14.0 ECOSYSTEMS

The Office of Surface Mining Reclamation and Enforcement (OSMRE) regulations require all surface mining operations to minimize, to the extent possible, any adverse effects on fish, wildlife and related environmental values in the permit and adjacent areas (it is assumed that state regulations will require the same perspective). EPA has prepared "assessment guidelines" for New Source Coal Gasification Facilities (EPA-130/6-80-001). An outline of potential environmental impacts and relevant pollutants resulting from site preparation and construction practices has been previously prepared by others (Table 14.1) that provides the basis for individual project evaluation.

Similarly, a perturbation matrix can be developed relating activities during the construction and operation phases to environmental perturbations (biologic, geologic, edaphic, topographic, hydrologic, and meteorologic). A preliminary framework for the development of such a matrix is illustrated in Figure 14.1. Note that the development activities in this framework are essentially the same as those provided in Table 12.1 (Geology and Soils).

Many of the impacts associated with the exploration phase of the development of a coal mining project have already occurred in the general area due to activities of the oil, gas and logging industries. The area is crossed with many roads and seismic trails and dotted with barrow pits and abandoned drilling locations. Numerous air strip locations and old camp sites are also found throughout the region. Human activity, in the form of subsistence hunting and fishing, recreation and permanent residency occurs throughout the area.

CONSTRUCTION AND LONG-TERM EFFECTS

This section summarizes by project activity both the potential construction and long term effects of this project on the terrestrial,

Table 14.1

OUTLINE OF POTENTIAL ENVIRONMENTAL IMPACTS AND RELEVANT POLLUTANTS RESULTING FROM SITE PREPARATION AND CONSTRUCTION PRACTICES

Construction practice	Potential environmental impacts	Primary pollutants
1. Preconstruction		
a. Site inventory	Short term and nominal	Dust, noise, sediment
(1) Vehicular traffic	Dust, sediment, tree injury	
(2) Test pits	Tree root injury, sediment	
b. Environmental monitoring	Negligible if properly done	Visual
c. Temporary controls	Short term and nominal	Sediment spoil, nutrients, solid waste
(1) Sedimentation ponds	Vegetation destroyed, water quality improved	
(2) Dikes and berms	Vegetation destroyed, water quality improved	
(3) Vegetation	Fertilizers in excess	
(4) Dust control	Negligible if properly done	
2. Site Work		
a. Clearing and demolition	Short term	Dust, sediment, noise solid wastes, wood wastes
(1) Clearing	Decreased area of protective tree, shrub, ground covers; stripping of topsoil; increased soil erosion, sedimentation, stormwater runoff; increased stream water temperatures; modification of stream banks and channels, water quality	
(2) Demolition	Increased dust, noise, solid wastes	
b. Temporary facilities	Long term	Gases, odors, fumes particulates, dust, deicing chemicals, noise, petroleum products, wastewater, solid wastes aerosols, pesticide
(1) Shops and storage sheds	Increased surface areas impervious to water infiltration, increased water runoff, petroleum products	
(2) Access roads and parking lots	Increased surface area, impervious to water infiltration, increased water runoff, generation of dust on unpaved areas	

Table 14.1

Continued

OUTLINE OF POTENTIAL ENVIRONMENTAL IMPACTS AND RELEVANT POLLUTANTS RESULTING FROM SITE PREPARATION AND CONSTRUCTION PRACTICES

Construction practice	Potential environmental impacts	Primary pollutants
(3) Utility trenches and backfills	Increased visual impacts, soil erosion, sedimentation for short periods	
(4) Sanitary facilities	Increased visual impacts, solid wastes	
(5) Fences	Barriers to animal migration	
(6) Laydown areas	Visual impacts, increased runoff	
(7) Concrete batch plant	Increased visual impacts; disposal of wastewater, increased dust and noise	
(8) Temporary and permanent pest control (termites, weeds, insects)	Nondegradable or slowly degradable pesticides are accumulated by plants and animals, then passed up the food chain to man. Degradable pesticides having short biological half-lives are preferred for use	
c. Earthwork	Long term	Dust, noise, sediment debris, wood wastes solid wastes, pesticides, particulates bituminous products soil conditioner chemicals
(1) Excavation (2) Grading (3) Trenching (4) Soil treatment	Stripping, soil stockpiling, and site grading; increased erosion, sedimentation, and runoff; soil compaction; increased in-soil levels of potentially hazardous materials; side effects on living plants and animals, and the incorporation of decomposition products into food chains, water quality	
d. Site drainage	Long term	Sediment
(1) Foundation drainage (2) Dewatering (3) Well points (4) Stream channel relocation	Decreased volume of underground water for short and long time periods, increased stream flow volumes and velocities, downstream damages, water quality	
e. Landscaping		Nutrients, pesticides
(1) Temporary seeding (2) Permanent seeding and sodding	Decreased soil erosion and overland flow of stormwater, stabilization of exposed cut and fill slopes, increased water infiltration and underground storage of water, minimized visual impacts	

Table 14.1
Continued

OUTLINE OF POTENTIAL ENVIRONMENTAL IMPACTS AND RELEVANT POLLUTANTS RESULTING FROM SITE PREPARATION AND CONSTRUCTION PRACTICES

Construction practice	Potential environmental impacts	Primary pollutants
3. Permanent facilities		
a. Coal gasification plant and heavy traffic areas	Long term	Sediment, dust, noise particulates
(1) Parking lots	Stormwater runoff, petroleum products	
(2) Switchyard	Visual impacts, sediment, runoff	
(3) Railroad spur line	Stormwater runoff and sedimentation	
b. Other buildings	Long term	Solid wastes
(1) Warehouses	Impervious surfaces, stormwater runoff, solid wastes, spillages	
(2) Sanitary waste treatment	Odors, discharges, bacteria, viruses	
c. Possible ancillary facilities	Long term	Sediment, trace elements, noise, caustic chemical wastes, spoil, flocculants, particule fumes, solid waste nutrients.
(1) Intake and discharge channel	Shoreline changes, bottom topography changes, fish migration, benthic fauna changes	
(2) Water supply and treatment	Waste discharges, water quality	
(3) Stormwater drainage	Sediment, water quality	
(4) Wastewater treatment	Sediment, water quality	
(5) Dams and impoundments	Dredging, shoreline erosion	
(6) Breakwaters, jetties, etc.	Circulation patterns in the waterway	
(7) Fuel handling equipment	Spillages, fire, and visual impacts	
(8) Seed storage areas and preparation facilities	Visual impacts, waste discharges	
(9) Oxygen plant and gas upgrading plant	Sediment runoff, landscape alteration, waste discharges	
(10) Cooling towers, power transmission lines, pipelines, substations	Visual impacts, sedimentation and erosion	

Table 14.1
Continued

OUTLINE OF POTENTIAL ENVIRONMENTAL IMPACTS AND RELEVANT POLLUTANTS RESULTING FROM SITE PREPARATION AND CONSTRUCTION PRACTICES

Construction practice	Potential environmental impacts	Primary pollutants
(11) Conveying systems (cranes, hoists, chutes)	Visual impacts	
(12) Cooling lakes and ponds	Conversion of terrestrial and free flowing stream environment to a lake environment(land use trade-offs); hydrological changes, habitat changes, sedimentation, water quality	
(13) Solid waste handling equipment (incinerators, trash compactors)	Noise, visual impacts	Particulates, dust, solid wastes
d. Security fencing	Long term	Sediments, wood wastes
(1) Access road	Increased runoff	
(2) Fencing	Barriers to animal movements	

Source: Hittman Associates, Inc. 1974. General environmental guidelines for evaluating and reporting the effects of nuclear power plant site preparation, plant and transmission facility construction. Modified from: Atomic Industrial Forum, Inc. Washington DC.

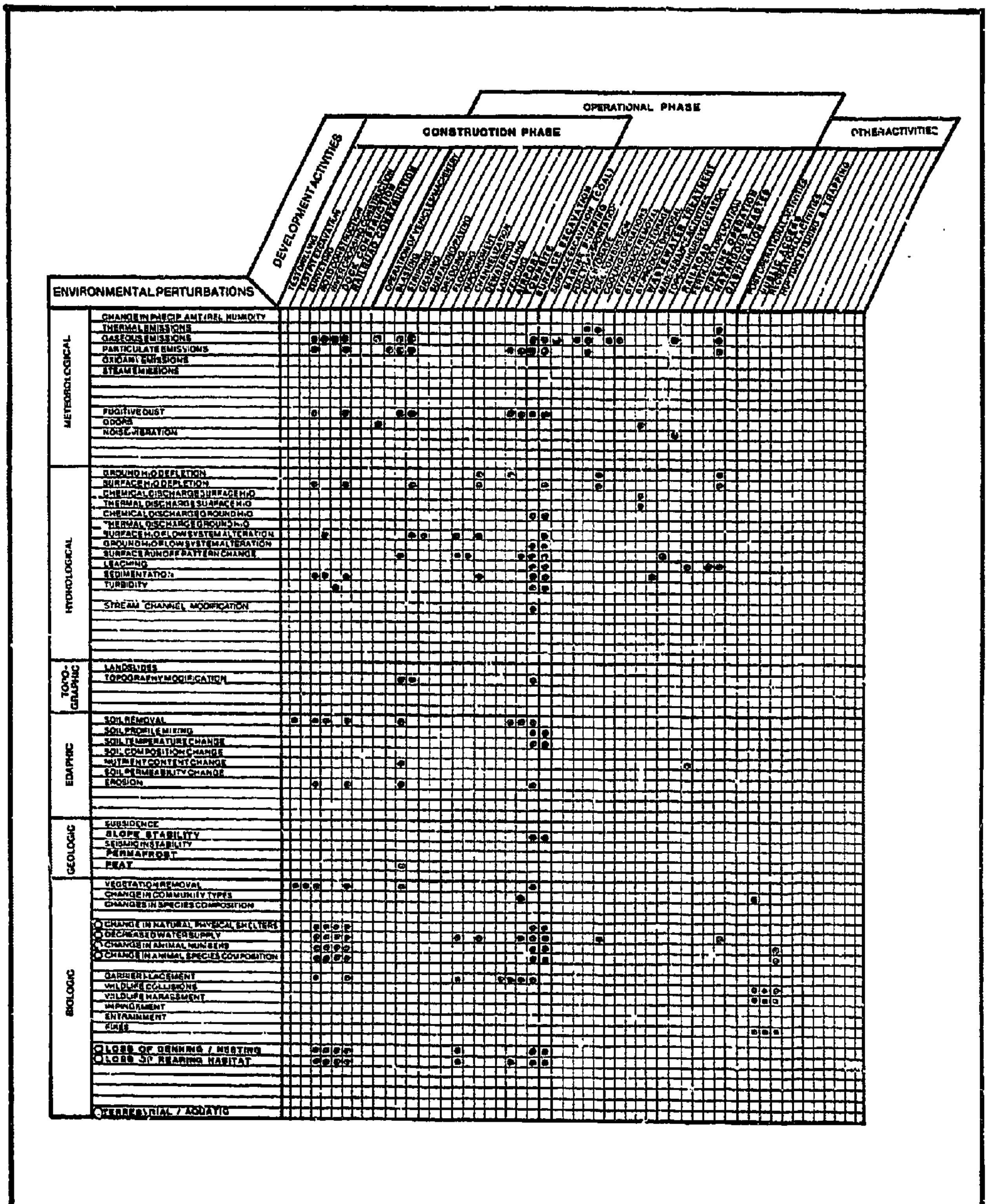

FIGURE 14.1 A POSSIBLE PERTURBATION MATRIX FOR CONSIDERING ENVIRONMENTAL IMPACTS OF THE METHANOL PROJECT

aquatic and marine ecosystems.

