

III. ENVIRONMENTAL IMPACTS OF ALTERNATIVE ROUTES

"The short history of Environmental Impact Assessments and their review in general, has not been a happy one, and there is been the serious risk that all concerned become drowned in paper. A paramount need, especially where there are limitations in the time available, seems to be to strike a balance between the essential and the exhaustive. A review must be authoritative, incisive and comprehensive in the sense of including the important, but it defeats its own ends if it becomes unreadable and indigestible by excessive coverage of minor concerns."

Pipeline Application Assessment Group, Mackenzie Valley Pipeline Assessment: Environmental and Socio-Economic Effects of the Proposed Canadian Arctic Gas Pipeline on the Northwest Territories and Yukon, Minister of Indian Affairs and Northern Development, Ottawa, November 1974; p. 155.

"A catalog of environmental parameters such as local air and water quality indices, meteorological conditions, acres of land in selected uses, and species of plants and animals is necessary, but not sufficient for an environmental assessment. Further understanding of the productivity and value of discrete ecosystems should be developed. Such an evaluation requires an understanding of the complex interrelationships between living plants and animals and the physical environment in an area large enough to be distinguishable as an ecological system... It is important....that each ecosystem be assessed with respect to its uniqueness of character and its productivity, as well as its economic and social value... The danger of environmental intrusion by man is not necessarily the temporary loss of populations but rather the loss of or permanent change in the dynamics of the system that supports its productivity...in order to improve the base of knowledge necessary for understanding and assessing the impacts of man's activities, data [must] be developed to establish the natural ecosystems' dynamics."

Review Committee of the Environmental Studies Board, National Research Council, Issues in the Assessment of Environmental Impacts of Oil and Gas Production on the Outer Continental Shelf: A Critique of ... a Report to the President Prepared by the Council on Environmental Quality, National Academy of Sciences, National Academy of Engineering, Washington, D.C., 1974, pp. 21-23.

"An indication of the complexity and inevitable subjectivity of the environmental appreciations involved is the fact that each of the three principal parties viewing itself as having a duty to protect the public interest and natural environment suggest that a different route is environmentally superior. The Conservation Intervenors favor Alcan; the State of Alaska prefers El Paso; and the FPC Staff, based on its own and the DOI Staff analysis, recommends Arctic Gas."

Federal Power Commission, Initial Decision on Competing Applications for an Alaskan Natural Gas Transportation Project, February 1, 1977, p. 188.

How the task of this chapter was to be approached was made difficult not only by the magnitude of each of the three proposals which are now before the Federal Power Commission, their technological differences and complexities, the great geographic distances covered, and the diversity of the environmental areas covered--but also by the size and unevenness of the data base available. The sheer bulk of existing reports, studies and supporting documents from which an environmental analysis could be made is impressive, and the task of review and assessment of these sources at times appeared greater than the environmental assessment itself. In its February, 1977, report for example, the Federal Power Commission (FPC) staff reviewed the "record" at its closing on November 12, 1976.

"It consists of 253 volumes of transcript, embracing almost 45,000 pages, about 1,000 exhibits (some such as the environmental impact statements being almost 1,000 pages each), and innumerable items by reference.The applications and evidentiary material on the environment is massive. Arctic Gas alone submitted, for example, a superb 34-volume Biological Report series of books and book of component environmental overlay maps for its proposed route (AA-AA) as part of its initial back-up material for its environmental presentation. The Department of the Interior's EIS, large portions of which were adopted by the Commission's environmental staff, comprises eleven volumes weighing about 30 pounds, and the Staff's Final Environmental Statement is six volumes, which adopt in turn massive portions of its earlier three-volume draft statement."¹

Upon examination, much of this accumulation suffered the deficiencies noted in the opening quotations: sins of commission

(excessive minor coverage "just to be on the safe side") and sins of omission (a lack of sense of dynamics and process within existing systems--natural and human--and their potential interrelations with pipeline activities). The first difficulty could be overcome by the review process, but time and means did not allow the second to be corrected and the assessment remains essentially two-dimensional and static. Finally, there is the third difficulty noted above, the basically subjective nature of the task of assessment which has resulted in a complete lack of consensus among parties "having a duty to protect the public interest and natural environment." For this there is no cure, particularly as the present reviewer also has his own subjective bias.

Comparisons between the three competing proposals could only be approximate because of differences in technology (a mix of transport modes or a single mode) and purposes to be served (transport of Alaska gas only or a combination of Alaskan and Canadian gas) and, most importantly, because of significant differences in the stage of design development and the data base supporting each proposal. The Canadian government assessment group's 1974 characterization of the Arctic Gas proposal (the only one before it at the time) as a feasibility report only "concentrating on principles, theory and assurances" rather

than comprehensive data and analysis no longer can be applied to that proposal as supported in November, 1976. But because of the complexity and uncertainty of technology of LNG treatment and transport on the scale proposed by El Paso and the short time spent on the development of the Alcan proposal, these applications can still be characterized as resting heavily upon "theory and assurances." The FPC staff sums up the data support of the last two applications as follows:

"El Paso's knowledge...is general in nature. Alcan knows less. The fact of the matter is that El Paso, and possibly Alcan, apparently made a policy decision that it is sufficient for environmental purposes to meet NEPA requirements solely by identifying the most critical environmental impacts and giving a general plan as to how further site-specific work will be accomplished. There is really little to be said beyond this observation. El Paso ... relies almost exclusively on published literature ... As for Alcan, no question as to the depth of its environmental analysis had to be asked, since its minimum preparation in the spring and summer of 1976 did not even encompass a one-year base period. ... What this record is left with, therefore, is a minute dissection of every aspect of Arctic Gas' plan, because it is most complete to begin with, but only vagueness and non-specificity when it comes to discussing the other two projects."²

In the final analysis, in preparing this chapter, reliance had to be placed primarily upon the draft and final statements of the government agencies charged with making the official environmental impact assessments, with other sources being used to evaluate their performance and data used. The United States

government statements not only sifted through the mass of data provided by its own professional staffs, consulting firms, the applicants and numerous comments from other public and private sources, but organized the relevant data, analyzed the competing systems proposed and came up with firm recommendations as to the most environmentally acceptable. After a review of these statements and as much of the background data as time would permit, the present review concurs in these judgments. The subject of this chapter, therefore, is not so much an independent environmental assessment as a brief recapitulation and gloss of the official statements and the conclusions to which they lead, and a critique of the process more than the assessments.

Principal Existing Assessments

The Arctic Gas and Alcan proposals would be located for major portions of their length within Canada and the final official environmental assessments must include the results of investigation made by the Canadian government. The Mackenzie Valley Pipeline Inquiry (Berger Commission) closed its two-year hearings and evidence collection activities late in 1976, but at this writing has issued no draft or final reports of findings. The first phase of a report is scheduled to be issued in May, 1977, and a second in August, 1977. Coverage will

compare with the U.S. efforts. The hearings have been divided, for example, into four phases: (1) Engineering and construction: specifications, location, timing, employment, etc., (2) Physical environment impact: impact on land, air and water and effects on permafrost, river crossings, slope stability, borrow locations, etc., (3) Living environment impact: impact on plant and animal life, and (4) Human environment impact: social and economic impacts.³ A preliminary Canadian assessment was made in 1974 by social-economic and environmental teams from the Department of Indian Affairs and Northern Development of the Arctic Gas application, with a very brief note on the Fairbanks Corridor alternative.⁴ The Group is at pains to point out that although they may have "performed a somewhat parallel analytical process", this is not "an Environmental impact assessment in the normally understood sense of this term." Their purpose was "an appraisal or judgment of the quality of the materials, answers, and proposals submitted by the Application" in the light of the environmental aspects in the Expanded Guidelines for Northern Pipelines.⁵

The Department of the Interior through an understanding arrived at in 1974 with the Canadian government did produce a final environmental impact statement for the Canadian portions of the Arctic Gas proposal and a somewhat briefer statement for the Fairbanks Corridor alternative. This task was somewhat

hampered, however, by efforts "to avoid any inadvertent appearance of criticism of the Canadian Government or any implication of gratuitous advice" and the terms of the agreement "that the statement would be based upon documents and data provided by the Applicant and the Canadian Government, that no studies would be done in Canada by the United States, and that no suggestion would be made for additional studies to be accomplished by the Canadian Government."⁶ In the absence of the Canadian Government's final assessment of proposed projects traversing their territory, therefore, this chapter is limited to the data contained in the applications⁷, the preliminary 1974 Canadian assessment and the "Canada" volume of the Department of the Interior's "Final Environmental Impact Statement" of March, 1976.

