 144.77      | 64.05       |
| 28        | 147.51      | 68.24       |
| 29        | 150.07      | 72.53       |
| 30        | 152.44      | 76.94       |
| 31        | 153.66      | 79.47       |

Circle Center At X = 49.8 ; Y = 129.3 and Radius, 115.2

\*\*\* 1.769 \*\*\*

Failure surface specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.50       | 15.54       |
| 2         | 36.38       | 14.46       |
| 3         | 41.31       | 13.62       |
| 4         | 46.27       | 13.01       |
| 5         | 51.26       | 12.64       |
| 6         | 56.26       | 12.51       |
| 7         | 61.26       | 12.63       |
| 8         | 66.25       | 12.98       |
| 9         | 71.21       | 13.57       |
| 10        | 76.14       | 14.39       |
| 11        | 81.03       | 15.46       |
| 12        | 85.86       | 16.75       |
| 13        | 90.62       | 18.28       |

|    |        | Profile.out |
|----|--------|-------------|
| 14 | 95.30  | 20.03       |
| 15 | 99.89  | 22.01       |
| 16 | 104.39 | 24.20       |
| 17 | 108.77 | 26.60       |
| 18 | 113.03 | 29.22       |
| 19 | 117.17 | 32.03       |
| 20 | 121.16 | 35.04       |
| 21 | 125.00 | 38.24       |
| 22 | 128.69 | 41.62       |
| 23 | 132.21 | 45.17       |
| 24 | 135.55 | 48.88       |
| 25 | 138.72 | 52.76       |
| 26 | 141.69 | 56.78       |
| 27 | 144.47 | 60.93       |
| 28 | 147.05 | 65.22       |
| 29 | 149.41 | 69.62       |
| 30 | 151.57 | 74.14       |
| 31 | 153.50 | 78.75       |
| 32 | 153.77 | 79.48       |

Circle Center At X = 56.4 ; Y = 116.8 and Radius, 104.2

\*\*\* 1.769 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 32.25       | 15.65       |
| 2         | 37.12       | 14.50       |
| 3         | 42.03       | 13.59       |
| 4         | 46.99       | 12.93       |
| 5         | 51.97       | 12.52       |
| 6         | 56.97       | 12.35       |
| 7         | 61.97       | 12.43       |
| 8         | 66.96       | 12.76       |
| 9         | 71.93       | 13.34       |
| 10        | 76.86       | 14.16       |
| 11        | 81.74       | 15.22       |
| 12        | 86.57       | 16.53       |
| 13        | 91.33       | 18.07       |
| 14        | 96.00       | 19.85       |
| 15        | 100.58      | 21.85       |
| 16        | 105.06      | 24.08       |
| 17        | 109.41      | 26.53       |
| 18        | 113.65      | 29.19       |
| 19        | 117.74      | 32.06       |
| 20        | 121.69      | 35.13       |
| 21        | 125.48      | 38.39       |
| 22        | 129.11      | 41.83       |
| 23        | 132.56      | 45.45       |
| 24        | 135.83      | 49.24       |
| 25        | 138.90      | 53.18       |
| 26        | 141.78      | 57.27       |
| 27        | 144.45      | 61.50       |
| 28        | 146.90      | 65.85       |
| 29        | 149.14      | 70.32       |
| 30        | 151.16      | 74.90       |

31            152.87            Profile.out  
79.39

Circle Center At x = 57.8 ; Y = 113.2 and Radius, 100.9

\*\*\*        1.771        \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 32.25       | 15.65       |
| 2         | 37.23       | 15.18       |
| 3         | 42.22       | 14.93       |
| 4         | 47.22       | 14.87       |
| 5         | 52.22       | 15.03       |
| 6         | 57.21       | 15.39       |
| 7         | 62.17       | 15.95       |
| 8         | 67.12       | 16.72       |
| 9         | 72.02       | 17.69       |
| 10        | 76.88       | 18.87       |
| 11        | 81.69       | 20.24       |
| 12        | 86.44       | 21.81       |
| 13        | 91.12       | 23.57       |
| 14        | 95.72       | 25.52       |
| 15        | 100.24      | 27.66       |
| 16        | 104.66      | 29.99       |
| 17        | 108.99      | 32.49       |
| 18        | 113.21      | 35.18       |
| 19        | 117.32      | 38.03       |
| 20        | 121.30      | 41.05       |
| 21        | 125.16      | 44.23       |
| 22        | 128.88      | 47.57       |
| 23        | 132.47      | 51.05       |
| 24        | 135.90      | 54.69       |
| 25        | 139.19      | 58.46       |
| 26        | 142.31      | 62.36       |
| 27        | 145.28      | 66.39       |
| 28        | 148.07      | 70.53       |
| 29        | 150.69      | 74.79       |
| 30        | 153.14      | 79.15       |
| 31        | 153.28      | 79.43       |

Circle Center At x = 46.0 ; Y = 136.3 and Radius, 121.5

\*\*\*        1.776        \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 33.00       | 15.75       |
| 2         | 37.77       | 14.25       |
| 3         | 42.61       | 13.00       |

|    |        | Profile.out |
|----|--------|-------------|
| 4  | 47.51  | 12.01       |
| 5  | 52.46  | 11.29       |
| 6  | 57.44  | 10.83       |
| 7  | 62.43  | 10.63       |
| 8  | 67.43  | 10.70       |
| 9  | 72.42  | 11.04       |
| 10 | 77.39  | 11.65       |
| 11 | 82.31  | 12.52       |
| 12 | 87.18  | 13.64       |
| 13 | 91.98  | 15.03       |
| 14 | 96.71  | 16.67       |
| 15 | 101.34 | 18.56       |
| 16 | 105.86 | 20.70       |
| 17 | 110.26 | 23.07       |
| 18 | 114.53 | 25.68       |
| 19 | 118.65 | 28.51       |
| 20 | 122.62 | 31.55       |
| 21 | 126.41 | 34.80       |
| 22 | 130.03 | 38.25       |
| 23 | 133.47 | 41.89       |
| 24 | 136.70 | 45.70       |
| 25 | 139.72 | 49.68       |
| 26 | 142.53 | 53.82       |
| 27 | 145.11 | 58.10       |
| 28 | 147.46 | 62.51       |
| 29 | 149.58 | 67.05       |
| 30 | 151.44 | 71.68       |
| 31 | 153.06 | 76.42       |
| 32 | 153.93 | 79.49       |

Circle Center At X = 63.6 ; Y = 104.4 and Radius, 93.8

\*\*\* 1.792 \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 32.25       | 15.65       |
| 2         | 37.03       | 14.18       |
| 3         | 41.88       | 12.96       |
| 4         | 46.79       | 12.01       |
| 5         | 51.74       | 11.31       |
| 6         | 56.72       | 10.87       |
| 7         | 61.72       | 10.70       |
| 8         | 66.72       | 10.79       |
| 9         | 71.70       | 11.14       |
| 10        | 76.67       | 11.75       |
| 11        | 81.59       | 12.62       |
| 12        | 86.46       | 13.76       |
| 13        | 91.26       | 15.14       |
| 14        | 95.99       | 16.78       |
| 15        | 100.62      | 18.66       |
| 16        | 105.15      | 20.78       |
| 17        | 109.56      | 23.14       |
| 18        | 113.83      | 25.73       |
| 19        | 117.97      | 28.54       |
| 20        | 121.95      | 31.56       |

|    |        | Profile.out |
|----|--------|-------------|
| 21 | 125.77 | 34.79       |
| 22 | 129.42 | 38.21       |
| 23 | 132.88 | 41.82       |
| 24 | 136.14 | 45.61       |
| 25 | 139.20 | 49.56       |
| 26 | 142.05 | 53.67       |
| 27 | 144.68 | 57.93       |
| 28 | 147.08 | 62.31       |
| 29 | 149.24 | 66.82       |
| 30 | 151.17 | 71.43       |
| 31 | 152.85 | 76.14       |
| 32 | 153.85 | 79.49       |

Circle Center At X = 62.5 ; Y = 105.7 and Radius, 95.1

\*\*\* 1.794 \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 30.00       | 15.33       |
| 2         | 34.81       | 13.96       |
| 3         | 39.68       | 12.84       |
| 4         | 44.61       | 11.97       |
| 5         | 49.57       | 11.35       |
| 6         | 54.55       | 10.98       |
| 7         | 59.55       | 10.87       |
| 8         | 64.55       | 11.00       |
| 9         | 69.54       | 11.39       |
| 10        | 74.49       | 12.04       |
| 11        | 79.41       | 12.93       |
| 12        | 84.28       | 14.07       |
| 13        | 89.09       | 15.46       |
| 14        | 93.81       | 17.09       |
| 15        | 98.45       | 18.95       |
| 16        | 102.99      | 21.05       |
| 17        | 107.42      | 23.38       |
| 18        | 111.72      | 25.92       |
| 19        | 115.89      | 28.68       |
| 20        | 119.91      | 31.65       |
| 21        | 123.78      | 34.82       |
| 22        | 127.48      | 38.18       |
| 23        | 131.01      | 41.73       |
| 24        | 134.35      | 45.45       |
| 25        | 137.50      | 49.33       |
| 26        | 140.45      | 53.37       |
| 27        | 143.19      | 57.55       |
| 28        | 145.71      | 61.86       |
| 29        | 148.02      | 66.30       |
| 30        | 150.09      | 70.85       |
| 31        | 151.94      | 75.50       |
| 32        | 153.27      | 79.43       |

