

HARZA-EBASCO

Susitna Joint Venture
Document Number

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Task 9 - Group 12

BOOK G

WATANA DAM

BORROW AREAS HAUL ROUTES
QUANTITIES USEABLE/WASTE

HAUL ROUTES
QUANTITIES: USABLE/WASTE

BORROW AREAS HAUL ROUTES QUANTITIES:
USEABLE/WASTE

(G).

UNIT PRICES - BACKUP CALCULATIONS

WATANA DAM

BORROW AREAS - HAUL ROUTE

QUANTITIES: USEABLE/WASTE

Haul Distances

Quantities Summaries

Borrow Areas Quantities

Seismic Profiles

Topographic Maps

HAUL DISTANCES

ROCK FROM OTHER SOURCES TO MAIN DAM



Calculations SUBITNA

SUBJECT: ESTIMATES

Useable Rock Excavation Quantities
Haul to Main Dam EL. 1450 ft.

JOB NUMBER P. 5700

FILE NUMBER

SHEET S. 1. OF

BY RDC Jan DATE 25/82

APP DATE

✓ RGA 1/25/82

Table: Weighted Haul lengths of Useable Rock Excavation Quantities
to Lower Stockpile and to Main Dam EL. 1450 ft.

Source	Useable Quantity (cu. yds.)	Haul Distance			
		to lower stockpile		to main dam EL. 1450	
		ft	miles	ft	miles
Powerhouse Vault	81,760	7470	1.41	10630	2.01
Draft Tube	27,200	7470	1.41	10630	2.01
Surge Chamber	60,000	7250	1.37	10410	1.97
Penstocks	28,100	8070	1.53	11230	2.13
Tailrace Works	63,520	4435	0.84	7595	1.44
Lower Chute	122,000	2750	0.52	5910	1.12
Valve Block/Flip Bucket	302,400	2050	0.39	5210	0.99
		Weighted Mean Distance			
$\Sigma A = 684,980$		3961	0.75	7120	1.35

Weighted mean distance to lower stockpile:

$$\begin{aligned}
 &= (81760/\Sigma A) \times 7470 + (27200/\Sigma A) \times 7470 + (60000/\Sigma A) \times 7250 + (28100/\Sigma A) \times 8070 \\
 &\quad + (63520/\Sigma A) \times 4435 + (122000/\Sigma A) \times 2750 + (302400/\Sigma A) \times 2050 \\
 &= 892 + 297 + 635 + 331 + 411 + 490 + 905 \\
 &= \underline{3961 \text{ ft}}
 \end{aligned}$$

Weighted mean distance to main dam EL. 1450 ft

$$\begin{aligned}
 &= ()_1 \times 10630 + ()_2 \times 10630 + ()_3 \times 10410 + ()_4 \times 11230 \\
 &\quad + ()_5 \times 7595 + ()_6 \times 5910 + ()_7 \times 5210 \\
 &= 1268 + 422 + 912 + 461 + 704 + 1053 + 2300 \\
 &= \underline{7120 \text{ ft}}
 \end{aligned}$$



Calculations

SUSITNA

SUBJECT: ~~ESTIMATES~~Useable Rock Excavation Quantities
Haul to Main Dam EL. 1800 ft.JOB NUMBER P. 5700

FILE NUMBER _____

SHEET SR. OF _____BY RDC Jan DATE 25/82

APP _____ DATE _____

✓ RGA 1/25/82

Table: Weighted haul lengths of Useable Rock Excavation Quantities
to Main Dam EL. 1800 ft.

Source	Useable Quantity (cu. yds.)	Haul Distance to Main Dam EL 1800 ft.		
		feet	miles	
Service Spillway (Valves)	133,600'	7500'	1.42	
Service Spillway (Approach)	1,888,000'	7100	1.34	
Intake Structure	1,046,800	6850	1.30	
Control Structure	90,800	7500	1.42	
Upper Chute	278,800	8100	1.53	
		Weighted Mean Distance		
$\Sigma B = 3,438,000$		7131	1.35	

Weighted mean distance to main dam 1800 ft

$$\begin{aligned}
 &= 133,600/\Sigma B \times 7500 + 1,888,000/\Sigma B \times 7100 + 1,046,800/\Sigma B \times 6850 \\
 &\quad + 90800/\Sigma B \times 7500 + 278,800/\Sigma B \times 8100 \\
 &= 291 + 3899 + 2086 + 198 + 657 \\
 &= \underline{7131 \text{ feet.}}
 \end{aligned}$$



Calculations

SUBJECT: ESTIMATES
Useable Rock Excavation Quantities
for Downstream Side of Main Dam

JOB NUMBER P. 5700
 FILE NUMBER _____
 SHEET 1 OF _____
 BY ROC Jan DATE 21/82
 APP _____ DATE _____

✓ RGA 1/25/82

Description	Excavated Rock				Approx. Estimated Haul Length (miles)
	Quantity	Waste Factor	Waste Qw	Useable Qu	
✓ (i) Powerhouse Vault	102,200	0.2	20,440	81,760 ✓	
• (ii) Draft Tube	34,000	0.2	6,800	27,200 ✓	
✓ (iii) Main Dam	1,767,000		1,234,000	533,000	
✓ (iv) Service Spillway Valves (inlet)	167,000	0.2	33,400	133,600 ✓	
✓ (v) Service Spillway Chute (approach)	2,360,000	0.2	472,000	1,888,000 ✓	
✓ (vi) Emergency Spillway	2,562,000	0.2	512,400	2,049,600	
✓ (vii) Intake Structure ✓	1,308,500	0.2	261,700	1,046,800 ✓	
✓ (viii) Surge Chamber ✓	75,000	0.2	15,000	60,000 ✓	
✓ (ix) Penstocks ✓	56,200	0.5	28,100	28,100 ✓	
✓ (x) Tailrace Works. ✓	79,400	0.2	15,880	63,520 ✓	
✓ (xi) Control Structure	113,500	0.2	22,700	90,800 ✓	
✓ (xii) Upper Chute	348,500	0.2	69,700	278,800 ✓	
(xiii) Lower Chute	152,500	0.2	30,500	122,000 ✓	
(xiv) Valve Block/ Flip Bucket	378,000	0.2	75,600	302,400 ✓	
				6,703,580	

JAY 6,700,000

Require 18,042,000 cu.yds. for Main Dam Shell (Downstream).

⇒ Need to find 18,042,000

- 6,700,000

11,342,000 cu.yds.

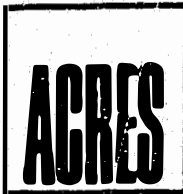
Discussion R. Lang 3-20pm 21 Jan 1982 ⇒ He has calculated the haul lengths for each of the above items at 2 miles

For 1 to 2 miles require same no. of trucks (3)

3 miles require one additional truck (4)

4 miles require an additional truck (5)

R. Lang costs based on uniform 2 mile haul length.



Calculations

SUBJECT: ESTIMATES

Excavated Rock Useable
Haul Lengths

JOB NUMBER P.5700

FILE NUMBER

SHEET 2 OF

BY RDC Jan DATE 21/82

APP DAT

✓ RGA 1/25/82

Consider haul lengths for each item listed on page 1 of this calc. set.
Assume road grade uniform 7%

→ For a 50' change in contour require a length of $\frac{100}{7} \times 50 = 715\text{ft}$.

(i) Powerhouse Vault: Haul to lower stockpile then to Main Dam
 Cof M to end of tailrace = $1400\text{ ft} + 5\% \text{ slope} = 1470\text{ ft}$.
 End of tailrace to lower stockpile = $7 \times 714 + 20\% = 6000\text{ ft}$
 Lower stockpile to main dam centre = $2 \times 714 + 20\% + 1450 = 3160\text{ ft}$
10630 ft ✓

(ii) Draft Tube: Same haul distance as powerhouse vault.
 Cof M to tailrace = 1470 ft
 End of tailrace to lower stockpile = 6000 ft
 Lower stockpile to main dam (centre) = 3160 ft
10630 ft ✓

(iii) Main Dam: F. Toth to calculate

(iv) Service Spillway (Valves): F. Toth to calculate.
 Check calculation
 Cof M to EL 2150 = 1500 ft
 EL 2150 to EL 1800 = $7 \times 714 + 20\% = 6000\text{ ft}$
7500 ft

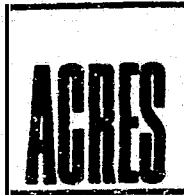
(v) Service Spillway Chute (Approach):
 Cof M to EL 2150 = 1100 ft
 EL 2150 to EL 1800 = (as above) 6000 ft
7100 ft

(vi) Emergency Spillway F. Toth to calculate

(vii) Intake Structure

(a) To EL 1800 Dam

Cof M to EL 1800 = $8 \times 714 + 20\% = 6850\text{ ft}$ ✓



Calculations

SUBJECT: ESTIMATES
Excavated Rock Useable
Haul Lengths

JOB NUMBER P. 5700
 FILE NUMBER _____
 SHEET 3 OF _____
 BY RDE Jan DATE 22/82
 APP _____ DATE _____

✓ RGA 1/25/82

(viii) Surge Chamber

C of M to end of tailrace =
 End of tailrace to lower stockpile = $7 \times 714 + 20\%$
 Lower stockpile to dam

1250 ft
 6000 ft
3160 ft. ✓
10410 ft

(ix) Powertacks: Inclined portion excavated with Allimak
 Conventional haul 600 ft to powerhouse vault.
 C of M to end of tailrace =
 End of tailrace to lower stockpile
 Lower stockpile to dam

2070 ft
 6000 ft
3160 ft ✓
11230 ft

(x) Tailrace works:

(a) South:

C of M to end of tailrace
 End of tailrace to lower stockpile
 Lower stockpile to dam

570 ft
 6000 ft (6570)
3160 ft
9730 ft

(b) North:

C of M to end of tailrace
 * End of tailrace to lower stockpile
 Lower stockpile to dam

750 ft
 1550 ft (2300)
3160 ft
5460 ft

4435
 7595 ft Ave

(xi) Control Structure (to EL 1800)

C of M to EL 2150
 EL 2150 to EL 1800 = $7 \times 714 + 20\%$

1500 ft
 6000 ft
7500 ft ✓

(xii) Upper Chute (to EL 1800)

C of M to EL 2150
 EL 2150 to EL 1800

2100 ft
 6000 ft
8100 ft



Calculations

SUBJECT: ESTIMATES
Excavated Rock Useable
Haul Lengths

JOB NUMBER P.5700
 FILE NUMBER _____
 SHEET 4 OF _____
 BY RDC Jan DATE 22/82
 APP _____ DATE _____

✓ RGA 1/25/82

(xiii) Lower Chute (to lower part, main dam)

C of M to lower stockpile.

