SECTION 2.—COST ESTIMATION

CAPITAL AND OPERATING COST CATEGORIES

Section 2 contains equations for estimating capital and operating costs associated with placer mining. Equations are provided for the following items.

Capital costs:
- Exploration:
  - Panning
  - Churn drilling
  - Bucket drilling
  - Trenching
  - General reconnaissance
  - Camp costs
  - Seismic surveying
  - Rotary drilling
  - Helicopter rental
- Development:
  - Access roads
  - Clearing
- Preproduction overburden removal:
  - Bulldozers
  - Draglines
  - Front-end loaders
  - Rear-dump trucks
  - Scrapers
- Mine equipment:
  - Backhoes
  - Bulldozers
  - Draglines
  - Front-end loaders
  - Rear-dump trucks
  - Scrapers
- Processing equipment:
  - Conveyors
  - Feed hoppers
  - Jig concentrators
  - Sluices
  - Spiral concentrators
  - Table concentrators
  - Trommels
  - Vibrating screens
- Supplemental:
  - Buildings
  - Employee housing
  - Generators
  - Pumps
  - Settling ponds

Operating costs:
- Overburden removal:
  - Bulldozers
  - Draglines
  - Front-end loaders
  - Rear-dump trucks
  - Scrapers
- Mining:
  - Backhoes
  - Bulldozers
  - Draglines
  - Front-end loaders
  - Rear-dump trucks
  - Scrapers
- Processing:
  - Conveyors
  - Feed hoppers
  - Jig concentrators
  - Sluices
  - Spiral concentrators
  - Table concentrators
- Tailings removal:
  - Bulldozers
  - Draglines
  - Front-end loaders
  - Rear-dump trucks
  - Scrapers
- Trommels
- Vibrating screens

Supplemental:
- Employee housing
- Generators
- Lost time and general services
- Pumps

Included in this section are summary forms (figs. 4-6) that may be used to aid in total capital and operating cost calculations. A bibliography of cost information sources is provided at the end of this section.

The appendix contains a complete sample cost estimation. This sample will familiarize the reader with cost estimation techniques used in this report.

EXPLORATION

Two methods are presented for calculating exploration costs. Method 1 allows the evaluator to roughly estimate costs with a minimum of information. Method 2 requires a detailed exploration plan and provides the user with a much more precise cost.

Method 1: If information concerning exploration of a deposit is not available, the following equation may be used to estimate an exploration capital cost. It must be emphasized, however, that *costs calculated from this equation can be very misleading,* and it is recommended that a detailed exploration program be designed if possible and that costs be assigned using method 2.

As stated in section 1, the amount of exploration required is a highly variable function of many factors. This equation is based on estimated exploration costs for several successful placer operations, but these deposits may have little in common with the one being evaluated.

The base equation is applied to the following variable:

X = Total estimated resource, in bank cubic yards (BCY)

Base Equation:

Exploration capital costs . . $Y_C = 0.669(X)^{0.849}$

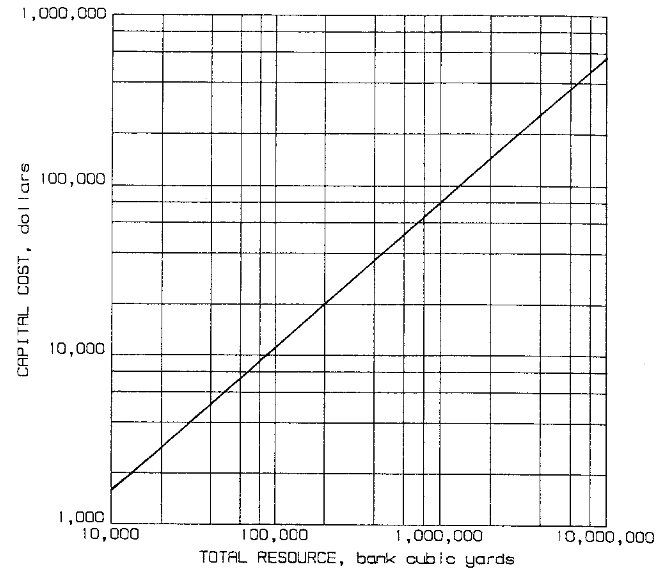
An exact breakdown of expenses included in this cost is not available. In general, exploration is a labor-intensive task. Unless the deposit is extremely remote, a large share of the exploration cost will be attributed to labor. If the deposit is remote, costs of access equipment (helicopters, etc.) will become a factor.

Method 2: Excellent cost data for most exploration functions may be found in the Bureau's Cost Estimation System (CES) Handbook (IC 9142). Functions covered in that publication include

Helicopter rental rates.
Sample preparation and analysis costs.
Drill capacities and costs for core, rotary, and hammer drills.
Survey charges.
Labor rates.
Travel costs.
Ground transportation costs.
Field equipment costs.
Geological, geophysical, and geochemical exploration technique costs.

Costs directly related to placer mining from the above list are summarized in the following tabulations. Several items particular to placer mining are not covered in the CES Handbook. These items, for which costs follow, include

Panning.
Churn drilling.
Bucket drilling.
Trenching.



Exploration capital costs

Exploration Cost Tabulations: As in the CES Handbook, costs are given in dollars per unit processed (cubic yard, sample, foot drilled, etc.). The product of the unit cost and the total units processed constitutes the total capital cost for any particular method of exploration. Total exploration costs consist of the sum of these individual exploration method expenses. A summary sheet for these calculations is shown in figure 4.

EXPLORATION—PANNING

Average cost per sample	$2.10
Cost range	$1.90–$2.60
Cost variables	Labor efficiency and material being panned.

EXPLORATION—CHURN DRILLING

Average cost per foot	$45
Cost range	$20–$70
Cost variables	Depth of hole, material being drilled, site access, and local competition.

EXPLORATION—BUCKET DRILLING

Average cost per foot	$9.20
Cost range	$5–$20
Cost variables	Depth of hole, material being drilled, and site access.

EXPLORATION—TRENCHING

Average cost per cubic yard	$7.10
Cost range	$2.25–$28.50
Cost variables	Labor efficiency, material being sampled, site access, equipment ownership, sampling method, and total volume of work to be done.

CES Exploration Cost Tabulations: Some of the more pertinent exploration cost items presented in the CES Handbook (IC 9142) are summarized in the following. A detailed description of these items can be found in that publication.

EXPLORATION—GENERAL RECONNAISSANCE

Average cost per worker-day	$195
Cost range	$175–$210
Cost variables	Deposit access, terrain, and labor efficiency.

EXPLORATION—CAMP COSTS

Average cost per worker-day	$30
Cost range	$19–$41
Cost variables	Deposit remoteness, terrain, access, and climate.

EXPLORATION—SEISMIC SURVEYING (REFRACTION)

Average cost per linear foot	$1.50
Cost range	$1.00–$2.50
Cost variables	Labor efficiency, deposit access, and terrain.

EXPLORATION—ROTARY DRILLING

Average cost per foot	$6.50
Cost range	$2.00–$11.50
Cost variables	Depth of hole, material being drilled, and site access.

EXPLORATION—HELICOPTER RENTAL

Average cost per hour	$395
Cost range	$305–$590
Cost variables	Passenger capacity, payload capacity, cruise speed, and range.

EXPLORATION COST SUMMARY FORM

Capital cost calculation:

General reconnaissance	______	worker-days	× $ ______	/worker-day	=	______
Camp costs	______	worker-days	× $ ______	/worker-day	=	______
Panning	______	samples	× $ ______	/pan	=	______
Churn drilling	______	ft drilled	× $ ______	/ft	=	______
Bucket drilling	______	ft drilled	× $ ______	/ft	=	______
Trenching	______	yd³	× $ ______	/yd³	=	______
Seismic surveying	______	linear ft	× $ ______	/linear ft	=	______
Rotary drilling	______	ft drilled	× $ ______	/ft	=	______
Helicopter time	______	h	× $ ______	/h	=	______
______	______		× $ ______	/______	=	______
______	______		× $ ______	/______	=	______
______	______		× $ ______	/______	=	______
______	______		× $ ______	/______	=	______
______	______		× $ ______	/______	=	______
______	______		× $ ______	/______	=	______
______	______		× $ ______	/______	=	______
______	______		× $ ______	/______	=	______
Total						______

Figure 4.—Exploration cost summary form.

DEVELOPMENT—ACCESS ROADS

Capital Cost Equation: This equation provides the cost per mile of road construction to the deposit and between various facilities. Costs include clearing and excavation, but do not account for any blasting or gravel surfacing that may be required. The equation is applied to the following variable:

X = Average width of roadbed, in feet.

The following assumptions were made in estimating road costs:

1. Side slope, 25%.
2. Moderate ground cover.
3. Moderate digging difficulty.

Base Equation:

Access road capital cost .... $Y_C = 765.65(X)^{0.922}$

The capital cost consists of 68% construction labor, 13% parts, 16% fuel and lubricants, and 3% tire replacement.

Brush Factor: The original equation is based on the assumption that ground cover consists of a mixture of brush and trees. If vegetation is light (i.e., consisting mainly of brush or grasses), the total cost per mile (covered with brush) must be multiplied by the factor obtained from the following equation:

$F_B = 0.158(X)^{0.325}$.

Forest Factor: If ground cover is heavy (i.e., consisting mainly of trees), the total cost per mile (covered with trees) must be multiplied by the factor obtained from the following equation:

$F_F = 2.000(X)^{-0.079}$.

Side Slope Factor: If average side slope of the terrain is other than 25%, the factor obtained from the following equation must be applied to the total cost per mile:

$F_S = 0.633e^{[0.021 \text{ (percent slope)}]}$.

