February 29, 1984 meeting comments: [Crandon Project]. 1984

[s.l.]: [s.n.], 1984

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LOWER STACKS

February 29, 1984 Meeting Comments

Comment No. 1:

Provide manufacturer's brochures describing the insertable collectors used in the coarse ore storage building.

Response:

The insertable particle collectors presently included in our design are a DCE Vokes Model DLM-V or equivalent. The attached vendor supplied information describes the principles of operation and other detailed specifications.

Comment No. 2:

Provide manufacturer's brochures describing the wet scrubber used in secondary and tertiary crushing and screening.

Response:

The wet scrubber presently included in our design is a Ducon Type UW-4, Model IV or equivalent. The attached vendor supplied information describes the principles of operation and other detailed specifications.

Comment No. 3:

Provide a copy of the source used for determining the emissions from the temporary diesel generators.

Response:

The emission factors used to estimate the emitted air contaminants from the temporary diesel generators were extracted from EPA, NEDS, Section 3, Chapter 7, Subject 0, p. 5, dated January 3, 1976. This information was provided to the DNR at the meeting in Madison on February 29, 1984 and is also attached as part of this response.

Comment Nos. 4 and 5:

Where are the estimated fugitive dust emissions accounted for from the construction of the access road (Comment No. 4) and railroad spur (Comment No. 5)?

Attachment for Comment No. 1

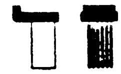
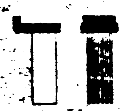
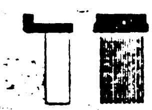
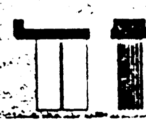
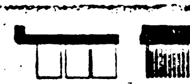
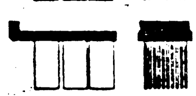
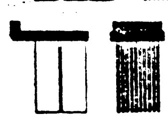
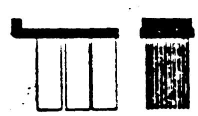
see us for dust

DCE VOKES

DCE VOKES Inc.
11301 Electron Drive
Jeffersontown
KENTUCKY 40299
Tel. (502) 267-0707
Telex 204306

THE FULL RANGE OF SIZES

NEW filters shown on blue panels

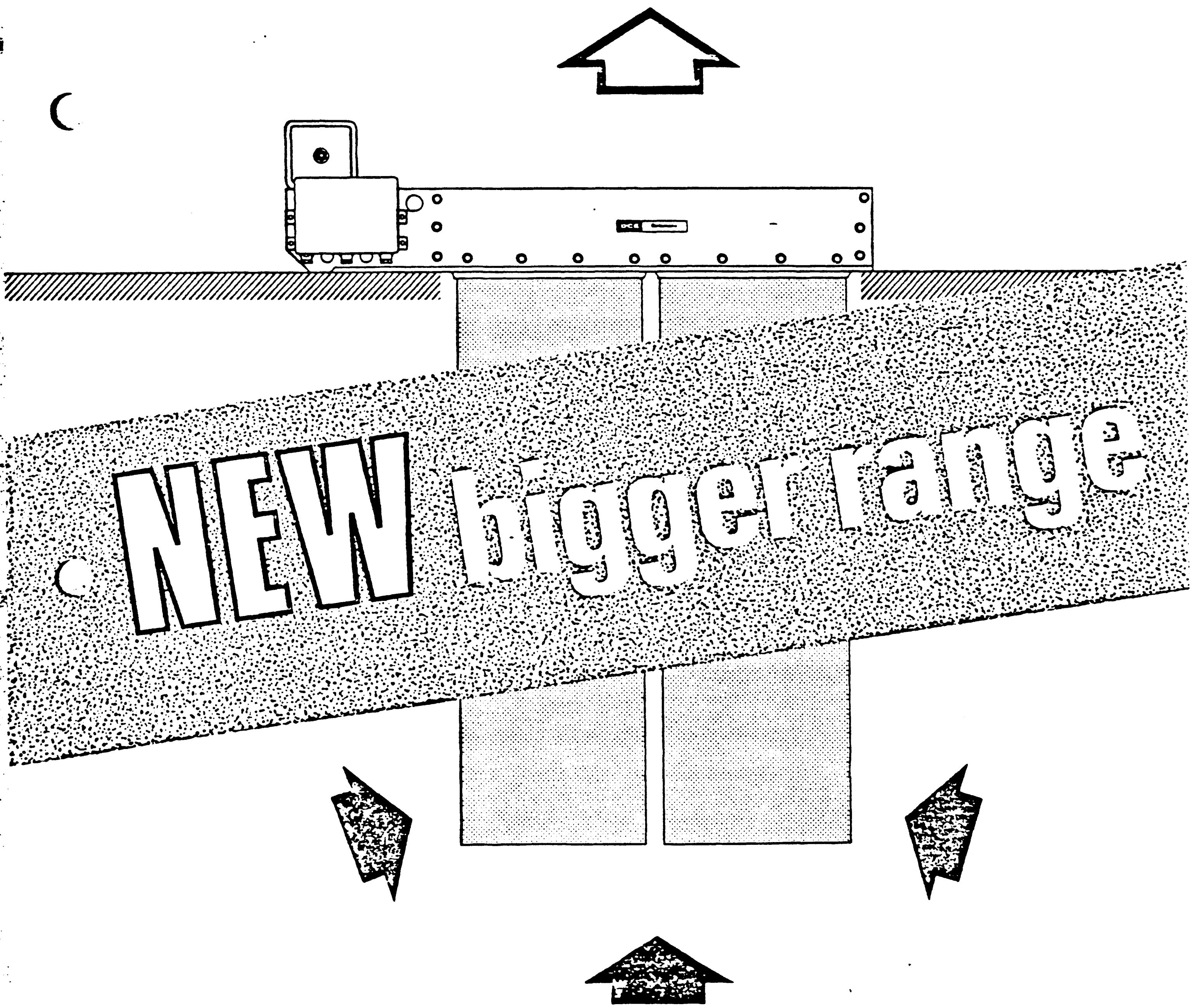
Filter Size Designation	Total Fabric Area	Filter Elements Number	Filter Elements Length	Filter Elements Configuration	Approx. Air Volume* m^3/hr	Approx. Air Volume* c.f.m.
DLM-V4/7	$4m^2$ ($43ft^2$)	6	0·7m		700	400
DLM-V6/10	$6m^2$ ($64ft^2$)	6	1·0m		1000	600
DLM-V7/7	$7m^2$ ($75ft^2$)	10	0·7m		1250	700
DLM-V8/7	$8m^2$ ($86ft^2$)	12	0·7m		1350	800
DLM-V9/15	$9m^2$ ($97ft^2$)	6	1·5m		1550	900
DLM-V10/10	$10m^2$ ($108ft^2$)	10	1·0m		1750	1000
DLM-V12/10	$12m^2$ ($129ft^2$)	12	1·0m		2000	1200
DLM-V14/7	$14m^2$ ($150ft^2$)	20	0·7m		2400	1400
DLM-V15/15	$15m^2$ ($161ft^2$)	10	1·5m		2550	1500
DLM-V18/15	$18m^2$ ($194ft^2$)	12	1·5m		3050	1800
DLM-V20/10	$20m^2$ ($215ft^2$)	20	1·0m		3500	2000
DLM-V21/7	$21m^2$ ($226ft^2$)	30	0·7m		3600	2100
DLM-V30/10	$30m^2$ ($323ft^2$)	30	1·0m		5100	3000
DLM-V30/15	$30m^2$ ($323ft^2$)	20	1·5m		5100	3000
DLM-V45/15	$45m^2$ ($484ft^2$)	30	1·5m		7650	4500

*NOTE: The air volumes shown above must be taken as a rough guide only. They can vary considerably according to the nature of the dust involved.

DCE VOKES

Dalamatic

insertable filters



DCE Dalamatic Insertable Filters

NEW BIGGER RANGE

DCE has more than doubled its range of Dalamatic automatic Insertable reverse jet filters by introducing a new 1·5m long filter element and increasing the maximum number of modules from two to three. The range now consists of 79 filters made up from 14 sizes of fabric area, 15 different filter configurations and four types. The new bigger sizes ($30m^2$ and $45m^2$ fabric area) have been developed to meet the increasing need for larger filters in the handling, processing and storage of bulk materials and powders. At the same time more sizes have been added to the middle of the range to increase its flexibility.

The new filters enjoy the other advantages of Dalamatic Insertables. They are easy to assemble and have excellent seals. Flat pad-shaped filter elements ensure compactness. No moving mechanical parts are involved. Filter elements are cleaned in turn by a brief burst of compressed air in the reverse direction to that of the main air flow. This is automatic and continuous, using an electronic controller of total solid state design. Only top quality felt media — vital to proper filter performance — is used. Advanced automated production methods ensure accurate components and inherently strong high quality products.

TYPES OF FILTER

There are four types in the DCE range of Dalamatic Insertable Filters:

Type B *Basic* filter for pressure systems sited internally.

Type H Filter with exit *Header* for connection to a fan or discharge ducting. The filter is weather-proof and suitable for internal and external applications.

Type W Filter with a *Weather cowl* for pressure systems where the filter is located outside or exposed to adverse site conditions.

Type F Weatherproof filter fitted with a *Fan* for applications normally operating below atmospheric pressure. All fans are integral, with a choice of two or three on most sizes.

SIZE RANGE

Each type is available in 14 different sizes with varying filtration capacities. They are based on two sizes of seal frame, containing either six or ten filter elements in one of three lengths: 0·7m, 1·0m or the new 1·5m. These are assembled into single module sizes which can be joined together in twos or threes as shown in the configurations opposite.

FILTER DESIGNATION

Dalamatic Insertable Filters are identified by the letter reference DLM-V followed by figures denoting (i) the fabric area and (ii) the length of element (see table opposite). A final letter is added to indicate the Type. For example: DLM-V4/7B; DLM-V30/15F etc.

THE DALAMATIC

DALAMATIC reverse jet fabric filters are designed for continuous operation on applications where product or nuisance dusts are involved and where high collection efficiencies are required. The Dalamatic is capable of filtering heavy dust burdens at a high filtration velocity and a constant level of resistance. Collection efficiency often exceeds 99·99%.

The Dalamatics have proven themselves through years of successful performance and have gained wide acceptance in the world's most demanding markets. The improvements in the current design have resulted from the experience gained through thousands of installations cleaning millions of CFM. These modifications have improved filter performance, capacity, and convenience of maintenance, without increasing costs. Today's Dalamatics meet today's rigid requirements.

Some Dalamatic advantages:

● Downward Flow
The top inlet of this filter insures a downward flow and more effective operation. Other types with bottom inlet and upward air flow have a higher pressure loss for a given filtration velocity.

● Cleanside Access
Full width access from the clean air side makes inspections and changing of filter envelopes easier and safer. Access from the dust side — as on some competitive models — is always unpleasant and may even be dangerous when toxic contaminants are involved.

● Convenient Envelope Size
Filter elements are designed so that one man can change a filter envelope without help. In some designs this is impossible.

● No Moving Parts
Filter envelopes are cleaned in turn by a brief burst of compressed air in the reverse direction of the main air flow. This is electronically controlled, automatic and continuous. With no moving parts, filter reliability is greater than with mechanical cleaning systems.

● Advanced Production Methods
Our designs utilize sophisticated manufacturing techniques which produce a sturdy filter casing at a relatively low cost.

● Tight Envelope Seals
The Dalamatic method of sealing each filter envelope by compressing an integral sealing ring between the insert header and the seal frame insures a tight seal — without screws and toggle bolts.

● Easy Access to Controls
The controller and filter cleaning assembly are located below the clean air chamber for easy access and adjustment. Top-mounted equipment can be difficult to reach.

● Very Compact
The flat envelope configuration of filter elements makes the Dalamatic extremely compact and insures maximum filtration area in a given space.

● Double Banking
To save additional space two multi-bank assemblies can be jointed on either the dirty or the clean air sides. This means a considerable saving in the need for access platforms and inspection doors while keeping the advantage of easy access for envelope changing.

APPLICATIONS

Dalamatics are applied in almost every industry which processes powdered or granulated materials, or uses equipment producing large quantities of dust. Some examples are: aluminum, asbestos, carbon, cement, chemicals, detergents, dyestuffs, flour, foodstuffs, graphite, glass, insecticides, pharmaceuticals, plastics, sugar, tobacco, and many others.

The Dalamatic *insertable* filters were originally designed to deal with the heavy dust burdens and high filtration velocities encountered in pneumatic conveying systems handling particulate products. Simply inserted into silos, the filter provided continuous filtration of the conveying air with a high collection efficiency. The range of the insertable filter has been expanded and now extends over many other applications, including mechanical conveying of bulk materials and a wide variety of process equipment into which the filter can be integrated.

DALAMATIC FILTER ASSEMBLY

Each filter assembly or 'cell' comprises a number of flat rectangular envelope-shaped filter elements inserted through parallel recessed slots in a seal frame which separates the dust side from the clean air side of the filter. Each filter element consists of a felted envelope supported on a rigid open mesh frame or insert which has an integral header and sealing flange welded to its mouth. A multi-nozzle jet tube is located along the mouth of each insert header. It is connected via a diaphragm valve to a compressed air manifold. The valves are linked to a solenoid timer specifically designed for use with Dalamatic filters.

PRINCIPLE OF OPERATION

The dust laden air is drawn onto the filter envelope, where the dust is retained on the outer surface of the fabric. Cleaned air passes through the fabric and out of the insert header as shown in Fig. 1, on the clean side of the filter. To maintain continuous operation each envelope must be regularly cleaned. This is achieved by reverse jet cleaning. An electronic timer activates each pilot valve in sequence at predetermined intervals on a continuous cycle. The pilot valve in turn opens the diaphragm valve (see Fig. 2). A short burst of compressed air is released and injected by the multi-nozzle jet tube through the insert header into the filter envelope. This causes a momentary reversal of the air flow through the filter envelope. The effect is a brief controlled inflation of the envelope so that the accumulated dust or dust cake is dislodged from its surface. Simultaneously the reversed air flow through the fabric assists dust removal. The collected dust falls either into a collection hopper beneath or directly back into the process served.

FILTER FABRIC

Well-designed reverse jet filters avoid mechanical stresses on the filtration medium, so that felted fabrics with their inherently higher efficiency and lower resistance compared with woven materials can be used without risk of damage. Felted fabrics in a number of synthetic and natural fibers are available, but the majority of applications are best served by standard polyester felt. Other felted materials include Nylon and Orlon while another — Nomex — is suitable for temperatures up to 400°F. All fabrics are manufactured to a strict specification and undergo stringent quality control testing. The quality of the fabric and the high standard of envelope manufacture are an intrinsic part of the filter design and govern the filtration properties of the filter. The use of substitutes could reduce the efficiency of the filter.

PAINT FINISH

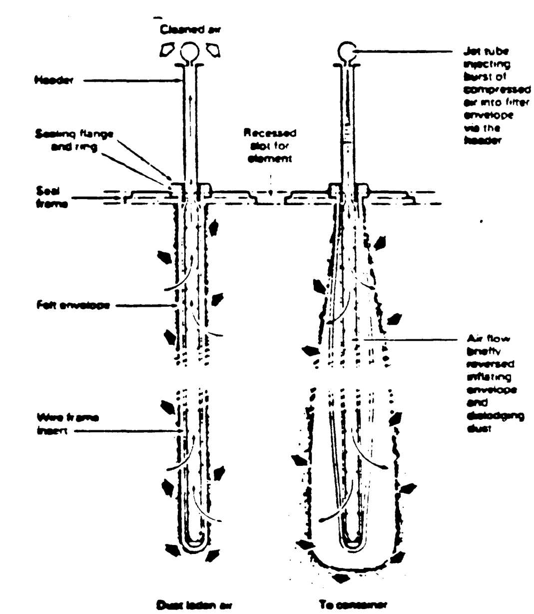
Series DLM

The main case, seal frame and internal components (except filter envelope inserts) are degreased, coated with epoxy powder by an electrostatic powder spray gun and then baked. Envelope inserts are degreased and dipped in a tank containing an electrophoretic water-based epoxy paint and then baked.

Series DLM-V

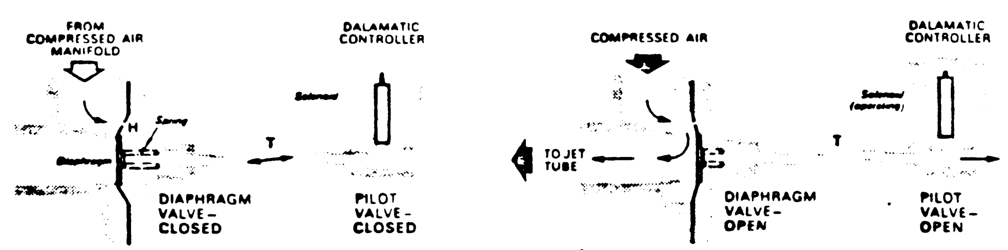
The same two processes are employed as follows: electrostatic epoxy powder for seal frames and electrophoretic epoxy dip for envelope inserts and all other components.

Note: For corrosive operating conditions reference should be made to DCE VOKES Inc. for alternative methods of protection.



a Filtering **b** Cleaning

Fig. 1 Section through filter elements



a Compressed air from the manifold penetrates diaphragm through fine hole 'H' into connecting tube 'T'

b When solenoid is activated the pilot valve opens, releasing the compressed air from connecting tube 'T' and allowing diaphragm to open

Fig. 2 The valve system

SIZE RANGE

The range of cased filters is based on a single cell size each consisting of a seal frame and ten filter envelopes with a total fabric area of approximately 105 sq. ft. Cells are then built up in banks and tiers to handle the air volume required by the particular application. Examples are given in the table below.

Units are available pre-assembled up to the maximum dimensions permitted by freight restrictions. Where conditions require larger units, they can be erected on the site from pre-assembled sub-assemblies.

CONSTRUCTION AND OPERATION

The Dalamatic reverse jet filter comprises an outer case enclosing the required number of cells. The benefits of long experience in types of joint and methods of sealing have been incorporated in the filter construction. Joints have been stiffened by double fold, and overlapped between case panels. The supporting structure and the collection hopper are bolted onto the main case underneath. The hopper has a bottom flange for attachment of a suitable device for removing the collected dust.

The dust laden air enters the cased Dalamatic through an inlet at the top and is directed downwards. After passing through the filter elements the air is discharged through an outlet above the clean side of the filter.

There are several methods of dust disposal. Single bank units are normally supplied with hoppers terminating in a flanged outlet to accept various sizes of rotary valve. Multibank assemblies are normally supplied with trough hoppers and screw conveyors; alternative arrangements can be made to suit special applications.

CONTROLLER

A 10-valve controller assembly is fitted to Dalamatic cased filters. It contains a fully automatic solid state dual timer, which activates the solenoid valves in the required sequence and governs the interval between the pulses of compressed air. The time interval is adjustable to suit the severity of the application and has a range of 5 to 35 seconds with a factory setting of 12 seconds.

The controller consists of a steel box, solid state transistorized circuit board, multi voltage transformer, plug-in uni-selector and quick acting fuse. It is recommended that a fused isolator, fitted with 2 amp HRC fuses, be installed between the controller and the incoming supply.

AIR SUPPLY

A supply of clean, dry compressed air at a pressure of 90 p.s.i.g. (7 atm) is required for efficient filter operation. (Moisture separators are supplied with cased filters.) Recommended design air volumes are given below.

Filter Size	AIR VOLUME (free air delivered) at 12 sec. intervals
DLM 1/2/10 DLM 1/3/10 DLM 1/4/10	8 c.f.m.
DLM 2/3/10 DLM 2/4/10	16 c.f.m.

In most applications experience will allow increasing the interval with a resulting decrease in compressed air consumption.

Designation	No. of Banks (a)	No. of Tiers (b)	No. of Cells (a) x (b)	No. of Envelopes (10 per cell)	Nominal Filter Area* sq. ft.	Approx. Air Volume† c.f.m.
DLM 1/2/10	1	2	2	20	210	1,500
DLM 1/3/10	1	3	3	30	315	2,250
DLM 1/4/10	1	4	4	40	420	3,000
DLM 2/3/10	2	3	6	60	630	4,500
DLM 2/4/10	2	4	8	80	840	6,000
DLM 3/4/10	3	4	12	120	1,260	9,000
DLM 4/4/10	4	4	16	160	1,680	12,000
DLM 5/4/10	5	4	20	200	2,100	15,000
DLM 6/4/10	6	4	24	240	2,520	18,000
DLM 7/4/10	7	4	28	280	2,940	21,000
DLM 8/4/10	8	4	32	320	3,360	24,000
DLM 9/4/10	9	4	36	360	3,780	27,000
DLM 10/4/10	10	4	40	400	4,200	30,000
DLM 20/4/10	20	4	80	800	8,400	60,000

*Exact filter area is 107 6 sq. ft. per cell. † This is a rough guide only, based on average dust burden and particle size distribution.

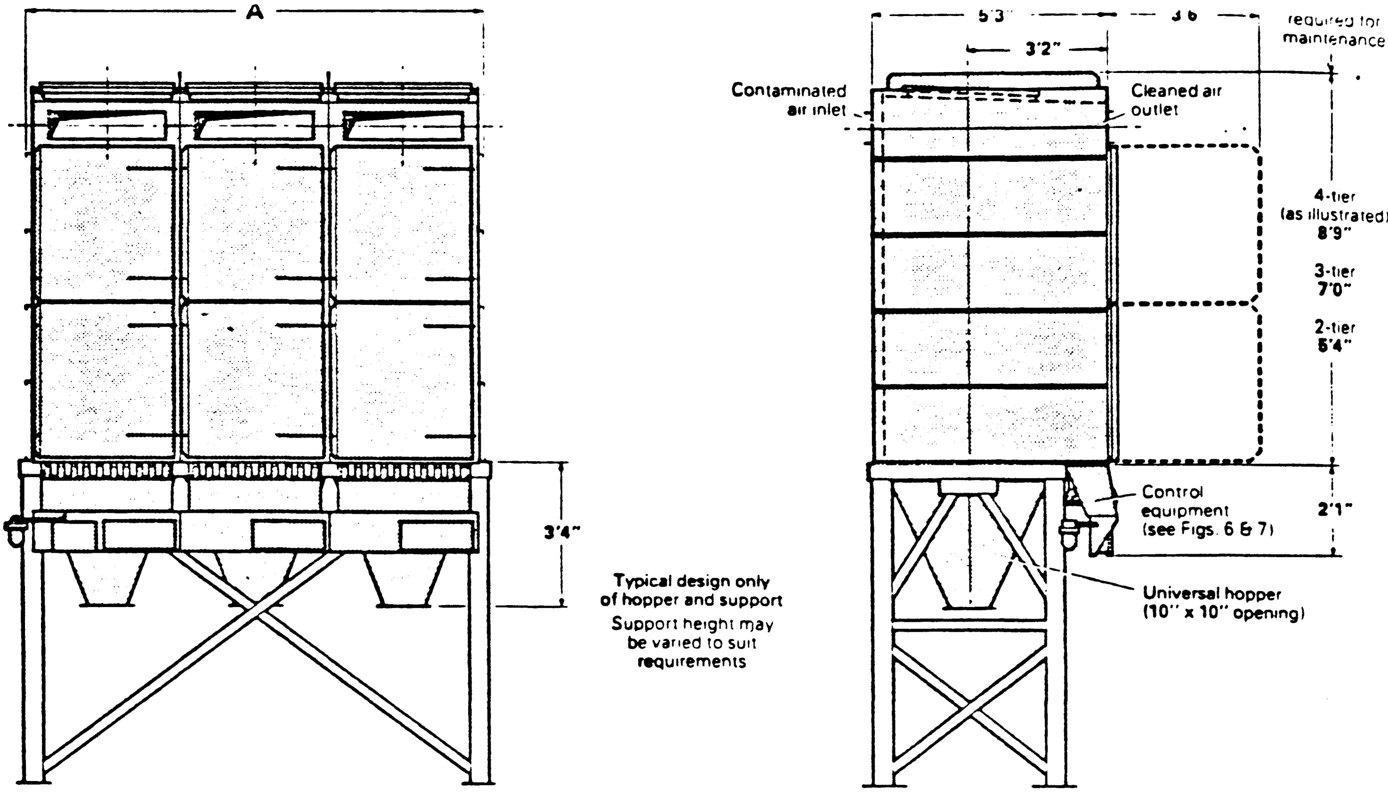


Fig. 3 Dalamatic 3-bank 4-tier filter (DLM 3/4/10) with universal hopper

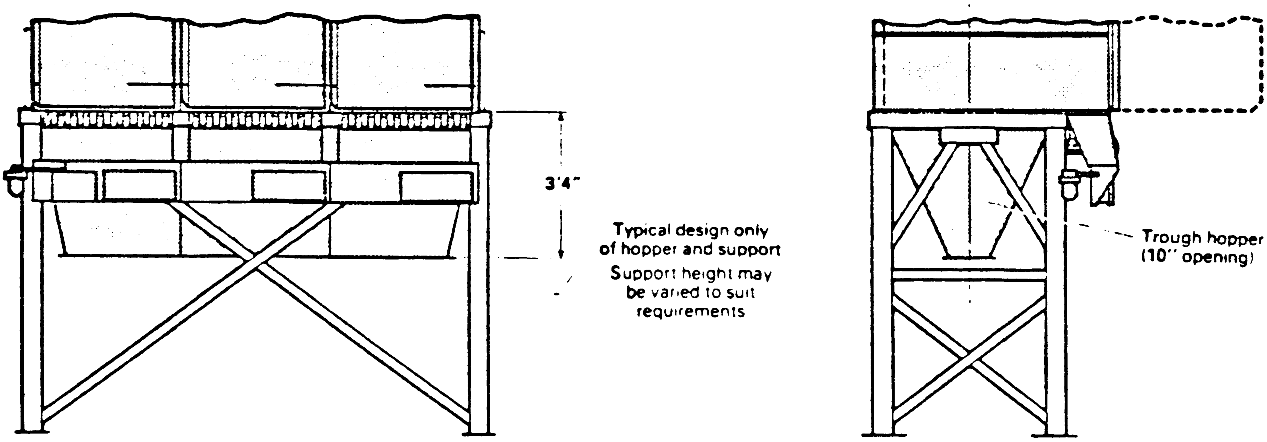


Fig. 4 Trough type hopper for attachment to screw conveyor

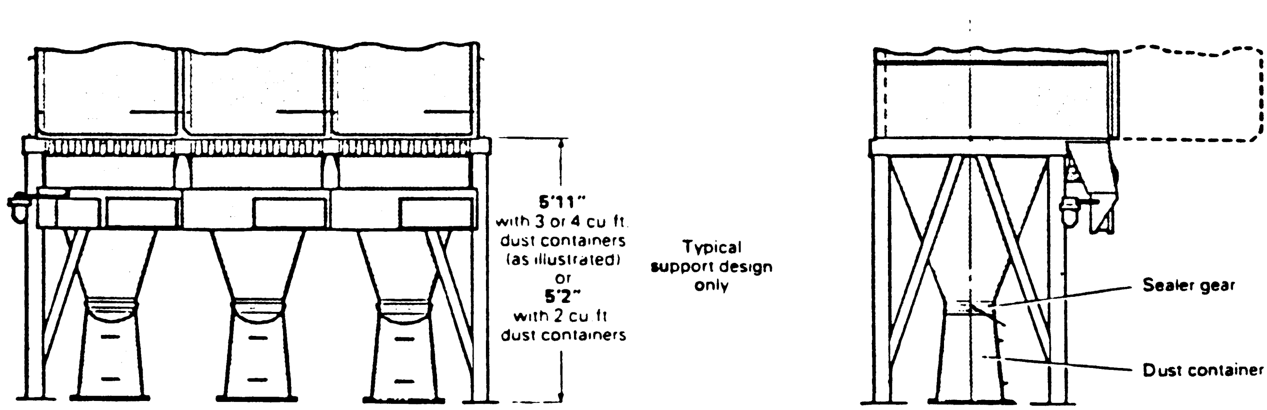


Fig. 5 DCE 'UMA' type dust containers with quick-release sealer gear

OVERALL WIDTHS OF SERIES DLM FILTERS

	1/2/10	–	–	–	–	–	–	–	–	–
	1/3/10	2/3/10	–	–	–	–	–	–	–	–
	1/4/10	2/4/10	3/4/10	4/4/10	5/4/10	6/4/10	7/4/10	8/4/10	9/4/10	10/4/10
	1/6/10	2/6/10	3/6/10	4/6/10	5/6/10	6/6/10	7/6/10	8/6/10	9/6/10	10/6/10
Dim. 'A'	3' 8"	6' 11"	10' 3"	13' 6"	16' 10"	20' 2"	23' 5"	26' 9"	30' 0"	33' 4"

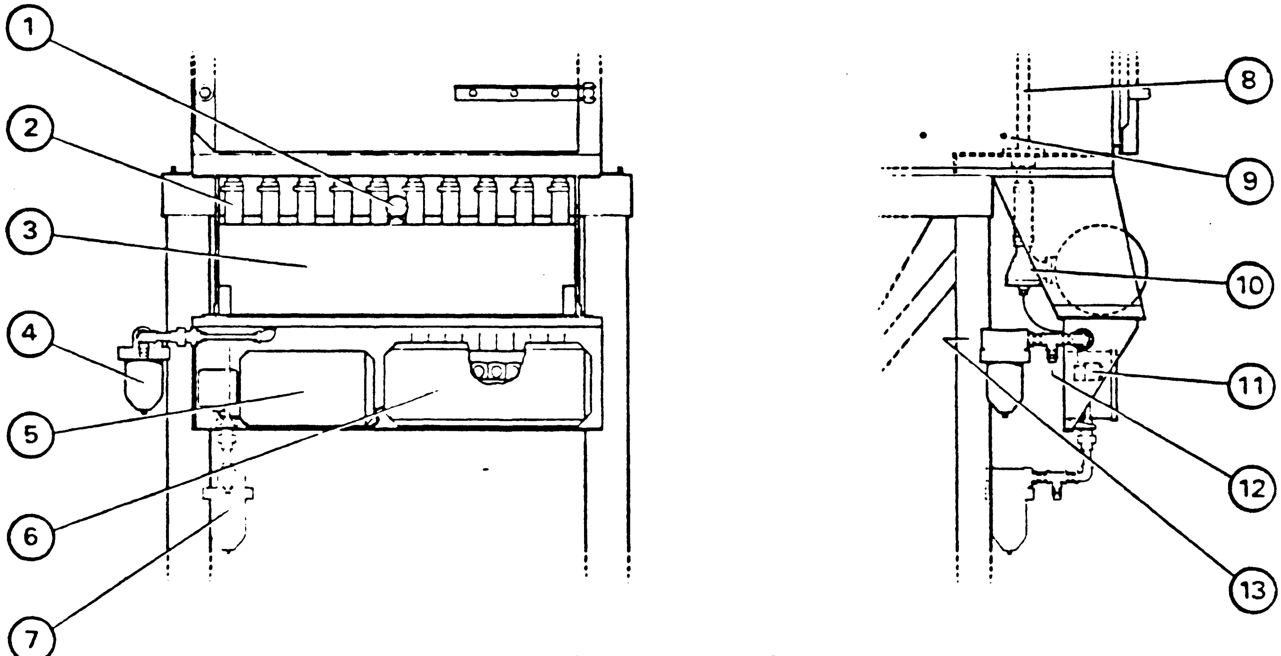
APPROXIMATE NET WEIGHTS

	FILTER COMPLETE (as Fig. 3)	FILTER WITHOUT SUPPORT, HOPPER OR DUST CONTAINER								
	1 Bank	2 Banks	3 Banks	4 Banks	5 Banks	6 Banks	7 Banks	8 Banks	9 Banks	10 Banks
2 Tiers	2100 lb	–	–	–	–	–	–	–	–	–
3 Tiers	2550 lb	5200 lb	–	–	–	–	–	–	–	–
4 Tiers	3100 lb	6200 lb	9300 lb	9050 lb	11300 lb	13500 lb	15700 lb	18150 lb	20300 lb	22550 lb
6 Tiers	3550 lb	6650 lb	9750 lb	12800 lb	15900 lb	19000 lb	22100 lb	25200 lb	28300 lb	31400 lb

DESIGN LIMITS (STANDARD EQUIPMENT)

Temperature range: *(two choices available, according to type of sealer used):* (a) 15°F to 140°F; or (b) 15°F to 400°F
For lower temperature applications consult with DCE VOKES Inc.

Pressure limits: –20"WG to ±8"WG **Dimension tolerances:** ± 3/16" on main dimensions; ± 1/16" on detail dimensions



Figs 6 & 7 Front and side elevations of Control Equipment
(see table below)

STANDARD COMPONENTS

1 Pressure gauge
2 Rubber connecting hose
3 Compressed air distribution manifold
4 Moisture separator (up to 6-bank)
5 Dalamatic controller
6 Solenoid terminal box
7 Moisture separator (over 6-bank)
8 Jet tube
9 Manometer connections
10 Diaphragm valve
11 Pilot valve – inside solenoid terminal box, item 6
12 Pressure relief valve
13 Compressed air inlet

Note: The illustrations on these two pages show the latest design of control equipment giving improved access to all components

TYPE

There are four types in the Dalamatic insertable filter range:

Type B Basic filter for pressure systems in applications for indoor use.

Type H Filter with exit header for connection to fan or for conveying filtered air from the filter. The filter is weatherproof and suitable for outdoor applications.

Type W Filter with a weather cowl for pressure systems in applications where the filter is sited outside or exposed to adverse site conditions.

Type F Filter fitted with integral fan for applications normally operating at below atmospheric pressure. This filter is also weatherproof.

SIZE

Each type is available in seven different single cell sizes with varying filtration capacities. They are based on two sizes of seal frame, one holding six envelopes and the other ten. Two lengths of envelope in combination with the two sizes of seal frame make up the size range as shown in the table below.

FILTER DESIGNATION

The designation of Dalamatic insertable filters begins with the prefix DLM-V and is followed by a figure denoting the size and a letter denoting the type, for example:

DLM-V 4B = Dalamatic Insertable with filter area of 40 sq. ft., Basic Type. (See inside back cover).

CONTROLLER

A 3-valve controller assembly is fitted to Dalamatic insertable filters sizes V4, V6 and V12, while a similar assembly incorporating 5 valves is fitted to sizes V7, V10, V14 and V20.

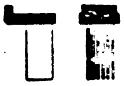
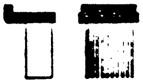
It contains a fully automatic solid state dual timer. The time interval has a range of 6 to 30 seconds with a normal initial setting of 20 to 25 seconds. A fused isolator fitted with a 2 amp HRC fuse should be installed between the controller and the incoming supply.

In the case of the DLM-V Type F model the fan should only operate in conjunction with the controller, but wherever possible the controller itself should be capable of independent operation so that the filter elements can be cleaned under static air conditions.

AIR SUPPLY

A supply of clean and dry compressed air, at a pressure of approximately 90 p.s.i.g. (7 atm.) is required for efficient filter operation. Recommended atmospheric air volumes are given below:

Filter Size	AIR VOLUME — F.A.D. 20-25 sec. interval
DLM-V4 DLM-V6	3·1 c.f.m.
DLM-V7 DLM-V10	5·1 c.f.m.
DLM-V12 DLM-V14 DLM-V20	5·5 c.f.m.

Filter size Designation	Nominal Filter Area sq. ft.	Filter Elements No. & Size	Filter Elements Arrangement	Approx. Air Volume* c.f.m.
DLM-V4	40	6 – Short		400
DLM-V6	63	6 – Long		600
DLM-V7	70	10 – Short		700
DLM-V10	105	10 – Long		1000
DLM-V12	126	12 – Long		1200
DLM-V14	140	20 – Short		1500
DLM-V20	210	20 – Long		2000

*This is a rough guide only, based on average dust burden and particle size distribution

ELECTRICAL SUPPLY

All Insertables require a two-wire supply of 115v or 230v to operate the controller. In addition, Type F filters require a three-phase supply to drive the fan motor — DCE VOKES standard motors being suitable for 230/460v, 3ph, 60Hz.

TYPICAL APPLICATIONS

(a) Venting Silos in Pneumatic Conveying Systems

1. Blowing system in which every part is under positive pressure and the fan or blower is at the beginning of the line, providing the motive power. (See Fig. 8a.)

2. Suction system where a suction fan at the end of the line draws the product along the line and keeps the whole system under suction. (Fig. 8b.)

3. System employing both blower and suction fan (see Fig. 8c). Examples are applications involving delivery to a silo which has to be kept below atmospheric pressure to avoid escape of dust through leakage, or where direct inspection of the interior of a silo is required while working.

The filter is inserted in the top of the silo or storage vessel to separate the product from conveying air so that product loss and dust nuisance are both prevented. The reverse jet cleaning system removes the collected dust continuously from the filter elements and returns it directly to the bulk content of the silo. The DLM-V Type B and DLM-V Type W are normally applied in blowing systems and the DLM-V Type H in suction systems. The DLM-V Type F is used in the third case on systems where the suction fan is needed to assist in the relief of pressure from the system.

(b) Mechanical Conveyors

The dust cloud which arises at loading, discharge and transfer points on mechanical conveyors can be controlled by a DLM-V Type F mounted in or above an aperture cut in the enclosure. The collected dust is returned directly to the product. This saves space, makes ducting and other ancillary equipment unnecessary and avoids the secondary dust problems associated with disposal of the collected dust. (See Fig. 9.)

(c) Silo Fed by Mechanical Conveyor

The DLM-V Type F is either mounted above the tipping point or in a separate opening adjacent to it. The filter keeps the silo under suction and so retains airborne particles which would otherwise be carried away by the displaced air escaping from the silo. The collected dust is continuously returned to the product in the silo.

(d) Ventilation of Air Slides

A DLM-V may be directly mounted at the end of an air slide powder transport system for air release. If the air slide system is extensive, it may be convenient to install the DLM-V at an intermediate junction or bend.

(e) Dust Control System with Pre-separation

With certain dusts, of extremely fibrous or abrasive nature for example, it is sometimes preferable that the filter should not come into direct contact with the bulk dust load.

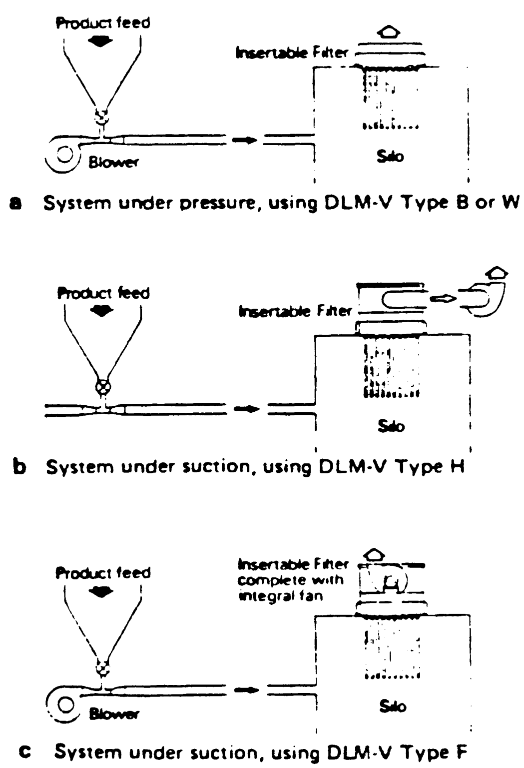


Fig. 8 Venting silos fed by pneumatic conveying systems

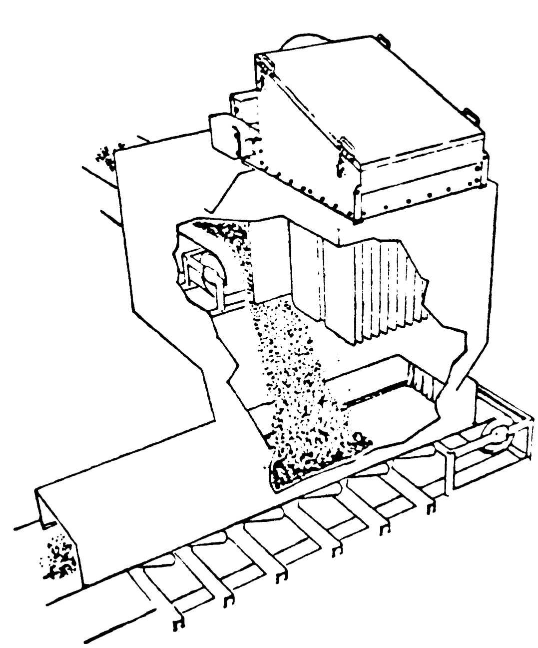


Fig. 9 DLM-V Type F mounted above belt transfer point

A typical solution (see Fig. 10) is to insert DLM-V filters in the top of a cone-shaped housing; the dust is then introduced tangentially to the housing below the filter elements, causing most of the dust to pre-separate to the bottom of the cone. The remaining fine dust is carried at low velocity to the filters above and the air discharged in cleaned condition to atmosphere. Depending on the duty involved, one or more Dalamatic filters may be inserted into the coned filter housing; either DLM-V Type H units each linked to an external fan or DLM-V Type F units with integral fans can be used.

As housing dimensions and operating conditions are critical in meeting the performance required, these applications must have careful assessment.

(f) Bin Fluidization

Powder storage bins may be fluidized by air blown in at the base of the vessel to prevent material 'packing' and to assist discharge without the need for steep angle trough hoppers or bin vibrators. A DLM-V inserted at the top of the vessel insures continuous clean discharge of the fluidizing air.

(g) Integration with Process Machinery

Dalamatic Insertable Filters may be actually integrated within specific process machinery requiring dust control such as fluid bed reactors, mixers, blenders, mills, crushers and similar equipment, or utilized for the ventilation of certain types of powder spray booths and automatic bag slitting machines. The field of application is virtually unlimited.

MOUNTING POSITIONS

All types of Insertable Filter may be mounted vertically or horizontally as shown in Fig. 11. All are suitable for in- or outdoor locations except the DLM-V Type B — the only model not fully weatherproof.

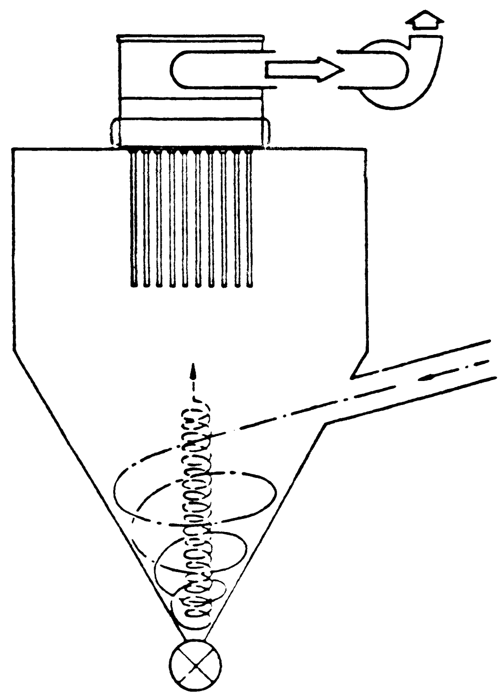


Fig. 10 DLM-V Type H used in dust control system with pre-separator

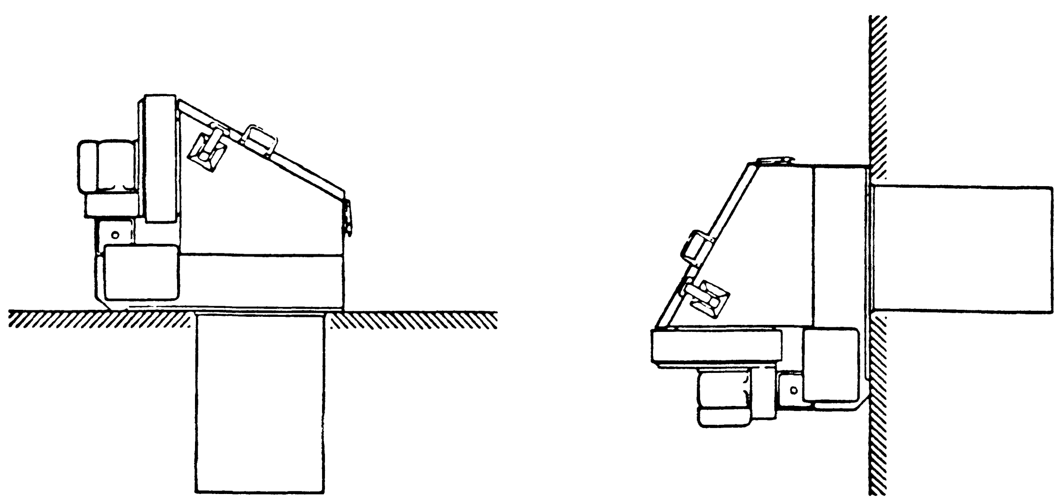
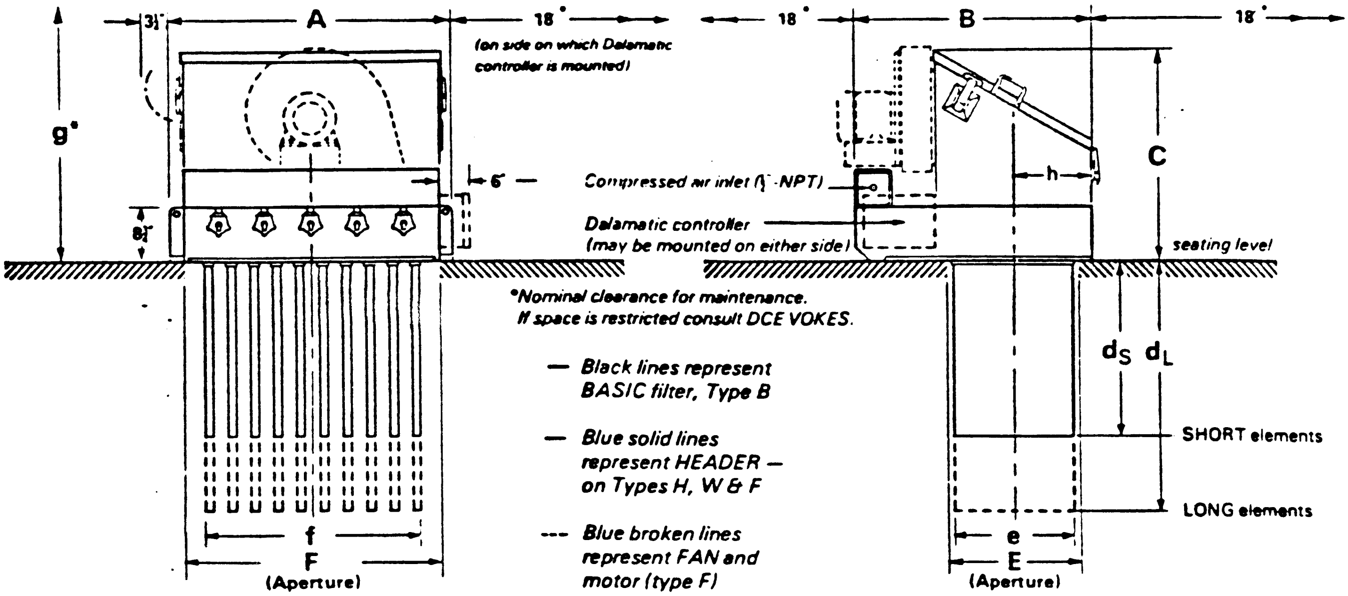


Fig. 11 Alternative mounting positions for DLM-V insertable filters (Type F illustrated)



FRONT ELEVATION   SIDE ELEVATION

Size DLM-V7 illustrated, larger elements representing DLM-V10

DIMENSIONS

(Tolerance ± ⅛" on main dimensions)

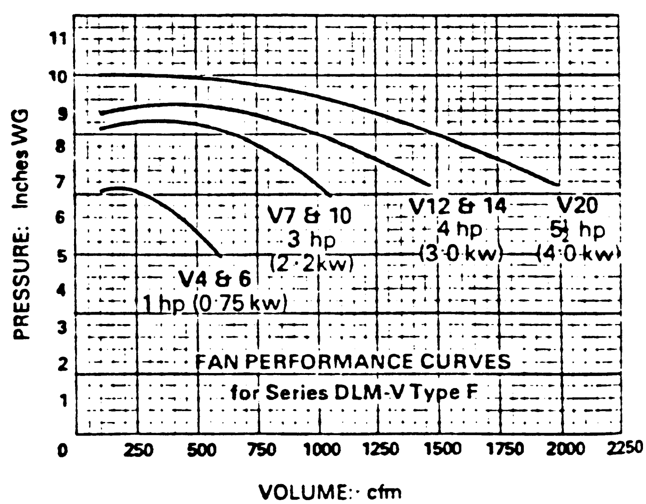
MODEL*	All Types								Type B			Types H, W & F†		
	A	d_S	d_L	E	e	F	f	h	B	C	g	B‡	C‡	g
DLM-V4	2'3½"	2'3½"	–	20½"	19"	23½"	18½"	12¼"	2'11¾"	14¾"	2'10"	2'11¾"	2'6⅛"	3'7"
DLM-V6	2'3½"	–	3'3½"	20½"	19"	23½"	18½"	12¼"	2'11¾"	14¾"	4'0"	2'11¾"	2'6⅛"	4'11"
DLM-V7	3'7½"	2'3½"	–	20½"	19"	3'3¼"	2'8½"	12¼"	3'0⅜"	14¾"	2'10"	3'0⅜"	2'8⅞"	3'7"
DLM-V10	3'7½"	–	3'3½"	20½"	19"	3'3¼"	2'8½"	12¼"	3'0⅜"	14¾"	4'0"	3'0⅜"	2'8⅞"	4'11"
DLM-V12	2'3½"	–	3'3½"	3'5¼"	3'3½"	23½"	18½"	22⅜"	5'0"	15¾"	4'0"	5'0"	2'10"	4'11"
DLM-V14	3'7½"	2'3½"	–	3'5¼"	3'3½"	3'3¼"	2'8½"	22⅜"	5'0"	15¾"	2'10"	5'0"	2'10"	3'7"
DLM-V20	3'7½"	–	3'3½"	3'5¼"	3'3½"	3'3¼"	2'8½"	22⅜"	5'0"	15¾"	4'0"	5'0"	2'10"	4'11"

*For number of elements and total filter areas see chart on page 8   †For fan details see below

‡Type F fan motors and cases may project by up to 2½" beyond these dimensions

APPROX. NET WEIGHTS

MODEL	Type B	Type H	Type W	Type F
DLM-V4	220 lb	270 lb	280 lb	320 lb
DLM-V6	250 lb	300 lb	310 lb	350 lb
DLM-V7	490 lb	540 lb	560 lb	630 lb
DLM-V10	540 lb	600 lb	620 lb	680 lb
DLM-V12	510 lb	560 lb	580 lb	660 lb
DLM-V14	620 lb	740 lb	760 lb	850 lb
DLM-V20	710 lb	830 lb	850 lb	960 lb



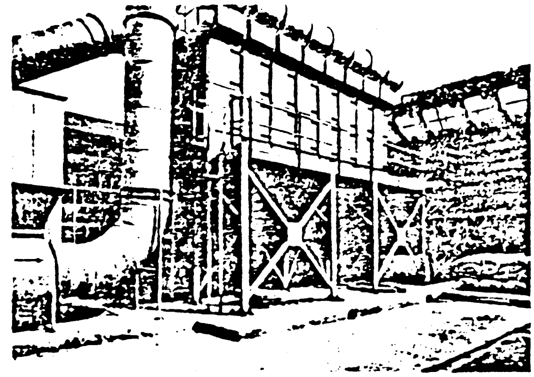
OPERATING DESIGN LIMITS

Temperature range: **Types B, H & W** *Two choices available:* **(a)** 15° to 140°F, **(b)** 15° to 250°F. **Type F** 15° to 140°F

For lower or higher temperature applications consult with DCE VOKES Inc

Pressure limits for Type H: −15" to +2" WG

Typical Installations — Cased Dalamatics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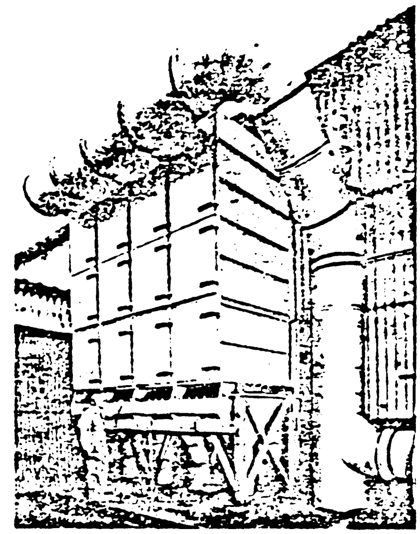
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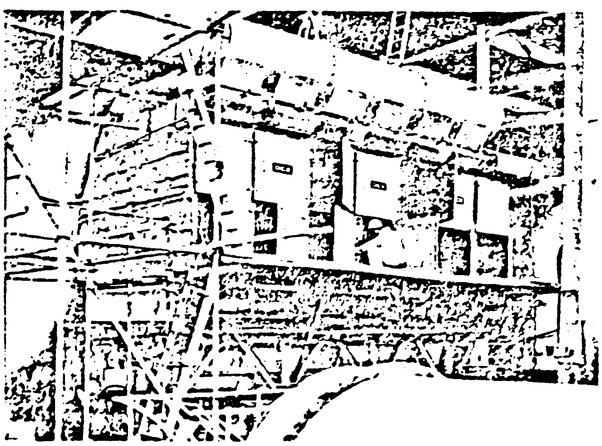
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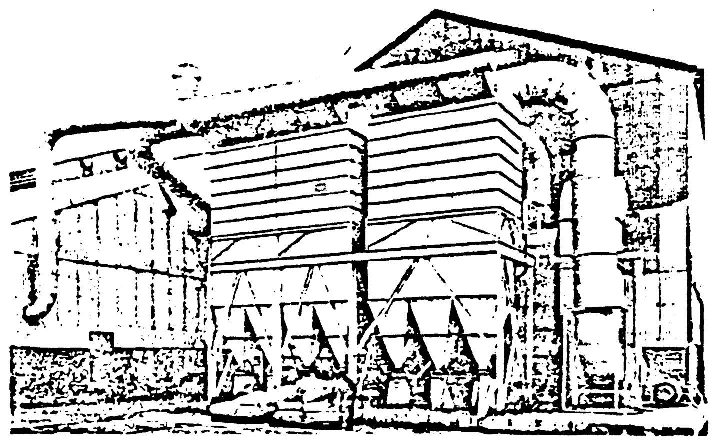
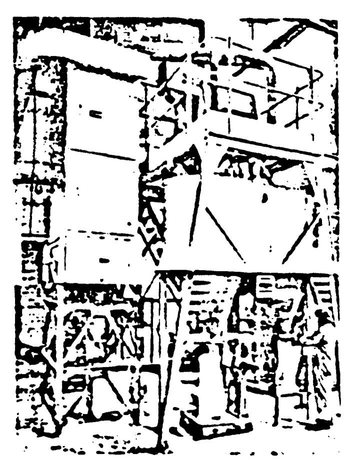

5

1 Dalamatic installation for collecting asbestos dust from board cutting operations.
2 Product recovery from the grinding of animal foodstuffs.
3 Dalamatic installation handling carbon dust.
4 Dalamatic filter installation under construction for a cement mill.
5 Two banks of Dalamatics handling graphite and carbon dust.
6 Dalamatic serving ball mills at a metal refinery.
7 Ground sandstone sieving system served by a Dalamatic filter plant.


