

Information Circular 8641

Basic Estimated Capital Investment and Operating Costs for Underground Bituminous Coal Mines

**Mines With Annual Production of 1.03 to 3.09
Million Tons From a 48-Inch Coalbed**

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UNITED STATES DEPARTMENT OF THE INTERIOR
Rogers C. B. Morton, Secretary

BUREAU OF MINES
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BASIC ESTIMATED CAPITAL INVESTMENT AND OPERATING COSTS FOR UNDERGROUND BITUMINOUS COAL MINES

Mines With Annual Production of 1.03 to 3.09 Million Tons
From a 48-Inch Coalbed

by

Sidney Katell¹ and E. L. Hemingway²

ABSTRACT

This Bureau of Mines study estimates capital investment, operating costs, and selling prices for three underground bituminous mines producing coal with annual production ranging from 1.03 to 3.09 million tons. It is assumed that the mines have a 20-year life. Wages and union welfare payments are considered as of November 12, 1973, under the Bituminous Wage Agreement of 1971, and costs for material and equipment are based on 1973 indexes.

Initial capital investment ranges from \$12,938,200 for the 1.03-million-ton-per-year (MM tpy) mine to \$31,435,500 for the 3.09 MM tpy mine. Total capital investment ranges from \$21,607,200 to \$51,982,000 for the same mines. Corresponding selling prices for the coal range from \$9.11 to \$8.06 per ton, assuming a 12-percent discounted cash flow rate of return after Federal income taxes.

INTRODUCTION

Growing public concern about the increasing demand for energy has brought about a renewed interest in coal production in the United States. Because cost is an important factor in determining the extent to which coal will be used to satisfy this energy requirement, the Bureau of Mines is preparing a series of reports which provide estimated capital investment and operating costs for hypothetical mines that may be utilized in the production of synthetic fuels or for electric utility plants.

This report is the second in the series. It presents a basic study of capital investment and production costs for three hypothetical underground bituminous coal mines with a 48-inch working height and with annual production ranging from 1.03 to 3.09 million tons. Since costs are affected by many factors, any particular mine, in reality, will have to be considered in relation to its own special situation and requirements.

The mines are assumed to have a 20-year life. Costs for wages and union welfare are those which went into effect November 12, 1973, under the terms of the Bituminous Wage Agreement of 1971. Costs for material and equipment are

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based on 1973 cost indexes. Selling prices are based on a 12-percent discounted cash flow (DCF) rate of return after Federal income taxes.

GENERAL MINING PLAN

It is assumed that the mines operate 5 days per week, 3 shifts per day, 220 days per year, and have a 20-year life. Continuous miner sections produce 344 tons of coal per unit per shift.

Acreage needed to produce the required tonnages are calculated assuming 1,800 tons of coal per acre-foot with 4 feet of mining height and 57-percent recovery. The coal rights only are purchased; surface rights are retained by the present owner. The following table shows the acreage requirements.

TABLE 1. - Acreage required to provide coal reserves necessary to sustain a 20-year mining operation

Production, MM tpy	Acres required, 57-percent recovery
1.03	5,018
2.06	10,035
3.09	15,053

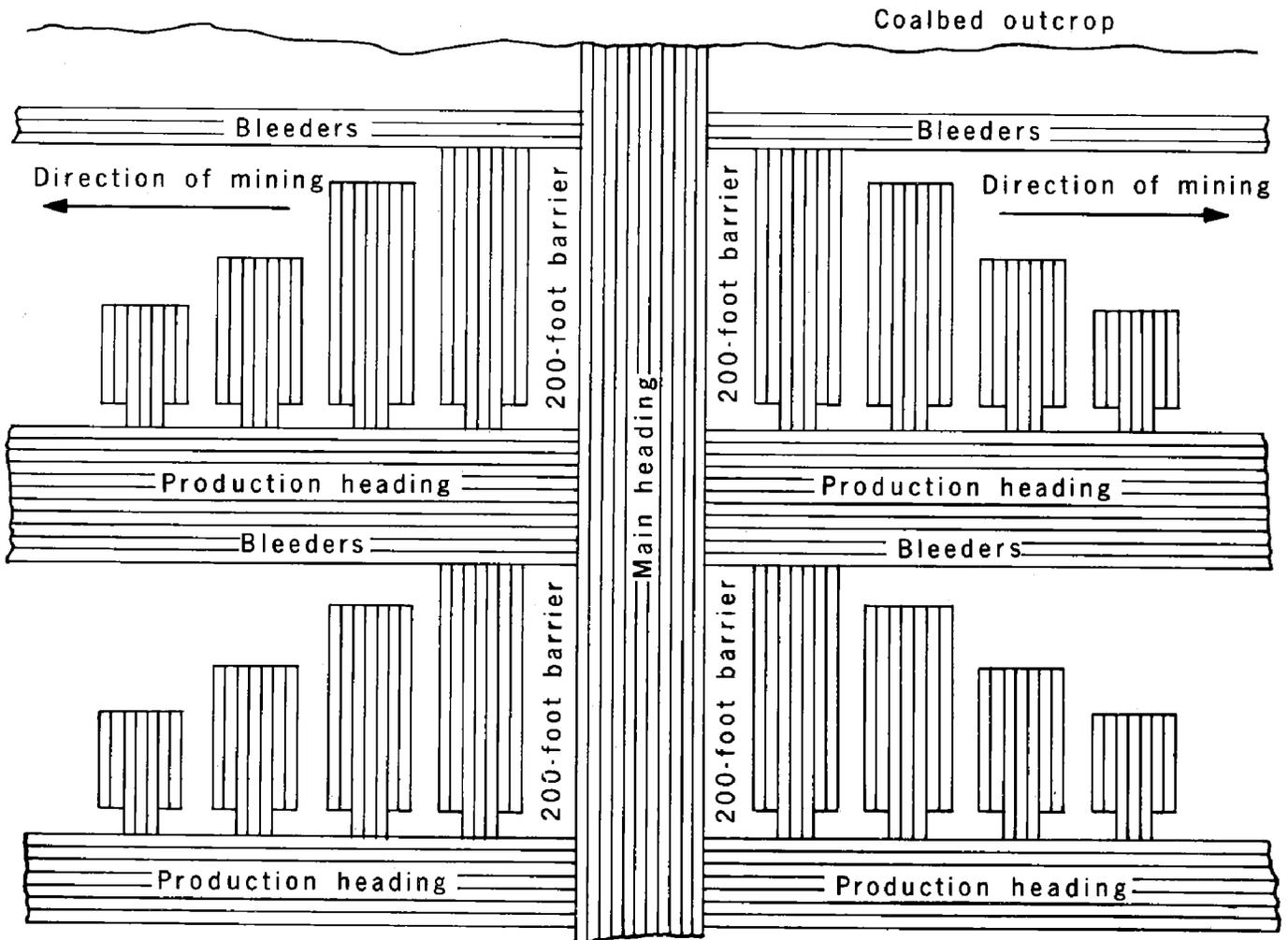


FIGURE 1. - General mining plan.

