Project Mountain Top

Date May 1986

WORKSHEET NO. 3

MATERIAL HANDLING PLAN SUMMARY SHEET

Listing of All Earthmoving Activities:

	Description	Volume	Origin	Destination	Haul Distance	Grade	Equipment to be Used
		(yd^3)					
1)	Grade spoil, 1/2-blasted rock, into pit	39,638	Highwall	Highwall	140'	-30%	D9L with U-Blade
2)	Grade spoil from temp. storage highwall	63,519	Storage	Highwall	100'	+30%	D9L with U-Blade
3)	Grade temporary spoil storage area	18,563	Spoil Storage	Storage Area	100'	0%	D9L with U-Blade
4)	Load topsoil	53,724	Storage	Trucks			992 C Loader
5)	Haul topsoil	53,724	Storage	Mined Area	650'	+5%	773B Truck
6)	Load topsoil	59,209	Storage	Trucks			992 C Loader
7)	Haul topsoil	59,209	Storage	A, B Hollowfill	600'	-5%	773B Truck
8)	Spread topsoil	56,467	Site	Disturbed Area	100'	+15%	D9L with U-Blade
9)	Remove ponds	11,500	Berm	Pond	100'	Level	D9L with U-Blade
10)	Remove pond roads	1,407	Fill	Cut	100'	-5%	D9L with U-Blade

Project Mountain Top

Date May 1986

WORKSHEET NO. 4

EARTHWORK QUANTITY WORKSHEET

CROSS-SECTION/ STATION	DIST.	END AREAS (ft^2)		VOLUMES (yds^3)		ADJUST. VOLUMES (yd^3)*		
	ft	CUT	FILL	CUT	FILL	CUT	FILL	MASS
Not used.								
TOTALS								

*Indicate swell factors used

Data Sources:

Project Mountain Top

Date May 1986

WORKSHEET NO. 4

EARTHWORK QUANTITY WORKSHEET

1. Grade blasted material. Assume 1/2 of the material is casted in blasting.

   Material Volume = 1/2 (1/2 x 58' x 32.95' x 1400' ÷ 27 ft^3/yd^3)
   = 24,774 yd^3 x 1.60 swell
   = 39,638 yd^3

2. Grade spoil peaks in temporary storage to highwall at lower seams. (See Figure B-8 at end of document.)

   Material Volume = 2 levels x 1/2 (35' x 35') x 1400' ÷ 27 ft^3/yd^3
   = 63,519 yd^3

3. Grade temporary spoil pile left after highwall backfilled.

   Material Volume = 1.0' (Depth) x 358' (Area) x 1400 ÷ 27 ft^3/yd^3
   = 18,563 yd^3

4. Load and haul topsoil.

   Material Volume/Hollowfill A & B = 73.4 ac x 43,560 ft^2/ac x 0.5 ft ÷ 27 ft^3/yd^3
   = 59,209 yd^3

   Material Volume/Mining, Basins, Ponds, etc. = 66.6 ac x 43,560 ft^2/ac x 0.5 ft ÷ 27 ft^3/yd^3
   = 53,724 yd^3

5. Spread topsoil. Assume 1/2 of topsoil is spread by trucks; 1/2 by dozers.

   Material Volume = 112,933 yd^3 ÷ 2
   = 56,467 yd^3

6. Pond removal. Remove ponds by grading to original contours.

Pond	Volume	Area
021	6.8 ac-ft	35,625 ft^2
022	11.9	63,000
023	6.8	35,625
024	3.3	21,000
Totals	28.2 ac-ft	155,250 ft^2

   Estimate Volume as a 2-ft depth over pond area.

   Material Volume = 155,250 ft^2 x 2 ft ÷ 27 ft^3/yd^3
   = 11,500 yd^3

7. Pond access road removal.

   Material Volume = 3800 ft x 10 ft x 1 ft ÷ 27 ft^3/yd^3
   = 1407 yd^3

Data Sources: Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 5A

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Grade spoil, 1/2-blasted rock, into open pit.

Characterization of Dozer Used (type, size, etc.):

D9L - U-blade, power shift transmission

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

The dozer is used to push 1/2 of blasted rock into the open pit. The material will be pushed 140 feet down - 30% effective grade.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 0.70 (material factor) × 0.84 (work hour factor) × 1.25 (grade factor) × 0.90 (weight correction factor**) × 1.00 (production method/blade factor*) × 1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.496

Net Hourly Production = 1100 (normal hourly production) yd^3/hr × 0.496 (operating adjustment factor) = 545.6 yd^3/hr

Hours Required = 39,638 (volume to be moved) yd^3 ÷ 545.6 (net hourly production) yd^3/hr = 73 hrs

*Normal dozing with straight and U-blades use 1.00.

**Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3}$ = 0.90

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 5B

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Grade spoil from temporary storage to open pit.

Characterization of Dozer Used (type, size, etc.):

D9L - U-blade, power shift transmission

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will push spoil 100 feet +30% effective grade.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 0.70 (material factor) × 0.84 (work hour factor) × 0.40 (grade factor) × 0.90 (weight correction factor**) × 1.00 (production method/blade factor*) × 1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.16

Net Hourly Production = 1450 (normal hourly production) yd^3/hr × 0.16 (operating adjustment factor) = 232 yd^3/hr

Hours Required = 63,519 (volume to be moved) yd^3 ÷ 232 (net hourly production) yd^3/hr = 274 hrs

*Normal dozing with straight and U-blades use 1.00.

**Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3} = 0.90$

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 5C

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Grade temporary spoil storage area to final reclaimed contours.

Characterization of Dozer Used (type, size, etc.):

D9L - U-blade, power shift transmission

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will grade spoil by pushing 100 feet on a 0% effective grade.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 0.70 (material factor) × 0.84 (work hour factor) × 1.00 (grade factor) × 0.90 (weight correction factor**) × 1.00 (production method/blade factor*)

1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.40

Net Hourly Production = 1450 (normal hourly production) yd^3/hr × 0.496 (operating adjustment factor) = 580 yd^3/hr

Hours Required = 18,563 (volume to be moved) yd^3 ÷ 580 (net hourly production) yd^3/hr = 32 hrs

*Normal dozing with straight and U-blades use 1.00.

**Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3} = 0.90$

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 5D

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Spread topsoil over disturbed area.

Characterization of Dozer Used (type, size, etc.):

D9L - U-blade, power shift transmission

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will spread topsoil 100 feet over +15% effective grade.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 1.20 (material factor) × 0.84 (work hour factor) × 0.75 (grade factor) × 0.90 (weight correction factor**) × 1.00 (production method/blade factor*) × 1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.510

Net Hourly Production = 1450 (normal hourly production) yd^3/hr × 0.510 (operating adjustment factor) = 739.5 yd^3/hr

Hours Required = 56,467 (volume to be moved) yd^3 ÷ 739.5 (net hourly production) yd^3/hr = 77 hrs

*Normal dozing with straight and U-blades use 1.00.

**Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3}$ = 0.90

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 5E

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Remove ponds by grading pond to original contours.

Characterization of Dozer Used (type, size, etc.):

D9L - U-blade, power shift transmission

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will push berms 100 feet to original drainage contours over mostly flat grades.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 1.20 (material factor) × 0.84 (work hour factor) × 1.00 (grade factor) × 0.90 (weight correction factor**) × 1.00 (production method/blade factor*) × 1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.68

Net Hourly Production = 1450 (normal hourly production) yd^3/hr × 0.68 (operating adjustment factor) = 986.0 yd^3/hr

Hours Required = 11,500 (volume to be moved) yd^3 ÷ 986.0 (net hourly production) yd^3/hr = 12 hrs

*Normal dozing with straight and U-blades use 1.00.

**Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3} = 0.90$

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 5F

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Remove access road to ponds.

Characterization of Dozer Used (type, size, etc.):

D9L - U-blade, power shift transmission

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer used to grade road and ditches to original contours. Push distance, 100 feet, -5% effective grade.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 1.10 (material factor) × 0.84 (work hour factor) × 0.92 (grade factor) × 0.90 (weight correction factor**) × 1.00 (production method/blade factor*) × 1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.574

Net Hourly Production = 1407 (normal hourly production) yd^3/hr × 0.574 (operating adjustment factor) = 807.6 yd^3/hr

Hours Required = 1,407 (yd^3 volume to be moved) ÷ 807.6 (yd^3/hr net hourly production) = 2 hrs

*Normal dozing with straight and U-blades use 1.00.

**Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3}$ = 0.90

Total Dozer Hours:	73
	274
	32
	77
	12
	2
	470

Data Sources: Caterpillar Performance Handbook, Edition 16 Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 6

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE--GRADING

Earthmoving Activity:

Not used.

Characterization of Dozer Used (type, size, etc.):

Description of Dozer Use (push distance, % grade, blade effective length, operating speed, etc.):

Productivity Calculations:

Operating Adjustment Factor = _____ (operator factor) x _____ (material factor) x _____ (work hour factor) x _____ (grade factor) x _____ (weight correction factor) x _____ (production method/blade factor) x _____ (visibility) x _____ (elevation) x _____ (direct drive transmission) = _____

Hourly Production = _____ (speed) mi/hr x _____ (eff. blade width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 = _____ ac/hr

Net Hourly Production = _____ (hourly prod.) ac/hr x _____ (op. adj. factor) = _____ ac/hr

Hours Required = _____ ac ÷ _____ ac/hr = _____ hrs

Data Sources:

Project Mountain Top

Date May 1986

WORKSHEET NO. 7

PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:

Not used.

Characterization of Dozer and Ripper Used:

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

Productivity Calculations:

Cycle time = (_____ ft (cut length) / 88 fpm (speed)) + _____ (turn time) = _____ min/pass

Passes/hour = _____ min/hr (work hour factor) ÷ _____ min/pass (cycle time) = _____ passes/hr

Volume cut per pass = (_____ ft (tool penetration) x _____ ft (cut spacing) x _____ ft (cut length)) / 27 ft^3/yd^3 = _____ bank yd^3/pass

Ripping Production = _____ bank yd^3/pass x _____ passes/hr = _____ bank yd^3/hr

Hours Required = _____ bank yd^3 (volume to be ripped) ÷ _____ bank yd^3/hr (hourly production) = _____ hrs

Calculate separate dozer hauling of ripped material in each lift on Worksheet No. 5, using material factor to account for swell.

Data Sources:

Project Mountain Top

Date May 1986

WORKSHEET NO. 8A

PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:

Load topsoil on trucks to be hauled to mined area.

Characterization of Loader Used (type, size, etc.):

992 C Loader, 13 yd^3

Description of Loader Use (origin, destination, grade, haul distance, etc.):

Load topsoil in storage area.

Productivity Calculations:

Cycle time = 0 (haul time (loaded)) + 0 (return time (empty)) + 0.80 (basic cycle time) = 0.80 min

Net Bucket Capacity = 13 (heaped bucket capacity) yd^3 x 0.85 (bucket fill factor) = 11.1 yd^3

Net Hourly Production = 11.1 (yd^3) (net bucket capacity) ÷ 0.80 (cycle time) min x 50 min/hr (work hour factor) = 693.8 yd^3/hr

Hours Required = 53,742 (yd^3) (volume to be moved) ÷ 693.8 (yd^3/hr) (net hourly production) = 77 hrs

Use Truck Time = 82 Hours

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 8B

PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:

Load topsoil on trucks to be hauled to Hollowfills A & B.

Characterization of Loader Used (type, size, etc.):

992 C Loader, 13 yd^3

Description of Loader Use (origin, destination, grade, haul distance, etc.):

Load topsoil in storage area.

Productivity Calculations:

Cycle time = 0 (haul time (loaded)) + 0 (return time (empty)) + 0.80 (basic cycle time) = 0.80 min

Net Bucket Capacity = 13 (heaped bucket capacity) yd^3 x 0.85 (bucket fill factor) = 11.1 yd^3

Net Hourly Production = 11.1 (yd^3) (net bucket capacity) ÷ 0.80 (cycle time) min x 50 min/hr (work hour factor) = 693.8 yd^3/hr

Hours Required = 59,209 (yd^3) (volume to be moved) ÷ 693.8 (yd^3/hr) (net hourly production) = 85 hrs

Use Truck Time = 86 Hours

Total Loader Time = 82 + 86 = 168 hours

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 9A

PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:

Haul topsoil from temporary storage to mined area.

Characterization of Truck Used (type, size, etc.):

773 B Truck, 44.6 yd^3

Description of Truck Use (origin, destination, grade, haul distance, truck capacity, etc.):

Haul topsoil from storage to disturbed area.
Haul distance is 350 feet over + 5% effective grade.

Productivity Calculations:

Cycle time = 0.57 (haul time) + 0.26 (return time) + 3.2 (total loading time) = 2.80 (dump and maneuver time) = 6.83 min

Number of Trucks Required = 6.83 (truck cycle time) ÷ 3.2 (total loading time) = 2.13 (2)

Production Rate = 44.6 (truck capacity) yd^3 × 2 (# of trucks) ÷ 6.83 (cycle time) min = 13.1 yd^3/min

Hourly Production = 13.1 (production rate) yd^3/min × 50 min/hr (work hour factor) = 655 yd^3/hr

Hours Required = 55,724 (volume to be moved) yd^3 ÷ 655 (hourly production) yd^3/hr = 82 hrs

Haul Time = 650 ft ÷ 1144 ft/min = 0.57 min
Return Time = 650 ft ÷ 2464 ft/min = 0.26 min

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 9B

PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:

Haul topsoil from temporary storage to Hollowfills A and B.