6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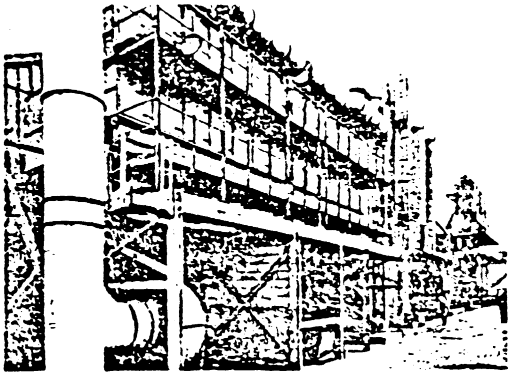
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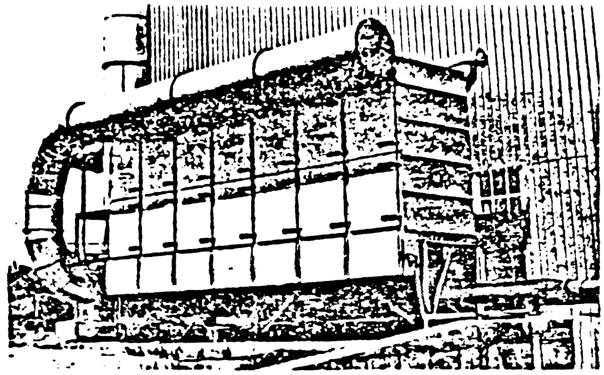
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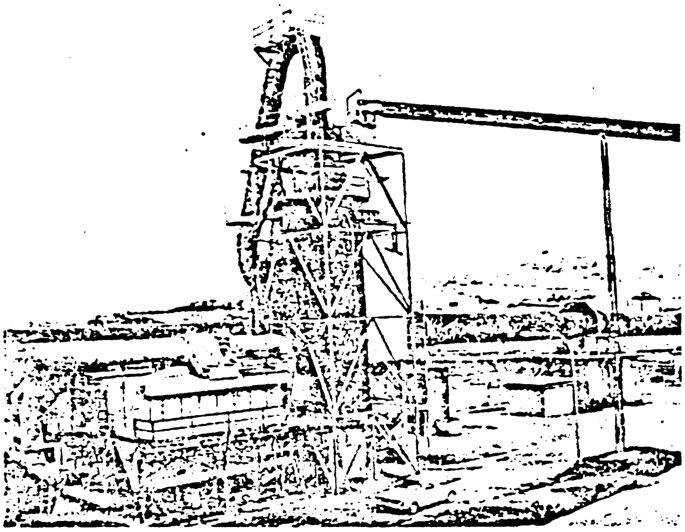
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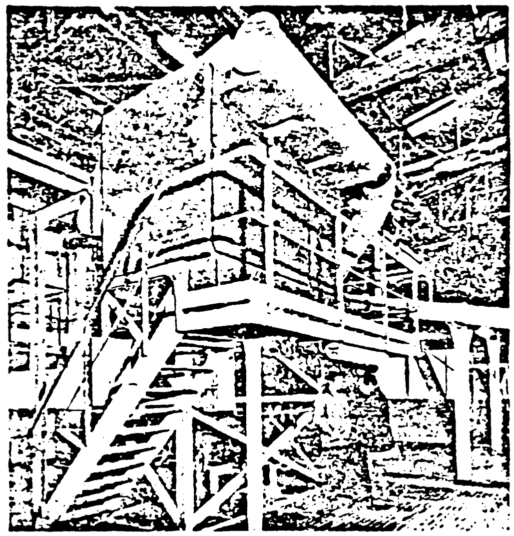
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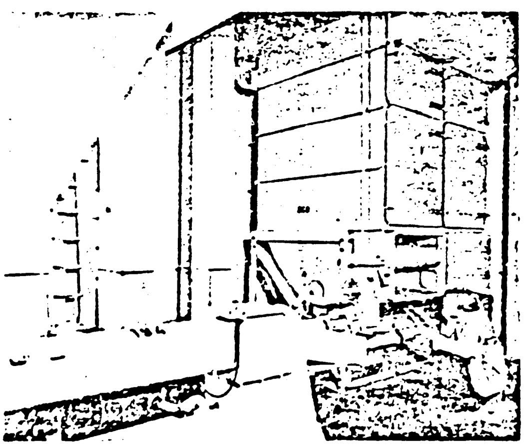
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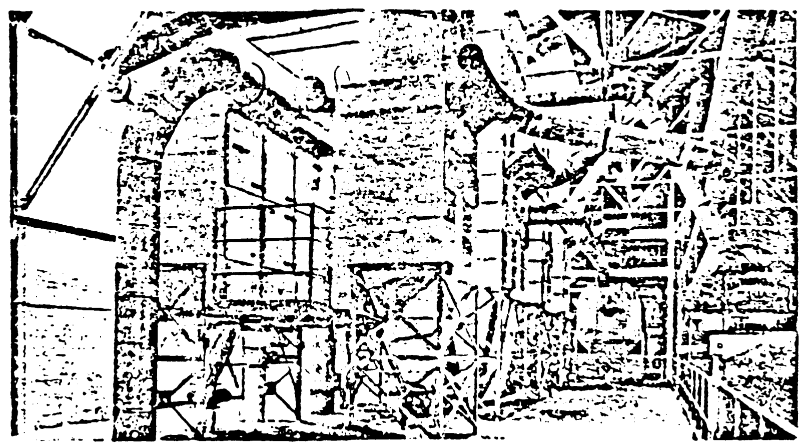
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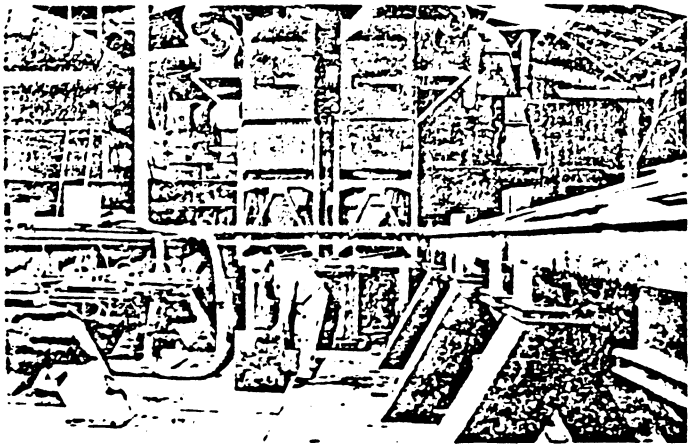

14

8 Dalamatic filter applied to foundry fettling and grinding

9 Dalamatic collecting dust from electric arc furnace

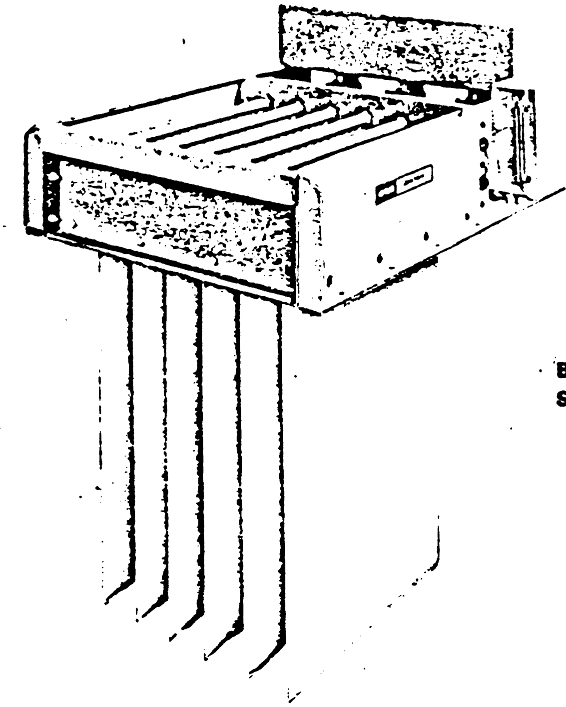
10 Dalamatic collecting dolomite dust from rotary kiln

11 Dalamatic filter applied to phosphate conveying system

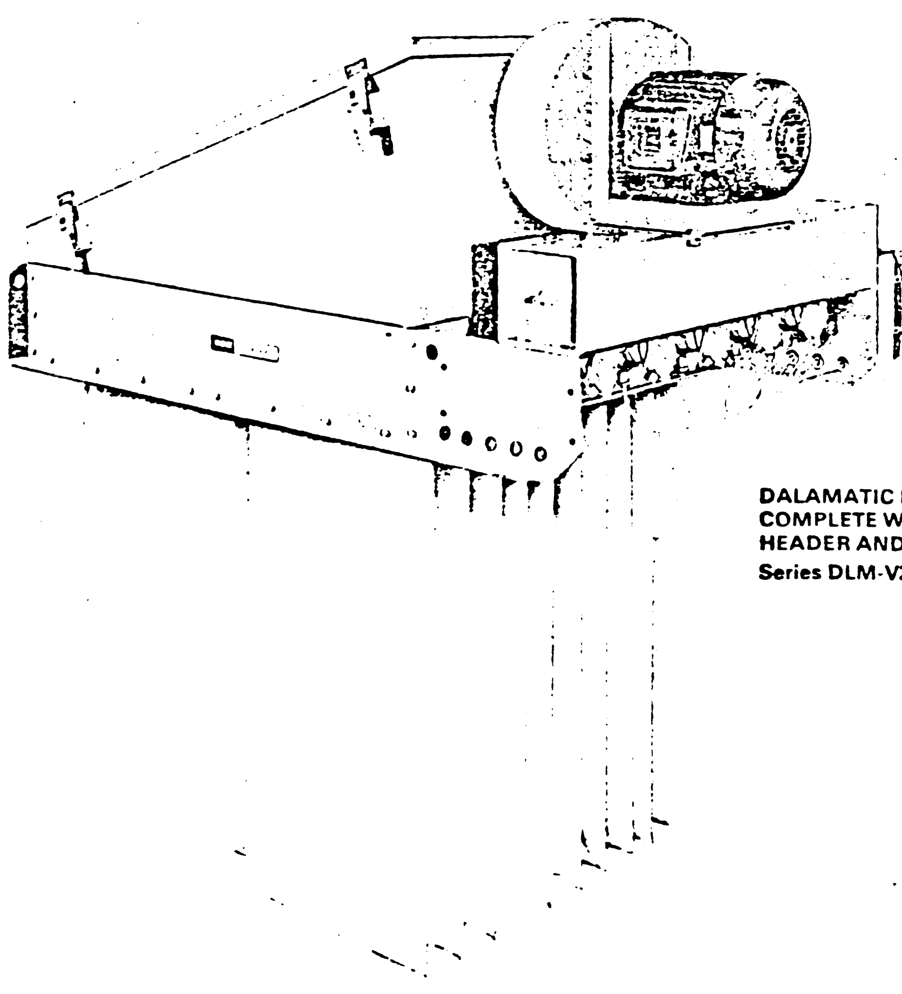
12 Dalamatic filter handling dust from feed mill

13 Dalamatic filters applied to sugar drying and packing.

14 Dalamatic installation collecting dust from animal feed preparation.

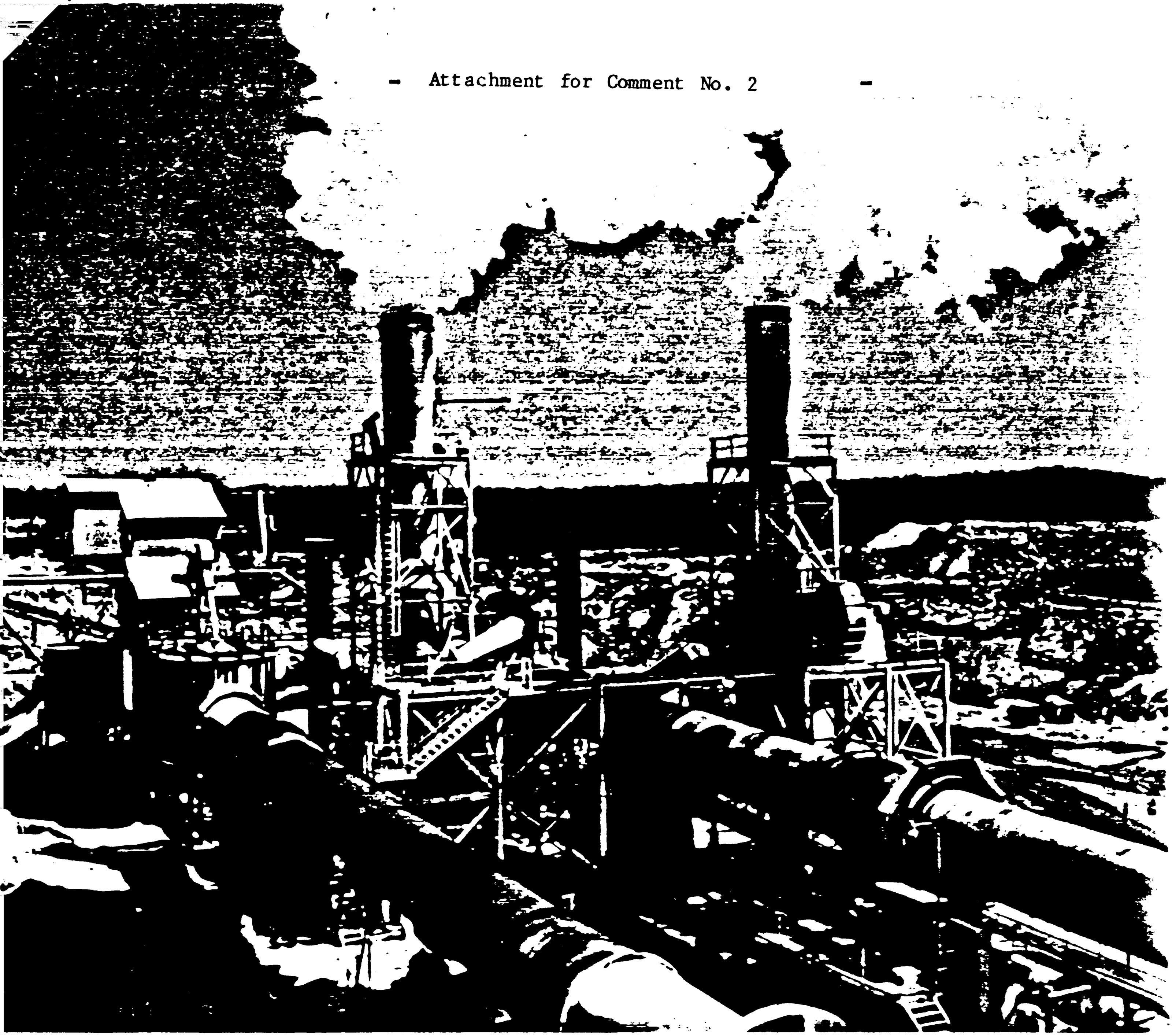


BASIC DALAMATIC INSERTABLE FILTER
Series DLM-V4 Type B



DALAMATIC INSERTABLE FILTER COMPLETE WITH WEATHERPROOF HEADER AND FAN
Series DLM-V20 Type F

- Attachment for Comment No. 2 -

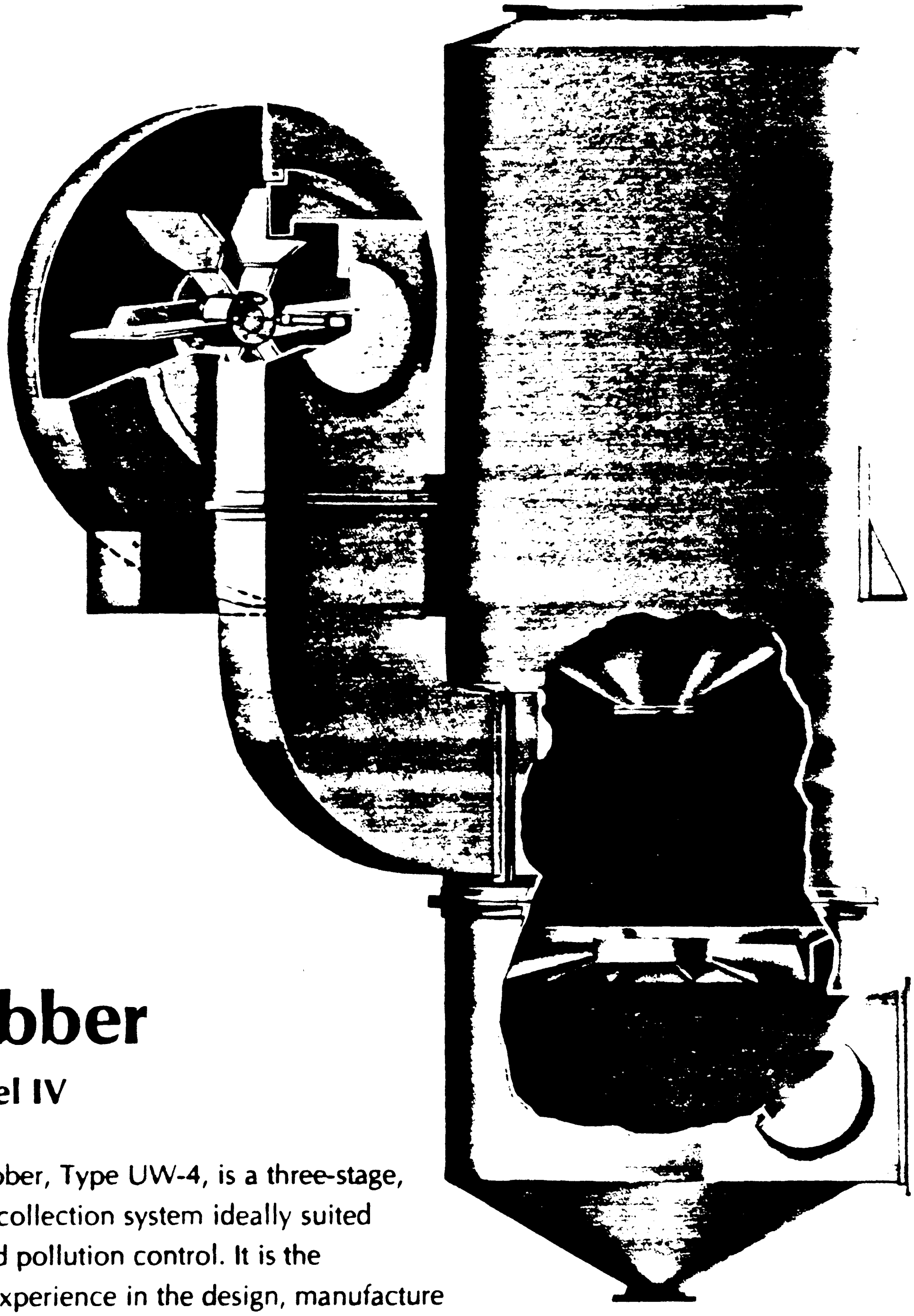


3031 TISCH WAY, #302
Factory Representative
California Clean Air, Inc.
(408) 249-9060
SAN JOSE, CA 95128

Dynamic Gas Scrubber

Type UW-4, Model IV

W-7578



Dynamic Gas Scrubber

Type UW-4, Model IV

The Dynamic Gas Scrubber, Type UW-4, is a three-stage, non-plugging, wet dust collection system ideally suited for product recovery and pollution control. It is the result of over 25 years experience in the design, manufacture and application of Dynamic Scrubbers. Hundreds of UW-4 scrubbers are in operation in the mining, fertilizer, chemical, steel, rock products, pulp and paper and allied industries. Its high collection efficiency of up to 99+% in the 1 to 2 micron range is achieved through "Dynamic" action. "Dynamic" scrubbing involves the use of a wet fan to mix gas, dust and water, in extreme turbulence, which forces dust particles into the scrubbing liquid.

Advantages

1. Continuous performance at maximum collection efficiencies.

2. Constant speed of "Dynamic Fan" assures peak performance even when gas flows are as low as 60-70% of design capacity.

3. Ability to handle upset conditions.

4. Built-in fan also acts as prime mover which eliminates need for additional exhaust fan to overcome system resistance external to scrubber. This also results in savings in installation cost.

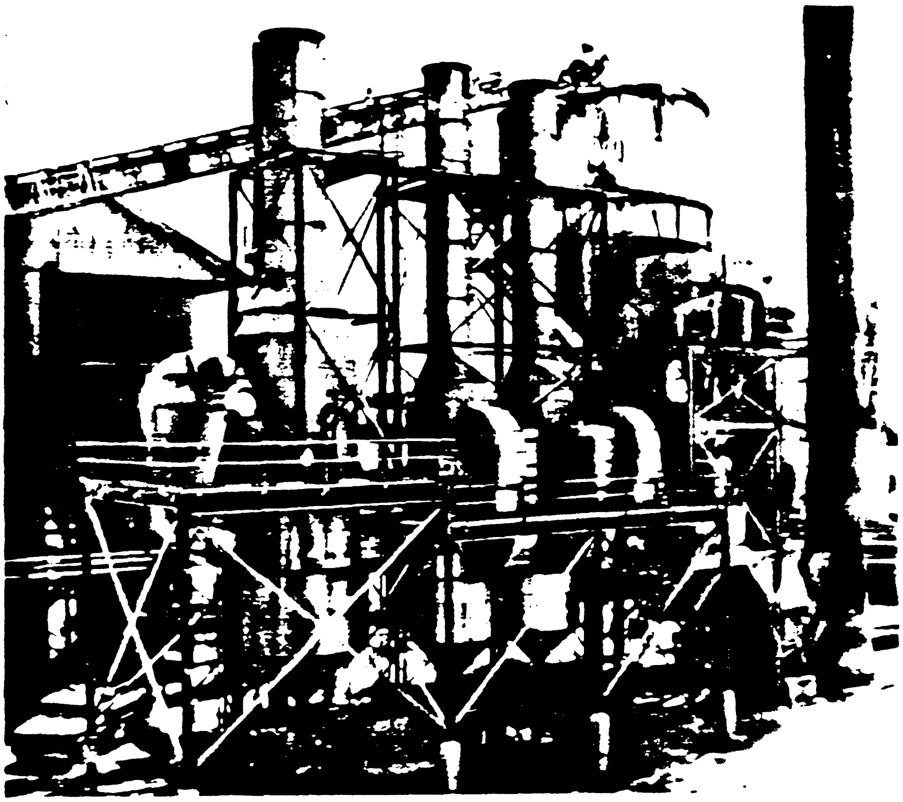
5. Thoroughly wetted fan greatly reduces normal problems of condensation, solids build-up and/or abrasion.

6. No wet/dry areas in system and no small openings to plug.

7. Minimum water usage since scrubbing liquid can be recycled.

8. Instantaneous start-up and shutdown are possible because no water level must be maintained.

9. Low maintenance.



Features

The Ducon Dynamic Scrubber, Type UW-4, has proved to be the most reliable and dependable choice for all drying and calcining kiln applications, pelletizing and sintering plants and for control of all types of material handling such as conveyor transfer points, screens, bins crushers and mills. It is also used in fluid bed processing and in cooling, classifying and general dust ventilation operations.

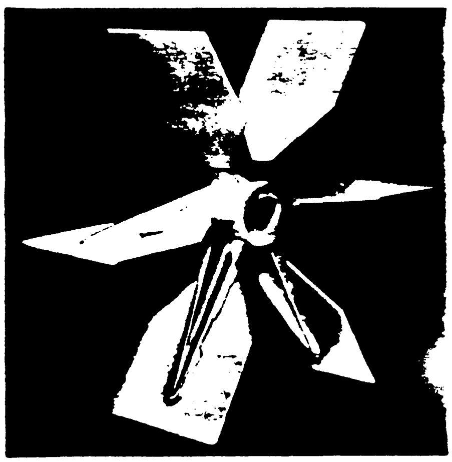
The wide acceptance of Ducon's Dynamic UW-4 Scrubber can be attributed as much to its maintenance-free operation as to its highly efficient performance. On-line performance is maintained even under severe or adverse operating conditions. On rotary limestone kilns, lime hydrators, and lime slakers, which are recognized as being very difficult applications, this unit is used extensively because it has proved to require less maintenance than other scrubber designs.

Two-Stage Pre-Cleaner

The pre-cleaner section of the Dynamic UW-4 scrubber provides several immediate advantages for the system. By eliminating up to 90% of the dust load before the fan section and causing particle growth through cooling and condensation on the remaining suspended particles, it promotes higher operating efficiencies in the two remaining stages.

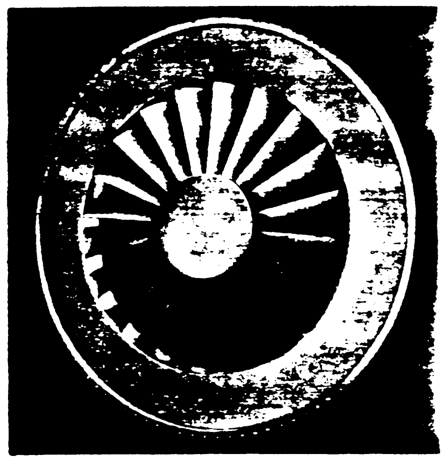
The wide open design of the pre-cleaner section assures trouble-free, non-plugging operation. Its efficiency and dependability have been proven in hundreds of difficult applications. Complete liquid flushing of the scrubbing vane in the UW-4 scrubber is another important factor in the elimination of build-up and plugging problems.

Fan Impeller

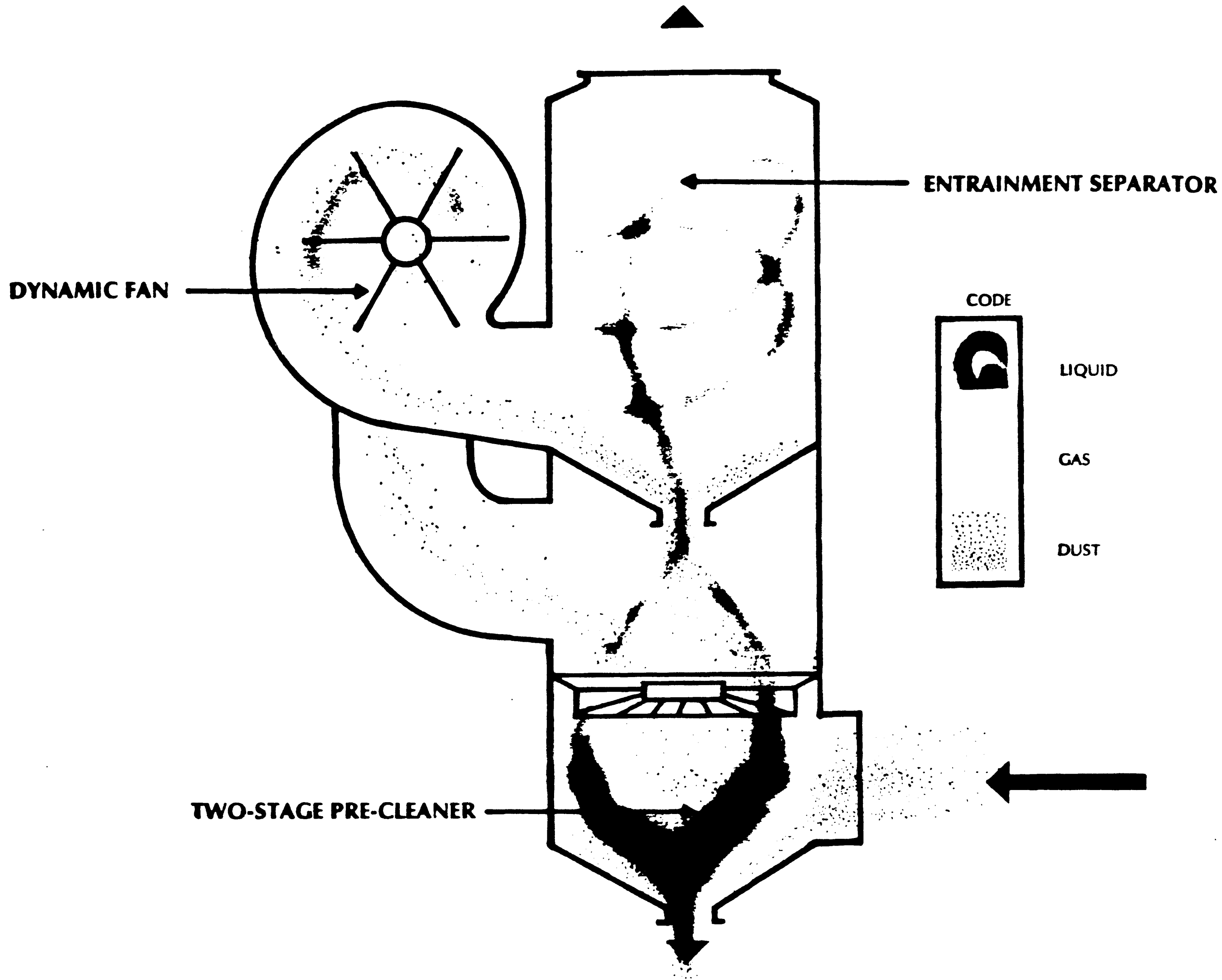


The wet "Dynamic Fan" combines the functions of exhaust system prime mover, atomization of scrubbing liquid and agglomeration of atomized liquid with suspended particulate matter. It not only promotes maximum scrubbing efficiency but it also eliminates the problems associated with exhaust fans installed in systems before or after gas scrubbers. When a fan is located on the high temperature inlet side of a scrubber, the fan is subject to considerable abrasion. Fans on the scrubber outlet side on the other hand, are subject to condensation and/or solids build-up on impeller blades with resulting wheel imbalance and in some case, corrosion. The UW-4 scrubber integral fan, however, never comes in contact with a mass of dry abrasive dust and is kept constantly and thoroughly wetted to protect against build-up and minimize the effects of corrosion.

Unique Vane Design



The wide open design of the conoidal impingement vane assures troublefree, non-plugging operation. Its efficiency and dependability has been proven in hundreds of difficult applications. Complete flushing of the vane in the UW-4 is another important factor in the elimination of build-up and plugging problems.



Two-Stage Pre-Cleaner

Dust-laden gases enter the lower part of the scrubber tangentially, resulting in a cyclonic flow thoroughly intermixed with scrubbing liquid. This forces the larger and more abrasive dust particles into the swirling liquid film on the surfaces and then, through the slurry outlet at the bottom. The gases pass through the scrubbing vane which provides: 1. Increased wetted surface area for particle impingement and 2. a swirling action for the mass of gas and liquid in the cylindrical section above. Here, intermediate size particles are collected and then flushed through the vane to the slurry discharge.

Dynamic Fan

The gases which are now conditioned, essentially saturated with water vapor and substantially free of large dust particles, are drawn into the interconnecting fan duct riser along with sufficient liquid from the bottom sections to flush clean the duct internal surfaces and to promote growth by agglomeration, of the remaining fine particles with liquid droplets.

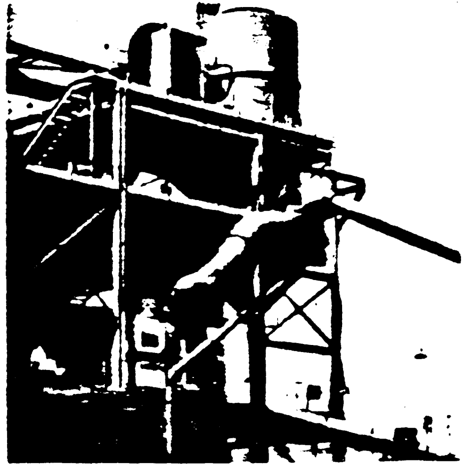
All of the scrubbing liquid for the unit is introduced into the "eye" of the fan, causing complete flushing (cleaning) of all the fan internal surfaces. Fine dust particles are then captured by:

1. Turbulent mixing of gases, liquid and dust particles causing liquid atomization and further particle "growth".
2. Impingement of fine dust particles on rotating wetted blades.
3. Centrifugal forces resulting from high fan wheel tip speeds causing impingement of dust particles and "agglomerates" on the moving film of water which completely covers the fan housing inside surfaces.

Entrainment Separator

The collected dust and liquid discharge from the fan tangentially into the final section of the scrubber where cyclonic action causes separation of slurry from the gas stream.

The entrainment separator increases gas velocity and directs gas flow so that entrained liquid droplets are thrown against the scrubber wall to descend and discharge through an intermediate cone orifice by gravity to become the liquid feed for the scrubbing vane below. Gases free of liquid droplets, discharge vertically through the scrubber gas outlet.

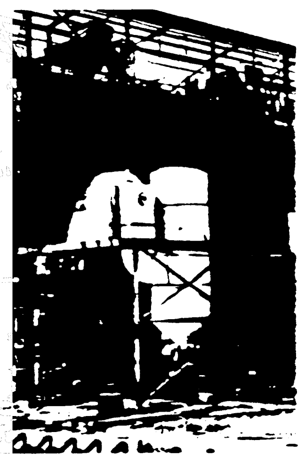


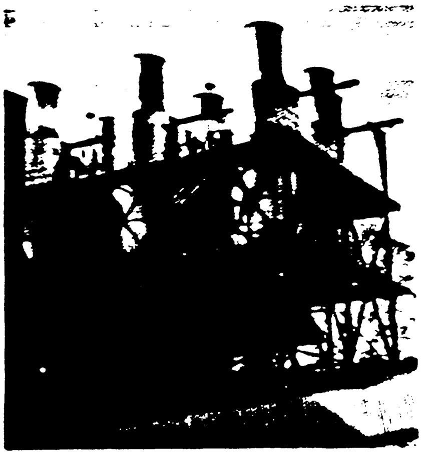
Capabilities

The Dynamic Scrubber, Type UW-4, Model IV is available with two performance capabilities, a standard and a high efficiency design.

The Dynamic Scrubber Type UW-4, Model IV High Efficiency, is an improved design which decreases outlet dust loadings up to 60% as compared to those obtained with prior standard efficiency models of the Dynamic Scrubber. As an example, in performance tests on talc dust, an average outlet dust loading of 0.016 gr/SCFD obtained with a standard Model IV Type UW-4 Scrubber was reduced to 0.006 gr/SCFD using the Model IV HE scrubber. This represents a reduction of 62%.

The improved performance of the Dynamic Scrubber, Type UW-4, Model IV HE results from improvements in configuration of unit internals and operating characteristics. The latter includes an increase in horsepower requirement (20-30%) and, in some instances, an increase in scrubbing liquid rate. However, the percentage increase in horsepower and scrubbing liquid requirements are far less than would be anticipated for the degree of improvement attained in scrubber performance.

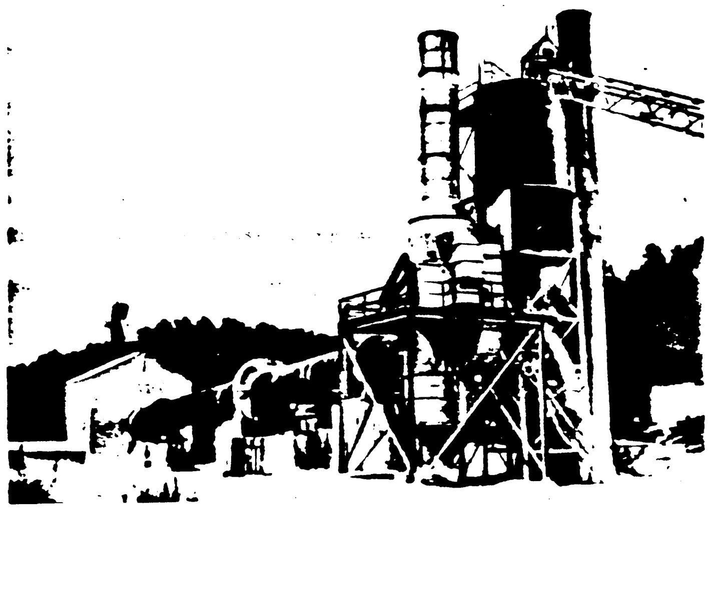




Applications

A partial list of applications includes: calcium hypochlorite • carbon black • clay • copper concentrate dryers • dyes • fertilizer • fluorspar dryers • lime hydrators • limestone • paper grinding • pelletizing • phthalic anhydride • plastics • potash • silica flour • sintering • soda ash • titanium dioxide pigments

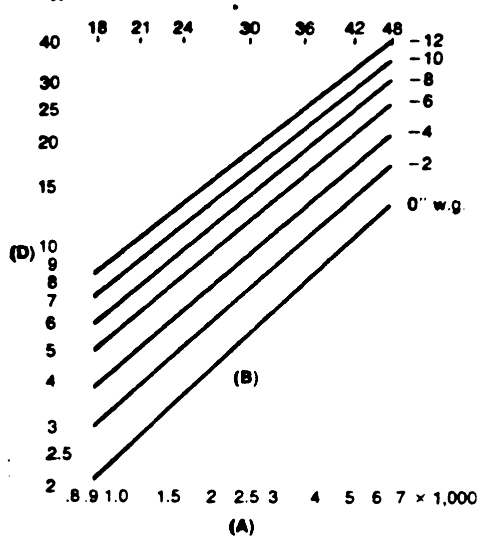
A Dynamic Scrubber, Type UW-4, Model IV Standard, handling exhaust gases from an expanded aggregate drying kiln, had outlet dust loadings averaging 0.101 gr/SCFD. After upgrading to a Model IV HE Dynamic Scrubber, the average outlet loadings were 0.026 gr/SCFD, a reduction of 75%.



SIZE AND HORSEPOWER SELECTION CHARTS FOR DYNAMIC SCRUBBER TYPE UW-4 MODEL IV

STANDARD DESIGN (UW-4S)

1.



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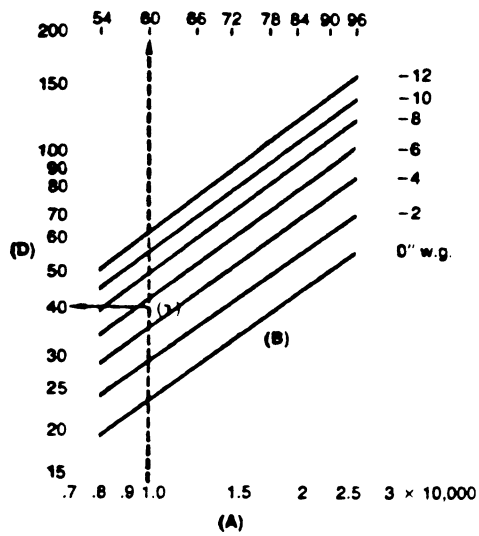

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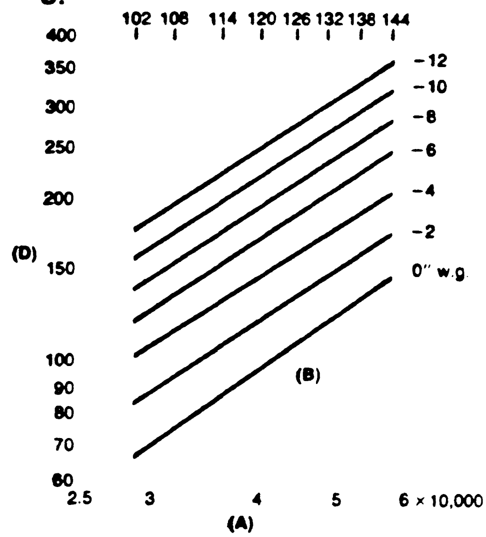
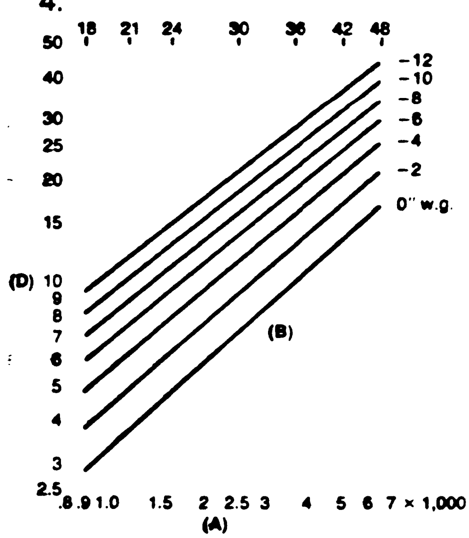


HIGH EFFICIENCY DESIGN (UW-4HE)

4.



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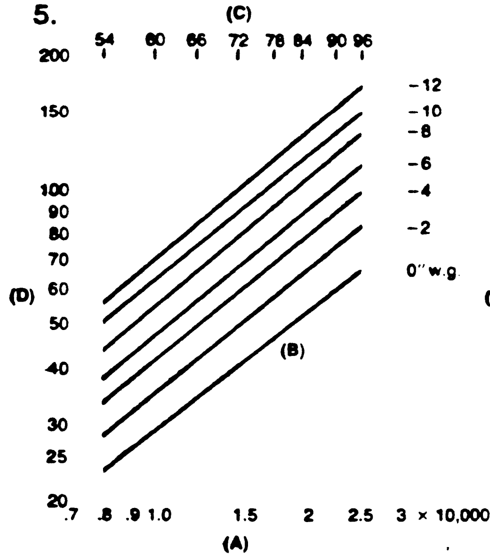

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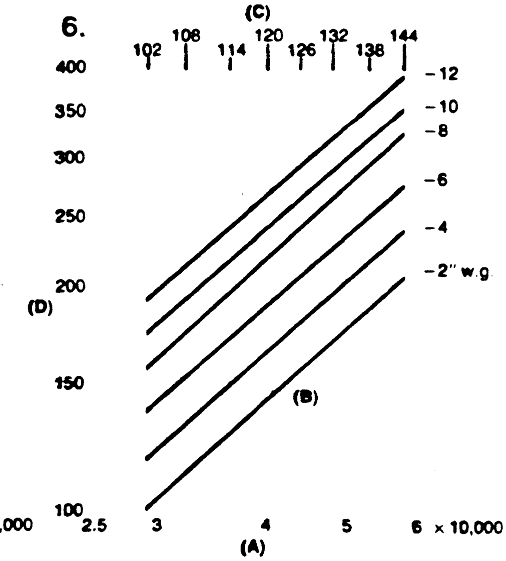

Scale (A) Saturated Gas Volume, ACFM (Scrubber Outlet Conditions)
Curve (B) Inlet Static Pressure converted to standard conditions
Scale (C) Scrubber Size
Scale (D) Brake Horse Power (Gas Density—0.075 #/ft³)

HOW TO USE THE CHARTS

Example (see chart #2)
12,000 acfm at 300°F and −5" wg inlet static pressure and containing 15% water vapor by volume.
Barometer −29,92" Hg.

1. Calculate adiabatically saturated gas volume (scrubber outlet) —9,800 acfm at 138°F (gas density = 0.062 #/ft³)
2. Correct −5" wg inlet static pressure for density.
   $-5x \frac{.075}{.062} = -6.0$ wg at standard conditions (at fan inlet)
3. Enter chart on Scale A at 9,800 acfm.
4. Move vertically to 6.0" wg (Curve B-Point 1).
5. From Point 1 move vertically to Scale C and read scrubber Size 60.
6. From Point 1 move left to Scale D and read 42 B.H.P. (Density 0.075 #/ft³)
7. Select 50 H.P. motor.

Size and horsepower selection approximate.

Ducon Service

The Ducon Company has been solving dust control and air pollution problems for more than 40 years. In addition to supplying a broad range of control equipment, including the most versatile and complete selection of scrubbing equipment offered to industry, cyclones and pneumatic conveying systems, Ducon can supply the necessary system engineering and construction management for total engineered and/or installed systems.

Ducon maintains a large staff of sales and service engineering personnel experienced and capable of solving virtually any air pollution or dust control problem. service engineers are available for system services, start-ups, and troubleshooting assignments.

For expert engineering assistance and the highest quality of dust control and air pollution control products available, contact Ducon Mineola or our local representative.

☐

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516-741-6100 TWX 510 9861

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Ducon-MikroPul Ltd., Ontario, Canada
MikroPul-Ducon Ltd., Shoeburyness, England
MikroPul-Ducon Eq. Ind. Ltda., Sao Paulo, Brazil

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 1083M

Attachment for Comment No. 3

ENVIRONMENTAL PROTECTION AGENCY	SECTION NEDS	SECTION	CHAPTER	SUBJECT
NATIONAL AIR DATA BRANCH	CHAPTER Source Classification Codes and Emission Factors	3	7	0
VOLUME V. AEROS MANUAL OF CODES	SUBJECT	DATE 1/3/76	PAGE 5	

		POUNDS EMITTED PER UNIT					UNITS
		PART	SOX	NOX	HC	CO	
INTERNLCOMBUSTION -ELECTRIC GENERATN							
DISTILLATE OIL							
2-01-001-01	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
2-01-001-02	RECIPROCATING		140. S				1000 GALLONS BURNED
NATURAL GAS							
2-01-002-01	TURBINE	14.0	940. S	413.	42.0	115.	MILLION CUBIC FEET
2-01-002-02	RECIPROCATING		940. S				MILLION CUBIC FEET
DIESEL							
2-01-003-01	RECIPROCATING	13.0	140. S	370.	37.0	225.	THOUSANDS OF GALLONS
2-01-003-02	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
RESIDUAL OIL							
2-01-004-01	TURBINE		159. S				1000 GALLONS BURNED
JET FUEL							
2-01-005-01	TURBINE		6.20				1000 GALLONS BURNED
CRUDE OIL							
2-01-006-01	TURBINE		146. S				1000 GALLONS BURNED
PROCESS GAS							
2-01-007-01	TURBINE		950. S				MILLION CUBIC FEET
OTHER/NOT CLASIFD							
2-01-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
2-01-999-98	SPECIFY IN REMARK						1000 GALLONS BURNED
INTERNLCOMBUSTION -INDUSTRIAL							
DISTILLATE OIL							
2-02-001-01	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
2-02-001-02	RECIPROCATING	33.5	144. S	469.	37.5	102.	1000 GALLONS BURNED
NATURAL GAS							
2-02-002-01	TURBINE	14.0	940. S	413.	42.0	115.	MILLION CUBIC FEET
2-02-002-02	RECIPROCATING		940. S				MILLION CUBIC FEET
GASOLINE							
2-02-003-01	RECIPROCATING	6.50	5.30	102.	161.	3,940.	1000 GALLONS BURNED
DIESEL FUEL							
2-02-004-01	RECIPROCATING	33.5	144. S	469.	37.5	102.	1000 GALLONS BURNED
2-02-004-02	TURBINE	5.00	140. S	67.8	5.57	15.4	1000 GALLONS BURNED
RESIDUAL OIL							
2-02-005-01	TURBINE		159. S				1000 GALLONS BURNED
JET FUEL							
2-02-006-01	TURBINE		6.20				1000 GALLONS BURNED
CRUDE OIL							
2-02-007-01	TURBINE		146. S				1000 GALLONS BURNED
PROCESS GAS							
2-02-008-01	TURBINE		950. S				MILLION CUBIC FEET
2-02-008-02	RECIPROCATING		950. S				MILLION CUBIC FEET BURNED
OTHER/NOT CLASIFD							
2-02-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
2-02-999-98	SPECIFY IN REMARK						1000 GALLONS BURNED

'A' INDICATES THE ASH CONTENT, 'S' INDICATES THE SULFUR CONTENT OF THE FUEL ON A PERCENT BASIS (BY WEIGHT)

Response:

Fugitive dust emissions resulting from construction of the access road are included in the estimated total provided for the mine/mill site in Table 1.1 of the January 24, 1984 letter on the air permit application. Clearing of trees, brush and other materials within the access road 30.5 m (100 ft) corridor will occur over approximately 15 ha (37.1 acres). The access road from shoulder to shoulder will encompass an estimated 12.2 m (40 ft) of this corridor; therefore, construction activities for this area including excavation were assumed to be approximately half of the 15 ha (37.1 acres), or 8 ha (19.8 acres). For the railroad spur, the cleared area estimate is for a 30.5 m (100 ft) corridor totalling 18 ha (44.5 acres). The actual railroad spur excavation construction activity was assumed to be approximately half of this area, or 9 ha (22.2 acres). Similarly for the mine/mill site, the cleared area is approximately 46 ha (113.7 acres), but the excavation construction activities were estimated to involve approximately 25 ha (61.8 acres).

Therefore, the estimated excavation construction activities total approximately 42 (25 + 8 + 9) ha or 104 acres (42 x 2.47 acres/ha). This acreage estimate incorporating the access road and railroad spur was utilized in the calculations for the response to Comment No. B1 of the January 24, 1984 letter on the air permit application.

Comment No. 6:

Provide information describing the baghouse used for emissions control on preproduction ore crushing.

Response:

The baghouse presently included in our design will be similar to a DCE Vokes Model DLM 1/3/10 with 315 sq ft of 16-oz dacron filter material and an air to cloth ratio of 5.6 (cfm) per 1.0 (ft^2). The vendor supplied brochure in the response to Comment No. 1 describes the principles of operation and other detailed specifications.

Comment No. 7:

Describe derivation of particle size ranges used for determination of settling rates for mine blasting emissions.

Response:

The particle size range used for mine blasting TSP emissions was <30 um as stated in EPA AP-42, Table 8.24-2 for surface blasting (May 1983). Emissions in this size range were then compared with EPA Appendix A, Table A-1, p. A-3, dated February 1972 (attached) for Mineral products, Stone quarrying and processing-Crushing in which the percentage distribution by particle size is:

Table A-1. PERCENTAGE DISTRIBUTION BY SIZE OF PARTICLES FROM SELECTED SOURCES WITHOUT CONTROL EQUIPMENT

Type of source	Particles by size range, %				
	<5 μ	5 to 10 μ	10 to 20 μ	20 to 44 μ	>44 μ
Stationary combustion					
Bituminous coal					
Pulverized	15	17	20	23	25
Cyclone	65	10	8	7	10
Stoker	4	6	11	18	61
Anthracite coal	35	5	8	7	45
Fuel oil	50	NA[a]	NA	NA	0
Natural gas	100	-	-	-	-
Solid waste disposal					
Refuse incineration	12	10	15	18	45
Mobile combustion					
Gasoline-powered motor vehicles	100	-	-	-	-
Diesel-powered motor vehicles	63	NA	NA	0	0
Aircraft	100	-	-	-	-
Chemical process					
Phosphoric acid	100	-	-	-	-
Soap and Detergents	5	15	40	30	10
Sulfuric acid	100	-	-	-	-
Food and agriculature					
Alfalfa dehydrating	Average size 2 to 10 μ		-	-	-
Cotton ginning	NA	NA	NA	NA	40
Feed and grain	5	15	20	45	15
Fish meal	1	1	3	8	87
Phosphate fertilizer	6	6	10	8	70
Metallurgical					
Primary aluminum	13	12	12	13	50
Primary zinc	14	17	40	NA	NA
Iron and steel					
Sintering	0	0	0	15	85
Blast furnace	NA	NA	NA	NA	70
Open hearth	46	22	17	10	5
Basic oxygen	99.5	0.5	0	0	0
Bessemer converter	-	-	-	100	-
Secondary aluminum	34	30	23	10	3
Brass and bronze	100	-	-	-	-
Gray iron foundry	18	8	12	14	48
Secondary lead	95	3	2	0	0
Secondary steel	60	14	11	9	6
Secondary zinc	100	-	-	-	-
Mineral products					
Asphalt batching	35	25	17	20	3
Asphalt roofing	100	-	-	-	-
Ceramic clay	36	NA	NA	40	6
Castable refractories	100	-	-	-	-
Cement	22	25	25	20	8
Concrete	13	21	27	25	14
Frit	45	15	15	15	10
Glass	26	NA	NA	NA	0
Gypsum	95% <10 μ		NA	NA	NA

Table A-1 (continued). PERCENTAGE DISTRIBUTION BY SIZE OF PARTICLES FROM SELECTED SOURCES WITHOUT CONTROL EQUIPMENT

Type of source	Particles by size range, %				
	<5 μ	5 to 10 μ	10 to 20 μ	20 to 44 μ	>44 μ
Mineral products (continued)					
Lime	2	8	24	38	28
Mineral wool	0.5	2.5	10	27	60
Perlite	32	10	10	13	35
Phosphate rock	80	15	5	0	0
Stone quarrying and processing					
Crushing	5	5	5	10	75
Conveying and screening	30	20	20	18	12
Petroleum refinery					
Catalyst regenerator	50	15	NA	NA	NA
Wood processing					
Fiberboard	NA	NA	NA	NA	25

[a]NA = no further breakdown of particle distribution available.

Particles by Size Range %

<5 um	5 to 10 um	10 to 20 um	20 to 44 um	>44 um
5	5	5	10	75

Since blasting produces emissions <30 um, the 20 to 44 um percentage of 10 was halved, leaving four size ranges with equal percentages. Therefore, the four predominate particle size ranges used for estimating the TSP emissions included the following distributions:

Particles by Size Range %

<5 um	5 to 10 um	10 to 20 um	20 to 30 um
25	25	25	25

Comment No. 8:

Describe how the estimate of 20 stope blasts per year was determined.

Response:

The estimate of 20 stope blasts per year was determined by dividing the estimated peak tonnage of ore extracted from the mine in any given year (3,276,000 t [3,611,000 st]) by the tonnage contained within a typical designed stope block blast (163,400 t/blast [180,100 st/blast]). The 163,400 t/blast is one-half of the total tonnage contained in a typical stope block. The design stope height is 120 m (395 ft), which is halved to allow for drilling (for blasting) from two mine levels. Separation of a stope block blast is necessary because of the drilling equipment limitations. Therefore, approximately 20 stope blasts or 10 complete stope blocks are estimated to be blasted for the estimated peak tonnage in any given year.

Comment No. 9:

Provide the source used for determination of the vertical gravity settling velocities in the mine.

Response:

The settling velocities used to determine gravity settling parameters in the mine were obtained from a TRC Environmental Consultants, Inc. 1981 publication titled "Coal Mining Emission Factor Development and Modeling Study." In the study, settling velocities were derived by an analytical procedure based upon field acquired dustfall data. Determination of actual settling velocities are presented in Part 1, pp. 13-23, Table 3.2 of the report. The data presented on p. 20 (Attachment 1) were used and extrapolated/interpolated for a density of 3.0 g/cm^3 (i.e., the density of Crandon rock to be blasted). The calculated settling velocities are presented in Attachment 2.

Attachment No. 1 for Comment No. 9

TABLE 3.2

STOKES LAW SETTLING VELOCITY (m/sec)

PARTICLE DIAMETER (μm)	PARTICLE DENSITY (g/cm^3)		
	ρ = 1.5	ρ = 2.0	ρ = 2.5
2	.00018	.00024	.00030
10	.0046	.0061	.0076
25	.0286	.038	.048
40	.073	.097	.122
55	.138	.184	.230
65	.193	.257	.322
70	.224	.298	.373
85	.330	.44	.55
90	.370	.49	.62
100	.457	.61	.76
115	.604	.81	1.01
130	.772	1.03	1.29

NOTE: ρ = 1.5 was utilized for Coal Dump Samples;

ρ = 2.0 was utilized for Coal Haulroad Samples; and

ρ = 2.5 was utilized for All Other Tests.

Attachment No. 2 for Comment No. 9

CRANDON PROJECT

Modified Stokes Law Settling Velocities (m/sec)
(In response to Comment No. 9)

Particle Diameter (um)	Particle Density (g/cm^3)			
	P = 1.5	P = 2.0	P = 2.5	P = 3.0
2	.00018	.00024	.00030	.00036*
5[a]	.00184*	.00244*	.00304*	.00364*
7.5	.00322*	.00427*	.00532*	.00637*
10	.0046	.0061	.0076	.0091*
15	.0126*	.0167*	.0211*	.0254*
25	.0286	.0380	.048	.0580*
30	.0434*	.0577*	.0727*	.0877*
40	.0730	.097	.122	.147*

*Extrapolated/interpolated values.

a. Example Calculation:

1) Determine the 2 um particle settling velocity at 3.0 g/cm^3

P = 1.5	P = 2.0	P = 2.5	P = 3.0
.00018	.00024	.00030	

Difference: .00006 .00006 +.00006 = .00036

2) To determine the 5 um particle settling velocity at 3.0 g/cm^3 density

a) First, derive the particle settling velocity at 3.0 g/cm^3 density for 10 um as in 1) above.

b) Next, determine the difference between 2 and 10 um particle settling velocities at 3.0 g/cm^3 density (i.e., 0.0091 - 0.00036 = 0.00874)

3) Then, multiply that difference by a proportion determined from

$$\frac{5\ \text{um} - 2\ \text{um}}{10\ \text{um} - 2\ \text{um}} = 3/8 \times 0.00874 = 0.00328$$

4) Add 0.00328 to 0.00036 = 0.00364 m/sec at 5 um

Comment No. 10:

Provide the manufacturer's brochure for the insertable dust collectors used for control of dust emissions near the primary crusher in the mine. Also provide the source of particle sizes for mine emission sources.

Response:

The responses submitted in our January 24, 1984 letter on the air permit application stated that emissions from coarse crushing and subsequent transfer operations will be controlled with insertable dust collectors similar to DCE Vokes Model No. DLM-V 45/15 F1. The manufacturer's brochure provided in response to Comment No. 1 of this letter describes the principles of operation and other detailed specifications.

The particle size distributions for rock handling presented in the January 24, 1984 letter were as stated from EPA AP-42, Appendix A, Table A-1, p. A-3, Stone quarrying and processing-Crushing. (See also the response to Comment No. 7 of this letter.)

Comment No. 11:

Will all mine air heating be performed on the surface at one location by direct fired heaters. What is the estimated peak hourly and annual fuel usage?

Response:

Mine air heating will be performed at two separate locations on the surface. They are: 1) the main shaft, and 2) the intake air shaft. No additional heating of mine air is planned underground other than that provided indirectly from sources such as the rock mass, equipment, and adabiatic compression of air as it descends the intake air shafts. The two heaters located at the intake shaft collars require a maximum of 91,800 SCF/hr of natural gas on a -25°F day; however, the units will be capable of consuming 100,000 SCF/hr (i.e., the combined total rated capacity). Yearly maximum consumption of natural gas for mine air heating is estimated to be 110,600,000 SCF.

Comment No. 12:

The estimated TSP emissions for the mine/mill site in-plant gravel roads for heavy duty diesel vehicles in response to Comment No. D5 of the January 24, 1984 air permit letter should be 1.9 st/yr instead of 1.6 st/yr and the total estimated TSP emissions for employee and plant operation traffic should be 49.2 st/yr instead of 48.9 st/yr.

Response:

Because of a rounding difference, the emission factor used for the heavy duty diesel vehicles (HDDV) was 0.5 instead of 0.6 lb/veh-mile. The estimated TSP emissions for HDDV should be 1.9 st/yr. Therefore, the total estimated TSP emissions (uncontrolled) should be 11.3 instead of 11.0 st/yr. The total estimated TSP emissions (controlled) should be 5.7 instead of 5.5 st/yr, and the total for employee and plant operation traffic should be 49.1 instead of 48.9 st/yr. The revised air permit application will include these changes. (See also Revised Table 1.1 in the response to Comment No. 13 of this letter.)

Comment No. 13:

Tabulation of the emission estimates beginning on p. 62 of the January 24, 1984 response letter shows TSP emissions from MWDF construction of 71.8 st/yr. Where is this number included in Table 1.1?

Response:

The 71.8 st/yr TSP estimate was included in the estimated 96.3 st/yr for construction of each tailing pond. The derivation of the 96.3 st/yr estimate is as follows.

Hauling emissions to and from the MWDF as well as excavated till hauling emissions were calculated based on soil material volumes presented in the air permit application. These soil material volumes were based on a 2-1/2 year construction period for each pond with 40%, 40% and 20% completed in the first, second and third years, respectively. Construction of each pond is now scheduled to be completed in 2 years rather than 2-1/2. Therefore, the 71.8 st/yr hauling emissions estimate was increased by 5/4 to 89.75 st/yr. The estimate also included wind-blown TSP emissions of 6.53 st/yr as shown in Table 2.6 of the air permit application. The estimated combination of hauling and wind-blown TSP emissions was 96.3 st (89.75 + 6.53 st) as shown on Table 1.1 of the air permit response letter of January 24, 1984.

Emissions from other MWDF construction related activities such as site clearing, surface excavation and scraping were included in the 112.8 st/yr estimate shown on Table 1.1 for site preparation.