Overburden Removal

- Loss of vegetation
- Soil disturbance
- Loss of physical shelter
- Changes in surface drainage

(All existing habitats above the coal would be lost permanently.)

Ovarburden Storage and Disposal

- Loss of habitat (by burial)
- Spoil piles could result in:
  - increased semimentation
  - wind-blow erosion of soil particles
  - Leaching of mineral
- Modification of topography
- Modification of surface drainage

Dewatering

- Drawdown of water table
- Disposal of pumped water (with high dissolved solids content, high acidity, and high metallic ion concentrations)

Among the long term effects to be considered from the project, most are related to the mining operation and transportation of the feed stock.

Aquifer Changes

- Elementation of shallow aquifers
- Alterations of percolation properties
- Interruption of groundwater flow
- Drawdown of deep aquifers

Acid Mine Drainage

- Low sulfur characteristics of Beluga coal may minimize acidification (some general conditions to be expected from dewatering include low pH, high specific conductance, high concentration of metallic ions including iron, aluminum and manganese, and a high sulfate concentration).

Sedimentation and Erosion

- Sedimentation would result from removal of overburden, transportation, stream diversions, stream crossings and mine restoration.
- Dewater discharges may contain fine coal particles, black shale and assorted minerals.
- Coal washing would result in the suspension of fine particles of coal.
- Solid residues would need to be landfilled.

Surface Water Contamination

- Potential sources of water contamination are acid mine drainage, surface runoff, thermal effluent, various water and coal treatment chemicals, dust, leacheates from blasting residues, spoil piles, fuel spillage, ash, toxic strata and industrial wastes.
- Introduction of these contaminants would include charges in the dissolved oxygen content of the water, altered rates of photosymthesis, reduced light penetration, temperature change, pH changes, metallic ion changes and a deterioration of the color and odor of water.

Groundwater Contamination

- Replacement of overburden in mine could have long-term effects on groundwater.
- Fuel spills.

Site Restoration

- New vegetation types (monoculture)
- Increased soil permeability (acceleration of mass wasting processes)

Surface Water Changes

- Changes in groundwater levels and/or stream flows

Methanol Production

- Groundwater and surface water depletion
- Thermal pollution
- Potential acid rainfall
- Methanol spills
- Surface water from contamination from sludge disposal, gas purification, and wastewater disposal

Increased Harvest and Utilization of Fish and Wildlife Resources

- Increased harvest of limited populations (due to increased population and ease of access)

Of the above possible impacts, the greatest concern focuses on the impacts related to possible harm to the fishery resource by:

- Destruction or removal of habitat
- Increased sedimentation
- Disruption or depletion of flows
- Changes in water quality

The final analysis of impacts from this project on fish, wildlife and related environmental values will require the completion of the requisite baseline studies and the completion of mine plans and final design of the project.

MAJOR REGULATORY REQUIREMENTS

Regulations for construction and operation of this facility relative to impacts on ecosystems would be enforced through the EPA, DEC, NMFS, FWS and DF&G. This regulation would most likely be in the form of stipulations concerning both construction and operation that became a part of either a COE permit for "Discharge of Dredged or Fill Material Into U.S. Waters" or an EPA "Permit to Discharge Into Water" (NPDES). In addition, stipulations related to the issuance of DF&G's "Anadromous Fish Protection Permit" would provide the state's primary method for protecting and preserving fish and game of anadromous waters.

ENVIRONMENTAL ACCEPTABILITY OF PROPOSED ACTION

The vast majority of the potential impacts associated with the proposed project can be mitigated by proper design, construction and operational procedures. However, impacts on the headwaters of many of the smaller streams within the system would be unavoidable due to the very nature of mining operations. The loss of habitat created by the mines should not, of itself, constitute a substantial impact on the terrestrial ecosystems; and the reclamation plans provide for the restoration of such habitat as is lost in the initial mining stages. Loss of some wetland habitat on the Nikolai escarpment would be inevitable with the construction of the facility.

Many of the potential impacts indicated will be considered in greater depth as field investigations continue and more adequate baseline information becomes available. This additional information will provide the basis for the development of adequate mitigative measures

15.0 AIR QUALITY

Atmospheric pollutant emissions are associated with virtually every aspect of the proposed project from the mining of coal to the synthesis and shipping of product methanol. Sulfur oxides, particulate matter, nitrogen oxides, carbon monoxide, and hydrocarbons represent the bulk of these emissions. The means by which pollutants are introduced to the atmosphere vary according to the operations creating the pollutants. Contaminated gas streams are directed to elevated stacks where possible; however, significant emissions are expected from diffuse, low-level sources such as vehicular traffic, wind-blown storage piles, and leaks in equipment fittings.

Once a particular pollutant reaches the atmosphere, the likelihood that it would adversely affect the environment depends on the ambient concentrations that result and the sensitivities of receptors that are present. Reasonable predictions of ambient air concentrations (± 25%) require detailed descriptions of existing conditions (pollutant monitoring), all important sources of air pollution, and the processes that will govern the transport and diffusion of pollutants (meteorological monitoring). An inventory of receptors in the area should consider sensitivities of animal and plant life, the possibility of altering soils and water systems, and other concerns such as inadvertent weather modification, changes in precipitation chemistry, deterioration of man-made materials, and visibility impairment. The existing data base is not sufficient to support a detailed analysis of the air quality impact of this project. There have been no previous efforts to collect meteorological or air quality data in the project area. The nearest National Weather Service stations are at Kenai and Anchorage, 35 and 75 miles away. Meteorological data also have been collected at the oil platforms in Cook Inlet, and at the Beluga power plant to the north and the Big River weather station to the south. The goals of this impact analysis therefore are limited to identification of the major sources of atmospheric pollutants, determination of the temporal and spacial scales over which significant impacts would occur, and recommendations on how to perform a more detailed analysis capable of satisfying the technical documentation requirements of a permit to operate a source of air pollution in the State of Alaska.

In the remainder of this section both construction and longer term effects are discussed with regard to the above objectives. An emissions inventory is presented for each case, and for situations when estimates of ambient air concentrations were possible the results of these calculations are discussed. Since the applicability of ambient air concentration estimates is limited to well defined sources of pollutants, the air quality impacts of construction and mining activities are described largely in qualitative terms.

CONSTRUCTION EFFECTS

Pollutants of concern which would be associated with the construction phase of this project are particulate matter, nitrogen oxides, carbon monoxide, hydrocarbons, and sulfur oxides. Emission rates would vary seasonally depending on the amount of construction activity and the frequency of precipitation. Total annual emissions of pollutants would also vary during the anticipated 38-month construction period, reaching a peak in 1986.

The two largest classes of air pollutant sources during plant construction would be land disturbances and vehicular exhausts. Particulate matter would be generated by site clearing and preparation, the action of wind on exposed surfaces, gravel extraction and preparation, concrete batching operations, the burning of tree and brush cover, and diesel and gasoline powered equipment. Combustion of diesel fuel, gasoline, and vegetative cover also would produce carbon monoxide and hydrocarbons. Nitrogen oxides and sulfur oxides would be associated with diesel fuel and gasoline combustion, and to a lesser extent tree and brush burning. Significant ambient air impacts from the various pollutants emitted could affect an area of 40 square kilometers around this concentration of sources.

Pollution control measures would focus on the largest source of pollutants, vehicular traffic. Roadways, once built, would receive regular maintenance and would be sprayed with chemically treated water during dry spells. To the maximum extent possible, traffic would be confined to these roads. Vehicular exhaust emissions would be minimized through a regular inspection and maintenance program. To insure that the above practices would be implemented throughout the entire construction phase, they could be incorporated in construction contracts along with the other usual construction specifications.

EMISSIONS AND LONG TERM EFFECTS

Process Plant Area Emissions

- Coal Preparation

  Coal arriving at the methanol plant would require a considerable amount of handling before use. Dust is generated during unloading; stacking and reclaiming of storage; and conveying, crushing, and screening operations. For the most part, this dust can be collected and passed through bag-type filters capable of 99.9% recovery. All operations except unloading, stacking and reclaiming can be controlled in this manner. A spray suppression system would control dust at the coal unloading station. Stacking and reclaiming of coal would be done with a bucket wheel stacker/reclaimer. When this piece of equipment is operated properly, dust emissions can be reduced significantly compared to conventional methods of storage addition and recovery. Also, vehicular traffic around the storage pile, which can contribute up to 40% of the total fugitive particulate matter emissions associated with raw material storage facilities, is virtually eliminated by this method.

- **Process Coal**

Process coal must be dried before gasification, and this would be accomplished with coal-fired thermal dryers. Particulate matter, sulfur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons would be emitted during this operation. The contaminated exhaust gases would be scrubbed of particulate matter, then vented to the atmosphere. Ash and char would be conveyed pneumatically from the boilers and gasifiers to the coal preparation area before being loaded aboard trains bound for the mine. The nitrogen gas used as a transport medium would be vented to the atmosphere after a baghouse removed particulate matter. Carbon monoxide and a small amount of hydrogen sulfide would be present in this exhaust.

- **Coal Gasification**

The major, distinct sources of pollutants in this section would be related to the acid gas removal and sulfur recovery processes. Excess carbon dioxide would be removed selectively from the synthesis gas in the acid gas removal process and then released to the atmosphere. This carbon dioxide exhaust would be contaminated with hydrogen sulfide, carbonyl sulfide and carbon monoxide. Synthesis gas also would be stripped of hydrogen sulfide, resulting in a contaminated gas stream that requires further processing. A Stretford sulfur recovery system would remove 99.5% of the hydrogen sulfide from this stream. Cleaned gas which contains a small amount of hydrogen sulfide, carbonyl sulfide and carbon monoxide then would be vented to the atmosphere.

In the area where methanol is produced from synthesis gas, a reformer furnace would be used which burns purge gases from downstream methanol synthesis operations. Combustion products containing nitrogen oxides would be exhausted to the atmosphere. The gasifier coal-feed system would require nitrogen purging to remove gases that escape from the gasifiers during charging. These purge streams would be directed to a continuously operating elevated flare. Vapor recovery systems on synthesis gas scrubber wastewater treatment and compression equipment also would be directed to this flare. Particulate scrubbing would be performed before the coal-feed system and wastewater treating vents were flared.

