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Application of Alcan Pipeline Company at

APPLICATION OF  
ALCAN PIPELINE COMPANY  
AT DOCKET NO. CP76-  
FOR  
CERTIFICATE OF PUBLIC CONVENIENCE  
AND NECESSITY

**ALCAN PIPELINE COMPANY**

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1976

UNITED STATES OF AMERICA

Before the

FEDERAL POWER COMMISSION

APPLICATION OF  
ALCAN PIPELINE COMPANY  
AT DOCKET NO. CP76-  
FOR  
CERTIFICATE OF PUBLIC CONVENIENCE  
AND NECESSITY

PURSUANT TO SECTION 7 (c) OF THE  
NATURAL GAS ACT

AUTHORIZING THE TRANSPORTATION  
OF NATURAL GAS IN INTERSTATE  
COMMERCE

**ARLIS**

Alaska Resources  
Library & Information Services  
Anchorage, Alaska

UNITED STATES OF AMERICA  
BEFORE THE  
FEDERAL POWER COMMISSION

ALCAN PIPELINE COMPANY       )       DOCKET NO. CP76-

APPLICATION OF ALCAN PIPELINE COMPANY FOR  
A CERTIFICATE OF PUBLIC CONVENIENCE AND  
NECESSITY AUTHORIZING THE CONSTRUCTION AND  
OPERATION OF FACILITIES AND THE TRANSPORTA-  
TION OF NATURAL GAS IN INTERSTATE COMMERCE

Alcan Pipeline Company ("Applicant"), pursuant to Section 7(c) of the Natural Gas Act ("Act"), as amended, and Part 157 of the Regulations of the Federal Power Commission ("Commission") thereunder, hereby files this application for a certificate of public convenience and necessity authorizing the construction and operation of facilities and the transportation of natural gas in interstate commerce, as more fully set forth below.

In support hereof, Applicant shows as follows:

I

GENERAL INFORMATION

The names titles and mailing addresses of the persons to whom correspondence and communications concerning this application should be addressed are as follows:

A. N. Porter, Vice President  
Alcan Pipeline Company  
315 East Second South  
Salt Lake City, Utah 84111

Edward J. Grenier, Jr., Esq.  
Richard P. Noland, Esq.  
Richard J. Pierce, Jr., Esq.  
Sutherland, Asbill & Brennan  
1666 K Street, N.W.  
Washington, D. C. 20006

David K. Watkiss, Esq.  
Watkiss & Campbell  
315 East Second South  
Salt Lake City, Utah 84111

William P. Diener, Esq.  
Assistant Secretary  
Alcan Pipeline Company  
315 East Second South  
Salt Lake City, Utah 84111

## II

### IDENTIFICATION OF APPLICANT

The exact legal name of Applicant is Alcan Pipeline Company, a corporation organized and existing under the laws of the State of Delaware, with authorization to conduct business in the State of Alaska and the State of Utah, and with its principal place of business located in Salt Lake City, Utah. Applicant is a wholly-owned subsidiary of Northwest Pipeline Corporation ("Northwest Pipeline"), a Delaware corporation engaged in the interstate transportation of natural gas, which is in turn a wholly-owned subsidiary of Northwest Energy Company ("Northwest Energy"). Northwest Energy, also a Delaware corporation, is a holding company whose principal asset is all of the outstanding common stock of Northwest Pipeline.

Although Applicant has no present natural gas operations, and is not now subject to the jurisdiction of the Commission, it will be a natural gas company subject to the Commission's jurisdiction under the Act upon the construction and operation of the proposed facilities and at the time when such facilities are ready to render the transportation service for which authority is requested herein.

## III

### GENERAL DESCRIPTION OF THE PROJECT

Applicant is requesting authority to construct and operate a 42-inch diameter natural gas pipeline and related compression and other facilities extending from Prudhoe Bay on the North Slope of Alaska to the Alaska-Yukon Border. Applicant also is requesting authority to transport natural gas through its proposed pipeline system for shippers which enter into contracts with Applicant for transportation service.

This application is part of an overall project to deliver natural gas from the Prudhoe Bay Area of the North Slope of Alaska to markets in the State of Alaska and in the lower 48 states. Volumes of gas would be delivered to Applicant by shippers at a point of receipt in the Prudhoe Bay

Area, and would then be transported by Applicant to the Alaska-Yukon Border. It is contemplated that certain volumes of natural gas would be delivered to Alaskan markets at Fairbanks, Alaska. The proposed route of Applicant's pipeline in the State of Alaska, which is set forth in detail in Exhibit F and Exhibit Z-6 hereto, parallels the Alyeska oil pipeline system for approximately 539 miles from Prudhoe Bay to Delta Junction south of Fairbanks, Alaska. At Delta Junction, the proposed pipeline would diverge from the Alyeska oil pipeline system and would then follow the Alcan Highway along an existing pipeline corridor 1/ for approximately 192 miles in a southeasterly direction to the Alaska-Yukon Border. At the Alaska-Yukon Border, natural gas would be delivered by Applicant to a Canadian company, Foothills Pipe Lines Ltd. ("Foothills"), or an affiliate thereof, which would then continue the transportation of the gas in a southeasterly direction for approximately 509 miles through a new 42-inch diameter pipeline and related facilities to be constructed along the Alcan Highway to a point on the Yukon-British Columbia Border near Watson Lake, Yukon. At the Yukon-British Columbia Border, the gas would be delivered by Foothills or its affiliate to Westcoast Transmission Company Limited ("Westcoast"), which would then transport the gas through a new 42-inch diameter pipeline system for a distance of approximately 259 miles along the Alcan Highway through the Province of British Columbia to a point of interconnection with the existing facilities of Westcoast at Fort Nelson, British Columbia. At Fort Nelson, approximately 30 percent of the gas would be delivered into existing or expanded transmission system of Westcoast for transportation by Westcoast in a generally southerly direction for approximately 796 miles for redelivery to western United States markets at a point of interconnection between the existing facilities of Westcoast and the existing facilities of Northwest Pipeline at Sumas, Washington.

The remaining portion of the gas (approximately 70 percent) would be transported by Westcoast from Fort Nelson, British Columbia, through a new 36-inch diameter pipeline system for approximately 97 miles to a point of interconnection with new facilities of The Alberta Gas Trunk Line (Canada) Limited ("AGTL(Canada)") at the Alberta-British Columbia Border. AGTL(Canada) would then transport the volumes of natural gas received from Westcoast through a new 36-inch diameter pipeline system for approximately 50 miles to a point of inter-

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1/ The corridor, which was previously used to transport liquid hydrocarbon products, extends from Delta Junction to Haines Junction, Yukon.

connection with the existing facilities of The Alberta Gas Trunk Line Company Limited ("AGTL") near Zama Lake, Alberta. At that point, the gas would be further transported by AGTL(Canada) through the existing or expanded natural gas transmission system of AGTL in a generally southerly direction for approximately 520 miles to a point in the vicinity of Caroline Junction, Alberta, where the volumes would be split for delivery to two different points on the Canadian-United States Border. One portion of the volumes at Caroline Junction would be further transported by AGTL(Canada) through the existing or expanded transmission system of AGTL in a southerly direction for approximately 190 miles to a point of interconnection between the existing facilities of AGTL and the existing facilities of Alberta Natural Gas Company Limited ("ANG") in the vicinity of Coleman, Alberta. These volumes would then be transported by ANG through its existing or expanded transmission system to a point of interconnection between the facilities of ANG and the existing facilities of Pacific Gas Transmission Company ("PGT") on the Canadian-United States Border at Kingsgate, British Columbia, for redelivery to western United States markets.

The remaining volumes at Caroline Junction, Alberta, would be transported by AGTL(Canada) through the existing or expanded transmission system of AGTL for approximately 233 miles to the Alberta-Saskatchewan Border in the vicinity of Empress, Alberta, where the gas would be delivered to Foothills. Foothills would then transport the gas from the Alberta-Saskatchewan Border through a new 36-inch diameter pipeline system for approximately 160 miles to the Canadian-United States Border at Monchy, Saskatchewan, where the gas would be delivered by Foothills to Northern Border Pipeline Company ("Northern Border") for redelivery to eastern and mid-western United States markets.

Applicant has entered into an agreement with Foothills, Westcoast, AGTL, AGTL(Canada), and Northwest Pipeline relating to the transportation of the gas from the Alaska-Yukon Border to the points of redelivery for United States markets on the Canadian-United States Border. 2/ It is presently contemplated that companion applications to this application will be filed with the National Energy Board of Canada ("NEB") by Foothills, Westcoast, and AGTL(Canada) in August or September, 1976, to construct and operate the new pipeline facilities from the Alaska-Yukon Border to Zama Lake, Alberta, and from the Alberta-Saskatchewan Border to Monchy, Saskatchewan. Also, appropriate authorizations will be requested from the NEB to utilize and expand the existing

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2/ This agreement is set forth in Exhibit Z-7 hereto.

systems of Westcoast, AGTL, and ANG in order to transport Prudhoe Bay gas to the points of delivery on the Canadian-United States Border. Detailed information relating to transportation of the natural gas in Canada is set forth in Exhibits Z-3, Z-4, and Z-5 hereto, including descriptions of facilities, construction schedules, operating plans, cost of facilities, pro forma financial statements, cost of service and tariffs, and financing plans.

Gas supply and deliverability information relating to the Prudhoe Bay Area is set forth in Exhibit H hereto. Exhibit H shows the total original oil and gas reserves in place in the Prudhoe Bay Area and sets forth several different cases assuming various rates of natural gas production, with the resulting recoverable oil and gas reserves for each case. As reflected therein, Applicant estimates approximately 42 Tcf of gas reserves in place in Prudhoe Bay, of which 15.27 Tcf is solution gas and the remaining 27 Tcf is associated gas. The actual rate of natural gas production will depend upon the operating plan for the Prudhoe Bay Field approved by the State of Alaska. For the purpose of this application, Applicant has assumed that deliverability at full capacity will be approximately 2,400 MMcf per average day. 3/

It is contemplated that there will be a period of capacity buildup over two years after initial deliveries. Assuming 2,400 MMcf per average day at full capacity, Applicant anticipates 1,200 MMcf per average day during the first year of deliveries, 1,600 MMcf per average day during the second year of deliveries, and 2,400 MMcf per average day during the third year of deliveries and thereafter. Of the total daily average volumes of gas available for redelivery to the Canadian-United States border at full capacity, approximately 669 MMcf per average day will be delivered to Northwest Pipeline at Sumas, Washington, for redelivery to markets in the western United States. Approximately 191 MMcf per average day will be delivered to PGT at Kingsgate, British Columbia, for redelivery to western markets. The remaining volumes -- approximately 1,342 MMcf per average day -- will be delivered to Northern Border at Monchy, Saskatchewan, for redelivery to markets in the eastern and midwestern United States.

Applicant proposes to operate its pipeline system as a contract carrier of Prudhoe Bay gas for individual shippers. Shippers will purchase Prudhoe Bay gas from pro-

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3/ Unless otherwise noted, all volumes are stated on an annual average day basis at a pressure base of 14.73 psia and 60 degrees F.

ducers, and will contract with Applicant for the transportation of the gas to Alaskan markets and to the Alaska-Yukon Border for further transportation to markets in the lower 48 states. The shippers will provide Applicant with the volumes of gas necessary for line pack and fuel and other company use gas in the operation of the system, as well as lost and unaccounted for gas. Under Applicant's proposed tariff set forth in Exhibit P hereto, the shippers will pay Applicant monthly charges equal to the total cost of service incurred by Applicant in that month in performing its transportation service, including a fair return on equity capital committed to the project. These monthly payments will be made "in all events," and will commence when Applicant's pipeline facilities are ready to render the contracted service. Similar tariff arrangements are contemplated for transportation of the gas in Canada.<sup>4/</sup>

Applicant's financing plan is set forth in Exhibit L hereto. As reflected therein, 25% of the external capital requirements for construction of the facilities will be in the form of equity to be subscribed to by shippers and other parties prior to commencement of construction. The remaining 75% of such capital necessary for construction will be obtained from term bank loans and from first mortgage bonds, which will be placed with institutional investors and/or will be sold publicly to institutional investors, pension funds, and others.

Applicant contemplates that initial deliveries of Prudhoe Bay gas would commence three years after all final regulatory approvals, including all related authorizations necessary to implement the project as well as Commission approval of final financing arrangements, are received. Assuming all final regulatory approvals are received no later than January 1, 1978, therefore, initial gas flow would begin in 1981. The project has been planned so that each segment, including the Alaskan, Canadian and lower United States facilities, will be placed in service at the same time.

#### IV

#### DESCRIPTION OF APPLICANT'S PROPOSED FACILITIES

The proposed facilities for which authorization is sought in this application consist of approximately 731 miles of 42-inch diameter pipeline extending from Prudhoe Bay to the Alaska-Yukon Border, 15 compressor stations with total

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<sup>4/</sup> Proposed tariffs for the transportation service to be rendered by the Canadian companies are set forth in Exhibits Z-3, Z-4, and Z-5 hereto.



installed horsepower of 586,440, and three metering stations and related facilities. Peak day design capacity of the pipeline is 2,567 MMcf per day, with annual average daily volumes of 2,400 MMcf per day. Each compressor station will have 26,500 horsepower, with an additional 13,830 horsepower required for refrigeration, except for three stations which will only require 7,660 horsepower for refrigeration.

Construction of the pipeline system required for initial gas flow will require three years from the date of receipt of final regulatory approvals. Total construction will take place in three phases and will require five years.

Phase I, which will require three years, will consist of the construction of approximately 731 miles of 42-inch diameter pipeline from Prudhoe Bay to the Alaska-Yukon Border, 13 compressor stations with 106,000 installed horsepower for compression and 173,620 installed horsepower for refrigeration, and three metering stations. The three metering stations will be located at Prudhoe Bay, Fairbanks, and the Alaska-Yukon border. At the completion of Phase I, the system will transport approximately 1,200 MMcf per average day. Total cost of construction up to the beginning of service will be approximately \$2,237.9 million in 1975 dollars, and \$2,973.1 million as escalated to the year of construction.

Phase II, which will require one year, will consist of the installation of an additional 79,500 compressor horsepower in existing stations. At the completion of Phase II, approximately 1,600 MMcf per average day will be transported through the system. Total cost of construction during that year will be approximately \$58.6 million in 1975 dollars, and \$89.6 million as escalated.

Phase III will require one year, and will consist of the construction of the remaining two compressor stations with the installation of 212,000 horsepower for compression and 15,320 horsepower for refrigeration. At the completion of Phase III, full capacity will be achieved and the system will transport approximately 2,400 MMcf per average day. Total cost of construction during the final year of construction will be approximately \$32.3 million in 1975 dollars and \$53.6 million as escalated.

The estimated total capital cost of Applicant's proposed facilities is \$2,328.8 million in 1975 dollars. As escalated to the year of construction, the estimated total capital cost is \$3,116.3 million.

The location of the proposed facilities is shown in Exhibit F to this application as well as the alignment sheets included in Exhibit Z-6. Appropriate flow diagrams and flow diagram data are set forth in Exhibits G, G-I and G-II, respectively. Detailed engineering, geotechnical, and construction information is included in Exhibit Z-2.

#### PUBLIC CONVENIENCE AND NECESSITY

The Alcan Pipeline Project proposed by Applicant is presented as an alternative to the two proposed transportation systems which have previously been filed with the Commission. These two proposals include the Arctic Gas Project and the El Paso Project, which have been consolidated by the Commission for hearing in FPC Docket Nos. CP75-96, et al. Applicant respectfully submits that the Alcan Pipeline Project is superior to either of these two competing proposals and will best serve the present and future public convenience and necessity.

There can be no question that the vast natural gas supplies which have been discovered in the Prudhoe Bay Field in the State of Alaska are desperately needed for United States markets in the lower 48 states. The Commission has frequently recognized the increasing severity of the shortage of natural gas supplies from conventional sources in the United States and the urgent need to obtain additional supplies in order to protect service to existing high-priority markets. Curtailments by interstate pipeline companies have been steadily increasing since the early 1970's, with some pipelines already curtailing service into Priority 2 markets under the order of priorities set forth in Order No. 467-B, Docket No. R-469, "Utilization and Conservation of Natural Resources - Natural Gas Act", issued March 2, 1973. Without large additional volumes of natural gas supplies, widespread economic disruption and hardship is virtually certain to occur in the United States within the next few years.

In view of the critical gas supply shortage, the fundamental question, Applicant respectfully submits, is not whether Alaskan gas should be transported to the United States markets; instead, it is which proposed transportation system will best serve the present and future public convenience and necessity. It is difficult to imagine any more important decision which the Commission has previously faced. An erroneous decision could cost the consumer untold millions of dollars and result in incalculable environmental damage. In considering which transportation system to approve, there-

fore, the Commission must determine which proposal will deliver Alaskan gas to the lower 48 states most economically, expeditiously, and with the least adverse environmental impact. In addition, because of the immense costs and great distances involved, the Commission should assure that it approves that transportation system which is the most reliable and predictable, with the least chance of massive cost overruns and construction delays.

Applicant respectfully submits that the Alcan Pipeline Project will best accomplish these objectives. There are several reasons for this.

First, the time required to complete construction prior to initial deliveries of Alaskan gas is at least two years less under the Alcan Pipeline Project than under either of the two competing proposals. This is because the Alcan Pipeline Project utilizes, to the maximum extent feasible, existing pipeline utility corridors and rights-of-way as well as existing transmission facilities within Canada. Some of the advantages of utilizing existing pipeline corridors, rights-of-way, and facilities include the presence of existing all-weather roads, communications systems, camps, air strips, construction facilities and equipment. In addition, the Alcan Pipeline Project would permit utilization of a major portion of the existing Alyeska oil pipeline work pad from Prudhoe Bay to Delta Junction.

Second, the Alcan Pipeline Project would provide for the delivery of Alaskan gas to the lower 48 states at lower overall capital cost and a lower cost of service per MMBtu than either of the two competing proposals. The estimated total capital cost of the Alcan Project is approximately \$6.4 billion, as escalated to the year of construction. Arctic Gas's and El Paso's estimated total capital costs as escalated are approximately \$11.0 and \$9.0 billion, respectively. Moreover, the Alcan Pipeline Project is estimated to deliver gas to the Canadian-United States border in 1987 (Applicant's estimate of the first full year of operation for the Arctic Gas Project) at a transportation cost of service of \$1.43 per MMBtu as compared with \$1.70 per MMBtu for Arctic Gas or an annual saving of over \$230 million. El Paso's transportation cost of service would be even greater than Arctic Gas. 5/

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5/ These are escalated estimates and include the effect of inflation between 1975 and 1987.

Third, the Alcan Pipeline Project would deliver Alaskan gas to United States markets with less adverse environmental impact than either of the other two proposals, principally because of maximum utilization of existing utility corridors, rights-of-way, and transmission facilities. Arctic Gas proposes to cross the Arctic National Wildlife Range in Alaska, one of the last large wildlife refuges in the world, and would require extensive construction through similar undeveloped wilderness areas in the Canadian North Slope and MacKenzie Delta areas. While El Paso would utilize the Alyeska oil pipeline corridor for a portion of its pipeline system, it would construct large new liquification and gasification facilities in environmentally sensitive areas of Southern Alaska and California and would require a fleet of LNG tankers. In addition, El Paso proposes to construct a lengthy portion of its system through previously undisturbed and environmentally sensitive areas, such as the Chugach National Forest and the Copper River Valley. Moreover, while El Paso's route parallels the Alyeska oil pipeline, it departs from that pipeline to such a great extent that it does not permit full utilization of the Alyeska work pad, camps, and haul roads. The Environmental Report submitted as Exhibit Z-1 to this application establishes that the adverse environmental impact of pipeline construction along the Alyeska oil pipeline corridor and the Alcan Highway, such as is proposed by Applicant, would be kept to a minimum.

Fourth, the Alcan Pipeline Project involves relatively conventional construction. Thus, the possibility of cost overruns and potential safety and reliability problems which are inherent in the Arctic Gas and El Paso proposals would be minimized. In addition, there is less chance of time-consuming construction delays as a result of unexpected obstacles and misadventures.

Applicant respectfully submits that there are a number of additional advantages to the Alcan Pipeline Project. The Alcan Pipeline Project would provide substantial economic benefits to the State of Alaska through the construction of a pipeline through Alaska and would permit the delivery of Prudhoe Bay gas supplies to Alaskan markets. In addition, since the Alcan Pipeline Project will transport only Alaskan gas from Prudhoe Bay, it will provide Canada with greater flexibility to determine the manner and timing of delivery of natural gas from the MacKenzie Delta to Canadian markets.

In summary, Applicant submits that the Alcan Pipeline Project provides the most reliable, expeditious, and economical means of delivering Alaskan North Slope gas to markets in the lower 48 states with the least environmental impact, and that the public convenience and necessity would best be served by approval of this application. The Alcan Pipeline Project has several of the advantages of the Arctic Gas Project and the El Paso Project but few of the disadvantages.

Concurrently with this application, Applicant is filing its motion requesting the Commission to consolidate this application with the applications previously filed in Docket Nos. CP75-96, et al, for a comparative hearing. As set forth in that motion in detail, the immense public interest in assuring that the best Alaskan gas transportation system is approved by the Commission requires full consideration of Applicant's proposal along with the Arctic Gas Project and the El Paso Project. Accordingly, Applicant is requesting the Commission to direct that this application be promptly consolidated for consideration with the two proposals heretofore filed by Arctic Gas and El Paso. Applicant fully appreciates and supports the need for expedition in determining which Alaskan gas transportation system should be approved in order that Alaskan gas may be made available to the lower 48 states at the earliest possible date. In fact, as shown above, if Applicant's proposal is approved by the Commission, Alaskan gas will be made available at a substantially earlier date than under either of the two competing proposals because of Applicant's use of existing pipeline corridors and rights-of-way as well as existing transmission systems in Canada. Accordingly, any minimal delay involved in consolidating this application for consideration with the competing proposals of Arctic Gas and El Paso, it is respectfully submitted, will be far more than offset by the earlier deliveries of gas that will occur under the Alcan Pipeline Project.

## VI

### RELATED AUTHORIZATIONS

The following applications are supplemental or related to this application and will be necessary to effectuate Applicant's proposal herein:

- (1) Application of Applicant to the Commission for Presidential Permit pursuant to Executive Order No. 10485 to construct, operate, connect and maintain facilities at the Alaska-Yukon Border;
- (2) Applications of Foothills, Westcoast and AGTL(Canada) to the National Energy Board of Canada for authority to construct and operate new pipeline facilities from the Alaska-Yukon Border to Zama, Alberta, and from Caroline Junction, Alberta to Monchy, Saskatchewan;
- (3) Applications of Westcoast, AGTL(Canada), and ANG to the National Energy Board of Canada for authority to utilize and/or expand the existing transmission systems of West-Coast, AGTL, and ANG in order to transport Prudhoe Bay gas;
- (4) Applications of Northern Border, PGT, and Northwest Pipeline to the Commission, pursuant to Section 7(c) of the Natural Gas Act, to construct and operate the facilities proposed in their respective applications and to render transportation service;
- (5) Applications of Northern Border, PGT, and Northwest Pipeline to the Commission for Presidential Permits pursuant to Executive Order 10485 to construct, operate, connect and maintain facilities at Monchy, Saskatchewan; Kingsgate, British Columbia; and Sumas, Washington, respectively;
- (6) Applications of various shippers to the Commission, pursuant to Section 3 of the Natural Gas Act, to export gas from Alaska and to import that gas into the United States;
- (7) Applications of various producers to the Commission, pursuant to Section 7(c) of the Natural Gas Act, for certificates to sell gas in interstate commerce to various shippers;
- (8) Applications of various shippers to the National Energy Board of Canada to import Alaskan gas into, and to export Alaskan gas from, Canada.



- (9) Applications for land use, construction and right-of-way permits to various governmental authorities.

Applicant is filing concurrently herewith its application for a Presidential Permit pursuant to Executive Order 10485. Also being filed concurrently herewith are applications by Northwest Pipeline pursuant to Section 3 and Section 7(c) of the Natural Gas Act as well as an application for a Presidential Permit. Applications have already been filed by Northern Border and PGT pursuant to Section 7(c) and Executive Order 10485, although certain amendments or revisions may be necessary to effectuate Applicant's proposal. The remaining applications will eventually be filed in the overall implementation of the project. To Applicant's knowledge, no other application to supplement or effectuate Applicant's proposal herein has been or is to be filed by Applicant with any Federal, State, or any other regulatory body.

## VII

### TABLE OF CONTENTS OF EXHIBITS

The table of contents below sets forth the exhibits filed in compliance with Section 157.14 of the Commission's Regulations:

Exhibit A	<u>Articles of Incorporation and By-Laws -</u> Submitted herewith.
Exhibit B	<u>State Authorizations -</u> Submitted herewith.
Exhibit C	<u>Company Officials -</u> Submitted herewith.
Exhibit D	<u>Subsidiaries and Affiliations -</u> Submitted herewith.
Exhibit E	<u>Other Pending Applications and Filings -</u> Submitted herewith.
Exhibit F	<u>Location of Facilities -</u> Submitted herewith.
Exhibit F-I	<u>Factors Considered in Use of Joint</u> <u>Right-of-Way -</u> Submitted herewith.
Exhibit F-II	<u>Factors Considered in Locating</u> <u>Facilities in Scenic, Historical,</u> <u>Recreational or Wildlife Areas -</u> Submitted herewith.

Exhibit F-III     State of Adoption of Guidelines  
Concerning Rights-of-Way and  
Construction Activities -  
Submitted herewith.

Exhibit F-IV     Statement Concerning the Requirements  
of the National Environmental Policy  
Act of 1969 -  
Submitted herewith.

Exhibit G, G-I,   Flow Diagrams and Flow Diagram Data -  
and G-II         Submitted herewith.

Exhibit H         Gas Supply Data -  
Submitted herewith, except for mat-  
ters required by subsections 157.14  
(a) (10) (iii), (v) and (vi), which  
are not applicable since Applicant  
will be a transporter of gas.

Exhibit I         Market Data -  
Submitted herewith.

Exhibit J         Conversion to Natural Gas -  
Submitted herewith.

Exhibit K         Cost of Facilities -  
Submitted herewith.

Exhibit L         Financing -  
Submitted herewith.

Exhibit M         Construction, Operation and Management -  
Submitted herewith.

Exhibit N         Revenues, Expenses and Income -  
Submitted herewith.

Exhibit O         Depreciation and Depletion -  
Submitted herewith.

Exhibit P         Tariff -  
Submitted herewith.

Exhibit Z-1       Environmental Report -  
The detailed report required by Sec-  
tion 2.82 of the Commission's General  
Policy and Interpretations is submit-  
ted herewith in four volumes.



- Exhibit Z-2      Supplementary Engineering Data -  
                    Submitted herewith.
- Exhibit Z-3      Exhibits of Foothills Pipe Lines, Ltd. -  
                    Submitted herewith.
- Exhibit Z-4      Exhibits of Westcoast Transmission  
                    Company, Ltd. -  
                    Submitted herewith.
- Exhibit Z-5      Exhibits of Alberta Gas Trunk Line  
                    (Canada), Ltd. -  
                    Submitted herewith.
- Exhibit Z-6      Alignment Sheets -  
                    Submitted herewith.
- Exhibit Z-7      Definitive Agreement between Alcan  
                    Pipeline Company, Foothills Pipe  
                    Lines Ltd., Westcoast Transmission  
                    Company Limited, The Alberta Gas Trunk  
                    Line (Canada) Limited, The Alberta Gas  
                    Trunk Line Company Limited, and  
                    Northwest Pipeline Corporation  
                    Submitted herewith.
- Exhibit Z-8      Total Investment and Cost of Service  
                    to the Canadian-United States Border -  
                    Submitted herewith.
- Exhibit Z-9      Geology and Soils Reports -  
                    Submitted herewith.

#### VII

#### NOTICE

A form of notice suitable for publication in the Federal Register is submitted herewith.

#### VIII

#### CONCLUSION

Applicant respectfully submits that the proposal herein is required by the present and future public convenience and necessity, that Applicant is willing and able to perform the acts proposed herein, and that, after appropriate proceedings, the authorizations requested herein should therefore be granted by the Commission.

WHEREFORE, Applicant, Alcan Pipeline Company, respectfully requests that the Commission, after appropriate proceedings have been completed, grant Applicant a certificate of public convenience and necessity authorizing the construction and operation of the facilities described herein and authorizing the transportation of gas in interstate commerce by means of such facilities.

Respectfully submitted,

ALCAN PIPELINE COMPANY

By /s/ A. N. Porter  
A. N. Porter  
Vice President

Of Counsel:

Edward J. Grenier, Jr., Esq.  
Richard P. Noland, Esq.  
Richard P. Pierce, Jr., Esq.  
Sutherland, Asbill & Brennan  
1666 K Street, N.W.  
Washington, D.C. 20006

David K. Watkiss, Esq.  
Watkiss & Campbell  
315 East Second South  
Salt Lake City, Utah 84111

William P. Diener, Esq.  
Assistant Secretary  
Alcan Pipeline Company  
315 East Second South  
Salt Lake City, Utah 84111

STATE OF UTAH )  
 : SS.  
COUNTY OF SALT LAKE )

A. N. PORTER, being first duly sworn, on oath,  
says:

That he is Vice President for Alcan Pipeline Company; that he has read the foregoing application of Alcan Pipeline Company for a certificate of public convenience and necessity authorizing the construction and operation of facilities and the transportation of natural gas in interstate commerce, and that he is familiar with the contents thereof; that, as such Vice President, he has executed the same for and on behalf of said Corporation with full power and authority to do so; and that the matters set forth therein are true to the best of his information, knowledge and belief.

/S/ A. N. PORTER

A. N. PORTER  
Vice President

SUBSCRIBED AND SWORN TO before me, the undersigned,  
this 8th day of July, 1976.

/S/ DAVID L. PAYNE

NOTARY PUBLIC

Residing at Salt Lake City, Utah

My Commission Expires:

12-29-79

In the Matter of )  
 ) Docket Nos. CP76-  
ALCAN PIPELINE COMPANY ) and CP76-

Take notice that on July 9, 1976, Alcan Pipeline Company ("Applicant"), a Delaware Corporation whose mailing address is 315 East Second South, Salt Lake City, Utah, 84111, filed in Docket No. CP76- an application for a certificate of public convenience and necessity pursuant to Section 7(c) of the Natural Gas Act ("Act") for authority to construct and operate a 42-inch diameter natural gas pipeline and related compression and other facilities extending from Prudhoe Bay on the North Slope of Alaska to the Alaska-Yukon border, and for authority to transport natural gas for shippers which enter into contracts with Applicant for transportation service, all as more fully set forth in the application on file with the Commission and open for public inspection.

Applicant states that gas would be transported by its proposed pipeline which parallels the Alyeska oil pipeline system for approximately 539 miles from Prudhoe Bay to Delta Junction south of Fairbanks, Alaska. At Delta Junction, the proposed pipeline would diverge from the Alyeska

oil pipeline system and would then follow the Alcan Highway for approximately 192 miles to the Alaska-Yukon border, where the gas would then be delivered by Applicant via an interconnection with a pipeline proposed by a Canadian company, Foothills Pipe Lines Ltd. ("Foothills"), or an affiliate thereof. The gas would then be further transported by Foothills or its affiliate along the Alcan Highway to the Yukon-British Columbia border, where the gas would be delivered to Westcoast Transmission Company Limited ("Westcoast"), which would then transport the gas to a point of interconnection with its existing pipeline system at Fort Nelson, British Columbia. At Fort Nelson, Applicant states that approximately 30 percent of the gas would be delivered into the existing or expanded transmission system of Westcoast for transportation by Westcoast to a point of interconnection between the existing facilities of Westcoast and the existing facilities of Northwest Pipeline at Sumas, Washington. The remaining portion of the gas (approximately 70 percent) would be transported by Westcoast from Fort Nelson to a point of interconnection with The Alberta Gas Trunk Line (Canada) Limited ("AGTL (Canada)") at the Alberta-British Columbia border. Applicant states that AGTL (Canada) would then transport the natural gas received from Westcoast to a point of interconnection with the existing facilities of The Alberta Gas Trunk Line Company Limited ("AGTL") near Zama Lake, Alberta. At that point, the gas would be further transported by AGTL (Canada) through the existing or expanded natural gas transmission system of AGTL to a point in the vicinity of Caroline Junction, Alberta, where the volumes would be split for delivery to two different points on the Canadian-United States border. According to Applicant, one portion of the volumes would be further transported by AGTL (Canada) through the existing or expanded transmission system of AGTL to a point of interconnection between the existing facilities of AGTL and the existing facilities of Alberta Natural Gas Company Limited ("ANG") in the vicinity of Coleman, Alberta. These volumes would then be transported by ANG through its existing or expanded transmission system to a point of interconnection between the facilities of ANG and the existing facilities of PGT on the Canadian-United States border at Kingsgate, British Columbia. The remaining volumes at Caroline Junction, Alberta, would be transported by AGTL (Canada) through the existing or expanded transmission system of AGTL to the Alberta-Saskatchewan border in the vicinity of Empress, Alberta, where the gas would be delivered to Foothills. Foothills would then transport the gas from the Alberta-Saskatchewan border to the Canadian-United States border at Monchy, Saskatchewan, where the gas would be delivered by Foothills to Northern Border.

Applicant states that it proposes to operate its pipeline system as a contract carrier of Prudhoe Bay gas for individual shippers. The facilities for which

authorization is sought will have a capacity of 2,400 MMcf per annual average day. Applicant states that initial deliveries of Prudhoe Bay gas would commence three years after all final regulatory approvals are received. Applicant contemplates a period of capacity buildup over two years after initial deliveries, with 1,200 MMcf per average day during the first year of deliveries, 1,600 MMcf per average day during the second year of deliveries, and 2,400 MMcf per average day during the third year of deliveries and thereafter.

Applicant states that the Alcan Pipeline Project is presented as an alternative to the two proposed transportation systems which have previously been filed with the Commission by Alaskan Arctic Gas Pipeline Company and El Paso Alaska Company and consolidated for hearing in FPC Docket Nos. CP75-96, et al. Applicant alleges that the public convenience and necessity requires approval of its proposal over the two competing proposals on the ground that the Alcan Pipeline Project provides the most reliable, expeditious, and economical means of delivering Alaskan North Slope gas to markets in the lower 48 states with the least environmental impact. Applicant also alleges that its project will deliver Alaskan gas to the lower 48 states at a lower overall capital cost and a lower transportation cost of service per MMBtu than either of the two competing proposals.

In addition, Applicant states that, concurrently with the filing of its application, it is filing a motion with the Commission requesting consolidation of its application with the applications previously filed in Docket Nos. CP75-96, et al., for a comparative hearing.

Also take notice that on the same date, Applicant filed in Docket No. CP76- an application for a Presidential Permit pursuant to Executive Order 10485 to construct, operate, connect and maintain facilities on the International Boundary between the United States and Canada, at a point of interconnection between the facilities of Applicant and those of Foothills Pipe Lines Ltd., all as more fully set forth in the application which is on file with the Commission and open to public inspection.

Any person desiring to be heard or to protest said filing should file a petition to intervene and protest with the Federal Power Commission, 825 North Capitol Street, N.E., Washington, D. C. 20426, in accordance with Sections 1.8 and 1.10 of the Commission's Rules of Practice and Procedure (18 C.F.R. 1.8, 1.10). All of such petitions or protests should be filed on or before . Protests will be considered by the Commission in determining the appropriate action to be taken, but will not serve to

make protestants parties to the proceeding. Any person wishing to become a party must file a petition to intervene. Copies of this filing are on file with the Commission and are available for public inspection.

Kenneth F. Plumb  
Secretary

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_

EXHIBIT A

ARTICLES OF INCORPORATION

AND

BY-LAWS



ALCAN PIPELINE COMPANY

EXHIBIT A

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CERTIFICATE OF INCORPORATION

OF

ALCAN PIPELINE COMPANY

\* \* \* \* \*

FIRST: The name of this Corporation is

ALCAN PIPELINE COMPANY

SECOND: Its registered office in the State of Delaware is to be located at 100 West Tenth Street in the City of Wilmington, County of New Castle, State of Delaware, and the name and address of its registered agent is The Corporation Trust Company, No. 100 West Tenth Street, Wilmington, Delaware.

THIRD: The nature of the business and the objects and purposes proposed to be transacted, promoted and carried on are to engage in any lawful acts or activities for which corporations may be organized under the General Corporation Law of Delaware.

FOURTH: The total number of shares of Common Stock which this Corporation shall have authority to issue is One Thousand (1,000) shares, all of which shall be with a par value of One Dollar (\$1.00) per share.

FIFTH: The name and mailing address of the incorporator is:

NAME

MAILING ADDRESS

David M. Higbee

P. O. Box 1526  
Salt Lake City, Utah 84110

SIXTH: Upon the filing of the Certificate of Incorporation, the authority of the incorporator shall terminate and the following-named individuals, whose mailing addresses are set out beside their names, shall serve as directors until the first Annual Meeting of the Stockholders or until their successors are elected and qualified:

NAME

MAILING ADDRESS

Thomas W. diZerega

P. O. Box 1526  
Salt Lake City, Utah 84110

<u>NAME</u>	<u>MAILING ADDRESS</u>
John G. McMillian	P. O. Box 1526 Salt Lake City, Utah 84110
William D. Owens	P. O. Box 1526 Salt Lake City, Utah 84110
A. N. Porter	P. O. Box 1526 Salt Lake City, Utah 84110

SEVENTH: The following provisions are inserted for the management of the business and for the conduct of the affairs of this Corporation and for defining and regulating the powers of this Corporation and its directors and stockholders:

1. The private property of the stockholders of the Corporation shall not be subject to the payment of corporate debts to any extent whatsoever.

2. The first meeting of the stockholders of the Corporation for the election of directors shall be held in Salt Lake City, Utah at the offices of the Corporation, on June 7, 1977, or at such other time and place as may be designated by the Board of Directors, and thereafter the directors shall be elected at the time and place named in the By-laws of this Corporation.

3. Written ballots shall not be required for the election of directors of this Corporation.

4. The Board of Directors shall have the power to make, alter, or repeal the By-laws of this Corporation.

5. The By-laws of this Corporation may fix or provide the manner for fixing and altering the number of directors constituting the Board of Directors, providing that such number shall not be less than three, and shall permit the election of members of the Board of Directors without written ballots.

IT WITNESS WHEREOF, I, the undersigned, being the incorporator of this Corporation hereinbefore named, do certify that the facts herein stated are true, that the execution of this instrument is my act and deed, and that I accordingly have hereunto set my hand this 17th day of May 1976.

/s/ David M. Higbee  
DAVID M. HIGBEE

BY-LAWS  
OF  
ALCAN PIPELINE COMPANY

Alcan Pipeline Company  
Docket No. CP76-  
Exhibit A  
Hearing Exhibit No. \_\_\_\_  
Page 3

ARTICLE I

Stockholders

Section 1.1. Annual Meetings. The annual meeting of the stockholders shall be held for the election of Directors at 8:30 a.m. on the first Tuesday in June in each year, beginning with the year 1977, if such day be not a legal holiday in the state where such meeting is to be held, or, if a legal holiday, then at the same time on the next succeeding business day at the principal office of the Corporation in the State of Delaware or at such other place either within or without the State of Delaware as may be designated by the Board of Directors from time to time. Any other proper business may be transacted at the annual meeting.

Section 1.2. Special Meetings. Special meetings of stockholders, to be held at the principal office of the Corporation in the State of Delaware or at such other place within or without the State of Delaware and at such date and time as may be stated in the notice of the meeting, and for any purpose or purposes, unless otherwise prescribed by statute, may be called by the Board of Directors or by the Chairman of the Board or by the President, and shall be called by the President or the Secretary at the request in writing of stockholders owning a majority of the issued and outstanding shares of capital stock of the Corporation of the class or classes which would be entitled to vote on the matter or matters proposed to be acted upon at such special meeting of stockholders. Any such request shall state the purpose or purposes of the proposed meeting.

Section 1.3. Notices of Meetings. Whenever stockholders are required or permitted to take any action at a meeting, a written notice of the meeting shall be given which shall state the place, date and hour of the meeting, and, in the case of a special meeting, the purpose or purposes for which the meeting is called. Unless otherwise provided by law, the written notice of any meeting shall be given not less than ten nor more than sixty days before the date of the meeting to each stockholder entitled to vote at such meeting. If mailed, such notice shall be deemed to be given when deposited in the United States mail, postage prepaid, directed to the stockholder at his address as it appears on the records of the Corporation.

Section 1.4. Adjournments. Any meeting of stockholders, annual or special, may adjourn from time to time to reconvene at the same or some other place, and notice need not be given of any such adjourned meeting if the time and place thereof are announced at the meeting at which the adjournment is taken. At the adjourned meeting, the Corporation may transact any business which might have been transacted at the original meeting. If the adjournment is for more than thirty days, or if after the adjournment a new record date is fixed for the adjourned meeting, a notice of the adjourned meeting shall be given to each stockholder of record entitled to vote at the meeting.

Section 1.5. Quorum. At any meeting of stockholders, except where otherwise provided by law or the certificate of incorporation or these by-laws, the holders of a majority of the outstanding shares of each class of stock entitled to vote at the meeting, present in person or represented by proxy, shall constitute a quorum. For purposes of the foregoing, two or more classes or series of stock shall be considered a single class if the holders thereof are entitled to vote together as a single class at the meeting. In the absence of a quorum the stockholders so present may, by majority vote, adjourn the meeting from time to time in the manner provided by Section 1.4 of these by-laws until a quorum shall attend. Shares of its own capital stock belonging on the record date for the meeting to the Corporation or to another corporation, if a majority of the shares entitled to vote in the election of directors of such other corporation is held, directly or indirectly, by the Corporation, shall neither be entitled to vote nor be counted for quorum purposes; provided, however, that the foregoing shall not limit the right of the Corporation to vote stock, including but not limited to its own stock, held by it in a fiduciary capacity.

Section 1.6. Organization. Meetings of stockholders shall be presided over by the Chairman of the Board, or in his absence by the President, or in his absence by a Vice President, or in the absence of the foregoing persons by a chairman designated by the Board of Directors, or in the absence of such designation by a chairman chosen at the meeting. The Secretary shall act as secretary of the meeting, but in his absence the chairman of the meeting may appoint any person to act as secretary of the meeting.

Section 1.7. Voting; Proxies. Unless otherwise provided in the certificate of incorporation, each stockholder entitled to vote at any meeting of stockholders shall be entitled to one vote for each share of stock held by him which has voting power upon the matter in question. Each stockholder entitled to vote at a meeting of stockholders or to express consent or dissent to corporate action in writing without a meeting may authorize another person or persons to act for him by proxy, but no such proxy shall be voted or acted upon after three years from its date, unless the proxy provides for a longer period. A duly executed proxy shall be irrevocable if it states that it is irrevocable and if, and only as long as, it is coupled with an interest sufficient in law to support an irrevocable power. A stockholder may revoke any proxy which is not irrevocable by attending the meeting and voting in person or by filing an instrument in writing revoking the proxy or another duly executed proxy bearing a later date with the Secretary of the Corporation. The vote for Directors and, upon the demand of any stockholder, the vote upon any question before the meeting shall be by written ballot. All elections shall be had and all questions decided, unless otherwise provided by law, the certificate of incorporation or these by-laws, by a plurality vote.

Section 1.8. Fixing Date for Determination of Stockholders of Record. In order that the Corporation may determine the stockholders entitled to notice of or to vote at any meeting of stockholders or any adjournment thereof, or to express consent to corporate action in writing without a meeting, or entitled to receive payment of any

dividend or other distribution or allotment of any rights, or entitled to exercise any rights in respect of any change, conversion or exchange of stock or for the purpose of any other lawful action, the Board of Directors may fix, in advance, a record date, which shall not be more than sixty nor less than ten days before the date of such meeting, nor more than sixty days prior to any other action. If no record date is fixed: (1) the record date for determining stockholders entitled to notice of or to vote at a meeting of stockholders shall be at the close of business on the day next preceding the day on which notice is given, or, if notice is waived, at the close of business on the day next preceding the day on which the meeting is held; (2) the record date for determining stockholders entitled to express consent to corporate action in writing without a meeting, when no prior action by the Board is necessary, shall be on the day on which the first written consent is expressed; and (3) the record date for determining stockholders for any other purpose shall be at the close of business on the day on which the Board adopts the resolution relating thereto. A determination of stockholders of record entitled to notice of or to vote at a meeting of stockholders shall apply to any adjournment of the meeting; provided, however, that the Board may fix a new record date for the adjourned meeting.

Section 1.9. List of Stockholders Entitled to Vote. The Secretary shall prepare and make, at least ten days before every meeting of stockholders, a complete list of the stockholders entitled to vote at the meeting, arranged in alphabetical order, and showing the address of each stockholder and the number of shares registered in the name of each stockholder. Such list shall be open to the examination of any stockholder, for any purpose germane to the meeting, during ordinary business hours, for a period of at least ten days prior to the meeting, either at a place within the city where the meeting is to be held, which place shall be specified in the notice of the meeting, or, if not so specified, at the place where the meeting is to be held. The list shall also be produced and kept at the time and place of the meeting during the whole time thereof and may be inspected by any stockholder who is present.

## ARTICLE II

### Board of Directors

Section 2.1. Powers; Numbers; Qualifications. The business and affairs of the Corporation shall be managed by the Board of Directors, except as may be otherwise provided by law or in the certificate of incorporation. The number of directors constituting the whole Board shall be not more than fifteen nor less than three. The authorized number of Directors within the limits above specified shall be determined by resolution of the Board of Directors.

Section 2.2. Election; Term of Office; Resignation; Vacancies. Each Director shall hold office until the annual meeting of stockholders next succeeding his election and until his successor is elected and qualified or until his earlier resignation or removal. Any Director may resign at any time upon written notice to the Board of Directors or to

the President or the Secretary of the Corporation. Such resignation shall take effect at the time specified therein, and unless otherwise specified therein no acceptance of such resignation shall be necessary to make it effective. Unless otherwise provided in the certificate of incorporation or these by-laws, vacancies and newly created directorships resulting from any increase in the authorized number of Directors or from any other cause may be filled by a majority of the Directors then in office, although less than a quorum.

Section 2.3. Regular Meetings. Regular meetings of the Board of Directors may be held at such places within or without the State of Delaware and at such times as the Board may from time to time determine, and if so determined notice thereof need not be given.

Section 2.4. Special Meetings. Special meetings of the Board of Directors may be held at any time or place within or without the State of Delaware whenever called by the Chairman of the Board or the President or by any two Directors. Reasonable notice thereof shall be given by the person or persons calling the meeting.

Section 2.5. Telephonic Meetings Permitted. Unless otherwise restricted by the certificate of incorporation or these by-laws, members of the Board of Directors, or any committee designated by the Board, may participate in a meeting of the Board or of such committee, as the case may be, by means of conference telephone or similar communications equipment by means of which all persons participating in the meeting can hear each other, and participation in a meeting pursuant to this by-law shall constitute presence in person at such meeting.

Section 2.6. Quorum; Vote Required for Action. At all meetings of the Board of Directors, Directors constituting a majority of the entire Board shall constitute a quorum for the transaction of business. The vote of a majority of the Directors present at a meeting at which a quorum is present shall be the act of the Board unless the certificate of incorporation or these by-laws shall require a vote of a greater number. In case at any meeting of the Board a quorum shall not be present, the members of the Board present may adjourn the meeting from time to time until a quorum shall attend.

Section 2.7. Organization. Meetings of the Board of Directors shall be presided over by the Chairman of the Board, or in his absence by the President, or in their absence by a chairman chosen at the meeting. The Secretary shall act as secretary of the meeting, but in his absence the chairman of the meeting may appoint any person to act as secretary of the meeting.

Section 2.8. Informal Action by Directors. Any action required or permitted to be taken at any meeting of the Board of Directors, or of any committee thereof, may be taken without a meeting if all members of the Board or of such committee, as the case may be, consent thereto in writing, and the writing or writings are filed with the minutes of proceedings of the Board or committee.

## ARTICLE III

### Committees

Section 3.1. Committees of the Board. The Board of Directors may, by resolution passed by a majority of the entire Board, designate one or more committees, each committee to consist of one or more of the Directors. The Board may designate one or more Directors as alternate members of any committee, who may replace any absent or disqualified member at any meeting of the committee. Vacancies in any such committee shall be filled by the Board, but in the absence or disqualification of a member of such committee, the member or members thereof present at any meeting and not disqualified from voting, whether or not he or they constitute a quorum, may unanimously appoint another member of the Board to act at the meeting in place of any such absent or disqualified member. Any such committee, to the extent provided in the resolution of the Board, shall have and may exercise all the powers and authority of the Board in the management of the business and affairs of the Corporation, and may authorize the seal of the Corporation to be affixed to all papers which may require it; but no such committee shall have power or authority in reference to amending the certificate of incorporation, adopting an agreement of merger or consolidation, recommending to the stockholders the sale, lease or exchange of all or substantially all of the Corporation's property and assets, recommending to the stockholders a dissolution of the Corporation or a revocation of dissolution, indemnifying Directors or amending these by-laws; and, unless the resolution expressly so provides, no such committee shall have the power or authority to declare a dividend or to authorize the issuance of stock.

Section 3.2. Committee Rules. Unless the Board of Directors otherwise provides, each committee designated by the Board may make, alter and repeal rules for the conduct of its business. In the absence of a provision by the Board or a provision in the rules of such committee to the contrary, a majority of the entire authorized number of members of such committee shall constitute a quorum for the transaction of business, the vote of a majority of the members present at a meeting at the time of such if a quorum is then present shall be the act of such committee, and in other respects such committee shall conduct its business in the same manner as the Board conducts its business pursuant to Article II of these by-laws.

## ARTICLE IV

### Officers

Section 4.1. Executive Officers. The officers of the corporation shall be a president, one or more vice presidents, a secretary, a treasurer, and such other officers as may be appointed as provided in these By-laws. The officers shall be elected annually by the board of directors at its first meeting following the annual meeting of the stockholders, and each officer shall hold office until the corresponding meeting in the next year and until his successor shall have been duly chosen and qualified, or until he shall have resigned or shall have been removed in the manner provided in Section 9 of this Article IV. Any vacancy in any of the above offices shall be filled for the unexpired term by the board of directors at any regular or special meeting.



Section 4.2. President. The president shall be the chief executive officer of the corporation. He shall preside at all meetings of the stockholders and of the board of directors; he shall have general charge and supervision of the business of the corporation; he may sign, with the secretary or treasurer or assistant secretary or assistant treasurer, certificates of stock of the corporation; he may sign and execute, in the name of the corporation, all authorized deeds, mortgages, bonds, contracts, or other instruments, except in cases in which the signing and execution thereof shall have been expressly delegated to some other officer or agent of the corporation; and, in general, the president shall perform all duties incident to the office of a president of a corporation, and such other duties as, from time to time, may be assigned to him by the board of directors.

Section 4.3. Vice President. At the request of the president or in his absence or disability, any vice president may perform all the duties of the president, and when so acting, shall have the powers of the president; he may sign, with the secretary or treasurer, or an assistant secretary or assistant treasurer, certificates of stock of the corporation; and he shall perform such other duties as, from time to time, may be assigned to him by the board of directors.

Section 4.4. Secretary. The secretary shall keep the minutes of the meetings of the stockholders, of the board of directors, and of any committee appointed by the board in books provided for the purpose; he shall see that all notices are duly given in accordance with the provisions of these By-laws or as required by law; he shall be custodian of the records and of the corporate seal or seals of the corporation; he shall see that the corporate seal is affixed to all documents, the execution of which, on behalf of the corporation, under its seal, is duly authorized, and when so affixed may attest the same; he may sign, with the president or a vice president, certificates of stock of the corporation; and, in general, he shall perform all duties incident to the office of a secretary of a corporation, and such other duties as, from time to time, may be assigned to him by the board of directors.

Section 4.5. Treasurer. The treasurer shall have charge of and be responsible for all funds, securities, receipts and disbursements of the corporation, and shall deposit, or cause to be deposited, in the name of the corporation, all moneys or other valuable effects in such banks, trust companies or other depositories as shall, from time to time, be selected by the board of directors; he shall render to the president and to the board of directors, whenever requested, an account of the financial condition of the corporation; he may sign, with the president or vice president, certificates of stock of the corporation; and, in general, he shall perform all the duties incident to the office of a treasurer of a corporation and such other duties as may be assigned to him by the board of directors.

Section 4.6. Assistant Officers. The board of directors may appoint one or more assistant officers. Each assistant officer shall, at the request of or in the absence or disability of the officer to whom he is an assistant, perform the duties of such officer and he shall have such other authority and perform such other duties as the board of directors may prescribe.

Section 4.7. Subordinate Officers. The board of directors may appoint such subordinate officers as it may deem desirable. Each such officer shall hold office for such period, have such authority and perform such duties as the board of directors may prescribe. The board of directors may, from time to time, authorize any officer to appoint and remove subordinate officers and prescribe the powers and duties thereof.

Section 4.8. Officers Holding Two or More Offices. Any number of the above offices may be held by the same person, but no officer shall execute, acknowledge or verify any instrument in more than one capacity if such instrument is required by law or by these By-laws to be executed, acknowledged or verified by two officers.

Section 4.9. Removal. Any officer of the corporation may be removed, with or without cause, by a vote of a majority of the entire board of directors at a meeting for that purpose.

Section 4.10. Signatures. Any corporate instrument signed by an officer shall be presumed to have been so signed (a) at the request of the board of directors or the president, as the case may be, or (b) in the absence or because of the disability of the officer or officers otherwise authorized to so sign, or (c) because of expressly delegated or assigned authority to the officer so signing, and such signature may be relied upon by the person to whom the instrument is delivered without establishing the authority or power of the officer to so sign.

## ARTICLE V

### Stock

Section 5.1. Certificates. Every holder of stock in the Corporation shall be entitled to have a certificate signed by or in the name of the Corporation by the Chairman of the Board or the President or a Vice President, and by the Treasurer or an Assistant Treasurer or the Secretary or an Assistant Secretary of the Corporation, certifying the number of shares owned by him in the Corporation. Any or all the signatures on the certificate may be a facsimile. In case any officer, transfer agent or registrar who has signed or whose facsimile signature has been placed upon a certificate shall have ceased to be such officer, transfer agent or registrar before such certificate is issued, it may be issued by the Corporation with the same effect as if he were such officer, transfer agent or registrar at the date of issue.

Section 5.2. Lost, Stolen or Destroyed Stock Certificates; Issuance of New Certificates. The Corporation may issue a new certificate of stock in the place of any certificate theretofore issued by it, alleged to have been lost, stolen or destroyed, and the Corporation may require the owner of the lost, stolen or destroyed certificate, or his legal representative, to give the Corporation a bond sufficient to indemnify it against any claim that may be made against it on account of the alleged loss, theft or destruction of any such certificate or the issuance of such new certificate.

## ARTICLE VI

## Miscellaneous

Section 6.1. Fiscal Year. The fiscal year of the Corporation shall end on the thirty-first day of December in each year, or on such other day as may be fixed from time to time by the Board of Directors.

Section 6.2. Seal. The Corporation may have a corporate seal which shall have inscribed thereon the name of the Corporation, the year of its organization and the words "Corporate Seal, Delaware". The corporate seal may be used by causing it or a facsimile thereof to be impressed or affixed or in any other manner reproduced.

Section 6.3. Waiver of Notice of Meetings of Stockholders, Directors and Committees. Whenever notice is required to be given by law or under any provision of the certificate of incorporation or these by-laws, a written waiver thereof, signed by the person entitled to notice, whether before or after the time stated therein, shall be deemed equivalent to notice. Attendance of a person at a meeting shall constitute a waiver of notice of such meeting, except when the person attends a meeting for the express purpose of objecting, at the beginning of the meeting, to the transaction of any business because the meeting is not lawfully called or convened. Neither the business to be transacted at, nor the purpose of, any regular or special meeting of the stockholders, directors, or members of a committee of directors need be specified in any written waiver of notice unless so required by the certificate of incorporation or these by-laws.

Section 6.4. Indemnification of Directors, Officers and Employees. The Corporation shall indemnify to the full extent authorized by law any person made or threatened to be made a party to any action, suit or proceeding, whether criminal, civil, administrative or investigative, by reason of the fact that he, his testator or intestate is or was a director, officer or employee of the Corporation or any predecessor of the Corporation or serves or served any other enterprise as a director, officer or employee at the request of the Corporation or any predecessor of the Corporation. In the event that the Board of Directors or stockholders refuse or fail to provide indemnity, a person may seek indemnity from the Corporation in court and have the court substitute its judgment as to the propriety of indemnity, or determine such propriety in the absence of any determination thereof by the Board or by stockholders.

Section 6.5. Interested Directors; Quorum. No contract or transaction between the Corporation and one or more of its directors or officers, or between the Corporation and any other corporation, partnership, association or other organization in which one or more of its directors or officers are directors or officers, or have a financial interest, shall be void or voidable solely for this reason, or solely because the director or officer is present at or participates in the meeting of the Board of Directors or committee thereof which authorizes the contract or transaction, or solely because his or their votes are counted for such purpose, if: (1) the material facts as to his relationship or interest and as to the contract or transaction are disclosed or are known to the

Board or the committee, and the Board or committee in good faith authorizes the contract or transaction by the affirmative votes of a majority of the disinterested directors, even though the disinterested directors be less than a quorum; or (2) the material facts as to his relationship or interest and as to the contract or transaction are disclosed or are known to the stockholders entitled to vote thereon, and the contract or transaction is specifically approved in good faith by vote of the stockholders; or (3) the contract or transaction is fair as to the Corporation as of the time it is authorized, approved or ratified, by the Board, a committee thereof or the stockholders. Common or interested directors may be counted in determining the presence of a quorum at a meeting of the Board or of a committee which authorizes the contract or transaction.

Section 6.6. Form of Records. Any records maintained by the Corporation in the regular course of its business, including its stock ledger, books of account and minute books, may be kept on, or be in the form of, punch cards, magnetic tape, photographs, microphotographs or any other information storage device, provided that the records so kept can be converted into clearly legible form within a reasonable time. The Corporation shall so convert any records so kept upon the request of any person entitled to inspect the same.

Section 6.7. Amendment of By-laws. These by-laws may be altered or repealed, and new by-laws made, by the affirmative vote of a majority of the entire Board of Directors, but the stockholders may make additional by-laws and may alter or repeal any by-law whether or not adopted by them.

Alcan Pipeline Company  
Docket No. CP76--  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT B

STATE AUTHORIZATIONS

STATE AUTHORIZATIONS

Applicant, being incorporated under the General Corporation Law of Delaware, is authorized to do business in the State of Delaware. Additionally, Applicant has applied for and received authorization to perform any lawful business activities permitted under the corporate laws of the State of Alaska and the State of Utah; copies of which are herewith submitted.

# State of Alaska

Department of Commerce

Juneau

## CERTIFICATE OF AUTHORITY

The undersigned, as Commissioner of Commerce of the State of Alaska, hereby certifies that duplicate originals of an Application of "ALCAN PIPELINE COMPANY"

for a Certificate of Authority to transact business in this State, duly signed and verified pursuant to the provisions of the Alaska Business Corporation Act, have been received in this office and are found to conform to law.

ACCORDINGLY the undersigned, as such Commissioner of Commerce, and by virtue of the authority vested in him by law, hereby issues this Certificate of Authority to "ALCAN PIPELINE COMPANY" to transact business in this State under the name of


"ALCAN PIPELINE COMPANY"

and attaches hereto a duplicate original of the Application for such Certificate \_\_\_\_\_

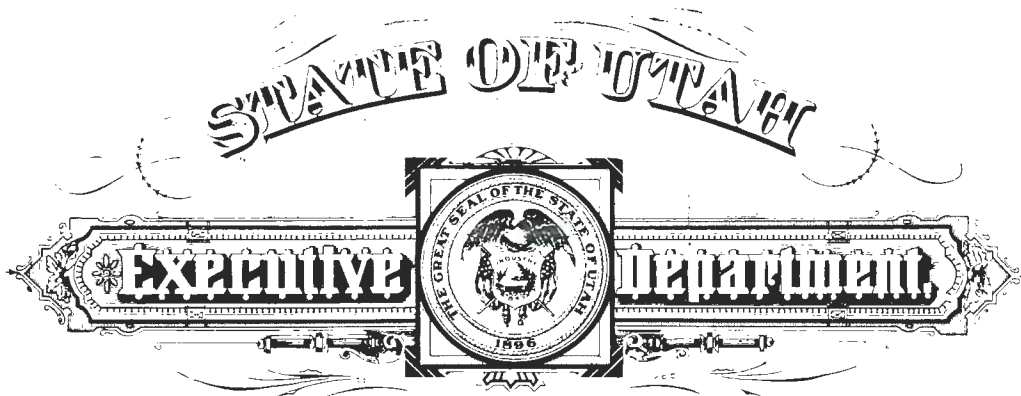
IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my official seal, at Juneau, the Capital, this

11th day of June

A.D. 19 76

  
LANGHORNE A. MOTLEY  
COMMISSIONER OF COMMERCE





Office of Secretary of State

Certificate of Authority  
of

ALCAN PIPELINE COMPANY

I, Clyde L. Miller, as Secretary of State of Utah, hereby  
certify that duplicate originals of an Application of

ALCAN PIPELINE COMPANY

for a Certificate of Authority to transact business in this State, duly  
signed and verified pursuant to the provisions of the Utah Business  
Corporation Act, have been received in this office and are found to  
conform to law.

Accordingly, the undersigned, as such Secretary of State, and  
by virtue of the authority vested in him by law, hereby issues this  
Certificate of Authority to

ALCAN PIPELINE COMPANY

to transact business in this State and attaches hereto a duplicate  
original of Application for such Certificate.

File #069176



In Testimony Whereof, I have  
hereunto set my hand and affixed  
the Great Seal of the State of  
Utah at Salt Lake City, Utah,  
this 9th day of June A.D.  
19 76.

*Clyde L. Miller*  
SECRETARY OF STATE

By *Harvard R. Hinton*  
DEPUTY



Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT C

DIRECTORS AND COMPANY OFFICIALS

DIRECTORS AND COMPANY OFFICIALS

DIRECTORS

<u>Name</u>	<u>Business Address</u>
John G. McMillian	P. O. Box 1526 Salt Lake City, Utah 84110
Thomas W. diZerega	P. O. Box 1526 Salt Lake City, Utah 84110
William D. Owens	P. O. Box 1526 Salt Lake City, Utah 84110
A. N. Porter	P. O. Box 1526 Salt Lake City, Utah 84110

OFFICERS

<u>Name and Title</u>	<u>Business Address</u>
John G. McMillian Chairman of the Board, President and Chief Executive Officer	P. O. Box 1526 Salt Lake City, Utah 84110
Thomas W. diZerego Vice President & Secretary	P. O. Box 1526 Salt Lake City, Utah 84110
William D. Owens Vice President	P. O. Box 1526 Salt Lake City, Utah 84110
A. N. Porter Vice President & Treasurer	P. O. Box 1526 Salt Lake City, Utah 84110
Darrell B. MacKay Vice President	P. O. Box 1526 Salt Lake City, Utah 84110
Gene C. Brown Assistant Treasurer	P. O. Box 1526 Salt Lake City, Utah 84110
William P. Diener Assistant Secretary	P. O. Box 1526 Salt Lake City, Utah 84110
David M. Higbee Assistant Secretary	P. O. Box 1526 Salt Lake City, Utah 84110
Norman J. Provost Assistant Secretary	P. O. Box 1526 Salt Lake City, Utah 84110

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT D

SUBSIDIARIES AND AFFILIATIONS

SUBSIDIARIES AND AFFILIATIONS

Applicant is a wholly-owned subsidiary of Northwest Pipeline Corporation ("Northwest Pipeline"). Northwest Pipeline is a Delaware corporation engaged in interstate transmission of natural gas with its principal place of business located in Salt Lake City, Utah. Northwest Pipeline is a wholly-owned subsidiary of Northwest Energy Company ("Northwest Energy"). Northwest Energy, a Delaware corporation, is a holding company whose principal asset is all of the outstanding common stock of Northwest Pipeline and whose principal place of business is also in Salt Lake City, Utah.

As of the date hereof, approximately 57 percent of the common stock of Northwest Energy was deposited in a voting trust pursuant to a Voting Trust Agreement. In accordance with the terms of the Voting Trust Agreement, Mr. John G. McMillian, Chairman of the Board and Chief Executive Officer of both Northwest Energy and Northwest Pipeline, is designated voting trustee and, in such capacity, is the record owner of such shares. Mr. McMillian, as voting trustee, votes the shares on deposit in the voting trust only at the direction of the Board of Directors of Northwest Energy.

With the exception of the above-described voting trust, of which Mr. McMillian is voting trustee, no other officer or director of the Company or the Company itself directly or indirectly owns, controls or holds with power to vote 10 percent or more of the outstanding voting securities of any person or entity engaged in the production, transportation, distribution or sale of natural gas or in the construction or financing of such enterprises or operations.

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT E

OTHER PENDING APPLICATIONS AND FILINGS

OTHER PENDING APPLICATIONS AND FILINGS

Applicant has no other applications pending under Sections 1, 3, 4 or 7 of the Natural Gas Act which significantly affect this application.

Applicant is filing concurrently herewith an Application for a Presidential Permit pursuant to Executive Order No. 10485, in order to construct, maintain, operate, and connect facilities at the Alaska-Yukon Boundary for trans-shipment of natural gas from the State of Alaska through the Dominion of Canada to the lower United States.

Alcan Pipeline Company  
Docket No. CP76-  
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EXHIBIT F

LOCATION OF FACILITIES

## LOCATION OF FACILITIES

### 1.0 INTRODUCTION

The facilities to be constructed include approximately 731.4 miles of 42-inch O.D. pipeline, three meter stations, fifteen compressor stations, and four district headquarters.

The major considerations in selecting the locations for facilities were economics, accessibility, environmental, and adherence to sound engineering practices, codes and governmental requirements and stipulations. A brief description of these considerations is as follows:

#### Economics

Utilization of the existing pipeline corridor provides many economic advantages. Among these are use of the existing work pad, temporary construction facilities, communications facilities, base line environmental and geotechnical data, access roads, construction equipment, and construction techniques.

#### Accessibility

Existing roads, Alyeska haul road and Alcan highway, provide year-round access to all parts of the project simplifying construction and operation.

#### Environmental

Construction of the Alyeska Pipeline and haul road, the Alcan highway, and Haines pipeline, have provided substantial base line environmental data which can be used to mitigate possible impacts. The existence of the roads and pipelines is an indication of the minimal impact to be expected.

#### Sound Engineering Practices

The pipeline and ancillary facilities are being designed for conventional construction and operating techniques. Special design and construction will be held to a minimum.

#### Codes

Design of the facilities will be in accordance with existing codes and regulations.



Governmental Stipulations

FPC regulations require utilization of existing corridors whenever possible. Applicant proposes to locate all facilities within existing pipeline corridors. Details of the implementation of the above are submitted in section 6 of Exhibit Z-2.

Section 1.0 of Exhibit Z-2 contains strip maps which show the general location of all facilities. Exhibit Z-6, Alignment sheets shows further details of the facilities location.

A complete description of the facilities to be installed, including pipe length, outside diameter and wall thickness, station gas compressor horsepower and other requirements, can be found in Exhibit G of this application.

2.0           SYSTEM MAP

A system map, indicating the general location of facilities, is provided on the following page.



50 0 50 100 MILES

LEGEND

- PROPOSED PIPELINE BY APPLICANT
- - - PROPOSED CANADIAN PIPELINE
- PROPOSED COMPRESSOR STATIONS
- △ PROPOSED METER FACILITIES

GULF INTERSTATE ENGINEERING COMPANY

ALCAN PIPELINE COMPANY

LOCATION OF FACILITIES

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No.

EXHIBIT F-1  
FACTORS CONSIDERED IN USE OF  
JOINT RIGHTS-OF-WAY

FACTORS CONSIDERED IN THE USE OF JOINT RIGHTS-OF-WAY

In order to minimize ecological disturbances in the area of the pipeline, to facilitate the acquisition of rights-of-way, and to ease or eliminate pipeline construction and operating difficulties, existing rights-of-way and areas adjacent to existing rights-of-way will be utilized to the maximum extent practical, consistent with good pipeline lining practice.

The route of the proposed pipeline was selected so that the line will be constructed along the right-of-way of the existing Trans-Alaska oil pipeline where feasible from Prudhoe Bay to Delta Junction, a distance of 539 miles. From Delta Junction the pipeline will be constructed parallel to the Alcan Highway, following the Haines Pipeline corridor to the USA/Canadian border, a distance of 192 miles.

The portion of the line which follows the existing Trans-Alaska oil line will utilize existing facilities. The existing facilities that may be used by applicant are, the work pads, camps, air strips, storage areas, communications facilities and the construction equipment stored there after construction.

Exhibit Z-1 of this application, the Environmental Report, gives a detailed description of the rights-of-way which will be used, and contains maps showing other facilities in the area including pipelines, electric powerlines, highways and railroads.

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT F-II  
FACTORS CONSIDERED IN LOCATING FACILITIES  
IN SCENIC, HISTORIC, RECREATIONAL OR  
WILDLIFE AREAS

FACTORS CONSIDERED IN LOCATING FACILITIES IN  
SCENIC, HISTORIC, RECREATIONAL OR WILDLIFE AREAS

Applicant states that the facilities proposed in the application will not be located in, or routed through, any of the national historic places listed in the National Register of Historic Places maintained by the Secretary of the Interior; natural landmarks listed in the National Register of Natural Landmarks maintained by the Secretary of the Interior; or, through any park, scenic, recreational or wildlife areas officially designated by duly constituted public authorities.

A detailed description of the pipeline route, the specified areas disturbed by the route, the reasons for locating the pipeline in relation to the specified area, and a list of those Federal, state and local agencies having jurisdiction which have been, or will be, consulted prior to construction, is presented in the separately bound volume of this application identified as Exhibit Z-1.

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No.

EXHIBIT F-III  
STATEMENT ON ADOPTION OF GUIDELINES  
CONCERNING RIGHT-OF-WAY AND  
CONSTRUCTION ACTIVITIES

STATEMENT ON ADOPTION OF GUIDELINES  
CONCERNING RIGHT-OF-WAY AND CONSTRUCTION ACTIVITIES

Applicant will adopt, as a general policy, the guidelines set forth in Section 2.69, Part 2, General Policy and Interpretations, Subchapter A, Chapter 1 of Title 18 of the Code of Federal Regulations.

These guidelines have been, or will be, issued to the employees of Applicant engaged in the planning and construction of this project and will be issued to contractors used by Applicant. These employees and contractors have been, or will be, instructed to follow these guidelines, where applicable, when planning and installing the facilities proposed herein.

These guidelines will also be issued to Applicant's employees engaged in system operations and right-of-way maintenance, with appropriate instructions.



Alcan Pipeline Company

Docket No. CP76-

Hearing Exhibit No. \_\_\_\_\_

EXHIBIT F-IV

STATEMENT CONCERNING THE REQUIREMENTS  
OF THE NATIONAL ENVIRONMENTAL POLICY

ACT OF 1969

STATEMENT BY THE APPLICANT CONCERNING THE  
REQUIREMENTS OF THE NATIONAL ENVIRONMENTAL  
POLICY ACT OF 1969

Applicant has prepared as a part of this application, Exhibit Z-1 entitled "Environmental Report". This exhibit contains a detailed analysis in compliance with the National Environmental Policy Act, and establishes that the proposed route is environmentally sound. Extensive studies relating to the environmental impact of Applicant's proposal have been completed and are reflected in the Environmental Report.

Additional studies are either underway or scheduled to provide site specific information for final design and construction of the project in anticipation of early approval of Applicant's proposal. A summary of this work is attached.

## SUMMARY OF FIELD WORK

The following provides a summary of the status of field work associated with the Alcan pipeline in Alaska, as of July 3, 1976. Field studies in the physical, natural and biological sciences are in varying stages of development. Scientists and engineers in each of the following disciplines have conducted, at a minimum, a field reconnaissance of the route segment from Delta Junction to the Yukon border: Geology, Geotechnical Engineering, Hydrology, Air Quality/Meteorology, Botany/Agronomy, Terrestrial Biology - Mammals, Terrestrial Biology - Birds, Aquatic Biology - Fish, Archaeology, Sociology, and Cultural Anthropology. In addition, a multi-disciplinary team including engineering personnel, was assembled on June 16 to survey the 15 compressor station sites. The team viewed all sites south of Fairbanks from the air, and conducted an on-ground reconnaissance on all sites between Fairbanks and Prudhoe Bay. Based primarily upon these two separate field excursions and a thorough literature review, a report was prepared on the environmental impacts of the construction and operation of the proposed facilities.

Further studies are being conducted. These studies will provide a basis for engineering decisions and additional environmental information on which to make determinations concerning site-specific environmental impacts of the project and provide a basis on which to make further recommendations concerning mitigating measures prior to actual construction.

The following is a description by discipline of work completed, programs in progress and programs scheduled.

### 1. Geology

Dr. Robert Forbes has been retained to conduct a survey of the relationship between prehistoric/historic movement and seismic activity along the Denali Fault including: the compilation of a 1:250,000 geologic map depicting the fault and trace and the geology of the terrain between the fault and the proposed route; helicopter reconnaissance of the fault trace; computer modeling of ground accelerations along the Big Delta-Yukon border route from magnitude 8.0 earthquakes along the Denali Fault and computer modeling of ground accelerations along northeast trending faults between Tok Junction and Johnson River.

Several additional studies are scheduled, including a microseismicity study of the Denali Fault between Isabelle Pass and the Yukon border; radiometric dating of rock units along the Denali Fault to refine estimated off-set rates in Tertiary time (concentrating on dating the Kluane-Shawack segment of the fault).

## 2. Geotechnical Engineering

A geological review by R & M Consultants, Inc. along the Alcan Highway segment considering general soil type, landforms, slope stability factors, significant erosional features or problems and existing materials sources (and mapping of each of these) is presently underway. The first phase of these studies, nearing completion, is a photogeologic review of the route. A field investigation to establish the ground truth to corroborate information obtained from the photo study is also underway. A key aspect of this investigation is a field boring program to obtain 50 foot cores at representative locations within the Haines Pipeline right-of-way, followed by laboratory analyses. This intense boring program, utilizing seven boring rigs four of which are working two 10-hour shifts, is currently underway. A boring program will be continued as necessary to develop sufficient soils information along the route.

## 3. Hydrology

R & M Consultants, Inc. conducted a field reconnaissance of the proposed route in early June; a general review of the major river crossings was performed by Dr. R. Carlson on June 19-20; and a combined aerial and on-ground survey was performed by other senior hydrologists.

A hydrologic team from R & M Consultants, Inc., is presently delineating drainage basins, locating stream channels and determining sub-areas within major basins to aid in the computation of design discharges.

Following completion of the general hydrologic assessment, a more precise and site-specific study is scheduled to be initiated to compute design discharges with a standard recurrence interval. Stream channels will be located and a listing of design discharge values for each basin will be prepared. A more detailed field verification and stream data program is scheduled to follow, including theoretical discharge computations as well as survey data for structural design. Data will be gathered at both small streams and major rivers and will include cross-sections, stream profiles, velocities, and stream-bed

material samples as required. Final discharge values and recommended drainage control structures for all small drainages will then be provided. At the major crossings, scour computations will be provided with recommendations for most economical type of crossing.

#### 4. Archaeology

Dr. John P. Cook made a field reconnaissance of the route segment Delta Junction to Tok in early June. Verification of previously unreported sites near Clearwater Road (close to Delta Junction), at the Gerstle River crossing, and at the communications tower at Tok suggest that additional sites may be found.

A detailed survey of the route east of Delta Junction to identify sites needing excavation and to determine where future survey will be necessary is underway.

A thorough mitigation program to cover the entire construction period incorporating mitigation required under Federal and State statutes, regulations and policies is scheduled.

#### 5. Socio-Cultural

Dr. Lawrence Gooding and Dr. L. L. Naylor conducted in late June an on-site inspection and reconnaissance of all communities, distinct populations and services along the Alcan Highway which provided: (1) updated familiarization with the communities and populations along this portion of the route; (2) a check on the existing information available on these communities to ascertain the reliability of currently published materials and to identify possible gaps in this information; and (3) the opportunity to collect further data and to initiate an update of existing census data for those communities.

A literature review and analysis of all relevant materials on the populations, culture, communities and services to be impacted by the construction and operation of the Alcan pipeline in Alaska has also been completed.

A demographic survey and census of the communities and populations contiguous to the Alcan pipeline route is underway and will provide an update of existing population statistics on the communities and baseline information on demographic characteristics. In concert with the demographic survey, an attitudinal survey of the communities (particularly native communities) with specific reference to the Alcan pipeline project has been initiated. The survey will assess the attitudes of the communities of Dot

Lake, Tanacross, Tetlin and Northway with respect to the construction and operation of the pipeline, provide information on possible mitigating measures that can be taken to offset any potentially disruptive effects of the project and establish mechanisms for ongoing community-pipeline communications.

6. Terrestrial Biology - Vegetation

Dr. J. D. McKendrick has conducted an on-ground and aerial reconnaissance of the full route from Prudhoe Bay to the Alaska-Yukon border, and has prepared a detailed characterization of plant communities encountered. Included in this study is a determination of the occurrence of vegetation types along the route (expressed in miles of right-of way), a discussion of the relative value of the various vegetative types to man and wildlife, an assessment of their sensitivity to disturbance and conceptual program for developing a viable revegetation.

A natural revegetation map for the route at a scale of 1:63,360 (1" mile) is scheduled to be developed prior to construction as an important tool in the preparation of a revegetation plan.

7. Terrestrial Biology - Mammals

A ground survey of the route east of Delta Junction and an aerial survey of the segment adjacent to the oil pipeline were conducted by D. Bromley during a ten day period in mid-June. This survey supplemented a comprehensive literature review, further field observations and discussions with government agency wildlife biologists, including those monitoring the oil pipeline construction.

8. Aquatic Biology

Dr. Jack Van Hyning has completed a field reconnaissance of streams along the pipeline route. The survey was conducted by vehicle and consisted of visual examination of the streams and lakes at the highway crossings or where the road comes near the water. Observations were taken on the general characteristics of the water body, productivity, water temperature, and turbidity. Photographs of most of the stream crossings were taken. The field trip was followed up with interviews with Alaska Department of Fish and Game personnel in Fairbanks who were familiar with the area.

A subsequent report characterized fish population and hydrology of all streams east of Delta Junction based upon literature review and the field observations.

Dr. Paul B. Holden is presently conducting an intensive field survey of fish streams east of Delta Junction that will extend the Joint State/Federal Fish and Wildlife Advisory team list of fish streams for the oil pipeline route. This information will be compiled and time windows around migration, spawning and over wintering times delineated.

A study is scheduled to determine by gill-netting whether salmon migrate in the Tanana River above the Gerstle River and identify spawning areas, if any.

Alcan Pipeline Company

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EXHIBIT G

FLOW DIAGRAMS

DAILY DESIGN CAPACITY



DAILY DESIGN CAPACITY

INDEX

<u>Description</u>	<u>Page</u>
1.0 Discussion	1
2.0 Flow Diagrams	
2.1 1981 Summer average day	5
2.2 1982 Summer average day	6
2.3 1983 Summer average day	7

### FLOW DIAGRAMS

Three flow diagrams are presented for the purpose of illustrating pipeline buildup as follows:

1. 1981 Summer Average Day @ 1200 MMSCFD
2. 1982 Summer Average Day @ 1600 MMSCFD
3. 1983 Summer Average Day @ 2400 MMSCFD

#### Design Case Flow Diagram

The case used for station spacing and system design is the 1983 Summer Peak Day. Peak day volume is determined by dividing the average day volume by the load factor which is taken as 93.5%.

The design case volume requires the installation of fifteen (15) compressor stations at an average spacing of forty-six (46) miles. Each compressor station will be equipped with a single pipeline gas compressing unit, refrigeration equipment and on-site power generation. Compressors and generators will be driven by gas turbine prime movers.

Under design conditions, the system will receive 2567 MMSCFD from production facilities at Prudhoe Bay with deliveries of 48.13 MMSCFD to the Fairbanks vicinity and 2421.56 MMSCFD to the Alaska-Yukon Territory border.

1981 Summer Average Day Flow Diagram

The buildup of the system based on the station locations dictated by the design case, for 1981 will require the following facilities:

- (1) Compressor stations at station locations 2, 6, 10 and 14.
- (2) Refrigeration and power generation equipment at station locations 4, 5, 7, 8, 9, 11, 12, 13 and 15.

Station sites 1 and 3 will remain unimproved for this initial buildup year.

With the installed facilities as outlined above, the system will receive 1200 MMSCFD from production facilities at Prudhoe Bay with deliveries of 22.5 MMSCFD to the Fairbanks vicinity and 1150.96 MMSCFD to the Alaska-Yukon Territory border.

1982 Summer Average Day Flow Diagram

The buildup necessary for this second operating year will require additions to the system over and above those installed for the first operating year. These additional facilities include the installation of pipeline gas compression at station locations 4, 8 and 12.

Station sites 1 and 3 are not required to be operational for this year.

This system will receive 1600 MMSCFD from production facilities at Prudhoe Bay with 30.0 MMSCFD delivered to the Fairbanks vicinity and 1537.16 MMSCFD delivered to the Alaska-Yukon Territory border.

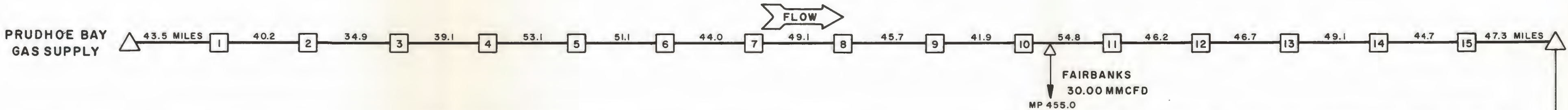
1983 Summer Average Day Flow Diagram

System buildup for the third operating year will be complete with fifteen full stations installed and operational.

Under the third operating year average day conditions, the system will receive 2400 MMSCFD from production facilities at Prudhoe Bay with deliveries of 45.0 MMSCFD to the Fairbanks vicinity and 2275.04 MMSCFD to the Alaska-Yukon Territory border.

1. ELEVATION - FEET ABOVE SEA LEVEL	21	410	1050	2575	2955	1405	1360	1371	1000	960	1360	806	1223	1598	1649	2225	2000
2. AMBIENT AIR TEMPERATURE °F.	41	41	48	49	54	58	59	59	60	60	60	58	59	59	59	59	59
3. STATION SUCTION PRESSURE PSIG			1026		1009	1207	1107	1159	1062	1159	1045		1049		1027	1139	1044
4. COMPRESSOR SUCTION PRESS. PSIG			1024		1007		1105		1060		1043		1047		1025		
5. COMPRESSOR DISCHARGE PRESS. PSIG			1253		1253		1253		1253		1253		1253		1253		
6. STATION DISCHARGE PRESSURE PSIG	1250		1250		1250	1202	1250	1154	1250	1154	1250		1250		1250	1134	1039
7. STATION SUCTION TEMPERATURE °F.			17		18	29	24	27	22	26	23		26		28	27	22
8. COMPRESSOR DISCHARGE TEMP. °F.			42		46		40		43		47		50		54		
9. STATION DISCHARGE TEMP. °F.	25		25		20	20	25	15	20	20	20		25		25	15	
10.																	
11. MMCF/D TO COMPRESSOR			1600.00		1596.20	1591.25	1590.47	1587.66	1586.58	1582.41	1581.89		1547.17		1543.01	1538.21	
12. FUEL - MMCF/D TOTAL			3.80		4.95	0.78	2.81	1.08	4.17	0.52	4.72		4.16		4.80	1.05	
13. NET DELIVERY TO PIPELINE MMCF/D	1600.00		1596.20		1591.25	1590.47	1587.66	1586.58	1582.41	1581.89	1577.17		1543.01		1538.21	1537.16	1537.16
14. MILEPOST	0	43.5	83.7	118.6	157.7	210.8	261.9	305.9	355.0	400.7	442.6	497.4	543.6	590.3	639.4	684.1	731.4

731.4 MILES 42" O.D. PIPELINE



15. COMPRESSION - RATIO		1.220		1.241		1.132		1.179		1.198		1.194		1.219	
16. - H.P. REQUIRED		12232		13450		7627		10188		11310		10955		12437	
17. - H.P. SPARE		12662		9763		16993		14750		13310		13787		11929	
18. - H.P. TOTAL - SITE RATED		24894		23213		24620		24938		24620		24742		24366	
19. - NO. OF UNITS/H.P. EACH ISO		1/26500		1/26500		1/26500		1/26500		1/26500		1/26500		1/26500	
20.															
21.															
22. REFRIGERATION - H.P. REQUIRED		4035		7244	2808	4139	3889	7006	1856	8115		6353		7482	3811
23. - H.P. INSTALLED ISO		7660		13830	13830	13830	13830	13830	13830	13830		13830		13830	13830
24. - LOAD - TONS		4069		6087	2250	3523	2788	5463	1437	6284		5486		6415	2732
25.															
26.															
27. TOTAL HORSEPOWER TO BE INSTALLED ISO		34160		40330	13830	40330	13830	40330	13830	40330		40330		40330	13830
28.															
29.															

NOTES: ALL VOLUMES ARE AT 14.73 PSIA AND 60° F.  
FLOW CONDITIONS:  
GRAVITY - 0.650  
EFFICIENCY - 0.800

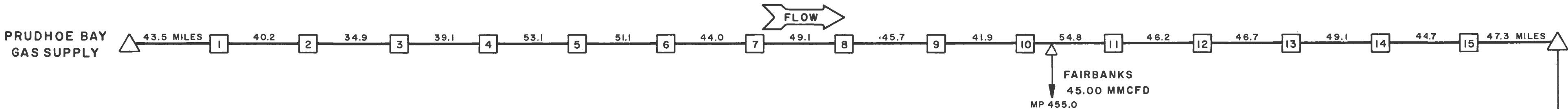
LEGEND  
□ COMPRESSOR STATIONS  
△ METER STATIONS

GULF INTERSTATE ENGINEERING COMPANY  
ALCAN PIPELINE COMPANY  
FLOW DIAGRAM  
1982 SUMMER AVERAGE DAY  
Q PRUDHOE = 1,600 MMSCFD



1. ELEVATION - FEET ABOVE SEA LEVEL	21	410	1050	2575	2955	1405	1360	1371	1000	960	1360	806	1223	1598	1649	2225	2000
2. AMBIENT AIR TEMPERATURE °F.	41	41	48	49	54	58	59	59	60	60	60	58	59	59	59	59	59
3. STATION SUCTION PRESSURE PSIG		1022	1029	1023	1047	1050	1029	1040	1030	1033	1035	1025	1023	1026	1028	1028	1053
4. COMPRESSOR SUCTION PRESS. PSIG		1017	1024	1018	1042	1045	1024	1035	1025	1028	1030	1020	1018	1021	1023	1023	
5. COMPRESSOR DISCHARGE PRESS. PSIG		1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	
6. STATION DISCHARE PRESSURE PSIG	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1048
7. STATION SUCTION TEMPERATURE °F.		13	13	11	16	22	18	18	19	20	18	19	17	18	18	18	20
8. COMPRESSOR DISCHARGE TEMP. °F.		40	39	38	40	46	44	43	45	46	44	46	44	45	45	45	
9. STATION DISCHARGE TEMP. °F.	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	
10.																	
11. MMCF/D TO COMPRESSOR		2400.00	2395.19	2390.44	2385.68	2380.99	2375.50	2369.84	2364.59	2358.87	2353.14	2302.70	2297.05	2291.55	2286.04	2280.55	
12. FUEL - MMCF/D TOTAL		4.81	4.75	4.76	4.69	5.49	5.66	5.25	5.72	5.73	5.44	5.65	5.50	5.51	5.49	5.51	
13. NET DELIVERY TO PIPELINE MMCF/D	2400.00	2395.19	2390.44	2385.68	2380.99	2375.50	2369.84	2364.59	2358.87	2353.14	2347.70	2297.05	2291.55	2286.04	2280.55	2275.04	2275.04
14. MILEPOST	0	43.5	83.7	118.6	157.7	210.8	261.9	305.9	355.0	400.7	442.6	497.4	543.6	590.3	639.4	684.1	731.4

731.4 MILES 42" O.D. PIPELINE



15. COMPRESSION - RATIO	1.232	1.224	1.231	1.204	1.198	1.224	1.211	1.222	1.219	1.217	1.228	1.231	1.228	1.225	1.225
16. - H.P. REQUIRED	19000	18278	18680	16838	17007	18651	17493	18514	18265	17886	18451	18507	18248	18009	18008
17. - H.P. SPARE	6458	6616	4869	6375	7574	5969	7118	6424	6708	6734	6658	6235	6163	6357	5851
18. - H.P. TOTAL - SITE RATED	25458	24894	23549	23213	24581	24620	24611	24938	24973	24620	25109	24742	24411	24366	23859
19. - NO. OF UNITS/H.P. EACH ISO	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500	1/26500
20.															
21.															
22. REFRIGERATION - H.P. REQUIRED	4544	4804	4557	5595	8333	7816	7162	8157	8337	7561	7946	7369	7572	7659	7744
23. - H.P. INSTALLED ISO	7660	7660	7660	13830	13830	13830	13830	13830	13830	13830	13830	13830	13830	13830	13830
24. - LOAD - TONS	5205	4844	4530	5149	7298	6654	6097	6944	7046	6391	6862	6363	6492	6567	6592
25.															
26.															
27. TOTAL HORSEPOWER TO BE INSTALLED ISO	34160	34160	34160	40330	40330	40330	40330	40330	40330	40330	40330	40330	40330	40330	40330
28.															
29.															

NOTES: ALL VOLUMES ARE AT 14.73 PSIA AND 60° F.  
FLOW CONDITIONS:  
GRAVITY - 0.650  
EFFICIENCY - 0.800

LEGEND  
□ COMPRESSOR STATIONS  
△ METER STATIONS

GULF INTERSTATE ENGINEERING COMPANY

ALCAN PIPELINE COMPANY

FLOW DIAGRAM  
1983 SUMMER AVERAGE DAY  
Q PRUDHOE = 2,400 MMSCFD

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT G-I

FLOW DIAGRAM

MAXIMUM CAPABILITIES



FLOW DIAGRAM - MAXIMUM CAPABILITIES

Description

The maximum capabilities of the system is considered to be the same as the 1983 Summer Peak Design and the 1983 Winter Peak Design as shown by the two flow diagrams in this exhibit.

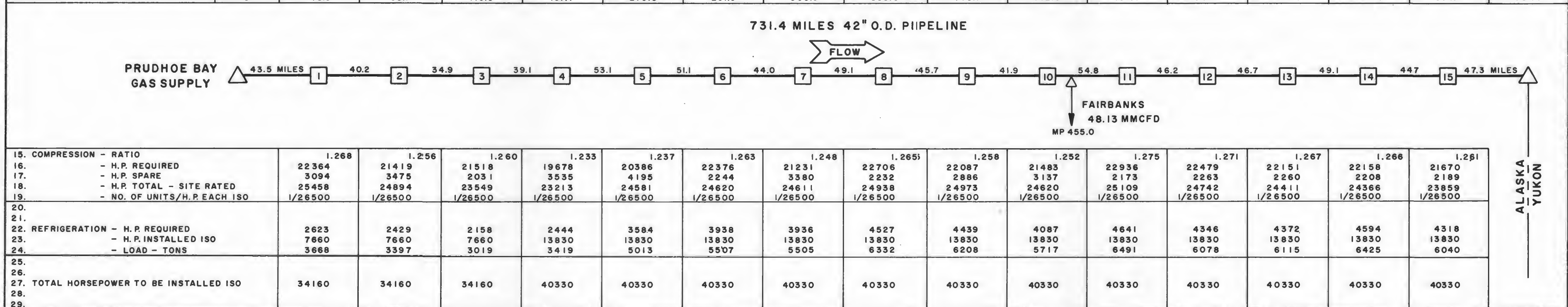
1983 Summer Peak Design

The 1983 Summer Peak Design requires the installation of fifteen (15) compressor stations at an average spacing of forty-six (46) miles. Each compressor station will be equipped with a single pipeline gas compressing unit, refrigeration equipment and on-site power generation. Compressors and generators will be driven by gas turbine prime movers. Under design conditions, the system will receive 2567 MMSCFD from production facilities at Prudhoe Bay with deliveries of 48.13 MMSCFD to the Fairbanks vicinity and 2421.56 MMSCFD to the Alaska-Yukon Territory border.

