

3.2. SURFACE MINING - OPERATING COSTS

3.2.2. MINING

3.2.2.1. DRILL AND BLAST
DRILLS

The curves have been developed in two parts. For mines excavating from 100 to 8,000 mtpd ore, the curves reflect costs for drilling 6-m high benches with crawler-type percussion drills. Spacing of 2.5-in holes is on a pattern of 1.5 by 2 m to a depth of 7 m. The powder factor is 0.30 kg/mt³.

For mines excavating from 8,000 to 100,000 mtpd, drilling is performed with rotary drills having a down pressure of from 13,600 to 56,700 kg. The powder factor varies from 0.11 to 0.20 kg/mt³ of ore. Holes drilled average 12.25-in (31.12-cm) diameter from a range of 6- to 13.75-in (15.24- to 34.93-cm) diameter. Costs are based on drilling hard rocks with an average compressive strength (30,000 psi or 2,100 kg/cm²). Bench heights are 12 to 18 m and average 15 m. Drilling patterns and overdrilling varies with a range of 80 to 200 mt of blasted material per linear meter of drill hole. Secondary drilling and blasting varies from 0 to 10% of blasted material.

The total daily cost is the sum of three separate cost curves (labor, supplies, and equipment operation) based on a production rate (X), in metric tons material per day. The curves are valid for operations between 100 and 100,000 mtpd, operating three shifts per day. The curves include all daily operating and maintenance costs associated with drill and blast.

BASE CURVE

(L) Labor Operating Cost (percussion drill) (Y_{L PERCUSSION}) = 1.747(X)^{0.909}
The operating labor costs are distributed as follows:

Direct labor.....	43%
Maintenance labor.....	57%

The direct labor costs consist of the following typical range of personnel:

	Small (100 to 3,000 mtpd)	Large (3,000 to 8,000 mtpd)	Av salary per hour (base rate)
Percussion drilling crew...	70%	83%	\$15.22
Blasting crew.....	30%	17%	14.79

The average wage for labor is \$15.41 per worker-hour (including burden and average shift differential).

- (L) Labor Operating Cost (rotary drill) $(Y_L \text{ ROTARY}) = 0.720(X)^{0.779}$
 The operating labor costs are distributed as follows:

	Small (8,000 to 30,000 mtpd)	Large (30,000 to 100,000 mtpd)
Direct labor.....	53%	47%
Maintenance labor.....	47%	53%

The direct labor costs consist of the following typical range of personnel:

	Small (8,000 to 30,000 mtpd)	Large (30,000 to 100,000 mtpd)	Av salary per hour (base rate)
Rotary and secondary drilling crew.....	70%	65%	\$15.29
Blasting crew.....	30%	35%	15.15

The average wage for labor is \$15.56 per worker-hour (including burden and average shift differential).

- (S) Supply Operating Cost (percussion drill) $(Y_S \text{ PERCUSSION}) = 30.278(X)^{0.504}$
 The supply costs include drill bits, steel-related items, and blasting supplies in the following cost proportions:

	Small (100 to 3,000 mtpd)	Large (3,000 to 8,000 mtpd)
Drill bits and steel- related items.....	10%	25%
Blasting supplies.....	90%	75%

- (S) Supply Operating Cost (rotary drill) $(Y_S \text{ ROTARY}) = 0.152(X)^{0.985}$
 The supply costs include drill bits, steel-related items and blasting supplies in the following cost proportions:

Drill bits and steel- related items.....	18%
Blasting supplies.....	82%

- (E) Equipment Operating Cost (percussion drill) $(Y_E \text{ PERCUSSION}) = 1.771(X)^{0.818}$
 The equipment operating costs include power for the drills, fuel and lubrication for trucks and drill compressors, repair parts for drills and supporting equipment, and tire costs for supporting equipment.

The equipment operating costs for percussion drill and blast consist of 86% for drilling equipment and 14% for trucks. Drilling equipment costs include 58% for repair parts and 42% for fuel and lubrication. Supporting equipment costs include 87% for fuel and lubrication, 8% for repair parts, and 5% for tires.

(E) Equipment Operating Cost (rotary drill) $(Y_E \text{ ROTARY}) = 0.614(X)0.783$

The equipment operating costs include power for the drills, fuel and lubrication for trucks and drill compressors, repair parts for drills and supporting equipment, and tire costs for supporting equipment.

The equipment operating costs for rotary drill and blast consist of 91% for drilling equipment and 9% for supporting equipment. Rotary drilling equipment operating costs include 77% for repair parts, 12% for fuel and lubrication, and 11% for power. Supporting equipment costs include 76% for fuel and lubrication, 17% for repair parts, and 7% for tires.

ADJUSTMENT FACTOR

Drill and Blast Factor (D & B Factor) The curves indicate average costs for a wide range of materials as can be noted by drill sizes, bit sizes, powder factors, and drill pattern. To determine drilling and blasting costs, consideration must be given to material hardness, abrasiveness, natural fractures and jointing, and maximum-size fragments that can be loaded, hauled, and processed.