Lower stockpile to main dam

2750 ft

3160 ft

5910 ft ✓

(xiv) Valve block / Flip bucket

C of M to lower stockpile

Lower stockpile to main dam

2050 ft

3160 ft

5210 ft. ✓

BORROW AREA E TO MAIN DAM

Table: Weighted Mean Haul Distances / Material Volumes.

DESCRIPTION	WEIGHTED MEAN DISTANCE		MATERIAL VOLUME @ 30% Waste (cu. yds.)
	(feet)	(Miles)	
Total Wet Excavation	23,450	4.44	40,889,219
Total Dry Excavation	15,590	2.95	28,506,566
Dry + Wet Excavation (Combined)	20,222	3.83	69,395,785

Maximum Haul Distance from Area II B of Downstream
continuation of Borrow Area E = 35,900 feet (6.80 miles)

ADAMS**Calculations**

SUBJECT:

SUSTNA
Haul Distances
SUMMARY

JOB NUMBER P. 5700

FILE NUMBER

SHEET 5.1 OF

BY/DC Jan DATE 8/82

APP DATE

✓ RGA 1/19/82

AGRES**Calculations**

SUBJECT: Haul Lengths.

JOB NUMBER P. 5700
 FILE NUMBER _____
 SHEET 1. OF _____
 BY RSC Jan DATE 8/82
 APP _____ DATE _____

✓ Rev 1/19/82

Comments: This is a coarse approximation of the weighted haul distance from borrow areas to centre of dam.
 Refer to SK-5700-C6-578
 Roads marked on by F.T. 8 Jan 82.

(i) Reference points on haul road (Marked on SK 5700-C6-578) attached.

D Dam centre
 S Branch to Upper Tsusena Creek.
 R Start borrow area E

(ii) Distances:

D to S	11000 ft	✓
S to 'UTC'	2000 ft	✓
S to R	3500 ft	✓

Notes:

Page 2, summarises haul distances from the centre of mass of each designated area to the Plant Area (adjacent to the Central Portion of the Tsusena Creek Borrow Area).

SK-5700-C6-578 outlines haulage distances from the marked points above to the centre of the dam.

Page 2 was adjusted to take account of the haulage to the dam centre; a summary of the haul distances being given on page 3.



Calculations

SUBJECT: SUSITNA
Haul Lengths
Mass Balance

JOB NUMBER P. 5700
FILE NUMBER P5700. 14. 09
SHEET 2 OF
BY RDE Jan DATE 6/82
APP DATE

Table: Summary of haulage lengths from the approximate centre of mass of designated area to the centre of the Plant Area

Borrow Area	Road length (point to point) (ft)	Road length to Plant Area (ft) *
Upper Tsusena Creek		
• Central portion		1820
• Top left "		3200
• Bottom right "		2600
	X → Plant Area 4400	
Borrow Area E		8999
Southern Extension of Borrow Area E		9800
	Y to X 9100	873350
	Z to Y 4500	
	Z' to Z 4800	
Downstream Continuation of Borrow Area E		
Area II		20400
Area IIA		22100
Area IIB		25800

* This is the haul distance from the centre of mass of the area concerned to the centre of the Plant Area.



Calculations

SUBJECT: SUSITNA
Haul Lengths
Mass Balance

JOB NUMBER P. 5700
 FILE NUMBER _____
 SHEET 3 OF _____
 BY RDC Jan DATE 8/82
 APP _____ DATE _____

✓ RGA 1/19/82

Borrow Area	Road length to 'R' from C of M	Road length to 'D' from C of M
Upper Tsusena Creek	N.A.	13,000' ✓ (2.46 miles)
Borrow Area E	4,500 ✓	19,000' ✓ (3.60 miles)
Southern Extension to Borrow Area E	8,950 ✓	23,450' ✓ (4.44 miles)
Downstream Continuation Area I	16,000 ✓	30,500 ✓ (5.78 miles)
Area II A	17,700 ✓	32,200 ✓ (6.10 miles)
Area II B	21,400 ✓	35,900 ✓ (6.80 miles)

ACRES**Calculations**

SUBJECT: SUSITNA

Haul Lengths

Wet Excavation

WET

JOB NUMBER P. 5700

FILE NUMBER

SHEET 4 OF

BY RDC Jan DATE 8/82

APP DATE

✓ RGA 1/19/82

Wet Excavation

Borrow Area	Useable Material @ 30% Waste (cy)	Haul distance (feet)
Upper Tsusena Creek	998,415 ✓	13,000 ✓
Borrow Area E	23,317,452 ✓	19,000 ✓
Southern Extension to Area E	4,180,273 ✓	23,450 ✓
Downstream Continuation Area I	5,466,865 ✓	30,500 ✓
Area II A	2,853,319 ✓	32,200 ✓
Area II B	4,072,895 ✓	35,900 ✓
$\Sigma A = 40,889,219$		

Weighted mean distance:

$$\begin{aligned}
 &= \frac{998,415}{\Sigma A} \times 13,000 + \frac{23,317,452}{\Sigma A} \times 19,000 + \frac{4,180,273}{\Sigma A} \times 23,450 \\
 &+ \frac{5,466,865}{\Sigma A} \times 30,500 + \frac{2,853,319}{\Sigma A} \times 32,200 + \frac{4,072,895}{\Sigma A} \times 35,900 \\
 &= 317' + 10,835 + 2,397 + 4,078 + 2,247 + 3,576 \\
 &= 23,450 \text{ feet} = 4.44 \text{ miles. } \checkmark
 \end{aligned}$$

G18

ACRES

Calculations

SUBJECT: SUSITNA
Haul Lengths
Dry Excavation - DRY

JOB NUMBER P. 5700
FILE NUMBER
SHEET 5 OF
BY RDC Jan DATE 8/82
APP DATE

COMBINED WET/DRY MEAN
✓ RGA 1/19/82

Dry Excavation

Borrow Area	Useable Material @ 30% Waste (CY)	Haul distance (feet)
Upper Tsusena Creek	16,204,342	13,000' ✓
Borrow Area E	12,302,224 ✓	19,000' ✓
TOTAL	28,506,566	

Weighted mean distance :

$$= \left(\frac{16,204,342}{28,506,566} \times 13,000' + \frac{12,302,224}{28,506,566} \times 19,000' \right)$$

$$= 7,390' + 8,200' \quad \checkmark$$

$$= \underline{15,590 \text{ feet}} \quad \checkmark = \underline{2.95 \text{ miles}} \quad \checkmark$$

Wet and Dry Excavation "Mean of means"

$$\bar{x} = \frac{40,889,219}{69,395,785} \times 23,450 + \frac{28,506,566}{69,395,785} \times 15,590$$

$$= 13,817' + 6,404'$$

$$= \underline{20,221 \text{ feet}} = \underline{3.83 \text{ miles.}} \quad \checkmark$$



Calculations

SUBJECT: SUSITNA
Haul Lengths
Wet/Dry Excavation

JOB NUMBER P. 5700

FILE NUMBER

SHEET 6 OF

BY RDC Jan DATE 8/82

APP DATE

COMBINED MEAN

VGA 1/19/82

Wet/Dry Combined Haul Distances (Check Calculation).

Borrow Area	Useable Material @ 30% Waste (CY)	Haul distance (feet)
Upper Tsusena Creek	17,202,757	13,000
Borrow Area E	35,619,676	19,000
Southern Extension to Area E	4,180,273	23,450
Downstream Continuation Area I	5,466,865	30,500
Area IIA	2,853,319	32,200
Area IIB	4,072,895	35,400.
$\Sigma_B = 69,395,785$		

Weighted mean distance:

$$= (17,202,757 / \Sigma_B) \times 13,000 + (35,619,676 / \Sigma_B) \times 19,000 \\ + (4,180,273 / \Sigma_B) \times 23,450 + (5,466,865 / \Sigma_B) \times 30,500 \\ + (2,853,319 / \Sigma_B) \times 32,200 + (4,072,895 / \Sigma_B) \times 35,400$$

$$= 3,223' + 9,752' + 1,413' + 2,403' + 1,324' + 2,107'$$

$$= \underline{20,222 \text{ feet}}$$

$$\underline{3.83 \text{ miles}}$$

ACRES

Calculations

SUBJECT: SUSITNA
Haul Lengths
Mass Balance

JOB NUMBER P 5700
FILE NUMBER P 5700.14.09
SHEET 1 OF
BY RSE Jan DATE 5/82
APP DATE

Comments:

Consider haul lengths initially to the Plant Area in the Upper Tsusena Creek deposit; from all borrow areas ~~ie~~ Downstream Continuation, Southern Extension to Area E, Borrow area E and The Upper Tsusena Creek.

