Alberta Oil Sands Corridor Study

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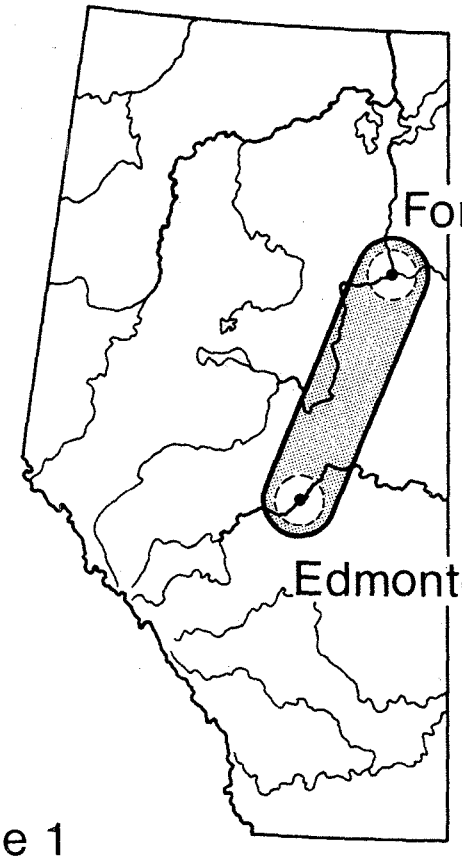

Volume 1

Report~Part 2

Corridor Development Plan

'ed for

by

IRONMENT

Alberta Oil Sands
Corridor Study Group

974

edmonton, alberta

ALBERTA OIL SANDS

CORRIDOR STUDY

VOLUME 1 REPORT, PART 2

CORRIDOR DEVELOPMENT PLAN

Prepared for:

Alberta
Environment

By:

Alberta Oil Sands
Corridor Study Group

June. 1974

Edmonton, Alberta

SUMMARY

ALBERTA OIL SANDS CORRIDOR STUDY
CORRIDOR DEVELOPMENT PLAN

In this plan a transportation corridor connects the oil sands resources of the Athabasca area to a new major provincial terminal which serves as a central hub for additional corridors radiating out to existing and future industrial facilities and extra-provincial terminals. The placement of these corridors and industrial facilities meets the location parameters agreed upon by the study group.

The new corridor components are pipelines, power transmission lines and a relatively short railway spur line in the vicinity of the terminal. Where possible the corridors are integrated with existing pipelines, highways and railways. The Corridor Concept is applicable.

"Alberta Skaro Terminal" is the provisional name used in this report for the major provincial terminal. The purpose of this terminal is to receive, measure, pass-through, transfer, or direct liquid hydrocarbons by pipeline, railway or truck between petrochemical complexes, refineries, extra-provincial terminals and the mineral source. An additional possible future terminal is indicated in the Hardisty area which will probably be interconnected with the system sometime in the future.

The plan envisions several major petrochemical complexes and refinery sites to be developed easterly along the south side of the North Saskatchewan River. The realization of these plants will depend upon many factors, but Alberta through its control of the developing hydrocarbon supplies from the Oil Sands can ensure feedstock supply on a long term basis. With the fast depletion of conventional oil reserves and the enormous increase in cost of conventional crude oil this assured feedstock supply may be the most important factor in determining where processing is to take place.

The parameters which were used by the study group in formulating the Corridor Development Plan covered: the social and physical environment, engineering and economic considerations, hydrocarbon supply and demand, decentralization of urban growth, continued support of existing facilities, export of surplus products and the location constraints of each facility.

Those participating in the "Corridor Concept" part of the plan involved the public, citizens' groups, industry and the multi-discipline consultant group. After this participation and additional study the consultant group prepared the plan contained in this report. Optimistic projections were made to ensure flexibility in order that the system can expand to accommodate any foreseeable industrial growth opportunities for Alberta.

LEGEND:

LAKES
RIVERS
ALBERTA OIL SANDS
TOWNS

EXISTING TRANSPORTATION
HIGHWAYS
RAILWAYS
OIL PIPELINES
A.G.T.L. GAS PIPELINE

EXISTING AND PROPOSED INDUSTRIAL SITES
MAJOR REFINERY (R)
MAJOR PETROCHEMICAL COMPLEX (P)
MAJOR POWER (E)
MAJOR TERMINAL (T)
EXISTING SITES SHOWN WITH *

CORRIDORS
NEW CORRIDOR COMPONENTS
RAILWAY
PIPELINE
POWER
APPLICATION OF CORRIDOR CONCEPT

NOTE: DATES PROVISIONAL AND INDICATE COMPLETION.

Fort McMurray
ATHABASCA RIVER
1978
1985
Chard
Conklin
Calling Lake
Wandering River
RIVER
ATHABASCA
Athabasca
Lac La Biche
Boyle
Existing
A.G.T.L. Gas Pipeline
Cold Lake
Bonnyville
Thorhild
Smoky Lake
NORTH SASKATCHEWAN RIVER
St. Paul
Redwater
Skaro
Andrew
Fort Saskatchewan
EDMONTON
Two Hills
1990
Myrnam
Possible Terminal By-Pass for Export Pipelines
Vegreville
Tofield
1980
Vermilion
Mannville
Viking
Camrose
Wetaskiwin
Existing I.P.P.L. Pipelines
Killam
Wainwright
Hardisty
1985
BATTLE RIVER

Alberta ENVIRONMENT

ALBERTA OIL SANDS CORRIDOR STUDY

CORRIDOR DEVELOPMENT PLAN

ALBERTA OIL SANDS CORRIDOR STUDY GROUP
STEWART WEIR STEWART WATSON & HEINRICHS

Scale: 1:1,000,000 (1"=16 miles approx.)	JUNE, 1974	Checked by: C.H.W.	Drawn by: D.W.	No.

PREFACE

Volume 1 Part 1 of the Alberta Oil Sands Corridor Study dealt with the "Corridor Concept". It covered the definition, history, application, advantages, disadvantages and implementation of the Corridor Concept as well as its potential application to development of the Alberta Oil Sands. The Corridor Concept received support from the public, industry, government and the consultant group. A summary of the Corridor Concept is contained in this report. This report, Volume 1 Part 2, deals with the Corridor Development Plan which covers the location and make up of the corridors and terminals.

The consultant group wishes to acknowledge and thank all the participants from government, industry, advisory groups, citizen groups and the general public who gave freely of their time to assist us in our work. With the help of this input we believe the Corridor Development Plan which is recommended in this report is more realistic and will receive wider acceptance.

Preserving and enhancing the quality of our environment and the quality of life must be an on-going activity. It is hoped that the cooperation that was evident in the preparation of this report will continue and prevail throughout the solving of the complex problems involving the development of the full potential of the Alberta Oil Sands.

C.H. Weir,
Project Manager

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1.1 INTRODUCTION

The Alberta Oil Sands represent a major world resource of hydrocarbon feedstocks for the refining and petrochemical industry. The need for greater supplies of these feedstocks, coupled with the rapid depletion of conventional reserves and the enormous and sudden increase in the cost of conventional crude oil, will cause a dramatic increase in the activities connected with the development of this resource. A major consequence of this resource development will be the need to transport people, energy and materials to and from the area. The transportation system is important in all developments but becomes a key issue when markets and supply centers are many miles away.

The purpose of this part of the study is to select the desired transportation corridor route(s) and the preferred location of the southern terminal(s) to serve the development of the Alberta Oil Sands. A portion of the transportation system namely: the highway and railway are already in existence and have their location established. Thus the primary concern is the location of a "pipeline corridor" and the possible integration of this corridor with existing and future transportation facilities. Before selecting the corridor route(s) the location of the southern pipeline terminal(s) must be determined. In this regard the logical and synergistic relationship between an integrated petrochemical industry, the petroleum refining industry, the feedstock source, the pipeline terminal and the pipeline corridor must be considered.

Transportation systems, once built, are generally in existence for many years and have a very real impact(both beneficial and detrimental) upon a region. The transportation systems into the Alberta Oil Sands must tie into provincial and national networks. The complex interactions between the various methods of transport and related facilities, and between these and the physical and social environment of a region must be recognized. The system should not be an end in itself but rather a means for achieving social and economic objectives related both to those regions directly affected and also to other regions.

1.2 PROCEDURE

The study is divided into two basic parts:

- firstly, the "Corridor Concept" as applied in general and in particular in regard to transportation systems out of the Alberta Oil Sands.

- secondly, the Corridor Development Plan which identifies general locations for a series of Industrial Sites, Terminals and Corridors.

The initial part of the study covered the gathering of data, investigating and studying existing reports and conditions with presentation in the form of maps, charts, summaries and statements. This involved a multi-discipline group of consultants as listed on page 59. The results of this part of the study are reported in the following appendix volumes.