1983 Winter Peak Design

This case requires that all facilities be installed and operational. Under these conditions, the system will receive 2567 MMSCFD from production facilities at Prudhoe Bay with deliveries of 48.13 MMSCFD to the Fairbanks vicinity and 2442.16 MMSCFD to the Alaska-Yukon Territory border.

1. ELEVATION - FEET ABOVE SEA LEVEL	21	410	1050	2575	2955	1405	1360	1371	1000	960	1360	806	1223	1598	1649	2225	2000
2. AMBIENT AIR TEMPERATURE °F.	-14	-14	-11	-10	-10	-11	-12	-11	-9	-8	-8	-8	-5	-7	-11	-14	-13
3. STATION SUCTION PRESSURE PSIG		993	1002	999	1021	1018	997	1009	995	1001	1006	987	991	994	995	998	1021
4. COMPRESSOR SUCTION PRESS. PSIG		988	997	994	1016	1013	992	1004	990	996	1001	982	986	989	990	993	
5. COMPRESSOR DISCHARGE PRESS. PSIG		1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	1257	
6. STATION DISCHARGE PRESSURE PSIG	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250	1016
7. STATION SUCTION TEMPERATURE °F.		5	5	4	7	11	10	11	12	12	11	12	11	11	12	12	14
8. COMPRESSOR DISCHARGE TEMP. °F.		35	34	33	34	38	40	40	42	42	41	43	42	42	43	42	
9. STATION DISCHARGE TEMP. °F.	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25	
10.																	
11. MMCF/D TO COMPRESSOR		2567.00	2562.09	2557.41	2552.79	2548.43	2543.63	2538.35	2533.29	2527.79	2522.43	2469.16	2463.58	2458.17	2452.82	2447.40	
12. FUEL - MMCF/D TOTAL		4.91	4.68	4.62	4.36	4.80	5.28	5.06	5.50	5.36	5.14	5.58	5.41	5.35	5.42	5.24	
13. NET DELIVERY TO PIPELINE MMCF/D	2567.00	2562.09	2557.41	2552.79	2548.43	2543.63	2538.35	2533.29	2527.79	2522.43	2517.29	2463.58	2458.17	2452.82	2447.40	2442.16	2442.16
14. MILEPOST	0	43.5	83.7	118.6	157.7	210.8	261.9	305.9	355.0	400.7	442.6	497.4	543.6	590.3	639.4	684.1	731.4



NOTES: ALL VOLUMES ARE AT 14.73 PSIA AND 60° F.  
FLOW CONDITIONS:  
GRAVITY - 0.650  
EFFICIENCY - 0.800

LEGEND  
□ COMPRESSOR STATIONS  
△ METER STATIONS

GULF INTERSTATE ENGINEERING COMPANY  
ALCAN PIPELINE COMPANY  
FLOW DIAGRAM  
1983 WINTER PEAK  
Q PRUDHOE = 2,567 MMSCFD

Alcan Pipeline Company  
Docket No. CP76  
Hearing Exhibit No. \_\_\_\_

EXHIBIT G-II

FLOW DIAGRAM DATA

## DESIGN DATA

Applicant retained Gulf Interstate Engineering Company to complete the system hydraulic design for the purpose of this submittal. Gulf Interstate Engineering Company performed the hydraulic studies utilizing the Foot-hills computer program outlined in Exhibit Z-2.

Gulf Interstate Engineering Company has many years of experience in the design of natural gas transmission systems. The company has performed gas transmission work for Gulf Interstate Gas Company (now Columbia Gulf Transmission Company), Transwestern Pipeline Transmission Company (now a subsidiary of Texas Eastern Transmission Company), Houston Natural Gas Company (Oasis Pipeline), Humble (Exxon) Industrial Gas Transmission Company and other gas transmission work.

The system consists of fifteen (15) compressor stations spaced along a pipeline from Prudhoe Bay to the Alaska-Yukon Territory border. Detailed data for the system are found in Exhibit Z-2.

The pipeline consists of 42-inch O.D. x 0.600-inch WT API 5LX-65 pipe with metallurgy applicable to arctic conditions. Detailed data for the pipeline material specifications are found in Exhibit Z-2.

Each station will consist of a single 26,500 HP gas turbine driven centrifugal compressor, refrigeration system capabilities to maintain gas temperatures below 25°F, on-site power generation and ancillary facilities necessary for operation and maintenance. Detailed data for the stations are found in Exhibit Z-2.

The computer program uses the energy, momentum and continuity equations for determining gas conditions along the length of the pipeline. A detailed explanation of the formulae and solution methods are found in Exhibit Z-2.

The applicant hereby certifies that they will design, install, inspect, test, construct, operate, replace and maintain all facilities for which a certificate is requested in accordance with Federal safety standards and plans for maintenance and inspection.

Alcan Pipeline Company  
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EXHIBIT H

TOTAL GAS SUPPLY DATA

Alcan Pipeline Company  
Docket No. CP76-  
Exhibit H  
Hearing Exhibit No. \_\_\_\_

TOTAL GAS SUPPLY  
INDEX

<u>Exhibit</u>	<u>Description</u>	<u>Tab No.</u>
H-1	Total Gas Supply Data	1.0
H-2	Gas Supply Study, Sadlerochit Reservoir, Prudhoe Bay Field, State of Alaska	2.0
H-3	Geology & Estimated Recoverable Gas Reserves of the North Slope (Onshore) of Alaska	3.0

TOTAL GAS SUPPLY DATA

This exhibit contains the basic information, as required by section 157.14, Exhibit H, sub-sections, (i), (ii) and (iv), relative to the present and potential reserves in the Prudhoe Bay field and vicinity. Studies are herein included which substantiate that sufficient gas reserves are available in the Prudhoe Bay field and vicinity to assure the economic feasibility and financibility of the Applicants proposed pipeline.

A Prudhoe Bay reservoir study by Core Laboratories, Inc., is included herein under Tab 2.0 and identified as Exhibit H-2. In this study, the estimated salable gas reserves available for transport by the Applicant are developed for various rates of oil and gas production. The study indicates that 22.28 Tcf will be recovered at an annual average day deliverability of 2.0 Bcf/day and 26.01 Tcf will be recovered at an annual average day deliverability of 2.4 Bcf/day after a two year build up period. The volumes of salable gas reflect the recovery at the time oil production was terminated. The salable gas volumes do not include recoveries during the blow-down phase of the production.

A report on the geology and estimated recoverable gas reserves of the North Slope (onshore) of Alaska, by Dr. James D. Lowell, is included herein under Tab 3.0 and identified as Exhibit H-3.

Whereas, Applicant proposes to be a transporter of shippers gas, section 157.14, Exhibit H, sub-sections (iii), (v), (vi) and (vii) are not applicable. It is anticipated that the information required for the deleted sub-sections will be filed by individual shippers upon consummation of gas purchase contracts with the producers.

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EXHIBIT H-2

GAS SUPPLY STUDY

SADLERECHIT RESERVOIR



ALCAN PIPELINE COMPANY  
DOCKET NO. CP76-\_\_\_\_\_  
EXHIBIT H-2  
HEARING EXHIBIT NO. \_\_\_\_\_

GAS SUPPLY STUDY  
SADLEROGHIT RESERVOIR  
PRUDHOE BAY FIELD  
STATE OF ALASKA

Prepared For

A L C A N   P I P E L I N E   C O M P A N Y

June 1976

Engineering and Consulting Department  
CORE LABORATORIES, INC.  
Dallas, Texas

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

This report presents the results of a reservoir study which utilized a two-dimensional, cross-sectional, three fluid-phase mathematical reservoir model to simulate the Sadlerochit reservoir in the Prudhoe Bay Field in Alaska. The basic purpose of the study was to evaluate the future gas supply from the Sadlerochit reservoir considering various operating alternatives and the accompanying effect upon the ultimate recovery of oil reserves. An economic evaluation of the results was not included in this work.

This study was made by the Engineering and Consulting Department of Core Laboratories, Inc. of Dallas, Texas upon the authorization of Mr. John McMillian, President of Alcan Pipeline Company of Salt Lake City, Utah.

Data utilized in the preparation of this report were furnished by Alcan Pipeline Company and also gathered from public records. The major sources of input data for the model study were the "In Place Volumetric Determination of Fluids - Sadlerochit Formation Prudhoe Bay Field" June, 1974 report and "Prediction of Reservoir Fluid Recovery - Sadlerochit Formation Prudhoe Bay Field - January 1976" prepared by H. K. van Poollen for the State of Alaska Department of Natural Resources.

## S U M M A R Y

A reservoir simulation model was used to generate production and injection data for 21 operating plans for the Sadlerochit reservoir, Prudhoe Bay Field, Alaska. Detailed annual data for these plans are presented in tabular form in Tables II through XXII, and graphically on Figs. 21 through 41, respectively.

Cases 1, 2 and 3 were run to evaluate the effects of the limited aquifer and water injection on oil recovery. Water influx and water injection were included in all subsequent cases which evaluated the effects of various oil production rates and gas sales.

An oil rate of 1.6 million barrels per day was used in each of the first three runs (Cases 1 through 3). For the gas sales cases, the maximum oil rates used were; 1.2, 1.6 and 2.0 million barrels per day. In all cases, an initial oil rate of 600 thousand barrels per day was used for the first 3 months of production. After the 3 months, the rate was increased to 1.2 million barrels per day, then later increased to 1.6 and 2.0 million barrels per day as required for the various cases.

Two types of gas sales schedules were used, constant sales rate and a gradual increase in gas sales volumes. In each case, gas sales commenced 3.5 years after oil production commenced.

In the cases which included water injection (Cases 3 through 21), the volume of water injected complemented the

natural water influx so that the pressure was maintained in the aquifer. The volumes of water injected as presented in Table XXIII varied from 0.518 million barrels per day with no gas sales to 1.592 million barrels per day with maximum gas sales. In all water injection cases, injection was started six years after oil production began.

Condensate recovery from the produced gas was not evaluated in this study. The recovery of condensate would enhance the total fluid recovery for the gas sales cases because of the earlier recovery of the liquids as compared to waiting until blowdown.

An overview of the findings of the study are presented below:

1. The range of oil recoveries from the cases evaluated varied from 8.36 billion barrels (42.8 percent of the original oil in place) to 5.96 billion barrels (30.5 percent).

The lowest oil recovery resulted with the case of the highest gas sales of 4 billion cubic feet per day with pressure maintenance.

The highest oil recovery occurred when all of the available gas was reinjected and pressure was maintained in the aquifer. The effect of factors such as liquid recovery for gas-cap processing, and power requirements to inject and recycle high gas volumes in the absences of gas sales were not considered in this study, but should be considered in the selection of the field operating plan.

2. The range of gas recoveries from cases considering gas sales varied from a low of 16.50 trillion cubic feet (39.42 percent) to a high of 29.02 trillion cubic feet (69.3 percent). The low recovery was from the case where gas sales were 1.2 billion cubic feet per day. The high value of gas recovery was for the sales rates of 3.0 and 4.0 billion cubic feet per day, which required a large volume of gas to be produced directly from the gas cap. In all cases, gas recoveries reflect the recovery at the time that oil production was terminated.

## CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations were based on the results of the twenty one operating plans presented in this report. The plans were selected to include a range of operating cases that may be considered as reasonable by the State of Alaska and the producers.

Because of a lack of pressures and production data, the performance predictions were based entirely on a theoretical reservoir simulation. While such a simulation technique is recognized as a reliable and accepted method of analysis, prediction values should not be considered to be absolute, but will provide a basis for reliable comparison of results to be expected from the operating plan that is implemented.

### Conclusions

1. The estimated in-place hydrocarbon volumes contained in the Sadlerochit reservoir are:

Oil	-	19.529 Billion barrels
Solution Gas	-	15.276 Trillion cubic feet
Gas-Cap Gas	-	26.578 Trillion cubic feet

2. Higher oil recoveries result from pressure maintenance by water injection.

3. The selection of an optimum operating plan will necessarily include economic factors. The operating limits



such as the limiting gas-oil ratios and gas sales rates may have to be adjusted based on the actual performance of the reservoir.

4. Highest volumes of gas sales resulted in lowest volumes of oil recovery. However, the oil recoveries resulting from no gas sales can be approached by a combination of limited gas sales, water injection and adjusting the field operating limits based on performance of the reservoir.

#### Recommendations

1. Monitor closely the early life pressure and production performance in order to evaluate the magnitude of the natural water influx.

2. If influx proves to be limited, start pressure maintenance of the reservoir by water injection during the early life of the field.

3. Each oil producer should be selectively perforated to take advantage of shale stringers in an attempt to minimize gas and water coning.

4. When evaluating the appropriate level for gas sales during the oil depletion period, consideration should also be directed toward the effect of recovering condensate from the gas-cap gas earlier, and the cost of equipment and fuel to reinject all of the produced gas.

5. After production begins, update the reservoir simulation studies to include performance data and modify operating limits to optimize recovery of the resources.

## D I S C U S S I O N

### GENERAL

The Prudhoe Bay Field was discovered in 1968 by the Atlantic Richfield Company. The Prudhoe Bay Field, as shown on Fig. 1, is located approximately 265 miles north of the Arctic Circle in the eastern portion of the Arctic Slope of Alaska and is the largest hydrocarbon accumulation thus far discovered on the North American continent. The structure of the large field is a westward plunging faulted anticline, limited on the east by an unconformity, faulting on the north and west, and an aquifer on the south. The geologic age of the producing reservoirs ranges from Mississippian to Jurassic. The Sadlerochit formation is a group of sandstones of early Triassic age and is the major hydrocarbon producing interval. The Sadlerochit is at a depth of approximately 8,000 to 9,000 ft subsea. The maximum oil and gas thicknesses of the zone are approximately 460 and 350 ft, respectively.

The Oil and Gas Conservation Committee of the State of Alaska has designated the Prudhoe Oil Pool to include the Sag River, Shublik, and the Sadlerochit reservoirs. Because the Sag River and Shublik reservoirs are of minor significance as compared to the Sadlerochit reservoir, only the hydrocarbons contained in the Sadlerochit have been included in this study. Likewise, the condensate contained in the associated gas-cap gas of the Sadlerochit reservoir

is minor compared to the oil volume and has not been included in this study.

Most of the geological interpretation, volumetric data, fluid distribution, and reservoir rock and fluid properties used in this reservoir study were obtained from van Poollen's prior work. An independent effort was made by Core Laboratories' engineers and geologists to verify the information; however, only the basic data in van Poollen's reports of June, 1974 and January, 1976 were available. Some minor variations in interpretation of these data resulted and were utilized in this study.

#### GEOLOGY

A stratigraphic column of the Prudhoe Bay Field is represented in Fig. 2. The basement formation at Prudhoe Bay is the pre-Mississippian Neruokpuk Formation. Overlying the Neruokpuk are two sequences of sedimentary rocks. In ascending order the lower sequence is made up of the Kekiktuk Conglomerate, Kayak Shale, Itkilyariak, and the Lisburne Group carbonates, which contain the Lisburne Pool, the lowest defined oil reservoir in the field. Following are the Sadlerochit, Shublik, and Sag River formations which are considered the most important hydrocarbon-bearing reservoirs in the Prudhoe Bay Field. Next are the Kingak Shale and the Kuparuk River sand which is the youngest unit in the lower sequence and the shallowest defined hydrocarbon-bearing zone in the field.

The upper sequence is made up mostly of nonmarine and marine clastics. In ascending order the formations included are as follows: an unnamed shale, the Seabee, the Prince Creek and Schrader Bluff, the Sagavanirktok, and the Gubik. The rocks in the upper sequence range in geological age from Early Cretaceous through Quaternary.

The upper sequence overlies the truncated lower sequence with the lower sequence forming a westward-plunging faulted anticlinal nose, with local structural closure in the western portion of the field. The hydrocarbons are trapped in the lower sequence by a combination of structural and stratigraphic traps. Fig. 3 presents a schematic geological east-west cross section of the field.

The Prudhoe Oil Pool has been defined by the Oil and Gas Conservation Committee of the State of Alaska, in Conservation Order No. 98-B, to include from top to bottom, the Sag River Sandstone, the Shublik, and the sandstone unit of the Ivishak Member of the Sadlerochit Formation. This reservoir simulation includes only the sandstone unit of the Ivishak Member of the Sadlerochit Formation, hereafter referred to as the Sadlerochit reservoir.

The Sadlerochit reservoir is of early Triassic geologic age and is considered to be of deltaic depositional environment. The reservoir varies in gross thickness from more than 600 ft in the central and southern portions of the field to approximately 300 ft in the extreme northeastern area. The lithology of the zone is mostly sand and conglomerate with

limited amounts of silt and shale. For this study, the Sadlerochit reservoir was divided into three basic zones (Upper, Middle, and Lower) on the basis of stratigraphy and rock properties defined from well logs.

The hydrocarbons in the Sadlerochit reservoir are trapped by faults, truncation of rock, and an oil-water contact. Fig. 4 presents a structure map contoured on top of the Upper Zone and Fig. 5 is a structure map contoured on the base of the Lower Zone. The fault pattern is based primarily on the structure maps previously presented by the operators at a public hearing. The interior faults are considered to be non-sealing to fluid movement.

#### RESERVOIR ROCK PROPERTIES

The reservoir rock properties used to determine the reservoir volumes and flow capacity were in general taken from van Poollen's work and verified where available data allowed.

##### Porosity

The porosity values used were determined from sonic log calculations. A correlation with core analysis porosity was established and used in the calculations. The resulting average porosities by zone are as follows:

<u>Zone</u>	<u>Average Porosity, percent</u>
Upper	23.56
Middle	20.17
Lower	21.07

### Absolute Permeability

The horizontal permeability used in the simulator was based on core analysis and flow tests, averaged 200 millidarcies. The vertical permeability used was 20 millidarcies. The horizontal permeabilities in a portion of the Upper and Middle Zones were increased by factors ranging from 3 to 5, based on variations in the core and flow tests.

### Rock Compressibility

A value of  $3.4 \times 10^{-6}$  psi<sup>-1</sup> was used in the model for the reservoir rock compressibility and was determined from porosity compaction tests.

### Relative Permeability

The relative permeability was determined from averaging data available from laboratory special core analysis tests.

Relative permeability to oil curves were developed for the area in the reservoir near the gas-oil contact and near the oil-water contact, as shown on Figs. 6 and 7, respectively. Relative permeability curves used in the model for gas-to-gas saturation and water-to-water saturation are shown on Figs. 8 and 9, respectively.

Van Poollen reported that the residual oil saturations behind the advancing aquifer or water injection front and advancing gas-cap gas were based on an extensive study of special core analysis studies. The values that are considered to be representative and used in this model study were 23.0

percent behind the water invaded zone and 32.0 percent behind the gas invaded zone. These residual values greatly influence the final oil recovery values obtained under the various operating plans.

#### Water Saturation

The irreducible water saturation was determined to be 19.0 percent and was based on log calculations. The interstitial water saturation distribution in the reservoir was based on capillary pressure data that were derived from log analysis.

#### FLUID CONTACTS

##### Gas-Oil Contact

The gas-oil contact in the Sadlerochit reservoir was determined by analyzing the Sidewall Neutron Porosity log in conjunction with the Borehole Compensated Sonic log. The contact was found to be a horizontal surface at 8,580 ft subsea.

##### Oil-Water Contact

The resistivity curves of the Dual Induction Laterolog were used to pick the oil-water contact. Although the contact varied somewhat over the field, probably resulting from changes in reservoir rock properties and capillarity, an average oil-water contact level was picked at 9,020 ft subsea for use in the model.

#### NET PAY DETERMINATION

The Sadlerochit reservoir is made up of sands and conglomerates with some interbedding of shale and silt. The

thickness of shale and silt beds, determined by examining the Spontaneous and Gamma Ray surveys, and were not considered to be net pay.

#### RESERVOIR TEMPERATURE AND PRESSURE

Reservoir temperature is described in the reservoir simulator for any given depth by the equation:

$$T(^{\circ}\text{F}) = 200^{\circ}\text{F} + 0.024^{\circ}\text{F}/\text{ft} [\text{Depth (ft ss)} - 8,620 \text{ ft}]$$

A plot of this relationship is shown on Fig. 10.

Reservoir pressure is described in the reservoir simulator for any given depth between the gas-oil and oil-water contacts by the equation:

$$P(\text{psig}) = 4,265 \text{ psig} + 0.31 \text{ psi}/\text{ft} [\text{Depth (ft ss)} - 8,400 \text{ ft}]$$

A plot of this relationship is shown on Fig. 11.

#### RESERVOIR FLUID PROPERTIES

The reservoir fluid properties for oil, gas, and water were taken from van Poollen's prior work. No original data were available for analysis. The oil properties were developed for six depth intervals between the gas-oil and oil-water contacts. These properties include the formation volume factor, solution gas-oil ratio and viscosity values as a function of pressure. Plots of these properties that were used in the model are shown on Figs. 12 through 17, respectively. The gas formation volume factor and viscosity plots versus pressure are shown on Fig. 18.

Water properties were based on published correlations using the following parameters:



Salinity	-	19,125 ppm
Pressure Range	-	0 - 5,000 psig
Temperature	-	210 °F

A plot of the water formation volume factor versus pressure is shown on Fig. 19.

#### HYDROCARBONS INITIALLY IN PLACE

Utilizing the basic data discussed above, the resulting hydrocarbons initially in place in the Sadlerochit reservoir are as follows:

Oil	-	19.529 Billion barrels
Solution Gas	-	15.276 Trillion cubic feet
Gas-Cap Gas	-	26.578 Trillion cubic feet

These volumes were used in the reservoir simulator.

#### RESERVOIR SIMULATION MODEL

The reservoir simulator used for this model study was a two-dimensional, cross-sectional, three fluid-phase mathematical simulator. The cross section included was oriented to reflect the configuration of the reservoir. A total of eight layers were used. Layers 1 through 4 were configured to the properties of the Upper and Middle Zones. The Bottom Zone was divided into four layers. Using the eight layers made it possible to more accurately describe the oil and water saturations in the model. Each of the layers were represented in 21 concentric cells, which simulated the structural configuration of the Sadlerochit reservoir as illustrated on Fig. 20.

The production capacity was distributed in relation to the volume of oil originally in place. Theoretical well productivity indices were calculated based on the reservoir rock and fluid properties and appeared reasonable.

The model included the capability of tracking the advancing gas cap and/or aquifer and taking into account the resulting changes in fluid saturations in the perforated interval. These saturations were then related to the relative permeability relationships which prescribed the gas-oil ratio and water-cut producing performance. As well workovers were required to reduce gas and water production beyond limiting conditions, the productivity indices in the wells were reduced in proportion to the amount of perforated interval remaining open.

The basic input data for the model were taken from van Poollen's prior work with some minor changes in interpretation made.

#### GENERAL OPERATING GUIDELINES

The guidelines that were generally applied to the operating programs considered were in the most part those set out by van Poollen's work reported in January, 1976. These guidelines seemed reasonable and may approximate future procedures.

In all operating alternatives considered the following conditions were adhered to:

1. Oil producing rates were:
  - 7-1-77 to  
10-1-77                -        0.600 Million B/D
  - 10-1-77 to  
12-31-78              -        1.200 Million B/D
  - 1-1-79 till        -        ranged from 1.2 to 2.0  
decline                      Million B/D
2. Oil wells were completed by perforating the center 80 percent of the oil zone between the gas-oil and oil-water contacts.
3. Two recompletions were allowed prior to abandonment because of excessive gas and/or water production. The first recompletion reduced the perforated interval to 40 percent of the original interval and the second recompletion reduced the remaining interval to 75 percent, either from the top or bottom, depending if gas or water limits were being exceeded.
4. The limiting water cut was 75 percent.
5. The limiting gas-oil ratio was 15,000 scf/B.
6. For cases considering no gas sales, 92 percent of the produced gas was reinjected with 8 percent assumed to be used as fuel.
7. For cases considering gas sales, the sales gas volumes equalled the produced gas volumes reduced by 12 percent to account for the removal of CO<sub>2</sub> and 100 x 10<sup>6</sup> scf/D assumed to be used for field fuel.

8. In cases considering pressure maintenance, it was assumed that the pressure in the aquifer would be maintained from the time injection was begun. With essentially no field performance available it is not known how much water injection will be required. It was assumed that a combination of water influx and injection would maintain the pressure.
9. The maximum bottom-hole pressure drawdown was restricted to 750 psig.
10. A field economic limit of approximately 100,000 B/D was used in all cases.

#### DEFINITION OF OPERATING ALTERNATIVES CONSIDERED

After the basic data were input in the model and the in-place hydrocarbon volumes were verified, a run was made that allowed an overall energy check of Core Lab's model as compared to van Poollen's model. With the model in a past history matching mode, the oil, gas, and water withdrawals from one of van Poollen's cases were simulated as being produced from Core Lab's model. The resulting reservoir pressure performance was very similar to van Poollen's results. This was expected and in essence generally verified van Poollen's results.

The following discussion presents a description of the operating alternatives that were considered during this model study. The results are summarized in Table I.

Case 1

No aquifer, no water injection, no gas sales, maximum oil rate of 1.6 Million B/D.

Case 2

With aquifer, no water injection, no gas sales and a maximum oil rate of 1.6 Million B/D.

Case 3

With aquifer, water injection, no gas sales and a maximum oil rate of 1.6 Million B/D.

Case 4

With aquifer, water injection, gas sales at a maximum sales rate of 2.25 Bcf/D, and a maximum oil rate of 1.2 Million B/D.

Case 5

With aquifer, water injection, maximum gas sales of 2.25 Bcf/D, with a maximum oil rate of 1.6 Million B/D.

Case 6

With aquifer, water injection, maximum gas sales of 2.25 Bcf/D, with a maximum oil rate of 2.0 Million B/D.

Case 7

With aquifer, with water injection, maximum gas sales of 2.40 Bcf/D, and a maximum oil rate of 1.2 Million B/D.

Case 8

With aquifer, with water injection, maximum gas sales of 2.4 Bcf/D and a maximum oil rate of 1.6 Million B/D.

Case 9

With aquifer, with water injection, maximum gas sales of 2.4 Bcf/D and a maximum oil rate of 2.0 Million B/D.

Case 10

With aquifer, with water injection, maximum gas sales of 1.2 Bcf/D and a maximum oil rate of 1.2 Million B/D.

Case 11

With aquifer, with water injection, maximum gas sales of 1.6 Bcf/D and a maximum oil rate of 1.2 Million B/D.

Case 12

With aquifer, with water injection, maximum gas sales of 1.8 Bcf/D and a maximum oil rate of 1.2 Million B/D.

Case 13

With aquifer, with water injection, maximum gas sales of 2.0 Bcf/D and a maximum oil rate of 1.2 Million B/D.

Case 14

With aquifer, with water injection, maximum gas sales of 3.0 Bcf/D and a maximum oil rate of 1.2 Million B/D.

Case 15

With aquifer, with water injection, maximum gas sales of 4.0 Bcf/D and a maximum oil rate of 1.2 Million B/D.

Case 16

With aquifer, with water injection, maximum gas sales of 1.2 Bcf/D and a maximum oil rate of 1.6 Million B/D.

Case 17

With aquifer, with water injection, maximum gas sales of 1.6 Bcf/D and a maximum oil rate of 1.6 Million B/D.

Case 18

With aquifer, with water injection, maximum gas sales of 1.8 Bcf/D and a maximum oil rate of 1.6 Million B/D.

#### Case 19

With aquifer, with water injection, maximum gas sales of 2.0 Bcf/D and a maximum oil rate of 1.6 Million B/D.

#### Case 20

With aquifer, with water injection, maximum gas sales of 3.0 Bcf/D and a maximum oil rate of 1.6 Million B/D.

#### Case 21

With aquifer, with water injection, maximum gas sales of 4.0 Bcf/D and a maximum oil rate of 1.6 Million B/D.

### DISCUSSION OF RESULTS

The three operating alternatives which considered no sale of produced gas, Cases 1, 2, and 3, yielded ultimate oil recoveries that range from 6.53 Billion barrels (33.5 percent) with no aquifer or water injection to 8.36 Billion barrels (42.8 percent) including a limited aquifer and water injection. This trend is to be expected and agrees with prior published studies. This being the case, all other operating plans that were considered included the effect of a limited aquifer and water injection in an attempt to maximize oil recovery. The detailed results of Cases 1, 2, and 3 are shown in Tables II, III, and IV and on Figs. 21, 22, and 23, respectively.

There were a total of 18 cases that considered the operating alternative of gas sales. Two groups of cases, with three cases in each group, considered maximum oil rates of 1.2, 1.6, and 2.0 Million B/D with a maximum sales gas rate of 2.25 Bcf/D for one group and 2.40 Bcf/D for the other group. Of these six cases, the highest ultimate oil

recovery of 7.31 Billion barrels (37.4 percent) resulted from the lowest gas sales and oil rates of 2.25 Bcf/D and 1.2 Million B/D, respectively. The lowest ultimate oil recovery of 7.04 Billion barrels (36.1 percent) resulted from the highest gas sales and oil rates of 2.40 Bcf/D and 2.0 Million B/D, respectively. The detailed results of these six cases are presented in Tables IV through X and on Figs. 24 through 29, respectively.

Another group of cases that considered gas sales amounted to six additional cases. In this group the maximum gas sales rate ranged from 1.2 to 4.0 Bcf/D with the maximum oil rate being 1.2 Million B/D. The highest ultimate oil recovery from this group was 7.72 Billion barrels (39.5 percent) for the operating program of lowest gas sales rate of 1.2 Bcf/D. The lowest ultimate oil recovery from this group of cases was 5.96 Billion barrels (30.5 percent) for the operating plan of the highest gas sales rate of 4.0 Bcf/D. The detailed results of these six cases are presented in Tables XI through XVI and on Figs. 30 through 35, respectively.

An additional group of six cases was run that considered gas sales ranging from 1.2 to 4.0 Bcf/D with a maximum oil rate of 1.6 Million B/D. The highest ultimate oil recovery from this group was 7.68 Billion barrels (39.3 percent) for the operating plan of the lowest gas sales rate of 1.2 Bcf/D. The lowest ultimate oil recovery from this group of cases was 6.23 Billion barrels (31.9 percent) for the case with the highest gas sales rate of 4.0 Bcf/D. The detailed results of these



six cases are presented in Tables XVII through XXII and on Figs. 36 through 41, respectively.

From the above discussed eighteen cases which include the sale of gas produced from the oil column wells and also gas produced from the gas-cap wells, if required to make the prescribed gas sales rate, the maximum ultimate oil recovery was 7.72 Billion barrels (39.5 percent). This operating program included the lowest gas sales rate of 1.2 Bcf/D and the lowest oil rate of 1.2 Million B/D. This operating plan also recovered the minimum gas volume of 16.50 Trillion cubic feet (39.4 percent) of the eighteen cases considered.

The lowest ultimate oil recovery from the eighteen gas sales cases was 5.96 Billion barrels (30.5 percent). This resulted from the case considering the highest gas sales rate of 4.0 Bcf/D and an oil rate of 1.2 Million B/D.

Ultimate gas recoveries varied from a low range of 16 to 17 Trillion cubic feet (40.0 percent) to a high range of 28 to 29 Trillion cubic feet (69.0 percent). As would be expected, the lower gas recoveries accompanied the lowest gas sales rate of 1.2 Bcf/D and the higher recoveries were from the higher gas sales rate of 3.0 and 4.0 Bcf/D. In all cases, gas recoveries reflect the recovery at the time that oil production was terminated. In actual operation, the difference in gas recoveries will be reduced by production during the blowdown phase.

# N O M E N C L A T U R E

$K_{ro}$	Relative permeability to oil fraction
$S$ and $S_{or}$	Residual oil saturation, percent of pore volume
$S_o$	Oil saturation, percent of pore volume
$K_{rg}$	Relative permeability to gas, fraction
$S_g$	Gas saturation, percent of pore volume
$S_{gr}$	Critical gas saturation, percent of pore volume
$K_{rw}$	Relative permeability to water, fraction
$S_w$	Water saturation, percent of pore volume
$S_{wc}$	Irreducible water saturation, fraction of pore volume
$B_o$	Oil formation volume factor, reservoir barrels per stock-tank barrel
$\mu_o$	Oil viscosity, centipoise
$cp$	Centipoise
$R_s$	Solution gas-oil ratio, standard cubic feet per stock-tank barrel
$B_g$	Gas formation volume factor, reservoir cubic feet per standard cubic feet
$\mu_g$	Gas viscosity, centipoise
$B_w$	Water formation volume factor, reservoir barrels per stock-tank barrel
$B/D$	Barrels per day
$scf/D$	Standard cubic feet per day
$Bcf/D$	Billion cubic feet per day
$Tcf$	Trillion cubic feet

## L I S T O F T A B L E S

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TABLE I  
SUMMARY OF SIMULATION RESULTS  
Sadlerochit Reservoir  
Prudhoe Bay Field

Case	Maximum Gas Sales MMMscf/D	Maximum Oil Rate MMSTB/D	Producing Life Years	Ultimate Oil Recovery MMSTB	Cumulative Gas Produced MMMscf	Cumulative Gas Injected MMMscf	Cumulative Gas Recovery MMMscf	Ultimate Oil Recovery % OIP	Cumulative Gas Recovery % GIIP
1	0.00	1.6	35	6.53	11.24	10.34	0.90	33.46	2.15
2	0.00	1.6	39	7.61	12.23	11.25	0.98	38.95	2.34
3	0.00	1.6	39	8.36	11.83	10.88	0.95	42.81	2.26
4	2.25	1.2	34	7.31	30.12	1.86	28.26	37.43	67.52
5	2.25	1.6	32	7.25	29.26	2.86	26.40	37.15	63.09
6	2.25	2.0	31	7.10	28.89	3.41	25.48	36.37	60.89
7	2.40	1.2	34	7.13	31.88	1.84	30.04	36.52	71.78
8	2.40	1.6	31	7.16	29.60	2.78	27.02	36.65	64.58
9	2.40	2.0	31	7.04	30.29	3.22	27.06	36.06	64.67
10	1.20	1.2	35	7.72	18.71	2.21	16.50	39.52	39.42
11	1.60	1.2	35	7.57	23.42	1.89	21.53	38.76	51.45
12	1.80	1.2	34	7.38	25.44	2.14	23.30	37.79	55.68
13	2.00	1.2	34	7.27	27.55	1.82	25.73	37.24	61.47
*14	3.00	1.2	27	6.63	30.54	1.57	28.98	33.93	69.23
*15	4.00	1.2	21	5.96	29.70	1.57	28.13	30.51	67.22
16	1.20	1.6	35	7.68	21.01	4.33	16.68	39.31	39.86
17	1.60	1.6	33	7.37	23.53	3.28	20.25	37.74	48.39
18	1.90	1.6	33	7.27	25.62	3.03	22.59	37.22	53.99
19	2.00	1.6	32	7.31	26.85	2.77	24.07	37.44	57.52
*20	3.00	1.6	27	6.71	31.10	2.08	29.02	34.35	69.34
*21	4.00	1.6	21	6.23	30.16	1.99	28.17	31.90	67.31

NOTE: 1. All cases except 1 and 2 included influx and water injection. Case 1 had no influx or water injection and Case 2 had influx only.  
2. No gas sales, 92% of gas returned to cap.

3. With gas sales, actual gas withdrawal is:  
1.46 BCF/D with sales of 1.2 BCF/D  
1.80 BCF/D with sales of 1.5 BCF/D  
1.92 BCF/D with sales of 1.6 BCF/D  
2.15 BCF/D with sales of 1.8 BCF/D  
2.37 BCF/D with sales of 2.0 BCF/D  
2.66 BCF/D with sales of 2.25 BCF/D  
2.83 BCF/D with sales of 2.4 BCF/D  
3.51 BCF/D with sales of 3.0 BCF/D  
4.65 BCF/D with sales of 4.0 BCF/D

Excess for CO<sub>2</sub> and Fuel

\* Shut-in because pressure in gas cap became too low.

# DETAILED RESULTS OF CASE 1

NO AQUIFER  
GAS INJECTION

NO WATER INJECTION  
NO GAS SALES

AVERAGE RATES FOR YEAR											CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE		
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %	
MMSTB DAY	MMMSCF/DAY					SCF STB	MB DAY	%	10 <sup>3</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA				
1	1.050	.974	.000	.974	.896	.078	928	0.	.0	.384	.356	.000	.356	.327	.029	0.	4199	1.97	.07	
2	1.540	1.912	.000	1.912	1.759	.153	1275	5.	.3	.931	1.054	.000	1.054	.970	.084	2.	4051	4.77	.20	
3	1.600	2.437	.000	2.437	2.242	.195	1523	24.	1.5	1.516	1.944	.000	1.944	1.789	.155	11.	3915	7.76	.37	
4	1.600	2.513	.000	2.513	2.312	.201	1571	66.	4.0	2.100	2.862	.000	2.862	2.633	.229	35.	3794	10.75	.55	
5	1.600	3.510	.000	3.510	3.230	.280	2194	134.	7.7	2.685	4.144	.000	4.144	3.813	.331	84.	3641	13.75	.79	
6	1.501	3.545	.000	3.545	3.261	.284	2362	202.	11.9	3.233	5.439	.000	5.439	5.004	.435	157.	3538	16.55	1.04	
7	1.168	2.370	.000	2.370	2.181	.189	2029	150.	11.4	3.660	6.305	.000	6.305	5.801	.504	212.	3478	18.74	1.20	
8	.910	2.927	.000	2.927	2.693	.234	3216	159.	14.9	3.992	7.374	.000	7.374	6.784	.590	270.	3415	20.44	1.41	
9	.723	1.420	.000	1.420	1.306	.114	1964	198.	21.5	4.256	7.892	.000	7.892	7.261	.631	342.	3392	21.79	1.51	
10	.669	1.321	.000	1.321	1.215	.106	1975	170.	20.3	4.500	8.375	.000	8.375	7.705	.670	404.	3351	23.04	1.60	
11	.570	1.694	.000	1.694	1.559	.135	2972	172.	23.2	4.708	8.994	.000	8.994	8.274	.720	467.	3310	24.11	1.72	
12	.462	.515	.000	.515	.474	.041	1115	128.	21.7	4.877	9.182	.000	9.182	8.447	.735	514.	3302	24.97	1.76	
13	.362	.710	.000	.710	.654	.056	1961	33.	8.4	5.010	9.441	.000	9.441	8.686	.755	526.	3285	25.65	1.80	
14	.319	.315	.000	.315	.289	.026	987	54.	14.5	5.126	9.556	.000	9.556	8.792	.764	545.	3274	26.25	1.83	
15	.307	.384	.000	.384	.354	.030	1251	66.	17.7	5.238	9.697	.000	9.697	8.921	.776	570.	3258	26.82	1.85	
16	.284	.464	.000	.464	.427	.037	1634	77.	21.3	5.342	9.866	.000	9.866	9.077	.789	598.	3241	27.35	1.89	
17	.251	.338	.000	.338	.311	.027	1347	73.	22.5	5.434	9.990	.000	9.990	9.191	.799	624.	3229	27.83	1.91	
18	.234	.230	.000	.230	.212	.018	983	59.	20.1	5.519	10.074	.000	10.074	9.268	.806	646.	3218	28.26	1.93	
19	.226	.268	.000	.268	.246	.022	1186	65.	22.3	5.602	10.172	.000	10.172	9.358	.814	670.	3205	28.69	1.94	
20	.215	.288	.000	.288	.265	.023	1340	72.	25.1	5.680	10.277	.000	10.277	9.455	.822	696.	3194	29.08	1.96	
21	.207	.192	.000	.192	.176	.016	928	70.	25.3	5.756	10.347	.000	10.347	9.519	.828	722.	3183	29.47	1.98	
22	.206	.191	.000	.191	.176	.015	927	53.	20.5	5.831	10.417	.000	10.417	9.584	.833	741.	3173	29.86	1.99	
23	.200	.199	.000	.199	.183	.016	995	56.	21.9	5.904	10.490	.000	10.490	9.650	.840	761.	3162	30.23	2.01	
24	.195	.193	.000	.193	.177	.016	990	58.	22.9	5.975	10.560	.000	10.560	9.715	.845	782.	3153	30.60	2.02	
25	.194	.192	.000	.192	.176	.016	990	61.	23.9	6.046	10.630	.000	10.630	9.780	.850	805.	3143	30.96	2.03	
26	.191	.259	.000	.259	.238	.021	1356	66.	25.7	6.116	10.724	.000	10.724	9.867	.857	829.	3131	31.32	2.05	
27	.182	.192	.000	.192	.177	.015	1055	69.	27.5	6.183	10.795	.000	10.795	9.931	.864	854.	3122	31.66	2.06	
28	.151	.235	.000	.235	.216	.019	1556	35.	18.8	6.238	10.881	.000	10.881	10.010	.871	867.	3116	31.94	2.08	
29	.134	.237	.000	.237	.218	.019	1769	30.	18.3	6.287	10.967	.000	10.967	10.090	.877	878.	3109	32.19	2.10	
30	.119	.138	.000	.138	.127	.011	1160	34.	22.2	6.330	11.018	.000	11.018	10.136	.882	890.	3105	32.41	2.11	
31	.118	.114	.000	.114	.105	.009	966	36.	23.4	6.373	11.059	.000	11.059	10.175	.884	904.	3099	32.63	2.11	
32	.114	.112	.000	.112	.103	.009	982	29.	20.3	6.415	11.100	.000	11.100	10.212	.888	914.	3094	32.85	2.12	
33	.111	.109	.000	.109	.100	.009	982	24.	17.8	6.455	11.140	.000	11.140	10.249	.891	923.	3089	33.05	2.13	
34	.111	.111	.000	.111	.102	.009	1000	26.	19.0	6.496	11.180	.000	11.180	10.286	.894	933.	3084	33.26	2.14	
35	.104	.155	.000	.155	.143	.012	1490	22.	17.5	6.534	11.237	.000	11.237	10.338	.899	941.	3079	33.46	2.15	

TABLE II

# DETAILED RESULTS OF CASE 2

AQUIFER

NO WATER INJECTION

GAS INJECTION

NO GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL	TOTAL GAS
	MMSTB DAY	MMMSCF / DAY					SCF STB	MB DAY	%	10 <sup>9</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA	%	%
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07
2	1.500	1.918	.000	1.918	1.765	.153	1279	11.	.7	.931	1.056	.000	1.056	.971	.085	4.	4095	4.77	.20
3	1.600	2.022	.000	2.022	1.861	.161	1264	56.	3.4	1.516	1.795	.000	1.795	1.651	.144	24.	4002	7.76	.34
4	1.600	3.248	.000	3.248	2.988	.260	2030	139.	8.0	2.100	2.981	.000	2.981	2.742	.239	75.	3861	10.75	.57
5	1.600	1.515	.000	1.515	1.394	.121	947	206.	11.4	2.685	3.534	.000	3.534	3.251	.283	151.	3804	13.75	.68
6	1.600	3.925	.000	3.925	3.611	.314	2453	212.	11.7	3.269	4.968	.000	4.968	4.570	.398	228.	3658	16.74	.95
7	1.436	2.759	.000	2.759	2.538	.221	1921	330.	18.7	3.793	5.976	.000	5.976	5.497	.479	349.	3613	19.42	1.14
8	1.164	2.172	.000	2.172	1.998	.174	1866	205.	15.0	4.219	6.769	.000	6.769	6.227	.542	423.	3572	21.60	1.30
9	.900	1.106	.000	1.106	1.018	.088	1229	144.	13.8	4.547	7.173	.000	7.173	6.599	.574	476.	3530	23.28	1.37
10	.789	1.659	.000	1.659	1.526	.133	2103	120.	13.2	4.836	7.779	.000	7.779	7.156	.623	520.	3483	24.76	1.49
11	.693	1.369	.000	1.369	1.260	.109	1975	131.	15.9	5.089	8.279	.000	8.279	7.616	.663	567.	3449	26.06	1.58
12	.637	1.401	.000	1.401	1.289	.112	2199	128.	16.7	5.321	8.790	.000	8.790	8.087	.703	614.	3414	27.25	1.68
13	.579	1.656	.000	1.656	1.523	.133	2860	146.	20.1	5.533	9.395	.000	9.395	8.644	.751	667.	3380	28.33	1.79
14	.458	.594	.000	.594	.546	.048	1297	165.	26.5	5.700	9.612	.000	9.612	8.843	.769	728.	3367	29.19	1.84
15	.417	1.000	.000	1.000	.920	.080	2398	182.	30.4	5.853	9.977	.000	9.977	9.179	.798	794.	3337	29.97	1.91
16	.371	.880	.000	.880	.809	.071	2372	166.	30.9	5.988	10.299	.000	10.299	9.475	.824	855.	3323	30.66	1.97
17	.344	.426	.000	.426	.392	.034	1238	146.	29.8	6.114	10.454	.000	10.454	9.618	.836	908.	3306	31.31	2.00
18	.333	.336	.000	.336	.309	.027	1009	139.	29.4	6.236	10.577	.000	10.577	9.731	.846	959.	3287	31.93	2.02
19	.306	.468	.000	.468	.431	.037	1529	140.	31.4	6.347	10.748	.000	10.748	9.888	.860	1010.	3269	32.50	2.05
20	.290	.586	.000	.586	.539	.047	2021	142.	32.9	6.453	10.962	.000	10.962	10.085	.877	1062.	3248	33.04	2.10
21	.269	.396	.000	.396	.364	.032	1472	147.	35.3	6.552	11.106	.000	11.106	10.218	.888	1115.	3238	33.55	2.12
22	.263	.232	.000	.232	.214	.018	882	136.	34.1	6.648	11.191	.000	11.191	10.296	.895	1165.	3224	34.04	2.14
23	.259	.252	.000	.252	.231	.021	973	125.	32.6	6.742	11.283	.000	11.283	10.380	.903	1211.	3209	34.52	2.16
24	.252	.229	.000	.229	.211	.018	909	120.	32.3	6.834	11.367	.000	11.367	10.458	.909	1255.	3197	34.99	2.17
25	.257	.266	.000	.266	.245	.021	1035	71.	21.6	6.928	11.464	.000	11.464	10.547	.917	1281.	3184	35.48	2.19
26	.231	.315	.000	.315	.290	.025	1364	64.	21.7	7.013	11.579	.000	11.579	10.653	.926	1304.	3175	35.91	2.21
27	.155	.189	.000	.189	.174	.015	1219	29.	15.8	7.069	11.648	.000	11.648	10.716	.932	1315.	3170	36.20	2.23
28	.145	.223	.000	.223	.206	.017	1538	30.	17.1	7.122	11.730	.000	11.730	10.791	.939	1326.	3163	36.47	2.24
29	.133	.168	.000	.168	.155	.013	1263	34.	20.4	7.171	11.791	.000	11.791	10.848	.943	1338.	3158	36.72	2.25
30	.132	.122	.000	.122	.112	.010	924	38.	22.4	7.219	11.836	.000	11.836	10.889	.947	1352.	3153	36.97	2.26
31	.131	.117	.000	.117	.108	.009	893	41.	23.8	7.267	11.879	.000	11.879	10.928	.951	1367.	3147	37.21	2.27
32	.130	.117	.000	.117	.108	.009	900	44.	25.3	7.314	11.921	.000	11.921	10.968	.953	1383.	3141	37.45	2.28
33	.129	.123	.000	.123	.113	.010	953	47.	26.7	7.361	11.966	.000	11.966	11.009	.957	1400.	3135	37.69	2.29
34	.121	.154	.000	.154	.142	.012	1273	45.	27.1	7.406	12.023	.000	12.023	11.061	.962	1416.	3129	37.92	2.30
35	.118	.107	.000	.107	.098	.009	907	47.	28.5	7.449	12.062	.000	12.062	11.097	.965	1434.	3124	38.14	2.31
36	.117	.124	.000	.124	.114	.010	1060	50.	29.9	7.491	12.107	.000	12.107	11.138	.969	1452.	3118	38.36	2.32
37	.109	.109	.000	.109	.100	.009	1000	52.	32.3	7.531	12.147	.000	12.147	11.175	.972	1471.	3113	38.56	2.32
38	.107	.103	.000	.103	.095	.008	963	51.	32.3	7.570	12.184	.000	12.184	11.210	.974	1490.	3107	38.76	2.33
39	.098	.120	.000	.120	.111	.009	1224	36.	26.9	7.606	12.229	.000	12.228	11.250	.978	1503.	3103	38.95	2.34
40	.094	.087	.000	.087	.080	.007	926	37.	28.2	7.640	12.260	.000	12.260	11.279	.981	1516.	3100	39.12	2.34

TABLE III

# DETAILED RESULTS OF CASE 3

AQUIFER

WITH WATER INJECTION

GAS INJECTION

NO GAS SALES

AVERAGE RATES FOR YEAR

CUMULATIVES TO YEAR END

YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
MMSTB DAY	MMMSCF/DAY					SCF STB	MB DAY	%	10 <sup>8</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA			
1	1.690	1.012	.000	1.012	.931	.081	964	0.	.0	.384	.369	.000	.369	.340	.029	0.	4215	1.97	.07
2	1.500	1.861	.000	1.861	1.712	.149	1241	15.	1.0	.931	1.049	.000	1.049	.965	.084	5.	4094	4.77	.20
3	1.600	2.065	.000	2.065	1.906	.165	1291	69.	4.1	1.516	1.803	.000	1.803	1.659	.144	30.	3995	7.75	.34
4	1.500	3.614	.000	3.614	3.324	.290	2259	163.	9.2	2.100	3.123	.000	3.123	2.877	.250	90.	3862	10.75	.60
5	1.600	1.719	.000	1.719	1.581	.138	1074	157.	8.9	2.685	3.751	.000	3.751	3.451	.300	147.	3794	17.75	.72
6	1.599	4.027	.000	4.027	3.705	.322	2520	270.	14.5	3.268	5.222	.000	5.222	4.804	.418	246.	3674	16.73	1.00
7	1.407	3.143	.000	3.143	2.891	.252	2234	406.	22.4	3.782	6.370	.000	6.370	5.860	.510	394.	3575	19.37	1.22
8	1.340	2.501	.000	2.501	2.301	.200	2002	316.	20.2	4.238	7.283	.000	7.283	6.700	.583	509.	3537	21.70	1.39
9	1.273	1.706	.000	1.706	1.569	.137	1594	221.	17.1	4.629	7.906	.000	7.906	7.274	.632	590.	3639	23.70	1.51
10	1.135	1.231	.000	1.231	1.132	.099	1315	301.	24.3	4.971	8.756	.000	8.756	7.687	.669	700.	3631	25.45	1.60
11	.452	.779	.000	.778	.715	.063	913	280.	24.7	5.282	8.640	.000	8.640	7.949	.691	802.	3616	27.05	1.65
12	.760	1.454	.000	1.454	1.337	.117	1898	177.	18.8	5.562	9.171	.000	9.171	8.437	.734	867.	3601	28.68	1.75
13	.660	1.227	.000	1.227	1.129	.098	1859	197.	22.6	5.403	9.619	.000	9.619	8.849	.770	938.	3605	29.71	1.84
14	.557	.548	.000	.548	.504	.044	966	266.	31.9	6.010	9.819	.000	9.819	9.034	.785	1075.	3616	30.77	1.88
15	.459	.427	.000	.427	.393	.034	910	284.	37.7	6.181	9.975	.000	9.975	9.177	.798	1139.	3516	31.65	1.91
16	.429	.471	.000	.471	.434	.037	1100	290.	40.4	6.338	10.148	.000	10.148	9.336	.812	1245.	3614	32.45	1.94
17	.371	.436	.000	.436	.401	.035	1175	270.	42.1	6.473	10.307	.000	10.307	9.482	.825	1343.	3514	33.15	1.97
18	.350	.307	.000	.307	.282	.025	877	265.	47.1	6.601	10.419	.000	10.419	9.585	.834	1440.	3616	33.80	1.99
19	.368	.406	.000	.406	.373	.033	1103	121.	24.7	6.735	10.567	.000	10.567	9.722	.845	1484.	3623	34.49	2.02
20	.346	.252	.000	.252	.232	.020	728	154.	30.8	6.862	10.659	.000	10.659	9.806	.853	1540.	3578	35.14	2.04
21	.326	.228	.000	.228	.210	.019	699	181.	35.7	5.981	10.742	.000	10.742	9.883	.859	1606.	3631	35.75	2.05
22	.321	.225	.000	.225	.207	.018	701	167.	34.2	7.098	10.825	.000	10.825	9.959	.866	1667.	3534	36.35	2.07
23	.306	.230	.000	.230	.212	.018	752	174.	36.3	7.214	10.908	.000	10.908	10.036	.872	1731.	3535	36.92	2.08
24	.287	.202	.000	.202	.186	.016	704	174.	37.7	7.314	10.982	.000	10.982	10.104	.878	1795.	3538	37.45	2.10
25	.273	.274	.000	.274	.252	.022	1004	126.	31.6	7.414	11.082	.000	11.082	10.196	.886	1840.	3543	37.96	2.12
26	.254	.190	.000	.190	.175	.015	748	122.	32.4	7.507	11.152	.000	11.152	10.260	.892	1885.	3547	38.44	2.13
27	.233	.270	.000	.270	.248	.022	1134	140.	37.0	7.594	11.250	.000	11.250	10.350	.900	1936.	3549	38.89	2.15
28	.220	.151	.000	.151	.139	.012	686	159.	42.0	7.674	11.305	.000	11.305	10.401	.904	1994.	3552	39.30	2.16
29	.212	.146	.000	.146	.134	.012	689	169.	44.4	7.752	11.359	.000	11.359	10.456	.909	2056.	3554	39.69	2.17
30	.216	.150	.000	.150	.138	.012	694	139.	39.2	7.831	11.414	.000	11.414	10.501	.913	2107.	3657	40.10	2.18
31	.211	.148	.000	.148	.136	.012	701	152.	41.9	7.908	11.468	.000	11.468	10.550	.918	2162.	3658	40.49	2.19
32	.204	.171	.000	.171	.157	.014	838	132.	39.3	7.982	11.530	.000	11.530	10.608	.922	2210.	3551	40.87	2.20
33	.197	.137	.000	.137	.126	.011	695	119.	37.7	8.054	11.580	.000	11.580	10.654	.926	2254.	3664	41.24	2.21
34	.190	.132	.000	.132	.122	.010	695	134.	41.4	8.123	11.628	.000	11.628	10.698	.930	2303.	3667	41.59	2.22
35	.182	.127	.000	.127	.117	.010	698	125.	40.7	8.194	11.675	.000	11.675	10.741	.934	2349.	3670	41.94	2.23
36	.138	.094	.000	.094	.087	.007	681	105.	43.2	8.240	11.709	.000	11.709	10.772	.937	2387.	3675	42.19	2.24
37	.122	.120	.000	.120	.111	.009	984	82.	40.2	8.285	11.753	.000	11.753	10.813	.940	2417.	3679	42.42	2.25
38	.107	.129	.000	.129	.119	.010	1206	92.	46.2	8.324	11.800	.000	11.800	10.856	.944	2450.	3584	42.62	2.26
39	.693	.082	.000	.082	.075	.007	837	100.	50.5	8.360	11.840	.000	11.840	10.884	.946	2487.	3588	42.81	2.26
40	.694	.088	.000	.088	.081	.007	936	80.	46.0	8.394	11.862	.000	11.862	10.913	.949	2516.	3592	42.98	2.27

# DETAILED RESULTS OF CASE 4

AQUIFER

WITH WATER INJECTION

GAS INJECTION

GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.727	.028	0.	4216	1.97	.07
2	1.200	1.426	.000	1.426	1.312	.114	1198	7.	.6	.822	.876	.000	.876	.806	.070	2.	4130	4.21	.17
3	1.200	1.642	.000	1.642	1.511	.131	1368	28.	2.3	1.260	1.475	.000	1.475	1.358	.118	13.	4055	6.45	.28
4	1.200	1.252	.000	1.252	1.151	.101	1043	53.	4.2	1.479	1.705	.000	1.705	1.568	.137	23.	4025	7.57	.33
5	1.200	1.514	.053	1.567	.895	1.472	1306	74.	5.8	1.698	1.981	.010	1.991	1.586	.405	36.	3960	8.69	.97
6	1.200	2.420	.058	2.478	.619	1.859	2065	118.	9.0	2.137	2.865	.031	2.896	1.812	1.084	79.	3790	10.94	2.59
7	1.200	1.948	.855	2.803	.134	2.669	2336	121.	0.2	2.575	3.576	.343	3.919	1.861	2.058	123.	3648	13.19	4.92
8	1.200	1.146	1.511	2.657	.000	2.657	2214	204.	14.5	3.317	3.995	.895	4.890	1.861	7.029	198.	3516	15.43	7.24
9	1.200	1.638	1.018	2.656	.000	2.656	2213	386.	24.3	3.452	4.593	1.767	5.860	1.861	3.990	378.	3395	17.68	9.56
10	1.200	1.269	1.387	2.656	.000	2.656	2213	732.	21.7	3.890	5.057	1.774	6.831	1.861	4.970	460.	3309	19.92	11.88
11	1.191	1.071	1.586	2.657	.000	2.657	2231	356.	23.0	4.325	5.448	2.357	7.801	1.861	5.940	500.	3223	22.15	14.19
12	1.048	1.036	1.621	2.657	.000	2.657	2535	515.	32.9	4.708	5.827	2.945	8.772	1.861	6.911	778.	3150	24.11	16.51
13	.949	1.014	1.643	2.657	.000	2.657	2900	321.	25.3	5.054	6.197	3.545	9.742	1.861	7.881	895.	3095	26.88	18.83
14	.834	.983	1.674	2.657	.000	2.657	3186	733.	28.5	5.359	6.556	4.155	10.712	1.861	8.851	1017.	3045	27.44	21.15
15	.735	.664	1.993	2.657	.000	2.657	3615	316.	30.1	5.627	6.799	4.884	11.682	1.861	9.821	1132.	3001	28.81	23.47
16	.599	.596	2.061	2.657	.000	2.657	4436	395.	39.7	5.846	7.016	5.637	12.653	1.861	10.792	1277.	2960	29.93	25.79
17	.492	.454	2.203	2.657	.000	2.657	5400	384.	43.9	6.026	7.182	6.441	13.623	1.861	11.762	1417.	2922	30.86	28.10
18	.402	.384	2.273	2.657	.000	2.657	6609	320.	44.3	6.177	7.322	7.272	14.594	1.861	12.733	1534.	2892	31.61	30.42
19	.388	.326	2.331	2.657	.000	2.657	6848	213.	35.4	6.314	7.441	8.123	15.564	1.861	13.707	1612.	2870	32.33	32.74
20	.366	.313	2.343	2.656	.000	2.656	7257	181.	73.1	6.448	7.556	8.979	16.575	1.861	14.674	1678.	2845	33.02	35.06
21	.316	.277	2.379	2.656	.000	2.656	8405	212.	40.2	6.563	7.657	9.848	17.505	1.861	15.644	1755.	2811	33.61	37.38
22	.276	.326	2.330	2.656	.000	2.656	9623	184.	40.0	6.664	7.777	10.697	18.476	1.861	16.615	1822.	2775	34.12	39.70
23	.233	.206	2.451	2.657	.000	2.657	11403	178.	43.3	6.760	7.852	11.594	19.446	1.861	17.585	1887.	2740	34.56	42.02
24	.195	.192	2.465	2.657	.000	2.657	13626	143.	42.3	6.821	7.922	12.494	20.416	1.861	18.555	1939.	2716	34.93	44.33
25	.176	.192	2.465	2.657	.000	2.657	15097	136.	43.6	6.885	7.992	13.395	21.387	1.861	19.526	1989.	2707	35.26	46.65
26	.160	.150	2.507	2.657	.000	2.657	16606	149.	48.2	6.944	8.047	14.310	22.357	1.861	20.496	2044.	2682	35.56	48.97
27	.157	.141	2.516	2.657	.000	2.657	16924	86.	35.4	7.001	8.098	15.229	23.327	1.861	21.466	2075.	2649	35.85	51.29
28	.144	.136	2.521	2.657	.000	2.657	18461	89.	38.2	7.053	8.148	16.150	24.298	1.861	22.437	2108.	2616	36.12	53.61
29	.129	.119	2.538	2.657	.000	2.657	20597	87.	40.3	7.101	8.191	17.077	25.268	1.861	23.407	2140.	2592	36.36	55.93
30	.125	.110	2.547	2.657	.000	2.657	21256	70.	35.9	7.146	8.231	18.007	26.238	1.861	24.377	2165.	2572	36.59	58.25
31	.123	.107	2.550	2.657	.000	2.657	21602	55.	30.9	7.191	8.270	18.939	27.209	1.861	25.348	2185.	2531	36.82	60.57
32	.116	.105	2.552	2.657	.000	2.657	22905	57.	32.9	7.233	8.309	19.871	28.180	1.861	26.319	2266.	2493	37.04	62.89
33	.109	.135	2.521	2.656	.000	2.656	24593	67.	38.3	7.277	8.358	20.797	29.150	1.861	27.289	2231.	2440	37.24	65.20
34	.099	.193	2.463	2.656	.000	2.656	26878	75.	43.1	7.309	8.429	21.691	30.120	1.861	28.259	2258.	2387	37.43	67.52
35	.094	.179	2.478	2.657	.000	2.657	28266	52.	35.6	7.343	8.494	22.596	31.090	1.861	29.229	2277.	2342	37.60	69.84
36	.089	.106	2.551	2.657	.000	2.657	29854	47.	34.6	7.376	8.533	23.528	32.061	1.861	30.200	2294.	2293	37.77	72.16

TABLE V



# DETAILED RESULTS OF CASE 5

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR											CUMULATIVES TO YEAR END										
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE			
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL X	TOTAL GAS X		
																				MMSTB DAY	MMSCF/DAY
1	1.650	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07		
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	3.	4108	4.58	.19		
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	3.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.33		
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41		
5	1.600	3.964	.000	3.964	2.300	1.664	2477	158.	9.0	2.064	2.887	.000	2.887	2.410	.477	70.	3847	10.57	1.14		
6	1.600	1.750	.749	2.099	.271	1.828	1312	176.	9.6	2.648	3.526	.127	3.653	2.509	1.144	133.	3717	13.56	2.73		
7	1.599	2.768	.166	2.934	.255	2.679	1835	244.	13.2	3.232	4.537	.188	4.725	2.602	2.123	222.	3528	16.55	5.07		
8	1.397	3.403	.020	3.423	.705	2.718	2450	404.	22.4	3.742	5.780	.195	5.975	2.859	3.116	269.	3404	19.16	7.45		
9	1.277	1.843	.814	2.657	.000	2.657	2081	232.	15.4	4.269	6.453	.493	6.946	2.859	4.087	454.	3324	21.55	9.77		
10	1.051	1.143	1.514	2.657	.000	2.657	2528	419.	28.5	4.593	6.870	1.046	7.916	2.859	5.057	607.	3238	23.52	12.08		
11	.918	1.124	1.533	2.657	.000	2.657	2894	404.	30.6	4.928	7.281	1.605	8.886	2.859	6.027	754.	3166	25.23	14.40		
12	.823	.857	1.800	2.657	.000	2.657	3228	294.	26.3	5.229	7.594	2.263	9.857	2.859	6.998	861.	3108	26.78	16.72		
13	.724	.732	1.924	2.656	.000	2.656	3648	311.	29.9	5.495	7.861	2.966	10.827	2.859	7.968	975.	3051	28.14	19.04		
14	.636	.594	2.063	2.657	.000	2.657	4178	345.	35.2	5.727	8.078	3.719	11.797	2.859	8.938	1101.	3001	29.33	21.36		
15	.545	.566	2.090	2.656	.000	2.656	4864	315.	36.6	5.925	8.285	4.483	12.768	2.859	9.909	1216.	2958	30.34	23.68		
16	.452	.430	2.227	2.657	.000	2.657	5878	354.	43.9	6.091	8.442	5.295	13.738	2.859	10.879	1345.	2915	31.19	25.99		
17	.396	.403	2.254	2.657	.000	2.657	6710	312.	44.1	6.236	8.590	6.119	14.709	2.859	11.850	1459.	2878	31.93	28.31		
18	.351	.333	2.324	2.657	.000	2.657	7570	182.	34.1	6.364	8.711	6.968	15.679	2.859	12.820	1526.	2847	32.59	30.63		
19	.323	.398	2.259	2.657	.000	2.657	8226	183.	36.2	6.482	9.857	7.793	16.650	2.859	13.791	1593.	2817	33.19	32.95		
20	.278	.279	2.377	2.656	.000	2.656	9554	194.	41.1	6.584	8.959	8.661	17.620	2.859	14.761	1664.	2792	33.71	35.27		
21	.249	.272	2.385	2.657	.000	2.657	10671	169.	40.4	6.675	9.058	9.572	18.590	2.859	15.731	1725.	2763	34.18	37.59		
22	.219	.211	2.445	2.656	.000	2.656	12128	159.	42.1	6.755	9.135	10.426	19.561	2.859	16.702	1784.	2726	34.59	39.91		
23	.193	.168	2.489	2.657	.000	2.657	13767	137.	41.5	6.825	9.197	11.335	20.532	2.859	17.673	1834.	2687	34.95	42.23		
24	.170	.151	2.506	2.657	.000	2.657	15629	150.	46.9	6.887	9.252	12.250	21.502	2.859	18.643	1888.	2551	35.27	44.55		
25	.159	.146	2.510	2.656	.000	2.656	16810	127.	44.6	6.945	9.305	13.167	22.472	2.859	19.613	1935.	2635	35.56	46.86		
26	.152	.129	2.527	2.656	.000	2.656	17474	86.	35.1	7.000	9.353	14.090	23.443	2.859	20.584	1966.	2520	35.84	49.18		
27	.138	.125	2.532	2.657	.000	2.657	19254	87.	38.7	7.051	9.398	15.015	24.413	2.859	21.554	1998.	2589	36.11	51.50		
28	.125	.180	2.477	2.657	.000	2.657	21256	97.	43.7	7.096	9.464	15.919	25.387	2.859	22.524	2034.	2544	36.34	53.82		
29	.120	.104	2.553	2.657	.000	2.657	22142	53.	30.6	7.140	9.502	16.852	26.354	2.859	23.495	2053.	2516	36.56	56.14		
30	.112	.098	2.559	2.657	.000	2.657	23723	57.	33.7	7.181	9.538	17.786	27.324	2.859	24.465	2074.	2498	36.77	58.46		
31	.105	.087	2.570	2.657	.000	2.657	25305	65.	38.2	7.219	9.569	18.725	28.294	2.859	25.435	2097.	2458	36.97	60.77		
32	.097	.084	2.573	2.657	.000	2.657	27392	70.	41.9	7.255	9.600	19.665	29.265	2.859	26.406	2123.	2415	37.15	63.09		
33	.090	.081	2.576	2.657	.000	2.657	29522	74.	45.1	7.288	9.630	20.605	30.235	2.859	27.376	2150.	2371	37.32	65.41		
34	.088	.079	2.578	2.657	.000	2.657	30193	41.	31.8	7.320	9.659	21.547	31.206	2.859	28.347	2165.	2315	37.48	67.73		
35	.083	.074	2.583	2.657	.000	2.657	32012	41.	33.1	7.351	9.686	22.490	32.176	2.859	29.317	2180.	2261	37.64	70.05		
36	.078	.082	2.574	2.656	.000	2.656	34051	44.	36.1	7.379	9.716	23.431	33.147	2.859	30.288	2196.	2205	37.78	72.37		

TABLE VI

# DETAILED RESULTS OF CASE 6

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

← AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END →									
YEAR	OIL PROD  MMSTB DAY	GAS					TOTAL GOR  SCF STB	WATER PROD  MB DAY	WATER CUT  %	CUM OIL  10 <sup>3</sup> STB	GAS					WATER PROD  10 <sup>6</sup> B	AVE OIL PRESS  PSIA	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
MMMSCF/DAY					TRILLION SCF														
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	3.	4108	4.58	.19
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	3.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.73
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41
5	2.000	4.882	.000	4.882	3.145	1.737	2441	207.	9.4	2.137	3.054	.000	3.054	2.564	.490	79.	3813	10.94	1.17
6	1.986	2.237	.083	2.320	.474	1.846	1168	201.	9.2	2.862	3.871	.030	3.901	2.737	1.164	153.	3556	14.66	2.78
7	1.596	4.071	.000	4.071	1.301	2.770	2551	338.	17.5	3.445	5.758	.030	5.388	4.212	2.176	276.	3478	17.64	5.20
8	1.326	3.260	.000	3.200	.499	2.701	2413	310.	18.9	3.930	6.527	.030	6.557	3.395	3.162	389.	3381	20.12	7.56
9	1.179	1.979	.718	2.697	.037	2.660	2288	289.	19.7	4.360	7.250	.292	7.542	3.408	4.134	495.	3302	22.33	9.88
10	.988	.997	1.660	2.657	.000	2.657	2689	396.	28.6	4.721	7.614	.899	8.513	3.408	5.115	639.	3221	24.17	12.20
11	.869	.948	1.709	2.657	.000	2.657	3058	728.	27.4	5.038	7.960	1.523	9.483	3.408	6.075	759.	3149	25.80	14.52
12	.756	.735	1.922	2.657	.000	2.657	3515	319.	29.7	5.314	8.229	2.225	10.454	3.408	7.046	876.	3084	27.21	16.84
13	.673	.671	1.986	2.657	.000	2.657	3948	327.	32.7	5.560	8.474	2.950	11.424	3.408	8.016	995.	3027	28.47	19.15
14	.577	.555	2.102	2.657	.000	2.657	4605	371.	39.1	5.771	8.675	7.718	12.394	3.408	8.986	1130.	2975	29.55	21.47
15	.482	.522	2.134	2.656	.000	2.656	5510	290.	37.6	5.947	8.867	4.497	13.364	3.408	9.056	1236.	2933	30.45	23.79
16	.404	.421	2.236	2.657	.000	2.657	6577	350.	46.4	6.094	9.021	5.314	14.375	3.408	10.927	1364.	2890	31.20	26.11
17	.350	.352	2.305	2.657	.000	2.657	7591	293.	45.6	6.222	9.149	6.156	15.305	3.408	11.897	1471.	2852	31.86	28.43
18	.313	.381	2.276	2.657	.000	2.657	8489	185.	47.1	6.337	9.248	6.987	16.275	3.408	12.867	1538.	2819	32.45	30.74
19	.269	.300	2.357	2.657	.000	2.657	9877	182.	48.4	6.435	9.398	7.848	17.246	3.408	13.838	1605.	2786	32.95	33.06
20	.238	.273	2.384	2.657	.000	2.657	11164	178.	42.8	6.522	9.497	8.719	18.216	3.408	14.808	1670.	2762	33.40	35.38
21	.212	.235	2.421	2.656	.000	2.656	12528	155.	42.2	6.599	9.583	9.607	19.186	3.408	15.778	1727.	2734	33.79	37.70
22	.188	.181	2.476	2.657	.000	2.657	14133	116.	38.2	6.668	9.649	10.508	20.157	3.408	16.749	1769.	2598	34.14	40.02
23	.167	.158	2.498	2.656	.000	2.656	15904	118.	41.4	6.729	9.707	11.420	21.127	3.408	17.719	1812.	2657	34.46	42.34
24	.146	.144	2.513	2.657	.000	2.657	18199	123.	45.7	6.782	9.760	12.738	22.098	3.408	18.690	1857.	2520	34.73	44.66
25	.144	.131	2.526	2.657	.000	2.657	18451	88.	37.9	6.835	9.808	13.261	23.069	3.408	19.661	1889.	2600	35.00	46.98
26	.145	.128	2.528	2.656	.000	2.656	18317	78.	35.0	6.888	9.855	14.184	24.079	3.408	20.631	1918.	2582	35.27	49.30
27	.132	.184	2.472	2.656	.000	2.656	20121	91.	40.8	6.936	9.922	15.087	25.009	3.408	21.601	1951.	2551	35.52	51.61
28	.122	.107	2.550	2.657	.000	2.657	21779	82.	40.2	6.981	9.961	16.019	25.980	3.408	22.577	1981.	2507	35.75	53.93
29	.118	.104	2.553	2.657	.000	2.657	22517	57.	32.6	7.024	9.999	16.951	26.950	3.408	23.547	2002.	2473	35.97	56.25
30	.110	.096	2.561	2.657	.000	2.657	24155	56.	33.7	7.064	10.074	17.887	27.921	3.408	24.513	2022.	2447	36.17	58.57
31	.103	.086	2.571	2.657	.000	2.657	25796	67.	39.4	7.102	10.065	18.826	28.891	3.408	25.483	2047.	2418	36.37	60.89
32	.095	.082	2.575	2.657	.000	2.657	27958	72.	43.1	7.137	10.095	19.766	29.861	3.408	26.453	2073.	2371	36.55	63.21
33	.090	.080	2.577	2.657	.000	2.657	29522	61.	40.4	7.170	10.125	20.707	30.837	3.408	27.424	2096.	2329	36.71	65.53
34	.087	.078	2.579	2.657	.000	2.657	30540	41.	32.0	7.201	10.153	21.649	31.802	3.408	28.394	2111.	2274	36.87	67.84
35	.081	.087	2.570	2.657	.000	2.657	32802	45.	35.7	7.231	10.185	22.588	32.773	3.408	29.365	2127.	2219	37.03	70.16

TABLE VII

# DETAILED RESULTS OF CASE 7

AQUIFER

WITH WATER INJECTION

GAS INJECTION

GAS SALES

YEAR	AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE		
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL	TOTAL	
MMSTB DAY	MMMSCF/DAY					SCF STB	MB DAY	%	10 <sup>3</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA	X	X		
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.727	.028	0.	4216	1.97	.07	
2	1.200	1.426	.000	1.426	1.312	.114	1188	7.	.6	.822	.876	.000	.876	.806	.070	2.	4130	4.21	.17	
3	1.200	1.642	.000	1.642	1.511	.131	1368	20.	2.3	1.260	1.476	.000	1.476	1.358	.118	17.	4055	6.45	.28	
4	1.200	1.252	.000	1.252	1.151	.101	1043	53.	4.2	1.479	1.705	.000	1.705	1.568	.137	23.	4025	7.57	.33	
5	1.200	1.514	.053	1.567	.095	1.472	1308	74.	5.8	1.698	1.981	.010	1.991	1.586	.405	36.	3960	8.69	.97	
6	1.200	2.410	.093	2.503	.537	1.966	2086	118.	9.0	2.177	2.861	.044	2.905	1.782	1.123	79.	3776	10.94	2.68	
7	1.200	2.340	.601	2.941	.104	2.837	2451	121.	9.2	2.575	3.716	.267	3.979	1.820	2.159	123.	3629	13.19	5.16	
8	1.200	2.790	.437	2.827	.000	2.827	2356	217.	15.7	3.013	4.589	.423	5.012	1.820	3.192	203.	3490	15.43	7.63	
9	1.200	2.567	.325	2.892	.059	2.833	2410	437.	26.7	3.452	5.526	.541	6.067	1.842	4.225	362.	3371	17.68	10.10	
10	1.200	1.967	.926	2.828	.000	2.828	2357	301.	26.1	3.890	6.721	.880	7.101	1.842	5.259	472.	3289	19.92	12.57	
11	1.198	1.141	1.586	2.827	.000	2.827	2360	397.	24.9	4.328	6.638	1.495	8.133	1.842	6.291	617.	3204	22.16	15.07	
12	1.046	1.056	1.771	2.827	.000	2.827	2703	458.	30.5	4.710	7.024	2.142	9.166	1.842	7.324	785.	3132	24.12	17.50	
13	.890	.811	2.016	2.827	.000	2.827	3176	865.	29.1	5.035	7.320	2.870	10.199	1.842	8.357	918.	3074	25.78	19.97	
14	.769	.882	1.945	2.827	.000	2.827	3676	358.	31.8	5.316	7.642	3.589	11.231	1.842	9.389	1049.	3019	27.22	22.43	
15	.658	.610	2.217	2.827	.000	2.827	4232	374.	35.9	5.560	7.865	4.399	12.264	1.842	10.422	1185.	2970	28.47	24.90	
16	.552	.574	2.253	2.827	.000	2.827	5121	395.	41.7	5.761	9.075	5.222	13.297	1.842	11.455	1330.	2926	29.50	27.37	
17	.437	.405	2.422	2.827	.000	2.827	6469	340.	43.8	5.921	8.223	6.106	14.329	1.842	12.487	1454.	2889	30.32	29.84	
18	.367	.372	2.455	2.827	.000	2.827	7703	331.	47.4	6.055	8.758	7.003	15.761	1.842	13.519	1575.	2855	31.01	32.30	
19	.349	.297	2.531	2.828	.000	2.828	8103	217.	38.3	6.182	9.467	7.928	16.395	1.842	14.553	1654.	2833	31.66	34.77	
20	.328	.297	2.531	2.828	.000	2.828	8622	181.	35.6	6.702	9.575	8.852	17.427	1.842	15.585	1720.	2800	32.27	37.24	
21	.284	.246	2.582	2.828	.000	2.828	9958	205.	41.9	6.406	8.665	9.795	18.460	1.842	16.518	1795.	2759	32.80	39.71	
22	.255	.315	2.512	2.827	.000	2.827	11096	153.	37.5	6.499	8.780	10.712	19.492	1.842	17.650	1851.	2721	33.28	42.17	
23	.218	.197	2.631	2.828	.000	2.828	12372	159.	42.2	6.579	8.852	11.673	20.525	1.842	18.683	1904.	2688	33.69	44.64	
24	.192	.185	2.642	2.827	.000	2.827	14724	132.	40.7	6.649	8.919	12.638	21.557	1.842	19.715	1957.	2676	34.05	47.11	
25	.174	.166	2.641	2.827	.000	2.827	16247	177.	44.1	6.713	8.987	13.603	22.590	1.842	20.748	2008.	2651	34.37	49.57	
26	.159	.165	2.662	2.827	.000	2.827	17780	142.	47.2	6.771	9.048	14.575	23.623	1.842	21.781	2059.	2614	34.67	52.04	
27	.159	.145	2.682	2.827	.000	2.827	17780	108.	40.4	6.829	9.101	15.555	24.656	1.842	22.814	2099.	2586	34.97	54.51	
28	.137	.130	2.697	2.827	.000	2.827	20635	86.	38.6	6.879	9.148	16.540	25.688	1.842	23.846	2130.	2567	35.22	56.98	
29	.126	.123	2.704	2.827	.000	2.827	22437	89.	41.4	6.925	9.193	17.529	26.721	1.842	24.879	2167.	2523	35.46	59.45	
30	.124	.119	2.708	2.827	.000	2.827	22798	64.	34.0	6.970	9.237	18.517	27.754	1.842	25.912	2186.	2479	35.69	61.91	
31	.121	.113	2.714	2.827	.000	2.827	23354	51.	29.7	7.015	9.278	19.508	28.786	1.842	26.944	2205.	2434	35.92	64.38	
32	.115	.107	2.720	2.827	.000	2.827	24583	60.	34.3	7.056	9.317	20.501	29.818	1.842	27.976	2227.	2375	36.13	66.85	
33	.107	.099	2.728	2.827	.000	2.827	26421	65.	37.8	7.096	9.354	21.498	30.852	1.842	29.010	2251.	2318	36.34	69.32	
34	.100	.091	2.737	2.828	.000	2.828	28280	70.	41.2	7.132	9.387	22.497	31.884	1.842	30.042	2276.	2272	36.52	71.78	

TABLE VIII

# DETAILED RESULTS OF CASE 8

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

YEAR	AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE		
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %	
MMSTB DAY	MMMSCF / DAY					SCF STB	MB DAY	%	10 <sup>9</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA				
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07	
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	3.	4108	4.58	.19	
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	7.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.73	
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41	
5	1.600	3.964	.000	3.964	2.300	1.664	2477	158.	9.0	2.064	2.887	.000	2.887	2.410	.477	70.	3843	10.57	1.14	
6	1.600	1.747	.447	2.194	.254	1.940	1371	161.	9.1	2.648	3.525	.163	3.688	2.502	1.186	129.	3713	13.56	2.83	
7	1.598	2.715	.261	2.976	.136	2.840	1862	247.	13.4	3.232	4.516	.258	4.774	2.552	2.222	219.	3519	16.55	5.31	
8	1.399	3.372	.123	3.495	.614	2.881	2498	386.	21.6	3.743	5.748	.303	6.051	2.776	3.275	360.	3390	19.17	7.83	
9	1.272	1.708	1.119	2.827	.000	2.827	2222	240.	15.9	4.207	6.372	.712	7.084	2.776	4.308	448.	3305	21.54	10.29	
10	1.042	1.070	1.757	2.827	.000	2.827	2713	422.	28.8	4.588	6.762	1.354	8.116	2.776	5.340	602.	3215	23.49	12.76	
11	.908	1.023	1.804	2.827	.000	2.827	3113	398.	70.5	4.919	7.136	2.017	9.149	2.776	6.373	747.	3141	25.19	15.23	
12	.818	.847	1.980	2.827	.000	2.827	3456	293.	26.4	5.218	7.446	2.736	10.182	2.776	7.406	854.	3077	26.72	17.70	
13	.716	.713	2.115	2.828	.000	2.828	3950	308.	30.1	5.480	7.705	3.508	11.214	2.776	8.438	967.	3017	28.06	20.16	
14	.627	.588	2.239	2.827	.000	2.827	4509	335.	34.8	5.709	7.921	4.324	12.247	2.776	9.471	1089.	2964	29.23	22.63	
15	.531	.555	2.272	2.827	.000	2.827	5324	312.	37.0	5.907	9.124	5.156	13.280	2.776	10.504	1203.	2919	30.23	25.10	
16	.436	.421	2.407	2.828	.000	2.828	6486	365.	45.6	6.062	8.277	6.035	14.312	2.776	11.536	1336.	2874	31.04	27.56	
17	.381	.380	2.447	2.827	.000	2.827	7420	287.	47.0	6.201	8.416	6.929	15.345	2.776	12.569	1441.	2835	31.75	30.03	
18	.340	.311	2.516	2.827	.000	2.827	8315	185.	35.2	6.325	8.530	7.848	16.378	2.776	13.602	1509.	2800	32.19	32.50	
19	.314	.384	2.443	2.827	.000	2.827	9003	181.	36.6	6.440	8.670	8.740	17.410	2.776	14.634	1575.	2772	32.98	34.97	
20	.271	.282	2.546	2.828	.000	2.828	10435	203.	47.4	6.539	8.773	9.070	18.443	2.776	15.667	1649.	2741	33.48	37.43	
21	.241	.247	2.580	2.827	.000	2.827	11770	156.	40.8	6.627	8.863	10.612	19.475	2.776	16.699	1710.	2704	33.93	39.90	
22	.213	.227	2.605	2.828	.000	2.828	13277	150.	41.3	6.705	8.945	11.564	20.509	2.776	17.737	1764.	2643	34.37	42.37	
23	.185	.164	2.663	2.827	.000	2.827	15281	137.	42.5	6.772	9.005	12.536	21.541	2.776	18.765	1814.	2623	34.68	44.84	
24	.163	.153	2.674	2.827	.000	2.827	17344	149.	47.8	6.832	9.068	13.517	22.573	2.776	19.797	1869.	2596	34.98	47.30	
25	.157	.143	2.684	2.827	.000	2.827	18006	123.	43.9	6.889	9.115	14.493	23.606	2.776	20.830	1913.	2578	35.28	49.77	
26	.145	.127	2.700	2.827	.000	2.827	19497	80.	35.6	6.942	9.159	15.440	24.639	2.776	21.863	1943.	2551	35.55	52.24	
27	.133	.123	2.704	2.827	.000	2.827	21256	89.	40.1	6.991	9.204	16.467	25.671	2.776	22.895	1975.	2504	35.80	54.70	
28	.122	.114	2.713	2.827	.000	2.827	23172	91.	42.7	7.035	9.246	17.459	26.705	2.776	23.929	2008.	2471	36.02	57.18	
29	.121	.132	2.695	2.827	.000	2.827	25364	69.	28.8	7.079	9.294	18.447	27.737	2.776	24.961	2026.	2450	36.25	59.64	
30	.111	.149	2.678	2.827	.000	2.827	25468	58.	24.3	7.120	9.348	19.421	28.769	2.776	25.993	2048.	2408	36.46	62.11	
31	.102	.080	2.739	2.827	.000	2.827	27716	62.	37.4	7.157	9.381	20.422	29.803	2.776	27.027	2070.	2361	36.65	64.58	
32	.095	.083	2.744	2.827	.000	2.827	29758	67.	41.4	7.191	9.411	21.424	30.875	2.776	28.059	2095.	2309	36.82	67.04	
33	.088	.079	2.748	2.827	.000	2.827	32125	73.	45.3	7.223	9.440	22.428	31.868	2.776	29.092	2122.	2248	36.99	69.51	
34	.086	.074	2.753	2.827	.000	2.827	32872	35.	28.9	7.255	9.467	23.437	32.900	2.776	30.124	2134.	2183	37.15	71.98	

TABLE IX

# DETAILED RESULTS OF CASE 9

AQUIFER

WITH WATER INJECTION

GAS INJECTION

GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL	TOTAL GAS
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.987	.000	.987	.904	.079	3.	4108	4.58	.19
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	7.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.73
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41
5	2.000	4.882	.000	4.882	3.145	1.737	2441	267.	9.4	2.137	3.054	.000	3.054	2.564	.490	79.	3813	10.94	1.17
6	1.995	2.228	.145	2.373	.418	1.955	1195	201.	9.2	2.862	3.868	.053	3.921	2.717	1.204	153.	3652	14.66	2.88
7	1.944	4.029	.000	4.029	1.105	2.924	2528	379.	17.5	3.444	5.339	.053	5.392	3.120	2.272	276.	3469	17.64	5.43
8	1.323	3.122	.006	3.128	.277	2.851	2364	312.	19.1	3.927	6.480	.055	6.535	3.222	3.313	390.	3769	20.11	7.92
9	1.174	1.825	1.002	2.827	.000	2.827	2408	294.	20.0	4.356	7.146	.421	7.567	3.222	4.345	497.	3283	22.31	10.38
10	.981	1.018	1.909	2.827	.000	2.827	2882	395.	28.7	4.715	7.518	1.082	8.600	3.222	5.378	642.	3197	24.14	12.85
11	.453	.958	1.869	2.827	.000	2.827	3314	341.	28.6	5.026	7.868	1.765	9.633	3.222	6.411	766.	3122	25.74	15.32
12	.754	.726	2.101	2.827	.000	2.827	3749	300.	28.5	5.302	8.133	2.532	10.665	3.222	7.443	876.	3055	27.15	17.78
13	.650	.679	2.149	2.828	.000	2.828	4285	325.	33.0	5.543	8.381	3.317	11.698	3.222	8.476	995.	2995	28.38	20.25
14	.556	.543	2.284	2.827	.000	2.827	4995	359.	38.8	5.750	8.580	4.151	12.731	3.222	9.509	1126.	2940	29.44	22.72
15	.467	.523	2.304	2.827	.000	2.827	6054	296.	38.8	5.920	8.771	4.993	13.764	3.222	10.542	1234.	2896	30.31	25.19
16	.387	.416	2.412	2.828	.000	2.828	7307	364.	48.5	6.062	8.922	5.874	14.796	3.222	11.574	1367.	2848	31.04	27.65
17	.343	.348	2.480	2.828	.000	2.828	8245	276.	44.6	6.187	9.049	6.780	15.829	3.222	12.607	1468.	2809	31.68	30.12
18	.301	.354	2.473	2.827	.000	2.827	9392	175.	36.8	6.297	9.179	7.683	16.862	3.222	13.640	1531.	2773	32.24	32.59
19	.261	.317	2.510	2.827	.000	2.827	10831	185.	41.5	6.392	9.295	8.600	17.895	3.222	14.673	1599.	2741	32.73	35.06
20	.232	.266	2.561	2.827	.000	2.827	12185	177.	43.3	6.477	9.392	9.535	18.927	3.222	15.705	1664.	2712	33.17	37.53
21	.204	.243	2.585	2.828	.000	2.828	13863	149.	42.2	6.551	9.480	10.479	19.959	3.222	16.737	1718.	2678	33.54	39.99
22	.180	.171	2.656	2.827	.000	2.827	15706	113.	38.6	6.617	9.547	11.449	20.992	3.222	17.770	1759.	2635	33.88	42.46
23	.161	.148	2.679	2.827	.000	2.827	17559	121.	42.9	6.675	9.597	12.428	22.025	3.222	18.803	1807.	2592	34.19	44.93
24	.143	.142	2.685	2.827	.000	2.827	19769	120.	45.6	6.728	9.649	13.409	23.058	3.222	19.836	1847.	2560	34.45	47.40
25	.143	.131	2.696	2.827	.000	2.827	19769	85.	37.3	6.780	9.697	14.394	24.091	3.222	20.869	1878.	2544	34.72	49.86
26	.141	.124	2.704	2.828	.000	2.828	20057	81.	36.5	6.832	9.742	15.381	25.123	3.222	21.901	1901.	2513	34.98	52.33
27	.130	.120	2.707	2.827	.000	2.827	21746	91.	40.9	6.879	9.786	16.370	26.156	3.222	22.934	1941.	2470	35.22	54.80
28	.123	.116	2.651	2.827	.000	2.827	22984	79.	39.1	6.925	9.850	17.338	27.188	3.222	23.966	1969.	2427	35.46	57.26
29	.114	.113	2.714	2.827	.000	2.827	24798	50.	30.5	6.966	9.891	18.330	28.271	3.222	24.999	1988.	2400	35.67	59.73
30	.107	.092	2.735	2.827	.000	2.827	26421	59.	35.5	7.005	9.925	19.329	29.254	3.222	26.032	2009.	2366	35.87	62.20
31	.100	.088	2.739	2.827	.000	2.827	28270	65.	39.4	7.042	9.957	20.329	30.286	3.222	27.064	2033.	2316	36.06	64.67
32	.092	.085	2.742	2.827	.000	2.827	30728	68.	42.5	7.075	9.988	21.331	31.319	3.222	28.097	2058.	2268	36.23	67.13
33	.087	.078	2.749	2.827	.000	2.827	32494	60.	40.8	7.107	10.017	22.335	32.752	3.222	29.130	2080.	2208	36.39	69.60

