Chapter A-5

GEOTECHNICAL ANALYSIS ARGENTINE RAISE

CHAPTER A-5
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A-5.1 INTRODUCTION

This chapter presents the results of the geotechnical evaluation performed as part of the future conditions alternatives study of the Kansas Citys, Missouri and Kansas, Flood Protection Projects. The levee units within the future conditions study area were originally designed by the U.S. Army Corps of Engineers (USACE), Kansas City District, and were constructed under its supervision. The levee raise alternatives are being considered for the Kansas River units. They are designated as the Argentine Unit, the Armourdale Unit, and the Central Industrial District Unit (CID–Kansas). The Argentine, Armourdale, and CID-Kansas Units are currently operated by the Kaw Valley Drainage District. The Argentine Unit is presented in this interim appendix, while analysis on the other two Kansas River units will be included in a final appendix.

The purpose of this portion of the study is to evaluate the Nominal 500-yr, Nominal 500-yr plus 3 feet, and the Nominal 500-yr plus 5 feet proposals. These alternatives were based on levee raises and required that underseepage and slope stability analyses be completed on the landside of the levee. The evaluations for slope stability were done in accordance with the EM-1110-2-1913, "Design and Construction of Levees", and EM 1110-2-1902 "Slope Stability". Underseepage analysis utilized spreadsheets in accordance with KCD seepage criteria per the KCD Web site: http://www.nwk.usace.army.mil/local_protection/guidance.html. The results of this phase of the study were used to determine the net-benefits attributed to levee raises.

A-5.2 SOURCES OF INFORMATION

The primary sources of information for this geotechnical analysis include the references listed in the References section of this chapter.

A-5.3 DESCRIPTION OF THE LEVEE UNIT

Refer to Section A-4.3.1 for a detailed description of the levee unit.

A-5.4 SITE CONDITIONS

A-5.4.1 General Geology of the Region (Kansas River)

Refer to Section A-4.4.2 for geology of the Kansas River region.

A-5.4.2 Subsurface Conditions

Assessments of the subsurface conditions along the various units were derived from a variety of sources consisting of Record Drawings, Design Memorandums and borings made at selected sites during the feasibility study. Typical subsurface blanket conditions generally consist of silts, sandy clays and lean clays of variable thickness ranging from 15 to 30 feet. The foundation contains isolated lenses of sand within the clay and silt blanket materials.

A-5.5 BASIC EXISTING LEVEE SECTIONS

The Argentine Unit is an existing Federal levee. It started as a local existing levee and was removed and replaced using Federal standards in 1936. After the flood of 1951, the Corps designed the reconstruction of damages section and the raise of the entire unit called the 1962-Modification of the Argentine Unit.

The basic existing levee sections were constructed with a 10- to 15-foot crown width, and side slopes ranging from 3:1 to 4:1 horizontal to vertical riverside and landside levee slopes. Underseepage and stability berms were constructed in reaches where the height of the levee exceeded 15 to 18 feet, depending on the foundation strength and hydraulic gradient. The levee embankment consists of compacted earthen material placed in random and impervious zones. Rock slope protection was provided on the riverside slopes as needed and around inlets and outlets of drainage structures. All other slope surfaces are protected by established grasses. The levee crown, turnouts, and ramps are surfaced with 6 inches of aggregate surfacing.

Soil parameters used in this study for the existing levee sections were taken from previous testing on projects in the Kansas City District. Representative testing on the Missouri River alluvial deposits from L-385, L-142, and the Blue River Channel were used, but the majority of the data was from the 1962-Modification of the Argentine Unit. The soil properties considered in the future conditions analysis are shown in Table A-5.1.

TABLE A-5.1
Geotechnical Soil Parameters

	Unit Weights		Soil Parameters	
Soil Zones	**Saturated, PCF**	**Moist, PCF**	**Cohesion, PSF**	**Phi Angle, Degrees**
Levee Strengths				
Undrained Impervious	120	110	1000	0
Drained Impervious	120	110	50	26
Random Fill (sand Parameters used)	120	110	0	32
Foundation Drained Strengths				
Clays	115	110	50	26
Silts	115	110	0	28
Sands	115	110	0	32
Foundation Undrained				
Sands	115	110	0	32
Clays and Silts	115	110	600	0

A-5.6 UNDERSEEPAGE ANALYSES

Three hundred and seventy five borings were used to characterize the foundation. These borings were located in the as-built drawings listed in the references. Two borings were completed in 2001 in order to supplement the existing borings near closure structures and a floodwall reach. An extensive laboratory testing program was accomplished during the development of the 1962-Modification Design Memorandum No. 2 to identify the soils and determine strength parameters. Only two borings were assigned in 2001 to supplement the existing data for this study. The borings D-526 and D-527 were needed to provide structural designers with foundation strength parameters for assessment of the existing and proposed raised closure structures and floodwall. The borings obtained standard penetration test blow counts and adjacent soil samples for index soil parameters.

The soils below the existing flood protection were characterized to obtain the profiles needed for assessment of underseepage and stability. In general, a 25 feet to 30 feet thick blanket deposit mixture includes silt, clay, silty sand and clayey sand. These soils overlie a 60 to 70 feet thick clean sand deposit. In some areas within the thick blanket, there exists clean sand lenses or deposits that will require underseepage control if continuous below the footprint of the levee.

The thicker blanket materials were assigned permeability parameters based on the content of silt, clay or sand. This information was used to evaluate the underseepage control needs for raising the flood protection to three different levels: a nominal 0.2% chance of exceedance (500-year) level, a level 3 feet above the nominal 0.2% chance (500-year), and a level 5 feet above the nominal 0.2% chance (500-year). These potential raises will be referred to hereafter as the nominal 500-year, nominal 500-year + 3 feet, and the nominal 500-year + 5 feet.

The relative magnitude of the permeability ratios of the clean foundation sands to the blanket materials was set after the District's observation of boil activity from the1951 flood. Engineers back-calculated safety factors against piping - these values are shown in Table A-5.2. The Kansas City District method of estimating the underseepage gradient and the required factors of safety deviate somewhat from the method presented in the EM-1110-2-1913. The approach used by the Kansas City District since the 1960's has proven effective in providing adequate underseepage control and has been accepted for use as the basis for determining the need for underseepage treatment on levee units within the District. It is based on conclusions of a Corps of Engineers Conference held in Omaha in November, 1962. The effectiveness of this procedure has been demonstrated by the excellent historical performance of the District's levees in multiple flood events, including the 1993 flood event on the Missouri River.

TABLE A-5.2
Permeability Ratios for Blanket Materials

Blanket Material	Assigned Permeability Ratio
SM : Silty Sand	100
ML : Silt	200-400
ML-CL : Silt/Clay	400
CL: Lean Clay	400-600
CH: Fat Clay	800-1000

The underseepage analysis was performed with the following assumptions: The gradient piping factor of safety is defined as:

$FS_i = i_c / i_{o,}$ where i_o = actual gradient and i_c = critical gradient

$i_c = \gamma_b / \gamma_{w,}$ when soil particle movement begins at the toe

and $\gamma_b = \gamma_{sat} - \gamma_w$ where γsat = saturated unit weight of the soil and

γ_w = unit weight of water

$i_o = \Delta h / z_{bl}$

i_o = upward gradient through the blanket = change in head from the base of the blanket to the top of the blanket. The reference datum is set at the top of the blanket.

Δh = change in head calculated from the base of the blanket measured to the top of the blanket. This gradient calculation procedure is provided in the Supplemental Exhibits section, with defined equations and illustrative nomenclature.

z_{bl} = the thickness of the blanket

then $FS_i = i_c / i_o = (\gamma_b / \gamma_w) / (\Delta h / z_{bl}) = (\gamma_b * z_{bl}) / (\Delta h * \gamma_w)$

The criteria used to determine the required Safety Factors is the same used for the L-142 project in Jefferson City, Mo. The criteria for the L-142 levee design was approved by Portland Division and the Independent Technical Reviewers in the St. Paul District. See the Supplemental Exhibits section for the proposed criteria. This criteria is more conservative than the criteria used in 1969 to design the 1962-Modification Argentine Unit levee raise. The underseepage criteria for the 1969 design allowed for a

vertical hydraulic gradient in the blanket equal to the soils critical gradient. This is equivalent to a factor of safety (with respect to gradient) of 1.1 with water at the top of levee. The revised traditional NWK criteria requires underseepage control when the factor of safety (with respect to gradient) is less than 1.1 with the water at the top of levee. An additional design requirement is to provide underseepage control when the factor of safety (with respect to critical gradient) is less than 1.5 with the design water surface 3 feet below the top of levee. Usually the 1.5 safety factor controls the required underseepage design.

The shallower deposits of sand within the thick blanket were considered as an underseepage control concern and evaluated separately. If it could be proven that the sand lenses were isolated at the landside toe and finite in lateral extent, the lenses could be removed and an impervious material could replace the lenses. Future subsurface investigation should be considered to justify this alternative for controlling seepage. If it appears the shallow deposit could be extensive in lateral extent, a buried collector/interceptor could be used to control the seepage and relieve the toe pressures causing excessive uplift or uncontrolled piping. The recommended control for the shallow lenses or deposits is listed in Tables A-5.3 through A-5.5.

Underseepage analysis was completed using a spreadsheet for the nominal 500-year, 500-year + 3 ft, and the 500-yr + 5 ft raises. The seepage analysis showed that one area requires an underseepage berm for all three cases. The location of the underseepage berm and dimensions are shown in Tables A-5.3 through A-5.5.

TABLE A-5.3
Required Underseepage Control for Embankments and Foundation,
Nominal 500-Year Level of Protection

ARGENTINE UNIT Required Underseepage Control (Nominal 500-Yr. Profile)					
Beginning Station (Feet)	**Ending Station (Feet)**	**Recommended Control with t' for Berms (Feet)**	**Recommended W_T (Feet)**	**Yt (Feet)**	**Slope 1 on**
0+00	34+00	None	None	N/A	N/A
34+00	40+00	Buried Collector	N/A	N/A	N/A
40+00	161+00	None	None	N/A	N/A
161+00	171+00	3.0	20	13	20
171+00	179+50	None	None	N/A	N/A
179+50	183+00	Buried Collector	N/A	N/A	N/A
183+00	202+00	None	None	N/A	N/A
202+00	207+00	Filter Blanket	None	N/A	N/A
207+00	223+50	None	None	N/A	N/A
223+50	227+00	Area Fill	None	N/A	N/A
227+00	244+00	None	None	N/A	N/A
244+00	246+00	Remove/Replace/Imp	None	N/A	N/A
246+00	278+00	None	None	N/A	N/A
278+00	282+00	Buried Collector	None	N/A	N/A
282+00	284+00	None	None	N/A	N/A
284+00	289+00	Buried Collector	None	N/A	N/A

The variable t' is the thickness of the berm above top of ground at the landside toe of the primary levee to the top of the berm. Yt is defined as the distance from the top of the levee to the top of the berm at the point where to top of the berm intersects the levee slope. The Slope is the grade of the top of the berm away (landside) from the primary levee slope.

TABLE A-5.4
Required Underseepage Control for Embankments and Foundation,
Nominal 500-Year + 3 Feet Level of Protection

ARGENTINE UNIT Required Underseepage Control (Nominal 500-Yr + 3 Ft. Profile)					
Beginning Station **(Feet)**	**Ending Station** **(Feet)**	**Recommended Control with t' for Berms** **(Feet)**	**Recommended W_T** **(Feet)**	**Yt** **(Feet)**	**Slope** **1 on**
0+00	34+00	None	None	N/A	N/A
34+00	40+00	Buried Collector	N/A	N/A	N/A
40+00	161+00	None	None	N/A	N/A
161+00	171+00	3.0	150	13	150
171+00	179+50	None	None	N/A	N/A
179+50	183+00	Buried Collector	N/A	N/A	N/A
183+00	202+00	None	None	N/A	N/A
202+00	207+00	Filter Blanket	None	N/A	N/A
207+00	223+50	None	None	N/A	N/A
223+50	227+00	Area Fill	None	N/A	N/A
227+00	244+00	None	None	N/A	N/A
244+00	246+00	None	None	N/A	N/A
246+00	278+00	None	None	N/A	N/A
278+00	282+00	Buried Collector	None	N/A	N/A
282+00	284+00	None	None	N/A	N/A
284+00	289+00	Buried Collector	None	N/A	N/A

The variable t' is the thickness of the berm above top of ground at the landside toe of the primary levee to the top of the berm. Yt is defined as the distance from the top of the levee to the top of the berm at the point where to top of the berm intersects the levee slope. The Slope is the grade of the top of the berm away (landside) from the primary levee slope.

TABLE A-5.5
Required Underseepage Control for Embankments and Foundation,
Nominal 500-Year + 5 Feet Level of Protection

ARGENTINE UNIT Required Underseepage Control (Nominal 500-Yr. + 5 Ft. Profile)					
Beginning Station (Feet)	**Ending Station (Feet)**	**Recommended Control with t' for Berms (Feet)**	**Recommended W_T (Feet)**	**Yt (Feet)**	**Slope 1 on**
0+00	34+00	None	None	N/A	N/A
34+00	40+00	Buried Collector	N/A	N/A	N/A
40+00	161+00	None	None	N/A	N/A
161+00	171+00	3.0	200	13	150
171+00	179+50	None	None	N/A	N/A
179+50	183+00	Buried Collector	N/A	N/A	N/A
183+00	202+00	None	None	N/A	N/A
202+00	207+00	Filter Blanket	None	N/A	N/A
207+00	223+50	None	None	N/A	N/A
223+50	227+00	Area Fill	None	N/A	N/A
227+00	244+00	None	None	N/A	N/A
244+00	246+00	None	None	N/A	N/A
246+00	278+00	None	None	N/A	N/A
278+00	282+00	Buried Collector	None	N/A	N/A
282+00	284+00	None	None	N/A	N/A
284+00	289+00	Buried Collector	None	N/A	N/A

The variable t' is the thickness of the berm above top of ground at the landside toe of the primary levee to the top of the berm. Yt is defined as the distance from the top of the levee to the top of the berm at the point where to top of the berm intersects the levee slope. The Slope is the grade of the top of the berm away (landside) from the primary levee slope.

A-5.7 STABILITY ANALYSIS

After the section was developed for underseepage control, the slope stability was considered. The slope stability evaluations were completed in accordance with the EM-1110-2-1913, "Design and Construction of Levees" and EM 1110-2-1902, "Slope Stability". The soil parameters shown in Table A-5.1 were used along with the underseepage gradients developed to determine the global stability of the raised flood protection.

The software used was the UTEXAS 4 SLOPE STABILITY PACKAGE for Steady Seepage case using a minimum safety factor equal to 1.4 with Spencer's procedure. A phreatic water surface was assumed to be 3 feet below top of levee for all cases. The reduced water surface was chosen because of the transient nature of the water surface. The hydraulic gradient for the clean foundation sands was developed using a water surface elevation at the top of levee or I-wall for all water level cases. The hydraulic gradient pressures at the base of the blanket were developed from the seepage analysis and entered into the UTEXAS 4 program.

The slope stability analyses showed that a stability berm was required for some areas in all levee raise alternatives considered. A general summary is presented below. A more detailed summary is presented in Tables A-5.6 through A-5.8.

A-5.7.1 Nominal 500-Year Raise

The existing top of levee survey indicates a variance as shown in the Hydrology and Hydraulics chapter. The variance appears to fluctuate through an absolute vertical change of one foot. The profiles show a drop in average elevation with increase in levee stationing, but with decrease in the Kansas River miles, as was intended in the design. The selection of the proposed top of the levee for the nominal 500-year option was based on the difference in the elevation between the 500-year nominal water surface and the fluctuation of the top of the existing levee. The top of the proposed levee was set such that at key control locations, the nominal 500-year proposed top of levee was at least one foot higher than the existing levee. Since the existing levee fluctuates, the high point of the fluctuation was used for control. Between control elevations, the new top of levee is assured to be higher than the 500-year elevation water surface. The one foot minimum allows for a more efficient construction along the top of the levee. The top of proposed levee averages 1.5 feet above the average profiles of the existing top of levee near the middle reach of the levee. At the extreme upstream end of the levee, the raise is approximately one-half foot. Near the downstream end of the levee, the raise increases to 3 feet. A stability berm is required for Stations 48+00 to 61+00 and Stations 118+00 to 183+00. The minimal width needed is 25 feet. The thickness of the berm is set using a spring point distance, yt, below the top of the levee. The spring point distance represents the distance from the top of the levee raise to the top of the stability berm. These recommended distances are given in Table A-5.6. A rockfill cap was used for raising the levee section that resulted in a steepened landside slope. The design prevents encroachment upon existing railroad right-of-way. The rockfill section serves as a more economical alternative to a concrete wall on sheet piling (I-wall) section.

A-5.7.2 Nominal 500-Year Raise Plus 3 Feet

The selection of the proposed top of the levee for the nominal 500-year + 3 feet was developed using the 500-year nominal water surface. The top was simply set 3 feet above the 500-year nominal water surface. This will result in a top of proposed levee being less than 3 feet above the average profiles of the existing top of levee for the upstream reach. Near the middle reach of the levee, the distance above the existing levee varies from 3 to 4.5 feet. At the downstream end of the levee, the increase in height varies from 5 to 6 feet. The lower end remains the area at which initial overtopping will occur due to the decrease in elevation of the levee from the upstream reach to the downstream reach. A stability berm is required for Stations 29+70 to 61+00, and for Stations 118+00 to 245+00. The minimal width needed is 35 feet. The spring point distances are recommended on Table A-5.7. The raise for the levee reach from Station 253+92 to Station 276+80 was designed using an I-wall, impervious fill, and a rockfill section at the landside toe. The section was used to eliminate encroachment upon the railroad right-of-way. In order to meet stability requirements, the landside existing levee section will require temporary removal of earth materials and replacement with rockfill materials. An I-wall is needed to raise the crest to the required elevation.

A-5.7.3 Nominal 500-Year Raise Plus 5 Feet

The selection of the proposed top of the levee for the nominal 500-year + 5 feet was developed using the 500-year nominal water surface. The top was simply set 5 feet above the 500-year nominal water surface. This will result in a top of proposed levee being less than 5 feet above the average profiles of the existing top of levee for the upstream reach. Near the middle reach of the levee, the distance above the existing levee varies from 5 to 6.5 feet. At the downstream end of the levee, the increase in height varies from 7 to 8 feet. The lower end remains the area at which initial overtopping will occur due to the decrease in elevation of the levee from the upstream reach to the downstream reach. A stability berm is required for Stations 29+70 to 61+00, and for Stations 118+00 to 245+00. The minimal width needed is 35 feet. The spring point distances are recommended on Table A-5.8.

Berms were designed to stabilize the levee based on the height of the levee, thickness of foundation blanket, levee and foundation soil parameters, foundation sand hydraulic gradient, and dissipation of the gradient through the blanket, through seepage phreatic water surface, and available right of way. In some areas, berms were not assigned due to the encroachment onto existing structures including buildings and rail lines. Relief wells or revised levee sections with rock sections were used as an alternate to stability berms. The wells were placed to provide adequate pressure relief in the foundation sand and additional dissipation in the blanket materials. A buried collector system consisting of perforated pipe with pervious drain materials was assigned to the area of the foundation blanket characterized as having shallow sand deposits above or within the foundation blanket. The areas shown for recommended buried collector system have been reported to have seepage problems during 1993. The buried collector system, well spacing, and discharge requirements are identified on Table A-5.8 and Section A-5.8.

TABLE A-5.6
Recommended Flood Protection Raise Stability Berm Summary
Nominal 500-Year Raise

Beginning Station	Ending Station	Structure Type	Berm Thickness (Feet)	Levee Height Raise (Feet)	w_t (Feet)	y_t (Feet)	Slope
-1+10	27+50	Raise with Top Cap	N/A	1.0 min	N/A	N/A	N/A
27+50	28+30	I-Wall	N/A	1.0	N/A	N/A	N/A
28+30	29+70	Stoplog Gap	N/A	1.0	N/A	N/A	N/A
29+70	40+00	Landside Raise	N/A	1.0-1.5	N/A	N/A	N/A
40+00	48+00	Raise with Top Cap	N/A	1.0-1.5	N/A	N/A	N/A
48+00	75+00	Raise with Berm	5	1.1-1.5	25	11	Flat
75+00	96+00	Raise on Levee	N/A	1.2-2.0	N/A	N/A	N/A
96+00	118+00	Cap with Rockfill	N/A	1.3-1.5	N/A	N/A	N/A
118+00	183+00	Raise with Berm	5	1.2 – 2	25	13	Flat
183+00	202+00	Raise on Levee	N/A	1.2-2.0	N/A	N/A	N/A
202+00	207+00	Raise with Berm	5	1.2-2.0	40	8	Flat
207+00	251+65	Raise on Levee	N/A	1.2-2.0	N/A	N/A	N/A
251+65	253+92	Floodwall	N/A	2 – 2.3	N/A	N/A	N/A
253+92	276+70	Cap with Rockfill	Railroad Restrictions – No berm or Wells Needed – Levee Raise 2.2 to 3 Feet				
276+70	289+00	Floodwall and Gap	Railroad Restrictions – No Berm or Wells but Buried Collector Needed Floodwall Raise 2 Feet (average)				
289+00	289+40	Levee Raise	N/A	2 avg	N/A	N/A	N/A

TABLE A-5.7
Recommended Flood Protection Raise Stability Berm Summary
Nominal 500-Year + 3 Feet Raise

Beginning Station	Ending Station	Structure Type	Berm Thickness (Feet)	Levee Height Raise (Feet)	w_t (Feet)	y_t (Feet)	Slope
-2+00	28+30	I-Wall	N/A	2 – 3.5	N/A	N/A	N/A
28+30	29+70	Floodwall and Gap	N/A	2 – 3.5	N/A	N/A	N/A
29+70	61+00	Landside Raise	5	3 – 3.5	35	14	Flat
61+00	118+00	I-Wall on Levee	N/A	3.5	N/A	N/A	N/A
118+00	245+00	Landside Raise	5	3.5 - 4	35	16	Flat
245+00	251+65	I-Wall on Levee	N/A	4 – 5	N/A	N/A	N/A
251+65	253+92	Floodwall	N/A	5 - 6	N/A	N/A	N/A
253+92	276+70	I-wall on Modified Levee	Railroad Restrictions – Levee landside section modified with rockfill toe 5.5 – 6 feet Raise				
276+70	289+09	Floodwall and Gap	Railroad Restrictions – Buried Collector Needed – Floodwall Raise 5 Feet				
289+09	289+40	I-Wall on Levee	Raise 6 Feet				

TABLE A-5.8
Recommended Flood Protection Raise Stability Berm Summary
Nominal 500-Year + 5 Feet Raise

Beginning Station	Ending Station	Structure Type	Berm Thickness (Feet)	Levee Height Raise (Feet)	w_t (Feet)	y_t (Feet)	Slope
-3+00	28+30	I-Wall	N/A	4 – 5.5	N/A	N/A	N/A
28+30	29+70	Floodwall and Gap	N/A	5	N/A	N/A	N/A
29+70	61+00	Landside Raise	5	5 - 6	45	17	Flat
61+00	118+00	I-Wall on Levee	N/A	5 - 6	N/A	N/A	N/A
118+00	245+00	Landside Raise	5	6 - 7	45	19	Flat
245+00	251+65	I-Wall on Levee	N/A	7	N/A	N/A	N/A
251+65	253+92	Floodwall	N/A	7 - 8	N/A	N/A	N/A
253+92	276+70	I-wall on Levee	Railroad Restrictions – Pumped Wells Spacing 150 Feet 7 – 8 Feet Raise				
276+70	289+09	Floodwall and Gap	Railroad Restrictions – Buried Collector Needed – Floodwall Raise 7 - 9 Feet				
289+09	289+40	I-Wall on Levee	Raise 9 Feet				

A-5.8 RELIEF WELLS

Fully penetrating 10-inch diameter pressure relief wells, that would be pumped to meet drawdown requirements, are proposed landward of the levee toe where railroad tracks or other alternative solutions for raising the levee are not feasible. This alternate method is only considered for the Nominal 500 + 5 feet raise. It is highly likely that environmental concerns will eliminate this alternative during future consideration of raising the levee. Other solutions that could be considered consist of driven or augered piles at the landside toe of the levee or lowering the levee to reduce driving forces and replacing it with a higher I-wall or floodwall. These alternatives were not considered in this report for the Nominal 500 + 5 feet raise. A detailed analysis for determination of the required spacing of piles would be needed for this alternative.

A-5.9 RECOMMENDED PLAN

Raising the existing flood protection is constrained by the railroad tracks and existing structures in certain areas. Therefore, multiple solutions in addition to the traditional landside levee raise with stability and underseepage berms have been investigated. These solutions include a levee top cap, I-wall, removal and replacement of existing levee section with rockfill materials, and the use of relief wells (as discussed above). It is recommended that additional subsurface investigations be accomplished in areas that appear to contain foundation sand lenses. The investigation may result in the reduction of the recommended buried collector system for some areas.

The recommended levee revision to raise the flood protection is identified in Tables A-5.3 to A-5.5 for the Nominal 500-year, the Nominal 500-year + 3 feet and the Nominal 500 year + 5 feet, respectively. Representative cross-sections are provided on Exhibits A-5.5 to A-5.13, Exhibits A-5.16 to A-5.18, Exhibits A-5.22 to A-5.27, Exhibits A-5.29 to A-5.32, and Exhibits A-5.42 to A-5.50.

A-5.10 REFERENCES

1. Operations and Maintenance Manual, Kansas Citys Flood Control Project, Missouri and Kansas River, Argentine Unit, Volume I, Dated 1979.

2. Operations and Maintenance Manual, Record Drawings, Kansas Citys Flood Control Project, Missouri and Kansas River, Argentine Unit, Volume I, Appendix II, Dated 1951 - 1974.

3. Operations and Maintenance Manual, Kansas Citys Flood Control Project, Missouri and Kansas River, Armourdale Unit, Volume I, Dated 1979.

4. Operations and Maintenance Manual, Record Drawings, Kansas Citys Flood Control Project, Missouri and Kansas River, Armourdale Unit, Volume I, Appendix I, Dated 1951 - 1954.

5. Operations and Maintenance Manual, Record Drawings, Kansas Citys Flood Control Project, Missouri and Kansas River, Armourdale Unit, Volume II, Appendix I, Dated 1954 - 1976.

6. Operations and Maintenance Manual, Kansas Citys Flood Control Project, Missouri and Kansas River, Central Industrial Unit Kansas Section, Volume I, Dated 1980.

7. Operations and Maintenance Manual, Record Drawings, Kansas Citys Flood Control Project, Missouri and Kansas River, Central Industrial Unit Kansas Section, Volume I, Appendix I, Dated 1950 - 1955.

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9. Operations and Maintenance Manual, Kansas Citys Flood Control Project, Missouri and Kansas River, Central Industrial Unit Missouri Section, Volume I, Dated 1981.

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13. Operations and Maintenance Manual, Kansas Citys Flood Control Project, Missouri and Kansas River, Fairfax-Jersey Creek Unit, Volume I, Dated 1979.

14. Operations and Maintenance Manual, Record Drawings, Kansas Citys Flood Control Project, Missouri and Kansas River, Fairfax-Jersey Creek Unit, Volume I, Appendix I, Dated 1944 - 1955.

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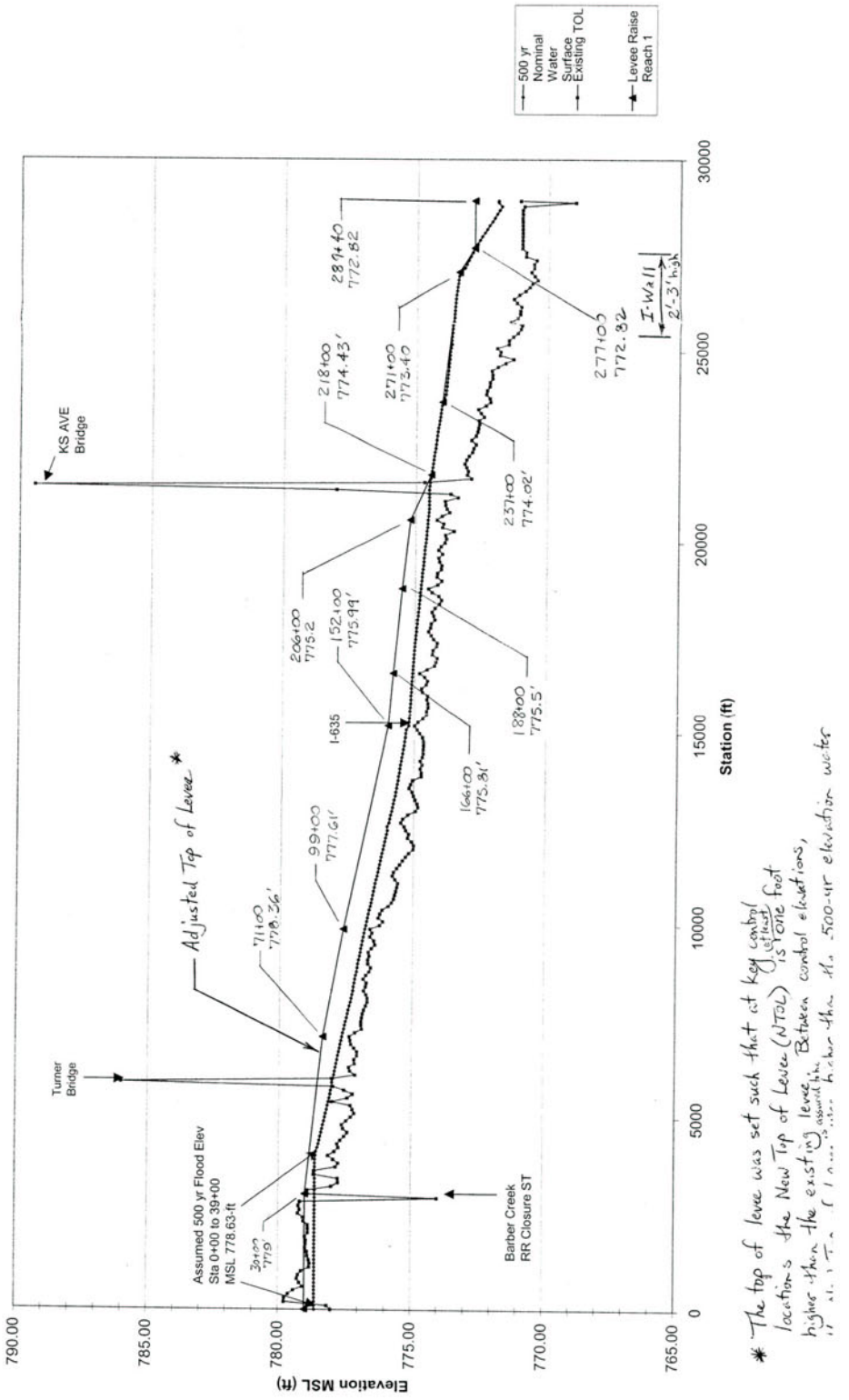
A-5.11 SUPPLEMENTAL EXHIBITS

NOMINAL 500-YEAR

EXHIBIT A-5.1
Argentine Unit 500-Yr Nominal Water Surface with Existing TOL



* The top of levee was set such that at key control locations the New Top of Levee (NTOL) is one foot higher than the existing levee. Between control elevations, [illegible]

UNDERSEEPAGE

EXHIBIT A-5.2

UNDERSEEPAGE ANALYSIS

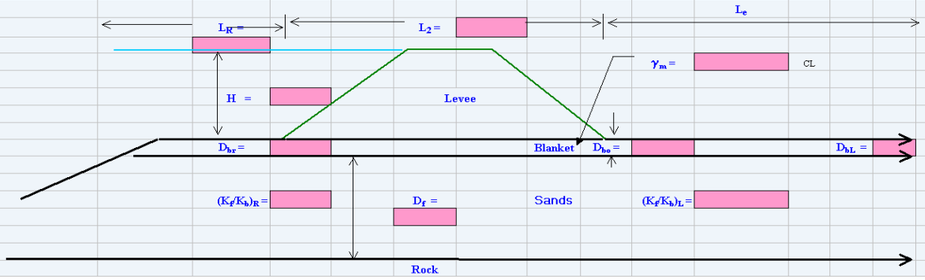
Note : This spreadsheet analysis should be used only if the blanket thickness is at least 1/4 of the height of the levee.

Argentine 500 Yr

Name : Campbell EC-GG

Date : 4/20/2004

Revised to reflect criteria developed for L-142



Recommended Permeability Ratio For Foundation Blanket Materials Chapter Underseepage Revision dated Oct 1998	
Blanket Material	Assumed Permeability Ratio, (Kf/Kb)
SM	100
ML	200 to 400
ML-CL	400
CL	400 to 600
CH	800 to 1000

NOMENCLATURE

$(K_f/K_b)_R$	= riverside permeability	t'	= required Berm thickness at toe
$(K_f/K_b)_L$	= landside permeability	Sc	= calc'd slope of underseepage berm
D_{br}	= riverside blanket thickness	q	= seepage /unit Length
D_{bo}	= levee toe blanket thickness	Q	= cummulated seepage
D_{bL}	= landside blanket thickness	FS_i	= i_c / i_o
D_f	= thickness of pervious foundation		
L_R	= length of riverside blanket		
L_t	= length of landside blanket		
H	= max head or levee height		
$H(W_T)$	= head above tailwater at end of underseepage berm		
$H(W_T)$	= $H(W_T/2)*e^{[-WT/(2*CL)]}$		
$H(W_{T2})$	= head above tailwater midpoint of underseepage berm		
	= H * L_e / L'_t		
W_T	= berm width		
i_o	= seepage gradient		
C_t	= riverside effective length coefficient		
C_L	= landside effective length coefficient		
where C =	$[(Kf/Kb) * Df * Db]^{1/2}$		
H'o	= head above tailwater at levee toe (w/ berm)		
i_c	= critical seepage gradient		
L_1	= riverside effective length		
where L_1	= $C * (e^{(2LR/C-1)}) / (e^{(2LR/C+1)})$		
L_2	= levee base width		
L_e	= landside effective length		
L_t	= total effective length		
L'_t	= Total Effective Length + 1/2 of Berm		

Input Parameters

Station	Begin Station Feet	End Station Feet	$(K_f/K_b)_R$	$(K_f/K_b)_L$	D_{bL}	D_{bo}	D_{br}	D_f	L_R	H	Remarks
0+0 to 30+0	0+00	30+00	500	500	28.0	28.0	28.0	66.0	170	5.0	
30+0 to 46+0	30+00	46+00	200	200	35.0	35.0	35.0	60.0	150.0	13.0	
46+0 to 50+0	46+00	50+00	250	250	25.0	25.0	25.0	67.0	100.0	12.5	
50+0 to 59+0	50+00	59+00	300	300	20.0	20.0	20.0	62.5	100.0	16.5	
59+0 to 70+0	59+00	70+00	300	300	23.0	23.0	23.0	58.0	150.0	16.0	
70+0 to 74+0	70+00	74+00	200	200	16.0	16.0	16.0	70.0	350.0	16.0	
74+0 to 86+0	74+00	86+00	200	200	16.0	16.0	16.0	70.0	350.0	11.0	
86+0 to 96+0	86+00	96+00	250	250	28.0	28.0	28.0	62.0	650.0	10.0	
96+0 to 110+0	96+00	110+00	150	150	30.0	30.0	30.0	66.0	1050.0	15.0	
110+0 to 118+0	110+00	118+00	250	250	20.0	20.0	20.0	65.0	400.0	16.0	
118+0 to 128+0	118+00	128+00	250	250	20.0	20.0	20.0	67.0	380.0	18.0	
128+0 to 135+0	128+00	135+00	300	300	25.0	25.0	25.0	67.0	360.0	16.5	
135+0 to 141+0	135+00	141+00	300	300	25.0	25.0	25.0	55.0	474.0	17.5	
141+0 to 151+0	141+00	151+00	300	300	20.0	20.0	20.0	60.0	425.0	16.5	
151+0 to 161+0	151+00	161+00	300	300	25.0	25.0	25.0	56.0	400.0	16.0	
161+0 to 170+0	161+00	170+00	300	300	12.0	12.0	12.0	65.0	250.0	16.0	
170+0 to 182+0	170+00	182+00	200	200	18.0	18.0	18.0	67.0	350.0	18.0	Has Berm
182+0 to 193+0	182+00	193+00	250	250	23.0	23.0	23.0	60.0	175.0	16.0	

Analysis of Without Berm Conditions

C_R Feet	C_L Feet	L_1 Feet	L_2 Feet	L_e Feet	L_t Feet	h_o Feet	i_o Ft/Ft	ic Ft/Ft	Check #1 Full Head Toe FS_i (need 1.1)	Check #1 Reduced Head Toe FS_i (need 1.5)	Remarks
961	961	168	49	961	1178	4.08	0.15	0.85	5.84	14.59	
648	648	147	75	648	870	9.68	0.28	0.85	3.07	4.00	
647	647	99	85	647	831	9.73	0.39	0.85	2.18	2.87	
612	612	99	110	612	821	12.30	0.61	0.85	1.38	1.69	
633	633	147	120	633	900	11.25	0.49	0.85	1.74	2.14	
473	473	298	85	473	856	8.85	0.55	0.85	1.54	1.89	
473	473	298	85	473	856	6.08	0.38	0.85	2.24	3.07	
659	659	498	81	659	1238	5.32	0.19	0.85	4.47	6.39	
545	545	522	102	545	1169	6.99	0.23	0.85	3.65	4.56	
570	570	345	115	570	1030	8.85	0.44	0.85	1.92	2.36	
579	579	333	128	579	1040	10.02	0.50	0.85	1.70	2.04	
709	709	332	118	709	1159	10.09	0.40	0.85	2.11	2.57	
642	642	403	84	642	1130	9.95	0.40	0.85	2.14	2.58	
600	600	366	123	600	1089	9.09	0.45	0.85	1.87	2.29	
648	648	356	105	648	1109	9.35	0.37	0.85	2.27	2.80	
484	484	230	120	484	834	9.28	0.77	0.85	1.10	1.35	
491	491	301	130	491	922	9.59	0.53	0.85	1.60	1.91	
587	587	170	100	587	857	10.96	0.48	0.85	1.78	2.20	

EXHIBIT A-5.2 (Continued)

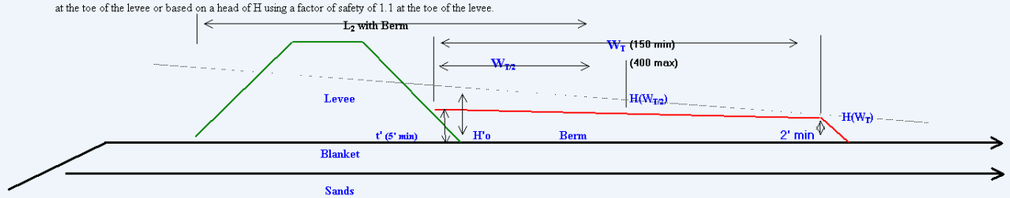
Station	Begin Station Feet	End Station Feet	Input Parameters								Remarks
			$(K_f/K_b)_R$	$(K_f/K_b)_L$	D_{bL}	D_{bo}	D_{br}	D_f	L_R	H	
193+0 to 203+0	193+00	203+00	300	300	25.0	25.0	25.0	66.9	93	18.0	Has Berm
203+0 to 210+0	203+00	210+00	250	250	25.0	25.0	25.0	74.0	73.0	17.0	Has Berm
210+0 to 218+0	210+00	218+00	250	250	30.0	30.0	30.0	62.5	150.0	9.0	
218+0 to 226+0	218+00	226+00	200	200	25.0	25.0	25.0	63.0	150.0	15.0	
226+0 to 234+0	226+00	234+00	300	300	28.0	28.0	28.0	55.0	170.0	17.5	Has Berm
234+0 to 245+0	234+00	245+00	250	250	25.0	25.0	25.0	61.0	150.0	17.0	Has Berm
245+0 to 260+0	245+00	260+00	300	300	28.0	28.0	28.0	62.0	160.0	15.5	
260+0 to 270+0	260+00	270+00	250	250	28.0	28.0	28.0	55.0	125.0	16.5	
270+0 to 275+0	270+00	275+00	300	300	28.0	28.0	28.0	66.9	94.0	13.5	
275+0 to 280+0	275+00	280+00	275	275	40.0	40.0	40.0	68.8	62.0	13.0	Floodwall
280+0 to 290+0	280+00	290+00	200	200	40.0	40.0	40.0	78.0	50.0	10.0	Floodwall

Analysis of Without Berm Conditions											
C_R Feet	C_L Feet	L_1 Feet	L_2 Feet	L_e Feet	L_t Feet	h_o Feet	i_o Ft/Ft	ic Ft/Ft	Check #1 Full Head Toe FS_i (need 1.1)	Check #1 Reduced Head Toe FS_i (need 1.5)	Remarks
708	708	92	88	708	889	14.35	0.57	0.85	1.48	1.78	
680	680	73	95	680	848	13.64	0.55	0.85	1.56	1.89	
685	685	148	103	685	935	6.59	0.22	0.85	3.87	5.81	
561	561	147	125	561	833	10.11	0.40	0.85	2.10	2.63	
680	680	167	123	680	969	12.27	0.44	0.85	1.94	2.34	
617	617	147	107	617	872	12.04	0.48	0.85	1.76	2.14	
722	722	157	107	722	986	11.34	0.41	0.85	2.10	2.60	
620	620	123	95	620	839	12.21	0.44	0.85	1.95	2.38	
750	750	94	86	750	929	10.89	0.39	0.85	2.19	2.81	
870	870	62	0	870	932	12.14	0.30	0.85	2.80	3.64	
790	790	50	0	790	840	9.41	0.24	0.85	3.61	5.16	

General Notes

Analysis of Existing Conditions : This portion uses full head for the check #1 for FS_i = 1.1 and Full Head less 3 feet for the Check #2 for FS_i = 1.5. If either of these two columns indicate that the required FS_i is not met then the underseepage berm design is needed.

Berm Design Information : The Excessive head columns provides the designer with a feel for which check case control. The design of the berm at the toe of the levee requires a FS_i of at least 1.5 for the controlling case, using the reduced head (87% of full head). The design of the extension of the berm is controlled using full head and a required FS_i of 1.1 at the toe of the berm. If the FS_i = 1.1 is not met with the width = 400 feet minimum, then the 400 feet is used . The berm thickness required at the toe of the levee is controlled using an H'o at the levee toe set based on FS_i = 1.1, projecting back to the width less than 400 feet, with no adjustment made to H'o. If the trail width is less than 400 feet, no adjustment to H'o is made. The minimum berm thickness is 5 feet (EM 1110-2-1913). The calculated berm thickness will be based on full head less 3 feet using a Factor of safety of 1.5 at the toe of the levee or based on a head of H using a factor of safety of 1.1 at the toe of the levee.



Berm Design Information

Station	Excessive Head Control (Feet)		Trial Width	Effective Length	Mid Berm Head, ft	H(W_T) Feet	Berm Toe Gradient	Safety Factor	H'o at Levee Toe	Trial Minimum Berm Thickness	Levee Toe Gradient	Safety Factor Check at Levee Toe	
	FS_i = 1.1	FS_i = 1.5	W_T	L'_t	H($W_{T/2}$)		I_{Berm}	Berm Toe	Feet	t'	I'o	For 1.5	For 1.1
0+0 to 30+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
30+0 to 46+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
46+0 to 50+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
50+0 to 59+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
59+0 to 70+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
70+0 to 74+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
74+0 to 86+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
86+0 to 96+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
96+0 to 110+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
110+0 to 118+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
118+0 to 128+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
128+0 to 135+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
135+0 to 141+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
141+0 to 151+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
151+0 to 161+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
161+0 to 170+0	0.01	0.74	5	909	8.5	8.5	0.71	1.20	6.96	2.5	0.31	2.77	
170+0 to 182+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
182+0 to 193+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA

Berm Design Information													
Berm Width Design									Berm Thickness Design				
Station	Excessive Head Control (Feet)		Trial Width	Effective Length	Mid Berm Head, ft	H(W_T) Feet	Berm Toe Gradient	Safety Factor	H'o at Levee Toe	Trial Minimum Berm Thickness	Levee Toe Gradient	Safety Factor Check at Levee Toe	
	FS_i = 1.1	FS_i = 1.5	W_T	L'$_t$	H($W_{T/2}$)		I_{Berm}	Berm Toe	Feet	t'	I'o	For 1.5	For 1.1
193+0 to 203+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
203+0 to 210+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
210+0 to 218+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
218+0 to 226+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
226+0 to 234+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
234+0 to 245+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
245+0 to 260+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
260+0 to 270+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
270+0 to 275+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
275+0 to 280+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA
280+0 to 290+0	NA	NA	0	NA	NA	NA	NA	NA	NA		NA	NA	
								Okay	NA		NA		NA

EXHIBIT A-5.4
Argentine Unit 500-Yr With Survey Data Added

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
0+00	0	778.63	778.00		0.63	Hillside Ditch		779.00	-0.37	1.00
1+00	100	778.63	778.15		0.48	Hillside Ditch		779.00	-0.37	0.85
2+00	200	778.63	779.77		-1.14	Hillside Ditch		779.00	-0.37	-0.77
3+00	300	778.63	779.75		-1.12	Hillside Ditch		779.00	-0.37	-0.75
4+00	400	778.63	779.61		-0.98	Hillside Ditch		779.00	-0.37	-0.61
5+00	500	778.63	779.42		-0.79	Hillside Ditch		779.00	-0.37	-0.42
6+00	600	778.63	779.08		-0.45	Hillside Ditch		779.00	-0.37	-0.08
7+00	700	778.63	779.19		-0.56	Hillside Ditch		779.00	-0.37	-0.19
8+00	800	778.63	779.27		-0.64	Hillside Ditch		779.00	-0.37	-0.27
9+00	900	778.63	779.23		-0.60	Hillside Ditch		779.00	-0.37	-0.23
10+00	1000	778.63	779.12		-0.49	Hillside Ditch		779.00	-0.37	-0.12
11+00	1100	778.63	778.82		-0.19	Hillside Ditch		779.00	-0.37	0.18
12+00	1200	778.63	778.80		-0.17	Hillside Ditch		779.00	-0.37	0.20
13+00	1300	778.63	778.83		-0.20	Key RD. 55th St		779.00	-0.37	0.17
14+00	1400	778.63	778.89		-0.26	Hillside Ditch		779.00	-0.37	0.11
15+00	1500	778.63	778.90		-0.27	Hillside Ditch		779.00	-0.37	0.10
16+00	1600	778.63	778.97		-0.34	Hillside Ditch		779.00	-0.37	0.03
17+00	1700	778.63	778.96		-0.33	Hillside Ditch		779.00	-0.37	0.04
18+00	1800	778.63	778.94		-0.31	Hillside Ditch		779.00	-0.37	0.06
19+00	1900	778.63	778.98		-0.35	Hillside Ditch		779.00	-0.37	0.02
20+00	2000	778.63	778.87		-0.24	Hillside Ditch		779.00	-0.37	0.13
21+00	2100	778.63	778.87		-0.24	Hillside Ditch		779.00	-0.37	0.13
22+00	2200	778.63	778.88		-0.25	Hillside Ditch		779.00	-0.37	0.12
23+00	2300	778.63	779.04		-0.41	Hillside Ditch		779.00	-0.37	-0.04
24+00	2400	778.63	779.06		-0.43	Hillside Ditch		779.00	-0.37	-0.06
25+00	2500	778.63	779.25		-0.62	Hillside Ditch		779.00	-0.37	-0.25
26+00	2600	778.63	779.19		-0.56	Hillside Ditch		779.00	-0.37	-0.19
27+00	2700	778.63	779.23		-0.60	Hillside Ditch		779.00	-0.37	-0.23
28+00	2800	778.63	779.18		-0.55	Hillside Ditch		779.00	-0.37	-0.18
28+60	2860							779.00		
29+00	2900	778.63	774.00		4.63	Barber Creek RR FG	Closure Structure	779.00	-0.37	5.00
30+00	3000	778.63	778.90		-0.27	Barber Creek		779.00	-0.37	0.10
31+00	3100	778.63	778.90		-0.27	Barber Creek		778.98	-0.35	0.08
32+00	3200	778.63	778.00		0.63	Barber Creek		778.97	-0.34	0.97
33+00	3300	778.63	777.75		0.88	Barber Creek		778.95	-0.32	1.20
34+00	3400	778.63	777.76		0.87	Barber Creek		778.94	-0.31	1.18

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
34+55	3455							778.93		
35+00	3500	778.63	778.67		-0.04	Barber Creek		778.92	-0.29	0.25
35+95	3595							778.91		
36+00	3600	778.63	778.66		-0.03	Barber Creek		778.91	-0.28	0.25
37+00	3700	778.63	777.84		0.79	Barber Creek		778.89	-0.26	1.05
37+60	3760							778.88		
38+00	3800	778.63	777.75		0.88	LV KS		778.88	-0.25	1.13
38+80	3880							778.87		
39+00	3900	778.63	777.94		0.69	LV KS		778.86	-0.23	0.92
40+00	4000	778.61	778.13		0.48	LV KS		778.84	-0.23	0.71
40+20	4020							778.84		
41+00	4100	778.59	777.89		0.70	LV KS		778.83	-0.24	0.94
42+00	4200	778.54	777.74		0.80	LV KS		778.81	-0.27	1.07
42+35	4235							778.81		
43+00	4300	778.50	777.79		0.71	LV KS		778.80	-0.30	1.01
44+00	4400	778.47	777.68		0.79	LV KS		778.78	-0.31	1.10
45+00	4500	778.44	777.53		0.91	LV KS		778.77	-0.33	1.24
46+00	4600	778.40	777.41		0.99	LV KS		778.75	-0.35	1.34
46+50	4650							778.74		
47+00	4700	778.37	777.57		0.80	LV KS		778.73	-0.36	1.16
47+58	4758							778.73		
48+00	4800	778.34	777.62		0.72	LV KS		778.72	-0.38	1.10
49+00	4900	778.30	777.46		0.84	LV KS		778.70	-0.40	1.24
50+00	5000	778.27	777.29		0.98	LV KS		778.69	-0.42	1.40
51+00	5100	778.24	777.16		1.08	LV KS		778.67	-0.43	1.51
51+60	5160							778.66		
52+00	5200	778.20	777.22		0.98	LV KS		778.66	-0.46	1.44
53+00	5300	778.17	777.30		0.87	LV KS		778.64	-0.47	1.34
54+00	5400	778.13	778.00		0.13	LV KS		778.63	-0.50	0.63
55+00	5500	778.10	777.42		0.68	LV KS		778.61	-0.51	1.19
55+50	5550							778.60		
56+00	5600	778.07	777.22		0.85	LV KS		778.59	-0.52	1.37
57+00	5700	778.05	777.54		0.51	LV KS		778.58	-0.53	1.04
58+00	5800	778.01	777.96		0.05	LV KS		778.56	-0.55	0.60
59+00	5900	778.00	786.00		-8.00	LV KS	Turner Bridge	778.55	-0.55	-7.45
59+43	5943							778.54		

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
60+00	6000	777.97	778.00		-0.03	LV KS	Turner Bridge	778.53	-0.56	0.53
61+00	6100	777.93	777.13		0.80	LV KS		778.52	-0.59	1.39
61+10	6110							778.51		
62+00	6200	777.91	777.33		0.58	LV KS		778.50	-0.59	1.17
62+70	6270							778.49		
63+00	6300	777.88	777.37		0.51	LV KS		778.49	-0.61	1.12
64+00	6400	777.85	777.15		0.70	LV KS		778.47	-0.62	1.32
64+40	6440							778.46		
65+00	6500	777.82	777.17		0.65	LV KS		778.45	-0.63	1.28
66+00	6600	777.79	777.07		0.72	LV KS		778.44	-0.65	1.37
67+00	6700	777.76	777.07		0.69	LV KS		778.42	-0.66	1.35
68+00	6800	777.73	777.18		0.55	LV KS		778.41	-0.68	1.23
69+00	6900	777.70	777.30		0.40	LV KS		778.39	-0.69	1.09
70+00	7000	777.67	777.33		0.34	LV KS		778.38	-0.71	1.05
70+85	7085							778.36		
71+00	7100	777.64	777.36		0.28	LV KS		778.36	-0.72	1.00
72+00	7200	777.61	777.15		0.46	LV KS		778.33	-0.72	1.18
73+00	7300	777.57	776.90		0.67	LV KS		778.31	-0.74	1.41
73+85	7385							778.28		
74+00	7400	777.54	776.92		0.62	LV KS		778.28	-0.74	1.36
75+00	7500	777.51	776.92		0.59	LV KS		778.25	-0.74	1.33
76+00	7600	777.47	776.90		0.57	LV KS		778.23	-0.76	1.33
77+00	7700	777.44	776.87		0.57	LV KS		778.20	-0.76	1.33
78+00	7800	777.41	776.82		0.59	LV KS		778.17	-0.76	1.35
78+85	7885							778.15		
79+00	7900	777.37	776.75		0.62	LV KS		778.15	-0.78	1.40
80+00	8000	777.33	776.69		0.64	LV KS		778.12	-0.79	1.43
81+00	8100	777.30	776.69		0.61	LV KS		778.09	-0.79	1.40
82+00	8200	777.27	776.74		0.53	LV KS		778.07	-0.80	1.33
83+00	8300	777.24	776.83		0.41	LV KS		778.04	-0.80	1.21
83+05	8305							778.04		
84+00	8400	777.22	776.76		0.46	LV KS		778.01	-0.79	1.25
85+00	8500	777.19	776.73		0.46	LV KS		777.98	-0.79	1.25
86+00	8600	777.17	776.85		0.32	LV KS		777.96	-0.79	1.11
86+75	8675							777.94		
87+00	8700	777.14	776.75		0.39	LV KS		777.93	-0.79	1.18
88+00	8800	777.11	776.63		0.48	LV KS		777.90	-0.79	1.27
89+00	8900	777.08	776.57		0.51	LV KS		777.88	-0.80	1.31
90+00	9000	777.06	776.68		0.38	LV KS		777.85	-0.79	1.17