Haul lengths taken to centre of mass of each borrow area.

Plant area placed in "central" portion of Upper Tsusena Creek Borrow Area..

Dimensions of area = $2000' \times 600' \Rightarrow \text{area} = 1,200,000 \text{ ft}^2$.

Implies:

Area and volume available in central portion will be reduced. Refer to Page 11, sales by T. Shah file P.5700.14.09 Ser. # 25. Central Portion Ave section depth in area of Plant Area approx 30 ft.

$\Rightarrow \text{Volume} = 1,200,000 \times 30 = 1,333,333 \text{ cu. yds.}$

30% waste $\Rightarrow$ deduct $0.7 \times 1,333,333 = 933,333 \text{ cu. yds}$ from the initial total of 18,536,090 from page 551.

$\Rightarrow$ New figure = 17,602,757 cu.yds.

Tentative haul roads have been marked on the 1" to 200' and 1" to 400' topographic maps and approximate locations of the mass centre for each area have been marked.

QUANTITIES
SUMMARIES

SUBJECT: SUSITNA
Fill Quantities "Rock"

JOB NUMBER P. 3700
FILE NUMBER P. 3700. 12 09
SHEET _____ OF _____
BY RDC Jan DATE 7/82
APP _____ DATE _____

Description	FILL QUANTITIES (ROCK)			
	Quantity	Waste Factor	Required Q _R	Waste Q _w
Upstream Cofferdam				
rock shell	47,000			
closure dike	43,000			
rip rap	14,000			
Downstream Cofferdam				
closure dike	42,000			
Main Dam				
rock fill upstream shell	25,009,000			
rip rap	1,331,000			
Channel Filter Blanket				
rip rap	75,000			

Fill Quantities
Impervious core to
Mod. Aquifer
each cell approx
quantity, rep
rep. for main
dam

BENDING

ALL

(1000000)

Revised design →
Require revised fine,
coarse filter quantities



Calculations

SUBJECT: SUSITNA
Fill Quantities "Gravel"

JOB NUMBER P. 5700
FILE NUMBER P. 5700.14.09
SHEET _____ OF _____
BY RDC Jan DATE 7/82
APP RGA DATE 1/15/82

Description	FILL QUANTITIES (GRAVEL)			
	Quantity * (BY)	Waste * Factor	Required Q _r	Waste Q _w
Upstream Cofferdam				
fine filter	39,000	0.1	42,900	3,900
coarse filter	54,000	0.1	59,400	5,400
Downstream Cofferdam				
fine filter	35,000	0.1	38,500	3,500
coarse filter	12,000	0.1	13,200	1,200
Main Dam				
fine filter	2,249,000	0.1	2,473,900	224,900
coarse filter	2,318,000	0.1	2,549,800	231,800
Drain Blanket †	2,500,000	0.3		
Channel Filter Blanket				
fine filter	900,000	0.1	990,000	90,000
coarse filter	1,200,000	0.1	1,320,000	120,000
Service Spillway Valves (b'fill)	3,200	0.1	3,520	320
Emergency Spillway (fuse plug)	54,200	0.1	59,620	5,420
Intakes (backfill)	16,300	0.1	17,930	1,630
Concrete Aggregate	609,413	0.45	883,646	274,235
Main Dam				
Gravel downstream shell	24,000,000			

* Quantities taken from Susitna Preliminary Estimate Computer Printout dated 10 Dec 81 file WACOST.DAT; 31 with modifications where noted

† Advised of quantity required for Drain Blanket by F. Toth 7 Jan 82.

7490 111 8452,416 962,305

* Waste factors defined by F. Toth 7 Jan 82.



Calculations

SUBJECT: SUSITNA
Overburden Excavation Quantities

JOB NUMBER P 5700
FILE NUMBER _____
SHEET _____ OF _____
BY RDC Jan DATE 7/82
APP RGA DATE 1/15/82

Description	Excavated Overburden Quantities			
	Quantity* (By)	Waste Factor	Waste Qw	Useable Qu
Main Dam Alluvium	5,400,000 ⁺	0.5	2,700,000	2,700,000
Overburden	1,846,000	1.0	1,846,000	
Access Tunnel Portals	6,000	1.0	6,000	—
Reservoir dams + waterways portal downstream	27,000	1.0	27,000	—
Service Spillway Valves inlet	21,000	1.0	21,000	—
Aux. Spillway Chute	1,603,000	1.0	1,603,000	—
Emergency Spillway	4,157,820 ⁺	1.0	4,157,820	—
Intake Structure	148,000	1.0	148,000	—
Tailrace works	42,000	1.0	42,000	—
			10,550,820	2,700,000

- * Quantities taken from Susitna Preliminary Estimate Computer Printout dated 10 Dec 81 file WACOST.DAT; 31 except where noted.
⁺ Quantity taken from calculations by Bill Kerpka, Jan 1982, following redesign of dam.
⁺ Revised quantities following redesign of emergency spillway.

ACRES

SUSITNA
Wetana Dam.

SUBJECT: Estimates
Rock Excavation

JOB NUMBER 5-5400

FILE NUMBER

SHEET 2. OF 2.

BY RDC Jan DATE 16/82

APP _____ DATE _____

Table REL-1 : Excavated Rock Quantities based on
Computer Listing WACOST.DAT; 38 16 Jan 82

Description	Excavated Rock			
	Quantity (BY)	Waste Factor	Waste Qw	Useable Qu
Powerhouse Vault	102,200 ✓	0.2	20,440	81,760
Draft tube	34,000 ✓	"	6,800	27,200
Access Tunnels + portals		0.~		
tunnels (main)	91,000 ✓	0.2	18,200	72,800
tunnels (Adams)	2,400 ✓	"	480	1,920
portals	3,000 ✓	"	600	2,400
Bus tunnels + shafts	7,200 ✓	"	1,440	5,760
Transformer gallery	39,000 ✓	"	7,800	31,200
Reservoir Dams + Waterways		-		
tunnels	377,000 ✓	0.2	75,400	301,600
portal upstream	240,000 ✓	"	48,000	192,000
portal downstream	50,000 ✓	"	10,000	40,000
Main Dam	1,767,000 ✓	"	353,400	1,413,600
Service Spillway Valves				
inlet	167,000 ✓	0.2	33,400	133,600
Aux. Spillway Chute (Approach)	2,360,000 ✓	"	472,000	1,888,000
Emergency Spillway	2,562,000 ✓	"	512,400	2,049,600
Intake Structure	1,308,500 ✓	"	261,700	1,046,800
Surge Chamber	75,000 ✓	"	15,000	60,000
Penstocks	56,200 ✓	0.5	28,100	28,100
Tailrace Works	79,400 ✓	0.2	15,880	63,520
Control Structure	113,500 ✓	"	22,700	90,800
Upper Chute	348,500 ✓	"	69,700	278,800
Lower Chute	152,500 ✓	"	30,500	122,000
Valve Block / Flip Bucket	378,000 ✓	"	75,600	302,400

Revised
Amended
February 1978

↑
need to
include M



Calculations

SUBJECT: SUSITNA
Excavated Rock Quantities

JOB NUMBER P.5400

FILE NUMBER P.5400. 14.09

SHEET _____ OF _____

BY RDC Jan DATE 6/82

APP RGA DATE 1/15/82

Description	Excavated - Rock			
	Quantity (BY)	Waste Factor	Waste Qw	Useable Qu
Powerhouse Vault	102,200	0.2	20,440	81,760
Draft tube	34,000	"	6,800	27,200
Access tunnels + portals				
tunnels (main)	91,000	0.2	18,200	72,800
tunnels (2ndary)	2,400	"	480	1,920
portals	3,000	"	600	2,400
Access Shafts	10,450	"	2,090	8,360
Fire Protection Headtank	2,000	"	400	1,600
Bus Tunnels and shafts	7,200	"	1,440	5,760
Transformer Gallery	39,000	"	7,800	31,200
Cable Shafts	2,850	"	570	2,280
Reservoir Dams + Waterways				
tunnels	377,000	0.2	75,400	301,600
portal upstream	240,000	"	48,000	192,000
portal downstream	50,000	"	10,000	40,000
Main Dam	3,202,000	"	640,400	2,609,600
Grout Galleries / Portals	20,110	"	4,022	16,088
Service Spillway Valves				
inlet	167,000	0.2	33,400	133,600
tunnels	59,800	"	11,960	47,840
Aux. Spillway Gate (Approach)	2,360,000	"	472,000	1,888,000
Emergency Spillway	1,383,000	"	276,600	1,106,400
Intake Structure	1,308,500	"	261,700	1,046,800
Surge Chamber	75,000	"	15,000	60,000
Penstocks	56,200	"	11,240	44,960
Tailrace Works	79,400	"	15,880	63,520
TOTAL			1,946,422	7,785,688

FORM NO. 152 REV. 1

QUANTITIES
SUMMARIES



Design Calculation Cover Sheet

Project No. 05700

File No. _____

Serial No. _____

Project Title SUSITNA WATANA DAMDepartment (CIVIL) (for Project Series)

Calculations for: Quantities / Estimates Watana Dam
Rock / Overburden
Fill
Concrete

Original By R. D. Chamberlain

Date / /

Checked By _____

Date / /

Rev. No.	By	Date	Checked	Date
_____	_____	/ /	_____	/ /
_____	_____	/ /	_____	/ /
_____	_____	/ /	_____	/ /
_____	_____	/ /	_____	/ /
_____	_____	/ /	_____	/ /
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_____	_____	/ /	_____	/ /

Approved By _____

Professional Engineers
Seal

Original Copies Placed in Main File on Closure of Project

By _____

Date / /

Total No. of Sheets 29



Calculations

SUBJECT: SUSITNA Water Dam
Summary Sheets
Support Calculations.