The general mining plan involves driving main entries along the center axis of the property with production headings on the right and left. All mining is concentrated on one side of the main heading, the plan being to mine one side of the main entries on the advance and the other side on the retreat.

The main headings have 11 entries, and the production headings have 8 entries, 14 feet wide on 95-foot centers. The production panels are on the 8-entry system, 16 feet wide on 95-foot centers. Production panels are 2,600 feet long plus an additional length for development of the bleeder system. Figure 1 is a diagram of the general mining plan.

Each loading unit will consist of a continuous miner, a loading machine, two shuttle cars, and a roof bolter. The shuttle cars will dump into a ratio feeder at the tailpiece of the unit belt conveyor. Unit manpower consists of 10 men and a foreman. Each unit is equipped with a power center to reduce high voltage to equipment requirements. A rectifier converts alternating current to direct current where necessary.

Coal is transported to the surface by belt conveyors. Main heading conveyors are 42 inches wide except for those in the 1.03 MM tpy mine, which are 36 inches wide. Production headings and panel belts are 36 inches wide for all mines.

The following detailed equipment list describes the principal pieces of equipment that will be used in the mines:

Continuous miner

Hp: 220.
Drive: Motor.

Loading machine

Loading rate: 25/30 tons per
minute (tpm).
Hp: 160.
Drive: Motor.

Shuttle car

Hp: 100.
Drive: Motor.

Roof bolter

Dual boom.
Hp: 50.
Equipped with dust collector.

Ratio feeder

Can accept 15+ tons of coal
and discharge at desired
rate.
Equipped with lumpster.
Self-tramming.
Hp: 125.

Supply motor

Hp: 80.
Drive: Motor.

Mainline belt power center

300 kV-A.

Section belt power center

150 kV-A.

Section rectifier

200 kV-A.

Triple duty rock duster

Hp: 30.

Main ventilation fan

Type: Dual.
Size: 8 ft.
350,000 cfm at 6-inch water gage.

Auxiliary fan

To provide more effective ventilation at working face. Size of fan varies according to amount of ventilation required.

Rectifier for track haulage

1,000 kW.

Information supporting the cost figures in this study is included in tables that make up appendixes A, B, and C for the 1.03, 2.06, and 3.09 MM tpy mines, respectively. The following tables are included for each of the mines.

<u>Table</u>	<u>Table title</u>
1	Capital investment summary
2	Manning table
3	Depreciation schedule
4	Power and water cost
5	Estimated annual production cost
6	Estimated development cost
7	Estimated working capital and total capital investment
8	Summary of discounted cash flow
9	Discounted cash flow

SUMMARY

This study furnishes cost analyses for three hypothetical underground bituminous mines that produce 1.03, 2.06, and 3.09 MM tpy of coal. A summary of the total capital investments, operating costs, and selling prices follows.

TABLE 2. - Summary of capital investment, operating costs, and selling price by annual output capacity

MM tons per year.....	1.03	2.06	3.09
Estimated initial capital investment.....	\$12,938,200	\$21,852,900	\$31,435,500
Estimated deferred capital investment.....	8,669,000	14,403,500	20,546,500
Total.....	21,607,200	36,256,400	51,982,000
Capital investment per ton of production.....	20.99	17.61	16.83
Operating cost per year.....	7,821,300	14,345,100	21,041,900
Operating cost per ton of production.....	7.60	6.97	6.81
Selling price per ton, 12 percent DCF ¹	9.11	8.27	8.06

¹Discounted cash flow.

TABLE A-1. - Capital investment summary, 1.03 MM tpy mine

Item	Quantity	Total cost
Continuous miner.....	6	\$978,000
Loading machine.....	6	378,000
Shuttle car.....	12	588,000
Roof bolter.....	7	308,000
Ratio feeder.....	6	216,000
Auxiliary fan.....	7	21,000
Mantrip Jeep ¹	5	70,000
Mechanic Jeep.....	3	33,000
Personnel Jeep.....	4	40,000
Trickle rock duster.....	7	24,500
Triple duty rock duster.....	7	217,000
Supply motor.....	3	75,000
Supply car.....	30	75,000
36-inch rope type belt conveyor.....	26,740 ft	1,417,200
Mainline belt power center (300 kV-A)....	5	75,000
Section belt power center (150 kV-A)....	5	50,000
Section power center (1,000 kV-A).....	6	138,000
Section rectifier (200 kW).....	6	12,000
Section switch house.....	6	45,000
Sectionalizing switch house.....	7	52,500
High voltage (HV) cable (300 million circular mill aluminum {MCM AL}).....	12,000 ft	90,000
PLM ¹ coupler.....	15	11,700
Section cable and coupler.....		37,300
Rectifier for track haulage.....		20,000
Trolley wire.....	24,740 ft	61,900
Track (60-lb).....	24,740 ft	197,900
Fresh water line.....	24,740 ft	74,200
Pumps and lines.....		15,000
Telephone (page phones).....		7,000
Conveyor fire protection.....		20,000
Automatic controls and alarms.....		40,000
Scoop tractor.....	7	175,000
Battery charger.....	7	14,000
All service mask.....	12	1,200
Breathing apparatus.....	12	7,500
Self rescuer.....	300	9,000
Stretcher set.....	8	1,000
Safety light.....	100	3,500
Methanometer.....	100	30,000
Fire chemical car.....	4	12,000
Lamp (including accessories).....	250	10,500
Dust sampler.....	20	6,000
Site preparation.....		20,000
Ventilation fan (dual).....	1	92,000
Concrete portal.....	5	70,000
Rock dust facility.....	1	15,000
Substation and distribution.....	1	65,000
Bathhouse, office, and lamphouse.....	1	285,000

TABLE A-1. - Capital investment summary, 1.03 MM tpy mine - Continued

Item	Quantity	Total cost
Shop and warehouse.....	1	150,000
Powder and cap house.....	1	5,000
Front-end loader.....	1	50,000
Forklift.....	1	20,000
Bulldozer.....	1	80,000
Utility truck.....	1	4,000
Pickup truck.....	1	3,000
Oil storage.....	1	10,000
Water tank.....	1	10,000
Supply yard.....	1	10,000
Mine drainage treatment plant....		30,000
Exploration.....		<u>50,000</u>
Total direct.....		6,626,900
Field indirect.....		<u>132,500</u>
Total construction.....		6,759,400
Engineering.....		135,200
Overhead and administration.....		<u>344,700</u>
		7,239,300
Contingency.....		<u>1,085,900</u>
		8,325,200
Fee.....		<u>166,500</u>
		8,491,700
Estimated development cost.....		<u>4,480,800</u>
		12,972,500
Interest during development.....		<u>389,200</u>
Gross estimate.....		13,361,700
Credit for coal mined during development at \$6.50 per ton.....		<u>3,928,600</u>
		9,433,100
Land acquisition at \$350 per acre.....		<u>1,756,300</u>
Net estimate.....		11,189,400

¹ Reference to specific trade names in this report is done to facilitate understanding and does not imply endorsement by the Bureau of Mines.

