NORTHERN CONSTRUCTION COMPANY
DIVISION OF MORRISON-KNUDSEN COMPANY, INC.

PREPARATION OF SHORE PROTECTION MATERIALS FOR FUTURE OFFSHORE ISLANDS

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NORTHERN CONSTRUCTION COMPANY
Division of Morrison-Knudsen Company, Inc.

1304 HORNBY STREET
VANCOUVER III, CANADA

V6Z 1W6

October 25th, 1974.

Imperial Oil Limited,
10025 Jasper Avenue,
Edmonton, Alberta. T5J 1S6

Attention: Mr. D. C. Wetterberg

Western Arctic Dredging
Preparation of Shore Protection Materials

Dear Sirs:

With reference to your Purchase Order No. 13 S 612157, we are pleased to submit our study of "Preparation of Shore Protection Materials for Future Offshore Islands."

Our study contains details of cost and procedure for the preparation of quarried rock rip rap and manufactured concrete modules in the King Pt. area of the Yukon Territory. It should be noted that the estimates have been prepared as if the quarry operation were carried out independent of the concrete operation. Significant savings in the costs of site services, facilities, and overhead could materialize to the Owner if both operations were carried out concurrently. Further savings could be realized depending on the type of contractual arrangement entered into for performance of the work.

We would be pleased to discuss details of this study at your convenience.

Yours very truly,

J. R. Hall,
Vice-President and
Division Manager.

JRH:DW

cc: Mr. J. J. A. DeJong, Calgary
Mr. J. G. Riley, Edmonton

SECTION 2. PROJECT DESCRIPTION AND SCHEDULE.

GENERAL.

The terms of reference of this study are "to provide a preliminary design and cost estimate of a rock quarrying system and a concrete block manufacturing facility for the production of shore protection materials for future off-shore islands."

The location of the work is at King Point Yukon Territory and the future offshore islands will be located in the Beaufort Sea.

The schedule is based on a contract award in November 1974, mobilization through 1975 and manufacture and transportation to offshore islands of the finished products in the years 1976 through 1981.

Items which will be required for completion of the project but which have not been made part of this report include the following:

a). An offshore breakwater required to protect the harbour.

b). A simple dock 300 feet long and a dredged area for barge traffic have been allowed for in the cost estimate. However a more detailed investigation of the site is required to provide a basis for complete design.

c). An airstrip capable of handling Hercules aircraft.

d). A study of the handling and placing of materials into position on the offshore islands.

ROCK OPERATION

The study is based on a delivery requirement of 856,700 Tons of sized rip rap and spalls over a 6 year period from 1976 to 1981.

Scheduled delivery is as follows:

Year	Tons delivered
1976	83,400
1977	85,200
1978	85,200
1979	126,800
1980	259,600
1981	216,500
	856,700 Tons

Five sizes of rock are required with the following quantities of each.

Size	Tons
0" - 8"	433,200
8" - 12"	127,900
12" - 18"	57,000
18" - 24"	104,200
+ 24"	134,400
	856,700 Tons

A quarry location at Mt. Sedgwick was specified. This location is 40 miles from the King Point dock area and is composed of granite rock with adjacent limestone.

A satellite camp and shop will be set up at Mt. Sedgwick in the winter of 1975-76. Fuel and supplies sufficient to complete one year's operation will be hauled in each winter. Personnel will be airlifted to and from the satellite camp from King Point. Pioneering and drilling is done with 2 crawlair CM/ECM 350 drills each with a 1050 cfm compressor. It is estimated that a solid volume of 603,000 cu. yd. will be shot to produce the required product. A powder factor 0.65 lbs/cu. yd. is estimated using a combination of Powerfrac 75 and Hydromex M-210 on a 35 ft. bench.

The rock processing plant is set up on a permanent location downhill from the quarry. Rock haul trucks of 35 Ton capacity with a 6 cu. yd. loader will haul shotrock from quarry to the processing plant.

The plant itself is a series of 4 vibrating grizzlies processing 310 Tons/hr.

The quarrying and processing of rock is scheduled as a summer operation over the months of July and August of each year.

Hauling of processed rock to the dock and stockpiling is scheduled as a winter operation to obviate the cost of access road construction. Winter haul will run from December to April of each season.

A fleet of 50 Ton sleds is used. The uncertain snow conditions in the 9 mile first leg of the haul, i.e. out of the valley, requires the use of Cat D7 tractors. Thereafter 6 large, transport vehicles (Husky 8) pulling 3 - 50 Ton sleds each will complete the remaining 31 mile leg over open tundra.

An equal quantity of rock is processed and hauled to stockpile each year to provide optimum use of equipment.

Processed rock will be stockpiled on a 14 acre storage pad in the immediate proximity of the dock. (see drawing No. IOD-4-3902 for stockpile location). A 10 cu. yd. front end loader will load from stockpiles to scows during the summer working season.

Sufficient support and spare equipment has been included to maintain the necessary production.

The work week for rock quarry and hauling operations is 7 days at 12 hrs.

CONCRETE MODULES.

The concrete shape used in the study is the TRI BAR module. Two sizes are to be manufactured, 5.3 tons and 3.75 tons; there being an equal number of each. The scheduled total number of TRI BARS and the quantity of concrete required are as follows:

TRI BARS. (50% @ 3.75 tons, 50% @ 5.3 tons)

Year	No. of TRI BARS	Concrete quantity cu. yds.
1976	8,600	19,900
1977	9,400	21,500
1978	14,000	32,200
1979	14,000	32,200
1980	14,000	32,200
Total	60,000	138,000

The choice of the plant for the construction of the TRI BARS was based on:

1). Ease of construction.
2). Minimum of winter work.
3). High cost of fuel.
4). Concrete quantities as shown above.

The concrete operation is scheduled for mobilization in 1975, production of modules in 1976-1980, with completion of loading out and demobilization in 1981.

A simple procedure of natural curing is adopted, based on a yearly 5 month summer schedule, May 15 - Oct. 15. The batch plant itself is winterized and facilities are included for heating of aggregates. Batch plant capacity is designed for a production rate of 33 cu. yds/hr.

One hundred and twenty insulated steel forms are used on a twenty-four hour schedule. Hoarding, with tarpaulins and mobile

space heaters, is provided for cold weather protection at each end of the season. Maximum production will be 120 modules per day with an overall average of 80 modules per day.

The work week generally is 7 days at 10 hours single shift with the exception of the roadbuilding crew in 1975 which works on a 7 day at 12 hours double shift per day work week.

Cement supply is the largest single item in the concrete work. A cement content of 512 lb/cu. yd. is used as the basis for the estimate. Quotes were received from, and discussions held with a number of transportation and handling companies. The coastal route, the Mackenzie route and an overland route were each studied.

On present day standards the Mackenzie route using bagged cement on pallets seems to be the most economical way to transport cement. However it is possible that a better system may have been developed before the year 1980 so that it is recommended that the cement supply and delivery be contracted on a 2 year basis.

The pallets are fully winterized and they can be stored, in an open storage area. Sufficient quantities of cement are stockpiled during one shipping season to carry concrete operation through to spring breakup (July 15).

Concrete aggregates are recovered from gravel deposits along the coastal plateau and from the bed of the Babbage River at a maximum distance of 12 miles from the concrete casting area.

The aggregates are hauled to a processing plant at the casting area along a 24 ft. wide all-weather road. Alternatively a coastal winter road may be practical and this warrants further study in conjunction with gravel deposit exploration. The processing plant incorporates a crusher, a 3-deck vibrating screen and a sand classifier to produce one size of aggregate at 1½" minus and washed sand. A silt settling pond will provide environmental control of wash water

and batchplant drainage.

The plant and casting yard occupies a prepared area of 30 acres.

TRI BARS are transported to the dockside on trailers using Cat 966 loaders (with forks) for handling.

Scow loading is completed using Cat 966 loaders at a "drive-on" ramp on the dock. Loading out of TRI BARS is completed in the 1981 season.

HARBOUR FACILITIES

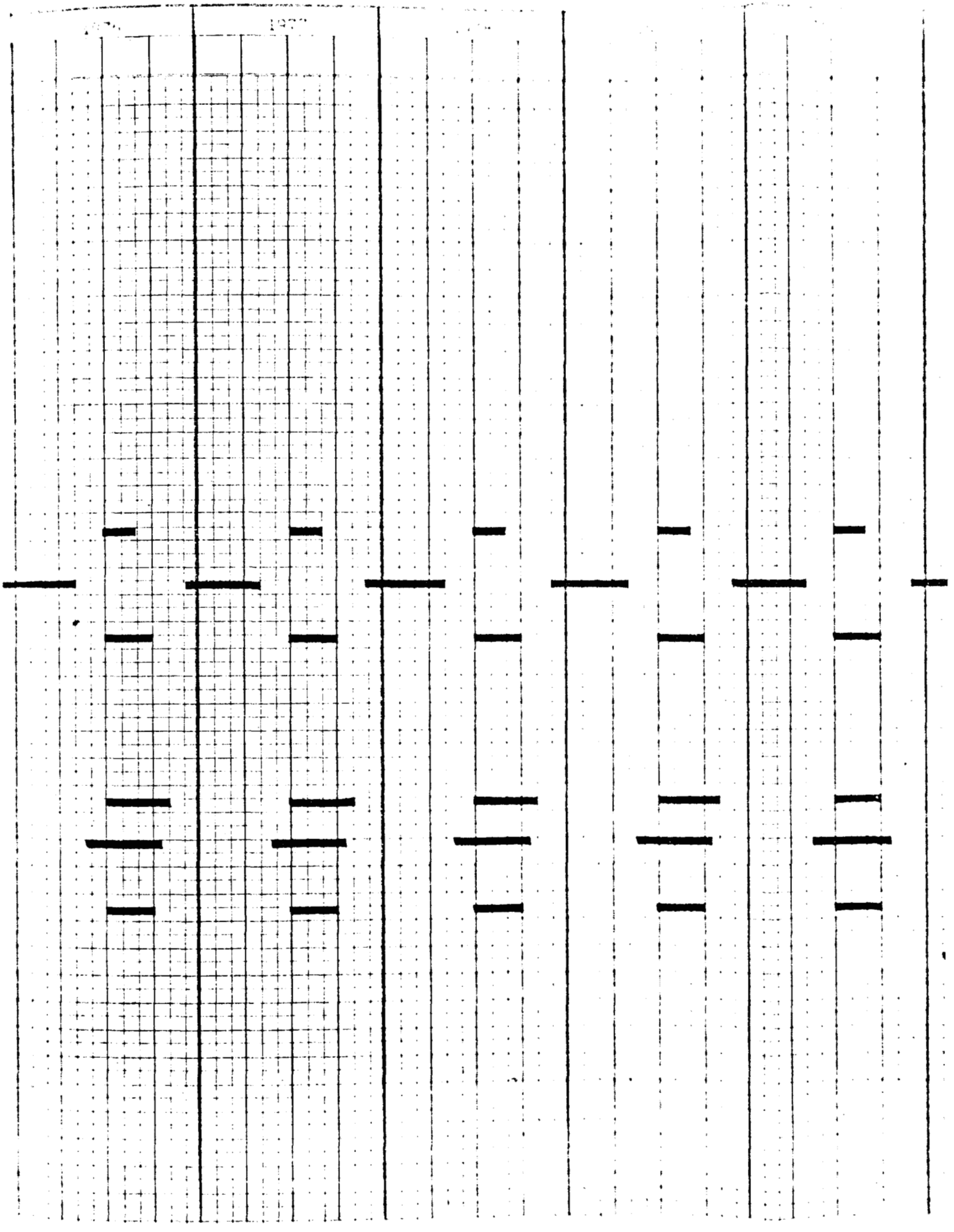
The study is based on the excavation of navigation channel through the existing gravel spit near King Point and the construction of a sheetpile dock in the first year of operation - 1975.

The preparation of a fifteen foot deep Navigation Channel and turning basin, with a minimum channel width at the toe of the slope of 120 feet, is estimated to require excavation of 183,000 cu. yds. of gravel. We expect some of this gravel to be frozen.

We have assumed the sheetpile dock to be 300 feet in length x 50 feet wide with the sheets tied back to a deadman using tie rods. There is a minimal storage area adjacent to the dock.

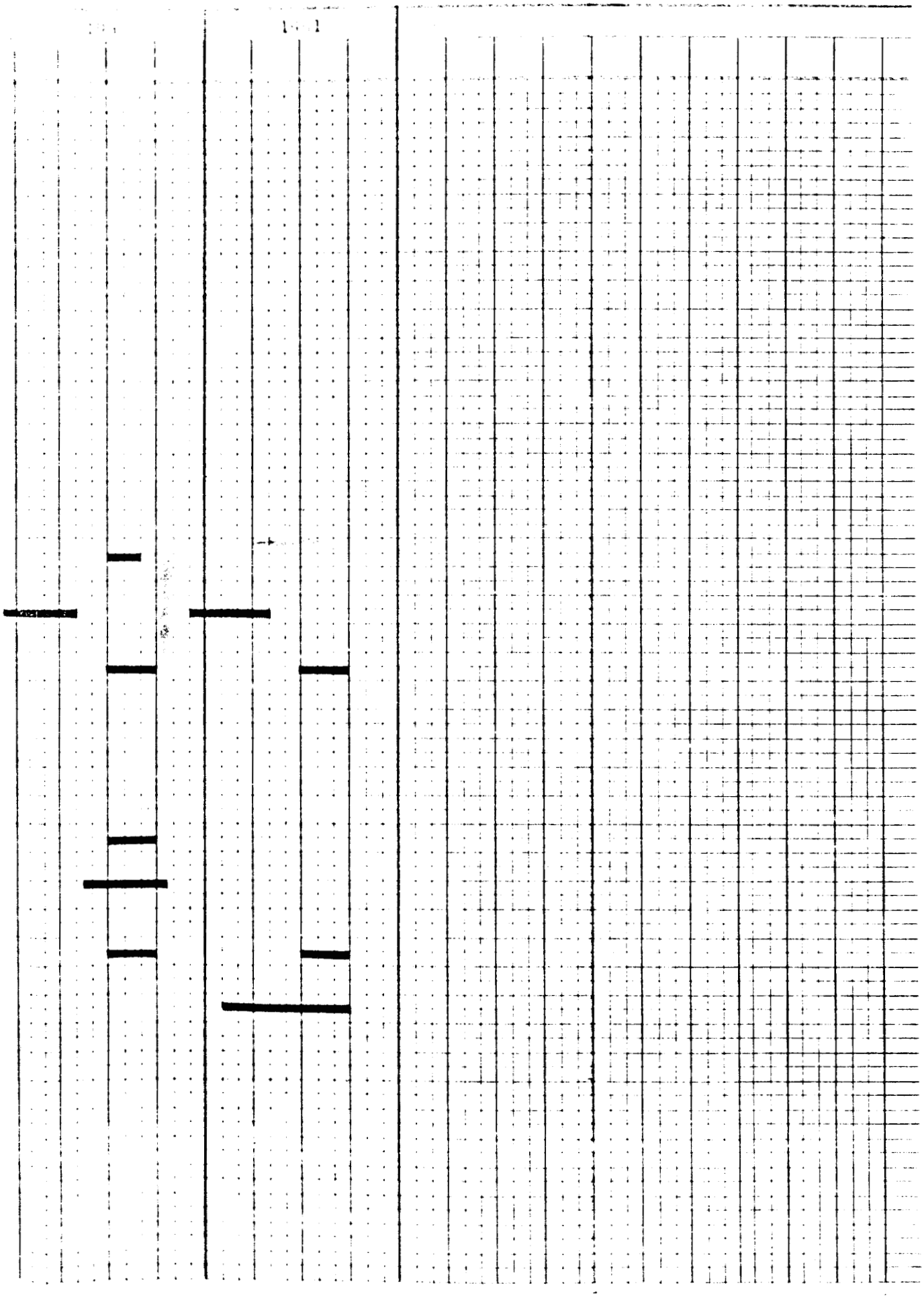
BID ITEM NO.	DESCRIPTION	QUANTITY	UNIT	1974
	CONTRACT AWARDS			
	MOBILIZATION			
	HANDLING FACILITIES			
	Channel Excavation			
	Dock Construction			
	ROCK OPERATION			
	Storage Pad Preparation			
	Work, Drill, Blast & Process			
	Rock Haul to Sizing Plant & Stockpile			
	Rock Load out to Scows			
	CONCRETE OPERATION			
	Plant Erection, Road Construction			
	Cement Delivery			
	Tri-Bar Production			
	Tri-Bar load out to Scows			
	DEMOBILIZATION			

CONSTRUCTION SCHEDULE



SHEET NO ____ OF ____

COMPLETION DATE ____ DATE October 1974



SECTION 3. EQUIPMENT LIST.

The equipment intended for use on the project is listed below. The equipment was selected primarily on the basis of proven ability to do the job and on delivery schedule.

A). Rock quarry equipment.

Description	Number
Drill & Blast	
ECM 350 Crawlair drills	2
Compressor 1050 cfm	2
Dozer Cat D8	1
Rock Separation	
Loader. Cat 988 6 cu.yd.	1
Rear dump trucks Cat 769 35 ton	2
Rock plant of 4 vibrating grizzlies	1
Generator 135 kw.	1
Rock haul	
Dozers Cat D7	6
Loader Cat 988 6 cu. yd.	2
Haul units Husky 8	6
Tracked vehicle TVS 600	2
Sleds 50 Ton	30
Rock Storage & Loading	
Loader. Cat 992. 10 cu.yd.	1
Service Equipment	
Pickup	1
Service truck	1

B). Concrete equipment

Aggregate system

Dozer Cat D7	3
Dozer Cat D8	1
Loader Cat 966 3½ cu.yd	1
Trucks 20 Ton. Highway	9
Grader Cat 14	1
Portable screen & crushing plant, 36"	1
Sand classifier 20" x 19" single screw	1

Concrete batch & placing

Batch & Mix plant 2 cu. yd.	1
Compressor. 460 cfm electric	1
Generator 312 kw	1
Boiler 80 HP	1
Truck mixers 8 cu.yd.	3
Flatrack 10 Ton	1
Loaders Cat 966	2

Formwork handling

Hydraulic mobile crane 12½ Ton	3
Truck crane 50 Ton	1

Tribar loading on scow

Loader with forks Cat 966	3
Tractor	1
Trailers	6

Service equipment

Pickups 3/4 Ton	11
Ambulance	1
Service trucks	2
Busses	3
Flatracks	2

C). Dock construction equipment

Floating

4600 Manitowoc with clamshell & dragline	1
Manitowoc spudded scow	1
Dump scows - 300 cy.	2
Tug - 960 HP	1
Pile hammer & leads D - 22	1
Flat scow 1000 T	1

Land

Dozer Cat D8	1
Loader Cat 966	1
End dump trucks 10 cu.yd.	3

SECTION 4. COST ESTIMATES.

1. Basis of estimate.

2. Detail cost estimates.

3. Estimated fuel consumption.

4. Labour rates contract.

5. Cost escalation.

6. Manpower.

1. Basis of Estimates.

The rock operation, concrete operation and harbour construction are estimated as separate operations, each self sufficient.

Estimates of cost are based on the following:

a) Labour rates covering wages, working conditions and fringe benefits are for the current 1974 season. A copy of these rates is included here in Section 4.

b) Supply items and permanent material costs are based on prices in effect October 1974.

c) Escalation of costs is not included in the estimates. This is discussed further in this section.

d) Estimates of cost include normal contractor mark-up and contingencies.

2. Camp facilities and board costs have been estimated at $25.00 per man day.

3. Imperial Oil Limited will supply free of charge:

a) Fuel Oil.
b) Air transportation to and from Edmonton.
c) Government Permits for land use and quarrying fees.
d) Land-line type telephone system at three locations.
e) Helicopter and aircraft service from Bar-C and Inuvik to the project.
f) Service Boat from Inuvik.

4. Federal sales tax has been included in equipment and supplies purchase. Present Government rulings are unclear and every effort should be made to have the project tax exempt.

5. No financing costs are included in the estimates.

DETAIL COST ESTIMATE.

a). Rock Operation.

Estimated cost of the rock operation is detailed below:

		Quantity	Rate	Amount
1.	Mobilization	LS	-	$ 7,898,496
2.	Drill & blast	857,600 T(Product)	0.89	763,264
3.	Rockplant operation	857,600 T(Product)	2.12	1,818,112
4.	Haulage to dock	857,600 T(Product)	13.75	11,792,000
5.	Load on scow	857,600 T(Product)	0.66	574,592
	Total cost	857,600 T(Product)	26.64	$ 22,846,464

DETAIL COST ESTIMATE.

b). Concrete Operation.

Estimated cost of the concrete operation is detailed below:

	Quantity	Rate	Amount
1. Mobilization	LS	-	$ 11,165,005
2. Cement supply	38,900 Tons	220.00	8,558,000
3. Aggregate recovery and processing	292,000 Tons(Product)	9.00	2,628.000
4. Concrete module production	138,000 cu.yds	82.50	11,385,000
5. Tribars transport and load on scow	271,500 Tons	6.25	1,696,875
Total cost	138,000 cu. yds	256.76	$ 35,432,880

DETAIL COST ESTIMATE.

c). Harbour construction.

Estimated cost of harbour construction is detailed below:

		Quantity	Rate	Amount
1.	Channel excavation	183,000 cu.yds	7.23	$ 1,323,090
2.	Dock construction	300 lft	1,660.00	498,000
	Total cost			$ 1,821,090

3). Estimated fuel consumption.

The estimated fuel consumption of equipment on all phases of the work is 3,315,850 gals (Imp.)