The final United States environmental impact statements on the proposed Arctic Gas System (from Prudhoe Bay to terminals in California, Oregon, and Illinois) and the competing El Paso Alaska System are the product of a division of labor between the staffs of the Federal Power Commission and the Department of the Interior. The FPC staff prepared the final statement for the proposals by El Paso Alaska Company and Western LNG Terminal Company, and "with certain stipulations" used the final statements of the Department of the Interior staff as

their environmental assessment of the joint proposal by Alaskan Arctic Gas Pipeline Company, Canadian Arctic Gas Pipeline Company, Ltd., Northern Border Pipeline Corporation, Pacific Gas Transmission Company and Pacific Gas and Electric.⁸

The Arctic Gas proposal was determined by the FPC to be environmentally preferable to the El Paso proposal. Among the principal reasons given were the elimination of (1) the highest seismic risk areas for pipeline construction and siting of two LNG terminals, (2) construction of an industrial site in an undeveloped Alaska area and a remote California area with attendant alterations of environment and land use, and (3) impacts of tanker and plant operations upon marine environments. The all-pipeline route would also provide a more operationally reliable system with substantially lower fuel consumption during operation. Their final conclusion, however, was to "strongly recommend that neither of the applicants' proposals be approved as proposed" (emphasis added).⁹

The FPC staff's preferred alternative to the Arctic Gas System was the Fairbanks Corridor without the Pacific Gas Transmission Line to the West Coast and without the Richards Island Lateral. When Mackenzie Delta gas becomes available, it was proposed that these additional volumes be attached to the system by a 756 mile long lateral pipeline along the Demster Highway

corridor.¹⁰ The Department of the Interior staff also appeared to favor the Fairbanks Corridor alternative over the two proposals for which applications had been made and from its earliest assessments has included comparisons with the Arctic Gas and El Paso proposals almost as though the materialization of a third application was certain.¹¹

On May 10, 1976, the Northwest Pipeline Corporation finally did issue a statement noting that "the facts brought to light in this proceeding suggest that the Fairbanks Corridor route offers the most environmentally acceptable, economic and feasible method of satisfying the majority of the interests in a manner that is beneficial to the consumers of both Alaska and the lower U.S."¹² It proposed a joint United States-Canada undertaking, therefore, that followed this corridor and used existing Canadian gas systems for final transmission to United States' markets. At Ft. Nelson, the West Coast portion would be diverted into expanded Westcoast Transmission Company, Ltd., facilities for delivery to Sumas, Washington, and at Zama Lake, Alberta, for delivery through expanded facilities of the Alberta Gas Trunk Line Company, Ltd., for mid-west and eastern markets. Mackenzie Delta gas would be transported via the proposed "Maple Leaf" project to the existing Alberta Gas Trunk Line system at Zama

Lake.¹³ Application was filed on July 9, 1976, and FPC staff issued a supplement to its FEIS "on or about September 15, 1976."¹⁴

On February 1, 1977, the FPC staff published its "Initial Decision" document which was the final document reviewed in the preparation of this chapter. This 430 page report (plus nine appendices) subjects all three competing applications to a final summarization and assessment. The argument in support of the staff's recommendation is based upon a broadening of the gas reserves to be transported from only the Prudhoe Bay fields to include all probable reserves of the North Slope and Mackenzie Delta. The environmental assessment is summed up as follows (emphasis added):

"The Commission Staff, after (1) supporting its own Fairbanks alternative as environmentally best and (2) asserting that approval of any of the applications will result in substantial environmental impacts, chooses the Arctic Gas proposal as the least undesirable application, then Alcan, and the El Paso. Its prime arguments relegate El Paso to third place but still environmentally acceptable (with implementation of appropriate mitigative measures) because of the 'environmentally dangerous' LNG facilities in both Alaska and California, unsound pipeline route through the pristine Chugach National Forest, tanker routes through sensitive fisheries, heated effluent discharges in Prince William Sound, and incursion of industry into otherwise non-developed Alaskan areas. In its view, Alcan's inability to carry projected volumes of other Alaskan gas as distinct from the initial Prudhoe volumes without another round of construction is seen to be an overwhelming negative aspect. Since Staff views both El Paso's and Alcan's proposals in the need for an additional pipeline to move Delta gas to Canadian markets,

it finds that the total combined proposed construction impacts of both pipeline systems (El Paso-Maple Leaf and Alcan-Maple Leaf) render them less desirable. Furthermore, Staff asserts that neither El Paso nor Alcan has done adequate environmental studies or preparation, and it particularly criticizes El Paso's lack of (1) seismic, (2) LNG site geological, (3) general biological, and (4) treated heated effluent investigation of possible adverse impacts at Gravina Point.

"Its support of Arctic Gas can best be described as picking the lesser of the evils. ... unless all hydrocarbon exploration and development in the Wildlife Range is prohibited, there will be future development within the range and no reason appears for precluding a gas transmission pipeline as inconsistent with the range. As previously stated, while faulting Arctic Gas for ignoring the probable environmental degradation of the Wildlife Range and its unbroken continuum of Arctic ecosystems, it grudgingly admits that substantial effective work and effort has gone into both the design and operation, that for the most part, it will be successful, and that it should be certificated."¹⁵

In addition to the three alternatives now before the Federal Power Commission and the U.S. Department of the Interior, the government statements considered numerous other alternatives, some in considerable depth. The Department of the Interior assessment included analysis of cost and benefits of alternatives to building any Alaska natural gas transport system (effects of deregulation, development of other natural gas sources, substitute fuels, etc.). In addition to a detailed consideration of the El Paso alternative (and five variations) to the Arctic Gas proposal, the Department also considered other alternative transportation systems (dense-phase pipeline, methanol pipeline, railway, monorail, ice-breaking tanker, submarine, airplane, helifloat,

dirigible, electrical generation at Prudhoe with energy transmission). The Federal Power Commission considered similar alternatives to the two original proposals with more emphasis upon the El Paso variations.¹⁶ Two private proposals were made in 1976 for conversion of Alaskan natural gas into fuel grade methanol for transport by tanker or in batches through the TAPS line (Westinghouse) or methanol with coal to produce a coal slurry for pipeline transport (Wentworth Brothers). Neither of these have been made the subject of applications to the FPC, have no environmental assessments, and it is assumed at this time that they will not progress further.

Assessments of all three projects by other parties are included in the hearings record and exhibits. The most technically detailed are the series of briefs and reply briefs as each applicant attacked their competitors' projects and defended their own. Most of this has been incorporated in the FPC final assessments. The "Conservation Intervenors" and State of Alaska contributions to the record are not so much true assessments as highly biased advocacy tracts which, judging by the FPC staff reactions to each, probably did their respective causes (the Alcan and El Paso projects) more harm than good in the final appraisal.¹⁷ Although these assessments were used in the present review process, they contributed no new data or analysis. The state of Alaska has

limited its assessment only to the Alaska sections of the three proposals and its concept of the purpose to the transport only of Prudhoe Bay gas.

Scope of Assessment

The purpose of this chapter is to provide a broad comparison of environmental assessments made of the three alternative natural gas pipeline routes now proposed to the FPC. In order to bring this task within manageable dimensions, a first step was to restrict the comparisons only to the three proposals as they stand in the FPC staff's February, 1977, decision document. Although Alcan offered a new proposal on March 8, 1977, enlarging the diameter of its pipe to increase potential capacity and overcome the FPC objections, for example, this has not been assessed as a basis for doing so does not exist at the time of this writing.

The second step taken was to limit the scope of the assessment of each proposal geographically to those portions of highest environmental concern (i.e. limiting the southward extension of the approximate points where the transmission systems leave the area of application of the Arctic pipeline construction procedure of the Canadian "Expanded Guidelines for Northern Pipelines" and enter areas of the Canadian provinces and the lower United States where gas transmission systems are already in existence). For

the El Paso proposal, this is the point of re-gasification in California; for the Alcan proposal, the points at which gas is transferred into the existing systems of Westcoast Transmission Company, Ltd., and Alberta Gas Trunk Line Company, Ltd., at Zama Lake, Alberta; and for Arctic Gas, the point where the Canadian Arctic Gas line crosses the NWT-Alberta border and continues south parallel to the route of the Alberta Gas Trunk Line Company, Ltd. (approximately 60 degrees north latitude).