Since the review meeting with the DNR on February 29, 1984, we have recalculated the MWDF construction emissions to account for several factors: 1) use of the latest EPA AP-42 emission factors for loading and dumping, and 2) to further incorporate current design criteria into our calculations; e.g., a 2 year construction period instead of 2-1/2, the inclusion of emission calculations for each pond rather than assuming equal emissions from each pond, the use of the current estimated excavated soil material volumes and haul miles traveled, and a revised wind-blown emission factor as presented in the January 24, 1984 air permit response letter.

Site preparation TSP emissions are the same as those shown in Table 1.1 of the January 24, 1984 air permit response letter. Revised estimates for the waste rock handling and individual tailing ponds construction are shown on the attached table (Revised Table 1.1). The attached table (Revised Table 1.1) also includes estimates of the other construction related activities for the tailing ponds such as hauling, loading and dumping, and wind-blown TSP emissions in the total number. The calculations for the revised TSP estimates are presented following the revised Table 1.1. Till excavation is now assumed to occur equally over two years. Other activities such as loading and dumping, and hauling of other construction soil materials (i.e., drain layer, liner) were conservatively assumed to be completed in the second year of each pond construction which represents the difference (see Revised Table 1.1) between the emissions in the first and second year for construction of each pond.

Revised Table 1.1 (In response to Comment Nos. 12, 13, 14, 15, 17, 20, 21, 24 and 25)

Schedule associated with Project activities during construction and operation phases and the estimated TSP air emissions from proposed sources (st/yr).

	CONSTRUCTION				OPERATION																	
Project Activities ( )**	1986	1987	1988	1989	1990	1991-92	1993	1994	1995	1996	1997	1998-2000	2001	2002	2003	2004	2005-06	2007	2008	2009	2010	2011-15
Site Preparation (trees & brush)																						
1. Mine Shafts (A1)	17.6																					
2. Mill/Mill Site (A3, B1)	77.3																					
3. MWIF Area (14)		112.8***					112.8					112.8[a]					112.8[b]					
4. Access Road/Powerline (A3, D5, D7)	2.7	3.2	3.24	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5. Railroad Spur (A3, D4)	4.2	0.14	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6. Haul Road (B1)	4.0																					
7. Water Discharge Pipeline (B5)	10.2																					
8. In-Plant Roads (B2, D5) (12)	4.8	49.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
9. Mobile Sources (Table 2.3)	8.0	*	*	*																		
10. Concrete Batch Plant (Table 2.3)	2.7	*	*	*																		
Construct Mine Support Facilities																						
1. Sink Main Shaft (15)	5.9	2.7																				
2. Sink and equip air intake shaft (15)	2.6	2.1																				
3. Construct east exhaust shaft (15)			2.0																			
4. Construct west exhaust shaft (15)				2.0																		
5. Power Generation (A2, C3)	4.2	0.2	*	*																		
Construct Major Surface Facilities																						
1. Construct Reclaim Pond R1 (17)	59.3																					
2. Construct Reclaim Pond R2 (17)		18.0	18.0																			
3. Construct Temporary Ore Storage Pad	Included in Mine Shafts																					

Project Activities ( )**	CONSTRUCTION				OPERATION																	
	1986	1987	1988	1989	1990	1991–92	1993	1994	1995	1996	1997	1998–2000	2001	2002	2003	2004	2005–06	2007	2008	2009	2010	2011–15
Construct MWDF Facilities																						
1. Construct Tailing Pipeline (21)			6.0	6.0																		
2. Install Liner (E4)	1.0		1.0	1.0				1.0	1.0				1.0	1.0				1.0	1.0			
a. Hauling of bentonite to MWDF (E1)			0.9	0.9	0.9			0.9	0.9				0.9	0.9				0.9	0.9			
3. Waste Rock Handling (13)																						
a. Loading and Dumping		0.01	0.07	0.1	0.03	0.03	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
b. Hauling	0.35	2.1	23.7	35.6	9.23	9.23	9.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23
4. Construct Tailing Pond T1 (13)			46.8	57.2																		
5. Construct Tailing Pond T2 (13)								66.8	79.6													
6. Reclaim Tailing Pond T1 (17)										49.0	49.0											
7. Construct Tailing Pond T3 (13)													55.8	65.6								
8. Reclaim Tailing Pond T2 (partial) (17)															64.8							
9. Construct Tailing Pond T4 (13)																		73.1	83.9			
10. Reclaim Tailing Pond T3 (17)																				60.5	60.5	
Underground Mine Development																						
1. Develop Drifts and Stopes (15)	0.01	0.09	1.7	3.7																		

Project Activities ( )**	CONSTRUCTION				OPERATION																	
	1986	1987	1988	1989	1990	1991–92	1993	1994	1995	1996	1997	1998–2000	2001	2002	2003	2004	2005–06	2007	2008	2009	2010	2011–15
Mine Production																						
1. Initial (15)					4.2																	
2. Full (C1)																						
a. Blasting						13.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
b. Rock handling						7.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
c. Mobile equipment						5.5	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
d. Mine air heating						0.6	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
Mill/Concentrator Operations																						
1. Coarse Ore Transport (20)		0.3	4.7	3.4	10.0	*																
2. Crushing and Screening (24)					8.4	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
3. Fine Ore Loading (Table 2.4)					0.7	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
4. Fine Ore Unloading (Table 2.4)					1.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
5. Concrete Batch Plant (D3)					0.1	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
6. Facility Heating (25)					0.9	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
7. Emergency Diesel Generators (C3)					0.2	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
TOTAL	204.9	201.4	168.3	173.3	88.2	110.7	213.5	164.4	177.2	144.7	144.7	208.5	153.4	163.2	160.5	95.7	208.5	170.7	182.0	156.2	156.2	95.7

* Means previous annual estimate is used for this year.

** Number within parentheses identifies January 24, 1984 air permit response letter, this letter, or the air permit application source for the information.

*** ___ This letter is the source of the information.

[a]In the year 2000 only.

[b]In the year 2006 only.

Example Calculations: MWDF Construction Emissions (TSP)

MWDF construction activities are separated into four categories for calculation of TSP emission estimates.

1. General construction: This includes clearing the land and surface earthwork (excavation to approximately 10 ft). This estimate uses the primary emission factor from AP-42 for construction activities for project facilities. However, where deep excavation (greater than 10 ft) and major hauling of soil material within the excavated area is involved, the TSP emissions from hauling, and loading and dumping of the soil material was calculated separately (i.e., in addition to the general construction emissions).

Emission Factor and Source: 1.2 st/acre/month; EPA AP-42, Section 11.2.4

Clearing and excavation (i.e., heavy construction):

Assume: Based on largest surface area disturbed in one year - Tailing Pond T1 - 94 acres

Duration: 12 months (94 ÷ 12 = 7.83 acres/month)

TSP = 1.2 st/acre/month x 7.83 acres/month x 12 months/yr = 112.8 st/yr

2. Hauling: TSP emissions generated by hauling excavated till within the pond construction area, within the MWDF boundary, and between the mine/mill site and MWDF.

Emission Factor and Source: EPA AP-42, Section 11.2.1

$$\text{TSP-EF} = (0.8)(5.9)(s/12)(S/30)^{2}(W/3)^{0.7}(w/4)^{0.5}(d/365) = \text{lb/veh-mile}$$

TSP-EF = suspended particulates - lb/veh-mile

s = silt content of road material - %
S = vehicle speed (mph)
W = average vehicle weight - st
w = number of wheels on vehicle
d = dry days/year - 230

Assume: Pond with largest quantity of soil material (till) excavation - Tailing Pond T4 (i.e., average excavation is 40 ft - upper 10 ft included in emissions from general construction). Therefore, 75% of excavated till haulage is within the pond area.

$$\begin{aligned}\text{TSP-EF} &= (0.8)(5.9)(15/12)(15/30)^{2}(63/3)^{0.7}(4/4)^{0.5}(230/365)\\ &= (4.72)(1.25)(0.25)(8.42)(1)(0.63) = 7.82 \text{ lb/veh-mile}\end{aligned}$$

Emissions (controlled) = 7.82 lb/veh-mile x 34,434 miles x st/2000 lb x 0.5*
= 67.3 st

See also attached Table 13-2.

---

*50% control with watering.

3. Loading and Dumping:

Emission Factor and Source: EPA AP-42, Section 11.2.3

$$\text{TSP-EF} = (k)(0.0018)\,\frac{(s/5)(U/5)(H/5)}{(M/2)^2(Y/6)^{0.33}} = \text{lb/st}$$

TSP-EF = emission factor - lb/st

k = particle size multiplier (dimensionless) - 0.73
s = silt content - %
U = wind speed (mph) - 7.2 mph (Crandon Project EIR, p. 2.1-17)
H = drop height - ft
M = material moisture content - %
Y = capacity of dumping device (yd^3)

Assume: Construction of Tailing Pond T-4:

$$\text{TSP-EF}_{\text{(Loading Till)}} = (0.73)(0.0018)\,\frac{(15/5)(7.2/5)(3/5)}{(2/2)^2(4.5/6)^{0.33}} = 0.0037\ \text{lb/st}$$

Emissions (uncontrolled) = 0.0037 lb/st x 82,800 yd^3 x 2970 lb/yd^3 x st/2000 lb x st/2000 lb = 0.23 st

See also attached Table 13-3.

4. Wind-blown:

Emission Factor and Source: Guide for Wind Erosion Control on Cropland in Great Plains States, Craig and Turelle, USDA-SCS, July 1964, in: Evaluation of fugitive dust emissions (PEDCo, 1976).

TSP-EF = aIKCLV

TSP-EF = st/acre/yr

a = total of wind erosion losses measured as suspended particulates (0.01 for ponds and storage area and 0.025 for haul roads)

I = soil erodibility factor (st/acre/yr) (134 for ponds and storage areas and 38 for haul road)

K = surface roughness factor - 1.0

C = climate factor; 0.05 for Crandon site area

L = unsheltered field width; 0.7 to 1.0 for Crandon site area

V = vegetative cover factor - 1.0

See Air Permit Application

Source	Acreage	Control*	Emission Factor	Emission (st/yr)
Haul Road	16	0.85	0.03325 st/acre[a]	0.18
Storage Area	20	0.85	0.0469 st/acre	0.14
Ponds	119	--	0.0469 st/acre	5.58
				5.80

*85% control with watering and chemical stabilization.

a. Factor of 0.3325 listed in air permit application was a typographical error. (See also air permit response letter of January 24, 1984.)

Table 13.1 Summary of Estimated MWDF Construction Emissions (TSP) - st/yr*

		Year 1	Year 2
Tailing Pond T-1 (1988-1989)	Hauling	41	49.6
	Loading and Dumping	--	1.8
	Wind-blown	5.8	5.8
		46.8	57.2
Tailing Pond T-2 (1994-1995)	Hauling	61	71.1
	Loading and Dumping	--	2.7
	Wind-blown	5.8	5.8
		66.8	79.6
Tailing Pond T-3 (2001-2002)	Hauling	50.0	57.71
	Loading and Dumping	--	2.1
	Wind-blown	5.8	5.8
		55.8	65.6
Tailing Pond T-4 (2007-2008)	Hauling	67.3	75.7
	Loading and Dumping	--	2.4
	Wind-blown	5.8	5.8
		73.1	83.9

*See Revised Table 1.1

5. Waste Rock Handling (See also 6. in Table 13-2)

Hauling

TSP-EF = $(0.8)(5.9)(6/12)(15/30)^2(51/8)^{0.7}(6/4)^{0.5}(0.63)$ = 3.3 lb/veh-mile

Emissions (controlled) = 3.3 lb/veh-mile x 1400 veh-miles x st/2000 lbs x 0.15*
= 0.35 st/yr

Year	Waste Rock Hauled (k-st)	Miles Traveled (k)	Controlled Emissions (st/yr)**
1986	1,144	1.4	0.35
1987	66	8.3	2.1
1988	761	95.7	23.7
1989	1,144	143.8	35.6
1990-1993	297	37.3	9.23
1994-2015	136	17.1	4.23

*85% control with watering and chemical stabilization.

Loading and Dumping

$$\text{TSP-EF}_{(\text{Loading})} = (0.73)(0.0018)\,\frac{(1.6/5)(7.2/5)(4/5)}{(4/2)^2(7/6)^{0.33}} = 0.00012 \text{ lb/st}$$

$$\text{TSP-EF}_{(\text{Dumping})} = (0.73)(0.0018)\,\frac{(1.6/5)(7.2/5)(4/5)}{(4/2)^2(28/6)^{0.33}} = 0.000073 \text{ lb/st}$$

Combined = 0.000193 lb/st for loading and dumping

Year	Waste Rock (k-st)	Emissions (st/yr)**
1986	11	---
1987	66	0.01
1988	761	0.07
1989	1,144	0.11
1990-1993	297	0.03
1994-2015	136	0.01

**See also Revised Table 1.1

Table 13-2. Source Inputs for Emission Factor in Estimating Hauling Emissions of Tailing Pond T-4

Source	s	S	w	W	d	Emission Factor lbs/veh-mile	Control Efficiency	Soil Material Moved k-yd^3	Miles Traveled	Emissions (st)
1. Hauling excavated till within pond	15	15	4	63	230	7.82	50%[a]	1,913[c]	34,434	67.3
2. Bentonite/soil to pond	6	15	6	30	230	2.27	85%	90[d]	5,012	0.85
3. Underdrain to pond	6	15	6	30	230	2.27	85%	264[d]	12,375	2.11
4. Filter material to pond	6	15	6	16	230	2.27	85%	383[d]	20,826	3.55
5. Rip-rap to pond	6	15	6	16	230	2.27	85%	237[d]	11,109	1.89
6. Waste rock to MWDF	6	15	6	51	230	3.31	85%[b]	108.8	17,097	4.2

a. 50% control with watering.

b. 85% control with watering and chemical stabilization.

c. Each of the two years of construction.

d. All in second year of T-4 construction.

Table 13-3. Source Inputs for Emission Factor in Estimating Loading and Dumping Emissions

Source	s	U	H		M	Y		Soil Material (k-st)	Emission Factor (lb/st)		Emissions (st)	
			Loading	Dumping		Loading	Dumping		Loading	Dumping	Loading	Dumping
1. Till at batch plant	15	7.2	3	3	2	4.5	8	122	0.0037	0.0031	0.23	0.19
2. Underdrain	1.6	7.2	3	3	4	4.5	9.6	330	0.0001	0.00008	0.017	0.013
3. Rip-rap	1.6	7.2	3	3	4	4.5	9.6	296	0.0001	0.00008	0.015	0.012
4. Filter	15	7.2	3	3	2	4.5	8	569	0.0037	0.0031	1.05	0.88

Table 13.4 Input to Hauling Emissions Calculations for MWDF

Activity	Vehicle Size	Material Bulk Density	Round Trip Distance/Haul	Volume of Material Moved by Area (k-yd^3)			
				T-1	T-2	T-3	T-4
1. Excavation	25 yd^3	2970 lb/yd^3	0.45 mi	3,068	4,652	3,750	5,100
2. Soil/Bentonite mixture	12 st	2970 lb/yd^3	0.45 mi	95	99	82	90
3. Underdrain	12 st	2500 lb/yd^3	0.45 mi	288	296	234	264
4. Filter material	12 st	2900 lb/yd^3	0.45 mi	280	460	357	383
5. Rip-rap	12 st	2500 lb/yd^3	0.45 mi	353	318	222	237

Comment No. 14:

How was the MWDF area TSP estimate of 112.8 st derived?

Response:

The surface area of construction disturbance for Tailing Pond T1 is estimated to be approximately 94 acres. Using the emission factor of 1.2 st/acre from EPA AP-42, the estimated TSP emissions are 112.8 st assuming these construction activities occur in one year. (See also the response to Comment No. 13 of this letter.) Because many areas of the additional tailing ponds are part of the previous construction activities (i.e., common embankment sections), it was assumed that 94 acres represents the additional surface area disturbance for the other ponds. Therefore, the estimated TSP emissions of 112.8 st was used for the early construction activities for the other tailing ponds. (See also Revised Table 1.1 in the response to Comment No. 13 of this letter.)

Comment No. 15:

Provide a description of the method used in determining construction emissions from sinking of the main shaft, intake air shaft, east exhaust shaft, west exhaust shaft and general underground development.

Response:

The procedure used to estimate TSP emissions from the different shaft sinkings (i.e., main, intake air) and general underground development is presented under its respective heading below. The estimated yearly TSP emissions for the different shaft sinkings were presented in Table 1.1 of the January 24, 1984 air permit response letter under the heading Construct Mine Support Facilities. The general underground development TSP emission estimates were presented in Table 1.1 under the heading of Underground Mine Development. However, these numbers have been recalculated based on the current design criteria. Therefore, revised Table 1.1 (See the response to Comment No. 13 of this letter) presents the estimated TSP emissions as calculated below.

Underground Blasting Emissions - Blasting using dynamite

Emission Factor and Source: AP-42, Table 8.24-2, Blasting - Surface Coal Mining

TSP-EF for emitted particles of less than or equal to 30 um

$$\text{TSP-EF} = \frac{344\ (A)^{0.8}}{(D)^{1.8}(M)^{1.9}}$$

where:

A = area blasted - m^2
D = hole depth - m
M = material moisture content - %

Main Shaft Sinking

$A = (8.5\ m/2)^2 \times 3.14 \div 2 = 28.36\ m^2$ (i.e., one half of area/blast)
D = 2.12 m
M = 15%

$$\text{TSP-EF} = \frac{344(28.36)^{0.8}}{(2.12)^{1.8}(15)^{1.9}} = 7.5 \text{ kg/blast} \times 2 \text{ blasts/day} = 15.1 \text{ kg/d}$$

Process Rate:

2 blasts/day, 30 blast days/month and 514 blast days/17 months

Example Calculation:

514 blast days/17 months x 15.1 kg/day x t/1000 kg = 7.8 t/17 months

Total TSP (Sink Main Shaft) = 8.6 st/17 months (1986-87) - (see also Revised Table 1.1 in Comment No. 13 of this letter)

Sink and Equip Air Intake Shaft

$A = (6.1\ m/2)^2 \times 3.14 \div 2 = 14.6\ m^2$ (i.e., one half of area/blast)
D = 2.12 m
M = 15%

$$\text{TSP-EF} = \frac{344(14.6)^{0.8}}{(2.12)^{1.8}(15)^{1.9}} = 4.4 \text{ kg/blast} \times 3 \text{ blasts/day} = 13.3 \text{ kg/d}$$

Process Rate:

3 blasts/day, 75 blast days/month and 326 blast days/10 months

Example Calculation:

326 blast days/10 months x 13.3 kg/day x t/1000 kg = 4.3 t/10 months

Total TSP (Air Intake Shaft) = 4.7 st/10 months (1986-87) - (see also Revised Table 1.1 in Comment No. 13 of this letter)

Construct East Exhaust Shaft (Raise) - EER

$A = (6.1\ m/2)^2 \times 3.14 - (1.83\ m/2)^2 \times 3.14 = 26.6\ m^2$
D = 2.12 m
M = 15%

$$\text{TSP-EF} = \frac{344(26.6)^{0.8}}{(2.12)^{1.8}(15)^{1.9}} = 7.2 \text{ kg/blast} \times 3 \text{ blasts/day} = 21.6 \text{ kg/d}$$

Process Rate:

3 blasts/day, 21 blast days/month, 85 blast days/total (yr)

Example Calculation:

85 blast days/total x 21.5 kg/day x t/1000 kg = 1.8 t/yr

Total TSP (EER) = 2.0 st/yr (1988) - (See also Revised Table 1.1 in Comment No. 13 of this letter)

Construct West Exhaust Shaft (Raise) - WER

TSP-EF = Same as EER

Total TSP (WER) = 2.0 st/yr (1989) - (see also Revised Table 1.1 in Comment No. 13 of this letter)

Underground Mine Development - Blasting of irregular sized openings of varying dimensions

TSP-EF = .0013 kg/t (for blasting overburden and coal)

From AMC report on "Fugitive Dust Emission Factors for the Mining Industry," Appendix p. D-3 - Colorado Fugitive Emissions.

Year	Waste Rock (k-st)	Ore (k-st)	Total (k-st)	st/yr*
1986	11	--	11	0.01
1987	66	--	66	0.09
1988	763	532	1295	1.7
1989	1146	1700	2846	3.7
1990	396	2814	3210	4.2

*See Revised Table 1.1 in the response to Comment No. 13 of this letter.

Example Calculation:

2,846,000 st/yr x 0.0026 lb/st x st/2000 lbs = 3.7 st/yr

Total TSP (Underground Mine Development) = 3.7 st/yr

The Colorado fugitive emissions reference is attached.

COLORADO DEPARTMENT OF HEALTH — Attachment for Comment No. 15 —
Division or Section of APCD

INTER-OFFICE COMMUNICATION

TO : All Interested Parties
THROUGH: COLORADO DEPARTMENT OF HEALTH, APCD
FROM: Thomas Tistinic, Public Health Engineer
DATE : September 30, 1981
SUBJECT: FUGITIVE DUST EMISSIONS

Attached find a compilation of fugitive dust emission factors the Division will be using to estimate emissions from sources of fugitive dust wishing to operate in the State of Colorado.

Unfortunately, agreement between sampling methods and between identical methods operated by different groups may show errors of degrees of magnitude. For this reason some general assumptions are needed to determine how the equations should be used and what the numbers mean.

Generally speaking:

1. The factors were developed based on those particles collected by the hi-vol sampler, considered to be mostly less than 30 microns in size.

2. The factors are not corrected for fallout. Until such time a fallout function may be incorporated into our dispersion model, we will assume:

   a. Maximum uncorrected distance of impact = 5 km (approximately 3 miles)

   b. Average wind speed in the State = 5 m/sec = μ

   c. Average stability class = D (see reference 9)

   Therefore, multiply factors by 0.24 or $0.24^{5/\mu}$ to get impact past 5 km.

3. EPA approved emission factors were used where possible.

4. Total annual emissions should be calculated for the estimated year of the greatest activity. Naturally some factors should be used in conjunction with total annual work days such as crushing, and some factors should be used in conjunction with 365 days per year such as wind erosion.

5. None of the factors, other than vehicle traffic and the wind erosion equation, appear to take into account emissions on days with .01 inches or more of rainfall (W). Multiplying the chosen emission factor by the quantity $(1-\frac{W}{365})$ will result in a modified emission factor corrected for wet days. See Appendix G for values of W.

We accept all comments to these factors and assumptions. This compilation will be updated regularly, probably every six months. Due to the large number of requests, it will be difficult to update any sooner than that, however, major changes will be given priority.

[signature]
Signature

TT/ea
AD BUS-29 (10-29-100)

TABLE D-1.

COLORADO FUGITIVE EMISSION PROJECT

PROCESS OPERATION	UNCONTROLLED FACTOR	CONTROL - EST. EFFICIENCY
Topsoil Removal - a combined factor which includes removal, haulage, and placement into storage area.	16 lb/scraper hour (5) or .38 lb/yd^3 (5) If no information provided we will assume: yd^3 topsoil = 1.5 tons (12) Average depth of topsoil = 1.5 feet (9) Capacity of scraper = 25 yd^3 (6)	Controls usually not practiced or required due to the relative moistness of the soil.
Topsoil Stockpile - once topsoil is placed in storage it is not worked continuously like product stockpiles. Therefore, once the surface fines have blown away, the topsoil will most likely show an ability to crust over making it resistant to all but very high wind velocities. However, unless the applicant can cite unusual soil conditions, to be conservative we will not apply a "natural crusting efficiency" for topsoil storage areas, but will assume a 5% monthly reduction due to loss of surface fines.	E_s = .01 [a I K C L^1 V^1] (15) Es = emission factor tons/acre/yr a = portion of total wind erosion losses that would be measured as suspended particulates I = soil erodibility in tons/acre/yr K = surface roughness factor (demensionless) C = climatic factor (dimensionless) L^1 = unsheltered field width factor (dimensionless) V^1 = vegetative cover factor (dimensionless) To calculate surface area of pile see Appendix A To obtain C values, see Appendix B and C To obtain a, I, K, L^1, and V^1 values, see Appendix D.	Chemical supressants - normally a synthetic polymer or copolymer - 85% (5) Mulch - 85% (5) Rapid revegetation - 75% (5) Wind breaks=height of pile - 50% (6) Wind breaks <height of pile - 30% (23) Frequent watering (twice a day) - 50% (8) Water as needed - 25% (6) Chemical/vegetative stabilization - 93% (20)
Drilling: Overburden or uranium ore Coal Rock	1.5 lbs/hole (5) .22 lbs/hole (9) .0013 lb/ton quarried (10) Plans reviewed indicate from 75 to 200 tons of broken granite produced per hole. Assuming 200 tons per hole would make the rock drilling emission factor = .26 lb/hole (29)	Bag Collector - 90% (6) Chemical Suppresants - 90% (6 & 11) Water Injection - 75% (6 & 11)
Blasting: Overburden or uranium ore Coal and/or Rock I will equate blasting of rock with the blasting of coal mainly because extremely wide variation in emission factors for blasting rock, i.e. from 2.2 to 4200 lbs per blast.	0.0026 $\frac{lb}{ton}$ blasted (9)(5)(6) This figure was derived using the highest EPA recommended emission factors for blasting, i.e. 85.3 lbs/blast and 78.1 lbs/blast for overburden and coal respectively. These factors were obtained from Reference 9 which also provided scant data on frequency of blasting and amounts of material mined. With this data the above factor of 0.0026 $\frac{lb}{ton}$ blasted was calculated.	Water filled plastic bags -50% (11) (controls rarely used during lasting, and control efficiency is highly speculative.)

Comment No. 16:

Table 1.1 does not include all of the sources from the original air permit application.

Response:

We have reviewed the tables in the original air permit application with the sources identified in the submittal of Table 1.1 of the air permit response letter of January 24, 1984. Some sources identified in the original air permit application have been eliminated in the current design as was indicated in the air permit letter of January 24, 1984 and others have been combined under a more general heading for Table 1.1. In other cases, sources emitting contaminants other than TSP were not repeated in Table 1.1 since they were not included in the annual estimates. All TSP emitting sources in the original air permit application were included in Table 1.1. If the DNR could indicate the specific sources from the tables of the original air permit application from which TSP estimates are not included in Table 1.1, we will review them immediately.

As also agreed at the meeting in Madison on February 29, 1984, we will provide in an additional table in the revised air permit application, all of the Project sources for all of the estimated air emissions. This table will follow the format provided to us by the DNR at the meeting. We will also include a separate table or tables for annual TSP emissions for the construction, operation and reclamation phases. This table will be similar to Tables 1.1 and 1.2 of the air permit response letter of January 24, 1984.

Comment No. 17:

What is the source for the estimated TSP emissions for the reclaim ponds?

Response:

Reclaim Ponds R1 and R2 are estimated to have construction activities including excavation over approximately 49.4 and 29.6 acres, respectively. Using the TSP emission factor of 1.2 st/acre from EPA AP-42 results in calculated total TSP emissions of approximately 59.3 and 36 st, respectively. Since Reclaim Pond R2 is constructed over two years, the estimated TSP emissions of 36 st are approximately 18 st/yr as presented in Table 1.1 of the January 24, 1984 air permit response letter.

Comment No. 18:

Provide the manufacturer's brochure describing the insertable collectors planned for use on emissions produced from handling of ore and waste rock in the headframe. Will the collector be ducted?

Response:

The insertable collectors planned for use to control TSP emissions produced from handling of ore and waste rock in the headframe will not be ducted to the atmosphere and will be similar to a DCE Vokes Model No. DLV-M 45/15 F1. The manufacturer's brochure is provided in response to Comment No. 1 of this letter.

Comment No. 19:

Will the cement silos for the backfill system be ducted to the insertable collectors and where will these collectors discharge?

Response:

The cement silos for the backfill system will be located inside the concentrator building which encloses the backfill surface operations and will not be vented (i.e., discharged) to the atmosphere. Each cement silo will have an insertable collector mounted on top of the silo which is similar to the other DCE Vokes models being used in the facility. (See also the response to Comment No. 1 of this letter.) The insertable collector will discharge the collected particles to the silo.

Comment No. 20:

It appears that the emissions estimate for preproduction ore handling is listed twice on Table 1.1.

Response:

The emissions listed on Table 1.1 of the air permit response letter of January 24, 1984 for preproduction ore handling (see Mine Production - Initial and Coarse Ore Transport) are listed twice. This has been changed in the revision to Table 1.1. (See Revised Table 1.1 in the response to Comment No. 13 of this letter.) Although the ore will be handled twice (i.e., initial loading at the mine, hauling and dumping at the preproduction ore storage pad; then reloaded from storage, and hauling and dumping into the crusher), initial ore storage will occur over a period of several years. Preproduction ore crushing will occur in 1990. The estimated emissions of 12.7 st are as shown on Table 1.1. This estimate has been revised using the latest emission factor from AP-42 for loading and dumping resulting in a reduction in total emissions to 10.0 st. (See also Revised Table 1.1 in the response to Comment No. 13 of this letter.) The maximum year for preproduction ore crushing is still 1990 with estimated TSP emissions as follows:

Activity	TSP emissions (st/yr)
Hauling of preproduction ore	6.4
Loading and dumping of preproduction ore	0.1
Wind-blown emissions*	0.2
Crushing and handling of preproduction ore*	3.3
	10.0

*See response to Comment No. A4 of the January 24, 1984 air permit letter.

PREPRODUCTION ORE HANDLING

1. Hauling - from main shaft to storage pad in 35 st dump truck

Haul distance = to storage - 1.2 mile round trip
from storage - 1.0 mile round trip

$$\text{TSP-EF} = (0.8)(5.9)(s/12)(S/30)^2(W/3)^{0.7}(w/4)^{0.5}(d/365) = \text{lb/veh-mile}$$
$$= (4.72)(6/12)(15/30)^2(51/3)^{0.7}(6/4)^{0.5}(230/365)$$
$$= 3.31 \text{ lb/veh-mile uncontrolled}$$

Example Calculation:

Emissions (controlled) = 3.31 lb veh-mile x 436 veh-miles/yr x st/2000 lbs x 0.15*
= 0.1 st/yr

Year	Volume Hauled (k-st) To Storage	From Storage	No. of Hauls	Miles Traveled	Emission (tons)
1986	---	---	---	---	---
1987	11	2**	371	446	0.1
1988	524	---	14,971	17,965	4.4
1989	366	---	10,457	12,548	3.1
1990		898	25,657	25,657	6.4

---

* 85% control with watering and chemical stabilization.

**Haul distance to pilot plant is the same as to storage (i.e., 1.2 miles round trip).

2. Loading and dumping (L&D):

Loading: Cat 988B - 7 yd^3 bucket

$$\text{TSP-EF} = (0.73)(0.0018)\frac{(1.6/5)(7.2/5)(4/5)}{(4/2)^2(7/6)^{0.33}} = 0.00012 \text{ lb/ton}$$

Dumping: 35 st dump truck - 35 st ÷ 2,500 lb/yd^3 x 2,000 lb/st = 28 yd^3

$$\text{TSP-EF} = (0.73)(0.0018)\frac{(1.6/5)(7.2/5)(4/5)}{(4/2)^2(28/6)^{0.33}} = 0.000073 \text{ lb/st}$$

Combined emission rate = 0.000193 lb/st loaded and dumped

Year	Volume Loaded and Dumped (k-st)	Emissions (st/yr)
1987	13	0.00
1988	524	0.05
1989	366	0.04
1990	898	0.09

Total Preproduction Ore Handling Emissions

Year	Hauling	L&D	Crushing	Wind-Blown	Total (TSP - st/yr)
1986	---	---	---	---	---
1987	0.1	0.0	---	0.2	0.3
1988	4.4	0.05	---	0.2	4.7
1989	3.1	0.04	---	0.2	3.4
1990	6.4	0.1	3.3	0.2	10.0

Comment No. 21:

What is the source for the estimated TSP emissions for the tailings pipeline construction?

Response:

The estimated acreage disturbed for construction of the tailings pipeline including excavation is approximately 10 acres. Using the TSP emission factor of 1.2 st/acre from EPA AP-42 results in calculated total TSP emissions of 12 st. Since the tailings pipeline is constructed over two years, the estimated TSP emissions of 12 st are approximately 6 st/yr as presented in Table 1.1 of the January 24, 1984 air permit letter.

Comment No. 22:

Table 1.1 shows 96.3 st/yr particulate emissions from MWDF construction. What was the input to this rate.

Response:

The derivation of this rate is explained in the response to Comment No. 13 of this letter. Note, however, that MWDF construction emissions have been revised to incorporate use of different emission factors for loading and dumping as requested by the WDNR and to provide more specific estimates for individual ponds. (See also Revised Table 1.1 in response to Comment No. 13 of this letter.)

Comment No. 23:

Where are the emissions calculations for drift development found?

Response:

The estimates for TSP emissions produced during mine drift development prior to and leading into mine operation are presented in the response to Comment No. 15 of this letter. Operations drift development TSP emission estimates are presented in the response to Comment No. C1 of the January 24, 1984 air permit letter.

Comment No. 24:

What is the source for the estimated TSP emissions for the crushing and screening in Table 1.1 of the January 24, 1984 air permit response letter.

Response:

The estimated TSP emissions for ore crushing and screening were recalculated after receipt of the revised EPA AP-42, Section 8.23 dealing with mining operations. The revised emission factors were obtained from Table 8.23-1 on p. 8.23-4. The calculations are as follows:

Fine Ore Crushing and Screening - Crushing and screening of high moisture ore

Emission Factors and Source: AP-42, Table 8.23-1

TSP-EF = 0.03 kg/t secondary and tertiary crushing
0.005 kg/t handling

Duration: 24 hr/day, 365 days/yr

Process Rate: 620 t/hr, 14,880 t/day, 3,629,000 t/yr

Example Calculation:

TSP = 3,629,000 t/yr x 0.03 kg/t x 2 (crushing and screening) x (1-.979) ÷ t/1000 kg = 4.6 t/yr
4.6 t/yr x 1.1 st/t = 5.1 st/yr

TSP = 3,629,000 x 0.005 x 8 (handling) x (1-.979) ÷ 1000 = 3.0 t/yr
3.0 t/yr x 1.1 st/yr = 3.3 st/yr

Total estimated TSP emissions from crushing and screening are 8.4 st/yr as presented in Table 1.1 of the January 24, 1984 air permit response letter.

Comment No. 25:

Provide the calculations used to determine the TSP emissions from combustion of natural gas for Facility Heating shown in Table 1.1.

Response:

Natural gas is used for three purposes in the surface facilities. They are: 1) heating the buildings, 2) water heating and 3) water treatment (brine crystallizer). Each of these processes are described in the following under its respective heading.

Heating Buildings - Use of natural gas unit heaters. Heat content is 1000 BTU/SCF for natural gas.

Emission Factors and Source: EPA-NEDS, Appendix C, p. C-3, December 1975 - <10 M BTU/hr (see attached)

TSP-EF = 10.0 $lb/10^6$ SCF of natural gas

SO_x-EF = 0.6 $lb/10^6$ SCF of natural gas

NO_x-EF = 120.0 $lb/10^6$ SCF of natural gas

CO-EF = 17.0 $lb/10^6$ SCF of natural gas

HC-EF = 3.0 $lb/10^6$ SCF of natural gas

Process Rate: 17,350 SCF/hr, 416,400 SCF/day and 33,960,000 SCF/yr of natural gas

Duration: As required by weather conditions

Control Method and Efficiency: Use of natural gas

TSP = (33,960,000)(10.0/1,000,000)/2000 = 0.17 st/yr

Water Heating - Heating of water in the concentrator building for the process using a 42,000 BTU/hr boiler. Also, heating water in the plant services building for washrooms and showers using a 1,005,000 BTU/hr water heater.

Emission Factors and Source: Same as building heating

Process Rate: 1,047 SCF/hr, 25,128 SCF/day and 9,172,000 SCF/yr of natural gas

Duration: 24 hrs/day, 365 days/yr

Control Method and Efficiency: Use of natural gas

TSP = (9,172,000)(10.0/1,000,000)/2000 = 0.05 st/yr

Water Treatment - Use of a boiler for VCE (i.e., initial) and brine crystallization operations in the vapor compression evaporator process. Boiler will consume 14,600,000 BTU/hr of natural gas.

Emission Factors and Source: Same as for heating buildings

Process Rate: 14,600 SCF/hr, 350,400 SCF/day and 127,900,000 SCF/yr of natural gas

Duration: 24 hrs/day, 365 days/yr

Control Method and Efficiency: Use of natural gas

TSP = (127,900,000)(10.0/1,000,000)/2000 = 0.64 st/yr

Total Estimated Facility Heating TSP Emissions

	TSP (st/yr)
Heating Buildings	0.17
Water Heating	0.05
Water Treatment	0.64
Total	0.86

NATIONAL EMISSION DATA SYSTEM
SOURCE CLASSIFICATION CODES

POUNDS EMITTED PER UNIT

		PART	SOX	NOX	HC	CO	UNITS
EXTCOMB BOILER	-ELECTRIC GENERATN						
LIQ WASTE-SPECIFY							
1-01-013-01	>100 MMBTU/HR						1000 GALLONS BURNED
1-01-013-02	10-100 MMBTU/HR						1000 GALLONS BURNED
1-01-013-03	<10 MMBTU/HR						1000 GALLONS BURNED
OTHER/NOT CLASIFD							
1-01-999-97	SPECIFY IN REMARK						MILLION CUBIC FEET BURNED
1-01-999-98	SPECIFY IN REMARK						1000 GALLON (LIQUID) BURNED
1-01-999-99	SPECIFY IN REMARK						TONS BURNED (SOLID)
EXTCOMB BOILER	-INDUSTRIAL						
ANTHRACITE COAL							
1-02-001-01	>100MMBTU/HR PULV	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-02-001-02	>100MMBTU/HR STKR	2.00 A	38.0 S	10.5	0.20	6.00	TONS BURNED
1-02-001-03	10-100MMBTU PULVD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-02-001-04	10-100MMBTU STKR	2.00 A	38.0 S	10.5	0.20	6.00	TONS BURNED
1-02-001-05	<10MMBTU/HR PULVD	17.0 A	38.0 S	18.0	0.03	1.00	TONS BURNED
1-02-001-06	<10MMBTU/HR STKR	2.00 A	38.0 S	6.00	0.20	10.0	TONS BURNED
1-02-001-07	<10MMBTU/HR HNDFR	10.0	36.0 S	3.00	2.50	90.0	TONS BURNED
1-02-001-99	OTHER/NOT CLASIFD	17.0 A	38.0 S	18.0	0.03	2.00	TONS BURNED
BITUMINOUS COAL							
1-02-002-01	>100MMBTU PULVWET	13.0 A	38.0 S	30.0	0.30	1.00	TONS BURNED
1-02-002-02	>100MMBTU PULVDRY	17.0 A	38.0 S	18.0	0.30	1.00	TONS BURNED
1-02-002-03	>100MMBTU CYCLONE	2.00 A	38.0 S	55.0	0.30	1.00	TONS BURNED
1-02-002-04	>100MMBTU SPDSTKR	13.0 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-05	10-100MMBTU OFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-06	10-100MMBTU UFSTK	5.00 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-07	10-100MMBTU PULWT	13.0 A	38.0 S	30.0	0.30	1.00	TONS BURNED
1-02-002-08	10-100MMBTU PULDY	17.0 A	38.0 S	18.0	0.30	1.00	TONS BURNED
1-02-002-09	10-100MMBTUSPDSTK	13.0 A	38.0 S	15.0	1.00	2.00	TONS BURNED
1-02-002-10	<10MMBTU OFD STKR	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-02-002-11	<10MMBTU UFD STKR	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-02-002-12	<10MMBTU PULV DRY	17.0 A	38.0 S	14.0	0.30	2.00	TONS BURNED
1-02-002-13	<10MMBTU SPD STKR	2.00 A	38.0 S	6.00	3.00	10.0	TONS BURNED
1-02-002-14	<10MMBTU HANDFIRE	20.0	38.0 S	3.00	20.0	90.0	TONS BURNED
1-02-002-99	OTHER/NOT CLASIFD	13.0 A	38.0 S	15.0	0.30	2.00	TONS BURNED
LIGNITE							
1-02-003-01	>100MMBTU PULVWET	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-02	>100MMBTU PULVDRY	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-03	>100MMBTU CYCLONE	6.50 A	30.0 S	17.0	0.30	1.00	TONS BURNED
1-02-003-04	>100MMBTU OFSTKR	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-05	>100MMBTU UFSTKR	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-06	>100MMBTU SPDSTKR	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-07	10-100MMBTU DYPUL	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-08	10-100MMBTU WTPUL	6.50 A	30.0 S	13.0	0.30	1.00	TONS BURNED
1-02-003-09	10-100MMBTU OFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-10	10-100MMBTU UFSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-11	10-100MMBTUSPDSTK	6.50 A	30.0 S	13.0	1.00	2.00	TONS BURNED
1-02-003-12	<10MMBTU PULV DRY	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-02-003-13	<10MMBTU OFSTOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-02-003-14	<10MMBTU UFSTOKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
1-02-003-15	<10MMBTU HANDFIRE	6.50 A	30.0 S	13.0	20.0	90.0	TONS BURNED
1-02-003-16	<10MMBTU SPDSTKR	6.50 A	30.0 S	13.0	3.00	10.0	TONS BURNED
RESIDUAL OIL							
1-02-004-01	>100MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-004-02	10-100MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-004-03	<10MMBTU/HR	23.0	157. S	60.0	3.00	4.00	1000 GALLONS BURNED
DISTILLATE OIL							
1-02-005-01	>100MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-005-02	10-100MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
1-02-005-03	<10MMBTU/HR	15.0	142. S	60.0	3.00	4.00	1000 GALLONS BURNED
NATURAL GAS							
1-02-006-01	>100MMBTU/HR	10.0	0.60	600.	3.00	17.0	MILLION CUBIC FEET BURNED
1-02-006-02	10-100MMBTU/HR	10.0	0.60	230.	3.00	17.0	MILLION CUBIC FEET BURNED
1-02-006-03	<10MMBTU/HR	10.0	0.60	120.	3.00	17.0	MILLION CUBIC FEET BURNED
PROCESS GAS							
1-02-007-01	REFINERY >100						MILLION CUBIC FEET BURNED
1-02-007-02	REFINERY 10-100						MILLION CUBIC FEET BURNED
1-02-007-03	REFINERY <10						MILLION CUBIC FEET BURNED
1-02-007-04	BLAST FNC >100						MILLION CUBIC FEET BURNED
1-02-007-05	BLAST FNC 10-100						MILLION CUBIC FEET BURNED
1-02-007-06	BLAST FNC <10						MILLION CUBIC FEET BURNED

'A' INDICATES THE ASH CONTENT, 'S' INDICATES THE SULFUR CONTENT OF THE FUEL ON A PERCENT BASIS (BY WEIGHT)

Comment No. 26:

Where are the estimated TSP emissions for the pilot plant activities?

Response:

Most of the pilot plant activities are currently designed for completing the program within the core storage building. The equipment will not be vented to the atmosphere and there will be no stack releasing emissions from this facility. The only activity producing air emissions is the temporary portable crusher outside the core storage building. The crusher will have a baghouse collector with an estimated efficiency of 99% as presented in the response to Comment No. A4 of the January 24, 1984 air permit response letter. The estimated TSP emissions for crushing and handling of all of the preproduction ore (898 k-st) is 3.3 st/yr as presented on p. 26 of the Janaury 24, 1984 letter. The pilot plant is estimated to process approximately 2 k-st (see p. 22 of the Janaury 24, 1984 letter) of preproduction ore. This represents 0.2% of the preproduction ore and 0.007 st of the calculated TSP emissions from crushing the 898 k-st of this ore. These TSP emissions were included in the 12.7 st/yr provided in Table 1.1 for Mine Production - Initial in 1990. They are now included in the 10.0 st/yr estimate provided in Revised Table 1.1 (see response to Comment No. 13 of this letter) for Mill/Concentrator Operations - Coarse Ore Transport (i.e., preproduction ore in 1990).

Comment No. 27:

How was the burning TSP emission estimate for forest residues determined? How will this material be burned - in one pile or several piles? Do you intend to apply for permits for the burning for each occurrence?

Response:

The TSP emission estimate for burning unspecified Forest residues was determined by using the available harvestable timber estimate provided in the report entitled, "Forest Inventory Timber Appraisal and Forest Management Recommendations on 3,474 Acres of the Crandon Mine Project," prepared by E. F. Steigerwaldt and Sons (1982), Tomahawk, Wisconsin (previously provided to the DNR) and the emission factors presented in EPA AP-42, Table 2.4-2, p. 2.4-3. The Steigerwaldt report provides a harvestable timber estimate for the acres to be cleared for construction of 12,677 total cords. Approximately 1.75 st/cord (3,500 lbs/cord) is the air dry weight (see Attachment 1) of this timber with brush and waste (i.e., unspecified Forest residues) an estimated 65% of the harvestable timber (see Attachment 2). See also Comment Nos. 129 (EIR letter of October 3, 1983) and 86 (Mine Permit letter of November 17, 1983). These estimates were used to calculate the tons (st) of unspecified Forest residues for the various areas of the Project facilities as follows:

1) The MWDF and reclaim ponds cover 614 acres with estimated harvestable timber of 8603 total cords (Steigerwaldt, 1982). The acreage for construction of the initial tailing and reclaim ponds

is approximately 136 acres or 22% of the total 614 acres. Therefore, approximately 1900 cords (8603 x 0.22) of timber will be harvested for construction of the initial tailing and reclaim ponds. The estimated air dry weight of these 1900 cords is 3325 st (1900 x 1.75) with approximately 2161.25 st (3325 x 0.65) of brush (i.e., unspecified Forest residues). The estimated brush tonnage of 2161.25 st was used with the emission factors of AP-42, Table 2.4-2 to calculate the estimated contaminant air emissions from burning. (See Comment No. 160 of the EIR response letter submitted to the DNR on October 3, 1983.)

2. The construction zone for the mine/mill site was estimated to be approximately 104 acres for the air permit response letter of January 24, 1984. This estimated acreage included approximately 14.7 and 89 acres from clearing the pad areas (see response A1 of the January 24, 1984 air permit letter) and the mine/mill site, respectively. (See also Comment No. 86 of the Mine Permit letter submitted to the DNR on November 17, 1983.) The estimated harvestable timber for the 89 acre mine/mill site is 1215 cords (Steigerwaldt, 1982). The estimated unspecified Forest residues for this 89 acres is approximately 1382 st (1215 x 1.75 x 0.65). Using the AP-42 TSP emission factor of 17 lb/st x 1382 st x st/2000 lbs, gives an estimate of 11.8 st/yr for TSP air emissions for burning of unspecified Forest residues at the mine/mill site. By proportion for the 89 to 104 acres, an estimated 1420 (1215 ÷ 89 x 104) cords of harvestable timber was calculated for the total 104 acres. Approximately 205 cords would be harvested from the pad areas (i.e., 14.7 acres). This 14.7 acres would also have approximately 233 st of unspecified Forest residues. Using the AP-42 TSP emission factor of 17 lb/st x 233 st x st/2000 lbs, gives an estimate of 2.0 st/yr for burning the unspecified Forest residues of the pad areas.

3. Similarly for the access road and railroad spur current estimates for cords of harvestable timber are 272 and 411 cords, respectively. Estimated unspecified Forest residues are 309 and 468 st, respectively. (See also Comment No. 129 of the EIR letter submitted to the DNR on October 3, 1983.) The revised air permit calculations for estimated TSP air emissions are 2.6 and 4.0 st/yr, respectively.

4. The slurry pipeline and haul road is estimated to have 87 cords of harvestable timber on the 8 acres for construction clearing. Approximately 99 st of Forest residues are estimated to be burned with TSP air emissions of approximately 0.8 st/yr. The revised air permit application will include these calculations.

Although we intend to utilize much of the unspecified Forest residues for mulching, we have conservatively assumed that all of it will be burned for the air permit application. Actual burning will occur periodically during the year as portions of the Project areas are cleared for construction

RECEIVED
MAR 12 1984
EXXON MINERALS

Wood for Home Heating
LOCATING, CUTTING, AND GATHERING WOOD

Gordon R. Cunningham and Arlan L. Wooden

You can buy wood for home heating from firewood dealers, or you can gather it (with permission, of course) from national, state, county, community, industrial, farm, and small private woodlands.

Nature makes most fuel wood available—trees die, and wind blows them over. Storms, fires, insects and diseases damage trees. Sometimes we cut healthy trees to leave more room for others to grow.

Most of the public forest managers, many industrial forest owners, and some private forest owners will give permission for harvesting wood for personal home heating. Locations of some of these forests, and regulations for harvesting fuel wood from them, are given at the end of this publication.

If the private woodland is your own, your concerns are to (1) figure how much wood you need for heating each year, (2) know how much your woodland will grow, and (3) plan how to gather and store wood for burning.

FIGURE HOW MUCH WOOD YOU NEED

The easiest way to figure how much fuel wood you will need for a heating season is to covert your present fuel consumption to wood equivalents. Or, you can estimate the heat loss and fuel needs for your house.

Below are figures to help convert your present fuel to wood equivalents. A standard cord of wood is a stack 4' x 4' x 8'; it includes 80 cubic feet of solid wood. The heavier (better) hardwoods weigh, per standard cord, between 3000 to 4000 pounds (1361 to 1814 kilograms) when air-dry, so you can use an average of 3500 pounds (1587 kg.) per cord for your estimate.

1 gallon of #2 fuel oil = 22.2 pounds of wood
1 therm (100 cubic feet) of natural gas = 14.0 pounds of wood
1 gallon of propane gas = 14.6 pounds of wood
1 kilowatt-hour of electricity = 0.59 pounds of wood
1 pound of coal = 1.56 pounds of wood.

Using #2 fuel oil as an example, if you burn 1000 gallons of fuel oil then 1000 x 22.2 = 22,200 pounds of wood. Dividing 22,200 by 3,500 means you would need 6 1/3 standard cords of wood. For a more accurate estimate, and information on how much you can afford to pay for wood compared to other fuels, see Publication G2874—Wood for Home Heating: WOOD AS FUEL.

The second method to figure how much fuel wood you need for a heating season is to calculate heat loss and fuel consumption for your house. Circular A1844 "How to Calculate Heat Loss and Fuel Consumption" will help you estimate heat losses through walls, ceilings, windows, doors and various kinds and amounts of insulation. Let's assume your calculations show your house is losing about 200 million Btu's per heating season. (A Btu, British thermal unit, is the heat needed to raise the temperature of one pound of water one degree Fahrenheit). A pound of air-dry wood provices about 5800 Btu's of heat, so 200,000,000 divided by 5800 equals 34,483 pounds of wood needed. And 34,483 divided by 3500 equals 9.8 standard cords of wood you need.

HOW MUCH WOOD WILL A WOODLAND GROW?

The average woodland in Wisconsin grows about 38 cubic feet of wood usable for fuel on each acre annually. This is about 1/2 a standard cord. Intensive management can double this growth rate. With careful selection of trees harvested for fuel wood, the remaining trees in a woodland will grow more vigorously, because they will have more soil moisture, nutrients, and sunlight. Removing some trees to favor others is called Timber Stand Improvement, or TSI as foresters abbreviate it.

A Department of Natural Resources forester, or a consulting or industrial forester, can mark the trees to cut. The forester will know how many trees can be removed without taking more than the woodland will grow.

Oneida Co. FD, Rhinelander 54501	W	RA	Maps	Lr T	PU 10 CDS.		Yes	6/1 - 11/15
Price Co. FD, Phillips 54555	W	RA	Ld	Lr D	PU		No	1 year
Rusk Co. FD, Ladysmith 54848	V	RA	Sales areas	Lr D T		No	No	
St. Regis Paper Co., Rhinelander 54501	W	RA	Ld	Lr D	PU	No	No	30 - 60 days
Sawyer Co. FD, Hayward 54843	W	RA	Map	Lr DD		Yes $1	No	Annual
Vilas Co. FD, Eagle River 54521	W	LOR	Ld & Map	Lr D T	PU	No	No	1 year - date issued
Washburn Co. FD, Spooner 54801	W	RA		Lr D		Yes $2.50	No	6 mos.
Wood Co. FD, Wisconsin Rapids 54494	W	RA	Ld	Lr D	PU	No	Yes	90 days

* For address information: Ask county Extension agent or forester.

** For standing marked trees. No charge for Lr/DD.

This publication is slightly revised. Earlier edition may be used.

Gordon R. Cunningham and Arlan L. Wooden are professor of forestry and extension forestry project assistant respectively, College of Agricultural and Life Sciences, University of Wisconsin-Madison, and Division of Economic and Environmental Development, University of Wisconsin-Extension.

COOPERATIVE EXTENSION PROGRAMS UWEX

UNIVERSITY OF WISCONSIN–EXTENSION/MADISON

University of Wisconsin-Extension, Gale L. VandeBerg, director, in cooperation with the United States Department of Agriculture and Wisconsin counties, publishes this information to further the purpose of the May 8 and June 30, 1914 Acts of Congress; and provides equal opportunities in employment and programming including Title IX requirements. This publication is available to Wisconsin residents from county Extension agents. It's available to out-of-state purchasers from Agricultural Bulletin Building, 1535 Observatory Drive, Madison, Wisconsin 53706. Editors, before publicizing, should contact the Agricultural Bulletin Building to determine its availability. **Order by serial number and title;** payment should include price plus postage.

JULY 1979

15¢

G2873 WOOD FOR HOME HEATING

The total of unharvested annual growth for each county was reduced by a proportion equal to the forest industry land ownership for that county, therefore factoring in the unavailability of forest industry timber. The remainder is considered available for use on a sustained basis. The figures in the next-to-last column represent roundwood volumes only, and do not include the weight of branches and tops. If branches and tops are added, the total tonnage would be increased by about 45 percent. The Forest Residues Energy Program report also adds cull trees, which would increase the estimated amount by about another 19 percent. The addition of these forest residues is accounted for in the last column of Table 5.

3.1.3.2 Mill Residues

Additional amounts of fuel are available in the form of mill residues (such as bark, sawdust, slabs, and edgings). Data for 1972 and 1973 on residue production from primary processing and unused residues are summarized in Table 6. Since that time, however, demand and use have increased. Currently, there are at least five major users of wood residues:

- Superior Power - at Ashland, Wisconsin
- Weyerhaeuser Mills - at Marshfield and Rothschild, Wisconsin
- Owens-Illinois - at Tomahawk, Wisconsin
- Champion International - just starting at Iron Mountain, Michigan
- Mead Mill - at Escanaba, Michigan

There is also a public school in Park Falls, Wisconsin, that heats with wood chips, and several other mills are discussing conversion to burning residue and chips.

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*Dames & Moore, 1981. Wood-fired Power Plant Siting Study. Conducted for Wisconsin Public Service Corporation. Excerpt is p. 2 of the report. Dames & Moore, Park Ridge, IL activities. Therefore, burning will be completed with several piles on the ground surface.

As agreed at the meeting in Madison with the DNR on February 29, 1984, we would coordinate each of these burnings with the North Central District DNR office in Rhinelander, Wisconsin. We would also apply for any necessary open burning permits required by local governments.

Comment No. 28:

Provide a copy of the memorandum from Mr. Charles A. Collins, Wyoming Department of Environmental Quality, which was referenced on p. 23 of your January 24, 1984 air permit response letter. This was used as the citation for squaring the vehicle speed correction factor ratio when calculating emission factors for transportation on unpaved roads.

Response:

A copy of the subject memorandum was provided to Mr. Steve Klafka at a review meeting in Madison, Wisconsin on March 1, 1984. Another copy of this memorandum is attached.

Comment No. 29:

It was assumed that the haul road and surface access roads had a silt content of 6%. Unless a gravel surface will be used on unpaved roads the silt content of native soil should be used.

Response:

Gravel obtained from local suppliers will be used on the haul road and unpaved surface access roads.

Comment No. 30:

The emission control factor used in Exxon's emission calculations for the haul road is 85% based on use of chemical stabilization. Please provide a reference for this control factor as AP-42 shows a control factor of 50% for chemical stabilization.

Response:

An excerpt of a letter from EPA Region VIII, December 10, 1979 is provided which shows a control factor of 85% for chemical stabilization of mine haul roads.

The control factor of 50% shown in AP-42 is a factor based on chemical stabilization only (no watering) of public unpaved roads. The reference from which that control factor was cited, also gives a control factor for

Attachment for Comment No. 28

MEMORANDUM

TO: Whom It May Concern

THROUGH: Randolph Wood
Administrator

FROM: Charles A. Collins
Air Quality Supervisor

SUBJECT: Fugitive Dust Emission Factors

DATE: January 24, 1979

Attached to this memorandum is a guideline for fugitive dust emission factors which the Division will be using to evaluate all future and pending applications regarding major sources of fugitive dust. The attached guideline will supercede a previous guideline dated November 14, 1978. The Division had proposed to use the November 14, 1978 guideline in conjunction with a fallout function for dispersion modeling purposes and has since determined that the use of a fallout function as presented by PEDCo in reference 1 of the attached material is not a workable tool.

The Division will be using the attached guideline emission factors as input to a CDM dispersion model (rural version) assuming no fallout or deposition of particles 30 um in size and smaller. The emission factors as presented and adjusted account only for that portion of emissions which are 30 um in size and smaller.