A consumption schedule for individual operations is shown below:

	FUEL CONSUMPTION (IMP. GALS.)						
	1975	1976	1977	1978	1979	1980	1981
Rock operation	92,960	340,300	340,300	340,300	340,300	340,300	314,570
Concrete operation	140,270	162,680	169,320	202,520	202,520	202,520	32,370
Dock construction	94,620						
	327,850	502,980	509,620	542,820	542,820	542,820	346,940

Total project fuel consumption = 3,315,850 Imp. Gals.

4. Labour rates

The wage rates, fringe benefits, and conditions in effect on Western Arctic Dredging work in 1974 have been used as the basis of labour costs.

Details of these rates are shown on the following pages 4 - 9 to 4 - 17.

A review of labour escalation follows in sub section 5.

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WESTERN ARCTI DREDGING

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Hrs. of Work Per Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shift Differential
					COMMISSIONING AND MOBILIZATION							
Foreman	7.35	10% of all earnings ($600.00 Min.) if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	N
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
Foreman	7.35	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	N

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WESTERN ARCTIC DREDGING

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Hrs. of Work Per Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shift Differenta
					COMMISSIONING AND MOBILIZATION							
Operator (4600 Manitowoc and similar)	7.00	10% of all earnings ($600.00 Min.) if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	N
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
Operator (4600 Manitowoc and similar)	7.00	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	N

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WESTERN ARCTIC DREDGING

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Hrs. of Work Per Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shift Differentail
					COMMISSIONING AND MOBILIZATION							
Leverman	7.00	10% of all earnings ($600.00 Min. if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
Leverman	7.00	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil

NORTHERN CONSTRUCTION COMPANY

WESTERN ARC) DREDGING

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Hrs. of Work Per Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shi Dif ent
					COMMISSIONING AND MOBILIZATION							
883 Operator and Crane Oper.	6.35	10% of all earnings ($600.00 Min.) if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	N
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
883 Operator and Crane Oper.	6.35	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	N

NORTHERN CONSTRUCTION COMPANY

WESTERN ARCTIC DREDGING

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Hrs. of Work Per Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shift Differentail
					COMMISSIONING AND MOBILIZATION							
Welder	5.85	10% of all earnings ($600.00 Min.) if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
Welder	5.85	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Hrs. of Work Per Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shift Differential
					COMMISSIONING AND MOBILIZATION							
Tractor Loader Oper.	5.65	10% of all earnings ($600.00 Min.) if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
Tractor Loader Oper.	5.65	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil

WESTERN ARCTIC DREDGING

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shift Differentail
					COMMISSIONING AND MOBILIZATION							
Oiler	4.50	10% of all earnings ($600.00 Min.) if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
Oiler	4.50	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil

WESTERN ARCTIC DREDGING

WAGE RATES, FRINGE BENEFITS AND CONDITIONS IN EFFECT FEBRUARY 18, 1974

Classification	Basic Hourly Rate	Bonus Rate	Hrs. of Work Per Day	Hrs. of Work Per Week	O/T CONDITIONS	Vacation Pay	Leave Entitlement	Pay for Leave Days	Transport on Leave	Med. Plans Pensions etc.	Room and Board	Shift Differentail
					COMMISSIONING AND MOBILIZATION							
Lab./Deckhand	4.10	10% of all earnings ($600.00 Min.) if Contract Period completed	8	48	Time and one-half for all O/T over 8/48	6%	one week after 60 days of employment	1 Day's Pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil
					OPERATIONAL SEASON NORMALLY JULY 1 to OCT. 31							
Lab./Deckhand	4.10	10% of all earnings ($600.00 Min.) if Contract Period completed	12	84	Time and one-half for hrs. worked beyond 208 in a month	6%	10 days after completion of 40 days employment	1 Day's pay each way	Fare paid to point of hire in Canada and return	.15¢ per hr. earned	Free	Nil

5. Cost Escalation.

A). Labour

A project at King Point, Yukon Territory, is subject to the general escalation forces applicable to Canadian construction industry and also to some forces peculiar to the job location.

Labour earnings increases in the years 1970 - 1974 are shown below. These give an indication of the historical trend of escalation in labour costs.

Average Weekly earnings

1). All industries (Alberta)

	Average weekly earnings	Index 1970 = 1.00	Percentage Increase per year
1970	123.53	1.00	
1971	133.29	1.08	7.9%
1972	142.70	1.16	7.1%
1973	155.70	1.26	9.1%
1974	168.05	1.36	7.9%

2). Construction Industry (Canada)

1970	160.48	1.00	
1971	172.04	1.07	7.2%
1972	198.03	1.23	15.1%
1973	220.18	1.37	11.2%
1974	233.27	1.45	5.9%

Wage rates.

1). General engineering (Canada).

	Average weekly earnings	Index 1970 = 1.00	Percentage Increase per year
1970	3.77	1.00	
1971	4.23	1.12	12.2%
1972	4.63	1.23	9.5%
1973	5.12	1.36	10.6%
1974	5.68	1.51	10.9%

Labour organization in the Mackenzie Delta area has been, to date, controlled by the Edmonton "locals" and has been subject to the Alberta wage base. King Point however is in the Yukon Territory. The southern portion of the Yukon is actively controlled by the British Columbia "Locals" and this active control will no doubt extend to the northern portion as the territory is opened up.

A further influence on King Point is the proximity of Prudhoe Bay and the pipeline work in Alaska (less than 400 miles to the West).

A start of the Mackenzie Valley pipeline would have a major influence on both supply and organization of labour.

Wage rates in B.C. and Prudhoe Bay are compared to present day Mackenzie Delta rates as follows:

Basic Wage Rates.

	Mackenzie Delta NWT (Mar.74-Dec.74)	B.C. (1Jul.74-1Nov.74)	Prudhoe B ay (1Jul.74-1Jan.75)
Labour	4.10	6.71	9.66
Heavy duty mechanic	6.35	7.90	11.17
Carpenter	7.00	7.97	11.35

B). Equipment

Firm quotes on equipment were difficult to obtain with vendors advising in the order of 1½% per month add-on from the date of quote to the date of purchase order.

C). Supplies

It was not possible to get firm quotes on cement supply over a five year period. However, an escalation of $5/ton/year was indicated.

One freight quote indicated a total escalation of 40% from 1975 rates to 1979 rates. Recent experience shows supplies escalation running at 15 - 20% per year.

In general, escalation of supplies and equipment costs is a difficult item to predict. One method of avoiding wild 'safety' factors on escalation is to contract work and supplies on a present - cost basis with a formula to handle escalation.

6. Manpower.

Camp facilities and operations are covered in the cost estimates at a rate of $25.00 per man day. A more detailed breakdown of camp requirements for the individual phases of the work is shown below. Camp capacity and mandays shown do not include catering personnel.

a). Rock operation.

The camp requirements for the rock operation is designed as a main camp operation at King Point with a satellite camp at Mt. Sedgwick. A small transient camp will be set up at the transfer point 9 miles from Mt. Sedgwick.

Camp capacity is as follows:

	Summer	Winter
King Point	12	37
Mt. Sedgwick	31	30
Transfer Point		30 (transient)

Man days estimated for the total rock operation is approximately 75,000 man days, with a distribution as follows:

	King Pt.	Mt. Sedgwick	Total
1975	600	1,500	2,100
1976	5,950	6,450	12,400
1977	5,950	6,450	12,400
1978	5,950	6,450	12,400
1979	5,950	6,450	12,400
1980	5,950	6,450	12,400
1981	5,950	4,950	10,900
			75,000 man days

b). Concrete operation.

The camp requirement for the concrete operation is a single camp set up immediately close by the casting yard area.

Concrete work is a summer operation only and peak manpower is 156 men. Total estimated man days for the concrete operation is 110,000 man days with a distribution as follows:

	Man days
1975	9,700
1976	19,900
1977	19,100
1978	19,100
1979	19,100
1980	19,100
1981	4,000
	110,000 mandays

c). Dock construction.

The dock & channel work is to be completed in the 1975 season. All manpower will be located at King Point with a peak number of 39 men.

Total man days on dock and channel work is estimated to be 2400 man days.

SECTION 5. CAPITAL COSTS.

Capital costs of equipment intended for use on the project are shown below. Some items of equipment will be replaced during the life of the project. Costs of replacement units are included. Federal Sales Tax is included in the price shown.

a). Rock operation.

	No.	New Price	Amount
ECM 350 Crawlair drills	2	60,000	$ 120,000
Compressors 1050 cfm	2	68,000	136,000
Dozer Cat D8	1	150,000	150,000
Dozer Cat D7	6	108,000	648,000
Loader Cat 988 6 cu.yd.	3	172,000	516,000
Loader Cat 992 10 cu. yd.	1	306,000	306,000
Rear dump trucks Cat 769 35 Ton	2	175,000	350,000
Haul units, Husky 8	6	170,000	1,020,000
Tracked vehicle TVS 600	2	45,000	90,000
Sleds 50 Ton	30	30,000	900,000
Rock Processing plant	1	208,000	208,000
Generator 135 kw.	1	19,000	19,000
Service equipment			20,000
			4,483,000

b). Concrete operation.

	No.	New Price	Amount
Aggregate plant	1	163,000	$ 163,000
Concrete batch plant	1	97,000	97,000
Concrete ready-mix trucks	3	58,000	174,000
Loader Cat 966	6	95,000	570,000
Dozer Cat D8	1	158,000	158,000
Dozer Cat D7	3	98,000	294,000
Haul trucks 20T.	9	43,000	387,000
Grader Cat 14G	1	93,000	93,000
Galion 125 hydraulic crane	3	81,000	243,000
P & H 50-ton mobile crane	1	220,000	220,000
50-ton tractor RS 797	1	50,000	50,000
Trailer units	6	5,000	30,000
Compressor, welders, generators			108,000
Pickups, buses, ambulance, service trucks			127,000
			$2,714,000

c). Dock construction.

The equipment required for construction of the dock and dredging of the channel is similar to Northern Construction Company equipment already operating in the MacKenzie Delta area. The estimate is based on rental of this equipment.

SECTION 6. CONTRACT ARRANGEMENTS

Many different types of contractual arrangements can be used in the procurement of construction or construction/management services for large-scale projects. Northern Construction Company has performed successfully in the past under many different types.

For the project described in this study a target type reimbursable contract is suggested. This type of contract is discussed below:

TARGET TYPE REIMBURSABLE CONTRACT

This type of contract has been devised for situations in which a firm bid cannot be made in advance of performance, but in which it is desired to give greater profit motivation to the contractor than exists in other cost-type contracts.

In this type of contract the owner and contractor at the outset negotiate an estimated target cost estimate, a target fee, (a minimum and a maximum fee), and a fee adjustment formula. Actual costs of performing the work are reimbursable. After performance of the contract the fee payable to the contractor is determined in accordance with the formula. The formula might typically provide that the contractor would be penalized 25 percent of the actual cost over-runs above the target estimate and rewarded by 25 percent of the under-runs - in both cases, subject to the previous agreed minimum and maximum fee. Such a contract can also have separate incentive provisions for early completion.

The principal advantage of this type of contract is that it permits work to commence early on projects for which the scope and conditions cannot be sufficiently defined to permit establishing firm price tenders.

The "Target Estimate" contract fosters close communication and cooperation between the owner and the contractor. Both parties are attempting to accomplish the same ends, i.e. lowest possible cost within an established time frame.

There still remains, however, a significant incentive on the part of the contractor to perform the work as economically as possible. The contingencies which must be borne by the contractor under firm price tenders are significantly reduced when establishing the Target Estimate.

Northern Construction has performed several multi-million dollar projects on Target Estimate type contracts. It is our experience that contracts of this type have worked to the mutual advantage of both parties and have eliminated to a great extent many of the problems of contract administration inherent in other contractual arrangements.

It is suggested that a Target Estimate type of contract be considered for the performance of the work contemplated in this study.

SECTION 7. CANADIAN LABOUR RELATIONS

PERSONNEL, RECRUITING, TRAINING, LABOUR RELATIONS AND SAFETY

In Canada, the Northern C onstruction Company Division of Morrison-Knudsen Company, Inc. maintains a full time staff responsible for the above-noted personnel functions. Since 1957, this group has been under the direction of Mr. W.H. Maunsell. Since that time, Mr. Maunsell has been responsible for all labour relations concerned with all Canadian contracts. He maintains a continuing good relationship with trade leaders across Canada and has a similar relationship with many government labour offices. T he areas of activity of the Labour Relations Department are summarized as follows:

Negotiation and execution of pre-bid job agreements.
Negotiation of labour agreements in areas where none exist.

Coordination with Canada Manpower and other labour bodies for work force supply.

Close contact with Provincial and Federal Department of Labour Officials.

Labour recruitment of all trade classifications across Canada.

Close working relationship with all levels of labour union officials.

Continuous research regarding available labour markets. Status of labour agreements on a Canada-wide basis.

Development of labour escalation formulas for long term contracts.

Outlined below is a general breakdown of the operations in these areas over the past years.

PERSONNEL, RECRUITING, TRAINING.

Northern's personnel staff has carried out extensive recruiting, training and development programs throughout Canada.

In the last 1950's during the construction of the Distant Early Warning Radar Network built in the Canadian Arctic, some 2500 workers were recruited during each year of the three-year program. Recruiting was carried out throughout Canada; however, every effort was made to recruit Eskimos and Northern Canadian Indians. An excellent program of training was established by Northern in conjunction with the Northern Affairs Department of the Canadian Government. Many natives learned construction skills and developed into good tradesmen.

Extensive recruiting programs were carried out in Northern Manitoba in 1962 and 1969 among the Indians of the area. A number of these workers became experts in drilling and blasting operations. In all areas of Canada, programs in recruiting have been established.

The staff over the years has carried out extensive studies in regard to maintaining work forces in remote areas and cold climates. Special labour contracts have been established to create an incentive for workmen to remain in remote areas. Combined with these incentives, Northern prides itself in offering the workers in these areas superior living and board conditions, combined with first-class recreation arrangements necessary to stabilize the work force. Good relations are maintained with all Canadian camp catering contractors.

Northern's staff has been active in associations concerned with training and development. The Director of Personnel and Labour Relations is a member of the following:

(a) A Trustee of the Operating Engineers Joint Apprenticeship Board of B.C. This Board is a joint union-management group dedicated to the training and upgrading of Heavy Duty Mechanics, Welders and Heavy Equipment Operators.

(b) A member of the Educational and Safety Committee of the Amalgamated construction Association of B.C. This group is responsible for establishing specialized training courses for Supervisors and Foremen in the construction industry.

(c) A member of the Advisory Board to Douglas College, a community college located in the Lower Mainland of B.C. The Advisory Board has been responsible for the development and operation of a new type of Construction Management Course.

The Director of Personnel has, over the years, developed a close relationship with officers of the various Government bodies across Canada involved in recruiting, training, etc. These include Canada Manpower local and regional officers and various apprenticeship branches of the Provincial Governments of Canada.

LABOUR RELATIONS

Northern's Director of Personnel and Labour Relations has been responsible for the negotiation and administration of union contracts in every area of Canada. The contracts have involved the AFL-CIO Building Trades; Mining operations under the United Steelworkers of America; and local plant operation covering manufacturing of plastic and steel products.

Some of the large type contracts were:

(a) Construction agreements covering 2500 workers employed on the construction of the Distant Early Warning Radar outposts in the Canadian Arctic. Eleven separate trade agreements were established to cover operation on the twenty-four remote locations. An excellant relationship was maintained with these unions over the life of the job and no work stoppages took place, and there were very few day-to-day problems.

(b) During the construction of the Alcan Project in British Columbia, both Northern and the parent company, Morrison-Knudsen Company, Inc., negotiated agreements with the B.C. construction trades and relationship with the unions was excellent.

(c) Agreements covering remote areas have been negotiated to work in Northern Manitoba, Northern Ontario and Quebec. Special clauses were included in these agreements to ensure that workmen were properly looked after in regard to climatic and isolated conditions.

(d) Negotiation of union agreement with the United Steel Workers of America covering mining operations in Northern Manitoba.

Northern's Director of Personnel and Labour Relations is involved in various association work across Canada such as:

(a) Senior member of the negotiating committee of the Construction Labour Relations Association of British Columbia. C.L.R.A. negotiates contracts for over 600 construction and supply firms in B.C.

(b) Executive Member of the Churchill Falls Power Development Contractors Association. This Association has been responsible for the negotiation and administration of the union agreements covering over 4000 workmen employed in the Northern part of Labrador. The Labrador Power Project involves an expenditure of approximately one billion dollars.

(c) Involved in labour relations with the Canadian Construction Association.

(d) A member of the Labour Relations Committee of the Mechanical Contractors Association of B.C. This Committee deals exclusively with the "metal trades", i.e. Pipefitters, Boilermakers, Ironworkers, Machinists and Millwrights. The prime purpose of the Committee is to head off strife and generally guide employers in their dealings with these problem unions.

(e) During the early part of 1971 the Director of Labour Relations has been involved in the establishment of a good working relationship with the unions in the Province of Quebec. These unions are involved in the construction of the extension to the Quebec Cartier Mining Company Railway.

(f) The Company has maintained excellent labour relations with the various construction locals across Canada. In addition, and excellent relationship has been maintained between the company and the International officers located throughout Canada and the U.S.

In all the areas that Northern has worked, a name file has been kept of the workers from that area and they are graded for their proficiency. Records have been compiled on existing jobs that indicate the length of time that a worker can be expected to stay on the job between trips to the "outside". Other records give an indication of the relative productivity of a man in remote areas as compared to those in the Southern portions of Canada, particularly in the fields of formwork, concrete work and heavy duty mechanics. The evaluation of this information is a strong contributing factor in the pricing of construction work in the various parts of Canada.

SAFETY.

The Company carries out an extensive program of Accident Prevention and Safety throughout its operations. The Company has been recognized as a leader in accident prevention across Canada, having won awards in various parts of Canada.

In 1970 the Company received the greatest number of awards presented to any contracting company operating in Newfoundland. The awards were in recognition of the excellent safety program carried out by Northern on the vast Churchill Falls Power Development in Labrador, Newfoundland.

NORTHERN CONSTRUCTION COMPANY
DIVISION OF MORRISON-KNUDSEN COMPANY, INC.

SECTION 8. RELATED EXPERIENCE

I N T R O D U C T I O N

Northern Construction Company has been engaged in business in Canada for 70 years. Formed in Winnipeg in 1904 by Andrew Robert Mann and Archibald Cameron McKenzie, the Company has successfully completed a wide range of construction projects in Canada and in the United States.

In 1911, a partnership was formed with the J.W. Stewart Construction Company, and in 1931 the partnership was incorporated under the name of Northern Construction Company and J.W. Stewart Limited Company headquarters remained in Winnipeg until 1924 when it was moved to Montreal.

Headquarters were transferred to 1304 Hornby Street, Vancouver in 1949 and have been located at the same address since that date. In 1945, Northern Construction Company and J.W. Stewart became an associate of Morrison-Knudsen Company, Inc. of Boise, Idaho, and in 1969, became a major operating division of M-K.

With 70 years of continuous experience, Northern Construction Company has gained experience that is equalled by few contractors. Company personnel have held responsibilities for many complex engineering and construction projects, and as a part of the Morrison-Knudsen organization, they have participated in virtually every possible kind of construction project not only in Canada but throughout the world.

Northern Construction Company offers a single source of responsibility for all phases of a project and comprises a company that is capable of handling all major assignments. This total capability is available under a concept which may include any or all of the following services:

- Planning
- Cost Estimating
- Feasibility Studies
- Procurement
- Engineering
- Construction Management

CONSTRUCTION EXPERIENCE IN CANADA

During the 70 years Northern Construction Company has been in the construction business, projects have been completed for both private industry and governmental agencies. The value of these projects ranges from a few thousand dollars to several million dollars. Much of this work has been performed under difficult conditions (weather, terrain, etc.) and many of the projects have been performed when time and money have been critical considerations. Northern Construction, in performing under these conditions, has gained a reputation for completing work on or ahead of schedule and within the budgeted amounts.

As a result of this experience, Northern has developed a highly effective cost control program. Development of this program has been necessary for internal job control on highly competitive and relatively simple unit cost projects. An owner is entitled to completion of the project within the time limit, within the intent of the technical specifications concerned, and most importantly, within the cost estimate upon which the owner originally based his decision to proceed with the work.

Planning and scheduling, procurement, personnel, safety and equipment are other important considerations which contribute to the successful completion of any project. All of these factors must be considered in the development of a project plan. Northern has extensive experience in all of these areas and this experience, when applied to the monitoring of a project plan, assures that the

best techniques are effectively scheduled and controlled. Available manpower and materials are utilized to the fullest extent and costly delays and other elements which add to the cost of the work are minimized.

Railroads, aqueducts, power developments, bridges and commercial facilities were among the projects completed during the early years of the Company's history. The value of all projects completed during the first 40 years of operations was approximately $500-million.

Northern has constructed more than 8,000 miles of railroad and has recently completed the construction of 90 miles of new railroad in Quebec. The new railroad, which will transport iron ore, was completed in 1973 and required 10-million cubic yards of excavation and the placement of 2-million cubic yards of fill and ballast plus the construction of four bridges and 90 miles of communication lines.

For over 30 years Northern has been involved in the construction of tunnels, shafts and other underground construction operations including mining developments and powerhouses. The Vancouver-Burnaby railway tunnel was completed in 1968 and is 10,760 feet in length. Other major tunnel projects include North Arm Interceptor Sewer Tunnel in Vancouver, the Fernie Coal Conveyor Tunnel and the Portage Mountain Underground Powerhouse access tunnels.

During the period from January 1955 to June 1957, Northern Construction Company constructed radar bases and airfields for the western section of the Distant Early Warning Line (DEW Line) on the shores of the Arctic Ocean for the U.S. Air Force. This massive project was constructed in an uninhabited area under the most difficult climatic conditions. Logistics alone required a major organization for at its peak, 2,800 men were involved.