Surfacing Factor: If gravel surfacing is required, the cost per mile must be multiplied by the following factor to account for the additional labor, equipment, and supply costs:

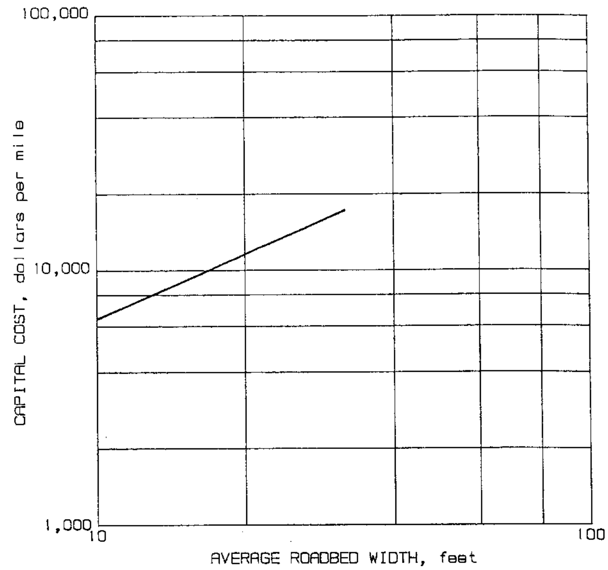
$F_G = 6.743$.

Blasting Factor: In hard-rock situations, blasting may be required. Should this be the case, the cost obtained from the following equation must be *added* to total access road cost.

$F_H = [12{,}059.18(X)^{0.534}] \times$ [miles of roadbed requiring blasting].

Total Cost: Access road capital cost is determined by

$[(Y_C \times F_B \times F_F \times F_S \times F_G) \times \text{total miles}] + F_H$.



Development capital costs - Access roads

This total cost is then entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.

DEVELOPMENT—CLEARING

Capital Cost Equation: This equation provides the total capital cost of clearing brush and timber from the surface of a deposit prior to mining. Costs include labor, equipment, and supplies required to completely strip the surface of growth, and to dispose of debris. The equation is applied to the following variable:

X = Total acreage to be cleared.

The following assumptions were made in estimating clearing costs:

1. Level slope.
2. Moderate ground cover.

Base Equation:

Clearing capital cost .... $Y_C = 1{,}043.61(X)^{0.913}$

The capital cost consists of 68% construction labor, 18% fuel and lubricants, 12% parts, and 2% steel supplies.

Slope Factor: The original equation is based on the assumption that the slope of the surface overlying the deposit is nearly level. If some slope is present, the factor obtained from the following equation must be applied to the clearing capital cost:

$F_S = 0.942e^{[0.008(\text{percent slope})]}$.

Brush Factor: Ground cover is assumed to consist of a mixture of brush and small trees. If the surface is covered with only brush and grasses, the following factor must be applied to the cost:

$F_B = 0.250.$

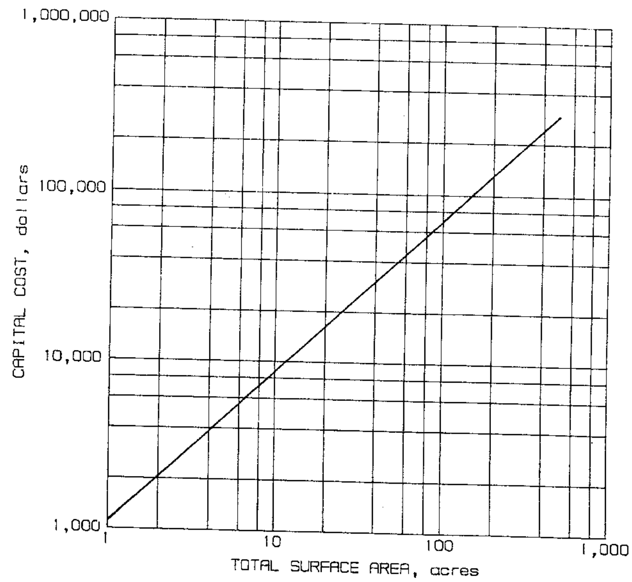
Forest Factor: If the surface is forested, capital cost must be multiplied by the following factor:

$F_F = 1.750.$

Total Cost: Clearing capital cost is determined by

$$(Y_C \times F_S \times F_B \times F_F).$$

This total cost is then entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Development capital costs - Clearing

PREPRODUCTION OVERBURDEN REMOVAL—BULLDOZERS

Capital Cost Equations: These equations provide the cost of excavating and relocating overburden using bulldozers. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by bulldozer.

The base equations assume the following:

1. No ripping.
2. Cutting distance, 50 ft.
3. Efficiency, 50 min/h.
4. Dozing distance, 300 ft.
5. Average operator ability.
6. Nearly level gradient.

Base Equations:

Equipment operating cost $Y_E = 0.993(X)^{-0.430}$
Labor operating cost . . . $Y_L = 14.01(X)^{-0.945}$

Equipment operating costs average 47% parts and 53% fuel and lubrication. Labor operating costs average 86% operator labor and 14% repair labor.

Distance Factor: If the average dozing distance is other than 300 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D = 0.00581(\text{distance})^{0.904}$.

Gradient Factor: If the average gradient is other than level, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_G = 1.041e^{[0.015(\text{percent gradient})]}$.

Ripping Factor: If ripping is required, total operating cost must be multiplied by the following factor, this will account for reduced productivity associated with ripping:

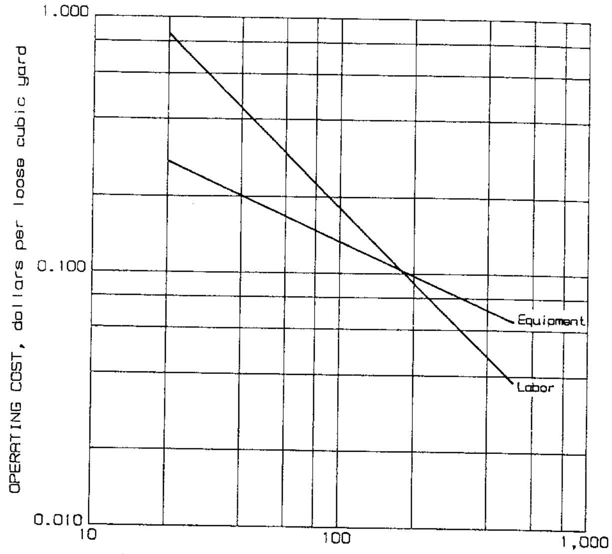
$F_R = 1.595$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor . . . . $U_e = 1.206(X)^{-0.013}$
Labor factor . . . . $U_l = 0.967(X)^{0.015}$

Digging Difficulty Factor: Parameters given in the discussion on site adjustment factors in section 1 should be used to determine if a digging difficulty factor is required. If so, one of the following should be applied to total cost per loose cubic yard:

F_H, easy digging . . 0.830
F_H, medium digging 1.000
F_H, medium-hard digging 1.250
F_H, hard digging . . . 1.670



Overburden removal capital costs - Bulldozers

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G \times F_H \times F_R.$$

To obtain overburden removal capital cost, the total cost per loose cubic yard must be multiplied by total amount of *overburden* handled by bulldozer prior to production. This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.

PREPRODUCTION OVERBURDEN REMOVAL—DRAGLINES

Capital Cost Equations: These equations provide the cost of excavating overburden using draglines. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by dragline.

The base curves assume the following:

1. Bucket efficiency, 0.90.
2. Full hoist.
3. Swing angle, 90°.
4. Average operator ability.

Base Equations:

Equipment operating costs.. $Y_E = 1.984(X)^{-0.390}$
Labor operating costs ..... $Y_L = 12.19(X)^{-0.888}$

Equipment operating costs consist of 67% parts and 33% fuel and lubrication. Labor operating costs consist of 78% operator labor and 22% repair labor.

Swing Angle Factor: If the average swing angle is other than 90°, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_S = 0.304\ (\text{swing angle})^{0.269}$.

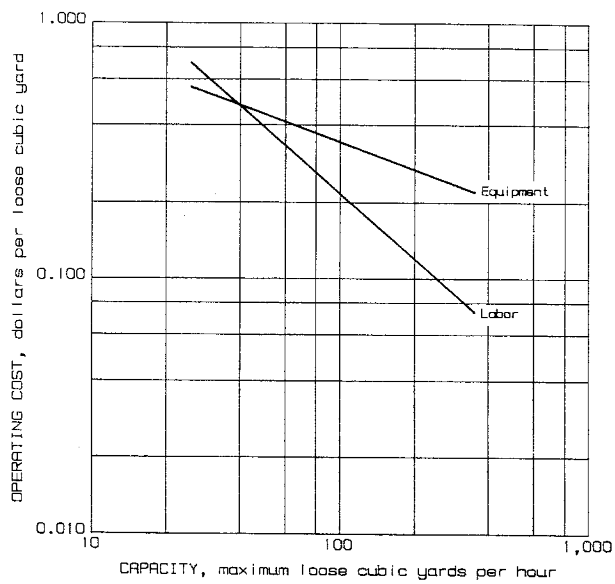
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor .... $U_e = 1.162(X)^{-0.017}$
Labor factor .... $U_l = 0.989(X)^{0.006}$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_S.$$

To obtain the overburden removal capital cost, the total cost per loose cubic yard must be multiplied by the total amount of *overburden* handled by dragline prior to production. This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Overburden removal capital costs - Draglines

PREPRODUCTION OVERBURDEN REMOVAL—FRONT-END LOADERS

Capital Cost Equations: These equations provide the cost of relocating overburden using wheel-type front-end loaders. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by front-end loader.

The base equations assume the following:

1. Haul distance, 500 ft.
2. Rolling resistance, nearly level gradient.
3. Inconsistent operation.
4. Wheel-type loader.

Base Equations:

Equipment operating cost $Y_E = 0.407(X)^{-0.225}$
Labor operating cost .... $Y_L = 13.07(X)^{-0.936}$

Equipment operating costs average 22% parts, 46% fuel and lubrication, and 32% tires. Labor operating costs average 90% operator labor and 10% repair labor.

Distance Factor: If the average haul distance is other than 500 ft, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_D = 0.023(\text{distance})^{0.616}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$F_G = 0.877e^{[0.046(\text{percent gradient})]}$.

Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor .... $U_e = 1.162(X)^{-0.017}$
Labor factor............ $U_l = 0.989(X)^{0.006}$

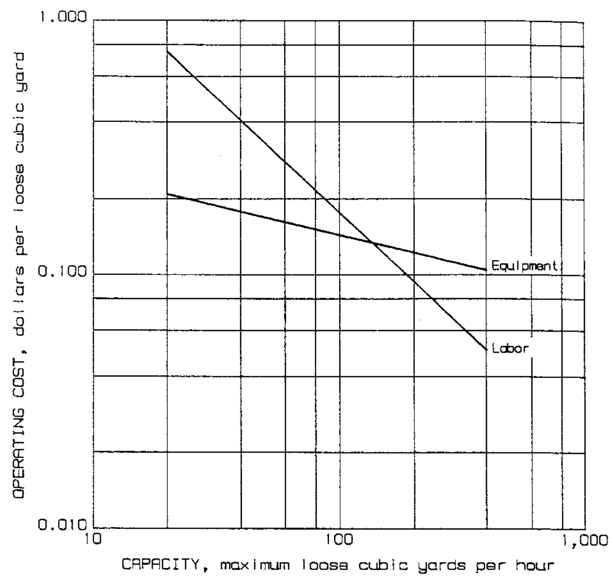
Track-Type Loader Factor: If track-type loaders are used, the following factors must be applied to the total cost obtained from the base equations:

Equipment factor .... $T_e = 1.378$
Labor factor............ $T_l = 1.073$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e)(T_e) + Y_L(U_l)(T_l)] \times F_D \times F_G.$$

To obtain the overburden removal capital cost, the total cost per loose cubic yard must be multiplied by the total amount of *overburden* handled by front-end loader prior to production. This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Overburden removal capital costs - Front-end loaders

PREPRODUCTION OVERBURDEN REMOVAL—REAR-DUMP TRUCKS

Capital Cost Equations: These equations provide the cost of hauling overburden using rear-dump trucks. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by rear-dump truck.

The base equations assume the following:

1. Haul distance, 2,500 ft.
2. Loader cycles to fill, 4.
3. Efficiency, 50 min/h.
4. Average operator ability.
5. Rolling resistance, 2%, nearly level gradient.

Base Equations:

Equipment operating costs. . $Y_E = 0.602(X)^{-0.296}$
Labor operating cost. . . . . . $Y_L = 11.34(X)^{-0.891}$

Equipment operating costs consist of 28% parts, 58% fuel and lubrication, and 14% tires. Labor operating costs consist of 82% operator labor and 18% repair labor.

Distance Factor: If average haul distance is other than 2,500 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$$F_D = 0.093(\text{distance})^{0.311}.$$

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to the total cost per loose cubic yard:

$$F_G = 0.907e^{[0.049(\text{percent gradient})]}.$$

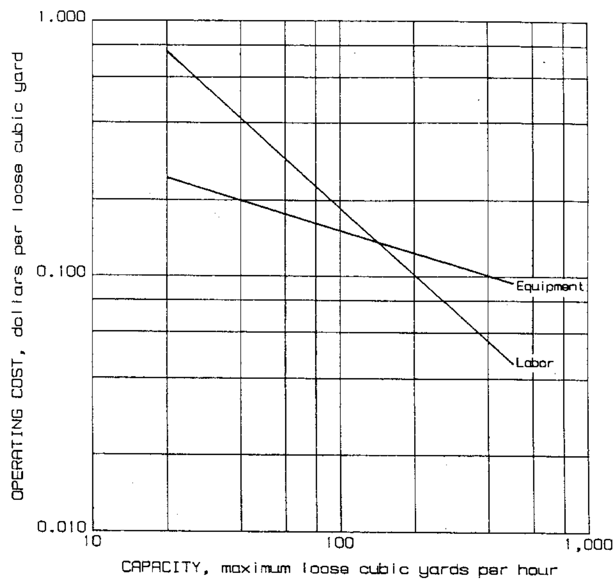
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor. . . . . $U_e = 0.984(X)^{0.016}$
Labor factor. . . . . $U_l = 0.943(X)^{0.021}$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G.$$

To obtain the overburden removal capital cost, the total cost per loose cubic yard must be multiplied by the total amount of *overburden* handled by truck prior to production. This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Overburden removal capital costs - Rear-dump trucks

PREPRODUCTION OVERBURDEN REMOVAL—SCRAPERS

Capital Cost Equations: These equations provide the cost of excavating and hauling overburden using scrapers. Costs are reported in dollars per loose cubic yard of overburden handled. The equations are applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and tails moved hourly by scraper.

The base curves assume the following:

1. Standard scrapers.
2. Rolling resistance, 6%, nearly level gradient.
3. Efficiency, 50 min/h.
4. Average haul distance, 1,000 ft.
5. Average operator ability.

Base Equations:

Equipment operating cost. . $Y_E = 0.325(X)^{-0.210}$
Labor operating cost. . . . . . $Y_L = 12.01(X)^{-0.930}$

Equipment operating costs consist of 28% parts, 58% fuel and lubrication, and 14% tires. Labor operating costs consist of 82% operator labor and 18% repair labor.

Distance Factor: If average haul distance is other than 1,000 ft, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_D = 0.01947(\text{distance})^{0.577}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 6%, the factor obtained from the following equation must be applied to total cost per loose cubic yard:

$F_G = 0.776e^{[0.047(\text{percent gradient})]}$.

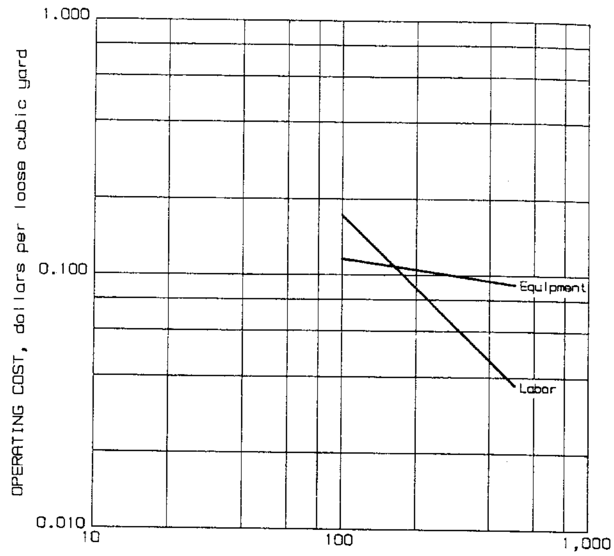
Used Equipment Factor: These factors account for added operating expenses accrued by equipment having over 10,000 h of previous service life. The respective equipment and labor portions of the base operating costs must be multiplied by factors obtained from the following equations:

Equipment factor. . . . . $U_e = 1.096(X)^{-0.006}$
Labor factor. . . . . $U_l = 0.845(X)^{0.034}$

Total Cost: Cost per loose cubic yard of overburden is determined by

$$[Y_E(U_e) + Y_L(U_l)] \times F_D \times F_G.$$

To obtain the overburden removal capital cost, the total cost per loose cubic yard must be multiplied by the total amount of *overburden* handled by scraper prior to production. This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Overburden removal capital costs - Scrapers

CAPITAL COSTS

MINE EQUIPMENT—BACKHOES

Capital Cost Equation: This equation furnishes the cost of purchasing the appropriate number and size of hydraulic backhoes needed to provide the maximum required production. Costs do not include transportation, sales tax, or discounts. The equation is applied to the following variable:

X = Maximum loose cubic yards of pay gravel moved hourly by backhoe.

The following capacities were used to calculate the base equation:

105 hp	95 to 200 LCY/h	195 hp	250 to 375 LCY/h
135 hp	175 to 275 LCY/h	325 hp	350 to 475 LCY/h

These capacities are based on the following assumptions:

1. Medium digging difficulty.
2. Average operator ability.
3. Swing angle, 60° to 90°.
4. Maximum digging depth, 0% to 50%.
5. No obstructions.

Base Equation:

Equipment capital cost . . . $Y_C = 84{,}132.01e^{[0.00350(X)]}$

Equipment capital costs consist entirely of the equipment purchase price.

Digging Depth Factor: If average digging depth is other than 50% of maximum depth obtainable for a particular make of backhoe, the factor obtained from the following equation must be applied to total capital cost:

$F_D = 0.04484(D)^{0.790}$,

where D = percent of maximum digging depth.

Used Equipment Factor: This factor accounts for the reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.386$.

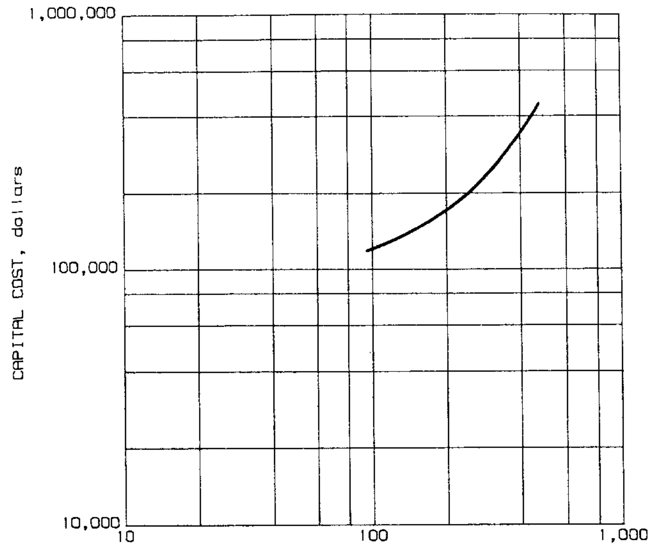
Digging Difficulty Factor: Parameters given in the discussion on site adjustment factors in section 1 should be used to determine if a digging difficulty factor is required. If so, one of the following should be applied to total capital cost:

F_H, easy digging	1.000	F_H, medium-hard digging	1.556
F_H, medium digging	1.330	F_H, hard digging	1.822

Total Cost: Backhoe capital cost is determined by

$$Y_C \times F_D \times F_U \times F_H.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Mine equipment capital costs - Backhoes

MINE EQUIPMENT—BULLDOZERS

Capital Cost Equation: This equation furnishes the cost of purchasing the appropriate size and number of crawler dozers needed to provide the maximum required production. Costs do not include transportation, sales tax, or discounts. The equation is applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and waste moved hourly by bulldozer.

