KIF Dredge Cell - Material Unit Weights SHEET 1 OF

Data from Singleton Labs report (9/29/94)
Eqns from "Essentials of Soil Mechanics & Foundations" by D.F. McCarthy COMPUTED DKE DATE 4/3/95

CHECKED DATE

Rolled, Compacted Earth

$G_s = 2.53$
$S = 80\%$ ← Assumed
$e = 0.679$

$$\gamma_{wet} = \frac{(G_s + Se)\gamma_w}{1+e}$$

$$\gamma_{wet} = \frac{[2.53 + (0.8)(.679)]62.4}{1+.679}$$

$$\gamma_{wet} = 114.2 \text{ pcf}$$

$$\gamma_{SAT} = \frac{(G_s + e)\gamma_w}{(1+e)}$$

$$\gamma_{SAT} = \frac{(2.53 + 0.679)62.4}{(1+.679)}$$

$$\gamma_{SAT} = 119.3 \text{ pcf}$$

Residual Material

$G_s = 2.72$
$S = 82.9\%$
$e = 0.445$

$$\gamma_{wet} = \frac{[2.72 + (0.829)(0.445)]62.4}{(1+0.445)}$$

$$\gamma_{wet} = 133.4 \text{ pcf}$$

$$\gamma_{SAT} = \frac{(2.72 + 0.445)62.4}{(1+0.445)}$$

$$\gamma_{SAT} = 136.7 \text{ pcf}$$

Bottom Ash

$G_s = 2.37$
$S = 80\%$ Assumed
$e = 0.633$

$$\gamma_{wet} = \frac{[2.37 + (0.80)(.633)]62.4}{1+0.633}$$

$$\gamma_{wet} = 109.9 \text{ pcf}$$

$$\gamma_{SAT} = \frac{(2.37 + .633)62.4}{(1+0.633)}$$

$$\gamma_{SAT} = 114.8 \text{ pcf}$$

TVA 11030 (WM-7-75)

KIF Dredge Cell - Material Unit Wts

SHEET 2 OF

COMPUTED BKE DATE 4/3/95

CHECKED DATE

$$\gamma_{wet} = \frac{[2.25 + (0.743)(0.757)]62.4}{1 + 0.757}$$

$\gamma_{wet} = 99.9$ pcf

$$\gamma_{SAT} = \frac{(2.25 + 0.757)62.4}{1 + 0.757}$$

$\gamma_{SAT} = 106.8$ pcf

Fly Ash (from Hole 7 samples)

$G_s = 2.25$

$S = 74.3\%$

$\gamma_{dry} = 79.9$ pcf

solve for void ratio

$$\gamma_{dry} = \frac{G_s \gamma_w}{1+e}$$

$$e = \frac{G_s \gamma_w}{\gamma_{dry}} - 1 = \frac{(2.25)(62.4)}{79.9} - 1$$

$e = 0.757$

solve for saturation %

$Se = wG_s$ $\quad w = 25\%$ = avg of class I & class II w's

$$S = \frac{wG_s}{e} = \frac{(25\%)(2.25)}{0.757}$$

$S = 74.3\%$

Remolded Fly Ash (3% wet of optimum & 85% of max wt)

$G_s = 2.25$

$\gamma_{dry} = 79.9$ pcf

$S =$

$$S = \frac{wG_s}{e} = \frac{28\%(2.25)}{0.757}$$

$S = 83.2\%$

$$\gamma_{wet} = \frac{[2.25 + (0.832)(0.757)]62.4}{1 + 0.757}$$

$\gamma_{wet} = 102.3$ pcf

TVA 11030 (WM-7-75)

TVA 488 B (DES-4-41)

TENNESSEE VALLEY AUTHORITY

SHEET 1 OF 2

SUBJECT STAGE B PARTNER QTY'S PROJECT KIF ~~DREDGE~~ CELL

COMPUTED BY BKE DATE 8/9/95 CHECKED BY DATE

NO.	ITEM	QUANTITY	UNIT	PRICE	AMOUNT	TOTAL
	Base Preparation					
	Woven Slit Film Geotextile (Synthetic Ind. Type 300ST)	27,700	SY			
	Toe Drain System					
	6"⌀ Perforated HDPE pipe	2,800	LF			
	6"⌀ Non-perforated HDPE pipe	1,850	LF			
	6"⌀ HDPE "Tee" section	14	EA			
	#1081 Crushed Stone	480	TN			
	Filter Fabric (Trevira Spun-Bound Type 1135 Non-Woven, Needlepunched)	2,300	SY			
	Cover System (Option B)					
	9" Intermediate Earth Cover	5,050	CY			
	Geosynthetic Clay Liner (Claymax 500SP or equiv.)	19,000	SY			
	Geonet (Gundle Fabrinet or equiv.)	19,000	SY			
	12" Final Earth Cover	6,650	CY			
	Seed/Mulch	19,000	SY			
	Spillway/Skimmer					
	Extension (See Dwg 10W425-12)	1	EA			
	Cover Drainage System					
	4"⌀ Perforated HDPE pipe	2800	LF			
	Concrete Collars (36"x12"x3")	14	EA			
	#1081 Crushed Stone	775	TN			
	Riprap	250	TN			

TVA 488 B (DES-4-41)

TENNESSEE VALLEY AUTHORITY

SUBJECT STAGE B PARTNER QTY'S (CONTD) PROJECT KIF DREDGE CELLS

COMPUTED BY BKE DATE CHECKED BY DATE

NO.	ITEM	QUANTITY	UNIT	PRICE	AMOUNT	TOTAL
	Cover System (Option A)					
	9" Intermediate Earth Cover	5,100	CY			
	12" Clay Cover (final)	7,500	CY			
	12" Earth Cover (final)	6,650	CY			
	Seed/Mulch	19,000	SY			

TVA 488 B (DES-4-41) TENNESSEE VALLEY AUTHORITY SHEET 2 OF 2

SUBJECT STAGE A PARTNER QTY'S PROJECT KIF DREDGE CELLS

COMPUTED BY BKE DATE 8/16/95 CHECKED BY DATE

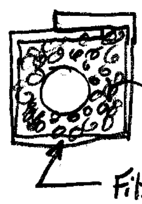
NO.	ITEM	QUANTITY	UNIT	PRICE	AMOUNT	TOTAL
	Cover System (Option A)					
	9" Intermediate Earth Cover	4,200	CY			
	12" Clay Cover (final)	29,700	CY			
	12" Earth Cover (final)	31,100	CY			
	Seed / Mulch	90,000	SY			

KIF Dredge Cell - Filter Fabric calc's for toe drain

SHEET 2 OF

COMPUTED BKE DATE 5/22/95

CHECKED DATE



From Singleton Labs report, >50% of ash passes the No. 200 sieve, so AOS of fabric should be ≥ No. 50 sieve. (From "Designing With Geosynthetics" by R.M. Koerner).

Use Trevira Spunbound Type 1145.

AOS = 100 to 140

O_{95} = 0.149 to 0.105

TVA 11030 (WM-7-75)

KIF Dredge Cell - Filter fabric calc's for toe drain

SHEET 1 OF

COMPUTED BKE DATE 5/22/95

CHECKED DATE

Soil Retention (For fly ash)

From Singleton grain size analysis of hole 7 - 11' to 13' depth

$d_{10} \approx 0.003$ mm

$d_{50} \approx 0.010$ mm

$d_{60} \approx 0.013$ mm

$CU = \frac{d_{60}}{d_{10}} = \frac{0.013 mm}{0.003 mm}$

$CU = 4.33 \Leftarrow$

Assume relative density is between 50% to 80%

From "Designing With Geosynthetics" by R.M. Koerner, p 122, Table 2.14

$O_{95} < \frac{13.5 d_{50}}{CU}$

$O_{95} < \frac{13.5 (0.010 mm)}{4.33}$

$O_{95} < 0.031$ mm

Closest sieve to this is the #400 (=0.037mm openings)

AOS must be #400

This is very strict. The fly ash is too finely graded. Try placing the toe drain in the bottom ash (dike) material.

TVA 11030 (WM-7-75)

KIF Dredge Cell - Filter fabric calc's for toe drain

SHEET 2 OF

COMPUTED BKE DATE 5/26/95

CHECKED DATE

Singleton grain size analysis of hole 6 - 13' to 15' depth

$d_{10} = 0.0035$ mm

$d_{50} = 0.040$ mm

$d_{60} = 0.095$ mm

$CU = \frac{d_{60}}{d_{10}} = \frac{0.095mm}{0.0035mm} = 27.1$

15' to 17'

$d_{10} = 0.004$

$d_{50} = 0.035$

$d_{60} = 0.060$

$CU = \frac{0.060}{0.004} = 15.0$

23.75

22.3

Assume relative density is greater than 80%

$O_{95} < \frac{18\ d_{50}}{CU}$ (From R. M. Koerner, p 122, Table 2.14)

$O_{95} < \frac{18\ (0.04mm)}{27.1}$

$\frac{18(0.035)}{15} = 0.042$

$O_{95} < 0.027$ mm

Closest sieve is again #400 (=.037 mm openings)

TVA 11030 (WM-7-75)

TVA-00013041

SUBJECT: Dredge Cells - Qty calc's ~~for~~ ditch across ash pond PROJECT: KIF

COMPUTED BY: BKE DATE: 10/2/96 CHECKED BY: DATE:

These calc's are typical for ditch of section A-A on dwg 10W426-2.

~~Area of dredge stack draining to head of ditch~~

$Q_{UP} = C\,i\,A$ Assume $C = 0.25$ [From Hydraulic Engineering, Roberson, Cassidy, Chaudry, 1988, p 67 Table 2-9, grass-covered clay soil 2% to 8% slope]

$Q_{UP} = (0.25)(0.2\ in/hr)(10.06\ acres)$ $i = \frac{4.9in}{24hr} = 0.20\ in/hr$ [Tech Paper 40 - 10yr, 24 hr storm]

$Q_{UP} = 0.51$ cfs $A = [(600)(680) + (100)(600)(1/2)]/43{,}560$

$A = 10.06$ acres

Area of both sides of ditch (to point at bottom of ditch)

$Q_T = Q_{up} + Q_{sides}$

$Q_{sides} = c\,i\,A$ Assume $C = 0.25$ (see above)

$i = 0.20\ in/hr$ (see above)

$Q_{sides} = (0.25)(0.2\ in/hr)(16.2\ acres)$ $A = [(400)(1760)]/43{,}560$

$Q_{sides} = 0.81$ cfs $A = 16.2$ acres

$Q_T = 0.51 + 0.81$

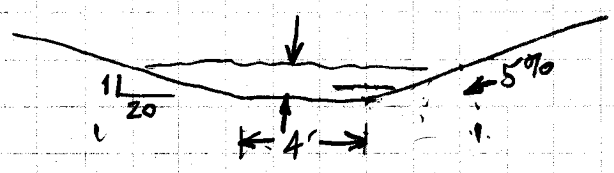
$Q_T = 1.32$ cfs

Assume no bacwater due to pipe discharging into stilling pool.

Calculate depth of water at bottom of ditch

SUBJECT Dredge Cells - Qty calc's for ditch across ash pond PROJECT KIF

COMPUTED BY BKE DATE 10/2/96 CHECKED BY DATE



Slope = 1% = 0.01 ft/ft

$n = 0.030$ [From Open Channel Hydraulics, French, p 127, vegetal lined channel]

Use Manning's formula

$$Q = \frac{1.49}{n} A R^{2/3} S_o^{1/2}$$

$$AR^{2/3} = \frac{nQ}{1.49 S_o^{1/2}}$$

$$[(4+20y)y]\left[\frac{(4+20y)y}{4+2y\sqrt{1+20^2}}\right]^{2/3} = \frac{(.030)(1.32)}{1.49\sqrt{0.01}}$$

Use Haested Methods Flowmaster to get depth

Assume

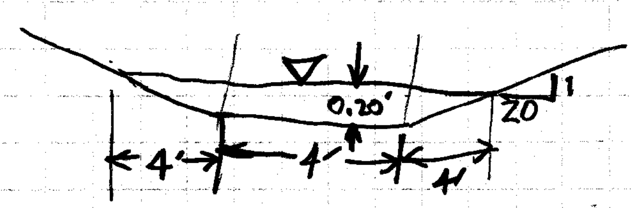
$n = 0.030$

$Q = 2.0$ cfs

$z = 20$

bottom width = 4 ft

This gives $y = 0.20$ ft



Will need to use 13 ft wide roll of turf reinforcement matrix to prevent erosion.

KIF Ash Pond Closure/Ditch over ash pond
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Kingston closure ditch over ash pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.010000	ft/ft
Left Side Slope	20.000000	H : V
Right Side Slope	20.000000	H : V
Bottom Width	4.00	ft
Discharge	2.00	cfs

Results		
Depth	0.20	ft
Flow Area	1.56	ft²
Wetted Perimeter	11.88	ft
Top Width	11.87	ft
Critical Depth	0.15	ft
Critical Slope	0.027677	ft/ft
Velocity	1.28	ft/s
Velocity Head	0.03	ft
Specific Energy	0.22	ft
Froude Number	0.62	
Flow is subcritical.		

KIF DREDGE CELL - COVER CALCULATIONS SHEET 1 OF

COMPUTED BKE DATE 6/13/95

CHECKED DATE

Flat area around toe of Stage A dike:

East & West Ends

$A_{ENDS} = 4.65 + 3.85 + 8.09 + 6.69$ (A_1, A_2, A_3, A_4)

$A_{ENDS} = 23.28\ in^2 \left(\frac{105.93\ ft}{1\ in}\right)^2 = 261{,}200\ ft^2$

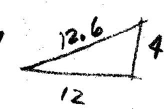
$Vol_{ENDS} = (1\ ft)(261{,}200\ ft^2) = 261{,}200\ ft^3 = 9670\ CY$

Compacted Clay → Assume 15% shrink for clay

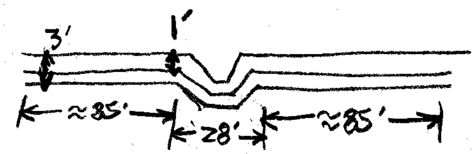
$Vol_{ECl} = \frac{9670\ CY}{0.85} = 11{,}380\ CY$ **SAY 11,400 CY**

Earth Cover → Assume 5% shrink for earth

$Vol_{EE} = \frac{9670\ CY}{0.95} = 10{,}180\ CY$ **SAY 10,200 CY**



North Ditch Area



Compacted Clay

$Vol = [(85')(1')(2) + 4'(1') + 2(12.6')(1')]\ 1377'$

$Vol = 274{,}300\ ft^3 = 10{,}160\ CY$

Assume 15% shrink (clay) → $Vol = \frac{10{,}160}{0.85} = 11{,}950\ CY$ **SAY 12,000 CY**

Earth Cover

$Vol = [(85')(1')(2) + (4')(1') + 2(12.6')(1') + 2(\tfrac{1}{2})(85')(1')]\ 1377'$

$Vol = 391{,}340\ ft^3 = 14{,}490\ CY$

Assume 5% shrink (earth) → $Vol = \frac{14{,}490}{0.95} = 15{,}250\ CY$ **SAY 15,300 CY**

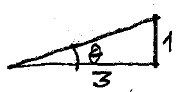
TVA 11030 (WM-7-75)

KIF DREDGE CELL - COVER CALCULATIONS SHEET 2 OF

COMPUTED BKE DATE 6/13/95

CHECKED DATE

STAGE A ~~outer slope~~



$\theta = \tan^{-1}\frac{1}{3}$

$\theta = 18.43°$

By planimeter

$A' = 2.24 + 0.36 + 2.69 + 3.60 + 2.41 + 0.81$

$A' = 12.11 \text{ in}^2$

$A = \frac{12.11 \text{ in}^2}{\cos 18.43°}$ [Adjust for 3:1 slope]

$A = 12.76 \text{ in}^2 \left(\frac{105.93 \text{ ft}}{\text{in}}\right)^2$

$A = 143{,}200 \text{ ft}^2$

Intermediate Cover

$V_{int} = (143{,}200 \text{ ft}^2)(9/12 \text{ ft})$

$V_{int} = 107{,}400 \text{ ft}^3 = 3978 \text{ yd}^3$

Assume 5% shrink → $V_{int} = \frac{3978 \text{ yd}^3}{0.95} = 4187 \text{ cy}$ **SAY 4200 CY**

Final Cover (clay)

$V_{FC} = (143{,}200 \text{ ft}^2)(1 \text{ ft})$

$V_{FC} = 143{,}200 \text{ ft}^3 = 5303 \text{ yd}^3$

Assume 15% shrink → $V_{FC} = \frac{5303 \text{ yd}^3}{0.85} = 6239 \text{ cy}$ **SAY 6300 CY**

TVA 11030 (WM-7-75)

COMPUTED BKE DATE 6/13/95

CHECKED DATE

STAGE A outer slope (cont'd)

Final Cover (Earth)

$V_{FE} = (143,200 ft^2)(1 ft)$

$V_{FE} = 143,200 ft^3 = 5303 yd^3$

Assume 5% shrink → $V_{FE} = \frac{5303 yd^3}{0.95} = 5582 yd^3$ **Say 5600 CY**

STAGE B outer slope

$A' = 2.32 + 0.30 + 1.73 + 3.32 + 2.17 + 1.00$

$A' = 10.84 in^2$

$A = \frac{10.84 in^2}{\cos 18.43°}$ [Adjust for 3:1 slope]

$A = 11.43 in^2 \left(\frac{105.93 ft}{1 in}\right)^2$

$A = 128,300 ft^2$

Intermediate Cover

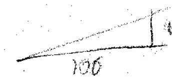
$V_{int} = (128,300 ft^2)(3/4 ft)$

$V_{int} = 96,225 ft^3 = 3560 yd^3$

Assume 5% shrinkage → $V_{int} = \frac{3560 yd^3}{0.95} = 3750 CY$ **Say 3800 CY**

TVA 11030 (WM-7-75)

STAGE B outer slope (cont'd)



Final Cover (Clay)

$V_{FC} = (128{,}300\,ft^2)(1\,ft)$

$V_{FC} = 128{,}300\,ft^3 = 4751\,yd^3$

Assume 15% shrink → $V_{FC} = \frac{4751\,yd^3}{0.85} = 5589\,CY$ **SAY 5600 CY**

Final Cover (Earth)

$V_{FE} = (128{,}300\,ft^2)(1\,ft)$

$V_{FE} = 128{,}300\,ft^3 = 4751\,yd^3$

Assume 5% shrink → $V_{FE} = \frac{4751\,yd^3}{0.95} = 5001\,CY$ **SAY 5000 CY**

Berm Between STAGE A & STAGE B

$A = lw$

$A = (2786.04\,ft)(15\,ft)$

$A = 41{,}790\,ft^2$

Intermediate Cover

$V_{int} = (41{,}790\,ft^2)(9/12\,ft)$

$V_{int} = 31{,}343\,ft^3 = 1161\,yd^3$

Assume 5% shrink → $V_{int} = \frac{1161\,yd^3}{0.95} = 1222\,CY$ **SAY 1250 CY**

Berm Between STAGE A & STAGE B (cont'd)

Final Cover (Clay)

$V_{FC} = (41,790\ ft^2)(1\ ft)$

$V_{FC} = 41,790\ ft^3 = 1548\ CY$

Assume 15% shrink → $V_{FC} = \frac{1548\ CY}{0.85} = 1822\ CY$ **SAY 1850 CY**

Final Cover (Earth)

$V_{FE} = (41,790\ ft^2)(1\ ft)$

$V_{FE} = 41,790\ ft^3 = 1548\ CY$

Assume 5% shrink → $V_{FE} = \frac{1548\ CY}{0.95} = 1629\ CY$ **SAY 1650 CY**

KIF DREDGE CELL - COVER CALCULATIONS SHEET 1 OF

COMPUTED BKE DATE 7/28/95

CHECKED DATE

STAGE C Outer Slope & Berm

$A_{berm} = P_c W_{berm}$

$A_{berm} = (7207\text{ ft})(15\text{ ft})$

$A_{berm} = 108,105\text{ ft}^2$

$A_c = P_c W_c$

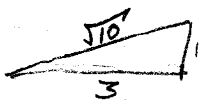
$A_c = (7207\text{ ft})(63\text{ ft})$

$A_c = 454,041\text{ ft}^2$

$A_{slope} = A_c - A_{berm}$

$A_{slope} = 454,041 - 108,105$

$A_{slope} = 345,936\text{ ft}^2$

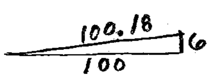


$\frac{3}{\sqrt{10}} = \frac{W}{X}$

$W = 1.054x$

$A'_{slope} = 345,936(1.054)$

$A'_{slope} = 364,648\text{ ft}^2$



$\frac{100}{100.18} = \frac{W}{x}$

$W = 1.002x$

$A'_{berm} = 108,105\text{ ft}^2(1.002)$

$A'_{berm} = 108,300\text{ ft}^2$

$A_c = 472,947\text{ ft}^2$

Intermediate Cover (9")

$V_{int} = (9/12\text{ ft})(472,950\text{ ft}^2)(\frac{1\text{ yd}^3}{27\text{ ft}^3})$

$V_{int} = 13,137\text{ CY}$ → Assume 5% shrink → $V_{int} = \frac{13,137\text{ CY}}{0.95}$

$V_{int} = 13,829\text{ CY}$

Say $V_{int} = 13,900\text{ CY}$

Final Cover (Earth)

$V_{FCE} = (472,947\text{ ft}^2)(1\text{ ft})(\frac{1\text{ CY}}{27\text{ ft}^3})$

$V_{FCE} = 17,517\text{ CY}$ → Assume 5% shrink → $V_{FCE} = \frac{17,517}{0.95} = 18,439\text{ CY}$

Say $V_{FCE} = 18,500\text{ CY}$

TVA 11030 (WM-7-75)

STAGE C (Cont'd)

Final Cover (Clay)

$V_{FCC} = 17{,}517\ CY \Rightarrow$ Assume 15% shrink $\Rightarrow V_{FCC} = \frac{17{,}517}{0.85}$

$V_{FCC} = 20{,}608$

Say $V_{FCC} = 20{,}700\ CY$

STAGE D

$A_D = A_{C3} - A_{D3}$ (Areas @ ℄ of stages as computed by GCL)

$A_D = 2{,}764{,}233 - 2{,}319{,}495$

$A_D = 444{,}738$

$A_{berm} = P_D(W_{berm})$

$A_{berm} = (6807\ ft)(15\ ft)$

$A_{berm} = 102{,}105\ ft^2$

$A_{slope} = A_D - A_{berm}$

$A_{slope} = 444{,}738 - 102{,}105$

$A_{slope} = 342{,}633\ ft^2$

Correct for slope

$A'_{slope} = (342{,}633\ ft^2)(1.054)$

$A'_{slope} = 361{,}167\ ft^2$

$A'_{berm} = (102{,}105\ ft^2)(1.002)$

$A'_{berm} = 102{,}309\ ft^2$

$A'_D = 463{,}476\ ft^2$

TVA 11030 (WM-7-75)

STAGED (Cont'd)

Intermediate Cover

$V_{int} = (9/2\ ft)(463{,}476\ ft^2)(1/27)$

$V_{int} = 12{,}874\ CY \rightarrow$ Assume 5% shrink $\rightarrow V_{int} = \frac{12{,}874}{0.95}$

$V_{int} = 13{,}552\ CY$

Say $V_{int} = 13{,}500\ CY$

Final Cover (Earth)

$V_{FCE} = (463{,}476\ ft^2)(1\ ft)(1/27)$

$V_{FCE} = 17{,}166\ CY \rightarrow$ Assume 5% shrink $\rightarrow V_{FCE} = \frac{17{,}166\ CY}{0.95}$

$V_{FCE} = 18{,}069\ CY$

Say $V_{FCE} = 18{,}100\ CY$

Final Cover (Clay)

$V_{FCC} = 17{,}166\ CY \rightarrow$ Assume 15% shrink $\rightarrow V_{FCC} = \frac{17{,}166\ CY}{0.85}$

$V_{FCC} = 20{,}195\ CY$

Say $V_{FCC} = 20{,}200\ CY$

TVA 11030 (WM-7-75)

STAGE E

$A_E = A_{D3} - A_{E3}$ (From Cell calcs)
$A_E = 2,319,495 - 1,901,788$
$A_E = 417,707\ ft^2$

$A_{berm} = P_E(W_{berm})$
$A_{berm} = (6407\ ft)(15\ ft)$
$A_{berm} = 96,105\ ft^2$

$A_{slope} = A_E - A_{berm}$
$A_{slope} = 417,707 - 96,105$
$A_{slope} = 321,602\ ft^2$

Correct for Slope

$A'_{slope} = (321,602\ ft^2)(1.054)$
$A'_{slope} = 338,998\ ft^2$

$A'_{berm} = (96,105\ ft^2)(1.002)$
$A'_{berm} = 96,277\ ft^2$

$A'_E = 435,276\ ft^2$

Intermediate Cover

$V_{int} = (435,276\ ft^2)(9/12\ ft)(1/27)$

$V_{int} = 12,091\ CY$ → Assume 5% shrink → $V_{int} = \frac{12,091\ CY}{0.95}$

$V_{int} = 12,727\ CY$

Say $V_{int} = 12,800\ CY$

Final Cover (Earth)

$V_{FCE} = (435,276\ ft^2)(1\ ft)(1/27)$

$V_{FCE} = 16,121\ CY$ → Assume 5% shrink → $V_{FCE} = \frac{16,121\ CY}{0.95}$
$V_{FCE} = 16,969\ CY$

Say $V_{FCE} = 17,000\ CY$

Final Cover (Clay)

$V_{FCC} = 16{,}121$ cy → Assume 15% shrink → $V_{FCC} = \frac{16{,}121 \text{ cy}}{0.85}$

$V_{FCC} = 18{,}965$ cy

Say $V_{FCC} = 19{,}000$ cy

Top of Cells

$A = 1{,}901{,}788 \text{ ft}^2$ (From GCL calc's)

Correct for slope

100.12 / 5 / 100

$\frac{100}{100.12} = \frac{X}{W}$

$W = 1.001X$

$A' = (1{,}901{,}788 \text{ ft}^2)(1.001)$

$A' = 1{,}904{,}164 \text{ ft}^2$

Intermediate Cover

$V_{int} = (1{,}904{,}164 \text{ ft}^2)(9/12 \text{ ft})(1/27)$

$V_{int} = 52{,}893$ cy → Assume 5% shrink → $V_{int} = 55{,}677$ cy

Say $V_{int} = 55{,}700$ cy

Final Cover (Earth)

$V_{FCE} = (1{,}904{,}164 \text{ ft}^2)(1 \text{ ft})(1/27)$

$V_{FCE} = 70{,}525$ cy → Assume 5% shrink → $V_{FCE} = 74{,}236$ cy

Say $V_{FCE} = 74{,}300$ cy

COMPUTED EKE DATE 7/26/95
CHECKED DATE

Top of Cells

Final Cover (Clay)

V_{FCC} = 70,525 cy → Assume 15% shrink → V_{FCC} = 82,970 cy

Say V_{FCC} = 83,000 cy

Kingston Fossil Plant 7/19/95
Stacking (These are taken along ℄ of berms.)

STAGE "A"

Area = 956692.0235 sq. ft.
Perimeter = 2788.7273 sq. ft.

STAGE "B"

Area = 884822.1486
Perimeter = 2765.6279

STAGE "C"

"C1" Area = 3059153.0925, Perimeter = 7462.5821
"C2" Area = 2947312.1467, Perimeter = 7366.9399
"C3" Area = 2764233.2111, Perimeter = 7206.9723

STAGE "D"

"D1" Area = 2598725.9568, Perimeter = 7063.8533
"D2" " = 2493462.8802, " = 6970.4499
"D3" " = 2319494.6992, " = 6807.4211

STAGE "E"

"E1" Area = 2164266.9839, Perimeter = 6663.5236
"E2" " = 2064888.0730, " = 6568.8872
"E3" " = 1901788.1894 " = 6407.5628

842 — Area = 1901788.1894 Length = 6404.1475

844 — " = 1650512.2263 " = 6156.2354

846 — " = 1409766.6732 " = 5839.1773

848 — " = 1187363.3462 " = 5296.2759

850 — " = 983391.3284 " = 4879.9570

852 — " = 795449.4549 " = 4513.1974

854 — " = 622196.7299 " = 4150.3713

~~854 = " = 622196.7299 " = 4150.3713~~

856 — " = 463208.4427 " = 3800.8689

858 — " = 318002.8380 " = 3460.7434

860 — " = 196209.6184 " = 2602.7697

862 — " = 105662.0462 " = 1921.7459

864 — " = 42772.5401 " = 1222.7294

866 — " = 5604.3642 " = 299.7218

SUMMARY - KINGSTON DREDGE CELL DIKE STABILITY
CONSTRUCION OF DIKES WITH 100% FLY ASH

We were asked to evaluate the stability of the dredge cell dikes should they be constructed with 100% fly ash. Construction to this date (el. 805.0) has been with a mixture of fly and bottom ash. An opportunity/need to market the bottom ash has been presented and the question asked of engineering "can this be done?"

Existing Plan:

Soil Parameters for the mixed dike material were obtained from undisturbed samples taken by Singleton in 1994 and used in developing the permit for the stack. These parameters are:

	Unit Weight (pcf)		Shear Strength						
			Q		R		Rbar		
	moist	sat	c (tsf)	(deg)	c (tsf)	(deg)	c (tsf)	(deg)	
Mixed bottom ash/ fly ash	109.9	114.8	0.0	37.4	0.95	15.9	0.49	29.1	

The factor of safety for long term stability using these parameters is 1.75. The earthquake factor of safety is 1.17. These were presented to the state in the permit. Figure 1 shows the failure plan for this condition as analyzed using UTexas3.

Proposed Plan:

It was not necessary to submit fly ash sample for lab testing. In 1994 we had Singleton perform tri-axle testing on samples of Kingston's fly ash.

	Unit Weight (pcf)		Shear Strength						
			Q		R		Rbar		
	moist	sat	c (tsf)	(deg)	c (tsf)	(deg)	c (tsf)	(deg)	
Fly ash (95% Standard Proctor)	99.9	106.8	1.04	23.7	0.19	17.9	0.27	28.3	25% moisture content

At face value the fly ash parameters are lighter in weight and weaker than the mixed ash. The analysis was performed by replacing these values for the previous values in the dike section above elevation 805.0, the current dike height. The factor of safety for long term stability using these parameters is 1.80. The earthquake factor of safety remains the same at 1.17. Figure 2 shows the failure plan for this condition as analyzed using UTexas3.

Studying the difference between Figures 1 and 2 shows how the factor of safety went up slightly after substituting the apparently weaker material in the dikes. The weakest failure plane remains thru the base of the stack. The reduction in the cohesion values (mixed ash to fly ash) does not play a significant role in the stack's long term Factor of Safety. The lighter weight of the material applied at the upper driving wedge of the failure circle has the most influence in the static force computations to increase factor of safety. Had pure fly ash been used at the lower levels of the dredge cell construction there could have been a dramatic reduction in the factor of safety.

Consequently, we concur that it is acceptable to construct the remaining lifts of the dredge cell using fly ash compacted to at least 95% Standard Proctor density.

An increase in localized sloughing of the dikes is likely to occur. We expect this to be tolerable and to best be handled by daily inspections and rapid attention to small rills before they expand.

We understand the field forces will add clay to the mix to help reduce dusting.

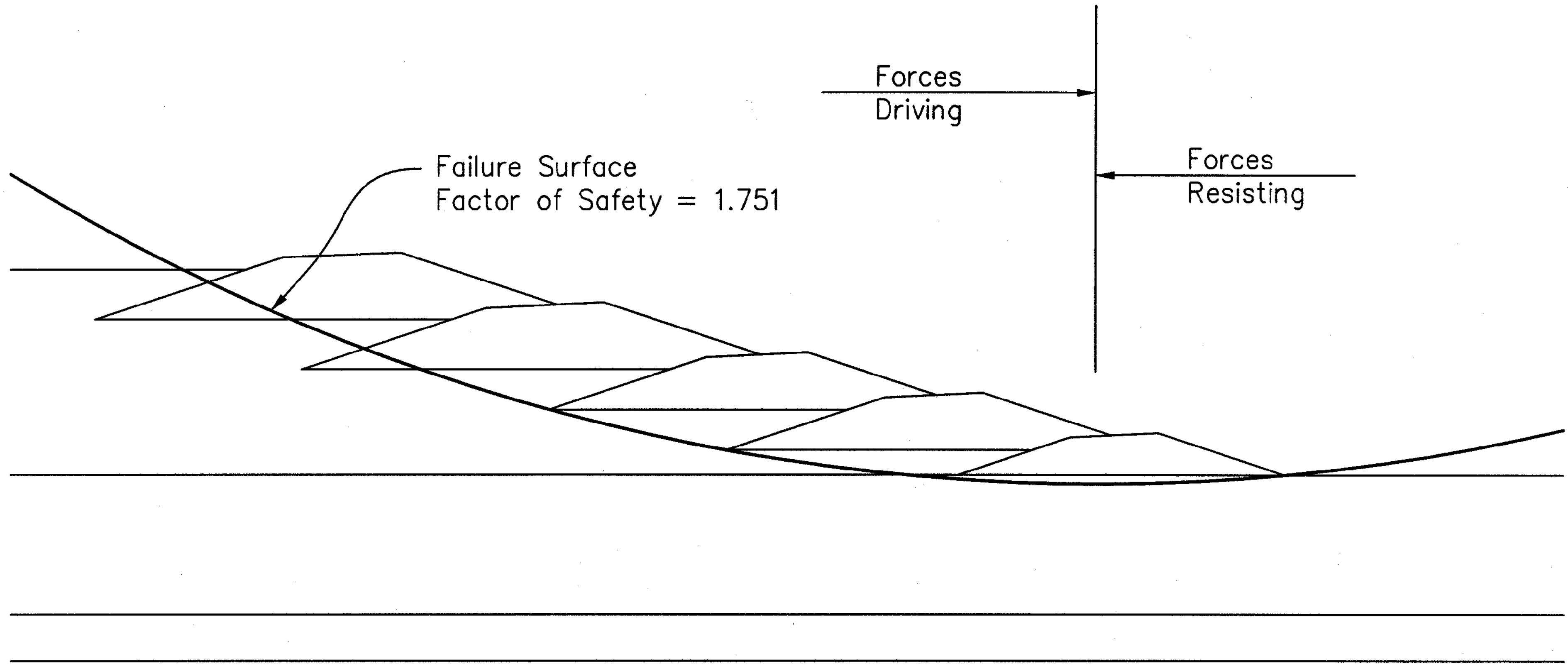


Figure 1 – Original Materials

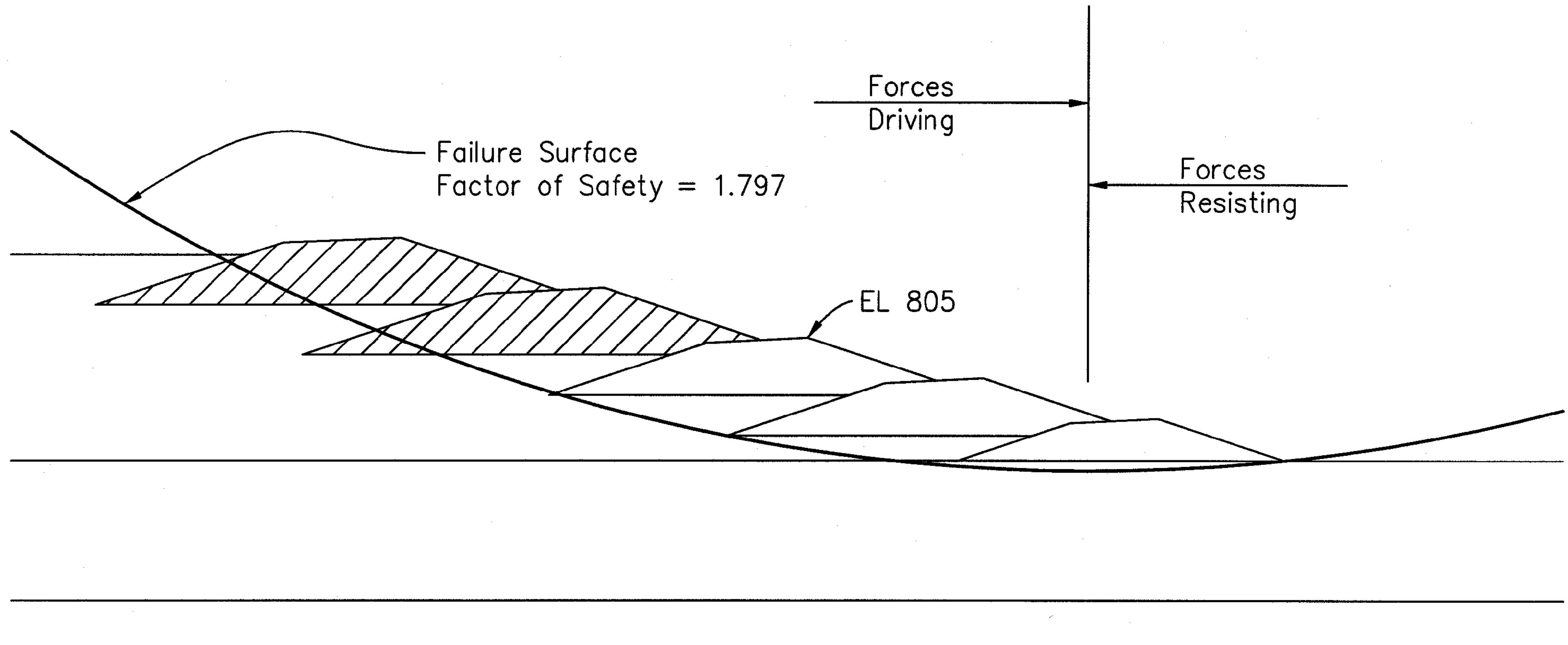


Figure 2 – Revised Materials

UTEXA 3 Results

9-25-2001

HLP-KYR1.DAT

FS FOR DISPLACEMENT COMPUTATIONS

```
        Factor of Safety - - - - - - - -     1.002
        Side Force Inclination - - - - -    -14.98
        Number of Iterations - - - - - -      9
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:   9:25:2001   Time: 13:54:38   Input file: HLP-KYR1.DAT
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

*FOR HLP-TIC.DAT

STATIC LONG TERM F.S.