ARCTIC CIRCLE DREDGING

The Northern Construction Division of M-K is currently under contract to supply special marine equipment and perform dredging operations in the Beaufort Sea near the mouth of the Mackenzie River. The purpose of this project is to create islands which are intended for use as stable year-around platforms for off-shore oil exploration drilling and later as production sites. Work is performed during the short 80 days when the area is ice free.

A prior project, completed in 1971, by Northern involved the removal of a navigational bottleneck on the Mackenzie River just 75 miles south of the Arctic Circle. Rock and shale at this point restricted a three-mile length of the navigable channel to a width of 125 feet. Northern excavated the channel to a minimum depth of eight feet and widths up to 600 feet.

CHURCHILL FALLS POWER DEVELOPMENT

The Churchill Falls Power Development is scheduled for final completion in 1975. Ultimately, with the world's largest underground powerhouse, the development will generate 5,225,000 kilowatts of electrical energy from water impounded high on the Labrador Plateau.

As a part of the overall effort, the Northern Construction Company Division of Morrison-Knudsen completed overall construction in 1971 of a massive intake channel and nine dikes which total 5.4 miles in length. The effort required more than 2,000,000 cubic yards of excavation and 5,600,000 cubic yards of zoned embankment fill.

Northern's present operations involve concrete placement and architectural work within the underground powerhouse, and construction of foundations, roads and service lines for 45 additional houses at the permanent townsite of Churchill Falls.

Scheduled for completion in 1974, these portions of the project require more than 53,000 cubic yards of concrete, 30,000 yards of which must be pumped into place, along with 2,225,000 pounds of reinforcing steel. Additional powerhouse activities scheduled for completion in 1975 include installation of hand rails, doors, floor tile, wall panels, and all painting and other finish work.

NORTHERN CONSTRUCTION COMPANY
DIVISION OF MORRISON-KNUDSEN COMPANY, INC.

PIPE LAKE OPENPIT NICKEL MINE DEVELOPMENT
at
THOMPSON, MANITOBA

Working under adverse conditions in this remote location, Northern Construction Company performed all phases of this developmental construction program that will increase nickel production still higher than the current annual output of more than 130 million pounds.

This construction program involved the excavation of 5,800,000 cubic yards of rock overburden in a pit 2,100 feet long, 1,600 feet wide and 160 feet deep to expose the main ore body; as well as a mine shaft headframe structure for underground mining, ore-handling and storage bin facilities, plus office, auxiliary and mine service buildings.

NORTHERN CONSTRUCTION COMPANY
DIVISION OF MORRISON-KNUDSEN COMPANY, INC.

FRASER RIVER BRIDGE PIERS

Nineteen concrete piers were completed in 1971 for a new highway bridge across the Fraser River at Mission City, British Columbia. Bridge abutments and earthfill approaches to the abutments were included in the project. A minimum of 70-feet of vertical clearance for navigation on the river is provided by the new bridge.

Nine of the piers are located in the river and the rest are land piers. A total of 29,000 lineal feet of timber piles, driven to depths of 35 feet, provide underpinning for the land piers, while a total of 647 steel H-piles, driven as deep as 155 feet, support the river piers.

H-piles were driven into the river bottom after a "glory hole" had been excavated at each pier site and the material (a total of 240,000 cubic yards) carried away by scow for placement in the earthfill approaches to the bridge abutments. Steel sheet piling was used to form a 40 x 60-foot cofferdam enclosure for each pier, followed by placement of instrusion gravel, then grout, to form a foundation slab. Concrete for the elliptic shaped shaft of each pier was then placed, followed by the segments of the pier.

NORTHERN CONSTRUCTION COMPANY
DIVISION OF MORRISON-KNUDSEN COMPANY, INC.

PORTAGE MOUNTAIN PROJECT

One of the most complex hydroelectric projects in the world was completed in 1969 by a Northern Construction Company sponsored joint-venture effort. Located near the town of Hudson Hope, approximately 500 air miles north of Vancouver, the power plant is located 500 feet underground. An earthfill dam, impounding 62,000,000 acre feet of water, serves the power plant. Designed for an ultimate capacity of 2,270,000 kilowatts, the power plant was completed in four years.

Underground appurtenances include: two tailrace manifolds, each 330 feet long and 110 feet high; two railrace tunnels each 70 feet high and 53 feet wide; and 10 penstock tunnels varying from 770 to 900 feet in length. The subterranean power house is a chamber three city blocks long and as high as a 17-storey building.

To complete the Portage Mountain Project more than 1,000,000 cubic yards of underground excavation and 2,555,000 cubic yards of surface excavation were required. More than 300,000 cubic yards of concrete were placed underground and 125,000 cubic yards of concrete were used above ground. Over 37,000,000 pounds of reinforcing steel, 750,000 lineal feet or rock bolts and 1,500,000 pounds of miscellaneous steel were also used.

GRAND RAPIDS GENERATING STATION

Grand Rapids Generating Station is located 250 miles north of Winnipeg, Manitoba and was constructed for the Manitoba Hydro-Electric Board by a Northern Construction Company sponsored joint venture.

The project encompassed a total of 16 miles of earthfill dikes and three principal concrete structures - an intake structure, a 330 foot-long powerhouse and a four-gated spilway.

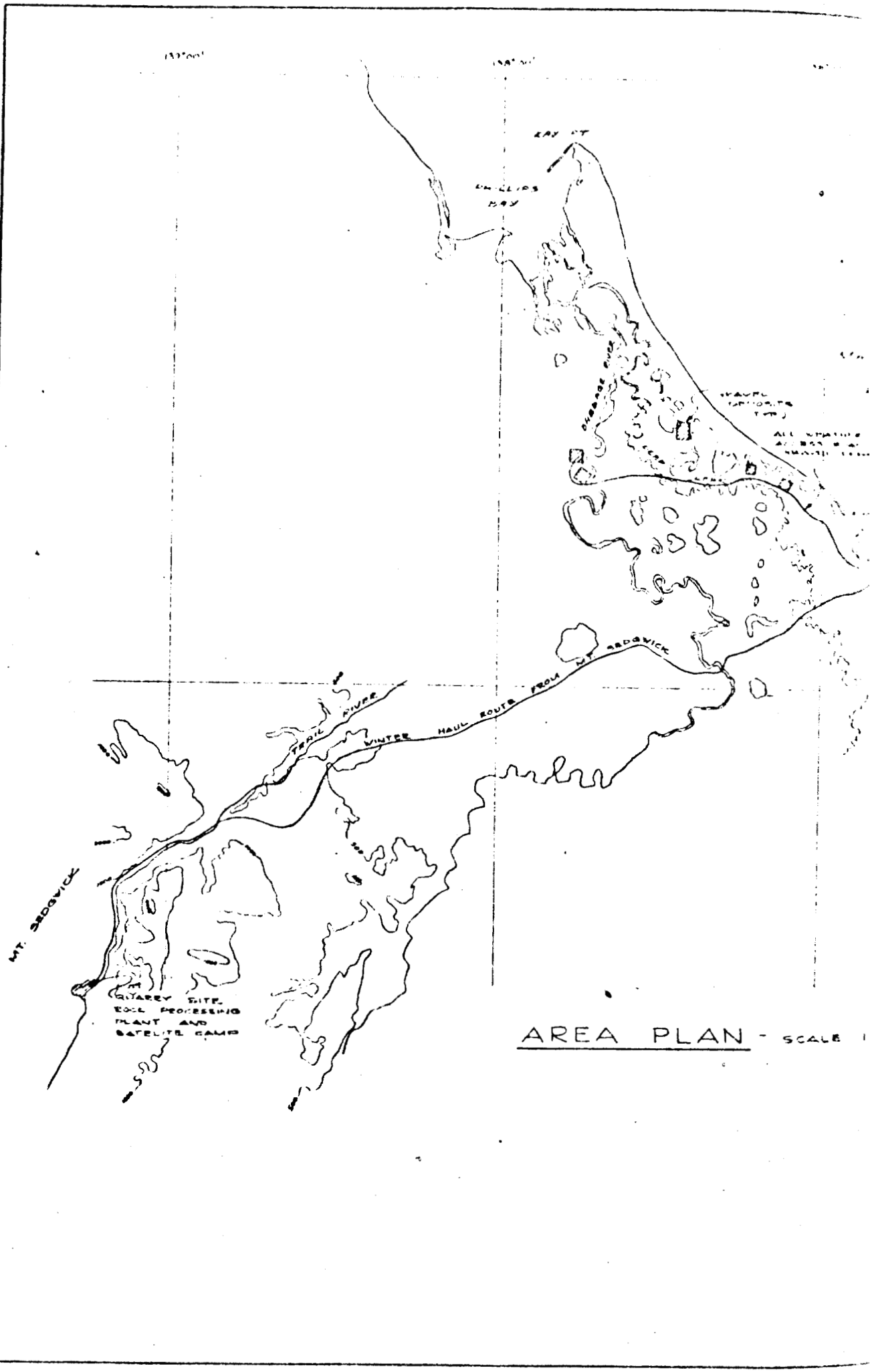
With an initial output of 330,000 kilowatts, the project required a total of 11.7-million cubic yards of earth and rock excavation and 7.3-million cubic yards of fill. Over 350,000 cubic yards of concrete were used, more than half of which were required for the 125-foot-high by 290-foot-long intake structure. The spilway is 410 feet long, 70 feet high and is capable of discharging water volumes up to 140,000 cubic feet per second.

RIPPLE ROCK

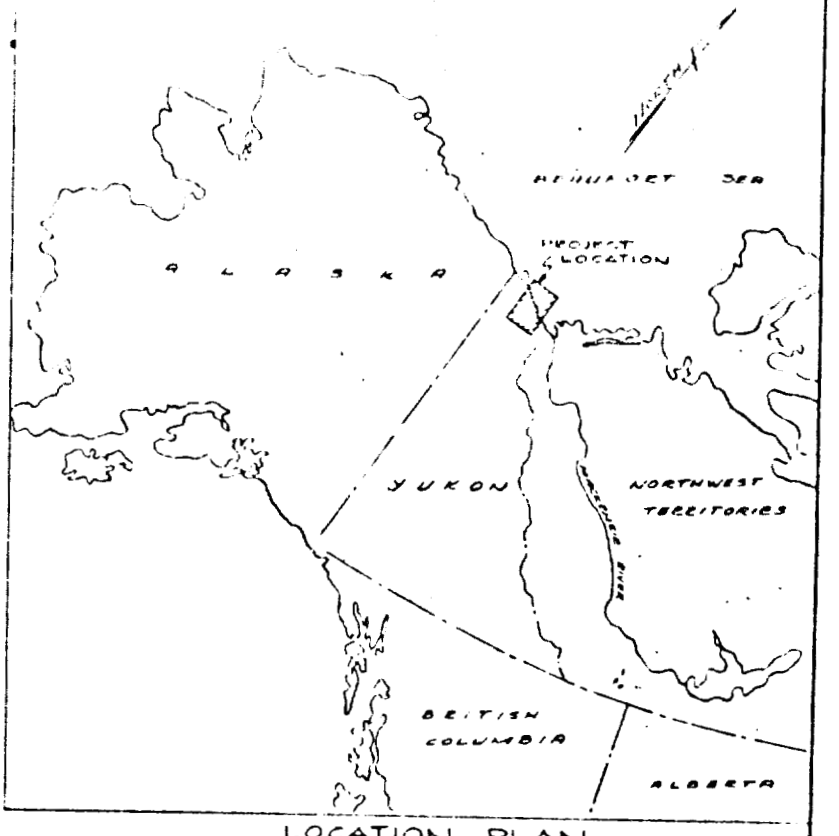
A total of 2,756,324 pounds of explosives were used to remove the underwater peaks of Ripple Rock which was located 100 miles northwest of Vancouver, British Columbia in the Inside Passage sea-lane.

The peaks of Ripple Rock were within nine feet of the surface of the water and had ripped the bottom out of scores of ships and caused at least 114 deaths in addition to untold amounts of delays to vessels forced to wait for slack tides before passing through the treacherous currents around the rocks. The enormous explosion lowered the peaks to 47 feet below the surface of the water.

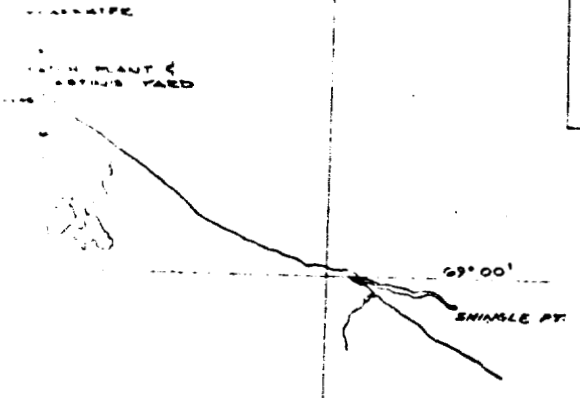
During the 30 months preceeding the blast a 572-foot-deep shaft was sunk on a nearby island and a one-half-mile long horizontal tunnel was driven under the channel to reach the underwater peaks. Vertical raises were bored upward from the tunnel branches into the peaks which were then honeycombed with a total of nearly 3,000 feet of coyote holes. These holes became the chambers into which thousands of metal cannisters of the explosives were planted.

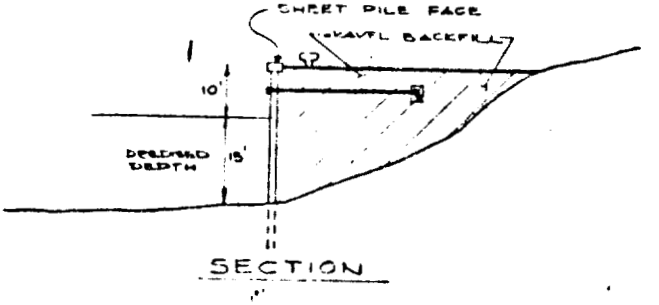


AREA PLAN - SCALE

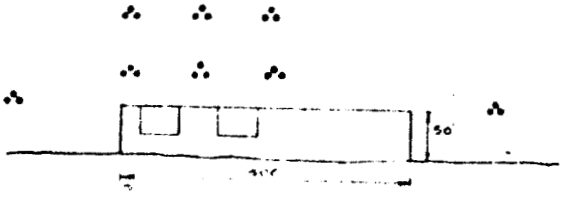


LOCATION PLAN





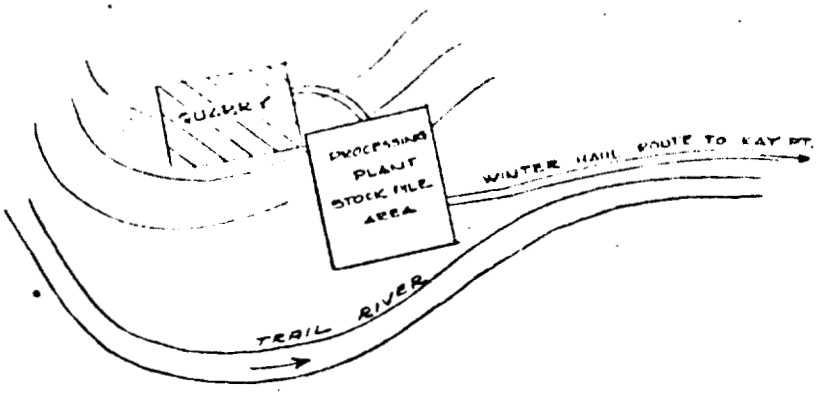
SECTION



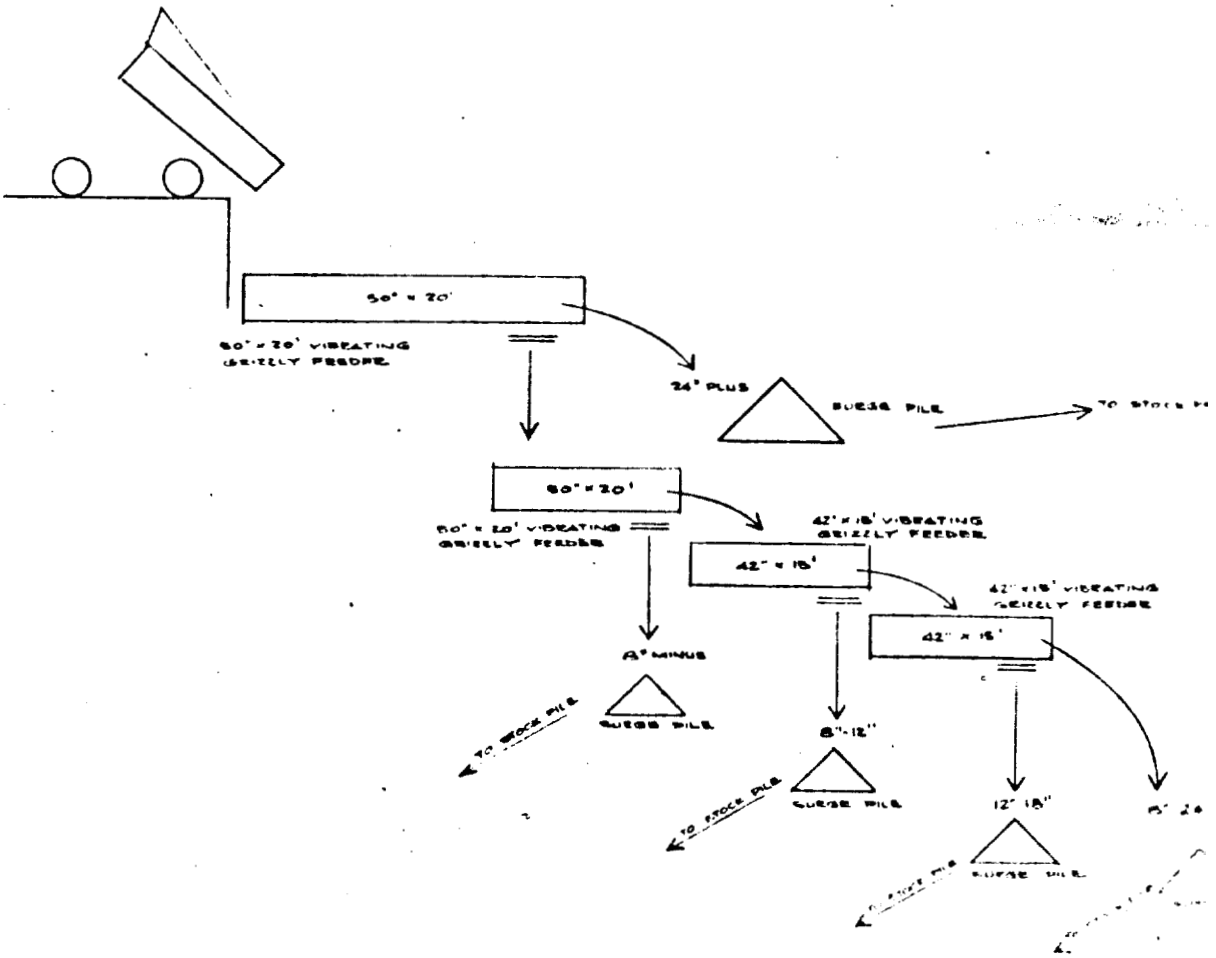
PLAN of DOCK

AREA PLAN AND DOCK LAYOUT

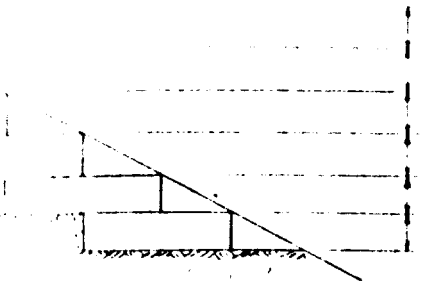
NORTHERN CONSTRUCTION COMPANY



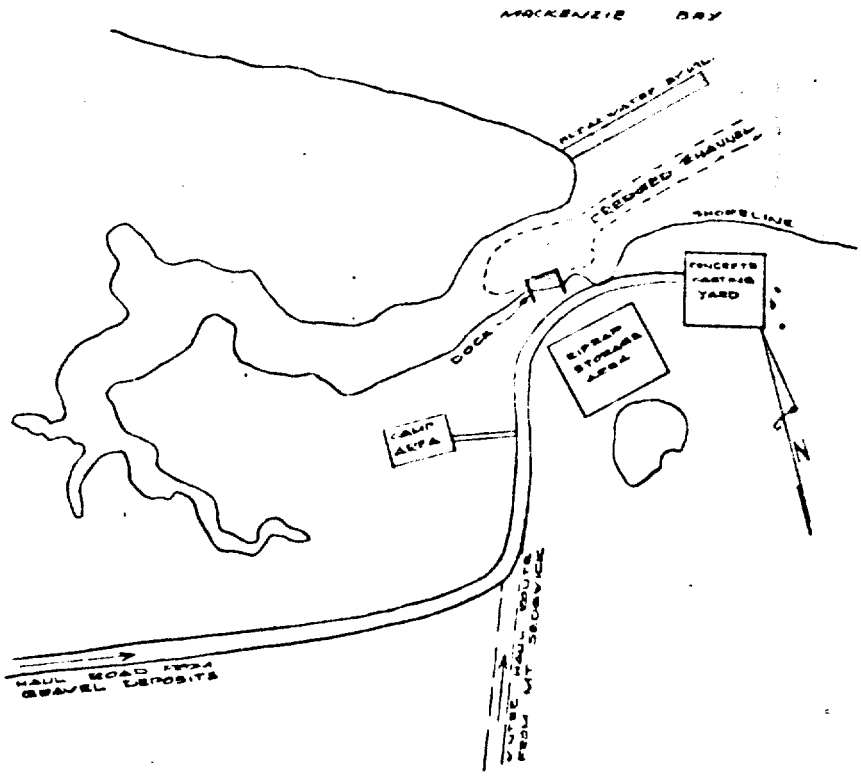
QUARRY LAYOUT PLAN



ROCK PROCESSING SCHEMATIC



QUARRY SECTION



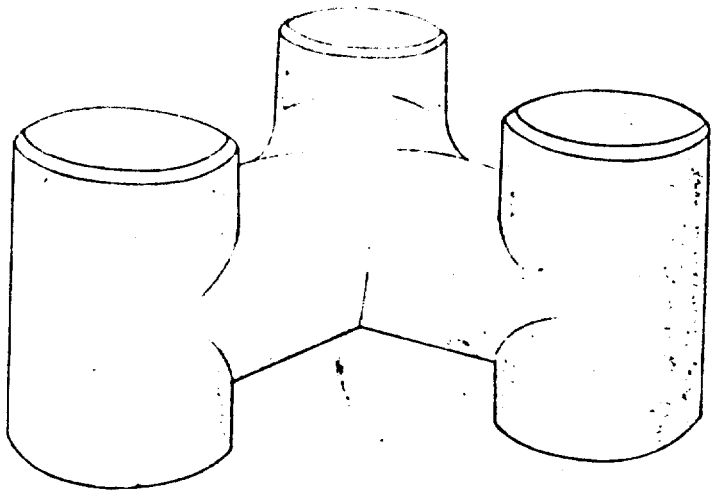
SHORE PROTECTION MATERIALS FOR OFFSHORE ISLAND

RIPRAP OPERATIONS

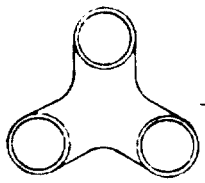
SCALE	DRAWN	APPROVED	DATED	CONTRACT NO.	DRAWING NO.
N.T.S.		E.E.S.	OCT/74		SD-A-1

NORTHERN CONSTRUCTION COMPANY

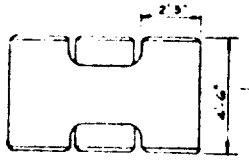
DIVISION OF BRAN-DON ENTERPRISES COMPANY LTD.