TABLE A-2. - Manning table, 1.03 MM tpy mine

Personnel	Total	Wages ¹ per day	Annual cost (220 workdays)	Cost per ton
<u>Underground</u>				
Continuous miner operator.	15	\$50.00	\$167,200	
Loading machine operator..	15	47.25	158,125	
Machine operator helper...	15	47.25	158,125	
Shuttle car operator.....	30	43.25	289,850	
Roof bolter.....	30	47.25	316,250	
Bratticeman.....	15	42.75	143,275	
Utility man.....	15	44.75	149,875	
Mechanic (section).....	15	50.00	167,200	
	150		1,549,900	\$1.51
Supply motorman.....	4	43.25	38,412	
Beltman.....	9	42.75	85,965	
Trackman.....	6	42.75	57,310	
Wireman.....	6	42.75	57,310	
Mason (precision).....	6	44.75	59,950	
Pumper.....	3	42.75	28,655	
Utility crew.....	9	44.75	89,925	
Roving mechanic.....	6	50.00	66,880	
	49		484,407	0.47
<u>Outside</u>				
Lampman.....	3	43.50	29,150	
Front-end loader operator.	2	43.50	19,316	
Shop mechanic.....	6	50.00	66,880	
	11		115,346	.11
<u>Salary</u>				
Superintendent.....	1		26,400	
General mine foreman.....	1		17,400	
Assistant mine foreman....	3		43,200	
Section foreman.....	15		189,000	
Maintenance superintendent	1		19,800	
General shop foreman.....	1		13,800	
Mine maintenance foreman..	3		41,400	
Chief mine engineer.....	1		20,400	
Draftsman.....	1		8,400	
Survey crew.....	3		27,000	
Safety director.....	1		18,000	
Safety inspector.....	3		39,600	
Dust sampler.....	3		28,800	
Office manager.....	1		14,400	
Timekeeper and bookkeeper.	1		10,000	
Purchasing supervisor.....	1		14,400	
Warehouseman.....	4		36,000	
	44		568,000	.55
Total labor and supervision.....	254		2,717,700	2.64

¹Figures in this column are for the day shift. Shift differentials for other shifts are reflected in the final column. Rates used are effective Nov. 12, 1973, under the Bituminous Wage Agreement of 1971.

TABLE A-3. - Depreciation schedule, 1.03 MM tpy mine

Item	Straight-line depreciation, years	Yearly charge
Exploration.....	20	\$2,500
Mine drainage treatment plant....	10	3,000
Supply yard.....	10	1,000
Water tank.....	10	1,000
Oil storage.....	10	1,000
Pickup truck.....	5	600
Utility truck.....	5	800
Bulldozer.....	10	8,000
Forklift.....	10	2,000
Front-end loader.....	10	5,000
Powder and caphouse.....	10	500
Shop and warehouse.....	20	7,500
Bathhouse, office, and lamp house	20	14,250
Substation.....	20	3,250
Bulk rock dust facility.....	10	1,500
Concrete portals.....	20	3,500
Ventilation fan.....	20	4,600
Site preparation.....	20	1,000
Coal mine safety equipment.....	5	26,000
Underground equipment.....	10	552,800
Interim equipment replacement....	20	125,000
Subtotal.....		<u>764,800</u>
Depreciation for field indirect, engineering, overhead and administration, contingency, fee, cost of development, and interest during development, less credit for coal mined at \$6.50 per ton.....	20	<u>140,300</u>
Total.....		905,100 or 0.88 per ton

TABLE A-4. - Power and water cost, 1.03 MM tpy mine

Number of units	Operation	Hp per unit	Hp, total load	Hr per day, full load	KW, total load	Total kWhr requirement
5	Continuous miner...	220	1,100	15	820	12,300
5	Loading machine....	160	800	15	597	8,955
10	Shuttle car.....	100	1,000	15	746	11,190
5	Roof bolter.....	50	250	18	187	3,366
5	Ratio feeder.....	125	625	15	466	6,990
5	Auxiliary fan.....	30	150	18	112	2,016
5	Mantrip Jeep.....	15	75	6	56	336
3	Mechanic Jeep.....	15	45	15	34	510
4	Personnel Jeep.....	7.5	30	15	22	330
7	Rock duster.....	30	210	12	157	1,884
3	Supply motor.....	80	240	12	179	2,148
10	36-inch conveyor...	85	850	15	634	9,510
1	Ventilation fan....	500	500	24	373	8,952
	Extra for pumps, lights, tools, etc		400	10	298	2,980
Total.....						71,467

Power: $\$0.01 \times 71,467 \times 220 = \$157,200 \div 1,029,600 = \0.15 per ton

Water: 3,000 gal per unit per shift at \$0.10 per M gal
 $= 3,000 \times 15 \times 220 \times 0.10 \div 1,000 = \$1,000$

TABLE A-5. - Estimated annual production cost, 1.03 MM tpy mine

	Annual cost	Cost per ton
<u>Direct cost</u>		
Production:		
Labor.....	\$1,848,700	\$1.80
Supervision.....	493,000	0.48
	<u>2,341,700</u>	<u>2.28</u>
Maintenance:		
Labor.....	301,000	0.29
Supervision.....	75,000	.07
	<u>376,000</u>	<u>.36</u>
Operating supplies:		
Mining machine parts.....	514,800	.50
Lubrication and hydraulic oil.....	205,900	.20
Roof bolts and timber.....	257,400	.25
Rock dust.....	103,000	.10
Ventilation.....	154,400	.15
Bits.....	82,400	.08
Cables.....	51,500	.05
Miscellaneous.....	103,000	.10
	<u>1,472,400</u>	<u>1.43</u>
Power.....	157,200	0.15
Water.....	1,000	
Payroll overhead (35 percent of payroll).	951,200	.93
Union welfare ¹	772,200	.75
<u>Indirect cost</u>		
15 percent labor, supervision, and supplies.....	628,500	.61
<u>Fixed cost</u>		
Taxes and insurance, 2 percent of mine cost.....	216,000	.21
Depreciation.....	905,100	.88
	<u>1,121,100</u>	<u>1.09</u>
Total.....	<u>7,821,300</u>	<u>7.60</u>

¹Effective Nov. 12, 1973, under the Bituminous Wage Agreement of 1971.
Annual cost difference due to rounding tonnage figure.