Circle Center At X = 59.3 ; Y = 109.5 and Radius, 98.6

\*\*\* 1.808 \*\*\*





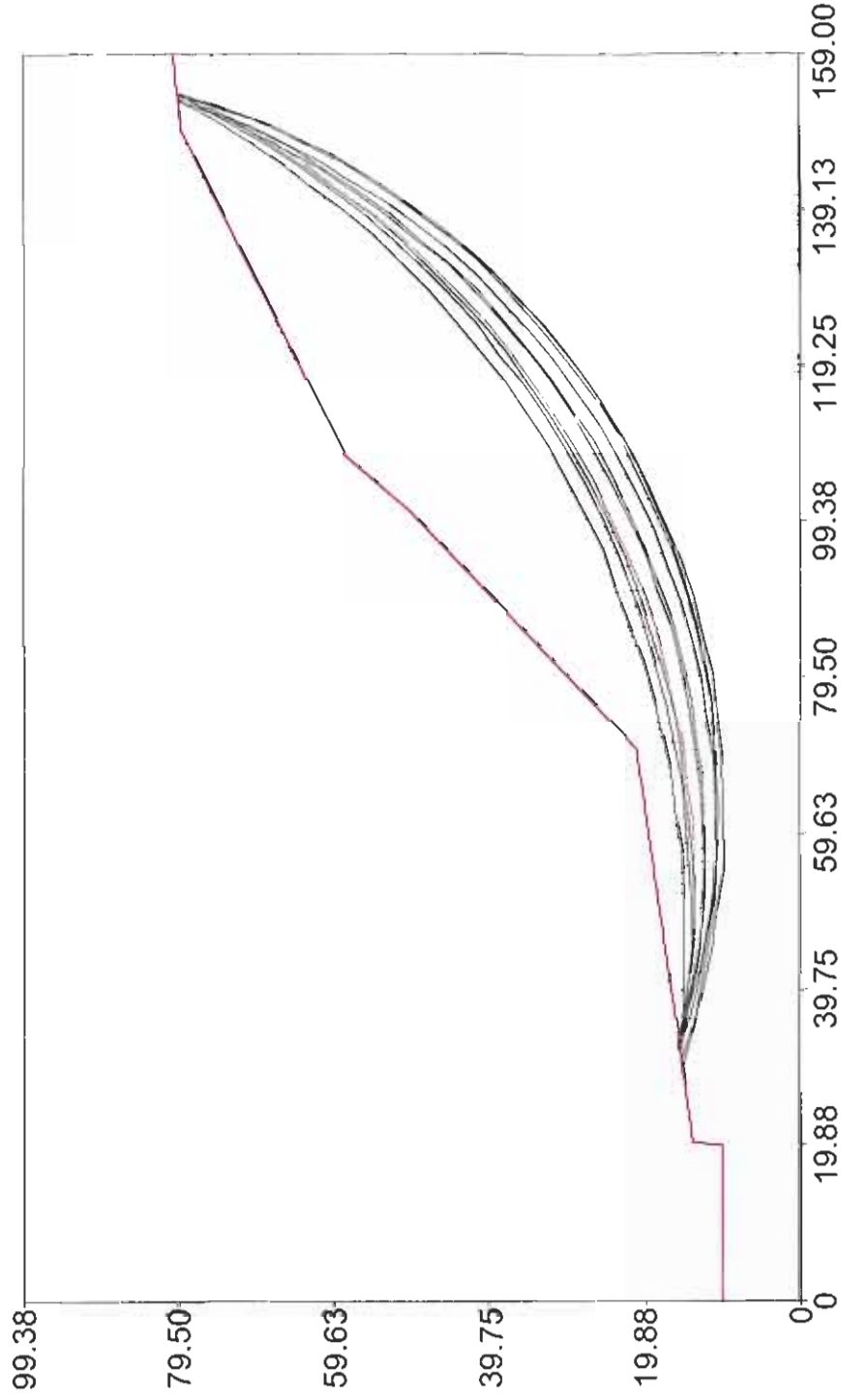
Profile.out

```

19.88 + * *
-
-
-          9
-         ..1
-         16
A  39.75 + .91.
-        ..926
-        ..71.
-        ..04 .
-        ..516
-        ..7416.
X  59.63 + ...94 ..
-.....7516.
-        ..7513..
-        ..094 ..*
-..... 7516.
-        ..07413..
I  79.50 +. ...0941 . *
-..    ..795 6 .
-        ..074126..
-        ..09413 .
-        ..    ..75 6 .
-        ..    ..7 4136..
S  99.38 + .    ..894136.. *
-        .....709 12 ..
-        .    ..7 4 6 .
-        .    ..074 16 .. *
-        ..    ..08 4136..
-        ..    ..79 4126..
119.25 + .    ..705 3 .
-        .    ..    ..7 41 6..
-        .    ..    ..074126 ..
-        .    ..    ..07 4136..
-        ..    ..    ..07 41 6.
-        ..    ..    ..07 41 6.
F  139.13 + .    ..    ..07 416..
-        .    ..    ..070416..
-        .    ..    ..70414..
-        .    ..    ..7.9141.6 *
-        .    ..    ..74131
-
T  159.00 + *

```

# Cross Section B-B' (0.2g)



# Safety Factors

|      |
|------|
| 1.30 |
| 1.30 |
| 1.30 |
| 1.30 |
| 1.31 |
| 1.31 |
| 1.32 |
| 1.32 |
| 1.33 |
| 1.34 |

Profile.out  
\*\* PCSTABL6 \*\*

by  
Purdue University

modified by  
Peter J. Bosscher  
University of Wisconsin-Madison

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

PROBLEM DESCRIPTION Cross Section B-B' (0.2g)

BOUNDARY COORDINATES

8 Top Boundaries  
8 Total Boundaries

| Boundary No. | X-Left (ft) | Y-Left (ft) | X-Right (ft) | Y-Right (ft) | Soil Type Below Bnd |
|--------------|-------------|-------------|--------------|--------------|---------------------|
| 1            | 0.00        | 10.00       | 20.00        | 10.00        | 3                   |
| 2            | 20.00       | 10.00       | 20.50        | 14.00        | 3                   |
| 3            | 20.50       | 14.00       | 70.50        | 21.00        | 3                   |
| 4            | 70.50       | 21.00       | 79.00        | 29.00        | 3                   |
| 5            | 79.00       | 29.00       | 101.00       | 50.00        | 2                   |
| 6            | 101.00      | 50.00       | 108.00       | 58.00        | 1                   |
| 7            | 108.00      | 58.00       | 149.00       | 79.00        | 1                   |
| 8            | 149.00      | 79.00       | 159.00       | 80.00        | 1                   |

ISOTROPIC SOIL PARAMETERS

3 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             | 110.0                | 110.0                    | 0.0                      | 32.0                 | 0.00                 | 0.0                     | 0                 |
| 2             | 120.0                | 120.0                    | 100.0                    | 34.0                 | 0.00                 | 0.0                     | 0                 |
| 3             | 105.0                | 105.0                    | 1000.0                   | 30.0                 | 0.00                 | 0.0                     | 0                 |

Profile.out

A Horizontal Earthquake Loading Coefficient  
Of 0.200 Has Been Assigned

A Vertical Earthquake Loading Coefficient  
Of 0.000 Has Been Assigned

Cavitation Pressure = 0.0 psf

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

25 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 5 Points Equally Spaced  
Along The Ground Surface Between X = 30.00 ft.  
and X = 33.00 ft.

Each Surface Terminates Between X = 152.00 ft.  
and X = 154.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation  
At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

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 Bishop Method \* \*

Failure Surface Specified By 31 Coordinate Points

| Point<br>No. | X-Surf<br>(ft) | Y-Surf<br>(ft) |
|--------------|----------------|----------------|
| 1            | 31.50          | 15.54          |
| 2            | 36.43          | 14.71          |
| 3            | 41.39          | 14.11          |
| 4            | 46.38          | 13.72          |
| 5            | 51.38          | 13.57          |
| 6            | 56.38          | 13.63          |
| 7            | 61.37          | 13.92          |
| 8            | 66.34          | 14.44          |
| 9            | 71.29          | 15.18          |
| 10           | 76.19          | 16.14          |
| 11           | 81.05          | 17.32          |
| 12           | 85.85          | 18.71          |

|    |        | Profile.out |
|----|--------|-------------|
| 13 | 90.59  | 20.32       |
| 14 | 95.24  | 22.15       |
| 15 | 99.81  | 24.17       |
| 16 | 104.29 | 26.41       |
| 17 | 108.66 | 28.84       |
| 18 | 112.91 | 31.46       |
| 19 | 117.05 | 34.28       |
| 20 | 121.05 | 37.27       |
| 21 | 124.91 | 40.45       |
| 22 | 128.63 | 43.79       |
| 23 | 132.19 | 47.30       |
| 24 | 135.60 | 50.96       |
| 25 | 138.83 | 54.77       |
| 26 | 141.89 | 58.73       |
| 27 | 144.77 | 62.82       |
| 28 | 147.46 | 67.03       |
| 29 | 149.96 | 71.36       |
| 30 | 152.27 | 75.80       |
| 31 | 153.98 | 79.50       |

Circle Center At X = 52.4 ; Y = 124.8 and Radius, 111.3

\*\*\* 1.299 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.50       | 15.54       |
| 2         | 36.44       | 14.78       |
| 3         | 41.41       | 14.23       |
| 4         | 46.40       | 13.91       |
| 5         | 51.40       | 13.81       |
| 6         | 56.40       | 13.93       |
| 7         | 61.39       | 14.26       |
| 8         | 66.36       | 14.82       |
| 9         | 71.30       | 15.60       |
| 10        | 76.20       | 16.59       |
| 11        | 81.05       | 17.80       |
| 12        | 85.84       | 19.23       |
| 13        | 90.57       | 20.86       |
| 14        | 95.22       | 22.70       |
| 15        | 99.78       | 24.74       |
| 16        | 104.25      | 26.99       |
| 17        | 108.61      | 29.42       |
| 18        | 112.87      | 32.05       |
| 19        | 117.00      | 34.87       |
| 20        | 121.00      | 37.86       |
| 21        | 124.87      | 41.03       |
| 22        | 128.60      | 44.36       |
| 23        | 132.17      | 47.86       |
| 24        | 135.59      | 51.51       |
| 25        | 138.84      | 55.31       |
| 26        | 141.92      | 59.24       |
| 27        | 144.83      | 63.31       |
| 28        | 147.55      | 67.51       |
| 29        | 150.08      | 71.82       |
| 30        | 152.43      | 76.24       |

31            153.97            Profile.out  
79.50

Circle Center At X = 51.2 ; Y = 127.0 and Radius, 113.2

\*\*\*        1.299        \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.50       | 15.54       |
| 2         | 36.38       | 14.46       |
| 3         | 41.31       | 13.62       |
| 4         | 46.27       | 13.01       |
| 5         | 51.26       | 12.64       |
| 6         | 56.26       | 12.51       |
| 7         | 61.26       | 12.63       |
| 8         | 66.25       | 12.98       |
| 9         | 71.21       | 13.57       |
| 10        | 76.14       | 14.39       |
| 11        | 81.03       | 15.46       |
| 12        | 85.86       | 16.75       |
| 13        | 90.62       | 18.28       |
| 14        | 95.30       | 20.03       |
| 15        | 99.89       | 22.01       |
| 16        | 104.39      | 24.20       |
| 17        | 108.77      | 26.60       |
| 18        | 113.03      | 29.22       |
| 19        | 117.17      | 32.03       |
| 20        | 121.16      | 35.04       |
| 21        | 125.00      | 38.24       |
| 22        | 128.69      | 41.62       |
| 23        | 132.21      | 45.17       |
| 24        | 135.55      | 48.88       |
| 25        | 138.72      | 52.76       |
| 26        | 141.69      | 56.78       |
| 27        | 144.47      | 60.93       |
| 28        | 147.05      | 65.22       |
| 29        | 149.41      | 69.62       |
| 30        | 151.57      | 74.14       |
| 31        | 153.50      | 78.75       |
| 32        | 153.77      | 79.48       |