The following capacities were used to calculate the base equation:

65 hp	.....19.0 LCY/h	200 hp	.....126.0 LCY/h
80 hp	.....31.5 LCY/h	335 hp	.....263.5 LCY/h
105 hp	.....56.5 LCY/h	460 hp	.....334.0 LCY/h
140 hp	.....82.0 LCY/h	700 hp	.....497.5 LCY/h

The above capacities are based on the following assumptions:

1. Straight "S" blades.
2. No ripping.
3. Average operator ability.
4. Cutting distance, 50 ft.
5. Dozing distance, 300 ft.
6. Efficiency, 50 min/h.
7. Even, nearly level gradient.

Base Equation:

Equipment capital cost... $Y_C = 3{,}555.96(X)^{0.806}$

Equipment capital costs consist entirely of equipment purchase price.

Distance Factor: If average dozing distance is other than 300 ft, the factor obtained from the following equation must be applied to capital costs. This will correct for the addition or reduction of equipment required to maintain maximum capacity:

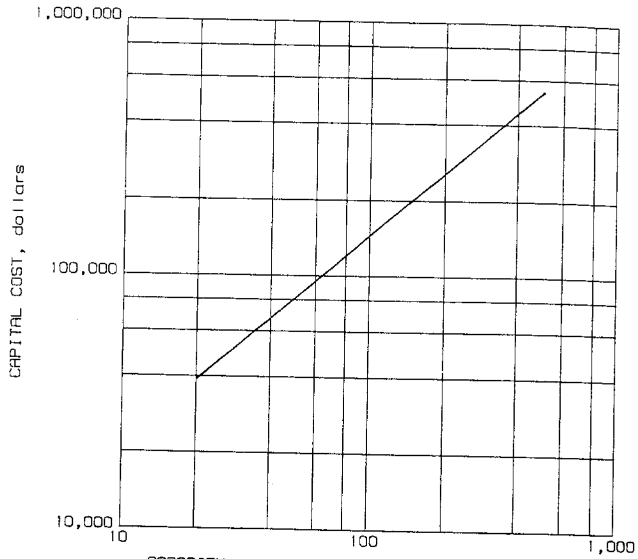
$F_D = 0.01549(\text{distance})^{0.732}$.

Gradient Factor: If the average gradient is other than level, the factor obtained from the following equation must be applied to total capital cost. This will correct for the addition or reduction of equipment required to maintain maximum capacity. (Favorable haul gradients should be entered as negative, uphill haul gradients as positive.)

$F_G = 1.041e^{[0.015(\text{percent gradient})]}$.

Digging Difficulty Factor: Variations from the base digging difficulty will necessitate changes in equipment size to maintain production capacity. Parameters given in the discussion on site adjustment factors in section 1 should be used to determine if a digging difficulty factor is required. If so, one of the following should be applied to total capital cost:

$F_{H.}$ easy digging ..0.863
$F_{H.}$ medium digging..........1.000
$F_{H.}$ medium-hard digging..........1.197
$F_{H.}$ hard digging ..1.509



Mine equiment capital costs - Bulldozers

Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.411$.

Total Cost: Bulldozer capital cost is determined by
$Y_C \times F_H \times F_D \times F_G \times F_U$.

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.

MINE EQUIPMENT—DRAGLINES

Capital Cost Equation: This equation furnishes the cost of purchasing the appropriate size dragline needed to provide the maximum required production. Costs do not include transportation, sales tax, or discounts. The equation is applied to the following variable:

X= Maximum loose cubic yards of pay gravel, overburden, and waste moved hourly by dragline.

The following capacities were used to calculate the base equation:

84 hp . . . 28 LCY/h	190 hp . . . 94 LCY/h
110 hp . . . 47 LCY/h	263 hp . . . 132 LCY/h
148 hp . . . 66 LCY/h	289 hp . . . 188 LCY/h
170 hp . . . 75 LCY/h	540 hp . . . 264 LCY/h

The above capacities are based on the following assumptions:

1. Bucket efficiency, 0.90.
2. Full hoist.
3. Swing angle, 90°.
4. Average operator ability.

Base Equation:

Equipment capital cost . . . . . $Y_C = 16{,}606.12(X)^{0.678}$

Equipment capital costs consist entirely of the equipment purchase price.

Swing Angle Factor: If the average swing angle is other than 90°, the factor obtained from the following equation must be applied to total capital cost. This factor will compensate for equipment size differences required to obtain the desired maximum capacity:

$F_S = 0.450(\text{swing angle})^{0.180}$.

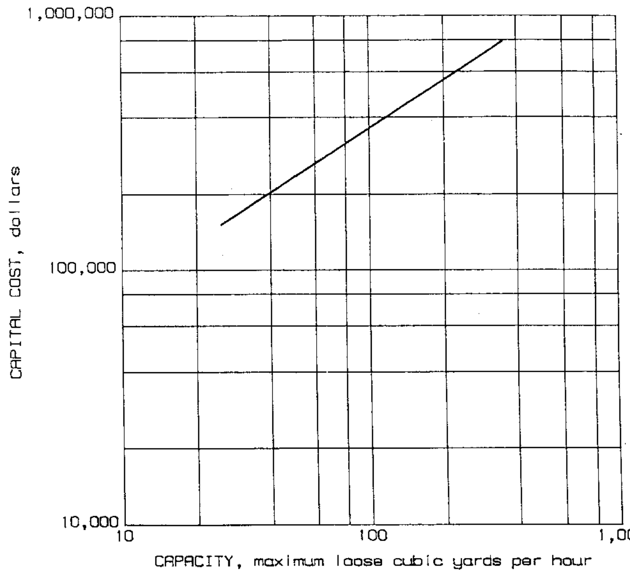
Used Equipment Factor: This factor accounts for the reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.422$.

Total Cost: Dragline capital cost is determined by

$$Y_C \times F_S \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Mine equipment capital costs - Draglines

MINE EQUIPMENT—FRONT-END LOADERS

Capital Cost Equation: This equation provides the cost of purchasing the appropriate size and number of wheel-type front-end loaders needed to supply the maximum required production. Costs do not include transportation, sales tax, or discounts. The equation is applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and waste moved hourly by front-end loader.

The base equation was calculated using the following capacities:

- 1.00-yd³ bucket, 65 hp . . . . 24.00 LCY/h
- 1.50-yd³ bucket, 80 hp . . . . 34.50 LCY/h
- 1.75-yd³ bucket, 105 hp . . . 38.50 LCY/h
- 2.25-yd³ bucket, 125 hp . . . 56.25 LCY/h
- 2.75-yd³ bucket, 155 hp . . . 66.00 LCY/h
- 3.50-yd³ bucket, 200 hp . . 129.50 LCY/h
- 4.50-yd³ bucket, 270 hp . . 171.00 LCY/h
- 6.50-yd³ bucket, 375 hp . . 234.00 LCY/h
- 12.00-yd³ bucket, 690 hp . . 348.00 LCY/h

The above capacities are based on the following assumptions:

1. Haul distance, 500 ft.
2. Rolling resistance, 2%, nearly level gradient.
3. Inconsistent operation.
4. Wheel-type loader.
5. Efficiency, 50 min/h.
6. General purpose bucket, heaped.

Base Equation:

Equipment capital cost . . . $Y_C = 2{,}711.10(X)^{0.896}$

Equipment capital costs consist entirely of the equipment purchase price.

Distance Factor: If the average haul distance is other than 500 ft, the factor obtained from the following equation must be applied to the capital cost. This will correct for the addition or reduction of equipment required to maintain maximum capacity. (If tracked loaders are to be used, the maximum haul distance should not exceed 600 ft.)

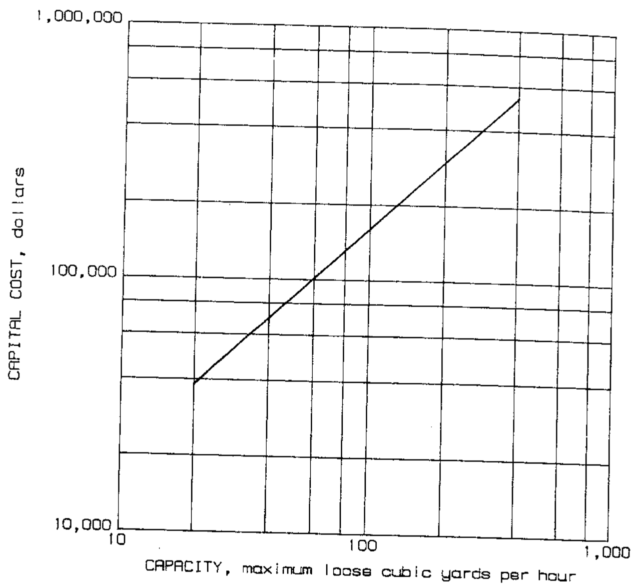
$F_D = 0.033(\text{distance})^{0.552}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to the total capital cost. This will correct for the addition or reduction of equipment required to maintain maximum capacity:

$F_G = 0.888e^{[0.041(\text{percent gradient})]}$.

Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life.

$F_U = 0.386$.



Mine equipment capital costs - Front-end loaders

Track-Type Loader Factor: If track-type loaders are used, the factor obtained from the following equation must be applied to total capital cost. This factor will account for the decrease in production efficiency and the difference in equipment cost:

$F_T = 0.414(X)^{0.272}$.

Total Cost: Front-end loader capital cost is determined by

$$Y_C \times F_D \times F_G \times F_U \times F_T.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.

MINE EQUIPMENT—REAR-DUMP TRUCKS

Capital Cost Equation: This equation furnishes the cost of purchasing the appropriate size and number of diesel rear-dump trucks needed to provide the maximum required production. Costs do not include transportation, sales tax, or discounts. The equation is applied to the following variable:

X = Maximum loose cubic yards of pay gravel, overburden, and waste moved hourly by rear-dump truck.

The following capacities were used to calculate the base equation:

3.0-yd³ truck .....32.3 LCY/h	12.0-yd³ truck .....124.5 LCY/h
5.0-yd³ truck .....53.4 LCY/h	16.0-yd³ truck .....163.9 LCY/h
6.0-yd³ truck .....63.6 LCY/h	22.8-yd³ truck .....223.5 LCY/h
8.0-yd³ truck .....83.5 LCY/h	34.0-yd³ truck .....326.3 LCY/h
10.0-yd³ truck .....104.2 LCY/h	47.5-yd³ truck .....444.8 LCY/h

The above capacities are based on the following assumptions:

1. Diesel rear-dump trucks.
2. Loader cycles to fill, 4.
3. Haul distance, 2,500 ft.
4. Rolling resistance, 2%, nearly level gradient.