TABLE A-6. - Estimated development cost¹, 1.03 MM tpy mine

Item	Total cost	Cost per ton
Total labor and supervision.....	\$2,026,200	\$3.35
Operating supplies.....	544,000	0.90
Power.....	60,400	.10
Payroll overhead.....	709,200	1.17
Union welfare.....	453,300	0.75
Indirect cost.....	385,500	.64
Fixed cost.....	302,200	.50
Total.....	4,480,800	7.41

Cost per ton = \$7.41

Tonnage = 604,400

Credit for coal mined at \$6.50 per ton = \$3,928,600

¹Estimated development cost covers the period of time required to place all units in operation within the projected mining plan.

TABLE A-7. - Estimated working capital and total capital investment, 1.03 MM tpy mine

Estimated working capital

Direct labor.....3 months...	\$679,400
Operating supplies.....3 months...	368,100
Payroll overhead.....3 months...	237,800
Indirect cost.....4 months...	209,500
Fixed cost.....0.5 percent of insurance base...	54,000
Spare parts.....	175,000
Miscellaneous.....	25,000
Total working capital.....	<u>1,748,800</u>

Total estimated capital investment

Total mine cost (insurance, tax base).....	\$10,800,200
Interest during development.....	389,200
Subtotal.....	<u>11,189,400</u>
Working capital.....	1,748,800
Estimated capital investment.....	<u>12,938,200</u>
Estimated deferred capital investment.....	8,669,000
Total capital investment and deferred investment..	<u>21,607,200¹</u>

¹This is an average cost of \$20.99 per ton of annual production.

TABLE A-8. - Summary of discounted cash flow, 1.03 MM tpy mine

Year	Capital investment	Cash flow	Present worth factor at 12 percent	Present worth capital investment at 12 percent	Present worth cash flow value at 12 percent
0	\$12,938,200	\$-12,938,200	1.	\$12,938,200	\$-12,938,200
1	125,000	1,951,500	0.8929	111,600	1,742,500
2	125,000	1,951,500	.7972	99,700	1,555,700
3	125,000	1,951,500	.7118	89,000	1,389,100
4	125,000	1,951,500	.6355	79,400	1,240,200
5	262,000	1,814,500	.5674	148,700	1,029,500
6	125,000	1,951,500	.5066	63,300	988,600
7	125,000	1,951,500	.4523	56,500	882,700
8	125,000	1,951,500	.4039	50,500	788,200
9	125,000	1,951,500	.3606	45,100	703,700
10	6,020,000	-3,943,500	.3220	1,938,400	-1,269,800
11	125,000	1,951,500	.2875	35,900	561,100
12	125,000	1,951,500	.2567	32,100	501,000
13	125,000	1,951,500	.2292	28,700	447,300
14	125,000	1,951,500	.2046	25,600	399,300
15	262,000	1,814,500	.1827	47,900	331,500
16	125,000	1,951,500	.1631	20,400	318,300
17	125,000	1,951,500	.1456	18,200	284,100
18	125,000	1,951,500	.1300	16,300	253,700
19	125,000	1,951,500	.1161	14,500	226,600
20	-3,380,100	5,456,600	.1037	-350,500	565,800
				15,509,500	900

TABLE A-9. - Discounted cash flow, 1.03 MM tpy mine

12 percent - 20 years

$$R = 15,509,500 \div 7.469^1 = \$2,076,500$$

$$\text{less depreciation} \quad 905,100$$

$$\text{Depletion + net profit} = \underline{1,171,400}$$

Gross profit = Federal income tax (FIT) + depletion + net profit

Depletion = 1/2 gross profit

FIT = net profit

Depletion + net profit = 3/4 gross profit

Gross profit = 4/3 x 1,171,400 = \$1,561,900

Sales.....	\$9,383,200
Operating cost.....	7,821,300
Gross profit.....	<u>1,561,900</u>
Depletion.....	780,900
Taxable income.....	<u>781,000</u>
FIT.....	390,500
Net profit.....	<u>390,500</u>

$$\text{Annual cash flow} = \text{net profit} + \text{depreciation} + \text{depletion}$$

$$= \$390,500 + 905,100 + 780,900 = \$2,076,500$$

$$\text{Selling price per ton} = \$9,383,200 \div 1,029,600 = \$9.11$$

¹Uniform series present worth factor.

Appendix B - 2.06 MM tpy mine

TABLE B-1. - Capital investment summary, 2.06 MM tpy mine

Item	Quantity	Total cost
Continuous miner.....	12	\$1,956,000
Loading machine.....	12	756,000
Shuttle car.....	24	1,176,000
Roof bolter.....	14	616,000
Ratio feeder.....	12	432,000
Auxiliary fan.....	14	42,000
Mantrip Jeep.....	10	140,000
Mechanic Jeep.....	5	55,000
Personnel Jeep.....	6	60,000
Trickle rock duster.....	14	49,000
Triple duty rock duster.....	14	434,000
Supply motor.....	5	125,000
Supply car.....	50	125,000
42-inch rope type belt conveyor.....	9,000 ft	576,000
36-inch rope type belt conveyor.....	30,240 ft	1,602,700
Mainline belt power center (300 kV-A).....	5	75,000
Section belt power center (150 kV-A).....	8	80,000
Section power center (1,000 kV-A).....	12	276,000
Section rectifier (200 kW).....	12	24,000
Section switch house.....	12	90,000
Sectionalizing switch house.....	10	75,000
HV cable (300 MCM AL).....	13,400	100,500
PLM coupler.....	17	13,300
Section cable and coupler.....		74,600
Rectifier for track haulage.....		40,000
Trolley wire.....	25,400 ft	63,500
Track (60-lb).....	25,400 ft	203,200
Fresh water line.....	25,400 ft	76,200
Pumps and lines.....		20,000
Telephone (page phones).....		9,000
Conveyor fire protection.....		23,000
Automatic controls and alarms.....		60,000
Scoop tractor.....	14	350,000
Battery charger.....	14	28,000
All service mask.....	36	3,600
Breathing apparatus.....	24	15,000
Self rescuer.....	500	15,000
Stretcher set.....	14	1,800
Safety light.....	225	7,900
Methanometer.....	200	60,000
Fire chemical car.....	8	24,000
Lamp (including accessories).....	500	21,000
Dust sampler.....	40	12,000
Site preparation.....		30,000
Ventilation fan (dual).....		92,000
Concrete portal.....		70,000
Substation and distribution.....		70,000
Rock dust facility.....		20,000
Bathhouse, office, and lamphouse.....		325,000

