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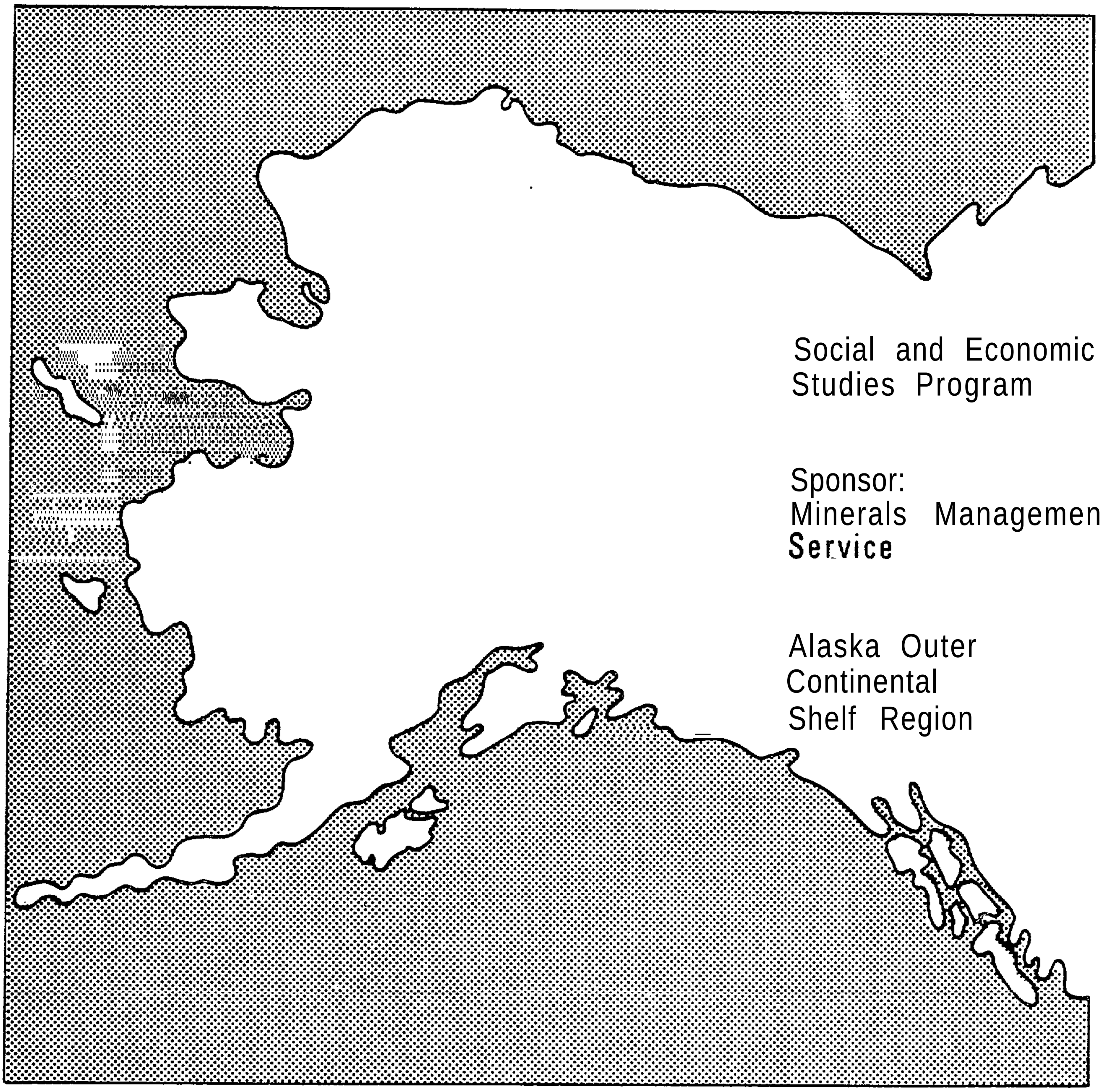

Social and Economic Studies Program

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Review of Cumulative Impact Assessment' Literature and North Slope Borough Development Projects.

SPECIAL REPORT NO. 5

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The Social and Economic Studies Program
Minerals Management Service
Alaska OCS Region

REVIEW OF CUMULATIVE IMPACT ASSESSMENT LITERATURE AND NORTH SLOPE BOROUGH DEVELOPMENT PROJECTS

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February 1985

NOTICE

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ABSTRACT

This report reviews a diverse group of environmental assessment literature to determine its potential applicability to assessment of the cumulative impacts of oil, gas, and other industrial and community development projects on the communities of the North Slope Borough. While it was initially hoped this review would yield a specific methodology which could be implemented by MMS in its next OCS lease sale assessment, no such methodology was uncovered. Instead, the literature revealed a set of difficulties which highlighted the inappropriateness of using any one method to assess the effects of large, technologically complex projects in the rapidly changing and relatively poorly understood human environment of the North Slope Borough (see section 4.2). However, the review did yield a set of six general approaches and several observations which could help MMS develop a new framework for subsequent cumulative impacts analyses. Some of these approaches are similar to the current set of methods used by MMS. Others are different, and would require changes not only in the specific methods used to conduct assessments, but also in the overall policies which guide the MMS environmental assessment program.

As noted in the table of contents, the literature reviewed is presented in seven different categories. The first general approach, regional or area-wide EIS's, was exhibited in references from several different categories. It develops a set of cumulative impact parameters (land area, employment, economic costs and benefits, etc.), and then forecasts the timing, intensity, and location of impacts under one or more development scenarios.

The comprehensive EIS approach, which was also exhibited in references from several categories, is similar to the current cumulative impact methodology used by MMS. This approach could be enhanced through the identification of indirect effects and the interaction of impact streams from individual projects and subsequent aggregation, if appropriate (see the review of Holling (p. 65) and Kruse (p. 144)).

Regional planning approaches, which have been utilized most successfully to date in environmental rather than socioeconomic impact analyses, analyzes the spatial effects of development through such technologies as constraint, composite, and overlay mapping (see the reviews of Dirschl (p. 199) and Porter (p. 76)). Regional planning approaches allow public input and have the potential to create an ongoing process for cumulative impact management when established within appropriate institutions. They also have the potential to be used in concert with geographic information systems, such as the one being developed by the North Slope Borough (see the review of Arctic Slope Technical Services (p.80)).

In a longitudinal monitoring approach, data on social, economic and cultural conditions are collected before, during and after development occurs (see the reviews of Corley (p. 209), Berkes (p. 197) and Bowles (p. 105)). By monitoring key indicators at regular intervals, both impacts from individual projects and ongoing change that result from the cumulative effects of several projects can be determined. A list of potential

sociocultural indicators assembled in the course of reviewing Alaskan and Canadian impact literature is presented in section 4.1.4.

The public inquiry approach, as typified by the Berger Inquiry in Canada (see the review of Berger (p. 193)), allows local residents to define for themselves the important cumulative social, economic and cultural impacts in an open and often adversarial setting. This approach has also found to be appropriate when native Americans or other indigenous people would be affected (see the review of Boggs (p. 241) and Geisler (p. 241)).

Although an OCS lease sale may not have a direct effect on the fiscal situation of the North Slope Borough, the cumulative effects of several other land-based projects, and the indirect effects of all projects would have a significant effect on Borough revenues. These revenues, in turn, provide the tax base on which local population-serving capital projects are based. These fiscal interrelationships highlight the need for incorporating a fiscal analysis as part of any assessment of cumulative impacts on the North Slope Borough (see the review of Kruse (p. 144) and Nebesky (p. 169)).

The report also describes 58 projects that may be included in future North Slope Borough cumulative impact assessments. Eight of these projects are firm oil development projects (including Prudhoe Bay) that have already been found commercially viable. Another eight projects involve oil discoveries that are large enough for production, but not commercially viable at current prices. Similarly, five projects involve gas discoveries that could be developed if transportation were available and gas prices were expected to remain firm. The report describes seven oil and gas exploration projects, four future lease sales, and three non-oil and gas resource development projects.

Finally, the current North Slope Borough capital improvements program, which extends through 1989, is described in terms of 23 projects which include education, public roads and streets, housing, water and sewer, solid waste disposal, health, libraries, power, public safety, airports, communications, industrial development and administration. The actual, planned, and potential locations of the resource development and capital improvements projects are shown on page 302 and in more detailed maps on subsequent pages.

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LIST OF ABBREVIATIONS

ANCSA -	Alaska Native Claims Settlement Act
ANILCA -	Alaska National Interest Lands Conservation Act
API -	American Petroleum Institute
B/D -	Barrels per Day
COE -	U.S. Army Corps of Engineers
CZMA -	Federal Coastal Zone Management Act of 1972
EIS -	Environmental Impact Statement
EOR -	Enhanced Oil Recovery (Tertiary Recovery)
FEARO -	Federal Environmental Assessment Review Office (Canada)
GIS -	Geographic Information System
MD -	Measure of Depth
MMS -	Mineral Management Service
NPRA -	National Petroleum Reserve in Alaska
NSB -	North Slope Borough
NSBCMP -	North Slope Borough Coastal Management Program
TAPS -	Trans-Alaska Pipeline System
TCF -	Trillion Cubic Feet
TVD -	True Vertical Depth
USDI -	United States Department of the Interior
USGS -	United States Geological Survey

1.0 INTRODUCTION

In order to help select an appropriate methodology to enable the Minerals Management Service (MMS) to perform cumulative impact assessment of the effects of petroleum development and other industrial development projects on the social, economic and cultural systems of North Slope Borough native communities, a literature review and annotated bibliography of selected methods, theories and other approaches were prepared. An extensive evaluation of several areas of the environmental impact assessment and applied social sciences literature was made. The literature review relied on computerized search services, previously assembled bibliographies and most importantly, networking with current practitioners. The geographic scope of the search was centered on North America, with a focus on methods developed to assess the impacts of modern industrial or resource development projects on Native American communities.* While not a major focus of the search, literature documenting methods and approaches for studying the impacts of modern industrial development on "non-western" cultures in Third World nations was also reviewed.

Promising references were obtained, reviewed, and screened to identify those methods, theories, or other approaches with promise for applicability in Alaskan Arctic sociocultural settings. The most promising methods or approaches were further reviewed and compared depending on completeness of documentation. In conjunction with the Minerals Management Service, the cumulative impact methodologies with greatest applicability to Arctic Alaskan conditions were selected. These were then reviewed in greater depth regarding their scientific validity, data requirements and ease of applicability to conditions found in the North Slope Borough.

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* It is recognized that such people are referred to by various terms such as Inuit, Indians, Amerindians, aboriginal inhabitants, original peoples as well as Native Americans; and that their societies are referred to by various terms such as nations, tribes, ethnic groups, bands, villages and communities.

This first chapter provides introductory background on the concept of cumulative impacts, their assessment and analysis. The second chapter reviews the methodology used in preparing this report. The third chapter provides the annotated bibliography, which is subdivided according to the major areas of the literature reviewed. The fourth chapter presents the more in-depth review of the most promising cumulative impact assessment methodologies. The fifth chapter summarizes the conclusions drawn from the completion of this task. A complete list of references is included and Appendix A summarizes individuals contacted during the course of the literature review.

An Introduction to the Concepts of Cumulative Impact

The concept of cumulative impact assessment or analysis of cumulative impacts is relatively new. While the analysis of cumulative impacts is a sub-field of environmental impact assessment, its origins are somewhat hazy and its terminology is not always uniform. Therefore, development of an acceptable methodology to enable the Minerals Management Service (MMS) to perform analyses of cumulative impacts for proposed OCS lease sale actions is a complex and evolutionary process. While no simple, generally available cumulative impact analysis methodologies exist which can be readily adapted to the Alaskan Arctic, this chapter of the report will provide an overview of concepts and issues associated with analysis of cumulative impacts.

On May 24, 1977, President Carter issued an Executive Order directing the Council on Environmental Quality (CEQ) to issue regulations for implementing the procedural provisions of the National Environmental Policy Act (NEPA). The promulgated regulations, which became effective July 30, 1979, are intended to establish formal guidance from the Council on the requirements of NEPA for use by the courts, and are binding on all federal agencies.

These CEQ guidelines explicitly included consideration of cumulative impacts for the first time as well as providing definitions for cumulative impact concepts and terminology. The concept of cumulative impacts is directly referred to in Parts 1500 and 1508 of CEQ regulations (40 CFR, 1978), which specify the purpose, policy and mandate for NEPA and the terminology for use by Federal agencies in interpreting the regulations. Part 1502, which details the requirements for environmental impact statements, also broadens the scope of NEPA compliance and environmental impact assessment to implicitly include cumulative impacts, when it is read in conjunction with the terminology of Part 1508.