TABLE X

# DETAILED RESULTS OF CASE 10

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
	MMSTB DAY	MMMSCF/DAY					SCF STB	MB DAY	%	10 <sup>9</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA		
1	1.050	.972	.000	.972	.895	.077	926	0.	.1	.384	.755	.000	.355	.327	.028	6.	4216	1.97	.07
2	1.200	1.426	.000	1.426	1.312	.114	1188	7.	.6	.822	.876	.000	.876	.806	.070	2.	4170	4.21	.17
3	1.200	1.642	.000	1.642	1.511	.131	1368	28.	2.3	1.260	1.476	.000	1.476	1.358	.118	13.	4055	6.45	.28
4	1.200	1.252	.000	1.252	1.151	.101	1043	53.	4.2	1.479	1.705	.000	1.705	1.568	.137	23.	4025	7.57	.33
5	1.200	1.514	.053	1.567	.095	1.472	1306	74.	5.8	1.698	1.991	.010	1.991	1.866	.125	36.	3960	8.69	.47
6	1.200	2.448	.001	2.449	.906	1.543	2041	118.	9.0	2.137	2.875	.010	2.885	1.917	.968	79.	3791	10.94	2.31
7	1.200	1.609	.284	1.893	.395	1.498	1577	117.	8.9	2.575	3.467	.114	3.577	2.061	1.516	122.	3714	13.19	3.62
8	1.200	1.301	.208	1.509	.042	1.467	1257	182.	17.2	3.017	3.978	.190	4.128	2.076	2.052	188.	3518	15.43	4.90
9	1.200	1.853	.006	1.859	.363	1.496	1549	340.	22.1	3.452	4.615	.192	4.807	2.209	2.598	317.	3528	17.68	6.21
10	1.200	1.220	.246	1.466	.002	1.464	1222	310.	27.5	3.890	5.060	.282	5.342	2.209	7.133	426.	3480	19.92	7.49
11	1.200	1.129	.335	1.464	.000	1.464	1220	335.	21.8	4.328	5.472	.404	5.876	2.209	3.667	548.	3419	22.16	8.76
12	1.101	1.010	.454	1.464	.000	1.464	1330	441.	28.6	4.730	5.841	.570	6.411	2.209	4.202	710.	3370	24.22	10.04
13	.964	.901	.563	1.464	.000	1.464	1519	414.	30.0	5.082	6.170	.775	6.945	2.209	4.735	861.	3334	26.02	11.32
14	.872	.874	.590	1.464	.000	1.464	1679	350.	28.6	5.401	6.490	.991	7.481	2.209	5.272	989.	3205	27.66	12.60
15	.761	.684	.779	1.463	.000	1.463	1922	348.	31.4	5.679	6.740	1.275	8.015	2.209	5.806	1116.	3279	29.08	13.87
16	.652	.588	.875	1.463	.000	1.463	2244	449.	40.8	5.917	6.954	1.595	8.549	2.209	6.340	1280.	3254	30.30	15.15
17	.568	.557	.906	1.463	.000	1.463	2576	346.	37.9	6.125	7.158	1.926	9.084	2.209	6.875	1406.	3239	31.36	16.43
18	.505	.428	1.035	1.463	.000	1.463	2897	362.	41.8	6.309	7.314	2.304	9.619	2.209	7.409	1538.	3222	32.71	17.70
19	.437	.572	.891	1.463	.000	1.463	3348	321.	42.3	6.469	7.523	2.630	10.153	2.209	7.944	1656.	3208	33.17	18.98
20	.389	.479	.985	1.464	.000	1.464	3763	191.	32.9	6.611	7.698	2.990	10.688	2.209	8.479	1725.	3204	33.85	20.26
21	.362	.305	1.159	1.464	.000	1.464	4044	177.	32.8	6.747	7.810	3.417	11.223	2.209	9.014	1790.	3194	34.53	21.54
22	.327	.305	1.159	1.464	.000	1.464	4477	182.	35.8	6.862	7.921	3.836	11.757	2.209	9.548	1857.	3185	35.14	22.81
23	.307	.282	1.181	1.463	.000	1.463	4765	148.	32.5	6.975	8.024	4.267	12.291	2.209	10.082	1911.	3178	35.72	24.09
24	.273	.213	1.251	1.464	.000	1.464	5367	138.	33.6	7.074	8.102	4.724	12.826	2.209	10.617	1961.	3175	36.22	25.37
25	.242	.305	1.159	1.464	.000	1.464	6050	138.	36.7	7.162	8.213	5.148	13.361	2.209	11.157	2012.	3169	36.67	26.65
26	.202	.155	1.309	1.464	.000	1.464	7248	146.	42.0	7.236	8.270	5.626	13.896	2.209	11.687	2065.	3160	37.05	27.92
27	.191	.147	1.317	1.464	.000	1.464	7665	137.	41.8	7.306	8.323	6.107	14.430	2.209	12.221	2115.	3147	37.41	29.20
28	.185	.141	1.322	1.463	.000	1.463	7908	126.	40.5	7.374	8.375	6.590	15.065	2.209	12.756	2161.	3132	37.76	30.48
29	.168	.127	1.336	1.463	.000	1.463	8708	129.	43.4	7.435	8.421	7.078	15.490	2.209	13.290	2209.	3119	38.07	31.75
30	.149	.111	1.352	1.463	.000	1.463	9819	100.	40.2	7.489	8.467	7.572	16.034	2.209	13.825	2245.	3109	38.35	33.03
31	.149	.113	1.351	1.464	.000	1.464	9826	67.	29.7	7.544	8.507	8.065	16.568	2.209	14.350	2268.	3104	38.63	34.31
32	.141	.158	1.306	1.464	.000	1.464	10383	72.	33.8	7.595	8.561	8.542	17.103	2.209	14.894	2294.	3103	38.89	35.59
33	.124	.123	1.341	1.464	.000	1.464	11806	85.	40.7	7.641	8.605	9.072	17.637	2.209	15.428	2325.	3095	39.13	36.86
34	.110	.082	1.382	1.464	.000	1.464	13309	81.	42.4	7.681	8.675	9.537	18.172	2.209	15.963	2354.	3086	39.33	38.14
35	.100	.078	1.386	1.464	.000	1.464	14640	84.	45.7	7.717	8.664	10.047	18.707	2.209	16.498	2385.	3071	39.52	39.42
36	.096	.081	1.383	1.464	.000	1.464	15250	87.	39.6	7.752	8.693	10.548	19.241	2.209	17.032	2408.	3055	39.69	40.70
37	.091	.078	1.386	1.464	.000	1.464	16088	56.	38.1	7.786	8.722	11.054	19.776	2.209	17.567	2429.	3041	39.87	41.97

TABLE XI

# DETAILED RESULTS OF CASE 11

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR											CUMULATIVES TO YEAR END										
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE			
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %		
																				MMSTB DAY	MMSCF/DAY
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.394	.755	.000	.755	.327	.028	0.	4216	1.97	.07		
2	1.200	1.426	.000	1.426	1.312	.114	1188	7.	.6	.827	.876	.000	.876	.406	.079	2.	4170	4.21	.17		
3	1.200	1.642	.000	1.642	1.511	.131	1368	28.	2.3	1.260	1.476	.000	1.476	1.358	.118	13.	4055	6.45	.28		
4	1.200	1.262	.000	1.262	1.151	.101	1063	53.	4.2	1.479	1.775	.000	1.775	1.705	.070	23.	4025	7.57	.33		
5	1.200	1.508	.410	1.918	.000	1.918	1598	74.	5.8	1.698	1.980	.075	2.055	1.568	.487	76.	3950	8.69	1.16		
6	1.200	2.338	.107	2.445	.484	1.961	2077	119.	9.0	2.137	2.834	.114	2.948	1.745	1.203	79.	3767	10.94	2.87		
7	1.200	2.367	.236	2.303	.354	1.949	1919	122.	9.2	2.575	3.589	.200	3.789	.874	1.915	124.	3667	13.19	4.58		
8	1.200	1.196	.732	1.918	.000	1.918	1598	262.	14.4	3.017	4.022	.467	4.489	1.874	2.615	198.	3561	15.43	6.25		
9	1.200	1.528	.425	1.953	.133	1.820	1627	375.	23.8	3.452	4.580	.523	5.203	1.886	3.317	735.	3466	17.68	7.93		
10	1.200	1.663	.262	1.925	.007	1.918	1604	339.	21.8	3.890	5.188	.719	5.907	1.889	4.318	457.	3792	19.92	9.60		
11	1.199	1.474	.490	1.918	.000	1.918	1600	325.	21.3	4.728	5.709	.899	6.607	1.889	4.718	576.	3328	22.16	11.27		
12	1.073	1.185	.733	1.918	.000	1.918	1788	522.	32.7	4.720	5.142	1.165	7.307	1.889	5.418	767.	3270	24.17	12.95		
13	.993	1.094	.824	1.918	.000	1.918	1932	324.	24.6	5.082	6.942	1.465	8.408	1.889	6.119	885.	3233	26.02	14.62		
14	.885	.912	1.006	1.918	.000	1.918	2172	312.	25.1	5.405	6.875	1.834	8.709	1.889	6.320	999.	3195	27.68	16.30		
15	.783	.673	1.239	1.918	.000	1.918	2494	363.	32.1	5.685	7.123	2.286	9.409	1.889	7.520	1132.	3160	29.11	17.97		
16	.667	.629	1.290	1.918	.000	1.918	2876	382.	36.4	5.929	7.352	2.754	10.110	1.889	8.221	1271.	3132	30.36	19.64		
17	.541	.543	1.375	1.918	.000	1.918	3545	392.	42.9	6.127	7.651	3.260	10.911	1.889	8.922	1414.	3107	31.37	21.32		
18	.432	.582	1.536	1.918	.000	1.918	4440	411.	48.8	6.265	7.690	3.821	11.511	1.889	9.622	1565.	3085	32.18	22.99		
19	.404	.377	1.545	1.918	.000	1.918	4748	246.	37.8	6.432	7.827	4.385	12.212	1.889	10.323	1654.	3068	32.94	24.67		
20	.343	.363	1.555	1.918	.000	1.918	4880	183.	31.8	6.576	7.959	4.953	12.912	1.889	11.023	1721.	3051	33.67	26.34		
21	.347	.377	1.541	1.918	.000	1.918	5527	202.	36.4	6.702	8.097	5.516	13.613	1.889	11.724	1795.	3035	34.32	28.01		
22	.309	.277	1.641	1.918	.000	1.918	6397	198.	30.8	6.812	8.198	6.116	14.714	1.889	12.425	1867.	3027	34.88	29.69		
23	.269	.265	1.652	1.918	.000	1.918	7130	194.	41.9	6.910	8.295	6.719	15.714	1.889	13.125	1938.	3010	35.38	31.36		
24	.229	.212	1.706	1.918	.000	1.918	8375	183.	44.4	6.994	8.373	7.342	15.715	1.889	13.826	2005.	2993	35.81	33.04		
25	.206	.160	1.758	1.918	.000	1.918	9311	140.	40.5	7.069	8.431	7.984	16.415	1.889	14.526	2056.	2971	36.20	34.71		
26	.181	.147	1.771	1.918	.000	1.918	10597	156.	46.7	7.135	8.485	8.531	17.116	1.889	15.227	2113.	2950	36.54	36.38		
27	.175	.191	1.727	1.918	.000	1.918	10960	129.	42.4	7.199	8.555	9.262	17.817	1.889	15.928	2160.	2934	36.86	38.06		
28	.155	.152	1.767	1.919	.000	1.919	12381	81.	34.3	7.256	8.610	9.907	18.517	1.889	16.628	2189.	2935	37.16	39.73		
29	.144	.110	1.808	1.918	.000	1.918	13319	96.	38.5	7.308	8.650	10.568	19.218	1.889	17.329	2222.	2927	37.42	41.41		
30	.135	.105	1.813	1.918	.000	1.918	14103	93.	40.6	7.358	8.689	11.230	19.919	1.889	18.030	2256.	2911	37.68	43.08		
31	.135	.106	1.812	1.918	.000	1.918	14227	64.	32.2	7.407	8.728	11.892	20.620	1.889	18.731	2279.	2887	37.93	44.76		
32	.124	.101	1.818	1.919	.000	1.919	15476	70.	36.1	7.452	8.764	12.555	21.320	1.889	19.431	2305.	2863	38.16	46.43		
33	.115	.092	1.826	1.918	.000	1.918	16678	66.	36.5	7.499	8.798	13.223	22.021	1.889	20.172	2329.	2855	38.38	48.10		
34	.107	.090	1.828	1.918	.000	1.918	17925	75.	41.5	7.534	8.831	13.891	22.722	1.889	20.873	2357.	2845	38.68	49.78		
35	.098	.132	1.786	1.918	.000	1.918	19571	81.	45.3	7.570	8.879	14.563	23.422	1.889	21.533	2387.	2822	38.76	51.45		
36	.087	.074	1.845	1.919	.000	1.919	22057	48.	35.6	7.602	8.906	15.217	24.123	1.889	22.234	2404.	2796	38.93	53.13		
37	.082	.063	1.855	1.918	.000	1.918	27390	47.	36.4	7.632	8.929	15.899	24.823	1.889	22.934	2421.	2773	39.08	54.80		

# DETAILED RESULTS OF CASE 12

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.784	.355	.000	.355	.327	.028	0.	4216	1.97	.07
2	1.200	1.426	.000	1.426	1.312	.114	1188	7.	.6	.822	.876	.000	.876	.806	.070	2.	4130	4.21	.17
3	1.200	1.642	.000	1.642	1.511	.131	1368	28.	2.3	1.260	1.476	.000	1.476	1.358	.118	13.	4355	6.45	.28
4	1.200	1.252	.000	1.252	1.151	.101	1043	53.	4.2	1.479	1.705	.000	1.705	1.568	.137	23.	4025	7.57	.33
5	1.200	1.505	.641	2.146	.000	2.146	1788	74.	5.8	1.698	1.979	.117	2.096	1.568	.528	36.	3944	8.69	1.26
6	1.200	2.280	.215	2.495	.321	2.174	2079	119.	9.0	2.137	2.812	.195	3.007	1.686	1.321	80.	3754	10.94	7.16
7	1.200	2.387	.072	2.459	.285	2.171	2049	123.	9.3	2.575	3.684	.222	3.906	1.791	2.215	125.	3634	13.19	5.05
8	1.200	2.430	.000	2.430	.262	2.168	2025	218.	15.4	3.013	4.571	.222	4.793	1.887	2.906	204.	3517	15.43	6.94
9	1.200	2.693	.000	2.693	.504	2.189	2244	425.	26.2	3.452	5.555	.222	5.777	2.070	3.707	359.	3420	17.68	8.86
10	1.200	2.262	.080	2.342	.181	2.161	1952	297.	19.8	3.890	6.381	.251	6.632	2.136	4.496	468.	3358	19.92	10.74
11	1.199	1.563	.582	2.145	.000	2.145	1789	393.	24.7	4.328	6.952	.464	7.416	2.136	5.280	612.	3290	22.16	12.62
12	1.097	1.147	.998	2.145	.000	2.145	1955	441.	28.7	4.729	7.771	.828	8.599	2.136	6.057	773.	3234	24.22	14.49
13	.952	.913	1.232	2.145	.000	2.145	2253	369.	27.9	5.076	7.705	1.278	8.983	2.136	6.847	907.	3189	25.99	16.36
14	.829	.900	1.245	2.145	.000	2.145	2587	325.	28.2	5.379	8.033	1.733	9.766	2.136	7.630	1026.	3148	27.54	18.23
15	.690	.632	1.513	2.145	.000	2.145	3109	454.	39.7	5.631	8.264	2.286	10.550	2.136	8.414	1192.	3106	28.83	20.10
16	.622	.612	1.534	2.146	.000	2.146	3450	383.	38.1	5.858	8.488	2.846	11.334	2.136	9.198	1332.	3075	30.00	21.98
17	.497	.513	1.633	2.146	.000	2.146	4318	378.	43.2	6.040	8.675	3.443	12.118	2.136	9.982	1470.	3047	30.93	23.85
18	.411	.368	1.778	2.146	.000	2.146	5221	342.	45.4	6.190	8.809	4.092	12.901	2.136	10.765	1595.	3022	31.70	25.72
19	.379	.359	1.787	2.146	.000	2.146	5662	269.	41.5	6.328	8.940	4.744	13.684	2.136	11.548	1693.	2999	32.40	27.59
20	.371	.314	1.831	2.145	.000	2.145	5782	186.	33.4	6.464	9.255	5.413	14.468	2.136	12.332	1761.	2983	33.10	29.47
21	.327	.373	1.773	2.146	.000	2.146	6563	195.	37.4	6.583	9.191	6.061	15.252	2.136	13.116	1832.	2968	33.71	31.34
22	.286	.246	1.899	2.145	.000	2.145	7500	192.	40.2	6.688	9.281	6.755	16.076	2.136	13.900	1902.	2947	34.25	33.21
23	.251	.241	1.904	2.145	.000	2.145	8546	182.	42.0	6.779	9.769	7.450	16.819	2.136	14.683	1969.	2922	34.71	35.08
24	.222	.213	1.933	2.146	.000	2.146	9667	145.	39.5	6.860	9.447	8.155	17.603	2.136	15.467	2021.	2898	35.13	36.06
25	.193	.155	1.991	2.146	.000	2.146	11119	145.	42.9	6.931	9.503	8.887	18.386	2.136	16.250	2074.	2873	35.49	36.83
26	.172	.148	1.997	2.145	.000	2.145	12471	155.	47.4	6.994	9.558	9.513	19.171	2.136	17.075	2131.	2859	35.81	37.70
27	.174	.139	2.006	2.145	.000	2.145	13238	107.	37.2	7.057	9.608	10.745	19.953	2.136	17.817	2169.	2854	36.14	42.57
28	.160	.146	2.000	2.146	.000	2.146	13412	101.	38.7	7.116	9.662	11.076	20.738	2.136	18.602	2206.	2840	36.44	44.45
29	.138	.182	1.964	2.146	.000	2.146	15551	94.	40.5	7.166	9.728	11.793	21.521	2.136	19.385	2240.	2816	36.69	46.32
30	.129	.105	2.039	2.145	.000	2.145	16628	88.	40.6	7.213	9.767	12.538	22.305	2.136	20.169	2272.	2786	36.93	48.19
31	.124	.101	2.044	2.145	.000	2.145	17298	57.	31.5	7.259	9.804	13.285	23.089	2.136	20.953	2293.	2780	37.17	50.06
32	.117	.097	2.048	2.145	.000	2.145	18333	61.	34.3	7.301	9.839	14.033	23.872	2.136	21.736	2315.	2765	37.59	51.94
33	.109	.089	2.057	2.146	.000	2.146	19688	71.	39.4	7.341	9.872	14.784	24.656	2.136	22.520	2341.	2753	37.99	53.81
34	.101	.084	2.062	2.146	.000	2.146	21248	77.	43.3	7.378	9.902	15.537	25.439	2.136	23.303	2369.	2701	37.78	55.68
35	.095	.082	2.054	2.146	.000	2.146	22589	65.	40.6	7.413	9.932	16.291	26.223	2.136	24.087	2393.	2675	37.96	57.55
36	.091	.099	2.047	2.146	.000	2.146	23582	44.	32.6	7.446	9.969	17.038	27.006	2.136	24.877	2409.	2641	38.13	59.42
37	.083	.075	2.070	2.145	.000	2.145	25943	51.	38.1	7.476	9.996	17.794	27.790	2.136	25.654	2428.	2605	38.28	61.30



# DETAILED RESULTS OF CASE 13

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR																	CUMULATIVES TO YEAR END																
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE															
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %														
	MMSTB DAY	MMMSCF/DAY					SCF STB	MO DAY	%	10 <sup>9</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA																
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4215	1.97	.07														
2	1.200	1.426	.000	1.426	1.312	.114	1188	7.	.6	.822	.876	.000	.876	.806	.070	2.	4130	4.21	.17														
3	1.200	1.642	.000	1.642	1.511	.131	1368	28.	2.3	1.260	1.476	.000	1.476	1.358	.118	13.	4055	6.45	.28														
4	1.200	1.252	.000	1.252	1.151	.101	1043	53.	4.2	1.479	1.705	.000	1.705	1.568	.137	23.	4025	7.57	.33														
5	1.200	1.502	.871	2.373	.000	2.373	1977	74.	5.8	1.698	1.979	.159	2.138	1.568	.570	36.	3939	8.69	1.36														
6	1.200	2.221	.358	2.579	.190	2.389	2149	120.	9.1	2.137	2.790	.290	3.080	1.638	1.442	80.	3742	10.94	3.45														
7	1.200	2.316	.284	2.600	.209	2.391	2167	117.	8.9	2.575	3.636	.394	4.030	1.714	2.316	123.	3611	13.19	5.53														
8	1.200	2.285	.121	2.406	.030	2.376	2005	225.	15.8	3.013	4.471	.438	4.909	1.725	3.184	205.	3492	15.43	7.61														
9	1.200	2.622	.024	2.646	.252	2.394	2205	442.	26.9	3.452	5.429	.446	5.875	1.817	4.058	365.	3387	17.68	9.70														
10	1.200	2.022	.362	2.384	.011	2.373	1987	296.	19.8	3.890	6.167	.579	6.746	1.821	4.925	474.	3319	19.92	11.77														
11	1.198	1.274	1.099	2.373	.000	2.373	1981	398.	24.9	4.377	6.632	.980	7.612	1.821	5.791	620.	3247	22.16	13.84														
12	1.069	1.014	1.358	2.372	.000	2.372	2219	444.	29.3	4.718	7.093	1.476	8.479	1.821	6.658	782.	3187	24.16	15.91														
13	.921	.837	1.536	2.373	.000	2.373	2577	377.	29.0	5.054	7.300	2.037	9.346	1.821	7.525	919.	3137	25.88	17.98														
14	.793	.874	1.499	2.373	.000	2.373	2992	355.	30.9	5.344	7.628	2.584	10.212	1.821	8.791	1049.	3090	27.36	20.05														
15	.683	.623	1.750	2.373	.000	2.373	3474	414.	37.7	5.594	7.855	3.224	11.079	1.821	9.258	1200.	3049	28.64	22.12														
16	.589	.576	1.796	2.372	.000	2.372	4027	382.	39.3	5.809	8.066	3.880	11.946	1.821	10.125	1340.	3014	29.75	24.19														
17	.468	.455	1.918	2.373	.000	2.373	5071	353.	43.0	5.979	8.232	4.580	12.812	1.821	10.991	1469.	2984	30.62	26.26														
18	.396	.362	2.011	2.373	.000	2.373	5992	328.	45.3	6.124	8.364	5.314	13.678	1.821	11.857	1589.	2956	31.36	28.33														
19	.364	.322	2.051	2.373	.000	2.373	6519	252.	40.9	6.257	8.482	6.064	14.546	1.821	12.725	1681.	2933	32.04	30.40														
20	.354	.287	2.086	2.373	.000	2.373	6703	182.	34.0	6.387	8.587	6.825	15.412	1.821	13.591	1748.	2915	32.71	32.47														
21	.310	.322	2.050	2.372	.000	2.372	7652	196.	38.7	6.500	8.705	7.574	16.279	1.821	14.458	1819.	2890	33.28	34.55														
22	.269	.272	2.101	2.373	.000	2.373	8822	193.	41.8	6.598	8.804	8.342	17.146	1.821	15.325	1889.	2862	33.79	36.62														
23	.240	.216	2.157	2.373	.000	2.373	9887	153.	38.9	6.686	8.883	9.130	18.017	1.821	16.192	1945.	2833	34.24	38.69														
24	.219	.205	2.168	2.373	.000	2.373	11100	144.	40.7	6.762	8.957	9.921	18.878	1.821	17.057	1998.	2803	34.63	40.76														
25	.185	.180	2.193	2.373	.000	2.373	12827	142.	43.4	6.830	9.023	10.722	19.745	1.821	17.924	2050.	2791	34.97	42.83														
26	.169	.144	2.229	2.373	.000	2.373	14041	142.	45.7	6.892	9.076	11.536	20.612	1.821	18.791	2101.	2779	35.29	44.90														
27	.174	.152	2.221	2.373	.000	2.373	13638	106.	37.9	6.955	9.131	12.347	21.478	1.821	19.657	2140.	2757	35.61	46.97														
28	.153	.130	2.242	2.372	.000	2.372	15503	94.	38.1	7.011	9.179	13.166	22.745	1.821	20.524	2174.	2731	35.90	49.04														
29	.138	.118	2.254	2.372	.000	2.372	17188	99.	41.8	7.061	9.222	13.990	23.212	1.821	21.391	2211.	2710	36.16	51.11														
30	.131	.145	2.228	2.373	.000	2.373	18115	73.	35.8	7.109	9.275	14.804	24.079	1.821	22.258	2237.	2597	36.40	53.18														
31	.124	.149	2.224	2.373	.000	2.373	19137	57.	31.5	7.154	9.329	15.616	24.945	1.821	23.124	2258.	2566	36.63	55.25														
32	.115	.096	2.277	2.373	.000	2.377	20635	62.	35.0	7.196	9.364	16.448	25.812	1.821	23.991	2281.	2527	36.85	57.32														
33	.108	.091	2.281	2.372	.000	2.372	21963	65.	37.6	7.235	9.398	17.281	26.679	1.821	24.858	2305.	2505	37.05	59.40														
34	.100	.087	2.285	2.372	.000	2.372	23720	73.	42.2	7.272	9.430	18.115	27.546	1.821	25.725	2331.	2557	37.24	61.47														
35	.095	.085	2.287	2.372	.000	2.372	24968	63.	39.9	7.307	9.461	18.951	28.412	1.821	26.591	2354.	2513	37.42	63.54														
36	.091	.080	2.293	2.373	.000	2.373	26077	47.	32.1	7.340	9.490	19.788	29.278	1.821	27.457	2370.	2474	37.59	65.60														
37	.085	.080	2.293	2.373	.000	2.373	27918	47.	35.6	7.371	9.519	20.626	30.145	1.821	28.324	2387.	2446	37.74	67.68														

TABLE XIV

# DETAILED RESULTS OF CASE 14

AQUIFER

WITH WATER INJECTION

GAS INJECTION

GAS SALES

YEAR	AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE		
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS	
MMSTB DAY	MMMSCF/DAY					SCF STB	MB DAY	%	10 <sup>8</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA	%	%		
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07	
2	1.200	1.426	.000	1.426	1.312	.114	1188	7.	.6	.822	.876	.000	.876	.805	.070	2.	4130	4.21	.17	
3	1.200	1.642	.000	1.642	1.511	.131	1368	28.	2.3	1.260	1.476	.000	1.476	1.358	.118	13.	4055	6.45	.28	
4	1.200	1.252	.000	1.252	1.151	.101	1043	53.	4.2	1.479	1.705	.000	1.705	1.568	.137	23.	4025	7.57	.33	
5	1.200	1.508	2.001	3.509	.000	3.509	2924	74.	5.8	1.698	1.980	.365	2.345	1.568	.777	36.	3911	8.69	1.86	
6	1.200	1.949	1.560	3.509	.000	3.509	2924	123.	9.3	2.137	2.692	.935	3.627	1.568	2.859	81.	3671	10.94	4.92	
7	1.200	2.423	1.087	3.510	.000	3.510	2925	125.	9.4	2.575	3.577	1.332	4.909	1.568	3.341	127.	3494	13.19	7.98	
8	1.200	1.798	1.711	3.509	.000	3.509	2924	267.	18.2	3.013	4.233	1.957	6.190	1.568	4.622	224.	3347	15.43	11.04	
9	1.200	1.737	1.772	3.509	.000	3.509	2924	475.	28.4	3.452	4.868	2.604	7.472	1.568	5.904	398.	3220	17.68	14.11	
10	1.200	1.286	2.223	3.509	.000	3.509	2924	305.	20.3	3.890	5.337	3.416	8.753	1.568	7.185	509.	3122	19.92	17.17	
11	1.163	1.085	2.424	3.509	.000	3.509	3017	413.	26.2	4.315	5.734	4.302	10.036	1.568	8.468	660.	3024	22.10	20.23	
12	.969	.978	2.531	3.509	.000	3.509	3621	477.	33.0	4.669	6.091	5.226	11.317	1.568	9.749	834.	2945	23.91	23.29	
13	.853	.835	2.674	3.509	.000	3.509	4114	311.	26.7	4.980	6.396	6.203	12.599	1.568	11.031	948.	2880	25.50	26.36	
14	.742	.711	2.798	3.509	.000	3.509	4729	339.	31.4	5.251	6.656	7.225	13.881	1.568	12.313	1072.	2815	26.89	29.42	
15	.622	.740	2.769	3.509	.000	3.509	5641	383.	38.1	5.478	6.926	8.236	15.162	1.568	13.594	1212.	2755	28.05	32.48	
16	.485	.454	3.055	3.509	.000	3.509	7235	360.	42.6	5.655	7.092	9.352	16.444	1.568	14.876	1347.	2706	28.96	35.54	
17	.385	.443	3.066	3.509	.000	3.509	9114	348.	47.8	5.796	7.254	10.472	17.726	1.568	16.158	1470.	2668	29.68	38.61	
18	.364	.332	3.177	3.509	.000	3.509	9640	243.	40.0	5.929	7.375	11.633	19.008	1.568	17.440	1559.	2625	30.36	41.67	
19	.326	.370	3.139	3.509	.000	3.509	10764	198.	37.8	6.048	7.510	12.779	20.289	1.568	18.721	1631.	2574	30.97	44.73	
20	.290	.273	3.237	3.510	.000	3.510	12103	176.	37.8	6.154	7.609	13.961	21.570	1.568	20.002	1695.	2518	31.51	47.79	
21	.249	.237	3.272	3.509	.000	3.509	14092	179.	41.8	6.245	7.696	15.157	22.853	1.568	21.285	1761.	2479	31.98	50.86	
22	.230	.216	3.293	3.509	.000	3.509	15257	128.	35.8	6.329	7.775	16.359	24.134	1.568	22.566	1807.	2454	32.41	53.92	
23	.203	.193	3.316	3.509	.000	3.509	17286	144.	41.5	6.403	7.845	17.570	25.415	1.568	23.847	1860.	2406	32.79	56.98	
24	.181	.191	3.318	3.509	.000	3.509	19387	130.	41.8	6.469	7.915	18.782	26.697	1.568	25.129	1907.	2365	33.13	60.04	
25	.155	.201	3.308	3.509	.000	3.509	22639	143.	48.0	6.526	7.989	19.991	27.980	1.568	26.412	1960.	2332	33.42	63.11	
26	.142	.173	3.336	3.509	.000	3.509	24711	131.	46.0	6.578	8.052	21.209	29.261	1.568	27.693	2007.	2266	33.68	66.17	
27	.133	.132	3.377	3.509	.000	3.509	26383	82.	38.1	6.627	8.109	22.447	30.543	1.568	28.975	2037.	2210	33.97	69.23	

# DETAILED RESULTS OF CASE 15

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
	MMSTB DAY	MMMSCF/DAY					SCF STB	MB DAY	%	10 <sup>8</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA		
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07
2	1.200	1.426	.000	1.426	1.312	.114	1188	7.	.6	.822	.876	.000	.876	.806	.070	7.	4130	6.21	.17
3	1.200	1.642	.000	1.642	1.511	.131	1368	28.	2.3	1.260	1.476	.000	1.476	1.358	.118	13.	4055	6.45	.28
4	1.200	1.252	.900	1.252	1.151	.101	1043	57.	4.2	1.479	1.705	.000	1.705	1.568	.137	23.	4025	7.57	.33
5	1.200	1.497	3.148	4.645	.000	4.645	3871	75.	5.9	1.698	1.978	.575	2.553	1.568	.985	36.	3884	8.69	2.35
6	1.200	1.669	2.977	4.646	.000	4.646	3872	125.	9.4	2.137	2.587	1.662	4.249	1.568	2.681	82.	3599	10.94	6.41
7	1.200	2.198	2.447	4.645	.000	4.645	3871	126.	9.5	2.575	3.390	2.556	5.946	1.568	4.378	128.	3380	13.19	10.46
8	1.200	2.143	2.503	4.646	.000	4.646	3872	310.	20.5	3.013	4.173	3.470	7.643	1.568	6.075	241.	3200	15.43	14.52
9	1.200	1.955	2.791	4.646	.000	4.646	3872	462.	27.8	3.452	4.850	4.489	9.339	1.568	7.771	410.	3054	17.68	18.57
10	1.200	1.763	2.883	4.646	.000	4.646	3872	315.	20.8	3.890	5.494	5.542	11.036	1.568	9.468	525.	2970	19.92	22.62
11	1.081	1.326	3.319	4.645	.000	4.645	4297	502.	31.7	4.285	5.979	6.755	12.734	1.568	11.166	708.	2814	21.94	26.68
12	.885	.953	3.692	4.645	.000	4.645	5249	429.	32.6	4.608	6.327	8.103	14.430	1.568	12.862	865.	2723	23.60	30.73
13	.767	.783	3.862	4.645	.000	4.645	6056	321.	29.5	4.888	6.617	9.514	16.127	1.568	14.559	982.	2636	25.03	34.79
14	.669	.674	3.971	4.645	.000	4.645	6943	320.	32.4	5.172	6.859	10.965	17.824	1.568	16.256	1099.	2550	26.28	38.84
15	.536	.577	4.068	4.645	.000	4.645	8666	386.	41.9	5.328	7.070	12.450	19.520	1.568	17.952	1240.	2484	27.28	42.89
16	.391	.443	4.202	4.645	.000	4.645	11880	341.	46.6	5.471	7.232	13.985	21.217	1.568	19.649	1364.	2422	28.01	46.95
17	.332	.483	4.162	4.645	.000	4.645	13991	313.	48.5	5.592	7.408	15.506	22.914	1.568	21.346	1479.	2343	28.63	51.00
18	.295	.309	4.337	4.646	.000	4.646	15749	211.	41.7	5.700	7.521	17.090	24.611	1.568	23.043	1556.	2264	29.19	55.06
19	.262	.278	4.367	4.645	.000	4.645	17729	170.	39.4	5.796	7.623	18.685	26.308	1.568	24.740	1618.	2200	29.68	59.11
20	.236	.255	4.391	4.646	.000	4.646	19686	167.	41.4	5.882	7.716	20.288	28.004	1.568	25.436	1679.	2146	30.12	63.17
21	.210	.225	4.420	4.645	.000	4.645	22119	138.	39.7	5.959	7.798	21.903	29.701	1.568	28.133	1729.	2076	30.51	67.22

TABLE XVI

# DETAILED RESULTS OF CASE 16

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL	TOTAL
	MMSTB DAY	MMMSCF/DAY					SCF STB	MB DAY	%	10 <sup>9</sup> STB	TRILLION SCF					10 <sup>6</sup> B	PSIA	%	%
1	1.050	.972	.000	.972	.895	.077	926	0.	.9	.394	.355	.000	.355	.327	.028	0.	4216	1.97	.07
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	3.	4108	4.58	.19
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	7.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.73
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41
5	1.600	3.964	.000	3.964	2.300	1.664	2477	158.	9.0	2.064	2.887	.000	2.887	2.410	.477	70.	3843	10.57	1.14
6	1.600	1.752	.084	1.836	.342	1.494	1147	170.	9.6	2.648	3.526	.031	3.557	2.535	1.022	132.	3732	13.56	2.44
7	1.600	2.947	.000	2.947	1.365	1.582	1842	238.	12.9	3.232	4.607	.071	4.634	3.033	1.661	219.	3575	16.55	3.83
8	1.410	3.712	.000	3.712	2.068	1.644	2673	417.	22.8	3.747	5.959	.031	5.990	3.789	2.201	372.	3485	19.19	5.26
9	1.300	2.819	.000	2.819	1.247	1.572	2168	221.	14.5	4.222	6.988	.031	7.019	4.244	2.775	453.	3476	21.62	6.63
10	1.089	1.401	.302	1.703	.220	1.483	1564	398.	26.8	4.620	7.500	.141	7.641	4.325	3.316	598.	3399	23.66	7.92
11	.978	1.343	.121	1.464	.000	1.464	1497	360.	26.9	4.977	7.990	.185	8.175	4.325	3.850	729.	3353	25.49	9.20
12	.865	.893	.571	1.464	.000	1.464	1692	290.	25.1	5.293	8.317	.394	8.711	4.325	4.386	835.	3116	27.10	10.48
13	.758	.835	.628	1.463	.000	1.463	1930	369.	32.7	5.570	8.622	.623	9.245	4.325	4.920	970.	3280	28.52	11.76
14	.679	.629	.835	1.464	.000	1.464	2156	367.	35.1	5.818	8.851	.928	9.779	4.325	5.454	1104.	3249	29.79	13.03
15	.578	.726	.738	1.464	.000	1.464	2533	389.	40.2	6.029	9.117	1.197	10.314	4.325	5.089	1246.	3222	30.87	14.31
16	.508	.457	1.006	1.463	.000	1.463	2880	294.	76.7	6.215	9.284	1.565	10.849	4.325	6.524	1354.	3205	31.82	15.59
17	.434	.417	1.047	1.464	.000	1.464	3373	339.	43.9	6.773	9.436	1.947	11.383	4.325	7.058	1477.	3186	32.63	16.86
18	.402	.432	1.032	1.464	.000	1.464	3642	262.	39.5	6.520	9.594	2.324	11.918	4.325	7.593	1573.	3171	33.39	18.14
19	.361	.338	1.125	1.463	.000	1.463	4053	248.	40.7	6.652	9.717	2.775	12.452	4.325	8.127	1664.	3157	34.06	19.42
20	.304	.300	1.164	1.464	.000	1.464	4816	170.	35.9	6.763	9.827	3.160	12.987	4.325	8.662	1726.	3148	34.63	20.70
21	.283	.234	1.229	1.463	.000	1.463	5176	166.	37.0	6.867	9.912	3.609	13.521	4.325	9.196	1786.	3135	35.16	21.97
22	.261	.258	1.206	1.464	.000	1.464	5609	150.	36.5	6.962	10.006	4.050	14.056	4.325	9.731	1841.	3123	35.65	23.25
23	.225	.264	1.200	1.464	.000	1.464	6507	143.	38.9	7.044	10.103	4.488	14.591	4.325	10.266	1893.	3113	36.07	24.53
24	.197	.158	1.305	1.463	.000	1.463	7426	129.	70.6	7.116	10.161	4.965	15.126	4.325	10.801	1940.	3107	36.44	25.81
25	.177	.138	1.325	1.463	.000	1.463	8266	120.	40.4	7.181	10.211	5.449	15.660	4.325	11.335	1984.	3100	36.77	27.08
26	.177	.138	1.326	1.464	.000	1.464	8271	96.	75.2	7.245	10.261	5.933	16.194	4.325	11.869	2019.	3091	37.10	28.36
27	.166	.130	1.334	1.464	.000	1.464	8819	111.	37.8	7.306	10.309	6.420	16.729	4.325	12.404	2056.	3077	37.41	29.64
28	.155	.121	1.343	1.464	.000	1.464	9445	116.	42.8	7.363	10.353	6.911	17.264	4.325	12.939	2099.	3061	37.70	30.92
29	.149	.123	1.341	1.464	.000	1.464	9826	96.	79.2	7.417	10.398	7.400	17.798	4.325	13.473	2133.	3045	37.98	32.19
30	.143	.167	1.297	1.464	.000	1.464	10238	61.	29.9	7.469	10.459	7.874	18.373	4.325	14.008	2156.	3031	38.25	33.47
31	.132	.132	1.331	1.463	.000	1.463	11083	68.	34.0	7.517	10.507	8.360	18.867	4.325	14.542	2181.	3017	38.49	34.75
32	.120	.101	1.362	1.463	.000	1.463	12192	81.	40.3	7.561	10.544	8.858	19.402	4.325	15.077	2210.	3012	38.72	36.02
33	.112	.091	1.372	1.463	.000	1.463	13062	89.	44.3	7.602	10.577	9.359	19.936	4.325	15.611	2247.	3008	38.93	37.30
34	.104	.087	1.377	1.464	.030	1.464	14077	85.	45.0	7.640	10.609	9.862	20.471	4.325	16.146	2274.	2999	39.12	38.58
35	.097	.080	1.384	1.464	.000	1.464	15093	49.	33.6	7.676	10.638	10.368	21.006	4.325	16.681	2292.	2987	39.31	39.86
36	.091	.077	1.387	1.464	.000	1.464	16088	55.	37.7	7.709	10.666	10.874	21.540	4.325	17.215	2312.	2972	39.47	41.13
37	.085	.072	1.391	1.463	.000	1.463	17212	64.	43.0	7.740	10.693	11.382	22.075	4.325	17.750	2335.	2952	39.63	42.41
38	.081	.070	1.394	1.464	.000	1.464	18074	66.	44.9	7.769	10.718	11.891	22.609	4.325	18.284	2350.	2936	39.78	43.69

# DETAILED RESULTS OF CASE 17

AQUIFER

WITH WATER INJECTION

GAS INJECTION

GAS SALES

AVERAGE RATES FOR YEAR											CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE		
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %	
																				MMSTB DAY
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.755	.000	.755	.377	.028	0.	4216	1.97	.07	
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	7.	4108	4.58	.19	
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	3.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.33	
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41	
5	1.600	3.952	.000	3.952	1.871	2.081	2470	159.	9.0	2.064	2.884	.000	2.884	2.331	.553	70.	3838	10.57	1.32	
6	1.600	1.729	.461	2.190	.249	1.941	1369	165.	9.3	2.648	3.516	.168	3.684	2.422	1.262	131.	3707	13.56	3.02	
7	1.599	2.688	.017	2.705	.724	1.981	1692	253.	13.7	3.232	4.498	.174	4.672	2.667	1.985	223.	3544	16.55	4.74	
8	1.413	3.397	.000	3.397	1.360	2.037	2409	389.	21.6	3.747	5.778	.174	5.912	3.184	2.728	765.	3444	19.19	6.52	
9	1.293	2.066	.144	2.210	.268	1.942	1709	231.	15.2	4.219	6.497	.227	6.720	3.282	3.438	449.	3389	21.60	8.21	
10	1.076	1.126	.792	1.918	.000	1.918	1783	418.	28.0	4.612	6.904	.515	7.420	3.282	4.138	602.	3326	23.62	9.89	
11	.940	.968	.950	1.918	.000	1.918	2040	348.	27.0	4.956	7.258	.867	8.121	3.282	4.839	729.	3276	25.38	11.56	
12	.810	.792	1.126	1.918	.000	1.918	2368	344.	29.8	5.252	7.547	1.275	8.822	3.282	5.547	854.	3228	26.89	13.24	
13	.743	.734	1.184	1.918	.000	1.918	2581	317.	29.9	5.523	7.815	1.707	9.522	3.282	6.240	970.	3145	28.28	14.91	
14	.640	.554	1.364	1.918	.000	1.918	2997	269.	38.6	5.757	8.018	2.205	10.223	3.282	6.941	1105.	3149	29.48	16.58	
15	.549	.574	1.344	1.918	.000	1.918	3494	326.	37.3	5.957	8.228	2.696	10.924	3.282	7.642	1224.	3121	30.50	18.26	
16	.474	.433	1.485	1.918	.000	1.918	4046	332.	41.2	6.130	8.386	3.238	11.624	3.282	8.347	1345.	3092	31.39	19.93	
17	.399	.594	1.324	1.918	.000	1.918	4807	322.	44.7	6.276	8.603	3.722	12.325	3.282	9.043	1463.	3066	32.14	21.61	
18	.355	.438	1.480	1.918	.000	1.918	5403	266.	42.8	6.406	8.767	4.267	13.026	3.282	9.744	1560.	3046	32.80	23.28	
19	.307	.284	1.635	1.919	.000	1.919	6251	164.	34.8	6.518	8.866	4.850	13.725	3.282	10.444	1620.	3028	33.38	24.95	
20	.276	.283	1.635	1.918	.000	1.918	6949	177.	39.1	6.619	8.970	5.457	14.427	3.282	11.145	1684.	3008	33.89	26.63	
21	.254	.249	1.669	1.918	.000	1.918	7551	136.	34.9	6.711	9.061	6.064	15.127	3.282	11.845	1734.	2997	34.76	28.30	
22	.228	.194	1.725	1.919	.000	1.919	8417	139.	37.9	6.795	9.132	6.696	15.828	3.282	12.546	1785.	2981	34.79	29.98	
23	.205	.184	1.734	1.918	.000	1.918	9356	121.	37.1	6.869	9.199	7.330	16.529	3.282	13.247	1829.	2966	35.17	31.65	
24	.174	.217	1.701	1.918	.000	1.918	11023	119.	40.6	6.933	9.278	7.951	17.229	3.282	13.947	1872.	2944	35.50	33.32	
25	.153	.165	1.753	1.918	.000	1.918	12536	135.	46.9	6.989	9.338	8.591	17.929	3.282	14.647	1921.	2920	35.79	35.00	
26	.156	.126	1.792	1.918	.000	1.918	12295	88.	36.1	7.046	9.384	9.246	18.639	3.282	15.348	1954.	2909	36.08	36.67	
27	.148	.116	1.802	1.918	.000	1.918	12959	79.	34.8	7.100	9.427	9.904	19.731	3.282	16.049	1982.	2877	36.36	38.35	
28	.139	.109	1.809	1.918	.000	1.918	13799	91.	39.6	7.150	9.466	10.565	20.031	3.282	16.749	2016.	2866	36.61	40.02	
29	.138	.109	1.809	1.918	.000	1.918	13899	70.	33.7	7.201	9.506	11.226	20.732	3.282	17.450	2041.	2859	36.87	41.69	
30	.133	.104	1.814	1.918	.000	1.918	14421	70.	34.5	7.250	9.544	11.889	21.433	3.282	18.151	2067.	2842	37.12	43.37	
31	.125	.099	1.819	1.918	.000	1.918	15344	73.	36.9	7.295	9.581	12.553	22.134	3.282	18.852	2093.	2819	37.35	45.04	
32	.112	.141	1.777	1.918	.000	1.918	17125	74.	39.8	7.376	9.637	13.207	22.834	3.282	19.557	2120.	2791	37.56	46.72	
33	.097	.087	1.832	1.919	.000	1.919	19784	78.	44.6	7.371	9.664	13.871	23.535	3.282	20.253	2149.	2768	37.74	48.39	
34	.091	.070	1.848	1.918	.000	1.918	21077	60.	39.7	7.405	9.689	14.546	24.235	3.282	20.953	2170.	2754	37.92	50.06	
35	.087	.065	1.854	1.919	.000	1.919	22057	50.	36.5	7.436	9.713	15.223	24.936	3.282	21.654	2189.	2750	38.08	51.74	
36	.081	.060	1.858	1.918	.000	1.918	23679	54.	40.0	7.466	9.735	15.902	25.637	3.282	22.355	2209.	2721	38.23	53.41	
37	.076	.059	1.859	1.918	.000	1.918	25237	53.	41.1	7.494	9.756	16.581	26.737	3.282	23.055	2228.	2697	38.37	55.09	

# DETAILED RESULTS OF CASE 18

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

AVERAGE RATES FOR YEAR											CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE DIL PRESS	RECOVERY OF ORIGINAL IN-PLACE		
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %	
																				MMSTB DAY
	1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.755	.000	.355	.727	.028	0.	4216	1.97	.07
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	7.	4108	4.58	.13	
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	3.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.39	
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41	
5	1.600	3.948	.000	3.948	1.854	2.289	2467	159.	9.0	2.064	2.844	.000	2.844	2.293	.591	70.	3834	10.57	1.41	
6	1.600	1.741	.637	2.378	.214	2.164	1486	163.	9.2	2.648	1.520	.237	1.757	2.771	1.382	130.	3588	13.56	3.70	
7	1.598	2.715	.051	2.766	.571	2.195	1731	254.	13.7	3.232	4.511	.251	4.762	2.579	2.183	223.	3519	16.55	5.22	
8	1.399	3.433	.000	3.433	1.184	2.249	2454	369.	21.8	3.743	5.765	.251	6.016	3.012	3.004	365.	3413	19.17	7.18	
9	1.280	1.885	.304	2.189	.040	2.149	1710	234.	15.5	4.210	6.454	.762	6.816	3.026	3.790	451.	3754	21.56	9.06	
10	1.065	1.162	.983	2.145	.000	2.145	2914	418.	28.2	4.599	6.878	.721	7.599	3.026	4.573	603.	3281	23.55	10.93	
11	.915	.937	1.209	2.146	.000	2.146	2345	370.	28.8	4.933	7.220	1.163	8.383	3.026	5.357	778.	3227	25.26	12.80	
12	.797	.806	1.339	2.145	.000	2.145	2691	328.	29.2	5.224	7.515	1.652	9.167	3.026	6.141	858.	3177	26.75	14.67	
13	.726	.706	1.439	2.145	.000	2.145	2955	313.	30.1	5.490	7.773	2.178	9.951	3.026	6.925	973.	3131	28.11	16.55	
14	.619	.570	1.575	2.145	.000	2.145	3465	378.	37.9	5.715	7.981	2.753	10.734	3.026	7.708	1110.	3089	29.26	18.42	
15	.533	.558	1.587	2.145	.000	2.145	4024	308.	36.6	5.910	8.185	2.333	11.514	3.026	8.492	1223.	3057	30.26	20.29	
16	.451	.414	1.732	2.146	.000	2.146	4758	327.	42.0	6.075	8.376	3.365	12.301	3.026	9.275	1342.	3026	31.11	22.16	
17	.383	.392	1.753	2.145	.000	2.145	5601	328.	46.1	6.215	8.479	4.505	13.085	3.026	10.059	1462.	2997	31.82	24.03	
18	.349	.436	1.710	2.146	.000	2.146	6149	236.	40.7	6.743	8.678	5.230	13.868	3.026	10.842	1548.	2971	32.48	25.91	
19	.300	.376	1.770	2.146	.000	2.146	7153	164.	35.3	6.452	8.775	5.877	14.652	3.026	11.626	1678.	2949	33.04	27.78	
20	.264	.278	1.867	2.145	.000	2.145	8125	196.	42.6	6.549	8.877	6.559	15.436	3.026	12.410	1680.	2926	33.53	29.65	
21	.243	.267	1.879	2.146	.000	2.146	8831	156.	39.1	6.638	8.974	7.245	16.219	3.026	13.193	1737.	2910	33.99	31.52	
22	.209	.192	1.953	2.145	.000	2.145	10263	155.	42.6	6.714	9.044	7.959	17.003	3.026	13.977	1793.	2893	34.38	33.40	
23	.192	.168	1.978	2.146	.000	2.146	11177	113.	37.0	6.784	9.106	8.681	17.787	3.026	14.761	1835.	2869	34.74	35.27	
24	.168	.157	1.989	2.146	.000	2.146	12774	123.	42.3	6.845	9.163	9.407	18.570	3.026	15.544	1880.	2838	35.05	37.14	
25	.150	.175	1.971	2.146	.000	2.146	14307	135.	47.4	6.900	9.227	10.127	19.354	3.026	16.328	1929.	2811	35.33	39.01	
26	.151	.164	1.982	2.146	.000	2.146	14212	70.	31.7	6.955	9.286	10.851	20.137	3.026	17.111	1955.	2788	35.61	40.88	
27	.143	.118	2.028	2.146	.000	2.146	15007	81.	76.2	7.007	9.329	11.592	20.921	3.026	17.895	1984.	2779	35.88	42.76	
28	.133	.108	2.037	2.145	.000	2.145	16128	96.	41.9	7.056	9.369	12.336	21.705	3.026	18.679	2019.	2764	36.13	44.63	
29	.134	.107	2.039	2.146	.000	2.146	16015	65.	32.7	7.104	9.408	13.081	22.489	3.026	19.463	2043.	2743	36.78	46.50	
30	.126	.103	2.043	2.146	.000	2.146	17032	66.	34.4	7.150	9.445	13.827	23.272	3.026	20.246	2067.	2714	36.61	48.38	
31	.115	.095	2.051	2.146	.000	2.146	18651	67.	36.8	7.192	9.480	14.576	24.056	3.026	21.030	2091.	2684	36.83	50.25	
32	.108	.090	2.056	2.146	.000	2.146	19870	67.	38.3	7.232	9.513	15.325	24.839	3.026	21.813	2116.	2670	37.07	52.12	
33	.100	.090	2.055	2.145	.000	2.145	21450	79.	44.1	7.268	9.546	16.077	25.623	3.026	22.597	2145.	2553	37.22	53.99	
34	.092	.122	2.024	2.146	.000	2.146	23326	54.	77.0	7.302	9.590	16.816	26.406	3.026	23.380	2165.	2522	37.39	55.86	
35	.083	.065	2.081	2.146	.000	2.146	25855	45.	35.2	7.332	9.614	17.575	27.190	3.026	24.164	2181.	2502	37.54	57.74	
36	.078	.060	2.085	2.145	.000	2.145	27500	48.	78.1	7.361	9.636	18.338	27.974	3.026	24.948	2199.	2564	37.69	59.61	
37	.073	.058	2.088	2.146	.000	2.146	29397	54.	42.5	7.387	9.657	19.101	28.758	3.026	25.732	2219.	2525	37.83	61.48	

TABLE XIX

# DETAILED RESULTS OF CASE 19

AQUIFER

WITH WATER INJECTION

GAS INJECTION

GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
								SCF STB	MB DAY	%									
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.355	.327	.028	0.	4216	1.97	.07
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	3.	4108	4.58	.19
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	7.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.33
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41
5	1.600	3.943	.000	3.943	1.445	2.498	2464	159.	9.0	2.064	2.883	.000	2.883	2.254	.629	70.	3830	10.57	1.50
6	1.600	1.740	.826	2.566	.178	2.388	1604	164.	9.3	2.648	3.518	.307	3.820	2.318	1.502	130.	3673	13.56	3.59
7	1.596	2.625	.112	2.737	.335	2.402	1715	259.	14.0	3.231	4.477	.343	4.820	2.441	2.379	225.	3500	16.54	5.68
8	1.399	3.348	.016	3.364	.911	2.453	2405	376.	21.2	3.742	5.700	.348	6.048	2.774	3.274	363.	3389	19.16	7.82
9	1.271	1.694	.678	2.372	.000	2.372	1866	246.	16.2	4.206	6.319	.596	6.915	2.774	4.141	452.	3321	21.54	9.89
10	1.049	1.058	1.314	2.372	.000	2.372	2261	417.	28.4	4.590	6.705	1.076	7.781	2.774	5.007	604.	3244	23.50	11.96
11	.922	1.096	1.277	2.373	.000	2.373	2574	380.	29.2	4.926	7.105	1.543	8.648	2.774	5.874	743.	3181	25.22	14.04
12	.827	.851	1.522	2.373	.000	2.373	2869	293.	26.2	5.228	7.416	2.099	9.515	2.774	6.741	850.	3129	26.77	16.11
13	.734	.711	1.662	2.373	.000	2.373	3273	312.	29.8	5.496	7.676	2.706	10.382	2.774	7.608	964.	3079	28.14	18.18
14	.641	.611	1.762	2.373	.000	2.373	3702	351.	35.4	5.730	7.899	3.349	11.248	2.774	8.474	1092.	2935	29.74	20.25
15	.555	.572	1.801	2.373	.000	2.373	4276	310.	35.8	5.933	8.107	4.007	12.114	2.774	9.340	1206.	2997	30.38	22.32
16	.466	.431	1.942	2.373	.000	2.373	5092	342.	42.3	6.103	8.265	4.717	12.982	2.774	10.208	1331.	2961	31.25	24.39
17	.407	.400	1.973	2.373	.000	2.373	5830	326.	44.5	6.257	8.411	5.437	13.848	2.774	11.074	1450.	2928	32.01	26.46
18	.362	.335	2.038	2.373	.000	2.373	6555	186.	33.9	6.384	8.533	6.182	14.715	2.774	11.941	1518.	2902	32.69	28.53
19	.334	.409	1.964	2.373	.000	2.373	7105	175.	34.4	6.506	8.682	6.899	15.581	2.774	12.807	1581.	2873	33.31	30.60
20	.289	.288	2.085	2.373	.000	2.373	8211	198.	40.7	6.612	8.787	7.669	16.447	2.774	13.673	1654.	2857	33.86	32.67
21	.261	.277	2.095	2.372	.000	2.372	9088	168.	39.2	6.707	8.889	8.426	17.315	2.774	14.541	1715.	2837	34.34	34.74
22	.228	.227	2.146	2.373	.000	2.373	10408	170.	42.7	6.790	8.971	9.210	18.181	2.774	15.407	1777.	2805	34.77	36.81
23	.201	.176	2.197	2.373	.000	2.373	11806	132.	39.6	6.864	9.036	10.012	19.048	2.774	16.274	1825.	2772	35.15	38.88
24	.179	.160	2.213	2.373	.000	2.373	13257	151.	45.8	6.929	9.094	10.920	19.914	2.774	17.140	1880.	2740	35.48	40.95
25	.162	.135	2.238	2.373	.000	2.373	14648	141.	46.5	6.988	9.144	11.638	20.782	2.774	18.008	1932.	2711	35.78	43.03
26	.160	.138	2.235	2.373	.000	2.373	14831	92.	36.5	7.047	9.194	12.454	21.648	2.774	18.874	1965.	2702	36.08	45.10
27	.141	.193	2.180	2.373	.000	2.373	16830	85.	37.6	7.098	9.264	13.250	22.514	2.774	19.740	1996.	2687	36.35	47.17
28	.127	.105	2.267	2.372	.000	2.372	18677	98.	43.6	7.144	9.303	14.078	23.381	2.774	20.607	2032.	2661	36.58	49.24
29	.129	.108	2.265	2.373	.000	2.373	18395	61.	37.1	7.191	9.342	14.905	24.247	2.774	21.473	2055.	2626	36.82	51.31
30	.118	.099	2.274	2.373	.000	2.373	20110	61.	34.1	7.235	9.378	15.736	25.114	2.774	22.340	2077.	2597	37.05	53.38
31	.110	.094	2.279	2.373	.000	2.373	21573	61.	35.7	7.275	9.413	16.568	25.981	2.774	23.207	2099.	2582	37.25	55.45
32	.102	.086	2.287	2.373	.000	2.373	23265	73.	41.7	7.312	9.444	17.403	26.847	2.774	24.073	2126.	2556	37.44	57.52
33	.094	.079	2.293	2.372	.000	2.372	25234	79.	45.7	7.367	9.473	18.241	27.714	2.774	24.940	2155.	2517	37.62	59.59
34	.092	.083	2.289	2.372	.000	2.372	25783	42.	31.3	7.380	9.504	19.077	28.581	2.774	25.807	2170.	2485	37.79	61.66
35	.085	.087	2.286	2.373	.000	2.373	27918	45.	34.6	7.411	9.535	19.912	29.447	2.774	26.673	2187.	2443	37.95	63.73
36	.079	.071	2.302	2.373	.000	2.373	30038	52.	39.7	7.440	9.561	20.753	30.314	2.774	27.540	2205.	2397	38.10	65.80
37	.074	.093	2.280	2.373	.000	2.373	32068	49.	39.8	7.467	9.595	21.586	31.181	2.774	28.407	2223.	2351	38.24	67.87

# DETAILED RESULTS OF CASE 20

AQUIFER

WITH WATER INJECTION

GAS INJECTION

GAS SALES

AVERAGE RATES FOR YEAR										CUMULATIVES TO YEAR END									
YEAR	OIL PROD  MMSTB DAY	GAS					TOTAL GOR  SCF STB	WATER PROD  MB DAY	WATER CUT  %	CUM OIL  10 <sup>6</sup> STB	GAS					WATER PROD  10 <sup>6</sup> B	AVE OIL PRESS  PSIA	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL %	TOTAL GAS %
1	1.050	.972	.000	.972	.895	.077	926	0.	0.	.784	.355	.000	.355	.727	.028	0.	4216	1.97	.07
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.983	.000	.983	.904	.079	3.	4108	4.50	.19
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	3.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.73
4	1.600	2.276	.000	2.276	2.094	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41
5	1.600	3.912	.118	4.030	.479	3.551	2519	159.	9.0	2.064	2.877	.022	2.899	2.077	.822	74.	3814	10.57	1.96
6	1.600	1.729	1.783	3.512	.003	3.509	2195	160.	9.1	2.648	3.508	.673	4.181	2.078	2.103	129.	3599	13.56	5.02
7	1.588	2.528	.989	3.517	.007	3.510	2215	286.	15.7	3.228	4.432	1.034	5.466	2.081	3.385	233.	3393	16.53	8.09
8	1.375	2.315	1.194	3.509	.000	3.509	2552	364.	20.9	3.730	5.278	1.470	6.748	2.081	4.667	366.	3262	19.10	11.15
9	1.247	1.452	2.057	3.509	.000	3.509	2814	709.	19.9	4.186	5.898	2.221	8.029	2.081	5.948	479.	3153	21.43	14.21
10	1.012	1.099	2.410	3.509	.000	3.509	3467	420.	20.3	4.556	6.209	3.102	9.311	2.081	7.230	631.	3055	23.33	17.28
11	.864	.838	2.672	3.510	.000	3.510	4062	389.	31.0	4.871	6.515	4.077	10.592	2.081	8.511	775.	2974	24.94	20.34
12	.757	.897	2.612	3.509	.000	3.509	4635	703.	28.6	5.148	6.843	5.031	11.874	2.081	9.793	865.	2899	26.76	23.40
13	.640	.637	2.872	3.509	.000	3.509	5483	738.	34.6	5.382	7.076	6.081	13.157	2.081	11.076	1009.	2831	27.56	26.46
14	.562	.612	2.897	3.509	.000	3.509	6244	703.	35.0	5.587	7.299	7.139	14.438	2.081	12.357	1120.	2771	28.61	29.53
15	.453	.436	3.073	3.509	.000	3.509	7746	328.	42.0	5.752	7.458	8.261	15.719	2.081	13.638	1239.	2716	29.45	32.59
16	.380	.417	3.092	3.509	.000	3.509	9234	343.	47.4	5.891	7.611	9.391	17.002	2.081	14.921	1365.	2658	30.17	35.65
17	.323	.303	3.207	3.510	.000	3.510	10867	206.	38.9	6.009	7.721	10.562	18.283	2.081	16.202	1440.	2522	30.77	38.71
18	.307	.300	3.209	3.509	.000	3.509	11430	167.	35.2	6.121	7.831	11.734	19.565	2.081	17.484	1501.	2581	31.34	41.78
19	.269	.253	3.256	3.509	.000	3.509	13045	190.	41.4	6.219	7.923	12.923	20.446	2.081	18.765	1571.	2529	31.84	44.84
20	.244	.238	3.271	3.509	.000	3.509	14381	151.	38.2	6.308	8.010	14.115	22.128	2.081	20.047	1626.	2473	32.30	47.90
21	.217	.277	3.232	3.509	.000	3.509	16171	142.	39.6	6.388	8.111	15.298	23.409	2.081	21.328	1678.	2417	32.71	50.96
22	.185	.222	3.287	3.509	.000	3.509	18968	126.	40.5	6.455	8.192	16.499	24.691	2.081	22.610	1724.	2390	33.05	54.02
23	.166	.175	3.334	3.509	.000	3.509	21139	125.	43.0	6.516	8.256	17.717	25.973	2.081	23.892	1769.	2344	33.37	57.09
24	.147	.172	3.337	3.509	.000	3.509	23871	146.	49.8	6.569	8.319	18.976	27.255	2.081	25.174	1822.	2296	33.64	60.15
25	.142	.173	3.336	3.509	.000	3.509	24711	112.	44.1	6.621	8.382	20.154	28.536	2.081	26.455	1867.	2254	33.90	62.21
26	.124	.133	3.176	3.509	.000	3.509	28298	77.	38.3	6.667	8.431	21.387	29.818	2.081	27.737	1892.	2211	34.14	66.27
27	.114	.118	3.391	3.509	.000	3.509	30781	87.	43.3	6.709	8.474	22.626	31.100	2.081	29.019	1923.	2143	34.75	69.34



# DETAILED RESULTS OF CASE 21

AQUIFER  
GAS INJECTION

WITH WATER INJECTION  
GAS SALES

← AVERAGE RATES FOR YEAR →										← CUMULATIVES TO YEAR END →									
YEAR	OIL PROD	GAS					TOTAL GOR	WATER PROD	WATER CUT	CUM OIL	GAS					WATER PROD	AVE OIL PRESS	RECOVERY OF ORIGINAL IN-PLACE	
		OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD					OIL ZONE PROD	GAS CAP PROD	TOTAL PROD	INJ.	NET PROD			OIL X	TOTAL GAS X
1	1.050	.972	.000	.972	.895	.077	926	0.	.0	.384	.355	.000	.755	.327	.428	0.	4216	1.97	.07
2	1.400	1.719	.000	1.719	1.581	.138	1228	9.	.6	.895	.987	.000	.987	.984	.079	3.	4108	4.58	.19
3	1.600	2.092	.000	2.092	1.925	.167	1307	52.	3.1	1.479	1.747	.000	1.747	1.607	.140	22.	4009	7.57	.33
4	1.600	2.276	.000	2.276	2.394	.182	1422	105.	6.2	1.771	2.163	.000	2.163	1.990	.173	41.	3945	9.07	.41
5	1.500	3.860	.798	4.658	.011	4.647	2911	159.	0.0	2.064	2.868	.146	3.014	1.992	1.022	71.	3795	10.57	2.44
6	1.600	1.854	2.791	4.645	.000	4.645	2903	167.	9.5	2.648	3.545	1.165	4.714	1.997	2.718	132.	3526	17.56	6.49
7	1.582	2.355	2.290	4.645	.000	4.645	2936	313.	16.5	3.226	4.405	2.002	6.407	1.992	4.415	245.	3286	18.52	10.85
8	1.336	1.735	2.910	4.645	.000	4.645	3477	362.	21.3	3.714	5.039	3.065	8.104	1.997	6.112	378.	3134	19.67	14.60
9	1.184	1.204	3.437	4.645	.000	4.645	3923	713.	20.9	4.146	5.488	4.320	9.800	1.992	7.808	402.	2997	21.23	18.66
10	.947	1.169	3.477	4.646	.000	4.646	4972	563.	34.8	4.490	5.907	5.590	11.497	1.997	9.505	676.	2969	22.99	22.71
11	.835	.872	3.774	4.646	.000	4.646	5564	322.	27.8	4.795	6.225	6.968	13.193	1.992	11.201	794.	2770	24.55	26.76
12	.720	.747	3.898	4.645	.000	4.645	6451	285.	28.4	5.058	6.498	8.792	14.990	1.997	12.898	898.	2678	25.90	30.82
13	.640	.819	3.827	4.646	.000	4.646	7259	261.	29.0	5.292	6.797	9.790	16.587	1.997	14.595	903.	2588	27.10	34.87
14	.539	.556	4.090	4.646	.000	4.646	8620	303.	36.0	5.489	7.000	11.284	18.284	1.992	16.292	1104.	2505	28.11	38.93
15	.446	.510	4.135	4.645	.000	4.645	10415	315.	41.4	5.652	7.197	12.794	19.981	1.997	17.989	1219.	2427	28.94	42.98
16	.354	.390	4.256	4.646	.000	4.646	13124	279.	44.1	5.781	7.329	14.349	21.678	1.992	19.686	1321.	2370	29.68	47.04
17	.315	.399	4.247	4.646	.000	4.646	14749	224.	41.6	5.896	7.475	15.900	23.375	1.992	21.383	1407.	2297	30.19	51.09
18	.284	.285	4.360	4.645	.000	4.645	16356	165.	36.7	6.000	7.579	17.492	25.071	1.992	23.079	1463.	2213	30.72	55.14
19	.235	.260	4.385	4.645	.000	4.645	19766	188.	44.2	6.086	7.674	19.094	26.768	1.992	24.776	1531.	2134	31.16	59.20
20	.208	.228	4.417	4.645	.000	4.645	22332	121.	36.8	6.162	7.757	20.707	28.464	1.997	26.472	1575.	2087	31.85	63.25
21	.188	.201	4.444	4.645	.000	4.645	24707	128.	40.1	6.230	7.831	22.371	30.162	1.992	28.170	1621.	2012	31.90	67.31

TABLE XXI

T A B L E   XXIII

S U M M A R Y   O F  
W A T E R   I N J E C T I O N  
R A T E S   A N D   V O L U M E S

Sadlerochit Reservoir  
Prudhoe Bay Field

<u>Case</u>	<u>Average Injection Rate Million BPD</u>	<u>Cumulative Injected Volume Billion BBL</u>
3	0.518	7.376
4	1.382	17.652
5	1.297	15.146
6	1.267	14.332
7	1.362	16.899
8	1.325	14.989
9	1.295	14.656
10	1.077	13.756
11	1.190	15.202
12	1.239	15.378
13	1.282	15.909
14	1.489	14.675
15	1.592	12.201
16	1.041	13.298
17	1.163	14.012
18	1.189	14.318
19	1.252	14.618
20	1.439	14.178
21	1.551	11.891

## L I S T O F F I G U R E S

FIGURE 1	LOCATION MAP
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FIGURE 11	DEPTH VS PRESSURE GRADIENT BETWEEN G/O AND O/W CONTACTS
FIGURE 12	OIL PVT DATA (DEPTH INTERVAL: 8580 FT SS - 8653 FT SS)
FIGURE 13	OIL PVT DATA (DEPTH INTERVAL: 8653 FT SS - 8727 FT SS)
FIGURE 14	OIL PVT DATA (DEPTH INTERVAL: 8727 FT SS - 8800 FT SS)
FIGURE 15	OIL PVT DATA (DEPTH INTERVAL: 8800 FT SS - 8873 FT SS)
FIGURE 16	OIL PVT DATA (DEPTH INTERVAL: 8873 FT SS - 8946 FT SS)
FIGURE 17	OIL PVT DATA (DEPTH INTERVAL: 8946 FT SS - 9020 FT SS)
FIGURE 18	GAS PVT DATA

LIST OF FIGURES (Cont'd)

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FIGURE 20	SCHEMATIC OF CROSS-SECTIONAL MODEL
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FIGURE 23	CASE 3 - PROJECTION OF PERFORMANCE
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FIGURE 25	CASE 5 - PROJECTION OF PERFORMANCE
FIGURE 26	CASE 6 - PROJECTION OF PERFORMANCE
FIGURE 27	CASE 7 - PROJECTION OF PERFORMANCE
FIGURE 28	CASE 8 - PROJECTION OF PERFORMANCE
FIGURE 29	CASE 9 - PROJECTION OF PERFORMANCE
FIGURE 30	CASE 10 - PROJECTION OF PERFORMANCE
FIGURE 31	CASE 11 - PROJECTION OF PERFORMANCE
FIGURE 32	CASE 12 - PROJECTION OF PERFORMANCE
FIGURE 33	CASE 13 - PROJECTION OF PERFORMANCE
FIGURE 34	CASE 14 - PROJECTION OF PERFORMANCE
FIGURE 35	CASE 15 - PROJECTION OF PERFORMANCE
FIGURE 36	CASE 16 - PROJECTION OF PERFORMANCE
FIGURE 37	CASE 17 - PROJECTION OF PERFORMANCE
FIGURE 38	CASE 18 - PROJECTION OF PERFORMANCE
FIGURE 39	CASE 19 - PROJECTION OF PERFORMANCE
FIGURE 40	CASE 20 - PROJECTION OF PERFORMANCE
FIGURE 41	CASE 21 - PROJECTION OF PERFORMANCE

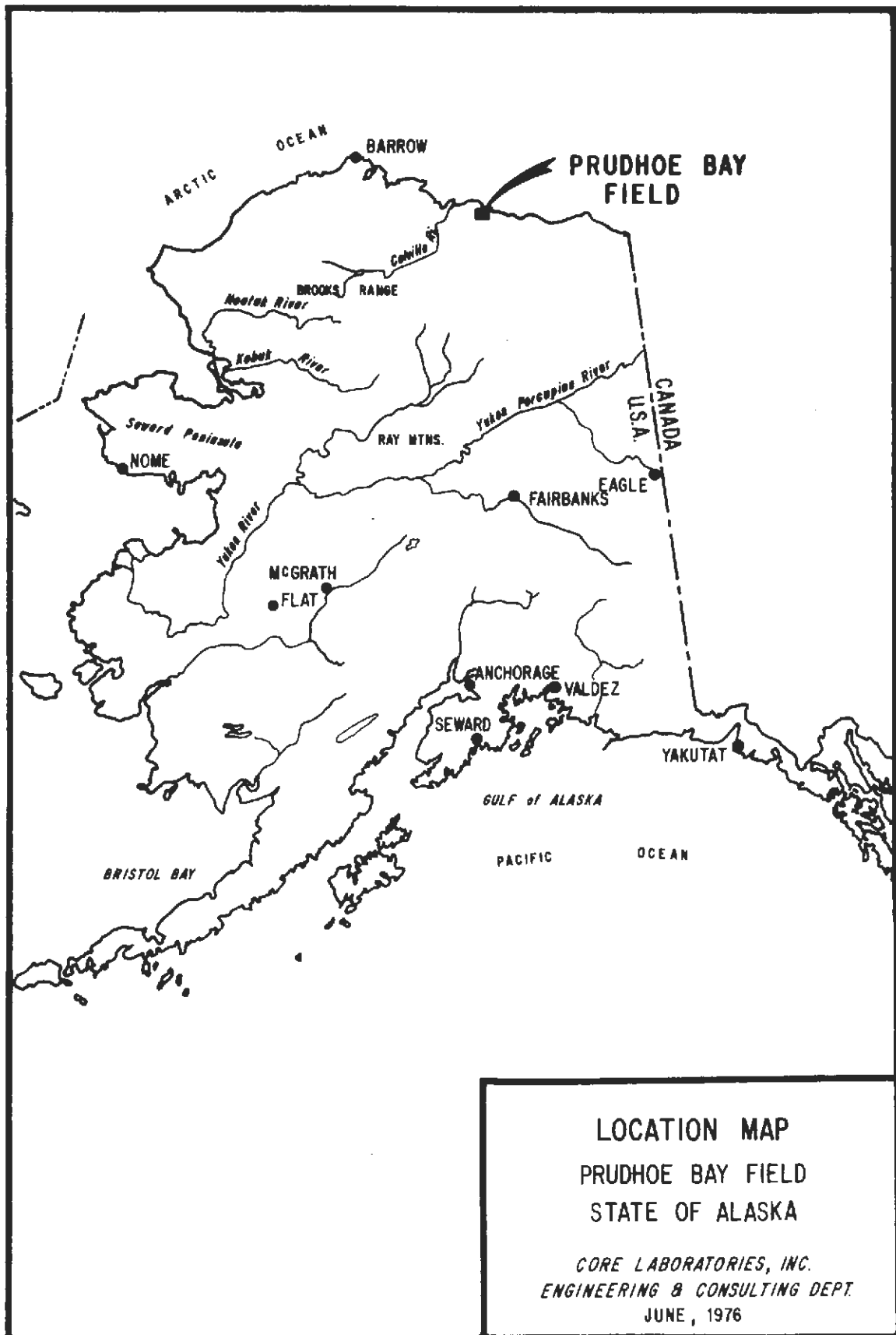


FIGURE 1

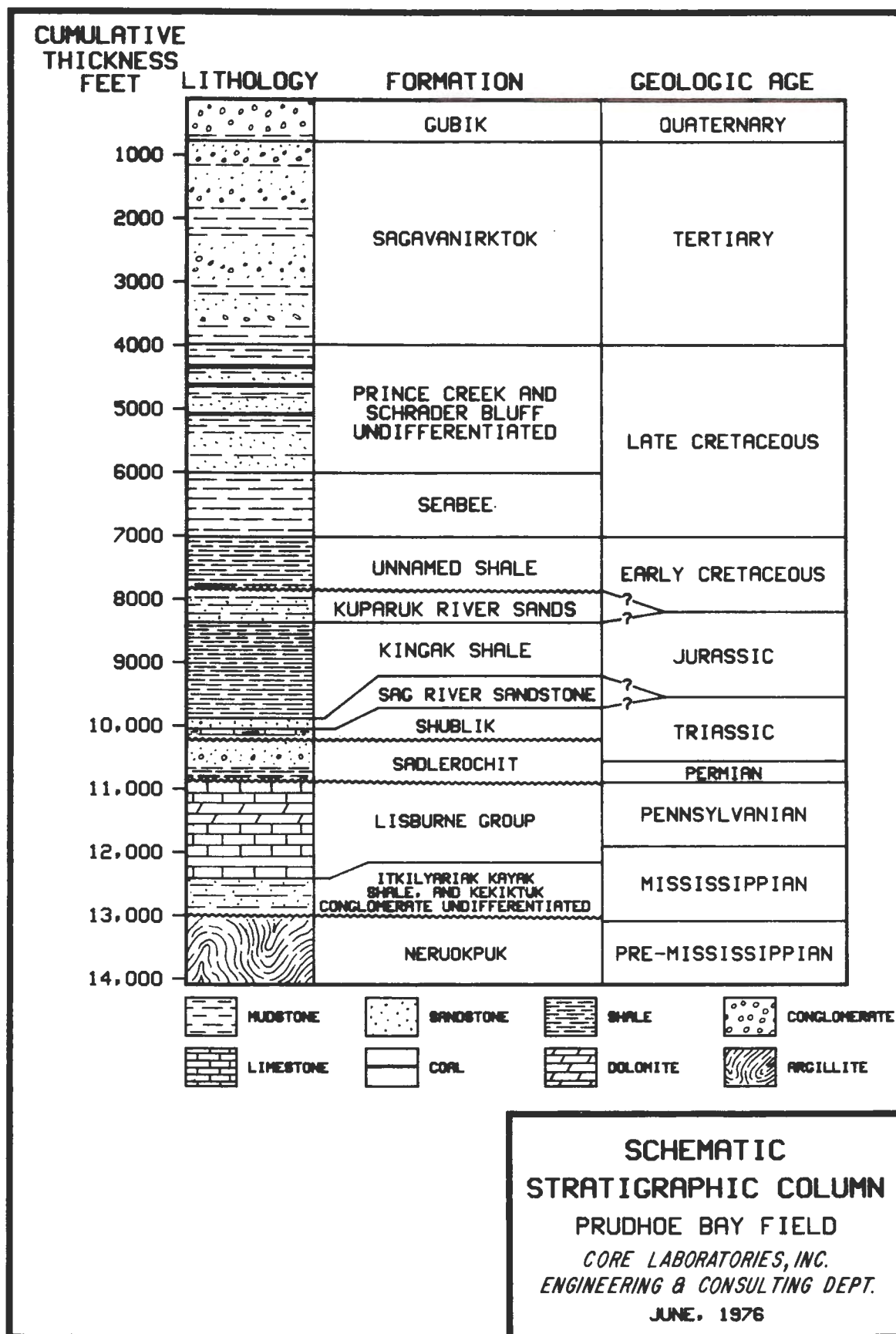


FIGURE 2

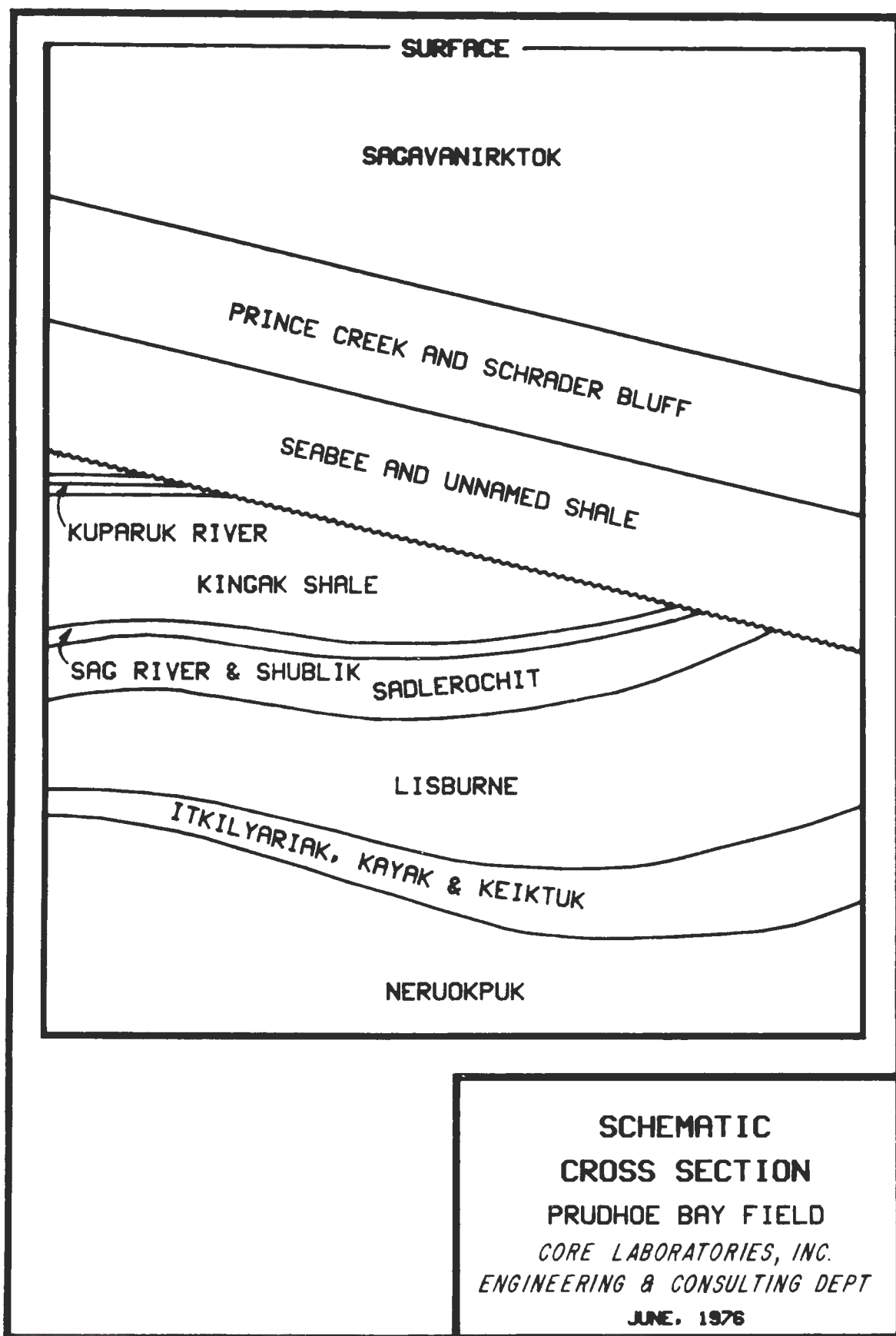


FIGURE 3

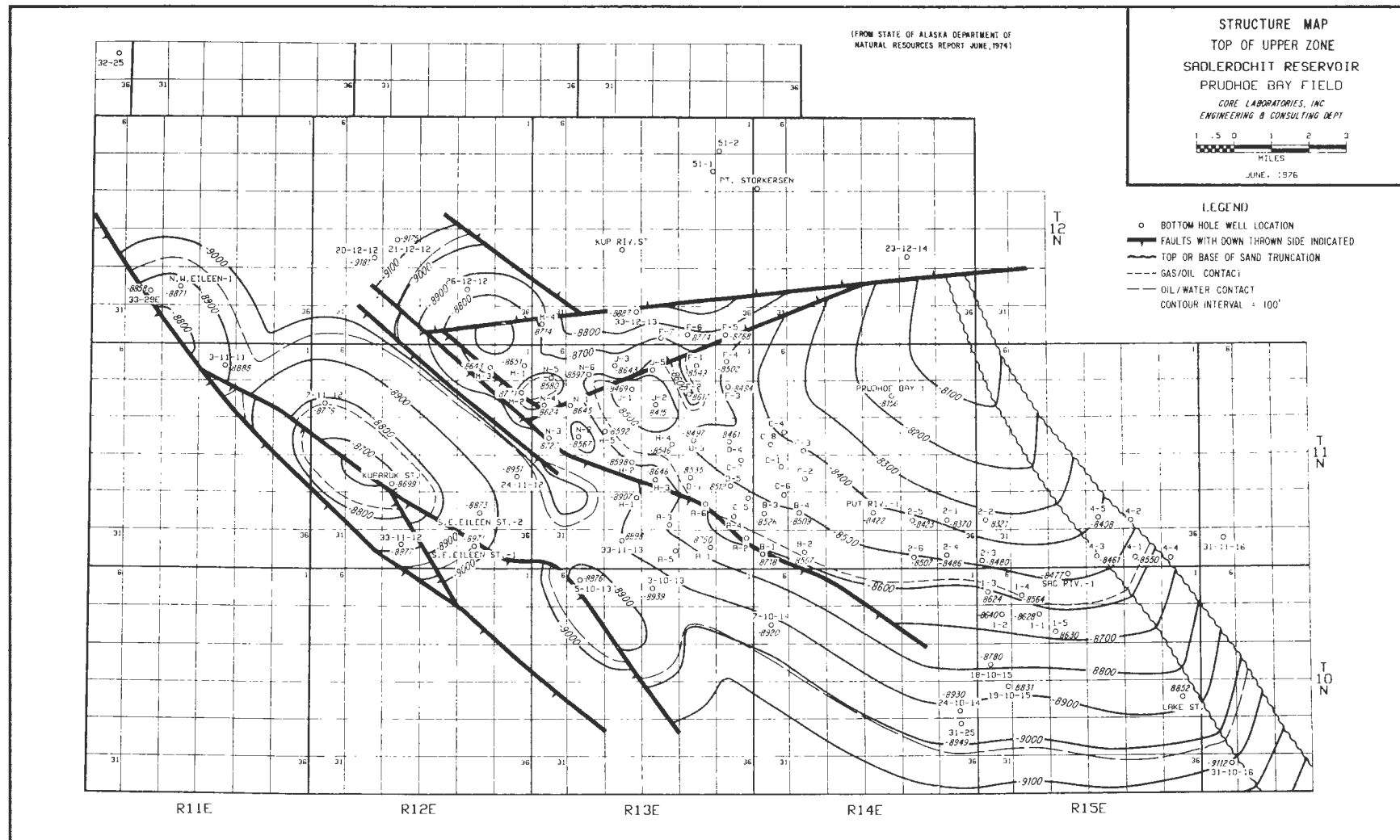
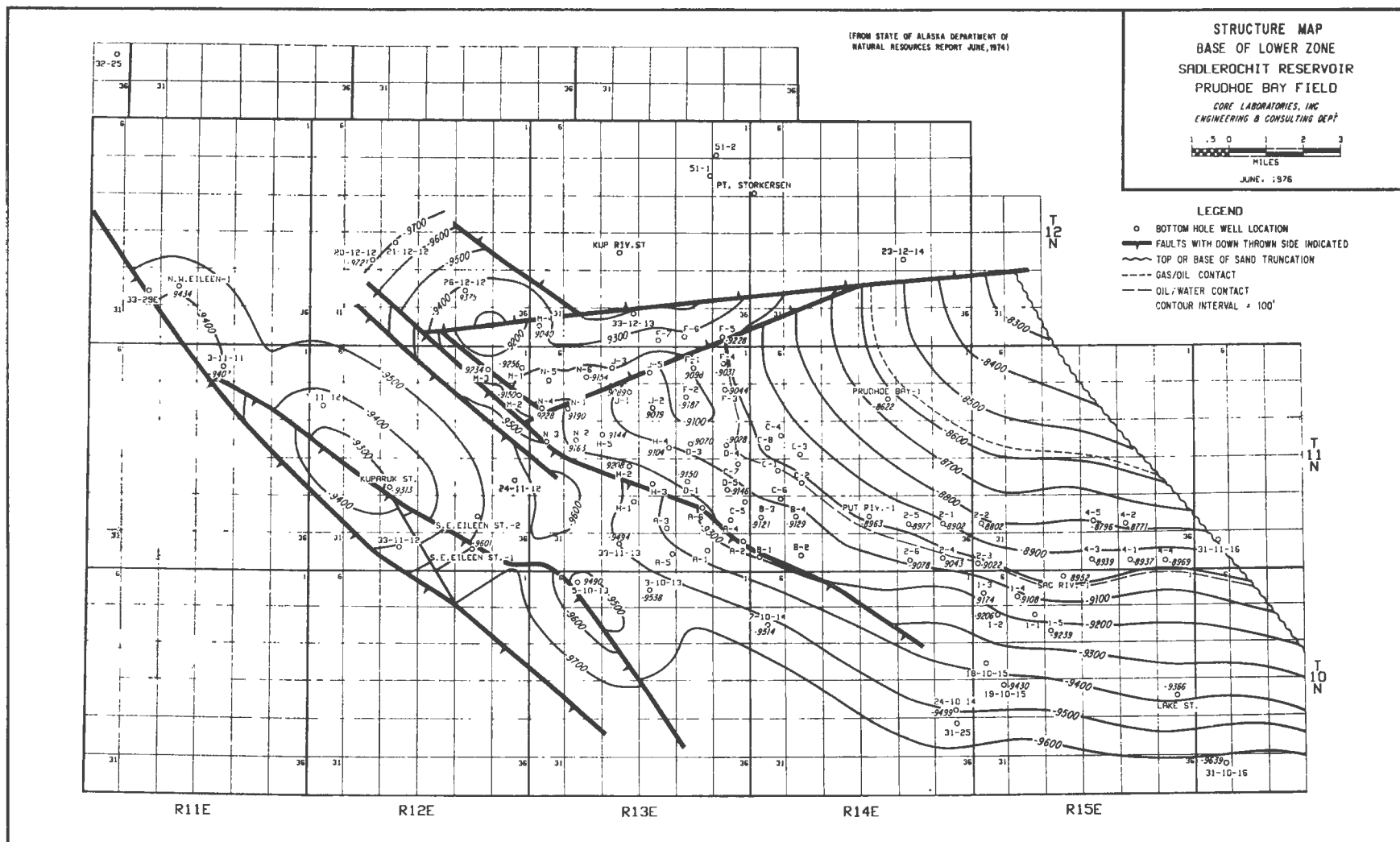


FIGURE 4





(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN, 1976)