Volume 2 - Extracts from Existing Literature

Volume 3 - The Effects of Existing Legislation

Volume 4(1 & 2) - Environment - General Characteristics and Conditions

Volume 5 - Effect Upon Human Settlement Patterns

Volume 6 - Environment & Engineering
Powerlines - Pipelines - Highways - Railways

Volume 7(A & B) - Public Meetings
Volume 8 - Corridors & Terminals

Included in the above but forming a distinct and important part of the study was the involvement of local municipal governments, citizen groups, advisory groups, representatives from industry, and the general public. To this end several public meetings and special group meetings were held as follows:

Phase I - Public Meetings

- Boyle, November 5, 1973
- Thorhild, November 6, 1973
- Athabasca, November 7, 1973
- Lac La Biche, November 8, 1973
- Fort Saskatchewan, November 9, 1973
- Conklin, November 12, 1973
- Fort McMurray, November 29, 1973

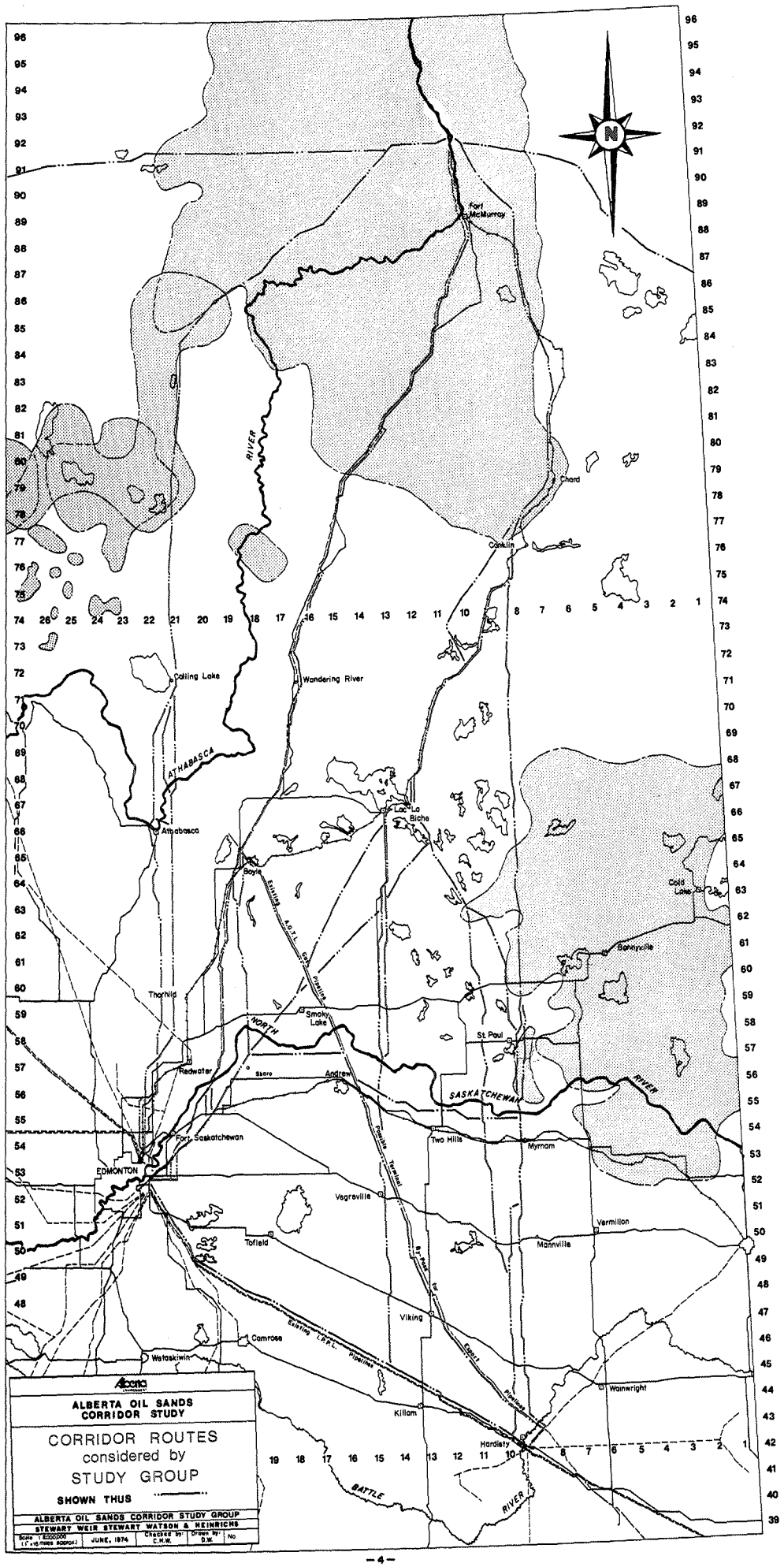
Phase II - Special Group Meetings

- Calgary Technical, November 22, 1973
- Calgary Industry, December 18, 1973
- Edmonton Study Group, January 21 & 22, 1974
- Edmonton Study Group, April 8, 1974

Subsequent to this the two final reports were completed as follows:

Volume 1 Part 1 "Corridor Concept"
Volume 1 Part 2 Corridor Development Plan

The study area covered northeastern Alberta south of the Fort McMurray area. General area assessments for the purpose of selecting the optimum routes and sites were made. Additional detailed work will be required when the facilities are located on the ground. The general routes considered by the study group are shown on page 4 .


Fort McMurray
Chard
Conklin
Calling Lake
Wandering River
ATHABASCA
RIVER
Athabasca
Boyle
Lac La Biche
Cold Lake
Bonnyville
Thorhild
Smoky Lake
St Paul
Redwater
Andrew
SASKATCHEWAN
RIVER
Fort Saskatchewan
EDMONTON
Two Hills
Myrnam
Vegreville
Vermilion
Mannville
Tofield
Viking
Camrose
Wetaskiwin
Killam
Wainwright
Hardisty
BATTLE
RIVER
ALBERTA OIL SANDS
CORRIDOR STUDY
CORRIDOR ROUTES
considered by
STUDY GROUP
SHOWN THUS
ALBERTA OIL SANDS CORRIDOR STUDY GROUP
STEWART WEIR STEWART WATSON & HEINRICHS
JUNE, 1974

1.3 LOCATION PARAMETERS

Before locating the corridors and terminals which are recommended in this study the following location parameters were defined and agreed upon by the study group:

1.3.1 The minimization of detrimental impact on the social and physical environment resulting from the construction, operation, maintenance and termination of the various transportation and terminal facilities.

1.3.2 The application of the "Corridor Concept" as outlined in Volume 1 Part 1 of this study and consideration of the usual engineering and economic location parameters associated with each mode of transport.

1.3.3 The recognition that supplies of conventional Alberta crude oil are fast approaching a level of peak production and will soon begin to decline. Thus, to replace the industrial and economic base which conventional crude oil now provides, there should be a maximization of the refining and processing of bitumen from the Alberta Oil Sands within the province.

1.3.4 The encouragement of rational regional development and the avoidance of massive agglomeration of industrial and urban growth in any one particular location. Decentralization of industrial development throughout the province is a fundamental tool in achieving the objective of decentralizing urban growth.

1.3.5 The production from the Athabasca Oil Sands can provide an assured supply of feedstocks for additional refining and petrochemical industry for many many years. Part of the production will be required to supplement the diminishing supply of conventional crude oil which feeds existing industrial facilities.

1.3.6 The allowance for the export of surplus production to extra-provincial and foreign markets by way of the existing national pipeline network.

1.3.7 The recognition that under present day economics, a petrochemical complex must be of a scale and magnitude to serve world markets. Refineries must also recognize the economy of large scale production to be competitive. Both industrial activities have definite basic location constraints which are dictated by feedstocks, water supply, transportation facilities, manpower and proximity to related industries and services.

1.3.8 The recognition that pipeline terminal facilities have less restrictive location parameters than refining and petrochemical industries; and that these should not be regarded as a substantial economic base activity for the generation of dependent industrial activity, service activities and consequent population growth.

1.3.9 The transporting of goods and materials through pipelines generally has much less detrimental impact on the environment than other methods of transport. Pipelines conveying conventional crude oil into existing terminals will soon be idle and can be used for other purposes for many years. Thus, use of these lines would be both environmentally and economically beneficial.

1.3.10 The expansion of that segment of the petrochemical industry based exclusively on natural gas (or ethane extracted therefrom) will not significantly affect the location of the Alberta Oil Sands corridor and terminal. However, the foreseeable growth of ethylene and related petrochemicals necessitates correlating these major industrial developments.

1.4 CORRIDOR DEVELOPMENT PLAN

The Corridor Development Plan is an arrangement of interlocking transportation facilities, petrochemical plants, refineries, associated plants, power plants and transfer facilities that will enable optimum development of the Alberta Oil Sands. Within this plan there is a further arrangement of the industrial facilities into "Industrial Parks", the transportation facilities into "Transportation Corridors" and the transfer facilities into a major provincial "Terminal". This whole arrangement has been made to meet, where possible, the location parameters as listed in 1.3.

The Athabasca Oil Sands area is connected by a corridor to the Alberta Skaro Terminal which serves as a central distribution point for two additional corridors. The first corridor connects to the existing Edmonton Industrial Area and the major extra-provincial terminal; the second corridor extends easterly along the south side of the North Saskatchewan River to serve future potential industrialization in the general region of Andrew, Two Hills and Myrnam. The second corridor joins the proposed corridor to serve the Cold Lake Oil Sands.

The Cold Lake Oil Sands area is connected by a corridor to the possible future Alberta Hardisty Terminal. This terminal is located near an extra-provincial terminal and in an area proposed for an Industrial Park should the Battle River be adequately upgraded. This corridor crosses the North Saskatchewan River near the Myrnam Industrial site where additional interconnections would be possible.

It is anticipated the plan would develop over a period of years as indicated in the Provisional Schedule on page 9. The map of the Corridor Development Plan also contains some provisional completion dates. An immediate

start on the first part of the program is urgent if the proposed Syncrude Project is to be accommodated.

The basic component of the plan is the number of actual industrial developments which may take place. This growth will depend upon oil export and industrial development policies in conjunction with world market and economic conditions.

Optimistic projections have been made in the design of the plan to ensure flexibility and that the system can expand and be complete at each growth stage. Conversely should some unforeseen event occur which would severely limit growth then with graduated development as indicated, problems may be avoided.

Additional major development of the Edmonton Industrial and the Fort Saskatchewan Industrial sites would lead to industrial agglomeration and further metropolitan population growth. All other sites will contribute to the decentralization of industrial and population growth which is one of our prime location parameters.