The Council's concern with cumulative impacts is introduced in a somewhat back-handed fashion in Section 1508.4 by enjoining agencies to reduce paperwork by using categorical exclusions to define categories of "actions which do not individually or cumulatively have a significant effect on the human environment" and which are, therefore, exempt from the requirements to prepare an environmental assessment or environmental impact statement (EIS). If an agency determines that a proposed action neither qualifies as a categorical exclusion nor requires a full-blown EIS, Section 1501.4 mandates that an environmental assessment is prepared. Even here agencies are required to consider whether the proposed action will have a cumulatively significant impact. Section 1508.27 of the regulations require that the significance of an action be considered both in context and intensity. A factor to be considered in evaluating intensity is "whether the action is related to other activities with individually insignificant but cumulatively significant impacts."

The primary vehicle providing for cumulative impact consideration is the scoping process, in which the scope of issues to be addressed in an EIS is determined. Section 1508.25 states that in determining scope, an agency must consider three types of actions, three types of alternatives, and three types of impacts in addition to the proposed action itself. Actions may be connected actions, cumulative actions, or similar actions. Cumulative actions are defined in Section 1502.14 as "actions, which when viewed with other proposed actions, have cumulatively significant impacts and should therefore be discussed in the same impact statement." The three types of alternatives are: the no action alternative, other reasonable courses of action, and mitigation measures not in the proposed actions. In preparing an EIS, consideration must be given to comparisons of the proposed action and each of the three types of alternatives.

The three types of impacts are: direct, indirect, and cumulative. Section 1508.7 states that a cumulative impact results from "the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time." Furthermore, in Section 1508.8, indirect effects are said to be "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Section 1508.27 which defines "significantly", includes a statement relating to cumulative impacts. One of the factors to be considered in defining the intensity of an action to determine its significance is: "whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Singificance exists if it is reasonable to anticipate a cumulatively significant impact on the environment."

Section 1502.4 details how the scoping criteria are to be included in an EIS and Section 1502.16 forms the scientific and analytic basis for an EIS's comparison of alternatives, including the proposed action. Both of these sections implicitly include the concept of cumulative impacts.

To summarize, CEQ's key sense of cumulative impacts applies not to single unconnected actions, but rather to actions which when viewed with other proposed actions, have cumulatively significant impacts. The concept is that some actions are insignificant individually but have cumulatively significant impacts, or that actions when viewed along with other "past, present and reasonable foreseeable future actions", have cumulatively significant impacts (also known as aggregative impacts).

In addition to the concept of cumulative impacts addressed by CEQ, another definition of cumulative impacts has come into usage and has been operationalized in EISS and other environmental assessments, including several developed for federal agencies such as the U.S. Army Corps of Engineers' regulatory program. The alternative concept of cumulative impacts applies to large scale projects in which direct and secondary impacts are anticipated to be significant, not only in the project construction phase but also over the life of the project's operation and for any additional actions which a major project induces. This sense of cumulative impacts is more comprehensive and assessments to track these impacts have relied on futures forecasting and other projective and impact modelling techniques.

Having reviewed the relatively new regulatory and procedural emphasis on analysis of cumulative impacts, implementation of these concepts within federal agencies will be briefly summarized.

INTERIOR DEPARTMENT

On July 10, 1979, the Department of the Interior (DOI) published proposed revised procedures for incorporating the CEQ regulations into the Department's decision-making process. The Department reserved the right to depart from the mandatory provisions of the CEQ requirements only "where compliance would be inconsistent with other statutory requirements" (516 Departmental Manual 1.7). DOI proposes "early and positive consultation, coordination and cooperation" with all interests and parties in determining the need for an EIS, the criteria for which include the relationship of a proposed action "to other actions with individually insignificant but cumulatively significant environmental effects" (516 Departmental Manual 2.3(3)(f)). Procedures, content, and format are in almost all instances governed by the CEQ regulations.

The MMS Alaska OCS region has undertaken limited review of potential cumulative impacts in its EISS for recent Diapir Field, St. George Basin, and Norton Sound lease sales. While MMS recognizes the importance of "identifying methods for measuring and evaluating cumulative impacts," no single integrated methodology has been developed for use in preparation of EISs. Instead, MMS has utilized qualitative assessments of the additive or aggregative effects of a variety of major projects in addition to the proposed lease sale action in its EISs. The major projects to be included are selected based on a set of criteria which include geographic considerations, and the project's significance and timing among others. Each individual disciplinary assessment section within the EIS has included a "cumulative effects assessment", which qualitatively considers the "future impacts attributable to these past and present actions." However, as MMS points out, "frequently, the cumulative effects assessment cannot differentiate the incremental effect of each action (past, present, and future), due to uncertain conditions and methodological difficulties. In these circumstances, the EIS assumes that the aggregate impact across all types of actions constitutes the cumulative impact." (MMS, 1982, p. 149-150).

The Bureau of Land Management (BLM) has published proposed guidance for NEPA Implementing Procedures in BLM Guidebook Series 1790-1799 to be used in conjunction with the Department Manual. BLM has undertaken several programmatic EISS, such as the EIS for the Federal Coal Management Program, which have attempted to assess the cumulative environmental impacts of its actions on an inter-regional basis.

The Fish and Wildlife Service (FWS) has been the agency within the Interior Department most active in attempts to develop appropriate methods for the assessment of the cumulative impacts of projects, although the focus of their efforts has been primarily on effects on fish and wildlife populations and affected ecosystems. Several of the reports developed under the FWS cumulative impacts project are reviewed in the annotated bibliography.

OTHER FEDERAL AGENCIES

The U.S. Army Corps of Engineers (COE) has been the most active federal agency in promoting the methodological development of cumulative impact assessment. The COE has sponsored several workshops and methodology development projects and developed a large number of reports and EISS that attempt to assess cumulative impacts. To date the COE efforts have been principally based in its Regulatory Functions Branch which authorizes permits. The

Corps' approach to cumulative impacts stresses hydrologic, ecosystem, and wetland impacts. Several COE reports and sponsored research are reviewed in the annotated bibliography.

The COE has utilized several approaches in grappling with the regulatory requirements to analyze the cumulative impacts of its permit program. The COE's first attempt to develop a workable methodology for the analysis of the cumulative impact of proposed permit activities was developed for the Baltimore District through a contract with the Mitre Corporation. The analysis was of the cumulative impact of proposed projects on Spa and Back Creeks near Annapolis, Maryland. In addition to its basic study, which was completed in May 1975, the COE requested that Mitre generalize the methodology used in the Spa and Back Creek analysis in a workbook format. This report, intended to be used for the analysis of small structures in navigable waters in any COE district was completed in June 1975.

The general approach employed by Mitre was decidedly limited and was flawed by both its incompleteness and its inability to be transferred to other settings. The authors themselves criticized the methodology in their conclusions. "The utility of this methodology depends on a detailed knowledge of existing conditions in the area of concern. Many environmental parameters that are or could be affected by project implementation have not been included in this report. Quantification of cumulative' ecological impacts necessitates the inclusion of many site-specific variables and therefore general guidelines are not tenable."

A second approach adopted by the COE was a series of "wetlands reviews" developed for the COE's Portland District by various contractors. These reviews were prepared for the Siletz and Nehalem coastal estuaries and Alsea Bay in 1976. The wetlands review concept was described by the COE as, "an attempt to anticipate cumulative effects by establishing permit standards based on capabilities and values inherent in the resource base." The general approach of the wetlands reviews was to organize existing data by key parameter profiles which were mapped. Geographic areas containing "wetlands of importance" and "areas of environmental concern" were delineated and performance standards and criteria were developed to regulate all potential permit activities.

However, the wetlands reviews are not true cumulative impact assessments. The process began with a presumption that the cumulative impacts of future permits would produce undesirable environmental and social impacts. Thus, the process is really a regulatory strategy for limiting cumulative impacts by holding them within prescribed and acceptable levels. It did not attempt to predict or forecast the magnitude of expected impacts. It is therefore a planning tool and regulatory guideline rather than a threshold-defining impact assessment methodology. Despite their utility as an interagency, regional planning approach the COE no longer prepares wetlands reviews.

A project-level approach was also employed in several cases. The COE contracted for and participated in two notable efforts of this type. The first, completed in late 1976, covered a proposed residential development called Mystic Harbor as well as other potential developments in the Chincoteague Bay region. The second study, completed in early 1978, was a study of the cumulative impacts of shorezone developments at Lake Tahoe. Both studies used modeling techniques to project social and environmental impacts of proposed developments. Both studies identified significant cumulative impacts although the Mystic Harbor study was more definitive than that for Lake Tahoe. Despite their sucessful completion, neither study offers a cumulative impact analysis methodology which can be readily adapted to other settings. Both studies were greatly dependent on pre-existing data bases and each study experienced difficulty in linking social impacts with ecological impacts.

In 1981, Dames & Moore prepared a "Methodology for the Analysis of Cumulative Impacts of Permit Activities Regulated by the U.S. Army Corps of Engineers." The report presents a methodological approach to analyze the cumulative impacts of Corps-regulated permit activities. The focus of the method is on separating permit activities into endogenous and exogenous types and subjecting endogenous or "growth accommodating" activities to a "bottom up" form of analysis designed to trace ecological effects through network analysis back into the social and economic spheres. "Growth-inducing" or exogenous activities are to be subjected to a more rigorous "top down" approach designed to analyze changes in regional development patterns likely to trigger additional activities and impacts. The handbook was designed to be used by Corps regulatory staff in the environmental review of permit applications in wetland and navigable waterways.

The U.S. Environmental Protection Agency (EPA) adopted into its own EIS regulations the CEQ regulations defining cumulative impacts, and the CEQ preparation process (part 6, 44 Federal Register 64, 174; November 6, 1979). Furthermore, EPA added to the CEQ EIS requirements by mandating a discussion of alternatives considered by the applicant, a discussion of alternatives available to the EPA and other permitting agencies, and an identification of the preferred alternative. In incorporating the concept of cumulative impact assessment into agency decision-making, several approaches have been taken. For its permitting activities (i.e. NPDES permits under the Clean Water Act), the responsible official is directed to examine the possibility of tiering EISS based on a consideration of the cumulative impacts of the proposed permit activities and their significance. Cumulative impact considerations are also explicitly or implicitly incorporated into policy declarations and program directions.

The Department of Housing and Urban Development and the Department of Transportation have also established cumulative impact assessment guidelines within their departmental environmental assessment procedures. To support these departmental policies, each agency also initiated several research studies designed to analyze methods for assessing the secondary and cumulative impacts of urban development and highways or mass transit projects, respectively.

In response to the CEQ cumulative impact guidelines, several states have instituted matching requirements within state environmental review statutes. Most notably California and Washington incorporated such guidance which in turn generated interest in appropriate methodologies to assess cumulative impacts. However the focus of such cumulative impact assessments has primarily been on ecological effects or on the cumulative impact of urban sprawl and urban development options. Other states such as New York and Maryland have incorporated the concept of cumulative impact into planning processes for activities such as statewide analyses of power plant siting. While these diverse applications illustrating the diffusion of the concept of cumulative impact are of interest, they have not tended to generate methods of impact assessment readily transferable to other settings.

2.0 METHODOLOGY EMPLOYED IN THIS LITERATURE REVIEW

To initiate the study and to gather information on methods of cumulative impacts assessment, a series of computerized and manual searches of available environmental and social impacts assessment literature was conducted. This literature review aimed to identify studies, working methods, and "meta-theories" concerning the identification and analysis of cumulative impacts of development projects, particularly upon social, economic and cultural systems.

For the computerized literature search, key word searches were conducted on several computerized bibliographic services, including ORBIT II, DIALOG, ENVIRONLINE, the National Technical Information System (NTIS), and the Defense Documentation Center. Careful preplanning of search terms and search strategy oriented the search to references dealing with cumulative impacts, cumulative effects, indirect effects, indirect impacts and other key words concerning cumulative impacts.

The results of this initial search of the cumulative impact literature was a disappointment. Relatively few new studies were identified and much of the cumulative impact literature already known to the study team did not appear. As a consequence, the focus of the literature search was shifted to a more intensive review of other bibliographic sources in recent newsletters and publications such as: Social Impact Assessment, Worldletter: Environmental Impact Assessment, Impact Assessment Bulletin, and Environmental Impact Assessment Review. This search yielded several articles and bibliographic references of interest.