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
90+55	9055							777.84		
91+00	9100	777.03	776.68		0.35	LV KS		777.82	-0.79	1.14
92+00	9200	777.00	776.63		0.37	LV KS		777.80	-0.80	1.17
93+00	9300	776.97	776.67		0.30	LV KS		777.77	-0.80	1.10
94+00	9400	776.95	776.55		0.40	LV KS		777.74	-0.79	1.19
94+45	9445							777.73		
95+00	9500	776.92	776.42		0.50	LV KS		777.72	-0.80	1.30
96+00	9600	776.89	776.46		0.43	LV KS		777.69	-0.80	1.23
97+00	9700	776.86	776.61		0.25	LV KS		777.66	-0.80	1.05
98+00	9800	776.83	776.53		0.30	LV KS		777.64	-0.81	1.11
99+00	9900	776.80	776.61		0.19	LV KS		777.61	-0.81	1.00
100+00	10000	776.77	776.25		0.52	LV KS		777.58	-0.81	1.33
101+00	10100	776.74	776.13		0.61	LV KS		777.55	-0.81	1.42
102+00	10200	776.71	776.30		0.41	LV KS		777.52	-0.81	1.22
103+00	10300	776.68	776.24		0.44	LV KS		777.49	-0.81	1.25
103+18	10318							777.48		
104+00	10400	776.65	776.16		0.49	LV KS		777.46	-0.81	1.30
105+00	10500	776.61	775.93		0.68	LV KS		777.43	-0.82	1.50
105+50	10550							777.41		
106+00	10600	776.58	775.81		0.77	LV KS		777.40	-0.82	1.59
107+00	10700	776.55	775.73		0.82	LV KS		777.37	-0.82	1.64
107+55	10755							777.35		
108+00	10800	776.52	775.69		0.83	LV KS		777.33	-0.81	1.64
109+00	10900	776.49	775.65		0.84	LV KS		777.30	-0.81	1.65
110+00	11000	776.46	775.61		0.85	LV KS		777.27	-0.81	1.66
111+00	11100	776.43	775.58		0.85	LV KS		777.24	-0.81	1.66
112+00	11200	776.40	775.68		0.72	LV KS		777.21	-0.81	1.53
113+00	11300	776.36	775.78		0.58	LV KS		777.18	-0.82	1.40
113+28	11328							777.17		
114+00	11400	776.33	775.74		0.59	LV KS		777.15	-0.82	1.41
115+00	11500	776.30	775.62		0.68	LV KS		777.12	-0.82	1.50
116+00	11600	776.27	775.51		0.76	LV KS		777.09	-0.82	1.58
117+00	11700	776.24	775.40		0.84	LV KS		777.06	-0.82	1.66
118+00	11800	776.21	775.29		0.92	LV KS		777.03	-0.82	1.74
118+25	11825							777.02		
119+00	11900	776.18	775.17		1.01	LV KS		777.00	-0.82	1.83
120+00	12000	776.14	775.01		1.13	LV KS		776.97	-0.83	1.96
121+00	12100	776.11	774.99		1.12	LV KS		776.94	-0.83	1.95
122+00	12200	776.08	775.08		1.00	LV KS		776.91	-0.83	1.83
123+00	12300	776.05	775.22		0.83	LV KS		776.88	-0.83	1.66

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
124+00	12400	776.02	775.18		0.84	LV KS		776.84	-0.82	1.66
124+95	12495							776.82		
125+00	12500	775.99	775.29		0.70	LV KS		776.81	-0.82	1.52
126+00	12600	776.00	775.35		0.65	LV KS		776.78	-0.78	1.43
127+00	12700	775.93	775.48		0.45	LV KS		776.75	-0.82	1.27
128+00	12800	775.90	775.40		0.50	LV KS		776.72	-0.82	1.32
129+00	12900	775.87	775.22		0.65	LV KS		776.69	-0.82	1.47
130+00	13000	775.83	774.93		0.90	LV KS		776.66	-0.83	1.73
131+00	13100	775.80	774.84		0.96	LV KS		776.63	-0.83	1.79
132+00	13200	775.77	774.87		0.90	LV KS		776.60	-0.83	1.73
132+15	13215							776.60		
133+00	13300	775.74	774.95		0.79	LV KS		776.57	-0.83	1.62
134+00	13400	775.70	775.01		0.69	LV KS		776.54	-0.84	1.53
134+15	13415							776.53		
135+00	13500	775.68	775.06		0.62	LV KS		776.51	-0.83	1.45
136+00	13600	775.65	775.17		0.48	LV KS		776.48	-0.83	1.31
137+00	13700	775.63	775.12		0.51	LV KS		776.45	-0.82	1.33
138+00	13800	775.60	775.04		0.56	LV KS		776.42	-0.82	1.38
139+00	13900	775.58	774.72		0.86	LV KS		776.39	-0.81	1.67
140+00	14000	775.55	774.72		0.83	LV KS		776.36	-0.81	1.64
141+00	14100	775.53	774.76		0.77	LV KS		776.32	-0.79	1.56
141+55	14155							776.31		
142+00	14200	775.51	774.69		0.82	LV KS		776.29	-0.78	1.60
143+00	14300	775.48	774.76		0.72	LV KS		776.26	-0.78	1.50
144+00	14400	775.46	774.68		0.78	LV KS		776.23	-0.77	1.55
144+20	14420							776.23		
145+00	14500	775.43	774.65		0.78	LV KS		776.20	-0.77	1.55
146+00	14600	775.41	774.65		0.76	LV KS		776.17	-0.76	1.52
147+00	14700	775.38	774.64		0.74	LV KS		776.14	-0.76	1.50
148+00	14800	775.36	774.64		0.72	LV KS		776.11	-0.75	1.47
148+10	14810							776.11		
149+00	14900	775.34	774.68		0.66	LV KS		776.08	-0.74	1.40
150+00	15000	775.32	774.79		0.53	LV KS	I-635	776.05	-0.73	1.26
150+85	15085							776.02		
151+00	15100	775.30	774.89		0.41	LV KS	I-635	776.02	-0.72	1.13
152+00	15200	775.21	774.99		0.22	LV KS	I-635	775.99	-0.78	1.00
153+00	15300	775.20	774.86		0.34	LV KS		775.98	-0.78	1.12
153+72	15372							775.97		
154+00	15400	775.19	774.67		0.52	LV KS		775.96	-0.77	1.29
154+80	15480							775.95		

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
155+00	15500	775.18	774.54		0.64	LV KS		775.95	-0.77	1.41
156+00	15600	775.17	774.54		0.63	LV KS		775.94	-0.77	1.40
157+00	15700	775.16	774.48		0.68	LV KS		775.93	-0.77	1.45
158+00	15800	775.15	774.49		0.66	LV KS		775.91	-0.76	1.42
159+00	15900	775.14	774.53		0.61	LV KS		775.90	-0.76	1.37
159+92	15992							775.89		
160+00	16000	775.14	774.50		0.64	LV KS		775.89	-0.75	1.39
160+18	16018							775.88		
161+00	16100	775.12	774.70		0.42	LV KS		775.87	-0.75	1.17
162+00	16200	775.12	774.73		0.39	LV KS		775.86	-0.74	1.13
162+50	16250							775.85		
163+00	16300	775.11	774.56		0.55	LV KS		775.85	-0.74	1.29
164+00	16400	775.10	774.51		0.59	LV KS		775.84	-0.74	1.33
165+00	16500	775.09	774.62		0.47	LV KS		775.82	-0.73	1.20
165+50	16550							775.82		
166+00	16600	775.08	774.81		0.27	LV KS		775.81	-0.73	1.00
167+00	16700	775.07	774.53		0.54	LV KS		775.80	-0.73	1.27
167+90	16790							775.78		
168+00	16800	775.06	774.25		0.81	LV KS		775.78	-0.72	1.53
169+00	16900	775.05	774.20		0.85	LV KS		775.77	-0.72	1.57
169+20	16920							775.76		
170+00	17000	775.04	774.15		0.89	LV KS		775.75	-0.71	1.60
170+20	17020							775.75		
171+00	17100	775.03	774.34		0.69	LV KS		775.74	-0.71	1.40
172+00	17200	775.02	774.31		0.71	LV KS		775.73	-0.71	1.42
172+65	17265							775.72		
173+00	17300	775.01	774.18		0.83	LV KS		775.71	-0.70	1.53
174+00	17400	775.00	774.15		0.85	LV KS		775.70	-0.70	1.55
175+00	17500	774.98	774.29		0.69	LV KS		775.68	-0.70	1.39
175+90	17590							775.67		
176+00	17600	774.97	774.39		0.58	LV KS		775.67	-0.70	1.28
177+00	17700	774.95	774.49		0.46	LV KS		775.65	-0.70	1.16
178+00	17800	774.94	774.41		0.53	LV KS		775.64	-0.70	1.23
178+85	17885							775.63		
179+00	17900	774.92	774.39		0.53	LV KS		775.63	-0.71	1.24
180+00	18000	774.91	774.25		0.66	LV KS		775.61	-0.70	1.36
180+25	18025							775.61		
180+45	18045							775.61		
181+00	18100	774.89	774.30		0.59	LV KS		775.60	-0.71	1.30

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
182+20	18220							775.58		
183+00	18300	774.86	774.25		0.61	LV KS		775.57	-0.71	1.32
184+00	18400	774.85	774.08		0.77	LV KS		775.56	-0.71	1.48
185+00	18500	774.83	774.00		0.83	LV KS		775.54	-0.71	1.54
185+55	18555							775.53		
186+00	18600	774.82	774.11		0.71	LV KS		775.53	-0.71	1.42
186+90	18690							775.52		
187+00	18700	774.81	774.37		0.44	LV KS		775.51	-0.70	1.14
188+00	18800	774.79	774.50		0.29	LV KS		775.50	-0.71	1.00
189+00	18900	774.78	774.15		0.63	LV KS		775.48	-0.70	1.33
190+00	19000	774.76	774.00		0.76	LV KS		775.47	-0.71	1.47
190+25	19025							775.46		
191+00	19100	774.75	774.18		0.57	LV KS		775.45	-0.70	1.27
192+00	19200	774.74	774.16		0.58	LV KS		775.43	-0.69	1.27
193+00	19300	774.72	774.02		0.70	LV KS		775.42	-0.70	1.40
194+00	19400	774.70	774.00		0.70	LV KS		775.40	-0.70	1.40
195+00	19500	774.69	774.09		0.60	LV KS		775.38	-0.69	1.29
196+00	19600	774.68	774.12		0.56	LV KS		775.37	-0.69	1.25
197+00	19700	774.66	773.98		0.68	LV KS		775.35	-0.69	1.37
198+00	19800	774.65	774.12		0.53	LV KS		775.33	-0.68	1.21
199+00	19900	774.64	774.04		0.60	LV KS		775.32	-0.68	1.28
200+00	20000	774.62	773.89		0.73	LV KS		775.30	-0.68	1.41
200+32	20032							775.29		
201+00	20100	774.60	773.83		0.77	LV KS		775.28	-0.68	1.45
202+00	20200	774.59	773.87		0.72	LV KS		775.27	-0.68	1.40
202+80	20280							775.25		
203+00	20300	774.58	773.54		1.04	LV KS		775.25	-0.67	1.71
204+00	20400	774.56	773.99		0.57	LV KS		775.23	-0.67	1.24
205+00	20500	774.55	773.95		0.60	LV KS		775.22	-0.67	1.27
205+55	20555							775.21		
206+00	20600	774.54	774.20		0.34	LV KS		775.20	-0.66	1.00
207+00	20700	774.52	774.00		0.52	LV KS		775.13	-0.61	1.13
208+00	20800	774.51	773.72		0.79	LV KS		775.06	-0.55	1.34
209+00	20900	774.50	773.82		0.68	LV KS		775.00	-0.50	1.18
210+00	21000	774.50	773.87		0.63	LV KS		774.93	-0.43	1.06
210+40	21040							774.90		
211+00	21100	774.50	773.89		0.61	LV KS		774.86	-0.36	0.97
212+00	21200	774.50	773.40		1.10	LV KS		774.79	-0.29	1.39
213+00	21300	774.50	773.68		0.82	KS AVE Bridge		774.72	-0.22	1.04
214+00	21400	774.50	778.00		-3.50	KS AVE Bridge		774.65	-0.15	-3.35
214+40	21440							774.63		

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
215+00	21500	774.49	789.43		-14.94	KS AVE Bridge		774.59	-0.10	-14.84
216+00	21600	774.47	774.68		-0.21	KS AVE Bridge		774.52	-0.05	-0.16
216+10	21610							774.51		
217+00	21700	774.45	772.89		1.56	LV KS		774.45	0.00	1.56
217+50	21750							774.41		
218+00	21800	774.43	773.06		1.37	LV KS		774.43	0.00	1.37
219+00	21900	774.40	773.02		1.38	LV KS		774.41	-0.01	1.39
220+00	22000	774.38	773.08		1.30	LV KS		774.39	-0.01	1.31
220+30	22030							774.38		
221+00	22100	774.36	773.15		1.21	LV KS		774.37	-0.01	1.22
221+65	22165							774.35		
222+00	22200	774.34	773.09		1.25	LV KS		774.34	0.00	1.25
223+00	22300	774.32	772.99		1.33	LV KS		774.32	0.00	1.33
224+00	22400	774.30	772.87		1.43	LV KS		774.30	0.00	1.43
224+50	22450							774.29		
225+00	22500	774.27	772.82		1.45	LV KS		774.28	-0.01	1.46
226+00	22600	774.25	772.73		1.52	LV KS		774.26	-0.01	1.53
227+00	22700	774.23	772.90		1.33	LV KS		774.24	-0.01	1.34
228+00	22800	774.21	772.73		1.48	LV KS		774.21	0.00	1.48
228+60	22860							774.20		
229+00	22900	774.19	772.67		1.52	LV KS		774.19	0.00	1.52
229+30	22930							774.19		
230+00	23000	774.17	772.64		1.53	LV KS		774.17	0.00	1.53
231+00	23100	774.14	772.60		1.54	LV KS		774.15	-0.01	1.55
232+00	23200	774.12	772.62		1.50	LV KS		774.13	-0.01	1.51
233+00	23300	774.10	772.43		1.69	LV KS		774.11	-0.01	1.68
234+00	23400	774.08	772.55		1.55	LV KS		774.08	0.00	1.53
235+00	23500	774.06	772.65		1.43	LV KS		774.06	0.00	1.41
235+06	23506							774.06		
235+30	23530							774.06		
236+00	23600	774.04	772.36		1.70	LV KS		774.04	0.00	1.68
237+00	23700	774.02	772.19		1.85	LV KS		774.02	0.00	1.83
237+30	23730							774.01		
238+00	23800	773.96	772.22		1.80	LV KS		774.00	-0.04	1.78
238+30	23830							774.00		
239+00	23900	773.89	772.35		1.61	LV KS		773.98	-0.09	1.63
240+00	24000	773.88	772.32		1.56	LV KS		773.97	-0.09	1.65
240+20	24020							773.96		
241+00	24100	773.86	772.22		1.64	LV KS		773.95	-0.09	1.73

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
241+20	24120							773.94		
242+00	24200	773.85	772.21		1.64	LV KS		773.93	-0.08	1.72
243+00	24300	773.84	772.11		1.73	LV KS		773.91	-0.07	1.80
244+00	24400	773.82	772.11		1.71	LV KS		773.89	-0.07	1.78
245+00	24500	773.81	772.14		1.67	LV KS		773.87	-0.06	1.73
245+15	24515							773.87		
245+70	24570							773.86		
246+00	24600	773.79	771.92		1.87	LV KS		773.86	-0.07	1.94
246+20	24620							773.85		
247+00	24700	773.78	771.62		2.16	LV KS		773.84	-0.06	2.22
248+00	24800	773.76	771.32		2.44	LV KS		773.82	-0.06	2.50
249+00	24900	773.75	771.84		1.91	LV KS		773.80	-0.05	1.96
250+00	25000	773.74	771.82		1.92	LV KS		773.78	-0.04	1.96
251+00	25100	773.72	771.95		1.77	LV KS		773.77	-0.05	1.82
251+40	25140							773.76		
252+00	25200	773.68	771.50		2.18	FW		773.75	-0.07	2.25
253+00	25300	773.69	771.50		2.19	FW		773.73	-0.04	2.23
254+00	25400	773.68	771.33		2.35	LV KS		773.71	-0.03	2.38
255+00	25500	773.66	771.16		2.50	LV KS		773.69	-0.03	2.53
256+00	25600	773.65	771.05		2.60	LV KS		773.67	-0.02	2.62
257+00	25700	773.64	771.01		2.63	LV KS		773.66	-0.02	2.65
258+00	25800	773.62	771.44		2.18	LV KS		773.64	-0.02	2.20
259+00	25900	773.60	771.19		2.41	LV KS		773.62	-0.02	2.43
260+00	26000	773.59	771.09		2.50	LV KS		773.60	-0.01	2.51
261+00	26100	773.57	771.07		2.50	LV KS		773.58	-0.01	2.51
262+00	26200	773.56	771.03		2.53	LV KS		773.57	-0.01	2.54
263+00	26300	773.54	771.20		2.34	LV KS		773.55	-0.01	2.35
264+00	26400	773.53	771.31		2.22	LV KS		773.53	0.00	2.22
265+00	26500	773.51	771.11		2.40	LV KS		773.51	0.00	2.40
265+55	26555							773.50		
266+00	26600	773.49	770.87		2.62	LV KS		773.49	0.00	2.62
267+00	26700	773.47	770.71		2.76	LV KS		773.47	0.00	2.76
268+00	26800	773.45	770.61		2.84	LV KS		773.46	-0.01	2.85
269+00	26900	773.44	770.41		3.03	LV KS		773.44	0.00	3.03
270+00	27000	773.42	770.53		2.89	LV KS		773.42	0.00	2.89
271+00	27100	773.36	770.66		2.70	LV KS		773.40	-0.04	2.74
272+00	27200	773.20	770.56		2.64	LV KS		773.30	-0.10	2.74
273+00	27300	773.13	770.56		2.57	LV KS		773.21	-0.08	2.65
274+00	27400	773.06	770.46		2.60	LV KS		773.11	-0.05	2.65
275+00	27500	772.98	770.87		2.11	LV KS		773.01	-0.03	2.14
276+00	27600	772.90	770.86		2.04	LV KS		772.92	-0.02	2.06
276+70	27670							772.85		
277+00	27700	772.82	771.00		1.82	LV KS		772.82	0.00	1.82

EXHIBIT A-5.4 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
278+00	27800	772.72	771.00		1.72	LV KS		772.82	-0.10	1.82
279+00	27900	772.63	771.00		1.63	LV KS		772.82	-0.19	1.82
280+00	28000	772.55	771.00		1.55	FW		772.82	-0.27	1.82
280+20	28020							772.82		
281+00	28100	772.45	771.00		1.45	FW		772.82	-0.37	1.82
282+00	28200	772.36	771.00		1.36	FW		772.82	-0.46	1.82
282+80	28280							772.82		
283+00	28300	772.27	771.00		1.27	FW		772.82	-0.55	1.82
284+00	28400	772.16	771.00		1.16	FW		772.82	-0.66	1.82
284+15	28415							772.82		
285+00	28500	772.07	771.00		1.07	FW		772.82	-0.75	1.82
285+70	28570							772.82		
286+00	28600	771.98	771.00		0.98	FW		772.82	-0.84	1.82
286+50	28650							772.82		
287+00	28700	771.89	771.00		0.89	FW		772.82	-0.93	1.82
287+92	28792							772.82		
288+00	28800	771.80	770.94		0.86		Stop Log	772.82	-1.02	1.88
289+00	28900	771.93	768.97		2.96		Stop Log	772.82	-0.89	3.85
289+40	28940	771.93	771.08		0.85		Stop Log	772.82	-0.89	1.74

SLOPE STABILITY

EXHIBIT A-5.5
500-Yr Station 54+00 -Stability Analysis without Berm
(Typical Sta. 31+00 to 54+00)

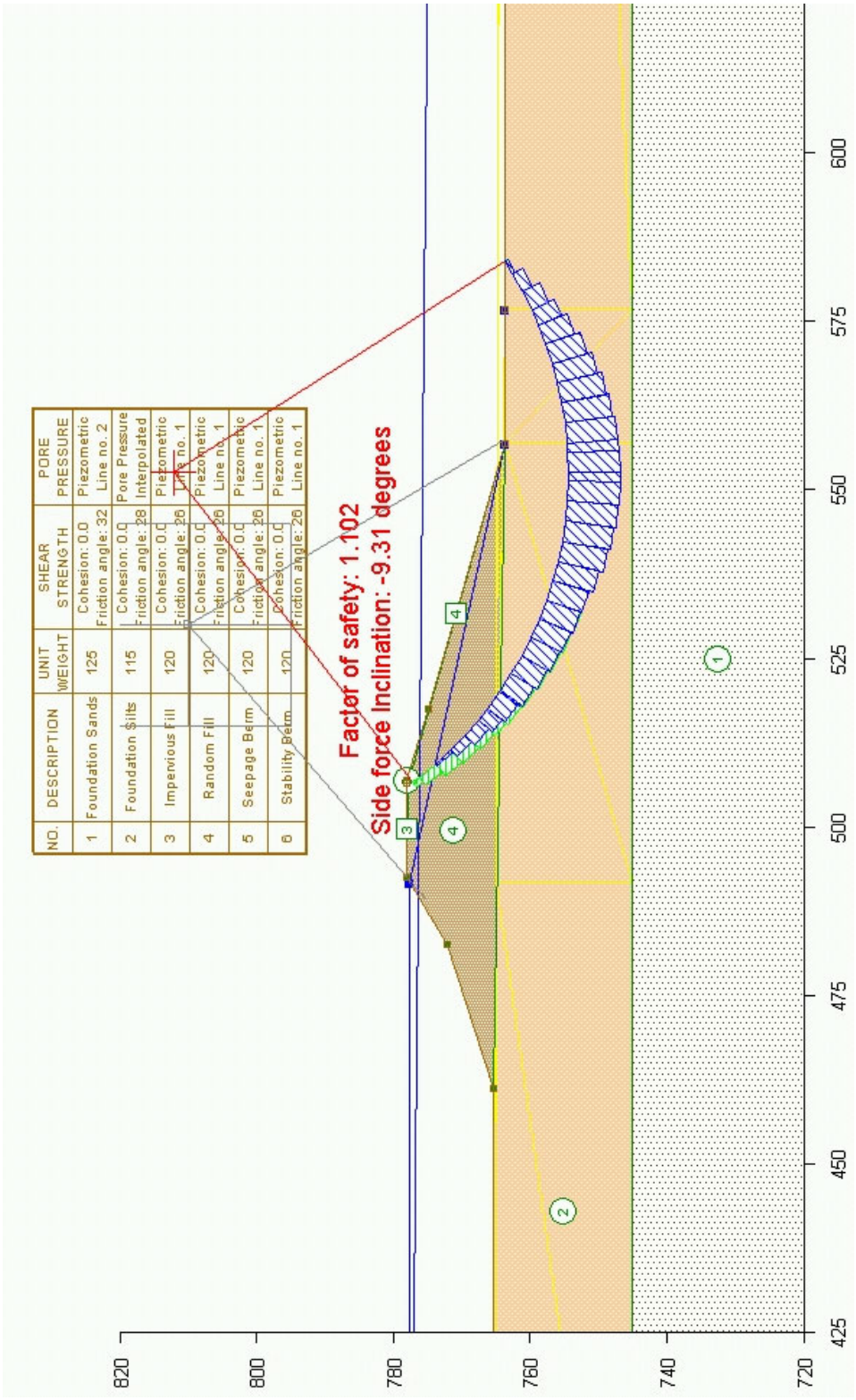


EXHIBIT A-5.6
500-Yr Station 61+00 -Stability Analysis with Berms
(Typical Sta. 31+00 to 61+00)

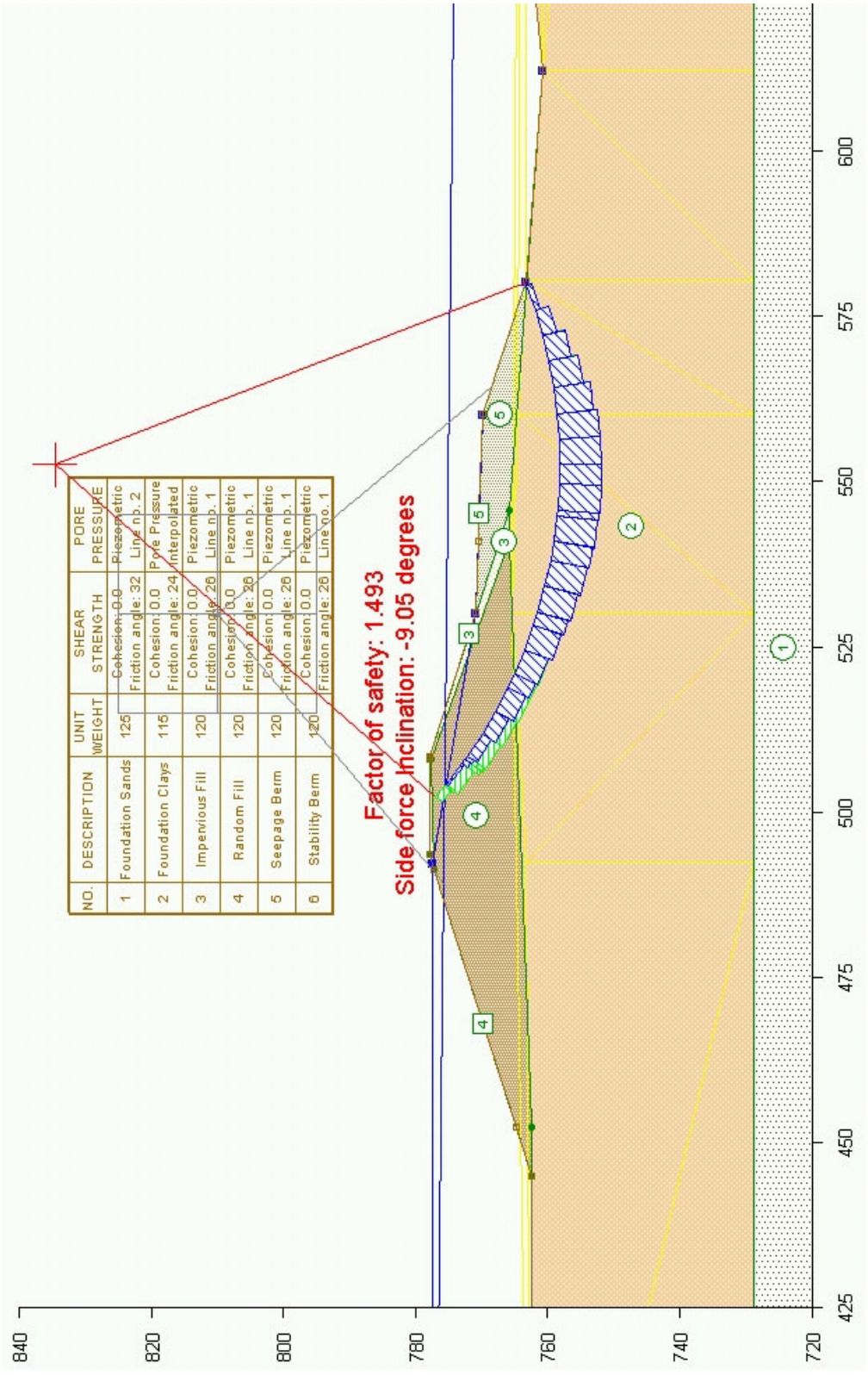


EXHIBIT A-5.7
500-Yr Station 118+00 -Stability Analysis without Berms
(Typical Sta. 118+00 to 182+20)

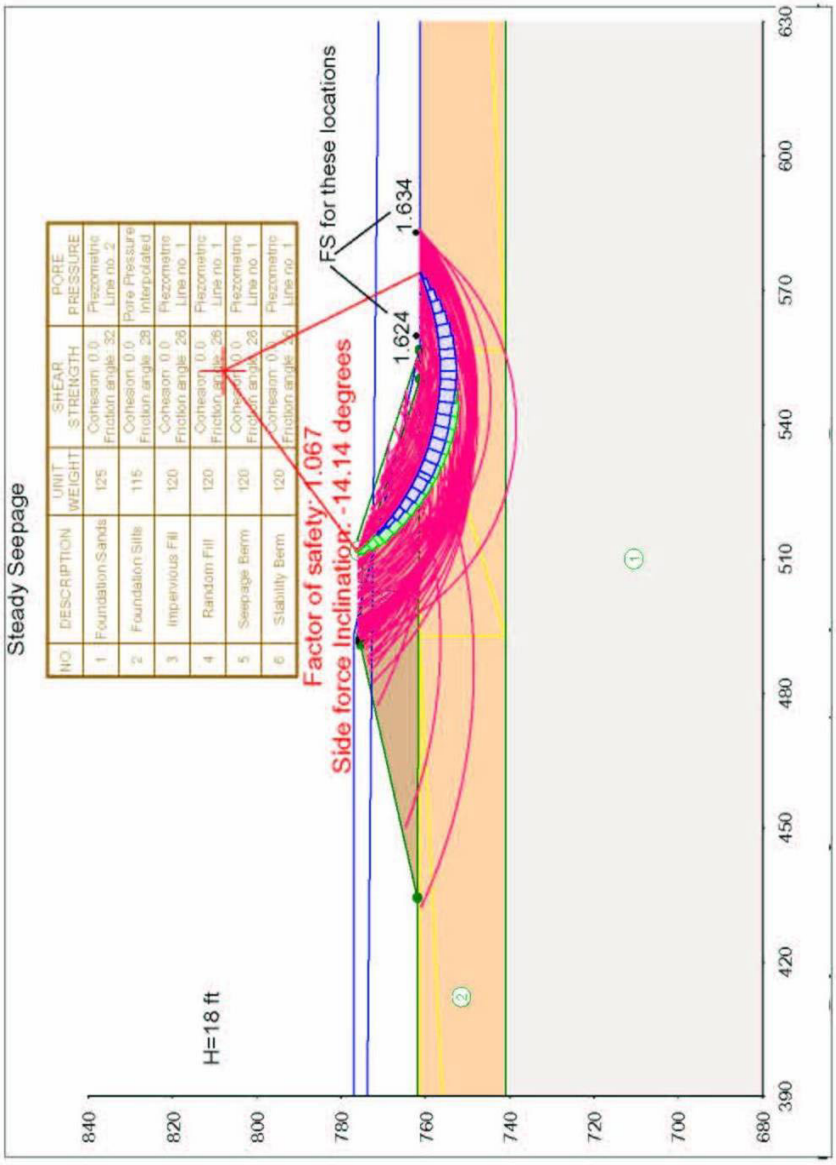


EXHIBIT A-5.8
500-Yr Station 118+00 -Stability Analysis with Berms
(Typical Sta. 118+00 to 182+20)

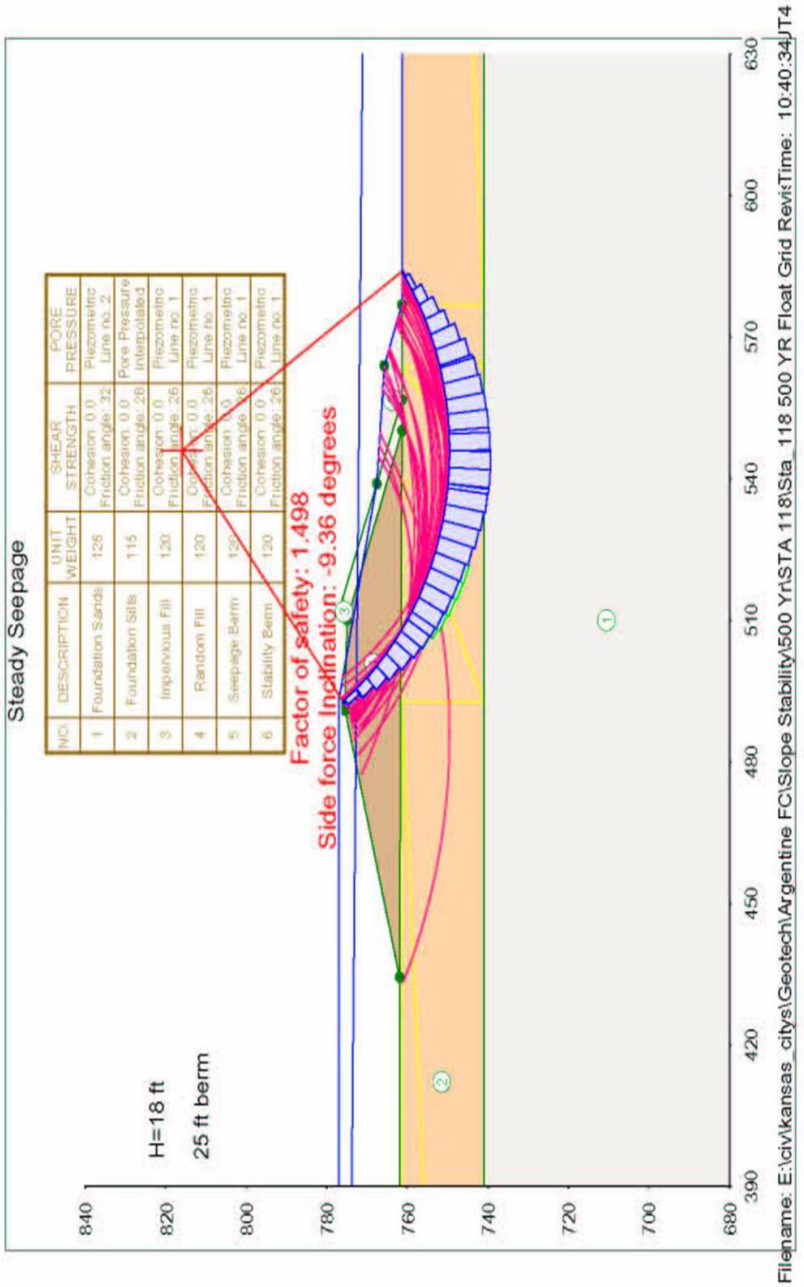


EXHIBIT A-5.9
500-Yr Station 118+00 -Stability Analysis with Berms
(Typical Sta. 118+00 to 118+20)

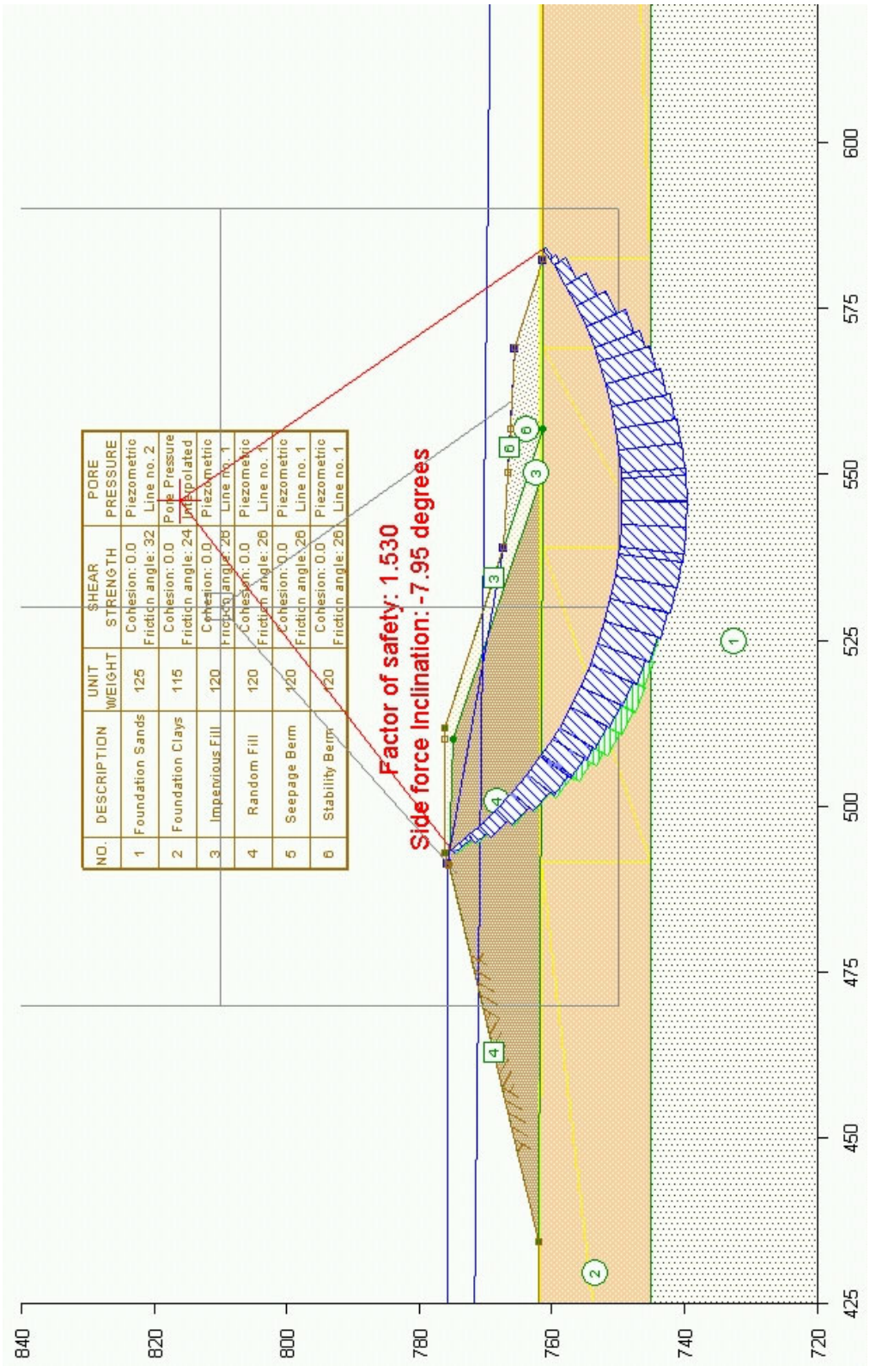


EXHIBIT A-5.10
500-Yr Station 257+00 -Stability Analysis with Berms
(Typical Sta. 254+00 to 257+00)

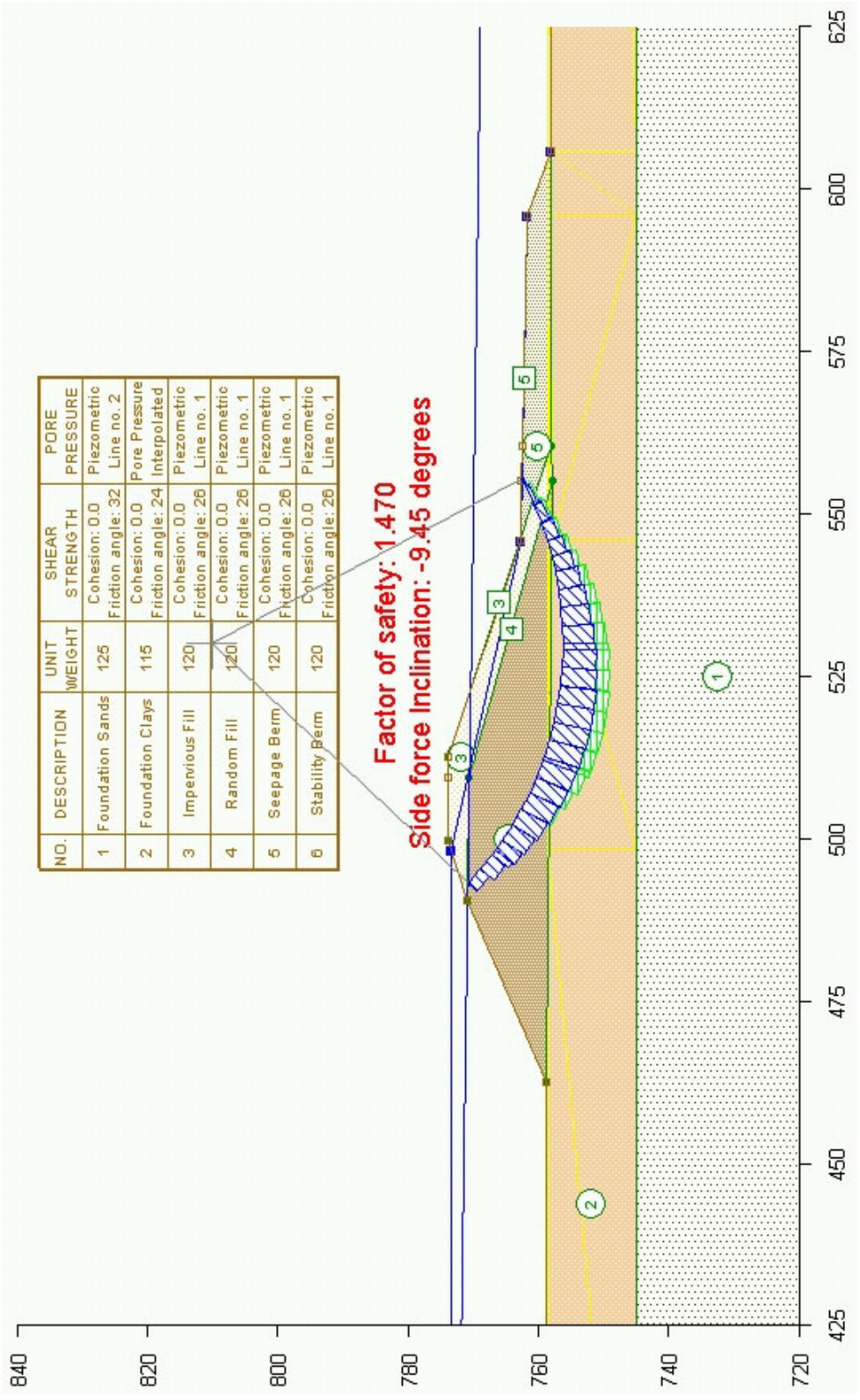


EXHIBIT A-5.11
500-Yr Station 265+00 -Stability Analysis without Berms No Rock Face
(Typical Sta. 258+00 to 276+70)

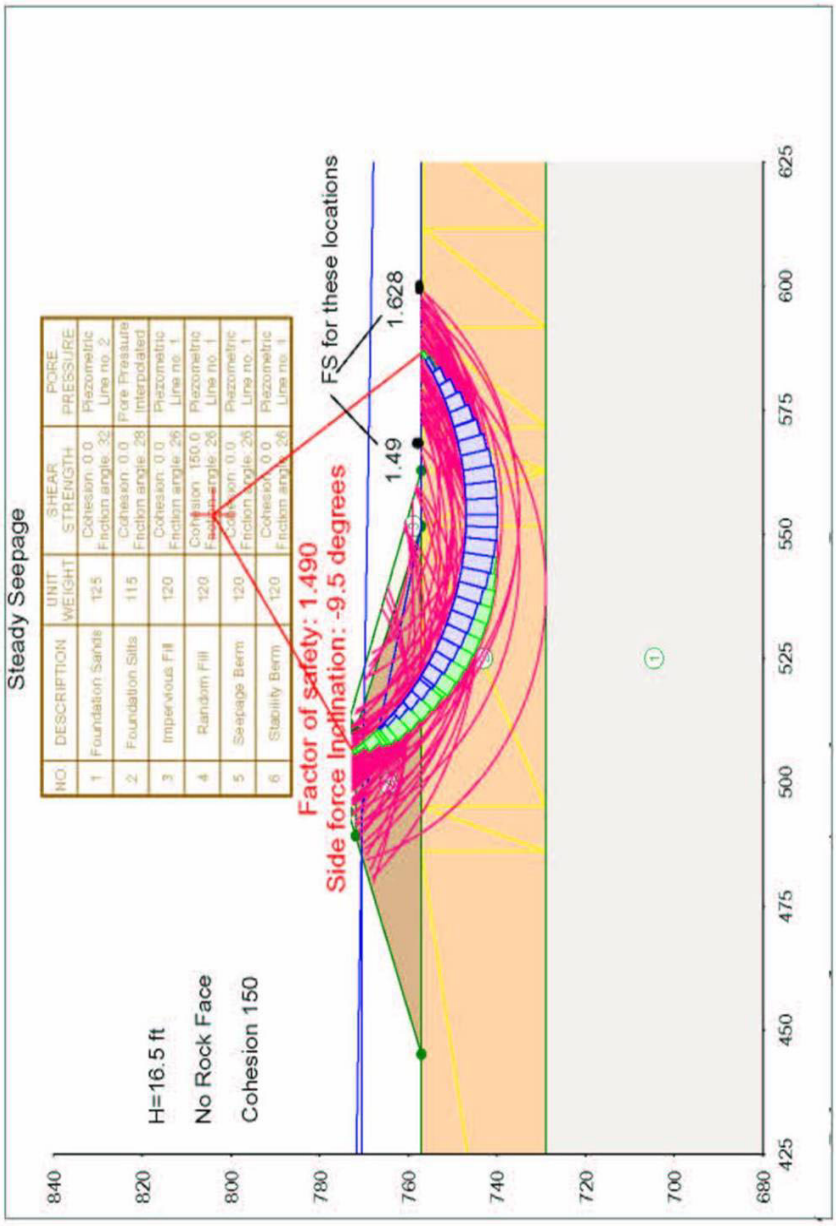


EXHIBIT A-5.12
500-Yr Station 265+00 -Stability Analysis without Berms Rock Face
(Typical Sta. 258+00 to 276+70)

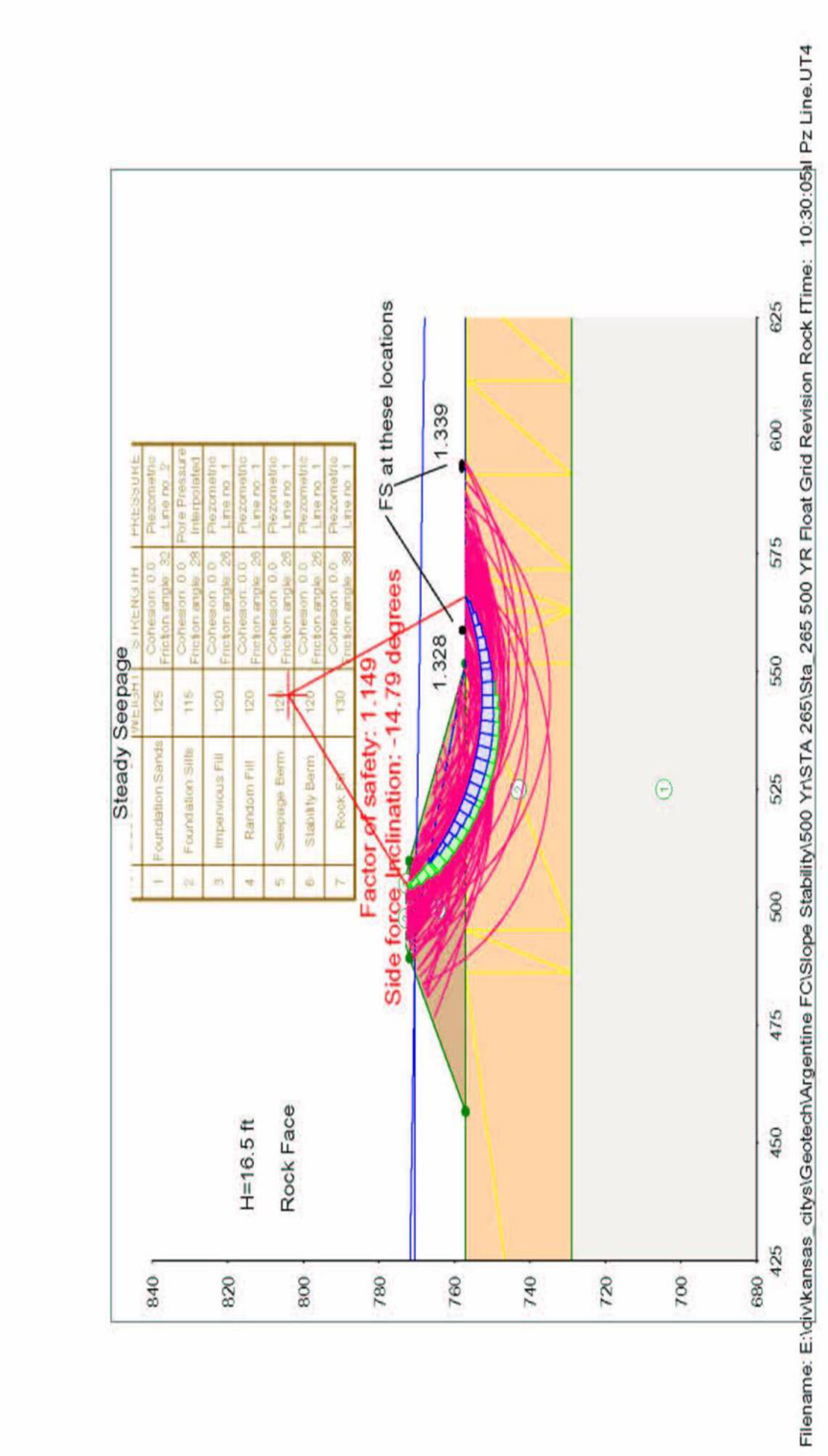


EXHIBIT A-5.13
500-Yr Station 265+00 -Stability Analysis without Berms
(Typical Sta. 258+00 to 276+70)

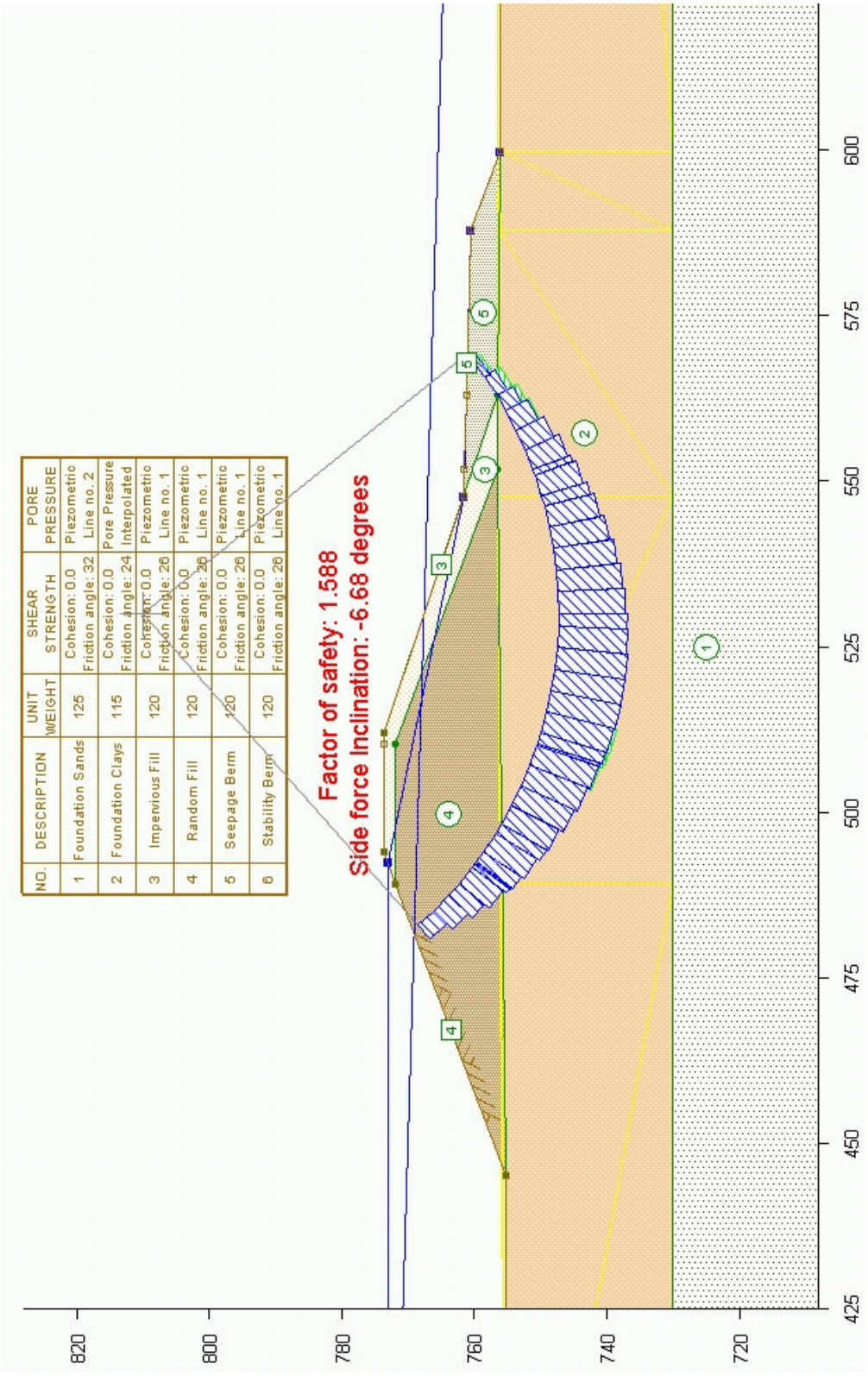
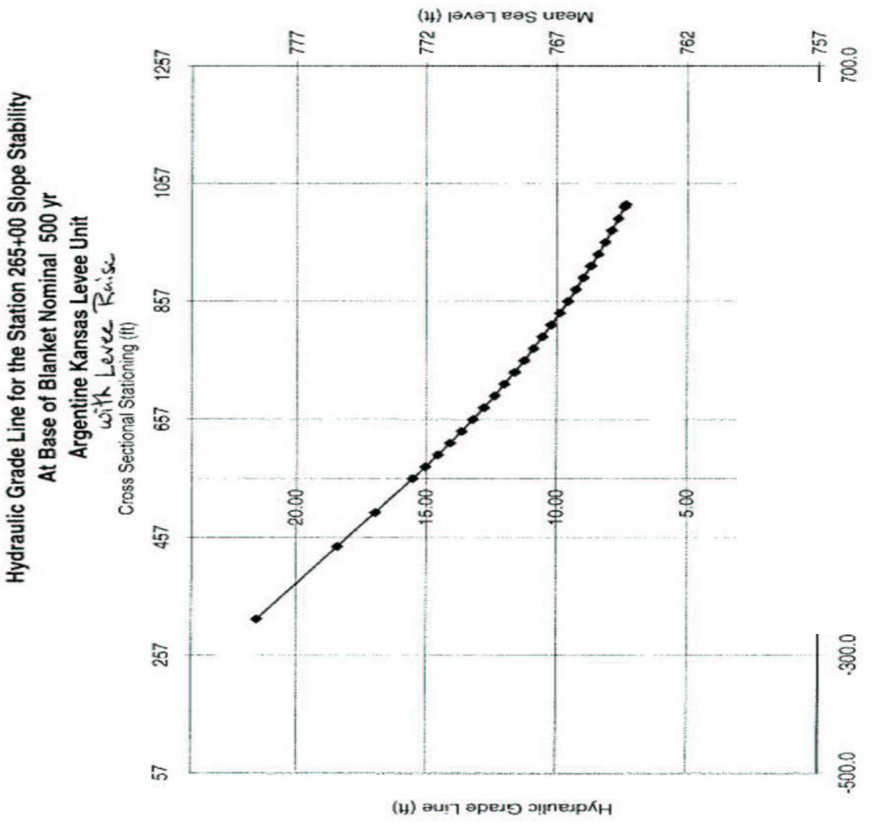