Circle Center At X = 56.4 ; Y = 116.8 and Radius, 104.2

\*\*\*        1.304        \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.50       | 15.54       |
| 2         | 36.45       | 14.85       |

|    |        | Profile.out |
|----|--------|-------------|
| 3  | 41.43  | 14.38       |
| 4  | 46.42  | 14.13       |
| 5  | 51.42  | 14.09       |
| 6  | 56.42  | 14.27       |
| 7  | 61.41  | 14.66       |
| 8  | 66.37  | 15.28       |
| 9  | 71.30  | 16.10       |
| 10 | 76.19  | 17.14       |
| 11 | 81.03  | 18.39       |
| 12 | 85.81  | 19.85       |
| 13 | 90.53  | 21.52       |
| 14 | 95.17  | 23.39       |
| 15 | 99.72  | 25.45       |
| 16 | 104.18 | 27.72       |
| 17 | 108.53 | 30.17       |
| 18 | 112.78 | 32.81       |
| 19 | 116.90 | 35.64       |
| 20 | 120.91 | 38.64       |
| 21 | 124.77 | 41.81       |
| 22 | 128.50 | 45.14       |
| 23 | 132.07 | 48.63       |
| 24 | 135.50 | 52.28       |
| 25 | 138.76 | 56.07       |
| 26 | 141.85 | 60.00       |
| 27 | 144.77 | 64.05       |
| 28 | 147.51 | 68.24       |
| 29 | 150.07 | 72.53       |
| 30 | 152.44 | 76.94       |
| 31 | 153.66 | 79.47       |

Circle Center At X = 49.8 ; Y = 129.3 and Radius, 115.2

\*\*\* 1.304 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 32.25       | 15.65       |
| 2         | 37.12       | 14.50       |
| 3         | 42.03       | 13.59       |
| 4         | 46.99       | 12.93       |
| 5         | 51.97       | 12.52       |
| 6         | 56.97       | 12.35       |
| 7         | 61.97       | 12.43       |
| 8         | 66.96       | 12.76       |
| 9         | 71.93       | 13.34       |
| 10        | 76.86       | 14.16       |
| 11        | 81.74       | 15.22       |
| 12        | 86.57       | 16.53       |
| 13        | 91.33       | 18.07       |
| 14        | 96.00       | 19.85       |
| 15        | 100.58      | 21.85       |
| 16        | 105.06      | 24.08       |
| 17        | 109.41      | 26.53       |
| 18        | 113.65      | 29.19       |
| 19        | 117.74      | 32.06       |
| 20        | 121.69      | 35.13       |



|    |        | Profile.out |
|----|--------|-------------|
| 21 | 125.48 | 38.39       |
| 22 | 129.11 | 41.83       |
| 23 | 132.56 | 45.45       |
| 24 | 135.83 | 49.24       |
| 25 | 138.90 | 53.18       |
| 26 | 141.78 | 57.27       |
| 27 | 144.45 | 61.50       |
| 28 | 146.90 | 65.85       |
| 29 | 149.14 | 70.32       |
| 30 | 151.16 | 74.90       |
| 31 | 152.87 | 79.39       |

Circle Center At X = 57.8 ; Y = 113.2 and Radius, 100.9

\*\*\* 1.307 \*\*\*

Failure surface specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 32.25       | 15.65       |
| 2         | 37.23       | 15.18       |
| 3         | 42.22       | 14.93       |
| 4         | 47.22       | 14.87       |
| 5         | 52.22       | 15.03       |
| 6         | 57.21       | 15.39       |
| 7         | 62.17       | 15.95       |
| 8         | 67.12       | 16.72       |
| 9         | 72.02       | 17.69       |
| 10        | 76.88       | 18.87       |
| 11        | 81.69       | 20.24       |
| 12        | 86.44       | 21.81       |
| 13        | 91.12       | 23.57       |
| 14        | 95.72       | 25.52       |
| 15        | 100.24      | 27.66       |
| 16        | 104.66      | 29.99       |
| 17        | 108.99      | 32.49       |
| 18        | 113.21      | 35.18       |
| 19        | 117.32      | 38.03       |
| 20        | 121.30      | 41.05       |
| 21        | 125.16      | 44.23       |
| 22        | 128.88      | 47.57       |
| 23        | 132.47      | 51.05       |
| 24        | 135.90      | 54.69       |
| 25        | 139.19      | 58.46       |
| 26        | 142.31      | 62.36       |
| 27        | 145.28      | 66.39       |
| 28        | 148.07      | 70.53       |
| 29        | 150.69      | 74.79       |
| 30        | 153.14      | 79.15       |
| 31        | 153.28      | 79.43       |

Circle Center At X = 46.0 ; Y = 136.3 and Radius, 121.5

\*\*\* 1.312 \*\*\*

Profile.out

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 33.00       | 15.75       |
| 2         | 37.77       | 14.25       |
| 3         | 42.61       | 13.00       |
| 4         | 47.51       | 12.01       |
| 5         | 52.46       | 11.29       |
| 6         | 57.44       | 10.83       |
| 7         | 62.43       | 10.63       |
| 8         | 67.43       | 10.70       |
| 9         | 72.42       | 11.04       |
| 10        | 77.39       | 11.65       |
| 11        | 82.31       | 12.52       |
| 12        | 87.18       | 13.64       |
| 13        | 91.98       | 15.03       |
| 14        | 96.71       | 16.67       |
| 15        | 101.34      | 18.56       |
| 16        | 105.86      | 20.70       |
| 17        | 110.26      | 23.07       |
| 18        | 114.53      | 25.68       |
| 19        | 118.65      | 28.51       |
| 20        | 122.62      | 31.55       |
| 21        | 126.41      | 34.80       |
| 22        | 130.03      | 38.25       |
| 23        | 133.47      | 41.89       |
| 24        | 136.70      | 45.70       |
| 25        | 139.72      | 49.68       |
| 26        | 142.53      | 53.82       |
| 27        | 145.11      | 58.10       |
| 28        | 147.46      | 62.51       |
| 29        | 149.58      | 67.05       |
| 30        | 151.44      | 71.68       |
| 31        | 153.06      | 76.42       |
| 32        | 153.93      | 79.49       |

Circle Center At X = 63.6 ; Y = 104.4 and Radius, 93.8

\*\*\* 1.322 \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 32.25       | 15.65       |
| 2         | 37.03       | 14.18       |
| 3         | 41.88       | 12.96       |
| 4         | 46.79       | 12.01       |
| 5         | 51.74       | 11.31       |
| 6         | 56.72       | 10.87       |
| 7         | 61.72       | 10.70       |
| 8         | 66.72       | 10.79       |
| 9         | 71.70       | 11.14       |
| 10        | 76.67       | 11.75       |

|    |        | Profile.out |
|----|--------|-------------|
| 11 | 81.59  | 12.62       |
| 12 | 86.46  | 13.76       |
| 13 | 91.26  | 15.14       |
| 14 | 95.99  | 16.78       |
| 15 | 100.62 | 18.66       |
| 16 | 105.15 | 20.78       |
| 17 | 109.56 | 23.14       |
| 18 | 113.83 | 25.73       |
| 19 | 117.97 | 28.54       |
| 20 | 121.95 | 31.56       |
| 21 | 125.77 | 34.79       |
| 22 | 129.42 | 38.21       |
| 23 | 132.88 | 41.82       |
| 24 | 136.14 | 45.61       |
| 25 | 139.20 | 49.56       |
| 26 | 142.05 | 53.67       |
| 27 | 144.68 | 57.93       |
| 28 | 147.08 | 62.31       |
| 29 | 149.24 | 66.82       |
| 30 | 151.17 | 71.43       |
| 31 | 152.85 | 76.14       |
| 32 | 153.85 | 79.49       |

Circle Center At X = 62.5 ; Y = 105.7 and Radius, 95.1

\*\*\* 1.323 \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 30.00       | 15.33       |
| 2         | 34.81       | 13.96       |
| 3         | 39.68       | 12.84       |
| 4         | 44.61       | 11.97       |
| 5         | 49.57       | 11.35       |
| 6         | 54.55       | 10.98       |
| 7         | 59.55       | 10.87       |
| 8         | 64.55       | 11.00       |
| 9         | 69.54       | 11.39       |
| 10        | 74.49       | 12.04       |
| 11        | 79.41       | 12.93       |
| 12        | 84.28       | 14.07       |
| 13        | 89.09       | 15.46       |
| 14        | 93.81       | 17.09       |
| 15        | 98.45       | 18.95       |
| 16        | 102.99      | 21.05       |
| 17        | 107.42      | 23.38       |
| 18        | 111.72      | 25.92       |
| 19        | 115.89      | 28.68       |
| 20        | 119.91      | 31.65       |
| 21        | 123.78      | 34.82       |
| 22        | 127.48      | 38.18       |
| 23        | 131.01      | 41.73       |
| 24        | 134.35      | 45.45       |
| 25        | 137.50      | 49.33       |
| 26        | 140.45      | 53.37       |
| 27        | 143.19      | 57.55       |

|    |        | Profile.out |
|----|--------|-------------|
| 28 | 145.71 | 61.86       |
| 29 | 148.02 | 66.30       |
| 30 | 150.09 | 70.85       |
| 31 | 151.94 | 75.50       |
| 32 | 153.27 | 79.43       |