```
        Factor of Safety - - - - - - - -     1.797
        Side Force Inclination - - - - -     -9.97
        Number of Iterations - - - - - -     22
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:   9:24:2001   Time: 16:21: 3   Input file: hlp-tic.dat
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

FOR HLP-SHT1.DAT

SHORT TERM FS

```
        Factor of Safety - - - - - - - -     3.204
        Side Force Inclination - - - - -     -8.12
        Number of Iterations - - - - - -     17
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:   9:25:2001   Time: 10:47:19   Input file: HLP-sht1.dat
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

FOR HLP-MHEA.DAT

EARTHQUAKE F.S.

```
        Factor of Safety - - - - - - - -     1.167
        Side Force Inclination - - - - -    -12.92
        Number of Iterations - - - - - -      5
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:   9:25:2001   Time: 11: 0:15   Input file: hlp-mhea.dat
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

UTEXA 3 Results

9-25-2001

HLP-KYR1.DAT

```
        Factor of Safety - - - - - - - -     1.002   FS FOR DISPLACEMENT COMPUTATIONS
        Side Force Inclination - - - - -    -14.98
        Number of Iterations - - - - - -     9
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:  9:25:2001   Time: 13:54:38   Input file: HLP-KYR1.DAT
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

*FOR HLP-TIC.DAT

```
        Factor of Safety - - - - - - - -     1.797   <- STATIC LONG TERM F.S.
        Side Force Inclination - - - - -     -9.97
        Number of Iterations - - - - - -    22
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:  9:24:2001   Time: 16:21: 3   Input file: hlp-tic.dat
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

FOR HLP-SHT1.DAT

```
        Factor of Safety - - - - - - - -     3.204   <- SHORT TERM FS
        Side Force Inclination - - - - -     -8.12
        Number of Iterations - - - - - -    17
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:  9:25:2001   Time: 10:47:19   Input file: HLP-sht1.dat
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

FOR HLP-MHEA.DAT