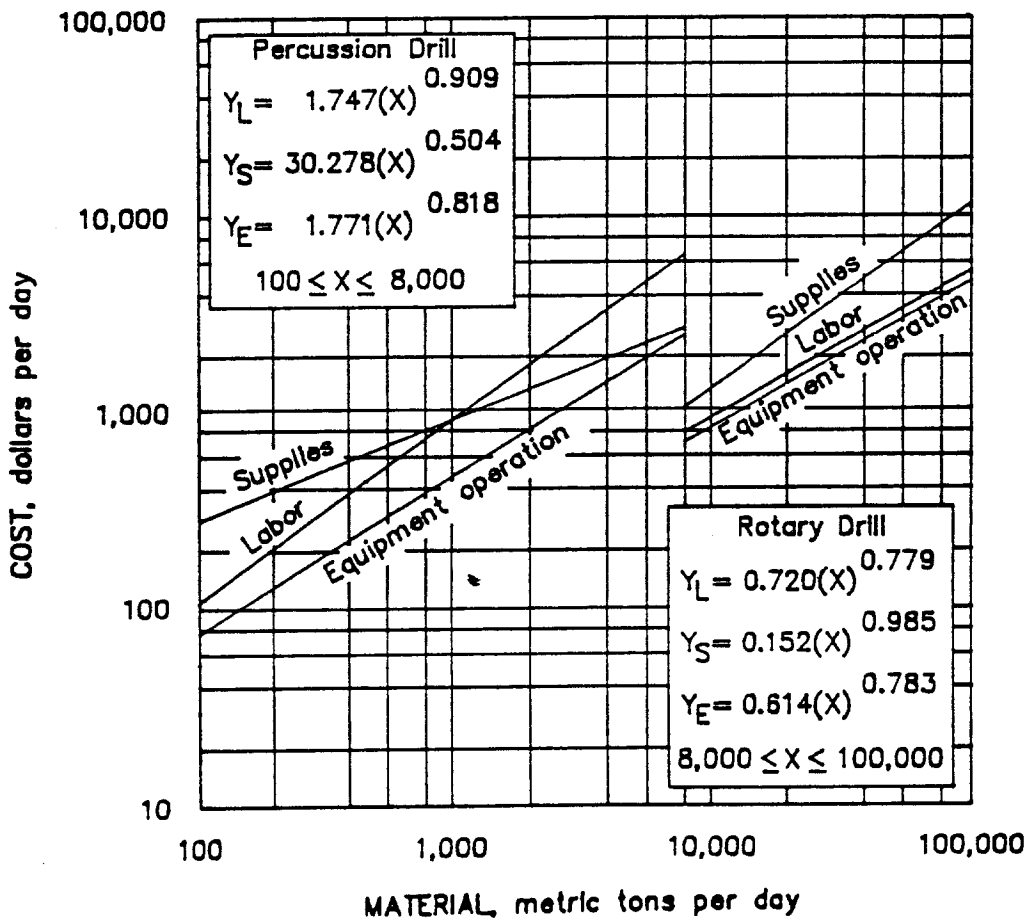
For favorable conditions, multiply the costs obtained from the curves by the following factor:

D & B factor $(F_D \text{ GOOD}) = 0.6$

Where the above conditions are unfavorable, multiply the costs obtained from the curves by the following factor:

D & B factor $(F_D \text{ SEVERE}) = 2.0$

Surface Mining—Operating Costs



3.2.2.1. Drill and blast
DRILLS

3.2. SURFACE MINING--OPERATING COSTS

3.2.2. MINING

3.2.2.2. EXCAVATION, LOAD AND HAUL
BUCKET WHEEL EXCAVATION

The total daily cost is the sum of the three separate cost curves (labor, supplies, and equipment operation) based on a production rate (X) in metric tons material per day. The curves are valid for operations between 2,200 and 125,000 mtpd, operating three shifts per day. The costs include only the operation of the bucket wheel excavator.

BASE CURVES

The base curve is predicated on excavating ore. The daily output of an excavator is based on the operating time and output efficiency of the machine. The base curve assumes an operating time of 50% and an output efficiency of 46%. The operating time is the percent of 24 hr that a machine operates each day. The output efficiency is the percent of theoretical capacity that a machine delivers for a particular overburden.

(L) Labor Operating Cost $(Y_L) = 7.414(X)^{0.556}$

The operating labor costs are distributed as follows:

Direct labor.....	65%
Maintenance labor.....	35%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Bucket wheel operator.....	72%	\$16.78
Bucket wheel helper.....	3%	13.66
Bucket wheel laborer.....	25%	11.68

The average wage for labor is \$15.58 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 0.058(X)^{0.859}$

The supply cost consists of 100% electric power.

(E) Equipment Operating Cost $(Y_E) = 0.212(X)^{0.681}$

The equipment operating cost consists of 100% for repair parts and materials.

ADJUSTMENT FACTORS

Shift Adjustment The curve is based on a three-shift-per-day operation. Typically, bucket wheel excavators are run continuously. For a one or two-shift operation, decrease the operating costs proportionately.

Operating Time Factor The base case assumes a 50% operating time. Bucket wheel excavators do not have high availabilities. The range of expected operating time is 41% to 60%. To adjust the base case for different operating times, multiply the the cost obtained from the labor curve by the following factor:

$$\text{Labor factor } (F_L) = [50/(T)]^{0.554}$$

where T = new percent operating time.