CONCRETE MODULE - 5·3 TONS



PLAN

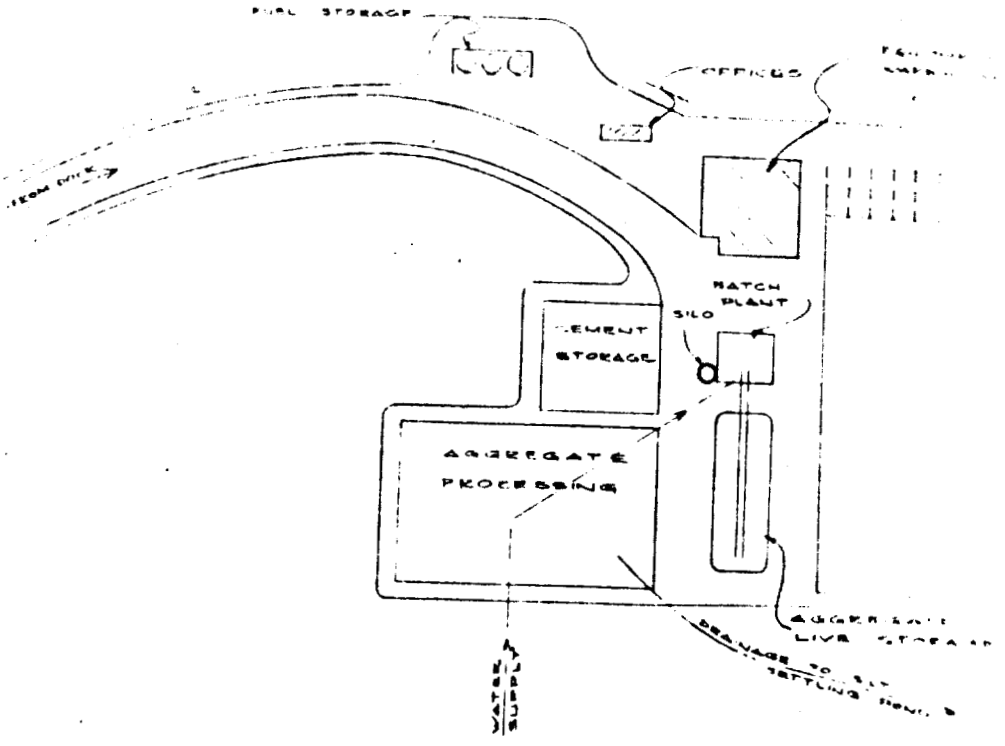


ELEVATION

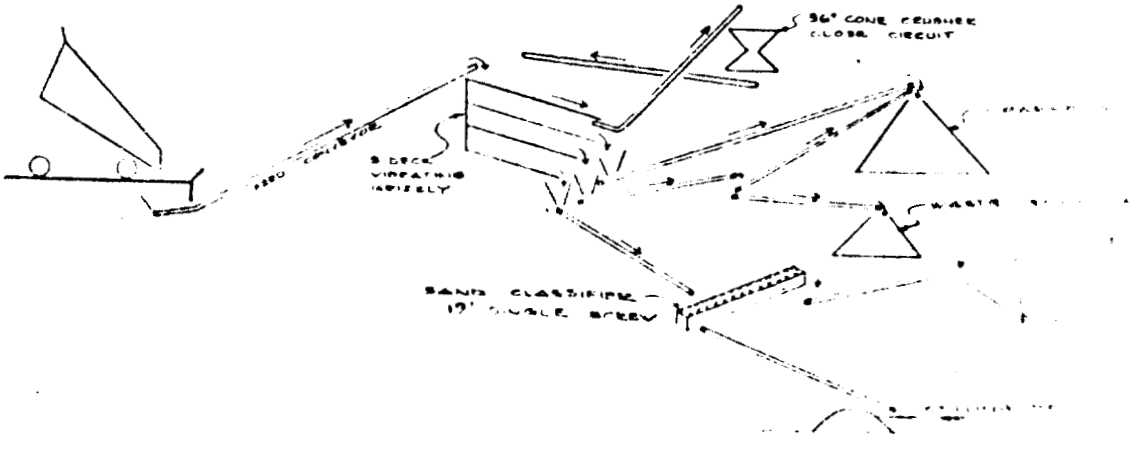
CASTING AREA

SCALE	DRAWN	APPROVED	ISSUED	CONTRACT NO.	DRAWING NO.
AS SHOWN					

NORTHERN CONSTRUCTION COMPANY



CONCRETE MODULE



AGGREGATE PROCESSING

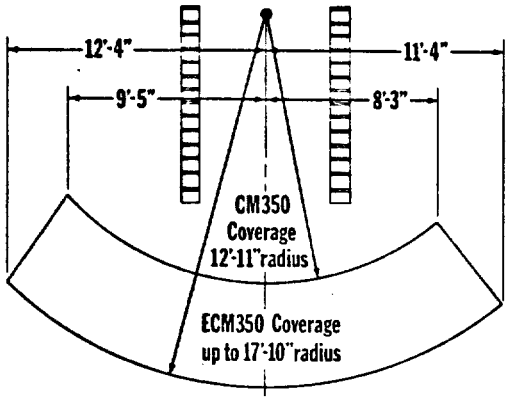
SECTION 10. EQUIPMENT BROCHURES.

Extracts from brochures of the following equipment items are included in this section:

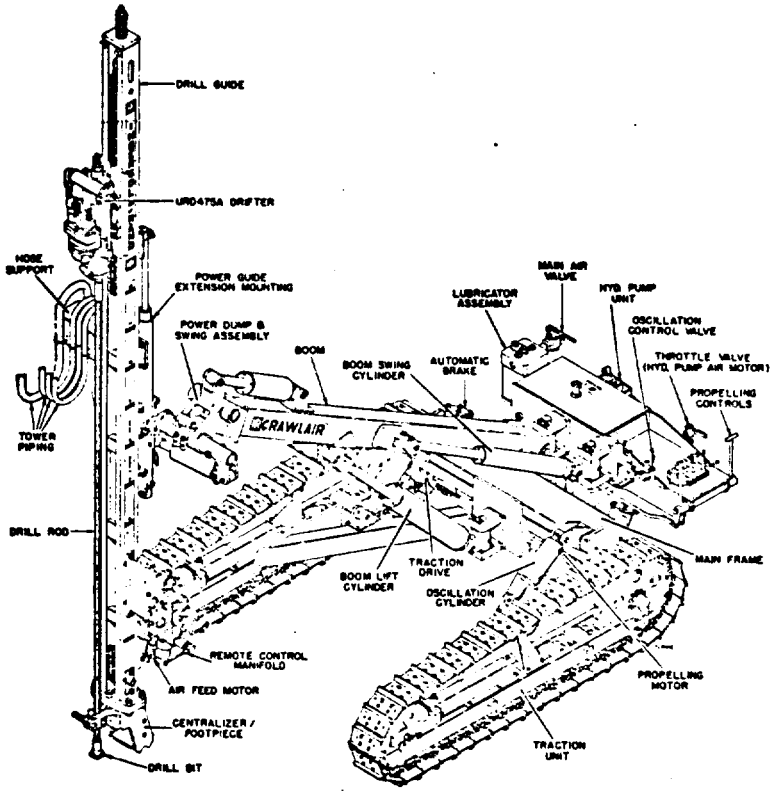
Rock drill	ECM 350
Compressor	DXL 1050
Vibrating feeder	Pioneer
Sled	Otaco "Deep Freeze"
Haul units	Husky 8
Tracked vehicle	TVS 600
Crushing & Screening plant	Telesmith 36S-G-CC
Concrete mixer	Koehring Johnson 224
Mobile crane	P & H 50 Ton
Mobile crane	Galion 125
Mixer trucks	Challenger 8 cu.yd.

CM/ECM 350 Crawlair

SPECIFICATIONS



COVERAGE PATTERN - CM and ECM350



	ECM 350		CM 350	
	English	Metric	English	Metric
Net Weight (Including URD475A Drill)	12,900 lb.	5851 kg	12,000 lb.	5443 kg
Overall Length (Less Boom & Drill Guide)	11 ft.-11½ in.	3645 mm	11 ft.-11½ in.	3645 mm
Overall Length (Boom Raised 45°, Guide Vertical including URD475A Drill)	13 ft.-11½ in.	4255 mm	13 ft.-11½ in.	4255 mm
Overall Length (Boom Raised 45°, Guide Ext. Mtg. Vertical, less Guide)	12 ft.-4 in.	3759 mm	12 ft.-4 in.	3759 mm
Overall Length (Boom & Guide Horizontal, Boom Extended, Guide Ext. Mtg. Ext., 12 ft. Steel Change)	29 ft.-8 in.	9042 mm		
Overall Length (Boom & Guide Horizontal, Guide Ext. Mtg. Ext., 12 ft. Steel Change)			24 ft.-8 in.	7518 mm
Overall Length (Track only)	9 ft.-5 in.	2870 mm	9 ft.-5 in.	2870 mm
Overall Width (Track & Complete Mtg.)	8 ft.-0 in.	2438 mm	8 ft.-0 in.	2438 mm
Width of Grousers	10 in.	254 mm	10 in.	254 mm
Drill Travel (12 ft. Steel Change)	14 ft.-3½ in.	4356 mm	14 ft.-3½ in.	4356 mm
*Minimum Height (Boom Lowered below Base Height, including Drill)	4 ft.-1½ in.	1257 mm	4 ft.-1½ in.	1257 mm
*Overall Height (Guide Vertical)	18 ft.-10½ in.	5753 mm	18 ft.-10½ in.	5753 mm
*Overall Height (Boom Raised 45°—Guide Horiz. URD475A Drill)	13 ft.-11½ in.	4255 mm	13 ft.-11½ in.	4255 mm
*Maximum Drilling Height (Centerline Drill, Boom 45°, Guide Horizontal, Boom Extended)	16 ft.-11 in.	5156 mm		
*Maximum Drilling Height (Centerline Drill, Boom 45°, Guide Horizontal)			13 ft.-1½ in.	4001 mm
*Ground Clearance	8 in.	203 mm	8 in.	203 mm
*Tow Hitch Height (Centerline)	1 ft.-9¾ in.	552 mm	1 ft.-9¾ in.	552 mm
Max. Horizontal Swing of Boom: Right	40°		40°	
Left	40°		40°	
Max. Vertical Movement of Boom: Above	45°		45°	
Below	15°		15°	
Max. Guide Dump	180°		180°	
Max. Guide Swing: Right	35°		35°	
Left	50°		50°	
Vertical Drill Coverage (Boom Closed):				
Left of Left Track	4 ft.-3 in.	1295 mm		
Right of Right Track	5 ft.-5 in.	1651 mm		
Total Coverage	17 ft.-7 in.	5539 mm		
Vertical Drill Coverage (Boom Extended):				
Left of Left Track	7 ft.-4 in.	2235 mm		
Right of Right Track	8 ft.-4 in.	2540 mm		
Total Coverage	23 ft.-8 in.	7213 mm		
Vertical Drill Coverage (Boom Closed):				
Left of Left Track			4 ft.-3 in.	1295 mm
Right of Right Track			5 ft.-5 in.	1651 mm
Total Coverage			17 ft.-7 in.	5539 mm

*NOTE:—Dimensions taken from tip of grouser—Crawlair on hard surface.

SUPER SPIRO-FLO XL standard equipment and specifications

Oil-cooled screw air end with I-R "swept-back" rotor design produces 15% more air per gallon of fuel than ordinary compressors, and is rated at 125 psig for better performance by air-powered equipment.

Double-Safety oil system (patented) employs both discharge pressure and a positive-displacement pump, to assure adequate oil flow to compressor under all conditions.

Extra-fine oil filtration in compressor system employs full-flow 25-micron replaceable-cartridge filters. In addition, all oil for bearings goes through 10-micron filters, meeting the most stringent requirements of any bearing manufacturer. (A 10-micron particle is smaller than some bacteria!) Less wear, longer life.

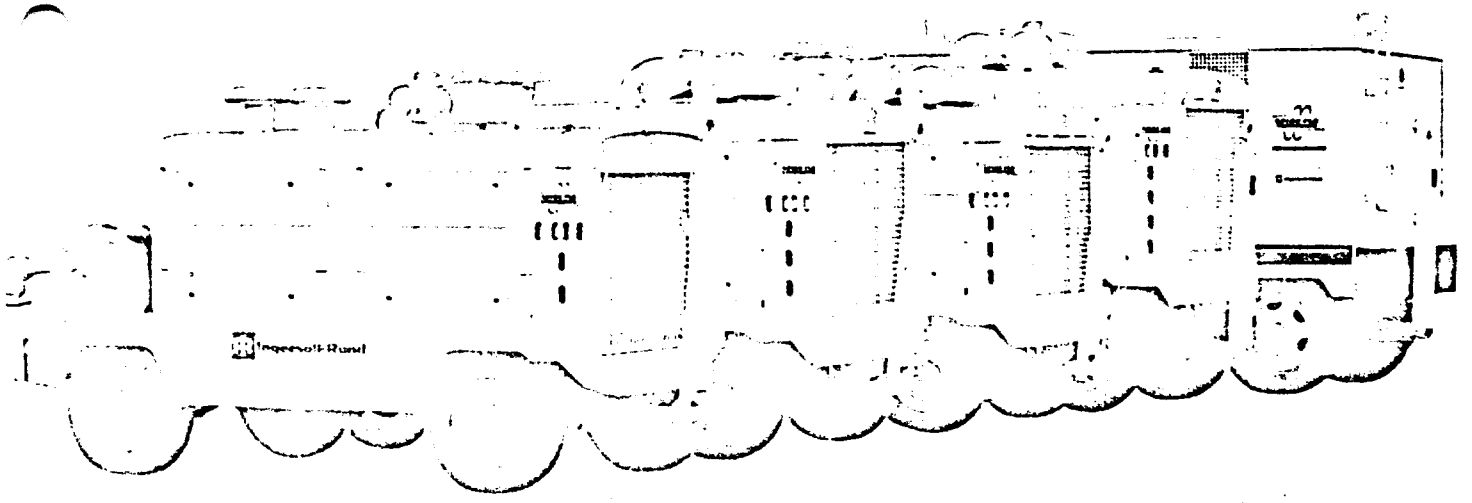
Two-stage separation system removes and recycles oil with minimum carry-over in the discharge air.

Air-Glide® regulation controls compressor capacity smoothly without steps, from full load to zero load in response to demand.

Two-stage dry centrifugal filters for engine and compressor inlet air have replaceable elements, and are easily serviced through rear doors.

(Continued on page 10)

Super Spiro-Flo	DXL-750	DXL-900
ENGINE	Detroit Diesel 6V-71N	Detroit Diesel 8V-71N
Displacement	426 cu. in. (7 liters)	568 cu. in. (9.3 liters)
(No. cyls.) bore x stroke	(6) 4¼ x 5"	(8) 4¼ x 5"
Rated speed	2100 rpm	2100 rpm
Avail. bhp on 70% duty curve	228 bhp	280 bhp
Fuel injectors	65 cubic mm.	60 cubic mm.
COMPRESSOR		
Rated operating pressure	125 psig (8.8 kg./cm.²)	125 psig (8.8 kg./cm.²)
Actual free-air delivery	750 cfm (21.25 m³/min.)	900 cfm (25.5 m³/min.)
Operating ambient temperature range	—20 to 125°F (—29 to 52°C)	—20 to 125°F (—29 to 52°C)
Oil flow at 125 psi rating	48 gpm (182 liters/min.)	50 gpm (189 liters/min.)
Maximum operating altitude @ 100 psi	13,500 ft. (4112 m.)	16,000 ft. (4877 m.)
Maximum operating altitude @ 125 psi	9000 ft. (2743 m.)	10,000 ft. (3048 m.)
UNIT WITH RUNNING GEAR		
Net weight including lube oil	9025 lbs. (4094 kg.)	9880 lbs. (4480 kg.)
Gross weight incl. fuel, water	9887 lbs. (4482 kg.)	11,033 lbs. (5005 kg.)
Overall length, drawbar folded up	13' 2" (400 cm.)	13' 1" (398 cm.)
Overall length, drawbar extended	19' 4" (589 cm.)	19' 1" (582 cm.)
Overall width	6' 3" (191 cm.)	6' 8" (204 cm.)
Overall height incl. mufflers	7' 3" (220 cm.)	7' 11" (241 cm.)
Wheelbase	7' 8" (234 cm.)	7' 4" (224 cm.)
Track width	5' 4" (163 cm.)	5' 6" (168 cm.)
ning radius	13' 10" (427 cm.)	15' 0" (457 cm.)
UNIT LESS RUNNING GEAR		
Net weight including lube oil	8345 lbs. (3785 kg.)	9110 lbs. (4132 kg.)
Gross weight incl. fuel, water	9207 lbs. (4176 kg.)	10,263 lbs. (4655 kg.)
Overall length	12' 3" (372 cm.)	12' 7" (382 cm.)
Overall width	6' 3" (191 cm.)	6' 8" (204 cm.)
Overall height incl. mufflers	5' 11" (180 cm.)	6' 10" (208 cm.)

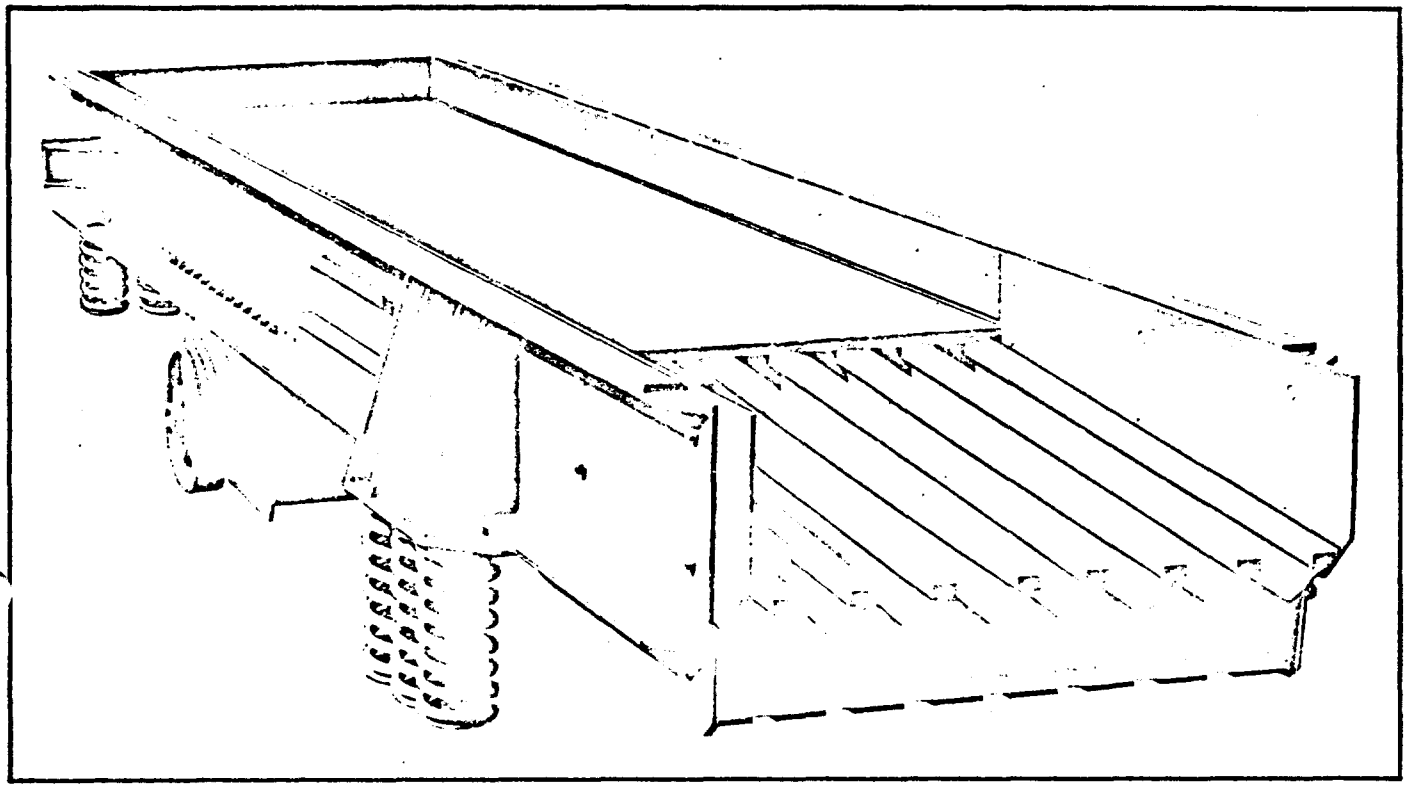


The Super Spiro-Flo 125-psi line: DXL-750, DXL-900, DXL-1050, DXL-1200; and on the right is one of their *Whisperized*© counterparts, a DXL-1200-S.

