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Project No. 86C8554P

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BASIN F 60% DESIGN COST ESTIMATE W/ 2 FT. CLAY LINER & CAP

STAGE ONE CONSTRUCTION

REMOVE RIP RAP (SO. END)	6,250 C.Y.	\$5.50	\$34,375.00
REGRADE SOUTH BERM	32,250 C.Y.	\$2.66	\$85,785.00
HAUL SLUDGE TO STOCKPILE	91,370 C.Y.	\$2.66	\$243,044.20
CLAY CAP (2 FT.)	48,070 C.Y.	\$6.87	\$330,240.90
	SUBTOTAL		\$693,445.10

LANDFILL CONSTRUCTION

EXTERIOR BERMS	20,200 C.Y.	\$7.34	\$148,268.00
CLAY LINER-BOTTOM (2 FT.)	43,300 C.Y.	\$7.34	\$317,822.00
CLAY LINER-TOP&SIDES (2 FT.)	51,970 C.Y.	\$10.78	\$560,236.60
INTERNAL GRADING	48,600 C.Y.	\$2.66	\$129,276.00
SELECT FILL (2 FT.)	56,760 C.Y.	\$7.59	\$430,808.40
TOP SOIL (6 IN.)	13,000 C.Y.	\$2.93	\$38,090.00
DRAINAGE NET(3 LAYERS)	1,986,410 S.F.	\$0.35	\$695,243.50
SYNTHETIC LINER(2 LAYERS)	1,307,160 S.F.	\$0.80	\$1,045,728.00
GEOTEXTILE FABRICS(3 LAYERS)	1,986,410 S.F.	\$0.25	\$496,602.50
SUMPS AND PIPING	1 L.S.	\$36,120.00	\$36,120.00
	SUBTOTAL		\$3,898,195.00

NORTH LAGOON (8.5 M GAL)

EXCAVATION	54,000 C.Y.	\$2.66	\$143,640.00
CLAY LINER (2 FT.)	11,000 C.Y.	\$7.34	\$80,740.00
SYNTHETIC LINER(2 LAYERS)	296,600 S.F.	\$0.80	\$237,280.00
DRAINAGE NET(1 LAYER)	148,300 S.F.	\$0.35	\$51,905.00
	SUBTOTAL		\$513,565.00

LEACHATE LAGOON (1.5 M GAL)

EXCAVATION	10,000 C.Y.	\$2.66	\$26,600.00
CLAY LINER (2 FT.)	3,750 C.Y.	\$7.34	\$27,525.00
SYNTHETIC LINER(2 LAYERS)	101,250 S.F.	\$0.80	\$81,000.00
DRAINAGE NET(1 LAYER)	50,625 S.F.	\$0.35	\$17,718.75
	SUBTOTAL		\$152,843.75

LIQUID REMOVAL

PUMPS AND APPURTENANCES	1 L.S.	\$63,192.00	\$63,192.00
FORCE MAIN	1 L.S.	\$298,617.00	\$298,617.00
ELECTRICAL	1 L.S.	\$18,514.00	\$18,514.00
O & M	600 HRS	\$13.76	\$8,256.00
	SUBTOTAL		\$388,579.00

CONTAMINATED MATERIAL REMOVAL

REMOVE RIP RAP	18,750 C.Y.	\$5.50	\$103,125.00
REMOVE SEWER AND MISC.	15,000 C.Y.	\$4.88	\$73,200.00
HAUL WASTE TO SOLIDIFICATION	337,540 C.Y.	\$4.08	\$1,377,163.20
HAUL TO WASTE PILE	337,540 C.Y.	\$4.32	\$1,458,172.80
	SUBTOTAL		\$3,011,661.00

SOLIDIFICATION

FACILITIES CONSTRUCTION	1 L.S.	\$442,344.00	\$442,344.00
EQUIPMENT	1 L.S.	\$730,572.00	\$730,572.00
ELECTRICAL	1 L.S.	\$178,752.00	\$178,752.00
ELECTRICAL POWER	1 L.S.	\$71,400.00	\$71,400.00
FLY ASH	40,000 C.Y.	\$28.70	\$1,148,000.00

O & M	1 L.S.	\$1,197,566.00	\$1,197,566.00
ADDITIONAL CHEMICALS	1 L.S.	\$4,670.00	\$4,670.00
	SUBTOTAL		\$3,773,304.00
SITE IMPROVEMENTS			
ROADWAYS (25 FT.) LEVEL B	4,167 C.Y.	\$11.33	\$47,212.11
ROADWAYS (25 FT.) LEVEL D	2,315 C.Y.	\$9.89	\$22,895.35
SIGNING	1 L.S.	\$10,000.00	\$10,000.00
FENCING (6' W/ 3 BARBS)	6,000 L.F.	\$12.00	\$72,000.00
	SUBTOTAL		\$152,107.46
RUNOFF/DUST CONTROL			
PUMPING	1 L.S.	\$50,000.00	\$50,000.00
DIKES	25,000 L.F.	\$1.00	\$25,000.00
DUST CONTROL	1 L.S.	\$50,000.00	\$50,000.00
	SUBTOTAL		\$125,000.00
LEACHATE/BLOWDOWN LIQUID HANDLING			
TRANSPORT TO LAGOONS	1,500,000 GAL.	\$0.10	\$150,000.00
	SUBTOTAL		\$150,000.00
EQUIPMENT DECONTAMINATION			
SOLIDIFICATION FACILITY	1 L.S.	\$25,000.00	\$25,000.00
LAGOONS	2 EA.	\$10,000.00	\$20,000.00
PUMP STATION AND FORCE MAIN	1 L.S.	\$7,500.00	\$7,500.00
DECON AREA & MISC.	1 L.S.	\$7,500.00	\$7,500.00
	SUBTOTAL		\$60,000.00
BASIN CAPPING/TOPSOILING			
GRADE AND SHAPE	224,500 C.Y.	\$2.66	\$597,170.00
CLAY CAP (2 FT.)	215,160 C.Y.	\$6.87	\$1,478,149.20
TOP SOIL (6 IN.)	73,880 C.Y.	\$2.93	\$216,468.40
SEEDING	510,000 S.Y.	\$0.15	\$76,500.00
	SUBTOTAL		\$2,368,287.60
	TOTAL		\$15,286,987.91
	10% CONTINGENCY		\$1,528,698.79
	5% MOBILIZATION		\$764,349.40
	4% COST GTH MDPT		\$611,479.52
	7% SUPERVISION		\$1,070,089.15
	12% O & P		\$1,834,438.55
			=====
	GRAND TOTAL		\$21,096,043.32

**COST BACK-UP
SUMMARY**

Subject BASIN F 60% COST ESTIMATE

Project No. 86 C8554P

By D. Hawk

Checked By T. Kelly

Task No. 2

File No. 21947

Date 7/7/87

Date 7/1/87

Sheet 1 of 2

STAGE ONE CONSTRUCTION

- MOVE MATERIAL ON SOUTH END OF BASIN AND PLACE CLAY CAP TO ALLOW CONSTRUCTION OF WASTE PILE AND SOLIDIFICATION FACILITY.

• REMOVE RIP RAP SOUTH END

$$\text{QUANTITY} = \frac{1}{4}(25,000 \text{ CY}) = 6250 \text{ CY}$$

$$\text{UNIT PRICE} = \$5.00/\text{CY}$$

(SEE COST ITEM 1)

$$\text{COST} = 6250 \text{ CY} \times \$5.00/\text{CY} = \$31,250$$

• Regrade South Berm

$$\text{QUANTITY} = \frac{1}{4}(129,000 \text{ CY}) = 32,250 \text{ CY}$$

(129,000 CY = TOTAL BASIN F BERM QUANTITY)

$$\text{UNIT PRICE} = \$2.66/\text{CY}$$

(SEE COST ITEM 2)

$$\text{COST} = 32,250 \text{ CY} \times \$2.66/\text{CY} = \$85,785$$

• Haul Sludge to Stockpile

$$\text{QUANTITY} = 91,370 \text{ CY}$$

$$\text{UNIT PRICE} = \$2.66/\text{CY}$$

$$\text{COST} = 91,370 \text{ CY} \times \$2.66/\text{CY} = \$243,044$$

(SEE COST ITEM 2)

• Place Clay Cap for Basin

$$\text{QUANTITY} = 91,370 - 43,300 = 48,070 \text{ CY}$$

(TOTAL STAGE 1 AREA - AREA OF LANDFILL USING 2 FT THICK CAP)

$$\text{UNIT PRICE} = \$10.87/\text{CY}$$

(SEE COST ITEM 3 & 4)

Subject BASIN F 60% COST ESTIMATE

Project No. 86C8554P

By D. HAWK

Checked By Tom Volk

Task No. 2

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Place Clay Cap for Basin F (continued)

Item 3 = \$4.42/cy

Item 4 = \$2.45/cy

TOTAL = \$6.87/cy

COST = 48,070 CY x \$6.87/cy = \$330,240.90 ✓

Subject BASIN F 60% COST ESTIMATEProject No. 86CB554PBy D. HAWKChecked By Tom. KelleyTask No. 2File No. 21947Date 7/7/87Date 7/15/87Sheet 1 of 3LANDFILL CONSTRUCTION• EXTERIOR BERM CONSTRUCTIONQUANTITY = 20,200 CYUNIT PRICE = \$7³⁴/CY (SEE COST ITEMS 3 & 5)ITEM 3 = \$4⁴²/CYITEM 5 = \$2⁹²/CYTOTAL = \$7³⁴/CYCOST = 20,200 CY × \$7³⁴/CY = \$148,268⁰⁰• CLAY LINER - BOTTOMQUANTITY = 43,300 CYUNIT PRICE = \$7³⁴/CY (SEE COST ITEMS 3 & 5)ITEM 3 = \$4⁴²/CYITEM 5 = \$2⁹²/CYTOTAL = \$7³⁴/CYCOST = 43,300 CY × \$7³⁴/CY = \$317,822⁰⁰• CLAY LINER - TOP AND SIDESQUANTITY = 51,970 CYUNIT PRICE = \$10⁷⁸/CY (SEE COST ITEM 6)COST = 51,970 CY × \$10⁷⁸/CY = \$560,236⁶⁰

Subject BASIN F 60% COST ESTIMATEProject No. 86 C8554PBy D. HawkChecked By Tom KellyTask No. 2File No. 21947Date 7/7/87Date 7/13/87Sheet 2 of 3• INTERNAL GRADINGQUANTITY = 48,600 CY ✓UNIT PRICE = \$2⁶⁶/CY (See Cost Item 2)COST = 48,600 × \$2⁶⁶/CY = \$129,276⁰⁰ ✓• PLACE SELECT FILL (SOIL LAYER)QUANTITY = 56,760 CY ✓UNIT PRICE = \$7⁵⁹/CY (See Cost Items 7 & 8)Item 7 = \$1⁸¹/CY ✓Item 8 = \$5⁷⁸/CY ✓TOTAL = \$7⁵⁹/CYCOST = 56,760 CY × \$7⁵⁹/CY = \$430,808⁴⁰ ✓• TOPSOILQUANTITY = 13,000 CY ✓UNIT PRICE = \$2⁹³/CY (See Cost Item 9)COST = 13,000 CY × \$2⁹³/CY = \$38,090⁰⁰ ✓• DRAINAGE NETQUANTITY = 1,986,410 SF ✓UNIT PRICE = \$0³⁵/SF (See Cost Item 10)COST = 1,986,410 SF × \$0³⁵ = \$695,243⁵⁰ ✓

Subject BASIN F 60% COST ESTIMATE

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By D. Hawk

Checked By Torr Kelley

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• SYNTHETIC LINER

$$\text{QUANTITY} = 1,307,160 \text{ SF}^1$$

$$\text{UNIT PRICE} = \$0.80/\text{SF}^1 \text{ (See Cost Item 10)}$$

$$\text{COST} = 1,307,160 \text{ SF} \times \$0.80/\text{SF} = \$1,045,728.00^1$$

• GEOTEXTILE FABRIC

$$\text{QUANTITY} = 1,986,410 \text{ SF}^1$$

$$\text{UNIT PRICE} = \$0.25/\text{SF} \text{ (See Cost Item 10)}$$

$$\text{COST} = 1,986,410 \text{ SF} \times \$0.25/\text{SF} = \$496,602.50^1$$

• SUMPS AND PIPING

$$\text{LUMP SUM} = \$36,120 \text{ (See Cost Item 11)}^1$$



Subject BASIN F 60% COST ESTIMATE

Project No. 86C8554P

By D. Hawk

Checked By Tom Kelly

Task No. 2

File No. 21947

Date 7/8/87

Date 7/12/87

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NORTH LAGOON CONSTRUCTION

• EXCAVATION

$$\text{QUANTITY} = 54,000 \text{ CY} \checkmark$$

$$\text{UNIT PRICE} = \$2.66/\text{CY} \checkmark (\text{See Cost Item 2})$$

$$\text{COST} = 54,000 \text{ CY} \times \$2.66/\text{CY} = \$143,640.00 \checkmark$$

• CLAY LINER (2 FT.)

$$\text{QUANTITY} = 2' \times 148,300 \text{ SF} \div 27 \frac{\text{CF}}{\text{CY}} = 10,985 \text{ CY} \checkmark$$

SAY 11,000 CY ✓

$$\text{UNIT PRICE} = \$7.34/\text{CY} \checkmark (\text{See Cost Items 3 \& 5})$$

$$\text{ITEM 3} = \$4.42/\text{CY} \checkmark$$

$$\text{ITEM 5} = \$2.92/\text{CY} \checkmark$$

$$\text{TOTAL} = \$7.34/\text{CY} \checkmark$$

$$\text{COST} = 11,000 \text{ CY} \times \$7.34/\text{CY} = \$80,740 \checkmark$$

• SYNTHETIC LINER (2 LAYERS)

$$\text{QUANTITY} = 2 \times 148,300 \text{ SF} = 296,600 \text{ SF} \checkmark$$

$$\text{UNIT PRICE} = \$0.80/\text{SF} \checkmark (\text{See Cost Item 10})$$

$$\text{COST} = 296,600 \text{ SF} \times \$0.80/\text{SF} = \$237,280 \checkmark$$



Subject BASIN F 60% COST ESTIMATE

Project No. 86CB554P

By D. Hawk

Checked By Tom Kelley

Task No. 2

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• DRAINAGE NET (1 LAYER)

QUANTITY = 148,300 SF

UNIT PRICE = \$0.35/SF (See Cost Item 10) ✓

COST = 148,300 SF x \$0.35/SF = \$51,905.00 ✓



Subject BASIN F 60% COST ESTIMATE

Project No. 86C8554P

By D. Hawk

Checked By Tom Kelley

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LEACHATE LAGOON CONSTRUCTION

• EXCAVATION

$$\text{QUANTITY} = 10,000 \text{ CY}$$

$$\text{UNIT PRICE} = \$2.64/\text{CY} \text{ (See Cost Item 2)}$$

$$\text{COST} = \$26,600.00$$

• CLAY LINER

$$\begin{aligned} \text{QUANTITY} &= 50,625 \text{ SF} \times 2 \text{ FT} \div 27 \frac{\text{CF}}{\text{CY}} \\ &= 3750 \text{ CY} \end{aligned}$$

$$\text{UNIT PRICE} = \$7.34/\text{CY} \text{ (See Cost Item 3 \& 5)}$$

$$\text{Item 3} = \$4.42/\text{CY}$$

$$\text{Item 5} = \$2.92/\text{CY}$$

$$\text{TOTAL} = \$7.34/\text{CY}$$

$$\text{COST} = 3750 \text{ CY} \times \$7.34/\text{CY} = \$27,525.00$$

• SYNTHETIC LINER (2 LAYERS)

$$\text{QUANTITY} = 2 \times 50,625 \text{ SF} = 101,250 \text{ SF}$$

$$\text{UNIT PRICE} = \$0.80/\text{SF} \text{ (See Cost Item 10)}$$

$$\text{COST} = 101,250 \text{ SF} \times \$0.80/\text{SF} = \$81,000.00$$

• DRAINAGE NET (1 LAYER)

$$\text{QUANTITY} = 50,625 \text{ SF}$$

$$\text{UNIT PRICE} = \$0.35/\text{SF} \text{ (See Cost Item 10)}$$

$$\text{COST} = 50,625 \text{ SF} \times \$0.35/\text{SF} = \$17,718.75$$

Subject BASIN F 60% Cost Estimate

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LIQUID REMOVAL SYSTEM (See Cost Item 12)

PUMPS AND APPURTENANCES

WATER	\$9663 ⁰⁰ ✓
CONCRETE SLABS	\$4393 ⁰⁰ ✓
GUARDRAILS	\$1645 ⁰⁰ ✓
AIR SUPPLY SYSTEM	19,822 ⁰⁰ ✓
PUMPS	<u>27,668⁰⁰✓</u>

TOTAL \$63,192⁰⁰✓

FORCE MAIN

LABOR	148,857✓
MATERIAL	148,748✓
EQUIPMENT	<u>1012</u>

TOTAL \$298,617⁰⁰✓

ELECTRICAL

BRANCH TO COMPRESSOR PAD	15,672✓
LIGHTING TO COMPRESSOR PAD	<u>2842</u>

TOTAL 18,514⁰⁰✓

O & M

600 HRS × \$137⁷⁶/HR = \$8256⁰⁰✓

Subject BASIN F 60% Cost Estimate

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CONTAMINATED MATERIAL REMOVAL

• REMOVE RIP RAP

$$\text{QUANTITY} = 25,000 \text{ CY} \times \frac{3}{4} = 18,750 \text{ CY}$$

$$\text{UNIT PRICE} = \$5.50/\text{CY} \text{ (see Cost Item 1)}$$

$$\text{Cost} = 18,750 \text{ CY} \times \$5.50/\text{CY} = \$103,125.00$$

• REMOVE SEWER AND MISCELLANEOUS DEBRIS

$$\begin{aligned} \text{QUANTITY} &= 12,000 \text{ CY} \times 1.25 = 15,000 \text{ CY} \\ &\text{(12,000 CY FROM CLOSURE PLAN, BASIN F} \\ &\text{ROCKY MOUNTAIN ARSENAL, EBASCO,} \\ &\text{DECEMBER, 1985 WITH 25\% CONTINGENCY)} \end{aligned}$$

$$\text{UNIT PRICE} = \$4.88/\text{CY} \text{ (see Cost Items 13 \& 14)}$$

$$\text{Cost Item 13} = \$4.08/\text{CY}$$

$$\text{Cost Item 14} = \$0.80/\text{CY}$$

$$\text{TOTAL} = \$4.88/\text{CY}$$

$$\text{Cost} = 15,000 \text{ CY} \times \$4.88/\text{CY} = \$73,200.00$$

• HAUL WASTE TO SOLIDIFICATION

$$\begin{aligned} \text{QUANTITY} &= 362,540 \text{ CY} - 25,000 \text{ CY} \\ &= 337,540 \text{ CY} \quad \text{RIP-RAP} \end{aligned}$$

$$\text{UNIT PRICE} = \$4.08/\text{CY} \text{ (see Cost Item 13)}$$

$$\begin{aligned} \text{Cost} &= 337,540 \text{ CY} \times \$4.08/\text{CY} \\ &= \$1,377,163.20 \end{aligned}$$



Subject BASIN F 60% COST ESTIMATE

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• HAUL WASTE TO WASTE PILE

QUANTITY = 337,540 CY ✓

UNIT PRICE = \$4³² (See Cost Items 14 & 15)

Item 14 = \$0⁸⁰/CY ✓

Item 15 = \$3⁵²/CY ✓

TOTAL = \$4³²/CY ✓

COST = 337,540 CY × \$4³²/CY = \$1,458,172⁸⁰ ✓

Subject BASIN F 60% Cost EstimateProject No. 86C8554PBy D. HawkChecked By T. KellyTask No. 2Date 7/10/87Date 7/13/87File No. 21947Sheet 1 of 1

SOLIDIFICATION (See Cost Item 16)

• FACILITIES CONSTRUCTION

WOOD WALL	\$9595 ⁰⁰ ✓
SITE WORK	\$19,511 ⁰⁰ ✓
CONCRETE SLAB	<u>413,238⁰⁰ ✓</u>

TOTAL \$442,344⁰⁰ ✓ *

• EQUIPMENT

FLY ASH TANKS	\$128,000 ⁰⁰ ✓
PUG MILLS	\$485,698 ⁰⁰ ✓
DUST CONTROL SYSTEM	\$22,560 ⁰⁰ ✓
AMMONIA SCRUBBER SYSTEM	<u>\$94,314⁰⁰ ✓</u>

TOTAL \$730,572⁰⁰ ✓ *

• ELECTRICAL

\$178,752⁰⁰ ✓ *

• ELECTRICAL POWER

\$71,400⁰⁰ ✓ *

• FLY ASH

\$1,148,000⁰⁰ ✓ *

• O & M

MANPOWER	\$459,202 ⁰⁰
EQUIPMENT	<u>\$738,364⁰⁰</u>

TOTAL \$1,197,566⁰⁰ ✓ *

• ADDITIONAL CHEMICALS

H ₂ SO ₄	3800 ⁰⁰
NaClO	360 ⁰⁰
NaOH	<u>510⁰⁰</u>

TOTAL \$4670⁰⁰ ✓ *

Subject BASIN F 60% COST ESTIMATE

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SITE IMPROVEMENTS

• ROADWAYS (LEVEL B)

$$\begin{aligned} \text{QUANTITY} &= 9000 \text{ FT} \times 25 \text{ FT} \times 0.5 \text{ FT} \div 27 \frac{\text{CF}}{\text{CY}} \quad \text{o.k.} \\ &= 4167 \text{ CY} \quad \checkmark \end{aligned}$$

$$\text{UNIT PRICE} = \$11.32/\text{CY} \quad (\text{See Cost Item 17})$$

$$\text{Cost} = 4167 \times \$11.32/\text{CY} = \$47,212.14 \quad \checkmark$$

• ROADWAYS (LEVEL D)

$$\begin{aligned} \text{QUANTITY} &= 5000 \text{ FT} \times 25 \text{ FT} \times 0.5 \text{ FT} \div 27 \frac{\text{CF}}{\text{CY}} \quad \text{o.k.} \\ &= 2315 \text{ CY} \quad \checkmark \end{aligned}$$

$$\text{UNIT PRICE} = \$9.89/\text{CY} \quad (\text{See Cost Item 18}) \quad \checkmark$$

$$\text{Cost} = 2315 \text{ CY} \times \$9.89/\text{CY} = \$22,895.35 \quad \checkmark$$

• SIGNING

$$\text{QUANTITY} = 50 \text{ signs (estimated)} \quad \checkmark$$

$$\text{UNIT PRICE} = \$200/\text{SIGN} \quad (\text{estimated}) \quad \text{o.k.}$$

$$\text{Cost} = 50 \times \$200/\text{SIGN} = \$10,000.00 \quad \checkmark$$

• FENCING

$$\text{QUANTITY} = 6000 \text{ LF (estimated)} \quad \text{o.k.}$$

$$\text{UNIT PRICE} = \$12.00/\text{LF}$$

(1987 MEANS 2.7-090-0600) o.k.

6' high aluminized steel w/ 3 bars = \$11.51/LF

SAY \$12.00/LF

$$\text{Cost} = 6000 \text{ LF} \times \$12.00/\text{LF} = \$72,000.00 \quad \checkmark$$



Subject BASIN F 60% COST ESTIMATE

Project No. 86CBSSYP

By D. Hawk

Checked By T. K. [Signature]

Task No. 2

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Date 7/17/87

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RUNOFF/DUST CONTROL

• PUMPING

QUANTITY = 5,000,000 gallons (estimated) ^{O.K.}

UNIT PRICE = \$0.01/gallon

FROM MEANS 1987 2.3-100-0800

8 hrs attended 2" diaphragm pump

Say averages 50 gpm @ 8 hrs/day

$$50 \text{ gal/min} \times \frac{60 \text{ min}}{\text{hr}} \times 8 \text{ hr} = 24,000 \frac{\text{gal}}{\text{day}}$$

$$\text{PRICE} = \$2.63/\text{DAY}$$

$$\begin{aligned} \text{UNIT PRICE} &= \$2.63/\text{DAY} \div 24,000 \text{ gal/day} \\ &= \$0.11/\text{GAL} \quad \text{O.K.} \end{aligned}$$

$$\text{COST} = 5,000,000 \text{ gal.} \times \$0.11/\text{gal} = \$550,000 \quad \checkmark$$

• DIKES

QUANTITY = 25,000 LF (ESTIMATED) ^{O.K.}

UNIT PRICE = \$1.00/LF (ESTIMATED) ^{O.K.}

$$\text{COST} = 25,000 \text{ LF} \times \$1.00/\text{LF} = \$25,000 \quad \checkmark$$

• DUST CONTROL

$$\text{COST} = \$50,000 \quad (\text{ESTIMATED}) \quad \text{O.K.}$$

Subject BASIN F 60% COST ESTIMATE

Project No. 86C8554P

By D. Hawk

Checked By Tom Kelly

Task No. 2

File No. 21947

Date 7/10/87

Date 7/13/87

Sheet 1 of 1

LEACHATE / BLOWDOWN LIQUID HANDLING

• TRANSPORT TO LAGOONS

QUANTITY = 1,500,000 gallons o.k.
(volume of pond)

UNIT PRICE = \$0¹⁰/gallon

(Use 4,000,000 gal ÷ 388,579⁰⁰ ✓
From LIQUID REMOVAL ITEM = \$0¹⁰/gallon

COST = 1,500,000 gal × \$0¹⁰/gal = \$150,000⁰⁰ ✓

Subject BASIN F 60% COST ESTIMATE

Project No. 86 C8554P

By D. HAWK

Checked By Tom Kelly

Task No. 2

File No. 21947

Date 7/10/87

Date 7/13/87

Sheet 1 of 1

EQUIPMENT DECONTAMINATION

- SOLIDIFICATION FACILITY

COST = \$25,000 (ESTIMATED)

O.K.

- LAGOONS

COST = 2 × 10,000⁰⁰ ea = \$20,000⁰⁰ (ESTIMATED)

O.K.

- PUMP STATION AND FORCE MAIN

COST = \$7,500⁰⁰ (ESTIMATED)

O.K.

- DECON AREA & MISCELLANEOUS

COST = \$7,500⁰⁰ (ESTIMATED)

O.K.



Subject BASIN F 60% COST ESTIMATE

Project No. 86C8554P

By D. Hawk

Checked By Tom Kelle

Task No. 2

File No. 21947

Date 7/10/87

Date 7/13/87

Sheet 1 of 2

BASIN CAPPING / TOPSOILING

• GRADE AND SHAPE

$$\text{QUANTITY} = 224,500 \text{ CY} \\ (256,750 - 32,250 \text{ (STAGE 1)})$$

$$\text{UNIT PRICE} = \$2.66/\text{CY} \text{ (see Cost Item 2)}$$

$$\text{Cost} = 224,500 \text{ CY} \times \$2.66/\text{CY} = \$597,170.00 \checkmark$$

• CLAY CAP (2 FT)

$$\text{QUANTITY} = 306,530 - 48,070 - 43,300 \text{ c.f.} \\ = 215,160 \text{ CY} \\ (\text{BASIN F PROPERZ - STAGE 1 CAP -} \\ \text{WASTE PILE CAP})$$

$$\text{UNIT PRICE} = \$6.87/\text{CY} \text{ (see Cost Items 3 \& 4)}$$

$$\text{Item 3} = \$4.42/\text{CY} \checkmark$$

$$\text{Item 4} = \$2.45/\text{CY} \checkmark$$

$$\text{TOTAL} = \$6.87/\text{CY} \checkmark$$

$$\text{Cost} = 215,160 \text{ CY} \times \$6.87/\text{CY} = \$1,478,149.20 \checkmark$$

• TOPSOIL

$$\text{QUANTITY} = 73,880 \text{ CY} \quad \text{o.k.}$$

$$\text{UNIT PRICE} = \$2.93/\text{CY} \text{ (see Cost Item 9)} \checkmark$$

$$\text{Cost} = 73,880 \text{ CY} \times \$2.93/\text{CY} = \$216,468.40 \checkmark$$



Subject BASIN F 60% COST ESTIMATE

Project No. 86 C8554P

By D. Hawk

Checked By Tom Kelly

Task No. 2

File No. 21947

Date 7/10/87

Date 7/13/87

Sheet 2 of 2

• SEEDING

$$\text{QUANTITY} = 510,000 \text{ SY} \quad \text{o.k.} \\ (105 \text{ Acre} \times 43,560 \div 9 = 508,200 \text{ SY})$$

$$\text{UNIT PRICE} = \$0.15 / \text{SY} \quad \text{o.k.} \\ (\$750 / \text{ACRE} \div 43,560 \times 9 = \$0.15 / \text{SY})$$

$$\text{Cost} = 510,000 \text{ SY} \times \$0.15 / \text{SY} = \$76,500$$

QUANTITIES



CHK by EWC

Project	RMA-Basin F - WWC	Computed	[Signature]	
Subject	Quantities - 7	Date	3/17/87	Sht. Of

1) Excavate For Wastepile & Solidification Area
 $810 \times 850 = 688,500 \text{ S.F.} \times 2.5' / 27 = 51,000 \text{ C.Y.}$
 $150 \times 300 = 45,000 \text{ S.F.} \times 2.5' / 27 = 3,333 \text{ C.Y.}$
 $\text{So. } 500' = 500' \times 1,000 \times 2 / 27 = 37,037 \text{ C.Y.}$
91,370 C.Y.

2) Wastepile Berm
 $2(755 + 805) = 3,120 \text{ L.F.}$
 $5 \times 20 + 5 \times 15 = 175 \text{ S.F.}$
 $(3,120)(175) / 27 = 20,222 \text{ C.Y.}$ SAY 20,200 CY
 slope yardage

3) Clay Blanket For Wastepile
 $(740 \times 790) 4' (110\%) / 27 = 95,268 \text{ C.Y.}$ SAY 95,200
 BOTTOM = $740 \times 790 \times 2 \text{ FT} / 27 = 43,300 \text{ CY}$
 TOP & SIDES = $95,270 \text{ CY} - 43,300 = 51,970 \text{ CY}$

4) Clay For Basin F Proper
 $[95A. (43,560) - (740 \times 790)] 2 / 27 = 306,530$
 ~~$243,330 \text{ C.Y.}$~~

5) Topsoil For Wastepile
 $(740 \times 790) 0.5' (120\%) / 27 = 12,991 \text{ C.Y.}$ SAY 13,000 C

6) Topsoil For Basin 'F' Proper
 $[105A. (43,560) - (740 \times 790)] 0.5' / 27 = 73,874 \text{ C.Y.}$

7) Excavate For Basin 'F' (Entire Site incl. Wastepile)
362,542 C.Y.