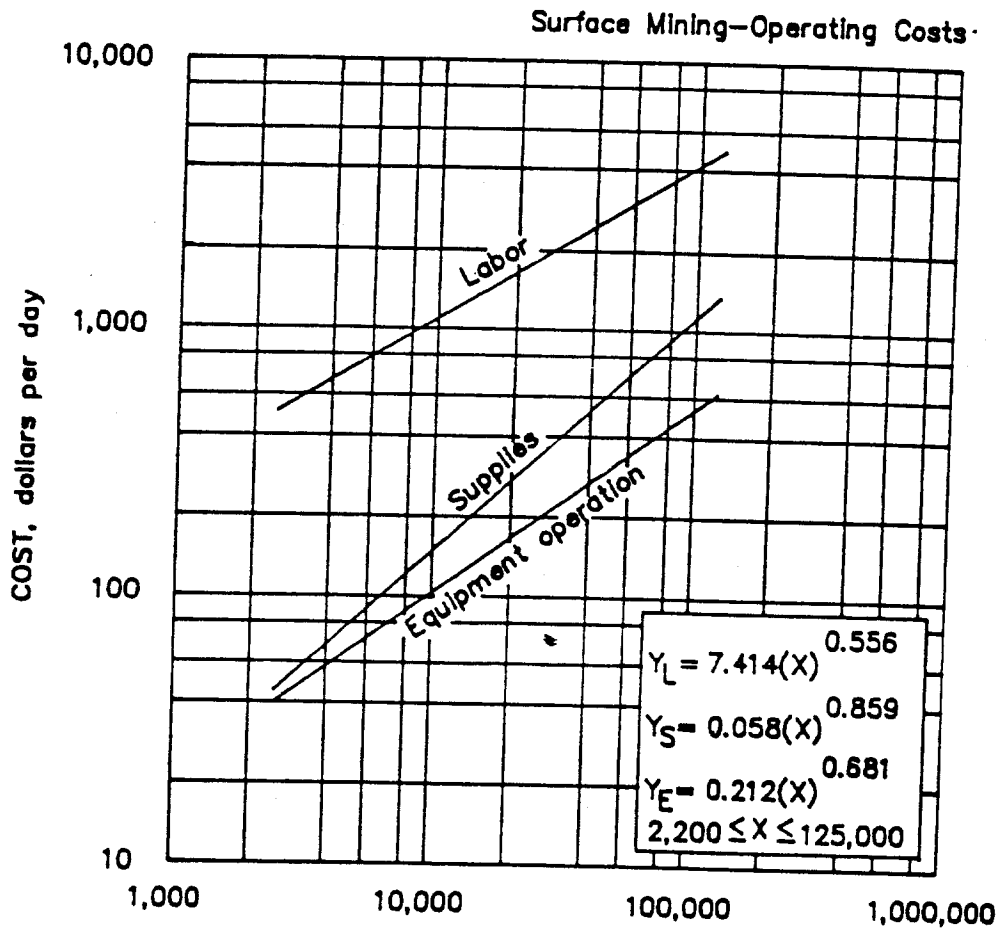
Output Efficiency Factor The output efficiency is the ratio of the actual production to the theoretical capacity of the bucket wheel excavator. The theoretical capacity is based on the number of bucket discharges per minute and the bucket size. The theoretical capacity is normally expressed in loose cubic meters per hour. The factors that determine the output efficiency are the difficulty of digging (required cutting force), the percentage of clay or compact material in the bank, and site-specific details such as climatology. The range of output efficiencies is from 44% to 85%. To adjust for different output efficiencies, multiply the costs obtained from the curves by the following factors:

$$\text{Labor factor } (F_L) = [46/(E)]^{0.555}$$

$$\text{Supply factor } (F_S) = [46/(E)]^{0.858}$$

$$\text{Equipment operation factor } (F_E) = [46/(E)]^{0.680}$$

where E = new percent output efficiency.



3.2.2.2. Excavation, load and haul
BUCKET WHEEL EXCAVATION

3.2. SURFACE MINING--OPERATING COSTS

3.2.2. MINING OF ORE

3.2.2.3. EXCAVATION, LOAD AND HAUL ORE
DRAGLINE

The curve for draglines covers excavating and casting a medium-digging ore from a dry pit into a spoil pile. The material is assumed to weigh 2.0 mt/m³ for crawler (diesel-powered) draglines and 1.5 mt/m³ for walking (electric-powered) draglines.

Crawling draglines range in size from 2.0- to 20-yd³ capacity; walking draglines, from 16 to 50 cubic-yard capacity. One dozer is provided for each dragline operation for cleanup and support.

The total daily cost for crawler draglines is the sum of the two separate cost curves (labor and equipment operation) and for walking draglines is the sum of the three separate cost curves (labor, supplies, and equipment operation) based on a production rate (X) in metric tons of ore per day. The curve for crawler draglines is valid for a production range of 2,000 to 15,000 mtpd, operating one shift per day; for walking draglines, the curves are valid for a production range of 15,000 to 150,000 mtpd, operating three shifts per day.

BASE CURVE

$$(L) \text{ Labor Operating Cost (crawler dragline)} \quad (Y_L \text{ CRAWLER}) = 43.884(X)^{0.363}$$

The operating labor costs are distributed as follows:

	Small (2,000 to 10,000 mtpd)	Large (10,000 to 15,000 mtpd)
Direct labor.....	59%	44%
Maintenance labor.....	41%	56%

The direct labor costs consist of the following typical range of personnel:

	Small (2,000 to 10,000 mtpd)	Large (10,000 to 15,000 mtpd)	Av salary per hour (base rate)
Dragline operator.....	41%	26%	\$18.11
Oiler.....	24%	22%	15.89
Dozer operator.....	25%	23%	16.33
Utility operator.....	10%	29%	13.66

Labor costs average \$16.13 per worker-hour (including burden and average shift differential).

(L) Labor Operating Cost (walking dragline) $(Y_L \text{ WALKING}) = 12.249(X)0.542$
 The operating labor costs are distributed as follows:

Direct labor.....	62%
Maintenance labor.....	38%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Dragline operator.....	30%	\$18.11
Oiler.....	26%	15.89
Dozer operator.....	27%	16.33
Utility operator.....	17%	13.66

Labor costs average \$16.46 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost (walking dragline) $(Y_S \text{ WALKING}) = 0.0395(X)1.003$
 The supply cost consists of 100% electric power for the electric draglines.

(E) Equipment Operating Cost (crawler dragline) $(Y_E \text{ CRAWLER}) = 2.218(X)0.688$
 The equipment cost distribution for crawler draglines is 70% for the dragline and 30% for support equipment consisting of 25% for crawler tractors and 5% for pickup trucks.

(E) Equipment Operating Cost (walking dragline) $(Y_E \text{ WALKING}) = 0.533(X)0.834$
 The equipment operating cost distribution for walking draglines is 66% for the dragline and 34% for support equipment consisting of 31% for crawler tractors and 3% for pickup trucks.