```
        Factor of Safety - - - - - - - -     1.167   <- EARTHQUAKE F.S.
        Side Force Inclination - - - - -    -12.92
        Number of Iterations - - - - - -     5
1       UTEXAS3 - VER. 1.200 - 12/16/92 - (C) 1985-1992 S. G. WRIGHT
        Date:  9:25:2001   Time: 11: 0:15   Input file: hlp-mhea.dat
          KIF dredge cell design
          Spencer's Method
          Search for critical shear surface
```

DIKE CONSTRUCTION /DREDGE OPERATIONS SEQUENCE

DIKE CONSTRUCTION

(BOTTOM ASH)

LIFTS BY LAYER DESIGNATION:

1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	A B	B	B C1	C1 C2	C2	C2 C3	C3	C3 D1	D1 D2	D2 D3	D3	D3 E1	E1	E1 E2	E2 E3	E3	E3	STORE	STORE	

CELLS 1 & 3 A	A B	B C1	C1 C2	C2 C3 D1	D1 D2	D2 D3	D3 E1 E2	E2 E3	E3 STORE

DREDGE OPERATIONS

(FLY ASH)

KIF DREDGE CELL Sheet 1 of
CHRONOLOGY FOR DIKE CONSTRUCTION
AND DREDGING

Computed: BKE Date: 7/20/95
Checked: Date:

YEAR	BOT. ASH PROD. (CY)	DIKE STAGE	B. A. REQD FOR DIKE (CY)	YEAR	FLY ASH PROD. (CY)	DREDGE STAGE	VOL. AVAIL. FOR F. A. (CY)
Present	131,000	A	135,000	Present	281,823	CELLS 1&3	531,600
1996	70,864	A	4,000	1996	291,557	A	332,300
		B	160,000				
1997	70,176	B	93,136	1997	288,724	A	290,520
1998	71,535	B	22,960	1998	294,317	B	356,800
		C1	101,752				
1999	71,482	C1	53,177	1999	294,099	B	64,279
		C2	99,761	2000	290,830	C1	587,497
2000	70,688	C2	81,456				
2001	69,858	C2	10,678	2001	287,416	C1	66,847
		C3	156,652	2002	297,295	C2	565,065
2002	72,259	C3	97,562				
2003	72,347	C3	25,303	2003	297,658	C2	47,201
		D1	96,312	2004	297,222	C3	517,696
2004	72,241	D1	49,268			D1	495,131
		D2	94,385				
2005	72,771	D2	71,412	2005	299,401	D1	465,148
		D3	147,958	2006	303,905	D2	466,758
2006	73,866	D3	146,599				
2007	74,431	D3	72,733	2007	306,229	D2	328,600
		E1	90,859	2008	311,459	D3	429,137
2008	75,702	E1	89,161				
2009	74,625	E1	13,459	2009	307,028	D3	140,049
		E2	88,955	2010	307,246	E1	407,978
2010	74,678	E2	27,789			E2	381,426
		E3	139,285				
2011	74,678	E3	92,396	2011	307,246	E2	315,179
2012	74,678	E3	17,718	2012	307,246	E3	345,826
		STORE*	56,960				
2013	74,678	STORE*	74,678	2013	307,246	E3	46,513
2014	74,678	STORE*	74,678	2014	307,246	STORE*	567,979
TOTAL TO BE STORED*:			206,316				567,979

* EXCESS ASH TO BE DREDGED/SLUICED INTO A FUTURE ADJACENT CELL AND DRIED FOR STACKING ON TOP OF THE DREDGE CELLS. CELLS WILL BE CAPPED AT END OF FISCAL YEAR 2014.

KIF DREDGE CELLS - STORAGE VOLUME
FLY ASH

SHEET ____ OF ____

COMPUTED BKE DATE 6/7/95
CHECKED ____ DATE ____

STAGE A

ELEVATION	AREA (IN²)	*AREA (FT²)	VOLUME (YD³)
768	66.12	741,970	
			54,960
770	66.12	741,970	
			56,590
772	70.03	785,850	
			59,370
774	72.83	817,270	
			62,590
776	77.77	872,710	
			65,560
778	79.98	897,510	
			299,100 CY

STAGE B

ELEVATION	AREA (IN²)	*AREA (FT²)	VOLUME (YD³)
778	57.84	649,020	
			48,710
780	59.37	666,230	
			50,650
782	62.49	701,240	
			52,970
784	64.97	729,070	
			54,750
786	66.76	749,160	
			56,230
788	68.54	769,130	
			57,770
790	70.45	790,560	
			321,110 CY

Assume 10% shrinkage during consolidation.

VOL_A = 332,300 CY VOL_B = 356,800 CY

* Areas taken from a 1" = 105.93' scale map.

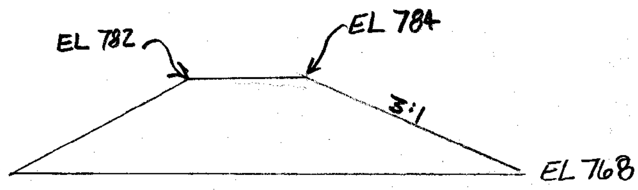
TVA 11030 (WM-7-75)

KIF DREDGE CELLS - STORAGE VOLUME
BOTTOM ASH (DIKE CONST)

SHEET ____ OF ____

COMPUTED BKE DATE 6/8/95
CHECKED ____ DATE ____

STAGE A



X-Section Area

$A = 2[\tfrac{1}{2}(42)(14)] + 30(14) + \tfrac{1}{2}(30)(2) + \tfrac{1}{2}(6)(2)$

$A = 588 + 420 + 30 + 6$

$A = 1044\ ft^2$

$V = AL$

$V = (1044\ ft^2)(2786.04\ ft)$

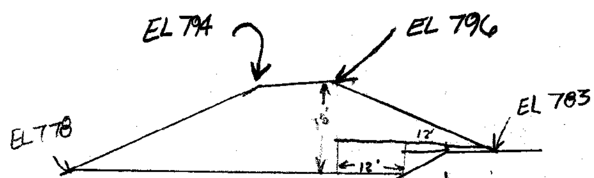
$V = 107,730\ CY$

Assume 20% shrink

$V = \frac{107,730}{0.80}$

V = 135,000 CY

STAGE B



$A = \tfrac{1}{2}(48)(16) + 30(16) + \tfrac{1}{2}(30)(2) + \tfrac{1}{2}(39)(13) + \tfrac{1}{2}(15)(1) + \tfrac{1}{2}(12)(4) + 12(1) + 12(5)$

$A = 384 + 480 + 30 + 253.5 + 7.5 + 24 + 12 + 60$

$A = 1251\ ft^2$

$V = (1251\ ft^2)(2761.16\ ft)$

$V = 127,930\ CY$

Assume 20% shrink

$V = \frac{127,930\ CY}{0.80}$

V = 160,000 CY

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STORAGE VOLUME (TOP OF STACK)

Computed: BKE Date: 7/21/95
Checked: Date:

ELEVATION (ft MSL)	AREA (ft^2)	VOLUME (CY)
840	1,901,788	
		131,567
842	1,650,512	
		113,344
844	1,409,767	
		96,190
846	1,187,363	
		80,398
848	983,391	
		65,883
850	795,449	
		52,505
852	622,197	
		40,200
854	463,208	
		28,934
856	318,003	
		19,045
858	196,209	
		11,180
860	105,662	
		5,498
862	42,773	
		1,792
864	5,604	
	TOTAL	646,536

Assume 15% shrink

Total = 760,630

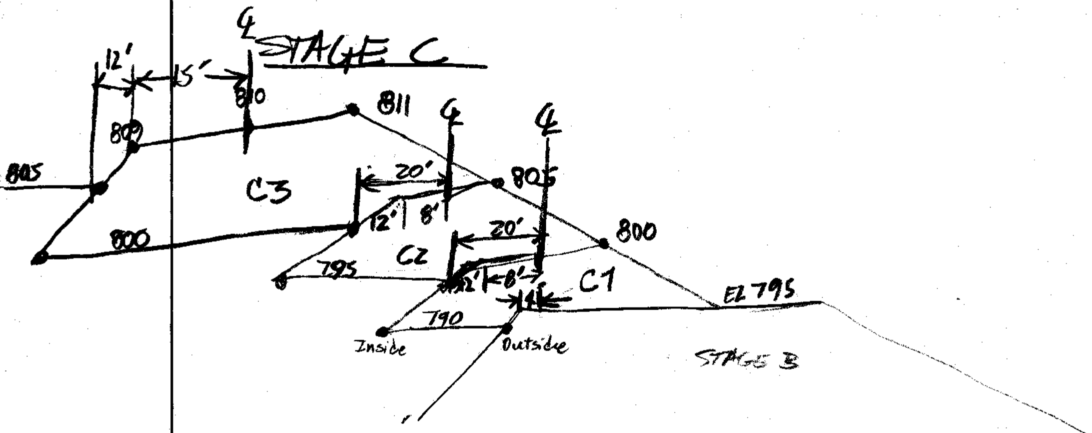
KIF DREDGE CELL - STORAGE VOLUME (FLY ASH)

SHEET 1 OF

COMPUTED BKE DATE 7/19/95

CHECKED DATE

See attached sheet from GCL containing areas & perimeters calculated via AutoCAD. See cross-section plots for geometry



A_{C1} = area at ℄ of stack C1
P_{C1} = perim.

To get area at elevation 790, take area at ℄ of C1 and subtract area between el. of ℄ & el. 790

790

Outside

$AO_{790} = A_{C1} - P_{C1}(4)$
$AO_{790} = 3,059,153 - (7463)(4')$
$AO_{790} = 3,029,301 \text{ ft}^2$

Inside

$AI_{790} = A_{C2} - P_{C2}(20)$
$AI_{790} = 2,947,312 - (7366)(20)$
$AI_{790} = 2,799,992 \text{ ft}^2$

795

$AO_{795} = A_{C2} - P_{C2}(5)$
$AO_{795} = 2,947,312 - (7367)(5)$
$AO_{795} = 2,910,477$

$AI_{795} = A_{C3} - P_{C3}(10)$
$AI_{795} = 2,764,233 - (7207)(10)$
$AI_{795} = 2,692,163$

800

$AO_{800} = A_{C3} + P_{C3}(5)$
$AO_{800} = 2,764,233 + 7207(5)$
$AO_{800} = 2,800,268$

$AI_{800} = A_{C3} - P_{C3}(42)$
$AI_{800} = 2,764,233 - (7207)(42)$
$AI_{800} = 2,461,539$

805

$AO_{805} = A_{D1} - P_{D1}(4)$
$AO_{805} = 2,598,726 - 7064(4)$
$AO_{805} = 2,570,470$

$AI_{805} = A_{D2} - P_{D2}(20)$
$AI_{805} = 2,493,463 - 6970(20)$
$AI_{805} = 2,354,063$

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STORAGE VOLUME (FLY ASH)

SHEET 2 OF

COMPUTED BKE DATE 7/19/95

CHECKED DATE

810

$AO_{810} = A_{D2} - P_{D2}(5)$
$AO_{810} = 2,493,463 - 6970(5)$
$AO_{810} = 2,458,613$

$AI_{810} = A_{D3} - P_{D3}(10)$
$AI_{810} = 2,319,495 - 6807(10)$
$AI_{810} = 2,251,425$

815

$AO_{815} = A_{D3} + P_{D3}(5)$
$AO_{815} = 2,319,495 + 6807(5)$
$AO_{815} = 2,285,460$

$AI_{815} = A_{D3} - P_{D3}(42)$
$AI_{815} = 2,319,495 - 6807(42)$
$AI_{815} = 2,033,601$

820

$AO_{820} = A_{E1} - P_{E1}(4)$
$AO_{820} = 2,164,267 - 6664(4)$
$AO_{820} = 2,137,611$

$AI_{820} = A_{E2} - P_{E2}(20)$
$AI_{820} = 2,064,888 - 6569(20)$
$AI_{820} = 1,933,508$

825

$AO_{825} = A_{E2} - P_{E2}(5)$
$AO_{825} = 2,064,888 - 6569(5)$
$AO_{825} = 2,032,043$

$AI_{825} = A_{E3} - P_{E3}(10)$
$AI_{825} = 1,901,788 - 6408(10)$
$AI_{825} = 1,837,708$

830

$AO_{830} = A_{E3} + P_{E3}(5)$
$AO_{830} = 1,901,788 + 6408(5)$
$AO_{830} = 1,869,748$

$AI_{830} = A_{E3} - P_{E3}(42)$
$AI_{830} = 1,901,788 - 6408(42)$
$AI_{830} = 1,632,652$

835

$AO_{835} = A_{E3} - P_{E3}(27)$
$AO_{835} = 1,901,788 - 6408(27)$
$AO_{835} = 1,728,772$

TVA 11030 (WM-7-75)

YR	FA PROD.	BA PROD	DIKE STAGE	BA Req'd for Dike	Dredge Stage	Vol. for Fly Ash
Present	281,823	131,000*	A	135,000	Cells 1 & 3	531,600
1996	291,557	70,864	A	4,000	"	(41,780)
			B	160,000		
1997	288,724	70,176	B	93,136		
1998	294,317	71,535	B	22,960		
			C1	101,752		
1999	294,099	71,482	C1	53,177		
			C2	99,761		
2000	290,830	70,688	C2	81,456		
2001	287,416	69,858	C2	10,678		
			C3	156,652		
2002	297,295	72,259	C3	97,562		
2003	297,658	72,347	C3	25,303		
			D1	96,312		
2004						

* Includes 63,000 CY presently stored in cell 2.

Dredge Operations	Year	Dike Construction
Cells 1 & 3 A	95	A
	96	A B
A B	97	B
	98	B C1
B C1	99	C1 C2
	00	C2
C1 C2	01	C2 C3
	02	C3
C2 C3 D1	03	C3 D1
	04	D1 D2
D1 D2	05	D2 D3
	06	D3
D2 D3	07	D3 E1
	08	E1
D3 E1 E2	09	E1 E2
	10	E2 E3
E2 E3	11	E3
	12	E3
E3 STORE	13	STORE
	14	STORE
	15	

KIF DREDGE CELL
TOE DRAINAGE SYSTEM
QUANTITY CALCULATIONS

Computed: BKE Date: 7/28/95
Checked: Date:

LIFT	PERIMETER (ft)	# OUTLETS	6" DIA PERF. HDPE (ft)	6" DIA NON-PERF. HDPE (ft)	6" DIA TEE SECTIONS (EA)	#1081 CR STONE 140 lb/ft³ (tons)	FILTER FABRIC* (sf)
A	2,786	14	** 3276 ~~2,786~~	910 ~~1,400~~	14	590 ~~481~~	20,895
B	2,761	14	3251 ~~2,761~~	1350 1,820	14	476	20,708
C1	7,463	38	8793 ~~7,463~~	1330 ~~2,660~~	38	1287	55,973
C2	7,367	37	8662 ~~7,367~~	740 ~~2,035~~	37	1271	55,253
C3	7,207	37	8502 ~~7,207~~	1295 ~~2,590~~	37	1243	54,053
D1	7,064	36	8324 ~~7,064~~	1260 ~~2,520~~	36	1219	52,980
D2	6,970	35	8195 ~~6,970~~	700 ~~1,925~~	35	1202	52,275
D3	6,807	35	8032 ~~6,807~~	1225 ~~2,450~~	35	1174	51,053
E1	6,664	34	7854 ~~6,664~~	1190 ~~2,380~~	34	1150	49,980
E2	6,569	33	7724 ~~6,569~~	660 ~~1,815~~	33	1133	49,268
E3	6,408	33	7563 ~~6,408~~	1155 ~~2,310~~	33	1105	48,060
		TOTALS	80,176 ~~68,066~~	11,795 ~~23,905~~	346	11,741	510,495

* Trevira Spunbound Type 1135 non-woven, needlepunched geotextile specified in the plans.

** Revised to account for 35 ~~feet~~ of perforated HDPE extending as lateral pipes from toe drain to connect with non-perforated HDPE.

KIF DREDGE CELL
DIKE BASE REINFORCEMENT
QUANTITY CALCULATIONS

Computed: BKE Date: 7/31/95
Checked: Date:

LIFT	PERIMETER (ft)	WIDTH (ft)	# ROLLS WIDE	# ROLLS LONG	**# ROLLS REQUIRED**
A	2,786	120	7	9	**63**
B	2,761	90	6	9	**54**
C1	7,463	31	2	25	**50**
C2	7,367	30	2	24	**48**
C3	7,207	47	3	24	**72**
D1	7,064	31	2	23	**46**
D2	6,970	30	2	23	**46**
D3	6,807	47	3	22	**66**
E1	6,664	31	2	22	**44**
E2	6,569	30	2	22	**44**
E3	6,408	47	3	21	**63**
		TOTALS	34	224	**596**

NOTE: SYNTHETIC INDUSTRIES TYPE 300 ST WOVEN SLIT FILM GEOTEXTILE ASSUMED. ROLL DIMENSIONS ARE 17.5' X 309'.

9
(500 SY per roll of 300ST)

KIF DREDGE CELL
COVER DRAINAGE SYSTEM (OPTION B)
QUANTITY CALCULATIONS

Computed: BKE Date: 7/31/95
Checked: Date:

LIFT	PERIMETER (ft)	# OUTLETS	**4" DIA PERF. HDPE (ft)**	**CONCRETE COLLARS* (ea)**	**#1081 CR STONE** (tons)**
A	2,786	8	**2,786**	**14**	**772**
B	2,761	8	**2,761**	**14**	**765**
C3	7,207	14	**7,207**	**28**	**1997**
D3	6,807	13	**6,807**	**26**	**1887**
E3	6,408	13	**6,408**	**26**	**1776**
		TOTALS	25,969	108	7,197

* Collars are ~~12"~~ 36" x 12" x 3" with no steel.
** Assumed weight of 115 pcf.

KIF DREDGE CELL
RIPRAP
QUANTITY CALCULATIONS

Computed: BKE Date: 8/03/95
Checked: Date:

LIFT	DOWNDRAIN LENGTH (ft)	VOLUME FOR DOWNDRAINS (ft^3)	# OF ENERGY DISSIPATORS	VOLUME FOR EN. DIS.	**WEIGHT** (tons)**
A	540	4,860	1	315	**298**
B	480	4,320	0	0	**248**
C	1,390	12,510	7	2,205	**846**
D	780	7,020	0	0	**404**
E	780	7,020	0	0	**404**
				TOTAL	2,199

** Assumed unit weight of 115 pcf.

KIF DREDGE CELL
COVER SYSTEM (OPTION A)
QUANTITY CALCULATIONS

Sheet 1 of 1

Computed: BKE Date: 7/31/95
Checked: Date:

LIFT	INT. EARTH COVER (9") (CY)	FIN. CLAY COVER (12")* (CY)	FIN. EARTH COVER (12") (CY)
A	4,200	29,700	31,100
B	5,050	7,500	6,650
C	13,900	20,700	18,500
D	13,500	20,200	18,100
E	12,800	19,000	17,000
TOP	55,700	83,000	74,300
TOTAL	105,150	180,100	165,650

* COMPACTED TO ACHIEVE HYD. CONDUCTIVITY OF 1 X 10-7 CM/SEC.

KIF DREDGE CELL
COVER SYSTEM (OPTION B)
QUANTITY CALCULATIONS

Computed: BKE Date: 7/31/95
Checked: Date:

LIFT	INT. EARTH COVER (9") (CY)	GCL* (ft^2)	GEONET** (ft^2)	FIN. EARTH COVER (12") (CY)
A	4,200	185,000	185,000	31,100
B	5,050	170,000	170,000	6,650
C	13,900	473,000	473,000	18,500
D	13,500	464,000	464,000	18,100
E	12,800	436,000	436,000	17,000
TOP	55,700	1,905,000	1,905,000	74,300
TOTAL	105,150	3,633,000	3,633,000	165,650

* CLAYMAX 500 SP OR EQUIVALENT.
** GUNDLE FABRINET OR EQUIVALENT.

KIF ASH POND
TOTAL VOLUME REQ'D FOR CLOSURE

Computed: BKE Date: 8/08/95
Checked: Date:

ELEVATION (ft MSL)	AREA (in^2)	AREA (ft^2)	VOLUME (CY)
758	103.31	4,132,400	
			295,600
760	96.22	3,848,800	
			268,430
762	84.97	3,398,800	
			233,926
764	72.93	2,917,200	
			195,481
766	59.02	2,360,800	
			155,156
768	45.71	1,828,400	
			114,000
770	31.24	1,249,600	
			75,052
772	19.42	776,800	
			46,356
774	11.87	474,800	
			26,844
776	6.25	250,000	
			12,711
778	2.33	93,200	
			4,548
780	0.74	29,600	
			1,437
782	0.23	9,200	
			370
784	0.02	800	

TOTAL 1,429,911
+ 71,496 (5% Shrink)
1,501,407

Volume For Cap
1,501,407
-1,191,026
310,381 CY

KIF ASH POND

VOLUME REQ'D FOR FINAL GRADE MINUS TWO FEET

Computed: BKE Date: 8/08/95
Checked: Date:

ELEVATION (ft MSL)	AREA (in^2)	AREA (ft^2)	VOLUME (CY)
758	96.22	3,848,800	
			268,430
760	84.97	3,398,800	
			233,926
762	72.93	2,917,200	
			195,481
764	59.02	2,360,800	
			155,156
766	45.71	1,828,400	
			114,000
768	31.24	1,249,600	
			75,052
770	19.42	776,800	
			46,356
772	11.87	474,800	
			26,844
774	6.25	250,000	
			12,711
776	2.33	93,200	
			4,548
778	0.74	29,600	
			1,437
780	0.23	9,200	
			370
782	0.02	800	
		TOTAL	1,134,311

+ 56,715 (5% shrink)

1,191,026

KIF DREDGE CELL - SPILLWAY MAT'L QTY's

SHEET 1 OF 1

COMPUTED BKE DATE 8/2/95

CHECKED ______ DATE ______

STAGE

	A	B	C	D	E	UNIT
CHANNEL (C 3x4.1 MIN)	42	36	36	48	44	LF
ANGLE (L 3x3x3/4 MIN)	20	16	16	24	20	LF
STEEL PLATE (1/4" MIN)	114	–	114	–	114	LB
48"ϕ CMP	11	6	10	8	12	LF
30"ϕ CMP "Cross" Section	1	–	1	–	1	EA
30"ϕ CMP "Tee" Section	–	–	1	–	1	EA
30"ϕ CMP	312	12	134	16	62	LF
2"x6" BOARD	96	96	80	128	96	LF

Plates

Bottom of 48"ϕ 1/2 pipe

$A = \frac{\pi r^2}{2}$ $\quad V = (6.283\,ft^2)(1/4\,in)(1\,ft/12\,in)$

$A = \frac{\pi (2\,ft)^2}{2}$ $\quad V = 0.1309\,ft^3$

$A = 6.283\,ft^2$

Assume $\gamma_{STEEL} = 490\,lb/ft^3$

$W = \gamma_s V$

$W = (490\,lb/ft^3)(0.1309\,ft^3)$

$W = 64\,lb$

Bottom of 30"ϕ pipe

$A = \pi r^2$ $\quad V = (4.909\,ft^2)(1/48\,ft)$

$A = \pi (1.25\,ft)^2$ $\quad V = 0.1023\,ft^3$

$A = 4.909\,ft^2$

$W = (490\,lb/ft^3)(0.1023\,ft^3)$

$W = 50\,lb$

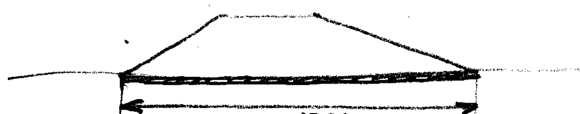
TVA 11030 (WM-7-75)

KIF Dredge Cell - Qty Calculation for geotextile reinforcement for Stage A

SHEET ____ OF ____

COMPUTED BKE DATE 6/2/95

CHECKED ____ DATE ____



Synthetic Industries Type 300 ST slit film woven geotextile was specified in the plans. This comes in rolls of 17.5' x 309'.

# of rolls wide

$$nw = \frac{\text{width of area}}{\text{width of roll}}$$

$$nw = \frac{120'}{17.5'} = 6.8$$

Say 7 rolls wide (=122.5')

# of rolls in length

$$nl = \frac{\text{length of area}}{\text{length of roll}}$$

$$nl = \frac{2786.04'}{309'} = 9.02$$

$$nl = 9$$

$$\text{Total} = (nw)(nl)$$

$$\text{Total} = (7)(9) = 63$$

Say 65 rolls needed

TVA 11030 (WM-7-75)

TVA 488 B (DES-4-41) TENNESSEE VALLEY AUTHORITY SHEET 1 OF 2

SUBJECT STAGE A PARTNER QTY'S PROJECT KIF DREDGE CELLS

COMPUTED BY BKE DATE 8/9/95 CHECKED BY DATE

NO.	ITEM	QUANTITY	UNIT	PRICE	AMOUNT	TOTAL
	Base Preparation					
	Stripping (6" from surface)	6200	CY			
	Woven Slit Film Geotextile (Synthetic Ind. Type 300ST)	37,200	SY			
	Toe Drain System					
	6" ϕ Perforated HDPE pipe	2,800	LF			
	6" ϕ Non-perforated HDPE pipe	1,400	LF			
	6" ϕ HDPE "Tee" section	14	EA			
	#1081 Crushed Stone	480	TN			
	Filter fabric (Trevira Spunbond Type 1135 Non-woven, Needlepunched)	2,325	SY			
	Cover System (Option B)					
	9" Intermediate earth cover	4,200	CY			
	Geosynthetic Clay Liner (Claymax 500SP or equiv.)	30,000	SY			
	Geonet (Gundle Fabrinet or equiv.)	30,000	SY			
	12" Clay Cover (Ditch Area)	23,500	CY			
	12" Final Earth cover	31,100	CY			
	Seed / Mulch	90,000	SY			
	Spillway/Skimmer					
	Spillway (See Dwg 10W425-12)	1	EA			
	Cover Drainage System					
	4" ϕ Perforated HDPE pipe	2,800	LF			
	Concrete Collars (~~36~~"x12"x3")	14	EA			
	#1081 Crushed Stone	775	TN			
	Riprap	300	TN			

KIF DREDGE CELL
RIPRAP
QUANTITY CALCULATIONS

Computed: BKE Date: 8/03/95
Checked: Date:

LIFT	DOWNDRAIN LENGTH (ft)	VOLUME FOR DOWNDRAINS (ft^3)	# OF ENERGY DISSIPATORS	VOLUME FOR EN. DIS.	**WEIGHT** (tons)**
A	540	4,860	1	315	**298**
B	480	4,320	0	0	**248**
C	1,390	12,510	7	2,205	**846**
D	780	7,020	0	0	**404**
E	780	7,020	0	0	**404**
				TOTAL	2,199

** Assumed unit weight of 115 pcf.

KIF DREDGE CELL Sheet 1 of
CHRONOLOGY FOR DIKE CONSTRUCTION
AND DREDGING

Computed: BKE Date: 7/20/95
Checked: Date:

YEAR	BOT. ASH PROD. (CY)	DIKE STAGE	B. A. REQD FOR DIKE (CY)	YEAR	FLY ASH PROD. (CY)	DREDGE STAGE	VOL. AVAIL. FOR F. A. (CY)
Present	131,000	A	135,000	Present	281,823	CELLS 1&3	531,600
1996	70,864	A	4,000	1996	291,557	A	332,300
		B	160,000				
1997	70,176	B	93,136	1997	288,724	A	290,520
1998	71,535	B	22,960	1998	294,317	B	356,800
		C1	101,752				
1999	71,482	C1	53,177	1999	294,099	B	64,279
		C2	99,761	2000	290,830	C1	587,497
2000	70,688	C2	81,456				
2001	69,858	C2	10,678	2001	287,416	C1	66,847
		C3	156,652	2002	297,295	C2	565,065
2002	72,259	C3	97,562				
2003	72,347	C3	25,303	2003	297,658	C2	47,201
		D1	96,312	2004	297,222	C3	517,696
2004	72,241	D1	49,268			D1	495,131
		D2	94,385				
2005	72,771	D2	71,412	2005	299,401	D1	465,148
		D3	147,958	2006	303,905	D2	466,758
2006	73,866	D3	146,599				
2007	74,431	D3	72,733	2007	306,229	D2	328,600
		E1	90,859	2008	311,459	D3	429,137
2008	75,702	E1	89,161				
2009	74,625	E1	13,459	2009	307,028	D3	140,049
		E2	88,955	2010	307,246	E1	407,978
2010	74,678	E2	27,789			E2	381,426
		E3	139,285				
2011	74,678	E3	92,396	2011	307,246	E2	315,179
2012	74,678	E3	17,718	2012	307,246	E3	345,826
		STORE*	56,960				
2013	74,678	STORE*	74,678	2013	307,246	E3	46,513
2014	74,678	STORE*	74,678	2014	307,246	STORE*	567,979
TOTAL TO BE STORED*:			206,316				567,979

* EXCESS ASH TO BE DREDGED/SLUICED INTO A FUTURE ADJACENT CELL AND DRIED FOR STACKING ON TOP OF THE DREDGE CELLS. CELLS WILL BE CAPPED AT END OF FISCAL YEAR 2014.

0.51

KIF Ash Pond Area Closure - Fill Qty's

SHEET ______ OF ______

COMPUTED ______ DATE ______

CHECKED ______ DATE ______

Assume Fly ash will be sluiced to elevation 758' over the entire pond area.

Areas by planimeter

Final Cover → 758

EL (ft)	Area (in^2)	Area (ft^2)	
758	103.31		3.11 + 11.50 + 15.25 + 17.06 + 17.33 + 17.92 + 12.57 + 8.57
760	96.22		Difference from 758: −(0.40 + 1.01 + 1.02 + 1.03 + 0.90 + 1.33 + 0.90 + 0.50)
762	84.97		−(1.02 + 1.52 + 1.55 + 1.55 + 1.44 + 1.52 + 1.45 + 1.20)
764	72.93		−(1.23 + 1.81 + 1.83 + 1.76 + 1.74 + 1.83 + 1.55 + 1.01 + 0.52) + 1.24
766	59.02		−(0.92 + 2.02 + 2.15 + 2.05 + 2.15 + 2.24 + 1.85 + 1.33 + 0.44) + 1.24
768	45.71		−(2.12 + 2.13 + 2.23 + 2.25 + 2.56 + 1.94 + 1.32) + 1.24
770	31.24		−(2.43 + 2.44 + 2.44 + 2.44 + 2.74 + 2.02 + 1.20) + 1.24
772	19.42		−(2.08 + 2.10 + 2.02 + 2.04 + 2.21 + 1.62 + 0.99) + 1.24
774	11.87		−(0.06 + 1.73 + 1.94 + 2.02 + 1.71 + 1.23 + 0.10) + 1.24
776	6.25		−(1.04 + 1.60 + 1.89 + 1.49 + 0.84) + 1.24
778	2.33		−(0.81 + 1.24 + 1.49 + 1.22 + 0.40) + 1.24
780	0.74		−(0.45 + 0.72 + 1.00 + 0.62 + 0.04) + 1.24
782	0.23		−(0.33 + 0.58 + 0.42) + 0.82
784	0.02		

TVA 11030 (WM-7-75)

SHEET ____ OF ____

COMPUTED ____ DATE ____

CHECKED ____ DATE ____

Well #	Plant Coords N	Plant Coords W	TN Coords N	TN Coords E
4B	6144	2407	558,118	2,440,564
6A	4296	1568 E	554,403	2,442,891
13B	3104	734	554,657	2,440,311
16A	4008	2787	556,533	2,439,082

Plant Origin

N 551,654.16
E 2,439,236.03

Angle N 33°00'00"E

Young, S.C., R. Schmidt-Petersen, M Ankeny and D.B. Stephens, 1993 "Physical and Hydraulic Properties of Fly-Ash and Other By-Products From Coal Combustion," EPRI Report TR-101999, Project 2485-05.

TVA 11030 (WM-7-75)

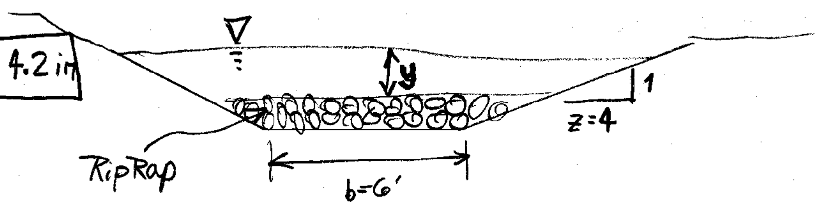
KIF DREDGE CELL
TERRACE DITCH CAPACITY CALC'S

Comp by: BKE Date: 08/03/95
Chkd by: Date:

Manning's Equation

		A*R^(2/3)	Q*n/phi*So^(1/2)
n=	0.04		
So=	0.33	1.138655	1.130921
Q=	24.2 cfs		
phi=	1.49		

b=	6 ft
z=	4
y=	0.35 ft = 4.2 in



These calc's are for a 25 yr, 30 min storm event using Rational Method for a 6 acre area with C=1.0 (We are using a GCL, so assume all of runoff goes to ditch).

KIF DREDGE CELL
TERRACE DITCH CAPACITY CALC'S

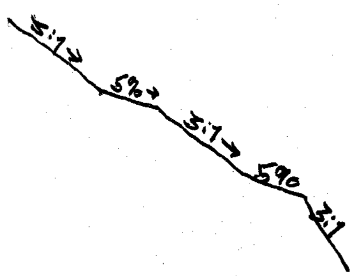
Comp by: BKE Date: 08/03/95
Chkd by: Date:

Manning's Equation

		A*R^(2/3)	Q*n/phi*So^(1/2)
n=	0.04		
So=	0.05	2.913577	2.905388
Q=	24.2		
phi=	1.49		

b=	6
z=	4
y=	0.59 ft = 7.1 in

These calc's are the same as previous page except slope is 5%, which models the terrace ditch at the berm. Depth will be greater here due to lesser slope.



TVA-00013091

KIF DREDGE CELL
TERRACE DITCH CAPACITY CALC'S

Comp by: BKE Date: 08/03/95
Chkd by: Date:

Manning's Equation

		A*R^(2/3)	Q*n/phi*So^(1/2)
n=	0.04		
So=	0.05	4.205895	4.205609
Q=	35.03 cfs		
phi=	1.49		

b=	6 ft
z=	4
y=	0.719 ft = 8.6 in

These calc's are for the bottom of the stack, taking into account the runoff from the top, stage C slope, stage D slope, & Stage E slope.