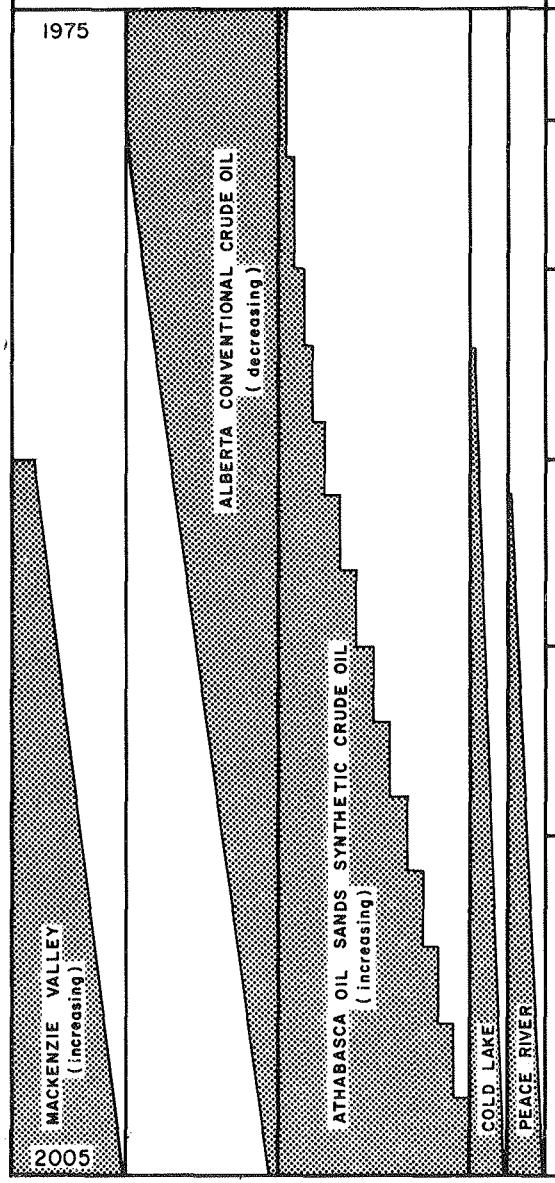
It is essential that the corridors should be acquired, designed and have space allotted for the various facilities well ahead of development. This also applies to the Industrial Parks; for example, the allotment of water from the North Saskatchewan River to each site should be made soon. Thus in both instances industry will be able to define their design parameters and proceed with greater certainty and fewer delays. Readily available space in the "Corridor" or in the "Industrial Park" will be a major incentive for realization of the Corridor Development Plan.

The realization of the Corridor Development Plan as proposed in this report would, in future, cover the basic activities associated with liquid hydrocarbons in Alberta. With the apparent growth of the petrochemical and other industry associated with natural gas in Southern Alberta then the total Alberta petrochemical development picture will be complete.

ALBERTA OIL SANDS CORRIDOR STUDY

TERMINALS, PETROCHEMICAL COMPLEXES, REFINERY SITES AND CORRIDORS

PROVISIONAL SCHEDULE



CRUDE OIL SUPPLY (Time frame approx. 30 yrs.)	PETROCHEMICAL COMPLEXES	REFINERY SITES	MAJOR TERMINALS	CORRIDORS	REMARKS
	Existing facilities at Edmonton and Fort Saskatchewan	Existing facilities at Edmonton	Existing facilities at Edmonton	Athabasca Oil Sands to Alberta Skaro Terminal with connecting corridors to Edmonton and Andrew industrial sites.	G.C.O.S. pipeline existing from Fort McMurray to Edmonton. Terminal site in Athabasca Oil Sands area not defined.
	ANDREW	ANDREW	ALBERTA SKARO TERMINAL		Start of progressive development east along North Saskatchewan River.
	TWO HILLS		ALBERTA HARDISTY TERMINAL	Hardisty Corridor Cold Lake region south to Hardisty and Corridor between Andrew industrial and Myrnam industrial sites.	Major power development northeast Camrose supplies power through alternate routes.
	MYRNAM	MYRNAM	EXPANSION		Mackenzie oil passes through province using part of existing system.
	HARDISTY		ALBERTA SKARO TERMINAL AND ALBERTA HARDISTY TERMINAL		Peace River Oil Sands (uses existing pipeline system).
	Use of abandoned crude oil pipelines to carry feedstocks to selected industrial sites in Alberta. Full development of Oil Sands with shipments of refinery products and petrochemical feedstocks south as well as synthetic crude oil.				Begin using abandoned conventional crude oil pipelines for transporting refinery products for Alberta consumption and export.
					Possible extension of Hardisty corridor south to Petrochemical Complex in Southern Alberta.
					Northern portion of Hardisty corridor between Cold Lake and Athabasca Oil Sands probably not needed.
					Sites associated exclusively with Natural Gas or outside study area not indicated.

1.5 INDUSTRIAL SITES

For the purpose of locating the "southern terminal" and "transportation corridor" several existing and provisional major industrial sites were identified. These are "general area locations" for a series of integrated petrochemical plants, refineries and associated industries, that could facilitate the development of the full potential of the Alberta Oil Sands. It is anticipated that after detailed site investigations and studies (geotechnical, ecological, hydrological, climatological, etc.) a comprehensively planned "Industrial Park" would be developed in each general area.

Seven sites have been identified and shown on the map of the Corridor Development Plan.

1.5.1 Edmonton Industrial

This is an existing site situated next to a large urban center having a population exceeding 500,000. There are three refineries, major export terminals, C.I.L. Petrochemicals and many other facilities. The area is growing and has problems with congested transportation facilities, sewage disposal, surface drainage, high land costs, etc. The area is zoned.

1.5.2 Fort Saskatchewan Industrial

This is an existing site situated 20 miles from Edmonton and next to a growing urban center. There are several large industrial plants and facilities in the area. The area is growing and in need of a comprehensive plan and zoning.

1.5.3 Athabasca Oil Sands

These will probably be developed along the Athabasca River north of Fort McMurray. Comprehensive studies are being carried on by others.

1.5.4 Andrew Industrial Site

There are many optional locations within a 20 to 30 square mile area of relatively flat, silty, sandy, swampy, non-agricultural land lying between one and five miles south of the North Saskatchewan River. The area is located 60 to 70 road miles northeast of Edmonton, 5 to 10 miles northwest of Andrew and 8 to 12 miles south of Smoky Lake.

The towns of Andrew and Smoky Lake are existing agricultural service centers not far from the site. Both have possible potential for growth. Alternatively there are several suitable locations in the vicinity where a New Town might be established. Passing through the site is a good standard paved secondary highway. Having a new bridge across the North Saskatchewan River, this highway provides a link between the two centers and between Highways 45 and 28.

1.5.5 Two Hills Site

This site is located on No. 3 agricultural land on the south side of the North Saskatchewan River, 3 to 5 miles north of Two Hills and 90 to 100 road miles east-northeast of Edmonton. The Town of Two Hills is located at the intersection of two provincial highways. An existing small chemical plant in the area has demonstrated that the town has the ability to accommodate growth.

1.5.6 Myrnam Site

This site is located a few miles north of Myrnam on the south side of the North Saskatchewan River on No. 3 agricultural land. Two corridors join at this point which will provide flexibility in choice of feedstocks as well as alternates for flow of refinery

products. The possibility of secondary terminal facilities should also be considered when designing this site.

Myrnam is an agricultural service center that may have potential for growth. Alternatively there are possible New Town locations along the river. The development of this site is a few years away thus the matter can receive further attention as the development of the whole system proceeds.

1.5.7 Hardisty Site

This site is located on No. 4 agricultural land southeast of Hardisty on the east side of the Battle River near the existing I.P.P.L. terminal and Home Oil Storage facilities. For a major site the Battle River would require improved water supply and regulation. Terminal facilities should also be included in the design of this site.

The Hardisty site which might ultimately contain both terminal and industrial facilities is the most southerly location of our study area. As such, it might provide a possible link with the chain of petrochemical developments of the southeast part of Alberta.

1.6 TERMINALS

Interprovincial Pipe Line Ltd. and Trans Mountain Oil Pipe Line Co. (both federally incorporated companies) own and operate common carrier, interprovincial pipelines, from their facilities in the Edmonton Industrial Area and are what can be called extra-provincial terminals. These two extra-provincial terminals are at the termination of many pipeline systems presently carrying conventional crude oil and other liquid hydrocarbons into the Edmonton area from many locations throughout Alberta. The oil and other products are then transferred into their pipelines for transport to other parts of Canada and foreign export. These terminal facilities are located in an industrial environment. Since moving the facilities and pipelines would be extremely expensive it follows that there should be a connection to this area from the proposed Alberta Skaro Terminal. These facilities could in future serve the double purpose of export connections and the distribution of refinery products through pipeline systems which become vacant with the depletion of conventional crude oil sources. The extent of these facilities are summarized in Volume 6, the appendix. Interprovincial Pipe Line Ltd. (I.P.P.L.) also operate a terminal at Hardisty where this situation presently exists on a reduced scale.

The location of the Athabasca Oil Sands Terminal is assumed to be situated on the west side of the Athabasca River, north of Fort McMurray. This area is being studied extensively by others. There can be considerable shift in this location before it will significantly affect the corridor. One of the reasons for this location is that the Athabasca River crossing is a major control point.

The locations for two provincial terminals have been recommended in this report. These are "general area locations" with the exact location to be decided after detailed

site investigations and studies. Of these two proposed terminals the Alberta Skaro Terminal would probably be primary with the Alberta Hardisty Terminal playing a reduced role. It is anticipated that each facility would be fully integrated to provide:

- above and below ground storage;
- pumping facilities;
- transfer capabilities to and from highway and railway facilities;
- exchange or transfer capability between pipelines;
- connections to extra-provincial terminals;
- flexibility of service to all customers and in reality be a "common carrier" terminal;
- area for electric power substation (power transmission line terminal).

1.6.1 Alberta Skaro Terminal

The Alberta Skaro Terminal is projected as a major integrated terminal for the transference of liquid hydrocarbons in general and particularly those from the Athabasca Oil Sands. It is located on relatively unproductive, sandy, pasture land at the western end of the general area which has been recommended for the Andrew Industrial Site. Preliminary investigation indicates Sections 27, 28, 33 and 34, Twp. 57, Rge. 19, W4M (3,000 acres) which lies 50 to 60 road miles northeast of Edmonton. The location parameters and constraints which determined this area are as follows:

1.6.1.1 Its proximity to the proposed industrial sites situated east along the south side of the North Saskatchewan River.

1.6.1.2 Its proximity to the environmentally and economically desirable corridor south from the Athabasca Oil Sands.

1.6.1.3 The eventual number and size of pipelines coming into or leaving the terminal is uncertain being dependent upon many studies and decisions to be made by others. This particular location has the best possibility of being the optimum location for minimization of pipeline lengths which represents a very substantial financial saving as well as the energy used for pumping.