DXL-1050	DXL-1200	
Cummins V-903	Detroit Diesel 12V-71N	Caterpillar D343-TA
903 cu. in. (14.8 liters)	852 cu. in. (14 liters)	893 cu. in. (14.6 liters)
(8) 5½ x 4¾"	(12) 4¼ x 5"	(6) 5.4 x 6½"
2600 rpm	2100 rpm	2100 rpm
307 bhp	420 bhp	390 bhp
(integral)	60 cubic mm.	(integral)
125 psig (8.8 kg./cm.²)	125 psig (8.8 kg./cm.²)	125 psig (8.8 kg./cm.²)
1050 cfm (29.7 m³/min.)	1200 cfm (34 m³/min.)	1200 cfm (34 m³/min.)
—20 to 125°F (—29 to 52°C)	—20 to 125°F (—29 to 52°C)	—20 to 125°F (—29 to 52°C)
56 gpm (212 liters/min.)	62 gpm (235 liters/min.)	62 gpm (235 liters/min.)
5000 ft. (1525 m.)	16,000 ft. (4877 m.)	16,000 ft. (4877 m.)
1000 ft. (304 m.)	12,000 ft. (3658 m.)	12,000 ft. (3568 m.)
9984 lbs. (4529 kg.)	13,550 lbs. (6150 kg.)	14,150 lbs. (6418 kg.)
10,950 lbs. (4965 kg.)	15,157 lbs. (6875 kg.)	15,757 lbs. (7147 kg.)
13' 1" (398 cm.)	14' 5" (440 cm.)	14' 5" (440 cm.)
19' 1" (582 cm.)	19' 3" (586 cm.)	19' 3" (586 cm.)
6' 8" (204 cm.)	7' 3" (220 cm.)	7' 3" (220 cm.)
7' 11" (241 cm.)	8' 10" (269 cm.)	8' 10" (269 cm.)
7' 4" (224 cm.)	8' 11" (271 cm.)	8' 11" (271 cm.)
5' 6" (168 cm.)	5' 8" (173 cm.)	5' 8" (173 cm.)
5' 0" (457 cm.)	16' 0" (488 cm.)	16' 0" (488 cm.)
9214 lbs. (4180 kg.)	12,280 lbs. (5560 kg.)	12,880 lbs. (5842 kg.)
10,180 lbs. (4618 kg.)	13,888 lbs. (6300 kg.)	14,480 lbs. (6568 kg.)
12' 7" (382 cm.)	13' 11" (424 cm.)	13' 11" (424 cm.)
6' 8" (204 cm.)	7' 3" (220 cm.)	7' 3" (220 cm.)
6' 10" (208 cm.)	7' 4" (222 cm.)	7' 4" (222 cm.)

Pioneer®
Vibrating Feeder

VIBRATING FEEDER FORM 715-B



FEATURES:

- LOW OPERATING COST
- COMBINES FEEDER AND GRIZZLY OPERATIONS
- FINES ARE BY-PASSED
- FEWER WEARING PARTS TO SERVICE
- COMPONENTS INTERCHANGEABLE BETWEEN MODELS
- BAR SPACING ADJUSTABLE FOR GREATER CONTROL OF FINES DUMPING

A rough, rugged pair has been added to the Pioneer line – two sizes of Pioneer Vibrating Feeder-Scalpers, which come equipped with plenty of muscle to handle your toughest feeder problems.

By combining feeders and grizzlies into single efficient units, Pioneer offers you machines with fewer wearing parts (less maintenance), requiring less power. Better yet, Pioneer Vibrating Feeders cost less than buying feeders and grizzlies separately.

The units' vibrating action feeds the crushers, shaking loose fines at the same time. This means better, smoother controlled rates of feed, to help prevent jamming. Loosened fines drop to the bottom of the load and are by-passed through the grizzly. Result: Your crusher capacity is boosted . . . so are your profits!

Grizzly bars are tapered to prevent fines from riding into the crusher. Bar spacing is adjustable (from 2" to 6") for greater control of fines dumping.

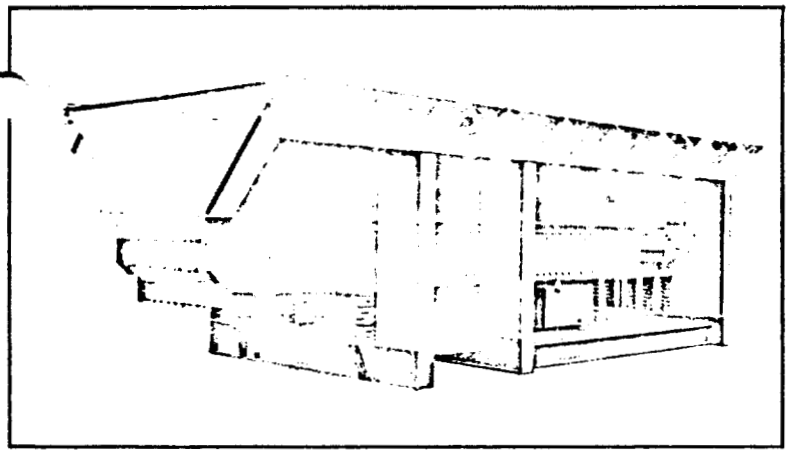
Deck plate is ¾" with other thickness optional. Feeder side plates are protected from wear with steel liners ½-inch thick. For further protection and cushioning against shock, the entire unit is mounted on heavy-duty springs. These springs also provide flexible support and absorb vibration which otherwise would be transmitted to the plant.

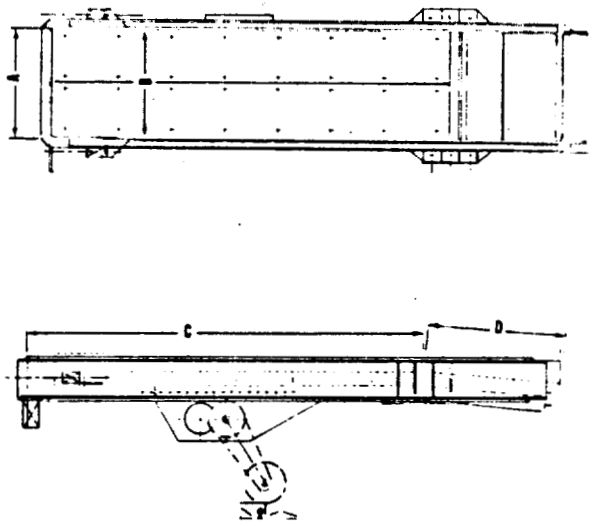
The two sizes of Pioneer Vibrating Feeders are: 42 inches wide by 15 feet long and 50 inches wide by 20 feet long. Tonnage capabilities range up to 500 TPH, depending on the size you select.

The vibrating mechanism is located under the feeder to protect it from rock. Yet it is easy to get at for servicing.

Since parts are interchangeable, both sizes of Pioneer Vibrating Feeders can be used on one job without carrying individual parts for each unit. Components such as bearings, seals, housings, gears, covers, etc., are all common to the line.

Pioneer Vibrating Feeders can be used with most sizes of primary jaw crusher plants as well as all sizes of single and double impact breaker installations. They also fit into stationary plants and tight spots where headroom is limited. Or the units can be installed beneath crushers, thereby protecting conveyor belts and eliminating surge loads on delivery conveyors. Often, this can actually reduce the size of the delivery conveyor you need.





OPTIONAL RECEIVING HOPPER

Receiving Hopper for Feeder, including sub-frame under Feeder, is fabricated of 1" plate with braces to Feeder sub-frame.

SPECIFICATIONS FOR VIBRATING FEEDER

Size	42" x 15'	50" x 20'
Weight, Lb.	8600	12,700
HP Required	25	30
Speed, RPM	900 Max.	900 Max.
Capacity, TPH	200-400	300-500

SPECIFICATIONS FOR VIBRATOR MECHANISM

Common to all units

Housing End Plate Thickness . . . . . 1-1/4"
Number of Shafts. 2
Shaft Material. SAE-4140
Shaft Diameter Between Bearings
42" x 15'. . . . . 8-1/4"
50" x 20'. . . . . 9-1/2"
Shaft Diameter at Bearings 4.331
Shaft Diameter at Drive Sheave . . . . . 2-5/16"
Bearing Type. . . . . Spherical
Timing Gears
Type . . . . . Spur
Lubrication
Bearings. . . . . Grease
Gears. . . . . Oil
Drive . . . . . Vee-Belt
Motor Mount. . . . . Pivoted

SPECIFICATIONS FOR VIBRATING FEEDER PAN

Sizes	42" x 15'	50" x 20'
(A) Width Between Pan Channels	42"	50"
(B) Width Between Side Liners	41"	49"
Maximum Hopper Inside Width With 1" Thick Sides.	37"	45"
(C) Length Solid Pan Deck	10'-0"	15'-0"
(D) Length Grizzly	5'-0"	5'-0"
Pan Side Wear Plate Thickness	1/2"	1/2"
Pan Deck Plate Thickness	3/4"	3/4"
Pan Deck Liner Thickness	Optional	Optional
Grizzly Bars	Fabricated, Tapered Alloy Steel	Fabricated, Tapered Alloy Steel
Grizzly Bar Adjustment	2" - 6"	2" - 6"
Pan Suspension	8 Springs	12 Springs

Engineered and Manufactured by:

[illegible] Inc.
Pioneer Division
3200 COMO AVENUE S.E.
MINNEAPOLIS, MINNESOTA 55414

Cable Pioneer
Telex No. 910-576-2670

Form No. 715-B

(10 CP5)

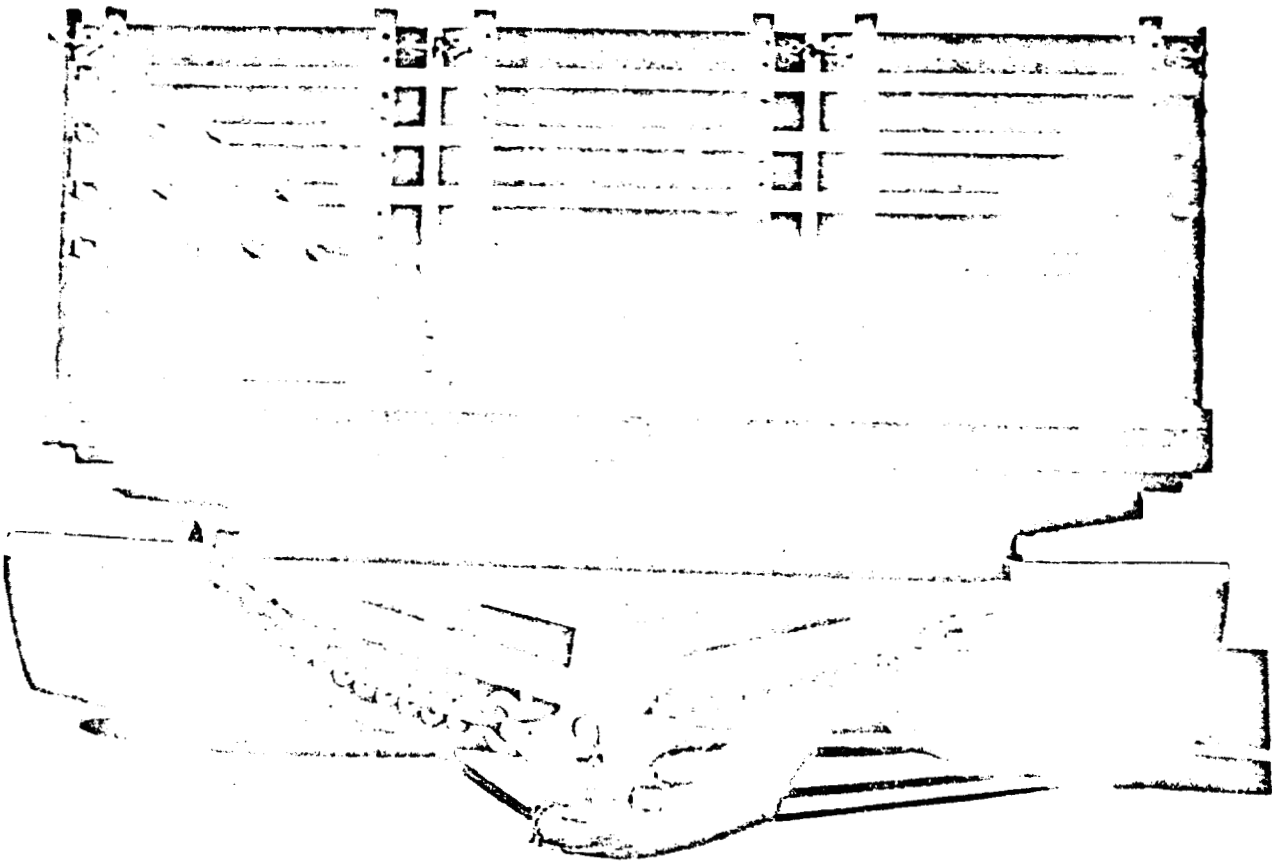
Litho in U.S.A.

Sold and Serviced by:

763 CLARK DRIVE, PHONE 253-5131
[illegible]

OTACO "DEEP FREEZE" SLED

MODEL NO. OL553A



These sleds, believed to be the largest ever built, were designed to U.S. Navy specifications for Antarctic duty on "Operation Deep Freeze." Their job was to carry equipment and supplies for the establishment of base camps—on relatively short runs from ships to coast-line bases and on the 400-mile-plus overland trek into the Antarctic interior to establish a station at Marie Byrd Land.

Carrying a whopping big load of up to 20 tons per sled, with a platform area of 12 by 24 feet, the "Deep Freeze" sled still has a high degree of flotation on powdery snow because of the design of its skis. Rear couplers permit joining sleds together for travel in trains of two to four units.

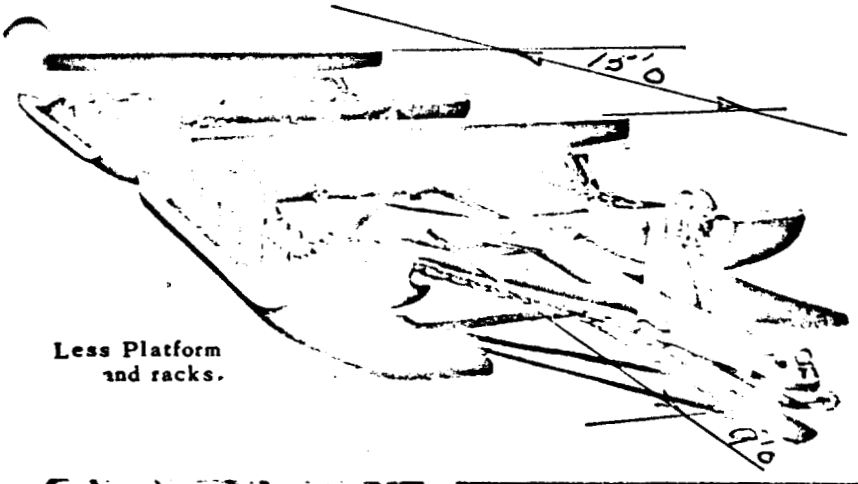
To ease starting impact, each bob of a sled train is put into motion independently. The sliding nose casting on the sled pole gives 9 inches of travel before front bob weight is felt; the wide platform pocket straddling the front sled bench permits a similar 9 inches of travel before the rear bob is set in motion.

All horizontal pulling strain is taken through the pole and the one-inch chain interconnecting the sled bobs. Runners, benches, bunks and platform are subjected only to the vertical strain of supporting the loads carried.

"Operation Deep Freeze" is the name given by the U.S. Navy to their assignment of providing logistics support to teams of U.S. scientists participating in the Antarctic phase of the International Geophysical Year programme.

OFFICIAL U.S. NAVY PHOTOGRAPH

OTACO "DEEP FREEZE" SLED MODEL NO. OL553A



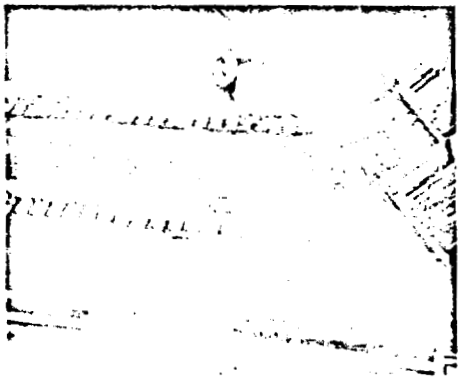
Less Platform and racks.

Without its platform, the Deep Freeze sled looks like this. You can see here the massive construction of the "running gear" and the chain arrangement through which all pulling strain is transmitted. Notice too the rocker-shaped bunks that help maintain load balance in rough travel.

The bob sled's only non-metal parts are the runners made from laminations of hardwood, covered top, bottom and sides with steel.

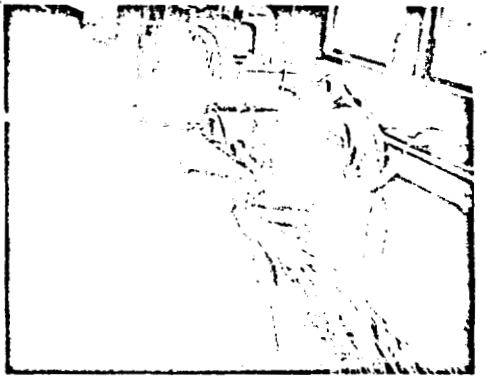
DUCTALLOY PARTS

Nose pieces above are made from Ductalloy (registered trade name for Otaco's ductile iron). This cast material has the impact strength of steel in combination with superior abrasion resistance. MacLaren Knee bodies and chain connecting links are other sled parts made from Ductalloy.



LAMINATED RUNNERS

Exceptional runner strength is obtained by laminated construction. Before ironing is assembled to top, bottom and sides of runners, laminations are dried to a moisture content of 12 to 14%. Runners are 10 ft. long and are assembled into 13-ft. long skis.

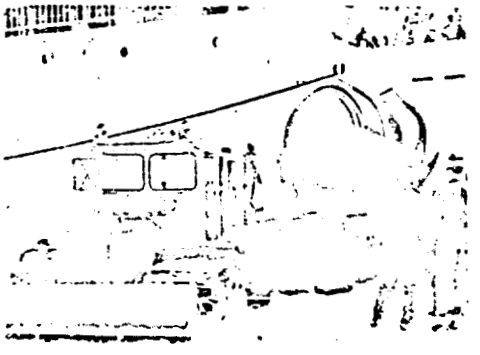


SMOOTHING SKIS

To minimize snow resistance, excess weld is ground from the under-side of skis. Skis are made from special shock and abrasion-resistant steel, measure 13 ft. long and have sufficient width that a 3 lb. p.s.i. ground pressure is not exceeded under a net payload of 40,000 lbs.