Circle Center At X = 59.3 ; Y = 109.5 and Radius, 98.6

\*\*\* 1.331 \*\*\*

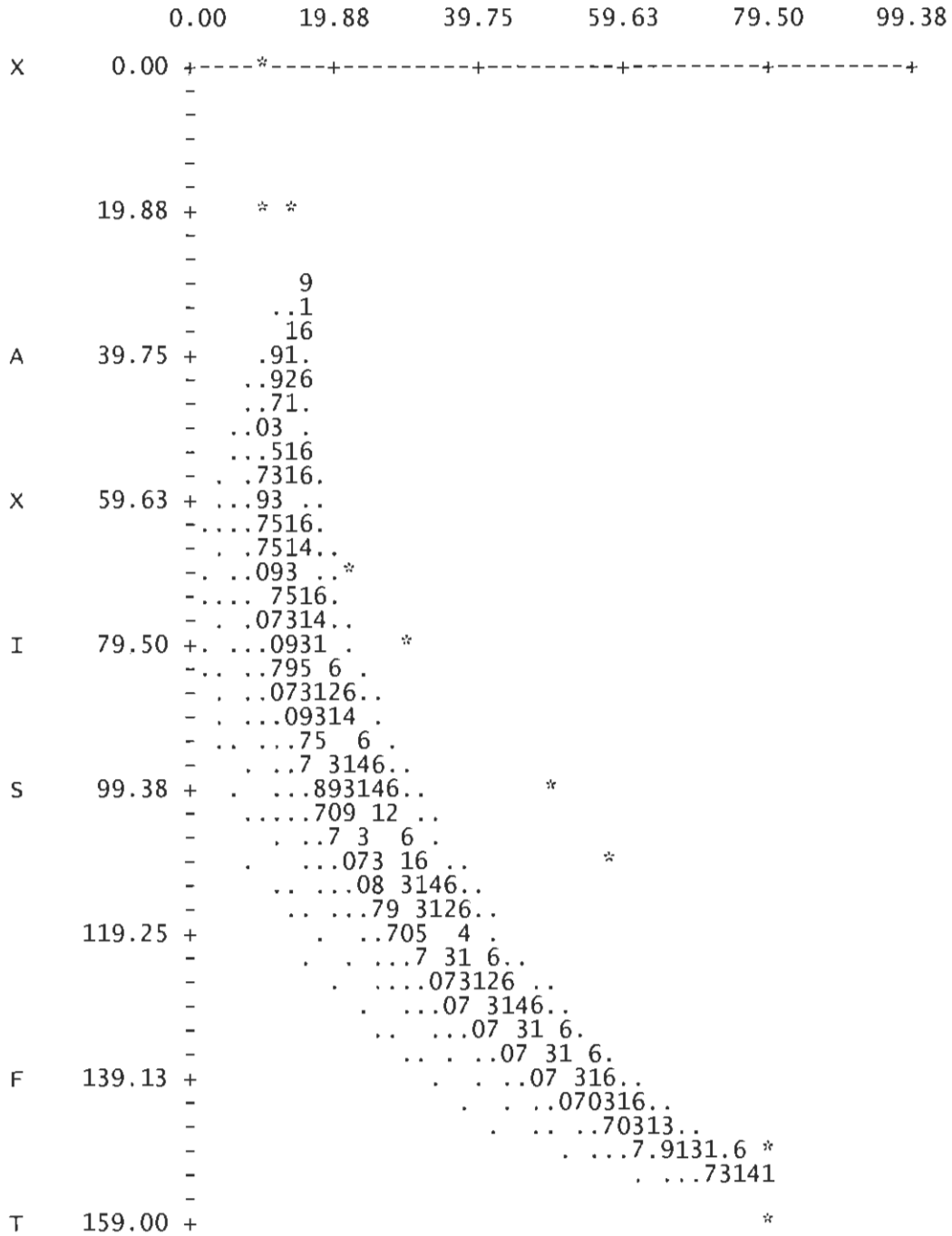
Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 30.75       | 15.44       |
| 2         | 35.50       | 13.88       |
| 3         | 40.33       | 12.58       |
| 4         | 45.22       | 11.54       |
| 5         | 50.16       | 10.75       |
| 6         | 55.13       | 10.23       |
| 7         | 60.13       | 9.97        |
| 8         | 65.13       | 9.98        |
| 9         | 70.12       | 10.25       |
| 10        | 75.09       | 10.78       |
| 11        | 80.03       | 11.57       |
| 12        | 84.91       | 12.62       |
| 13        | 89.74       | 13.93       |
| 14        | 94.49       | 15.50       |
| 15        | 99.15       | 17.31       |
| 16        | 103.71      | 19.36       |
| 17        | 108.15      | 21.65       |
| 18        | 112.47      | 24.18       |
| 19        | 116.65      | 26.92       |
| 20        | 120.67      | 29.89       |
| 21        | 124.54      | 33.06       |
| 22        | 128.23      | 36.43       |
| 23        | 131.74      | 40.00       |
| 24        | 135.05      | 43.74       |
| 25        | 138.17      | 47.65       |
| 26        | 141.07      | 51.72       |
| 27        | 143.75      | 55.94       |
| 28        | 146.21      | 60.30       |
| 29        | 148.43      | 64.77       |
| 30        | 150.42      | 69.36       |
| 31        | 152.16      | 74.05       |
| 32        | 153.65      | 78.82       |
| 33        | 153.81      | 79.48       |

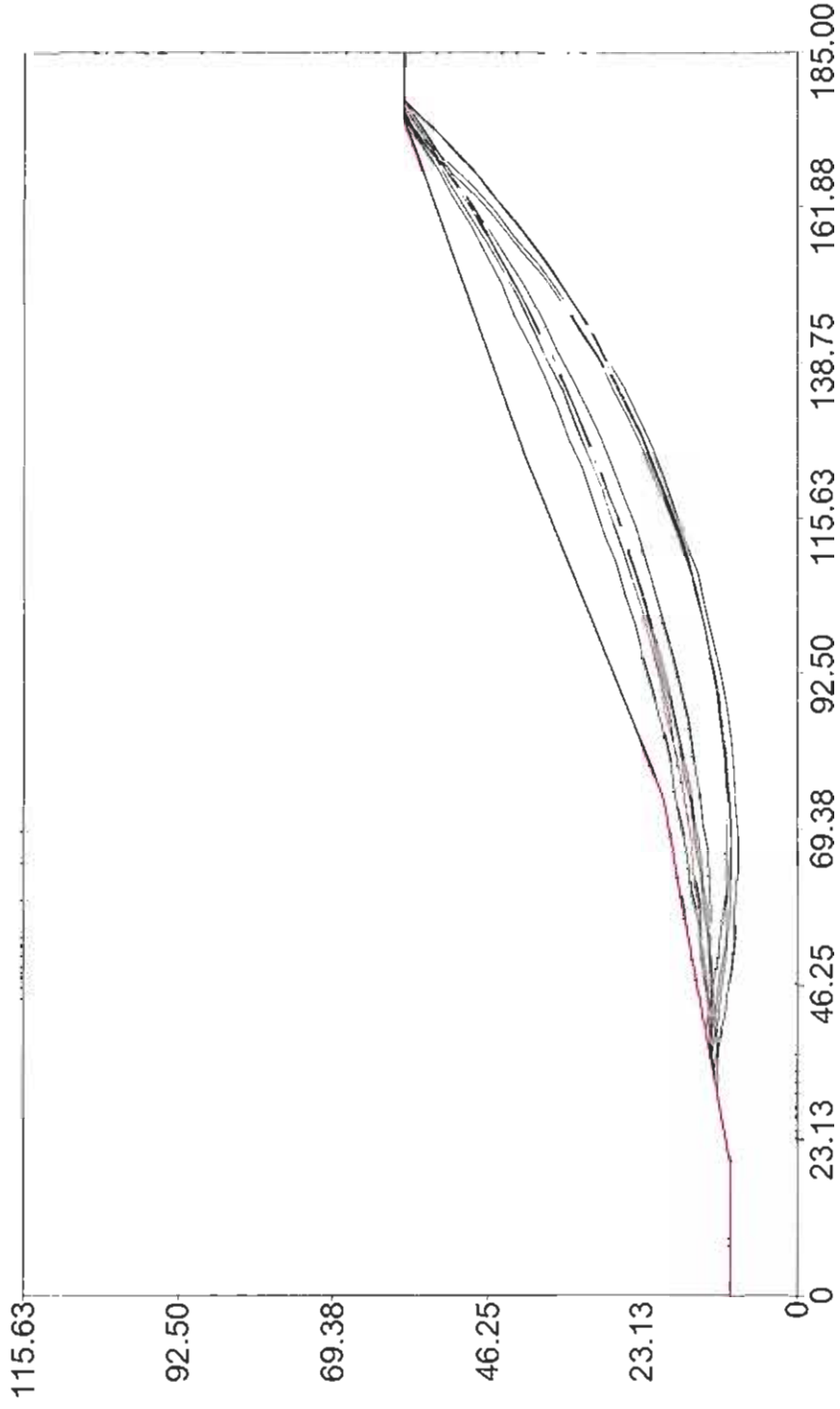
Circle Center At X = 62.5 ; Y = 104.6 and Radius, 94.7

\*\*\* 1.339 \*\*\*

Profile.out



Cross Section C-C' (0.2g)



Safety Factors

|      |
|------|
| 1.32 |
| 1.33 |
| 1.33 |
| 1.33 |
| 1.34 |
| 1.36 |
| 1.36 |
| 1.37 |
| 1.37 |
| 1.37 |

Profile.out  
\*\* PCSTABL6 \*\*

by  
Purdue University

modified by  
Peter J. Bosscher  
University of Wisconsin-Madison

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

PROBLEM DESCRIPTION Cross Section C-C' (0.2g)

BOUNDARY COORDINATES

5 Top Boundaries  
5 Total Boundaries

| Boundary No. | X-Left (ft) | Y-Left (ft) | X-Right (ft) | Y-Right (ft) | Soil Type Below Bnd |
|--------------|-------------|-------------|--------------|--------------|---------------------|
| 1            | 0.00        | 10.00       | 20.00        | 10.00        | 2                   |
| 2            | 20.00       | 10.00       | 74.00        | 20.00        | 2                   |
| 3            | 74.00       | 20.00       | 125.00       | 41.00        | 2                   |
| 4            | 125.00      | 41.00       | 175.00       | 59.00        | 1                   |
| 5            | 175.00      | 59.00       | 185.00       | 59.00        | 1                   |

ISOTROPIC SOIL PARAMETERS

2 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             | 110.0                | 110.0                    | 0.0                      | 32.0                 | 0.00                 | 0.0                     | 0                 |
| 2             | 120.0                | 120.0                    | 100.0                    | 34.0                 | 0.00                 | 0.0                     | 0                 |

A Horizontal Earthquake Loading Coefficient  
of 0.200 Has Been Assigned

Profile.out

A Vertical Earthquake Loading Coefficient  
Of 0.000 Has Been Assigned

Cavitation Pressure = 0.0 psf

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

25 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 5 Points Equally Spaced  
Along The Ground Surface Between X = 31.00 ft.  
and X = 40.00 ft.

Each Surface Terminates Between X = 169.00 ft.  
and X = 178.00 ft.