Most importantly, the focus of the literature review also expanded to network with other practitioners of social impact assessment, environmental impact assessment and related subfields. A list of individuals contacted during this process is contained in Appendix A. This approach was particularly useful in isolating important ongoing studies not currently reflected in the published literature and in establishing direct contact with practitioners concerned with the assessment of cumulative impacts and familiar with available methodological approaches.

As the literature search and retrieval process continued, it became clear that relatively little methodological development concerning assessment of cumulative impacts was occurring in international development projects in the Third World. Consequently with the approval of MMS, further research into this area was curtailed. On the other hand, contact with Canadian practitioners and institutions was expanded in an effort to identify research occurring in the Canadian Beaufort Sea region or other northern settings and likely to be transferable to the Alaskan North Slope.

Within the other categories of literature reviewed, a sharp break began to emerge between the cumulative impact assessment literature, the environmental impact assessment literature and the social impact assessment literature. A subfield of the environmental and social impact assessment literature related to large energy or other resource development projects that affect Native American populations was also singled out for more intensive investigation.

Simultaneously a review of the available Alaskan literature was conducted based on a review of the holdings of: the University of Alaska's Institute of Social and Economic Research and the Alaska Environmental Information and Data Center, MMS' Social and Economic Studies Program (SESP), the Alaska Resources Library, and the North Slope Borough. This review of the Alaskan literature revealed relatively little relevant methodological development related to cumulative impact assessment and virtually none outside the MMS SESP. Again, with MMS concurrence, the focus of this review was shifted to a more intensive analysis of the SESP literature in order to review study methods to determine what impact assessment methodologies might be adaptable to cumulative impact assessments of petroleum development in the Alaskan Arctic.

Through the processes previously described, a diverse collection of literature was assembled. The literature ranged from articles and books on specific impact assessment methods, to other analytical bibliographies, methodological comparisons and specific studies. There were also quite a number of informative articles analyzing one aspect or another of impact assessment techniques with relevance to this study. The hundreds of promising references accumulated duringthe literature search process were subjected to a screening process to identify those studies, books and articles of greatest relevance.

As promising references were identified and acquired, each abstract or study was briefly reviewed and indexed. Based on early consultations with MMS and using professional judgment, studies or other references were grouped into two categories:

- o selected to receive further consideration; or
- o given no further consideration.

A large number of references was eliminated from further consideration through this process. The remainder were then subjected to a more rigorous evaluation in order to prepare an annotated bibliography and to identify the most promising methodological approaches with applicability to the assessment of North Slope Borough cumulative social, economic and cultural impacts.

At the outset of this study, it was anticipated that a set of “entrance criteria” could be developed to aid in the further screening and evaluation of the literature selected for further consideration. Such criteria were intended to help identify and compare cumulative impact assessment methodologies from the standpoint of their applicability to the Alaskan Arctic. However, the diversity of form in the literature selected for further consideration and the limited number of relevant cumulative impact assessment methodologies identified prevented this approach from being utilized.

Based on the thorough evaluation of the selected literature, the annotated bibliography was prepared. The reviews of a reference in the annotated bibliography discuss the general purpose of the reference, identify its method or methodological implications, present its consideration of cumulative impacts, and any definitions of cumulative impact used. The reviews also evalute the method from the standpoint of its applicability to the assessment of Alaskan Arctic cumulative impacts.

Of the studies reviewed, these also separated into two categories based on their relevance to the development of a cumulative impact assessment method suited to the Alaskan Arctic. In the presentation of the Individual reviews these are grouped into two categories that reflect their relevance to the methodology developed in this report.

The preliminary results of the literature screening and evaluation effort were discussed with MMS and since little in the way of directly applicable methodologies had emerged, it was decided that the five methodological approaches which seemed most generally applicable to conducting assessments of the cumulative social, economic and cultural impacts of Arctic petroleum development would be presented for further review and consideration by MMS.

As in all studies of this type, a number of promising references were identified near the conclusion of this study. In most cases it was possible to include these sources in the bibliographic references at this report's conclusion. However, it was not possible to include them in the annotated bibliography itself. Nonetheless, the bibliography is substantial and does consider the majority of the available literature deemed to be of critical importance to this study.

3.0 ANNOTATED BIBLIOGRAPHY

This chapter presents the annotated bibliography prepared as the final "step of the literature review and evaluation process. The literature reviewed is broken down into seven basic classes as follows:

- cumulative impact assessment literature;
- environmental impact assessment literature;
- social impact assessment literature;
- MMS/Alaska OCS Socioeconomic Studies Program;
- Canadian literature;
- Native American literature; and
- International literature.

Each of the sections contains brief, synoptic reviews and evaluations of the key literature citations. The summary prepared for each citation generally presents a brief synopsis of the study's purpose, its general method, its consideration of cumulative impact concepts, any definitions of cumulative impacts, and a brief evaluation of the method's potential applicability to the assessment of the social, economic and cultural impacts of petroleum development in the Alaskan Arctic. Promising studies are featured at the beginning of each section organized in chronological order. This helps to evaluate the evolution of particular approaches and methods. Studies which received further examination after the initial screening but were found to be less helpful or inappropriate to the process of developing a North Slope Borough cumulative impact assessment method are grouped together at the end of each section.

3.1 Cumulative Impact Assessment Literature

From its inception with the issuance of the CEQ guidelines, analysis of concepts of cumulative impact and development of methods for assessing cumulative impacts have been the focus of a relatively small number of research projects. These projects are largely funded by federal agencies seeking mechanisms to comply with the broadened requirements of NEPA introduced

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when CEQ guidelines were expanded to include cumulative impact concepts. of cumulative impact has diffused relatively widely through the interdisciplinary field of environmental impact assessment where it has been analyzed, written about, and generally discarded as an intractable, relativistic concept with theoretical validity, but lacking methods for its practical implementation.

Simultaneously, several states incorporated cumulative impact assessment requirements into their NEPA-like environmental review statutes. The cumulative impact concept and definition, along with requirements for analysis of cumulative impacts, also found their way into other federal environmental planning statutes such as the Surface Mine Control and Reclamation Act of 1977 and energy planning and power plant siting laws in several states.

The attention to cumulative impact assessment initially followed a path of methodological development separate from, but related to, environmental impact assessment. Today it has been largely subsumed within environmental impact assessment with current EISS devoting some space to the qualitative evaluation of cumulative impacts. Rarely are organized methods used.

Of the specialized research efforts to develop specific cumulative impact assessment methods, relatively few have any relevance to this study. This is due largely to the recent development of the concept of cumulative impacts and the lack of similarity between the settings and contexts within which such methods were devised and the Alaskan Arctic. The cumulative impact assessment literature has also largely been focused on ecological effects and impacts rather than social or economic impacts. In addition, the complexity of operational izing cumulative impact concepts into viable, scientifically valid assessment methods has been extremely slow and difficult. Finally, the concept and definitions of cumulative impact assessment have been interpreted quite differently in some cases. The net result is that little convergence has developed to date within the methodologies for cumulative impact assessment. Methods developed to date tend to be poorly documented, relatively untested, and have not measured the magnitude and significance of cumulative impacts.

The concept of cumulative effects or cumulative impacts appears to have its origin in two separate but related concepts:

1. The ecological principles of interrelatedness in ecosystem function whereby a relatively minor change in one ecosystem function or component (i.e. primary producers in a food chain) triggers a series of systemic effects and changes, some of which ultimately affect man (i.e. reduction in fishery yields or recreation opportunities).

2. A second concept centers around the notion that a large number of seemingly unrelated small actions or activities (i.e. construction of piers, bulkheads or wetland dredge and fill projects) may take place in an area over a number of years, with each one being separately approved as a result of consideration of the environmental impacts of the limited project under review. While the environmental effects and impacts of each of these projects considered separately may be relatively slight, over time all of the projects may produce a degraded environmental setting.

While these concepts of cumulative impact are theoretically sound and valid at least as far as ecosystem functions are concerned, their translation into readily useable methods of assessment has been difficult. No easily general izable thresholds of impact exist, even for relatively well-studied ecological systems. Therefore the assessment of cumulative impacts becomes an exercise of professional judgment with relatively few methodological guide-posts.

Even less attention has been paid in the cumulative impact assessment literature to transfer concepts of cumulative impact from ecosystem settings to the analysis of changes in human systems. The great proportion of cumulative impact assessments considering social impacts have focused on the derivative social impacts resulting from physical environmental changes rather than the secondary or induced changes brought about in social, economic and cultural systems by other types of activities and effects generated by a project (i.e. employment, income, social stress, etc.).

Nearly unanimously, at the outset and conclusion of a reference within the cumulative impact assessment literature, the author or authors will point out the difficulty of analyzing and measuring cumulative impacts. They also point out the great commitments of time and resources that would be required to conduct such assessments and the limited data which is often available to contribute to such analyses. Based on our review of the literature available to date we concur with these general conclusions and find relatively little generalizable guidance for analyzing the cumulative social, economic and cultural impacts of petroleum development in the Alaskan Arctic in this literature.

However the following section does review several of the more relevant studies in greater detail. These include Stakhiv (1978), Philips et al. (1978), Clark and Zinn (1978), Stakhiv (1980), Merson and Eastman (1980), Dames & Moore (1981), and Science Applications, Inc. (1983). Of these studies, only Clark and Zinn (1978) and Dames & Moore (1981) provide any methodological insights which have relevance to the analysis of cumulative impacts of petroleum development in the Alaskan Arctic. A series of synopses of other studies are included in a group at the end of this section. While many of these studies mention cumulative impacts in their titles or appear to present cumulative impact assessment methods, they make no contribution to the development of an appropriate methodology.

RELEVANT STUDIES

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Stakhiv, E.Z. 1978. Cumulative impact assessment for Corps permit activities (Draft Working Paper). Institute for Water Resources, U.S. Army Corps of Engineers, Ft. Belvoir, VA.

Summary:

This research paper examines concepts of cumulative impact assessment, primarily drawn from ecosystems theory, in relation to the regulatory functions program under which permits are issued by the U.S. Army Corps of Engineers. Although the concepts of cumulative impacts are defined and explored theoretically, the emphasis throughout this work is on rational management of natural systems and ecosystems. The emphasis also applies only to the Corps' regulatory program. While much good source material concerning environmental impact assessment is referenced here, including much concerning secondary impacts, the overall conclusion of the report is unclear. While recognizing that cumulative impact assessment is needed, it does not present one preferred methodological approach and in fact, contained within the document are statements made in cited sources concerning the extreme difficulties in performing cumulative impact assessments. Examples are: "No solution is offered here [to the cumulative impact assessment problem] because the acceptable limits of cumulative impacts is more of a policy matter than a technical one." (Clark and Terrell, 1978); "Not only do we lack appropriate methodologies, but relevant data are highly qualitative consisting primarily of judgments and therefore, subject to varying interpretations, elastic definitions, contextual limitations and temporal preferences" (Vlachos and Hendricks, 1976).

This paper has only limited relevance to this study. It does help document the historic progression of cumulative impact concepts and their definition in relation to Corps permit programs. It also documents the difficulty of operationalizing and designing an acceptable cumulative impact assessment methodology.

Philips, B.R. et al. 1978. The cumulative impacts of shorezone development at Lake Tahoe. Prepared for California State Lands Commission, Tahoe Regional Planning Agency, State of Nevada, and the U.S. Army Corps of Engineers.

Summary:

The report attempts to analyze the cumulative impacts of shorezone development resulting from implementation of the Tahoe Regional Planning Agency's Shorezone Ordinance. Socioeconomic impacts were assessed using social and economic data drawn principally from user surveys and existing models of the tourist economy. The assessment utilized an Impact Assessment model incorporating hypothesized "cause and effect" relationships between areas of impact and key controlling factors. These relations of development to environmental change were mapped using the "stepped network" impact matrix (Sorenson, 1971). The model was then used to generate two scenarios of growth-induced effects, one a growth maximum and the other of intermediate dimensions.

Despite the conceptual potential of the stepped network matrix approach and the use of a sophisticated computer model to generate growth projects, an assessment of cumulative impacts was never made. This was because secondary impacts were specifically excluded. In addition the key focus of the assessment was on the lake's biological and physical condition, rather than of social, cultural and economic indirect effects of development. The study does not constitute a comprehensive cumulative impact assessment, primarily since secondary effects of development are not assessed.

Clark J.R. and J.A. Zinn. 1978. Cumulative effects in environmental assessments. Coastal Zone. 78:2481-2492.