Certain selected emission factors and accompanying 30 um cut off factors were selected from the 1978 PEDCo report. To arrive at presented emission factors, the Division went to Tables 4-1 through 4-7 of subject report to obtain average apparent emission rates and then selected the 30 um particle size fraction by reviewing data in Table D-1 and composite size distribution curves on figure 4-2. A fugitive dust emission rate diagram is presented following this memorandum to illustrate the Division's assumptions in extracting data from the PEDCo report for the following mine specific operations:

1. Overburden Removal
   Dragline, Mine B
   Truck/Shovel, Mine E
2. Product Removal
   Coal-Truck/Shovel, Mine B
3. Product Dumping
   Coal Truck Dump, Mine B
4. Stockpiles (wind erosion)
   Stockpile, All Mines

2/5

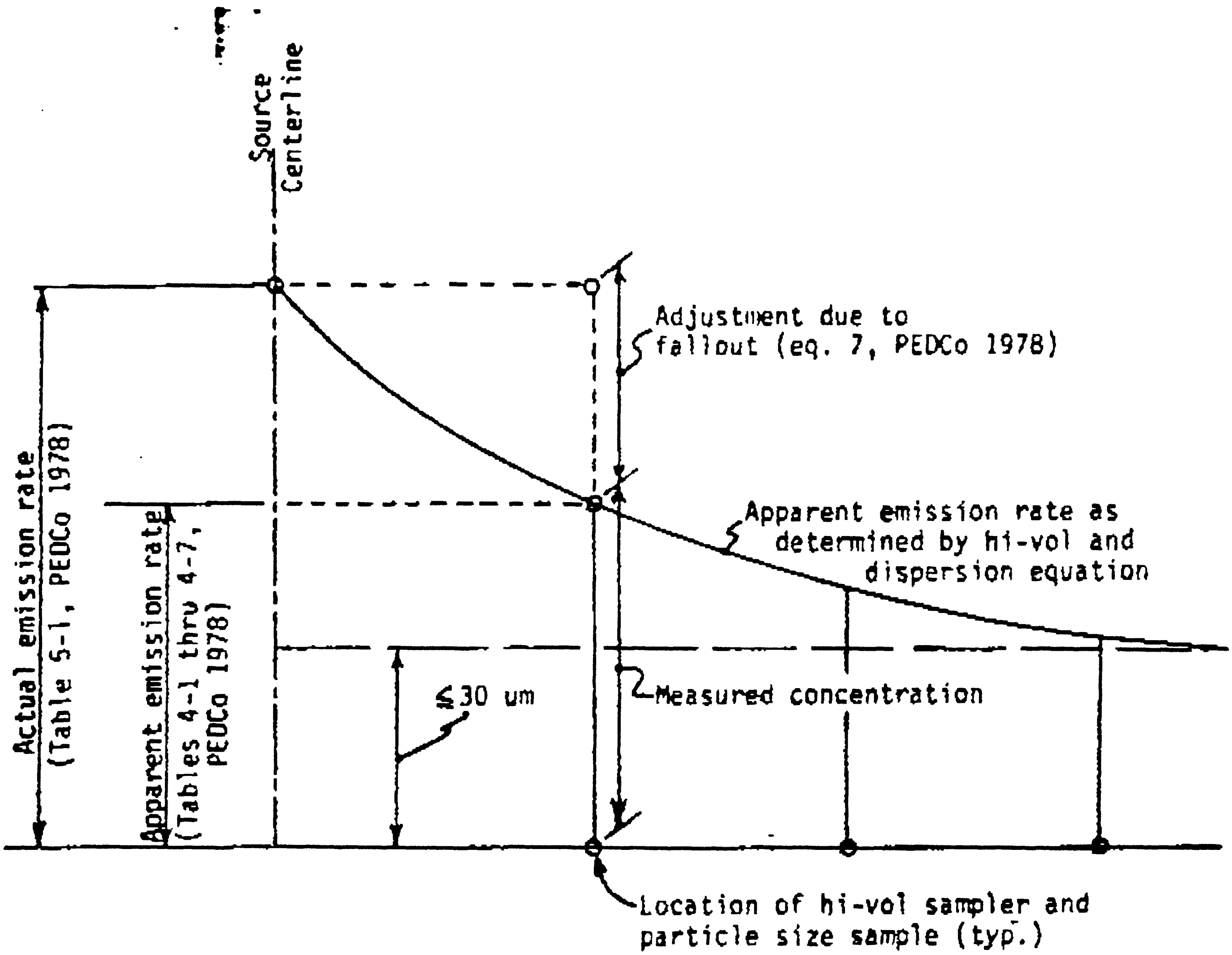

Figure C-1. Determination of apparent emission rate for fugitive dust source (after WDEQ 1979)

3/5

TABLE C-1.

STATE OF WYOMING
DIVISION OF AIR QUALITY
GUIDELINE FOR FUGITIVE DUST EMISSION FACTORS
FOR MINING ACTIVITIES , January, 1979
(Particulate size 30 um and smaller, no fallout function required)

Mining Activity	(note) Emission Factor (Ref) x % Suspended	Control Technique	Control Efficiency
1. Overburden Removal			
Dragline	0.04 lb/yd^3(1) x 0.75	—	—
Truck/Shovel	0.02 lb/ton(1) x 0.75	—	—
Scraper	[1]32 lbs/hr(2)	watering	50%
2. Haul Roads	[2]$E = 0.81s(S/30)\frac{(365-W)}{365}$ lb/VMT(3) x 0.62	a. watering	50%
		[3]b. oil or chemical dust suppressant	60%
Access Roads	[2]$E = 0.81s(S/30)\frac{(365-W)}{365}$ lb/VMT(3) x 0.62	a. asphalt paving or equal	85%
		b. stabilization of base with chip and seal surface	70%
3. Haul Road Repair and Construction			
Graders	[1]32 lbs/hr(2)	watering	50%
Scrapers	[1]32 lbs/hr(2)	watering	50%
4. Wind Erosion	[4]E = AIKCL'V' ton/acre/yr(4)	—	—
5. Product Removal			
Coal-Truck/Shovel	0.003 lb/ton(1) x 0.70	—	—
~~Coal-Frontend Loader~~	[5]0.003 lb/ton x 0.70	—	—
Uranium-Frontend Loader	[6]0.003 lb/ton	—	—
6. Product Dumping			
Coal-Truck Dump	0.017 lb/ton(1) x 0.75	a. coal-water sprays	50%
Uranium	[7]0.017 lb/ton	b. coal-negative pressure collection system	85%
7. Stockpiles (wind erosion)			
Coal	[8]1.2 u lb/acre/hr x 0.73	Enclosure	99%
Uranium	[9]E = 0.05(s/1.5)(d/235)(f/15)(D/90) lbs/ton(5)	watering	50%
8. Blasting			
Overburden	50 lb/blast(1) x 0.75	prevent overshooting	—
Coal	35 lb/blast(1) x 0.75	prevent overshooting	—

Notes:

1. If applicant's estimate of grader and scraper hours includes wet days, then reduce emissions by the factor $\frac{365-W}{365}$
   where W = no. of days where rain or snow precipitation is 0.01" or greater

2. From Reference 3 $E = 0.81s(S/30)\frac{(365-W)}{365}$ lbs/VMT

   where s = silt content of road surface material(%)
   S = vehicle speed in mph
   W = no. of days with 0.01" precipitation or more
   S/30 factor shou'd be squared for speeds less than 30 mph
   Apply correction for number or width of tires compared to light vehicles

3. Frequency and rate of application as per manufacturer's recommendation or as justified by applicant for site, specific road materials and experience.

4. From Reference 4 E = AIKCL'V' ton/acre/yr
   where A = portion of losses which become suspended
   I = soil erodibility
   K = surface roughness factor
   C = climatic factor
   L'= unsheltered field width factor
   = 0.7 for 1000' & 1.0 for 2000' and greater
   V'= vegetative cover factor (use V' = 1.0)

Soil Type	A	I, ton/acre/yr
Rocky, Gravelly	0.025	38
Sandy	0.010	134
Fine	0.041	52
Clay Loam	0.025	47

K - Varies from 0.5 to 1.0; 1.0 is normally used.
C - Table 3.11 of reference or $C = 0.345\ (u^3) \div (P\text{-}E)^2$
where u = average wind velocity (mph)

5. It was felt that given the similarity of operation of a frontend loader to a shovel that measured emissions from Reference 1 of 10 to 20 times more (loader vs. shovel) were not reasonable, thus the selection of 0.003 lbs/ton.

6. Given the usual wetness of observed uranium ore in surface mines this factor is probably conservative. Factor estimate only - not measured. No correction is made for % suspended material as data is not available.

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TABLE C-1 (completed).

GUIDELINE FOR FUGITIVE DUST EMISSIONS (con't)

Notes:

7. Estimate only - not measured. No correction is made for % suspended material as data is not available.

8. 1.2 u lb/acre/hour where u is wind speed in m/sec. Factor includes some equipment activity around and on piles. Total emission should include truck dumping, etc. Adjust by ratio of dry days to total days in existence.

9. From Reference 5 E = 0.05(s/1.5)(d/235)(f/15)(D/90)lbs/ton throughput through pile
   where s = silt content of material (%)
   d = no. of dry days/yr
   f = percentage of time wind speed exceeds 12 mph
   D = duration of material in storage (days)

References:

(1) EPA-908/1-78-003, "Survey of Fugitive Dust from Coal Mines", by PEDCo Environmental, Inc., February, 1978.

(2) EPA-908/1-76-004, "Wyoming Air Quality Maintenance Area Analysis", by PEDCo Environmental, Inc., May, 1976.

(3) AP-42 "Compilation of Air Pollutant Emission Factors (Supplements 1-8)", May, 1978.

(4) PEDCo 1976, "Evaluation of Fugitive Dust Emissions from Mining", by PEDCo Environmental, Inc., April, 1976.

(5) C. Cowherd and R.V. Hendriks, "Development of Fugitive Dust Emission Factors for Industrial Sources", Paper No. 78-55.4, Annual Meeting Air Pollution Control Association, Houston, Texas (June, 1978).

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Attachment for Comment No. 30

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII
1860 LINCOLN STREET
DENVER, COLORADO 80295

DEC 10 1979

REF: 8AH-A

Dear Colleague:

In January, 1979, the Environmental Protection Agency (EPA) Region VIII distributed an Interim Policy Paper on the Air Quality Review of Surface Mining Operations. This paper attempted to present guidelines on the review of surface mining operations pursuant to the Prevention of Significant Deterioration of Air Quality (PSD) regulations, 40 CFR 52.21.

Two hundred people attended a public meeting to discuss this paper on February 6, 1979. We are today distributing a revised document entitled "Compilation of Past Practices and Interpretations by EPA on the Air Quality Review of Surface Mining Operations." This paper is being distributed today in full awareness of the June 1979 Alabama Power Company v. EPA opinion of the District of Columbia Circuit, U. S. Court of Appeals, and the September 5, 1979, EPA reproposal of the PSD regulations (44 FR 51924) in response to the above decision. This distribution is being made for the following reasons:

1. Potential permit applicants have asked for guidance on what control methods constitute BACT. This attached paper provides information on past BACT decisions.

2. The final Alabama Power v. EPA decision and final PSD regulations may be several months away in time.

3. The existing PSD regulations (40 CFR 52.21 (1978)) are still being implemented at this time.

4. This document will provide guidance to States in Region VIII whose PSD regulations closely resemble 40 CFR 52.21 (1978). SIP revisions to incorporate the next revision of the federal PSD regulation may not be formally approved until late 1980 or early 1981.

5. The EPA Region VIII Energy Policy Statement indicates that efforts will be made to provide industry and the concerned public with a better understanding of EPA policies.

This office fully expects to make all necessary revisions to this document when the next set of PSD regulations are finalized.

If you have any questions on this document please refer them to Norman Huey or David Joseph of the Air Programs Branch, Air and Hazardous Materials Division, at (303) 837-3763.

Roger L. Williams
Regional Administrator

Attachment

Compilation of Past Practices and Interpretations by EPA Region VIII on Air Quality Mining

I. Background

On December 5, 1974, EPA promulgated regulations under the 1970 version of the Clean Air Act for the prevention of significant deterioration of air quality (PSD). These regulations established a program for protecting areas with air quality cleaner than the national ambient air quality standards (NAAQS). The primary mechanism for implementation of that program was a preconstruction review program applicable to specific categories of major stationary sources. Nineteen source categories were listed in those regulations. Under that new source review program which has been implemented by EPA, a proposed major facility was reviewed according to the following criteria:

(1) The combined impacts of that source and other new sources in the area could not exceed prescribed ambient air quality increments. Increments for total suspended particulates (TSP) and sulfur dioxide were established and in a given area are a function of the PSD classification of the area; and

(2) The new or modified source must utilize best available control technology (BACT).

On August 7, 1977, Congress amended the Clean Air Act and Part C of the new Act contains specific requirements for the prevention of significant deterioration.

For the most part the 1977 Amendments were a codification of the EPA regulations. However, some additional requirements were included. A few of these additional requirements are:

(1) The source category list was expanded to 29 and the Amendments added a general provision requiring applicability to any new or modified source which will have potential emissions of 250 tons per year;

(2) The air quality increments were revised;

(3) Certain areas were established as mandatory Class I areas and the Federal Land Managers for these areas were given specific responsibilities to protect the air quality related values of the areas; and

(4) One calendar year of ambient air quality monitoring data may be required to accompany a PSD application.

The expansion of the applicability of the PSD program has resulted in the inclusion of fugitive dust sources in the PSD coverage. In fact, because of the nature of fugitive dust sources, such as surface mines, the 1977 Amendments have applied the preconstruction review program to relatively many small operations.

Because of the differences between point (stack) sources and fugitive dust sources in terms of control technology, as well as localized versus regional air quality impacts, it was necessary for EPA to develop unique criteria in the review of preconstruction applications for operations which cause fugitive dust. These provisions were codified in regulations published on June 19, 1978, (43 FR 26388). Since promulgation of those regulations, EPA Region VIII has received more than 40 permit applications from companies planning operations which would cause fugitive dust emissions. During that period, because of the complexity of the PSD program, particularly with respect to the unique provisions for fugitive dust sources, numerous questions have surfaced which need immediate resolution. The following discussions are intended to address these questions and the manner in which they were resolved, and are intended to provide insight as to the interpretations by Region VIII staff regarding some portions of the PSD regulations. Four general areas are addressed:

(1) General - Discussions of the interpretation of certain definitions as they apply to fugitive dust sources and interpretations of other general provisions of the PSD regulations.

(2) Monitoring - Region VIII interpretation of the intent of the preconstruction/postoperation monitoring requirements as they apply to operations which cause fugitive dust, and the design of monitoring programs which have been approved by Region VIII.

(3) BACT - Region VIII interpretaton of the applicability of the BACT requirement with respect to fugitive dust and control practices considered in reviewing pending applications.

(4) Modeling - Region VIII's current thinking regarding available models for fugitive dust sources.

II. General Interpretations

During the consideration of permit applications received to date a number of clarifications and interpretations of the intent of the PSD regulations with respect to fugitive dust have been necessary. Some of these involved clarification of the definitions contained in the 40 CFR 52.21(b) of the PSD regulations. Others involved clarification of other portions of the regulations and their application to fugitive dust sources. The following is a discussion of some of the issues that have needed resolution and the interpretation which was implemented by Region VIII.

(1) Fugitive Dust - Included in this category are overburden and topsoil removal, grading, exposed soils, and haul roads. Not included are operations involving the processing of product or product ore (i.e., coal, uranium ore). The processing of product includes the emissions resulting from the actual removal of the product from the earth (e.g., blasting, and removal of coal from the seam), as well as emissions resulting from the conveying, crushing, screening, storage and transfer of the product.

(2) Best Available Control Technology - This is usually expressed as a numerical emission limitation. However, for operations which cause fugitive dust it is expressed as a set of work practices designed to minimize, to the maximum extent practicable, emissions of fugitive dust.

(3) Potential Emissions - Total uncontrolled emissions, including fugitive dust.

(4) Allowable Emissions - Total controlled emissions. Depending upon the application of allowable emissions, it may either include or exclude fugitive dust (See Item II-5).

(5) Review Criteria - Any source (i.e. mine) with potential emissions greater than 250 tons per year is subject to PSD review. Potential emissions are computed for all facilities within an operation, including fugitive dust. BACT is required of all facilities if the total allowable emissions from all facilities are greater than 50 tons per year or 1000 pounds per day. In this portion of the review, controlled fugitive dust emissions would be included in the determination as to whether the allowable emissions exceed 50 tons per year or 1000 pounds per day. Air quality review, including monitoring, modeling, and additional impact analyses, is required if allowable emissions (excluding fugitive dust emissions) exceed the above criteria given for BACT. As described in 40 CFR 52.21(k)(5), the allowable emissions would not include fugitive dust and the air quality review could exclude impacts of fugitive dust.

(6) Boundaries - The air quality review need not consider impacts within the applicant's boundaries or within the boundaries of neighboring industrial operations. The source boundary is

generally defined as the permitted area (or area owned by the applicant) as specified in an approved mining plan. On certain occasions it may be necessary to define the boundaries in terms of the leased area. If a well defined mine plan Boundary does not exist, then a case-by-case determination of such boundaries must be made during the permit review.

(7) Modifications - A modification is referred to as a change in the operation which would increase potential emissions by 250 tons per year. In the case of a mining operation an applicable modification would usually consist of an increase in the production rate above that which existed on August 7, 1977, or above that which is stipulated in a PSD or State new source permit. Changes in the areas of an operation can also be considered a modification if there is a net increase in emissions of more than 250 tons per year. Specifically, for an operation which has a PSD permit, that permit will stipulate those areas which can be mined without being considered a modification.

(8) Emission Factors - The state-of-art for emission factors for fugitive dust is extremely limited at present, and additional field studies are absolutely necessary. Those factors which Region VIII believes best represent particulate emissions from mining operations are shown in Section IV of this paper. However, this list is not all inclusive and other representative emission factors can be used after consultation with Region VIII staff. EPA has recently contracted Midwest Research Inc. and Pedco-Environmental to perform a joint study to develop better emission factors for western surface mining operations. This guideline document will be updated to incorporate the new emission factors when they become available in early 1980.

(9) Emission Categories - While the major facilities within a operation which causes fugitive dust are taken into account when determining the total potential emissions from the overall source, clarification is required concerning a few categories.

(a) Mobile Sources - Tail pipe emissions are ignored for PSD purposes.

(b) Construction Emissions - These emissions are not considered in determining whether a new or modified source is subject to the PSD regulation. However, if a PSD permit is required, the construction phase emissions of an operation is subject to the BACT requirements.

(c) Secondary Emissions - In computing potential emissions, all on-site reentrained dust traffic emissions are included. In addition, off-site reentrained dust from hauling product or product ore are considered. However, reentrained dust from off-site employee traffic is ignored.

III. Monitoring

Section 52.21(n) of the PSD regulations provides the opportunity for EPA to require ambient air quality monitoring both prior to submission of a PSD application and during the operation of the source. This requirement applies only to a major source whose allowable emissions, excluding fugitive dust, exceed 50 tons per year or 1000 pounds per day.

The main purpose of this requirement is to assess the air quality impact of the source and to determine if the source is contributing to a violation of a national ambient air quality standard. The extent of air quality data which must be collected is determined by EPA on a case-by-case basis depending upon the need for data and the representativeness of the air quality data already being collected or previously collected in the vicinity of the proposed operation. Considerations which EPA has used in the review of PSD ambient air monitoring network reviews are discussed in Appendix A. This internal checklist may provide useful information for prospective applicants.

As an example, the type of ambient monitoring which is being performed for various reasons by a few large surface mines in the west is described below:

Preconstruction

For baseline levels, TSP data is collected for one year using hi-vol samplers at one or more sites in the vicinity of the proposed mining operations. To provide statistical confidence in the monitored results, a sampling frequency of once-every-third day should be utilized. State schedules which prescribe some other frequency, representativeness of data collected on other less frequent sampling schedules, availability of electrical power and manpower, and costs are considerations which influence the choice of an optimum monitoring frequency. In addition to TSP, one air monitor should be equipped to provide information on particle size distributon. These data could provide some insight to the general contribution of very large particles to high concentrations of TSP. If sophisticated "level two" diffusion modeling (as described in Section V) will be utilized to predict ambient impacts, it would be to the applicant's advantage to collect continuous meteorological data at one location to collect data needed as input to the model. Also "event-triggered" precipitation dat would be extremely useful for computing annual emissions where prediction of emissions is dependent upon precipitation.

Operational

In order to determine the variability of air quality impacts from mining activities, TSP data could be recorded on a more frequent basis than during the baseline program at three locations (two in the prevailing downwind direction and one upwind). One of the two downwind sites should also collect particle size data. In addition, meteorological data similar to that collected in the preconstruction phase should be recorded. Collection of these data should allow the mine operator to be able to better demonstrate the contribution which his operations are making toward recorded air quality concentrations.

IV. Modeling

The PSD regulations (40 CFR 52.21(1), (k) and (b)(6) require an air quality impact analysis on the non-fugitive dust portion of the particulate matter emissions resulting from mining activities if the allowable emissions (excluding fugitive dust) from these sources exceed 50 tons per year or 1000 pounds per day, whichever is more restrictive. EPA recommends that the impact analysis make use of existing atmospheric dispersion models such as those discussed in the "Guidelines on Air Quality Models" (EPA-450/2-78-027). If the applicant has access to a model, or models, which are equivalent to or an improvement over those listed in the guidelines document, for a specific application, and can demonstrate their equivalence or improvement, the applicant may use such models pursuant to the requirements of 40 CFR 52.21(m). Departures from the Guideline models must be subject to public notice and opportunity for public comment.

Because model applications for particulate matter with an appreciable settling, and model verification studies for such applications, have not reached the same degree of acceptance as for gaseous pollutants, it is recommended that two levels of sophistication be considered. The first level would be a rather simple approach which would make use of screening techniques using acceptable models in which the particulate matter would be assumed to behave much the same as gaseous pollutants. This approach would make use of the commonly acceptable dispersion models which are applicable for screening techniques as referenced in the "Guidelines." This simple technique would be expected to provide conservative estimates. If this analysis demonstrates that the mining operation causes an insignificant impact (e. g. one-half the controlling increment or less), no additional anal would be required. If the analysis shows a significant impact (e. g. greater than one-half the controlling increment), additional, more sophisticated modeling techniques may be necessary.

Simple Gaussian models which consider both point and area sources would be appropriate for this first level of review. Past practice at EPA Region VIII has been to often use the EPA Valley Model. The usual limitations which restrict the use of atmospheric dispersion models (see Guideline on Air Quality Models) should be taken into consideration in the impact analyses on mining activitie.

The second level of sophistication would require using models not provided in the referenced guidelines document. Models appropriate for this more refined analysis should consider fall velocity and deposition velocity of particles. This approach requires emissions data not commonly available; i.e., particle size of the point or area emissions. This information must be provided by the applicant.

Because more sophisticated models are not referenced in the Guidelines, it will be necessary for the applicant to review model use with EPA Region VIII and comply with the public review provisions of 40 CFR 52.21(m) and (r). Those models may range from Gaussian types such as the Industrial Complex Source Model, ERTAQ, or others, to numerical models such as Systems Applications, Inc., IBM, IMPACT, Lawrence Livermore Lab, SRI, or others.

Finally as discussed in Section II of this policy paper, air quality impacts will be assessed beyond the mine "permitted area" boundary. Long term and short term simulation models will be required. Application of the models will limit prediction of concentrations out to a maximum distance of 50 kilometers and/or when the TSP concentration becomes less than 1 ug/m^3 for 24 hour average. However, any reasonably expected impacts (such as greater than ten percent of the Class I increment) must be considered for Class I areas regardless of the above distance and significant criteria.

V. Best Available Control Technology (BACT)

BACT on all emissions from mining activities, both fugitive and non-fugitive, is required pursuant to 40 CFR 52.21(j) if allowable emissions (fugitive plus non-fugitive) exceed 50 tons per year or 1000 pounds per day. Under the Clean Air Act Amendments of 1977 and the revised PSD regulations (43 FR 26388), BACT is to be determined on a case-by-case basis rather than automatically applying an applicable federal New Source Performance Standard (NSPS) as was the case under the previous PSD regulation.

EPA has published general guidelines for determining BACT. (This guideline document appears as Appendix B.) Case-by-case determinations of BACT must take into account several factors including cost, energy and technical feasibility. The procedure for determining BACT requires first, that the applicant propose in its PSD application air pollution control systems which the applicant believes represents BACT. EPA reviews the proposed controls and may request supporting information and/or considerations of alternative control systems prior to making a final decision on BACT. Pre-application meetings between EPA Region VIII and potential applicants have proven to be a useful tool in helping applicants to define BACT for their particular source or operation.

Suggested factors that may be considered in a BACT impact analysis include, but are not limited to: energy consumption; air, water and solid waste pollution; economic costs; capital availability; geographical and climatic factors; or the physical characteristics of the product (e.g., high moisture content).

Economic ratios such as the ratio of total control costs to total investment costs, cost per unit of pollutant removed, and unit production costs may prove helpful in defining the point at which a given control measure becomes economically infeasible. The Appendix B guideline discusses the above ideas in more detail.

In response to numerous questions during pre-application meetings concerning what control practices would constitute BACT for surface mining operations, we include Table 1. This table summarizes EPA Region VIII's past practices and experiences with BACT determinations for previously permitted large surface coal mines (greater than 4 MM tons per year) and open pit uranium mines. Deviations from this list of BACT practices may well be expected for smaller operations, operations in other geographical areas, various precipitation conditions, and other types of surface mining operations. Again, we stress the importance of determining BACT on a case-by-case basis considering environmental, energy and economic factors. TAble 1 does not constitute a definition of BACT for all surface mining operations. Rather, it provides a concrete illustration of what Region VIII has accepted as BACT for certain operations in areas of the western United States. For example, baghouses and enclosed storage piles may be economically infeasible for the small coal mine operator. The BACT determination can reflect this and allow for alternate schemes of control.

Table 1 also lists the emission factors and control efficiencies used in past BACT analyses. The EPA Region VIII office will consider the use of other emission factors if the applicant can demonstrate their appropriateness.

Table 1

Summary of Past BACT Determinations Made by Region VIII for Large Surface Coal and Uranium Operations

Process Operation	BACT Practice	Uncontrolled Emission Factor Range	Uncontrolled Emission Factor Best Estimate	BACT Control Efficiency
1. Topsoil removal		16 #/scraper hr. (4) or 0.38 #/yd3 (1)		
2. Topsoil stock pile	Stabilization via either			
	a. rapid revegetation or,			75%
	b. mulch or,			85%
	c. chemical dust suppressant* or,			85%
	d. establish wind breaks			50%
3. Drilling	Use of bag type collector on air drill, or water injected			90%
a. coal			0.22 #/hole (1)	
b. overburden			1.5 #/hole (1)	
4. Blasting	a. Minimize area to be blasted			f(area blasted)
	b. Prevent overshooting			f(amount of blasting)
a. overburden		14.2 - 85.3 #/blast (1)		
b. coal		25.1 - 78.1 #/blast (1)		
5. Overburden removal	a. Minimize fall distance of material			
a. dragline		.0056 - .053 #/yd^3 (1)		
b. truck/shovel			.037 #/ton (1)	
c. scraper			16 #/scraper hr. (4)	
6. Overburden stockpile	Stabilization via either			
	a. Temporary vegetation or,		Soil loss equation	75%
	b. Mulch or,		** (3)	85%
	c. Chemical dust suppressant*			85%

Table 1

BACT - Mining

Process Operation	BACT Practice	Uncontrolled Emission Factor: Range	Uncontrolled Emission Factor: Best Estimate	BACT Control Efficiency
7. Overburden shaping	a. Leave ridges with K = 2 - 5		soil loss equation** (3)	
	b. Establish wind breaks			
	c. Orient piles perpendicular to prevailing wind			
	d. Rapid revegetation (i.e. within one growing season)			
	e. Minimize spoil pile area			
8. Product removal	Minimize Fall Distance			
a. Coal-Truck/shovel		0.0035-0.014 #/ton (1)		
Coal-Front end loader			0.12 #/ton (1)	
b. Uranium			0.05 #/ton (4)	
9. Product dumping	a. Negative pressure or,			85%
	b. Spray system on dumped material			50%
a. Coal-bottom dump		0.005-0.027 #/ton (1)		
Coal-end dump			0.007 #/ton (1)	
b. Uranium-end dump			0.04 #/ton (4)	
10. Product storage				
a. Coal wind erosion from open pile	a. Enclosed		1.6 u #/acre hr (1) where u = wind speed, m/sec	99%
b. Uranium	a. Pile wetting		****	50%

Table 1

BACT - Mining

Process Operation	BACT Practice	Uncontrolled Emission Factor: Range	Uncontrolled Emission Factor: Best Estimate	BACT Control Efficiency
11. Product loading				
a. Coal load into silo Coal load out from silo	a. Baghouse on silo, b. Retractable chute on load out, c. Minimize no. of openings d. Spraying of coal in cars		0.0002 #/ton (1)	95%
b. Uranium	___________		0.05 #/ton (4)	
12. Haul roads	a. Speed control, and b. Chemical stabilization worked into road* c. Restrict off road use		$E = \frac{(0.6)(0.81s)}{30} S \left(\frac{365-w}{365}\right)^{**}$ (2)	f(speed) 85% 100%
13. Access roads				
a. If public	___________	_____	_____	_____
b. If controlled by operator	a. Paving or equivalent stabilization b. Speed control, and c. Restrict off road use		$E = \frac{(0.6)(0.81s)}{30} S \left(\frac{365-w}{365}\right)^{**}$ (2)	85 - 100% f(speed) 100%
14. Road maintenance	a. Removal of loose debris, grading b. Chemical stabilization of roadbed after grading*		32 #/road grader hour (4)	
15. Disturbed areas	Stabilization via either a. Chemical dust suppressant*, or b. Mulch, or c. Revegetation within one growing season, or d. Minimize area disturbed		Soil loss equation** (3)	85% 85% 75% f(area)

Table 1

BACT - Mining

Process Operation	BACT Practice	Uncontrolled Emission Factor: Range	Uncontrolled Emission Factor: Best Estimate	BACT Control Efficiency
16. Conveyors	Fully Covered		0.2 #/ton (4) for all conveyors and transfer points	
a. Fully covered				100%
b. Partially covered				90%
17. Transfer points	a. Enclosed and vent to baghouse or equivalent			99% 20% opacity
	b. Ducting to a central baghouse			99.0% and 0.01 gr/acf 20% opacity
18. Uranium Crushing and Screening	Baghouse or equivalent	@9-10% H_2O, E = 0.002 #/ton (5) @8% ", E= 0.040 #/ton @6% ", E= 0.16 #/ton		99.0% and 0.01 gr/acf
19. Coal crushing	Baghouse or equivalent			
a. Primary			0.02 #/ton (4)	99.0% and 0.01 gr/acf
b. Secondary			0.06 #/ton (4)	
20. Coal Screening	Baghouse or equivalent		0.1 #/ton (4)	99.0% and 0.01 gr/acf
21. Coal Cleaning				
a. Thermal dryer			0.031 gr/dscf	NSPS
b. Pneumatic cleaning			0.018 gr/dscf	NSPS
22. Transportation	Bus service			f(VMT)
23. Construction	a. Chemical dust suppression of all roads and disturbed areas			50%
	b. Gravel parking lots			50%
	c. Confine traffic to specified roads			100%
	d. Minimize area of land disturbed			100%
	e. Prewater areas to be disturbed			50%

Table 1

BACT - Mining

Process Operation	BACT Practice	Uncontrolled Emission Factor: Range	Uncontrolled Emission Factor: Best Estimate	BACT Control Efficiency
24. Miscellaneous	a. Extinguish smoldering or burning areas in the mine			100%
	b. Chipping and mulching of vegetative material; removal from mine site rather than open burning			f(amount burned)
	c. Minimize all haulage distances			f(VMT)
	d. Prevent overloading of trucks			f(present practice)
	e. Covered haul trucks if haulage is on a public highway			f(VMT)

* Note -- Dilution ratio of dust suppressant, rate of application, and frequency of application is important. An example for Coherex is shown. This example is provided for guidance only. Mention of trade names does not mean endorsement of any material. Use of other suppressants shall meet equivalent specifications. Deviations from the specifications below shall be justified on a case-by-case basis, based upon data submitted by the applicant. Also, it is anticipated that the PSD permit condition may need to be revised upon adequate showing by the applicant or by the permitting authority.

	Dilution of Coherex	Rate of application	Frequency of Application
Haul roads preparation	1:4	1 gal/yd^2	Initial
Access roads preparation	1:4	1 gal/yd^2	Initial
Road maintenance	1:10	1/2 gal/yd^2	Once per month when the number of days when rainfall does not exceed 0.01 in. = 10 days
Disturbed areas not subject to vehicles	1:10	1/2 gal/yd^2	Initial

** Note -- From Reference 3 Universal soil loss equation is E = 0.025 IKCLV
where E = tons of suspended particulate per acre per year
I = soil erodibility factor
K = soil ridge roughness factor
C = localized climate factor
L = field width
V = vegetative cover

*** Note -- From Reference 2 $E = 0.6(0.81s)\left(\frac{S}{30}\right)\left(\frac{365-W}{365}\right) = \left(\frac{sS}{60}\right)\left(\frac{365-W}{365}\right)$

where s = silt content of road in percent
S = vehicle speed in mph
W = mean annual (number of days with > 0.01 inches of rain)

Corrections may be applied for vehicle speed and number of vehicle tires.

An alternative method is to use the following:

$E = 5.9\left(\frac{s}{12}\right)\left(\frac{S}{30}\right)\left(\frac{W}{3}\right)^{0.8}\left(\frac{d}{365}\right)$ Reference 6

where E = #/VMT
s = silt content in percent
S = average vehicle speed, mph.
W = average vehicle weight, tons
d = dry days per year (number of days less than 0.01 inches of rain)

****

$E = 0.05\left(\frac{s}{1.5}\right)\left(\frac{d}{235}\right)\left(\frac{f}{15}\right)\left(\frac{D}{90}\right)$ #/ton Reference 6

where s = silt content in percent
d = dry days per year
D = duration of material storage, days
f = % of time wind speed exceeds 12 mph.

References

(1) Survey of Fugitive Dust from Coal Mines, EPA 908/1-78-003, February 1978, EPA Region VIII, Denver, Colorado

(2) Compilation of Air Pollutant Emission Factors, AP-42, Second Edition

(3) Guide for Wind Erosion Control on Cropland in the Great Plains States, Craig and Turelle, USDA-SCS, July 1964

(4) Evaluation of Fugitive Dust Emissions from Mining, prepared by PEDCO for EPA-IERL-Cin, June 1976

(5) ORNL-TM-4903 "Correlation of Radioactive Waste Treatment Costs and the Environmental Impact of Waste Effluents in the Nuclear Fuel Cycle for Use in Establishing as Low as Practicable Guides Milling of Uranium Ores" by Oak Ridge National Laboratory, May 1975

(6) Fugitive Emissions From Integrated Iron and Steel Plants, EPA - 600/2-78-050, March 1978 by R. Bohn, et al, Midwest Research Institute

watering alone of 50%. However, it notes that watering is impractical for a public road (not to be confused with a mine haul road), and therefore, no additional control efficiency was listed for watering. The combination of well maintained chemical stabilization, supplemented with watering, if needed, results in the control factor of 85% shown in the EPA Region VIII policy memorandum.

Comment No. 31:

Please use the emission factor from EPA AP-42, May 1983 for loading and dumping emissions.

Response:

The emission factor from EPA AP-42, May 1983 was used to recalculate emissions from loading and dumping. Revised emissions are incorporated in the revision to Table 1.1. (See Revised Table 1.1 in the response to Comment No. 13.)

Input used in developing the respective emission factors are as follows:

Particle size multiplier	- 0.73
Material silt content	- Till - 18%; Waste rock and ore - 1.6%*
Mean wind speed	- 7.2 mph (Crandon Project EIR, p. 2.1-17)
Drop height	- 3 ft for small loader and trucks (12 ton); 4 ft for large loader and trucks (35 ton)
Moisture content	- 2% for till; - 4% for waste rock and ore
Dumping device	- varies from 7 to 28 yd^3

*There should be no silt in this material. However, the percent shown in Table 11.2.3-1 of AP-42 for Stone Quarrying was used to provide a conservative estimate.

Comment No. 32:

Provide the source used to determine the particle size distributions presented on p. 35 of the January 24, 1984 letter to the DNR.

Response:

The methodology used for determination of particle size distributions and the reference source is presented in Comment No. 7 of this letter.

Comment No. 33:

Were emissions from tire wear included in the emissions in Table 1.1 of the January 24, 1984 air permit response letter. If not, use the emission factor in AP-42, Section 3.1.4 of $0.2 \frac{\text{(number of tires)}}{4}$ g/mile.

Response:

Because of the way the particulate emission factor equations were developed, tire wear emission rates should already be included in the estimates generated for inclusion in Table 1.1 of the January 24, 1984 air permit response letter. However, since the subject references do not verify this, the emission factor from AP-42, Section 3.1.4 was used to generate tire wear TSP emissions. The TSP emissions for the maximum year of hauling is based on activity estimated for 1989. The following result indicates that tire wear TSP emissions are a very small contribution to the atmosphere.

Activity for 1989	Miles Traveled	$(\frac{T}{4})$	Emissions st/yr
Waste rock hauling	143,817	1.5	0.050
Bentonite hauled	1,148	4.5	0.001
Employee traffic	103,250	1	0.022
Service truck traffic	3,000	4.5	0.003
			0.076

These calculations will be provided in the revised air permit application.

Comment No. 34:

We could not find the formula presented for wind-blown emissions in the reference cited in your air permit application and the letter of January 24, 1984. Where in the reference is this discussion?

Response:

During our meeting in Madison on February 29, 1984, we provided Mr. Steve Klafka with the cited report so that DNR could copy those pages describing the formula for estimating wind-blown TSP emissions as discussed in the report beginning on p. 68.

The full citation for the report is:

PEDCo - Environmental Specialists, Inc. 1976. Evaluation of Fugitive Dust Emissions from Mining. Task 1 Report. Identification of fugitive dust sources associated with mining. Contract No. 68-02-1321. Task No. 36. April 1976. U.S. Environmental Protection Agency. Cincinnati, Ohio.

Comment Nos. 35 and 36:

What are the short-term emission rates for the annual estimates presented in the response to our Comment No. F1 of the February 24, 1984 air permit letter? The emission rates used for the 24-hour modelling efforts need to be defined for the fugitive dust sources. The emission rates presented for the mobile and stationary sources appear to be satisfactory for the 24-hour model calculations.

Response:

As discussed at our meeting in Madison on March 1, 1984, the emission rates for the 24-hour modeling calculations will be presented to the DNR in a separate letter by the end of March. We agreed with the DNR that the mobile and stationary source emission rates as presented are to be used in the modeling efforts. However, the fugitive dust sources annual emission rates are to be reviewed by EMC and adjusted to account for peak daily activity to the extent possible. These adjusted emission rates would be discussed and presented in a letter to the Bureau of Air Management by the end of March. After the DNR reviews these adjusted emission rates, we would meet and discuss them during the second week in April (tentative), after which the DNR would provide final approval of the modeling conditions.

Comment No. 37:

Further modeling efforts for the other criteria pollutants such as SO_x and NO_x are not required for the revised air permit application. However, revised estimates for the annual emissions and a discussion of these estimates related to the original air permit application should be completed with the revision document submittal. Further, this revision document should also include a discussion of the estimated emissions for the metals presented in our September 12, 1983 letter. Additional calculations for Pb are to be included as well as a discussion relating these estimated concentrations to TLV criteria.

Response:

As agreed at the meeting in Madison on February 29, 1984, we will review and discuss all of the criteria pollutants in our revised air permit application. We will also include the metals (i.e, aluminum, arsenic, cadmium, copper, lead, mercury and zinc) mentioned in the DNR's September 12, 1983 letter and a discussion relating them to TLV criteria.

Comment No. 38:

We would appreciate a copy of all building elevation drawings that you have available from your current engineering design.

Response:

Copies of our current engineering design for the Project buildings were presented for your review at our meeting in Madison on February 29, 1984. We agreed to provide an additional figure in the revised air permit application which would show the relation of stack heights to building dimensions and location. This would likely be a profile drawing through the mine/mill site since this is the area with major sources having stack emissions.

CHAPTER 1

Comment No. A1

In the May 11 letter to Exxon, there were four questions on manpower needs. The questions were aimed at clarifying peak manpower needs and identifying the skills required for the construction and operations work forces. When we know what Exxon's specific hiring needs are, they can be compared to the availability of skills of the local work force. From this comparison an estimate of local hires can then be made. All other hires are assumed to be non-local, thereby requiring worker immigration. Immigration is a key variable in determining socioeconomic impacts, including impacts on local facilities and services, schools, housing, taxes and others. Exxon's responses did not provide sufficiently detailed information (for example, mine technical, mine operation, mill technical, operation and maintenance) for us to estimate whether the jobs could be filled locally. Please provide us with explicit descriptions of the essential skills required for each type of Exxon construction and contract construction and operations workers to be hired. Each type of work position should also be identified by the appropriate 4-digit Standard Occupational Classification Code (SOC) of the U.S. Department of Commerce. This explicit description should include the skills and knowledge required for each SOC code as a prior condition for employment at the project.

Response:

The attached tables (A1-1 and A1-2) summarize the current employee estimates that will be required for construction and operation of the Crandon Project. The 4-digit Standard Occupational Classification Code (SOC) from the U.S. Department of Commerce has been listed for each job category along with the number of employees, general educational level required and an indication of whether the position requires previous experience. The job category identifies the general skills necessary for the employees (i.e., cement mason) expected to be hired.

These tables represent only general guidelines for education and experience. The hiring and job interview process will balance the education and experience levels. In actual practice some deviation from the education and experience requirements, as indicated in the attached tables, will probably occur through the employment process.

Comment No. A2

Exxon has frequently stated they are committed to preferentially hiring local people to the extent allowable under applicable laws. To which federal and state laws does this refer and what are the implications? Are there any existing or planned agreements with local governments or Indian tribes relating to proposed hiring practices? What activities does Exxon plan in cooperation with local educational institutions to support training of local workers in order to increase local hiring? Would Exxon financially support a locally organized van or bus transportation system between outlying areas, including Indian reservation lands, and the mine site to encourage local hires?

(Table A1-1 for the Response to Comment No. A1)

NON-EMC EMPLOYEES

JOB CATEGORY	SOC[a]	NO. OF EMP.[b]	EDUCATION[c]	EXPERIENCE[d]
		Mine Construction		
Pipefitters	6450	3	V	Y
Welders	7710	3	V	Y
Electricians	6430	6	V	Y
Millwrights	6178	6	V	Y
Mechanics	6140	24	H	Y
Equipment Operators	8310	25	H	Y
Ironworkers	6472 & 6473	12	V	Y
Carpenters	6420	6	H	Y
Laborers	8710	33	H	N-Y
Cement Masons	6463	18	H	Y
Shaft and Drift Miners/ Rock Drillers	6530	102	H	Y
Hoistmen	8314	12	H	Y
Surveyors	1640	4	V	Y
Supervisors	6310	22	H-C	Y
Engineers	162 & 163	5	C	Y
		Surface Facilities Construction		
Boilermakers	6814	90	V	Y
Carpenters	6420	160	H	Y
Electricians	6430	120	V	Y
Laborers	8710	145	H	N-Y
Operating Engineers	8310	145	H	Y
Millwrights	6178	60	V	Y
Painters	6440	15	H	Y
Pipefitters	6450	120	V	Y
Ironworkers	6472 & 6473	200	V	Y
Teamsters/Mechanics	6140	40	H	Y
Cement Masons	6463	20	H	Y
Surveyors (Rodmen)	1640	5	V	Y
Finishers	6463	5	H	Y
Supervisors	6310	100	H-C	Y
Engineers	162 & 163	25	C	Y

[a] Standard Occupational Classification Code (SOC) - U.S. Department of Commerce.

[b] Numbers reflect employment needs within job categories. Due to timing differences, totals may not agree with Project employment totals.

[c] Education: H - High School
V - Vocational Technology
C - College

[d] Y - yes; N - none required; N-Y - some employees will need prior experience and others will be trained on the job.

(Table A1-2 for the Response to Comment No. A1)

EMC EMPLOYEES

JOB CATEGORY	SOC[a]	NO. OF EMP.[b]	EDUCATION[c]	EXPERIENCE[d]
	Administration	86		
Secretaries/Clerks	46-47	22	H	N-Y
Janitors	5240	7	H	N-Y
Security	5140	8	V	Y
Accountants	1412	2	C	Y
Warehouse	8724	11	H	N-Y
Purchasing	1449	1	H	Y
Paramedics	5236	3	V	Y
Employee Relations/ Safety/Training	1430	15	C	Y
Public Affairs	3320	1	C	Y
Environmental	1849	3	C	N-Y
Supervision	12-13	9	C	Y
Engineers	162 & 163	4	C	Y
	Mine Technical	35		
Supervisors/Engineers	162 & 163	10	C	N-Y
Geologists	1847	6	C	N-Y
Draftsmen	3720	3	V	N-Y
Engineers/Geology Technicians	3710	8	V	N-Y
Surveyors	1640	6	V	Y
Clerks	46-47	2	H	N-Y
	Mine Operations	276		
Secretaries/Clerks	46-47	4	H	N-Y
Miners	6530	87	H	N-Y
Equipment Operators	6540	108	H	N-Y
Laborers	6560	41	H	N
Supervisors	6320	32	V	Y
Hoistmen	8314	4	H	Y

[a] Standard Occupational Classification Code (SOC) - U.S. Department of Commerce.

[b] Numbers reflect employment needs within job categories. Due to timing differences, totals may not agree with Project employment totals.

[c] Education: H - High School
V - Vocational Technology
C - College

[d] Y - yes; N - none required; N-Y - some employees will need prior experience and others will be trained on the job.

(Table A1-2 for the Response to Comment No. A1 [continued])

JOB CATEGORY	SOC[a]	NO. OF EMP.[b]	EDUCATION[c]	EXPERIENCE[d]
	Mine Maintenance	85		
Equipment Mechanics	6110	40	H	N-Y
Pump/Fan Mechanics	6130	3	H	Y
Welders	7710	3	V	Y
Electricians	6430	9	V	Y
Maintenance	6179	19	H	N-Y
Clerks	46-47	3	H	N-Y
Supervisors	6000	7	V	Y
	Mill Operations	60		
Secretaries/Clerks	46-47	2	H	N-Y
Mill Operators	6960	43	H	N-Y
Laborers	8650	8	H	N-Y
Supervisors	6320	7	H	Y
	Mill Technical	26		
Lab Technicians	3831	13	V	N-Y
Metallurgists/Chemists/ Engineers	162 & 163	10	C	N-Y
Technicians	3710	2	V	N-Y
Typist/Clerks	46-47	1	H	N-Y
	Mill Maintenance	30		
Supervisors	6000	2	V	Y
Mechanics/Oilers	6140	20	H	N-Y
Welders	7710	4	V	Y
Instrument Repairs	6170	4	V	Y

(Table A1-2 for the Response to Comment No. A1 [continued])

JOB CATEGORY	SOC[a]	NO. OF EMP.[b]	EDUCATION[c]	EXPERIENCE[d]
Central Maintenance		68		
Supervisors	6000	8	V	Y
Machinists	6813	2	V	Y
Electricians	6430	18	V	N-Y
Mobile Equip Maintenance	6110	27	H	N-Y
Draftsmen	3720	1	V	N-Y
Welders/Fabricators	7710	6	V	Y
Carpenters	6420	1	H	Y
Secretaries/Clerks	46-47	2	H	N-Y
Maintenance Planners	4750	2	H	Y
Engineers	162 & 163	2	C	Y
Construction Management		26		
Engineers	162 & 163	7	C	Y
Purchasing	1449	2	H	Y
Accounting	1412	3	C	Y
Secretaries/Clerks	46-47		H	N-Y
Supervisors	6320	14	H	Y

Response:

To the extent allowed by the state and federal anti-discrimination laws, Exxon has an announced policy of preferentially hiring qualified local people during the construction and operation phase of the Crandon Project. As presently interpreted, the state and federal anti-discrimination laws do not prohibit the granting of local preferential treatment in the hiring decision provided the hiring is conducted in a nondiscriminatory manner within the local area. There are no existing or currently planned agreements with local governments or Indian tribes relating to proposed hiring practices.

We will outline job skills required for various positions at the Crandon Project and review curricula developed by the local schools if requested. We currently see no need to support an organized van or bus system to encourage local hires.

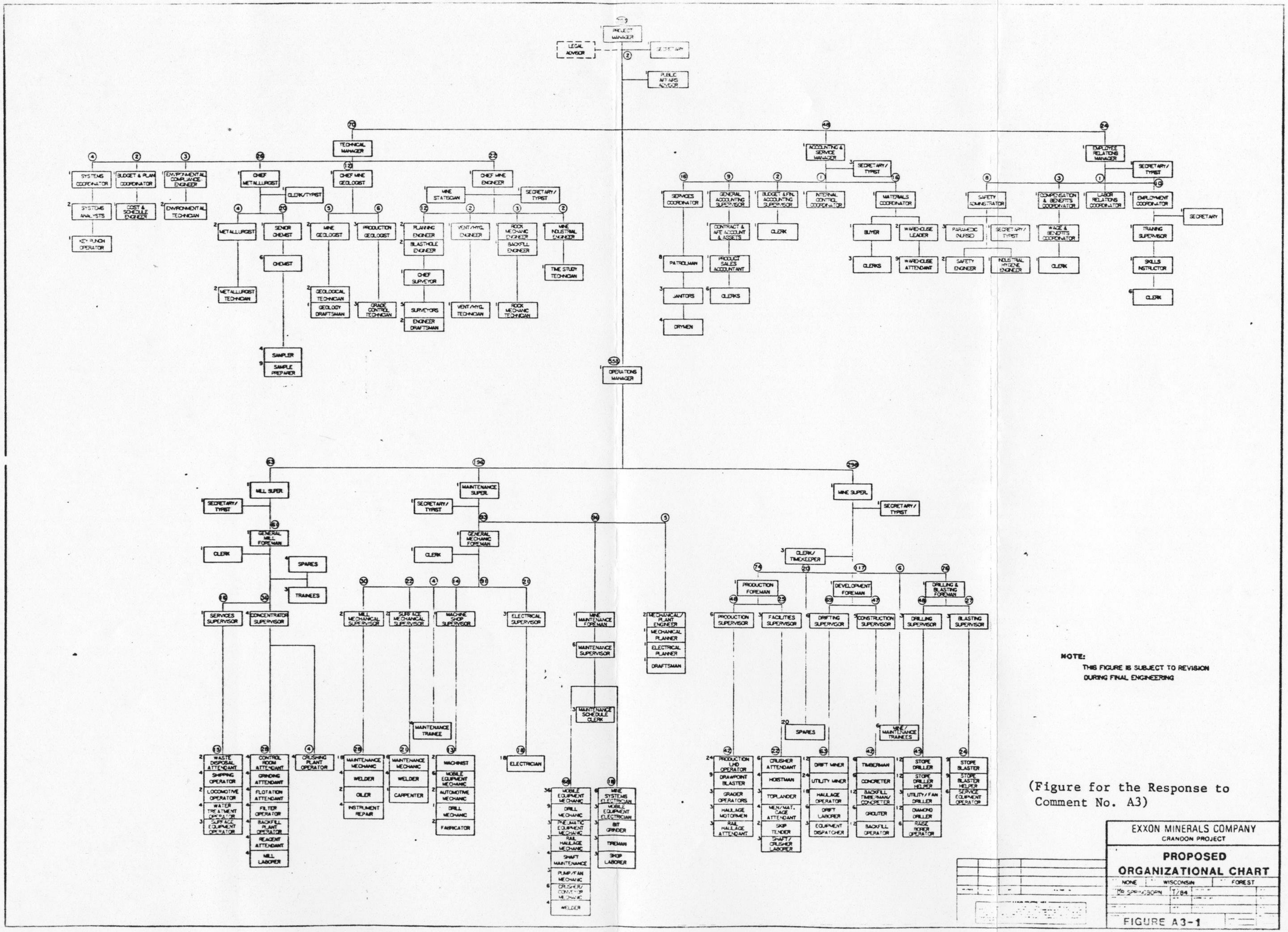
Comment No. A3

At the November 18, 1983 meeting in Madison, when the Future Conditions Report was discussed by Exxon, the subject of local hiring rate was raised. Exxon stated that a skills analysis of the local study area had been performed and had been used as the basis for determining that the local hiring rate for operations workers could be as high as 60%. That figure was used for calculating impacts in the three scenarios used in the Future Conditions Report - minimum, most likely, and maximum impact scenarios. Please provide us with that skills assessment and any other data used to calculate the local hiring rate so we can verify your approximations of local hiring rates.

Response:

The draft organization diagram proposed for the Crandon Project with job category titles for the employees in various departments is presented in the attached figure. Recently, a compilation of the Rhinelander Applicant Counts for the occupations listed by Exxon Minerals Company for the Crandon Project was developed by the Department of Industry, Labor and Human Relations. These data are presented in the attached Table A3-1.

The permanent (operations-and-maintenance) work forces of large mining projects and similar resource developments generally are comprised largely of craftsmen-technicians, equipment operators, and mechanics. Because wages paid by mines are generally higher than those in most other rural area jobs demanding similar skills, many of the local workers with appropriate skills typically are interested in obtaining employment at a new mine (Leholm et al., 1975; Murdock and Leistritz, 1979). Thus, even in areas with relatively sparse population (and thus small local labor pools), mining firms have often been able to achieve high rates of local recruitment. For example, a survey of workers at seven coal mines and seven power plants in the Northern Great Plains indicated that local workers made up 62 percent of the overall work force (Wieland et al., 1977; Wieland et al., 1979). Substantial variations in the rates of local hiring were found among these projects, with higher rates of local hiring usually occurring where the local (area) labor pool was larger in relation to the project's labor requirements. The local hire rate was less than 60 percent at only two of the seven mines surveyed.



NOTE:
THIS FIGURE IS SUBJECT TO REVISION DURING FINAL ENGINEERING

(Figure for the Response to Comment No. A3)

EXXON MINERALS COMPANY
CRANDON PROJECT

PROPOSED ORGANIZATIONAL CHART

NONE | WISCONSIN | FOREST

T/84

FIGURE A3-1

(Table A3-1 for the Response to Comment No. A3)

NORTH CENTRAL WISCONSIN JOB SERVICE APPLICANTS FOR SELECTED OCCUPATIONAL CODES December 22, 1983	Total	Active	Inactive
Total All Occupations	13,623	6,788	6,835
SELECTED DOT CODES	-	-	-
010061.....Mining Engineer	-	-	-
011061.....Metallurgists	-	-	-
016187.....Surveyor, Mine	-	-	-
019167.....Project Engineer	3	-	3
020162.....Programmer, Business	2	1	1
022061.....Chemist	2	1	1
024061.....Geologist	4	3	1
075374.....Nurse, Staff, Occupational Health	11	5	6
079374.....Emergency Medical Technician	36	17	19
097227.....Instructor, Vocational Training	2	1	1
110107.....Lawyer	-	-	-
160167.....Accountant	37	15	22
162157.....Purchasing Agent	15	8	7
165067.....Public-Relations Representative	5	2	3
166117.....Manager, Personnel	7	1	6
166167.....Manager, Labor Relations, Employment	1	-	1
166227.....Training Representative	1	1	-
166267.....Employment Interviewer	10	4	6
169167.....Clerk, General Assistant	45	28	17
181117.....Mine Superintendant	2	2	-
189117.....Project Director	6	3	3
201362.....Secretary, Legal Secretary, Medical Sec.	138	54	84
203582.....Data Typist	27	13	14
209562.....Clerk, General	189	80	109
213362.....Computer Operator	13	8	5
216482.....Accounting Clerk	38	18	20
219362.....Administrative Clerk	358	144	214
222387.....Inventory Clerk	43	20	23
372167.....Guard, Chief	1	1	-
372667.....Guard, Security	44	19	25
408662.....Hydro-Sprayer Operator	-	-	-
409683.....Farm-Machine Operator	5	2	3
454683.....Tree-Shear Operator	3	-	3
454687.....Chainsaw Operator	2	2	-
519687.....Laborer, General	14	6	8
562662.....Log-Chipper Operator	-	-	-
564662.....Log-Chipper Operator	-	-	-
603685.....Bit-Sharpener Operator	5	3	2
620261.....Mine-Machinery, Heavy Equip., Truck Mechanic	147	69	78
630381.....Conveyor-Maintenance Mechanic	-	-	-
638281.....Maintenance Mechanic	49	23	26
710281.....Instrument Mechanic	2	-	2
801361.....Structural-Steel Worker	25	17	8
805261.....Boilermaker 1	4	3	1
805381.....Boilermaker 11	-	-	-
819384.....Welder, Combination	76	50	26
824261.....Electrician	63	40	23
840381.....Painter	60	27	33
844364.....Cement Mason	57	40	17
849663.....Concrete-Pump Operator	-	-	-
850663.....Motor-Grader Operator	1	1	-
850683.....Bulldozer Operator	13	9	4
859682.....Earth-Boring-Machine Operator	1	-	1
859683.....Operating Engineer	136	81	55
860381.....Carpenter	328	167	161
861381.....Bricklayer	33	14	19
862381.....Pipe Fitter	95	45	50
869664.....Construction Worker 1	281	152	129
869665.....Auxillary-Equipment Tender	-	-	-
869683.....Compactor	2	1	1
869687.....Construction Worker 11	244	143	101
900683.....Concrete-Mixing Truck Driver	3	2	1
902683.....Dump-Truck Driver	25	15	10
903683.....Tank-Truck Driver	1	1	-
904383.....Tractor-Trailer Driver	181	74	107
905663.....Truck Driver, Heavy	181	102	79
905683.....Water-Truck Driver	3	3	-
906683.....Truck Driver, Light	77	43	34
913663.....Chauffeur	1	1	-
921663.....Hoist Operator	22	6	16
921683.....Front-End Loader Operator	73	34	39
929137.....Warehouse Supervisor	2	2	-
929683.....Tractor	26	12	14
930382.....Driller, Machine	3	2	1
930682.....Core-Drill Operator	-	-	-
936687.....Company Laborer	-	-	-
939281.....Miner 1	-	-	-
939667.....Cager	4	3	1
955585.....Wastewater-Treatment Plant Attendant	-	-	-

More recent surveys of operations work forces indicate rates of local hiring similar to those previously cited. For example, a survey of workers at two coal mines near Sheridan, Wyoming indicated that about 60 percent of the work forces had been recruited locally (Hooper and Branch, 1983). Similar results were reported from a survey at the Jim Bridger power plant in southwestern Wyoming (Browne, Bortz, and Coddington, 1981). Large-scale development projects can strain the local labor supply, however. For instance, a survey of 15 companies developing coal mines in Campbell County, Wyoming indicated that only 40 percent of the 523 workers hired during 1981 had lived in the county for six months or more prior to their employment by the energy firm (Browne, Bortz, and Coddington, 1982).