Unless Further Limitations Were Imposed, The Minimum Elevation  
At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

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 Bishop Method \* \*

Failure Surface Specified By 31 Coordinate Points

| Point<br>No. | X-Surf<br>(ft) | Y-Surf<br>(ft) |
|--------------|----------------|----------------|
| 1            | 37.75          | 13.29          |
| 2            | 42.75          | 13.50          |
| 3            | 47.74          | 13.81          |
| 4            | 52.72          | 14.22          |
| 5            | 57.70          | 14.71          |
| 6            | 62.66          | 15.30          |
| 7            | 67.61          | 15.99          |
| 8            | 72.55          | 16.76          |
| 9            | 77.48          | 17.63          |
| 10           | 82.38          | 18.60          |
| 11           | 87.27          | 19.65          |
| 12           | 92.14          | 20.80          |
| 13           | 96.98          | 22.04          |
| 14           | 101.80         | 23.37          |
| 15           | 106.59         | 24.79          |
| 16           | 111.36         | 26.30          |



|    |        | Profile.out |
|----|--------|-------------|
| 17 | 116.10 | 27.90       |
| 18 | 120.81 | 29.59       |
| 19 | 125.48 | 31.36       |
| 20 | 130.12 | 33.23       |
| 21 | 134.72 | 35.18       |
| 22 | 139.29 | 37.22       |
| 23 | 143.81 | 39.34       |
| 24 | 148.30 | 41.55       |
| 25 | 152.74 | 43.84       |
| 26 | 157.14 | 46.22       |
| 27 | 161.50 | 48.67       |
| 28 | 165.80 | 51.21       |
| 29 | 170.06 | 53.83       |
| 30 | 174.27 | 56.54       |
| 31 | 177.96 | 59.00       |

Circle Center At X = 28.8 ; Y = 278.6 and Radius, 265.5

\*\*\* 1.319 \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 35.50       | 12.87       |
| 2         | 40.50       | 12.67       |
| 3         | 45.50       | 12.59       |
| 4         | 50.50       | 12.64       |
| 5         | 55.49       | 12.80       |
| 6         | 60.48       | 13.09       |
| 7         | 65.47       | 13.51       |
| 8         | 70.44       | 14.04       |
| 9         | 75.40       | 14.70       |
| 10        | 80.33       | 15.48       |
| 11        | 85.25       | 16.37       |
| 12        | 90.15       | 17.39       |
| 13        | 95.02       | 18.53       |
| 14        | 99.86       | 19.79       |
| 15        | 104.66      | 21.17       |
| 16        | 109.43      | 22.66       |
| 17        | 114.17      | 24.27       |
| 18        | 118.86      | 26.00       |
| 19        | 123.51      | 27.84       |
| 20        | 128.11      | 29.79       |
| 21        | 132.67      | 31.86       |
| 22        | 137.17      | 34.03       |
| 23        | 141.61      | 36.32       |
| 24        | 146.00      | 38.72       |
| 25        | 150.33      | 41.22       |
| 26        | 154.60      | 43.83       |
| 27        | 158.80      | 46.54       |
| 28        | 162.93      | 49.35       |
| 29        | 166.99      | 52.27       |
| 30        | 170.98      | 55.28       |
| 31        | 174.90      | 58.39       |
| 32        | 175.62      | 59.00       |

Circle Center At X = 46.2 ; Y = 216.4 and Radius, 203.8

Profile.out

\*\*\* 1.326 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 37.75       | 13.29       |
| 2         | 42.75       | 13.47       |
| 3         | 47.74       | 13.75       |
| 4         | 52.72       | 14.13       |
| 5         | 57.70       | 14.61       |
| 6         | 62.67       | 15.19       |
| 7         | 67.62       | 15.86       |
| 8         | 72.56       | 16.63       |
| 9         | 77.49       | 17.50       |
| 10        | 82.39       | 18.47       |
| 11        | 87.28       | 19.53       |
| 12        | 92.14       | 20.69       |
| 13        | 96.98       | 21.94       |
| 14        | 101.80      | 23.29       |
| 15        | 106.59      | 24.73       |
| 16        | 111.34      | 26.27       |
| 17        | 116.07      | 27.90       |
| 18        | 120.76      | 29.62       |
| 19        | 125.42      | 31.44       |
| 20        | 130.04      | 33.34       |
| 21        | 134.63      | 35.34       |
| 22        | 139.17      | 37.43       |
| 23        | 143.67      | 39.60       |
| 24        | 148.13      | 41.87       |
| 25        | 152.54      | 44.22       |
| 26        | 156.91      | 46.66       |
| 27        | 161.22      | 49.18       |
| 28        | 165.49      | 51.79       |
| 29        | 169.70      | 54.48       |
| 30        | 173.86      | 57.26       |
| 31        | 176.36      | 59.00       |

Circle Center At X = 30.9 ; Y = 267.0 and Radius, 253.8

\*\*\* 1.326 \*\*\*

Failure Surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 33.25       | 12.45       |
| 2         | 38.25       | 12.55       |
| 3         | 43.25       | 12.74       |
| 4         | 48.24       | 13.03       |
| 5         | 53.22       | 13.42       |
| 6         | 58.20       | 13.91       |

|    |        | Profile.out |
|----|--------|-------------|
| 7  | 63.16  | 14.50       |
| 8  | 68.12  | 15.19       |
| 9  | 73.05  | 15.97       |
| 10 | 77.98  | 16.85       |
| 11 | 82.88  | 17.83       |
| 12 | 87.76  | 18.91       |
| 13 | 92.62  | 20.08       |
| 14 | 97.46  | 21.35       |
| 15 | 102.27 | 22.71       |
| 16 | 107.05 | 24.17       |
| 17 | 111.80 | 25.72       |
| 18 | 116.53 | 27.37       |
| 19 | 121.21 | 29.11       |
| 20 | 125.86 | 30.94       |
| 21 | 130.48 | 32.87       |
| 22 | 135.06 | 34.88       |
| 23 | 139.59 | 36.99       |
| 24 | 144.08 | 39.19       |
| 25 | 148.53 | 41.47       |
| 26 | 152.93 | 43.84       |
| 27 | 157.29 | 46.30       |
| 28 | 161.59 | 48.84       |
| 29 | 165.84 | 51.47       |
| 30 | 170.04 | 54.18       |
| 31 | 174.19 | 56.98       |
| 32 | 177.06 | 59.00       |

Circle Center At X = 31.0 ; Y = 264.9 and Radius, 252.4

\*\*\* 1.332 \*\*\*

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.00       | 12.04       |
| 2         | 36.00       | 12.11       |
| 3         | 41.00       | 12.29       |
| 4         | 45.99       | 12.56       |
| 5         | 50.98       | 12.92       |
| 6         | 55.95       | 13.39       |
| 7         | 60.92       | 13.95       |
| 8         | 65.88       | 14.60       |
| 9         | 70.82       | 15.36       |
| 10        | 75.75       | 16.21       |
| 11        | 80.66       | 17.15       |
| 12        | 85.55       | 18.19       |
| 13        | 90.42       | 19.33       |
| 14        | 95.27       | 20.56       |
| 15        | 100.09      | 21.88       |
| 16        | 104.88      | 23.30       |
| 17        | 109.65      | 24.81       |
| 18        | 114.39      | 26.41       |
| 19        | 119.09      | 28.10       |
| 20        | 123.76      | 29.89       |
| 21        | 128.40      | 31.76       |
| 22        | 132.99      | 33.73       |
| 23        | 137.55      | 35.78       |

|    |        | Profile.out |
|----|--------|-------------|
| 24 | 142.07 | 37.92       |
| 25 | 146.55 | 40.15       |
| 26 | 150.98 | 42.47       |
| 27 | 155.36 | 44.87       |
| 28 | 159.70 | 47.36       |
| 29 | 163.99 | 49.93       |
| 30 | 168.23 | 52.58       |
| 31 | 172.41 | 55.32       |
| 32 | 176.54 | 58.13       |
| 33 | 177.76 | 59.00       |

Circle Center At x = 29.6 ; Y = 269.3 and Radius, 257.2

\*\*\* 1.335 \*\*\*

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 35.50       | 12.87       |
| 2         | 40.42       | 11.99       |
| 3         | 45.37       | 11.26       |
| 4         | 50.34       | 10.70       |
| 5         | 55.32       | 10.29       |
| 6         | 60.31       | 10.05       |
| 7         | 65.31       | 9.97        |
| 8         | 70.31       | 10.06       |
| 9         | 75.31       | 10.30       |
| 10        | 80.29       | 10.71       |
| 11        | 85.26       | 11.28       |
| 12        | 90.20       | 12.01       |
| 13        | 95.13       | 12.89       |
| 14        | 100.01      | 13.94       |
| 15        | 104.87      | 15.15       |
| 16        | 109.68      | 16.51       |
| 17        | 114.44      | 18.03       |
| 18        | 119.15      | 19.70       |
| 19        | 123.81      | 21.53       |
| 20        | 128.40      | 23.50       |
| 21        | 132.93      | 25.62       |
| 22        | 137.39      | 27.89       |
| 23        | 141.77      | 30.30       |
| 24        | 146.07      | 32.85       |
| 25        | 150.28      | 35.54       |
| 26        | 154.41      | 38.37       |
| 27        | 158.44      | 41.33       |
| 28        | 162.37      | 44.41       |
| 29        | 166.20      | 47.63       |
| 30        | 169.93      | 50.96       |
| 31        | 173.54      | 54.42       |
| 32        | 177.04      | 57.99       |
| 33        | 177.97      | 59.00       |

Circle Center At x = 65.3 ; Y = 164.1 and Radius, 154.2

\*\*\* 1.358 \*\*\*

Profile.out

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 40.00       | 13.70       |
| 2         | 44.91       | 12.75       |
| 3         | 49.85       | 11.97       |
| 4         | 54.81       | 11.37       |
| 5         | 59.79       | 10.95       |
| 6         | 64.79       | 10.70       |
| 7         | 69.79       | 10.64       |
| 8         | 74.79       | 10.75       |
| 9         | 79.78       | 11.04       |
| 10        | 84.76       | 11.51       |
| 11        | 89.71       | 12.15       |
| 12        | 94.65       | 12.97       |
| 13        | 99.55       | 13.97       |
| 14        | 104.41      | 15.14       |
| 15        | 109.22      | 16.48       |
| 16        | 113.99      | 18.00       |
| 17        | 118.70      | 19.68       |
| 18        | 123.34      | 21.53       |
| 19        | 127.92      | 23.55       |
| 20        | 132.42      | 25.72       |
| 21        | 136.84      | 28.06       |
| 22        | 141.17      | 30.55       |
| 23        | 145.42      | 33.20       |
| 24        | 149.56      | 35.99       |
| 25        | 153.61      | 38.93       |
| 26        | 157.54      | 42.02       |
| 27        | 161.37      | 45.24       |
| 28        | 165.07      | 48.59       |
| 29        | 168.66      | 52.08       |
| 30        | 172.11      | 55.69       |
| 31        | 175.06      | 59.00       |