For slopes

$Q = CIA$

$Q = 1.0\,(4.0\,\text{in/hr})(600\,\text{ft})(65\,\text{ft})\left(\frac{1\,\text{ft}}{12\,\text{in}}\right)\left(\frac{1\,\text{hr}}{3600\,\text{sec}}\right)$

$Q = 3.61$ cfs

$Q_{total} = \underset{\text{top}}{24.2\,\text{cfs}} + \underset{\text{slopes}}{3(3.61\,\text{cfs})}$

$Q_{total} = 35.03$ cfs

KIF Dredge Cell - Runoff calc's (top of stack) SHEET 1 OF 1

COMPUTED BKE DATE 8/3/95

CHECKED ______ DATE ______

The largest drainage area on the top of the stack is 6.0 acres. Using Tech Paper 40, assume a 25yr, 30 minute storm event (4.0 in/hr). Use Rational Method to estimate runoff from the area ($Q = CIA$)

(1.0in)(261,360ft²)(1ft/12in) = 21,780 ft³

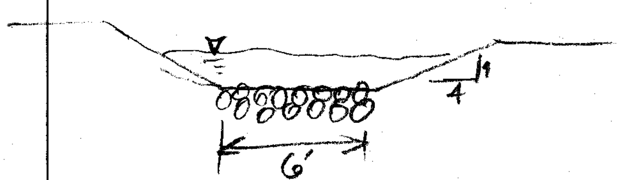
Assume C = 1.00 (Roberson et al. recommends a value of 0.17 to 0.25 for grass covered clay soils on a 2% to 8% slope) This area will be underlain by a GCL, so more runoff will be produced at the ditch (from the surface and from the perforated drain pipes in the ditch)

$$Q = CIA$$

$$Q = (1.00)(4.0\,\text{in/hr})(261{,}360\,\text{ft}^2)\left(\frac{1\,\text{ft}}{12\,\text{in}}\right)\left(\frac{1\,\text{hr}}{3600\,\text{sec}}\right)$$

$$Q = 24.2\,\text{ft}^3/\text{s}$$

Use Manning's eqn to find depth of flow in ditch



$S_0 = 0.333$

Assume $n = 0.040$

$$Q = \frac{\phi}{n} A R^{2/3} S_0^{1/2}$$

$$\frac{Qn}{\phi S_0^{1/2}} = (b+zy)y\left[\frac{(b+zy)y}{b+2y\sqrt{1+z^2}}\right]^{2/3}$$

$$\frac{(12.1)(0.040)}{1.49(0.333)^{1/2}} = (6+4y)y\left[\frac{(6+4y)y}{6+2y\sqrt{17}}\right]^{2/3}$$

$$0.5655 = (6+4y)(y)\left[\frac{(6+4y)y}{6+2y\sqrt{17}}\right]^{2/3}$$

TVA 11030 (WM-7-75)

KIF Dredge Cell - Stage A Hor. Alignment SHEET 1 OF

COMPUTED BKE DATE 5/4/95

CHECKED DATE

Distances between PI's

STA 0+00 to PI ①

$$d = \sqrt{(X_1 - X_2)^2 + (y_1 - y_2)^2}$$

$$d_1 = \sqrt{(556,448 - 556,547)^2 + (2,440,965 - 2,441,014)^2}$$

$$d_1 = 110.46$$

Similar calc's can be made for other PI's

	N Lamb. Coord	E Lamb. Coord	Distance
Sta 0+00	556,448	2,440,965	
			110.46
PI ①	556,547	2,441,014	
			331.39
PI ②	556,398	2,441,310	
			582.90
PI ③	556,891	2,441,621	
			1567.83
PI ④	557,867	2,440,394	
			649.33
End Sta.	557,272	2,440,134	

TVA 11030 (WM-7-75)

KIF Dredge Cell - Stage A Hor. Alignment SHEET 2 OF

COMPUTED BKE DATE 5/4/95

CHECKED DATE

STA 0+00 to PI ①

line 1
$b_1 + m_1(2{,}440{,}965) = 556{,}448$
$b_1 + m_1(2{,}441{,}014) = 556{,}547$
$> N = -4{,}375{,}298 + 2.0204082 E$

PI ① to PI ②

line 2
$b_2 + m_2(2{,}441{,}014) = 556{,}547$
$b_2 + m_2(2{,}441{,}310) = 556{,}398$
$> N = 1{,}785{,}301 - 0.5033784 E$

PI ② to PI ③

line 3
$b_3 + m_3(2{,}441{,}310) = 556{,}398$
$b_3 + m_3(2{,}441{,}621) = 556{,}891$
$> N = -3{,}313{,}589 + 1.5852090 E$

PI ③ to PI ④

line 4
$b_4 + m_4(2{,}441{,}621) = 556{,}891$
$b_4 + m_4(2{,}440{,}394) = 557{,}867$
$> N = 2{,}499{,}044 - .7954360 E$

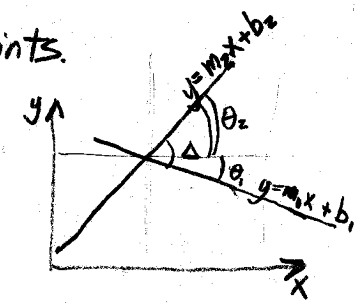
PI ④ to End Sta

line 5
$b_5 + m_5(2{,}440{,}394) = 557{,}867$
$b_5 + m_5(2{,}440{,}134) = 557{,}272$
$> N = -5{,}026{,}881 + 2.2884615 E$

TVA 11030 (WM-7-75)

TVA-00013095

Need external angle, Δ, of all intersection points.



$\tan\theta$ = slope = m. So for two intersecting lines,

$\Delta = \theta_2 - \theta_1$

$\Delta = \arctan(m_2) - \arctan(m_1)$

PI ①

$\Delta_1 = \arctan(2.0204082) - \arctan(-0.5033784)$

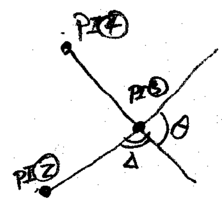
$\Delta_1 = 90.387°$

PI ②

$\Delta_2 = \arctan(1.5852090) - \arctan(-0.5033784)$

$\Delta_2 = 84.475°$

PI ③



$\theta = \arctan(-0.7954360) - \arctan(1.5852090)$

$\theta = 96.255$

$\Delta_3 = 180 - \theta = 83.745°$

PI ④

$\Delta_4 = \arctan(2.2884615) - \arctan(-0.7954360)$

$\Delta_4 = 104.896°$

Tangent Distances

$$T = R\tan\left(\frac{\Delta}{2}\right)$$

Length of Curve

$$L = 100\frac{\Delta}{D}$$

$$D = \frac{5729.58}{R}$$

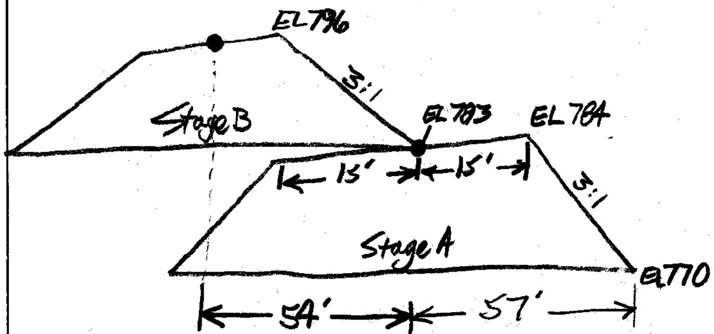
PI	R (ft)	Δ	T (ft)	D	L (ft)
①	~~90~~ 50	90.387°	~~90.61~~ 50.34	~~63.66~~ 114.59	~~141.98~~ 78.88
②	~~250~~ 300	84.475	~~226.98~~ 272.38	~~22.92~~ 19.10	~~368.56~~ 442.28
③	300	83.745	268.91	19.10	438.46
④	300	104.896	390.23	19.10	549.19

KIF Dredge Cell - Stage B Hor. Alignment — SHEET 1 OF ___

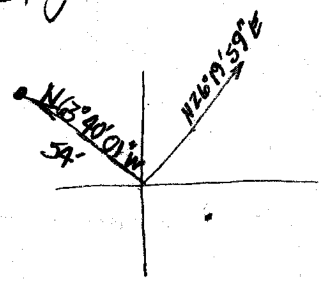
Determine new PI's for Stage B based on Stage A

COMPUTED DKE DATE 5/5/95

CHECKED ___ DATE ___



Need a 54' offset from ℄ of stage A.



Line 1 (Sta 0+00 to PI①)

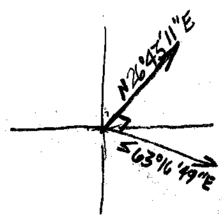
N26°19'59"E

Base Point (556,448 ; 2,440,965)

Offset Point (556,518 ; 2,441,000)

Use Program SY-02 on TI-59

N - 556,571
E - 2,440,966
> Coordinates of point 54' offset from line 1



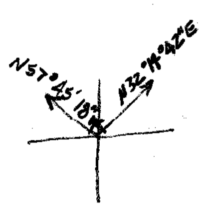
Line 2 (PI① to PI②)

S63°16'49"E

Base Point (556,547 ; 2,441,014)

100' distance along line 2 → Offset Point (556,502 ; 2,441,103)

N - 556,595
E - 2,441,038
> Coordinates of point 54' offset from line 2



Line 3 (PI② to PI③)

N32°14'42"E

Base Point (556,398 ; 2,441,310)

100' distance along line 3 → Offset Point (556,483 ; 2,441,363)

N - 556,427
E - 2,441,264
> Coordinates of point 54' offset from line 3

TVA 11030 (WM-7-75)

KIF Dredge Cell - Stage B Hor. Alignment SHEET 2 OF

Determine new PI's for Stage B based on Stage A

COMPUTED BKG DATE 5/8/95

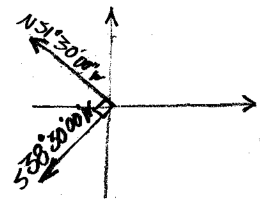
CHECKED ______ DATE ______

<u>Line 4 (PI ⑤ to PI ④)</u>

N51°30'00"W

Base Point (556,891; 2,441,621)

Offset Point (556,953; 2,441,543)



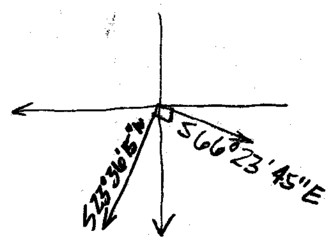
N- 556,849
E- 2,441,587
> Coordinates of point 54' offset from line 4

<u>Line 5 (PI④ to End Sta)</u>

S23°36'15"W

Base Point (557,867; 2,440,394)

Offset Point (557,775; 2,440,354)



N- 557,845
E- 2,440,443
> Coordinates of point 54' offset from line 5

Determine New PI's using TI-59 program SY-16

PI	N	E
1B	556,619	2,440,990
2B	556,468	2,441,290
3B	556,879	2,441,549
4B	557,781	2,440,415

To compute begin station (sta 0+00), then traverse 240' along line 1 (S 26°19'59"W). Use TI59 program 02 to get coords:

N - 556,404
E - 2,440,884

To compute end station, traverse 660' along line 5 (S 23°36'15"W) Use TI59 program 02 to get coords:

N - 557,176
E - 2,440,151

KIF Dredge Cell - Stage B Hor. Alignment SHEET 3 OF

COMPUTED BKE DATE 5/8/95

CHECKED DATE

Now, compute total distances between PI's

	N Lambert	E. Lambert	Distance (ft)
Sta 0+00	556,404	2,440,884	
			239.71
PI (1B)	556,619	2,440,990	
			335.86
PI (2B)	556,468	2,441,290	
			485.80
PI (3B)	556,879	2,441,549	
			1448.99
PI (4B)	557,781	2,440,415	
			660.09
End Sta	557,176	2,440,151	

Since these coord's are based on lines that parallel those from Stage A, then external angles are the same as those already computed.

$T = R\tan(\frac{\Delta}{2})$ $L = 100\frac{\Delta}{D}$ $D = \frac{5729.58}{R}$

PI	R (ft)	Δ	T (ft)	D	L (ft)
(1B)	100 ~~150~~	90.387	100.68 ~~151.02~~	57.30 ~~38.20~~	157.74 ~~236.62~~
(2B)	250 ~~200~~	84.475	226.98 ~~181.59~~	22.92 ~~28.65~~	368.56 ~~294.85~~
(3B)	250	83.745	224.10	22.92	365.38
(4B)	250	104.896	325.19	22.92	457.66

TVA 11030 (WM-7-75)

DIKE CONSTRUCTION /DREDGE OPERATIONS SEQUENCE

DIKE CONSTRUCTION
(BOTTOM ASH)

LIFTS BY LAYER DESIGNATION:

Lifts		A B	B	B C1	C1 C2	C2	C2 C3	C3	C3 D1	D1 D2	D2 D3	D3	D3 E1	E1	E1 E2	E2 E3	E3	E3	STORE	STORE	
Year	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015

CELLS 1 & 3 A	A B	B C1	C1 C2	C2 C3 D1	D1 D2	D2 D3	D3 E1 E2	E2 E3	E3 STORE

DREDGE OPERATIONS
(FLY ASH)

KIF DREDGE CELL
STAGE C HORIZONTAL ALIGNMENT

Sheet 1 of

CURVE DATA

Computed: BKE Date: 6/27/95
Checked: Date:

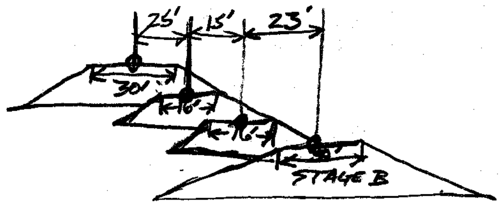
PI	Lambert Coordinates		R	Δ	T	D	L	PC	PT
	North	East	(ft)	(deg)	(ft)		(ft)	(sta)	(sta)
1C	556,650	2,440,980	125	90.387	125.85	45.84	197.19	0.00	197.19
2C	556,498	2,441,282	225	84.475	204.29	25.46	331.73	205.15	536.88
3C	556,873	2,441,518	225	83.745	201.69	25.46	328.87	573.99	902.86
4C	557,744	2,440,424	225	104.896	292.68	25.46	411.93	1806.88	2218.80
5C	557,213	2,440,192	500	23.399	103.54	11.46	204.19	2402.05	2606.25
6C	556,264	2,439,174	500	16.902	74.29	11.46	147.50	3820.15	3967.65
7C	555,643	2,438,814	225	97.980	258.74	25.46	384.77	4352.42	4737.18
8C	555,104	2,440,140	250	83.235	222.10	22.92	363.18	5687.71	6050.89
9C	556,422	2,440,867	500	2.554	11.15	11.46	22.29	7322.85	7345.14
10C	556,670	2,440,973	140	90.387	140.95	40.93	220.86	0	220.86
11C	556,517	2,441,276	210	84.475	190.67	27.28	309.62	228.68	538.3
12C	556,869	2,441,499	210	83.745	188.24	27.28	306.94	576.08	883.02
13C	557,719	2,440,430	210	104.896	273.16	27.28	384.46	1787.37	2171.83
14C	557,205	2,440,205	515	23.399	106.65	11.13	210.32	2353.11	2563.43
15C	556,255	2,439,187	485	16.902	72.06	11.81	143.07	3777.15	3920.22
16C	555,650	2,438,836	210	97.98	241.49	27.28	359.12	4306.12	4665.23
17C	555,123	2,440,133	235	83.235	208.77	24.38	341.39	5614.95	5956.34
18C	556,425	2,440,852	485	2.554	10.81	11.81	21.62	7224.09	7245.71
19C	556,703	2,440,962	165	90.387	166.12	34.72	260.3	0	260.3
20C	556,550	2,441,267	185	84.475	167.97	30.97	272.76	267.43	540.19
21C	556,864	2,441,465	185	83.745	165.83	30.97	270.4	577.6	848
22C	557,679	2,440,440	185	104.896	240.64	30.97	338.69	1751.04	2089.74
23C	557,192	2,440,227	540	23.399	111.82	10.61	220.53	2268.81	2489.34
24C	556,241	2,439,207	460	16.902	68.35	12.46	135.7	3703.73	3839.43
25C	555,663	2,438,872	185	97.98	212.74	30.97	316.36	4226.4	4542.76
26C	555,155	2,440,121	210	83.235	186.56	27.28	305.07	5491.82	5796.89
27C	556,457	2,440,840	460	2.554	10.25	12.46	20.5	7087.41	7107.91

7208

KIF DREDGE CELL - STAGE C HOR. ALIGNMENT SHEET 1 OF

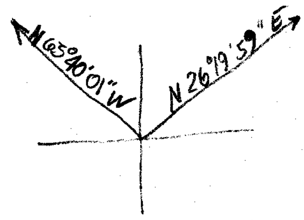
COMPUTED BKE DATE 6/20/95

CHECKED DATE



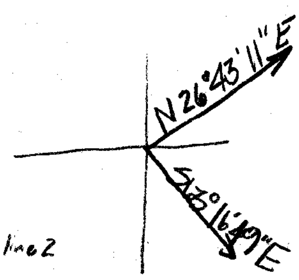
Need a 23' offset from ℄ of STAGE B

<u>Line 1 (Sta 0+00 to PI 1B)</u>
N 26°19'59" E
Base Point (556,404 ; 2,440,884)
100 ft along line 1 → Offset Point (556,494 ; 2,440,928)



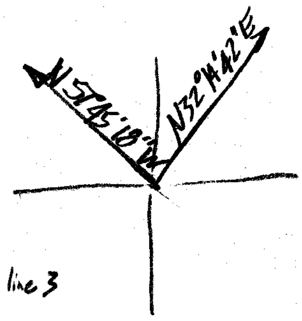
N - 556,504
E - 2,440,908 > Coord's of pt 23' offset from line 1

<u>Line 2 (PI 1B to PI 2B)</u>
S 63°16'49" E
Base Point (556,619 ; 2,440,990)
100 ft along line 2 → Offset Point (556,574 ; 2,441,079)



N - 556,595
E - 2,441,090 > Coords of pt 23' offset from line 2

<u>Line 3 (PI 2B to PI 3B)</u>
N 32°14'42" E
Base Point (556,468 ; 2,441,290)
Offset Point (556,553 ; 2,441,343)



N - 556,565
E - 2,441,324 > Coords of pt 23' offset from line 3

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 2 OF

COMPUTED BKE DATE 6/20/95

CHECKED ______ DATE ______

Line 4 (PI 3B to PI 4B)

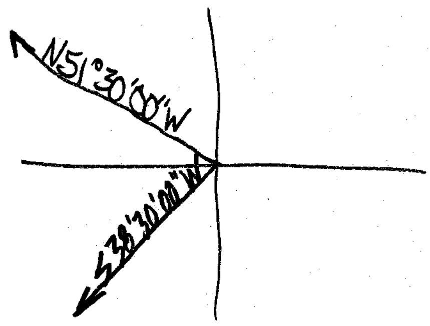
N 51°30'00" W

Base Point (556,879 ; 2,441,549)

Offset Point (556,941 ; 2,441,471)

N - 556,923 } coords of pt 23' offset from line 4

E - 2,441,456



Line 5 (PI 4B to End Sta)

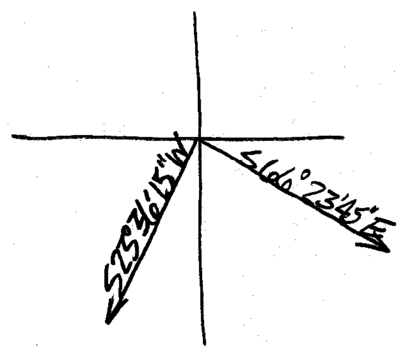
S 23°36'15" W

Base Point (557,781 ; 2,440,415)

Offset Point (557,689 ; 2,440,375)

N - 557,680 } coords of pt 23' offset from line 5

E - 2,440,396



Determine new PI's using TI-59 program SY-16

	PI	N	E
A	1C	556,650	2,440,980
B	2C	556,498	2,441,282
C	3C	556,873	2,441,518
D	4C	557,744	2,440,424

Determine PI's around remainder of stack by scaling,

	PI	N	E	Corrected N	Corrected E
E	* 5C	557,216	2,440,195	557,213	2,440,192
F	6C	556,264	2,439,174		
G	7C	555,643	2,438,814		
H	8C	555,104	2,440,140		
I	* 9C	556,380	2,440,844	556,422	2,440,867

* Preliminary

KIF DREDGE CELL
STAGE C HORIZONTAL ALIGNMENT

Total Distance Between PI's

Computed: BKE Date: 6/22/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 9C	556,422	2,440,867	
PI 1C	556,650	2,440,980	254.47
PI 2C	556,498	2,441,282	338.09
PI 3C	556,873	2,441,518	443.08
PI 4C	557,744	2,440,424	1,398.38
PI 5C	557,213	2,440,192	579.47
PI 6C	556,264	2,439,174	1,391.73
PI 7C	555,643	2,438,814	717.80
PI 8C	555,104	2,440,140	1,431.36
PI 9C	556,422	2,440,867	1,505.21
			8059.59

KIF DREDGE CELL - STAGE C HOR. ALIGNMENT SHEET 4 OF

COMPUTED BKE DATE 6/22/95

CHECKED DATE

External angles have already been calculated for PI's 1C, 2C, 3C, & 4C. Need to calculate them for remaining PI's.

PI D (4C) to PI E (5C)

line 1C

$b_1 + m_1(2,440,424) = 557,744$

$b_1 + m_1(2,440,195) = 557,216$

$> N = -5,069,085 + 2.3056769E$

↑ The slope here does not match the slope calc'd for earlier line (line 5 in stage A - slope = 2.2884615)

PI E (5C) to PI F (6C)

line 2c

$b_2 + m_2(2,440,195) = 557,216$

$b_2 + m_2(2,439,174) = 556,264$

$> N = -1,718,069 + 0.9324192E$

PI F (6C) to PI G (7C)

line 3c

$b_3 + m_3(2,439,174) = 556,264$

$b_3 + m_3(2,438,814) = 555,643$

$> N = -3,651,311 + 1.7250000E$

PI G (7C) to PI H (8C)

line 4c

$b_4 + m_4(2,438,814) = 555,643$

$b_4 + m_4(2,440,140) = 555,104$

$> N = 1,546,986 - 0.4064857E$

PI H (8C) to PI I (9C)

line 5c

$b_5 + m_5(2,440,140) = 555,104$

$b_5 + m_5(2,440,844) = 556,380$

$> N = -3,867,650 + 1.8125000E$

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 5 OF

COMPUTED BKE DATE 6/22/95

CHECKED ______ DATE ______

I A

PI (9C) to PI (1C)

line 6C

$b_6 + m_6(2{,}440{,}844) = 556{,}380$

$b_6 + m_6(2{,}440{,}980) = 556{,}650$

> $N = -4{,}289{,}413 + 1.9852941\,E$

↑ the slope here does not exactly match slope calc'd for stage A line. (line 1 in stage A slope = 2.0204082)

Equations have already been calculated for the line from PI (1C) to PI (5C) and for the line from PI (9C) to PI (2C) in the calculations for stage A (PI (5) to End Sta and Sta 0+00 to PI (1)). The bearings of these lines are:

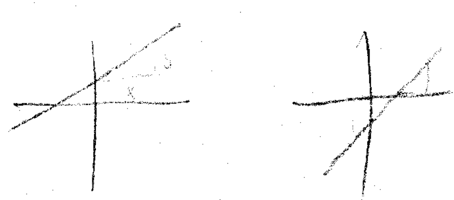
Sta 0+00 to PI (1) (line 1)
N26°19'59"E

PI (5) to End Sta (line 5)
S23°36'15"W

To maintain consistency, the bearing of these lines will be used rather than the newly calculated bearings from scale. The intersection point of each of these lines with adjoining lines scaled from pond III must be found.

PI (1C) to PI (2C) (line 2C)
S47°00'11" W

PI (8C) to PI (9C) (line 5C)
N28°53'12" E



Now, line (1) & line (5C) should intersect
Use TI-59 Program SY-16

N 556,422
E 2,440,867 > PI (9C)

Similarly, line (5) & line (2C) should intersect

N 557,213
E 2,440,192 > PI (8C)

TVA 11030 (WM-7-75)

TVA-00013107

KIF DREDGE CELL - STAGE C HOR. ALIGNMENT — SHEET 6 OF ___

COMPUTED BKE DATE 6/23/95

CHECKED ___ DATE ___

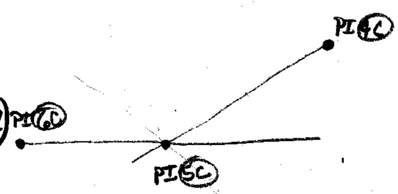
Compute external angle of all intersection points

External angle has already been computed for PI (1C) thru PI (4C)

$\Delta_{1c} = 90.387°$
$\Delta_{2c} = 84.475°$
$\Delta_{3c} = 83.745°$
$\Delta_{4c} = 104.896°$

PI (5C)

$\Delta_{5c} = \arctan(2.2884615) - \arctan(0.9324192)$



$\Delta_{5c} = 23.399°$

PI (6C)

$\Delta_{6c} = \arctan(1.7250000) - \arctan(0.9324192)$

$\Delta_{6c} = 16.902°$

PI (7C)

$\theta = \arctan(1.7250000) - \arctan(-0.4064857)$

$\theta = 82.020°$

$\Delta_{7c} = 180 - \theta = 97.980°$

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 7 OF

COMPUTED BKE DATE 6/23/95

CHECKED DATE

PI (8C)

$\Delta_{8C} = \arctan(1.8125000) - \arctan(-0.4064857)$

$\Delta_{8C} = 83.235°$

PI (9C)

$\Delta_{9C} = \arctan(2.0204082) - \arctan(1.8125000)$

$\Delta_{9C} = 2.554°$

$T = R\tan(\frac{\Delta}{2})$ $L = 100\frac{\Delta}{D}$ $D = \frac{5729.58}{R}$

PI	R(ft)	Δ	T(ft)	D	L(ft)
1C	175	90.387	176.19	32.74	276.08
2C	175	84.475	158.89	32.74	258.02
3C	225	83.745	201.69	25.46	328.93
4C	225	104.896	292.68	25.46	412.00
5C	500	23.399	103.54	11.46	204.18
6C	500	16.902	74.29	11.46	147.49
7C	200	97.980	229.99	28.65	341.99
8C	250	83.235	222.10	22.92	363.15
9C	500	2.554	11.14	11.46	22.29

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE C HORIZONTAL ALIGNMENT

Sheet 7A of

FIRST LIFT CURVE DATA

Computed: BKE Date: 6/27/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
1C	125	90.387	125.85	45.84	197.19	0.00	197.19
2C	225	84.475	204.29	25.46	331.73	205.15	536.88
3C	225	83.745	201.69	25.46	328.87	573.99	902.86
4C	225	104.896	292.68	25.46	411.93	1806.88	2218.80
5C	500	23.399	103.54	11.46	204.19	2402.05	2606.25
6C	500	16.902	74.29	11.46	147.50	3820.15	3967.65
7C	225	97.980	258.74	25.46	384.77	4352.42	4737.18
8C	250	83.235	222.10	22.92	363.18	5687.71	6050.89
9C	500	2.554	11.15	11.46	22.29	7322.85	7345.14

For next spiral, need a 15' offset from 1st spiral.

9C 1C
PI (I) to PI (A)
N26°19'59"E
Base Point (556,422 ; 2,440,867)
Offset Point (556,512 ; 2,440,911)

N- 556,518
E - 2,440,898
> Coord's of pt 15' offset from line

1C 2C
PI (A) to PI (B)
S63°16'49"E
Base Point (556,650 ; 2,440,980)
Offset Point (556,605 ; 2,441,069)

N - 556,618
E - 2,441,076
> Coord's of pt 15' offset from line

2C 3C
PI (B) to PI (C)
N32°14'42"E
Base Point (556,498 ; 2,441,282)
Offset Point (556,583 ; 2,441,335)

N - 556,591
E - 2,441,323 >

3C 4C
PI (C) to PI (D)
N51°30'00" W
Base Point (556,873 ; 2,441,518)
Offset Point (556,935 ; 2,441,440)

N - 556,923
E - 2,441,431 >

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 9 OF

COMPUTED BKE DATE 6/26/95

CHECKED DATE

4C → 5C

PI D to PI E

S23°36'15"W

Base Point (557,744 ; 2,440,424)

Offset Point (557,652 ; 2,440,384)

N - 557,646 > Pt. offset 15' from line
E - 2,440,398

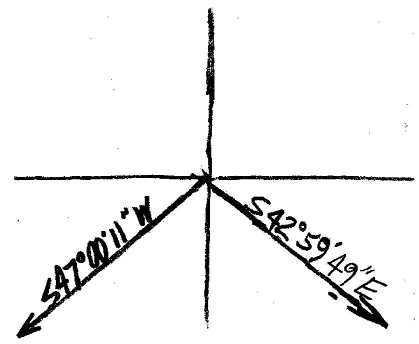
5C → 6C

PI E to PI F

S47°00'11"W

Base Point (557,213 ; 2,440,192)

Offset Point (557,145 ; 2,440,119)



N - 557,134 >
E - 2,440,129

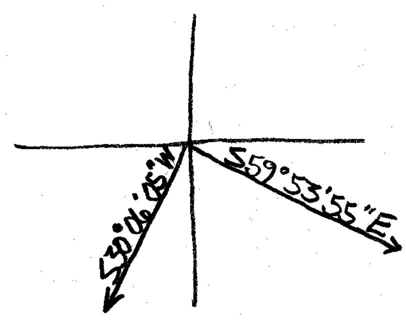
6C → 7C

PI F to PI G

S30°06'05"W

Base Point (556,264 ; 2,439,174)

Offset Point (556,177 ; 2,439,124)



N - 556,256 >
E - 2,439,187

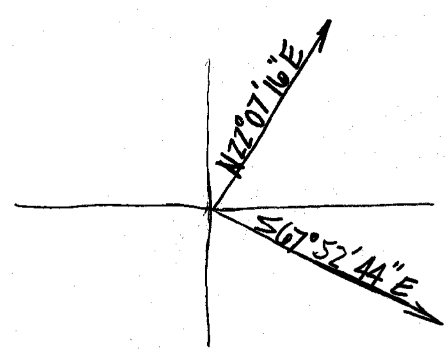
7C → 8C

PI G to PI H

S67°52'44" E

Base Point (555,613 ; 2,438,814)

Offset Point (555,605 ; 2,438,907)



N - 555,619
E - 2,438,912

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 10 OF

COMPUTED BKE DATE 6/27/95

CHECKED ______ DATE ______

8C 9C

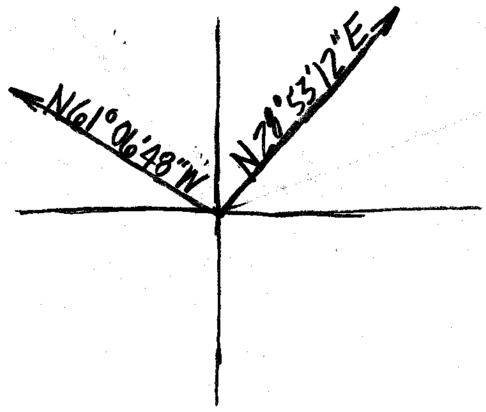
PI (H) to PI (I)

N 28°53'12" E

Base Point (555,104 ; 2,440,190)

Offset Point (555,192 ; 2,440,188)

N - 555,111
E - 2,440,127



Determine New PI's by using TI-59 program SY-16

PI	N	E
10C	556,670	2,440,973
11C	556,517	2,441,276
12C	556,869	2,441,499
13C	557,719	2,440,430
14C	557,205	2,440,205
15C	556,255	2,439,187
16C	555,650	2,438,836
17C	555,123	2,440,133
18C	556,425	2,440,852

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE C HORIZONTAL ALIGNMENT

Total Distance Between PI's

Computed: BKE Date: 6/27/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 10C	556,670	2,440,973	
			339.44
PI 11C	556,517	2,441,276	
			416.69
PI 12C	556,869	2,441,499	
			1,365.75
PI 13C	557,719	2,440,430	
			561.09
PI 14C	557,205	2,440,205	
			1,392.42
PI 15C	556,255	2,439,187	
			699.45
PI 16C	555,650	2,438,836	
			1,399.98
PI 17C	555,123	2,440,133	
			1,487.33
PI 18C	556,425	2,440,852	
			273.25
PI 10C	556,670	2,440,973	
		TOTAL	7935.392

KIF DREDGE CELL
STAGE C HORIZONTAL ALIGNMENT

SECOND LIFT CURVE DATA

Computed: BKE   Date: 6/27/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
10C	140	90.387	140.95	40.93	220.86	0.00	220.86
11C	210	84.475	190.67	27.28	309.62	228.68	538.30
12C	210	83.745	188.24	27.28	306.94	576.08	883.02
13C	210	104.896	273.16	27.28	384.46	1787.37	2171.83
14C	515	23.399	106.65	11.13	210.32	2353.11	2563.43
15C	485	16.902	72.06	11.81	143.07	3777.15	3920.22
16C	210	97.980	241.49	27.28	359.12	4306.12	4665.23
17C	235	83.235	208.77	24.38	341.39	5614.95	5956.34
18C	485	2.554	10.81	11.81	21.62	7224.09	7245.71

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 13 OF

COMPUTED BKE DATE 6/27/95

CHECKED DATE

For next spiral, need a 25' offset from 2nd spiral

PI (18C) to PI (10C)

N 26°19'59" E

Base Point (556,425; 2,440,852)

Offset Point (556,515; 2,440,896)

N - 556,526

E - 2,440,874

PI (10C) to PI (11C)

S 63°16'49" E

Base Pt (556,670; 2,440,973)

Offset Pt (556,625; 2,441,062)

N - 556,647

E - 2,441,074

PI (11C) to PI (12C)

N 32°14'42" E

Base Pt (556,517; 2,441,276)

Offset Pt (556,602; 2,441,329)

N - 556,615

E - 2,441,308

PI (12C) to PI (13C)

N 51°30'00" W

Base Pt (556,869; 2,441,499)

Offset Pt (556,931; 2,441,421)

N - 556,912

E - 2,441,405

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 14 OF

COMPUTED BKE DATE 6/27/95
CHECKED DATE

PI (13C) to PI (14C)
S23°36'15"W
Base Pt (557,719 ; 2,440,430)
Offset Pt (557,627 ; 2,440,390)

N- 557,617
E- 2,440,413

PI (14C) to PI (15C)
S47°00'11" W
Base Pt (557,205 ; 2,440,205)
Offset Pt (557,137 ; 2,440,132)

N- 557,119
E- 2,440,149

PI (15C) to PI (16C)
S30°06'05"W
Base Pt (556,235 ; 2,439,187)