EXHIBIT A-5.14
500-Yr Station 265+00 -Stability Analysis Hydraulic Grade Line



NOMINAL 500-YEAR + 3 FEET

EXHIBIT A-5.15
Assumed 500-Yr Flood Elevation
Station 0+00 to 39+00

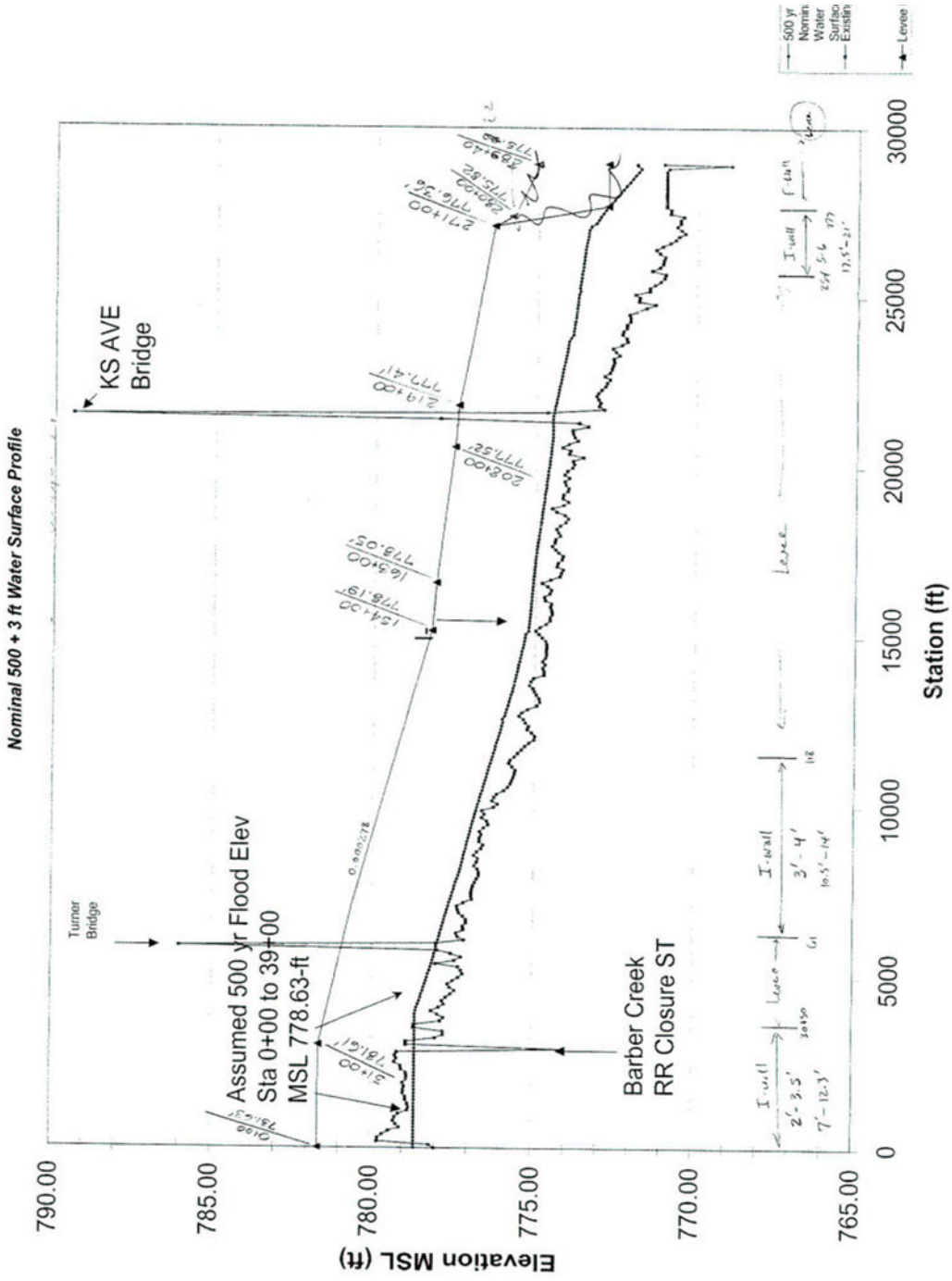


EXHIBIT A-5.16
Argentine Levee Raise N500+3

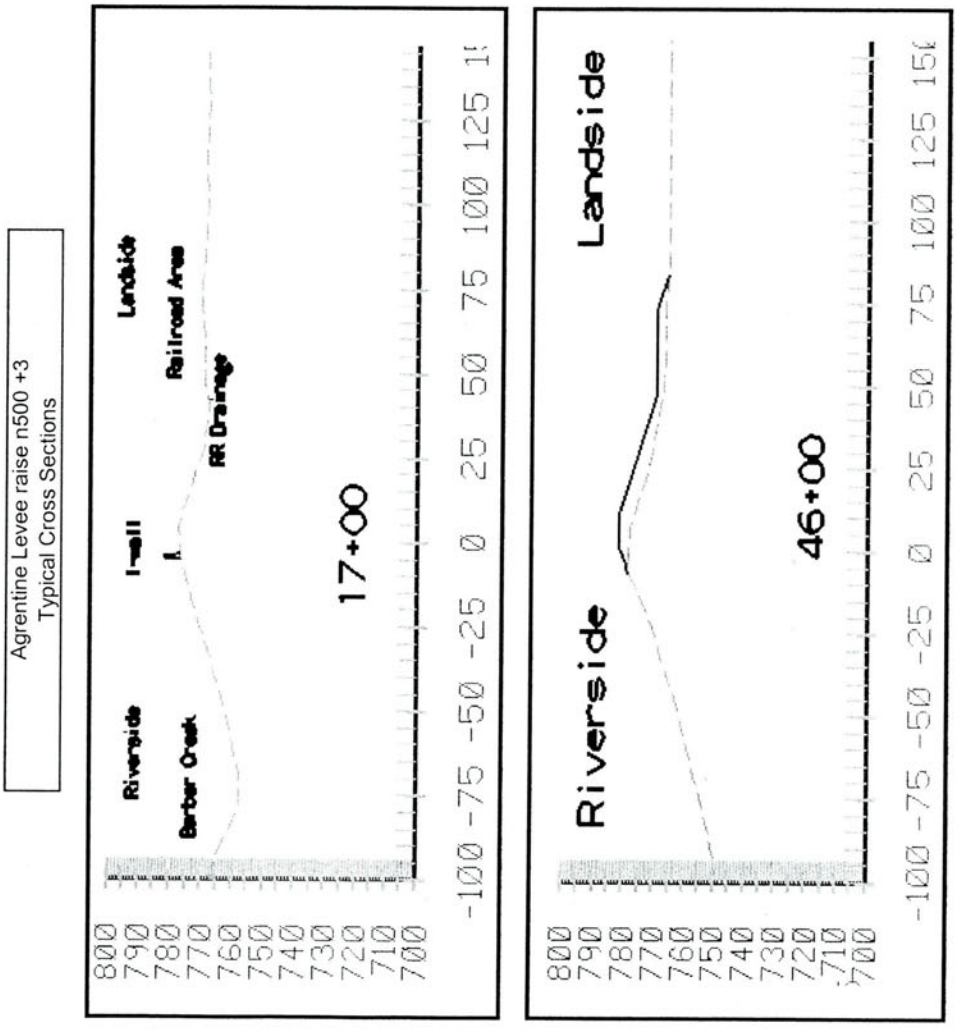


EXHIBIT A-5.17
Argentine Levee Raise N500+3

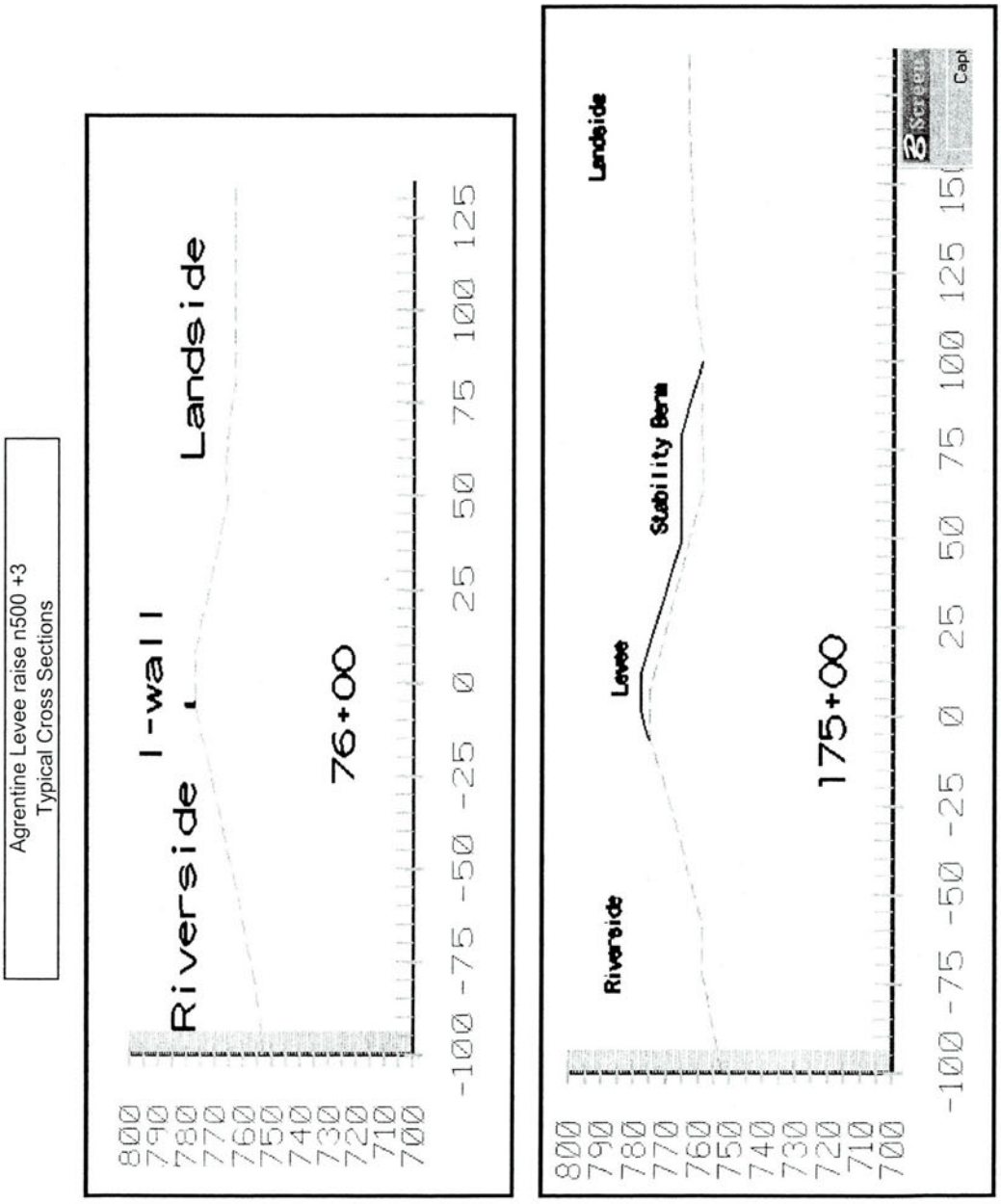
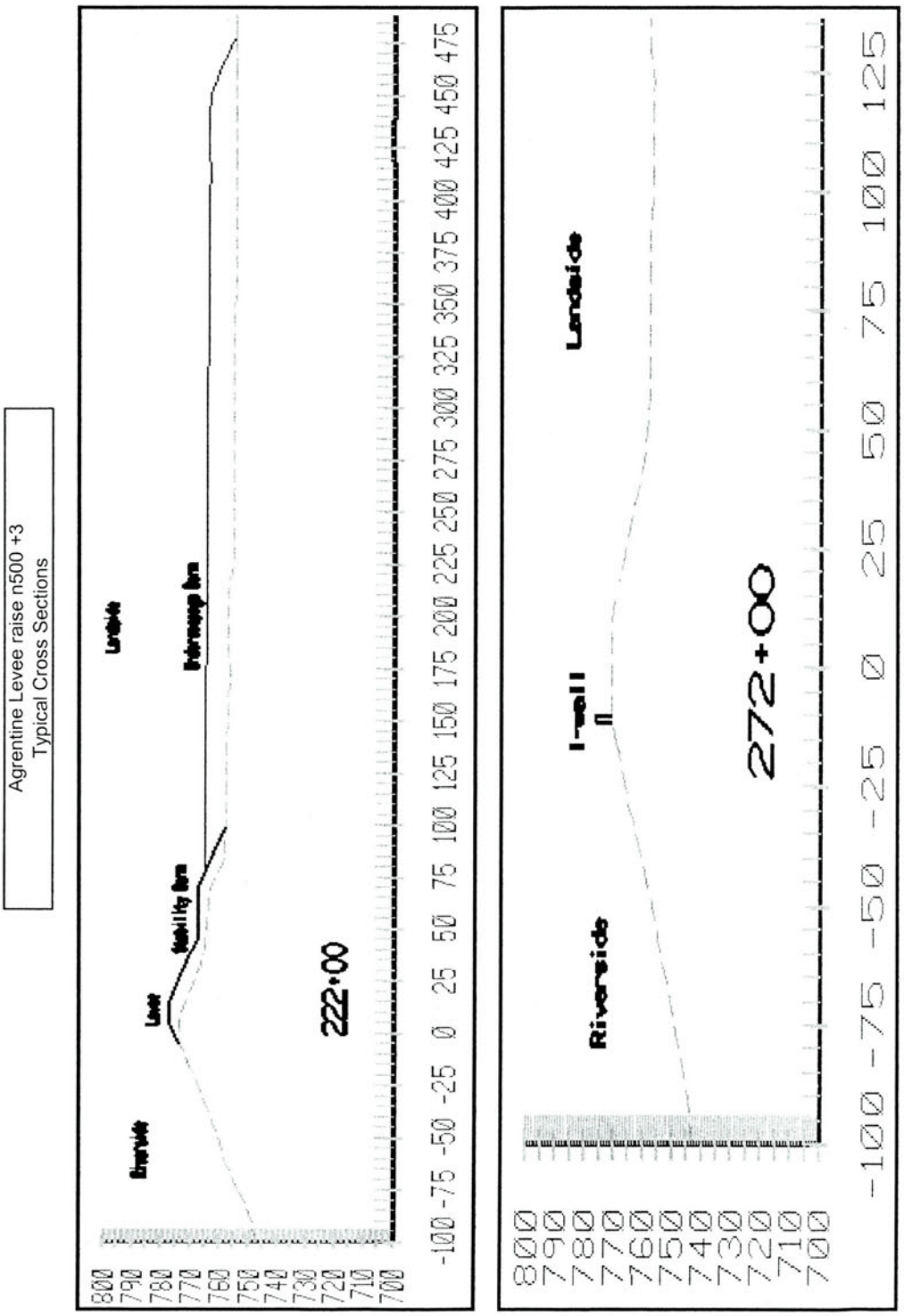


EXHIBIT A-5.18
Argentine Levee Raise N500+3



UNDERSEEPAGE

UNDERSEEPAGE ANALYSIS

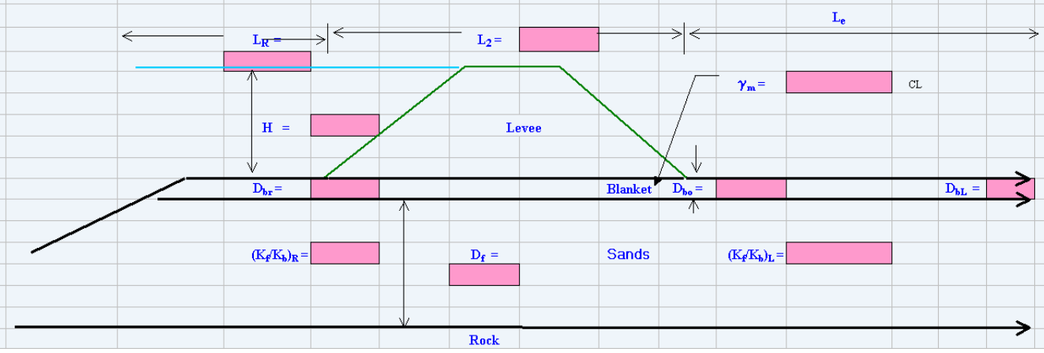
Note : This spreadsheet analysis should be used only if the blanket thickness is at least 1/4 of the height of the levee.

Argentine 3

Name : Campbell EC-GG

Date : 4/20/2004

Revised to reflect criteria developed for L-142



Recommended Permeability Ratio For Foundation Blanket Materials Chapter Underseepage Revision dated Oct 1998	
Blanket Material	Assumed Permeability Ratio, (Kf/Kb)
SM	100
ML	200 to 400
ML-CL	400
CL	400 to 600
CH	800 to 1000

D_{br}	= riverside blanket thickness	q	= seepage /unit Length
D_{bo}	= levee toe blanket thickness	Q	= cummulated seepage
D_{bL}	= landside blanket thickness	FS_i	= i_c / i_o
D_f	= thickness of pervious foundation		
L_R	= length of riverside blanket		
L_L	= length of landside blanket		
H	= max head or levee height		
$H(W_T)$	= head above tailwater at end of underseepage berm		
$H(W_T)$	= $H(W_T/2)*e^{(-WT/(2*CL))}$		
$H(W_{T/2})$	= head above tailwater midpoint of underseepage berm		
	= $H * L_e / L'_t$		
W_T	= berm width		
i_o	= seepage gradient		
C_r	= riverside effective length coefficient		
C_L	= landside effective length coefficient		
where C =	$[(Kf/Kb) * Df * Db]^{1/2}$		
H'o	= head above tailwater at levee toe (w/ berm)		
i_c	= critical seepage gradient		
L_1	= riverside effective length		
where L_1	= $C * (e^{(2LR/C-1)}) / (e^{(2LR/C+1)})$		
L_2	= levee base width		
L_e	= landside effective length		
L_t	= total effective length		
L'_t	= Total Effective Length + 1/2 of Berm		

			Input Parameters 3 Ft Raise								
Station	Begin Station Feet	End Station Feet	$(K_f/K_b)_R$	$(K_f/K_b)_L$	D_{bL}	D_{bo}	D_{br}	D_f	L_R	H	Remarks
0+0 to 30+0	0+00	30+00	500	500	28.0	28.0	28.0	66.0	170	7.6	
30+0 to 46+0	30+00	46+00	200	200	35.0	35.0	35.0	60.0	150.0	13.6	
46+0 to 50+0	46+00	50+00	250	250	25.0	25.0	25.0	67.0	100.0	15.0	
50+0 to 59+0	50+00	59+00	300	300	20.0	20.0	20.0	62.5	100.0	18.5	
59+0 to 70+0	59+00	70+00	300	300	23.0	23.0	23.0	58.0	150.0	18.5	
70+0 to 74+0	70+00	74+00	200	200	16.0	16.0	16.0	70.0	350.0	16.0	
74+0 to 86+0	74+00	86+00	200	200	16.0	16.0	16.0	70.0	350.0	16.5	
86+0 to 96+0	86+00	96+00	250	250	28.0	28.0	28.0	62.0	650.0	13.5	
96+0 to 110+0	96+00	110+00	150	150	30.0	30.0	30.0	66.0	1050.0	17.0	
110+0 to 118+0	110+00	118+00	250	250	20.0	20.0	20.0	65.0	400.0	17.3	
118+0 to 128+0	118+00	128+00	250	250	20.0	20.0	20.0	67.0	380.0	21.0	
128+0 to 135+0	128+00	135+00	300	300	25.0	25.0	25.0	67.0	360.0	17.5	
135+0 to 141+0	135+00	141+00	300	300	25.0	25.0	25.0	55.0	474.0	18.5	
141+0 to 151+0	141+00	151+00	300	300	20.0	20.0	20.0	60.0	425.0	20.0	
151+0 to 161+0	151+00	161+00	300	300	25.0	25.0	25.0	56.0	400.0	18.2	
161+0 to 170+0	161+00	170+00	300	300	12.0	12.0	12.0	65.0	250.0	18.1	
170+0 to 182+0	170+00	182+00	200	200	18.0	18.0	18.0	67.0	350.0	20.0	Has Berm
182+0 to 193+0	182+00	193+00	250	250	23.0	23.0	23.0	60.0	175.0	18.0	

														Analysis of Without Berm Conditions 3 Ft Raise		
C_R Feet	C_L Feet	L_1 Feet	L_2 Feet	L_e Feet	L_t Feet	h_o Feet	i_o Ft/Ft	ic Ft/Ft	Check #1 Full Head Toe FS_i (need 1.1)	Check #1 Reduced Head Toe FS_i (need 1.5)	Remarks
---	---	---	---	---	---	---	---	---	---	---	---
961	961	168	52	961	1181	6.21	0.22	0.85	3.83	6.32	
648	648	147	125	648	920	9.55	0.27	0.85	3.12	4.00	
647	647	99	98	647	844	11.50	0.46	0.85	1.85	2.31	
612	612	99	110	612	821	13.79	0.69	0.85	1.23	1.47	
633	633	147	108	633	888	13.18	0.57	0.85	1.48	1.77	
473	473	298	102	473	873	8.68	0.54	0.85	1.57	1.93	
473	473	298	102	473	873	8.95	0.56	0.85	1.52	1.86	
659	659	498	95	659	1252	7.10	0.25	0.85	3.35	4.31	
545	545	522	125	545	1192	7.77	0.26	0.85	3.28	3.98	
570	570	345	135	570	1050	9.39	0.47	0.85	1.81	2.19	
579	579	333	140	579	1052	11.55	0.58	0.85	1.47	1.72	
709	709	332	121	709	1162	10.68	0.43	0.85	1.99	2.40	
642	642	403	118	642	1164	10.21	0.41	0.85	2.08	2.48	
600	600	366	135	600	1101	10.90	0.55	0.85	1.56	1.83	
648	648	356	121	648	1125	10.48	0.42	0.85	2.03	2.43	
484	484	230	120	484	834	10.50	0.88	0.85	0.97	1.16	
491	491	301	115	491	907	10.83	0.60	0.85	1.41	1.66	
587	587	170	110	587	867	12.19	0.53	0.85	1.60	1.92	

EXHIBIT A-5.19 (Continued)

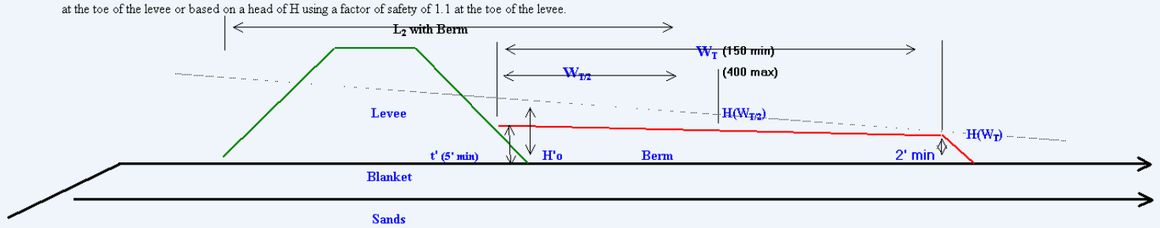
			Input Parameters 3 Ft Raise								
Station	Begin Station Feet	End Station Feet	$(K_f/K_b)_R$	$(K_f/K_b)_L$	D_{bL}	D_{bo}	D_{br}	D_f	L_R	H	Remarks
193+0 to 203+0	193+00	203+00	300	300	25.0	25.0	25.0	66.9	93	18.5	Has Berm
203+0 to 210+0	203+00	210+00	250	250	25.0	25.0	25.0	74.0	73.0	18.5	Has Berm
210+0 to 218+0	210+00	218+00	250	250	30.0	30.0	30.0	62.5	150.0	19.4	
218+0 to 226+0	218+00	226+00	200	200	25.0	25.0	25.0	63.0	150.0	22.8	
226+0 to 234+0	226+00	234+00	300	300	28.0	28.0	28.0	55.0	170.0	21.2	Has Berm
234+0 to 245+0	234+00	245+00	250	250	25.0	25.0	25.0	61.0	150.0	21.5	Has Berm
245+0 to 260+0	245+00	260+00	300	300	28.0	28.0	28.0	62.0	160.0	20.5	
260+0 to 270+0	260+00	270+00	250	250	28.0	28.0	28.0	55.0	125.0	19.5	
270+0 to 275+0	270+00	275+00	300	300	28.0	28.0	28.0	66.9	94.0	13.6	
275+0 to 280+0	275+00	280+00	275	275	40.0	40.0	40.0	68.8	62.0	10.0	Floodwall
280+0 to 290+0	280+00	290+00	200	200	40.0	40.0	40.0	78.0	50.0	8.8	Floodwall

Analysis of Without Berm Conditions 3 Ft Raise											
C_R Feet	C_L Feet	L_1 Feet	L_2 Feet	L_e Feet	L_t Feet	h_o Feet	i_o Ft/Ft	ic Ft/Ft	Check #1 Full Head Toe FS_i (need 1.1)	Check #1 Reduced Head Toe FS_i (need 1.5)	Remarks
708	708	92	101	708	902	14.53	0.58	0.85	1.46	1.75	
680	680	73	103	680	856	14.70	0.59	0.85	1.45	1.73	
685	685	148	107	685	939	14.14	0.47	0.85	1.80	2.13	
561	561	147	122	561	830	15.42	0.62	0.85	1.38	1.59	
680	680	167	150	680	996	14.46	0.52	0.85	1.65	1.92	
617	617	147	145	617	910	14.60	0.58	0.85	1.46	1.69	
722	722	157	145	722	1024	14.45	0.52	0.85	1.65	1.93	
620	620	123	129	620	873	13.86	0.50	0.85	1.72	2.03	
750	750	94	103	750	946	10.78	0.38	0.85	2.21	2.83	
870	870	62	14	870	946	9.20	0.23	0.85	3.70	5.28	
790	790	50		790	854	8.14	0.20	0.85	4.18	6.34	

General Notes

Analysis of Existing Conditions : This portion uses full head for the check #1 for FS_i = 1.1 and Full Head less 3 feet for the Check #2 for FS_i = 1.5.
If either of these two columns indicate that the required FS_i is not met then the underseepage berm design is needed.

Berm Design Information : The Excessive head columns provides the designer with a feel for which check case control.
The design of the berm at the toe of the levee requires a FS_i of at least 1.5 for the controlling case, using the reduced head (87% of full head).
The design of the extension of the berm is controlled using full head and a required FS_i of 1.1 at the toe of the berm.
If the FS_i = 1.1 is not met with the width = 400 feet minimum, then the 400 feet is used . The berm thickness required at the toe of the levee is controlled using an H'o at the levee toe set based on FS_i = 1.1, projecting back to the width less than 400 feet, with no adjustment made to H'o.
If the trail width is less than 400 feet, no adjustment to H'o is made. The minimum berm thickness is 5 feet (EM 1110-2-1913). The calculated berm thickness will be based on full head less 3 feet using a Factor of safety of 1.5 at the toe of the levee or based on a head of H using a factor of safety of 1.1 at the toe of the levee.



Berm Design Information 3 Ft Raise

Station	Excessive Head Control (Feet)		Trial Width	Effective Length	Mid Berm Head, ft	H(W_T) Feet	Berm Toe Gradient	Safety Factor	H'o at Levee Toe	Trial Minimum Berm Thickness	Levee Toe Gradient	Safety Factor Check at Levee Toe	
	FS_i = 1.1	FS_i = 1.5	W_T	L'_t	H($W_{T/2}$)		I_{Berm}	Berm Toe	Feet	t'	I'o	For 1.5	For 1.1
0+0 to 30+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
30+0 to 46+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
46+0 to 50+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
50+0 to 59+0	NA	0.22	10	896	12.6	12.5	0.63	1.36	10.67	2.5	0.36	2.34	
59+0 to 70+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
70+0 to 74+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
74+0 to 86+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
86+0 to 96+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
96+0 to 110+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
110+0 to 118+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
118+0 to 128+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
128+0 to 135+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
135+0 to 141+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
141+0 to 151+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
151+0 to 161+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
161+0 to 170+0	1.23	1.96	155	911	9.6	8.2	0.68	1.25	9.30	2.5	0.47	1.81	
170+0 to 182+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
182+0 to 193+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	

Berm Design Information 3 Ft Raise													
Berm Width Design									Berm Thickness Design				
Station	Excessive Head Control (Feet)		Trial Width	Effective Length	Mid Berm Head, ft	$H(W_T)$ Feet	Berm Toe Gradient	Safety Factor	H'o at Levee Toe	Trial Minimum Berm Thickness	Levee Toe Gradient	Safety Factor Check at Levee Toe	
	FS_i = 1.1	FS_i = 1.5	W_T	L'_t	$H(W_{T/2})$		I_{Berm}	Berm Toe	Feet	t'	I'o	For 1.5	For 1.1
193+0 to 203+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
203+0 to 210+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
210+0 to 218+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
218+0 to 226+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
226+0 to 234+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
234+0 to 245+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
245+0 to 260+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
260+0 to 270+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
270+0 to 275+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
275+0 to 280+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
280+0 to 290+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA

EXHIBIT A-5.21
Argentine Unit 500 yr + 3 ft With Survey Data Added

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
0+00	0	778.63	778.00	770.00	0.63	Hillside Ditch		781.63	-3.00	3.63
1+00	100	778.63	778.15	770.00	0.48	Hillside Ditch		781.63	-3.00	3.48
2+00	200	778.63	779.77	770.00	-1.14	Hillside Ditch		781.63	-3.00	1.86
3+00	300	778.63	779.75	768.00	-1.12	Hillside Ditch		781.63	-3.00	1.88
4+00	400	778.63	779.61	768.00	-0.98	Hillside Ditch		781.63	-3.00	2.02
5+00	500	778.63	779.42	768.93	-0.79	Hillside Ditch		781.63	-3.00	2.21
6+00	600	778.63	779.08	770.00	-0.45	Hillside Ditch		781.63	-3.00	2.55
7+00	700	778.63	779.19	770.00	-0.56	Hillside Ditch		781.63	-3.00	2.44
8+00	800	778.63	779.27	770.00	-0.64	Hillside Ditch		781.63	-3.00	2.36
9+00	900	778.63	779.23	770.00	-0.60	Hillside Ditch		781.63	-3.00	2.40
10+00	1000	778.63	779.12	770.00	-0.49	Hillside Ditch		781.63	-3.00	2.51
11+00	1100	778.63	778.82	768.00	-0.19	Hillside Ditch		781.63	-3.00	2.81
12+00	1200	778.63	778.80	768.00	-0.17	Hillside Ditch		781.63	-3.00	2.83
13+00	1300	778.63	778.83	768.00	-0.20	Key RD. 55th St		781.63	-3.00	2.80
14+00	1400	778.63	778.89	768.00	-0.26	Hillside Ditch		781.63	-3.00	2.74
15+00	1500	778.63	778.90	768.00	-0.27	Hillside Ditch		781.63	-3.00	2.73
16+00	1600	778.63	778.97	768.00	-0.34	Hillside Ditch		781.63	-3.00	2.66
17+00	1700	778.63	778.96	768.00	-0.33	Hillside Ditch		781.63	-3.00	2.67
18+00	1800	778.63	778.94	768.00	-0.31	Hillside Ditch		781.63	-3.00	2.69
19+00	1900	778.63	778.98	768.34	-0.35	Hillside Ditch		781.63	-3.00	2.65
20+00	2000	778.63	778.87	768.83	-0.24	Hillside Ditch		781.63	-3.00	2.76
21+00	2100	778.63	778.87	768.00	-0.24	Hillside Ditch		781.63	-3.00	2.76
22+00	2200	778.63	778.88	770.00	-0.25	Hillside Ditch		781.63	-3.00	2.75
23+00	2300	778.63	779.04	772.00	-0.41	Hillside Ditch		781.63	-3.00	2.59
24+00	2400	778.63	779.06	772.00	-0.43	Hillside Ditch		781.63	-3.00	2.57
25+00	2500	778.63	779.25	772.00	-0.62	Hillside Ditch		781.63	-3.00	2.38
26+00	2600	778.63	779.19	772.00	-0.56	Hillside Ditch		781.63	-3.00	2.44
27+00	2700	778.63	779.23	772.00	-0.60	Hillside Ditch		781.63	-3.00	2.40
28+00	2800	778.63	779.18	774.00	-0.55	Hillside Ditch	Closure Structure	781.63	-3.00	2.45
29+00	2900	778.63	774.00	****	4.63	Barber Creek RR FG	Closure Structure	781.63	-3.00	7.63
30+00	3000	778.63	778.90	768.00	-0.27	Barber Creek		781.63	-3.00	2.73
31+00	3100	778.63	778.90	766.00	-0.27	Barber Creek		781.61	-2.98	2.71
32+00	3200	778.63	778.00	768.00	0.63	Barber Creek		781.58	-2.95	3.58
33+00	3300	778.63	777.75	768.00	0.88	Barber Creek		781.56	-2.93	3.81
34+00	3400	778.63	777.76	****	0.87	Barber Creek Thorne Dr		781.53	-2.90	3.77
35+00	3500	778.63	778.67	766.00	-0.04	Barber Creek		781.51	-2.88	2.84
36+00	3600	778.63	778.66	766.00	-0.03	Barber Creek		781.49	-2.86	2.83
37+00	3700	778.63	777.84	766.00	0.79	Barber Creek		781.46	-2.83	3.62
38+00	3800	778.63	777.75	768.00	0.88	LV KS		781.44	-2.81	3.69
39+00	3900	778.63	777.94	766.00	0.69	LV KS		781.41	-2.78	3.47
40+00	4000	778.61	778.13	766.00	0.48	LV KS		781.39	-2.78	3.26
41+00	4100	778.59	777.89	766.00	0.70	LV KS		781.36	-2.77	3.47
42+00	4200	778.54	777.74	765.00	0.80	LV KS		781.34	-2.80	3.60
43+00	4300	778.50	777.79	765.00	0.71	LV KS		781.32	-2.82	3.53
44+00	4400	778.47	777.68	765.00	0.79	LV KS		781.29	-2.82	3.61
45+00	4500	778.44	777.53	766.00	0.91	LV KS		781.27	-2.83	3.74

EXHIBIT A-5.21 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
46+00	4600	778.40	777.41	766.00	0.99	LV KS		781.24	-2.84	3.83
47+00	4700	778.37	777.57	766.00	0.80	LV KS		781.22	-2.85	3.65
48+00	4800	778.34	777.62	767.00	0.72	LV KS		781.20	-2.86	3.58
49+00	4900	778.30	777.46	766.00	0.84	LV KS		781.17	-2.87	3.71
50+00	5000	778.27	777.29	766.00	0.98	LV KS		781.15	-2.88	3.86
51+00	5100	778.24	777.16	766.00	1.08	LV KS		781.12	-2.88	3.96
52+00	5200	778.20	777.22	766.00	0.98	LV KS		781.10	-2.90	3.88
53+00	5300	778.17	777.30	764.00	0.87	LV KS		781.07	-2.90	3.77
54+00	5400	778.13	778.00	764.00	0.13	LV KS		781.05	-2.92	3.05
55+00	5500	778.10	777.42	764.00	0.68	LV KS		781.03	-2.93	3.61
56+00	5600	778.07	777.22	762.00	0.85	LV KS		781.00	-2.93	3.78
57+00	5700	778.05	777.54	762.00	0.51	LV KS		780.98	-2.93	3.44
58+00	5800	778.01	777.96	762.00	0.05	LV KS		780.95	-2.94	2.99
59+00	5900	778.00	786.00	***	-8.00	LV KS	Turner Bridge	780.93	-2.93	-5.07
60+00	6000	777.97	778.00	***	-0.03	LV KS	Turner Bridge	780.91	-2.94	2.91
61+00	6100	777.93	777.13	762.00	0.80	LV KS		780.88	-2.95	3.75
62+00	6200	777.91	777.33	762.00	0.58	LV KS		780.86	-2.95	3.53
63+00	6300	777.88	777.37	762.00	0.51	LV KS		780.83	-2.95	3.46
64+00	6400	777.85	777.15	762.00	0.70	LV KS		780.81	-2.96	3.66
65+00	6500	777.82	777.17	762.00	0.65	LV KS		780.78	-2.96	3.61
66+00	6600	777.79	777.07	762.00	0.72	LV KS		780.76	-2.97	3.69
67+00	6700	777.76	777.07	762.00	0.69	LV KS		780.74	-2.98	3.67
68+00	6800	777.73	777.18	762.00	0.55	LV KS		780.71	-2.98	3.53
69+00	6900	777.70	777.30	762.00	0.40	LV KS		780.69	-2.99	3.39
70+00	7000	777.67	777.33	762.00	0.34	LV KS		780.66	-2.99	3.33
71+00	7100	777.64	777.36	762.00	0.28	LV KS		780.64	-3.00	3.28
72+00	7200	777.61	777.15	762.00	0.46	LV KS		780.61	-3.00	3.46
73+00	7300	777.57	776.90	764.00	0.67	LV KS		780.58	-3.01	3.68
74+00	7400	777.54	776.92	764.00	0.62	LV KS		780.55	-3.01	3.63
75+00	7500	777.51	776.92	764.00	0.59	LV KS		780.52	-3.01	3.60
76+00	7600	777.47	776.90	764.00	0.57	LV KS		780.49	-3.02	3.59
77+00	7700	777.44	776.87	764.00	0.57	LV KS		780.46	-3.02	3.59
78+00	7800	777.41	776.82	764.00	0.59	LV KS		780.43	-3.02	3.61
79+00	7900	777.37	776.75	764.00	0.62	LV KS		780.40	-3.03	3.65
80+00	8000	777.33	776.69	762.00	0.64	LV KS		780.37	-3.04	3.68
81+00	8100	777.30	776.69	762.00	0.61	LV KS		780.34	-3.04	3.65
82+00	8200	777.27	776.74	762.00	0.53	LV KS		780.31	-3.04	3.57
83+00	8300	777.24	776.83	764.00	0.41	LV KS		780.28	-3.04	3.45
84+00	8400	777.22	776.76	764.00	0.46	LV KS		780.25	-3.03	3.49
85+00	8500	777.19	776.73	764.00	0.46	LV KS		780.22	-3.03	3.49
86+00	8600	777.17	776.85	765.00	0.32	LV KS		780.19	-3.02	3.34
87+00	8700	777.14	776.75	766.00	0.39	LV KS		780.16	-3.02	3.41
88+00	8800	777.11	776.63	766.00	0.48	LV KS		780.13	-3.02	3.50
89+00	8900	777.08	776.57	766.00	0.51	LV KS		780.10	-3.02	3.53
90+00	9000	777.06	776.68	768.00	0.38	LV KS		780.07	-3.01	3.39
91+00	9100	777.03	776.68	768.00	0.35	LV KS		780.04	-3.01	3.36

EXHIBIT A-5.21 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
92+00	9200	777.00	776.63	768.00	0.37	LV KS		780.01	-3.01	3.38
93+00	9300	776.97	776.67	768.00	0.30	LV KS		779.98	-3.01	3.31
94+00	9400	776.95	776.55	768.00	0.40	LV KS		779.95	-3.00	3.40
95+00	9500	776.92	776.42	768.00	0.50	LV KS		779.92	-3.00	3.50
96+00	9600	776.89	776.46	768.00	0.43	LV KS		779.89	-3.00	3.43
97+00	9700	776.86	776.61	766.00	0.25	LV KS		779.86	-3.00	3.25
98+00	9800	776.83	776.53	764.00	0.30	LV KS		779.83	-3.00	3.30
99+00	9900	776.80	776.61	764.00	0.19	LV KS		779.80	-3.00	3.19
100+00	10000	776.77	776.25	764.00	0.52	LV KS		779.77	-3.00	3.52
101+00	10100	776.74	776.13	764.00	0.61	LV KS		779.74	-3.00	3.61
102+00	10200	776.71	776.30	764.00	0.41	LV KS		779.71	-3.00	3.41
103+00	10300	776.68	776.24	764.00	0.44	LV KS		779.68	-3.00	3.44
104+00	10400	776.65	776.16	764.00	0.49	LV KS		779.65	-3.00	3.49
105+00	10500	776.61	775.93	764.00	0.68	LV KS		779.62	-3.01	3.69
106+00	10600	776.58	775.81	762.00	0.77	LV KS		779.59	-3.01	3.78
107+00	10700	776.55	775.73	762.00	0.82	LV KS		779.56	-3.01	3.83
108+00	10800	776.52	775.69	762.00	0.83	LV KS		779.53	-3.01	3.84
109+00	10900	776.49	775.65	762.00	0.84	LV KS		779.50	-3.01	3.85
110+00	11000	776.46	775.61	762.00	0.85	LV KS		779.47	-3.01	3.86
111+00	11100	776.43	775.58	762.00	0.85	LV KS		779.44	-3.01	3.86
112+00	11200	776.40	775.68	762.00	0.72	LV KS		779.41	-3.01	3.73
113+00	11300	776.36	775.78	762.00	0.58	LV KS		779.38	-3.02	3.60
114+00	11400	776.33	775.74	762.00	0.59	LV KS		779.35	-3.02	3.61
115+00	11500	776.30	775.62	762.00	0.68	LV KS		779.32	-3.02	3.70
116+00	11600	776.27	775.51	762.00	0.76	LV KS		779.29	-3.02	3.78
117+00	11700	776.24	775.40	762.00	0.84	LV KS		779.26	-3.02	3.86
118+00	11800	776.21	775.29	762.00	0.92	LV KS		779.23	-3.02	3.94
119+00	11900	776.18	775.17	762.00	1.01	LV KS		779.20	-3.02	4.03
120+00	12000	776.14	775.01	762.00	1.13	LV KS		779.17	-3.03	4.16
121+00	12100	776.11	774.99	759.00	1.12	LV KS		779.14	-3.03	4.15
122+00	12200	776.08	775.08	759.00	1.00	LV KS		779.11	-3.03	4.03
123+00	12300	776.05	775.22	758.00	0.83	LV KS		779.08	-3.03	3.86
124+00	12400	776.02	775.18	758.00	0.84	LV KS		779.05	-3.03	3.87
125+00	12500	775.99	775.29	758.00	0.70	LV KS		779.02	-3.03	3.73
126+00	12600	776.00	775.35	758.00	0.65	LV KS		778.99	-2.99	3.64
127+00	12700	775.93	775.48	758.00	0.45	LV KS		778.96	-3.03	3.48
128+00	12800	775.90	775.40	758.00	0.50	LV KS		778.93	-3.03	3.53
129+00	12900	775.87	775.22	756.00	0.65	LV KS		778.90	-3.03	3.68
130+00	13000	775.83	774.93	756.00	0.90	LV KS		778.87	-3.04	3.94
131+00	13100	775.80	774.84	761.00	0.96	LV KS		778.84	-3.04	4.00
132+00	13200	775.77	774.87	760.00	0.90	LV KS		778.81	-3.04	3.94
133+00	13300	775.74	774.95	762.00	0.79	LV KS		778.78	-3.04	3.83
134+00	13400	775.70	775.01	762.00	0.69	LV KS		778.75	-3.05	3.74
135+00	13500	775.68	775.06	761.00	0.62	LV KS		778.72	-3.04	3.66
136+00	13600	775.65	775.17	760.00	0.48	LV KS		778.69	-3.04	3.52
137+00	13700	775.63	775.12	760.00	0.51	LV KS		778.66	-3.03	3.54

EXHIBIT A-5.21 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
138+00	13800	775.60	775.04	760.00	0.56	LV KS		778.63	-3.03	3.59
139+00	13900	775.58	774.72	760.00	0.86	LV KS		778.60	-3.02	3.88
140+00	14000	775.55	774.72	760.00	0.83	LV KS		778.57	-3.02	3.85
141+00	14100	775.53	774.76	760.00	0.77	LV KS		778.54	-3.01	3.78
142+00	14200	775.51	774.69	760.00	0.82	LV KS		778.51	-3.00	3.82
143+00	14300	775.48	774.76	758.00	0.72	LV KS		778.48	-3.00	3.72
144+00	14400	775.46	774.68	758.00	0.78	LV KS		778.45	-2.99	3.77
145+00	14500	775.43	774.65	756.00	0.78	LV KS		778.42	-2.99	3.77
146+00	14600	775.41	774.65	758.00	0.76	LV KS		778.39	-2.98	3.74
147+00	14700	775.38	774.64	758.00	0.74	LV KS		778.36	-2.98	3.72
148+00	14800	775.36	774.64	758.00	0.72	LV KS		778.33	-2.97	3.69
149+00	14900	775.34	774.68	759.00	0.66	LV KS		778.30	-2.96	3.62
150+00	15000	775.32	774.79	760.00	0.53	LV KS	I-635	778.27	-2.95	3.48
151+00	15100	775.30	774.89	762.00	0.41	LV KS	I-635	778.24	-2.94	3.35
152+00	15200	775.21	774.99	760.00	0.22	LV KS	I-635	778.21	-3.00	3.22
153+00	15300	775.20	774.86	760.00	0.34	LV KS		778.20	-3.00	3.34
154+00	15400	775.19	774.67	760.00	0.52	LV KS		778.19	-3.00	3.52
155+00	15500	775.18	774.54	760.00	0.64	LV KS		778.18	-3.00	3.64
156+00	15600	775.17	774.54	760.00	0.63	LV KS		778.17	-3.00	3.63
157+00	15700	775.16	774.48	757.00	0.68	LV KS		778.16	-3.00	3.68
158+00	15800	775.15	774.49	760.00	0.66	LV KS		778.15	-3.00	3.66
159+00	15900	775.14	774.53	760.00	0.61	LV KS		778.14	-3.00	3.61
160+00	16000	775.14	774.50	760.00	0.64	LV KS		778.13	-2.99	3.63
161+00	16100	775.12	774.70	760.00	0.42	LV KS		778.12	-3.00	3.42
162+00	16200	775.12	774.73	760.00	0.39	LV KS		778.11	-2.99	3.38
163+00	16300	775.11	774.56	760.00	0.55	LV KS		778.10	-2.99	3.54
164+00	16400	775.10	774.51	760.00	0.59	LV KS		778.09	-2.99	3.58
165+00	16500	775.09	774.62	760.00	0.47	LV KS		778.08	-2.99	3.46
166+00	16600	775.08	774.81	760.00	0.27	LW Ramp		778.08	-3.00	3.27
167+00	16700	775.07	774.53	760.00	0.54	LV KS		778.07	-3.00	3.54
168+00	16800	775.06	774.25	760.00	0.81	LV KS		778.05	-2.99	3.80
169+00	16900	775.05	774.20	760.00	0.85	RW Ramp		778.04	-2.99	3.84
170+00	17000	775.04	774.15	760.00	0.89	LV KS		778.03	-2.99	3.88
171+00	17100	775.03	774.34	759.00	0.69	LV KS		778.01	-2.98	3.67
172+00	17200	775.02	774.31	758.00	0.71	LV KS		778.00	-2.98	3.69
173+00	17300	775.01	774.18	760.00	0.83	LV KS		777.99	-2.98	3.81
174+00	17400	775.00	774.15	760.00	0.85	LV KS		777.97	-2.97	3.82
175+00	17500	774.98	774.29	760.00	0.69	LV KS		777.96	-2.98	3.67
176+00	17600	774.97	774.39	760.00	0.58	LV KS		777.95	-2.98	3.56
177+00	17700	774.95	774.49	760.00	0.46	LV KS		777.94	-2.99	3.45
178+00	17800	774.94	774.41	760.00	0.53	LV KS		777.92	-2.98	3.51
179+00	17900	774.92	774.39	760.00	0.53	LV KS		777.91	-2.99	3.52
180+00	18000	774.91	774.25	758.00	0.66	LV KS		777.90	-2.99	3.65
181+00	18100	774.89	774.30	756.00	0.59	LV KS		777.88	-2.99	3.58
182+00	18200	774.88	774.36	756.00	0.52	LV KS		777.87	-2.99	3.51
183+00	18300	774.86	774.25	756.00	0.61	LV KS		777.86	-3.00	3.61

EXHIBIT A-5.21 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
184+00	18400	774.85	774.08	756.00	0.77	LV KS		777.84	-2.99	3.76
185+00	18500	774.83	774.00	757.00	0.83	LV KS		777.83	-3.00	3.83
186+00	18600	774.82	774.11	758.00	0.71	LV KS		777.82	-3.00	3.71
187+00	18700	774.81	774.37	760.00	0.44	LV KS		777.80	-2.99	3.43
188+00	18800	774.79	774.50	760.00	0.29	LV KS		777.79	-3.00	3.29
189+00	18900	774.78	774.15	760.00	0.63	LV KS		777.78	-3.00	3.63
190+00	19000	774.76	774.00	760.00	0.76	LV KS		777.76	-3.00	3.76
191+00	19100	774.75	774.18	760.00	0.57	LV KS		777.75	-3.00	3.57
192+00	19200	774.74	774.16	760.00	0.58	LV KS		777.73	-2.99	3.57
193+00	19300	774.72	774.02	758.00	0.70	LV KS		777.72	-3.00	3.70
194+00	19400	774.70	774.00	758.00	0.70	LV KS		777.71	-3.01	3.71
195+00	19500	774.69	774.09	758.00	0.60	LV KS		777.69	-3.00	3.60
196+00	19600	774.68	774.12	756.00	0.56	LV KS		777.68	-3.00	3.56
197+00	19700	774.66	773.98	758.00	0.68	LV KS		777.67	-3.00	3.68
198+00	19800	774.65	774.12	759.00	0.53	LV KS		777.65	-3.00	3.53
199+00	19900	774.64	774.04	757.00	0.60	LV KS		777.64	-3.00	3.60
200+00	20000	774.62	773.89	756.00	0.73	LV KS		777.62	-3.00	3.73
201+00	20100	774.60	773.83	759.00	0.77	LV KS		777.61	-3.01	3.78
202+00	20200	774.59	773.87	760.00	0.72	LV KS		777.60	-3.01	3.73
203+00	20300	774.58	773.54	762.00	1.04	LV KS		777.58	-3.00	4.04
204+00	20400	774.56	773.99	760.00	0.57	LV KS		777.57	-3.01	3.58
205+00	20500	774.55	773.95	758.00	0.60	LV KS		777.55	-3.00	3.60
206+00	20600	774.54	774.20	758.00	0.34	LV KS		777.54	-3.00	3.34
207+00	20700	774.52	774.00	758.00	0.52	LV KS		777.53	-3.01	3.53
208+00	20800	774.51	773.72	759.00	0.79	LV KS		777.52	-3.01	3.80
209+00	20900	774.50	773.82	760.00	0.68	LV KS		777.51	-3.01	3.69
210+00	21000	774.50	773.87	760.00	0.63	LV KS		777.50	-3.00	3.63
211+00	21100	774.50	773.89	761.00	0.61	LV KS		777.49	-2.99	3.60
212+00	21200	774.50	773.40	766.00	1.10	LV KS		777.49	-2.98	4.08
213+00	21300	774.50	773.68	*****	0.82	KS AVE Bridge		777.48	-2.98	3.80
214+00	21400	774.50	778.00	*****	-3.50	KS AVE Bridge		777.47	-2.97	-0.53
215+00	21500	774.49	789.43	*****	-14.94	KS AVE Bridge		777.46	-2.97	-11.97
216+00	21600	774.47	774.68	*****	-0.21	KS AVE Bridge		777.45	-2.98	2.77
217+00	21700	774.45	772.89	758.00	1.56	LV KS		777.44	-2.99	4.55
218+00	21800	774.43	773.06	758.00	1.37	LV KS		777.43	-3.00	4.37
219+00	21900	774.40	773.02	757.00	1.38	LV KS		777.41	-3.01	4.39
220+00	22000	774.38	773.08	757.00	1.30	LV KS		777.39	-3.01	4.31
221+00	22100	774.36	773.15	757.00	1.21	LV KS		777.37	-3.01	4.22
222+00	22200	774.34	773.09	757.00	1.25	LV KS		777.34	-3.00	4.25
223+00	22300	774.32	772.99	757.00	1.33	LV KS		777.32	-3.00	4.33
224+00	22400	774.30	772.87	757.00	1.43	LV KS		777.30	-3.00	4.43
225+00	22500	774.27	772.82	756.00	1.45	LV KS		777.28	-3.01	4.46
226+00	22600	774.25	772.73	756.00	1.52	LV KS		777.26	-3.01	4.53
227+00	22700	774.23	772.90	756.00	1.33	LV KS		777.24	-3.01	4.34
228+00	22800	774.21	772.73	756.00	1.48	LV KS		777.21	-3.00	4.48
229+00	22900	774.19	772.67	758.00	1.52	LV KS		777.19	-3.00	4.52