Whatever project is finally built, additional lines will be required in the lower States and Canada in order to provide the almost nation-wide market spread each seeks. As Alcan has demonstrated by its proposal, opportunities exist for use of existing systems with some modification to increase capacity. In any case, the addition of new lines in existing corridors would result in relatively minor environmental impact increments. The Department of the Interior in its 1974 feasibility study demonstrated that greater flexibility is available than contained in the applications for the use of displacement and exchange agreements as a means of maximizing use of existing facilities instead of constructing new facilities.¹⁸ Finally, for portions of the projects excluded, the environmental issues are not unique relative to lines running through virgin wilderness, permafrost or ice rich soils, extreme Arctic climatic conditions, tundra vegetative cover, meandering rivers, earthquake zones, etc., and LNG processing and transportation.¹⁹

Further, an attempt was made to strike a balance between the essential required for this generalized assessment and the exhaustive required by the official statements. In this, the approach used by the Canadian assessment group was instructive and was approximate in the preliminary review process in identifying environmentally sensitive areas. An environmental matrix of impacting and impacted variables was first devised by the environmental group as a general check list and as the basis for identification of selected major topics related to the purpose of the assessment (i.e. appraisal of the proposal in the light of the expanded construction and operating guidelines). Within the six main stages of pipeline development (preconstruction, construction, start up, operation, maintenance, and abandonment), a total of 141 specific activities were listed as having potentially significant environmental effects upon an identified 136 environmental components. Of the resulting 19, 176 possible interactions between pipeline activities and environmental components, 12 percent were rated as having major, 8 percent medium, 7 percent minor, and 73 percent no potential significance. The topic selections for specific studies selected from among the 27 percent significant interactions were neither project-oriented nor environment-oriented, but were defined by the processes of interaction between both and the purpose of their assessment.²⁰

Although their approach was useful, the Canadian group's final topic selection was not, because of the differences of purposes to be served. For example, their selection focused upon details of engineering design in relation to soil stability, etc., but the issue of land-use conflicts, a key issue for the present assessment, was excluded on the assumption "that the pipeline right-of-way and all other lands to be used will be selected only after due allowance has been made to avoid land-use conflicts" such as overlap of Native subsistence areas, archaeological sites, established or potential land reserves, areas of unique landscape or aesthetic qualities, recreational areas (present and future), scarce resource areas required for local use, critical habitats, etc.²¹ The assumption is made, not because it is realistic, but the issues excluded by it are not highly relevant to an assessment of design planning and execution standards for pipelines in a northern environment, the primary purpose of the Canadian assessment.

This chapter focuses upon issues which were excluded in the preliminary Canadian assessment and in turn largely assumes away what it had selected as its focus (i.e. assessment of engineering and design standards). Little, if any, reference will be made to issues of interaction of engineering and physical environment on the assumption made in this chapter that in all three projects

the governments will enforce and the developers will seek (in the interest of reliable and economic operation) the highest standards for project design planning and execution in order to avoid soil stability failure and erosion, for example, that in all cases, the most stringent mitigation measures will be exercised, and that the same specifications will be followed in construction clean-up, revegetation and removal of causes of "deleterious environmental effects" after inactivation or abandonment.

The FPC staff's approach to striking a balance between the essential and the exhaustive was first to define the key environmental issues. This not only reduced the magnitude of the comparative assessment task, but also predetermined the staff's decision.

"There are three important and controversial 'physical' environmental issues in this proceeding affecting Alaska: the Arctic Gas proposal to contract and operate a pipeline across the Arctic National Wildlife Range and El Paso's proposal to both (1) cut across the Chugach National Forest and (2) establish an industrial marine facility in Prince William Sound. On the broader scale, there is only one key 'physical' environmental issue: a comparison of the environmental impact of building a project to transport only U.S. gas as against a project to transport both U.S. and Canadian gas. The environmental effect of having to build two separate transportation systems, El Paso and Maple Leaf or Alcan-Maple Leaf must be weighed as against the overall environmental impact of building only one."²²

The remaining assessment task, however, was still "awesome" (to use an FPC staff expression). "This record is literally awash with excellent material relating to every aspect of the (physical) environment." In addition to the physical, there were the socio-economic environmental impacts and there was the troublesome long and short-term time dimensions of the impacts (e.g. the disruptive short-term impact with no long-term effect and the minor short-term impact with totally unacceptable long-term impacts). Although the matrix-type analysis undertaken by the Canadian study group was not made explicit in the FPC assessment, it was inherent in the judgment used in narrowing the specific areas of study. The final element in their approach and methodology was to assume that maximum mitigation measures would be applied in all three cases.

"The routes proposed all traverse many areas where there would be only a limited effect upon the environment, either short- or long-term, and no effort will be made to discuss the impact which might occur except in those areas which are particularly sensitive. Similarly, some socio-economic impacts are not so significant as to merit separate discussion. ... It is also assumed that ... respective federal, state and local licensing authorities will have a substantial voice as to mitigative environmental activities (such as site-specific avoidance of sensitive areas or timing of construction). It is further expected that relatively minor realignments or mitigative measures will occur to cure localized events. A discussion of each applicant's route and viable alternative routes from an environmental point of view will be made, therefore, only as to those areas where the environmental effect is significant or the parties have argued it is significant."²³

This chapter will not attempt any summary of the contents of the environmental material in the record or in the environmental impact statements of the Department of the Interior and the FPC staff, but will sort out and focus on impacts that these sources have identified as significant. The heroic assumption that somehow mitigation will be undertaken and will be effective where it is indicated as being possible is also accepted. Although the three key issues and one general issue defined by the FPC staff will provide some organization for the discussion, they should not be accepted without further questioning and evaluation.

Physical Features and Requirements of the Three Proposed Alternatives

Tables 1, 2, and 3 summarize a few of the environmental aspects of the three proposed alternative routes (Alcan alternative No. 2 is not included) in terms of physiographic regions and divisions crossed by the lines, number of major river crossings, degree of penetration of wilderness, and length of each line through permafrost zones. These are only a sample of the many physical features of the environment which were considered in the record in assessing the safety and potential impact of the engineering design and routing of the three proposals. The problem of arriving at some convenient form of comparison, however, is made almost impossible by differences in the amount of back-up research done by the applicants. Only Arctic Gas appears entitled to

TO ZAMA LAKE, ALBERTA - MAIN PHYSICAL FEATURES

Physiographic Region or Division	Number of Pipeline Miles	Number of Major River Crossings	Miles Through Permafrost		
			Continuous	Widespread - Discontinuous	So. Fringe - Sporadic
<u>I. Alcan Pipeline Company (Alaska)</u>					
Arctic Coastal plain	60	0	60	-	-
Arctic Foothills	68	3	68	-	-
Central & Eastern Brooks Range, Amblor-Chandalar Ridge & Lowland	122	7	122	-	-
McKone-Hodzana Highlands & Rampart Trough	120	2	-	120	-
Yukon-Tanana Upland	135	6	-	135	-
Tanana-Kuskokwim Upland & Yukon Plateau, North	226	6	-	226	-
<u>Sub total</u>	<u>731</u>	<u>24</u>	<u>250</u>	<u>481</u>	<u>-</u>
<u>II. Foothills Pipe Lines, Ltd. (Yukon Territory)</u>					
Tanana-Kuskokwim Upland & Yukon Plateau, North	48	1	-	48	-
Shokwak Valley	142	2	-	141	1
Yukon Plateau, South	221	4	-	-	221
Cassiar Mountains	63	0	-	-	63
Laird Plain	35	0	-	-	35
<u>Sub total</u>	<u>509</u>	<u>7</u>	<u>-</u>	<u>119</u>	<u>390</u>
<u>III. West Coast Transmission Co., Ltd. (British Columbia)</u>					
Laird Plain	92	2	-	-	92
Laird Plateau	57	1	-	-	57
Fort Nelson Lowland	207	5	-	-	207
<u>Sub total</u>	<u>356</u>	<u>8</u>	<u>-</u>	<u>-</u>	<u>356</u>
<u>IV. Alberta Gas Trunk Line, Ltd. (Alberta)</u>					
Fort Nelson Lowland	50	0	-	-	50
<u>GRAND TOTAL</u>	<u>1,646</u>	<u>39</u>	<u>250</u>	<u>600</u>	<u>796</u>

IN ALASKA

Miles Through Permafrost

Physiographic Region or Division	Number of Pipeline miles	Number of Major River Crossings	Miles Through Permafrost		
			Continuous	Widespread, discontinuous	So. Fringe sporadic
Arctic Coastal Plain	60	0	60		
Arctic Foothills	68	0	68		
Central & Eastern Brooks Range, Ambler-Chandalar Ridge & Lowlands	122	6	122		
Kokrine-Hodzana Highlands & Rampart Trough	120	2		120	
Inukjuag-Upland & Tanana-Kuskokwim Lowland	167	8		167	
North Foothills & Alaska Range	55	8		55	
Gulkana Upland	40	0		40	
Copper River Lowland	55	3		55	
Kenai-Chugach Mountains	123	4			53
<u>GRAND TOTAL</u>	<u>810</u>	<u>31</u>	<u>250</u>	<u>437</u>	<u>53</u>

Wilderness: approximately 40 miles of line through Chugach National Forest.