Offset Pt (556,168 ; 2,439,137)

N- 556,156
E- 2,439,158

PI (16C) to PI (17C)
S67°52'44" E
Base Pt (555,650 ; 2,438,836)
Offset Pt (555,612 ; 2,438,929)

N- 555,636
E- 2,438,938

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE C HOR ALIGNMENT SHEET 15 OF

COMPUTED BHE DATE 6/27/95

CHECKED DATE

PI 179 to PI 186
N 28°53'12" E
Base Pt (555,123; 2,440,133)
Offset Pt (555,211; 2,440,181)

N - 555,223
E - 2,440,159

Determine New PI's by using T.I.59 program SY-16

PI	N	E
19C	556,703	2,440,962
20C	556,550	2,441,267
21C	556,864	2,441,465
22C	557,679	2,440,440
23C	557,192	2,440,227
24C	556,241	2,439,207
25C	555,663	2,438,872
26C	555,155	2,440,121
27C	556,457	2,440,840

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE C HORIZONTAL ALIGNMENT

Sheet 16 of

Total Distance Between PI's

Computed: BKE Date: 6/27/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 19C	556,703	2,440,962	
			341.22
PI 20C	556,550	2,441,267	
			371.21
PI 21C	556,864	2,441,465	
			1,309.52
PI 22C	557,679	2,440,440	
			531.54
PI 23C	557,192	2,440,227	
			1,394.56
PI 24C	556,241	2,439,207	
			668.06
PI 25C	555,663	2,438,872	
			1,348.36
PI 26C	555,155	2,440,121	
			1,487.33
PI 27C	556,457	2,440,840	
			274.59
PI 19C	556,703	2,440,962	
		TOTAL	7726.411

KIF DREDGE CELL
STAGE C HORIZONTAL ALIGNMENT

Sheet 17 of

THIRD LIFT CURVE DATA

Computed: BKE Date: 6/27/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
19C	165	90.387	166.12	34.72	260.30	0.00	260.30
20C	185	84.475	167.97	30.97	272.76	267.43	540.19
21C	185	83.745	165.83	30.97	270.40	577.60	848.00
22C	185	104.896	240.64	30.97	338.69	1751.04	2089.74
23C	540	23.399	111.82	10.61	220.53	2268.81	2489:34
24C	460	16.902	68.35	12.46	135.70	3703.73	3839.43
25C	185	97.980	212.74	30.97	316.36	4226.40	4542.76
26C	210	83.235	186.56	27.28	305.07	5491.82	5796.89
27C	460	2.554	10.25	12.46	20.50	7087.41	7107.91

KIF DREDGE CELL
STAGE D HORIZONTAL ALIGNMENT

Sheet 1 of

CURVE DATA

Computed: BKE Date: 6/29/95
Checked: Date:

PI	Lambert Coordinates		R	Δ	T	D	L	PC	PT
	North	East	(ft)	(deg)	(ft)		(ft)	(sta)	(sta)
1D	556,734	2,440,952	190	90.387	191.29	30.16	299.73	0.00	299.73
2D	556,580	2,441,259	160	84.475	145.27	35.81	235.90	306.64	542.54
3D	556,858	2,441,434	160	83.745	143.42	35.81	233.86	582.34	816.20
4D	557,642	2,440,449	160	104.896	208.12	35.81	292.92	1723.58	2016.50
5D	557,178	2,440,246	565	23.399	117.00	10.14	230.74	2197.84	2428.58
6D	556,226	2,439,225	435	16.902	64.63	13.17	128.32	3642.92	3771.24
7D	555,674	2,438,905	160	97.980	183.99	35.81	273.61	4160.66	4434.28
8D	555,185	2,440,111	185	83.235	164.35	30.97	268.75	5387.30	5656.05
9D	556,488	2,440,830	435	2.554	9.70	13.17	19.39	6970.22	6989.61
10D	556,754	2,440,945	205	90.387	206.39	27.95	323.4	0	323.4
11D	556,599	2,441,253	145	84.475	131.65	39.51	213.78	330.16	543.94
12D	556,855	2,441,415	145	83.745	129.98	39.51	211.94	585.26	797.2
13D	557,618	2,440,455	145	104.896	188.61	39.51	265.46	1704.89	1970.35
14D	557,171	2,440,260	580	23.399	120.11	9.88	236.87	2149.31	2386.18
15D	556,217	2,439,238	420	16.902	62.4	13.64	123.9	3601.74	3725.64
16D	555,681	2,438,927	145	97.98	166.74	39.51	247.96	4116.18	4364.14
17D	555,203	2,440,103	170	83.235	151.03	33.7	246.96	5315.8	5562.77
18D	556,506	2,440,822	420	2.554	9.36	13.64	18.72	6890.59	6909.31
19D	556,788	2,440,933	230	90.387	231.56	24.91	362.84	0	362.84
20D	556,633	2,441,241	120	84.475	108.95	47.75	176.92	367.13	544.05
21D	556,851	2,441,379	120	83.745	107.57	47.75	175.4	585.54	760.94
22D	557,579	2,440,465	120	104.896	156.09	47.75	219.69	1665.77	1885.46
23D	557,157	2,440,281	605	23.399	125.28	9.47	247.08	2064.45	2311.53
24D	556,203	2,439,259	395	16.902	58.69	14.51	116.52	3525.63	3642.15
25D	555,694	2,438,963	120	97.98	138	47.75	205.21	4034.28	4239.48
26D	555,235	2,440,092	145	83.235	128.82	39.51	210.65	5191.41	5402.06
27D	556,529	2,440,805	395	2.554	8.81	14.51	17.61	6741.87	6759.47

Total → 6809.47

KIF DREDGE CELL - STAGE D HOR ALIGNMENT SHEET 1 OF

COMPUTED BKE DATE 6/28/95

CHECKED ______ DATE ______

Need a 23' offset from Stage C.

PI 27C to PI 19C
N26°19'59"E
Base (556,457 ; 2,440,840)
Offset (556,547 ; 2,440,884)

N - 556,557
E - 2,440,864

PI 19C to PI 20C
S63°16'49"E
Base (556,703 ; 2,440,962)
Offset (556,658 ; 2,441,051)

N - 556,679
E - 2,441,062

PI 20C to PI 21C
N32°14'42"E
Base (556,560 ; 2,441,267)
Offset (556,635 ; 2,441,320)

N - 556,647
E - 2,441,301

PI 21C to PI 22C
N51°30'00"W
Base (556,864 ; 2,441,465)
Offset (556,926 ; 2,441,387)

N - 556,908
E - 2,441,372

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGED HOR ALIGNMENT SHEET 2 OF

COMPUTED BKE DATE 6/28/95
CHECKED DATE

PI 22C to PI 23C
S23°36'15"W
Base (557,679; 2,440,440)
Offset (557,587; 2,440,400)

N - 557,578
E - 2,440,421

PI 23C to PI 24C
S47°00'11"W
Base (557,192; 2,440,227)
Offset (557,124; 2,440,154)

N - 557,107
E - 2,440,170

PI 24C to PI 25C
S30°06'05"W
Base (556,241; 2,439,207)
offset (556,154; 2,439,157)

N - 556,143
E - 2,439,177

PI 25C TO PI 26C
S67°52'44"E
Base (555,665; 2,438,872)
Offset (555,625; 2,438,965)

N - 555,647
E - 2,438,973

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE D HOR ALIGNMENT SHEET 3 OF

COMPUTED BKE DATE 6/28/95

CHECKED ______ DATE ______

PI 26C to PI 27C

N28°53'12"E

Base (555,155 ; 2,440,121)

Offset (555,243 ; 2,440,169)

N - 555,254

E - 2,440,149

USE TI-59 PROGRAM SY-16 to get new PI's

PI	N	E
1D	556,734	2,440,952
2D	556,580	2,441,259
3D	556,858	2,441,434
4D	557,642	2,440,449
5D	557,178	2,440,246
6D	556,226	2,439,225
7D	555,674	2,438,905
8D	555,185	2,440,111
9D	556,488	2,440,830

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE D HORIZONTAL ALIGNMENT

Total Distance Between PI's

Computed: BKE   Date: 6/28/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 1D	556,734	2,440,952	
			343.46
PI 2D	556,580	2,441,259	
			328.50
PI 3D	556,858	2,441,434	
			1,258.92
PI 4D	557,642	2,440,449	
			506.46
PI 5D	557,178	2,440,246	
			1,395.97
PI 6D	556,226	2,439,225	
			638.05
PI 7D	555,674	2,438,905	
			1,301.37
PI 8D	555,185	2,440,111	
			1,488.21
PI 9D	556,488	2,440,830	
			274.59
PI 1D	556,734	2,440,952	
		TOTAL	7535.529

KIF DREDGE CELL
STAGE D HORIZONTAL ALIGNMENT

FIRST LIFT CURVE DATA

Computed: BKE Date: 6/28/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
1D	190	90.387	191.29	30.16	299.73	0.00	299.73
2D	160	84.475	145.27	35.81	235.90	306.64	542.54
3D	160	83.745	143.42	35.81	233.86	582.34	816.20
4D	160	104.896	208.12	35.81	292.92	1723.58	2016.50
5D	565	23.399	117.00	10.14	230.74	2197.84	2428.58
6D	435	16.902	64.63	13.17	128.32	3642.92	3771.24
7D	160	97.980	183.99	35.81	273.61	4160.66	4434.28
8D	185	83.235	164.35	30.97	268.75	5387.30	5656.05
9D	435	2.554	9.70	13.17	19.39	6970.22	6989.61

KIF DREDGE CELL - STAGE D HOR. ALIGNMENT SHEET 6 OF

COMPUTED BKE DATE 6/29/95

CHECKED ____ DATE ____

Now, need a 15' offset from 1st spiral.

PI 9D to PI 1D
N 26°19'59"E
Base (556,488 ; 2,440,830)
offset (556,578 ; 2,440,874)

N - 556,584
E - 2,440,861

PI 1D to PI 2D
S 63°16'49"E
Base (556,734 ; 2,440,852)
Offset (556,689 ; 2,441,041)

N - 556,702
E - 2,441,048

PI 2D To PI 3D
N 32°14'42"E
Base (556,580 ; 2,441,259)
Offset (556,665 ; 2,441,312)

N - 556,675
E - 2,441,300

PI 3D to PI 4D
N 51°30'00"W
Base (556,858 ; 2,441,434)
Offset (556,920 ; 2,441,356)

N - 556,909
E - 2,441,346

PI 4D to PI 5D
S 23°36'15"W
Base (557,642 ; 2,440,449)
Offset (557,550 ; 2,440,409)

N - 557,544
E - 2,440,423

PI 5D to PI 6D
S 47°00'11"W
Base (557,178 ; 2,440,246)
Offset (557,110 ; 2,440,173)

N - 557,099
E - 2,440,183

PI 6D to PI 7D
S 30°06'05"W
Base (556,226 ; 2,439,225)
Offset (556,139 ; 2,439,175)

N - 556,132
E - 2,439,188

PI 7D to PI 8D
S 67°52'44"E
Base (555,674 ; 2,438,905)
Offset (555,634 ; 2,438,998)

N - 555,650
E - 2,439,003

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE D HOR ALIGNMENT

SHEET 7 OF

COMPUTED BKE DATE 6/29/95

CHECKED DATE

PI 8D to PI 9D

N28°53'12"E

Base (555,185 ; 2,440,111)

Offset (555,273 ; 2,440,159)

N - 555,280

E - 2,440,146

USE TI59 PROGRAM SY-16 to get new PI's

PI	N	E
10D	556,754	2,440,945
11D	556,599	2,441,253
12D	556,856	2,441,415
13D	557,618	2,440,455
14D	557,171	2,440,260
15D	556,217	2,439,238
16D	555,681	2,438,927
17D	555,203	2,440,103
18D	556,506	2,440,822

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE D HORIZONTAL ALIGNMENT

Total Distance Between PI's

Computed: BKE Date: 6/29/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 10D	556,754	2,440,945	
			344.80
PI 11D	556,599	2,441,253	
			302.95
PI 12D	556,855	2,441,415	
			1,226.28
PI 13D	557,618	2,440,455	
			487.68
PI 14D	557,171	2,440,260	
			1,398.07
PI 15D	556,217	2,439,238	
			619.69
PI 16D	555,681	2,438,927	
			1,269.43
PI 17D	555,203	2,440,103	
			1,488.21
PI 18D	556,506	2,440,822	
			276.83
PI 10D	556,754	2,440,945	
		TOTAL	7413.951

KIF DREDGE CELL
STAGE D HORIZONTAL ALIGNMENT

SECOND LIFT CURVE DATA

Computed: BKE Date: 6/29/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
10D	205	90.387	206.39	27.95	323.40	0.00	323.40
11D	145	84.475	131.65	39.51	213.78	330.16	543.94
12D	145	83.745	129.98	39.51	211.94	585.26	797.20
13D	145	104.896	188.61	39.51	265.46	1704.89	1970.35
14D	580	23.399	120.11	9.88	236.87	2149.31	2386.18
15D	420	16.902	62.40	13.64	123.90	3601.74	3725.64
16D	145	97.980	166.74	39.51	247.96	4116.18	4364.14
17D	170	83.235	151.03	33.70	246.96	5315.80	5562.77
18D	420	2.554	9.36	13.64	18.72	6890.59	6909.31

KIF DREDGE CELL - STAGE D HOR ALIGNMENT SHEET 10 OF

COMPUTED BKE DATE 6/29/95

CHECKED DATE

Now, need a 25' offset from 2nd spiral

PI 18D to PI 10D
N26°19'59"E
Base (556,506; 2,440,822)
Offset (556,596; 2,440,866)

N - 556,607
E - 2,440,844

PI 10D to PI 11D
S63°16'49"E
Base (556,754; 2,440,945)
Offset (556,709; 2,441,034)

N - 556,731
E - 2,441,046

PI 11D to PI 12D
N 32°14'42"E
Base (556,599; 2,441,253)
Offset (556,684; 2,441,306)

N - 556,697
E - 2,441,282

PI 12D to PI 13D
N 51°30'00"W
Base (556,855; 2,441,415)
Offset (556,917; 2,441,337)

N - 556,898
E - 2,441,321

PI 13D to PI 14D
S23°36'15"W
Base (557,618; 2,440,455)
Offset (557,526; 2,440,415)

N - 557,516
E - 2,440,438

PI 14D to PI 15D
S47°00'11"W
Base (557,171; 2,440,260)
Offset (557,103; 2,440,187)

N - 557,085
E - 2,440,204

PI 15D to PI 16D
S30°06'05"W
Base (556,217; 2,439,238)
Offset (556,130; 2,439,188)

N - 556,118
E - 2,439,209

PI 16D to PI 17D
S67°52'44"E
Base (555,681; 2,438,927)
Offset (555,643; 2,439,020)

N - 555,667
E - 2,439,029

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE D HOR ALIGNMENT SHEET 11 OF

COMPUTED BKE DATE 9/29/95

CHECKED DATE

PI 17D to PI 18D

N 28°53'12"E

Base (555,203 ; 2,440,103)

Offset (555,291 ; 2,440,151)

N - 555,303

E - 2,440,129

USE TI 59 PROGRAM SY-16 to get new PI's

PI	N	E
19D	556,788	2,440,933
20D	556,633	2,441,241
21D	556,851	2,441,379
22D	557,579	2,440,465
23D	557,157	2,440,281
24D	556,203	2,439,259
25D	555,694	2,438,963
26D	555,235	2,440,092
27D	556,529	2,440,805

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE D HORIZONTAL ALIGNMENT

Sheet 12 of

Total Distance Between PI's

Computed: BKE Date: 6/29/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 19D	556,788	2,440,933	
			344.80
PI 20D	556,633	2,441,241	
			258.01
PI 21D	556,851	2,441,379	
			1,168.49
PI 22D	557,579	2,440,465	
			460.37
PI 23D	557,157	2,440,281	
			1,398.07
PI 24D	556,203	2,439,259	
			588.81
PI 25D	555,694	2,438,963	
			1,218.74
PI 26D	555,235	2,440,092	
			1,477.43
PI 27D	556,529	2,440,805	
			288.90
PI 19D	556,788	2,440,933	
		TOTAL	7203.628

KIF DREDGE CELL
STAGE D HORIZONTAL ALIGNMENT

THIRD LIFT CURVE DATA

Computed: BKE Date: 6/29/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
19D	230	90.387	231.56	24.91	362.84	0.00	362.84
20D	120	84.475	108.95	47.75	176.92	367.13	544.05
21D	120	83.745	107.57	47.75	175.40	585.54	760.94
22D	120	104.896	156.09	47.75	219.69	1665.77	1885.46
23D	605	23.399	125.28	9.47	247.08	2064.45	2311.53
24D	395	16.902	58.69	14.51	116.52	3525.63	3642.15
25D	120	97.980	138.00	47.75	205.21	4034.28	4239.48
26D	145	83.235	128.82	39.51	210.65	5191.41	5402.06
27D	395	2.554	8.81	14.51	17.61	6741.87	6759.47

KIF DREDGE CELL
STAGE E HORIZONTAL ALIGNMENT

Sheet 1 of

CURVE DATA

Computed: BKE Date: 7/05/95
Checked: Date:

PI	Lambert Coordinates		R	Δ	T	D	L	PC	PT
	North	East	(ft)	(deg)	(ft)		(ft)	(sta)	(sta)
1E	556,819	2,440,923	255	90.387	256.73	22.47	402.28	0.00	402.28
2E	556,663	2,441,233	95	84.475	86.25	60.31	140.06	406.33	546.40
3E	556,846	2,441,348	95	83.745	85.16	60.31	138.85	591.12	729.97
4E	557,541	2,440,474	95	104.896	123.57	60.31	173.92	1637.89	1811.82
5E	557,142	2,440,299	630	23.399	130.46	9.09	257.29	1993.47	2250.76
6E	556,190	2,439,279	370	16.902	54.97	15.49	109.15	3460.56	3569.71
7E	555,705	2,438,997	95	97.980	109.25	60.31	162.46	3966.51	4128.97
8E	555,264	2,440,082	120	83.235	106.61	47.75	174.33	5084.31	5258.64
9E	556,532	2,440,781	370	2.554	8.25	15.49	16.49	6591.69	6608.18
10E	556,839	2,440,916	270	90.387	271.83	21.22	425.94	0	425.94
11E	556,682	2,441,227	80	84.475	72.64	71.62	117.95	429.85	547.8
12E	556,842	2,441,329	80	83.745	71.71	71.62	116.93	593.21	710.14
13E	557,517	2,440,480	80	104.896	104.06	71.62	146.46	1618.99	1765.46
14E	557,135	2,440,314	645	23.399	133.57	8.88	263.41	1944.34	2207.75
15E	556,183	2,439,293	355	16.902	52.74	16.14	104.72	3417.41	3522.13
16E	555,712	2,439,019	80	97.98	92	71.62	136.81	3922.29	4059.09
17E	555,283	2,440,075	105	83.235	93.28	54.57	152.54	5013.63	5166.16
18E	556,537	2,440,767	355	2.554	7.91	16.14	15.82	6497.23	6513.05
19E	556,872	2,440,905	295	90.387	297	19.42	465.38	0	465.38
20E	556,715	2,441,218	55	84.475	49.94	104.17	81.09	468.61	549.7
21E	556,837	2,441,295	55	83.745	49.3	104.17	80.39	594.73	675.12
22E	557,477	2,440,490	55	104.896	71.54	104.17	100.69	1582.69	1683.38
23E	557,120	2,440,334	670	23.399	138.74	8.55	273.62	1862.7	2136.32
24E	556,167	2,439,312	330	16.902	49.03	17.36	97.35	3345.93	3443.28
25E	555,725	2,439,056	55	97.98	63.25	104.17	94.05	3841.78	3935.84
26E	555,315	2,440,063	80	83.235	71.07	71.62	116.22	4888.79	5005
27E	556,560	2,440,751	330	2.554	7.36	17.36	14.71	6349.03	6363.74

KIF DREDGE CELLS - STAGE E HOR ALIGNMENT

SHEET 1 OF

COMPUTED BKE DATE 6/30/95

CHECKED DATE

Need a 23' offset from Stage D

PI 27D to PI 19D
N26°19'59"E
Base (556,529; 2,440,805)
Offset (556,619; 2,440,849)

N - 556,629
E - 2,440,829

PI 19D to PI 20D
S63°16'49"E
Base (556,788; 2,440,933)
Offset (556,743; 2,440,022)

N - 556,764
E - 2,441,033

PI 20D to PI 21D
N32°14'42"E
Base (556,635; 2,441,241)
Offset (556,718; 2441,294)

N - 556,730
E - 2,441,275

PI 21D to PI 22D
N51°30'00"W
Base (556,851; 2,441,379)
Offset (556,913; 2,441,301)

N - 556,895
E - 2,441,286

PI 22D to PI 23D
S23°36'15"W
Base (557,579; 2,440,465)
Offset (557,487; 2,440,425)

N - 557,478
E - 2,440,446

PI 23D to PI 24D
S47°00'11"W
Base (557,157; 2,440,281)
Offset (557,089; 2,440,208)

N - 557,072
E - 2,440,224

PI 24D to PI 25D
S30°06'05"W
Base (556,203; 2,439,289)
Offset (556,116; 2,439,209)

N - 556,105
E - 2,439,229

PI 25D to PI 26D
S67°52'44"E
Base (555,694; 2,438,963)
Offset (555,656; 2,439,056)

N - 555,678
E - 2,439,064

TVA 11030 (WM-7-75)

KIF DREDGE CELLS - STAGE E HOR ALIGNMENT SHEET 2 OF

COMPUTED BKE DATE 6/30/95

CHECKED DATE

PI 26D to PI 27D
N 28°53'12"E
Base (555,235; 2,440,092)
offset (555,323; 2,440,140)

557,541
2,440,474

N - 555,334
E - 2,440,120

USE TI 59 PROGRAM SY-16 to get new PI's

PI	N	E
1E	556,819	2,440,923
2E	556,663	2,441,233
3E	556,846	2,441,348
4E	557,541	2,440,474
5E	557,142	2,440,299
6E	556,190	2,439,279
7E	555,705	2,438,997
8E	555,264	2,440,082
9E	556,532	2,440,781

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE E HORIZONTAL ALIGNMENT

Total Distance Between PI's

Computed: BKE Date: 6/30/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 1E	556,819	2,440,923	
			347.04
PI 2E	556,663	2,441,233	
			216.13
PI 3E	556,846	2,441,348	
			1,116.65
PI 4E	557,541	2,440,474	
			435.69
PI 5E	557,142	2,440,299	
			1,395.24
PI 6E	556,190	2,439,279	
			561.02
PI 7E	555,705	2,438,997	
			1,171.20
PI 8E	555,264	2,440,082	
			1,447.90
PI 9E	556,532	2,440,781	
			320.21
PI 1E	556,819	2,440,923	
		TOTAL	7011.089

KIF DREDGE CELL
STAGE E HORIZONTAL ALIGNMENT

FIRST LIFT CURVE DATA

Computed: BKE Date: 6/30/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
1E	255	90.387	256.73	22.47	402.28	0.00	402.28
2E	95	84.475	86.25	60.31	140.06	406.33	546.40
3E	95	83.745	85.16	60.31	138.85	591.12	729.97
4E	95	104.896	123.57	60.31	173.92	1637.89	1811.82
5E	630	23.399	130.46	9.09	257.29	1993.47	2250.76
6E	370	16.902	54.97	15.49	109.15	3460.56	3569.71
7E	95	97.980	109.25	60.31	162.46	3966.51	4128.97
8E	120	83.235	106.61	47.75	174.33	5084.31	5258.64
9E	370	2.554	8.25	15.49	16.49	6591.69	6608.18

15' offset from 1st spiral

PI 9E to PI 1E
N26°19'59"E
Base (556,532; 2,440,781)
Offset (556,622; 2,440,825)

N- 556,628
E- 2,440,812

PI 1E to PI 2E
S63°16'49"E
Base (556,819; 2,440,923)
Offset (556,774; 2,441,012)

N- 556,787
E- 2,441,019

PI 2E to PI 3E
N32°14'42"E
Base (556,663; 2,441,233)
Offset (556,748; 2,441,286)

N- 556,756
E- 2,441,274

PI 3E to PI 4E
N51°30'00"W
Base (556,846; 2,441,348)
Offset (556,908; 2,441,270)

N- 556,897
E- 2,441,260

PI 4E to PI 5E
S23°36'15"W
Base (557,541; 2,440,474)
Offset (557,449; 2,440,434)

N- 557,443
E- 2,440,448

PI 5E to PI 6E
S47°00'11"W
Base (557,142; 2,440,299)
Offset (557,074; 2,440,226)

N- 557,063
E- 2,440,236

PI 6E to PI 7E
S30°06'05"W
Base (556,190; 2,439,279)
Offset (556,103; 2,439,229)

N- 556,096
E- 2,439,242

PI 7E to PI 8E
S67°52'44"E
Base (555,705; 2,438,997)
Offset (555,667; 2,439,098)

N- 555,681
E- 2,439,095

KIF DREDGE CELL - STAGE E HOR ALIGNMENT SHEET 6 OF

COMPUTED BKE DATE 6/30/95

CHECKED DATE

PI 8E to PI 9E

N 28°53'12"E

Base (555,264; 2,440,082)

Offset (555,352; 2,440,130)

N - 555,359

E - 2,440,117

USE TI59 PROGRAM ~~SV~~-16 to get new PI's

PI	N	E
10E	556,839	2,440,916
11E	556,682	2,441,227
12E	556,842	2,441,329
13E	557,517	2,440,480
14E	557,135	2,440,314
15E	556,183	2,439,293
16E	555,712	2,439,019
17E	555,283	2,440,075
18E	556,537	2,440,767

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE E HORIZONTAL ALIGNMENT

Total Distance Between PI's

Computed: BKE Date: 6/30/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 10E	556,839	2,440,916	
			348.38
PI 11E	556,682	2,441,227	
			189.75
PI 12E	556,842	2,441,329	
			1,084.63
PI 13E	557,517	2,440,480	
			416.51
PI 14E	557,135	2,440,314	
			1,395.97
PI 15E	556,183	2,439,293	
			544.90
PI 16E	555,712	2,439,019	
			1,139.81
PI 17E	555,283	2,440,075	
			1,432.26
PI 18E	556,537	2,440,767	
			336.76
PI 10E	556,839	2,440,916	
		TOTAL	6888.981

KIF DREDGE CELL
STAGE E HORIZONTAL ALIGNMENT

SECOND LIFT CURVE DATA

Computed: BKE Date: 6/30/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
10E	270	90.387	271.83	21.22	425.94	0.00	425.94
11E	80	84.475	72.64	71.62	117.95	429.85	547.80
12E	80	83.745	71.71	71.62	116.93	593.21	710.14
13E	80	104.896	104.06	71.62	146.46	1618.99	1765.46
14E	645	23.399	133.57	8.88	263.41	1944.34	2207.75
15E	355	16.902	52.74	16.14	104.72	3417.41	3522.13
16E	80	97.980	92.00	71.62	136.81	3922.29	4059.09
17E	105	83.235	93.28	54.57	152.54	5013.63	5166.16
18E	355	2.554	7.91	16.14	15.82	6497.23	6513.05

COMPUTED BKE DATE 6/30/95

CHECKED DATE

25' offset from 2nd lift

PI 18E to PI 10E
N 26°19'59"E
Base (556,537; 2,440,767)
Offset (556,627; 2,440,811)

N - 556,638
E - 2,440,789

PI 10E to PI 11E
S 63°16'49"E
Base (556,839; 2,440,916)
Offset (556,794; 2,441,005)

N - 556,816
E - 2,441,017

PI 11E to PI 12E
N 32°14'42"E
Base (556,682; 2,441,227)
Offset (556,767; 2,441,280)

N - 556,780
E - 2,441,259

PI 12E to PI 13E
N 51°30'00"W
Base (556,842; 2,441,329)
Offset (556,904; 2,441,251)

N - 556,885
E - 2,441,235

PI 13E to PI 14E
S 23°36'15"W
Base (557,517; 2,440,480)
Offset (557,425; 2,440,440)

N = 557,415
E = 2,440,463

PI 14E to PI 15E
S 47°00'11 W
Base (557,135; 2,440,314)
Offset (557,067; 2,440,241)

N - 557,049
E - 2,440,258

PI 15E to PI 16E
S 30°06'05"W
Base (556,183; 2,439,293)
Offset (556,096; 2,439,243)

N - 556,084
E - 2,439,264

PI 16E to PI 17E
S 67°52'44"E
Base (555,712; 2,439,019)
Offset (555,674; 2,439,112)

N - 555,698
E - 2,439,121

TVA 11030 (WM-7-75)

KIF DREDGE CELL - STAGE E HOR ALIGNMENT SHEET 10 OF