EXHIBIT A-5.21 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
230+00	23000	774.17	772.64	758.00	1.53	LV KS		777.17	-3.00	4.53
231+00	23100	774.14	772.60	757.00	1.54	LV KS		777.15	-3.01	4.55
232+00	23200	774.12	772.62	757.00	1.50	LV KS		777.13	-3.01	4.51
233+00	23300	774.10	772.43	757.00	1.69	LV KS		777.11	-3.01	4.68
234+00	23400	774.08	772.55	758.00	1.55	LV KS		777.08	-3.00	4.53
235+00	23500	774.06	772.65	758.00	1.43	LV KS		777.06	-3.00	4.41
236+00	23600	774.04	772.36	758.00	1.70	LV KS		777.04	-3.00	4.68
237+00	23700	774.02	772.19	757.00	1.85	LV KS		777.02	-3.00	4.83
238+00	23800	773.96	772.22	757.00	1.80	LV KS		777.00	-3.04	4.78
239+00	23900	773.89	772.35	757.00	1.61	LV KS		776.98	-3.09	4.63
240+00	24000	773.88	772.32	757.00	1.56	LV KS		776.96	-3.08	4.64
241+00	24100	773.86	772.22	757.00	1.64	LV KS		776.94	-3.08	4.72
242+00	24200	773.85	772.21	758.00	1.64	LV KS		776.92	-3.07	4.71
243+00	24300	773.84	772.11	758.00	1.73	LV KS		776.90	-3.06	4.79
244+00	24400	773.82	772.11	758.00	1.71	LV KS		776.88	-3.06	4.77
245+00	24500	773.81	772.14	758.00	1.67	LV KS		776.86	-3.05	4.72
246+00	24600	773.79	771.92	758.00	1.87	LV KS		776.85	-3.06	4.93
247+00	24700	773.78	771.62	758.00	2.16	LV KS		776.83	-3.05	5.21
248+00	24800	773.76	771.32	758.00	2.44	LV KS		776.81	-3.05	5.49
249+00	24900	773.75	771.84	758.00	1.91	LV KS		776.79	-3.04	4.95
250+00	25000	773.74	771.82	759.00	1.92	LV KS		776.77	-3.03	4.95
251+00	25100	773.72	771.95	758.00	1.77	LV KS		776.75	-3.03	4.80
252+00	25200	773.68	771.50	*****	2.18	FW		776.73	-3.05	5.23
253+00	25300	773.69	771.50	*****	2.19	FW		776.71	-3.02	5.21
254+00	25400	773.68	771.33	760.00	2.35	LV KS		776.69	-3.01	5.36
255+00	25500	773.66	771.16	758.00	2.50	LV KS		776.67	-3.01	5.51
256+00	25600	773.65	771.05	758.00	2.60	LV KS		776.65	-3.00	5.60
257+00	25700	773.64	771.01	758.00	2.63	LV KS		776.63	-2.99	5.62
258+00	25800	773.62	771.44	758.00	2.18	LV KS		776.61	-2.99	5.17
259+00	25900	773.60	771.19	757.00	2.41	LV KS		776.59	-2.99	5.40
260+00	26000	773.59	771.09	757.00	2.50	LV KS		776.57	-2.98	5.48
261+00	26100	773.57	771.07	757.00	2.50	LV KS		776.55	-2.98	5.48
262+00	26200	773.56	771.03	757.00	2.53	LV KS		776.53	-2.97	5.50
263+00	26300	773.54	771.20	757.00	2.34	LV KS		776.52	-2.98	5.32
264+00	26400	773.53	771.31	757.00	2.22	LV KS		776.50	-2.97	5.19
265+00	26500	773.51	771.11	757.00	2.40	LV KS		776.48	-2.97	5.37
266+00	26600	773.49	770.87	757.00	2.62	LV KS		776.46	-2.97	5.59
267+00	26700	773.47	770.71	757.00	2.76	LV KS		776.44	-2.97	5.73
268+00	26800	773.45	770.61	758.00	2.84	LV KS		776.42	-2.97	5.81
269+00	26900	773.44	770.41	758.00	3.03	LV KS		776.40	-2.96	5.99
270+00	27000	773.42	770.53	758.00	2.89	LV KS		776.38	-2.96	5.85
271+00	27100	773.36	770.66	758.00	2.70	LV KS		776.36	-3.00	5.70
272+00	27200	773.20	770.56	758.00	2.64	LV KS		775.77	-2.57	5.21
273+00	27300	773.13	770.56	758.00	2.57	LV KS		775.18	-2.05	4.62
274+00	27400	773.06	770.46	758.00	2.60	LV KS		774.59	-1.53	4.13
275+00	27500	772.98	770.87	758.00	2.11	LV KS		774.00	-1.02	3.13

EXHIBIT A-5.21 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
276+00	27600	772.90	770.86	758.00	2.04	LV KS		773.41	-0.51	2.55
277+00	27700	772.82	771.00	760.00	1.82	LV KS		772.82	0.00	1.82
278+00	27800	772.72	771.00	760.00	1.72	LV KS		772.82	-0.10	1.82
279+00	27900	772.63	771.00	762.00	1.63	LV KS		772.82	-0.19	1.82
280+00	28000	772.55	771.00	762.00	1.55	FW		772.82	-0.27	1.82
281+00	28100	772.45	771.00	762.00	1.45	FW		772.82	-0.37	1.82
282+00	28200	772.36	771.00	763.00	1.36	FW		772.82	-0.46	1.82
283+00	28300	772.27	771.00	764.00	1.27	FW		772.82	-0.55	1.82
284+00	28400	772.16	771.00	764.00	1.16	FW		772.82	-0.66	1.82
285+00	28500	772.07	771.00	764.00	1.07	FW		772.82	-0.75	1.82
286+00	28600	771.98	771.00	764.00	0.98	FW		772.82	-0.84	1.82
287+00	28700	771.89	771.00	766.00	0.89	FW		772.82	-0.93	1.82
288+00	28800	771.80	770.94	766.00	0.86		Stop Log	772.82	-1.02	1.88
289+00	28900	771.93	768.97	*****	2.96		Stop Log	772.82	-0.89	3.85
289+40	28940	771.93	771.08	******	0.85		Stop Log	772.82	-0.89	1.74

SLOPE STABILITY

EXHIBIT A-5.22
500-Yr + 3 ft. Station 54+00 - Stability Analysis with Berms
(Typical Sta. 2+00 to 54+00)

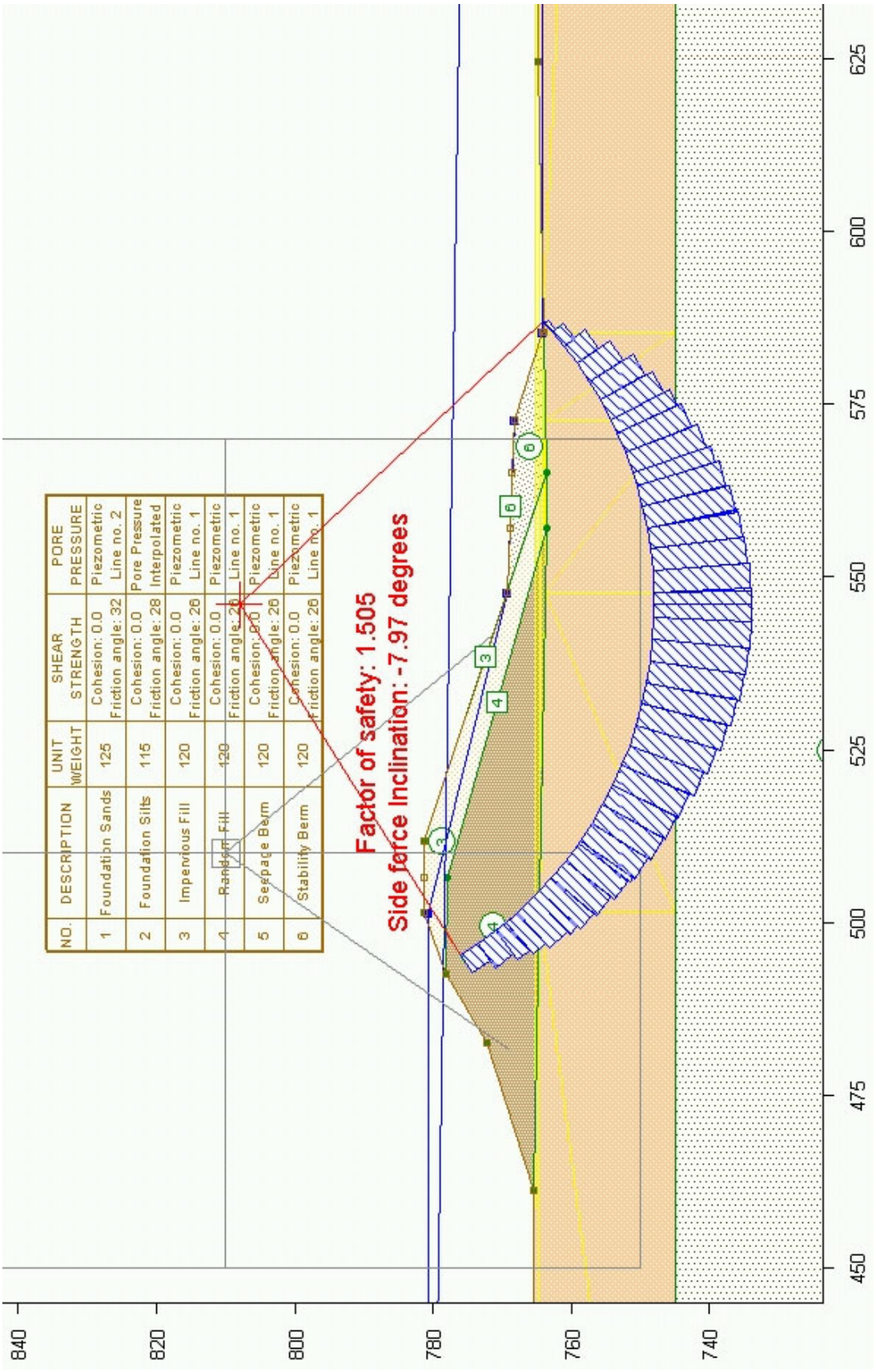


EXHIBIT A-5.23

500 Yr + 3 ft. Station 61+00 - Stability Analysis with Berms

(Typical Sta. 55+00 to 61+00)

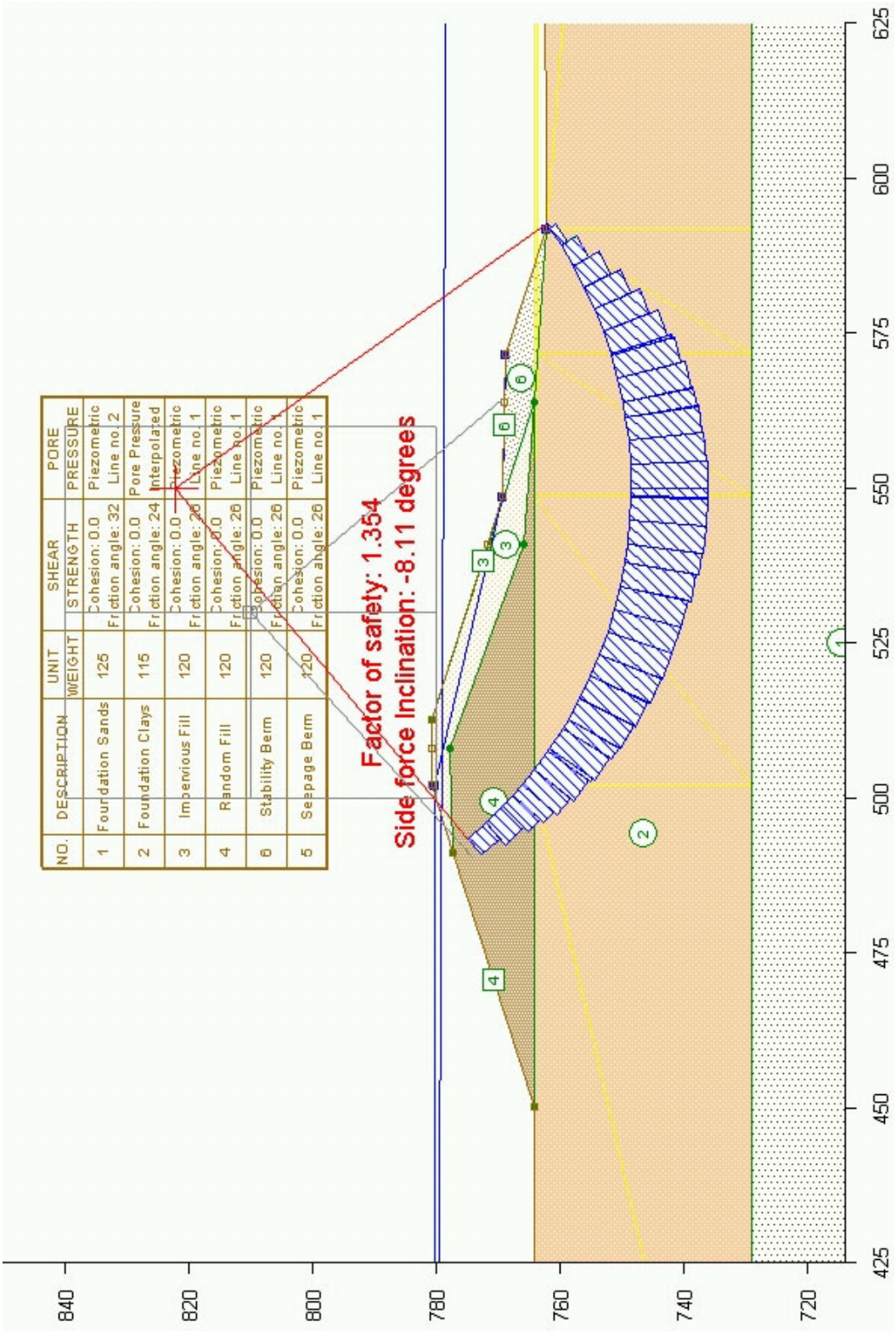


EXHIBIT A-5.24

500-Yr + 3 ft. Station 118+00 - Stability Analysis with Berm

(Typical Sta. 118+00 to 182+20)

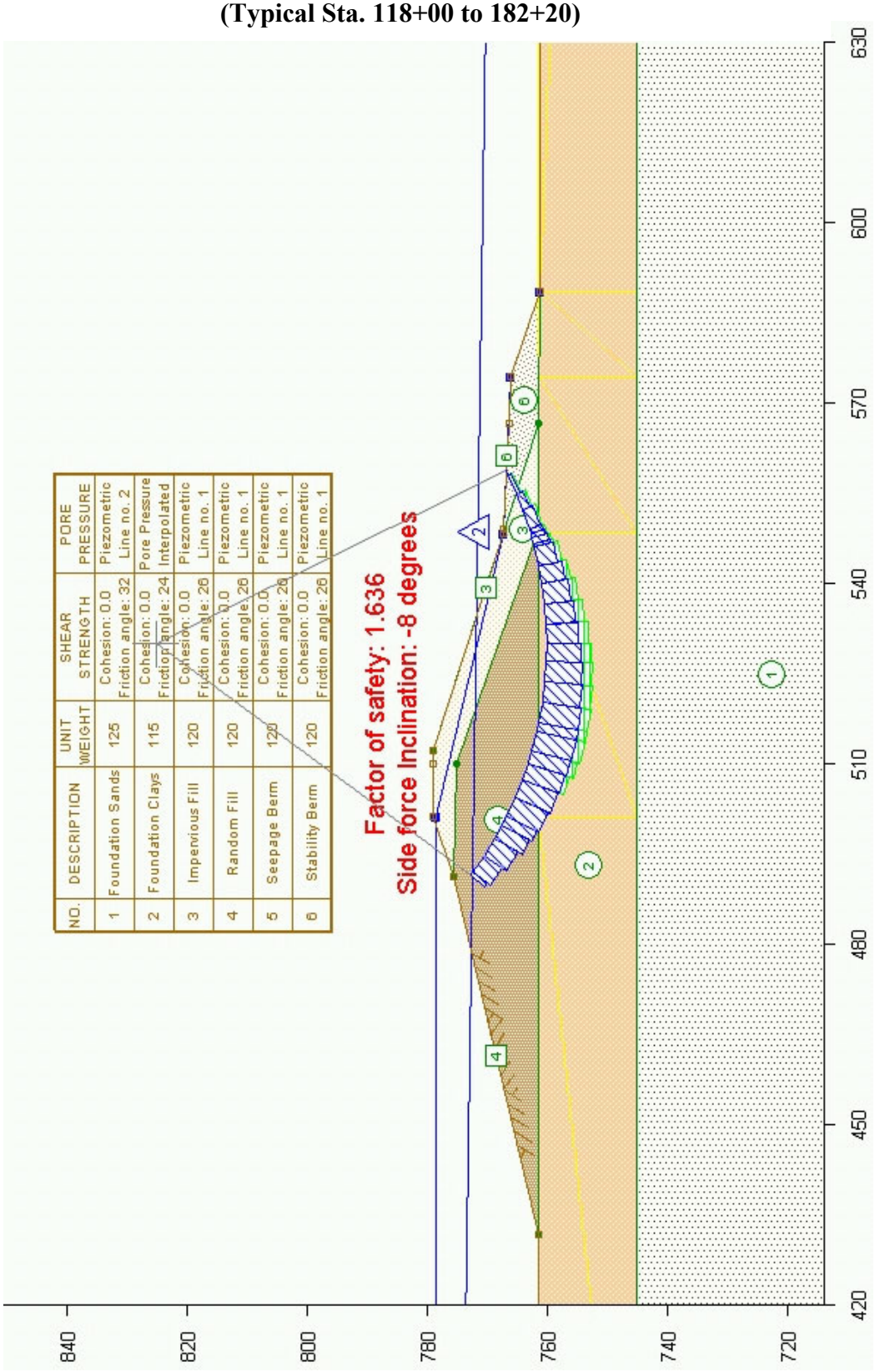


EXHIBIT A-5.25
500-yr + 3 ft. Station 264+00 – Existing Condition
Stability Analysis

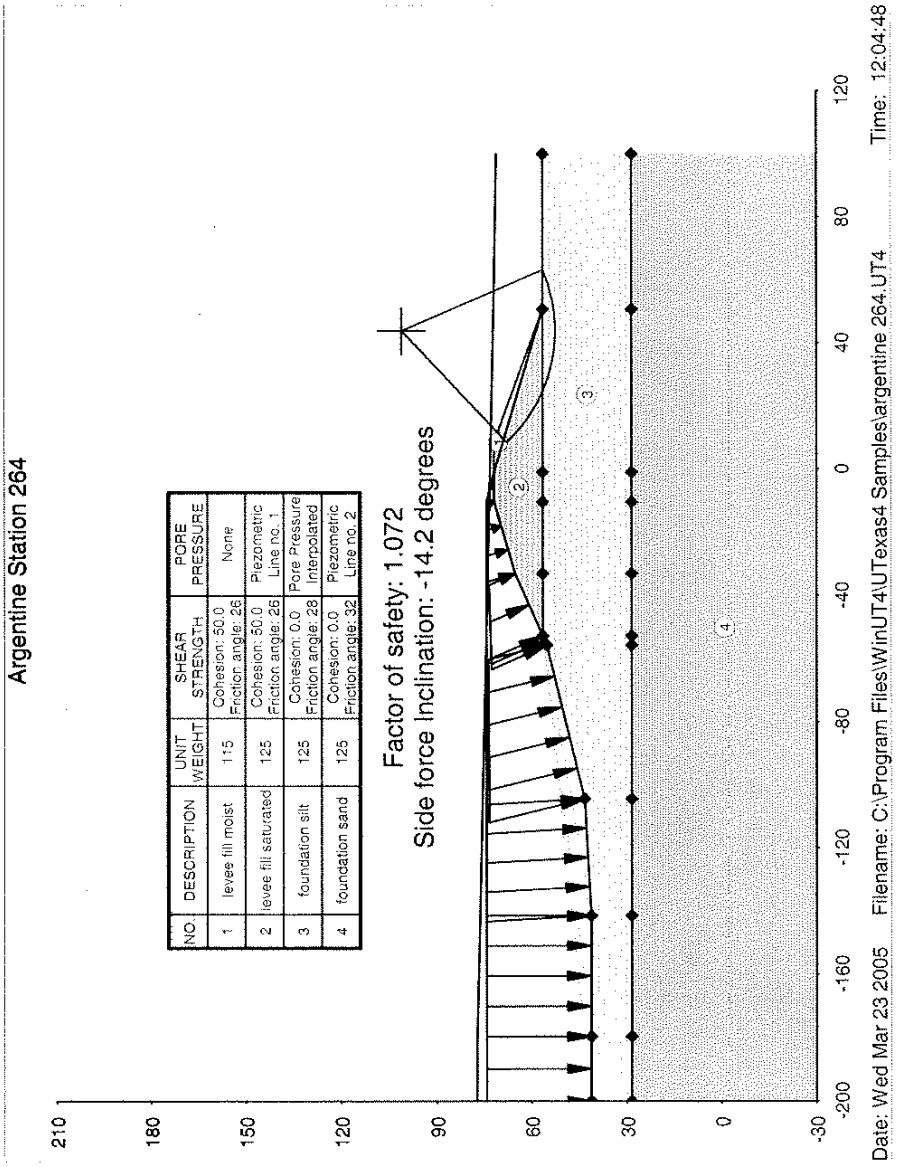


TABLE NO. 1
COMPUTER PROGRAM DESIGNATION: UTEXAS4
Originally Coded By Stephen G. Wright
Version No. 4.0.0.9 - Last Revision Date: 07/27/2001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**********************************************************************
* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE              *
* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE            *
* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA           *
* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS     *
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**********************************************************************
```

```
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TABLE NO. 3
**************************
* NEW PROFILE LINE DATA *
**************************

-------------------------------------------------------------
----- Profile Line No. 1 - Material Type (Number): 1 -----
-------------------------------------------------------------
Description: Levee Fill moist

Point         X            Y

   1        -0.96        71.90
   2         8.60        71.90
   3        50.80        56.50

-------------------------------------------------------------
----- Profile Line No. 2 - Material Type (Number): 2 -----
-------------------------------------------------------------
Description: levee fill saturated

Point         X            Y

   1       -52.66        56.50
   2       -33.00        65.20
   3       -10.40        71.90
   4        -0.96        71.90
   5        50.80        56.50

-------------------------------------------------------------
----- Profile Line No. 3 - Material Type (Number): 3 -----
-------------------------------------------------------------
Description: foundation silt

Point         X            Y

   1      -200.00        41.10
   2      -179.60        41.10
   3      -141.40        41.10
   4      -104.40        43.20
   5       -55.60        55.20
   6       -52.66        56.50
   7        50.80        56.50
   8       100.00        56.50

-------------------------------------------------------------
----- Profile Line No. 4 - Material Type (Number): 4 -----
-------------------------------------------------------------
Description: foundation sand

Point         X            Y
```

1	-200.00	28.50
2	100.00	28.50

```
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TABLE NO. 4
**************************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**************************************************************************

--------------------------------------------------------------------------
---------------------- DATA FOR MATERIAL NUMBER 1 ----------------------
--------------------------------------------------------------------------
Description: levee fill moist

Unit weight of soil (material): 115.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 50.0
Friction angle - - - - - 26.00 (degrees)

No (zero) pore water pressures.
Negative pore water pressures are NOT allowed - set to zero.

--------------------------------------------------------------------------
---------------------- DATA FOR MATERIAL NUMBER 2 ----------------------
--------------------------------------------------------------------------
Description: levee fill saturated

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 50.0
Friction angle - - - - - 26.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

--------------------------------------------------------------------------
---------------------- DATA FOR MATERIAL NUMBER 3 ----------------------
--------------------------------------------------------------------------
Description: foundation silt

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 28.00 (degrees)
Pore water pressures calculated by interpolation of
specified values of pore water pressure.
Negative pore water pressures are NOT allowed - set to zero.

--------------------------------------------------------------------------
---------------------- DATA FOR MATERIAL NUMBER 4 ----------------------
--------------------------------------------------------------------------
```

Description: foundation sand

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 32.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 2
Negative pore water pressures are NOT allowed - set to zero.

```
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TABLE NO. 6
*************************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*************************************************************************

-------------------------------------------------------------
--------------- Piezometric Line Number 1 ----------------
-------------------------------------------------------------
Description: design line
Unit weight of fluid (water): 62.4

Point         X            Y

  1      -200.00        74.30
  2       -10.40        74.30
  3        -0.96        71.90
  4        50.80        56.50
  5       100.00        56.50

-------------------------------------------------------------
--------------- Piezometric Line Number 2 ----------------
-------------------------------------------------------------
Description: underseepage line
Unit weight of fluid (water): 62.4

Point         X            Y

  1      -200.00        77.30
  2      -179.60        77.30
  3      -141.40        76.42
  4      -104.40        75.57
  5       -55.60        74.45
  6       -52.66        74.38
  7       -33.00        73.93
  8       -10.40        73.41
  9        -0.96        73.19
 10        50.80        72.00
 11       100.00        71.15
```

```
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TABLE NO. 11
**************************************************************************
* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**************************************************************************
                                    Normal          Shear
Point        X           Y         Pressure        Stress

Distributed loads will be generated from piezometric line number 1
See Output Table number 27
```

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TABLE NO. 8
****
* NEW INTERPOLATION DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Input Point Material No.	Assigned Point No.	X	Y	Variable	Type
1	1	-200.00	41.10	2071.7 Pore Pressure	3
2	2	-200.00	28.50	3045.1 Pore Pressure	3
3	3	-179.60	41.10	2071.7 Pore Pressure	3
4	4	-179.60	28.50	3045.1 Pore Pressure	3
5	5	-141.40	41.10	2071.7 Pore Pressure	3
6	6	-141.40	28.50	2990.2 Pore Pressure	3
7	7	-104.40	43.20	1940.6 Pore Pressure	3
8	8	-104.40	28.50	2937.2 Pore Pressure	3
9	9	-55.60	55.20	1191.8 Pore Pressure	3
10	10	-55.60	28.50	2867.3 Pore Pressure	3
11	11	-52.66	56.50	1110.7 Pore Pressure	3
12	12	-52.66	28.50	2862.9 Pore Pressure	3
13	13	-33.00	56.50	1110.7 Pore Pressure	3
14	14	-33.00	28.50	2834.8 Pore Pressure	3
15	15	-10.40	56.50	1110.7 Pore Pressure	3
16	16	-10.40	28.50	2802.4 Pore Pressure	3
17	17	-0.96	28.50	2788.7 Pore Pressure	3
18	18	-0.96	56.50	961.0 Pore Pressure	3
19	19	50.80	56.50	0.0 Pore Pressure	3
20	20	50.80	28.50	2714.4 Pore Pressure	3
21	21	100.00	56.50	0.0 Pore Pressure	3
22	22	100.00	28.50	2661.4 Pore Pressure	3

Number of new interpolation points read: 22
Number of old interpolation points retained: 0

```
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TABLE NO. 16
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Starting Center Coordinate for Search at -
                                              X: 25.00
                                              Y: 150.00

Required accuracy for critical center
(= minimum spacing between grid points): 0.500

No center allowed to pass below: 28.50

Critical shear surface not allowed to pass below Y: 28.50
For the initial mode of search circles are tangent to horizontal line at
-
                                              Y: 56.50
                                              Radius: 93.50

Conventional (single-stage) computations will be performed.
Automatic search output will be in short form.
Depth of crack: 4.000
Radii for each grid point will be sorted in the order of increasing
radius.
Critical circles for grid points will be output in the order of
increasing factor of safety.
Search will be continued after the initial mode to find a most critical
circle.
Procedure of Analysis: Spencer

--------------------------------------------------------------------------
--------
The following represent default values or values that were prevously
defined:
Subtended angle for slice subdivision: 3.00(degrees)
There is no water in a crack.
Seismic coefficient: 0.000
Unit weight of water (or other fluid) in crack: 62.4
Maximum number of trial grids for a given search mode: 50
No restrictions exist on the lateral extent of the search.
No shear surfaces other than the most critical will be saved for display
later.
Neither slope face was explicitly designated for analysis.
Standard sign convention used for direction of shear stress on shear
surface.
Iteration limit: 100
Force imbalance: 1.000000e-005 (fraction of total weight)
Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)
Minimum weight required for computations to be performed: 100
Initial trial factor of safety: 3.000
```

Initial trial side force inclination: 17.189 (degrees)
Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00

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TABLE NO. 26
****
* NEW, COMPUTED SLOPE GEOMETRY DATA *
****

These slope geometry were generated from the Profile Lines.

Point	X	Y
1	-200.00	41.10
2	-179.60	41.10
3	-141.40	41.10
4	-104.40	43.20
5	-55.60	55.20
6	-52.66	56.50
7	-33.00	65.20
8	-10.40	71.90
9	-0.96	71.90
10	8.60	71.90
11	50.80	56.50
12	100.00	56.50

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TABLE NO. 27

****

* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

****

Point	X	Y	Normal Pressure	Shear Stress
1	-200.00	41.10	2071.7	0.0
2	-179.60	41.10	2071.7	0.0
3	-141.40	41.10	2071.7	0.0
4	-104.40	43.20	1940.6	0.0
5	-55.60	55.20	1191.8	0.0
6	-52.66	56.50	1110.7	0.0
7	-33.00	65.20	567.8	0.0
8	-10.40	71.90	149.8	0.0
9	-0.96	71.90	0.0	0.0

The above data were generated automatically from piezometric
line number 1.

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -200.00
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -179.60
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -141.40
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -104.40
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -55.60
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -52.66
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -0.96
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 8.60
from piezometric line number 2 (Stage 1).

```
UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 50.80
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 100.00
from piezometric line number 2 (Stage 1).

Search will be conducted for RIGHT face of slope
```

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TABLE NO. 32
****
* SHORT-FORM OUTPUT FOR TYPE 1 AUTOMATIC SEARCH WITH CIRCLES *
****

Mode of Search	Messages	Center Coordinates of Critical Circle X	Y	Radius	1-Stage Factor of Safety	Side Force Inclin.
Circles tangent to horiz. line at Y = 56.50		40.00	105.50	49.000	1.297	- 15.17
Circles all have the same radius = 49.000		44.00	101.50	49.000	1.073	- 14.18
Circles tangent to horiz. line at Y = 52.50		44.00	101.00	48.500	1.072	- 14.20

```
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TABLE NO. 33
*****************************************
* 1-STAGE FINAL CRITICAL CIRCLE INFORMATION *
*****************************************
X Coordinate of Center . . . . . .  44.00
Y Coordinate of Center . . . . . .  101.00
Radius . . . . . .  48.50
Factor of Safety . . . . . 1.072
Side Force Inclination (degrees) . . . . . -14.20
Number of Circles Tried  . . . . . .  147
Number of Circles F Calculated for . . . . . .  135
Time Required for Search (seconds) . . . . . .  0.4
```

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TABLE NO. 43

```
************************************************************
* Coordinate, Weight, Strength and Pore Water Pressure     *
* Information for Individual Slices for Conventional       *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the critical shear surface in the    *
* case of an automatic search.)                            *
************************************************************
```

Slice No.	X	Y	Slice Weight	Matl. No.	Cohesion	Friction Angle	Pore Pressure
	8.55	67.90					
1	8.58	67.87	23	2	50.0	26.00	74.2
	8.60	67.85					
2	9.49	66.94	983	2	50.0	26.00	115.2
	10.38	66.04					
3	11.32	65.18	1292	2	50.0	26.00	191.0
	12.26	64.33					
4	13.24	63.52	1590	2	50.0	26.00	259.1
	14.22	62.72					
5	15.24	61.96	1870	2	50.0	26.00	319.1
	16.27	61.21					
6	17.33	60.51	2126	2	50.0	26.00	371.0
	18.39	59.81					
7	19.48	59.17	2351	2	50.0	26.00	414.7
	20.58	58.53					
8	21.70	57.95	2540	2	50.0	26.00	449.9
	22.83	57.36					
9	23.77	56.93	2183	2	50.0	26.00	474.9
	24.71	56.50					
10	25.89	56.03	2776	3	0.0	28.00	493.4
	27.07	55.55					
11	28.27	55.14	2840	3	0.0	28.00	507.1
	29.47	54.73					
12	30.69	54.38	2854	3	0.0	28.00	511.8
	31.91	54.03					
13	33.15	53.75	2815	3	0.0	28.00	

```
507.4
          34.39     53.46
  14      35.64     53.24          2723    3          0.0    28.00
494.1
          36.89     53.02
  15      38.15     52.87          2577    3          0.0    28.00
471.8
          39.41     52.72
  16      40.67     52.63          2378    3          0.0    28.00
440.5
          41.94     52.54
  17      42.97     52.52          1748    3          0.0    28.00
405.0
          44.00     52.50
  18      45.27     52.53          1890    3          0.0    28.00
392.5
          46.54     52.57
  19      47.80     52.67          1554    3          0.0    28.00
376.0
          49.07     52.77
  20      49.93     52.87           852    3          0.0    28.00
352.9
          50.80     52.98
  21      52.05     53.19          1036    3          0.0    28.00
320.9
          53.30     53.40
  22      54.54     53.68           875    3          0.0    28.00
273.7
          55.78     53.95
  23      57.01     54.29           675    3          0.0    28.00
213.9
          58.23     54.63
  24      59.43     55.04           440    3          0.0    28.00
141.7
          60.64     55.44
  25      61.82     55.91           175    3          0.0    28.00
57.3
          63.00     56.38
  26      63.14     56.44             2    3          0.0    28.00
6.0
          63.29     56.50
```

```
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TABLE NO. 44
**********************************************************
* Seismic Forces and Forces Due to Distributed Loads for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations.               *
* (Information is for the critical shear surface in the  *
* case of an automatic search.)                          *
**********************************************************

There are no seismic forces or forces due to distributed loads
for the current shear surface
```

```
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TABLE NO. 47
**********************************************************************
*  Information for the Iterative Solution for the Factor of  *
*  Safety and Side Force Inclination by Spencer's Procedure  *
**********************************************************************
Allowable force imbalance for convergence:  4.3167e-001
Allowable moment imbalance for convergence: 13

        Trial      Trial
       Factor    Side Force      Force        Moment                    Delta
Iter-    of     Inclination    Imbalance    Imbalance     Delta-F       Theta
ation  Safety    (degrees)       (lbs.)     (ft.-lbs.)
(degrees)

   1   3.00000    -17.1887   -7.528e+003   4.659e+005
First-order corrections to F and Theta .....    -5.5004      7.6493
Reduced values - Deltas were too large .....    -0.5000      0.6953

   2   2.50000    -16.4934   -6.701e+003   4.147e+005
First-order corrections to F and Theta .....    -3.3731      5.4482
Reduced values - Deltas were too large .....    -0.5000      0.8076

   3   2.00000    -15.6858   -5.453e+003   3.374e+005
First-order corrections to F and Theta .....    -1.7421      3.0158
Reduced values - Deltas were too large .....    -0.5000      0.8655

   4   1.50000    -14.8203   -3.359e+003   2.079e+005
First-order corrections to F and Theta .....    -0.5997      0.9365
Reduced values - Deltas were too large .....    -0.5000      0.7808

   5   1.00000    -14.0394    8.512e+002   -5.250e+004
First-order corrections to F and Theta .....     0.0675     -0.1454
Second-order corrections to F and Theta ....     0.0728     -0.1595

   6   1.07283    -14.1989   -4.695e+000    2.891e+002
First-order corrections to F and Theta .....    -0.0004      0.0011
Second-order corrections to F and Theta ....    -0.0004      0.0011

   7   1.07240    -14.1978    7.670e-007   -4.707e-005
First-order corrections to F and Theta .....     0.0000     -0.0000
```

```
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TABLE NO. 55
**************************************************************************
* Check of Computations by Spencer's Procedure (Results are for the *
* critical shear surface in the case of an automatic search.)       *
**************************************************************************

Summation of Horizontal Forces: 2.97118e-012

Summation of Vertical Forces: 1.73417e-012

Summation of Moments: 5.87477e-011

Mohr Coulomb Shear Force/Shear Strength Check Summation: 2.75735e-012
```

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TABLE NO. 58

****

*

* Final Results for Stresses Along the Shear Surface

*

* (Results are for the critical shear surface in the case of a search.)

*

****

*

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY
Factor of Safety: 1.072 Side Force Inclination: -14.20

	-------- VALUES AT CENTER OF BASE OF SLICE --------				
Slice No.	X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	8.58	67.87	282.9	208.6	141.5
2	9.49	66.94	346.7	231.4	151.9
3	11.32	65.18	467.2	276.2	172.2
4	13.24	63.52	580.2	321.1	192.7
5	15.24	61.96	684.4	365.3	212.8
6	17.33	60.51	778.7	407.7	232.0
7	19.48	59.17	862.2	447.5	250.2
8	21.70	57.95	933.8	483.9	266.7
9	23.77	56.93	988.3	513.4	280.1
10	25.89	56.03	1033.4	540.0	267.7
11	28.27	55.14	1065.3	558.2	276.7
12	30.69	54.38	1081.6	569.8	282.5
13	33.15	53.75	1081.3	573.9	284.5
14	35.64	53.24	1063.4	569.3	282.3
15	38.15	52.87	1026.8	555.0	275.2
16	40.67	52.63	970.2	529.7	262.6
17	42.97	52.52	901.3	496.3	246.1
18	45.27	52.53	807.2	414.7	205.6
19	47.80	52.67	676.8	300.9	149.2
20	49.93	52.87	545.2	192.3	95.4
21	52.05	53.19	463.2	142.4	70.6
22	54.54	53.68	407.4	133.7	66.3
23	57.01	54.29	329.5	115.6	57.3
24	59.43	55.04	226.9	85.1	42.2
25	61.82	55.91	95.9	38.6	19.1
26	63.14	56.44	10.4	4.4	2.2

```
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Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 264.dat

    Argentine Station 264
    Steady State

TABLE NO. 59
**************************************************************************
*
* Final Results for Side Forces and Stresses Between Slices
*
* (Results are for the critical shear surface in the case of a search.)
*
**************************************************************************
*
```

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
			VALUES AT RIGHT SIDE OF SLICE			
1	8.60	8	67.87	0.005	-3.8	7.7
2	10.38	375	66.73	0.133	-83.9	223.4
3	12.26	867	65.51	0.190	-115.7	385.1
4	14.22	1441	64.32	0.225	-127.1	518.8
5	16.27	2055	63.18	0.249	-127.4	632.4
6	18.39	2670	62.09	0.267	-120.5	728.5
7	20.58	3246	61.07	0.282	-108.1	807.6
8	22.83	3751	60.12	0.295	-90.5	868.9
9	24.71	4087	59.40	0.304	-72.5	904.9
10	27.07	4448	58.55	0.312	-56.8	954.3
11	29.47	4667	57.80	0.321	-34.2	981.2
12	31.91	4734	57.14	0.332	-4.6	984.9
13	34.39	4641	56.57	0.344	33.3	963.5
14	36.89	4393	56.11	0.361	81.7	914.3
15	39.41	4002	55.76	0.383	144.9	832.6
16	41.94	3491	55.53	0.415	230.6	710.8
17	44.00	3009	55.45	0.455	327.2	

```
572.9
   18        46.54          2415         55.44      0.524        487.1
366.0
   19        49.07          1886         55.49      0.624        729.5
108.3
   20        50.80          1596         55.49      0.712        998.6      -
119.6
   21        53.30          1212         55.48      0.671        767.5
9.0
   22        55.78           811         55.59      0.643        572.6
44.7
   23        58.23           435         55.82      0.638        412.6
39.2
   24        60.64           141         56.22      0.735        311.1      -
52.9
   25        63.00             2         56.47      0.794         42.7      -
11.8
   26        63.29             0         56.50      0.000          0.0
0.0

Read end-of-file on input while looking for another command word.
End of input data assumed - normal termination.
```

EXHIBIT A-5.26
500-yr + 3 ft. Station 264+00 – Proposed Condition
Stability Analysis

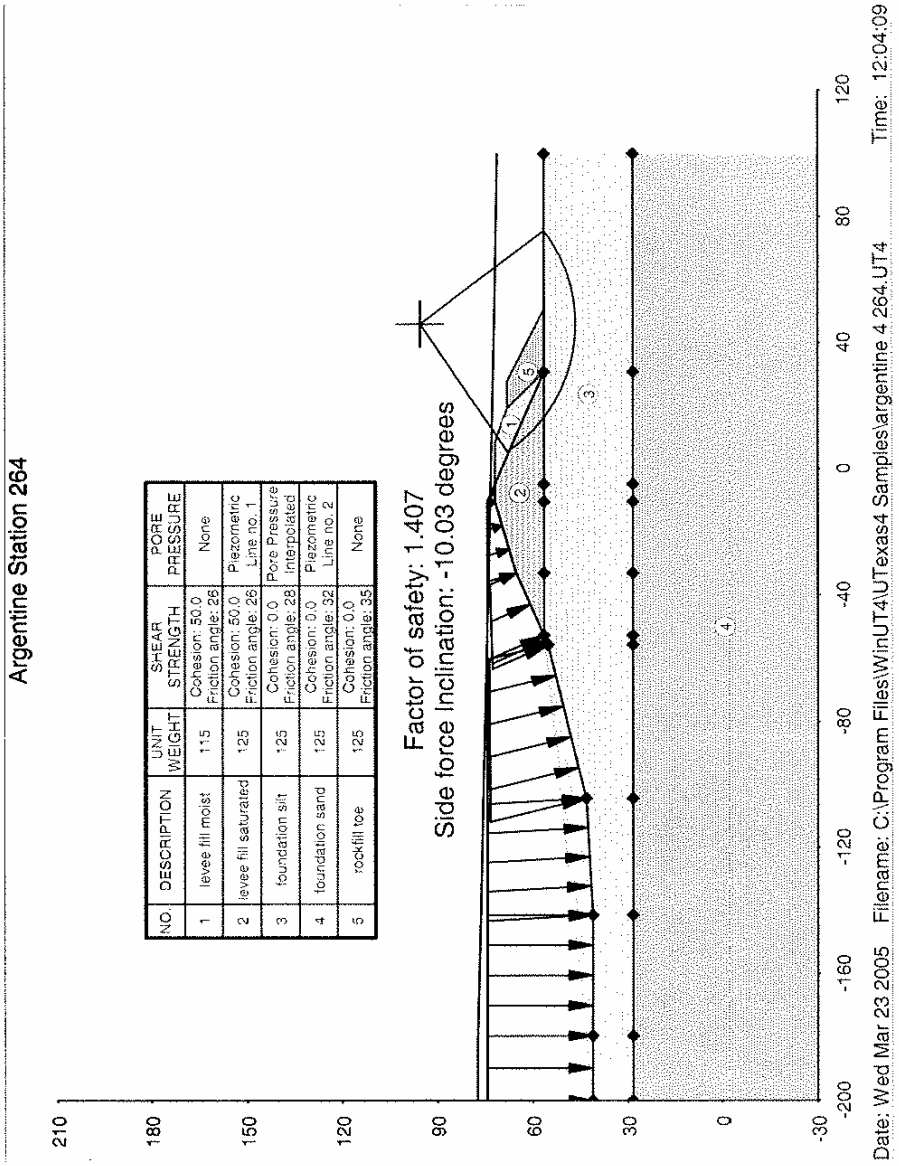

TABLE NO. 1
COMPUTER PROGRAM DESIGNATION: UTEXAS4
Originally Coded By Stephen G. Wright
Version No. 4.0.0.9 - Last Revision Date: 07/27/2001


```
**********************************************************************
* RESULTS OF COMPUTATIONS PERFORMED USING THIS SOFTWARE              *
* SHOULD NOT BE USED FOR DESIGN PURPOSES UNLESS THEY HAVE            *
* BEEN VERIFIED BY INDEPENDENT ANALYSES, EXPERIMENTAL DATA           *
* OR FIELD EXPERIENCE. THE USER SHOULD UNDERSTAND THE ALGORITHMS     *
* AND ANALYTICAL PROCEDURES USED IN THIS SOFTWARE AND MUST HAVE      *
* READ ALL DOCUMENTATION FOR THIS SOFTWARE BEFORE ATTEMPTING         *
* TO USE IT.  NEITHER SHINOAK SOFTWARE NOR STEPHEN G. WRIGHT         *
* MAKE OR ASSUME LIABILITY FOR ANY WARRANTIES, EXPRESSED OR          *
* IMPLIED, CONCERNING THE ACCURACY, RELIABILITY, USEFULNESS          *
* OR ADAPTABILITY OF THIS SOFTWARE.                                  *
**********************************************************************
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Dec 15 11:36:10 2004
Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 3
*************************
* NEW PROFILE LINE DATA *
*************************

-------------------------------------------------------------
----- Profile Line No. 1 - Material Type (Number): 1 -----
-------------------------------------------------------------
Description: Levee Fill moist

Point         X            Y

   1        -4.84        71.90
   2         8.60        71.90
   3        19.31        67.99
   4        30.80        56.50

-------------------------------------------------------------
----- Profile Line No. 2 - Material Type (Number): 2 -----
-------------------------------------------------------------
Description: levee fill saturated

Point         X            Y

   1       -52.66        56.50
   2       -33.00        65.20
   3       -10.40        71.90
   4        -4.84        71.90
   5        30.80        56.50

-------------------------------------------------------------
----- Profile Line No. 3 - Material Type (Number): 3 -----
-------------------------------------------------------------
Description: foundation silt

Point         X            Y

   1      -200.00        41.10
   2      -179.60        41.10
   3      -141.40        41.10
   4      -104.40        43.20
   5       -55.60        55.20
   6       -52.66        56.50
   7        50.80        56.50
   8       100.00        56.50

-------------------------------------------------------------
----- Profile Line No. 4 - Material Type (Number): 4 -----
-------------------------------------------------------------
Description: foundation sand
```

Point	X	Y
1	200.00	28.50
2	100.00	28.50

----- Profile Line No. 5 - Material Type (Number): 5 -----

Description: rockfill toe

Point	X	Y
1	19.31	67.99
2	27.80	67.99
3	50.80	56.50

```
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Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
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    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 4
*************************************************************************
* NEW MATERIAL PROPERTY DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
*************************************************************************

-------------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 1 -----------------------
-------------------------------------------------------------------------
Description: levee fill moist

Unit weight of soil (material): 115.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 50.0
Friction angle - - - - - 26.00 (degrees)

No (zero) pore water pressures.
Negative pore water pressures are NOT allowed - set to zero.

-------------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 2 -----------------------
-------------------------------------------------------------------------
Description: levee fill saturated

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 50.0
Friction angle - - - - - 26.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 1
Negative pore water pressures are NOT allowed - set to zero.

-------------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 3 -----------------------
-------------------------------------------------------------------------
Description: foundation silt

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - 0.0
Friction angle - - - - - 28.00 (degrees)
Pore water pressures calculated by interpolation of
specified values of pore water pressure.
Negative pore water pressures are NOT allowed - set to zero.

-------------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 4 -----------------------
```

```
Description: foundation sand

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 0.0
Friction angle - - - - - - 32.00 (degrees)

Pore water pressures are defined by a piezometric line.
Piezometric line number: 2
Negative pore water pressures are NOT allowed - set to zero.

------------------------------------------------------------------------
-------------------- DATA FOR MATERIAL NUMBER 5 ------------------------
------------------------------------------------------------------------
Description: rockfill toe

Unit weight of soil (material): 125.0

CONVENTIONAL (ISOTROPIC) SHEAR STRENGTHS
Cohesion - - - - - - - - - 0.0
Friction angle - - - - - - 35.00 (degrees)

No (zero) pore water pressures.
Negative pore water pressures are NOT allowed - set to zero.
```

```
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Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 6
**************************************************************************
* NEW PIEZOMETRIC LINE DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**************************************************************************

--------------------------------------------------------------
---------- Piezometric Line Number 1 ----------
--------------------------------------------------------------
Description: design line
Unit weight of fluid (water): 62.4

Point         X            Y

  1      -200.00        74.30
  2       -10.40        74.30
  3        -4.84        71.90
  4        30.80        56.50
  5       100.00        56.50

--------------------------------------------------------------
---------- Piezometric Line Number 2 ----------
--------------------------------------------------------------
Description: underseepage line
Unit weight of fluid (water): 62.4

Point         X            Y

  1      -200.00        77.30
  2      -179.60        77.30
  3      -141.40        76.42
  4      -104.40        75.57
  5       -55.60        74.45
  6       -52.66        74.38
  7       -33.00        73.93
  8       -10.40        73.41
  9        -0.96        73.19
 10        50.80        72.00
 11       100.00        71.15
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 11
**************************************************************************
* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
**************************************************************************
                                    Normal          Shear
Point        X           Y         Pressure        Stress

Distributed loads will be generated from piezometric line number 1
See Output Table number 27
```

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Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
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Argentine Station 264
Steady State
Rockfill Toe

TABLE NO. 8
****
* NEW INTERPOLATION DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *
****

Input Point Material No.	Assigned Point No.	X	Y	Variable	Type
1	1	-200.00	41.10	2071.7 Pore Pressure	3
2	2	-200.00	28.50	3045.1 Pore Pressure	3
3	3	-179.60	41.10	2071.7 Pore Pressure	3
4	4	-179.60	28.50	3045.1 Pore Pressure	3
5	5	-141.40	41.10	2071.7 Pore Pressure	3
6	6	-141.40	28.50	2990.2 Pore Pressure	3
7	7	-104.40	43.20	1940.6 Pore Pressure	3
8	8	-104.40	28.50	2937.2 Pore Pressure	3
9	9	-55.60	55.20	1191.8 Pore Pressure	3
10	10	-55.60	28.50	2867.3 Pore Pressure	3
11	11	-52.66	56.50	1110.7 Pore Pressure	3
12	12	-52.66	28.50	2862.9 Pore Pressure	3
13	13	-33.00	56.50	1110.7 Pore Pressure	3
14	14	-33.00	28.50	2834.8 Pore Pressure	3
15	15	-10.40	56.50	1110.7 Pore Pressure	3
16	16	-10.40	28.50	2802.4 Pore Pressure	3
17	17	-4.84	28.50	2794.2 Pore Pressure	3
18	18	-4.84	56.50	961.0 Pore Pressure	3
19	19	30.80	28.50	2714.4 Pore Pressure	3
20	20	30.80	56.50	0.0 Pore Pressure	3
21	21	100.00	56.50	0.0 Pore Pressure	3
22	22	100.00	28.50	2661.4 Pore Pressure	3

Number of new interpolation points read: 22
Number of old interpolation points retained: 0

```
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Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
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    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 16
*********************************
* NEW ANALYSIS/COMPUTATION DATA *
*********************************

Starting Center Coordinate for Search at -
                                            X: 25.00
                                            Y: 150.00

Required accuracy for critical center
(= minimum spacing between grid points): 0.500

No center allowed to pass below: 28.50

Critical shear surface not allowed to pass below Y: 28.50
For the initial mode of search circles are tangent to horizontal line at
-
                                            Y: 56.50
                                            Radius: 93.50

Conventional (single-stage) computations will be performed.
Automatic search output will be in short form.
Depth of crack: 4.000
Radii for each grid point will be sorted in the order of increasing
radius.
Critical circles for grid points will be output in the order of
increasing factor of safety.
Search will be continued after the initial mode to find a most critical
circle.
Minimum weight required for computations to be performed: 80000
Procedure of Analysis: Spencer

--------------------------------------------------------------------------
---------
The following represent default values or values that were prevously
defined:
Subtended angle for slice subdivision: 3.00(degrees)
There is no water in a crack.
Seismic coefficient: 0.000
Unit weight of water (or other fluid) in crack: 62.4
Maximum number of trial grids for a given search mode: 50
No restrictions exist on the lateral extent of the search.
No shear surfaces other than the most critical will be saved for display
later.
Neither slope face was explicitly designated for analysis.
Standard sign convention used for direction of shear stress on shear
surface.
Iteration limit: 100
Force imbalance: 1.000000e-005 (fraction of total weight)
Moment imbalance: 1.000000e-005 (fraction of moment due to total weight)
```

Initial trial factor of safety: 3.000
Initial trial side force inclination: 17.189 (degrees)
Minimum (most negative) side force inclination allowed in Spencer's procedure: -10.00

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Argentine Station 264
Steady State
Rockfill Toe

TABLE NO. 26
****
* NEW, COMPUTED SLOPE GEOMETRY DATA *
****

These slope geometry were generated from the Profile Lines.

Point	X	Y
1	-200.00	41.10
2	-179.60	41.10
3	-141.40	41.10
4	-104.40	43.20
5	-55.60	55.20
6	-52.66	56.50
7	-33.00	65.20
8	-10.40	71.90
9	-4.84	71.90
10	8.60	71.90
11	19.31	67.99
12	27.80	67.99
13	30.80	66.49
14	50.80	56.50
15	100.00	56.50

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Argentine Station 264
Steady State
Rockfill Toe

TABLE NO. 27

****

* NEW DISTRIBUTED LOAD DATA - CONVENTIONAL/FIRST-STAGE COMPUTATIONS *

****

Point	X	Y	Normal Pressure	Shear Stress
1	-200.00	41.10	2071.7	0.0
2	-179.60	41.10	2071.7	0.0
3	-141.40	41.10	2071.7	0.0
4	-104.40	43.20	1940.6	0.0
5	-55.60	55.20	1191.8	0.0
6	-52.66	56.50	1110.7	0.0
7	-33.00	65.20	567.8	0.0
8	-10.40	71.90	149.8	0.0
9	-4.84	71.90	0.0	0.0

The above data were generated automatically from piezometric
line number 1.

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -200.00
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -179.60
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -141.40
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -104.40
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -55.60
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -52.66
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -4.84
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = -0.96

```
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 8.60
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 19.31
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 27.80
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 30.80
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 50.80
from piezometric line number 2 (Stage 1).