SOURCE: Applicant's route atlas and Federal Power Commission, Alaska Natural Gas Transportation System: Final Environmental Impact Statement, April 1, 1976

passing marks in support of its design and route proposals. At one point, the FPC staff report in frustration (a frequent occurrence during the course of the document) states:

"El Paso, primarily through its lawyers, has made a silk purse out of a sow's ear. It has done little intermediate design work and its design, while impressive on paper and in the strip maps, has no particular backup by core samples or even general site-specific work anywhere along its actual route. At Gravina Point and through the Chugach Mountains in particular, this omission is significant... Alcan itself has not met its burden of proof on construction schedules and its 3-year phased-in construction plan is not supported by the evidence."²⁴

In making its assessment, FPC staff had to fall back on the knowledge that the competing consortiums are made up of "experienced and knowledgeable companies" and that deficiencies can be assumed to be made up by "piggybacking" on the evidence of Arctic Gas and the experience of Alyeska.

The reference to the several different physiographic environments through which each line proposes to run from the Arctic coastal plains to the coastal rain forests in the case of El Paso and to the central plateau country of Alberta in the other two, through a rich variety of geological and vegetative zones, each presenting its own special set of engineering challenges and threat of potential environmental degradation if design is not adequate. Problems of soil stability, terrain and slope characteristics are common to all, but the river crossings and permafrost

zones have been chosen here as giving at least an index of the relative difficulties faced by each in terms of physical environmental impacts and design problems.

Major stream crossings are critical points in the lines because of potential unstable soil conditions, disruption of stream beds (including in some instances important fish spawning beds), the possibility of introducing chemical substances into the aquatic environment and the spread through the flow of waters, presentation of special problems during construction and design problems in increasing the integrity of the pipeline, correction or avoidance of construction problems by stream modification (by culverts, riprapping, channelization, diversion) and so on. Arctic Gas appears to exceed the numbers of stream crossings required by the other two lines, but if the FPC assumption is accepted that they would each require construction of a second line (the Maple Leaf Project) in order to move all of the available natural gas, Arctic Gas appears the most desirable in terms of this measure.

Most Alaskans are familiar with the significant impact of permafrost upon construction--the melting of ground ice, subsidence, thermal and other erosion, destructive drainage

changes, topographic and slope fracture, massive soil sloughing, serious damage to vegetation, to name a few items that come readily to mind. The Alyeska hot oil line attempted to avoid these undesirable results through elevating much of its line above ground and artificially refrigeration of soil in critical places. All three natural gas pipelines are basically buried chilled gas lines which should avoid the thaw problems associated with the hot oil line, but introduce an entirely new set of problems. The use of chilled lines under certain permafrost conditions produce frost heave and buoyancy uplift problems which result not only in environmental damage but instability of the pipeline. This is most likely in discontinuous permafrost areas where water migration can occur through the soil to the buried pipe where the below 32 degree Fahrenheit temperature of the gas would cause ice lens to form, resulting in frost heave. FPC estimates that Arctic Gas will encounter about 250 miles of soils susceptible to frost heave, Alcan 100 miles and El Paso between 50 and 100 miles. As in almost every other instance, only Arctic Gas has specifically identified frost heave areas and experimented with means of coping with them.

Degradation of the vegetative covering in either continuous or discontinuous permafrost zones will cause thermokarsting (progressive deterioration of the surface until a new equilibrium of heat exchange is established) which would result both

in environmental damage and instability of the buried pipeline. The Arctic Gas line leads in distance through continuous and discontinuous permafrost with a total of 1,111 miles, Alcan is second with a total of 850 miles and El Paso third with only 687 miles. But again, if the purpose of the system is to transport all natural gas from the North Slope and Mackenzie Delta, the Maple Leaf line will be required if Alcan and El Paso are built and the combination of either set of two lines compared with Arctic Gas gives the single line a distinct advantage. As in the case of the river crossing, this comparison makes clear why the FPC staff believes that there is only one key 'physical' environmental issue: a comparison of the environmental impact of building one consolidated system or two separate transportation systems, as was noted above.

A final category in which general comparisons can be made of the three routes refers to seismicity. One of the major pluses for Arctic Gas is that its route appears to avoid entirely the problems associated with seismic threat. The El Paso line is the most vulnerable to earthquake rupture hazard as it traverses several seismically active areas. In southcentral Alaska, these include three active linear faults, five alleged inactive faults and numerous faults in the Chugach Mountains which have not been studied. The final environmental impact statement summary puts the matter into a few words:

"In Alaska, the danger of large-scale earthquakes presents serious hazards to the pipeline and LNG plant. Tsunamis resulting from the earthquakes could endanger loading docks and tankers. There is the possibility of the existence of a fault within two miles of the property proposed for LNG facility construction, and this area is on the strike of the major faults involved in the 1964 event. In California, the proposed pipeline route crosses at least 22 mapped fault traces."²⁵

In general, the FPC staff found El Paso's seismic research and design to be "preliminary and inadequate" although agreeing this could be overcome. Notice was also taken that with both the oil and natural gas lines traversing approximately the same areas, a seismic event could result in the simultaneous rupturing of both systems for transporting hydrocarbons, while the use of a different route for natural gas would at least assure a continuation of a portion of this flow to meet "public convenience and necessity" requirements. The Alcan line would share with El Paso the hazard of proximity to the Denali fault and in Yukon Territory, its route would parallel the Shakwak fault. Design would have to take into account these hazards, but the problem would be minor compared with those faced by El Paso.

Land and Native materials requirements of the three lines present further measurable physical environmental impacts. In addition to the rights-of-way for the line itself, a number of support facilities are required in each project which are a function of length, strength, and size of pipe and topography.²⁶

Within Alaska, Arctic Gas will construct 195 miles of pipeline supported by four compressor stations, two seaports with docking facilities, 16 aircraft facilities (plane landing fields and helipads), 250 miles of road (only two miles of which will be permanent access roads) and other miscellaneous sites (material stock piles, etc.). The total land requirements would be 4,630 acres of which 3,720 acres would be permanent and used in the operating phase. El Paso's project calls for a 809 mile pipeline with 12 compressor stations and a gas liquefaction facility and tanker terminal. The construction right-of-way land requirements would be 14,712 acres (it is not stated whether this is only the line right-of-way or if it includes the land requirements for related facilities) of which 5,247 acres would be retained for the life of the project. The LNG plant and terminal would require 450 acres. Alcan would construct a total of 731.4 miles of pipeline within Alaska supported by 15 compressor stations and other facilities (pipe storage, river crossing works, access roads, etc.). The total land requirements are 12,100 acres. Data are not available for the land required on a temporary basis for pipe storage years at Prudhoe Bay, Valdez and Fairbanks and construction camps.

Within Canada, the record does not present as complete land requirements data as it does for Alaska. The continuation of

the Arctic Gas line from the Alaska-Y.T. border to the N.W.T.-Alberta border would be approximately 1,118 miles in length and require 18 compressor stations, while the continuation of the Alcan route from the Alaska-Y.T. border to Zama Lake, Alberta, would be 914.8 miles in length and require a total of 17 to 18 compressor stations. In California, the El Paso proposal would require 227 acres for its regasification facility, 31 acres for terminal, 2,250 acres for construction of pipelines from the regasification plant to existing transportation systems (a pair of 142.3 mile long, 42 inch pipelines and one 108.9 mile long 42 inch line) of which 1,300 acres would be permanent. To complete the picture, the FPC summary includes a brief description of the proposed adjunct to the Alcan proposal, the Foothills application to the Canada National Energy Board to construct the Maple Leaf line from Richards Island on the Mackenzie Delta to Zama Lake, Alberta. This is a competitor to the Alcan Canadian extension and follows approximately the same route, absent the Prudhoe Bay supply line. The main line would be 817 miles of 42 inch diameter pipe with a 15 mile-30 inch lateral connecting the Parsons Lake field. The project also calls for construction of 18 compressor stations and other appurtenant facilities. Following the FPC assessment criteria, this line would also have to be added to the El Paso project to meet their requirement

that the systems certified be capable of transporting all natural gas from the North Slope and Mackenzie Delta.