1.6.1.4 The terminal is strategically located for distribution of liquid hydrocarbons from the Athabasca Oil Sands to existing Edmonton and Fort Saskatchewan Industrial Area, the proposed industrial sites along the North Saskatchewan River and to the extra-provincial terminals.

1.6.1.5 The site can be connected by a single railway spur line (14 miles) to the two national carriers (C.N.R. and C.P.R.) in a convenient location (Bruderheim) where they are adjacent to one another. The spur line would also serve the Andrew Industrial Site.

1.6.1.6 Several additional reasons for this site selection are that:

- minimum of farmland will be crossed diagonally;
- the North Saskatchewan River crossing will be through a suitable area;
- possible future integration with pipelines from the Arctic;
- the power transmission line corridor from the south will fit in well;
- connecting corridors to Fort Saskatchewan, the I.P.P.L. terminal and the Edmonton industrial area are feasible;
- possibility of underground storage in high quality salt beds.

1.6.2 Alberta Hardisty Terminal

The Alberta Hardisty Terminal is projected as an integrated terminal for the transfering of liquid hydrocarbons generally and in particular those associated with the development of the Cold Lake Oil Sands and the Athabasca Oil Sands. There are several possible site locations in the general Hardisty area. The actual site should be determined in conjunction with the industrialization concept mentioned under 1.5.7.

The eventual role of this terminal could be shared and coordinated with a possible secondary terminal at the Myrnam Industrial Site. However, as construction is a few years away the matter can receive further attention as the development of the whole system proceeds.

1.7 CORRIDORS

Several alternatives for an integrated system of industrial parks, terminals and transportation corridors exist within the study area. The guidelines used in selecting the corridors and terminals recommended in this report are the location parameters outlined under 1.3.1 to 1.3.10. The location of the corridors are approximate. The accurate location and definition of the corridor limits would come after detailed planning and design as outlined in Volume 1 Part 1.

In the design of the corridor and the allotment of space for future utilities, greater potential will occur from over-estimating the number of corridor components than under-estimating them. The logic of this is supported when one considers that: in agricultural areas productive farming operations can still be carried on; clearing of tree cover can be carried out on a graduated

basis; people in the urban areas will benefit from the open space, and with increasing land prices the early purchase of extra land would be desirable.

It is anticipated the corridors would develop over a period of years as indicated in the Provisional Schedule and in the Corridor Development Plan. An immediate start on the Athabasca Oil Sands to Skaro to Edmonton corridors is urgent if the proposed Syncrude Project is to be accommodated.

Following is a short description of the transportation corridors recommended in the Corridor Development Plan.

1.7.1 Athabasca Oil Sands to Alberta Skaro Terminal

The corridor commences in the Athabasca Oil Sands area and generally follows southerly along the existing Great Canadian Oil Sands Limited (G.C.O.S.) pipeline right-of-way to a point a few miles north of the Village of Boyle. At this point there are alternate locations either to the west or east of the village which require further detailed investigation and local participation. After bypassing the Village of Boyle the corridor then proceeds almost due south to the Alberta Skaro Terminal. Depending upon the location of the northern terminal, which is being defined by others, it will be some 240 miles long. The northern portion (140 miles) is through boreal forest and gently rolling terrain where wildlife is relatively sparse. The southern portion (100 miles) is through generally open flat agricultural land. Following are some salient features regarding this corridor:

1.7.1.1 Of all the corridors examined by the study group this particular corridor was favored both in regard to minimization of detrimental impact on the environment and in regard to economy of construction and operation.

1.7.1.2 Corridor Components:

Unless something unforeseen happens the number of facilities listed here are probably over-estimated.

- three large diameter pipelines (30" to 40"),
- eight smaller diameter pipelines (12" to 20"),
- two power transmission lines.

The number and size of pipelines to be built is uncertain. At this point in time all indications point to a 36" synthetic oil pipeline being built immediately with other lines to follow as required. Pipelines built to serve the Athabasca Oil Sands will have a much longer predicted use than those which have been built into conventional oil fields.

A power transmission line is presently being built into the Athabasca Oil Sands region from the Mitsue area. Thus the construction of a powerline in the corridor, at least in the northern portion, is several years away.

1.7.1.3 Where the corridor is integrated with Highway 63, provision should be made for a future four-lane highway facility. There are some scenic areas along Highway 63 where special attention should be paid to aesthetics.

1.7.1.4 To provide greater flexibility of operation in the earlier stages, consideration should be given to having the G.C.O.S. pipeline used as a "common carrier" and including it in the total system.

1.7.1.5 The immediate Fort McMurray area requires special attention and construction procedures:

- first, where the corridor passes through existing and future residential areas;
- second, at the crossing of the Athabasca River.

Consideration should be given to laying several pipelines at one time in the same trench in critical portions of these two areas as the corridor width will be very confined and such a procedure would minimize disturbance and possibly cost.

1.7.2 Alberta Skaro Terminal to Edmonton

The corridor commences at the Alberta Skaro Terminal and heads southwesterly across flat, open, agricultural land directly into the established Edmonton Industrial Area. Except for the first 14 miles the corridor is adjacent to and on the south side of the C.P.R. Willington Branch railway. A small diversion will be required at the Hamlet of Josephburg and possibly at two farmsteads. Commencing either 1½ or 2½ miles east of Highway 55 there is a possible alternate route which comes directly south across Highway 16 and then directly west into the Edmonton Industrial Area. The length of the corridor is about 40 or 45 miles depending upon which route is selected. Both routes tie into the recently declared "Restrictive Development Area", which lies adjacent to the easterly boundary of Highways 14X and 16A. This area can be considered the termination point. Some salient features about this particular route are:

1.7.2.1 The last 10 miles near the Edmonton Industrial Area is in a region that is developing rapidly. It has enormously escalating land prices and contains many other facilities; therefore an early decision on the corridor could represent a large financial saving.

1.7.2.2 Alternate Routes:

(a) Along Railway:

- would disrupt two farmsteads;
- would disrupt some developing industrial sub-divisions;
- several pipelines and utilities already follow a good portion of the route.

(b) Along Alternate Route:

- goes through relatively open farmland;
- could limit the industrial area and the growth northward of the Hamlet of Sherwood Park;
- depending upon number of pipelines this route could cost several millions of dollars extra.

1.7.2.3 Corridor Components:

Again these have probably been over-estimated unless something unforeseen happens.

- sixteen pipelines of various sizes;
- two power transmission lines;
- one railway spur line for about fourteen miles at the beginning of the corridor;
- several utilities (sewer, water, gas, power,etc.) in portion closer to Edmonton.

The immediate components required are the railway, powerline and a pipeline. Consideration should be given to building a smaller sized pipeline (24") which could make future operations more flexible when a series of pipelines will be required.

1.7.2.4 A connection to the Fort Saskatchewan Industrial area would also be required. There are several existing lines between Edmonton and Fort Saskatchewan.

1.7.3 Alberta Skaro Terminal to Myrnam Industrial Area

The corridor commences at the Alberta Skaro Terminal and runs directly east to the proposed Andrew Industrial Site, then east and south to the Two Hills Industrial Site and then ends at the Myrnam Industrial Site where it joins the Hardisty Corridor. This particular corridor will probably be built in sections as industrialization progresses east along the south side of the North Saskatchewan River.

The first section required is between the Alberta Skaro Terminal and the Andrew Industrial Park. The immediate components of this corridor will be two smaller sized pipelines, a powerline, railroad spur line and a two-lane paved road. In allotment of space for future components, an additional ten pipelines, one power transmission line, several communication lines and possibly some utility lines should be allowed for in the design. This part of the corridor passes through some sandy areas which will require special attention.

The need for the remaining sections to Two Hills Industrial Park and Myrnam Industrial Park are several years hence and will require a similar type corridor except for the railway and road.

1.7.4 Athabasca Oil Sands to Hardisty

The corridor commences in the Athabasca Oil Sands north of Fort McMurray and heads southeast to a crossing of the Clearwater River then southerly along the N.A.R. to Devenish. From here it heads almost straight south past Glendon, St. Paul, Mannville, Irma and into the Hardisty Industrial Area. Depending upon the location of the northern terminal, which is being defined by others, it will be some 330 miles long. It is divided into two main sections with only the southerly portion being included in the Corridor Development Plan.

1.7.4.1 Northern Portion(Cold Lake Oil Sands north):

The northern portion is in mixed forested area and some 200 miles long. Of the several corridors examined by the study group, this particular area was the most sensitive to disturbance. It is anticipated that this portion of the corridor would not be required unless some unforeseen event greatly increases production out of the Athabasca Oil Sands. If required, it could contain but one major sized pipeline and the "Corridor Concept" would not apply. This portion has not been shown as part of the Corridor Development Plan.

1.7.4.2 Southern Portion(Cold Lake Oil Sands to Hardisty):

The southern end of the Hardisty Corridor is generally through agricultural farmland and 130 miles long. The main purpose would be connections to the Cold Lake Oil Sands and the Industrial Parks along the North Saskatchewan River with the Hardisty Industrial and Terminal Area. The corridor components would probably be several pipelines and two power transmission lines. Since the necessity to design the corridor are several years away a better assessment can be made as the development of the whole system proceeds. Should the portion of the Hardisty route north of Cold Lake not be required then some adjustments to the upper portion of this route might be made to better serve the Cold Lake Oil Sand region.

There are environmentally sensitive areas along this route which will require attention. As pipelines and power transmission lines are the only facilities planned for this route the construction period will be the most critical. Once these facilities are constructed, the effect will be minimal.

1.8 ADDITIONAL COMPONENTS

1.8.1 Terminal Bypass Pipeline Route

The Corridor Development Plan indicates a possible pipeline route along the existing A.G.T.L. gas pipeline from the Boyle area to Hardisty. It is anticipated that this route could be used for an export pipeline should the need arise. Probably only one pipeline would be required thus this route is not shown as coming under the Corridor Concept. If the same right-of-way were utilized or widened slightly then the impact on the physical and social environment would be minimal once construction was complete. Also this route could be a replacement for the northerly part of the Hardisty route (mentioned under item 1.7.4.1) which might be required should some unforeseen event greatly increase production out of the Athabasca Oil Sands.