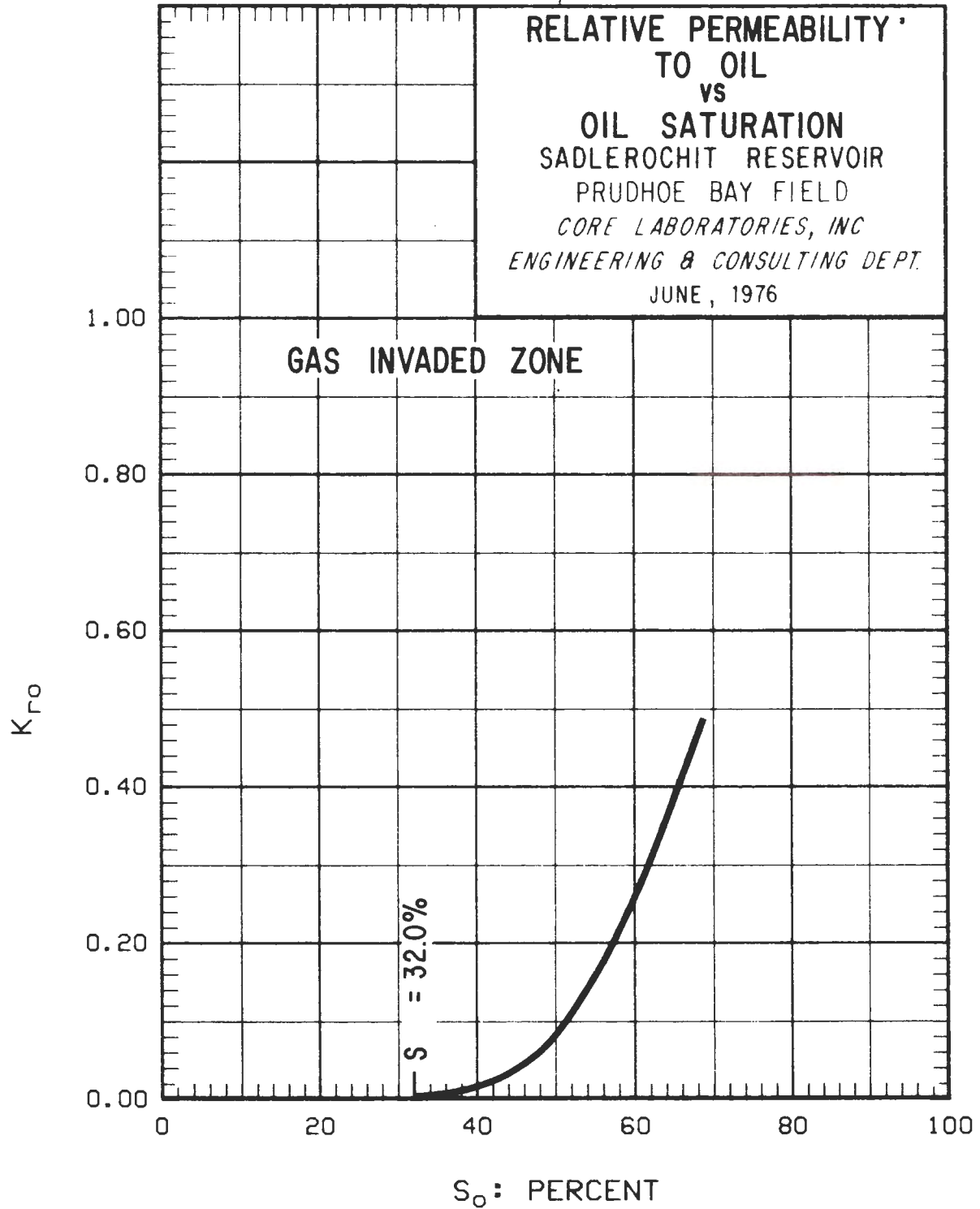


FIGURE 6

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

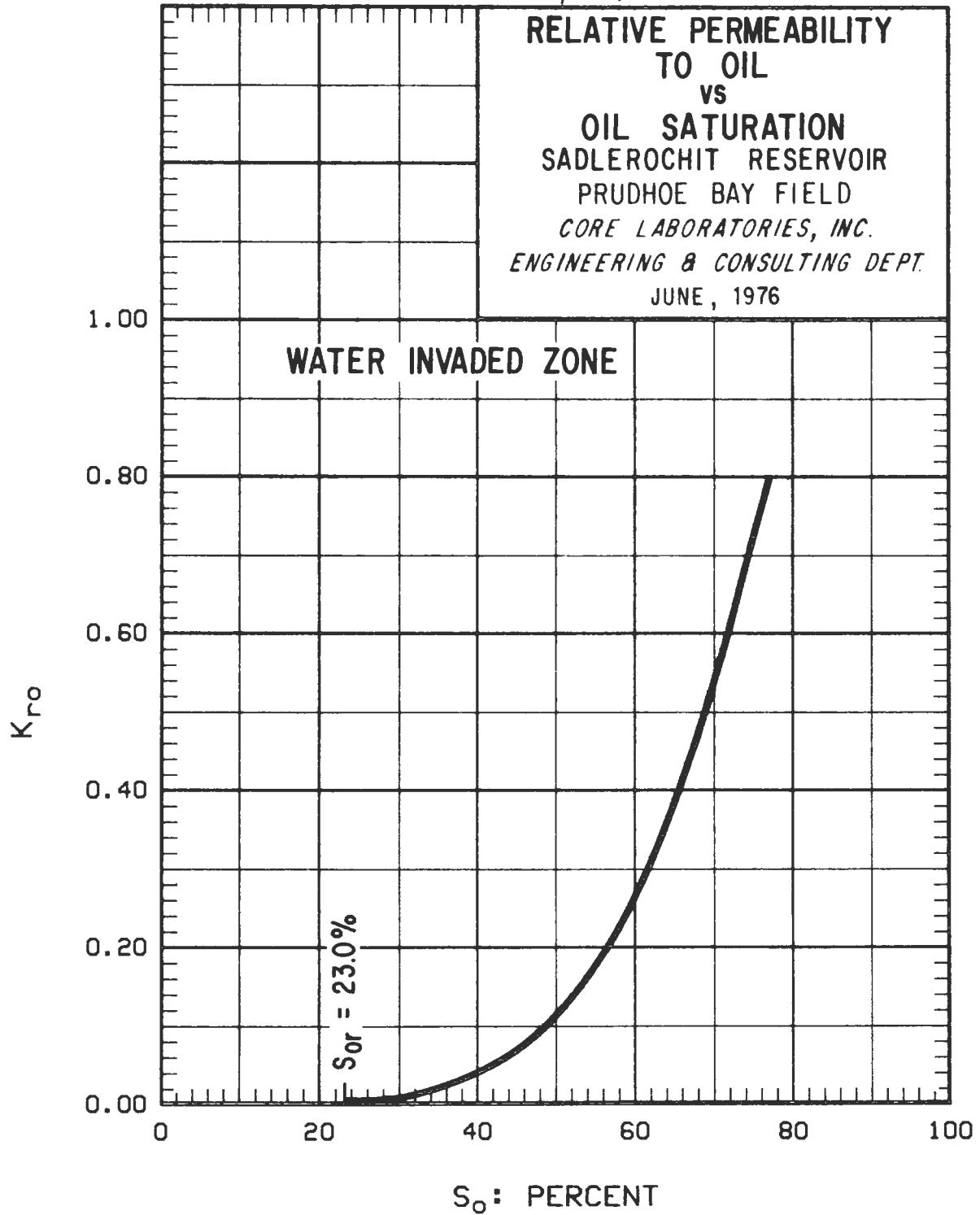


FIGURE 7

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

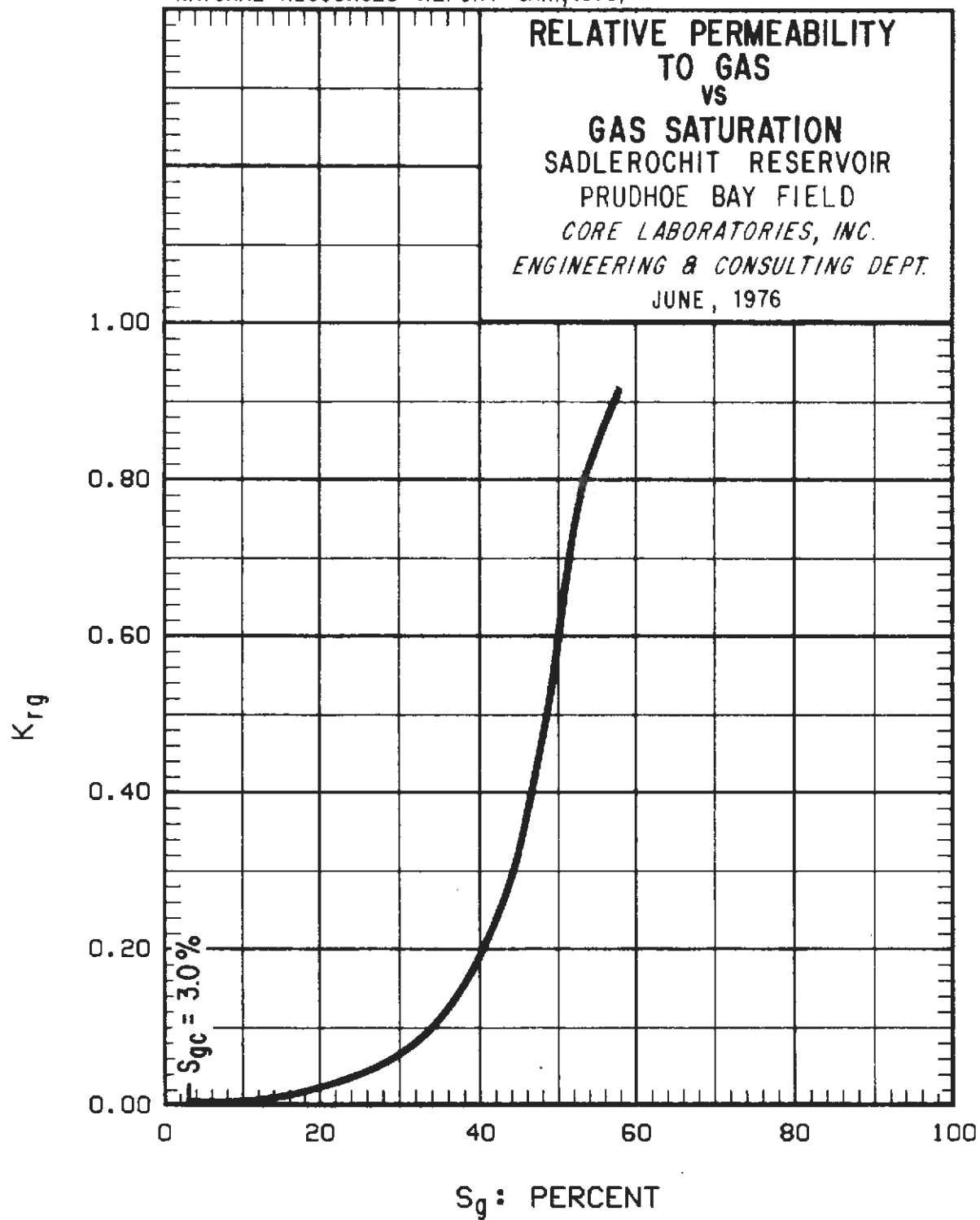


FIGURE 8

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

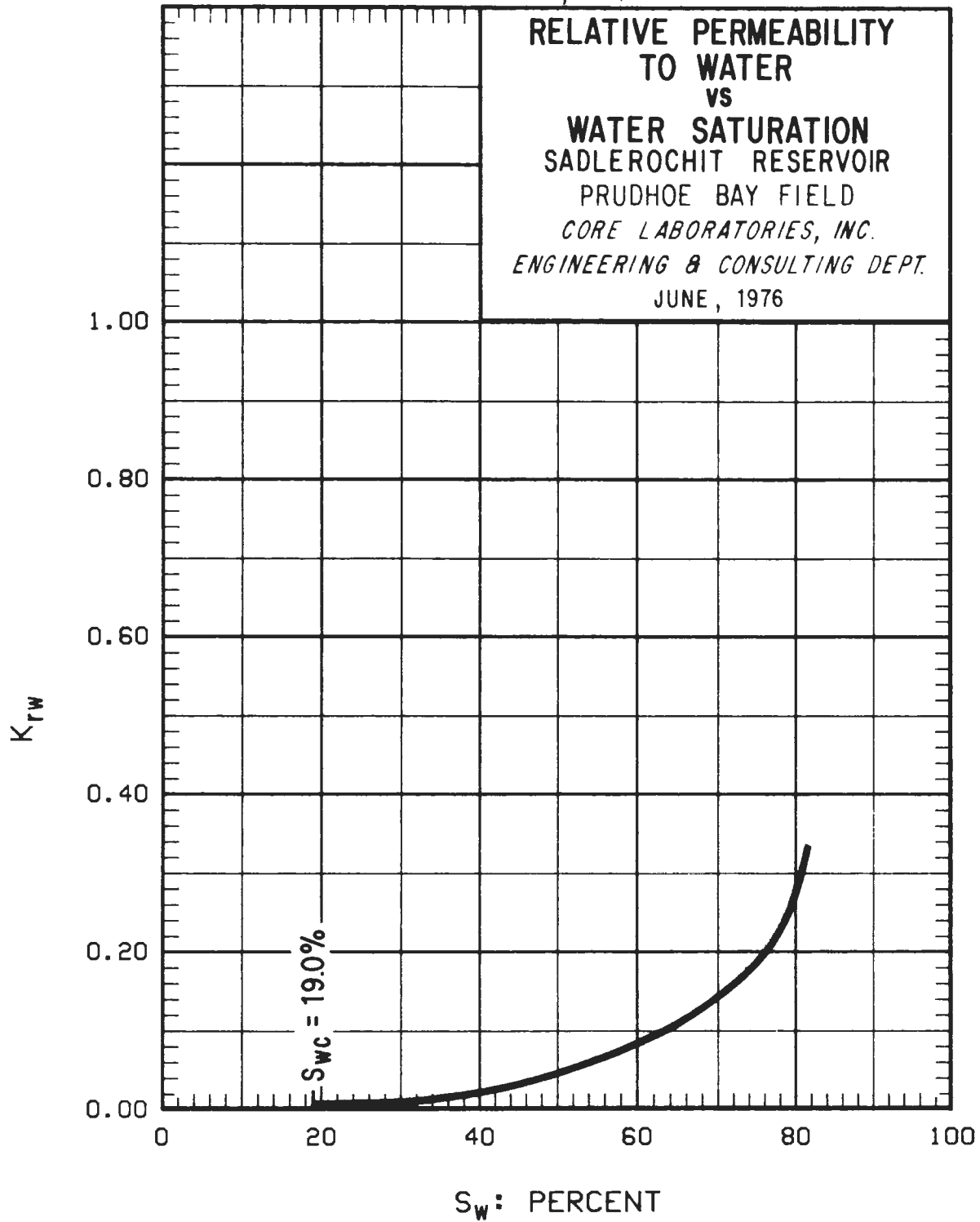


FIGURE 9

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

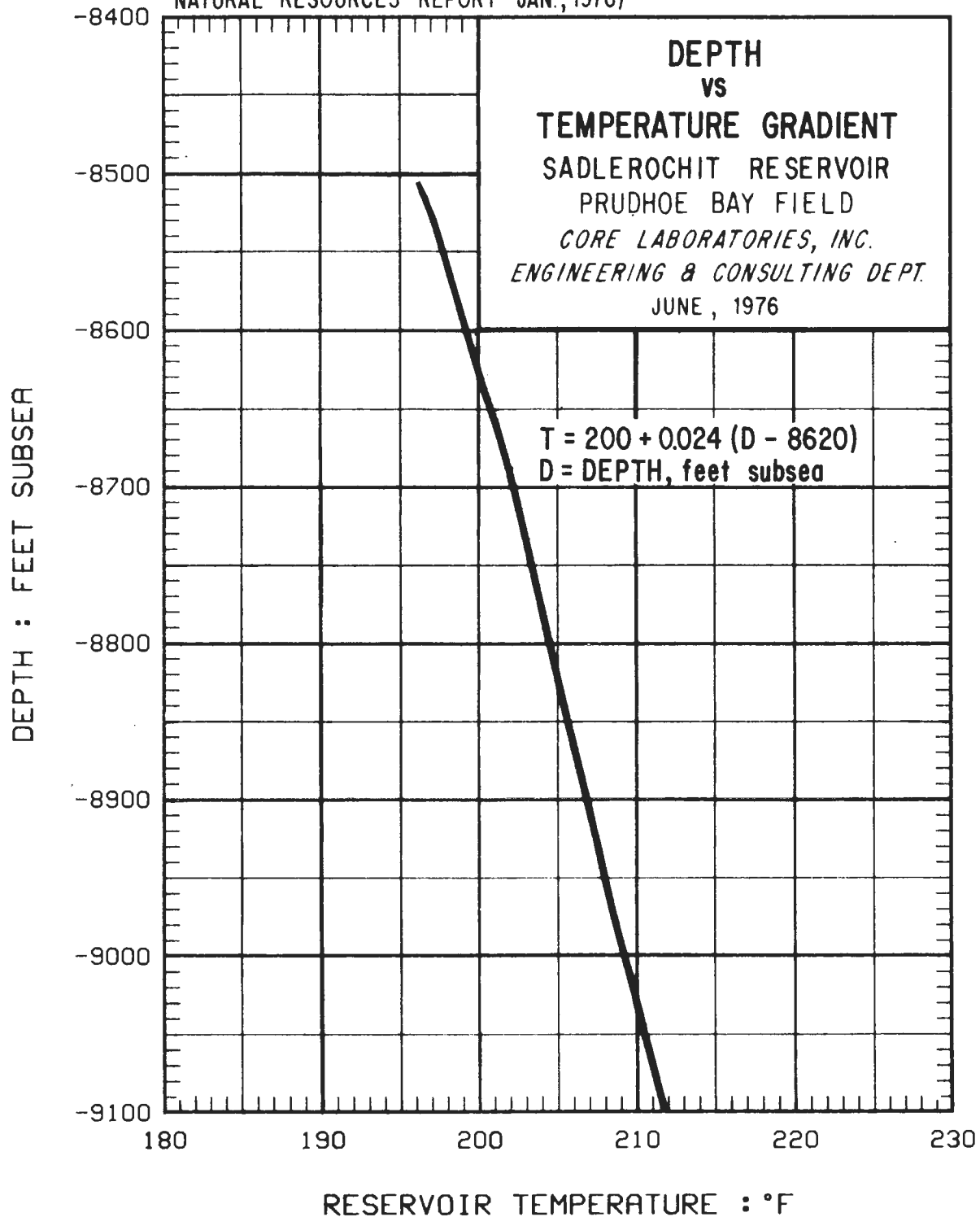


FIGURE 10

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

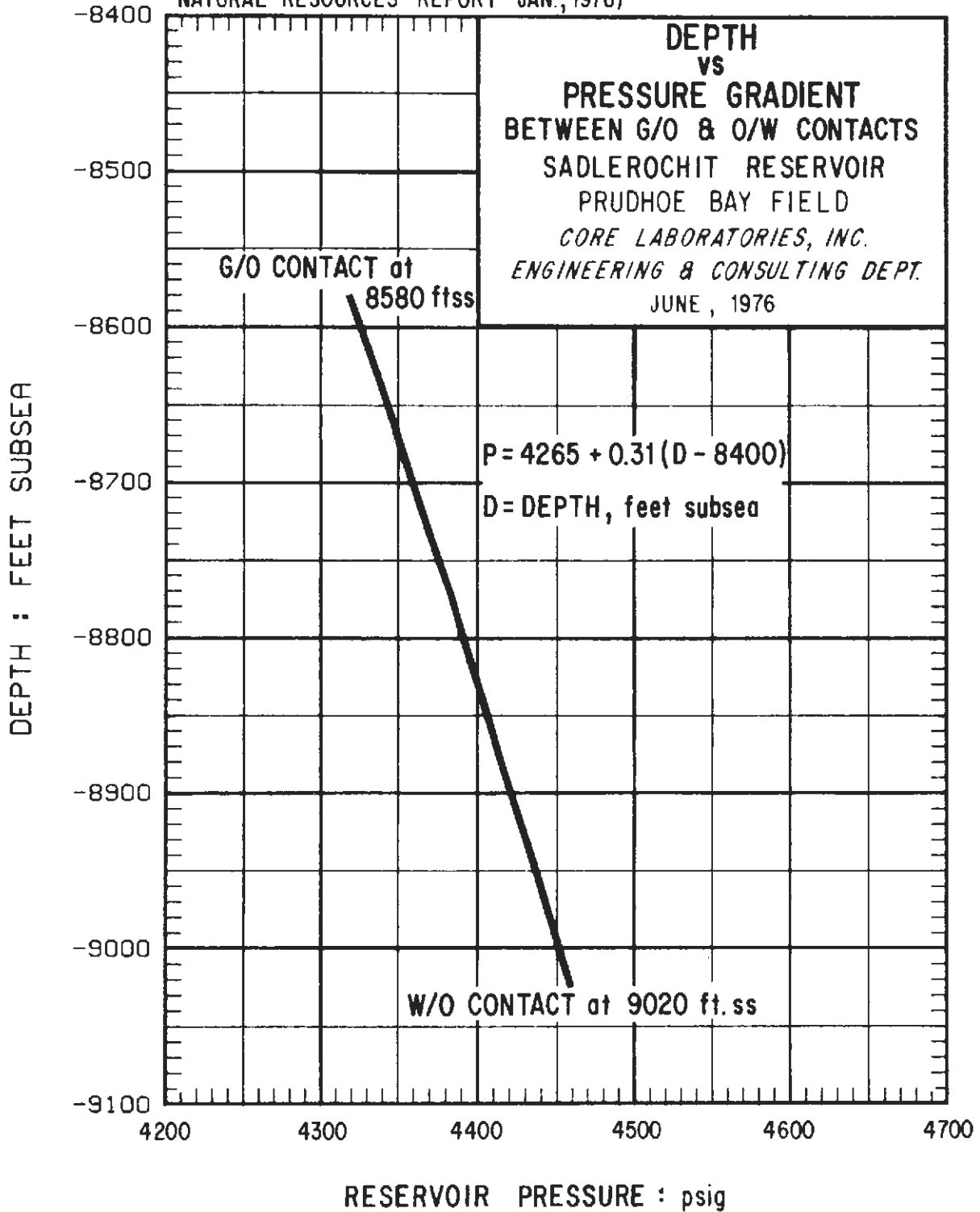


FIGURE 11

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN, 1976)

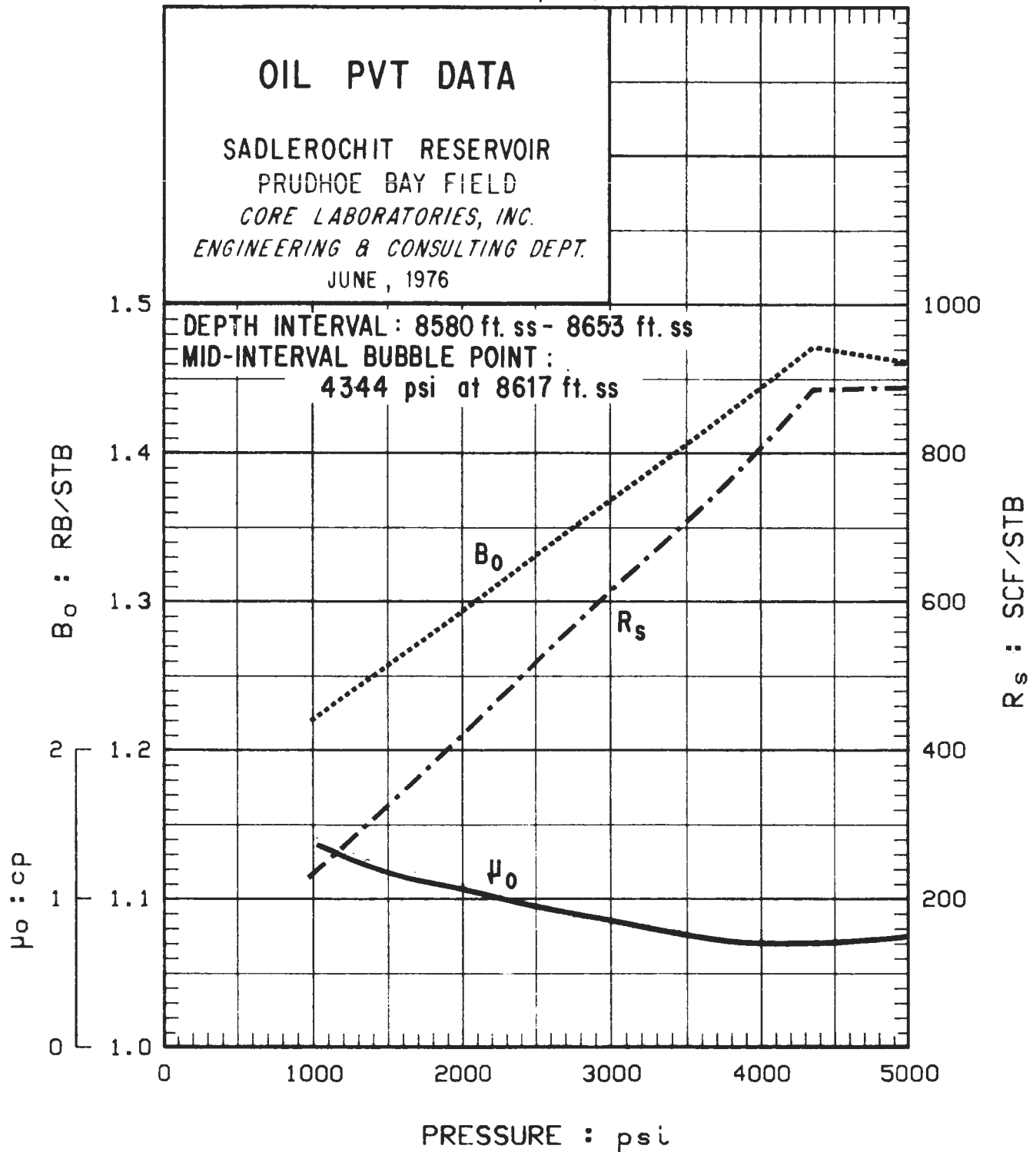


FIGURE 12



(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

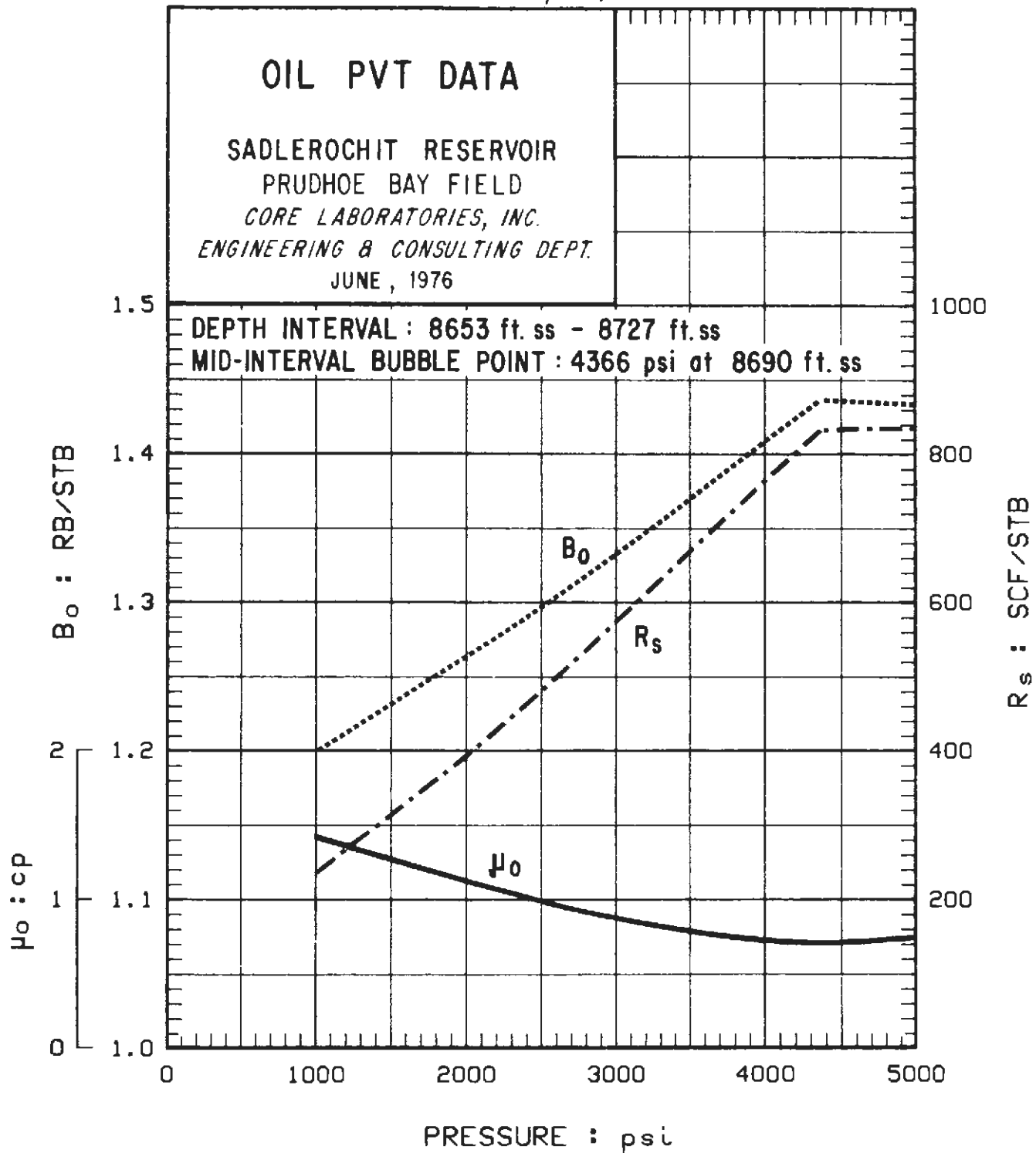


FIGURE 13

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

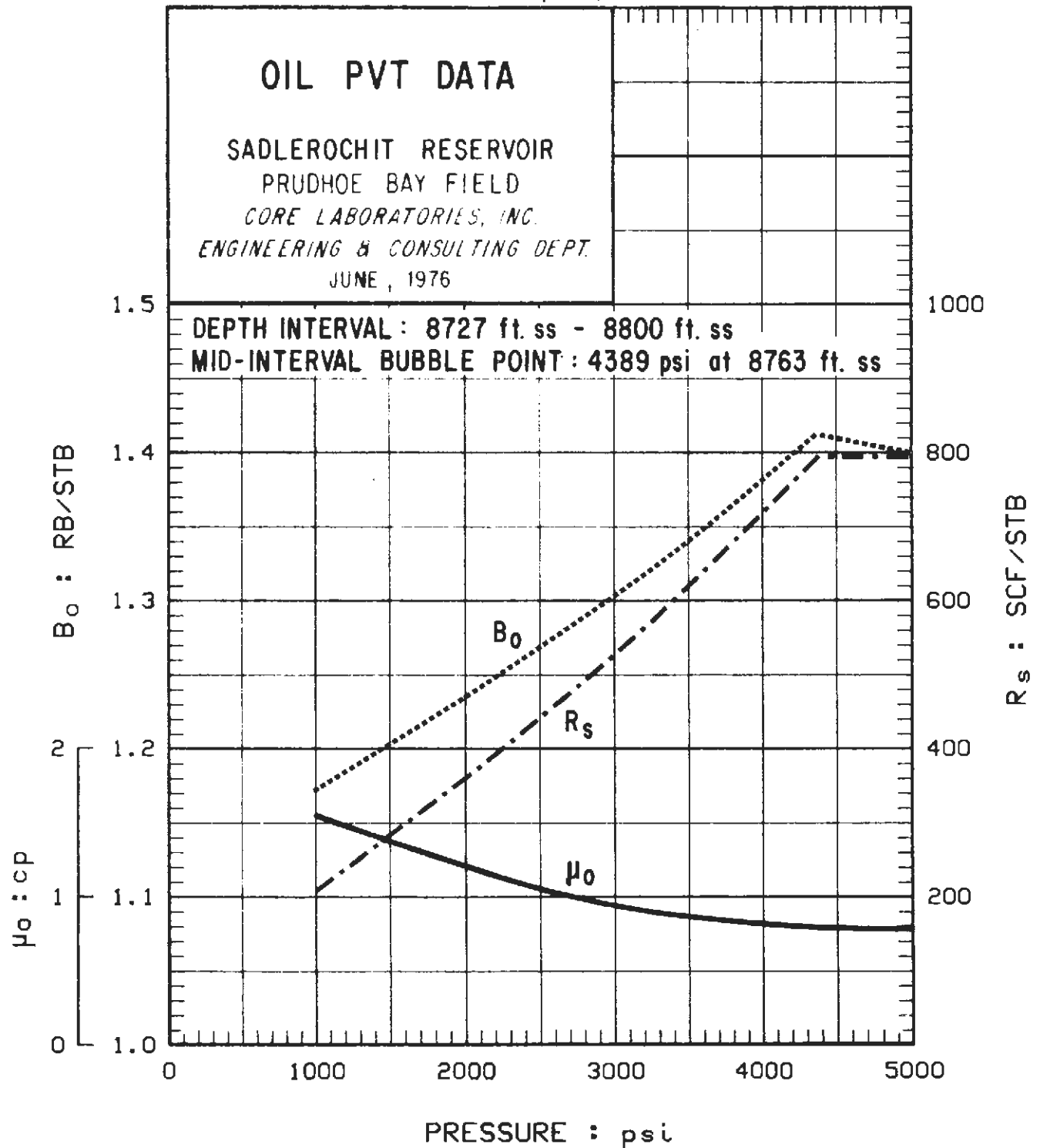


FIGURE 14

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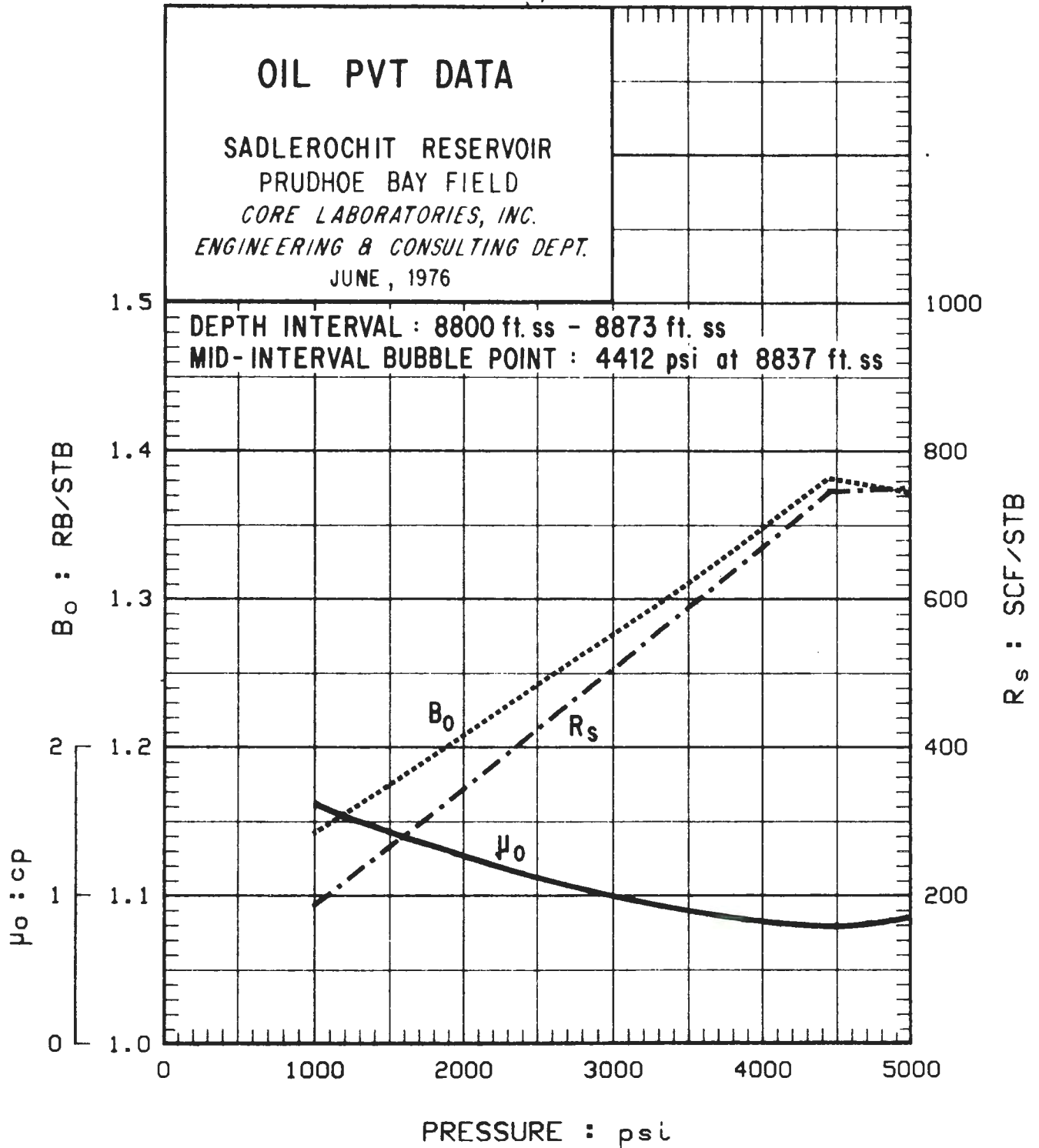


FIGURE 15

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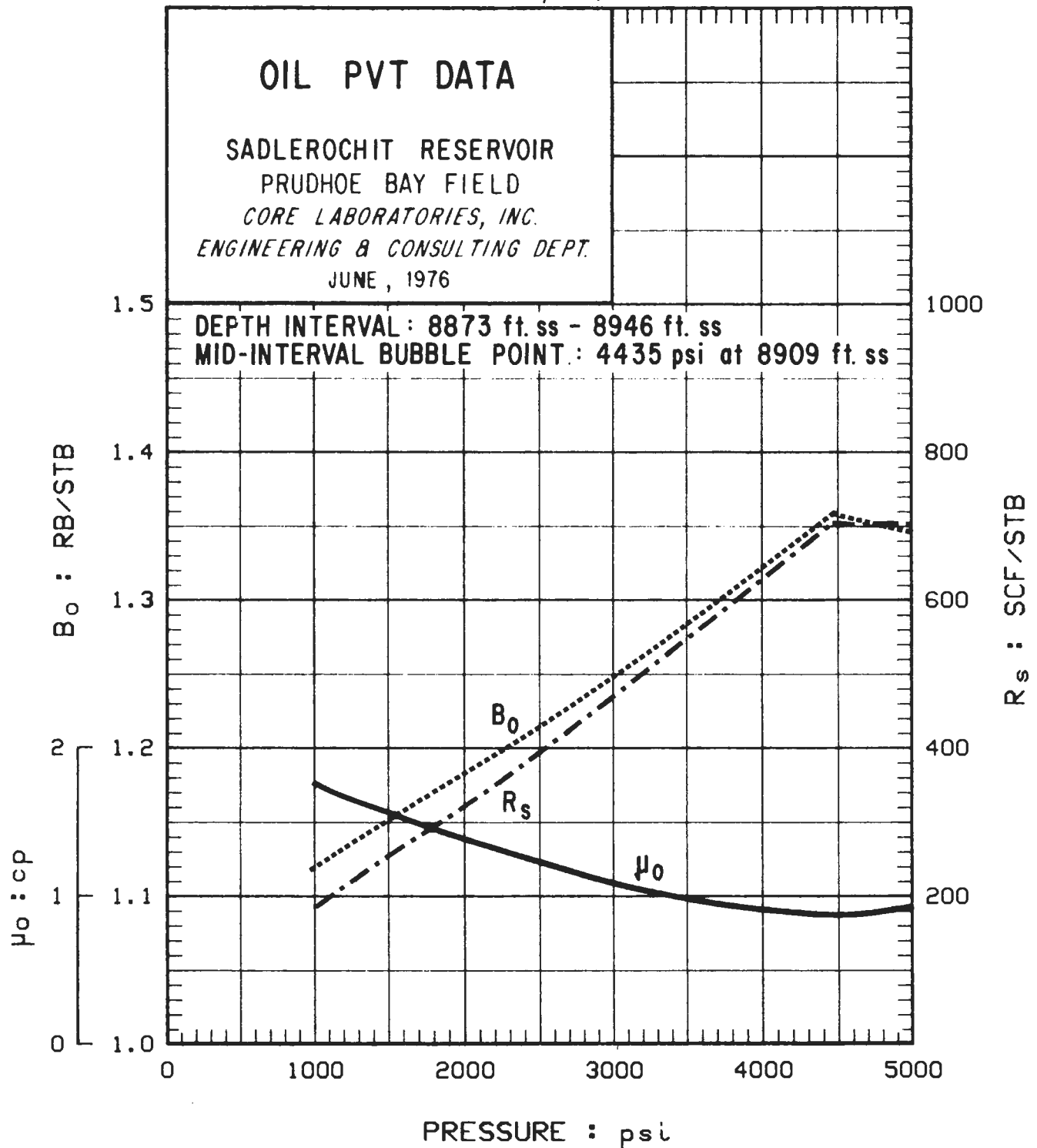


FIGURE 16

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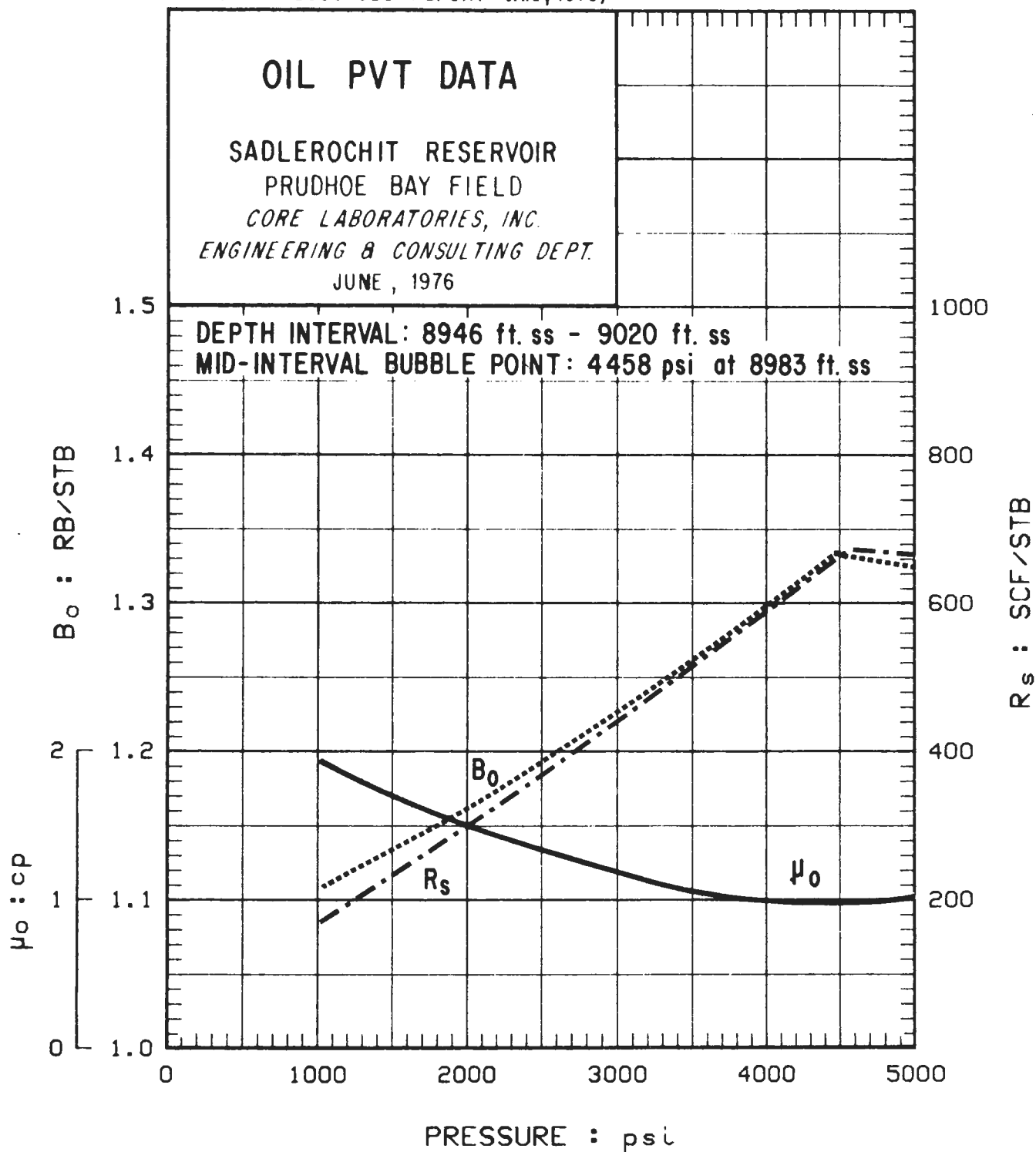


FIGURE 17

(FROM STATE OF ALASKA DEPARTMENT OF  
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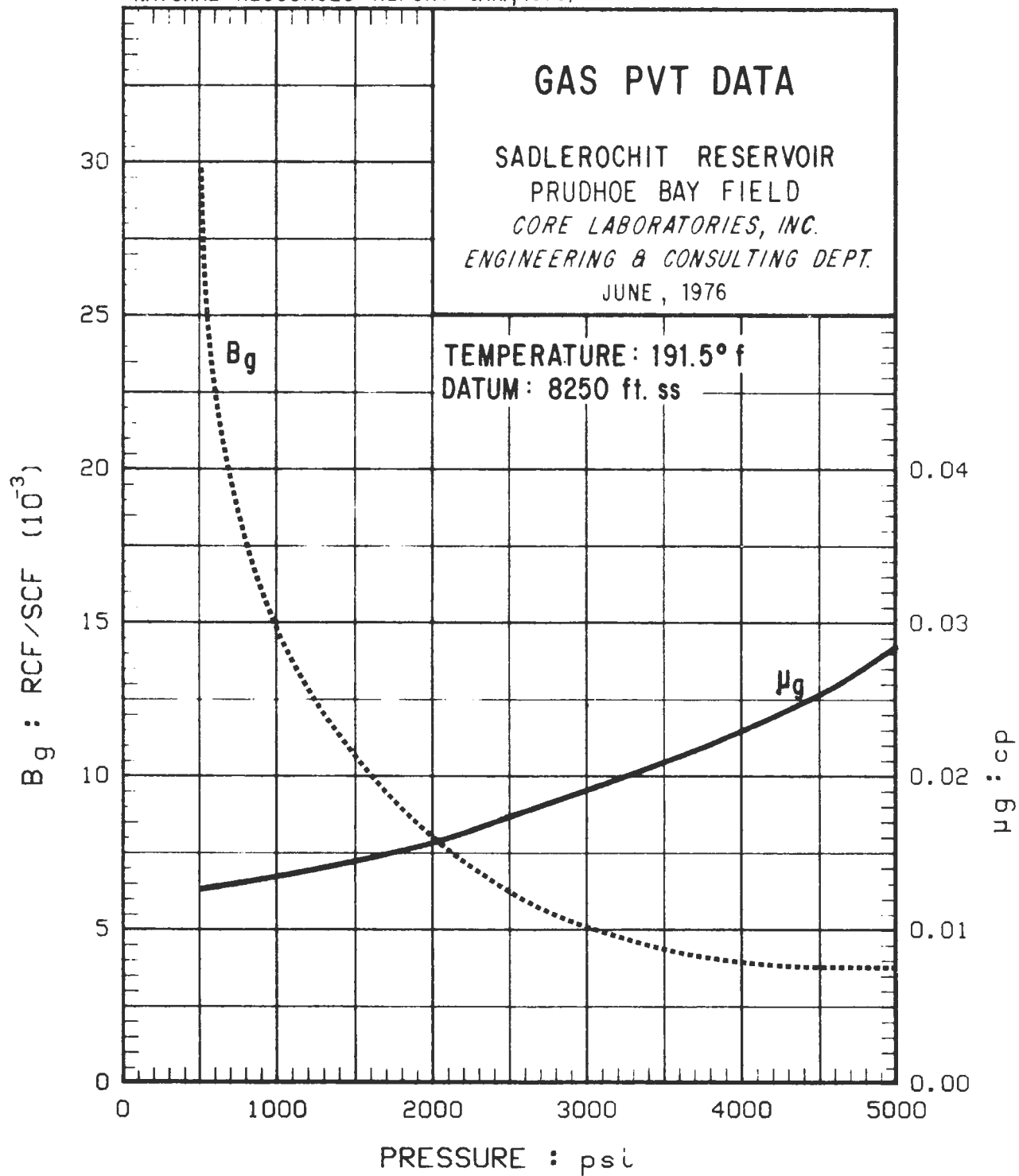


FIGURE 18

(FROM STATE OF ALASKA DEPARTMENT OF  
NATURAL RESOURCES REPORT JAN., 1976)

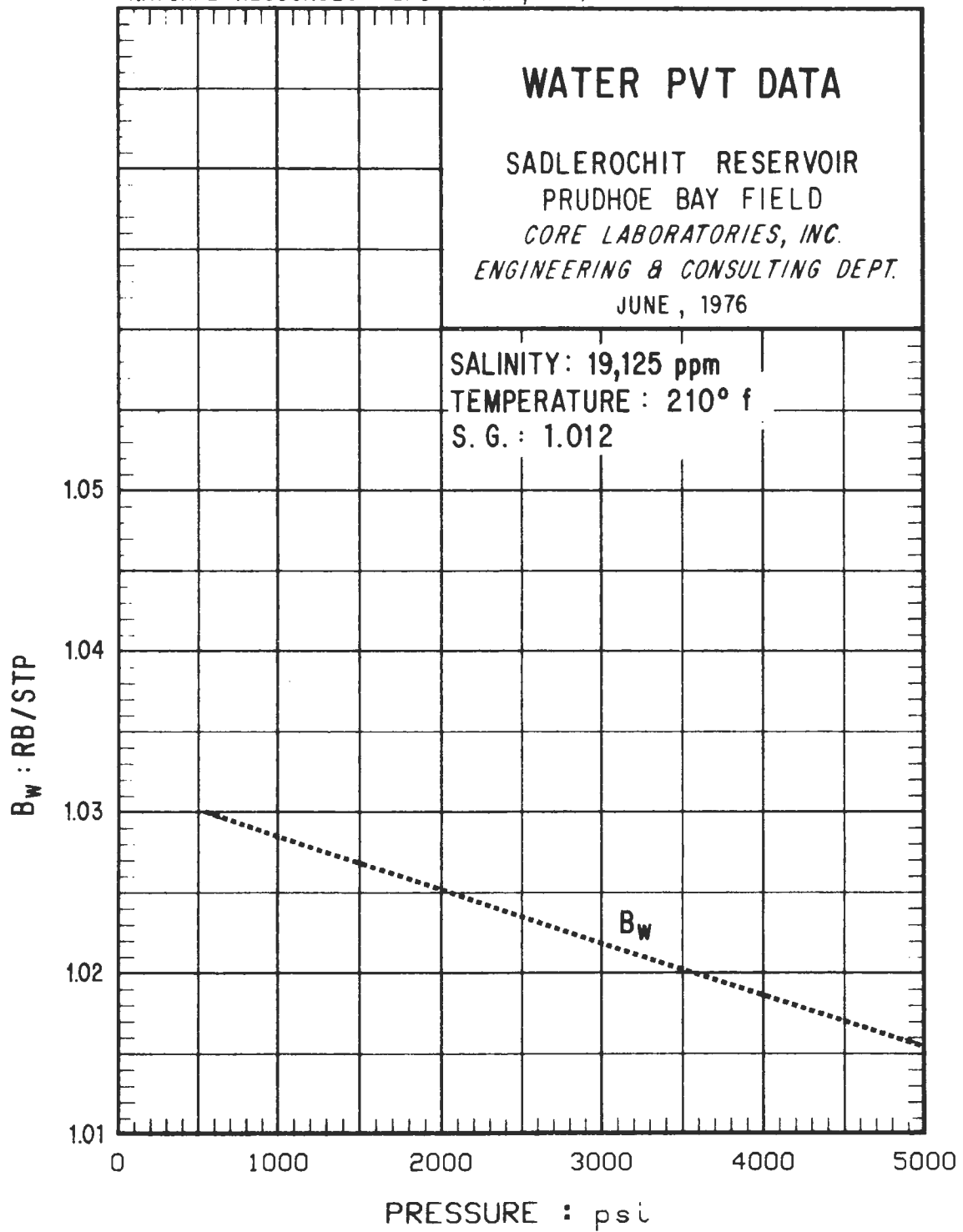
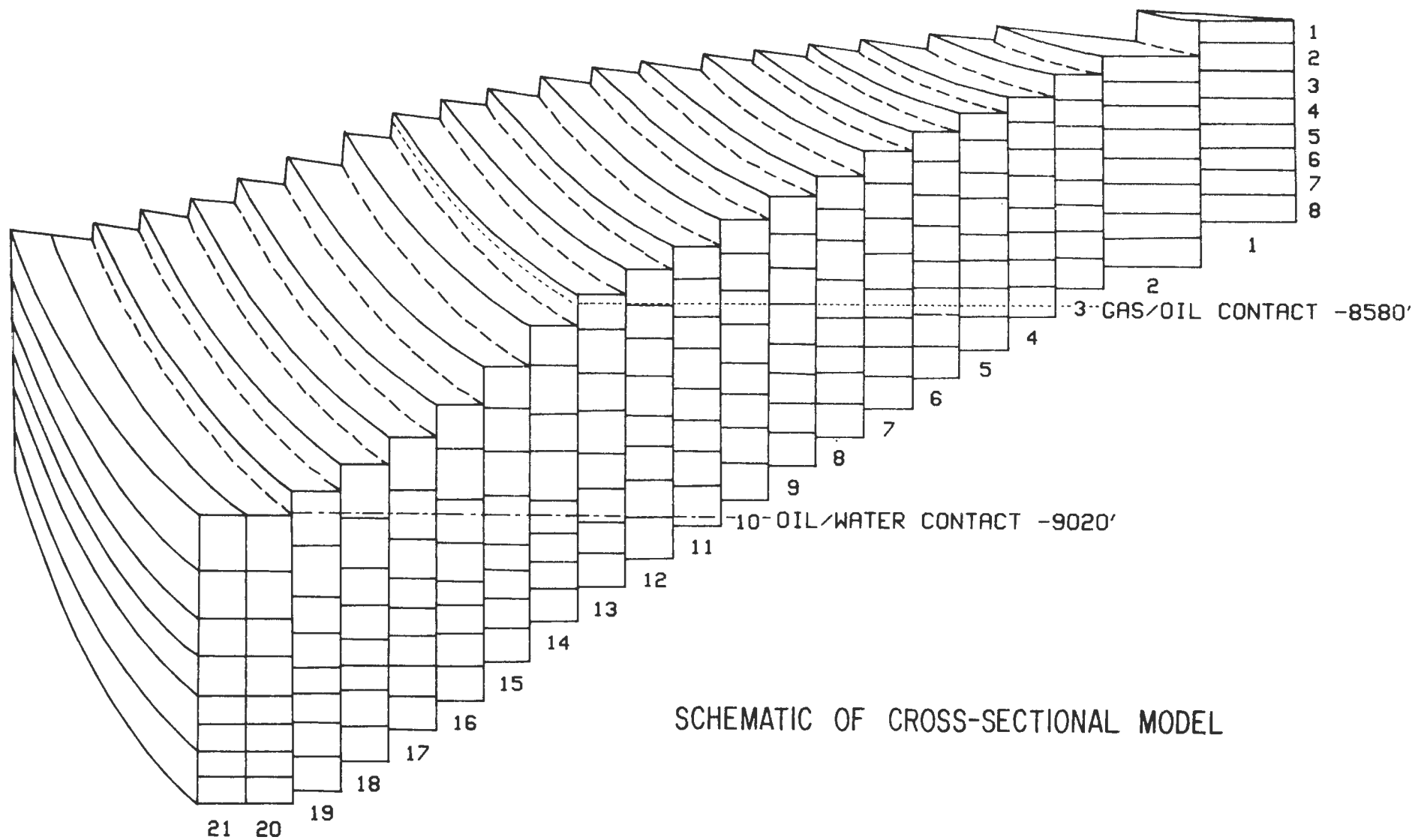


FIGURE 19

FIGURE 20





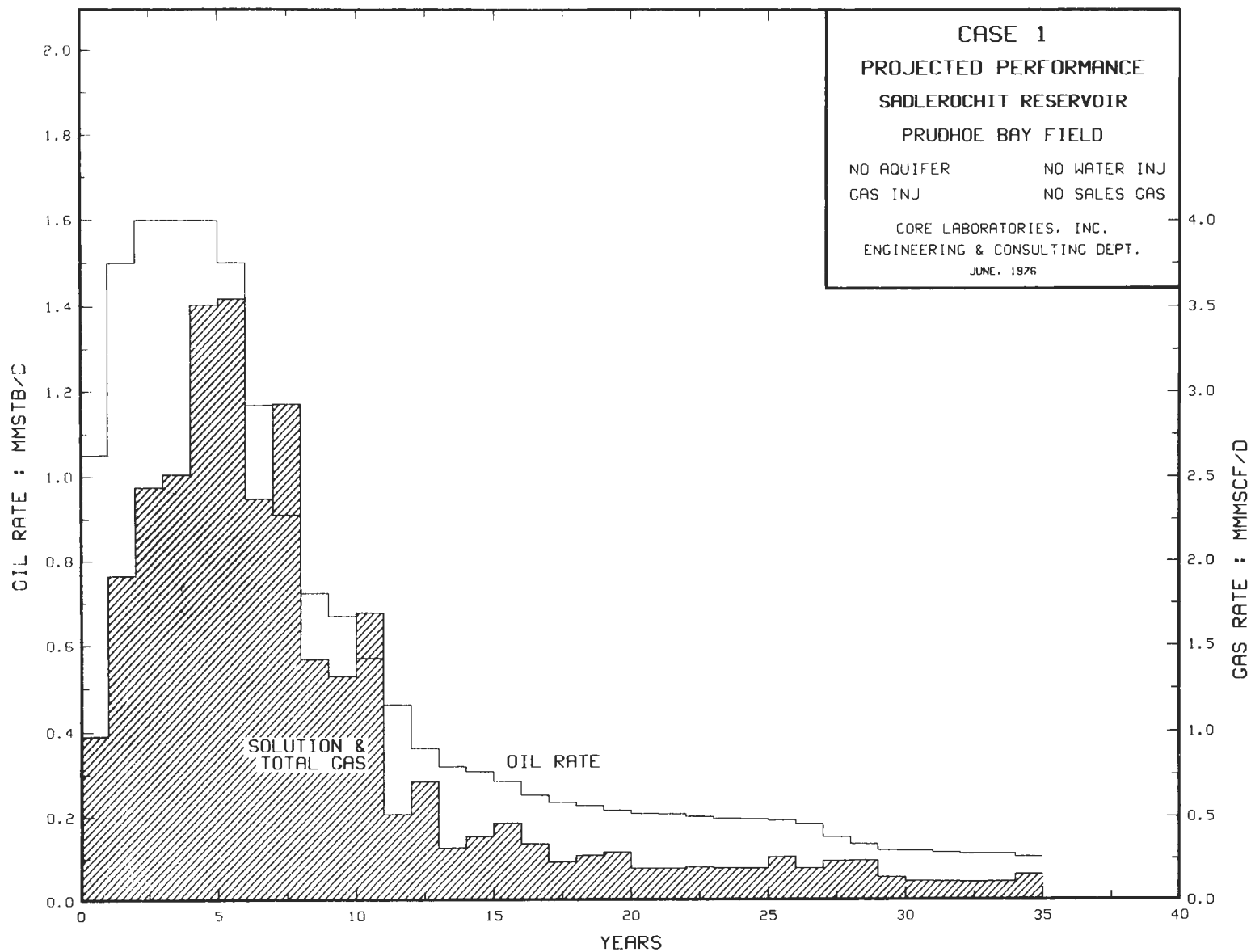


FIGURE 21

FIGURE 22

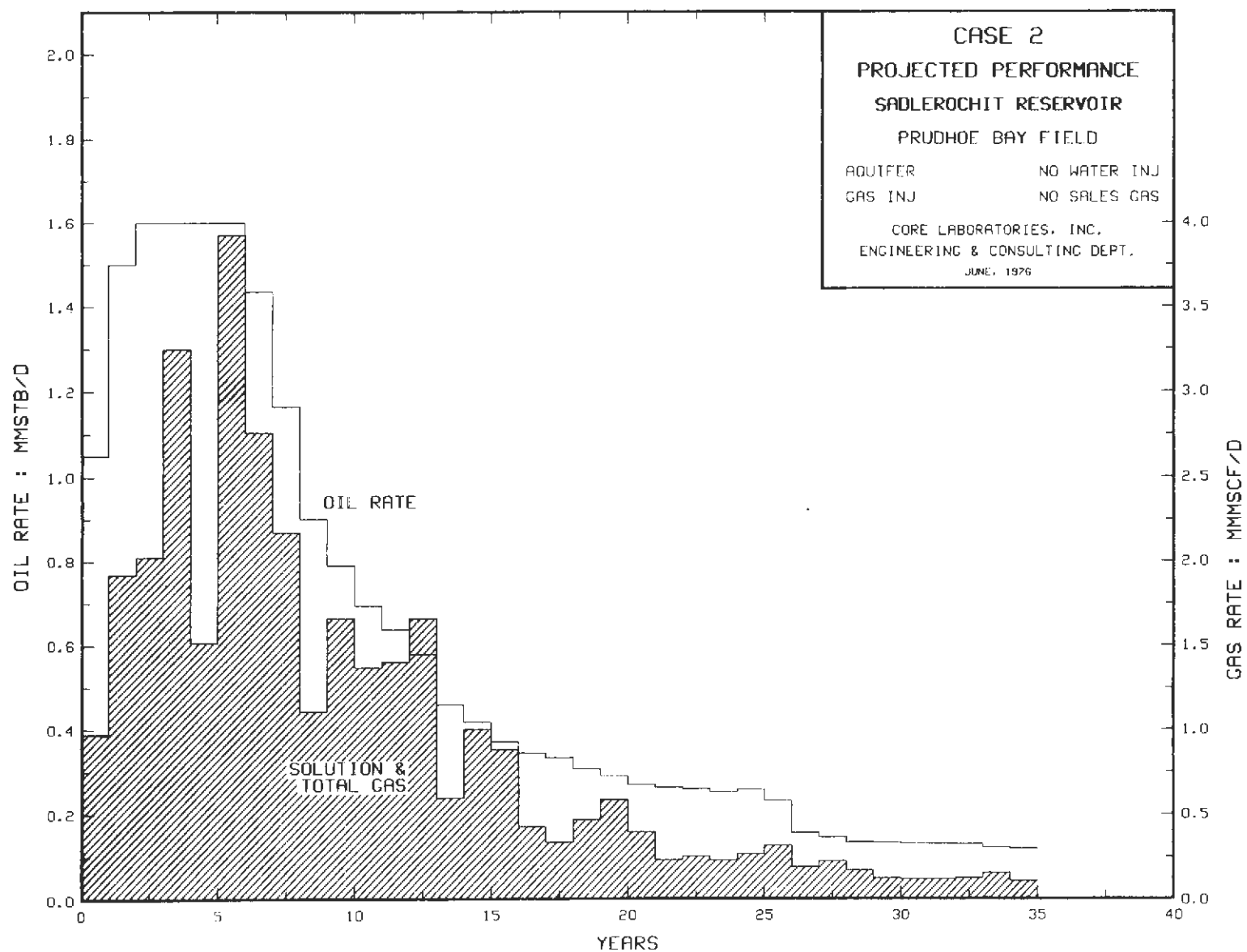
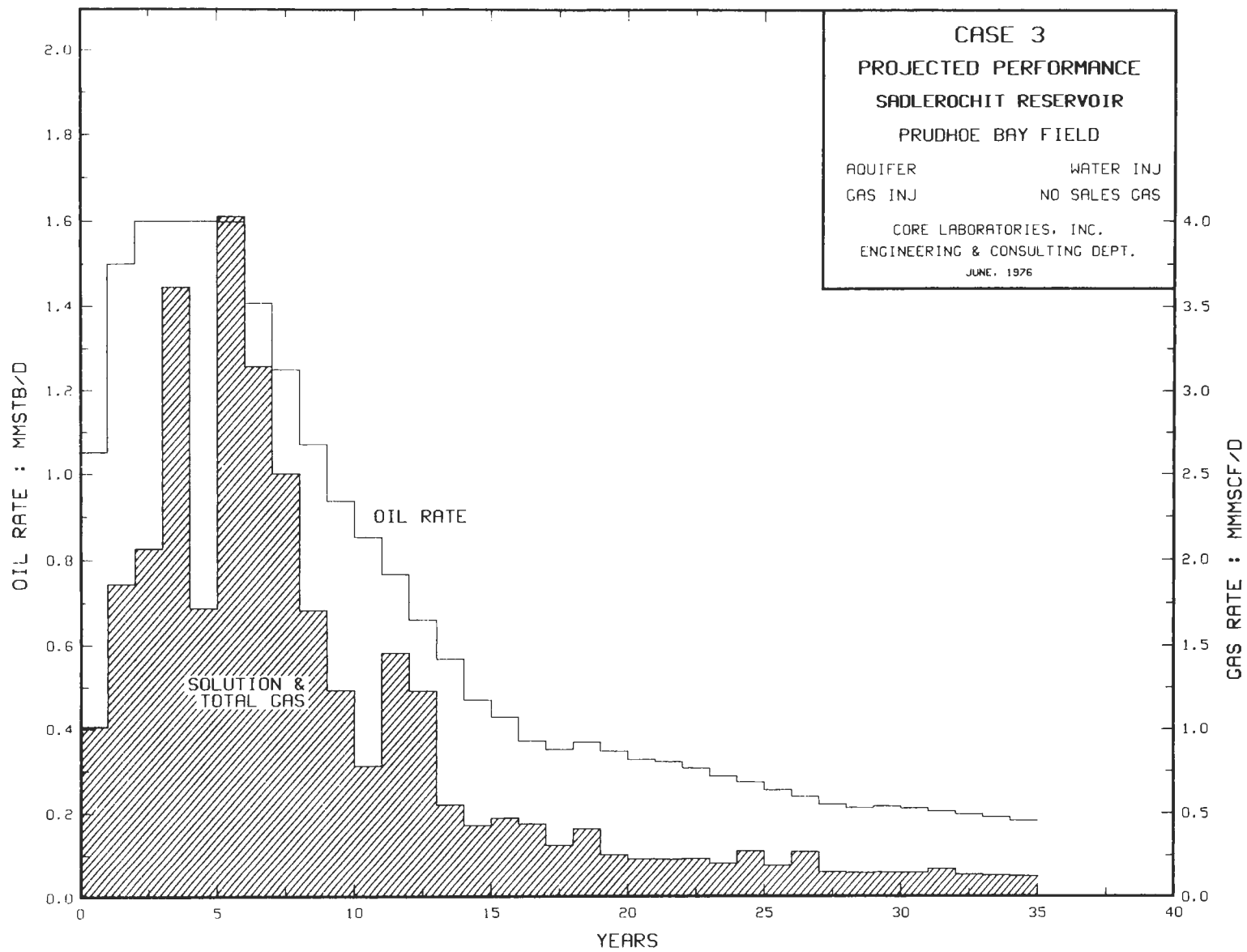


FIGURE 23



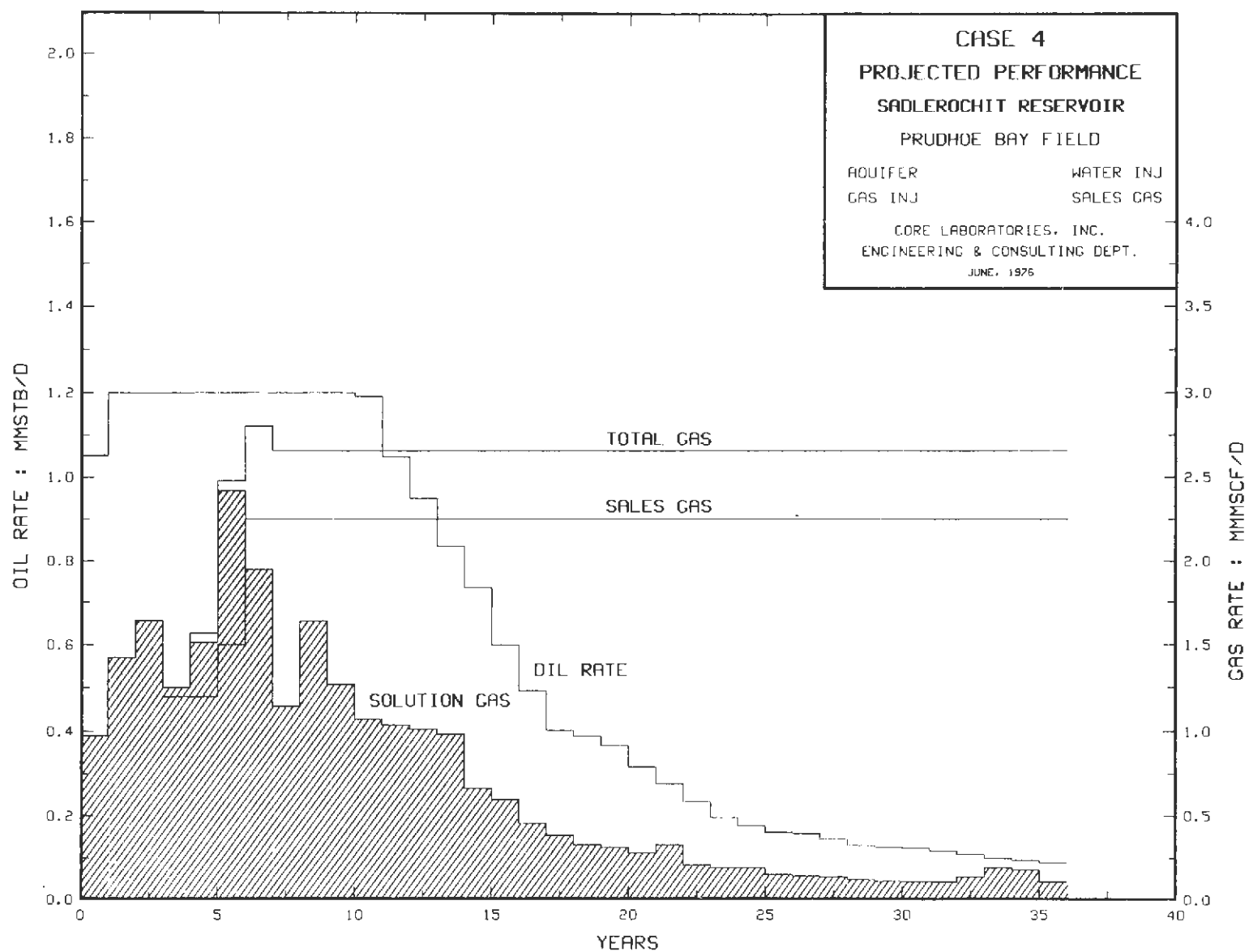


FIGURE 24

FIGURE 25

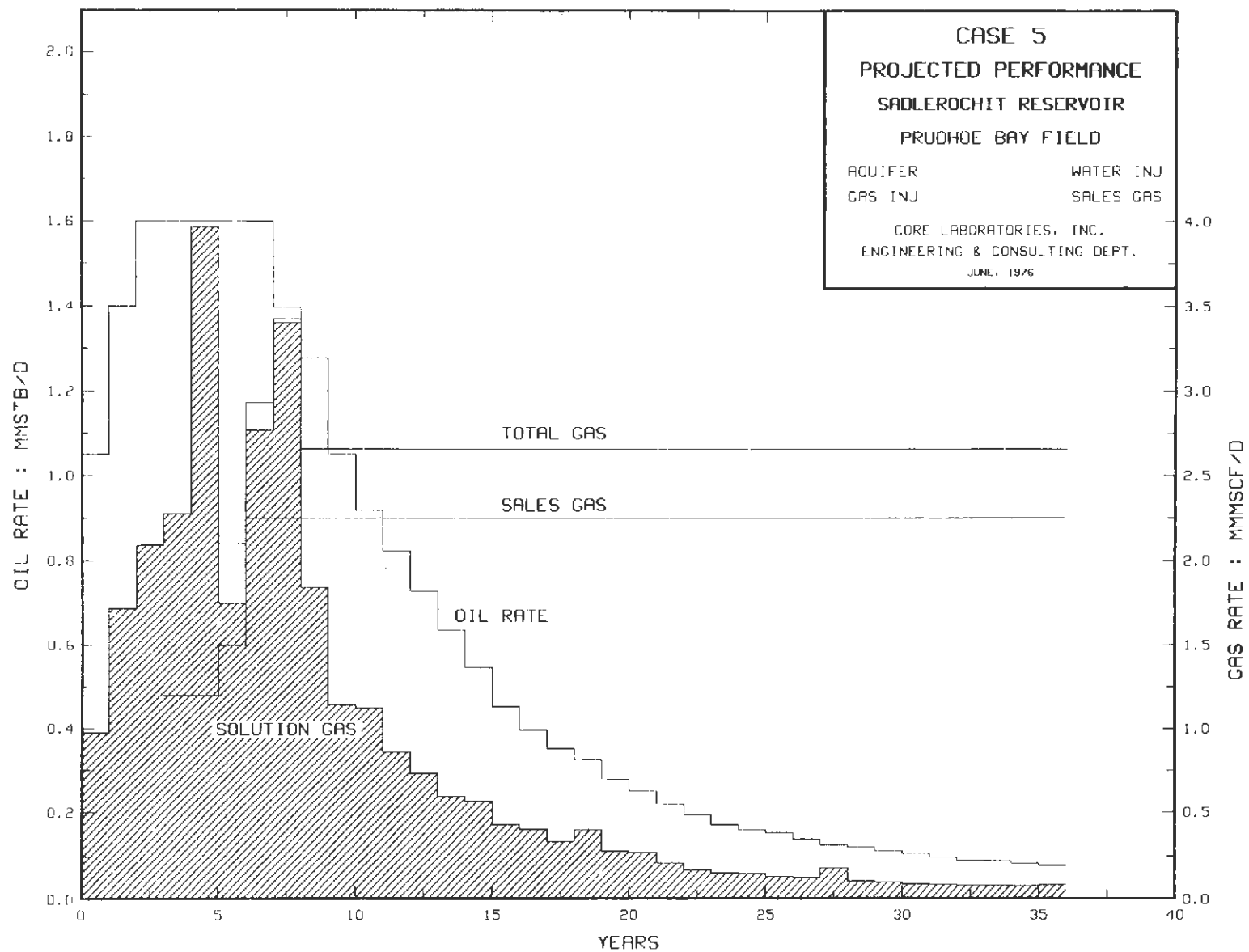
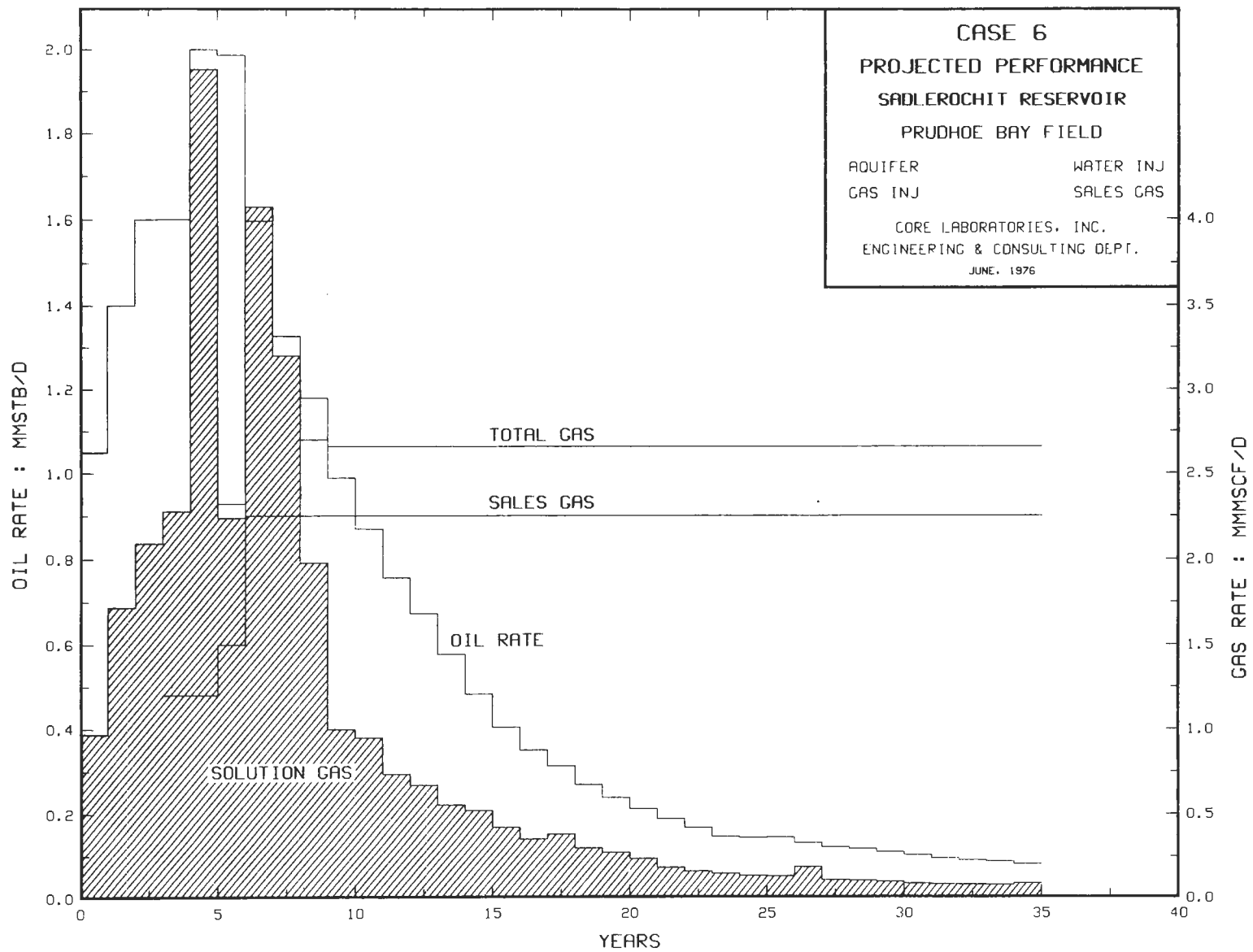