UTEXAS WARNING NUMBER 4240
Possible artesian pressures detected at x = 100.00
from piezometric line number 2 (Stage 1).

Search will be conducted for RIGHT face of slope
```

```
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    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 32
**************************************************************
* SHORT-FORM OUTPUT FOR TYPE 1 AUTOMATIC SEARCH WITH CIRCLES *
**************************************************************

                          Center Coordinates of                  1-Stage
                             Critical Circle                     Factor
Side
                                                                   of
Force
Mode of Search                    X          Y       Radius      Safety
Inclin.          Messages


Circles tangent to horiz.      13.00      133.00      76.500      3.955
-5.41
line at Y = 56.50


************************************************************
CAUTION - THE FACTOR OF SAFETY COULD NOT BE COMPUTED
FOR SOME OF THE GRID POINTS AROUND THE MINIMUM
************************************************************

Circles all have the same      48.50      122.00      76.500      1.455
-8.92
radius = 76.500


Circles tangent to horiz.      46.00       95.50      50.000      1.410
-9.61
line at Y = 45.50


Circles all have the same      46.00       96.50      50.000      1.407  -
10.04
radius = 50.000


Circles tangent to horiz.      46.00       95.50      49.000      1.407  -
10.03
line at Y = 46.50
```

```
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    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 33
*******************************************
* 1-STAGE FINAL CRITICAL CIRCLE INFORMATION *
*******************************************
X Coordinate of Center . . . . . .  46.00
Y Coordinate of Center . . . . . .  95.50
Radius . . . . . .  49.00
Factor of Safety . . . . . . 1.407
Side Force Inclination (degrees) . . . . . -10.03
Number of Circles Tried  . . . . . .  225
Number of Circles F Calculated for . . . . . .  172
Time Required for Search (seconds) . . . . . .  0.7
```

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Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
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Argentine Station 264
Steady State
Rockfill Toe

TABLE NO. 43
****
* Coordinate, Weight, Strength and Pore Water Pressure *
* Information for Individual Slices for Conventional *
* Computations or First Stage of Multi-Stage Computations. *
* (Information is for the critical shear surface in the *
* case of an automatic search.) *
****

Slice No.	X	Y	Slice Weight	Matl. No.	Cohesion	Friction Angle	Pore Pressure
	5.51	67.90					
1	5.75	67.56	234	1	50.0	26.00	0.0
	5.98	67.22					
2	6.75	66.20	1017	2	50.0	26.00	43.4
	7.52	65.17					
3	8.06	64.51	941	2	50.0	26.00	113.7
	8.60	63.84					
4	9.45	62.88	1758	2	50.0	26.00	177.1
	10.31	61.93					
5	11.21	61.02	2134	2	50.0	26.00	246.3
	12.11	60.11					
6	13.06	59.24	2501	2	50.0	26.00	307.0
	14.01	58.38					
7	15.01	57.57	2854	2	50.0	26.00	359.1
	16.00	56.76					
8	16.17	56.63	504	2	50.0	26.00	386.5
	16.34	56.50					
9	17.38	55.75	3236	3	0.0	28.00	411.0
	18.42	55.00					
10	18.86	54.70	1443	3	0.0	28.00	439.4
	19.31	54.41					
11	20.40	53.74	3768	3	0.0	28.00	461.2
	21.50	53.07					
12	22.62	52.45	4273	3	0.0	28.00	485.3
	23.75	51.84					

13	24.91	51.29	4756	3	0.0	28.00
518.3						
	26.07	50.74				
14	26.93	50.37	3779	3	0.0	28.00
602.8						
	27.80	50.01				
15	29.00	49.56	5337	3	0.0	28.00
676.8						
	30.21	49.12				
16	30.50	49.02	1308	3	0.0	28.00
726.2						
	30.80	48.92				
17	32.03	48.55	5325	3	0.0	28.00
770.6						
	33.26	48.19				
18	34.51	47.88	5223	3	0.0	28.00
835.2						
	35.75	47.58				
19	37.01	47.35	5056	3	0.0	28.00
887.2						
	38.27	47.11				
20	39.55	46.94	4825	3	0.0	28.00
926.4						
	40.82	46.77				
21	42.10	46.67	4531	3	0.0	28.00
952.7						
	43.37	46.57				
22	44.66	46.54	4178	3	0.0	28.00
966.0						
	45.94	46.50				
23	45.97	46.50	95	3	0.0	28.00
969.4						
	46.00	46.50				
24	47.28	46.53	3758	3	0.0	28.00
966.2						
	48.56	46.57				
25	49.68	46.65	2908	3	0.0	28.00
954.8						
	50.80	46.74				
26	52.07	46.89	3056	3	0.0	28.00
931.2						
	53.35	47.05				
27	54.61	47.28	2911	3	0.0	28.00
893.9						
	55.87	47.50				
28	57.12	47.80	2718	3	0.0	28.00
843.8						
	58.37	48.09				
29	59.60	48.44	2482	3	0.0	28.00
781.1						
	60.83	48.80				
30	62.05	49.22	2206	3	0.0	28.00
705.8						
	63.26	49.64				
31	64.45	50.12	1894	3	0.0	28.00
618.2						
	65.63	50.61				
32	66.80	51.15	1553	3	0.0	28.00
518.6						
	67.96	51.69				
33	69.09	52.30	1188	3	0.0	28.00

```
407.2
          70.22     52.90
  34      71.32     53.57          805    3          0.0     28.00
284.3
          72.42     54.23
  35      73.48     54.95          412    3          0.0     28.00
150.3
          74.54     55.67
  36      75.10     56.08           58    3          0.0     28.00
40.3
          75.66     56.50
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
Licensed for use by: Mary Perlea, U. S. Army Corps of Engineers
Time and date of run: Wed Dec 15 11:36:10 2004
Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 44
**********************************************************
* Seismic Forces and Forces Due to Distributed Loads for *
* Individual Slices for Conventional Computations or the *
* First Stage of Multi-Stage Computations.               *
* (Information is for the critical shear surface in the  *
* case of an automatic search.)                          *
**********************************************************

There are no seismic forces or forces due to distributed loads
for the current shear surface
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Dec 15 11:36:10 2004
Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 47
**************************************************************
*  Information for the Iterative Solution for the Factor of  *
*  Safety and Side Force Inclination by Spencer's Procedure  *
**************************************************************
Allowable force imbalance for convergence:  9.5026e-001
Allowable moment imbalance for convergence: 34

        Trial      Trial
       Factor   Side Force      Force        Moment                  Delta
Iter-    of     Inclination   Imbalance    Imbalance    Delta-F      Theta
ation  Safety    (degrees)      (lbs.)     (ft.-lbs.)
(degrees)

   1   3.00000   -17.1887  -9.602e+003   4.945e+005
First-order corrections to F and Theta .............   -3.4543      9.3499
Reduced values - Deltas were too large .............   -0.5000      1.3534

   2   2.50000   -15.8354  -7.878e+003   4.036e+005
First-order corrections to F and Theta .............   -1.9647      7.3352
Reduced values - Deltas were too large .............   -0.5000      1.8668

   3   2.00000   -13.9686  -5.281e+003   2.671e+005
First-order corrections to F and Theta .............   -0.8471      4.6581
Reduced values - Deltas were too large .............   -0.5000      2.7493

   4   1.50000   -11.2193  -9.772e+002   4.380e+004
First-order corrections to F and Theta .............   -0.0989      1.2237
Second-order corrections to F and Theta ............   -0.0931      1.1943

   5   1.40688   -10.0250   3.854e+000  -1.748e+002
First-order corrections to F and Theta .............    0.0003     -0.0044
Second-order corrections to F and Theta ............    0.0003     -0.0044

   6   1.40722   -10.0294  -2.214e-007   1.003e-005
First-order corrections to F and Theta .............   -0.0000      0.0000
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Dec 15 11:36:10 2004
Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 55
**************************************************************************
* Check of Computations by Spencer's Procedure (Results are for the *
* critical shear surface in the case of an automatic search.)       *
**************************************************************************

Summation of Horizontal Forces: 1.17240e-011

Summation of Vertical Forces: 6.67910e-012

Summation of Moments: 1.72804e-011

Mohr Coulomb Shear Force/Shear Strength Check Summation: 3.81384e-012
```

```
UTEXAS4 S/N:C0001  - Version: 4.0.0.9 - Latest Revision: 07/27/2001
Licensed for use by: Mary Perlea, U. S. Army Corps of Engineers
Time and date of run: Wed Dec 15 11:36:10 2004
Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

    Argentine Station 264
    Steady State
    Rockfill Toe

TABLE NO. 58
*************************************************************************
*
* Final Results for Stresses Along the Shear Surface
*
* (Results are for the critical shear surface in the case of a search.)
*
*************************************************************************
*

SPENCER'S PROCEDURE USED TO COMPUTE THE FACTOR OF SAFETY
Factor of Safety: 1.407     Side Force Inclination: -10.03
```

Slice No.	VALUES AT CENTER OF BASE OF SLICE -------- X-Center	Y-Center	Total Normal Stress	Effective Normal Stress	Shear Stress
1	5.75	67.56	268.2	268.2	128.5
2	6.75	66.20	389.7	346.3	155.6
3	8.06	64.51	552.5	438.8	187.6
4	9.45	62.88	690.8	513.7	213.6
5	11.21	61.02	833.7	587.4	239.1
6	13.06	59.24	968.2	661.1	264.7
7	15.01	57.57	1093.0	733.9	289.9
8	16.17	56.63	1162.7	776.2	304.6
9	17.38	55.75	1229.6	818.6	309.3
10	18.86	54.70	1303.4	864.0	326.5
11	20.40	53.74	1412.7	951.5	359.5
12	22.62	52.45	1590.0	1104.7	417.4
13	24.91	51.29	1763.9	1245.7	470.7
14	26.93	50.37	1915.4	1312.6	496.0
15	29.00	49.56	1992.1	1315.3	497.0
16	30.50	49.02	2007.1	1281.0	484.0
17	32.03	48.55	2004.0	1233.4	466.0
18	34.51	47.88	1981.9	1146.7	433.3
19	37.01	47.35	1937.1	1049.9	396.7
20	39.55	46.94	1869.0	942.6	356.2
21	42.10	46.67	1777.0	824.3	311.5
22	44.66	46.54	1660.4	694.4	262.4
23	45.97	46.50	1593.0	623.6	235.6
24	47.28	46.53	1514.6	548.4	207.2
25	49.68	46.65	1357.3	402.6	152.1
26	52.07	46.89	1266.9	335.8	126.9
27	54.61	47.28	1237.9	344.0	130.0
28	57.12	47.80	1190.9	347.1	131.1
29	59.60	48.44	1125.2	344.2	130.0
30	62.05	49.22	1039.9	334.1	126.3
31	64.45	50.12	933.9	315.6	119.3
32	66.80	51.15	805.5	286.9	108.4

33	69.09	52.30	652.8	245.6	92.8
34	71.32	53.57	472.7	188.3	71.1
35	73.48	54.95	260.7	110.4	41.7
36	75.10	56.08	72.6	32.3	12.2

UTEXAS4 S/N:C0001 - Version: 4.0.0.9 - Latest Revision: 07/27/2001
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Time and date of run: Wed Dec 15 11:36:10 2004
Name of input data file: C:\Program Files\WinUT4\UTexas4 Samples
\argentine 4 264.dat

Argentine Station 264
Steady State
Rockfill Toe

TABLE NO. 59

****

*

* Final Results for Side Forces and Stresses Between Slices

*

* (Results are for the critical shear surface in the case of a search.)

*

****

*

---------- VALUES AT RIGHT SIDE OF SLICE ----------

Slice No.	X-Right	Side Force	Y-Coord. of Side Force Location	Fraction of Height	Sigma at Top	Sigma at Bottom
1	5.98	123	67.52	0.063	-41.9	93.7
2	7.52	694	66.27	0.164	-103.3	306.3
3	8.60	1232	65.35	0.187	-132.0	433.1
4	10.31	2204	64.03	0.225	-151.5	615.9
5	12.11	3308	62.76	0.252	-150.9	770.8
6	14.01	4494	61.54	0.274	-137.6	904.3
7	16.00	5711	60.38	0.291	-114.7	1018.7
8	16.34	5911	60.19	0.294	-110.2	1035.9
9	18.42	7129	59.10	0.308	-81.3	1135.7
10	19.31	7619	58.66	0.313	-66.6	1171.3
11	21.50	8744	57.67	0.308	-86.9	1240.8
12	23.75	9765	56.74	0.304	-106.5	1297.5
13	26.07	10637	55.90	0.299	-123.5	1337.7
14	27.80	11188	55.33	0.296	-136.6	1361.8
15	30.21	11775	54.63	0.312	-83.9	1396.0
16	30.80	11887	54.47	0.316	-68.9	1400.9

```
  17       33.26        12212        53.89      0.334        1.9
1406.5
  18       35.75        12326        53.39      0.353       88.9
1388.3
  19       38.27        12236        52.99      0.376      195.0
1345.4
  20       40.82        11958        52.67      0.401      324.6
1276.1
  21       43.37        11518        52.44      0.430      484.7
1178.5
  22       45.94        10954        52.28      0.465      686.3
1049.4
  23       46.00        10939        52.28      0.466      691.8
1045.9
  24       48.56        10296        52.17      0.507      955.8
879.3
  25       50.80         9719        52.09      0.548     1264.2
696.0
  26       53.35         8981        52.05      0.529     1097.1
775.4
  27       55.87         8081        52.11      0.512      946.4
822.9
  28       58.37         7044        52.27      0.497      809.0
840.0
  29       60.83         5905        52.53      0.484      683.0
827.1
  30       63.26         4707        52.89      0.473      567.0
784.2
  31       65.63         3503        53.34      0.464      460.4
709.9
  32       67.96         2356        53.90      0.459      363.8
601.8
  33       70.22         1341        54.56      0.460      279.9
454.7
  34       72.42          546        55.33      0.486      217.0
256.9
  35       74.54           75        56.18      0.620      153.2
25.1
  36       75.66           -0        56.50      0.000        0.0
0.0