- **Fugitive Emissions**

  Associated with synthesis gas processing would be fugitive emissions from leaks in pipeline valves and flanges, relief and sampling valves, pump and compressor seals, and fuel and product storage tanks. Product storage losses and compressor seal losses would be controlled by vapor recovery systems. This is also true for losses associated with shiploading of methanol. The remaining sources of fugitive emissions must be controlled through regular monitoring and maintenance. These fugitive emissions would include hydrocarbons, carbon monoxide and hydrogen sulfide.

  A single water cooling system using mechanical draft cooling towers would serve various heat exchanging equipment throughout the plant. Water losses to the atmosphere would only be contaminated by leaks that develop in any of these heat exchangers. Possible contaminants include gaseous compounds such as carbon monoxide and hydrogen sulfide, hydrocarbons (mostly methanol), and dissolved solids that are not removed in make-up water treatment.

Power Plant

The majority of steam and all power requirements would be supplied by coal and gasifier char fired boilers. Combustion products would be vented directly to the atmosphere after approximately 99.9% particulate removal by a bag-type dust collector. This exhaust stream would contain residual particulate matter, nitrogen oxides, sulfur oxides, carbon monoxide and hydrocarbons. Particulate matter emissions would have a composition similar to the ash produced. With a few notable exceptions, trace elements would appear in the same concentrations both in bottom ash and fly ash. Very efficient particulate removal is, therefore, an effective way of minimizing trace element emissions. Certain emissions of mercury and selenium may be volatile in the boiler exhaust gas and could not be captured by a bag filter. Elements such as lead and cadmium tend to be concentrated in the fly ash, thus decreasing the effectiveness with which a baghouse can reduce their emission. Other trace elements of concern that have been detected in Alaska coals are beryllium and fluorine.

- Start-up and Shutdown

  Pollutant emissions during start-up would differ from normal operating emissions for two important reasons: Initial heat requirements would be supplied by natural gas combustion, and off-specification synthesis gas would require disposal. One low-pressure flare system would be necessary to burn off-specification synthesis gas produced in the gasification start-up sequence. This gas would be scrubbed of particulate matter before flaring. It would not pass through sulfur removal equipment, so sulfur oxides would be emitted, as well as nitrogen oxides and particulate matter. Natural gas burned for initial equipment heating would create nitrogen oxides, sulfur oxides, carbon monoxide, particulate matter and hydrocarbons. In the coal preparation area a small increase in fugitive particulate matter emissions would be expected due to the increased activity around storage piles as they are brought up to the required size.

  Process equipment must be shut down for inspection, maintenance and cleaning, causing changes in emissions similar to those experienced during start-up. Particulate matter, sulfur oxides and nitrogen oxides would be emitted from the low pressure flare system until gasification stops. The initial purge of shutdown equipment also requires flaring.

- Emergencies

  Diverted synthesis gas would be directed to either the high or low pressure flare system in the event of process upsets that cause or require equipment shutdowns in any of the three methanol production trains. Nitrogen oxides, sulfur oxides, particulate matter, carbon monoxide and hydrocarbons would result from flaring the diverted gas streams.

Mining Area Emissions

The largest emissions of air pollution which would be associated with the surface mining activities arise from major equipment operation and haul road traffic. Minor sources include the coal handling facilities, and blasting, drilling, and ash unloading operations. The diesel-electric railroad which would transport coal from the mine to the plant and ash from the plant to the mine would be a significant source of pollutants. Most of the total emissions from all of the above sources would be comprised of particulate matter; however, diesel fuel combustion also produces nitrogen oxides, carbon monoxide, sulfur oxides and hydrocarbons.

Air pollution control measures for mining and coal transportation address both major and minor sources. Water trucks would be used to wet haul roads in dry weather. Emissions from diesel fuel combustion can be minimized by an aggressive repair and maintenance program. Dust collection would be possible for coal handling operations (screening, crushing, conveying). Coal storage piles, normally one of the largest sources of particulate matter, would be enclosed, and recovery of coal would be from the bottom of the heap. Temporary stabilization of spoil piles before recycling and of ash soil cover before revegetation would minimize wind-generated dust.

Air Emission Effects

Emission rates for the various pollutants were related to ambient air concentrations by means of computer-based atmospheric dispersion models. These dispersion models are generally classified as the Gaussian type and are considered to be state-of-the-art techniques for estimating the impact of non-reactive pollutants. Some basic assumptions inherent in these algorithms are:

1. The emission rate is constant and continuous over the time period of interest.

2. All meteorological variables are constant over the time period of interest.

3. The wind speed is constant throughout the height of the plume.

4. Concentration profiles in the crosswind and verticle directions are described by Gaussian distributions.

5. Adsorption, deposition, and possible chemical changes within the plume are not considered.

6. The effects of terrain on wind currents are not considered.

The procedures used to make dispersion estimates were: All plant emissions were quantified and points of release were described; meteorological conditions leading to high ambient air concentrations were identified for each source type; and finally, calculations were made of the maximum ambient air concentrations which could result. The values obtained were compared to applicable air quality standards.

Models Used

Two EPA recommended dispersion models were used in this screening analysis. The PTMAX model, a single source model capable of estimating maximum ambient air impacts and the distance downwind that they will occur, was used for evaluating the impact of point sources in neutral/unstable atmospheric conditions for averaging periods 24 hours or less. The VALLEY model was used for estimating 24-hour average concentrations due to all sources for which stable atmospheric conditions and impaction of plumes on elevated terrain was a concern. VALLEY was also used for calculating annual average concentrations for SO_2, NO_2, and particulate matter.

Since estimates of pollutant concentrations are required for various averaging times ranging from 1 hour to a day, and the PTMAX model only calculates concentrations appropriate for a 1 hour average, factors relating concentrations averaged over different time periods were used. In this way multiple hourly average concentrations could be estimated from 1 hour average concentrations. These factors were applied independent of stability classification and in the following manner:

$$X\text{ (3-hour)} = 0.8X\text{(1-hour)}$$
$$X\text{ (8-hour)} = 0.6X\text{(1-hour)}$$
$$X\text{(24-hour)} = 0.3X\text{(1-hour)}$$

Table 15.1 summarizes New Source Performance Standards (NSPS) emission requirements and expected emission rates based on a methanol production rate of 54,000 barrels per day.

The Clean Air Act created regulatory requirements to prevent significant deterioration (PSD) of air quality both in attainment areas, or areas of the country currently cleaner than the National Ambient Air Quality Standards (NAAQS). The Beluga-Tyonek areas currently have ambient air quality cleaner than defined in the NAAQS for criteria pollutants, and has been designated a Class II attainment area.

Table 15.1

NEW SOURCE PERFORMANCE STANDARDS AND ANTICIPATED EMISSION RATES

Source	NSPS EMISSION LIMITATIONS				EXPECTED EMISSIONS (μg/dscm unless specified)				
	SO_2	NO_2	Particulate	Opacity	SO_2	NO_2	Particulate	CO	Reduced S
Boilers	1.2 lbs/MMBtu	0.70 lbs/MMBtu	0.10 lbs/MMBtu	20%	0.53 lbs/MMBtu	0.70 lbs/MMBtu	0.10 lbs/MMBtu	0.08 lbs/MMBtu	
Coal Dryers			70 μg/dscm	20%	44	82.1	24.2	27	
Coal Preparation			40 μg/dscm	10%					
Ash Loading							0.2 gm/sec		
Coal Storage							4.4 gm/sec		
Flare					18.3	23			
Sulfer Recovery								50	28
Ash & Char Transport							1.6	547.3	5.5
Reformer						78.7			

PSD review is required when a criteria pollutant in an attainment area for that pollutant is emitted in excess of 100 to 250 tons per year after the use of pollution control equipment. Acceptable and expected emissions levels for applicable criteria and non-criteria pollutants are given in Table 15.2.

Table 15.3 summarizes the yearly emissions of particulate matter, sulfur oxides, nitrogen oxides, carbon monoxide, reduced sulfur compounds, and hydrocarbons that would be associated with the coal gasification plant and the mine. The emissions rates are based on a methanol production rate of 54,000 barrels per day.

The procedures for estimating maximum concentration increases due to the new source were designed to describe worst case situations with a factor of safety. When it was determined that allowable increases or concentration ceilings would be threatened, it was concluded that the disperson of emissions creating these conditions should be analyzed in more detail.

The models used are subject to limitations not only due to assumptions inherent in their use but also because the input data are not necessarily truly representative of conditions at the proposed site. The primary concerns about the applicability of this analysis and their impact on a preconstruction monitoring program are discussed below.

1. PTMAX and VALLEY models use vertical and horizontal dispersion parameters (σz and σy in the calculations) that were developed for releases over open, flat terrain and short (a few kilometers) distances of travel. Dispersion in complex terrain is better described by site-specific parameters that can be developed from measurements of wind speed fluctuations. Since the diffusion of pollutants is sensitive to these measurements of turbulence, a monitoring program that would provide enough data to calculate

Table 15.2

ACCEPTED AND ANTICIPATED EMISSION LEVELS

Pollutant	Air Quality Standards[a] ($\mu g/M^3$)	PSD Class II Increment[b] ($\mu g/M^3$)	Maximum Impact of all Sources ($\mu g/M^3$)	Distance of Maximum (KM)	Significant Ambient Air Impacts[c] ($\mu g/M^3$)	Significant Monitoring Concentrations[d] ($\mu g/M^3$)	Area of Significant Impact (Km^2)	Comments
Sulfur Oxides								1. No monitoring exemption. 2. Area of significant impact entirely north/northwest of plant site.
3 hr.	1300	512			25			
24 hr.	365	91	100	10	5	13		
Annual								
Nitrogen Oxides								(See Sulfur Oxides)
24 hr.						14		
Annual	100		6	10	1		100+	
Particulate Matter								1. No monitoring exemption. 2. Area of significant impact to the immediate northwest of plant site (3 km).
24 hr.	150	37	40	7	5	10		
Annual	60	19			1		4	
Carbon Monoxide								1. Possible monitoring exemption. However, all sources have not been considered.
1 hr.	40000				2000			
8 hr.	40000		200	3.5	500	575		
Reduced Sulfur								(See Carbon Monoxide)
30 min.	50	10 (1 hr)	3.5-7.0		.04 (H_2S)			

a. 18 aal 50.10.
b. 40 CFR 51.24.
c. "Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)," USEPA, November, 1980.