All systems would require huge volumes of gravel to meet right-of-way, road and facility construction pad requirements. Within Alaska, the estimated Arctic gas requirements are 3.9 million cubic yards, El Paso 16.4 million cubic yards, and Alcan 11.3 million cubic yards. The continuation of the Arctic Gas line to 60° N. in Canada would require approximately 27.6 million cubic yards. Data are not available as to Alcan's Canadian extension requirements.²⁷ The assessments by Department of the Interior and the applicants appear to indicate that all of the gravel requirements of Arctic Gas and Alcan could be met by use of existing gravel borrow pits created during the construction of the Alyeska oil line and highways near the proposed routes. Although El Paso strongly contends the same situation would apply to their project, the issue was hotly debated and the FPC staff concluded that "there are localized and even regional shortages" and that "there is in fact a gravel shortage along El Paso's alignment on the North Slope for some 200 miles from the Brooks Range to Prudhoe Bay." To meet this shortage may require stream-bed gravel collection which would severely impact fish and water quality, but the staff also suggests the use of snow workpads, as proposed by Arctic Gas. In any case, "additional studies must be forthcoming from El Paso on this matter."²⁸

The Arctic engineering design includes a unique feature not contained in the other projects, namely the resort to use of snow as work pad material in constructing its line and facilities across the North Slope. The technique has been used elsewhere and Alyeska made limited and experimental use of it, but this is the first time it is proposed as a major element in a project of this magnitude. If feasible, it has a number of apparent advantages from the environmental standpoint. If the snow pad is adequate, it should impose only temporary and readily corrected damage on environment and can be made to "disappear" upon abandonment. The proposal has received interested review by all assessments from the 1974 preliminary Canadian assessment to the 1977 "Initial Decision" report of the FPC staff.²⁹ It has also been a prime target of attack by the other two applicants, the Conservation Intervenors (who are against the whole project on principal) and the state of Alaska as to its feasibility.

It is proposed by Arctic Gas to collect natural snow by snow fencing and harvesting from frozen lakes and other sources. Its investigations have demonstrated that because of the relatively low snow fall on the North Slope, this will have to be supplemented by the manufacture of snow. In general, snow roads and work pads will be used in all areas of sensitive permafrost north of 65° N. latitude, an estimated total of 915 miles. The process of

construction is based upon study of past experience and the actual building and testing of three roads under conditions similar to those anticipated to be encountered on the actual route (the tests were at San Sault, Norman Wells and Inuvik). The snow-making process is similar to that used on many American ski slopes. The FPC staff after assessing contributions made by all parties to the record and the results of Arctic Gas' studies and experiments found that the applicant "has demonstrated, by the weight of vast evidence, that its snow road plan is both feasible and effective and can be accomplished with a minimum of environmental harm." This conclusion is further strengthened when it is remembered "that the alternative is gravel pads, involving problems of borrow sites, aesthetics, permanent accessibility, changes in thermal regime, drainage and added expenses."³⁰

The principal environmental impacts of snow roads and work pads are concerned with water withdrawal for snow making and vegetative mat compaction through use of the road. Arctic Gas estimated the need for a total of 8,222,000 bbl. of water for construction from Prudhoe Bay to the west side of the Mackenzie Delta. Of this amount 6 million bbl. would be for manufacture of snow. Although potential sources of water from groundwater, mountain and tundra spring streams and lakes and ponds appear adequate, the problem arises from the fact that only spring streams and a few lakes are not frozen to the bed during winter.

These limited sources are also habitat for spawning and overwintering fish. Debate focused, therefore, on water availability after freeze-up. Arctic Gas water studies have concluded that sufficient water would be available during this critical period without environmental damage on withdrawal from lakes which contain no fish and by use of other lakes following strict precautions as to size of lake, volume of water not frozen and limit on withdrawal which would avoid fish habitat damage. FPC staff concurs on this conclusion with the qualifier that "more precise information concerning water sources must and will be gathered during the final design stages."³¹ Potential problems concerning impact of snow roads upon vegetative mat were primary impact upon the vegetation and the secondary impact of compaction of the mat. The Inuvik tests appear to have demonstrated that a processed snow road could protect the underlying vegetation, and that with proper construction secondary impacts of compaction could be avoided or minimized. Because the Norman Wells tests results introduced some ambiguities on this last subject, the conclusion was that although the Inuvik tests were "auspicious" further tests would be desirable.³² Again, these assessments must be considered in the context of the only alternative (if a project is to be built) of using gravel pads.

The El Pasco assessment was uncomfortably vague on the safety factors of the LNG plant at Gravina Point and the marine link

with California. The essence of the proposal was given in these terms: "El Paso proposes to transport natural gas 800 miles due south from Prudhoe Bay, liquefy it at a plant in a seismically active area, load the LNG onto 165,000 cubic meter tankers, transport the LNG in the tankers 1,900 miles to a point in California and unload the LNG into a regasification plant also in a seismically active area." Although this system is not based upon any new technology, it does involve a significant "scaling-up" of existing technology which creates engineering and operating uncertainties, the location of shore facilities in high seismic areas, the introduction of its own version of super-LNG tankers into a heavy traffic flow of the Alyeska super-oil tankers through the most active inshore and offshore domestic and foreign commercial fishing areas in the Gulf of Alaska and across the main domestic freight lanes from the continental United States into southcentral Alaska (to say nothing of an area which has the highest storm frequency in the Northern Hemisphere), skirts the heavily populated area of southern California and ports at Oxnard terminal also in a high seismic area. With some surprise the FPC staff notes: "No Party has raised the question of LNG technology safety until the closing briefs of the California State Commission and the Conservation Intervenors did so in an almost off-handed manner. Consequently, it was not briefed, although it could have been." El Paso did file a 55 page brief in reply

which "addresses all LNG safety issues except risk analysis."³³ Checking the assessments in the FEIS of the FPC, their Volume II on the El Paso Alaska System devotes only one-half page to the impact of tanker operations and this is concerned with the reduction of area available for commercial fishing through its exclusion from tanker lanes and destruction of crabbing gear and salmon seines due to "tanker straying and wave action," while the brief Coast Guard risk assessment in an appendix makes a risk assessment of casualties onshore from an LNG ship accident in Alaska based on tanker safety records in Cook Inlet and Valdez ports for the period 1969-74. Volume III on the California terminal contains a brief accident probability analysis based upon tanker accident statistics for major ports in the United States and probability of a spill following an accident and LNG plume behavior and ignition probability. The probability of fatal accidents (except to members of the crew) is set at or near zero and although the testimony in the record is highly conflicting, the FPC staff appears to conclude that the risk factor is low, although I am not certain. The basic problem is that there is as yet insufficient data with LNG handling, and none at the scale proposed, by which theoretical conflict could be resolved.

The FPC staff finds other faults with the proposed system on which it is more firm than on the safety risk. The LNG plant

would be the largest ever constructed, involving in its system six processing trains designated to a 220 percent scaling-up from the largest existing train. The proposed cryogenic tankers would also be scaled-up to a 165,000 cubic meter design as compared with the present largest 125,000 cubic tanker. Beyond the absence of anything beyond "estimates abstracted from an engineering calculation" to back up the applicant's claim that its scaled-up design is feasible, the staff finds that the planned total system of processing, storage and shipping does not contain sufficient flexibility to assure reliability of service. "No finding can be made that this proposed design meets the public convenience and necessity...It is simply not credible as presented."³⁴ In the face of this conclusion, therefore, the matter of safety risk appears academic and may explain why it was not more thoroughly addressed.

The Living Environment: the Key Concerns, Wilderness and Wildlife

The record and the final environmental impact statement volumes by the Department of the Interior and Federal Power Commission staffs devote considerable space to the cataloguing of environmentally sensitive areas. Where these draw upon the massive research by Arctic Gas they permit a very detailed description of vegetative areas by zone, type, extent, commercial forest harvest potential, wildlife habitat, etc., and indices of sensi-

tivity and mitigation recommendations. Similarly, biological species are identified and classified, their relative abundance and habitat requirements quantified and located, their behavior and sensitivity to disturbance noted, and mitigation measures recommended. Unfortunately, such assessment in depth is possible only for the Arctic Gas case, the others claiming either that their route avoids the most sensitive areas or the impact is minimum or only incremental because of use of existing corridors. Rather than attempt a total assessment, therefore, the FPC staff in its "initial decision" document limited its comparison to wilderness and a selected few specific other impacts.