8) Grading For Basin 'F'
 $C = 256,744 \text{ C.Y.}$ SAY 256,750 CY
 $F = 271,208 - 20,222 = 255,986 \text{ C.Y.}$
 (w/ Berm)

9) Internal Grading (WASTE PILE)
 $(700' \times 750 \times 5/2) 27 = 48,611 \text{ C.Y.}$ SAY 48,600 CY

10) Select Fill (WASTE PILE)
 $(810 \times 800 \times 2 / 27) 110\% = 54,760 \text{ C.Y.}$

11) Stage One Berm Removal
 $1/4 \text{ Berm Vol. } (129,000) = 32,250 \text{ CY}$

229,743
 267,660

256,744
 271,208

ad 42

Project

Computed

Subject

Date

Sht.

Of

Berm = 85,600 C.Y.

Fill = 315,500 C.Y.

Cut (incl. Berm) = 156,000 C.Y.

Rip-Rap Qty.



Project <u>Basin F</u>	Computed <u>CAT</u>
Subject <u>Fluid Quantities</u>	Date <u>1/5/87</u> Sh. <u>1</u> Of <u>1</u>

North Pool

Area = 870,411 S.F.

Ave. Depth = 0.33 ft. (based on info in 23 Oct 86 letter of Holme Roberts & Owen)

Vol. = (870,411)(0.33)(7.481) = 2,149,303 gal.

Southwest Pool

Area = 116,510 - 193 = 116,317 S.F.

Ave. Depth = 0.23 ft. (based on 23 Oct 86 letter)

Vol. = 116,317(0.23)(7.481) = 200,139 gal.

Southeast Pool

Area = 139,741 S.F.

Ave. Depth = 0.45 ft. (based on 23 Oct 86 letter)

Vol. = 139,741(0.45)(7.481) = 470,431 gal.

2 S.E. Pools

Area = 7,451 + 5,814 = 13,265 S.F.

Ave. Depth = 0.1 ft. (assumed)

Vol. = 13,265(0.1)(7.481) = 9,923 gal.

Total Vol. = 2,829,796 gal. $\Rightarrow$ 2 10/25/86

Subject LINER QUANTITYProject No. 86CB554FBy D. HawkChecked By EWGTask No. 2File No. 21947Date 3/21/87

Date

Sheet 1 of 1LANDFILL

TOP AREA	$500 \times 550 = 275,000 \text{ SF} \times 1.02 = 280,500$
SIDE AREA	$143.7' \times 2720 \text{ LF} = 390,930 \text{ SF} \times 1.02 = 398,750$
BOTTOM AREA	$810 \times 860 = 695,600 \text{ SF} \times 1.02 = 709,512$

1,307,160 SFDRAINAGE NETS

1	BOTTOM	=	$627,910 \times 1$	=	627,910
2	TOPS	=	$2 \times 280,500$	=	561,000
2	SIDES	=	$2 \times 398,750$	=	797,500

1,986,410SYNTHETIC LINERS

1	BOTTOM	}	See above	1,307,160 SF
1	SIDE			
1	TOP			

GEOTEXTILE NETS

1	BOTTOM	}	SEE DRAINAGE NETS	1,986,410
2	TOPS			
2	SIDS			

Subject EXCAVATION FOR NORTH LAGOONProject No. 86C8554PBy D. HawkChecked By T. KillTask No. 2File No. 21947Date 7/8/87Date 7/11/87Sheet 1 of 1NORTH LAGOON. QUANTITY FOR EXCAVATIONFROM DESIGN DIMENSIONS 60%310' @ BOTTOM12' deep382' @ TOPVOLUME

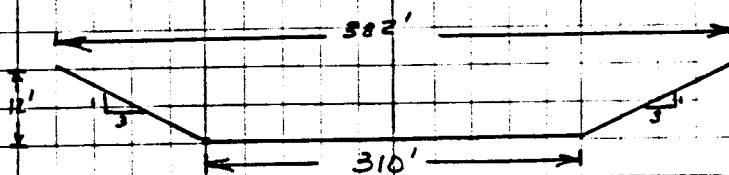
$$\left[\frac{310^2 + 382^2}{2} \right] \times 12' \div 27 \frac{\text{CF}}{\text{CY}} = 53,783 \text{ CY}$$

$$\left[\frac{310 + 382}{2} \right]^2 \times 12' \div 27 = 53,207 \text{ CY}$$

SAY 54,000 CY O.K.AREA

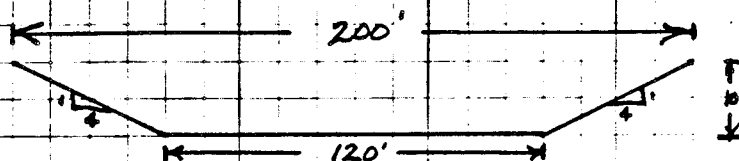
$$\text{BOTTOM LENGTH} = 2 \times \sqrt{12^2 + 36^2} + 310 = 385'$$

$$\text{AREA} = (385')^2 = 148,225 \text{ SF}$$

SAY 148,300 SF O.K.

Subject QUANTITIES FOR LEACHATE LAGOONProject No. 86CB554PBy D. HawkChecked By T. KellyTask No. 2File No. 21947Date 7/9/87Date 7/13/87Sheet 1 of 1

LEACHATE LAGOON (1.5 million gallons)



a) Area of Liner (Use 225' w/ Berms) G.K.

$$225' \times 225' = 50,625 \text{ SF}$$

b) Volume of excavation

$$\frac{(200 \text{ FT})^2 + (120 \text{ FT})^2}{2} \times 10 \text{ FT} \div 27 \frac{\text{CF}}{\text{CY}} = 10,074 \text{ CY}$$

9507 cy

SAY 10,000 CY O.K.



Project

Computed

Checked

Subject

Date

Shr.

Of

- 5) Area of Excavation Below El. 5188 (Clay Cap would be part of F:11) ≈ 60 A.

$$\text{Vol.} = 60 \times 43,560 \times 2 / 27 \approx 190,000 \text{ C.Y.}$$

- 6) Cover (Size Mat. for Topsoil)

$$\text{Area} \approx 110 \text{ A.}$$

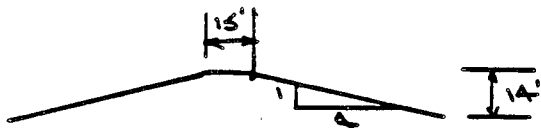
Assume 12" depth

$$\text{Vol.} = 110 (43,560) (1) / 27 = 177,500 \text{ C.Y.}$$

- 7) Wastepile Berm Qty

28' ht. pile (25' waste + 3' cover) ≈ 12 A. square

$$\text{Berm Length} = 723' + 7' = 730'$$



$$\text{Area} = 15 \times 14 + 14 (4 \times 14) = 994 \text{ S.F.}$$

$$\text{Vol./L.F.} = 994 / 27 = 36.8 \text{ C.Y.}$$

$$\text{Vol.} = 36.8 (4 \times 730) = 107,500 \text{ C.Y.}$$

- 8) Qty Waste lined Rip-Rap

$$393,300 \text{ C.Y.}$$

- 9) Clay Cap

$$93.5 \text{ A.} - 3.5 \text{ A.} - 12 \text{ A.} = 78 \text{ A.}$$

$$78 \times 2 \times 43,560 / 27 = 251,500 \text{ C.Y.}$$



Project

Computed

Chk by EWR

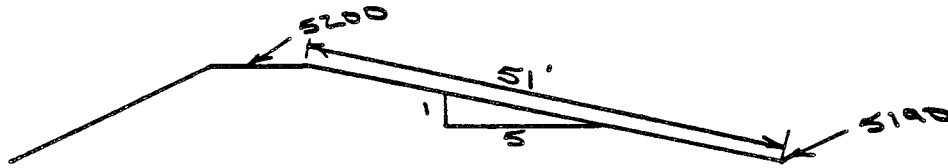
Subject

Date

1/27/87

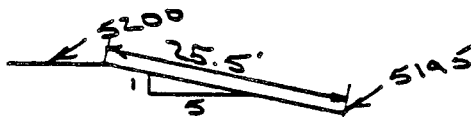
Sh.

Of

1) Rip Rap QtyAssume 8"-18" size $\Rightarrow$ 24" thickness

North Section
Beam $\Rightarrow$ 200' E. Duct

$$11.5' \times (187.71'/1') \times 2' \times 51' \times (1' / 27' \text{ CF}) = 8,155 \text{ C.Y.}$$



Basin F-1

$$19' \times (187.71'/1') \times 2' \times 25.5' \times (1' / 27') = 6,735 \text{ C.Y.}$$

$$7' \times (187.71'/1') \times 2' \times 9.5' \times (1' / 27') = 9,245 \text{ C.Y.}$$

East Side

Approx. Rip Rap Qty = 24,135 C.Y. based on 24" thickness
SAY 25,000 C.Y.

2) Beam Qty

From CADD

Vol. = 85,600 C.Y.

3) Fill Qty

From CADD

Vol. = 315,500 C.Y.

4) Cut (Incl. Beam)

From CADD

Vol. = 154,000 C.Y.

COST ITEMS

86C8554P (21947ts) (LJH)

- Rip Rap Removal Operation

Subject CONTAMINATED RIP RAP REMOVALProject No. B6C8554PBy D. HumeChecked By T. K.Task No. 4File No. 21947Date 1/23/87Date 1/16/87Sheet 1 of 1

RIP RAP REMOVAL UNIT RATES

1) DOZER 300 HP

DAILY RATE
\$898⁰⁰

2) FRONT END LOADER 225 CY

432⁰⁰3) 2 EQUIP OPERATOR @ 166⁰⁰332⁰⁰ASSUME 7 = 1240 LOADS/HR
= 100 CY

@ 8 HRS = 800 CY

4) 3 1240 END DUMPS @ 278⁰⁰834⁰⁰5) 3 TRUCK OPERATORS @ 135⁰⁰406⁰⁰2903⁰⁰/DAY

$$\$2900 / 800 \text{ CY} = \$3.60 / \text{CY}$$

$$\text{W/ SAFETY @ 50\%} = \$1.80 / \text{CY}$$

$$\text{TOTAL } \$5.40 / \text{CY} \quad \text{SAY } \$5.50 / \text{CY}$$

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 5-2-87	
For use of this form, see TM 5-800-2, the proponent agency is USACE.						
PROJECT RMA			PREPARED BY D. Hawk		CREW REF NO.	
LOCATION DENVER, CO			CHECKED BY Tom Kelley			
CREW COMPOSITION						
WORK TYPE EXCAVATION/HAULING		WORK SCHEDULE		SPECIAL INFORMATION RIP RAP REMOVAL HAUL TO STOCKPILE OR WASTE PILE		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT DBL DOZER	1	16 ⁸⁸	16 ⁸⁸	106 ³⁷	106 ³⁷	
CAT 906 D LOADER	1	16 ⁸⁸	16 ⁸⁸	61 ¹⁰	61 ¹⁰	
12 CY END DUMP TANDEM AXLE	3	16 ⁷⁸	50 ³⁴	37 ³⁰	111 ⁹⁰	
TOTALS	MANHOURS	5	LABOR COST	84 ¹⁰	EQUIPMENT COST 279 ³⁷	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
EXCAVATION/HAULING	98 CY/HR		\$0 ⁸⁶ /CY	\$2 ⁸⁵ /CY		
SAFETY			—	\$1 ⁹⁵ /CY		
TOTAL EQUIPMENT, LABOR & SAFETY				\$5 ⁶⁶ /CY	✓	
					USE \$5 ⁵⁰ /CY AS O.K.	
					IN PREL. ESTIMATE	

*Including fringe benefits
DA FORM 5418-R, Apr 85

(17A)

CREW AND PRODUCTIVITY WORKSHEET						DATE PREPARED
For use of this form, see TM 5-800-2; the procuring agency is USACE.						5/2/87
PROJECT RMA				PREPARED BY D. Hawk		CREW REF NO
LOCATION DENVER, CO				CHECKED BY T. Kelly		
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION RIP RAP REMOVAL HAUL TO STOCK PILE OR WASTE PILE		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	5	—	—	38 ²⁰	191 ⁰⁰	
TOTALS	MANHOURS	LABOR COST	—	EQUIPMENT COST	191 ⁰⁰	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
SAFETY	98 CY/HR		—	\$1.25/CY		

*Including fringe benefits

- **Sludge Handling**
- **Stage 1 Stockpiling**
- **Regrade Berms**
- **Waste Pile Internal Grading**
- **North Lagoon Excavation**
- **Grade and Shape Basin F**
- **Leachate Lagoon Excavation**
- **Topsoil Grading**

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 5-800-2. The predominant agency is USACE						
PROJECT RMA			PREPARED BY D. Hawk		CREW REF NO	
LOCATION DENVER, CO.			CHECKED BY T. Kelley 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/HAULING		WORK SCHEDULE		SPECIAL INFORMATION SLUDGE HANDLING STAGE 1 STOCKPILING		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 627 B SCRAPERS	6	17 ⁰³	102 ¹⁸	117 ²⁷	706 ⁶²	
CAT D8L DOZERS	4	16 ⁸⁸	67 ⁵²	106 ³⁷	425 ⁴⁸	
CAT 14G MOTOR GRADER	1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹	
CAT D6 DOZER	1	16 ⁸⁸	16 ⁸⁸	46 ⁴⁰	46 ⁴⁰	
MRS 1-1005 TRACTOR W/ DISC	1	16 ⁸⁸	16 ⁸⁹	83 ⁰⁹	83 ⁰⁹	
LABORERS	2	12 ⁷⁶	25 ⁵²	—	—	
CAT 627 B SCRAPERS (STANDBY)	1	—	—	75 ³⁷	75 ³⁷	
TOTALS	MANHOURS	15	LABOR COST	246 ⁰¹	EQUIPMENT COST 1412 ⁵⁷	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION/HAULING	870 CY/HR		*0 ²⁵ /CY	*1 ⁶² /CY		
SAFETY	870 CY/HR		*0 ¹⁵ /CY	*0 ⁵³ /CY		
TOTAL EQUIPMENT WITH LABOR & SAFETY				→ *2 ⁶⁶ /CY		

*Including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED	
For use of this form, see TM 5-800-2; the proponent agency is USACE.					3-18-87	
PROJECT RMA			PREPARED BY D. Hawk		CREW REF NO	
LOCATION DENVER, CO.			CHECKED BY T. Kelley 3-18-87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/Hauling		WORK SCHEDULE		SPECIAL INFORMATION SLUDGE HANDLING STAGE 1 STOCKPILING		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	13	—	—	38 ²⁰	496 ⁶⁰	
STANDBY HEAVY EQUIPMENT	1	—	—	4 ⁴⁵	4 ⁴⁵	
LABORERS	2	78 ⁰⁵	156 ¹⁰	—	—	
TOTALS	MANHOURS	LABOR COST	156 ¹⁰	EQUIPMENT COST	501 ⁰⁵	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
SAFETY	870 ^{cy/hr}		*0 ¹⁸ /cy	*0 ⁵⁸ /cy		

*Including fringe benefits

Subject LANDFILL CONSTRUCTION - SLUDGE REMOVAL COSTS

Project No. 86C8554P

By TEK

Checked By D. Hawk

Task No. 2

File No. 21947

Date 3/13/87

Date 3/18/87

Sheet 1 of 4

SLUDGE HANDLING : COSTS TO STOCKPILE

The work work will include excavating and hauling excavated material from the solidification area and the landfill area, outside the inner berm, to the sludge stockpile area inside the berm where it will be disc'd and allowed to drain and dry. ✓

Dozers will be used to excavate material down to the liner and push load scrapers. 2 additional dozers will be used to excavate the material below the liner down to the finished grade. The scrapers will be used to haul material to the sludge stockpile where a light dozer will assist in moving material and a tractor with disc attachment will be used for discing and aerating the material. A motor grader will be used to maintain haul roads to the stockpile and 2 laborers will be used as spotters. ✓

It was assumed that portions of the excavation area and sludge could have rolling resistances as high as 15% to 20%, whereas other parts of the haul would be on haul roads with very low rolling resistance. Thus, an average rolling resistance of 10% was assumed for the haul. ✓

Subject LAND FILL CONSTRUCTION - SLUDGE REMOVAL COSTS Project No. 86C8554P

By TKR

Checked By D. Hawk

Task No. 2

File No. 21947

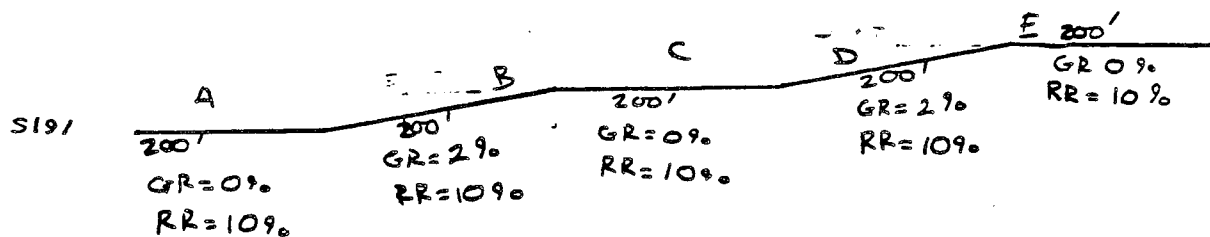
Date 3/13/87

Date 3/18/87

Sheet 2 of 4

ESTIMATED CYCLE TIMES

HAUL PROFILE (CAT 627B SCRAPER) FROM BOTTOM OF EXCAVATION TO TOP OF STOCK PILE



HAUL CYCLE	LENGTH	LOADED TR TIME		UNLOADED TR TIME	
A	200'	10%	0.31	10%	0.22
B	200'	12%	0.35	8%	0.19
C	200'	10%	0.31	10%	0.22
D	200'	12%	0.35	8%	0.19
E	200'	10%	0.31	10%	0.22

TOTAL TIME	1.63 ✓	1.04 ✓
@ 93% ALTITUDE DERATION	1.75 ✓	1.12 ✓

TOTAL ESTIMATED CYCLE TIME

HAUL	1.75 ✓
RETURN	1.12 ✓
LOAD	0.8 ✓ SELF LOAD OR
MANUEVERA DUMP	0.8 ✓ PUSH LOAD

4.47 min/cycle @ 100% eff. ✓

Subject LANDFILL-SLUDGE REMOVAL COSTS

Project No. 86C8554P

By T. KELLEY

Checked By D. Hawk

Task No. 2

File No. 21947

Date 3/13/87

Date

3/18/87

Sheet 3 of 4

ESTIMATED PRODUCTION:

1) ESTIMATED LOAD

(0.8 ASSUMED LOAD FACTOR)

$$18 \text{ cy} \times 0.8 \text{ LF} = 14.4 \text{ cy/LOAD} \checkmark$$

2) CYCLES PER HOUR

$$(60 \text{ min/hr.}) (1 \text{ cycle} / 4.47 \text{ min}) = 13.4 \text{ cycles/hr.} \checkmark$$

3) HOURLY UNIT PRODUCTION

$$(13.4 \text{ cycles/hr.}) \times 14.4 (\text{cy/cycle}) = 193 \text{ cy/hr.} \checkmark$$

4) NEED 1 SCRAPER EVERY 0.8 minutes

$$4.47 \text{ min} / 0.8 = 5.59 \checkmark$$

USE 6 scrapers $\checkmark$

5) CHECK PUSH DOZER BALANCE

$$\text{DOZER CYCLE } 1.4(0.8) + 0.25 = 1.37 \text{ minutes} \checkmark$$

$$\frac{\text{Scraper cycle}}{\text{dozer cycle}} = \frac{4.47}{1.37} = 3.26 \checkmark$$

so use 2 dozers to handle 6 scrapers. $\checkmark$

6) FLEET PRODUCTION EFFICIENCY @ 100% EFFICIENCY

$$6 \times 193 \text{ cy/hr.} = 1,158 \text{ cy/hr.} \checkmark$$

7) ADJUSTED PRODUCTION

(USE 45 min/hr. for level B)

$$1,158 \text{ cy/hr.} (45/60) = 870 \text{ cy/hr.} \checkmark$$

Subject LANDFILL CONSTRUCTION - SLUDGE REMOVAL COSTS Project No. 86C8554P

By TEK

Checked By D. Hawk

Task No. 2

File No. 21947

Date 3/13/87

Date 3/18/87

Sheet 4 of 4

EQUIPMENT AND FLEET COSTS

✓ 6	CAT 627 B SCRAPERS @	\$134 ⁸⁰	=	808 ⁸⁰	✓
✓ 3	CAT D-8L DOZERS @	123 ²⁵	=	493 ²⁰	✓
✓ 1	CAT 627 B scraper				
	(standby) @	75 ³⁷	=	75 ³⁷	✓
✓ 1	CAT 14G MOTOR GRADER @	92 ⁶⁴	=	92 ⁶⁴	✓
✓ 2	LABORERS	12 ⁷⁶	=	25 ⁵²	✓
✓ 1	TRACTOR WITH DISC ATTACHMENT			99 ⁹⁷	✓
✓ 1	CAT D-6 DOZER			63 ²⁸	✓
				<u>1658⁵⁸</u>	✓

COST +

$\$1,658⁵⁸ / HR \div 870^{CY} / hr. = \$1.91 / CY$ ✓

* Note: No safety considerations taken into account for this cost except 45/60 % efficiency.

- Haul Clay from Borrow to Stockpile

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED	
For use of this form, see TM 5-800-2, the proponent agency is USACE.					5/2/87	
PROJECT RMA			PREPARED BY D. Hawk		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY Tom Kelly			
CREW COMPOSITION						
WORK TYPE EXCAVATE / HAUL		WORK SCHEDULE		SPECIAL INFORMATION CLAY FROM BORROW TO STOCKPILE		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 245 BACKHOE	1	17 ⁰³	17 ⁰³	142 ⁰⁷	142 ⁰⁷	
CAT D8L DOZER	1	16 ⁸⁸	16 ⁸⁸	106 ³⁷	106 ³⁷	
CAT D6D DOZER	1	16 ⁸⁸	16 ⁸⁸	46 ⁴⁰	46 ⁴⁰	
MRS 1-100S TRACTOR w/ DISC	1	16 ⁸⁸	16 ⁸⁸	83 ⁰⁹	83 ⁰⁹	
10,000 GALLON WATER TANKER	1	17 ⁰⁹	17 ⁰⁹	119 ⁰²	119 ⁰²	
END DUMP 18 CY.	11	17 ⁰⁹	187 ⁹⁹	41 ¹⁸	452 ⁹⁸	
TOTALS	MANHOURS	16	LABOR COST	272 ⁷⁵	EQUIPMENT COST	949 ⁹³
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
EXCAVATE AND HAUL CLAY TO STOCKPILE	310 CY/HR		\$0 ⁸⁸ /CY	\$3 ⁰⁶ /CY	BASED ON QUANTITY ESTIMATED AFTER PLACEMENT	
STRIPPING				\$0 ⁴⁸ /CY		
TOTAL EXCAVATE, HAUL AND STRIP					\$4 ⁴² /CY	
* NOTE: INCLUDES SOME MOISTURE CONDITIONING AND ASSUMES 5 MILE HAUL (1-WAY)						

Subject EXCAVATED CLAY COST FOR LANDFILL

Project No. 3623554P

By D. HAWK

Checked By T. K

Task No. 2

File No. 21947

Date 2/13/87

Date 1.13.7

Sheet 1 of 9

FROM PRELIMINARY CONSTRUCTION COST ESTIMATES

GIVEN:

- ABOUT 360,000 CY ARE REQUIRED (COMPACTED)
- CLAY IN-PLACE @ 100% COMPACTION
 $\gamma_D = 113.3 \text{ pcf}$
 $M_c = 14\%$
- ASSUMED CLAY IN-SITU
 $\gamma_D = 96.3 \text{ pcf}$
- CLAY SWELL IN TRUCK = 25% VS COMPACTED
 $\gamma_D = 113.3 \div 1.25 = 90 \text{ pcf}$

THUS:

AMOUNT OF MATERIAL IN-SITU REQUIRED

$$360,000 \text{ CY} \times \frac{113.3 \text{ pcf}}{96.3} = 423,500 \text{ CY}$$

AREA ASSUMING CLAY IS 5' THICK AND 80% USEABLE

$$\frac{1}{.80} \times 423,500 \text{ CY} \times \frac{27 \text{ CF}}{\text{CY}} \times \frac{1}{5 \text{ FT}} \times \frac{\text{ACRE}}{43,560 \text{ FT}^2} = 65.6 \text{ ACRE}$$

FOR HAULAGE BY VOLUME

$$360,000 \times \frac{113.3}{90} = 453,200 \text{ CY}$$

Subject Clay borrow Cost Estimate

Project No. 86C8554P

By D. Hawk

Checked By T K

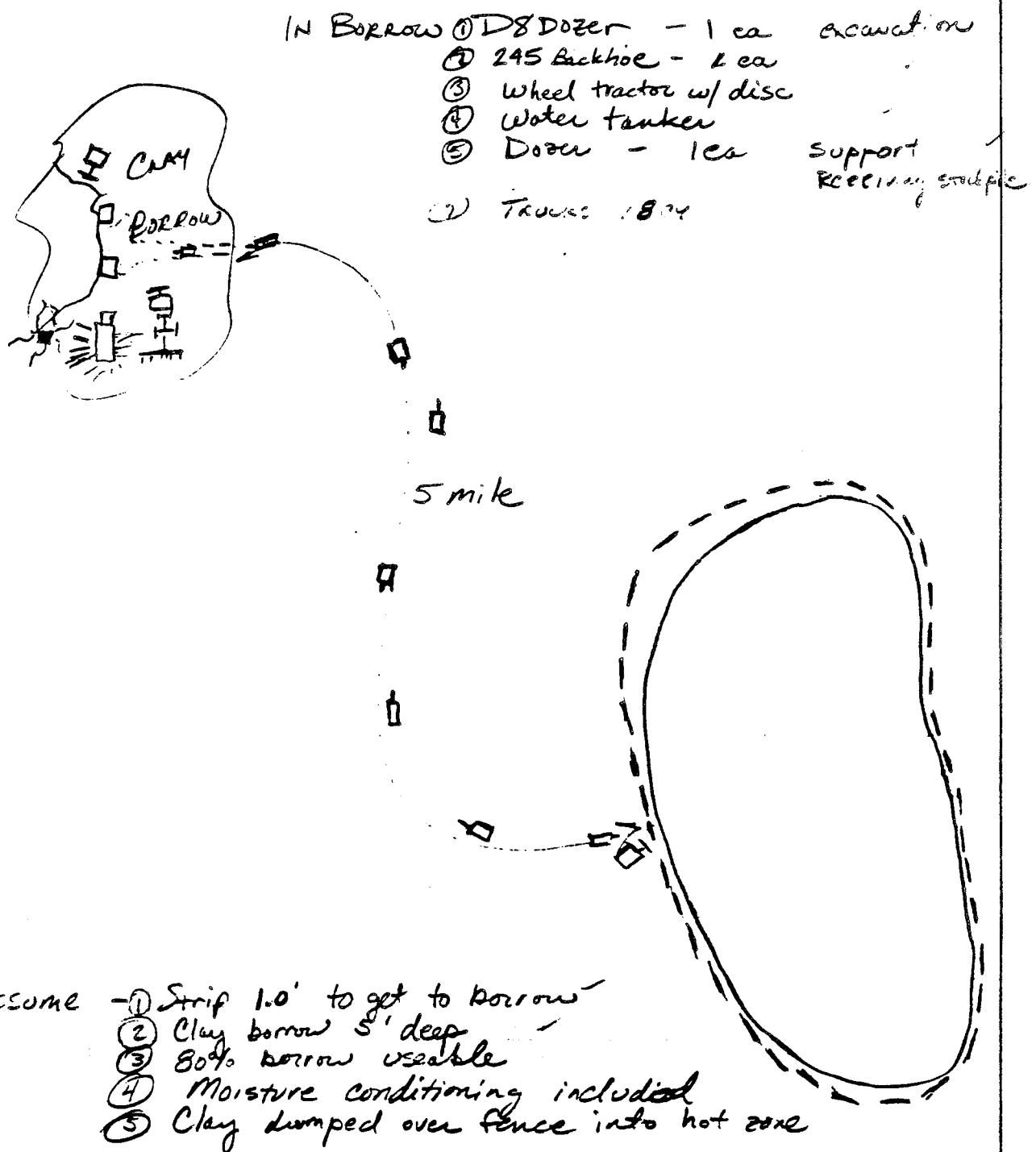
Task No. 2

File No. 21947

Date 2/13/87

Date 3/2/87

Sheet 2 of 9



Subject Clay borrow Cost EstimateProject No. 36C9554DBy D. HawkChecked By TETask No. 2File No. 21947Date 2/13/87Date 3/12/87Sheet 3 of 9EQUIPMENT

Truck: Use 6x4/6x2 Diesel Powered Trucks Rear Dump

TRUCK CAPACITY = 12-18 CY

HP = 375

MONTHLY RATE = \$4130⁰⁰OC/HR = \$18⁶⁰/HROPERATOR = \$17⁰⁹/HR

1984 ADJUSTMENT RATE = .901

Regional Adjustment = 1.05

SAH 173 HR/MONTH

$$\Rightarrow 1.05 \times .901 \times 4130^{00} \div 173 = \begin{array}{r} 22^{58} \\ 18^{60} \\ \hline 17^{09} \end{array} \begin{array}{l} \text{EQUIPMENT} \\ \text{OPERATING} \\ \text{OPERATOR} \end{array}$$

\$58²⁷/HR w/ OPER.