Characterization of Truck Used (type, size, etc.):

773 B Truck, 44.6 yd^3

Description of Truck Use (origin, destination, grade, haul distance, truck capacity, etc.):

Haul topsoil from storage to Hollowfills A and B.
Haul distance is 600 feet down - 5% effective grade.

Productivity Calculations:

Cycle time = 0.24 (haul time) + 0.24 (return time) + 3.2 (total loading time) = 2.80 (dump and maneuver time) = 6.84 min

Number of Trucks Required = 6.48 (truck cycle time) ÷ 3.2 (total loading time) = 2.03 (2)

Production Rate = 44.6 (truck capacity) yd^3 × 2 (# of trucks) ÷ 6.48 (cycle time) min = 13.77 yd^3/min

Hourly Production = 13.77 (production rate) yd^3/min × 50 min/hr (work hour factor) = 688.5 yd^3/hr

Hours Required = 59,209 (volume to be moved) yd^3 ÷ 688.5 (hourly production) yd^3/hr = 86 hrs

Haul Time = 600 ft ÷ 2464 ft/min = 0.24 min
Return Time = 600 ft ÷ 2464 ft/min = 0.24 min

Total Truck time = 82 + 86 = 168 hours

Data Sources: Caterpillar Performance Handbook, Edition 16
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 10

PRODUCTIVITY FOR HYDRAULIC EXCAVATOR USE (BACKHOE OR POWER SHOVEL)

Earthmoving Activity:

Not used.

Characterization of the Excavator Used (type, size, etc.):

Description of Excavator Used (loading geometry, materials, etc.):

Productivity Calculations:

Net bucket capacity = _____ (heaped bucket capacity) yd^3 x _____ (fill factor) = _____ yd^3

Net Hourly Production = _____ (net bucket capacity) yd^3 x _____ (work hour factor) min/hr _____ (cycle time) min = _____ yd^3/hr

Hours Required = _____ (volume to be handled) yd^3 ÷ _____ (net hourly production) yd^3/hr = _____ hrs

Data Sources:

Project Mountain Top

Date May 1986

WORKSHEET NO. 11

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Not used.

Characterization of Scraper Used (type, capacity, etc.):

Description of Scraper Route (haul distance, % grade, etc.):

Cycle time = ____ (load time) min + ____ (loaded trip time) min + ____ (maneuver and spread time) min + ____ (return trip time) min = ____ min

Cycles/Hour = 50 min/hr (work hour factor) ÷ ____ min/cycle = ____ cycles/hr

Hourly Production = ____ (Adjusted load) yd^3 x ____ cycles/hr = ____ yd^3/hr

Hours Required = ____ (volume to be handled) yd^3 ÷ ____ (net hourly production) yd^3/hr = ____ hrs

Data Sources:

Project Mountain Top

Date May 1986

WORKSHEET NO. 12

PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE--GRADING

Earthmoving Activity:

Not used.

Characterization of Grader Used (type, size capacity, etc.):

Description of Grader Route (push distance, % grade, blade effective length, operating speed, etc.)

Productivity Calculations

Contour Grading:

Hourly Production = _____ (speed) mi/hr x _____ (eff. blade width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Scarification:

Hourly Production = _____ (work speed) mi/hr x _____ (scarifier width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Hours Required = _____ ac ÷ _____ ac/hr = _____ hrs

Data Sources:

Project Mountain Top

Date May 1986

WORKSHEET NO. 13

SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment Type	Owning and Operating Costs ($/hr) Equipment + Accessories			Labor Cost* ($/hr)		Total Hrs Req'd		Total Cost ($)
D9L U blade	[(102.98 - 12.57 + 14.26	)	+	15.58	] x	470	=	56,518
992C Loader	[(188.80	)	+	15.58	] x	168	=	34,336
773B Truck	[(89.96	)	+	12.47	] x	168	=	17,208
773B Truck	[(89.96	)	+	12.47	] x	168	=	17,208
	[(	)	+		] x		=	
	[(	)	+		] x		=	
	[(	)	+		] x		=	
	[(	)	+		] x		=	
	[(	)	+		] x		=	
	[(	)	+		] x		=	
	[(	)	+		] x		=	
	[(	)	+		] x		=	

Total Cost = $125,270

Equipment and Accessory Identification:

D9L - U Blade: D9L Dozer Cost - Straight Dozer Cost + U Dozer Cost

*Labor adjusted for Tennessee using 1986 Dodge Guide to Public Works and Heavy Construction Costs.

Data Sources: Dataquest, Cost Reference Guide for Construction Equipment, 1986
Dodge, Guide to Public Works and Heavy Construction Costs, 1986

Project Mountain Top

Date May 1986

WORKSHEET NO. 14

REVEGETATION COSTS

Name and Description of Area to be Revegetated:

All disturbed acreage requires seeding; no tree planting.

Description of Revegetation Activities:

Hydroseeding will be used.

Reseeding:

140 acres (# of acres to be reseeded) x ($ 180 ($/acre for seedbed preparation) per acre + $ 720 ($/acre for seeding, fertilizing, and mulching) per acre) = $126,000 (costs for reseeding)

Planting Trees and Shrubs:

0 acres (# of acres for planting) x $ 0 ($/acre for planting trees and shrubs) per acre = $ 0 (costs for planting)

Other Revegetation Activity for this Area (e.g., Soil Sampling):

(Describe and provide cost estimate with documentation; use additional sheets if necessary.)

TOTAL REVEGETATION COST FOR THIS AREA = $ 126,000

Data Sources: AML costs

Project Mountain Top

Date May 1986

WORKSHEET NO. 15A

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity:

Maintenance, pumping, and treatment of ponds

Assumptions:

Volume = 28.8 ac-ft

Cost Estimate Calculations:

28.8 ac-ft x 43,560 ft^2/ac x \$0.15/10 ft^3 = \$18,818

TOTAL = \$ 18,818

Other Documentation or Notes:
(Include additional sheets, maps, calculations, etc., as necessary to document estimate.)

Data Sources: AML costs
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 15B

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity:

Haulroad maintenance during reclamation.

Assumptions:

Haulroad - 3.5 ac

Cost Estimate Calculations:

3.5 ac x $600/ac = $2,100

TOTAL = $ 2,100

Other Documentation or Notes:
(Include additional sheets, maps, calculations, etc., as necessary to document estimate.)