FIGURE 26



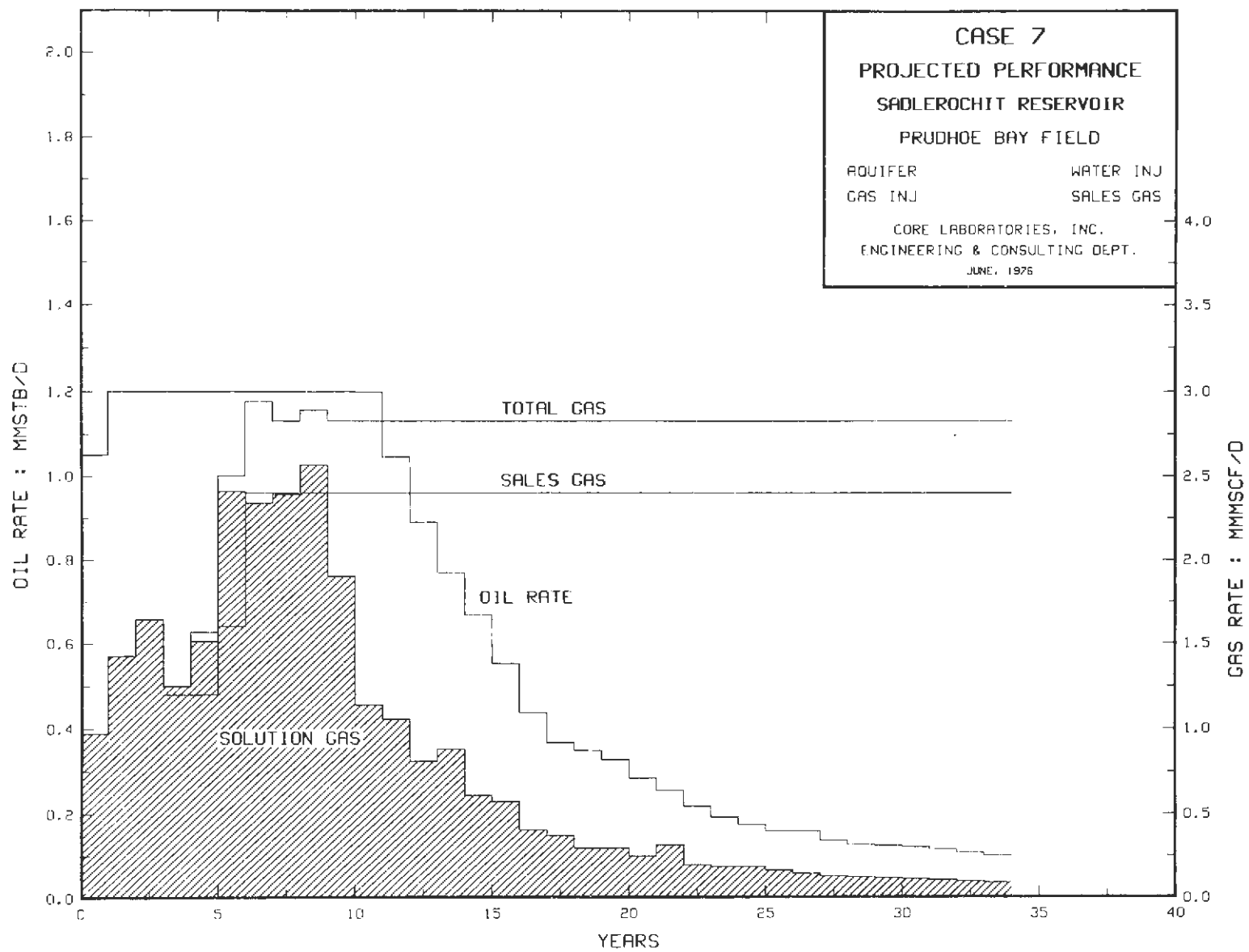


FIGURE 27

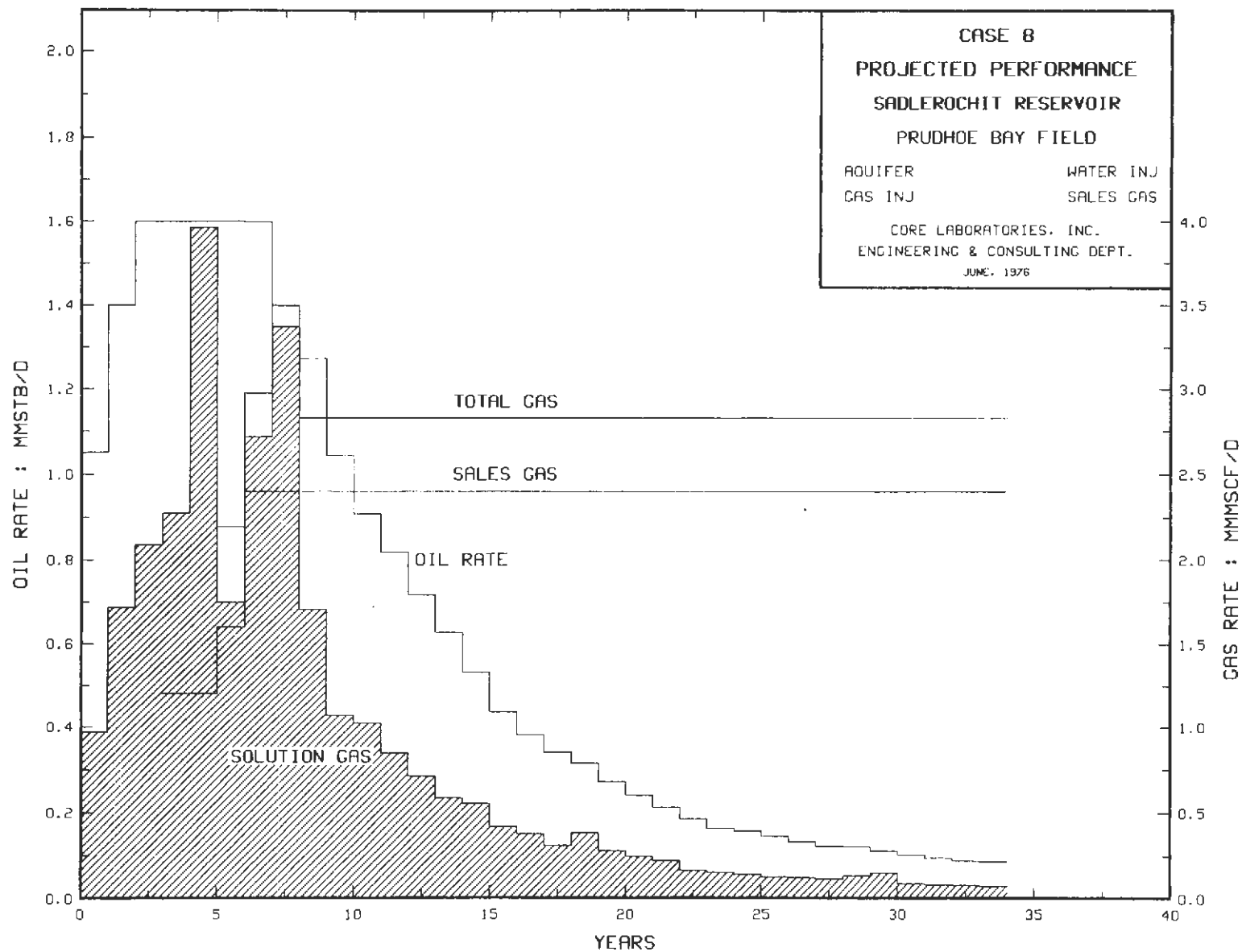


FIGURE 28



FIGURE 29

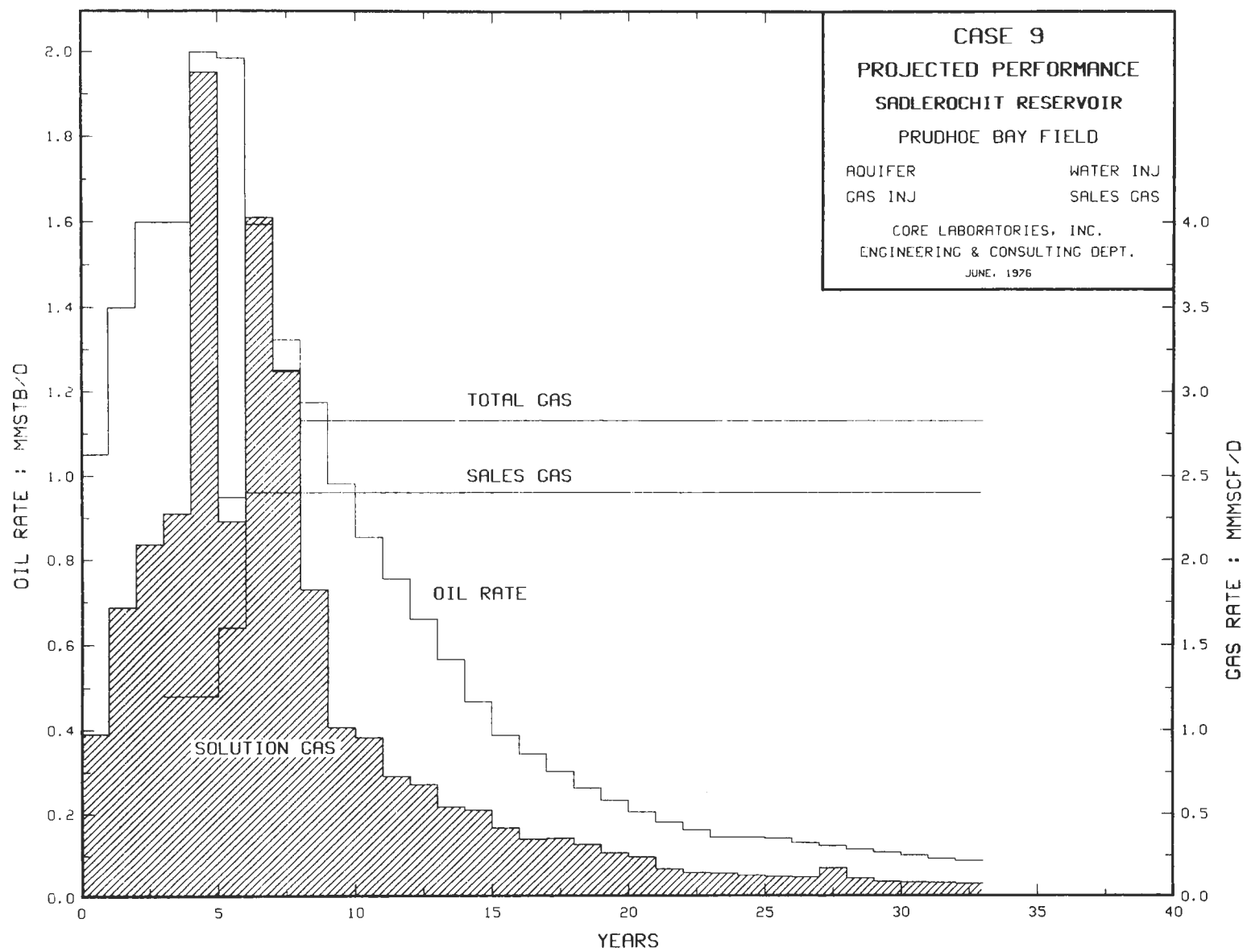


FIGURE 30

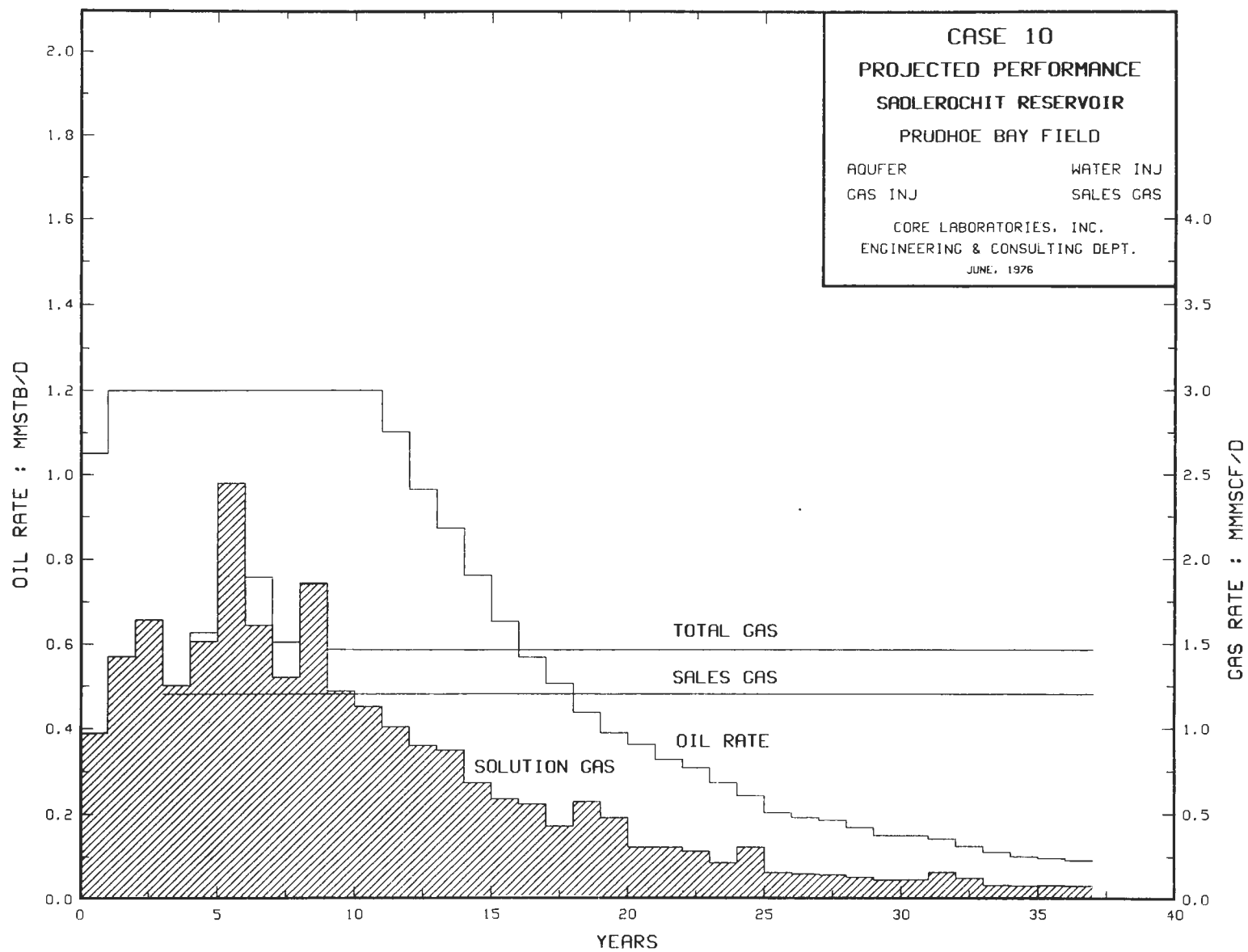


FIGURE 31

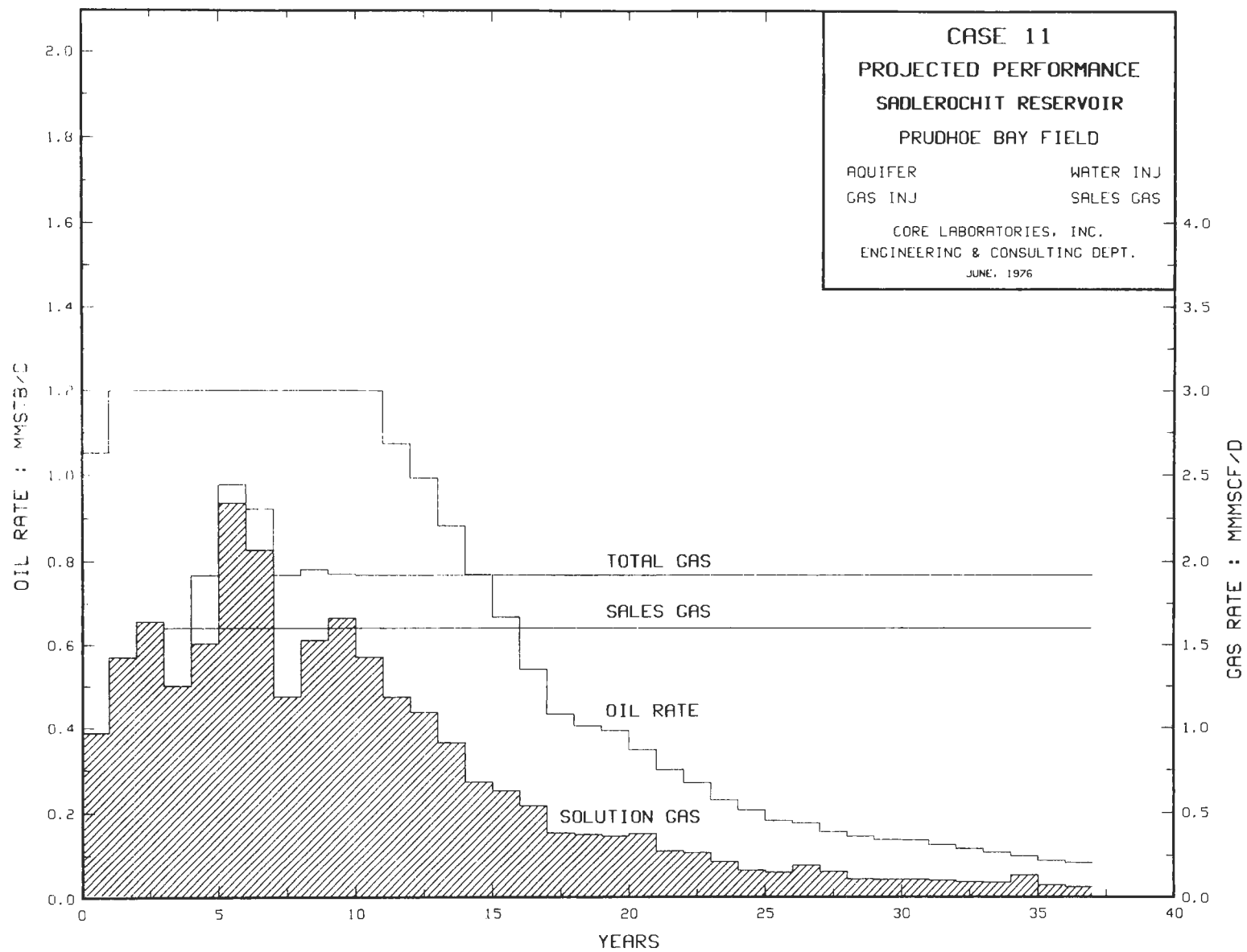


FIGURE 32

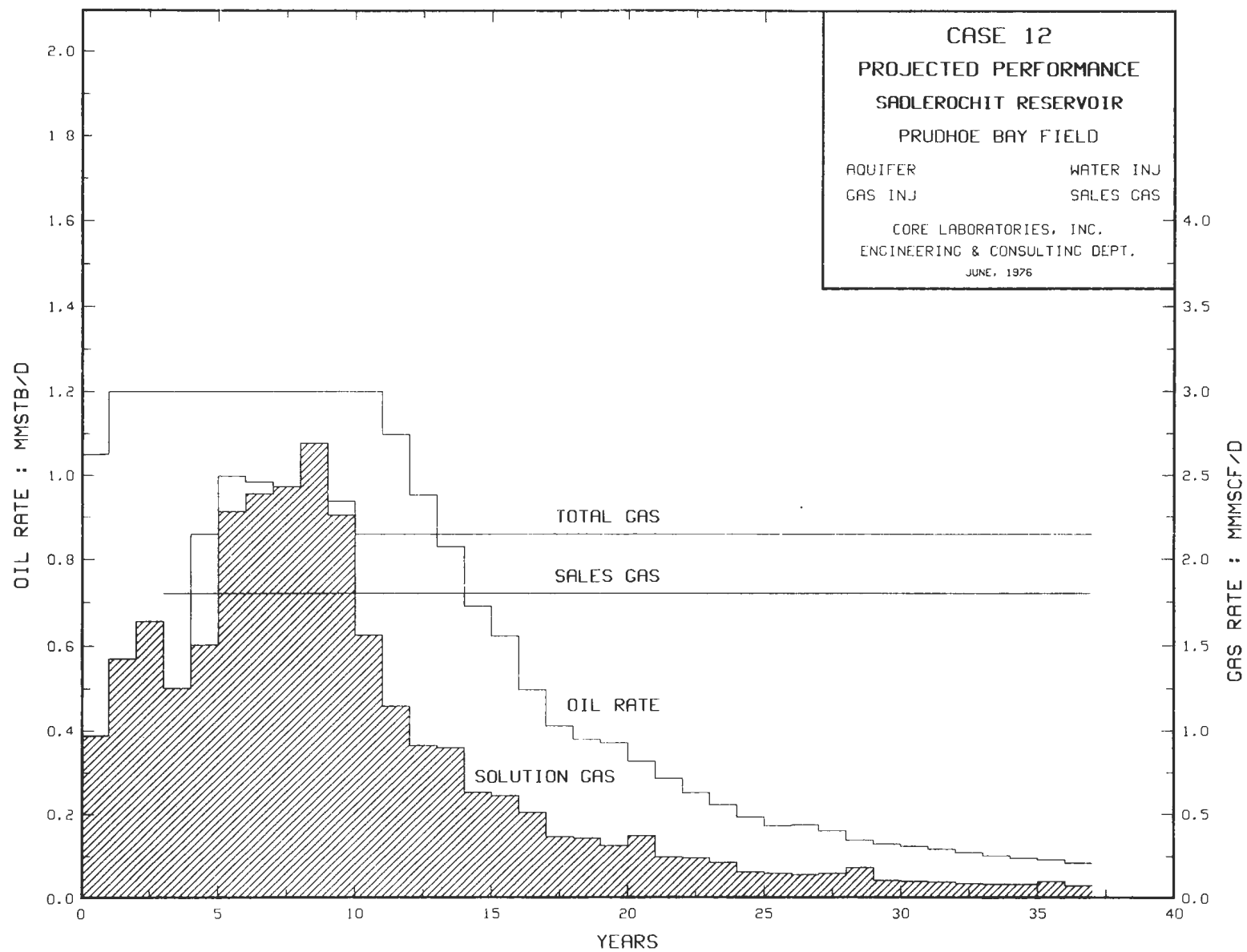


FIGURE 33

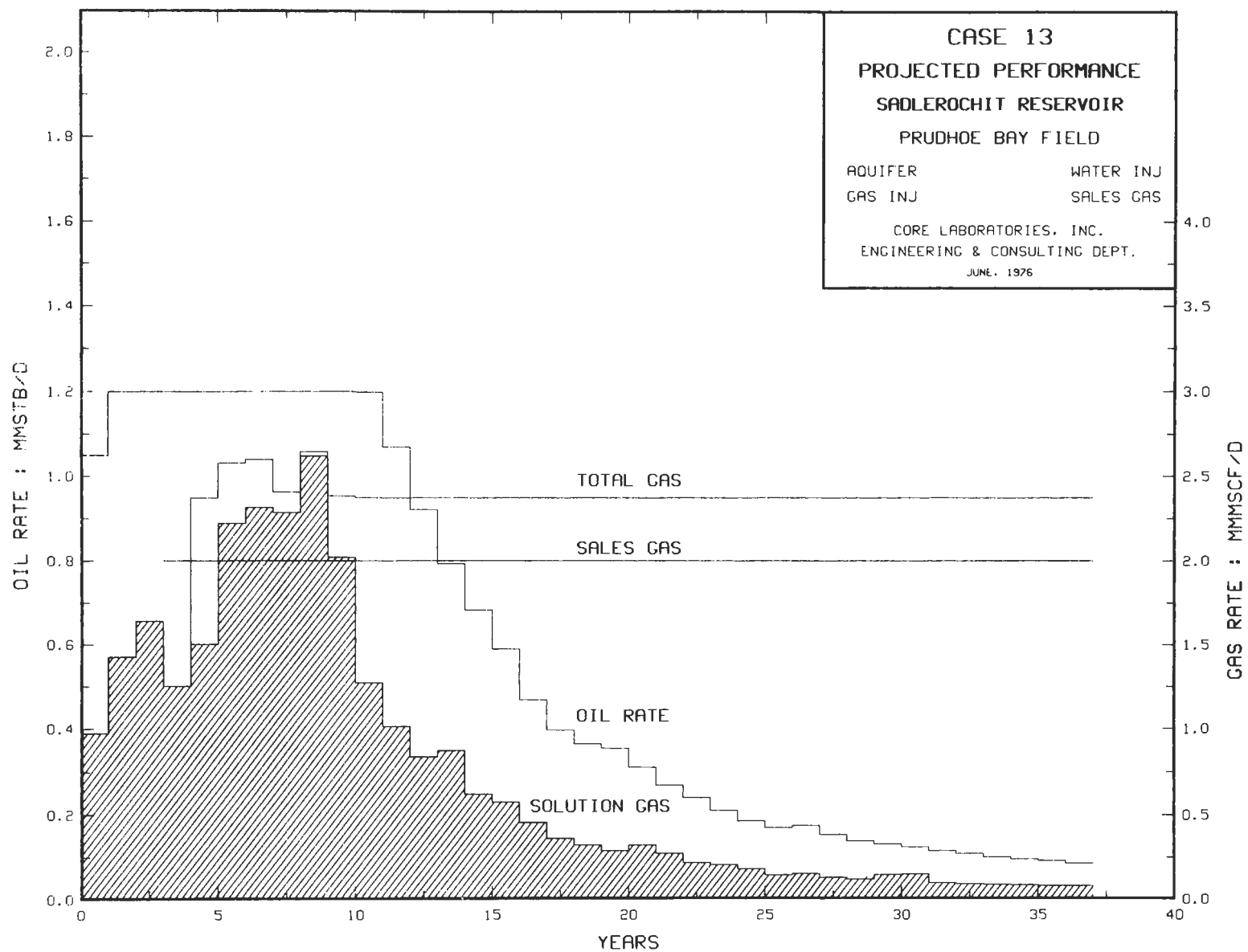


FIGURE 34

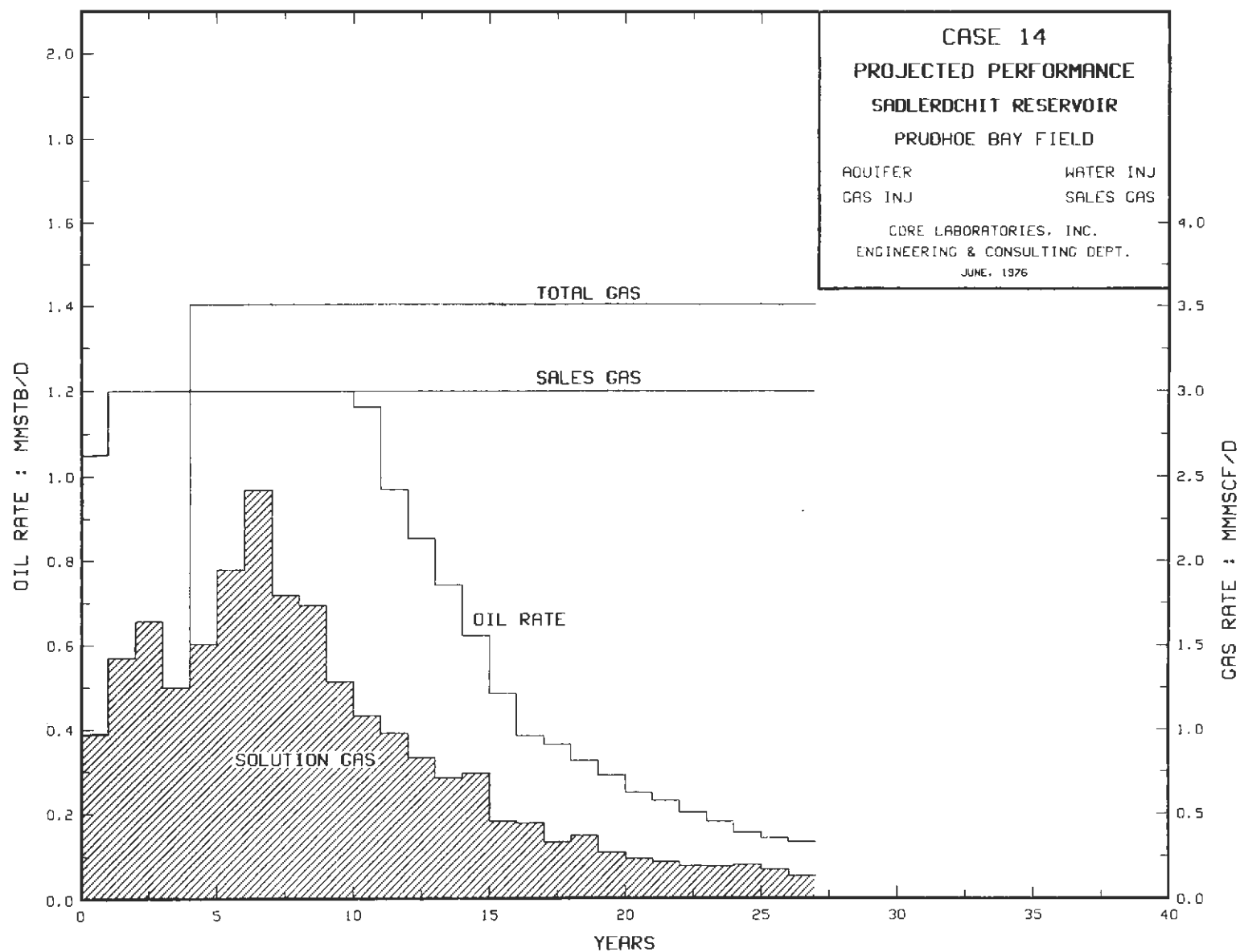
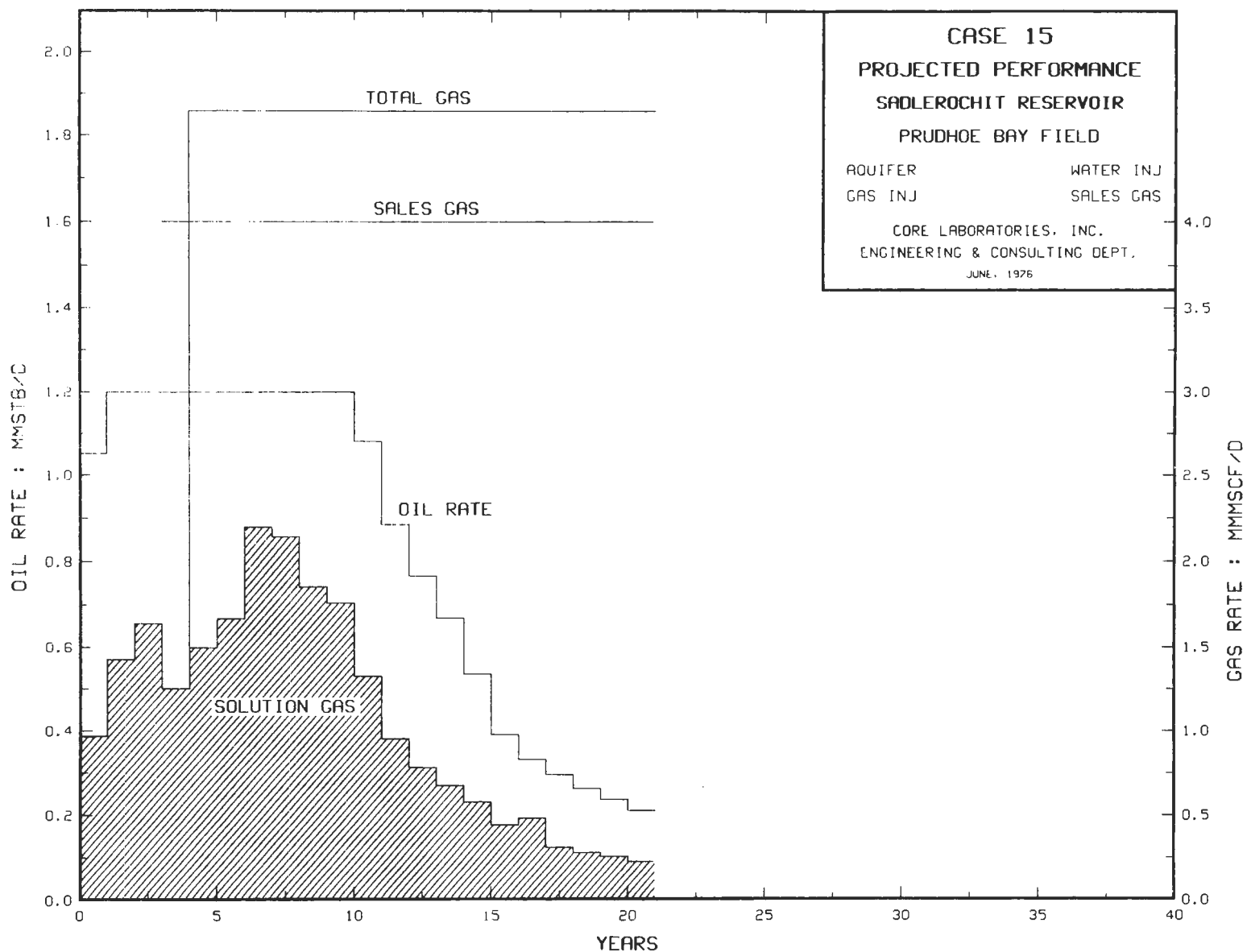


FIGURE 35



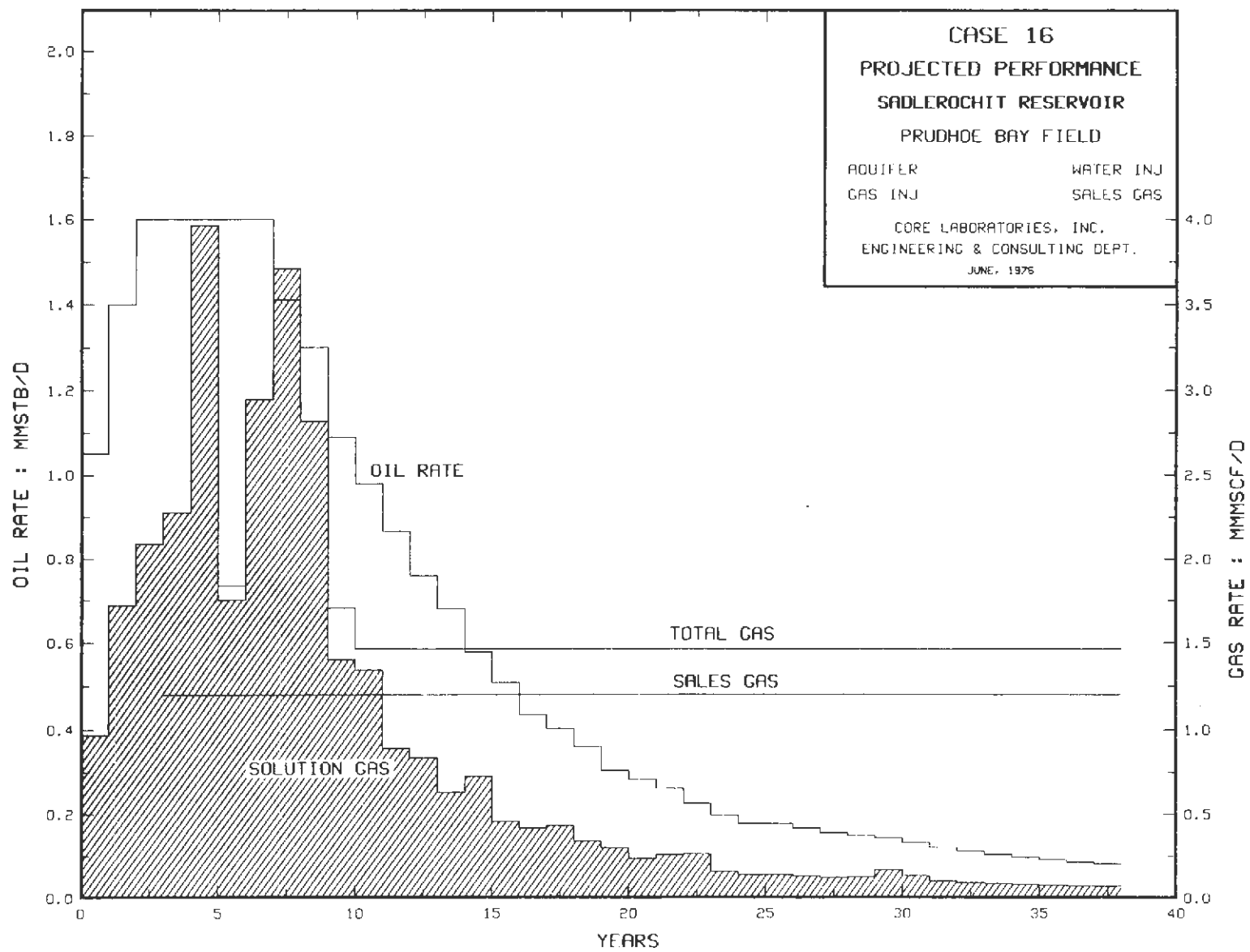


FIGURE 36



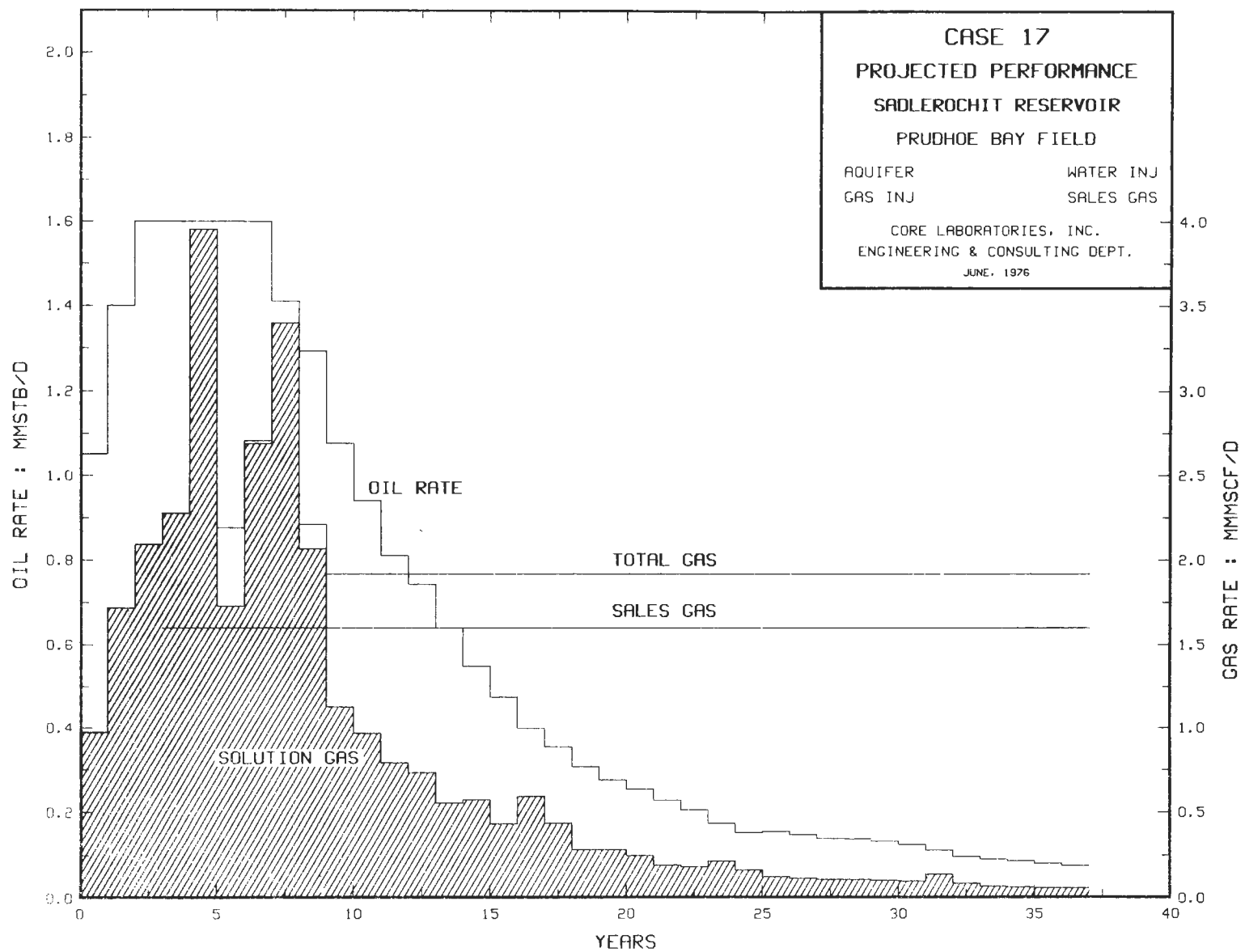
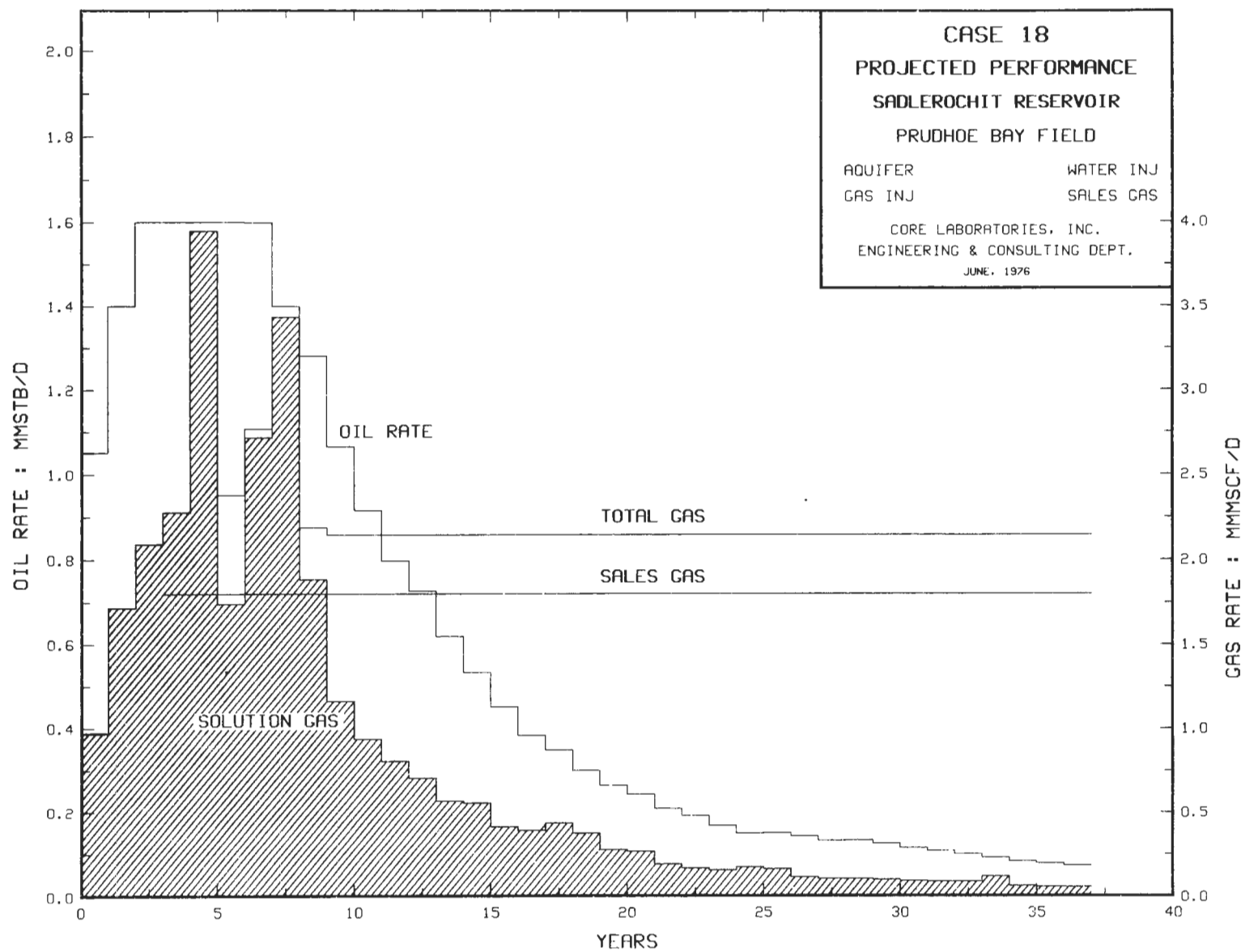


FIGURE 38



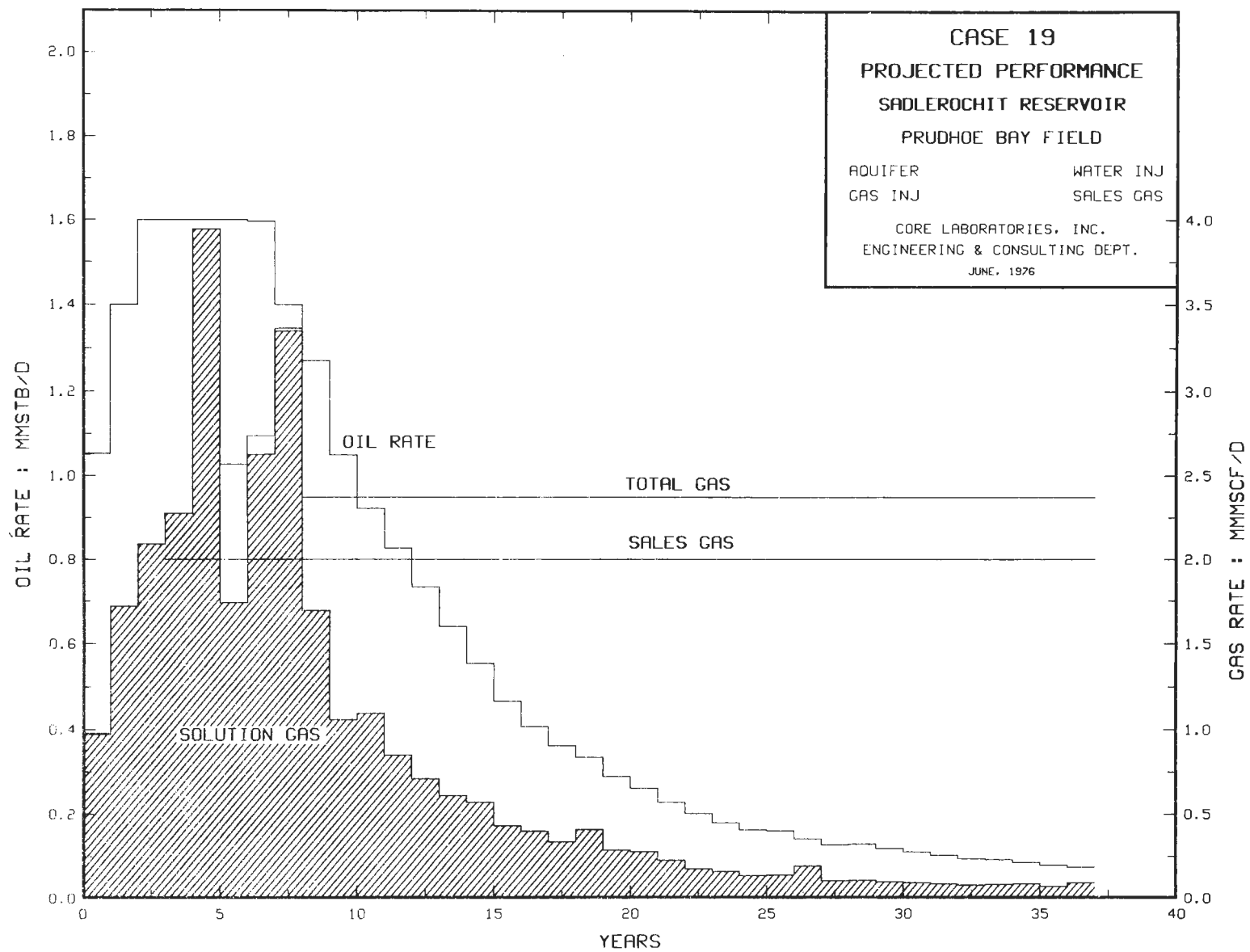


FIGURE 40

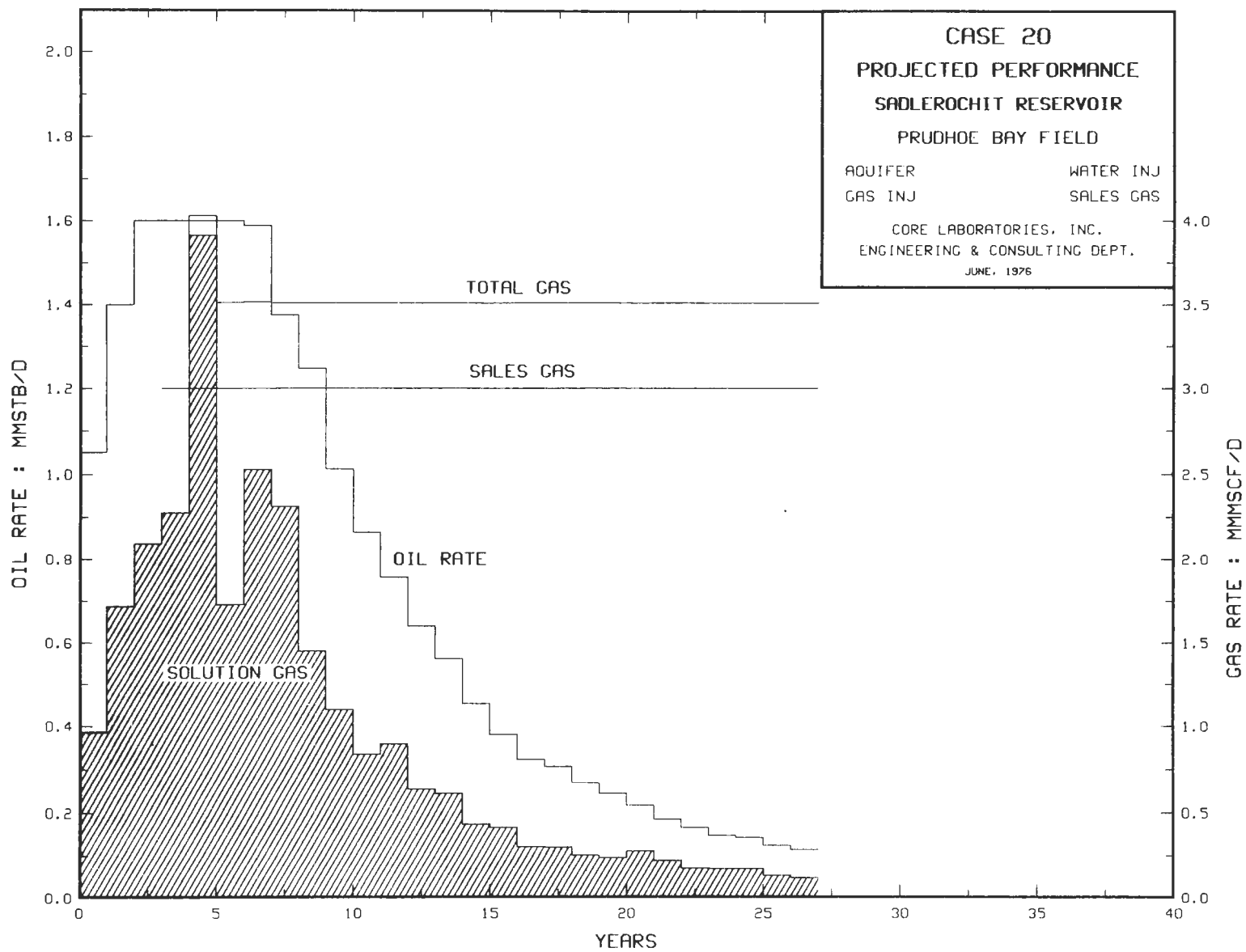
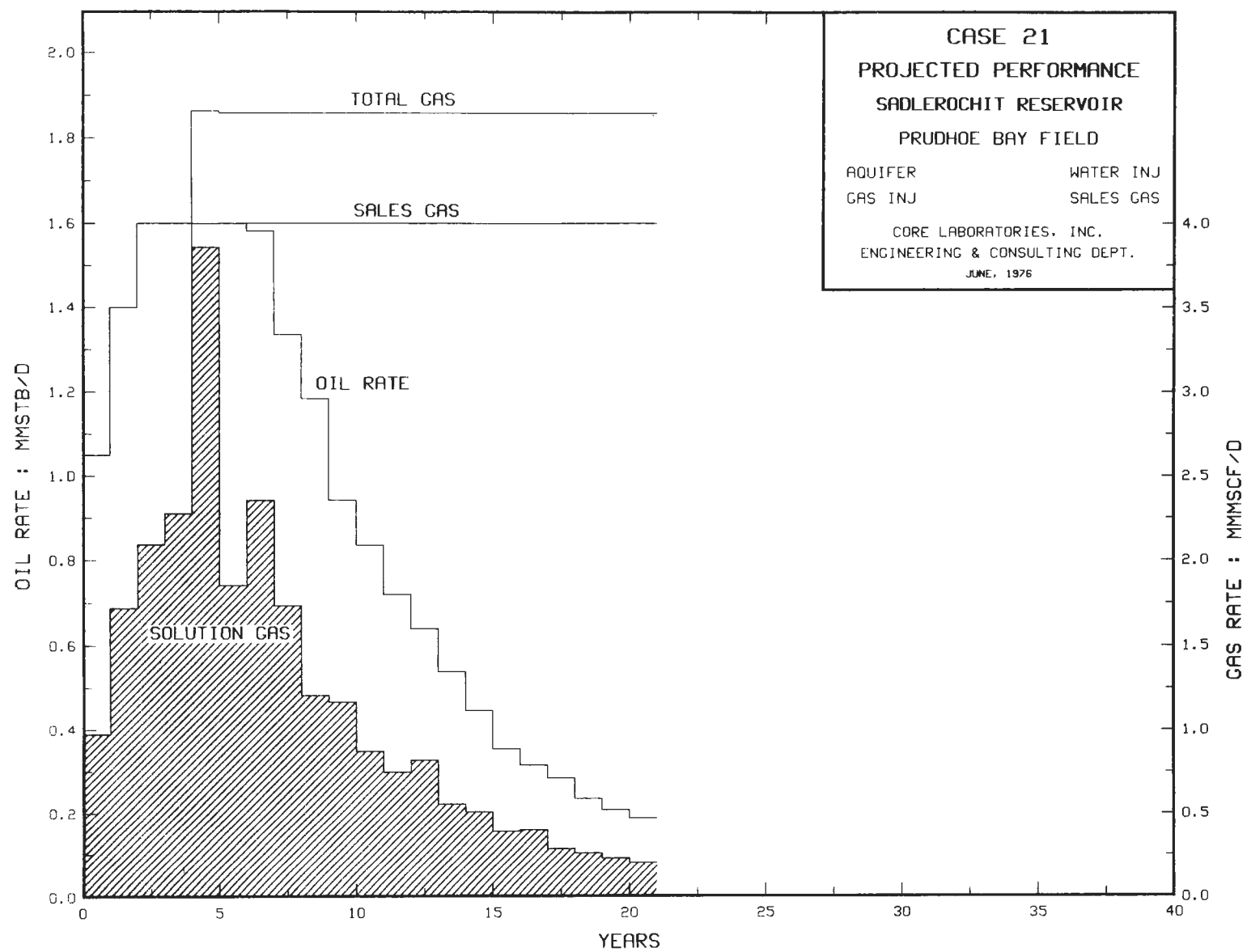


FIGURE 41



GEOLOGY AND ESTIMATED RECOVERABLE GAS RESERVES  
OF THE NORTH SLOPE (ONSHORE) OF ALASKA

by  
Dr. James D. Lowell  
Consulting Geologist  
Denver, Colorado  
June 28, 1976

Introduction

The purpose of this report is to demonstrate that, based on known geologic conditions, estimated remaining recoverable gas reserves of the Alaska North Slope (onshore), while significant, are less than previous estimates that did not properly take critical geologic relationships into account.

The report is divided into two major parts, first, discussion of North Slope geology with emphasis on the Prudhoe Bay accumulation, and second, consideration of North Slope gas reserves. Discussed briefly are three other sedimentary basins, Yukon Kandik, Middle Tanana, and Copper River, which are on or relatively near the proposed Alcan route (Pl. 1), but have much less potential than the North Slope for major gas reserves.

North Slope Geology

The general configuration of the North Slope Basin is defined by structure contours which are drawn on top of basement and show a strongly asymmetric trough deepest along the western end of the Brooks Range (Pl. 2). Exploratory well control and oil and gas fields are also plotted. As of January 1, 1975, fifty-two exploratory wells were drilled between the Arctic National Wildlife Range and Naval Petroleum Reserve Number 4. In addition, thirty-seven test wells and forty-five core holes were drilled on NPR-4 in the time period of 1945-1955. During 1975, thirteen more exploratory wells were drilled, including two on NPR-4. Two additional exploratory wells were drilling at the year's end. Drilling thus far has established two important facts: 1) the giant Prudhoe Bay oil and gas field, located more than 150 miles from the deepest part of the basin is the only field being commercially developed at this time; and 2) a very special combination of structure, reservoir, unconformity, and source rock has led to the large hydrocarbon accumulation at Prudhoe and this

combination is unlikely to occur anywhere else onshore west of the Canning River.

Plate 3 shows a diagrammatic cross-section from the Brooks Range to the Barrow Arch on which Prudhoe field is located (see Pl. 2 for line of section A-A'). The main reservoir is porous and permeable sandstone of the Sadlerochit Formation of Triassic and Permian age. In the Prudhoe Bay portion of the Barrow Arch, Lower Cretaceous marine shales have been deposited above an unconformity (erosion surface) which has cut progressively across older rocks such that Lower Cretaceous shale lies directly on Triassic-Permian reservoir. This is the single most important relationship for the entrapment of petroleum at Prudhoe as can be seen from the following discussion.

According to geochemical studies (Pl. 4) the Lower Cretaceous marine shale has the highest content of organic matter and is by far the best source rock in the entire North Slope stratigraphic section to supply hydrocarbons to potential surrounding reservoirs. The Jurassic marine shale is also a good source rock, but it is not in contact with all the Prudhoe Bay reservoirs (which, in addition to the Sadlerochit, include the Upper Jurassic Kuparuk River sandstone, Lower Jurassic Sag River sandstone, and Pennsylvanian-Mississippian Lisburne carbonate rocks) as is the Lower Cretaceous shale. Furthermore, the presence of an impermeable zone at the top of the Triassic (Shublik Formation shales and limestones) restricts migration from the potential Jurassic source into the underlying Sadlerochit. Morgridge and Smith (1972) found that all pre-Jurassic rocks investigated have low oil-generating potential. It is critical, then, for a Prudhoe-type and size accumulation that rich Lower Cretaceous marine shales be juxtaposed with potential reservoirs, particularly Sadlerochit sandstones to allow migration of hydrocarbons from the shale into the sandstone. The shale, in turn, serves as an impervious seal for hydrocarbons trapped in the sandstone. The juxtaposition must also take place where the Lower Cretaceous is thin for only here has organic material (the precursor to petroleum) been highly concentrated. To the south where the Lower Cretaceous is much thicker, organic material is more finely disseminated and the unit is not a good source rock. This difference in source rock capability is indicated on Plate 3 by a color contrast within the Lower Cretaceous between the organically rich thin marine shale and the organically lean thick more continental rocks.

A sequential evolution of North Slope geology emphasizing the Prudhoe Bay Field is given on Plate 5. In stage A the main Permian-Triassic reservoirs were derived from what is



presently the north. Southward spreading and laterally migrating braided streams resulted in a highly porous and permeable uniform blanket deposit over the entire field area (Morgridge and Smith, 1972). During Upper Jurassic-Lower Cretaceous uplift in stage B much of the earlier Paleozoic-Triassic deposits were eroded in the vicinity of Prudhoe and had more of the Permian-Triassic been cut out, as indeed it has been to the east, the Prudhoe Bay field would not exist today. In Cretaceous time (stage C) thrusting caused the Brooks Range to rise in the south which in turn furnished sediments that were shed to the north and provided source and seal shales across the Prudhoe structure. Continued sediment supply from the south and sagging of the continental margin on the north throughout the Late Cretaceous and Tertiary (stage D) has brought the North Slope to its present configuration wherein the thickest Tertiary section is developed offshore. A thickness of 8000 feet of Upper Cretaceous-Tertiary sediments has buried Lower Cretaceous source rocks deeply enough that higher temperatures and compaction at those levels have respectively generated petroleum and squeezed it into adjacent reservoirs.

A cross-section through NPR-4 (Pl. 6) demonstrates that the ingredients to create another Prudhoe Bay Field are lacking there. Permian-Triassic reservoirs are missing because of onlap on the pre-Mid-Devonian basement to the north and they are not in contact with Lower Cretaceous sourcing shales.

Plate 7 summarizes the possibility of locating another field comparable to the Prudhoe Bay Field. The northern distribution of the Permian-Triassic Sadlerochit reservoir sandstones is shown as being limited by truncation on the east and onlap on the west in NPR-4. The probability of another Prudhoe-type accumulation existing along the Sadlerochit zone of truncation is greatest offshore, but the difficulty of developing offshore fields in the Arctic and the problem of building gas pipelines through the scoring, gouging and plowing zones may considerably prolong the time when any such field, if found, can become available as a source of gas to the lower 48. From the structure contours on Plate 7, it can be seen that the Prudhoe structure has drained hydrocarbons over a great distance, especially from the south and east; a very substantial drainage area is another condition that must exist for a large accumulation of hydrocarbons. The onlap distribution of the Sadlerochit (Pl. 7) taken in conjunction with the lack of contact of the Sadlerochit with the Lower Cretaceous source shale (Pl. 6) reveals that the chance for a Prudhoe-type accumulation in NPR-4 is virtually nil.



### Estimated Recoverable Gas Reserves

Considering the poor likelihood for a gas accumulation comparable to the size of Prudhoe to be found anywhere onshore on the Alaska North Slope west of the Canning River, estimated reserves of future recoverable gas, especially gas that is economically producible, should be carefully tempered. For example, the only other gas field of any size on the North Slope is Gubik (Pl. 2) with estimated reserves of 300 billion cubic feet. This field, however, has never been produced. Moreover, the reservoir at Gubik is lower Upper Cretaceous shoreline sandstone and comparable Cretaceous sandstones in the Oumalik well to the west (Pl. 2) have poor reservoir quality. "The reservoirs (at Oumalik) are poor because of the excessive amount of carbonate (calcite and particularly dolomite) cement present. Furthermore, in all but three samples, the primary pore pattern is unfavorable, because well over 60 percent of the pore wall area is coated with clay" (Robinson, 1956). These cementation and clay-plugging problems are likely to plague the bulk of Cretaceous reservoirs on the North Slope.

It is evident from the foregoing that information is sufficient to reveal the geologic parameters which control the occurrence of large hydrocarbon accumulations on the onshore North Slope of Alaska. Exploration is sufficiently advanced to invalidate the volumetric reserve assessment approach. This is a technique most frequently used in frontier areas where no well control is available, in which volume of sediment (completely lumped together without regard to its lithologic makeup) is multiplied by a recovery number (X cubic feet of gas per cubic unit - taken from some producing basin or basins) to yield estimated reserves. In the absence of any geologic information other than rough basin size and thickness of sedimentary section, the volumetric method may be acceptable but later experience proves it is almost always too high. Where geologic control is available estimations by volume should be avoided. Clearly, the speculative recoverable 41.8 trillion cubic feet of gas for the onshore North Slope estimated by Klein et al, (1974) using the volumetric method (modified in some unspecified way) is too high.

Later estimates of undiscovered recoverable reserves of gas on the onshore North Slope made by the United States Geological Survey (Miller et al, 1975) are based on more geological input and seem more reasonable:

<u>95% probability that at least this much is present</u>	<u>Statistical Mean</u>	<u>5% probability that at least this much is present</u>
14 TCFG	28 TCFG	49 TCFG

In good accord with the USGS estimates, I consider the most likely ultimate recoverable undiscovered gas reserves for the entire onshore North Slope are in the range of 25 trillion cubic feet of gas. Of this amount, only about one half will be available to exploration because the remaining one half is probably located beneath the Arctic National Wildlife Range. Furthermore, the timing of discovery of much of the available gas reserves may be many years in the future because of the remoteness, weather severity and harsh operating conditions associated with arctic exploration and production.

#### Other Possible Gas Reserves

Three other sedimentary basins (Yukon-Kandik, Middle Tanana, and Copper River) lie athwart or near the route of the Alcan pipeline. The first well Louisiana Land & Exploration Company, Doyon Ltd. No. 1, Sec. 32, T 10N, R 27E to be drilled in the Yukon-Kandik Basin is located about 150 miles northeast of Fairbanks and is currently drilling below 8000 feet as part of a four well exploratory program for this region. The presence of several volcanic sequences detracts from the prospectiveness of the Yukon-Kandik Basin. It is of interest that the Alaska Scouting Service (May 26, 1976) reported that "some very hard formations have reportedly made for slow drilling" in the well now underway.

The only deep well in the Middle Tanana Basin is the Union Oil Company of California Nenana No. 1 (Sec. 7, T 4S, R 10W) which was drilled to a depth of 3062 feet after having penetrated approximately 3000 feet of non-marine Tertiary rocks before bottoming in the Birch Creek schist. This well together with the fact that the basin is simply an alluvial plain punctuated with monadnocks or small hills of basement clearly rules out the presence of significant gas reserves.

Eight holes, ranging in depth from 2793 to 8837 feet, have been drilled in the Copper River Basin. All of the wells were dry with no reported shows of oil or gas and no drill stem tests conducted.

Even limited geologic information makes highly suspect the volumetrically derived speculative reserves of

11.4 TCFG for the Yukon-Kandik Basin and 1.2 TCFG for the Copper River Basin (Klein et al, 1974). In much better accord with the geologic observation that reservoir rocks are poor in all three basins is the U.S.G.S. estimate (Miller et al, 1975) of recoverable gas reserves ranging from 0 (95% probability) to 5 (5% probability) TCFG with a statistical mean of 2 TCFG for all of the interior basins of Alaska (excludes North Slope and Gulf of Alaska). The proposed Alcan pipeline is ideally routed to deliver the anticipated amounts of gas that may be found in the Yukon-Kandik, Middle Tanana, and Copper River basins.

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11.4 TCFG for the Yukon-Kandik Basin and 1.2 TCFG for the Copper River Basin (Klein et al, 1974). In much better accord with the geologic observation that reservoir rocks are poor in all three basins is the U.S.G.S. estimate (Miller et al, 1975) of recoverable gas reserves ranging from 0 (95% probability) to 5 (5% probability) TCFG with a statistical mean of 2 TCFG for all of the interior basins of Alaska (excludes North Slope and Gulf of Alaska). The proposed Alcan pipeline is ideally routed to deliver the anticipated amounts of gas that may be found in the Yukon-Kandik, Middle Tanana, and Copper River basins.

KEY WELLS

NORTH SLOPE BASIN

Gulf Oil Corporation - Colville Delta State #1  
Mobil-Phillips-SOCAL - West Staines State 18-9-23  
Atlantic Richfield Co. - North Prudhoe Bay State #1  
Mobil-Phillips - Mikkelsen Bay State #13-9-19  
Home Oil Co. - Bush Federal #1  
Union Oil Co. of California - Kalubik Creek #1  
Shell Oil Company - Lake 79 Federal No. 1  
Atlantic Richfield Co. - West Sak River State #1  
Placid Oil - PLAGHM Beechey Point #1  
Mobil Oil Corp. - Beli Unit #1  
BP Oil Corporation - Sag Delta 31-11-16  
Texaco, Inc. - W. Kurupa #1  
Texaco, Inc. - East Kurupa Unit #1  
Atlantic Richfield - Nora Federal No. 1  
Atlantic Richfield Co. - Susie Unit No. 1  
Pan American Petroleum Corp. - Kavik No. 1  
Exxon - Canning River Unit B-1  
Texaco, Inc. - West Kavik Unit No. 1  
Mobil - West Staines State #2  
Humble Oil & Refining Co. - East Mikkelsen Bay State #1  
Mobil Phillips - Kadler State 15-9-16  
Exxon Corp. - Alaska State A#1  
Atlantic Richfield Co. - Delta State No. 1  
Atlantic Richfield - Prudhoe Bay State No. 1  
Hamilton Brothers - Kup Delta 51-1  
Sinclair Oil & Gas Co. - Colville No. 1  
U. S. Navy - Cape Halkett #1  
Forest Oil Corp. - Lupine Unit #1  
Exxon Corp. - Canning River Unit Block A#1  
AMOCO Production Co. - Aufeis Unit #1  
Atlantic Richfield Co. - Kavik Unit #3  
Atlantic Richfield Co. - Kavik Unit #2  
Mobil Oil Corp. - Echooka Unit #1  
Forest Oil Corp. - Kemik Unit #1  
McCulloch Oil Corp. - Fin Creek Unit #1  
Atlantic Richfield Co. - Lake State No. 1 (24-10-15)  
Hamilton Bros., et al., Milne Point 18-1

YUKON-KANDIK BASIN

Louisiana Land & Exploration Co. - Doyon Ltd. #1

MIDDLE TANANA BASIN

Union Oil Co. of California - Nenana No. 1

COPPER RIVER BASIN

Aledo Oil Co. - Alaska O&G Dev. Co. - Eureka No. 1  
Union Oil Co. of California - Tazlina Unit No. 1  
Aledo Oil Co. - Eureka #2  
Pan American Petroleum Corp. - Moose Creek Unit No. 1  
Mobil Oil Company - Salmon Berry Lake Unit No. 1  
Consolidated Oil & Gas, Allied & Embassy Miami - Tawawe Lake Unit #1  
Atlantic Refining Co. - Rainbow No. 1  
Atlantic Refining Co. - Rainbow Federal No. 1

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Prudhoe Bay Hydrocarbon Sources.....	4
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Limits and Hydrocarbon Drainage Patterns of the Sadlerochit Formation.....	7

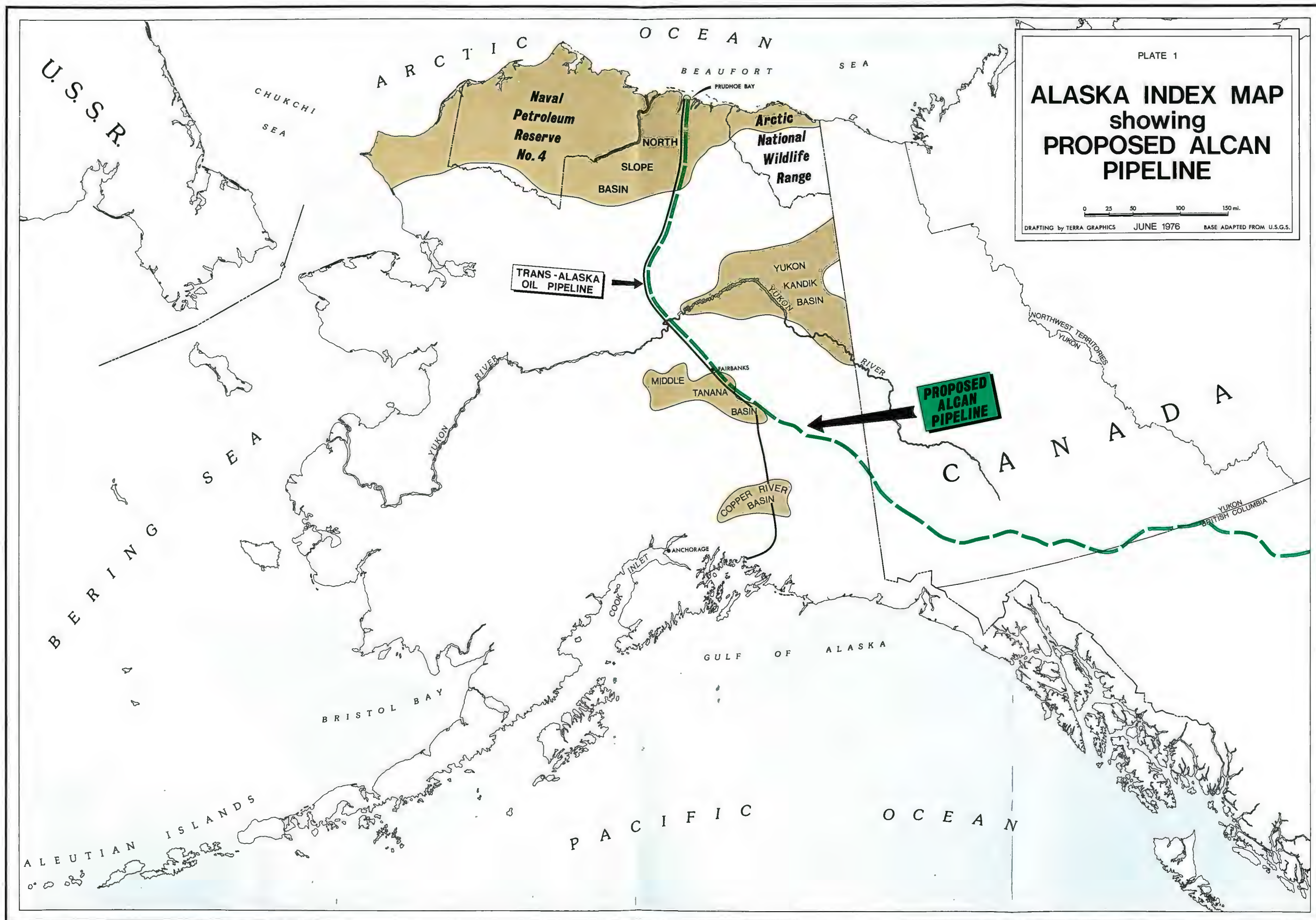


PLATE 1

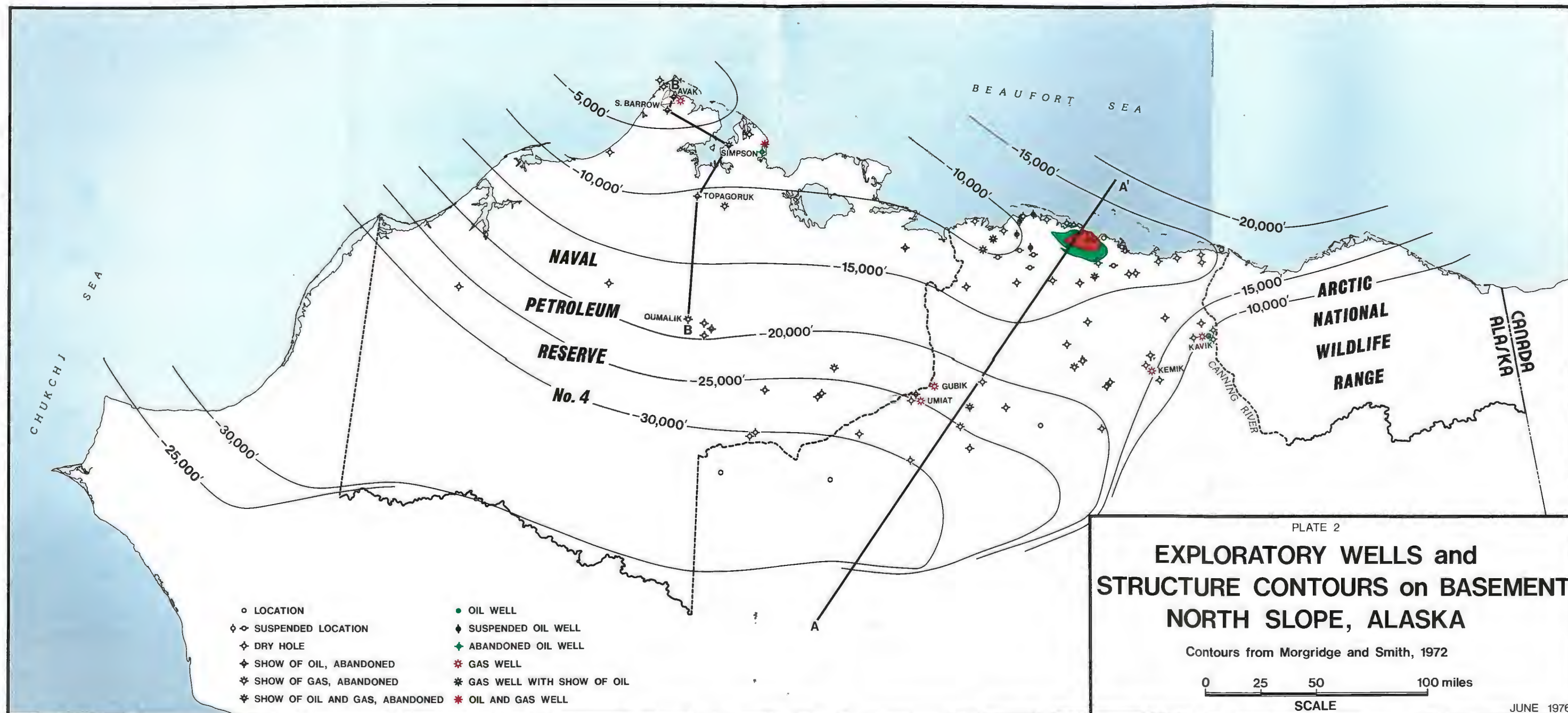
# ALASKA INDEX MAP showing PROPOSED ALCAN PIPELINE

0 25 50 100 150 mi.

DRAFTING by TERRA GRAPHICS JUNE 1976 BASE ADAPTED FROM U.S.G.S.









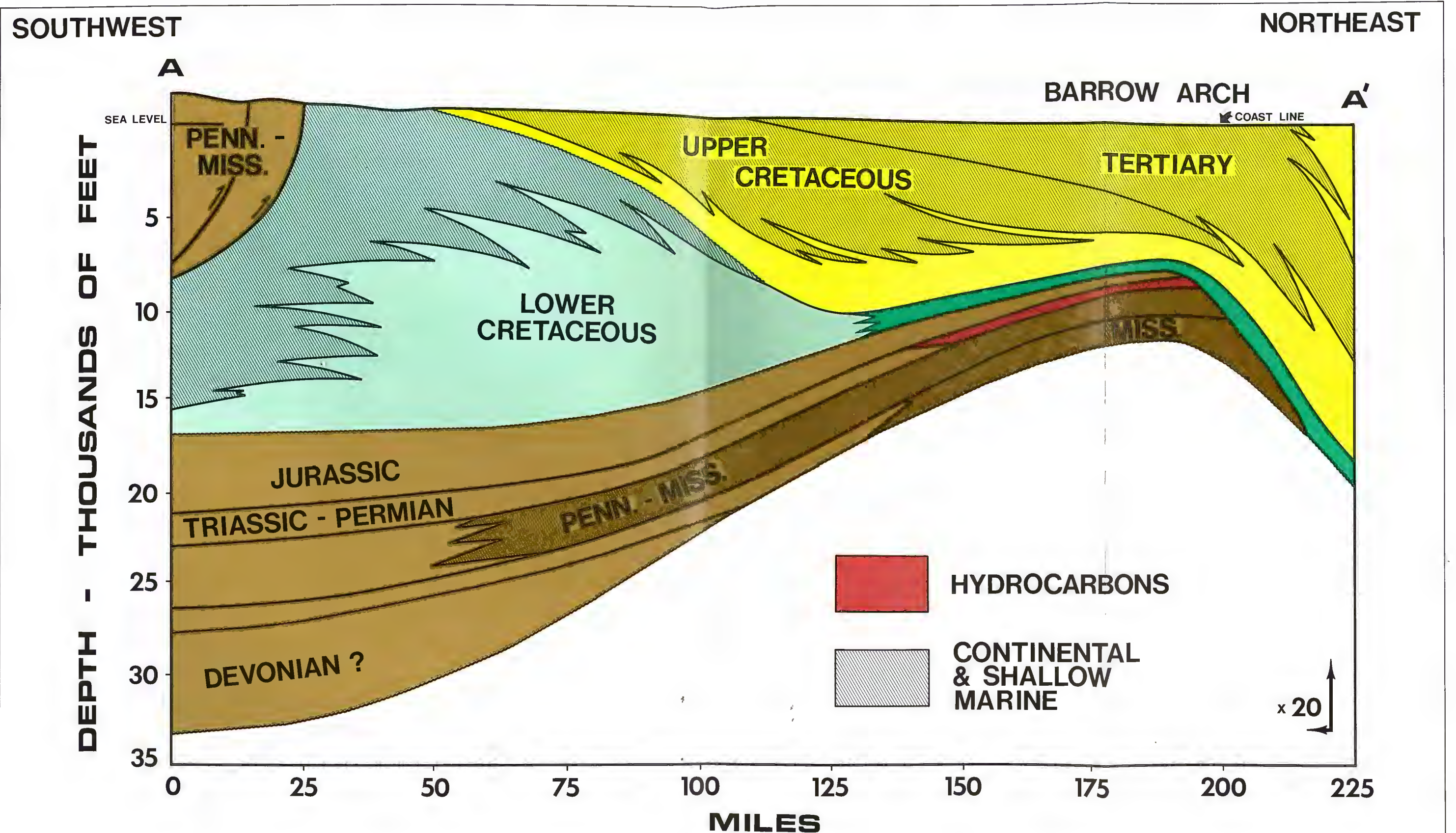
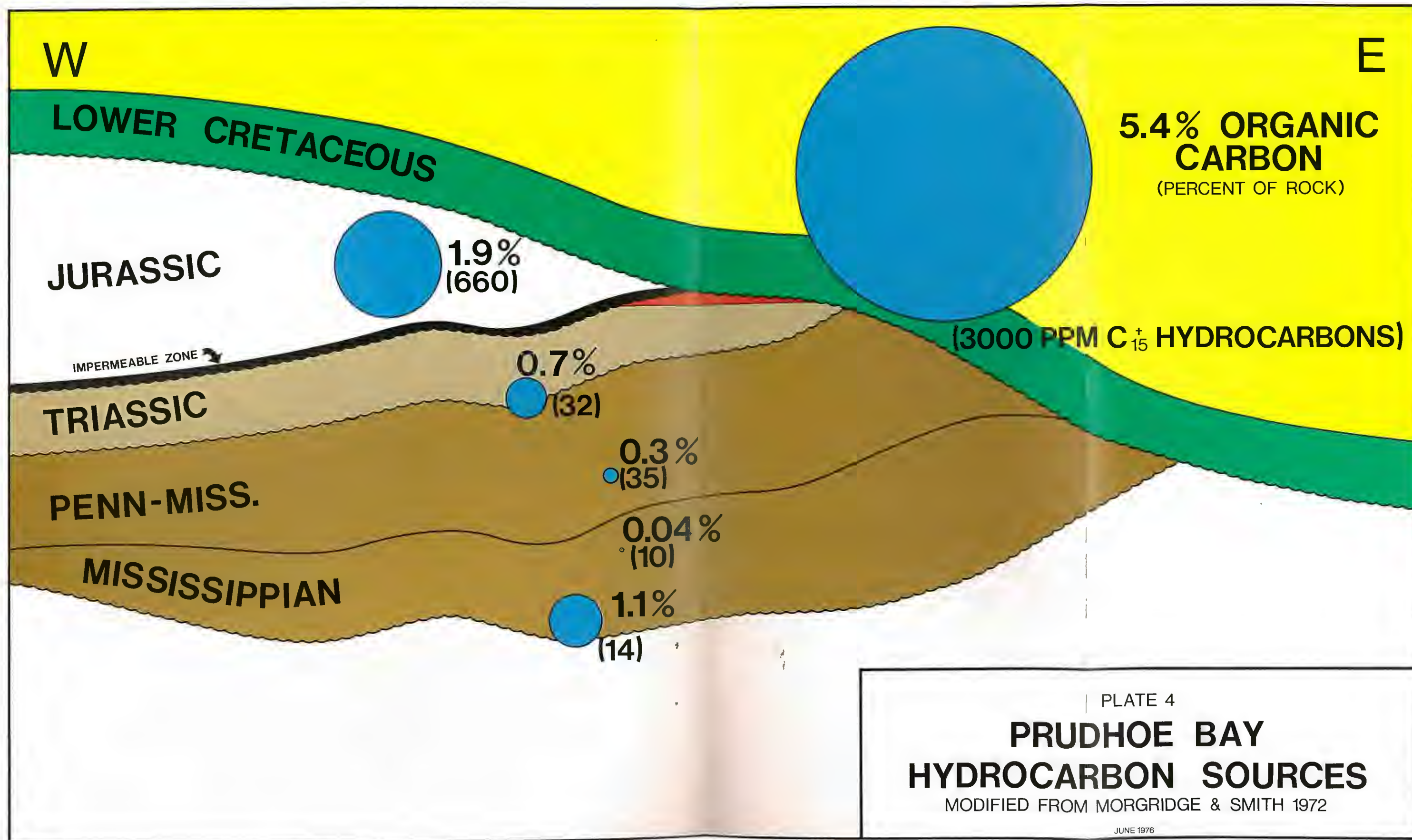


PLATE 3

**SCHEMATIC CROSS SECTION THROUGH PRUDHOE BAY**

(MODIFIED FROM MORGRIDGE & SMITH 1972)

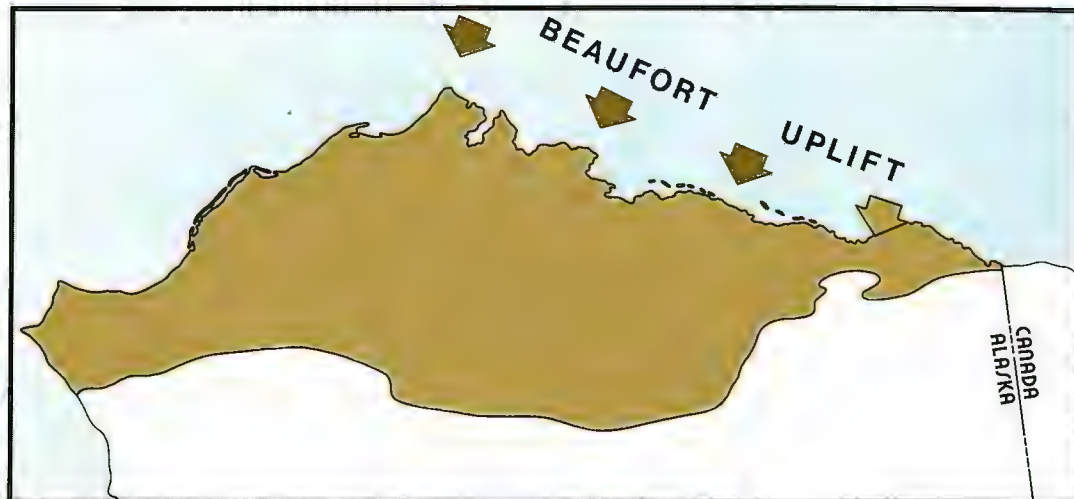
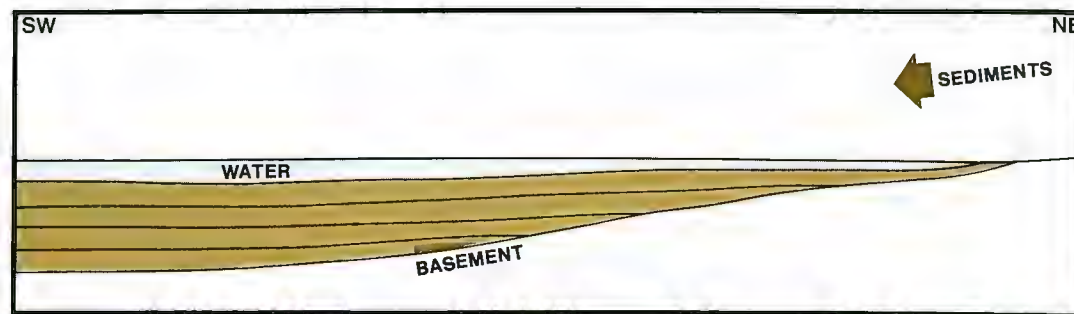






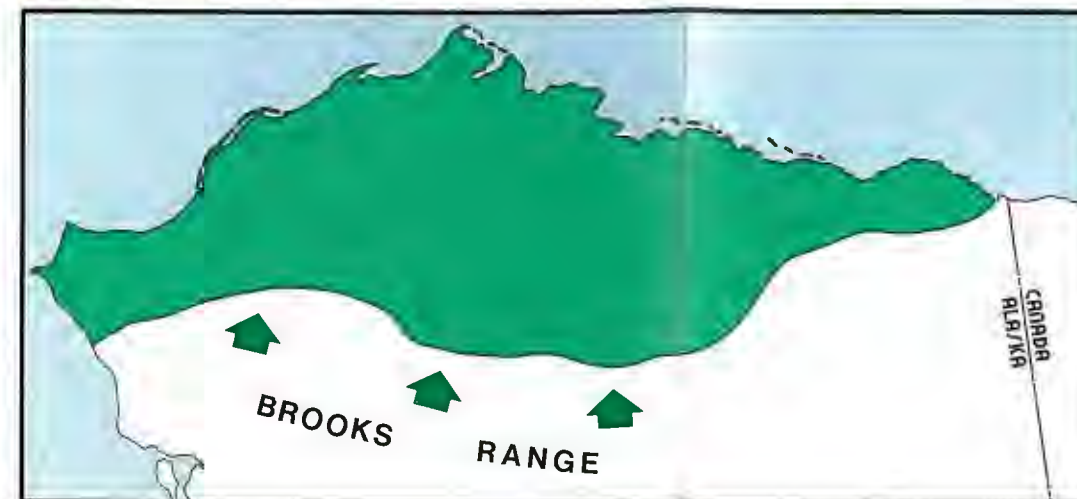
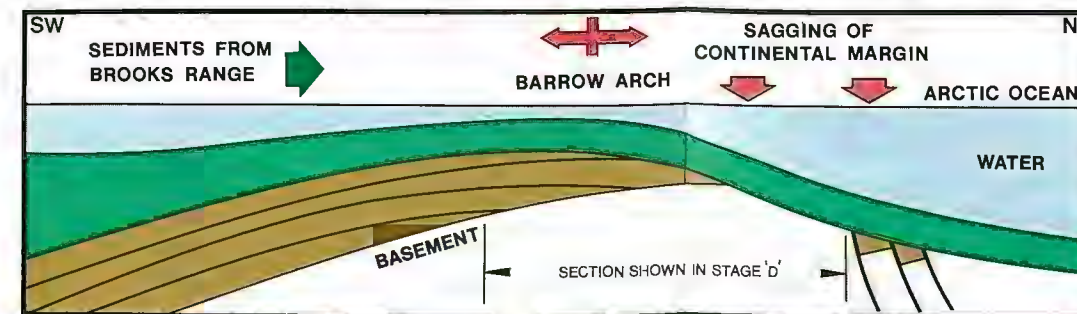
## PALEOZOIC-TRIASSIC SEDIMENTATION

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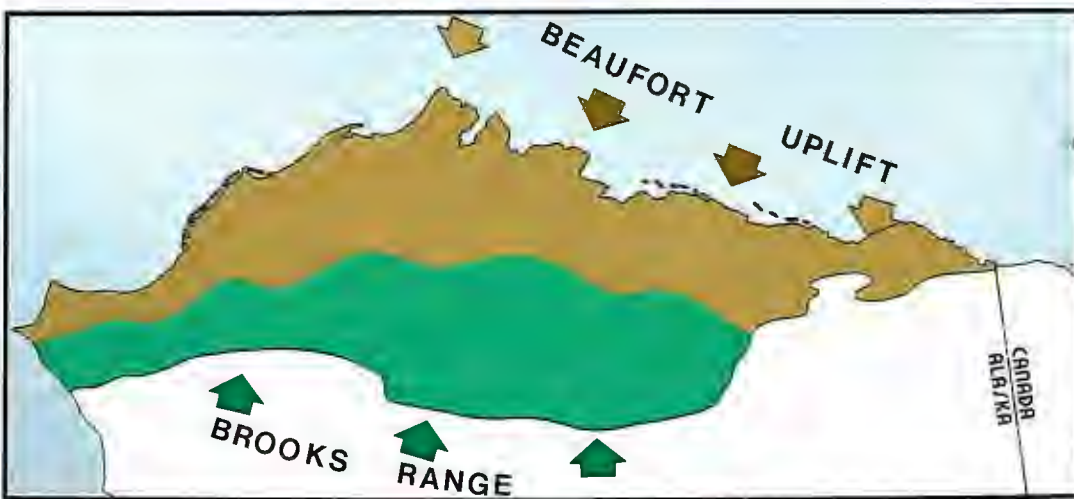
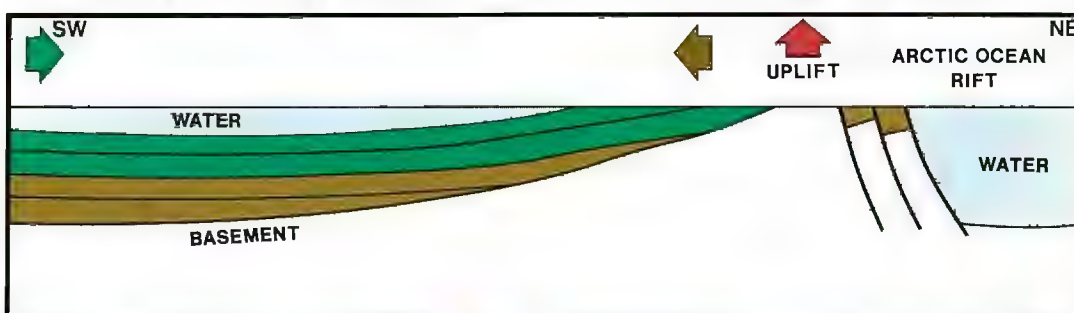
## CRETACEOUS SEDIMENTATION

C



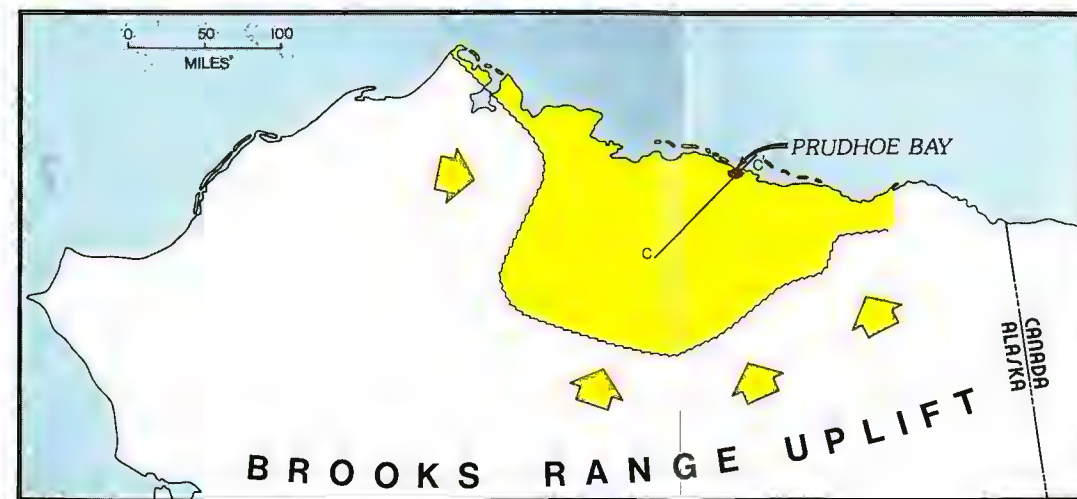
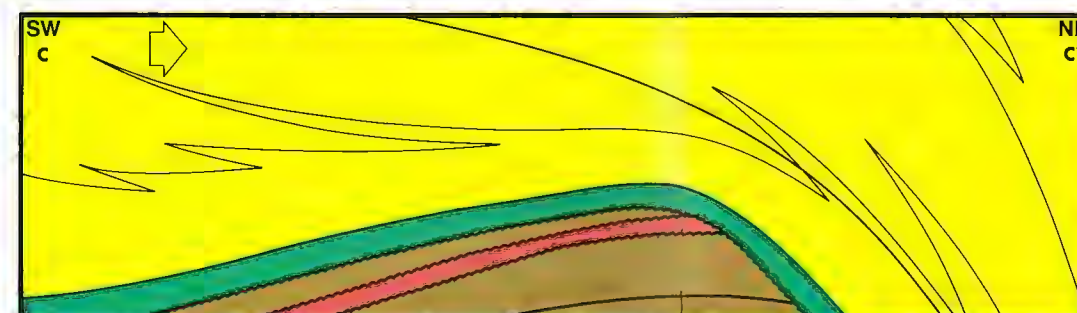
## U. JURASSIC-L. CRETACEOUS UPLIFT

B



## UPPER CRETACEOUS-TERTIARY SEDIMENTATION

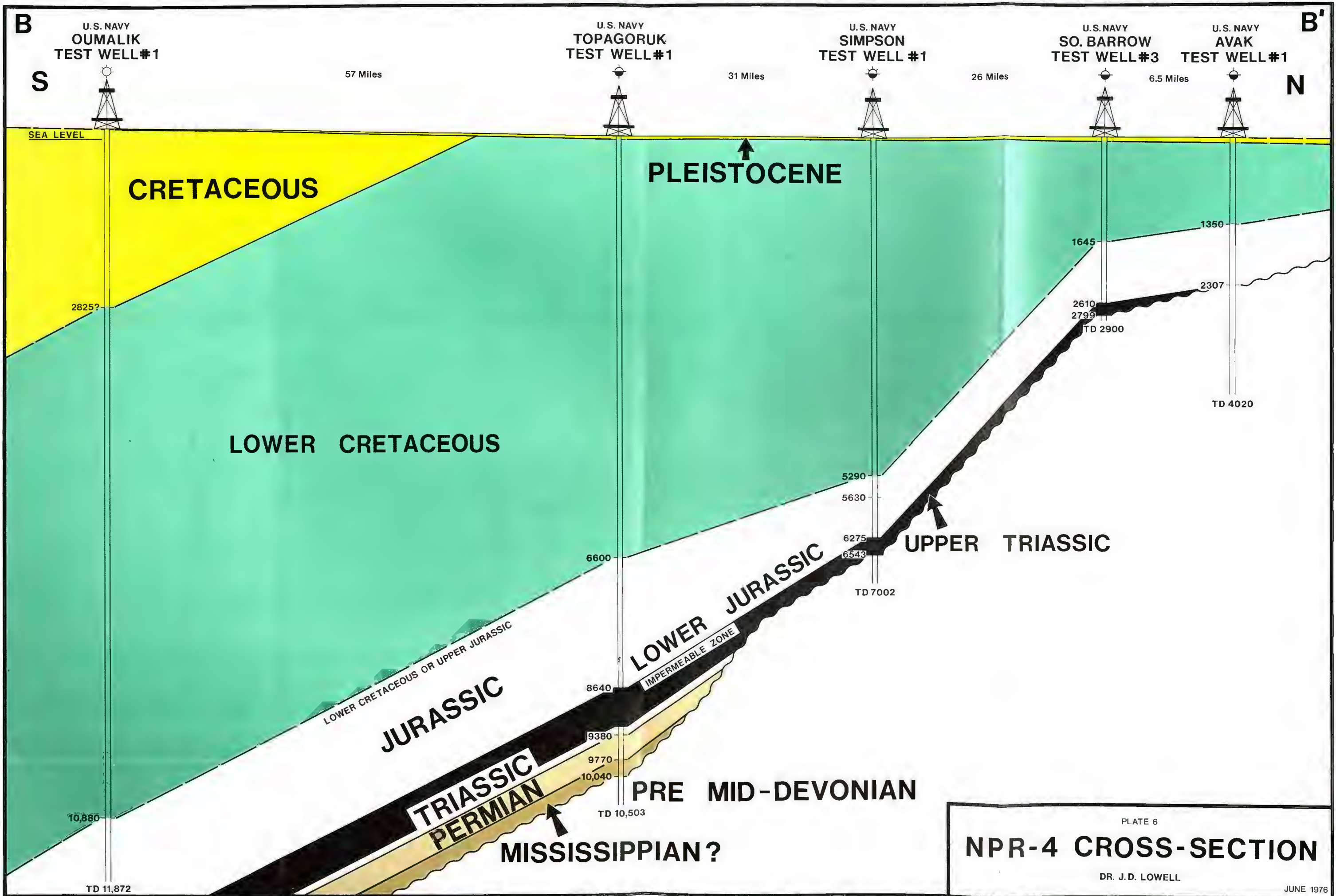
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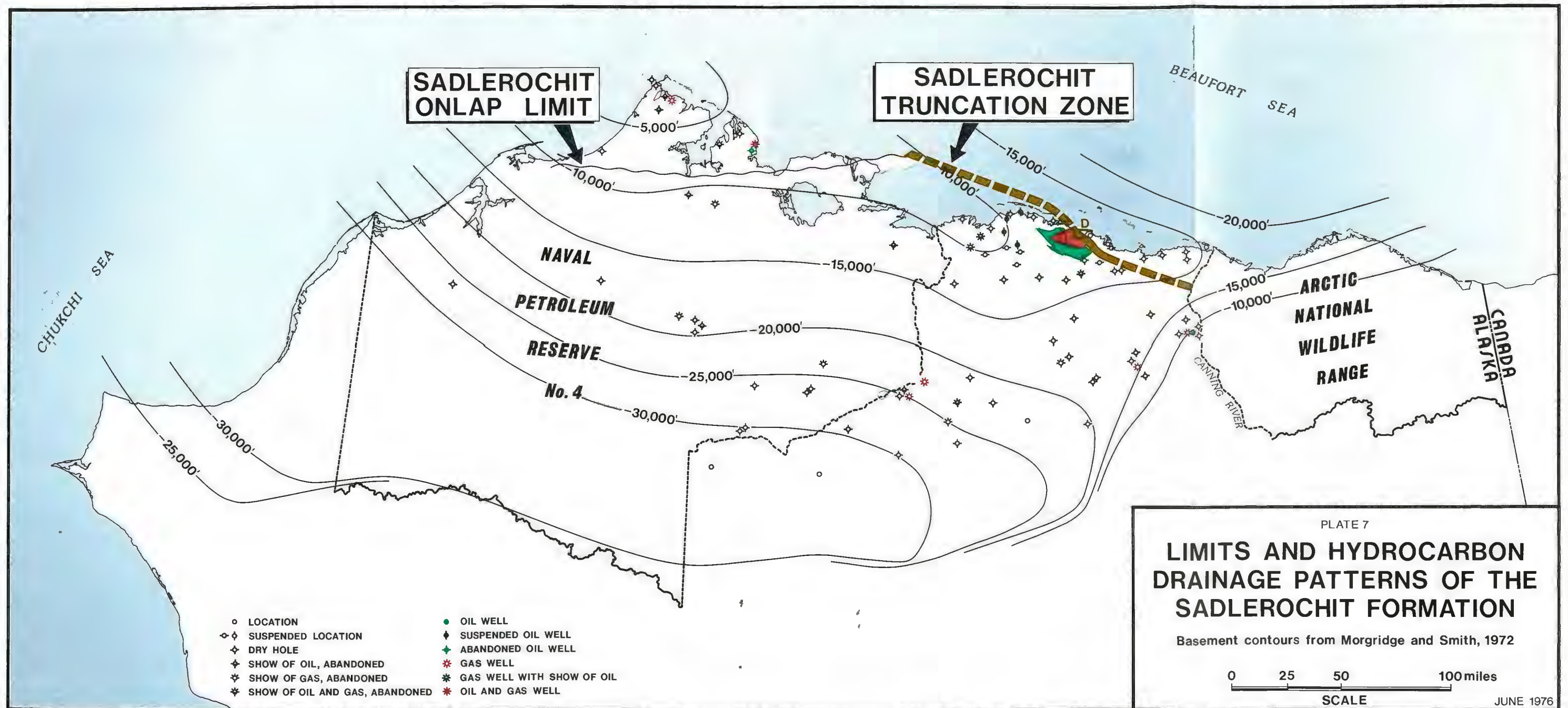


## EVOLUTION OF NORTH SLOPE GEOLOGY

MODIFIED FROM RICKWOOD 1970 - MORGRIDGE & SMITH 1972







Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No.

EXHIBIT I

MARKET DATA



MARKET DATA

Applicant has no operations at present and cannot have any until governmental authorization are received. Accordingly, Applicant has had no gas sales to date.

Applicant proposes to operate as a transporter of gas owned by others (Shippers).

The volumes of gas to be received from shippers for transportation by Applicant and upon which Applicant has based its facilities, for the purpose of this application, for the first five years of operation are as follows:

<u>Year</u>	<u>Annual Volumes in MCF</u>	<u>Peak Day Volumes in MCF</u>
First	438,000	1,284
Second	584,000	1,711
Third	876,000	2,567
Fourth	876,000	2,567
Fifth	876,000	2,567

The distribution of shippers' gas to the delivery points at Sumas, Washington; Kingsgate, Alberta; and Monchy, Saskatchewan, on an annual average day basis for the first five years of operation is shown in Schedule 1.

(i) Applicant proposes to act as a transporter of gas for shippers which purchase or otherwise acquire natural gas and will not sell volumes of gas which it transports for shippers. Information relating to end-use requirements to be served with the gas will be or has been submitted by the shippers.

(ii) Since Applicant proposes to be a transporter only, it will have no sales, or categories of customers, such as is contemplated by Section 157.14, Exhibit I, part (ii).

(iii) Since Applicant proposes to be a transporter only, it expects no curtailments.

(iv) Since Applicant proposes to be a transporter only, it has not estimated future requirements as contemplated by part (iv).



(v) Transportation will be rendered pursuant to the proposed tariff set forth in Exhibit P, filed by Applicant herein, as finally approved by the Commission. Service Agreements thereunder are expected to be executed upon final consummation of gas purchases from producers by Shippers and certification of Applicant's facilities. Applicant will be the basic transporter of gas from the North Slope of Alaska, if certificated, and it is assumed that the shippers will utilize the services of Applicant to transport gas purchased from producers in the vicinity of Prudhoe Bay. When Applicant has secured executed service Agreements or other agreements from Shippers, they will be filed with the Commission.

(vi) Gas to be transported by Applicant will be transported through Canada by Foothills Pipe Lines, Limited; Westcoast Transmission Company, Limited; Alberta Gas Trunk Line (Canada), Limited; and Alberta Natural Gas Company. Detailed information relating to the facilities in Canada including a description thereof, estimated costs, by whom they are to be constructed, and evidence of economic feasibility are set forth in Exhibits Z3, Z4, and Z5 hereto. Similar information relating to the facilities to be constructed in the lower 48 states is set forth in the applications of the various transporters.

(vii) Applicant has made no market surveys. However, to assess the reasonableness of Applicant's assumption that 15 percent of the Alaskan royalty gas will be transported for delivery at Fairbanks, Alaska, Applicant has reviewed the projected gas demands for the State of Alaska which were developed by Resource Planning Associates and incorporated in the Federal Power Commission Staff's Alaska Natural Gas Transportation Systems, Final Environmental Impact Statement, Volume I, Section C.

(viii) Applicant does not propose to distribute gas, but instead proposes to transport gas for shippers which purchase such gas from producers in the gas-producing area of the Prudhoe Bay field.

(ix) Not Applicable.

(x) Not Applicable.