Table 15.3

EMISSION INVENTORY

Source	Particulate Matter	Sulfur Oxides (AS SO_2)	Nitrogen Oxides (AS SO_2)	Carbon Monoxide	Reduced Sulfur Compounds* (AS SO_2)	Hydrocarbons
	LONG TERM EMISSIONS (TN/YR)					
1. Boilers	1720	8935	12000	1314	--	263
2. Dryers	613	1112	2090	280	--	44
3. Continuous Flaring	N.E.	140	180	N.E.	--	N.E.
4. Acid Gas Removal CO_2 Vent	--	--	--	2300	48	--
5. Sulfur Recovery	--	--	--	302	102	--
6. Coal Preparation Area Dust Collection	47	--	--	--	--	
7. Coal Storage	175	--	--	--	--	--
8. Railroad	30	70	390	190	--	33
9. Reformers	13[a]	25[a]	814	31[c]	--	6[a]
10. Ash & Char Transport	9	--	--	1000	6	--
11. Storage Tanks	--	--	--	X	--	X
12. Process Plant Fugitive	N.E.	--	--	N.E.	N.E.	N.E.

Table 15.3
Continued

EMISSION INVENTORY

	LONG TERM EMISSIONS (TN/YR)					
Source	Particulate Matter	Sulfur Oxides (AS SO_2)	Nitrogen Oxides (AS SO_2)	Carbon Monoxide	Reduced Sulfur Compounds* (AS SO_2)	Hydrocarbons
13. Mining						
a. Fugitive	N.E.	--	--	--	--	--
b. Heavy Equipment	X	X	X	X	--	X
Startup Emissions (lb/hr)						
1. Gasifiers (10 hrs.)					--	
2. Boilers (2 hrs.)					--	
3. Flaring (2 hrs.)					--	
Emergency Emissions (lb/hr)						
1. Low Pressure Flaring (10 min.)						
2. High Pressure Flaring (10 min.)						

X = Later

the dispersion parameters appropriate for the proposed plant site is necessary.

2. Background concentrations used in this analysis were necessarily conservative. In some cases they represent a significant portion of the ambient air concentration ceiling. A monitoring program to measure the actual concentrations of SO_2, NO_2, and TSP would greatly improve estimates of maximum impacts. In addition, monitoring data for NO_2 taken by others south of the plant site and across Cook Inlet, where most of the industrial development is located, would help to determine whether pristine conditions are present in that area also.

3. Meteorological data used for input to the annual average analysis was collected at a National Weather Service Station near Kenai. These data must be assumed to vary somewhat from actual conditions in the project area, but are considered sufficiently representative for use in this preliminary feasibility analysis.

MAJOR REGULATORY REQUIREMENTS

The federal Clean Air Act Prevention of Significant Deterioration (PSD) program and the State of Alaska Air Quality Control Permit to Operate program are the two significant regulatory frameworks that would impose major permit requirements on this project. The PSD program requires preconstruction approval of plants that have significant emissions potentials. A plant is subject to PSD regulations if potential emissions of any regulated pollutant exceed 100 tons per year for plants within 28 specified industrial categories or if potential emissions exceed 250 tons per year for any other plant. Coal gasification or methanol plants are not listed among the 28 source types. However, the proposed plant would generate the pollutant emissions estimated to exceed 250 tons per year, so PSD preconstruction review would be required. The review is an extensive procedure involving baseline meteorological and air quality monitoring, rigorous data analysis and an intensive permit review by the Environmental Protection Agency (EPA). The Region 10 office of the EPA would review this project and issue the PSD permit. PSD permits typically stipulate compliance monitoring and reporting. A lead time of 24 to 30 months should be allowed to complete the permitting process.

The State of Alaska Air Quality Control permit program is administered under the authority of 18 AAC 50 by the Alaska Department of Environmental Conservation. This program involves a permit to operate, compared to the preconstruction review concept on which the PSD program is based. Permit applications should be filed with the DEC 30 days or more prior to the commencement of operations, and must be accompanied with a specified set of information and operating documents. The DEC may require the permit applicant to install and maintain monitoring equipment, and to provide source test reports, emission data and periodic reports. The Air Quality Control Permit to Operate is issued for a period not to exceed 5 years, at which time a permit application must be filed anew.

ENVIRONMENTAL ACCEPTABILITY OF PROPOSED ACTION

A review of existing data concerning meteorological and ambient air quality background conditions and the screening review of the anticipated emissions from the plant indicate that the proposed facility could be built well within the limits of present air quality laws using current technology. There would be measurable deterioration of the ambient air quality surrounding the immediate project area, but it would be well within the allowable increments set forth in the federal environmental regulations. This feasibility study indicates that both the state and federal permits could be obtained, although in the case of the PSD permit it could be an expensive and time consuming process.

16.0 OCEANOGRAPHY

CONSTRUCTION EFFECTS

Oceanographic conditions within the Beluga/Trading Bay/Drift River area probably would be only slightly and temporarily affected by construction of the proposed facilities including the construction dock. The primary impact would be relatively small increases in the amounts of sediment and turbidity in the marine environment.

The ocean floor would be disturbed temporarily by the driving of piles for the construction dock facilities. Fill material utilized in the construction of the dock would be clean, well graded sands and gravels to minimize the impact on water quality. The estimated suspended sediment which would be created by all the construction activities is very small relative to the normal amount of sediment naturally present in upper Cook Inlet waters.

LONG-TERM EFFECTS

The effects of accidental spills of methanol into the marine environment are considered later in Section 21.0 METHANOL IN THE ENVIRONMENT. This discussion considers the source and transport of those potential spills. The most likely opportunity for an accidental spill would be at the Drift River terminal, either during maneuvering or load transfer operations. Spills also could occur in transit, most commonly due to equipment failure, human error, ballast discharges, structural failures or vessel casualities. Hazards to navigation in Cook Inlet and ice conditions are considered in Section 7.0 OCEANOGRAPHY.

The two main factors which affect transport of spills are currents and wind. Generally the speed of pollutant transport due to current and wind is 3% of the wind speed plus the current speed. Detailed current measurements along the west side of upper Cook Inlet are lacking, therefore, specific pollutant transport determinations cannot be made. Generally, currents move north along the west side of the inlet, mixing with freshwater sources which flow in from the major tributaries, and then move easterly near Fire Island, and south along the Kenai Peninsula. Bathymetry, tidal ranges, and currents are being studied in this general area as part of another project study related to the development of the Beluga coal fields.

MAJOR REGULATORY REQUIREMENTS

During construction, fill material would be dredged out of and/or placed into upper Cook Inlet -- a navigable waterway. In addition, the construction operation would place a structure in a navigable waterway. These operations would require two permits, to be obtained from the U.S. Department of Defense, Department of the Army, Corps of Engineers.

The discharge of dredge or fill material into U.S. waters, including tidelands and wetlands, must be authorized by the Corps of Engineers. This permit is mandated primarily by Section 404 of the Clean Water Act, as Amended. The other major federal permit concerns the placement of any structure in or over the navigable waters of the United States; or the excavation of material in such; or the accomplishment of any other work affecting the course, location, condition or capacity of such waters. This permit requirement originates from Section 10 of the River and Harbor Act of 1899.

In addition to the above federal programs, state regulations affecting the proposed project are concerned primarily with discharges to the marine environment and adherence to pertinent coastal zone management regulations.

ENVIRONMENTAL ACCEPTABILITY OF PROPOSED ACTION

The anticipated short-term construction effects on the marine environment are considered to be nominal due primarily to the size of Cook Inlet and the heavy natural sediment load. With adequate safeguards, the long-term impacts should also be negligible.

17.0 ARCHAEOLOGIC AND HISTORIC SITES

CONSTRUCTION EFFECTS

A literature survey of historical and archaeological sites indicates that there are eight sites besides the many within the present Village of Tyonek that are near the study area. Only the site at the Village of Ladd lies outside of the former Moquawkie Reservation boundaries in the lower Chuitna River vicinity. The possibility that undiscovered sites might be found or impacted during construction activities is always present.

An on-the-ground survey would be necessary to determine the probable location and significance of any sites in the area. Probable sites would include aboriginal hunting trails; remains of structures and artifacts situated along those trails; seasonal camp sites, particularly in fishing areas; storage cache pits; and military trails.

Greatest potential impact to unidentified archaeologic and historic sites would arise during opening of and production from a surface coal mine. Any site not identified before production begins probably would not be recognized during production. Indirect impacts to the sites could arise from exposure to the influx of additional people to the previously remote area.

LONG-TERM EFFECTS

Long-term effects of the proposed development regarding preservation of archaeologic and historic sites could result from the increased use of the area, particularly if visitors included amateur artifact collectors.

MAJOR REGULATORY REQUIREMENTS

Prior to commencement of construction, a letter detailing the proposed construction and a map outlining the impacted area must be sent to the chief of the State Office of History and Archaeology. A review of the application will be made by the state, and a determination will be made concerning whether an on-the-ground survey of the area is necessary. The guidelines for such a survey can be found at 36 CFR 800, Protection of Historic and Cultural Properties.

ENVIRONMENTAL ACCEPTABILITY OF PROPOSED ACTION

There are no known archaeologic or historic sites in the immediate project area. Although research indicates a potential for various cultural remains in the general vicinity, careful construction practices and a preconstruction archaeological survey would prevent adverse effects on potential archaeologic or historic sites.

18.0 SOLID WASTE

CONSTRUCTION EFFECTS

Clearing Debris

Vegetation consisting of brush and moderate tree cover would be cleared from approximately a 1,000-acre plant site area. In addition, vegetation would be cleared from a transportation corridor to the the mine areas. Material would be stacked and burned. Air quality would be temporarily impacted adversely in the surrounding area but rapid dispersion in a clean air shed should quickly alleviate the effects.

Construction Refuse

Solid waste refuse produced during construction would consist primarily of construction rubble including boxes, cans, wrapping paper, hardware, broken and leftover materials, etc. Construction workers would generate additional refuse (Table 18.1), at a rate of about 7 lbs. per worker per day. This refuse would be compacted and disposed of in an environmentally acceptable landfill.

Table 18.1
CONSTRUCTION REFUSE

Manpower (Date)	Compacted Refuse		Bulky Refuse	
	Lbs./Day	Cu.Ft./Day	Lbs./Day	Cu.Ft./Day
500 Construction (1984-85)	3,500	88	3,500	605
3,500 Construction (1986)	24,500	612	24,500	4,235

Basis: 7 lbs/day generated per man. (Anderson 1972)
Bulky Refuse: 162 lb./cu.yd. (Jackson 1979)
Compacted Refuse: 40 lb./cu.ft. (Kroneburger 1977)

LONG-TERM EFFECTS

Ash and Sludge

Ash and char would account for the largest amount of solid waste. There also would be some sludge, which would be predominantly ash that has been scrubbed from the raw gas, then concentrated.

Ash and sludge streams would be generated from coal storage and preparation, gasification, raw gas cleaning, and cooling processes. Precipitation would be the major problem in the coal storage and preparation area. Runoff water would contain suspended particulate matter. This water would be collected in a retention pond lined to prevent groundwater seepage, and would have a residence time of significant duration to allow solids to settle and to promote biological action.

Retained solids would result from stockpiled coal, which is not a solid waste as defined by 40 CFR 261 (A) and, therefore, not subject to Resource Conservation and Recovery Act (RCRA) regulations.