Read end-of-file on input while looking for another command word.
End of input data assumed - normal termination.
```

NOMINAL 500-YEAR + 5 FEET

EXHIBIT A-5.27
Assumed 500-Yr Flood Elevation Sta 0+00 to 39+00

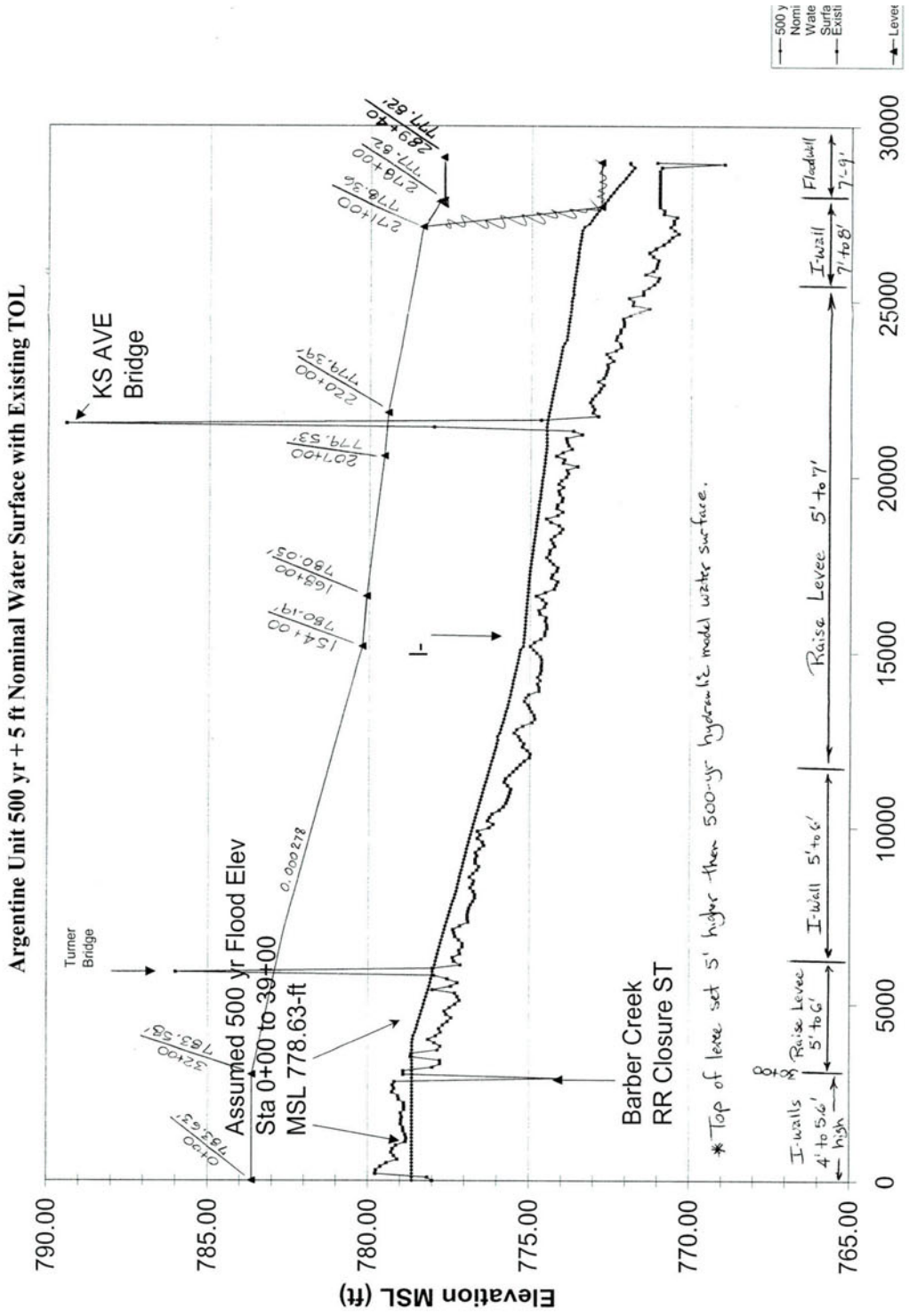


EXHIBIT A-5.28
Argentine Feasibility Cross Section N500+5

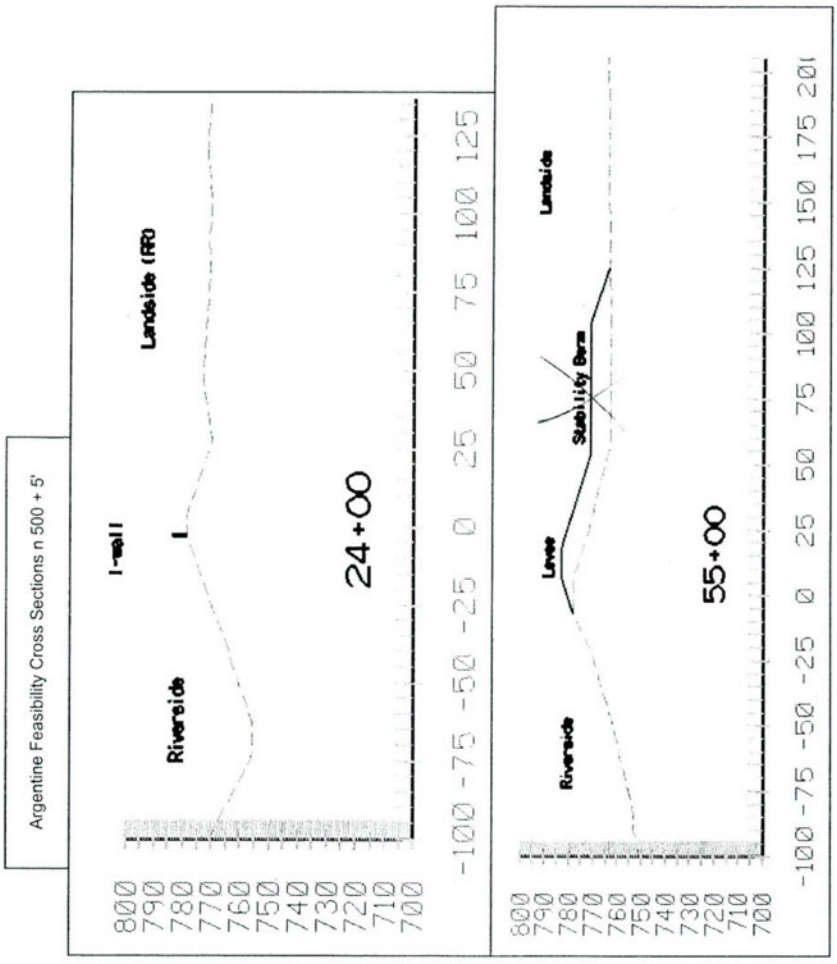


EXHIBIT A-5.29
Argentine Feasibility Cross Section N500 + 5

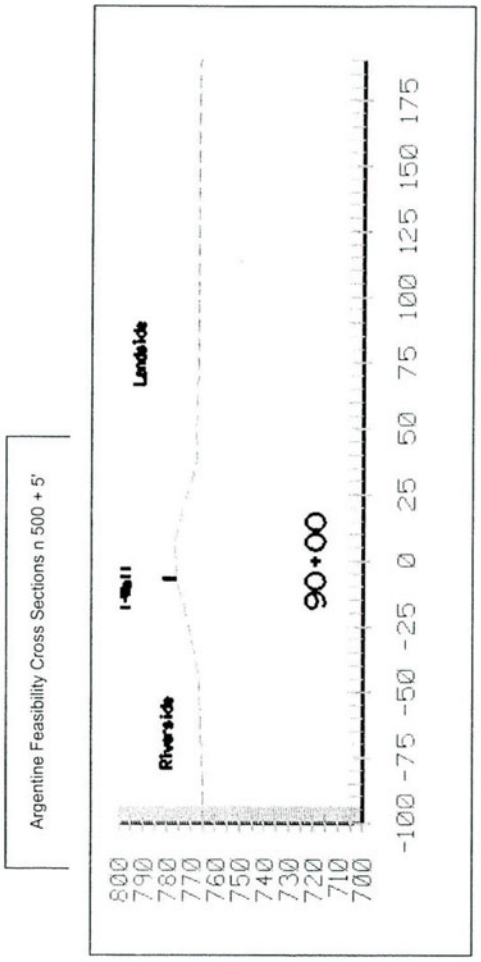


EXHIBIT A-5.30
Argentine Feasibility Cross Section N500 + 5

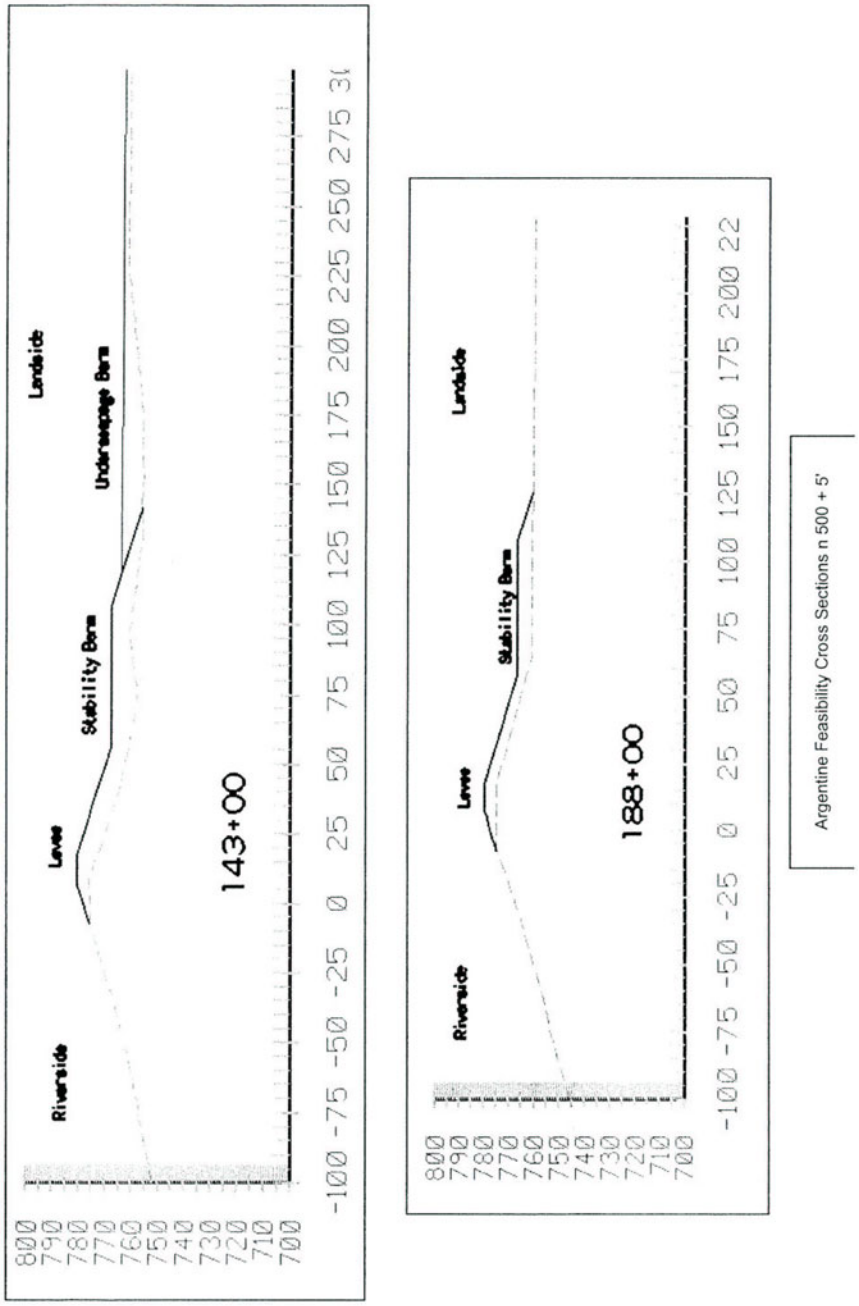
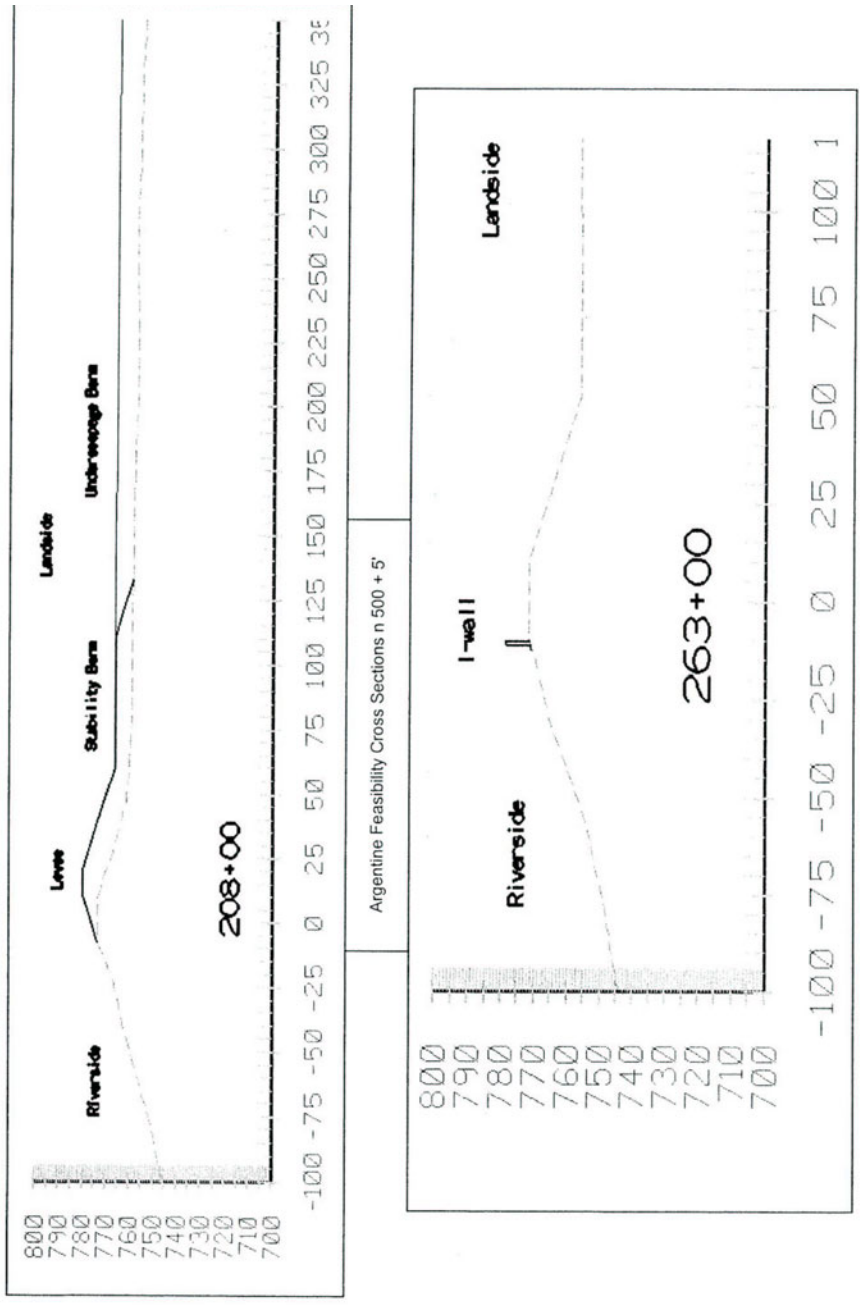


EXHIBIT A-5.31
Argentine Feasibility Cross Section N500 + 5



UNDERSEEPAGE

UNDERSEEPAGE ANALYSIS

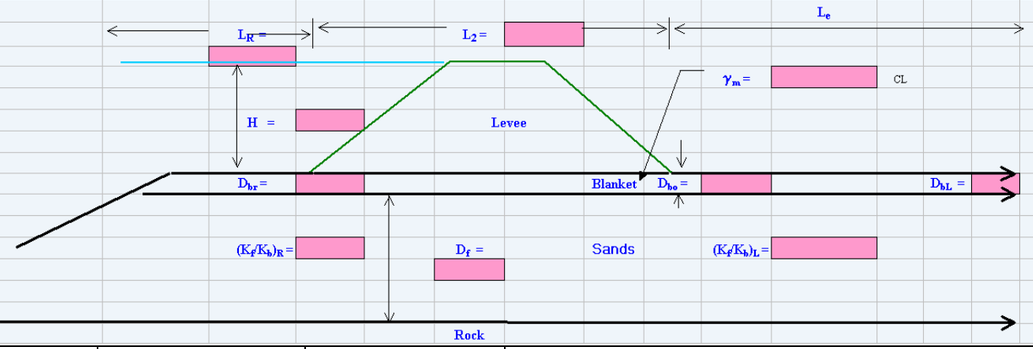
Note : This spreadsheet analysis should be used only if the blanket thickness is at least 1/4 of the height of the levee.

Argentine 5

Name : Campbell EC-GG

Date : 4/20/2004

Revised to reflect criteria developed for L-142



Recommended Permeability Ratio For Foundation Blanket Materials Chapter Underseepage Revision dated Oct 1998	
Blanket Material	Assumed Permeability Ratio, (Kf/Kb)
SM	100
ML	200 to 400
ML-CL	400
CL	400 to 600
CH	800 to 1000

NOMENCLATURE

$(K_f/K_b)_R$	= riverside permeability	t'	= required Berm thickness at toe
$(K_f/K_b)_L$	= landside permeability	Sc	= calc'd slope of underseepage berm
D_{br}	= riverside blanket thickness	q	= seepage /unit Length
D_{bo}	= levee toe blanket thickness	Q	= cummulated seepage
D_{bL}	= landside blanket thickness	FS_i	= i_c / i_o
D_f	= thickness of pervious foundation		
L_R	= length of riverside blanket		
L_L	= length of landside blanket		
H	= max head or levee height		
$H(W_T)$	= head above tailwater at end of underseepage berm		
$H(W_T)$	= $H(W_T/2)*e^{(-WT/(2*CL))}$		
$H(W_{T/2})$	= head above tailwater midpoint of underseepage berm		
	= $H * L_e / L'_t$		
W_T	= berm width		
i_o	= seepage gradient		
C_r	= riverside effective length coefficient		
C_L	= landside effective length coefficient		
where C =	$[(Kf/Kb) * Df * Db]^{1/2}$		
H'o	= head above tailwater at levee toe (w/ berm)		
i_c	= critical seepage gradient		
L_1	= riverside effective length		
where L_1	= $C * (e^{(2LR/C-1)}) / (e^{(2LR/C+1)})$		
L_2	= levee base width		
L_e	= landside effective length		
L_t	= total effective length		
L'_t	= Total Effective Length + 1/2 of Berm		

Station	Begin Station Feet	End Station Feet	Input Parameters 5 Ft Raise $(K_f/K_b)_R$	$(K_f/K_b)_L$	D_{bL}	D_{bo}	D_{br}	D_f	L_R	H	Remarks	C_R Feet	C_L Feet	L_1 Feet	L_2 Feet	L_e Feet	L_t Feet	h_o Feet	i_o Ft/Ft	ic Ft/Ft	Check #1 Full Head Toe FS_i (need 1.1)	Check #1 Reduced Head Toe FS_i (need 1.5)	Remarks
			First row is tied to above graphs! Change Graphics only!																				
0+0 to 30+0	0+00	30+00	500	500	28.0	28.0	28.0	66.0	170	11.6		961	961	168	61	961	1190	9.39	0.34	0.85	2.53	3.42	
30+0 to 46+0	30+00	46+00	200	200	35.0	35.0	35.0	60.0	150.0	17.6		648	648	147	140	648	935	12.16	0.35	0.85	2.45	2.95	
46+0 to 50+0	46+00	50+00	250	250	25.0	25.0	25.0	67.0	100.0	17.0		647	647	99	118	647	864	12.73	0.51	0.85	1.67	2.03	
50+0 to 59+0	50+00	59+00	300	300	20.0	20.0	20.0	62.5	100.0	20.5		612	612	99	127	612	838	14.97	0.75	0.85	1.14	1.33	
59+0 to 70+0	59+00	70+00	300	300	23.0	23.0	23.0	58.0	150.0	20.5		633	633	147	150	633	930	13.95	0.61	0.85	1.40	1.64	
70+0 to 74+0	70+00	74+00	200	200	16.0	16.0	16.0	70.0	350.0	18.0		473	473	298	120	473	891	9.56	0.60	0.85	1.42	1.71	
74+0 to 86+0	74+00	86+00	200	200	16.0	16.0	16.0	70.0	350.0	18.5		473	473	298	120	473	891	9.83	0.61	0.85	1.38	1.65	
86+0 to 96+0	86+00	96+00	250	250	28.0	28.0	28.0	62.0	650.0	15.5		659	659	498	110	659	1267	8.06	0.29	0.85	2.95	3.66	
96+0 to 110+0	96+00	110+00	150	150	30.0	30.0	30.0	66.0	1050.0	19.0		545	545	522	141	545	1208	8.57	0.29	0.85	2.98	3.53	
110+0 to 118+0	110+00	118+00	250	250	20.0	20.0	20.0	65.0	400.0	19.3		570	570	345	145	570	1060	10.38	0.52	0.85	1.64	1.94	Stability Berm Required
118+0 to 128+0	118+00	128+00	250	250	20.0	20.0	20.0	67.0	380.0	23.0		579	579	333	160	579	1072	12.42	0.62	0.85	1.37	1.57	Stability Berm Required
128+0 to 135+0	128+00	135+00	300	300	25.0	25.0	25.0	67.0	360.0	19.5		709	709	332	130	709	1171	11.81	0.47	0.85	1.80	2.13	
135+0 to 141+0	135+00	141+00	300	300	25.0	25.0	25.0	55.0	474.0	20.5		642	642	403	153	642	1199	10.99	0.44	0.85	1.93	2.27	
141+0 to 151+0	141+00	151+00	300	300	20.0	20.0	20.0	60.0	425.0	22.0		600	600	366	136	600	1102	11.98	0.60	0.85	1.42	1.64	
151+0 to 161+0	151+00	161+00	300	300	25.0	25.0	25.0	56.0	400.0	20.2		648	648	356	129	648	1133	11.55	0.46	0.85	1.84	2.16	
161+0 to 170+0	161+00	170+00	300	300	12.0	12.0	12.0	65.0	250.0	20.1		484	484	230	130	484	844	11.53	0.96	0.85	0.89	1.04	
170+0 to 182+0	170+00	182+00	200	200	18.0	18.0	18.0	67.0	350.0	22.0	Has Berm	491	491	301	150	491	942	11.47	0.64	0.85	1.33	1.54	
182+0 to 193+0	182+00	193+00	250	250	23.0	23.0	23.0	60.0	175.0	20.0		587	587	170	134	587	891	13.18	0.57	0.85	1.48	1.75	

EXHIBIT A-5.32 (Continued)

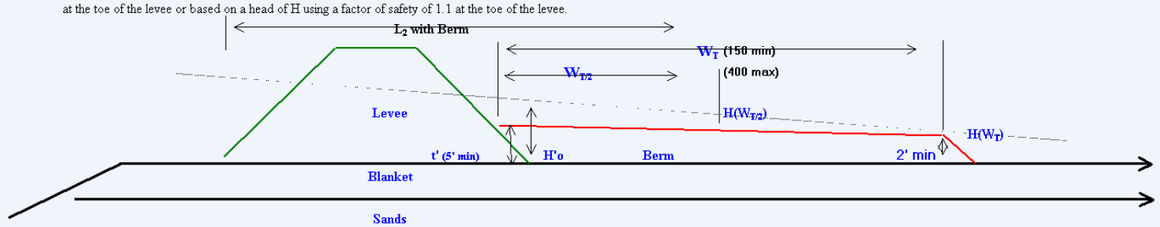
			Input Parameters 5 Ft Raise								
Station	Begin Station Feet	End Station Feet	$(K_f/K_b)_R$	$(K_f/K_b)_L$	D_{bL}	D_{bo}	D_{br}	D_f	L_R	H	Remarks
193+0 to 203+0	193+00	203+00	300	300	25.0	25.0	25.0	66.9	93	20.5	Has Berm
203+0 to 210+0	203+00	210+00	250	250	25.0	25.0	25.0	74.0	73.0	20.5	Has Berm
210+0 to 218+0	210+00	218+00	250	250	30.0	30.0	30.0	62.5	150.0	21.4	
218+0 to 226+0	218+00	226+00	200	200	25.0	25.0	25.0	63.0	150.0	24.8	
226+0 to 234+0	226+00	234+00	300	300	28.0	28.0	28.0	55.0	170.0	23.2	Has Berm
234+0 to 245+0	234+00	245+00	250	250	25.0	25.0	25.0	61.0	150.0	23.5	Has Berm
245+0 to 260+0	245+00	260+00	300	300	28.0	28.0	28.0	62.0	160.0	22.5	
260+0 to 270+0	260+00	270+00	250	250	28.0	28.0	28.0	55.0	125.0	21.5	
270+0 to 275+0	270+00	275+00	300	300	28.0	28.0	28.0	66.9	94.0	15.6	
275+0 to 280+0	275+00	280+00	275	275	40.0	40.0	40.0	68.8	62.0	12.0	Floodwall
280+0 to 290+0	280+00	290+00	200	200	40.0	40.0	40.0	78.0	50.0	10.8	Floodwall

Analysis of Without Berm Conditions 5 Ft Raise											
C_R Feet	C_L Feet	L_1 Feet	L_2 Feet	L_e Feet	L_t Feet	h_o Feet	i_o Ft/Ft	ic Ft/Ft	Check #1 Full Head Toe FS_i (need 1.1)	Check #1 Reduced Head Toe FS_i (need 1.5)	Remarks
708	708	92	135	708	936	15.52	0.62	0.85	1.37	1.60	Stability Berm Required
680	680	73	120	680	873	15.97	0.64	0.85	1.33	1.56	
685	685	148	125	685	957	15.31	0.51	0.85	1.67	1.94	
561	561	147	125	561	833	16.71	0.67	0.85	1.27	1.45	
680	680	167	124	680	970	16.25	0.58	0.85	1.46	1.68	
617	617	147	135	617	900	16.13	0.65	0.85	1.32	1.51	
722	722	157	133	722	1012	16.04	0.57	0.85	1.48	1.71	
620	620	123	143	620	887	15.04	0.54	0.85	1.58	1.84	
750	750	94	121	750	964	12.13	0.43	0.85	1.96	2.43	
870	870	62	0	870	932	11.20	0.28	0.85	3.03	4.05	
790	790	50	0	790	840	10.16	0.25	0.85	3.35	4.63	

General Notes

Analysis of Existing Conditions : This portion uses full head for the check #1 for $FS_i = 1.1$ and Full Head less 3 feet for the Check #2 for $FS_i = 1.5$.
If either of these two columns indicate that the required FS_i is not met then the underseepage berm design is needed.

Berm Design Information : The Excessive head columns provides the designer with a feel for which check case control.
The design of the berm at the toe of the levee requires a FS_i of at least 1.5 for the controlling case, using the reduced head (87% of full head).
The design of the extension of the berm is controlled using full head and a required FS_i of 1.1 at the toe of the berm.
If the FS_i = 1.1 is not met with the width = 400 feet minimum, then the 400 feet is used . The berm thickness required at the toe of the levee is controlled using an H'o at the levee toe set based on $FS_i = 1.1$, projecting back to the width less than 400 feet, with no adjustment made to H'o.
If the trail width is less than 400 feet, no adjustment to H'o is made. The minimum berm thickness is 5 feet (EM 1110-2-1913). The calculated berm thickness will be based on full head less 3 feet using a Factor of safety of 1.5 at the toe of the levee or based on a head of H using a factor of safety of 1.1 at the toe of the levee.



Berm Design Information 5 Ft Raise

Berm Width Design								Berm Thickness Design				
Station	Excessive Head Control (Feet)		Trial Width	Effective Length	Mid Berm Head, ft	$H(W_T)$ Feet	Berm Toe Gradient	Safety Factor	H'o at Levee Toe	Trial Minimum Berm Thickness	Levee Toe Gradient	Safety Factor Check at Levee Toe
	FS_i = 1.1	FS_i = 1.5	W_T	L'_t	$H(W_{T/2})$		I_{Berm}	Berm Toe	Feet	t'	I'o	For 1.5 / For 1.1
0+0 to 30+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
30+0 to 46+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
46+0 to 50+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
50+0 to 59+0	NA	1.45	10	913	13.7	13.6	0.68	1.25	11.83	2.5	0.41	2.05
59+0 to 70+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
70+0 to 74+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
74+0 to 86+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
86+0 to 96+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
96+0 to 110+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
110+0 to 118+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
118+0 to 128+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
128+0 to 135+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
135+0 to 141+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
141+0 to 151+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
151+0 to 161+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
161+0 to 170+0	2.25	3.01	210	949	10.2	8.2	0.69	1.24	10.61	3	0.51	1.67
170+0 to 182+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA
182+0 to 193+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA

Berm Design Information 5 Ft Raise													
Berm Width Design								Berm Thickness Design					
Station	Excessive Head Control (Feet)		Trial Width	Effective Length	Mid Berm Head, ft	$H(W_T)$	Berm Toe Gradient	Safety Factor	H'o at Levee Toe	Trial Minimum Berm Thickness	Levee Toe Gradient	Safety Factor Check at Levee Toe	
	FS_i = 1.1	FS_i = 1.5	W_T	L'_t	$H(W_{T/2})$	Feet	I_{Berm}	Berm Toe	Feet	t'	I'o	For 1.5	For 1.1
193+0 to 203+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
203+0 to 210+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
210+0 to 218+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
218+0 to 226+0	NA	0.53	10	908	15.3	15.2	0.61	1.40	13.60	2.5	0.40	2.11	
								Okay	15.47	2	0.50		1.70
226+0 to 234+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
234+0 to 245+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
245+0 to 260+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
260+0 to 270+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
270+0 to 275+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
275+0 to 280+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA
280+0 to 290+0	NA	NA	0	NA	NA	NA	NA	NA	NA	0	NA	NA	
								Okay	NA	0	NA		NA

EXHIBIT A-5.34
Argentine Unit 500-Yr + 5 ft With Survey Data Added

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
0+00	0	778.63	778.00	770.00	0.63	Hillside Ditch		783.63	-5.00	5.63
1+00	100	778.63	778.15	770.00	0.48	Hillside Ditch		783.63	-5.00	5.48
2+00	200	778.63	779.77	770.00	-1.14	Hillside Ditch		783.63	-5.00	3.86
3+00	300	778.63	779.75	768.00	-1.12	Hillside Ditch		783.63	-5.00	3.88
4+00	400	778.63	779.61	768.00	-0.98	Hillside Ditch		783.63	-5.00	4.02
5+00	500	778.63	779.42	768.93	-0.79	Hillside Ditch		783.63	-5.00	4.21
6+00	600	778.63	779.08	770.00	-0.45	Hillside Ditch		783.63	-5.00	4.55
7+00	700	778.63	779.19	770.00	-0.56	Hillside Ditch		783.63	-5.00	4.44
8+00	800	778.63	779.27	770.00	-0.64	Hillside Ditch		783.63	-5.00	4.36
9+00	900	778.63	779.23	770.00	-0.60	Hillside Ditch		783.63	-5.00	4.40
10+00	1000	778.63	779.12	770.00	-0.49	Hillside Ditch		783.63	-5.00	4.51
11+00	1100	778.63	778.82	768.00	-0.19	Hillside Ditch		783.63	-5.00	4.81
12+00	1200	778.63	778.80	768.00	-0.17	Hillside Ditch		783.63	-5.00	4.83
13+00	1300	778.63	778.83	768.00	-0.20	Key RD. 55th St		783.63	-5.00	4.80
14+00	1400	778.63	778.89	768.00	-0.26	Hillside Ditch		783.63	-5.00	4.74
15+00	1500	778.63	778.90	768.00	-0.27	Hillside Ditch		783.63	-5.00	4.73
16+00	1600	778.63	778.97	768.00	-0.34	Hillside Ditch		783.63	-5.00	4.66
17+00	1700	778.63	778.96	768.00	-0.33	Hillside Ditch		783.63	-5.00	4.67
18+00	1800	778.63	778.94	768.00	-0.31	Hillside Ditch		783.63	-5.00	4.69
19+00	1900	778.63	778.98	768.34	-0.35	Hillside Ditch		783.63	-5.00	4.65
20+00	2000	778.63	778.87	768.83	-0.24	Hillside Ditch		783.63	-5.00	4.76
21+00	2100	778.63	778.87	768.00	-0.24	Hillside Ditch		783.63	-5.00	4.76
22+00	2200	778.63	778.88	770.00	-0.25	Hillside Ditch		783.63	-5.00	4.75
23+00	2300	778.63	779.04	772.00	-0.41	Hillside Ditch		783.63	-5.00	4.59
24+00	2400	778.63	779.06	772.00	-0.43	Hillside Ditch		783.63	-5.00	4.57
25+00	2500	778.63	779.25	772.00	-0.62	Hillside Ditch		783.63	-5.00	4.38
26+00	2600	778.63	779.19	772.00	-0.56	Hillside Ditch		783.63	-5.00	4.44
27+00	2700	778.63	779.23	772.00	-0.60	Hillside Ditch		783.63	-5.00	4.40
28+00	2800	778.63	779.18	774.00	-0.55	Hillside Ditch	Closure Structure	783.63	-5.00	4.45
29+00	2900	778.63	774.00	****	4.63	Barber Creek RR FG	Closure Structure	783.63	-5.00	9.63
30+00	3000	778.63	778.90	768.00	-0.27	Barber Creek		783.63	-5.00	4.73
31+00	3100	778.63	778.90	766.00	-0.27	Barber Creek		783.61	-4.98	4.71
32+00	3200	778.63	778.00	768.00	0.63	Barber Creek		783.58	-4.95	5.58
33+00	3300	778.63	777.75	768.00	0.88	Barber Creek		783.56	-4.93	5.81
34+00	3400	778.63	777.76	****	0.87	Barber Creek Thorne Dr		783.53	-4.90	5.77
35+00	3500	778.63	778.67	766.00	-0.04	Barber Creek		783.51	-4.88	4.84
36+00	3600	778.63	778.66	766.00	-0.03	Barber Creek		783.49	-4.86	4.83
37+00	3700	778.63	777.84	766.00	0.79	Barber Creek		783.46	-4.83	5.62
38+00	3800	778.63	777.75	768.00	0.88	LV KS		783.44	-4.81	5.69
39+00	3900	778.63	777.94	766.00	0.69	LV KS		783.41	-4.78	5.47
40+00	4000	778.61	778.13	766.00	0.48	LV KS		783.39	-4.78	5.26
41+00	4100	778.59	777.89	766.00	0.70	LV KS		783.36	-4.77	5.47
42+00	4200	778.54	777.74	765.00	0.80	LV KS		783.34	-4.80	5.60
43+00	4300	778.50	777.79	765.00	0.71	LV KS		783.32	-4.82	5.53

EXHIBIT A-5.34 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
44+00	4400	778.47	777.68	765.00	0.79	LV KS		783.29	-4.82	5.61
45+00	4500	778.44	777.53	766.00	0.91	LV KS		783.27	-4.83	5.74
46+00	4600	778.40	777.41	766.00	0.99	LV KS		783.24	-4.84	5.83
47+00	4700	778.37	777.57	766.00	0.80	LV KS		783.22	-4.85	5.65
48+00	4800	778.34	777.62	767.00	0.72	LV KS		783.20	-4.86	5.58
49+00	4900	778.30	777.46	766.00	0.84	LV KS		783.17	-4.87	5.71
50+00	5000	778.27	777.29	766.00	0.98	LV KS		783.15	-4.88	5.86
51+00	5100	778.24	777.16	766.00	1.08	LV KS		783.12	-4.88	5.96
52+00	5200	778.20	777.22	766.00	0.98	LV KS		783.10	-4.90	5.88
53+00	5300	778.17	777.30	764.00	0.87	LV KS		783.07	-4.90	5.77
54+00	5400	778.13	778.00	764.00	0.13	LV KS		783.05	-4.92	5.05
55+00	5500	778.10	777.42	764.00	0.68	LV KS		783.03	-4.93	5.61
56+00	5600	778.07	777.22	762.00	0.85	LV KS		783.00	-4.93	5.78
57+00	5700	778.05	777.54	762.00	0.51	LV KS		782.98	-4.93	5.44
58+00	5800	778.01	777.96	762.00	0.05	LV KS		782.95	-4.94	4.99
59+00	5900	778.00	786.00	***	-8.00	LV KS	Turner Bridge	782.93	-4.93	-3.07
60+00	6000	777.97	778.00	***	-0.03	LV KS	Turner Bridge	782.91	-4.94	4.91
61+00	6100	777.93	777.13	762.00	0.80	LV KS		782.88	-4.95	5.75
62+00	6200	777.91	777.33	762.00	0.58	LV KS		782.86	-4.95	5.53
63+00	6300	777.88	777.37	762.00	0.51	LV KS		782.83	-4.95	5.46
64+00	6400	777.85	777.15	762.00	0.70	LV KS		782.81	-4.96	5.66
65+00	6500	777.82	777.17	762.00	0.65	LV KS		782.78	-4.96	5.61
66+00	6600	777.79	777.07	762.00	0.72	LV KS		782.76	-4.97	5.69
67+00	6700	777.76	777.07	762.00	0.69	LV KS		782.74	-4.98	5.67
68+00	6800	777.73	777.18	762.00	0.55	LV KS		782.71	-4.98	5.53
69+00	6900	777.70	777.30	762.00	0.40	LV KS		782.69	-4.99	5.39
70+00	7000	777.67	777.33	762.00	0.34	LV KS		782.66	-4.99	5.33
71+00	7100	777.64	777.36	762.00	0.28	LV KS		782.64	-5.00	5.28
72+00	7200	777.61	777.15	762.00	0.46	LV KS		782.61	-5.00	5.46
73+00	7300	777.57	776.90	764.00	0.67	LV KS		782.58	-5.01	5.68
74+00	7400	777.54	776.92	764.00	0.62	LV KS		782.55	-5.01	5.63
75+00	7500	777.51	776.92	764.00	0.59	LV KS		782.52	-5.01	5.60
76+00	7600	777.47	776.90	764.00	0.57	LV KS		782.49	-5.02	5.59
77+00	7700	777.44	776.87	764.00	0.57	LV KS		782.46	-5.02	5.59
78+00	7800	777.41	776.82	764.00	0.59	LV KS		782.43	-5.02	5.61
79+00	7900	777.37	776.75	764.00	0.62	LV KS		782.40	-5.03	5.65
80+00	8000	777.33	776.69	762.00	0.64	LV KS		782.37	-5.04	5.68
81+00	8100	777.30	776.69	762.00	0.61	LV KS		782.34	-5.04	5.65
82+00	8200	777.27	776.74	762.00	0.53	LV KS		782.31	-5.04	5.57
83+00	8300	777.24	776.83	764.00	0.41	LV KS		782.28	-5.04	5.45
84+00	8400	777.22	776.76	764.00	0.46	LV KS		782.25	-5.03	5.49
85+00	8500	777.19	776.73	764.00	0.46	LV KS		782.22	-5.03	5.49
86+00	8600	777.17	776.85	765.00	0.32	LV KS		782.19	-5.02	5.34
87+00	8700	777.14	776.75	766.00	0.39	LV KS		782.16	-5.02	5.41

EXHIBIT A-5.34 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
88+00	8800	777.11	776.63	766.00	0.48	LV KS		782.13	-5.02	5.50
89+00	8900	777.08	776.57	766.00	0.51	LV KS		782.10	-5.02	5.53
90+00	9000	777.06	776.68	768.00	0.38	LV KS		782.07	-5.01	5.39
91+00	9100	777.03	776.68	768.00	0.35	LV KS		782.04	-5.01	5.36
92+00	9200	777.00	776.63	768.00	0.37	LV KS		782.01	-5.01	5.38
93+00	9300	776.97	776.67	768.00	0.30	LV KS		781.98	-5.01	5.31
94+00	9400	776.95	776.55	768.00	0.40	LV KS		781.95	-5.00	5.40
95+00	9500	776.92	776.42	768.00	0.50	LV KS		781.92	-5.00	5.50
96+00	9600	776.89	776.46	768.00	0.43	LV KS		781.89	-5.00	5.43
97+00	9700	776.86	776.61	766.00	0.25	LV KS		781.86	-5.00	5.25
98+00	9800	776.83	776.53	764.00	0.30	LV KS		781.83	-5.00	5.30
99+00	9900	776.80	776.61	764.00	0.19	LV KS		781.80	-5.00	5.19
100+00	10000	776.77	776.25	764.00	0.52	LV KS		781.77	-5.00	5.52
101+00	10100	776.74	776.13	764.00	0.61	LV KS		781.74	-5.00	5.61
102+00	10200	776.71	776.30	764.00	0.41	LV KS		781.71	-5.00	5.41
103+00	10300	776.68	776.24	764.00	0.44	LV KS		781.68	-5.00	5.44
104+00	10400	776.65	776.16	764.00	0.49	LV KS		781.65	-5.00	5.49
105+00	10500	776.61	775.93	764.00	0.68	LV KS		781.62	-5.01	5.69