ALCAN PIPELINE PROJECT

GAS BALANCE 1981 - 1983

(Annual Average Day Volumes in MMCF/D at 14.73 psia and 60 degrees F)

LINE NO.		1981				1982				1983-85			
		SUMAS (a)	KINGSGATE (b)	MONCHY (c)	TOTAL (d)	SUMAS (e)	KINGSGATE (f)	MONCHY (g)	TOTAL (h)	SUMAS (i)	KINGSGATE (j)	MONCHY (k)	TOTAL (l)
1	Prudhoe Supply @ 1122 BTU	483.0	-	717.0	1200.0	503.5	140.4	956.1	1600.0	761.2	205.0	1433.8	2400.0
2	Fuel to Fairbanks	5.2	-	7.7	12.9	6.0	1.7	11.3	19.0	15.1	4.1	28.5	47.7
3	Fairbanks Delivery	22.3	-	-	22.3	29.6	-	-	29.6	44.1	-	-	44.1
4	Out of Fairbanks	455.5	-	709.3	1164.8	467.9	138.7	944.8	1551.4	702.0	200.9	1405.3	2308.2
5	Fuel to Yukon	2.6	-	4.1	6.7	2.5	.7	5.1	8.3	7.7	2.2	15.3	25.2
6	Yukon Delivery	452.9	-	705.2	1158.1	465.4	138.0	939.7	1543.1	694.3	198.7	1390.0	2283.0
7	Fuel to B. C. Border	3.6	-	5.5	9.1	5.4	1.6	10.8	17.8	16.3	4.7	32.6	53.6
8	B. C. Delivery	449.3	-	699.7	1149.0	460.0	136.4	928.9	1525.3	678.0	194.0	1357.4	2229.4
9	Fuel to Ft. Nelson	.7	-	1.2	1.9	2.4	.7	4.7	7.8	9.5	2.7	18.9	31.1
10	Ft. Nelson Delivery	448.6	-	698.5	1147.1	457.6	135.7	924.2	1517.5	668.5	191.3	1338.5	2198.3
	SPLIT:												
11	AGTL Delivery	-	-	698.5	698.5	-	135.7	924.2	1059.9	-	191.3	1338.5	1529.8
12	WTC Delivery	448.6	-	-	448.6	457.6	-	-	457.6	668.5	-	-	668.5
13	Fuel to Sumas	23.3	-	-	23.3	22.8	-	-	22.8	37.9	-	-	37.9
14	Sumas Delivery @ 1122 BTU	425.3	-	-	425.3	434.8	-	-	434.8	630.6	-	-	630.6
15	Sumas Delivery @ (1) BTU	454.9	-	-	454.9	465.1	-	-	465.1	668.7	-	-	668.7
16	Fuel to Zama Lake	-	-	2.4	2.4	-	0.8	5.6	6.4	-	1.0	6.7	7.7
17	Zama Lake Delivery	-	-	696.1	696.1	-	134.9	918.6	1053.5	-	190.3	1331.8	1522.1
18	Fuel to Kingsgate	-	-	-	-	-	5.0	-	5.0	-	7.3	-	7.3
19	Kingsgate Delivery @ 1122 BTU	-	-	-	-	-	129.9	-	129.9	-	183.0	-	183.0
20	Kingsgate Delivery @ 1077 BTU	-	-	-	-	-	135.3	-	135.3	-	190.6	-	190.6
21	Fuel to Monchy	-	-	39.0	39.0	-	-	36.2	36.2	-	-	59.1	59.1
22	Monchy Delivery @ 1122 BTU	-	-	657.1	657.1	-	-	882.4	882.4	-	-	1272.7	1272.7
23	Monchy Delivery @ (2) BTU	-	-	689.7	689.7	-	-	926.1	926.1	-	-	1342.1	1342.1

Footnotes: (1) 1981 - 1049 BTU/ft<sup>3</sup>, 1982-1049 BTU/ft<sup>3</sup>, 1983-1058 BTU/ft<sup>3</sup>  
 (2) 1981 - 1069 BTU/ft<sup>3</sup>, 1982-1069 BTU/ft<sup>3</sup>, 1983-1064 BTU/ft<sup>3</sup>

Alcan Pipeline Company  
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EXHIBIT J

CONVERSION TO NATURAL GAS

CONVERSION TO NATURAL GAS

Applicant will be a transporter of natural gas for shippers which contract to purchase gas from producers in the supply areas served by Applicant's proposed pipeline. As a transporter of gas, Applicant will neither purchase nor sell gas and thus no conversions to natural gas from other fuels are proposed by reason of this application.

Applicant anticipates that the shippers which will have purchased gas and contracted with Applicant for the transportation thereof, will file, with the Commission, applications for facilities for the transportation and/or sale of such gas and that such applications will provide information to the Commission relating to the requirements of Section 157.14, Exhibit J.

Alcan Pipeline Company  
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EXHIBIT K

COST OF FACILITIES

COST OF FACILITIES  
INDEX

<u>Description</u>	<u>Page</u>
1.0 Introduction	1
2.0 Cost Basis	2
3.0 Cost Categories	4
4.0 Cost Tables	7

1.0 INTRODUCTION

This section details the estimated cost of the facilities required for the fully developed Alcan Pipeline system as described in Exhibit F.

The estimate includes the cost of labor, materials and supplies, construction equipment costs, logistics costs, contract work, insurance, injuries and damages, privileges, overheads charged to construction, and allowance for funds used during construction.

The Applicants' system when fully developed will consist of approximately 731 miles of 42-inch O.D. pipeline 15 compressor/chiller stations, and the necessary ancillary facilities for complete system operations at an average-day Prudhoe Bay input volume of 2.40 BCFD. The system would supply natural gas to two delivery points: Fairbanks and the Alaska/Yukon border near Scotties Creek, Alaska.

2.0 COST BASIS

The Cost of Facilities estimates are based on 1975 costs of labor, materials, equipment and supplies as quoted by vendors, contractors and consultants. The estimate has been developed by estimating the direct material purchase and installation costs of the separate facilities required for the system, and adding allowances for project overheads, contingencies, and funds used during construction.

The 1975 dollar cost base has been escalated to the appropriate year of material purchase or installation in accordance with the project construction schedule in Exhibit Z-2, Section 6.0. Escalation rates used were as follows:

Labor	Eight percent per annum
Material	Seven percent per annum

Cost estimates for the Alcan Pipeline System have been prepared by Gulf Interstate Engineering Company, consultants with experience in arctic construction and cost estimating.

Material costs for pipeline and stations are based on vendors' quotations.

It is the Applicants' contention that a major advantage enjoyed by the Alcan proposal is in the high level of confidence which may be placed in the cost estimates for the system. The Alcan project is not subject to the same cost and scheduling uncertainties which face typical frontier-area construction projects. Alcan system costs are more predictable as a result of the advantages of the proposed pipeline route and system construction plan. These advantages include:

- a) An existing civil infrastructure, including road systems, borrow pits, and the Alyeska work pad.
- b) Existing construction support systems used for Alyeska construction, including construction camps, communications systems and pipeyards.
- c) Established logistics patterns and capabilities, and good access along the entire route.



d) The use of an extended Alyeska work pad will make summer construction possible over the first 539 miles of the route. Summer construction will also be possible over much of the remainder of the route, where the line will parallel the Alcan highway.

e) Established construction techniques used on the Alyeska project will be used for Alcan pipeline construction where applicable.

f) As a result of the above advantages, the scale and complexity of construction operations will be such that effective project control and delegation of a share of construction cost responsibilities to the contractors will be possible.

Difficulties associated with unproven construction techniques in a remote and unserviced area will not be encountered by the Alcan system construction, and project costs and schedules are more predictable. The Applicants' proposed construction plan is discussed in detail in Exhibit Z-2, Section 6.0.

### 3.0 COST CATEGORIES

The cost estimates for the Applicants' proposed system have been presented in Tables 4.1 through 4.5 in terms of the following cost categories:

#### 3.1 PIPELINE

This category includes:

a) Land Costs. The costs of purchasing or leasing land for temporary and permanent pipeline facilities, including pipeline right-of-way, pipeline construction zone requirements, and appurtenance land requirements.

b) Material Costs. Material costs for mainline pipeline material include mainline carrier pipe and coating, scraper trap assemblies and bypass, mainline block valve assemblies, cathodic protection materials and frost heave sensors. Materials generated on site--e.g., granular materials and rip-rap--are included in pipeline installation costs. Included in the material costs are costs to ship the material to Alaska, and inland freight charges to haul the material to stockpile sites.

c) Installation Costs. Installation costs include all mainline construction operations, including pipe double-jointing operations, and the cost of installing pipeline appurtenances. Costs for the installation of the work pad extension required for construction of the Applicants' system are also included in this section, as are right-of-way revegetation costs. The costs include construction materials and supplies, and contractor overhead and profit.

#### 3.2 COMPRESSOR STATIONS AND METER STATIONS

Costs in the category include all costs associated with the installation of compression and metering facilities as described in Exhibit Z-2, Section 4.0, Station Design. These costs include:

a) Land Costs. The costs for the purchase or lease of land required for station sites and access roads.

b) Material Costs. Compressor station costs are for a nominal 26500 horsepower gas compression units, chiller units and ancillary station facilities for 15 stations. The cost of materials includes freight costs to Alaska, and inland freight costs to the compressor station sites.

c) Installation. Station installation costs include site development costs, material receiving costs, startup costs, and contractors' overhead and profit. The cost of construction materials and on-site generated materials are also included.

### 3.3 COMMUNICATIONS

Costs include:

a) Leasing of a temporary construction communications system from the central Fairbanks project office to the contractors' jobsite offices. Field communications system costs are included in the direct contractor cost estimates for civil and pipeline construction.

b) Provision for a permanent supervisory control system as described in Exhibit Z-2, Section 5.0, Supervisory and Control.

### 3.4 GENERAL PLANT

Costs for general plant include all costs associated with the installation and provision of operating and maintenance facilities and equipment as described in Exhibit Z-2, Section 7.0, Operating and Maintenance Plan.

### 3.5 SALES TAX

This category includes Federal and State taxes applied to the purchase price of all permanent and temporary material and equipment.

### 3.6 TEMPORARY FACILITIES

Temporary facilities provides for the costs of new camps required for construction crews, and the cost of mobilizing the existing Alyeska camps. Camp fuel costs are also included in this category.

### 3.7 SERVICE AND SUPPLIES

Service and supplies costs provide for catering services supplied to construction labor. These costs include food, transportation, preparation and service, laundry services, commissary services, cleaning equipment and supplies, linens, etc. Catering costs for project management personnel are included in the project management estimate.

3.8 PROJECT MANAGEMENT AND ASSOCIATED COSTS

This cost provides for the estimated cost of a project management contract. The project management contract would provide for all design and construction coordination functions of the project management group, and for project quality control, and reporting requirements. Costs in this category also provide for detailed engineering costs, and costs of the Applicants' head office operations prior to system startup.

3.9 INTANGIBLE PLANT

Intangible plant costs include pre-permit costs associated with the preparation of pipeline application supporting material, hearing costs, costs for engineering, and construction planning prior to permit receipt, and costs associated with the requirements for interfacing with regulatory agencies. These costs include funds for regulatory agency studies and monitoring over the construction period.

3.10 CONTINGENCY

These costs represent unforeseen costs which may be encountered during the design and construction of the system.

3.11 ALLOWANCE FOR FUNDS USED DURING CONSTRUCTION

These costs represent the cost of funds used during construction of the Alcan Pipeline systems.

TABLE 4.1.a  
ALCAN PIPELINE 1975 (\$1,000) UNESCALATED  
TOTAL PROJECT COST SUMMARY

COST CATEGORY	1978	1979	1980	1981	1982	TOTAL
1. PIPELINE	\$460,037	\$477,357	\$282,379	\$ -	\$ -	\$1,219,773
2. COMPRESSOR STATIONS	33,579	199,043	60,644	46,713	24,390	364,369
3. COMMUNICATIONS	685	1,875	2,550	-	-	5,000
4. GENERAL PLANT	-	-	11,324	-	-	11,324
5. SALES TAX	40	40	20			100
6. TOTAL DIRECT COST	494,341	678,315	356,807	46,713	24,390	1,600,566
7. TEMPORARY FACILITIES	52,098	4,082	3,290	1,345	100	60,915
8. SERVICES & SUPPLIES	4,350	24,621	20,857	884	682	51,394
9. TOTAL INDIRECT COST	56,448	28,703	24,147	2,229	782	112,309
10. PROJECT MANAGEMENT	33,085	24,814	24,814	3,000	3,000	88,713
11. INTANGIBLE PLANT	16,000	9,000	9,000	1,000	1,000	36,000
12. SUB-TOTAL	599,874	740,832	414,768	52,942	29,172	1,837,588
13. CONTINGENCY	26,994	33,337	18,665	2,382	1,313	82,691
14. A.F.C.	48,000	135,000	220,400	3,300	1,800	408,500
15. TOTAL	674,868	909,169	653,833	58,624	32,285	2,328,779

TABLE 4.1.b  
ALCAN PIPELINE (\$1,000) ESCALATED  
TOTAL PROJECT COST SUMMARY

COST CATEGORY	1978	1979	1980	1981	1982	TOTAL
1. PIPELINE	\$566,891	\$ 644,480	\$414,815	\$ -	\$ -	\$1,626,186
2. STATIONS	42,008	264,185	88,766	71,224	40,243	506,426
3. COMMUNICATIONS	863	2,550	3,584	-	-	6,997
4. GENERAL PLANT	-	-	16,349	-	-	16,349
5. SALES TAX	49	52	28	-	-	129
6. TOTAL DIRECT COST	609,811	911,267	523,542	71,224	40,243	2,156,087
7. TEMP. FACILITIES	63,820	5,351	4,616	2,019	161	75,967
8. SERVICE & SUPPLIES	5,489	33,484	30,639	1,403	1,169	72,184
9. TOTAL INDIRECT	69,309	38,835	35,255	3,422	1,330	148,151
10. PROJECT MANAGEMENT	41,687	33,747	36,452	4,761	5,142	121,789
11. INTANGIBLE PLANT	20,160	12,240	13,221	1,587	1,714	48,922
12. SUB-TOTAL	740,967	996,089	608,470	80,994	48,429	2,474,949
13. CONTINGENCY	33,344	44,824	27,381	3,645	2,179	111,373
14. A.F.C.	60,700	172,500	288,800	5,000	3,000	530,000
15. TOTAL	835,011	1,213,413	924,651	89,639	53,608	3,116,322

TABLE 4.2.a  
ALCAN PIPELINE 1975 (\$1,000) UNESCALATED  
TOTAL PROJECT COST SUMMARY  
BREAKDOWN BY MATERIAL AND INSTALLATION

COST CATEGORY	1978	1979	1980	1981	1982	TOTAL
1. PIPELINE						
MATERIAL	\$364,448	\$ 96,429	\$ -	\$ -	\$ -	\$ 460,877
INSTALLATION	95,589	380,928	282,379	-	-	758,896
2. COMPRESSOR STATIONS						
MATERIAL	8,610	132,920	4,842	33,836	14,462	194,670
INSTALLATION	24,969	66,123	55,802	12,877	9,928	169,699
3. COMMUNICATIONS	685	1,875	2,440	-	-	5,000
4. GENERAL PLANT						
MATERIAL	-	-	4,335	-	-	4,335
INSTALLATION	-	-	6,989	-	-	6,989
5. SALES TAX	40	40	20	-	-	100
6. TOTAL DIRECT COST	494,341	678,315	356,807	46,713	24,390	1,600,566
7. TEMPORARY FACILITIES	52,098	4,082	3,290	1,345	100	60,915
8. SERVICE & SUPPLIES	4,350	24,621	20,857	884	682	51,394
9. TOTAL INDIRECT COST	56,448	28,703	24,147	2,229	782	112,309
10. PROJECT MANAGEMENT	33,085	24,814	24,814	3,000	3,000	88,713
11. INTANGIBLE PLANT	16,000	9,000	9,000	1,000	1,000	36,000
12. SUB-TOTAL	599,874	740,832	414,768	52,942	29,172	1,837,588
13. CONTINGENCY	26,994	33,337	18,665	2,383	1,313	82,691
14. A.F.C.	48,000	135,000	220,400	3,300	1,800	408,500
15. TOTAL	674,868	909,169	653,833	58,624	32,285	2,328,779

TABLE 4.2.b  
ALCAN PIPELINE (\$1,000) ESCALATED  
TOTAL PROJECT COST SUMMARY

COST CATEGORY	1978	1979	1980	1981	1982	TOTAL
1. PIPELINE MATERIAL INSTALLATION	\$446,449 120,442	\$126,418 518,062	\$ - 414,815	\$ - -	\$ - -	\$ 572,867 1,053,319
2. COMPRESSOR STATION MATERIAL INSTALLATION	10,547 31,461	174,258 89,927	6,793 81,973	50,788 20,436	23,226 17,017	265,612 240,814
3. COMMUNICATION	863	2,550	3,584	-	-	6,997
4. GENERAL PLANT MATERIAL INSTALLATION	- -	- -	6,082 10,267	- -	- -	6,082 10,267
5. SALES TAX	49	52	28	-	-	129
6. TOTAL DIRECT COST	609,811	911,267	523,542	71,224	40,243	2,156,087
7. TEMPORARY FACILITIES	63,820	5,351	4,616	2,019	161	75,967
8. SERVICE & SUPPLIES	5,489	33,484	30,639	1,403	1,169	72,184
9. TOTAL INDIRECT	69,309	38,835	35,255	3,422	1,330	148,151
10. PROJECT MANAGEMENT	41,687	33,747	36,452	4,761	5,142	121,789
11. INTANGIBLE PLANT	20,160	12,240	13,221	1,587	1,714	48,922
12. SUB-TOTAL	740,967	996,089	608,470	80,994	48,429	2,474,949
13. CONTINGENCY	33,344	44,824	27,381	3,645	2,179	111,373
14. A. F. C.	60,700	172,500	288,800	5,000	3,000	530,000
15. TOTAL	835,011	1,213,413	924,651	89,639	53,608	3,116,322



TABLE 4.3. a  
ALCAN PIPELINE COMPANY UNESCALATED  
COST OF PIPELINE PORTION SPLIT BY YEAR

	1978	1979	1980	TOTAL
A. LAND & LAND RIGHTS				
R.O.W	\$ 987	\$ 261	\$ -	\$ 1,248
ROYALTY	1,596	423	-	2,019
DAMAGES	100	26	-	126
				\$ 3,393
B. MATERIAL				
PIPELINE	317,423	83,987	-	401,410
VALVES & FITTINGS	8,161	2,159	-	10,320
COATING	6,709	1,775	-	8,484
WEIGHTS	17,397	4,603	-	22,000
MISCELLANEOUS	12,075	3,195	-	15,270
				\$ 457,484
C. CONSTRUCTION				
MAINLINE	66,251	264,014	195,712	525,977
DOUBLE JOINTING	1,559	6,213	4,606	12,378
AERIAL AND ROAD CROSSINGS	797	3,175	2,353	6,325
CIVIL	26,982	107,526	79,708	214,216
				\$ 758,896
TOTAL	\$460,037	\$477,357	\$282,379	\$1,219,773

TABLE 4.3.b  
ALCAN PIPELINE COMPANY ESCALATED (\$1,000)  
COST OF PIPELINE PORTION FROM 1975 BASE TO YEAR REQUIRED

COST BREAKDOWN	1978	1979	1980	TOTAL
PIPELINE				
A. LAND & LAND RIGHTS				
R.O.W.	\$ 1,209	\$ 342	\$ -	\$ 1,551
ROYALTY	1,955	555	-	2,510
DAMAGES	123	34	-	157
				\$ 4,218
B. MATERIAL				
PIPELINE	388,843	110,107	-	498,950
VALVES & FITTINGS	9,997	2,830	-	12,827
COATING	8,219	2,327	-	10,546
WEIGHTS	21,311	6,035	-	27,346
MISCELLANEOUS	14,792	4,188	-	18,980
				\$ 568,649
C. CONSTRUCTION				
MAINLINE	83,476	359,059	287,501	730,036
DOUBLE JOINTING	1,965	8,450	6,766	17,181
AERIAL AND ROAD CROSSINGS	1,004	4,318	3,457	8,779
CIVIL	33,997	146,235	117,091	297,323
				\$1,053,319
TOTAL	\$566,891	\$644,480	\$414,815	\$1,626,186

TABLE 4.4.a  
ALCAN PIPELINE COMPANY  
COST OF FACILITIES COMPRESSOR STATIONS  
(1,000'S OF 1975 \$'S)

JULY 1, 1975 COST BASE BY CALENDAR YEAR						
DESCRIPTION	1978	1979	1980	1981	1982	TOTAL
STATION 1 - MATERIAL	----	----	1,516	11,255	70	12,841
INSTALLATION	----	552	1,423	5,632	3,930	11,537
2 - MATERIAL	1,527	11,044	65	----	----	12,636
INSTALLATION	1,974	5,371	4,126	----	----	11,471
3 - MATERIAL	----	----	1,531	11,194	57	12,782
INSTALLATION	----	552	1,423	5,613	3,930	11,518
4 - MATERIAL	1,494	9,116	90	2,813	----	13,513
INSTALLATION	1,974	5,034	4,126	420	----	11,554
5 - MATERIAL	563	9,898	44	----	2,879	13,384
INSTALLATION	1,974	5,047	4,126	----	420	11,567
6 - MATERIAL	546	12,359	35	----	----	12,940
INSTALLATION	1,974	5,454	4,126	----	----	11,554
7 - MATERIAL	543	9,620	33	----	2,872	13,068
INSTALLATION	1,974	5,053	4,126	----	420	11,573
8 - MATERIAL	543	9,770	33	2,873	----	13,219
INSTALLATION	1,875	4,747	3,868	404	----	10,894
9 - MATERIAL	508	9,601	16	----	2,864	12,989
INSTALLATION	1,875	4,746	3,868	----	404	10,893
10 - MATERIAL	497	12,134	11	----	----	12,642
INSTALLATION	1,875	5,091	3,869	----	----	10,835
11 - MATERIAL	489	9,500	10	----	2,860	12,859
INSTALLATION	1,875	4,746	3,868	----	404	10,893
12 - MATERIAL	484	9,326	13	2,858	----	12,681
INSTALLATION	1,875	4,729	3,868	404	----	10,876
13 - MATERIAL	441	8,980	6	2,843	----	12,270
INSTALLATION	1,875	4,746	3,868	404	----	10,893
14 - MATERIAL	486	12,073	22	----	----	12,581
INSTALLATION	1,875	5,091	3,868	----	----	10,834
15 - MATERIAL	488	9,333	21	----	2,860	12,702
INSTALLATION	1,974	5,053	4,126	----	420	11,573
METER MATERIAL	1	166	1,396	----	----	1,563
STATIONS(3) INSTALLATION	----	111	1,123	----	----	1,234
TOTAL MATERIAL	8,610	132,920	4,842	33,836	14,462	194,670
TOTAL INSTALLATION	24,969	66,123	55,802	12,877	9,928	169,699
TOTAL	33,579	199,043	60,644	46,713	24,390	364,369

TABLE 4.4. b

## ALCAN PIPELINE COMPANY

## COST OF FACILITIES COMPRESSOR STATIONS

(1,000'S OF DOLLARS)

JULY 1, 1975 COST BASE ESCALATED TO YEAR OF CONSTRUCTION

DESCRIPTION	1978	1979	1980	1981	1982	TOTAL
STATION 1 - MATERIAL INSTALLATION	---- ----	---- 751	2,127 2,090	16,894 8,938	112 6,736	19,133 18,515
2 - MATERIAL INSTALLATION	1,871 2,487	14,479 7,305	91 6,062	---- ----	---- ----	16,441 15,854
3 - MATERIAL INSTALLATION	---- ----	---- 751	2,148 2,090	16,803 8,908	92 6,737	19,043 18,486
4 - MATERIAL INSTALLATION	1,830 2,487	11,951 6,846	126 6,061	4,222 667	---- ----	18,129 16,061
5 - MATERIAL INSTALLATION	690 2,487	12,976 6,863	62 6,061	---- ----	4,624 720	18,352 16,131
6 - MATERIAL INSTALLATION	669 2,487	16,203 7,417	49 6,061	---- ----	---- ----	16,921 15,965
7 - MATERIAL INSTALLATION	665 2,487	12,612 6,872	46 6,061	---- ----	4,612 720	17,935 16,140
8 - MATERIAL INSTALLATION	665 2,363	12,808 6,456	47 5,682	4,312 641	---- ----	17,832 15,142
9 - MATERIAL INSTALLATION	622 2,363	12,587 6,455	22 5,682	---- ----	4,600 692	17,831 15,192
10 - MATERIAL INSTALLATION	609 2,362	15,908 6,924	15 5,684	---- ----	---- ----	16,532 14,970
11 - MATERIAL INSTALLATION	599 2,362	12,454 6,455	14 5,682	---- ----	4,593 692	17,660 15,191
12 - MATERIAL INSTALLATION	593 2,363	12,226 6,431	18 5,682	4,290 641	---- ----	17,127 15,117
13 - MATERIAL INSTALLATION	540 2,363	11,773 6,455	8 5,682	4,267 641	---- ----	16,588 15,141
14 - MATERIAL INSTALLATION	595 2,363	15,827 6,924	31 5,682	---- ----	---- ----	16,453 14,969
15 - MATERIAL INSTALLATION	598 2,487	12,236 6,872	29 6,061	---- ----	4,593 720	17,456 16,140
METER STATIONS(3) MATERIAL INSTALLATION	1 ----	218 150	1,960 1,650	---- ----	---- ----	2,179 1,800
TOTAL MATERIAL	10,547	174,258	6,793	50,788	23,226	265,612
TOTAL INSTALLATION	31,461	89,927	81,973	20,436	17,017	240,814
TOTAL	42,008	264,185	88,766	71,224	40,243	506,426

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ITEM	UNESCALATED 1975 DOLLARS (\$1000)
1. DISTRICT HEADQUARTERS	
CIVIL WORK (PADS)	\$ 436
MATERIALS (BUILDINGS ETC.)	2,998
INSTALLATION	6,989
2. OFFICE FURNITURE AND EQUIPMENT	51
3. TRANSPORTATION EQUIPMENT	337
4. MAINTENANCE EQUIPMENT	511
5. TOOLS AND SPARE PARTS (INCLUDED IN WORKING CAPITAL.)	
	TOTAL \$11,324

TABLE 4.5.b  
COST OF FACILITIES  
GENERAL PLANT  
(O&M)

ITEM	( \$1000 )	ESCALATED TO 1980
1. DISTRICT HEADQUARTERS		
CIVIL WORK (PADS)	\$	612
MATERIALS		4,207
INSTALLATION		10,267
2. OFFICE FURNITURE AND EQUIPMENT		72
3. TRANSPORTATION EQUIPMENT		473
4. MAINTENANCE EQUIPMENT		718
5. TOOLS & SPARE PARTS		
	TOTAL MATERIAL	\$ 6,082
	INSTALLATION	\$10,267

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EXHIBIT L

FINANCING

FINANCING

INDEX

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## FINANCING PLAN

### 1. INTRODUCTION

This exhibit is a description of the plan to finance the facilities, estimated to cost approximately \$3.1 billion on an escalated basis, necessary to transport Alaskan gas to the Alaska/Yukon border as part of a coordinated "System" to transport such gas to markets in the "lower 48". Alcan Pipeline Company, a wholly-owned subsidiary of Northwest Pipeline Corporation, is sponsoring this application. The information contained in this exhibit and in Exhibits N and P illustrates the economics of Applicant's facilities based on 1975 dollar capital cost estimates escalated through the year of construction and on operating expenses escalated to the year incurred.

This plan necessarily assumes conditions about capital supply and cost at the time the financing is actually arranged. It assumes that financial markets are stable and that conditions at the time of financing will be generally similar to those of today. Financial markets do not remain static, however, and changes may be required in the final financing arrangements to reflect conditions at that time.

The information and underlying assumptions reflected herein and in Exhibits N and P illustrate the general plan for acquiring funds to construct the proposed facilities. Definitive financing arrangements will be negotiated with lenders and other investors and such arrangements will be submitted to the Federal Power Commission ("FPC") as a supplement to this application after the certificate of public convenience and necessity has been received by Applicant.

Applicant proposes to finance its facilities on a project basis with the revenues from the facilities providing cash flow for all costs and expenses, including debt service. The financing will be supported by a Tariff and contractual agreements between Applicant and the shippers of natural gas, which will provide that each shipper will be committed to pay its pro rata share of Applicant's full cost of service.

Applicant has retained Loeb, Rhoades & Co. of New York to advise it with respect to alternatives and requirements relating to its long-term financing. Bank of

America National Trust and Savings Association of San Francisco has been retained to advise Applicant with respect to the commercial banking portion of the financing.

II. The Facilities

Applicant proposes to install facilities to transport natural gas from the Prudhoe Bay Area of the North Slope of Alaska south through Fairbanks to Delta Junction, Alaska, paralleling the same general route as the Alyeska oil pipeline. From Delta Junction the pipeline will follow the Alcan Highway to a point on the Alaska/Yukon border. The gas will then be transported by Canadian companies through Canada for delivery at the U.S.-Canadian border to U.S. Pipeline companies. Details regarding the Canadian transportation facilities and the related financings are being submitted concurrently by Foothills Pipe Lines Ltd. ("Foothills"), Westcoast Transmission Company Limited ("Westcoast"), and The Alberta Gas Trunk Line Company Limited ("AGTL") in Exhibits Z-3, Z-4 and Z-5, respectively.

III. Financial Objectives and Overview

Applicant has developed its financing plan with the objective of attracting sufficient amounts of capital in the most practical manner to complete its facilities. In order to do this, the project must be economically viable and creditworthy.

Applicant believes that its external cash requirements can be provided (i) through the sale of equity securities to interested parties which may include, in addition to shippers of natural gas, the State of Alaska, vendors, and the general public and (ii) the sale of various types of secured debt instruments to commercial banks and long-term lenders. It is planned that equity and borrowed funds will provide 25% and 75%, respectively, of the external capital needs.

The financing plan described herein is solely that of Applicant covering the facilities from the Prudhoe Bay area to the Alaska/Yukon border. Foothill's facilities will be financed on a project basis concurrently with Applicant's facilities. AGTL and Westcoast will finance their expansions independently on a conventional basis as part of their capital programs. Applicant and the Canadian companies

intend that the implementation of the financing necessary to transport Alaskan natural gas to U.S. Markets will be coordinated.

Requirements of a Successful Financing

In order to obtain the capital required to finance the proposed facilities, Applicant believes the following factors are essential:

(a) Investors will have to be satisfied that the economics of the project are sound, that the project is technically feasible, and that all necessary approvals, including regulatory approvals, are received. It is implicit in this requirement that adequate reserves of natural gas be in place, and that the natural gas be deliverable in quantity and marketable at the prices delivered by the System.

(b) Commitments for all debt and equity funds necessary for construction of Applicant's and Foothills' facilities, including adequate provisions for inflation, cost overruns and delay in generation of funds from operations, must be in place prior to the beginning of construction.

(c) The Tariff must allow and provide a mechanism for Applicant to recover all of its costs and expenses through charges to the shippers. The shippers' respective Tariffs must allow these costs to be reflected in their rates to their customers. In turn, their customers must be allowed to recover the costs from the end user.

(d) Adequate assurances must be provided that, in the absence of completion, Applicant's costs and expenses, including timely payment of debt maturities and interest payments, will be recovered. It is contemplated that contracts will be entered into between Applicant and the shippers providing for the payment of all costs and expenses in the event of non-completion. These contracts will be independent of Applicant's service agreements with the shippers but will have received prior regulatory approval. All costs and expenses in the event of non-completion must be recovered from the end user.

Assurances must also provide for the recovery of costs and expenses in the event of interruption of service for any reason, including force majeure. These assurances will be contained in the Tariff.

(e) The Tariff or, prior to the Tariff becoming effective, the contractual agreements must assure that the flow of funds that they provide for will commence no later than the fourth anniversary of the date of the beginning of construction. Lenders would be willing to make commitments for predetermined periods of time but they cannot be expected to forego agreed upon repayment of principal because of construction delays.

The cost recovery provisions described in (c), (d), and (e) above must be structured in a way that the flow of funds cannot be disturbed for any reason.

#### Financial Assumptions

The nature of capital markets prevents Applicant from describing in advance of negotiations with lenders and investors all of the detailed provisions of the financing arrangements. Therefore, in order to prepare the exhibits in this application, it was necessary to make several assumptions regarding the sources and quantities of capital funds, interest rates, returns to common equity and other factors. For illustrative purposes, Applicant has assumed:

(a) All of Applicant's equity will be common stock and will earn a rate of return of 15% per annum.

(b) Long-term lenders and commercial banks will provide debt capital with an annual interest cost of 10% and with provisions for orderly retirement of the debt.

(c) Internally generated funds, which begin in 1981, are used to assist in financing the remaining construction of Applicant's facilities.

In addition, based on discussions with its financial advisors, Applicant has assumed the following:

(1) Equity will provide 25% of Applicant's external capital requirements and various debt securities will provide 75% of such requirements. These requirements will be provided by a combination of debt and equity such that the ratio of debt to paid-in equity will not exceed 3:1.

(2) Commitments will be obtained for all capital funds prior to commencement of construction in amounts of 120% of escalated capital requirements, thereby providing a contingency for cost overruns and delay in generation of funds from operations.

(3) The U.S. capital and bank markets possess adequate capacity to provide the funds necessary to construct these facilities.

#### Capital Commitments

The capital commitments shown below reflect the assumptions and requirements cited above:

Class of Investors	Millions of Dollars		
	Estimated Capital Requirements	Estimated Contingency Requirements	Estimated Total Commitments
(a) Institutional lenders	\$1,530	\$310	\$1,840
(b) Commercial banks	566	114	680
(c) Equity holders	<u>710</u>	<u>145</u>	<u>855</u>
	<u>\$2,806</u>	<u>\$569</u>	<u>\$3,375</u>

#### Institutional Lenders

This plan assumes that U.S. institutional lenders, consisting of major life insurance companies and others, will provide approximately 55% of the external cash requirements of Applicant's facilities. Such lenders' commitments will exceed their share of the estimated capital requirements by 20% to provide for contingencies. The commitments will be in place prior to the initiation of construction and Applicant will pay a commitment fee on all unused portions of the commitments.

The mortgage bonds will have a maturity of twenty-one years; or, in the event operations begin as scheduled (as shown in the financial statements in this Exhibit L), a maturity of twenty years. The following table summarizes the timing of the first mortgage bond takedowns and repayments.

<u>Amount</u>	<u>Takedown</u>	<u>Term (1)</u>	<u>Number of Annual Sink- ing Funds (1) Payments</u>	<u>Percent of Issue Retired Annually</u>
\$500 million	1978	20 years	17	5.88%
\$500 million	1979	20 years	18	5.56%
\$530 million	1980	20 years	19	5.26%

(1) In the event operations are delayed, the initiation of sinking fund payments would be delayed by one year thereby extending the term of the bonds by one year.

#### Commercial Banks

A commercial bank loan commitment for \$680 million will be obtained from a syndicate of U.S. commercial banks. The commitment exceeds the projected bank borrowings by 20% as a contingency for unforeseen increases in construction costs. The bank loan will be structured as a four-year revolving credit, which will be converted to a term loan to be amortized equally over three years. Although Exhibit L, Part vii, reflects a conversion of the revolving credit at the beginning of 1981, the revolving credit commitment will be available through the end of 1981, thereby providing an additional year of credit availability in the event operations do not begin as scheduled. During the construction period, borrowings under the bank credit will periodically be reduced by the proceeds of the sale of other long-term debt. The bank credit will be secured and rank pari passu with the first mortgage bonds.

#### Equity

At least \$280 million of equity will be contributed prior to the date of commencement of construction. Subsequent equity contributions of \$210 million and \$220 million, respectively, will be made no later than 12 months and 24 months after such date. Lenders will have to be satisfied that the subsequent infusions of equity will, in fact, be forthcoming. If they cannot be satisfied, they will require that all of the equity funds be in place before any borrowings are taken down.

In addition, the equity investors will be committed to contribute additional amounts up to 20% of their share of the estimated capital requirements, as shown on the table on the previous page, as part of the plan to provide for contingencies.

IV. Conclusions

Applicant and its financial advisors believe that this financing plan meets the objectives set forth herein, and, under the assumptions and requirements stated, can be accomplished.

NET PROCEEDS FROM FINANCING

Applicant has made certain assumptions regarding the net proceeds to be received from the various securities to be issued.

Mortgage bonds described in the plan will be issued at par and the proceeds will be reduced by an estimated 1% issuance expense as described in Part iv. The bank term loans will be subject to normal commitment and management fees. Applicant has made no provision for the issuance expense of its equity securities because the majority of the stock will be privately placed. Should common or preferred stock be sold to the public, the proceeds will be reduced by normal underwriting and issuance expenses.



STATEMENT OF ESTIMATED EXPENSES,  
FEES AND COMMISSIONS

Applicant has estimated the following expenses in connection with obtaining the capital necessary to finance construction of the facilities. These expenses have been incorporated into the pro forma financial and cost of service statements submitted as part of this application.

	<u>Rate</u>	<u>Amount (Millions)</u>
Mortgage Bonds and Term Loans		
Commitment Fees	.5%	\$29.4
Underwriting, Management and Issuance Expenses	1.0%	<u>21.0</u>
		<u>\$50.4</u>

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STATEMENT OF RESTRICTIONS AS TO  
ISSUANCE OF SECURITIES

Applicant has no outstanding securities, and consequently, the consent of holders of securities is not required. The restrictions covering the original issuance of the initial securities, and any subsequent issues, have not been determined.

ALCAN PIPELINE COMPANY  
PRO FORMA CASH FLOW STATEMENTS  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A) SOURCE OF FUNDS	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
<hr/>											
	OPERATIONS										
1	NET INCOME	21.0	60.9	102.3	140.6	150.2	202.6	208.6	191.1	159.7	116.7
	NON CASH OPERATING CHARGE/(CREDITS)										
2	DEPRECIATION	-	-	-	119.0	122.6	124.6	124.6	124.6	124.6	124.6
3	DEFERRED INCOME TAXES	-	-	-	163.8	175.5	70.4	58.9	50.7	42.4	34.3
4	AMORTIZ OF DEBT EXPENSE	.3	.6	2.3	2.3	2.3	2.4	.9	.9	.9	.9
5	ALLOWANCE FOR EQUITY FUNDS USED DURING CONSTRUCTION	(21.0)	(60.9)	(102.3)	(2.1)	(1.4)	-	-	-	-	-
6	ALLOWANCE FOR DEBT EXPENSE AMORTIZED DURING CONSTRUCTION	(.3)	(.6)	(2.3)	-	-	-	-	-	-	-
<hr/>											
7	TOTAL FUNDS PROVIDED FROM OPERATIONS	-	-	-	423.6	449.2	400.0	393.0	367.3	327.6	276.5
	OTHER SOURCES										
8	BANK LOANS	38.7	446.9	75.4	-	-	-	-	-	-	-
9	LONG-TERM DEBT NET OF DEBT EXPENSE	495.0	495.0	524.7	-	-	-	-	-	-	-
10	COMMON STOCK	280.0	210.0	220.0	-	-	-	-	-	-	-
11	TOTAL FUNDS PROVIDED	813.7	1151.9	820.1	423.6	449.2	400.0	393.0	367.3	327.6	276.5
<hr/>											
	APPLICATION OF FUNDS										
<hr/>											
12	PLANT ADDITIONS	835.0	1213.4	924.7	89.6	53.6	-	-	-	-	-
13	LESS: ALLOWANCE FOR EQUITY FUNDS USED DURING CONSTRUCTION	(21.0)	(60.9)	(102.3)	(2.1)	(1.4)	-	-	-	-	-
14	ALLOWANCE FOR DEBT EXPENSE AMORTIZED DURING CONSTRUCTION	(.3)	(.6)	(2.3)	-	-	-	-	-	-	-
15	LONG-TERM DEBT RETIREMENTS	-	-	-	274.0	274.0	274.0	85.1	85.1	85.1	85.1
16	CASH DIVIDENDS	-	-	-	46.6	122.4	125.1	307.3	281.6	241.8	190.7
17	INCREASE/(DECREASE) IN WORKING CAPITAL	-	-	-	15.5	.6	.9	.6	.6	.7	.7
18	TOTAL APPLICATION OF FUNDS	813.7	1151.9	820.1	423.6	449.2	400.0	393.0	367.3	327.6	276.5

ALCAN PIPELINE COMPANY  
FRO FORMA CASH FLOW STATEMENTS  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
(A)	(L)	
	SOURCE OF FUNDS	
	OPERATIONS	
1	NET INCOME	EXHIBIT L PART IX B LINE 17
	NON CASH OPERATING	
	CHARGE/(CREDITS)	
2	DEPRECIATION	4% OF PLANT IN SERVICE
3	DEFERRED INCOME TAXES	EXHIBIT P PART II F LINE 16
4	AMORTIZ OF DEBT EXPENSE	DEBT LIFE AMORTIZATION
5	ALLOWANCE FOR EQUITY FUNDS USED DURING CONSTRUCTION	
6	ALLOWANCE FOR DEBT EXPENSE AMORTIZED DURING CONSTRUCTION	
7	TOTAL FUNDS PROVIDED FROM OPERATIONS	
	OTHER SOURCES	
8	BANK LOANS	
9	LONG-TERM DEBT NET OF DEBT EXPENSE	
10	COMMON STOCK	
11	TOTAL FUNDS PROVIDED	
	APPLICATION OF FUNDS	
12	PLANT ADDITIONS	
13	LESS: ALLOWANCE FOR EQUITY FUNDS USED DURING CONSTRUCTION	
14	ALLOWANCE FOR DEBT EXPENSE AMORTIZED DURING CONSTRUCTION	
15	LONG-TERM DEBT PAYMENTS	EXHIBIT L PART VII TOTAL
16	CASH DIVIDENDS	
17	INCREASE/(DECREASE) IN WORKING CAPITAL	
18	TOTAL APPLICATION OF FUNDS	

ALCAN PIPELINE COMPANY  
 PRO FORMA STATEMENT OF DEBT RETIREMENTS  
 FOR THE CALENDAR YEARS 1981 - 1987  
 (DOLLARS IN MILLIONS)

YEAR	TERM BANK LOANS	MORTGAGE BONDS	TOTAL RETIREMENTS
----	-----	-----	-----
1981	188.9	85.1	274.0
1982	188.9	85.1	274.0
1983	188.9	85.1	274.0
1984	-	85.1	85.1
1985	-	85.1	85.1
1986	-	85.1	85.1
1987	-	85.1	85.1

BALANCE SHEET AND INCOME STATEMENT  
FOR MOST RECENT TWELVE MONTH PERIOD

Applicant has not begun operations, other than those necessary to file this Application. Therefore, a Balance Sheet and an Income Statement reflecting operations during the most recent twelve month period are not applicable.

ALCAN PIPELINE COMPANY  
PRO FORMA BALANCE SHEETS  
AS OF DECEMBER 31 FOR THE YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A) ASSETS	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
	PROPERTY, PLANT, AND EQUIPMENT										
1	PLANT IN SERVICE	-	-	-	2973.1	3062.7	3116.3	3116.3	3116.3	3116.3	3116.3
2	CONSTRUCTION WORK IN PROG.	835.0	2048.4	2973.1	89.6	53.6	-	-	-	-	-
3	GROSS PLANT	835.0	2048.4	2973.1	3062.7	3116.3	3116.3	3116.3	3116.3	3116.3	3116.3
4	LESS: ACCUMULATED DEPRECIATION	-	-	-	119.0	241.6	366.2	490.8	615.4	740.0	864.6
5	NET PLANT	835.0	2048.4	2973.1	2943.7	2874.7	2750.1	2625.5	2500.9	2376.3	2251.7
	CURRENT ASSETS										
6	MATERIALS AND SUPPLIES	-	-	-	9.4	9.4	9.4	9.4	9.4	9.4	9.4
7	OTHER WORKING CAPITAL, NET	-	-	-	6.1	6.7	7.6	8.2	8.8	9.5	10.2
8	TOTAL CURRENT ASSETS	-	-	-	15.5	16.1	17.0	17.6	18.2	18.9	19.6
	DEFERRED CHARGES										
9	UNAMORTIZED DEBT EXPENSE	4.7	9.1	17.8	15.5	13.2	10.8	9.9	9.0	8.1	7.2
10	TOTAL ASSETS	839.7	2057.5	2990.9	2974.7	2904.0	2777.9	2653.0	2528.1	2403.3	2278.5

ALCAN PIPELINE COMPANY  
 FPC FORM A BALANCE SHEETS  
 AS OF DECEMBER 31 FOR THE YEARS 1978 - 1987  
 (DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
	(A)	(L)
	ASSETS	
	PROPERTY, PLANT, AND EQUIPMENT	
1	PLANT IN SERVICE	
2	CONSTRUCTION WORK IN PROG.	
3	GROSS PLANT	
4	LESS: ACCUMULATED DEPRECIATION	25 YEAR STRAIGHT LIFE
5	NET PLANT	
	CURRENT ASSETS	
6	MATERIALS AND SUPPLIES	
7	OTHER WORKING CAPITAL, NET	
8	TOTAL CURRENT ASSETS	
	DEFERRED CHARGES	
9	UNAMORTIZED DEBT EXPENSE	DEBT LIFE AMORTIZATION
10	TOTAL ASSETS	



ALCAN PIPELINE COMPANY  
PRO FORMA BALANCE SHEETS  
AS OF DECEMBER 31 FOR THE YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
	LIABILITIES AND STOCKHOLDER'S EQUITY										
	CAPITALIZATION										
11	COMMON STOCK	280.0	490.0	710.0	710.0	710.0	710.0	710.0	710.0	710.0	710.0
12	RETAINED EARNINGS	21.0	81.9	184.2	278.2	306.0	383.5	284.8	194.3	112.2	38.2
13	TOTAL EQUITY	301.0	571.9	894.2	988.2	1016.0	1093.5	994.8	904.3	822.2	748.2
14	BANK LOANS	38.7	485.6	566.7	377.8	188.9	-	-	-	-	-
15	LONG-TERM DEBT	500.0	1000.0	1530.0	1444.9	1359.8	1274.7	1189.6	1104.5	1019.4	934.3
16	TOTAL CAPITALIZATION	839.7	2057.5	2990.9	2810.9	2564.7	2368.2	2184.4	2008.8	1841.6	1682.5
	ACCUMULATED DEFERRED										
17	INCOME TAXES	-	-	-	163.8	339.3	409.7	468.6	519.3	561.7	596.0
18	TOTAL LIABILITIES AND STOCKHOLDER'S EQUITY	839.7	2057.5	2990.9	2974.7	2904.0	2777.9	2653.0	2528.1	2403.3	2278.5

ALCAN PIPELINE COMPANY  
PRO FORMA STATEMENTS OF INCOME AND RETAINED EARNINGS  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
1	OPERATING REVENUES	-	-	-	701.9	699.5	694.7	676.4	636.6	597.5	563.0
2	OPERATION & MAINTENANCE	-	-	-	14.7	16.3	21.7	23.3	25.0	26.9	28.9
3	ADMINISTRATIVE & GENERAL	-	-	-	6.9	7.5	8.2	8.8	9.5	10.2	11.0
4	DEPRECIATION	-	-	-	119.0	122.6	124.6	124.6	124.6	124.6	124.6
5	TAXES OTHER THAN INCOME	-	-	-	61.7	59.6	57.1	54.1	50.6	47.1	43.8
6	INCOME TAXES	-	-	-	-	-	-	-	-	-	-
7	- CURRENT (FEDERAL & STATE)	-	-	-	-	-	113.2	125.7	117.9	110.5	105.1
7	- DEFERRED (FEDERAL & STATE)	-	-	-	163.8	175.5	70.4	58.9	50.7	42.4	34.3
8	TOTAL OPERATING EXPENSES	-	-	-	366.1	381.5	395.2	395.4	378.3	361.7	347.7
9	NET OPERATING INCOME	-	-	-	335.8	318.0	299.5	281.0	258.3	235.8	215.3
OTHER INCOME/(EXPENSES)											
10	INVESTMENT TAX CREDIT	-	-	-	-	-	46.5	51.7	48.4	31.0	-
11	ALLOWANCE FOR FUNDS USED DURING CONSTRUCTION	60.7	172.5	288.8	5.0	3.0	-	-	-	-	-
12	TOTAL OTHER INCOME/(EXPENSE)	60.7	172.5	288.8	5.0	3.0	46.5	51.7	48.4	31.0	-
INTEREST CHARGES											
13	INTEREST ON LONG-TERM DEBT	26.9	101.2	179.1	195.9	168.5	141.0	123.2	114.7	106.2	97.7
14	OTHER INTEREST EXPENSE	12.5	9.8	5.1	2.0	-	-	-	-	-	-
15	AMORTIZ OF DEBT EXPENSE	.3	.6	2.3	2.3	2.3	2.4	.9	.9	.9	.9
16	TOTAL INTEREST CHARGES	39.7	111.6	186.5	200.2	170.8	143.4	124.1	115.6	107.1	98.6
17	* NET INCOME	21.0	60.9	102.3	140.6	150.2	202.6	208.6	191.1	159.7	116.7
18	RETAINED EARNINGS, BEGINNING OF YEAR	-	21.0	81.9	184.2	278.2	306.0	383.5	284.8	194.3	112.2
19	CASH DIVIDENDS	-	-	-	46.6	122.4	125.1	307.3	281.6	241.8	190.7
20	NET INCOME	21.0	60.9	102.3	140.6	150.2	202.6	208.6	191.1	159.7	116.7
21	RETAINED EARNINGS, END OF YEAR	21.0	81.9	184.2	278.2	306.0	383.5	284.8	194.3	112.2	38.2

ALCAN PIPELINE COMPANY  
PRO FCPMA BALANCE SHEETS  
AS OF DECEMBER 31 FOR THE YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
<hr/>		<hr/>
	(A)	(L)
	LIABILITIES AND STOCKHOLDER'S EQUITY	
	CAPITALIZATION	
	<hr/>	
11	COMMON STOCK	EXHIBIT L PART VI LINE 10
12	RETAINED EARNINGS	EXHIBIT L PART IX B LINE 21
13	TOTAL EQUITY	
14	BANK LOANS	
15	LONG-TERM DEBT	
16	TOTAL CAPITALIZATION	
	ACCUMULATED DEFERRED	
	<hr/>	
17	INCOME TAXES	EXHIBIT P PART II F LINE 16
	<hr/>	
18	TOTAL LIABILITIES AND STOCKHOLDER'S EQUITY	

ALCAN PIPELINE COMPANY  
PRO FORMA STATEMENTS OF INCOME AND RETAINED EARNINGS  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
1	OPERATING REVENUES	-	-	-	701.9	699.5	694.7	676.4	636.6	597.5	563.0
2	OPERATION & MAINTENANCE	-	-	-	14.7	16.3	21.7	23.3	25.0	26.9	28.9
3	ADMINISTRATIVE & GENERAL	-	-	-	6.9	7.5	8.2	8.8	9.5	10.2	11.0
4	DEPRECIATION	-	-	-	119.0	122.6	124.6	124.6	124.6	124.6	124.6
5	TAXES OTHER THAN INCOME	-	-	-	61.7	59.6	57.1	54.1	50.6	47.1	43.8
6	INCOME TAXES	-	-	-	-	-	-	-	-	-	-
7	- CURRENT (FEDERAL & STATE)	-	-	-	-	-	113.2	125.7	117.9	110.5	105.1
7	- DEFERRED (FEDERAL & STATE)	-	-	-	163.8	175.5	70.4	58.9	50.7	42.4	34.3
8	TOTAL OPERATING EXPENSES	-	-	-	366.1	381.5	395.2	395.4	378.3	361.7	347.7
9	NET OPERATING INCOME	-	-	-	335.8	318.0	299.5	281.0	256.3	235.8	215.3
OTHER INCOME/(EXPENSES)											
10	INVESTMENT TAX CREDIT	-	-	-	-	-	46.5	51.7	48.4	31.0	-
11	ALLOWANCE FOR FUNDS USED DURING CONSTRUCTION	60.7	172.5	288.8	5.0	3.0	-	-	-	-	-
12	TOTAL OTHER INCOME/(EXPENSE)	60.7	172.5	288.8	5.0	3.0	46.5	51.7	48.4	31.0	-
INTEREST CHARGES											
13	INTEREST ON LONG-TERM DEBT	26.9	101.2	179.1	195.9	168.5	141.0	123.2	114.7	106.2	97.7
14	OTHER INTEREST EXPENSE	12.5	9.8	5.1	2.0	-	-	-	-	-	-
15	AMORTIZ OF DEBT EXPENSE	.3	.6	2.3	2.3	2.3	2.4	.9	.9	.9	.9
16	TOTAL INTEREST CHARGES	39.7	111.6	186.5	200.2	170.8	143.4	124.1	115.6	107.1	98.6
17	NET INCOME	21.0	60.9	102.3	140.6	150.2	202.6	208.6	191.1	159.7	116.7
RETAINED EARNINGS,											
18	BEGINNING OF YEAR	-	21.0	81.9	184.2	278.2	306.0	383.5	284.8	194.3	112.2
19	CASH DIVIDENDS	-	-	-	46.6	122.4	125.1	307.3	281.6	241.8	190.7
20	NET INCOME	21.0	60.9	102.3	140.6	150.2	202.6	208.6	191.1	159.7	116.7
RETAINED EARNINGS,											
21	END OF YEAR	21.0	81.9	184.2	278.2	306.0	383.5	284.8	194.3	112.2	38.2

ALCAN PIPELINE COMPANY  
PRO FORMA STATEMENTS OF INCOME AND RETAINED EARNINGS  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
-----	-----	-----
	(A)	(L)
1	OPERATING REVENUES	
2	OPERATION & MAINTENANCE	
3	ADMINISTRATIVE & GENERAL	
4	DEPRECIATION	EXHIBIT L PART VI LINE 2
5	TAXES OTHER THAN INCOME INCOME TAXES	ALASKAN PROPERTY TAX AND GROSS RECEIPTS TAX
6	- CURRENT (FEDERAL & STATE)	EXHIBIT P PART II F LINES 17 & 18
7	- DEFERRED (FEDERAL & STATE)	EXHIBIT P PART II F LINE 16
8	TOTAL OPERATING EXPENSES	
9	NET OPERATING INCOME	EXHIBIT P PART II C 1 LINE 11
	OTHER INCOME/(EXPENSES)	
10	INVESTMENT TAX CREDIT	EXHIBIT P PART II F LINE 27
11	ALLOWANCE FOR FUNDS USED DURING CONSTRUCTION	
12	TOTAL OTHER INCOME/(EXPENSE)	
	INTEREST CHARGES	
13	INTEREST ON LONG-TERM DEBT	
14	OTHER INTEREST EXPENSE	
15	AMORTIZ OF DEBT EXPENSE	EXHIBIT L PART VI LINE 4
16	TOTAL INTEREST CHARGES	
17	NET INCOME	
18	RETAINED EARNINGS, BEGINNING OF YEAR	
19	CASH DIVIDENDS	EXHIBIT L PART VI LINE 15
20	NET INCOME	
21	RETAINED EARNINGS, END OF YEAR	

MISCELLANEOUS STATEMENTS

Applicant has not entered into any agreements, contracts, mortgages, deeds of trust, indentures, agreements to advance materials or supplies or render services, or any other agreement or documents of a similar nature in return for its securities.

Applicant has not submitted to any person, including the Securities and Exchange Commission, in connection with the proposed financing, any applications, supporting exhibits, registration statements, reports, letters or other documents, including business studies, forecasts of earnings and similar financial or accounting reports, statements or documents.

Concurrent with the submission of this application Applicant has no additional data or information not disclosed herein upon which it proposes to rely upon in illustrating the adequacy and availability of resources for financing the proposed facilities.

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_

EXHIBIT M

CONSTRUCTION, OPERATION AND MANAGEMENT

CONSTRUCTION, OPERATION AND MANAGEMENT

Applicant will act as manager of the construction and operation of the proposed facilities. The construction and operating plans are described under Tab 6.0 and 7.0, respectively, in Exhibit Z-2 of this application.

Applicant has no construction, engineering, management or other similar service agreements or contracts with respect to construction or operation of the proposed facilities.

Contracts for the engineering and construction will be solicited from reputable engineering firms and pipeline construction contractors in a timely manner. Applicant further contemplates that one or more organizations may be engaged by contract to perform supervision of such contractors, and to direct, coordinate and plan the work of such contractors, under the general management of employees of Applicant.

Gulf Interstate Engineering Company ("Gulf Interstate") provided the engineering design and environmental assessment relative to this application.

Gulf Interstate owns 2.4 percent of the outstanding common stock of Northwest Energy Company which owns 100% of Northwest Pipeline Corporation which in turn owns 100% of Applicant.

All accounting, legal and other similar professional services shall be performed by those parties selected by Applicant which Applicant deems most qualified to perform such services. However, no contracts for these services have been entered into by Applicant as of the date of filing of this Exhibit.



Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT N

REVENUES - EXPENSES - INCOME

REVENUES - EXPENSES - INCOME

Applicant is a new company which has had no prior operations and thus will not have operating revenues or operating expenses to submit for the last year preceding the first year of construction or service.

Applicant proposes one class of transportation service, the billing procedures of which are set forth in the proposed FPC Gas Tariff filed herein as Exhibit P.

The pro forma statement of revenues, expenses and income for the two year capacity build up period and the first five years of operation at full capacity are included herein on pages 2 and 3 of Exhibit N.

ALCAN PIPELINE COMPANY  
PRO FORMA STATEMENT OF REVENUES, EXPENSES, AND INCOME  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

EXHIBIT N  
PART I AND II

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
	GAS TRANSPORTATION FOR OTHERS										
1	ANNUAL CONTRACTED RECEIPTS-BCF	-	-	-	438.0	584.0	876.0	876.0	876.0	876.0	876.0
2	OPERATING REVENUES	-	-	-	701.9	699.5	694.7	676.4	636.6	597.5	563.0
	OPERATING EXPENSES										
3	OPERATION AND MAINTENANCE	-	-	-	14.7	16.3	21.7	23.3	25.0	26.9	28.9
4	ADMINISTRATION AND GENERAL	-	-	-	6.9	7.5	8.2	8.8	9.5	10.2	11.0
5	DEPRECIATION	-	-	-	119.0	122.6	124.6	124.6	124.6	124.6	124.6
6	TAXES OTHER THAN INCOME	-	-	-	61.7	59.6	57.1	54.1	50.6	47.1	43.8
7	INCOME TAXES										
8	- CURRENT (FEDERAL & STATE)	-	-	-	-	-	113.2	125.7	117.9	110.5	105.1
	- DEFERRED (FEDERAL & STATE)	-	-	-	163.8	175.5	70.4	58.9	50.7	42.4	34.3
9	TOTAL OPERATING EXPENSES	-	-	-	366.1	381.5	395.2	395.4	378.3	361.7	347.7
10	NET OPERATING INCOME	-	-	-	335.8	318.0	299.5	281.0	258.3	235.8	215.3
11	RATE BASE	-	-	-	2847.2	2646.9	2454.9	2266.2	2087.4	1917.0	1754.7
12	RATE OF RETURN	-	-	-	11.8%	12.0%	12.2%	12.4%	12.4%	12.3%	12.3%

ALCAN PIPELINE COMPANY  
PRO FORMA STATEMENT OF REVENUES, EXPENSES, AND INCOME  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

EXHIBIT N  
PART I AND II

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
	(A)	(L)
	GAS TRANSPORTATION FOR OTHERS -----	
1	ANNUAL CONTRACTED RECEIPTS-BCF	
2	OPERATING REVENUES -----	EXHIBIT L PART IX B LINE 1
	OPERATING EXPENSES -----	
3	OPERATION AND MAINTENANCE	EXHIBIT L PART IX B LINE 2
4	ADMINISTRATION AND GENERAL	EXHIBIT L PART IX B LINE 3
5	DEPRECIATION	EXHIBIT L PART VI LINE 2
6	TAXES OTHER THAN INCOME	EXHIBIT L PART IX B LINE 5
	INCOME TAXES	
7	- CURRENT (FEDERAL & STATE)	EXHIBIT P PART II F LINES 17 & 18
8	- DEFERRED (FEDERAL & STATE)	EXHIBIT P PART II F LINE 16
9	TOTAL OPERATING EXPENSES	
10	NET OPERATING INCOME	EXHIBIT L PART IX B LINE 9
11	RATE BASE -----	EXHIBIT P PART II C1 LINE 9
12	RATE OF RETURN -----	EXHIBIT P PART II C2 LINE 12

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Page 3

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EXHIBIT O

DEPRECIATION AND DEPLETION

DEPRECIATION AND DEPLETION

Alcan Pipeline Company, the Applicant, plans to record monthly provisions for depreciation and amortization of its depreciable and amortizable gas plant in service using the straight line method, based on the balances in the accounts of the utility plant in service at the beginning of the billing month. Depreciation is proposed to be recorded on communication, office, shop, garage, stoves, laboratory and miscellaneous equipment, tools, office furniture and other tangible property at 10% per year; and transportation and power-operated equipment at 20% per year. Alcan proposes an initial annual composite rate of 4% for all other gas plant in service, which is expected to be primarily included in transmission plant accounts, subject to adjustment during the project life to fully depreciate facilities over the remaining years of the project life.

The 10% and 20% rates are based on the estimated useful life the the various classifications of property and are consistent with the general practice in the industry.

Alcan Pipeline Company  
Docket No. CP76-  
Hearing exhibit No. \_\_\_\_

EXHIBIT P

TARIFF

TARIFF

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ii a & b	Pro Forma Cost of Service for the Calendar Years 1978-1987. Most of the Cost of Service under Rate Schedule T-1 Firm Service, which used the method of "Contract Mcf-Miles" to allocate costs among the Shippers. A small, but unknown, portion of the total cost of service will apply to service under Rate Schedule OT-1 Overrun Service which used the method described in Section 3 of that Rate Schedule to compute the amount charged.	3
ii c (1)	Pro Forma Return of Rate Base for the Calendar Years 1981-1987	3
ii c (2)	Pro Forma Rate of Return for the Calendar Years 1981-1987 (based upon an assumed 15% rate of return on common equity)	3
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## DESCRIPTION OF NEW GAS TARIFF PROPOSED

### Introduction

This Description of the New Gas Tariff proposed contains a brief summary of the principal characteristics of the FPC Gas Tariff under which Alcan Pipeline Company (Alcan) proposes to transport natural gas for its customers (Shippers), who will own the gas. The point or points of receipt of the gas, as well as delivery, are mutually agreeable points on Alcan's proposed pipeline system. The points of delivery may be located within the State of Alaska, but it is anticipated that most of the gas transported will be delivered at the international border between Alaska and the Yukon Territory of Canada, to the pipeline facilities of Foothills Pipe Lines Limited, for further transportation to markets within the lower 48 states.

Alcan's Tariff provides that the total of all monthly charges paid by all Shippers to Alcan shall equal the total cost of service incurred by Alcan in that month in performing its transportation services. The total cost of service includes a fair return on the equity capital committed to the project. These payments will be made "in all events", and will begin when Alcan's pipeline facilities are ready to render the contracted service. Accordingly Alcan will not profit more than this return on equity, even though the gas volumes transported increase from those occurring at the start of operations to the maximum volumes authorized by the FPC in its initial order on these matters, and to those greater volumes which could be authorized later. Conversely, Alcan will receive its cost of doing business even if the gas volumes transported would be reduced, or stopped completely. These features are essential to the successful financing of the project.

### Description of Tariff

The Tariff will consist of four documents: Rate Schedule T-1 Firm Service, Rate Schedule OT-1 Overrun Service, General Terms and Conditions, and the Service Agreement to be executed between Alcan and each Shipper.

Rate Schedule T-1 Firm Service

Rate Schedule T-1 governs the basic service to be provided, pursuant to Article 1 of the Service Agreement. Section 3.1 provides that a Shipper must pay its "allocable share" of Alcan's "Cost of Service" for each month, so that all Shippers pay all of the Cost of Service. Section 3.2 defines the term "Shipper's Allocable Share" and states that the Shipper's Monthly Charge for any billing month shall be the product obtained by multiplying the Shipper's Allocable Share by the Company's Cost of Service for such billing month. Definitions of the term "Effective Allocation Factor", "Allocation Factor", and "Contract Mcf-Miles" in Section 1 of the General Terms and Conditions explain how "Shipper's Effective Allocation Factor" is determined.

Section 4 defines the method by which the "Cost of Service" for each month is determined, including the accounts (Subsection 4.2) and accounting principles (Subsection 4.3) to be used. The Cost of Service is to be the sum of the Operation and Maintenance Expenses (Subsection 4.4); Depreciation and Amortization, computed basically on a straight-line basis (Subsection 4.51); Taxes, Other Than Income (Subsection 4.6); Income Taxes, including deferred income taxes (Subsection 4.7); various adjustments including revenue under Rate Schedule OT-1 (Subsection 4.8); and an amount of "Return" computed by multiplying the "Overall Rate of Return" (Subsection 4.91 through 4.93) by the "Rate Base" (Subsection 4.94).

The Overall Rate of Return will be computed monthly in the manner shown in Subsections 4.91 through 4.93, and will reflect Alcan's actual capitalization as well as the cost of debt and preferred shares for the month plus the rate of return on common equity, which is to be authorized by the Federal Power Commission. Alcan has not yet determined the rate of return on common equity which it will propose, but will do so at a later date in these proceedings. This fact is indicated by the blank spot before the "%" in the Item (i) of Subsection 4.92.

The Rate Base is to be computed each month (Subsection 4.94) as the average of the beginning and end of month balances (with one exception) of gas plant in service (paragraph a), plus working capital allowance (paragraph b). Gas plant in service is basically original cost of plant, less accrued depreciation and accumulated deferred taxes. Working capital includes 150% of monthly gas operating and maintenance expenses, plus pre-payments, materials and supplies, and deposits required by U.S. Government and state authorities.

Rate Schedule T-1 Firm Service continued

Subsection 4.10 defines the method for computing the allowance for funds used during construction which later becomes a part of the gas plant in service. The rate for computation of such allowance is to be the effective overall cost of capital as computed in Subsections 4.91 through 4.93, and is to be applied monthly to the balance of gas plant under construction. The amounts so computed are to be added monthly to the balance of gas plant under construction, to recognize the impact of compounding on the cost of funds.

Finally, Section 5 provides for reductions in Alcan's charges to a Shipper if Alcan fails to take receipt of gas tendered by the Shipper under certain conditions. (There shall be no reduction if the Shipper causes such failure, Subsection 5.51.) The basic "Billing Adjustment" reduction of charge is that proportion of the charges attributable to the rate of return on common equity, which the quantity of gas which is tendered but not accepted is of the Shipper's Daily Receipt Quantity, plus taxes relative to such amount of reduction. (Subsection 5.2) This reduction shall only apply if Applicant takes receipt of less than 80% of the quantities of gas tendered in a month in accordance with Article 1 of Shipper's Service Agreement. Subsection 5.3 provides that Applicant will make up to the extent practicable, by excess receipts and deliveries thereafter, the gas it did not accept, while Subsection 5.4 provides that if such make-up gas exceeds the gas for which no billing reduction was made pursuant to Subsection 5.2 the excess shall be paid for by Shipper at the unit rate per Mcf of the billing reduction which Shipper received relative to such deficiency. The billing reductions, and any payments for make-up gas, shall not affect the Cost of Service (Subsection 5.6).

Rate Schedule OT-1

Rate Schedule OT-1 applies to overrun transportation, pursuant to Article 2 of the Service Agreement, which does not include make-up gas under Section 6 of Rate Schedule T-1. Subsection 3.1 provides for the computation of the Overrun Rate, and specifies that it shall not apply to overrun gas transported in a month, and any following month, which is not in excess of the deficiency of receipts by Applicant in the month. Revenues received by Applicant under Rate Schedule OT-1 are applied to reduce the Cost of Service computed under Rate Schedule T-1.

### General Terms and Conditions

This document defines many of the terms used in the contract documents, and amplifies the provisions of the Service Agreement.

As is customary, it contains provisions relating to the measurement of gas, quality specifications, billing, the making of payments, liability of parties, temporary and permanent transfer of delivery capacity and other such topics. It also contains a number of provisions reflecting the specific nature of the transportation service to be provided by Applicant. In particular:

- (a) Section 13 contains detailed provisions dealing with the computation of the quantities and aggregate Btu content of gas required to be delivered by Applicant to each Shipper, and the provision of line pack gas to Applicant by the Shippers:
- (b) Section 19 sets out Applicant's policy with respect to lateral lines; and
- (c) Section 26 provides for the survival of certain rights and obligations following the termination of a Service Agreement.

### Service Agreement

The Service Agreement states the basic contractual agreement of the parties. Article 1 allows the Shipper to tender any amount of gas each day, up to the contractual quantity for which it contracts (Maximum Receipt Quantity specified in Exhibit A to the Service Agreement), adjusted by the planned, maintenance and scheduled downtime factors provided in Subsection 1.12 of the General Terms and Conditions (Daily Receipt Quantity). Provision is made for more than one point at which Shipper may deliver gas to Alcan, with separate contractual quantities for each point of receipt. Alcan must accept receipt of the amount of gas so tendered. Provision is also made for more than one point at which Alcan may deliver gas to the Shipper, with separate contractual quantities for each point of delivery.

Service Agreement continued

Article 2 provides for the delivery to Alcan by Shipper of amounts of gas on a day in excess of the contractual quantity of a Shipper but only if and so long as Alcan elects to receive such gas, in light of its ability and other obligations.

Article 3 and 4 provide that Applicant's obligation to deliver gas and its right to payment are governed by Section 13 of the General Terms and Conditions and by the Rate Schedules, respectively. Of course, the Rate Schedules and General Terms and Conditions are an integral part of the Service Agreement (Article 9). Article 5 sets forth the procedures for changing the Tariff.

Exhibit A to the Service Agreement specifies most of the contractual terms which are unique to the Shipper, including a description of the points of receipt and delivery of gas, the allowable pressures and temperatures, maximum receipt and delivery quantities at each point, and the effective date of Exhibit A.

ALCAN PIPELINE COMPANY  
FPC Gas Tariff, Original Volume No. 1

PRO FORMA

FPC GAS TARIFF

Original Volume No. 1

of

ALCAN PIPELINE COMPANY

Filed With

Federal Power Commission

Communications Concerning This Tariff  
Should Be Addressed To:

(Name, Title)

Alcan Pipeline Company

(Address)

Issued by:

Effective:

Issued on:

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PRELIMINARY STATEMENT

Alcan Pipeline Company (Company) is a corporation engaged in rendering a transportation service for the owners of natural gas produced in Alaska (Shippers). The Company is a "natural gas company" as defined by the Natural Gas Act and, as such, is subject to the jurisdiction of the Federal Power Commission. It operates in interstate commerce a natural gas pipeline system extending from the Prudhoe Bay area of Alaska's North Slope southward to a point near Delta Junction, Alaska and then eastward to a point of interconnection with the pipeline system of Foothills Pipe Lines Limited, a Canadian corporation, at the international border between Alaska and the Yukon Territory, Canada. Company transports natural gas for Shippers from a point, or points, of receipt to a point, or points, of delivery on its pipeline system, each of these points being mutually agreed upon.

The Company undertakes to render natural gas transportation service only pursuant to written Service Agreements with Shippers which are acceptable to it, in light of its outstanding commitments to others and of other factors deemed pertinent to it.

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RATE SCHEDULE T-1--FIRM SERVICE

1. AVAILABILITY

This Rate Schedule is available to any Shipper under its Service Agreement.

2. APPLICABILITY AND CHARACTER OF SERVICE

This Rate Schedule shall apply to all transportation service under a Shipper's Service Agreement, other than service specifically provided for in another Rate Schedule.

3. SHIPPER'S OBLIGATION TO PAY COST OF SERVICE; SHIPPER'S MONTHLY CHARGE

3.1 Shipper's Obligation to Pay Cost of Service: Shipper shall be obligated to pay to Company in respect of each billing month, beginning with Shipper's First Billing Month, Shipper's Allocable share, determined in accordance with Subsection 3.2 hereof, of Company's Cost of Service, determined in accordance with Section 4 hereof, for each such billing month. Such obligation is subject to adjustment as provided in Section 5 hereof and shall be discharged as provided herein and in Section 6 of the General Terms and Conditions.

3.2 Shipper's Monthly Charge: Shipper's Allocable Share for any billing month shall be a fraction, the numerator of which shall be the daily weighted average of Shipper's Effective Allocation Factor during such billing month and the denominator of which shall be the sum of the daily weighted average of the Effective Allocation Factors of all Shippers during such billing month. Shipper's Monthly Charge for any billing month shall be Shipper's Allocable Share for such billing month multiplied by Company's Cost of Service for such billing month.

4. COST OF SERVICE

4.1 Computation: Company's Cost of Service shall be determined by Company in United States dollars for each billing month and shall be equal to the aggregate of the items described in Subsections 4.4 through 4.9 hereof for such billing month determined in accordance with this Section 4.

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4. COST OF SERVICE Continued

4.2 Company's Accounts: Company shall maintain books of account in accordance with the requirements of the Federal Power Commission applicable to Company and, to the extent not inconsistent with such requirements, in accordance with generally accepted accounting principles. Computations of Cost of Service under this Section 4 shall be made in accordance with the provisions of such Section and shall be based on the amounts recorded in Company's books of account except to the extent that such amounts must be adjusted in order to give effect to the provisions of this Section 4.

4.3 Uniform System of Accounts: Account numbers specified herein are those provided for in the Uniform System of Accounts Prescribed for Natural Gas Companies by the Federal Power Commission, as in effect at September 30, 1974 ("Uniform System of Accounts"). In the event that the Uniform System of Accounts is, after such date, replaced, amended, modified or revised, the accounts and the description thereof referred to herein shall be deemed to refer to the corresponding accounts in such replaced, amended, modified or revised Uniform System of Accounts, all without prejudice to the ability of Company to receive payment equal to all of its costs (including but not limited to those in the categories described in Subsections 4.4 through 4.9 hereof) as and in the manner contemplated by the Tariff.

4.4 Operation and Maintenance Expenses: All reasonable gas operation and maintenance expenses for the billing month properly includable in Account Nos. 700 through 932, inclusive, but excluding any provision with respect to doubtful accounts or bad debts relating to amounts payable by Shippers hereunder and excluding expenses related to research and development unless specific prior authorization therefor has been received from the Federal Power Commission.

4.5 Depreciation and Amortization: A provision for depreciation and amortization of Company's depreciable or amortizable gas plant in service properly recorded in Account Nos. 403 through 407.2, which shall be the amount computed pursuant to Subsection 4.51 hereof.

4.51 An amount equal to one-twelfth of the sum of the products resulting from multiplying each annual straight-line depreciation rate set forth in the Depreciation Rate Table below times the actual original cost, at the beginning of the billing month, of the items included in each applicable class of depreciable or amortizable gas plant in service to which such rate applies on such Table; provided, however, that (a) leasehold improvements may, at the option of Company, be amortized on a straight-line basis over the initial term of the lease to which they relate, and (b) transportation and power operated equipment may, at the option of the Company, be depreciated using an accelerated method of depreciation and a five year life.

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DEPRECIATION RATE TABLE

<u>Classes of Gas Plant in Service</u>	<u>Uniform System of Accounts Account No.</u>	<u>Annual Straight-Line Rate</u>
Communication, office, shop, garage, stores, laboratory, and miscellaneous equipment, tools, office furniture and other tangible property	370,391,393 394,395,397 398 and 399	10%
Transportation and power operated equipment	392 and 396	20%
All other gas plant in service	301 through 399 except those listed above	4%

4.6. Taxes Other Than Income: Accruals recorded in Account No. 408.1 for the billing month with respect to taxes other than income taxes associated with operations plus any interest received or paid on tax refunds or deficiencies, as recorded in Account Nos. 419 or 431. Such accruals shall be appropriately adjusted for taxes, tax deficiencies and tax penalties paid for which accruals have not been made and for refunds of taxes paid which have previously accrued. Any such adjustment shall be made in the billing month in which any such tax, tax deficiency, or tax penalty is paid or in which such tax refund is received.

4.7. Income Taxes: A monthly allowance for federal and state income taxes, including current income taxes and provision for deferred income taxes computed in accordance with comprehensive tax allocation accounting procedures, all as recorded in Account Nos. 409.1, 409.3, 410.1 and 411.1, plus any interest received or paid on tax refunds or deficiencies, as recorded in Account Nos. 419 or 431. As used in this Subsection 4.7, "comprehensive tax allocation accounting procedures" shall mean those procedures which require recording a full provision for all income tax effects of timing differences between recorded amounts and amounts reported for income tax purposes, including but not limited to (a) interest, taxes and pension costs capitalized per books and expensed currently for tax purposes, (b) all differences between book and tax depreciation and (c) any other timing differences between the recording of other revenues and expenses for book and tax purposes.

4.8. Adjustments: An addition or deduction, as the case may be, to Cost of Service equal to the result of combining the following amounts properly included for the billing month:

4.81. An addition or deduction as the case may be equal to the amount of net foreign exchange losses or gains actually realized in the billing month by Company (as recorded in Account No. 930)

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4.8. Adjustments continued

which relate to gas operations, such loss or gain in respect of payments of principal, interest premium, preferred share redemptions or preferred share dividends to be calculated consistently with the provisions of Subsection 4.93 hereof;

4.82. A deduction equal to other revenues which relate to gas operations, including but not limited to revenue under Rate Schedule OT-1, interest pursuant to Subsection 6.3 of the General Terms and Conditions as recorded in Account No. 487, and revenues properly recorded in Account Nos. 412, 488, 492 through 495, provided that any expenses incurred in the production of these revenues may be offset against them.

4.9. Return: An amount of return which shall be the product of multiplying one-twelfth of the annual Overall Rate of Return for the billing month computed pursuant to Subsections 4.91 through 4.93 hereof times the Rate Base for the billing month computed pursuant to Subsection 4.94 hereof.

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4.91. The annual Overall Rate of Return for the billing month shall be item (m) in the following tabulation, which tabulation shall be completed by inserting therein the appropriate amounts obtained in accordance with Subsection 4.92 hereof.

	<u>Capitalization</u>		<u>Weighted Average Component Cost</u>	<u>Component Rate</u>
	<u>Amount</u>	<u>% of Total</u>		
Debt. . . . .	\$(a)	(d)	(g)	(j)%
Preferred Shares. .	\$(b)	(e)	(h)	(k)%
Common Equity . . .	\$(c)	(f)	(i)	(l)%
Total . . . . .	<u>\$(s)</u>	<u>100%</u>		<u>(m)%</u>

4.92. The amounts to be inserted in place of the letters in the tabulation contained in Subsection 4.91 hereof shall be obtained as follows, the account balances referred to in items (a), (b) and (c) below being the daily weighted average balance of such accounts for the billing month with the exception of Account Nos. 215 and 216, the account balances for which shall be as of the beginning of the billing month. The amounts to be inserted in (d) through (m) inclusive shall be calculated to the nearest 1/10,000th of one percent.

#### CAPITALIZATION

Item (a) Debt: The sum of the balances in Account Nos. 221, 223, 224, 225, 231, 233, 239, 240 and 257 (less the balance in Account Nos. 181, 189, 222 and 226 and the balance of Escrowed Construction Funds).

Item (b) Preferred Shares: The sum of the balances in Account Nos. 204, 205 and 206 plus any portion of the balances in Account No. 207 which is applicable to any issues of preferred shares, less any portions of the balances in Account Nos. 213, 214, and 217 which are applicable to any issue of preferred shares.

Item (c) Common Equity: The sum of the balances in Account Nos. 201, 202, 203, 208 through 212, 215 and 216, plus the excess of any balance in Account No. 207 over any portion thereof included in

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(b), less the excess of any balances in Account Nos. 213, 214 and 217 over any portions thereof included in (b).

Item (s): The sum of (a), (b) and (c)

Item (d) Debt Percentage: The percentage which (a) is of (s)

Item (c) Preferred Percentage: The percentage which (b) is of (s)

Item (f) Equity Percentage: The percentage which (c) is of (s)

#### Weighted Average Component Cost

Item (g): The result obtained by multiplying the total debt charge for the billing month as recorded in Account Nos. 427, 428, 428.1, 430 and 431 (less the sum of the credits in Account Nos. 429, 429.1 and the Earnings on Escrowed Construction Funds, all for the billing month) by twelve and dividing the product by the amount in (a).

Item (h): The result obtained by multiplying the amount of dividends on preferred shares outstanding from time to time during the billing month that would be accrued during the billing month at their stated annual rate (whether or not paid or payable) by twelve and dividing the product by the amount in (b).

Item (i): %.

#### Component Rates

Item (j): The product resulting from the multiplication of (d) times (g).

Item (k): The product resulting from the multiplication of (e) times (h).

Item (l): The product resulting from the multiplication of (f) times (i).

#### Overall Rate of Return

Item (m): The sum of (j), (k) and (l).

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4.93. For the purposes of this Subsection 4.9, where any amounts included in the computation of (a) or (b) as described in Subsections 4.91 and 4.92, or used in the computation of (g) or (h) as described in those Subsections, relate to debts or preferred shares denominated in foreign currency, or debt charges or dividends payable with respect thereto, the United States dollar amount taken into account in the computation shall be the equivalent in United States dollars of the foreign currency amounts when translated at the Foreign Exchange Rate in effect when the debts or preferred shares to which such items relate were incurred or issued.

4.94. The Rate Base for the billing month shall be the average of the sum of the balances of the items listed in (a) below as of the beginning and as of the end of such billing month, except in the case of the balance of accumulated deferred income taxes (Account Nos. 190, 281, 282 and 283), which shall be as of the beginning of the billing month, plus the amount determined in accordance with (b) below.

(a) (i) The sum of the balances of: actual or original investments in gas plant in service as properly recorded in Account Nos. 301 through 399; gas plant leased to others (Account No. 104); gas plant held for future use (Account No. 105); completed construction not classified (Account No. 106); and accumulated deferred income taxes (Account No. 190); less (ii) the sum of the balances of: accumulated depreciation and amortization reserves (Account Nos. 108 and 111); customer advances for construction (Account No. 252); and accumulated deferred income taxes (Account Nos. 281, 282 and 283).

(b) A working capital allowance represented in the sum of (1) outstanding balances of prepayments and necessary materials and supplies for operating purposes, plus (2) the daily weighted average for the billing month of cash or securities (valued at cost) deposited with both U.S. Government and State authorities to secure any obligations of Company, contingent or otherwise, plus (3) cash working capital equivalent to 150% of the gas operation and maintenance expenses for the billing month.

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4. COST OF SERVICE continued

4.10 Allowance for Funds Used During Construction (AFUDC): Commencing with the month in which the balance recorded in Account No. 107 (construction work in progress) first exceeds \$100,000, AFUDC shall be computed each month by multiplying one-twelfth of the annual Overall Rate of Return computed (or which would be computed if Cost of Service for such month were being determined) for such month pursuant to Subsections 4.91 through 4.93 hereof by the average of the sum as of the beginning of such month and as of the end of such month of the balance of plant under construction, as recorded in Account No. 107. The AFUDC so computed shall concurrently be closed out pro rata to the other sub-accounts of Account No. 107 by allocating such balance among such other sub-accounts in proportion to the balances of such other sub-accounts on such dates.

4.11 Balances for Initial Service Month: For purposes of Subsection 4.5 hereof and (a) of Subsection 4.94 hereof, the balances as of the beginning of the Initial Service Month of the accounts referred to therein shall be deemed to be the balances of such accounts as of the earliest Billing Commencement Date of any Shipper.

5. BILLING ADJUSTMENT FOR FAILURE TO ACCEPT GAS

5.1 General. If Company shall, in any billing month after the Billing Commencement Date, fail for any reason (including but not limited to its inability or refusal to receive gas from or deliver gas to such Shipper) to take receipt from any Shipper of the whole or any portion of the quantity of gas tendered by such Shipper to Company in accordance with such Shipper's Service Agreement, such Shipper shall nevertheless be liable to Company for, and shall pay to Company in accordance with Section 6 of the General Terms and Conditions, such Shipper's Monthly Charge for such billing month and all other amounts invoiced to such Shipper pursuant to its Service Agreement, subject only to the provisions of this Section 5.

5.2 Billing Adjustment: If, in any billing month, the quantity of gas received by Company from Shipper is less than 80% of the quantity of gas tendered by Shipper to Company pursuant to Article 1 of Shipper's Service Agreement, Shipper shall be entitled to a credit in respect of such billing month ("Billing Adjustment") which is (a) the product resulting from multiplying the portion of Shipper's Allocable Share of

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5. BILLING ADJUSTMENT FOR FAILURE TO ACCEPT GAS continued

Company's Cost of Service for such billing month that is attributable to the return on common equity computed pursuant to Subsection 4.9 hereof, by a fraction, the numerator of which is the difference between the quantity of gas so tendered by Shipper to Company in such billing month and the quantity of gas actually taken receipt of by Company from Shipper during such billing month and the denominator of which is the sum of Shipper's Daily Receipt Quantities for all days during such billing month, plus (b) the amount of current and deferred income taxes and any revenue-related taxes included in computing such Cost of Service related to the amount referred to in (a). Each Billing Adjustment shall be reflected in an invoice to Shipper as provided in Subsection 6.1 of the General Terms and Conditions.

5.3 Receipt Deficiencies: If, on any day, Company fails to take receipt from Shipper of any portion of the gas tendered by Shipper to Company on such day pursuant to Article 1 of Shipper's Service Agreement, such portion shall be Shipper's Receipt Deficiency for such day. Receipt Deficiencies arising in a billing month shall be discharged to the extent of gas received by Company from Shipper pursuant to Article 2 of Shipper's Service Agreement on any day during such billing month whether before or after the day on which any such Receipt Deficiency arose. To the extent not so discharged, Receipt Deficiencies shall be discharged only by the receipt of Make-up Gas in subsequent billing months.

If, in any billing month, the quantity of gas received by Company from Shipper pursuant to Article 2 of Shipper's Service Agreement exceeds the aggregate of Shipper's Receipt Deficiencies arising in that billing month, the excess shall be Make-up Gas to the extent of undischarged Shipper's Receipt Deficiencies arising in prior billing months, and the balance, if any, shall be governed by Rate Schedule OT-1.

If Company is on any day required to allocate service under Article 2 of the Service Agreements of two or more Shippers, it shall give priority in such allocation to quantities of gas desired to be tendered in respect to Receipt Deficiencies to the extent, in the case of each such Shipper, of its undischarged Receipt Deficiencies on such day.

Service in respect of gas received pursuant to Article 2 of Shipper's Service Agreement and applied to the discharge of Receipt Deficiencies shall be deemed to have been provided under this Subsection 5.3.

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5. BILLING ADJUSTMENT FOR FAILURE TO ACCEPT GAS continued

5.4 Payment for Make-up Transportation: If, in any billing month, the quantity of gas received by Company from Shipper is less than the quantity of gas tendered by Shipper to Company in such billing month pursuant to Article 1 of Shipper's Service Agreement, and such deficiency is less than 20% of the gas so tendered, Make-up Gas received in any subsequent billing month by Company from Shipper shall, to the extent of the quantity of such deficiency ("No Billing Adjustment Gas"), not be subject to any payment pursuant to this Subsection 5.4, and, for such purposes, No Billing Adjustment Gas shall be deemed to be received by Company from Shipper before other Make-up Gas, and No Billing Adjustment Gas relating to an earlier billing month shall be deemed to be received by Company from Shipper before No Billing Adjustment Gas relating to a later billing month. To the extent that Make-up Gas received by Company from Shipper in any billing month is not No Billing Adjustment Gas, Shipper shall be obligated to pay to Company in respect of such billing month, for each Mcf of such Make-up Gas, an amount equal to the result arrived at by dividing the Billing Adjustment for the billing month to which the Make-up Gas in which such Mcf is included relates, by the number of Mcf of gas which Company failed to take receipt of from Shipper in such billing month, and, for such purpose, Make-up Gas relating to an earlier billing month shall be deemed to be received by Company from Shipper before Make-up Gas relating to a later billing month. Each amount so payable shall be reflected in an invoice to Shipper as provided in Subsection 6.1 of the General Terms and Conditions.

5.5 Exceptions:

5.51. Subsections 5.2 through 5.4 hereof shall not apply to any failure of Company to take receipt from Shipper of any gas tendered by Shipper pursuant to Article 1 of Shipper's Service Agreement if such failure is caused in whole or in part by, or results in whole or in part from, failure of Shipper to, or to be able to, deliver or take delivery of such gas, or by any other action of Shipper or Persons acting on its behalf which causes or results in such failure by Company.

5.52. If, in any billing month, Company shall wilfully refuse to take receipt from any Shipper of the whole or any portion of the quantity of gas tendered by such Shipper to Company in accordance with Article 1 of such Shipper's Service Agreement, and if but for such wilful refusal, Company would have been able to take receipt of and transport, and make deliveries in respect of, the gas receipt of which was refused, Shipper shall, in addition to any other remedy to which it may be entitled and to any credit to which it may be entitled under Subsection 5.2 hereof, be entitled to a credit in respect of such billing month equal to the amount by which (a) the product of multiplying Shipper's Allocable Share of Company's Cost of Service for such billing

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5. BILLING ADJUSTMENT FOR FAILURE TO ACCEPT GAS continued

month by a fraction, the numerator of which is the quantity of gas receipt of which was so wilfully refused by Company in such billing month and the denominator of which is the sum of Shipper's Daily Receipt Quantities for all days during such billing month, exceeds (b) the Billing Adjustment of Shipper determined in respect of such billing month.

5.6 No Effect on Cost of Service Determination: In determining the items described in Subsections 4.4, 4.6, 4.7, and 4.8 hereof for the purpose of computing Cost of Service for a billing month, no account shall be taken of credits arising under Subsection 5.2 or Subsection 5.52 hereof or of amounts paid or payable to Company pursuant to Subsection 5.4 hereof, all of such items being determined for such purpose as though no such credit had ever been given or required to be given and no such amounts had ever been paid or become payable, provided that the item described in Subsection 4.6 hereof, to the extent it is determined by reference to amounts computed pursuant to Subsection 4.8 hereof, shall be determined by reference to the actual amounts so computed.

6. HEAT CONTENT

Refer to Section 5 of the General Terms and Conditions

7. MEASUREMENT BASE

Refer to Section 4 of the General Terms and Conditions

8. GENERAL TERMS AND CONDITIONS

The General Terms and Conditions are applicable to this Rate Schedule

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RATE SCHEDULE OT-1--OVERRUN SERVICE

1. AVAILABILITY

This Rate Schedule is available to any Shipper under its Service Agreement.

2. APPLICABILITY AND CHARACTER OF SERVICE

This Rate Schedule shall apply to transportation service pursuant to Article 2 of Shipper's Service Agreement other than service which by the terms of Subsection 5.3 of Rate Schedule T-1 is deemed to be provided under said Subsection.

3. PAYMENT FOR SERVICE

3.1 Determination: Shipper shall pay to Company for each Mcf of gas received by Company from Shipper to which this Rate Schedule is applicable an amount equal to Shipper's Overrun Rate for the billing month in which such gas is received; provided that if Shipper on any day in any billing month does not tender all or a portion ("Tender Deficiency") of such Shipper's Daily Receipt Quantity, then no payment shall be due to Company under this Rate Schedule in respect of gas received by Company pursuant to Article 2 of Shipper's Service Agreement and which is governed by this Rate Schedule, on any other day during such billing month and any following billing month up to the undischarged amount of such Tender Deficiency. Shipper's Rate for Overrun Service for any billing month shall be computed by dividing (a) Shipper's Allocable Share for the next preceding billing month, as defined in Subsection 3.2 of Rate Schedule T-1, of the sum of Company's Cost of Service for such billing month plus the amount credited in determining such Cost of Service in respect of revenues from all Shippers under this Rate Schedule OT-1, by (b) the sum of Shipper's Daily Receipt Quantities for all days in such preceding billing month.

