

DCND 108

HARZA ENGINEERING CO.

Date Received

3/16/83 ✓

Routed To

A. J. LaGrassa

Classified for Filing by

Project Number

Classification

Subject Description

(7) FEASIBILITY ESTIMATE

PRELIMINARY QUANTITIES

WATANA DAM HEIGHT OPTIMIZATION



Calculations

SUBJECT: SUSITNA HEP
WATANA - REVISIONS TO COST
ESTIMATE - DAM HGT EL. 2205 F

JOB NUMBER 5700.09
FILE NUMBER _____
SHEET 1 OF _____
BY RJH DATE 12/2/81
APP _____ DATE _____

REFER TO WATANA DAM HEIGHT OPTIMIZATION FILE
PREFERRED SCHEMES DATED 10/21 & 28/81 by WAK
10/29 by GEM

ITEM DESCRIPTION REVISED COST / QTY
1) 330 .1 LAND < EL 2240 36750 > 6280 $\left(\frac{15}{50}\right) = 1884$
INTERPOLATE EL 2190 30470
 $30470 + 1884 = \$ \underline{32,354,000}$

2) 331 .12 ACCESS TUNNELS & PORTALS - 700' LESS @ 2140 -
 $\left(\frac{35}{100}\right) 700 \text{ LESS @ } 2205 \text{ OR } 245' \text{ LESS}$
PROPORTIONAL $\frac{3040 - 245}{3040} = .92$

.121 EXC. ROCK $99,000 \times .92 = \underline{91,000 \text{ CY}}$

.124 CONC. $3,800 \times .92 = \underline{3500 \text{ CY}}$
REINF ST. $150 \times .92 = \underline{138 \text{ TON}}$

.125 SUPPORT - ROCK BOLTS $120 \times .92 = \underline{110 \text{ TON}}$
STEEL SUPPORT $350 \times .92 = \underline{322 \text{ TON}}$

3) 331 .13 ACCESS SHAFTS - IS PROPORTIONAL TO HGT.
 $\frac{650 - 35}{650} = .95$

.131 EXC ROCK $11,000 \times .95 = \underline{10,450 \text{ CY}}$

.134 CONC. LINING $6,000 \times .95 = \underline{5,700 \text{ CY}}$
REINF STEEL $70 \times .95 = \underline{67 \text{ TON}}$

.135 SUPPORT ROCK BOLTS $50 \times .95 = \underline{48 \text{ TON}}$

.138 STEEL / STR. $40 \times .95 = \underline{38 \text{ TON}}$

.13 C MECH ELEV $320,000 \times .95 = \$ \underline{304,000.00}$



Calculations

SUBJECT: SUSITNA HEP
WATANA - REVISIONS TO COST
ESTIMATE-DAM EL @ 2205 FT

JOB NUMBER P5700.09

FILE NUMBER

SHEET 2

CF

BY RJH

DATE 12/7/91

APP

DATE _____

ITEM DESCRIPTION		REVISED COST / QTY
3) 331 .171 CABLE SHAFTS - ROCK EXC. -		
	3,000 X .95 =	<u>2850 CY</u>
.174 CONC. LINING	1900 X .95 =	<u>1800 CY</u>
REINF STEEL	95 X .95 =	<u>91 TON</u>
.175 SUPPORT-ROCKBOLTS	50 X .95 =	<u>48 TON</u>
.178 STEEL / STR.	9 X .95 = 8.55 =	<u>9 TON</u>
.17C MECH. ELEVATOR	173,000 X .95 =	\$ <u>164,300.00</u>
4) 332 RESERVOIR, DAMS, & WATERWAYS		
.11 RESERV. CLEARING		
EL 2205 < EL: 2215 15375 >	375 ($\frac{15}{25}$) =	225 + 15,000 =
EL: 2190 15000		\$ <u>15,225,000.00</u>
PROPORTION: (SH. 10A - GEM - 10/28/81)		
EL 2205 < EL 2215 $\frac{443,500}{450,000} = .9856$		
EL 2190 - $\frac{437,000}{450,000} = .9710$	> .0146 + .9710 =	
PROPORTION @ 2205 =	<u>.986</u>	
.211 EXC. ROCK	382,000 X .986 =	<u>377,000 CY</u>
.214 CONC. LINING	74,900 X .986 =	<u>73,900 CY</u>
STEEL LINING	1,200 X .986 =	<u>1,185 CY</u>
.215 ROCKBOLTS	395 X .986 =	<u>390 TON</u>
STEEL SUPPRT	1067 X .986 =	<u>1052 TON</u>



Calculations

SUBJECT: SUSITNA H.E.P.
WATANA-REVISIONS TO COST
ESTIMATE - DAM EL. @ 2205 FT.

JOB NUMBER P5700.09
FILE NUMBER _____
SHEET 3 OF _____
BY RJH DATE 12/3/81
APP _____ DATE _____

ITEM DESCRIPTION REVISED COST / QTY

4332 .313 FOUND. PREP/GROUTING - SAME PROPORT. AS O.B.

① PROPORTIONAL TO CONTACT LENGTH - 4400 LF @ EL 2240'

$$\Delta H = 35' \quad \text{SLOPE} = 1:1 \quad \frac{1.4}{1} \quad 4400 - 2(35')(1.4) = \frac{4300}{4400} = .977 \text{ SAY } .98$$

CONSOLID GROUT:

A) DRILL HOLES $890,000 \times .98 =$ 872,000 LF

B) GROUT $3,560,000 \times .98 =$ 3,500,000 CF

GROUT CURTAIN

A) DRILL HOLES $408,000 \times .98 =$ 400,000 LF

B) GROUT $816,000 \times .98 =$ 800,000 CF

.317 DRAIN HOLES $130,000 \times .98 =$ 128,000 LF

.32 GROUT GALLERIES/PORTALS

① HORIZ. PROPOR TO CREST LENGTH

3900 LF @ 2240 FROM DAM VOL. DWGS = .98

3790 LF @ 2205 " " " "

② VERT. PROP. TO HEIGHT

$$2240 - 1360 = 880 \quad \frac{845}{880} = .96$$

$$2205 - 1360 = 845$$

A) HORIZ ROCK EXC. $18,400 \times .98 =$ 18,000 CY

B) VERT ROCK EXC. $2,200 \times .96 =$ 2110 CY

.324 CONC. & SHOTCRETE

A) TUNNEL CONC. LINING $2,100 \times .98 =$ 2060 CY

B) " SHOTCRETE $55,000 \times .98 =$ 53,900 SF

C) SHAFTS CONC. LINING $300 \times .96 =$ 290 CY

.325 SUPPORT

A) TUN. ROCK BOLTS $22 \times .98 =$ 22 TON

B) " STEEL SUPPORTS $350 \times .98 =$ 345 TON

ACRES

Calculations

SUBJECT: SUSITNA H.E.P.
WATANA-REVISIONS TO COST
ESTIMATE - DAM EL @ 2205'

JOB NUMBER P 5700 C9
FILE NUMBER _____
SHEET 4 OF _____
BY RJH DATE 12/3/81
APP _____ DATE _____

ITEM	DESCRIPTION	REVISED COST / QTY
433Z	.5 SERVICE SPILLWAY VALVES	
	① SHORTENED BY 100' FOR EL. 2140	
	$\therefore \frac{35}{100} \times 100' = 35' \text{ FOR EL } 2205 \text{ FT}$	
	$2040 - 35 = \frac{2005}{2040} = .98$	
.511	TUNNEL ROCK	
	EXC. HORIZ. 61,000 X .98 =	<u>59,800 CY</u>
.514	CONC. LINING	18,000 X .98 = <u>17,700 CY</u>
	REINF STEEL 720 X .98 =	<u>705 TON</u>
.515	SUPPORT - ROCK BOLTS	215 X .98 = <u>210 TON</u>
	STEEL SUPPORT 120 X .98 =	<u>118 TON</u>
.518	STEEL/MANIFOLD LINER	2300 X .98 = <u>2250 TON</u>
2 6	.51C MECH./SVC VALVES	9,000,000 X .98 = <u>\$ 8,820,000.00</u>
	.52 AUX. SPILLWAY CHUTE -	
	① NO REDUCTION IN FLIP & INTAKE	
	② REDUCE CHUTE 20% FOR 100' DROP	
	$\therefore \frac{35}{100} (.20) = .07 \text{ FOR } 35' \text{ DROP OR } .93$	
.521	EXC. O.B.	1,724,000 X .93 = \$ <u>1,603,000.00</u>
	ROCK USEABLE	2,537,000 X .93 = \$ <u>2,360,000.00</u>
.523	FOUND. PREP/GROUTING - STRUCTURE CHUTE -	
	ROCK HORIZ. 285,000 X .93 =	<u>265,000 SF</u>
	ROCK INCLINED 177,000 X .93 =	<u>165,000 SF</u>
	DENTAL CONC. 24,000 X .93 =	<u>22,300 CY</u>
	CONSOLID GROUT -	
	DRILL HOLES 37,400 X .93 =	<u>34,800 LF</u>
	GROUT 149,600 X .93 =	<u>139,200 CF</u>



Calculations

SUBJECT: SUSITNA H.E.P.

WATANA - REVISIONS TO COST
ESTIMATE - DAMEL @ 2205F

JOB NUMBER P5700.09

FILE NUMBER _____

SHEET 5 OF _____

BY RJH

DATE 12/3/81

APP _____

DATE _____

ITEM DESCRIPTION

REVISED COST/QT

4)332 .524 CONC. & SHOTCRETE

WALLS - ONE FORM	59,600 X .93 =	<u>55,400 CY</u>
" TWO "	35,600 X .93 =	<u>33,100 CY</u>
SLAB - ONE FORM	44,100 X .93 =	<u>41,000 CY</u>
" TWO "	5,700 X .93 =	<u>5,300 CY</u>
REINF. STEEL	5310 X .93 =	<u>4,950 TON</u>
.525 SUP. APP. ROCK BOLTS	790 X .93 =	<u>735 TON</u>

.6 INTAKES INTAKE HGT: 2240 - 190' + $\Delta \frac{75'}{100'}$ DROP
2140 - 265'

HGT @ 2205 = $190 + (.35) 75 = \frac{215'}{190} = 1.13(\text{INC.})$

.611 EXC. O.B.	131,000 X 1.13 =	<u>148,000 CY</u>
ROCK USEABLE	1,158,000 X 1.13 =	<u>1,308,500 CY</u>
.612 BACK FILL	14,400 X 1.13 =	<u>16,300 CY</u>
.614 CONC. & SHOTCRETE		
CONC. STRUCTURE	126,400 X 1.13 =	<u>142,800 CY</u>
" MASS	28,000 X 1.13 =	<u>31,600 CY</u>
REINF. STEEL	6320 X 1.13 =	<u>7,145 TON</u>
.615 SUPPORT STR. ROCK BOLTS	125 X 1.13 =	<u>142 TON</u>

.8 PENSTOCKS - PRORATE :

EL 2240 - EXC 58,500 > 3150 FOR 50' -

" 2190 - " 55,350

@ " 2205 - $(\frac{15'}{50'}) 3150 = 945 + 55350 = 56,295$

" 2205 - $\frac{56295}{58500} = .96$

" 2240 -

.811 TUN. ROCK EXC.	58,500 X .96 =	<u>56,200 CY</u>
.814 CONC. / LINER	29,400 X .96 =	<u>28,200 CY</u>
REINFORCING STEEL	1,200 X .96 =	<u>1,152 TON</u>
.815 SUP. - ROCK BOLTS	290 X .96 =	<u>280 TON</u>
.818 STEEL / LINER		

4400 →

\$ 4800/TON
6



Calculations

SUBJECT: SUSITNA H.E.P.
WATANA - REVISIONS TO
COST ESTIMATE - DAM EL. 2205 FT

JOB NUMBER P 5700.09
FILE NUMBER _____
SHEET 6 OF _____
BY R J H DATE 12/3/81
APP _____ DATE _____

ITEM DESCRIPTION

REVISED COST/QTY

.9 TAIL RACE WORKS - PORTALS - NO CHANGE
A) ^{EXC} EL. 2240 - EXC - 98,000 > 53,600
" 2140 - " 44,400
" 2205 = 98,000 - $\left(\frac{35}{100}\right) 53,600 = \frac{79,240}{98,000} = .81$

ps 8C
B) ^{BOLTS} EL. 2240 - 100 TON > 62
2140 - 38 TON
" 2205 - 100 - $\left(\frac{35}{100}\right) 62 = 78$ TON

C) ^{STEEL} EL. 2240 - 270 TON > 169
" 2140 - 101 "
" 2205 - 270 - $\left(\frac{35}{100}\right) 169 = 210$ TON

.911 TON. ROCK EXC. 98,000 x .81 = 79,400 CY

.914 CONC & SHOT.