The largest amounts of ash and char would be produced by the gasification of coal in the Winkler gasifiers and the subsequent gas cooling and char recovery. Ash and char also would be generated in the coal receiving, storage and preparation areas. Char from the waste heat recovery system would be removed by dry cyclones and used as fuel in the offsite boilers and therefore is not a waste stream, but a fuel material. Ash would be produced from the power plant boilers. The combined solid waste that must be disposed of is described in Table 18.2.

Ash would be produced by the power plant boilers. The combined solid waste that must be disposed of is described in Table 18.2. The ash and char solid waste is not a hazardous waste as described in 40 CFR 261.3. The preferred method of handling would be to

Table 18.2

COMBINED SOLID WASTE

Tons per Day (TPD)/Cubic Yards per Day (Cy/d)

Coal/Char TPD	Ash TPD	Water TPD	Total TPD	Total Cy/d	Dry Cy/d	Wet Cy/d
181.0	689.1	2,917.6	2,917.6	3,974	1,544	2,430
132.5	4,595.9	945.2	5,673.6	9,831	8,709	1,122
313.5	5,285.0	2.992.7	8,591.2	13,805	10,253	3,552

return it to the mine pit as part of the surface mining reclamation program. Two trains each utilizing 11 special side-dump ash cars would operate three trips per day to dispose of a total 66 carloads of ash. Two trains utilizing 12 special side-dump sludge cars would make three trips daily to dispose of a total 72 carloads of sludge per day. The combined ash and car would contribute a total dry volume of 10,253 cubic yards per day of solid waste toward filling the mine pit. Although this volume would be easily accommodated in the mine pit, a substantial committment of real estate would be required to dispose of the same quantity in a sanitary landfill.

Any solids remaining in the raw gas would be removed in the raw gas cleaning and cooling sections by Quench Venturi type scrubbing. The spent water would be withdrawn to settlers where the particle-laden water would be concentrated to 15% solids content, then sent to a rotary filter system it would be concentrated to 70% solids. The filtrate would be sent to wastewater treatment. Further evaluation of the cake is necessary to determine an environmentally suitable method of disposal.

Methanol Process Solid Wastes

Solid process wastes consist of spent catalysts from various process sections including CO shift and COS hydrolysis, acid gas removal, sulfur recovery system, guard vessels, and methanol synthesis. It must be emphasized that catalysts are only disposed of periodically. Expected normal catalyst lives are given in Table 18.3.

Table 18.3

EXPECTED LIVES OF CATALYSTS

Catalysts	Normal Life
CO Shift	3 years
COS Hydrolysis	5 years
Sulfur Guard (ZnO)	1.5 years
Chlorine Guard (Proprietary)	1.5 years
Methanol Synthesis (Cu Based, Proprietary)	5 years

Further evaluation of each spent catalyst will be needed to determine methods of disposal which are environmentally acceptable. Spent catalysts in solvents generally would be regenerated, but those which must eventually be thrown away are sufficiently benign that they can safely be disposed in a landfill. Several spent catalysts may have a marketable value for recovery of metals. These include ZnS from spent ZnO and spent copper-based catalyst from methanol synthesis.

Further evaluation of purge solution from the acid gas recovery unit is also needed. However, sodium sulfate, sodium thiosulfate and sodium carbonate are not on the hazardous materials list (40 CFR 261[D]).

Approximately 22 tons per day of by-product sulfur would be produced from the Stretford sulfur recovery unit. This would be a chemically inert material most likely in the form of molten sulfur. It is nonhazardous. The preferred method of handling the material would be to return it to the mine pit as part of the surface mining reclamation program.

Hazardous Substances

The solid waste materials anticipated to be produced from the gasification/methanol plant operation were reviewed, and at this time there are no materials known which are considered to be hazardous per the Subpart D list of materials in the Hazardous Waste Management System (40 CFR 261[D]). After the plant commences operation, a testing program would be required to confirm that hazardous materials are not being produced. If it is discovered that any of the materials are hazardous, they would be subject to the "cradle-to-grave" control as defined in RCRA.

Fugitive Coal Dust

Although coal dust is a solid waste by-product from plant operation, the discussion of its impacts is presented in Section 15.0 AIR QUALITY since it is an airborne contaminant.

Refuse

Operation of the plant and mine would generate refuse in amounts estimated as:

Manpower Basis	1,000	
Compacted Refuse	175 cu.ft./day	(7,000 lbs/day)
Bulky Refuse	1,210 cu.ft./day	(7,000 lbs/day)

This material either would be incinerated or disposed of in an environmentally acceptable landfill. An incinerator would be subject to environmental controls under Alaska Solid Waste Management Regulations (18 AAC 60) which control particulate emissions to the atmosphere. A landfill would be subject to regulations under the same program to control possible leachate contamination of surface and groundwater systems.

Sanitary Waste Solids

Sanitary wastes would be processed in a treatment plant at the secondary level such that the effluent can be discharged either to Cook Inlet or Nikolai Creek in a manner that does not cause violation of Alaska Water Quality Standards. The sludges would be disposed of in a landfill.

MAJOR REGULATORY REQUIREMENTS

RCRA of 1976 (Federal)

The Resource Conservation and Recovery Act of 1976 (RCRA) requires the Environmental Protection Agency to establish a national Hazardous Waste Management Program to regulate all aspects of hazardous waste from the time it is generated to the time it is properly disposed of. This gives the EPA important regulatory authorities with respect to hazardous waste.

On May 2, 1980 the EPA instituted a "cradle-to-grave" management system which was promulgated in the May 19, 1980 Federal Register. These regulations are expected to have a major effect on the methods used for hazardous waste disposal.

The new regulations require previous land-based disposal and combustion management techniques to exhibit more efficient disposal technologies. Land-based disposal facilities are required to demonstrate more effective containment of waste. This containment should prevent the leaching of contaminants into groundwater sources. Ambient groundwater monitoring of surface impoundments, landfills and land-treatment facilities containing hazardous wastes will be implemented to evaluate containment efficiency. Ambient groundwater monitoring must be initiated by November 19, 1981 unless it can be shown that the hazardous waste has a low potential for migration.

Combustion technologies will also be required to show improved performance standards for emission control, destruction efficiency and residual management.

A solid waste is classified hazardous if it exhibits any one of the four characteristics of ignitability, corrosivity, reactivity and toxicity (40 CFR 261 [C]) or is included on the list developed by EPA (40 CFR 261 [D]). Persons who generate, transport, treat, store or dispose of such hazardous wastes must comply with all applicable requirements of 40 CFR 122, 124 and 262 through 265 of Chapter 1 and the notification requirements of Section 3010 of RCRA. 40 CFR 261 (A) establishes special requirements for small-quantity generators (less than 1,000 kg/mo). It also contains the EPA definitions of solid and hazardous wastes plus a list of materials which are either wholly or partially excluded from the requirements in 40 CFR Parts 262 through 265, 122 and 124.

18 AAC 60 (State of Alaska)

Under the Alaska Administrative Code (ACC), a Solid Waste Management program is administered by the Alaska Department of Environmental Conservation. The program institutes a permitting procedure to control landfill operations and incinerators with greater capacity than 200 pounds per hour. The disposal methods selected for this project would require permitting under 18 AAC 60.

ENVIRONMENTAL ACCEPTABILITY OF PROPOSED ACTION

All known solid wastes from this project should be safely disposable either in a landfill or by incineration. There are some methods of disposal for certain sludges that are yet to be defined. If any of these materials turn out to be hazardous or otherwise unsafe to dispose of either in a sanitary landfill or in the mine reclamation operations, other environmentally acceptable alternatives such as incineration or removal to a hazardous waste depository would be employed.

19.0 SHORT- AND LONG-TERM SOCIOECONOMIC EFFECTS

COOK INLET IMPACTS

Population and Employment

In the long term, it is expected that the project would create some 1,300 direct and indirect jobs at the project site, and a local population of approximately 2,600. Much of this employment likely would originate from Anchorage and the Kenai Peninsula. It is unlikely that additional employment and population would result directly from this project on the west side of Cook Inlet (discussed further in the following section). However, it is expected that the project would generate additional employment in Anchorage and the Kenai-Soldotna area. These off-site employment effects would result from the purchases of goods and services by the plant and its work force, and from the expenditure of property tax revenue by the Kenai Peninsula Borough.

As the commercial transportation and communications center of Alaska, Anchorage is affected to some extent by resource development throughout the state. The secondary economic impact on Anchorage would be significant with this project because it is located only 75 air miles from the city. It is likely that the plant operator would locate its administrative headquarters in Anchorage, thus creating direct project employment in the municipality. However, it is indirect employment and income created by the plant which would be most important to Anchorage. Substantial quantities of operation and maintenance supplies would be purchased in Anchorage or through Anchorage dealers, as would construction, engineering, transportation, and other services. Material and labor for specialty fabrication and construction associated with ongoing capital improvements would also be purchased in Anchorage and, to a lesser extent, in the Kenai area.

In addition to goods and services purchased by the plant operator and its contractors, Anchorage would also provide goods and services to the residents of the new west Cook Inlet community. Anchorage wholesalers would supply local retailers with the bulk of groceries and durable goods that they would market in the new town.

Public sector expenditures from property tax revenues derived from the project may also be expected to create employment, in this case for the Kenai-Soldotna area. Predictions of future property tax revenues to the Kenai Peninsula Borough from the project have not been attempted, but they likely would be substantial. Much of the property tax revenue generated by the project likely would be used to provide local services to the new town residents. However, the plant would represent a significant taxing asset to the entire borough (it would substantially increase the per capita valuation of the borough), and revenue derived from it would be used to expand borough services and facilities on the peninsula, as well as in the west Cook Inlet project area. Thus, the project would result in an expansion of borough employment and borough-related employment (construction and maintenance work, etc.) in Soldotna and elsewhere in the borough. Also, the scope of routine administrative tasks of the borough (planning and zoning, for example) would expand as a result of the existence of the plant and new town, necessitating some increase in borough staff.

Growth-Inducing Effects

Apart from the secondary employment effects in the Anchorage and Kenai areas discussed above, this project would not be expected to stimulate "downstream" industrial development or other sizable commercial or resource development ventures locally or elsewhere in the state.

Methanol produced by this project would be used primarily as a supplemental fuel source. Its primary market would be the west coast of the United States. Its high cost relative to other energy sources in Alaska does not make it attractive as a source of energy for new industry or feedstock for local petrochemical manufacture.

Construction and operation of the mine, plant, and town sites should not effect the economic feasibility of other resource ventures in the west side of Cook Inlet, such as gas and oil exploration, logging and timber processing, hardrock mining, fish processing, or manufacturing ventures. These types of projects stand or fall on the basis of economic factors and forces that are largely external to the region. Facilities used in the operation of this coal-methanol project do not have direct application to development projects that are not coal related.