COMPUTED BKE DATE 7/5/95

CHECKED DATE

PI 17E to PI 18E

N 28°53'12"E

Base (555,283; 2,440,078)

Offset (555,371; 2,440,123)

N - 555,383

E - 2,440,101

USE TI-59 PROGRAM SY-16 to get new PI's

PI	N	E
19E	556,872	2,440,905
20E	556,715	2,441,218
21E	556,837	2,441,295
22E	557,477	2,440,490
23E	557,120	2,440,334
24E	556,167	2,439,312
25E	555,725	2,439,056
26E	555,315	2,440,063
27E	556,560	2,440,751

TVA 11030 (WM-7-75)

KIF DREDGE CELL
STAGE E HORIZONTAL ALIGNMENT

Total Distance Between PI's

Computed: BKE Date: 7/05/95
Checked: Date:

Point	N Lambert Coord.	E Lambert Coord.	Distance (ft)
PI 19E	556,872	2,440,905	
			350.17
PI 20E	556,715	2,441,218	
			144.27
PI 21E	556,837	2,441,295	
			1,028.41
PI 22E	557,477	2,440,490	
			389.60
PI 23E	557,120	2,440,334	
			1,397.39
PI 24E	556,167	2,439,312	
			510.78
PI 25E	555,725	2,439,056	
			1,087.27
PI 26E	555,315	2,440,063	
			1,422.45
PI 27E	556,560	2,440,751	
			347.94
PI 19E	556,872	2,440,905	
		TOTAL	6678.267

KIF DREDGE CELL
STAGE E HORIZONTAL ALIGNMENT

Sheet 12 of

THIRD LIFT CURVE DATA

Computed: BKE Date: 7/05/95
Checked: Date:

PI	R (ft)	Δ (deg)	T (ft)	D	L (ft)	PC (sta)	PT (sta)
19E	295	90.387	297.00	19.42	465.38	0.00	465.38
20E	55	84.475	49.94	104.17	81.09	468.61	549.70
21E	55	83.745	49.30	104.17	80.39	594.73	675.12
22E	55	104.896	71.54	104.17	100.69	1582.69	1683.38
23E	670	23.399	138.74	8.55	273.62	1862.70	2136.32
24E	330	16.902	49.03	17.36	97.35	3345.93	3443.28
25E	55	97.980	63.25	104.17	94.05	3841.78	3935.84
26E	80	83.235	71.07	71.62	116.22	4888.79	5005.00
27E	330	2.554	7.36	17.36	14.71	6349.03	6363.74

	920	
	kg	lb
0	5330	11,750
0	3515	7,750
0	2495	5,500
0	1928	4,250
0	1588	3,500
n		
%		
t/min	15.25 m/min	50 ft/min
ft	24.4 m	80 ft
25"	10 mm	.375"

80C		977*	
		*Capacities shown are with optional counterweight.	
	lb	kg	lb
	33,000	18 598	41,000
	29,000	11 431	25,200
	22,000	8210	18,100
	18,000	6305	13,800
	15,000	4944	10,900
	12,000		
	10,000		
min	68 ft/min	19 m/min	62 ft/min
m	150 ft		
m	.625"	16 mm	.625"

Assumed 657B Pan for haul road design

CATERPILLAR WHEEL TRACTOR-SCRAPERS

600

CONTENTS

Features, all models:

- **Semi-automatic power shift transmissions** with eight speeds forward. (613B has four speed conventional power shift, and 615 six speeds.)
- **Differential lock** . . . operator controlled, rigidly connects both tractor drive wheels for positive traction.
- **Cushion Hitch** (except 613B and 615) absorbs haul road shocks, stabilizes machine travel, substantially increases usable working speeds.
- **Double-acting hydraulics** supply positive cutting edge penetration, apron closure and material ejection. Positive bulldozer-type ejection (633D and 639D scraper floor pivots). Automatic ejector return kickout.
- **Quick-drop valves** for pump loading. Carry check valves isolate bowl cylinders to carry load rather than hydraulic lines.
- **Hydraulic retarder** standard on 651B up, optional on 621B through 639D. Not available on 613B or 615.

Tandem Powered:

- **Push-Pull arrangement** allows two 627B, 637D or 657B scrapers to assist one another in self-loading.

Elevating:

- **Variable capacity torque converter** (623B, 633D and 639D) provides four different loading ranges to suit different conditions.
- **Two-speed elevator** allows operator to match elevator speed to material conditions.

Wheel Tractor-Scrapers

651B

410 kW	550 HP
58 310 kg	128,550 lb
24.5 m³	32 yd³
33.6 m³	44 yd³
47 170 kg	104,000 lb
67%	
33%	
52%	
48%	
D346	
1900	
19.5 L	1190 in³
50 km/h	31 mph
13.5 m	44'2"
16.4 m	53'10"
37.5-39, 36 PR (E-3)	
37.5-39, 36 PR (E-3)	
3.63 m	11'11"
405 mm	16"
510 mm	20"
1060 L	280 gal
4.29 m	14'1"
9.73 m	31'11"
15.34 m	50'4"
4.32 m	14'2"
3.81 m	12'6"
2.72 m	8'11"
2.59 m	8'6"

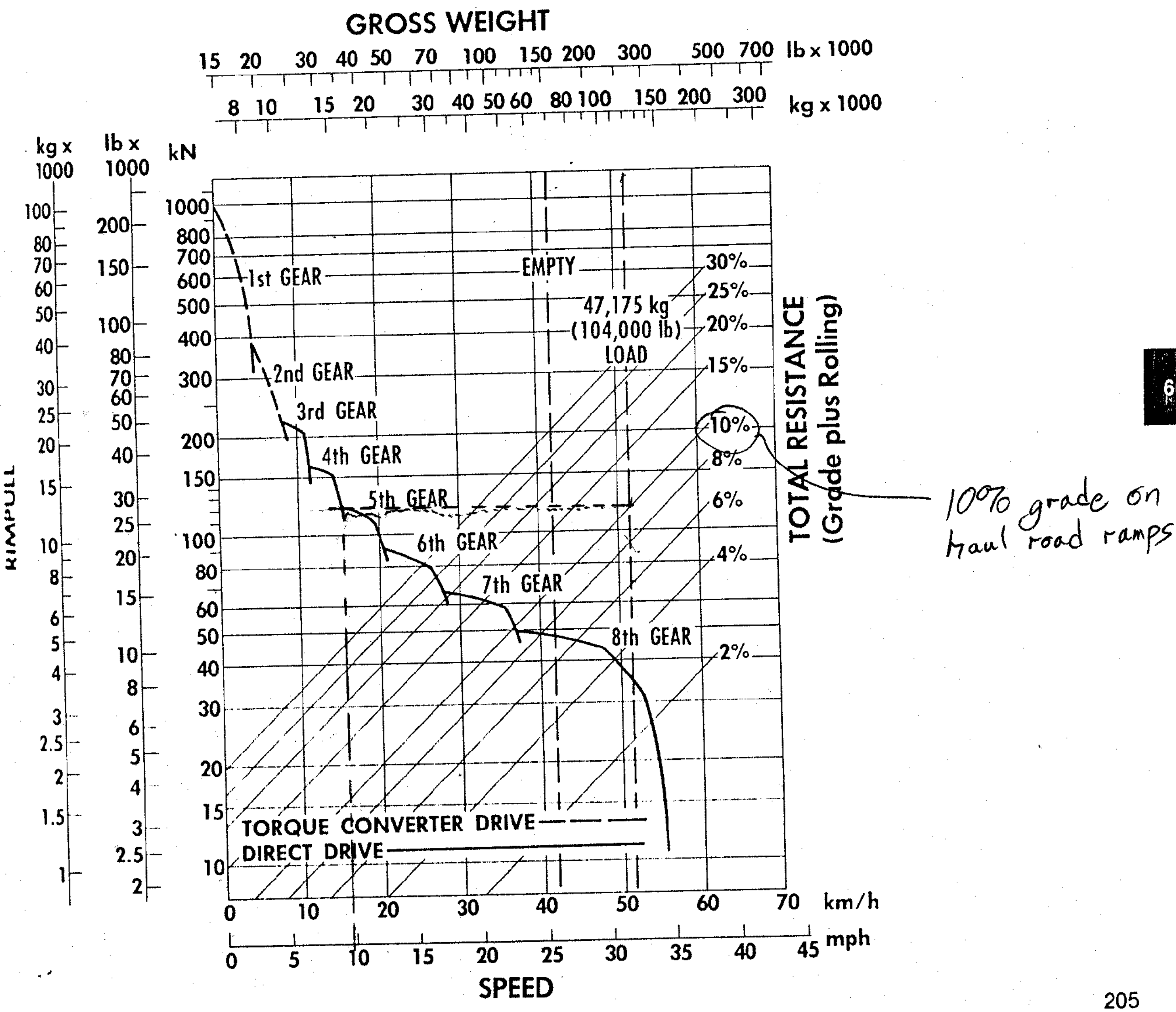


	627B		637D		657B	
Flywheel power: Tractor	168 kW	225 HP	336 kW	450 HP	410 kW	550 HP
Scraper	168 kW	225 HP	186 kW	250 HP	298 kW	400 HP
Operating weight (empty)*	34 430 kg	75,910 lb	48 625 kg	107,200 lb	69 320 kg	152,830 lb
Scraper capacity: Struck	10.7 m³	14 yd³	16.1 m³	21 yd³	24.5 m³	32 yd³
Heaped	15.3 m³	20 yd³	23.7 m³	31 yd³	33.6 m³	44 yd³
Rated load	21 770 kg	48,000 lb	34 020 kg	75,000 lb	47 175 kg	104,000 lb
Weight distribution — Empty: Drive	58%		61%		59%	
Rear	42%		39%		41%	
Weight distribution — Loaded: Drive	49%		50%		49%	
Rear	51%		50%		51%	
Engine model: Tractor	3306		3408		D346	
Scraper	3306		3306		D343	
Rated engine RPM: Tractor	2100		2000		1900	
Scraper	2200		2200		1900	
Displacement: Tractor	10.5 L	638 in³	18.0 L	1099 in³	19.5 L	1190 in³
Scraper	10.5 L	638 in³	10.5 L	638 in³	14.6 L	893 in³
Top speed (loaded)	55 km/h	34 mph	53 km/h	33 mph	53 km/h	33 mph
Non-stop turning circle	11.1 m	36'6"	12.2 m	40'1"	13.7 m	45'1"
With ROPS restriction	—		—		16.8 m	55'1"
Tires: Tractor drive	29.5-29, 28 PR (E-3)		33.25-35, 38 PR (E-3)		37.5-39, 44 PR (E-3)	
Scraper	29.5-29, 28 PR (E-3)		33.25-35, 38 PR (E-3)		37.5-39, 44 PR (E-3)	
Width of cut	3.02 m	9'11"	3.49 m	11'5.5"	3.63 m	11'11"
Maximum depth of cut	340 mm	13.4"	483 mm	19"	406 mm	16"
Maximum depth of spread	460 mm	18"	425 mm	16.7"	510 mm	20"
Fuel tank refill capacity: Tractor	511 L	135 gal	946 L	250 gal	1060 L	280 gal
Scraper	492 L	130 gal	643 L	170 gal	757 L	200 gal
GENERAL DIMENSIONS:						
Height to top of scraper	3.63 m	11'11"	4.17 m	13'8"	4.21 m	13'10"
Wheelbase	7.72 m	25'4"	8.74 m	28'8"	10.03 m	32'11"
Overall length	13.3 m	43'9"	14.8 m	48'8"	15.7 m	51'8"
Overall width	3.45 m	11'4"	3.96 m	13'	4.32 m	14'2"
Shipping width (draft arms on inside of bowl)	—		3.66 m	12'0"	3.56 m	11'8"
Scraper tread	2.18 m	7'2"	2.46 m	8'1"	2.67 m	8'9"
Tractor tread	2.21 m	7'3"	2.46 m	8'1"	2.59 m	8'6"
PUSH-PULL GENERAL DIMENSIONS:						
Operating weight (empty)*	35 990 kg	79,350 lb	50 140 kg	110,540 lb	71 320 kg	157,230 lb
Overall length	14.91 m	48'11"	16.53 m	54'3"	17.63 m	57'10"
Weight distribution — Empty: Drive	60%		63%		60%	
Rear	40%		38%		40%	
Weight distribution — Loaded: Drive	51%		51%		49%	
Rear	49%		49%		51%	

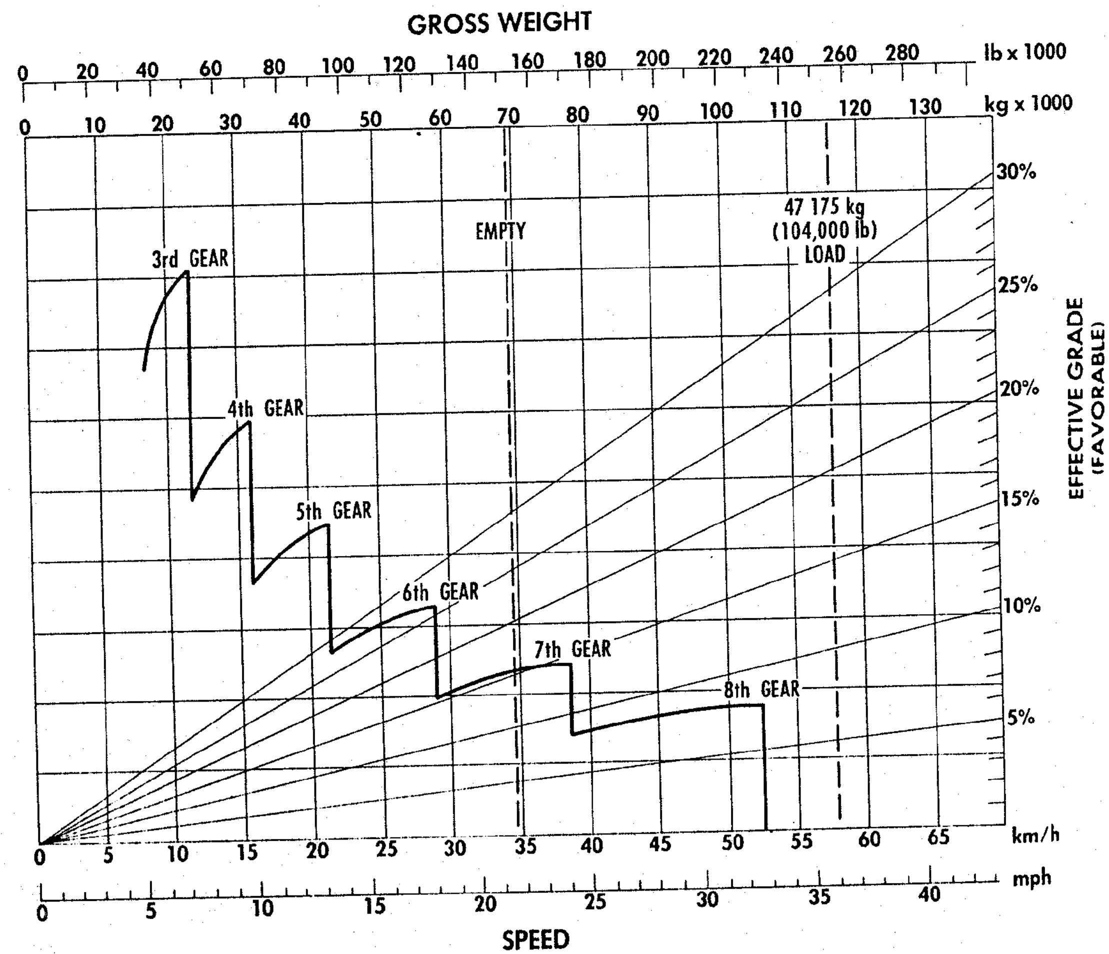
*Operating weight includes coolant, lubricants, full fuel tank, ROPS and operator.

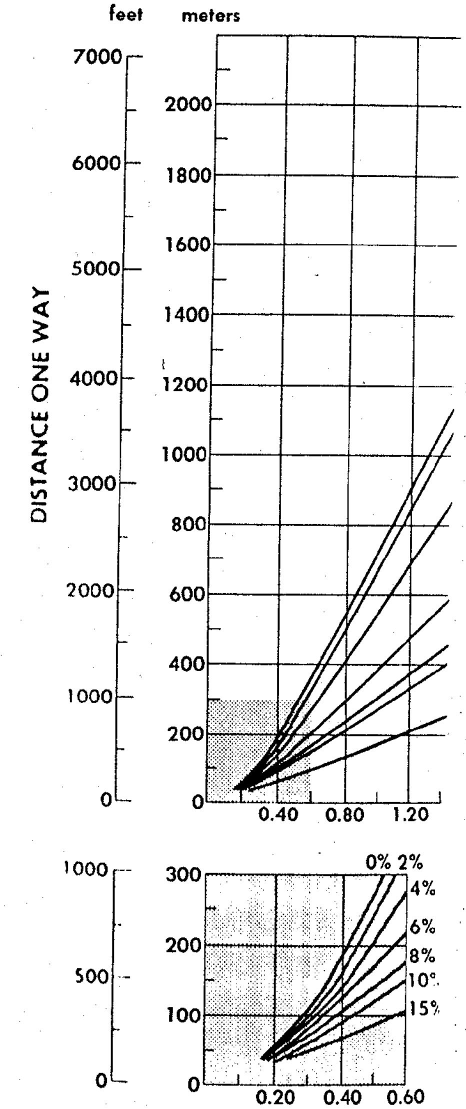
600

TVA-00013149


GROSS WEIGHT
15 20 30 40 50 70 100 150 200 300 500 700 lb x 1000
8 10 15 20 30 40 50 60 80 100 150 200 300 kg x 1000
kg x 1000
lb x 1000
kN
RIMPULL
1st GEAR
2nd GEAR
3rd GEAR
4th GEAR
5th GEAR
6th GEAR
7th GEAR
8th GEAR
EMPTY
47,175 kg
(104,000 lb)
LOAD
30%
25%
20%
15%
10%
8%
6%
4%
2%
TOTAL RESISTANCE
(Grade plus Rolling)
10% grade on haul road ramps
TORQUE CONVERTER DRIVE
DIRECT DRIVE
km/h
mph
SPEED

600

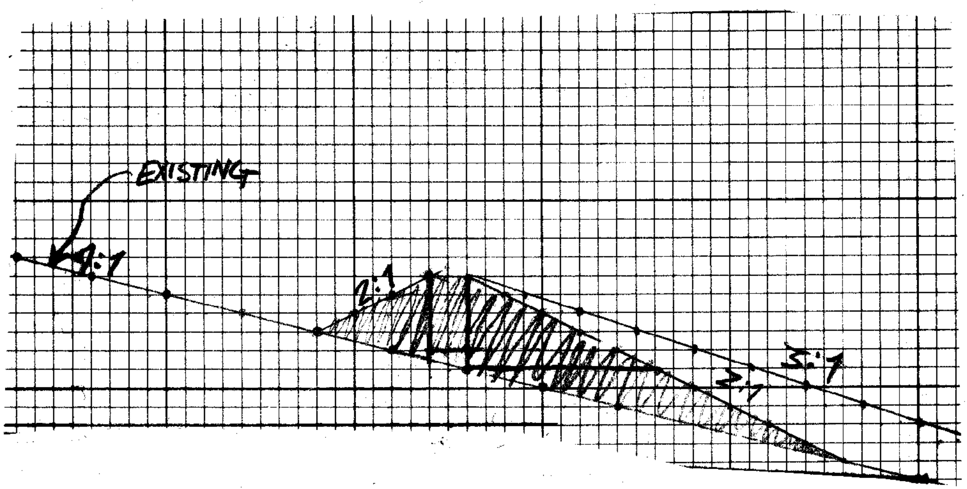

GROSS WEIGHT
lb x 1000
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280
kg x 1000
0 10 20 30 40 50 60 70 80 90 100 110 120 130
EMPTY
47 175 kg (104,000 lb) LOAD
3rd GEAR
4th GEAR
5th GEAR
6th GEAR
7th GEAR
8th GEAR
30%
25%
20%
15%
10%
5%
EFFECTIVE GRADE (FAVORABLE)
km/h
0 5 10 15 20 25 30 35 40 45 50 55 60 65
mph
0 5 10 15 20 25 30 35 40
SPEED


feet
meters
DISTANCE ONE WAY
7000 6000 5000 4000 3000 2000 1000 0
2000 1800 1600 1400 1200 1000 800 600 400 200 0
0.40 0.80 1.20
1000 500 0
300 200 100 0
0.20 0.40 0.60
0% 2%
4%
6%
8%
10%
15%

KIF DREDGE CELL - BERM DITCH QTY CALC's SHEET 1 OF

COMPUTED DKE DATE 7/19/95

CHECKED DATE



X-Sectional Area

$A = \frac{1}{2}(4.5)(6) + 2(4) + \left(\frac{0.5+1}{2}\right)(2) + \frac{1}{2}(5)(10) + \frac{1}{2}(20.8)(2.4)$

$A = 72.96 = 73\ ft^2$

For 2:1 side slopes

Vol = (Length)(A)

Vol = (2800' + 2300')(73')

Vol = 13,800 CY Assume 5% shrink → Say **Vol = 14,500 CY**

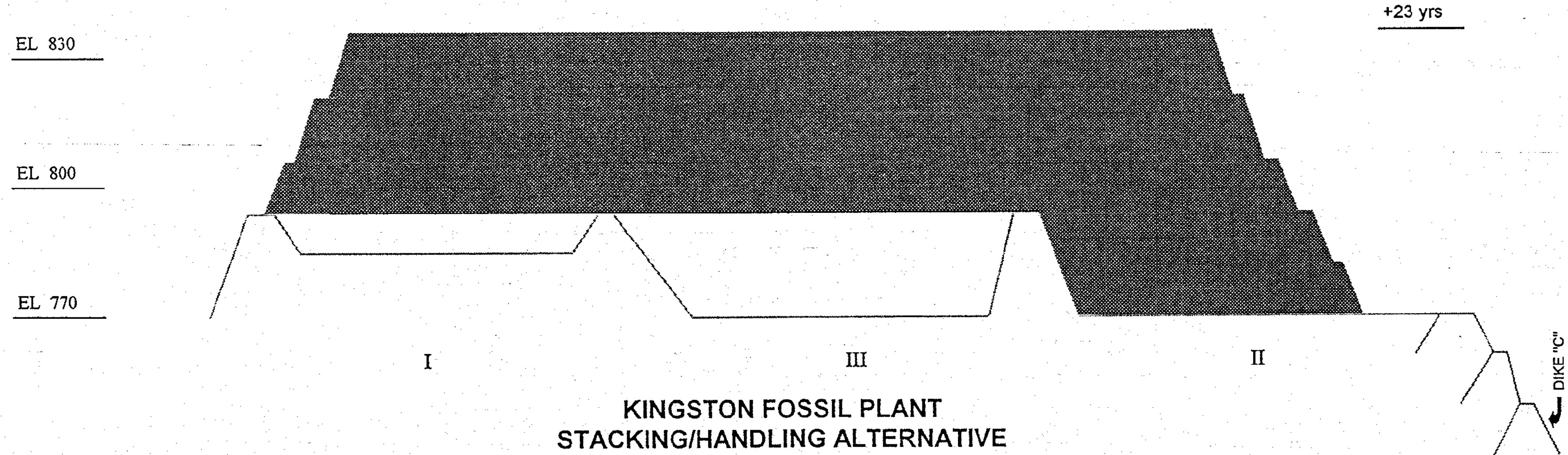
TVA 11030 (WM-7-75)

SHEET		OF	
COMPUTED		DATE	
CHECKED		DATE	

Line	Bearing	Perpindicular
1	N26°19'59"E	N63°40'01"W
2	S63°16'49"E	N26°43'11"E
3	N32°14'42"E	N57°45'18"W
4	N51°30'00"W	S38°30'00"W
5	S23°36'15"W	S66°23'45"E
6	S47°00'11"W	S42°59'49"E
7	S30°06'05"W	S59°53'55"E
8	S67°52'44"E	N22°07'16"E
9	N28°53'12"E	N61°06'48"W

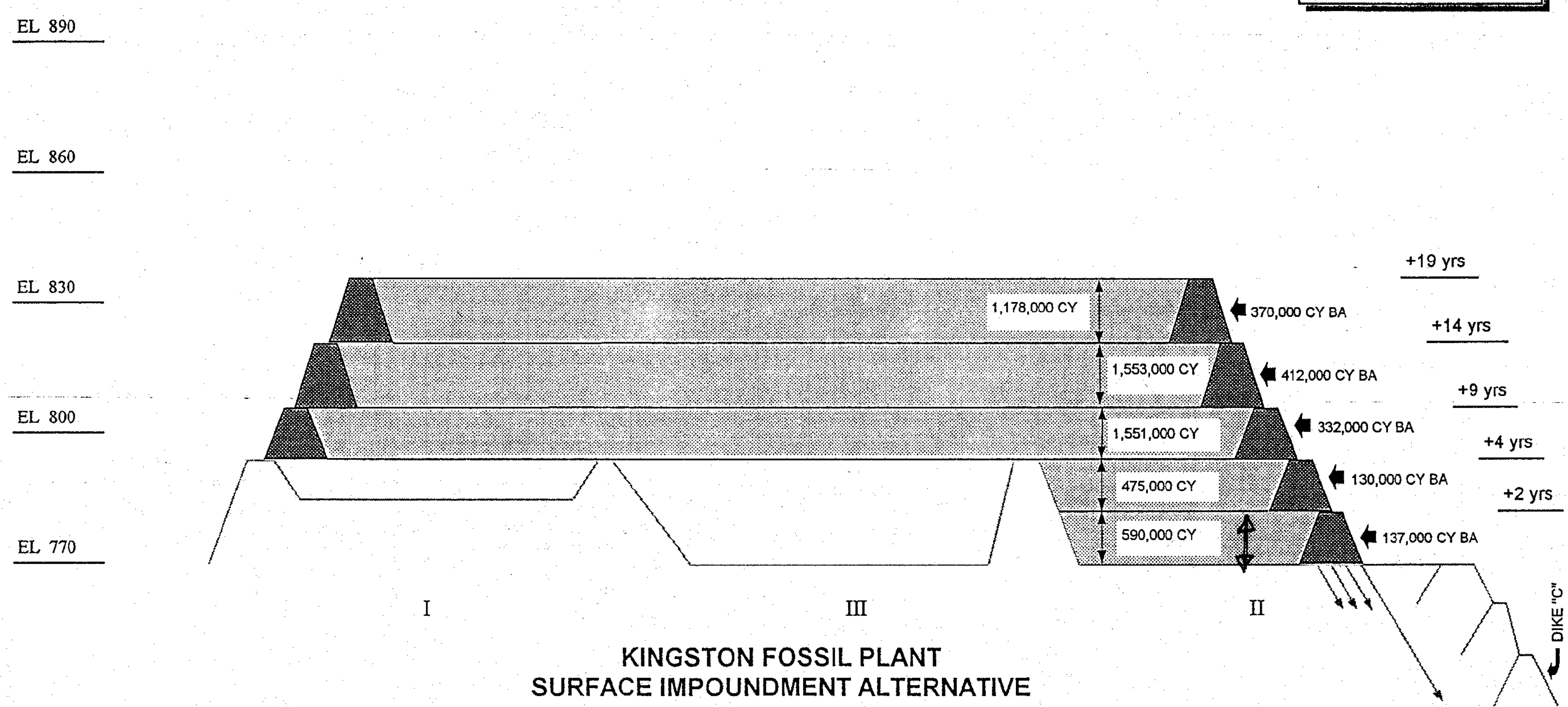
TVA 11030 (WM-7-75)

EXHIBIT A



KINGSTON FOSSIL PLANT
STACKING/HANDLING ALTERNATIVE

EXHIBIT B



KINGSTON FOSSIL PLANT
SURFACE IMPOUNDMENT ALTERNATIVE
(CONTINUE DREDGING)

6850
950
7800
5700

KINGSTON FOSSIL PLANT
SURFACE IMPOUNDMENT ALTERNATIVE
ESTIMATED QUANTITIES

STAGE	BOT. ASH (FOR DIKE)	FLY ASH	UNDERDRAIN PIPE	COVER SURFACE AREA	DIKE PERIMETER	INTERMEDIATE EARTH FILL (6" THICK)	FINAL EARTH FILL (12" THICK)
	(yd^3)	(yd^3)	(ft)	(ft^2)	(ft)	(yd^3)	(yd^3)
A	137,000	590,000	4,400	208,700	3,600	3,900	7,800
B	130,000	475,000	4,200	197,100	3,400	3,700	7,300
C	332,000	1,551,000	10,700	504,200	8,700	9,400	18,700
D	412,000	1,553,000	11,000	526,000	7,800	9,800	19,500
E	370,000	1,178,000	9,800	3,282,900	7,000	60,800	121,600

ASSUMPTIONS:

1. All dike slopes are 3 to 1.
2. 50,000 square yards of Tensar-type geogrid will be required for Stage A foundation.
3. The toe of the Stage A dike will be offset 200 feet from the top of Dike C.
4. Stages A, B, and C will have a depth of 12 feet and Stages D and E will be 15 feet deep.

ENGINEERING
UPTO 30%
FA WITH BOTTOMASH
FOR DIKES

BUDGET PLAN
USES 20%

KIF Dredge Cells

SHEET ______ OF ______

Areas by planimeter
(Calculated for use by Norris Lab in the hydrogeologic model of the area)

COMPUTED BKE DATE 5/23/95

CHECKED ______ DATE ______

Area at top of finished stack

$A_1 = 14.57$

$A_2 = 12.50$

$A_3 = 10.03$

$A_4 = 13.52$

$A_5 = 13.32$

$A_6 = 10.82$

$A_7 = 16.92$

$A_8 = 12.02$

$A_9 = 8.13$

$A_{10} = 13.55$

$A_{11} = 16.01$

$A_{12} = 15.65$

$$A = 157.04\,in^2 \left(\frac{100\,ft}{1\,in}\right)^2 \left(\frac{1\,acre}{43{,}560\,ft^2}\right)$$

A = 36.05 acres

TVA 11030 (WM-7-75)

KIF Dredge Cells

SHEET ______ OF ______

COMPUTED BKE DATE 5/23/95

CHECKED ______ DATE ______

Area of slopes (hor. projection)

$A_{13} = (315')(700') = 220,500\ ft^2$

$A_{14} = (335')(1060') = 355,100\ ft^2$

$A_{15} = (375')(790') = 296,250\ ft^2$

$A_{16} = (490')(370') = 181,300\ ft^2$

$A_{17} = (360')(1100') = 396,000\ ft^2$

$A_{18} = 11.57\ in^2 = 115,700\ ft^2$

$A_{19} = 14.45\ in^2 = 144,500\ ft^2$

$A_{20} = 18.35\ in^2 = 183,500\ ft^2$

$A_{21} = 13.82\ in^2 = 138,200\ ft^2$

$A_{22} = 33.65\ in^2 = 336,500\ ft^2$

$A_{23} = 19.35 = 193,500\ ft^2$

$A = 2,561,050\ ft^2$

$A = 58.79$ acres

True value (projected on slope)

$A = (1.05)(58.79) = 61.97$ acres

TVA 11030 (WM-7-75)

KIF Dredge Calcs

SHEET ____ OF ____

COMPUTED BKE DATE 5/23/95

CHECKED ____ DATE ____

Area of Ash Pond (from drwg 10N420)

Active

$$A = 13.59 \text{ in}^2 \left(\frac{606 \text{ ft}}{\text{in}}\right)^2 = 4,990,737 \text{ ft}^2$$

A = 114.57 acres

Stilling Pool

$$A = 4.07 \text{ in}^2 \left(\frac{606 \text{ ft}}{\text{in}}\right)^2 = 1,494,650 \text{ ft}^2$$

A = 34.31 acres

TVA 11030 (WM-7-75)

KIF Dredge Cells - Displacement due to seismic load

SHEET 1 OF

COMPUTED BKE DATE 6/12/95

CHECKED ______ DATE ______

From UTEXAS3 computer simulation the factor of safety equals 0.99 for a seismic factor of 0.062.

$K_y = 0.062$

Failure surface is: X = 250.0
Y = 434.5
R = 374.5

Check for deformation at the bottom of the stack.

From Fig. 3

$\frac{y}{H} = \frac{117ft}{117ft} = 1.0$

$U_{max} = 0.57g$ (see previous calcs)

$\frac{K_{max}}{U_{max}} = 0.33$

$K_{max} = 0.33(0.57g)$

$K_{max} = 0.188g$

From Fig 4

$\frac{K_y}{K_{max}} = \frac{0.062g}{0.188g} = 0.33$

Assume $M = 7.5 \rightarrow \frac{U}{K_{max}T_o} = 0.10s$

$U = (0.10s)(0.188)(32.2 ft/s^2)(0.6s)$

$U = 0.36 ft = 4.4 in$

TVA 11030 (WM-7-75)

Now check for deformation at top of stack (Assume a depth of 2 feet just below top cap).

$\frac{y}{h} = \frac{2}{117} = 0.02$

Figure 3

$\frac{K_{max}}{U_{max}} = 0.99$

$K_{max} = 0.99(0.57g)$

$K_{max} = 0.564g$

Figure 4

Assume M-7.5

$\frac{U}{K_{max} T_o} = 0.775s$

$U = (0.775s)(0.564)(32.2 ft/s^2)(0.6s)$

$U = 8.4 ft$

NEWMARK PROCEDURE (CONTINUED)

STEP 6. Determine the maximum value of average acceleration (k_{max}) for any level within the embankment using the maximum crest acceleration (u_{max}) determined in Step 5 and entering Figure 3.

[NOTE : THE NUMBER 0 IN THE y/h COLUMN IS THE CREST OF THE EMBANKMENT.]

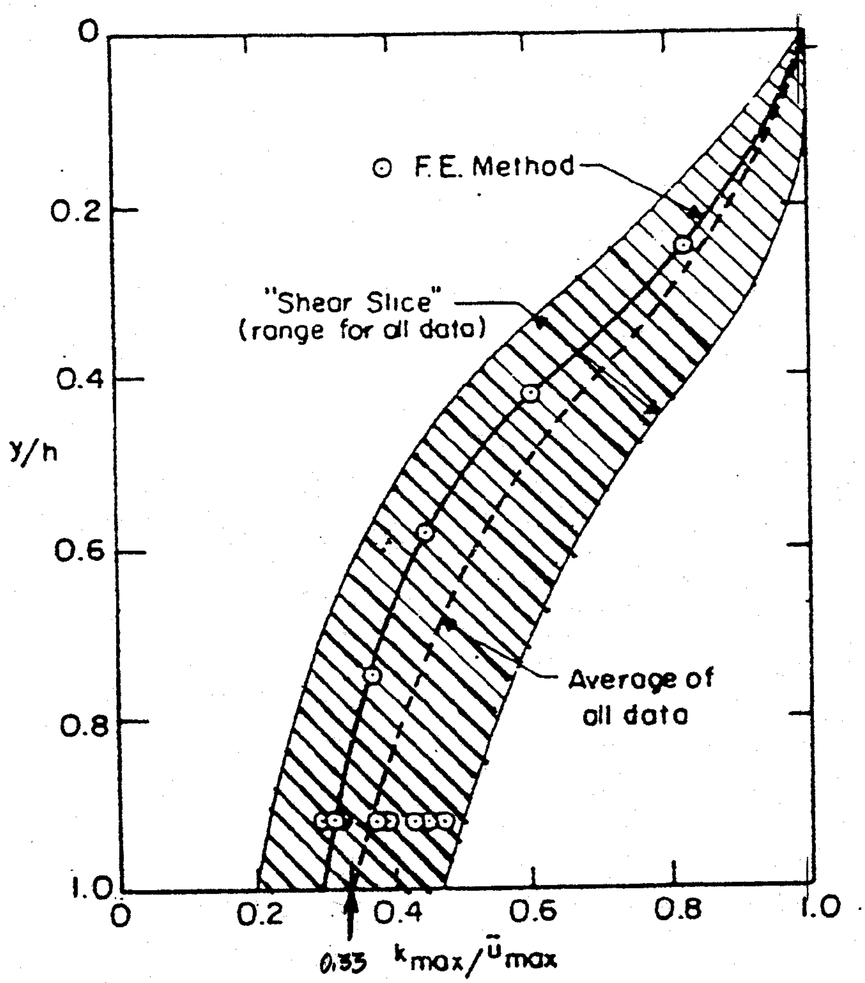


FIGURE 3: VARIATION OF " MAXIMUM ACCELERATION RATIO " WITH DEPTH OF SLIDING MASS

NEWMARK PROCEDURE (CONTINUED)

STEP 7. Determine the permanent displacements (U) for the yield acceleration (K_y) by entering Figure 4 with the appropriate values of k_{max} and T_o.

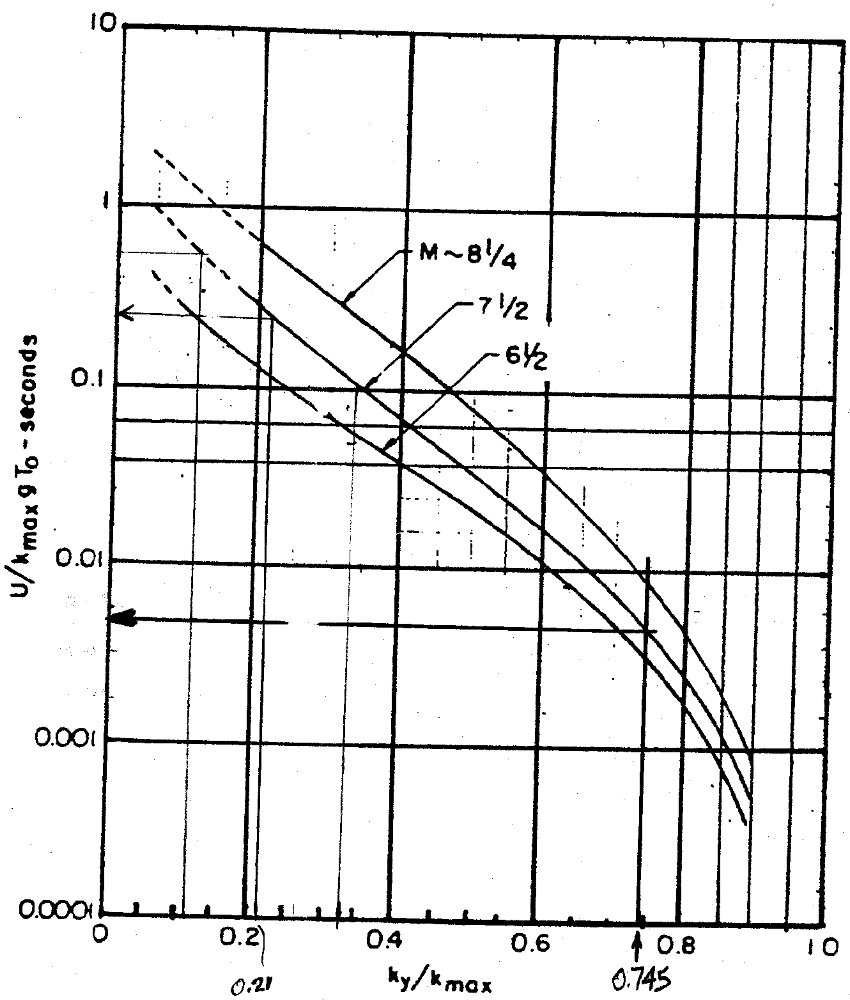


FIGURE 4: VARIATION OF AVERAGE NORMALIZED DISPLACEMENT WITH YIELD ACCELERATION

TVA-00013163

SHEET ______ OF ______

COMPUTED BKE DATE 6/9/95

CHECKED ______ DATE ______

Crack depth = 14

SEISFAC	Failure Surface X	Y	R	FS	# tried	# calc	Initial
0.061	359.5	526.0	483.0	1.287	355	351	
0.062	250.0	434.5	374.5	0.993	165	161	Tangent 0.0
0.062	355.5	1029.5	970.9	1.13	322	235	Point 408, 60
0.062	255.0	388.0	328.0	0.992	100	99	Tangent 60.0
0.062	362.5	1063.0	1004.6	1.13	256	208	Point 420, 60

TVA 11030 (WM-7-75)

HOLE 1

INITIAL CONSTRUCTION
ROLLED EARTH FILL

0'-10' CLAY (over water Table)

(8-10') $\gamma = 107.3$

10'-28' CLAY (under water table)

(22-24') $\gamma = -94.2$ ← use

$\bar{R}$ $\phi = 22.6$

$c = .40$ ← why are others so high?

use for both sections

HOLE 4

I. C. R. E. F.

0'-10' CLAY (over water Table)

$\gamma = 103.6$ ← use

10'-28' CLAY (under water table)

(22'-24') $\gamma = -106.8$

(24'-26') $\gamma = 116.9$ (not sat.?)

Overburden CLAY

$\gamma = 105.6$ (not sat ?)

HOLE 3

3 - WT ≈ 10'
6 - WT ≈ 17'

0'-24' DREDGE CELL DIKE

{ 0'-10' over water table
{ 10'-24' under water table

24-51' ex ash

51'-57' clay overburden

57'-63' sandy (FA) overburden

(15-17') Dredge cell Dike under water table

$\gamma = 77.9$ (why not (-)?)

test $\phi =$

$c =$

(33-35) Existing Ash

$\gamma = 97.8$ (why not (-)?)

$\phi =$ use table

$c =$ MEll cons

Hole 6 water table 16'7"

(13'-15') $\gamma = 87.1$

(15'-17') $\gamma = 82.8$

ex. ash (30-32') $\gamma = 84.9$ $\phi = 9.2$ $c = 2.91$

use Mc...

Maximum Crest Acceleration Calculations

COMPUTED BKE DATE 4/25/95

CHECKED ______ DATE ______

Data

$N = 24$ (Avg. SPT of site soils from Singleton Tests)

$a_{max} = 0.2g$ (From USGS Map MF-2120)

$h = 117$ ft

$\gamma_g = 100$ pcf (From Singleton test)

$\gamma_{soil} = 133$ pcf (From Singleton test)

$\rho_{soil} = \frac{\gamma_{soil}}{g} = \frac{133 \text{ pcf}}{32.2 \text{ ft/s}^2} = 4.13 \text{ sl}$

Approximate $G_{max} = 65N$

$G_{max} = 65(24) = 1560$ tsf

$V_{max} = \sqrt{\frac{G_{max}}{\rho}} = \sqrt{\frac{(1560 \text{ ton/ft}^2)(2000 \text{ lb/ton})}{4.13 \text{ sl}}} = 869$ ft/s

1st Iteration

Assume $V_s = 500$ ft/s

$\frac{G}{G_{max}} = \left(\frac{V_s}{V_{max}}\right)^2 = \left(\frac{500}{869}\right)^2 = 0.33$

From Fig 1
$\epsilon = 0.08\%$
$\lambda = 15\%$

Natural Frequencies & Periods

$\omega_1 = 2.4(V_s/h) = 2.4\left(\frac{500}{117}\right) = 10.26$ rad/s $\quad T_1 = \frac{2\pi}{\omega_1} = \frac{2\pi}{10.26} = 0.61$ sec

$\omega_2 = 5.52(V_s/h) = 5.52\left(\frac{500}{117}\right) = 23.59$ rad/s $\quad T_2 = \frac{2\pi}{\omega_2} = \frac{2\pi}{23.59} = 0.27$ sec

$\omega_3 = 8.65(V_s/h) = 8.65\left(\frac{500}{117}\right) = 36.97$ rad/s $\quad T_3 = \frac{2\pi}{\omega_3} = \frac{2\pi}{36.97} = 0.17$ sec

TVA 11030 (WM-7-75)

From Fig 2

$$\frac{S_{a1}}{a_{max}} = 1.21 \rightarrow S_{a1} = 1.21(0.2g) = 0.24g$$

$$\frac{S_{a2}}{a_{max}} = 1.53 \rightarrow S_{a2} = 1.53(0.2g) = 0.31g$$

$$\frac{S_{a3}}{a_{max}} = 1.38 \rightarrow S_{a3} = 1.38(0.2g) = 0.28g$$

Maximum Crest Accelerations ($\phi_1 = 1.6$, $\phi_2 = 1.06$, $\phi_3 = 0.86$)

$$u_{1max} = \phi_1 S_{a1} = 1.6(0.24g) = 0.38g$$

$$u_{2max} = \phi_2 S_{a2} = 1.06(0.31g) = 0.33g$$

$$u_{3max} = \phi_3 S_{a3} = 0.86(0.28g) = 0.24g$$

$$u_{max} = \sqrt{u_{1max}^2 + u_{2max}^2 + u_{3max}^2} = \sqrt{(0.38g)^2 + (0.33g)^2 + (0.24g)^2} = 18.0 \text{ ft/s}^2$$

Average shear strain

$$(\gamma_{ave})_{eq} = 0.65 \times 0.3 \times \frac{h}{V_s^2} \times S_{a1} = (0.65)(0.3)\left(\frac{117}{500^2}\right)[(0.24)(32.2)] = 0.071\%$$

Assumed shear strain does not match calculated ($\epsilon \neq (\gamma_{ave})_{eq}$)

2nd Iteration

Assume $\epsilon = 0.071\%$

From Fig 1

$$\frac{G}{G_{max}} = 0.346$$

$$\lambda = 14.4\%$$

TVA 11030 (WM-7-75)

Maximum Crest Acceleration Calculations

COMPUTED BKE DATE 4/25/95

CHECKED ______ DATE ______

$$\frac{G}{G_{max}} = \left(\frac{V_s}{V_{max}}\right)^2$$

$$V_s = V_{max}\sqrt{\frac{G}{G_{max}}} = 869\sqrt{0.346} = 511 \text{ ft/s}$$

Natural Frequencies & Periods

$$\omega_1 = 2.4\left(\frac{511}{117}\right) = 10.48 \text{ rad/s} \qquad T_1 = \frac{2\pi}{10.48} = 0.60 \text{ sec}$$

$$\omega_2 = 5.52\left(\frac{511}{117}\right) = 24.11 \text{ rad/s} \qquad T_2 = \frac{2\pi}{24.11} = 0.26 \text{ sec}$$

$$\omega_3 = 8.65\left(\frac{511}{117}\right) = 37.78 \text{ rad/s} \qquad T_3 = \frac{2\pi}{37.78} = 0.17 \text{ sec}$$

From Fig. 2

$$\frac{S_{a1}}{a_{max}} = 1.25 \rightarrow S_{a1} = 0.25g$$

$$\frac{S_{a2}}{a_{max}} = 1.55 \rightarrow S_{a2} = 0.31g$$

$$\frac{S_{a+}}{a_{max}} = 1.39 \rightarrow S_{a3} = 0.28g$$

Maximum Crest Accelerations

$$U_{1max} = 1.6(0.25g) = 12.88 \text{ ft/s}^2$$

$$U_{2max} = 1.06(0.31g) = 10.58 \text{ ft/s}^2$$

$$U_{3max} = 0.86(0.28g) = 7.75 \text{ ft/s}^2$$

$$U_{max} = \sqrt{(12.88)^2 + (10.58)^2 + (7.75)^2} = 18.4 \text{ ft/s}^2$$

Average Equivalent Shear Strain

$$(\gamma_{ave})_{eq} = (0.65)(0.3)\left(\frac{117}{511^2}\right)[(0.25)(32.2)] = 0.070\%$$

The assumed strain was 0.071%, so iterate one more time.

TVA 11030 (WM-7-75)

3rd Iteration

Assume $\epsilon = 0.070\%$

From Fig. 1

$$\frac{G}{G_{max}} = 0.342$$

$$\lambda = 14.3\%$$

$$\frac{G}{G_{max}} = \left(\frac{V_s}{V_{max}}\right)^2$$

$$V_s = V_{max}\sqrt{\frac{G}{G_{max}}} = 869\sqrt{0.342} = 508 \text{ ft/s}$$

Natural Frequencies & Periods

$\omega_1 = 2.4\left(\frac{508}{117}\right) = 10.42$ rad/s $\qquad T_1 = \frac{2\pi}{10.42} = 0.60$ sec

$\omega_2 = 5.52\left(\frac{508}{117}\right) = 23.97$ rad/s $\qquad T_2 = \frac{2\pi}{23.97} = 0.26$ sec

$\omega_3 = 8.65\left(\frac{508}{117}\right) = 37.55$ rad/s $\qquad T_3 = \frac{2\pi}{37.55} = 0.17$ sec

From Fig 2

$\frac{S_{a1}}{a_{max}} = 1.25 \rightarrow S_{a1} = 0.25g$

$\frac{S_{a2}}{a_{max}} = 1.55 \rightarrow S_{a2} = 0.31g$

$\frac{S_{a3}}{a_{max}} = 1.39 \rightarrow S_{a3} = 0.28g$

Maximum Crest Accelerations

$u_{1max} = 1.6(0.25g) = 12.88$ ft/s²

$u_{2max} = 1.06(0.31g) = 10.58$ ft/s²

$u_{3max} = 0.86(0.28g) = 7.75$ ft/s²

TVA 11030 (WM-7-75)

Maximum Crest Acceleration Calculations

COMPUTED BKE DATE 4/25/95

CHECKED ______ DATE ______

$$u_{max} = \sqrt{(12.88)^2 + (10.58)^2 + (7.75)^2} = 18.4 \text{ ft/s}^2$$

Average Shear Strain

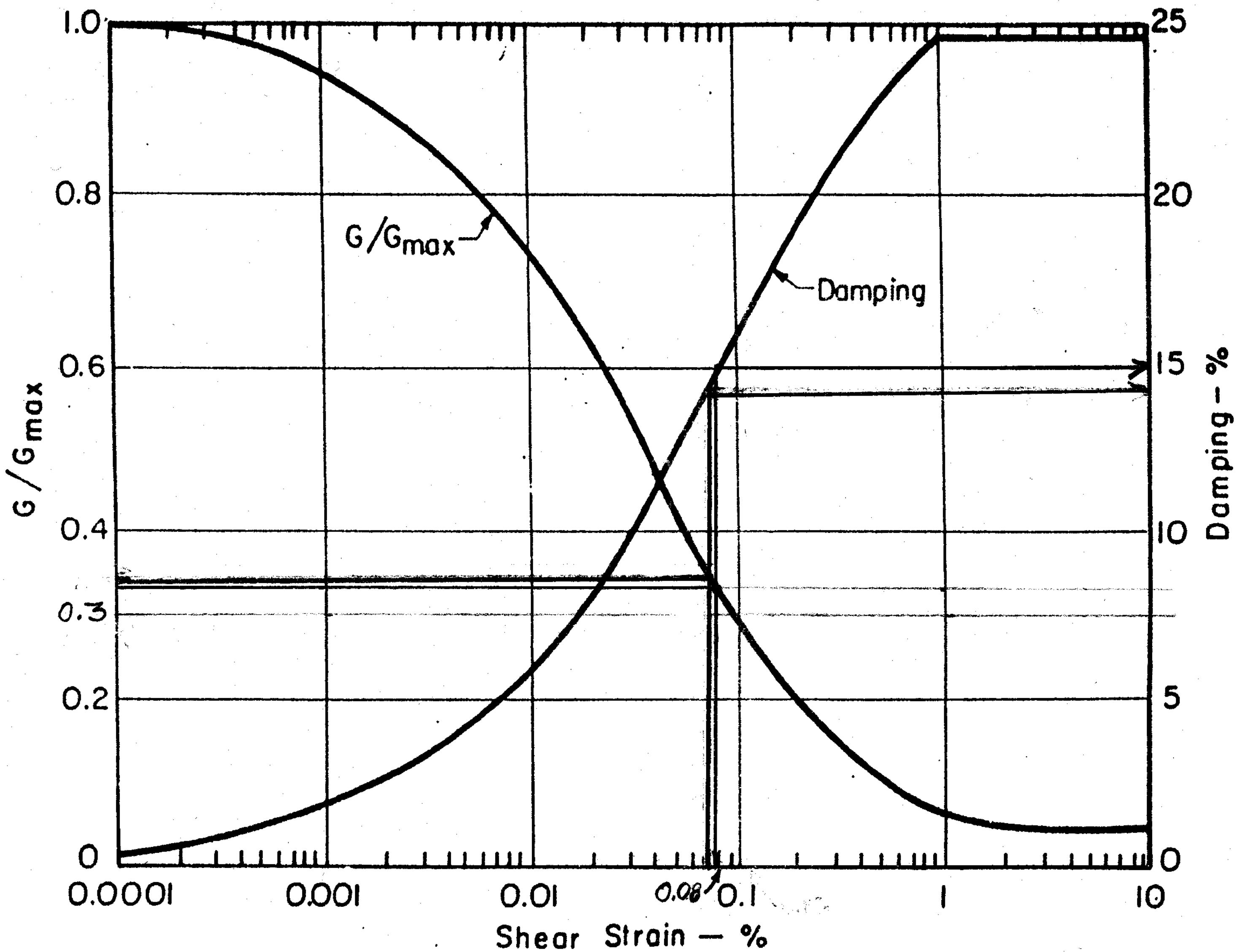
$$(\gamma_{AVE})_{eq} = (0.65)(0.3)\left(\frac{117}{508^2}\right)\left[(0.25)(32.2)\right] = 0.070\%$$

Assumed shear strain matches calculated value ($\epsilon = \gamma_{AVE}$), so maximum crest acceleration is

$$\boxed{u_{max} = 18.4 \text{ ft/s}^2}$$

TVA 11030 (WM-7-75)

7



— 1st Iteration

FIGURE 1: SHEAR MODULUS AND DAMPING CHARACTERISTICS USED IN RESPONSE CALCULATIONS

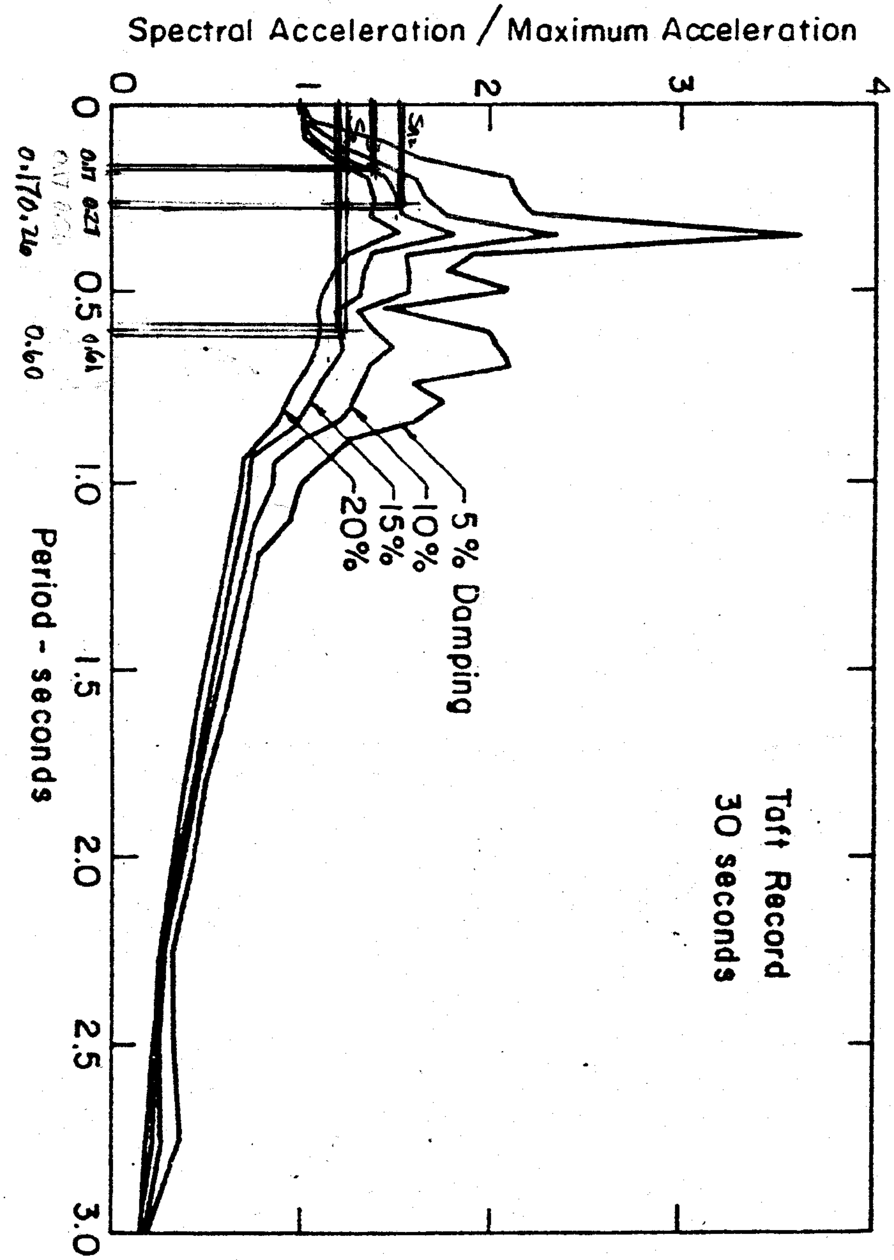


FIGURE 2: NORMALIZED ACCELERATION RESPONSE SPECTRA - TAFT RECORD
(NORTH - SOUTH COMPONENT)

File	data file	Failure Surface X	Y	R	FS	Initial Search	Comments
KIFSEIS1.OUT	KIFSEIS.DAT	347.0	391.5	376.5	1.003	Circle x=330 Y=310 Tangent Y=1.0	Seismic Factor = 0.14
KIFSEIS2.OUT	KIFSEIS	348.5	404.0	389.0	0.974	same	Seismic Factor = 0.15 (some points did not converge)
KIFSEIS3.OUT	"	347.0	391.5	376.5	1.003	x=330 Y=200 Tangent Y=1.0	Seismic Factor = 0.14 New initial location
KIFSEIS4.OUT	"	347.0	391.5	376.5	1.003	X=320 Y=200 Tangent Y=1.0	same as above
KIFSEIS5.OUT	"	347.0	391.5	376.5	1.003	X=330 Y=310 Tangent Y=5.0	same as above

177 171

217 208

233 220 / 13

230 220 / 12

16 589 545 / 44

30 598 490 / 108

17 208 158 / 50

18 236 178 / 58

20 557 503 / 54

15 603 tried 558 calculated / 45

12 904 836

13 222 178 / 44

14 tried 236 calc 192 / 44

SHEET ______ OF ______

COMPUTED ______ DATE ______

CHECKED ______ DATE ______

OUTPUT FILE	INPUT FILE	FS	Failure Circle X	Failure Circle Y	Failure Circle R	Initial Try Circle	Initial Try Tangent / Point