SPECIFICATIONS

CAPACITY	- 20 tons
TRACK	- 106 inches
RUNNER	- laminated white oak with steel shoeing, steel top banding and side plates. Length 10 ft. McLaren knees connecting with bench.
RUNNER SHOE	- 5/8 X 4 inches
SKIS	- removable; constructed from shock and abrasion resistant steel; approx. 4# p.s.i. ground pressure under full capacity load
BUNKS	- fabricated steel construction
BENCH	- fabricated steel construction
POLE	- tubular steel with sliding nose casting and hitch plate.
ROLLER	- tubular steel
CHAIN	- 1-inch size triple B
PLATFORM	- length 24 feet, width 12 feet, one-piece welded steel construction
STAKE RACKS	- 18; removable; joined together with Hooks and eyes
SHIPPING WEIGHT	- 19,556 lbs. (sled, platform and racks)



OFFICIAL U.S. N. PHOTO

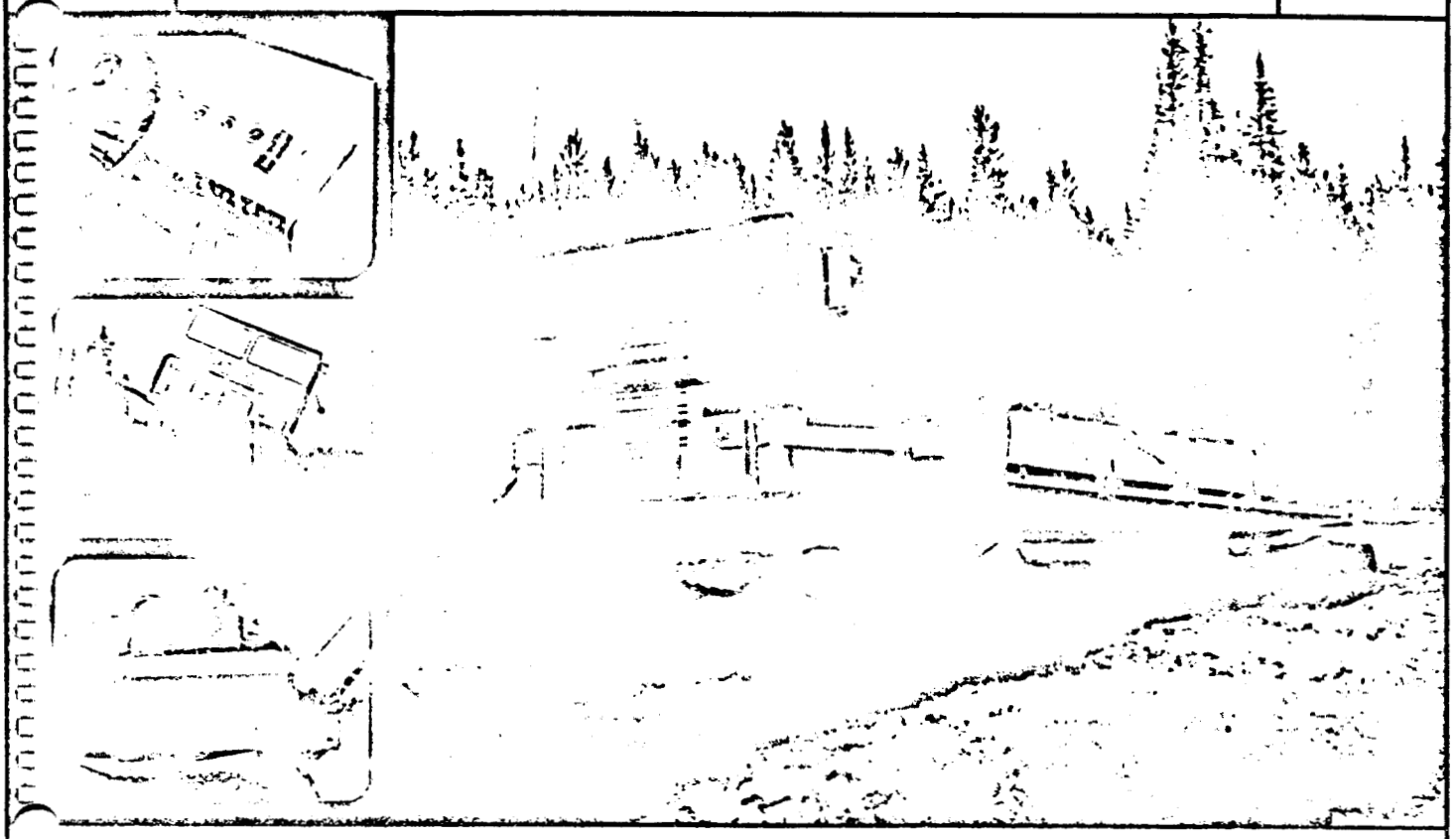
IN THE ANTARCTIC

Ship secured alongside the Antarctic ice shelf lowers gasoline-filled drums to a waiting Otaco sled, by means of its crane. Sleds transported building materials, supplies, etc. from ships to base camps at the several U.S. bases in the Antarctic.

Two and sometimes three sleds are hauled in trains to speed transport.

Husky 8

REF.
H-8
7-74



GENERAL DESCRIPTION

A large four track, transport vehicle. Extra high strength components throughout the frame, powertrain and track system.

DESIGN DUTY

The Husky 8 is constructed to carry loads up to 40 tons (36.2 tonnes) over ground conditions such as snow, sand, muskeg and swamp. It is adaptable as a prime mover to pull wheeled or skid-mounted trailers.

MAIN FEATURES

1. The flexible, belted tracks absorb shock loads and conform to uneven terrain while providing higher ground speeds than steel tracks.
2. All four tracks are powered. Two point steering permits front and rear tracks to follow one another in the same path. Minimum turning radius 45 ft. (13.7 m).
3. Undercarriage is sealed and designed to operate submersed in mud or water. Drive lines are hanger bearing supported with splined slip joints that allow front track oscillation.
4. Independent suspension at each wheel is provided by coil spring and crank arm arrangement. This heavy duty system allows almost constant ground contact for the track as it rolls over obstacles. Provides smooth ride for operator and cargo.
5. Cab: Designed for maximum operator liveability with customer choice of "Arctic Package" or "Desert Package" interior. Steel, unit-welded cab with escape hatch at top. Tilt cab for servicing convenience.
6. Controls: Steering wheel operation. Full-function instrument gauges monitor engine, hydraulic and temperature systems.
7. Optional equipment to increase vehicle loading and carrying capacity include:
   - Winch, gin pole and live roll arrangement.
   - Hydraulic, side-mounted, "knuckleboom" loaders. Custom engineering of a variety of carrier configurations is available upon request.

FOREMOST INTERNATIONAL INDUSTRIES LTD.

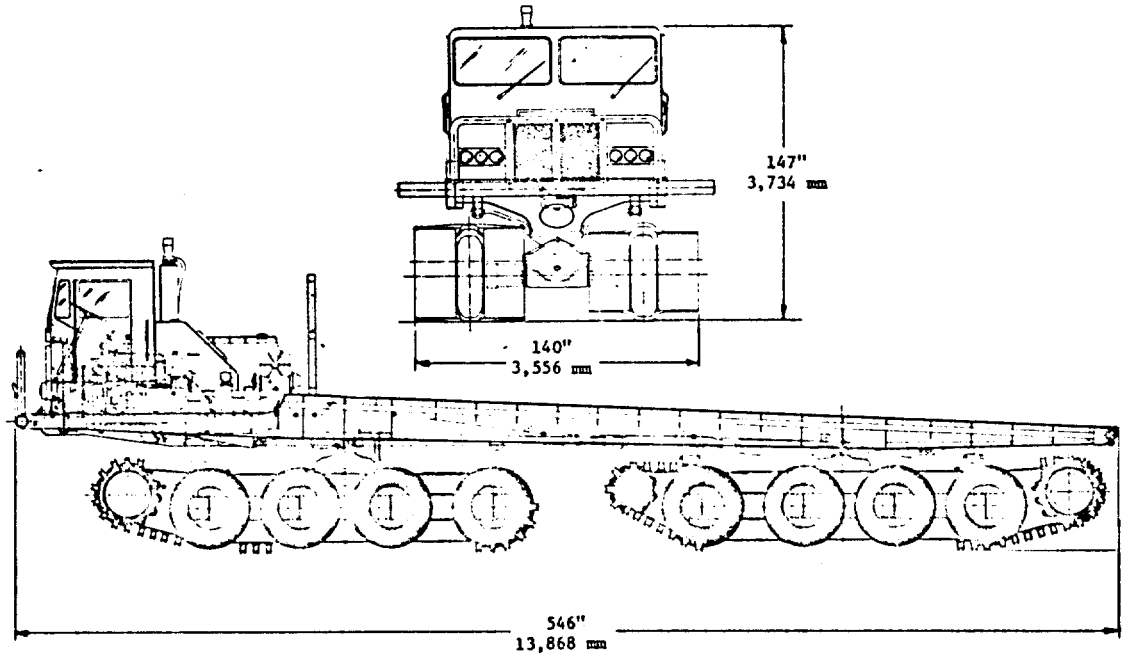
Telephone (403) 272-3322 • Telex 038-22772 1616 Meridian Road N.E., Calgary, Alberta, Canada T2A 2P1

BRIEF SPECIFICATIONS

ENGINE:	Cummins NT 855 (335 hp at 2100 rpm). *Optional* — Detroit Diesel 8V71 (318 hp at 2100)		
TRANSMISSION:	Powershift with torque converter. Transmission provides 6 speeds forward and 1 speed reverse.		
DIFFERENTIAL:	Rockwell 200 with planetary reduction.		
STEERING:	Two point system, steering wheel controlled — hydraulic cylinders with equalizing levers.		
BRAKES:	Air operated drum-type on drive line. *Optional* — Caliper-disc, air/hydraulic on each drive pinion.		
TRACK ASSEMBLY:	Extra heavy duty fabric cord with rubber covered belting. Heavy duty spring steel grousers. Special 20" (508 mm) smooth crawler tires. Track width 54" (142.2 cm)		
SPROCKETS:	Urethane		
SUSPENSION:	Torsional coil spring and crank arm for each wheel with oil bath hubs.		
FRAME:	Integral frame and cargo deck with outside frame rails. High tensile steel.		
ELECTRICAL:	12 volt running system. 84 amp alternator.		
WINCH:	Braden MS20 or equivalent mounted at front of deck. Line pull 45,000 lb. (20,410 kg.) Cable size 1" (25.4 mm), length 100' (30.5 m).		
WEIGHTS:	Vehicle weight	80,000 lb.	36,280 kg.
	Payload	80,000 lb.	36,280 kg.
	Gross weight	160,000 lb.	72,560 kg.
DECK SIZE:	9' x 33'	2.74 m x 10.05 m	
PERFORMANCE:	Gradeability —	60% forward	40% side slope
	Fording Depth —	6'0"	1.83 m
	Maximum Speed —	10 mph	16 km/h
	Inside Turning Radius —	45 ft.	13.7 m
	Ground Clearance	18 in.	45.6 cm

Ground Pressure:

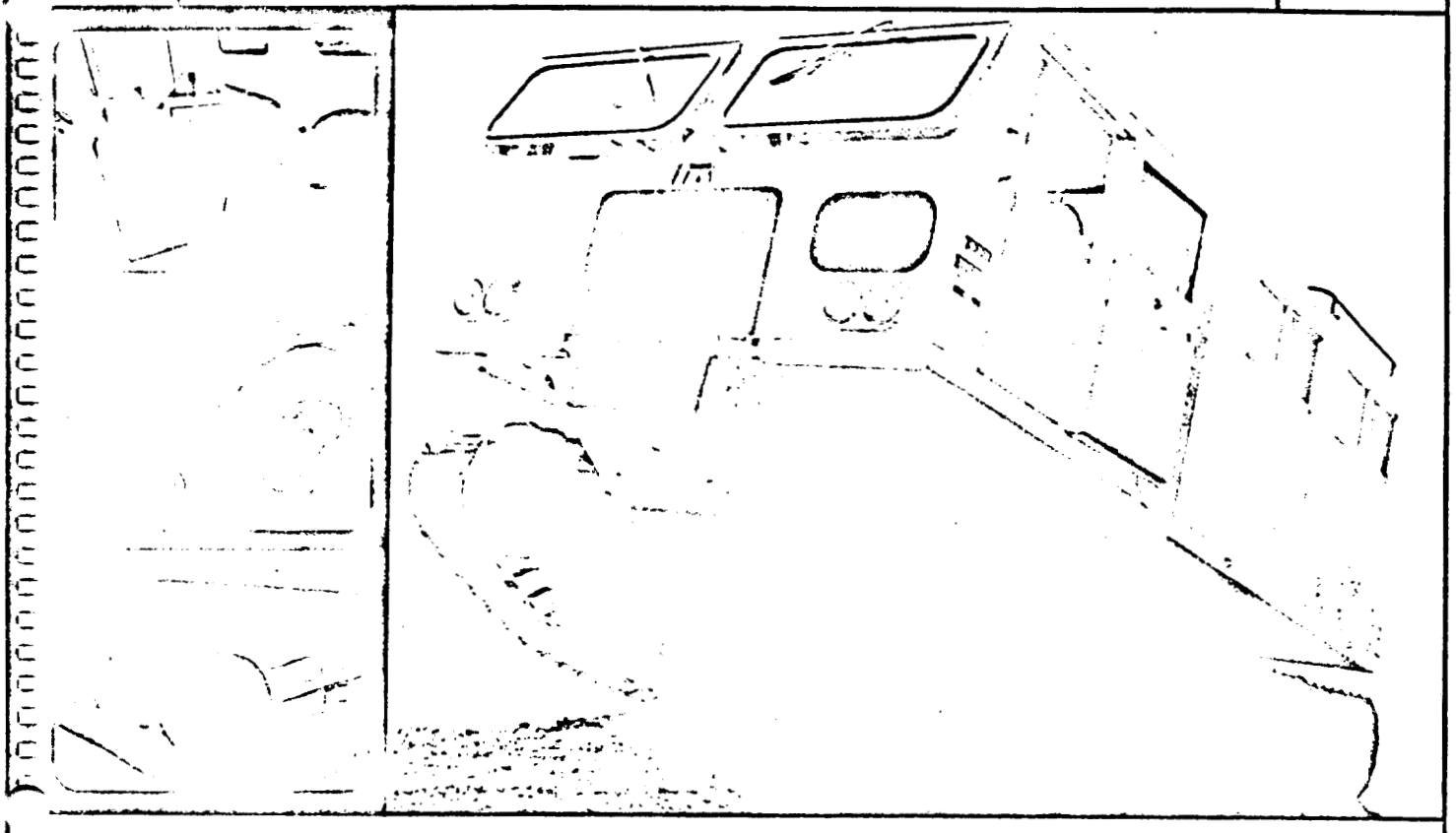
Tons Load	psi	Tonnes Load	Kg/cm²
0	2.3	0	1.6
20	3.4	18.1	2.3
40	4.6	36.2	3.1



FOR FURTHER INFORMATION

TVS 600

REF.
TVS-600
7-74



GENERAL DESCRIPTION

A durable two track carrier and transport vehicle. Reliable powertrain components, a strong chassis and a proven track system provide economic haulage over a variety of off-highway terrain conditions.

DESIGN DUTY

The TVS 600 is a general purpose tracked vehicle suited to the logistic requirements of transporting personnel or cargo over tough terrain areas. The rated payload of this vehicle is 6,000 lbs. (2,721 kg.)

MAIN FEATURES

1. Performance. The TVS 600 utilizes high engine torque plus great track strength to produce maximum drawbar pull. The heavy duty frame has been proven in a variety of demanding applications.
2. The size of the TVS 600 enables it to be transported via highway truck or aircraft to remote operational areas.
3. Dual tracks and short overall machine length deliver responsive maneuverability and short turning radius.
4. The undercarriage is fully sealed and enables the TVS 600 to operate effectively while submerged in mud or water to a draft depth of 3'6" (1.07 m). Ideal for work in previously inaccessible areas, the TVS 600 reflects a ground bearing pressure of 2.0 psi (1.37 N/cm²) even while under a full 3 ton (2.7 tonne) payload.
5. The mechanical, lever actuated steering control system engages planetary brakes for short radius turns.
6. As an option, the TVS 600 offers the choice of a 2 or 4 man cab. Fully insulated, this cab features complete instrumentation, roll down windows, escape hatch at top and is designed with maximum operator liveability. The interiors can be fitted for either arctic or tropical applications.

FOREMOST INTERNATIONAL INDUSTRIES LTD.

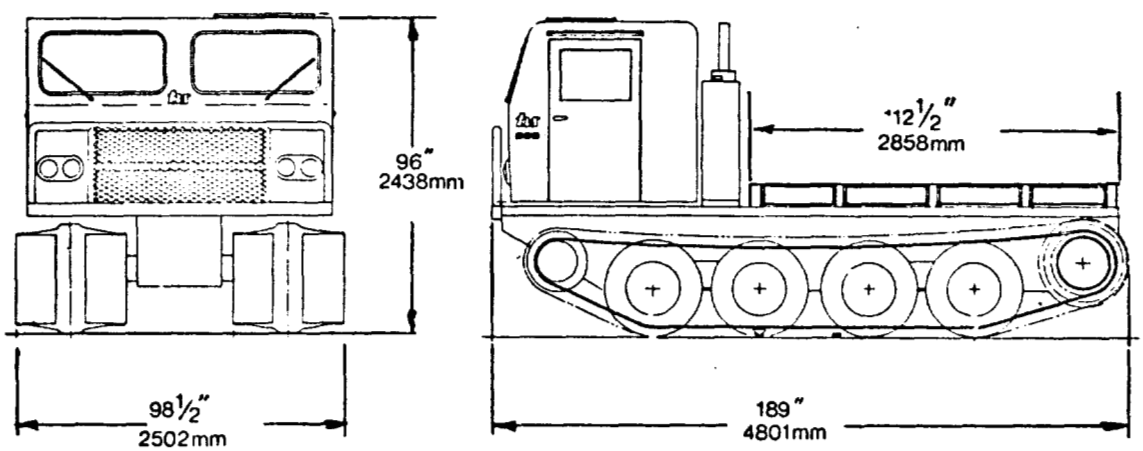
Telephone (403) 272-3322 **Telex 038-22772 1616 Meridian Road N.E., Calgary, Alberta, Canada T2A 2P1

BRIEF SPECIFICATIONS

ENGINE:	G.M. 3-53 Diesel (101 hp at 2800 rpm) *Optional* — 300 cu. in. Ford gasoline (103 hp at 2800 rpm)		
TRANSMISSION:	Standard, providing 5 speeds forward and 1 speed reverse.		
DIFFERENTIAL:	Planetary axels with oil bath and controlled differential.		
STEERING:	Hydraulic steering, dual lever controlled.		
BRAKES:	Internal drum type system. *Optional* — Mico Lever Lock.		
TRACK ASSEMBLY:	Fabric cord, rubber covered belting. Spring steel grousers. Support tires, 10 ply 6.00 x 16. Track width 33" (83.8 cm)		
SPROCKETS:	Urethane drive and solid rubber idler.		
SUSPENSION:	Walking beam.		
FRAME:	All welded steel frame construction.		
ELECTRICAL:	12 volt running system, 45 amp alternator.		
WINCH:	*Optional* — Front mounted 8,000 lb. (3,628 kg.) line pull.		
WEIGHTS:	Vehicle weight	10,500 lb.	4,762 kg.
	Payload	6,000 lb.	2,721 kg.
	Gross weight	16,500 lb.	7,483 kg.
DECK SIZE:	Standard	7'7½" x 9'4½"	2.32m x 2.86m
PERFORMANCE:	Gradeability —	60% forward	40% side slope
	Fording Depth —	3'6"	1.07 m
	Maximum Speed —	13.5 mph	22 km/h
	Inside Turning Radius —	8'8"	2.6 m
	Ground Clearance —	14¼ in.	36.2 cm

Ground Pressure:

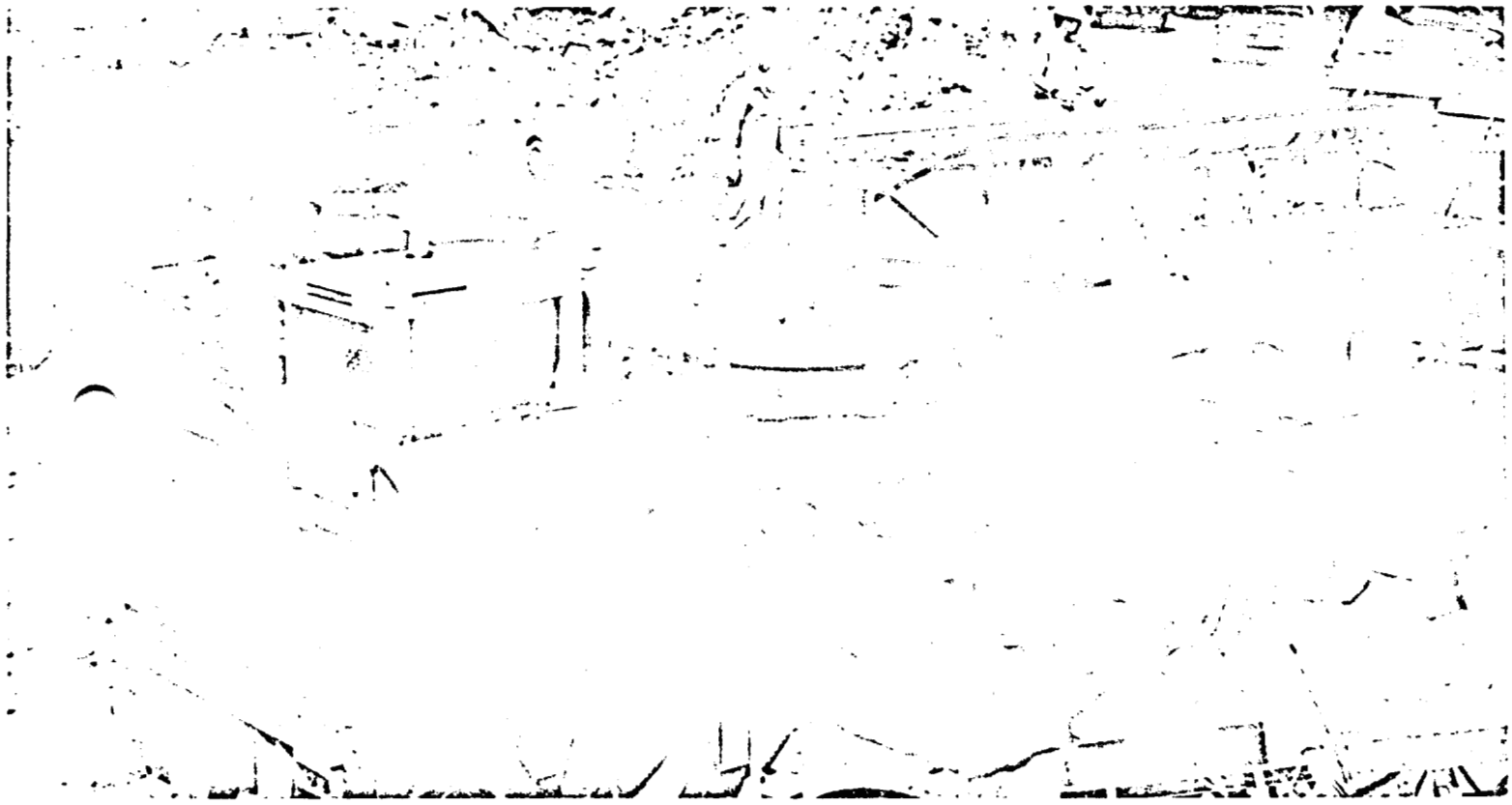
Tons Load	psi	Tonnes Load	Kg/cm²
0	1.3	0	.89
1.5	1.6	1.4	1.13
3	2.0	2.7	1.37