BACKHOE: Use CAT 245 HOE w/ 3.25 CY BUCKET 325 HP

MONTHLY RATE = \$19,695⁰⁰OC/HR = \$41³⁰/HROPERATOR = \$17⁰³/HR

1984 ADJUSTMENT RATE = .843

$$\Rightarrow 1.05 \times .843 \times 19,695^{00} \div 173 = \begin{array}{r} 100^{27} \\ 41^{30} \\ \hline 17^{03} \end{array} \begin{array}{l} \text{EQUIP} \\ \text{OPERATING} \\ \text{OPERATOR} \end{array}$$

\$159¹⁰/HR w/ OPER.CYCLE TIMEBACKHOE CYCLE TIME = 23 seconds with 3.25 CY BUCKET
FROM CAT PERFORMANCE HANDBOOK.

USE 23 SECOND CYCLE TIME WITH 3 CY BUCKET

 $\Rightarrow$ LOAD TIME FOR 18 CY STRUCK CAPACITY TRUCK

$$18 \text{ CY} / 3 \text{ CY} \times 23 \text{ SEC} = 138 \text{ SEC}$$

$$\frac{138 \text{ SEC}}{60 \text{ SEC/MIN}} = 2.3 \text{ MINUTES. LOAD TIME}$$

Subject Clay borrow Cost EstimateProject No. 86C8554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 2/13/87

Date

Sheet 4 of 9

TRUCK CYCLE 10 MILE HAUL (5 MILE 1-WAY)

TURN & POSITION	.5	MINUTES
LOAD	2.3	"
TRANSPORT LOAD	10.8	"
TURN & DUMP	1.0	"
TRANSPORT EMPTY	<u>7.1</u>	"

TOTAL CYCLE 21.7 minutes

ADD 1 min MISC. 2.0 minutes
 START/STOP TIME EACHWAY

23.7 minutes

LOADED .8 min 9.2 min .8 min
 0-30mph 30mph (net 27 mph w/ 1 min delay) 30-0 mph
 .2 mi 4.6 mi .2 mi

UNLOADED .5 min 6.1 min .5 min
 0-45mph 45mph (net 39 mph w/ 1 min delay) 45-0 mph
 .2 mi 4.6 mi .2 mi

USE 24 minute cycle time.

With 24 minute cycle time and 2.3 minute load time

$$24 \div 2.3 = 10.4$$

USE 11 trucks



Subject Clay borrow Cost EstimateProject No. 86C8554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 2/13/87

Date

Sheet 5 of 9

CALCULATE UNIT RATE / HOUR AND PRODUCTION RATE

PRODUCTION RATE BASED ON BACKHOE

$$\begin{aligned} & 3 \text{ CY} / 23 \text{ SEC} \times \frac{60 \text{ SEC}}{\text{MIN}} \times \frac{60 \text{ MIN}}{\text{HR}} \times \frac{50}{60} (\text{efficiency}) \\ & = 391 \frac{\text{CY}}{\text{HR}} (\text{LOOSE}) \end{aligned}$$

<u>COST</u>	1	BACKHOE	@	\$ 159 ¹⁰ /HR	=	\$ 159 ¹⁰
	11	TRUCKS	@	58 ²⁷ /HR	=	640 ⁹⁷
						\$ 800 ⁰⁷ /HR

UNIT RATE \$ 800⁰⁷/HR ÷ 391 CY/HR = \$ 2⁰⁵/CY LOOSE

CONVERT FROM LOOSE TO IN-PLACE AT LANDFILL

$$\begin{aligned} & \$ 2⁰⁵/CY \times \frac{113.3 \text{ PCF}}{90 \text{ PCF}} = \$ 2⁵³/CY (\text{COMPACTED}) \end{aligned}$$

$$\text{IN-PLACE PRODUCTION} = \frac{391 \times 90}{113.3} = 310 \frac{\text{CY}}{\text{HR}}$$

Subject Clay borrow Cost EstimateProject No. 3609554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 2/16/87

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Sheet 6 of 9

ADDITIONAL COSTS

- 1) STRIP 1.0 FT FROM TOP
- 2) SUPPORT DOZERS
- 3) MOISTURE CONDITIONING

1) COST OF STRIPPING

$$1.0 \text{ FT} \times 65.6 \text{ ACRE} \times \frac{43,560 \text{ SF}}{\text{ACRE}} \div 27 = 105,835 \text{ CY.}$$

FROM MEANS 2.3-164-0300

COMMON EARTH SCRAPER EXCAVATION
WITH 1500 FT. HAUL

$$\text{UNIT RATE} = \$1.89/\text{CY}$$

$$105,835 \times \$1.89/\text{CY} = \$200,000$$

$$\text{UNIT RATE} = 200,000/340,000 = \$0.59/\text{CY} \text{ SAY } \$0.43/\text{CY}$$

2) Add 2 dozers for production time (length-days)

$$24 \frac{\text{min}}{\text{cycle}} \times \frac{\text{cycle-truck}}{18 \text{ CY (loose)}} \times \frac{1}{11 \text{ Trucks}} \times 453,200 \text{ CY (loose)} \times \frac{60 \text{ min}}{50}$$

$$= 45,920 \text{ min} \times \frac{\text{HR}}{60 \text{ min}} \times \frac{2 \text{ AD}}{8 \text{ HR}}$$

$$= 137 \text{ work days}$$

FROM BLUE BOOK RENTAL FOR DSL (530 HP)

1984 ADJUSTMENT RATE

See Analysis ①

OPERATING COST

OPERATOR

$$= 73.47/\text{HR} \text{ EQUIP.}$$

$$= 32.70/\text{HR}$$

$$= \$1.05/\text{HR}$$

$$123.22/\text{HR} \times 3 \text{ HR} = \$4986.00/\text{DAY}$$

Subject Clay borrow Cost Estimate

Project No. 36C8554P

By D. Hawk

Checked By TEK

Task No. 2

File No. 21947

Date 2/14/87

Date

Sheet 7 of 9

DGD FOR SUPPORT 140 HP

1984 ADJUSTMENT .910

EQUIPMENT $-1.05 \times 5920^{00} \times .910 \div 173 = 32^{20}$

OPERATING COST $= 13^{20}$

OPERATOR $= 16^{20}$

$\$ 63^{28}/HR \text{ w/ OPER.}$

$\$ 63^{28}/HR \times 8 \text{ HR/DAY} = \$ 506^{24}/\text{DAY}$

FOR DGL & DGD COSTS

$\$ (986^{00} + 506^{24}) \times 137 \text{ DAYS} = \$ 204,000$

Subject Clay borrow Cost Estimate

Project No. 86C9554P

By D. Hawk

Checked By TEK

Task No. 2

File No. 271947

Date 2/16/87

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Sheet 8 of 9

3) PROCESS CLAY FOR MOISTURE CONTENT

USE 1 TRACTOR WITH DISC AND 1 WATER TRUCK

USE 10,000 gal water tanker, off-highway 330HP
1984 RATE ADJUSTMENT = .883

EQUIPMENT $.883 \times 15,575^{00} \times 1.05 \div 173 = 83^{47}$

OPERATING = 35^{55}

OPERATOR = 17^{09}

$\$136^{11}/HR$ w/ OPER

$137 \times 8 \times \$136^{11} = \$149,000$

ASSUME WATER PROVIDED ON-SITE
BY RMA

USE 1 wheel tractor w/ disc attachment

USE MRS 1-100S 310 HP WHEEL TRACTOR w/disc

1984 RATE ADJUSTMENT

EQUIPMENT $.877 \times 9405^{00} \div 173 \times 1.05 = 50^{06}$

OPERATING = 30^{35}

OPERATOR 16^{93}

DISC RENTAL $400^{00} \times .877 \times 1.05 \div 173 = 2^{13}$

OPERATING 0^{55}

$\$99^{97}/HR$ w/ OPER

$137 \text{ DAYS} \times 8 \text{ HRS/DAY} \times \$99^{97}/HR = \$110,000$

TOTAL = $\$110,000 + 149,000 = \$259,000$

Subject Clay borrow Cost Estimate

Project No. 86C855KP

By D. Hawk

Checked By TEK

Task No. 2

File No. 21947

Date 2/16/87

Date

Sheet 9 of 9

TOTAL COST TO EXCAVATE AND PROCESS CLAY

$\$22/cy \times 360,000$	=	$\$792,800$
ITEM 1	=	200,000
ITEM 2	=	204,000
ITEM 3	=	<u>259,000</u>
		$\$1,591,800$

UNIT RATE

$$\frac{\$1,591,800}{360,000} = \$4.42/cy$$

- Clay - Stockpile to Cap Basin F

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3/18/87	
For use of this form, see TM 8-800-2: the predecessor agency is USACE.						
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. HAWK 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION		WORK SCHEDULE		SPECIAL INFORMATION CLAY - STOCKPILE TO CAP BASIN F		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 627B SCRAPER	8	17 ⁰³	136 ²⁴	117 ⁷⁷	942 ¹⁶	
CAT D8L DOZER	3	16 ⁸⁸	50 ⁶⁴	106 ³⁷	319 ¹¹	
CAT 825C COMPACTOR	1	16 ⁸⁸	16 ⁸⁸	90 ⁵²	90 ⁵²	
10,000 gallon WATER TANKER	1	17 ⁰⁹	17 ⁰⁹	119 ⁰²	119 ⁰²	
CAT 14G MOTOR GRADER	1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹	
MRS 1-100S TRACTOR W/DISC	1	16 ⁸⁸	16 ⁸⁸	83 ⁰⁹	83 ⁰⁹	
LABORERS	3	12 ⁷⁶	38 ²⁸	—	—	
CAT 627B SCRAPERS (STANDBY)	2	—	—	75 ³⁷	150 ⁷⁴	
TOTALS	MANHOURS	18	LABOR COST	293 ⁰⁴ ✓	EQUIPMENT COST	1780 ²⁵ ✓
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION / PLACEMENT	1176 ccy/hr.		0.25 / ccy ✓	151 / ccy ✓		
SAFETY	1176 ccy/hr.		0.20 / ccy	049 / ccy		
TOTAL EQUIPMENT, LABOR, SAFETY					245 / ccy ✓	

*Including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 8-800-2; the procuring agency is USACE.						
PROJECT RMA				PREPARED BY T. KELLEY		CREW REF NO.
LOCATION DENVER, CO				CHECKED BY D. Hawk 3/18/87		
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION CLAY- STOCK PILE TO CAD BASIN F		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	15	—	—	38 ²⁰	573 ⁰⁰	
STANDBY EQUIPMENT	2	—	—	4 ⁴⁵	8 ⁹⁰	
LABORERS	3	78 ⁰⁵	234 ¹⁵	—	—	
TOTALS	MANHOURS	LABOR COST	234 ¹⁵ ✓	EQUIPMENT COST	581 ⁹⁰ ✓	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
SAFETY	1176 ^{ccy/hr.}		020 ^{ccy} ✓	042 ^{ccy} ✓		

*Including fringe benefits

⑨

Subject EARTHWORK COSTS - BASIN F CONSTRUCTION

Project No. 86C8554P

By D. Hawk

Checked By TCK

Task No. 2

File No. 21947

Date 3/10/87

Date 3/12/87

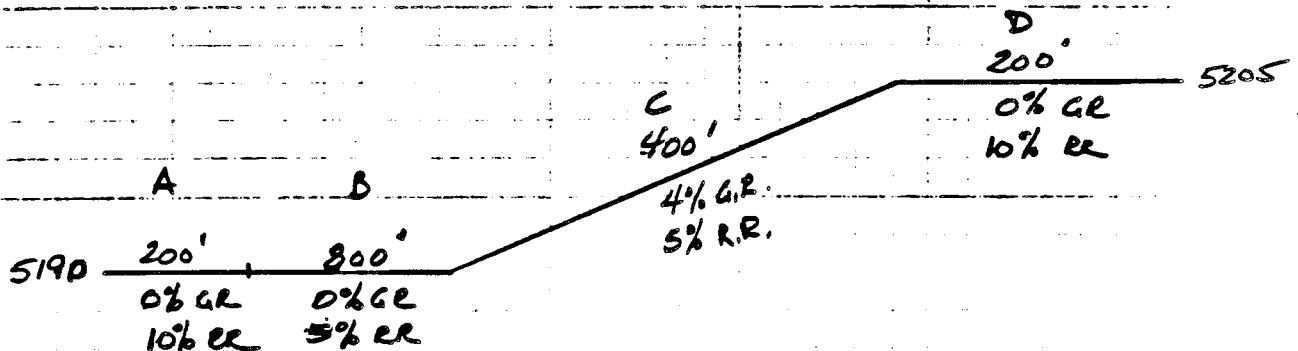
Sheet 1 of 4

PLACEMENT OF CLAY CAP FOR BASIN F

THE WORK INVOLVED WILL CONSIST OF HAULING CLAY FROM STOCKPILES WITHIN BASIN F TO THE BASIN F AREA FOR CAPPING. THIS WILL BE PERFORMED AS EXCAVATION PROGRESSES TO MINIMIZE AREA OF BASIN F EXPOSED FOR RUN OFF. TWO D9 DOZERS WILL BE USED FOR LOADING, SCRAPERS AND ANOTHER TO ASSIST IN SPREADING CLAY OVER BASIN BOTTOM. A CAT 144 MOTOR GRADER WILL BE USED FOR LEVELING AND SPREADING. THE MATERIAL WILL BE DISCED AND MOISTURE CONDITIONED DURING PLACEMENT AND COMPACTED WITH A CAT 925 C COMPACTOR. THREE LABORERS FOR SPITTING AND GRADE CHECKING WILL BE REQUIRED.

THE CLAY STOCKPILE AREA USED FOR LANDFILL CONSTRUCTION WILL BE USED FOR CLAY CAP OVER BASIN F.

ASSUME ALL OF THE WORK PERFORMED IN LEVEL B,

Subject EARTHWORK COSTS - BASIN F CONSTRUCTIONProject No. 86CB554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 3/10/87Date 3/12/87Sheet 2 of 4AVERAGE HAUL PROFILE - BASED ON EXCAVATION PLANESTIMATE CYCLE TIME (CAT 627B SCRAPPERS)

SECTION	LENGTH	LOADED		UNLOADED	
		TR	TIME	TR	TIME
A	200'	10%✓	.31	10%	.23✓
B	800'	5%✓	.65	5%	.50✓
(25 mph assumed) C	400'	-1% (✓)	.18	9%	.38✓
D	200'	10%✓	.31	10%	.23✓
			1.45 min!		1.34 min!
			w/ 93% Altitude Deration		1.44 min!

TOTAL CYCLE TIME

HAUL = 1.56 min
 RETURN = 1.44 min
 LOAD = .60 min
 MANEUVER & DUMP = .60 min
 ADDITIONAL MANEUVER = .26 min

4.40 min @ 100% EFF.✓

Subject EARTHWORK COSTS - BASIN F CONSTRUCTION Project No. 86C8554P
 By D. HAWK Checked By TLK Task No. 2
 Date 3/10/87 Date 3/12/87 File No. 21947
 Sheet 4 of 4

EQUIPMENT LIST AND COSTS

1)	8	CAT 627 B SCRAPERS	@	\$134 ²⁰	=	\$1078 ⁴⁰
2)	3	CAT DBL DOZERS	@	123 ²⁵	=	369 ⁷⁵
3)	1	CAT 825C COMPACTOR	@	107 ⁴⁰	=	107 ⁴⁰
4)	1	WATER TANKER (10,000 GALS)	@	136 ⁴¹	=	136 ⁴¹
5)	1	CAT 14 4 MOTOR GRADER	@	92 ⁶⁴	=	92 ⁶⁴
6)	1	TRACTOR w/ DISC ATTACHMENT	@	99 ⁹²	=	99 ⁹²
7)	2	CAT 627 B SCRAPERS (STANDBY)	@	75 ²⁷	=	150 ²⁷
8)	3	LABORERS	@	12 ²⁴	=	38 ²²

\$2073²⁹/HR ✓

UNIT COST OF CLAY PLACEMENT FOR BASIN F CAP

$$\$2073²⁹/HR \div 1176 \text{ CY/HR} = \$1,76/\text{CY} \text{ } \checkmark$$

* NOTE: THIS COST IS WITHOUT SAFETY CONSIDERATIONS EXCEPT PRODUCTION EFFICIENCY OF 45/60.

Subject EARTHWORK COSTS - BASIN F CONSTRUCTIONProject No. 86C8554PBy D. HawkChecked By TEKTask No. 2Date 3/10/87Date 3/12/87File No. 21947Sheet 3 of 4ESTIMATE PRODUCTION

1) ESTIMATED LOAD $18 \text{ LCY} \times \frac{0.8}{80} = 14.4 \frac{\text{CCY}}{\text{LOAD}} \checkmark$

2) CYCLES PER HOUR $\frac{60 \text{ min}}{\text{HR}} \div \frac{4.40 \text{ min}}{\text{CYCLE}} = 13.6 \frac{\text{CYCLE}}{\text{HR}} \checkmark$

3) HOURLY PRODUCTION RATE = $14.4 \frac{\text{CCY}}{\text{LOAD}} \times 13.6 \frac{\text{LOAD}}{\text{HR}} = 196 \frac{\text{CCY}}{\text{HR}} \checkmark$

4) NEED ONE SCRAPER EVERY 0.6 MINUTES
 $4.40 \text{ min} \div 0.6 \text{ minutes} = 7.3 \text{ scrapers. Use 8}$

5) CHECK PUSHER COMBINATION

PUSHER CYCLE TIME = $1.4(6) \times .25 = 1.09 \text{ min} \checkmark$

SCRAPER CYCLE TIME = 4.40 min

$\Rightarrow 4.40 / 1.09 = 4.0 \checkmark$

Each dozer can handle 4.0 scrapers $\checkmark$ OK

6) HOURLY FLEET PRODUCTION

$8 \text{ SCRAPERS} \times 196 \text{ CCY/HR} = 1568 \frac{\text{CCY}}{\text{HR}} \checkmark$

7) ADJUSTED PRODUCTION - (USE 45/60 EFFICIENCY TO ACCOUNT FOR LEVEL B PROTECTION) $\checkmark$

$45/60 \times 1568 \text{ CCY/HR} = 1176 \text{ CCY/HR} \checkmark$

8) CHECK COMPACTION BALANCE 1 CAT 825 C @ 6 mph w/6" lifts, 3 ft

PRODUCTION = 1444 CY/HR

ALTITUDE OPERATION = $.94$

EFFICIENCY = $45/60$

$1444 \times .94 \times 45/60 = 1018 \text{ CY/HR} < 1176 \text{ CCY/HR} \checkmark$

ASSUME ADDITIONAL COMPACTION FROM
SCRAPERS? WATER TANKER $\checkmark$ OR D.K.

COST ITEM 5

- Stockpiled Clay to Waste Pile Bottom Clay Liner
- Stockpiled Clay to Waste Pile Berms
- Stockpiled Clay to North Lagoon Liner
- Stockpiled Clay to Leachate Lagoon Liner

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED	
For use of this form, see TM 5-800-2 the proponent agency is USACE					3-18-87	
PROJECT RMA			PREPARED BY D. Hawk		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY T. Kelley 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION / PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION STOCKPILED CLAY TO LANDFILL CLAY LINER		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 627 B SCRAPERS	9	17 ⁰³	153 ²⁷	117 ⁷⁷	1059 ⁹³	
CAT DBL DOZERS	3	16 ⁸⁸	50 ⁶⁴	104 ³⁷	319 ¹¹	
CAT 825C COMPACTOR	1	16 ⁸⁸	16 ⁸⁸	90 ⁵²	90 ⁵²	
10,000 gallon WATER TANKER	1	17 ⁰⁹	17 ⁰⁹	119 ⁰²	119 ⁰²	
CAT 14 G MOTOR GRADER	1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹	
MRS 1-100S TRACTOR W/DISC	1	16 ⁸⁸	16 ⁸⁸	83 ⁰⁹	83 ⁰⁹	
LABORERS	3	12 ⁷⁶	38 ²⁸	—	—	
CAT 627 B SCRAPERS (STANDBY)	2	—	—	75 ³⁷	150 ⁷⁴	
TOTALS	MANHOURS	19	LABOR COST	510 ⁰⁷	EQUIPMENT COST	1898 ⁰²
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
EXCAVATION / PLACEMENT	1050 CY/HR		\$0 ³⁰ /CY	\$1 ⁸¹ /CY		
SAFETY	1050 CY/HR		\$0 ²² /CY	\$0 ⁵⁹ /CY		
TOTAL EQUIPMENT LABOR & SAFETY					→ \$2 ⁹² /CY	

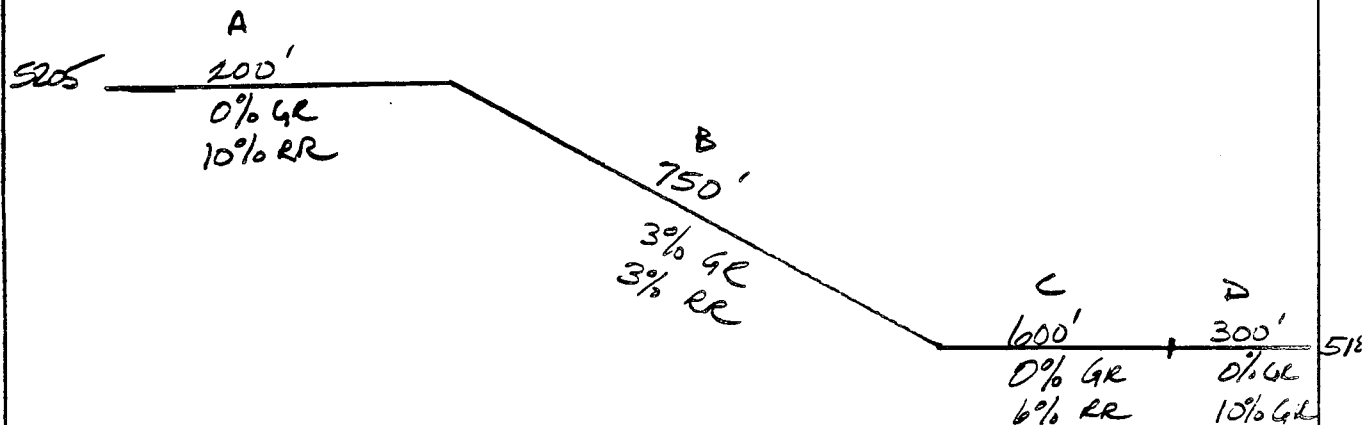
CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 5-800-2. the proponent agency is USACE.						
PROJECT RMA			PREPARED BY D. Hawk		CREW REF NO	
LOCATION DENVER, CO.			CHECKED BY T. Kelley 3/18/87			
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION STOCK PILED CLAY TO LANDFILL CLAY LINER		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	14			38 ²⁰	611 ²⁰	
STANDBY EQUIPMENT	2			4 ⁴⁵	8 ⁹⁰	
LABOR	3	78 ⁰⁵	234 ¹⁵			
TOTALS	MANHOURS		LABOR COST 234¹⁵	EQUIPMENT COST	620¹⁰	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
SAFETY	1050 CY/HR		10 ¹² /CY	10 ⁵⁹ /CY		

* Including fringe benefits

③

Subject LANDFILL CONSTRUCTION - EARTHWORK COST Project No. 86CE554P
 By D. Hawk Checked By T. F. Task No. 2
 Date 3/6/87 Date 3 1 87 File No. 21947
 Sheet 1 of 5

CLAY TO LANDFILL CLAY LINERS



ESTIMATED CYCLE TIMES

SECTION	LENGTH	LOADED		UNLOADED	
		TR	TIME	TR	TIME
A	200'	10%	.30	10%	.25
B	750'	0%	.45	6%	.50
C	600'	6%	.52	6%	.45
D	300'	10%	.41	10%	.32
	<u>1850'</u>		<u>1.68</u> ✓		<u>1.52</u> ✓

- 1) CAT 627B LOADED @ 1850' = 1.68
- 2) CAT 627B EMPTY @ 1850' = 1.52
- 3) LOAD TIME = .60
- 4) MANEUVER TIME = .60
- 5) ADDITIONAL MANEUVER (TIGHT STOCKPILE) = .20

4.60 min ✓

@ 93% efficiency (altitude adjustment) = 5.0 min

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTS Project No. 86C8554P
 By D. HAWK Checked By T. Task No. 2
 Date 3/6/87 Date 3/1/87 File No. 21947
 Sheet 2 of 5

Need one scraper every 0.6 minutes

$$5.0 \text{ min/cycle} \div 0.6 \text{ minutes} = 8.3 \text{ scrapers}$$

Use 2 D8L push CATS for nine scrapers Use 9 scrapers ✓

Check balance

BOOST TIME	=	0.1 min	=	.1
RETURN TIME	=	.4 x (.6)	=	.24
Maneuver	=	.15	=	.15
Load Time	=	.6	=	.6

1.09 min/cycle

Scraper Cycle = 5.0 min
 PUSH Cycle = 1.1 min

⇒ Each Push CAT can handle $\frac{5.0}{1.1} = 4.5 \text{ scrapers}$

⇒ 2 D8L PUSH CATS CAN HANDLE 9 SCRAPERS ✓

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTS Project No. 86C8554P
 By D. HAWK Checked By T. J. HAWK Task No. 2
 Date 3/4/87 Date 11-2-87 File No. 21947
 Sheet 3 of 5

PRODUCTION

WITH 9 SCRAPERS handling @ 18 LCY/LOAD

FROM GEOTECHNICAL INFORMATION

CLAY @ 100% COMPACTION ASTM-D-698 = 113.3 pcf
 Opt. MC = 14.6%

SAY 113 pcf @ 15% MC

LOAD FACTOR FOR CLAY = 0.8 ASSUMED

$\therefore 18 \text{ LCY} \times 0.8 = 14.4 \text{ CY/LOAD}$

SAY 14 CY/LOAD

CYCLE TIME = 5.0 minutes @ 100% efficiency

PRODUCTION = $\frac{60 \text{ min}}{\text{hr}} \div \frac{5 \text{ min}}{\text{cycle}} = 12 \frac{\text{cycles}}{\text{hr/unit}}$

UNIT PRODUCTION = $14 \frac{\text{CY}}{\text{cycle}} \times 12 \frac{\text{cycles}}{\text{hr}} = 168 \frac{\text{CY}}{\text{hr}}$

ADJUSTED PRODUCTION
 45 min. hour $168 \frac{\text{CY}}{\text{hr}} \times \frac{45 \text{ min}}{60 \text{ min}} = 126 \frac{\text{CY}}{\text{hr}}$

FLEET PRODUCTION (compacted) $8.3 \text{ UNITS} \times 126 \frac{\text{CY}}{\text{hr/unit}} = 1050 \frac{\text{CY}}{\text{hr}}$

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 8628554PBy D. HawkChecked By T. F.Task No. 2File No. 21947Date 5/7/87Date 11/1/87Sheet 4 of 5EQUIPMENT LIST

- 9 CAT 627B SCRAPERS
- 3 CAT D8L DOZERS
- 1 CAT 825C COMPACTOR w/ DOZER
- 1 DIESEL POWERED WATER TANKER (10,000 GALLONS)
- 1 CAT 14G MOTOR GRADER
- 2 CAT 627B SCRAPERS (STANDBY)
- 1 TRACTOR w/ DISC ATTACHMENT
- 3 LAZERS (SPOTTERS - GRADE CHECK)

NOTE: ALL EQUIPMENT COSTS DETERMINED PREVIOUSLY
FOR GENERAL FILL EXCEPT TRACTOR w/ DISC

TRACTOR w/ DISC ATTACHMENT:

USE MRS 1-100S 310 HP

$$\begin{array}{lcl}
 \text{EQUIPMENT} & \frac{9405^{00}}{\text{MO}} \times \frac{\text{MO}}{173(\text{HRS})} \times .877 \times 1.05 = & \$150^{00}/\text{HR} \\
 \text{OPERATING} & \frac{30^{35}}{\text{HR}} & = 30^{35}/\text{HR} \\
 \text{OPERATOR} & \frac{16^{88}}{\text{HR}} & = 16^{88}/\text{HR} \\
 & & \text{TOTAL } \$97^{23}/\text{HR}
 \end{array}$$

DISC ATTACHMENT (MEANS 1986)

$$\begin{array}{lcl}
 \text{EQUIPMENT} & \frac{400^{00}}{\text{MO}} \times \frac{\text{MO}}{173(\text{HRS})} \times .877 \times 1.05 = & 2^{13}/\text{HR} \\
 \text{OPERATING} & \frac{0^{55}}{\text{HR}} & = 0^{55}/\text{HR} \\
 \text{OPERATOR} & 0 & = 0 \\
 & & \text{TOTAL } 2^{63}/\text{HR}
 \end{array}$$

$$\text{TOTAL COST TRACTOR w/ DISC} = \$99^{27}/\text{HR}$$

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 803954PBy D. HawkChecked By T. P.Task No. 2File No. 21947Date 3/7/87Date 3/11/87Sheet 5 of 5CLAY LINER PLACEMENT COSTS / HOUR

9	SCRAPERS @	\$134 ⁸⁰	=	\$1213 ²⁰
3	DOZERS @	123 ²⁵	=	369 ⁷⁵
1	COMPACTOR @	107 ⁴⁰	=	107 ⁴⁰
1	WATER TANKER @	136 ¹¹	=	136 ¹¹
1	MOTOR GRADER @	92 ⁶⁴	=	92 ⁶⁴
3	LABOREE @	12 ²⁰	=	38 ²⁰
2	SCRAPERS STANDBY @	75 ²⁷	=	150 ²⁷
1	TRACTOR W/ DISC @	99 ²⁷	=	99 ²⁷

\$2208²⁷ / HRUNIT COST WITHOUT SAFETY

$$\$2208^{27} / \text{HR} \div 1050 \text{ CY} / \text{HR} = \boxed{\$2.10 / \text{CY}}$$

- Stockpiled Clay to Waste Pile Top and Side Clay Liner

Subject CLAY COVER PLACEMENTProject No. 86C8554PBy D. HawkChecked By TEKTask No. 2Date 3/20/87Date 7/13/87File No. 21947Sheet 1 of 1

CLAY COVER PLACEMENT FOR TOP AND SLOPES OF THE WASTEPILE

- 1) PLACEMENT MUST BE CAREFULLY PERFORMED BECAUSE IT IS ABOVE SYNTHETIC LINERS
- 2) PLACEMENT WILL BE SIMILAR TO SAND DRAIN PLACEMENT; HOWEVER, A COMPACTOR WILL BE REQUIRED AND MATERIAL COSTS WILL BE SIMILAR TO THAT FOR OTHER CLAY PLACED.