The feasibility of other coal development projects could be enhanced if certain infrastructure could be shared between projects: The airport; segments of the transportation corridor between the mine areas and the plant; the new town; telecommunications towers; dock, and/or other facilities. Savings realized through cost sharing and economies of scale from joint use of infrastructure could result in significant reductions in capital costs.

Joint use of infrastructure would require a great deal of planning by the ventures involved, including consideration of the location of facilities, their design, and financing.

Land Use, Transportation and Ownership Changes

In terms of land use, changes would tend to accelerate a process begun with the timber sale to Kodiak Lumber Mills in 1975. That is, most of the area proposed for development of the plant, camp, new town and airport is now crisscrossed by logging roads, and most of the spruce trees have been cut. Timber cutting and sporadic oil, gas and coal exploration activities in recent years have already introduced some permanent changes to an area formerly used only for subsistence hunting and fishing.

Despite these recent areawide activities, the project would affect land ownership and management practices of the state, borough, CIRI, and possibly the Tyonek Native Corporation.

- State Lands

The new town and airport would be located on state land. The methanol plant likely would be on CIRI land. The state already has granted a 300-foot-wide easement for the mine-to-dock transportation corridor. The state Department of Natural Resources likely would lease land for the town, whose developers would in turn sublease properties for housing, commercial and other development. The DNR would oversee siting of the town, camp, airport and plant, giving particular attention to issues of sanitation, potential for stream degradation, availability of water, and other land management and classification criteria (AS 38.04.900, AS 38.05.020, AS 38.05.300). Ultimately, the Kenai Peninsula Borough would be responsible for town zoning, subdivisions, and miscellaneous permits.

The normal mechanism for DNR disposal of land for project facilities requires that land first be classified for specific purposes. Most of the state land in the project area is classified for Resource Management, the broadest of 17 management categories (coastal sections are mostly designated Industrial Lands). DNR's Planning Section could (under present statutes) develop an area land use plan to determine more specific classifications better suited to the proposed uses. For example, the methanol plant could be designated as Industrial Land (as were the Kodiak Lumber Mill dock at North Foreland and the Chugach Electric power plant north of Tyonek). The town site could be designated as

Commercial Land or Residential Land, or conceivably the entire project could be classified as Industrial Land. Each of the state departments which would take part in preparation of the plan (such as Fish and Game, Community and Regional Affairs, Transporation and Public Facilities, Environmental Conservation, Commerce and Economic Development, and the DNR Division of Parks) presumably would wish to establish land classifications specific to their concerns. Native corporations, the borough and industry also would participate in preparing the plan.

Additional likely areas of concern to the state would be Material Land classification for appropriate gravel extraction sites, and possible Wildlife Habitat Land for certain streams. Dual or multiple-use classifications are possible, if uses are compatible (11 AAC 55.040).

Once the land use plan for state lands had been approved, the DNR Division of Forest, Land and Water Management could execute land disposal (lease, sale, grant or exchange) agreements for sites or proposed project facilities. If lease arrangements were executed, special provisions (such as restrictions on airport use to approved aircraft, and/or eventual public use and maintenance of the airport) could be included. DNR could also grant miscellaneous road and power easements.

The preparation of an areawide plan utilizing public hearings can be a very time-consuming task (2-3 years). The Governor's Coal Policy Group and the Beluga Interagency Task Force could help expedite the process by assisting in identifying critical issues and appropriate land use planning responses.

However the plan is prepared, it should consider not only the CIRI/Placer Amex project, but also the Bass-Hunt-Wilson coal mine and port, and other possible power generation projects in the vicinity. Extension of a new road or rail line from the Matanuska Valley and construction of new power lines to serve these projects have been discussed in the past. The Alaska Power Authority will soon be studying the feasibility of hydroelectric power generation at Lake Chakachamna, about 25 miles west of the project site. These projects all have implications for growth in the Matanuska-Susitna and Kenai Peninsula boroughs. How these projects fit into regional patterns of growth and energy facilities siting has not been investigated.

Thus, a land use plan should not only consider state lands, but other ownerships as well, to guide the development of west Cook Inlet. Such a plan might seek to minimize the duplication of transportation and utility corridors, or to consolidate development of the proposed CIRI/Placer Amex and Bass-Hunt-Wilson town sites. It might also consider the kind and location of port facilities which are being studied for the entire state by the Department of Transportation and Public Facilities (report due September 1981).

° <u>Borough Lands</u>

The proposed camp site and a portion of the transportation corridor cross Kenai Peninsula Borough land west of Congahbuna Lake. CIRI/Placer Amex would have to negotiate with the borough for right-of-way and lease of about 175 acres for the camp. Although the camp would be dismantled, some road and utility lines could remain in place. A small 50-man camp could remain for visitors after the plant is in operation.

° <u>Cook Inlet Region, Inc. Lands (CIRI)</u>

CIRI is an active participant in the venture and would seek to expedite project development on its lands. Most of the methanol plant likely would be located on land whose surface estate is owned by CIRI. CIRI's ownership allows for gravel removal.

There do not appear to be significant pre-existing leases which would preclude plant development at this site.

° <u>Tyonek Native Corporation Lands</u>

No facilities are planned on land owned by the Tyonek Native Corporation, and Tyonek Native Corporation has stated its opposition to any easements across its land.

<u>Borough Services Impacts</u>

Development of a town near the plant could require the provision of some services from the Kenai Peninsula Borough. These services would include education, planning, and regulation of land use. The level of planning, zoning and subdivision services provided by the borough would depend on whether the community functions as a "company town" or becomes an incorporated city. Education would be the responsibility of the borough in either a company town or an incorporated city.

Actual impacts upon the borough would be expected to be small. The cost of education is borne almost entirely by the state; and even if the new town became an incorporated city, the borough would be expected to delegate most of its planning and land use regulation powers to the city. Also, although the borough can establish local service districts in unincorporated areas to provide such services as sewer, water, roads, and solid waste, this is considered unlikely. Rather, industry would choose to develop these facilities under its own needs and timetable.

The borough should be affected only if significant growth takes place outside the town, on the Kenai Peninsula itself. Under these circumstances, expansion of streets, utilities and subdivisions could make demands upon the borough which might require some form of short-term impact funding assistance.

- **Options for Town Management and Governance**

The choice between a company town or an incorporated city involves questions of development control and cost-sharing for the provision of services. A decision by industry to build and maintain all of the town's facilities and services would allow for greater control than would be possible if it became an incorporated city. Involvement of borough government in a company town would be largely restricted to the development and operation of schools.

On the other hand, if the city were to incorporate, it would be eligible for state revenue sharing funds; however, costs of municipal administration would also be created. A second-class city may be formed upon petition to the Local Boundary Commission. Requirements include: Designation of city limits within which municipal services are to be provided; demonstration that the community includes sufficient human and financial resources to support services; demonstration of a need for city government. The degree of difficulty for the Kenai borough to provide some services to the remote site would play a part in this decision.

When the community reached a permanent population of 400, it could incorporate as a first-class city which could levy and collect special charges, property and sales taxes or assessments to amortize bonded indebtedness for sewage collection and water distribution systems, streets and other facilities. The municipality would be eligible for other state and federal aid not available to a private community.

Bills now in the state legislature (SB 180, HB 170) propose changes to the Municipal Code. Under the proposals, a city incorporated after July 1, 1981 is entitled to an "organizational grant" of $50,000 for the first year of transition to city government. A city eligible for the first-year grant would be eligible for a second year grant of $25,000.

The bills also abolish "Development Cities" legislation enacted some years ago to facilitate energy-related new town development (AS 29.18.230-450). Part of the argument to drop the legislation stems from a state policy which discourages funding for special private interest projects, such as a company new town, where broad public benefits are negligible. On the other hand, incorporation would make a community eligible for a variety of state-funded programs. The legislation is expected to be enacted in the 1982 legislative session.

- Borough Planning of the Town Site

Under state law, boroughs have responsibilities for planning, platting and land use regulation on an areawide basis. However, the borough assembly may delegate any of its powers and responsibilities to a general law city in the borough, if the city first consents by ordinance to this delegation. The emerging policy of the Kenai Peninsula Borough is to pass on zoning and platting powers to towns, while retaining an overall planning function. Thus, if the town became an incorporated city, it could have many of the planning powers it would have as a company town, albeit in a somewhat different form. The borough has no formal policy on town site development associated with the proposed methanol plant.

- Impacts if Growth Occurs in the Kenai Peninsula

Because the town would be isolated, impacts upon the borough might be negligible. However, the situation could change if only a small town were ultimately developed, with a sizable number of people living on the Kenai Peninsula. There could be a need for greater fire and police protection, more planning and administrative responsibilities and other new services associated with an expanded population in Kenai.

Experience from other areas of the country, notably Montana and North Dakota, indicates that the areawide economic benefits of energy projects lag for several years after project start-up. During early years of project mobilization and construction, local jurisdictions may be called upon to increase their planning staffs, expand schools, widen roads and install new utilities. This may occur during a period when little, if any, revenues flow to these jurisdictions. In the worst case, jurisdictions may be incapable of adequately responding to the project until it is too late and disruption is severe. Resentment for the project by local residents may be only partly lessened by the large property tax revenues received at a later time.

If rapid growth occurred on the Kenai Peninsula, some form of short-term impact assistance funding might be considered for the Kenai Peninsula Borough.

The key to any funding assistance agreement would be the identification and quantification of short-term project impacts in contrast to those associated with areawide growth.

TYONEK VILLAGE IMPACTS

Potential effects of the project on the Village of Tyonek are the most significant socioeconomic impact issue raised by this project. The nature and extent of actual impacts on Tyonek would depend upon the success of planning and mitigation measures undertaken by the project sponsors, the state and borough governments, the Cook Inlet Native Association, the Tyonek Native Corporation, and the villagers themselves. Certain village impacts seem inevitable, such as increased contact with non-Native people and institutions, and conflicts with non-Native sportfishing and hunting. The project would create substantial opportunities for economic benefit to the community; but the extent to which these would be realized depends on the responses of the village residents, and the village and regional Native corporations.

Village Impacts

Planning by the Tyoneks should be able to adequately protect the village and its institutions from direct impact by the project. That is, there is no reason why the project should have direct physical intrusions into the community from automobile traffic, sightseers, nonlocal school children, shoppers, and so on. The traditional village council and the Tyonek Native Corporation can legally control access to the village by nonresidents. The Tyonek School is too small and too far from the project town site to be a practical alternative to construction of a new school at the community.

Once the mine, plant, and new community were developed and operating, the village and its new neighbors probably would adjust to a mutually acceptable pattern of coexistence that would not require formal restrictions on movement. However, the village could prohibit access across its land if problems were to occur.

Culture and Life-style Changes

In contrast to the physical penetration of daily village life by the project, defenses against intrusions on the village culture and life-style are less readily available to the Tyoneks. It is here that impacts seem inevitable, although the severity and long-term significance cannot be foreseen.