TABLE B-1. - Capital investment summary, 2.06 MM tpy mine - Continued

Item	Quantity	Total cost
Shop and warehouse.....		\$200,000
Powder and cap house.....		6,000
Front-end loader.....	1	50,000
Forklift.....	1	20,000
Bulldozer.....	1	80,000
Utility truck.....	1	4,000
Pickup truck.....	1	3,000
Oil storage.....	1	15,000
Water tank.....	1	15,000
Supply yard.....	1	15,000
Mine drainage treatment plant.....		30,000
Exploration.....		<u>100,000</u>
Total direct.....		11,131,300
Field indirect.....		<u>222,600</u>
Total construction.....		11,353,900
Engineering.....		227,100
Overhead and administration.....		<u>579,100</u>
		12,160,100
Contingency.....		<u>1,824,000</u>
		13,984,100
Fee.....		<u>279,700</u>
		14,263,800
Estimated development cost.....		<u>7,581,500</u>
		21,845,300
Interest during development.....		<u>655,400</u>
Gross estimate.....		22,500,700
Credit for coal mined during development at \$6.50 per ton.....		<u>7,432,100</u>
		15,068,600
Land acquisition at \$350 per acre.....		<u>3,512,300</u>
Net estimate.....		<u>18,580,900</u>

TABLE B-2. - Manning table, 2.06 MM tpy mine

Personnel	Total	Wages ¹ per day	Annual cost (220 workdays)	Cost per ton
<u>Underground</u>				
Continuous miner operator..	30	\$50.00	\$334,400	
Loading machine operator...	30	47.25	316,250	
Machine operator helper....	30	47.25	316,250	
Shuttle car operator.....	60	43.25	579,700	
Roof bolter.....	60	47.25	632,500	
Bratticeman.....	30	42.75	286,550	
Utility man.....	30	44.75	299,750	
Mechanic (section).....	30	50.00	334,400	
	300		3,099,800	\$1.51
Supply motorman.....	6	43.25	57,970	
Beltman.....	21	42.75	200,585	
Trackman.....	9	42.75	85,965	
Wireman.....	9	42.75	85,965	
Mason (precision).....	12	44.75	119,900	
Pumper.....	3	42.75	28,655	
Utility crew.....	18	44.75	179,850	
Roving mechanic.....	9	50.00	100,320	
	87		859,210	0.42
<u>Outside</u>				
Lampman.....	3	43.50	29,150	
Front-end loader operator..	3	43.50	29,150	
Shop mechanic.....	9	50.00	100,320	
	15		158,620	.08
<u>Salary</u>				
Superintendent.....	1		26,400	
General mine foreman.....	1		17,400	
Assistant mine foreman....	3		43,200	
Section foreman.....	30		378,000	
Maintenance superintendent.	1		19,800	
General shop foreman.....	1		13,800	
Mine maintenance foreman...	3		41,400	
Chief mine engineer.....	1		20,400	
Draftsman.....	1		8,400	
Survey crew.....	3		27,000	
Safety director.....	1		18,000	
Safety inspector.....	3		39,600	
Dust sampler.....	3		28,800	
Office manager.....	1		14,400	
Timekeeper and bookkeeper..	1		10,000	
Purchasing supervisor.....	1		14,400	
Warehouseman.....	4		36,000	
	59		757,000	.36
Total labor and supervision.....	461		4,874,600	2.37

¹Figures in this column are for the day shift. Shift differentials for other shifts are reflected in the final column. Rates used are effective Nov. 12, 1973, under the Bituminous Wage Agreement of 1971.

TABLE B-3. - Depreciation schedule, 2.06 MM tpy mine

Item	Straight-line depreciation, years	Yearly charge
Exploration.....	20	\$5,000
Mine drainage treatment plant....	10	3,000
Supply yard.....	10	1,500
Water tank.....	10	1,500
Oil storage.....	10	1,500
Pickup truck.....	5	600
Utility truck.....	5	800
Bulldozer.....	10	8,000
Forklift.....	10	2,000
Front-end loader.....	10	5,000
Powder and cap house.....	10	600
Shop and warehouse.....	20	10,000
Bathhouse, office, and lamp house	20	16,300
Substation.....	20	3,500
Bulk rock dust facility.....	10	2,000
Concrete portals.....	20	3,500
Ventilation fan.....	20	4,600
Site preparation.....	20	1,500
Coal mine safety equipment.....	5	44,500
Underground equipment.....	10	976,400
Interim equipment replacement....	20	185,000
Subtotal.....		<u>1,276,800</u>
Depreciation for field indirect, engineering, overhead and administration, contingency, fee, cost of development, and interest during development, less credit for coal mined at \$6.50 per ton.....	20	<u>196,900</u>
Total.....		<u>1,473,700</u> or \$0.72 per ton

TABLE B-4. - Power and water cost, 2.06 MM tpy mine

Number of units	Operation	Hp per unit	Hp, total load	Hr per day, full load	KW total load	Total kWhr requirement
10	Continuous miner...	220	2,200	15	1,641	24,615
10	Loading machine....	160	1,600	15	1,194	17,910
20	Shuttle car.....	100	2,000	15	1,492	22,380
10	Roof bolter.....	50	500	18	373	6,714
10	Ratio feeder.....	125	1,250	15	933	14,000
10	Auxiliary fan.....	30	300	18	224	4,032
10	Mantrip Jeep.....	15	150	6	112	672
5	Mechanic Jeep.....	15	75	15	56	840
6	Personnel Jeep.....	7.5	45	15	34	510
10	Rock duster.....	30	300	12	224	2,688
4	Supply motor.....	80	320	12	239	2,868
3	42-inch conveyor...	125	375	15	280	4,200
2	36-inch conveyor...	100	200	15	149	2,235
10	36-inch conveyor...	50	500	15	373	5,595
1	Ventilation fan....	500	500	24	373	8,952
	Extra for pumps, tools, light, etc.		500	10	373	3,730
Total.....						121,941

Power: $\$0.01 \times 121,941 \times 220 = \$268,300 \div 2,059,200 = \0.13 per ton.