3) FOR CLAY COVER CREW

From Activity (6) (ATTACHED)

a) Labor	= 207 ⁰⁴
b) EQUIPMENT	= 625 ⁴⁰
c) SAFETY ON LABOR	= 234 ¹⁵
d) SAFETY ON EQUIPMENT	= 386 ⁴⁵

From SHEET (1) OF EQUIPMENT COSTS

FOR CAT 825 C COMPACTOR

a) Labor	= 16 ²⁸
b) EQUIPMENT	= 90 ⁵²
c) Safety on Labor	= —
d) Safety on Equipment	= 38 ²⁰

TOTAL COST = \$1598 ⁶⁴/HRPRODUCTION = 251 CY/HR
(FROM ACTIVITY (6))

4) COSTS

a) LABOR & EQUIPMENT = $1598 \frac{64}{251} = \$6 \frac{36}{CY}$ ✓b) MATERIALS = \$4 ⁴²/CY ✓
(FROM ACTIVITY (3)) (COST ITEM 3)TOTAL = 10 ⁷⁸/CY ✓

CREW AND PRODUCTIVITY WORKSHEET						DATE PREPARED
For use of this form, see TM 5-800-2; the procuring agency is USACE.						3-18-87
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION SUPPLY AND PLACE SAND DRAINS		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT OBL DOZER	1	16 ⁸⁸	16 ⁸⁸	106 ³⁷	106 ³⁷	
CAT 966D LOADER	1	16 ⁸⁸	16 ⁸⁸	61 ¹⁰	61 ¹⁰	
12 CUBIC YARD END DUMP TRUCK	4	16 ⁷⁸	67 ¹²	37 ³⁰	149 ²⁰	
CAT D6 DOZER	2	16 ⁸⁸	33 ⁷⁶	46 ⁴⁰	92 ⁸⁰	
CAT 14G MOTOR GRADER	1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹	
10,000 gallon WATER TANKER	1	17 ⁰²	17 ⁰²	119 ⁰²	119 ⁰²	
LABORERS	3	12 ⁷⁶	38 ²⁸	—	—	
END DUMP TRUCK (STANDBY)	1	—	—	21 ³⁰	21 ³⁰	
TOTALS	MANHOURS	13	LABOR COST	207 ⁰⁴ ✓	EQUIPMENT COST	625 ⁴⁰ ✓
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION/ PLACEMENT	251 CY/HR		\$0 ⁸² /CY ✓	\$249/CY ✓		
SAFETY	251 CY/HR		\$0 ⁹³ /CY ✓	\$154/CY ✓		
MATERIALS DELIVERED TO STOCK PILE				\$10 ²⁰ /CY ✓		
TOTAL EQUIPMENT, MATERIALS, LABOR, SAFETY				\$15 ⁹⁸ /CY ✓		

*Including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 8-800-2; the procuring agency is USACE.						
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO.	
LOCATION DENVER, CO			CHECKED BY D. HAWK 3/18/87			
CREW COMPOSITION						
WORK TYPE SAFETY / IF NOT		WORK SCHEDULE		SPECIAL INFORMATION SUPPLY AND PLACE SAND DRAINS		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	10	—	—	38 ²⁰	382 ⁰⁰	
STANDBY HEAVY EQUIPMENT	1	—	—	4 ⁴⁵	4 ⁴⁵	
LABORERS	3	78 ⁰⁵	234 ¹⁵	—	—	
TOTALS	MANHOURS	LABOR COST	234 ¹⁵	EQUIPMENT COST	386 ⁴⁵	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
SAFETY	251 CY/HR		\$0.93 / 1.14	\$1.54 / 1.14		

* Including fringe benefits

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 86CB554FBy D. HawkChecked By Task No. 2File No. 81947Date 3/7/87Date Sheet 1 of 6PLACEMENT OF SAND DRAIN SYSTEMS

THE WASHED SAND REQUIRED WILL BE OBTAINED FROM OFF-SITE. THE MATERIALS WILL BE DELIVERED BY THE SUPPLIER TO THE LEVEL B LINE AND DUMPED FROM A RAMP ACROSS TO A SPECIFIED STOCKPILE AREA. THE STOCKPILE AREA WILL BE PREPARED USING CLEAN GENERAL FILL. IT IS ASSUMED THAT 10% OF THE WASHED SAND WILL BE WASTED BECAUSE IT WILL BECOME MIXED WITH FINES IN THE STOCKPILE (PRIMARILY AT THE STOCKPILE BASE)

A DOZER WILL BE REQUIRED TO WORK THE STOCKPILE SO THAT CONTINUAL DRAINING MAY OCCUR. ONCE IN THE BASIN, THE SAND WILL BE LOADED WITH FRONT-END LOADERS INTO TRUCKS AND CARRIED TO THE LANDFILL WHERE IT WILL BE DUMPED AND THEN SPREAD USING DOZERS AND MOTOR GRADERS. COMPACTION WILL BE PERFORMED BY SEVERAL PASSES WITH A TRACKED DOZER AND MOISTURE ADDED WITH A WATER TRUCK. SEVERAL SPOTTERS WILL BE REQUIRED IN THIS OPERATION TO POSITION TRUCKS AND CHECK GRADES.

LIGHT TRUCKS SUCH AS TEN-TWELVE CUBIC YARD TANDEM'S WILL BE USED FOR HAULING SAND IN BASIN F BECAUSE THEY WILL BE RUNNING OVER LINER WITH ONLY 1-FOOT OF COVER. POSSIBLY MAY BUILD HAUL ROADS OF GENERAL FILL OUT OVER SAND DRAINAGE BLANKET TO ALLOW TRUCKS TO GET CLOSE TO DUMPING POINT WITHOUT DAMAGING LINER. HAUL ROAD WOULD PROBABLY BE 1 TO 2 FEET OF GENERAL FILL OVER 1 FOOT DRAIN SAND.

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 86CB554PBy D. HawkChecked By T. HawkTask No. 2File No. 21947Date 3/7/87Date 3/1/87Sheet 2 of 6COST OF SAND DRAIN MATERIAL FROM SUPPLIER

ATTACHED ARE PRICE QUOTES FROM SUPPLIERS FOR
WASHED SAND DELIVERED TO RMA
FILTER MATERIAL CDOH CLASS A, B OR C, PROBABLY ADEQUATE
PAGE 701 CDOH SPECS 1981

COST OF MATERIALS (DELIVERED)

SUPPLIER	HAUL	TYPE	COST MATERIAL	COST Haul
MOBILE PREMIX (THORNTON)	—	B	\$8/TON	—
	5 mi	C	\$4/TON	\$1.95/TON
	5 mi	GRAVEL 1 1/2"	\$7.50/TON	\$1.18/TON
	15 mi	ROAD BASE 3/4"	\$3.25/TON	\$5.25/TON
ALBERT FLETCHER & SONS (HENDERSON)	5 mi	B	\$4.25/TON	
	5 mi	C	4.25/TON	
	5 mi	ROAD BED 1	6.25/TON	
BEINKMAN WOODWARD CONSTRUCTION (HENDERSON)	5 mi	FILTER SAND	\$4.25/TON	
	5 mi	ROAD BASE	5.25/TON	

FROM QUOTED INFORMATION ASSUME MATERIAL AT
PLANT WILL COST \$4.00/TON

DELIVERY WILL PROBABLY BE FROM WITHIN 6 MILE
RADIUS OF RMA AND ASSUME 4 MILE ON-SITE
HAUL.

DELIVERY WILL BE ABOUT 10 MILES @
ABOUT \$0.20/TON-MILE

$$\therefore \$4.00/\text{TON} + 10 \text{ MILES} \times \$0.20/\text{TON-MILE} = \$6.00/\text{TON}$$

USE 3400 lb/cy IN-PLACE

$$\$6.00/\text{TON} \times \text{TON}/2000 \times 3400/\text{CY} = \$10.20/\text{CY}$$

Subject LANDELL CONSTRUCTION - EARTHWORK COSTSProject No. 86C8554PBy D. HawkChecked By TEKTask No. 2Date 3/7/87Date 3/11/87File No. 21947Sheet 3 of 6

A CAT 946C* LOADER WITH 4 CY BUCKET WILL BE USED TO LOAD TRUCKS @ 100% EFF $4 \times 50/60 = 3.33 \text{ CY/LOAD}$
O.K.

Cycle time for loader = 0.40 minutes / 38 CY
TRUCKS ARE 12 CY TANDUM AXLS. END DUMPS
USE 0.2 minutes for first load; .4 minutes thereafter
 $\Rightarrow 0.2 + 2 \times 0.40 \text{ minutes} = 1.0 \text{ min/load (4 CY)}$
* 946C has no deration factor for altitude @ 5000' R.
TRUCK cycle time for short haul ~ 2000 LF
ONE WAY WILL BE ABOUT THE SAME AS
SCRAPERS (13 mph) ✓

ADDITIONAL HAUL LENGTH WILL BE REQUIRED FOR TRUCKS AS THEY WILL HAVE TO STAY ON DESIGNATED HAUL ROADS IN LANDELL TO AVOID DAMAGE TO HDPE LINER.

$\Rightarrow$ ADD 300' TO AVERAGE HAUL FROM STOCKPILE TO LANDELL WHICH WAS 1700' FOR SCRAPERS

$\Rightarrow$ AVG. HAUL FOR TRUCKS = 2000' ✓

DUE TO GRADES INVOLVED AND SHORT HAUL RESTRICTIONS, RETURN TRIP IS JUST SLIGHTLY FASTER THAN LOADED TRIP - SAY 16 mph AVG.

LOADED HAUL = $2000' \times 1 \text{ hr} / 13 \text{ mi} \times \text{mi} / 5280 \text{ ft} \times 60 \text{ min} / \text{hr} = 1.75$

EMPTY = $2000' \times 1 \text{ hr} / 16 \text{ mi} \times \text{mi} / 5280 \text{ ft} \times 60 \text{ min} / \text{hr} = 1.42$

EXCHANGE TIME	0.50
LOAD	1.00
HAUL LOADED	1.75
MANEUVER & DUMP	.70
RETURN	1.42
	<u>5.37 min</u>
	SAY 5.4 min ✓

EXCHANGE AND LOAD = 1.5 min and with 5.4 min/cycle

WE NEED $5.4 / 1.5 = 3.6$ USE 4 TRUCKS ✓

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 86 C8554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 3/7/87Date 3/11/87Sheet 4 of 6ESTIMATE PRODUCTION

AVG. HAUL = 10 CY LOOSE ✓

LOAD FACTOR SAND = .9 ✓

∴ 10 CY HAULETS = 10(.9) = 9 CY IN-PLACE ✓

UNIT PRODUCTION @ 100% EFFICIENCY

$$1 \text{ load} / 5.8 \text{ min} \times 9 \frac{\text{CY}}{\text{LOAD}} \times \frac{60 \text{ min}}{\text{HR}} = 93 \text{ CY} / \text{HR} \text{ - UNIT} \checkmark$$

We actually have only 3.6 units hauling in cycle effectively ✓

$$\Rightarrow \text{PRODUCTION} = 3.6 \times 93 \text{ CY} / \text{HR} = 335 \text{ CY} / \text{HR} \checkmark$$

$$\Rightarrow \text{PRODUCTION w/ INEFFICIENCY} = 45/60 \times 335 = 251 \text{ CY} / \text{HR} \checkmark$$

EQUIPMENT LIST

- 1 CAT 08L TO WORK STOCKPILE ✓
- 1 CAT 944 D TO LOAD @ STOCKPILE ✓
- 4 12 CY TANDEM AXLE END DUMPS ✓
- 2 CAT D4 DOZERS TO SPREAD ✓
- 1 CAT 144 MOTOR GRADER TO LEVEL ✓
- 1 10,000 GALLON WATER TANKER FOR MOISTURE ✓
- 1 STANDBY TANDEM AXLE END DUMP ✓
- 3 LABORS (SPOTTERS & LEAD CHECKERS) ✓



Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 3623554FBy D. HawkChecked By T *Task No. 2File No. 21947Date 3/8/87Date 11/1/87Sheet 5 of 6EQUIPMENT & LABOR COSTS1) *CAT DBL = \$123.²⁵/HR

2) CAT 966 D LOADER (200 HP)
 EQUIPMENT $7490^{\text{00}}/\text{MO} \times \frac{\text{MO}}{173 \text{ HRS}} \times .891 \times 1.05 = 40^{\text{50}}/\text{HR}$
 OPERATING = $20^{\text{00}}/\text{HR} = 20^{\text{00}}/\text{HR}$
 OPERATOR = $16^{\text{88}} = 16^{\text{88}}/\text{HR}$

TOTAL = 77.⁹⁸/HR

3) TANDEM AXLE END DUMP P4 20-8 6x4 w/ RISE AXLE (300 HP)
 EQUIPMENT $3945^{\text{00}}/\text{MO} \times \frac{\text{MO}}{173 \text{ HRS}} \times .901 \times 1.05 = 21^{\text{30}}/\text{HR}$
 OPERATING = $16^{\text{00}}/\text{HR} = 16^{\text{00}}/\text{HR}$
 OPERATOR = $16^{\text{78}} = 16^{\text{78}}/\text{HR}$

TOTAL = 54.⁰⁸/HR

4) CAT D6 DOZERS (140 HP)
 EQUIPMENT $5920^{\text{00}}/\text{MO} \times \frac{\text{MO}}{173 \text{ HRS}} \times .910 \times 1.05 = 32^{\text{70}}/\text{HR}$
 OPERATING = $13^{\text{70}}/\text{HR} = 13^{\text{70}}/\text{HR}$
 OPERATOR = $16^{\text{88}} = 16^{\text{88}}/\text{HR}$

TOTAL = \$63.²⁸/HR5) *CAT 14G MOTOR GRADER = \$92.⁰⁴/HR6) *WATER TANKER (10,000 GALLON CAPACITY) 450HP = \$136.¹¹/HR7) STANDBY TANDEM AXLE END DUMP = \$21.³⁰/HR8) LABORERS (GROUP 1) = \$12.⁷⁶/HR

* NOTE - COSTS GENERATED IN GENERAL FILL COST CALCULATIONS

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTS

Project No. 86C8554 P

By D. Hawk

Checked By TEK

Task No. 2

File No. 21947

Date 3/8/87

Date 3/11/87

Sheet 6 of 6

Total Equipment Costs

1	D8L DOZER	@	*123 ²⁵ /HR	=	*123 ²⁵
1	CAT 964D Loader	@	77 ¹¹ /HR	=	77 ¹⁸
4	END DUMPS	@	54 ⁰⁰ /HR	=	216 ²²
2	CAT D6 DOZERS	@	63 ²⁸ /HR	=	126 ⁵⁶
1	CAT 14G GRADER	@	92 ⁶⁴ /HR	=	92 ⁶⁴
1	WATER TANKER	@	136 ¹¹ /HR	=	136 ¹¹
1	STANDBY END DUMP	@	21 ²⁰ /HR	=	21 ²⁰
3	LABORERS	@	12 ²⁵ /HR	=	38 ²⁸

TOTAL = \$ 832⁴⁴ / hr

COST TO DELIVER SAND, HAUL TO LANDFILL FROM STOCKPILE,
SPREAD & PLACE

① MATERIAL DELIVERED TO STOCKPILE = \$1020/cy

② HAUL & PLACE
(SPREAD 16" TO LANDFILL) $= 832 \frac{44}{\text{HR}} \times \frac{\text{HR}}{25 \text{ CY}} = 332 \frac{32}{\text{CY}}$

TOTAL = 1/3 ⁵²/cy

NOTE: THIS COST IS WITHOUT SAFETY CONSIDERATIONS FOR ITEM 2, EXCEPT FOR PRODUCTION EFFICIENCY OF 45%.

- Waste Pile Select Fill

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED	
For use of this form, see TM 5-800-2: the predecessor agency is USACE.					3-18-87	
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/19/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION GENERAL FILL - BORROW TO STOCKPILE		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 966D LOADERS	2	16 ⁸⁸	33 ⁷⁶	61 ¹⁰	122 ²⁰	
CAT DBL DOZERS	3	16 ⁸⁸	50 ⁶⁴	106 ³⁷	319 ¹¹	
18 CUBIC YARD END DUMP TRUCK	5	17 ⁰⁹	85 ⁴⁵	41 ¹⁸	205 ⁹⁰	
LABORERS	3	12 ⁷⁶	38 ²⁸	—	—	
18 CUBIC YARD END DUMP (STANDBY)	1	—	—	22 ⁵⁸	22 ⁵⁸	
TOTALS	MANHOURS	13	LABOR COST	208 ¹³ ✓	EQUIPMENT COST	669 ²⁸ ✓
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION/ PLACEMENT	548 ^{CCY} /HR		0 ³⁸ /CY ✓	1 ²² /CY ✓		
SAFETY	548 ^{CCY} /HR		—	0 ²¹ /CY ✓		
TOTAL EQUIPMENT, LABOR, SAFETY				1 ⁸¹ /CY ✓		

*including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED	
For use of this form, see TM 8-500-2: the procuring agency is USACE.					3-18-87	
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. HAWK 3/18/87			
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION GENERAL FILL - BORROW TO STOCKPILE		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT (LEVEL D)	8	—	—	4 ⁴⁵	35 ⁶⁰	
* HEAVY EQUIPMENT (LEVEL B)	2	—	—	38 ²⁰	76 ⁴⁰	
HEAVY EQUIPMENT (STANDBY)	1	—	—	4 ⁴⁵	4 ⁴⁵	
* 2 CAT DBL DOZERS IN LEVEL B CONDITIONS, ALL OTHER						
HEAVY EQUIPMENT IN LEVEL D.						
TOTALS	MANHOURS		LABOR COST	—	EQUIPMENT COST 116 ⁴⁵ ✓	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	S/UNIT			
SAFETY	548 CCY/HR		—	* 0 ²¹ /CH ✓		

* including fringe benefits

(10)

Subject EARTHWORK COSTS - LANDFILL CONSTRUCTION Project No. 86C8554P

By D. Hawk

Checked By TEK

Task No. 2

File No. 21947

Date 3/11/87

Date 3/12/87

Sheet 1 of 4

GENERAL FILL - BORROW TO STOCKPILE

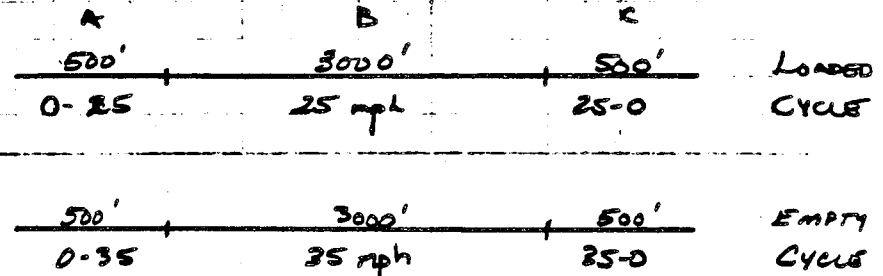
The work involved in this cost will consist of excavating general fill from nearby stockpile area (assume $3/4$ mile distance) and dumping the material in a stockpile just inside the level B zone. Because of the transfer of material across the Zone B fence line it is assumed that end dumps would be more practical as scrapers or bottom dumps would have difficulty with this maneuver without crossing the boundary.

Several ramps will be constructed up to the fence line (zone barrier) and haul roads constructed such that the end dumps may turn and dump efficiently. Two dozers will be required to remove material from the ramp areas and spread it to other parts of the stockpile. Two CAT 966 D loaders with the assistance of a D8L dozer will load trucks in the borrow area. No moisture conditioning will be performed at this time. All work outside of the level B zone will be performed at level D. Three spotters will be required in Level D zone.

Assume stripping costs will be considered elsewhere. (See Topsoil)

Subject EARTHWORK COSTS - LANDFILL CONSTRUCTION Project No. 86 C8554P
 By D. Hawk Checked By T. K Task No. 2
 Date 3/11/87 Date 3/18/87 File No. 21947
 Sheet 2 of 4

HAUL CYCLE (3/4 mile one-way) Use 4000' TRUCKS ARE TANDUM AXLE 18 CY CAPACITY



SECTION	LENGTH	AVG. SPEED		TRAVEL TIME	
		LOADED	UNLOADED	LOADED	UNLOADED
A	500'	12.5 ✓	17.5 ✓	.45 ✓	.32 ✓
B	3000'	25 ✓	35 ✓	1.36 ✓	.97 ✓
C	500'	12.5 ✓	17.5 ✓	.45 ✓	.32 ✓
				2.26 min ✓	1.61 min ✓

EXAMPLE CALCULATION:

$$500 \text{ ft} \times \frac{1 \text{ hr}}{125 \text{ mi}} \times \frac{1 \text{ mi}}{5280 \text{ ft}} \times \frac{60 \text{ min}}{1 \text{ hr}} = .45 \text{ min}$$

LOAD CYCLE USE 2 CAT 966D IN COMBINATION WITH 1 DPL CAT 966D USES 4 CY BUCKET
 * DOZER PRODUCTION = 100 CY @ 50 ft. DB w/3 down
 * No Loader Deration Factor for altitude @ 5000'
 Use .2 min first pass + .4 min for additional passes

For 4 CY BUCKET @ .9 Load factor = 3.6 CY/LOAD

18 CY / 3.6 CY/LOAD = 5 PASSES OF LOADER
 .2 + 4(.4) = 1.80 min / LOAD (TRUCK) @ 100% EFF.

* Caterpillar Performance Handbook (Pg. 37)

Subject EARTHWORK COSTS - LANDFILL CONSTRUCTION Project No. 86CB554P
 By D. HAWK Checked By TEK Task No. 2
 Date 3/11/87 Date 3/15/87 File No. 21947
 Sheet 3 of 4

TOTAL TRUCK CYCLE TIME

EXCHANGE TIME	0.50	minutes
LOAD (2 LOADERS @ 1.40 ea)	0.90	
HAUL	2.26	
MANEUVER & DUMP	0.70	
RETURN	1.61	

TOTAL CYCLE = 5.97 minutes @ 100% EFF.

EXCHANGE & LOAD = 1.40 minutes WITH 5.97 min cycle

⇒ WE NEED $5.97 / 1.40 = 4.3$ TRUCKS USE 5
 PRODUCTION BASED ON 4.3 TRUCKS

ESTIMATE PRODUCTION

1) AVG LOAD PER CYCLE = 18 CY LOOSE
 LOAD FACTOR = .85

AVG. LOAD = $18 \text{ CY} \times .85 = 15.3 \text{ CCY/LOAD}$

2) CYCLES PER HOUR = $60 \text{ min/hr} \times \text{CYCLES} / 5.97 \text{ min} = 10.0 \text{ cycles/hr}$

3) HOURLY PRODUCTION RATE = $15.3 \frac{\text{CCY}}{\text{LOAD}} \times 10.0 \frac{\text{LOAD}}{\text{HR}} = 153 \frac{\text{CCY}}{\text{HR}}$

4) HOURLY FLEET PRODUCTION = $4.3 \text{ TRUCKS} \times 153 \frac{\text{CCY}}{\text{HR}} = 658 \frac{\text{CCY}}{\text{HR}}$

5) CHECK DOZER PRODUCTION $1200 \times .85 = 1020 \frac{\text{CCY}}{\text{HR}} > 658 \frac{\text{CCY}}{\text{HR}}$

6) ADJUSTED PRODUCTION @ 50/60 EFF.

$658 \frac{\text{CCY}}{\text{HR}} \times \frac{50}{60} = 548 \frac{\text{CCY}}{\text{HR}}$

- Waste Pile Select Fill

Subject EARTHWORK COSTS - LANDFILL CONSTRUCTION Project No. 86 C 8554 P

By D. HAWK

Checked By TEK

Task No. 2

File No. 21947

Date 3/11/87

Date 3/18/87

Sheet 4 of 4

EQUIPMENT LIST AND COSTS⁺

1) 2 CAT 906 D LOADERS @	\$77 ²³ /HR	=	\$155 ⁴⁶	✓
2) 2 CAT DBL DOZER (LEVEL D) @	123 ⁵⁵	=	246 ⁵⁰	✓
3) 1 CAT DBL DOZER @	123 ⁵⁵	=	123 ⁵⁵	✓
4) 5 TANDUM AXLE END DUMPS 18W @	58 ²⁷	=	291 ³⁵	✓
5) 1 TANDUM AXLE STANDBY @	22 ⁵⁸	=	22 ⁵⁸	✓
6) 2 LABORERS @	12 ²⁶	=	58 ²⁸	✓

TOTAL COST = \$877⁹²/HR

+ ALL EQUIPMENT LEVEL D EXCEPT AS NOTED.

COST TO HAUL GENERAL FILL FROM BORROW TO STOCKPILE

\$877⁹²/HR * HR/548 CUY = \$160/CY ✓

- Topsoil for Waste Pile

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 5-800-2; the procuring agency is USACE.						
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION SUPPLY AND PLACE SAND DRAINS		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT OBL DOZER	1	16 ⁸⁸	16 ⁸⁸	106 ³⁷	106 ³⁷	
CAT 966D LOADER	1	16 ⁸⁸	16 ⁸⁸	61 ¹⁰	61 ¹⁰	
12 CUBIC YARD END DUMP TRUCK	4	16 ⁷⁸	67 ¹²	37 ³⁰	149 ²⁰	
CAT D6 DOZER	2	16 ⁸⁸	33 ⁷⁶	46 ⁴⁰	92 ⁸⁰	
CAT 14G MOTOR GRADER	1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹	
10,000 gallon WATER TANKER	1	17 ⁰²	17 ⁰²	119 ⁰²	119 ⁰²	
LABORERS	3	12 ⁷⁶	38 ²⁸	—	—	
END DUMP TRUCK (STANDBY)	1	—	—	21 ³⁰	21 ³⁰	
TOTALS	MANHOURS	13	LABOR COST	207 ⁰⁴ ✓	EQUIPMENT COST	625 ⁴⁰ ✓
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION/ PLACEMENT	251 CY/HR		\$0 ⁸² /CY ✓	\$249/CY ✓		
SAFETY	251 CY/HR		\$0 ⁹³ /CY ✓	\$154/CY ✓		
MATERIALS DELIVERED TO STOCK PILE				\$10 ²⁰ /CY ✓		
TOTAL EQUIPMENT, LABOR & SAFETY WITHOUT MATERIALS					\$578/CY	
TOTAL EQUIPMENT, MATERIALS, LABOR, SAFETY					\$1698/CY ✓	

*Including fringe benefits

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. BLOCBS54PBy D. HawkChecked By T. KTask No. 2File No. 91947Date 3/7/87Date 3/11/87Sheet 1 of 6PLACEMENT OF SAND DRAIN SYSTEMS

THE WASHED SAND REQUIRED WILL BE OBTAINED FROM OFF-SITE. THE MATERIALS WILL BE DELIVERED BY THE SUPPLIER TO THE LEVEL B LINE AND DUMPED FROM A RAMP ACROSS TO A SPECIFIED STOCKPILE AREA. THE STOCKPILE AREA WILL BE PREPARED USING CLEAN GENERAL FILL. IT IS ASSUMED THAT 10% OF THE WASHED SAND WILL BE WASTED BECAUSE IT WILL BECOME MIXED WITH FINES IN THE STOCKPILE (PRIMARILY AT THE STOCKPILE BASE)

A DOZER WILL BE REQUIRED TO WORK THE STOCKPILE SO THAT CONTINUAL DUMPING MAY OCCUR. ONCE IN THE BASIN, THE SAND WILL BE LOADED WITH FRONT-END LOADERS INTO TRUCKS AND CARRIED TO THE LANDFILL WHERE IT WILL BE DUMPED AND THEN SPREAD USING DOZERS AND MOTOR GRADERS. COMPACTION WILL BE PERFORMED BY SEVERAL PASSES WITH A TRACKED DOZER AND MOISTURE ADDED WITH A WATER TRUCK. SEVERAL SPOTTERS WILL BE REQUIRED IN THIS OPERATION TO POSITION TRUCKS AND CHECK GRADES.

LIGHT TRUCKS SUCH AS TEN-TWELVE CUBIC YARD TANDEMIS WILL BE USED FOR HAULING SAND IN BASIN F BECAUSE THEY WILL BE RUNNING OVER LINER WITH ONLY 1-FOOT OF COVER. POSSIBLY MAY BUILD HAUL ROADS OF GENERAL FILL OUT OVER SAND DRAINAGE BLANKET TO ALLOW TRUCKS TO GET CLOSE TO DUMPING POINT WITHOUT DAMAGING LINER. HAUL ROAD WOULD PROBABLY BE 1 TO 2 FEET OF GENERAL FILL OVER 1 FOOT DRAIN SAND.

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 86CB554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 3/7/87Date 3/11/87Sheet 2 of 6COST OF SAND DRAIN MATERIAL FROM SUPPLIER

ATTACHED ARE PRICE QUOTES FROM SUPPLIERS FOR
WASHED SAND DELIVERED TO RMA
FILTER MATERIAL CDOH CLASS A, B OR C, PROBABLY ADEQUATE
PAGE 701 CDOH SPECS 1981

COST OF MATERIALS (DELIVERED)

SUPPLIER	HAUL	TYPE	COST MATERIAL	COST HAUL
MOBILE PRMX (THORNTON)	—	B	\$8/TON	—
	5 mi	C	\$4/TON	\$1.85/TON
	5 mi	GRAVEL 1 1/2"	\$7.50/TON	\$1.85/TON
	15 mi	ROAD BASE 3/4"	\$3.25/TON	\$5.25/TON
ALBERT FOST & SONS (HENDERSON)	5 mi	B	\$4.25/TON	
	5 mi	C	\$4.25/TON	
	5 mi	ROAD BED 1	\$6.25/TON	
BENKMAN WOODWARD CONSTRUCTION (HENDERSON)	5 mi	FILTER SAND	\$4.45/TON	
	5 mi	ROAD BASE	\$5.25/TON	

FROM QUOTED INFORMATION ASSUME MATERIAL AT
PLANT WILL COST \$4.20/TON

DELIVERY WILL PROBABLY BE FROM WITHIN 6 MILE
RADIUS OF RMA AND ASSUME 4 MILE ON-SITE
HAUL.