3.2 Payment: Each amount payable pursuant to Subsection 3.1 of this Rate Schedule shall be reflected in an invoice to Shipper as provided in Subsection 6.1 of the General Terms and Conditions.

3.3 Application of Revenues: Revenues under this Rate Schedule shall be credited to Cost of Service as provided in Rate Schedule T-1.

4. MINIMUM BILL

None

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5. HEAT CONTENT

Refer to Section 5 of the General Terms and Conditions.

6. MEASUREMENT BASE

Refer to Section 4 of the General Terms and Conditions.

7. GENERAL TERMS AND CONDITIONS

The General Terms and Conditions are applicable to this Rate Schedule.

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GENERAL TERMS AND CONDITIONS

1. DEFINITIONS

The following terms, when used in this Tariff or a Service Agreement, shall have the following respective meanings:

1.1. The term "Allocation Factor" relative to a Shipper shall mean such Shipper's Contract Mcf-Miles.

1.2. The term "Billing Commencement Date" relative to a Shipper shall mean the day designated as such by Company by not less than one day's notice to such Shipper, which notice shall state that Company has facilities, which are ready for service and have the capacity, not required by Company in order to comply with its obligations under Service Agreements with other Shippers, to receive gas at Shipper's Point or Points of Receipt and to make related deliveries of gas at Shipper's Point or Points of Delivery, all in accordance with the provisions of Shipper's Service Agreement.

1.3. The term "billing month" shall mean the period beginning at 8:00 A.M., Standard Time used at Fairbanks, Alaska, on the first day of a calendar month and ending at 8:00 A.M. Standard Time used at Fairbanks, Alaska on the first day of the next succeeding calendar month.

1.4. The term "Btu" shall mean British thermal unit.

1.5. The term "calendar year" shall mean the period from 8:00 A.M., Standard Time used at Fairbanks, Alaska, on January 1 of any year to 8:00 A.M., Standard Time used at Fairbanks, Alaska, on January 1 of the next succeeding year.

1.6. The term "Company " shall mean Alcan Pipeline Company, a Delaware corporation.

1.7. The term "Company Use Gas" for any period shall mean the total volume of gas, including but not limited to gas used as fuel or for testing, used by Company in its gas operations during such period, as determined by Company.

1.8. The term "Contract Mcf-Miles" relative to a Shipper shall mean the number calculated by (i) allocating Shipper's Maximum Receipt Quantity for

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GENERAL TERMS AND CONDITIONS continued

each of its points of Receipt among such Shipper's Points of Delivery in the ratio which the Maximum Delivery Quantity for each such Point of Delivery bears to the sum of Shipper's Maximum Delivery Quantity for each such Point of Delivery bears to the sum of Shipper's Maximum Delivery Quantities, (ii) Multiplying the volume of gas so allocated to a Point of Delivery by the number of miles of Company's pipeline which gas must traverse between such Point of Receipt and such Point of Delivery and (iii) adding together the products of each such multiplication; provided, however, that if the sum of Shipper's Maximum Delivery Quantities exceeds its Total Maximum Receipt Quantity, the amount of such excess shall, for the purposes of the allocation required by (i) above, be deducted from such Shipper's Maximum Delivery Quantities at its Points of Delivery beginning with its Point of Delivery that is the least number of miles distant from any of its Points of Receipt, the balance of such excess, if any, being deducted from its Maximum Delivery Quantities at its other Points of Delivery in order of increasing distances from any of such Shipper's Points of Receipt until the entire amount of such excess shall have been so deducted.

1.9. The term "Cost of Service" relative to a billing month shall mean the amount determined for such billing month pursuant to Section 4 of Rate Schedule T-1.

1.10. The term "day" shall mean a period of 24 consecutive hours beginning and ending at 8:00 A.M., Standard Time used at Fairbanks, Alaska. The reference date for any day shall be the date of the beginning of such day.

1.11. The term "Daily Delivery Quantity" relative to a Point of Delivery of a Shipper for any day shall mean such Shipper's Maximum Delivery Quantity for such Point of Delivery or such lesser quantity as Company shall from time to time determine, with not less than four hours notice thereof to Shipper, on a basis which reflects seasonal variations in the capacity of Company's Facilities and reductions in the capacity of such facilities resulting from maintenance operations and does not discriminate among Shippers.

1.12. The term "Daily Receipt Quantity" relative to a Point of Receipt of a Shipper for any day shall mean the lesser of: (a) the product of such Shipper's Maximum Receipt Quantity for such Point of Receipt and the planned maintenance and scheduled down time factor shown as a percentage in the following table for the month in which such day occurs; or (b) such quantity as Company shall

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GENERAL TERMS AND CONDITIONS continued

from time to time determine for any day on a basis which reflects reductions in the capacity of Company's facilities resulting from maintenance or other operating conditions and does not discriminate among Shippers.

<u>Month</u>	<u>Percentage</u>
January	100
February	100
March	99
April	95
May	93
June	91
July	90
August	91
September	92
October	94
November	96
December	100

1.13. The term "Earnings on Escrowed Construction Funds" shall mean any income, by way of interest or otherwise, earned in respect of Escrowed Construction Funds, whether such income is immediately available to Company or is required to be held in the same manner as Escrowed Construction Funds.

1.14. The term "Effective Allocation Factor" relative to a Shipper for any day shall mean such Shipper's Allocation Factor for such day, provided such day falls on or after Shipper's Billing Commencement Date..

1.15. The term "Escrowed Construction Funds" shall mean that portion of the proceeds of any money borrowed by Company which is held by a fiduciary or is otherwise segregated from the other funds of Company and which may be disbursed to Company or upon its order only upon compliance with conditions intended to ensure application of such proceeds to purposes related to the construction of Company's gas plant.

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GENERAL TERMS AND CONDITIONS continued

1.16. The term "Federal Power Commission" shall mean the Federal Power Commission of the United States of America or any other tribunal which may hereafter exercise the functions now exercised by that Commission with respect to the regulation of gas pipelines.

1.17. The term "First Billing Month" relative to a Shipper shall mean the billing month in which such Shipper's Billing Commencement Date Occurs.

1.18. The term "Foreign Exchange Rate" for any day shall mean the average of the spot buying and selling rates for the currency in question of The Bank of America National Trust and Savings Association, San Francisco, California at noon on such day.

1.19. The term "gas" shall mean natural gas, manufactured, artificial or synthetic gas, or any mixture or combination thereof.

1.20. The term "gas plant" shall mean all tangible and intangible plant of Company, excluding plant that is entirely distinct from and is not operated in connection with Company's gas operations.

1.21. The term "General Terms and Conditions" shall mean, at any time, these General Terms and Conditions as from time to time amended or supplemented.

1.22. The term "gross heating value", when used in respect of any gas, shall mean the number of Btus which would be produced by the combustion, in a recording calorimeter at constant pressure, of the amount of such gas which would occupy a volume of one cubic foot at a temperature of 60 F when saturated with water vapor, and under a pressure of 14.73 psia with air of the same temperature and pressure as the gas, when the products of combustion are cooled to the initial temperature of the gas and air, and when the water vapor formed by combustion is condensed to the liquid state.

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General Terms and Conditions continued

1.23. The term "Initial Service Month" shall mean the First Billing Month of the first Shipper to have a Billing Commencement Date .

1.24. The term "Interest Rate" for any period shall mean the annual rate (based on a 365 day year) which is one percentage point over the daily weighted average prime rate for loans charged during such period to its commercial customers by the Bank of America National Trust & Savings Association, San Francisco, California.

1.25. The term "Line Pack Change" for any period shall mean the difference between the total volume of line pack gas contained in Company's pipeline at the beginning and end of such period, as computed by Company.

1.26. The term "Lost or Otherwise Unaccounted for Gas" for any period shall mean the difference between the total volume of gas received by Company from all Shippers in such period and the sum, for that period, of (a) all gas delivered by Company to all Shippers, plus (b) Company Use Gas, plus or minus (c) Line Pack Change.

1.27. The term "Maximum Delivery Quantity" relative to a Point of Delivery to a Shipper for any day shall mean the volume of gas shown as the Maximum Delivery Quantity for such point of Delivery on Exhibit A to such Shipper's Service Agreement.

1.28. The term "Maximum Receipt Quantity" relative to a Point of Receipt from a Shipper for any day shall mean the volume of gas shown as the Maximum Receipt Quantity for such Point of Receipt on Exhibit A to such Shipper's Service Agreement.

1.29. The term "Mcf" shall mean 1000 cubic feet of gas determined in accordance with the measurement base described in Subsection 4.1 hereof.

1.30. The term "Monthly Charge" relative to a Shipper for a billing month shall mean the amount computed as such Shipper's Monthly Charge pursuant to Section 3.2 of Rate Schedule T-1.

1.31. The term "Person" shall mean an individual, a corporation, a partnership, an association, a joint venture, a trust, an unincorporated organization or a government or political subdivision thereof; and pronouns shall have a similarly extended meaning.

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GENERAL TERMS AND CONDITIONS continued

1.32. The term "Point of Delivery" relative to a Shipper shall mean one of the Points of Delivery shown on Exhibit A to such Shipper's Service Agreement for delivery of gas to such Shipper.

1.33. The term "Point of Receipt" relative to a Shipper shall mean one of the Points of Receipt shown on Exhibit A to such Shipper's Service Agreement for receipt of gas from such Shipper.

1.34. The term "psia" shall mean pounds per square inch, absolute.

1.35. The term "psig" shall mean pounds per square inch, gauge.

1.36. The term "Pro Rata Share" relative to a Shipper whose Billing Commencement Date has occurred shall mean, at any time, a fraction, the numerator of which is such Shipper's Contract Mcf-Miles at such time and the denominator of which is the sum of the Contract Mcf-Miles at such time of all Shippers whose Billing Commencement Dates have theretofore occurred.

1.37. The terms "Rate Schedule T-1" and Rate Schedule OT-1" shall mean Rate Schedule T-1 and Rate Schedule OT-1, respectively, of Company as from time to time on file with the Federal Power Commission and in effect; and the term "Rate Schedules" shall mean both thereof together with all other rate schedules of Company as from time to time on file with the Federal Power Commission and in effect.

1.38. The term "Service Agreement" shall mean, at any time with respect to any Shipper, an executed Service Agreement for service under this Tariff made by and between Company and such Shipper which is then in effect.

1.39. The term "Shippers" shall mean, at any time, the Persons which have entered into Service Agreements with Company which are then in effect; and the term "Shipper" shall mean one of such Persons.

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GENERAL TERMS AND CONDITIONS continued

1.40. The term "Tariff" shall mean the compilation on file with the Federal Power Commission of Company's Rate Schedules, General Terms and Conditions and related forms of Service Agreement from time to time in effect.

1.41. The term "tendered" relative to a quantity of gas and a Shipper shall mean that (a) such Shipper has informed Company that it plans to deliver a quantity of gas which such Shipper is entitled to deliver to Company pursuant to such Shipper's Service Agreement at a specified Point of Receipt on a specified day, (b) except to the extent Company refuses to receive such quantity, such Shipper in fact delivers such quantity to Company at such Point of Receipt on such day, (c) to the extent Company refuses to receive such quantity of gas at such Point of Receipt on such day, such Shipper is in fact ready, willing and able so to deliver the quantity so refused or would have been able to do so had Company not so refused, and (d) such Shipper is in fact ready, willing and able to accept delivery from Company on such day of the related quantity of gas in accordance with such Shipper's Service Agreement; and the term "tender" shall have a corresponding meaning.

1.42. The term "Total Maximum Receipt Quantity" relative to a Shipper for any day shall mean the Total Maximum Receipt Quantity shown on Exhibit A to such Shipper's Service Agreement, which shall equal the sum of all Maximum Receipt Quantities shown thereon.

2. PRESSURE AND TEMPERATURE

2.1. Receipt Pressure: Shipper shall deliver gas to Company at each of Shipper's Points of Receipt at a pressure sufficient to cause it to flow into Company's facilities, provided that Shipper shall not be required to deliver gas to Company at any Point of Receipt at a pressure in excess of the Maximum Pressure specified with respect to such Point of Receipt in Exhibit A to such Shipper's Service Agreement.

2.2. Delivery Pressure: Company shall deliver gas to Shipper at each of Shipper's Points of Delivery at the pressure existing in Company's pipeline at such Point of Delivery, provided that Company shall not deliver gas to any Shipper at any Point of Delivery at a pressure less than the Minimum Pressure specified with respect to such Point of Delivery in Exhibit A to such Shipper's Service Agreement.

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PRESSURE AND TEMPERATURE continued

2.3. Maximum Receipt Temperature: The temperature of gas delivered by Shipper to Company at a Point of Receipt shall not exceed the Maximum Temperature specified with respect to such Point of Receipt in Exhibit A to such Shipper's Service Agreement which shall in no event exceed 30°F.

2.4. Operating Conditions: Subject to the provisions of Subsections 2.1, 2.2 and 2.3 hereof, the temperature and pressure of gas delivered to Company by Shipper, and of gas delivered to Shipper by Company, shall, at each of Shipper's Points of Receipt and Points of Delivery, be consistent with the overall operating conditions of Company's pipeline system. Company shall use due care and diligence to deliver gas to Shipper at such uniform pressure as is consistent with the operating conditions of Company's pipeline system.

3. MEASURING EQUIPMENT

3.1. Company's Measuring Equipment: Unless otherwise agreed by Company and Shippers, at each Point of Receipt, and at each Point of Delivery, of a Shipper, Company shall cause to be furnished, installed, maintained, and operated all equipment, devised and material necessary to determine gas volume, pressure, temperature, gross heating value, quality, specific gravity and supercompressibility.

3.11. When orifice meters are used, the manufacture, installation, operation and maintenance thereof shall be consistent with the recommendations and specifications contained in the latest edition from time to time of "Orifice Metering of Natural Gas--Gas Measurement Committee Report No. 3," including any appendices and amendments thereto, published by the American Gas Association.

3.12. Measuring equipment other than orifice meters, if used, shall be of a type acceptable to Company and Shippers. Such meters may also be equipped with a device for recording flow rate and/or a device for integrating the product of the volume of gas measured multiplied by pressure and temperature corrections; and indicating the volume of gas received or delivered.

3.13. Recording calorimeters shall be of a standard type acceptable to Company and Shippers.

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MEASURING EQUIPMENT continued

3.14. Recording specific gravity instruments shall be of a standard manufacture acceptable to Company and Shippers, and shall be installed so as to properly record the specific gravity of the gas. Any such instrument shall be checked at least once each month by the use of an Edwards balance, or by any other method agreed upon by Company and Shippers.

3.2. Check Measuring Equipment: At each Point of Receipt, and at each Point of Delivery, of a Shipper, the Shipper or Shippers affected, at its or their own expense, may cause to be furnished, installed, maintained and operated check measuring equipment, provided however that such equipment does not interfere with the operations of the measuring equipment caused to be installed by Company.

3.3. Right of Access: Company and the Shipper or Shippers affected, in the presence of each other, shall each have access to the other's measuring equipment at all reasonable times, but the reading, calibrating and adjusting thereof and the changing of charts shall be done only by employees of the company which has installed such equipment, unless otherwise agreed upon. Both Company and the Shipper or Shippers affected shall have the right to be present at the time of any installing, reading, cleaning, changing, repairing, inspecting, testing, calibrating, or adjusting done in connection with the other's measuring equipment. The records from such measuring equipment shall remain the property of the company installing such equipment, but, upon request, each will submit to the other its records and charts, together with calculations therefrom, for inspection, subject to return within 30 days after receipt thereof.

3.4. Reasonable Care: Company shall exercise reasonable care in the installation, maintenance and operation thereof so as to avoid any inaccuracy in the determination of the volume and other attributes of gas received and delivered.

3.5. Testing Measuring Equipment: Company shall conduct tests to verify the accuracy thereof, using means and methods acceptable to Company and the Shipper or Shippers affected, at least once each month, or at such other interval as may be mutually agreed upon and at other times upon request of Shipper or Shippers. Notice of the time and nature of each test shall be

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3.5 MEASURING EQUIPMENT continued

given by Company to such Shipper or Shippers in advance to permit convenient arrangement for the presence of the other's representatives. If, after notice, a Shipper fails to have a representative present, the results of the test shall nevertheless be considered accurate until the next test. All tests of such measuring equipment shall be made at the expense of the Company, except that Shipper or Shippers requesting a test shall bear the expense of such test if the inaccuracy is found not to exceed two percent, at a reading corresponding to the average hourly rate of flow.

3.6. Correction and Adjustment: If, upon test, any measuring equipment is found to be registering inaccurately by not more than two percent, at a reading corresponding to the average hourly rate of flow, then readings of such equipment since the time of the last test thereof shall be considered accurate in computing deliveries of gas. If, upon test, any measuring equipment is found to be registering inaccurately by more than two percent, at a reading corresponding to the average hourly rate of flow, then readings of such equipment shall be corrected to zero error for any past period definitely known, or agreed, to have been inaccurate, or if the inaccuracy during all or part of the period of time since the last test of such equipment is not so known or agreed upon, for a period of sixteen days, or one-half of the elapsed time since such last test, whichever is the shorter period. Any recording equipment found to be registering inaccurately shall be immediately adjusted to register accurately.

3.7. Failure of Measuring Equipment: If Company's measuring equipment at any Point of Receipt or Point of Delivery of a Shipper is out of Service for any period, the measurement determinants for such Point of Receipt or Point of Delivery during such period shall be determined:

3.71. By using the data recorded by any check measuring equipment accurately registering; or

3.72. If such check measuring equipment is not registering accurately but the percentage of error is ascertainable by a calibration test, by using the data recorded, corrected to zero error; or

3.73. If neither of the methods provided in Subsections 3.71 and 3.72 above can be used, by estimating the necessary determinants by reference to receipts or deliveries under similar conditions.

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MEASURING EQUIPMENT continued

3.8. Preservation of Records: Both Company and the Shipper or Shippers affected shall preserve for a period of at least three years, or such longer period as may be required by public authority, all test data, charts, and other similar records.

4. MEASUREMENTS

4.1. Unit of Measurement and Measurement Base: The volumetric measurement base of all volumes of gas referred to in any Service Agreement or this Tariff shall be one cubic foot of gas at a pressure base of 14.73 psia, at a temperature base of 60°F. and without adjustment for water vapor content.

4.2. Computation of Volume from Meter Readings and Registrations:

4.21. Company and Shipper shall endeavor to agree upon methods so that volumes of gas received and delivered under Shipper's Service Agreement shall be computed in accordance with the latest approved methods in use in the industry generally.

4.22. When orifice meters are used, gas volumes shall be computed in accordance with the specifications prescribed in the latest edition from time to time of "Orifice Metering of Natural Gas-- Gas Measurement Committee Report No. 3" published by the American Gas Association, including any appendices and amendments thereto.

4.23. If positive displacement and turbine meters are used, measurements of the volumes received or delivered at flowing pressures and temperatures shall be corrected to the volumetric measurement base by the application of proper correction factors for (a) absolute static pressure, (b) flowing temperature and (c) supercompressibility. If an integrating device is used, correction for the deviation from Boyle's Law may be built into the device; otherwise such correction shall be applied to the volume of gas indicated.

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MEASUREMENTS continued

4.3. Flowing Temperature: The flowing temperatures of the gas shall be determined by the use of standard continuously recording thermometers. The flowing temperatures used in determining the flowing temperature factor for each meter chart shall be the arithmetical average of the temperatures at each hour shown by the recording thermometers during the period of time covered by the meter chart.

4.4. Specific Gravity: The specific gravity of the gas shall be determined by a recording specific gravity instrument as specified in Subsection 3.14 hereof. The arithmetical average of the hourly specific gravity recording each day shall be deemed to be the specific gravity of the gas for that day.

4.5. Supercompressibility: Measured gas volumes shall be corrected for supercompressibility (deviation of the gas from the laws of ideal gases) at the pressures and temperatures at which the gas is measured. Except as otherwise agreed by Company and Shippers, the factors for such corrections shall be obtained from data contained in the A. G. A. Manual for the Determination of Supercompressibility Factors for Natural Gas developed under P.A.R. Research Project NX-19 completed in December 1962, or any subsequent revision or replacement thereof.

4.6. Atmospheric Pressure: For purposes of measurement, the absolute atmospheric (barometric) pressure at each measuring station shall be assumed to be the pressure corresponding to the elevation at such station, and shall be stated in pounds per square inch.

4.7. Gross Heating Value: The gross heating value of the gas shall be determined by use of a recording calorimeter as specified in Subsection 3.13 hereof. The arithmetical average of the hourly gross heating values so recorded each day shall be deemed to be the gross heating value of the gas for such day.

4.8. Measurement Responsibility: Subject to the provisions of Subsections 3.6 and 3.7 hereof, measurement of gas volumes and gross heating values shall, for all purposes of this Tariff, be as recorded on or computed from the measuring equipment and devices installed and operated by Company.

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5. QUALITY OF GAS

5.1. Quality Standards of Gas Received by Company: Company may refuse to accept gas which does not conform to the following specifications:

5.11. Shall not contain sand, dust, gums, crude oil, impurities or other objectionable substances which may be injurious to pipelines or may interfere with the transmission of the gas; and

5.12. Shall have a hydrocarbon dew-point less than  $-5^{\circ}\text{F.}$  at 800 psia,  $-10^{\circ}\text{F.}$  at 1000 psia, or  $-18^{\circ}\text{F.}$  at 1100 psia, or such higher dew-point approved by Company as, without treatment by Company, may be compatible with the operating conditions of Company's pipeline; and

5.13. Shall not contain more than 0.25 grain of hydrogen sulphide per 100 cubic feet; and

5.14. Shall not contain more than 10 grains of total sulphur per 100 cubic feet; and

5.15. Shall contain not more than three-tenths grains of mercaptan sulphur per 100 cubic feet, or such higher content as, in Company's judgment, will not result in deliveries by Company to Shippers of gas containing more than three-tenths grains of mercaptan sulphur per 100 cubic feet; and

5.16. Shall not contain more than two percent by volume of carbon dioxide; and

5.17. Shall not have a water vapor content in excess of two-tenths of a pound per MMcf; and

5.18. Shall be as free of oxygen as it can be kept through the exercise of all reasonable precautions and shall not in any event contain more than four-tenths of one percent by volume of oxygen; and

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QUALITY OF GAS continued

5.19. Shall have a gross heating value of not less than 950 Btu per cubic foot.

5.2. Quality Tests: At each Point of Receipt of a Shipper, Company shall cause tests to be made, by approved standard methods in general use in the gas industry, to determine whether the gas conforms to the quality specifications set out in Subsection 5.1 hereof. Such tests shall be made at such intervals as Company may deem reasonable, and at other times, but not more often than once per day, at the request of any Shipper.

5.3. Failure to Conform: If gas delivered by a Shipper does not comply with the quality specifications set out in Subsection 5.1 hereof, Company shall have the right, in addition to all other remedies available to it by law, to refuse to accept any such gas. Company may, at its option, accept receipt of gas not complying with the quality specifications set out in Subsection 5.1 hereof provided Company, at the expense of such Shipper, makes all changes necessary to bring such gas into compliance with such specifications. Any change in the gross heating value of gas treated by Company pursuant to this Subsection 5.3 shall, for purposes of Section 13 hereof, be appropriately reflected in the total Btu content of gas received by Company from the Shipper whose gas is so treated.

5.4. Quality Standards of Gas Transported by Company: Company shall use reasonable diligence to deliver gas under a Shipper's Service Agreement which shall meet the quality specifications set out in Subsection 5.1 hereof, but shall only be obligated to deliver gas of the quality which results from the commingling of the gas received by Company from Shippers and, except as required by Subsection 5.3 hereof, shall not be required to treat any gas delivered to it by a Shipper. Company may treat any gas delivered to it by a Shipper to the extent required, in Company's opinion, to prevent damage to or interference with the efficient operation of Company's facilities, provided it determines, except in the case of treatment pursuant to Subsection 5.3 hereof, that the gross heating value of such gas will not be materially reduced, nor the other quality standards of such gas materially adversely affected, thereby.

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6. BILLING AND PAYMENT

6.1 Billing: On or before the fifteenth day of each billing month beginning with the billing month immediately following Shipper's First Billing Month, Company shall cause to be received by Shipper an invoice for the amount payable under Shipper's Service Agreement during such billing month. Such invoice shall reflect:

- (a) Shipper's Monthly Charge for the immediately preceding billing month, computed pursuant to Section 3.2 of Rate Schedule T-1;
- (b) any credit to which Shipper is entitled in respect of the second billing month pursuant to Subsection 5.2 or Subsection 5.52 of such Rate Schedule;
- (c) any amount payable by Shipper in respect of the second preceding billing month pursuant to Subsection 5.4 of such Rate Schedule;
- (d) any amount payable by Shipper in respect of the second preceding billing month pursuant to Section 3 of Rate Schedule OT-1; and
- (e) other charges or credits to Shipper hereunder;

and shall set forth in reasonable detail the basis of determining the amount shown thereby to be payable.

6.2 Payment-On or before the 25th day of each month Shipper shall pay the bill rendered pursuant to Subsection 6.1 to Company. Such payment shall be made in immediately available funds on or before the due date to a depository designated by Company. If the 25th falls on a day that the designated depository is not open in the normal course of business to receive Shipper's payment, then Shipper's payment shall be made on or before the business day prior to the 25th that such depository is available.

6.3 Late Payment. Should Shipper fail to pay all of the amount of any bill when such amount is due, interest on the unpaid portion of such amount shall accrue at the then-current prime rate charged by the Bank of America National Trust and Savings Association, San Francisco, California charged by, or successor thereto, from the date when the payment was due until the date payment is made.

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BILLING AND PAYMENT continued

6.4. Late Billing: If the receipt of an invoice by Shipper is delayed beyond the date provided in Subsection 6.1 hereof, then the time for payment shall be extended correspondingly unless Shipper is responsible for such delay.

6.5. Billing Error. In the event an error is discovered in the amount billed in any statement rendered by Company, such error shall be adjusted within thirty (30) days of the determination thereof.

6.6. Remedies for Failure to Pay Bills: If a failure by Shipper to pay in full the amount of any invoice rendered by Company as herein provided shall continue for 60 days after payment is due, Company may, after any required application to and authorization from any regulatory authority having jurisdiction, suspend further receipt of gas from and delivery of gas to Shipper until such amount is paid in full, in addition to any other remedies it may have. Such suspension shall not terminate Shipper's Service Agreement or otherwise affect Shipper's obligations to Company under Shipper's Service Agreement and no reduction in Shipper's Monthly Charge or Billing Adjustment pursuant to Subsection 5.2 of Rate Schedule T-1 shall be made because thereof.

7. OPERATING INFORMATION TO BE SUBMITTED

Upon request of Company, Shipper shall from time to time give Company written notice, as far in advance as operating conditions will permit, of the estimated daily, monthly and annual quantities of gas Shipper intends to deliver to Company pursuant to its Service Agreement.

Company shall from time to time give Shippers written notice, as far in advance as operating conditions will permit, of the estimated daily, monthly and annual quantities of gas Company expects to be able to receive and deliver pursuant to Shipper's Service Agreements.

Shipper and Company shall use their best judgment and experiences in arriving at such estimates, but shall not be bound thereby nor limited to the quantities thereof. Each shall promptly notify the other or others of any significant known or reasonably anticipated modification to the estimates last furnished.

8. INDEMNITY

Company and Shipper shall each indemnify and save harmless the other from all liability, damages, costs, losses and charges of every character resulting from any claim made against such other by any Person for injury or death to Persons, or damage to property, in any way connected with the property and equipment of the indemnitor or the presence of gas deemed hereby to be the responsibility of the indemnitor, unless such injury, death or damage is caused by the negligence or wilful misconduct of the indemnitee or any Person

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INDEMNITY continued

for whose actions the indemnitee is responsible in law; provided that neither Company nor Shipper shall be liable to indemnify the other unless the Person requesting indemnification shall have promptly notified the other in writing of any claim, suite or action for or in respect of which indemnification is to be claimed. The Person receiving such notification shall be entitled to participate in any such suit or action, and, to the extent that it may wish, assume the defense thereof with counsel who shall be to the reasonable satisfaction of the Person requesting indemnification, and after notice from the indemnitor to the indemnitee of its election so to assume the defense thereof, the indemnitor will not be liable to the indemnitee for any legal or other expenses incurred by the indemnitee in connection with the defense thereof. An indemnitor shall not be liable to indemnify an indemnitee on account of any settlement of any claim, suit or action effected without the consent of such indemnitor. Claims made under this Section 8 with respect to injury or death to Persons or damage to property occurring during the term of a Shipper's Service Agreement shall survive the termination thereof.

9. LIABILITY FOR NON-PERFORMANCE

9.1. Limitation of Liability: Company shall have no liability in damages to Shipper in respect of failure for any reason whatever, other than Company's wilful default, to accept receipt of, receive or deliver gas pursuant to the provisions of Shipper's Service Agreement and Shipper shall, notwithstanding any such failure, for any reason whatever, to accept receipt of, receive or deliver gas, make payment to Company in the amounts, in the manner and at the times provided in Shipper's Service Agreement.

9.2 Force Majeure: Neither Company nor Shipper shall be liable in damages to the other for any act, omission or circumstance which shall be caused, in whole or substantial part, by a condition of force majeure. The term "force majeure", as used herein, shall mean any acts of God, strikes, lockouts or other labor disputes or industrial disturbances, acts of the public enemy, wars, blockades, insurrections, riots, epidemics, landslides, lightning, earthquakes, fires, hurricanes, tornadoes, other storms, floods, washouts or other acts of nature, civil disturbances, explosions, breakage, accident or repairs to machinery or lines of pipe, temporary or permanent failure of gas supply, inability to obtain or unavoidable delay in obtaining pipe, materials or other equipment, acts or binding orders of any court or other governmental authority having jurisdiction, and any other cause, whether similar or dissimilar to any above enumerated, not reasonably within the control of the Person claiming relief from liability and which such Person was or would have been unable to prevent by the exercise of due diligence. Failure to prevent or settle any strike or strikes or any dispute leading to a lock-out shall not be considered to be a matter within the control of the Person claiming relief. Force majeure affecting the performance by either Shipper or Company of any of its obligations under Shipper's Service Agreement shall not relieve the Person seeking relief from liability in

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9.2 Force Majeure continued.

respect of any period when the continuance of its inability to perform such obligations is due to its failure to use reasonable efforts to remedy the situation in a reasonable manner and with reasonable dispatch, nor shall force majeure relieve Company or Shipper from its obligations to make payments of amounts due under Shipper's Service Agreement. The Person claiming relief from liability by reason of force majeure shall give prompt notice to the other of the occurrence and cessation of such force majeure. Nothing contained in this Subsection 9.2 shall in any way limit or affect any of the provisions of Subsection 9.1 hereof.

10. TEMPORARY INTERRUPTIONS

10.1 Notice of Interruption: Company shall at all times attempt to operate, or cause to be operated, its pipeline system in a manner designed to make possible, as nearly as practicable, continuous receipt of gas from, and delivery of gas to, Shipper in the respective quantities provided for in Shipper's Service Agreement. If a temporary interruption or curtailment of such receipt and/or delivery shall become necessary, Company shall at once notify Shipper by telephone, telegraph or other prompt means of communication of the nature, extent and probable duration of such temporary interruption or curtailment and of the volumes of gas which Company estimates it will be able to receive from and deliver to Shipper during the period of interruption or curtailment, and shall give like notice of the cessation of such interruption or curtailment.

10.2 Allocation of Reduced Capacity: If the effective capacity of all or a portion of Company's pipeline is reduced as a result of force majeure, repairs, maintenance or any other cause, whether similar or dissimilar, and some curtailment of the quantity of gas to be received from Shippers under their Service Agreements is required as a result, the reduced capacity shall, during the period of curtailment, be allocated proportionately, according to their respective Total Maximum Receipt Quantities, among those Shippers whose gas must be received or delivered at, or transported through, the affected facilities.

11. WAIVER OF DEFAULT

No waiver by either Company or Shipper of any one or more defaults by the other in the performance of any provisions of Shipper's Service Agreement shall operate or be construed as a waiver of any subsequent or other default or defaults, whether of a like or of a different character.

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## 12. SEPARATE LIABILITY OF SHIPPER

The execution of a Service Agreement by Shipper shall result in Shipper undertaking obligations of a separate nature, and shall not be deemed to cause a joint, or joint and several, obligation vis a vis any one or more other Shippers.

## 13. DELIVERIES OF GAS AND SUPPLY OF LINE PACK

13.1 Delivery of Commingled Gas: It is recognized that the gas delivered by Shipper to Company under Shipper's Service Agreement will be commingled in Company's pipeline with gas received by Company from other Shippers under their Service Agreements, and that the gas which Company will deliver to Shipper will not be the identical gas which Shipper shall delivery to Company. So long as the gas delivered by Company to Shipper meets the specifications set forth in the General Terms and Conditions, such gas may be gas from any other source in lieu of all or any part of said gas delivered by Shipper to Company.

13.2 Definition: As used in this Section 13, "Line Pack Requirement" shall mean at any time that volume of gas which is calculated by Company as the total volume of gas required as line pack for the efficient operation of its pipeline, which volume may be changed whenever the design capacity of Company's pipeline is changed.

13.3 Delivery Obligation: Beginning on Shipper's Billing Commencement Date and ending on the termination date set forth in the Service Agreement, Company shall deliver to Shipper on a daily basis a volume of gas which has an aggregate Btu content equal to the difference between (a) and (b) below.

(a) The total Btu content of all gas received by Company from Shipper pursuant to Articles 1 and 2 of Shipper's Service Agreement plus Shipper's allocable portion of any decrease in Line Pack Requirement.

(b) The total Btu content of Shipper's allocable portion, determined as provided below, of Company-Use Gas and Lost or Otherwise Unaccounted-for Gas, plus Shipper's allocable portion of any increase in Line Pack Requirement.

The Btu content of Company-Use Gas and Lost or Otherwise Unaccounted-for Gas shall, for the purposes of (b) above and for the purposes of Subsections 13.5 and 13.8 hereof, be determined for each day by use of the best available data concerning the Btu content of such gas. Shipper's allocable portion of Company-Use Gas and Lost or Otherwise Unaccounted-for Gas for any day shall be the product of the total Btu content of all such gas for such day multiplied by a fraction, the numerator of which shall be the number of

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13.3 DELIVERIES OF GAS AND SUPPLY OF LINE PACK continued:

Mcf-miles of transportation required in respect of the gas so received by Company from Shipper on such day pursuant to Articles 1 and 2 of Shipper's Service Agreement, and the denominator of which shall be the number of Mcf-miles of transportation required in respect of all gas so received by Company from all Shippers on such day. The number of Mcf-miles of transportation required in respect of gas shall, for purposes of the immediately preceding sentence of this Subsection 13.3, be determined by multiplying the volume of gas received by the distance between the point at which it is received and the point at which it is delivered, determined on the basis that the entire volume of gas received by Company from any Shipper at each of such Shipper's Points of Receipt shall be considered to be transported to such Shipper's Points of Delivery in the proportions designated by Shipper pursuant to Subsection 13.6 hereof (or, if such Shipper is not entitled to deliveries of gas on such day, in the proportions which the Maximum Delivery Quantities for such Shipper's Points of Delivery bear to one another) and on the basis of actual mileage.

13.4 Beginning of Delivery Obligation: Company shall have no obligation to deliver gas to Shipper prior to Shipper's Billing Commencement Date.

13.5 Daily Deliveries: Company, subject to operating conditions affecting Shipper and Company and the available capacity of their respective facilities, shall endeavor to deliver to Shipper on each day beginning with Shipper's Billing Commencement Date that volume of gas computed as provided in Subsection 13.3 hereof. It is recognized, however, that Company may not deliver to Shipper on each or any day the exact volume provided for above. Company shall allocate deviations from such volumes among Shippers based on existing conditions and consultation with the Shippers concerned. If Company, on any day, delivers to Shipper a volume of gas different from that described in the first sentence of this Subsection 13.5, Company shall, as soon as practicable thereafter, make adjustment for the Btu content of such difference by appropriately increasing or decreasing the volume of gas delivered to Shipper on one or more subsequent days.

13.6 Allocation of Deliveries: If Shipper has more than one Point of Delivery, it shall each day designate the portion of the gas to be delivered to it on such day which it desires to receive at each such Point of Delivery and Company shall endeavor to make deliveries in accordance with such designation; provided that Company shall not be obliged to deliver to Shipper, or Shipper to receive from Company, at any of such Points of Delivery on any day a volume of gas in excess of Shipper's Daily Delivery Quantity for such Points of Delivery for such day.

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DELIVERIES OF GAS AND SUPPLY OF LINE PACK continued:

13.7 Provision of Line Pack Gas: Shipper shall provide Company, in accordance with this Subsection 13.7, with a volume of gas equal to Shipper's Pro Rata Share of Line Pack Requirement, together with related Company-Use Gas and Lost or Otherwise Unaccounted-for Gas. Line pack gas provided to Company by Shipper shall remain the property of Shipper but Company shall not be obliged to make deliveries to Shipper in respect of such gas except as provided in Subsection 13.8 hereof.

13.71. Upon its Service Agreement becoming effective, Shipper shall, to the extent it is able to do so, deliver to Company each day, for the purpose of supplying line pack gas, such volume of gas at such points on Company's pipeline as Company may request, up to such Shipper's Total Maximum Receipt Quantity. Shipper may, on any day, deliver such additional volume of gas for such purpose as Company and Shipper may agree. Beginning with Shipper's Billing Commencement Date, Shipper may tender gas to Company for such purpose at any points on Company's pipeline and in any volume, but Company shall not be obliged to receive such gas except to the extent it is tendered in accordance with Article 1 of such Shipper's Service Agreement, but may do so if, in its judgment, it is able to receive such consistently with its obligations under Service Agreement with other Shippers and with sound operating practice.

13.72. If, at any time following Shipper's Billing Commencement Date, there is an increase in the volume of gas which is Shipper's Pro Rate Share of Line Pack Requirement, gas first received thereafter by Company from Shipper shall, up to the amount of such increase, be deemed to be received on account of Shipper's obligation to furnish line pack gas and related Company Use Gas and Lost or Otherwise Unaccounted for Gas under this Subsection 13.7, and not pursuant to Articles 1 and 2 of Shipper's Service Agreement, provided that the volume of gas which Shipper is entitled to tender on any day pursuant to such Article 1 shall not be increased as a result.

Issued by:

Effective:

Issued on:

DELIVERIES OF GAS AND SUPPLY OF LINE PACK continued:

13.73. If Company is on any day required to allocate service under Article 2 of the Service Agreements of two or more Shippers, it shall, after giving effect to the provisions of Subsection 6.3 of Rate Schedule T-1, give priority in such allocation to quantities of gas desired to be tendered in fulfillment of Shipper's obligation under this Subsection 13.7; provided that, except for the purposes of such allocation, such gas shall be deemed not to be received pursuant to Articles 1 and 2 of Shipper's Service Agreement.

13.8 Return of Line Pack Gas: If at any time Shipper's Pro Rata Share of Line Pack Requirement becomes less than the volume of gas which Shipper has delivered to Company as line pack gas, Company shall deliver to Shipper, as soon thereafter as is practicable and consistent with Company's obligations to all Shippers and Shipper's obligations under Subsection 13.7 hereof, a volume of gas having a Btu content equal to the difference between the Btu content of the past and present Line Pack Requirements.

14. WARRANTY AS TO DELIVERY RIGHT

Shipper warrants its right to deliver to Company pursuant to and for the purposes described in Shipper's Service Agreement, all gas that Company receives from Shipper, and shall indemnify and save harmless Company against any claims, liability, loss or damage which Company may incur or suffer as a result of the lack of such right or other breach of such warranty or any claim made against Company by any Person asserting an interest in such gas.

15. RESPONSIBILITY FOR GAS

As between Shipper and Company, Company shall be responsible for all gas delivered to it by Shipper between the time such gas is received by it from Shipper at any Point of Receipt and the time gas is delivered to Shipper by Company at any Point of Delivery, and at no other time.

15.1 Point of Receipt: The point of transfer of responsibility at each Point of Receipt shall be on the inlet side of the measuring station at such Point of Receipt or at such other point as may be agreed between Company and Shipper, or all Shippers who utilize such Point of Receipt.

15.2 Point of Delivery: The point of transfer of responsibility at each Point of Delivery shall be on the outlet side of the measuring station at such Point of Delivery or at such other point as may be agreed upon between Company and Shipper, or all Shippers who utilize such Point of Delivery.

Issued by:

Effective:

Issued on:

16. RIGHT TO AUDIT BOOKS

Shipper shall have the right, at reasonable times, during normal business hours, upon written request and at Shipper's expense, to review, or cause to be reviewed by Shipper's representatives, all books, records, documents and other data of Company pertaining to its performance under Shipper's Service Agreement necessary to verify the amount payable by Shipper to Company under Shipper's Service Agreement in any billing month, so long as such review shall be completed within six billing months following the end of the calendar year in which such amount is payable.

17. AUTHORIZED PERSONS

Shipper may, by notice to Company, authorize connecting pipelines or other Persons to make or receive deliveries of gas on behalf of Shipper in accordance with the provisions of Shipper's Service Agreement. Unless such authorization is revoked by notice from Shipper to Company, Shipper shall be bound by all actions taken by any Person so authorized in connection with the receipt, delivery, measurement or testing of gas received or delivered by Company under Shipper's Service Agreement. Shipper shall cause any Person authorized to make deliveries of gas on its behalf to inform Company of the portion of the volume of gas delivered to Company by such Person which was delivered for the account of Shipper and of all other relevant information concerning the volume, gross heating value and other quality specifications of such gas, and may require Company to supply similar information to any Person authorized to receive deliveries of gas from Company on behalf of Shipper.

18. COORDINATION

Company shall use its best efforts to make such arrangements with all Persons, including Shippers, that deliver gas to or receive gas from Company, as may be required to ensure proper coordination of the dispatching of gas and other operations of Company and connecting facilities and as may be desirable to promote the efficient operation of Company's pipeline system. Such arrangements may include provision for consultation among Company and such Persons and mutual inspection of relevant records.

19. LATERAL LINE POLICY: Company's general policy is not to build or contribute to the cost of building any lateral line. Nothing in this policy statement shall require Company to file an application for a certificate of public convenience and necessity under section 7(c) of the Natural Gas Act. Nothing in this policy statement, further, shall prevent Company from contesting an application for service filed pursuant to section 7(a) of such Act. Company reserves the right to seek a waiver of the policy set forth herein, for good cause shown, during any proceeding before the Federal Power Commission instituted under section 7 of the Natural Gas Act.

Issued by:

Effective:

Issued on:

## 20. NOTICES

Any notice or other communication required to be given or made in writing under a Shipper's Service Agreement shall be sufficiently given if reduced to writing and delivered, mailed by prepaid mail, or sent by telegraph or other mechanical means of transmitting written messages, to the Person to which it is to be given or made at the address of such Person provided for in Exhibit A to such Service Agreement or at such other address as shall have last been notified by such Person to the other in the manner provided in this Section 20. Any such notice or other communication which is mailed or sent as aforesaid shall only be considered to be given or made when it is actually received by the Person to which it is given or made.

## 21. DEFAULTS

No default in the performance of any of the obligations of Company or Shipper under Shipper's Service Agreement shall operate to terminate such Service Agreement, or except as specifically provided in such Service Agreement, to relieve Company or such Shipper from due and punctual compliance with its obligations thereunder.

## 22. SUCCESSORS AND ASSIGNS

Any Person which shall succeed by purchase, amalgamation, merger, or consolidation to the properties, substantially as an entirety, of Shipper or of Company, as the case may be, and which shall assume all obligations under Shipper's Service Agreement of Shipper or Company, as the case may be, shall be entitled to the rights, and shall be subject to the obligations, of its predecessor under Shipper's Service Agreement. Either party to a Shipper's Service Agreement may pledge or charge the same under the provisions of any mortgage, deed of trust, indenture or similar instrument which it has executed covering substantially all of its properties, or assign such Service Agreement to any affiliated Person (which for such purpose shall mean any Person which controls, is under common control with or is controlled by such party). Nothing contained in this Section 22 shall, however, operate to release predecessor Shipper from its obligations under its Service Agreement unless Company shall, in its sole discretion, consent in writing to such release, which it shall not do unless it concludes that, on the basis of the facts available to it, such release is not likely to have a substantial adverse effect upon other Shippers or other Persons who may become liable to provide funds to Company to enable it to meet any of its obligations. Shipper shall, at Company's request, execute such instruments and take such other action as may be desirable to give effect to any such assignment of Company's rights under such Shipper's Service Agreement or to give effect to the right of a Person whom the Company has specified pursuant to Subsection 6.21 hereof as the Person to whom payment of amounts invoiced by Company shall be made.

Issued by:

Effective:

Issued on:

23. FORM OF SERVICE AGREEMENTS

Company shall not be obliged to enter into a Service Agreement with any Person in a form other than the form of Service Agreement forming part of the Tariff.

24. AMENDMENT OF EXHIBIT A TO SHIPPER'S SERVICE AGREEMENT

Shipper and Company may at any time and from time to time, amend Exhibit A to Shipper's Service Agreement by executing a new Exhibit A, which shall be given effect as of the effective date designated by the Federal Power Commission and shall thereupon be deemed to be incorporated in Shipper's Service Agreement.

25. SEVERABILITY

If any provision of a Shipper's Service Agreement shall be contrary to or prohibited by applicable law, such provision shall be severable from the remaining provisions of such Service Agreement and shall be deemed to be deleted therefrom, and all of the provisions of such Service Agreement which are not contrary to or prohibited by applicable law shall, notwithstanding such deletion, remain in full force and effect. If any provision of Shipper's Service Agreement requires the payment of interest at a rate which exceeds the rate which the Person to whom such interest is required to be paid is permitted under applicable law to receive, or which the Person required to pay such interest is permitted under applicable law to receive, or which the Person required to pay such interest is permitted under applicable law to pay, such rate shall be reduced to the highest rate which is permitted under applicable law.

26. SURVIVAL OF OBLIGATIONS

Notwithstanding the termination of Shipper's Service Agreement:

- (a) Shipper shall remain liable thereafter to pay all invoices rendered by Company to it under Section 6 hereof in the manner contemplated, and subject to Shipper's rights in respect of such payments provided in, such Section;
- (b) Company shall remain liable thereafter to make all payments to Shipper required to be made under Section 6 hereof;
- (c) Company and Shipper shall remain liable thereafter to indemnify each other as provided in Section 8 hereof with respect to events taking place prior to such termination;
- (d) Company shall remain liable thereafter to deliver gas to Shipper to the extent necessary to discharge Company's undischarged obligations under Section 13 hereof; and

Issued by:

Effective:

Issued on:

26. SURVIVAL OF OBLIGATIONS continued

(e) Shipper and Company shall remain liable thereafter to discharge all other obligations to the date of such termination.

With all reasonable dispatch after the giving of a notice of termination under Article 6 of Shipper's Service Agreement, Company and Shipper shall enter into such arrangements as may be reasonably necessary to ensure performance of the foregoing obligations and otherwise as may be necessary or desirable in connection with such termination.

27. HEADINGS

The headings appearing in these General Terms and Conditions or in any other part of the Tariff or a Shipper's Service Agreement are for the purpose of convenient reference only and shall not affect the interpretation thereof.

28. ARBITRATION

28.1 Except where the Federal Power Commission has exclusive jurisdiction under law, in the event the parties are unable to agree on any part of the matters of fact or law related to this agreement, any party may upon written notice call for submission of such matter to binding arbitration. The party requesting arbitration shall set forth in such notice in adequate detail the issues to be arbitrated, and within ten (10) days from the receipt of such notice, the other party may set forth in adequate detail additional related issues to be arbitrated. Such arbitration shall be conducted in accordance with such rules as the parties may mutually agree to or failing such agreement in accordance with the Rules of the American Arbitration Association by three arbitrators appointed under said Rules. Arbitration proceedings shall take place in New York or such other place as the parties may agree.

28.2 The party or parties calling for any such submission shall submit to the panel of arbitrators the issues to be decided and their position thereon. The other parties shall also be entitled to submit their positions thereon. The arbitrators may request additional or such other evidence, including oral argument, as they deem necessary. Upon determination of any such dispute, the arbitrators shall assess the costs attributable to such arbitration to the party or parties whose position is farthest away from the actual decision rendered. In the case of a monetary dispute, the arbitrators shall be entitled to assess interest. The arbitrators shall be empowered to divide the costs related to such arbitration equally if they deem it appropriate.

Issued by:

Effective:

Issued on:



28.3 Subject to the provisions of Subsection 28.4 below, it is the intent of the parties that all disputes which cannot be mutually resolved shall be decided pursuant to arbitration. Any party seeking to set any arbitration decision aside or to seek a remedy, either legal or equitable, in any other forum shall be deemed to have breached this contract and subject to all costs, damages, including consequential, and attorneys fees related to the enforcement and satisfaction hereof.

28.4 Notwithstanding the other provisions of this Section 28, the parties shall pay within the period of time set forth in any executed service agreement all amounts billed thereunder without any resort to the arbitration provisions of the Section 28. The parties shall be entitled to seek any remedy at law or equity in any forum having jurisdiction to enforce collection of such amounts and no such party will in any collection proceedings in such forum raise as a defense to such collection the provisions for arbitration herein provided. Payment of such amounts shall not be deemed to be a waiver of the right to arbitrate the appropriateness of any such billing.

Issued by:

Effective:

Issued on:

ALCAN PIPELINE COMPANY

SERVICE AGREEMENT

This Agreement is made and entered into as of \_\_\_\_\_, 19\_\_\_\_, by and between ALCAN PIPELINE COMPANY, a Delaware Corporation, hereinafter referred to as "Company" and \_\_\_\_\_, a(n) \_\_\_\_\_ Corporation, hereinafter referred to as "Shipper".

WHEREAS, Shipper wishes to obtain service relating to the transportation of natural gas through Company's pipeline system which extends from the Prudhoe Bay area of Alaska's North Slope to a point of interconnection with the pipeline system of Foothills Pipelines Limited, a Canadian Corporation, on the international border between Alaska and the Yukon Territory, Canada; and

WHEREAS, Company is willing to provide such service;  
In consideration of their respective covenants and agreements hereinafter set out, the parties hereto covenant and agree as follows:

Article 1 - Basic Receipts

Shipper shall on each day beginning with Shipper's Billing Commencement Date, as defined in Section 1 of the General Terms and Conditions of Company's FPC Gas Tariff be entitled to tender and, following tender, deliver to Company, at each of Shipper's Points of Receipt, a quantity of gas not in excess of the Daily Receipt Quantity for such Point of Receipt for such day, and Company shall, on such day, take receipt of the quantity of gas so tendered and delivered by Shipper at such Point of Receipt.

Article 2 - Excess Receipts

If Shipper shall desire to tender to Company on any day beginning with Shipper's Billing Commencement Date, at any of Shipper's Points of Receipt, a quantity of gas in excess of Shipper's Daily Receipt Quantity for such Point of Receipt for such day, it shall notify Company of such desire. If Company, in its sole judgment, determines that it has available the necessary capacity to receive and transport all or any part of such excess quantity and make deliveries in respect thereof, and that the performance of Company's obligations to other Shippers under their Service Agreements will not be adversely affected thereby, Company may elect to receive from Shipper said excess quantity or part thereof, and shall so notify Shipper.

Issued by:

Effective:

Issued on:

Article 2 - Excess Receipts continued

If more than one of the Shippers shall notify Company of a desire to tender gas to Company pursuant to Article 2 of their respective Service Agreements on any day, Company, if it elects to receive less than all of such gas, shall, except as otherwise required by Subsection 6.3 of Rate Schedule T-1 and Subsection 13.73 of the General Terms and Conditions, allocate among such Shippers the aggregate quantity it so elects to receive in proportion to their respective Total Maximum Receipt Quantities or in such other equitable manner as Company's operating conditions and the availability of its facilities may reasonably require.

Receipt of gas under this Article 2 which Company has previously elected to receive from Shipper may be curtailed partially or entirely at any time or from time to time by Company at will, in which event Company shall so notify Shipper of its decision.

Article 3 - Deliveries

Company shall deliver gas to Shipper in accordance with Section 13 of the General Terms and Conditions.

Article 4 - Payments

Shipper shall make payments to Company in accordance with the Rate Schedules and the other applicable terms and provisions of this Agreement.

Article 5 - Change in Tariff Provisions

Upon notice to Shipper, Company shall have the right to file with the Federal Power Commission any changes in the terms of any of its Rate Schedules, General Terms and Conditions or Form of Service Agreement as Company may deem necessary, and to make such changes effective at such times as Company desires and is possible under applicable law. Shipper may protest any filed changes before the Federal Power Commission and exercise any other rights it may have with respect thereto.

Article 6 - Cancellation of Prior Agreements

When this Service Agreement becomes effective, it shall supersede, cancel and terminate the following agreements:

Issued by:

Effective:

Issued on:

Article 7 - Term

This Service Agreement shall become effective on the Billing Commencement Date and shall continue in effect for a period of twenty-five years thereafter.

Article 8 - Applicable Law

This Agreement and Company's Tariff, and the rights and obligations of Company and Shipper thereunder are subject to all relevant and lawful statutes, rules, regulations and orders of duly constituted authorities having jurisdiction.

Article 9 - Exhibit A to Service Agreement, Rate Schedules and General Terms and Conditions

Exhibit A to Service Agreement is an integral part of this Service Agreement. Also, Company's Rate Schedules and General Terms and Conditions, which are on file with the Federal Power Commission and in effect, are each applicable to this Agreement and are hereby incorporated in, and made a part of, this Agreement.

IN WITNESS WHEREOF, the parties hereto have caused this Agreement to be duly executed as of the day and year first set forth above.

ATTEST:

ALCAN PIPELINE COMPANY

\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

ATTEST:

(NAME OF SHIPPER)

\_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

Issued by:

Effective:

Issued on:

EXHIBIT A TO SERVICE AGREEMENT

COMPANY - Alcan Pipeline Company

COMPANY'S ADDRESS -

SHIPPER -

SHIPPER'S ADDRESS -

Points of Receipt	Maximum Receipt Quantity (per day)	Maximum Pressure	Maximum Temperature
Describe Point 1	_____ Mcf	_____ psig	_____ °F
Describe Point 2	_____ Mcf	_____ psig	_____ °F
etc.	_____ Mcf	_____ psig	_____ °F
Total Maximum Receipt Quantity	_____ Mcf		

Points of Delivery	Maximum Delivery Quantity	Minimum Pressure
Describe Point 1	_____ Mcf	_____ psig
Describe Point 2	_____ Mcf	_____ psig
etc.	_____ Mcf	_____ psig

Allocation Factor of Shipper (Contract Mcf-Miles) \_\_\_\_\_

This Exhibit A is made and entered into as of \_\_\_\_\_, 19\_\_\_\_.  
On the effective date designated by the Federal Power Commission, it shall  
supersede the Exhibit A dated as of \_\_\_\_\_, 19\_\_\_\_.

Effective Date of this Exhibit A is \_\_\_\_\_.

Issued by:

Effective:

Issued on:

ATTEST:

\_\_\_\_\_

ALCAN PIPELINE COMPANY

By: \_\_\_\_\_

Title: \_\_\_\_\_

ATTEST:

\_\_\_\_\_

(NAME OF SHIPPER)

By: \_\_\_\_\_

Title: \_\_\_\_\_

Issued by:

Effective:

Issued on:

ALCAN PIPELINE COMPANY  
PRO FORMA COST OF SERVICE  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
		(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
	COST OF SERVICE										
1	OPERATION AND MAINTENANCE	-	-	-	14.7	16.3	21.7	23.3	25.0	26.9	28.9
2	ADMINISTRATION AND GENERAL	-	-	-	6.9	7.5	8.2	8.8	9.5	10.2	11.0
3	DEPRECIATION	-	-	-	119.0	122.6	124.6	124.6	124.6	124.6	124.6
4	TAXES OTHER THAN INCOME	-	-	-	61.7	59.6	57.1	54.1	50.6	47.1	43.8
	INCOME TAXES										
5	- CURRENT (FEDERAL & STATE)	-	-	-	-	-	113.2	125.7	117.9	110.5	105.1
6	- DEFERRED (FEDERAL & STATE)	-	-	-	163.8	175.5	70.4	58.9	50.7	42.4	34.3
7	RETURN ON RATE BASE	-	-	-	335.8	318.0	299.5	281.0	258.3	235.8	215.3
8	TOTAL COST OF SERVICE	-	-	-	701.9	699.5	694.7	676.4	636.6	597.5	563.0

ALCAN PIPELINE COMPANY  
 PRO FORMA COST OF SERVICE  
 FOR THE CALENDAR YEARS 1978 - 1987  
 (DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OF FORECAST BASIS
-----	-----	-----
	(A)	(L)
	COST OF SERVICE	
	-----	
1	OPERATION AND MAINTENANCE	EXHIBIT L PART IX B LINE 2
2	ADMINISTRATION AND GENERAL	EXHIBIT L PART IX B LINE 3
3	DEPRECIATION	EXHIBIT L PART VI LINE 2
4	TAXES OTHER THAN INCOME	EXHIBIT L PART IX B LINE 5
	INCOME TAXES	
5	- CURRENT (FEDERAL & STATE)	EXHIBIT P PART II F LINES 17 & 18
6	- DEFERRED (FEDERAL & STATE)	EXHIBIT P PART II F LINE 16
7	RETURN ON RATE BASE	EXHIBIT P PART II C1 LINE 11
8	TOTAL COST OF SERVICE	



ALCAN PIPELINE COMPANY  
PRO FORMA RETURN ON RATE BASE  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
	RATE BASE										
1	AVERAGE PLANT IN SERVICE	-	-	-	2973.1	3062.7	3116.3	3116.3	3116.3	3116.3	3116.3
2	LESS: AVERAGE ACCUMULATED DEPRECIATION	-	-	-	(59.5)	(180.3)	(303.9)	(428.5)	(553.1)	(677.7)	(802.3)
3	AVERAGE NET PLANT	-	-	-	2913.6	2882.4	2812.4	2687.8	2563.2	2438.6	2314.0
	AVERAGE WORKING CAPITAL										
4	CASH WORKING CAPITAL	-	-	-	2.7	3.0	3.7	4.0	4.3	4.6	5.0
5	MATERIALS & SUPPLIES	-	-	-	9.4	9.4	9.4	9.4	9.4	9.4	9.4
6	PREPAYMENTS	-	-	-	3.4	3.7	3.9	4.2	4.5	4.9	5.2
7	TOTAL AVERAGE WORKING CAPITAL	-	-	-	15.5	16.1	17.0	17.6	18.2	18.9	19.6
	DEDUCT:										
8	AVERAGE ACCUMULATED DEFERRED TAXES	-	-	-	81.9	251.6	374.5	439.2	494.0	540.5	578.9
9	RATE BASE	-	-	-	2847.2	2646.9	2454.9	2266.2	2087.4	1917.0	1754.7
10	RATE OF RETURN	-	-	-	11.8%	12.0%	12.2%	12.4%	12.4%	12.3%	12.3%
11	RETURN ON RATE BASE	-	-	-	335.8	318.0	299.5	281.0	258.3	235.8	215.3

ALCAN PIPELINE COMPANY  
 PRO FORMA RETURN ON RATE BASE  
 FOR THE CALENDAR YEARS 1978 - 1987  
 (DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
---	-----	-----
	(A)	(L)
	RATE BASE	
	-----	
1	AVERAGE PLANT IN SERVICE	
	LESS: AVERAGE	
2	ACCUMULATED DEPRECIATION	
3	AVERAGE NET PLANT	
	AVERAGE WORKING CAPITAL	
4	CASH WORKING CAPITAL 12.5% OF ANNUAL O & M AND A & G EXPENSES	
5	MATERIALS & SUPPLIES	
6	PREPAYMENTS	
7	TOTAL AVERAGE WORKING CAPITAL	
	DEDUCT:	
8	AVERAGE ACCUMULATED DEFERRED TAXES	
9	RATE BASE	
10	RATE OF RETURN	EXHIBIT P PART II C2 LINE 12
	-----	
11	RETURN ON RATE BASE	
	-----	

ALCAN PIPELINE COMPANY  
PRO FORMA RATE OF RETURN  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
	AVERAGE CAPITALIZATION										
1	AVERAGE OUTSTANDING DEBT, LESS AVERAGE UNAMORTIZED DEBT EXPENSE	267.0	1005.3	1777.7	1943.1	1671.4	1399.7	1221.8	1137.6	1053.4	969.2
2	AVERAGE EQUITY, INCLUDING RETAINED EARNINGS	150.5	436.5	733.0	941.2	1002.1	1054.8	1044.2	949.6	863.3	785.2
3	TOTAL AVERAGE CAPITALIZATION	417.5	1441.8	2510.7	2884.3	2673.5	2454.5	2266.0	2087.2	1916.7	1754.4
	CAPITALIZATION PERCENTAGE										
4	DEBT PERCENTAGE	64.0%	69.7%	70.8%	67.4%	62.5%	57.0%	53.9%	54.5%	55.0%	55.2%
5	EQUITY PERCENTAGE	36.0%	30.3%	29.2%	32.6%	37.5%	43.0%	46.1%	45.5%	45.0%	44.8%
6	TOTAL	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	RATE OF RETURN										
7	TOTAL INTEREST CHARGES	-	-	-	200.2	170.8	143.4	124.1	115.6	107.1	98.6
8	WEIGHTED COST OF DEBT	-	-	-	10.3%	10.2%	10.2%	10.2%	10.2%	10.2%	10.2%
9	RATE OF RETURN ON COMMON EQUITY	-	-	-	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%	15.0%
	RATE OF RETURN COMPONENTS										
10	DEBT COMPONENT	-	-	-	6.9%	6.4%	5.8%	5.5%	5.6%	5.6%	5.6%
11	EQUITY COMPONENT	-	-	-	4.9%	5.6%	6.4%	6.9%	6.8%	6.7%	6.7%
12	RATE OF RETURN	-	-	-	11.8%	12.0%	12.2%	12.4%	12.4%	12.3%	12.3%

ALCAN PIPELINE COMPANY  
 PRO FORMA RATE OF RETURN  
 FOR THE CALENDAR YEARS 1978 - 1987  
 (DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
-----	-----	-----
	(A)	(L)
	AVERAGE CAPITALIZATION	
	-----	
1	AVERAGE OUTSTANDING DEBT, LESS AVERAGE UNAMORTIZED DEBT EXPENSE	
2	AVERAGE EQUITY, INCLUDING RETAINED EARNINGS	
3	TOTAL AVERAGE CAPITALIZATION	
	CAPITALIZATION PERCENTAGE	
4	DEBT PERCENTAGE	
5	EQUITY PERCENTAGE	
6	TOTAL	
	RATE OF RETURN	
	-----	
7	TOTAL INTEREST CHARGES	EXHIBIT L PART IX B LINE 16
8	WEIGHTED COST OF DEBT	LINE 7 / LINE 1
9	RATE OF RETURN ON COMMON EQUITY	
	RATE OF RETURN COMPONENTS	
10	DEBT COMPONENT	LINE 4 X LINE 8
11	EQUITY COMPONENT	LINE 5 X LINE 9
12	RATE OF RETURN	LINE 10 + LINE 11

PRO FORMA COMPUTATION OF DEPRECIATION  
AND AMORTIZATION FOR THE CALENDAR  
YEARS 1981-1987

The depreciation and amortization rates to be established are described in Exhibit O. However, in the financial statements included in Exhibits L, N and P, a composite annual depreciation rate of 4% is used because substantially all of Alcan's pipeline facilities are transmission facilities. The resulting annual depreciation and amortization expense is set forth on Line 3 of Exhibit P, Part ii a and b.

ALCAN PIPELINE COMPANY  
FEDERAL AND STATE INCOME TAXES  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
		(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
1	RETURN ON RATE BASE	-	-	-	335.8	318.0	299.5	281.0	258.3	235.8	215.2
2	LESS: INTEPEST CHARGES	-	-	-	197.3	169.2	143.4	124.1	115.6	107.1	98.6
3	EQUITY PORTION OF RETURN	-	-	-	138.5	148.8	156.1	156.9	142.7	128.7	116.7
4	BOOK DEPRECIATION OF EQUITY RETURN CAPITALIZED DURING CONSTRUCTION	-	-	-	7.4	7.5	7.5	7.5	7.5	7.5	7.5
5	EQUITY RETURN AFTER TAXES	-	-	-	145.9	156.3	163.6	164.4	150.2	136.2	124.2
6	FEDERAL INCOME TAX EXPENSE	-	-	-	134.7	144.3	151.0	151.8	138.6	125.7	114.6
7	INCOME AFTER STATE INCOME TAX EXPENSE	-	-	-	280.6	300.6	314.6	316.2	288.8	261.9	238.9
8	STATE INCOME TAX EXPENSE	-	-	-	29.1	31.2	32.6	32.8	30.0	27.2	24.6
9	TAX TIMING ADJUSTMENTS										
10	INTEREST CAPITALIZED	(39.7)	(111.6)	(186.5)	(2.9)	(1.6)	-	-	-	-	-
11	TAX DEPRECIATION	-	-	-	(276.7)	(254.9)	(244.5)	(228.5)	(213.0)	(197.4)	(181.9)
12	BOOK DEPRECIATION LESS: DEPREC OF EQUITY RETURN	-	-	-	111.6	115.1	117.1	117.1	117.1	117.1	117.1
13	TAX LOSS CARRY-OVER	39.7	111.6	186.5	(141.7)	(190.4)	(5.7)	-	-	-	-
14	TOTAL ADJUSTMENTS	-	-	-	(309.7)	(331.8)	(133.1)	(111.4)	(95.0)	(80.3)	(64.8)
15	DEFERRED INCOME TAXES										
16	FEDERAL	-	-	-	134.7	144.3	57.9	48.4	41.7	34.9	28.2
17	STATE	-	-	-	29.1	31.2	12.5	10.5	9.0	7.5	6.1
18	DEFERRED INCOME TAXES	-	-	-	163.8	175.5	70.4	58.9	50.7	42.4	34.3

ALCAN PIPELINE COMPANY  
FEDERAL AND STATE INCOME TAXES  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
	(A)	(L)
1	RETURN ON RATE BASE	EXHIBIT P PART II C1 LINE 11
2	LESS: INTEREST CHARGES	EXHIBIT L PART IX B LINE 16 LESS LINE 9 BELOW
3	EQUITY PORTION OF RETURN	
4	BOOK DEPRECIATION OF EQUITY RETURN CAPITALIZED DURING CONSTRUCTION	
5	EQUITY RETURN AFTER TAXES	
6	FEDERAL INCOME TAX EXPENSE	92.308% OF LINE 5
7	INCOME AFTER STATE INCOME TAX EXPENSE	
8	STATE INCOME TAX EXPENSE	10.375% OF LINE 7
9	TAX TIMING ADJUSTMENTS	
10	INTEREST CAPITALIZED TAX DEPRECIATION BOOK DEPRECIATION LESS:	
11	DEPREC OF EQUITY RETURN	EXHIBIT L PART VI LINE 2 LESS LINE 4 ABOVE
12	TAX LOSS CARRY-OVER	
13	TOTAL ADJUSTMENTS	
14	DEFERRED INCOME TAXES	
15	FEDERAL	43.5% OF LINE 13
15	STATE	9.4% OF LINE 13
16	DEFERRED INCOME TAXES	

ALCAN PIPELINE COMPANY  
FEDERAL AND STATE INCOME TAXES  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	PERIOD OF INITIAL CONSTRUCTION			PERIOD OF CAPACITY BUILDUP		INITIAL YEARS OF FULL OPERATION				
		1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
		(F)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)
TAX SUMMARY											
17	CURRENT TAX - FEDERAL	-	-	-	-	-	93.1	103.4	96.9	90.8	86.4
18	- STATE	-	-	-	-	-	20.1	22.3	21.0	19.7	18.7
19	DEFERRED TAX - FEDERAL	-	-	-	134.7	144.3	57.9	48.4	41.7	34.0	28.2
20	- STATE	-	-	-	29.1	31.2	12.5	10.5	9.0	7.5	6.1
21	TOTAL TAX EXPENSE	-	-	-	163.8	175.5	183.6	184.6	168.6	152.9	139.4
OPERATING LOSS CARRY-OVER											
22	BEGINNING BALANCE	-	39.7	151.3	337.8	196.1	5.7	-	-	-	-
23	LESS: OPERATING LOSS CARRY-OVER UTILIZED	39.7	111.6	186.5	(141.7)	(190.4)	(5.7)	-	-	-	-
24	ENDING BALANCE	39.7	151.3	337.8	196.1	5.7	-	-	-	-	-
INVESTMENT TAX CREDIT											
25	BEGINNING BALANCE	-	-	-	-	168.4	174.2	131.1	79.4	31.0	-
26	ADDITIONS	-	-	-	168.4	5.8	3.4	-	-	-	-
27	LESS: INVESTMENT TAX CREDIT UTILIZED	-	-	-	-	-	(46.5)	(51.7)	(48.4)	(31.0)	-
28	ENDING BALANCE	-	-	-	168.4	174.2	131.1	79.4	31.0	-	-



ALCAN PIPELINE COMPANY  
FEDERAL AND STATE INCOME TAXES  
FOR THE CALENDAR YEARS 1978 - 1987  
(DOLLARS IN MILLIONS)

LINE NO.	DESCRIPTION	REFERENCE OR FORECAST BASIS
	(A)	(L)
	TAX SUMMARY	
17	CURRENT TAX - FEDERAL	LINE 6 LESS LINE 14
18	- STATE	LINE 8 LESS LINE 15
19	DEFERRED TAX - FEDERAL	
20	- STATE	
21	TOTAL TAX EXPENSE	
	OPERATING LOSS CARRY-OVER	
22	BEGINNING BALANCE	
23	LESS: OPERATING LOSS CARRY-OVER UTILIZED	EXHIBIT L PART IX B LINE 16
24	ENDING BALANCE	
	INVESTMENT TAX CREDIT	
25	BEGINNING BALANCE	
26	ADDITIONS	7% OF QUALIFYING CAPITAL EXPENDITURES
27	LESS: INVESTMENT TAX CREDIT UTILIZED	50% OF LINE 17
28	ENDING BALANCE	

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT Z-7

Definitive Agreement Between Alcan  
Pipeline Company, Foothills Pipe  
Lines Ltd., Westcoast Transmission  
Company Limited, The Alberta Gas  
Trunk Line (Canada) Limited,  
The Alberta Gas Trunk Line Company  
Limited, and Northwest Pipeline  
Corporation

DEFINITIVE AGREEMENT

MEMORANDUM OF AGREEMENT made and entered into as of this 5th day of July, 1976, by and between:

FOOTHILLS PIPE LINES LTD., a body corporate  
with an office in Calgary, Alberta, Canada

OF THE FIRST PART

- and -

THE ALBERTA GAS TRUNK LINE COMPANY LIMITED,  
and THE ALBERTA GAS TRUNK LINE (CANADA)  
LIMITED, bodies corporate with their head  
offices in Calgary, Alberta, Canada

OF THE SECOND PART

- and -

WESTCOAST TRANSMISSION COMPANY LIMITED,  
a body corporate with its head office  
in Vancouver, British Columbia, Canada

OF THE THIRD PART

- and -

NORTHWEST PIPELINE CORPORATION and ALCAN  
PIPELINE COMPANY, bodies corporate with  
their head offices in Salt Lake City,  
Utah, United States of America

OF THE FOURTH PART

WHEREAS the parties have heretofore agreed to participate in  
the Project upon the terms and conditions hereafter set out;

AND WHEREAS the parties deem it expedient that their agreements  
relative to the Project be reduced to writing;

NOW THEREFORE THIS AGREEMENT WITNESSETH the parties hereto in

consideration of the covenants herein expressed have agreed together as follows:

## ARTICLE I

### DEFINITIONS AND APPENDICES

#### 1.1 Definitions

In this agreement, in context, the plural means the singular and vice versa, the pronoun "it" refers to one of the parties and the following words and phrases have the meanings ascribed:

"Alaska Gas" means natural gas produced in the State of Alaska including, inter alia, natural gas produced in the Prudhoe Bay area of that State.

"Alcan" means Alcan Pipeline Company.

"Alcan Pipeline" means a Pipeline for the transmission of Alaska Gas to a point of interconnection with the Yukon Pipeline at a point on the Alaska/Yukon border at or near Scottie Creek.

"Alberta Gas Trunk" means The Alberta Gas Trunk Line Company Limited and/or The Alberta Gas Trunk Line (Canada) Limited, as the case may be.

"Alberta Pipeline" means a Pipeline and such loop lines as required for the transmission of Alaska Gas through Alberta from a point of connection with the B.C. Pipeline at a point on the British Columbia/Alberta border at or near NTS 94-1-9 Block H in British Columbia to delivery points at or near Empress, Alberta and Coleman, Alberta.

"B.C. Pipeline" means a Pipeline and such loop lines as required for the transmission of Alaska Gas through British Columbia from a point of connection with the Yukon Pipeline at a point on the Yukon/British Columbia border near Watson Lake in the Yukon Territory to a delivery point on the international boundary between Canada and the United States at or near Sumas, Washington, and a Pipeline for the transmission of Alaska Gas to a point of connection with the Alberta Pipeline at a point on the British Columbia/Alberta border at or near NTS 94-1-9 Block H in British Columbia.

"Day" means a period of twenty-four consecutive hours beginning at 8:00 A.M. local time.

"F.P.C." means the Federal Power Commission or any successor thereto.

"Foothills" means Foothills Pipe Lines Ltd. or a subsidiary or an affiliated company.

"Heating Value" means the number of B.T.U. produced by the combustion in a recording calorimeter at constant pressure of the amount of gas which would occupy a volume of one (1) cubic foot at a temperature of sixty degrees Fahrenheit (60°F.) if saturated with water vapour, and under a pressure equal to that of thirty (30) inches of mercury at thirty-two degrees Fahrenheit (32°F.) and under standard gravitational force (acceleration nine hundred and eighty and six hundred and sixty-five thousandths (980.665) cm. per second per second) with air of the same temperature and pressure as the gas, when the products of combustion are cooled to the initial temperature of the gas and air, and when the water formed by combustion is condensed to the liquid state.

"Maple Leaf Project" means a joint Pipeline project of Foothills, Alberta Gas Trunk and Westcoast to construct a Pipeline under Canadian ownership to transport Canadian gas to Canadian consumers.

"Month" means a calendar month beginning on the first day thereof.

"N.E.B." means the National Energy Board or any successor thereto.

"Northwest" means Northwest Pipeline Corporation.

"Operating Representatives" means individuals with duties as set out in Section 6.6 herein.

"Pipeline" means a pipeline as defined in the National Energy Board Act and such other works and facilities as may be necessary for or incidental to the Project.

"Project" means the design, financing, construction and installation of the Project Pipeline and any and all studies, filings and applications related thereto.

"Project Pipeline" means and includes the Alcan Pipeline, the Yukon Pipeline, the B.C. Pipeline, the Alberta Pipeline and the Saskatchewan Pipeline.

"Saskatchewan Pipeline" means the pipeline facilities utilized from the connection with the Alberta Pipeline at or near Empress, Alberta to delivery points on the U.S. Canadian border at or near Monchy, Saskatchewan.

"Segment" means one or other of the Alcan Pipeline, the Yukon Pipeline, the B.C. Pipeline, the Alberta Pipeline and the Saskatchewan Pipeline.

"Service Agreement" means the contract for the transportation of gas between Shipper and the owner of a Segment pursuant to a transportation tariff.



"Shipper" means those parties owning or having rights to Alaska Gas who transport such gas through the Project Pipeline.

"Westcoast" means Westcoast Transmission Company Limited.

"Yukon Pipeline" means a Pipeline for the transmission of Alaska Gas from a point of connection with the Alcan Pipeline at a point on the Alaska/Yukon border at or near Scottie Creek to a point of connection with the B.C. Pipeline at a point on the Yukon/British Columbia border near Watson Lake in the Yukon Territory.

## 1.2 Appendices

The following appendices annexed to this agreement form a part hereof and are incorporated herein to all intents and purposes as though the same had been written out in full herein:

- (a) Pro forma tariffs and Service Agreements (Appendix "A").
- (b) Map showing the proposed routing of the Project Pipeline (Appendix "B").
- (c) The proposed schedule of construction for the Alcan Pipeline (Appendix "C").

ARTICLE II

GENERAL

2.1 Representation

Northwest supports the Maple Leaf Project and subject to the acknowledgment and agreement that the first priority of Foothills, Alberta Gas Trunk and Westcoast is to obtain the necessary approvals and financing for the Maple Leaf Project:

- (a) Each party represents to the other that it has the right, power and authority to enter into this agreement.
- (b) Each party represents to the other that it will diligently seek to obtain all necessary approvals, authorizations and financing as are required to implement the Project subject to qualifications set out in Section 3.6(b).
- (c) Each party represents to the other that it will promptly undertake, as appropriate, to arrange with such other parties as may be necessary to implement the Project in a timely manner.

2.2 Letter of Intent

This agreement is entered into pursuant to the letter of intent dated the 5th day of May, 1976 executed by Northwest,

Foothills, Alberta Gas Trunk and Westcoast and in the event of any conflict between provisions of this agreement and the said letter of intent or any other agreement or understanding between the parties, other than the cost sharing agreement between Alberta Gas Trunk and Westcoast, the provisions of this agreement shall prevail.

2.3 Term

This agreement shall come into force and be effective on the day and date first above written and shall thereafter continue in full force and effect until terminated pursuant to Section 5.7.

ARTICLE III

THE PROJECT

3.1 General Description

- (a) The Project provides for the construction, installation, operation and maintenance of a large diameter natural gas pipeline (the "Project Pipeline") designed for the transmission of Alaska Gas up to an approximate average of 2.4 billion cubic feet per Day at a 93.5% load factor from the Prudhoe Bay area of the State of Alaska to the 49th parallel for markets in the lower forty-eight States of the United States of America.
- (b) The Project Pipeline will be built and operated in five Segments, as follows: The Alcan Pipeline by Northwest and/or Alcan, the Yukon Pipeline by Foothills, the B.C. Pipeline by Westcoast, the Alberta Pipeline by Alberta Gas Trunk and the Saskatchewan Pipeline by Foothills.
- (c) It is presently contemplated that approximately one-third (1/3) of the volumes of Alaska Gas transported will be delivered at the existing delivery point near Sumas, Washington, and the balance of such gas will be transported to Coleman, Alberta and Monchy, Saskatchewan, or such other delivery points as may be mutually agreed upon.

3.2 Ownership of Alaska Gas

(a) None of the owners or operators of the Segments of the Project Pipeline in Canada shall:

(i) have or take legal title to Alaska Gas while it is in their respective Segments of the Project, save that used or consumed as fuel or deemed lost;

(ii) be liable or subjected to demand for payment with respect to such use or loss;

and subject as aforesaid each such party shall have possession thereof and the rights and obligations including any liability imposed by law for injuries or damages while in such possession.

(b) None of the owners or operators of the Segments of the Project Pipeline in Canada shall voluntarily accede to the request of any person, firm, corporation or body politic to transport and/or deliver any Alaska Gas from its particular Segment of the Project Pipeline other than as provided herein, except as specifically directed in writing by the owner(s) of such Alaska Gas and/or as approved by the F.P.C. or the N.E.B., as the case may be, and it is acknowledged that all Alaska Gas transported through the Canadian Segments of the Project will be subject to the regulation of the N.E.B.

- (c) All deliveries of Alaska Gas at the Alaska/Yukon border at the discharge of each of the Segments in Canada and again at the United States/Canadian boundary at the various delivery points on the 49th parallel shall be measured for Heating Value. In each instance the Heating Value equivalent to the Alaska Gas received during such Day, less actual calculated fuel use and losses, shall be redelivered. Balancing of the Heating Value of the volumes of Alaska Gas shall occur not less frequently than Monthly.
  
- (d) While all of the owners of the Segments of the Project Pipeline in Canada have committed not to take legal title to Alaska Gas while it is in their Segments of the Project, save that used as fuel or deemed lost, it is planned that a Canadian Gas Distribution Company will arrange with one of the Shippers of Alaska Gas to exchange some portion of that Shipper's gas for service to Yukon and British Columbia communities and industry and return to that Shipper at a mutually agreeable point in the Province of Alberta a volume of gas of an equivalent Heating Value for delivery by southern Segments of the Project Pipeline to the 49th parallel for that Shipper's market in the lower forty-eight States of the United States of America.

3.3 General Undertaking

- (a) Each party will design, construct, install, operate and maintain that particular Segment of the Project allotted to it in a good and workmanlike manner and in timely fashion to the end that its Segment will be completed and put into operation concurrently with the other Segments.
- (b) The owners of the Canadian Segments of the Project agree that as of the date hereof the proposed schedule of construction for the Alcan Pipeline as set out in Appendix "C" is compatible with the construction schedule for the Canadian Segments.

3.4 Specific Undertaking

Each party in connection with its Segment of the Project will, subject to Section 3.6:

- (a) Prepare, file and prosecute diligently all applications necessary to obtain all authorizations to enable it to construct, install, operate and maintain its particular Segment in connection with the transmission of Alaska Gas and no application pursuant to this agreement nor any future application pursuant to this agreement or otherwise, except F.P.C. Docket No. CP76-174, including that of Northwest and/or Alcan, will contain any component which would interfere with the expeditious achievement of the Maple Leaf Project and/or the Project Pipeline.

- (b) Do, perform and carry out all such acts, matters and things as may be necessary for or incidental to the design, financing, construction, installation, operation and maintenance thereof, and in this connection, but not by way of limitation, each party will accept delivery of and will transmit that portion of the Alaska Gas delivered to it by one or other of the parties through its Segment and deliver the same to the delivery point applicable to its particular Segment, minus such part thereof as is used and consumed for fuel or other Pipeline purposes or unavoidably lost through shrinkage or other causes.
- (c) Each party will design and construct its particular Segment so that the incremental build up to the total volume of Alaska Gas to be ultimately transmitted through the Project Pipeline, that is up to an approximate average of 2.4 billion cubic feet per Day at a 93.5% load factor, will take place over such period as may be required to ensure that the demand in Canada for engineering services, construction crews, equipment, materials and supplies necessary for or incidental to the construction and installation of the Canadian Segments can be met with a reasonable degree of certainty from Canadian sources. Except as expressly agreed by all parties hereto, no Segment will be so designed as to require the use of untried construction techniques, equipment, material



or supplies or will require pipe of a diameter in excess of 42".

3.5 Financing

Each party shall arrange for financing in connection with its particular Segment and no party as a result of this agreement shall be under any obligation, either express or implied, to assist another party in raising the necessary monies.

3.6 Applications to Regulatory Agencies

- (a) Northwest and/or Alcan will, in a timely manner, make application as necessary to the proper authorities of the United States of America and to its apposite regulatory agencies, particularly the F.P.C., for permission to construct, install, operate and maintain the Alcan Pipeline in conjunction with the other Segments, filing the requisite data in that connection. Notwithstanding the foregoing, Northwest and/or Alcan shall not be required by the terms hereof to make any filing with the U.S. Department of Interior or any subdivision or agency subject to its control or successor thereto or with the State of Alaska and its apposite agencies until deemed appropriate by Northwest and/or Alcan, but shall do so in not less than thirty (30) Days after obtaining and accepting the requisite authorizations from the F.P.C.
- (b) Upon receipt by Alberta Gas Trunk, Foothills and Westcoast of information, which is in their opinion

adequate, that the F.P.C. will hear and rule upon Northwest's application concurrent with its hearing and ruling on the applications of Alaskan Arctic Gas Pipeline Company and El Paso Alaska Company presently being heard by that body in F.P.C. Docket Nos. CP75-96, et al, then Alberta Gas Trunk, Foothills and Westcoast will each, as soon thereafter as practicable, from time to time file and prosecute such applications to the authorities of Canada, particularly the N.E.B., and its provinces and territories and to their apposite regulatory agencies for such permits, licences and other authorizations as may be necessary or requisite to enable each to proceed with the phased construction of its respective Segments of the Project. Subject to the foregoing, it is presently contemplated that appropriate filings with the N.E.B. will be in August or September, 1976.

### 3.7 Approvals

Upon receipt by any party of any of the approvals required in Section 3.6 in a form satisfactory to such party, it shall promptly notify the other parties hereto.

### 3.8 Filings After Initial Approvals

After receipt of all the approvals required in Section 3.6, in the event that thereafter any party makes any filing with any governmental entity in connection with the Project or otherwise related directly thereto, such party shall contemporaneously with such filing serve a copy thereof on all parties hereto.

ARTICLE IV

TARIFF OBLIGATIONS

4.1 Contract Carrier

Northwest and/or Alcan acknowledges and agrees that the transportation charges for the Canadian Segments will be on a contract carrier cost of service tariff.

4.2 Tariff Charges

Notwithstanding any provisions of this agreement to the contrary, all billings for tariff charges applicable to the transportation of Alaska Gas in the Segments in Canada shall be rendered by the owner of each Segment. Such billings and payments shall be rendered and paid as provided in the respective pro forma tariffs and Service Agreements attached hereto as Appendix "A".

4.3 Contracts for Shipment

To promote a degree of uniformity among the various transmission contracts, Northwest will, in a timely manner, make every effort to enter into negotiations with those persons having the right to transmit Alaska Gas to market in the lower forty-eight States of the United States of America and to promote contractual relationships between the parties and such persons so as to provide for the transmission, upon terms acceptable to the parties, of up to an approximate average of 2.4 billion cubic feet per Day at a 93.5% load factor of Alaska Gas through the facilities of the Project Pipeline.

4.4 Transportation Charges

- (a) The cost of service and rate base calculations will be on the basis of full incremental costs of service for all new facilities required to transport Alaska Gas only, plus full incremental costs of service for all additions to existing facilities required to transport Alaska Gas, plus allocated costs of service for existing facilities or additions thereto to be utilized to carry both Alaska Gas and Canadian gas. Existing surplus capacity will be available for the transmission of Alaska Gas until such time as that capacity is required for the transmission of Canadian gas. When Canadian gas needs this capacity, other capacity will be provided on a timely basis by the owner of the apposite Canadian Segment or its designee for the transportation of Alaska Gas, as required.
- (b) The cost of service will commence when the Canadian Segments are completed and ready to accept delivery of Alaska Gas and will continue whether any gas is being transported through them or not and for a term sufficient to amortize the cost of the Canadian Segments.
- (c) The cost of service will not include a charge for fuel which will be deemed to be Alaska Gas. In effect, Canadian gas will not be used to transport Alaska Gas.

The amount delivered at the discharge of each of the Canadian Segments will be the Heating Value equivalent to the amount received at the inlet of each, less the actual amount of compressor fuel and other typical pipeline uses and losses in the Segment for transporting the Alaska Gas.

#### 4.5 Rate of Return

The parties recognize that U.S. shippers of U.S. gas across Canada will be expected to pay a rate for this service which will produce a return on common equity comparable to the highest return on common equity authorized to be earned by any of the three major natural gas pipelines in Canada under substantially similar circumstances, and if any of these three pipeline companies are authorized to earn a rate of return which produces more than 16% after taxes on common equity on pipeline operations other than the subject Project, the Canadian companies will be entitled to apply for such higher return.

It is agreed that the cost of service will initially provide, for all newly constructed facilities, a rate of return on rate base sufficient to cover the embedded cost of debt and of other securities plus 16% on common equity after income taxes, and for jointly used facilities, at the owner of each Segments option, either the same rate of return as on new facilities or the return on rate base then in effect on such jointly used facilities.

4.6 Exchange Protection

Tariff payments for transportation through Canadian Segments will be made in Canadian funds, but if the owner of a Canadian Segment shall require for its part of the Project, financing in whole or in part by way of the sale of securities requiring repayment of principal and/or payment of interest in United States dollars, then Shipper will in its payment for the transportation of its portion of Alaska Gas through such Segment substitute for the same number of Canadian dollars, and the owner of such Segment will accept in substitution the number of United States dollars required in the manner as set out in the tariff for the owner of such Canadian Segment.

4.7 Normalization of Taxes

The treatment of normalization of taxes by each party is included in the pro forma tariffs and Service Agreements attached hereto as Appendix "A".

ARTICLE V

LIABILITIES

5.1 Laws to Apply

This agreement and the rights and obligations of the parties are subject to all present and future laws, rules, regulations and orders of any government or governmental authority or court now or hereafter having jurisdiction.

5.2 Force Majeure

No party shall be liable to any other under this agreement for a default or failure in the performance by it of any obligation in whole or in part when such default or failure results from causes, other than financial difficulties, beyond its reasonable control, PROVIDED that a defaulting party takes all reasonable steps, save the settlement of a labour dispute, to remedy the cause of such default; AND FURTHER PROVIDED that where the cause of the default or failure results from the negligence or the contributing negligence of a party the cause of the default or failure shall not be deemed to be beyond its reasonable control. The provisions of this clause shall not apply to the Pro Forma Tariffs and Service Agreements referred to in Section 1.2(a) hereof.

5.3 Effect on Title

Nothing in this agreement shall operate to or be so construed as a transfer by any party of a legal or equitable estate in such party's Segment of the Project Pipeline to any other party or group of parties.

5.4 Partnership Denied

- (a) The relationship of the parties the one to the other created by this agreement is not that of a partnership, which is specifically denied, but is more in the nature of a syndicate or consortium formed for the purpose of carrying out the Project through the coordination of the efforts of the individual members of the group as herein provided for. The liability of each party therefor to third parties is neither joint nor joint and several but individual, and each party shall be liable to third parties whether in tort or in contract only for damages resulting from its acts of commission or omission, save where there is contributory negligence of another party.
- (b) Notwithstanding any other provision hereof, no party hereto shall be, nor considered to be, the agent, servant or employee of any other party.

5.5 Delegation

The parties may individually or jointly delegate to one of them or to a third party the right to operate the Project Pipeline as an independent contractor on behalf of all of them and any party may appoint a third party to operate its Segment of the Project Pipeline for it, but no such delegation or appointment shall relieve a party of its obligations and liabilities under



this agreement, but no party is required to delegate its right to operate without its consent.

#### 5.6 Default

- (a) Should a party commit an act of default in the performance of its obligation under this agreement to construct, install, operate and maintain its particular Segment of the Project Pipeline, or should it make an assignment in bankruptcy, the other parties may, but shall not be obligated to, subrogate the defaulting party and at the risk, cost and expense of the defaulting party rectify the default or advance the necessary monies so to do and any such cost, expense or advance shall be and become a debt due and owing by the defaulting party to those parties which rectified the default.
- (b) A waiver by any party of one or more defaults by a party hereto shall not operate as a waiver of any future default or defaults, whether of a like or different character.

#### 5.7 Termination Provisions

- (a) This agreement may be terminated upon written notice:
  - (i) If all the parties hereto so agree or if it is reasonably apparent that the arrangement contem-

plated hereunder has no reasonable chance of obtaining the necessary approvals in the United States and/or Canada; or

(ii) If all the applications referred to in Section 3.6 have not been granted and accepted by the parties pursuant to Section 3.7 on or before January 1, 1978.

(b) Upon termination, this agreement shall cease to have any force or effect, save as to unsatisfied obligations or liabilities of any party hereto arising hereunder prior to 12:00 Midnight on the date of such termination or arising thereafter as a result of such termination, and such obligation or liability shall continue and survive the termination of this agreement.

#### 5.8 Indemnification

(a) There shall be reasonable and proper indemnification to each of the parties by the others for any loss or damage caused by a breach of any obligation hereunder save where there is reasonable cause.