Considering the Crandon Project specifically, several factors would suggest that a relatively high rate of local recruitment can be expected. These include: the large local labor force (relative to project labor requirements), the substantial percentage of local workers possessing skills consistent with Project employment requirements, the general stock condition of the local labor market (as evidenced by a persistent trend of moderate to substantial unemployment), and the fact that no other major projects are anticipated to be developed in the area during the period when the major hiring for Crandon will occur. Thus, the 60 percent rate of local hiring assumed in the impact assessment could prove to be conservative.

CITATIONS

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Hooper, J. E. and Branch, K. M. 1983. Big Horn and Decker Mine Worker Survey Report. Billings, Montana: Mountain West Research-North, Inc.

Leholm, A. G., Leistritz, F. L., and Wieland, J. S. 1975. Profile of North Dakota's Coal Mine and Electric Power Plant Operating Work Force. Ag. Econ. Rpt. No. 100. Fargo: North Dakota Ag. Exp. Station.

Murdock, S. H. and Leistritz, F. L. 1979. Energy Development in the Western United States: Impact on Rural Areas. New York: Praeger Publishers.

Wieland, J. S., Leistritz, F. L., and Murdock, S.H. 1979. "Characteristics and Residential Patterns of Energy-Related Work Forces in the Northern Great Plains." Western Journal of Agricultural Economics 4:57-68.

Wieland, J. S., Leistritz, F. L., and Murdock, S. J. 1977. Characteristics and Settlement Patterns of Energy-Related Operational Workers in the Northern Great Plains. Agricultural Economic Report No. 123. Fargo: North Dakota Agricultural Experiment Station.

Comment No. A4

The following data are from Exxon's Forecast of Future Conditions Report (1983); Scenario I (minimum impact) identifies that in 1989 there would be 1,410 workers on site; Scenario II (most-likely impact) identifies 1680 workers on site; Scenario III (maximum impact) has 1830 workers on site. These are approximate staffing levels needed during peak hiring in the final year of construction (p. 17).

In Exxon's response to comment number 154, a peak hiring number of slightly more than 1,400 employees would occur as the construction and operations workers overlapped. Which number of peak total workers is correct and why?

Response:

The response to the earlier EIR comment No. 154, showing a peak hiring number of slightly more than 1,400 employees, is correct based on current engineering design basis and plan (see also response to comment No. 1 of this letter). As explained in the response to the earlier EIR comment No. 30, this projection is based on new construction estimates developed in early 1983. We believe that this new peak (1,417 employees per response to earlier EIR comment No. 30) is a more accurate representation of the most likely peak number of construction/operations people because it is based on current Project design.

The data contained in the Forecast of Future Conditions for Scenario I (1,410 workers), Scenario II (1,680 workers), and Scenario III (1,830 workers) were based on earlier Project design information. As indicated in the Forecast of Future Conditions, the different scenarios were an attempt to bracket the expected range of construction phase personnel for the Project since the actual number of people employed will vary somewhat from any forecast. To the extent that Scenario I approximates current estimates for Project employees, a review of its information will provide projected effects.

Comment No. A5

Exxon has indicated to the Department of Industry, Labor and Human Relations that for planning purposes for the septic system at the mill, 1,400 workers was the peak employment. If the peak employment is 1,680 workers as indicated in the Future Conditions Report's, most-likely scenario, would the septic tank and soil absorption field be adequately sized? Please explain.

Response:

As explained in the response to comment No. A4, Exxon Minerals Company's current estimate of peak employment is approximately 1400 people. At that point during the construction period approximately 10 percent are contractor personnel for shaft and underground construction, 33 percent are Exxon employees and the remainder (57 percent) are contractor personnel for surface facilities construction.

The sanitary sewage soil absorption field was sized following DILHR guidelines based on the current estimate of the operations phase work force of 703 people. With allowance for visitors and approximately 10 percent contingency, 800 people were used for estimating sanitary sewage waste generation.

In following Wisconsin Administrative Code H63.15(3)(C)2, a total per day per person sanitary sewage waste generation rate of 0.13 m^3 (35 gallons) (20 gallons sanitary waste and 15 gallons for showers) was assumed. The 35 gallon per person per day is conservative because most employees and visitors will not shower in Exxon facilities. However, using these criteria and adding 2.84 m^3 (750 gallons) per day of base flow (per code), the total daily sanitary sewage flow is estimated to be 108.8 m^3 (28,750 gallons) which is equivalent to an approximate average flow rate of 4.54 m^3/h (20 gallons per minute).

Assuming one-half of the shaft and underground construction personnel (i.e., 70) and one-fourth of the Exxon permanent employees (i.e., 116) shower during the temporary construction peak, the sewage flow would be:

Those showering:

0.10 x 1400 x 0.5 x 35 gal/day = 2450 gal/day
0.33 x 1400 x 0.25 x 35 gal/day = 4043 gal/day

Those not showering:

0.10 x 1400 x 0.5 x 20 gal/day = 1400 gal/day
0.33 x 1400 x 0.75 x 20 gal/day = 6930 gal/day
0.57 x 1400 x 1.00 x 20 gal/day = 15960 gal/day
30783 gal/day

Although this temporary peak construction flow rate is approximately 7 percent greater than the soil absorption field design flow rate, it is within the variations of flow the DILHR design criteria (area loading rate) are meant to tolerate. For the septic tank, which is sized for a one-day retention time for the sewage flow rate, the retention time would also be shortened by about 7 percent during this construction peak. This would have no effect on the operation of the system.

Comment No. A6

Are there any federal requirements and regulations relating to training, mine safety, or other prerequisites for underground miners which could impact Exxon's local hiring? Are there any other barriers to local hiring? Please discuss.

Response:

Initially a core of experienced underground miners must be hired (i.e., approximately 70 people) to begin early mine level (i.e., drifts) construction. To our knowledge, there are no laws that will impact Exxon's local hiring practices, as long as the preferential hiring of local people does not result in a violation of state or federal civil rights. There are MSHA training requirements which must be fulfilled prior to assigning an employee to work underground. This training will be conducted after employment and will be given to all underground employees regardless of experience levels. Therefore, this training requirement should not impact hiring.

Comment No. A7 (Comment #45)

Exxon's response indicates that an inventory of all private water wells and systems within the 1 meter potential groundwater drawdown area was undertaken. However, the appropriate drawdown area must be defined by the 0-meter contour and under a worst-case scenario analysis. These data are required so that impact to all potentially affected wells can be evaluated.

Response:

An inventory of private water wells in the environmental study area was completed in 1978 as part of the baseline evaluation and the results are reported in EIR subsection 2.3.3.7. The inventory included those wells located in the area of potential ground water drawdown.

The current hydrogeology program will provide information on the extent of the ground water potentiometric surface drawdown defined by the 0-meter contour under a worst-case analysis. These data will provide the basis for evaluating the impact to potentially affected wells in the site area. When this field and laboratory program has been completed, we will discuss the results with the DNR. These results will also provide the basis for an inventory of private water wells and systems within the drawdown area. The scope of this inventory, including the inventory area, schedule and field and laboratory data to be collected, will be determined jointly with the DNR.

Comment No. A8 (Comment #72)

Please identify classes or "typical" chemicals which may be used as dewatering agents.

Response:

Dewatering agents are chemicals used to lower the surface tension of water and/or flocculate mineral particles so that they can be filtered more easily. The mining industry uses these chemicals to aid in filtering mineral concentrates. Dewatering agents that are currently marketed are sulfo-succinate surfactants. A particular dewatering agent has not been identified for use at Crandon, nor has the absolute need for a dewatering agent been established. It is unlikely that they will be needed. Operating experience with pressure filters on sulfide concentrates at other operations has not shown the need for dewatering agents.

Comment No. A9 (Comment #102)

Surface fuel storage facilities would be surrounded by dikes to contain accidental spills. Please provide details on how precipitation would be permitted to run off the site while accidental fuel spills would be contained.

Response:

The two main fuel oil storage tanks and the two subsidiary downhole measuring tanks, together with their containment dikes, are shown on Drawing No. 051-1-G-003 (Attachment No. 1). The dikes surrounding both storage areas have been sized to contain the combined volume of the tanks in each facility. This drawing is subject to revision during final engineering.

Under normal circumstances the sluice gate valves, shown in Section C (see Attachment No. 1), will be closed at all times. Rainwater will thus be contained within the berm. Periodically or after each storm and assuming no fuel oil spills have occurred, the gate valves would be opened and the water allowed to drain into the surrounding area.

In the event of minor contamination of the water within the dike, the oily water would be pumped to a tanker truck and transported to the industrial sewer system, which is equipped with an oil/water separator, for disposal.

The transfer pumps are located in a small pump house outside of the dike for fire safety reasons. The pumps also will be surrounded by a concrete wall 0.25 m (0.8 feet) high to contain any spills which might occur in the pump house.

In the unlikely event of a tank rupture, the spilled fuel would be totally contained within the dike. If such an event should occur, the spilled fuel would be pumped to a tanker truck for disposal at an approved disposal location off-site or to a reprocessor if appropriate. Similarly, any major spills less than a tank rupture could be handled in the same way.

Comment No. A10 (Comment #104)

Our comment was erroneous. Since there will be no permanent residences the potable water supply system will be classified as a noncommunity water supply. As such, the approval for well construction and chemical treatment are governed by NR 112, Wisconsin Administrative Code.

Response:

Comment acknowledged and construction and chemical treatment of the potable water supply well will be completed in accordance with NR 112, Wisconsin Administrative Code.

Comment No. A11 (Comment #176)

Please provide either plan elevation drawings or a schematic representation showing dust collection points and duct work to the dust collector(s).

Response:

Drawings No. 051-5-G-002, 051-1-M-001, 051-5-G-005, and 051-5-G-004 showing the dust collectors and their locations were provided with the air permit response letter sent to the DNR on January 24, 1984. Please review the response to comment No. 3 of the January 24, 1984 letter for this information.

Comment No. A12 (Comment #186)

Please discuss the potential for generation of hydrogen sulfide from the concentrator.

Response:

There are no process conditions that are conducive to the production of hydrogen sulfide. Sodium sulfide will be added to the primary grinding circuit for stringer ore. This is used to precipitate any soluble metals, particularly copper, in the stringer ore slurry. Since this reagent is expensive, its use will be closely controlled to avoid excess use. Assuming 250 g of sodium sulfide are added per ton of stringer ore and that the pH of the ground ore slurry is 10.3, the theoretical concentration of hydrogen sulfide in air just over the slurry would be less than 1 ppm. This assumes that 5 percent of the added sulfide exists as unreacted sulfide in the ore slurry and that all excess hydrogen sulfide reaches the air. Any hydrogen sulfide formed will react with soluble metals to form an insoluble metal sulfide. Hydrogen sulfide will also react with polythionates in recycle process water to form thiosulfate according to the following reaction:

$$2H_2S + 4S_4O_6^{=} + 3H_2O \text{ -----> } 9S_2O_3^{=} + 10H^+$$

Because these mechanisms prevent hydrogen sulfide from being emitted, hydrogen sulfide generation has not been identified as a problem in massive sulfide concentrators.

CHAPTER II

Comment No. A13 (Comment #5)

The most accurate characterization of the Department's role in air monitoring would be to state that the Department certified Exxon's air monitoring data.

Response:

Comment acknowledged and the EIR will be revised to state that the Department certified Exxon Minerals Company's air monitoring data.

Comment No. A14 (Comment #9)

The equation provided for calculating the geometric mean value is incorrect, perhaps due to a typographical error. Please provide the correct equation.

Response:

Comment acknowledged. The correct expression of the equation is:

$$\log(\text{G.M.}) = \frac{1}{n} \sum_{i=1}^{n} \log x_i$$

Our calculations are correct; however, the equation was incorrect because of a typographical error.

Comment No. A15 (Comment #16)

Please identify the locations of test wells and soil borings which have been abandoned and describe the abandonment methodology.

Response:

Figure 2.2-5 of the EIR shows the location of all test wells and soil borings in the environmental study area. Borings in which piezometers have been installed are marked by solid black circles. All others have been abandoned.

The following description from a drilling contract outlines abandonment methodology:

"Grouting of Boreholes

Upon satisfactory completion of each boring which does not contain a ground water observation well, and acceptance thereof by Exxon, the contractor shall refill the borehole with grout.

All boreholes are to be grouted. The grout mix shall consist of seven (7) gallons of water and two (2) pounds of powdered bentonite per sack (94 pounds) of Type I Portland cement. The contractor, at his option, may use an accelerating agent in the grout to achieve a rapid set and hardening of the grout. Exxon reserves the right to adjust the grout mix proportions in order to provide a grout consistency which is in Exxon's judgment better suited to the project needs.

The grout shall be pumped into the borehole through a pipe or hose. Pumping shall be initiated with the pipe or hose extended to the bottom of the borehole. The grout pipe or hose shall then be withdrawn in a tremmie fashion until the casing or hole is full. Casing where used shall then be removed from the borehole in no more than ten (10) foot increments with the grout level in the remaining casing re-established to the top of the hole after each increment of casing is removed. The grout added after the initial pumping may be poured down the casing rather than being pumped. It is estimated that the grout mix specified herein, without an accelerating agent, will require 12 to 24 hours to achieve its initial set. If at any time prior to completion of the refilling operation the borehole is left unattended, it shall be suitably capped and protected."

Comment No. A16 (Comment #21)

This response does not address the potential for contamination of the samples from drilling fluids.

Response:

At the selected sampling depth, a split spoon sampler is attached to the end of the drill string and lowered to hole bottom. By hammering on the drill rods, the split spoon sampler is driven into the undisturbed glacial soil material for approximately 457 mm (18 inches). The split spoon sampler is opened after removal from the hole. Generally, only the upper 25 to 51 mm (1 to 2 inches) of the sample have been disturbed by the rotary bit and drilling fluids. That portion of the sample is discarded. To further insure an undisturbed sample and a sample free of contamination by drilling fluids, only the lowermost 152 mm (6 inches) are logged and saved in a plastic container for laboratory testing.

Comment No. A17 (Comment #23)

We feel that additional testing for asbestiform materials is warranted. While the bulk analyses performed to date indicate a general absence of asbestiform minerals, even trace amounts of asbestiforms fibers can be a potential health hazard. Since asbestiform fibers would tend to be concentrated in the tailings and the concentrate fines, it is necessary to investigate these materials using trace techniques. Similar analyses could also be conducted on waste rock and glacial till samples.

The fines fractions should be analyzed as if they were air particulates obtained by special sampling techniques. The analysis should conform with that specified in the U.S. EPA document "Electron Microscope Measurement of Airborne Asbestos Concentrations; A Provisional Methodology Manual", EPA - 600/2-77-178 (Revised June, 1978). Please consult with our Bureau of Air Management before initiating this program.

Response:

A preliminary test program has been developed to determine if asbestiform minerals are present in tailings resulting from pilot testing of Crandon ores. We intend to review this proposed program and all previously acquired data with the DNR to determine (1) if further asbestiform testing is indeed necessary, and (2) the details of a test program if it is required. A meeting will be scheduled within the next 30 days with the Bureau of Air Management to discuss and resolve the program for additional testing of asbestiform materials.

Comment No. A18 (Comment #25)

This response does not provide the requested information. Please provide quality control data collected when Exxon's samples were analyzed and describe the evaluation of these data.

Response:

We do not maintain contractor quality control data in our files. It is the responsibility of our contractors to maintain these data files.

Because these contractors have several clients and analyze many samples each year, it is time consuming and costly to retrieve quality control data. These data are generally maintained in laboratory files which have EMC data interspersed with other client data and a technician must search the entire file to retrieve specific quality control data. We recently experienced this in providing Aqualab, Inc. quality control data which the Department requested.

We will provide these data, however, the DNR must make their request as specific as possible. We need to know the type of samples analyzed and the specific time the samples were analyzed (i.e., June 1979). Once this information is received, it will take us approximately 90 days to provide the data.

Comment No. A19 (Comment #34)

Please provide interpretive lithologic logs for the exploration holes drilled to evaluate the mineral potential of sites 40 and 41. Discuss the degree of bedrock fracturing, weathering, and permeability of these two sites.

Response:

The requested information will be included as part of a forthcoming report to the DNR entitled "Bedrock Hydrology." The contents of this report were discussed at the January 11, 1984 meeting with the DNR in Madison, Wisconsin.

Comment No. A20 (Comment #33)

Please provide the results of the analyses for the 6 till samples cited in this response.

Response:

Permeability estimates for three till samples were completed at two different densities (i.e., 125 and 135 pounds per cubic foot [pcf] dry weight) using the published Federal Highway Administration (FHWA) nomograph. The relevant data required for the analysis are as follows:

Boring	Sample	Depth (m)	D10 (mm)	%-200*	Unit Dry Weight (pcf)	Coefficient of Permeability (cm/sec)
G41-G15	SA 5A & 5B	20	.003	27	125	1.4×10^{-6}
			.003	27	135	2.1×10^{-7}
G41-L19	SA-2	3	.017	18	125	1.0×10^{-5}
			.017	18	135	1.7×10^{-6}
G41-E13	SA-9	12.5	.06	11	125	1.0×10^{-4}
			.06	11	135	1.5×10^{-5}

Grain size curves for the referenced samples and the nomographs illustrating the analyses are provided on the attached figures (A20-1 through A20-6).

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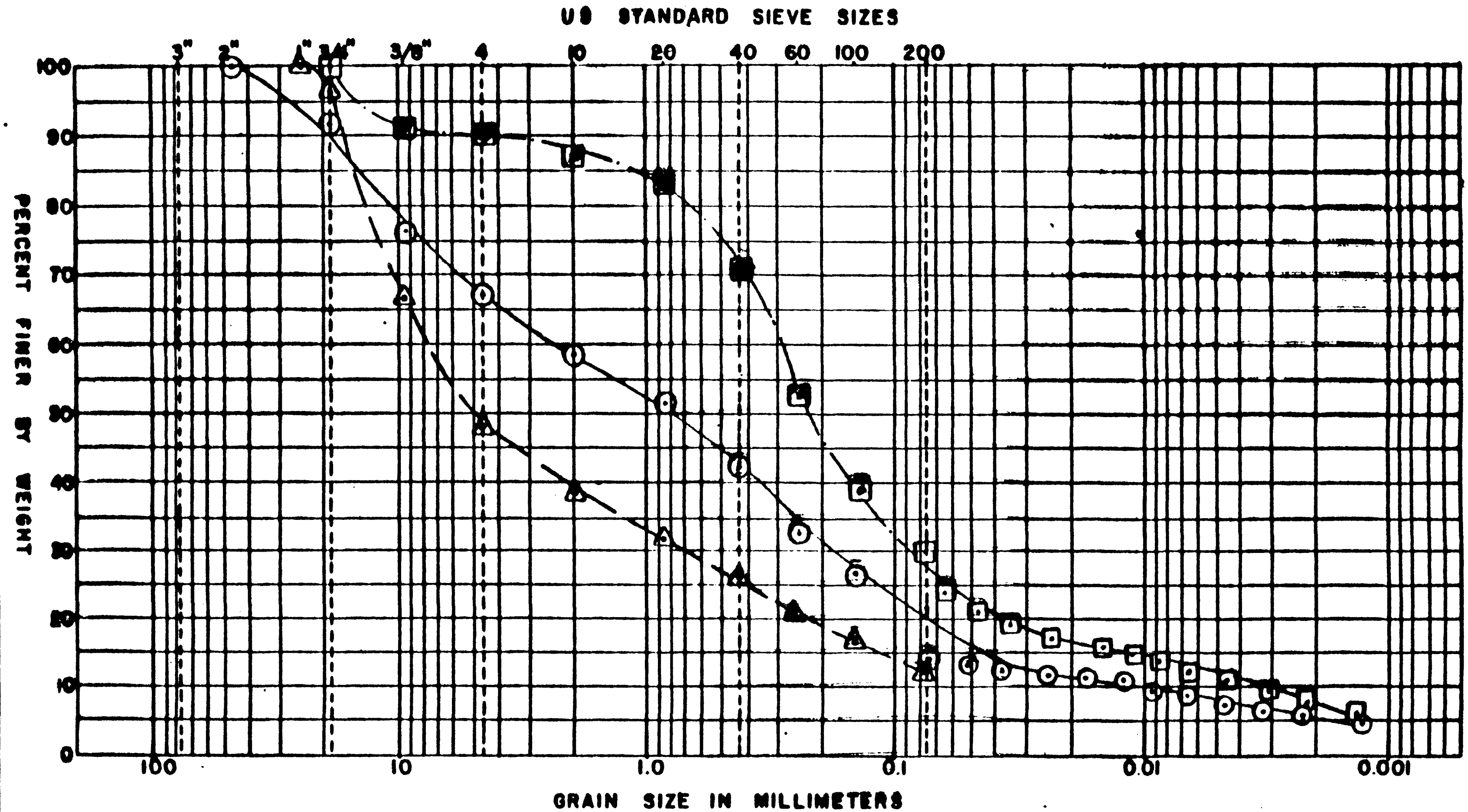
*Percentage of soil passing a No. 200 mesh sieve on a dry weight basis -- commonly referred to as the percentage of fines.

GRAIN SIZE DISTRIBUTION

(Figure A20-1 for Response to Comment No. A20)



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	w_n	w_L	w_p	I_p	DESCRIPTION OR CLASSIFICATION
G41-G15 SA-1 —○—	13.11m-13.41m (43.0'-44.0')	-	-	-	-	Brown, fine to coarse gravelly, fine to coarse SAND, some silt, trace clay (SM)
SA-3 – –△– –	16.46m-16.61m (54.0'-54.5')	-	-	-	-	Brown, fine to coarse GRAVEL and fine to coarse SAND, some silt (GM)
SA-5A&B – ·–□–· –	19.96m-20.27m (65.5'-66.5')	-	-	-	-	Red-brown, silty, fine to coarse SAND, some fine gravel, trace clay (SM)

Date 6/7/79
Job No. 786035

Golder Associates

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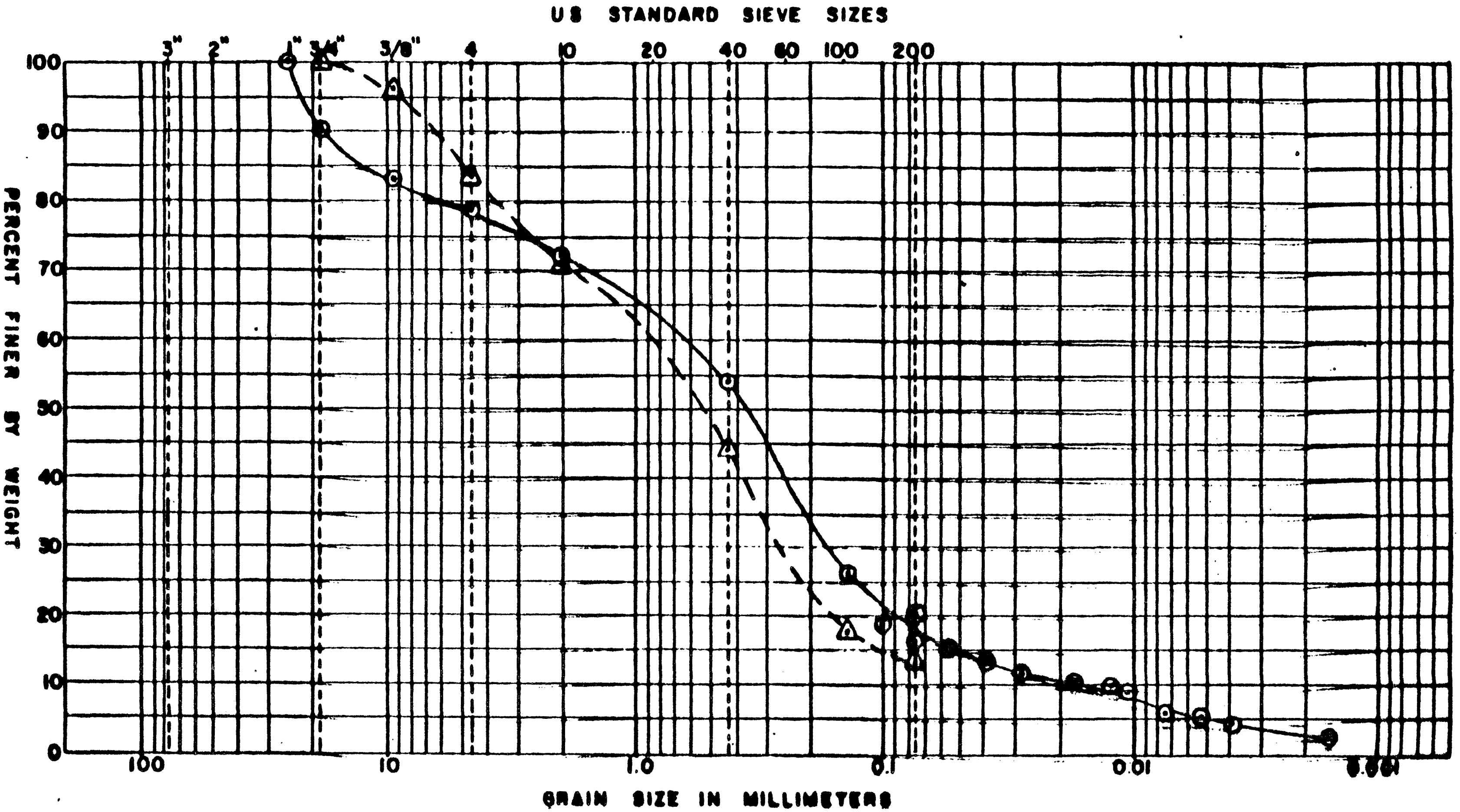
GRAIN SIZE DISTRIBUTION

(Figure A20-2 for Response to Comment No. A20)



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
G41-L19 SA-2 —o—	2.74m-3.20m (9.0'-10.5')	-	-	-	-	Brown, fine to coarse gravelly, fine to coarse SAND, some silt, trace clay (SM)
SA-5 - -Δ- -	7.32m-7.77m (24.0'-25.5')	-	-	-	-	Brown, fine to coarse SAND, some fine gravel, some silt, trace clay (SM)

Date 6/14/79
Job No. 786035

Golder Associates

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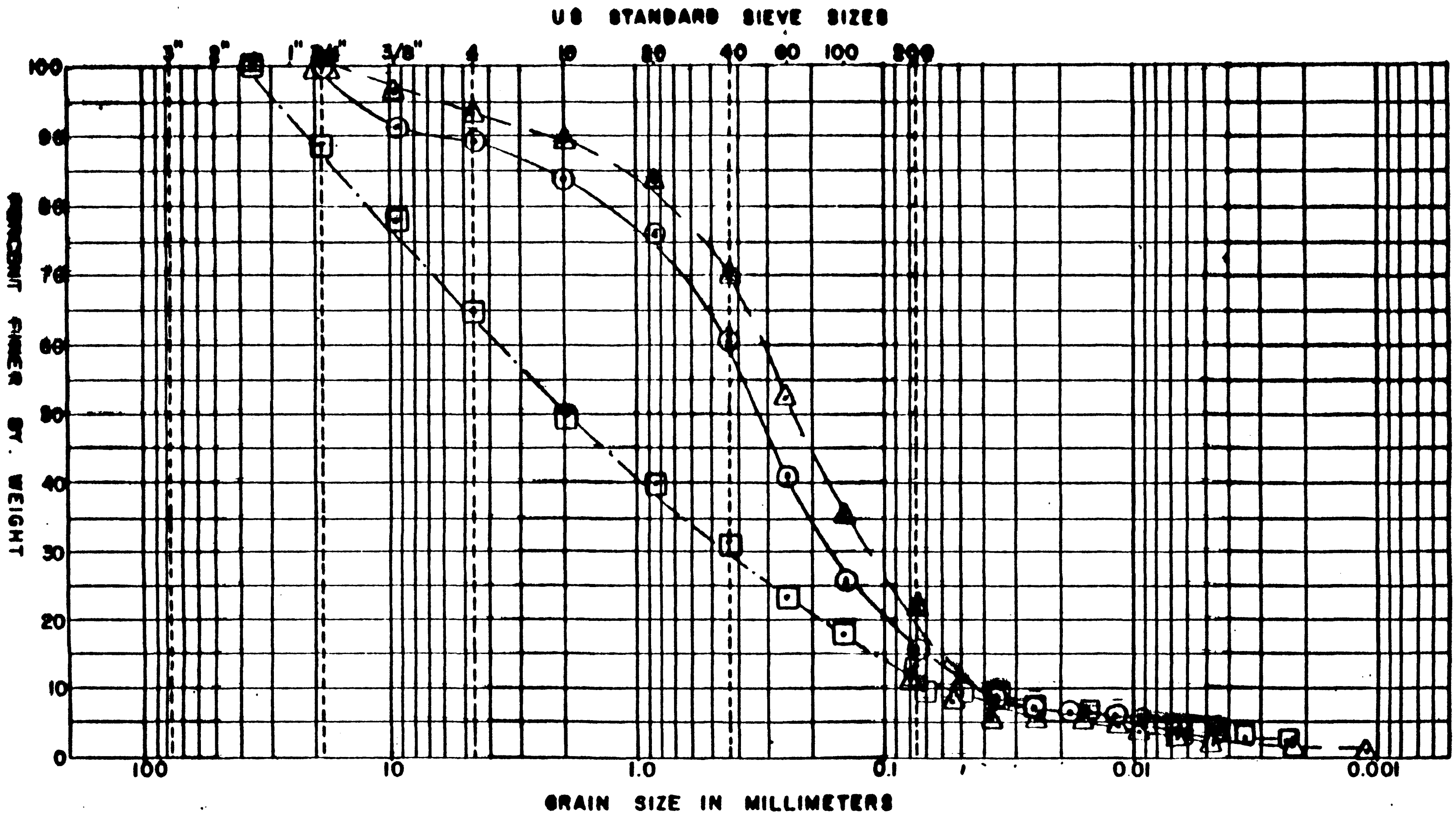
Approved JFC

GRAIN SIZE DISTRIBUTION

(Figure A20-3 for Response to Comment No. A20)



COBBLES	GRAVEL		SAND			FINES	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZES	CLAY SIZES

BORING NO.	ELEV. OR DEPTH	W_n	W_L	W_p	I_p	DESCRIPTION OR CLASSIFICATION
G41-E13 SA-3 —⊙—	3.05m-3.51m (10.0'-11.5')	-	-	-	-	Red-brown, fine to coarse SAND, some fine gravel, some silt, trace clay (SM)
SA-5 – –△– –	6.10m-6.55m (20.0'-21.5')	-	-	-	-	Light brown, fine to coarse SAND, some fine gravel, some silt, trace clay (SM)
SA-9 – –⊡– –	12.19m-12.65m (40.0'-41.5')	-	-	-	-	Red-brown, fine to coarse SAND and fine GRAVEL, trace silt, trace clay (SM)

Date 6/7/79

Golder Associates

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JFC

G41-G15 (SA-5A+B) 65-66'

USCS	P_{200}	D_{10}
SM	27%	.003mm

γ_d-125pcf-135pcf
k-1.4 x 10^{-6} to 2.1 x 10^{-7} cm/sec

$$k = \frac{6.214\times10^{5}(D_{10})^{1.478}(n)^{6.654}}{(P_{200})^{0.597}} \quad \text{(ft./day)}$$

$$n = \text{Porosity} = \left(1 - \frac{\gamma_d}{62.4G}\right)$$

G = Specific Gravity

(Assumed = 2.70)

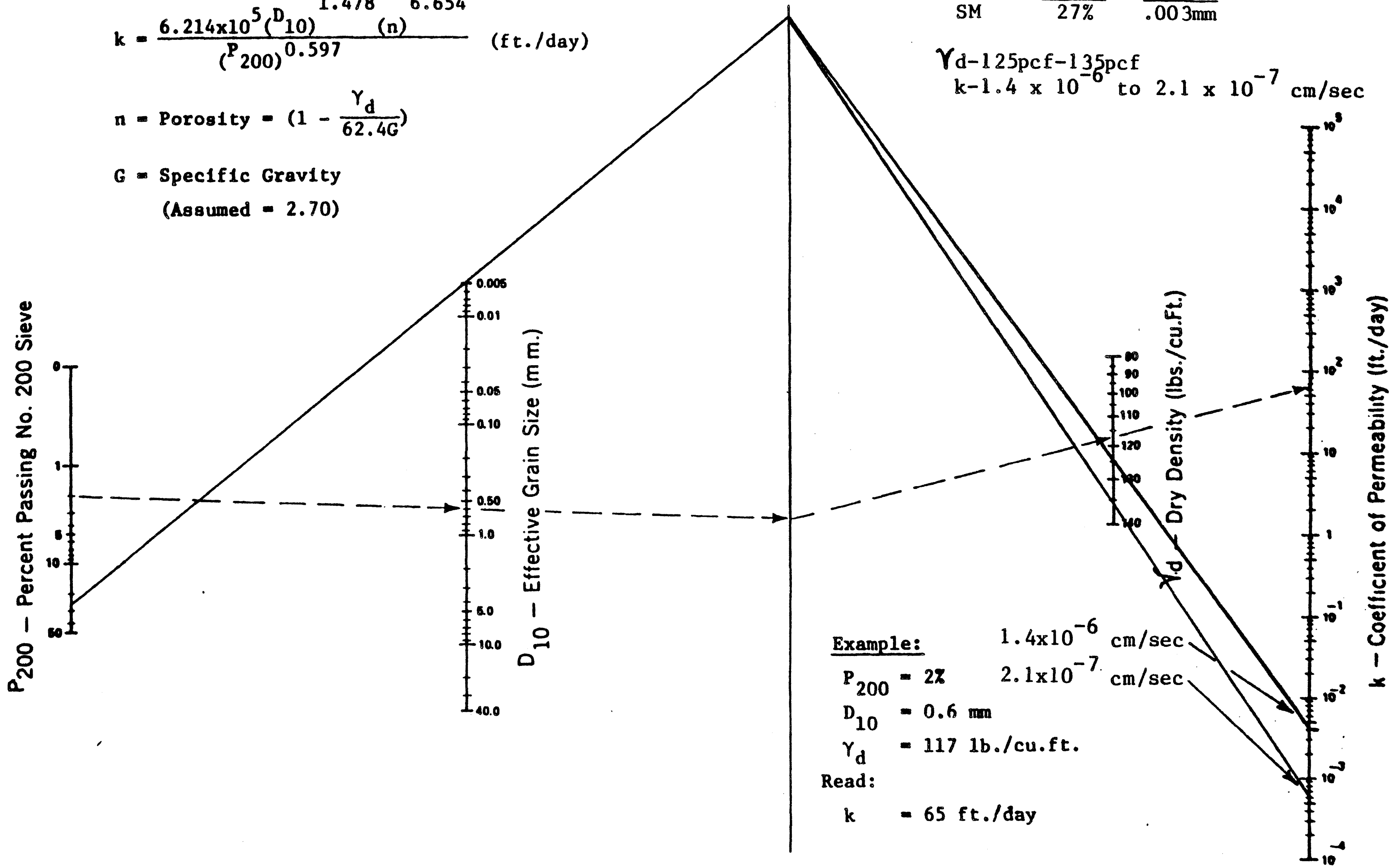

Figure 28. Chart For Estimating Coefficient of Permeability of Granular Drainage and Filter Materials (Source: Federal Highway Administration Report No. FHWA-TS-80-224, August 1980)

——— EMC

— — — Federal Highway Administration

(Figure A20-4 for the Response to Comment No. A20)

G41-L19 (SA-2) USCS / SM P_{200} / 18% D_{10} / .017

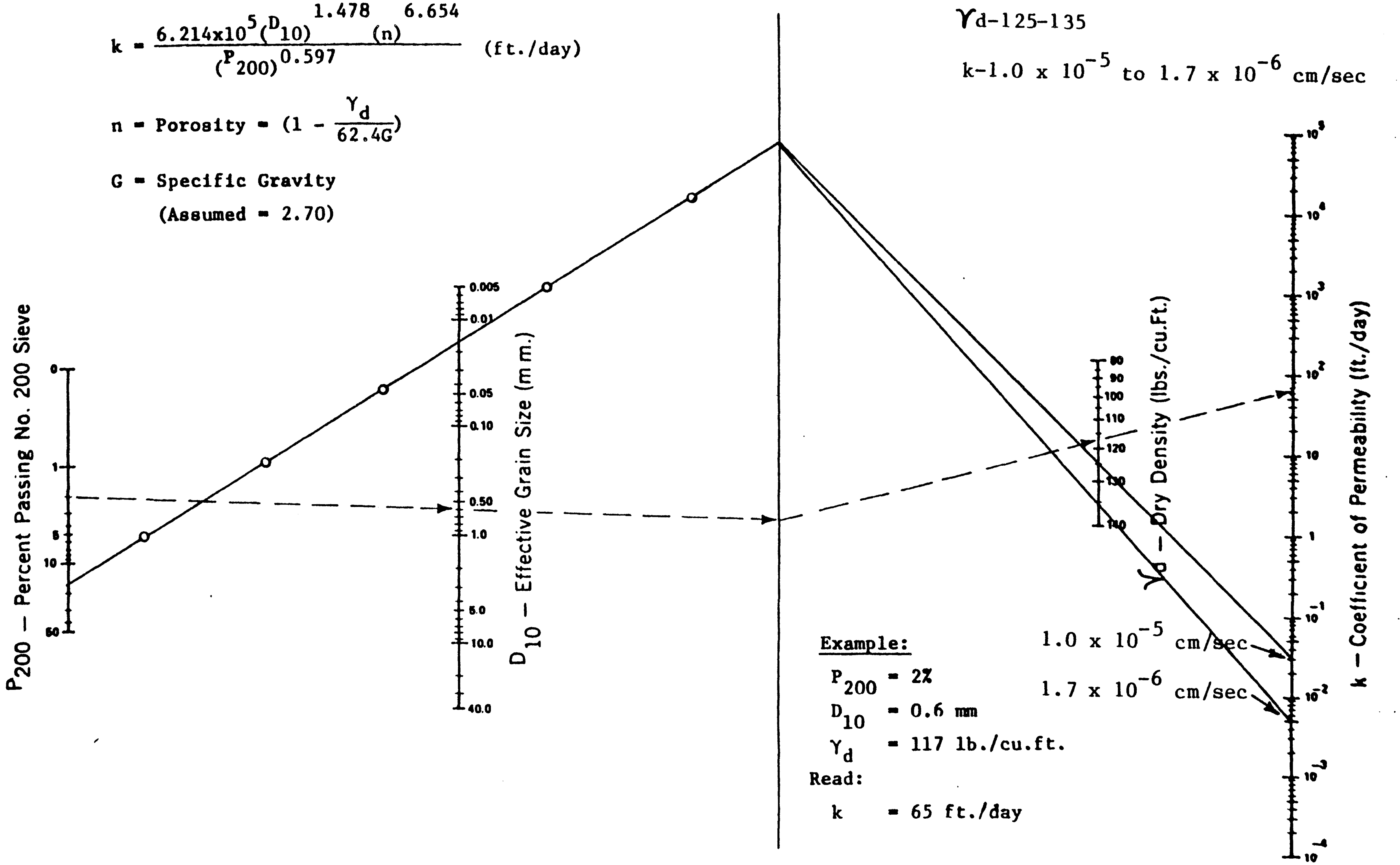

Figure 28. Chart For Estimating Coefficient of Permeability of Granular Drainage and Filter Materials (Source: Federal Highway Administration Report No. FHWA-TS-80-224, August 1980)

——— EMC

– – — Federal Highway Administration

(Figure A20-5 for the Response to Comment No. A20)

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326-443 O - 80 - 5

G41-E13 (SA-9) 40-41.5'

USCS	P_{200}	D_{10}
SM	11%	.06

$$k = \frac{6.214\times10^{5}(D_{10})^{1.478}(n)^{6.654}}{(P_{200})^{0.597}} \quad \text{(ft./day)}$$

$$n = \text{Porosity} = (1 - \frac{\gamma_d}{62.4G})$$

G = Specific Gravity

(Assumed = 2.70)

γ_d= 125-135pcf
k- 1.0 x 10^{-4} to 1.5 x 10^{-5} cm/sec

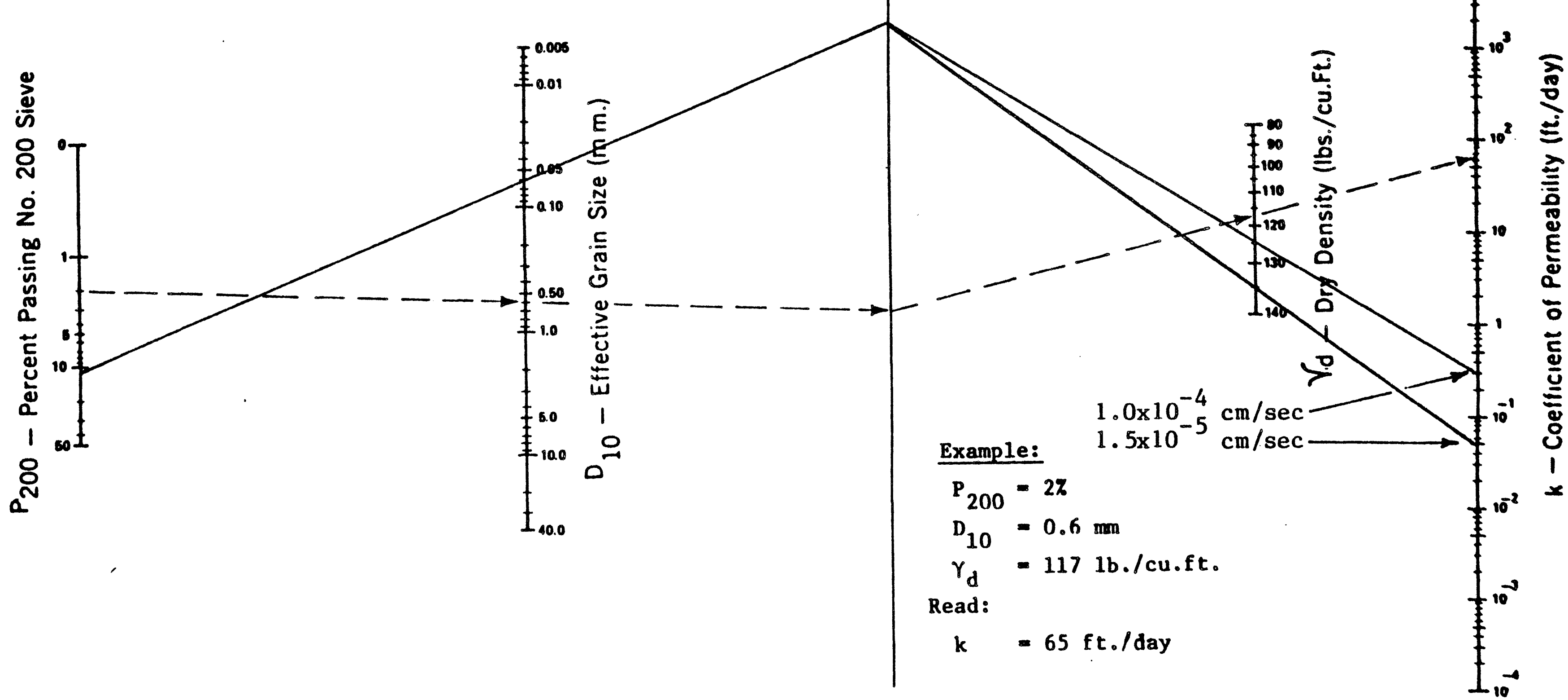


Figure 28. Chart For Estimating Coefficient of Permeability of Granular Drainage and Filter Materials (Source: Federal Highway Administration Report No. FHWA-TS-80-224, August 1980)

——— EMC
– – – Federal Highway Administration

(Figure A20-6 for the Response to Comment No. A20)

Comment No. A21 (Comment #44)

Please provide noninterpretive lithologic logs which address bedrock weathering and fracturing for the deep exploration holes used in the packer tests and the data obtained from these tests. Attachment 2, submitted in support of response 18, should be amended to indicate which holes had been subjected to the packer tests.

Response:

Noninterpretive lithologic logs which address weathering and fracturing for the deep exploration holes used in the packer tests and the data obtained from these tests will be presented in an Exxon Minerals Company report entitled "Bedrock Hydrology." This report is in preparation and will be submitted to the DNR when completed.

Attachment No. 2 which was submitted in support of response to comment No. 18 in the May 11, 1983 DNR letter will be amended to indicate which holes were subjected to packer tests. This amended attachment will be provided within 30 days.

Comment No. A22 (Comment #58)

Please indicate the ground water divides on Figure 2.3-4.

Response:

A dotted line as shown on the attached figure will be added to EIR Figure 2.3-4 to indicate the approximate axis of the ground water table "ridge." There is no other defined ground water divide, although a ground water mound occurs northeast of Little Sand and Duck lakes.

Comment No. A23 (Comment #61)

Provide at least one illustrative comparison of a selected groundwater hydrograph with piezometer data or a stream hydrograph, and precipitation data to substantiate this response.

Response:

Limited precipitation data in the site area are available. However, a long-term precipitation record is available from Nicolet College in Rhinelander, Wisconsin. These data indicate that the maximum precipitation occurs from May through September (see attached Table 2.4-14). From May through September rainfall is approximately 63 percent of the annual precipitation which occurs.

The USGS stream gage at State Highway 55 above Rice Lake is the nearest sampling station to the site area with a long-term record of surface water flow rates. As indicated in attached EIR Appendix Table C-1, the months with highest surface water flow rates are from April to October. This record closely follows the average monthly precipitation totals summarized in Table 2.4-14. With the exception of April, the surface water flow rate data suggest a lag time of approximately one month between increased precipitation and higher flow rates.

TABLE 2.4-14

AVERAGE MONTHLY PRECIPITATION AT
NICOLET COLLEGE, RHINELANDER, WISCONSIN
1908 THROUGH 1977[a]

MONTH	AVERAGE PRECIPITATION (mm)[b]	PERCENT OF ANNUAL PRECIPITATION
October	59.4	7.6
November	47.8	6.1
December	28.2	3.6
January	26.9	3.4
February	25.4	3.3
March	38.4	4.9
April	59.4	7.6
May	85.3	10.9
June	115.6	14.8
July	97.3	12.4
August	102.6	13.1
September	95.2	12.2
Total	781.6	100

[a]Black, 1978.

[b]25.4 mm = 1 inch.

TABLE C-1

USGS DAILY STREAM DISCHARGE RECORD
FOR SWAMP CREEK ABOVE RICE LAKE AT HIGHWAY 55 NEAR MOLE LAKE, WISCONSIN
AUGUST 1977 TO SEPTEMBER 1980
USGS STATION NUMBER 04074538

DAILY DISCHARGE (cfs)

	1977					1978								
DAY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1	--	43	40	28	26	27	17	16	25	37	57	27	37	36
2	--	44	38	29	26	25	17	16	29	32	53	46	37	33
3	12	43	36	37	26	24	17	16	27	34	46	68	35	34
4	--	40	33	46	25	24	17	16	34	31	41	61	32	32
5	--	37	34	42	25	24	17	16	41	30	38	49	30	29
6	--	36	34	38	25	24	17	17	49	30	36	50	28	29
7	--	36	32	38	25	23	17	17	57	29	35	49	26	29
8	--	34	41	43	25	22	17	17	56	31	39	41	25	28
9	12	31	51	42	25	22	18	17	54	40	37	37	23	27
10	16	28	50	41	25	22	18	17	66	42	34	34	22	26
11	14	25	48	39	26	21	18	17	74	37	32	31	24	24
12	13	25	49	37	26	21	18	17	69	36	32	28	22	27
13	13	27	47	33	26	21	18	17	66	36	31	28	21	39
14	13	25	45	31	26	21	18	17	58	53	31	27	20	59
15	11	23	45	30	26	21	18	17	51	60	43	25	25	64
16	17	27	38	28	26	21	18	17	47	51	40	24	64	54
17	19	31	38	27	27	21	18	17	44	42	37	22	72	45
18	16	32	35	26	30	21	18	18	45	37	35	41	61	42
19	12	54	33	24	31	21	17	18	58	35	32	72	54	44
20	11	63	31	26	31	21	17	18	64	34	30	64	49	43
21	12	58	29	36	29	21	17	19	62	34	31	50	43	40
22	13	50	29	33	29	20	17	19	56	31	31	51	39	36
23	11	45	29	30	28	20	16	19	54	30	29	90	43	33
24	10	48	28	33	28	20	16	19	58	29	28	98	59	30
25	8	55	28	30	29	20	16	20	56	28	27	81	60	28
26	14	55	28	28	29	20	16	21	52	29	26	68	52	26
27	31	55	25	27	29	20	16	21	48	35	26	61	50	32
28	43	50	26	26	29	19	16	21	44	53	24	53	54	33
29	35	46	27	26	29	19	--	22	43	56	24	48	52	35
30	27	43	29	26	28	19	--	23	40	60	22	43	45	40
31	33	--	28	--	28	18	--	24	--	55	--	39	39	--
Total (cfs)	--	1,209	1,104	980	843	663	480	566	1,527	1,194	1,027	1,506	1,243	1,077
Mean (cfs)	--	40.3	35.6	32.7	27.2	21.4	17.1	18.3	50.9	38.5	34.2	48.6	40.1	35.9
MONTHLY STREAM DISCHARGE														
Acre-feet	--	2,398	2,189	1,946	1,672	1,316	950	1,125	3,029	2,367	2,035	2,988	2,466	2,136
Inches of Runoff	--	0.97	0.89	0.79	0.68	0.53	0.39	0.46	1.23	0.96	0.83	1.21	1.00	0.87

Notes: 1978 Water year = October 1, 1977 to September 30, 1978.
Total stream discharge, 1978 water year = 24,219 acre-feet (9.83 inches of runoff).
Mean daily stream discharge, 1978 water year = 33.5 cfs.
Location: See Figure 2.4-1.
Drainage Area: 119.7 km^2 (46.2 square miles).
Period of Record: August 1977 to current year.
To convert to m^3/s, multiply cfs by 0.02832.
Source: USGS, 1979.

TABLE C-1 (continued)

DAY	1978 OCT	NOV	DEC	1979 JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
	DAILY DISCHARGE (cfs)											
1	37	19	17	21	21	26	67	55	43	40	38	31
2	35	18	17	21	21	26	62	55	41	37	32	43
3	35	18	17	21	21	27	57	57	40	38	29	43
4	35	18	18	20	21	27	56	53	36	42	27	39
5	35	18	18	20	21	27	57	50	35	39	26	35
6	38	18	18	19	21	28	62	53	34	35	25	32
7	34	17	17	19	22	28	54	62	36	33	23	31
8	30	17	17	19	22	28	53	69	41	32	22	26
9	27	18	17	19	22	28	51	82	39	35	21	22
10	26	18	18	19	22	27	48	91	61	34	24	21
11	26	18	18	19	22	26	46	81	78	34	25	20
12	26	18	19	19	22	27	47	74	60	79	24	23
13	26	19	19	19	22	27	59	65	47	87	25	30
14	24	23	19	19	22	27	67	64	41	94	25	29
15	22	23	19	18	21	26	69	62	39	83	22	25
16	22	20	18	18	21	28	'5	53	43	66	18	21
17	22	22	18	19	21	29	,3	47	117	57	20	19
18	21	31	18	19	21	30	25	44	128	44	22	17
19	21	26	19	19	22	33	137	58	90	38	25	16
20	21	24	20	20	23	42	151	82	70	36	24	15
21	21	21	21	21	23	47	149	75	80	35	22	15
22	20	19	21	21	23	54	131	63	78	33	24	15
23	21	18	21	21	25	68	113	55	66	31	38	13
24	21	18	21	21	25	92	102	52	54	30	41	17
25	21	18	21	21	24	90	96	47	48	38	36	19
26	21	18	21	21	23	80	91	43	46	42	29	17
27	20	18	20	21	24	76	80	43	45	38	29	17
28	20	18	20	21	25	72	68	42	42	37	30	14
29	18	19	21	21	--	68	61	40	43	34	29	14
30	18	18	21	21	--	65	58	39	41	32	27	15
31	19	--	21	21	--	65	--	41	--	40	25	--
Total (cfs)	783	588	590	618	623	1,344	2,395	1,797	1,662	1,373	827	694
Mean (cfs)	25.3	19.6	19.0	19.9	22.3	43.4	79.8	58.0	55.4	44.3	26.7	23.1
	MONTHLY STREAM DISCHARGE											
Acre-feet	1,556	1,166	1,168	1,224	1,238	2,669	4,748	3,566	3,297	2,724	1,642	1,375
Inches of Runoff	0.63	0.47	0.47	0.50	0.50	1.08	1.93	1.45	1.34	1.11	0.67	0.56

Notes: 1979 Water year = October 1, 1978 to September 30, 1979.
Total stream discharge, 1979 water year = 26,373 acre-feet (10.70 inches of runoff).
Mean daily stream discharge, 1979 water year = 36.4 cfs.
Source: USGS, 1980.

DAILY DISCHARGE (cfs)

	1979			1980								
DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP
1	15	57	20	23	19	17	32	33	49	31	24	47
2	17	45	20	22	18	17	33	32	42	29	24	47
3	17	36	22	21	18	17	35	32	37	26	25	40
4	16	34	24	19	18	17	32	30	27	24	26	41
5	16	32	26	19	18	17	36	30	35	23	32	39
6	15	39	27	19	19	17	46	29	61	33	30	34
7	18	37	28	18	18	17	59	29	62	29	29	29
8	20	33	27	18	18	17	78	28	64	23	36	26
9	19	29	28	18	18	17	107	26	52	23	40	25
10	17	27	28	18	18	18	91	25	42	23	34	24
11	17	22	28	20	19	17	70	32	35	23	30	22
12	17	27	25	20	19	17	61	32	30	24	27	21
13	18	26	24	20	19	17	53	35	28	23	24	26
14	16	25	23	21	18	17	46	35	28	21	22	31
15	15	25	23	23	18	17	42	34	35	20	21	28
16	15	22	22	27	18	17	40	31	32	21	19	28
17	15	25	21	30	18	18	40	28	28	25	18	27
18	14	26	21	32	18	19	43	28	31	25	17	24
19	15	28	21	30	19	20	46	28	45	27	16	22
20	19	32	22	28	20	22	47	27	50	31	17	25
21	23	33	24	27	21	22	46	25	41	35	21	68
22	48	36	24	26	22	20	47	26	34	31	22	95
23	86	36	25	25	21	20	44	25	31	26	21	77
24	74	35	26	24	20	21	40	23	29	21	23	56
25	49	33	25	23	19	20	37	22	27	21	31	45
26	38	35	25	22	19	22	34	20	26	20	36	41
27	33	40	23	21	20	23	32	22	27	19	49	34
28	37	35	22	21	19	22	33	39	48	18	47	31
29	37	32	23	19	18	24	34	42	45	25	39	28
30	34	22	22	19	--	27	34	54	37	25	37	28
31	33	--	22	19	--	31	--	60	--	24	37	--
Total (cfs)	823	964	741	692	547	604	1,418	962	1,158	769	874	1,109
Mean (cfs)	26.5	32.1	23.9	22.3	18.9	19.5	47.3	31.0	38.6	24.8	28.2	37.0
MONTHLY STREAM DISCHARGE												
Acre-feet	1,629	1,912	1,470	1,373	1,085	1,198	2,813	1,908	2,297	1,525	1,734	2,200
Inches of Runoff	0.66	0.78	0.60	0.56	0.44	0.49	1.14	0.77	0.93	0.62	0.70	0.89

Notes: 1980 Water year = October 1, 1979 to September 30, 1980.
Total stream discharge, 1980 water year = 21,144 acre-feet (8.58 inches of runoff).
Mean daily stream discharge, 1980 water year = 29.2 cfs.
Source: USGS, 1981 (provisional).

The increase in April surface water flow rates are a result of increased precipitation (i.e., 4.9 to 7.6 percent from March to April) and surface water drainage from melting snow.

Similarly, the piezometer hydrographs for boring locations DW-1A, DW-1U, and DW-1L (see attached EIR Figure B-2) indicate an increase in ground water elevation in June, July and August of 1978. An increase is also evident in 1977 for hydrograph DW-1L. The increase in the ground water elevation also appears to occur from 1 to 2 months later than the melting snow or precipitation percolation to the main ground water table. This pattern is more evident in hydrograph DW-1L than in DW-1A and DW-1U during 1977.

Comment No. A24 (Comment #62)

Provide an illustrative demonstration of the comparability of data recorded by continuous and intermittent water level recorders.

Response:

The attached ground water hydrographs from wells TW-1 (EIR Figure 2.3-11) and DW-2U (EIR Appendix Figure B-3) show the comparability of data recorded continuously (TW-1) and on a monthly basis (DW-2U). These wells are located within 1.6 km (1 mile) of each other and are screened in approximately the same aquifer zone. Over the common period of record, October 1977 through October 1978, the hydrographs exhibit almost identical response.

Comment No. A25 (Comment #83)

Please note that the same methodology for total sulfur analysis should be used in future analysis to insure comparability of data.