A nearby new town with movies, recreational activities, restaurants and so forth would be an irresistable attraction to village residents, especially younger people. Tyonek youth are familiar with the modern white world (Anchorage is an inexpensive plane flight away, and the village receives direct line-of-sight television signals from Anchorage); but now this life-style would be at their doorsteps.

interaction between villagers and the new town would doubtless hasten the process of acculturation which has been under way in Tyonek for a century, and the cultural cohesion of the community would be weakened further.

The presence of the new project community and interaction with Tyonek residents could result in problems of a social-psychological nature. The Battelle study (1979) speculates at length about the potential for this type of problem:

> Although Tyonek residents have had considerable contact with the dominant American lifestyle, this contact would be greatly expanded by coal development. Under those circumstances, a variety of interpersonal and intergroup conflicts would likely surface . . . Coal development would also mean that, for the first time in their long history, Tyonek residents would be in the minority in their own region. Minority status usually is a breeding ground for racism and discrimination. Status and cultural differences therefore can be factors in intensifying unfriendly and perhaps hostile relationships.
>
> With the potential for social conflict comes a potential for social deviancy such as vandalism, larceny, alcoholism, and drug abuse. All of these forms of deviancy contribute to one another and in many cases can be emphasized by prevailing differences of opinions, intergroup relations, and feelings of inferiority, especially on the part of the group relegated to a minority status. Intergroup conflict can also affect employment, job productivity, learning in the classroom, and can disrupt a community's total way of life.

Proximity of the new town to Tyonek would also seem likely to create conflicts between village subsistence hunters and fishermen and non-Native sportsmen. Many of the new town's residents would be outdoorsmen (indeed, the population of this remote Alaska setting could tend to be self-selected for this interest). The Tyoneks have traditionally hunted and fished over a wide geographical area -- wider, certainly, than the limits of the land they now control through selections made under the Alaska Native Claims Settlement Act. Even if the project work force did not have automobiles, hunters and fishermen would have mobility by snowmachine, motor bikes, small all-terrain vehicles, airplanes, and boats. Preferential treatment of the Tyoneks under the state's subsistence law seems unlikely, since management distinctions are based on place of residence rather than race or length of residency. Therefore, the stage is set for conflict and competition between the villagers and newcomers over increasingly scarce fish and game resources on the west side of Cook Inlet.

Erosion of the Tyoneks' subsistence resource base poses a potentially serious threat to the traditional village life-style and cultural values. Seasonal subsistence pursuits are an important source of food, focus of village life, and spiritual link with the past. Further decline of the fish and wildlife population that supports this activity could contribute to the emergency of social-psychological problems discussed above.

Economic Impacts

The project would create employment and business opportunities for individual Tyonek residents and the village as a whole. The villagers themselves must act to realize the potential benefits of this economic opportunity, although the project sponsor could enhance the opportunities through such methods as job training, flexible hours and work schedules, and preferential contracting and purchasing policies.

During the construction phase, there would be high demand for laborers, equipment operators, mechanics and other craft workmen. Also, there would be demand for food service and housekeeping labor in the construction camp. These jobs would be filled by the respective unions, which probably would be obligated to minimum Equal Employment Opportunity (EEO) goals by the project labor agreement. There would also be demand for office and clerical help at the site, which is typically non-union.

After the mines, plant, town, and airport were developed and operating, the range of employment opportunities would expand and the complications of union dispatch would be lessened or eliminated. Numerous skilled and unskilled jobs in the mine, plant, and maintenance shops would be available. The town would create approximately 220 jobs in stores, restaurants, banks, a hotel, post office, airport, and other private and public enterprises, many of which would require little or no training and would appeal equally to women and men. In short, there would be ample opportunity for motivated villagers to obtain employment with some aspect of the project.

In addition to direct employment opportunities, the project would offer the possibility of Native-owned businesses supplying goods or services required for maintenance and operation. For example, a business formed by the Tyonek Native Corporation might negotiate a maintenance contract for roads, or a snow-removal contract for the airport runway. Also, it might seek to obtain a business franchise at the town, or become a vendor of supplies and material purchased regularly by the plant and its contractors. In this case, the village corporation would be an employer, and it might wish to provide work schedules, hours, and job-sharing to accommodate seasonal local subsistence activities. Thus, a village-owned enterprise could contribute to community income through jobs and business profits.

20.0 ACOUSTIC ENVIRONMENT

CONSTRUCTION EFFECTS

Construction Activities

During construction of the proposed methanol plant, the primary noise source would be earthmoving equipment, pile drivers and compressors. Typical noise levels for this equipment measured at a distance of 50 feet are:

Earthmoving Equipment	80 dBa
Pile Drivers	95 dBa
Compressors	75 dBa

This would impose a significant noise increment on a pristine 30 to 40 dBa area, but the increase would be temporary and would have little or no adverse effect on present inhabitants. The nearest permanent inhabitants are at the Union Oil collection facility near Granite Point, and there is one permanent residence on the Granite Point beach area. There are also several seasonal residents on the beach during fishing season. The construction activities should be sufficiently far away (one to two miles) to be muffled by the terrain and vegetation and to be virtually un-noticed by the nearest inhabitants. The largest earthmoving equipment in the mine areas would be 15 to 25 miles away and would have no impact on the few individuals currently in the area. The noise from all construction activities would be expected, at least temporarily, to displace wildlife. The project construction activity and noise would not affect any known critical habitat areas.

Vehicular Traffic

General transportation requirements for project construction activities would substantially increase the volume of vehicular traffic in the general Granite Point area. The traffic would be slow-moving and would occur in fairly heavily vegetated areas, factors which would minimize traffic-generated noise to a relatively un-noticeable level to the local inhabitants. The sound level of various truck traffic would range from approximately 72 to 89 dBa at 50 feet and decrease to a range of 54 to 71 dBa at about 400 feet.

LONG-TERM EFFECTS

When the plant is operational, the principal continuous sources of noise would be the coal crushers, blowers, burners, agitators, compressors, pumps, turbines, condensors, coolers, air fins and diesel engines. To estimate the effects of this catagory of noise sources an analysis was done of 91 major noise-producing sources. Each had acoustic emissions in excess of 90 dBa at 50 feet. The analysis also assumes the noises emitted are from the source on a flat plain and does not consider the dampening effects of terrain, vegetation or special noise abating modifications that could be made to the equipment. At the fence line of the plant, an average distance of 1,000 feet from the noise sources, the sound levels were predicted to be 58 to 67 dBa. At a distance of one mile, the sound pressure level is estimated to drop to 51 dBa. At a distance of two miles, which is in the proximity of the nearest inhabitants, the sound pressure level is estimated to be 45 dBa. With the sound dampening effects of terrain and vegetation, and additional acoustic treatment required by the Occupational Safety and Health Act (OSHA) on high concentrations of noise sources, it is expected that the 45 dBa level could be further reduced to somewhere near the high end of the present ambient level of about 40 dBa. For this analysis to be conservative, dBa values in a high range were intentionally used.

Other equipment associated with the methanol plant is not influential when considering environmental impacts of noise at a large distance from the plant. These noises are relevant when considering compliance with OSHA worker exposure levels of 90 dBa, 8-hour time-weighted average (29 CFR 1910.95). When the equipment cannot meet these requirements, other noise control measures such as silencers, noise control installations, acoustical hoods, and closures, etc. would be employed. Heavy pieces of mechanical equipment with vibrating characteristics would be mounted on vibration isolators and piped with elastomer couplings to minimize noise. Steam piping and other gas lines are designed for reduced velocities to prevent excess noise. Ejectors, reducers and related equipment which might otherwise produce excessive noise are insulated.

Figure 20.1 illustrates levels of noise anticipated with the plant operation.

MAJOR REGULATORY REQUIREMENTS

There are no State of Alaska areawide noise control regulations outside of the Department of Labor Occupational Safety and Health Standards. The Kenai Peninsula Borough, which has jurisdiction over this area, also does not have a noise control ordinance program. The principal noise control requirements would be through the federal OSHA Occupational Safety and Health Standards (29 CFR 1910) which basically cover individual source noise emissions particularly as they relate to employee safety within the confines of the workplace.

ENVIRONMENTAL ACCEPTABILITY OF PROPOSED ACTION

The short-term construction noise effects are considered to be nominal in terms of a significant impact on the human population or wildlife of the area. With reasonable engineering, the long-term noise effects from plant operation should be limited to an area within a two mile radius (12 square miles) which is primarily within the

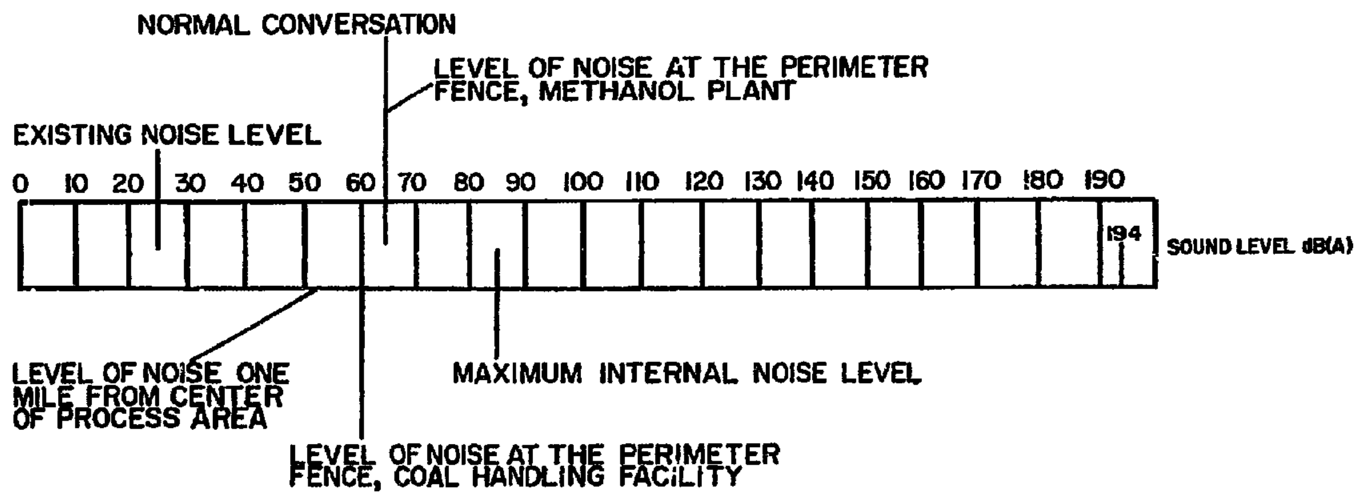

FIGURE 20J LEVELS OF NOISE, dB(A) – BELUGA METHANOL PLANT range of the nearest population. Noise impacts on wildlife would not be severe and should in all cases be acceptable both from an environmental safeguard and a permitting standpoint. In the long-term, the population near Granite Point is expected to expand and eventually exist somewhat closer to the plant site than it currently does. Accompanying this growth would be a higher ambient noise level of 40 to 50 dBa on which would be imposed noise emission levels estimated to measure 51 to 67 dBa between the plant fence line and a point one mile away. In neither the short nor the long term is it expected that noise levels in a populated area would exceed an urban/residential level of 60 dBa or exceed an annoyance level of about 65 dBa.