Water: 3,000 gal per unit per shift at \$0.10 per M gal
 $= 3,000 \times 30 \times 220 \times 0.10 \div 1,000 = \$2,000.$

TABLE B-5. - Estimated annual production cost, 2.06 MM tpy mine

	Annual cost	Cost per ton
<u>Direct cost</u>		
Production:		
Labor.....	\$3,582,600	\$1.74
Supervision.....	682,000	0.33
	<u>4,264,600</u>	<u>2.07</u>
Maintenance:		
Labor.....	535,000	0.26
Supervision.....	75,000	.04
	<u>610,000</u>	<u>.30</u>
Operating supplies:		
Mining machine parts.....	1,029,600	.50
Lubrication and hydraulic oil.....	411,800	.20
Roof bolts and timber.....	514,800	.25
Rock dust.....	205,900	.10
Ventilation.....	308,900	.15
Bits.....	164,700	.08
Cables.....	103,000	.05
Miscellaneous.....	205,900	.10
	<u>2,944,600</u>	<u>1.43</u>
Power.....	268,300	0.13
Water.....	2,000	
Payroll overhead (35 percent of payroll)..	1,706,100	.83
Union welfare ¹	1,544,400	.75
<u>Indirect cost</u>		
15 percent labor, supervision, and supplies.....	1,172,900	.57
<u>Fixed cost</u>		
Taxes and insurance, 2 percent of mine cost.....	358,500	.17
Depreciation.....	1,473,700	.72
	<u>1,832,200</u>	<u>.89</u>
Total.....	14,345,100	6.97

¹Effective Nov. 12, 1973, under the Bituminous Wage Agreement of 1971.

TABLE B-6. - Estimated development cost¹, 2.06 MM tpy mine

Item	Total cost	Cost per ton
Total labor and supervision.....	\$3,236,300	\$2.83
Operating supplies.....	1,029,100	0.90
Power.....	114,300	.10
Payroll overhead.....	1,132,700	.99
Union welfare.....	857,600	.75
Indirect cost.....	639,800	.56
Fixed cost.....	571,700	.50
Total.....	7,581,500	6.63

Cost per ton = \$6.63

Tonnage = 1,143,400

Credit for coal mined at \$6.50 per ton = \$7,432,100

¹Estimated development cost covers the period of time required to place all units in operation within the projected mining plan.

TABLE B-7. - Estimated working capital and total capital investment,
2.06 MM tpy mine

Estimated working capital

Direct labor.....3 months...	\$1,218,700
Operating supplies.....3 months...	736,200
Payroll overhead.....3 months...	426,500
Indirect cost.....4 months...	391,000
Fixed cost.....0.5 percent of insurance base...	89,600
Spare parts.....	360,000
Miscellaneous.....	50,000
Total working capital.....	<u>3,272,000</u>

Total estimated capital investment

Total mine cost (insurance, tax base).....	\$17,925,500
Interest during development.....	655,400
Subtotal.....	<u>18,580,900</u>
Working capital.....	3,272,000
Estimated capital investment.....	<u>21,852,900</u>
Estimated deferred capital investment.....	<u>14,403,500</u>
Total capital investment and deferred investment..	<u>36,256,400¹</u>

¹This is an average capital cost of \$17.61 per annual ton of production.

TABLE B-8. - Summary of discounted cash flow, 2.06 MM tpy mine

Year	Capital investment	Cash flow	Present worth factor at 12 percent	Present worth capital investment at 12 percent	Present worth cash flow value at 12 percent
0	\$21,852,900	\$-21,852,900	1.	\$21,852,900	\$-21,852,900
1	185,000	3,296,400	.8929	165,200	2,943,400
2	185,000	3,296,400	.7972	147,500	2,627,900
3	185,000	3,296,400	.7118	131,700	2,346,400
4	185,000	3,296,400	.6355	117,600	2,094,900
5	414,500	3,066,900	.5674	235,200	1,740,200
6	185,000	3,296,400	.5066	93,700	1,670,000
7	185,000	3,296,400	.4523	83,700	1,491,000
8	185,000	3,296,400	.4039	74,700	1,331,400
9	185,000	3,296,400	.3606	66,700	1,188,700
10	10,429,500	-6,948,100	.3220	3,358,300	-2,237,300
11	185,000	3,296,400	.2875	53,200	947,700
12	185,000	3,296,400	.2567	47,500	846,200
13	185,000	3,296,400	.2292	42,400	755,500
14	185,000	3,296,400	.2046	37,900	674,400
15	414,500	3,066,900	.1827	75,700	560,300
16	185,000	3,296,400	.1631	30,200	537,600
17	185,000	3,296,400	.1456	26,900	480,000
18	185,000	3,296,400	.1300	24,100	428,500
19	185,000	3,296,400	.1161	21,500	382,700
20	-6,599,300	10,080,700	.1037	-684,300	1,045,400
				26,002,300	2,000

TABLE B-9. - Discounted cash flow, 2.06 MM tpy mine

12 percent - 20 years

$$\begin{aligned}
 R &= 26,002,300 \div 7.469^1 = \$3,481,400 \\
 &\quad \text{less depreciation} \quad \underline{1,473,700} \\
 \text{Depletion + net profit} &= \underline{2,007,700}
 \end{aligned}$$

Gross profit = Federal income tax (FIT) + depletion + net profit

Depletion = 1/2 gross profit

FIT = net profit

Depletion + net profit = 3/4 gross profit

Gross profit = 4/3 x 2,007,700 = \$2,676,900

Sales.....	\$17,022,000
Operating cost.....	<u>14,345,100</u>
Gross profit.....	2,676,900
Depletion.....	<u>1,338,500</u>
Taxable income.....	1,338,400
FIT.....	<u>669,200</u>
Net profit.....	669,200

$$\begin{aligned}
 \text{Annual cash flow} &= \text{net profit} + \text{depreciation} + \text{depletion} \\
 &= 669,200 + 1,473,700 + 1,338,500 = \$3,481,400
 \end{aligned}$$

$$\text{Selling price per ton} = \$17,022,000 \div 2,059,200 = \$8.27$$

1Uniform series present worth factor.