CONC SLAB 3400 x .81 =

2700 CY

REINF. STEEL 225 x .81 =

185 TON

STEEL MESH 5 x .81 =

4 TON

SHOTCRETE 5400 x .81 =

4400 SF

.915 SUPPORT

B) ROCK BOLTS 100 -

78 TON

C) STEEL SUPPORT 270 -

210 TON

Note Pages 10, 11
on Relief Channel

SUSITNA HYDROELECTRIC PROJECT

Updated Estimate Summary

JANUARY 1982 DOLLARS

	CREST ELEVATION (FEET)		
	2215	2165	2115
	<u>\$MILLIONS</u>	<u>\$MILLIONS</u>	<u>\$MILLIONS</u>
WATANA SITE AND ACCESS COSTS			
Construction	\$ 2,720	\$ 2,449	\$ 2,195
Contingency	544	489	439
Owner Costs/Engineering	<u>408</u>	<u>367</u>	<u>329</u>
Subtotal	3,672	3,305	2,963

WATANA TRANSMISSION COSTS			
Transmission Lines and Substations	263	263	263
Contingency	53	53	53
Owner Costs/Engineering	40	40	40
Land	<u>18</u>	<u>18</u>	<u>18</u>
Subtotal	374	374	374

TOTAL WATANA COST	\$ 4,046	\$ 3,679	\$ 3,337
DEVIL CANYON SITE AND ACCESS COSTS			
Construction	\$ 1,136	\$ 1,136	\$ 1,136
Contingency	228	228	228
Owner Costs/Engineering	<u>170</u>	<u>170</u>	<u>170</u>
Subtotal	1,534	1,534	1,534

DEVIL CANYON TRANSMISSION COSTS			
Transmission Lines and Substations	69	69	69
Contingency	14	14	14
Owner Costs/Engineering	<u>10</u>	<u>10</u>	<u>10</u>
Subtotal	93	93	93

TOTAL DEVIL CANYON COST	\$ 1,627	\$ 1,627	\$ 1,627
TOTAL PROJECT COST	\$ 5,673	\$ 5,306	\$ 4,964



Calculations
SUBJECT: *SADDLE DAM & AELICT CHANNEL*
WATANA -
HEIGHT ADJUSTMENTS

JOB NUMBER *P5700 09*
FILE NUMBER _____
SHEET *1* OF *1*
BY *DM* DATE *09 NOV 81*
APP _____ DATE _____

	CREST EL	<i>2240</i>	<i>000</i>				
<i>MAT</i>							
<i>(OST)</i>							
<i>SADDLE DAM</i>		<i>\$ 10 568</i>		<i>2090</i>		<i>2140</i>	
				<i>(2135)</i>		<i>(2135)</i>	
				<i>411 ACRES</i>	<i>x 1.9</i>		
				<i>23 ACRES</i>	<i>MILLION</i>		
				<i>400</i>		<i>NONE</i>	
<i>CURTAIN</i>		<i>\$ 127 725</i>		<i>145</i>	<i>x</i>	<i>107</i>	<i>x</i>
<i>WALL</i>		<i>18 049</i>					<i>60</i>
		<i>\$ 156 342</i>				<i>107 400</i>	<i>60 000</i>

REASONABLE

<i>SADDLE DAM</i>	<i>10 568</i>	<i>SAME AS ABOVE</i>	
<i>CURTAIN</i>	<i>102 159</i>	<i>87</i>	<i>49</i>
<i>WALL</i>	<i>16 237</i>		
	<i>\$ 128 964</i>		

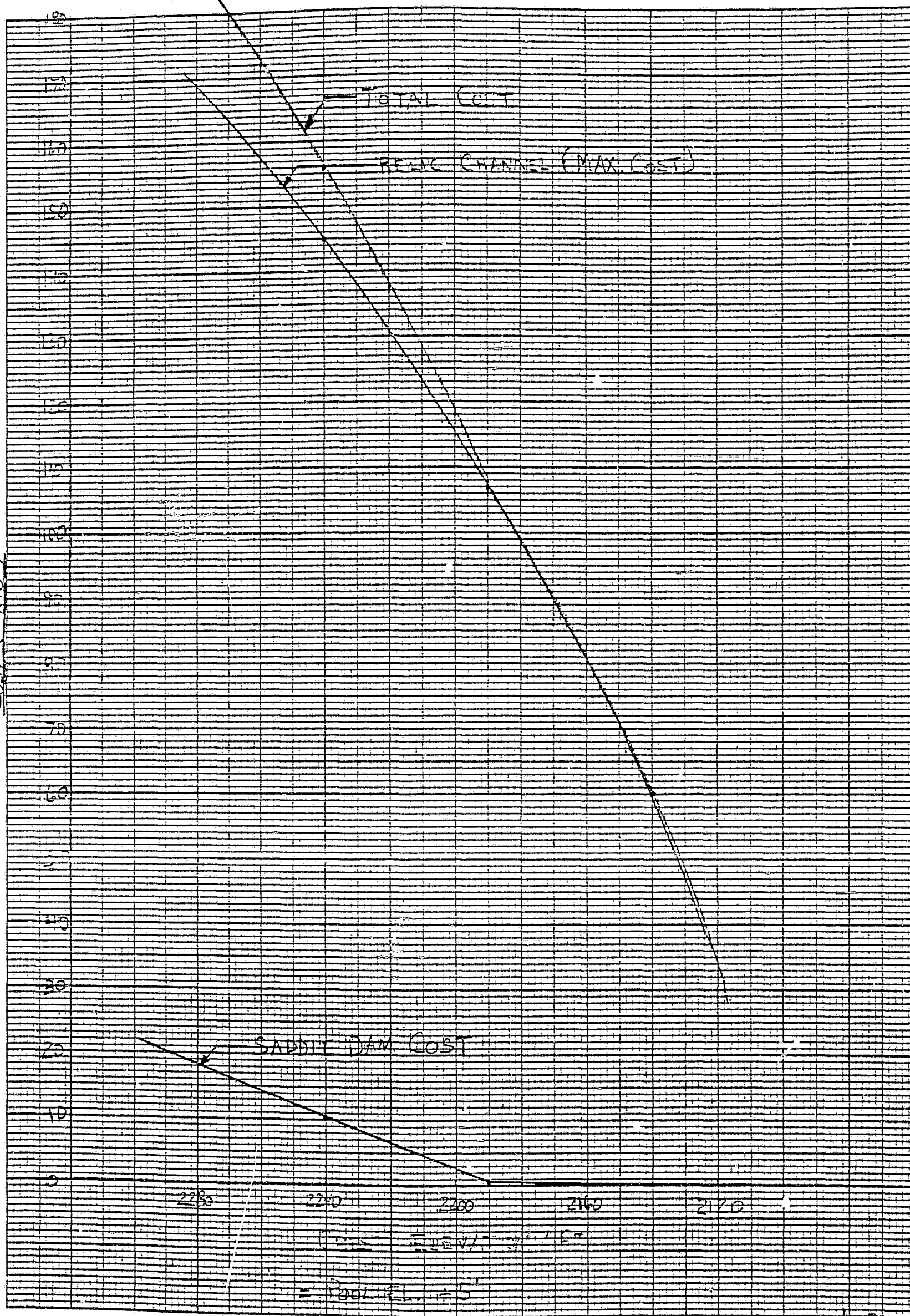
PER LCD CALCS - REC'D 11/6/81
DM ADJ. - 11/9/81

000108

46 1320

K&E 10 X 10 TO 1 1/2 INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

Cost (\$x10⁴)



JLB
11/9/81 10



Calculations WATANA

SUBJECT:

RELIC CHANNEL, SADDLE DAM SITE

JOB NUMBER 5700.05.

FILE NUMBER

SHEET

OF

BY

L. J. E.

DATE 11-10-81

APP

DATE

Rec'd 11-10-81

INTERPOLATION FROM ATTACHED GRAPH; FIGURES RECEIVED FROM S.I.

(5)

COSTS (\$ 10⁶)

	EL. 2240	EL. 2215	EL. 2190	EL. 2165	EL. 2140
RELIC CHANNEL STABILIZATION	145.000	127.500	107.000	85.000	60.000
SADDLE DAM	10.568	5.484	0.400	0.200	0.000
TOTAL COST 2 ITEMS	155.568	132.984	107.400	85.200	60.000
Reservoir N. WS	2215	2190	2165	2140	2115



Calculations

SUBJECT:

9000

WATANA DAM HEIGHT OPTIMIZATION
ADJUSTMENT TO "BATTELLE" ^①
ESTIMATE

PREVIOUS WORK

SOURCES ① WAK 10/21/81
SUSITNA - WATANA PREFERRED
SCHEME
② JAB - SUMMARY OF COSTS
SADDLE DAM 11/10/81
③ DM - RELICT CHANNEL 09 NOV 81

JOB NUMBER _____
FILE NUMBER _____
SHEET 1 OF 1
BY DM DATE 13 NOV 81
APP _____ DATE _____

CAEST	SOURCE	2240	Δ	2190	Δ	2140	②2240	2190	2140	COMMENTS
LAND	①	36750	(6280)	30470	(4570)	25900	36750	30470	25900	
RESERVOIR CLEAR	①	15750	(150)	15000	(750)	14250	15750	15000	14250	
MAIN DAM	②	1137395	(176007)	961378	(162059)	799319	1159942	923935	821876	ADJUST BY D'S PREVIOUS
POWERHOUSE	①	138825	(1593)	137232	(1604)	135628	135952	134359	132755	ADJUST BY D'S PREVIOUS
PENSTOCKS	①	24418	(1336)	23082	(1338)	21744	24711	23375	22037	" " "
TAIL RACE	①	10499	(2507)	7992	(2510)	5482	10499	7992	5482	
SADDLE DAM/ CHANNEL	③	156342	(48942)	107400	(47400)	60000	156342	107400	60000	USE CONSERVATIVE RELICT CHANNEL COR
SWITCHYARD	①	14900	-	14900	-	14900	14900	14900	14900	
MISC STRUCT	①	8400	-	8400	-	8400	8400	8400	8400	
DIVERSION	①	124647	(1355)	123292	(1455)	121837	124941	123586	122131	ADJUST BY D'S PREVIOUS
AUX ^{SEV} SPILLWAY	①	180115	(5265)	174850	(6742)	168108	196831	191586	184844	" " "
ENTER SPILLWAY	①	46918	-	46918	-	46918	48418	48418	48418	ASSUME CONSTANT PRICE
INTAKE'S	①	82202	+16235	98437	+16239	114676	82514	104749	120988	
SUBTOTAL		1977151	(227800)	1749351	(212189)	1537162	2021970	1794170	1581981	
ACCESS CAMP							259093	259093	259093	CONSTANT USE "BATTELLE" FOR 2240 SAME PROP. AT LOWER
CONT/ENGR 1.2 x 1.125							439300	389334	343290	
TOTAL							2720363	2442597	2184364	
							395253	354407		
							2448516	2195481		
							3672490	2997506	2448591	
							3305496			
							375	348	2963899	TOTALS 12

NOTE ① "BATTELLE" ESTIMATE AT 2240
IS ESTIMATE PRODUCED FOR
BATTELLE ENERGY COMPUTATIONS
SEE DM 11/12/81 - SUMMARY
REVISED WATANA & DEVIL CANYON
COST ESTIMATES
2190 & 2140 ARE ADJUSTED "BATTELLE" COSTS

NEW INFO NOT
AVAIL - LEAVE
AT CONSTANT PRICE
JWH

439
1925
25917
2021
→
REVISE

Δ50'



Calculations

SUBJECT:

\$1000

WATANA DAM HEIGHT OPTIMIZATION
ADJUSTMENT TO
"BATTELLE" ^①
ESTIMATE

PREVIOUS WORK

SOURCES ① WAK 10/21/81
SUSITNA - WATANA PREFERRED
SCHEME
② JAB - SUMMARY OF COSTS
SADDLE DAM 11/10/81
③ DM - RELICT CHANNEL 09 NOV 81

JOB NUMBER _____
FILE NUMBER _____
SHEET 1 OF 1
BY DM DATE 13 NOV 81
APP _____ DATE _____

CAEST	SOURCE	2240	Δ [±]	2190	Δ [±] _{50'}	2140	②2240	2190	2140	COMMENTS
LAND	①	36750	(6280)	30470	(4570)	25900	36750	30470	25900	
RESERVOIR CLEAR	①	15750	(150)	15000	(750)	14250	15750	15000	14250	
MAIN DAM	②	1137395	(176007)	961378	(162059)	799319	1139942	983935	821876	ADJUST BY D'S PREVIOUS
POWERHOUSE	①	138825	(1593)	137232	(1604)	135628	135952	134359	132755	ADJUST BY D'S PREVIOUS
PENSTOCKS	①	24418	(1336)	23082	(1338)	21744	24711	23375	22037	" " "
TAIL RACE	①	10499	(2507)	7992	(2510)	5482	10499	7992	5482	
SADDLE DAM/ CHANNEL	③	156342	(48942)	107400	(47400)	60000	156342	107400	60000	USE CONSERVATIVE RELICT CHANNEL COST
SWITCHYARD	①	14900	-	14900	-	14900	14900	14900	14900	
MISC STRUCT	①	8400	-	8400	-	8400	8400	8400	8400	
DIVERSION	①	124617	(1355)	123292	(1455)	121837	124941	123586	122131	ADJUST BY D'S PREVIOUS
AUX ^{JERY} SPILLWAY	①	180115	(5265)	174850	(6742)	168108	196851	191586	184844	" " "
EMER SPILLWAY	①	46918	-	46918	-	46918	48418	48418	48418	ASSUME CONSTANT PRICE
INTAKES	①	82202	+16235	98437	+16239	114676	88514	104749	120988	
SUBTOTAL		1977151	(227800)	1749351	(212189)	1537162	2021970	1794170	1581981	
ACCESS CAMP							259093	259093	259093	CONSTANT USE "BATTELE" FOR 2240 SAME PROP. AT LOWER
CONT/ENER 1.2 x 1.125							439300	389334	343290	
TOTAL							2720363	2442597	2184364	
							3672490	3297506	2948891	← TOTALS
								375M	349M	13