1.8.2 Peace River Oil Sands

The Peace River Oil Sands being outside our study area has received minimum consideration. There are several existing oil pipelines located in the immediate area which can be utilized once they cease carrying conventional crude oil. Alternatively, additional synthetic crude oil pipelines could be built in the same right-of-way or in a widened right-of-way adjacent to the existing pipelines.

1.8.3 Major Power Source

A major coal-fired generating plant near Dodds(N.E. of Camrose) of up to 5 units totalling 2,125 M.W.s is planned to begin service in 1980 with completion of all units in 1983. The first 500KV line is planned to tie this plant to the provincial power grid near Calgary and 240KV lines will tie it to the grid in the Edmonton area. Transmission at either of these voltages will be available for extension to the Alberta Oil Sands depending upon requirements in those areas.

1.9 RECOMMENDATIONS

1.9.1 Corridor Concept

Recommendations regarding the "Corridor Concept" were made in Volume 1 Part 1 and are relisted on page 58 under Sec. 2.7.6 in this report. The action taken on these recommendations will influence the realization of the "Corridor Development Plan" and in particular the transportation corridor portion of the plan. The first component (a pipeline) of the transportation corridor is scheduled to be needed early in 1978 to serve the Syncrude project. With the large number of projects being planned and the world-wide shortage of pipeline materials it is necessary that the pipe be ordered in the next few months if this schedule is to be met. Confirmation of the location of the corridor and terminals is therefore urgent and time is of the essence.

1.9.2 Corridor Development Plan

1.9.2.1 It is recommended that the "Corridor Development Plan" be considered for immediate acceptance in principle by the appropriate government authorities.

1.9.2.2 Immediately upon acceptance of the plan all the land required for corridor, terminal or industrial site purposes should be temporarily declared a Restricted Development area.

1.9.2.3 Until such time as the recommended corridor legislation and Corridor Authority have been established an inter-governmental committee of senior government officials could be appointed and authorized to coordinate and direct the initial implementation of the Plan. Their responsibilities might include the following: to receive representations from future

users and interested parties, to coordinate government activities, to communicate with potential industrial developers, to obtain any necessary approvals that may be required, to obtain final confirmation of the Plan, to commission detailed site investigations and studies, to acquire land, to act as an information center and to assume responsibility for other necessary activities.

1.9.2.4 Site investigations should be commissioned to determine actual locations and specific land requirements for the corridors, terminals and industrial sites. Implementation of the Plan may be undertaken on a progressive basis with the more urgently needed portions being investigated and determined first. Such investigations would essentially be multi-disciplinary in nature covering such items as ecological, geotechnical, hydrological, climatological, archaelogical, land value appraisals, etc. and would be geared to the particular facilities being investigated.

1.9.2.5 Upon determination of actual land requirements, those lands required for corridor, terminal and industrial site purposes should be acquired by the Corridor Authority and the balance of the lands not required released from the Restricted Development Area designation. Again this can be done on a progressive basis with the more urgent portions being completed first.

1.9.2.6 Comprehensive urban planning and socialogical studies should be initiated to determine the manner in which population growth generated by industrial activity can be most effectively accommodated in the vicinity of the proposed industrial sites.

SECTION II

BACKGROUND SUMMARY

2.1 FISH AND WILDLIFE

2.1.1 Introduction

Fish, birds and mammals of five potential corridors were examined, the summary of which is contained in the appendix volumes. General area assessments were used in selecting the most desirable corridor for fish and wildlife. When the corridors (shown on the development plan) are designed in detail, considerable additional information must be gathered in order that damage to the environment may be minimized.

The general assessment of wildlife was made by Miss Joanna Jacks(ecologist), Mr. Ernie Ewaschuk(biologist for Ducks Unlimited, Edmonton) and Mr. Peter Davidson(biologist for Stewart Weir and Co.). Data concerning the fishery potential of streams and rivers in the study area was made available to us by Dr. Martin Paetz(Chief Fisheries Biologist, Alberta Lands and Forests) and Mr. William Griffiths(Fishery Biologist, Alberta Lands and Forests). Canada Land Inventory Maps were used to assess potential impact of corridor construction on ungulates and waterfowl. The potential influence of corridor construction and maintenance was inferred using knowledge of bird (Godfrey, 1966; Salt and Wilk, 1966) and mammal (Dewey and Soper, 1964) behavior, habitat and migration.

2.1.2 Route Selection

A comparison of five potential corridors based upon limited field data and from studies of available material have indicated that the Central Corridor would be the least disruptive to fish, birds and mammals. The order of preference of routes is reinforced when the potential effect of construction and maintenance of a corridor upon the habitat of fish and wildlife is considered. The order of preference of each of the main routes studied is followed by a description of fish and wildlife in the corridors which were finally adopted by the present study group.

2.1.2.1 The Central Corridor:

This corridor extends from the Athabasca Oil Sands area along the G.C.O.S. oil pipeline and Highway 63. It bypasses the hamlets of Wandering River and Atmore, the towns of Boyle, Radway and Fort Saskatchewan, and terminates in the industrial area of east Edmonton.

2.1.2.2 The Western Corridor:

This corridor begins in the Athabasca Oil Sands area southwest through the Thickwood Hills. From here it heads south, past Pelican Lake, Calling Lake, the towns of Athabasca, Thorhild and Gibbons, and terminates in the Edmonton Industrial area.

2.1.2.3 The Eastern Corridor:

This corridor begins in the Athabasca Oil Sands area and heads southeast parallel to the N.A.R. Railway past Anzac, Conklin, Devenish, Imperial Mills and Lac La Biche. From Lac La Biche this corridor heads southwest through Warspite and Bruderheim to the Edmonton Industrial area.

2.1.2.4 The Vegreville Route:

This corridor follows the Eastern route as far as Lac La Biche, but then heads straight south past Vilna, Hairy Hill, Vegreville and Bruce to terminate in the I.P.P.L. line near Wavy Lake north of Strome, Alberta.

2.1.2.5 The Hardisty Route:

This corridor is similar to the Eastern Corridor as far as Devenish, from which point it heads due south past Glendon, St. Paul, Myrnam, Mannville and Irma to terminate in the Hardisty area.

The corridors proposed in the Corridor Development Plan are: the Central Corridor, modified in the southern agricultural area, the southern portion of the Hardisty Route and an additional corridor through agricultural land lying south of the North Saskatchewan River.

2.1.3 Corridors as Recommended on the Development Plan

The proposed corridor system envisages the construction of pipelines and powerlines except for a small portion between the Alberta Skaro Terminal and Bruderheim where a railway spur line is added. The greatest disturbance to wildlife is during the construction stages. If care is used and construction time tables are properly arranged the impact on wildlife can be kept to a minimum. Following is a brief summary of some pertinent factors about each of the recommended routes. More detailed summaries and maps are found in the appendix volumes.

2.1.3.1 Athabasca Oil Sands to Alberta Skaro Terminal:

From Tar Island to the Town of Fort McMurray wildlife is scarce. In the mixed forest area from Tar Island to the Wandering River area, moose is the main ungulate encountered. Deer (mule and whitetail), caribou, bear (black), wolves, coyotes, wolverines, fisher and martens are relatively scarce. Beaver, muskrat, red squirrels and lynx are fairly abundant. The House and Wandering Rivers are excellent fishing rivers especially for grayling and northern pike(Martin Paetz ARDA Sports Fishery Capability - from Robertson, 1967). Lyle Lake which lies just north of the Hamlet of Wandering River is a good staging area for waterfowl.

The corridor will traverse agricultural land from the vicinity of the Wandering River to Skaro. Lake and mountain whitefish, cisco, goldeye and northern pike are plentiful in the La Biche River which will be crossed about 15 miles south of the Wandering River townsite. A waterfowl staging area on Charron Lake will be bypassed six miles south of here. Two miles west of Boyle, the corridor will bypass Flat Lake, an important waterfowl staging area. Flat Lake is also a good production area for waterfowl and shorebirds. East of Alpen, this corridor will pass approximately two miles west of Long Lake Provincial Park. The area from Boyle to the North Saskatchewan River contains a high density of ephemeral and seasonal potholes which makes a good muskrat, waterfowl, shorebird and raptor terrain. The fishing potential of the North Saskatchewan River is only fair. Because the neighboring aspen groves are heavily grazed by livestock, few deer inhabit the area or winter in the river coulees.

2.1.3.2 Alberta Skaro Terminal to the Edmonton Industrial Area:

This corridor will pass near good deer range one-half mile north of the Town of Elk Island and near Akenside (see Volume 4 appendix Chapter III p.48). Waterfowl production is high due to the numerous potholes between Bruderheim and Greisbach (Volume 4 appendix Chapter III p.47). Beaverhill and Ross Creek have no fishing potential (Volume 4 appendix Chapter III p.49). Raptor, willow grouse and small birds are abundant in this route.

2.1.3.3 Alberta Skaro Terminal to Myrnam Industrial Area:

This corridor will pass through good deer range near Whitford and Hairy Hill. From Andrew to four miles east of Hairy Hill this corridor will bisect an area having many potholes and good waterfowl production (Volume 4 appendix Chapter III p.47).