RUN1.OUT	RUN1C.DAT	2.361	345.0	325.5	317.0	Circle X=330 Y=310	Tangent Y=1.0
RUN2.OUT	RUN2.DAT	1.762	345.0	657.0	600.3	Circle X=330 Y=310	Point X=408 Y=60
RUN3.OUT	RUN3.DAT	1.771	342.5	601.0	544.95	Circle X=250 Y=310	Point X=408 Y=60
→ RUN4.OUT	RUN4.DAT	1.751	347.5	714.0	656.8	X=330 Y=600	Point X=408 Y=60

STATIC

TVA 11030 (WM-7-75)

TVA-00013175

File	.dat file	Proc	Failure Surface X	Failure Surface Y	R	FS	Initial Search	Comments
KIF1.OUT		Spencer	330.5	309.5	283.09	1.566	X=330 Y=310 Point w/ X=408 Y=60	R̄ values for strength c assumed = 0 for all $\phi = 34°$ for BA $\phi = 20°$ for FA
KIF2.OUT		Corps	328.0	305.5	277.07	1.561	Same	Same / Angle of force = 10°
KIF3.OUT		Bishop	330.0	307.5	281.85	1.568	Same	Same / Hor side force
KIF4.OUT		Spencer	330.0	307.5	281.00	1.566	X=330 Y=310 Radius = 290	
KIF5.OUT		Spencer	774.0	102.5	88.0	1.179	X=740 y=140 Tangent to y=-1.0	Increased c value of Rolled compacted earth to 50lb/ft²
KIF6.OUT		Spencer	765.5	168.0	154.00	1.409	Same	Increased c value to c=100
KIF7.OUT		Spencer	770.5	96.0	82.0	1.268	Same	Make c=75
This one worked → KIF8.OUT		Spencer	330.0	308.5	282.34	1.566	X=330 Y=310 Point w X=408 Y=60	Kifcella.dat except FS = 9.0 instead of 3.0 initially
KIF9.OUT		Spencer	751.5	137.5	122.5	1.423	X=735 Y=135 Tangent to 15.0	Same as above but with different starting coords c=100 for rolled earth (groups 4&5)
KIF10.OUT		Spencer	330.0	308.5	282.34	1.566	Same as KIF8	Same as KIFCELLC runs but corrected γ of residual material & γ of rolled earth
KIF11.OUT	Kifcelld	Spencer	302.0	331.5	316.35	1.332	circle w/ X=330 Y=310 Point w/ X=408 Y=68	Kifcelld.dat w/ actual values from tests (r strength) assumed strength for fly ash
KIF12.OUT	Kifcelld	Spencer	705.0	305.0	290.0	2.917	Circle w/ x=735, Y=135, Tan to 15.0	Same as KIF11 w/ different starting point
KIF13.OUT	KIFSEIS	Spencer	325.0	294.0	276.24	1.657	Circle X=330 y=310 Point x=408 Y=60	SEISMIC run w/ seismic coeff equal to zero
KIF14.OUT	Kifcellc	Spence	320.5	351.0	308.0	1.280	Circle X=330 y=31 tan to y=1.0	Used new values for fly ash from Singleton Labs

SEISFAC = 0.14

Initial FS = 15.0

FS = 1.003 Iter = 40

\# tried = 257

\# calc = 239

SEISFA = 0.135

Intial FS = 9.0

Iter. = 40

\# tried 264

\# calc. 256

Initial FS = 12.0

FS = 1.018

\# tried 259

\# calc 253

Changed intial BC From Point @ 400,60 to Tangent @ 1.0

Initial FS = 9.0

SEISFAC = 0.14

391.00
- 375.824

15.176

X = 346.50

Y = 391.00

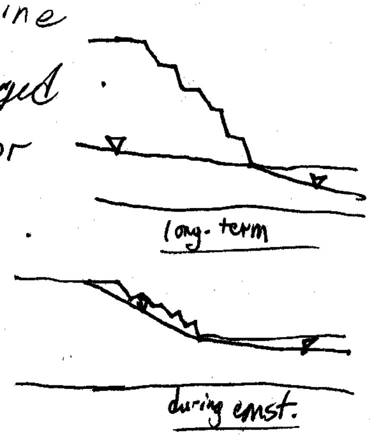
R = 375.824

Kifcella.dat - uses $\bar{R}$-values w/ c = 0 - used $\phi = 34°$ for bottom ash & $\phi = 20°$ for fly ash based on Cumberland stability analysis. Got FS ≈ 1.56 for new dike & FS ≈ 0.84 for existing dike.

Kifcellb.dat - same as above but increased the c value of the rolled, compacted earth

Kifcellc.dat - same as Kifcella.dat with a factor of safety initially set to 9.0

Kifcelld.dat - same as Kifcellc except the piezometric line and material property data was changed to reflect a higher water level for just-constructed conditions



Mark 535-8626

SOIL IDENTIFICATION	UNIT WEIGHT (pcf)		SHEAR STRENGTH						REMARKS
			Q		R		Rbar		
	γ_{moist}	γ_{sat}	c (tsf)	Φ (deg)	c (tsf)	Φ (deg)	cbar (tsf)	Φbar (deg)	
Rolled, compacted earth dike	114.2	119.3	0.0	12.7	0.69	6.1	0.40	22.6	Values from Singleton Lab test (Sep. 94)
Residual material	133.4	136.7	1.16	11.0	1.24	14.7	0.60	29.6	"
Bottom ash	109.9	114.8	0.0	37.4	0.95	15.9	0.49	29.1	"
Fly ash	110.1	114.4	1.30	22.3	0.32	35.8	0.0	37.5	"
Bottom ash (CUF '86)	108	124			0.75	24	0	34	CUF Ash Pond Dike Stability Analysis - 12/86
Fly ash (CUF '86)					0.10	15	0	15	"

Plant: Kingston Fossil
Project: Dredge Cell Design
Description: Liquefaction Calculations (At x=90 on the calc. grid)
Vertical slice through top of dike
Computed: B K Elder
Date: 5/2/95

Depth (ft)	Ptot (psf)	Po (psf)	Cn	N	N1	rd	Ri	Rf	FS
10	1099	1099	1.31	30	39.30	0.98	0.127	0.476	3.74
20	2198	2198	0.97	30	29.10	0.95	0.124	0.312	2.53
30	3197	3197	0.80	5	4.00	0.92	0.120	0.044	0.37
40	4227	3946	0.72	5	3.60	0.85	0.118	0.040	0.34
50	5295	4390	0.67	5	3.35	0.75	0.118	0.038	0.32
60	6363	4834	0.63	5	3.15	0.66	0.113	0.033	0.29
70	7431	5278	0.60	5	3.00	0.59	0.108	0.032	0.30
80	8499	5722	0.57	10	5.70	0.55	0.106	0.066	0.62
90	9567	6166	0.54	10	5.40	0.52	0.105	0.061	0.58
100	10635	6610	0.52	10	5.20	0.49	0.102	0.058	0.57

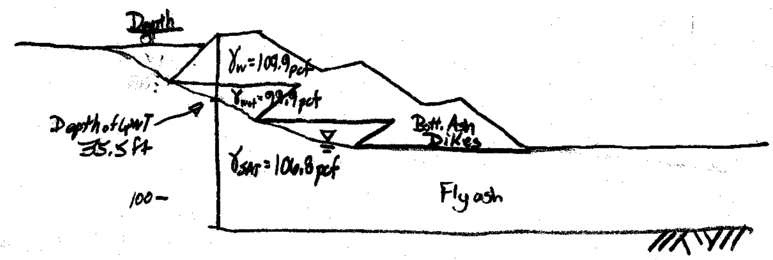
KIF - Dredge Cell Design SHEET 1 OF

Liquefaction Calculations (At x = 90 on calc. grid)

COMPUTED BKE DATE 5/2/93

CHECKED DATE

As an example, calculations are presented for a depth of 50 feet. Calculations were made for depths from 10 to 100 feet and are presented in the accompanying table.



Depth = 50 ft

$P_{tot} = \Sigma \gamma_i d_i$

$P_{tot} = (20\text{ ft})(109.9\text{ pcf}) + (15.5\text{ ft})(99.9\text{ pcf}) + (14.5\text{ ft})(106.8\text{ pcf})$

$P_{tot} = 5295$ psf

$P_o = \Sigma \gamma_i d_i + \Sigma(\gamma_j - \gamma_{H_2O}) d_j$

$P_o = (20\text{ ft})(109.9\text{ pcf}) + (15.5\text{ ft})(99.9\text{ pcf}) + (14.5\text{ ft})(106.8\text{ pcf} - 62.4\text{ pcf})$

$P_o = 4390$ psf

Use Fig 5

$C_n = 0.67$

$N = 5$ for this depth

$N_1 = C_N N = 0.67(5) = 3.35$

Use Fig 6

$r_d = 0.75$

$R_i = 0.65 a_{max} \frac{P_{tot}}{P_o} r_d$

$R_i = 0.65(0.2)\left(\frac{5295}{4390}\right)(0.75)$

$R_i = 0.118$

TVA 11030 (WM-7-75)

KIF - Dredge Cell Design — SHEET 2 OF

Liquefaction Calculations (At x=90 on calc. grid)

COMPUTED BKE DATE 5/2/95

CHECKED DATE

Use Fig 7 (Assume M=7.5)

$R_f = 0.038$

$FS = \frac{R_f}{R_i}$

$FS = \frac{0.038}{0.118}$

$FS = 0.32 < 1.0$ so liquefaction may occur

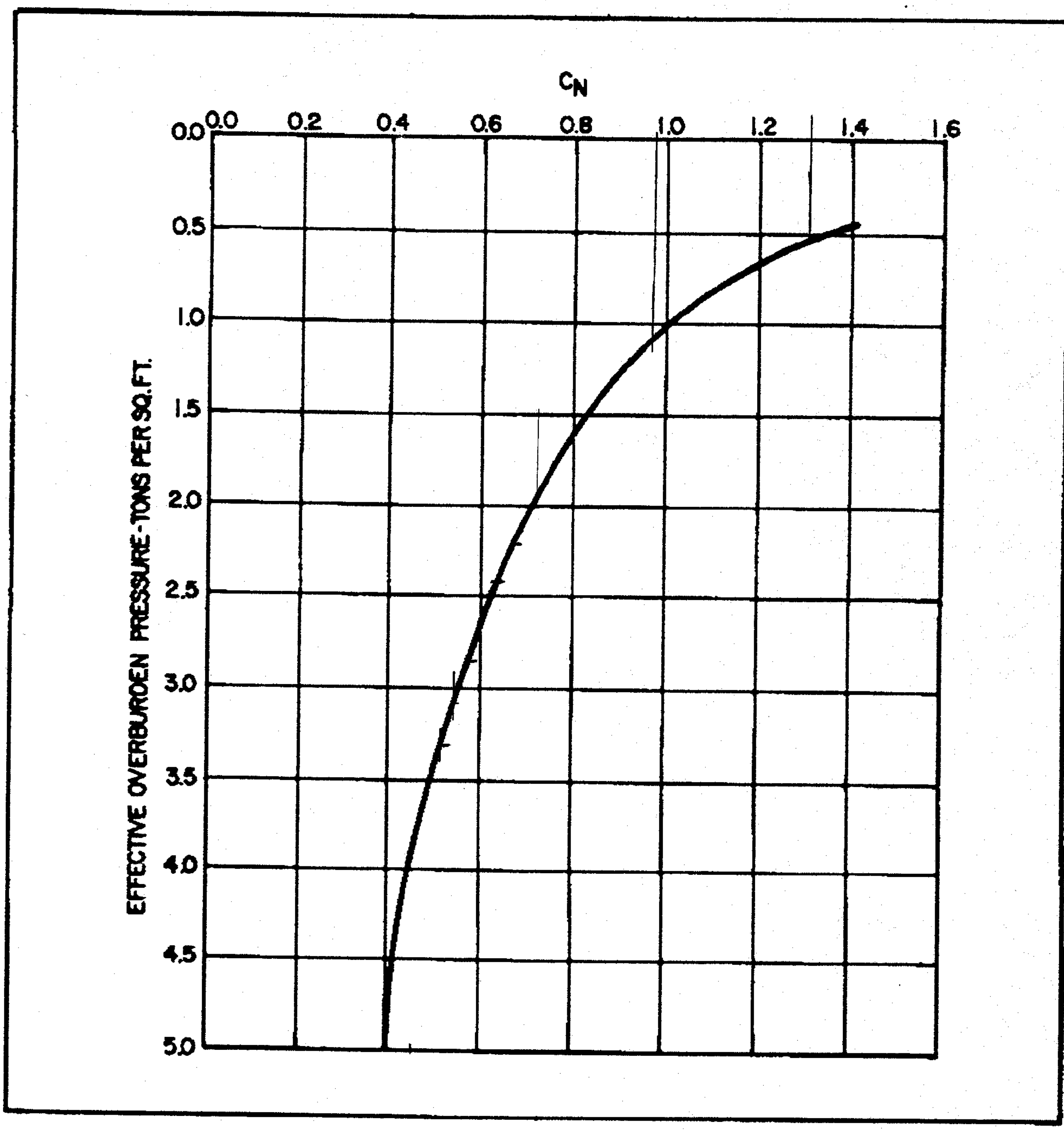
Use Fig 8 to determine if damage will occur to surface

Surface layer thickness = 20 ft = 6.1 m

Thickness of liquefiable layer = 30 ft = 9.1 m

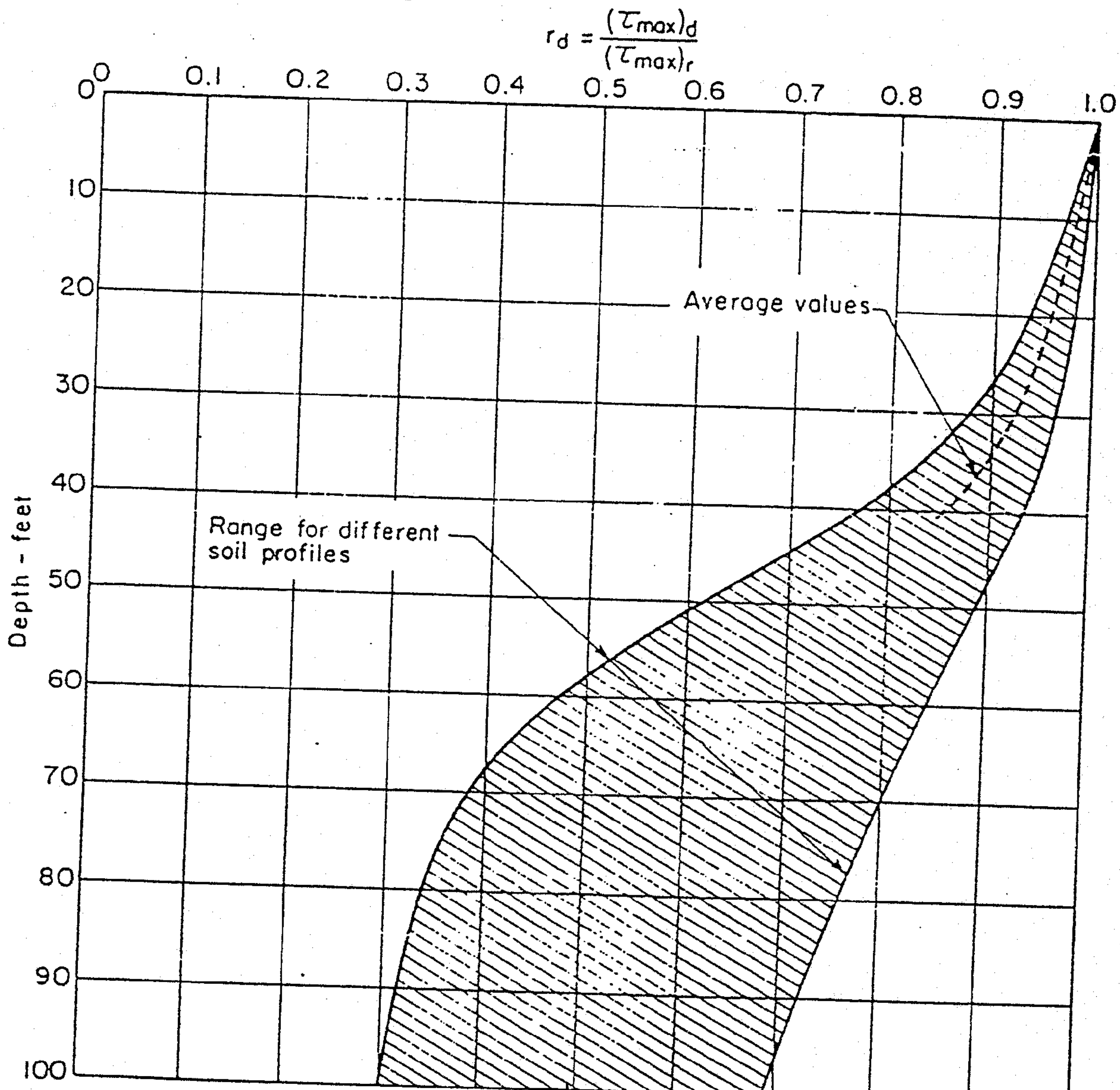
No damage will occur to the dikes for any depth of fly ash that liquefies according to Fig 8. The surface layer thickness is greater than the minimum thickness required to prevent damage for a maximum acceleration of 0.2g.

TVA 11030 (WM-7-75)



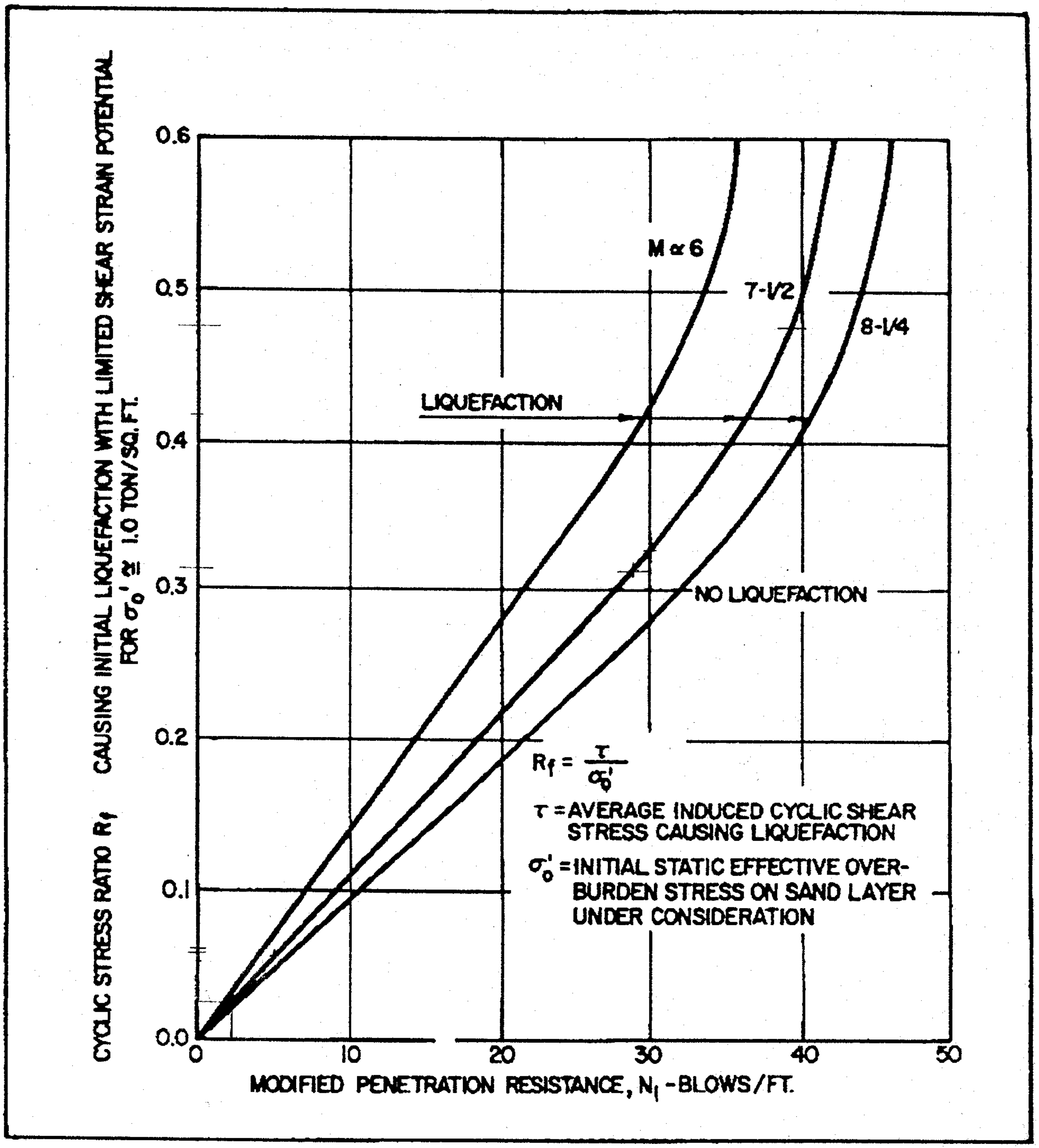
Correlation Between C_N and Effective Overburden Pressure

FIGURE 5
(FROM NAVFAC 7.3)



—RANGE OF VALUES OF r_d FOR DIFFERENT SOIL PROFILES

FIGURE 6
(FROM H. B. SEED)



Correlation Between Field Liquefaction Behavior of Sands for Level Ground Conditions and Modified Penetration Resistance

FIGURE 7
(FROM NAVFAC 7.3)

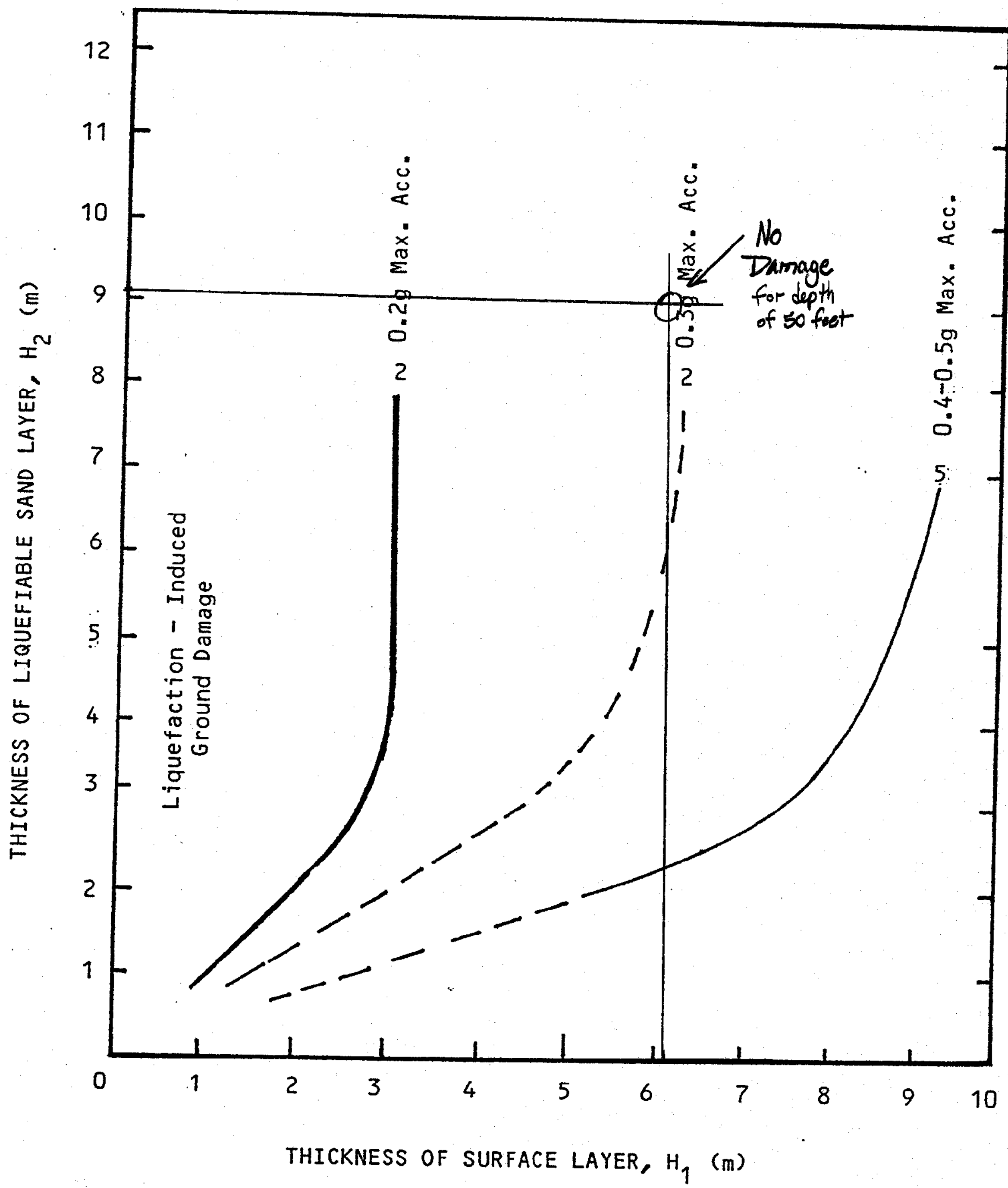


FIGURE 8

BOUNDARY CURVES FOR LIQUEFACTION SURFACE EVENT
(Ishihara, 1985)

Maximum Surface Acceleration = 0.22g

Assume N=5

Depth	P_{tot}	P_o	C_N	N_1	Γ_d	R_i	R_c	FS
0	0	0	—	—	—	—		
10	999	999	1.35	6.75	0.98	0.127	0.078	0.614
20	1998	1998	1.0	5	0.95	0.124	0.055	0.444
30	2997	2997	0.83	4.15	0.92	0.120		
40	3996	3996	0.72	3.6	0.85	0.111		
50	4995	4995	0.62	3.1	0.75	0.0975		
60	5994	5994	0.55	2.75	0.66	0.086		
70	6993	6681	0.51	2.55	0.59	0.080		
80	7992	7056	0.50	2.50	0.55	0.081		
90	8991	7431	0.48	2.40	0.52	0.082		
100	9990	7806	0.45	2.25	0.49	0.082		
110	10,989	8181	0.43	2.15				

Moist ↑ / Sat ↓

FS<1 for all cases !!!

Liquefaction Calcs

$a_{max} = 0.20g$

Assume $N = 5$

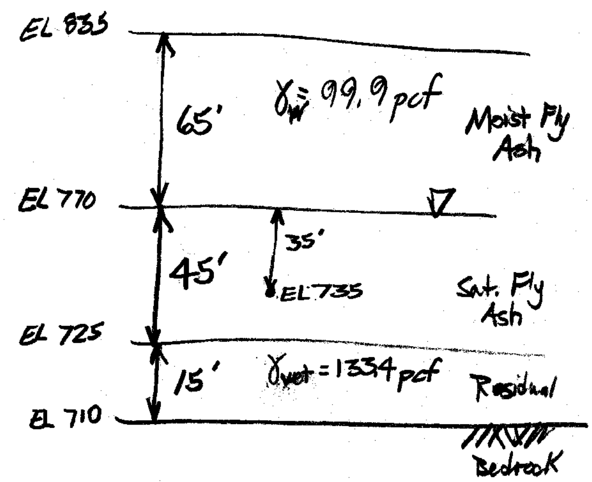
Assume pt. @ El 735 in center of area (beyond influence of dikes)

$P_o = (99.9\,pcf)(65') + 35'(99.9 - 62.4)$

$P_o = 7806\,psf = 3.90\,tsf$

$P_{tot} = 99.9\,pcf\,(100\,ft)$

$P_{tot} = 9990\,psf$



Use Fig 5 to get C_N

$C_N = 0.46$

$N_1 = C_N \cdot N = 0.46(5) = 2.3$

Fig 6 → $r_d = 0.49$

$R_i = 0.65\,a_{max} \frac{P_{tot}}{P_o} r_d$

$R_i = 0.65(0.2)\left(\frac{9990}{7806}\right)(0.49)$

$R_i = 0.0815$

If $N = 10$

$N_1 = 4.6$

Fig 7 (Assume $M = 7.5$)

$R_f = 0.025$

$F_s = \frac{R_f}{R_i}$

$F_s = \frac{0.025}{0.0815}$

$F_s = 0.31$

KIF Dredge Cell Design — SHEET 1 OF

Liquefaction Calc's (At x = 90 on the calc. grid) — COMPUTED BKE DATE 5/1/95

CHECKED ____ DATE ____

	Depth	P_{tot}	P_o	C_N	N*	N_1	r_d	R_i	R_f ⊕	FS
	10	1099	1099	1.35	30	40.50	0.98	0.127	0.418	3.29
γ_{wet} = 109.9 pcf	20	2198	2198	1.00	30	30.0	0.95	0.124	0.325	2.62
	30	3866	3866	0.83	5	4.15	0.92	0.120	0.047	0.39
Depth 33.5 ∇	40	4896 (4415)	4615	0.72	5	3.60	0.85	0.117	0.041	0.35
γ_{wet} = 99.9 pcf	50	5964	5059	0.62	5	3.10	0.75	0.115	0.035	0.30
γ_{SAT} = 106.8 pcf	60	7032	5503	0.55	5	2.75	0.66	0.110	0.029	0.26
	70	8100	5947	0.51	5	2.55	0.59	0.104	0.027	0.26
	80	9168	6391	0.50	10	5.0	0.55	0.103	0.056	0.54
	90	10,236	6835	0.48	10	4.80	0.52	0.101	0.053	0.52
	100	11,304	7279	0.45	10	4.50	0.49	0.099	0.050	0.51
	110	12,372	7723	0.43	10	4.30	?			
γ_{wet} = 133.4 pcf; γ_{SAT} = 136.7 pcf	120									

* 0 to 20 ft - avg of BA dike values for hole 8 & 9 = 44
20 to 70 ft - SPT of 5 assumed based on FA data
70+ ft - SPT of 10 assumed due to consolidation & data from hole 9

⊕ Assume M = 7.5

TVA 11030 (WM-7-75)

For SEISFAC = 0.14, FS = 1.003

So $K_y = 0.14$

Failure Surface - $X = 347.0$
$Y = 391.5$
$R = 376.5$

For Figure 3

$H = 117$ ft
$y = 117$ ft $\rightarrow \frac{y}{H} = 1.0$

$U_{max} = 18.4 \text{ ft/s}^2 = 0.57g$

Use Fig 3 $\rightarrow \frac{K_{max}}{U_{max}} = 0.33$

$K_{max} = 0.33(0.57g)$

$K_{max} = 0.188g$

Fig. 4 Displacements

$\frac{K_y}{K_{max}} = \frac{0.14g}{0.188g} = 0.745$

Assume M=7.5

$\frac{U}{K_{max}T_0} = 0.0071 \Rightarrow$

$U = (0.0071)(0.188)(32.2 \text{ ft/s}^2)(0.6s)$

$U = 0.026$ ft $= 0.3$ in

$\frac{12.8}{x} = \frac{19}{0.2}$

$x = 0.1347$

$\frac{K_{max}}{U_{max}} = 0.2 + 0.13$

$= 0.33$

Fig 4 - abscissa

Using tenths of an inch on scale

$\frac{77}{0.2} = \frac{x}{0.145}$

$x = 56$

Fig 4 - ordinate

Using tenths of an inch on scale

$\frac{96}{0.009} = \frac{65}{x}$

$x = 0.0061$

$\frac{U}{K_{max}T_0} = 0.001 + 0.0061$

$= 0.0071$

KIF Dredge Cells - North Ditch

SHEET ____ OF ____

COMPUTED BKE DATE 5/30/95

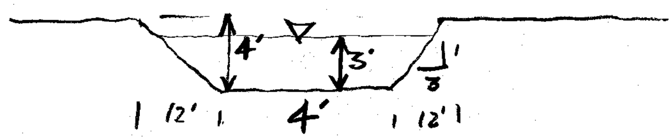
CHECKED ____ DATE ____

There is not enough vertical clearance to construct a grass lined (natural) ditch along the north side & achieve an adequate slope to drain. From previous runoff calc's, approximately 93 cfs will be delivered to the ditch by a 25yr, 30min storm.

Assume a slope of 0.25%, or 0.0025 ft/ft

Assume a Manning's n = 0.012 (for concrete)

Assume a trapezoidal channel as follows:



$R = \frac{(b+zy)y}{b+2y\sqrt{1+z^2}}$ $A = (b+zy)y$ $Q = \frac{\phi}{n} A R^{2/3} S_0^{1/2}$

$R = \frac{(4+(3)(3))3}{4+2(3)\sqrt{1+3^2}}$ $A = (4+3(3))3$ $Q = \frac{1.49}{0.012}(39)(1.70)^{2/3}(0.0025)^{1/2}$

$R = 1.70$ ft $A = 39 \text{ ft}^2$ $Q = 345$ cfs

TVA 11030 (WM-7-75)

KIF Dredge Cells

SHEET ____ OF ____

COMPUTED BKE DATE 5/30/95

CHECKED ____ DATE ____

Area draining to north ditch

from calculations for Norris Lab on 5/23/95

$A_1 + A_2 + A_{18} + A_{19} + A_{13} + A_{20} + A_4 + A_6 + \frac{1}{2}A_{17} =$

$14.57 + 12.50 + 11.57 + 14.45 + 22.05 + 18.35 + 13.52 + 10.82 + \frac{1}{2}(39.6) = 137.63 \text{ in}^2$

$A = 137.63 \text{ in}^2 \left(\frac{100 \text{ ft}}{\text{in}}\right)^2$

$A = 1,376,300 \text{ ft}^2$

Assume $i = 4.0$ in/hr (25yr, ½hr rainfall = 2.0in from Tech Paper 40)

Assume $C = 0.7$

$Q = CiA$

$Q = (0.7)(4.0 \text{ in/hr})(1,376,300 \text{ ft}^2)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right)\left(\frac{1 \text{ hr}}{3600 \text{ sec}}\right)$

$Q = 89.2$ cfs = capacity needed for north ditch

TVA 11030 (WM-7-75)

SHEET ______ OF ______

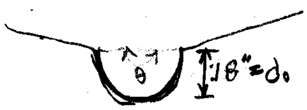
COMPUTED ______ DATE ______

CHECKED ______ DATE ______

$0.5\% = 0.005(1700)$
$8.5\,ft$

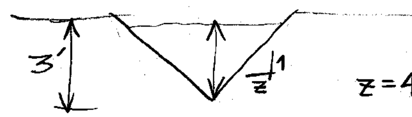
$$V = \frac{\phi}{n} R^{2/3} S_0^{1/2}$$

Assume
$V = 1\,fps$
$n = 0.01$ (ADS 36" corrugated N-12 polyethylene pipe)
$\phi = 1.49$



$\theta = \pi$

$R = \frac{1}{4}\left(1 - \frac{\sin\theta}{\theta}\right) d_0$
$R = \frac{1}{4}\left(1 - \frac{\sin\pi}{\pi}\right)(3')$
$R = 3/4'$



$z = 4$
$y = 2'$

$n = 0.012$

$V = \frac{\phi}{n} R^{2/3} S_0^{1/2}$

$S_0 = \left(\frac{Vn}{\phi R^{2/3}}\right)^2$

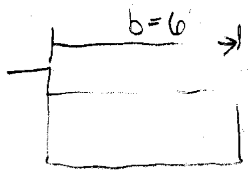
$S_0 = \left(\frac{(1)(0.01)}{1.49(.75)^{2/3}}\right)^2$

$S_0 = 0.0000066 = 0.007\%$

$R = \frac{zy}{2\sqrt{1+z^2}}$
$R = \frac{4(2)}{2\sqrt{1+4^2}}$
$R = 0.97\,ft$

$S_0 = \left(\frac{(1)(0.012)}{1.49(.97)^{2/3}}\right)^2$

$S_0 = 6.8\times10^{-5}\,ft/ft = 0.0068\%$



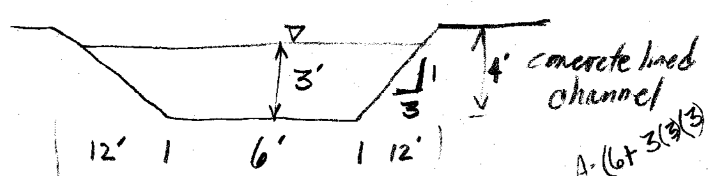
$n = 0.012$ (concrete)

$R = \frac{by}{b+2y}$
$R = \frac{(6)(2)}{6+2(2)}$
$R = 1.2'$

$S_0 = \left(\frac{Vn}{\phi R^{2/3}}\right)^2$

$S_0 = \left(\frac{(1)(0.012)}{1.49(1.2)^{2/3}}\right)^2$

$S_0 = 5.1\times10^{-5} = 0.0051\%$



$A = (6+3(3))(3)$
$Q = AV$
$Q = (3\,fps)(45\,ft^2)$
$Q = 135\,cfs$

$R = \frac{(b+zy)(y)}{b+2y\sqrt{1+z^2}}$
$R = \frac{(6+3(3))(3)}{6+2(3)\sqrt{1+3^2}}$
$R = 1.80'$

Assume $V = 3\,fps$

$S_0 = \left(\frac{3(0.012)}{1.49(1.8)^{2/3}}\right)^2$

$S_0 = 2.7\times10^{-4} = 0.027\%$

TVA 11030 (WM-7-75)

SHEET ____ OF ____

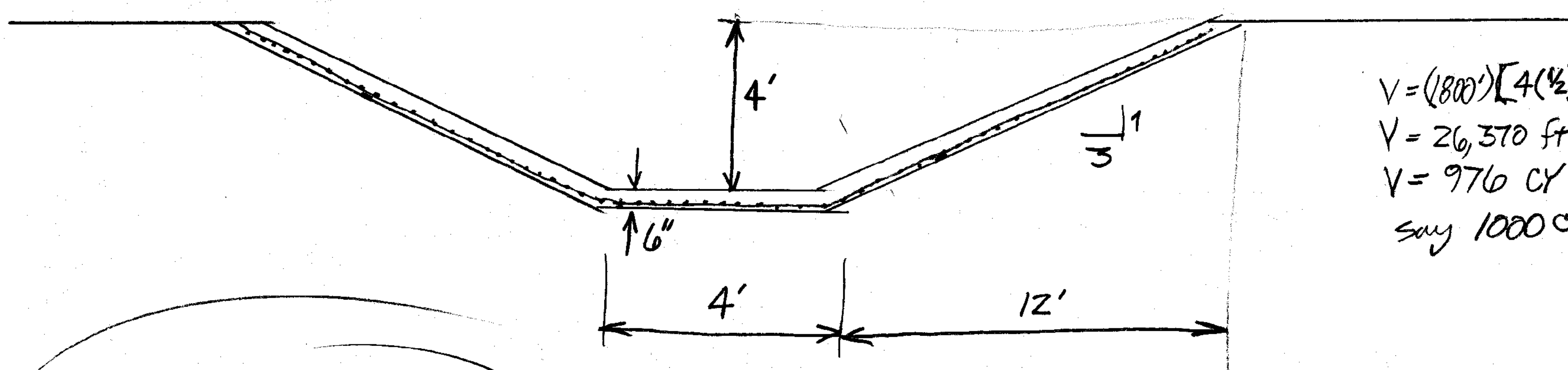
COMPUTED ____ DATE ____

CHECKED ____ DATE ____

16
08
64

64
1800
5|1800
64
115,200 ft³

27)115,200 = 42
108
72
54
8



$V = (1800')[4(1/2) + 12.65(1/2)(2)]$

$V = 26,370\ ft^3$

$V = 976\ CY$

say 1000 CY

1000 CY CLASS B CONC
53,000 SF WWF

$2.^{50}$ sq ft

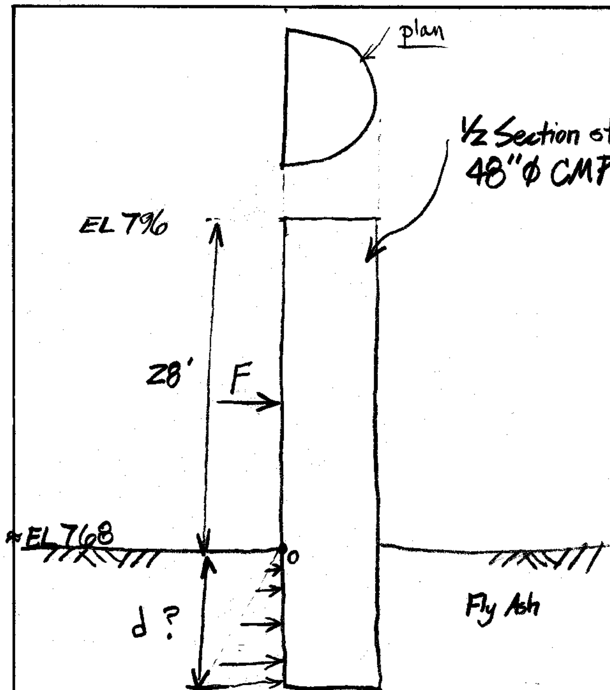
from Jim Short
5/31/95

$26,500

KIF Dredge Cell - Spillway Stability Calc's SHEET 1 OF

COMPUTED BKE DATE 5/11/95

CHECKED DATE



How deep to bury the foundation?

$\gamma_{FA} = 75\ pcf$

Assume that pipe is a flat plane

$W_{FA} = \frac{1}{2}(d)(\gamma_{FA} d)(4') = 2\gamma_{FA} d^2$

See next page for wind load calc's

$F = p_o A = (11.18 psf)(28 ft)(4 ft)$

$F = 1252\ lb = 1.252\ K$

Balance the moment (According to "Minimum Design Loads for Buildings & Other Structures", overturning moment can only be 2/3 of resisting moment.)

$\Sigma M_o = 0$

$\frac{2}{3}\left[2\gamma_{FA} d^2 \left(\frac{2}{3}d\right)\right] - 28F = 0$

$\frac{8}{9}\gamma_{FA} d^3 = 28F$

$d = \sqrt[3]{\frac{9(28)F}{8\gamma_{FA}}}$

$d = \sqrt[3]{0.42F}$

$d = \sqrt[3]{0.42(1252)}$

$\boxed{d = 8.07\ ft}$

TVA 11030 (WM-7-75)

TVA-00013195

SUBJECT KIF Dredge Cell - Spillway Stability Calc's PROJECT

CEL 5/11/95

COMPUTED BY DATE CHECKED BY DATE

KINGSTON

$q_z = 0.00256\, K_z (IV)^2$

$I = 0.95$

$V = 70_{mph}$

$K_z = 0.98$

$q_z = 0.00256\,(0.98)\{(0.95)(70)\}^2$

$q_z = 11.09$

$G_H = 1.26$

$C_p = 0.8$

$P = q\, G_h\, C_p$

$P = (11.09)(1.26)(0.8) = 11.18_{psf}$

$P = 11.18\,psf$

AVG SPT of Site Soils → N = 24

$a_{max} = 0.2g$ (from USGS map)

Determine crest acceleration

$h = 117$ ft

$\gamma_g = 100$ pcf (from samples)

$\gamma_{soil} = 133$ pcf (from samples)

$\rho_g = \frac{\gamma_g}{32.2} = \frac{100}{32.2} = 3.11$

$\rho_{soil} = \frac{\gamma_{soil}}{32.2} = \frac{133}{32.2} = 4.13\ sl = 4.13\ \frac{lb \cdot s^2}{ft^4}$

$\frac{lb/ft^3}{ft/s^2}$ $\quad \frac{lb \cdot s^2}{ft^4}$

$G_{max} = 65N = 65(24)$

$G_{max} = 1560$ TSF

$V_{max} = \sqrt{\frac{G_{max}}{\rho}} = \sqrt{\frac{1560 \frac{ton}{ft^2}(2000 \frac{lb}{ton})}{4.13 \frac{lb \cdot s^2}{ft^4}}} = \underline{869\ fps}$

1st Iteration

Assume $V_s = 500$ fps

$\frac{G}{G_{max}} = \left(\frac{V_s}{V_{max}}\right)^2 = \left(\frac{500}{869}\right)^2 = 0.33$

9.5

from Fig 1

$\epsilon = 0.08\%$

$\lambda = 15\%$

Natural Frequencies

$\omega_1 = 2.4(V_s/h) = 2.4\left(\frac{500}{117}\right) = 10.26$ rad/sec $\quad T_1 = 0.61$ sec

$\omega_2 = 5.52(V_s/h) = 5.52\left(\frac{500}{117}\right) = 23.59$ rad/sec $\quad T_2 = 0.27$ sec

$\omega_3 = 8.65(V_s/h) = 8.65\left(\frac{500}{117}\right) = 36.97$ rad/sec $\quad T_3 = 0.17$ sec

From Fig 2

$\frac{S_{a1}}{a_{max}} = 1.21 \rightarrow S_{a1} = 1.21(0.2g) = 0.24g$

$\frac{S_{a2}}{a_{max}} = 1.53 \rightarrow S_{a2} = 1.53(0.2g) = 0.31g$

$\frac{S_{a3}}{a_{max}} = 1.38 \rightarrow S_{a3} = 1.38(0.2g) = 0.28g$

Max crest accelerations $\phi_1 = 1.6$ $\phi_2 = 1.06$ $\phi_3 = 0.86$

$U_{1max} = \phi_1 S_{a1} = 1.6(0.24g) = 0.38g$

$U_{2max} = \phi_2 S_{a2} = 1.06(0.31g) = 0.33g$

$U_{3max} = \phi_3 S_{a3} = 0.86(0.28g) = 0.24g$

$U_{max} = \sqrt{(.38g)^2 + (0.33g)^2 + (0.24g)^2}$

$U_{max} = 0.56g = 18.0 \text{ ft/s}^2$

Average Equiv. Shear Strain

$(\gamma_{ave})_{eq} = 0.65 \times 0.3 \times \frac{h}{V_s^2}(S_{a1}) = (0.65)(0.3)\left(\frac{117}{500^2}\right)[(0.24)(32.2)]$

$(\gamma_{ave})_{eq} = 0.071\%$

Assumed shear strain was $\epsilon = 0.08\%$

2nd Iteration

$\epsilon = 0.071\% \rightarrow$ From Fig 1 $\rightarrow \frac{G}{G_{max}} = 0.346$ $\lambda = 14.4\%$

$\frac{G}{G_{max}} = \left(\frac{V_s}{V_{max}}\right)^2 \rightarrow V_s = V_{max}\sqrt{\frac{G}{G_{max}}}$

$V_s = 869\sqrt{0.346}$

$V_s = 511$ fps

$\omega_1 = 2.4\left(\frac{511}{117}\right) = 10.48$ rad/sec $\qquad T_1 = \frac{2\pi}{10.48} = 0.60$ sec

$\omega_2 = 5.52\left(\frac{511}{117}\right) = 24.11$ " $\qquad T_2 = \frac{2\pi}{24.11} = 0.26$ sec

$\omega_3 = 8.65\left(\frac{511}{117}\right) = 37.78$" $\qquad T_3 = \frac{2\pi}{37.78} = 0.17$ sec

From Fig 2

$\frac{S_{a1}}{a_{max}} = 1.25 \rightarrow S_{a1} = 0.25g$

$\frac{S_{a2}}{a_{max}} = 1.55 \rightarrow S_{a2} = 0.31g$

$\frac{S_{a3}}{a_{max}} = 1.39 \rightarrow S_{a3} = 0.28g$

$\ddot{u}_{1max} = 1.6(0.25g) = 12.88$ ft/s²

$\ddot{u}_{2max} = 1.06(0.31g) = 10.58$ "

$\ddot{u}_{3max} = 0.86(0.28g) = 7.75$ "

$\ddot{u}_{max} = \sqrt{12.88^2 + 10.58^2 + 7.75^2}$

$\ddot{u}_{max} = 18.4$ ft/s²

Avg Eq. Shear Strain

$(\gamma_{ave})_{eq} = (0.65)(0.3)\left(\frac{117}{511^2}\right)[(0.25)(32.2)]$

$(\gamma_{ave})_{eq} = 0.070\%$

3rd Iteration

$\epsilon = 0.070\% \rightarrow$ Fig 1 $\frac{G}{G_{max}} = 0.342 \quad \lambda = 14.3\%$

$$\frac{G}{G_{MAX}} = \left(\frac{V_s}{V_{MAX}}\right)^2 \longrightarrow V_s = V_{max}\sqrt{\frac{G}{G_{MAX}}}$$

$$V_s = 869\sqrt{0.342}$$

$$V_s = 508 \text{ fps}$$

$$\omega_1 = 2.4\left(\frac{508}{117}\right) = 10.42 \text{ rad/sec} \qquad T_1 = \frac{2\pi}{10.42} = 0.60 \text{ sec}$$

$$\omega_2 = 5.52\left(\frac{508}{117}\right) = 23.97 \text{ ''} \qquad T_2 = \frac{2\pi}{23.97} = 0.26 \text{ sec}$$

$$\omega_3 = 8.65\left(\frac{508}{117}\right) = 37.55 \text{ ''} \qquad T_3 = \frac{2\pi}{37.55} = 0.17 \text{ sec}$$

From Fig 2

$$\frac{S_{a1}}{a_{max}} = 1.25 \longrightarrow S_{a1} = 0.25g$$

$$\frac{S_{a2}}{a_{max}} = 1.55 \longrightarrow S_{a2} = 0.31g$$

$$\frac{S_{a3}}{a_{max}} = 1.39 \longrightarrow S_{a3} = 0.28g$$

$$U_{1max} = 1.6(0.25g) = 12.88 \text{ ft/sec}^2$$

$$U_{2max} = 1.06(0.31g) = 10.58 \text{ ft/sec}^2$$

$$U_{3max} = 0.86(0.28g) = 7.75 \text{ ft/sec}^2$$

$$U_{max} = \sqrt{12.88^2 + 10.58^2 + 7.75^2}$$

$$U_{max} = 18.4 \text{ ft/s}^2$$

Ave eq. Shear Strain

$$(\gamma_{ave})_{eq} = (0.65)(0.3)\left(\frac{117}{508^2}\right)[(0.25)(32.2)]$$

$$(\gamma_{ave})_{eq} = 0.070\%$$

Same as assumed strain $\longrightarrow U_{MAX} = 18.4 \text{ ft/s}^2$

Determine max avg accelleration (Fig 3)

At top

$K_{max} = \dot{U}_{max} = 17.8$ ft/s²

Depth	y/H	$K_{max}/\dot{U}_{max}$	K_{max} (ft/s²)
23.4	0.2	0.88	15.7
46.8	0.4	0.70	12.5
70.2	0.6	0.52	9.26
93.6	0.8	0.42	7.48

Assume N=5 for fly Ash

$$G_{max} = 65(5) = 325 \text{ tsf}$$

$$V_{max} = \sqrt{\frac{G_{max}}{\rho}} = \sqrt{\frac{(325)(2000)}{3.11}}$$

$$V_{max} = 457 \text{ fps}$$

SPT of Site Soils

Hole	N (@ elev [illegible])	
1	N/A	
2	28	7[illegible]8
3	N/A	—
4	36	715
5	30	713
6	N/A	
7	N/A	[illegible]
8	13	721
9	19	719
10	18	717

AVG = 24.0

131.5
− 15
116.5

ASCE Fax
212-705-7300
Name Address
Telephone #
Mem ID #

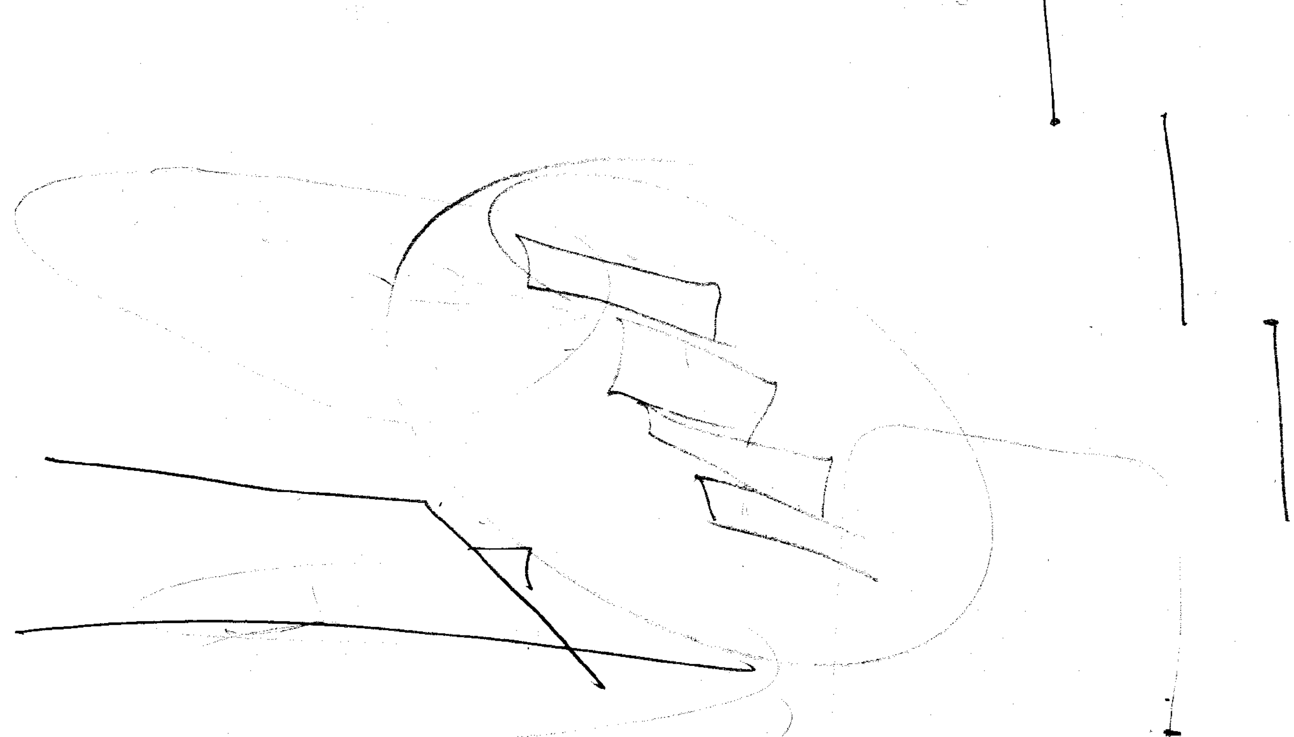
Todd 855-2506

SHEET ______ OF ______

COMPUTED ______ DATE ______

CHECKED ______ DATE ______

EXISTING (Plan)
~~STAGE A Design (Profile)~~
~~STAGE B Design (Profile)~~
~~STAGE A&B Details (Spillway,~~ drainage pipe etc)
~~STAGES~~ C,D,E Design (Plan)
STAGES C,D,E Design (Profiles/Details)



Fly Ash ~~$\omega = 25\%$~~ → $S = 74.3\%$

$G_s = 2.25$

$\gamma_{wet} = \dfrac{(G_s + Se)\gamma_w}{1+e}$

$\gamma_{wet} = \dfrac{[2.25 + (0.743)(0.757)]62.4}{1+0.757}$

$\gamma_{wet} = 99.9$ pcf

$\gamma_{SAT} = \dfrac{(2.25 + 0.757)62.4}{1+0.757} = 106.8$ pcf

$Se = \omega G_s$

$Se = (25)(2.25)$

$S = \dfrac{(25)(2.25)}{0.757}$

$S = 74\%$

$\gamma_{dry} = \dfrac{G_s \gamma_w}{(1+e)}$

$1+e = \dfrac{G_s \gamma_w}{\gamma_{dry}}$

$e = \dfrac{(2.25)(62.4)}{79.9} - 1$

$e = 0.757$

TVA 11030 (WM-7-75)

KIFCELLD.DAT