NOTE ① "BATTELE" ESTIMATE AT 2240
IS ESTIMATE PRODUCED FOR
BATTELE ENERGY COMPUTATIONS
SEE DM 11/12/81 - SUMMARY
REVISED WATANA & DEVIL CANYON
COST ESTIMATES
2190 & 2140 ARE ADJUSTED "BATTELE" COSTS

NEW INFO NOT
AVAIL - LEAVE
AT CONSTANT PRICE
JWH

439
2021 = .217
→

60.04.01 FC 48A



Calculations

SUBJECT:

SUSITNA
WATANA - PREFERRED SCHEMES

Summary (\$ 000)

JOB NUMBER P5700.06

FILE NUMBER

SHEET Summary of

BY WAK

DATE 10/21/81

APP GEM

DATE 10/21/81

	EL 2240	REV 2240	EL 2215	EL 2190	EL 2165	EL 2140
2 - LAND ACQUISITION	36750	36750	33400	30470	28000	25900
2 - RESERVOIR CLEARING	15750	15750	15375	15000	14625	14250
1 MAIN DAM	1,171,174	1,137,388	1,055,326	970,574	882,854	802,193
2 POWERHOUSE & ASSOC. ITEMS	136,585	133,825	138,028	137,232	136,425	135,123
1 - PENSTOCKS	24,418	24,418	23,750	23,082	22,415	21,744
1 - POWER INTAKES	82202	82202	90,319	98,437	106,559	114,676
2 - TAILRACE	10499	10499	4,244	7,992	6,738	5,452
X 1 - SADDLE DAM	47774	47774	47774	47774	47774	47774
1 - SWITCHYARD	14900	14900	14900	14900	14900	14900
X 1 - MISC. STRUCTS & EQUIP.	8400	8400	8400	8400	8400	8400
1 - ACCESS	74865	74865	74865	74865	74865	74865
2 - DIVERSION	124647	124647	123,943	123,292	122,538	121,837
3 - SERVICE / AUX SPILLWAY	180115	180115	177,029	174,350	171,028	168,108
4 - EMERGENCY SPILLWAY	46918	46918	46,918	46,918	46,918	46,918
TOTAL	1,974,999	1,943,451	1,859,032	1,773,786	1,689,073	1,602,675



Calculations

SUBJECT:

WATANA - Preferred Schemes

DAM FILL Items & Exc. From
Rev 2240 to 2240 From Computer Vols.

JOB NUMBER P570006
FILE NUMBER _____
SHEET 1A OF 13
BY WAK DATE 10/21/81
APP _____ DATE _____

EL 2240				REV 2240		EL 2215	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
- H Land Acquisition	LS \$ 36,759,000	LS	36,750		36,750		33,400 ✓
- D Reservoir Clearing	LS \$ 15,750,000	LS	15,750		15,750		15,375
MAIN DAM							
- E EXCAVATE ROCK	4,940,000 CY	21	101640	3,620,000	76020	3,340,000	70140
- E EXCAVATE OVERBURDEN	8,373,000 CY	840	70334	6,440,000	55776	6,480,000	54432
- B EXCAVATE GROUT Gallery - Horiz.	12,000 CY	90	1080	12,000	1080	11,300	1017
- A EXCAVATE GROUT Gallery - Vertical	2,200 CY	105	231	2200	231	2140	225
- G SURFACE PREPARATION	730,000 SY	1580	11534	579,000	19148	565,000	8927
- E ROCK FILL	26,200,000 CY	1580	413960	27,720,000	437976	25,350,000	400530
- E GRAVEL	26,200,000 CY	1260	330120	27,720,000	349,272	25,350,000	319410
- E COARSE FILTER	4,000,000 CY	1470	58800	3,140,000	46158	3,000,000	44100
- E FINE FILTER	3400,000 CY	840	28560	2,750,000	23100	2,630,000	22092
- B CONC. GROUT GALLERY - Horiz.	15,400 CY	250	3850	15400	3850	14500	3675
- A CONC. GROUT GALLERY - VERT	300 CY	475	143	300	143	290	138
- C CONSOLIDATION GROUTING	474,000 LF	63	29862	474,000	29862	472,600	29,774
- C GROUTING FROM SURFACE	93,000 LF	53	4929	93,000	4929	88,800	4706
- C GROUTING FROM ADITS	176,000 LF	63	11088	176,000	11088	168,000	10584
- C RELIEF DRAINS	LS \$ 3,150,000	LS	3150		3150		3007
- B ROCK BOLTS GROUT GALLERY	200 TON	3500	700	200	700	189	665
- B Support steel GROUT GALLERY	350 TON	3700	1295	350	1295	330	1221
- F RIP RAP	1,500,000 CY	1260	18900	1,500,000	18900	1,468,500	18503
- E CORE	9,000,000 CY	900	81000	7,190,000	64710	6,880,000	61920

1,171,176

12,000

1,137,388

1,015,326

1,055,013

- A - PROPORTIONAL TO DAM HEIGHT Bottom EL 1360
- B - Horiz. Galleries Prop. to CREST LENGTH 2900' @ EL 2240
- C - GROUTING & DRAINAGE Prop. to LENGTH (CONTACT SURFACE) 4400' @ EL 2240
- D - 1,500,000 Less @ EL 2140 - other ELEVS PROP.
- E - REV 2240 THRU EL 2140 Comp BY TAB 10/15/81
- F - RIP RAP Loss to EL 2140 - $2(1/2 \times 100 \times 500) + 2900(100) \times 5 = 4427 \times 126,000$ CY OTHER ELEVS PROP.
- G - PROPORTION SURFACE PREP. SAME % AS OVERBURDEN ETC AS PER T2LI 10/21/81
- H - Derived From GRAPH BY DAM 7/2/81



Calculations

SUBJECT:

WATAIYA - Preferred Schemes

JOB NUMBER P570006

FILE NUMBER

SHEET 18 OF 13

BY WIK DATE 10/21/14

APP DATE

EL 2240				EL 2190		EL 2165	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
H Land Acquisition	LS \$ 36,759,000	LS			30470		28000
D Reservoir Clearing	LS \$ 15,750,000	LS			15,000		14,625
MAIN DAM							
E EXCAVATE ROCK	4,940,000 CY	21		3,090,000	64,890	2,850,000	59850
E EXCAVATE OVERBURDEN	8,373,000 CY	840		6,290,000	52,836	6,050,000	50820
B EXCAVATE GROUT Gallery - Horiz.	1200 CY	90		10,900	981	10200	918
A EXCAVATE GROUT Gallery - Vertical	2,200 CY	105		2075	218	2013	211
G SURFACE PREPARATION	730,000 SY	1580		548,000	8658	528,000	8342
E ROCKFILL	26,200,000 CY	1580		23,070,000	364,506	20,940,000	330852
E GRAVEL	26,200,000 CY	1260		23,070,000	290,682	20,940,000	263844
E COARSE FILTER	4,000,000 CY	1470		2,770,000	40,719	2,410,000	35427
E FINE FILTER	3,400,000 CY	840		2,430,000	19,440	2,110,000	17724
B CONC. GROUT GALLERY - Horiz.	15,400 CY	250		14,000	3500	13,100	3275
A CONC. GROUT GALLERY - VERT	300 CY	475		283	134	274	130
C CONSOLIDATION GROUTING	474,000 LF	63		444,000	27972	409,800	25817
C GROUTING FROM SURFACE	93,000 LF	53		87,100	4616	80400	4261
C GROUTING FROM ADITS	176,000 LF	63		164,800	10383	152,000	9576
C RELIEF DRAINS	LS \$ 3,150,000	LS			2950		2220
B ROCK BOLTS GROUT GALLERY	200 TON	3500		183177	640	170166	595581
B Support steel GROUT GALLERY	350 TON	3700		320311	1184115	298291	11031077
F RIP RAP	1,500,000 CY	1260		1,437,000	18106	1,405,500	17709
E CORE	9,000,000 CY	900		6,360,000	57240	5,520,000	49680

A - PROP. TO DAM HEIGHT - Bot. EL 1360

B - Horiz. Galleries Prop. to CREST Length 3900' @ EL 2240

C - PROP to Length (Contract Surface) 4400' ± @ 2240

D - See Note Sheet Prev.

E - See Note Prev. Sheet

F - See Note Prev. Sheet

G - See Note Prev. Sheet

H - See Note Prev. Sheet



Calculations

SUBJECT:

NATAYA - PREFERRED Schemes

JOB NUMBER P-70006
FILE NUMBER _____
SHEET 16 OF 13
BY Wick DATE 10/21/41
APP _____ DATE _____

EL 2240				EL 2140			
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
H/LAND ACQUISITION	LS \$ 36,759,000	LS			25900		
D RESERVOIR CLEARING	LS \$ 15,750,000	LS			14,250		
MAIN DAM							
E EXCAVATE ROCK	4,840,000 CY	21		2,639,000 -	55230 -		
E EXCAVATE OVERFLOW	8,373,000 CY	840		5,630,000 -	47292 -		
B EXCAVATE GROUT GALLERY - Horiz.	1200 CY	90		9300 -	837 -		
A EXCAVATE GROUT GALLERY - Vertical	2,200 CY	105		1950 -	205 -		
G SURFACE PREPARATION -	730,000 SY	1580		491,000 -	7758 -		
E ROCKFILL	26,200,000 CY	1580		18,910,000 -	298,778 -		
E GRAVEL	26,200,000 CY	1260		18,910,000 -	238,266 -		
E COARSE FILTER	4,000,000 CY	1420		2,170,000 -	31,899 -		
E FINE FILTER	3400,000 CY	840		1,900,000 -	15,960 -		
B CON. GROUT GALLERY - Horiz.	15,400 CY	250		11900 -	2975 -		
A CON. GROUT GALLERY - VERT	300 CY	475		270266	+28126		
C CONSOLIDATION GROUTING	474,000 LF	63		380000 -	23940 -		
C GROUTING FROM SURFACE	93,000 LF	53		74500 -	3949 -		
C GROUTING FROM ADITS	176,000 LF	63		140600 -	8870 -		
C RELIEF DRAINS	LS \$3,150,000	LS			2520 -		
B ROCK BOLTS GROUT GALLERY	200 TON	3500		155 -	543 -		
B Support steel GROUT GALLERY	350 TON	3700		271 -	1003 -		
F RIP RAP	1,500,000 CY	1260		1,374,000 -	17312 -		
E CORE	9,000,000 CY	900		4,979,000 -	44730 -		

- A - PROP. to Dam Height - Bot. EL 1360
B - PROP. to Crest Length 3900' @ EL 2240
C - PROP. to Length (CONTACT SURFACE) 4400' @ EL 2240
D - See Note - Prev. sheet
E - See Note - Prev. sheet
F - See Note - Prev. sheet
G - See Note - Prev. sheet
H - See Note - Prev. sheet

802195
902193



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.04
 FILE NUMBER _____
 SHEET 2A OF 13
 BY _____ DATE _____
 APP CRM DATE 10/24/81

EL 2240				EL 2190		EL 2165	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>POWERHOUSE & ASSOC. ITEMS</u>							
<u>PH CIVIL</u>							
EXCAVATE VAULT-ROCK	102,200 CY	42	4292				
EXCAVATE DRAFT TUBE ROCK	34,000 CY	50	1700				
CONCRETE POWERHSE	27,300 CY	380	10374				
CONCRETE DRAFT TUBE	14,200 CY	380	5396				
ROCKBOLT / MESH	80 TON	3500	280				
FOUNDATION PREPARATION	31,000 SF	1 20	37				
RE STEEL POWERHSE	1400 TON	2100	2940				
RE STEEL DRAFT TUBE	710	2100	1491				
ARCHITECTURAL	\$1,600,000	LS	1600				
			<u>28,110</u>		<u>28,110</u>		<u>28,110</u>
<u>SURGE CHAMBER CIVIL</u>							
EXCAVATE ROCK	75,000 CY	50	3750				
CONCRETE	2,000 CY	360	720				
ROCKBOLTS	54 TON	3500	196				
RE STEEL	80 TON	2100	168				
			<u>4834</u>		<u>4834</u>		<u>4834</u>



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P570004
FILE NUMBER _____
SHEET 2 R OF 13
BY _____ DATE _____
APP GEM DATE 10/2/19

	EL 2240			EL 2190		EL 2165	
	QUANTITY	UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>POWERHOUSE & ASSEC. ITEMS</u>							
<u>PH CIVIL</u>							
EXCAVATE VAULT - ROCK	102,200 CY	42					
EXCAVATE DRAFT TUBE ROCK	34,000 CY	50					
CONCRETE POWERHSE	27,300 CY	380					
CONCRETE DRAFT TUBE	14,200 CY	380					
ROCKBOLT / MESH	80 TON	3500					
FOUNDATION PREPARATION	31,000 SF	1 20					
RE STEEL POWERHSE.	1400 TON	2100					
RE STEEL DRAFT TUBE	710	2100					
ARCHITECTURAL	\$ 1,600,000	LS					
					28,110		28,110
<u>SURGE CHAMBER CIVIL</u>							
EXCAVATE ROCK	75,000 CY	50					
CONCRETE	2,000 CY	360					
ROCKBOLTS	54 TON	3500					
RE STEEL	80 TON	2100					
					4834		4834