Circle Center At X = 69.2 ; Y = 150.8 and Radius, 140.2

\*\*\* 1.362 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 35.50       | 12.87       |
| 2         | 40.49       | 13.25       |
| 3         | 45.46       | 13.72       |
| 4         | 50.43       | 14.27       |
| 5         | 55.39       | 14.90       |
| 6         | 60.34       | 15.62       |
| 7         | 65.28       | 16.41       |
| 8         | 70.20       | 17.29       |
| 9         | 75.11       | 18.25       |
| 10        | 80.00       | 19.30       |

|    |        | Profile.out |
|----|--------|-------------|
| 11 | 84.87  | 20.42       |
| 12 | 89.72  | 21.63       |
| 13 | 94.55  | 22.91       |
| 14 | 99.36  | 24.28       |
| 15 | 104.15 | 25.72       |
| 16 | 108.91 | 27.25       |
| 17 | 113.65 | 28.85       |
| 18 | 118.36 | 30.53       |
| 19 | 123.04 | 32.30       |
| 20 | 127.69 | 34.13       |
| 21 | 132.30 | 36.05       |
| 22 | 136.89 | 38.04       |
| 23 | 141.44 | 40.11       |
| 24 | 145.96 | 42.26       |
| 25 | 150.44 | 44.47       |
| 26 | 154.88 | 46.77       |
| 27 | 159.29 | 49.13       |
| 28 | 163.65 | 51.57       |
| 29 | 167.97 | 54.09       |
| 30 | 172.25 | 56.67       |
| 31 | 175.97 | 59.00       |

Circle Center At X = 14.9 ; Y = 312.4 and Radius, 300.3

\*\*\* 1.367 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 37.75       | 13.29       |
| 2         | 42.66       | 12.34       |
| 3         | 47.60       | 11.58       |
| 4         | 52.57       | 10.98       |
| 5         | 57.55       | 10.56       |
| 6         | 62.54       | 10.32       |
| 7         | 67.54       | 10.26       |
| 8         | 72.54       | 10.37       |
| 9         | 77.53       | 10.65       |
| 10        | 82.51       | 11.11       |
| 11        | 87.47       | 11.75       |
| 12        | 92.40       | 12.56       |
| 13        | 97.31       | 13.55       |
| 14        | 102.17      | 14.71       |
| 15        | 106.99      | 16.03       |
| 16        | 111.76      | 17.53       |
| 17        | 116.48      | 19.19       |
| 18        | 121.13      | 21.02       |
| 19        | 125.72      | 23.02       |
| 20        | 130.23      | 25.17       |
| 21        | 134.66      | 27.48       |
| 22        | 139.01      | 29.95       |
| 23        | 143.27      | 32.56       |
| 24        | 147.44      | 35.33       |
| 25        | 151.50      | 38.24       |
| 26        | 155.46      | 41.29       |
| 27        | 159.31      | 44.48       |
| 28        | 163.05      | 47.81       |

|    |        |             |
|----|--------|-------------|
|    |        | Profile.out |
| 29 | 166.66 | 51.26       |
| 30 | 170.15 | 54.84       |
| 31 | 173.42 | 58.43       |

Circle Center At X = 66.9 ; Y = 152.1 and Radius, 141.8

\*\*\* 1.370 \*\*\*

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 33.25       | 12.45       |
| 2         | 38.16       | 11.49       |
| 3         | 43.09       | 10.69       |
| 4         | 48.05       | 10.05       |
| 5         | 53.03       | 9.58        |
| 6         | 58.02       | 9.27        |
| 7         | 63.02       | 9.12        |
| 8         | 68.02       | 9.13        |
| 9         | 73.01       | 9.31        |
| 10        | 78.00       | 9.65        |
| 11        | 82.98       | 10.16       |
| 12        | 87.93       | 10.83       |
| 13        | 92.86       | 11.66       |
| 14        | 97.76       | 12.65       |
| 15        | 102.63      | 13.80       |
| 16        | 107.46      | 15.10       |
| 17        | 112.24      | 16.57       |
| 18        | 116.97      | 18.19       |
| 19        | 121.64      | 19.97       |
| 20        | 126.25      | 21.89       |
| 21        | 130.80      | 23.97       |
| 22        | 135.28      | 26.20       |
| 23        | 139.68      | 28.57       |
| 24        | 144.00      | 31.08       |
| 25        | 148.24      | 33.74       |
| 26        | 152.39      | 36.53       |
| 27        | 156.44      | 39.45       |
| 28        | 160.40      | 42.51       |
| 29        | 164.26      | 45.69       |
| 30        | 168.01      | 49.00       |
| 31        | 171.64      | 52.43       |
| 32        | 175.17      | 55.98       |
| 33        | 177.98      | 59.00       |

Circle Center At X = 65.1 ; Y = 161.9 and Radius, 152.8

\*\*\* 1.371 \*\*\*

Y A X I S F T

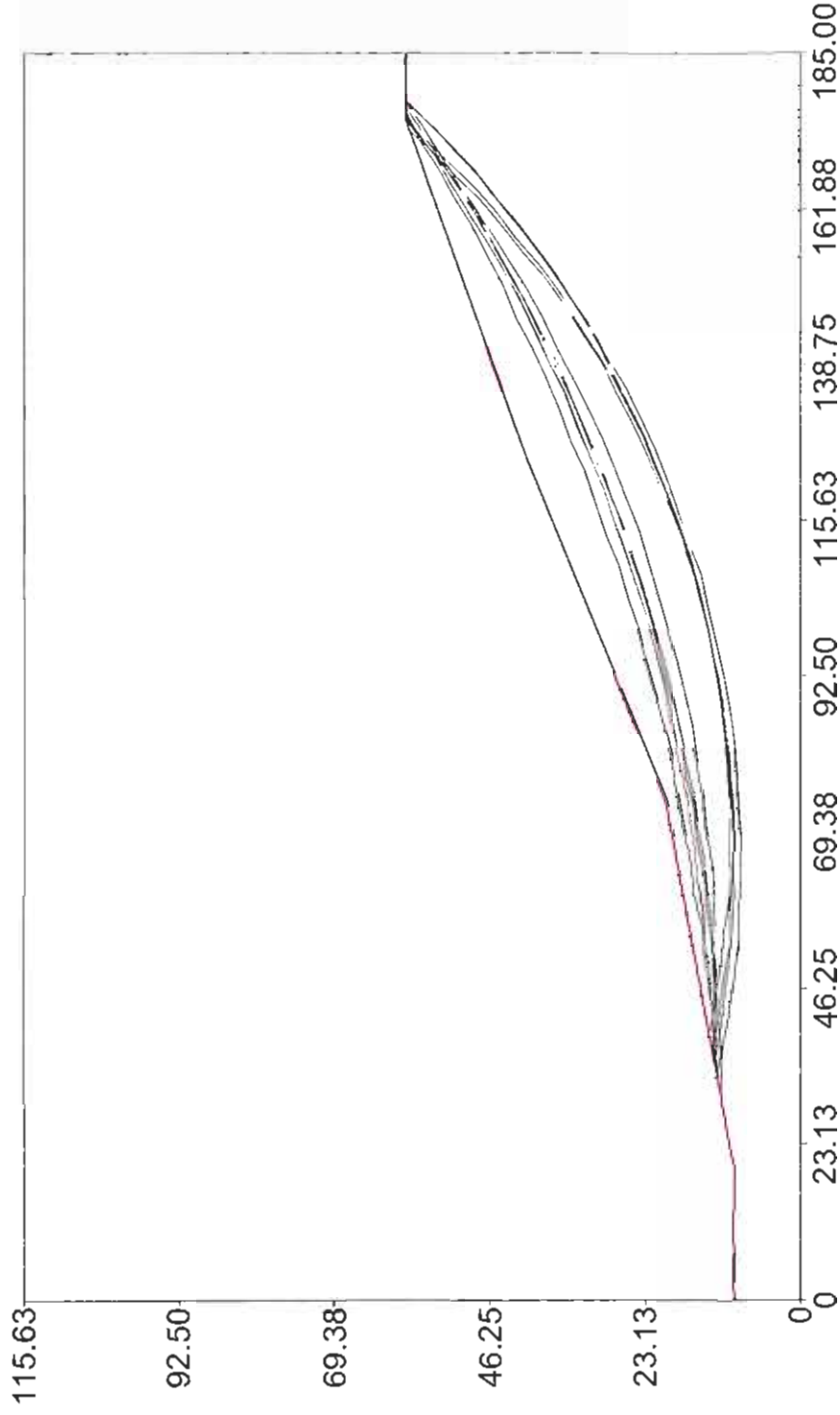
Profile.out

|   | 0.00   | 23.13          | 46.25  | 69.38  | 92.50  | 115.63 |
|---|--------|----------------|--------|--------|--------|--------|
| X | 0.00   | +-----*        | +----- | +----- | +----- | +----- |
|   |        | -              |        |        |        |        |
|   |        | -              |        |        |        |        |
|   |        | -              |        |        |        |        |
|   |        | -              | *      |        |        |        |
|   | 23.13  | +              |        |        |        |        |
|   |        | -              |        |        |        |        |
|   |        | -              | 5      |        |        |        |
|   |        | -              | .42    |        |        |        |
|   |        | -              | .41    |        |        |        |
|   |        | -              | .21    |        |        |        |
| A | 46.25  | + .021         |        |        |        |        |
|   |        | - ...24        |        |        |        |        |
|   |        | - ..671        |        |        |        |        |
|   |        | -...091        |        |        |        |        |
|   |        | -...6721       |        |        |        |        |
|   |        | -...6728       |        |        |        |        |
| X | 69.38  | ....6721       |        |        |        |        |
|   |        | -...97 18*     |        |        |        |        |
|   |        | ....69241      |        |        |        |        |
|   |        | .....6 21      |        |        |        |        |
|   |        | . ..06 248     |        |        |        |        |
|   |        | . ...6 18      |        |        |        |        |
| I | 92.50  | . ...9 1       |        |        |        |        |
|   |        | . ...06 231    |        |        |        |        |
|   |        | -.....6 21     |        |        |        |        |
|   |        | .. ...96 248   |        |        |        |        |
|   |        | - . ....6 218  |        |        |        |        |
|   |        | -.....09 18    |        |        |        |        |
| S | 115.63 | + .....6 251   |        |        |        |        |
|   |        | - ..... 6 251  |        |        |        |        |
|   |        | - .....6 258 * |        |        |        |        |
|   |        | - .. ...06 218 |        |        |        |        |
|   |        | - .....06 1 8  |        |        |        |        |
|   |        | - .....09 1    |        |        |        |        |
|   | 138.75 | + .....69 21   |        |        |        |        |
|   |        | - .....69 21   |        |        |        |        |
|   |        | - .....69 21   |        |        |        |        |
|   |        | - .....67928   |        |        |        |        |
|   |        | - .....06918   |        |        |        |        |
|   |        | - .....06918   |        |        |        |        |
| F | 161.88 | + .. 06718     |        |        |        |        |
|   |        | - ...0612      |        |        |        |        |
|   |        | - ...0612.     |        |        |        |        |
|   |        | - ..012*       |        |        |        |        |
|   |        | - 51           |        |        |        |        |
|   |        | -              |        |        |        |        |
| T | 185.00 | + *            |        |        |        |        |