```
HEADING
   KIF - New Dredge Cell Design
   Long-term analysis using r-bar strengths
   3:1 side slopes and 200' offset from current dike
PROFILE LINES
    1    1   Drained fly ash
           0         126
          75         126

    2    1   Drained fly ash
          27         110
         141         110

    3    1   Drained fly ash
          93          94
         211          94

    4    1   Drained fly ash
         172          81
         268          81

    5    1   Drained fly ash
         229          68
         327          68

    6    2   Bottom ash - dike
          27         110
          87         130
       124.5       131.5
      174.75      114.75
      189.75       115.5
         240       98.75
         255        99.5
      296.25       85.75
      311.25        86.5
       352.5       72.75
       367.5        73.5
         408          60

    7    2   Bottom ash - dike
         93           94
        141          110

    8    2   Bottom ash - dike
        172           81
        211           94

    9    2   Bottom ash - dike
        229           68
        268           81

   10    2   Bottom ash - dike
        303           60
        327           68

   11    2   Bottom ash - lower dike
      566.8           50
        592         62.6
        608         63.4
        650         52.6
```

Get MHEA at top of stack

$$MHEA = \frac{\tau_h g}{\gamma z}$$

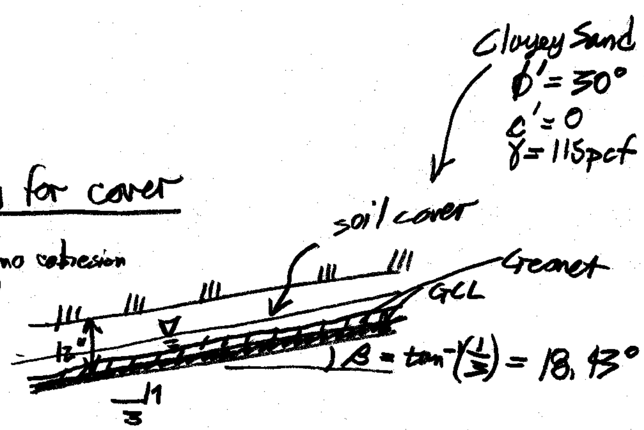
$$MHEA = \frac{(115.15\,psf)\,g}{(110\,pcf)(2\,ft)}$$

$$MHEA = 0.523\,g$$

Use infinite slope analysis to get K_y for cover

$$F = A\frac{\tan\phi'}{\tan\beta} + B\frac{c'}{\gamma H}\;\; c' = 0$$ (assume no cohesion in cover)

$$F = A\frac{\tan\phi'}{\tan\beta}$$



$$A = 1 - \frac{\gamma_w H_w}{\gamma H \cos^2\beta}$$

Assume 3" water running over surface of GCL (Geonet is aiding in drainage).

$$A = 1 - \frac{(62.4)(\frac{3}{12})\cos(18.43)}{(115\,pcf)(1')\cos(18.43)\cos^2(18.43)}$$

$$A = 0.849$$

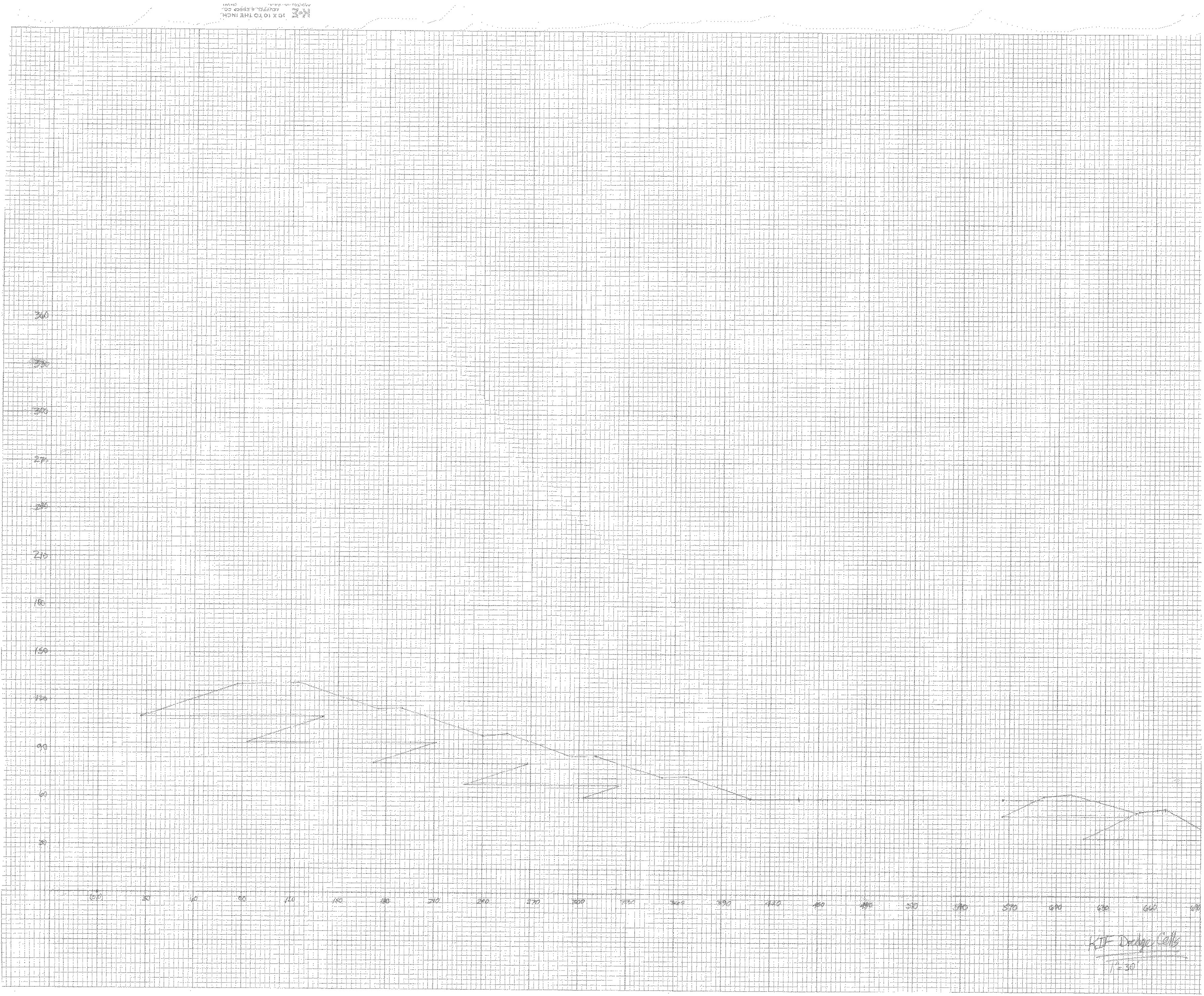
$$F = 0.849\left(\frac{\tan 30°}{\tan(18.43)}\right) = 1.471$$

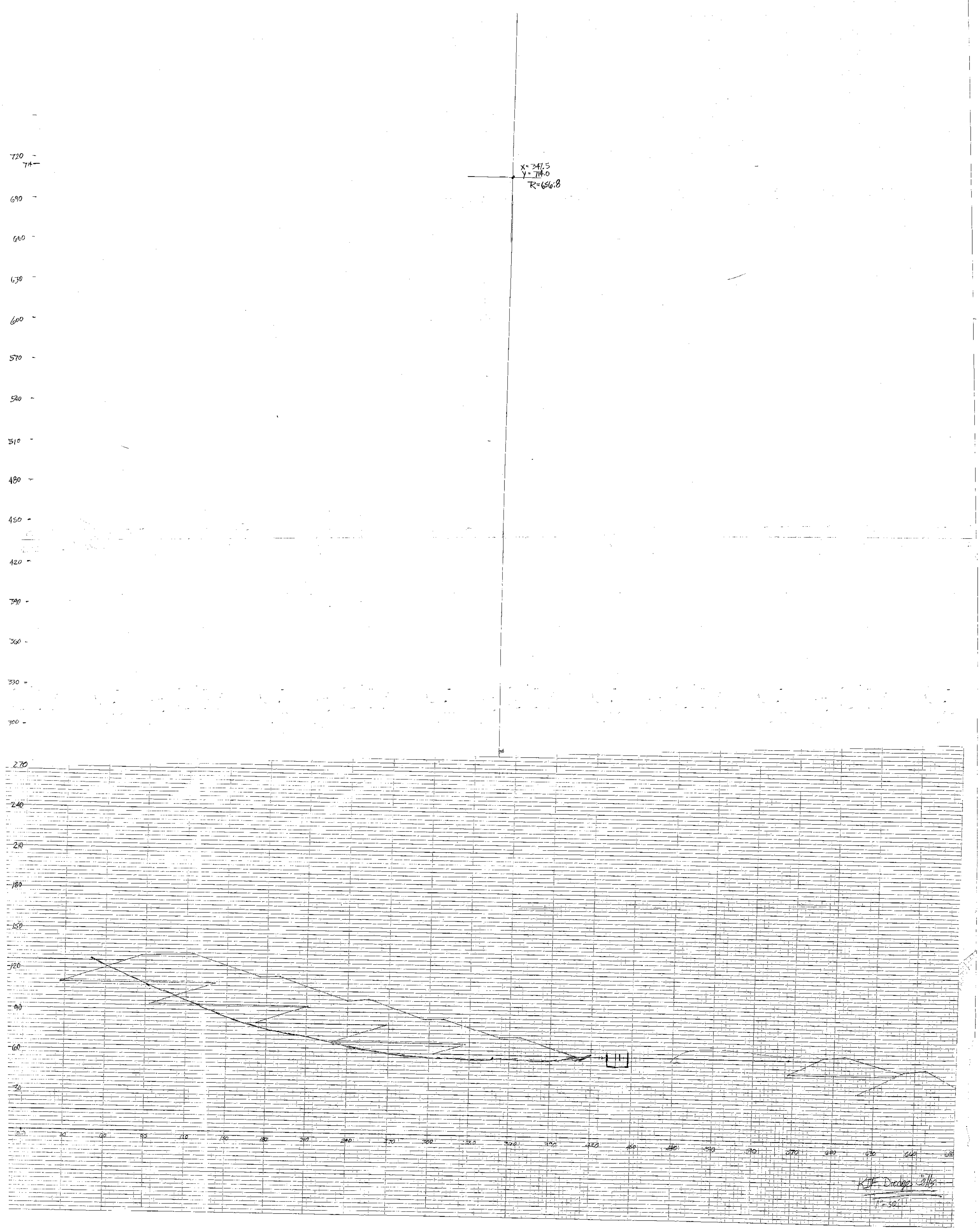
Now, when seismic factor causes $F = 1.0$, then K_y = seismic factor.

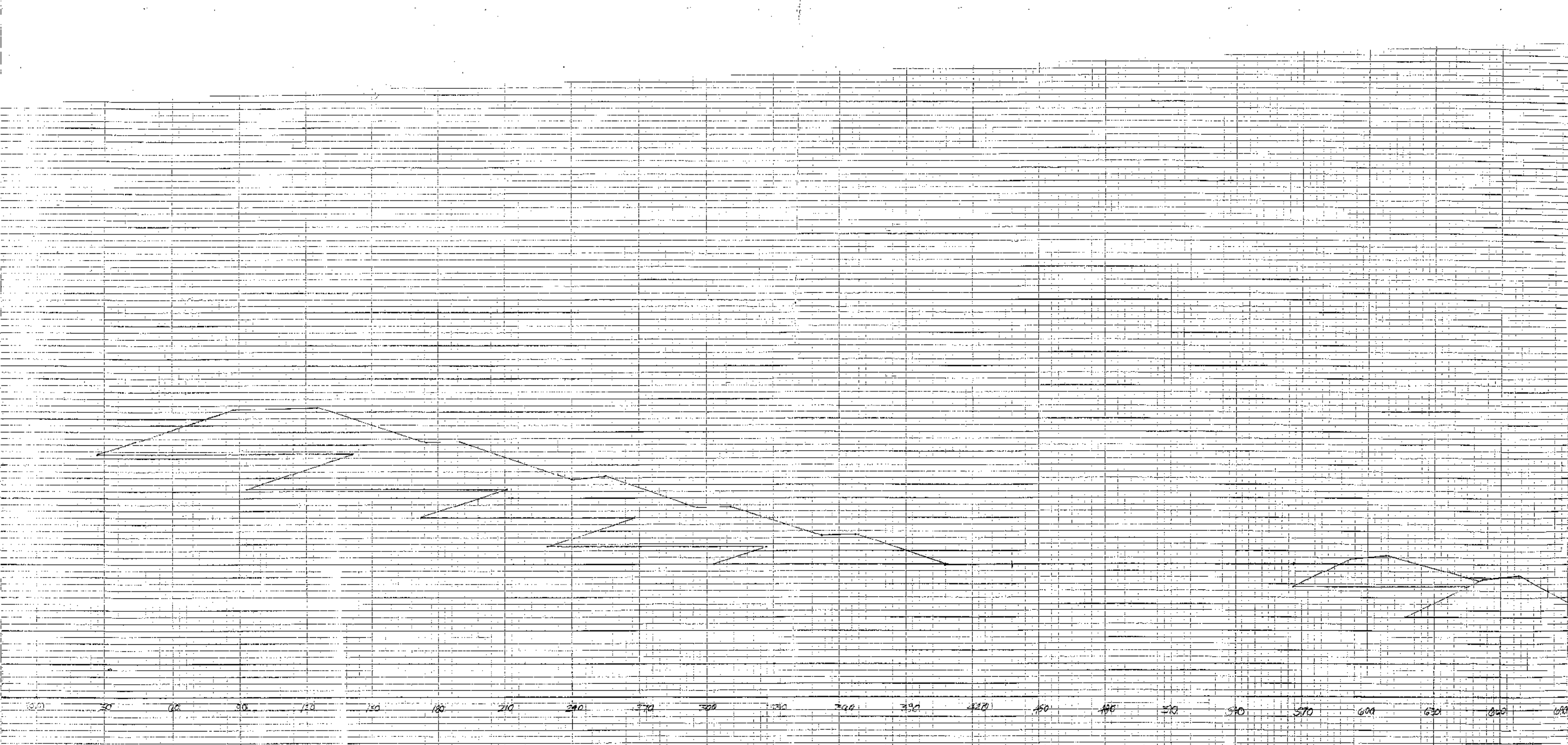
```
12    3   Fly ash - wet
    303           60
  586.8           60

13    3   Fly ash - wet
    600           50
  644.8           50

14    4   Rolled, compacted earth - wet
  616.8           36
    652         53.6
    668         54.4
    700        41.55
    718        42.45
  740.9           31

15    5   Rolled, compacted earth - saturated
    670           36
  740.9           31
    744        29.45
 783.25           15

16    5   Rolled, compacted earth - saturated
    646           15
    682           30

17    6 8 Fly ash - saturated
      0          126
     27          110
     93           94
    172           81
    229           68
    303           60
  566.8           50
    600           50
  616.8           36
    670           36
    682           30

18    7   Residual material - saturated
       0          15
  783.25          15
     824           0

19    8   Rock
       0           0
     824           0
     850           0

HEADING
  Case 2 - Short term post-construction (R strength)
  Piezometric defined pore pressure
  Surface water at el 741
MATERIAL PROPERTY
   1   Drained fly ash at 82% saturation
    109.1 = moist unit weight
    Conventional shear strength
     200.0      15.0
```

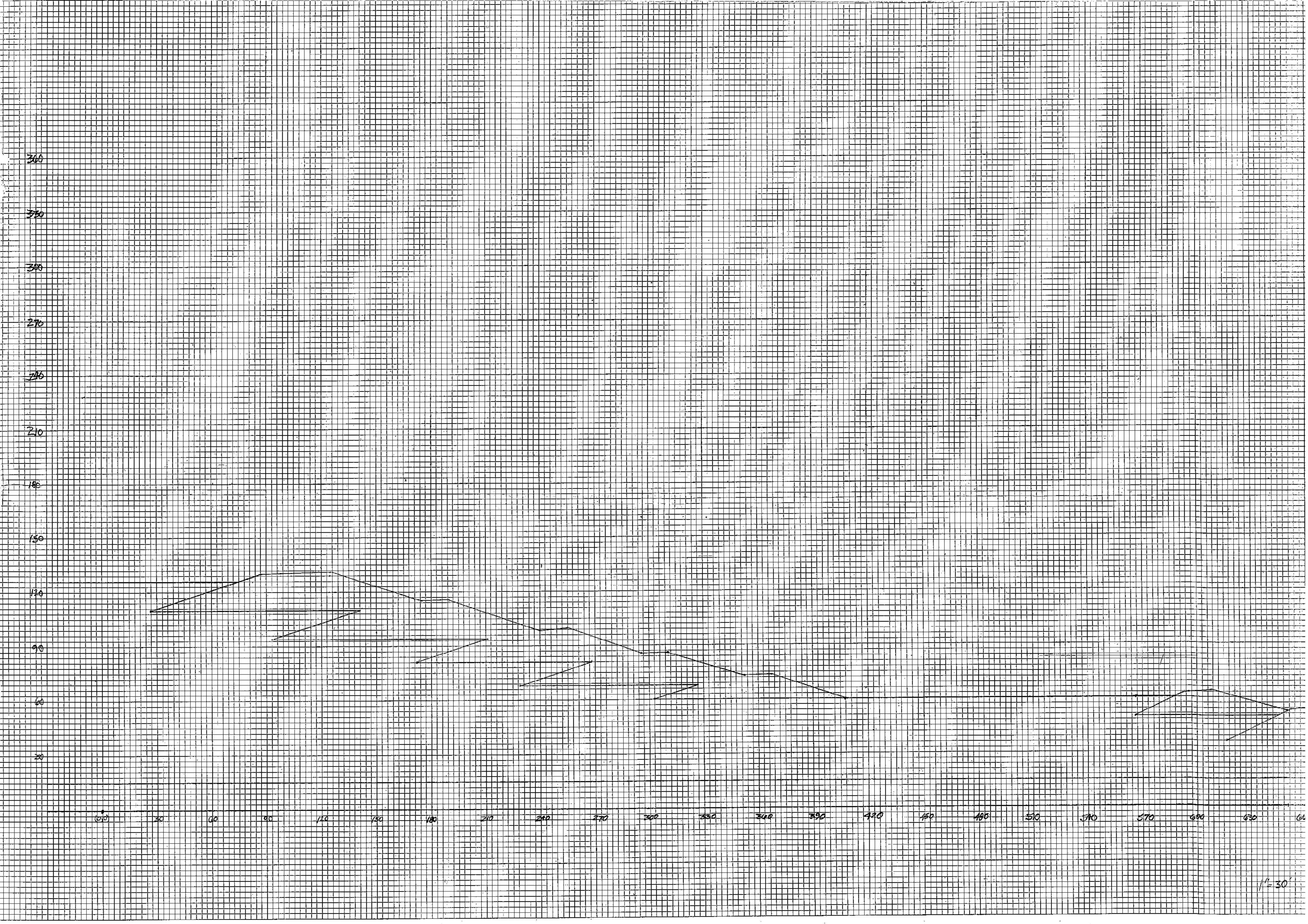
```
 NO pore pressures
 2   Bottom ash (dike material)
 109.9 = moist unit weight
 Conventional shear strength
 1500.0      24.0
 NO pore pressures
3   Fly ash at 95% saturation
 112.9 = moist unit weight
 Conventional shear strength
  200.0      15.0
 NO pore pressures
4   Rolled, compacted earth - moist
 114.2 = moist unit weight
 Conventional shear strength
 1380.0       6.1
 NO pore pressures
5   Rolled, compacted earth - saturated
 119.3 = saturated unit weight
 Conventional shear strength
 1380.0       6.1
 Piezometric Line
      1   Piez line for groundwater
6   Saturated fly ash
 114.4 = saturated unit weight
 Conventional shear strength
  200.0      15.0
 Piezometric Line
      1   Piez line for groundwater
7   Residual material - saturated
 136.7 = saturated unit weight
 Conventional shear strength
 2480.0      14.7
 Piezometric Line
      1   Piez line for groundwater
8   Rock
   165 = saturated unit weight
 Conventional shear strength
    0.0       45
 Piezometric Line
      1   Piez line for groundwater

PIEZOMETRIC LINE DATA
   1   62.4   Groundwater table
          0        126
         27        110
         93         94
        172         81
        229         68
        303         60
      566.8         50
        600         50
      616.8         36
        670         36
      740.9         31
        850         31


SURFACE PRESSURE
      740.9         31          0          0
        744      29.45      96.72          0
```

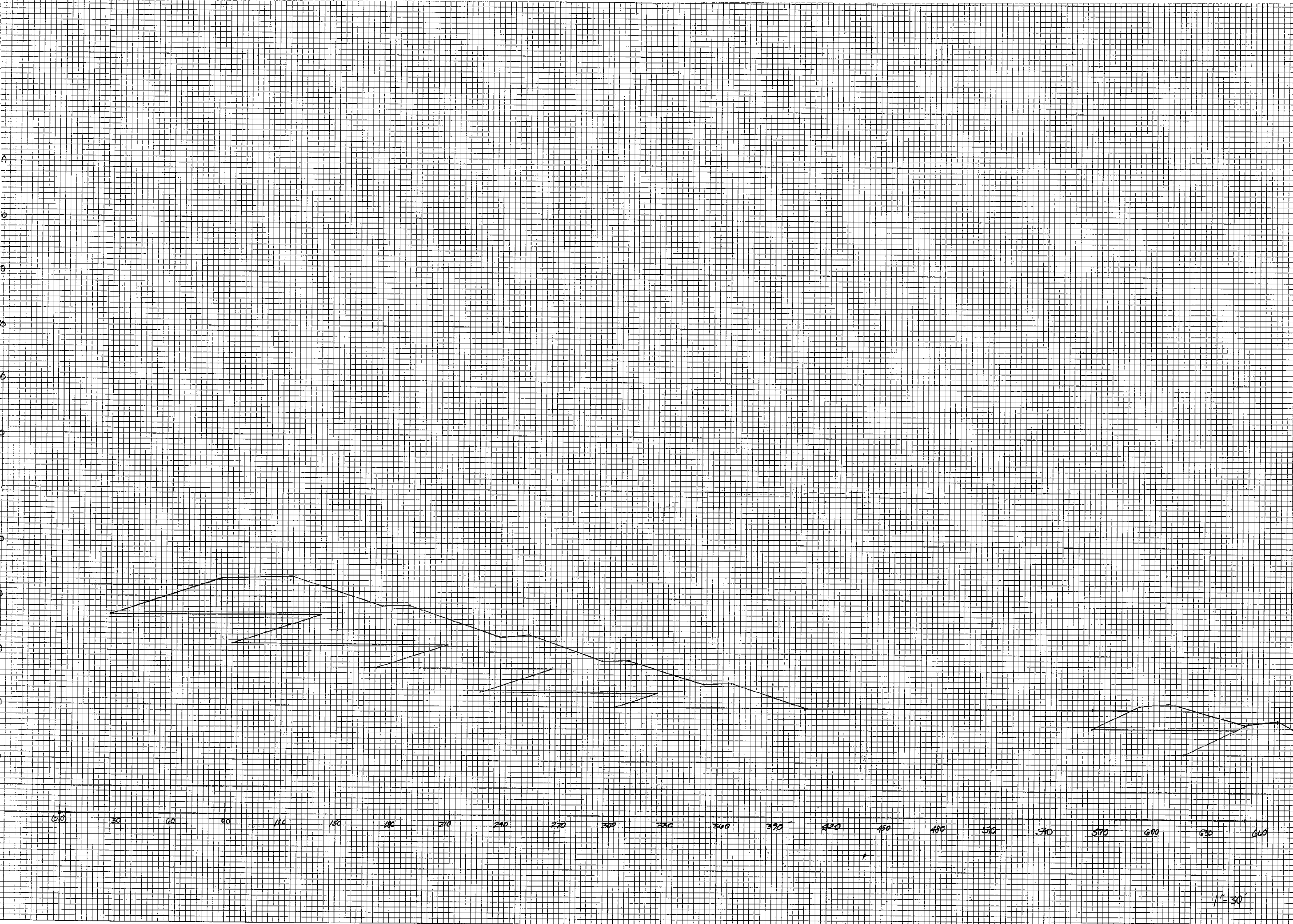
```
     824          0     1934.4          0
     850          0     1934.4          0

HEADING
  KIF dredge cell design
  Spencer's Method
  Search for critical shear surface
PLOT
ANALYSIS/COMPUTATION
  Circular Search
   330  310 0.5  -10
   POINT
   408  60
   FACTOR OF SAFETY
    9.0
   PROCEDURE
    Spencer

COMPUTE
```

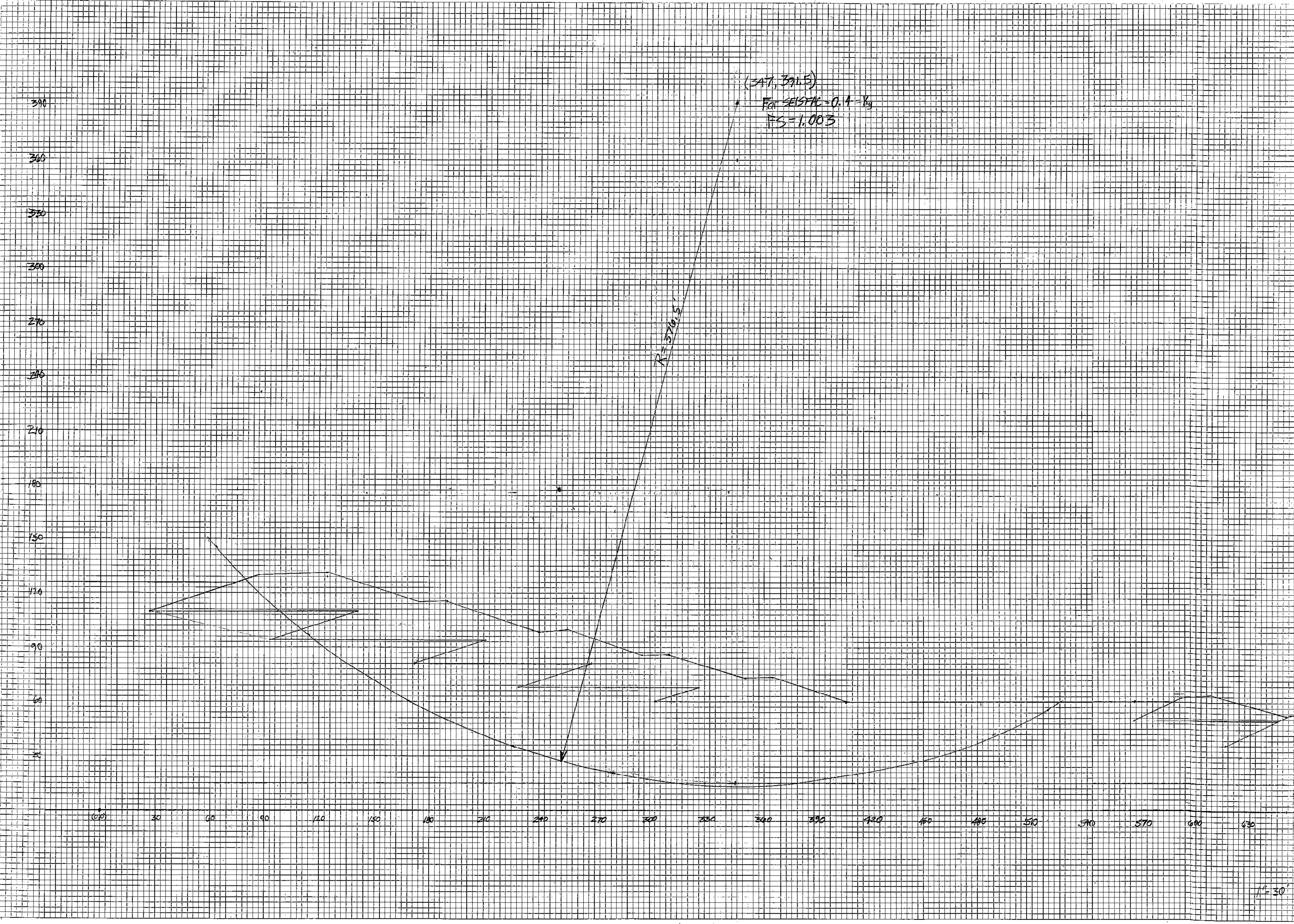

KIF Dredge Cells


X = 347.5
Y = 714.0
R = 656.8
KIF Dredge Cells
1" = 30'

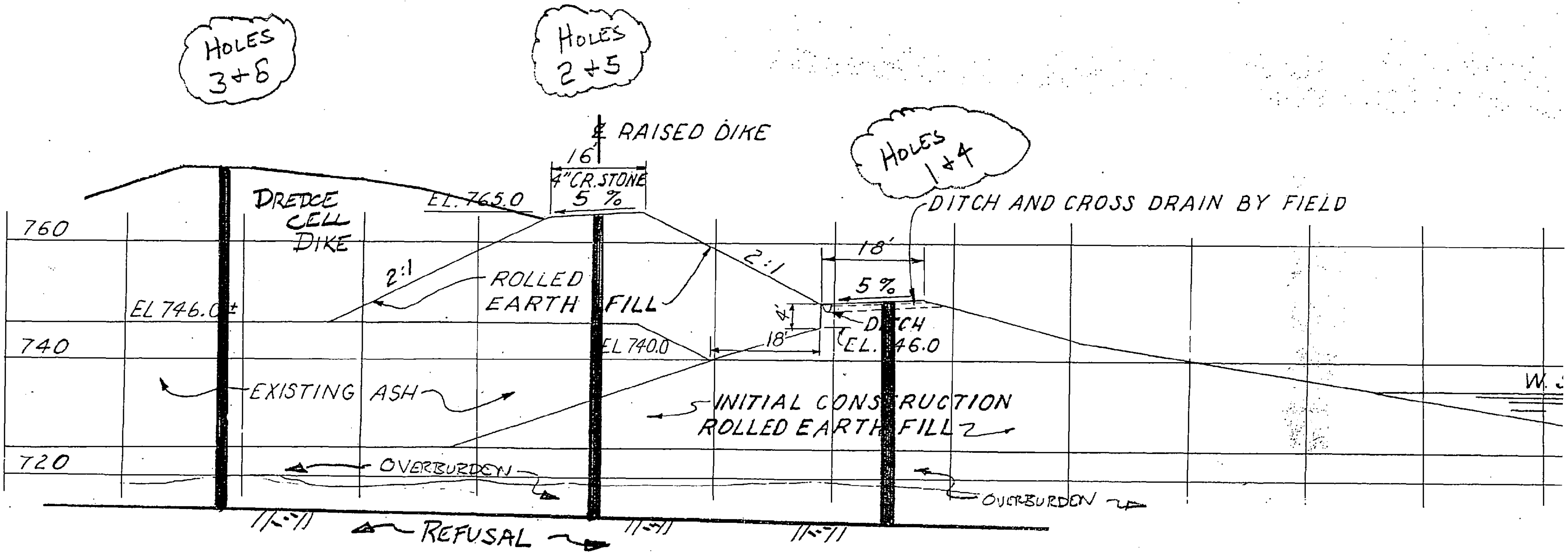

30 60 90 120 150 180 210 240 270 300 330 360 390 420 450 480 510 540 570 600 630 660 690
KIF Dredge Cells
1" = 30'


360
330
300
270
240
210
180
150
120
90
60
30
(0,0)
30
60
90
120
150
180
210
240
270
300
330
360
390
420
450
480
510
540
570
600
630
1" = 30'


(0,0)
30
60
90
120
150
180
210
240
270
300
330
360
390
420
450
480
510
540
570
600
630
660
1"=30'



(347, 391.5)
For SEISFAC = 0.14 = K_y
FS = 1.003
R = 370.5'
390
360
330
300
270
240
210
180
150
120
90
60
30
30
60
90
120
150
180
210
240
270
300
330
360
390
420
450
480
510
540
570
600
630
1" = 30'



HOLES 3+6
HOLES 2+5
HOLES 1+4
℄ RAISED DIKE
16'
4" CR. STONE
5 %
EL. 765.0
DREDGE CELL DIKE
DITCH AND CROSS DRAIN BY FIELD
760
18'
2:1
2:1
5 %
ROLLED EARTH FILL
EL 746.0±
4'
DITCH EL. 746.0
740
EL 740.0
18'
EXISTING ASH
INITIAL CONSTRUCTION ROLLED EARTH FILL
720
OVERBURDEN
OVERBURDEN
REFUSAL