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 26 OF 13
BY _____ DATE _____
APP SEM DATE 10/29/87

EL 2240				EL 2140			
				QUANTITY	\$ 000	QUANTITY	\$ 000
<u>POWERHOUSE & ASSOC. ITEMS</u>							
<u>PH CIVIL</u>							
EXCAVATE VAULT-ROCK	102,200	CY	42				
EXCAVATE DRAFT TUBE ROCK	24,000	CY	50				
CONCRETE POWERHSE	27,300	CY	380				
CONCRETE DRAFT TUBE	14,200	CY	390				
ROCKBOLT / MESH	80	TON	3500				
FOUNDATION PREPARATION	31,000	SF	120				
RE STEEL POWERHSE	1400	TON	2100				
RE STEEL DRAFT TUBE	710		2100				
ARCHITECTURAL	\$1,600,000		LS				
							28110
<u>SURGE CHAMBER CIVIL</u>							
EXCAVATE ROCK	75,000	CY	50				
CONCRETE	2,000	CY	360				
ROCKBOLTS	56	TON	3500				
RE STEEL	80	TON	2100				
							4834



Calculations

SUBJECT:

WATHNA PREFEIZED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 3A OF 13
BY _____ DATE _____
APP GEM DATE 10/29/81

EL 2240				REV 2240		EL 2215	
				QUANTITY	\$ 000	QUANTITY	\$ 000
POWERHOUSE & ASSOC. ITEMS (CONT)							
TRANSFORMER GALLERY - CIVIL							
EXCAVATE ROCK	39,000 CY	50	1950				
CONCRETE	2,700 CY	315	851				
ROCK BOLTS	64 TON	3500	224				
RE STEEL	135 TON	2100	283				
			3308		3308		3308
MAIN ACCESS SHAFT - CIVIL							
A EXCAVATE ROCK	- 11,000 CY	75	825			10577 -	793
A CONCRETE	- 6,000 CY	475	2850			5769 -	2740
A ROCK BOLTS	- 50 TON	3500	175			48	168
A RE STEEL	70 TON	2100	147			67	141
A STRUCTURAL STEEL	- 40 TON	3675	147			38	140
			4144		4144		3982
ACCESS TUNNEL PORTAL							
EXCAVATE ROCK	3000 CY	15	45				
EXCAVATE OVERBURDEN	6000 CY	530	32				
ROCK BOLTS	5 TON	3500	17				
			94		94		94

A - EL 2140 100' LESS THAN EL 2240 - QUANTITIES 650' - 100' = 550/650 - OTHER ELEV. PROP.



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 32 OF 13
BY _____ DATE _____
APP GEM DATE 1/29/81

EL 2240				EL 2190		EL 2165	
				QUANTITY	\$ 000	QUANTITY	\$ 000
POWERHOUSE & ASSOC. ITEMS (CONT)							
TRANSFORMER GALLERY - CIVIL							
EXCAVATE ROCK	39,000	CY	50				
CONCRETE	2,700	CY	315				
ROCK BOLTS	64	TON	3500				
RE STEEL	135	TON	2100				
					3308		3308
MAIN ACCESS SHAFT - CIVIL							
A EXCAVATE ROCK	11,000	CY	75	10153 -	761 -	9731 -	730 -
A CONCRETE	6,000	CY	475	5538 -	2631 -	5308 -	2521 -
A ROCK BOLTS	50	TON	3500	46	161 -	44	154 -
A RE STEEL	70	TON	2100	65	137 -	62	130 -
A STRUCTURAL STEEL	40	TON	3675	37	136 -	35	129 -
					3826 -		3664 -
ACCESS TUNNEL PORTAL							
EXCAVATE ROCK	3000	CY	15				
EXCAVATE OVERBURDEN	6000	CY	530				
ROCK BOLTS	5	TON	3500				
					94		94

A - See Note Prev. sheet



Calculations

SUBJECT:

WATHNA PREFERIZED SCHEMES

JOB NUMBER P5700.06

FILE NUMBER

SHEET 36 OF 13

BY

DATE

APP GEM

DATE 10/20/01

EL 2240				EL 2140			
				QUANTITY	\$ 000	QUANTITY	\$ 000
POWERHOUSE & ASSOC. ITEMS (CONT)							
TRANSFORMER GALLERY - CIVIL							
EXCAVATE ROCK	39,000	CY	50				
CONCRETE	2,700	CY	315				
ROCK BOLTS	64	TON	3500				
RE STEEL	135	TON	2100				
							3308
MAIN ACCESS SHAFT - CIVIL							
A EXCAVATE ROCK	11,000	CY	75	9308	698		
A CONCRETE	6,000	CY	475	5077	2412		
A ROCK BOLTS	50	TON	3500	42	147		
A RE STEEL	70	TON	2100	59	124		
A STRUCTURAL STEEL	40	TON	3675	34	125		
							3506
ACCESS TUNNEL PORTAL							
EXCAVATE ROCK	3000	CY	15				
EXCAVATE OVERBURDEN	6000	CY	530				
ROCK BOLTS	5	TON	3500				
							94

A - see note Prev. sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 4A OF 13
BY _____ DATE _____
APP GEM DATE 12/1/81

EL 2240				Re U 2240		EL 2215	
				UNIT PRICE	\$ 000	QUANTITY	\$ 000
PowerHouse & Assoc. Items (cont)							
CABLE SHAFTS - CIVIL							
A	EXCAVATE ROCK	3000	CY	75	225	2871	215
A	CONCRETE	1900	CY	475	903	1818	864
A	STRUCTURAL STEEL	9	TON	3675	33	9	33
A	ROCKBOLTS	50	TON	3500	175	48	168
A	RESTEEL	95	TON	2100	199	91	191
					1535		1471
BUS TUNNELS - CIVIL							
	EXCAVATE ROCK - HORIZ.	7200	CY	45	324		
	CONCRETE	2000	CY	250	500		
	ROCKBOLTS	24	TON	3500	91		
	RESTEEL	100	TON	2100	210		
					1125		1125
FIRE PROTECTION HEADTANK - CIVIL							
	EXCAVATE ROCK	2000	CY	70	140		
	CONCRETE	340	CY	475	162		
	ROCKBOLTS	3	TON	3500	10		
	RESTEEL	14	TON	2100	30		
	STEEL Support	10	TON	3675	37		
					379		379

A - HEIGHT 100' LESS @ EL 2140 - QUANTITIES 580'-100' 480/580 - OTHER ELEV. PROP.



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P570006
FILE NUMBER _____
SHEET 4B OF 13
BY _____ DATE _____
APP GEM DATE 10/29/89

EL 2240				EL 2190		EL 2165	
		UNIT PRICE	\$000	QUANTITY	\$000	QUANTITY	\$000
<u>Powerhouse & Assoc. Items (con't)</u>							
<u>CABLE SHAFTS - CIVIL</u>							
A	EXCAVATE ROCK	3000 CY	75	2742			
A	CONCRETE	1900 CY	475	2741 -	206	2612 -	194
A	STRUCTURAL STEEL	9 TON	3675	1736 -	825 -	1654 -	781786
A	ROCKBOLTS	50 TON	3500	8	30 -	8	3029
A	RESTEEL	95 TON	2100	46	161 -	4443	154151
				87	183 -	83	174 -
					1405		1335
					1404		1336
<u>BUS TUNNELS - CIVIL</u>							
	EXCAVATE ROCK - HORIZ.	7200 CY	45				
	CONCRETE	2000 CY	250				
	ROCKBOLTS	24 TON	3500				
	RESTEEL	100 TON	2100				
					1125		1125
<u>FIRE PROTECTION HEADTANK - CIVIL</u>							
	EXCAVATE ROCK	2000 CY	70				
	CONCRETE	340 CY	475				
	ROCKBOLTS	3 TON	3500				
	RESTEEL	14 TON	2100				
	STEEL Support	10 TON	3675				
					379		379

A - see Note Prev. sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER PS70006

FILE NUMBER

SHEET 4c OF 13

BY DATE

APP GEM DATE 10/29/81

EL 2240				EL 2140			
				QUANTITY	\$000	QUANTITY	\$000
<u>PowerHouse & Assoc. Items (con't)</u>							
<u>CABLE SHAFTS - CIVIL</u>							
A	EXCAVATE ROCK	3000 CY	75	2483 -	186 -		
A	CONCRETE	1900 CY	475	1572 -	747 -		
A	STRUCTURAL STEEL	9 TON	3675	7 -	26 -		
A	ROCKBOLTS	50 TON	3500	41 -	144 -		
A	RESTEEL	95 TON	2100	79 -	166 -		
					1269 -		
<u>BUS TUNNELS - CIVIL</u>							
	EXCAVATE ROCK - HORIZ.	7200 CY	45				
	CONCRETE	2000 CY	250				
	ROCKBOLTS	24 TON	3500				
	RESTEEL	100 TON	2100				
					1125		
<u>Fire Protection HeadTANK - CIVIL</u>							
	EXCAVATE ROCK	2000 CY	70				
	CONCRETE	340 CY	475				
	ROCKBOLTS	3 TON	3500				
	RESTEEL	14 TON	2100				
	STEEL Support	10 TON	3675				
					379		

A- See Note Prev. sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER PS100.06
FILE NUMBER _____
SHEET 5 A OF 13
BY _____ DATE 10/20/91
APP GEM

EL 2240				Rev 2240		EL 2215	
	UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000	
<u>POWERHOUSE & ASSOC ITEMS (CON'D)</u>							
<u>MECHANICAL</u>							
TURBINES & GOVERNORS	LS	\$ 33,060,000	LS	33060			
CRANES	LS	\$ 1,460,000	LS	1460			
MECHANICAL MISC.	LS	\$ 4,690,000	LS	6690			
SURGE CHAMBER GATES	LS	\$ 375,000	LS	375			
MAIN SHAFT ELEVATOR	LS	\$ 320,000	LS	320			
CABLE SHAFT ELEVATOR	LS	\$ 173,000	LS	173			
				<u>42078</u>		<u>42078</u>	
<u>ELECTRICAL</u>							
GENERATORS	LS	\$ 27,000,000	LS	27000			
TRANSFORMERS	LS	\$ 3,500,000	LS	3500			
ASSOC. ITEMS	LS	\$ 10,700,000	LS	10700			
				<u>41200</u>		<u>41200</u>	



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 53 OF 13
BY _____ DATE _____
APP GEM DATE 01/29/81

EL 2240

EL 2190

EL 2165

POWERHOUSE & ASSOC ITEMS (CON'L)

MECHANICAL

TURBINES & GOVERNORS	LS \$ 33,060,000	LS
CRANES	LS \$ 1,460,000	LS
MECHANICAL MISC.	LS \$ 6,690,000	LS
SURGE CHAMBER GATES	LS \$ 375,000	LS
MAIN SHAFT ELEVATOR	LS \$ 320,000	LS
CABLE SHAFT ELEVATOR	LS \$ 173,000	LS

ELECTRICAL

GENERATORS	LS \$ 27,000,000	LS
TRANSFORMERS	LS \$ 3,500,000	LS
ASSOC. ITEMS	LS \$ 10,700,000	LS

UNIT
PRICE

\$ 000

QUANTITY

\$ 000

QUANTITY

\$ 000

42078

42078

41200

41200



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER PS700 B1

FILE NUMBER _____

SHEET 5c OF 13

BY _____ DATE _____

APP GEM DATE 10/29/91

EL 2240

EL 2140

POWERHOUSE & ASSOC ITEMS (CON'L)

MECHANICAL

TURBINES & GOVERNORS	LS \$ 33,060,000	LS
CRANES	LS \$ 1,460,000	LS
MECHANICAL MISC.	LS \$ 4,690,000	LS
SURGE CHAMBER GATES	LS \$ 375,000	LS
MAIN SHAFT ELEVATOR	LS \$ 320,000	LS
CABLE SHAFT ELEVATOR	LS \$ 173,000	LS

ELECTRICAL

GENERATORS	LS \$ 27,000,000	LS
TRANSFORMERS	LS \$ 3,500,000	LS
ASSOC. ITEMS	LS \$ 10,700,000	LS

UNIT
PRICE

\$ 000

QUANTITY

\$ 000

QUANTITY

\$ 000

42078

41200



Calculations

SUBJECT: WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
 FILE NUMBER _____
 SHEET 6A OF 13
 BY _____ DATE _____
 APP GEM DATE 12/29/89

EL 2240				Rev 2240		EL 2215	
				QUANTITY	\$ 000	QUANTITY	\$ 000
<u>POWERHOUSE & ASSOC. ITEMS (CON'T)</u>							
<u>SECONDARY ACCESS TUNNELS</u>							
EXCAVATE ROCK	2400 CY	45	108				
CONCRETE SLAB	120 CY	250	30				
ROCK BOLTS	7 TON	3500	24				
RE STEEL	5 TON	2100	11				
STEEL SUPPORT	25 TON	3675	92				
			<u>265</u>		<u>265</u>		<u>265</u>
<u>MAIN ACCESS TUNNELS</u>							
A EXCAVATE ROCK	99,000 CY	68	6732			301 93627	6344
A CONCRETE SLAB	3800 CY	200	760			3501 12544	6367
A RE STEEL	150 TON	2100	315			142.	719.716
A ROCK BOLTS	120 TON	3500	420			TT4113	298
A STEEL SUPPORT	350 TON	3675	1284			331 330	399.396
			<u>9513</u>		<u>9513</u>		<u>1216.1213</u>
							<u>8999</u>
							8967
<u>TOTAL Powerhouse</u>					<u>136,585</u>		<u>135843</u>
					<u>138,825</u>		<u>138028</u>