Data Sources: AML costs
Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 15C

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity:

Drilling and blasting

Assumptions:

Quantities - See Worksheet 15D

Drill - (RR-10-HD)
Blaster Cost = $11.88/hr

Cost Estimate Calculations:

Drilling Cost = (185.5 hr x $131.93/hr) + (185.5 hr x $15.68/hr) + (185.5 hr x $11.88/hr)
(Ownership Cost) (Driller Cost) (Blaster Cost)
= 24,473 + 2,909 + 2,204
= $29,586

3 bits - $1500/ea = $4,500
Explosives - $0.145/lb x 33,540 lb = $4,863

TOTAL = $38,949

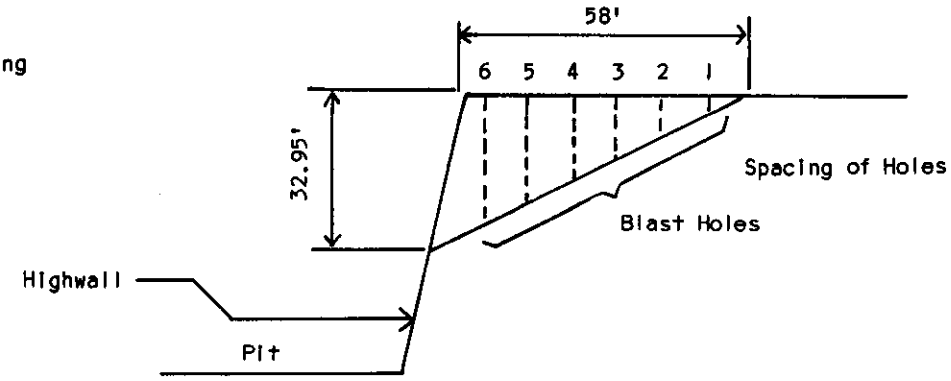
	$38,949
	18,818
	2,100
GRAND TOTAL--OTHER COSTS	$59,867

Other Documentation or Notes:
(Include additional sheets, maps, calculations, etc., as necessary to document estimate.)

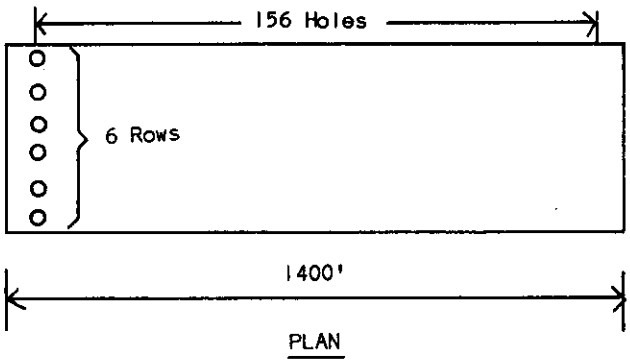
Data Sources: Dodge, Construction Cost Guide, 1986
Dataquest, Cost Reference Guide for Construction Equipment, 1986
Means, Building Construction Cost Data, 1985
E.I. duPont de Nemours & Co., Blaster's Handbook

WORKSHEET 15C (continued)

Drilling and Blasting



Drill Hole	1	2	3	4	5	6	Total
Distance To Highwall Face	54'	45'	36'	27'	18'	9'	
Drill Hole Depth	5'	10.2'	15.3'	20.5'	25.6'	30.7'	107'
Lbs. Explosive In Column	10	21	27	42	52	63	215



PLAN

$$\text{Total No./Holes} = \frac{1400'}{9'} = 156 \text{ Holes} \times 6 \text{ Rows} = 936 \text{ Holes}$$

Total Feet of Drilling Required

107 ft/6 holes x 156 = 16,692 ft
Avg. Drilling Rate = 1.5 ft/min
Time = 16,692 ft ÷ 1.5 ft/min. x 60 min/hr
= 185.5 hrs

Total Amount of Explosives Required

215 lb/6 holes x 156 = 33,540 lbs

Project Mountain Top

Date May 1986

WORKSHEET NO. 16

RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$	1,500
2.	Total Earthmoving Costs		125,270
3.	Total Revegetation Costs		126,000
4.	Total Other Reclamation Activities Costs		59,867
5.	Subtotal: Total Direct Costs		312,637
6.	Mobilization and Demobilization at 5% of Item 5) (1% to 5% of Item 5)		15,631
7.	Contingencies (at 10 % of Item 5) (see Table 4)		31,263
8.	Engineering Redesign Fee (at 7 % of Item 5) (see Graph 1)		21,884
9.	Contractor Profit and Overhead (at 10 % of Item 5) (see Graph 2)		31,263
10.	Reclamation Management Fee (at 5 % of Item 5) (see Graph 3)		15,631
11.	GRAND TOTAL BOND AMOUNT (Sum of Items 5 through 10)		$428,309

Engineering News Record Cost Index: _____ Date: _____

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT
BOND AMOUNT COMPUTATION

Applicant Processing Plant Example

Permit Number Example No. 5

Date April 1986

Number of Acres 31

Type of Operation Coal Processing

Location USA

Prepared by D.H. Bond

Project Processing Plant

Date April 1986

WORKSHEET NO. 1A

DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

The coal-processing operation consists of a processing plant, a rail loading facility, and a refuse disposal area. The processing/loading site covers a disturbed area of approximately 9 acres, and the refuse disposal site covers approximately 22 acres. (Figures B-10 through B-13 pertain to this example and can be found at the end of this document.)

The processing/loading operation consists of: a raw coal stockpile, an underground conveyor to the plant, the processing plant, and conveyors from the plant to the refuse stockpile and the clear coal silo/stockpile. Support structures for the operation include: scale house/office, scale, and shop building. Surface drainage control structures include diversion ditches, two storage basins that supply water to the plant, and sedimentation pond No. 001.

Refuse from the processing operation is transported via a public road a distance of approximately 1.4 miles to the refuse disposal area. The refuse disposal site is an abandoned surface coal mine. The spoil from the abandoned mine is salvaged, segregated, stored along the perimeter of the refuse area, and used as a topsoil substitute to cover the refuse. Refuse is compacted in lifts, and topsoil substitute is graded to cover the completed lifts with 4 feet of material. Sedimentation pond No. 002 provides surface drainage control for the refuse disposal site.

Reclamation of the area includes removal of all structures from the processing/loading site. Waste coal and contaminated soil will be excavated and transported to the refuse disposal area. The surface of the site will be ripped to loosen and mix the compacted soil prior to seedbed preparation. The site will be returned to its approximate original contour and vegetated with herbaceous species, achieving a condition capable of supporting an industrial postmining land use. The refuse disposal area will be covered with the topsoil substitute and vegetated with species that will stabilize the site and provide wildlife enhancement, achieving an undeveloped postmining land use.

When it has been determined that vegetation has been successfully established and the surface drainage control structures are no longer required, the storage basins and sedimentation pond No. 001 will be backfilled and eliminated and the sites vegetated. Sedimentation pond No. 002 will be eliminated, a rock-lined channel will be constructed on the pond site, and the adjacent terrain will be vegetated.