Summary

This article presents a step-by-step system to analyze the full range of effects of projects of varying size including their secondary and cumulative effects. However, the proposed system was designed to analyze primary, secondary and cumulative ecological effects. It is not oriented to the analysis of social, economic and cultural impacts. Nevertheless it provides some interesting insights into cumulative impact assessment. The article acknowledges, "perhaps the most difficult aspect of environmental impact review . ..is dealing with cumulative effect s." The article goes on to point out that "there are also many difficulties in conducting them. Unfortunately the basic procedures have not been developed and published. In determining the seriousness of cumulative effects, one must look very broadly at the situation to know the extent of the problem."

The article sets out a general assessment system and a procedure for evaluating cumulative effects. The general assessment system is centered around a careful set of terms and concepts designed to distinguish: projects, sub-project components, activities, disturbances, effects and impacts. The assessment method is divided into seven steps as follows:

1. Identification of Activities (analysis of project workplan to identify subprojects and activities);

2. Identification of Potential Disturbances (reduce list of potential disturbances to those of significance);

3. Evaluation of Disturbances and Effects (determine all potential ecological effects);

4. Determination of Additive Effects (combined effects from different disturbances evaluated separately in step 3);

5. Determination of Extended and Cumulative Effects (consider seriousness of extended, associated and induced effects and accumulated effects as detailed in separate step-by-step cumulative impact assessment method);

6. Evaluation of Significance (especially magnitude); and

7. Delineation of Project Conditions (suggest modifications or adjustments in proposed projects including possible mitigation measures or alternatives).

The article also sets out a separate step-by-step procedure for the identification and evaluation of extended and cumulative effects. The article points out that the term ‘effects’ rather than ‘impacts’ was chosen, “to focus on the ecological rather than the sociological.” The seven stages in cumulative and extended effects assessment are as follows:

1. Identify all associated disturbances of potential significance and evaluate effects;

2. Identify all induced disturbances of potential significance and evaluate effects;

3. Summarize all primary, associated and induced effects, review and adjust for additive effects;

4. Delineate the Local Effects Field;

5. Delineate Regional and Expanded Effects Fields if required;

6. For each relevant cumulative Effects Field:

   a) Evaluate present ecological condition
   b) Examine alteration (development disturbance) trends
   c) Analyze relationship of a) and b) above to estimate cumulative effects, current baseline level and project them to the future
   d) Compare to disturbance effects potential of project under review and make evaluation; and

7. Review and combine results of 3 and 6 above for final determination of significance of effects and make recommendation of acceptability.

The first three steps are designed to explore, to analyze and to incorporate into the assessment all secondary or extended effects of the project or projects, particularly the associated and induced effects. Steps four through seven are designed to explore, to aria' yze and to prepare for use in the assessment process the cumulative effects background of the project under review. In the method presented, the key to cumulative effects analysis is delineating the effects field (completed in Steps 4 and 5). This is the area over which the influence of the ecological effect operates. In most cases a local ecosystem would first be delineated. At times a wider regional or expanded effects field will be necessary. The delineation of the effects field is to provide a basis for comparative analysis. These steps effectively bound the analysis geographically.

In step six each particular cumulative effect is evaluated in terms of the present condition and trends of the appropriate ecological function in the relevant effects field. This step provides a comparative background against which to judge the significance and acceptability of cumulative effects. In step seven, the reviewer values a judgment as to the significance and acceptability of all of the cumulative effects listed in step three and later analyzed. The authors point out that this judgment is made by contrasting the effect against the trends occurring in the appropriate effect field chosen for each.

While this method does present an approach for assessing cumulative impacts or cumulative effects, it was designed to analyze ecological alterations rather than social, economic or cultural impacts. It was also formulated principally to analyze the cumulative ecological effects of a series of small-scale projects in the coastal zone likely to require permit applications (i.e. piers, bulkheads, dredge and fill, etc.). It was based on a definition of cumulative effects derived from the notion that, "a project under review may have relatively minor effects but a whole series of such projects would lead to major ecological damage". "An assessment of the cumulative effects of the probable combination of past, present and future projects should be made."

While the basic concepts and steps contained in this method may have some relevance to cumulative impact assessment of social, economic and cultural impacts of petroleum development on the North Slope Borough, this applicability needs to be further established. The method operates on the assumption that relatively clear cause and effect relationships exist between project activities and disturbances and secondary and cumulative effects and impacts. However, this presumption has not been borne out regularly in ecosystem analysis and is even less tenable for social system analysis. Unless clear cause and effect relationships between project-generated disturbances and social, economic and cultural effects can be established, this method will prove to be of little relevance to this study since it is principally oriented to ecological relationships.

Stakhiv, E.Z. (cd). 1980. An approach for analysis of cumulative impacts (ACI) of permit actions regulated by the Corps of Engineers. Institute for Water Resources, U.S. Army Corps of Engineers, Ft. Belvoir, VA.

Summarv:

This report summarizes the evolution of the concept of analysis of cumulative impacts (ACI) within the Corps' regulatory program. The report extends the theoretical examination of cumulative impact concepts and methods and reports on a workshop on "Analysis of Cumulative Impact" held in 1980 that included participants from academia, Corps field personnel and Corps policymakers. The report acknowledges that, "ACI is in the earliest stages of evolution" and discusses several methodological approaches. The report also points out, "the analysis of cumulative effects poses very difficult and complex conceptual and methodological obstacles and thereby has the potential for occupying an inordinate amount of time and resources for its resolution." Several approaches to diagnose cumulative effects are discussed. Figure 1 illustrates one diagnostic analysis of the components of the cumulative impact concept developed originally by Stakhiv (1978).

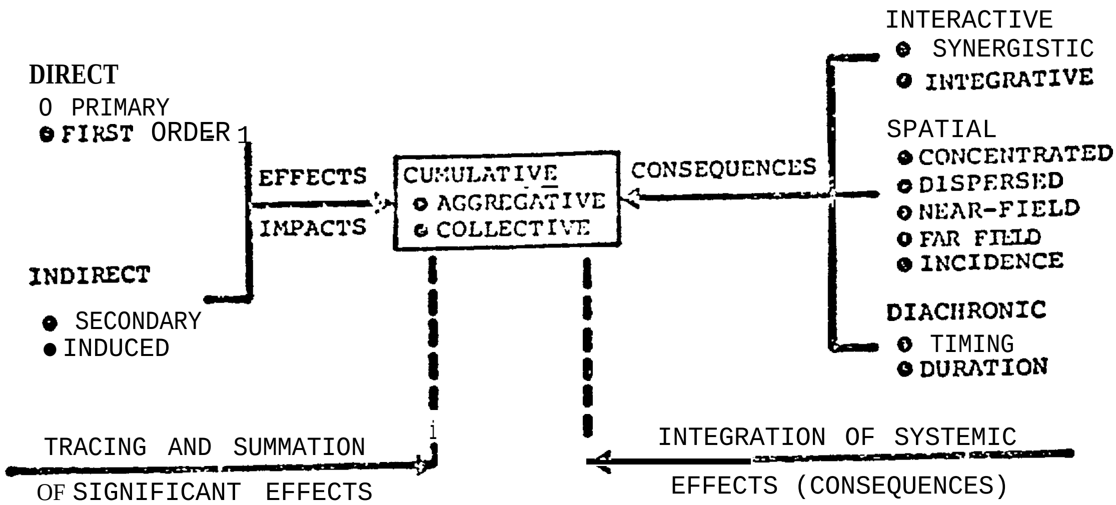
In addition to presenting three definitions of cumulative impacts (Stakhiv, 1978; Vlachos and Hendricks, 1976; and CEQ, 1977), the report states, "there is no definitive explicit view or perception of what constitutes cumulative impacts; how they should be measured; and how the results or knowledge may ultimately be factored into the bases of the decision to grant or deny a

permit. Baseline data, regional inventories, mapping and continuous monitoring systems were suggested as the keys to resolving ACI". Methods proposed are most appropriate to the permit process administered by the Corps and physico-hydrological environments over which it has jurisdiction. Cumulative impacts is simplified to include:

- o causal chains of traceable direct effects;
- o an additive or aggregative emphasis; and
- o long-term interactive/synergistic sequences resulting from induced effects of growth and development.

For the Corps, "the crux of the problem of cumulative impacts remains one of land use planning at the local levels." A broadening of the "public interest review process" to include cumulative impacts is the suggested pragmatic approach. Although this report helps to provide theoretical background and some general guidance on cumulative impact assessment methods, no specific methods appropriate to assessing social, economic and cultural cumulative effects of North Slope Borough petroleum development are detailed. Therefore, this report has only limited relevance to this study.

A. BILATERAL APPROACH TO ACI



B. IMPACT HEIRARCHY

ACTIVITY/ACTION
- ● GOAL
- O OBJECTIVE
- ● PROGRAM
- ● PROJECT
  - ● CONSTRUCTION
  - ● PHYSICAL PRESENCE
  - ● PERATION
  - ● MAINTENANCE

Disturbance

RESPONSE/EFFECTS

IMPACT (DIRECT} **(INDIRECT)**

CONSEQUENCES (CUMULATIVE)
- o **MORPHOLOGICAL**
- ● **STRUCTURAL**
- ● **PROXEMIC**
- o **CULTURAL**

C. IMPACT MEASURES/COMPONENTS

SIGNIFICANCE
TRACEABILITY
TIMING
INTENSITY
ORDER
DURATION
INCIDENCE/SPACE
MAGNITUDE/HIERARCHY
CONSTRAINTS
- ● CARRYING CAPACITY
- ● LIMITING FACTORS
- ● CRITICAL EFFECTS
- ● BOUNDARY CONDITIONS
- ● **TOLERANCE LEVELS**
- ● **BREAKPOINT** ANALYSIS
- ● **THRESHOLD** LEVELS
  - (I) MANIFESTATION
  - (II) EXTINCTION
  - (III) PHASE **CHANGE**
  - (IV) REVERSAL
- O STANDARDS
- O **CRITERIA**
- ● SINGULARITY
- ● **REVERSIBILITY**
- O **CERTAINTY/PROBABILITY**

FIGURE 1

Merson, A. and K. Eastman. 1980. Cumulative impact assessment of western energy development: will it happen. vol. 51.

Summary:

This article reviews the legal underpinnings of cumulative impact assessment, and within the context of proposed energy resource developments in Colorado questions whether the cumulative impacts of such projects will be adequately assessed. The article states, "Although reasonably familiar procedures exist to determine the environmental impacts of individual energy development projects, it is critical that we study the cumulative impacts of such projects." The article reviews the various regulatory mechanisms developed under NEPA which mandate the ascertainment of cumulative or synergistic impacts of major federal actions significantly affecting the environment. The article also discusses state and local legal and regulatory mechanisms available to reinforce or encourage consideration of the cumulative impacts of resource development projects.

With regard to state and local issues, the article concludes, "the non-federally-mandated side of state environmental control consists largely of planning and coordinating requirements addressed to local governments or regional councils of governments, an industrial siting or facility siting permit process, or the newly developed Colorado prototype of coordinated permitting known as the Colorado Joint Review Process. As with local review of energy development, state processes focus almost exclusively on site-specific, rather than cumulative, aspects of development, and place particular emphasis on actual burdens imposed as front-end costs on energy boom towns. At present the emphasis of the Colorado Joint Review Process is on stream-lining numerous federal, state, and local permitting processes and not on anticipating cumulative or synergistic impacts of forthcoming activities."

The article states, "when geographic parameters tend to dominate, and the issues are more of regional importance than of national or global significance, regional environmental impact statements become the appropriate tool for assessing cumulative impacts". The Supreme Court in Kleppe v. Sierra

Club (427 U.S. 390 1976) ruled that federal agencies have the prerogative to establish when regional impact statements are required to analyze cumulative impacts. The decision states, "Cumulative environmental impacts are, indeed, what require a comprehensive impact statement. But determination of the extent and effect of these factors, and particularly identification of the geographic area within which they may occur, is a task assigned to the special competency of the appropriate agencies."

The article reviews the North Slope Borough v. Andrus (13 E.R.C. 2097, D.D.C., 1979) in which, "the District Court for the District of Columbia looked sympathetically upon the need for a comprehensive EIS to examine cumulative impacts of oil and gas leasing in the Beaufort Sea off Alaska. While denying a preliminary injunction to halt the offshore leasing, the court found considerable support for 'contentions that the Final Environmental Impact Statement (EIS) . . . fails to adequately analyze the cumulative impact of the Beaufort Sea project and other major federal and state projects in the area . . .'"