Equipment operating cost distribution for draglines and support equipment is

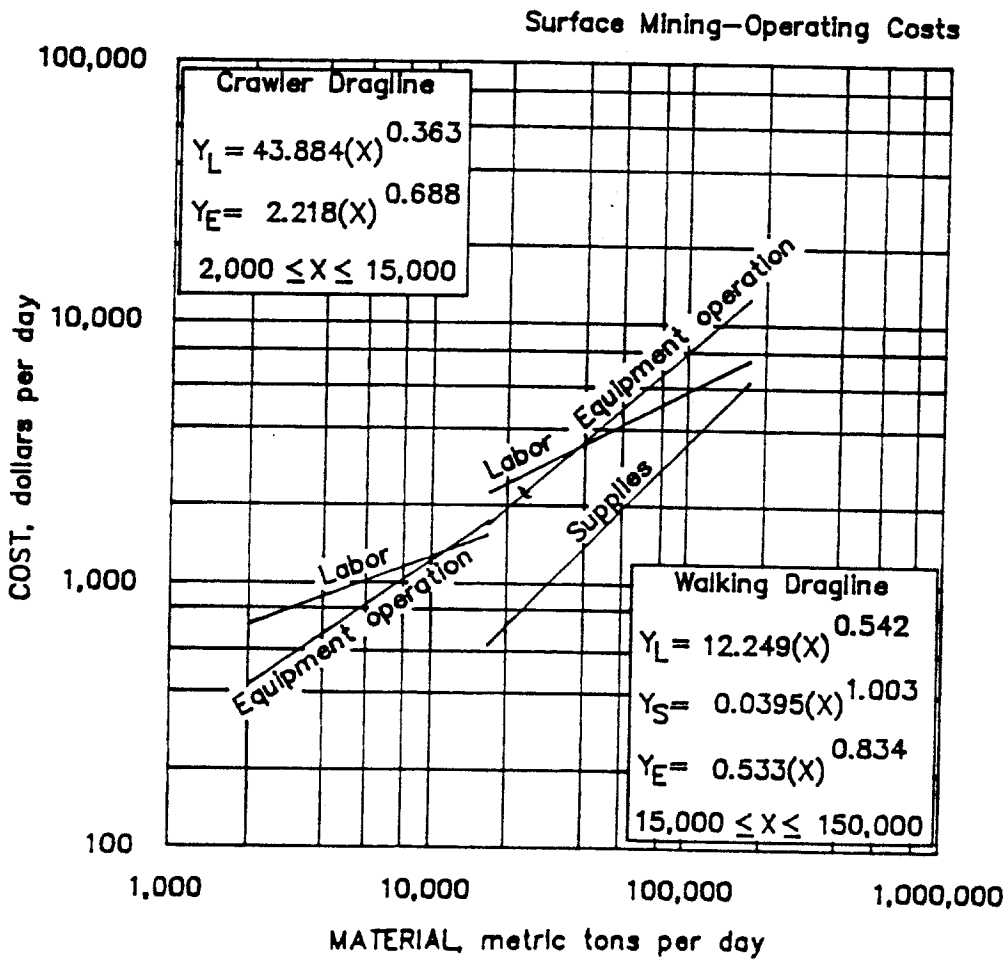
	<u>Repair parts</u>	<u>Fuel and lube</u>	<u>Tires</u>
Walking draglines.....	94%	6%	-
Crawler draglines.....	65%	35%	-
Crawler dozers.....	49%	51%	-
Rubber-tired support....	8%	90%	2%

ADJUSTMENT FACTOR

Truck Haulage To determine the cost of a crawler dragline operation loading to trucks, use the values obtained from the curve for electric shovels and trucks. Adjust the values by increasing each curve component 25% and combine equipment operation and supplies curve to account for substitution of diesel fuel for electric power. (NOTE.--Supplies values for the electric shovels and trucks curve include only electric power.)

LIMITATIONS OF DRAGLINE EXCAVATION CURVES

The cost curves for draglines are very general and are meant to represent a typical excavating operation. Factors that greatly affect dragline excavation costs include the swing angle of boom and hoisting height.



**3.2.2.3. Excavation, load and haul
DRAGLINES**

3.2. SURFACE MINING—OPERATING COSTS

3.2.2. MINING

3.2.2.4. EXCAVATION, LOAD AND HAUL DREDGING

There are basically two kinds of dredging systems used in placer mining and in construction: mechanical, such as the bucket-line dredges, and hydraulic such as the suction dredges (bucket wheel and cutterhead types).

The curves for dredging in this section cover costs for single bucket-line dredges, which are used in the most common method of placer excavation and recovering of free gold, platinum, tin, sand, and gravel. Suction dredges are mostly used in construction, in fine-sand mining and (only to a very minor extent) in placer mining; consequently, they are not included in the curves.

Bucket-line dredge operations normally work continuously 9 to 12 months per year, depending on weather conditions. Cleanup and repairs are performed one or two shifts per week. The total daily cost is the sum of the three separate cost curves (labor, supplies and equipment operation) based on a production rate (X) in bank cubic meters of material dredged per day. The curves are valid for operations between 500 and 20,000 bank m³, operating three shifts per day. The curves cover dredging depths ranging from 10 to 50 m below the pond water level. All the cost components exclude mineral processing.

BASE CURVES

(L) Labor Operating Cost $(Y_L) = 302.529(X)^{0.254}$

The operating labor costs are distributed as follows:

Direct labor.....	60%
Maintenance labor.....	40%

The direct labor costs consist of the following typical range of personnel:

	Small (500 to 4,000 m ³)	Large (4,000 to 20,000 m ³)	Av salary per hour (base rate)
Winch operator.....	47%	28%	\$21.32
Oiler.....	39%	39%	17.69
Helper.....	14%	33%	14.56

Labor costs average \$18.18 per worker-hour for all levels of production (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 1.692(X)^{0.724}$

The supply cost consists of 100% electric power. Typically, dredges are supplied with purchased power.

(E) Equipment Operating Cost $(Y_E) = 7.454(X)^{0.595}$

Equipment operation costs consist of 95% parts and 5% lubricants.

ADJUSTMENT FACTORS

Depth Factor To adjust the costs for actual dredging depths and swell factors, multiply the costs obtained from the curves by the following factors:

$$\text{Labor factor } (F_L) = 0.65 + [3.33(D)(X)^{-0.615}]$$

$$\text{Supply factor } (F_S) = 7.62(D)(S)^{-1.0}(X)^{-0.615}$$

$$\text{Equipment operation factor } (F_E) = 7.62(D)(S)^{-1.0}(X)^{-0.615}$$

where D = actual depth, in meters,

X = volume to be dredged, in bank cubic meters per day,

and S = actual swell factor (the reciprocal of 1 plus the decimal equivalent of percent swell); the base swell factor is 0.80.