Of all the environmental concerns expressed, that for preservation of wilderness appears to be the motherhood issue. Defining wilderness simply as "undeveloped" areas, the Arctic Gas project racks up an impressive _____ miles while the El Paso project comes in second with _____ miles (Alcan avoids this by being entirely within or near existing development). Much of the Arctic Gas mileage, however, is along the Mackenzie River, itself a major transportation corridor used for centuries, and even the most ardent defender of wilderness might concede that not all of this qualifies as wilderness. In any case, the wilderness concern has narrowed down to two areas -- the National Arctic Wildlife Range and undeveloped areas of Chugach National Forest.

The strongest environmental criticisms of the Arctic Gas proposals in the record relate to crossing the Alaska National Wildlife Range. The similar intrusion of the El Paso project into a "pristine" area of the Chugach National Forest, on the other hand, received similar but milder criticism. The FPC staff did not find it "strange" that the State sought expert testimony as to the Alaska National Wildlife Range wilderness value, but avoided the same assessment of the Chugach National Forest. In the staff's opinion, the State is "more an advocate on economic grounds than a concerned party merely seeking to protect its environmental heritage." But they were unable to understand why after making "a cause celebre issue on the Wildlife Range," in considering El Paso's entry into the undisturbed wilderness area of the Chugach National Forest the Conservation Intervenors' opposition is quite muted and lacking in inferences that anyone seeking such an invasion is voracious or insensitive to wildlife and wilderness values" (a reference to the type of rhetoric employed when addressing the Arctic Gas proposal). In fact, they find that "not one word in the Conservation Intervenors' Brief is even addressed to the environmental consequences of spreading industry through the generally unblemished Alaskan countryside."³⁵

Granting that wilderness values are in the eye of the beholder, when comparing the two areas there is some substance to the FPC

staff's assessment that "from the view of a relatively unimpacted area of both vigorous and spectacular scenic beauty, the mountainous area east of Valdez and Cordova exceeds that of the North Slope."³⁶ This view is clearly not shared by the State or the Conservation Intervenors, but it should not be overlooked in making an objective comparison as it must have been in order to justify a complete difference of treatment in making comparisons between the intrusion in each of the areas. The FPC staff attempts no explanation of this contradictory behavior (beyond attributing the State's to short-term economic motivation), but it appears to be a matter of strategy on the part of the Conservation Intervenors in preparation for the further consideration of the route choice by Congress. The tactic would be to make the Wildlife Refuge a symbol of "wilderness under seige," as indicated in a report of the kickoff testimony of Brock Evans of the Sierra Club before the House public lands subcommittee on March 22, 1977. "He said the Arctic Gas route proposed through the Arctic National Wildlife Refuge 'is by far the worst choice, from an environmental standpoint, and should never be built.' Evans also cited environmental problems with proposals from El Paso Natural Gas Co. and Northwest Pipeline Corp., but concentrated on the Arctic plan. He said the pipeline across the refuge and south through Canada would 'invade and severely damage, if not completely destroy, one of the finest untouched wildernesses we still possess.'"³⁷

This last sentence quoted from Brock's testimony sums up the Conservation Intervenors' main opposition to the Arctic Gas proposal and has been replied to at considerable length in the record and the final FPC staff report. Describing the Range as our "finest" remaining wilderness is a totally subjective matter, but even in those terms it is an overstatement. The FPC staff argues that, quite aside from whether or not it is the "finest," it is far from unique. "There are no endangered animals, birds, fish or other fauna or flora in the Wildlife Range, and the same type of animals -- whether it be polar bear, caribou or arctic char -- can be found throughout the remainder of the 750 miles or so of Arctic Coastal plain. While the ecosystems at any one place are certainly distinctive, peculiar characteristics would be equally noted for each area of the North Slope, just as each human being would 'define' a different man. The more subtle appreciations of uniqueness argued here, therefore, are (1) the juxtaposition of certain physical aspects of the coastal plain with the foothills and mountains of the Brooks Range, but for the most part, the same coastal plain, foothills, and mountains occur across the North slope, and (2) that it, unlike the rest of the North Slope, is 'unspoiled.'"³⁸

Reviewing the record of history, the Range is not unimpacted by man and, by definition, cannot be held to be "unspoiled." Until the U. S. Navy exploration programs between 1944-53 and the

continuing U.S.G.S. program up until 1964 drew the Native population of the North Slope into Barrow (in the 1939 census Barrow accounted for 23 percent of the region's total Native population and in 1970 for 78 percent), they made extensive use of the range area for subsistence, as was demonstrated in hearings supporting their aboriginal land claims. During the last century, commercial whaling activities along the entire coast, including the wintering over of whaling crews at Herschel Island, drew heavily upon the land as well as aquatic resources and within the Range area, resulted in the extermination of the musk ox herds. Barter Island, Camden Bay, and Demarcation Bay have been used within the Range for military purposes and petroleum exploration both onshore and offshore is proceeding today. The Range has been a popular hunting area and the State and Native corporations are encouraging guided hunting trips as a means of bringing cash income to the Native population.

"Smack in the middle of the coastal section of the Wildlife Range is an operating active Dew Line site with multistory radar receptors, an airfield, dock, boats, etc. Next to it is Kaktovik. Nothing appears to rust very fast in the Arctic and because of the permafrost, nothing, or little, is buried. And, since the terrain is flat, the debris of civilization, broken snowmobiles and beached boats, discarded appliances, etc., are visible around and about all of the houses of Native villages. ...From external appearances, the long-abandoned Dew Line station at Demarcation Bay visited on the official tour appeared as if the people could have walked away just a few days earlier."³⁹

Compared with the existing evidence of man's intrusions, the Arctic Gas pipeline would have a relatively lower impact in the eyes of the FPC staff. Snow road construction techniques would minimize vegetative damage and use of gravel from Native sites and remove means of access when construction is completed. Except for four compressor stations, the line would be completely underground.

A further argument advanced by proponents of the Arctic Gas line justifying its route across the Wildlife Range is that this is not legally a wilderness area. The Range was created in 1960 by a public land order issued by the Secretary of the Interior "for purposes of preserving unique wildlife, wilderness and recreational values." The lands were withdrawn from all forms of appropriation under public land laws, "but not the mineral leasing laws, nor disposals of materials under the Act of July 31, 1947 (61 ZStat. 681; 30 U.S.C. 601-604)." When the National Wildlife Refuge System was created in 1966, the Range was placed within this system with management by the U.S. Fish and Wildlife Service. It does not have any legal status under the Wilderness Preservation Act, although wilderness values were cited in the 1960 public order.

A final argument advanced by the staff is that in the context of the national energy and natural gas shortages, "the ultimate

incursion into the range for such exploitation must be considered a virtual certainty" and that the gas line construction "becomes a benefit from the point of lessening the environmental cost of attaching the new supply."⁴⁰

To Alcan's claim that its project avoids the wilderness impact, FPC staff falls back on their basic premise that only Arctic Gas avoids the necessity of building two pipeline systems.

"Both the U.S. and Canada pay the same environmental cost under Alcan's proposal. Under the Arctic Gas proposal, the U.S. environmental cost (albeit by going through the Wildlife Range), becomes less significant and the Canadian impact remains, at worst, the same. Canada is eventually going to exploit frontier energy. ...the same consideration is true of El Paso if it is true of Alcan. ... The overall environmental advantages to the U.S. and Canada in building a single line far exceed an LNG-ship-LNG project at the end of an 800 mile pipeline and an additional 1,000 miles of pipeline for Maple Leaf."⁴¹

This exchange on wilderness has been reported at considerable length because in all this emphasis upon the wilderness aspects of the Range, sight appears to be lost of the real threat presented to the main assets it was originally created to protect. The wilderness defense is a vulnerable one and if it fails, the wildlife value must be defended on an individual special basis. Unfortunately, the record does not always provide the means to do so.