The article reviews the CEQ regulations implementing cumulative impact assessment promulgated in 1979 (40 CFT SS 1500-1508). In determining whether a proposed action requires an EIS or qualifies as a categorical exclusion, CEQ mandates that "the significance of an action be considered both in context and intensity. A factor to be considered in evaluating intensity is 'whether the action is related to other activities with individually insignificant but cumulatively significant impacts.'"

CEQ indicates that "the primary vehicle providing for cumulative impact consideration is the scoping process, in which the scope of issues to be addressed in an EIS is determined. In determining scope, an agency must consider three types of actions, three types of alternatives and three types of impacts. Actions [to be considered including the proposed action] may be connected actions, cumulative actions, or similar actions. Cumulative actions are defined as 'actions, which when viewed with other proposed actions, have cumulatively significant impacts and therefore should be discussed in the same impact statement.' The three types of alternatives are: the no action alternative, other reasonable courses of action, and mitigation measures not in the proposed actions. The three types of impacts are: direct, indirect, and cumulative. A cumulative impact results from 'the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time'."

Furthermore, indirect effects are said to be "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth-inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects in air and water and other natural systems, including ecosystems."

The article reviews the performance of federal agencies in Colorado in performing cumulative impact assessments or comprehensive EIS's for major projects and concludes, "there is little to suggest that consideration of cumulative or synergistic impacts will take place outside the mandated requirements of NEPA. Compliance with those requirements will depend largely upon the willingness of the responsible federal agencies conscientiously to pursue a decision-making process of sufficient breadth to portray with accuracy the likely cumulative impacts." The article presents no detailed methods for undertaking cumulative impacts assessment.

Dames & Moore. 1981. Methodology for the analysis of cumulative impacts of permit activities regulated by the U.S. Army Corps of Engineers - final handbook. Prepared for U.S. Army Corps of Engineers, Contract DACW72-80-C-0012. Institute for Water Resources, Fort Belvoir, VA.

Summary

This handbook was prepared to guide Corps' regulatory personnel in performing analyses of the cumulative environmental impacts of activities requiring Corps permit applications. It provides a generalized and flexible methodology for accomplishing cumulative impact assessment for any of a range of engineering activities occurring in Corps-regulated environments (wetlands, navigable waterways, etc.). The method is centered around a system for "tiering" the analysis to fit the activity and its range- of anticipated impacts.

Projects which are major, strongly exogenous (growth-inducing) and/or controversial are subjected to comprehensive analysis under Tier I. Projects of a large scale but, endogenous (growth-accommodating), projects of a smaller scale, but exogenous, and projects located in stressed environments or developmental "hot spots" are subjected to an intermediate analysis in Tier II. Projects of a small scale with endogenous impacts and located in an unstressed environment are reviewed in a brief analysis under Tier III. A special programmatic tier is also defined for General Permits.

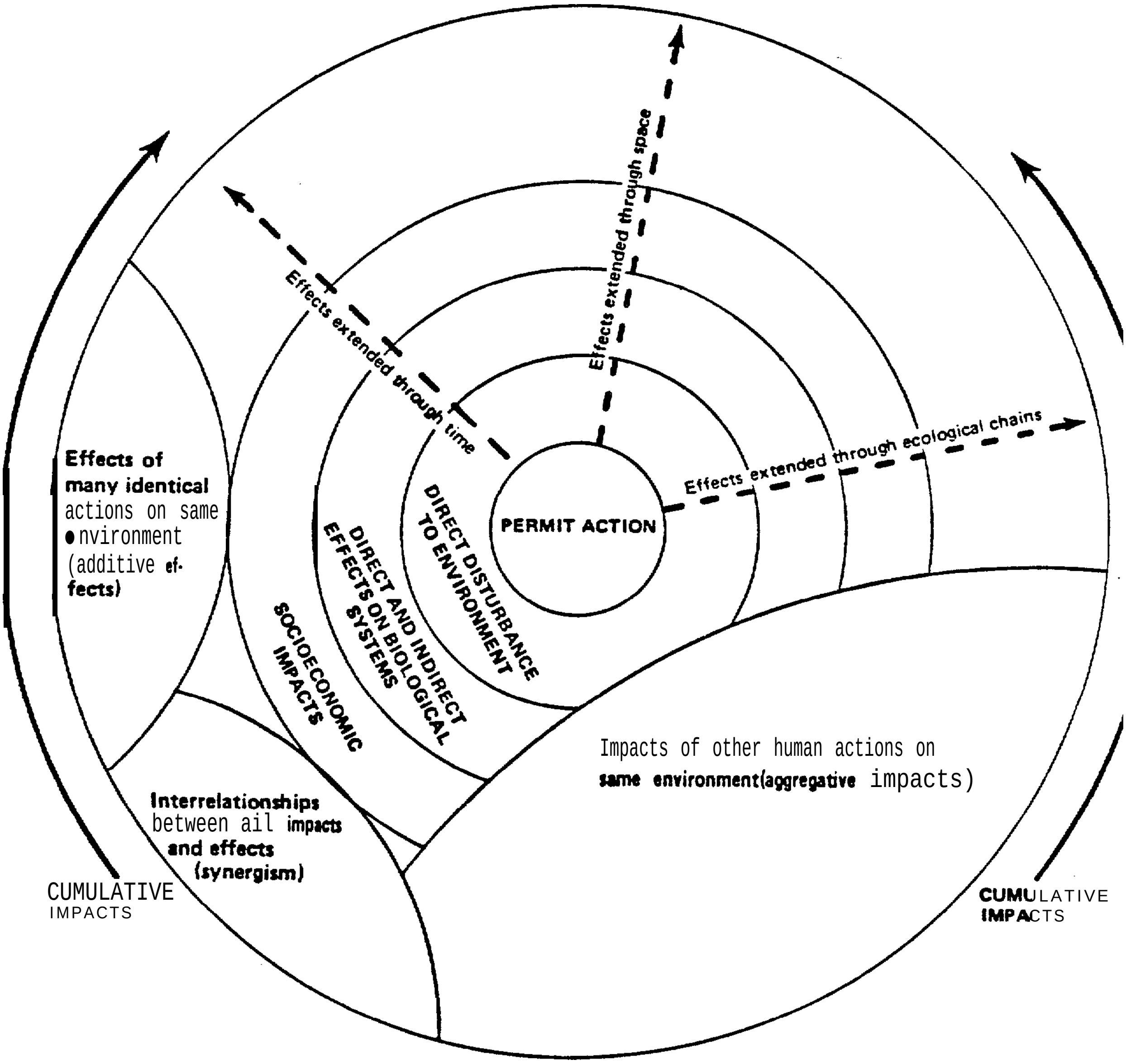
Following assignment to a tier, the major components of analysis are "Bottom Up Analysis" (growth-accommodating or growth-neutral) and "Top Down Analysis" (growth-inducing), illustrated later in this review. "Bottom Up Analysis" traces the identified primary disturbances associated with a project through time and systemic interconnections into direct and indirect biological and ecological effects. In "Top Down Analysis" primary emphasis is placed on tracking the potential growth-inducing aspects of a proposed permit action from the immediate physical environment affected by a project into the socio-economic sphere.

The handbook defines cumulative impacts as, "all of the changes--beneficial and detrimental--which will occur as a result of a proposed permit action. Cumulative impacts include physical, chemical, and biological changes; but they also include economic, social, and behavioral effects, and the effects of these changes on health, economic well-being, quality of life and communities or basic social organization. Cumulative impacts are the sum of all of these changes and the reinforcing or dampening interactions between them."

This handbook develops a methodology capable of satisfying both of the main definitions of cumulative impacts. The first concept applies not to single unconnected actions, but rather to actions which when viewed along with other "past, present, and reasonably foreseeable future actions," have cumulatively significant impacts (also known as aggregative impacts). The second concept of cumulative impacts is more applicable to the stream of impacts originating form large-scale projects. This second definition stresses the importance of considering the totality of impacts resulting from an action, including the primary or direct impacts, the secondary or indirect impacts, and any actions and derivative impacts induced by the initial action. Figure 2 illustrates the breadth of these two concepts when superimposed.

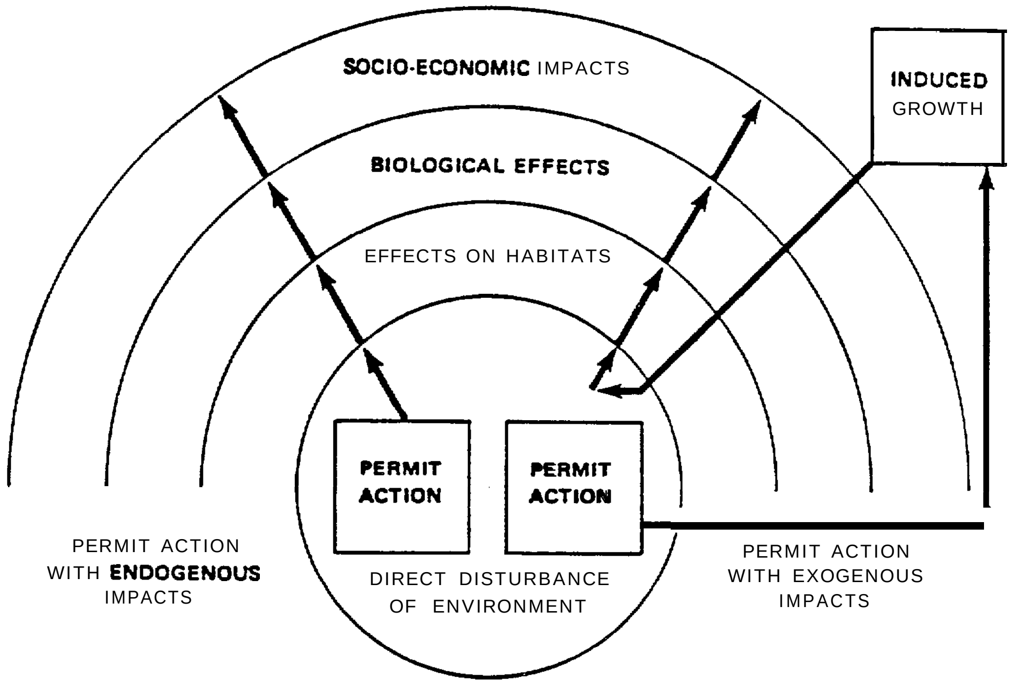
The handbook points out that secondary and indirect impacts are extremely important and in some cases may be more significant than any primary effect. The method also extends into the operational time frame to include life-cycle impacts of permitted actions, and spatially through the ecological and social systems. The report points out that, "summed (or aggregate) cumulative impacts arise from the aggregation and synergism of the numerous individual impact types both at the direct and indirect level. Additionally, cumulative effects result from the superimposition of the effects resulting from one project on those stemming from other projects within the same ecosystem. These cumulative effects tend to act on the critical features of the ecosystem."