2.1.3.4 Athabasca Oil Sands to Alberta Hardisty Terminal:

2.1.3.4.1 Athabasca Oil Sands to Cold Lake Oil Sands (Northern Portion-Athabasca Oil Sands to Hardisty)

From west of the Athabasca River, north of Fort McMurray, the corridor will cross the Athabasca River which has excellent fishing potential (C.L.I. map Volume 4 appendix Chapter III p.49). From here to the Clearwater River little wildlife is found. The Clearwater River has excellent fishing potential. Its banks provide good winter range for moose and the few deer of the area. The corridor will pass within one mile of the east side of Gregoire Lake near Anzac. The Lower Cottonwood and Pony Creek

crossings will be through good fishing streams. The Christina River is an excellent sport fish river which also contains otter. From here to the Ipiatik River is good woodland caribou and moose range. Birch and Sunday streams near Devenish are good fish streams (C.L.I. maps Volume 4 appendix Chapter III p.49). The corridor may provide access to Logan Lake which is a major staging area for waterfowl. East of Lac La Biche the corridor will pass by a series of excellent fishing lakes - Spencer, Seibert (trophy) and Pinehurst. From the Spencer Lake area to the Beaver River, the corridor runs parallel to the Sand River which is an excellent fishing river. This route crosses a good fish stream draining Seibert Lake (Punk Creek), then passes south across the Beaver River and follows the Cold Lake to Hardisty Corridor described hereafter. The banks of the Sand River are good wintering areas for deer and moose. This corridor would probably necessitate the building of access roads used to serve the facilities in the corridor from Devenish to Spencer Lake. This road would open an area previously inaccessible to hunting, fishing, and other forms of recreation. This section of the Hardisty Corridor would require special attention to minimize detrimental impact upon the streams, rivers and lakes having excellent game fish potential. It has not been included in the Corridor Development Plan. See 1.7.4.1.

2.1.3.4.2 Cold Lake to Hardisty Portion

This corridor will begin near Goodridge just south of the Beaver River which is an excellent fishing river (C.L.I. maps Volume 4 Chapter III p.49). The banks of the Beaver River are good deer wintering areas (C.L.I. map Volume 4 Chapter III p.47). The corridor will pass within several miles of Lower Therian Lake which contains a pelican and a cormorant colony. A golden eagle and an osprey eyrie are found here (personal communication, Fish and Wildlife Officer, Lac La Biche). The Drysdale Lake area just north of St. Paul is an important waterfowl production area while the Upper Therien Lake is a major waterfowl staging area (C.L.I. maps Volume 4 Chapter III p.48). Lower Therien Lake has a fair fishing potential (C.L.I. maps Volume 4 Chapter III p.49) for perch, pike.

This corridor will pass through a winter range area heavily utilized by deer when it crosses the North Saskatchewan River (Blaire Rippon, personal communication). The rough hummocky morraine area from Mrynam to Mannville provides excellent range for deer. Because of the rough silt-sand soil and numerous potholes, little of this land is farmed. Populations of beaver and muskrats are very high in potholes of this area while waterfowl utilization of them as breeding areas is intensive. From Mannville south to Hardisty the rolling terrain has many aspen-poplar clumps and a good density of ephemeral and seasonal potholes which make excellent range for deer and waterfowl respectively. If the corridor were moved two miles east this rough productive (for wildlife) terrain could be avoided.

Just north of Grattan Coulee near Irma, the corridor passes through sharptail dancing grounds. The potholes of Grattan Coulee are a major staging area for whistling swans. The corridor will pass through dancing grounds of sharptail grouse from the north side of the Battle River almost to the Interprovincial Terminal site east of Hardisty. The coulees of Battle River provide excellent range for wintering deer especially the west-facing slopes. In the agricultural zone which extends from the Beaver River, the corridor could disrupt habitat of willow grouse, partridge, pheasant, raptors and small birds especially in the Hardisty area.

Construction of this segment of the corridor could:

- affect three rare bird species especially during the nesting season;

- destroy cover in limited winter range of deer;

- disrupt sharptail dancing grounds if done in spring or fall; and

- disrupt mating and reproduction of small mammals, small birds, shorebirds and waterfowl.

In summary, the Hardisty Corridor would necessitate constraints in the timing of construction if environmental damage is to be avoided.

2.2 SOILS & VEGETATION

2.2.1 Introduction

The soils and vegetation of the potential corridors were examined in the field to a limited extent and from existing soil maps of the area. The soils of the northern half of the area under consideration are mainly Gray Wooded with extensive areas of organic soils, wetlands and sand dunes. The soils of the southern portion of the corridor system are mainly Black Chernozemic with a fair acreage of Gray Wooded soils and sand dune areas; wetlands and organic soils form only a small acreage of the southern portion of the study area.

The northern portion of the area is forested while the southern area is mostly agricultural with some forested areas.

2.2.2 Soils

Black Chernozemic soils which occupy the largest acreage in the southern portion of the area are readily reconstituted. Removal of the top soil prior to ditching and replacement after filling the excavation is recommended.

Gray Wooded soils are more difficult to bring back into production because of their leached surface. However removal of the top soil and replacement after construction will aid in reconstitution of farmland. Mixing the top soil and subsoil creates a very undesirable physical situation which should be avoided. Seeding of legumes on the replaced top soil helps to re-establish vegetation.

Wetlands are difficult to handle because of the very nature of the soil. Wet conditions prevail most of the year in these soils. If these soils are disturbed and dry out, they become extremely hard to handle.

Organic soils are very difficult to handle because of wetness and lack of stability of the surface peat. The best time to work these soils is in the winter time.

Sand dune areas are quite extensive throughout the area. Because of rough topography and loose nature of these soils, they are very subject to wind erosion. It is very difficult to re-establish vegetation once it has been removed because of the low water holding capacity, low plant natural status of these soils and their susceptibility to wind erosion.

2.2.2.1 Western Corridor: (Description 2.1.2.2)

This corridor route passes through extensive areas of organic soils from Fort McMurray to Calling Lake. Mineral soils such as Gray Wooded soils form only a minor part of this area. From Calling Lake south the soils are Gray Wooded with some Black Chernozemic soils.

Topography is no hazard to soils in this area.

There is very little marketable timber in this area.

This area was undesirable because of the extensive areas of organic soils through which the corridor will have to pass.

2.2.2.2 Northern Portion Hardisty Route: (Description 2.1.2.5)

This area begins at Fort McMurray and follows the N.A.R. to Devenish and then south near Glendon. Organic soils and wetlands are extensive in this area. Sand dune areas are common. Gray Wooded soils occur. The topography is rolling to hilly (9 - 20 percent slopes) in some sections.

There is very little marketable timber in this area.

This area is not very acceptable because of the variability in the problem soils and topography.

2.2.2.3 Central Corridor:

This was the most acceptable route as far as detrimental impact upon the soils are concerned. The present highway follows the height of land from Wandering River north to near Fort McMurray. As a consequence, most of the soils are well-drained mineral soils. There is a minimum of organic, wetland and sand dune soils. The mineral soils are mainly Gray Wooded.

The topography is undulating to gently rolling (slopes of 2 - 9 percent). There are some areas of rough terrain adjacent to the headwaters of the streams. Precautions should be taken in the construction of pipelines crossing these streams to prevent soil erosion when the soils are denuded of vegetation.

There is very little marketable timber in the area.

From Wandering River south to the Alberta Skaro Terminal and into Edmonton, the soils are mainly Black Chernozemic with areas of Gray Wooded soils. Small areas of organic soils and wetlands occur but should create no problems.

This area is mainly agricultural land.

2.2.2.4 Alberta Skaro Terminal to Myrnam Industrial Area:

The soils are mainly Chernozemic and can be re-constituted readily.

The sand dune area at the Skaro Terminal and Industrial area northwest of Andrew may suffer from wind erosion if control measures are not used to prevent blowing. From casual observation, the sand varies from 5 to 25 feet in thickness.

This area can be readily drained into the North Saskatchewan River if necessary.

Care has to be taken in preparation of foundations in this area because of the sandy nature of the soil.

2.2.2.5 Cold Lake to Hardisty Terminal:

This proposed corridor should not present any problems. Rough topography (slopes of 9 - 15 percent or greater) would be the major obstacle. The soils would lend themselves to reclamation quite readily as they are well-drained mineral soils on the whole and could be brought back into production quite readily. The Gray Wooded soils north of St. Paul would take longer to bring back into production because of their leached nature.

Most of this area is agricultural land.

2.2.3 Summary

2.2.3.1 The central corridor along the present highway is the one recommended from soils standpoint, the main reason being for the most part well-drained mineral soils which are the easiest to reconstitute.

2.2.3.2 Since a highway is already present, the increase in width necessary for the corridor would have less impact on the environment than if a new corridor was constructed. As a mode of transportation is already there, failures in the facilities could be repaired with a minimum of delay and result in less damage to the environment.

2.2.3.3 Very little marketable timber is endangered by the proposed central corridor.

2.2.3.4 With proper conservation measures taken during and after construction the physical environmental impact would be minimal.

2.3 URBAN GROWTH

2.3.1 Industrial Activity & Population Growth

The decentralization of population growth can best be achieved through the decentralization of basic industrial activity to selected locations within Alberta. The achievement of industrial decentralization will require a substantial initiative on the part of the Government to overcome the natural tendency of industry to agglomerate in large concentrations in metropolitan centers.

The selections of locations to which industry is decentralized should not only take into account the physical and geographical characteristics of potential locations but should also include consideration of the impact which the industrial development will have upon existing and future communities. The selection of industrial decentralization locations should be undertaken in recognition of the need to provide the potential for growth of future urban communities. These should be large enough to support an adequate range of public and commercial services in a location distant enough from established metropolitan centers to achieve a social and economic viability which is not undermined by proximity to that metropolitan center.

A refining and petrochemical industry can be regarded as a significant economic base activity by virtue of the magnitude of the employment opportunities created. A modern, integrated refining and petrochemical complex developed to serve global markets could create between 1,500 to 3,000 basic employment opportunities and support thereby a population varying between 7,500 and 15,000 persons.

2.3.2 Industrial Agglomeration

The disadvantages of industrial agglomeration can generally be described by the list of major problems which characterize large urban communities. Since large industrial agglomerations inevitably give rise to large urban populations, the results of industrial agglomeration will be urban problems.

2.3.3 Decentralization Alternatives

2.3.3.1 Expansion of Existing Agricultural Service Centers:

One population decentralization alternative would be to locate industrial activity near existing agricultural service centers in Alberta which have experienced declines, or at best have maintained a modest rate of growth, in their populations. One or several communities of this type in a selected area could serve as nuclei around which planned development could occur to house the population which would be supported by the industrial activity. The selection of one or more existing communities as a nucleus for growth would have to be based upon a community's need for growth revitalization and its physical, financial and political capacity to accommodate such growth. The growth anticipated for one or more communities should be sufficient in magnitude to ensure the provision of a reasonable level of urban services and amenities.