21.0 METHANOL IN THE ENVIRONMENT (SUMMARY)*

METHANOL IN THE ENVIRONMENT (GENERAL)

Environmental Hazards, Aquatic and Marine

Investigations of the biological consequences of methanol spills or leaks into aquatic ecosystems indicate that many organisms are tolerant to low concentrations. However, significant disruptions of ecosystem dynamics may occur under certain conditions. The biological effects of an aquatic methanol accident are correlated with many factors including scale and duration of spill, tidal involvement, currents, temperature, available oxygen, potential organic and inorganic synergists, particular flora and fauna involved, and the interactions of ecosystem components.

Marine and Estuarine

The following discussion presents a synopsis of the relative effects that might be anticipated in the event there were a methanol spill in Cook Inlet.

Substrate-forming invertebrates are key organisms in intertidal marine and estuarine environments. Both coastal and estuarine communities are largely dependent upon shelled or tube-dwelling organisms for substrate stability, temperature regulation, canopy, and larval settlement characteristics. Substrate formers with sealable shells or tubes vary in susceptibility to experimental concentrations of 100 ppm to 5% methanol. However, many invertebrates cannot survive acute, short-term exposure to concentrations ranging from 0.1 to 5% in filtered seawater. Immediate physiological consequences of acute exposure to methanol include reversible and/or irreversible ciliary narcosis, neuronal disruptions leading to disorientation,

* Prepared by Peter D'Eliscu

"biological clock" suppression and alteration, inappropriate color changes, untimely autotomy and cardiac arrhythmia. Carbon-14 (C^{14}) labeled methanol was found to concentrate in excretory organs, neurons and gonadal tissues after only a few minutes exposure to low-level alcohol-seawater mixes. Chronic exposure to methanol (0.01 to 1% for 7 to 14 days) proved to be disruptive to gametogenesis, embryogenesis, larval development and larval settlement in many molluscs, crustaceans, polychaetes, and other invertebrates.

In addition, the molting processes of several crustaceans (including many commercial and game species) are accelerated by methanol exposure. In spill situations this acceleration could cause premature instar and adult molting, allowing increased population loss through disease, predation, or other environmental factors. In some molluscs, resistance to both tissue invasion and destruction by trematode parasites is greatly reduced. This could also lead to increased incidence of infection in the bird and fish definitive hosts of these parasites. Plankton, mollusc and polychaete larvae are generally susceptible to methanol concentrations as low as 100 ppm. However, these larvae and many invertebrates with ciliated respiratory structures are much less affected in highly aerated conditions. A concentration of about 1% methanol in seawater is tolerated by many common components of intertidal, mudflat, and estuarine ecosystems if heavy metals are eliminated from methylation. However, lower levels of methanol are toxic if metal contamination is considered. Molting disruptions and cardiac arrhythmias of selected crustaceans have been monitored, with commercially important crabs and lobsters receiving major focus. Examples have included toxic disruptions of the eastern lobster Homarus, and several Cancer crab species from the west coast. As in previous crustacean investigations, ethanol proved more toxic than methanol, causing death or irreversible neuromuscular disruptions at 1 to 3% volume. Methanol tolerance limits are generally higher for those animals studied, ranging from 3 to 10% depending on species, size and nutritional state of the organism.

Other test animals evaluated for fuel-water physiological tolerances and responses include the marine gastropods Tegula funebralis, Barleeia sp., and several limpet species of Notoacmaea. The intertidal crab Pachygrapsus crassipes has also been monitored. In exposures to 1 to 30% by volume fuel in water, operculate snails Tegula and Barleeia were not differentially susceptible to alcohol or gasoline. However, gasoline-water mixtures were 25 to 45% more lethal than either alcohol for the non-operculate limpet Notoacmaea.

Crab test animals proved 50 to 60% more disrupted by gasoline mixtures in comparison to both alcohols. In LD_{50} determinations, line-scaled on 100 to 0 non-unit comparison, the rank is indolene 100--ethanol 50--methanol 30. In procedures monitoring myogenic heart rates and neurobiology of Pachygrapsus, significant disruptions of rhythm, pulse intensity, secondary beats, and chamber coordination occur with indolene at 1% volume, 3% ethanol, and 5% methanol per 1 hour exposures. In most cases, arrhythmias are reversible for methanol, but recovery is generally incomplete for indolene exposures, with permanent neuromuscular damage occurring in many cases thus far monitored.

Since low levels of methanol occur naturally in many stable habitats and as alcohol is generally quite miscible, volatile, and degradable, gross environmental impact from moderate spills appears unlikely.

An evaluation of the toxicity of crude oil versus methanol in the marine environment shows major differences in effect. While many of the components of crude oil are held at the surface at ambient temperatures, some extremely toxic components are soluble in water and directly affect subsurface organisms. Since methanol is less toxic initially and has a much shorter residence time than oil (hours vs. years), it is considered a much less disruptive pollutant. Normal biodegradation of methanol is more rapid than crude oil or gasoline in aquatic and terrestrial habitats. In addition, recolonization by important organisms is much more rapid in alcohol-disrupted habitats.

Assessments of experimental spill sites for methanol and ethanol have shown nearly equivalent recovery. Coastal sites may show Shannon-Weaver diversity indices of 6.2 to 6.4 seven months post-spill. Sites have nearly fully recovered, nearing the 8.15 diversity index of the prespill baseline study.

Work with commercially important crabs and other marine anthropods has focused on the neuromuscular disruptions from fuel exposure, and clearance time and physiology. Electronic monitoring of isolated heart nuclei from these animals in vivo demonstrated rapid arrhythmia in ethanol and methanol exposures of 3% volume in seawater. Autoradiographs of haemolymph samples taken at five minute intervals after C^{14} methanol exposure have demonstrated rapid partial clearance from the body. However, muscle and antennal gland samples have indicated continued toxicity after 55 minutes of clearance time for some specimens. Various physiological and behavioral disruptions associated with methanol spill situations would probably be short-term in field conditions. However, complete tissue clearance of alcohols is a matter of 2 to 5 hours, depending upon size, nutritional state, and microhabitat of the organism tested. Therefore, animals collected from a spill encounter should not be eaten unless purged (alive), or leached for more than minimum clearance time.

Comparison of Marine Environmental Impact Costs: Methanol/Oil

A comparison of the costs and consequences of crude oil spills versus alcohol spills indicates a further benefit in the transportation sector of alcohol fuel utilization. In assessing the direct and indirect costs of major oil spills, it is apparent that both acute immediate losses and residual losses are more severe than those losses associated with methanol.

An evaluation of the cleanup costs, repair for physical damage to boats, nets, filters, etc., and various socioeconomic losses due to some monitored oil spills shows a general pattern. In a major spill involving coastlines, such as those of the 1967 Torrey Canyon spill (off Cornwall, England), the 1969 Santa Barbara Channel spill and the 1978 Amaco Cadiz spill on the French Burgundy coast, costs may include initial expenditures for containment of the spill such as transportation and placement of physical barriers. Further attempts with suction-pump recollection, chemical surfacant dispersal, detergent application or absorption to straw, floating bellets or other material are generally applied. Later removal or degradation of larger residue is considered a "final" step. However, the residence time of some soluble components of the oil and small particulate residue pollutant is very long. An estimate of seven to 12 years retention of these residues in soft organic substrates and marshlands of France is not considered conservative. The monetary loss of fragile commercial species of crustacea, molluscs, and fish can be greater than the initial losses. In the case of the Amaco Cadiz spill, nearly all the commerical oyster industry of this region was lost and required waiting five to six years for reseading of spat to replenish the industry. Loss of marshlands in the Santa Barbara and Amaco Cadiz spills and consequent decreases in some commercial crustacean and fish populations have been estimated at $2 million and $10 million, respectively. The physical and biological properties of alcohol fuels (methanol in particular) negate several of the possibilities for fiscal losses which would be expected in a spill situation involving oil. Short biological residence time, dilution and very rapid microbial degradation of methanol compared to crude oil components all contribute to this reduced loss.

Cleanup of a moderate to large methanol spill would involve removal of dead organisms, if necessary, monitoring of alcohol levels for several tidal periods, possible aeration of water as a restoration technique and perhaps innoculation of water with methotrophic bacteria, such as Pseudomonas flourescens. The most likely efforts to be employed for minor spills of methanol would be maintaining security of the area for one or two tidal periods. Normal degradation would complete the cleanup process with the least disruptions.

While monetary costs of floral and faunal losses due to oil pollution in the sea are not well documented, the physiological effects and population disruptions to birds, mammals, sessil invertebrates, zooplankton, phytoplankton, algal canopy, and other organisms are the objects of intensive current research.

Table 21.1 shows a comparison of the costs of example spills of crude oil, diesel fuel, and methanol. There is a large reduction in cleanup cost for methanol in contrast to diesel oil and crude oil. The petroleum figures taken from are from literature, and the methanol costs are estimated assuming worst-case conditions, based on research and small scale experiments conducted on the Santa Cruz, California coast. The major cost reduction factors associated with methanol spill clean-up are:

a. Decreased Manpower Requirements. Fewer man-hours for immediate cleanup operations are required for methanol. These figures include lower involvements of death of vertebrate animals, chemical treatments, monitoring, and health security operations.

b. Residual Toxic Effects are Shorter. Methanol toxic effects would last hours rather than years as would effects of heavy fuel oil.

c. Costs of Cleanup Materials. Possible innoculation of waters with alcohol-consuming bacteria and aeration of water or intertidal zones are significantly less expensive than sweeping, suction, dispersant-coagulant, or other technologies necessary for oil clean-up operations.

d. Transportation. Transportation costs of vehicles and vessels necessary for alcohol clean-ups are much less than those for oil spill situations.

e. Legal. Fines for environmental losses would likely be significantly less for methanol spills. However, for this comparison they are considered equivalent.

Table 21.1

COST COMPARISON OF SELECTED CRUDE OIL, DIESEL FUEL, AND METHANOL SPILLS

Fuel	Spill Situation	Year	Estimated Total Cost	Volume	Cost Volume
Diesel	Tampico Mara	1957	1,000,000	20,000 Met. Ton	$50/MT
Crude	Torrey Canyon	1967	17,020,000	100,000 Met. Ton	$172/MT
Crude	Santa Barbara	1967	[illegible]500,000	3.4 Mill. Gals	14.9¢/gal
Crude	Amoco Cadiz, Fr.	1978	100,[illegible]0,000	6.0 Mill. Gals	16.7¢/gal
Methanol*	Santa Cruz, CA	1977/78	120,000	1.0 Mill. Gals	.12¢/gal

* Methanol estimate established in 100 gallon spill enclosed system experiments.