A major distinction is drawn between growth-inducing actions (exogenous) and growth-accommodating actions (endogenous) as a means to better analyze cumulative impacts. Figure 3 illustrates the contrast between endogenous and exogenous impact flow types. The handbook also stresses the importance of using network diagrams to help identify primary and secondary impacts. "In sketching the web of interrelationships between project, subproject, construction activity/operation activity, environmental disturbance, ecological effect, and environmental impact, emphasis should be placed on as many known causal relationships as possible. It will not be possible to quantify all of the mapped interrelationships. But an essential first step in conducting an analysis of cumulative impacts is to prepare a comprehensive list of impact



THE CONCEPT OF CUMULATIVE IMPACTS

FIGURE 2



IMPACT FLOW **TYPES-ENDOGENOUS** VS. EXOGENOUS

FIGURE 3

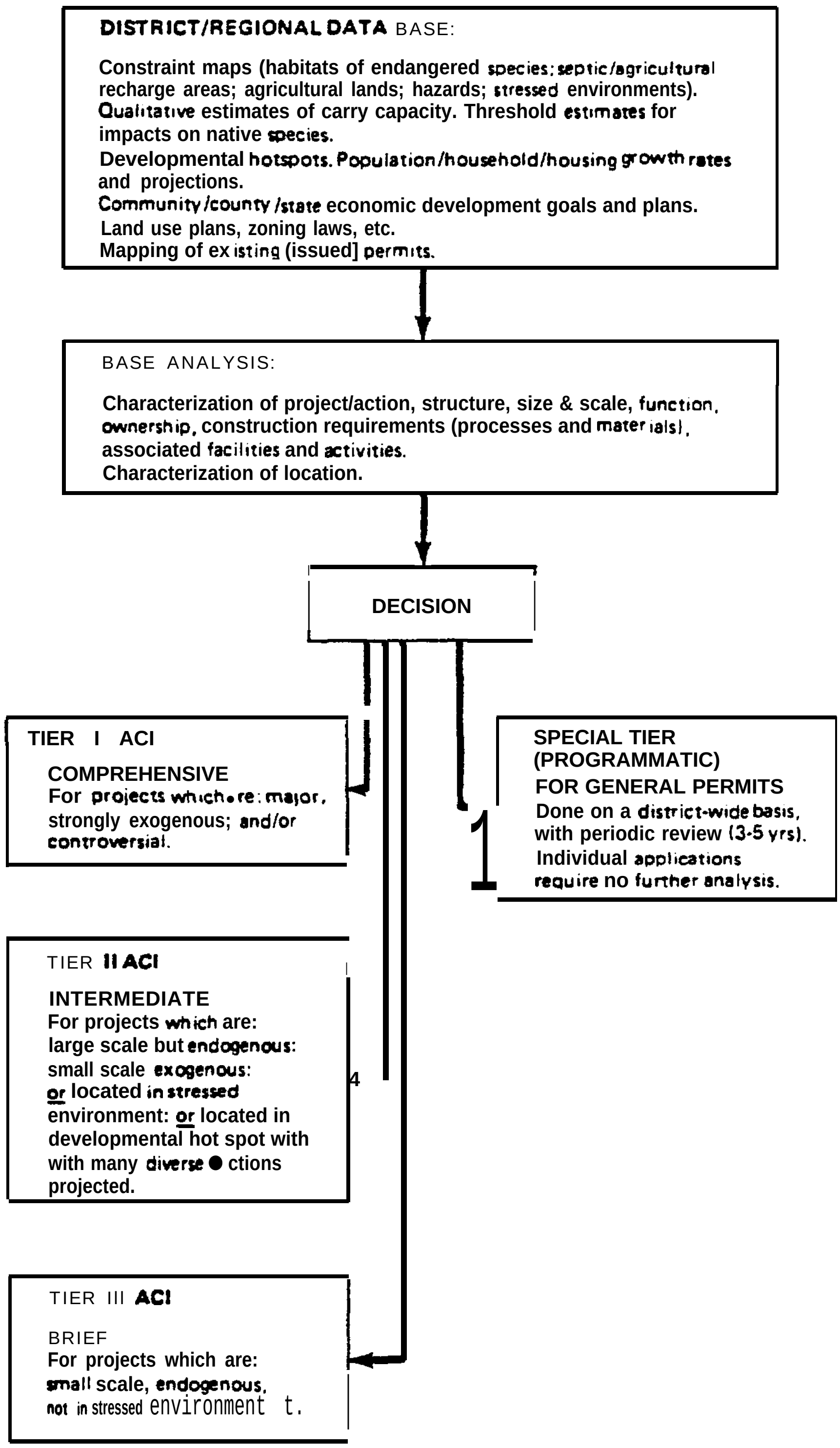
networks." The authors add that secondary effects and impact chains are not thoroughly understood, in spite of more than a decade of increasingly sophisticated environmental impact assessment.

The report presents a series of generalized impact networks for commonly permitted activities such as dredging, bulkhead construction and shore protection structures. The applicability of these specific network diagrams to the assessment of cumulative impacts in the Alaskan Arctic is limited. However, the method of developing network diagrams and their further analysis is a valid technique which should be incorporated into future cumulative impact assessment methods.

The method developed in this handbook employs several steps. Before bounding and initiating an analysis of the cumulative impacts of a proposed activity in one of the three tiers, the methodology calls for completion of two preliminary descriptive steps: characterization of the proposed permit action and characterization of the environment in which the permit action is to occur. Once these two steps are complete, the method helps to select one of three tiers for analysis and selection of the appropriate assessment technique.

In selecting an appropriate level of analysis and an assessment approach, first the assessment is scoped to define its substantive content and then the study's geographic and temporal boundaries are established. The next step allows selection of an appropriate "tier" for analysis and then an appropriate assessment approach is selected. Figure 4 shows the tiering system for cumulative impact assessment.

The method provides a decision tree for helping to select the appropriate assessment approach, either the "bottom up" approach for a project or projects with chiefly endogenous impacts or the "top down" approach for a project or projects with largely exogenous impacts. This is shown in Figure 5. Figure 6 compares the two approaches. Figures 7 and 8 illustrate the "top down" approach and the "bottom up" approach to cumulative impact assessment.



TIERING SYSTEM FOR CUMULATIVE IMPACT ASSESSMENT

FIGURE 4

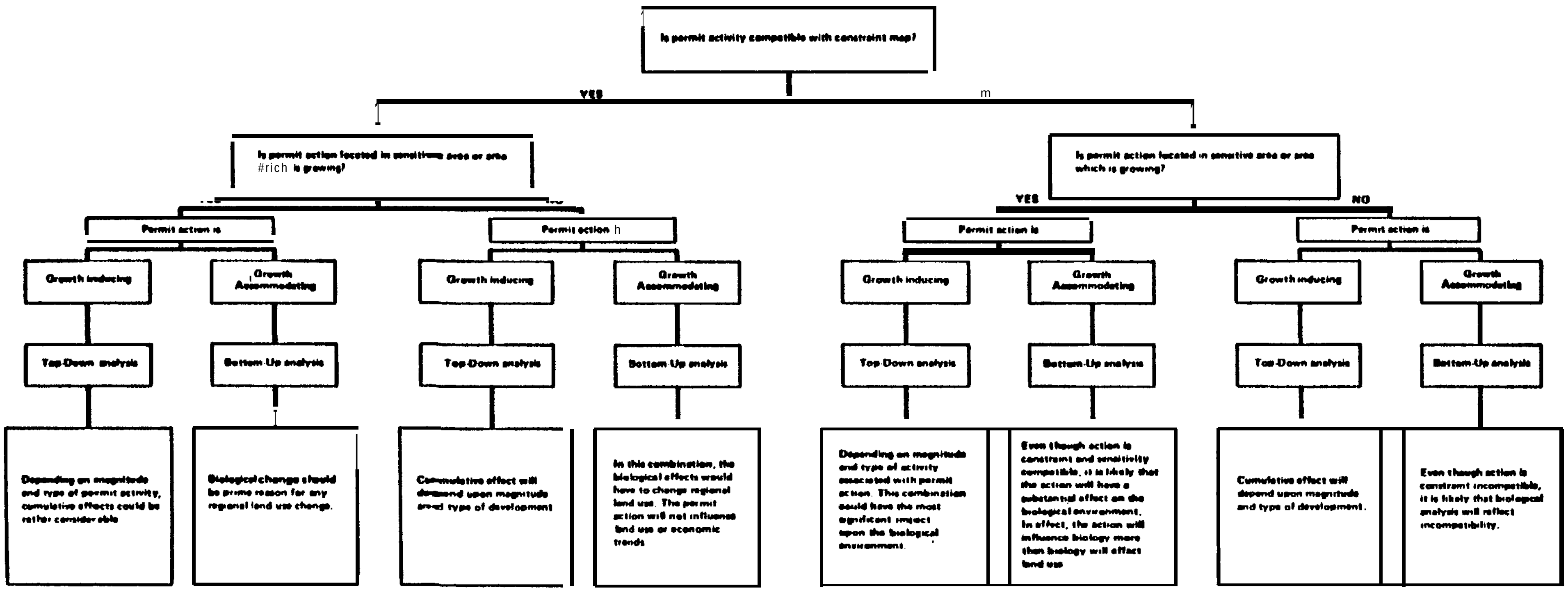
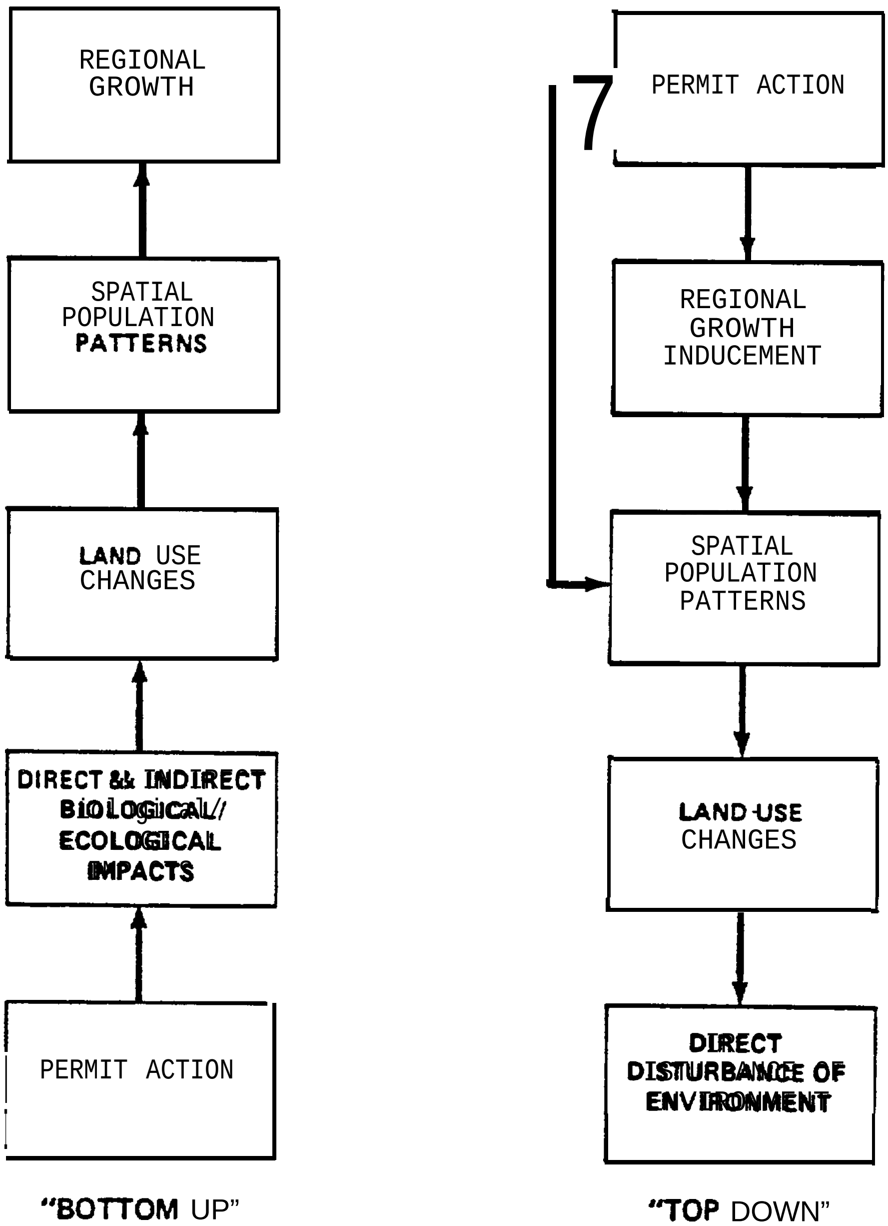