Response:

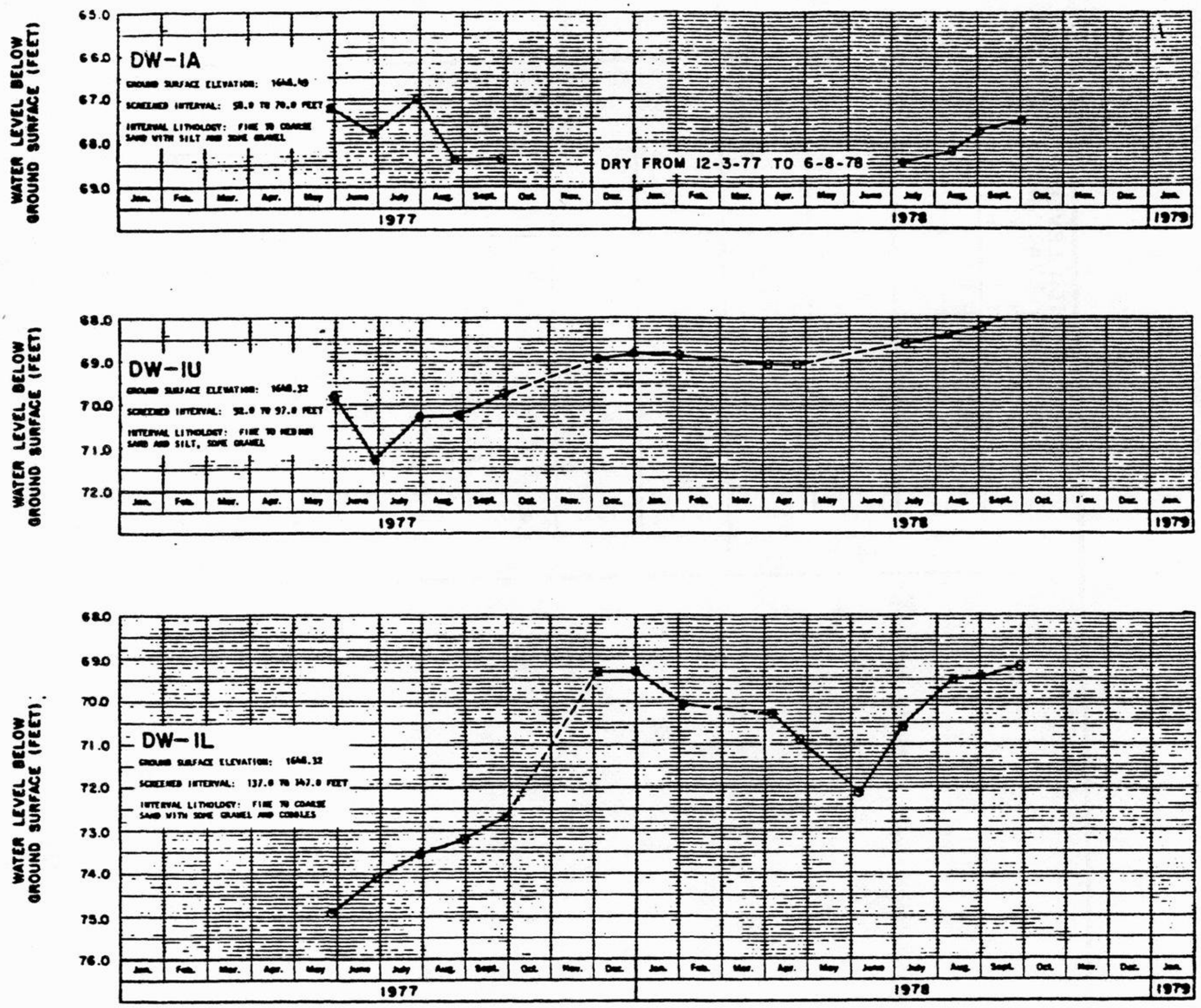
Comment acknowledged and the same methodology for total sulfur analysis used during the baseline monitoring program will be employed for any future analyses of this parameter.

Comment No. A26 (Comment #84)

This response does not address the comment. Please explain how total sulfur data can be reported to a greater number of significant figures than the sulfate data from which it is partially derived.

Response:

As stated in EMC's response to earlier EIR comment No. 84 in the DNR's May 11, 1983 letter, the analytical detection limit for sulfate is 1 mg/l. If total sulfur is being reported from sulfate analytical results, then the detection limit is correspondingly $S/SO_4 = 32/96$, or 0.3 mg/l. The detection limit value of 0.01 mg/l for total sulfur which was originally reported in EIR Table 2.4-10 was incorrect and will be corrected in the revised EIR. Thus, as the DNR correctly stated, total sulfur values can only be reported to the nearest mg/l.



KEY:

⊙ GROUND WATER LEVEL MEASUREMENTS

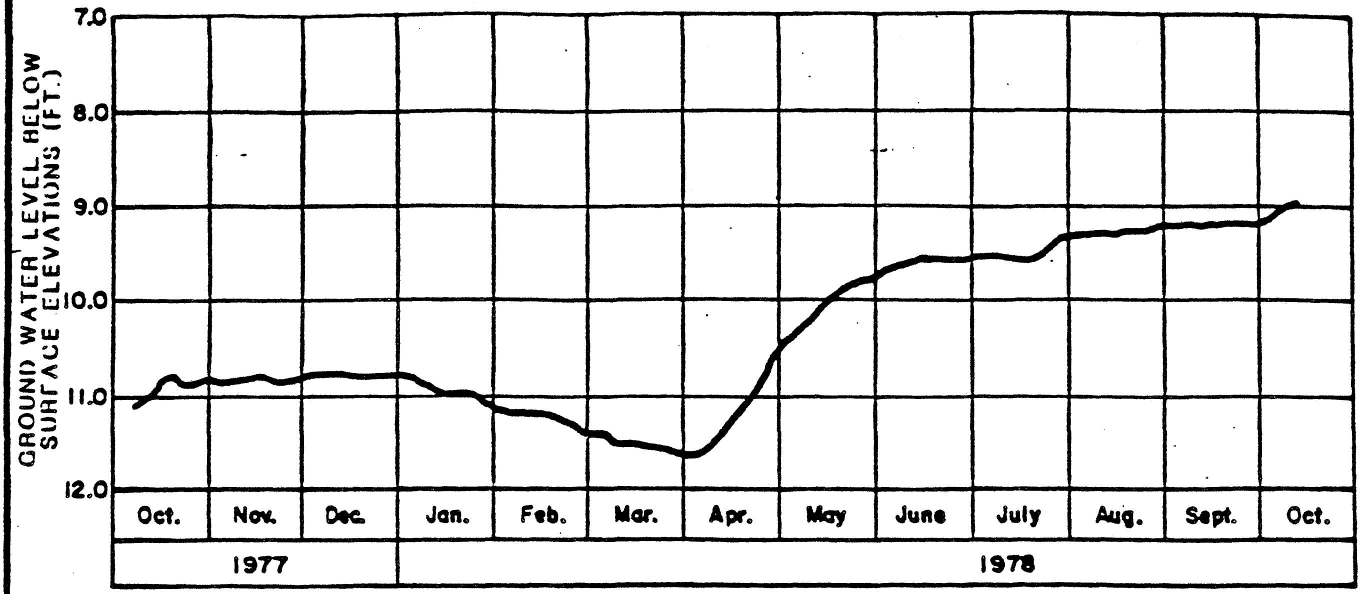
--- INFERRED WHEN DATA MISSING

EXXON MINERALS COMPANY
CRANDON PROJECT

PIEZOMETER HYDROGRAPHS

DAMES & MOORE

FIGURE B-2



TW-1

GROUND SURFACE ELEVATION: 1601.19

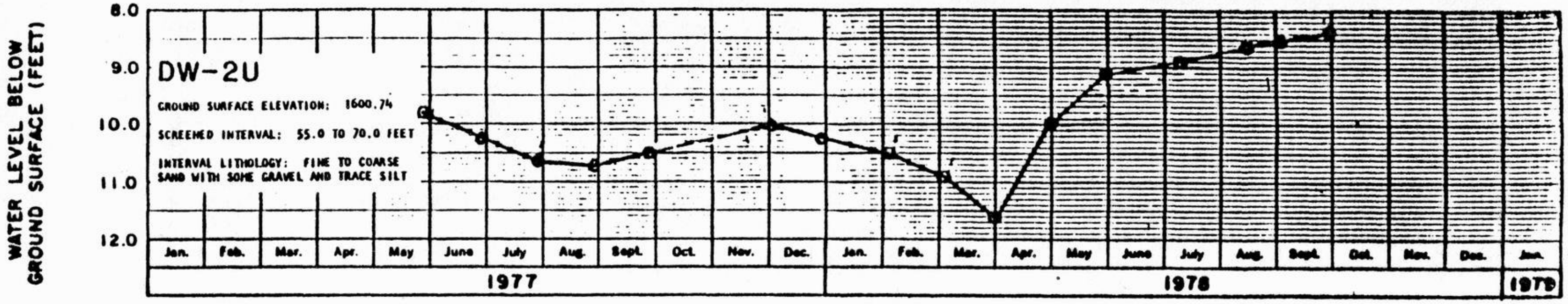
SCREENED INTERVAL: 40.0 TO 55.0 FEET

EXXON MINERALS COMPANY
CRANDON PROJECT

GROUND WATER HYDROGRAPHS FOR TW-1

DAMES & MOORE

FIGURE 2.3-11



KEY:

⊙ GROUND WATER LEVEL MEASUREMENTS

--- INFERRED WHEN DATA MISSING

EXXON MINERALS COMPANY

CRANDON PROJECT

PIEZOMETER HYDROGRAPHS.

DAMES & MOORE

FIGURE B-3

Comment No. A27 (Comment #87)

Is the 0.01 mg/l detection limit for Cr^{+6} listed in Table 2.4-10 correct?

Response:

The detection limit for Chromium (VI) as listed in Table 2.4-10 is 0.01 mg/l.

Comment No. A28 (Comment #119)

Analysis of the most recent surface water quality samples collected from Duck Lake revealed that baseline conditions have not been reestablished since the 1980 pumping test. Values for conductivity, alkalinity and pH remain elevated. Exxon must continue monitoring Duck Lake on a periodic basis until baseline conditions are reestablished.

Response:

Comment acknowledged and Exxon Minerals Company will monitor Duck Lake on a quarterly basis for pH, alkalinity, total hardness, total dissolved solids, and specific conductance (conductivity) until baseline conditions are reestablished or agreement with the DNR that continued monitoring is not required.

Comment No. A29 (Comment #123)

We believe that the low dissolved oxygen levels at Station Z are attributable to aquatic plant communities in that segment of the Wolf River rather than inputs of low dissolved oxygen water from Swamp Creek, Spider, and Pickerel Creeks.

Response:

In our response to comment No. 123 in the DNR's May 11, 1983 comment letter, we provided a possible explanation for the low dissolved oxygen levels at Station Z in the summer of 1978. We acknowledge the presence of aquatic plant communities in this segment of the Wolf River and it could be speculated that these communities affected dissolved oxygen concentrations in the water during this period.

Comment No. A30 (Comment #128)

Contrary to your response, there are sediment metal concentrations significantly outside the expected range of values (e.g. Cr and Pb in sediment at Station D). Please provide a discussion and explanation for these unusually high concentrations.

Response:

Chemical analyses on stream sediment samples in the Swamp Creek drainage basin in March 1978 indicate a mean of 43.5 ppm with a standard deviation of 21.4 ppm for chromium, exclusive of Station D. Station D in Swamp Creek had a single reported value of 180.8 ppm which is six standard deviations from the above mean of the chromium values reported for the Swamp Creek drainage basin.

The lead concentration in the sediment sample at Station I, Little Sand Lake in the Pickerel Creek drainage basin, was 156 ppm which was approximately 10 standard deviations from the mean, 16.9 ppm ($\pm$13.3 ppm), of the nine samples exclusive of Station I.

These chromium and lead values are anomalously high compared to other analyzed concentrations during the sampling period and appear to be non-representative of the sediments for the drainage basins. In EIR Appendix 2.4L, Tables L5 and L6 more recent chemical analyses are presented of sediment samples collected at two stations on Swamp Creek in May 1982. The total chromium concentrations measured were lower than those reported in 1978 and had less statistical variance. Possible explanation for the earlier reported unusually high concentrations in the sediment samples may be contamination from a nearby corroding lead sinker (fishing equipment), stainless steel tool or machine part and would thus not be representative of the drainage basin.

Comment No. A31 (Comment #137)

Rather than selecting a representative species from each trophic level, it is only necessary to sample a top level predator (i.e., walleye, bass, or northern) and a bottom feeder (i.e. carp or suckers).

Response:

Comment acknowledged. Analysis of metal concentrations in fish tissue has been completed as part of the 1983 Aquatic Monitoring Program in Swamp Creek. Fish species representative of a bottom feeder (white sucker) and a top predator (northern pike) were included in the analyses. Rock bass were also included in the analyses as an example of a diverse feeder consuming plant material, insects and fish. Any additional analyses of fish tissues will include only samples from top level predators and bottom feeders.

Comment No. A32 (Comment #138)

As a point of clarification, metal analysis of bullheads and catfish should be conducted with skin-off fillets.

Response:

Comment acknowledged.

Comment No. A33 (Comment #146)

The statement that "The fish community structure upstream and downstream of Rice Lake is similar" is inaccurate since a native brook trout fishery (Class II) exists in Swamp Creek above Rice Lake but is nonexistent downstream of Rice Lake.

Response:

In Swamp Creek the fish community trophic structure upstream and downstream of Rice Lake is considered similar. Insectivorous, omnivorous and piscivorous species are present in both segments of the creek. There are differences in species composition in fish communities upstream and downstream of Rice Lake and these are discussed in detail in subsection 4.1 in Ecological Analysts' "Final Report on the Aquatic Biology of Swamp Creek" dated August 1983 (report previously provided to the DNR).

CHAPTER III

Comment No. A34 (Comment #2)

Please provide a discussion of the likelihood and ramifications of ore reserves significantly exceeding the current estimate.

Response:

There is little likelihood of finding ore reserves "significantly" exceeding the current estimated reserve of 68.7 million metric tons (75.7 million short tons). Drilling from the surface has defined the extent of the orebody along the east/west strike and perpendicular across the deposit into the hanging wall and footwall.

The Crandon ore deposit has not been definitively defined at depth. However, the deep orebody drilling indicates that the deposit thins rapidly below the 710 m level. The current mine plan assumes the recovery of ore down to the 830 m level.

The decision by Exxon Minerals Company to recover additional reserves, should they be found, would be based on a detailed study that would consider the technical, environmental, and economic parameters at the time of mining. Based on this study a "mine" or "do not mine" decision would be made.

The ramifications of the unlikely event of finding "significantly" more ore and recovering these reserves would probably result in an extended mine life beyond the present forecast of 20 years of production. The current facilities design and the constraints of underground mining limit the daily production from Crandon to a normalized 9100 t/d (10,033 short tons per day). With the exception of the MWDF, the extended operation would have the same impact as the normal operations. The additional tailings that would be generated would simply fill the contingent capacity allowed for in the current design of the MWDF.

Comment No. A35 (Comment #10)

Due to the lack of an adequate buffer zone between Skunk Lake and the proposed slurry pipeline and haul road corridor, we recommend consideration of a more southern route as an alternative.

Response:

Exxon Minerals Company originally considered four potential routes from the mine/mill site to the MWDF area and a fifth "no-wetlands" alternative was identified in response to an earlier EIR comment No. 10 in the May 11, 1983 DNR letter. All five of the routes are presented in the attached revised Figure 3.4-6.

(Figure for Response to Comment No. A35)

While there are not substantial differences among any of the five routes, we favor routes 1, 2, or 3 because they are not located adjacent to Sand Lake Road. This avoids having to relocate Sand Lake Road and eliminates any potential adverse impact on traffic use of the road. Of these three routes, we prefer route 1 as proposed in EIR Chapter 1.0.

Alternative routes 1 and 2 are aligned to maximize the use of existing corridors. The proposed route and Alternatives 2 and 3 are each projected to effect a maximum of 0.5 ha (1.3 acres) of wetland vegetation. The proposed route also has a greater probability of impacting waterfowl use of Skunk Lake than either Alternatives 2 or 3. Alternative routes 2 and 3 cross wetland F11 at the same location and the total wetland disturbance is the same over the entire length of both alternatives. Construction of the proposed route would disturb wetland F11 at two locations on its perimeter, whereas Alternatives 2 and 3 cross this wetland and would divide it into two segments connected by culverts (see attached EIR Figure 3.4-6). Alternatives 2 or 3 would have a greater effect on the hydrologic functions of wetland F11 than would the proposed route. If there is additional evidence to support one of the alternatives, we would review and discuss it further with the DNR to ensure that the route selected has the least impact on the environment.

Comment No. A36 (Comment #24)

Localized pumping of the overburden aquifer appears to be under active consideration by Exxon. If so, this proposal should be discussed in the appropriate sections of the EIR and mining plan with greater detail on pumping rates, mine inflow control and excess water discharge.

Response:

Although overburden pumping is a possible method of mine dewatering, we are not actively considering using this method in the current design of mine operations.

Comment No. A37 (Comment #29)

Please discuss the alternative of installing a second tailings transport pipeline as a backup system.

Response:

During preliminary engineering studies for the tailings transport system, we considered a backup tailings pipeline. However, based on continuing study and planning of the system a single pipeline was selected. The design and construction procedures proposed for the tailings transport system reduce the risk of an unplanned shutdown to such a low level that the additional cost of a backup system is not justified. The design and installation procedures are more comparable to an underground water transmission line installation rather than a conventional tailings transport line laid above ground. These procedures reduce the susceptibility of the tailings transport line to damage or failure. If a failure would occur, operations would be interrupted for the repair period. Repair materials will be stockpiled and procedures established prior to operations to ensure repairs are made as expeditiously as possible to minimize environmental impacts.

An increase in pipeline length over that currently being proposed would increase the overall probability of a leak. Even though a backup pipeline would only be used in the event of failure in the main line, it would double the pipeline length and likewise increase the potential risk of failure.

Comment No. A38 (Comment #33)

Will the synthetic membrane system alternative require a 6 inch bentonite liner? Also, no seepage collection systems are included for alternatives 2 and 3. If seepage collection systems are components of these alternatives, the cost estimates should be modified accordingly.

Response:

The three liner systems discussed in the earlier response to comment No. 33 were not presented for purposes of directly comparing one system to another. The first liner system was proposed for seepage control in the tailing ponds (underdrain plus bentonite modified soil liner); the second was proposed for use in the water reclaim ponds (bentonite modified soil liner beneath a membrane liner); and the third system was a 1.5 m (5 feet) thick native clay liner that could be used in either application.

The use or function of a pond is a key factor in the selection of a seepage control system. For example, if there is no requirement to actually maintain water in the pond (i.e., the tailing ponds as opposed to the water reclaim ponds) and if the water can be effectively removed, then removing water from the pond becomes a primary means of ultimately controlling seepage. In that case, a combination underdrain and liner system becomes the best overall system. The underdrain, as used in the tailing ponds, is the drainlayer overlying the liner which collects and removes water leaching from the tailings, thereby removing the pressure head on the liner and reducing the quantity of water which could seep through the liner.

For a pond designed to contain water, such as the water reclaim ponds, the primary liner must contain the water, so there is no use for an underdrain component similiar to the concept used in the tailing ponds. However, for a water containing pond, use of a secondary liner for added protection to the primary liner assures minimal risk in the event of primary liner failure.

Using the data presented in the response to comment No. 33, the following alternative seepage control systems for use in a tailing ponds are estimated to cost:

1) <u>Bentonite Modified Soil Liner and Underdrain Seepage Control System (the proposed system)</u>

a.	0.15 m (6 inch) thick bentonite modified till liner - (4 percent bentonite)	-	$0.29/ft^2$
b.	0.46 m (18 inch) thick underdrain layer of processed till	-	$0.31/ft^2$
c.	0.46 m (18 inch) thick filter layer of unprocessed till	-	$0.10/ft^2$
	Total cost	-	$0.70/ft^2$

2) <u>Membrane Liner and Underdrain Seepage Control System</u>

a.	synthetic liner - 36 mil Hypalon	-	$0.55/ft^2$
b.	0.46 m (18 inch) thick underdrain layer of processed till	-	$0.31/ft^2$
c.	0.46 (18 inch) thick filter layer of unprocessed till	-	$0.10/ft^2$
	Total cost		$0.96/ft^2$

3) <u>Native Clay Liner and Underdrain Seepage Control System</u>

a.	1.5 m (5 foot) thick native clay liner hauled from Fence area in Florence County	-	$3.70/ft^2$
b.	0.46 m (18 inch) thick underdrain layer of processed till	-	$0.31/ft^2$
c.	0.46 m (18 inch) thick filter layer of unprocessed till	-	$0.10/ft^2$
	Total cost	-	$4.11/ft^2$

However, in these alternative seepage control systems the important component is the underdrain. When the underdrain performs its function of reducing the pressure head (i.e., by collection and removal of water) acting to cause seepage through the liner, then the primary factor causing seepage has been eliminated and minimal seepage will have been achieved.

APPENDICES

Comment No. A39 (Comment #A4)

Attachment number A2 does not provide data from Northern Lakes Services. Please provide these data if they are available.

Response:

Mr. Ronald Krueger, Northern Lakes Services has conducted a complete search of their files and no additional Duck Lake data are available. EMC has provided DNR with all of the available Duck Lake water quality data.

CHAPTER 1

Subsection 1.1.2.3 Project Schedules

Comment No. 1

The EIS indicates that over 4 years are required to construct the mine and mill complex, about 3 years to reach full production, and 26 years of operation. The Future Conditions Report, however, indicated an operations life of 21 years. Please explain why the estimated operation life was shortened by 5 years. Are the other schedules accurate? Will the operating duration change result in any project construction or operation changes?

Response:

The current Project basis and plan are:

1) A construction period of about 3-1/2 years;

2) A mine production buildup period of about 3 years to full production -- 1 year during the construction phase (1989) and 2 years during the early operation phase (1990-1991); and

3) A full production period (operation phase) of about 20 years.

The 20 year full production period represents our current plan based on revised mine ore reserve calculations of 68.7 million metric tons (75.7 million short tons). The 26 year full production period in the EIR contained a contingency factor to allow for a larger ore reserve and processing more ore than the current estimate. The 20 year full production period contains no contingency.

The current Project basis and plan supercede all previous schedules. The operating duration change has no effect on other Project construction or operations plans. EMC will provide a Project basis and plan schedule in March 1984.

Section 1.2.1.2.1 Main Shaft

Comment No. 2:

Construction of the main shaft will require blasting of consolidated bedrock material for the proper placement of the shaft collar and headframe foundation. Discuss the potential for bedrock fracturing during blasting which could increase the rate of ground water flow into the mine. Will grouting be capable of minimizing these inflows?

Response:

Shaft advance by drill-blast-muck methods is anticipated to produce a 10 percent overbreak in the bedrock beyond the design rib "neat" line. The overbreak rock material will be removed during the normal course of rib scaling and mucking cycles. Beyond the overbreak boundary, it is anticipated that a zone about 0.5 to 1 m (1.6 to 3.3 feet) thick will be loosened by blasting, reflecting an increase in aperture of existing discontinuities. Undisturbed rock will be present beyond the loosened zone.

Temporary "construction" support estimates include the use of grouted rock bolts, approximately 2.7 m (9.0 feet) in length, placed in a 1.2 m (4.0 feet) center to center pattern. The temporary support will probably be located within 4 m (13.1 feet) of the shaft bottom and is expected to maintain the integrity of the loosened zone and minimize further loosening with time.

Tentative construction plans indicate that the final support will probably consist of slipform concrete which will be located approximately 15 m (50 feet) behind the advancing shaft bottom. The concrete will be placed against the rock rib generally without voids between the rock and concrete.

Pressure grouting will be employed to control point sources of ground water inflow which are large enough to hinder sinking operations. Grouting as a general practice is not anticipated to be necessary below the interface of the shaft collar, bedrock and overburden. This is primarily a result of the clay filling of discontinuities in the weathered rock zone which extends from 18 to 30 m (59 to 98 feet) below the overburden-bedrock contact. Also, the bedrock displays a general and a rapid reduction in fracture frequency and discontinuity aperture, respectively, with depth.

The loosened zone around the shaft is expected to perform somewhat like a thin sand backfill for a standpipe piezometer installed in clay. Water will migrate from the intact rock zone to the loosened zone and drain towards the shaft bottom or behind the final support. However, the amount of migrating water will depend upon the amount of water in the intact rock zone, which is expected to be small, based on packer test results.

Also see subsection 1.3.1.4.2, Shafts and Collar, in the construction section of the EIR.

Section 1.2.1.2.4 Stopes

Comment No. 3

Supergene weathering of the hanging wall and the Crandon formation has created a very deep weathering slot that extends as deep as 230 m. Figure 1.2-4 indicates that mining will occur between 140 m. and 230 m. Describe in greater detail the precautions that will be taken to minimize groundwater inflows and mine gallery collapse in these weathered bedrock areas.

Response:

The EMC response to EIR comment No. 61 in the May 11, 1983 DNR letter describes in detail the precautions that will be taken to minimize ground water inflows.

Exploratory diamond drilling techniques will be employed to identify active water courses prior to advance of the mine face. Flows encountered on the uppermost mine level will be captured in interceptor drill holes and contained to avoid contamination by the mining processes at levels below.

Mine water control drifts will be developed ahead of production entry in the upper mine areas to maintain the ability to intercept ground water prior to contamination and entry into the active mining areas. Ultimately, the ground water interceptor system would function as shown on the conceptual Mine Inflow Control cross-section (see attached figure). Cement grouting of rock may be used for local inflow control or diversion.

As the mine progresses upward from the 230 m level, the required mine water control drifts will simply be normal production access drifts developed prematurely and dedicated for exploration and interception of ground water.

The exploration diamond drill holes, in fact, become part of the ground water interception system. As is common practice in other mines, the diamond drill hole collars will be packed and fitted with pipe connections.

Support of the mine workings in these areas is not expected to present any major problems. Rock strength in the weathered zone that will be mined is expected to be in the range of 5,000 to 10,000 psi. The planned mining methods for the upper portions of the mine (modified cut and fill) have been developed with the recognition of lower rock strength. These mining methods will maintain the overall rock mass integrity and prevent the collapse of the mine entries.

Section 1.1.3.6 Requirements for Governmental Service

Comment No. 4

Could sludge from sewage treatment be disposed in the tailings pond or on site as a fertilizing amendment?

Response:

There are no plans for disposal of sewage sludge in an operating tailings pond or as a soil fertilizing amendment. We believe disposal in a facility specifically designed for that purpose, and handled by personnel specifically trained and experienced in that activity is the proper method for disposal of this material.

Section 1.2.1.2.14 Fuel Handling and Storage

Comment No. 5

Will the fuel handling storage facilities in the mine have a liner as well as retaining walls to contain spilled fuels? How will spilled fuels be collected and disposed/recycled? What equipment will be used and will each level with a fuel storage area have this equipment available?

Response:

As specified in the EMC response to Mining Permit Application comment No. 44 in the October 10, 1983 DNR letter, the floors of the fuel spill retention areas will be bedrock behind the cement retaining walls. Spilled fuel will be collected with a sump pump, filtered, and recycled to the fuel tank. Two fuel stations will be located underground on the 350 m and 695 m levels. These stations will contain the same equipment which includes: (1) 1 -

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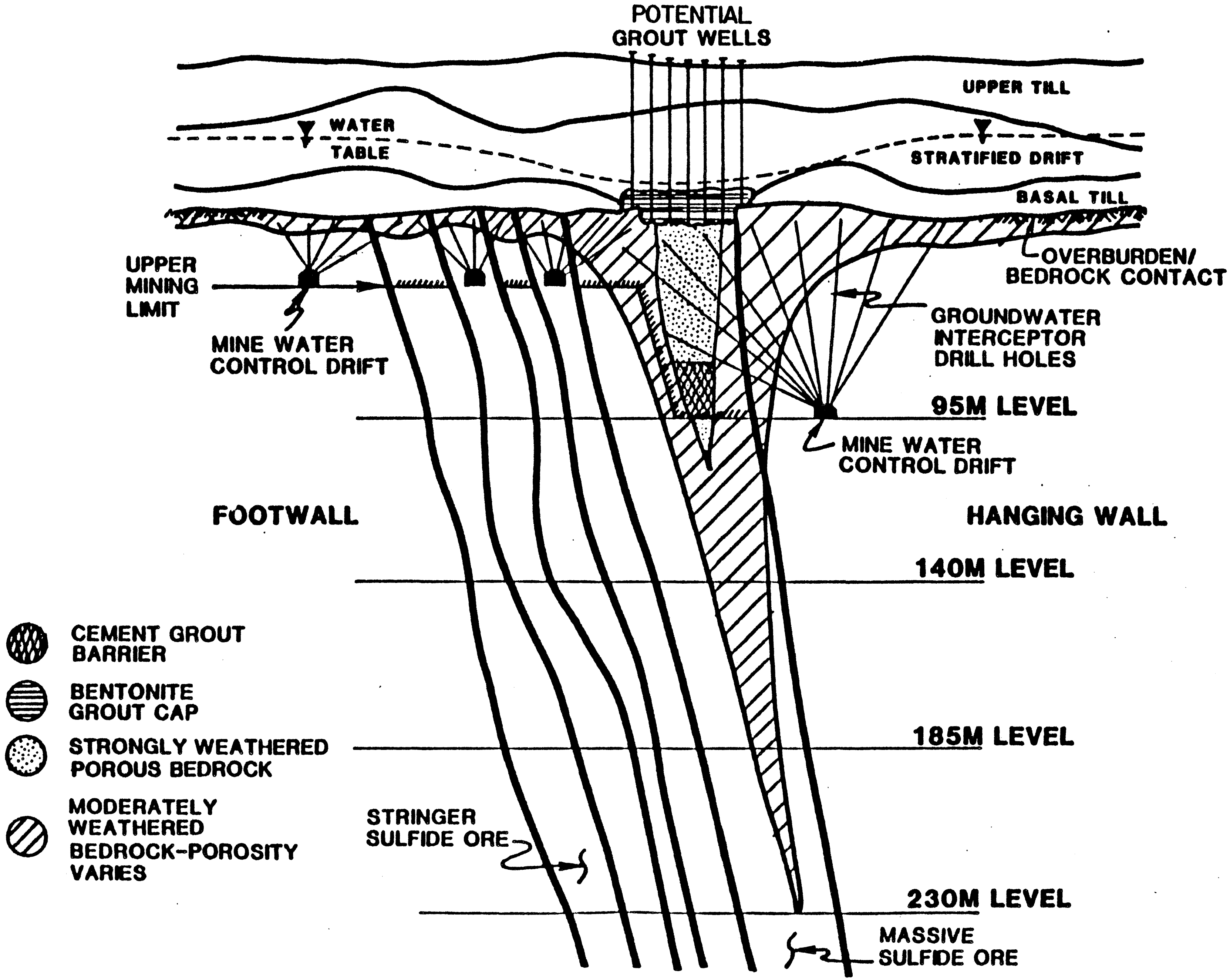
MINE INFLOW CONTROL METHODS

(CONCEPTUAL X-SECTION)



(Figure for Response to Comment No. 3)

4,000 gallon tank; (2) fuel pump, valving, and piping; (3) sump pump, valving, and piping; (4) foam generator for fire suppression; and (5) fire doors and sensors.

Section 1.2.2.3 Concentrating

Comment No. 6

The EIR states that "floors will drain to separate sump pumps which return the various product spills to appropriate feed points". Will there be general floor drains to remove cleanup or rain waters that enter the building? Will spilled material be recyclable without treatment?

Response:

The sump pumps used to handle any spills will also be used for general clean-up. Sumps have not been provided specifically for rain water; the building is designed to prevent entrance of precipitation. Spilled material can be recycled without any treatment; this is common practice in mineral processing plants.

Section 1.2.2.10 Spill Control Facilities

Comment No. 7

What capacity will the spill control surge tank have? If multiple spills occur for different process lines can the materials be safely mixed? If recovered spills cannot be recycled where will they be stored pending disposal?

Response:

The spill control surge tank referred to in subsection 1.2.2.10, Spill Control Facilities, was intended for spills in the reagent preparation area. Current engineering does not incorporate the concept of using a common tank to collect all liquid reagent spills so the spill control surge tank has been deleted. Rather, curbing will be provided around the reagent mixing tanks. Any spills will be confined within the curbing for a given mixing tank. If multiple spills were to occur, they could not mix with each other. Spills will be collected in a blind sump provided within each curbed area. The spill will simply be pumped back into the respective mixing tank using a portable sump pump. Available details for the reagent preparation areas have been provided to the department.

There will be four process lines in the concentrator:

1) Grinding stringer ore and flotation for copper recovery;

2) Grinding massive ore and flotation for copper and lead recovery;

3) Copper-lead separation and lead upgrading; and

4) Zinc flotation.

The sump system is designed to keep potential spills from these areas separated. Allowing spills to mix would not be a safety hazard; however, from the standpoint of process control it is not desirable.

There is no reason that process slurry spills cannot be recovered and pumped back into the process. There is also no reason why reagent spills cannot be recovered for use as intended.

Section 1.2.4.2 Access Road

Comment No. 8

The EIR states that the access road will be two paved lanes (12 feet each) with 8 feet shoulders. For the projected traffic load (600-780 vehicles/day) two paved lanes (11 feet each) with 6 feet shoulders should be adequate.

Response:

During the preliminary engineering design work for the access road, consideration was given to a lower design class or standard for the roadway. An 11-foot paved lane and a 6-foot shoulder width would be the next lower standard. However, the higher standard affords some safety and operating improvements that are worthwhile but admittedly are difficult to quantify.

In winter weather additional roadway and shoulder width improves snow plowing operations and ability to maintain an open road. Also, with a stalled vehicle or an accident, traffic can be more easily maintained with the wider road. While these considerations would be less important for other roads with our traffic load and more normal traffic patterns, most of our traffic will occur during the three shift changes each day. An interruption to traffic flow during one of the shift changes might affect operations. During final engineering of the access road, the lane and shoulder widths will again be considered.

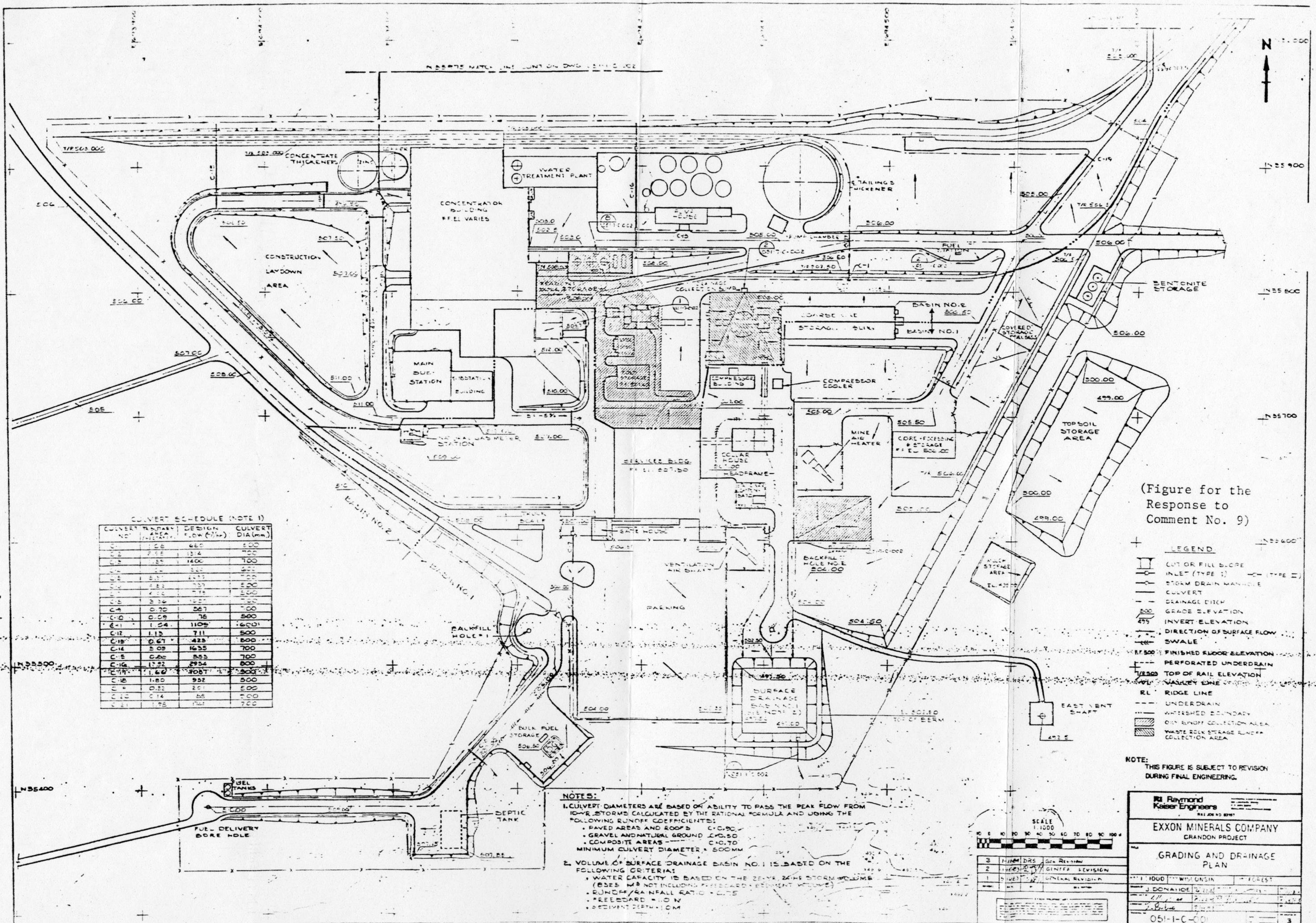
Section 1.2.4.3 Parking and Gate House

Comment No. 9

Describe in greater detail the two water retention basins on the site. If basin siltation requires dredging, where will the dredged materials be dumped? Estimate the quality of the water leaving these basins. To which streams will this water flow?

Response:

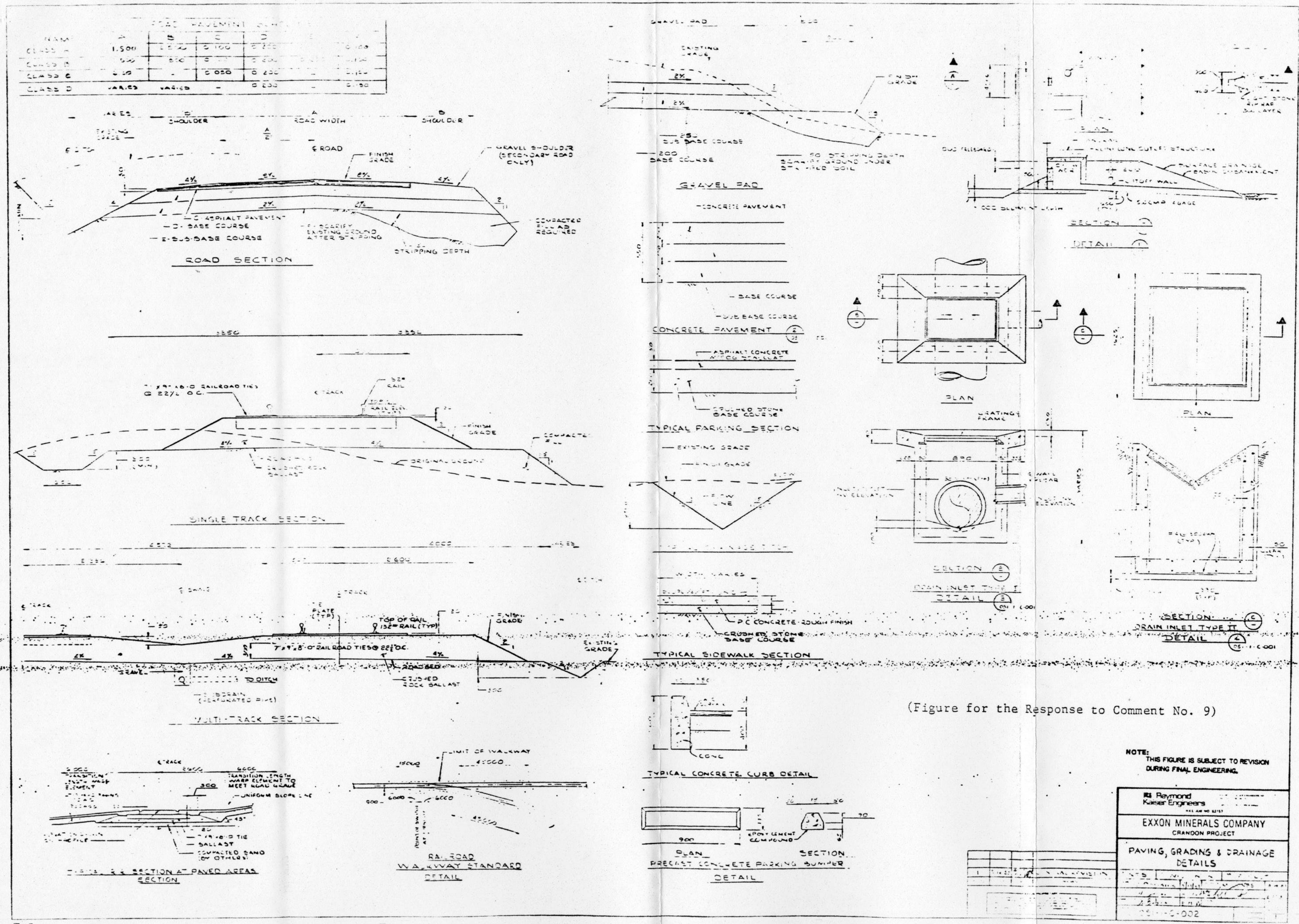
The three attached figures show the current mine/mill site layout, including the locations of the two water drainage basins used for collection, retention, and release of all uncontaminated surface waters in the mine/mill area. Details of the drainage basins and the other surface water drainage facilities, the drainage area for each basin, and the basin sizing criteria are all included on the figures. These figures are subject to revision during final engineering.



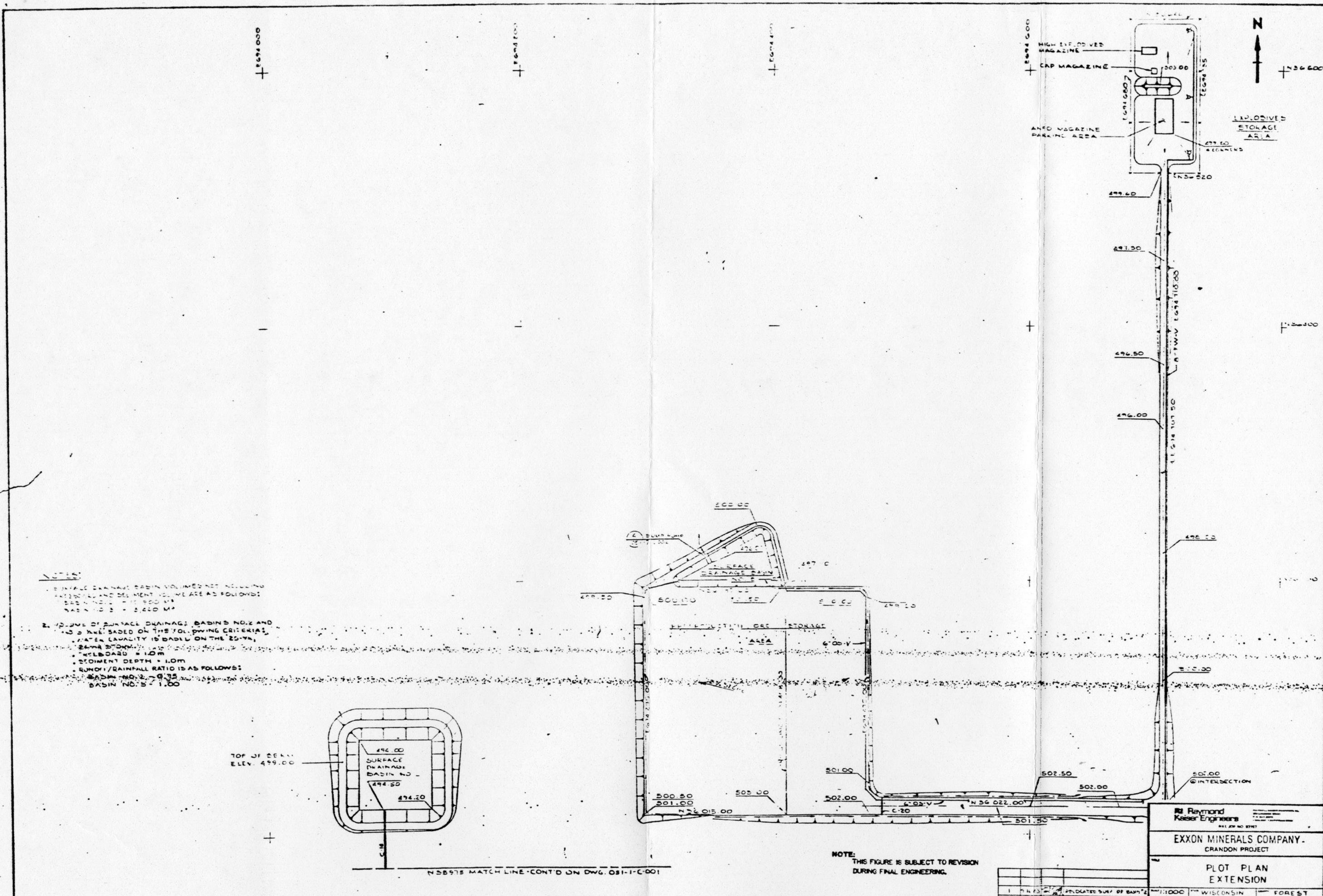
CULVERT SCHEDULE (NOTE 1)

CULVERT NO.	TRIBUTARY AREA (HECTARES)	DESIGN FLOW (m³/hr)	CULVERT DIA (mm)
C-1	1.08	660	500
C-2	7.95	1314	700
C-3	1.59	1400	700
C-4	[illegible]	[illegible]	600
C-5	[illegible]	[illegible]	700
C-6	4.82	737	500
C-7	[illegible]	[illegible]	500
C-8	3.36	[illegible]	700
C-9	0.70	567	700
C-10	0.09	76	500
C-11	1.54	1109	600
C-12	1.15	711	500
C-13	0.67	423	500
C-14	3.09	1635	700
C-15	0.60	553	700
C-16	17.92	2954	800
C-17	1.66	4087	900
C-18	1.80	952	500
C-19	0.32	201	500
C-20	0.14	58	500
C-21	1.95	1744	700

(Figure for the Response to Comment No. 9)



(Figure for the Response to Comment No. 9)



(Figure for the Response to Comment No. 9)

If the basins collect sediment in excess of their design, the sediments will be removed (excavated) and hauled to the topsoil stockpile or one of the soil material stockpiles at the MWDF. Separate basins (e.g., surface drainage basin No. 3) are provided in the mine/mill site to collect and transfer for treatment any surface waters that could potentially be contaminated from mining operations.

Except for possible contaminants from parking lots and roadways and slightly higher suspended solids content, the surface runoff water quality should be comparable to current surface drainage water quality in the site area.

Water from drainage basin No. 1 will be discharged to the south of the mine/mill site into wetland F11 between Skunk and Little Sand lakes. Ultimately, this water would enter Little Sand Lake.

Basin No. 2 will discharge surface water into wetland P2 north of the mine/mill site. Ultimately, this water would enter Swamp Creek.

Section 1.2.4.5 Combustible Storage Building

Comment No. 10

What measures will be taken to contain, control, and clean up spills (e.g. contingency plans, liners, berms, recycling, disposal, safety equipment)?

Response:

Combustible materials will be stored in a separate building now designated as the lubricant storage building. Lubricants, paints, and cleaning materials for the mine and mill will be stored in this building. The building floor will be concrete without floor drains. There will be no long-term storage of large quantities of these materials. the building and contents will be inspected daily and any spills will be cleaned manually as required.

Section 1.3.1 Facilities Construction

Comment No. 11

Please provide a list of nonmetallic minerals needed for construction purposes. This would include gravel for all road and facility construction, the ballast for the railroad spur, and materials for road/facility surfacing. Include the processing plants associated with these activities if appropriate, and indicate quantity of materials needed, estimated cost, and likely source.

Response:

The primary nonmetallic minerals needed for construction of the Crandon Project along with estimated quantities and costs are summarized below:

Item	Quantity	1982$/Unit
Concrete (includes surface and underground)	46,900 m^3	34.40
Base Course (includes access road and in-plant roads)	24,400 m^3	6.68
Subbase (includes access road and in-plant roads)	28,800 m^3	3.92
Asphalt Pavement	7,400 m^3	29.73
Railroad Ballast (includes spur and siding)	37,900 t	3.86
Railroad Subbase	12,400 t	3.92
Bentonite	7,700 t	117.16

Sand and aggregate for the above items could be supplied from a number of local sand and gravel pits. The bentonite to be used primarily for the MWDF probably will be obtained from out of state and will be delivered by rail tank cars.

Two separate batch plants will be used on or near the Project construction site. Descriptions of the batch plants and their estimated air emissions have been included in the air permit application. The first, a temporary concrete batch plant, will be located to the southeast of the main shaft. This facility will provide most of the concrete for the surface buildings and for underground mine construction.

A second processing plant will be located in the tailing ponds construction area. This batch plant will mix the bentonite with native soils to provide liner material for the tailing ponds, reclaim water ponds, and the temporary ore storage pad.

Section 1.3.1.3 Access Road Construction

Comment No. 12

Please provide additional details on access road construction activities including topsoil stockpile areas, location and design of erosion control methods such as sediment basins, and deposition of peat removed from wetlands.

Response:

Existing topsoil will be stripped and saved from all cleared and grubbed areas along the access road right-of-way. Based on preliminary engineering for the access road, approximately 12.1 ha (29.9 acres) of right-of-way will be cleared and grubbed. Assuming a depth of suitable topsoil of 0.15 m (6 inches) throughout the cleared area, a total volume of 18,150 m^3 (23,700 cubic yards) of topsoil would be available for stockpile and reuse. Suitable areas along the right-of-way would be chosen to temporarily stockpile the topsoil. If temporary protection (control of surface water runoff) was required, it would also be provided.

Construction of the access road includes topsoiling, fertilizing, and seeding of all disturbed areas along the right-of-way. Most salvaged topsoil will be applied to the road side slopes prior to seeding. However, at the completion of access road construction any unused topsoil will be hauled to the permanent topsoil stockpile at the mine/mill site.

The plan and profile and detail drawings from the plan set of preliminary engineering drawings for the access road depict the entire alignment from STH 55 to the mine/mill site interface point (see Attachment No. 10 included with the response to EIR comment No. 129 in the DNR's May 11, 1983 comment letter). Drainage structure locations, typical sections showing revegetation, and settling basin details are included. The plan sheets also show the approximate slope intercept lines along the entire route, including limits of revegetation after construction. These drawings are subject to revision during final engineering.

Locations of the temporary erosion control facilities to be utilized during construction, such as the straw bale or filter fabric silt traps and the sheet piling at the Swamp Creek crossing, will be determined during final engineering. These temporary facilities will be subject to further minor adjustments in the field depending upon actual conditions and performance.

The total estimated amount of wetland soil materials removed along the access road during construction is approximately 4800 m^3 (6275 cubic yards). No separate estimate of peat materials within this volume has been made. These soil materials will be used as a top dressing on the roadway side slopes outside the edges of the aggregate base course.

Section 1.3.1.9 Railroad Construction

Comment No. 13

Please provide additional details for railroad construction and associated activities, including topsoil stockpile location, retention basin details, and deposition of wetland organic soils.

Response:

The construction activities planned for the railroad spur are similiar to those for the access road. In the preliminary engineering work for the railroad spur, an estimated 13.6 ha (33.6 acres) will be cleared and grubbed within the right-of-way. Assuming 0.15 m (6 inches) of suitable topsoil throughout the cleared area, approximately 20,400 m^3 (26,700 cubic yards) of topsoil would be stripped and saved. In the preliminary engineering study an estimated 11,000 m^3 (14,400 cubic yards) of topsoil will be used during railroad spur construction for reclaiming disturbed areas and embankment or cut slopes. Any excess topsoil will be relocated to the topsoil stockpile at the mine/mill site.

The permanent drainage and erosion control structures for the railroad spur are shown in the plan and profile and detail drawings (see Attachment No. 10 included with the response to EIR comment No. 129 in the DNR's May 11, 1983 comment letter). The temporary erosion control measures will include the same measures as suggested for the access road construction (see response to comment No. 12). Tentative locations (subject to final verification in the field at the time of construction) for the temporary erosion control facilities will be established during final engineering for the railroad spur. Also, depending upon actual performance of the temporary facilities, modifications may also be made in the field.

Wetland soil materials excavated for construction of the railroad spur will be used as top dressing along the railroad spur embankment or cut side slopes. For the railroad spur the volume of wetland excavation was estimated to be 12,700 m^3 (16,600 cubic yards).

Section 1.4.2.3 Ventilation and Air Heating

Comment No. 14

How will controlled amounts of clean air be withdrawn for each level?

Response:

Early mine development will be performed with air being supplied from the surface through ducting to each active heading. In-line fans will be used to establish the required air volume necessary to remove combustion products produced by diesel engines and detonation of explosives. Similar methods of air movement will be used for heading advance after primary ventilation circuits are operational.

Movement of air down the main and intake air shafts will be accomplished by operation of the main mine exhaust fans located on the surface at the east and west exhaust raises. The intake shafts will act as common free splitting plenums; each level in the mine will receive a predetermined volume of air necessary to conduct work activities on that level. Mine level air splits will be achieved with the aid of "regulators" (used on levels nearer the surface), air doors, and booster fans (required for those levels farthest from the air flow created by the main mine exhaust fans). These devices or combination of devices will be located at the primary exhaust points of each level.

A "regulator" is simply a device which restricts flow and induces the air along its path of least resistance. In an operating mine a regulator is a blockage (bulkhead) in an airway with an adjustable opening. The opening is adjusted as required to accommodate changes in the required mine air movement.

Air doors are large doors which physically separate sections of the mine while allowing passage of large mining equipment via mechanical opening and closing methods. Generally, air doors are installed in pairs to form an air lock and to minimize leakage.

Booster fans are used as energy additions to a mine ventilation system. Generally they are found in locations most distant from the main mine exhaust fans. These types of fans are much smaller in size than the main surface units and act in conjunction with them. Location of these units will generally be the same as for the regulators.

The use of these devices serves to control and direct air movements on each mine level. The underground environment is constantly changing with the relocation of primary work areas. Acceptable air movement conditions will be achieved through constant attention and monitoring by mine management.

The planned techniques for ventilation control are those in common use throughout the industry for underground mining. These techniques have been refined and proven through many years of use by the industry.

Section 1.4.7 Operations Traffic

Comment No. 15

This section estimates a total of 623 vehicles used to transport 782 operations workers on a daily basis, with an occupancy rate of 1.25 persons per vehicle. In section 1.3.3.4 on construction traffic, only 550 vehicles are needed to transport over 1,450 construction workers and staff in the peak year of construction. Please explain why fewer vehicles would be needed for a greater number of workers during construction than during operations.

Response:

The Socioeconomic study report entitled, "Forecast of Future Conditions" provides an early estimate of vehicle traffic for the construction and operation phases of the Project. Based on an occupancy rate of 1.6 persons per vehicle and approximately 1,400 employees during the peak construction year, an estimated 875 vehicles would be required to transport these people to and from the mine/mill site. The number of employee vehicles currently estimated for the operation phase with 703 employees is approximately 440 (703/1.6).

Section 1.5.1 Facilities Removal

Comment No. 16

The EIR states that drifts, raises, and shafts will not be backfilled. Why shouldn't they be filled with tailings and plugged with concrete or bentonite to minimize surface subsidence and maximize the amount of waste rock returned to the mine? What is the volume of mine drifts, raises and shafts that would not be backfilled? How does this compare with the volume of the stopes which will be backfilled?

Response:

During the operational life of the mine and mill, an attempt will be made to maximize the amount of material returned underground to be used as fill. However, at the completion of the milling operation the current plan is to reclaim the tailings that have been deposited in the tailing ponds. Consideration of several factors have led to this decision.

First, not all of the tailings could be returned underground. Through the mining and milling process, the density of a cubic meter (1.30 cubic yards) of rock decreases from 3.32 t/m^3 (2.80 short tons per cubic yard) to a tailings density of 1.73 t/m^3 (1.46 short tons per cubic yard). This is approximately double the volume of space required for disposal of the tailings compared to the mined ore tonnage.

Second, the amount of tailings that could be readily accessed would be limited to those contained in the last active pond. The tailings in the other ponds would have been reclaimed in previous years.

Third, to move the tailings from the disposal ponds to the mine would require repulping of the tailings. This would be done by mechanical agitation and/or by the use of water jets. Both of these methods have the potential to disrupt the liner system.

Finally, there is an additional cost to remove and transport the tailings from the disposal ponds to the mine. For these reasons tailings in the final pond will be reclaimed and not backfilled upon completion of mine and mill operations.

The total volume of excavation underground, including ore and waste rock, will be approximately 23.3 M m^3. Of this volume, approximately 21.3 M m^3 will be backfilled during mine operation, leaving less than 10 percent of the mine entries open after mine closure.

The question of surface subsidence has been addressed in the response to comment No. 54 of the DNR's earlier comments on Chapter 1.0 of the EIR (EMC letter dated October 3, 1983) and again in the response to comment No. 41 of the comments on the Mining Permit Application (EMC letter dated November 11, 1983).

CHAPTER 2

Section 2.4.1.2 Stream Flow Rates

Comment No. 17

There are a number of streams which may be impacted by lowering the groundwater potentiometric surface. However, the information presented in the EIR does not indicate the maximum worst-case scenario if mine inflow is greater than 2,000 gpm. When this information is available, we will be able to determine whether additional streams may be impacted. An example of streams which could be impacted are the five unnamed streams tributary to the north and east sides of Rolling Stone Lake. Three of these contain brook trout populations and are Class I trout streams. For these or other streams within the ultimate groundwater drawdown zone of influence, we may require water quality, low flows, and biotic data gathering as necessary to document premining conditions.

Response:

We believe that the analysis presented in the EIR of the impacts of the mine inflow of 0.126 m^3/s (2,000 gallons per minute) is an accurate assessment of the worst-case scenario. We are currently working with the DNR in securing additional data and performing additional analyses to verify the maximum extent of potential ground water impacts from mine operation. The results of this activity should address the concerns stated in this comment.

