2.2. SURFACE MINING--CAPITAL COSTS

2.2.6. INFRASTRUCTURE

2.2.6.1.1. ACCESS ROADS CLEARING

The total cost per kilometer is the sum of two separate cost curves (labor and equipment operation) having a roadway width (X), in meters. The curves are valid for widths between 3 and 30 m, operating one shift per day. This cost is multiplied by the total kilometers to obtain the capital cost. Each curve includes all of the daily operating and maintenance costs associated with clearing for access roads. Supplies have not been considered in the clearing costs because it is assumed that cleared brush or timber would be buried under the excavation waste; thus, supplies of fuel oil for burning the clearing slash are not required.

BASE CURVE

The curves are based on estimated costs for clearing medium growth on terrain with a side slope of 25%. Medium growth varies from heavy brush to one tree, 0.33 m in diameter, per 40 m^2.

(L) Labor Operating Cost $(Y_L) = 1,135.467(X)^{0.711}$
The operating labor costs are distributed as follows:

Direct labor...............	86%
Maintenance labor..........	14%

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

		Av salary per hour (base rate)
Dozer operator............	12%	$16.33
Wheel-loader operator......	12%	16.33
Flatbed-truck driver.......	12%	15.89
General laborer............	64%	13.86

The average wage for labor is $14.63 per worker-hour (including burden and average shift differential).

(E) Equipment Operating Cost $(Y_E) = 467.945(X)^{0.711}$
The equipment operating cost consists of 35% for repair parts, 53% for fuel and lubrication, and 12% for tires.

The equipment operation curve consists of

Dozer crawler..............................	31%
Wheel loader...............................	47%
Flatbed truck..............................	12%
Pickup truck...............................	9%
Chainsaws..................................	1%

The equipment operating cost distribution is

	Repair parts	Fuel and lube	Tires
Dozer crawler..............	52%	48%	-
Wheel loader...............	36%	43%	21%
Flatbed truck..............	9%	80%	11%
Pickup truck...............	8%	90%	2%
Chainsaws..................	39%	61%	-

ADJUSTMENT FACTORS

Brush Factor For light clearing conditions where the growth consists mainly of brush and small trees, multiply the curves by the following factors

Brush factor $(F_{B\ LIGHT}) = 0.25$

For heavy clearing conditions, defined as when clearing a dense growth of trees (diameter of the trees commonly exceeding 0.33 m), multiply the curves by the following factor:

Brush factor $(F_{B\ DENSE}) = 1.75$

Side Slope Factor For clearing on terrain with side slopes other than 20% to 30% multiply the curves by the following factors:

For clearing on terrain with side slopes of 0% to 20%,

Side slope factor $(F_{S\ 0\%-20\%}) = 0.8$

For clearing on terrain with side slopes of 30% to 50%,

Side slope factor $(F_{S\ 30\%-50\%}) = 1.8$

For clearing on terrain with side slopes of 50% to 100%,

Side slope factor $(F_{S\ 50\%-100\%}) = 2.5$

Burning Equation If fuel oil (for burning slash) or other supplies, such ascables and chokers, are used, add the following supply cost equation to the total cost per km. The total cost per kilometer for supplies is for a roadway of width (X), in meters, varying in width from 3 to 30 m.

(S) Supply Operating Cost $(Y_{S\ BURNING}) = 269.796[0.100(X)]^{-0.0303}$

This cost is multiplied by the total km, valid for values between 3.33 to 3,333.33 km, to obtain the capital cost.

For clearing operations from 1 to 500 ha (roadway width in meters multiplied by roadway length in meters multiplied by 0.0001), the supplies consist of 78% for fuel oil and 22% for tools, cables, and chokers. For clearing operations of 500 to 1,000 ha, supplies consist of 83% for fuel oil (for burning wood and scrub) and 17% for tools, cables, and chokers.