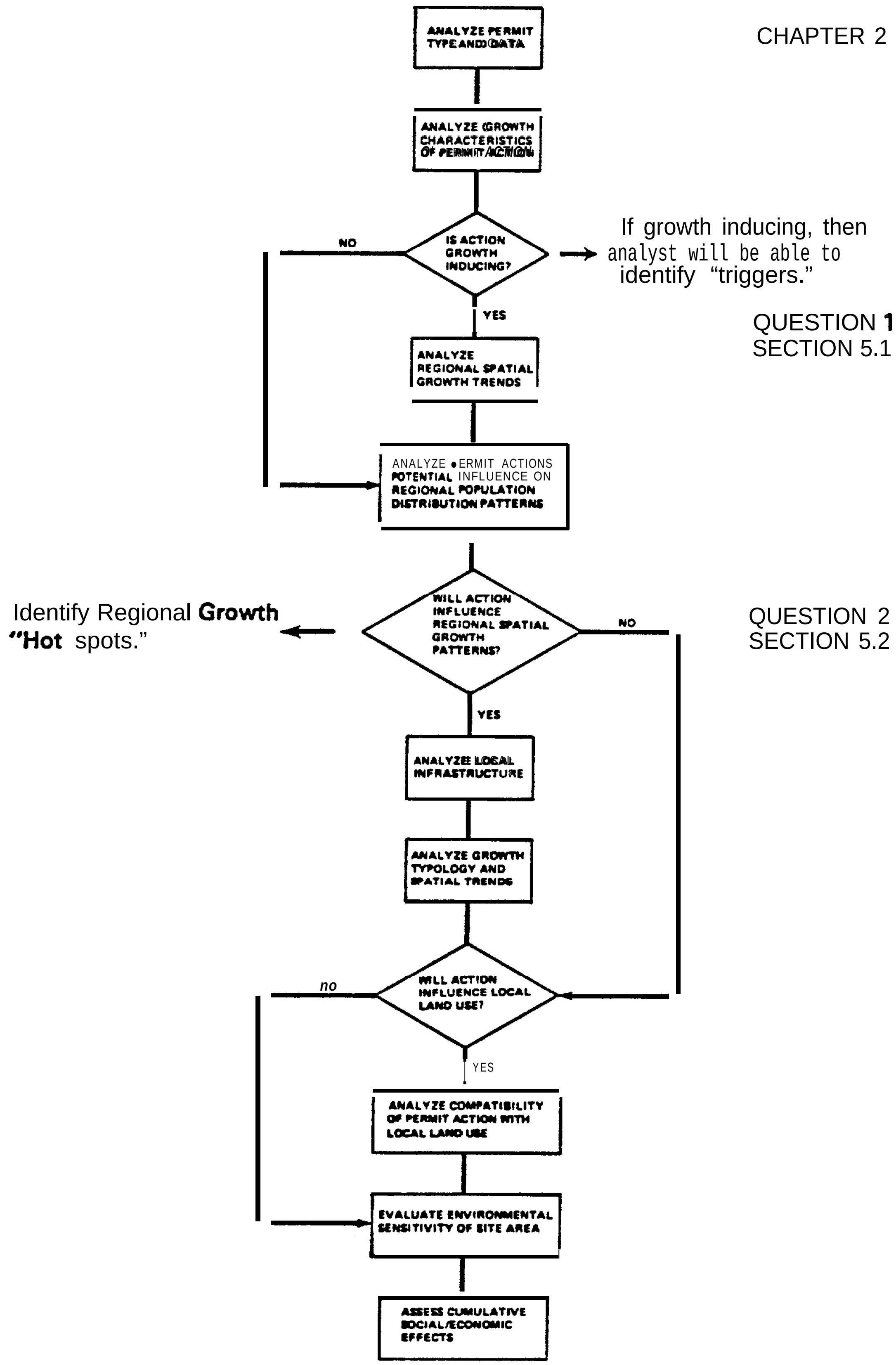
FIGURE 5

DECISION TREE FOR APPROACH CLASSIFICATION



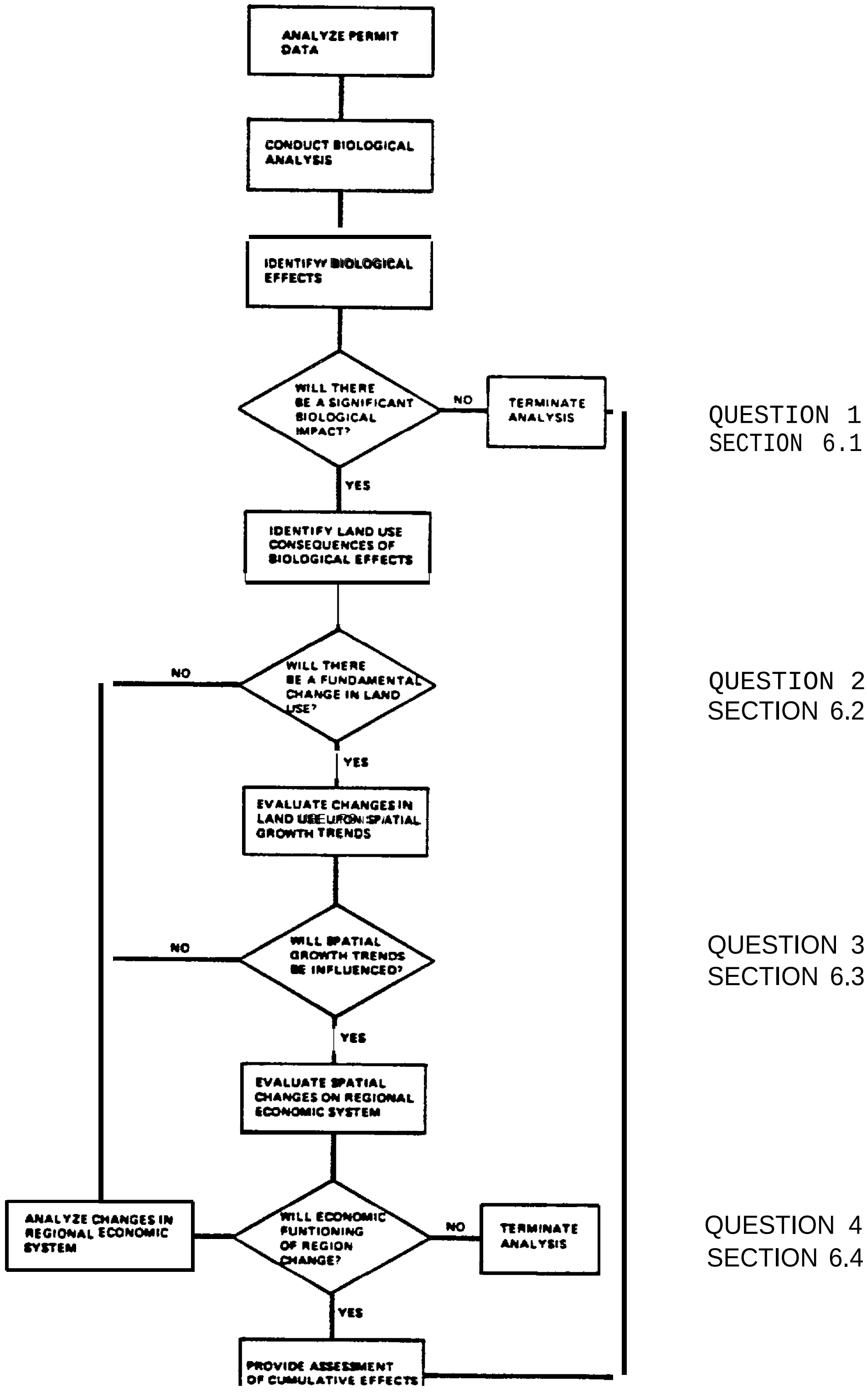
COMPARISON OF ASSESSMENT APPROACHES

FIGURE 6



TOP DOWN ASSESSMENT APPROACH

FIGURE 7



"BOTTOM-UP" ASSESSMENT APPROACH

FIGURE 8

Within the framework of these two basic approaches a variety of more detailed analytical methods are suggested. In the "top down" method, the focus on growth-inducing and growth-induced activity results in a focus in the analysis of social and economic effects is in regional economic effects identified through such approaches as: economic base theory, input/output models, or econometric models. The method focuses on identifying potential triggers to growth, regional hot spots and spatial patterns of development. However, this whole approach is inappropriate to the North Slope Borough since it was designed to help the Corps of Engineers anticipate and analyze the cumulative impacts of permit activities resulting from regional growth and development in rapidly urbanizing areas.

The bottom up analysis process handles social and economic impacts in the more traditional method of tracing biological effects and impacts through a causal network and establishing their secondary and higher order impacts on social and economic systems. The focus in assessment again is on land use changes, changes in regional spatial growth trends, and economic functioning of a region. This approach is definitely a requirement for assessing the cumulative impacts of North Slope Borough petroleum development but it needs to be supplemented by a separate analysis of accelerated social, economic and cultural changes only indirectly produced by petroleum development.

In conclusion, while this handbook's careful illustration of cumulative impact concepts and definitions provides a valuable starting point in developing an assessment method for analyzing the cumulative impacts of North Slope petroleum development on Inupiat communities, the report's cumulative impact assessment method would need to be extensively modified in order to suit that purpose. This is because the focus of the method is limited to the area of the Corps' jurisdiction, and is predominantly oriented towards water-related effects and impacts and ecological systems. In addition, many of the social and economic assessment techniques suggested require data inputs currently unavailable or inappropriate to the North Slope Borough.

Science Applications, Inc. 1983. Draft environmental impact statement/report, Santa Ynez unit/Las Flores Canyon development and production plan, technical Appendix 13 cumulative impacts. Prepared for U.S. Minerals Management Service, California State Lands Commission, County of Santa Barbara, Santa Barbara, CA.

Summary:

This report, prepared as part of an EIS, provides a semi-quantitative analysis of cumulative impacts. The report's cumulative impacts analysis was prepared in response to the requirements of the California Environmental Quality Act (CEQA) which mandates consideration of such impacts. The CEQA guidelines state that: "a list of past, present and reasonably anticipated future projects producing related or cumulative impacts, including those projects outside the control of the agency will be provided." "A summary of the expected environmental effects to be produced by those projects with specific reference to additional information stating that where information is available will be provided." The guidelines further state that "all significant cumulative impacts resulting from the proposed project will be discussed and analyzed." "The discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided of the effects attributable to the project alone. The discussion shall be guided by the standards of practicality and reasonableness."

The semi-quantitative method employed in this analysis is the "cumulative effects matrix process" which incorporates a scaling procedure to define impacts for the proposed project, other reasonably foreseeable projects and all project alternatives. The basic method contained three steps:

1. Describe all the other reasonably foreseeable projects (which in this instance were largely petroleum development and transportation related);

2. Prepare summary scaled matrices providing an analysis of the expected environmental impacts of these projects, both individually and in all possible combinations of projects and project alternatives; and

3. Provide a "reasonable" analysis of the "cumulative impacts" themselves, which in addition to being summarized in summary matrices, were incorporated into the body of the EIS under the appropriate disciplinary reviews.

The definition of cumulative impacts used was the "interactive and additive attributes of the individual foreseeable projects." Impacts were quantified for each disciplinary element (i.e. air quality, cultural resources, marine biology, socioeconomic, etc.) according to a set of index values (O = no impacts, 1 = adverse but not significant impacts, 3 = significant impacts that can be mitigated, 9 = unavoidable significant impacts), to represent the degree of impact. Two separate scoring mechanisms were employed. The first scoring mechanism deals with an independent analysis of the foreseeable projects and the second addresses the interaction between these projects and the proposed project. The procedure of quantifying the impact levels made possible a procedure for quantifying cumulative project impacts. However, impacts were assumed to be additive. The flaw in this procedure is that not all impacts are additive. This raises the possibility of inaccurate or misleading conclusions.

Once the proposed project's components and each of the foreseeable projects were scored by impact category, a matrix showing the possible combinations of the project and each of the foreseeable projects was constructed for each impact category. The result is an upper triangular matrix for each issue area which shows on its diagonal the scores for the foreseeable projects considered independently of each other and, on the upper diagonal element, the scores for that issue area element when those two projects are taken in concert with each other. In addition a separate row matrix was prepared for each issue area element (i.e. air quality or marine biology) showing the comparative quantitative score in impact level for each project alternative.