Appendix C - 3.09 MM tpy mine

TABLE C-1. - Capital investment summary, 3.09 MM tpy mine

Item	Quantity	Total cost
Continuous miner.....	18	\$2,934,000
Loading machine.....	18	1,134,000
Shuttle car.....	36	1,764,000
Roof bolter.....	20	880,000
Ratio feeder.....	18	648,000
Auxiliary fan.....	20	60,000
Mantrip Jeep.....	15	210,000
Mechanic Jeep.....	6	66,000
Personnel Jeep.....	10	100,000
Trickle rock duster.....	20	70,000
Triple duty rock duster.....	20	620,000
Supply motor.....	7	175,000
Supply car.....	75	187,500
42-inch rope type belt conveyor.....	9,000 ft	576,000
36-inch rope type belt conveyor.....	48,000 ft	2,544,000
Mainline belt power center (300 kV-A)....	6	90,000
Section belt power center (150 kV-A)....	12	120,000
Section power center (1,000 kV-A).....	18	414,000
Section rectifier (200 kW).....	18	36,000
Section switch house.....	18	135,000
Sectionalizing switch house.....	12	90,000
HV cable (300 MCM AL).....	18,500 ft	138,800
PLM coupler.....	19	14,900
Section cable and coupler.....		100,000
Rectifier for track haulage.....		60,000
Trolley wire.....	42,500 ft	106,300
Track.....	42,500 ft	340,000
Fresh water line.....	42,500 ft	127,500
Pumps and lines.....		30,000
Telephone (page phones).....		12,000
Conveyor fire protection.....		30,000
Automatic controls and alarms.....		75,000
Scoop tractor.....	20	500,000
Battery charger.....	20	40,000
All service mask.....	36	3,600
Breathing apparatus.....	36	22,500
Self rescuer.....	700	21,000
Stretcher set.....	25	3,000
Safety light.....	300	10,600
Methanometer.....	300	90,000
Fire chemical car.....	10	30,000
Lamp (including accessories).....	700	29,400
Dust sampler.....	50	15,000
Site preparation.....		40,000
Ventilation fan (dual).....		92,000
Concrete portal.....		70,000
Substation and distribution.....		75,000
Rock dust facility.....		30,000
Bathhouse, office, and lamphouse.....		400,000

TABLE C-1. - Capital investment summary, 3.09 MM tpy mine - Continued

Item	Quantity	Total cost
Shop and warehouse.....		\$250,000
Powder and cap house.....		7,000
Front-end loader.....	1	50,000
Forklift.....	1	20,000
Bulldozer.....	1	80,000
Utility truck.....	1	4,000
Pickup truck.....	1	3,000
Oil storage.....		20,000
Water tank.....		20,000
Supply yard.....		15,000
Mine drainage treatment plant.....		30,000
Exploration.....		<u>150,000</u>
Total direct.....		16,009,100
Field indirect.....		<u>320,200</u>
Total construction.....		16,329,300
Engineering.....		326,600
Overhead and administration.....		<u>832,800</u>
		17,488,700
Contingency.....		<u>2,623,300</u>
		20,112,000
Fee.....		<u>402,200</u>
		20,514,200
Estimated development cost.....		<u>11,304,500</u>
		31,818,700
Interest during development.....		<u>954,600</u>
Gross estimate.....		32,773,300
Credit for coal mined during development at \$6.50 per ton.....		<u>11,433,500</u>
		21,339,800
Land acquisition at \$350 per acre.....		<u>5,268,600</u>
Net estimate.....		<u>26,608,400</u>

TABLE C-2. - Manning table, 3.09 MM tpy mine

Personnel	Total	Wages ¹ per day	Annual cost (220 workdays)	Cost per ton
<u>Underground</u>				
Continuous miner operator.	45	\$50.00	\$501,600	
Loading machine operator..	45	47.25	474,375	
Machine operator helper...	45	47.25	474,375	
Shuttle car operator.....	90	43.25	869,550	
Roof bolter.....	90	47.25	948,750	
Bratticeman.....	45	42.75	429,825	
Utility man.....	45	44.75	449,625	
Mechanic (section).....	45	50.00	501,600	
	450		4,649,700	\$1.51
Supply motorman.....	9	43.25	86,955	
Beltman.....	30	42.75	286,550	
Trackman.....	15	42.75	143,275	
Wireman.....	15	42.75	143,275	
Mason (precision).....	15	44.75	149,875	
Pumper.....	3	42.75	28,655	
Utility crew.....	30	44.75	299,750	
Roving mechanic.....	15	50.00	167,200	
	132		1,305,535	0.42
<u>Outside</u>				
Lampman.....	3	43.50	29,150	
Front-end loader operator.	3	43.50	29,150	
Shop mechanic.....	12	50.00	133,760	
	18		192,060	.06
<u>Salary</u>				
Superintendent.....	1		26,400	
General mine foreman.....	1		17,400	
Assistant mine foreman....	3		43,200	
Section foreman.....	45		567,000	
Maintenance superintendent	1		19,800	
General shop foreman.....	1		13,800	
Mine maintenance foreman..	3		41,400	
Chief mine engineer.....	1		20,400	
Draftsman.....	1		8,400	
Survey crew.....	3		27,000	
Safety director.....	1		18,000	
Safety inspector.....	3		39,600	
Dust sampler.....	3		28,800	
Office manager.....	1		14,400	
Timekeeper and bookkeeper.	1		10,000	
Purchasing supervisor.....	1		14,400	
Warehouseman.....	4		36,000	
	74		946,000	.31
Total labor and supervision.....	674		7,093,300	2.30

¹Figures in this column are for the day shift. Shift differentials for other shifts are reflected in the final column. Rates used are effective Nov. 12, 1973, under the Bituminous Wage Agreement of 1971.

TABLE C-3. - Depreciation schedule, 3.09 MM tpy mine

Item	Straight line depreciation, years	Yearly charge
Exploration.....	20	\$7,500
Mine drainage treatment plant.....	10	3,000
Supply yard.....	10	1,500
Water tank.....	10	2,000
Oil storage.....	10	2,000
Pickup truck.....	5	600
Utility truck.....	5	800
Bulldozer.....	10	8,000
Forklift.....	10	2,000
Front-end loader.....	10	5,000
Powder and cap house.....	10	700
Shop and warehouse.....	20	12,500
Bathhouse, office, and lamp house.	20	20,000
Substation.....	20	3,750
Bulk rock dust facility.....	10	3,000
Concrete portals.....	20	3,500
Ventilation fan.....	20	4,600
Site preparation.....	20	2,000
Coal mine safety equipment.....	5	60,100
Underground equipment.....	10	1,434,950
Interim equipment replacement.....	20	250,000
Subtotal.....		<u>1,827,500</u>
Depreciation for field indirect, engineering, overhead and administration, contingency, fee, cost of development, and interest during development, less credit for coal mined at \$6.50 per ton.....	20	<u>266,500</u>
Total.....		2,094,000 or 0.68 per ton

TABLE C-4. - Power and water cost, 3.09 MM tpy mine

Number of units	Operation	Hp per unit	Hp, total load	Hr per day, full load	KW, total load	Total kWhr requirement
15	Continuous miner....	220	3,300	15	2,462	36,930
15	Loading machine.....	160	2,400	15	1,790	26,850
30	Shuttle car.....	100	3,000	15	2,238	33,570
15	Roof bolter.....	50	750	18	560	10,080
15	Ratio feeder.....	125	1,875	15	1,399	20,985
15	Auxiliary fan.....	30	450	18	336	6,048
15	Mantrip Jeep.....	15	225	6	168	1,008
6	Mechanic Jeep.....	15	90	15	67	1,005
10	Personnel Jeep.....	7.5	75	15	56	840
7	Supply motor.....	80	560	12	418	5,016
30	Rock duster.....	30	900	12	671	8,052
3	42-inch conveyor....	200	600	15	448	6,720
3	36-inch conveyor....	100	300	15	224	3,360
12	36-inch conveyor....	50	600	15	448	6,720
1	Ventilation fan.....	500	500	24	373	8,952
	Extra for pumps, tools, lights, etc.		500	10	373	3,730
Total.....						179,866

Power: $\$0.01 \times 179,866 \times 220 = \$395,700 \div 3,088,800 = \0.13 per ton.