A-Tunnels 700' Less @ 2140 OR 3040-700 = 2340' (EXCAVATION) OTHER ITEMS SAME % DIFF



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 68 OF 13
BY _____ DATE _____
APP SEM DATE 6/29/91

EL 2240				EL 2190		EL 2165	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>POWERHOUSE & Assoc. Items (cont.)</u>							
<u>SECONDARY ACCESS TUNNELS</u>							
EXCAVATE ROCK	2400 CY	45					
CONCRETE SLAB	120 CY	250					
ROCK BOLTS	7 TON	3500					
RE STEEL	5 TON	2100					
STEEL SUPPORT	25 TON	3675					
					<u>265</u>		<u>265</u>
<u>MAIN ACCESS TUNNELS</u>							
A EXCAVATE ROCK	99,000 CY	68		87602	5957 -	81903 -	5569 -
A CONCRETE SLAB	3800 CY	200		3363	673 -	3144 -	629 -
A RE STEEL	150 TON	2100		133 -	220279	124 -	260
A ROCK BOLTS	120 TON	3500		106 -	371	99 -	347 -
A STEEL SUPPORT	350 TON	3675		310	1139	269	9891062
					<u>8420</u>	<u>289</u>	<u>7794</u>
					8419		7867
TOTAL POWERHOUSE					135,034		<u>134,186</u>
					137232		136,425

A - See Note Previous Sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06

FILE NUMBER _____

SHEET 6c OF 13

BY _____ DATE _____

APP GEM DATE 6/1/06

EL 2240				EL 2140			
				QUANTITY	\$ 000	QUANTITY	\$ 000
POWERHOUSE & ASSOC. ITEMS (CON'T)							
SECONDARY ACCESS TUNNELS							
EXCAVATE ROCK	2400 CY	45					
CONCRETE SLAB	120 CY	250					
ROCK BOLTS	7 TON	3500					
RE STEEL	5 TON	2100					
STEEL SUPPORT	25 TON	3675					
					265		
MAIN ACCESS TUNNELS							
A EXCAVATE ROCK	99,000 CY	68		74204-	5182-		
A CONCRETE SLAB	3800 CY	200		2925-	585-		
A RE STEEL	150 TON	2100		115-	242		
A ROCK BOLTS	120 TON	3500		92-	322-		
A STEEL SUPPORT	350 TON	3675		269-	989-		
					7320-		
TOTAL POWERHOUSE					133488		
					135,620		

A - See Note Previous sheet



Calculations

SUBJECT:

WATANA Preferred Schemes

EL 2240

REV 2240

EL 2215

JOB NUMBER P-5700-06

FILE NUMBER

SHEET 7A OF 13

DATE

APP GEM DATE 10/29/81

PENSTOCKS

A	EXCAVATE TUNNEL	58,500 CY	55
A	CONCRETE LINE	29,400 CY	380
A	REINFORCING STEEL	940 TON	2100
A	ROCK BOLTS	290 TON	3500
B	STEEL LINE	1600 TON	4400

UNIT PRICE	\$ 000
	3217
	11172
	1974
	1015
	7040
	24418

QUANTITY	\$ 000
	24418

QUANTITY	\$ 000
56925 -	3130 -
28608	10871 -
915	1922
282 -	987 -
1555	68402
	23,750.

POWER INTAKES

C	EXCAVATE ROCK	1,158,000 CY	12 ⁵⁰
↑	EXCAVATE OVERBURDEN	131,000 CY	6 ³⁰
	CONCRETE MASS	28,000 CY	200
	CONCRETE STRUCTURES	126,400 CY	300
	REINFORCING STEEL	6300 TON	2100
	ROCK BOLTS	125 TON	3500
	GRAVEL BACKFILL	14400 CY	7 ⁰⁰
	GATES	\$ 14,875,000	LS
C	ROCK CREDIT	7,052,000 CY	6

14475
825
5600
37920
14280
438
101
14875
- 4312
82202

1,272,250 -	15903 -
144000 -	907 -
30750 -	6150 -
138875 -	41663 -
7475 -	15698
137 -	480
15825	111 -
\$ 16,343,000	16343 -
1,156,000 -	- 6938
	90319 -

A - PROP. to HEIGHT - EL 2140 10N' Less THAN 2240 (10.5 CY/FT) PER²⁵ ELU. CHANGE = 25(10.5)6 = 1575 CY (EXC) OTHER SAME % DIFF
 B - PROP. to HEIGHT - Bot EL 1360 (HT = 300' @ 2240)
 C - Reduction to EL 2140 Results in INCREASED QUANTS (FACTOR 265/190) AS PER R.180010N 10/22/81 STRAIGHT LINE TRANS. 2240-2140



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER PS100.06

FILE NUMBER

SHEET 7B OF 13

BY DATE

APP GEM DATE 11/29/61

EL 2240				EL 2190		EL 2165	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>PENSTOCKS</u>							
A	EXCAVATE TUNNEL	58,500 CY	55	55350 -	3044 -	53775 -	2958 -
A	CONCRETE LINE	29,400 CY	380	27817	10570 -	27025	10270 -
A	REINFORCING STEEL	940 TON	2100	890	1869	864	1814
A	ROCK BOLTS	290 TON	3500	274	959 -	268	935 931
B	STEEL LINE	1600 TON	4400	1509	6640	1464	6442 -
					23082 -		22419
							22415
<u>POWER INTAKES</u>							
	EXCAVATE ROCK	1,158,000 CY	12 ⁵⁰	1,386,500 -	17331 -	1,500,750 -	18759 -
	EXCAVATE OVERBURDEN	131,000 CY	6 ³⁰	157,000 -	989 -	170,000 -	1071 -
	CONCRETE MASS	23,000 CY	200	33500 -	6700 -	34250 -	7250 -
	CONCRETE STRUCTURES	126,400 CY	300	151,350 -	45405	163825 -	49148
	REINFORCING STEEL	6800 TON	2100	8150 -	17115	8825 -	18532
	ROCK BOLTS	125 TON	3500	150 -	525 -	162 -	567 -
	GRAVEL BACKFILL	14400 CY	7 ⁰⁰	17250	121 -	18675 -	131 -
	GATES	\$ 14,875,000	LS	\$ 17,811,000 -	17811	\$ 19,279,000	19279
	ROCK CREDIT	1,052,000 CY	6	1,260,000	- 7560	- 1,363,000	- 8178
					98437 -		106559 -

- A - Prop to Height - See Note Prev sheet
 B - Prop to Height - Pot. EL 1360 (Ht = 830 @ 2240)
 C - SEE NOTE - PREV. SHEET



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES
EL 2240

JOB NUMBER P5700-06

FILE NUMBER

SHEET 7c OF 13

BY

DATE

APP CEM DATE 10/29/8

			UNIT PRICE	\$ 000	EL 2140	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>PENSTOCKS</u>									
A	EXCAVATE TUNNEL	58,500 CY	55			52200 -	2871 -		
A	CONCRETE LINE	29,400 CY	350			26234	9969 -		
A	REINFORCING STEEL	940 TON	2100			839	1742		
A	ROCK BOLTS	290 TON	3500			258	907 9.03		
B	STEEL LINE	1600 TON	4400			1418	4239		
							21748		
							21744		
<u>POWER INTAKES</u>									
	EXCAVATE ROCK	1,158,000 CY	12 ⁵⁰			1,615,000 -	20138 -		
	EXCAVATE OVERBURDEN	131,000 CY	6 ³⁰			183,000 -	1153 -		
	CONCRETE MASS	23,000 CY	200			29,000 -	7800 -		
	CONCRETE STRUCTURES	126,400 CY	300			176,300 -	52890		
	REINFORCING STEEL	6800 TON	2100			9500 -	19950		
	ROCK BOLTS	125 TON	3500			174 -	609 -		
	GRAVEL BACKFILL	14400 CY	7 ⁰⁰			20100 -	141 -		
	GATES	\$ 14,875,000	LS			820,747 -	20747		
	ROCK Credit	1,052,000 CY	6	-		1,467,000 -	- 3802		
							114676 -		

A- See Note Prev. sheet

B- Prop. to Height - Bot EL 1360 (HT=880 @ 2240)

C- See Note Prev. sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P57206
FILE NUMBER
SHEET 8A OF 13
BY
APP GEM DATE 10/20/01

EL 2240				REV 2240		EL 2215	
		UNIT PRICE	\$000	QUANTITY	\$000.	QUANTITY	\$000
<u>TAILRACE</u>							
A	ROCK EXCAVATION	98000 CY	50	4900		84,600	4230
B	ROCK BOLTS	100 TON	3500	350		84	4230
C	STEEL SUPPORT	270 TON	3675	992 -		228	294
A	SHOTCRETE	50 CY	275	1485		4662	838 -
No Change CONCRETE WALLS		2200 CY	275	605		4717	1247 1282
A	CONCRETE SLABS	3400 CY	190	646		2200	605
A	REINFORCING STEEL	290 TON	2100	609		2935	564 558
						2470	534 525
						253	
						250	
Portal		\$ 912,000	LS	912		912	
				10,499 -	10499	9321	9244
<u>SADDLE DAM</u>							
	SURFACE PREPARATION	16,600 SY	10 50	174			
	ROCKFILL	120,000 CY	12 60	1512			
	FILTERS	18,000 CY	15 80	285			
	IMPERVIOUS MATERIAL	31,000 CY	10 50	851			
	EXCAVATE OVERBURDEN	140,000 CY	6 30	882			
	SLURRY TRENCH	78,000 SY	565	44070			
				47,774 -			

A - TUNNEL (2) shortened by 700' @ EL 2140 other ELEUS. PROP. (EL 2215: 98000 - 1035 ft² x 350 ÷ 27 = 85600) Reinf Same Prop
B - ROCK BOLTS - @ EL 2140 = (- 88.4 x 1400 x 25% ÷ 25 ÷ 20 = 62 tons) OTHER ELEUS PROP.
C - steel Supports @ EL 2140 = (1400 / 6 x 5800 ÷ 2000 x 25% = 169 tons Less) OTHER ELEUS PROP.



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5702.06
FILE NUMBER _____
SHEET 8 B OF 13
BY _____ DATE _____
APP GER DATE 12/21/01

EL 2240				EL 2190				EL 2165			
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000		
<u>TAILRACK</u>											
A	ROCK EXCAVATION	98000 CY	50	71 200	3560	57,800	2890				
B	ROCK BOLTS	100 TON	3500	72,200	3610	58,800	2940				
C	STEEL SUPPORT	270 TON	3675	69	242	54	189				
A	SHOTCRETE	5400 CY	275	186	684	143	526				
No Change	CONCRETE WALLS	2200 CY	275	3924	1079	3185	876				
A	CONCRETE SLABS	3400 CY	190	3929	1094	3240	894				
A	REINFORCING STEEL	290 TON	2100	2200	405	2200	405				
				2370	476 469	2005	388 381				
				2305	449	2040					
				214	441	174	305				
				210	441	171	359				
	Portal	\$ 912,000	LS		912		912				
<u>SADDLE DAM</u>											
	SURFACE PREPARATION	16,600 SY	10 ⁵⁰		8072		6316				
	ROCKFILL	120,000 CY	12 ⁶⁰		7992		6738				
	FILTERS	18,000 CY	15 ⁸⁰								
	IMPERVIOUS MATERIAL	81,000 CY	10 ⁵⁰								
	EXCAVATE OVERBURDEN	140,000 CY	6 ³⁰								
	SLURRY TRENCH	78,000 SY	565								

A- See Note Prev. Sheet
B- See Note Prev. Sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06

FILE NUMBER _____

SHEET 86 OF 13

BY _____ DATE _____

APP GEM DATE 10/29/87

EL 2240			EL 240					
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000	
<u>TAILRACE</u>								
A	ROCK EXCAVATION	98000 CY	50	44,400	2220			
B	ROCK BOLTS	100 TON	3500	45,400	2270			
C	STEEL SUPPORT	270 TON	3675	(38)	133			
A	SHOTCRETE	5400 CY	275	101	371			
No Change	CONCRETE WALLS	2200 CY	275	2447	688	673		
A	CONCRETE SLABS	2400 CY	190	2200	605			
A	REINFORCING STEEL	290 TON	2100	1540	299	293		
				154	281	275		
				131				
	Portal	\$ 912,000	LS		912			
<u>SADDLE DAM</u>								
	SURFACE PREPARATION	16,600 SY	10 50		5554			
	ROCKFILL	120,000 CY	12 60		5482			
	FILTERS	18,000 CY	15 80					
	IMPERVIOUS MATERIAL	31,000 CY	10 50					
	EXCAVATE OVERBURDEN	140,000 CY	6 30					
	SLURRY TRENCH	78,000 SY	5 65					