Mineral Processing Factor To include operating cost of a mineral process plant mounted on the dredge (i.e., jigging or other gravity separation method), multiply the costs obtained from the curves by the following factors:

Minimal mineral processing:

$$\text{Labor factor } (F_L \text{ MINIMAL}) = 1.51$$

$$\text{Supply factor } (F_S \text{ MINIMAL}) = 1.34$$

$$\text{Equipment operation factor } (F_E \text{ MINIMAL}) = 1.37$$

Some mineral processing:

$$\text{Labor factor } (F_L \text{ SOME}) = 1.57$$

$$\text{Supply factor } (F_S \text{ SOME}) = 1.36$$

$$\text{Equipment operation factor } (F_E \text{ SOME}) = 1.41$$

Complex mineral processing:

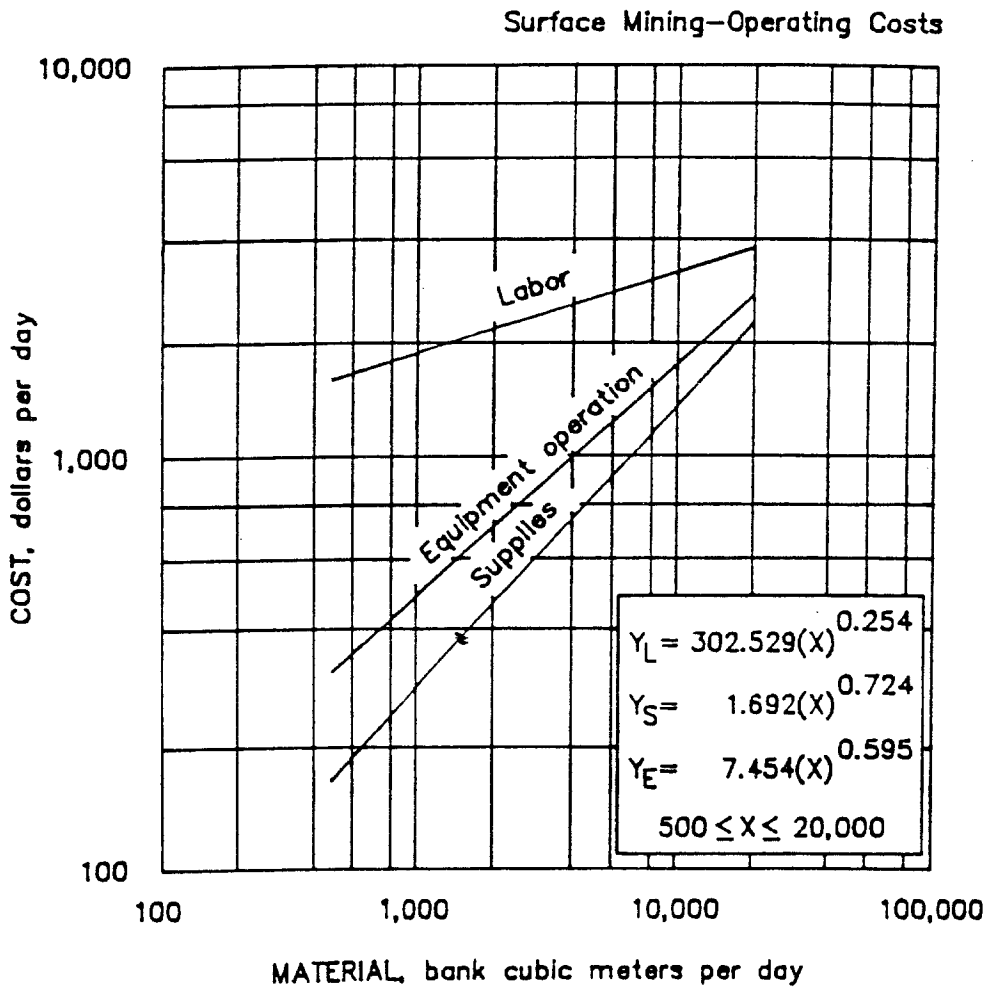
$$\text{Labor factor } (F_L \text{ COMPLEX}) = 1.63$$

$$\text{Supply factor } (F_S \text{ COMPLEX}) = 1.38$$

$$\text{Equipment operation factor } (F_E \text{ COMPLEX}) = 1.45$$

Power For locations where electric power can not be purchased, estimate the supply cost using the curve for portable power generation (section 3.2.4.6.). If the actual number of kilowatt-hours of power consumption is available, estimate the supply cost by multiplying the kilowatt-hours by the actual cost per kilowatt-hour.

Multiple Dredges If the surface mine operation requires more than one dredge, estimate the operating costs separately for each dredge with the curves and the applicable factors given. The manual user should be aware that the combined labor cost might be slightly lower than the sum of the separate labor costs because of improved maintenance-labor distribution for the dredges.



3.2.2.4. Excavation, load and haul
DREDGING

3.2. SURFACE MINING - OPERATING COSTS

3.2.2. MINING

3.2.2.5. EXCAVATION, LOAD AND HAUL
ELECTRIC SHOVEL AND TRUCKS

The total daily cost is the sum of three separate cost curves (labor, supplies, and equipment operation) based on a production rate (X), in metric tons of material per day. The curves are valid for operations between 8,000 and 100,000 mtpd, operating three shifts per day. The curves include all daily operations and maintenance costs associated with load and haul.

The loading units are electric shovels and diesel front-end loaders ranging in size from 5 to 30 yd³, with an average of 15 yd³. Rear-dump trucks from 35 to 170 st are the main hauling units, with the average size of all trucks at 100 st. The ratio of trucks to loading units averages 6:1. The curves reflect an average haul of 2,000 m one-way on an 8% grade from a pit 120 m in depth on wide, well-maintained roads.