The Range is of great importance as the support base for the Procupine caribou herd (about 110,000 to 120,000 animals) migrating

within a 120,000 square mile area in the Yukon Territory and the Brooks Range and North Slope in Alaska. The most critical areas in relation to ultimate survival are the calving areas. The herd calves at Camden Bay on the Beaufort Sea between the last weeks of May and the first in June.⁴² This area also would be a barge unloading and general marshaling area for the Arctic Gas line. The applicant believes, and FPC staff apparently concur, that adverse impacts on the calving of the herd can be avoided by scheduling of unloading and construction activities and mitigated by height limitations by aircraft overflights. If a compressor station is built at Camden Bay, however, permanent impacts might result, although Arctic Gas asserts adequate protective measures can be taken. Aside from this one point of impact, it is assumed that at all other points of the migration patterns, the construction and operation of all the proposals would not harm caribou herds or could be scheduled to avoid such harm.⁴³

Beyond the Wildlife Range, the primary environmental concern of the cross-delta route in Canada involves snow geese. During a normal year when the North Slope is generally snow-free from late August to late September, 25,000 snow geese stage on the delta, but in a year of very heavy snow fall on the North Slope (averaging about once every eight years), as many as 270,000 geese may arrive at Shallow Bay. To mitigate the hazards of

compressor station noise, human ground activity, and aircraft overflight, Arctic Gas plans to move CD-08 from the central part of the delta to Tununuk Junction and to strictly limit and control human activity during construction, restrict vehicular and water traffic and prohibit local hunting. There did not appear to be a consensus among the expert witnesses called by the other parties, however, as to whether or not this would provide sufficient protection and the FPC staff fell back upon the suggestion that if the flock is adversely affected during construction, hunting of snow geese on the North American continent could be curtailed.⁴⁴

Other possible impacts are on polar bear, barren ground grizzly bears, Dall sheep, migratory birds, raptors (gyrfalcons, peregrine falcons, eagles, hawks). In California, the endangered San Joaquin kit fox may be affected and the use of vehicles and operation of the regasification plant may adversely affect the prairie falcon. Polar bears are more aquatic mammals than land, and so presumed to be safe from harm. It appears from the evidence in the record that impact on other species of mammals and birds can be avoided or minimized by route realignments (only Arctic has the studies to do this, however), noise abatement measures and other means. All of these require considerably more site-specific study than is apparent from the record, again excepting Arctic Gas.

A final word must be said on the heated water and effluent discharge of the proposed El Paso LNG plant at Gravina Point. The plant proposed would have a once-through sea water cooling system. After intake, an algacide is added and before discharge, a neutralizing agent would be introduced. The returning water would average 20.7° Fahrenheit warmer than the water in Orca Bay and the minimum design flow would be 490,000 gallons per minute (equivalent to a 40 foot by 40 foot four-story building), and the final design flow would be 658,000 gallons per minute. The record shows that El Paso has done none of the baseline oceanographic population and temperature tolerance studies necessary for an affirmative finding as to acceptable impact upon the marine biota of Prince William Sound.⁴⁵

Human Environment: the Socio-economic Impacts

The National environmental Policy Act also requires discussion and analysis of the socio-economic impacts of major federal actions.

"The principal issue here is not only an assessment of those impacts which may occur, particularly in Alaska, but how much weight should be given to these factors in determining which project to certificate. The complexity of the issues marshalled for consideration under this rather innocuous heading is awesome: the net national benefit of these projects to the United States' economy for the next 25 years, the impact upon native Alaskan communities which have just gained an independent economic base, the synergistic impacts, if any, on the

State of Alaska, the effect upon short- and long-term employment, as well as the cost to the state of possible further perpetuation of the boom-bust cycle, projections of future Alaskan demography, industry, taxes, state services, etc., and how all of these relate to the literally billions of dollars which the state will reap from its oil and natural gas royalties and severance taxes regardless of the gas pipeline project approved."⁴⁶

The arguments presented in the record concerning the various socio-economic impacts did not touch on net national benefits, but were limited to Alaska and focused on certain aspects of population, employment, gross state product, personal income, and government revenues and expenditures. The several parties to these arguments used different data and analytical systems: Department of the Interior and FPC staff and Alcan used economic models developed by the Institute of Social and Economic Research at the University of Alaska (referred to as the MAP models); El Paso used projections made by the Human Resources Planning Institute (HRPI) and the Urban and Rural Systems Associated (URSA) of Seattle; Arctic Gas' analysis was done by URSA; and the state of Alaska projections were based on revenue-cost analysis by various state officials.

Not only do the several parties use different basis for their analysis, they also put different weights on the elements of their own findings in arriving at their conclusions. For example, the state of Alaska concludes its employment and income analysis with the following findings supporting their general conclusion that El Paso is best for Alaska:

"To summarize, the El Paso line offers the largest number of employment opportunities (including the long-term jobs which are associated with the LNG facility), and thus, the highest contribution to total personal income. The Alcan alternative also supplies high employment and income potentials, although less than does El Paso. The Arctic Gas proposal results in the least change in total personal income since it involves far fewer jobs." (emphasis added)⁴⁷

When this comparison is made on the basis of change in real per capita income generated by the same model, however, the reverse findings result: Arctic would increase real per capita income over the analysis period (1977-1990), while both El Paso and Alcan would result in a decline over the period! This is noted in the Task Force brief but discounted in the discussion immediately following:

"Many of the overall costs and benefits of the gas line choices emerge from the studies undertaken, but there is little solid information concerning who precisely it is that gains and loses from this change in employment. Thus, it cannot be assumed that the increase in per capita income will provide most resident Alaskans with improved financial positions."

Because of "other conditions," the report prefers to measure "benefits" in total rather than per capita data.⁴⁸ This is curious because by the same reason, it also can be argued that it cannot be assumed that total personal income increase will improve the financial lot of resident Alaskans. Obviously, the choice was made on the basis of which set of comparisons appeared to most benefit the El Paso case.

The FPC staff, in its review, cites further examples of practices which tend to "cook" the results of the analysis, even though they appear to emerge from impartial-appearing econometric models: "...inputs into the equation were often arbitrary or based on unsupportable assumptions. Even assuming the inputs were not arbitrary, the analysis itself is incomplete (perhaps necessarily), since only direct, foreseeable costs and expenditures were included." They found that in calculating induced employment, the "selection of the multiplier is so arbitrary as to be almost useless." For example, "El Paso uses a multiplier of 35.83 to predict that 21,000 total jobs will be created from about 600 direct jobs in 1983. ... Arctic Gas suggests that only a 1.5 multiplier should be employed, which is the most common multiplier used in Alaska."⁴⁹ When the calculations extend to population, the FPC staff observes: "Merely to say that the projected increases suggested by the parties vary is an understatement. El Paso estimates a population increase from its project of 57,000 by 1980 (the assumed peak year of pipeline construction), while Staff estimates 24,000 and the state of Alaska, 46,000."⁵⁰

The state of Alaska concluded its socio-economic brief:

"When the benefits of the El Paso project so far outweigh any of its costs, and when its net socio-economic benefits would so far exceed those of the Arctic Gas projects, the State cannot conceive of refusing to grant the El Paso project a preference on socio-economic grounds."⁵¹

Nowhere in the briefs of the State, El Paso, or the record is there any data or analysis which would support such sweeping conclusions. All that are presented anywhere are only fragments of the type of analysis required to arrive at such conclusions. The FPC staff is correct in its statement that "the record does not permit a 'bottom line' comparison of net benefits to the State from alternative proposals. ... Conclusions about net benefit rankings should be based on a benefit-cost analysis using methods normally applied by economists in benefit-cost analysis...This, according to the Staff, is missing from this case."⁵² Beyond the economic benefit-cost analysis required, there is also needed an analysis of social benefit-cost from each project which is even farther out of reach here than the economic. Perhaps the only honest performance in this part of the record was that of Alcan which made no analysis. "Alcan does not make any net benefit comparisons with the other projects. Rather, it simply asserts that the total socio-economic impact on Alaska from its project would be greater than Arctic Gas and less than El Paso."⁵³ This assertion can be neither proved nor disproved from what is presently available. It should also be noted that Alcan does not say whether the impact is or is not a benefit.

The most that can be said here is that the Staff is correct in concluding that all three projects would provide a net benefit

to the state. It is also correct in stating that:

"The most substantial economic benefits to the state will come from hydrocarbon severance taxes and royalty payments. It is obvious that these sums are so large as to overwhelm any associated costs of the project once operations begin. Assuming only 2.25 Bcf/d rate of flow from the Prudhoe field, and a wellhead price for gas of \$1.00 per Mcf, Alaska's 12.5 percent royalty interest and 4 percent severance tax will net the state \$135.5 million a year. ... Once the fact is accepted that all the projects will produce approximately the same revenues in severance taxes and royalties, other economic variables become somewhat less significant. The bottom line for the state's development is the manner in which the state expends the billions in revenue. It is those state policies which will determine the ultimate socio-economic effects of the projects." (emphasis added)⁵⁴

Discussion and material are included in the record on the impact of the projects on local communities, particularly those where the population is largely or wholly Native (Eskimo, Indian, or Aleut). These are subsistence or rather mixed cash-subsistence economies and the threat of any of the projects is stated in terms of depletion or diminution of wildlife for subsistence harvest, increased dependence upon cash and changes in cultural values and lifestyle. In view of what has already taken place and continues in the areas in which the projects are proposed (the earlier introduction of the cash economy, construction and operation of defense facilities, oil and gas exploration and development, the construction of the Alyeska oil pipeline, the Alaska Native Land Claims Settlement Act and organization and funding of regional and village corporations, and the development of local

self-government), however, these impacts on Native communities will be incremental at most and the only difference between the projects will be geographic variations of the impacts.