A - See note PREV. sheet

B - See Note Prev. sheet



Calculations

SUBJECT: WATANA PREFETTERED SCHEMES

JOB NUMBER PS700.04
FILE NUMBER _____
SHEET 9A OF 13
BY _____ DATE _____
APP GEM DATE 10/23/81

EL 2240				REV 2240		EL 2215	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>SWITCHYARD</u>							
ALL INCLUSIVE	LS \$14,900,000	LS	14900 -		14900 -		14900 -
<u>MISC. STRUCTURES & EQUIP</u>							
RECREATION FACILITIES	LS \$1,050,000	LS	1050				
BUILDINGS & GROUNDS	LS \$4,200,000	LS	4200				
PERMANENT OPERATING EQUIP	LS \$3,100,000	LS	3100				
			<u>8400</u>		<u>8400 -</u>		<u>8400</u>
<u>ACCESS / ROAD AIR STRIP</u>							
PERMANENT ACCESS ROAD	70 MILES	630,000	44100				
PERMANENT BRIDGES	LS 21,000,000	LS	21000				
CONSTRUCTION ACCESS SITE	15 MILES	231,000	3465				
AIRSTRIP	LS 6,300,000	LS	6300				
			<u>74865 -</u>		<u>74865 -</u>		<u>74865 -</u>



Calculations

SUBJECT:

WATANA PREFETIZED SCHEMES

JOB NUMBER P5700.04
FILE NUMBER _____
SHEET 9B OF 13
BY _____ DATE _____
APP GEM DATE 10/28/81

EL 2240		UNIT PRICE	\$ 000	EL 2190		QUANTITY	\$ 000	EL 2165		QUANTITY	\$ 000
<u>SWITCH YARD</u>											
ALL INCLUSIVE	LS \$14,900,000	LS	14900				14900				14900
<u>MISC. STRUCTURES & EQUIP</u>											
RECREATION FACILITIES	LS \$1,050,000	LS									
BUILDINGS & GROUNDS	LS \$4,200,000	LS									
PERMANENT OPERATING EQUIP.	LS \$3,100,000	LS									
							8400				8400
<u>ACCESS / ROAD AIR STRIP</u>											
PERMANENT ACCESS ROAD	70 MILES	630,000									
PERMANENT BRIDGES	LS 2,100,000	LS									
CONSTRUCTION ACCESS SITE	15 MILES	231,000									
AIRSTRIP	LS 6,300,000	LS									
							74865				74865



Calculations

SUBJECT:

WATANIA PREFERRED SCHEMES

JOB NUMBER PS700.04
FILE NUMBER _____
SHEET 9c OF 13
BY _____ DATE _____
APP GEM DATE 10/28/01

EL 2240			EL 2140					
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000	
<u>SWITCHYARD</u>								
ALL INCLUSIVE	LS \$14,900,000	LS			14900			
<u>MISC. STRUCTURES & EQUIP</u>								
RECREATION FACILITIES	LS \$1,050,000	LS						
BUILDINGS & GROUNDS	LS \$4,200,000	LS						
PERMANENT OPERATING EQUIP	LS \$3,100,000	LS						
					<u>8400</u>			
<u>ACCESS / ROAD / AIR STRIP</u>								
PERMANENT ACCESS ROAD	70 MILES	630,000						
PERMANENT BRIDGES	LS 2,100,000	LS						
CONSTRUCTION ACCESS SITE	15 MILES	231,000						
AIRSTRIP	LS 6,300,000	LS						
					<u>74865</u>			



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 10A OF 13
BY _____ DATE _____
APP SEM DATED 1/28/81

EL 2240				REV 2240		EL 2215	
				UNIT PRICE	\$ 000	QUANTITY	\$ 000
DIVERSION						QUANTITY	\$ 000
-	A	EXCAVATE ROCK - Portal	290,000 CY	15	4350 -	290,000	4350
-	A	EXCAVATE TUNNELS - ROCK	450,000 CY	55	24750	450,000	24750
		CONCRETE LINER @ Portals	4,200 CY	260	1092 -	4200	1092 -
-	A	CONCRETE LINER - TUNNEL	69,900 CY	250	17475	69,900	17475
		CONCRETE Inlet Portal Headwall	17,200 CY	260	4472 -	17200	4472 -
		CONCRETE Inlet Portal Pier	600 CY	295	177 -	600	177 -
		CONCRETE Outlet Headwall	7500 CY	260	1950 -	7500	1950 -
		CONCRETE Plugs	20000 CY	500	10000	20000	10000
		DOWNSTREAM COFFER DAM	125000 CY	7 ³⁵	919	125,000	919
		DEWATERING	\$ 3,675,000	LS	3675	\$ 3,675,000	3675
		CUTOFF	\$ 6,825,000	LS	6825	\$ 6,825,000	6825
		REINFORCING STEEL	1249 TON -	2100	2623	1249	2623
-	A	ROCK BOLTS - TUNNELS	500 TON -	3500	1750	500	1750
		ROCK BOLTS - Portals	125 TON -	3500	438	125	438
		ROCK SURFACE TREATMENT	2700 SY -	1580	43	2700	43
-	A	SUPPORT STEEL	1300 TON -	3675	4777	1300	4777
		GATES, ETC.	\$ 4,600,000	LS	4600	\$ 4,600,000	4600
		UPSTREAM COFFER DAM					
		RIP RAP	30,000 CY	12 ⁶⁰	378	30000	378
		CLOSURE DIKE	68,000 CY	12 ⁶⁰	857	68000	857
		ROCK FILL	283,000 CY	15 ⁸⁰	4472	283000	4472
		COARSE FILTER	94,000 CY	14 ⁷⁰	1382	94000	1382
		FINE FILTER	84,000 CY	8 ⁴⁰	706	84000	706
		CORE	215,000 CY	9 ⁰⁰	1936	215000	1936
		LOW LEVEL RELEASES	\$ 25,000,000	LS	25000	25,000	25,000

Est. 124,647 / 124,647 123,943
A - TUNNELS 1240' SHORTER @ EL 2140 (600' TOTAL FOR 2 TUNNELS) STRAIGHT LINE PROP

ADD
D/S COFFER DAMS
REMOVAL



Calculations

SUBJECT:

WATANA PREFEIZED SCHEMES

JOB NUMBER PS700.06

FILE NUMBER

SHEET 105 OF 13

BY GEM DATE 11/26/06

APP _____ DATE _____

EL 2240				EL 2190		EL 2165	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>DIVERSION 1</u>							
	EXCAVATE ROCK - Portal	290,000 CY	15	290,000	4350	290,000	4350
A	EXCAVATE TUNNELS - ROCK	450,000 CY	55	437,000	24035	430,500	23678
	CONCRETE LINER @ Portals	4,200 CY	260	4200	1092	4200	1092
A	CONCRETE LINER - TUNNEL	69,900 CY	250	67850	16962	66820	16705
	CONCRETE Inlet Portal Headwall	17,200 CY	260	17200	4472	17200	4472
	CONCRETE Inlet Portal Pier	600 CY	295	600	177	600	177
	CONCRETE Outlet Headwall	7500 CY	260	7500	1950	7500	1950
	CONCRETE Plugs	20000 CY	500	20000	10000	20000	10000
	DOWNSTREAM COFFER DAM	125000 CY	7 ³⁵	125,000	919	125000	919
	DEWATERING	\$ 3,675,000	LS		3675		3675
	CUTOFF	\$ 6,825,000	LS		6875		6875
	REINFORCING STEEL	1249 TON	2100	1249	2623	1249	2623
A	ROCK BOLTS - TUNNELS	500 TON	3500	486	1701	479	1677
	ROCK BOLTS - PORTALS	125 TON	3500	125	438	125	438
	ROCK SURFACE TREATMENT	2700 SY	15 ⁸⁰	2700	43	2700	43
A	SUPPORT STEEL	1300 TON	3675	1265	4649	1247	4583
	GATES, ETC.	\$ 4,600,000	LS		4600		4600
	UPSTREAM COFFER DAM						
	ZIP RAP	30,000 CY	12 ⁶⁰	30,000	378	30,000	378
	CLOSURE DIKE	68,000 CY	12 ⁶⁰	68,000	857	68000	857
	ROCK FILL	283,000 CY	15 ⁸⁰	283,000	4472	283,000	4472
	COARSE FILTER	94,000 CY	14 ⁷⁰	94,000	1382	94000	1382
	FINE FILTER	84,000 CY	8 ⁴⁰	84,000	706	84000	706
	CORE	215,000 CY	9 ⁰⁰	215,000	1936	215000	1936
	LOW LEVEL RELEASES	\$ 25,000,000	LS		25,000		25,000

A - SEE NOTE PREV. SHEET

123292

122588



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 10c OF 13
BY _____ DATE _____
APP GEM DATE 10/21/91

EL 2240				EL 2140			
				QUANTITY	\$ 000	QUANTITY	\$ 000
DIVERSION							
	EXCAVATE ROCK - Portal	290,000 CY	15	290,000	4350		
A	EXCAVATE Tunnels - ROCK	450,000 CY	55	424,000	23320		
	CONCRETE LINER @ Portals	4,200 CY	260	4200	1092		
A	CONCRETE LINER - TUNNEL	69,900 CY	250	65800	16450		
	CONCRETE Inlet Portal Headwall	17,200 CY	260	17200	4472		
	CONCRETE Inlet Portal Pier	600 CY	295	600	177		
	CONCRETE Outlet Headwall	7500 CY	260	7500	1950		
	CONCRETE Plugs	20000 CY	500	20000	10,000		
	Downstream Cofferdam	125000 CY	7 ³⁵	125000	919		
	Dewatering	\$ 3,675,000	LS		3675		
	CUTOFF	\$ 6,825,000	LS		6825		
	REINFORCING steel	1249 TON	2100	1249	2623		
A	ROCK BOLTS - Tunnels	.500 TON	3500	472	1652		
	ROCK BOLTS - Portals	125 TON	3500	125	438		
	ROCK SURFACE TREATMENT	2700 SY	1580	2700	43		
A	SUPPORT steel	1300 TON	3675	1230	4520		
	Gates, Etc.	\$4,600,000	LS		4600		
	UPSTREAM COFFERDAM						
	ZIP RIP	30,000 CY	12 ⁶⁰	30,000	378		
	CLOSURE DIKE	68,000 CY	12 ⁶⁰	68,000	857		
	ROCK FILL	283,000 CY	15 ⁸⁰	283,000	4472		
	COARSE FILTER	94,000 CY	14 ⁷⁰	94000	1382		
	FINE FILTER	84,000 CY	8 ⁴⁰	84000	704		
	CORE	215,000 CY	9 ⁰⁰	215000	1936		
	LOW LEVEL RELEASES	\$25,000,000	LS		25,000		

121,837

A - SEE NOTE PREV. SHEET



Calculations

SUBJECT:

WATANA

PREFERRED SCHEMES

JOB NUMBER P5700.06

FILE NUMBER

SHEET 11A OF 13

BY

DATE

APP GEM

DATE 10/28/0

EL 2240

REV 2240

EL 2215

			UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>SERVICE SPILLWAY</u>								
A	EXCAVATE ROCK	2,537,000 - CY	17	43129			2,460,500 -	41829 -
A	EXCAVATE OVERBURDEN	1,724,000 CY	6 ³⁰	10861			1,695,500 -	10682 -
<u>Concrete Walls</u>								
A	Form one Face	59,600 CY	260	15496			58840 -	15298
A	Form Both Faces	35,600 - CY	280	9968			34300 -	9404
<u>Concrete Slabs</u>								
<u>Approach</u>								
		9,600 CY	190	1824			9600	1824 -
A	No Forms	44,100 CY -	170	7497			43,030	73135
A	Form one side	5700 CY	190	1083			5410	1028
	Form both sides	NA	200	-			-	-
<u>Concrete Gate/Chute</u>								
	Form one side	2200 CY	295	649			2200	649 -
	Form both sides	4700 CY	315	1481			4700	1481 -
<u>Concrete Structure</u>								
	No Forms	NA	210	-			-	-
	Formed	NA	250	-			-	-
	Form one Face	10,100 CY	295	2979			10,100	2979 -
	Form both Faces	3400 CY	315	1071			3400	1071 -
	Concrete Bridge	1,800 CY	600	945			1800	945 -
A	Reinforcing steel	5960 TON	2100	12516			5780 ⁹⁰	12138
				109499 -			106845	845

(SECTION ONLY)
A - Reduction of 20% IN CHUTE QUANTITIES due to DOWNHILL SHIFT OF SPILLWAY & Reduction in Length of 330' @ EL 2146 (Dam).
other Eleus. Prop. - NO Reduction IN FLIP BUCKET + INTAKE.