# Cross Section C-C'

# Safety Factors



Profile.out  
\*\* PCSTABL6 \*\*

by  
Purdue University

modified by  
Peter J. Bosscher  
University of Wisconsin-Madison

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

PROBLEM DESCRIPTION Cross Section C-C'

BOUNDARY COORDINATES

5 Top Boundaries  
5 Total Boundaries

| Boundary No. | X-Left (ft) | Y-Left (ft) | X-Right (ft) | Y-Right (ft) | Soil Type Below Bnd |
|--------------|-------------|-------------|--------------|--------------|---------------------|
| 1            | 0.00        | 10.00       | 20.00        | 10.00        | 2                   |
| 2            | 20.00       | 10.00       | 74.00        | 20.00        | 2                   |
| 3            | 74.00       | 20.00       | 125.00       | 41.00        | 2                   |
| 4            | 125.00      | 41.00       | 175.00       | 59.00        | 1                   |
| 5            | 175.00      | 59.00       | 185.00       | 59.00        | 1                   |

ISOTROPIC SOIL PARAMETERS

2 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             | 110.0                | 110.0                    | 0.0                      | 32.0                 | 0.00                 | 0.0                     | 0                 |
| 2             | 120.0                | 120.0                    | 100.0                    | 34.0                 | 0.00                 | 0.0                     | 0                 |

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

Profile.out

25 Trial Surfaces Have Been Generated.

5 Surfaces Initiate From Each Of 5 Points Equally Spaced  
Along The Ground Surface Between X = 31.00 ft.  
and X = 40.00 ft.

Each Surface Terminates Between X = 169.00 ft.  
and X = 178.00 ft.

Unless Further Limitations were Imposed, The Minimum Elevation  
At Which A Surface Extends Is Y = 0.00 ft.

5.00 ft. Line Segments Define Each Trial Failure Surface.

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 Bishop Method \* \*

Failure Surface Specified By 31 Coordinate Points

| Point<br>No. | X-Surf<br>(ft) | Y-Surf<br>(ft) |
|--------------|----------------|----------------|
| 1            | 37.75          | 13.29          |
| 2            | 42.75          | 13.50          |
| 3            | 47.74          | 13.81          |
| 4            | 52.72          | 14.22          |
| 5            | 57.70          | 14.71          |
| 6            | 62.66          | 15.30          |
| 7            | 67.61          | 15.99          |
| 8            | 72.55          | 16.76          |
| 9            | 77.48          | 17.63          |
| 10           | 82.38          | 18.60          |
| 11           | 87.27          | 19.65          |
| 12           | 92.14          | 20.80          |
| 13           | 96.98          | 22.04          |
| 14           | 101.80         | 23.37          |
| 15           | 106.59         | 24.79          |
| 16           | 111.36         | 26.30          |
| 17           | 116.10         | 27.90          |
| 18           | 120.81         | 29.59          |
| 19           | 125.48         | 31.36          |
| 20           | 130.12         | 33.23          |
| 21           | 134.72         | 35.18          |
| 22           | 139.29         | 37.22          |
| 23           | 143.81         | 39.34          |
| 24           | 148.30         | 41.55          |
| 25           | 152.74         | 43.84          |
| 26           | 157.14         | 46.22          |

|    |        | Profile.out |
|----|--------|-------------|
| 27 | 161.50 | 48.67       |
| 28 | 165.80 | 51.21       |
| 29 | 170.06 | 53.83       |
| 30 | 174.27 | 56.54       |
| 31 | 177.96 | 59.00       |

Circle Center At X = 28.8 ; Y = 278.6 and Radius, 265.5

\*\*\* 2.165 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 37.75       | 13.29       |
| 2         | 42.75       | 13.47       |
| 3         | 47.74       | 13.75       |
| 4         | 52.72       | 14.13       |
| 5         | 57.70       | 14.61       |
| 6         | 62.67       | 15.19       |
| 7         | 67.62       | 15.86       |
| 8         | 72.56       | 16.63       |
| 9         | 77.49       | 17.50       |
| 10        | 82.39       | 18.47       |
| 11        | 87.28       | 19.53       |
| 12        | 92.14       | 20.69       |
| 13        | 96.98       | 21.94       |
| 14        | 101.80      | 23.29       |
| 15        | 106.59      | 24.73       |
| 16        | 111.34      | 26.27       |
| 17        | 116.07      | 27.90       |
| 18        | 120.76      | 29.62       |
| 19        | 125.42      | 31.44       |
| 20        | 130.04      | 33.34       |
| 21        | 134.63      | 35.34       |
| 22        | 139.17      | 37.43       |
| 23        | 143.67      | 39.60       |
| 24        | 148.13      | 41.87       |
| 25        | 152.54      | 44.22       |
| 26        | 156.91      | 46.66       |
| 27        | 161.22      | 49.18       |
| 28        | 165.49      | 51.79       |
| 29        | 169.70      | 54.48       |
| 30        | 173.86      | 57.26       |
| 31        | 176.36      | 59.00       |

Circle Center At X = 30.9 ; Y = 267.0 and Radius, 253.8

\*\*\* 2.175 \*\*\*

Failure Surface Specified By 32 Coordinate Points

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

Profile.out

|    |        |       |
|----|--------|-------|
| 1  | 35.50  | 12.87 |
| 2  | 40.50  | 12.67 |
| 3  | 45.50  | 12.59 |
| 4  | 50.50  | 12.64 |
| 5  | 55.49  | 12.80 |
| 6  | 60.48  | 13.09 |
| 7  | 65.47  | 13.51 |
| 8  | 70.44  | 14.04 |
| 9  | 75.40  | 14.70 |
| 10 | 80.33  | 15.48 |
| 11 | 85.25  | 16.37 |
| 12 | 90.15  | 17.39 |
| 13 | 95.02  | 18.53 |
| 14 | 99.86  | 19.79 |
| 15 | 104.66 | 21.17 |
| 16 | 109.43 | 22.66 |
| 17 | 114.17 | 24.27 |
| 18 | 118.86 | 26.00 |
| 19 | 123.51 | 27.84 |
| 20 | 128.11 | 29.79 |
| 21 | 132.67 | 31.86 |
| 22 | 137.17 | 34.03 |
| 23 | 141.61 | 36.32 |
| 24 | 146.00 | 38.72 |
| 25 | 150.33 | 41.22 |
| 26 | 154.60 | 43.83 |
| 27 | 158.80 | 46.54 |
| 28 | 162.93 | 49.35 |
| 29 | 166.99 | 52.27 |
| 30 | 170.98 | 55.28 |
| 31 | 174.90 | 58.39 |
| 32 | 175.62 | 59.00 |

Circle Center At X = 46.2 ; Y = 216.4 and Radius, 203.8

\*\*\* 2.185 \*\*\*

Failure surface Specified By 32 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 33.25       | 12.45       |
| 2         | 38.25       | 12.55       |
| 3         | 43.25       | 12.74       |
| 4         | 48.24       | 13.03       |
| 5         | 53.22       | 13.42       |
| 6         | 58.20       | 13.91       |
| 7         | 63.16       | 14.50       |
| 8         | 68.12       | 15.19       |
| 9         | 73.05       | 15.97       |
| 10        | 77.98       | 16.85       |
| 11        | 82.88       | 17.83       |
| 12        | 87.76       | 18.91       |
| 13        | 92.62       | 20.08       |
| 14        | 97.46       | 21.35       |
| 15        | 102.27      | 22.71       |
| 16        | 107.05      | 24.17       |

|    |        | Profile.out |
|----|--------|-------------|
| 17 | 111.80 | 25.72       |
| 18 | 116.53 | 27.37       |
| 19 | 121.21 | 29.11       |
| 20 | 125.86 | 30.94       |
| 21 | 130.48 | 32.87       |
| 22 | 135.06 | 34.88       |
| 23 | 139.59 | 36.99       |
| 24 | 144.08 | 39.19       |
| 25 | 148.53 | 41.47       |
| 26 | 152.93 | 43.84       |
| 27 | 157.29 | 46.30       |
| 28 | 161.59 | 48.84       |
| 29 | 165.84 | 51.47       |
| 30 | 170.04 | 54.18       |
| 31 | 174.19 | 56.98       |
| 32 | 177.06 | 59.00       |

Circle Center At X = 31.0 ; Y = 264.9 and Radius, 252.4

\*\*\* 2.196 \*\*\*

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 31.00       | 12.04       |
| 2         | 36.00       | 12.11       |
| 3         | 41.00       | 12.29       |
| 4         | 45.99       | 12.56       |
| 5         | 50.98       | 12.92       |
| 6         | 55.95       | 13.39       |
| 7         | 60.92       | 13.95       |
| 8         | 65.88       | 14.60       |
| 9         | 70.82       | 15.36       |
| 10        | 75.75       | 16.21       |
| 11        | 80.66       | 17.15       |
| 12        | 85.55       | 18.19       |
| 13        | 90.42       | 19.33       |
| 14        | 95.27       | 20.56       |
| 15        | 100.09      | 21.88       |
| 16        | 104.88      | 23.30       |
| 17        | 109.65      | 24.81       |
| 18        | 114.39      | 26.41       |
| 19        | 119.09      | 28.10       |
| 20        | 123.76      | 29.89       |
| 21        | 128.40      | 31.76       |
| 22        | 132.99      | 33.73       |
| 23        | 137.55      | 35.78       |
| 24        | 142.07      | 37.92       |
| 25        | 146.55      | 40.15       |
| 26        | 150.98      | 42.47       |
| 27        | 155.36      | 44.87       |
| 28        | 159.70      | 47.36       |
| 29        | 163.99      | 49.93       |
| 30        | 168.23      | 52.58       |
| 31        | 172.41      | 55.32       |
| 32        | 176.54      | 58.13       |
| 33        | 177.76      | 59.00       |