Equipment Factor Where it is necessary to purchase equipment, or have a subcontractor perform the work, multiply the equipment operation value by the following applicable factor in order to obtain the total value of equipment expense for ownership and operation:

Shifts per day	1	2	3
Factor	1.91	1.68	1.61

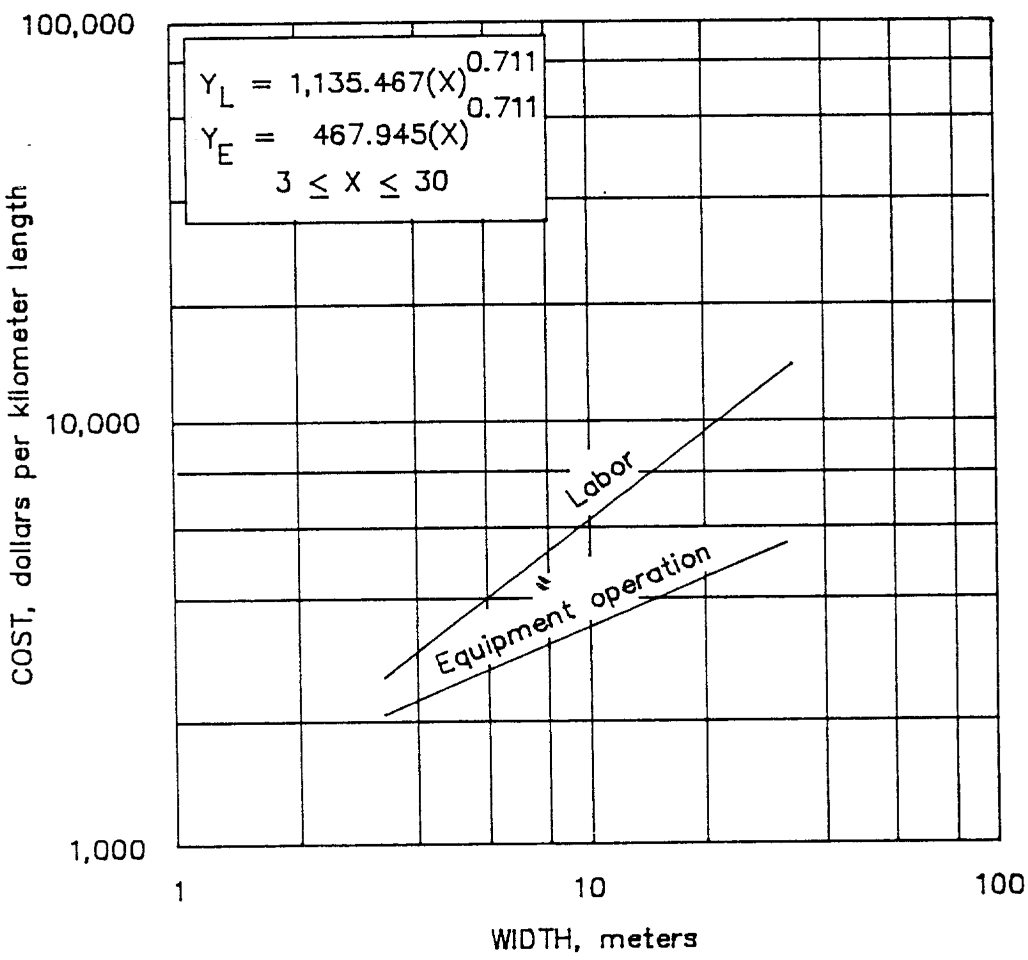
Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs by the following factors:

Labor factor $(F_L) = 1.5$

Supply factor $(F_S) = 1.2$

Equipment operation factor $(F_E) = 1.2$

Surface Mining—Capital Costs



2.2.6.1.1. Access roads
CLEARING

2.2. SURFACE MINING--CAPITAL COSTS

2.2.6. INFRASTRUCTURE

2.2.6.1.2. ACCESS ROADS
DRILL AND BLAST

The total cost per kilometer is the sum of three separate cost curves (labor, supplies, and equipment operation) for a roadway width (X), in meters. The curves are valid for widths between 3 and 30 m, operating one shift per day. This cost is multiplied by the total kilometers to obtain the capital cost. Each curve includes all of the daily operating and maintenance costs associated with drilling and blasting for access roads.