JOB NUMBER P5400
 FILE NUMBER _____
 SHEET _____ OF _____
 BY RDC Jcn DATE 4/82
 APP _____ DATE _____

CONTENTS

- C. 001 Revised Quantities Emergency Spillway / Main Dam.
- C. 002 Tabulation Rock / Overburden quantities WACOST.DAT ; 31
- C. 003 Tabulation Fill Quantities WACOST.DAT ; 31
- C. 004 Tabulation Concrete Quantities WACOST.DAT ; 31



Calculations

C. 001

SUBJECT: SUSITNA

Emergency Spillway/Main Dam
Revised Quantities

JOB NUMBER P. 5700

FILE NUMBER P. 5700.12.09

SHEET _____ OF _____

BY RDC Jan DATE 7/82.

APP _____ DATE _____

Comments: ~~Emergency Spillway~~ Redesign necessitated
a revision to quantities / estimates.

Revised Quantities attached as Addendum: I.

~~Main Dam alluvium.~~ Redesign of dam required
a revision to quantities / estimates.

Following table gives revised quantities from Bill Kerpka 7 Jan 82.

Excavation Main Dam

Description	Below 1500'	Above 1500'	Total (CY)
Alluvium	5,400,000	—	5,400,000
Overburden	—	1,846,000	1,846,000
Rock (Shell)	967,000	1,853,000	2,820,000
Rock (Core)	533,000	1,234,000	1,767,000



Calculations

SUBJECT:

SUSITNA
HYDRO PROJECT
QUANTITY SUMMARY
FINAL ESTIMATE

SITE WATANAACCOUNT# 332.53ITEM EMERGENCY SPILLWAY.JOB NUMBER 1570009FILE NUMBER 332.53SHEET 1 OF BY DATE APP DATE

SUB NUMBER	DESCRIPTION	UNIT	CALC		REVISIONS		NOTES SEE LAST SHEET
			QUAN.	BY DATE SHEET	QUAN	BY DATE SHEET	
531	EXCAVATION (INCLUDING BRIDGE) + FUSE PLUG						③
✓	OVERBURDEN	CY	4,115,086	5 JAN 82	3	4,157,820	RTM 1/6/82 3 OF 3
✓	ROCK (WASTED)	CY	519,787	2		522,688	RTM 1/6/82 2 OF 3
✓	ROCK (USED)	CY	2,819,857	1		2,561,639	RTM 1/6/82 1 OF 3
532	FUSE PLUG						
		CY					
		CY					
		CY					
		CY					
533	FOUNDATION PREP/GROUTING FOUNDATION PREP. UNDER FUSE PLUG	SF					
SEE SHEET 3	BRIDGE PIERS/ABUTMENTS	SF					
534	CONCRETE						
	BRIDGE DECK	CY					
	BRIDGE PIERS/ABUTMENT	CY					

COMMENTS &
REMARKS

Addendum: I

Excavation Quantities.

7 Jan 1982 RDS.

Rock

DESCRIPTION	QUANTITIES (CY)						Unsound Rock Use
	Overburden	Overburden Dry	Rock Useable	Rock Waste	Rock Unspecified	Unsound Rock Waste	
Powerhouse Vault Rock					✓ 102,200	0.8	
Draft Tube Rock					✓ 34,000	0.8	
Access Tunnels & Portals							
• tunnels (main)					✓ 91,000	0.8	
• tunnels (2ndary)					✓ 2,400	0.1	
• portals	6,000		3,000	200			
Access Shafts					✓ 10,450	0.8	
Fire Protection Headtank					✓ 2,000	0.1	
Bus tunnels & shafts (horiz)					✓ 7,200	0.1	
Transformer Gallery					✓ 39,000	0.8	
Cable Shafts					✓ 2,850	0.1	
Reservoir, Dams & Waterways							
• tunnels					✓ 377,000	0.1	
• portal upstream			240,000	172,000			
• portal downstream		27,000				24,000	50,000
Main dam	6,544,000		3,262,000	0.1			
Grout Galleries/Portals					✓ 20,110	0.8	
Saddle Dam & Filter	65,000						
Service Spillway Valves							
• inlet	21,000		167,000	0.1			
• tunnels					✓ 59,800	0.8	
Aux. Spillway Chute (Approach)	1,603,000		2,360,000	0.1			
Emergency Spillway	3,551,000		1,383,000	0.1			
Intake structure	148,000		1,308,500	0.1			

ADAMS
ADAMS

Calculations

C. 002

SUBJECT: SUSITNA

Watana Dam

Rock Quantities (Excavation)

533

JOB NUMBER

FILE NUMBER

SHEET 4 OF

BY RDC DEC DATE 29/81

APP DATE

33

DESCRIPTION	QUANTITIES (CY)						
	Overburden	Overburden Dry	Rock Useable	Rock Waste	Rock Unspecified	Unsound Rock Waste	Unsound Rock Use
Surge Chamber Penstocks Tailrace Works		42,000		15,000	✓ 75,000 ✓ 56,200 ✓ 79,400		



Calculations

SUBJECT: SUSITNA

Watana Dam

Rock Quantities

(Excavation)

Reference: Preliminary Estimate Computer Printout dated 10 Dec 1981
File: WACOST.DAT ; 31

JOB NUMBER _____
FILE NUMBER _____
SHEET 5 OF _____
BY RDC DEC DATE 24/81
APP _____ DATE _____

QUANTITIES (CY)

Description	Core (Imp. core)	Fine Filter	Coarse Filter	Filter	MISC.	Rock Shell	Closure Dike	Rip Rap
Upstream Cofferdam	80,000	39,000	54,000			77,000	43,000	14,000
Downstream Cofferdam		35,000	12,000				42,000	
Main Dam	6,966,000	2,249,000	2,318,000					1,351,000
Gravel downstream shell					23,037,000	24,000,000		
Rock fill upstream shell					24,959,000	25,000,600		
DEBRIS BLANKET 2.5x10 ⁶ (30%) x 1.3								
Saddle Dam Filter Blanket								
Heel rock					21,000			
Shore protection								24,000
Waste rock					26,000			
Channel Filter Blanket		900,000	1,200,000					75,000
Service Spillway Valves								
Backfill					3,200			
Emergency Spillway (Fuse Plug)					54,200			
Intakes (backfill)					16,300			
	7,090,000	3,223,000	3,584,000	12,000		49,126,000	85,000	1,458,000

ACRIS

Calculations

SUBJECT: SUSITNA

Watana Dam

Fill Quantities

C. 003

535

JOB NUMBER _____
 FILE NUMBER _____
 SHEET 5 OF _____
 BY RDC DEC DATE 28/81
 APP DATE _____

Reference: Preliminary Estimate Computer Printout dated 10 Dec 1981

File: WACOST.DAT:31

ACRES**Calculations**

C. 004

SUBJECT: Susitna
Watana Dam
Concrete Quantities

JOB NUMBER _____
FILE NUMBER _____
SHEET 1 OF _____
BY RDC DEC DATE 28/81
APP _____ DATE _____

Description	Quantity (CY)	
Powerhouse	27 300	
Draft Tube	14 200	
Tunnels (Main) Conc. lining	3 500	
Tunnels (Zndary) Conc. lining	120	
Portals: conc. base slab	6 350	
Access shafts: conc. lining	5 700	
Fire Protection Headtank	340	
Bus Tunnels and Shafts (base slab)	2 000	
Transformer Gallery (base slab)	2 700	
Cable Shafts	1 800	
Reservoir dams, waterways		
• tunnels (conc. lining)	73 900	
• portal upstream (headwall)	4 800	
• " " (pier)	600	
• portal downstream (headwall)	4 100	
• concrete plugs	5 200	
Main Dam		
Tunnels, Conc. lining	2 060	
Shafts, conc. lining	290	
Service Spillway Valves		
• Inlet, base slab	6 300	
structure	28 200	
• Tunnels, lining	17 700	
• Conc. Walls (one form)	55 400	
(two form)	33 100	
• conc. slab approach	9 600	
no form	11 000	
one form	5 300	
• Conc. gate shoot (one form)	2 200	
" " " (two form)	4 700	
• Conc. structure (one form)	10 100	
(two form)	3 400	

341,960

36
SUB TOTAL I



Calculations

SUBJECT: Susitna
Watana Dam
Concrete Quantities

JOB NUMBER _____
 FILE NUMBER _____
 SHEET 2 OF _____
 BY RDC DEC DATE 28/81
 APP _____ DATE _____

Description	Quantity (CY)	
• concrete top slab (bridge)	1 800	
Intakes		
• Structure (structure)	142 800	
(mass)	31 600	
Surge Chamber	2 000	
Penstocks conc. liner	28 200	
Tailrace works		
Tunnels • lining	2 200	
• slab	2 700	
Portals • base slab	100	
• walls	650	
		212,050 SUB TOTAL II
		341,960 SUB TOTAL I
		554,010 TOTAL
Allowance for Miscellaneous Structures	10%	55,401
		609,411 TOTAL
Allowance for Wastage Advised by F.Tell 6 Jan 82	4.5%	274,235
		883,646
		Cubic Yards -

Reference: Preliminary Estimate Computer Printout dated 10 Dec 1981
 File: WACOST.DAT ; 31.