Base Equation:

Equipment capital cost... $Y_C = 472.09(X)^{1.139}$

Equipment capital costs consist entirely of the equipment purchase price.

Distance Factor: If the average haul distance is other than 2,500 ft, the factor obtained from the following equation must be applied to capital cost. This will correct for the addition or reduction of equipment required to maintain maximum capacity:

$F_D = 0.06240(\text{distance})^{0.364}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 2%, the factor obtained from the following equation must be applied to total capital cost. This will correct for the addition or reduction of equipment required to maintain the maximum capacity. (Favorable haul gradient should be entered as negative, uphill haul grades as positive.)

$F_G = 0.896e^{[0.056(\text{percent gradient})]}$.

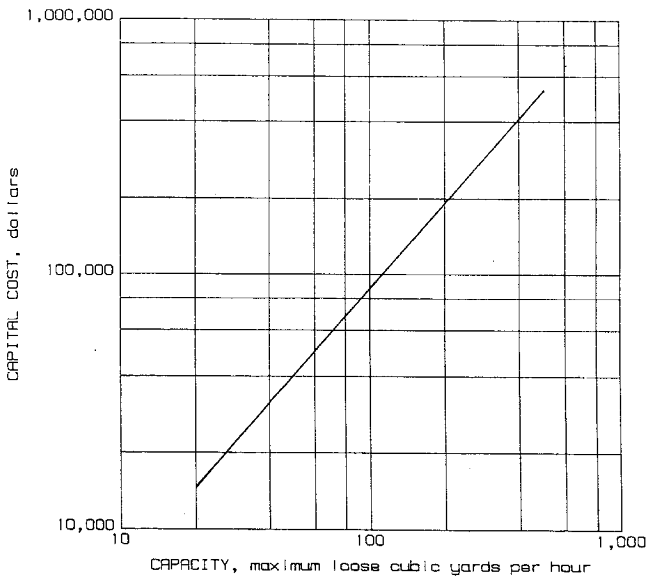
Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.243$.

Total Cost: Truck capital cost is determined by

$Y_C \times F_D \times F_G \times F_U$.

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Mine equipment capital costs - Rear-dump trucks

MINE EQUIPMENT—SCRAPERS

Capital Cost Equation: This equation furnishes the cost of purchasing the appropriate size and number of scrapers needed to provide maximum required production. Costs do not include transportation, sales tax, or discounts. The equation is applied to the following variable:

X=Maximum loose cubic yards of pay gravel, overburden, and waste moved hourly by scraper.

The following capacities were used to calculate the base equation:

330 hp.......201 LCY/h 550 hp.......420 LCY/h
450 hp.......323 LCY/h

The above capacities are based on the following assumptions:

1. Standard scrapers.
2. Rolling resistance, 6%, nearly level gradient.
3. Average haul distance, 1,000 ft.
4. Average operator ability.
5. Dozing distance, 300 ft.
6. Efficiency, 50 min/h.

Base Equation:

Equipment capital cost ..... $Y_C = 1{,}744.42(X)^{0.934}$

Equipment capital costs consist entirely of the equipment purchase price.

Distance Factor: If the haul distance is other than 1,000 ft, the factor obtained from the following equation must be applied to the total capital cost. This will correct for the addition or reduction of equipment required to maintain maximum production capacity:

$F_D = 0.025\ (\text{distance})^{0.539}$.

Gradient Factor: If total gradient (gradient plus rolling resistance) is other than 6%, the factor obtained from the following equation must be applied to total capital cost. This will correct for the addition or reduction of equipment required to maintain the maximum production capacity. (Favorable haul gradients are entered as negative, uphill haul gradients as positive.)

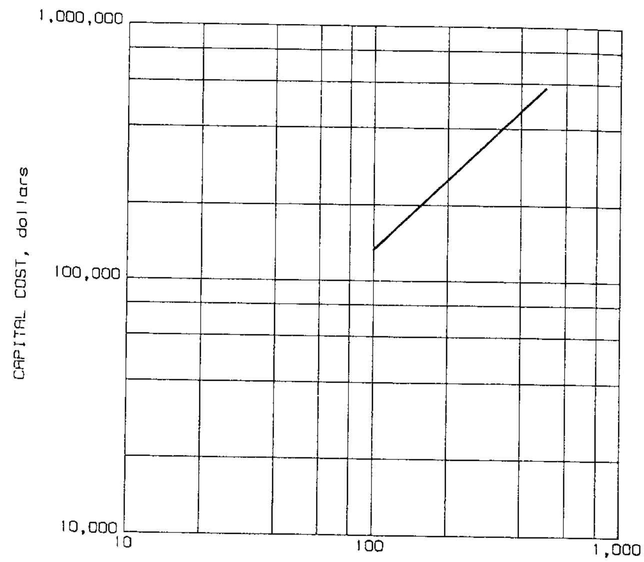
$F_G = 0.776e^{[0.047(\text{percent gradient})]}$.

Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.312$.

Total Cost: Scraper capital cost is determined by $Y_C \times F_D \times F_G \times F_U$.

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Mine equipment capital costs - Scrapers

PROCESSING EQUIPMENT—CONVEYORS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate size conveyors needed to meet maximum required production. A separate cost must be calculated for each conveyor in the circuit. The cost includes associated drive motors and electrical hookup. Equipment transportation, sales tax, and discounts are not accounted for. The equation is applied to the following variable:

X=Maximum cubic yards of material moved hourly by conveyor.

The following capacities were used to calculate the base equation:

18-in-wide conveyor . . . . . .96 yd^3/h	30-in-wide conveyor . . . . . .320 yd^3/h
24-in-wide conveyor . . . . . .192 yd^3/h	36-in-wide conveyor . . . . . .480 yd^3/h

Base Equation:

Equipment capital cost . . . . . . $Y_C = 4{,}728.36(X)^{0.287}$

The capital cost consists of 89% equipment purchase price, 8% installation labor, and 3% construction materials.

Length Factor: If the required conveyor length is other than 40 ft, the factor obtained from the following equation must be applied to the calculated capital cost. This factor is valid for conveyors 10 to 100 ft long:

$F_L = 0.304(\text{length})^{0.330}$.

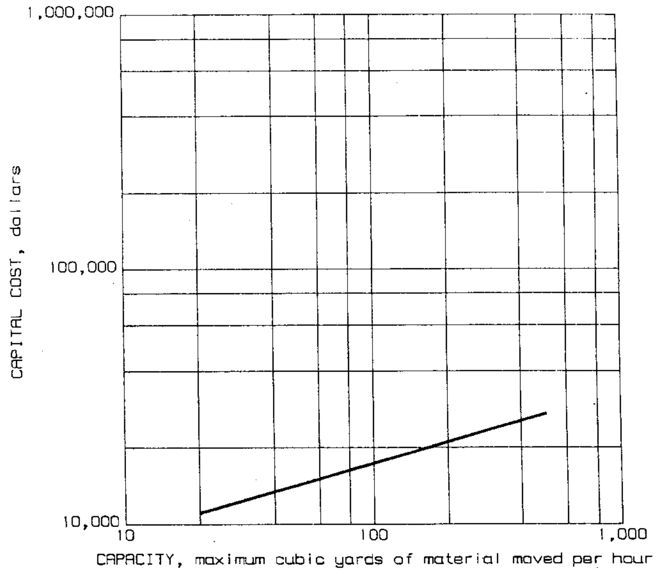
Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.505$.

Total Cost: Conveyor capital cost is determined by

$Y_C \times F_L \times F_U$.

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs -Conveyors

PROCESSING EQUIPMENT—FEED HOPPERS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate size vibrating feeder needed to meet maximum required production. The cost includes associated drive motors, springs, and electrical hookup, plus the expense of a hopper. Equipment transportation, sales tax, and discounts are not accounted for. The equation is applied to the following variable:

X=Maximum cubic yards of material handled hourly by feed hopper.

The following capacities were used to calculate the base equation:

12-in-wide unit	16 yd^3/h
24-in-wide unit	211 yd^3/h
36-in-wide unit	522 yd^3/h

The above capacities are based on the following assumptions:

1. Unsized feed.
2. Feed density, 2,300 lb/yd^3.

Base Equation:

Equipment capital cost . . . . $Y_C = 458.48(X)^{0.470}$

The capital cost consists of 82% equipment purchase price, 14% construction and installation labor, and 4% steel.

Hopper Factor: In many instances a vibrating feeder may not be required. If a hopper is the only equipment needed, multiply the calculated cost by the factor obtained from the following equation. This factor will account for material and labor required to construct and install a hopper:

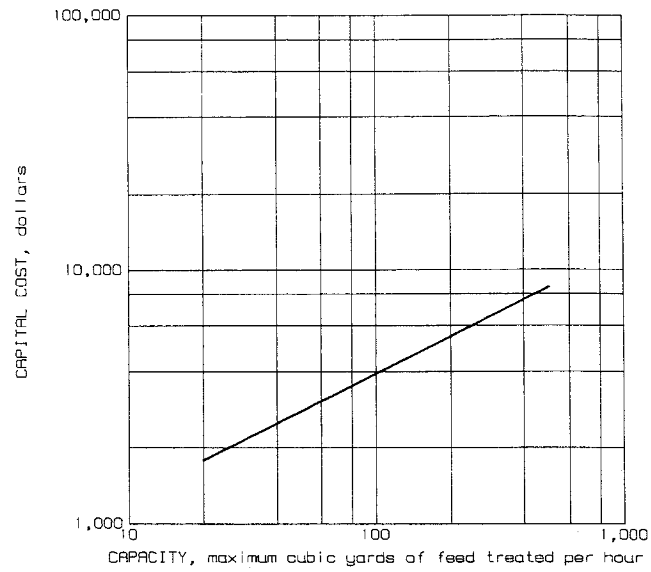
$F_H = 0.078e^{[0.00172(X)]}$.