Data Sources: Permit application

Project Processing Plant

Date April 1986

WORKSHEET NO. 1B

DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

1. Earthmoving

Waste coal and contaminated soil:	Soil will be removed to a depth of 6 inches from the three stockpile areas that total 1.4 acres. With 15 percent final swell volume, total volume is 1,300 cubic yards.
Topsoil substitute material:	Material salvaged for final lift area at refuse disposal site; 0.86-acre surface area with depth of 4 feet, plus 15 percent final swell volume, yields total volume of 6,400 cubic yards.
Storage basins and sediment pond No. 001:	Pond No. 001 embankment contains 5,000 cubic yards; the material excavated from the basins and comprising the berms will be used to fill the basins; basin No. 1 volume is 313 cubic yards; basin No. 2 volume is 333 cubic yards; with 15 percent final swell volume, total volume is 6,500 cubic yards.
Area to be ripped:	Two acres of a 9-acre processing/loading site is vegetated and will not be redisturbed; remaining 7 acres will be ripped.

2. Revegetation

Processing/loading site:	Seven acres will require revegetation.
Refuse disposal site:	Maximum disturbance will occur with final lift; concurrent reclamation will have resulted in 17 acres of a 22-acre site with vegetation; remaining 5 acres will require revegetation.

3. Other Reclamation Activity

Sediment pond No. 002:	Embankment will be graded and eliminated during construction of rock-lined drainage channel.
Treating and Dewatering basins/ponds:	Volume of water to be removed is total of basins' and ponds' volumes at normal pool level.

Basin No. 1	8,450 ft^3
Basin No. 2	9,000 ft^3
Pond No. 001	214,751 ft^3
Pond No. 002	463,914 ft^3
	696,115 ft^3

Data Sources: Permit application

Project Processing Plant

Date April 1986

WORKSHEET NO. 2

STRUCTURE DEMOLITION AND DISPOSAL COST SUMMARY

Listing of Buildings to be Demolished:

Item	Type of Construction Material	Volume (cubic feet)	Unit Cost Basis	Demolition Cost
1) Processing Plant	Steel beam; metal siding and roofing	200,000	$0.14/ft^3	$28,000
2) Scale house/office	Wood frame; asphalt siding and roofing	5,600	$0.14/ft^3	$ 784
3) Scale	Steel	750	$0.14/ft^3	$ 105
4) Shop building	Wood frame; metal siding; asphalt roofing	8,100	$0.14/ft^3	$ 1,134
5)				

Total Cost = $30,023

Other Items to be Demolished:

Conveyor systems: Structural steel supports for elevated units; underground units enclosed in metal pipe; total length of conveyor system is 790 feet.

790 lf x $16/lf = $12,640

Debris Handling and Disposal Costs:

Lump-sum cost includes demolition of concrete block foundation of plant and concrete coal silo, grading of rubble into underground conveyor excavations, and removal/disposal of culverts.

Lump Sum = $ 3,000

TOTAL DEMOLITION AND DISPOSAL COST = $45,663

Data Sources: Means, Building Construction Cost Data, 1986
AML data
Conveyor demolition cost developed from crew and equipment composition and cost data from Means' Building Construction Cost Data

Project Processing Plant

Date April 1986

WORKSHEET NO. 3

MATERIAL HANDLING PLAN SUMMARY SHEET

Listing of All Earthmoving Activities:

	Description	Volume	Origin	Destination	Haul Distance	Grade	Equipment to be Used
1)	Excavate coal waste	1300 yd^3			50 ft	0%	D7U
2)	Load and haul waste	1300 yd^3	Processing Site	Refuse Site	7400 ft	0%	988B, 769C
3)	Grade waste and refuse	1300 yd^3			50 ft	0%	D7U
4)	Rip surface of site; 7 acres					0%	D7U, ripper
5)	Grade topsoil substitute	6400 yd^3			150 ft	0%	D7U
6)	Grade to remove basins and pond No. 001	6500 yd^3			100 ft	0%	D7U
7)	Grade to remove pond No. 002 and construct channel						Workesheet No. 15A
8)							
9)							
10)							

Project Processing Plant

Date April 1986

WORKSHEET NO. 4

EARTHWORK QUANTITY WORKSHEET

CROSS-SECTION/ STATION	DIST. ft	END AREAS (ft^2) CUT	END AREAS (ft^2) FILL	VOLUMES (yds^3) CUT	VOLUMES (yds^3) FILL	ADJUST. VOLUMES (yd^3)* CUT	ADJUST. VOLUMES (yd^3)* FILL	MASS
Refer to Worksheet No. 1B for earthwork quantities.								
TOTALS								

*Indicate swell factors used

Data Sources:

Project Processing Plant

Date April 1986

WORKSHEET NO. 5A

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Excavate 6-inch layer of waste and contaminated soil from 1.4-acre stockpile area for loading and hauling to refuse area. Volume of material is 1300 cubic yards.

Characterization of Dozer Used (type, size, etc.):

D7G with U-blade

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will excavate and pile material for loading. The average push distance is 50 feet and the effective grade is 0 percent. The material weight is 2300 lb/yd^3.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 0.80 (material factor) × 0.83 (work hour factor) × 1.00 (grade factor) × 1.00 (weight correction factor*) × 1.00 (production method/blade factor**)

1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.50

Net Hourly Production = 1050 (normal hourly production) yd^3/hr × 0.50 (operating adjustment factor) = 525 yd^3/hr

Hours Required = 1300 (volume to be moved) yd^3 ÷ 525 (net hourly production) yd^3/hr = 3 hrs

*Weight Factor = $\frac{2300 \text{ lb/yd}^3}{2300 \text{ lb/yd}^3}$ = 1.00

**Normal dozing with U-blade use 1.00

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Processing Plant

Date April 1986

WORKSHEET NO. 5B

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Grade waste/soil at refuse site to blend with contour of fill.

Characterization of Dozer Used (type, size, etc.):

D7G with U-blade

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will grade material to blend with refuse and achieve final contour of fill. The average push distance is 50 feet and the effective grade is 0 percent. The material weight is 2300 lbs/yd^3.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) x 1.20 (material factor) x 0.83 (work hour factor) x 1.00 (grade factor) x 1.00 (weight correction factor*) x 1.00 (production method/blade factor**)

1.00 (visibility) x 1.00 (elevation) x 1.00 (direct drive transmission) = 0.75

Net Hourly Production = 1050 (normal hourly production) yd^3/hr x 0.75 (operating adjustment factor) = 788 yd^3/hr

Hours Required = 1300 (volume to be moved) yd^3 ÷ 788 (net hourly production) yd^3/hr = 2 hrs

*Weight Factor = $\frac{2300\ lb/yd^3}{2300\ lb/yd^3}$ = 1.00

**Normal dozing with U-blade use 1.00

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Processing Plant

Date April 1986

WORKSHEET NO. 5C

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Grade topsoil substitute material to distribute over refuse and achieve final contour. Volume to be graded is 6400 cubic yards.