DELIVERY WILL BE ABOUT 10 MILES @
ABOUT \$0.20/TON-MILE

$$\therefore \$4.20/\text{TON} + 10 \text{ MILES} \times \$0.20/\text{TON-MILE} = \$6/\text{TON}$$

USE 3400 lb/cy IN-PLACE ✓

$$\$6/\text{TON} \times \text{TON}/2000 \times 3400/\text{CY} = \$10.20/\text{CY} \checkmark$$

Subject LANDELL CONSTRUCTION - EARTHWORK COSTSProject No. 06C8554PBy D. HawkChecked By TLKTask No. 2Date 3/7/87Date 3/11/87File No. 21947Sheet 3 of 6

A CAT 946 C* loader with 4 CY bucket will be used to load trucks @ 100% eff $4 \times 50/60 = 3.33 \text{ CY/load}$
O.K.

Cycle time for loader = 0.40 minutes / 38 CY
Trucks are 12 CY capacity and dumps
Use 0.2 minutes for first load; .4 minutes thereafter
 $\Rightarrow 0.2 + 2 \times 0.40 \text{ minutes} = 1.0 \text{ min/load (38 CY)}$
+ 946 C has no deration factor for altitude @ 5000 ft.
Truck cycle time for short haul ~ 2000 LF
one way will be about the same as
scrapers (13 mph) ✓

Additional haul length will be required
for trucks as they will have to stay
on designated haul roads in landfill
to avoid damage to HDPE liner.

$\Rightarrow$ Add 300' to average haul from
stockpile to landfill which was
1700' for scrapers

$\Rightarrow$ Avg. haul for trucks = 2000' ✓

Due to grades involved and short haul
restrictions, return trip is just slightly
faster than loaded trip - say 16 mph avg.
Loaded haul = $2000' \times 1.47/13 \text{ mi} \times \text{mi}/5280 \text{ ft} \times 60 \text{ min/hr} = 1.12$
Empty = $2000' \times 1.47/16 \text{ mi} \times \text{mi}/5280 \text{ ft} \times 60 \text{ min/hr} = 1.42$

Exchange time	0.50 ✓
Load	1.00 ✓
Haul loaded	1.75 ✓
Maneuver & Dump	.70 ✓
Return	1.42 ✓
	<u>5.37 min</u>
	say 5.4 min ✓

Exchange and load = 1.5 min and with 5.4 min/cycle

We need $5.4/1.5 = 3.6$ Use 4 trucks ✓

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTS

Project No. 86C8554P

By D. Hawk

Checked By TEK

Task No. 2

Date 3/7/87

Date 3/11/87

File No. 21947

Sheet 4 of 6

ESTIMATE PRODUCTION

AVG. HAUL = 10 CY LOOSE ✓

LOAD FACTOR SAND = .9 ✓

∴ 10 CY HAULETS = 10(.9) = 9 CY IN-PLACE ✓

UNIT PRODUCTION @ 100% EFFICIENCY

$$1 \text{ haul} / 5.8 \text{ min} \times 9 \frac{\text{CY}}{\text{LOAD}} \times \frac{60 \text{ min}}{\text{HR}} = 93 \text{ CY} / \text{HR-UNIT} \checkmark$$

We actually have only 3.6 units hauling in cycle effectively ✓

$$\Rightarrow \text{PRODUCTION} = 3.6 \times 93 \text{ CY/HR} = 335 \text{ CY/HR} \checkmark$$
$$\Rightarrow \text{PRODUCTION / INSTANTANEOUSLY} = 335 / 1.35 = 251 \text{ CY/HR} \checkmark$$

EQUIPMENT LIST

- 1 CAT 08L TO WORK STOCKPILE ✓
- 1 CAT 944 D TO LOAD @ STOCKPILE ✓
- 4 12 CY TANDUM AXLE END DUMPS ✓
- 2 CAT D4 DOZERS TO SPREAD ✓
- 1 CAT 144 MOTOR GRADER TO LEVEL ✓
- 1 10,000 GALLON WATER TANKER FOR MOISTURE ✓
- 1 STANDBY TANDUM AXLE END DUMP ✓
- 3 LOADERS (SPREADERS & GRADE CHECKERS) ✓

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 86CB554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 3/8/87Date 3/11/87Sheet 5 of 6EQUIPMENT & LABOR COSTS1) *CAT DBL = \$123²⁵/HR ✓

2) CAT 966 D. LOADER (200 HP)
 EQUIPMENT $7490^{\text{00}}/\text{mo} \times \frac{1\text{mo}}{173\text{ HRS}} \times .891 \times 1.05 = 40^{\text{00}}/\text{HR} \checkmark$
 OPERATING = $20^{\text{00}}/\text{HR} = 20^{\text{00}}/\text{HR}$
 OPERATOR = $16^{\text{00}}/\text{HR} = 16^{\text{00}}/\text{HR}$

TOTAL = 77²⁵/HR ✓

3) TANDEM AXLE END DUMP P4 20-8 6x4 w/ BOULE AXLE (300 HP)
 EQUIPMENT $3895^{\text{00}}/\text{mo} \times \frac{1\text{mo}}{173\text{ HRS}} \times .901 \times 1.05 = 21^{\text{00}}/\text{HR} \checkmark$
 OPERATING = $16^{\text{00}}/\text{HR} = 16^{\text{00}}/\text{HR}$
 OPERATOR = $16^{\text{00}}/\text{HR} = 16^{\text{00}}/\text{HR}$

TOTAL = 54⁰⁰/HR ✓

4) CAT D6 DOZERS (140 HP)
 EQUIPMENT $5920^{\text{00}}/\text{mo} \times \frac{1\text{mo}}{173\text{ HRS}} \times .910 \times 1.05 = 32^{\text{00}}/\text{HR} \checkmark$
 OPERATING = $13^{\text{00}}/\text{HR} = 13^{\text{00}}/\text{HR}$
 OPERATOR = $16^{\text{00}}/\text{HR} = 16^{\text{00}}/\text{HR}$

TOTAL = 63⁰⁰/HR ✓5) *CAT 14G MOTOR GRADER = \$92⁰⁰/HR6) *WATER TANKER (10,000 GALLON CAPACITY) 450HP = \$136⁰⁰/HR7) STANDBY TANDEM AXLE END DUMP = \$21⁰⁰/HR8) LABORERS (GROUP 1) = \$12²⁵/HR

* NOTE - COSTS GENERATED IN GENERAL FILL COST CALCULATIONS

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 86C8554 PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 3/8/87Date 3/11/87Sheet 6 of 6TOTAL EQUIPMENT COSTS

1	D8L DOZER	@	\$123 ²⁵ /HR	=	\$123 ²⁵
1	CAT 966 D Loader	@	77 ²⁸ /HR	=	77 ²⁸
4	END DUMPS	@	54 ²² /HR	=	216 ²²
2	CAT D6 DOZERS	@	63 ²² /HR	=	126 ²²
1	CAT 14G GRADER	@	92 ⁶⁴ /HR	=	92 ⁶⁴
1	WATER TANKER	@	136 ⁴⁴ /HR	=	136 ⁴⁴
1	STANDBY END DUMP	@	21 ²⁰ /HR	=	21 ²⁰
3	LABORERS	@	12 ²⁶ /HR	=	36 ²⁶

TOTAL = \$832⁶⁴/HCOST TO DELIVER SAND, HAUL TO LANDFILL FROM STOCKPILE,
SPREAD & PLACE① MATERIAL DELIVERED TO STOCKPILE = \$10²²/CY② HAUL & PLACE
(STOCKPILE TO LANDFILL) = \$832⁶⁴/HR × HR/257 CY = \$3³²/CYTOTAL = \$13⁵²/CYNOTE: THIS COST IS WITHOUT SAFETY CONSIDERATIONS
FOR ITEM 2, EXCEPT FOR PRODUCTION
EFFICIENCY OF 45/100.

COST ITEM 10

- 60 mil HDPE Liner
- 12 oz. Geotextile Filter Fabric
- 200 mil HDPE Geonet (Drainage Net)

Subject TOPSOIL

By D. Hawk

Date 7/7/87

Checked By Tom Kelly

Date 7/13/87

Project No. 86C8554P

Task No. 2

File No. 21947

Sheet 1 of 1

TOPSOIL SUMMARY

a) BORROW TO STOCKPILE
ACTIVITY (1)

1.60/CY

b) STOCKPILE TO BASIN F
ACTIVITY (8)

1.33/CY

2.93/CY

7

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED	
For use of this form, see TM 5-800-2; the proponent agency is USACE.					3/18/87	
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION TOPSOIL BORROW TO STOCKPILE		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 627 B SCRAPER	8	17 ⁰³	136 ²⁴	117 ⁷⁷	942 ¹⁶	
CAT D6 DOZER	1	16 ⁸⁸	16 ⁸⁸	46 ⁹⁰	46 ⁹⁰	
LABORER	1	12 ⁷⁶	12 ⁷⁶	—	—	
CAT 627 B SCRAPER (STANDBY)	2	—	—	75 ³⁷	150 ⁷⁴	
TOTALS	MANHOURS	10	LABOR COST	165 ⁸⁸	EQUIPMENT COST 1139 ⁸⁰	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION/ PLACEMENT	847 ^{BCY} /HR		0 ²⁰ ✓	1 ³⁴ ✓		
SAFETY	847 ^{BCY} /HR		—	0 ⁰⁶ ✓		
TOTAL EQUIPMENT LABOR AND SAFETY					\$160/BCY ✓	

*including fringe benefits

7A

CREW AND PRODUCTIVITY WORKSHEET						DATE PREPARED
For use of this form, see TM 5-800-2; the procuring agency is USACE.						3/18/87
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/18/87			
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION TOPSOIL BORROW TO STOCKPILE		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
STANDBY EQUIPMENT	11	—	—	445	48 ⁹⁵	
TOTALS	MANHOURS		LABOR COST	—	EQUIPMENT COST 48 ⁹⁵ ✓	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
SAFETY	847 Bcy/HR		—	006 ✓	ALL EQUIPMENT EXCEPT TRUCKS ON STANDBY SAFETY FOR LEVEL-D	

*Including fringe benefits

Subject EARTHWORK COSTS - LANDFILL CONSTRUCTION

Project No. 86C8554P

By D. HAWK

Checked By TSK

Task No. 2

File No. 21947

Date 3/10/87

Date 3/12/87

Sheet 1 of 3

TOPSOIL COSTS - BORROW TO STOCKPILE

THE WORK INVOLVED IN THIS COST WILL INVOLVE STRIPPING OF TOPSOIL AND PLACEMENT IN A STOCKPILE NEAR BASIN F. IT IS ASSUMED THAT ALL TOPSOIL USED FOR BOTH THE LANDFILL AND BASIN COVER WILL BE FOUND WITHIN 1 MILE OF BASIN F. SOME, IF NOT ALL OF THIS MATERIAL MAY ORIGINATE FROM THE GENERAL FILL BORROW AREA. IF THE ACTUAL CLAY BORROW SOURCE IS 5 MILES AWAY TOPSOIL FROM THIS AREA PROBABLY WON'T BE HAULED TO BASIN F DUE TO THE HAUL LENGTH.

THE CAT 627 B SCRAPERS SHOULD BE WELL SUITED FOR TOPSOIL LOADING WITHOUT DOZER ASSISTANCE. SOME INCREASE IN LOAD TIME AND REDUCTION IN PAY LOAD MAY BE EXPECTED HOWEVER. LOAD REDUCTION WILL BE ACCOUNTED FOR IN LOAD FACTOR (USE 0.70).

ONE CAT D6 DOZER WILL BE USED TO SHAPE STOCKPILE AND AS NEEDED FOR SUPPORT. ONE SPOTTER WILL BE USED AT AREA BEING STRIPPED.

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTSProject No. 86C8554PBy D. HawkChecked By TETask No. 2File No. 21947Date 3/10/87Date 3/12/87Sheet 2 of 3CYCLE TIME CAT 627 B SCRAPERS

ASSUME AVERAGE HAUL LENGTH < 1 MILE USE $\frac{3}{4}$ MILE
ASSUME AVERAGE GRADE RESISTANCE = 5%

HAUL LENGTH = $\frac{3}{4}$ (5280) = 3960' USE 4000' ✓

AT 5% TR AND 4000' HAUL AND 93% ALTITUDE DERATION ✓

HAUL TIME = 2.63 MIN ✓ (2.45 + .93)

RETURN TIME = 1.88 MIN ✓ (1.75 + .93)

LOAD TIME = .80 MIN ✓

MANEUVER DUMP = .60 MIN O.K. ✓

TOTAL CYCLE TIME 5.91 MIN @ 100% EFF. ✓

ESTIMATE PRODUCTION

1) ESTIMATED LOAD = 18 CY × .70 (L.F.) = 12.6 CY/LOAD ✓

2) CYCLES PER HOUR = $\frac{60 \text{ MIN}}{\text{HR}} \times \frac{1 \text{ CYCLE}}{5.91 \text{ MIN}} = 10.1 \frac{\text{CYCLES}}{\text{HR.}}$ ✓

3) HOURLY UNIT PRODUCTION = $12.6 \text{ BCY} \times 10.1 \frac{\text{CYCLES}}{\text{HR}} = 127 \frac{\text{BCY}}{\text{HR}}$ ✓

4) NEED ONE SCRAPER EVERY 0.8 MINUTES
⇒ $5.91 \div 0.8 = 7.4$ SAY 8 SCRAPERS ✓

5) HOURLY FLEET PRODUCTION

8 SCRAPERS × $127 \frac{\text{BCY}}{\text{HR-SCRAPER}} = 1016 \frac{\text{CY}}{\text{HR}}$ ✓

6) ADJUSTED PRODUCTION (50 MINUTE HOUR NON-HAZARDOUS)

$50/60 \times 1016 \frac{\text{BCY}}{\text{HR}} = 847 \frac{\text{BCY}}{\text{HR}}$ ✓

Subject LANDFILL CONSTRUCTION - EARTHWORK COSTS

Project No. 86C8554P

By D. Hawk

Checked By TEK

Task No. 2

Date 3/10/87

Date 3/12/87

File No. 21947

Sheet 4 of 3

EQUIPMENT LIST & COSTS

1)	8	CAT 627 B SCRAPERS	@	\$134 ²⁰	=	1078 ⁴⁰
2)	1	CAT D6 DOZER	@	63 ²⁸	=	63 ²⁸
3)	2	CAT 627 B SCRAPERS (STANDBY)	@	75 ²²	=	150 ²²
4)	1	LABORER (SPOTTER)	@	12 ⁷⁶	=	12 ⁷⁶

\$1305¹⁸/HR

COST TO STRIP AND STOCKPILE TOPSOIL NEAR BAWN F

$$\$1305^{18}/HR \times 1 HR/847 BCM = \$1.54/BCM$$

(6)

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3/18/87	
For use of this form, see TM 8-800-2: the procuring agency is USACE.						
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. HAWK 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION TOPSOIL-STOCKPILE TO BASIN F		
CREW DESCRIPTION		NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST	
			HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)
CAT 627B SCRAPER		6	17 ⁰³	102 ¹⁸	117 ⁷⁷	706 ⁶²
CAT DBL DOZERS		2	16 ⁸⁸	33 ⁷⁶	106 ³⁷	212 ⁷⁴
CAT 14G MOTOR GRADER		1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹
CAT D6 DOZER		1	16 ⁸⁸	16 ⁸⁸	46 ⁴⁰	46 ⁴⁰
LABORERS		2	12 ⁷⁶	25 ⁵²	—	—
CAT 627B SCRAPER(STANDBY)		1	—	—	75 ³⁷	75 ³⁷
TOTALS	MANHOURS	12	LABOR COST	195 ³⁷ ✓	EQUIPMENT COST	1,116 ⁷⁴ ✓
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
EXCAVATION/PLACEMENT	1020 ccy/hr		#012/104	#109/104		
SAFETY			—	#005/104		
TOTAL EQUIPMENT, LABOR AND SAFETY				#133/ccy ✓		

* including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3/18/87	
For use of this form, see TM 5-800-2: the predecessor agency is USACE.						
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO.	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/18/87			
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION TOPSOIL-STOCKPILE TO BASIN F		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
STANDBY EQUIPMENT	11	—	—	4.45	48.95	
TOTALS	MANHOURS	LABOR COST	—	EQUIPMENT COST	48.95 ✓	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
SAFETY	1020 ccy/hr		—	0.05 ✓	ALL EQUIPMENT EXCEPT TRUCKS ON STANDBY SAFETY FOR LEVEL D.	

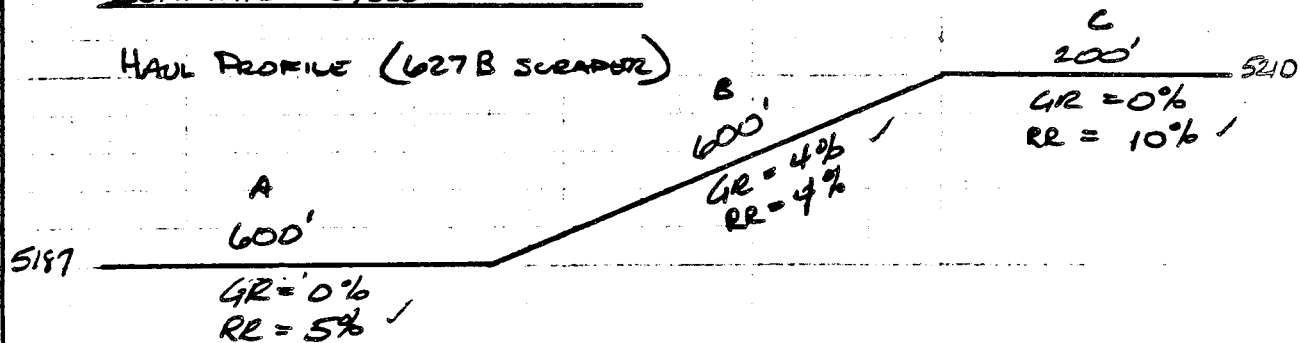
Subject EARTHWORK COSTS - BASIN F CONSTRUCTION Project No. 86CB554P
By D. Hawk Checked By TEK Task No. 2
Date 3/10/87 Date 3/12/87 File No. 21947
Sheet 1 of 4

TOPSOIL COSTS - STOCKPILE TO BASIN F

THE WORK INVOLVED IN THIS COST WILL INVOLVE PICKING UP TOPSOIL FROM A STOCKPILE NEAR BASIN F AND PLACING IT ABOVE THE BASIN AND LANDFILL CLAY CAPS. CAT 627 B SCRAPERS WILL BE USED ASSISTED BY 2 CAT D8L DOZERS AT THE STOCKPILE.

THE TOPSOIL WILL BE TRACKED IN-PLACE WITH A CAT D6 DOZER AND SPREAD AND LEVELED WITH ONE CAT 144 MOTOR GRADER. TWO LABORERS WILL BE REQUIRED FOR SPITTING AND GRADE CHECKING.

IT IS ASSUMED THAT ALL TOPSOIL PLACEMENT WILL BE PERFORMED AFTER CLAY CAP PLACEMENT UNDER LEVEL D DEGREE OF HAZARD CONDITIONS.

Subject EARTHWORK COSTS - BASIN F CONSTRUCTIONProject No. 86C0554PBy D. HAWKChecked By TEKTask No. 2File No. 21947Date 3/10/87Date 3/12/87Sheet 2 of 4ESTIMATED CYCLE TIMESHAUL CYCLE

SECTION	LENGTH	LOADED		UNLOADED	
		TR	TIME	TR	TIME
A	600'	5%	.50 ✓	5%	.41 ✓
B	600'	0%	.40 ✓	8%	.48 ✓
C	200'	10%	.31 ✓	10%	.23 ✓
Total Time			1.21 min		1.12 min
@ 93% Altitude Deration			1.30 min ✓		1.20 min ✓

TOTAL ESTIMATED CYCLE TIME

HAUL	=	1.30 min
RETURN	=	1.20
LOAD	=	.60 ✓
MANEUVER & DUMP	=	.60 ✓

3.70 min @ 100% EFF. ✓
cycle



Subject EARTHWORK COSTS - BASIN F CONSTRUCTION Project No. 86CB554P
By D. HAWK Checked By TJR Task No. 2
Date 3/10/87 Date 3/12/87 File No. 21947
Sheet 3 of 4

ESTIMATED PRODUCTION

1) ESTIMATED LOAD $18 \text{ CY} \times .70 (\text{LOAD FACTOR}) = 12.6 \text{ CCY/LOAD}$ ✓

2) CYCLES PER HOUR $\frac{60 \text{ MIN}}{\text{HR}} \times \frac{\text{CYCLE}}{3.70 \text{ MIN}} = 16.2 \frac{\text{CYCLES}}{\text{HR}}$ ✓

3) HOURLY UNIT PRODUCTION $12.6 \frac{\text{CY}}{\text{CYCLE}} \times 16.2 \frac{\text{CYCLES}}{\text{HR}} = 204 \frac{\text{CCY}}{\text{HR}}$ ✓

4) NEED 1 SCRAPER EVERY 0.6 MINUTES
 $\Rightarrow 3.70 \div 0.6 = 6.2 \text{ SCRAPERS} \Rightarrow \text{USE } 6$ ✓

5) CHECK PUSH DOZER BALANCE

DOZER CYCLE = $1.4(.6) + .25 = 1.09 \text{ MINUTES}$ ✓

$\frac{\text{SCRAPER CYCLE}}{\text{DOZER CYCLE}} = \frac{3.70}{1.09} = 3.4 \text{ SCRAPERS/DOZER}$ ✓

$\Rightarrow$ Each dozer can handle 3+ scrapers ✓ ✓

6) FLEET PRODUCTION @ 100% EFFICIENCY $6 \times 204 \frac{\text{CCY}}{\text{HR}} = 1224 \frac{\text{CCY}}{\text{HR}}$ ✓

7) ADJUSTED PRODUCTION
(USE 50 MINUTE HOUR
LEVEL D PROTECTION) $50/60 \times 1224 \text{ CY/HR} = 1020 \frac{\text{CCY}}{\text{HR}}$ ✓

Subject EARTHWORK COSTS - BASIN F CONSTRUCTIONProject No. 86CB554PBy D. HawkChecked By TEKTask No. 2File No. 21947Date 3/10/87Date 3/12/87Sheet 4 of 4EQUIPMENT FLEET & COSTS

6	CAT 627 B SCRAPERS	@	\$134 ⁸⁰	=	808 ⁸⁰	✓
2	CAT D8L DOZERS	@	123 ²⁵	=	246 ⁵⁰	✓
1	CAT 144 MOTOR GRADER	@	92 ⁶⁴	=	92 ⁶⁴	✓
1	CAT D6 DOZER	@	63 ²⁸	=	63 ²⁸	✓
1	CAT 627 B SCRAPER (STANDBY)	@	75 ³⁷	=	75 ³⁷	✓
2	LABORERS	@	12 ²⁶	=	25 ⁵²	✓

TOTAL COST = \$1312⁴⁴/HR ✓

COST TO PLANT TOPSOIL - STOCKPILE TO BASIN F

\$1312⁴⁴/HR × 1 HR/1020 CCY = \$1,29/CCY ✓

- **Waste Pile Sumps and Piping**

RECORD OF VERBAL QUOTE

Project: Name: Basin F
 Location: RMA

Quote #: 18-1 (Estimate Sht. No.)

Firm: Name: See below
 Location:
 Telephone No.: ()
 Person Talked To:

Type of Quote: Supplier, material only (FOB Point:)
X Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

Our cost estimate was based upon an independent calculation of the manhours required to install these materials added to the manufacturing cost, and upon telephone estimates from the three leading companies in manufacture/installation of HDPE geomembranes. All costs were based upon installation of synthetic materials under summer conditions and in level B personal protective gear. The cost estimates do not include: construction field and office engineering; independent quality assurance engineering; preparation of subgrade (cut-and-fill, compaction, removal of rocks larger than 1/2-inch); site dewatering; pump station for leachate/leak removal. We also assume that our conceptual design (with a minimum number of penetrations or liner) will be implemented. The estimates are displayed in the accompanying table.

ITEM	ESTIMATED COST (\$/LAYER/SF)	ESTIMATED BY	INSTALLATION COMMENTS	
1. 60-mil HDPE Geomembrane	\$0.74	HDR	Level B PPG	
	\$0.75	Gundie	"	
	\$0.80	National Seal	"	use 0 ⁸⁰ / ₁₀₀
	\$0.88	Schlegel	"	
2. 16 oz. PP Geotextile	\$0.24	Schlegel	"	
	\$0.22	National Seal	"	use 0 ²⁵ / ₁₀₀
3. Drainage Net (Geonet)	\$0.32	National Seal	"	
	\$0.26	Gundie	"	use 0 ²⁵ / ₁₀₀

Date Quote Received:

Quote Received By: D. Sprague

FML INSTALLATION COST ESTIMATE

ASSUME:

Supplied Air
Protective Clothing
20,000 sq. ft./day

LABOR CLASSIFICATION	DAYS	SALARY	RENTAL	PER DIEM	PERSONNEL	MOBILIZATION EQUIPMENT	SAFETY EQUIPMENT	DIRECT + FEE	SALARY + PROFIT	TOTAL
Supervisor (1)	46	\$5,497	\$0	\$2,287	\$1,200	\$0	\$3,430	\$7,609	\$6,322	\$13,931
Head Welder (1)	46	\$4,398	\$0	\$2,287	\$1,200	\$0	\$3,430	\$7,609	\$5,058	\$12,667
Welders (2)	91	\$7,916	\$0	\$4,574	\$2,400	\$0	\$6,861	\$15,218	\$9,104	\$24,322
Technicians (3)	137	\$9,895	\$0	\$6,861	\$3,600	\$0	\$10,291	\$22,827	\$11,380	\$34,207
Qual. Contr. (1)	46	\$5,277	\$0	\$2,287	\$1,200	\$0	\$3,438	\$7,609	\$6,069	\$13,678
Laborers (12)	549	\$35,876	\$0	\$0	\$0	\$0	\$41,164	\$45,281	\$41,027	\$86,308
Operators (1)	46	\$0	\$0	\$0	\$0	\$0	\$3,430	\$3,773	\$0	\$3,773
F. M. Loader (1)	46	\$0	\$22,869	\$0	\$0	\$1,000	\$0	\$26,256	\$0	\$26,256
1007		\$88,659	\$22,869	\$18,296	\$9,600	\$1,000	\$72,044	\$136,182	\$78,960	\$215,142

\$ 0.235 per sq. ft. labor
\$ 0.220 per sq. ft. material
\$ 0.180 per sq. ft. profit and overhead

SUBTOTAL = \$ 0.635 per sq. ft.
\$ 0.739 incl. contingency

USE $0.88/SF$ WHICH INCLUDES SUB OIP
BUT NOT CONTRACTOR OIP

$\times 1.12$ OIP

$0.90/SF$ w/ OIP

- **Liquid Removal System**

SHEET / OF

RMA

DENVER, CO

WCC/HDR

☒ OTHER (Specify) 60% DESIGN

D. Hawk

Tom Keller

B* INDICATES LEVEL B HAZARD - SAFETY INCLUDED

- Sewer and Miscellaneous Debris Removal
- Haul Waste to Solidification

CONSTRUCTION COST ESTIMATE					DATE PREPARED 3/87		SHEET OF			
PROJECT <u>BASIN F</u>					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☒ OTHER (Specify) <u>60% Design</u>					
LOCATION <u>RMA Denver</u>										
ARCHITECT ENGINEER <u>HDR</u>										
DRAWING NO.			ESTIMATOR <u>D. A. Kottwitz</u>			CHECKED BY <u>AL ERICKSON</u>				
Sifework		SUMMARY		QUANTITY		LABOR		MATERIAL		Equipment TOTAL COST
		NO. UNITS	UNIT MEAS.	PER UNIT	① TOTAL	PER UNIT	TOTAL			
<u>Civil</u>										
<u>Water</u>										
Top Exist 2" Line		2	EA	10.00	B 120	30.00	60			
Pipe PVC Class 160 2"		315	LF	1.76	B 3,226	0.32	101			
Backflow Preventer 4th 2"		2	EA	26.00	B 312	420	340			
Manhole 4'ID x 6'Dep		2	EA	52.00	B 624	320	640	20 - 4		
Manhole Top 8" Thk		2	EA	52.00	B 624	82	164	20 - 4		
Manhole Covers 24"Ø 300lb		2	EA	48.00	B 576	115	230	18.60 - 3		
Screened Stone Bedding For Manholes Compacted 7 1/2"		2	CY	3.72	B 45	16.00	32	0.40 - 1		
Excavation for Manholes Using Backhoe 1 CY cap.		41	CY	0.86	B 212		-	1.21 - 5		
Backfill by hand Vib. Plate Compaction 6" Lifts		9	CY	5.22	B 282		-	0.45 -		
Trench - Excavation 60" deep		315	LF	0.24	B 454		-	0.30 - 7		
- Bedding		6	CY	2.68	B 96	5.00	30	0.27 -		
- Backfill Air Temp		29	CY	3.47	B 604		-	0.78 -		
Subtotal					7,274		2,097	2'		
					7,175					
<u>Process Forcemain</u>										
Pipe - PVC Containment 6"		1,600	LF	-	Included in material total	85.00	136,000	Quote #5		
Valves - PVC Ball 4"		1	EA	18.49	B 111	288.00	288			
- Diaphragm - Non- pressure Lined 6"		1	EA	160.00	B 960	1,100	1,100	Quote #7		
Pipe Supports: Total of 160										
Pipe Clamps Galv. 10"		160	EA	3.45	B 3,312	19.43	3,109			
Galv. Threaded Rod 1/2"		640	LF	1.28	B 4,916	0.38	243			
Concrete		83	CY		-	50.10	4,174			
Forms - 4 uses		4,480	SFCA	5.10	B 137,088	0.85	3,818	0.22 - 96		
Concrete Placement		83	CY	4.96	B 2,470	0.31	26	0.31 - 20		
Subtotal					148,857	✓	148,743	101		

① "B" Designates Level B. Labor multiplied by factor of 6.