BASE CURVE

(L) Labor Operating Cost $(Y_L) = 2.407(X)^{0.782}$

The operating labor costs are distributed as follows:

	Small (8,000 to 50,000 mtpd)	Large (50,000 to 100,000 mtpd)
Direct labor.....	61%	53%
Maintenance labor.....	39%	47%

The direct labor costs consist of the following typical range of personnel:

	Small (8,000 to 50,000 mtpd)	Large (50,000 to 100,000 mtpd)	Av salary per hour (base rate)
Shovel operator.....	14%	8%	\$18.11
Oiler.....	6%	4%	15.89
Dozer operator.....	17%	23%	16.33
Grader operator.....	5%	7%	16.33
Front-end loader operator..	3%	1%	16.33
Truck driver.....	52%	57%	15.89
General laborer.....	3%	-	13.66

Labor costs average \$16.54 per worker-hour for all levels of production (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 0.0671(X)^{0.856}$

The supply cost consists of 100% electric power for electric shovels.

(E) Equipment Operating Cost $(Y_E) = 1.284(X)^{0.882}$

The equipment operating cost covers the daily operating cost for all excavation, loading, and hauling equipment and includes allowances for repair parts, tires, lubrication, and fuel consumption.

Equipment operating cost distribution for an electric shovel and truck operation is

Shovel, electric.....	7%
Rear-dump trucks.....	70%
Crawler dozers.....	12%
Rubber-tired support.....	11%

The general equipment operating cost component distribution is:

	<u>Repair parts</u>	<u>Fuel & lube</u>	<u>Tires</u>
Shovels, electric.....	96%	4%	-
Rear-dump trucks.....	25%	48%	27%
Crawler dozers.....	50%	50%	-
Rubber-tired support.....	35%	47%	18%

ADJUSTMENT FACTOR

Haulage Factor To determine costs for hauls of varying length or depth of pit, multiply the costs obtained from the curves by the following factors:

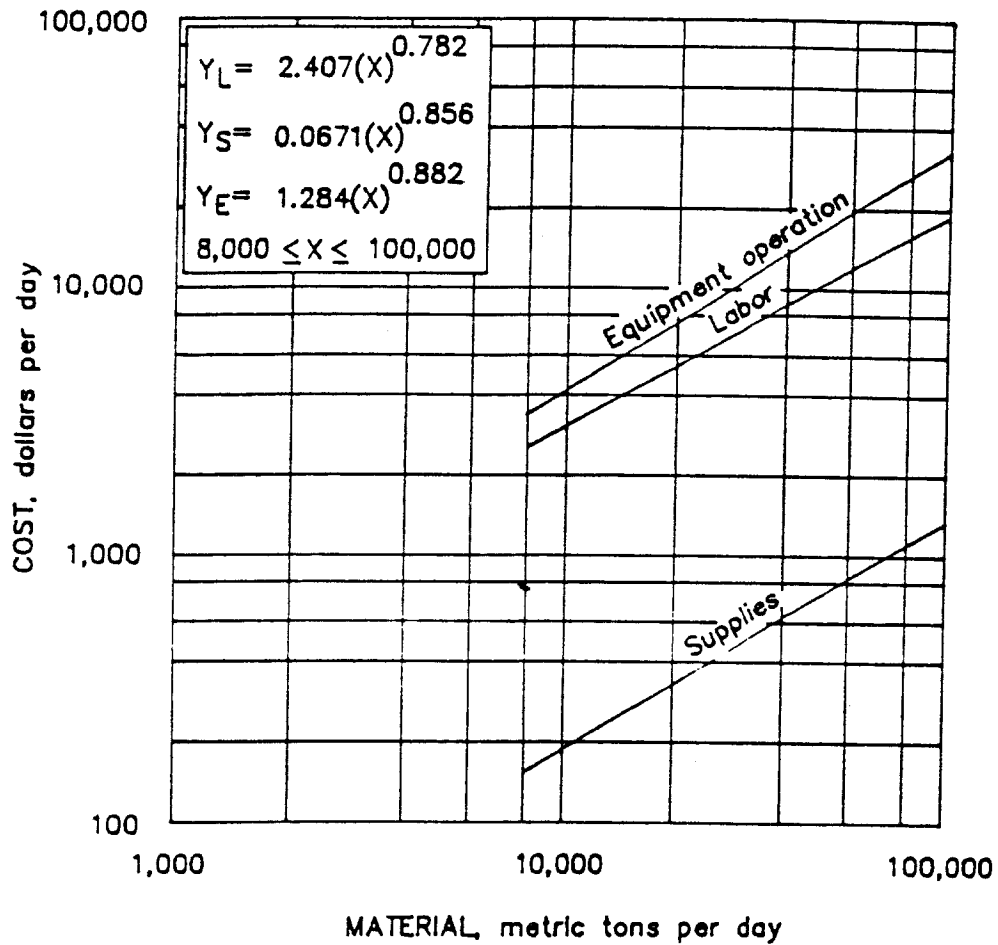
Labor factor $(F_L) = 0.117(R)^{0.030}(L)^{0.263}$

Equipment operation factor $(F_E) = 0.0546(R)^{0.047}(L)^{0.353}$

where R = depth of pit, in meters (R = 1.0 for negative or 0% grade from loading point),

and L = length of haul, in meters.

Surface Mining—Operating Costs



3.2.2.5. Excavation, load and haul
ELECTRIC SHOVEL AND TRUCKS

3.2. SURFACE MINING—OPERATING COSTS

3.2.2. MINING

3.2.2.6. EXCAVATION, LOAD AND HAUL
FRONT-END LOADER OR DIESEL SHOVEL AND TRUCKS

The curve shows the cost per day for loading and hauling both common and shot rock. For common earth excavation, 1 bank m³ equals 2.08 mt; for shot rock, 1 bank m³ equals 2.61 mt.

The curve is based on mines using front-end loaders or diesel shovels for loading and trucks for haulage. The loaders and shovels range in size from 1 to 6 yd³ and the trucks range from 10 to 35 st. The curves reflect an average haul of 750 m one way on an 8% grade from a pit 60 m in depth.

The total daily cost is the sum of the two separate cost curves (labor and equipment operation) based on a production rate (X), in metric tons of material per day. The curves are valid for operations between 100 and 10,000 mtpd, operating three shifts per day. The curves include all daily operating and maintenance costs associated with excavation, loading, and haulage.