BASE CURVE

The curves are based on estimated costs for drilling and blasting a cut with a single ditch. The terrain has a side slope of 0% to 20%, and the cut contains 50% rock.

(L) Labor Operating Cost $(Y_L) = 9{,}633.822(X)^{0.496}$
The operating labor costs are distributed as follows:

Direct labor...............	79%
Maintenance labor..........	21%

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

		Av salary per hour (base rate)
Air-track driller..........	33%	$16.78
Compressor operator........	17%	17.23
Chuck tender...............	27%	13.86
Powderman..................	8%	16.33
Powderman helper...........	7%	14.56
Flatbed-truck driver.......	8%	15.89

The average wage for labor is $15.68 per worker-hour (including burden and average shift differential).

(S) Supply Operating Cost $(Y_S) = 7{,}247.524(X)^{0.644}$
The supply cost consists of 79% blasting supplies and 21% drilling supplies. Drilling supplies consist of percussion drill bits, rods, striking bars, and couplings; blasting supplies consist of dynamite, ANFO, electric blasting caps, and connecting wire.

(E) Equipment Operating Cost $(Y_E) = 4{,}109.384(X)^{0.496}$
The equipment operation curve consists of 51% for repair parts, 48% for fuel and lubrication, and 1% for tires.

The equipment operation curve consists of

Air-track drills...........	33%
Portable compressors.......	55%
Flatbed truck..............	7%
Pickup truck...............	5%

The equipment operating cost distribution is:

	Repair parts	Fuel & lube	Tires
Air-track drills...........	93%	7%	-
Portable compressors.......	34%	65%	1%
Flatbed truck..............	9%	80%	11%
Pickup truck...............	8%	90%	2%

ADJUSTMENT FACTORS

Rock Factor For drilling and blasting cuts that contain other than 50% rock, multiply the curves by the following factors:

For drilling and blasting cuts containing 25% rock,

Rock factor $(F_{R\ 25\%}) = 0.60$

For drilling and blasting cuts containing 100% rock,

Rock factor $(F_{R\ 100\%}) = 1.40$

Side Slope Factor For terrain with side slopes of 0% to 20% which require drilling and blasting for two ditches and for providing material for a minimum fill, the base costs should be used without any adjustments. With side slopes other than 0% to 20% multiply the cost obtained from the curves by the following factors:

For clearing on terrain with side slopes of 20% to 50%,

Side slope factor $(F_{S\ 20\%-50\%}) = 1.5$

For claering on terrain with side slopes of 50% to 100%,

Side slope factor $(F_{S\ 50\%-100\%}) = 3.0$

Equipment Factor Where it is necessary to purchase equipment, or have a subcontractor perform the work, multiply the equipment operation value by the following applicable factor in order to obtain the total value of equipment expense for ownership and operation:

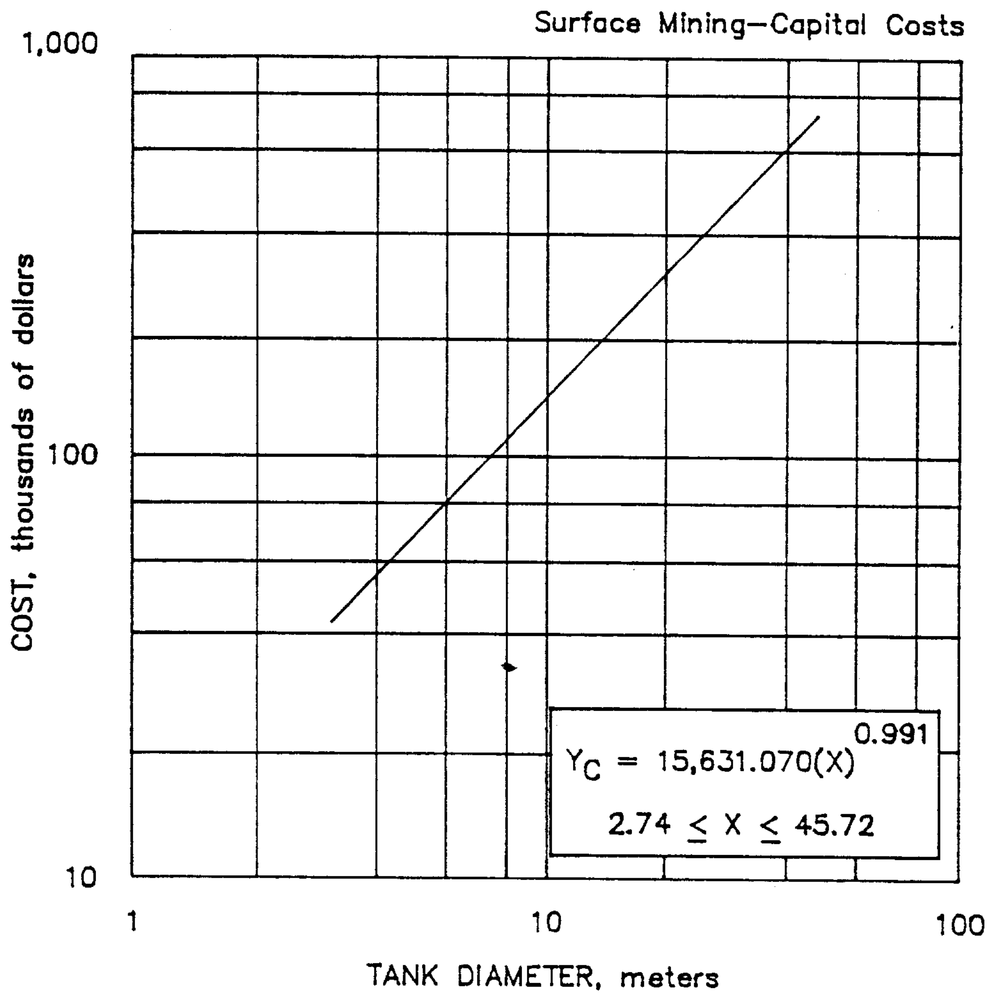
Shifts per day.............	1	2	3
Factor.....................	2.12	1.84	1.75

Subcontractor Factor If a subcontractor is used, to compensate for the subcontractor's markup, multiply the costs by the following factors:

Labor factor $(F_L) = 1.50$

Supply factor $(F_S) = 1.20$

Equipment operation factor $(F_E) = 1.20$



2.2.6.4.1. Wastewater treatment
CLARIFICATION

2.2. SURFACE MINING--CAPITAL COSTS

2.2.6. INFRASTRUCTURE

2.2.6.4.2. WASTE WATER TREATMENT NEUTRALIZATION

The Environmental Protection Agency's publication EPA-600/2-82-00/d "Treatability Manual, Vol. IV, Cost Estimating," April 1983, was the source of cost development. One is referred to this manual if further detail in neutralization costs is needed. Additionally, other waste water treatment methods are costed in this EPA manual.

The capital cost curves cover neutralization of waste water effluent (out-of-pipe) when required. The basic design variable is wastewater flow. Applicability of the curves are for effluent to be neutralized that ranges in volume from 0.001 to 876 L/s (22.8 to 20 million gal/d). It is assumed that flow equalization is provided by a tailings pond. The costs apply to the neutralization of either acidic or basic waste water streams originating from mine, mill, or combined mine and mill after it flows out-of-pipe from the central impoundment pond. In most mining operations further waste water treatment costs are not required. The system consists of chemical addition and two-stage neutralization tanks. It is assumed that pH and suspended-dissolved solid content of influent to the system will be unknown at this level of costing. Basis of design uses a standard dosage of 100 mgLl lime and 100 mg/L acid to achieve a pH of 7.0 over a pH range of 6.5 to 8.0.