2.3.3.2 Development of a New Town:

The alternative to upgrading and expanding existing towns or villages is the development of a totally new town near the site upon which the decentralized industrial activity will be located. This alternative would provide a fresh start for the creation of a new and attractive community to house the population generated by industrial development. The new town concept has the advantage of providing the basis for a totally planned community in which all the foreseeable needs of the future population could be anticipated and accommodated. It has the disadvantage of not having a nucleus of existing commercial and public facilities which would be available in many of Alberta's existing agricultural service centers.

2.3.4 Essential Public Services

Regardless of the decentralization alternative chosen, it will be essential that the Provincial Goverment ensure the availability of a high standard of normally accepted urban public services to ensure that the quality of life available to the resident of a new town or expanded existing town is comparable to that which is available in larger centers. Specifically, social services such as education, health and recreation programs should be stimulated with a view to establishing a quality of service which residents of larger centers regard as essential. The extent to which the imbalance in the level of such services which presently exists between larger and smaller communities can be corrected will determine, to a large extent, the success of the policy of decentralization of population growth in Alberta.

2.4 SUPPLY AND DEMAND

2.4.1 Overall Considerations

The major factor inhibiting refinery and petrochemical plant construction in the United States and other industrialized area in recent years has been an uncertainty of supply of crude oil and natural gas both as to quantity and price. Alberta, through its potential control of new sources of hydrocarbon supply, can ensure that a maximum of processing will be done in Alberta.

While it is anticipated that the overall demand for Alberta oil from both Canadian and American sources will be greatly in excess of any expectation of productive capacity, there will be increasing oil and gas supplies available for refining and processing in Alberta. An increasing percentage of oil supplied to existing markets will be required to come from the Athabasca Oil Sands area so the need for additional pipeline capacity from the Fort McMurray area is obvious.

Shortage of oil supply and other factors continue to exert upward pressure on price. It is anticipated that the price of oil will continue at levels high enough to ensure that the exploitation of the oil sands will be a viable proposition.

With increasing prices and production, revenues to Alberta will be greatly in excess of those we have received in the past. As oil and gas prices increase, transportation costs of both crude and finished products become less important than was formerly the case. With substantially increased revenues Alberta will be in a position to assist in the development of alternate locations for refinery and petrochemical sites should this assistance be necessary.

In addition to the influence of supply and demand, pricing factors, revenues and physical constraints on the location of corridors, and refinery and petrochemical sites, a number of assumptions were made:

2.4.1.1 That Alberta would continue its policy of:
- ensuring a hydrocarbon supply for Canada's needs;
- pursue all opportunities for additional processing in Alberta;
- utilize hydrocarbon development to realize a more balanced regional development; and
- realize the maximum return to Albertans from exportable surpluses.

2.4.1.2 That the refining and processing facilities in the Edmonton area would continue to be served by Alberta crude oil both from conventional and bitumen sources at present volumes or more.

2.4.1.3 That Canadian refinery centers located outside of Alberta and presently served by Alberta crude would continue to expect to receive the volumes presently being delivered as long as there was a supply of crude oil in excess of Alberta's needs.

Based on these assumptions, Alberta must harness the future production potential of the Athabasca Oil Sands through a transportation system or network which is capable of sustaining and supplementing existing refining and petrochemical facilities. In addition there is the need and wish to stimulate additional expansion of the refining and petrochemical activity within Alberta. This latter objective is one which should be considered within the context of another objective which is the decentralization of population growth within Alberta.

The decentralization of population will be achieved primarily through the decentralization of economic activity, particularly basic economic activity such as refining and the petrochemical industry. Future production from the Alberta Oil Sands promises to ensure the long term availability of the feedstocks, or raw materials upon which such industry could depend. Although the initial production from the Oil Sands will tend to merely supplement declining conventional crude oil supplies it can be assumed that future feedstocks from the Oil Sands will be sufficient in magnitude to supply whatever future refining and petrochemical industries may be developed in Alberta to serve national and world markets.

It is obvious that any pipeline corridor originating from the Oil Sands must connect to the Edmonton Industrial complex. This is necessary to tie into both the existing national pipeline system and to supplement the supply of conventional crude oil which presently serves existing industry. It is also obvious that if economic growth is to be decentralized throughout the Province, the pipeline corridor must also serve non-metropolitan areas into which future refining and petrochemical industrial development could be channelled.

2.5 PETROLEUM REFINING AND PETROCHEMICAL COMPLEXES

2.5.1 Petroleum Refining

Conventional crude oil provides the feedstock to the petroleum refineries which produce commercial liquid fuels, such as: gasoline, jet motor fuels, and heating oils.

Until very recently, petroleum refining in Alberta has been limited to small refineries to supply localized markets. Several of the international oil companies have operated Alberta refineries, many of which have been concentrated in the proximity of the I.P.P.L. (Edmonton) terminal, where feedstocks are readily available. This location is able to provide other facilities essential to a refinery, e.g. water, power, transportation facilities, and manpower. More recently Gulf Oil Canada Limited has built an 80,000 barrel/day refinery, also in east Edmonton. In the same general location Imperial Oil Ltd. is constructing a 140,000 barrel/day refinery. Both of these projects represent a consolidation of corporate refining activities for western Canada. It is reasonable to expect that other major oil companies will also select Alberta as a central site for the large scale petroleum refining.

The historic relationship between petroleum refining and the conventional crude oil industry is readily apparent. For purposes of our corridor study, however, we must give special consideration to the future pattern of developments.

The Alberta Energy Resources Conservation Board has predicted "peak producibility from existing conventional reserves at 1.92 million barrels/day in 1977." Hence the crude oil transferred through the existing I.P.P.L. terminal will decline in rate, starting in 1977.

Synthetic crude oil can be used to supplement crude oil as refinery feedstock. By 1980, synthetic crude oil production is expected to reach 220,000 barrels/day (from mineable oil sands), and by 1985 is projected to expand to 815,000 barrels/day(still mostly from mineable oil sands). After 1985, the synthetic crude oil production is predicted to increase by 150,000 barrels/day every two years to a level of 1.94 million barrels/day by the year 2000.

Although it is conceivable that some refined products may eventually be made at the bitumen source it is logical to expect that the southern terminal of the synthetic crude oil pipeline will be a focal point for an expanded refining industry.

While still on the subject of refinery feedstocks, we must also consider the future possibility of a conventional crude oil pipeline from the Mackenzie Delta. The Alberta Energy Resources Conservation Board has predicted that: "Mackenzie Delta reserves would come on at 293,000 barrels/day in 1980 and rise to 1.2 million barrels/day in 1998."

We have now identified four inter-related factors pertaining to the future terminal activities for liquid hydrocarbons, namely:

- the existing extra-provincial terminals
- expanded petroleum refining
- future synthetic crude oil production
- Mackenzie Delta oil pipeline

The existing extra-provincial terminal could continue to handle all of Alberta's crude oil production, which will decline in throughput after 1977. The synthetic crude oil production from the G.C.O.S. plant is also distributed through the

existing terminal. The present terminal is capable of major expansions to handle greater throughput volumes.

A new synthetic crude oil pipeline is needed immediately to serve Syncrude and possibly other future oil sand plants. This new line could be brought into the I.P.P.L. terminal directly, or alternately, it could be routed farther east or northeast to provide a new transfer point for liquid hydrocarbons. The latter option would encourage industrial growth further away from the established industrial sites. The choice of a more easterly location must be made carefully to ensure the viability of future industrial developments. A basic consideration pertains to the magnitude and nature of such developments. In this regard, the petrochemical industry could be a major factor.

2.5.2 Petrochemical Industry

Petrochemicals represent a very complex industry because of the multiplicity of possible feedstocks and products. Alberta has three principal sources of hydrocarbon feedstocks for petrochemicals, namely: natural gas, petroleum refinery products and bitumen distillates.

Methane is the starting material for one segment of the petrochemical industry. Natural gas is the most abundant and most economical source of methane. By means of a relatively simple process of reforming with air, methane can be converted into methanol or ammonia.

These petrochemicals derived from methane comprise a relatively independent segment of the chemical industry, which does not require complex transfers of materials from other segments of the industry. Alberta's production capacity for these methane based products can

be expected to grow very substantially without any significant impact on the oil sands industry and its corridor. The main thrust of this growth could logically occur in the southern part of the Province, since the two A.G.T.L. systems, i.e., the Plains and the Foothills Division, culminate in the southeast and southwest corners of Alberta. This southern region also contains the gas reserves in the Suffield Block.

Ethane is another important source of petrochemicals. It occurs in refinery off-gases, and also in the light ends of bitumen distillates;however, its preferred source is natural gas. Ethane is the most efficient feedstock for ethylene which can be converted directly into polyethylene resins (as presently done by C.I.L. at Edmonton on a small scale) or converted to PVC resin by adding chlorine which is produced from salt (of which Alberta has enormous deposits), or converted to polystyrene resins by adding benzene. Another major derivative of ethylene is ethylene glycol, which is used extensively as an antifreeze, and also in the manufacture of synthetic resins. These resins, collectively, supply most of today's vast plastics fabricating industry, which manufactures an infinite profusion of consumer, industrial and building products. The manufacturing possibilities in the plastics field are virtually unlimited, and are adaptable to geographic decentralization within the Province.

Alberta's initial production of ethylene petrochemicals is expected to be derived from ethane extracted from natural gas. This imminent industrial development involves three basic options for locating the plant sites, namely:

- The total complex might be located at the ethane source, i.e., in the vicinity of Cochrane or Empress.

- The ethane could be transferred by pipeline to another Alberta site where the ethylene and probably also the derivatives would be manufactured.

- The ethylene might be manufactured at the ethane source and transferred by pipeline to other Alberta sites where the derivatives would be manufactured.

If either the ethane or ethylene is piped away from the ethane source, it would move north, in the eastern part of the Province, because of the following factors:

- water is more plentiful in the more northern rivers, such as the North Saskatchewan River.

- some derivatives require chlorine which is produced from salt, which is plentiful in high quality deposits in east-central Alberta; these salt deposits also enable underground cavern storage.

- some derivatives require benzene which will be produced from liquid hydrocarbons.