Used Equipment Factor: The factor calculated from the following equation accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.476e^{[0.00036(X)]}$.

Total Cost: Feeder capital cost is determined by $Y_C \times F_H \times F_U$.

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs - Feed hoppers

PROCESSING EQUIPMENT—JIG CONCENTRATORS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate size and number of jigs needed to meet maximum required production. The cost includes associated drive motors, piping, and electrical hookup. Equipment transportation, sales tax, and discounts are not accounted for. The equation is applied to the following variable:

X=Maximum cubic yards of feed handled hourly by jig concentrators.

The following capacities were used to calculate the base equation:

12- by 12-in simplex ..... 0.617 yd^3/h
26- by 26-in simplex ..... 2.896 yd^3/h
36- by 36-in duplex ......11.106 yd^3/h
36- by 36-in triplex ...16.659 yd^3/h
42- by 42-in triplex ...22.675 yd^3/h

The above capacities are based on the following assumptions:

1. Cleaner service.
2. Hourly capacity, 0.617 yd^3/ft^2.
3. Feed solids, 3,400 lb/yd^3.
4. Slurry density, 40% solids.
5. Gravity feed.

Base Equation:

Equipment capital cost ...... $Y_C = 6{,}403.82(X)^{0.595}$

The capital cost consists of 62% equipment purchase price, 12% construction labor and installation, and 26% construction materials.

Rougher-Coarse Factor: If jigs are to be used for rougher service, or a coarse feed, higher productivity will be realized. To account for the reduction in equipment required to maintain production, the calculated capital cost must be multiplied by the following factor:

$F_R = 0.531.$

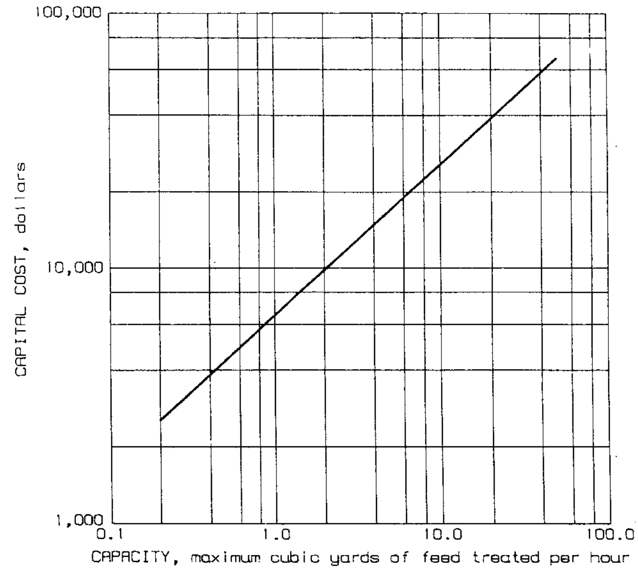
Used Equipment Factor: This factor accounts for the reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.697.$

Total Cost: Jig concentrator capital cost is determined by

$$Y_C \times F_R \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs - Jig concentrators

PROCESSING EQUIPMENT—SLUICES

Capital Cost Equation: This equation furnishes the cost of constructing and installing the appropriate size and number of sluices needed to meet maximum required production. Costs do not include material transportation or sales tax. The equation is applied to the following variable:

X=Maximum cubic yards of feed handled hourly by sluice.

The following capacities were used to calculate the base equation:

18-in-wide box	20.75 yd^3/h	36-in-wide box	75.00 yd^3/h
24-in-wide box	31.25 yd^3/h	42-in-wide box	125.00 yd^3/h
30-in-wide box	50.00 yd^3/h	48-in-wide box	218.75 yd^3/h

The above capacities are based on the following assumptions:

1. Steel plate construction.
2. Angle-iron riffles.
3. Feed solids, 3,400 lb/yd^3.
4. Length-to-width ratio, 4:1
5. Gravity feed.

Base Equation:

Equipment capital cost .... $Y_C = 113.57(X)^{0.567}$

The capital cost consists of 61% construction and installation labor, and 39% construction materials.

Wood Construction Factor: If sluices are to be made of wood rather than steel, the following factor will account for reduced material and construction costs:

$F_W = 0.499(X)^{-0.023}$.

Length Factor: This factor will account for changes in the desired length of the sluice. The factor obtained from the following equation must be applied to capital cost:

$F_L = 1.001(L)^{0.753}$,

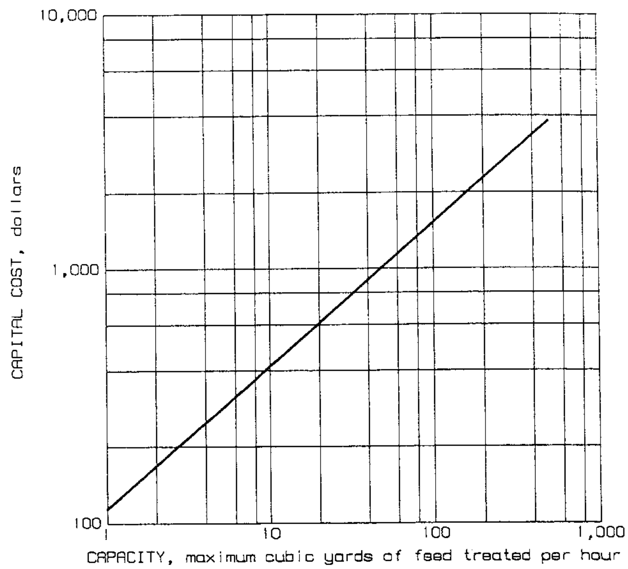
where L = desired length divided by length assumed for the base calculation (width × 4.0).

Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life.

$F_U = 0.574$.

Total Cost: Sluice capital cost is determined by $Y_C \times F_W \times F_L \times F_U$.

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs - Sluices

PROCESSING EQUIPMENT—SPIRAL CONCENTRATORS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate number of spirals needed to meet maximum required production. Cost of slurry splitters, fittings, and pipe are all included. Costs do not include transportation, sales tax, or discounts. The equation is applied to the following variable:

X = Maximum cubic yards of feed handled hourly by spiral concentrator.

The following capacities were used to calculate the base equation:

2 starts	2 yd^3/h	50 starts	50 yd^3/h
10 starts	10 yd^3/h	100 starts	100 yd^3/h

The above capacities are based on the following assumptions:

1. Rougher service.
2. Solids per start, 1.75 st/h.
3. Feed solids, 3,400 lb/yd^3.
4. Slurry density, 10% solids.
5. Gravity feed.

Base Equation:

Equipment capital cost... $Y_C = 3{,}357.70(X)^{0.999}$

The capital cost consists of 71% equipment purchase price, 13% construction labor and installation, and 16% construction materials.

Cleaner-Scavenger Service Factor: If spirals are to be used for cleaner or scavenger functions, unit capacity will decrease. To account for additional equipment needed to maintain production, calculated capital cost must be multiplied by the following factor:

$F_C = 2.333.$

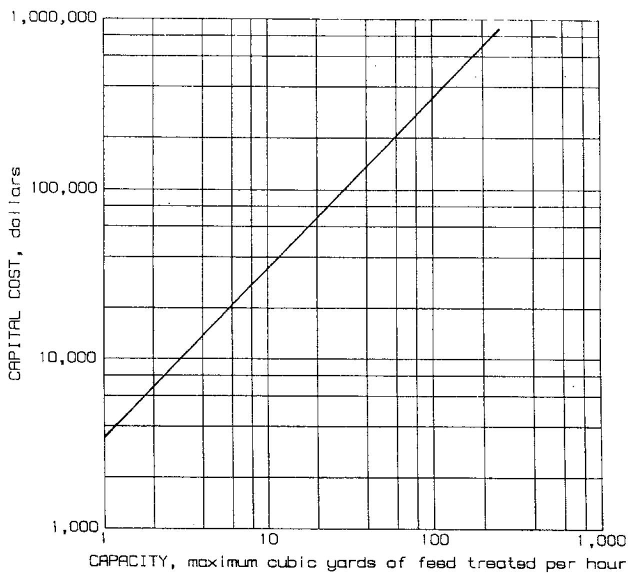
Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.654.$

Total Cost: Spiral concentrator capital cost is determined by

$$Y_C \times F_C \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs - Spiral concentrators

PROCESSING EQUIPMENT—TABLE CONCENTRATORS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate size and number of tables needed to meet maximum required production. Cost includes associated drive motors, piping, and electrical hookup. Equipment transportation, sales tax, and discounts are not accounted for. The equation is applied to the following variable:

X = Maximum cubic yards of feed handled hourly by table concentrator.

The following capacities were used to calculate the base equation:

18 ft^2 .... 0.147 yd^3/h	140 ft^2 .... 1.471 yd^3/h
32 ft^2 .... 0.442 yd^3/h	240 ft^2 .... 2.471 yd^3/h
80 ft^2 .... 0.882 yd^3/h	

The above capacities are based on the following assumptions.

1. Cleaner service.
2. Feed solids, 3,400 lb/yd^3.
3. Slurry density, 25% solids.
4. Gravity feed.

Base Equation:

Equipment capital cost... $Y_C = 20{,}598.06(X)^{0.643}$

The capital cost consists of 62% equipment purchase price, 12% construction labor and installation, and 26% construction materials.

Rougher-Coarse Factor: If tables are to be used for rougher service, or a coarse feed, higher productivity will be realized. To account for reduction in equipment required to maintain production, the calculated capital cost must be multiplied by the following factor:

$F_R = 0.568.$

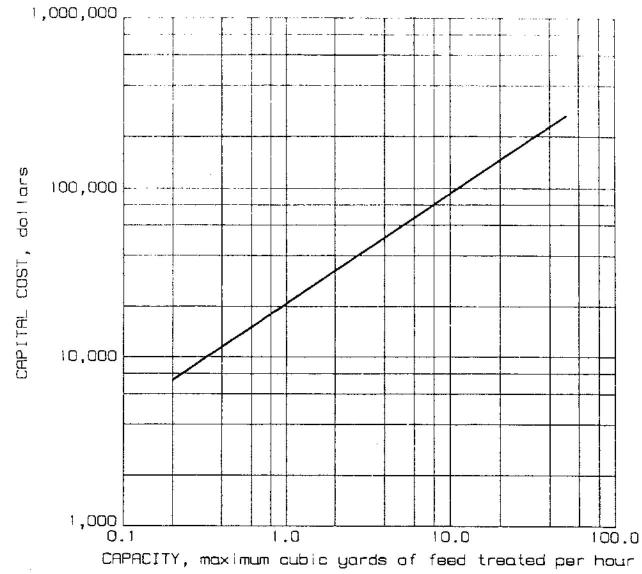
Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.596.$

Total Cost: Table concentrator capital cost is determined by

$$Y_C \times F_R \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs - Table concentrators

PROCESSING EQUIPMENT—TROMMELS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate size trommels needed to meet maximum required production. Cost includes associated drive motors, piping, and electrical hookup. Equipment transportation, sales tax, and discounts are not accounted for. The equation is applied to the following variable:

X = Maximum cubic yards of feed handled hourly by trommels.