Note:

BORROW AREAS
QUANTITIES



Calculations

SUBJECT: SUSITNA
Summary Borrow Area Volumes
(Allowing 30% wastage).

JOB NUMBER P. 5700
 FILE NUMBER P. 5700.14
 SHEET _____ OF _____
 BY RDE Jan DATE 6/82
 APP _____ DATE _____

Table: Summary of material volumes available from each borrow area.

Borrow Area	Useable Material @ 30% Waste.		
	Below water table	Above water table	TOTAL
Upper Tsusena Creek			
• Central portion	* 998,415	3,993,659	4,992,074
• Top left		5,483,100	5,483,100
• Bottom right		6,727,583	6,727,583
Borrow Area E	23,317,452	12,302,224	35,619,676
Southern Extension to Area E	4,180,273		4,180,273
Downstream Continuation from Borrow Area E			
• Area I	5,466,865		5,466,865
• Area II A	2,853,319		2,853,319
• Area II B	4,072,895		4,072,895
	40,889,219	28,506,566	69,395,785

* Quantities from Upper Tsusena Creek calculated by others. Conversation Lance Duncan implied most of excavation above water level. Excavation to shallow depth only was considered near the creek. Assumption was that 20% of Central Portion is below water level.



Design Calculation Cover Sheet

PROJECT No. P 5700FILE No. P 5700. 14. 01

SERIAL No. _____

PROJECT TITLE ELUSITNA KATANA DAMDEPARTMENT CIVIL (for Project Services)CALCULATIONS FOR: Basin Area for Katana DamORIGINAL BY R. D. ChamberlainDATE 7 / Jan / 1952

CHECKED BY _____

DATE / / /

REV No.	BY	DATE	CHECKED	DATE
_____	_____	/ /	_____	/ /
_____	_____	/ /	_____	/ /
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APPROVED BY _____

PROFESSIONAL ENGINEERS
SEAL

ORIGINAL COPIES PLACED IN MAIN FILE ON CLOSURE OF PROJECT

BY _____

DATE / / /TOTAL No. OF SHEETS 41



Calculations

SUBJECT: SUSITNA
Borrow Area Volumes

JOB NUMBER P 5700
FILE NUMBER P 5700 14. Jan
SHEET _____ OF _____
BY RDC Jan DATE 7/82
APP _____ DATE _____

CONTENTS

- (i) Downstream Continuation of Borrow Area E
Contributory Areas: I (Calcs, areas, volumes)
II A
II B
- (ii) Upper Tsusena Creek
Contributory Areas: Central Portion
Top Left Portion
Bottom Right Portion.
Calculations, Summary of volumes.
- (iii) Borrow Area F
Information, map for calculating borrow volumes
- (iv) Borrow Area E
Modification of volumes to take account of overburden.
Volumes of material from Southern Extension to
Borrow Area E.
- (v) Borrow Area E
Worst case, large quantity of overburden.
- (vi) Borrow Area E
Initial calculations for Borrow Area E.



Calculations

(i)

SUBJECT: SUSITNA

Downstream Continuation of
Borrow Area E.

JOB NUMBER P. 5700

FILE NUMBER P. 5700, 12. 09

SHEET 1 OF

BY RDC Jan DATE 4/82

APP DATE

✓ RGA 1/16/82

Comments:

Quickest method of excavation dragline.

Dragline to be considered effective out to 250 ft.

Land areas to be exploited where contours allow.

Refer to topographic maps for delineation of areas
considered able to be exploited.

Ref: Aerial Topographic Map

Devils Canyon Reservoir

Scale 1" to 400'

Date of Photography 7-19-80.

Land areas to be exploited on West side of River
contained within solid blue lines on drawing.

Dragline reach limit defined by dashed blue lines.

Land areas are I, IIA, IIB and III.

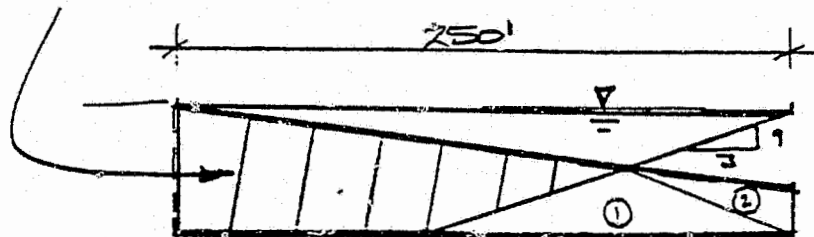
Red lines indicate steep contours $\Rightarrow$ no exploitation.

Area I:

$$\begin{aligned}\text{Land Area} &= \frac{1}{2} \times 1860 \times 2630 + \frac{1}{2} \times 2650 \times 1100 + \\ &= 2,445,900 + 1,457,500 \\ &= 3,903,400 \text{ ft}^2.\end{aligned}$$

$$\underline{3,903,400 \text{ ft}^2}$$

Dragline area: Consider a unit length



$$\begin{aligned}\text{Sectional area} &= \frac{50+20}{2} \times 250 - \frac{1}{2} \times 150 \times 30 - \frac{1}{2} \times 70 \times 20 \\ &= 8750 - 2250 - 700 \\ &= 5800 \text{ ft}^2.\end{aligned}$$

$$\begin{aligned}\text{Perimeter dist} &= 2600 + 2650 = 5250 \text{ ft} \Rightarrow \text{Vol} = \underline{30,450,000 \text{ ft}^3} \\ \text{Multiply by 0.9 for waste} &\quad \text{Vol} = 27,405,000 \text{ ft}^3\end{aligned}$$



Calculations

SUBJECT: SUSITNA

Downstream Continuation of
Borrow Area E

JOB NUMBER P. 5700

FILE NUMBER P. 5700, 1L 0A

SHEET 2 OF

BY RDE Jan DATE 4/82

APP DATE

✓ RGA (upto III) 1/16/82

Area IIA:

$$\begin{aligned}\text{Land area} &= \frac{1}{2} \times 1150 \times 320 + \frac{1}{2} \times 1870 \times 1000 + \frac{1}{2} \times 1670 \times 800 \\ &\quad + \frac{1}{2} \times 900 \times 460 \\ &= 184,000 + 935,000 + 668,000 + 207,000 \\ &= \underline{1,994,000 \text{ ft}^2}\end{aligned}$$

Dragline volume:

$$\begin{aligned}\text{Perimeter length} &= 420 + 620 + 1450 + 640 \\ &= 3,130 \text{ ft}\end{aligned}$$

$$\begin{aligned}\text{Vol} &= 5800 \times 3130 = \frac{18,154,000 \text{ ft}^3}{\times 0.9} = \underline{16,338,600 \text{ ft}^3}\end{aligned}$$

Area IIB:

$$\begin{aligned}\text{Land area} &= \frac{1}{2} \times 4170 \times 640 + \frac{1}{2} \times 2980 \times 870 + \frac{1}{2} \times 1830 \times 620 \\ &= 1,334,400 + 1,296,300 + 567,300 \\ &= \underline{3,198,000 \text{ ft}^2}\end{aligned}$$

Dragline volume:

$$\begin{aligned}\text{Perimeter length} &= 970 + 3000 + 1120 \\ &= 5090 \text{ ft}\end{aligned}$$

$$\begin{aligned}\text{Vol} &= 5800 \times 5090 = \frac{29,522,000 \text{ ft}^3}{\times 44/50} = \underline{25,979,360 \text{ ft}^3}\end{aligned}$$

Area III:

$$\begin{aligned}\text{Land area} &= \frac{1}{2} \times 2000 \times 650 + \frac{1}{2} \times 1290 \times 1870 + \frac{1}{2} \times 2070 \times 1570 \\ &\quad + \frac{1}{2} \times 2010 \times 1430 + \frac{1}{2} \times 1260 \times 1530 + \frac{1}{2} \times 1380 \times 1280 \\ &\quad + \frac{1}{2} \times 2680 \times 870 + \frac{1}{2} \times 2550 \times 650 + \frac{1}{2} \times 1670 \times 520 \\ &\quad + \frac{1}{2} \times 2600 \times 570 \\ &= 650,000 + 1,206,150 + 1,624,950 + 1,437,150 + 963,900 \\ &\quad + 883,200 + 1,165,800 + 828,750 + 434,200 \\ &\quad + 741,000 \\ &= \underline{9,935,100 \text{ ft}^2}\end{aligned}$$

Dragline volume:

$$\begin{aligned}\text{Perimeter length} &= 1600 + 850 + 2080 + 1270 + 2680 + 650 + 900 + 1160 \\ &= 11,190 \text{ ft}\end{aligned}$$

$$\text{Vol} = 5800 \times 11190 = \underline{64,902,000 \text{ ft}^3}$$

Avg gravel depth = 44' ∴ reduce dragline volume by 44

ACRES

Calculations

SUBJECT: SUSITNA

Downstream Continuation of
Borrow Area E

JOB NUMBER P, 5700

FILE NUMBER D, 5700-14.09

SHEET 3 OF

BY RDC Jan DATE 4/82

APP DATE

Area III :

$$\begin{aligned}
 \text{Land area} &= \frac{1}{2} \times 1150 \times 200 + \frac{1}{2} \times 2150 \times 680 + \frac{1}{2} \times 800 \times 1340 \\
 &\quad + \frac{1}{2} \times 2790 \times 1360 + \frac{1}{2} \times 2800 \times 570 + \frac{1}{2} \times 2060 \times 1350 \\
 &\quad + \frac{1}{2} \times 1210 \times 1300 + \frac{1}{2} \times 1130 \times 1090 + \frac{1}{2} \times 950 \times 930 \\
 &= 115,000 + 731,000 + 536,000 + 1,897,200 + 798,000 \\
 &\quad + 1,390,500 + 786,500 + 615,850 + 441,750 \\
 &= 7,311,800 \text{ ft}^2
 \end{aligned}$$

Of area III it is estimated that 60% is above water level
The remainder is under water

Above water 4,387,080 ft²
Below water 2,924,720 ft²

Effective perimeter length (Only part perimeter useable)

$$\text{length} = 2150 + 1100 = 3250 \text{ ft}$$

$$\text{Vol} = 5800 \times 3250 = \underline{18,850,000 \text{ ft}^3}$$

Average Depths :

To determine the average depths that apply across the borrow areas
consider the seismic profiles. Gravel depths at various sections
extracted from WAK calculations dated 12/21/81 Serial No. 010

Borrow Area	From: Station	Gravel Depth (ft)	To Station	Gravel Depth (ft)	Average Gravel Depth.
I	30	> 50'	80	> 50'	50'
II A	65	> 50'	85	> 50'	50'
II B	85	> 50'	145	38'	<u>44'</u>
III	220	20'	330	15'	17'
IV	365	8	430	1'	4'

↓
Not worth
exploiting.