BASE CURVES

Total costs are described by two sets of cost curves based on daily average waste water flow rate (X) in liters per second. The curves include all costs associated with the construction of the treatment facility including mixing tank, attenuation tank, chemical storage, agitators, piping, electrical, and instrumentation. These costs are distributed as follows:

Construction labor cost.......	22%
Construction supply cost......	13%
Purchased equipment cost......	65%

For waste water effluent rates between 0.001 to 8.76 L/s the capital cost is $(Y_{C\ 0.001\text{-}8.76\ L/s}) = 123{,}144.490(X)^{0.094}$ and is distributed as follows:

(L) Construction Labor Cost $(Y_{L\ 0.001\text{-}8.76\ L/s}) = 27{,}091.780(X)^{0.094}$

(S) Construction Supply Cost $(Y_{S\ 0.001\text{-}8.76\ L/s}) = 16{,}008.780(X)^{0.094}$

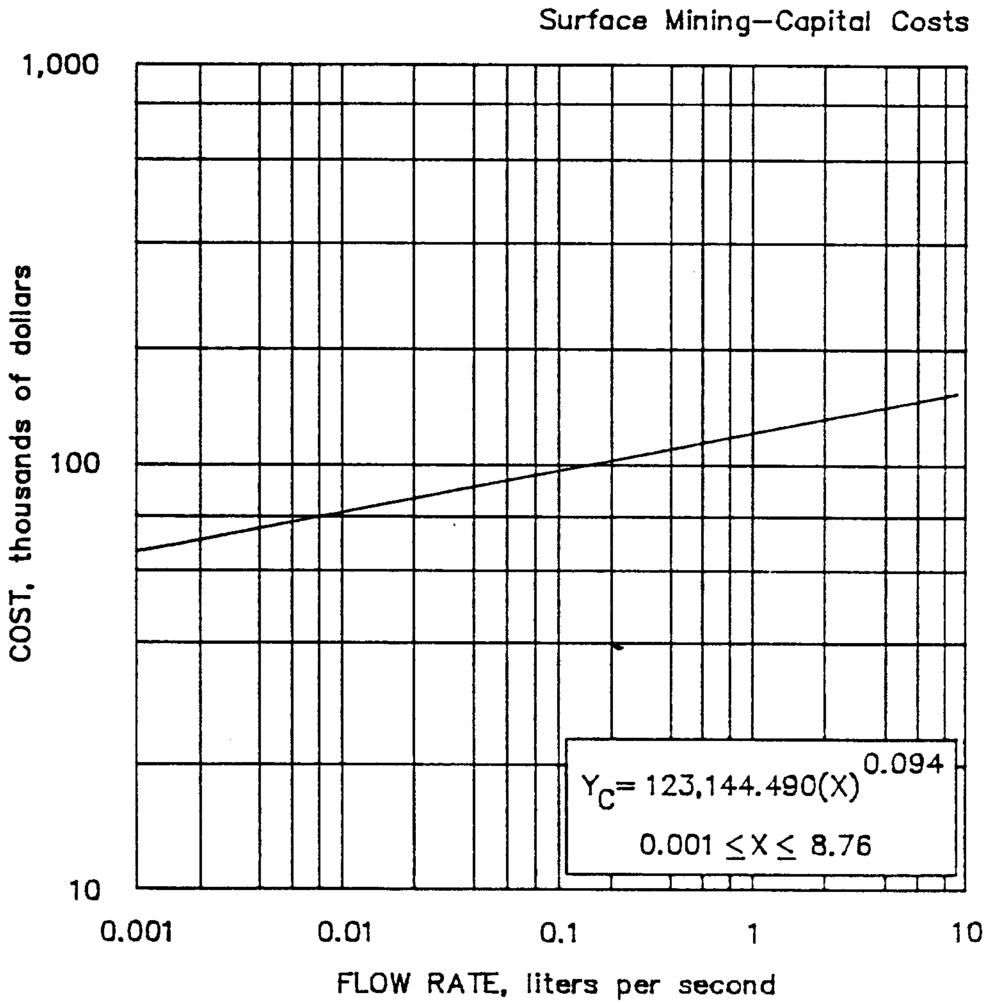
(E) Purchased Equipment Cost $(Y_{E\ 0.001\text{-}8.76\ L/s}) = 80{,}043.930(X)^{0.094}$