The following capacities were used to calculate the base equation:

3.0-ft diam . . . 40 yd^3/h.
3.5-ft diam . . . 50 yd^3/h.
4.0-ft diam . . . 85 yd^3/h.
4.5-ft diam . . . 150 yd^3/h.
5.0-ft diam . . . 250 yd^3/h.
5.5-ft diam . . . 300 yd^3/h.
7.0-ft diam . . . 500 yd^3/h.

The above capacities are based on the following assumptions:

1. Trommels are sectioned for scrubbing and sizing.
2. Gravity feed.
3. Feed density, 2,300 lb/yd^3.

Base Equation:

Equipment capital cost . . . $Y_C = 7,176.21(X)^{0.559}$

The capital cost consists of 64% equipment purchase price, 26% construction and installation labor, and 10% construction materials.

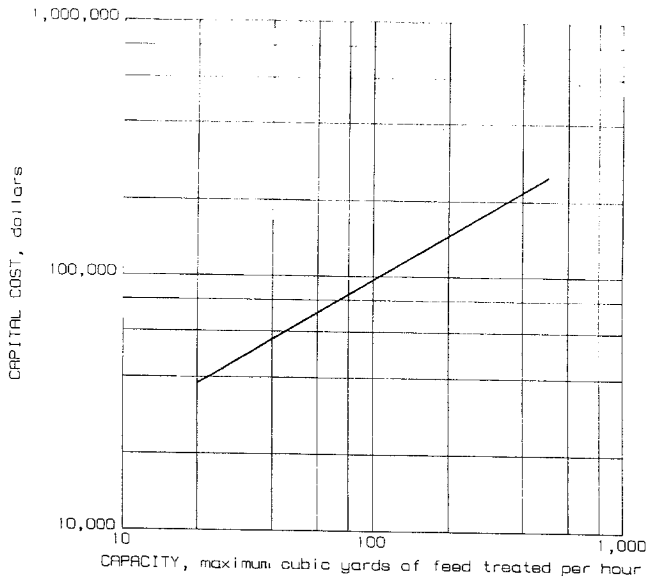
Used Equipment Factor: This factor accounts for the reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.516.$

Total Cost: Trommel capital cost is determined by

$$Y_C \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs - Trommels

PROCESSING EQUIPMENT—VIBRATING SCREENS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate size and number of vibrating screens needed to meet maximum required production. Cost includes installation and electrical hookup of both the screens and the associated drive motors. Equipment transportation, sales tax, and discounts have not been taken into account. The equation is applied to the following variable:

X = Maximum cubic yards of feed handled hourly by vibrating screens.

The following capacities were used to calculate the base equation:

30-ft^2 screen surface ..... 47 yd^3/h
56-ft^2 screen surface ..... 87 yd^3/h
60-ft^2 screen surface ..... 93 yd^3/h
96-ft^2 screen surface ...... 150 yd^3/h
140-ft^2 screen surface ...... 218 yd^3/h

The above capacities are based on the following assumptions:

1. An average of 0.624 ft^2 of screen is required for every cubic yard of hourly capacity.
2. Feed solids, 3,120 lb/yd^3.
3. Gravity feed.

Base Equation:

Equipment capital cost... $Y_C = 1,870.20(X)^{0.631}$

The capital cost consists of 75% equipment purchase price, 10% construction and installation labor, and 15% construction materials.

Capacity Factor: If anticipated screen capacity is other than 0.624 ft^2/yd^3 of hourly feed capacity, the calculated capital cost must be multiplied by the following factor. This will account for the increase or reduction in equipment size required to maintain production:

$F_C = 1.322(C)^{0.629}$,

where C = anticipated capacity in square feet per cubic yard of hourly feed.

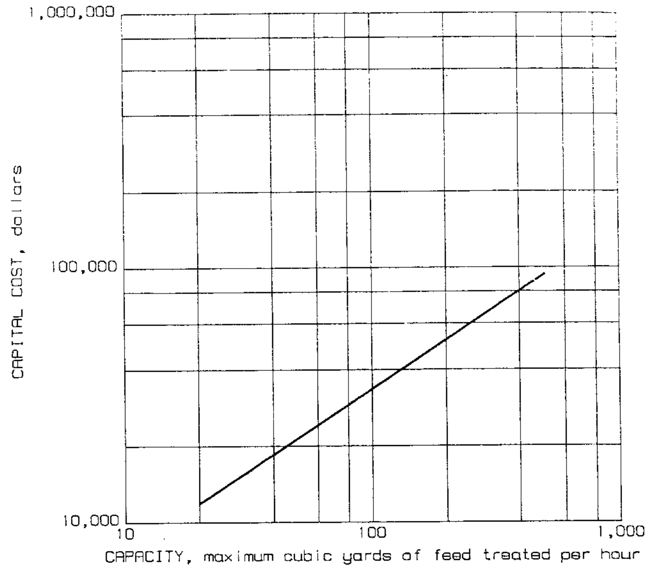
Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.565$.

Total Cost: Vibrating screen capital cost is determined by

$$Y_C \times F_C \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Processing equipment capital costs - Vibrating screens

SUPPLEMENTAL—BUILDINGS

Capital Cost Equation: This equation provides the cost of materials and construction for any buildings needed at the site. These may include storage sheds, shops, or mill buildings. Costs do not include sales tax, material transportation, or discounts. A separate cost must be calculated for each building, and the equation is applied to the following variable:

X = Estimated floor area, in square feet.

Building costs are based on the following assumptions:

1. Average quality temporary structures.
2. Steel frame with metal siding and roofing.
3. Concrete perimeter foundations with wood floors.
4. Electricity and lighting provided.

Base Equation:

Capital cost .... $Y_C = 34.09(X)^{0.907}$

The capital cost consists of 34% construction labor, 41% construction materials, and 25% equipment.

Cement Floor Factor: If a cement floor is required, the cost calculated from the base equation must be multiplied by the factor obtained from the following equation:

$F_C = 1.035(X)^{0.008}$.

Plumbing Factor: If plumbing is required, the following factor must be applied to the total capital cost:

$F_P = 1.013(X)^{0.002}$.

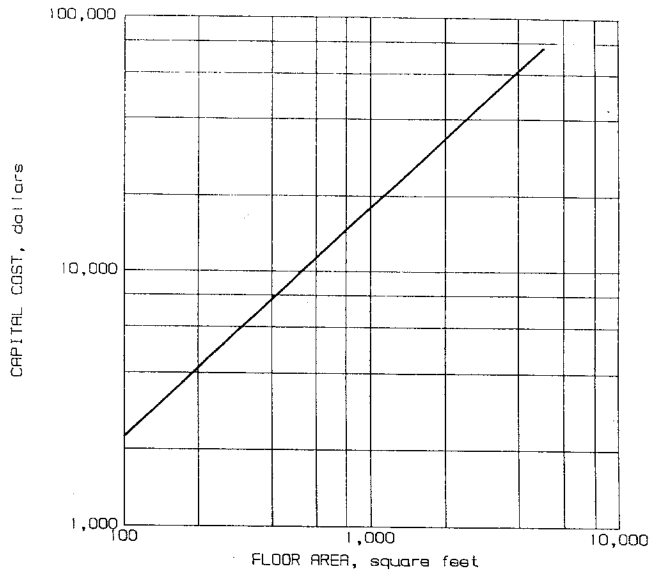
Foundation Factor: If a concrete foundation and wood floor are not needed, multiply the capital cost by the factor obtained from the following equation. This will account for the cost of wood blocks and sills for the foundation:

$F_F = 0.640(X)^{0.026}$.

Total Cost: Building capital cost is determined by

$$Y_C \times F_C \times F_P \times F_F.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Supplemental capital costs - Buildings

SUPPLEMENTAL—EMPLOYEE HOUSING

Capital Cost Equation: Costs of purchasing, outfitting, and installing trailers for workers living at the minesite are provided by this equation. Costs are based on fair quality single-wide trailers capable of meeting minimum building code requirements. Costs do not include sales tax, equipment transportation, or discounts. The equation is applied to the following variable:

X = Average loose cubic yards of overburden and pay gravel handled hourly.

The following capacities were used to calculate the base equation:

25 LCY/h	3.1 workers	150 LCY/h	6.6 workers
50 LCY/h	4.2 workers	400 LCY/h	9.9 workers

The above capacities are based on the following assumptions:

1. Average workforce for placer mines in the western United States (including Alaska).
2. Two workers per trailer.
3. Trailers contain cooking facilities.

Base Equation:

Capital cost .... $Y_C = 7{,}002.51(X)^{0.418}$

The capital cost consists of 90% equipment purchase price, 7% construction and installation labor, and 3% construction materials.

Used Equipment Factor: This factor accounts for the reduced expense of purchasing used trailers. The adjusted cost is obtained by multiplying the calculated capital cost by the following factor:

$F_U = 0.631.$

Workforce Factor: The equation used to compute labor for capital cost estimation is:

Workforce = $0.822(X)^{0.415}$.