Table A :

Description	Best Case (Cubic Yards).			Worst Case (Cubic Yards).		
	Below water table	Above water table	Total	Below water table	Above water table	Total
Borrow Area E	25,221,902	20,596,743	45,818,645	23,317,452	12,302,234	35,619,676
Upper Tsarena Creek			26,480,129			26,480,129
South Ext. Area E			5,971,819			4,777,455
Distream continuation			17,704,398			14,163,518
						81,040,000

← This item use volume as shown

← These items use 70% of volumes shown.
(Suggested by Frank Toth 5 Jan '82.)

ACRES

Calculations

SUBJECT:

SUSITNA
Borrow Areas
SUMMARY

JOB NUMBER P 57400
FILE NUMBER P 57400.14.09
SHEET 5 OF
BY RDC JGA DATE 4/82
APP DATE



Calculations

SUBJECT: SUSITNA

Downstream Continuation of
Borrow Area E

JOB NUMBER P 5700
FILE NUMBER P 5700, 14.09
SHEET 4 OF
BY RDC Jan DATE 5/82
APP DATE

✓ RGA 1/16/82

Considering the preceding table discount Areas III and IV.
Reduce average depth of gravel by 3 feet to take account
of overburden.

Borrow Area	Effective depth	Volume (cu. yds)	Sub Totals (cu. yds)
I	47'	6,794,807 1,015,000	7,809,807 ✓ 5,466,865 *
II A	47'	3,471,037 605,133	4,076,170 ✓ 2,853,319 *
II B	41'	4,856,222 962,199	5,818,421 ✓ 4,072,895 *
TOTAL			17,704,398. ✓ 12,393,079 *

Note: Allowing for 30% wastage new sub volumes *

Comments:

Seismic Profiles indicate:

SL 81 - 8 : Material velocity is 3800 to 4800 ft per sec
from ground level to 60 ft minimum depth
Closest bedrock at 60 ft depth

SL 81 - 9 : Material velocity 3000 to 3500 ft per sec
to average depth of 30 feet.
Closest bedrock at depth 80 ft.



Calculations

SUBJECT: SUSITNA
DOWNSTREAM CONTINUATION OF
BORROW AREA E

JOB NUMBER PS700
FILE NUMBER _____
SHEET _____ OF _____
BY RGA DATE 1/16/82
APP _____ DATE _____

ADDENDUM TO CALCS. By RDC Jan. 4/82:

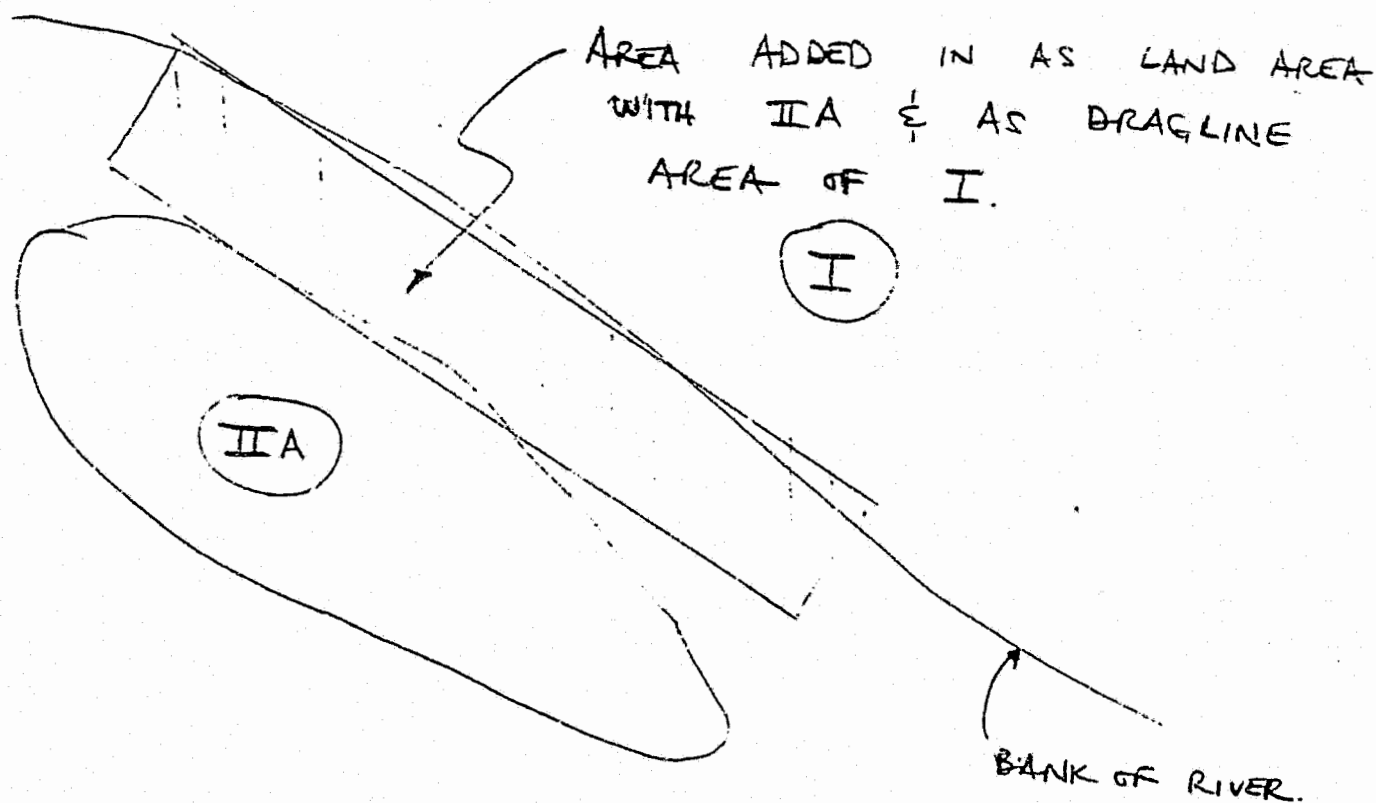
Part of the land area of Area IIA used by RDC in his calcs. had already been added in under the dragline section of Area I.

(see pg. 1 & 2)

The extra volume is as follows: (as land area of IIA)

$$\begin{aligned} & \text{(Approx.) } (250' \text{ wide}) \times (1850 \text{ long}) \times (50' \text{ deep}) \\ & = 23,125,000 \text{ cf} \\ & = \underline{856,500 \text{ cy}} \end{aligned}$$

Sketch:



SUMMARY:

The volume calculated for Area IIA is high by $\approx 856,500 \text{ py}$.

This is approx. 1.2% of the total excavated material volume. 48

649



Upper Tsusitna Creek

Calculations

SUBJECT: SUSITNA (ii)
Upper Tsusitna Creek Borrow Area
Revised Quantities

JOB NUMBER P577
FILE NUMBER P577.1a.21
SHEET _____ OF _____
BY RDC Jan DATE 3/51
APP _____ DATE _____

MATH CHECK RGA 1/18/82

Revised quantities allow 30% wastage ~~and~~ reduced volume of Central Portion due to ~~reduction of part area~~

Previous 10 sheets computed by T. Shaw. This sheet presents a tabulation sheet based on the corrections presented on page 10.