In order to produce the total range of potential products, Alberta's ethylene petrochemical industry will be obliged to design future facilities to include utilization of liquid hydrocarbon feedstocks. As explained, these materials are routed through the existing I.P.P.L. terminal and would be available from the proposed Skaro terminal. Hence, there is a synergistic relationship between: the petrochemical industry, petroleum refining, the oil sands industry, and liquid hydrocarbon terminals.

Alberta's future as a potential petrochemical center will depend in large measure upon its posture regarding the manufacture of ethylene and its derivatives. At the present time, three major proposals are being contemplated, any of which could have a profound effect upon the Province's future role in ethylene petrochemicals. One proposal would export ethane out of Alberta and out of Canada, and would also convert some ethane into ethylene most of which would be exported to the U.S.A. and Sarnia. Another proposal would convert Alberta ethane to ethylene, all of which would be processed within the Province. The other proposal would consume 170,000 barrels/day of conventional crude oil from Alberta to produce ethylene and its derivatives in Sarnia. The magnitude of these potentially competitive proposals attests to the overwhelming significance of ethylene and its hydrocarbon feedstocks in the development of a petrochemical industry.

For the purpose of this study, it is important to recognize that the two systems; i.e., the liquid hydrocarbon network and the ethane/ethylene system, will probably be interconnected by pipelines. Our proposal provides complete flexibility for such a connection, either at the eastern or western extremity, or at an intermediate point(e.g. at the Skaro Terminal).

The final choice of options for the location of ethane processing will require detailed consideration by both industry and government. This, in turn, will determine whether this phase of industrial development is concentrated in southern Alberta, or in east-central Alberta, or, possibly dispersed between the two locations. Hence, our designation of potential sites for

petrochemicals along the liquid hydrocarbon system, is, of necessity, speculative; and we have been deliberately optimistic merely to demonstrate the capacity for future growth.

2.5.3 Other Location Factors

Refineries and petrochemical plants have several other requirements relative to their location. Of these, the principal common factors are: water, power and manpower.

Large volumes of water are needed for cooling, steam generation, and process addition. A reliable source of electric power is essential to continuous operation.

The manpower requirements for the process industry involves a high proportion of professionals and paraprovessionals, and the operating and maintenance staff must have a high degree of skill and training. A petroleum refinery and a petrochemical complex together account for approximately 2,000 direct jobs.

2.6 FUTURE CONSIDERATIONS

In designing the proposed system of corridor and terminals it has been necessary to anticipate future events. We have used a "surprise-free - standard world projection", that is, projecting the past through the present and into the future considering current trends, policies and plausible possibilities with no world shattering happening to disturb the normal course of events.

Proposing plans for the future has certain risks such as: that almost any day has some chance of bringing up some new crisis or unexpected event that becomes an historical turning point, diverting current tendencies so that expectations for the future must shift. Some remote possibilities or what has been referred to as "unforeseen events" that could affect the Corridor Development Plan are as follows:

- Major breakthrough in the in-situ process making the total Athabasca Oil Sands reserves as readily available as some of the most productive conventional crude oil fields.

- Severe limitation in the number of Athabasca Oil Sands plants (mineable area) brought into production.

- Major breakthrough which would allow a much higher rate of recovery from existing crude oil fields. The technology permitting this breakthrough could easily be associated with that releasing the oil sand in-situ processing - thus creating still another interesting speculative situation.

- Major work stoppage for environmental or other causes.

- A significant number of competitive petrochemical complexes built outside the study area.

- With the accelerating rate of technological advances and scientific discoveries, new and cheaper sources of energy might become available.

- Change in policy to that of maximization of export of the raw product or conversely no export.

- Major recession, war, major labor strike, political uncertainties, severe material shortages, economic sanctions, some unforeseen world-shattering event, etc.

Giving increased attention to the above factors and ignoring the location parameters set out in Chapter I, except those of engineering and economics as applied to pipelines, then possibly another plan would be resolved. Under these conditions a smaller sized pipeline (26") located within or adjacent to the existing G.C.O.S. line and coming directly into Edmonton would likely be practicable. Such a pipeline would be able to serve the Syncrude Project and possibly one or two additional plants and in itself would be a financial success while ignoring the other important factors already outlined.

Another risk associated with planning for the future is making an accurate forecast and then making an error on some obvious side-effect - for example - In 1889 a well-known writer in Scientific American accurately forsaw the triumph of the automobile over the horse. He then made the mistake of adding "The improvement in city conditions can hardly be overestimated, streets clean, dustless, odorless would eliminate a greater part of the nervousness, distraction and strain of modern metropolitan life." With the multi-discipline approach, the background material available and appropriate site investigations, misjudgments of this type might be avoided.

While no system can be completely "surprise-free" should any of the above unforeseen events occur, the effect on the recommended Corridor Development Plan would be less than on any reasonable alternative that was considered by the study group.

2.7 CORRIDOR CONCEPT

A Transportation Corridor can be defined as a continuous strip of land of varying width connecting two geographically separate points and containing two or more facilities for the conveyance of people, energy and/or materials. The "Corridor Concept" implies comprehensive planned development of the corridor.

The planning and design will take into consideration many factors such as: the number of transportation modes, environmental and social safeguards, engineering and design considerations, safety and security, topography, land use, economics, zoning, legal factors, future expansion and the location parameters of the various modes of transport. The components and the design of a corridor may vary throughout its length, being dependent upon many factors, some of which have already been mentioned. The total width will likewise vary from several hundred meters to several kilometers being dependent upon many of the same factors.

2.7.1 Application Parameters

- The impact on the social and physical environment is reduced when all modes of transport come together in a corridor.
- The impact on the environment of the construction activities associated with all modes of transportation requires special attention.
- Application of the Corridor Concept must include public involvement.
- Corridor occupants must be prepared to relinquish some of their independence and individuality.
- Corridor occupants and users must be responsible citizens.

- Implementation of the Corridor Concept can be best achieved by vesting responsibility in a single authority.
- Location of the corridor will be limited by the transportation facility with the most rigid location parameters.
- Design of the corridor requires an expanded multi-disciplinary approach.
- The corridor must be declared, acquired and designed as to the placing of the utilities well ahead of development.

2.7.2 Advantages

- Conservation of land and space.
- Environmental disturbance restricted to a limited area.
- Can be used as a positive force in shaping land use pattern.
- Administrative and operative efficiencies, assuming a single authority.
- Economic and social advantage of a single land acquisition program.
- Economic and social advantage of an established and approved right-of-way.

2.7.3 Disadvantages

- Reconciliation of conflicting interests created by the Corridor Concept.
- Potentially higher intensity of environmental disturbance in a restricted area.
- Complications in engineering design within the corridor.
- Vulnerability to major catastrophes.

2.7.4 Corridor from Athabasca Oil Sands

Corridors coming out of the Athabasca Oil Sands area will pass through four general regions, each requiring a different approach. The corridor will extend to terminals inside the Athabasca Oil Sands area and should be integrated with the gathering system.

In the wilderness-forested areas placing all the facilities in a single right-of-way will mean much less clearing of trees. In our study, consideration was given to 252 species of birds and 60 species of mammals. The overall summation favored the single corridor. In some areas where a species is predominant and this species finds the wide clearing a barrier, then buffer zones should be designed into the corridor. Along Highway 63 there are some areas with scenic qualities requiring buffers if the corridor is to be integrated with the highway.

In the agricultural farming area the establishment of pipelines and powerlines in a corridor would cause some temporary disruption to the physical and social environment of the farm community during the construction periods of each facility but once operating the impact is relatively small. With ample notice, fair compensation and proper construction practices, very little opposition would be expected from the farming community. The multi-purpose corridor is recommended rather than many single rights-of-way in the agricultural farm community. The farm residents have a serious interest and concern in the Corridor Concept and should be consulted throughout its development.

In urban fringe areas, special consideration should be given to accommodating utilities other than those that may be directly concerned with the Athabasca Oil Sands.

Consideration should be given to a "pipeline corridor", a "transmission line corridor" and/or a combined "pipeline - transmission line corridor" to accommodate the facilities which development of the Athabasca Oil Sands will generate. Although these components are the only new facilities which can presently be foreseen, the application of the corridor concept should not preclude additional future components, nor should it preclude the integration of existing facilities such as the highway, pipeline and/or railway within the corridor.

2.7.5 Conclusions from Volume 1 Part 1

- Advantages of the "Corridor Concept" outweigh the disadvantages.
- Combined corridors can only be achieved when initiated and encouraged by government legislation and action.
- The necessity of providing adequate transportation facilities to accommodate the future development of the Alberta Oil Sands affords and excellent opportunity to apply the Corridor Concept.
- The Corridor Concept can be implemented using two basic techniques:
  (a) Restrictive zoning with covering regulations and government inspection and approval services.
  (b) A single authority owning and managing the corridor.
- Additional legislation is required in Alberta to encourage and implement the Corridor Concept.

2.7.6 Recommendations from Volume 1 Part 1

- Enabling legislation and regulations be enacted providing for the zoning of corridors and/or the formation of corridor authorities which could acquire (buy or expropriate), own, lease, design, manage, operate, maintain and/or terminate corridors.
- In relationship to the impending development of the Alberta Oil Sands it is recommended:
  (a) Immediately upon determination of an acceptable corridor location that any land which may be required be temporarily zoned for corridor purposes.
  (b) Detailed planning and design be carried out to accurately define the limits of the corridor.
  (c) A Quasi-Governmental authority be formed to acquire, own, lease and manage the corridor or corridors for the various organizations which may operate transportation facilities in relation to development of the Alberta Oil Sands.
- The potential application of the Corridor Concept should be examined as a solution to multi-transportation problems in other parts of the province.

2.7.7 Corridor Components

A corridor may contain highways, railways, canals, multiple pipelines, powerlines, communication systems, water lines, sewer lines, other utilities and other transportation facilities. The use of the corridor is not limited only to transportation facilities but could also include other specialized land uses compatible with its operation such as hiking trails, hunting reserves, sports fields, golf courses, gardens, picnic sites, service centers, maintenance centers, agricultural uses, wildlife habitat, etc.

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