Comment No. 18

For all streams within the area potentially impacted by mine dewatering, low flows (7-day Q_{10}) must be determined. Please include information on how stream low flows are determined. Low flow information is required to adequately assess the potential drawdown impacts on these streams. The analyses of flow reductions based on average total flow or average base flow are inadequate.

Response:

Extreme stream low flow estimates (Q7,10) were completed for nine locations in the Crandon Project environmental study area (Golder Associates, 1982). All of these locations are within the Swamp Creek and Pickerel Creek drainage basins and are shown on EIR Figure 2.4-1.

Q7,10: The Q7,10 (7 day - 10 year recurrence) extreme low flow discharge rate is defined as that average statistical low flow rate over a 7 day period for which the flow will be less than an average of once in 10 years (10 year recurrence) (Gebert and Holmstrom, 1977).

Stream Low Flow Periods: Two stream low flow periods occur annually in the Crandon Project environmental study area. The annual extreme low flow period occurs during late summer (August through September). The winter low flow period occurs between late November and early March and is virtually all base flow. The annual seven consecutive day extreme low flow period may be determined by comparing the daily variations in stream flow exhibited during annual low flow periods. Periods with relatively constant flow rates are controlled by base flow, while periods with variable flow rates show that relatively constant base flow is augmented with surface runoff.

Inspection of the flow records of the USGS maintained stream gage on Swamp Creek at STH 55 (August 1977 to 1983) indicated that while the extreme low flow occurs during late summer, the winter period low flow (late winter/early spring) is virtually all base flow. This was based on the daily flow variation in the late summer and the near constant flow during the late winter. Therefore, the 7 day, 10 year low flow estimates were prepared considering flow during the entire year.

Methodology: The annual low flow analysis was performed using the USGS procedures and equations presented in Holmstrom (1980) which use the longer stream flow records of surrounding basins. The procedures are considered to be applicable in Forest and Langlade counties (Golder Associates, 1982). Equations are presented which allow estimates of the 7 day, 10 year low flows to be made based on watershed characteristics. Holmstrom (1980) presented a correlation procedure for both ungaged basins and for basins with limited stream flow data. Details of this application are presented in Golder Associates (1982). The attached table presents the results of this analysis.

References

Gebert, W. A. and B. K. Holmstrom, Low Flow Characteristics at Gaging Station on the Wisconsin, Fox and Wolf Rivers, Wisconsin, U. S. Geological Survey, Water Resources Investigation 77-27, June 1977.

Holmstrom, B. K., Low Flow Characteristics of Streams in the Menominee-Oconto-Peshtigo River Basin, Wisconsin, U.S. Geological Survey, Open File Report 80-749, August 1980.

Golder Associates, Inc., Geohydrologic Site Characterization, Exxon Minerals Company, Crandon Project, Chapter 5 - Surface Water Hydrology, pp. 50-79, Atlanta, Georgia, 1982.

Section 2.5.2.1 Drainage Lakes and Associated Streams (Aquatic Ecology)

Comment No. 19

Page 2.5-37, - Baetis, in particular, is a very common mayfly in Swamp Creek that was not identified to species. Because of the numerical importance of this genus, species identifications should be made. As a general guideline, species identification should be made on all future Exxon benthos specimens, when possible, with the exception of biotic index samples which may not require species identification for tolerance assessment.

Response:

During the 1983 Swamp Creek Aquatic Monitoring Program, Baetis pygmaeus was identified at Stations 3, 4 and 5 in macroinvertebrate collections to determine Hilsenhoff's biotic index values. No other mayfly species of this taxon was identified, which is consistent with NCD-DNR identifications completed to date (February 1, 1984) in samples from Swamp Creek (personal communication from R. Young NCD-DNR to H. Lewis, EMC). The final report of the 1983 Aquatic Monitoring Program will be provided to the DNR within 60 days.

During the pre-construction aquatic monitoring program, all benthos identifications of numerically important species will be to the lowest positive taxonomic level. We acknowledge the comment that biotic index samples may not require species identifications for tolerance assessment.

(Table For Response to Comment No. 18)

Statistical Extreme (Q7,10) Low Flow Analysis Results

Station or Location	Estimated Annual (Q7,10) m^3/s	Estimated Annual (Q7,10) cfs
Swamp Creek Drainage Basin		
Swamp Creek at County Road K (USGS)	0.895	31.55
Swamp Creek at County Road M Below Rice Lake (USGS)	0.45	16
Swamp Creek at Highway 55 Above Rice Lake (USGS)	0.34	12
SG 3 on Swamp Creek below confluence of Outlet Creek	0.319	11.27
Swamp Creek below confluence with Hemlock Creek (ungaged)	0.028	1.0
SG 6 on Hemlock Creek below Ground Hemlock Lake	0.008	0.29
Pickerel Creek Drainage Basin		
SG 19 on Pickerel Creek into Rolling Stone Lake	0.015	0.53
SG 23 on Creek 12-9 into Rolling Stone Lake	0.016	0.56
SG 22 on Pickerel Creek at East Shore Road	0.097	3.44

Section 2.5.2.1 Drainage Lakes and Associated Streams (Aquatic Ecology)

Comment No. 20

With regard to Table 2.5-13, the practice of "lumping" or "splitting" taxonomic groups for data presentation affects our ability to review and compare data sets. If many taxonomic groups are "lumped" as in Table 2.5-13, it makes DNR's verification of the data cumbersome and time consuming. Rather than requiring a complete remake of this and other similar tables, please send raw data and/or unpublished copies of the necessary data for review purposes.

Response:

We recognize the inherent problems associated with summary tables and their limitations for comparison with other data sets. However, to minimize the number and length of tables used in EIR Section 2.5, it was necessary to consolidate and summarize the raw data sheets rather than present the detailed genus and species classification and enumeration data. The raw data that provided the basis for Table 2.5-13, as well as for other macroinvertebrate tables presented in Section 2.5, are presented in Appendix 2.5D. The data used in developing Table 2.5-13 are cited on EIR page 2.5-39; these are Appendix 2.5D, Tables D-58 through D-64. Classifications were completed in all cases to the lowest positive taxonomic category possible.

Section 3.5.6.1 Water Treatment Systems

Comment No. 21

Compare the expected quality of the sodium sulfate byproduct from the water treatment process with the commercially available sodium sulfate presently used in the paper making industry. If the reclaimed sodium sulfate is not of commercial quality please discuss the alternatives for purifying the sodium sulfate versus land disposal.

Response:

As a result of a telephone survey conducted in the spring of 1982, there are two sources of salt cake used by the Kraft mills in Wisconsin -- Saskatchewan Minerals in Chaplin, Saskatchewan, Canada and Green Bay Packaging in Green Bay, Wisconsin. The salt cake produced by Saskatchewan Minerals is from natural brines and a typical chemical analysis of this product is presented in the attached table.

Green Bay Packaging, a pulp and paper mill, is the only reported source of sodium sulfate within the state of Wisconsin. Green Bay Packaging produces a byproduct sodium sulfate, which is recovered from sulfide pulp waste liquor. This byproduct sodium sulfate is known in the trade as Copeland sulfate and is typically a mixture of sodium sulfate and sodium carbonate. Green Bay Packaging's Copeland sulfate is reportedly 79.4 percent sodium sulfate, 20.1 percent sodium carbonate, and 2.9 percent insolubles.

Salt Cake

CHAPLIN, SASKATCHEWAN, CANADA

TYPICAL ANALYSIS

CHEMICAL ANALYSIS

	%
Insolubles	.40
Moisture	0.00
$CaSO_4$	.06
$MgSO_4$	.25
Na_2CO_3	.06
$NaHCO_3$	.22
NaCl	.08
Na_2SO_4	98.93

pH 8.3-9.5

SCREEN ANALYSIS

Screen Number Tyler	Screen Number U.S.	Opening Size in Inches	% Retained
14	16	.0469	1.1
20	20	.0328	3.4
28	30	.0232	3.0
35	40	.0165	2.6
48	50	.0116	3.1
60	60	.0098	2.1
80	80	.0070	7.3
100	100	.0059	8.2
150	140	.0041	20.1
200	200	.0029	24.0
Pan (Thru 200)			25.1

Bulk Density 74-80 lbs./cu. ft.
Whiteness 60

This information is believed to be reliable but is not to be construed as a warranty or representation for which we assume legal responsibility. Users should undertake sufficient verification and testing to determine the suitability for their own particular purpose of the product described herein. NO WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE IS MADE.

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420 Lexington Avenue • New York, NY 10170
Phone: 212-972-6811 Telex: 7106613945

(Table for the Response to Comment No. 21)

The purity of sodium sulfate consumed in the chemical treatment of wood pulp in a Kraft mill is not well defined. It is normally based more on what is cheaply available. The expected quality of the sodium sulfate byproduct from the Project water treatment process for recycle is expected to be similar to that produced by Saskatchewan Minerals. Both recovery methods would use crystallization from sodium sulfate brines.

The processing steps will ensure a high purity, 99+ percent, sodium sulfate. The proposed post VCE brine treatment system, which includes brine soda ash softening, sodium sulfate crystallization and a wash centrifugation, has the inherent flexibility to achieve essentially any level of purity required.

Section 3.5.2 Process Alternatives

Comment No. 22

Due to the environmental hazards associated with the use of cyanide compounds please discuss the use of alternative reagents in the copper beneficiation process.

Response:

In the recovery of copper minerals from massive ore, sodium cyanide along with zinc sulfate and lime is used to control and prevent the activation and premature flotation of zinc minerals which would otherwise be a contaminant in the copper-lead bulk product. It also serves to depress the flotation of pyrite. The sodium cyanide is added to the process as a zinc cyanide complex $[Zn(CN)_4^{=}]$ which is formed in a mixture of sodium cyanide, zinc sulfate and lime. Hydrogen cyanide is not involved in the process. Cyanide is not required in the treatment of the stringer ore.

Researchers have been attempting to develop alternatives to sodium cyanide as a depressant or as a component of a depressant scheme. No reagent has been identified as a universal replacement for sodium cyanide. During the development of the process for treating the Crandon massive ore, many alternatives to sodium cyanide were investigated, none of which were sufficiently effective.

Sodium sulfite (Na_2SO_3) and sodium sulfide (Na_2S) were investigated as replacements for the sodium cyanide-zinc sulfate mixture. The combination of sodium cyanide-zinc sulfate allows for higher recovery of copper and lead while keeping the amounts of pyrite and sphalerite in the copper-lead rougher scavenger concentrate at a minimum.

The proposed processing flowsheets utilize the lowest practical amounts of cyanide.

Section 3.5.2 Process Alternatives

Comment No. 23

Briefly discuss the feasibility of heap leaching the tailings to enhance metal recovery.

Response:

Heap leaching of finely ground tailings from massive sulfide flotation is not practiced at any mining operation. Heap leaching of Crandon tailings is impractical for the following reasons:

1) Low residual metal value and complex mineralogy (e.g., copper, lead and zinc).

2) Insoluble nature of the copper, lead, and zinc remaining in the tailing; a strongly oxidizing leaching solution would be required;

3) Low permeability of the tailings which would allow for only very slow percolation rate of the leaching solution; and

4) Any solution resulting from the oxidative leaching of the tailing would be high in iron content but low in copper and zinc content; recovery of copper and zinc from this solution would be impractical, if not impossible.

Heap leaching is generally done on low-grade overburden removed during the open-pit mining of porphyry copper ores in the west and southwest regions of the United States. Some of these overburden materials contain recoverable amounts of copper as mixed oxides and sulfides and, in some cases, gold. Since the overburden material consists of blasted rock (i.e., not ground to a fine size like flotation tailings), it has a permeability suitable for leaching. The Crandon Project is an entirely different situation and heap leaching of tailings is not planned.

CHAPTER 3

SECTION 3.5.6.3 Water Treatment Waste Disposal

Comment No. 24

This section states that water treatment wastes could potentially be sold to Kraft paper mills in Wisconsin, or transported to and disposed of in a secure landfill site. One of the tailings ponds could be used for the storage of this waste if a separately bermed area was provided. If this alternative were chosen, would it require any modifications to the size of the tailings ponds? How would sodium sulfate be handled and disposed in the tailings ponds?

Response:

The water treatment process will produce up to 10.2 t/d (11.2 short tons per day) or 8.5 m^3 (300 cubic feet) per day of anhydrous sodium sulfate. Disposal of this sodium sulfate in a bermed portion of a tailing pond would require 76,500 m^3 (2.7 x 10^6 cubic feet) for a mine life of 20 years (assuming the water treatment plant operates for 25 years). This total volume of sodium sulfate represents only 1 percent of the storage capacity of the first tailing pond (6.0 x 10^6 m^3) or a fraction of 1 percent of each of the other three ponds. Thus, the tailing ponds should not require a modification to their design size to include sodium sulfate disposal.

The salt cake for disposal would be removed from the covered storage bunker at the water treatment plant with a front-end loader and transferred to a dump truck for transportation to the MWDF. The sodium sulfate would need to be covered progressively as it is dumped into the tailing pond. Sodium sulfate is very water soluble, its disposal in the separate bermed area in the tailing pond would require a synthetic liner to hydrostatically isolate it from the water in the tailings and in the underdrain system. (See also the response to comment No. 21 for marketing of sodium sulfate.)

III. Chapter 4, Comments on Environmental Consequences

Comment No. 25

Introduction

The following comments pertain to Exxon's EIR Chapter 4, Environmental Consequences. The first group of comments is referenced to the corresponding EIR section for your convenience. The second group of general comments has no corresponding section in Chapter 4.

These comments represent our initial review of Chapter 4. We have incorporated the appropriate concerns identified by local units of government, the general public, Indian tribes, state and federal agencies and our Department staff into these comments. As additional comments on the EIR are received, they will be transmitted to you as appropriate.

We have not provided complete comments on several sections in Chapter 4 of the EIR, especially those sections on impacts to surface waters and groundwater. Discussions on these issues between the Department and Exxon are currently underway to determine additional field data requirements and further analytical modeling needs. The Department's position on information needs was detailed in the November 14, 1983 letter to Exxon, hereby incorporated by reference. The specific data needs and analyses which must be addressed by Exxon include:

1) a worst-case analysis of the mine inflow rate;

2) the extent of the ultimate groundwater potentiometric surface drawdown which must be identified by the 0-meter contour interval;

3) acceptable low flow (7-day Q_{10}) data on streams, rather than average flows, on which to calculate flow changes due to mine dewatering.

4) quantified impacts to surface water (lake, streams, springs and wetlands) quality and quantity due to lowering the groundwater potentiometric surface and from altered surface drainage;

5) impacts to water wells from groundwater potentiometric surface drawdown;

6) potential impacts to groundwater and surface water quality due to contaminant movement out of the mine and the mine waste disposal facility after closure; and

7) mitigation strategies for potentially impacted water wells, groundwater, and surface waters.

We will continue to work with Exxon toward resolving these issues by developing a comprehensive hydrogeological program.

Response:

Comment acknowledged.

Section 4.1.1.2 Ambient Air Quality

Comment No. 26

Page 4.1-2: The EIR states: "Since the estimated component air emissions rates for construction and operation sources are essentially equal, the results of the operation air quality impacts modeling are considered representative of impacts from construction." Though construction and operation emissions may be approximately equal, this does not mean the impact from these emissions will be equal. The emissions must be emitted in the same manner, over similar time intervals and from the same areas to have the same impact. However, during operation approximately 80 tons of particulate matter will be emitted from the concentrator building at heights ranging from 25 to 133 feet above the ground. Sixty of those tons will be emitted at 133 feet with an upward exit velocity of 20.8 m/s. By comparison, construction particulate emissions will be emitted near the ground. Since construction emissions will be released at ground level they will have greater impact closer to the facility than will operation emissions. Construction phase emissions may have less affect on air quality off Exxon's property. Please include a discussion of these differences.

Response:

We agree that construction air emissions will be emitted closer to the ground surface than operations emissions and that they will have less effect on air quality off our property. Further, construction activities will be of short duration as compared with emissions produced during the 20 year operations phase. That was one of the major reasons we performed air quality modeling for the operations activities. In our letter of January 24, 1984, submitted in response to DNR comments on the air permit application, revised estimates of Project air emissions were provided for the construction and operation phases. These estimates indicate a lower quantity of particulate emissions than what was previously provided. These revised estimates as well as conditions for the air quality modeling will be reviewed with the DNR to establish the basis for final air quality modeling.

Section 4.1.1.2 Ambient Air Quality

Comment No. 27

Tables 4.1-1, 2 and 3: Emissions are not estimated in Tables 4.1-1, 2, 3 for several air contaminant sources described or mentioned in the project description. Please include estimates for these sources:

1. Existing gravel access roads (page 1.3-3)

2. Temporary on-site diesel power generators (page 1.3-4)

3. Burning of stumps and brush during site clearing (pages 1.3-2, 1.3-5, and others)

4. Wind erosion from MWDF stockpiles (p. 1.3-13)

5. Screening and stacking plant to produce MWDF liner and underdrain materials (p. 1.3-15)

6. Primary crusher and related ore handling facilities during construction (p. 1.2-9)

7. Ore loading, hauling and dumping (p. 1.4-3)

8. Removal of rock from shaft during underground mine construction (p. 1.3-7)

Response:

Revised estimates, including all of the above sources, have been provided to the DNR in our letter of January 24, 1984 in response to comments on the air permit application. In particular, see responses B2, B3, A3, A4, E4, and C1 of the January 24, 1984 letter.

Section 4.1.2.2 Landscape

Comment No. 28

More discussion on the landscape changes caused by the MWDF are needed.

Response:

The total area disturbed for the MWDF and reclaim ponds will be approximately 248 ha (614 acres). As each tailing pond is developed, vegetation will be cleared for a distance of approximately 15 m (50 feet) from the toe of the outer embankments of each pond. No disturbance to the existing land forms or vegetation will occur outside this zone. When the grades of the embankments have been established, herbaceous plant species (grasses and legumes) will be planted to stabilize the soil surface. A fence will be erected around the perimeter of each pond and a road will be constructed between the toe of the embankments and the fence.

Detailed drawings of the MWDF and discussion of construction, including dimensions of the ponds, landscape disturbance and erosion control, are presented in EIR Chapter 1.0 and the Feasibility Report. The Reclamation Plan contains further documentation on the physical and vegetation aspects of reclamation of this facility during the construction phase. An assessment of the potential visual impacts of the MWDF in relation to the surrounding undisturbed environment and mitigative measures are presented in EIR subsection 4.2.9.2.

CHAPTER 4

Section 4.1.3.1 Groundwater Hydraulics

Comment No. 29

Figure 4.1-2: Percolation rates should be converted to volume measures.

Response:

The percolation rates on EIR Figure 4.1-2, "Project Facilities Schedule and Hydraulic Data" are only presented in millimeters per year (inches per year) since the area of each tailing or reclaim pond is different. However, EIR Table 4.2-5, "Projected Seepage Rate of MWDF," does present seepage rate data both as percolation rate per unit area and volume, m^3/s (gallons per minute).

Section 4.1.3.1 Groundwater Hydraulics

Comment No. 30

In the discussion on p. 4.1-8, it should be mentioned that wells in the area are also discharge points for local groundwater.

Response:

A statement will be added to subsection 4.1.3.1 (p. 4.1-8) of the revised EIR that wells in the site area are also discharge points for local ground water.

Section 4.1.3.2 Groundwater Quality

Comment No. 31

The redirection of groundwater flow which would occur during mine dewatering could result in water quality changes in nearby private water supplies. These changes could occur if the redirection causes wells to be down-gradient of contamination sources, such as septic systems or recharge areas with low pH water which may contain elevated levels of iron, manganese, and possibly hydrogen sulfide. In addition, there could be induced infiltration from groundwater discharge areas due to groundwater gradient reversal. These potential impacts on groundwater quality must be discussed in the EIR for both the drawdown of the groundwater potentiometric surface and its rebound following mine closure.

Response:

Computer simulations of the affected mining operations on the ground water regime have defined the extent of the cone of depression from mine dewatering. These simulations are described in Appendix 4.1A. A change in the direction of the gradient of ground water flow will occur in the immediate vicinity of the mine. This direction change is not predicted to affect the quality of private water supplies in this area. Properly designed septic systems within the affected area will discharge into the unsaturated zone which will not experience any flow reversal. Such discharges should be naturally purified before they reach the saturated zone. There are no other known sources of contamination such as those described, or discharge areas within the affected area, which might cause the effect hypothesized.

In areas outside the immediate vicinity of the mine, the gradients to discharge areas are not reversed, and therefore, there will not be induced infiltration from them. Furthermore, as stated in the EIR, we have committed to assure a reliable water supply to ground water users whose supply has been affected as a result of mining operations. The hydrogeologic system is projected to return to its pre-mining condition after mine closure.

Section 4.1.4.1.1 Surface Water Quantity - Streams

Comment No. 32

Since groundwater has different chemical and physical characteristics than surface runoff, any change in the proportion of groundwater and surface water going into a stream will result in changes in stream water quality. For example, during drought conditions, a loss of groundwater flow to a stream may increase stream temperatures and cause a possible reduction in available dissolved oxygen. Reduced groundwater flow into cold water streams could adversely affect cold water fisheries. Please discuss potential impacts to streams, especially Swamp Creek, due to the mine discharge.

Response:

The predicted base stream flow rate reduction to Swamp Creek is approximately 0.047 m^3/s (1.66 cubic feet per second) along segment BC for the unmitigated mine inflow case at year 33 of operation (see EIR Table 4.2-7A). This results in approximately a 4 percent reduction in the total average annual stream flow for the same period (see EIR Table 4.2-9). Water quality analyses for the Swamp Creek segment BC are shown in Table 2.3-10 of the EIR. The general quality classification of the stream is a moderately hard, neutral pH stream with an average dissolved oxygen content of approximately 9 mg/l. Water quality analyses from piezometers in the environmental study area indicate that the ground water is hard and has a neutral pH. Dissolved oxygen was not measured in the ground water samples. There are no predicted alterations to stream water chemistry from reduced stream flow as a result of mine dewatering. The percentage of stream flow reduction is small, and no measurable effects on stream water temperatures are expected.

We will reassess the mine dewatering impacts to streams following completion of the hydrogeology field and laboratory program.

Section 4.1.4.1.1 Surface Water Quantity - Streams

Comment No. 33

Increased flooding potential on the segment of Swamp Creek below the wastewater discharge should be discussed in this section.

Response:

The flood potential on Swamp Creek below the wastewater discharge is not increased as a result of the discharge. An outfall discharge of 0.126 m^3/s (2,000 gallons per minute) is less than 4 percent of the peak flood stream flow. Therefore, the outfall discharge will be less than 4 percent of peak flood flows on Swamp Creek.

Swamp Creek experiences peak flood flows as a result of thunderstorms and rain in combination with snowmelt and are most common in spring and early summer. The extensive lake and wetland areas associated with the Swamp Creek drainage basin further facilitate the storage of peak flows, thereby reducing the flood risk.

Flooding potential on the aquatic ecosystems downstream of the outfall is minor, consisting of a temporary water level increase from Swamp and Squaw creeks inflows. The hazard to human life and structures is negligible because the drainage areas are small, water level fluctuations are minor, and stream bank/wetlands storage is high.

Section 4.1.4.1.1 Surface Water Quantity - Streams

Comment No. 34

Estimates of impacts on stream water quality due to soil erosion from the various construction activities must be provided. Activities which could increase soil erosion include construction of tailings ponds, and reclaim ponds, slurry pipeline, haul road, mine-mill complex, access road, railroad spur, discharge pipeline, and topsoil stockpiling. Please provide soil sediment loading estimates for the impacted streams.

Response:

The Project erosion control plan presented in the Mining Permit Application will be used during construction and operation to minimize erosion potential and prevent any discernible increase in silt loading on affected streams and lakes. Large surface areas such as the mine/mill site will have surface water runoff patterns to the drainage basins. Other surface areas (i.e., access road, railroad) will have surface water drainage patterns through filter fabric (i.e., approximately 99% effective), which will ensure removal of residual sediment loadings. The areas where these and other erosion control procedures and facilities will be used are fully described in Appendix 2.1A of the Reclamation Plan submitted as part of the Mining Permit Application. Proper design and timely placement of these erosion control procedures and facilities should prevent any discernible increase in sediment loading to site area waters.

Section 4.1.4.1.1 Surface Water Quantity - Streams

Comment No. 35

The treatment system for the water discharge to Swamp Creek may be designed to meet WPDES permit limits; however, this does not guarantee that the system will always work as designed and that limits will always be met. Exxon must discuss potential impacts to Swamp Creek if the treatment system malfunctions. A reasonable range of possible malfunctions should be considered, with potential impacts on Swamp Creek flow rates and water chemistry calculated.

Response:

Water treatment system upsets could occur as a result of a number of conditions involving equipment malfunctions. The "worst-case" upset condition would be if the entire treatment system is off-line. As a result, it would not be possible to treat the wastewater. However, during partial or complete shutdown of the treatment system, water not meeting effluent limits would be held within the storage capacity of the treatment system (i.e., the treated water storage tank and the reclaim ponds), and/or the operating tailing pond. There is sufficient capacity above the normal operating level in the reclaim ponds alone to hold all anticipated discharge water for more than 40 days. This is based on using 75 percent of the total freeboard volume. Additional capacity is available in the operating tailing pond. Therefore, we do not anticipate upset conditions which would result in the need to discharge water not meeting WPDES permit limits.

To ensure that water is not discharged which does not meet WPDES limits, an automated monitoring system will be used to continuously monitor pH, turbidity and conductivity of the treated effluent and the uncontaminated mine water. In addition, chemical analyses of samples will be performed routinely for other critical constituents. The frequency and type of the chemical analyses and the exact constituents analyzed will be reviewed with the DNR Industrial Wastewater Section, Bureau of Wastewater Management, in conjunction with the development of the WPDES permit for this discharge. This monitoring system combined with sufficient storage capacity for any short-term upset will ensure that water is not discharged which would impair the integrity of Swamp Creek.

Subsection 4.1.4.1.1 Surface Water Quantity, Streams

Comment No. 36

Duration of the possible malfunctions should be identified, and a scenario based on low flow conditions should be calculated.

Response:

This information was previously provided in response to comment No. 169 of the DNR's Mining Permit Application letter of October 10, 1983.

Section 4.1.4.1.2 Lakes

Comment No. 37

P4.1-15: The impacts of stormwater runoff on surface water quality during both the construction and operation phases should be discussed in the EIR. Siltation could have significant impacts on aquatic habitat and water quality. Please provide quantitative estimates of siltation into lakes during construction.

Response:

See response to comment No. 34.

Section 4.1.4.1.4 Wetlands

Comment No. 38

Figures 4.1-13 through 4.1-19: The hydrologic connections between Wetlands F-57 and F-60, and F-64 and F-65 should be indicated. Were they disconnected because of road placement? (There are also roads between F-23 and F-25 and F-17, yet these connections were shown.) Waterflow networks of all affected wetlands should be shown.

Response:

The hydrological connections between wetlands F57 and F60, and F64 and F65 will be indicated on Figures 4.1-16 through 4.1-19 in the revised EIR. These connections were inadvertently omitted in the original EIR. Water flow networks will be shown on Figures 4.1-13 through 4.1-19 for all wetlands that could be affected during construction of Project facilities.

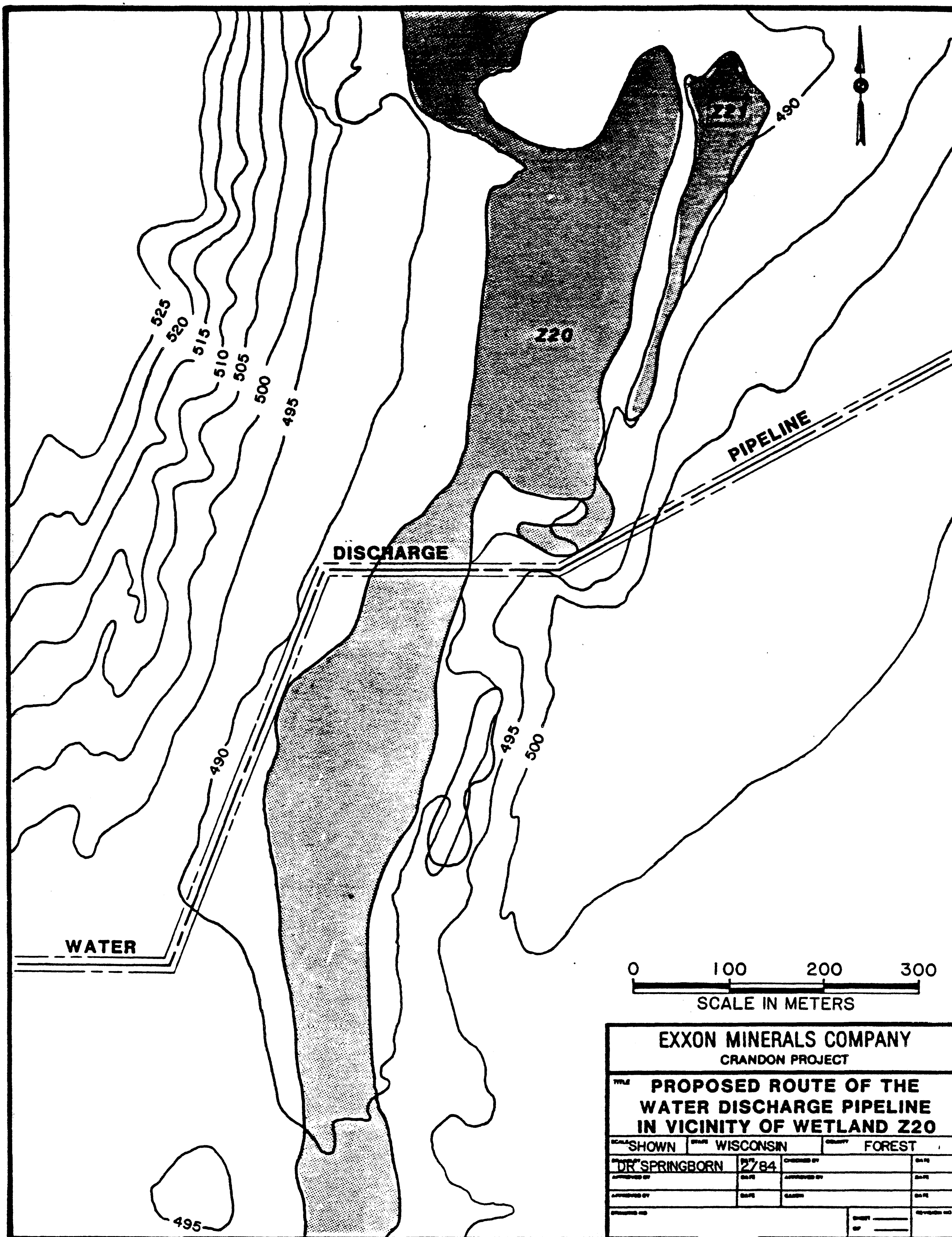
Section 4.1.4.1.4 Wetlands

Comment No. 39

Figure 4.1-13: The discharge pipeline crosses the drainage outlet of Wetland Z-20. The possible effects to this wetland and its outlet from the pipeline construction should be addressed.

Response:

The water discharge pipeline will be aligned to minimize impacts to wetland Z20. As shown in the attached figure, the pipeline will be routed so that wetland Z20 is crossed at a narrow point. During construction and installation of the pipeline, less than 0.03 ha (0.09 acre) of wetland Z20 will be affected. To ensure there are no long-term adverse impacts on the hydrologic characteristics of this wetland, as well as other wetlands that may be disturbed during construction of the pipeline, the trench will be backfilled with free draining granular fill materials and the organic soils originally removed during excavation. These materials will allow maintenance of existing surface and subsurface flow conditions through the wetland and there will be no long-term effects on the hydrology of the wetland or its outlet.



(Figure for Response to Comment No. 39)

Vegetation will be lost in the area disturbed during construction of the pipeline through wetland Z20. However, vegetation will be reestablished in the zone of disturbance following the construction period. Until vegetation becomes established a slight increase in the sediment load may occur in surface water flowing through the wetland. However, any increase in sediment load would be of short duration and may not occur because surface flow through wetland Z20 to wetland Z17 is intermittent. In summary, the effect of pipeline construction on wetland Z20 will be short-term and reversible and no long-term effects on the hydrologic and biological functions are expected.

Section 4.1.4.1.4 Wetlands

Comment No. 40

Figures 4.1-15: The wetlands along the east 1/4 of Alternate C should also be shaded. The osprey nest location is in error. It is further south - the correct location has previously been given to Exxon.

Response:

In Figure 4.1-15 of the revised EIR wetlands will be shaded along the east one-quarter of Alternative C for the railroad spur. The location of the osprey nest on Figure 4.1-15 will be designated at the correct site.

Section 4.1.4.1.4 Wetlands

Comment No. 41

Page 4-1-20: Standard construction methods for wetlands will be used..." What are these standard methods? In order to know what the impacts to adjacent wetlands will be, these construction activities (e.g., dredging, diversions, sediment pond construction and discharge, soil disposal, erosion potential, stockpiling, etc.) must be identified and the potential impacts to wetland hydrology specified. Even if these impacts are "short term and localized" (p. 4.1-21) they must be identified.

Response:

The various techniques or methods to be used for minimizing impacts to surrounding areas from construction in wetlands have been discussed in Section 1.3 of the EIR (e.g., see subsections 1.3.1.3, 1.3.1.7 and 1.3.1.9). Also, wetland construction techniques for use during installation of the water discharge pipeline are discussed in the EMC response to comment No. 163 in the May 11, 1983 DNR letter. We have not chosen specific construction methodology on a wetland by wetland basis. The specific construction methods for use in wetland areas will be determined during final engineering and these may be subject to field modification as differing conditions require.

For the MWDF, control of the surface water runoff in each area of construction has been planned on a phase-by-phase basis to minimize wetland impacts (see EIR Figures 1.3.3 through 1.3.8). Some method of siltation control (sediment pond, straw bale, or filter fabric trap) has been included for each surface drainage area. In the MWDF, all of the wetlands are perched above the main ground water aquifer, and most are connected through surface water drainage. As the MWDF is developed, wetland soil material removal will normally begin at the most up-gradient wetland or portion of a wetland and proceed down-gradient through the wetland's watershed. This construction sequence will keep surface water runoff through newly graded areas to a minimum thereby reducing the potential for siltation.

No wetlands are located within the limits of the mine/mill site. However, to eliminate the potential for siltation to nearby wetlands and lakes by surface water runoff from the mine/mill site, all mine/mill site drainage will be controlled by drainage basins. The drainage basins planned as part of the permanent mine/mill site facilities will be constructed early in the development sequence to provide the primary means of protection from siltation.

The remainder of the erosion control facilities are located within corridors for the access road, railroad spur, haul road/tailings transport system, and water discharge line. For the corridors, entire wetlands are not removed. Generally, the corridor crosses the wetland and a culvert or other means of maintaining wetland water drainage through the corridor is provided. The wetland soil materials are removed and replaced with select materials in the area of the corridor. The initial procedure will be to provide a temporary diversion ditch or channel to allow the wetland water flow to continue while the wetland soil is being removed and the culvert installed. The temporary erosion control measures (e.g., straw bales, filter fabric silt traps, siltation ponds) will be employed on a wetland-by-wetland basis as necessary. The detailed design and location for these temporary control measures will be developed during final engineering for the various corridors. However, these types of temporary control measures will also be subject to final adjustment in the field to accommodate actual conditions.

Construction within the water discharge corridor is slightly different than in the other corridors because no roadways or embankments are included and once the pipe is installed, drainage across or along the route will be allowed to return to initial conditions. The EMC response to comment No. 163 in the DNR's May 11, 1983 comment letter provides additional detail on wetland construction techniques for this pipeline system.

Section 4.1.4.1.4 Wetlands

Comment No. 42

Tables 4.1-16 and 4.1-17: Wetland #F-23 is incorrectly numbered. In the Normandeau Study, the correct number of the wetland is F-32.

Response:

Comment acknowledged and wetland F32 northeast of Duck Lake will be correctly numbered on Figures 4.1-16 and 4.1-17 in the revised EIR.

Section 4.1.4.1.4 Wetlands

Comment No. 43

Throughout the life of this project, erosion control "catch basins" will be constructed to trap soil particles and slowly release storm waters. Will the discharge be to wetlands adjacent to local surface water bodies? The discharges could result in physical and chemical changes within the wetlands. There needs to be further discussion on the impacts of siltation and runoff water quantity and quality on adjacent wetlands and surface waters.

Response:

As described in the response to comment No. 9, two surface drainage basins will be maintained and operated in the mine/mill site throughout the construction and operational life of the Project to collect, retain and release uncontaminated surface waters. Detailed characteristics of these basins are given in the figures included with the response to comment No. 9. Water from drainage basin No. 1 will be indirectly discharged to wetland F11, a coniferous swamp located between Skunk Lake and Little Sand Lake. Surface water from wetland F11 flows into wetland F10, also a coniferous swamp, associated with Little Sand Lake. Water that is discharged from surface drainage basin No. 2 will enter wetland P2, a coniferous swamp, and then flow northward to Swamp Creek.

Uncontaminated water from the mine/mill site will be collected and discharged from these drainage basins. Separate basins and transport facilities are provided in the mine/mill site to collect and transfer for treatment any surface waters that have potential to be contaminated from mining operations (e.g., surface drainage basin No. 3 will collect water from the preproduction ore storage area and from there it will be pumped to the water treatment facility).

Under average meteorological conditions, the quantity of water to be discharged from drainage basins No. 1 and 2 is estimated to be low if any. The basins are designed to contain a 25-year, 24-hour storm event using a runoff coefficient of 0.75. Only during prolonged periods of rainfall or unusual storm events would a major amount of water be discharged from these basins. During most months of the year, water collected in the basins will be retained and will either evaporate or seep from the basins.

During the 4-year construction phase of the mine/mill facilities when disturbed areas have not been completely stabilized with vegetation, suspended solids levels will be higher in surface water collected in the basins than during the operational phase when the disturbed areas have been stabilized and landscaped. Water discharged from the basins during the construction period may contain an elevated suspended solids level; however, the ponds are designed so that most suspended particles will settle prior to discharge. Only minor increases in sedimentation are expected during the construction period in the wetlands receiving discharge water, and no long-term adverse effects on the functions of these wetlands are projected. One of the major functions of wetlands is the removal of suspended sediment from water moving through them. A decrease in water velocity and the presence of vegetation in these wetlands will promote settling of suspended particles; therefore, no increase in suspended solids concentrations is expected in the surface water bodies (Little Sand Lake and Swamp Creek) ultimately receiving discharge from wetlands W10 and P2.

Other water quality characteristics of water collected from the mine/mill site and discharged via the drainage basins should be similar to existing surface water runoff in the site area. Therefore, no adverse effect on water quality in the wetlands receiving discharge water is projected to occur.

Section 4.1.5.2 Aquatic Biota

Comment No. 44

Table 4.1-14: Is the fish "brook silverside" correct or was "brook stickleback" intended? Are the capture locations known and voucher specimens available for verification?

Response:

The fish listed as brook silverside in Table 4.1-14 is incorrect and should be brook stickleback. Table 4.1-14 will be corrected in the revised EIR. The sensitivity of brook stickleback to turbidity and sedimentation is "intermediate" and will be presented accordingly in revised Table 4.1-14.

Section 4.1.6.1.2 Wetland Communities

Comment No. 45

Page 4.1-33: Pipeline placements do not necessarily "remove" acreage from wetlands (such as Z-20) if the buried pipeline does not involve wetland fill, and the corridor is allowed to revegetate as proposed.

Response:

Comment acknowledged. None of the wetland areas crossed during construction of the water discharge pipeline will be permanently removed. No wetlands will be filled and wetland as well as upland areas will be allowed to revegetate after construction activities have been completed. Subsection 4.1.6.1.2 will be revised to indicate that no removal of wetland acreage will occur during construction of the water discharge pipeline.

Section 4.1.6.1.2 Wetland Communities

Comment No. 46

Table 4.1-19: A 200 foot corridor width was used by Exxon to calculate wetland loss; figures should be revised using a width of 100 feet. Transmission lines and pipelines, for example, while constructed through wetlands, would not result in complete loss of those wetlands.

Response:

In the revised EIR, calculations of potential wetland impacts during construction will be revised based on a corridor width of 30 m (100 feet) for the access road/transmission line and 40 m (131 feet) for the haul road/tailings pipeline. The projected wetland losses presented in EIR Table 4.1-19 are based on a worst-case analysis using a corridor width of 60 m (200 feet) for both of these facilities. The analysis of potential wetland impacts associated with the water discharge pipeline will not change and will be based on a corridor width of 15 m (50 feet) even though the actual disturbed area in most segments of the corridor will be considerably less than this width. We acknowledge the fact that during construction a complete loss of wetlands will not occur in the corridors designated for transmission lines and pipelines.

Section 4.1.9.1.4 Residential

Comment No. 47

Exxon should indicate the number of summer cottages purchased (Little Sand Lake and others, if any) and discuss their eventual use.

Response:

Exxon Minerals Company currently owns 22 homes in the area of Little Sand Lake. These homes are in varying stages of construction and completeness, with approximately twelve being available for use on a year-round basis if properly renovated. Eventually, those homes which can be converted to year-round use will be available to the local housing stock on a lease basis. The remaining homes could possibly be utilized on a seasonal basis if justified by demand.

Section 4.2.1.1 Local Meteorology and Air Quality

4.2.1.1 Local Meteorology

Comment No. 48:

The EIR states: "Under some conditions the mine exhaust ventilation shafts will cause water vapor plumes." Additional information is needed on when water vapor plumes will be formed, their frequency, magnitude, and likely consequences.

Response:

The air physics experienced in mine exhaust shafts are similar to those for an ideal gas, as presented by the equation $PV = nRT$; where P = pressure, V = volume, n = weight of air in pounds (lbs), R = universal gas constant (i.e., 53.3), and T = temperature. In this equation the decrease in pressure and the increase in volume cause a decrease in temperature (i.e., 2°F per 1,000 ft rise); therefore, supersaturation occurs and water droplets form. These droplets begin to fall as they combine with other droplets. Some of the condensed moisture contacts the shaft walls as it falls and some is deposited at the shaft bottom or re-evaporated and distributed with the air as it rises in the exhaust shaft.

In the mine exhaust shafts only the smallest droplets remain in the air stream and eventually are discharged from the shaft. Once outside the shafts, the contained moisture will condense further (i.e., cold conditions) and deposit rapidly or evaporate (i.e., warm conditions). In general, these water vapor plumes will be visible when the atmospheric air temperature is at or below dew point temperature. This will mainly occur between late autumn and early spring. Water vapor plumes will be most prevalent in magnitude and frequency during the winter. There are no consequences except visibility of the water vapor plumes.

Comment No. 49:

Page 4.2-2 (Second paragraph): The EIR states that air quality constituent concentrations are expected to be below primary and secondary federal and state ambient air quality standards at the project boundary. However, the EIR does not identify the contribution to emissions by the handling, storage, and use of processing reagents. Please include such a discussion.

Response:

Current engineering design indicates no emissions from handling, storage and use of processing reagents will be vented to the atmosphere. As a result, they will not be an added source for atmospheric contributions and air quality constituent concentrations are expected to remain below primary and secondary federal and state ambient air quality standards. See also response to comment No. D6 of the air permit application letter submitted to the DNR on January 24, 1984.

Comment No. 50:

Table 4.1-1: Please revise or explain the total emission figures because they are not equal to the sum of the components.

Response:

Table 4.1-1 of the EIR presents the estimated air emissions per unit activity and for the annual usage. Many of the activities only occur periodically during the year and the annual estimate is not simply a summation of a daily estimate. For example, the daily estimate for blasting in Table 4.1-1 is 141.1 kg/d (311.1 pounds per day). However, these blasts do not occur every day. Therefore, the daily estimate cannot simply be multiplied by 365 to obtain the annual rate. Consequently, the total emission figures will not be equal to the sum of the components.

Revised estimates of emissions have been provided to the DNR in the air permit letter of January 24, 1984. Table 4.1-1 will also be revised in the EIR to be consistent with these estimates.

Comment No. 51:

Table 4.2-2: This table should include air emissions from the burnt pebble lime facility (p. 1.4-45).

Response:

There are no atmospheric air emissions from the lime facility.

Comment No. 52:

Table 4.2-4: This table should include SO_2 emissions from the SO_2 scrubber tower (Fig. 1.4-13).

Response:

Current engineering design has eliminated the SO_2 scrubber tower.

Section 4.2.1.1. Local Meteorology

Comment No. 53

Page 4.2-3 (Second paragraph): The EIR indicates that the control of 95% of dust emissions in the mine by gravity settling and the humid conditions has been documented. The reference should be provided.

Response:

The documented control efficiency addressed in the EIR is presented in AP-42, Appendix A, Table A-2 for a spray tower which has an overall control efficiency of approximately 95 percent. A complete discussion of the air physics present in the exhaust shafts resulting from humid mine conditions is presented in our letter of January 24, 1984 in response to DNR comments on our air permit application (see response to comment No. C1). In addition, a revised estimate of mine air emissions is presented in the response to comment No. C1 in which detailed calculations were performed for each mine TSP emission source and the path of air movement through the mine. Gravity settling conditions and calculations for revised TSP emissions were also included in the January 24, 1984 letter.

Section 4.2.3.2 Groundwater Quality

Comment No. 54

The data presented does not indicate whether the concentration gradients from the tailings ponds decrease in the future. The implication is that the concentration gradients will increase continuously such that concentration gradients at the top of the stratified drift and perhaps at the compliance boundary may exceed groundwater standards. There should be some explanation that the MWDF seepage quantity or quality will correct itself in the future.

Response:

The projected composition of the leachate in the tailing ponds underdrain system before seepage through the bentonite modified soil liner is presented in EIR Table 4.2-6, "Projected MWDF Tailings Pond Seepage Chemistry." The quality of this leachate improves after reclamation as depicted in this same table. The volume of the seepage per pond is presented in EIR Table 4.2-5, "Projected Seepage Rate of MWDF," and it also varies slightly with time.

This water quality and quantity information was used to calculate the normalized concentration (initial concentration = 1.0) of chemical constituents at the top of the water table, 15 m (49 feet) below the bottom of the pond in the glacial till. For those few chemical constituents assumed not to be totally chemically attenuated by the 15 m (49 feet) of partially-saturated till, such as sulfate and TDS, their concentration at the top of the water table immediately beneath the MWDF eventually (i.e., 200+ years) attains initial seepage concentrations (see EIR Figures 4.2-5, "Normalized Concentration at Different Depths for Various Times in Partially-Saturated Till," and A33, "Normalized Concentration at Top of Water Table for Various Times in Partially-Saturated Till)."

For the normalized concentrations of those chemical constitutents assumed as not totally chemically attenuated to attain initial seepage concentrations at the top of the stratified drift, typically an additional 20 m (66 feet) of saturated till, requires approximately 1,000 years assuming the seepage water quality remains unchanged. Therefore, the water quality directly beneath the MWDF at that time, 1,000+ years, would meet present federal and state drinking water standards, except for sulfate and TDS. The ground water quality at the compliance boundary will also meet drinking water standards for sulfate and TDS even if the initial seepage water quality and quantity continue indefinitely, which they will not. The modeling results to support this statement are presented in Attachment A.6, "Long-Term Ground Water Quality Analysis Adjacent to MWDF," Appendix 4.1A, EIR Volume VIII.

Section 4.2.4 Surface Water

Comment No. 55

Table 4.2-7A: The discrepancy between the reported difference in flow cfs for Rolling Stone Lake and lower portion of Pickerel Creek for Project Year 33 (reported as -0.04) versus the same value reported in Table 4.1-7 (reported as -0.35 cfs) should be explained.

Response:

The value shown for the Project Year 33 difference in the Pickerel Creek flow rate should be -0.04 cfs in Table 4.1-7. The value of -0.35 cfs shown is a typographical error and will be corrected in the revised EIR.

Section 4.2.4 Surface Water

Comment No. 56

Page 4.2-13 (Last Paragraph): Effects on the portion of Pickerel Creek above Rolling Stone Lake should also be summarized in this section.

Response:

The description of the effects of mine operations on Pickerel Creek summarized in the last paragraph on page 4.2-13 is for the entire length of Pickerel Creek, including the segment above Rolling Stone Lake. This segment is shown as DEF on Tables 4.2-7A, -7B, -8, and -9. The segment above Rolling Stone Lake is segment DE on these same tables and the segment below Rolling Stone Lake is EF.

Section 4.2.4.2 Surface Water Quality

Comment No. 57

Sources other than seepage from the MWDF must be considered in evaluating impacts to surface water quality. Additional factors include chemical and physical changes in Swamp Creek due to the wastewater inputs, reduced flows, altered temperatures in streams, and increased siltation.

Response:

The exact chemical and physical changes in Swamp Creek resulting from discharge of excess water will vary with stream flow, and discharge water characteristics. However, the water quality limits which will be imposed on the discharge by the DNR Bureau of Wastewater Management through the WPDES permit will ensure protection of existing stream uses. The limits imposed will be based on water quality standards being developed by the DNR to provide for the protection and propagation of fish and aquatic life. Therefore, the existing stream uses will not be changed or impaired by the proposed discharge.

For example, the effect on water quality will be primarily an increase in total dissolved solids (TDS). However, this is not expected to result in any predictable change in the aquatic ecosystem. The greatest increase in TDS is expected to occur during low stream flow conditions. Average TDS in Swamp Creek as measured during the 1982-1983 aquatic monitoring period* is 128 mg/l.

Under conservative assumptions of discharge flow rate and quality combined with low stream flow conditions the concentration of TDS in Swamp Creek at the discharge site would be approximately 330 mg/l which can be tolerated by the existing aquatic life.

Changes, if any, in Swamp Creek flow from ground water drawdown will be minor. As shown in EIR Appendix 4.1A, Table A-20, the projected percent reduction of Swamp Creek flow above Rice Lake is less than 3 percent, assuming a conservative mine inflow of 0.13 m^3/s (2,000 gallons per minute). This small stream flow reduction is well within the normal fluctuations in stream flow and should have no impact on aquatic life.

Upstream of the proposed water discharge site the stream flow rate varied during the 1982-1983 monitoring period from 15 to 120 cfs with an average 47 cfs (USGS gaging station at County Trunk Highway M). The proposed discharge of 0.13 m^3/s (2,000 gallons per minute) represents less than a 10 percent increase in the average flow rate which is within the range of normal stream flow rate variations and would not result in any detrimental physical effect on the stream environment.

The Project will be adding little if any heat load to the mine water or uncontaminated ground water which represents the only water proposed for normal discharge. This should result in a relatively uniform discharge temperature assumed to be approximately 9°C which will result in slightly

*Ecological Analysts final report, "Water and Sediment Chemistry and Hydrology in Swamp Creek for the Crandon Project, " July 1983.

cooler stream temperatures during warmer months and warmer temperatures during the cooler months. The existing annual temperature range at the proposed discharge site is 0°-23.5°C. The proposed discharge temperature is near the mean of this range and should not result in any changes to aquatic life.

The proposed discharge will not cause a buildup of silt in Swamp Creek. The discharge water will be clarified and filtered as needed to remove suspended solids. The maximum effluent concentration is expected to be less than 30 mg/l and the average less than 20 mg/l total suspended solids. In actual operation, the TSS of the discharge should be comparable to pre-operational stream conditions.

Section 4.3.1 Meteorology and Air Quality

Comment No. 58:

The EIR should discuss fugitive dust and vehicle emissions which will occur during site decommissioning (removal of facilities), landscaping and other reclamation activities.

Response:

Estimates of the air emissions resulting from site decommissioning have been provided to the DNR in the air permit application letter of January 24, 1984 (see response to comment No. 17). The EIR will be revised to include this information.

Section 4.3.3 Ground Water

Comment No. 59

The EIR states that when the groundwater potentiometric surface has returned to its preconstruction level, the effects due to lowering the potentiometric surface on local users of groundwater will no longer exist. This statement discounts the potential impacts due to: 1) the possibility of dewatered aquifer subsidence; 2) the potential chemical (e.g. oxidation-reduction potentials) and physical (e.g. permeability) alteration of aquifer materials caused by the dewatering operations (28 yrs.) and time required for groundwater potentiometric surface to return to normal (total of 64 years); 3) altered bedrock-overburden flow gradients due to the abandoned underground mine; and 4) the altered surface recharge because of the mine waste disposal facility. Exxon must consider these four factors in their groundwater analysis for the period after closure.

Response:

1) Aquifer subsidence -- The glacial soil materials that form the overburden including the aquifer have been preconsolidated by the pressure and movement associated with the glaciers' occurrence. Because of this preconsolidation the soil materials should not undergo further compression and consolidation. Therefore, removal of water from them should not result in any measurable subsidence of the land surface.

2) Physical and chemical reactions -- The exposure of the glacial aquifer soil materials to partially unsaturated conditions during mine operations will be relatively short. The dewatering during operations will expose the aquifer soil materials to partially unsaturated conditions for about 28 years; however, the water level in the aquifer is predicted to return to about 90 percent of its original level in approximately 3 years. Reduction and oxidation processes in geologic materials generally require hundreds or thousands of years to occur to the point of measurability.

3) Altered bedrock-overburden flow gradients -- After closure of the mine it is projected that the ground water flow regime will return to its premining condition. The premining bedrock-overburden flow regime does not exhibit strong gradients within the mine area and mining operations are not expected to alter the overburden-bedrock interface. Therefore, it is reasonable to assume that once the mine is closed and the mine has resaturated that the premining flow regime will be re-established.

4) Altered recharge distribution in the MWDF -- Placement of a relatively impermeable reclamation cover over the tailing ponds will have the effect of reducing surface water recharge to the ground water under the ponds. There will be some water recharge from pond seepage, but the amount will be far less than the average annual precipitation recharge. Precipitation falling on the reclamation cover will be subject to evapotranspiration, surface drainage, and drainage layer runoff. This surface drainage and runoff will be reintroduced into the hydrologic regime at the perimeter of the tailing ponds where it will evaporate, be transpired and/or infiltrate into the subsoil to recharge the ground water. This infiltration process will occur as the water spreads over the ground and will result in a higher than ambient ground water recharge in the area around the ponds. This higher recharge value has been calculated and included in the hydrologic impact modeling results presented in Appendix 4.1A of the EIR.

Section 4.4.1.7 Groundwater Discharge

Comment No. 60

Groundwater Discharge - The discussion of the three alternative locations for groundwater discharge of excess treated water must be expanded to include potential impacts to groundwater quality and hydrology.

Response:

As stated in EIR subsection 4.4.1.7, four sites were evaluated as potential locations for seepage lagoons (i.e., discharge of excess water to ground water). Of these four sites only two had subsoil materials with permeabilities high enough to be practical locations for seepage lagoon construction. During the operational period of these lagoons, the glacial soil material beneath them would become saturated and a ground water mound would form. In Area 3 (see EIR Figure 4.4-3) a ground water recharge mound would tend to mitigate the effect of mine dewatering on the hydrogeologic regime. A lagoon in Area 2 would alter the configuration of the ground water potentiometric surface below and immediately surrounding the pond, but would not have any detrimental effect on the hydrogeologic regime. In all cases the water in the lagoons for infiltration would be of the quality required to meet appropriate discharge permit standards and would also have to meet ground water quality standards at the compliance boundary.

Section 4.4.2.3 Tailings Disposal Methods

Comment No. 61

The EIR does not identify the major potential impacts associated with alternative subaerial and dry tailings disposal methods. Potential impacts could occur during construction, operations and reclamation. Please provide a discussion of the major potential impacts to air quality, groundwater quality, surface waters and wetlands that the alternatives could create.

Response:

Subaerial Disposal Method

Potential impacts which could occur during the construction, operation and reclamation phases of the Project as a result of tailings disposal by the subaerial method are generally similar but on a somewhat reduced scale to those associated with the proposed wet method. Although most of these reduced activities would indicate fewer environmental effects, application of the subaerial technology has been limited in a climatic region such as northeastern Wisconsin. Because of that, there is a much higher uncertainty associated with the performance of this system.

The major features of the subaerial method are primarily related to water removal from the tailings. Similar features will be incorporated in the proposed subaqueous (wet) method to the extent that they are possible. The underdrain is the main feature in this respect.

One of the most significant differences between the subaerial method and the proposed wet system is the method of deposition of the tailings. In the subaerial method, the tailings are deposited in thin layers (4 inches) and are allowed to partially dry before another layer is deposited. Partial drying causes the formation of a dense layer of tailings. In this manner, an overall higher density of tailings may be achieved.

The operation of this process requires that two deposition areas be available at any one time for the alternating flooding and drying process. This requires that the entire subaerial facility be constructed and operated for most of the mine life. The impacts of this method relative to the proposed wet method are expected to be as follows:

1) Wetlands

Overall, wetlands impacts are expected to be about the same. Although the proposed facility has a bigger size (202 ha [499 acres]), its development is phased, allowing material stockpiles and construction work areas to be located within the confines of the facility. While the subaerial facility is smaller (150 ha [276 acres]), it must be operated in a fully developed or completed configuration, meaning reclamation material stockpiles, borrow areas, work areas and other construction support areas must be located outside the confines of the subaerial facility. When these factors are taken into account, the total area impacted (either by the facility or to support its construction) is approximately the same (220 ha [543 acres]). However, the impacts at any one time for the subaerial facility will be slightly higher because the phased nature of the proposed system will require only approximately 40 ha (100 acres) to be in operation at any one time.

2) Surface Water

Potential surface water impacts from development of the subaerial disposal system should be similar to those associated with the proposed wet system. Erosion control measures, similar to those described in EIR subsection 1.3.1.7 for the proposed wet system, also would be applied for the subaerial method. These erosion control measures would control surface water runoff from the active construction and operation area and would ensure that surface water quality outside the confines of the facility would not be adversely affected.