106+00	10600	776.58	775.81	762.00	0.77	LV KS		781.59	-5.01	5.78
107+00	10700	776.55	775.73	762.00	0.82	LV KS		781.56	-5.01	5.83
108+00	10800	776.52	775.69	762.00	0.83	LV KS		781.53	-5.01	5.84
109+00	10900	776.49	775.65	762.00	0.84	LV KS		781.50	-5.01	5.85
110+00	11000	776.46	775.61	762.00	0.85	LV KS		781.47	-5.01	5.86
111+00	11100	776.43	775.58	762.00	0.85	LV KS		781.44	-5.01	5.86
112+00	11200	776.40	775.68	762.00	0.72	LV KS		781.41	-5.01	5.73
113+00	11300	776.36	775.78	762.00	0.58	LV KS		781.38	-5.02	5.60
114+00	11400	776.33	775.74	762.00	0.59	LV KS		781.35	-5.02	5.61
115+00	11500	776.30	775.62	762.00	0.68	LV KS		781.32	-5.02	5.70
116+00	11600	776.27	775.51	762.00	0.76	LV KS		781.29	-5.02	5.78
117+00	11700	776.24	775.40	762.00	0.84	LV KS		781.26	-5.02	5.86
118+00	11800	776.21	775.29	762.00	0.92	LV KS		781.23	-5.02	5.94
119+00	11900	776.18	775.17	762.00	1.01	LV KS		781.20	-5.02	6.03
120+00	12000	776.14	775.01	762.00	1.13	LV KS		781.17	-5.03	6.16
121+00	12100	776.11	774.99	759.00	1.12	LV KS		781.14	-5.03	6.15
122+00	12200	776.08	775.08	759.00	1.00	LV KS		781.11	-5.03	6.03
123+00	12300	776.05	775.22	758.00	0.83	LV KS		781.08	-5.03	5.86
124+00	12400	776.02	775.18	758.00	0.84	LV KS		781.05	-5.03	5.87
125+00	12500	775.99	775.29	758.00	0.70	LV KS		781.02	-5.03	5.73
126+00	12600	776.00	775.35	758.00	0.65	LV KS		780.99	-4.99	5.64
127+00	12700	775.93	775.48	758.00	0.45	LV KS		780.96	-5.03	5.48
128+00	12800	775.90	775.40	758.00	0.50	LV KS		780.93	-5.03	5.53
129+00	12900	775.87	775.22	756.00	0.65	LV KS		780.90	-5.03	5.68
130+00	13000	775.83	774.93	756.00	0.90	LV KS		780.87	-5.04	5.94
131+00	13100	775.80	774.84	761.00	0.96	LV KS		780.84	-5.04	6.00

EXHIBIT A-5.34 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
132+00	13200	775.77	774.87	760.00	0.90	LV KS		780.81	-5.04	5.94
133+00	13300	775.74	774.95	762.00	0.79	LV KS		780.78	-5.04	5.83
134+00	13400	775.70	775.01	762.00	0.69	LV KS		780.75	-5.05	5.74
135+00	13500	775.68	775.06	761.00	0.62	LV KS		780.72	-5.04	5.66
136+00	13600	775.65	775.17	760.00	0.48	LV KS		780.69	-5.04	5.52
137+00	13700	775.63	775.12	760.00	0.51	LV KS		780.66	-5.03	5.54
138+00	13800	775.60	775.04	760.00	0.56	LV KS		780.63	-5.03	5.59
139+00	13900	775.58	774.72	760.00	0.86	LV KS		780.60	-5.02	5.88
140+00	14000	775.55	774.72	760.00	0.83	LV KS		780.57	-5.02	5.85
141+00	14100	775.53	774.76	760.00	0.77	LV KS		780.54	-5.01	5.78
142+00	14200	775.51	774.69	760.00	0.82	LV KS		780.51	-5.00	5.82
143+00	14300	775.48	774.76	758.00	0.72	LV KS		780.48	-5.00	5.72
144+00	14400	775.46	774.68	758.00	0.78	LV KS		780.45	-4.99	5.77
145+00	14500	775.43	774.65	756.00	0.78	LV KS		780.42	-4.99	5.77
146+00	14600	775.41	774.65	758.00	0.76	LV KS		780.39	-4.98	5.74
147+00	14700	775.38	774.64	758.00	0.74	LV KS		780.36	-4.98	5.72
148+00	14800	775.36	774.64	758.00	0.72	LV KS		780.33	-4.97	5.69
149+00	14900	775.34	774.68	759.00	0.66	LV KS		780.30	-4.96	5.62
150+00	15000	775.32	774.79	760.00	0.53	LV KS	I-635	780.27	-4.95	5.48
151+00	15100	775.30	774.89	762.00	0.41	LV KS	I-635	780.24	-4.94	5.35
152+00	15200	775.21	774.99	760.00	0.22	LV KS	I-635	780.21	-5.00	5.22
153+00	15300	775.20	774.86	760.00	0.34	LV KS		780.20	-5.00	5.34
154+00	15400	775.19	774.67	760.00	0.52	LV KS		780.19	-5.00	5.52
155+00	15500	775.18	774.54	760.00	0.64	LV KS		780.18	-5.00	5.64
156+00	15600	775.17	774.54	760.00	0.63	LV KS		780.17	-5.00	5.63
157+00	15700	775.16	774.48	757.00	0.68	LV KS		780.16	-5.00	5.68
158+00	15800	775.15	774.49	760.00	0.66	LV KS		780.15	-5.00	5.66
159+00	15900	775.14	774.53	760.00	0.61	LV KS		780.14	-5.00	5.61
160+00	16000	775.14	774.50	760.00	0.64	LV KS		780.13	-4.99	5.63
161+00	16100	775.12	774.70	760.00	0.42	LV KS		780.12	-5.00	5.42
162+00	16200	775.12	774.73	760.00	0.39	LV KS		780.11	-4.99	5.38
163+00	16300	775.11	774.56	760.00	0.55	LV KS		780.10	-4.99	5.54
164+00	16400	775.10	774.51	760.00	0.59	LV KS		780.09	-4.99	5.58
165+00	16500	775.09	774.62	760.00	0.47	LV KS		780.08	-4.99	5.46
166+00	16600	775.08	774.81	760.00	0.27	LW Ramp		780.08	-5.00	5.27
167+00	16700	775.07	774.53	760.00	0.54	LV KS		780.07	-5.00	5.54
168+00	16800	775.06	774.25	760.00	0.81	LV KS		780.05	-4.99	5.80
169+00	16900	775.05	774.20	760.00	0.85	RW Ramp		780.04	-4.99	5.84
170+00	17000	775.04	774.15	760.00	0.89	LV KS		780.03	-4.99	5.88
171+00	17100	775.03	774.34	759.00	0.69	LV KS		780.01	-4.98	5.67
172+00	17200	775.02	774.31	758.00	0.71	LV KS		780.00	-4.98	5.69
173+00	17300	775.01	774.18	760.00	0.83	LV KS		779.99	-4.98	5.81
174+00	17400	775.00	774.15	760.00	0.85	LV KS		779.97	-4.97	5.82
175+00	17500	774.98	774.29	760.00	0.69	LV KS		779.96	-4.98	5.67

EXHIBIT A-5.34 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
176+00	17600	774.97	774.39	760.00	0.58	LV KS		779.95	-4.98	5.56
177+00	17700	774.95	774.49	760.00	0.46	LV KS		779.94	-4.99	5.45
178+00	17800	774.94	774.41	760.00	0.53	LV KS		779.92	-4.98	5.51
179+00	17900	774.92	774.39	760.00	0.53	LV KS		779.91	-4.99	5.52
180+00	18000	774.91	774.25	758.00	0.66	LV KS		779.90	-4.99	5.65
181+00	18100	774.89	774.30	756.00	0.59	LV KS		779.88	-4.99	5.58
182+00	18200	774.88	774.36	756.00	0.52	LV KS		779.87	-4.99	5.51
183+00	18300	774.86	774.25	756.00	0.61	LV KS		779.86	-5.00	5.61
184+00	18400	774.85	774.08	756.00	0.77	LV KS		779.84	-4.99	5.76
185+00	18500	774.83	774.00	757.00	0.83	LV KS		779.83	-5.00	5.83
186+00	18600	774.82	774.11	758.00	0.71	LV KS		779.82	-5.00	5.71
187+00	18700	774.81	774.37	760.00	0.44	LV KS		779.80	-4.99	5.43
188+00	18800	774.79	774.50	760.00	0.29	LV KS		779.79	-5.00	5.29
189+00	18900	774.78	774.15	760.00	0.63	LV KS		779.78	-5.00	5.63
190+00	19000	774.76	774.00	760.00	0.76	LV KS		779.76	-5.00	5.76
191+00	19100	774.75	774.18	760.00	0.57	LV KS		779.75	-5.00	5.57
192+00	19200	774.74	774.16	760.00	0.58	LV KS		779.73	-4.99	5.57
193+00	19300	774.72	774.02	758.00	0.70	LV KS		779.72	-5.00	5.70
194+00	19400	774.70	774.00	758.00	0.70	LV KS		779.71	-5.01	5.71
195+00	19500	774.69	774.09	758.00	0.60	LV KS		779.69	-5.00	5.60
196+00	19600	774.68	774.12	756.00	0.56	LV KS		779.68	-5.00	5.56
197+00	19700	774.66	773.98	758.00	0.68	LV KS		779.67	-5.00	5.68
198+00	19800	774.65	774.12	759.00	0.53	LV KS		779.65	-5.00	5.53
199+00	19900	774.64	774.04	757.00	0.60	LV KS		779.64	-5.00	5.60
200+00	20000	774.62	773.89	756.00	0.73	LV KS		779.62	-5.00	5.73
201+00	20100	774.60	773.83	759.00	0.77	LV KS		779.61	-5.01	5.78
202+00	20200	774.59	773.87	760.00	0.72	LV KS		779.60	-5.01	5.73
203+00	20300	774.58	773.54	762.00	1.04	LV KS		779.58	-5.00	6.04
204+00	20400	774.56	773.99	760.00	0.57	LV KS		779.57	-5.01	5.58
205+00	20500	774.55	773.95	758.00	0.60	LV KS		779.55	-5.00	5.60
206+00	20600	774.54	774.20	758.00	0.34	LV KS		779.54	-5.00	5.34
207+00	20700	774.52	774.00	758.00	0.52	LV KS		779.53	-5.01	5.53
208+00	20800	774.51	773.72	759.00	0.79	LV KS		779.52	-5.01	5.80
209+00	20900	774.50	773.82	760.00	0.68	LV KS		779.51	-5.01	5.69
210+00	21000	774.50	773.87	760.00	0.63	LV KS		779.50	-5.00	5.63
211+00	21100	774.50	773.89	761.00	0.61	LV KS		779.49	-4.99	5.60
212+00	21200	774.50	773.40	766.00	1.10	LV KS		779.49	-4.98	6.08
213+00	21300	774.50	773.68	*****	0.82	KS AVE Bridge		779.48	-4.98	5.80
214+00	21400	774.50	778.00	*****	-3.50	KS AVE Bridge		779.47	-4.97	1.47
215+00	21500	774.49	789.43	*****	-14.94	KS AVE Bridge		779.46	-4.97	-9.97
216+00	21600	774.47	774.68	*****	-0.21	KS AVE Bridge		779.45	-4.98	4.77
217+00	21700	774.45	772.89	758.00	1.56	LV KS		779.44	-4.99	6.55
218+00	21800	774.43	773.06	758.00	1.37	LV KS		779.43	-5.00	6.37
219+00	21900	774.40	773.02	757.00	1.38	LV KS		779.41	-5.01	6.39

EXHIBIT A-5.34 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
220+00	22000	774.38	773.08	757.00	1.30	LV KS		779.39	-5.01	6.31
221+00	22100	774.36	773.15	757.00	1.21	LV KS		779.37	-5.01	6.22
222+00	22200	774.34	773.09	757.00	1.25	LV KS		779.34	-5.00	6.25
223+00	22300	774.32	772.99	757.00	1.33	LV KS		779.32	-5.00	6.33
224+00	22400	774.30	772.87	757.00	1.43	LV KS		779.30	-5.00	6.43
225+00	22500	774.27	772.82	756.00	1.45	LV KS		779.28	-5.01	6.46
226+00	22600	774.25	772.73	756.00	1.52	LV KS		779.26	-5.01	6.53
227+00	22700	774.23	772.90	756.00	1.33	LV KS		779.24	-5.01	6.34
228+00	22800	774.21	772.73	756.00	1.48	LV KS		779.21	-5.00	6.48
229+00	22900	774.19	772.67	758.00	1.52	LV KS		779.19	-5.00	6.52
230+00	23000	774.17	772.64	758.00	1.53	LV KS		779.17	-5.00	6.53
231+00	23100	774.14	772.60	757.00	1.54	LV KS		779.15	-5.01	6.55
232+00	23200	774.12	772.62	757.00	1.50	LV KS		779.13	-5.01	6.51
233+00	23300	774.10	772.43	757.00	1.69	LV KS		779.11	-5.01	6.68
234+00	23400	774.08	772.55	758.00	1.55	LV KS		779.08	-5.00	6.53
235+00	23500	774.06	772.65	758.00	1.43	LV KS		779.06	-5.00	6.41
236+00	23600	774.04	772.36	758.00	1.70	LV KS		779.04	-5.00	6.68
237+00	23700	774.02	772.19	757.00	1.85	LV KS		779.02	-5.00	6.83
238+00	23800	773.96	772.22	757.00	1.80	LV KS		779.00	-5.04	6.78
239+00	23900	773.89	772.35	757.00	1.61	LV KS		778.98	-5.09	6.63
240+00	24000	773.88	772.32	757.00	1.56	LV KS		778.96	-5.08	6.64
241+00	24100	773.86	772.22	757.00	1.64	LV KS		778.94	-5.08	6.72
242+00	24200	773.85	772.21	758.00	1.64	LV KS		778.92	-5.07	6.71
243+00	24300	773.84	772.11	758.00	1.73	LV KS		778.90	-5.06	6.79
244+00	24400	773.82	772.11	758.00	1.71	LV KS		778.88	-5.06	6.77
245+00	24500	773.81	772.14	758.00	1.67	LV KS		778.86	-5.05	6.72
246+00	24600	773.79	771.92	758.00	1.87	LV KS		778.85	-5.06	6.93
247+00	24700	773.78	771.62	758.00	2.16	LV KS		778.83	-5.05	7.21
248+00	24800	773.76	771.32	758.00	2.44	LV KS		778.81	-5.05	7.49
249+00	24900	773.75	771.84	758.00	1.91	LV KS		778.79	-5.04	6.95
250+00	25000	773.74	771.82	759.00	1.92	LV KS		778.77	-5.03	6.95
251+00	25100	773.72	771.95	758.00	1.77	LV KS		778.75	-5.03	6.80
252+00	25200	773.68	771.50	*****	2.18	FW		778.73	-5.05	7.23
253+00	25300	773.69	771.50	*****	2.19	FW		778.71	-5.02	7.21
254+00	25400	773.68	771.33	760.00	2.35	LV KS		778.69	-5.01	7.36
255+00	25500	773.66	771.16	758.00	2.50	LV KS		778.67	-5.01	7.51
256+00	25600	773.65	771.05	758.00	2.60	LV KS		778.65	-5.00	7.60
257+00	25700	773.64	771.01	758.00	2.63	LV KS		778.63	-4.99	7.62
258+00	25800	773.62	771.44	758.00	2.18	LV KS		778.61	-4.99	7.17
259+00	25900	773.60	771.19	757.00	2.41	LV KS		778.59	-4.99	7.40
260+00	26000	773.59	771.09	757.00	2.50	LV KS		778.57	-4.98	7.48
261+00	26100	773.57	771.07	757.00	2.50	LV KS		778.55	-4.98	7.48
262+00	26200	773.56	771.03	757.00	2.53	LV KS		778.53	-4.97	7.50
263+00	26300	773.54	771.20	757.00	2.34	LV KS		778.52	-4.98	7.32

EXHIBIT A-5.34 (Continued)

Station	Station	500 yr Elevation	Existing TOL	Levee Toe	500 - ETOL	Notes	TYP Cross Section	New TOL	500 - NTOL	NTOL - ETOL Levee Raise
264+00	26400	773.53	771.31	757.00	2.22	LV KS		778.50	-4.97	7.19
265+00	26500	773.51	771.11	757.00	2.40	LV KS		778.48	-4.97	7.37
266+00	26600	773.49	770.87	757.00	2.62	LV KS		778.46	-4.97	7.59
267+00	26700	773.47	770.71	757.00	2.76	LV KS		778.44	-4.97	7.73
268+00	26800	773.45	770.61	758.00	2.84	LV KS		778.42	-4.97	7.81
269+00	26900	773.44	770.41	758.00	3.03	LV KS		778.40	-4.96	7.99
270+00	27000	773.42	770.53	758.00	2.89	LV KS		778.38	-4.96	7.85
271+00	27100	773.36	770.66	758.00	2.70	LV KS		778.36	-5.00	7.70
272+00	27200	773.20	770.56	758.00	2.64	LV KS		777.44	-4.24	6.88
273+00	27300	773.13	770.56	758.00	2.57	LV KS		776.51	-3.38	5.95
274+00	27400	773.06	770.46	758.00	2.60	LV KS		775.59	-2.53	5.13
275+00	27500	772.98	770.87	758.00	2.11	LV KS		774.67	-1.69	3.80
276+00	27600	772.90	770.86	758.00	2.04	LV KS		773.74	-0.84	2.88
277+00	27700	772.82	771.00	760.00	1.82	LV KS		772.82	0.00	1.82
278+00	27800	772.72	771.00	760.00	1.72	LV KS		772.82	-0.10	1.82
279+00	27900	772.63	771.00	762.00	1.63	LV KS		772.82	-0.19	1.82
280+00	28000	772.55	771.00	762.00	1.55	FW		772.82	-0.27	1.82
281+00	28100	772.45	771.00	762.00	1.45	FW		772.82	-0.37	1.82
282+00	28200	772.36	771.00	763.00	1.36	FW		772.82	-0.46	1.82
283+00	28300	772.27	771.00	764.00	1.27	FW		772.82	-0.55	1.82
284+00	28400	772.16	771.00	764.00	1.16	FW		772.82	-0.66	1.82
285+00	28500	772.07	771.00	764.00	1.07	FW		772.82	-0.75	1.82
286+00	28600	771.98	771.00	764.00	0.98	FW		772.82	-0.84	1.82
287+00	28700	771.89	771.00	766.00	0.89	FW		772.82	-0.93	1.82
288+00	28800	771.80	770.94	766.00	0.86		Stop Log	772.82	-1.02	1.88
289+00	28900	771.93	768.97	*****	2.96		Stop Log	772.82	-0.89	3.85
289+40	28940	771.93	771.08	******	0.85		Stop Log	772.82	-0.89	1.74

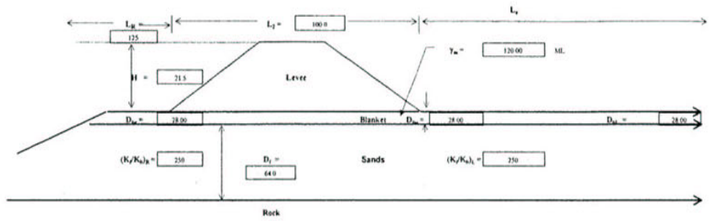
UNDERSEEPAGE ANALYSIS

Note : This spreadsheet analysis should be used only if the blanket thickness is at least 1/4 of the height of the levee

Argentine : Station 265	
KCMOKS	Area

Name	Loehr	EC-GD
Date	5/20/2004	Revised

Revised to reflect criteria developed for L-142



Recommended Permeability Ratio
For Foundation Blanket Materials
Chapter Underseepage Revision dated Oct 1998

Blanket Material	Assumed Permeability Ratio, (K/Kb)
SM	100
ML	200 to 400
ML-CL	400
CL	400 to 600
CH	400 to 1000

NOMENCLATURE

$(K_f/K_b)_R$ = riverside permeability
$(K_f/K_b)_L$ = landside permeability
D_{bl} = riverside blanket thickness
D_{bs} = levee toe blanket thickness
D_{bs} = landside blanket thickness
D_f = thickness of pervious foundation
L_{tg} = length of riverside blanket
L_s = length of landside blanket
H = max head or levee height
$H(W_3)$ = head above tailwater at end of underseepage berm
$H(W_3) = H(W_3/2)/e^{(-W3*(2*C3))}$
$H(W_{3/2})$ = head above tailwater midpoint of underseepage berm
$= H * L_e / L'_1$
W_3 = berm width
i_e = seepage gradient
C_3 = riverside effective length coefficient
C_1 = landside effective length coefficient
where $C = [(K/Kb) * Df * Db]^{1/2}$
Hfo = head above tailwater at levee toe (w/ berm)
i_c = critical seepage gradient
L_1 = riverside effective length
where $L_1 = C * (e^{(3.8.C/2)}) / (e^{(3.8.C/L)})$
L_2 = levee base width
L_s = landside effective length
L_e = total effective length
L'_1 = Total Effective Length + 1/2 of Berm
f = required berm thickness at toe
Sc = calc'd slope of underseepage berm
q = seepage unit Length
Q = cummulated seepage
FS, i_c / i_e

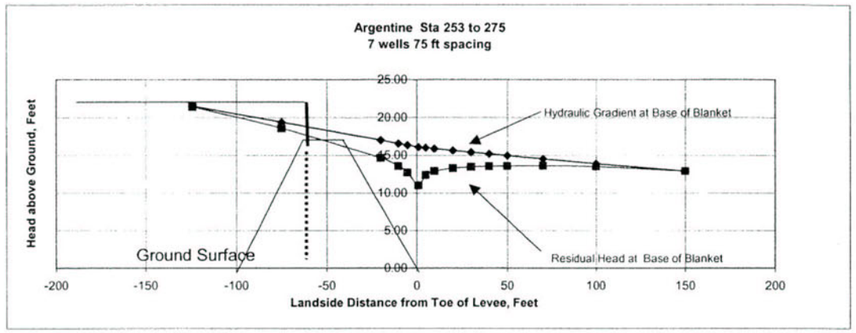
Input Parameters

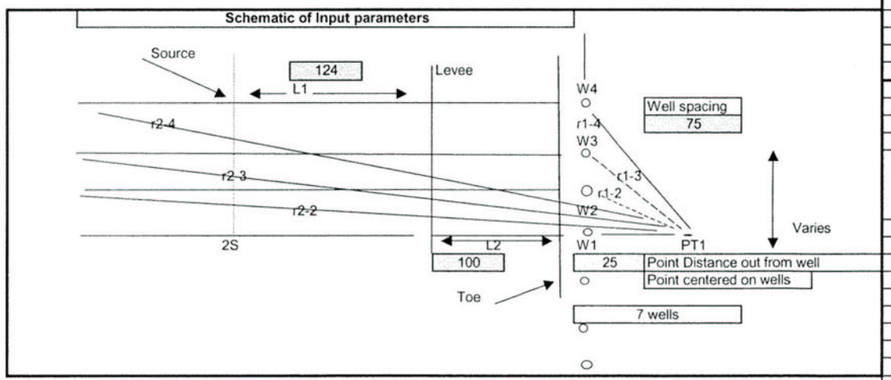
Station	Begin Station Feet	End Station Feet	$(K_f/K_b)_R$	$(K_f/K_b)_L$	D_{bL}	D_{bs}	D_{bl}	D_f	L_{tg}	H	Remarks
Current Condition:											
Example			250	250	28.0	28.0	28.0	64.0	125	21.5	Example
265+00	253+00	275+00	250	250	28.0	28.0	28.0	64.0	125	21.5	150 ft space
265+00	253+00	289+00	250	250	28.0	28.0	28.0	64.0	125	21.5	250 ft space

Analysis of Without Berm Conditions

Station Feet	C_R Feet	C_L Feet	L_1 Feet	L_2 Feet	L_s Feet	L_e Feet	h_o Feet	i_e Ft/Ft	i_c Ft/Ft	Check #1 Full Head Toe FSi (need 1.1)	Check #1 Reduced Head Toe FSi (need 1.5)	Remarks
	669	669	124	100	669	893	16.12	0.58	0.92	1.60	1.86	
253+00 to 275+00	669	669	124	100	669	893	16.12	0.58	0.92	1.60	1.86	
253+00 to 289+00	669	669	124	100	669	893	16.12	0.58	0.92	1.60	1.86	
	0	0	#DIV/0!		0	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!	#DIV/0!	

Well Design Calculations
Loehr : EC-GD 5/20/2004
Checked By :





Well Drawdown Influence Table

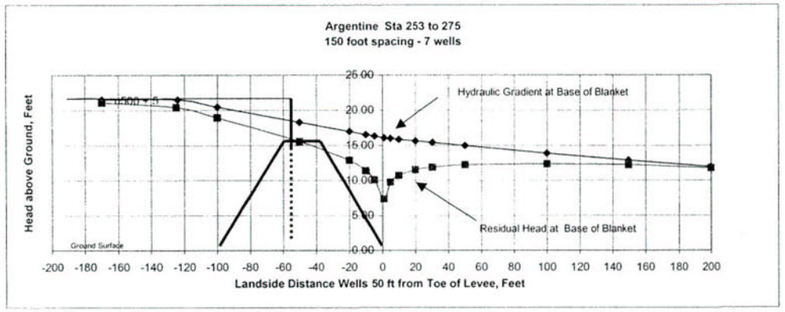
Argentine : Station 253 to 275

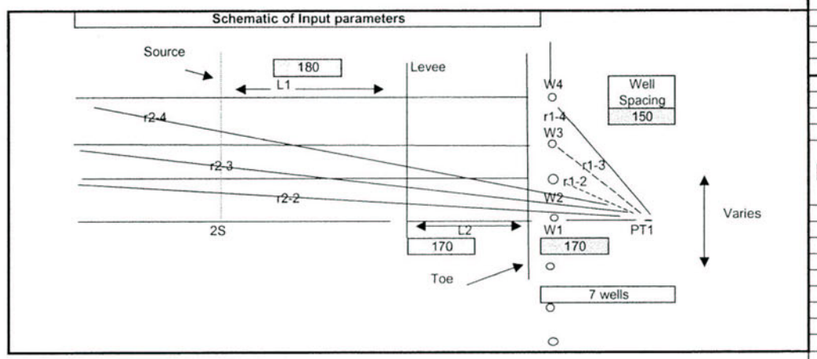
	ic =	0.92	Well losses	0.84	(entrance, velocity bends)		
Ground = 0			Discharge elev loss	0.5	Dbl=	28	Feet
Location of points at the base of the blanket perpendicular to the center well			DD at Well	**5.12**	Qw =	1.4	cfs
			X_L	669	k =	0.0037	ft /sec
			h0	16.12	Df =	64.0	feet
Distance	**Head**	**Well 0**	**DDwx**	**Residual Head**	**Gradient Factor**		
gx	**hx**	**wx**	**Feet**	**Feet**	**of Safety**		
-124	**21.50**	**-124**	**0.1**	**21.40**	**1.20**		
-75	**19.38**	**-75**	**0.83**	**18.55**	**1.39**		
-20	**16.99**	**-20**	**2.35**	**14.64**	**1.76**		
-10	**16.55**	**-10**	**2.99**	**13.56**	**1.90**		
-5	**16.33**	**-5**	**3.63**	**12.70**	**>>1.5**		
1	**16.09**	**1**	**5.12**	**10.97**	**>>1.5**		
5	**16.00**	**5**	**3.63**	**12.37**	**>>1.5**		
10	**15.88**	**10**	**2.99**	**12.89**	**>>1.5**		
20	**15.64**	**20**	**2.35**	**13.29**	**>>1.5**		
30	**15.41**	**30**	**1.95**	**13.46**	**>>1.5**		
40	**15.18**	**40**	**1.64**	**13.54**	**>>1.5**		
50	**14.96**	**50**	**1.38**	**13.58**	**>>1.5**		
70	**14.52**	**70**	**0.93**	**13.59**	**>>1.5**		
100	**13.88**	**100**	**0.38**	**13.50**	**>>1.5**		
150	**12.88**	**150**	**0**	**12.88**	**>>1.5**		

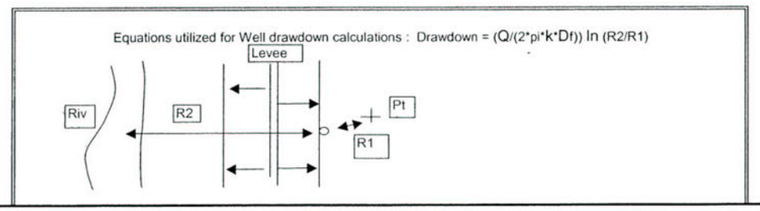
Example Calculation

		PT1				
		data	well 1		well 2	
			S =	224		
			r2-1=	473	r2-2=	479
			r1-1=	25	r1-2 =	79
			DDw1=	2.77	DDw2=	1.69
			well 3		well4	
			r2-3 =	496	r2-4=	524
			r1-3=	152	r1-4=	226
			DDw3=	1.11	DDw4=	0.79
	Dist x	DDwx	Headlosses	Number	All DD	
	25	2.77	1.34	1	1.43	
		1.69	1.34	2	0.71	
		1.11	1.34	2	0.00	
		0.79	1.34	2	0.00	
			PT1 Sum DD =	**2.14**	feet	

Well Design Calculations
Loehr EC-GD 5/20/2004







Well Drawdown Influence Table

Argentine : Station 253 to 275 150 foot well spacing

	ic =	0.92	Well losses	1.65	(entrance, velocity bends)	
Ground = 0			Discharge elev loss	0.5	Dbl=	28	Feet
Location of points at the base of the blanket perpendicular to the center well			DD at Well	**8.71**	Qw =	2.33	cfs
			X_L	669	k =	0.0037	ft /sec
			h0	16.12	Df =	64.0	feet

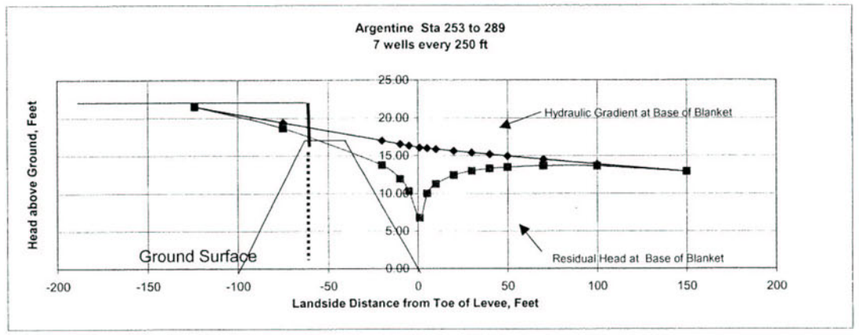
Distance	Head	Well 0	DDwx	Residual Head	Gradient Factor
gx	hx	wx	Feet	Feet	of Safety
-170	21.50	-170	0.41	21.09	1.44
-124	21.50	-125	1.09	20.41	1.49
-100	20.47	-100	1.53	18.94	1.60
-50	18.30	-50	2.73	15.57	1.95
-20	16.99	-20	4.11	12.88	2.36
-10	16.55	-10	5.16	11.39	2.66
-5	16.33	-5	6.21	10.12	3.00
1	16.09	1	8.71	7.38	4.11
5	16.00	5	6.21	9.79	3.10
10	15.88	10	5.16	10.72	2.83
20	15.64	20	4.11	11.53	2.63
30	15.41	30	3.51	11.90	2.55
50	14.96	50	2.73	12.23	2.48
100	13.88	100	1.53	12.35	2.46
150	12.88	150	0.66	12.22	2.48
200	11.95	200	0.21	11.74	2.59

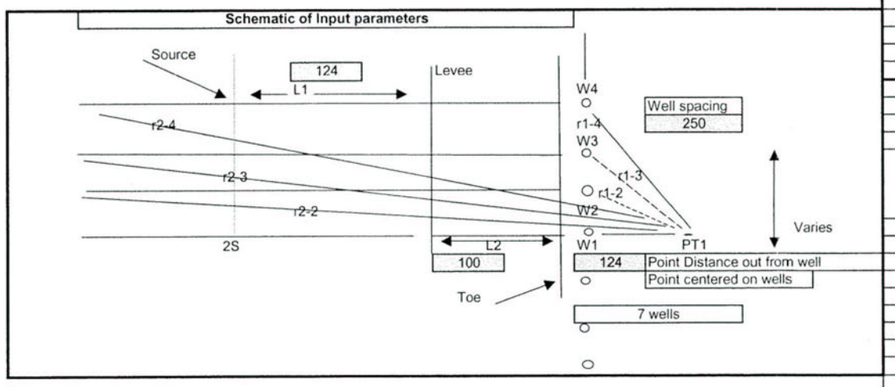
Example Calculation

		PT1			well 2	
		data	well 1			
			S =	350		
			r2-1=	870	r2-2=	883
			r1-1=	170	r1-2 =	227
			DDw1=	2.56	DDw2=	2.13
			well 3		well4	
			r2-3 =	920	r2-4=	979
			r1-3=	345	r1-4=	481
			DDw3=	1.54	DDw4=	1.11

	Dist x	DDwx	Headlosses	Number	All DD
	170	2.56	2.15	1	0.41
		2.13	2.15	2	0.00
		1.54	2.15	2	0.00
		1.11	2.15	2	0.00
		PT1 Sum DD =		**0.41**	feet

Well Design Calculations
Loehr : EC-GD 5/20/2004
Checked By :





Well Drawdown Influence Table