CONSTRUCTION COST ESTIMATE					DATE PREPARED 3/87		SHEET OF	
PROJECT BASIN F					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☒ OTHER (Specify) 60% Design			
LOCATION RMA Denver								
ARCHITECT ENGINEER HDR								
DRAWING NO. Pump Station			ESTIMATOR D. A. Kottwitz		CHECKED BY A. C. ERICKSON			
Structural	SUMMARY	QUANTITY		LABOR		MATERIAL		Equipment TOTAL COST
		NO. UNITS	UNIT MEAS.	PER UNIT	① TOTAL	PER UNIT	TOTAL	
Concrete (Div. 3)								
Slabs on Grade:								
Concrete - 4000 psi	11	CY			-	54.20	596	-
Placing	11	CY	7.45	B	492		-	0.96 -
WWF - 6x6 #4/4	5.95	CSF	13.10	B	468	20.20	120	-
Edge Forms	136	LF	1.04	B	849	0.16	22	0.05 -
Screed - 2x4	14	LF	0.69	B	58	0.79	11	0.04 -
Finishing (Broom Finish)	595	SF	0.23	B	821		-	0.04 -
Curing (Sprayed Membrane)	5.95	CSF	2.71	B	97	1.70	10	-
Equipment Pads:								
Concrete - 4000 psi	1	CY				54.20	54	-
WWF - 6x6 #4/4	0.48	CSF	13.10	B	38	20.20	10	-
Placing	1	CY	7.45	B	45		-	1.46 -
Forms	50	LF	1.04	B	312	0.16	8	0.05 -
Finishing (Float Finish)	48	SF	0.22	B	63			0.04 -
Curing (Sprayed Membrane)	0.48	CSF	2.71	B	8	1.70	1	-
Anchor Bolts 5"Ø x 12"	8	EA	2.00	B	99	2.20	16	-
1/2"Ø x 6"	12	EA	1.83	B	143	0.64	8	-
					3498		858	4
					3481			
Metals (Div 5)								
Guardrails - Steel	14.5	LF	2.84		247	21.00	305	
- Painting	14.5	LF	0.50		44	0.50	7	
- Anchor Bolts 1/2"	20	EA	2.06		247	1.88	38	
- Bolt Layout & Drilling	20	EA	6.30		756	0.05	1	
					1,294		351	
① "B" Designates Level B, Labor multiplied by factor of 6.								

CONSTRUCTION COST ESTIMATE					DATE PREPARED 3/27		SHEET OF			
PROJECT BASIN F					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☒ OTHER (Specify) 60% Desi.					
LOCATION RMA Denver										
ARCHITECT ENGINEER HDR										
DRAWINGS Pump Station			ESTIMATOR D.A. Kottwitz		CHECKED BY A.C. FRICKSON					
Mechanical / Process Fluid Pumping System			QUANTITY		LABOR		MATERIAL			
			NO. UNITS	UNIT MEAS.	PER UNIT	① TOTAL (MH)	PER UNIT	TOTAL	TOTAL COST	
Disphragm Pumps - 150 gpm			2	EA	3.2	B	33.4	8.338	16,676	Quote #
@ 150 FT TDH (P. 101 & 210)										
Flex. Connections - Neoprene 3"			4	EA	1.5	B	36.0	259.00	1,036	
Quick Couplings - Std. Std. 4"			2	EA	1.6	B	19.2	330.00	660	
Flex Suct. Hose w/ Std. Std.			10	EA	1.5	B	90.0	530.45	5,305	Quote #
Quick Coupling Ends - 4" x 20"										
Pipe - PVC Suck 4"			12	LF	0.33	B	23.8	3.60	43	
PVC Containment 6"			20	LF	-	Includes in material	25.00		1,700	Quote #
Ball Valves - PVC 4"			2	EA	0.92	B	11.0	288.00	576	
Disphragm Valves - Neoprene			1	EA	7.92	B	27.5	1,100	1,100	Quote #
Lined Neoprene Disphragm Flanged										
Pipe Supports: Total of 2										
Pipe Clamps 10"			2	EA	0.16	B	1.9	19.43	20	
Galv. Threaded Rod 1/2"			8	LF	0.06	B	2.9	0.38	3	
Concrete			1.04	CY				50.70	53	
Forms - 1 use			56	SFCA	0.30	B	100.8	*1.82	102	* Includes Equip. Co.
Concrete Placing			1.04	CY	0.43	B	2.7	*0.49	1	* Equipment
Subtotal							374.2		27,294	
ELECTRICAL										
BRANCH TO COMP. PAD			1500	LF						15,677
LIGHTING TO COMP. PAD										2,842
LABOR										
24 hr/day for 25 WD			600	hrs	13.76		8256			8256
① "B" Designates Level B. Labor Multiplied by Factor of 6.										

RECORD OF VERBAL QUOTE

Project: Name: BASIN F
Location: DENVER

Quote #: 1 (Estimate Sht. No.)

Firm: Name: INGERSOLL-RAND
Location: OMAHA
Telephone No.: (402) 330-5831
Person Talked To: STEVE ZIMMERLE

Type of Quote: X Supplier, material only (FOB Point: DENVER)
 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

MODEL SSR EP 75

- w/ • Reduced voltage starting
- Protective shutdown annunciator
- TEFC motor
- Dust inlet

electrical 460V 3 ϕ 60Hz
330 cfm Free Air Delivery @ 125 psig
\$17,800 ea

Weight = 2350 lb

Date Quote Received: 1/19/87
Quote Received By: FURNE

RECORD OF VERBAL QUOTE

Project: Name: Basin F

Location: RMA Denver

Quote #: 2 (Estimate Sht. No. 1)

Firm: Name: CPI Sales

Location: Omaha

Telephone No.: (402) 334-7317

Person Talked To: Brod Baustead

Type of Quote: X Supplier, material only (FOB Point: Denver)

 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

Air Operated Diaphragm Pumps

Wilden Model M-15

Accessories & Options:

Non Watted Parts: Cast Iron

Ball Valves: Neoprene

Valve Seats: Neoprene

Diaphragms: Neoprene

Oiler

Filter

Regulator

Polypropylene Surge Supressor

TOTAL COST FOB = \$4165

Weight = 215 lb each

Date Quote Received: 1-19-87

Quote Received By: FURNE

RECORD OF VERBAL QUOTE

Project: Name: BASIN F

Location: DENVER

Quote #: 4 (Estimate Sht. No.)

Firm: Name: Ranger Rubber

Location: Omaha, NE

Telephone No.: (402) 551-2300

Person Talked To: John

Type of Quote: X Supplier, material only (FOB Point:)

 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

4" Suction Hose w/ Sta. Sta. quick couplings

All chemical type hose

20 ft lengths

Male x Female Couplings

\$530 ~~45~~ each

Date Quote Received: 3-17-87

Quote Received By: D Kottwitz

RECORD OF VERBAL QUOTE

Project: Name: BASIN F

Location: DENVER

Quote #: 5 (Estimate Sht. No.)

Firm: Name: Gartner & Assoc. Co. Inc.

Location: Omaha, NE

Telephone No.: (402) 572-6969

Person Talked To: Rene Nelson

Type of Quote: X Supplier, material only (FOB Point: Denver)

 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:



ESTIMATE
THIS ESTIMATE FROM
Gartner & Assoc. Co. Inc.
5606 W. 99th St.
Omaha, Ne. 68134
(402) 572-5569 Rene Nelson

PROPOSAL

DATE 2-20-87

*Per phone conversation
3-19-87, determined
that \$35 / FT is
price including
installation excluding
pipe supports.*

TO: NEW INFRASTRUCTURE
8404 Indian Hills Drive
Omaha, Ne. 68114-4049

NAME OF JOB: Barve Agent disposal Denver Co.

Attn: Thomas Furne

You, confirming our phone conversation today is a list of some of the specifics for the SAF-T-GARD piping system. I will send additional additional information as I receive. Thank you for your time and consideration. I will be in touch shortly.

SAF-T-GARD CONTAINMENT PIPING SYSTEM:

- 6" sch40 PVC carrier pipe - solvent welded
- 10" sch40 PVC containment pipe- PVC welded
- 2" polyurethane foam in place insulation
- 14" final system size with a finished PVC outer casing, common stock couplings

HEAT TRACING:

The piping system shall be electrically heat tape traced. The heat tape and an aluminum wrap to prevent hot spots will be installed in a continuous manner around the containment pipe before the insulation is foamed in place. The electrical connection point will be a Mid Feed System running out 1000 feet on either side. Thermostat(s) included. Voltage and breaker size to be clarified. Heat tape to be designed for ambient temperature of 20°F and to maintain fluid at 80°, entering piping system at 33°.

MISCELLANEOUS MATERIAL

Leak detection - pumps with sight glass, drain valve. Spacing as required.
Expansion joints- flanged neoprene type. As required.
Elbows and tee or "T" fittings -factory fabricated. PVC ball valves
Carrier pipe supports -internal to the piping system
Baffles internal to the piping system

PIPING SYSTEM SUPPORTS:

To be field erected by others (Concrete pedestals, "U" straps)

Estimate price to include material, freight to job site,
field service instructions

\$ 35.00 per foot

Date Quote Received: 2-20-87

Quote Received By: FURNE

RECORD OF VERBAL QUOTE

Project: Name: BASIN F

Location: RMA DENVER

Quote #: 6 (Estimate Sht. No.)

Firm: Name: INGERSOLL-RAND

Location: OMAHA, NEBRASKA

Telephone No.: (402) 330-5831

Person Talked To: Steve Eimmerle

Type of Quote: X Supplier, material only (FOB Point: Denver)

 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

Model VCG2412 Air Receiver

120 gal

Coast Guard Approved

Epoxy Coated

\$342 FOB Denver

Weight -

Date Quote Received: 3-17-87

Quote Received By: D.A. Kottwitz

RECORD OF VERBAL QUOTE

Project: Name: BASIN F

Location: DENVER

Quote #: 7 (Estimate Sht. No.)

Firm: Name: Central States Industrial Supply, Inc.

Location: Omaha, NE

Telephone No.: (402) 344-8900

Person Talked To: Keith

Type of Quote: X Supplier, material only (FOB Point: Denver)

 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

6" Saunders Straight Thru Diaphragm Valve
with neoprene lining and neoprene diaphragm.
Weight = 250 lb.

\$1100 FOB Denver

Date Quote Received: 3-18-87

Quote Received By: D A. Kottwitz

- **Sewer and Miscellaneous Debris Removal
(Compaction in Waste Pile)**
- **Haul Waste to Waste Pile
(Compaction in Waste Pile)**

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 5-800-2. the proponent agency is USACE.						
PROJECT RMA				PREPARED BY D. Hawk		CREW REF NO.
LOCATION DENVER, CO.				CHECKED BY T. Kelley 3-18-87		
CREW COMPOSITION						
WORK TYPE EXCAVATION / HAULING		WORK SCHEDULE		SPECIAL INFORMATION SLUDGE HANDLING BASIN F TO SOLIDIFICATION FACILITY		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 627 B SCRAPERS	4	17 ⁰³	68 ¹²	117 ⁷⁷	471 ⁰⁸	
CAT D8L DOZERS	2	16 ⁸⁸	33 ⁷⁶	106 ³⁷	212 ⁷⁴	
CAT D6 DOZER	1	16 ⁸⁸	16 ⁸⁸	46 ⁴⁰	46 ⁴⁰	
CAT 14 G MOTOR GRADER	1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹	
MRS 1-100 S TRACTOR W/DISC	1	16 ⁸⁸	16 ⁸⁸	83 ⁰⁹	83 ⁰⁹	
LABORERS	2	12 ⁷⁶	25 ⁵²	—	—	
CAT 627 B SCRAPERS (STANDBY)	1	—	—	75 ³⁷	75 ³⁷	
TOTALS	MANHOURS	11	LABOR COST	178 ¹⁹	EQUIPMENT COST	964 ²⁹
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION / HAULING	404 CY/HR		# 0 ⁴⁴ /CY	# 2 ³⁹ /CY		
SAFETY	404 CY/HR		# 0 ³⁹ /CY	# 0 ⁸⁶ /CY		
TOTAL EQUIPMENT, LABOR & SAFETY					→ # 4 ⁰⁸ /CY	

*Including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET						DATE PREPARED
For use of this form, see TM 5-800-2; the proponent agency is USACE.						3-18-87
PROJECT RMA				PREPARED BY D. Hawk		CREW REF NO
LOCATION DENVER, CO.				CHECKED BY T. Kelley 3-18-87		
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION SLUDGE HANDLING BASIN F TO SOLIDIFICATION FACILITY		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	9	—	—	38 ²⁰	343 ⁸⁰	
STANDBY HEAVY EQUIPMENT	1	—	—	4 ⁴⁵	4 ⁴⁵	
LABORERS	2	78 ⁰⁵	156 ¹⁰	—	—	
TOTALS	MANHOURS	LABOR COST	156 ¹⁰	EQUIPMENT COST	348 ²⁵	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
SAFETY	404 CY/42		\$ 0 ³² /CY	\$ 0 ⁸⁶ /CY		

* Including fringe benefits

Subject Landfill construction - Sludge removal costs. Project No. 86C8554P
By TEK Checked By D. Hawk Task No. 2
Date 3/16/87 Date 3/18/87 File No. 21947
Sheet 1 of 5

SLUDGE HANDLING AND HAULING BASIN F TO SOLIDIFICATION

This work will include mixing and drying sludge, excavating to final grade and hauling to the solidification area.

It is envisioned that Dozers will be used to excavate material down to liner grade and to push load scrapers. Additional dozers will be used to excavate below the liner to the finished grade. Scrapers will be used to haul excavated materials from Basin F to the solidification area rather than trucks as it was assumed they'd be more mobile. It was assumed that portions of the excavation area and sludge could have rolling resistances as high as 15% to 20% whereas other parts of the haul would be on haul roads with very low rolling resistance. Thus, an average rolling resistance of 10% was assumed for the haul.

It was estimated that mixing and drying of the sludge would be achieved by discing with a tractor and disc attachment and a light dozer. A motor grader was envisioned being used for maintaining the haul roads. It was also assumed that 2 laborers would be used as spotters.

Daily production for the excavation fleet should roughly match that of the solidification Pig mill.

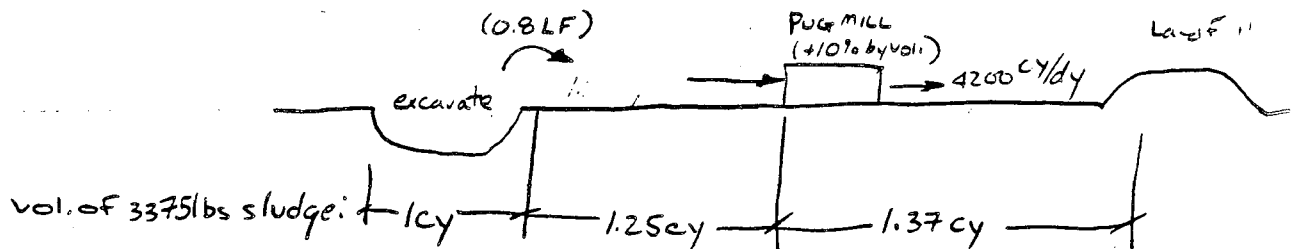
Subject Landfill Construction - Sludge-Kernel Cots Project No. 86CE554P
 By TEK Checked By D. Hawk Task No. 2
 Date 3/16/87 Date 3/18/87 File No. 21947
 Sheet 2 of 5

REQUIRED PRODUCTION:

IT IS ESTIMATED THAT THE PUG-MILL WILL HAVE A PRODUCTION OF 300 cy/hr. and WILL OPERATE 14 hours a day PRODUCTIVELY,

$$\text{PUG MILL PRODUCTION} = 300 \text{ cy/hr} \times 14 \text{ hrs/day} = 4,200 \text{ cy/day}$$

IN TERMS OF BANK CUBIC YARDS:



$$\text{BCY Production} = 4,200 \frac{\text{cy}}{\text{day}} \left(\frac{1 \text{ bcY}}{1.37 \text{ cy}} \right) = 3,066 \text{ bcY/day} \checkmark$$

FOR EXCAVATION CREW @ 8 hours per day

$$3066 \frac{\text{bcY}}{\text{day}} \left(\frac{1 \text{ day}}{8 \text{ hours}} \right) = \underline{\underline{383 \text{ bYd}^3/\text{hr.}}} \checkmark$$

Subject Land Fill Construction - Sludge removal costs Project No. 86C 8554P

By TEK

Checked By D. Hawk

Task No. 2

File No. 21947

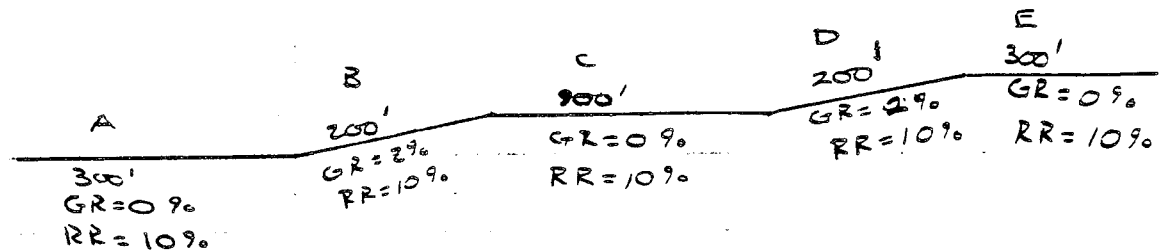
Date 3/16/87

Date 3/18/87

Sheet 3 of 5

ESTIMATED CYCLE TIMES

HAUL PROFILE (CAT 627B SCRAPER) FROM BOTTOM OF EXCAVATION TO SOLIDIFICATION AREA. ASSUME PROFILE IS ESSENTIALLY THE SAME AS THAT FOR SLUDGE EXCAVATION AND HAULING TO STOCKPILE EXCEPT AVERAGE HAUL IS APPROX. 1600 FT. + 300 FT MANUEVERING = 1900 FT AS SHOWN BELOW



HAUL LEG	LENGTH	LOADED		UNLOADED	
		TR	TIME	TR	TIME
A	300'	10%	0.39	10%	0.32
B	200'	12%	0.35	8%	0.24
C	900'	10%	1.12	10%	0.76
D	200'	12%	0.35	8%	0.24
E	300'	10%	0.39	10%	0.32
TOTAL TIME			2.60 min. ✓		1.88 min. ✓
@ 93% ALTITUDE DERATION			2.80 min. ✓		2.02 min. ✓

TOTAL ESTIMATED CYCLE TIME

HAUL	2.80 ✓
RETURN	2.02 ✓
LOAD	0.8 ✓
MANUEVER AND DUMP	0.8 ✓

6.42 min./cycle @ 100% eff. ✓

Subject Landfill Construction - Sludge removal CostsProject No. 36C5554PBy TEKChecked By D. HawkTask No. 2File No. 21947Date 3/16/87Date 3/18/87Sheet 4 of 5ESTIMATED PRODUCTIONESTIMATED LOAD

(0.8 ASSUMED LOAD FACTOR)

$$18 \text{ cy} \times 0.8 \text{ L.F.} = 14.4 \text{ bcyl/LOAD} \checkmark$$

2) CYCLES PER HOUR

$$\left(\frac{60 \text{ min}}{\text{hr.}} \right) \left(\frac{1 \text{ cycle}}{6.42 \text{ min.}} \right) = 9.34 \text{ cycles/hr.} \checkmark$$

3) ADJUSTED HOURLY UNIT PRODUCTION (45 min/hr. for level B)

$$\left(\frac{45 \text{ min}}{60 \text{ min}} \right) (9.34 \text{ cycles/hr.}) (14.4 \text{ bcyl/LOAD}) = 100.9 \text{ bcyl/hr.} \checkmark$$

4) NEED 383 bcyl/hr.

$$\frac{383 \text{ bcyl/hr.}}{100.9 \text{ bcyl/unit}} = 3.80 \checkmark$$

use 4 scrapers $\checkmark$

5) CHECK PUSH DOZER BALANCE

$$\text{DOZER CYCLE } 1.4(0.8) + 0.25 = 1.37 \text{ minutes} \checkmark$$

$$\frac{\text{SCRAPER CYCLE}}{\text{DOZER CYCLE}} = \frac{6.42 \text{ min}}{1.37 \text{ min}} = 4.69 \checkmark$$

SO USE 1 DOZER TO HANDLE 4 SCRAPERS $\checkmark$

6) FLEET PRODUCTION @ LEVEL B EFFICIENCY (45 min/hr)

$$4 \times 100.9 \text{ bcyl/hr.} = \underline{\underline{403.6 \text{ bcyl/hr.}}} \checkmark$$



Subject Landfill Construction-Sludge Removal Costs Project No. EGCESS4P
 By TEK Checked By D. Hawk Task No. 2
 Date 3/16/87 Date 3/18/87 File No. 21947
 Sheet 5 of 5

EQUIPMENT AND FLEET COSTS:

4 CAT 627B SCRAPERS @ \$134 ⁸⁰	=	\$ 539 ²⁰	✓
2 CAT D-8L DOZERS @ \$123 ²⁵	=	\$ 246 ⁵⁰	✓
1 CAT 627B SCRAPER (STANDBY) @ \$75 ³⁷	=	\$ 75 ³⁷	✓
1 CAT 14G MOTOR GRADER @ \$92 ⁶⁴	=	\$ 92 ⁶⁴	✓
1 CAT D-6 DOZER @ \$63 ²⁸	=	\$ 63 ²⁸	✓
1 TRACTOR WITH DISC ATTACHMENT @ \$99 ⁹⁷	=	\$ 99 ⁹⁷	✓
2 LABORERS @ \$12 ⁷⁶	=	\$ 25 ⁵²	✓
		<u>\$1142⁴⁸</u>	✓

COST:

$$\frac{\$1,142⁴⁸/HR \checkmark}{403.6^{CY}/HR \checkmark} = \$2⁸³/CY \checkmark$$

- Haul Waste to Waste Pile

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 5-800-2. the proponent agency is USACE.						
PROJECT RMA			PREPARED BY D. Hawk		CREW REF NO	
LOCATION DENVER, CO.			CHECKED BY T. Kelley 3-18-87			
CREW COMPOSITION						
WORK TYPE GRADING/COMPACTING		WORK SCHEDULE		SPECIAL INFORMATION SLUDGE HANDLING GRADE AND COMPACT IN LANDFILL		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 825 C COMPACTOR	1	16⁸⁸	16⁸⁸	90⁵²	90⁵²	
CAT DBL DOZER	1	16⁸⁸	16⁸⁸	106³⁷	106³⁷	
TOTALS	MANHOURS	2	LABOR COST	33⁷⁶	EQUIPMENT COST 196⁸⁹	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
GRADING/COMPACTION	383 CY/HR		\$0²⁹/CY	\$0⁵¹/CY		
SAFETY			—	\$0²⁰/CY		
TOTAL EQUIPMENT LABOR & SAFETY					\$0⁸⁰/CY	

* Including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 5-800-2; the proponent agency is USACE.						
PROJECT RMA				PREPARED BY D. Hawk		CREW REF NO.
LOCATION DENVER, CO.				CHECKED BY T. Kelly 3-18-87		
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE			SPECIAL INFORMATION	
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	2	—	—	38²⁰	76⁴⁰	
TOTALS	MANHOURS		LABOR COST	—	EQUIPMENT COST	76⁴⁰
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
SAFETY	383^{cy}/hr		—	0²⁰/cy		

*Including fringe benefits

Subject Landfill Costs - Landfill grading and Compaction Project No. 86C8554P
By TEK Checked By D. Hawk Task No. 2
Date 3/17/87 Date 3/18/87 File No. 21947
Sheet 1 of 2

GRADE AND PLACE WASTE IN LANDFILL

This work will include spreading of the solidified material dumped by the scrapers, and compacting in the landfill.

It is assumed that one dozer will spread the material to grade and a compactor will compact the material with one pass. Two laborers will be used as spotters.

Production should roughly match that of the scrapers hauling the solidified material to the landfill (525 cy./hr. or 383 bcy./hr.)

Subject landfill costs - landfill grading and compaction Project No. 86C 8554P

By TEK

Checked By D. Hawk

Task No. 2

File No. 21947

Date 3/17/87

Date

3/18/87

Sheet 2 of 2

REQUIRED PRODUCTION

hourly prod. = 525 cy./hr. (~~383~~ = bcy/hr.)

scraper cycle = 1.483 min @ 100% efficiency
4 scrapers, 1 scraper every 1.21 min. ✓

CHECK COMPACTOR PRODUCTION:

CAT 825 C Performance ; 3 passes, 4 mph, 8 inch lifts,
(From CAT Performance Handbook) production = 1283 yd³/hr. ✓ o.k.
 $1283 \times \frac{45}{60} = 962 \text{ yd}^3/\text{hr.}$
so use 1 compactor assisted
by 1 D-8 DOZER ✓

FLEET COST

1 CAT 825C compactor @ \$107.40 = \$107.40 ✓
1 CAT D-8 DOZER @ \$123.25 = \$123.25 ✓

\$230.65/hr. ✓

COST

$\frac{\$230.65/\text{hr.}}{525 \text{ cy./hr.}} = \$0.44/\text{cy.} ✓$

$\frac{\$230.65/\text{hr.}}{4303 \text{ bcy/hr.}} = \$0.60/\text{bcy} ✓$

*Note: No safety considerations taken into account
for this cost except 45/60 % efficiency.

- Solidification

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 5-800-2, the proponent agency is USACE.						
PROJECT RMA			PREPARED BY D. HAWK		CREW REF NO	
LOCATION DENVER, CO.			CHECKED BY T. KELLEY 3-18-87			
CREW COMPOSITION						
WORK TYPE EXCAVATION / HAULING		WORK SCHEDULE		SPECIAL INFORMATION SLUDGE HAULING SOLIDIFICATION FACILITY TO LANDFILL		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT 627 B SCRAPERS	4	17 ⁰³	68 ¹²	117 ²⁷	471 ⁰⁸	
CAT D8L DOZERS	1	16 ⁸⁸	16 ⁸⁸	106 ³⁷	106 ³⁷	
CAT 966D LOADERS	2	16 ⁸⁸	33 ⁷⁶	61 ¹⁰	122 ³⁰	
LABORERS	2	12 ⁷⁶	25 ⁵²	—	—	
CAT 627B SCRAPERS (STANDBY)	1	—	—	75 ³⁷	75 ³⁷	
TOTALS	MANHOURS	9	LABOR COST	144 ²⁸	EQUIPMENT COST	775 ⁰²
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
EXCAVATION / HAULING	383 CY/HR		\$0 ³⁸ /CY	\$2 ⁰² /CY		
SAFETY	383 CY/HR		\$0 ⁴¹ /CY	\$0 ²¹ /CY		
TOTAL EQUIPMENT WITH LABOR & SAFETY					→ \$3 ⁵² /CY	

* Including fringe benefits

(13A)

CREW AND PRODUCTIVITY WORKSHEET

For use of this form, see TM 5-800-2; the predominant agency is USACE.

DATE PREPARED

3-18-87

PROJECT

RMA

PREPARED BY

D. Hawk

CREW REF NO

LOCATION

DENVER, CO.

CHECKED BY

T. Kelley 3-18-87

CREW COMPOSITION

WORK TYPE

SAFETY

WORK SCHEDULE

SPECIAL INFORMATION SLUDGE HANDLING
SOLIDIFICATION FACILITY TO LANDFILL

CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST	
		HOURLY* RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)
HEAVY EQUIPMENT	7	—	—	38 ²⁰	267 ⁴⁰
STANDBY HEAVY EQUIPMENT	1	—	—	4 ⁴⁵	4 ⁴⁵
LABORERS	2	78 ²⁵	156 ¹⁰	—	—
TOTALS	MANHOURS	LABOR COST	156 ¹⁰	EQUIPMENT COST	271 ⁸⁵

CREW PRODUCTIVITY

WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS
		MM/UNIT	\$/UNIT		
SAFETY	383 ^{cy/hr}		\$0 ⁴¹ /cy	\$0 ²¹ /cy	

*Including fringe benefits

Subject Landfill Costs - Solidification to Landfill

Project No. 86C3554P

By TEK

Checked By D. Hawk

Task No. 2

File No. 21947

Date 3/16/87

Date 3/18/87

Sheet 1 of 4

SLUDGE HAULING - SOLIDIFICATION AREA TO LANDFILL

This work will include loading material from the solidified sludge stockpile at the Pug mill into scrapers and hauling and dumping it in the landfill.

It is assumed that loaders will be used to top load scrapers. Scrapers will then haul the material to the landfill and dump it. A D-8 Dozer will assist the loaders. 2 laborers will be used as spotters.

Daily production of the fleet should roughly match the output of the pug mill.

Subject Landfill Costs - Solidification to landfill Project No. EGCE554P
 By TEK Checked By D. Hawk Task No. 2
 Date 3/16/87 Date 3/18/87 File No. 21947
 Sheet 2 of 4

REQUIRED PRODUCTION:

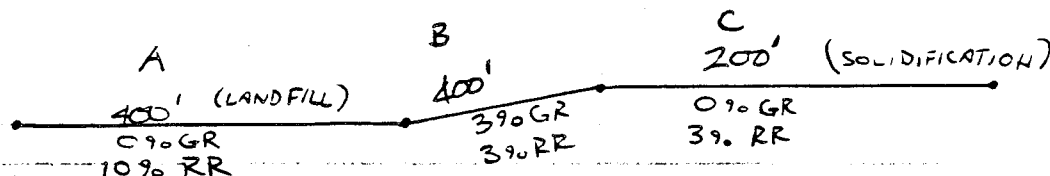
PVG MILL OUTPUT = 4,200 cy/day (3066 bcy/day)

Adjusted Landfill hauling Fleet production for
 an 8-hour day = 525 cy/hr.