Some General Observations on the Process of Environmental Assessment

A professional economist or other social scientist can only review with dismay those sections of the FPC initial decision report dealing with the socio-economic impacts of the three competing projects. This is not that the record contains no sound work. On the contrary, it is replete with socio-economic statistics--demographic, employment, income, government revenues and expenditures, etc.--drawn from reliable published and unpublished sources. There are some attempts to relate these data in econometric models (as indicated in the listing of the consulting organizations used by the parties) or to calculate change in data by use of multipliers in the absence of complete modeling. Unfortunately, the results are, for the most part, merely projected sets of data on income levels, employment and government finance to replace or extend the historical data with no reflection of changes in the hierarchy of systems from which these results emerge. The real difficulty arises, however, because the several socio-economic assessments made have been translated into briefs which are used as ammunition in an adversary proceeding. These proceedings are based on a Dark Ages' theory

that somehow truth will emerge from armed combat between the adversaries on a field of honor, God being on the side of the one who survives. What this does to otherwise sound professional work (or what sometimes is that) is illustrated in the quotations from brief in the record above.

A more fundamental problem goes beyond distortion and suppression of evidence common to adversary proceedings and differences of opinion among expert witnesses and interpretation of findings. It even goes beyond the missing benefit-cost analysis and other "methods of analysis normally applied by economists." What is missing is an understanding or sense of what is involved in the interactions between the creation and operation of a man-made physical system, in this case a system for the transport of natural gas, and the collection of other man-made social and economic systems within a given geographic area. In some instances the specific interactions result in modification of the existing social and economic systems and in others they are completely transformed. Whether this is good or bad must be evaluated in terms of value systems held by those persons who are part of this process.

This shortcoming goes beyond the socio-economic and applies to physical and biological assessment as well. In the Department of the Interior and Federal Power Commission staff's final en-

vironmental impact statements (as well as other FEIS for other projects), a major exclusion is consideration of impact upon existing natural ecosystems. For the most part the underlying analytical framework of these and other environmental impact statements has been implicitly or explicitly some variation of a matrix, a catalogue of impacting and impacted variables. Although using this format for its EIS, the Department of the Interior staff recognize the limitations of the two-dimensional matrix and would agree with the National Research Council's OCS impact review committee that more appropriate means must be developed to assess the character and productivity of ecosystems and their modification by man's activities (refer to the second quotation at the head of this chapter). But this type of assessment is not presently possible. Of the total 778 pages in the Alaska volume of the Department's EIS only 14 pages are devoted to generalized recognition of the existence of ecological considerations and only 33 pages of the 825 page Canada volume. The Department's staff had reasons for this deficiency, "The classification of ecosystems, their descriptions, the explanations of their processes, and the synthesis of component parts into total units have never been accomplished for the regions of interest and the intricate relationships forbid hasty interpretations of systems which at best are poorly known. ...The fact is, ecosystems are rather intractable objects of study.

...The disruption of the functions of a plant community, a lemming population, or a caribou herd are primary effects but the secondary and tertiary effects pulse through the entire ecosystems along all functional pathways of community inter-relationships."⁵⁵

The space devoted by the Department to impact of the project upon natural ecosystems does not reflect their assessments of their importance. "There is no possibility of predicting the total impact of the proposed project on any major ecosystems that would be affected. The changes would be generally adverse and perhaps the greatest overall result would be the toll taken in the shrinking number of ecosystems in their natural state. All systems are capable of absorbing some change and recovering, but how much change is not known and it would be prudent to know. In the absence of predictive capacity, it becomes a crucial question whether or not the project would foreclose future options of preserving natural communities at major ecosystem scales."⁵⁶ For the present it appears that our assessments cannot get much beyond "a catalog of environmental parameters."

The review of the record, the reports and the findings on environmental impacts leaves a strong impression that the best of all possible solutions as to how to move our frontier natural gas to market with the least adverse environmental impact

has not been arrived at. Two of the applicants use the corridor concept as though it were a magic word cutting through all argument about environmental impact. The FPC staff in its final report appears to throw up its hands when confronted with the massive record on environmental impacts and uses a similar short hand, the argument that one system is better than two systems (the necessary sleight of hand being simply to say that the purpose is to transport both Canadian and United States gas). All arguments for the El Paso and the Alcan proposals fall before that weapon. The Canadian conditions under which Arctic Gas first launched its proposal, however, have altered in the intervening years. The current situation was recently summed up as follows:

"Canadians are locked in a major national debate over northern resource and energy development. Until recently, it was assumed that large new gas reserves would be discovered in the Mackenzie Delta area and transported south through the Arctic Gas pipeline also carrying Alaskan gas. But gas discoveries in the Delta have been disappointing. The president of Canadian Arctic Gas, V.L. Horte, has indicated that Mackenzie reserves are now adequate to provide only about half the flow of Canadian gas originally anticipated.

"At the same time, though, prospectors for Panarctic Oils, a consortium of private companies, and the Canadian government, have discovered important gas reserves in the high Arctic islands northwest of Hudson Bay, far to the east and north of the Mackenzie Delta. Proved reserves so far are at least 15 trillion cubic feet, almost three times the Mackenzie reserves. A pipeline serving the high Arctic islands gas fields would pass hundreds of miles to the east of the Mackenzie Delta region.

"While gas exploration in the Delta has failed to pan out, opposition has grown among Native people -- Indians and Eskimos -- to early large-scale energy development in the region. A substantial body of Canadian opinion appears to be in sympathy with the Natives."⁵⁷

If the course of events rules out the Arctic Gas proposal, the Presiding Administrative Law Judge finds: "...if Arctic Gas is unable to accept a certificate, this record supports findings that El Paso's proposal, as required to be modified by the findings above, would also meet the present and future public convenience and necessity. No findings from this record supports even the possibility that a grant of authority to Alcan can be made."⁵⁸ The reasons for the judge's relegating the Alcan proposal to last place are based upon conditions which appear to make its proposed financing plan inoperative and that "Alcan's present design is clearly neither efficient nor economic since the pipeline is undersized. The suggested three years construction schedule...cannot occur. Moreover, its arguments as to how it can be financed in separate time frames from Maple Leaf...is totally unsupported by hard evidence...[therefore] not enough is left of its original proposal to serve as a basis for granting its application."⁵⁹

Criticism of the Alcan proposal for lack of preparation, due largely to their late filing, is certainly justified and

both the staff and judge make no effort to disguise their annoyance (the judge's reference to "Alcan's willingness to build anything anyone wants," for example). But the objections can be overcome and Alcan has made yet another attempt to file an amended proposal. Financing plans are not graven in stone and after an applicant has been certified and the others are rejected, there should be wide opportunity for revisions to support a more adequate financing plan. The other objections of the judge are still based on the assumption that the line must be tied to the simultaneous development and transport of the Mackenzie Delta gas, an assumption which should be carefully re-examined not in a 1973 context, but a current one.

It is unfortunate that the FPC staff concluded at the onset of its environmental assessment that "No useful purpose would be served by any attempt to give a detailed summary of that environmental material contained in the evidence of the parties and in the environmental impact statements of the Department of the Interior (DOI) or the Commission staff."⁶⁰ In the decision statement there are hints that the staff is divided as to the environmental superiority of the final choice of Arctic Gas. "The DOI and staff environmental witnesses, relying only on environmental considerations and looking solely at Alaska...favor a Fairbanks alternative, something akin to Alcan in Alaska."⁶¹

And at another place, "In its Position Brief, Staff states that the Fairbanks alternative with the Richards Island Lateral [a 756-mile pipeline from Richards Island to Whitehorse, Y.T.] is environmentally superior to the Arctic Gas, Alcan or El Paso systems. ...the environmental Staff of the FPC concluded (by a 3-to-1 vote) that the Fairbanks alternative with a Richards Island Lateral is superior to the Arctic Gas prime route..."⁶² Unfortunately none of this is developed in the report and the suggestions that the environmental Staff or its witnesses might have something important to say is set aside immediately by reference to lack of supporting environmental studies, economic feasibility (in some places this appears to be based only on inability to do any cost analysis absent a design) and adherence to the requirement that the system also transport Mackenzie Delta gas via a Maple Leaf route (the apparently environmentally superior Richards Island Lateral has not been proposed by anyone but the DOI and FPC staff and, therefore, cannot be considered).