BASE CURVE

(L) Labor Operating Cost (Y_L) = 37.003(x)^{0.529}

The operating labor costs are distributed as follows:

Direct labor..... 70%
Maintenance labor..... 30%

The direct labor costs consist of the following typical range of personnel:

	Small (100 to 3,000 mtpd)	Large (3,000 to 10,000 mtpd)	Av salary per hour (base rate)
Loader/shovel crew.....	30%	21%	\$16.24
Truck haulage crew.....	46%	37%	15.89
Dozer operator.....	24%	17%	16.33
Rubber-tired support crew.....	-	25%	16.11

A typical small front-end loader-diesel shovel and truck operation is based on a composite crew having an average rate of \$16.20 per worker-hour (including burden and average shift differential). Large load and haul operations are based on a composite crew having an average rate of \$16.42 per worker-hour (including burden and average shift differential).

(E) Equipment Operating Cost $(Y_E) = 24.620(X)^{0.576}$

The equipment operating cost distribution for front-end loader-diesel shovel and truck operation is

Loader/shovel.....	18%
Rear-dump truck.....	43%
Crawler dozer.....	23%
Rubber-tired support.....	16%

The general equipment cost component distribution is as follows:

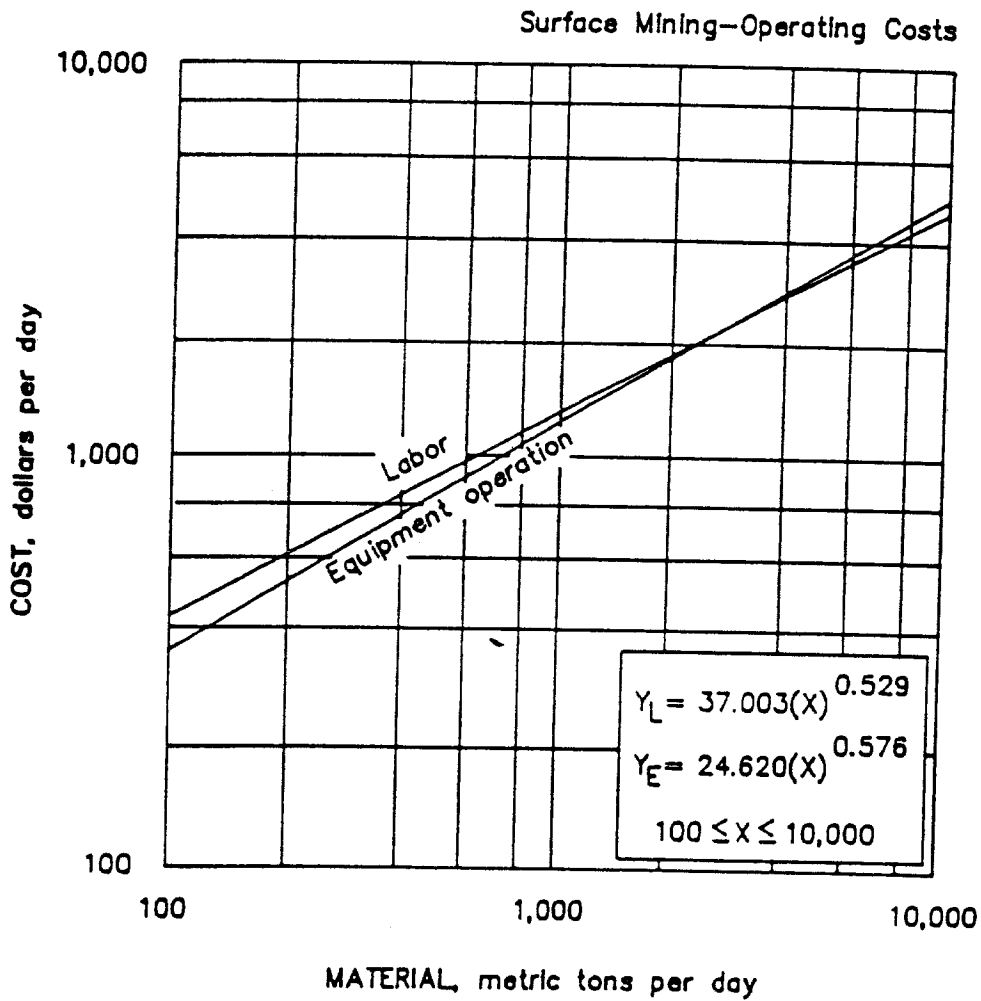
	<u>Repair parts</u>	<u>Fuel and lube</u>	<u>Tires</u>
Shovel, diesel.....	70%	30%	-
Front-end loader.....	33%	44%	23%
Rear-dump truck.....	28%	52%	20%
Crawler dozer.....	51%	49%	-
Rubber-tired support.....	28%	63%	9%

ADJUSTMENT FACTOR

Haulage Factor To determine costs for hauls of varying haul length or depth of pit, multiply the costs obtained from the curves by the following factors:

$$\text{Labor factor } (F_L) = 0.155(R)^{0.030}(L)^{0.263}$$

Equipment operation factor $(F_E) = 0.080(R)^{0.047}(L)^{0.353}$
 where R = depth of pit, in meters (R = 1.0 for negative or 0%
 grade from the loading point),
 and L = length of haul, in meters.



3.2.2.6. Excavation, load and haul
FRONT-END LOADER OR DIESEL SHOVEL AND TRUCKS

3.2. SURFACE MINING--OPERATING COSTS

3.2.2. MINING

3.2.2.7. EXCAVATION, LOAD AND HAUL
HYDRAULIC MINING

The operating costs for hydraulic mining are given on a metric ton per day of ore slurried. The costs include the operation of the monitors and high-pressure water pumps. Not included in the estimates is the cost for pumping the slurry. The total daily cost is the sum of the three separate cost curves (labor, supplies, and equipment operation) based on a production rate (X), in metric tons of ore slurried per day. The curves are valid for operations between 9,500 and 58,000 mtpd, operating three shifts per day.