Characterization of Dozer Used (type, size, etc.):

D7G with U-blade

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will grade material to achieve 4-foot depth over 0.86-acre surface of fill. The average push distance is 150 feet and the effective grade is 0 percent. The material weight is 2550 lbs/yd^3.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) x 1.20 (material factor) x 0.83 (work hour factor) x 1.00 (grade factor) x 0.90 (weight correction factor*) x 1.00 (production method/blade factor**) x 1.00 (visibility) x 1.00 (elevation) x 1.00 (direct drive transmission) = 0.67

Net Hourly Production = 450 (normal hourly production) yd^3/hr x 0.67 (operating adjustment factor) = 302 yd^3/hr

Hours Required = 6400 (volume to be moved) yd^3 ÷ 302 (net hourly production) yd^3/hr = 21 hrs

*Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3}$ = 0.90

**Normal dozing with U-blade use 1.00

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Processing Plant

Date April 1986

WORKSHEET NO. 5D

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Grade embankment material to backfill storage basins and pond 001. Volume of material to be graded is 6500 cubic yards.

Characterization of Dozer Used (type, size, etc.):

D7G with U-blade

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Dozer will grade embankment material to fill excavations. The average push distance is 100 feet and the effective grade is 0 percent. The material weight is 2550 lbs/yd^3.

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 1.00 (material factor) × 0.83 (work hour factor) × 1.00 (grade factor) × 0.90 (weight correction factor*) × 1.00 (production method/blade factor**) × 1.00 (visibility) × 1.00 (elevation) × 1.00 (direct drive transmission) = 0.56

Net Hourly Production = 660 (normal hourly production) yd^3/hr × 0.56 (operating adjustment factor) = 370 yd^3/hr

Hours Required = 6500 (volume to be moved) yd^3 ÷ 370 (net hourly production) yd^3/hr = 18 hrs

*Weight Factor = $\frac{2300\ lb/yd^3}{2550\ lb/yd^3} = 0.90$

**Normal dozing with U-blade use 1.00

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Processing Plant

Date April 1986

WORKSHEET NO. 6

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE--GRADING

Earthmoving Activity:

Final grading is not required in reclamation of the area.

Characterization of Dozer Used (type, size, etc.):

Description of Dozer Use (push distance, % grade, blade effective length, operating speed, etc.)

Productivity Calculations:

Operating Adjustment Factor = _____ (operator factor) x _____ (material factor) x _____ (work hour factor) x _____ (grade factor) x _____ (weight correction factor) x _____ (production method/blade factor) x _____ (visibility) x _____ (elevation) x _____ (direct drive transmission) = _____

Hourly Production = _____ (speed) mi/hr x _____ (eff. blade width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 = _____ ac/hr

Net Hourly Production = _____ (hourly prod.) ac/hr x _____ (op. adj. factor) = _____ ac/hr

Hours Required = _____ ac ÷ _____ ac/hr = _____ hrs

Data Sources:

Project Processing Plant

Date May 1986

WORKSHEET NO. 7

PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:

Rip surface area of 7 acres of processing/loading site to loosen and mix soil prior to seedbed preparation.

Characterization of Dozer and Ripper Used:

D7G with U-blade and triple-shank ripper

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

Dozer will rip surface area of 304,920 square feet. The average cut length is 200 feet, ripping depth is 2 feet, and ripping width is 9.9 feet.

Productivity Calculations:

Cycle time = (200 (cut length) ft / 88 fpm (speed)) + 0.3 (turn time) = 2.6 min/pass

Passes/hour = 50 (work hour factor) min/hr ÷ 2.6 (cycle time) min/pass = 19.2 passes/hr

Volume cut per pass = (2 (tool penetration) ft x 9.9 (cut spacing) ft x 200 (cut length) ft) / 27 ft^3/yd^3 = 147 bank yd^3/pass

Ripping Production = 147 bank yd^3/pass x 19.2 passes/hr = 2822 bank yd^3/hr

Hours Required = 22,587 (volume to be ripped) bank yd^3 ÷ 2822 (hourly production) bank yd^3/hr = 8 hrs

Calculate separate dozer hauling of ripped material in each lift on Worksheet No. 5 using material factor to account for swell.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Processing Plant

Date April 1986

WORKSHEET NO. 8

PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:

Load excavated waste coal and contaminated soil for haul to refuse area. Volume of material is 1300 cubic yards.

Characterization of Loader Used (type, size, etc.):

988B

Description of Loader Use (origin, destination, grade, haul distance, etc.):

Loader will load material for haul.

Productivity Calculations:

Cycle time = 0 (haul time (loaded)) + 0 (return time (empty)) + 0.65 (basic cycle time) = 0.65 min

Net Bucket Capacity = 7 (heaped bucket capacity) yd^3 x 0.85 (bucket fill factor) = 6 yd^3

Net Hourly Production = 6 (net bucket capacity) yd^3 ÷ 0.65 (cycle time) min x 50 min/hr (work hour factor) = 462 yd^3/hr

Hours Required = 1300 (volume to be moved) yd^3 ÷ 462 (net hourly production) yd^3/hr = 3 hrs 4 hrs*

*Loader productivity is limited by truck productivity, so loader is required for same number of hours as trucks (refer to Worksheet No. 9).

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Processing Plant

Date April 1986

WORKSHEET NO. 9

PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:

Haul waste coal and contaminated soil to refuse disposal site. Volume of material is 1300 cubic yards.

Characterization of Truck Used (type, size, etc.):

769C

Description of Truck Use (origin, destination, grade, haul distance, truck capacity, etc.):

Trucks will haul material from processing/loading site to disposal site, a haul distance of 1.4 miles (7400 feet). The effective grade is 0 percent.

Productivity Calculations:

Cycle time = 3.50 (haul time) + 3.00 (return time) + 3.25 (total loading time) + 2.80 (dump and maneuver time) = 12.55 min

Number of Trucks Required = 12.55 (truck cycle time) ÷ 3.25 (total loading time) = 3

Production Rate = 30.8 (truck capacity) yd^3 × 3 (# of trucks) ÷ 12.55 (cycle time) min = 7.4 yd^3/min

Hourly Production = 7.4 (production rate) yd^3/min × 50 min/hr (work hour factor) = 370 yd^3/hr

Hours Required = 1300 (volume to be moved) yd^3 ÷ 370 (hourly production) yd^3/hr = 4 hrs

Haul Time: 7400 ft/2112 fpm = 3.50 minutes
Return Time: 7400 ft/2464 fpm = 3.00 minutes

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Processing Plant

Date April 1986

WORKSHEET NO. 10

PRODUCTIVITY FOR HYDRAULIC EXCAVATOR USE (BACKHOE OR POWER SHOVEL)

Earthmoving Activity:

Excavator not used in reclamation of the area.