Calculations

SUBJECT:

WATANA

PREFERRED SCHEMES

JOB NUMBER P5700.06

FILE NUMBER

SHEET 118 OF 13

BY DATE

APP GEM DATE 6/28/87

EL 2240				EL 2190		EL 2165		BY	DATE
				UNIT	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
				PRIC					
SERVICE SPILLWAY									
A	EXCAVATE ROCK	2,537,000	CY	17		2,384,000	40528	2,307,500	39228
A	EXCAVATE OVERBURDEN	1,724,000	CY	4 ³⁰		1,667,000	10502	1,638,500	10323
Concrete Walls									
A	Form one Face	59,600	CY	260		58080	15101	57320	14903
A	Form Both Faces	35,600	CY	280		33000	9240	31700	8876
Concrete Slabs									
APPROACH									
		9,600	CY	190		9600	1824	9600	1824
A	No Forms	44,100	CY	170		41956	7132	40876	6948 ⁵⁰
A	Form one side	5700	CY	190		5130	975	4440	928 ⁵⁰
	Form Both Sides	NA		200					
Concrete Gate/CHUTE									
	Form one side	2200	CY	295		2200	649	2200	649
	Form Both Sides	4700	CY	315		4700	1481	4700	1481
Concrete STRUCTURE									
	No Forms	NA		210					
	Formed	NA		250					
	Form one Face	10,100	CY	295		10,100	2979	10,100	2979
	Form Both Faces	3400	CY	315		3400	1071	3400	1071
	Concrete Bridge	1,800	CY	600		1800	945	1800	945
A	Reinforcing steel	5960	TON	2100		5610	12514	5438 ⁴⁰	11403

A - See Note Prev. Sheet



Calculations

SUBJECT:

WATANA

PREFERRED SCHEMES

JOB NUMBER P5702.06

FILE NUMBER

SHEET 11c OF 13

BY SEM DATE

APP SEM DATE 10/20/01

EL 2240				EL 2140					
			UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000	
<u>SERVICE SPILLWAY</u>									
A.	EXCAVATE ROCK	2,537,000	CY	17	2,231,000 -	37927 -			
A	EXCAVATE OVERBURDEN	1,724,000	CY	4 ³⁰	1,610,000	10143 -			
Concrete Walls									
A	Form one Face	59,600	CY	260	56560 -	14706			
A	Form both Faces	35,600	CY	280	30400 -	8512			
Concrete Slabs									
Approach									
		9,600	CY	190	9600	1824 -			
A	No Forms	44,100	CY	170	39800	6766 -			
A	Form one side	5700	CY	190	4560 -	867			
	Form both sides	NA		200					
Concrete Gate/Chute									
	Form one side	2200	CY	295	2200	649 -			
	Form both sides	4700	CY	315	4700	1485 -			
Concrete Structure									
	No Forms	NA		210					
	Formed	NA		250					
	Form one Face	10,100	CY	295	10,100	2979 -			
	Form both Faces	3400	CY	315	3400	1071 -			
	Concrete Bridge	1,800	CY	600	1800	945 -			
A	Reinforcing steel	5960	Ton	2100	5260	11046			
						98916 -			

A - See Note Prev Sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER PS700.06

FILE NUMBER

SHEET 12A OF 13

BY

DATE

APP GFM

DATE 10/20/87

EL 2240				REV 2240		EL 2215	
		UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
<u>SERVICE SPILLWAY (CON'T)</u>							
B	ROCKBOLTS	790 TON	3500	2765		780	2730 -
	GATES	LS \$1,860,000	LS	1860		1,860,000	1860 -
	DENTAL CONCRETE	LS \$4,800,000	LS	4800		4,800,000	4800 -
	GROUTING	LS \$2,100,000	LS	2100		2,100,000	2100 -
	WINTERIZATION	LS \$6,400,000	LS	6400		6,400,000	6400 -
	ALLUVIUM REMOVAL						
	ABOVE WATER LEVEL	760,000 CY	7.00	5320		760,000	5320 -
	BELOW WATER LEVEL	860,000 CY	17	14620		860,000	14620 -
	SURFACE TREATMENT						
B	VERTICAL	20,200 SY	15.80	319		19550 -	309 -
B	HORIZONTAL	32,600 -SY	10.50	342		31400 -	330 -
	SERVICE TUNNEL						
A	STEEL LINER	2300 TON	4400	10120		2272 -	9997 -
A	EXCAVATE TUNNEL-ROCK	61000 CY	55	3355		40252 -	3314 -
A	CONCRETE TUNNEL	18000 CY	380	6840		17779 -	6756 -
A	REINFORCING STEEL	720 TON	2100	1512		711 -	1493 -
A	ROCKBOLTS	215 TON	3500	753		212 -	742 -
A	STEEL SUPPORT	475 TON	3675	1746		469 -	1723 -
	SAME H/B & MISC. MECH.	LS \$9,000,000	LS	9000		\$ 9,000,000	9000 -
				71852	71852		71494 -

A- Service Tunnel - Shorten By 100' = 2040-100 = 1940/2040 (EL 2140) other Elevs Prop.

B- Reduction of 20% IN CHUTE QUANTITIES DUE TO DOWNHILL SHIFT OF SPILLWAY & REDUCTION IN LENGTH OF 330' @ EL 2140 (DHW) other Elevs. Prop.



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER PS70006

FILE NUMBER _____

SHEET 128 OF 13

BY _____ DATE _____

APP SEM DATE 10/20/01

SERVICE SPILLWAY (CON'T)

EL 2240			UNIT PRICE	\$ 000	EL 2190		EL 2165	
					QUANTITY	\$ 000	QUANTITY	\$ 000
B	ROCKBOLTS	790 TON	3500		770 -	2695	760 -	2660 -
	GATES	LS \$1,860,000	LS		1,860,000	1860	1860,000	1860 -
	DENTAL CONCRETE	LS \$4,800,000	LS		4,800,000	4800	4,800,000	4800 -
	GROUTING	LS \$2,100,000	LS		2,100,000	2100	2,100,000	2100 -
	WINTERIZATION	LS \$6,400,000	LS		6,400,000	6400	6,400,000	6400 -
	ALLUVIUM REMOVAL							
	ABOVE WATER LEVEL	760,000 CY	7 ⁰⁰		760,000	5320	760,000	5320 -
	BELOW WATER LEVEL	860,000 CY	17		860,000	14620	860,000	14620 -
	SURFACE TREATMENT							
B	VERTICAL	20,200 SY	15 ⁸⁰		18900 -	299 -	18250 -	288 -
B	HORIZONTAL	32,600 SY	10 ⁵⁰		30200 -	317	29000 -	305
	SERVICE TUNNEL							
A	STEEL LINER	2300 TON	4400		2244 -	9874 -	2215 -	9746 -
A	EXCAVATE TUNNEL-ROCK	61000 CY	55		59505 -	3273 -	58757 -	3232 -
A	CONCRETE TUNNEL	18000 CY	380		17559 -	6672 -	17338 -	6588 -
A	REINFORCING STEEL	720 TON	2100		703 -	1476 -	694 -	1457 -
A	ROCKBOLTS	215 TON	3500		210 -	735 -	207 -	725 -
A	STEEL SUPPORT	475 TON	3675		463 -	1702 -	458 -	1683 -
Same	H/B & MISC. MECH.	LS \$9,000,000	LS		\$ 9000	9,000	\$ 9,000,000	9,000 -
					71143 -		70784 -	

A - See Note Prev. Sheet

B - See Note Prev. Sheet



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER PS700.06

FILE NUMBER

SHEET 12c OF 13

BY

DATE

APP SEM

DATE 10/20/91

EL 2240

EL 2140

SEIZURE SPILLWAY (CON'T)

			UNIT PRICE	\$ 000	QUANTITY	\$ 000	QUANTITY	\$ 000
B	ROCKBOLTS	790 TON	3500		750 -	2625 -		
	GATES	LS \$1,860,000	LS		1,860,000	1860 -		
	DENTAL CONCRETE	LS \$4,800,000	LS		4,800,000	4800 -		
	GROUTING	LS \$2,100,000	LS		2,100,000	2100 -		
	WINTERIZATION	LS \$6,400,000	LS		6,400,000	6400 -		
	ALLUVIUM REMOVAL							
	ABOVE WATER LEVEL	760,000 CY	7.00		760,000	5320 -		
	BELOW WATER LEVEL	860,000 CY	17		860,000	14620 -		
	SURFACE TREATMENT							
B	VERTICAL	20,200 SY	15.80		17600 -	278 -		
B	HORIZONTAL	32,600 SY	10.50		27800 -	292 -		
	SERVICE TUNNEL							
A	STEEL LINER	2300 TON	4400		2187 -	9623 -		
A	EXCAVATE TUNNEL-ROCK	61000 CY	55		58010 -	3191 -		
A	CONCRETE TUNNEL	13000 CY	380		17118 -	6505 -		
A	REINFORCING STEEL	720 TON	2100		685 -	1439 -		
A	ROCKBOLTS	215 TON	3500		204 -	714 -		
A	STEEL SUPPORT	475 TON	3675		452 -	1661 -		
SAME	H/B & MISC. MECH.	LS \$9,000,000	LS		9,000,000	9,000 -		
						70,428 -		

A - SEE NOTE PREV. SHEET

B - SEE NOTE PREV. SHEET



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5700.06
FILE NUMBER _____
SHEET 13A OF 13
BY _____ DATE _____
APP GEM DATE 10/23/9

EL 2240				REV 2240		EL 2215	
		UNIT PRICE	\$000	QUANTITY	\$000	QUANTITY	\$000
<u>SERVICE SPILLWAY (CON'T)</u>							
SERVICE TUNNEL INTAKE							
EXCAVATE OVERBURDEN	21,000 CY	6 ³⁰	132			21,000	132 -
EXCAVATE ROCK	167,000 CY	12 ⁵⁰	2088			167,000	2088 -
CONCRETE STRUCT. MASS	28,200 CY	300	8460			28,200	8460 -
RESTEEL	6,300 CY	200	1260			6300	1260 -
ROCK BOLTS	1400 TON	2100	2940			1400	2940 -
GRAVEL BACKFILL	28 TON	3500	98			28	98 -
ADDITIONAL GATES	3200 CY	7 ⁰⁰	22			3200	22 -
ROCK CREDIT	\$500,000	LS	500			500,000	500 -
	2,092,000 CY	8 ⁰⁰	- 16736			2092000	- 16736 -
			180,115		180115		177,099 103
<u>EMERGENCY SPILLWAY</u>							
EXCAVATE ROCK	1,383,000 CY	17	23511				
EXCAVATE OVERBURDEN	3,551,000 CY	6 ⁵⁰	23082				
PLACE FUSE PLUG	54,200 CY	6	325				
			46918 -		46918 -		46918 -
GRAND TOTAL			1,974,999				



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES

JOB NUMBER P5702.06

FILE NUMBER

SHEET 133 OF 13

BY

DATE

APP GSM

DATE 10/22/07

EL 2240

EL 2190

EL 2165

SERVICE SPILLWAY (CONT)

SERVICE TUNNEL INTAKE

EXCAVATE OVERBURDEN 21,000 CY 6³⁰

EXCAVATE ROCK 167,000 CY 12⁵⁰

CONCRETE STRUCT. 28,200 CY 300

MASS 6,300 CY 200

RESTEEL 1400 TON 2100

ROCK BOLTS 28 TON 3500

GRAVEL BACKFILL 3200 CY 7⁰⁰

ADDITIONAL GATES \$500,000 LS

ROCK CREDIT 2,092,000 CY 8⁰⁰

21000 132

167000 2088

28200 8460

6300 1260

1400 2940

28 98

3200 22

500,000 500

2,092,000 - 16736

174,850 -

21000 132 -

167000 2088 -

28200 8460 -

6300 1260 -

1400 2940 -

28 98 -

3200 22

500,000 500 -

2,092,000 - 16736

171,098

102

EMERGENCY SPILLWAY

EXCAVATE ROCK 1,333,000 CY 17

EXCAVATE OVERBURDEN 3,551,000 CY 6⁵⁰

PLACE FUSE PLUG 54,200 CY 6

46918.

46918.



Calculations

SUBJECT:

WATANA PREFERRED SCHEMES.

JOB NUMBER PS102.05

FILE NUMBER _____

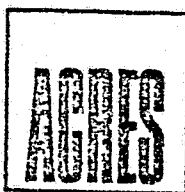
SHEET 13c OF 13

BY _____ DATE _____

APP SEM DATE 10/20/89

60.04.01 Form 14BA

EL 2240			EL 2140		EL 2140		EL 2140	
			UNIT PRICE	\$000	QUANTITY	\$000	QUANTITY	\$000
<u>SERVICE TUNNEL (CON'T)</u>								
SERVICE TUNNEL INTAKE								
EXCAVATE OVERBURDEN	21,000 CY		6 ³⁰		21,000	132 -		
EXCAVATE ROCK	167,000 CY		12 ⁵⁰		167,000	2038 -		
CONCRETE STRUCT.	28,200 CY		300		28,200	8460 -		
MASS	6,300 CY		200		6300	1260 -		
RESTEEL	1400 TAN		2100		1400	2940 -		
ROCK BOLTS	28 TAN		3500		28	98 -		
GRAVEL BACKFILL	3200 CY		7 ⁰⁰		3200	22 -		
ADDITIONAL GATES	\$500,000		LS		500,000	500 -		
ROCK CREDIT	2,092,000 CY				2,092,000	-16736		
						<u>168108 -</u>		
<u>EMERGENCY SPILLWAY</u>								
EXCAVATE ROCK	1,383,000 CY		17					
EXCAVATE OVERBURDEN	3,551,000 CY		6 ⁵⁰					
PLACE FUSE PLUG	54,200 CY		6					
						<u>46918 -</u>		



Calculations

SUBJECT:

JOB NUMBER _____

FILE NUMBER _____

SHEET _____ OF _____

BY _____ DATE _____

APP _____ DATE _____

To: R. Ibbotson.

PS700.07.06

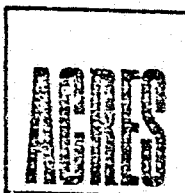
From: D. Crawford.

21 Oct 81

Subject: Susitna HEP
Energy Simulation
Reduced dam heights with various drawdowns:

As per your request we have performed energy simulations with reduced water surface elevations (2215, 2165 and 2115). Included are simulation results with various drawdown constraints. Results are attached.