Water: 3,000 gal per unit per shift at \$0.10 per M gal
 $= 3,000 \times 45 \times 220 \times 0.10 \div 1,000 = \$3,000$.

TABLE C-5. - Estimated annual production cost, 3.09 MM tpy mine

	Annual cost	Cost per ton
<u>Direct cost</u>		
Production:		
Labor.....	\$5,344,700	\$1.73
Supervision.....	871,000	0.28
	<u>6,215,700</u>	<u>2.01</u>
Maintenance:		
Labor.....	802,600	0.26
Supervision.....	75,000	.03
	<u>877,600</u>	<u>.29</u>
Operating supplies:		
Mining machine parts.....	1,544,400	.50
Lubrication and hydraulic oil.....	617,800	.20
Rock bolts and timber.....	772,200	.25
Rock dust.....	308,900	.10
Ventilation.....	463,300	.15
Bits.....	247,100	.08
Cables.....	154,400	.05
Miscellaneous.....	308,900	.10
	<u>4,417,000</u>	<u>1.43</u>
Power.....	395,700	0.13
Water.....	3,000	
Payroll overhead (35 percent of payroll)	2,482,700	.80
Union welfare ¹	2,316,600	.75
<u>Indirect cost</u>		
15 percent labor, supervision, and supplies.....	1,726,500	.56
<u>Fixed cost</u>		
Taxes and insurance, 2 percent of mine cost.....	513,100	.16
Depreciation.....	2,094,000	.68
	<u>2,607,100</u>	<u>.84</u>
Total.....	<u>21,041,900</u>	<u>6.81</u>

¹Effective Nov. 12, 1973, under the Bituminous Wage Agreement of 1971.

TABLE C-6. - Estimated development cost¹, 3.09 MM tpy mine

Item	Total cost	Cost per ton
Total labor and supervision.....	\$4,716,000	\$2.68
Operating supplies.....	1,583,100	0.90
Power.....	211,100	.12
Payroll overhead.....	1,650,600	.94
Union welfare.....	1,319,300	.75
Indirect cost.....	944,900	.54
Fixed cost.....	879,500	.50
Total.....	11,304,500	6.43

Cost per ton = \$6.43

Tonnage = 1,759,000

Credit for coal mined at \$6.50 per ton = \$11,433,500

¹Estimated development cost covers the period of time required to place all units in operation within the projected mining plan.

TABLE C-7. - Estimated working capital and total capital investment, 3.09 MM tpy mine

Estimated working capital

Direct labor.....3 months...	\$1,773,300
Operating supplies.....3 months...	1,104,300
Payroll overhead.....3 months...	620,700
Indirect cost.....4 months...	575,500
Fixed cost.....0.5 percent of insurance base...	128,300
Spare parts.....	550,000
Miscellaneous.....	75,000
	<u>4,827,100</u>

Total estimated capital investment

Total mine cost (insurance, tax base).....	\$25,653,800
Interest during development.....	954,600
Subtotal.....	26,608,400
Working capital.....	4,827,100
Estimated capital investment	31,435,500
Estimated deferred capital investment	20,546,500
Total capital investment and deferred investment....	<u>51,982,000¹</u>

¹This is an average capital cost of \$16.83 per annual ton of production.

TABLE C-8. - Summary of discounted cash flow, 3.09 MM tpy mine

Year	Capital investment	Cash flow	Present worth factor 12 percent	Present worth capital investment at 12 percent	Present worth cash flow value at 12 percent
0	\$31,435,500	\$-31,435,500	1.	\$31,435,500	\$-31,435,500
1	250,000	4,743,300	.8929	223,200	4,235,300
2	250,000	4,743,300	.7972	199,300	3,781,400
3	250,000	4,743,300	.7118	178,000	3,376,300
4	250,000	4,743,300	.6355	158,900	3,014,400
5	557,500	4,435,800	.5674	316,300	2,516,900
6	250,000	4,743,300	.5066	126,700	2,403,000
7	250,000	4,743,300	.4523	113,100	2,145,400
8	250,000	4,743,300	.4039	101,000	1,915,800
9	250,000	4,743,300	.3606	90,200	1,710,400
10	15,181,500	-10,188,300	.3220	4,888,400	-3,280,600
11	250,000	4,743,300	.2875	71,900	1,363,700
12	250,000	4,743,300	.2567	64,200	1,217,600
13	250,000	4,743,300	.2292	57,300	1,087,200
14	250,000	4,743,300	.2046	51,200	970,500
15	557,500	4,435,800	.1827	101,900	810,400
16	250,000	4,743,300	.1631	40,800	773,600
17	250,000	4,743,300	.1456	36,400	690,600
18	250,000	4,743,300	.1300	32,500	616,600
19	250,000	4,743,300	.1161	29,000	550,700
20	-9,845,700	14,839,000	.1037	-1,021,000	1,538,800
				37,294,800	2,500

TABLE C-9. - Discounted cash flow, 3.09 MM tpy mine

12 percent - 20 years

$$R = 37,294,800 \div 7.469^1 = \$4,993,300$$

less depreciation	2,094,000
Depletion + net profit =	<u>2,899,300</u>

Gross profit = Federal income tax (FIT) + depletion + net profit

Depletion = 1/2 gross profit

FIT = net profit

Depletion + net profit = 3/4 gross profit

Gross profit = 4/3 x 2,899,300 = \$3,865,700

Sales.....	\$24,907,600
Operating cost.....	<u>21,041,900</u>
Gross profit.....	3,865,700
Depletion.....	<u>1,932,900</u>
Taxable income.....	1,932,800
FIT.....	<u>966,400</u>
Net profit.....	966,400

$$\begin{aligned} \text{Annual cash flow} &= \text{net profit} + \text{depreciation} + \text{depletion} \\ &= 966,400 + 2,094,000 + 1,932,900 = \$4,993,300 \end{aligned}$$

$$\text{Selling price per ton} = \$24,907,600 \div 3,088,800 = \$8.06$$

¹Uniform series present worth factor.