Characterization of the Excavator Used (type, size, etc.):

Description of Excavator Used (loading geometry, materials, etc.):

Productivity Calculations:

Net bucket capacity = _____ (heaped bucket capacity) yd^3 x _____ (fill factor) = _____ yd^3

Net Hourly Production = _____ (net bucket capacity) yd^3 x _____ (work hour factor) min/hr _____ (cycle time) min = _____ yd^3/hr

Hours Required = _____ (volume to be handled) yd^3 ÷ _____ (net hourly production) yd^3/hr = _____ hrs

Data Sources:

Project Processing Plant

Date April 1986

WORKSHEET NO. 11

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Scraper not used in reclamation of the area.

Characterization of Scraper Used (type, capacity, etc.):

Description of Scraper Route (haul distance, % grade, etc.):

Cycle time = ____ min (load time) + ____ min (loaded trip time) + ____ min (maneuver and spread time) + ____ min (return trip time) = ____ min

Cycles/Hour = 50 min/hr (work hour factor) ÷ ____ min/cycle = ____ cycles/hr

Hourly Production = ____ yd^3 (Adjusted load) x ____ cycles/hr = ____ yd^3/hr

Hours Required = ____ yd^3 (volume to be handled) ÷ ____ yd^3/hr (net hourly production) = ____ hrs

Data Sources:

Project Processing Plant

Date April 1986

WORKSHEET NO. 12

PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE--GRADING

Earthmoving Activity:

Motorgrader not used in reclamation of the area.

Characterization of Grader Used (type, size capacity, etc.):

Description of Grader Route (push distance, % grade, blade effective length, operating speed, etc.)

Productivity Calculations:

Contour Grading:

Hourly Production = _____ (speed) mi/hr x _____ (eff. blade width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Scarification:

Hourly Production = _____ (work speed) mi/hr x _____ (scarifier width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Hours Required = _____ ac ÷ _____ ac/hr = _____ hrs

Data Sources:

Project Processing Plant

Date April 1986

WORKSHEET NO. 13

SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment Type	Owning and Operating Costs ($/hr) Equipment + Accessories				Labor Cost ($/hr)		Total Hrs Req'd		Total Cost ($)
D7G U-blade	[(	48.14 + 6.58	)	+	15.58	] x	44	=	3093
U-blade D7G ripper	[(	48.14 + 9.96	)	+	15.58	] x	8	=	589
988B	[(	99.42	)	+	15.68	] x	4	=	460
769C	[(	68.46	)	+	12.47	] x	4	=	324
769C	[(	68.46	)	+	12.47	] x	4	=	324
769C	[(	68.46	)	+	12.47	] x	4	=	324
	[(		)	+		] x		=	
	[(		)	+		] x		=	
	[(		)	+		] x		=	
	[(		)	+		] x		=	
	[(		)	+		] x		=	
	[(		)	+		] x		=	

Total Cost = $5,114

Equipment and Accessory Identification:

U-blade $6.58/hr
Ripper $3.38/hr

Data Sources: Dataquest, Cost Reference Guide for Construction Equipment, 1986
Dodge, Guide to Public Works and Heavy Construction Costs, 1986

Project Processing Plant

Date April 1986

WORKSHEET NO. 14

REVEGETATION COSTS

Name and Description of Area to be Revegetated:

Seven acres of the processing/loading site and 5 acres of the refuse site.

Description of Revegetation Activities:

Seedbed preparation; liming, fertilizing, seeding, and mulching; shrub-planting pattern will cover total area of 1 acre.

Reseeding:

12 (# of acres to be reseeded) acres x ($ 180 ($/acre for seedbed preparation) per acre + $ 720 ($/acre for seeding, fertilizing, and mulching) per acre) = $ 10,800 (costs for reseeding)

Planting Trees and Shrubs:

1 (# of acres for planting) acres x $ 270 ($/acre for planting trees and shrubs) per acre = $ 270 (costs for planting)

Other Revegetation Activity for this Area (e.g., Soil Sampling):

(Describe and provide cost estimate with documentation; use additional sheets if necessary.)

TOTAL REVEGETATION COST FOR THIS AREA = $ 11,070

Data Sources: AML data

Project Processing Plant

Date April 1986

WORKSHEET NO. 15A

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity:

Grade to eliminate embankment of sediment pond No. 002 and construction of rock-lined drainage channel. Channel will be 300 feet long.

Assumptions:

Unit cost includes elimination of embankment.

Cost Estimate Calculations:

$16.20 per lf
$16.20/lf x 300 lf =

TOTAL = $ 4,860

Other Documentation or Notes:
(Include additional sheets, maps, calculations, etc., as necessary to document estimate.)

Data Sources: AML data

Project Processing Plant

Date April 1986

WORKSHEET NO. 15B

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity:

Basins and sedimentation ponds are acidic and require treatment. Treat basins and ponds prior to dewatering.

Assumptions:

Water volume is total of structures' normal capacity; 696,000 cubic feet.

Cost Estimate Calculations:

Combined treatment and dewatering cost is $0.15 per 10 cubic feet.
$0.15/ft^3 x 696,000 ft^3 =

TOTAL = $10,440

Other Documentation or Notes:
(Include additional sheets, maps, calculations, etc., as necessary to document estimate.)

Data Sources: AML data

Project Processing Plant

Date April 1986

WORKSHEET NO. 16

RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$ 45,663
2.	Total Earthmoving Costs	5,114
3.	Total Revegetation Costs	11,070
4.	Total Other Reclamation Activities Costs	15,300
5.	Subtotal: Total Direct Costs	77,147
6.	Mobilization and Demobilization at 5% of Item 5) (1% to 5% of Item 5)	3,857
7.	Contingencies (at 10 % of Item 5) (see Table 4)	7,715
8.	Engineering Redesign Fee (at 9 % of Item 5) (see Graph 1)	6,943
9.	Contractor Profit and Overhead (at 13 % of Item 5) (see Graph 2)	10,029
10.	Reclamation Management Fee (at 6 % of Item 5) (see Graph 3)	4,629
11.	GRAND TOTAL BOND AMOUNT (Sum of Items 5 through 10)	$110,320

Engineering News Record Cost Index: _____ Date: _____

Appendix C

GUIDANCE FOR EQUIPMENT SELECTION

APPENDIX C

GUIDANCE FOR EQUIPMENT SELECTION

INTRODUCTION

The selection and matching of equipment for a surface mining operation is a complex task requiring a knowledge of equipment productivity for the reclamation tasks that are typically encountered. Proper selection of equipment allows completion of reclamation tasks in an efficient manner and results in the lowest possible performance bond.