Argentine : Station 253 to 289

	ic =	0.92	Well losses	2.75	(entrance, velocity bends)		
Ground = 0			Discharge elev loss	0.5	Dbl=	28	Feet
Location of points at the base of the blanket perpendicular to the center well			DD at Well	**9.31**	Qw =	3.06	cfs
			X_L	669	k =	0.0037	ft /sec
			h0	16.12	Df =	64.0	feet
Distance	**Head**	**Well 0**	**DDwx**	**Residual Head**	**Gradient Factor**		
gx	**hx**	**wx**	**Feet**	**Feet**	**of Safety**		
-124	**21.50**	**-124**	**0**	**21.50**	**1.20**		
-75	**19.38**	**-75**	**0.74**	**18.64**	**1.38**		
-20	**16.99**	**-20**	**3.23**	**13.76**	**1.87**		
-10	**16.55**	**-10**	**4.62**	**11.93**	**2.16**		
-5	**16.33**	**-5**	**6.02**	**10.31**	**>>1.5**		
1	**16.09**	**1**	**9.31**	**6.78**	**>>1.5**		
5	**16.00**	**5**	**6.02**	**9.98**	**>>1.5**		
10	**15.88**	**10**	**4.62**	**11.26**	**>>1.5**		
20	**15.64**	**20**	**3.23**	**12.41**	**>>1.5**		
30	**15.41**	**30**	**2.44**	**12.97**	**>>1.5**		
40	**15.18**	**40**	**1.89**	**13.29**	**>>1.5**		
50	**14.96**	**50**	**1.48**	**13.48**	**>>1.5**		
70	**14.52**	**70**	**0.87**	**13.65**	**>>1.5**		
100	**13.88**	**100**	**0.25**	**13.63**	**>>1.5**		
150	**12.88**	**150**	**0**	**12.88**	**>>1.5**		

Example Calculation

		PT1				
		data	well 1		well 2	
			S =	224		
			r2-1=	572	r2-2=	624
			r1-1=	124	r1-2 =	279
			DDw1=	3.14	DDw2=	1.66
			well 3		well4	
			r2-3 =	760	r2-4=	943
			r1-3=	515	r1-4=	760
			DDw3=	0.80	DDw4=	0.44
	Dist x	DDwx	Headlosses	Number	All DD	
	124	3.14	3.25	1	0.00	
		1.66	3.25	2	0.00	
		0.80	3.25	2	0.00	
		0.44	3.25	2	0.00	
			PT1 Sum DD =	**0.00**	feet	

EXHIBIT A-5.39

KCMOKS - Argentine- Kansas

Designed By:	Scott Loehr	Reviewed By:	
Date:	5/20/2004	Date :	

Design Flood: n = 500 Year + 5 ft (Feasibility Report 2003, App. B)
Relief Well Calculations
Stations 253 to 275

Assumptions:

Gradient for finite top stratum dissipates to L_e
Impervious Minimum Blanket thickness = 28 ft.

i_c = 0.84
Worst Case L_e = 620 (From Berm Design Calcs plus EM allowance for sloping bank)
L_R+L_2= S = 225

Infinite wells, equally spaced — $FS_i = i_c/i_o = i_c/(H_m/D_b)$
r_w = 1.00 ft — H_{Ta} allowed = i_c*D_b/FS
W/D = 100%
Inner well diameter = 10 in. — Discharge assumed at 0.5 ft. above ground surface

Parameters:

i_c = Critical Gradient	K = Permeability
FS = Factor of Safety	D = Depth of Pervious Material
D_b = Depth of Blanket Material	H_m = Head Midway Between Wells
h_a = Allowable Head	H_{av} = Head within Plane of Wells
L_e = Distance from Centerline of Well to Edge of Blanket	Q_w = Flow Rate from Wells
S = Distance from Source to Centerline of Well	H_e = Entrance Well Loss
a = Spacing	H_f = Frictional Well Loss
L = Total Distance from Source to Edge of Blanket	H_v = Velocity Well Loss
Θ_a = Average Uplift Well Factor	H_w = Total Well Losses
Θ_m = Midwell Uplift Factor	H_T = Total Head (H_m + H_w)
H = Head on Riverside of Levee	i_o = Gradient Through Blanket

Allowable Head

i_c	FS	D_b	H_{Ta}	head		
N/A	N/A	28	N/A	21.5		
Calculations in this spreadsheet used in Slope Stability Only						

$$Q_w = \frac{H*k*D}{(S/a) + (L/L_e)*\Theta_a} \quad *$$

$$H_{av} = \frac{H*\Theta_a}{(S/a) + (L/L_e)*\Theta_a} \quad *$$

$$H_m = \frac{H*\Theta_m}{(S/a) + (L/L_e)*\Theta_a} \quad *$$

$$H_w = H_e + H_f + H_v \quad *$$

Finite Top Stratum

Trial	L_e (ft)	S (ft)	a (ft)	L (ft)	Θ_a**	Θ_m**	H (ft)	k (ft/s)	D (ft)	H_m (ft)	H_{av} (ft)	Q_w (gpm)	Q_w (ft^3/s)	H_e (ft)	H_f (ft) ***	H_v (ft) ***	H_w (ft)	Hd(ft)	H_T (ft)	H_Ta	Ideal FS	Trial
1	669	224	400	893	0.70	0.85	21.5	3.8E-03	64	12.23	10.07	1546.92	3.45	0.10	2.50	0.70	3.30	0.50	16.03			1
2	669	224	350	893	0.61	0.75	21.5	3.8E-03	64	11.09	9.02	1589.61	3.55	0.10	2.50	0.73	3.33	0.50	14.92			2
3	669	224	250	893	0.58	0.70	21.5	3.7E-03	64	9.01	7.47	1372.27	3.06	0.10	2.00	0.65	2.75	0.50	12.26			3
4	669	224	150	893	0.50	0.62	21.5	3.7E-03	64	6.17	4.98	1055.02	2.36	0.10	1.10	0.45	1.65	0.50	8.32			4
5	669	224	100	893	0.43	0.57	21.5	3.7E-03	64	4.36	3.29	810.11	1.81	0.10	0.73	0.36	1.19	0.50	6.05			5
6	669	224	75	893	0.39	0.50	21.5	3.7E-03	64	3.07	2.39	649.98	1.45	0.10	0.45	0.29	0.84	0.50	4.41			6
7	669	224	50	893	0.32	0.45	21.5	3.7E-03	64	1.97	1.40	464.56	1.04	0.10	0.26	0.23	0.59	0.50	3.06			7
8	669	224	25	893	0.23	0.33	21.5	3.7E-03	64	0.77	0.53	246.00	0.55	0.10	0.10	0.12	0.32	0.50	1.59			8

Trials 1 to 8 calculate conditions of water at top of levee.

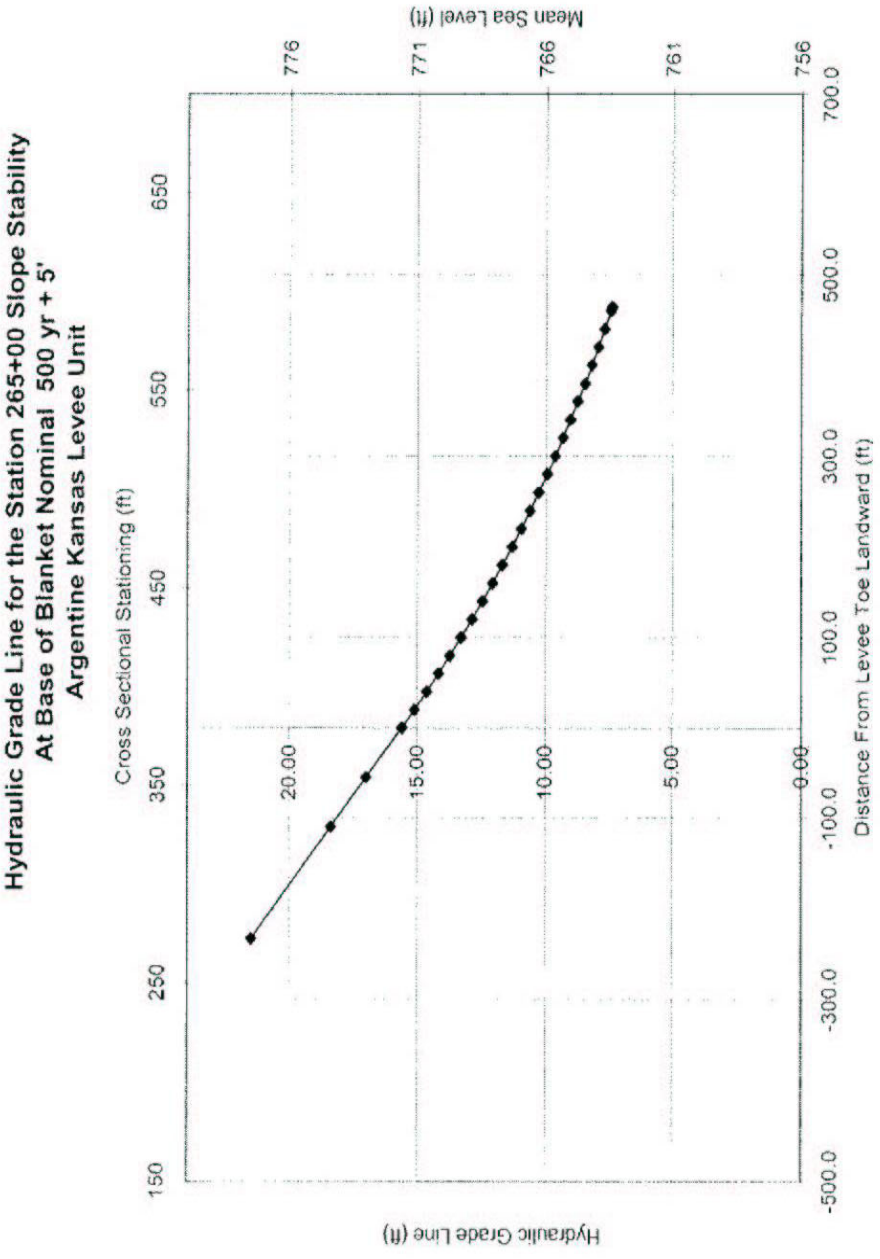
* EM 1110-2-1914, May 29, 1992.
** Civil Works Engineering Bulletin 55-1, Plate No.1.
*** Well loss variables, H_v and H_f, determined using Civil Works Engineering Bulletin 55-11, Plates 2 and 3 respectively.

EXHIBIT A-5.40
Hydraulic Grade Line for Sta 265+00 Argentine Kansas

Hydraulic Grade Line for Station 265+00 Argentine Kansas			
Elevation New Top of Levee (MSL)	778.48	Nominal 500yr	
Elevation at Levee Toe (MSL)	756.5		
Elevation Bottom of Blanket (MSL)	728.5		
Driving Head (ft)	21.48		
L1 (ft)	123		
L2 (ft)	109.91		
Le (ft)	620		
ho	15.61		
	Distance From Landward Levee Toe (ft)	Hydralic Gradient (ft)	MSL (ft)
Full Head -Entrance	-233.2	21.48	778.0
Riverside Toe levee	-109.91	18.38	774.9
Centerline Levee	-54.955	16.99	773.5
Landside Toe Levee	0	15.61	772.1
Landside of Levee Toe	20	15.12	771.6
	40	14.64	771.1
	60	14.17	770.7
	80	13.72	770.2
	100	13.29	769.8
	120	12.87	769.4
	140	12.46	769.0
	160	12.06	768.6
	180	11.68	768.2
	200	11.31	767.8
	220	10.95	767.5
	240	10.60	767.1
	260	10.27	766.8
	280	9.94	766.4
	300	9.63	766.1
	320	9.32	765.8
	340	9.03	765.5
	360	8.74	765.2
	380	8.46	765.0
	400	8.19	764.7
	420	7.93	764.4
	440	7.68	764.2
	460	7.44	763.9
	464	7.39	763.9

Argentine Sta 265+00 n500 sal peer Hydraulic Line CL out LW DRAFT 5/19/2004

EXHIBIT A-5.41
Hydraulic Grade Line for Sta 265+00 Slope Stability at Base of Blanket
Nominal 500-Yr + 5 ft. Argentine Unit



SLOPE STABILITY

EXHIBIT A-5.42
500-Yr + 5 ft. Station 54+00 - Stability Analysis with Berms
(Typical Sta. 2+00 to 60+00)

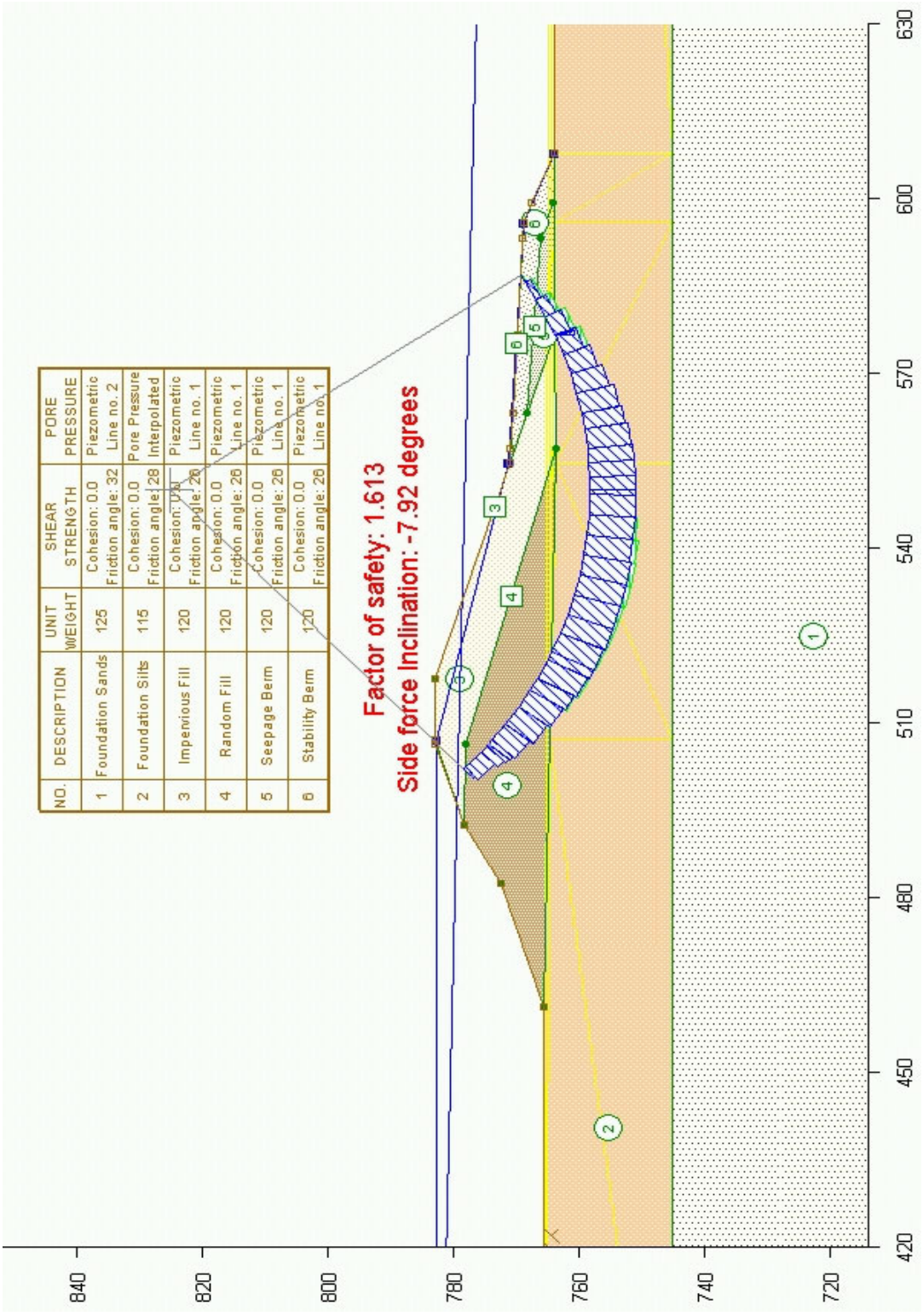


EXHIBIT A-5.43
500-Yr + 5 ft. Station 61+00 - Stability Analysis with Berms
(Typical Sta. 61+00 to 117+00)

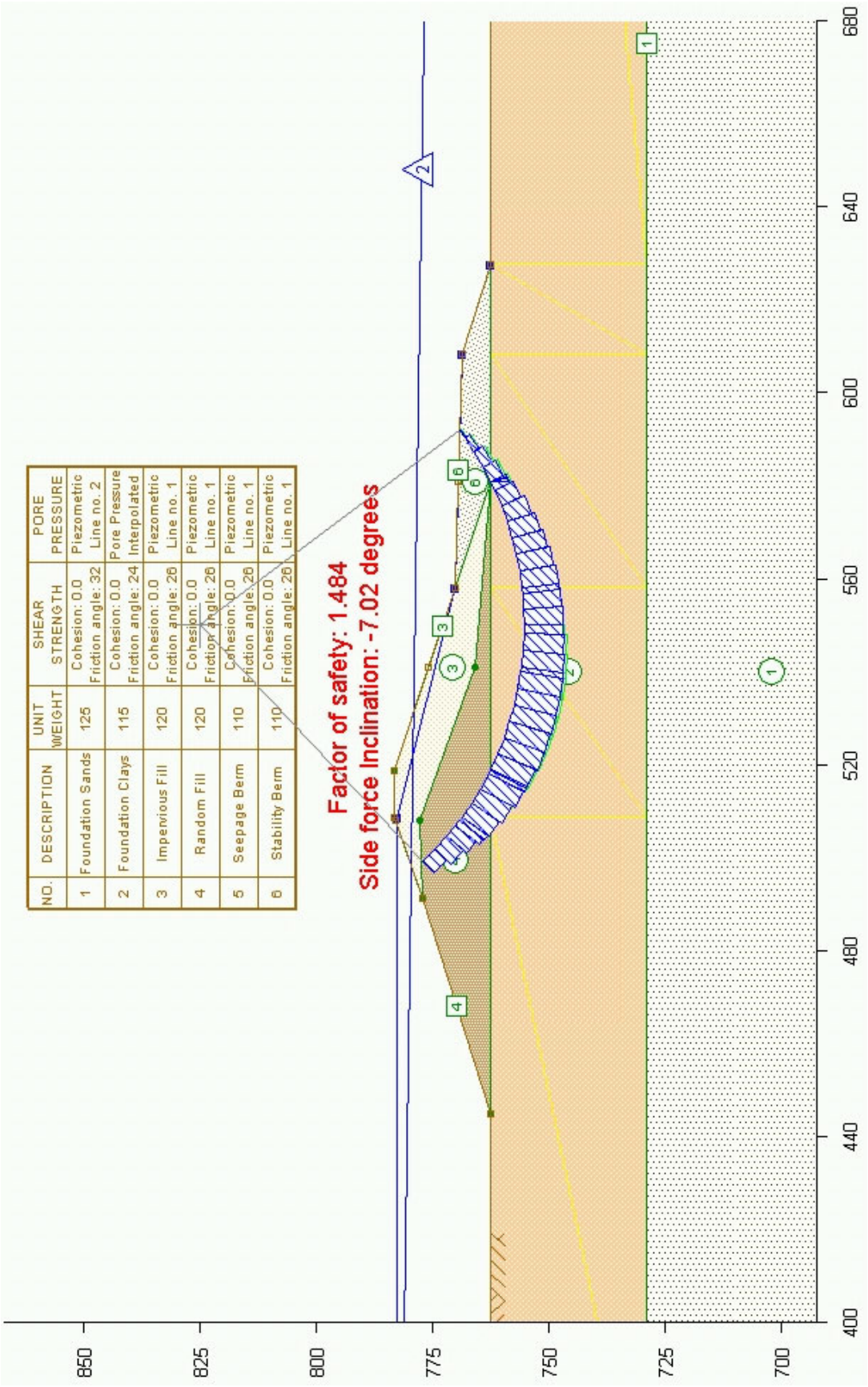


EXHIBIT A-5.44
500-Yr + 5 ft. Station 118+00 - Stability Analysis without Berms
(Typical Sta. 118+00 to 182+20)

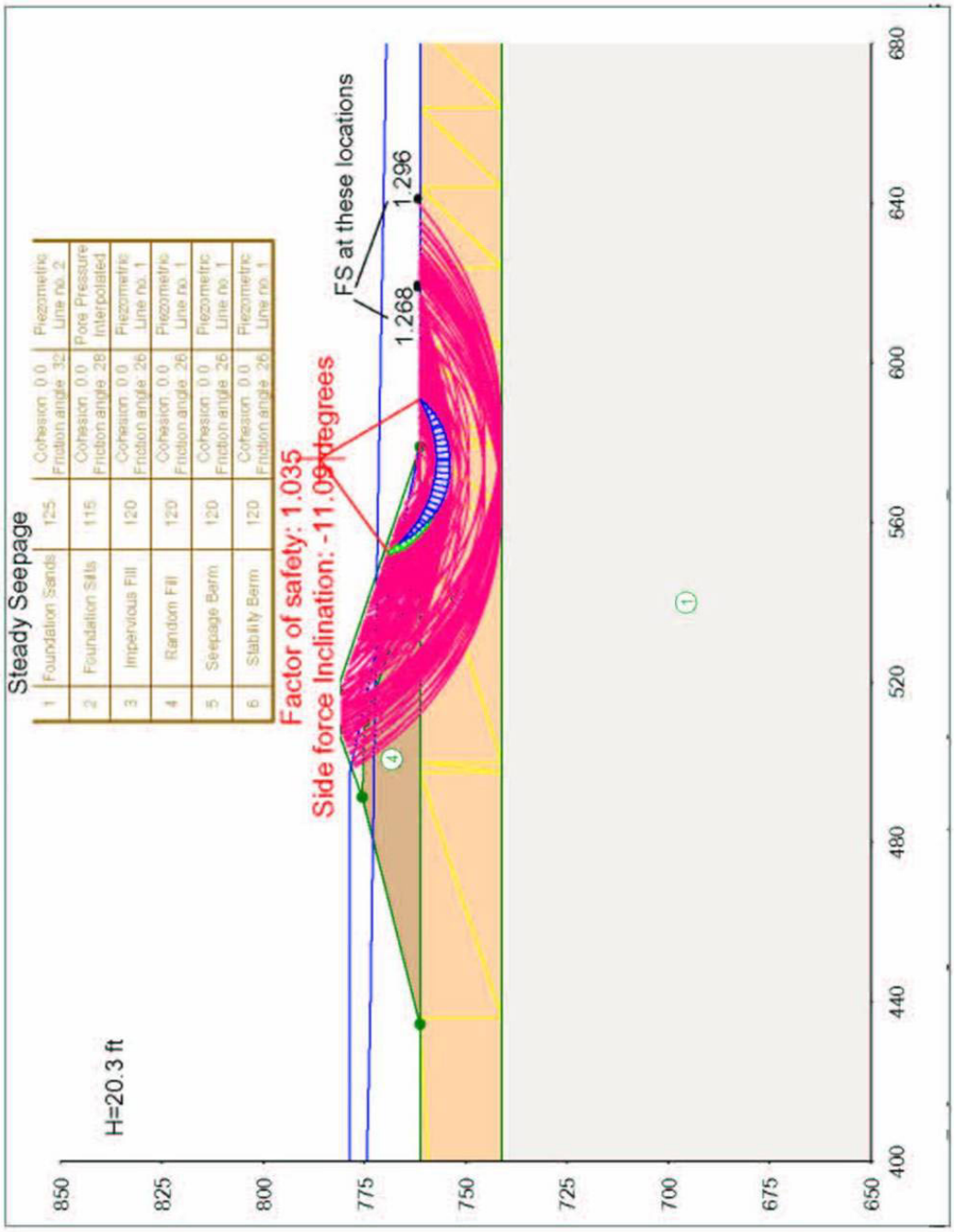


EXHIBIT A-5.45
500-Yr + 5 ft. Station 183+00 - Stability Analysis with Berms
(Typical 182+20 to 253+00)

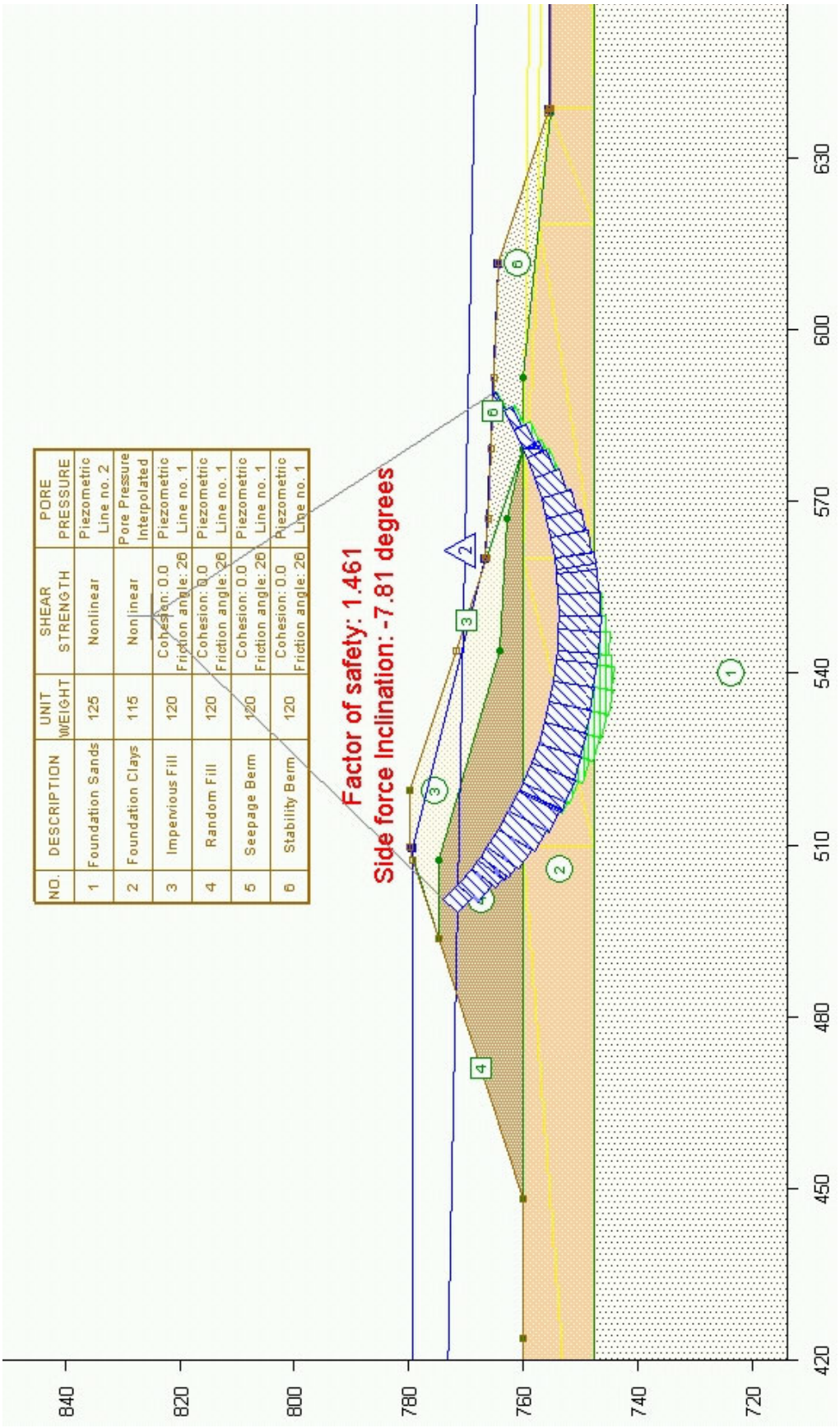


EXHIBIT A-5.46
500-Yr + 5 ft. Station 265+00 - Stability Analysis without Berms
(Typical 258+00 to 276+70)

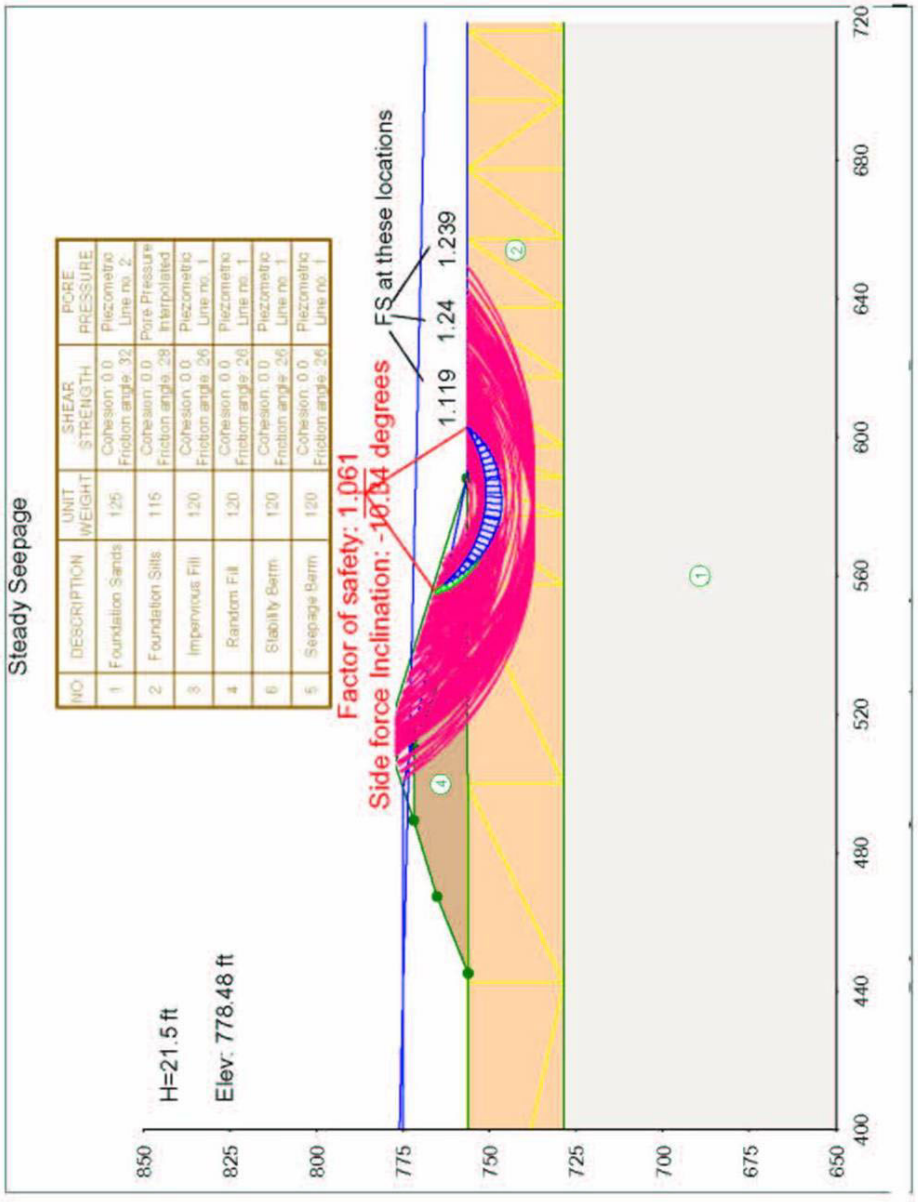


EXHIBIT A-5.47
500-Yr + 5 ft. Station 265+00 - Stability Analysis without Berms with I Walls
(Typical 258+00 to 276+70)

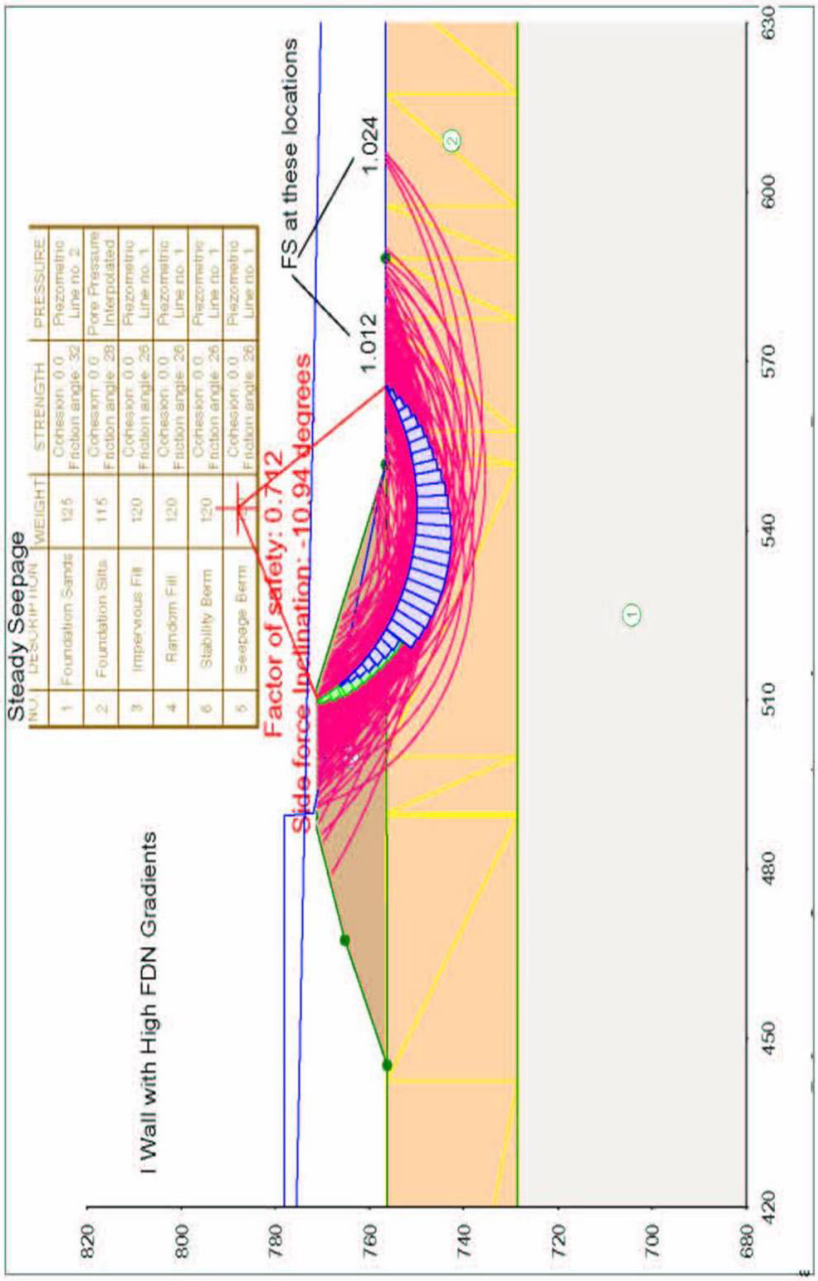


EXHIBIT A-5.48
500-Yr + 5 ft. Station 257+00 - Stability Analysis with Berms
(Typical Sta. 254+00 to 264+00)

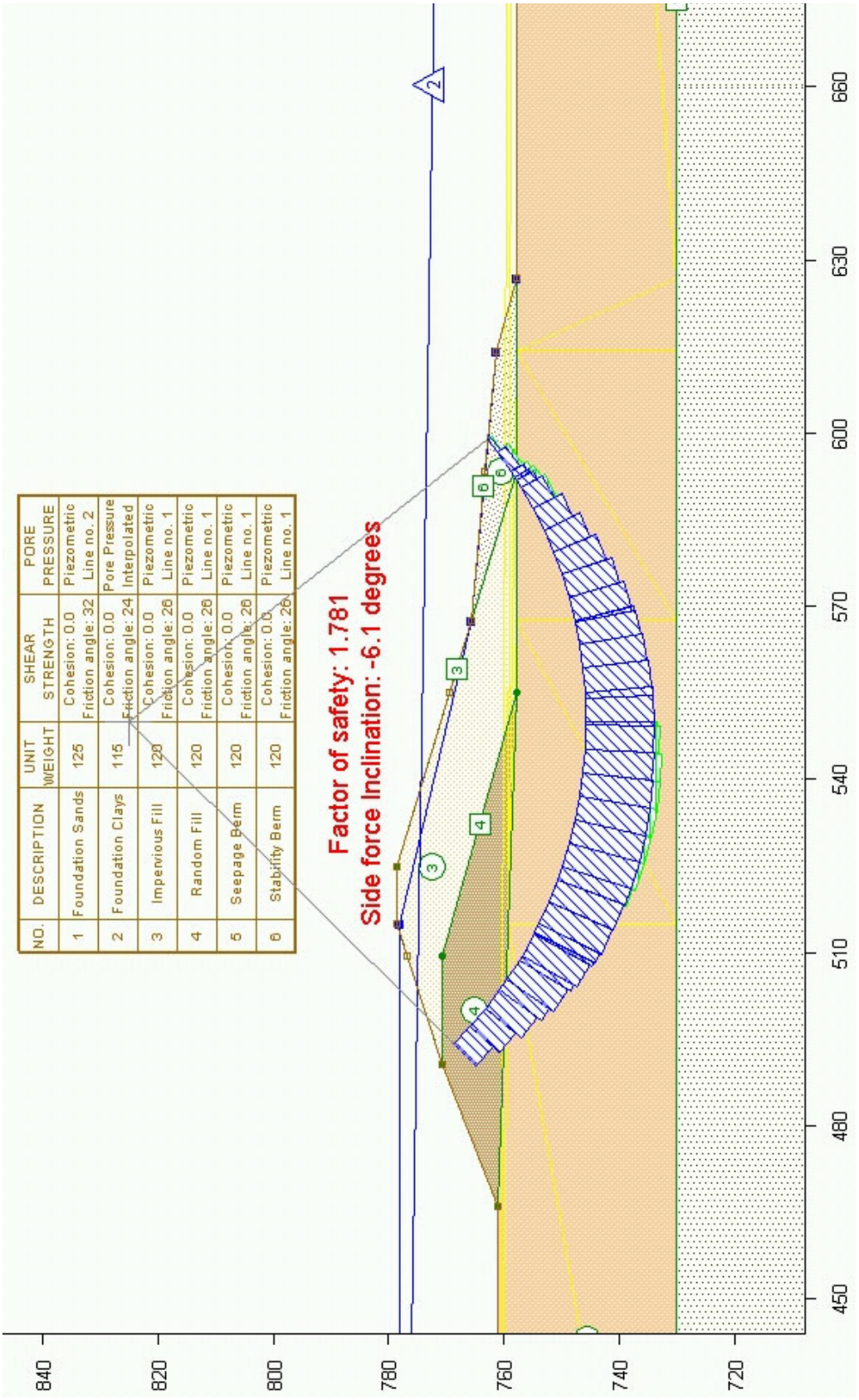


EXHIBIT A-5.49
500-Yr + 5 ft. Station 265+00 - Stability Analysis with Berms
(Typical Sta. 265+00 to 276+70)

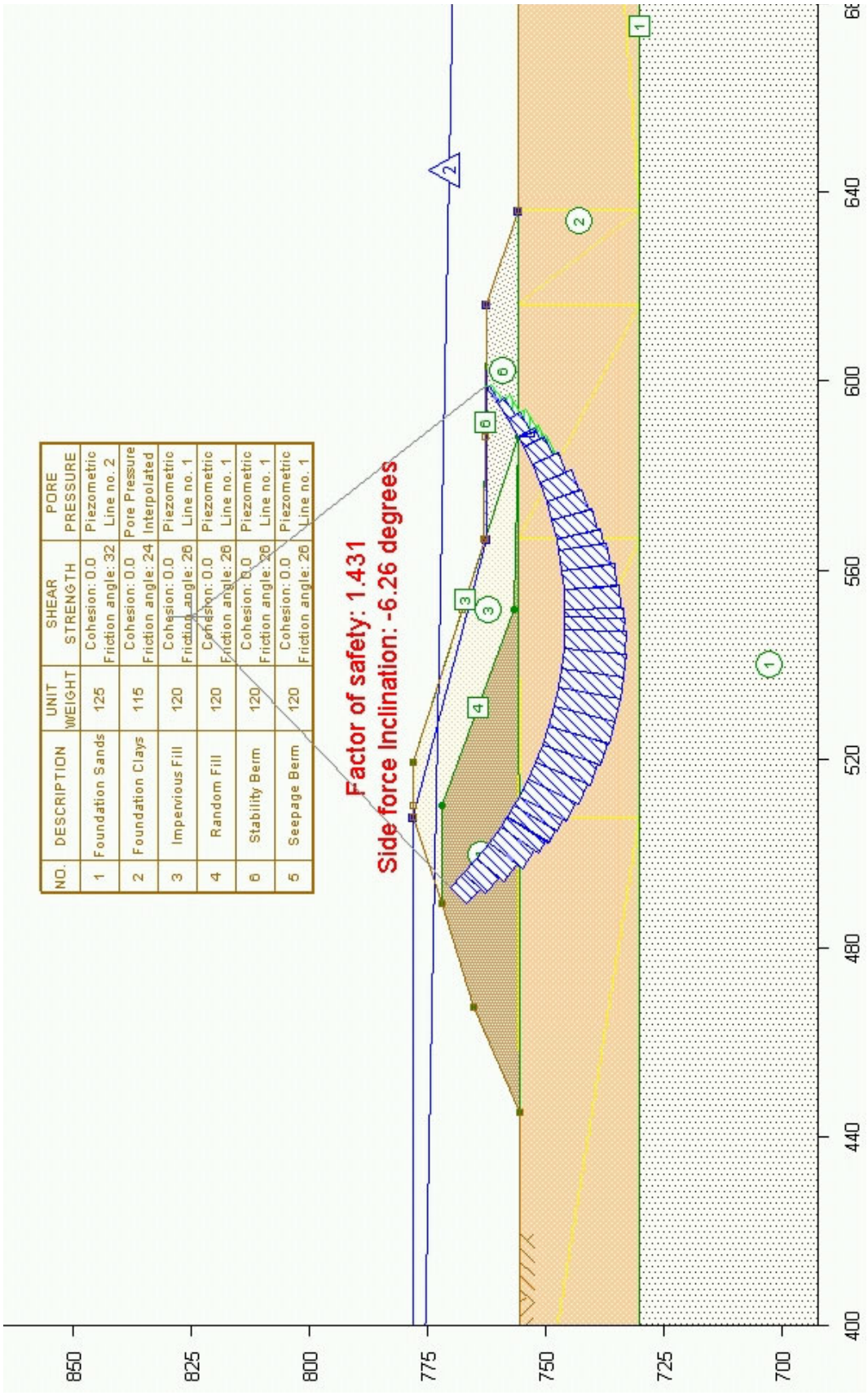


EXHIBIT A-5.50
500-Yr + 5 ft. Station 265+00 - Stability Analysis with Berms
(Typical Sta. 265+00 to 276+70)

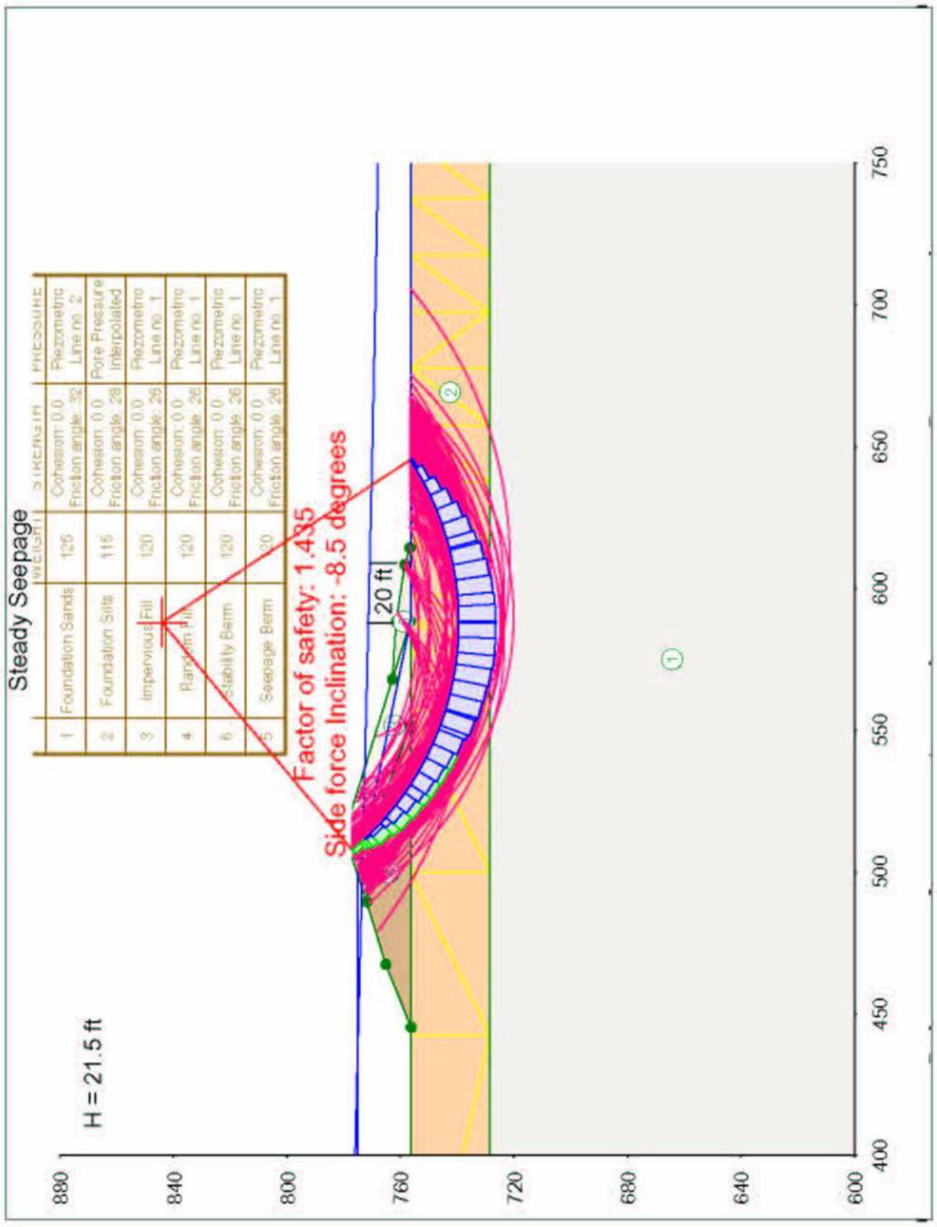


EXHIBIT A-5.51
Hydraulic Grade Line for the Sta 265+00 Slope Stability At Base of Blanket
Nominal 500 Yr + 5 Wall Argentine Unit

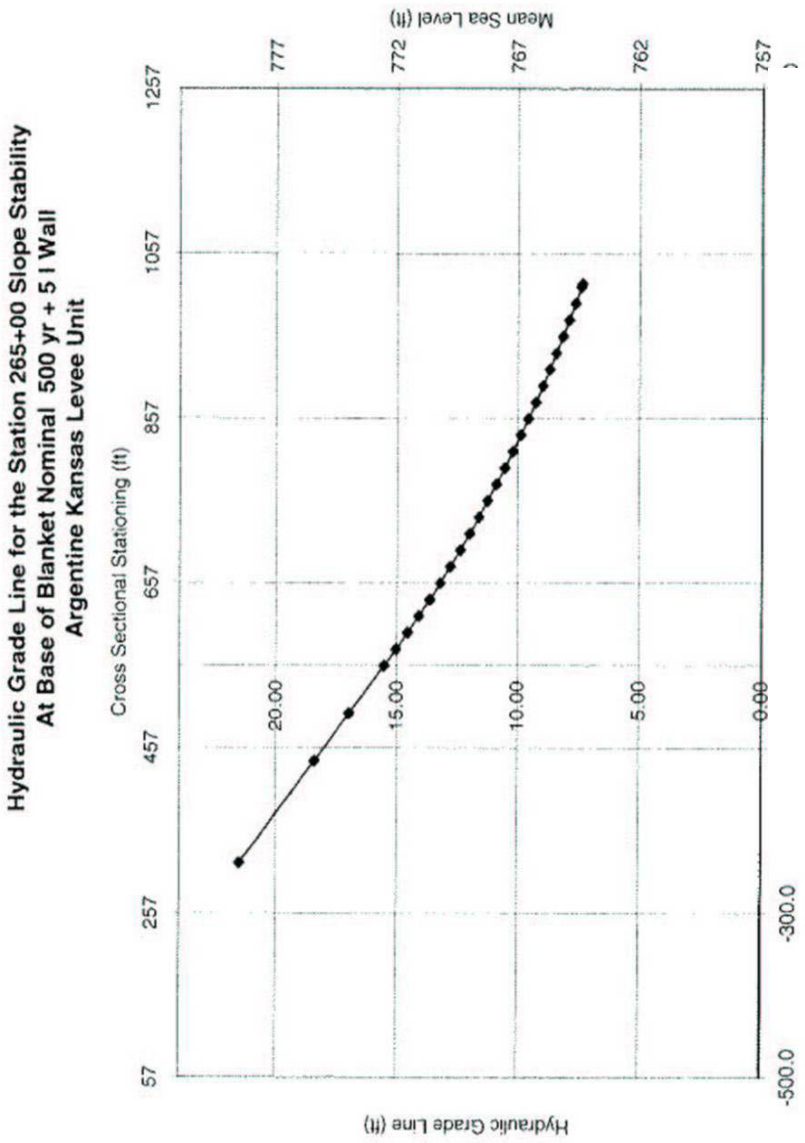


EXHIBIT A-5.52
Hydraulic Grade Line for the Sta 265+00
Wall Argentine Unit

Hydraulic Grade Line for Station 26500 I Wall Argentine Kansas

Elevation New Top of Levee (MSL)	778	500 yr + 5
Elevation at Levee Toe (MSL)	756.5	
Elevation Bottom of Blanket (MSL)	728.5	
Driving Head (ft)	21.5	
L1 (ft)	123	
L2 (ft)	115	
Le (ft)	620	
ho	15.52	

	Distance From Landward Levee Toe (ft)	Hydralic Gradient (ft)	MSL (ft)		
Full Head -Entrance	-238.3	21.50	778.00	3088.80	319.16
Riverside Toe levee	-115	18.40	774.90	2895.66	442.50
Centerline Levee	-57.5	16.96	773.46	2805.62	500.00
Landside Toe Levee	0	15.52	772.02	2715.58	557.50
Landside of Levee Toe	20	15.03	771.53	2684.87	577.50
	40	14.55	771.05	2655.13	597.50
	60	14.09	770.59	2626.33	617.50
	80	13.64	770.14	2598.44	637.50
	100	13.21	769.71	2571.44	657.50
	120	12.79	769.29	2545.30	677.50
	140	12.38	768.88	2519.98	697.50
	160	11.99	768.49	2495.47	717.50
	180	11.61	768.11	2471.74	737.50
	200	11.24	767.74	2448.75	757.50
	220	10.89	767.39	2426.50	777.50
	240	10.54	767.04	2404.96	797.50
	260	10.21	766.71	2384.09	817.50
	280	9.88	766.38	2363.89	837.50
	300	9.57	766.07	2344.33	857.50
	320	9.27	765.77	2325.39	877.50
	340	8.97	765.47	2307.05	897.50
	360	8.69	765.19	2289.29	917.50
	380	8.41	764.91	2272.10	937.50
	400	8.14	764.64	2255.45	957.50
	420	7.89	764.39	2239.33	977.50
	440	7.64	764.14	2223.72	997.50
	460	7.39	763.89	2208.60	1017.50
	464	7.35	763.85	2205.64	1021.50

-67.6	489.9	18.25	774.75	2885.94212
-59.91	497.59	17.02	773.52	2809.3979
-0.74	556.76	15.54	772.04	2716.7388
30.8	588.3	14.77	771.27	2668.68747
34.1	591.6	14.69	771.19	2663.79962

junkArgentine n500 +5 sal peer.xls

Hydraulic Line CL out LW DRAFT

5/20/2004

EXHIBIT A-5.53
Hydraulic Grade Line for the Station 265+00 Argentine

Hydraulic Grade Line for Station 26500 Argentine Kansas

Elevation New Top of Levee (MSL)	778	500 yr + 5
Elevation at Levee Toe (MSL)	756.5	
Elevation Bottom of Blanket (MSL)	728.5	
Driving Head (ft)	21.5	
L1 (ft)	123	
L2 (ft)	115	
Le (ft)	620	
ho	15.52	

	Distance From Landward Levee Toe (ft)	Hydralic Gradient (ft)	MSL (ft)		
Full Head -Entrance	-238.3	21.50	778.00	3088.80	319.16
Riverside Toe levee	-115	18.40	774.90	2895.66	442.50
Centerline Levee	-57.5	16.96	773.46	2805.62	500.00
Landside Toe Levee	0	15.52	772.02	2715.58	557.50
Landside of Levee Toe	20	15.03	771.53	2684.87	577.50
	40	14.55	771.05	2655.13	597.50
	60	14.09	770.59	2626.33	617.50
	80	13.64	770.14	2598.44	637.50
	100	13.21	769.71	2571.44	657.50
	120	12.79	769.29	2545.30	677.50
	140	12.38	768.88	2519.98	697.50
	160	11.99	768.49	2495.47	717.50
	180	11.61	768.11	2471.74	737.50
	200	11.24	767.74	2448.75	757.50
	220	10.89	767.39	2426.50	777.50
	240	10.54	767.04	2404.96	797.50
	260	10.21	766.71	2384.09	817.50
	280	9.88	766.38	2363.89	837.50
	300	9.57	766.07	2344.33	857.50
	320	9.27	765.77	2325.39	877.50
	340	8.97	765.47	2307.05	897.50
	360	8.69	765.19	2289.29	917.50
	380	8.41	764.91	2272.10	937.50
	400	8.14	764.64	2255.45	957.50
	420	7.89	764.39	2239.33	977.50
	440	7.64	764.14	2223.72	997.50
	460	7.39	763.89	2208.60	1017.50
	464	7.35	763.85	2205.64	1021.50

30.8	588.3	14.77	771.27	2668.68747

Argentine n500 +5 sal peer.xls | Hydraulic Line CL out LW DRAFT | 5/20/2004

DESIGN DATA

EXHIBIT A-5.54
1962 – Mod Design Data - Silts

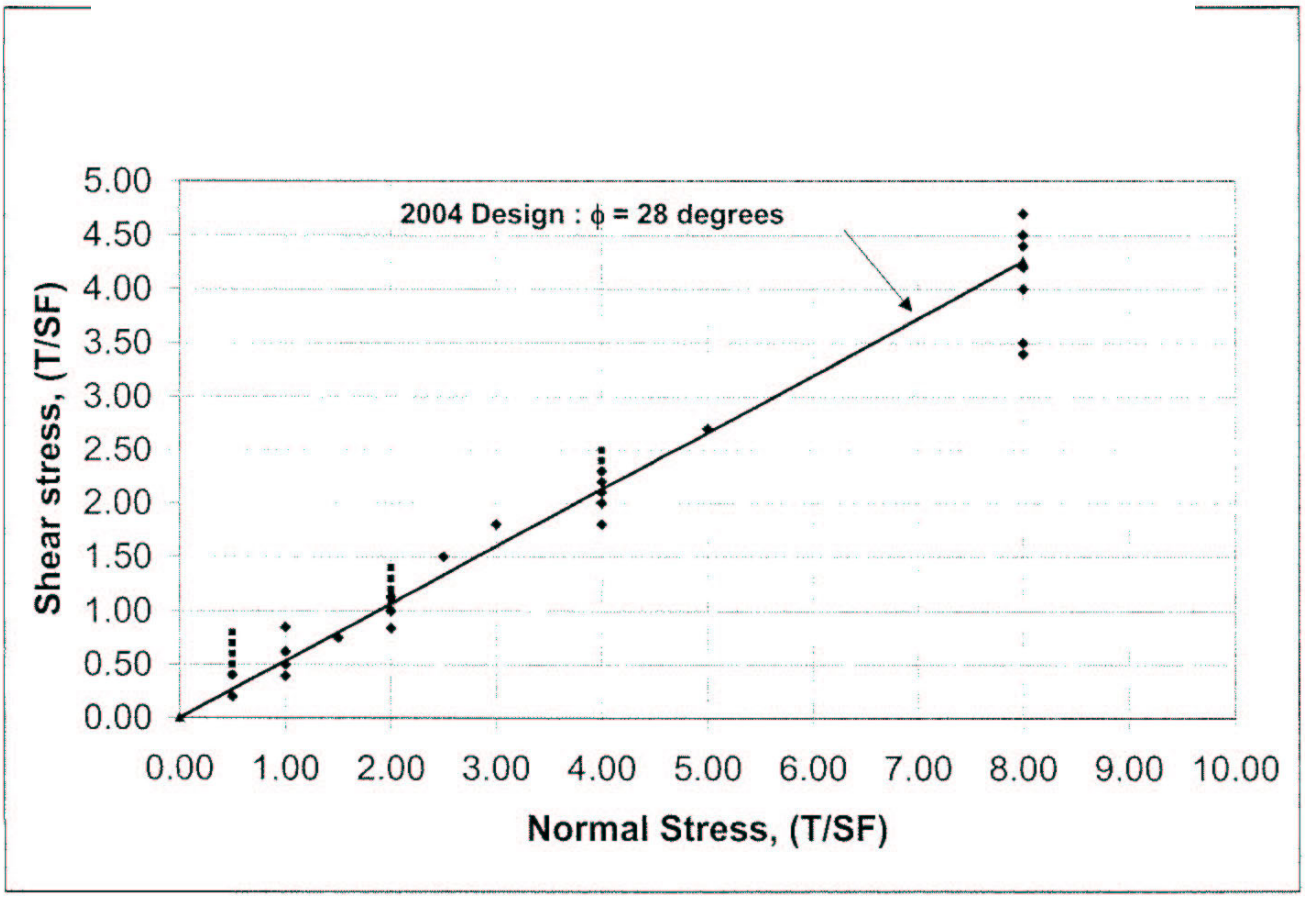


EXHIBIT A-5.55
Kansas City, Kansas – 1962 MOD Argentine Unit

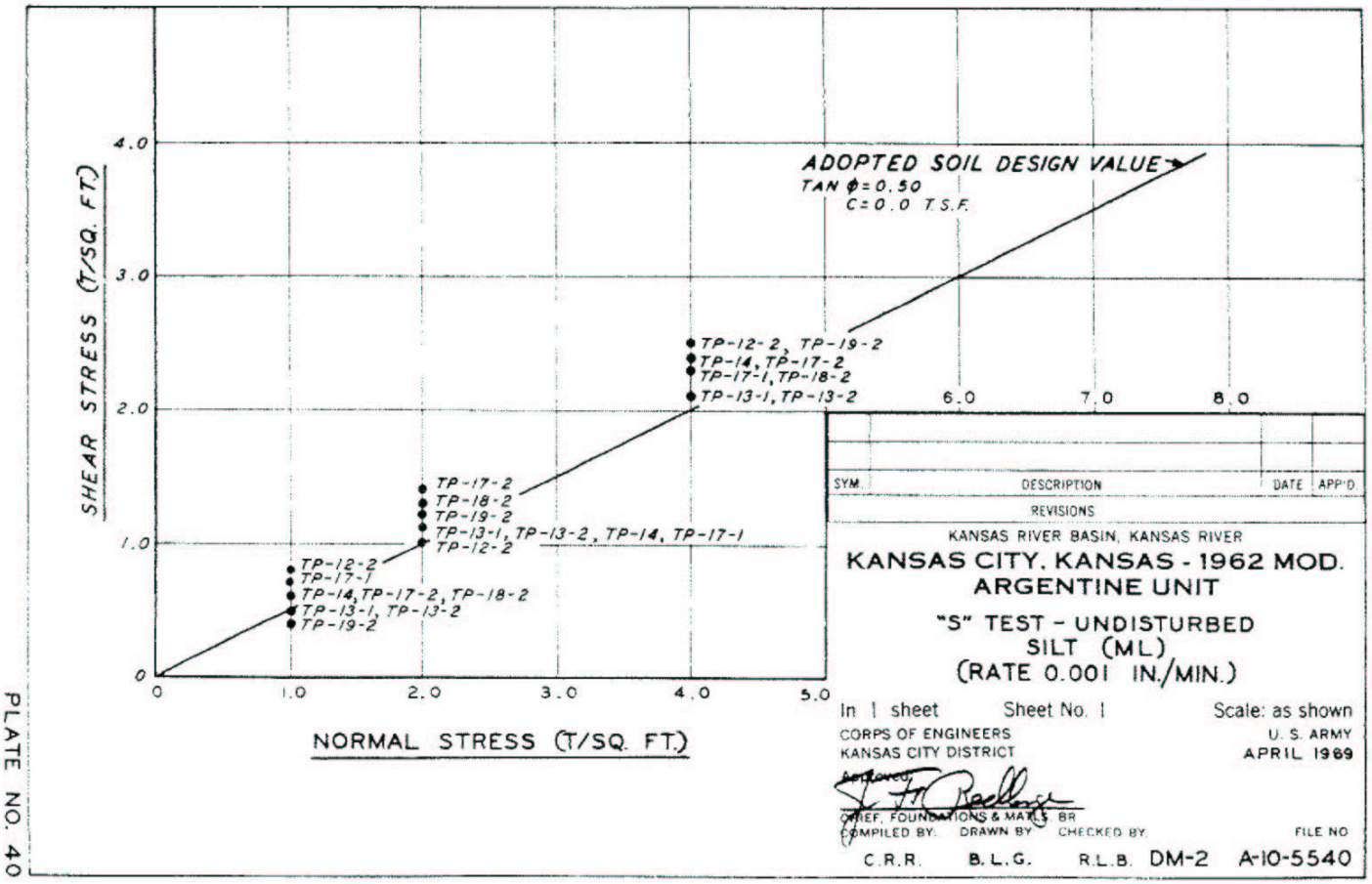


EXHIBIT A-5.56
Kansas City, Kansas – 1962 MOD Argentine Unit

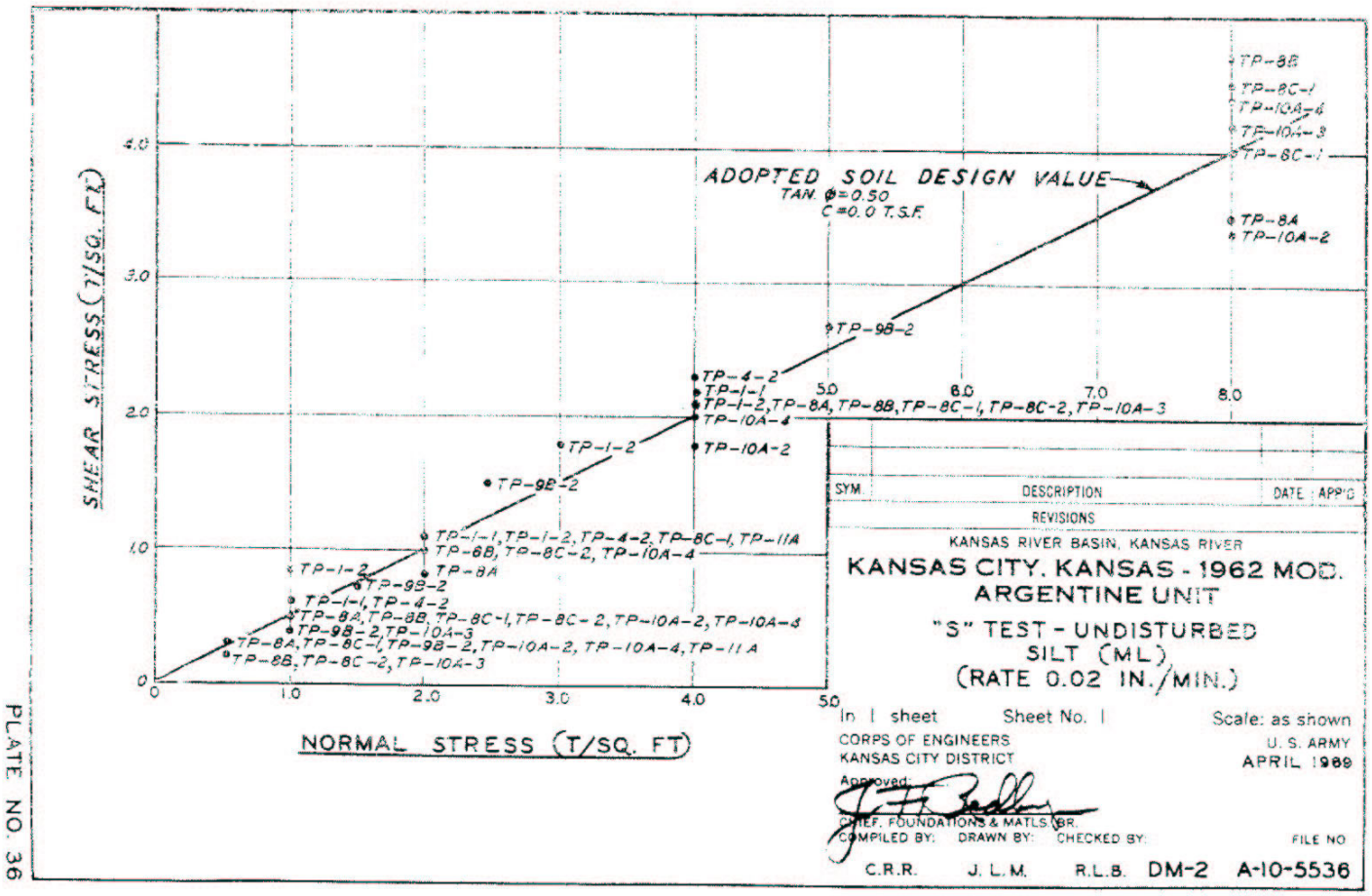


EXHIBIT A-5.57
1962 – Mod Design Data - Clays

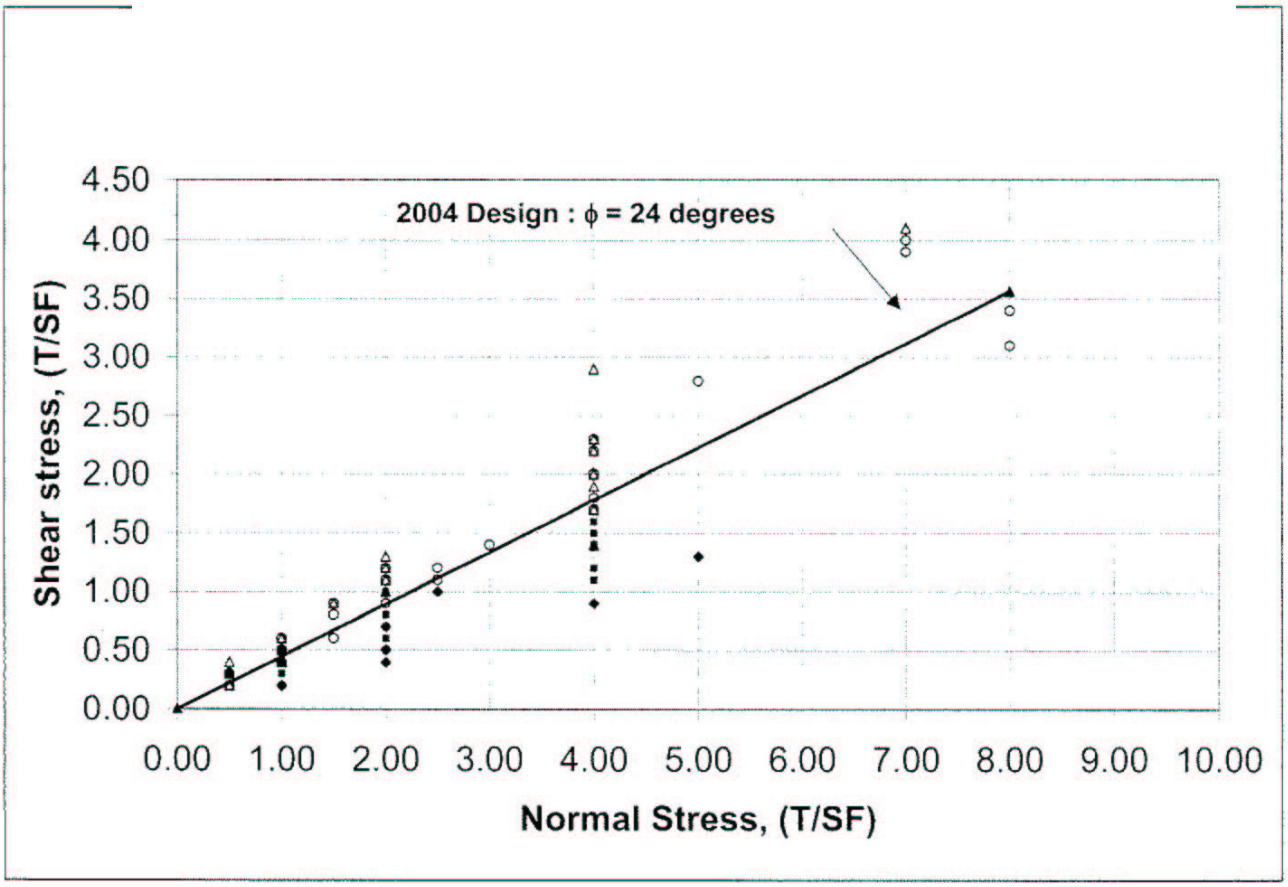


EXHIBIT A-5.58
Kansas City, Kansas – 1962 MOD Argentine Unit

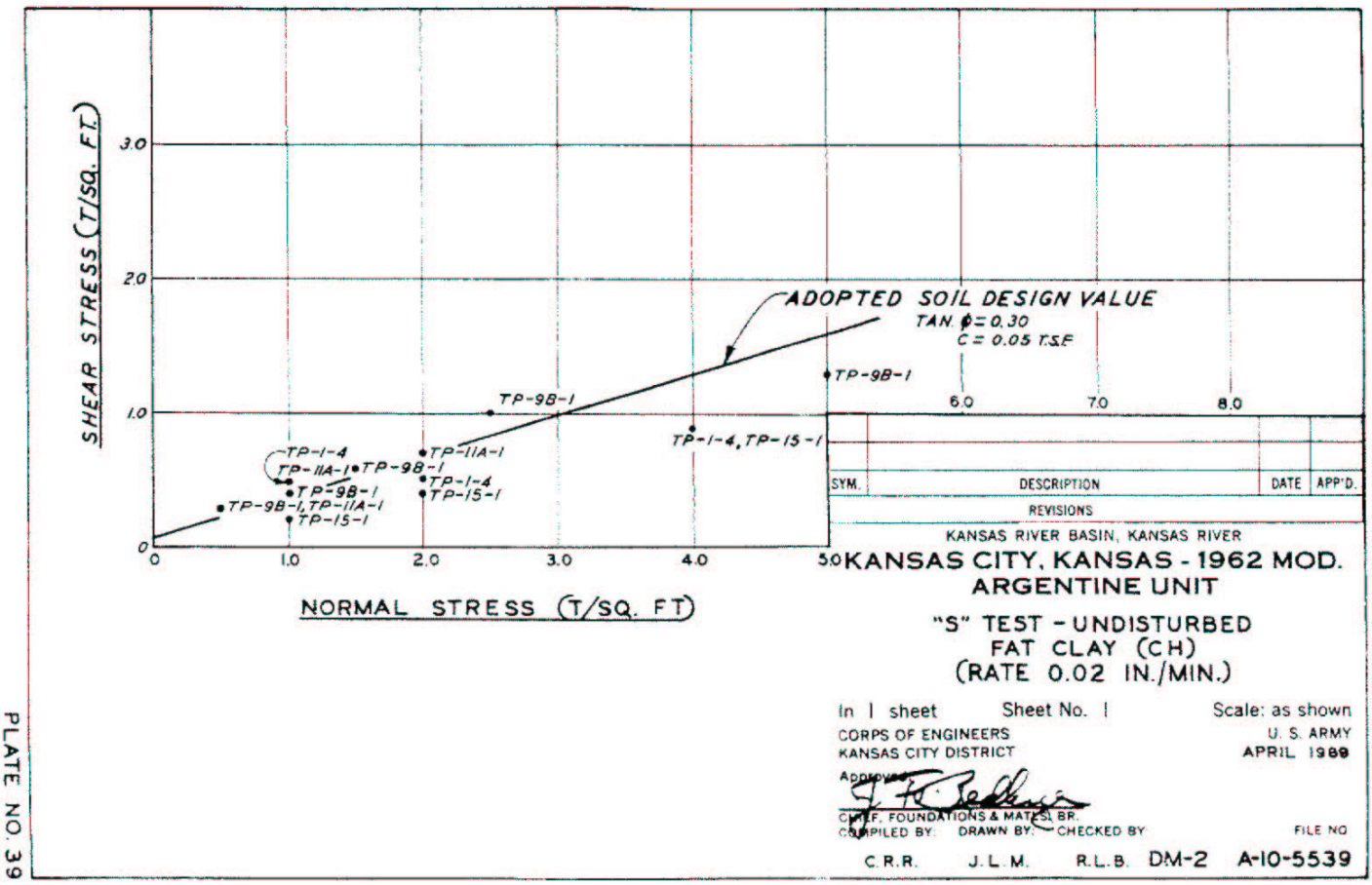


EXHIBIT A-5.59
Kansas City, Kansas – 1962 MOD Argentine Unit

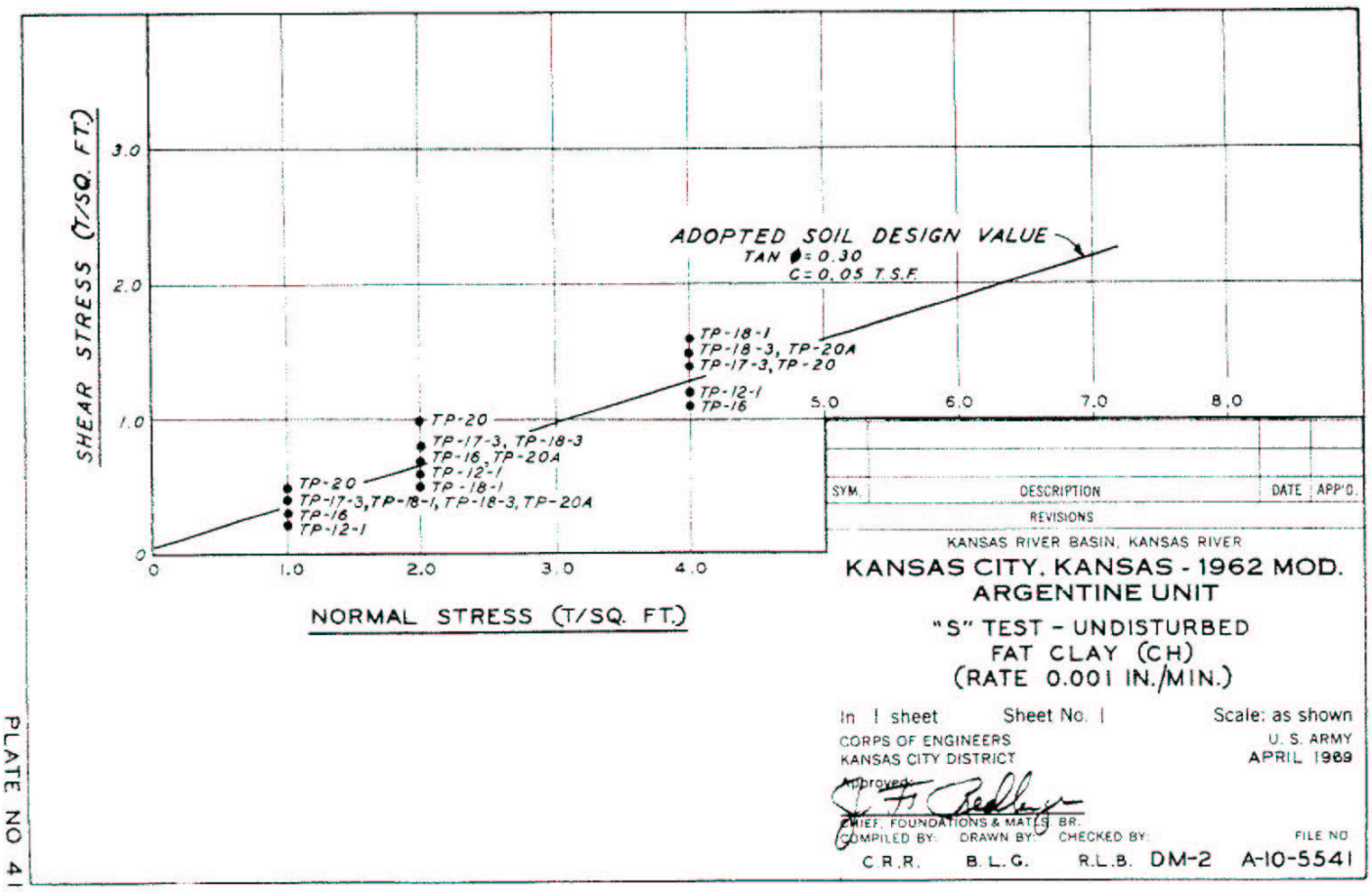


EXHIBIT A-5.60
Kansas City, Kansas – 1962 MOD Argentine Unit

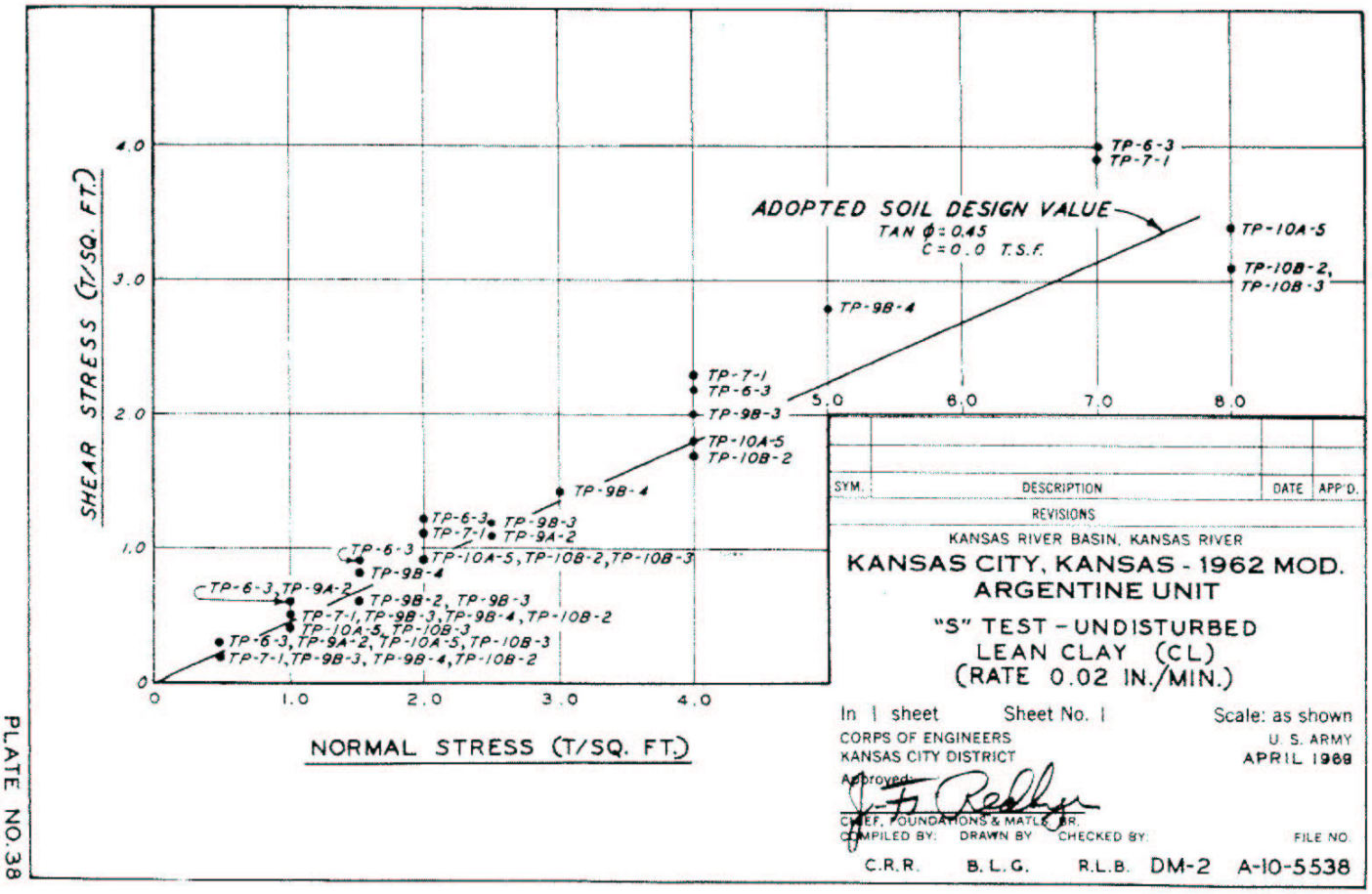


EXHIBIT A-5.61
Kansas City, Kansas – 1962 MOD Argentine Unit

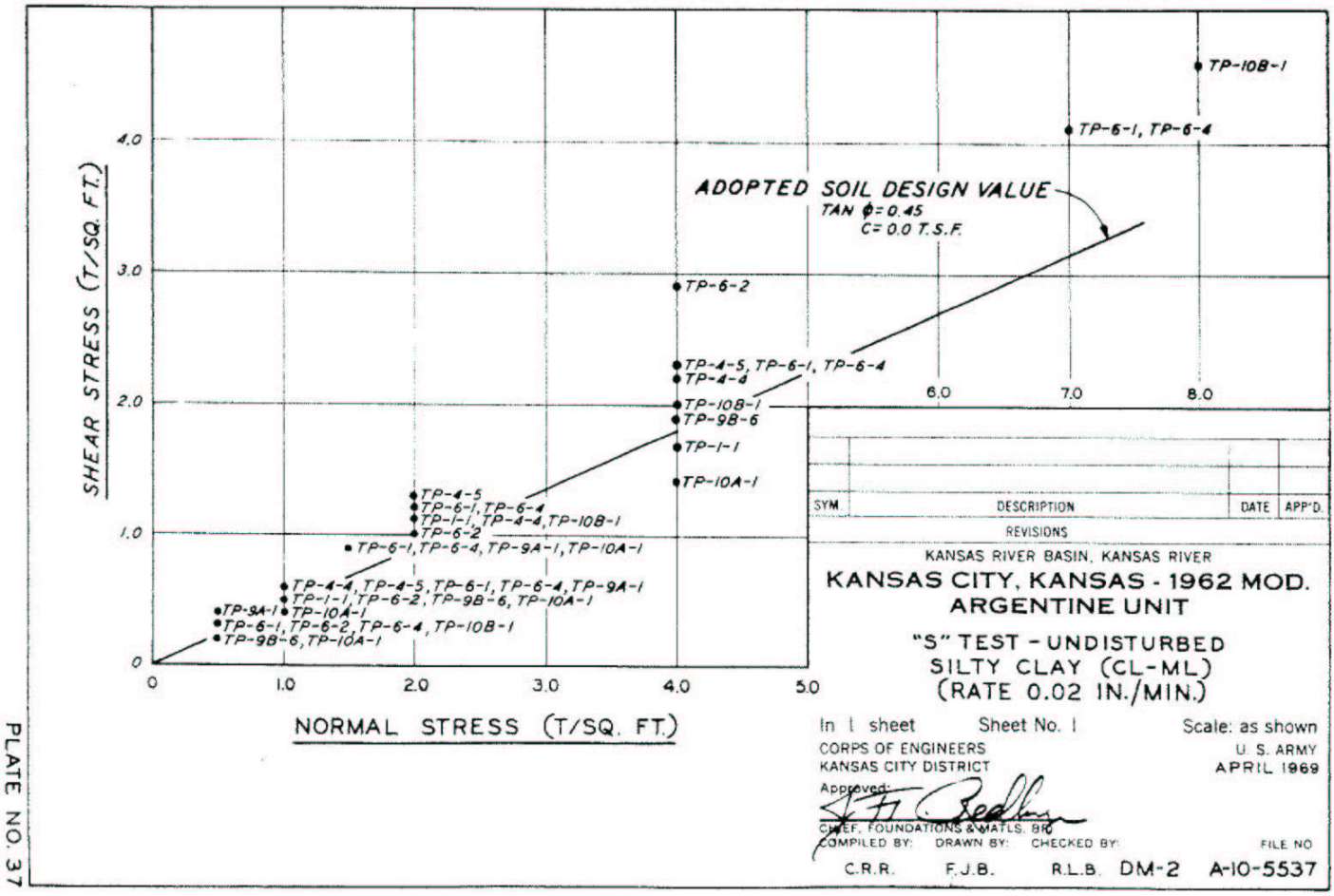


EXHIBIT A-5.62
1962 MOD Design Data – Levee Impervious

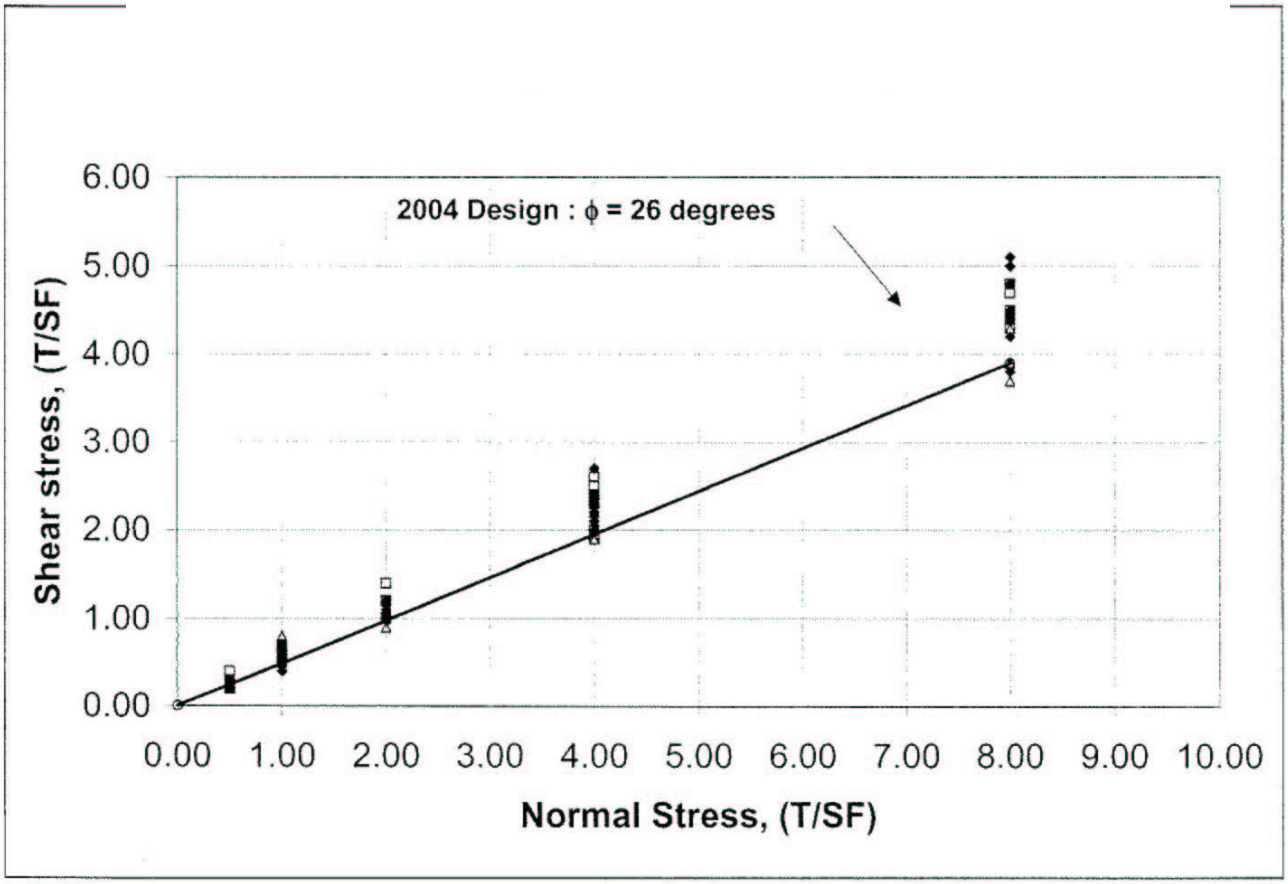


EXHIBIT A-5.63
Kansas City, Kansas – 1962 MOD Argentine Unit

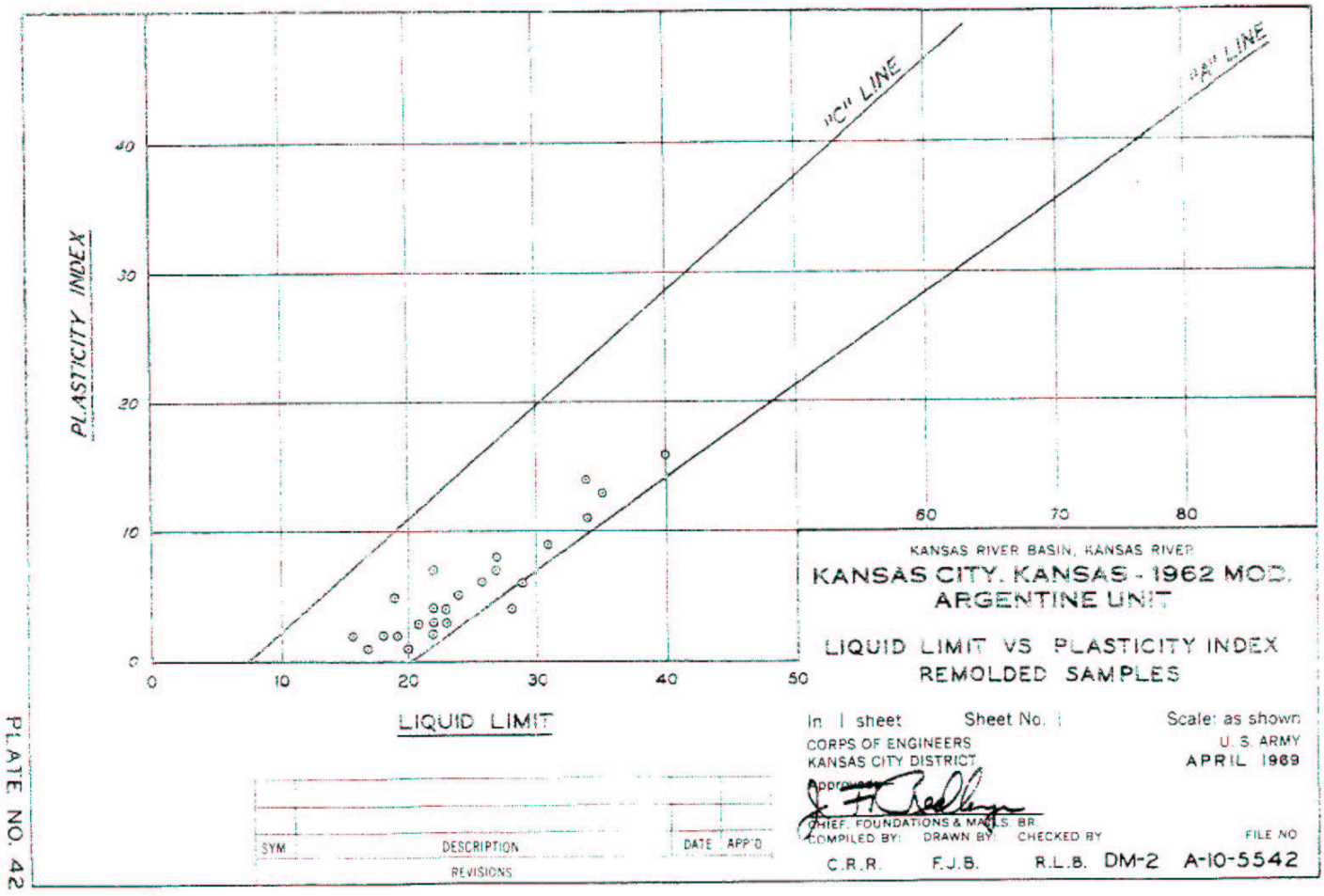


EXHIBIT A-5.64
Kansas City, Kansas – 1962 MOD Argentine Unit

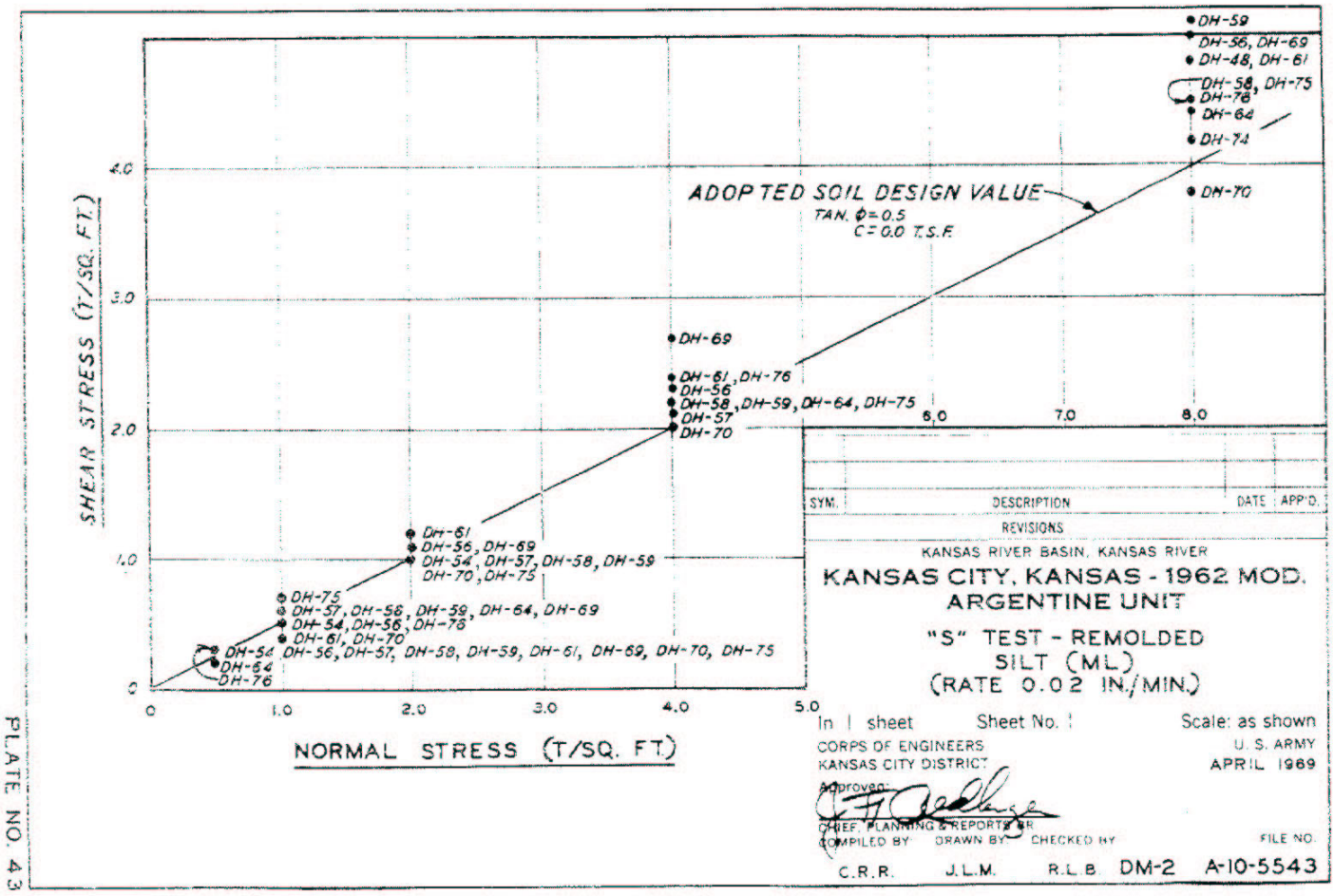


EXHIBIT A-5.65
Kansas City, Kansas – 1962 MOD Argentine Unit

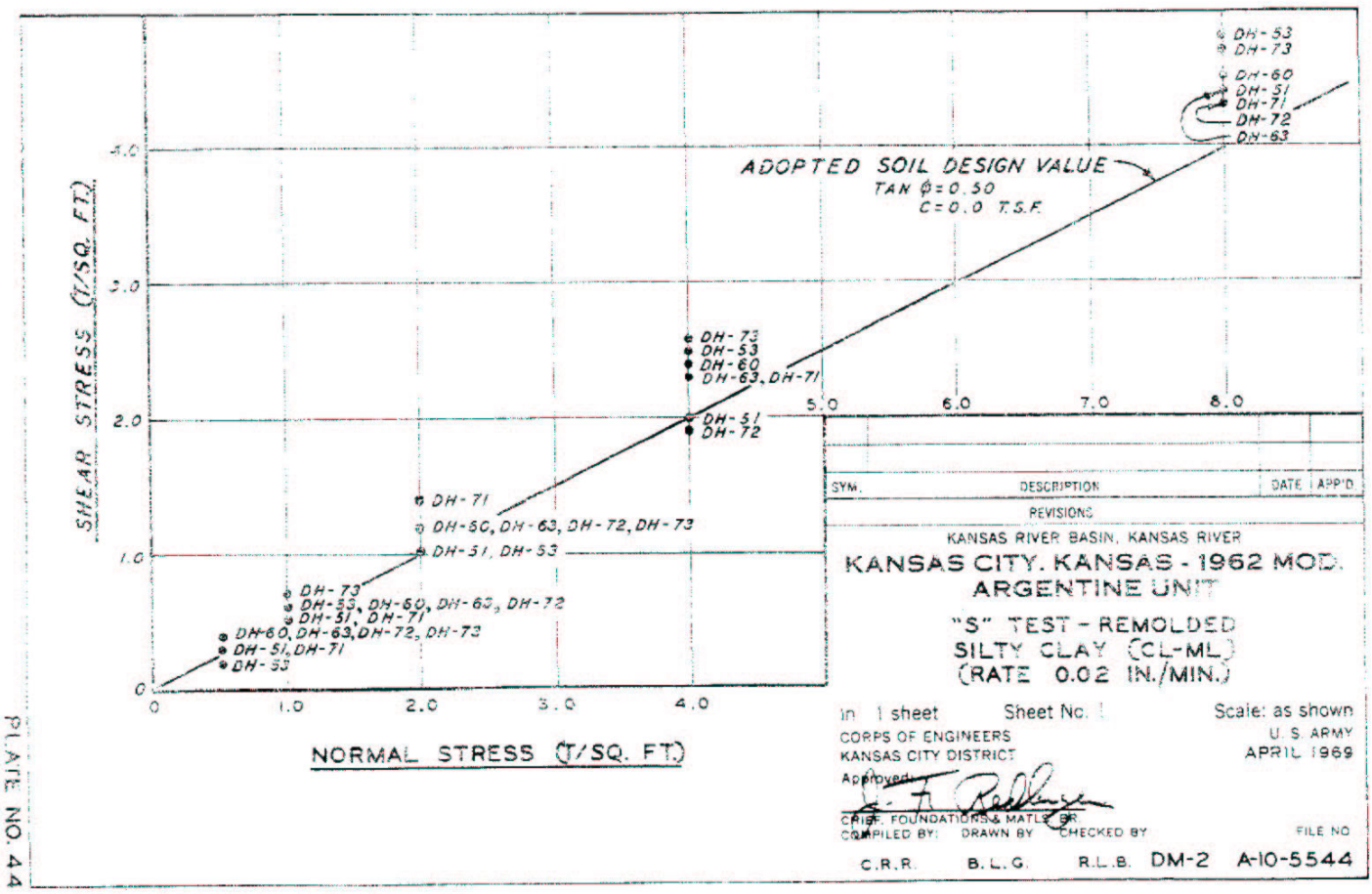


EXHIBIT A-5.66
Kansas City, Kansas – 1962 MOD Argentine Unit

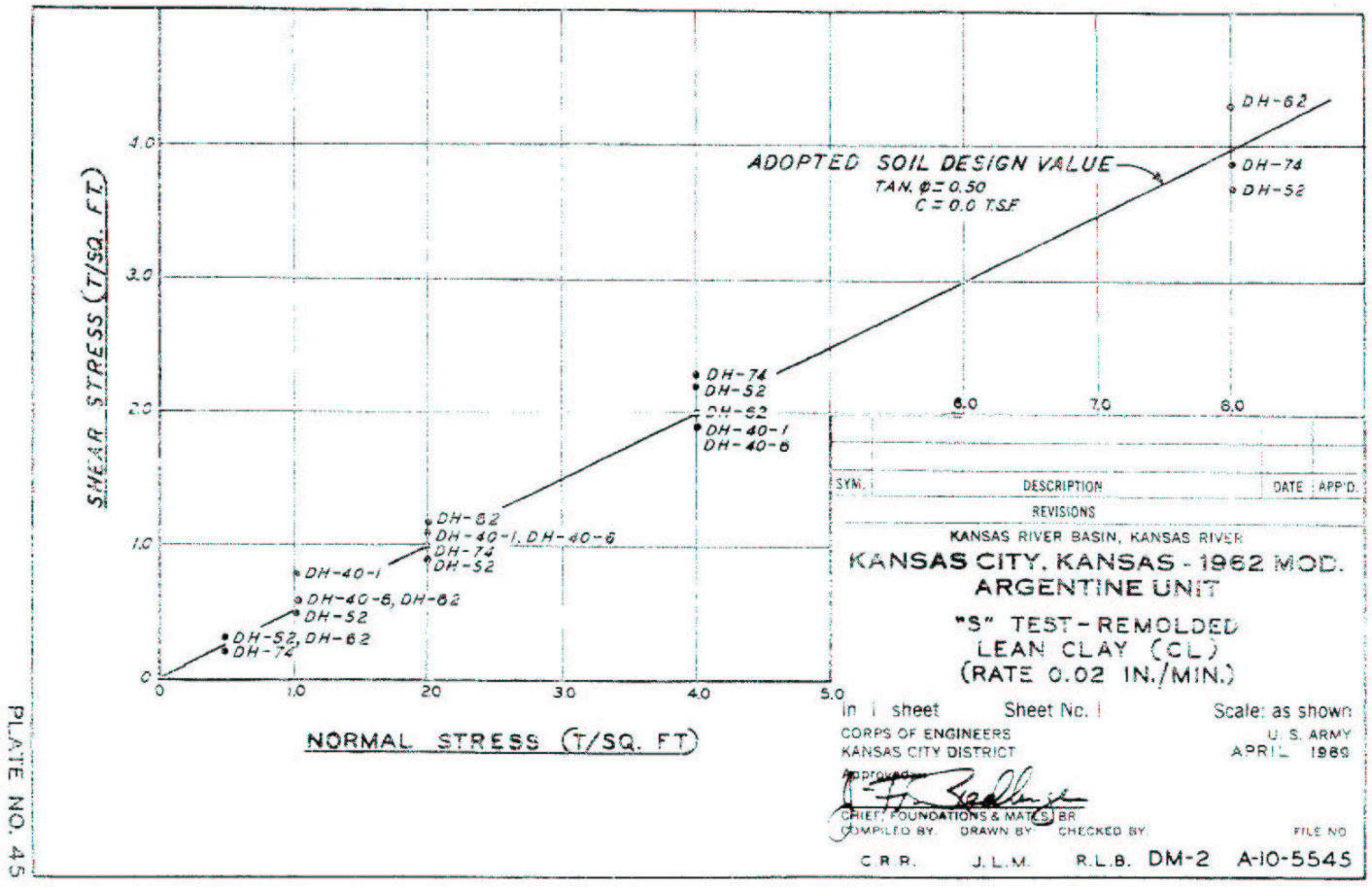
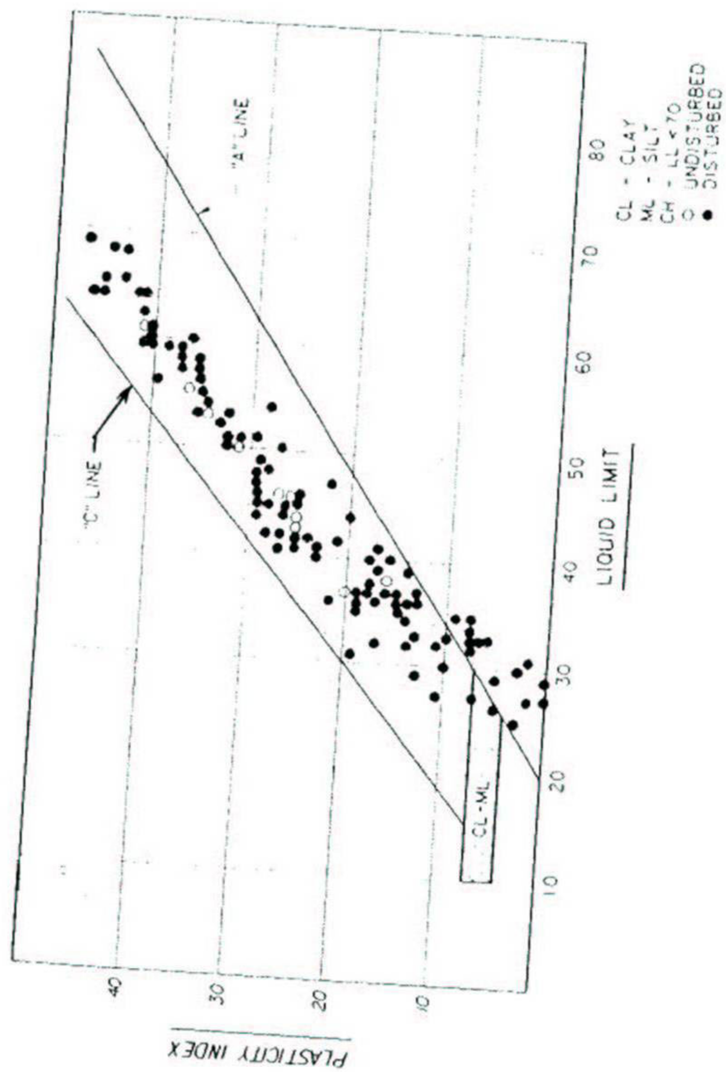
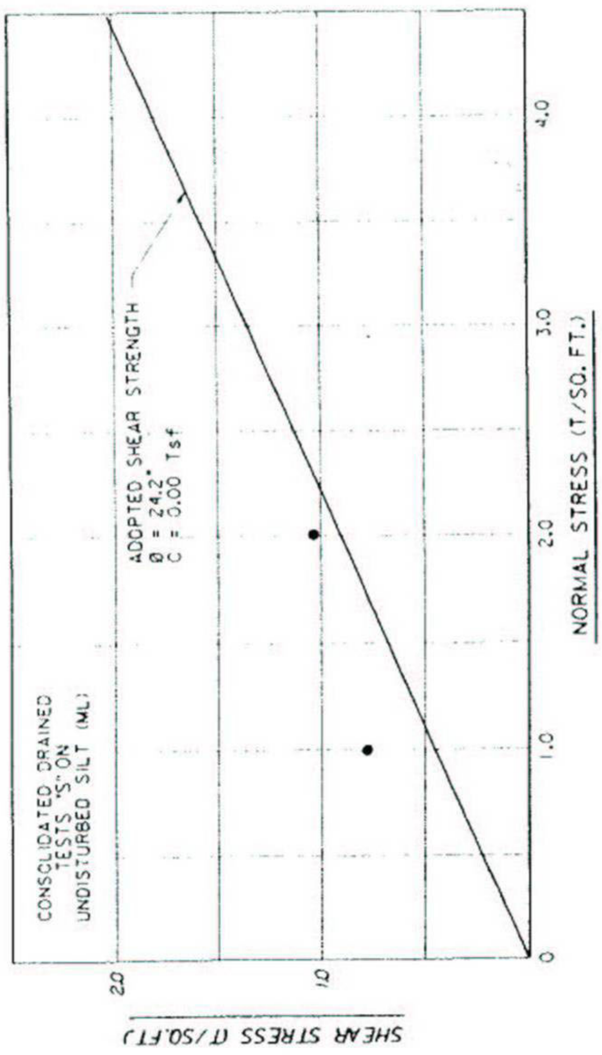
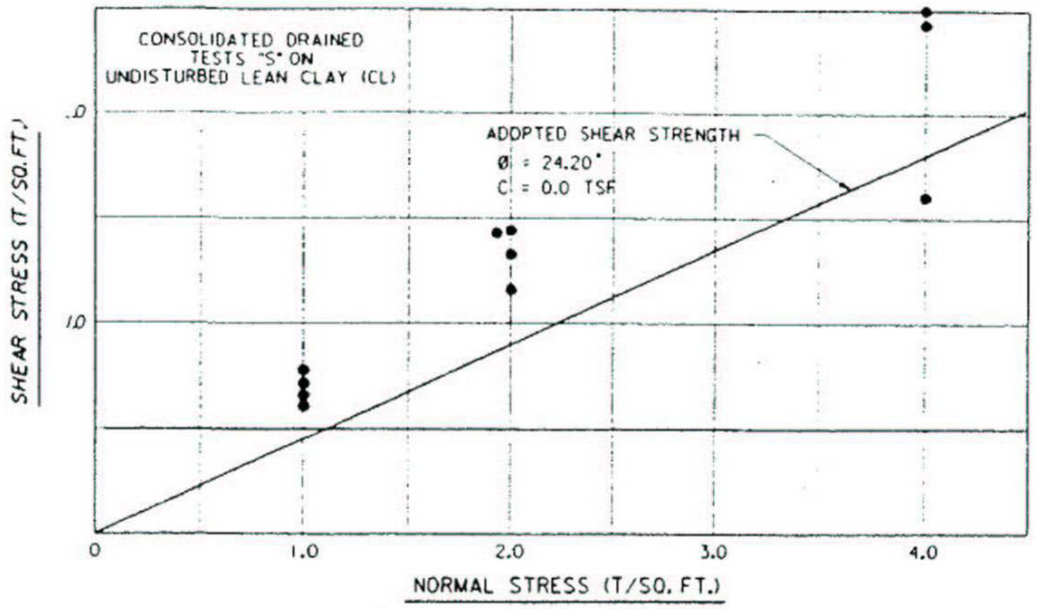
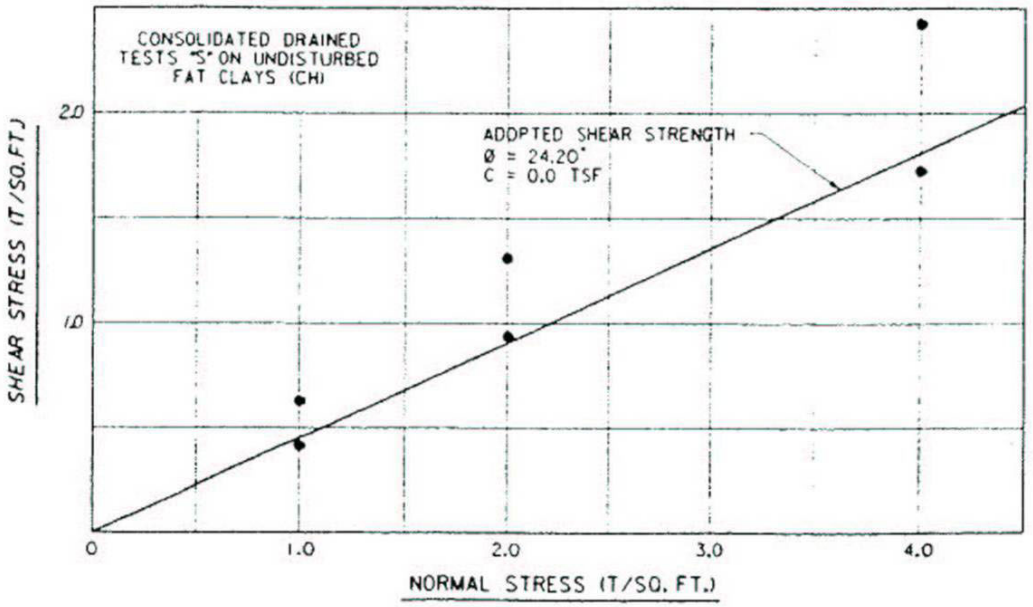


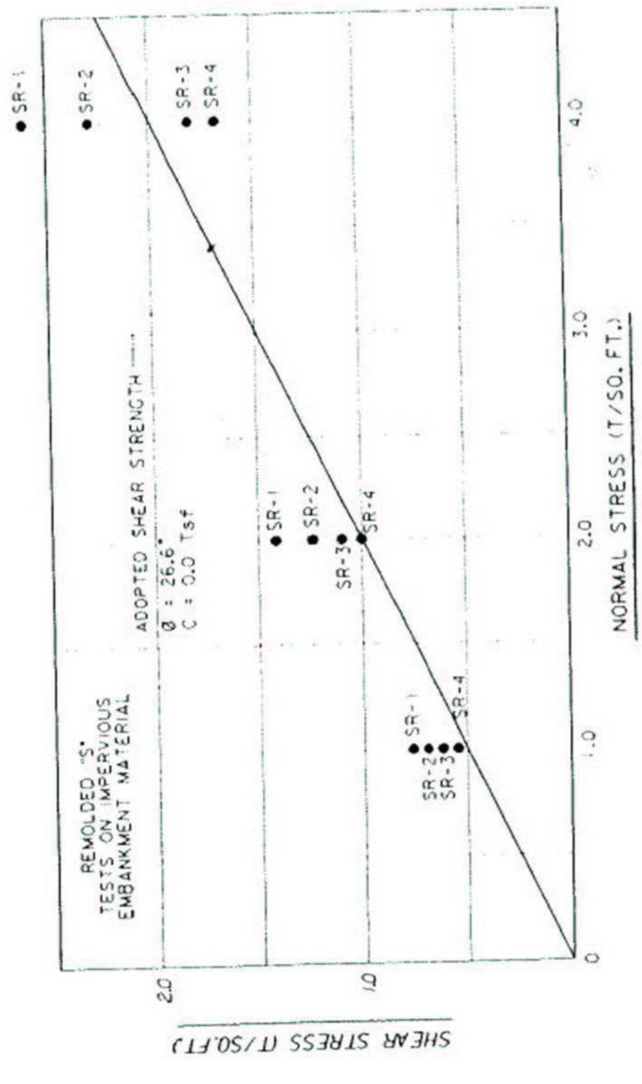
EXHIBIT A-5.67
L-385 Information


"C" LINE
"A" LINE
CL - ML
LIQUID LIMIT
PLASTICITY INDEX
10
20
30
40
50
60
70
80
10
20
30
40
CL - CLAY
ML - SILT
CH - LL > 70
○ UNDISTURBED
● DISTURBED


CONSOLIDATED DRAINED
TESTS "S" ON
UNDISTURBED SILT (ML)
ADOPTED SHEAR STRENGTH
Ø = 24.2°
C = 0.00 Tsf
NORMAL STRESS (T/SQ. FT.)
SHEAR STRESS (T/SQ.FT.)
0
1.0
2.0
3.0
4.0
1.0
2.0


CONSOLIDATED DRAINED
TESTS "S" ON
UNDISTURBED LEAN CLAY (CL)
ADOPTED SHEAR STRENGTH
Ø = 24.20°
C = 0.0 TSF
SHEAR STRESS (T/SQ.FT.)
.0
1.0
0
1.0
2.0
3.0
4.0
NORMAL STRESS (T/SQ. FT.)


CONSOLIDATED DRAINED
TESTS "S" ON UNDISTURBED
FAT CLAYS (CH)
ADOPTED SHEAR STRENGTH
Ø = 24.20°
C = 0.0 TSF
SHEAR STRESS (T/SQ.FT.)
2.0
1.0
0
1.0
2.0
3.0
4.0
NORMAL STRESS (T/SQ. FT.)

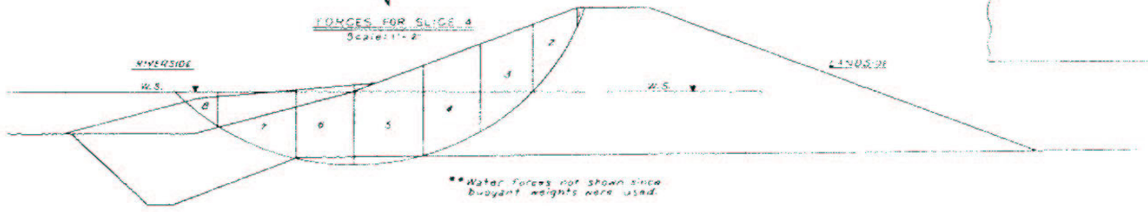

REMOLDED "S"
TESTS ON IMPERVIOUS
EMBANKMENT MATERIAL
ADOPTED SHEAR STRENGTH
Ø = 26.6°
C = 0.0 Tsf
SR-1
SR-2
SR-3
SR-4
0
1.0
2.0
3.0
4.0
NORMAL STRESS (T/SQ.FT.)
SHEAR STRESS (T/SQ.FT.)

SOIL PROPERTIES				
	K - TSF	γ_s TSF	φ °	C TSF
Emb	.055	.0268	50	0
Berm	.055	.0268	35	0
CL	.055	.0268	43	0
ML	.055	.0268	50	0
CH	.052	.0210	30	.05
CL-ML	.055	.0268	45	0
SP-SM	.057	.0288	50	0
Fill (Clay org.)	.055	.0268	35	0

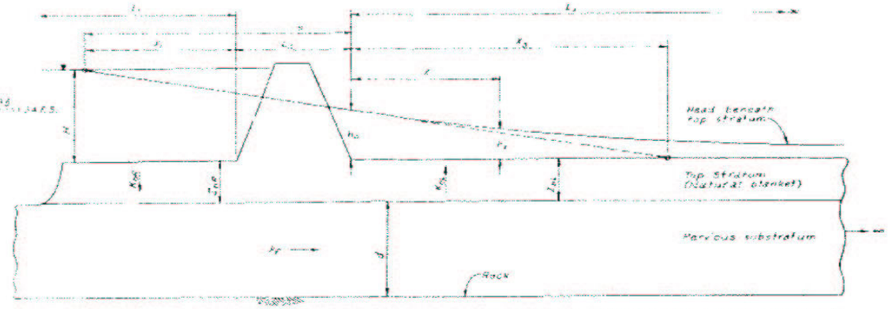
SLICE	HORIZONTAL WIDTH - FEET	FT. LEFT SIDE OF SLICE	FT. RIGHT SIDE OF SLICE	AVERAGE HEIGHT OF SLICE	WEIGHT OF SLICE	EFF. NORMAL FORCE - KIPS	TAN. FORCE KIPS
1	15	2.3	3	2.0	0.7	0.06	0.16
2	8.5	14.8	4.8	9.4	4.39	.55	3.65
3	10.5	10.5	4.8	12.85	7.31	6.50	3.50
4	12.5	8.5	0	4.25	1.20		
	11.0	8.0	6.5	16.25	4.99	7.55	3.45
	11.0	14.0	8.5	11.25	5.32		
5	4.8	1.5	0	9.75	0.16	0.20	-.25
	18.0	9.5	6.0	3.23	3.59		
	14.3	14.9	14.0	14.0	15.25		
	8.0	1.9	0	0.9	0.34		
6	11.5	9.5	1.5	1.0	0.83	3.15	0.70
	11.5	3.0	0	1.5	0.46		
	11.5	11.0	14.0	12.5	3.85		
	11.5	6	1.8	0.9	0.28		
7	15.5	6.5	3.5	5.0	2.98	4.00	-1.70
	5.5	0	11.0	5.5	2.28		
8	7.5	0	6.5	3.25	0.61	0.46	-0.39
						33.27	11.22

$\frac{16.46 \times 5 + 14.35 \times 34 + 4.02 \times 5 + 0.46 \times 38}{77.52} = 1.34$ K.S.

Use Buoyant wts.**



**Water forces not shown since buoyant weights were used.



For additional information see Waterways Experiment Station Technical Memorandum No. 3-424, Investigation of Underseepage and its Control

UNDERSEEPAGE ANALYSIS

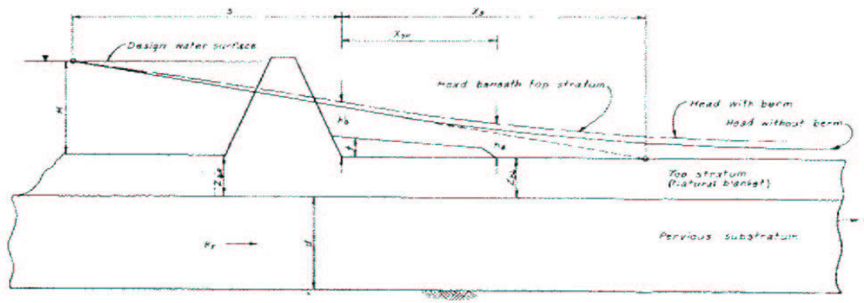
H Total net head on levee
L Distance from riverside toe of levee to river
L_2 Base width of levee and berm if present.
L_1 Landward (effective) extent of top stratum
S Distance from landside toe of levee (or berm) to effective source of seepage entry
$S = X_1 + L_2$
X_1 Effective length of blanket riverside of levee
$X_1 = \frac{\tan h \frac{L}{C}}{C}$
$C = \sqrt{\frac{K_{BR}}{K_F Z_{BR} d}}$
X_2 Distance from landside toe of levee (or berm) to effective seepage exit
$X = \frac{1}{C}$
$C = \sqrt{\frac{K_{BL}}{K_F Z_{BL} d}}$
Z_{BL} Effective thickness of top stratum landward of levee.
Z_{BR} Effective thickness of top stratum riverward of levee.
K_{BL} Vertical permeability of top stratum landward of levee
K_{BR} Vertical permeability of top stratum riverward of levee.
d Effective thickness of pervious substratum
K_F Horizontal permeability for the effective thickness of the pervious substratum
h_0 Head (net) beneath top stratum at landside toe of levee (without seepage control measures) assuming top stratum capable of withstanding such a head
$h_0 = H \frac{X_2}{S + X_1}$
h_x Head (net) beneath top stratum at a distance X landward from landside toe of levee
$h_x = h_0 E^{-CX}$ $E = 2.718$

STATION TO STATION		SEC	H	SAFETY FACTOR ST.	F.C.	D.D.	R.S.
0+00	*28+35	A	28	1.5	NC		
8+00	9+50	Wall		1.40	NC		
9+50	18+50	B	45	1.50	NC		1.27
18+50	41+25	C	25	1.35	1.27		
41+25	43+00	Wall		1.40	NC		
43+00	99+00	C	25	1.35	NC		
99+00	127+00	C	25	1.35	NC		
127+00	139+00	C	28	1.35	NC		
139+92	138+00	D	28	1.22	NC		1.49
138+00	150+00	D	26	1.22	NC		
150+70	200+00	E	52	1.49	NC		
200+00	223+00	E	54	1.43	NC		
223+00	233+50	E	56	1.40	NC		
233+26	236+00	Wall		1.40	NC		
236+00	267+00	G	58	1.23	NC		
267+00	277+84	H	64	1.60	NC		
277+84	End	Wall		1.40	NC		

*28+35 Rk = 8+50 Ah

TYPICAL STABILITY ANALYSIS

FS = 1.0 →



SEEPAGE BERM DESIGN

E. The head for underseepage control is determined as follows:
a. Underseepage control is required if the uplift gradient "i" at the landside toe of the levee, without a berm, is greater than 1.0 for agricultural levees, or greater than the value of the critical gradient (i_c) for municipal levees.
$i = \frac{h_0}{Z_{BL}}$ $i_c = \frac{\gamma_s}{\gamma_w}$
Where
γ_s is the submerged unit wt. of landside top stratum.
γ_w Unit wt. of water
b. The allowable upward gradient (i_c) at the landside toe of the berm provides for a factor of safety of 0.8 for agricultural levees and 1.0 for municipal levees.
$i_c = \frac{\gamma_s}{\gamma_w}$

E. Computing the width of berm X_{BH} (Trial berm method)
The distance from the effective source of seepage entry to the effective seepage exit plus one half the length of a pervious berm ($S = X_1 + X_{BH} + \frac{X_{BH}}{2}$) is used to compute a new head at the $\frac{X_{BH}}{2}$ point. The head (h_x) is computed at the toe of berm using $X = X_{BH}$.
More than one trial may be required to obtain a net head (h_x) equal to the allowable net head (h_a) where $h_a = i_c Z_{BL}$

F. The berm thickness (t) at the landside toe of the levee is established at a minimum thickness of 3 feet. If additional stability analysis will indicate additional thickness is required for factors of safety equal to 1.25 and 1.5 against sliding for agricultural levees and municipal levees, respectively.

h_0 Head at landside toe of levee with a landside seepage berm.

SYM	DESCRIPTION REVISIONS	DATE	APPD

KANSAS RIVER BASIN, KANSAS RIVER

KANSAS CITY, KANSAS - 1962 MOD. ARGENTINE UNIT

TYPICAL STABILITY ANALYSIS AND UNDERSEEPAGE ANALYSIS

In 1 Sheet | Sheet No 1 | Scale as shown

CORPS OF ENGINEERS KANSAS CITY DISTRICT | U.S. ARMY APRIL 1959

Submitted: CHIEF, ENGINEERING DIVISION | Recommended: CHIEF, ENGINEERING DIVISION | Approved: DIVISION ENGINEER

TAK MDS K.L.B. DM-2 A-10-5526

PLATE NO. 26