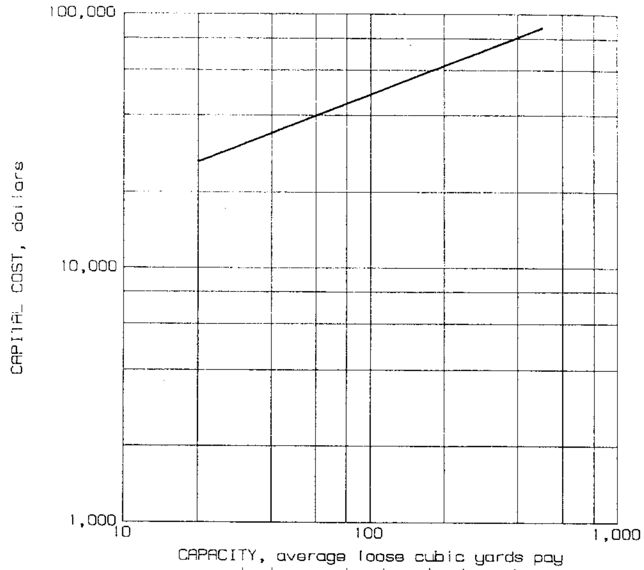
If the workforce for the operation under evaluation is known, and is different than that calculated from the above equation, the correct capital cost may be obtained from the following equation:

Y_C = (Number of workers) × 8,608.18.

Total Cost: Employee housing capital cost is determined by

$$Y_C \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Supplemental capital costs - Employee housing

SUPPLEMENTAL—GENERATORS

Capital Cost Equation: This equation provides the cost of purchasing and installing the appropriate size generator required to meet maximum production. Cost includes installation and connection through the fuse box, and allows for mill, mine, camp, and ancillary function power consumption. Costs do not include equipment transportation, sales, tax, or discounts. The equation is applied to the following variable:

X = Maximum cubic yards of feed handled per hour.

The following capacities were used to calculate the base equation:

10-kW generator	10 yd^3/h	75-kW generator	125 yd^3/h
30-kW generator	40 yd^3/h	125-kW generator	200 yd^3/h
45-kW generator	75 yd^3/h	250-kW generator	400 yd^3/h

The above capacities are based on the assumption that 0.57 kW is needed for every cubic yard of mill capacity. This is average for a mine with a basic plant containing trommels, conveyors, mechanical gravity separation devices (jigs or tables), and other necessary ancillary equipment. In all cases, a slightly higher rated generator has been selected for costing purposes to account for demand surges and miscellaneous electrical consumption, such as camp electricity. A factor is provided below for operations with power consumption rates other than 0.57 kW/yd^3.

Base Equation:

Equipment capital cost... $Y_C = 1{,}382.65(X)^{0.604}$

The capital cost consists of 75% equipment purchase price, 19% construction and installation labor, and 6% construction materials.

Alternate Power Consumption Factor: If anticipated power consumption rate is other than 0.57 kW/yd^3 mill capacity, the capital cost must be multiplied by the factor obtained from the following equation:

$F_P = 1.365(P)^{0.618}$,

where P = anticipated power consumption rate.

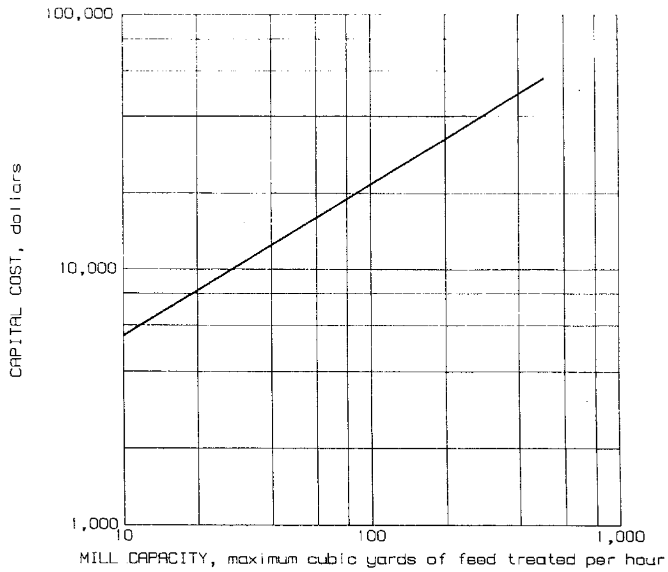
Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.481$.

Total Cost: Generator capital cost is determined by

$$Y_C \times F_P \times F_U.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Supplemental capital costs - Generators

SUPPLEMENTAL—PUMPS

Capital Cost Equation: This equation furnishes the cost of purchasing and installing the appropriate size of pump needed for each particular function (i.e., providing fresh mill water, recirculating spent water through settling ponds, etc.). If more than one pump is required, a separate cost must be calculated for each installation. Guidelines for pump requirements are listed in section 1. In general, however, at least one pump will be required if water is recycled through settling ponds. Costs of diesel-driven centrifugal pumps, polyvinyl chloride (PVC) pipe, and pump and pipe installation labor are all considered. Costs of equipment transportation, sales tax, and discounts are not included. The equation is applied to the following variable:

X = Maximum gallons per minute of water handled.

The following capacities were used to calculate the base equation:

0.50-hp pump	50 gpm	10.50-hp pump	1,000 gpm
2.00-hp pump	200 gpm	18.50-hp pump	1,750 gpm
5.25-hp pump	500 gpm	37.00-hp pump	3,500 gpm

The above capacities are based on the following assumptions:

1. Total head of 25 ft.
2. Diesel-powered pumps.
3. Abrasion-resistant steel construction.
4. Total engine-pump efficiency of 60%.

Base Equation:

Equipment capital cost... $Y_C = 63.909(X)^{0.618}$

The capital cost consists of 70% equipment purchase price, 22% construction materials, and 8% construction and installation labor.

Head Factor: If total pumping head is other than 25 ft, the factor calculated from the following equation will correct for changes in pump size requirements. The product of this factor and the original cost will provide the appropriate figure:

$F_H = 0.125(H)^{0.637}$,

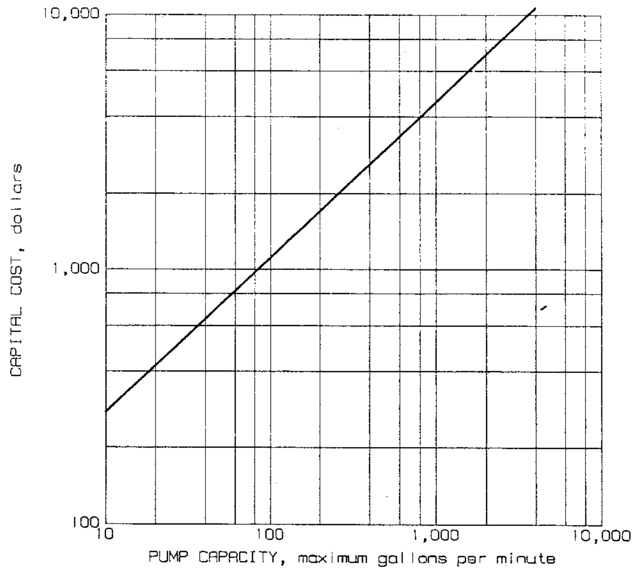
where H = total pumping head.

Used Equipment Factor: This factor accounts for reduced capital expenditure of purchasing equipment having over 10,000 h of previous service life:

$F_U = 0.615$.

Total Cost: Pump capital cost is determined by

$$Y_C \times F_H \times F_U.$$



Supplemental capital costs - Pumps

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.

SUPPLEMENTAL—SETTLING PONDS

Capital Cost Equation: This equation furnishes the cost of settling ponds for waste-water treatment. Costs of labor and equipment operation for site selection, size determination, rough surveying, excavation, ditching, grading, and placement of sized gravel are all included. The equation is applied to the following variable:

X = Maximum mill water consumption, in gallons per minute.

If the water consumption rate is not known, one can be estimated from the following equation:

$X = 94.089(Y)^{0.546}$,

where Y = maximum cubic yards of mill feed handled per hour.

The following capacities were used to calculate the base equation:

400 gpm .... 1,426-yd³ liquid capacity.	900 gpm .... 3,208-yd³ liquid capacity
600 gpm .... 2,139-yd³ liquid capacity	1,400 gpm ... 4,991-yd³ liquid capacity

The above capacities are based on the following assumptions:

1. Pond located in mined-out area.
2. Excavated by bulldozer.
3. Capable of holding 12 h of waste water produced by mill.
4. Based on jig plant water consumption rate.

Base Equation:

Capital cost... $Y_C = 3.982(X)^{0.952}$

The capital cost consists of 75% construction labor, 13% fuel and lubrication, and 12% equipment parts.

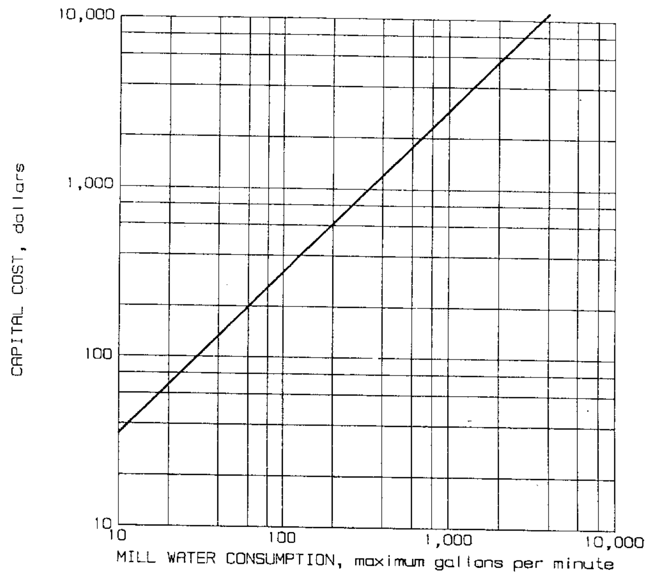
Liner Factor: In order to meet water quality standards, some settling ponds must be lined with an impervious material. If such a liner is required, total capital cost must be multiplied by the factor calculated from the following equation: This factor covers cost of the liner and associated installation labor:

$F_L = 27.968(X)^{-0.314}$.

Total Cost: Settling pond capital cost is determined by

$$Y_C \times F_L.$$

This product is subsequently entered in the appropriate row of the tabulation shown in figure 5 for final capital cost calculation.



Supplemental capital costs - Settling ponds