Factors governing equipment productivity are capacity; cycle time (the time required to complete the operation); and site conditions such as space limitations, grades, and material characteristics that affect the performance of the machinery. Equipment selection involves evaluating the advantages and disadvantages in using different types of equipment to perform reclamation tasks. Familiarity with earthmoving equipment suitable for surface mining reclamation can be gained through review of equipment production and cost-estimating guides available from firms such as Terex, Caterpillar, Komatsu, and others. The estimator, once familiar with the uses and capabilities of various pieces of earthmoving equipment, will be faced with the task of comparing two or more combinations of equipment to determine which is the most efficient for the reclamation task at hand.

EARTHMOVING EQUIPMENT

Track-type Tractors

Bulldozers in the range of 300 to 450 horsepower, outfitted with universal (reclamation) blades for backfilling and rough grading and straight blades for final or contour grading, are normally appropriate for reclamation activities requiring dozers. However, dozers suitable for reclamation activities have horsepower ratings that range from 200 to 700. In choosing a particular dozer, the estimator must consider the volume of material to be handled and the space available to maneuver the machine.

Additionally, dozers can be equipped with a ripper for breakage of consolidated material prior to dozing. The seismic velocity of material may be used to determine whether the material can be ripped. However, because this information is rarely available in permit applications, stratigraphic information from borehole logs and cross-sections must be used. Most shales, siltstones, interbedded shale, sandstone, and thin-bedded limestone and sandstone units can be ripped. Massive, well-indurated formations such as sandstone, limestone, or conglomerate foundations would probably require blasting.

Trucks

Most reclamation tasks requiring off-highway trucks can be accomplished with trucks having capacities of 35 tons (26 cubic yards) to 63 tons (48 cubic yards). However, off-road trucks are available with capacities ranging from 25 tons (20 cubic yards) to 130 tons (100 cubic yards). As with dozers and loaders, selection of trucks is based on the amount of material to be handled and the space available to maneuver the truck.

Generally, the estimator will find that trucks similar to those used by the operator are the largest that can be selected because of limitations of haulroad capabilities.

Bottom dump haul trucks should be considered for spreading large volumes of subsoil material needed to reclaim surface mines especially in prime farmland areas where the hauls are of 10,000 feet or more and prevention of soil compaction is critical. For such activities, bottom dump trucks with capacities of 63 tons (48 cubic yards) are normally adequate.

Excavators

Because of their ability to excavate solid bank material--such as shaley bedrock and compacted fill material--and to work in confined areas, there are certain applications where hydraulic excavators may substitute for wheel loaders. Two types of excavators are used, the front shovel and the backhoe. The front shovel is used to excavate above-grade material while the hydraulic backhoe will excavate below grade. Both machines are useful in reclamation where backfill material must be obtained from the solid bank state or a compacted fill. Backhoes are also useful in cleaning sediment from diversion ditches and siltation structures. Front-shovel excavators with bucket capacities between 3 and 5 cubic yards and backhoes with capacities of 1.5 to 5 cubic yards are typical for reclamation tasks. The estimator must be careful to ensure that the excavator matches the haul trucks to be used so that excavator loading cycles are minimized.

Scrapers

Scrapers with capacities between 20 and 35 cubic yards are typical for most reclamation activities; once again, maneuvering space and the volume of material to be moved will dictate the size of the scraper to be selected. Push-pull scrapers can be used in pairs and no pushers will be required. However, where larger scraper fleets are employed or pusher dozer tasks, such as site cleanup, are available to fill wait times, the non-push-pull scrapers/push dozers combination may be employed.

Conventional (single-engined) scrapers may be economically substituted for tandem-powered units where there are no steep grades and where rolling resistance is low. Elevating or self-loading scrapers may be used where soft, fine-grained, or unconsolidated materials free of hard rock are encountered. Elevating scrapers have an advantage of working alone without support equipment (other than haulroad maintenance) and are well-suited for work requiring the flexibility to adjust to small variations in the cut and fill. They have traditionally been used for fine or finish grading. Tandem-powered scrapers can be operated independently where soft materials are loaded and where loading is downhill. However, due to the earthmover's inability to completely fill the bowl in this mode of operation, capacity should be reduced by one-third. When selecting auxiliary equipment, the estimator must determine the requirements for dozer pushers. There must be a match between the scraper selected, the dozer used, and the style of push-loading. Generally, track dozers are used as pushers.

Motor Graders

Motor graders (motor patrols) can be used in a wide variety of reclamation tasks, but they are used primarily for haulroad maintenance. In some instances, it may be cost-effective to use a grader as a substitute for a track dozer for final grading, light leveling work, and diversion ditch construction. Motor graders typically used for most reclamation activities range from 125 to 275 horsepower. Graders used for surface mining are generally the articulating type and can be equipped with a rear-mounted ripper or scarifier.

EQUIPMENT SELECTION OVERVIEW

When making the initial decision about what types of equipment--for example, dozers versus scrapers--are needed for each earthmoving activity, the estimator should refer to Worksheet No. 3, the Material Handling Plan Summary Sheet, and note the one-way haul distance. If this distance is less than 500 feet, bulldozers of appropriate size will be the optimum equipment for the job in most cases. If the distance is between 500 to 1,000 feet, then scrapers will probably be optimum assuming underfoot conditions allow use of wheeled equipment and the material does not contain large boulder-size rocks. For distances over 1,000 feet, off-road trucks with compatible wheel loaders or hydraulic shovels begin to become more efficient. It is also generally the case that as rolling resistance increases scrapers tend to be less efficient and trucks should be used. As the distance increases to a mile, truck-loader combinations are usually optimum.

After the type of equipment is initially selected, the equipment size must be determined. To do this, the estimator should note the volume and characteristics of material to be moved and the underfoot conditions. Obviously, the larger pieces of equipment are more appropriate for moving large amounts of materials. Most equipment manufacturers can provide performance books that contain information to guide model selection. When in doubt, select a model and calculate the cost of the job. Next, make the same calculation using a smaller sized model and again using a larger model. In this way, the optimum-sized equipment can be determined. With a little experience, the proper type and size of equipment can usually be determined in the first iteration. However, it is generally good practice to try another iteration with different-sized equipment to make certain that optimum equipment has been selected.

Table C-1 lists advantages and disadvantages of earthmoving equipment typically employed in reclamation of mine sites. Reclamation equipment can also be rated by the suitability to perform backfilling and grading tasks and topsoil removal/replacement (see Tables C-2 and C-3). The influence of haul distance and rolling resistance on the proper selection of reclamation equipment is illustrated in Figure C-1.