$(525 \div 1.37) = (383 \text{ bcy/hr})$

ESTIMATED CYCLE TIMES

HAUL PROFILE (CAT 627B SCRAPERS) AVG. HAUL = 800 ft.
 USE 1,000 ft WITH MANUEVERING



SECTION	LENGTH	LOADED		UNLOADED	
		TR	TIME (min)	TR	TIME (min)
A	400'	10%	.54	10%	.41
B	400'	0%	.34	6%	.34
C	200'	3%	.25	3%	.19

TOTAL TIME 1.13 min. ✓ 0.94 min. ✓
 @ 93% altitude deviation 1.22 min. ✓ 1.01 min. ✓

LOAD CYCLE

- USE 0.2 min. first load, 0.4 min. additional loads
- For 4 cy bucket @ 1.0 Load Factor = 4.0 cy/load
- (18 cy scraper vol.) (4.0 cy/load) = 4.5 passes of bucket (say)
- $0.2 + 4(0.4) = 1.8 \text{ min/load @ 100\% eff}$ ✓
- (No loader deviation for 5000' altitude.) ✓

Subject Landfill Costs - Solidification to Landfill

By TEK

Checked By D. Hawk

Date 3/16/87

Date

3/18/87

Project No. 86C 8554 P

Task No. 2

File No. 21947

Sheet 3 of 4

TOTAL ESTIMATED CYCLE TIME

HAUL	1.22 min. ✓
RETURN	1.01 min. ✓
LOAD	1.8 min. ✓
MANUEVER & DUMP	0.8 min. ✓

4.83 min/cycle @ 100% eff. ✓

ESTIMATED PRODUCTION:

1) ESTIMATED LOAD (1.0 assumed load factor)

$$18 \text{ cy/load} \times 1.0 \text{ L.F.} = 18.0 \text{ cy/load} \quad \checkmark$$

2) cycles per hour

$$\left(\frac{60 \text{ min}}{\text{hr.}} \right) \left(\frac{1 \text{ cycle}}{4.83 \text{ min.}} \right) = 12.4 \text{ cycles/hour.} \quad \checkmark$$

3) Adjusted Hourly Unit Production (45 min/hr. for level B) ✓

$$\left(\frac{45 \text{ min}}{60 \text{ min}} \right) (12.4 \text{ cycles/hr}) (18.0 \text{ cy/load}) = 167.4 \text{ cy/hr/unit} \quad \checkmark$$

4) NEED 525 cy/hr. (loose)

$$\left(\frac{525 \text{ cy/hr}}{167.4 \text{ cy/hr/unit}} \right) = 3.14 \quad \checkmark$$

$$\left(\frac{525 \text{ cy/hr}}{167.4 \text{ cy/hr/unit}} \right)$$

use 4 scrapers ✓

5) Check loader balance

$$\left(\frac{\text{scraper cycle}}{\text{loader cycle}} \right) = \frac{4.83 \text{ min}}{1.8 \text{ min}} = 2.68 \frac{\text{scrapers}}{\text{loader}}$$

use 2 loaders for 4 scrapers ✓

6) FLEET Production @ Level B efficiency (45 min/hr.)

$$4 \times 167.4 \text{ cy/hr/unit} = 669.6 \text{ cy/hr.} \quad \checkmark$$

$$= \left(\frac{383 \text{ bcy}}{525 \text{ cy}} \right) (669.6 \text{ cy/hr}) = 488.5 \text{ bcy/hr} \quad \checkmark$$

Subject Landfill Costs - Solidification to Landfill

Project No. 86CE554P

By TEK

Checked By D. Hawk

Task No. 2

File No. 21947

Date 3/16/87

Date 2/18/87

Sheet 4 of 4

4	CAT 627B scrapers @ \$134 ⁸⁰	=	\$539 ²⁰ ✓
1	Cat 627B scraper (standby) @ \$75 ³⁷	=	\$75 ³⁷ ✓
2	Cat 966D loader @ \$77 ⁹⁸	=	\$155 ⁹⁶ ✓
1	Cat D-8 Dozer @ \$123 ²⁵	=	\$123 ²⁵ ✓
2	laborers @ \$12 ⁷⁶	=	\$25 ⁵² ✓

TOTAL HOURLY

\$919³⁰ ✓

COST PER CY.

$$* (\$919^{30}/\text{hr.}) / (525 \text{ cy/hr.}) = \$175 / \text{cy.} \checkmark$$

$$* (\$919^{30}/\text{hr.}) / (383 \text{ bcy/hr.}) = \$240 / \text{bcy} \checkmark$$

USE THIS
PRICE BASED ON
BCY EXCAVATED.
THIS WILL INCLUDE
10% ADDITION OF
SOLIDIFICATION
MATERIAL (VOLUME)

* NOTE: These costs do not include safety consideration costs except for 45/60 % efficiency.

CONSTRUCTION COST ESTIMATE				DATE PREPARED 3/87		SHEET 1 of 1	
PROJECT BASINF - RMA				BASIS FOR ESTIMATE			
LOCATION DENVER, CO				☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☒ OTHER (Specify) 60% Design			
ARCHITECT ENGINEER WCC/HDR				LABOR 6x on Level B			
DRAWING NO.		ESTIMATOR KOTTWITZ-GRACHER		CHECKED BY AL ERICKSON			
Absorption System SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
WOOD WALL							
2x4 Frame	2640	LF	1.68	4436	0.24	634	5070
1/2" Plywood	2160	SF	1.26	2722	0.41	886	3608
Nails	100	lb	—	—	0.48	48	48
Expansion Anchors	60	Ea	11.82	710	2.65	159	869
SITEWORK						SUBTOTAL	9595 ✓
2" PVC Water	255	LF	13.00	3315	8.33	2124	5439 ✓
Incoming Power	4000	LF	—	75,202	—	103,550	178,752
Sump Excavation	1000	CF	1.98	1,980	0.25	250	2,230
- Concrete	4	CY	437.4	1,750	70	280	2,030
- Formwork	400	SF	23.04	9,216	1.49	596	9,812
EQUIPMENT						SUBTOTAL	198,263
Flu Ash Tanks	2	Ea	24,000	48,000	40,000	80,000	128,000
Pulv Mills	3	LS	—	10,000	—	96,000	106,000
- Hoppers	4	Ea	1,200	4,800	7,000	8,000	12,800
- Electrical	—	—	—	5856	—	565	6,421
Belt Conveyors (Full)	240	LF	100	24,000	750	180,000	204,000
Belt Conveyors (Pilot)	120	LF	100	12,000	600	72,000	84,000
- Electrical	—	—	—	12,700	—	7,300	20,000
Lighting (Abs. Pouch)	—	LS	—	28,098	—	9,004	37,102
Rotary Feeders	—	—	—	—	—	—	—
- Feeders, Motor	3	Ea	1,800	5,400	1385	4,155	9,555
- VFD 3HP	3	Ea	402	1206	1538	4,614	5,820
Dust Control System							
- Cyclone	1	Ea	—	5,000	—	12,000	17,000
- Blower	1	Ea	—	1560	—	2,800	4,360
- Electrical	1	Ea	—	400	—	800	1,200
						SUBTOTAL	636,252
SUBTOTAL PG 1				258,351		585,765	844,116

CONSTRUCTION COST ESTIMATE				DATE PREPARED <u>3/87</u>		SHEET <u>2</u> of <u>2</u>			
PROJECT <u>BASIN F - RMA</u>				BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) ☒ OTHER (Specify) <u>60% Design</u>					
LOCATION <u>DENVER, CO</u>									
ARCHITECT ENGINEER <u>WCC/HDR</u>									
DRAWING NO.		ESTIMATOR <u>KOTTWITZ - GRACHEK</u>		CHECKED BY <u>AL ERICKSON</u>					
ABSORPTION AREA SUMMARY		QUANTITY		LABOR		MATERIAL		TOTAL COST	
		NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
<u>Ammonia Scrubber System</u>									
- Scrubber		1	Ea		10,000		15,000	25,000	
- Pumps, Piping		1	Ea		30880		31,174	62,050	
- Blower		1	Ea		1560		4,500	6,060	
- Electrical		1	Ea		400		800	1,200	
<u>OPERATIONS</u>							<u>SUBTOTAL</u>	<u>94,310</u>	
<u>Chemicals</u>									
- Fly Ash		40,000	CY			28.70	1,148,000	1,148,000	
- H ₂ SO ₄		5000	Gal			0.76	3,800	3,800	
- NaClO		400	Gal			0.90	360	360	
- NaOH		500	Gal			1.02	510	510	
							<u>SUBTOTAL</u>	<u>1,152,670</u>	
<u>Electrical Power</u>		720,000	W.HR	-	4700/hr	DEMAND CHARGE 28,200	0.06	43,200	71,400
<u>Maintenance</u>							<u>SUBTOTAL</u>	<u>71,400</u>	
5 Equip Operators		15600	hrs	17.18	268,008			268,008	
2 Laborers		6240	hrs	13.76	85,862			85,862	
1 Pul Mill Operator		3120	hrs	16.88	52,666			52,666	
1 Fly Ash Operator		3120	hrs	16.88	52,666			52,666	
<u>Equipment</u>							<u>SUBTOTAL</u>	<u>459,200</u>	
4 Loaders 130HP		5320	hrs			61.10	508,352	508,352	
1 Dozer 140HP		2080	hrs			46.40	96,512	96,512	
CAP OUTLAY COST		1	LS				66,000	66,000	
Abs. Maint Cost		1	LS				67,500	67,500	
<u>CONC SLAB</u>		1	LS		329,422	LS	83,816	413,238	
<u>SUBTOTAL PG 2</u>					859,664		2,069,524	2,929,188	
<u>SUBTOTAL PG 1</u>					258,351		585,765	844,116	
<u>TOTAL</u>					1,118,015		2,655,289	3,773,304	

CONSTRUCTION COST ESTIMATE					DATE PREPARED <u>3/87</u>		SHEET <u>1</u> OF <u>2</u>	
PROJECT <u>RMA</u>					BASIS FOR ESTIMATE ☐ CODE A (No design completed) ☐ CODE B (Preliminary design) ☐ CODE C (Final design) <u>60% &c</u> ☒ OTHER (Specify) <u>AL FRICK</u>			
LOCATION <u>DENVER, CO</u>								
ARCHITECT ENGINEER <u>WCC/HDR</u>								
DRAWING NO.			ESTIMATOR <u>FURNE</u>		CHECKED BY			
SUMMARY	QUANTITY		LABOR		MATERIAL		TOTAL COST	
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL		
GROUND SLAB								
125' x 100' x 8" 0.75	12.500	SF	\$0.46 B	34.500	1.44	18.000	52.50	
Rebar								
#4's - $(84 \times 125' \times 0.668 \text{ lb/ft}) +$	5.74	Ton	305 B	10.504	505	2.899	13.40	
$(67 \times 100' \times 0.668 \text{ lb/ft})$								
$12000 \text{ lb/ton} = 5.74 \text{ T}$								
1.220								
$(3' \text{ slab} \times (125' + 100' + 100') \times 0.37)$	24.2	CY	99 B	14.375	75	1815	16.190	
$1.27 = 24.19 \text{ CY}$								
#5's $3.5' \times 3.5' \times 1.042 \text{ lb/ft} / 12000 \text{ lb}$	0.59	Ton	230 B	214	505	298	111.2	
#4's $2.1' \times 2.5' \times 0.668 \text{ lb/ft} / 12000 \text{ lb}$	0.33	Ton	230 B	455	505	167	62.2	
Form's Part								
100' x 100' x 4"	10.000	SF	0.43 B	25.900	0.71	7.100	32.900	
Rebar WWF-1/2" x 6" #4/2	125	CSF	13.10 B	9.825	20.20	2.525	12.35	
Concrete slab								
125' x 125' x 1 1/2"	15.125	SF	0.49 B	45.932	1.80	28.125	74.06	
#4's $(2 \times (84 \times 125' \times 0.668 \text{ lb/ft}) / 12000)$	7.01	Ton	305 B	12.328	505	3.540	16.36	
Wall $(125 \times 5' \times 14") / 127 = 19.3$	19.3	CY	99 B	11.464	75	1.448	12.9	
$1/3 \times 125 \times 0.668 / 12000 +$								
$(125 \times 3.5' \times 0.668 / 12000) = 0.54 \text{ T}$	0.54	Ton	230 B	745	505	273	1.018	
Finishing								
$(125 \times 125) + (125 \times 100) + (125 \times 100) =$	40,625	SF	0.22 B	53,625			53.62	
Curbs $40,625 / 100$	406	CSF	2.71 B	6,602	1.70	690	7.29	

- Haul Roads (Level B)

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED	
For use of this form, see TM 5-800-2: the procement agency is USACE.					3/18/87	
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. HARK 3/18/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION HAUL ROADS - LEVEL B AREAS		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT D-8 DOZER	2	16 ⁸⁸	33 ⁷⁶	106 ³⁷	212 ⁷⁴	
CAT 966 LOADER	1	16 ⁸⁸	16 ⁸⁸	61 ¹⁰	61 ¹⁰	
18 CUBIC YARD END DUMP TRUCK	3	17 ⁰⁹	51 ²⁷	41 ¹⁸	123 ⁵⁴	
CAT 14G MOTOR GRADER	1	17 ⁰³	17 ⁰³	75 ⁶¹	75 ⁶¹	
LABORERS	2	12 ⁷⁶	25 ⁵²	—	—	
TOTALS	MANHOURS	9	LABOR COST	144 ⁴⁶ ✓	EQUIPMENT COST	472 ⁹⁹ ✓
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MM/UNIT	\$/UNIT			
EXCAVATION/PLACEMENT	317 ^{ccy/hr.}		*0 ⁴⁶ /cy ✓	*1 ⁴⁹ /cy ✓		
SAFETY	317 ^{ccy/hr.}		*0 ⁴⁹ /cy ✓	*0 ⁸⁴ /cy ✓		
MATERIALS DELIVERED TO STOCKPILE	—		—	*8 ⁰⁵ /cy ✓		
TOTAL EQUIPMENT MATERIALS, LABOR, SAFETY					*11 ³³ /ccy ✓	

*including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET						DATE PREPARED
For use of this form, see TM 5-800-2; the predominant agency is USACE.						3-18-87
PROJECT RMA				PREPARED BY T. KELLEY		CREW REF NO
LOCATION DENVER, CO				CHECKED BY D. Hawk 3/18/87		
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION HAUL ROADS- LEVEL B AREAS		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	7	—	—	38 ²⁰	267 ⁴⁰	
LABORERS	2	78 ⁰⁵	156 ¹⁰	—	—	
TOTALS	MANHOURS	LABOR COST	156 ¹⁰ ✓	EQUIPMENT COST	267 ⁴⁰ ✓	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
SAFETY	317 ccy/hr.		\$ 0 49 / cy ✓	\$ 0 84 / cy ✓		

*including fringe benefits

Subject Land fill Construction - Level B haul Rd Cat Project No. 86C8554 PBy TEKChecked By D. HawkTask No. 2File No. 21947Date 3/17/87Date 3/18/87Sheet 1 of 5HAUL ROADS - , LEVEL B AREAS -

THIS WORK will include supplying and transporting haul road material to a stockpile just inside the level B zone, maintaining the stockpile in the level B area, and hauling and placing the material in the level B area.

Several ramps will be constructed up to the fence line (zone B boundary) and haul roads constructed such that end dumps can turn and dump efficiently. A dozer will be required to move material from the ramp area to other parts of the stockpile. A cat 966 loader with the assistance of a D-8 dozer will load trucks in the stockpile area. The loaded trucks will then haul the material an assumed average distance of 1500 ft. and dump the material, where it will be spread by a D-8 Dozer. Two laborers will be used as spotters. A motor grader will be used to maintain the haul roads.

Subject Landfill Construction - Red Bluff Project No. 86C85547
 By TEK Checked By D. Hawk Task No. 2
 Date 3/17/87 Date 3/18/87 File No. 21947
 Sheet 2 of 5

MATERIAL COST TO STOCKPILE:

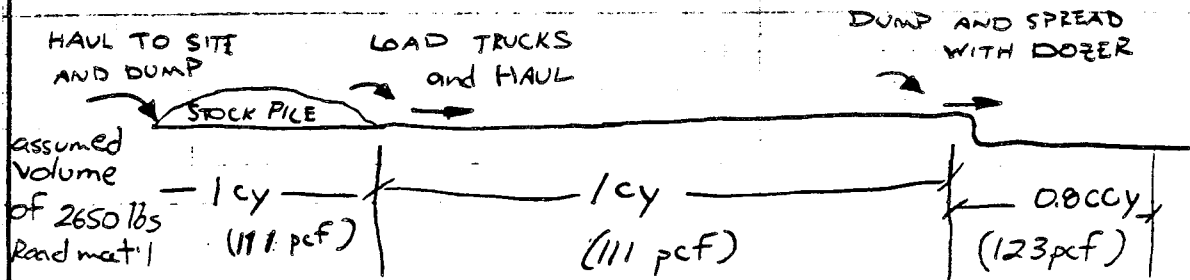
<u>SUPPLIER</u>	<u>MAT'L</u>	<u>COST</u>	<u>HAULING</u>	<u>TOTAL</u>
BRINKMAN - WOODWARD CONSTRUCTION CO.	3/8" max. size PIT RUN Gravel	\$ ~~300~~ /TON	\$185/TON (FOR 10 mile Haul)	\$485/TON ✓

COST PER CCY

$$\left(\$485/\text{TON} \right) \left(\frac{1 \text{ TON}}{2000 \text{ lbs}} \right) \left(\frac{123 \text{ lbs}}{\text{CCF}} \right) \left(\frac{27 \text{ f}^3}{1 \text{ yd}^3} \right) = \$805/\text{CCY} \quad \checkmark$$

Subject Landfill Construction - Level B haul line Project No. 86C8554 P
 By TEK Checked By D. Hawk Task No. 2
 Date 3/17/87 Date 3/18/87 File No. 21947
 Sheet 3 of 5

ASSUMED LOAD FACTORS



LOAD FACTOR FOR LOADING AND HAULING
 $= 1 \text{ cy} / 0.9 \text{ ccy} \checkmark$

LOAD CYCLE

- USE 0.2 min. for first pass and 0.4 min for additional passes
- FOR 4 CY BUCKET @ 90% EFF. = 3.6 cy/LOAD (WASE) $\checkmark$

18 cy Truck / 3.6 cy/LOAD = 5 LOADS $\checkmark$

$0.2 + 4(0.4) = 1.8 \text{ min}$ to load truck with assistance of one D-8 dozer $\checkmark$

HAUL CYCLE

SECTION	LENGTH	Avg speed		TRAVEL TIME	
		LOADED	EMPTY	LOADED	EMPTY
A	500'	7.5	10	0.76 $\checkmark$	0.57 $\checkmark$
B	500'	15	20	0.38 $\checkmark$	0.28 $\checkmark$
C	500'	7.5	10	0.76 $\checkmark$	0.57 $\checkmark$
				1.90	1.42

A 500' 0-15
 B 500' 15
 C 500' 15-0
 LOADED CYCLE
 A 500' 0-20
 B 500' 20
 C 500' 20-0
 EMPTY CYCLE

TIME = $500 \text{ ft} \times \frac{1 \text{ mi}}{5280 \text{ ft}} \left(\frac{60 \text{ min}}{\text{hr}} \right) \left(\frac{1}{\text{Speed (mi/hr.)}} \right) = \frac{5.68}{\text{Speed (mi/hr.)}} \text{ (min)}$

Subject Landfill Construction - level B haul Road Cst Project No. 86C8554 P
 By TEK Checked By D. Hawk Task No. 2
 Date 3/17/87 Date 3/18/87 File No. 21947
 Sheet 4 of 5

TOTAL TRUCK CYCLE

EXCHANGE TIME	0.5 minutes ✓
LOAD	1.8 minutes ✓
HAUL	1.9 minutes ✓
RETURN	1.42 minutes ✓
MANUEVER + DUMP	<u>0.7 minutes ✓</u>

TOTAL CYCLE 6.32 minutes @ 100% eff. ✓

NO. OF TRUCKS

EXCHANGE & LOAD CYCLE
 $= 1.8 \text{ min} + 0.5 = 2.3 \text{ min} ✓$

NEED
 $6.32 \text{ min.} / 2.3 \text{ min} = 2.75 \text{ TRUCKS} ✓$

USE 3 Trucks ✓

production based
 on 2.75 trucks ✓

ESTIMATE PRODUCTION

1) AVG LOAD / CYCLE / UNIT

$= 18 \text{ cy} / \text{UNIT LOAD} \times 0.9 \text{ L.F.} = 16.2 \text{ ccy} / \text{Unit Load}$

2) CYCLES PER HOUR $\left(\frac{60 \text{ min}}{\text{hr.}} \times \frac{1 \text{ cycle}}{6.32 \text{ min}} \right) = 9.49 \text{ cycles/hr.} ✓$

3) HOURLY PRODUCTION RATE

$\left(16.2 \text{ ccy} / \text{load} \times \frac{9.49 \text{ load/unit}}{\text{hr}} \right) = 153.7 \text{ ccy} / \text{unit-hr.}$

4) FLEET PRODUCTION

$2.75 \text{ units} (153.7 \text{ ccy} / \text{unit-hr.}) = 423 \text{ ccy} / \text{hr.} ✓$

5) CHECK DOZER PRODUCTION

$1200 \text{ cy/hr} \times 0.9 \text{ ccy/cy} = 1080 \text{ ccy/hr.} > 423 \text{ ccy/hr.} ✓$

Subject Landfill Construction - Level 3 haul Road Const. Project No. 86C8554P
 By TEK Checked By D. Hawk Task No. 2
 Date 3/17/87 Date 3/18/87 File No. 21947
 Sheet 5 of 5

6) PRODUCTION ADJUSTED FOR EFFICIENCY ($45 \text{ min}/60 \text{ min/hr}$)
 $(423 \text{ ccy/hr}) (45 \text{ min}/60 \text{ min}) = 317 \text{ ccy/hr.}$

EQUIPMENT LIST AND COSTS

1)	2 CAT D-8 DOZERS	@ 123 ²⁵	= 246 ⁵⁰ /HR.	✓
2)	1 CAT 966 LOADER	@ 77 ⁹⁸	= 77 ⁹⁸	✓
3)	3 18CY END DUMP TRUCKS	@ 58 ²⁷	= 174 ⁸¹	✓
4)	2 LABORERS	@ 12 ⁷⁶	= 25 ⁵²	✓
5)	1 CAT 14G MOTOR GRADER	@ 92 ⁶⁹	= 92 ⁶⁹	
TOTAL COST			<u>\$617⁹⁵ /HR</u>	✓

COST TO HAUL FROM STOCKPILE AND PLACE

$\frac{\$617⁹⁵ /HR}{317 \text{ ccy/hr}} = \$1⁹⁵ /ccy$

TOTAL COST FOR SUPPLYING AND PLACING

\$ 1⁹⁵ /ccy ✓
 + \$ 8⁰⁵ /ccy ✓
 \$ 10⁰⁰ /ccy *

* COST W/O SAFETY EXCEPT 45/60 EFFICIENCY

- Haul Roads (Level D)

CREW AND PRODUCTIVITY WORKSHEET					DATE PREPARED 3-18-87	
For use of this form, see TM 8-800-2: the predecessor agency is USACE.						
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/19/87			
CREW COMPOSITION						
WORK TYPE EXCAVATION/PLACEMENT		WORK SCHEDULE		SPECIAL INFORMATION HAUL ROADS - LEVEL D AREAS		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
CAT D-8L DOZER	2	1688	3376	10637.	21274.	
CAT 966 LOADER	1	1688	1688	6110	6110	
18 CUBIC YARD END DUMP TRUCK	3	1709	5127	4118	12354	
CAT 14 G MOTOR GRADER	1	1703	1703	7561	7561	
LABORER	2	1276	2552	—	—	
TOTALS	MANHOURS	9	LABOR COST	14446	EQUIPMENT COST	47299
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT		COMMENTS
		MH/UNIT	\$/UNIT			
EXCAVATION/ PLACEMENT	352 ccY/hr.	—	\$041/cy	\$137/cy		
SAFETY	352 ccY/hr.		—	\$009/cy		
MATERIALS DELIVERED TO STOCKPILE				\$805/cy		
TOTAL EQUIPMENT, MATERIALS, LABOR, SAFETY					\$989/cy	

*including fringe benefits

CREW AND PRODUCTIVITY WORKSHEET						DATE PREPARED
For use of this form, see TM 5-800-2: The procurement agency is USACE.						3-18-87
PROJECT RMA			PREPARED BY T. KELLEY		CREW REF NO	
LOCATION DENVER, CO			CHECKED BY D. Hawk 3/18/87			
CREW COMPOSITION						
WORK TYPE SAFETY		WORK SCHEDULE		SPECIAL INFORMATION HAUL ROADS - LEVEL D AREAS		
CREW DESCRIPTION	NO. REQUIRED IN CREW	LABOR COST		EQUIPMENT COST		
		HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	HOURLY RATE (\$/HR)	TOTAL FOR CREW (\$/HR)	
HEAVY EQUIPMENT	7	—	—	4.95	31.15	
TOTALS	MANHOURS	LABOR COST	—	EQUIPMENT COST	31.15 ✓	
CREW PRODUCTIVITY						
WORK TASK	PRODUCTIVITY RATE UNIT/HR	LABOR		EQUIPMENT \$/UNIT	COMMENTS	
		MH/UNIT	\$/UNIT			
SAFETY	352 CY/HR		—	\$0.99/CY		

*Including fringe benefits

Subject Landfill Construction - Level D Haul Road Project No. 86C8554 P
By TEK Checked By D. Hawk Task No. 2
Date 3/17/87 Date 3/18/87 File No. 21947
Sheet 1 of 4

HAUL ROADS, LEVEL D AREAS

This work will include supplying and transporting haul road material to the site. I and stockpiling the material near the landfill site, but outside of the level B area, maintaining the stockpile, and hauling and placing the material in the level D areas.

It is assumed that a dozer will be required to maintain the stockpile. A cat 966 loader with the assistance of a D-8 dozer will load trucks in the stockpile area. The loaded trucks will then haul the material an assumed distance of 1500 ft. and dump the material, where it will be spread by a D-8 dozer. Two laborers will be used as spotters.

Subject Landfill Construction - feed Dhaul Road Project No. E6C8554P
 By T. Keiser Checked By D. Hawk Task No. 2
 Date 3/17/87 Date 3/18/87 File No. 21947
 Sheet 2 of 4

Material Costs to Stockpile

(See level B haul Roads)

mat'l hauling
 $\$3.00/\text{ton}$ $\$1.85/\text{ton}$ = $\$4.85/\text{ton}$ ✓

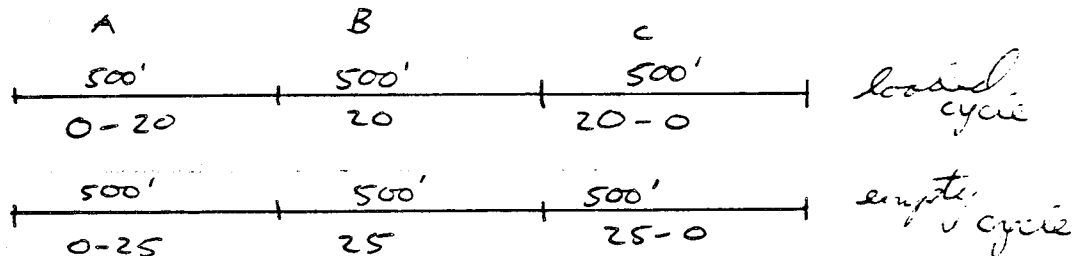
$$\text{Cost Per CCY} = \$8.05/\text{ccy} \quad \checkmark$$

$$= \frac{\$4.85}{\text{ton}} \times \frac{1 \text{ ton}}{2000 \text{ lb}} \times \frac{123 \text{ lb}}{\text{cf}} \times \frac{27 \text{ CF}}{\text{yd}^3} = \$8.05/\text{ccy} \quad \checkmark$$

LOAD CYCLE

= 1.8 min / truck For CAT 966 Loader
 WITH ASSISTANCE FROM CAT D-8 DOZER
 (SEE level B haul roads) ✓

HAUL CYCLE



section	length	avg. speed loaded	avg. speed Empty	Travel Time loaded	Travel Time Empty
A	500'	10	12.5	0.57 ✓	0.45 ✓
B	500'	20	25	0.28 ✓	0.23 ✓
C	500'	10	12.5	0.57 ✓	0.45 ✓

$$\text{time} = 500' \left(\frac{1 \text{ mi}}{5280'} \right) \left(\frac{60 \text{ min/hr}}{\text{speed}} \right) \left(\frac{1}{\text{speed}} \right) = \frac{5.68}{\text{speed}} \left(\frac{\text{min}}{\text{hr}} \right)$$

TOTAL TRUCK CYCLE

exchange time	0.5 minutes ✓
load	1.8 ✓
Haul	1.42 ✓
Maneuver + Dump	0.7 ✓
Return	1.13 ✓

Total Truck Cycle = 5.55 minutes ✓

Subject Highway Construction - Level Baul Road Project No. 86C8554P
 By TEK Checked By D. Hawk Task No. 2
 Date 3/17/87 Date 3/18/87 File No. 21947
 Sheet 3 of 4

No. of Trucks

Exchange + load cycle = 2.3 min. (see level B haul roads)

Need 5.55 minutes / 2.3 min = 2.41 trucks ✓

use 3 trucks ✓

production estimate based on 2.41 trucks

ESTIMATE PRODUCTION:

1) avg load/cycle-unit

$$18 \text{ cy} \times 0.9 = 16.2 \text{ ccy/unit-load} \quad \checkmark$$

(see level B haul roads)

2) cycles per hour

$$\left(\frac{60 \text{ min}}{\text{hr}} \right) \left(\frac{1 \text{ cycle}}{5.55 \text{ min}} \right) = 10.81 \frac{\text{cycles}}{\text{hr}}$$

3) Hourly Production Rate

$$(16.2 \text{ ccy/load}) \left(\frac{10.81 \text{ load/unit}}{\text{hr}} \right) = 175.1 \frac{\text{ccy}}{\text{hr}}$$

4) fleet production

$$(2.41 \text{ units}) (175.1 \text{ ccy/hr-unit}) = 422 \text{ ccy/hr} \quad \checkmark$$

5) check dryer production

$$1200 \text{ cy/hr} \times 0.8 \text{ ccy/cy} = 960 \text{ ccy/hr} > 422 \text{ ccy/hr}$$

6) production adjusted for efficiency (50 min/hr)

$$(422 \text{ ccy/hr}) \left(\frac{50 \text{ min}}{60 \text{ min}} \right) = 352 \text{ ccy/hr} \quad \checkmark$$