Profile.out

Circle Center At X = 29.6 ; Y = 269.3 and Radius, 257.2

\*\*\* 2.206 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 35.50       | 12.87       |
| 2         | 40.49       | 13.25       |
| 3         | 45.46       | 13.72       |
| 4         | 50.43       | 14.27       |
| 5         | 55.39       | 14.90       |
| 6         | 60.34       | 15.62       |
| 7         | 65.28       | 16.41       |
| 8         | 70.20       | 17.29       |
| 9         | 75.11       | 18.25       |
| 10        | 80.00       | 19.30       |
| 11        | 84.87       | 20.42       |
| 12        | 89.72       | 21.63       |
| 13        | 94.55       | 22.91       |
| 14        | 99.36       | 24.28       |
| 15        | 104.15      | 25.72       |
| 16        | 108.91      | 27.25       |
| 17        | 113.65      | 28.85       |
| 18        | 118.36      | 30.53       |
| 19        | 123.04      | 32.30       |
| 20        | 127.69      | 34.13       |
| 21        | 132.30      | 36.05       |
| 22        | 136.89      | 38.04       |
| 23        | 141.44      | 40.11       |
| 24        | 145.96      | 42.26       |
| 25        | 150.44      | 44.47       |
| 26        | 154.88      | 46.77       |
| 27        | 159.29      | 49.13       |
| 28        | 163.65      | 51.57       |
| 29        | 167.97      | 54.09       |
| 30        | 172.25      | 56.67       |
| 31        | 175.97      | 59.00       |

Circle Center At X = 14.9 ; Y = 312.4 and Radius, 300.3

\*\*\* 2.235 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 40.00       | 13.70       |
| 2         | 44.91       | 12.75       |
| 3         | 49.85       | 11.97       |
| 4         | 54.81       | 11.37       |

|    |        | Profile.out |
|----|--------|-------------|
| 5  | 59.79  | 10.95       |
| 6  | 64.79  | 10.70       |
| 7  | 69.79  | 10.64       |
| 8  | 74.79  | 10.75       |
| 9  | 79.78  | 11.04       |
| 10 | 84.76  | 11.51       |
| 11 | 89.71  | 12.15       |
| 12 | 94.65  | 12.97       |
| 13 | 99.55  | 13.97       |
| 14 | 104.41 | 15.14       |
| 15 | 109.22 | 16.48       |
| 16 | 113.99 | 18.00       |
| 17 | 118.70 | 19.68       |
| 18 | 123.34 | 21.53       |
| 19 | 127.92 | 23.55       |
| 20 | 132.42 | 25.72       |
| 21 | 136.84 | 28.06       |
| 22 | 141.17 | 30.55       |
| 23 | 145.42 | 33.20       |
| 24 | 149.56 | 35.99       |
| 25 | 153.61 | 38.93       |
| 26 | 157.54 | 42.02       |
| 27 | 161.37 | 45.24       |
| 28 | 165.07 | 48.59       |
| 29 | 168.66 | 52.08       |
| 30 | 172.11 | 55.69       |
| 31 | 175.06 | 59.00       |

Circle Center At X = 69.2 ; Y = 150.8 and Radius, 140.2

\*\*\* 2.239 \*\*\*

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 35.50       | 12.87       |
| 2         | 40.42       | 11.99       |
| 3         | 45.37       | 11.26       |
| 4         | 50.34       | 10.70       |
| 5         | 55.32       | 10.29       |
| 6         | 60.31       | 10.05       |
| 7         | 65.31       | 9.97        |
| 8         | 70.31       | 10.06       |
| 9         | 75.31       | 10.30       |
| 10        | 80.29       | 10.71       |
| 11        | 85.26       | 11.28       |
| 12        | 90.20       | 12.01       |
| 13        | 95.13       | 12.89       |
| 14        | 100.01      | 13.94       |
| 15        | 104.87      | 15.15       |
| 16        | 109.68      | 16.51       |
| 17        | 114.44      | 18.03       |
| 18        | 119.15      | 19.70       |
| 19        | 123.81      | 21.53       |
| 20        | 128.40      | 23.50       |
| 21        | 132.93      | 25.62       |
| 22        | 137.39      | 27.89       |



|    |        | Profile.out |
|----|--------|-------------|
| 23 | 141.77 | 30.30       |
| 24 | 146.07 | 32.85       |
| 25 | 150.28 | 35.54       |
| 26 | 154.41 | 38.37       |
| 27 | 158.44 | 41.33       |
| 28 | 162.37 | 44.41       |
| 29 | 166.20 | 47.63       |
| 30 | 169.93 | 50.96       |
| 31 | 173.54 | 54.42       |
| 32 | 177.04 | 57.99       |
| 33 | 177.97 | 59.00       |

Circle Center At X = 65.3 ; Y = 164.1 and Radius, 154.2

\*\*\* 2.243 \*\*\*

Failure Surface Specified By 31 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 37.75       | 13.29       |
| 2         | 42.66       | 12.34       |
| 3         | 47.60       | 11.58       |
| 4         | 52.57       | 10.98       |
| 5         | 57.55       | 10.56       |
| 6         | 62.54       | 10.32       |
| 7         | 67.54       | 10.26       |
| 8         | 72.54       | 10.37       |
| 9         | 77.53       | 10.65       |
| 10        | 82.51       | 11.11       |
| 11        | 87.47       | 11.75       |
| 12        | 92.40       | 12.56       |
| 13        | 97.31       | 13.55       |
| 14        | 102.17      | 14.71       |
| 15        | 106.99      | 16.03       |
| 16        | 111.76      | 17.53       |
| 17        | 116.48      | 19.19       |
| 18        | 121.13      | 21.02       |
| 19        | 125.72      | 23.02       |
| 20        | 130.23      | 25.17       |
| 21        | 134.66      | 27.48       |
| 22        | 139.01      | 29.95       |
| 23        | 143.27      | 32.56       |
| 24        | 147.44      | 35.33       |
| 25        | 151.50      | 38.24       |
| 26        | 155.46      | 41.29       |
| 27        | 159.31      | 44.48       |
| 28        | 163.05      | 47.81       |
| 29        | 166.66      | 51.26       |
| 30        | 170.15      | 54.84       |
| 31        | 173.42      | 58.43       |

Circle Center At X = 66.9 ; Y = 152.1 and Radius, 141.8

\*\*\* 2.257 \*\*\*

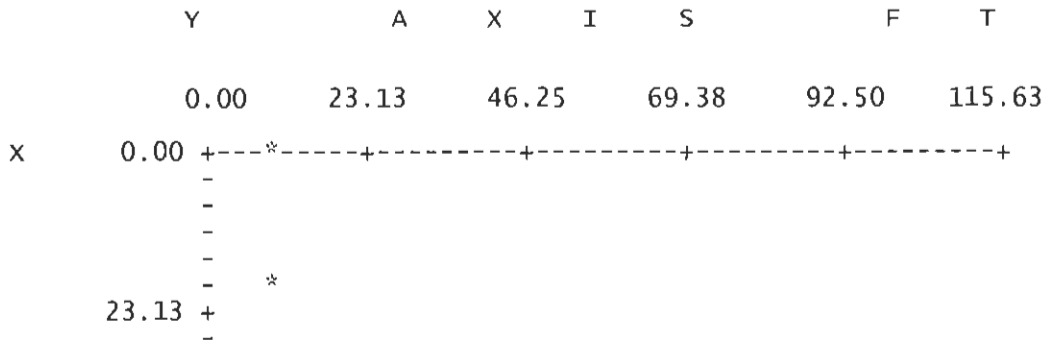
Profile.out

Failure Surface Specified By 33 Coordinate Points

| Point No. | X-Surf (ft) | Y-Surf (ft) |
|-----------|-------------|-------------|
| 1         | 33.25       | 12.45       |
| 2         | 38.16       | 11.49       |
| 3         | 43.09       | 10.69       |
| 4         | 48.05       | 10.05       |
| 5         | 53.03       | 9.58        |
| 6         | 58.02       | 9.27        |
| 7         | 63.02       | 9.12        |
| 8         | 68.02       | 9.13        |
| 9         | 73.01       | 9.31        |
| 10        | 78.00       | 9.65        |
| 11        | 82.98       | 10.16       |
| 12        | 87.93       | 10.83       |
| 13        | 92.86       | 11.66       |
| 14        | 97.76       | 12.65       |
| 15        | 102.63      | 13.80       |
| 16        | 107.46      | 15.10       |
| 17        | 112.24      | 16.57       |
| 18        | 116.97      | 18.19       |
| 19        | 121.64      | 19.97       |
| 20        | 126.25      | 21.89       |
| 21        | 130.80      | 23.97       |
| 22        | 135.28      | 26.20       |
| 23        | 139.68      | 28.57       |
| 24        | 144.00      | 31.08       |
| 25        | 148.24      | 33.74       |
| 26        | 152.39      | 36.53       |
| 27        | 156.44      | 39.45       |
| 28        | 160.40      | 42.51       |
| 29        | 164.26      | 45.69       |
| 30        | 168.01      | 49.00       |
| 31        | 171.64      | 52.43       |
| 32        | 175.17      | 55.98       |
| 33        | 177.98      | 59.00       |

Circle Center At X = 65.1 ; Y = 161.9 and Radius, 152.8

\*\*\* 2.270 \*\*\*



Profile.out

```

-      5
-     .43
-     .41
-    .31
A  46.25 + .031
-   .34
-   .871
-  .091
- .8731
- .8736
X  69.38 .8731
- .97 16*
- .89341
- .7 31
- .07 346
- .7 16
I  92.50 .9 1
- .07 321
- .7 31
- .97 346
- .7 316
- .09 16
S  115.63 + .7 351
-   .7 351
-   .7 356 *
-   .07 316
-   .07 1 6
-   .09 1
138.75 +   .79 31
-   .79 31
-   .87936
-   .07916
-   .07916
F  161.88 +   .08716
-   .0713
-   .0812.
-   .012*
-   51
T  185.00 + *

```