1 acre = 43,560 square feet (Ft.²)

Sections	Area of portion ≤ 5000 F.P.S. (Ft. ²)	Area of portion > 5000 F.P.S. (Ft. ²) but ≤ 9100 F.P.S.	Volume of portion ≤ 5000 F.P.S. (Ft. ³)	Volume > 5000 F.P.S. but ≤ 9100 F.P.S.
Central Portion				
1-1	10,600	-	109,060,000	-
2-2	55,500	-	113,070,000	21,850,000
3-3	34,960	17,480		
Summation:	101,060 Ft. ²	17,480 Ft. ²	222,130,000 (Ft. ³)	21,850,000 (Ft. ³)
	or 2.3 acres	0.4 acres	8,227,037 Cu. Yd.	809,259 Cu. Yd.
Top Left Portion Flatt Area reduces volume by 1,533,333 Ft. ² 4,900				
			5,758,926	566,481
			6,325,407	
			112,590,000	98,901,000
2-2	116,820	106,920		
Summation:	121,720 Ft. ²	106,920 (Ft. ²)	112,590,000 (Ft. ³)	98,901,000 (Ft. ³)
	or 2.8 acres	2.5 acres	4,170,000 Cu. Yd.	3,663,000 Cu. Yd.
Bottom Right Portion				
1-1	0	-	2,919,000	2,564,100
			675,000	-
2-2	7,500	-	37,012,500	55,125,000
3-3	63,000	105,000	62,505,000	104,175,000
4-4	75,900	126,500		
Summation:	146,400 Ft. ²	231,500 Ft. ²	100,192,500 (Ft. ³)	159,300,000 (Ft. ³)
	or 3.4 acres	or 5.3 acres	3,710,833 Cu. Yd.	5,900,000 Cu. Yd.
			2597583	4,130,000

* Volumes multiplied by a factor of 0.7 to allow for 30% waste

Total = 26,1180,129

Total = 18,536,000

Revised Total = 202,754



Calculations

SUBJECT: SUSITNA (iii)
Quantities - Estimates
Borrow Area F

JOB NUMBER P. 5700
FILE NUMBER P5700.14.09
SHEET _____ OF _____
BY RDC DEC DATE 31/81
APP _____ DATE _____

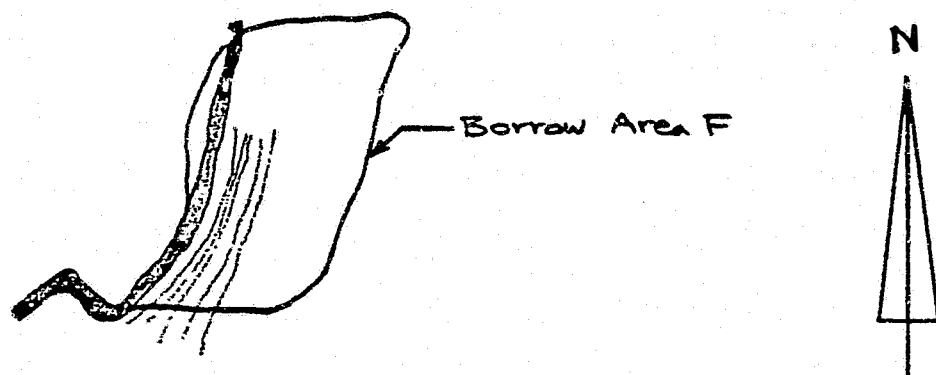
(a) Location / Mapping

To date no large scale topographic map is available for Borrow Area F.

The only map showing the extent of the region is Figure 3.1, titled "WATANA - PREVIOUS EXPLORATION MAP" in Susitna HEP, 1980 Geotechnical Report

Task 5 : Geotechnical Exploration, June 1981.

A large scale copy of this map is not available at present.



Scale in feet

Initially the map was obtained from ;

Reference : U.S. Army Corps of Engineers, 1979 (18)

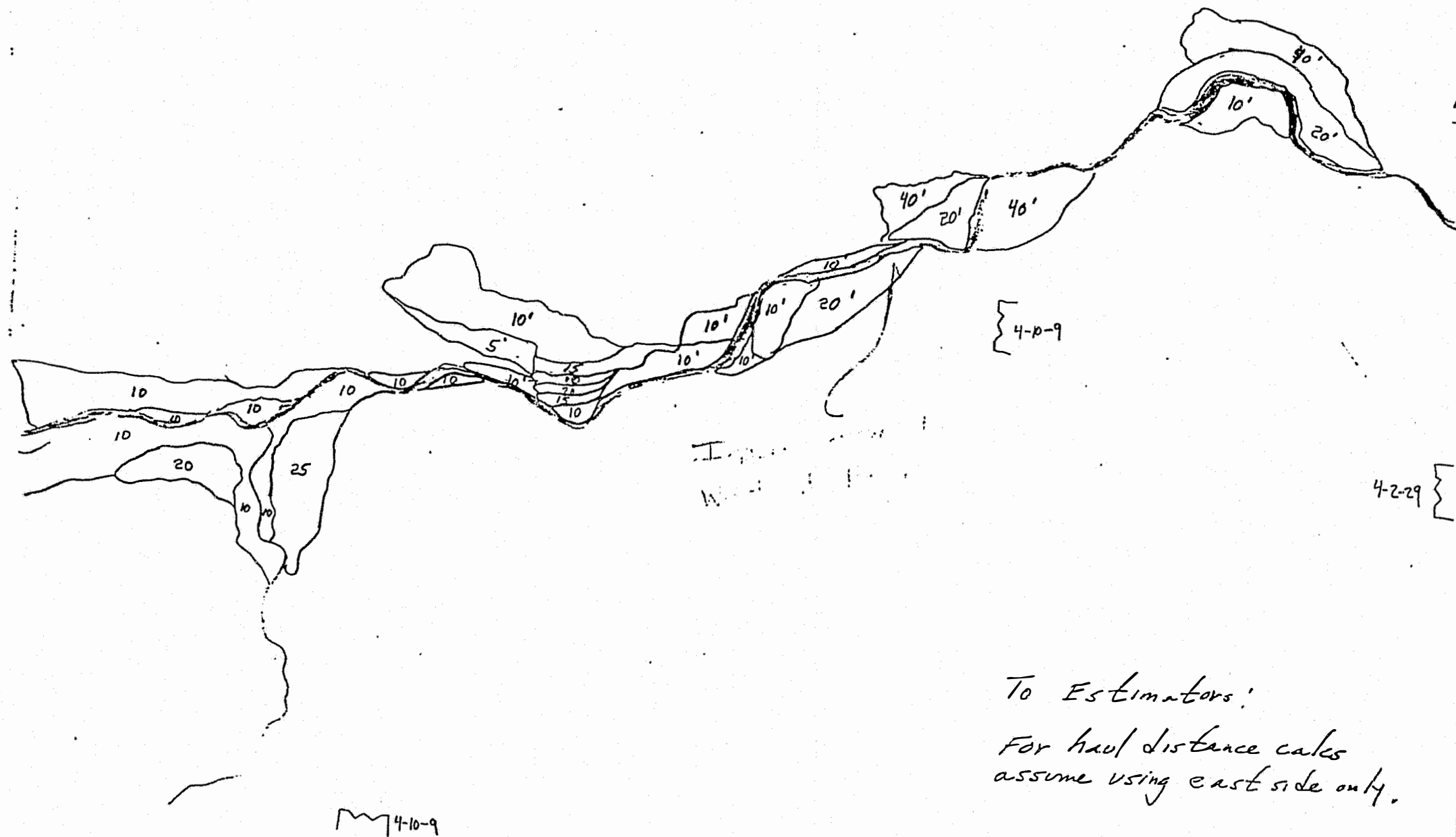
Borrow area F is a river terrace - Geotech estimates depth of accessible gravels between 10' and 30'. Attached find 1" to 2000' scale map showing extent and average depths through Borrow Area F.

Map plotted by Lance Duncan.

Area found by scaling off R and M 1" to 2000' colour aerial photos flown 1980.

← N

4-2-29 GSI 1:50,000
 1"=2000' 1981



To Estimators:
 For haul distance calculations
 assume using east side only.

From: Air Photo Interpretation LCD
 R&M Reservoir Photos 1980

Borrow Area F
 Area Limits &
 Excavation Depths
 LCD 1/4/82



Calculations

(iv)

SUBJECT: SUSITNA
Quantities - Estimates
Borrow Area E

JOB NUMBER P. 5700
FILE NUMBER P5700.14.09
SHEET 1 OF
BY RDC JAN DATE 2/82
APP DATE

✓ RGA 1/19/82

Overburden at Borrow Area E.

Conversation with Lance Duncan 31st Dec 1981 (Acres Buf)

In reviewing the seismic profiles through area E it is apparent that a considerable volume of material has a seismic velocity ≤ 2000 ft per second. This was initially thought to be overburden - however in conversation with Lance Duncan this material is suitable for concrete aggregate, and the reason for the apparent low velocity is that the material lies very loose in the ground.

For stripping purposes it was suggested that only two to four feet need be discounted as waste overburden. As a result of this discussion Tables I and II of Quantity calculations dated 30 Dec 1981 have been modified to take account of 4 feet overburden.

(i) Section SW-10

Section length (along ground surface) = 2470'
Overburden area ($2470' \times 4'$) = 9880 ft²
Overburden volume (1100×9880) = 10,868,000 ft³ ✓

(ii) Section SW-11

Section length = 2350' Overburden area = 9400 ft² ✓
Overburden volume = $1283 \times 9400 = 12,060,200$

(iii) Section SW-12

Section length = 2650' Overburden area = 10,600 ft² ✓
Overburden volume = $1548 \times 10,600 = 16,408,800$

(iv) Section SW-13

Section length = 2830' Overburden area = 11,320 ft² ✓
Overburden volume = $1635 \times 11320 = 18,508,200$