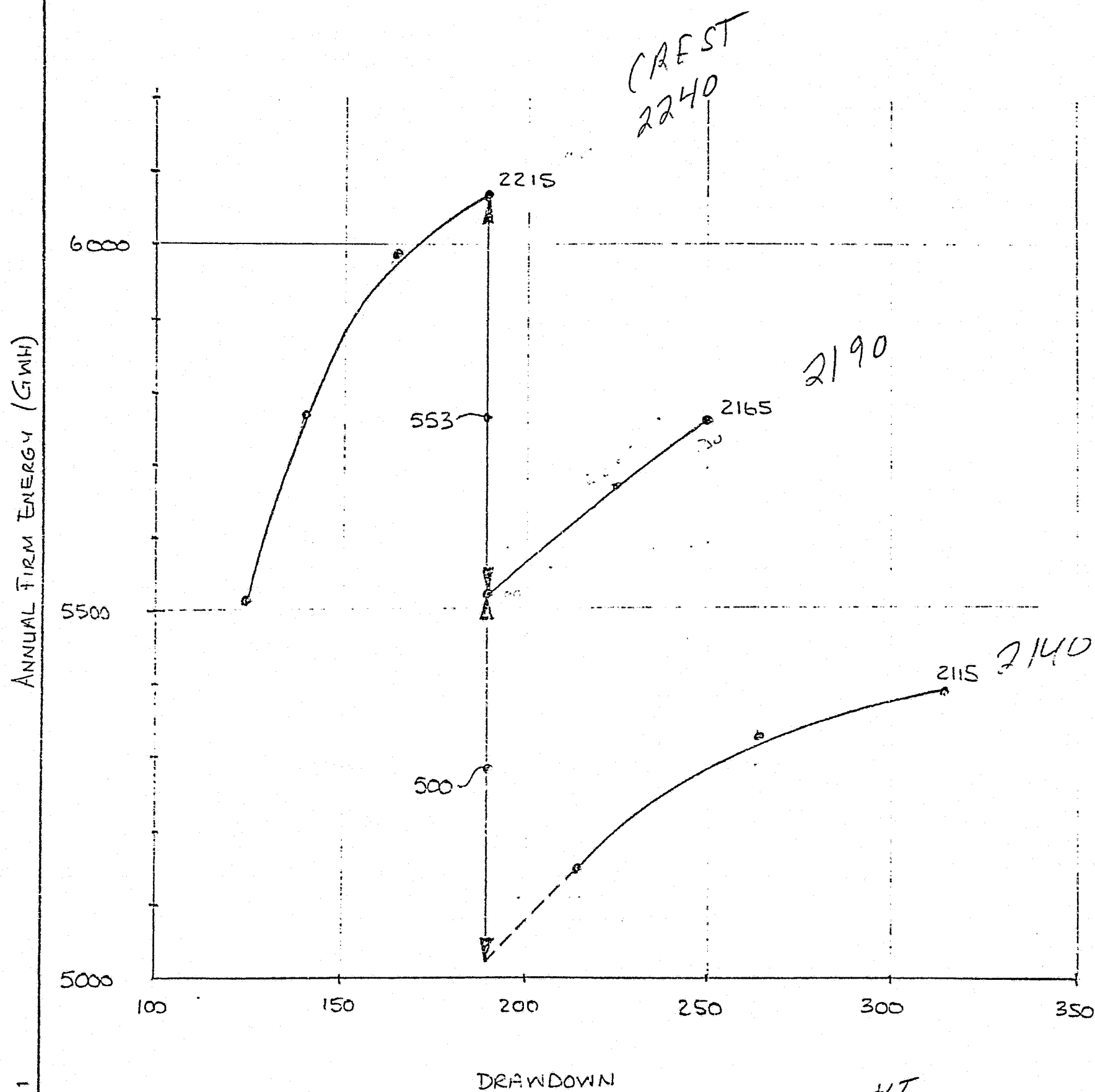
David Crawford.



Calculations

SUBJECT: ENERGY SIMULATION.
DRAWDOWN.

JOB NUMBER _____
FILE NUMBER _____
SHEET _____ OF _____
BY DC DATE 21 OCT 81
APP _____ DATE _____



FORM NO. 152 REV. 1

Based on two Reservoir Simulation Model.
No Flow constraints, Standard Energy Pattern.

2140 HIT
265

22110 190



Calculations

SUBJECT:

JOB NUMBER _____
FILE NUMBER _____
SHEET _____ OF _____
BY DC DATE 20 OCT 81
APP _____ DATE _____

WATANA / DEVIL CANYON

WSEL	WATANA D/DOWN	ENERGY	
		FIRM	AVE.
2215	* 189	6073	6670
2165	* 249	5765	6387
	190	5520	6366
2115	* 315	5398	6106
	265	5336	6073
	215	5152	6089



Calculations SUSITNA

SUBJECT: WATANA

Intake (Power) - Preferred Scheme

JOB NUMBER P5700.06

FILE NUMBER

SHEET 1 OF 2

BY WEL DATE 10/23/81

APP DATE

Reduction in Dam Height From 2240 to 2140
Results in an increase of 265/190 in all

Intake Structure Items. 2240 to 2140 St. Line Corr.
Data Supplied By R. Ibbotson 10/22/81

Quantities from Comp. Cost sheet 7 of 13
Item Quantity x Factor Rev. Quant.

Exc. Rock	1,153,000 cy	265/190	1,615,000 cy
Exc Overbdn	131,000 cy	"	183,000 cy
Concrete Mass	28,000 cy	"	39,000 cy
Conc. Structures	126,400 cy	"	176,300 cy
Reinf. Steel	6800 ton	"	9500 ton
RockBats	125 ton	"	174 ton
Gravel Backfill	14400 cy	"	20,100 cy
Gates	\$ LS 14,115,000	"	\$ 20,747,000
Rock Credit	1,052,000 cy	"	1,467,000 cy



Calculations SUSITNA

SUBJECT: WATANIA

TWTAKE (POWER) Preferred Scheme

JOB NUMBER P5700.06

FILE NUMBER _____

SHEET 2 OF 2

BY WELK DATE 10/23/81

APP _____ DATE _____

<u>Item</u>	<u>2240</u>	<u>2215</u>	<u>2190</u>	<u>2165</u>	<u>2140</u>
Exc. Rock	1,158,000 cy	1272250	1386500	1500750	1,615,000
Exc. Overblow	131,000 cy	144000	157000	170000	183,000
Conc. Mass	28,000 cy	30750	33500	36250	39,000
Conc. Struts	126,400 cy	138875	151350	163825	176,300
Reinf. Steel	6800 ton	7475	8150	8825	9500
Rock Bolts	125 ton	137	150	162	174
Gravel Back	14400 cy	15825	17250	18475	20100
Empts	\$ 14,575,000	16343	17811	19279	20,747,000
Rock Credit	1,052,000 cy	1156	1260	1363	1,467,000



Calculations

SUBJECT:

ADJUSTMENTS
FOR UATANA
AT 2140 PER
AKI 330 PM

JOB NUMBER _____
FILE NUMBER _____
SHEET 1 OF _____
BY _____ DATE _____
APP _____ DATE _____

Notes on Meeting

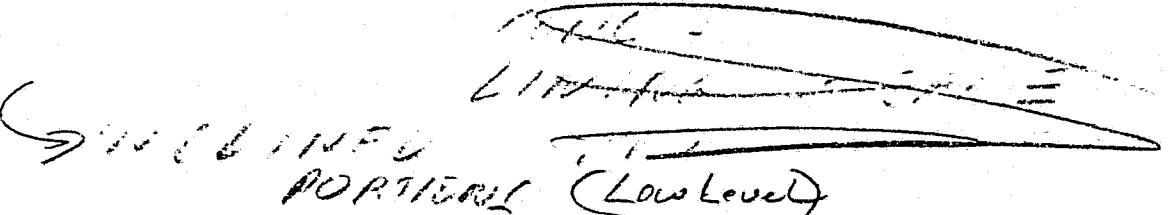
10/15/81

- ① VERTICAL GALL PROP TO DAM HEIGHT
SURFACE PREP TO O/B FAC
- ✓ HOR GALL PROP TO CREST LENGTH
- ✓ GROUTING & DRAINAGE { TO ~~DRAINAGE~~
LENGTH CONTACT SURFACE
- ✓ ~~ADJUSTMENTS~~ STEEL TO CREST LENGTH

✓ LOW LEVEL — SAME for all Levels

- ② ✓ ~~ADJUSTMENTS~~ — FILE?

100' LESS



- ✓ STEEL LINER PROP TO ~~ADJUSTMENTS~~
of Dam %

- ③ ~~ADJUSTMENTS~~ $\frac{2500}{2500} = 1$
w/ OFFSHORE SIGNIFICANT MAY BE ADD

- ④ BASE SLAB GATES SAME



Calculations

SUBJECT:

JOB NUMBER _____

FILE NUMBER _____

SHEET 2 OF _____

BY _____ DATE _____

APP _____ DATE _____

PHI - ~~BA~~ SAME
✓ 700' LESS IN ACCESS
TUNNELS AND TAILRAIL ~~42X~~
✓ 100' LESS IN VERTICAL SHAFTS

✓ 100' LESS IN SERVICE SPILLWAY
TUNNEL

✓ SERVICE SPILLWAY -

MOVE AS DRAWING

Per RKI - QUANT. % of change in chute length 10/29/81

✓ RES CLEAR 1.5 MILLION
LESS @ 2140

SADDLE DAM CUTOFF

EMERG

} later
from RKI

DIVERSION

SHORTEN TUNNELS 240'

Land - Reduce By amt - See GRAPH



Calculations

SUBJECT:

JOB NUMBER _____

FILE NUMBER _____

SHEET 2 OF _____

BY _____ DATE _____

APP _____ DATE _____

APPROACH - FINISH 2240 COMPARISON
w/ New Aelict Channel
Info

PRORATE AND ADJUST AT
2140

STRAIGHT LINE IN BETWEEN

EXCEPT DAM VOLS & COSTS
FROM J. BOGE

~~ETWA~~ SADDLE DAM / AELICT
CHANNEL

Summary only
of earlier estimate
to 2300, (Pg. 62)

Board of Consultants
were concerned about geotechnical
problems at this elevation. Would
be interesting to see their report.

WPK
11 March 83

WATANA HEIGHT OPTIMIZATION

COST SUMMARY - JULY 1981

DESCRIPTION (\$000)	CREST ELEVATION (FEET)						
	(4) 2,300	(4) 2,275	(4) 2,250	Base Estimate (1,2) 2,225	2,200	2,175	2,150
Land Acquisition	\$000	\$000	\$000	\$000	\$000	\$000	\$000
Reservoir Clearing	50,750	43,750	38,500	35,000	32,200	29,050	26,950
Main Dam	15,000	15,000	15,000	15,000	15,000	15,000	15,000
Diversion & Cofferdam	1,448,412	1,328,187	1,221,599	1,126,815	1,032,720	948,292	849,959
Penstocks	106,309	105,005	103,103	101,803	101,102	99,801	99,101
Power Intakes	14,711	14,373	13,924	13,587	13,135	12,798	12,460
Powerhouse & Associated Items	57,154	57,154	57,154	57,154	57,154	57,154	57,154
Service Spillway	179,955	179,794	179,666	179,536	179,406	179,245	179,084
Tailrace	210,126	204,614	199,100	195,424	189,910	186,235	180,721
Saddle Dam & Cutoff	12,922	12,710	12,394	12,184	11,868	11,657	11,446
Switchyard	124,540	92,792	57,242	45,196	33,140	27,000	23,000
Miscellaneous Structures & Equipment	7,018	7,018	7,018	7,018	7,018	7,018	7,018
Access Road/Airstrip	8,000	8,000	8,000	8,000	8,000	8,000	8,000
	98,310	98,140	97,920	97,700	97,480	97,480	97,480
Subtotal	2,333,207	2,166,537	2,010,620	1,894,417	1,778,133	1,678,730	1,567,373
Miscellaneous Adjustment to Volume Change (3)	5,957	5,407	4,953	4,544	4,166	3,826	3,498
Subtotal	2,339,164	2,171,944	2,015,573	1,898,961	1,782,299	1,682,556	1,570,871
Support & Camp @ 15.6%	364,909	338,824	314,429	296,238	278,035	262,479	245,056
Subtotal	2,704,073	2,510,768	2,330,002	2,195,199	2,060,314	1,945,035	1,815,927
Contingency @ 20%	540,815	502,152	466,000	439,039	412,063	389,005	363,185
Subtotal	3,244,888	3,012,920	2,796,002	2,634,238	2,472,377	2,334,042	2,179,112
Engineering, Owner Costs, Administration @ 12.5%	405,611	376,616	349,501	329,279	309,047	281,755	272,389
TOTAL	3,650,499	3,389,536	3,145,503	2,963,517	2,781,424	2,625,797	2,451,501

NOTES:

1. All estimates are based upon estimate for crest elevation 2,225 with appropriate adjustments made to reflect varied dam volumes, lengths of tunnels, length of spillways, etc. at other elevations.
2. Crest elevation 2,225 estimate total (\$2,963 million) is original upper limit estimate (March 1981) as used in economic model analysis.
3. Dam volumes are based on 2.75:1 upstream slope and have been adjusted to reflect additional topographic information.
4. No adjustment in costs have been made to reflect schedule impact of additional volumes ~~at~~ higher elevations.

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Support material for
these estimates was not requested
WPK