BASE CURVES

The base curve is for the hydraulic mining of phosphate matrix. The matrix is excavated by draglines and deposited in "pits" where hydraulic mining occurs. The hydraulic monitors (also called guns, giants, or water cannons) break down the matrix for pumping to the processing plant. The monitors are mounted on a pit gun car that advances with the dragline. The base case assumes an 85% operating time and a water ratio of 0.67 mt of slurried ore per metric ton of water used.

(L) Labor Operating Curve $(Y_L) = 0.406(X)^{0.771}$

The operating labor costs are distributed as follows for all production levels:

Direct labor.....	83%
Maintenance labor.....	17%

The direct labor costs consist of the following typical range of personnel:

		Av salary per hour (base rate)
Monitor operator.....	58%	\$16.78
Monitor helper.....	32%	13.66
Monitor laborer.....	10%	11.68

The average wage for labor is \$15.65 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 0.883(X)^{0.685}$

The supply cost consists of 100% electric power.

(E) Equipment Operating Cost $(Y_E) = 0.019(X)^{0.748}$

The equipment operating cost consists of monitor repair parts and materials. The repair costs are divided 30% for water pumps and 70% for the monitor systems (hydraulic pumps, controls, and monitors).

ADJUSTMENT FACTORS

Water Ratio Factor Each deposit to be hydraulically mined will require different quantities of water, and therefore, different sizes or numbers of monitors. The more competent (tougher) the deposit, the more water that will be required. The measure of difficulty in slurrying the deposit is the mass ratio of ore excavated to water used. To adjust the base curves for different water requirements, multiply the costs obtained from the curves by the following factors:

$$\text{Labor factor } (F_L) = [0.67/(R)]^{0.050}$$

$$\text{Supply factor } (F_S) = [0.67/(R)]^{1.285}$$

$$\text{Equipment operation factor } (F_E) = [0.67/(R)]^{0.327}$$

where R = new water ratio, defined as metric ton of ore slurried per metric of of water used.

For phosphate, the water ratio can vary from 0.7 to 0.3. For other applications it can vary from 1.5 to 0.2.

Tailings Factor Hydraulic mining can be used to excavate old tailings ponds for the reprocessing of the tailings. This application normally requires higher water pressure and larger monitors. To adjust the base curves for the hydraulic mining of tailings, multiply the costs obtained from the curves by the following factors:

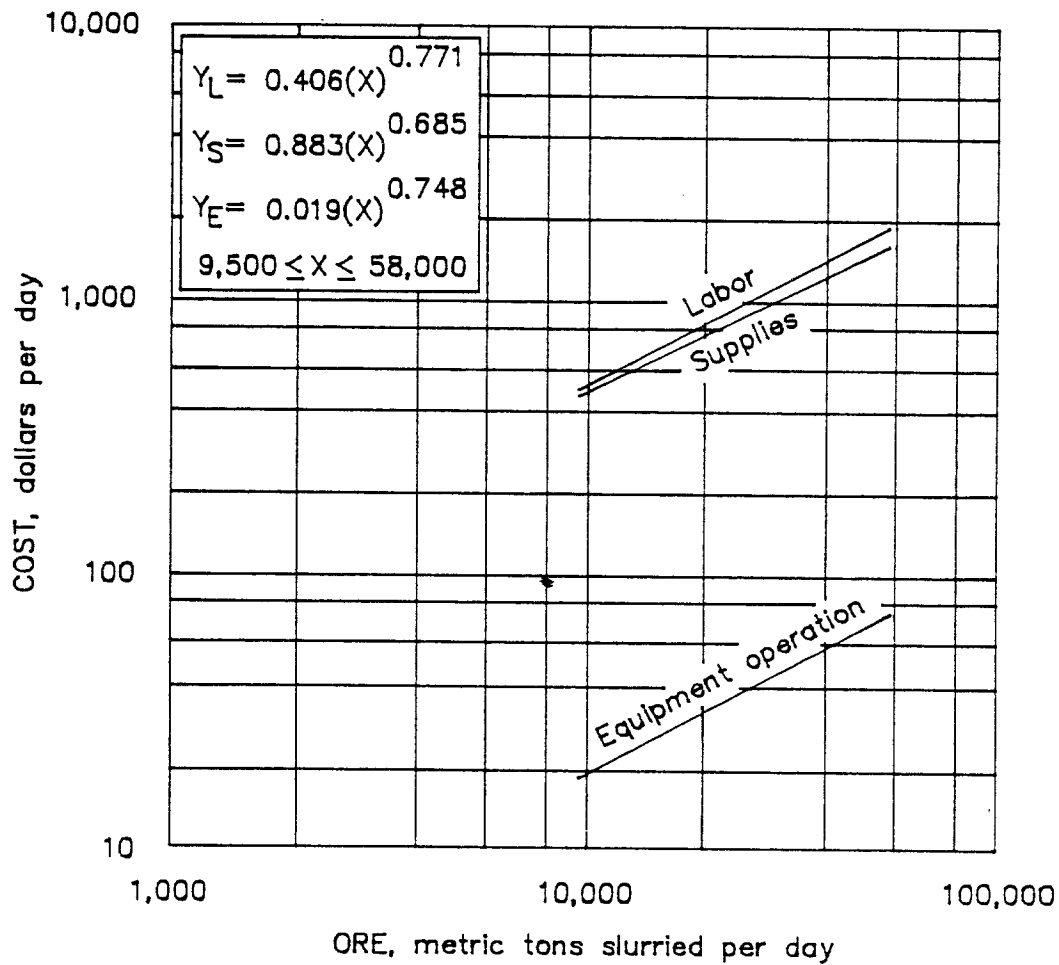
$$\text{Labor factor } (F_L) = 3.32$$

$$\text{Supply factor } (F_S) = 1.51$$

$$\text{Equipment operation factor } (F_E) = 1.12$$

The tailings adjustment is based on a water ratio of 1.22 mt of tailings slurried per mt of water applied.

Surface Mining—Operating Costs



3.2.2.7. Excavation load and haul
HYDRAULIC MINING