(b) In the event that any party shall fail to diligently proceed with preparing, filing and prosecuting any of the applications to be made in the United States

and/or Canada required hereunder, in addition to all other remedies at law, any party may seek to recover for all loss or damage occurring as a result of any such failure to proceed with due diligence. Any adverse governmental decision in the United States and/or Canada shall not provide a basis for seeking damages.

ARTICLE VI

MISCELLANEOUS

6.1 Assignment

No party may assign its interest in this agreement in whole or in part, except (i) by a party to its parent, affiliate or subsidiary, or (ii) by a party as a collateral assignment to secure indebtedness or to obtain financing, without the consent of each of the other parties hereto which consent, however, shall not be unreasonably withheld.

6.2 Headings

The headings used herein are for convenience only and are not to be construed as interpreting this agreement.

6.3 Notices

Notices shall be served in writing upon each party herein at the following addresses:

Foothills Pipe Lines Ltd.  
1600 Bow Valley Square  
205 - 5th Avenue, S.W.  
Calgary, Alberta T2P 2W4

The Alberta Gas Trunk Line Company Limited  
The Alberta Gas Trunk Line (Canada) Limited  
205 - 5th Avenue, S.W.  
Box 2535  
Calgary, Alberta T2P 2N6

Westcoast Transmission Company Limited  
1333 West Georgia Street  
Vancouver, British Columbia V6E 3K9

Northwest Pipeline Corporation  
P. O. Box 1526  
Salt Lake City, Utah 84110

Alcan Pipeline Company  
P. O. Box 1529  
Salt Lake City, Utah 84110

Each party hereto may change its address by notice in writing to each of the other parties.

6.4 Enurement

This agreement shall enure to the benefit of and be binding upon the parties hereto, their successors and approved assigns. This agreement may be signed in counterpart and the four (4) counterparts so signed shall be and constitute one agreement as though all parties had signed the one instrument.

6.5 Amendment

This agreement shall only be amended by an instrument in writing executed by all parties hereto.

6.6 Operating Representatives

(a) The purpose of the Operating Representatives is to establish an orderly and continuing means of dealing with the design, engineering, installation, operating and accounting for the Project Pipeline during the term of this agreement.

- (b) As soon as practicable after the execution of this agreement, Northwest and/or Alcan shall designate one individual and Westcoast, Foothills and Alberta Gas Trunk shall each designate one individual. The designated individuals shall act as Operating Representatives. Alternates shall also be designated to act when the Operating Representative is unable to do so.
- (c) Although the Operating Representative shall not be entitled to amend this agreement, they shall coordinate and make joint recommendations regarding the matters set forth in (a) above. Such joint recommendations shall be submitted to the parties with such explanatory report as is deemed appropriate. Such recommendations shall become effective when approved in writing by all parties hereto. Such approved recommendations shall be deemed to be part of, and within the scope of, this agreement without being deemed an amendment. In addition to the general matters set forth in (a) above, the Operating Representatives may:
  - (i) recommend standard operating practices and procedures for the Project Pipeline, including measurement practices;
  - (ii) recommend accounting and reporting details to carry out the provisions hereof;

- (iii) exchange technical and environmental data and information related to the Project Pipeline;
- (iv) recommend such other studies or actions, including alternatives not previously considered, appropriate to ensure proper implementation of the Project in a timely manner;

but such recommendations shall not be binding until agreed to in writing by the parties hereto.

#### 6.7 Arbitration

- (a) Except where the N.E.B. has exclusive jurisdiction under law, in the event the parties are unable to agree on any of the matters of fact or law related to this agreement, any party may upon written notice call for submission of such matter to binding arbitration. The party requesting arbitration shall set forth in such notice in adequate detail the issues to be arbitrated, and within ten (10) Days from the receipt of such notice, the other party may set forth in adequate detail additional related issues to be arbitrated. Such arbitration shall be conducted in accordance with such rules as the parties may mutually agree to or failing such agreement in accordance with the Rules of Conciliation and Arbitration of

the International Chamber of Commerce by three arbitrators appointed under said Rules and shall be decided according to English Common Law. Arbitration proceedings shall take place in Zurich or in such other place as the parties may agree and shall be carried out in English.

- (b) The party or parties calling for any such submission shall submit to the panel or arbitrators the issues to be decided and their position thereon. The other parties shall also be entitled to submit their positions thereon. The arbitrators may request additional or such other evidence, including oral argument, as they deem necessary. Upon determination of any such dispute, the arbitrators shall assess the cost attributable to such arbitration to the party or parties whose position is farthest away from the actual decision rendered. In the case of a monetary dispute, the arbitrators shall be entitled to assess interest. The arbitrators shall be empowered to divide the costs related to such arbitration equally if they deem it appropriate.
- (c) Subject to (d) below, it is the intent of the parties that all disputes which cannot be mutually resolved shall be decided pursuant to arbitration; any party seeking to set any arbitration decision aside or to seek a remedy, either legal or equitable, in any other forum shall be deemed to have breached this contract and subject to all costs, damages, including consequential, and attorneys fees related to the enforcement and satisfaction hereof.
- (d) Notwithstanding the other provisions of this Section 6.7, the parties shall pay within the period of time set forth in any

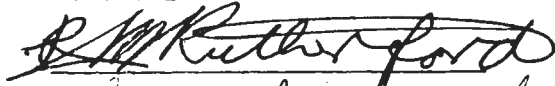
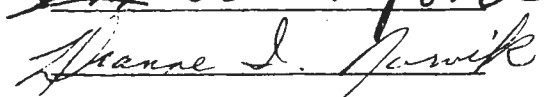


executed Service Agreement all amounts billed thereunder without any resort to the arbitration provisions herein. The parties shall be entitled to seek any remedy at law or equity in any forum having jurisdiction to enforce collection of such amounts and no such party will in any collection proceedings in such forum raise as a defence to such collections the provisions for arbitration herein provided. Payment of such amounts shall not be deemed to be a waiver of the right to arbitrate the appropriateness of any such billing.


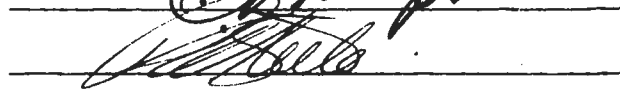
- (e) An arbitration provision substantially similar to this Section 6.7 shall be included in all tariffs and Service Agreements executed with Shippers of Alaska Gas.

IN WITNESS WHEREOF the parties hereto have caused these presents to be executed in six (6) duplicate originals as of the day and year first above written.

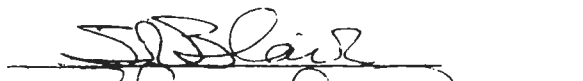
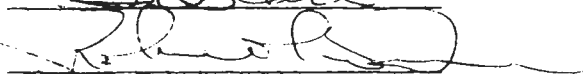
FOOTHILLS PIPE LINES LTD.

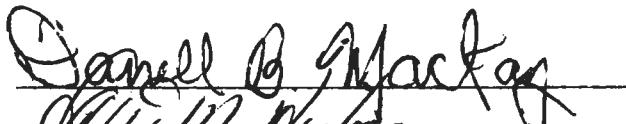

WESTCOAST TRANSMISSION COMPANY LIMITED


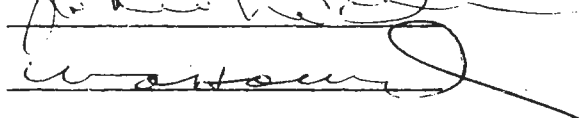
THE ALBERTA GAS TRUNK LINE  
COMPANY LIMITED


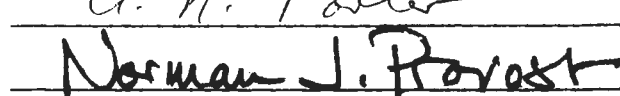
NORTHWEST PIPELINE CORPORATION

THE ALBERTA GAS TRUNK LINE  
(CANADA) LIMITED

ALCAN PIPELINE COMPANY

APPENDIX "A"

WESTCOAST TRANSMISSION COMPANY LIMITED  
Transportation Tariff No. 1

WESTCOAST TRANSMISSION COMPANY LIMITED  
TRANSPORTATION TARIFF NO. 1

This Tariff has been filed with the  
National Energy Board and is available  
for inspection at the head office of

Westcoast Transmission Company Limited  
1333 West Georgia Street  
Vancouver, B.C. V6E 3K9

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Effective :

Issued on :

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## Transportation Tariff No. 1

## RATE SCHEDULE MDQ-1 - FIRM SERVICE

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## RATE SCHEDULE MDQ-1 - FIRM SERVICE

## 1. AVAILABILITY

This Rate Schedule MDQ-1 is available to any Shipper under its Contract for Service where such prospective Shipper's pipeline or distribution system connects or can reasonably be made to connect with Company's Transmission System.

## 2. APPLICABILITY

This Rate Schedule MDQ-1 will apply to all transportation service performed by Company for Shipper under Shipper's Contract for Service, other than service specifically provided for in another Rate Schedule.

## 3. CONTRACT FOR SERVICE

This Rate Schedule MDQ-1 is subject to all of the terms, conditions, stipulations and provisions of the Contract for Service.

## 4. GENERAL TERMS AND CONDITIONS

This Rate Schedule MDQ-1 is subject to all of the terms, conditions, stipulations and provisions of the General Terms and Conditions.

## 5. EFFECTIVE DATE

This Rate Schedule MDQ-1 will be effective as and from the date fixed by the National Energy Board.

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## RATE SCHEDULE MDQ-1 - FIRM SERVICE

## 6. CHARACTER OF SERVICE

6.1 Firm Service

Gas transported by Company for Shipper under this Rate Schedule MDQ-1 shall not be subject to curtailment or interruption except as provided in the General Terms and Conditions.

6.2 Maximum Daily Quantity

Company will transport for Shipper and Shipper will take delivery from Company of a volume of Gas up to but not exceeding the currently effective Maximum Daily Quantity as specified in the Contract for Service. To assist Company in scheduling its daily operations, Shipper will advise Company currently of the daily quantity of Gas it desires to have transported but such quantity may not exceed the Maximum Daily Quantity.

6.3 Rate of Flow

The daily quantities of Gas to be received by Company at the Points of Receipt and delivered by Company at the Points of Delivery will be pursuant to dispatchers' schedules and be as nearly uniform as possible.

6.4 Multiple Delivery Points

If the Contract for Service specifies that Seller will deliver Gas to Shipper at more than one Point of Delivery the rates provided herein will be applied for billing purposes to the sum of the volumes registered by individual meters, as if the billing were for a single meter or Point of Delivery.

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## RATE SCHEDULE HDQ-1 - FIRM SERVICE

## 7. RATE

Company's Transmission System has four designated parts (Part A, Part B, Part C, and Part D) as indicated in the Contract for Service. Shipper will pay Company each Billing Month a Transportation Charge comprised of a Fixed Charge and a Variable Charge. These charges will be equal to the sum of Shipper's allocable share of Company's Cost of Service allocated to Alaska Gas on each of the four Parts of Company's Transmission System.

7.1 Shipper's Allocable ShareA. Fixed Charge

Shipper's allocable share of Company's fixed Transmission System Cost of Service charges allocated to Alaska Gas for any Billing Month will be a fraction obtained by taking the sum of the fractions calculated under (a), (b), (c) and (d) below:

- (a) A fraction the numerator of which will be the daily weighted average of Shipper's Maximum Daily Quantity in Part A and the denominator of which will be the weighted average Maximum Daily Quantity of all Shippers transporting Alaska Gas through Part A during such Billing Month.
- (b) A fraction the numerator of which will be the daily weighted average of Shipper's Maximum Daily Quantity in Part B and the denominator of which will be the weighted average Maximum Daily Quantity of all Shippers transporting Alaska Gas through Part B during such Billing Month.

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- (c) A fraction the numerator of which will be the daily weighted average of Shipper's Maximum Daily Quantity in Part C and the denominator of which will be the weighted average Maximum Daily Quantity of all Shippers transporting Alaska Gas through Part C during such Billing Month.
- (d) A fraction the numerator of which will be the daily weighted average of Shipper's Maximum Daily Quantity in Part D and the denominator of which will be the weighted average Maximum Daily Quantity of all Shippers transporting Alaska Gas through Part D during such Billing Month.

B. Variable Charge

Shipper's allocable share of Company's variable Transmission System Cost of Service charges allocated to Alaska Gas for any Billing Month will be a fraction obtained by taking the sum of the fractions calculated under (a), (b), (c) and (d) below:

- (a) A fraction the numerator of which will be the daily weighted average of Shipper's deliveries through Part A and the denominator of which will be the sum of the daily weighted average deliveries of all Shippers transporting Alaska Gas through Part A during such Billing Month.
- (b) A fraction the numerator of which will be the daily weighted average of Shipper's deliveries through Part B and the

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denominator of which will be the sum of the daily weighted average deliveries of all Shippers transporting Alaska Gas through Part B during such Billing Month.

(c) A fraction the numerator of which will be the daily weighted average of Shipper's deliveries through Part C and the denominator of which will be the sum of the daily weighted average deliveries of all Shippers transporting Alaska Gas through Part C during such Billing Month.

(d) A fraction the numerator of which will be the daily weighted average of Shipper's deliveries through Part D and the denominator of which will be the sum of the daily weighted average deliveries of all Shippers transporting Alaska Gas through Part D during such Billing Month.

## 8. MINIMUM MONTHLY BILL

The minimum monthly bill will be the Shipper's allocable share of the Alaska Cost of Service fixed charge component of the Transportation Charge as determined in accordance with Section 7 and Section 9 herein. Such minimum monthly bill will be subject to adjustment as provided in Section 10 herein.

## 9. ALASKA COST OF SERVICE

For purpose of calculating Company's Transportation Charge the Company's Alaska Cost of Service includes:

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- A. All fixed and variable costs properly chargeable to the New Facilities installed in Part A.
- B. All fixed and variable costs properly chargeable to the New Facilities installed in Part B less those allocated to any Canadian Gas which may use these facilities directly or through displacement.
- C. All fixed and variable costs properly chargeable to the New Facilities installed in Part C plus that portion of the fixed and variable costs properly chargeable to the Joint Transmission Facilities in Part C less those allocated to the BCPC, the Alberta Producers and the Territories Producers.
- D. All fixed and variable costs properly chargeable to the New Facilities installed in Part D plus that portion of the fixed and variable costs properly chargeable to the Joint Transmission Facilities in Part D less those allocated to the BCPC, the Alberta Producers and the Territories Producers.

For each Billing Month, Company will calculate in Canadian dollars pursuant to subsection 9.1 herein, its monthly Alaska Cost of Service for each Part and each Shipper will pay to Company that Shipper's share, if any, of such monthly Alaska Cost of Service as allocated pursuant to Section 7 herein.

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## RATE SCHEDULE MDQ-1 - FIRM SERVICE

9.1 Method of Calculation

Such monthly Alaska Cost of Service for each Part will equal the sum of the amounts properly chargeable to that Part under the following subsections of this section 9.1.

A. New Facilities

- (a) Operating Expenses: All reasonable and necessary operating expenses on the New Facilities for the Billing Month properly charged to Accounts 610 to 889 inclusive of the Gas Pipe Line Uniform Accounting Regulations under the National Energy Board Act as in effect at September 30, 1974.
- (b) Depreciation: An amount equal to one-twelfth of the sum accrued by Company as the depreciation expense for the Year on the basis of the approved composite annual depreciation applied to the New Facilities as of the beginning of the calendar Year.
- (c) Amortization: Accruals recorded for the Billing Month for amortization of (i) amounts properly allocable to New Facilities which would be classified as amortizable under Account 304 of the accounting regulations, or which have been directed to be amortized by the National Energy Board, and (ii) all pre-operational costs properly allocable to New Facilities incurred (for example, cost of obtaining authorizations, costs of negotiating contracts, interest

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on funds borrowed, taxes and administrative and general expenses) to the extent, if any, that such costs are now amortizable under one of the above accounts. The amortization period for each amount shall be established in accordance with accepted accounting practices.

- (d) Taxes: All taxes relative to the Billing Month which relate to New Facilities including but not limited to current income and other taxes and provision for deferred income taxes computed in accordance with comprehensive tax allocation accounting procedures, all as recorded in Account Nos. 305 and 306, and the applicable tax portions of the charges or credits included in Account Nos. 351 and 353 which relate to New Facilities but excluding taxes associated with revenues from non-operating sources and investments; provided, however, that the tax effect of any provision with respect to doubtful accounts or bad debts excluded from subsection 9.1A(a) hereof shall be excluded in determining taxes pursuant to this subsection 9.1(d). As used in this subsection 9.1A(d), "comprehensive tax allocation accounting procedures" shall mean those procedures which require recording a full provision for all income tax effects of timing differences between recorded amounts and amounts reported for income tax purposes, including but not limited to (i) interest, taxes and pension costs capitalized per books and expensed currently for tax purposes, (ii) all differences between book and tax depreciation and (iii) any other timing differences between the recording of other revenues and expenses for book and tax purposes.

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(e) Return: Return on Company's rate base allocable to New Facilities will be the product of one-twelfth of the annual rate of return for the Billing Month computed pursuant to subsection 9.1A(e)(i) herein times the rate base relating to New Facilities for the Billing Month computed pursuant to subsection 9.1A(e)(ii) herein.

(i) The annual rate of return (r) on New Facilities for any Billing Month will be obtained by:

$$r = xD_c + yP_c + zE_c + tT_c$$

where:

x is the percentage of New Facilities capitalization which is debt.

y is the percentage of New Facilities capitalization which is preferred shares.

z is the percentage of New Facilities capitalization which is common equity.

t is the percentage of New Facilities capitalization which is deferred income taxes.

D is the total debt as recorded in Account Nos. 220, 221, 250 and 258. Any debt denominated in foreign currency or debt charges payable with respect thereto shall be

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converted to Canadian dollar equivalent by taking the Canadian dollars of the foreign currency amounts when translated at the Foreign Exchange Rate in effect when the debt to which such items relate was incurred.

- P is the total preferred shares as recorded in Account No. 200.  
Any preferred shares denominated in foreign currency or dividends payable with respect thereto shall be converted to Canadian dollar equivalent by taking the Canadian dollars of the foreign currency amounts when translated at the Foreign Exchange Rate in effect when the preferred shares to which such items relate were issued.
- E is the total common equity being the sum of the balances in Account Nos. 205 and 212 plus the excess of any balance in Account No. 210.
- T is the total pool of deferred income taxes as recorded in Account No. 276.
- D<sub>c</sub> is the weighted average cost of debt obtained by multiplying the total debt charge for the Billing Month as recorded in Account Nos. 320 through 323 by twelve and dividing the product by D.

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$P_c$  is the weighted average cost of preferred shares obtained by multiplying the amount of dividends on preferred shares outstanding from time to time during the Billing Month at their stated annual rate by twelve and dividing the product by  $P$ .

$E_c$  is the return allowed on common equity which will be that return as approved by the National Energy Board.

$T_c$  is the weighted average return allowed on the pool of deferred income taxes.

- (ii). The rate base for the Billing Month shall be the sum of the average New Facilities in service as recorded in Company accounts and a working capital allowance represented by the sum of the balances of prepayments and necessary materials and supplies as of the end of the Billing Month, plus the daily weighted average for the Billing Month of non-Interest bearing deposits required by written agreement to be maintained by Company with financial institutions in order to secure loans from such institutions plus the daily weighted average for the Billing Month of cash or securities (valued at cost) deposited with governmental authorities to secure any obligations of Company.

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contingent or otherwise, plus an amount for cash working capital equal to 150% of the operating expenses described in subsection 9.1A(a) herein.

B. Joint Transmission Facilities

- (a) Operating Expenses: All reasonable and necessary operating expenses on the Joint Transmission Facilities for the Billing Month properly charged to Accounts 610 to 889 inclusive of the Gas Pipe Line Uniform Accounting Regulations under the National Energy Board Act as in effect at September 30, 1974.
- (b) Depreciation: An amount equal to one twelfth of the sum accrued by Company as the depreciation expense for the Year on the basis of the approved composite annual depreciation applied to the Joint Transmission Facilities as of the beginning of the calendar Year.
- (c) Amortization: Accruals recorded for the Billing Month for amortization of (i) amounts properly allocable to Joint Transmission Facilities which would be classified as amortizable under Account 304 of the accounting regulations, or which have been directed to be amortized by the National Energy Board, and (ii) all pre-operational costs properly allocable to Joint Transmission Facilities incurred (for example, costs of obtaining authorizations, costs of negotiating contracts, interest on funds borrowed, taxes

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and administrative and general expenses) to the extent, if any, that such costs are now amortizable under one of the above accounts. The amortization period for each amount shall be established in accordance with accepted accounting practices.

- (d) Taxes: All taxes relative to the Billing Month which relate to Joint Transmission Facilities, including but not limited to current income and other taxes.
- (e) Return: Return on Company's rate base allocable to Joint Transmission Facilities will be the product of one-twelfth of the annual approved rate of return for the Billing Month as indicated in subsection 9.1B(e)(i) herein and the rate base relating to Joint Transmission Facilities for the Billing Month computed pursuant to subsection 9.1B(e)(ii) herein.
  - (i) The annual rate of return for the Billing Month will be that return as approved by the National Energy Board.
  - (ii) The rate base for the Billing Month shall be the sum of the average Joint Transmission Facilities in service as recorded in Company accounts and a working capital allowance represented by the sum of the balances of prepayments and necessary materials and supplies as of the end of the Billing Month, plus the Daily weighted average for the

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Billing Month of non-interest bearing deposits required by written agreement to be maintained by Company with financial institutions in order to secure loans from such institutions plus the daily weighted average for the billing month of cash or securities (valued at cost) deposited with governmental authorities to secure any obligations of Company, contingent or otherwise, plus an amount of cash working capital equal to 150% of the operating expenses described in subsection 9.1B(a) herein.

## 10. ADJUSTMENTS

10.1 Billing Adjustment

If, in any Billing Month, Company is unable, for any reason, to take receipt from Shipper of the quantity of Gas nominated by such Shipper to Company in accordance with Shipper's Contract for Service then Shipper's monthly charge for such Billing Month will be adjusted as herein described. When the quantity of Gas, in any Billing Month, received by Company from Shipper is less than 80 percent of the quantity of Gas nominated by Shipper pursuant to the Shipper's Contract for Service, the Shipper will receive an adjustment to the monthly bill calculated by taking the sum of A and B:

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- A. The product of (a), (b) and (c) below;
- (a) Shipper's allocable share of Company's fixed Alaska Cost of Service determined pursuant to 7.1A herein,
  - (b) Total Canadian dollar amount of the return on Company's rate base attributable to return on common equity, and
  - (c) A fraction, the numerator of which is the difference between the quantity of Gas nominated, up to the sum of the Maximum Daily Quantities on each Day, by Shipper, in such Billing Month and the quantity of Gas actually taken by Company from Shipper during such Billing Month (such Gas hereinafter called "Adjustment Gas") and the denominator of which is the sum of Shipper's Maximum Daily Quantity for all Days during such Billing Month;
- B. The amount of current and deferred taxes included in calculating the Alaska Cost of Service for such Billing Month relating to the return on common equity.

10.2 Receipt Deficiencies

If, on any Day, Company fails to take receipt from Shipper of any portion of the Gas nominated by Shipper on such Day pursuant to Shipper's Contract for Service, such portion will be referred to as Shipper's "Receipt Deficiencies" for such Day. Receipt Deficiencies arising in a Billing Month will be transported to the extent Gas is received by Company from Shipper pursuant to Article 1, Section 1.2 of Shipper's Contract for

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Service on any Day during such Billing Month whether before or after the Day on which such Receipt Deficiencies arose. To the extent not so transported during such Billing Month, Receipt Deficiencies will be transported only by the receipt of "Make-up Gas" in subsequent Billing Months.

If, in any Billing Month, the quantity of Gas received by Company pursuant to Article 1, Section 1.2 of Shipper's Contract for Service exceeds the aggregate of Shipper's Receipt Deficiencies arising in that Billing Month, the excess shall be Make-up Gas to the extent of Shipper's Receipt Deficiencies not transported which arose in prior Billing Months, and the remainder, if any, will be governed by Rate Schedule A0-1.

If Company is, on any Day, required to allocate service under Article 1, Section 1.2 of the Contracts for Service of two or more Shippers, it will give priority, in such allocation to quantities of Gas nominated in respect of Receipt Deficiencies to the extent, in the case of each such Shipper, of its Receipt Deficiencies not transported to such Day.

Service in respect of Gas received pursuant to Article 1, Section 1.2 of Shipper's Contract for Service and applied to the transportation of Receipt Deficiencies will be deemed to be provided under this Subsection 10.2.

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10.3 Payment for Transportation of Make-up Gas

Make-up Gas volumes received by Company from Shipper in any Billing Month, will be applied to the earliest incurred Receipt Deficiencies. To the extent that Make-up Gas received by Company from Shipper in any Billing Month is used to reduce that portion of the Receipt Deficiencies attributable to Adjustment Gas, Shipper will pay to Company, each Billing Month, for each Mcf of such Make-up Gas an amount equal to the result arrived at by dividing the Billing Adjustment for the Billing Month to which the Make-up Gas in which such Mcf is included relates by the number of Mcf of Gas which Company failed to take receipt of from Shipper in such Billing Month. All other Make-up Gas will not be subject to any payment pursuant to this Subsection 10.3.

10.4 Exceptions

Subsections 10.1 through 10.3 herein will not apply to any failure of Company to take receipt from Shipper of any Gas nominated by Shipper pursuant to Article 1, Section 1.1 of Shipper's Contract for Service if such failure is caused in whole or in part by, or results in whole or in part from, failure of Shipper to, or to be able to, deliver or take delivery of such Gas, or by any other action of Shipper or Persons acting on its behalf which causes or results in such failure by Company.

10.5 Other Deductions

Each Billing Month Company will deduct from the fixed Alaska Cost of Service charge an amount equal to revenue received during Billing Month under Rate Schedule AD-1 and interest pursuant to Subsection 6.5 of the General Terms and Conditions.

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RATE SCHEDULE AO-1 - OVERRUN SERVICE

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## RATE SCHEDULE AO-1 - OVERRUN SERVICE

## 1. AVAILABILITY

This Rate Schedule is available to any Shipper under its Contract for Service.

## 2. APPLICABILITY AND CHARACTER OF SERVICE

This Rate Schedule shall apply to transportation service pursuant to Shipper's Contract for Service other than service which by the terms of Section 2 of Rate Schedule MDQ-1 is deemed to be provided under said Section.

## 3. PAYMENT FOR SERVICE

3.1 Determination

Shipper shall pay to Company for each Mcf of Gas received by Company from Shipper to which this Rate Schedule is applicable an amount equal to Shipper's Overrun Rate for the Billing Month in which such Gas is received; provided that if Shipper on any Day in any Billing Month does not tender all or a portion of such Shipper's Maximum Daily Quantity, then no payment shall be due to Company under this Rate Schedule in respect of Gas received by Company pursuant to Shipper's Contract for Service, and which is governed by this Rate Schedule, on any other Day during such Billing Month and the immediately following Billing Month up to the undischarged amount of such deficiency. Shipper's Overrun Rate for any Billing Month shall be computed by dividing (a) Shipper's allocable share for the next preceding Billing Month, as defined

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## RATE SCHEDULE A0-1 - OVERRUN SERVICE

in Section 7.1 of Rate Schedule MDQ-1, of the sum of Company's Alaska Cost of Service for such Billing Month plus the amount credited in determining such Alaska Cost of Service in respect of revenues from All Shippers under this Rate Schedule A0-1 by (b) the sum of Daily receipts from Shipper for all Days in such preceding Billing Month.

3.2 Payment

Each amount payable pursuant to Subsection 3.1 of this Rate Schedule shall be reflected in an invoice to Shipper as provided for in Subsection 6.1 of the General Terms and Conditions.

3.3 Application of Revenues

Revenues under this Rate Schedule shall be credited to the Alaska Cost of Service as provided in Rate Schedule MDQ-1.

## 4. GENERAL TERMS AND CONDITIONS

The General Terms and Conditions are applicable to this Rate Schedule.

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## GENERAL TERMS AND CONDITIONS

## 1. DEFINITIONS

Except where the context otherwise requires, when used in the Tariff the plural means the singular and vice versa, the pronoun "it" or "his" means Company or Shipper, as the case may be and the following words and phrases have the meanings ascribed:

- 1.1 "Alaska Gas" means Gas which Shipper has delivered, or caused to be delivered, to a Point of Receipt, which Gas has its origin within the legal bounds of the State of Alaska in the United States of America.
- 1.2 "Alaska Cost of Service" has the meaning ascribed in Section 9 of this Transportation Tariff.
- 1.3 "Alberta Producers" means those producers from whom Company purchases Gas located in Alberta which Gas is transported to market through Company's Transmission System.
- 1.4 "BCPC" means British Columbia Petroleum Corporation.
- 1.5 "Billing Commencement Date" means the Day designated by Company by not less than one Day notice to such Shipper, which notice shall state that Company has facilities which are ready for service and have the capacity not required by Company to fulfill its obligations under Contracts for Service with other Shippers, to receive Gas at Shipper's Point or Points of Receipt and to make related deliveries of Gas at Shipper's Point or Points of Delivery all in accordance with the provisions of Shipper's Contract for Service.

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- 1.6 "Billing Month" means the period beginning at 8:00 A.M., Pacific Standard Time, on the first Day of a calendar month and ending at 8:00 A.M., Pacific Standard Time, on the first Day of the next succeeding calendar month.
- 1.7 "Board" means the National Energy Board of Canada or any other tribunal which may hereafter exercise the functions now exercised by that Board with respect to the regulation of gas pipelines.
- 1.8 "British Thermal Unit" means the amount of heat that must be added to one avoirdupois pound of pure water to raise its temperature from 58.5° degrees Fahrenheit to 59.5° degrees Fahrenheit, under an absolute pressure of a column of mercury 30 inches high at 32° degrees Fahrenheit, under standard gravity.
- 1.9 "Btu" means British Thermal Unit.
- 1.10 "Company" means Westcoast Transmission Company Limited.
- 1.11 "Company Use Gas" means the volume of Gas, including but not limited to Gas used as fuel or for testing, used during any specific period by Company in its operations, as determined by the Company.
- 1.12 "Contract for Service" means a contract for the transportation of Gas pursuant to this Transportation Tariff.
- 1.13 "Cubic Foot" means the volume of Gas which occupies one cubic foot when such Gas is at a temperature of 14.73 pounds per square inch absolute.

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- 1.14 "Gas" means natural gas or any other hydrocarbon or mixture of hydrocarbons that is in a gaseous state.
- 1.15 "General Terms and Conditions" means those agreements, covenants, stipulations and provisions contained in these General Terms and Conditions as amended or supplemented from time to time.
- 1.16 "Joint Transmission Facilities" means that portion of the Company's Transmission System, excluding all New Facilities as defined herein, which is not looped specifically to transport Alaska Gas.
- 1.17 "Mcf" means 1,000 Cubic Feet.
- 1.18 "New Facilities" means the facilities installed by Company to move Alaska Gas and more specifically, but not limited to, the facilities listed in Schedules A to D below:
- |        |   |                        |
|--------|---|------------------------|
| Part A | - | Schedule of facilities |
| Part B | - | Schedule of facilities |
| Part C | - | Schedule of facilities |
| Part D | - | Schedule of facilities |
- 1.19 "Part A" means that portion of the Company's Utility System commencing at a point in N.T.S. system 104-P-14-Block 1 and proceeding southeast to a point near Fort Nelson, adjacent to Mile Post 285 on the Alaska Highway, in District Lot 2683, Peace River District, in the Province of British Columbia.

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- 1.20 "Part B" means that portion of the Company's Utility System commencing at the existing Westcoast Fort Nelson mainline system located adjacent to Mile Post 285 on the Alaska Highway in District Lot 2683, Peace River District, and proceeding eastward to a point located in N.T.S. system 94-1-9, Block H, all in the Province of British Columbia.
- 1.21 "Part C" means that portion of the Company's Utility System commencing at the existing Westcoast Fort Nelson mainline system located adjacent to Mile Post 285 on the Alaska Highway in District Lot 2683, Peace River District and proceeding southward to Westcoast Compressor Station No. 2 located in Lot 373, Peace River District, all in the Province of British Columbia.
- 1.22 "Part D" means that portion of Company's Utility System commencing at Compressor Station No. 2 located in Lot 373, Peace River District and proceeding southward to the International Border to a point near Sumas located in Lot 1, Plan 3931, and Lot B, Plan 15967, both of S.W. corner of Section 6, Township 19, New Westminster District, all in the Province of British Columbia.
- 1.23 "Person" means any individual, corporation, partnership, association, trust, unincorporated organization, or government or political subdivision thereof and pronouns shall have a similarly extended meaning.

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- 1.24 "Point of Delivery" means one of the Points of Delivery shown in the Contract for Service with any one Shipper for delivery of Gas to such Shipper.
- 1.25 "Point of Receipt" means one of the Points of Receipt shown in the Contract for Service with any one Shipper for receipt of Gas from such Shipper.
- 1.26 "Psia" means pounds per square inch absolute.
- 1.27 "Shippers" means the persons which have entered into Contract for Service with Company which are then in effect and the term "Shipper" shall mean one of such persons.
- 1.28 "Shipper's Allocable Share" has the meaning ascribed in Section 7.1 of this Transportation Tariff.
- 1.29 "Territories Producers" means those producers from whom Company purchases Gas located in the Yukon Territories or Northwest Territories which Gas is transported to market through Company's Transmission System.
- 1.30 "Heating Value" means the number of B.t.u. produced by the combustion in a recording calorimeter at constant pressure of the amount of gas which would occupy a volume of One (1) cubic foot at a temperature of Sixty Degrees Fahrenheit (60°F.), if saturated

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with water vapour, and under a pressure equal to that of Thirty (30) inches of mercury at Thirty-Two Degrees Fahrenheit (32°F.) and under standard gravitational force (acceleration Nine Hundred and Eighty and Six Hundred and Sixty-Five Thousandths (980.665) cm. per second per second) with air of the same temperature and pressure as the gas, when the products of combustion are cooled to the initial temperature of the gas and air, and when the water formed by combustion is condensed to the liquid state.

- 1.31 "Transmission System" means that portion of Company's total Utility System defined as Parts A, B, C and D.
- 1.32 "Utility System" means all Company's facilities dedicated to its utility operations as recorded in Company accounts.
- 1.33 "Year" means a period of twelve consecutive months beginning at 8:00 A.M., Pacific Standard Time, January 1 and ending at 8:00 A.M., Pacific Standard Time on the next succeeding January 1.

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## GENERAL TERMS AND CONDITIONS

## 2. TRANSPORTATION TARIFF

These General Terms and Conditions form part of the Transportation Tariff.

## 3. QUALITY OF GAS

3.1 Quality Specifications

Shipper shall deliver Gas to Company at the Points of Receipt pursuant to the Contract for Service that conforms to the following specifications:

(a) Odors and Solids

It shall be commercially free from objectionable odors, solid matter, dust, gums and gum-forming constituents which might interfere with its merchantability or cause injury to or interference with proper operation of the lines, regulators, meters or other appliances through which it flows.

(b) Oxygen

It shall not have an oxygen content in excess of one percent by volume.

(c) Liquids:

It shall be free of water and hydrocarbons in liquid form. It shall not contain water vapour in excess of four (4) pounds per million cubic feet as determined by dewpoint apparatus approved by the Bureau of Mines of the United States of America but need

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not be dehydrated to a dewpoint less than zero degrees Fahrenheit (0°F) at the delivery pressure. It shall be free of hydrocarbons liquefiable at temperatures in excess of fifteen degrees Fahrenheit (15°F) at eight hundred (800) pounds per square inch absolute.

(d) Hydrogen Sulphide

It shall not contain more than one-quarter ( $\frac{1}{4}$ ) grain of hydrogen sulphide per 100 Cubic Feet.

(e) Total Sulphur

It shall not contain more than ten grains of total sulphur (hydrogen sulphide and mercaptan sulphur) per 100 Cubic Feet.

(f) Carbon Dioxide

It shall not contain more than two percent (2%) by volume of carbon dioxide.

(g) Heating Value

It shall have a Total Heating Value of not less than 950 Btu.

3.2 Failure to Meet Specifications

If Gas tendered by Shipper fails to conform to the specifications set forth in these General Terms and Conditions, then Company shall notify Shipper of such failure, and if Shipper fails promptly to take such action as may be reasonably necessary to remedy such failure,

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then Company may either refuse to accept such Gas pending remedy by Shipper, or accept such Gas and make changes necessary to bring such Gas into conformity with such specifications in which event Shipper will reimburse Company for any reasonable expense incurred by Buyer in effecting such change.

## 4. RECEIPT AND DELIVERY CONDITIONS

4.1 Receipt Pressure

Shipper shall deliver Gas to Company at each of Shipper's Points of Receipt at a pressure sufficient to cause it to flow into Company's pipeline, provided that Shipper shall not be required to deliver Gas to Company at any Point of Receipt at a pressure in excess of the Maximum Pressure specified with respect to such Point of Receipt in Shipper's Contract for Service.

4.2 Delivery Pressure

Company shall deliver Gas to Shipper at each of Shipper's Points of Delivery at the pressure existing in Company's pipeline at such Point of Delivery, provided that Company shall not deliver Gas to any Shipper at any Point of Delivery at a pressure less than the Minimum Pressure specified with respect to such Point of Delivery in such Shipper's Contract for Service.

4.3 Maximum Receipt Temperature

The temperature of Gas delivered by Shipper to Company at a Point of Receipt shall not exceed the Maximum Temperature specified with respect to such Point of Receipt in such Shipper's Contract for Service.

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4.4 Operating Conditions

Subject to the provisions of subsections 4.1, 4.2 and 4.3 hereof, the temperature and pressure of Gas delivered to Company by Shipper, and of Gas delivered to Shipper by Company, shall at each of Shipper's Points of Receipt and Points of Delivery, be consistent with the overall operating conditions of Company's pipeline system. Company shall use due care and diligence to deliver Gas to Shipper at such uniform pressure as is consistent with the operating conditions of Company's pipeline system.

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## 5. MEASUREMENT

5.1 Company's Measuring Equipment

Save as otherwise provided in the Contract for Service, Company will install, maintain and operate at its own expense equipment required for the measurement of the volumes of all Gas received hereunder at each Point of Receipt and delivered hereunder at each Point of Delivery. Company will install, maintain and operate at its own expense equipment required for the measurement of Total Heating Value at a point on Company's pipeline where the sample of Gas used in the determination may be truly representative of the Gas received by Company from Shipper and Gas delivered by Company to Shipper and the arithmetic average of the computed daily Total Heating Values shall be used in determining compliance with the specifications set out above and in making any adjustment for heating value. Shipper shall have access to the measuring equipment of Company at all reasonable hours, but the calibrating and adjusting of the measuring equipment and the changing of charts shall be done only by Company.

5.2 Check Measuring Equipment

Shipper may install, maintain and operate at its own expense check measuring equipment as desired, provided that such equipment shall be so installed as not to interfere with the operating of Company's measuring equipment at or near each Point of Receipt and Point of Delivery.

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5.3 Right to be Present

Shipper shall have the right to be present at the time of any testing or calibrating done in connection with the measuring equipment used in measuring deliveries hereunder, and shall be given reasonable notice thereof in order that it may be present.

5.4 Calibration and Test of Meters

To determine the accuracy of the measuring equipment at each Point of Receipt and Point of Delivery Company shall conduct tests using means and methods acceptable to the Shipper, at least once each month, or at such other intervals as may be mutually agreed upon, and at other times upon request by the Shipper. Notice of the time and nature of each test shall be given by the party conducting the test to the other party sufficiently in advance to permit convenient arrangement for the presence of its representative. If, after notice, a party fails to have a representative present, the results of the test shall nevertheless be considered valid. If any measurement equipment is found to be registering incorrectly in any percentage, it shall be adjusted at once to read as accurately as possible. In the event that a party requests a test, and if on such test the inaccuracy is found to be Two percent (2%) or less, then the party so requesting the test shall bear the expense of such test. If upon any test any measuring equipment shall be found to be inaccurate by an amount exceeding Two percent (2%), then any previous readings of such equipment shall be corrected to zero error for any period which is known definitely or agreed upon, but, in case the period is not known definitely or agreed upon, such correction shall be for a period covering the last half of the time elapsed since the date of the last

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test, but not exceeding a period of Fifteen (15) days.

5.5 Correction of Metering Errors

The volume of Gas received by Company from Shipper and the volume of Gas delivered by Company to Shipper will be determined by the volume of Gas measured by the measuring equipment of Company.

If the measuring equipment is out of service or out of repair so that the quantity of Gas delivered is not correctly indicated by the reading thereof, the Gas received or delivered during the period such measuring equipment is out of service or out of repair shall be estimated and agreed upon on the basis of the best data available, using the first of the following methods which is feasible:

- (a) By using the registration of any check measuring equipment if installed and accurately registering; or
- (b) By correcting the error if the percentage is ascertained by calibration, test or mathematical calculations; or
- (c) By estimating the quantity received or delivered by receipts or deliveries during the preceding periods under similar conditions when the meter was registering accurately.

5.6 Preservation of Records

Both Shipper and Company will preserve for a period of at least two Years all test data, charts and other records of Gas measurement.

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5.7 Unit of Volume

The unit of volume for all purposes shall be one Cubic Foot at an absolute pressure of 14.73 pounds per square inch at a temperature of 60 Fahrenheit computed in accordance with Boyle's Law governing pressure and volume of gases (with corrections for deviation as hereinafter provided).

5.8 Determination of Volume

The volume of Gas received or delivered hereunder, if measured by an orifice meter, shall be computed in accordance with "Consumer and Corporate Affairs, Departmental Instructions, Regarding Inspection of Gas Meters and Auxiliary Devices" - Part VII orifice meters dated April, 1976, or subsequent revisions acceptable to both Shipper and Company. If Gas received or delivered hereunder is measured with a turbine or positive displacement meter, the volumes received or delivered at flowing pressures and temperatures shall be corrected by the application of proper correction factors for (a) absolute static pressure, (b) flowing temperature, and (c) deviation from Boyle's Gas Law as set forth below.

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5.9 Deviation from Boyle's Gas Law

Correction shall be made for the deviation of the Gas from Boyle's Law at the average pressure and temperature at which the Gas is metered. To determine the factors for such correction a quantitative analysis of the Gas shall be made at reasonable intervals, but not less than once a month by Seller, with such apparatus as shall be agreed upon by the parties; and such factors shall be obtained from data contained in a "Manual For Determination of Supercompressibility Factors for Natural Gas - Par Research Project NX-19", as published by the American Gas Association in 1962, or any subsequent revision thereof acceptable to the parties. When displacement type meters are used, the deviation factor shall be obtained under the procedure noted above, but the correction factor shall be the square of the supercompressibility factor  $F_{pv}$ .

5.10 Specific Gravity

The specific gravity of the Gas shall be determined by means of a recording gravitometer. The arithmetic average specific gravity each Day shall be used in computing receipts and deliveries of Gas during such Day. The gravitometer installed at the Point of Receipt or Point of Delivery shall be installed, operated and maintained by Company in accordance with "Consumer and Corporate Affairs, Departmental Instructions In Regards To The Inspection of Gas Meters and Auxiliary Devices," Section VID gravitometer and specific gravity determination. The arithmetic average of the specific gravity recorded each Day shall be used in computing volumes of Gas measured at the Point of Receipt or Point of Delivery.

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5.11 Flowing Temperatures

The flowing temperature of the Gas in the meters shall be determined by means of a recording thermometer to be installed in accordance with "Department of Consumer and Corporate Affairs, Departmental Instructions In Regards To The Inspection of Gas Meters and Auxiliary Devices" Part VII - orifice meters, and the arithmetic average temperature each Day shall be used in computing the deliveries of Gas during such Day. If approved meters are used, which include automatic temperature compensation, these shall be used rather than the record temperatures.

5.12 Atmospheric Pressure

The absolute atmospheric pressure will be determined by test calculated to the nearest 0.25 Psia, and mutually agreed upon by both Company and Shipper, as it relates to the point where the metering facilities are to be located, prior to the first receipt or delivery of Gas.

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## 6. BILLING AND PAYMENT

6.1 Billing

Company will on or before the fifteenth Day of each month, beginning with the month following the Billing Commencement Date, render an itemized bill to Shipper showing the monthly Alaska Cost of Service charge calculated for Shipper in accordance with the Transportation Tariff covering all Gas transported for Shipper during the preceding month and in such bill will state in reasonable detail the manner in which the bill was computed and provide sufficient detail to enable Shipper to check such computation. The bill will include the number of United States dollars, if any, which will be substituted for Canadian dollars pursuant to Subsection 6.3 below.

6.2 Examination of Records

Company and Shipper each may at all reasonable times examine the books, records and charts of the other, to the extent necessary to verify the accuracy of any statement, charge or computation made pursuant to any of the provisions of this Transportation Tariff.

6.3 Partial Payment in U.S. Dollars

If Company shall cause the construction of New Facilities or Joint Transmission Facilities to be financed in whole or in part by the sale of securities of Company requiring repayment of principle and/or payment of interest in United States dollars (such securities herein after referred to as "U.S. Pay Securities"), then Shipper will in its payment of its portion of the monthly Alaska Cost of Service charge substitute for the same number of Canadian dollars,

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and Company will accept in substitution, the number of United States dollars required as hereinafter set forth.

Company will, not later than 30 days after each sale of any U.S. Pay Securities, give notice to Shipper setting forth the following:

- (a) the total outstanding amount of U.S. Pay Securities;
- (b) a schedule of the total annual amounts of such repayments and/or payments unconditionally required by the terms of such U.S. Pay Securities to be made in United States dollars; and
- (c) the place where Company desires to receive that part of the said monthly Alaska Cost of Service charge which is to be paid by Shipper to Company in United States dollars

The amount of United States dollars to be so paid monthly by Shipper will be its allocable share (determined pursuant to Section 7 of Rate Schedule MDQ-1) of one-twelfth of the amount of United States dollars set forth in the schedule referred to in (b) above for the Year in which the Shipper's payment hereunder is due.

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6.4 Payment

Shipper will pay Company within ten Days after being billed for Gas delivered under this Transportation Tariff during the preceding month as billed by Company in the statement for said month. Shipper will pay directly to Company, in Canadian currency, that portion of the bill stated in Canadian currency and that portion of the bill stated in United States currency in such currency, to an agreed upon depository, for account of Company, in the United States of America. Should Shipper fail to pay the amount of any bill rendered by Company as herein provided when due, interest shall accrue at the percentage rate per annum equivalent to ten percent greater than the average of the prime bank rate charged from Day to Day by The Royal Bank of Canada at Vancouver, British Columbia, on loans to prime customers over the period of six months, terminating on April 30 and October 31 respectively.

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6.5 Failure To Pay

If Shipper should fail to pay any bill within sixty Days after payment is due, Company may suspend further delivery of Gas to Shipper until such bill is paid, provided, however, that if Shipper in good faith either disputes the amount of any such statement and within thirty Days furnishes a surety bond in an amount and with sureties satisfactory to Company (but on request of Shipper, Company shall designate as satisfactory a surety company licensed to do business as such in British Columbia) conditioned upon the payment of any amounts ultimately found due after a final determination (which may be reached either by agreement pursuant to arbitration agreed upon by the parties or judgment of the courts), then the amount of such statement shall not be deemed to be due within the meaning of this section unless and until default be made in the conditions of such bond.

6.6 Determination of Dispute

If Company shall require Shipper to furnish such a bond, Company will institute appropriate proceedings to determine the dispute with respect to which the bond has been furnished within one Year after the date of the statement in dispute.

6.7 Other Remedies

None of the foregoing provisions shall operate to bar either Company or Shipper from asserting any other remedy it may have at law or in equity.

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6.8 Incorrect Billing

- (a) If Shipper shall find at any time within twelve months after the date of any bill rendered by Company that it has been overcharged and if Shipper shall have paid such overcharge and shall have made a claim within sixty Days from the date of discovery thereof, Company shall upon verification thereof refund the principal of any such overcharge within thirty Days from the determination thereof, and, upon failure to do so, Shipper may set off the amount of the overcharge against monies owing by Shipper to Company.
- (b) If Company shall find at any time within twelve months after the date of any statement rendered by it that it has undercharged Shipper it may submit a statement for such undercharge and Shipper shall pay the same without interest, but this provision shall not preclude Shipper from disputing the amount of such statement or the fact that there has been an undercharge.

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## 7. LIABILITIES

7.1 Warranty and Title of Gas

Shipper warrants and represents that it owns or controls the Gas to be delivered to the Point of Receipt and that it has the right, power and authority to enter into a Contract for Service in respect thereof.

7.2 Possession of Gas

Gas received by Company from Shipper for Transportation shall be deemed to be in the custody and under the control of Company from the time such Gas is accepted for Transportation at any Point of Receipt and until delivered by Company to Shipper at any Point of Delivery.

7.3 Responsibility

As between Shipper and Company, Company shall be responsible for all Gas received from Shipper between the time such Gas is received by it from Shipper at any Point of Receipt and the time Gas is delivered to Shipper by Company at any Point of Delivery, and at no other time.

7.4 Force Majeure

Neither party shall be liable in damages to the other for any failure to perform its obligations under the Transportation Tariff (whether by an act of commission or omission) where failure is due to any cause beyond its reasonable control,

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save and except in the case of such party's contributory negligence, provided that failure to settle or prevent any strike or other controversy with employees or with anyone purporting or seeking to represent employees shall not be a matter within the control of the party claiming relief.

Where a party is guilty of contributory negligence or where a party fails to use due diligence to remedy the situation and remove the cause in an adequate manner and with all reasonable dispatch, it shall not be relieved of liability in damages to the other.

Notwithstanding the foregoing, neither party shall be relieved of an obligation to make payments to the other of amounts due hereunder at the time of failure to perform its obligations under the Transportation Tariff.

7.5 Impaired Deliveries

If due to any cause whatsoever Company is unable on any Day to receive from Shippers or to deliver to Shippers all of the volumes of Gas it would have received or delivered if such inability did not exist, then Company will curtail or interrupt receipts or deliveries of Gas in the following order of priority and in proportion to the Maximum Daily Quantity of each Shipper:

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- (a) First: Those transporting Gas under Rate Schedule A0-1.
- (b) Second: Those purchasing Gas under Rate Schedule MDQ-1.

7.6 Default

Should either Company or Seller waive its rights against the other in respect of any default by such other party in the performance of its obligation under the Transportation Tariff, such waiver shall not operate or be construed as a waiver of future default whether of a like or of a different character.

7.7 Applicable Law

The Contract for Service between Company and Shipper, this Transportation Tariff and the rights and obligations of the parties are subject to all present and future laws, rules, regulations and orders of any legislative body or duly constituted authority now or hereafter having jurisdiction over the subject matter thereof.

Issued by :

Effective :

Issued on :

## GENERAL TERMS AND CONDITIONS

## 8. DELIVERIES OF GAS

It is recognized that the Gas received by Company from Shipper under Shipper's Contract for Service will be comingled in Company's Transmission System with Gas received by Company from other Shippers under their Contracts for Service and with Gas purchased from the BCPC, Territories Producers and Alberta Producers, and that the Gas which Company will deliver to Shipper will not be the identical Gas which Company will receive from Shipper. If the Gas delivered by Company to Shipper meets the specifications set forth in the General Terms and Conditions, then such Gas may be Gas from other sources in lieu of all or any part of said Gas delivered by Shipper to Company.

8.1 Daily Scheduling

The daily quantities of Gas to be received by Company at the Points of Receipt, and delivered by Company at the Points of Delivery will be pursuant to dispatcher's schedules, which will to the extent practicable, reflect variations in Total Heating Value of the Gas pursuant to Section 8.2 as well as the volume of Gas delivered by Shipper to Company pursuant to Section 9 of the General Terms and Conditions.

8.2 Balancing For Total Heating Value

Gas delivered at the Point of Delivery by Company shall balance with the Gas tendered by Shipper to Company on a Total Heating Value basis.

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## GENERAL TERMS AND CONDITIONS

8.3 Balancing

Due to variations in operating conditions daily and monthly deliveries to Shipper by Company may differ from the corresponding daily and monthly receipts by Company for the account of Shipper. Shipper and Company shall cooperate to keep such differences to the minimum permitted by operating conditions, and to balance out such differences as soon as practicable. Any such differences are to be made up in Gas, and receipt and delivery of such balancing Gas shall be scheduled by mutual agreement of dispatchers of Company and Shipper.

8.4 Scheduling of Alterations and Repairs

Company shall have the right to interrupt or reduce service to Shipper when necessary alterations, modifications, enlargements or repairs to any facilities or property comprising a part of Company's pipeline system or otherwise related to the operation thereof. Except in the event of unforeseen emergency, Company shall provide affected Shipper with as much notice as practicable under the circumstances, and Company shall endeavor to schedule such alterations, modifications, enlargements or repairs in cooperation with Shipper so that Shipper may arrange for alternate supply or otherwise accommodate its operations to such reduction or interruption of service.

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## GENERAL TERMS AND CONDITIONS

## 9. GAS USED AND LOST

9.1 Gas Used

Company shall have the right but shall not be obligated to use Gas being transported for Shipper for the operation, maintenance and construction of Company's facilities; such use to include among other things:

- (a) fuel used in the operation of compressor stations;
- (b) fuel used in buildings;
- (c) purging, testing, and line pack for Company's facilities or any part thereof.

Apportionment, pursuant to Section 9.3 hereof, shall apply to Shippers Gas used by Company.

9.2 Gas Lost

Company shall not be responsible for Gas lost by explosion, fire or other calamity, line losses and other unaccounted for Gas, but shall keep account of any such Gas and the provisions of this section relative to apportionment among Shippers shall apply.

9.3 Apportionment Among Shippers

In those Parts of the Company Transmission System used to transport Alaska Gas only, the Gas used and lost by Company shall be apportioned among all Shippers obtaining service from Company in proportion to the volumes received by Company from such Shippers at the Point of Receipt. Company may make estimates of the apportionment of Gas used and lost each month but such estimates shall be subject to final balancing as of December 31 of each

Issued by :

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Issued on :

GENERAL TERMS AND CONDITIONS

Year, at the time when final determinations are made for such calendar Year.

In those Parts of the Company Transmission System where Alaska Gas is commingled with other Gas, the Gas used and lost by Company to transport Alaska Gas shall be determined on a volumetric basis and adjusted to reflect differences in the heating content of the commingled stream.

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## GENERAL TERMS AND CONDITIONS

## 10. MISCELLANEOUS

10.1 Operating Information and Estimates

In order to facilitate load dispatching by Company, Shipper will advise Company in advance, to the extent practicable, of any substantial known or anticipated change in its Gas transportation requirements, other than changes resulting from weather conditions.

10.2 Headings

The headings and subheadings in these General Terms and Conditions are inserted for purpose of convenient reference only and are not intended to be a part of these General Terms and Conditions or to be considered in any interpretation of the same.

10.3 Notices

Any notice, request, demand, statement or bill provided for in this Transportation Tariff, or any notice which either Company or Shipper may desire to give to the other, shall be in writing and shall be considered as fully delivered when mailed postpaid to the address set out in the Contract for Service or to such other address as such party shall designate by formal written notice. Routine communications and advice of any contingency or emergency affecting deliveries to Shipper shall be by telephone or telecommunication as soon as possible after Company becomes aware thereof.

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## GENERAL TERMS AND CONDITIONS

10.4 Arbitration

- (a) Except where the Board has exclusive jurisdiction under law, in the event the parties are unable to agree on any of the matters of fact or law related to this agreement, any party may upon written notice call for submission of such matter to binding arbitration. The party requesting arbitration shall set forth in such notice in adequate detail the issues to be arbitrated, and within ten (10) days from the receipt of such notice, the other party may set forth in adequate detail additional related issues to be arbitrated. Such arbitration shall be conducted in accordance with such rules as the parties may eventually agree to or failing such agreement in accordance with the Rules of Conciliation and Arbitration of the International Chamber of Commerce by three arbitrators appointed under said Rules and shall be decided according to English Common Law Arbitration proceedings shall take place in Zurich or in such other place as the parties may agree and shall be carried out in English.
- (b) The party or parties calling for any such submission shall submit to the panel or arbitrators the issues to be decided and their position thereon. The other parties shall also be entitled to submit their positions thereon. The arbitrators may request additional or such other evidence, including oral argument, as they deem necessary. Upon determination of any such dispute, the arbitrators shall assess the costs attributable

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## GENERAL TERMS AND CONDITIONS

to such arbitration to the party or parties whose position is farthest away from the actual decision rendered. In the case of a monetary dispute, the arbitrators shall be entitled to assess interest. The arbitrators shall be empowered to divide the costs related to such arbitration equally if they deem it appropriate.

- (c) Subject to (d) below, it is the intent of the parties that all disputes which cannot be mutually resolved shall be decided pursuant to arbitration; any party seeking to set any arbitration decision aside or to seek a remedy, either legal or equitable, in any other forum shall be deemed to have breached this contract and subject to all costs, damages, including consequential, and attorneys fees related to the enforcement and satisfaction hereof.
- (d) Notwithstanding the other provisions of this Section 10.4, the parties shall pay within the period of time set forth in any executed Service Agreement all amounts billed thereunder without any resort to the arbitration provisions herein. The parties shall be entitled to seek any remedy at law or equity in any forum having jurisdiction to enforce collection of such amounts and no such party will in any collection proceedings in such forum raise as a defense to such collections the provisions for arbitration herein provided. Payment of such amounts shall not be deemed to be a waiver of the right to arbitrate the appropriateness of any such billing.

Issued by :

Effective :

Issued on :

WESTCOAST TRANSMISSION COMPANY LIMITED

Transportation Tariff No. 1

CONTRACT FOR SERVICE

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Issued by :

Effective :

Issued on :

WESTCOAST TRANSMISSION COMPANY LIMITED

Transportation Tariff No. 1

FORM OF  
CONTRACT FOR SERVICE  
FOR TRANSPORTATION OF GAS

This AGREEMENT made this \_\_\_\_\_ day of \_\_\_\_\_

BETWEEN:

WESTCOAST TRANSMISSION COMPANY LIMITED,  
a body corporate having an office and  
carrying on business in the City of  
Vancouver in the Province of British  
Columbia (herein referred to as  
"Company")

OF THE FIRST PART

AND:

\_\_\_\_\_  
(Name of Shipper)  
(herein referred to as "Shipper")

OF THE SECOND PART

Issued by :

Effective :

Issued on :

CONTRACT FOR SERVICE

WHEREAS, Shipper wishes to obtain service relating to the transportation of Gas through Company's Transmission System which extends from the Yukon Territory - British Columbia border to points in Southern Canada, as it may have been extended and enlarged from time to time; and

WHEREAS, Company is willing to provide such service;

In consideration of the premises and of the mutual covenants herein contained, the parties do covenant and agree as follows:

Issued by :

Effective :

Issued on :

## CONTRACT FOR SERVICE

## ARTICLE 1

Scope of Agreement

- 1.1 Company agrees to receive Gas from Shipper at each Point of Receipt herein specified and to transport and deliver Gas to Shipper at each Point of Delivery herein specified, and Shipper agrees to accept such Gas deliveries from Company, subject to the terms and conditions of this Contract for Service, up to the quantity of Gas equal to Maximum Daily Quantity.
- 1.2 If Shipper desires to tender to Company on any Day at any of Shipper's Points of Receipt, a quantity of Gas in excess of Shipper's Maximum Day Quantity for such Point of Receipt for such Day, it shall notify Company of such desire. If Company, in its sole judgement, determines that it has the necessary capacity available to receive and transport all or any part of such excess quantity and make deliveries in respect thereof, and that the performance of Company's obligations to other Shippers under their Contracts for Service will not be adversely affected thereby, Company may elect to receive from Shipper said excess quantity or part thereof, and so notify Shipper.

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CONTRACT FOR SERVICE

ARTICLE 2

Rate Schedule and Rates

- 2.1 This Contract for Service is subject to the provisions of Rate Schedules \_\_\_\_\_ and the General Terms and Conditions contained in Company's Transportation Tariff, Volume No. 1 as they may be amended or superseded from time to time, which Rate Schedules and General Terms and Conditions are by this reference incorporated herein and made a part hereof.
- 2.2 Shipper shall pay Company for all Gas Transported and delivered hereunder during the term of this Contract for Service in accordance with such Rate Schedule as filed with the National Energy Board as may hereafter amended or superseded pursuant to the National Energy Board Act.

ARTICLE 3

Term of Agreement

- 3.1 This Contract for Service shall become effective on the Billing Commencement Date and shall continue in effect for a period of twenty-five years thereafter.

Issued by :

Effective :

Issued on :

## CONTRACT FOR SERVICE

## ARTICLE 4

Receipt and Delivery Points and Pressures

- 4.1 All receipts of Gas from Shipper hereunder shall be at or near the inlet side of the appropriate measuring station, as identified in Appendix A attached to this Contract for Service, as the same may be in effect from time to time.
- 4.2 The Points of Delivery for Gas to be Transported hereunder shall be those points set forth in Appendix B attached to this Contract for Service as the same may be in effect from time to time.
- 4.3 The delivery pressure of the Gas tendered by Shipper to Company for Transportation shall be at a pressure sufficient to enter Company's system at the Point of Receipt, up to that specified for such Point of Receipt in Appendix A attached to the Contract for Service.

The delivery pressure of the gas delivered by Company to Shipper shall be at the pressure available from Company's system at the Points of Delivery as specified for such Point of Delivery in Appendix B attached to this Contract for Service.

Issued by :

Effective :

Issued on :



## CONTRACT FOR SERVICE

## ARTICLE 5

Title and Custody

- 5.1 Title to the Gas received by Company under this Contract for Service for Transportation shall remain in Shipper at all times. Gas received by Company from Shipper hereunder shall be deemed to be in the custody and under the control of Company from the time such Gas is accepted for Transportation at the Points of Receipt until it is delivered to Shipper at the Points of Delivery.

## ARTICLE 6

Address of Parties

- 6.1 Every notice, statement and bill provided for in the Contract for Service shall be in writing and each of them and every payment provided for herein shall be directed to the party to whom given, made or delivered at such party's address as follows:

SHIPPER: \_\_\_\_\_

Issued by :

Effective :

Issued on :

## CONTRACT FOR SERVICE

COMPANY: Westcoast Transmission Company Limited  
1333 West Georgia Street  
Vancouver, B.C. V6E 3K9

Any notice hereunder shall be deemed to have been given seventy-two hours, excluding Saturdays, Sundays and statutory holidays, after such notice has been deposited in a post office with requisite postage thereon. Either party may change its address by giving written notice to the other party.

## ARTICLE 7

Miscellaneous Provisions

- 7.1 The interpretation of this Contract for Service shall be in accordance with the laws of Canada.
- 7.2 This Contract for Service is solely for the Transportation of Gas and Shipper does not acquire any right to, title or interest in or to the use of the facilities of Company or any part thereof nor does Company dedicate any portion of its system to Transportation of Shipper's Gas.

Issued by :

Effective :

Issued on :

CONTRACT FOR SERVICE

ARTICLE 8

Agreements Being Superseded

8.1 This agreement supersedes as of \_\_\_\_\_ the following agreements between parties hereto for the Transportation of Gas by Company for the Shipper:

IN WITNESS WHEREOF the parties hereto have hereunto executed these presents all as of the day, month and year first above written.

WESTCOAST TRANSMISSION COMPANY LIMITED

Per: \_\_\_\_\_

Per: \_\_\_\_\_

(Shipper)

Per: \_\_\_\_\_

Per: \_\_\_\_\_

Issued by :

Effective :

Issued on :

Transportation Tariff No. 1

## CONTRACT FOR SERVICE

"Appendix A"

to

Contract for Service for

Transportation of Gas

Dated \_\_\_\_\_

Identification of Points of Receipt  
and Receipt Pressures

Point of Receipt Location	Shipper Identification Number	Maximum Daily Quantity Mcf	Maximum Receipt Pressure, Psig
------------------------------	----------------------------------	-------------------------------	-----------------------------------

This Appendix A (as of the date of execution) supersedes the following (agreements or Appendix A) between the parties:

WESTCOAST TRANSMISSION COMPANY LIMITED

Per: \_\_\_\_\_

Per: \_\_\_\_\_

(Shipper)

Per: \_\_\_\_\_

Per: \_\_\_\_\_

Issued by :

Effective :

Issued on :

## CONTRACT FOR SERVICE

"Appendix B"

to

Contract for Service for  
Transportation of Gas

Dated \_\_\_\_\_

Identification of Points of Delivery  
and Delivery PressuresPoint of  
Delivery  
LocationShipper  
Identification  
NumberMinimum Delivery  
Pressure, Psig

This Appendix B (as of the date of execution) supersedes the  
following (agreements or Appendix B) between the parties:

WESTCOAST TRANSMISSION COMPANY LIMITED

Per: \_\_\_\_\_

Per: \_\_\_\_\_

(Shipper)

Per: \_\_\_\_\_

Per: \_\_\_\_\_

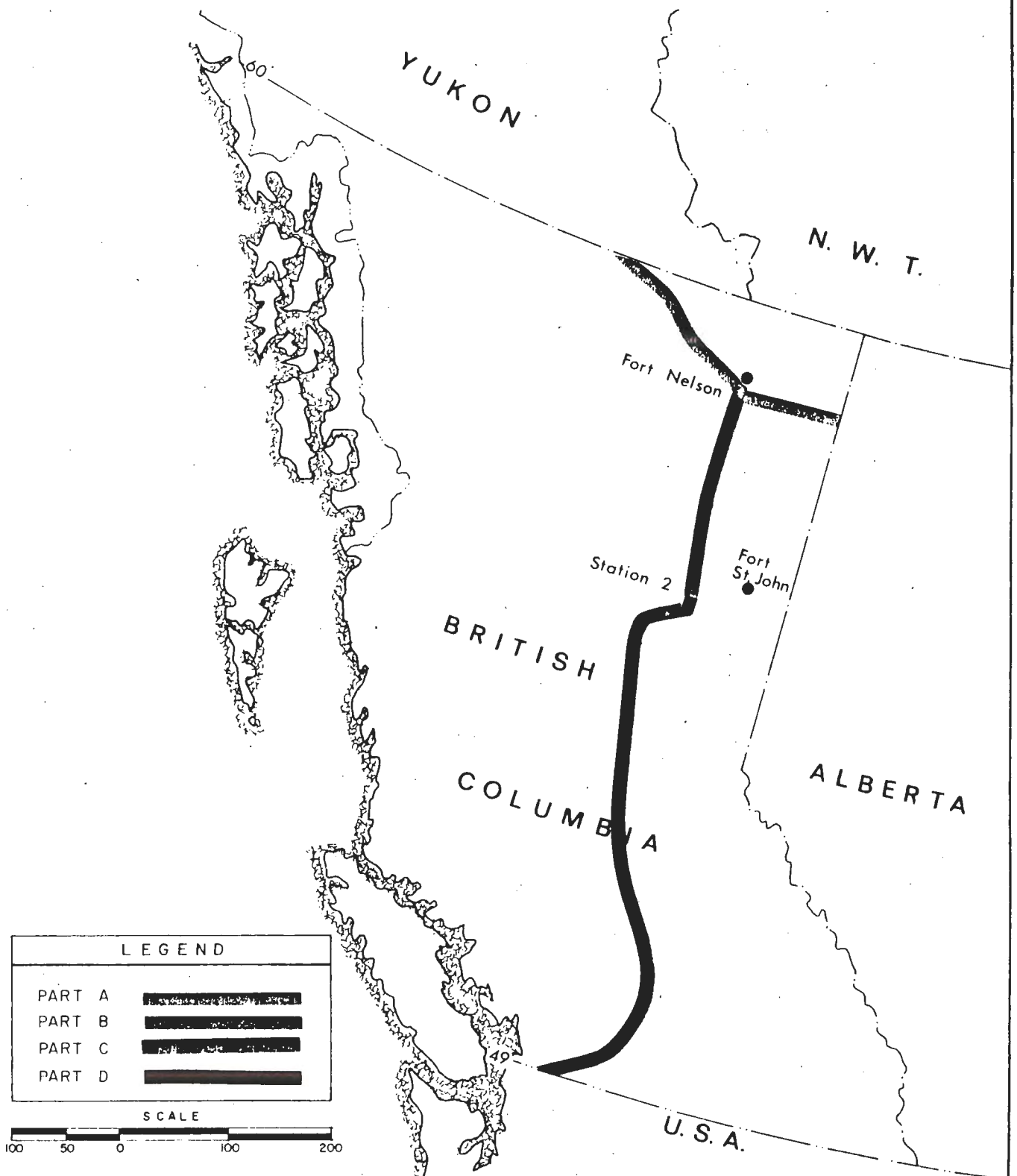
Issued by :

Effective :

Issued on :

"APPENDIX C"  
to  
Contract for Service  
for Transportation of Gas

Dated \_\_\_\_\_



## APPENDIX "A"

The pro forma tariff and Service Agreement  
of Foothills is incorporated by reference  
herein from Exhibit Z-3 of Alcan's F.P.C.  
Docket CP76- .

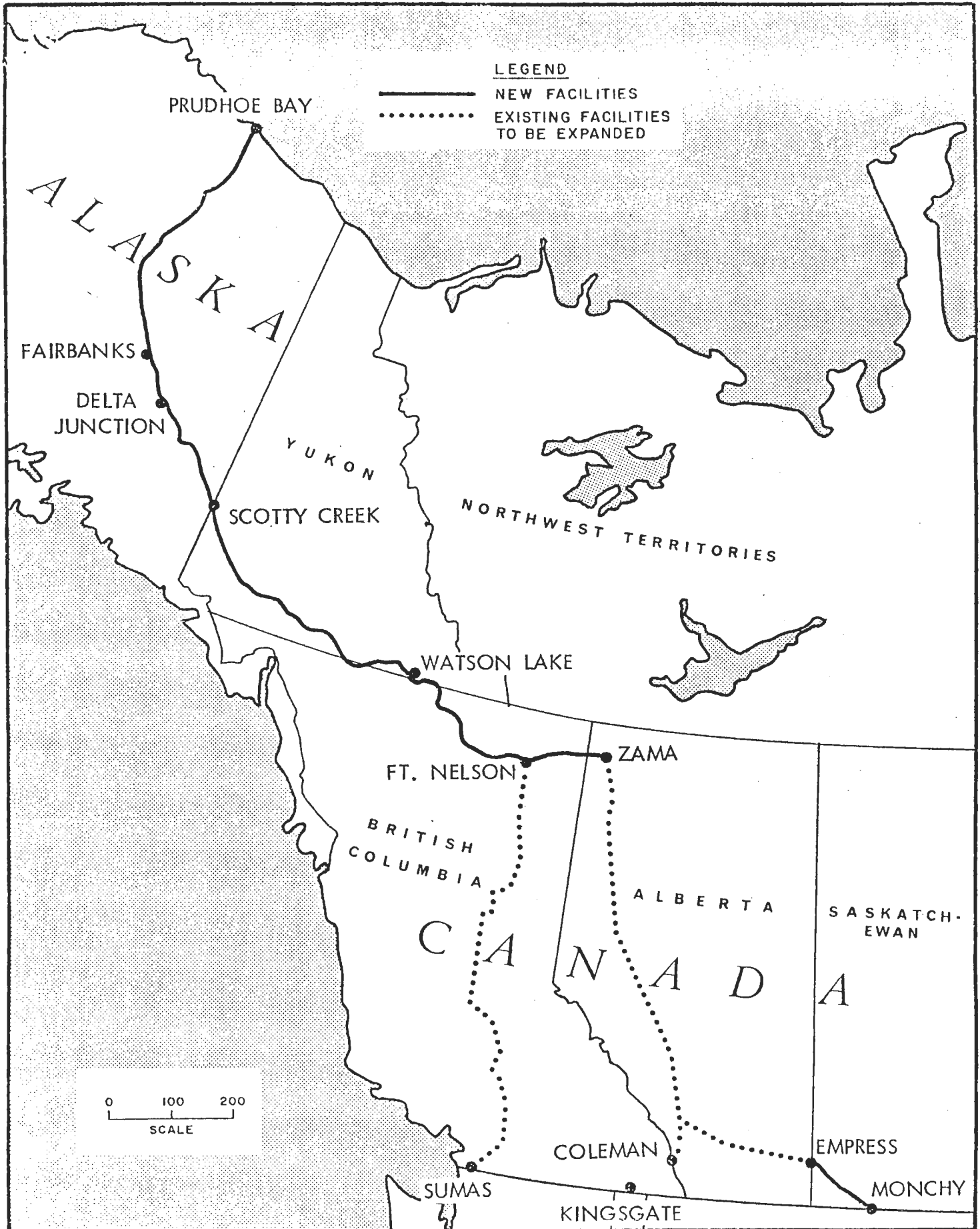
## APPENDIX "A"

The pro forma tariff and Service Agreement  
of Alberta Gas Trunk is incorporated by  
reference herein from Exhibit Z-5 of Alcan's  
F.P.C. Docket CP76- .



APPENDIX "A"

The pro forma tariff and Service Agreement  
of Alcan is incorporated by reference herein  
from Exhibit P of Alcan's F.P.C. Docket  
CP76- .



PROJECT PIPELINE

## APPENDIX C

### PROPOSED GENERAL CONSTRUCTION SCHEDULE

#### FOR ALCAN PIPELINE

-----

##### PHASE 1

Phase 1, which will require three (3) years will consist of the construction of approximately 730 miles of 42-inch diameter pipeline from Prudhoe Bay to the Alaska-Yukon border. In connection with such pipeline, thirteen (13) compressor stations with 106,000 installed horsepower for compression and 173,620 installed horsepower for refrigeration will be constructed. Three (3) meter stations will also be installed in Alaska. At the completion of Phase 1 this system will transport approximately 1,200 MMcf per average Day.

##### PHASE 2

Phase 2, which will require one (1) year will consist of additions to the existing thirteen (13) compressor stations in Alaska with 79,500 compressor horsepower. Approximately 1,600 MMcf per average Day will be transported through this system

##### PHASE 3

Phase 3, will consist of one (1) year during which the remaining two (2) compressor stations with a total of 212,000 horsepower for compression and 15,320 horsepower for refrigeration

will be constructed in Alaska. Upon completion of Phase 3 full capacity will be achieved and the system will transport approximately 2,400 MMcf per average Day.

OUTLINE OF SPECIFIC PLANT CONSTRUCTION  
ASSUMING GOVERNMENTAL APPROVALS AND FINANCING RECEIVED  
BY JANUARY 1, 1978  
-----

1978  
---

1. ANTICIPATED MAJOR ACTIVITIES

- A. Ordering Materials
- B. Selection of Contractor
- C. Civil Construction
- D. Construction of Communication Facilities

2. PERCENTAGE COMPLETION

- A. Design and Preliminary Work      97 percent
- B. Field Construction                      10 percent
- C. Major Equipment and Materials      0 percent

1979  
---

1. ANTICIPATED MAJOR ACTIVITIES

- A. Pipeline Construction
- B. Station Construction
- C. Hydrostatic Testing
- D. Clean Up and Reclaim, as Appropriate

2. PERCENTAGE COMPLETION

- A. Design and Preliminary Work 99.6 percent
- B. Field Construction 60 percent
- C. Major Equipment and Materials 55 percent

1980

1. ANTICIPATED MAJOR ACTIVITIES

- A. Pipeline Construction
- B. Station Construction
- C. Hydrostatic Testing
- D. Clean Up and Reclaim, as Appropriate

2. PERCENTAGE COMPLETION

- A. Design and Preliminary Work 100 percent
- B. Field Construction 97 percent
- C. Major Equipment and Materials 97 percent

1981

1. ANTICIPATED MAJOR ACTIVITIES

- A. Station Construction
- B. Clean Up and Reclaim, as Appropriate

2. PERCENTAGE COMPLETION

- A. Design and Preliminary Work 100 percent
- B. Field Construction 98 percent
- C. Major Equipment and Materials 98 percent

1982  
\_ \_ \_ \_

1. ANTICIPATED MAJOR ACTIVITIES  
\_ \_ \_ \_ \_

A. Station Construction

B. Clean Up and Reclaim, as Appropriate

2. PERCENTAGE COMPLETION  
\_ \_ \_ \_ \_

A. Design and Preliminary Work 100 percent

B. Field Construction 100 percent

C. Major Equipment and Materials 100 percent

Alcan Pipeline Company  
Docket No. CP76-  
Hearing Exhibit No. \_\_\_\_\_

EXHIBIT Z-8

Total Investment and Cost of Service  
to the Canadian-United States Border

ALCAN PIPELINE COMPANY

Capital Cost and Transportation  
To the United States-Canadian Border  
(Based on Escalated Cost)

EXPLANATION OF EXHIBIT Z-8

In Exhibit Z-8 the capital cost and transportation cost for Alcan Pipeline Company, Foothills Pipe Lines, Limited, Westcoast Transmission Company Limited and Alberta Gas Trunk Line (Canada) Limited are combined in order to show the total cost of the Alcan Project for transporting Alaskan gas to the United States-Canadian border. The costs are shown for the first five full years of operation and have been escalated in order to show the estimated cost which will actually occur. The exhibit also includes a comparison of the capital cost of the Alcan Project with the Arctic Gas Project and the El Paso Project based on escalated dollars and 1975 dollars. Finally, the exhibit shows a comparison of the total transportation cost on an escalated basis, at the United States-Canadian border for the Alcan Project with the Arctic Gas Project.

Schedule 1 shows the cost of service and unit cost for deliveries at the Sumas, Kingsgate, and Monchy delivery points under the Alcan Project. The estimated cost of service for the Alberta Natural Gas Company Limited is included to determine the cost delivered to Kingsgate.

Schedule 2 shows the comparison of capital costs at the 1975 level and on an escalated basis for the Alcan Project, the Arctic Gas Project, as adjusted in Schedule 4, and the El Paso Project.

Schedule 3 shows a comparison of the transportation cost for gas delivered to the United States-Canadian border on an escalated basis for the Alcan Project and the Arctic Gas Project, as adjusted. Costs are compared for the estimated first full year of operation for both projects -- 1983 for Alcan and 1987 for Arctic Gas. Alcan's cost for the year 1987 is also shown in order to compare concurrently with Arctic Gas.



Alcan Pipeline Company  
Docket No. CP76-  
Exhibit Z-8  
Hearing Exhibit No. \_\_\_\_  
Page 2 of 2

Schedule 4 shows the bases for the adjustment of capital costs and escalation of the cost for the Arctic Gas Project. This schedule also shows the basis for allocating the Canadian portion of the Arctic Gas Project capital cost between that for transportation of Alaskan gas and that for transportation of Canadian gas.

ALCAN PIPELINE COMPANY  
TRANSPORTATION COSTS FOR GAS DELIVERED  
TO THE UNITED STATES-CANADIAN BORDER  
(BASED ON ESCALATED COSTS)

--Dollars in Millions Except as Noted--  
Initial Years of Full Capacity Operation

LINE NO.	DESCRIPTION (a)	1983 (d)	1984 (e)	1985 (f)	1986 (g)	1987 (h)
<u>DELIVERIES AT SUMAS</u>						
1	Alcan Pipeline Company (Prudhoe Bay to Yukon border)	208.8	203.3	191.3	179.6	169.2
2	Foothills Pipe Lines (Yukon border to B.C. border)	69.2	68.0	67.9	67.4	66.7
3	Westcoast Transmission Company (B.C. border to Ft. Nelson)	40.3	39.0	38.5	37.5	37.0
4	Westcoast Transmission Company (Ft. Nelson to Sumas)	<u>110.3</u>	<u>115.0</u>	<u>112.7</u>	<u>111.0</u>	<u>110.9</u>
5	Total Transportation Costs	<u>428.6</u>	<u>425.3</u>	<u>410.4</u>	<u>395.5</u>	<u>383.8</u>
6	Delivered Volumes at Sumas (Bcf at 1000 Btu/Cu. Ft.)	258.4	258.4	258.4	258.4	258.4
7	Unit Transportation Cost (\$/Mbtu)	<u>1.66</u>	<u>1.65</u>	<u>1.59</u>	<u>1.53</u>	<u>1.49</u>
<u>DELIVERIES AT KINGSGATE</u>						
8	Alcan Pipeline Company (Prudhoe Bay to Yukon border)	59.7	58.2	54.8	51.4	48.4
9	Foothills Pipe Lines (Yukon border to B.C. border)	19.8	19.5	19.5	19.3	19.1
10	Westcoast Transmission Company (B.C. border to Ft. Nelson)	11.5	11.1	11.0	10.7	10.6
11	Westcoast Transmission Company (Ft. Nelson to Alta. border)	3.4	3.2	3.2	3.1	3.1
12	Alberta Gas Trunk Line (Canada) (Alta. border to Coleman)	20.9	19.8	19.2	18.7	18.3
13	Alberta Natural Gas (Coleman to Kingsgate)	<u>2.6</u>	<u>2.4</u>	<u>2.3</u>	<u>2.1</u>	<u>2.0</u>
14	Total Transportation Costs	<u>117.9</u>	<u>114.2</u>	<u>110.0</u>	<u>105.3</u>	<u>101.5</u>
15	Delivered Volumes at Kingsgate (Bcf at 1000 Btu/Cu. Ft.)	75.0	75.0	75.0	75.0	75.0
16	Unit Transportation Cost (\$/MMbtu)	<u>1.57</u>	<u>1.52</u>	<u>1.47</u>	<u>1.40</u>	<u>1.35</u>

ALCAN PIPELINE COMPANY  
TRANSPORTATION COSTS FOR GAS DELIVERED  
TO THE UNITED STATES-CANADIAN BORDER  
(BASED ON ESCALATED COSTS)

--Dollars in Millions Except as Noted--  
Initial Years of Full Capacity Operation

LINE NO.	DESCRIPTION (a)	1983 (b)	1984 (c)	1985 (d)	1986 (e)	1987 (f)
<u>DELIVERIES AT MONCHY</u>						
17	Alcan Pipeline Company (Prudhoe Bay to Yukon border)	418.0	407.0	383.0	359.5	338.8
18	Foothills Pipe Lines (Yukon border to B.C. border)	138.5	136.1	136.0	134.8	133.6
19	Westcoast Transmission Company (B.C. border to Ft. Nelson)	80.8	78.0	77.2	75.1	74.1
20	Westcoast Transmission Company (Ft. Nelson to Alta. border)	23.6	22.7	22.4	21.8	21.5
21	Alberta Gas Trunk Line (Canada) (Alta. border to Empress)	145.3	137.9	133.4	130.1	127.4
22	Foothills Pipe Lines (Empress to Monchy)	<u>47.9</u>	<u>47.4</u>	<u>46.8</u>	<u>44.9</u>	<u>43.9</u>
23	Total Transportation Costs	<u>854.1</u>	<u>829.1</u>	<u>798.8</u>	<u>766.2</u>	<u>739.3</u>
24	Deliveries at Monchy (Bcf at 1000 Btu/Cu. Ft.)	521.6	521.6	521.6	521.6	521.6
25	Unit Transportation Cost (\$/MMbtu)	<u>1.64</u>	<u>1.59</u>	<u>1.53</u>	<u>1.47</u>	<u>1.42</u>
<u>TOTAL DELIVERIES TO LOWER 48 STATES</u>						
26	Alcan Pipeline Company	686.5	668.5	629.1	590.5	556.4
27	Foothills Pipe Lines	275.4	271.0	270.2	266.4	263.3
28	Westcoast Transmission Company	269.9	269.0	265.0	259.2	257.2
29	Alberta Gas Trunk Line (Canada)	166.2	157.7	152.6	148.8	145.7
30	Alberta Natural Gas	<u>2.6</u>	<u>2.4</u>	<u>2.3</u>	<u>2.1</u>	<u>2.0</u>
31	Total Transportation Costs	<u>1400.6</u>	<u>1368.6</u>	<u>1319.2</u>	<u>1267.0</u>	<u>1224.6</u>
33	Deliveries to Lower 48 States (Bcf at 1000 Btu/Cu. Ft.)	855.0	855.0	855.0	855.0	855.0
33	Unit Transportation Cost (\$/MMbtu)	1.64	1.60	1.54	1.48	1.43

ALCAN PIPELINE COMPANY

Comparison of Capital Cost  
(Millions of Dollars)

Line No.	Description (a)	Amount	
		1975 Cost (b)	Escalated Cost (c)
1	Alcan Project (2.4 Bcf/D)		
2	Alcan Pipeline	\$2,328.8	\$3,116.3
3	Foothills Pipeline	1,036.8	1,366.4
4	Westcoast	805.0	1,201.4
5	AGTL (Canada)	<u>547.6</u>	<u>740.8</u>
6		<u>\$4,718.2</u>	<u>\$6,424.9</u>
7	Arctic Gas Project, As		
8	Adjusted (2.25 Bcf/D)		
9	Alaskan Arctic	\$ 869.8	\$1,313.4
10	Canadian Arctic allocated		
11	to Alaskan Gas (1)	4,148.2	5,737.0
12	Alberta Natural	<u>53.1</u>	<u>73.4</u>
13		<u>\$5,071.1</u> (2)	<u>\$7,123.8</u> (2)
14	El Paso Project (2.4 Bcf/D)	<u>\$6,424.0</u> (3)	<u>\$8,993.6</u> (4)

Notes:

- (1) See Exhibit Z-8, Schedule 4.
- (2) The total capital cost, including the amount applicable to Canadian gas is \$7,896.7 at 1975 cost and \$11,031.6 at escalated cost.
- (3) See Exhibit N.W.- (HCO-2)
- (4) Escalated at the same ratio as Arctic Gas above.

ALCAN PIPELINE COMPANY

Comparison of Transportation Cost  
To U. S. - Canadian Border  
(Based on Escalated Cost)

<u>Line No.</u>	<u>Description</u> (a)	<u>Reference</u> (b)	<u>Cost Per MMBTU</u> (c)
1	Alcan Pipeline Project		
2	Year 1983 - First Year		
3	of Full Operation	Exh.Z-8,Schedule 1	\$1.64
4	Year 1987	Exh.Z-8,Schedule 1	1.43
5	Arctic Gas Project		
6	Year 1987, As Adjusted	Exh.Z-8,Schedule 4	1.70

Note: Alcan estimates that Arctic Gas's first year of full operation will be 1987. See Schedule 4 herein for the basis of Alcan's adjustment.

ALCAN PIPELINE COMPANY  
Cost of Service For  
Arctic Gas Project, As Adjusted  
(Based on Escalated Cost)

Line No.		1975 Cost Basis (Million \$)	Escalation Factor	Escalated Basis (Million \$)		
		Total Allocated Capital Cost (Alaskan Gas) (a)		Total Allocated Capital Cost (c)	Cost of Service (Percent of Investment) (d)	Total Allocated Cost of Service (e)
1	ALASKAN ARCTIC	\$ 869.8	1.510	\$1,313.4	21.15	\$ 277.8
2	CANADIAN ARCTIC	4,148.2	1.383	5,737.0	21.20	1,216.2
3	ALBERTA NATURAL GAS	53.1	1.383	73.4	16.14	11.9
4	TOTALS	<u>\$5,071.1</u>		<u>\$7,123.8</u>		<u>\$1,505.9</u>
5	DELIVERED VOLUMES AT					
6	MONCHY & KINGSGATE					
7	(BCF 1000Btu/cf)					887.1
8	UNIT COST OF SERVICE					
9	(\$/MMBTU)					<u>\$ 1.70</u>

Notes: Col.(a) See page 2, Column K, herein, for Canadian and Alaskan Arctic cost and Exhibit AA - (JAJ-2) for Alberta Natural cost.  
Col.(b) Alaskan Arctic composite escalation factor based on Alcan Pipeline escalation rates and Canadian Arctic composite escalation factor based on consolidated filing before NEB plus delay of two years.

ALCAN PIPELINE COMPANY  
Estimated Canadian Arctic  
And Alaskan Arctic Capital Cost  
And Allocation of Canadian  
Arctic Capital Cost  
(Millions of Dollars)

Line No.	Line Segment (a)	Direct Capital Cost		Allocation of 1975 Capital Cost (d)	Adjustments to Capital Costs (e)	Revised Capital Costs (f)	AFUDC (g)	Total Capital Cost (h)	Segment Allocation Percent By Delivered Volumes		Allocated Capital Cost	
		Amount (b)	Percent (c)						U.S. (i)	Can. (j)	U.S. (k)	Can. (l)
1	CANADIAN											
2	ARCTIC	2	296.8	7.22	356.5	135.9	432.4	105.1	597.5	100.0	597.5	-
3		3	204.3	4.97	245.4	87.4	332.8	71.0	403.8	100.0	403.8	-
4		4	63.8	1.55	76.5	31.6	108.1	23.1	131.2	-	131.2	100.0
5		5	1928.5	46.91	2316.3	554.6	2870.9	612.6	3483.5	49.8	50.2	1734.8
6		6	1099.3	26.74	1320.4	-	1320.4	281.8	1602.2	54.6	45.4	874.8
7		7	273.8	6.66	328.9	-	328.9	70.2	399.1	45.3	54.7	180.8
8		8	138.4	3.37	166.4	-	166.4	35.5	201.9	100.0	-	201.9
9		9	106.1	2.58	127.4	-	127.4	27.2	154.6	100.0	-	154.6
10	Totals		4111.0	100.00	4937.8	809.5	5747.3	1226.5	6973.8		4148.2	2825.6
11	ALASKAN											
12	ARCTIC	1			535.1	186.7	721.8	148.0	869.8	100.0	869.8	-

Notes: Col.(b) Taken from CAGPE Consolidated submission with adjustment of Parson's Lake lateral from Line Segment 5 to Line Segment 4  
Col.(d) Total costs taken from P.H. Dau prepared direct evidence before the FPC - Exhibit AA- (PHD-1 and PHD-2).  
Col.(e) Based on 1975 Foothills Pipeline estimating parameters for logistics and construction applied to AAGPL and CAGPL cases.  
Col.(g) Based on J.A. Jeter prepared direct evidence before the FPC - Exhibit AA - (JAJ-1).  
Col.(i) and (j) Based on Page 3  
Col.(k) and (l) Segment allocation percentages applied to Col.(h)

ALCAN PIPELINE COMPANY  
Allocation of Canadian Arctic  
Capital Cost by Line Segment

Line No.		U.S. GAS (BCF)			Canadian Gas (V.C.F.)			Total U.S. and Canadian Gas 1000 BTU/CF (g)	Allocation Factor In Percent	
		1145	1095	1000	1045	1095	1000		U.S.	Canadian
		BTU/CF (a)	BTU/CF (b)	BTU/CF (c)	BTU/CF (d)	BTU/CF (e)	BTU/CF (f)		(h)	(i)
1	A. SUPPLY									
2	Prudhoe Bay	821.8		941.0				941.0		
3	MacKenzie Delta				821.9		858.9	858.9		
4	Totals							1799.9		
5	B. ANNUAL DELIVERIES									
6	FULL OPERATION									
7	WCTL				135.9	129.7	742.0	142.0		
8	Empress				644.0	614.6	673.0	673.0		
9	Sub-total				779.9	744.3	815.0	815.0		
10	Monchy	534.2	558.6	611.7				611.7		
11	Alberta-BC Border	240.5	251.5	275.4				275.4		
12	Sub-total	774.7	810.1	887.1				887.1		
13	Totals							1702.1		
14	C. FUEL AND LOSSES			53.9			43.9	97.8		
15	D. ALLOCATION BY LINE									
16	SEGMENT ON DEL'VD									
17	VOLUMES									
18	LINE SEGMENT NO.									
19	2	774.7			-			100.0	-	
20	3	774.7			-			100.0	-	
21	4	-			779.9			-	100.0	
22	5	774.7			779.9			49.8	50.2	
23	6	774.7			644.0			54.6	45.4	
24	7	534.2			644.0			45.3	54.7	
25	8	534.2			-			100.0	-	
26	9	240.5			-			100.0	-	

NOTES: Supply and delivered volumes taken from Canadian Arctic prepared direct evidence for NEB hearings, Phase A.