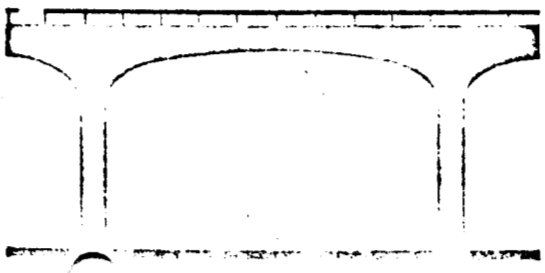


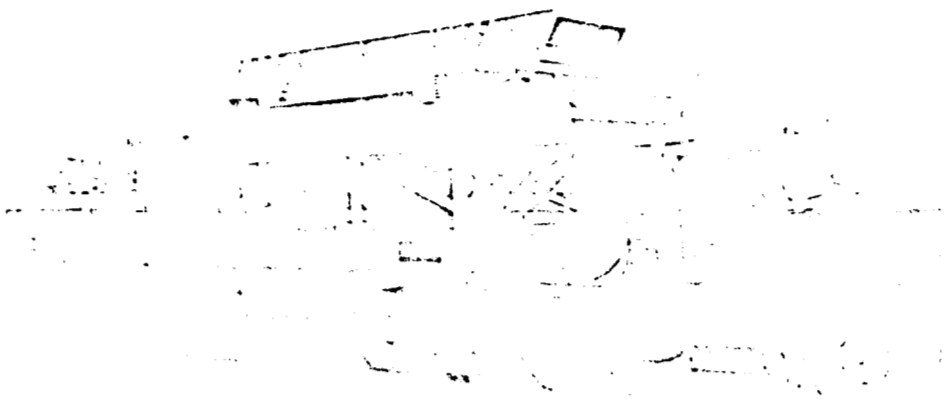
FOR FURTHER INFORMATION

TELSMITH

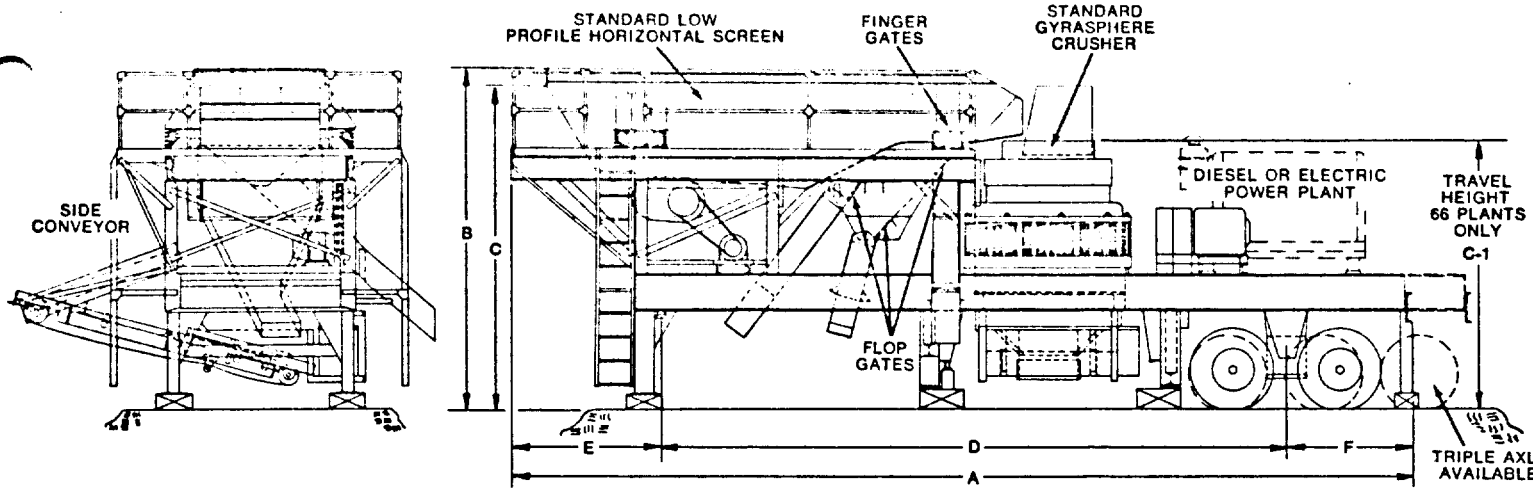
low-profile PORTABLE GYRASPHERE CRUSHING PLANTS







low-profile PORTABLE GYRASPHERE® CLOSED CIRCUIT PLANT



Model No. (Note 1)	A	Operating Height B	Travel Height C	D	E	F	Weight, Basic Plant (Note 2) Pounds	Kilograms
36S-G-CC 367S-G-CC 36FC-G-CC	34′-0″ (10363.2 mm)	13′-5⅛″ (4092.6 mm)	13′-5⅛″ (4092.6 mm)	23′-11″ (7289.8 mm)	2′-0″ (609.6 mm)	6′-9″ (2057.4 mm)	47,200 48,500 49,000	21,240 21,825 22,050
48S-G-CC 489S-G-CC 48FC-G-CC	38′-0″ (11582.4 mm)	14′-3¾″ (4362.4 mm)	13′-9″ (4191.0 mm)	26′-6″ (8077.2 mm)	6′-2¼″ (1886.0 mm)	5′-3¾″ (1619.2 mm)	76,000 77,750 79,200	34,200 34,988 35,640
66S-G-CC 6614S-G-CC 66FC-G-CC	40′-6″ (12344.4 mm)	C-1 17′-7½″ (5372.1 mm)	C-1 14′-1½″ (4305.3 mm)	32′-4″ (9855.6 mm)	5′-9¼″ (1759.0 mm)	6′-11″ (2108.2 mm)	164,125 165,375 166,375	73,856 74,418 74,869

Note 1—Dimensions shown are in customary and metric systems. Note 2—Weight of basic plant without power.

BRIEF SPECIFICATIONS

MODEL NO.	36S-G-CC	367S-G-CC	36FC-G-CC	48S-G-CC	489S-G-CC	48FC-G-CC	66S-G-CC	6614S-G-CC	66FC-G-CC
CRUSHER									
Size, Gyrasphere	36S	367S	36FC	48S	489S	48FC	66S	6614S	66FC
Diesel Engine, Horsepower, Continuous Rating	80	100	120	190	190	250	310	375	375
Electric Motor, Horsepower	60	75	100	150	150	200	250	300	300
RPM	1200	1200	1200	1200	1200	1200	870	870	870
SCREEN									
Size, Horizontal D.D.	4′x12′*	4′x12′*	4′x12′*	5′x14′**	5′x14′**	5′x14′**	6′x18′***	6′x18′***	6′x18′***
	(1219 x 3658 mm)			(1524 x 4267 mm)			(1829 x 6096 mm)		
Electric Motor, Horsepower	15	15	15	20	20	20	40	40	40
RPM	1750	1750	1750	1750	1750	1750	1750	1750	1750

* 4′x14′ D.D. screen can be furnished. ** 5′x16′ D.D. screen can be furnished. *** 6′x20′ D.D. screen can be furnished.

Koehring
Road Division

JOHNSON
Mobile Mixer
Models 124 and 224

CONDENSED SPECIFICATIONS:

TRAVEL DIMENSIONS:

Length	30 ft. 4 in.	9.246 M
Width	8 ft. 0 in.	2.438 M
Overall Height	13 ft. 1-1/2 in.	4.001 M
Operating Height	13 ft. 3 in.	4.038 M
Weight-Basic Unit	1 cubic yard mixer 19,500 lbs.	8.845 Metric Tons
Weight-Basic Unit	2 cubic yard mixer 22,000 lbs.	9.525 Metric Tons

POWER UNIT

Diesel Engines 73 HP 2400 R.P.M. - 1 c.y. mixer
105 HP 2400 R.P.M. - 2 c.y. mixer
Fuel Tank: - approximately 30 U.S. gallons.

Electric Motors 75 HP 1750 R.P.M. - 1 c.y. mixer
100 HP 1750 R.P.M. - 2 c.y. mixer

SCALE SYSTEM

Cement ..... beam scales
Aggregate ..... dial scales
1 cubic yard ..... 5,000 lbs. ..... 2,500 kg.
2 cubic yard ..... 10,000 lbs. ..... 5,000 kg.

CEMENT SCREW TRANSFER CONVEYOR AND BAG RECEIVING HOPPER

Size ..... 6 inches diameter .... .152M
Receiving Hopper ..... 3 ft. X 3 ft. with cover

DRIVES

Mixer ..... Hydraulic
Belt conveyor ..... Hydraulic
Screw conveyor ..... Hydraulic
Air compressor ..... V-belt - sheaves

MIXER CAPACITIES

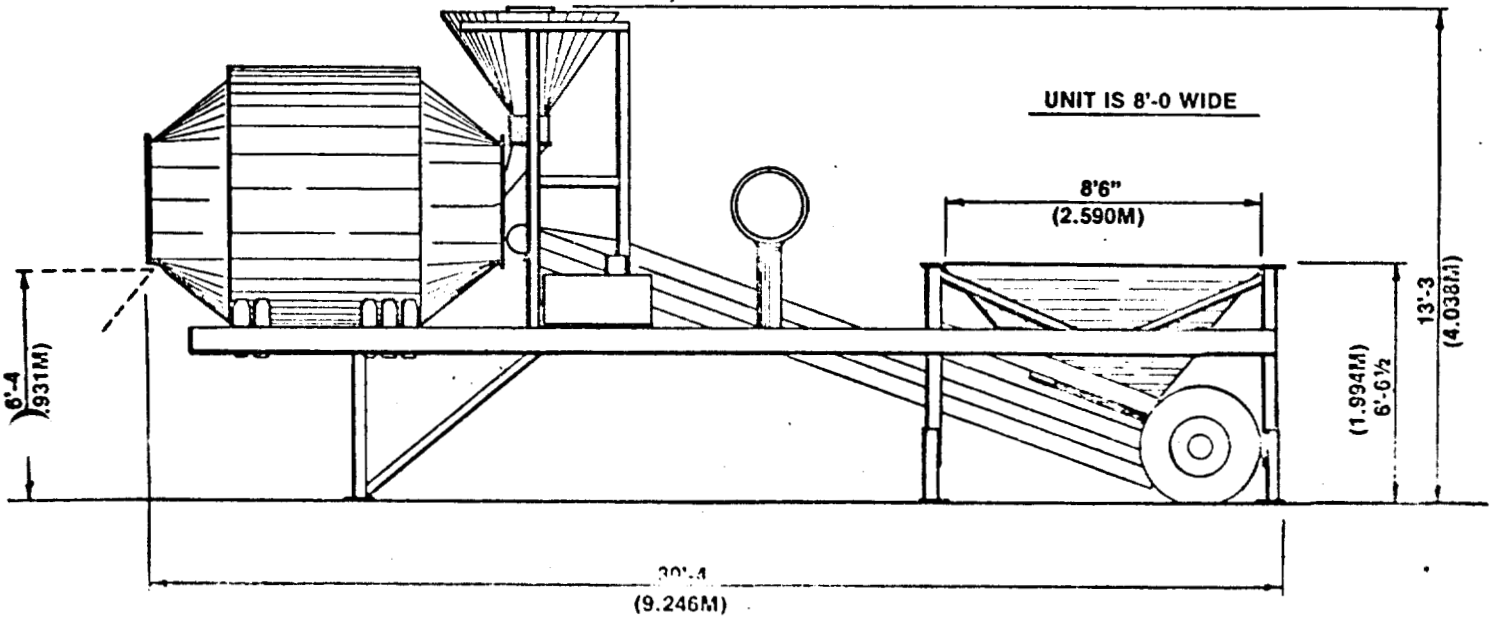
1 c.y. (.76M³) mixer ..... 25 to 30 c.y./hr.
2 c.y. (1.52M³) mixer ..... 50 to 60 c.y./hr.
(Special Note: Capacities based on 60 second mixing time)

AGGREGATE BATCH TRANSFER CONVEYOR

Width ..... 24 in. (Deep Troughing) ... .610M

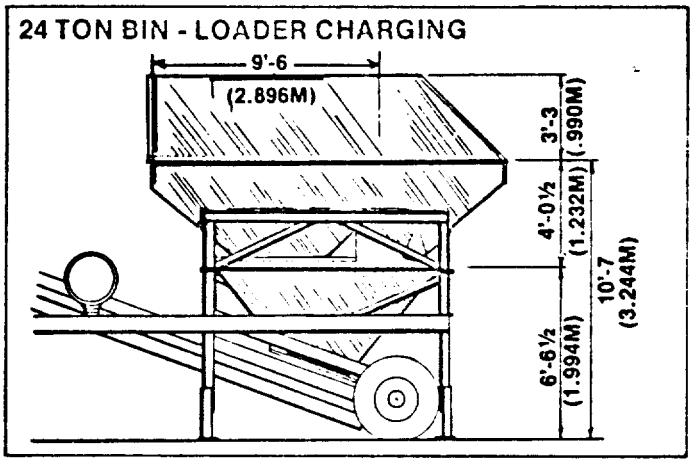
WATER SYSTEM

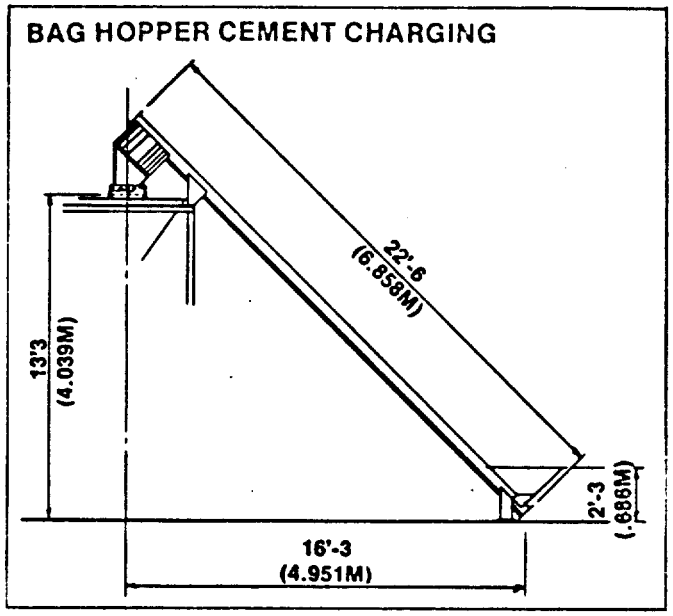
2" (.051 meters) Impulse meter with piping to mixer.



MOBILE MIXER

Mobile Mixer Options





OPTIONAL EQUIPMENT

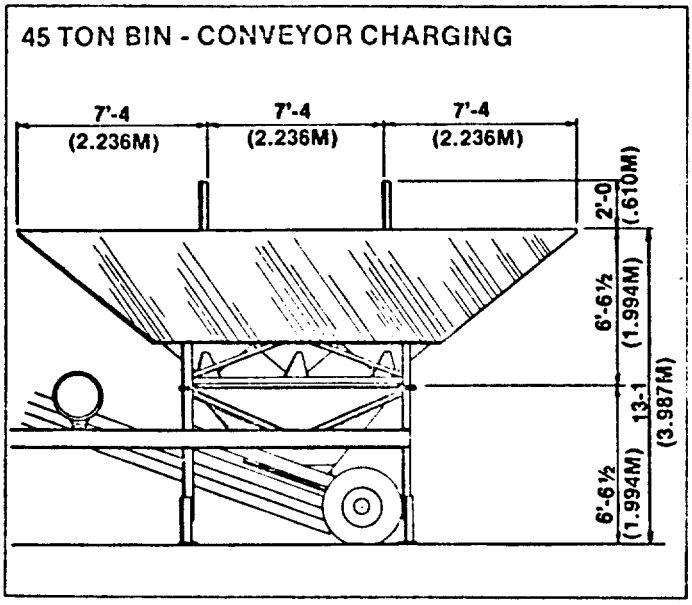
24 ton Aggregate Bin (3 compartments) - (21.77 metric tons)

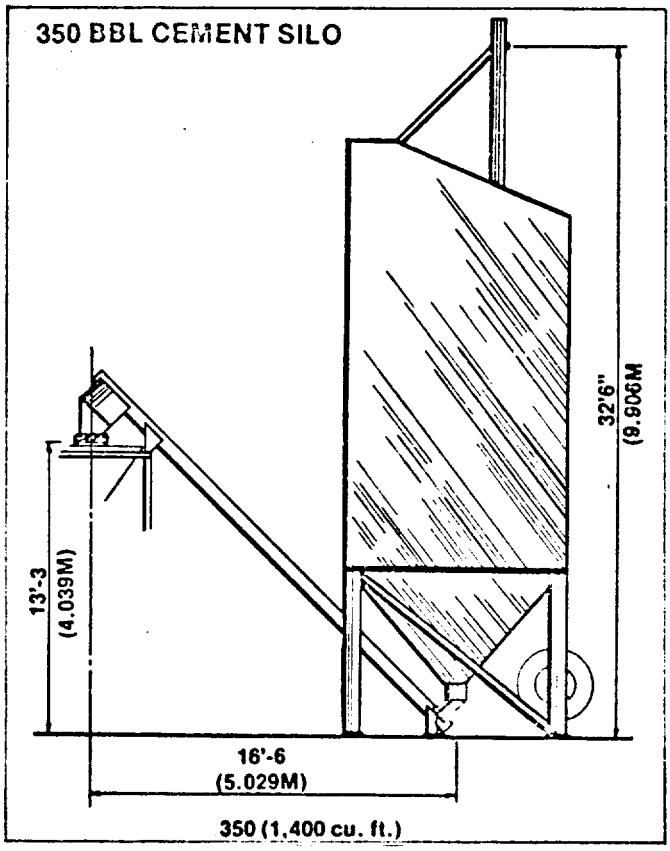
45 ton Aggregate Bin (3 compartments in tandem) - (40.82 metric tons)

350 BBL Mobile Cement Silo
(8 ft. X 10 ft. X 32 ft.-6 in. = 1,400 cu. ft.)
(2.438 meters X 3.048 meters X 9.905 meters = 69.62 cubic meters)

Water pump - 170 G.P. M.

Radial stacker conveyor with 10" X 10" charging hopper.





PURVES RITCHIE
Division of the West Coast – Purves Ritchie Company

PM-10-22
Printed in U.S.A.

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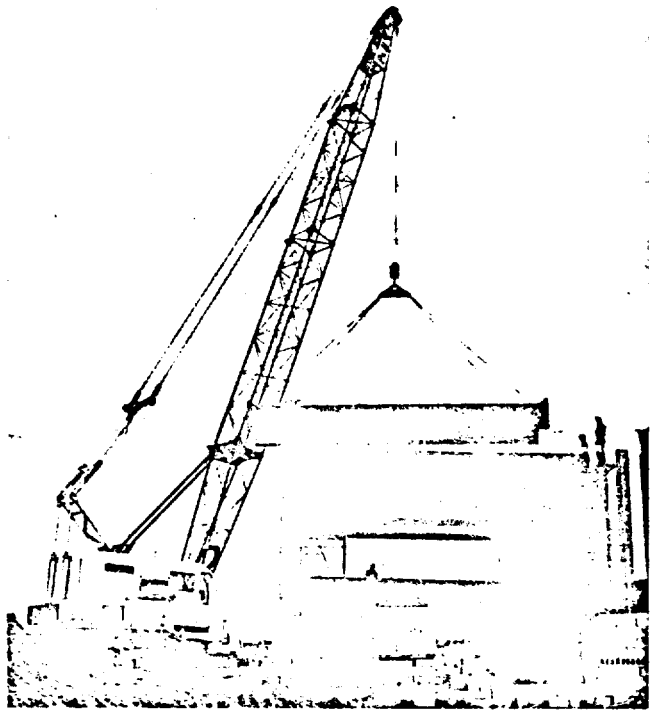
KOEHRING

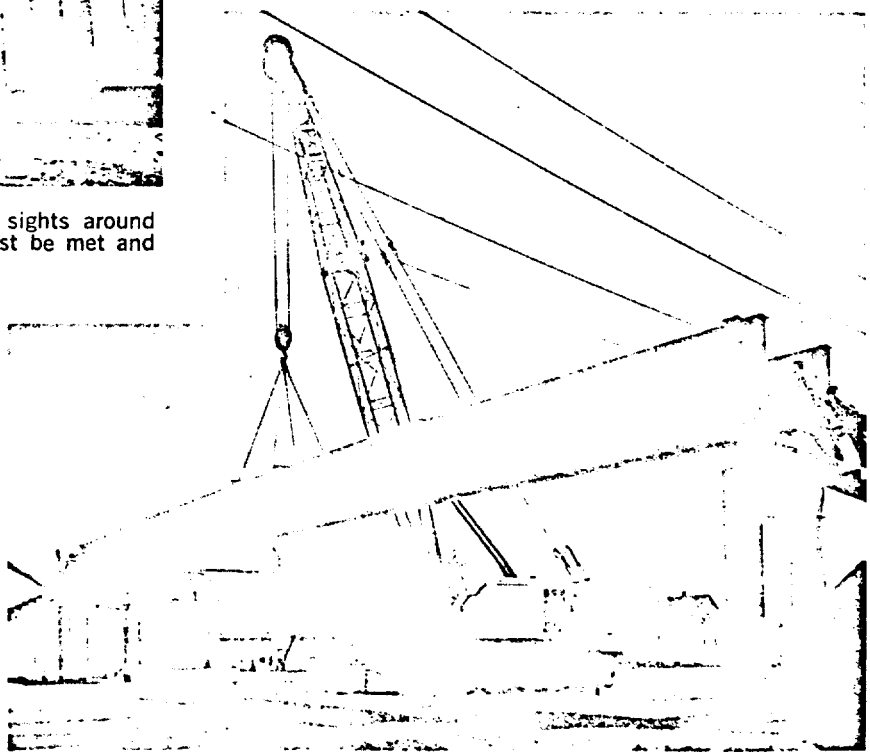
Koehring
Road Division
Champaign, Illinois 61820

650A-TC



Modern construction techninues require modern, high-performance equipment, like this P&H 650A-TC setting pre-cast concrete roof beams.