(v) Section SW-14

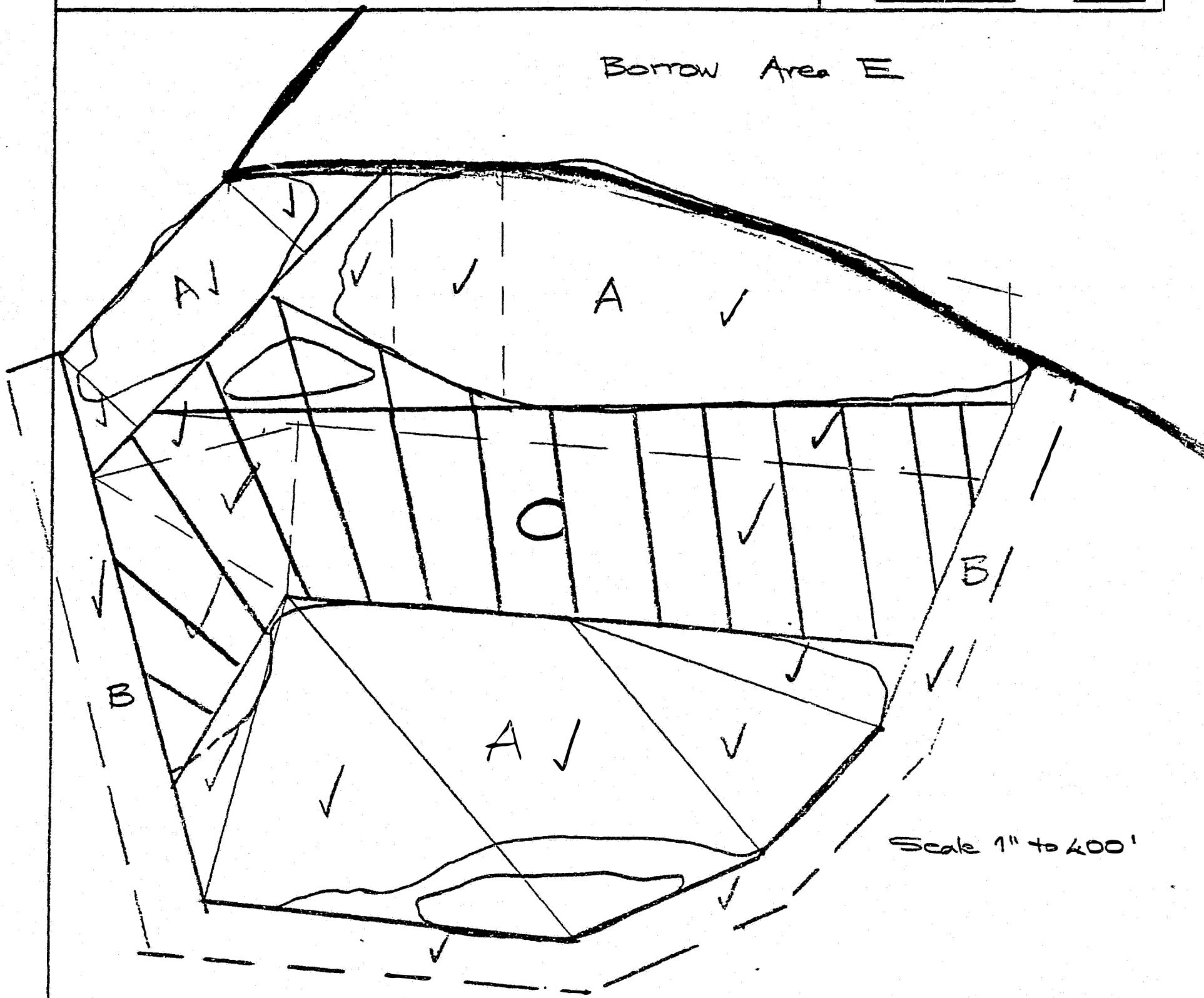
Section length = 2530' Overburden area = 10,120 ft² ✓
Overburden volume = $1745 \times 10120 = 17,659,400$
TOTAL VOLUME = 75,504,600 ft³ ✓

ACRES

Calculations

SUBJECT: SUSITNA
Southern Extension to
Borrow Area E

JOB NUMBER P. 5700
FILE NUMBER P. 5700.14.09
SHEET 2 OF
BY RDE Jan DATE 2/81
APP DATE



Southern Extension to Borrow Area E

Borrow Area E may be extended to include the area outlined with the green dashed line, by building a causeway out into the river.

Split into three sub areas:

- Area A bounded by solid green line
- Area B bounded by dashed green line
- Area C yellow hatched area

Note: From seismic profile SL 81-7
seismic velocity = 5000 ft per sec
from water level to a depth
exceeding 50 ft along whole
length of section. ⇒ Good
quality gravel to full required
depth of 50 ft. 53



Calculations

SUBJECT: SUSITNA

Southern Extension to
Borrow Area E

JOB NUMBER P. 5400

FILE NUMBER P. 5400.14.09

SHEET 3 OF

BY RDC Jan DATE 2/81

APP DATE

✓ RGA 1/19/82

(i) Area A : Islands (above water level)

* Assume islands average two feet above water level

Allowing 4' overburden depth $\Rightarrow$ dragline can operate to
a depth of 50 ft - 4 ft = 46 ft.

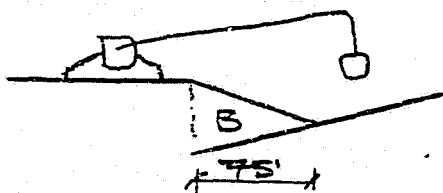
$$\begin{aligned} \text{Land area} = & \frac{1}{2} \times 170' \times 270' + \frac{1}{2} \times 280' \times 270' + 270' \times 630' \\ & + \frac{1}{2} \times 500' \times 325' + \frac{610' + 500'}{2} \times 240' + \frac{610' + 240'}{2} \times 1325' \\ & + \frac{1}{2} \times 830' \times 150' + \frac{1}{2} \times 1170' \times 680' + \frac{1170' + 790'}{2} \times 525' \\ & + \frac{1}{2} \times 860' \times 410' + \frac{1}{2} \times 890' \times 210' \end{aligned}$$

$$\begin{aligned} = & 22,950 + 37,800 + 170,100 + 81,250 + 160,950 \\ & 596,250 + 62,250 + 397,800 + 514,500 \\ & 176,300 + 93,450 \end{aligned}$$

$$\text{Land area} = 2,313,600 \text{ ft}^2$$

$$\text{Volume} = 2,313,600 \times 46' = 106,425,600 \text{ ft}^3 \quad \underline{3,941,689 \text{ CY}}$$

Area B : River edge (limited material excavatable).



Dragline reach 150'

Effective depth 46'

Red hatch = effective excavatable area

$$= \frac{1}{2} \times 50' \times 75' = 1875 \text{ ft}^2$$

Perimeter length of Southern Region of Borrow Area E is:

$$1030' + 460' + 550' + 950' + 1490' = 4,480'$$

$$\Rightarrow \text{Volume} = 1875 \times 4,480 = 8,400,000 \text{ ft}^3 = \underline{311,111 \text{ CY}}$$

Area C : Submerged gravels (assume avg water depth 15')

$$\text{Effective depth} = 50' - 15' = 35 \text{ ft.}$$

$$\begin{aligned} \text{Submerged area} = & \frac{1}{2} \times 2250' \times 200' + \frac{1800' + 1650'}{2} \times 450' + \frac{1}{2} \times 550' \times 130' \\ & + \frac{1}{2} \times 590' \times 400' + \frac{1}{2} \times 580' \times 590' \\ = & 225,000 + 776,250 + 35,750 + 118,000 \\ & + 171,100 \end{aligned}$$

$$\text{Submerged area} = 1,326,100 \text{ ft}^2$$

$$\text{Volume} = 1,326,100 \times 35 = 46,413,500 \text{ ft}^3 = \underline{1,719,019 \text{ CY}}$$

$$\text{Total Volume} = \underline{5,971,819 \text{ CY}}$$

54

$$\text{Volume at 30% waste} = 4,180,273 \text{ cu. yds.}$$

ACRES

Calculations

SUBJECT: SUSITNA (v)
 Quantities - Borrow Area E
 SUMMARY - Useable Volumes

JOB NUMBER P. 5700

FILE NUMBER

SHEET SAI OFBY RDC Jan DATE 2/81

APP DATE

Table II A

Useable Material Volume

✓ RGA 1/18/82

Material available in Borrow Area E with
 seismic velocity > 2000 ft per second.

Section No	Useable Volume ft ³ (CY)		
	Below water table	Above water table	Total
SW 14	172,275,125 (6,380,560)	43,787,285 (1,621,751)	216,062,410 (8,002,311)
SW 13	163,115,775 (6,041,325)	41,610,750 (1,541,139)	204,726,525 (7,582,464)
SW 12	126,587,700 (4,688,455)	63,964,908 (2,369,071)	190,552,608 (7,057,504)
SW 11	87,160,605 (3,228,171)	35,947,094 (1,331,574)	123,107,699 (4,559,544)
SW 10	80,432,000 (2,978,963)	146,850,000 (5,438,889)	227,282,000 (8,417,852)
<u>ΣA</u>	<u>(23,317,452)</u>	<u>(12,302,224)</u>	<u>(35,619,675)</u>
Upper Tsusena Creek Area	Previous calculations by others	These volumes to be used, although conservative F. Toth Updated	← (26,480,129)
Total		Updated	← (62,099,804)

FINAL.
 accepted
 7 Jan 1982.



Calculations

SUBJECT: SUSITNA
Quantities - Borrow Area E
SUMMARY - Sectional Areas

JOB NUMBER P, 5700

FILE NUMBER _____

SHEET SA II OF _____

BY RDC Jan DATE 2/81

APP _____ DATE _____

Table I A Useable Cross Sectional Areas ✓ RGA 1/18/82
 Material available in Borrow Area E with
 seismic velocity > 2000 ft per second.

Section No.	Section applied over distance of (ft)	Useable Cross Sectional Area (ft ²)			
		Below water table	Above water table	TOTAL	
SW 14	1745	98,725	25,093	123,818	✓
SW 13	1635	99,765	25,450	125,215	✓
SW 12	1548	81,775	41,321	123,096	✓
SW 11	1283	67,935	28,018	95,953	✓
SW 10	1100	73,120	133,500	206,620	✓