For waste water effluent rates between 8.76 to 876 L/s the capital cost is $(Y_{C}\ 8.76\text{-}876\ L/s) = 26{,}346.39(X)^{0.562}$ and is distributed as follows:

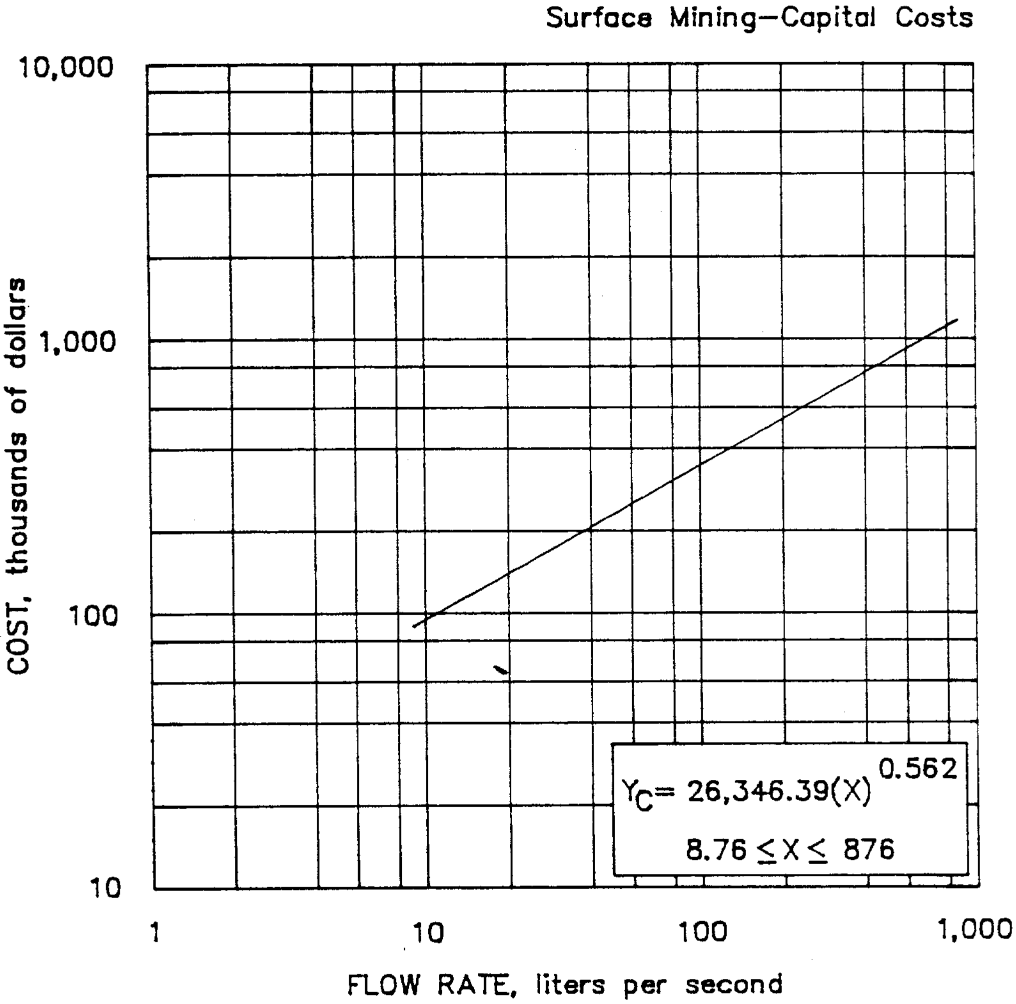
(L) Construction Labor Cost $(Y_L\ 8.76\text{-}876\ L/s) = 5{,}796.21(X)^{0.562}$

(S) Construction Supply Cost $(Y_S\ 8.76\text{-}876\ L/s) = 3{,}425.03(X)^{0.562}$

(E) Purchased Equipment Cost $(Y_E\ 8.76\text{-}876\ L/s) = 17{,}125.15(X)^{0.562}$



2.2.6.4.2.a Wastewater treatment
NEUTRALIZATION



2.2.6.4.2.b Wastewater treatment
NEUTRALIZATION