Dependable P&H Truck Cranes are common sights around expressway construction, where deadlines must be met and costs kept down.



Bulky lifts require exceptional load control. The 650A-TC has it.

NOTE: In furtherance of our policy of continual product improvement, all designs and specifications are subject to change without advance notice. Data published herein is informational in nature and shall not be construed to warrant suitability of the machine for any particular purpose as performance may vary with the conditions encountered. The only warranty applicable is our standard written warranty for this machine. Manufactured and sold in conformance with U. S. Department of Commerce Commercial Standard CS 90-58.

Harnischfeger

P&H

On Rubber

RATED CRANE LOADS IN POUNDS—MAIN BOOM—WITHOUT OUTRIGGERS—TIRES AT 100 P.S.I.

Oper Rad Ft.	40 Ft. Boom			50 Ft. Boom			60 Ft. Boom			70 Ft. Boom			80 Ft. Boom			90 Ft. Boom			100 Ft. Boom			Oper Rad. Ft.
	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear		Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	
12	79	53,600	69,200																			12
15	74	39,000	50,800	77	38,900	50,700																15
20	67	26,500	34,800	72	26,400	34,700	75	26,200	34,500	77	26,000	34,300										20
25	58	19,700	26,300	65	19,600	26,100	70	19,400	26,000	73	19,200	25,700	75	19,000	25,500	77	18,800	25,300	78	18,500	25,000	25
30	50	16,100	20,900	59	16,000	20,700	64	15,900	20,600	68	15,700	20,300	71	15,400	20,100	73	15,200	19,900	75	15,000	19,600	30
35	39	13,100	17,200	52	13,000	17,000	59	12,800	16,900	64	12,600	16,600	67	12,400	16,500	70	12,200	16,450	72	12,000	16,400	35
40	25	10,900	14,900	44	10,800	14,800	53	10,600	14,600	59	10,400	14,400	63	10,200	14,200	67	10,000	14,000	69	9,750	13,700	40
45				35	9,150	12,700	47	9,000	12,500	54	8,800	12,300	59	8,550	12,100	63	8,350	11,800	66	8,100	11,600	45
50				23	7,850	11,000	40	7,700	10,800	49	7,500	10,600	55	7,300	10,400	59	7,050	10,200	63	6,800	9,950	50
60							20	5,800	8,400	37	5,600	8,200	46	5,400	7,950	52	5,150	7,750	56	4,950	7,500	60
70	RATINGS SHOWN DO NOT EXCEED MAXIMUM APPROVED TIRE CAPACITY.									21	4,300	6,500	35	4,100	6,250	44	3,850	6,050	49	3,650	5,800	70
80													19	3,150	5,000	33	2,900	4,800	41	2,650	4,550	80

RATED CRANE LOADS IN POUNDS—MAIN BOOM—WITHOUT OUTRIGGERS—TIRES AT 100 P.S.I.

Oper Rad Ft.	40 Ft. Boom			50 Ft. Boom			60 Ft. Boom			70 Ft. Boom			80 Ft. Boom			90 Ft. Boom			100 Ft. Boom			Oper Rad. Ft.
	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	Angle	Over Side	Over Rear	
12	79	57,600	73,200																			12
15	74	44,800	56,500	77	44,700	56,400																15
20	67	30,500	38,800	72	30,400	38,700	75	30,300	38,500	77	30,000	38,300										20
25	58	22,900	29,300	65	22,700	29,200	70	22,600	29,000	73	22,300	28,800	75	22,100	28,600	77	21,900	28,300	78	21,600	28,100	25
30	50	18,100	23,400	59	17,900	23,200	64	17,800	23,000	68	17,500	22,800	71	17,300	22,600	73	17,100	22,400	75	16,900	22,100	30
35	39	15,300	19,300	52	15,200	19,100	59	15,000	19,000	64	14,800	18,700	67	14,600	18,500	70	14,400	18,300	72	14,100	18,000	35
40	25	12,800	16,600	44	12,700	16,600	53	12,500	16,500	59	12,300	16,300	63	12,100	16,100	67	11,900	15,800	69	11,600	15,600	40
45				35	10,800	14,300	47	10,600	14,100	54	10,400	13,900	59	10,200	13,700	63	10,000	13,500	66	9,750	13,200	45
50				23	9,350	12,400	40	9,150	12,300	49	8,950	12,100	55	8,750	11,800	59	8,500	11,600	63	8,300	11,400	50
60							20	7,000	9,550	37	6,800	9,350	46	6,600	9,150	52	6,400	8,950	56	6,150	8,700	60
70	RATINGS SHOWN DO NOT EXCEED MAXIMUM APPROVED TIRE CAPACITY.									21	5,300	7,500	35	5,100	7,250	44	4,900	7,050	49	4,650	6,800	70
80													19	4,000	5,900	33	3,800	5,650	41	3,550	5,450	80

WARNING: Read for Safety

Using this equipment in excess of rated loads, in areas of chart not rated, or with disregard of instructions will result in unsafe operating conditions and is a violation of the U.S. Dept. of Labor Safety and Health regulations for construction.

When operating crane "without outriggers" loads lifted over rear and swung over side will increase in radius due to tire deflection. This increase in radius must be compensated for by raising boom, or machine may tip over.

When three-quarter inch dia. P&H Type II Wire Rope (18 x 7 Non Rotating Preformed Improved Plow Steel Wire Rope Fiber Core) is used for jib line, maximum lifted load including hook and swivel must not exceed 12,000 lbs. Non-rotating rope is approved for single line operation.

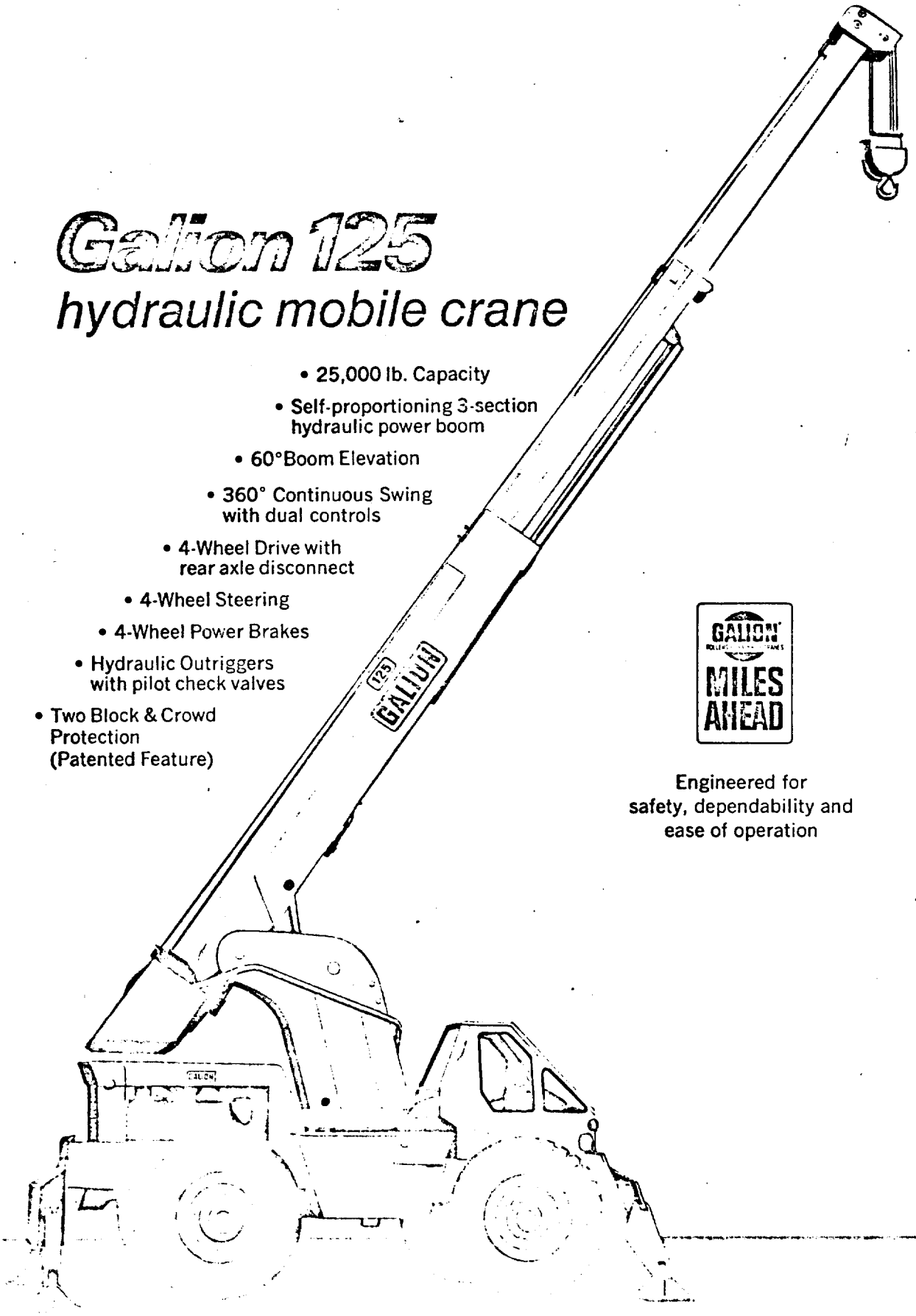
Welding or other repair to tubular steel boom may weaken the structure. See your P&H dealer for authorized boom repair service. Unauthorized boom repair service will void all warranties.

The wind effect on the lifted load can cause sufficient side load to overstress boom or jib structure. When suspended, load will not remain in line with boom derate chart by 25%. We recommend stopping operation when wind is above 30 M.P.H. and tieing off or lowering boom when wind is above 50 M.P.H.

FOLDER NO. 473 E
(Replaces No. 473-D)

Galion 125
hydraulic mobile crane

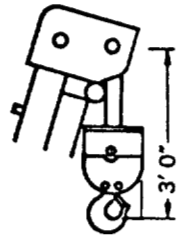
- 25,000 lb. Capacity
- Self-proportioning 3-section hydraulic power boom
- 60°Boom Elevation
- 360° Continuous Swing with dual controls
- 4-Wheel Drive with rear axle disconnect
- 4-Wheel Steering
- 4-Wheel Power Brakes
- Hydraulic Outriggers with pilot check valves
- Two Block & Crowd Protection (Patented Feature)



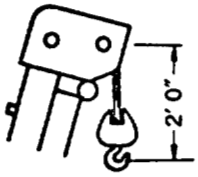
GALION
MILES AHEAD

Engineered for safety, dependability and ease of operation

Safe loads Model 125 hydraulic

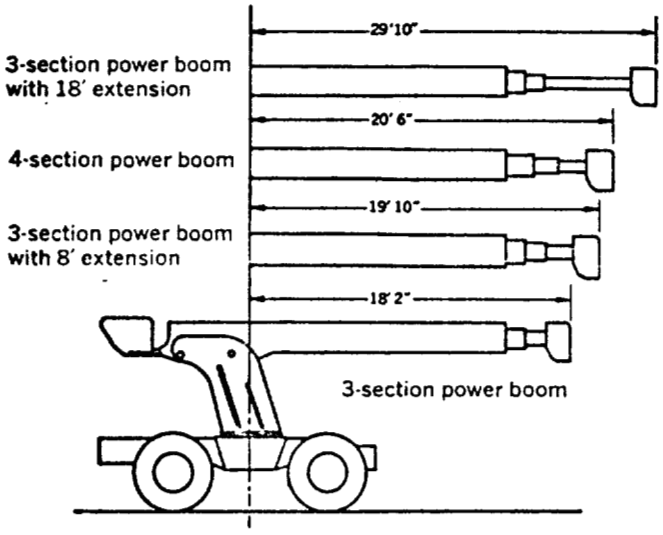


STANDARD HOOK BLOCK



OPTIONAL HOOK BLOCK

RETRACTABLE TRAVEL LENGTHS



HORIZONTAL BOOM RANGE

3-SECTION POWER BOOM 17'6" TO 37'6"				
Length of Extension	8'	18'	15' Jib w/8' Ext.	15' Jib w/18' Ext.
Horizontal Range Extension Retracted	19'2" to 39'2"	29'2" to 49'2"	34'2" to 54'2"	44'4" to 64'2"
Horizontal Range Extension Extended	25'6" to 45'6"	35'6" to 55'6"	40'6" to 60'6"	50'6" to 70'6"

HORIZONTAL BOOM RANGE
4-SECTION POWER BOOM 20' TO 60'

3-SECTION POWER BOOM LOAD IN LBS.

WORKING RADIUS IN FEET	360° ROTATION		OFF FRONT OF CRANE	
	WITHOUT OUTRIGGERS	WITH OUTRIGGERS	WITHOUT OUTRIGGERS	WITH OUTRIGGERS
10	17,900	25,000	25,000	25,000
12	15,150	20,830	20,830	20,830
14	11,800	17,850	16,000	17,850
16	9,230	15,620	12,750	15,620
18	7,300	13,860	10,450	13,860
20	5,860	12,500	8,750	12,500
22	4,850	11,050	7,450	11,360
24	4,080	9,460	6,400	10,400
26	3,480	8,175	5,600	9,600
28	3,060	7,225	4,925	8,940
30	2,640	6,450	4,340	8,330
32	2,300	5,785	3,820	7,800
34	1,980	5,185	3,360	7,350
36	1,660	4,720	2,910	6,750

4-SECTION POWER BOOM LOAD IN LBS.

WORKING RADIUS IN FEET	360° ROTATION		OFF FRONT OF CRANE	
	WITHOUT OUTRIGGERS	WITH OUTRIGGERS	WITHOUT OUTRIGGERS	WITH OUTRIGGERS
10		25,000	25,000	25,000
12	13,700	25,000	22,800	25,000
14	10,600	21,400	17,600	21,400
15	9,350	20,000	15,600	20,000
16	8,300	18,500	13,800	18,800
18	6,600	14,950	11,000	16,750
20	5,260	12,300	8,900	15,000
22	4,160	10,300	7,260	13,700
24	3,360	8,600	5,950	12,500
25	2,970	7,800	5,450	11,950
30	1,600	5,250	3,600	8,680
35	850	3,800	2,500	6,450
40	420	3,000	1,780	4,950
45	170	2,380	1,300	4,000
50		1,870	920	3,300
55		1,440	590	2,800
60		1,100	350	2,300

Rated lifting capacities shown are maximum allowable loads. The maximum allowable loads shown above the solid lines are based on the structural strength of machinery components. The maximum allowable loads must NOT be exceeded at any time. If the maximum allowable loads are exceeded, then the manufacturer's warranty does not apply and is voided.

Ratings are based on the crane standing on a firm, level, uniform supporting surface.

The weight of the hook block and all load handling devices are considered part of the load lifted

the closer you look

the better they look

CB

CHALLENGE TRUCK MIXERS

Leadership through creative engineering

ESSO

PRODUCING DEPARTMENT - WESTERN REGION

☐ MATERIAL and/or SERVICE ORDER

No. 13 S 612157

DATE Sept 17/74

TO: Northern Construction Co.
1304 Hornby St
Vancouver 111, B.C.
attention: D. Coulter

SHIP TO: IMPERIAL OIL LIMITED - PRODUCING DEPARTMENT

VIA

#	TRANS	MESSAGE NO.	ORDER NO.	ORDER DATE MO DAY YR	F.O.B. DEL. POINT	DESTINATION	END USE LOC'N.	REVERSAL	ORIGINATING LOCATION
	302								

SUPPLY THE UNDERNOTED GOODS AND/OR SERVICES SUBJECT TO THE TERMS AND CONDITIONS ON REVERSE SIDE HEREOF.

QUANTITY	UNIT	MATERIAL	MATERIAL CODE
		For engineering services required to prepare a preliminary design and cost estimate of a rock quarrying system and a concrete block manufacturing facility. Verbally requested 17th by J.J.R. de Jong	

INVOICE INSTRUCTIONS:

PLEASE INDICATE IF YOUR INVOICE IS: PARTIAL OR FINAL

SUBMIT YOUR INVOICES IN TRIPLICATE SHOWING ABOVE ORDER NUMBER INCLUDING W.C.B. ACCOUNT NUMBER ON SERVICE ORDERS ONLY AND MAIL TO:

IMPERIAL OIL LIMITED
WESTERN PURCHASING DIVISION
10025 JASPER AVENUE, EDMONTON, CANADA T5J 1S6

INSTRUCTIONS FOR I.O.L. PERSONNEL ONLY

FOR ARCTIC OPERATIONS - SUBMIT PARTS 1, 2, 3 & 4 IMMEDIATELY TO FIELD SERVICES DEPARTMENT, EDMONTON.

FOR OTHER OPERATIONS - SUBMIT PARTS 1, 2 & 3 IMMEDIATELY TO PURCHASING DEPARTMENT, EDMONTON.

ALL DATA BELOW MUST BE COMPLETED

END USE: Slope protection for future offshore islands

IMPERIAL OIL LIMITED
PER: Peacocke
PURCHASING DEPT.

REQUESTED BY

APPROVED BY: Leyell

IMPERIAL OIL LIMITED

500 SIXTH AVENUE SOUTH WEST, CALGARY, ALBERTA T2P 0S1

PRODUCTION DEPARTMENT

E. M. KEMP
PRODUCTION OPERATIONS MANAGER

February 4, 1975

File: 20300

O-65

Dr. M. J. Ruel
Water, Lands, Forest & Environmental
Division
Department of Indian and Northern Affairs
Centennial Tower
400 Laurier Avenue West
Ottawa K1A OH4
Ontario

Dear Dr. Ruel:

With reference to our recent discussions concerning Imperial's proposal for a harbour near King Point and the rock quarry at Mount Sedgewick, I hope that the following information may assist you in further evaluating our proposal.

The need for slope protection material is based on the assumptions that the development of our Adgo discovery will require up to four permanent artificial islands and that future discoveries in water depths of up to 40 feet will also be developed on artificial islands. The type, size and quantity of slope protection material needed for these islands has been calculated by our consultants, Hydronamic B.V., on the basis of a hypothetical program of exploration and development in the Beaufort Sea. The timing of the requirements is based on our assumption that Canada will urgently require additional oil production by 1983 and that part of this production will originate from Adgo and from additional discoveries that may be expected in the next few years as a result of our continued exploration program in the Beaufort Sea.

Working back from the "On Production" year of 1983, we believe that orderly and economical development of the Adgo pool will require that rip rap with weights from 50 to 3,000 lbs be available not later than 1977. By that time we will require some permanent wells for full-scale production tests and the islands on which these wells are located will also have to be permanent. In the attached time schedule, we have attempted to provide you with a logical chain of events and the timing that is necessary to reach our objective of having rip rap available by 1977.

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After 1977, additional discoveries in deeper water will demand slope protection materials with weights of up to 11.5 tons. The maximum size of the available quarry stone is 2.5 tons and rip rap heavier than that will therefore have to be concrete blocks.

A report prepared at our request by Northern Construction Company of Vancouver, a copy of which is attached, shows the preliminary plans for a rock quarry near Mt. Sedgewick and a concrete manufacturing plant near King Point. The report is meant to be a feasibility study and should not be considered an engineering proposal.

Section 4 of the report deals with costs and shows that the cost per ton of quarry stone is $26.64 as compared to $126.76 for concrete. If it were necessary to manufacture concrete blocks in the full range of rip rap required (50 lbs to 11.5 tons), this estimate would have to be revised. Concrete manufacturing is much more labour intensive than rock quarrying (see pages 4-21 and 4-22 of the report), and a proliferation of concrete block sizes would cause this comparison to become worse. Where there is some scope to effect a reduction in unit costs for the rock quarrying operation by increasing total output, we do not see this opportunity in the concrete manufacturing process.

The cost of slope protection for permanent islands using a combination of quarry stone and concrete has been estimated at 50% of the total cost of an island. The decision to use only concrete could therefore increase the cost of each island by 200% or more.

We should also point out that the Federal Department of Public Works in their report, "Herschel Island, Feasibility of a Marine Terminal", consider the Mt. Sedgewick area the logical source for quarry stone for any of their future plans.

In the area of environmental impact, we plan to use the CAGSL reports covering the area as a basis and we are presently considering what additional studies need to be made.

We appreciate your concern that we should not embark on fairly costly studies in view of the evident opposition of the Department of the Environment to our proposal. However, we

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believe that we can operate the project in an environmentally acceptable fashion, and are prepared to risk the study costs, since without an early commencement, we will be unable to achieve our objectives for island construction.

Yours very truly,

G. G. Mainland

JJAdeJong:jn
Atts. 1

G. G. Mainland
Frontier Planning Manager

FIGURE 3

SLOPE PROTECTION FOR ISLANDS