When reclamation is complete, the subaerial disposal facility should have a reduced effect to surrounding surface waters because of its projected smaller overall size in contrast to the proposed wet facility. The reclamation system for the proposed facility, including the seal and the surface water management work in the 366-m (1200-foot) perimeter area, will minimize the potential for impacts to surface water bodies. However, because it does encompass a larger area than the subaerial facility, there would be a greater potential for impacts since the reclamation seal and work in the 366-m (1200-foot) zone would be comparable for either facility.

3) Ground Water

Overall, the impacts to ground water should be lower for the subaerial method due to the lesser area involved. However, during the operating life they may be equal or higher because of the greater active area involved with the subaerial system. (The unit seepage rate - gpm/ft^2 for the two systems should be the same because the liner/underdrain systems are the same).

4) Air Quality - Construction/Reclamation

Emissions will be generated from the excavation and deployment of soil materials and the associated construction equipment activity at the MWDF. Potential impacts associated with the subaerial method are expected to be less than the proposed wet system because of the lesser earthwork associated with MWDF construction and the shorter time and fewer pieces of equipment required to develop the facility. The proposed facility has an estimated total excavation of approximately 13 M m^3 (17 million cubic yards), while the subaerial facility is estimated at approximately 5 M m^3 (6.6 million cubic yards).

5) Air Quality - Operation

Because of the need to alternately flood and partially dry the subaerial deposit, wind blown air emissions may be higher with the subaerial system. The exact amount will depend upon the nature of the deposited tailings, the area exposed, the efficiency of dust control measures, and the wind velocity and direction. In any event, the area of exposed tailings will be greater for the subaerial system because of the phased reclamation of the proposed system.

Because of the similarities in design between the two systems (i.e., underdrain), the proposed system may achieve higher than projected densities. In that case, the ultimate facility size may be reduced. Conversely, if the subaerial facility did not fully achieve the tailings density increases and other expected benefits, then its final stage of development would be increased in size. As a result, the expected differences between the environmental impacts associated with the two systems could be much less than indicated above.

The greatest drawback to the subaerial system is uncertainty about its ability to perform in northern Wisconsin where precipitation exceeds evaporation and long periods of below-freezing temperatures are experienced. Additional operating experience is necessary to confirm the projected performance of this system which is now based on laboratory and engineering studies.

Dry Disposal Alternatives

The differences in concept between the dry disposal alternatives (cut and cover and landfill) and the proposed wet method are much greater. The technology to dewater the tailings is the most questionable element of the dry disposal concept. The cost and performance unknowns for such a critical element as the dewatering step preclude a commitment to the dry disposal method at this time. In addition, the physical properties of the dewatered tailings are not sufficiently well known to assure that either of the conceptual designs (cut and cover or the landfill system) will work.

Knowing this, it is possible to comment on the potential impacts as follows:

1) Cut and Cover Method

It is estimated that the cut and cover method would require a total excavation of approximately 16 M m^3 (21.0 million cubic yards). This is approximately 3 M m^3 (3.9 million cubic yards) greater than the proposed wet method. Earth moving equipment usage would be much less, consisting of a dragline and a dozer for grading the covered tailings. This equipment would, however, operate continuously throughout the life of the mine as compared with the periodic pond construction of the proposed wet method. Reclamation for the cut and cover system would be ongoing and would finally be completed in a much shorter time.

A comparison of the potential impacts is as follows:

a) Wetlands

Overall, the wetlands impacts are expected to be equivalent or somewhat greater due to the aerial extent of the cut and cover operation compared to the proposed wet method area requirement of approximately 202 ha (499 acres). However, if the angle of the repose of the filtered tailings is less than that predicted in the analysis, the cut and cover operation could require more land area.

b) Surface Water

If the cut and cover alternative worked as proposed, there would be little change in existing surface water quality. Infiltration and ground water recharge, which presently occur throughout the area, would continue during operation and reclamation of the facility through the windows between the disposal trenches. The relatively low surface runoff now occurring in the area could be accomplished with the final detailed reclamation grading plans. There would be flexibility in the layout and grading of the trench and tailings cover layer to achieve a desired balance of runoff versus infiltration.

c) Ground Water

In the cut and cover method, ground water protection depends upon the impermeability of the tailings mass and the angle of repose to prevent infiltration of precipitation through the tailings. The method of construction does not permit the installation of a liner or a top cover. Our most recent studies have indicated that the top cover is most important in the prevention of infiltration. Ground water impacts will probably be greater without the positive control afforded by the liner and top cover systems.

d) Air Quality

Emissions generated from the deployment of soil materials and the associated construction activities are expected to be greater, but less intense than the proposed wet method, due to the large amount of earth work performed continuously over the life of the mine. Windblown emissions from the tailings themselves are expected to be less due to the short time before reclamation.

2) Landfill Method

In the landfill method, a total excavation of approximately 8 M m^3 (10.5 million cubic yards) is required. This is substantially less than the 13 M m^3 (17.0 million cubic yards) required by the proposed system. As in the cut and cover method, equipment usage is continuous throughout the life of the mine but at a lower level of utilization than the proposed wet method. Reclamation would also be ongoing and would be completed sooner than the proposed method.

A major uncertainty associated with the landfill method, in addition to the dewatering process, is the physical characteristics of the dewatered tailings. For this method to be successful, the tailings must be workable by means of earth moving equipment. The filtered tailings should be able to withstand equipment bearing pressures, be not excessively plastic, nor sticky and difficult to move. It will be necessary to work the tailings during periods of heavy rain, snow and freezing temperatures. This lack of confidence in a knowledge of the workability of the dewatered tailings is a serious impediment to the application of this method.

As in the case of the cut and cover method, it is possible to discuss the potential impacts of this method as follows:

a) Wetlands

Overall, the wetlands impacts are expected to be equivalent or somewhat less than the proposed system due to the lesser amount of earth work estimated to be required. This, of course, depends greatly on the strength and flow properties of the filtered tailings. If the tailings are strong and non-plastic, then they can be stacked higher and thus occupy less area. The reverse is, of course, also true. If the tailings are weak and plastic, then the land requirements will be substantially greater.

b) Surface Water

A reclamation seal would be employed for the landfill method which would have the same "umbrella effect" as for the proposed wet facility or the subaerial facility. The ultimate size of the facility would depend upon the success of the tailings dewatering and handling steps. Assuming favorable results, the landfill dry disposal facility would be smaller than the proposed facility and the potential for surface water impacts would be reduced.

c) Ground Water

The landfill method lends itself to the installation of both a liner/underdrain system and a top cover/overdrain system. These systems, in combination with the reduced area requirements, theoretically provide the maximum ground water protection. Thus, ground water impacts with a successful landfill-type dry disposal system should be the least.

d) Air Quality

Total air emissions from the landfill method are also expected to be less than that from the proposed wet method. This conclusion results from the lesser amount of earth work estimated to be required and the rapid reclamation of exposed tailings.

The landfill-type dry disposal method has a number of conceptual advantages that make it appear to be environmentally highly desirable. When equipped with liner and top seal systems, it offers theoretically the maximum ground water protection. However, it has the most risk of all of the methods that we have studied. The costs and the effectiveness of the technology related to the filtering of the tailings are highly uncertain. Likewise, the strength and flow properties of the dewatered tailings remain largely unknown. When taking into consideration the climatic conditions under which the system must successfully operate, and the potential for liquefaction and flow of the tailings under load, the possibility of environmental impacts is many times greater than those that might be attributed to the proposed wet method. It is the potential severity of environmental impact and the uncertainty associated with the successful operation of the dry disposal system that rules out its application.

Section 4.4.2.6 Surface Water Discharge

Comment No. 62

The data from the pump test discharge to Duck Lake indicate more impacts (such as elevated alkalinity and pH, etc.) could occur than indicated. Exxon's own data on Duck Lake raises question on this analysis "...the only incremental impacts associated with lake discharge would be a possible increase in the lake water surface elevation or discharge flow out of the lake." Although Little Sand Lake's volume is greater than Duck Lake's, the temporary nature of the Duck Lake pump test discharge vs. long-term pumping in Little Sand Lake, and comparative dilution factors need more than a cursory analysis. Exxon should provide a more detailed analysis of this problem. It is possible that lake levels will be lowered by mine dewatering, and various alternative mitigating strategies, including discharge into lakes, would be required.

From the existing discussion, there is no basis for assessing why a lake discharge is not a preferred alternative.

Response:

Please refer to the full text from which this citation was excerpted; i.e., "The effluent standards and mixing zone requirements that would be imposed for a lake discharge will ensure protection of the lake ecosystem. If the water quality standards are met, the only incremental impacts associated with lake discharge would be a possible increase in lake water surface elevation or discharge flow out of the lake."

The water quality standards would be specific to the receiving lake, and WPDES permit limits would be compatible with existing lake conditions. This would preclude discharge of water to the lake with "elevated alkalinity and pH, etc.," unless these elevated conditions are compatible with existing lake water quality.

Although both lake and stream discharge alternatives are viable, there would be a larger change in surface flow from existing conditions with a lake discharge than the proposed discharge to Swamp Creek. As stated in the EIR subsection 4.4.2.6, the lake would have to be relatively large, or the discharge split and discharged to several lakes so not to drastically change the existing hydrologic conditions in the lake and down gradient streams.

The base flow immediately below Little Sand Lake, for example, is estimated to be less than 0.028 m^3/s (1 cubic feet per second) (EIR Table 2.4-19) while the estimated Project discharge is 0.11 m^3/s (4 cubic feet per second), resulting in a four-fold increase in base flow rate. However, the base flow at the proposed discharge is approximately 0.42 m^3/s (15 cubic feet per second) and the increase in flow caused by the Project discharge can easily be absorbed in the existing stream capacity.

Also, potential discharge lakes all have adjoining wetlands which may be impacted by the proposed discharge. Discharge to Swamp Creek in accordance with NR 1.95 would provide less potential for adverse impacts on wetlands, and this combined with the greater physical hydrologic effects on lakes and down gradient streams from a lake discharge make discharge to Swamp Creek the alternative with the least overall adverse environmental impact and, therefore, the proposed alternative.

Section 4.4.2.6 Surface Water Discharge

Comment No. 63

The alternative of a wetland discharge needs additional discussion. A brief discussion of the major impacts to wetlands hydrology, surface water and groundwater quality, vegetation must be provided.

Response:

Before a potential water discharge to wetlands could be proposed as the desired alternative, a considerable amount of information/data would be required. As part of the analytical process, potential wetlands would have to be selected to receive the proposed water discharge and seasonal environmental data obtained and evaluated. Concurrent with this analytical process, the DNR would have to develop water quality standards as a basis for the WPDES permit. The standards would probably vary depending on the type of wetland selected (i.e., shrub swamp, conifer swamp, marsh).

Although a wetlands discharge might theoretically have potential, particularly as it may relate to mitigation of Project operational effects, we perceive design and year-round operational problems which preclude us from seriously pursuing this alternative. Operational difficulties could be quite variable, depending on the type of discharge water distribution system selected, the hydrological regime of the wetland and the wetland vegetative type selected. During the winter period, frozen ground could prevent the discharge water from penetrating the wetland substrate and channels could form. Water passing through these channels would not have the benefit of the "living filter" function of the wetland ecosystem and could eventually reach a surface water body unattenuated. Without adequate attenuation of some chemical parameters, difficulties could arise in meeting the WPDES permit limits year-round. Overall it remains to be determined whether or not a particular wetland site in northern Wisconsin could be operated effectively throughout the year.

Generically, hydrologic impacts from a wetland discharge would result from an increase in the surface water flow. Initially, this could cause local scouring at the discharge site and possibly produce or increase channeling through the wetland. This may be particularly true during the winter.

Provided that the discharge water met DNR water quality standards, there should be no adverse impact to wetland plant and animal communities. Also, because most of the wetlands near the mine/mill site are perched overlying poorly drained low permeability soils, impacts to ground water quality should be negligible.

Realizing that water table wetlands in the site area are discharge points for ground water, it should follow that the discharge of mine intercept water (uncontaminated ambient ground water) at a flow rate commensurate with the size of the wetland should not have adverse impacts to the overall functions of the wetland. However, based on our monitoring of stream flow rates in wetlands, there are no wetland systems in the site area for which a discharge of 0.126 m^3/s (2000 gallons per minute) would not be a major increase in the estimated base flow rate. Consequently, such an increase would probably result in some impacts on the watershed functions of the wetland.

Section 4.4.2.7 Groundwater Discharge

Comment No. 64

Groundwater Discharge - For the three described alternatives (injection wells, infiltration basin, and drain field), please provide additional brief discussions of the potential impacts to groundwater hydrology and quality.

Response:

The impact to the ground water hydrologic regime from any of the three alternatives would be similar. In each case a ground water mound could be expected to form after saturation of the glacial soil material under the ponds or drain fields and around each injection well. Formation of the ground water mounds would not be a permanent feature of the hydrogeologic regime. After mining operations ceased, the ground water mounds would dissipate and the potentiometric surface would return to premining conditions.

The required quality of the water to be discharged in all three alternatives would meet appropriate discharge permit standards and would also have to meet ground water quality standards at the compliance boundary. There would not be any detrimental effects to the ground water quality.

Comment No. 65

In the EIR there is no discussion of the potential threats to the integrity of the MWDF reclamation cap. Eventual penetration by deep-rooted trees, soil creep, settling, erosion, animal burrows and frost heaving will act to slowly degrade the reclamation cap. Please provide an analysis on the integrity of the reclamation cap based on these factors.

Response:

The reclamation cap for the MWDF is a key element in the design and performance of the facility in controlling long-term seepage. The integrity of the cap is important in assuring that it continues to perform as planned.

Engineering design of the reclamation cap emphasized minimization of seepage through the cap. The bentonite/soil seal and the coarse drainage layer over the seal are important seepage control elements. The thickness of the protective soil cover has some minimal effect on seepage and water balance because of its water holding capacity; however, the soil cover primarily provides a vegetative growth media and protects the underlying cap components.

The 0.91-m (3-feet) thickness for the soil cover was determined by Exxon Minerals Company and its consultants, and judged satisfactory for the type of vegetative cover (black spruce and hybrid popular) originally proposed for the reclamation cap. During that study the black spruce rooting depth was the primary criterion in determining the cover thickness.

Long-term settlement of the tailings was studied and judged not to be a problem in reclaiming the tailing ponds. The tailings will consolidate somewhat, and settling occurs rapidly. Also, the reclamation work would be planned so that the grades could be checked over a season and readjusted if necessary before final planting of the vegetative cover.

The 2 percent grade planned for the cover will prevent ponding but is minimal enough to reduce erosion, especially when used in conjunction with a suitable vegetative ground cover. Also, the coarse grained nature of all soil materials in the cap, coupled with the final surface grades, eliminates stability or creep concerns for the cap.

Some revisions to the reclamation cap design are under consideration at the present time. Among the potential revisions or improvements being considered are design for invasion of site area vegetation types, increased thickness of the soil cover, incorporation of a root barrier layer, and handling and management of runoff waters in the area surrounding the MWDF.

Exxon Minerals Company will perform additional study in these areas as well as for the more general aspect of long-term future use for the MWDF area. This work will be performed with DNR and local community input and will be completed within the next few months.

Section 4.4.2.6 Surface Water Discharge

Comment No. 66

The proposed mine-mill complex will utilize a number of process reagents, some of them toxic, others potentially hazardous, in large quantities. The reagents will require a substantial amount of transport handling and storage, before they are utilized and eventually disposed. The potential impacts of an accidental spill, railroad car or truck accident, or other release of chemicals to the environment need to be discussed. Potential impacts to air quality, groundwater, surface water, and wetlands should be addressed.

Response:

During the life of the Project, the mill operation will use many different types of reagents in the ore processing. The anticipated quantities of reagents which will be stored on-site, the mode of transportation to the site from the supplier, reagent form (liquid or solid), and unit size (bulk or small quantities) are presented in EIR Table 1.4-4. The reagents will be unloaded and generally stored prior to use. Reagent storage and delivery systems will be designed based on reagent characteristics to prevent leaks or spills.

All equipment and operating procedures will be designed to meet applicable fire protection regulations. Emergency showers, eyewashes, and other first aid equipment will be conveniently located in the reagent handling areas.

The major concern with the use of reagents is spills. Spills could occur during transportation, unloading, storage, mixing, and/or use in the process. Certain chemicals, if mixed, could react to produce gaseous by-products. These gases could be toxic. However, when proper action is taken, these spills will not result in hazardous conditions.

The Project procedures will provide for curbing on-site and will ensure that spills are contained and handled properly; thereby avoiding accumulation in the soil and ultimately any possible effects to ground water, and preventing surface drainage of water and/or liquid reagents into nearby wetlands, lakes or streams. This will eliminate any long-term consequence which could adversely affect the environment and, ultimately, the public health and safety.

The likelihood of transportation related spills occurring within the Project boundary is considered negligible. The access road will be maintained and the posted speed will ensure safe operation. The railroad spur will be inspected and maintained regularly. In addition, the grade will be less than 1 percent and the operating speed will be slow. All equipment will be maintained in a condition which complies with all the Department of Transportation requirements. Therefore, equipment failure becomes a negligible factor.[1]

Documentation of off-site reagent spills in the mining industry is not available. However, the reagent transport, handling and storage facilities were selected to reduce the potential for spills. The greatest volume (approximately 80 percent) of reagents would be shipped by rail. Although specific probabilities of rail transport accidents involving reagents are not available, probabilities of various industrial accidents are provided in Reliability and Risk Analysis by N. J. McCormick, Academic Press, 1981. The probability of a train crash is listed as 1×10^{-1} to 1×10^{-2}

[1]Transport Canada, "Tank Truck Accidents Involving Dangerous Goods - Standards Assessment," December 1980.

events per year. Based on the previous experience of mill workers in Exxon Minerals Company, the probability of a major spill resulting from transportation of reagents to the Crandon Project is very low and we would not anticipate a major reagent spill over the life of the Project.

However, should such a low probability off-site transportation accident occur and result in a spill of a reagent cargo, most of which will be in solid form, appropriate steps should be taken to contain and clean up the spill area as soon as possible. Most reagents will be shipped in solid form and any resulting negative impacts to the environment should be localized and reversible.

Reagent spills in the mill during operation are also an important consideration in plant design. Spills may present hazardous working conditions for the worker. Spills pose a potential threat to the environment, are costly and adversely affect plant operating efficiency. Generally, the engineering design is required to ensure that reagent spill events have a low probability of occurrence. Reagent storage areas and handling facilities in the mill will have concrete floors and be designed to contain spills and keep spills of dissimilar materials separated. Solid spills will be thoroughly reclaimed. Liquid spills will be contained in blind sumps and the contents will be used as originally intended. Liquid spills will be recycled to original bulk containers or to mixing tanks as appropriate.

The following assessment of select reagents was made with the assumption that spills were unattended and no effort was made to contain or clean up the spill. In actual operation, this would not occur.

Sulfur dioxide, sodium cyanide, sodium dichromate, and sulfuric acid are the only reagents listed in EIR Table 1.4-4 which were considered to present a potential risk. A spill of liquid sulfur dioxide in large quantities could pose a short-term, environmental consequence. Liquid sulfur dioxide, if spilled, would vaporize rapidly at temperatures above -10°C (14 degrees Fahrenheit). This effect would result in gaseous sulfur dioxide being transported mainly through air movements because of its chemical properties. Therefore, contamination of surface water should not occur. Sulfur dioxide spills which occur during warmer months would vaporize and be transported by air movement. The effect would be directly dependent on the size of the spill, and the wind direction and velocity. In general, the immediate effects would be short-term and reversible. Public health and safety impairment from airborne SO_2 would be very small, depending on location.

During winter months, spilled liquid sulfur dioxide might remain in a liquid form and, if contact were made with surface water, a low pH would result. This condition would be short-term and reversible.

The construction materials required for storage, and the equipment required for safe handling of liquid sulfur dioxide are well defined. Sulfur dioxide is used in many industries and is handled, stored, and used daily in a safe, acceptable manner. Some other major industrial users include paper mills, food and grain processing, malting, and wastewater treatment facilities.

The sulfur dioxide storage area at the Crandon Project will be within an enclosed building adjacent to the mill, with a concrete floor and washdown facilities which drain to the water treatment system. Personnel will be trained for standard operating and emergency procedures. Safety equipment will also be available. In addition, the facility will be designed to comply with appropriate Mine Safety and Health Administration (MSHA) regulations. When facilities are properly engineered and operated, sulfur dioxide spills will have an extremely low probablity of occurrence.

Sodium cyanide will be received as briquettes which will minimize dusting during operation. The briquettes will be received in Flow-Bins™ which contain 1,364 kg (3,000 pounds). The empty bins will be returned to the supplier. The bins will be stored inside the mill. A briquette spill would have no public health and safety consequence resulting from transport of airborne particles.

If a spill of sodium cyanide occurs to surface water, it has potential to temporarily affect surface water quality. Sodium cyanide solution could be transported beyond the Project boundaries. However, sodium cyanide solutions require high alkalinity to maintain a free cyanide form. As pH decreases below 9.3, sodium cyanide will hydrolyze to form sodium hydroxide and hydrogen cyanide (HCN). The hydrogen cyanide has a high vapor pressure and, therefore, reacts further, establishing an equilibrium between HCN (liquid) and HCN (vapor). In addition to decreasing pH, increased temperature and turbulence (such as mixing) will accelerate volatilization of HCN. Any HCN remaining in liquid form will tend to oxidize to the cyanate (CNO) form, which can be complexed with metal ions or can further decompose to ammonia (NH_3) and carbonate (CO_3).

Because of the unstable nature of free cyanide, it is unlikely that sodium cyanide will remain in its original form, if it reaches surface water. Volatilization and oxidation will occur as well as complexing and decomposition with the result that minimal environmental effects will be realized beyond the Project boundary. Therefore, any effect realized off-site would be short-term and reversible.

Reagent mixing and solution storage will be designed in compliance with MSHA regulations. The floor in the reagent area will be concrete and designed to contain reagent spills separately. Solid spills will be swept into containers and the area washed. Liquid spills will be washed into the sump and pumped to the tailing thickener for treatment.

Materials of construction and other associated equipment required for sodium cyanide storage and handling will reduce the probability of a major cyanide spill. Containment and control of minor, accidental spills will further reduce the risk of potential environmental impact to a low probability. With a properly engineered and operated system the risks to the environment are negligible.

As with sodium cyanide, spills of sodium dichromate solution could pose potential environmental consequences through transport by surface water. Effects on the environment could occur in two ways: (1) hexavalent chromium (Cr^{+6}) concentrations higher than allowable water quality standards could result and (2) aquatic and terrestrial plant uptake of chromium. The environmental effects of hexavalent chromium are documented in the literature[2]. Should sodium dichromate solution infiltrate the soil on-site, studies performed have shown that chromium ions will be attenuated by the soil[3]. The effects of sodium dichromate would be short-term and reversible.

Sodium dichromate handling and storage systems will be designed with the proper construction materials and equipment to prevent accidental spills. Proper design indicates low probability of a spill. Within the concentrator building and the storage area, all spills will be contained and kept separate from other materials. This will afford the operator an opportunity to control and clean up spills in a safe manner.

Sulfuric acid will be received in bulk by truck or rail and will be stored in an above ground tank. The tank will be bermed and the berm will be lined to contain all spills. Materials of construction for vessels containing concentrated sulfuric acid are well defined.

With a proper design which complies with the MSHA regulations, the possibility of a spill is very low. Containment of spills in the storage area and the areas of use (water treatment) mitigate the potential effects to the environment. Should accidental sulfuric acid spills reach surface water, the pH of the water would be reduced in proportion to the amount of dilution. This effect would be short-term and reversible.

The effect outside the Project boundary would be small in that major consequences would require a continual spill of sizable quantity over a long period of time.

Conclusions

The risk of accidental reagent spills during routine Project operation will be a low probability event with properly designed reagent handling and storage systems. Consequences of small spills during reagent use will be mitigated by the containment and proper handling of each spill. Because these spills would be minor, discrete, short-term events, the consequences would not be severe. Since accidental spills would be localized, no threat to public health and safety will arise.

Contingency plans will be developed for the use of each reagent prior to operation. These plans will be used as training guides for the operators in the reagent area.

Comment No. 67

The EIR assumes that once the mine is operating, it will continue operating until the ore body has been completely mined. Exxon has addressed (comment 167) temporary shut down conditions, when the mine and facilities would be

[2]U.S. Environmental Protection Agency (EPA), "Water Quality Criteria Documents," 45 FR 79318, November 28, 1980.

[3]D'Appolonia, "Ground Water/Soil Attenuation Study, Crandon Project," July 1982.

maintained in a state of readiness. Under that situation, pumping the MWDF underdrain would continue, the mine dewatering would continue, and the tailings ponds would remain ready for use, and mining/milling could begin at short notice. In addition to short-term shutdowns, there is a possibility that mining would cease for longer periods of time. If that happened, would the mine ever be allowed to flood? Would the MWDF underdrain continue to be pumped? Would the tailings and reclaim ponds be allowed to dry? What would the closing duration have to be for these events to occur? For example, please discuss the potential impacts which would result from a closure of 2-5 years. Include in the discussion potential impacts to ground water quality, surface water quality, and implications of restarting the mine.

Response:

Cessation of mining, not set forth in the Mining Plan, will be conducted in a lawful manner under Wisconsin Statute 144.875, which requires that the operator notify the department and commence stabilization of the mining site. As presented in Statute 144.875, "If the department determines after hearing that stabilization of the mining site is inadequate to protect the environment, the department shall order the operator to commence additional measures to protect the environment, including, if the cessation is reasonably anticipated to extend for a protracted period of time, reclamation according to the reclamation plan or part of the reclamation plan." The following discussion briefly considers the points raised in the questions.

Evaluations of shutdown/startup questions during the operating life of the property consider many of the same parameters as the initial decision to start construction of a new mine. These considerations are similar whether the shutdown period is several months or several years. Some of these factors include:

1) The cost of maintaining facilities during shutdown, including environmental costs;

2) The cost of restarting the facilities;

3) The anticipated future metal prices and operating expenses;

4) The anticipated availability of personnel if the facility is restarted;

5) The remaining ore reserves; and

6) The cost of reclamation.

In general, the potential to restart the operation is more likely early in the property life when future ore reserves are still relatively high. As the remaining tonnage to be mined decreases, the restart of the operation becomes more difficult.

If the Project stopped operations for 2 to 5 years and the understanding was that it would be restarted at the end of this period, then the following might be expected:

1) The mine dewatering pumps would continue to operate;

2) The tailings underdrain pumps would continue to operate;

3) Chemical stabilization would occur of the tailings surface; and

4) The water treatment facilities would continue in operation.

The ramification of the above events would be the extension of the mine/mill operation and reclamation time periods.

If the shutdown decision included allowing the mine to flood, then there would be little hope that the mine would be restarted. In this instance the property would be closed and final reclamation work begun. The ramification of these events would be the premature termination of the operations. Environmental impacts would be as projected for the closure period and the reclamation plan would be completed.

Comment No. W1

The areas proposed for development appear reasonable based on the wetland acreage minimization criterion outlined in ch. NR 132. Further discussion is needed, however, to justify wetland impacts of the preferred access road corridor, since it is not the least acreage alternative.

Response:

The difference in wetland area affected by the proposed access road (2.6 ha [6.6 acres]) versus Alternative E (1.0 ha [2.5 acres]) is 1.6 ha (4.1 acres) (see EIR Table 4.4-2). Alternative E is aligned with the existing road system from STH 55 to the mine/mill site (EIR Figure 4.1-14). Alternative A would have a greater effect by 2.4 ha (5.9 acres) on wetlands than would the proposed action.

The main reason Alternative E was not selected is because a portion of this route passes through the Mole Lake Indian Reservation. This route also requires traffic to and from the mine/mill site to pass through the Sokaogan-Chippewa Community on STH 55. An increase in traffic of approximately 46 percent over current levels would occur if Alternative E is selected as the preferred route. Because of the potential impacts associated with increased traffic through the Sokaogon-Chippewa Community by using Alternative E, this alternative was not selected as the proposed route. The minor increase in disturbance of wetland vegetation (1.6 ha [4.1 acres]) associated with the proposed route was judged to be less of an impact than those associated with Alternative E.

In addition to the above factors, when the impacts to wetlands are reevaluated using a 30 m (100 feet) rather than a 60 m (200 feet) corridor width for the access road, as requested by the DNR, the area disturbed will be considerably reduced (see response to comment No. 46).

Comment No. W2

It is predicted that the only wetland to be affected by mine dewatering is Z17 (EIR 4.2-26), identified as the only water table wetland within the expected cone-of-depression. Yet there is some reduction in flow to certain surface waters even beyond the expected zone of influence. Since these surface waters possess associated wetlands, it would appear that some wetland impacts may also be expected. Also, the extent of groundwater connected wetland impacts may be influenced by further refinement and modification of groundwater models by Exxon and the Department. We will have to review this new information as it relates to wetlands as it becomes available.

Response:

Comment acknowledged. After additional ground water modeling has been completed to address specific DNR verification needs, as identified in comment No. 25, the potential impacts to water table wetlands, including those associated with surface water bodies (e.g., Swamp and Hemlock creeks), will be reevaluated. The results of this reevaluation will be presented in the revised EIR.

Comment No. W3

Wetlands were identified as being perched or water table linked without explanation of how this was determined for each wetland. Explanation of how this condition was determined for each wetland inventoried within the expected zone of influence of mine dewatering is necessary to evaluate impacts to these wetlands. In your explanation please refer to the presence of spring seeps in the vicinity of wetlands that have been classified as perched (Figure 2.3-17 of the EIR).

Response:

The determination of perched versus water table hydrologic position for wetlands was based upon the following: The surficial geological map prepared by Simpkins et al. (1981) was examined to determine if the wetland in question occurred in an area of stratified sand and gravel or in an area of glacial till. Stratified sand and gravel were considered to have a higher potential to be water table wetlands than perched. The opposite was considered for wetlands on glacial till. The piezometric surface map prepared by Golder Associates was also reviewed. Wetlands which had a ground surface elevation similar to that of the piezometric level were considered to be water table wetlands. Those wetlands which occurred in till areas that had an elevation above the piezometric surface were considered perched. Each wetland was examined in the field and an opinion was formed based upon characteristics such as vegetation, open water, inflow-outflow differences, springs, and observed surficial geology. Spring seeps shown on Figure 2.3-17 of the EIR were not used in the determination of perched versus water table wetlands. Presence of spring seeps alone does not prove conclusively that a wetland is a water table wetland. Spring seeps can be caused by a large number of hydrogeologic features. In areas of dense till, spring seeps are commonly associated with perched wetlands caused by soil interflow occurring at the interface between weathered and unweathered till (i.e., piping and long joints in till).

Comment No. W4

In testing the consultants' wetland evaluation models on a sample of wetlands, both with our own field data as well as theirs, we had difficulty in achieving the same results. While the size of the differences are not substantial, the number of differences are. The number of differences can affect the relative rankings and the model means which are used in the impact analysis. This problem needs to be reconciled.

Response:

The DNR review of the model results consisted of two parts: Calculation of model scores using the data contained on the consultants' wetland inventory reports and comparison of those scores with the consultants' scores, and field verification of the models by DNR staff and comparison of those scores with the consultants' scores. Review of these score differences with the DNR personnel performing these checks showed that in all cases the consultants' scores were mathematically correct and the models properly applied. Differences between DNR calculated scores using the consultants' data and scores calculated by the consultants were a result of the DNR not fully understanding all of the elements used in the model and the application of those elements to the models. In addition, some mathematical errors and possible computer errors were identified in the DNR data, which created differences in scores. Also, the DNR used a draft wetland inventory report, whereas the consultants used the final wetland inventory report in their data calculations. The final wetland inventory report included additional elements which were not included in the draft inventory report. This caused misinterpretation on the part of the DNR regarding data on the geologic deposits of the wetland versus those of the watershed.

Other differences in data collection resulted from the DNR staff spending more time in the field in the 12 wetlands they investigated compared to the time spent in these same wetlands by the consultants. This resulted in more lengthy plant species lists; however, this did not affect the model results. Discrepancies between DNR and the consultants' estimates of ecological elements, such as vegetative density, were attributed to differences in professional judgment and were within the variations expected by the consultants.

In summary, the consultants' model scores were correct. Actual differences between the DNR field data and the consultants were minor and did not affect the relative rankings and the model means used in the impact analysis.

Comment No. W5

We have not been able to normalize the wetland scores to achieve the same results as the consultant. We understand, from an inquiry by the Department (R. Read) to the consultant, that the normalization process described in Appendix L of the Wetland Assessment Report was not used. Instead a scaling process was utilized. However, we have still not been able to achieve the same "normalized" results that are presented in Table 6.2-2 of the Assessment Report and Table 5.2-2 of the Supplemental Assessment Report. This problem needs to be reconciled.

Response:

The model scores of the 127 wetlands presented in the August 1982 Wetlands Assessment Report were normalized using the method contained in Appendix L of that report. The model scores of the 31 wetlands in the August 1983 Supplemental Wetlands Assessment Report were not normalized using the method in Appendix L, but were normalized by using a scaling procedure. Minor changes will be made in wetland inventory data resulting from combining additional DNR wetland observations since 1979 with those of the consultants. These changes will affect the unnormalized scores of 15 wetlands. Once these unnormalized scores are computed, all 158 wetlands will be normalized using the method defined in Appendix L. Table 5.2-2 of the Supplemental Wetlands Assessment Report will be revised using the new normalized scores.

Comment No. W6

1) Based on the known geographical distribution of the following species, we believe that they may have been misidentified by the consultants. Examination of vouchers by the consultants should be made to determine the correct identification. Should they prove to be correctly identified, the presence of these species in studied wetlands would indicate special biotic values.

2) Picea rubens (Red Spruce) — Not recognized as a native Wisconsin species.

3) Kalmia angustifolia (Sheep Laurel) -- An eastern species not yet recognized as a native Wisconsin species.

4) Vaccinium corymbosum (Highbush Blueberry) — An exceedingly uncommon species in Wisconsin, not known to occur in northeastern Wisconsin.

5) Quercus muehlenbergii (Chinquapin Oak) — Quercus muehlenbergii occurs in Wisconsin on dry prairie sites in southwestern Wisconsin.

6) Scirpus atrocinctus (Bulrush) — Considered synonymous with S. cyperinus (Wool-grass), which is also listed as occurring in the same wetland (Z1) (plus cf. 3.1 - 2, Supplemental Assessment Report).

7) Fraxinus pennsylvanica var, subintegerrima and Fraxinus nigra -- Our field investigations found that F. nigra was by far the most prevalent ash species in wetlands, while the consultants found green ash to be most common. We think black ash is the common wetland ash species.

Response:

1) If there were species misidentifications, this had no effect on the results of any of the models or the relative rating or ranking of the wetlands. One case involved confusion between two nearly identical species having different distributions (e.g., Spiraea latifolia mistaken for S. alba). In two other cases, the problems involve a typing error (the species name for bur oak) or differences in the proportions of two similar species (green and black ash).

2) Picea rubens (Red Spruce) -- Foliage samples collected from specimens that appeared different during the field examination from typical black spruce were examined in the laboratory (based upon descriptions in Grays Manual and Britton and Brown) and had characteristics inconsistent with black spruce and more nearly matching those of red spruce. Lacking mature cones at the time of the investigations, conclusive identification was not possible. A statement will occur on the errata sheet that red spruce on the field inventory report should be Picea sp.

3,4) Kalmia angustifolia (Sheep Laurel) and Vaccinium corymbosum (Highbush Blueberry) -- A statement will also be included on the errata sheet that sheep laurel and highbush blueberry on the field inventory reports are to be revised to Kalmia sp. and Vaccinium sp., respectively.

5) Quercus muehlengergii (Chinquapin Oak) — A statement will occur on the errata sheet noting this change in species name to Q. macrocarpa on the field inventory report.

6) Scirpus atrocinctus (Bulrush) — Considered a separate species in Grays Manual, and readily distinguished from S. cyperinus on the basis of (1) spikelete pedicelled and (2) base of involucre and involucels black. In S. cyperinus spikelets are sessile, base of involucre and involucels brownish.

7) Fraxinus pennsylvanica var. subintegerrima and Fraxinus nigra (Green Ash and Black Ash) -- It is acknowledged that black ash may be more prevalent in some areas of the site area than others. Differences in opinion may be based on (1) the wetlands and portions of wetlands visited and (2) difficulties in distinguishing these species during early spring without examination of the buds, which was usually not possible. Since both species have been positively identified in the site area by the DNR and EMC wetlands consultants, their relative proportions are not important with regard to the results of the investigations.

Comment No. W7

We would like to know how the element describing the surficial geologic material of the wetland bank (Storm and Flood Water Storage Function Model) was distinguished from "surficial material of watershed" element for the same model. There is no place on the field data collection sheet for recording of "wetland bank surficial material."

Response:

The element "Surficial Geologic Material of the Wetland Bank" in the Storm and Flood Water Storage Function Model is obtained primarily from the element "Surficial Material." In most cases they are identical. "Surficial Material" is that geologic material which underlies the wetland. "Surficial Geological Material of the Wetland Bank" is that geologic material which constitutes the wetland's immediate banks (upland area). Occasionally they are different when the wetland-upland boundary is also a surficial geologic boundary. The surficial geologic map of Simpkins et al. (1981) was used for these determinations as well as field observations by the geological consultant. "Surficial Material of the Watershed" is the dominant (>50 percent) surficial geological material which is found within the wetland's watershed and is not always the same as the "Surficial Material" under the wetland nor the "Surficial Material of the Wetland Bank."

Comment No. W8

Table 6.1-1 in the Assessment Report, and Table 5.1-1 in the Supplemental Report, summarize the major elements used to describe and evaluate the wetlands. These are qualitative descriptors, and are not explained in the text. It is not clear how they were derived from the field data sheets. The derivation of most of these elements can be surmised, such as: "Water Storage" in the tables apparently summarizes "Dominant Hydrologic Type" on the field inventory sheets. A discussion of what these descriptive elements are, and how they achieved, would be useful. For example, what exactly is meant by "Living Filter Capacity"?

Response:

The following information describes the major qualitative elements in Table 6.1-1:

Dominant Wetland Type - Synonymous with "Dominant Wetland Class" in the wetland inventory report. This assignment is made at the end of the wetland visit after all of the wetland subclasses and their relative proportions are known.

Amount of Edge - "Wetland Class Richness", "Subclass Richness" and "Vegetative Interspersion" are the elements in the wetland inventory report that are the basis for this qualitative element. The number of different wetland classes and subclasses and their degree of interspersion are the factors controlling the amount of edge in the wetland. This determination is made from aerial photographs and wetland visits after all the classes and subclasses and their shapes and distributions have been established.

Water/Cover Ratio - This element is based entirely on "Cover Type" in the wetland inventory report, and denotes the relative proportions of vegetative cover and water in a wetland and their degree of interspersion. This is determined from aerial photographs and wetland visits after an overview of the wetland has been completed.

Surrounding Habitat Variability - This element is synonymous with "Surrounding Habitat Variability" in the wetland inventory report, and denotes the number of different landscape elements comprising the surroundings. A wetland surrounded by an upland mixed forest would be assigned to the second designation under this element, whereas one bordered by a forest on one side and a lake or open field on another would be considered to be surrounded by "90 percent of 2 or more of the listed types." The types are not actually listed in the inventory report, but this terminology refers to any landscape elements which are predominantly non-urban. This determination would be made from aerial photographs following the wetland field reconnaissance.

Percent Bordering Open Water - Synonymous with "Percent Wetland Bordering Open Water" in the wetland inventory report. This determination is made from aerial photographs following the wetland field reconnaissance.

Recharge Potential - Elements that were considered to qualitatively assess a wetland's ability (i.e., potential) to recharge surface water to the underlying ground water were "Surficial Geologic Material," "Dominant Hydrologic Type," "Hydrologic Position," and "Ground Water Outflow" with "Surficial Geologic Material" being the dominant element. These elements were determined using available geologic and hydrogeologic data and field observations.

Water Storage - This element is an estimate of a wetland's ability to detain and retain surface water. The inventory elements which were used to estimate qualitatively a wetland's water storage potential were "Topographic Configuration," "Wetland Gradient," "Topographic Position in Watershed," "Organic Material," "Dominant Hydrologic Type," "Water Level Fluctuation," and "Surficial Geologic Material of the Watershed." The dominant element considered was dominant hydrologic condition. These elements were determined by using geologic and topographic maps, available hydrogeologic data, and field observations.

Discharge To Downstream Aquatic Systems - This is an estimate of a wetland's ability to maintain downstream water quality and quantity. Inventory elements used in this qualitative assessment were "Topographic Configuration," "Topographic Position in the Watershed," "Hydrologic Position," "Dominant Hydrologic Type," "Hydrologic

Connection" and "Outlet." Available hydrologic data, topographic and geologic maps, and field inspection were used to obtain this data.

Living Filter Capacity - This element denotes pollution attenuation capacity of the wetland and is assessed on the basis of best professional judgment applied to the vegetation and soil characteristics observed in the wetland, and the wetland's geologic setting. The length of time that a unit of water spends in the wetland, the wetness of the substrate, physical characteristics of the substrate as they relate to cation exchange capacity, life form of the vegetation as it relates to the uptake of nutrients, metals and other elements, and vegetative density are all factors that determine the wetlands' "Living Filter Capacity." "Dominant Wetland Class," "Cover Type," "Vegetative Density," "Topographic Configuration," and "Dominant Hydrologic Type" are the major elements in the wetland inventory report that determine the "Living Filter Capacity." These elements are determined from aerial photographs and from wetland visits after an overview of the geological and biological conditions has been completed.

Size - After a wetland's acreage has been measured, it is assigned to a size category. These categories are established after the size distribution of all wetlands in the area of interest has been determined.

Comment No. W9

Inventory Report Format: The dominant class listings on the field data sheets do not conform to the six classes described in the text. Deciduous and coniferous swamps are lumped together on the front page of the inventory, yet are distinguished elsewhere in the report. Conversely, though "Wet Meadow" and "Shallow Marsh" are considered identical in the report, they are presented as two distinct categories on the cover page of the inventory report form.

Response:

The inventory report cover sheets should have divided wooded swamp into deciduous and coniferous components. The inventory data contained on the second page in Appendix G and on the wetland maps all divided wooded swamp into coniferous and deciduous parts. Conversely, wet meadows and shallow marsh are both listed on the cover and on the second page. The information on the front page is summary information and is not used in calculating the model scores. The data shown on the front page have no influence on the model scores or the ranking of wetlands.

Comment No. W10

Throughout the Assessment Report there are disagreements about the dominant wetland class of various wetlands. We have used the field data sheets as the final word on any questions about wetland type, but the high number of these presumably typographic errors needs to be pointed out. There are numerous discrepancies among the inventory reports, Table 3.5-1, Table 6.1-1, and Appendix G. For example:

Wetland	Inventory Report	Table 3.5-1	Table 6.1-1	Appendix G
D3	D.S.	D.S.	D.S.	C.S.
D3	D.S.	D.S.	D.S.	C.S.
F60	C.S.	D.S.	C.S.	C.S.
B4	C.S.	C.S.	C.S.	C.S.

D.S. = Decidous Swamp
C.S. = Coniferous Swamp

When the field data sheets are used to correct these discrepancies, summary tables, such as Table 6.3-1 in the Assessment Report, are significantly changed (seven wetlands out of forty-six are shifted into different categories in Table 6.3-1.

Response:

The dominant wetland class shown on the wetland inventory reports is used when entering data into the models for the purpose of calculating model scores. The discrepancies noted by the DNR in the tables of the report are typographical errors and do not affect the model scores. The typographical errors will be addressed in an errata sheet and Table 6.3-1 of the Wetland Assessment Report will be revised and submitted as part of the errata sheet.

Comment No. W11

Comments on Specific Wetlands:

The following specific comments apply to wetlands in the vicinity of the proposed mine which were identified in the Supplemental Wetlands Assessment Report (SWAR) and Wetland Assessment Report (WAR). The comments are listed here as examples of differences between Department and Exxon's consultant's observation of wetland classification and function. While some of these differences may not be significant in terms of wetland evaluation or impacts to them, others may be significant. Please review the following comments and address those which could be significant in altering wetland scoring or facility placement, or significantly alter projections of impacts.

Response:

During a meeting on January 24, 1984 with DNR (G. Egtvedt, R. Read and J. Welch), EMC and EMC's wetlands consultants (IEP, Inc. and Normandeau Associates, Inc.) discussed each of the following specific comments. The results of this meeting provided the basis for the responses to comments No. W12 through W42. Some of the changes in the biological and hydrological characteristics of the wetlands that were agreed upon during the meeting may affect the model results. The inventory reports for the affected wetlands and the model results presented in tables in the Wetlands Assessment reports will be revised. An errata sheet listing the revisions and revised copies of the tables and inventory reports for the Wetlands Assessment reports will be issued to the DNR when completed.

Comment No. W12

Wetland Z-2 - There is an open water area located along this wetland's southern edge not identified in the SWAR. Also, separate from this wetland is a small pond. The pond appears to discharge to Z-2 during high water periods.

Response:

Following a discussion of this comment with the DNR, it was concluded that the small pond referenced is separate from wetland Z2. Although the pond may discharge to wetland Z2 under high water conditions, during average conditions it does not. This comment does not affect the model results.

Comment No. W13

Wetland Z-5 - The field inspection and the vegetation list provided in the SWAR indicate this wetland should be classified a "shallow marsh" rather than a "shrub swamp".

Response:

The acreage indicated on the cover page of the inventory report was improperly labeled "Shrub Swamp" rather than "Shallow Marsh"; however, on the second page of the report the data were correctly presented in the shallow marsh category. Data presented on the second page of the inventory report are used in calculating model results; therefore, no change in model results is necessary. The error on the cover page of the inventory report will be corrected and a revised report will be included with the errata sheet containing revisions to the Wetlands Assessment reports.

Comment No. W14

Wetland Z-6 - This wetland does not have an inlet from Wetland Z-10, as indicated in the SWAR (see direction on Wetland Z-10 for details).

Response:

The DNR's observation that wetland Z10 discharges to Z9 rather than Z6 is correct. The inventory report for Z6 will be changed to remove the inlet from Z10. This change will affect the Hydrologic Support, Storm and Flood Water Storage, Ground Water, and Water Quality Maintenance function models by decreasing their scores by 1, 1, 2 and 2 points, respectively. These changes do not affect the ranking of this wetland.

Comment No. W15

Wetland Z-7 and Wetland Z-9 - These wetlands are the headwaters of streams 24-14 and 24-15 T35N R12E. Department surveys have determined both of these streams pass through Wetland W-2 before reaching Swamp Creek. The original "Wetlands Assessment Report" indicates Wetland W-2's outlet is located "off site". Wetland W-2's inventory report should be completed now that it is included in the wetland study area.

Response:

The EMC wetlands consultants observed these streams in the field and agree with the DNR's observations. The study area for the original Wetland's Assessment Report did not include both streams within the area assessed for wetland W2. However, the study area for the Supplemental Wetlands Assessment included both of these streams as part of wetland W2. One perennial inlet will be added to W2's inventory report which will increase the Hydrologic Support function by 2 points, Ground Water by 3 points, Storm and Flood Water Storage by 2 points and Water Quality Maintenance by 4 points. This will not greatly change this wetlands ranking.

Comment No. W16

Wetland Z-9 - The SWAR does not indicate that this wetland receives surface water flow from Wetland Z-10 (see Wetland Z-10 discussion for details).

Response:

The DNR's observation that wetland Z10 discharges to Z9 is correct. The inventory report for Z9 will be corrected and the models recalculated. The Hydrologic Support function will increase by 2 points, Ground Water by 3 points, Storm and Flood Water Storage by 2 points and Water Quality Maintenance by 4 points. This wetland's ranking will not change.

Comment No. W17

Wetland Z-10 - This wetland discharges to Wetland Z-9 via a culvert under the logging road that separates the two wetlands. Creek 24-4, T35N, R12E, originates in Wetland Z-10. A channel approximately two feet wide is present immediately downstream from the culvert. There was a flow of approximately one-half cfs during a July 26, 1983, field inspection. Wetland Z-10's outlet is incorrectly identified as flowing to Wetland Z-6 in the SWAR.

Response:

As discussed in the response to comments No. W14, W15 and W16, discharge from wetland Z10 is to Z9. This correction results in no change to the inventory or model results for wetland Z10.

Comment No. W18

Wetland Z-15 - Though not indicated in the SWAR, water from this wetland appears to follow its historical route to Z-11 during high water periods passing over the town road that separates the two wetlands. No culvert could be found connecting the two wetlands.

Response:

Comment acknowledged. Both the EMC wetlands consultants and the DNR are in agreement that ephemeral discharge from wetland Z15 occasionally occurs; however, this surface water flow disappears before it reaches another wetland and thus no outlet occurs. No change in the model results is necessary.

Comment No. W19

Wetland Z-16 - The SWAR lists this wetland as having no outlet. However, a District field inspection determined the wetland intermittently drains to the south through a culvert under Keith Siding Road to Wetland T-4. The open water portion of the wetland identified in the SWAR is listed in "Surface Waters of Forest County" as Lake 17-16, T35N, R13E.

Response:

During detailed inspection by DNR staff a culvert was located which intermittently drains water from wetland Z16 to T4. Wetland Z16 will be given an ephemeral outlet. This will add 32 points to the Hydrologic Support function model score, 2 points to Ground Water, minus 1 point from the Storm and Flood Water Support Model and minus 2 points from the Water Quality Maintenance function model. A minor change in the ranking of this wetland probably will occur. Wetland T4 which has three inlets on the inventory sheet will be credited with a fourth inlet and its scores will increase similar to those described for Z9 (see response to comment No. W16); however, the ranking of this wetland should not change. We acknowledge the fact that the open water portion of wetland Z16 is listed in the "Surface Waters of Forest County."

Comment No. W20

Wetland Z-18 - The SWAR does not recognize that this wetland complex is listed as Hoffman Spring in the "Surface Waters of Forest County."

Response:

Comment acknowledged.

Comment No. W21

Wetland Z-20 - Our inspection of this wetland determined the forested portion has primarily "conifer" rather than "deciduous" tree species as listed in the SWAR.

Response:

Based on a discussion of wetland Z20 with the DNR staff, it was agreed that this wetland would remain as a deciduous swamp. No change in the model results is necessary.

Comment No. W22

Wetland Z-21 - This wetland discharges to Z-20 during periods of high water, contrary to being listed as having no outlet in SWAR. Wetlands Z-20 and Z-21 appears to be contiguous on their north ends during high water periods.

Response:

Based on a discussion of wetlands Z20 and Z21 with the DNR staff, it was agreed that these wetlands should remain separate. No change in the model results is necessary.

Comment No. W23

Wetland Z-22 - This wetland drains south through a culvert under Little Sand Lake Road to Wetland Z-20 during high water periods. This is contrary to the "absent" outlet listing in the SWAR. The open water area portion of the wetland identified in the SWAR listed as Lake 25-11, T35N, R12E, in the "Surface Waters of Forest County".

Response:

The DNR staff located a culvert under Little Sand Lake Road between wetlands Z22 to Z20. The inventory reports for both of these wetlands will be revised to include an outlet for Z22 and an inlet for Z20. The model scores for these wetlands will be recalculated and included in an errata sheet containing the revisions to the Wetland Assessment reports. We acknowledge the fact that the open water portion of wetland Z22 is listed in the "Surface Waters of Forest County."

Comment No. W24

Wetland Z-23 - The drainage characteristics of this wetland have not yet been determined. However, recent information indicates that the wetland discharges to both Rolling Stone and Mole Lakes rather than having Mole Lake as its outlet. Our inspection of this wetland determined the primary tree species are black spruce and tamarack. Black spruce is listed in the SWAR as only an "occasional" species and tamarack is not listed at all.

Response:

Based on a discussion of wetland Z23 with DNR staff, it was agreed that surface water flow occurs in both a northerly and southerly direction in this wetland. It is also acknowledged that black spruce and tamarack are dominant species in this wetland. These conclusions have no impact on the model results.

Comment No. W25

Wetland F-10 - While this wetland is for the most part contiguous with Little Sand Lake, it is doubtful if waterflow is perennial as listed in WAR.

Response:

Wetlands contiguous with a surface water body (i.e., lakes) were defined as having a perennial outlet because of year-round exchange of water between the two systems.

Comment No. W26

Wetland F-15 - The WAR did not identify the ephemeral surface water discharge in this wetland's southwest corner. In addition, the WAR does not identify the large portion of Wet Meadow within this wetland.

Response:

A well defined connection between wetland F15 and Skunk Lake is not evident as discussed in the response to comment No. W18. The EMC wetlands consultants agree that a portion of this wetland is wet meadow, but this has no impact on the model scores.

Comment No. W27

Wetland F-17 - This wetland's ephemeral surface water discharge to Wetland F-16 was not identified in the WAR.

Response:

Although the EMC wetlands consultants did not observe an outlet from wetland F17 during the 1982 field inventory, the DNR's observations confirm such an outlet. The wetland inventory report will be revised to include an ephemeral outlet, and the model scores for wetland F17 will be recalculated. The score changes will be similar to those discussed in the response to comment No. W19 for wetland Z16 and a minor change in ranking probably will occur.

Comment No. W28

Wetland F-19 - Water depth in the portion of this wetland adjacent to Deep Hole Lake would be sufficient to require a classification of Deep Marsh. This was not recognized in the WAR.

Response:

Following a discussion of this comment with the DNR, it was agreed that no change in the inventory report of wetland F19 is necessary.

Comment No. W29

Wetland F-33 - The WAR did not identify this wetland's ephemeral surface water discharge to the north during high water conditions. It is not an isolated wetland and could be included in the water balance study.

Response:

EMC wetlands consultants and the DNR agreed that wetland F33 does not have an outlet. Field observations have not confirmed that surface water from wetland F33 does reach another wetland. No change in the inventory report for wetland F33 is needed.

Comment No. W30

Wetland F-60 - The WAR lists this wetland's inlet as originating in F-68. There is no F-68 wetland.

Response:

The inlet for wetland F60 originates in F61. This typographical error will be listed in the errata sheet containing revisions to the Wetlands Assessment reports.

Comment No. W31

Wetland F-62 - This wetland is listed as a zero summer discharge, however, it has been observed flowing during and after rainy periods.

Response:

The inventory report lists an ephemeral outlet for wetland F62 which is in agreement with the DNR observations. No change in the model results is required.

Comment No. W32

Wetland F-70 - Our investigation of this wetland resulted in a classification of Shallow Marsh. The WAR classified the wetland as Wooded Swamp.

Response:

The wetland maps (WAR Figures 4.3-1 and 4.3-11) indicate wetland F70 is predominately a shallow marsh. The inventory report will be revised and the model results recalculated. Ranking of this wetland should not be affected. The corrected model scores will be included in the errata sheet containing revisions to the Wetlands Assessment reports.

Comment No. W33

Wetland F-72 - The WAR did not identify this wetland's ephemeral surface water discharge to Wetland F-60.

Response:

Discussion of this comment between the EMC wetlands consultants and the DNR resulted in an agreement that an outlet did not exist and changes in the model results for wetland F72 are not necessary.

Comment No. W34

Wetland F-81 - This small pond intermittently drains south across the road via a steel pipe. This surface discharge was not identified in the WAR.

Response:

The EMC wetlands consultants acknowledge that a culvert does exist but flow from this culvert does not reach another wetland and thus wetland F81 does not have an outlet. The DNR staff agreed with this observation and no change in the model scores is needed for F81.

Comment No. W35

Wetland F-114 - The WAR did not identify this wetland's ephemeral surface water discharge to the southwest.

Response:

Based upon the DNR's longer record of observations of this wetland, an ephemeral outlet will be assigned to F114 and the wetland model scores will be revised. These revisions will be similar to those made for wetland Z16 (see response to comment No. W19) and a minor change in ranking probably will occur.

Comment No. W36

Wetland F-119 - We identified a portion of this wetland as Shallow Marsh in addition to the WAR classification of Wooded Swamp.

Response:

The inventory report for wetland F119 includes shallow marsh as a subtype but the area of this wetland type was too small to phototype and measure. No change in the model scores for F119 is required.

Comment No. W37

Wetland H-1 - The WAR did not identify this wetland's ephemeral surface water discharge to the east.

Response:

Following discussion with the DNR staff, it was agreed that there is no outlet for wetland H1. No change in the model results is necessary.

Comment No. W38

Wetland K-4 - We classified this wetland as Shallow Marsh, while the WAR made the classification of Shrub Swamp.

Response:

After discussing this comment with the DNR staff, it was agreed that shallow fresh marsh would be added as a subtype and the model scores recalculated. Minor changes will occur in this wetland's score; however, its ranking should not be altered. The corrected scores and ranking will be included in the errata sheet containing revisions to the Wetland Assessment reports.

Comment No. W39

Wetland K-5 - The WAR did not identify this wetland's ephemeral surface water discharge to the northeast.

Response:

The EMC wetlands consultants and the DNR agreed that ephemeral surface water flow from wetland K5 does not reach another wetland; therefore, no outlet exists. No change in the model results is required.

Comment No. W40

Wetland M-4 - The WAR did not identify this wetland's ephemeral surface water discharge to the north.

Response:

Based on a discussion of the hydrological characteristics of wetland M4 with the DNR staff, it was agreed that no outlet exists. No change in model results is necessary.

Comment No. W41

Wetland R-7 - The WAR did not identify this wetland's ephemeral surface water inlet across the road to the north from Wetland R-7A.

Response:

There is no culvert under the road dividing wetlands R7 and R7A. Because the DNR has observed intermittent water flow over the road for a number of years, this wetland will be assigned an ephemeral outlet and its model results will be revised. The revisions will be similar to those for wetland Z16 (see response to comment No. W19) and a minor change in ranking probably will occur.

Comment No. W42

Wetland R-8 - The WAR did not identify this wetland's ephemeral surface water outlet to Wetland R-7A.

Response:

Based on a discussion of the hydrological characteristics of wetland R8 with the DNR staff, it was agreed that no ephemeral outlet exists. No change in the model results is necessary.