Subject Landfill Construction - Level D Haul road Project No. 86C8554P
 By T. Kelley Checked By D. Hawk Task No. 2
 Date 3/17/87 Date 3/18/87 File No. 21947
 Sheet 4 of 4

Equipment List and Costs

- 1) 2 cat D-8 Dozers @ \$123²⁵ = \$246⁵⁰/hr. ✓
- 2) 1 cat 966 loader @ \$77⁹⁸ = 77⁹⁸ ✓
- 3) 3 18cy end dump trucks @ 58²² = 174⁸¹ ✓
- 4) 2 rollers @ 12⁷⁶ = 25⁵²/hr. ✓
- 5) 1 cat 14G MOTOR GRADER = 92⁶⁴/hr
- Total Cost \$617⁴⁵/hr. ✓

Cost To Haul From Stockpile and Place

$$\frac{\$617.45}{\text{hr.}} \div 352 \text{ ccy/hr.} = \$1.75 \text{ ccy} \checkmark$$

TOTAL COST FOR SUPPLYING AND PLACING

$$\begin{aligned} & \$1.75 / \text{ccy} \checkmark \\ & \$8.05 / \text{ccy} \checkmark \end{aligned}$$

$$\text{TOTAL } \$9.80 / \text{ccy} * \checkmark$$

* COST w/o safety except 50/60 efficiency

MISCELLANEOUS
COST BACK-UP

1. DRAFT GUIDANCE DOCUMENT FOR PERFORMING EXPEDITED
RESPONSE ACTIONS (ERA's) 11/27/85

COST FACTORS AS A PERCENTAGE

- | | |
|---|---|
| 1. Mobilization | - ranges from 2 to 5% of total direct construction costs; use 5% for preliminary estimate |
| 2. Contingency | - ranges from 15 to 25% of total construction cost; use 25% for preliminary estimate |
| 3. Engineering | - ranges from 7 to 15% of total construction cost; use 15% for preliminary estimate |
| 4. Legal and Administration | - ranges from 1 to 5% of total construction cost; use 5% for preliminary estimate |
| 5. Protection Cost Factor | - see Table 1 for different percentage at various protection levels; use most conservative value for preliminary estimate |
| 6. Equipment O&M Costs | - 3 to 5%/yr of equipment cost |
| 7. Insurance Cost | - 1% of total capital cost |
| 8. Equipment Replacement | - 1% per year of capital cost |
| 9. Labor Fringe Benefits for O&M Costs | - 20 to 30% of wages |
| 10. Start Up and Shake Down Cost | - 5 to 20% of total capital cost; use 20% for complex systems |
| 11. Supervision and Administration during Construction | - 8% of estimated project cost |
| 12. Engineering and Design during Construction | - 15% of estimated project cost |
| 13. Change Order Contingency | - 15% of construction cost |
| 14. Non-component costs associated with a site where an onsite treatment facility will be built from "scratch" (applied to total construction costs). | |
| site preparation | - 1-10% |
| piping | - 8-15% |
| electrical | - 5-12% |
| instrumentation | - 3-10% |

REF: DRAFT GUIDANCE DOCUMENT FOR
PERFORMING EXPEDITED RESPONSE
ACTIONS (ERA's) 11/27/85

**AVERAGE PERCENT INCREASE FOR TOTAL COSTS AT
FOUR DEGREE-OF-HAZARD LEVELS***

Unit Operation	Level B	Level C	Level D	Level A
<u>Surface Water Controls:</u>				
1. Surface Sealing - Synthetic Membrane	114%	119%	122%	124%
2. Surface Sealing - Clay	109%	119%	124%	127%
3. Surface Sealing - Asphalt	--	--	--	--
4. Surface Sealing - Fly Ash	--	--	--	--
5. Revegetation	117%	124%	126%	128%
6. Contour Grading	122%	133%	140%	146%
7. Surface Water Diversion Structures	135%	144%	151%	154%
8. Basins and Ponds	135%	138%	145%	150%
9. Dikes and Berms	130%	133%	136%	141%
<u>Ground Water Controls:</u>				
1. Well Point System	110%	117%	121%	128%
2. Deep well System	--	--	--	--
3. Drain System	128%	138%	143%	148%
4. Injection System	--	--	--	--
5. Bentonite Slurry Trench	109%	114%	122%	136%
6. Grout Curtain	--	--	--	--
7. Sheet Piling Cutoff	--	--	--	--
8. Grout Bottom Sealing	--	--	--	--
<u>Gas Migration Controls:</u>				
1. Passive Trench Vent	--	--	--	--
2. Passive Trench Barriers	--	--	--	--
3. Active Gas Extraction Systems	--	--	--	--
<u>Waste Controls:</u>				
1. Chemical Fixation (Solidification)	122%	129%	133%	137%
2. Chemical Injection	--	--	--	--
3. Excavation of Wastes/Contaminated Soil	307%	337%	397%	715%
4. Leachate Recirculation	--	--	--	--
5. Treatment of Contaminated Water	119%	121%	125%	128%
6. Drum Processing	201%	228%	244%	317%
7. Bulk Tank Processing	195%	248%	419%	549%
8. Transformer Processing	--	293%	--	--

- * Values given include 100 percent for base construction costs.
- + This unit operation was deemed appropriate for performance only at Level C. Costs at Levels D, B, and A were not provided.

Source: "Worker Health and Safety Considerations: Cost of Remedial Actions at Uncontrolled Hazardous Waste Sites", Draft Final Report, 1983. SCS Engineers for US EPA, Covington, KY

CONSTRUCTION COST ESTIMATE WORKSHEET

For use of this form, see TM 5-800-2; the procuring agency is USACE.

DATE PREPARED

3-18-87

SHEET 1 OF 2

PROJECT

RMA

LOCATION

DENVER

PLAN NO.

ESTIMATOR

T. Kelley

CHECKED BY

D. Hawk

Item descr.	1984 Adjust	Region Adjust	Blue Book monthly Rental	Hourly Rate (173 hr./mo.)	Operating Cost	ARMY CORPS Operator Rates	TOTAL (\$/HR.)
TRUCK:							
- Rear Dump							
- ON/OFF HIGHWAY							
- 375 HP Diesel							
- 18 C.Y.	.901	1.05	\$4130 ⁰⁰	22 ⁵⁸	18 ⁴⁰	17 ⁰⁹	58 ²⁷
TRUCK:							
- REAR DUMP							
- 300 H.P.							
- 12 C.Y.	.901	1.05	\$3895 ⁰⁰	21 ³⁰	16 ⁰⁰	16 ⁷⁸	54 ⁰⁸
DOZER:							
- CAT DBL	.91	1.05	\$12790 ⁰⁰	70 ⁶⁴	32 ¹⁰		
- Straight blade							
- Angle Tilt	.90	1.05	\$170 ⁰⁰	0 ⁹³	0 ²⁰		
- Cushion	.90	1.05	\$385 ⁰⁰	2 ¹⁰	0 ⁴⁰		
- Total				73 ⁶⁷	32 ⁷⁰	16 ⁸⁸	123 ²⁵
DOZER:							
- CAT D6	.91	1.05	\$5920 ⁰⁰	32 ⁷⁰	13 ⁷⁰	16 ⁸⁸	63 ²⁸
SCRAPER:							
- CAT 627B	.887	1.05	\$14000 ⁰⁰	75 ³⁷	42 ⁴⁰	17 ⁰³	134 ⁸⁰
COMPACTOR:							
- CAT 825C							
- Straight blade	.880	1.05	\$11,780	62 ⁹²	27 ⁴⁰	16 ⁸⁸	107 ⁴⁰
WATER TANKER:							
- 10,000 gal							
- 450 H.P.	.883	1.05	\$15,575 ⁰⁰	83 ⁴⁷	35 ⁵³	17 ⁰⁹	136 ¹¹
- 12							

For use of this form, see TM 5-800-2; the proponent agency is USACE.

3-18-47

PROJECT

R. MA

LOCATION

DENVER, CO

PLAN NO.

ESTIMATOR

T. kennedy

CHECKED BY

D. Hawk

DA FORM 5421-R, Apr 85

Subject WAGE RATES FOR RMAProject No. 86C8554PBy D. HawkChecked By T. KellyTask No. 2File No. 21947Date 2/12/87Date 6/26/87Sheet 1 of 3WAGE RATES FOR COST ESTIMATINGREF: GENERAL WAGE DECISION NO. C086-1

- RMA IS LOCATED IN ADAMS COUNTY, COLORADO
T2S, R67W
- BASIN F IS IN SECTION 26

- ⇒ ELECTRICIANS - AREA 1
- PAINTERS - AREA 1
- LABORER - GROUP 1 & 2
- POWER EQUIPMENT
OPERATORS - ZONE 1
- TRUCK DRIVERS - ZONE 2

CATEGORY	Work Description	WAGE	FRINGE	TOTAL
1) ELECTRICIANS	ELECTRICIANS	16.85	2.10 + 33%	18.95 +
	CABLE SPLICERS	17.10	2.10 + 3.3%	19.20 +
2) CARPENTERS	ALL	13.90	3.22	17.12
3) CEMENT MASONS	ALL	12.40	3.79	16.19
4) IRONWORKERS	ALL	11.00	3.53	
5) LABORERS	① FENCIBLES	7.22	2.24	9.46
	① Minimum Labor	10.52	2.24	12.76
	Fence Erectors			
	Seeding, Stake Chase,			
	Tie Bar & Chairs in			
	Concrete, paving.			
	② Hydraulic & Electrical Tools	10.57	2.24	12.81
	Torches, drills, tampers			
	jack hammers, form setters			
	concrete saws, asphalt labor,			
	pipelayer, conduit, pump			
	operator			

Subject WAGE RATES FOR RMAProject No. 86C8554PBy D. HawkChecked By T KellyTask No. 2File No. 2947Date 2/12/87Date 6/26/87Sheet 2 of 3

CATEGORY	Work Description	WAGE	FRINGE	TOTAL
6) Power Equipment Operators	① Air Compressor, Mechanic, Welder Light plants, Single unit conveyor Pumps, Tractor under 70 HP ≤ 360 CFM Compressor	12.41	3.77	16.18
	② Conveyor, building materials, trenching Pulmill, self-propelled roller, rubber tired under 5 tons	12.76	3.77	16.53
	③ Asphalt Plant, Concrete batching Finish Machines Paving, Hoist 1 drum, Hydraulic backhoes under 3/4 CY, Loader ≤ 6 CY, Motor grader (rough), rollers over 5 tons, 70 HP 3 over tractor	13.11	3.77	16.88
	④ Crane and backhoes 5 CY and under Hydraulic Hoe 3/4 CY and over, Loader over 6 CY, Mechanic Finish motor grader Multiple Unit Crusher Scraper ≤ 40 CY Welder	13.24	3.77	17.03
	⑤ Heavy-duty mechanic welder, scraper > 40 CY	13.41	3.77	17.18

Subject WAGE RATES FOR RMAProject No. 86 C8554PBy D. Hawk

Checked By

T. KellyTask No. 2File No. 21947Date 2/12/87

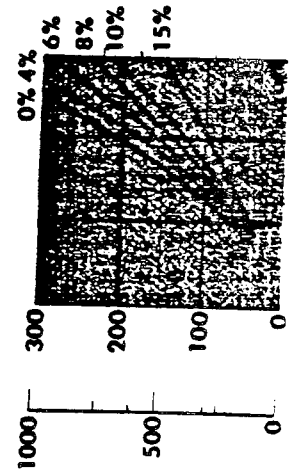
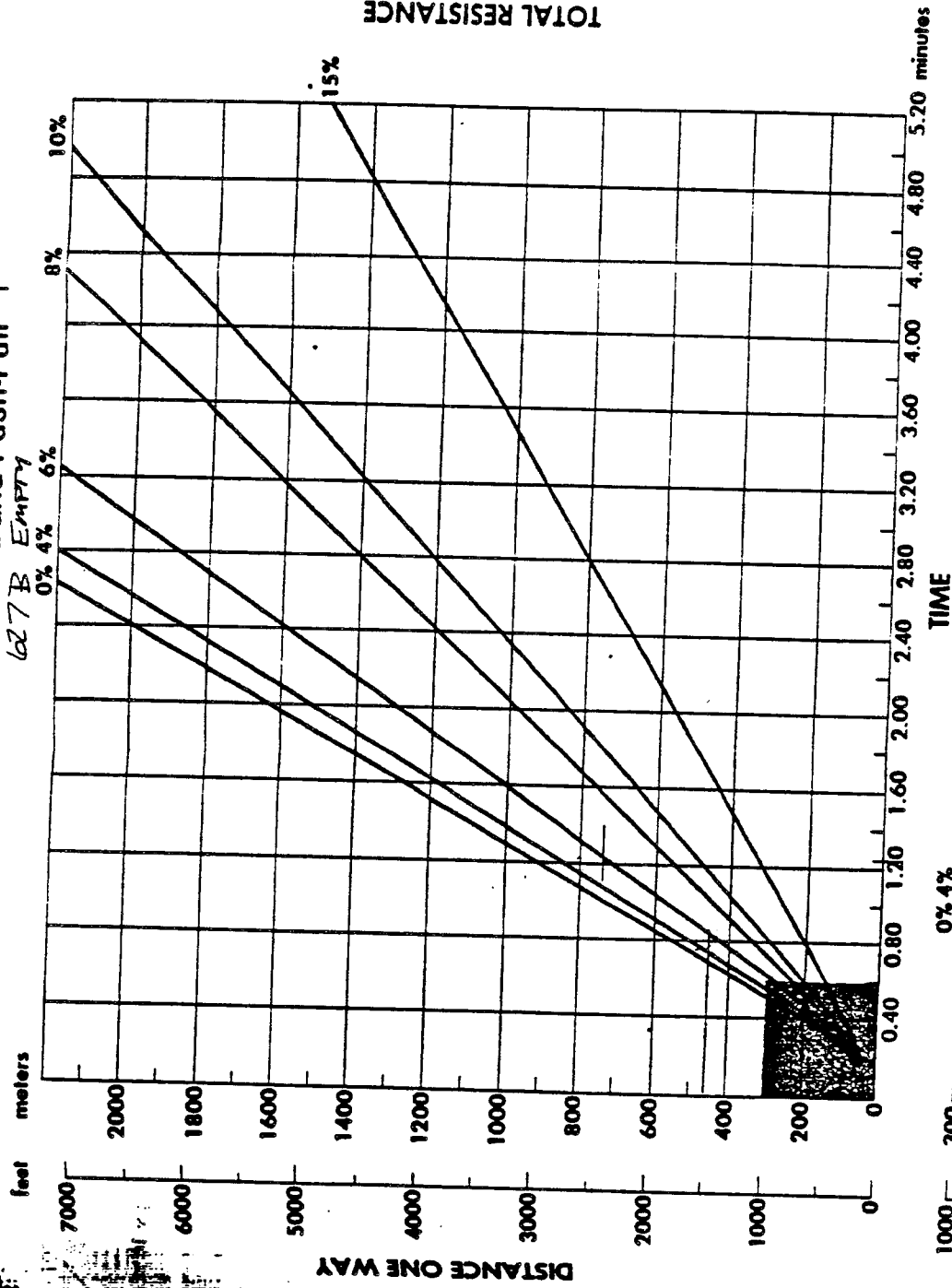
Date

6/26/87Sheet 3 of 3

CATEGORY	WORK DESCRIPTION	WAGE	FRINGE	TOTAL
1) TRUCK DRIVERS	① Pick-up, Truck Driver Tenors, Dumpmen, Graders	12.88	3.64	16.52
	② Truck Driver ≤ 6 CY Flat bed, single axle Shuttle truck, single axle liquid tanker	13.01	3.64	16.65
	③ Flat rack tandem axle, mechanics tenders, dump 6 to 14 CY	13.14	3.64	16.78
	④ Straddle Truck, Lumber Carrier	13.21	3.64	16.85
	⑤ Fork Lift, Fuel Truck	13.26	3.64	16.90
	⑥ Cement Mixer to 10 CY	13.33	3.64	16.97
	⑦ Multi-purpose & Hoist	13.38	3.64	17.02
	⑧ Dump truck > 14 CY but < 29 CY, semi liquid tanker, bulk tanker	13.45	3.64	17.09
	⑨ Truck driver, snow plow	13.58	3.64	17.22
	⑩ Cement mixer 10 to 15 CY	13.64	3.64	17.28
	⑪ Dump truck 29 to 39 CY	13.76	3.64	17.40
	⑫ Tire man, dump truck 39 to 54 CY	14.01	3.64	17.65
	⑬ Cement Mixer > 15 CY	14.06	3.64	17.70
	⑭ Mechanic	14.13	3.64	17.77
	⑮ Heavy Duty diesel mechanic, body men welders	15.51	3.64	19.15
	⑯ Highboy, Lowboy, Semi	15.76	3.64	19.40

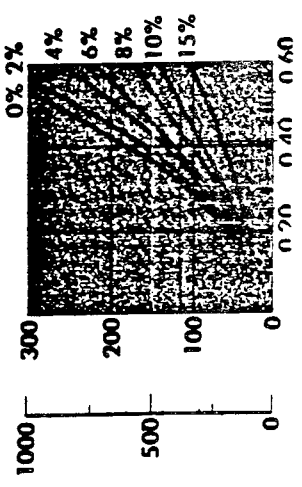
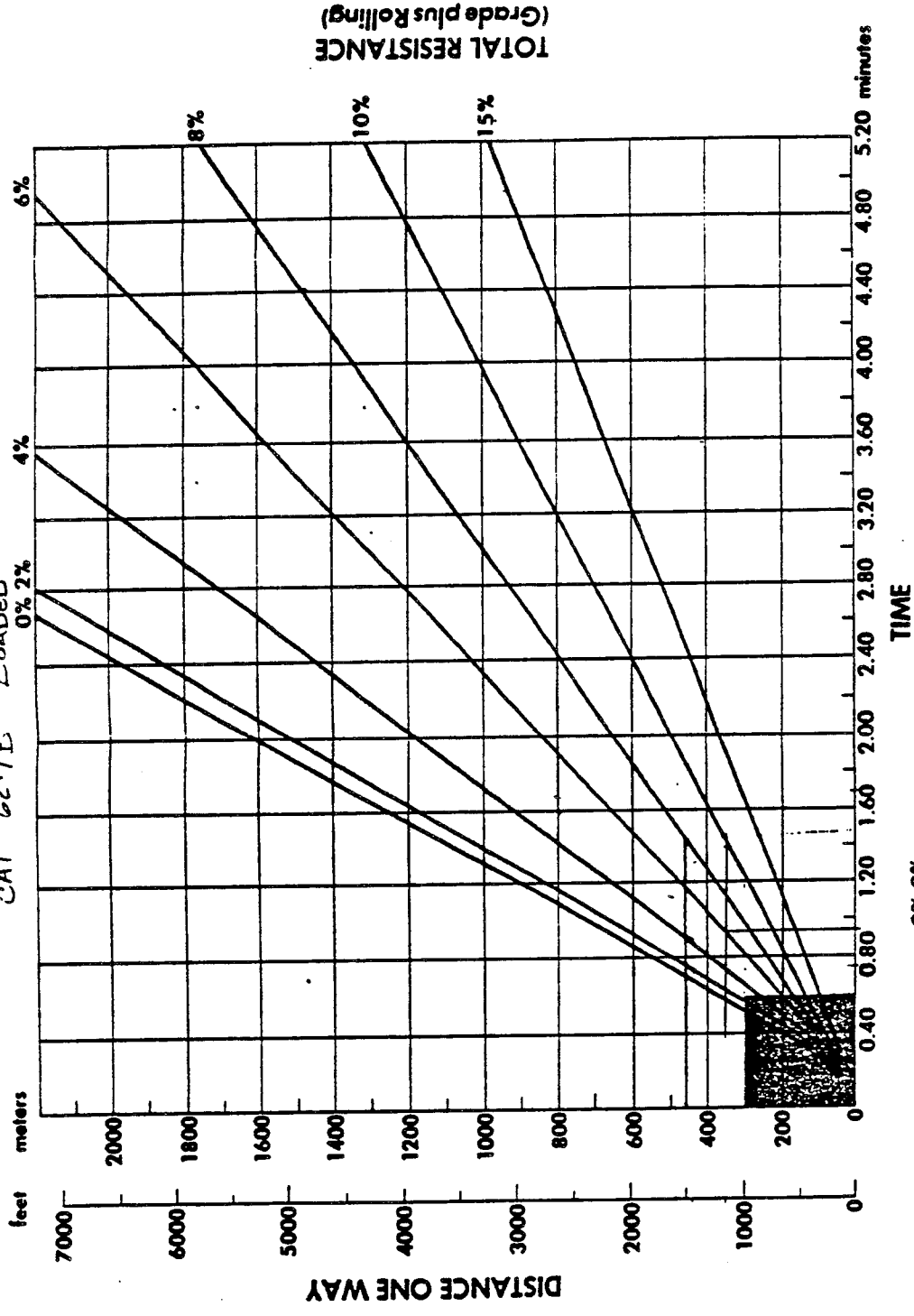


• Standard and Push-Pull



Vehicle empty weight: 33 250 kg (73,300 lb).

CAT 627B LOADED



Vehicle empty weight: 33 250 kg (73,300 lb).
 Payload: 21 770 kg, 12.2 Bm³ (48,000 lb, 16.0 BCY).

Subject HEALTH AND SAFETY COSTSProject No. 86CB554PBy D. HAWKChecked By T. KELLEYTask No. 2File No. 21947Date 3/17/87Date 3/18/87Sheet 1 of 2DIRECT HEALTH AND SAFETY COSTS FOR EQUIPMENTD CAT 627 B SCRAPER & OPERATOR (HEAVY EQUIPMENT)

a) [†] Enclosed CAB (Range 240 ⁰⁰ -605 ⁰⁰ /ea) =	425 ⁰⁰ /mo
b) Air Conditioner =	150 ⁰⁰ /mo
c) Air Cylinders ⁹ 15/day @ 600 ⁰⁰ /ea =	885 ⁰⁰ /mo
d) Protective clothes & changeover/ea =	3085 ⁰⁰ /mo
e) Dress/Decon 2 hr/day @ 17 ⁰⁰ /hr =	875 ⁰⁰ /mo
f) 1/4 Standby operator @ 17 ⁰⁰ /hr =	1095 ⁰⁰ /mo
⑩ HRS / DAY	
TOTAL MONTHLY =	\$6015/mo.

One time costs

a) Brackets for cylinders =	\$500 ⁰⁰
b) Air line System =	400 ⁰⁰
c) Communication System (light) =	200 ⁰⁰
d) First Aid Kit =	25 ⁰⁰
e) Fire Extinguisher =	40 ⁰⁰
f) Level B training =	\$1500 ⁰⁰
g) Physical (2) @ 450 ⁰⁰ /ea =	\$900 ⁰⁰

TOTAL 1-TIME = \$3565⁰⁰
 Assume 6 mo = \$595/mo.

TOTAL MONTHLY COST CAT 627 B SAFETY = \$4610⁰⁰/mo

Assume 173 Hrs/mo TOTAL HOURLY COST = \$35⁰⁰/hr

* Average cab cost used for this cost $\frac{240^{00} + 605^{00}}{2} = 425^{00}$

Scrapers @ low end 240⁰⁰/ea - 627B
 Dozers @ high end 605⁰⁰/ea - D8

NOTE: USE 6 WORKDAYS/WEEK AND 30 CALENDAR DAY MONTH

Subject HEALTH & SAFETY COSTSProject No. 86C8554PBy D HAWKChecked By T KELLETask No. 2File No. 21947Date 3/17/87Date 3/18/87Sheet 2 of 2DIRECT HEALTH & SAFETY FOR LABORERS IN AIR PACKS

- 1) EACH LABORER WILL BE ON 30 MINUTE PACKS WITH 5 MINUTE HIP PACKS. ABOUT 1.5 BACK-UP LABORERS WILL BE REQUIRED IN ROTATING FASHION PER LABORER. THIS WILL ALLOW FOR 30 minutes on - 30 minutes off - 15 min WALK TO AND FROM POST / 2 LABORER. FIVE CHANGEOUTS OF DISPOSABLE GARMENTS ARE ASSUMED.

DAILY CHARGES

a) PROTECTIVE CLOTHES	43°	=	43° /DAY
b) 5 CHANGEOUTS @	16°	=	80° /DAY
c) 1.5 LABORERS @	123° /HR = 8HR	=	153° /DAY
d) Protective clothes for extra laborers	$1.5(123^{\circ})$	=	184° /DAY
e) SCBA Refill	$2.5 \times \frac{15}{15} (\$15^{\circ})$	=	22° /DAY
f) DRESS / ODCON	$2.5 \times 2HR = 12^{\circ}$ /HR	=	63° /DAY
<u>TOTAL DAILY</u>		=	<u>546°/DAY</u>

ONE TIME CHARGES / 6 MO.

a) LEVEL B TRAINING	$1500^{\circ} \times 2.5$	=	3750°
b) COMMUNICATION SYSTEM	$100^{\circ} \times 2.5$	=	250°
c) SCBA	$2.5 \times 1500^{\circ}$	=	3750°
d) RUBBER BOOTS	$20^{\circ} \times 2.5$	=	50°
e) PHYSICALS 2 @	$450^{\circ} \times 2.5$	=	2250°

TOTAL ONE TIME = \$10,050
ASSUME 6 MO = \$1675/MO.

TOTAL HOURLY COSTS

$$546^{\circ}/8 + 1675/173 = \$78^{\circ}/HR$$

Note: This labor charge should be used only where air lines are impractical and production does not depend on laborer.

Subject HEALTH AND SAFETY COSTS - STANDBY EQUIPMENT Project No. 86C8554P

By T. KELLEY

Checked By D Hawk

Task No. 2

File No. 21947

Date 3/18/87

Date 3/18/87

Sheet 1 of 1

NON-OPERATIONAL HEALTH AND SAFETY COST FOR STANDBY

EQUIPMENT

1) ONGOING RENTAL:

a) Enclosed Cab (Range 240°--605°/mo) = \$425⁰⁰/mo

b) Air Conditioner = \$150⁰⁰/mo

TOTAL MONTHLY \$575⁰⁰/mo ✓

2) ONE TIME COSTS

a) Brackets For Cylinders \$500⁰⁰

b) Airline System \$400⁰⁰

c) Communication System (Light) \$200⁰⁰

d) First Aid Kit \$25⁰⁰

e) Fire Extinguisher \$40⁰⁰

TOTAL 1-Time \$1,165⁰⁰ ✓

ASSUME FOR 6 mo. \$194⁰⁰/mo ✓

TOTAL MONTHLY STANDBY EQUIPMENT COST

SAFETY COST = \$769/mo ✓

ASSUMING 173 HR/mo, STANDBY HOURLY = \$444/HR

Say \$445/HR. ✓

DATE: 3/14/87 TIME: 2:50 <u>PM</u>	TELEPHONE MEMORANDUM	PROJECT NO. 86C8554P
(TO) (FROM) MR. BOB ADAMS		ROUTING
COMPANY TVLOR CONSTRUCTION CO.		D JRO
RECORDED BY Dan Hawk		
PROJECT RMA.		FILE 21947 T2

Bob called back with estimates for level B equipment modification. The following information was provided.

- 1) Quote in Bob's files for heavy equipment \$175⁰⁰/day/machine
FOR MONTHLY RATE \$2100⁰⁰/month/machine (includes 1 Oper)
- 2) Enclosed cab only: CAT 627R \$275⁰⁰/mo.
CAT 966 \$340⁰⁰/mo.
CAT 235 \$250⁰⁰/mo.
CAT D6 \$410⁰⁰/mo.
CAT D8 \$605⁰⁰/mo.
- 3) Air Conditioner - Standard \$150⁰⁰/mo./machine
- 4) Breathing Device Brackets outside of cab
- one time expend \$500⁰⁰/machine
- negligible operating cost.
- 5) Consider Hazardous Waste Premium due to risk involved. Contractors will rent higher than expected. With six months guaranteed rental the price will become refined (less contingency). Six months is not considered short term and will provide incentive.

RECORD OF VERBAL QUOTE

Project: Name: Rocky mtn Arsenal
Location: Denver

Quote #: 1 MISC. (Estimate Sht. No.)

Firm: Name: Henry's Safety + Supply
Location: Golden, CO
Telephone No.: (303) 279-8811
Person Talked To: Ron

Type of Quote: ☒ Supplier, material only (FOB Point:)
☐ Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

5 minute escape packs \$612
mask, 5 min. bottle
belt, pigtail

Total AIRLINE
~\$400⁰⁰

Airline

\$169.30 for 100ft \$105 for 50ft

Pigtail

\$13.40 each

T's

\$14.50 each

Regulator w/ filter

\$145 w/o filter \$105

Alarm (<500psi incylinder)

\$93 each

Microphone

Hand mouth (throat mic)

\$198

Throat mic w/ radio transmitter
and head set (Earmark)

\$1840

Survivair 60 min SCBA
(3416)

\$1795 list price

30min SCBA
(2316)

Date Quote Received:

Quote Received By:

RECORD OF VERBAL QUOTE

Project: Name: Rocky Mtn. Arsenal
Location: Denver

Quote #: 2 MISC. (Estimate Sht. No.)

Firm: Name: Air Products
Location: Denver
Telephone No.: (303) 329-9353
Person Talked To: Dan Literas

Type of Quote: X Supplier, material only (FOB Point: RMA)
 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

They truck in all their air from Kansas.
Not certified to pump air in Denver from their facility.

\$ 15/cylinder

no delivery or pick-up charge
\$3.95 charge per cylinder if keep past
the end of the month

Date Quote Received: 3/17/87
Quote Received By: Risa Gerhart

RECORD OF VERBAL QUOTE

Project: Name: RMA

Location: Denver, CO

Quote #: 3 MISC. (Estimate Sht. No.)

Firm: Name: Air Products

Location: Denver

Telephone No.: (303) 329-9353

Person Talked To: Dan

Type of Quote: X Supplier, material only (FOB Point:)

 Subcontractor, material installed (Cost to Prime)

Scope/Description/Amount of Quote:

New quote:

If they are looking at 30-40 cylinders a day
they will get certified to pump air in Denver.
They will charge \$8.50 cylinder
\$3.00 per cylinder for every
cylinder kept past
the end of the month.

Date Quote Received: 3/20/87

Quote Received By: Olisa Herliart