At the top of Figure 9 is shown the basic impact score matrix or "S" matrix. The .th elements are the rows of the matrix (horizontal) and j^{th} elements are the columns (vertical). The individual numbers represent the projects considered in the analysis (i.e. 1. Proposed Exxon project; 2. Getty Gaviota consolidated facility; 3. ARCO Coal Oil Point project;

$$
S^* = \begin{bmatrix}
s_{1,1} & s_{1,2} & s_{1,3} & s_{1,4} & s_{1,5} & s_{1,6} & s_{1,7} & s_{1,8} & s_{1,9} & s_{1,10} & s_{1,11} \\
 & s_{2,2} & s_{2,3} & s_{2,4} & s_{2,5} & s_{2,6} & s_{2,7} & s_{2,8} & s_{2,9} & s_{2,10} & s_{2,11} \\
 & & s_{3,3} & s_{3,4} & s_{3,5} & s_{3,6} & s_{3,7} & s_{3,8} & s_{3,9} & s_{3,10} & s_{3,11} \\
 & & & s_{4,4} & s_{4,5} & s_{4,6} & s_{4,7} & s_{4,8} & s_{4,9} & s_{4,10} & s_{4,11} \\
 & & & & s_{5,5} & s_{5,6} & s_{5,7} & s_{5,8} & s_{5,9} & s_{5,10} & s_{5,11} \\
 & & & & & s_{6,6} & s_{6,7} & s_{6,8} & s_{6,9} & s_{6,10} & s_{6,11} \\
 & & & & & & s_{7,7} & s_{7,8} & s_{7,9} & s_{7,10} & s_{7,11} \\
 & & & & & & & s_{8,8} & s_{8,9} & s_{8,10} & s_{8,11} \\
 & & & & & & & & s_{9,9} & s_{9,10} & s_{9,11} \\
 & & & & & & & & & s_{10,10} & s_{10,11} \\
 & & & & & & & & & & s_{11,11}
\end{bmatrix}
$$

$$
S = \begin{bmatrix}
3 & 3 & 9 & 9 & 9 & 9 & 3 & 9 & 9 & 3 & 3 \\
 & 3 & 9 & 9 & 9 & 9 & 3 & 9 & 9 & 3 & 3 \\
 & & 3 & 9 & 9 & 9 & 3 & 9 & 9 & 3 & 3 \\
 & & & 3 & 9 & 9 & 3 & 9 & 9 & 3 & 3 \\
 & & & & 3 & 9 & 3 & 9 & 9 & 3 & 3 \\
 & & & & & 3 & 3 & 9 & 9 & 3 & 3 \\
 & & & & & & 3 & 9 & 9 & 3 & 3 \\
 & & & & & & & 9 & 9 & 9 & 9 \\
 & & & & & & & & 3 & 3 & 3 \\
 & & & & & & & & & 1 & 1 \\
 & & & & & & & & & & 0
\end{bmatrix}
$$

The Air Quality Cumulative Impacts.

$$
S = \begin{bmatrix}
3 & 3 & 9 & 9 & 9 & 3 & 9 & 3 & 9 & 3 & 3 \\
3 & 3 & 9 & 9 & 9 & 3 & 9 & 3 & 9 & 3 & 3 \\
3 & 3 & 9 & 9 & 9 & 3 & 9 & 3 & 9 & 3 & 3 \\
3 & 3 & 9 & 9 & 9 & 3 & 9 & 3 & 9 & 3 & 3 \\
9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 \\
3 & 3 & 9 & 9 & 9 & 3 & 9 & 3 & 9 & 3 & 3 \\
3 & 3 & 9 & 9 & 9 & 3 & 9 & 3 & 9 & 3 & 3 \\
1 & 3 & 1 & 1 & 1 & 1 & 1 & 1 & 9 & 1 & 3 \\
9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 & 9 \\
3 & 3 & 9 & 9 & 9 & 3 & 9 & 3 & 9 & 3 & 3
\end{bmatrix}
$$

Cumulative Impacts Matrix for the Project Alternatives.
Replacement Rows

FIGURE 9

4. Chevron Pt. Arguello project; 5. Union OES Tract P-0411; 6. Aminoil marine terminal expansion; 7. Las Flores terminal; 8. Petroleum Transportation Committee projections; 9. Pt. Conception LNG terminal; 10. Hunter Oil Ellwood oil field; and 11. Hyatt Hotel and resort complex). Therefore $S_{1,1}$ would represent the "proposed" project's "overall" score for air quality, arrived at by summing the scores of its individual project components; $S_{1,2}$ would represent the combined interactive score of the proposed project with the Getty project combined and so on until all project combination taken two at a time in the upper triangle of the matrix have been represented. One can estimate the combined impacts of project subsets by adding those "S" elements representing the desired project pairs. When the sum of the scores equals or exceeds an impact level index, it is assigned that impact level.

In the middle of Figure 9 is the "S" matrix for the air quality issue area. As can be seen, the large number of '9' scores for project pairs indicates a significant percentage of unavoidable adverse cumulative impacts. At the bottom of Figure 9 another matrix is shown. This matrix is designed to be used to modify the basic "S" matrix for air quality by considering how replacement of the proposed Exxon project by each of the alternative projects would affect the cumulative impact assesment. Each row, numbered 1 through 10, represents 1 of the 10 alternatives (i.e. 1. onshore oil processing; 2. collocation of project facilities at Exxon's site; 3. alternative sites; 4. scaled oil and gas production; 5. pipeline oil transport; 6. pier tanker mooring; 7. electric power production; 8. subsea production; 9. reinfection vs. ocean outfall for produced gas and water; and 10. no project). By replacing a row of the air quality matrix with the appropriate row of the replacement matrix, the revised matrix represents the selected alternative as the proposed project.

In conclusion, although this method attempts to analyze the cumulative impacts of the proposed project and all reasonably foreseeable projects, it fails as a usable analytical tool for several reasons. First and foremost, as acknowledged in the report, the matrix technique serves no mathematical function and is merely designed to organize the scores into a framework in which they can be examined visually. Thus no quantitative analysis is undertaken. Second, within the context of impact scoring, the scoring framework is flawed. As the sum of scores are added for pairs of projects (i.e. a 3 for the proposed project and a 3 for another concurrent project), impact levels are adjusted. When the sum of the scores equals or exceeds an impact level index, it is assigned that index level. And yet as the report acknowledges, “generally the matrices show a significant high percentage of unavoidable adverse cumulative impact. This is illustrated by the number of ‘9’ scores which appear in the matrices.” But no attempt is made to interpret or assess these “significant unavoidable adverse cumulative impacts,” or to further isolate the source of such impacts to particular project components. Thus the analysis’ use of numerical values disguises a diversity of impact causation and interaction. This overly simplifies the process of cumulative impact assessment and offers no guidance to policy-makers on how to manage, mitigate or predict adverse cumulative impacts.

In addition the matrix comparison is only made for pairs of projects and does not consider the cumulative effects of all the projects simultaneously. In this regard the report noted, “If projects are considered in higher groupings, an increasing percentage of ‘9’ scores would be anticipated, showing an even further unavoidable cumulative impact.” However, no attempts were made to analyze this aggregation of all of the likely foreseeable projects. Such an aggregation is precisely where the analysis of cumulative impacts needs to be oriented. However, the qualitative, numerically-scaled, impact assessment matrix approach utilized by SAI fails to meet this challenge.

More importantly, from the standpoint of transferability to the Alaskan Arctic this approach is inappropriate for other reasons as well. Analysis of social, economic and cultural considerations is limited and adapted to the project’s setting, a relatively developed, urbanized, area of Santa Barbara County. Also under CEQA, “an economic or social change by itself shall not be considered a significant effect on the environment. A social or economic change related to a physical change may be considered in determining whether the physical change is significant.” Finally, the method only included assessment of the near-term, primary effects of the principal project components. No attempt was made to model or predict secondary impacts or to include such effects in the cumulative impact matrices. This method has no relevance to this project except to illustrate the limitations of semi-quantitative, scaling approaches to cumulative impact assessment.

STUDIES WITH NO DIRECT RELEVANCE

Mitre Corporation. 1975. Guidelines for the analysis of cumulative environmental effects of small projects in navigable waters. Prepared for U.S. Army Corps of Engineers, Baltimore Districts.

Summary:

This report was intended as a set of general guidelines for conducting cumulative impact assessments for the construction and operation of "small projects in navigable waters." However, only primary impacts were considered. No attention was paid to secondary or induced impacts. Socioeconomic analysis considered standard indicators: population, housing, employment, vehicular traffic, aesthetics and economics. This study has no direct relevance to this project due to its lack of a proven cumulative impact assessment method.

Vlachos, E. and D.W. Hendricks. 1976. Secondary impacts and consequences of highway projects. Colorado State University, Ft. Collins, CO. Report for Federal Highway Administration, U.S. Department of Transportation.

Summary:

This report is a manual for conducting cumulative impact assessment of highway projects. However, its focus is on the measurement of growth-inducing effects of highway projects in urbanized areas. This report has minimal relevance to this study except for its definitions, descriptions, and elaboration of secondary impact assessment techniques. However, none of the methods presented seem directly applicable to conditions in the Alaskan Arctic.

Center for Wetland Resources. 1977. Cumulative impact studies in the Louisiana coastal zone: eutrophication. land loss. Prepared for Louisiana State Planning Office.

Summary:

This report reviews methods used to study two complex changes in ecological wetland systems: cultural eutrophication and canalization. As ecological studies, their relevance to the study is minimal. Part 1 recognizes that eutrophication is a widespread problem throughout the coastal zone of Louisiana. It leads to poor water quality, development of nuisance algal blooms, decline in desirable commercial and sports fishery species, and diminished recreational usefulness of water bodies. The major cultural sources of nutrients leading to eutrophication are: urban runoff, domestic sewage, and agricultural runoff. The causes and consequences of wetland losses in coastal Louisiana are examined in the second part. Man-induced land losses result from flood control practices, impoundments, and dredging of canals and channels with their subsequent widening. Wetland loss also results from the placement of spoil upon the marsh and impounding areas which are drained for land reclamation. Some of the cumulative impacts of land loss are: increased saltwater intrusions, a loss of a capacity to buffer the impact of large additions of nutrients, and a reduction in storm buffer capacities. Management concepts and guideline recommendations center around the need to appreciate the long-term interrelations of the wetland estuarine sys tern.

Although this study examines cumulative impacts of two complex ecological effects, the report contains no general methodology. In fact each of the separate constituent studies utilizes different analytic techniques. More importantly however, none of these ecological effect chains are traced into the social system. Therefore this study has no direct relevance to this project.

Abt, Associates. 1978. Manual for evaluating secondary impacts of wastewater treatment facilities. Office of Research and Development, U.S. Environmental Protection Agency.

Summary:

This manual is intended to serve as a guide to assessment of the secondary environmental impacts of wastewater treatment facilities construction. However, as the manual was developed to project growth and land use in urban areas with degraded water quality, it has no direct application to this study. Secondary economic impacts considered are limited to: agricultural land use changes, energy demand shifts, and land value changes. The manual's methods address only one class of secondary impacts, namely, environmental impacts resulting from the growth induced by wastewater treatment facilities in urban fringe areas. This report has no direct relevance to this project.

Sharp, J.M. and S.G. Appan. 1978. Cumulative effects of oil drilling and production on estuarine and near-shore ecosystems. Estuarine interactions. Academic Press, New York.

Summary

This paper describes a two-year, eight-season interdisciplinary synoptic field and laboratory study to determine whether 25 years of intensive oil drilling and production had produced observable environmental and ecological change in Timbalier Bay and the adjacent offshore area in southern Louisiana. An integrated set of biological, chemical, geological, and physical field studies was conducted and integrated with available prior data "to determine whether long-term and intensive petroleum drilling and production has resulted in harmful environmental or ecological effects in offshore and adjacent estuarine ecosystems." No socioeconomic investigation was conducted. No formal cumulative impact assessment methodology was employed. Rather the investigation proceeded from the assumption that the cumulative effects of 25 years of low-level drilling and production discharges (i.e. chronic effects of low-level discharges on biota) would be measurable if in fact they had occurred. The research's conclusion was that the study area has not undergone significant ecological change as a result of petroleum drilling and production and that no cumulative effects were apparent. Due to its excessive focus on ecological parameters, this monitoring study is not relevant to cumulative impact assessment for the North Slope Borough. This report has no direct relevance to this project.

New York State Energy Research and Development Authority. 1981. Cumulative environmental impacts of coal conversion. NYSERDA-81-29. (Microfiche).

Summary:

This report presents analyses of potential cumulative impacts of proposed construction of 14 coal-fired power plants in New York as called for by the New York State Energy Master Plan and the State Environmental Quality Review process. The report highlights potentially significant cumulative effects in the following areas: air quality, solid waste disposal, water quality and supply, transportation, visual and aesthetics, ecological effects and health and safety. The study does not consider potential social and economic costs or potential land use changes. This report has no direct relevance to this study.

Horak, G.C. and **E.A. Whippo.** 1981. Planning for induced impacts on fish and wildlife. Prepared for the U.S. Dept. of the Interior, Western Energy and Land Use Team, Fish and Wildlife Service, EnviroControl, Inc., Fort Collins, CO.

Summary:

This report concerns the prediction of and planning for induced impacts, or indirect socioeconomic effects. The principal focus of the indirect effects considered in the report are those associated with large-scale energy development projects in western states which impact fish and wildlife populations (i.e., increased road kills, habitat disturbance and recreation pressure affecting indigenous fish and wildlife populations in the general region of a proposed project). The report concludes that while induced impacts may be more severe than primary or direct impacts, “a holistic method for predicting induced impacts on fish and wildlife has not yet been developed.” The report recommends one promising methodological approach, that of aggregating impact predictions for various projects on a regional scale. Explanations of induced impacts and sample impact network diagrams are shown in Figure 10. The study’s conceptual impact model is shown in Figure 11. This report has no direct relevance to this study.

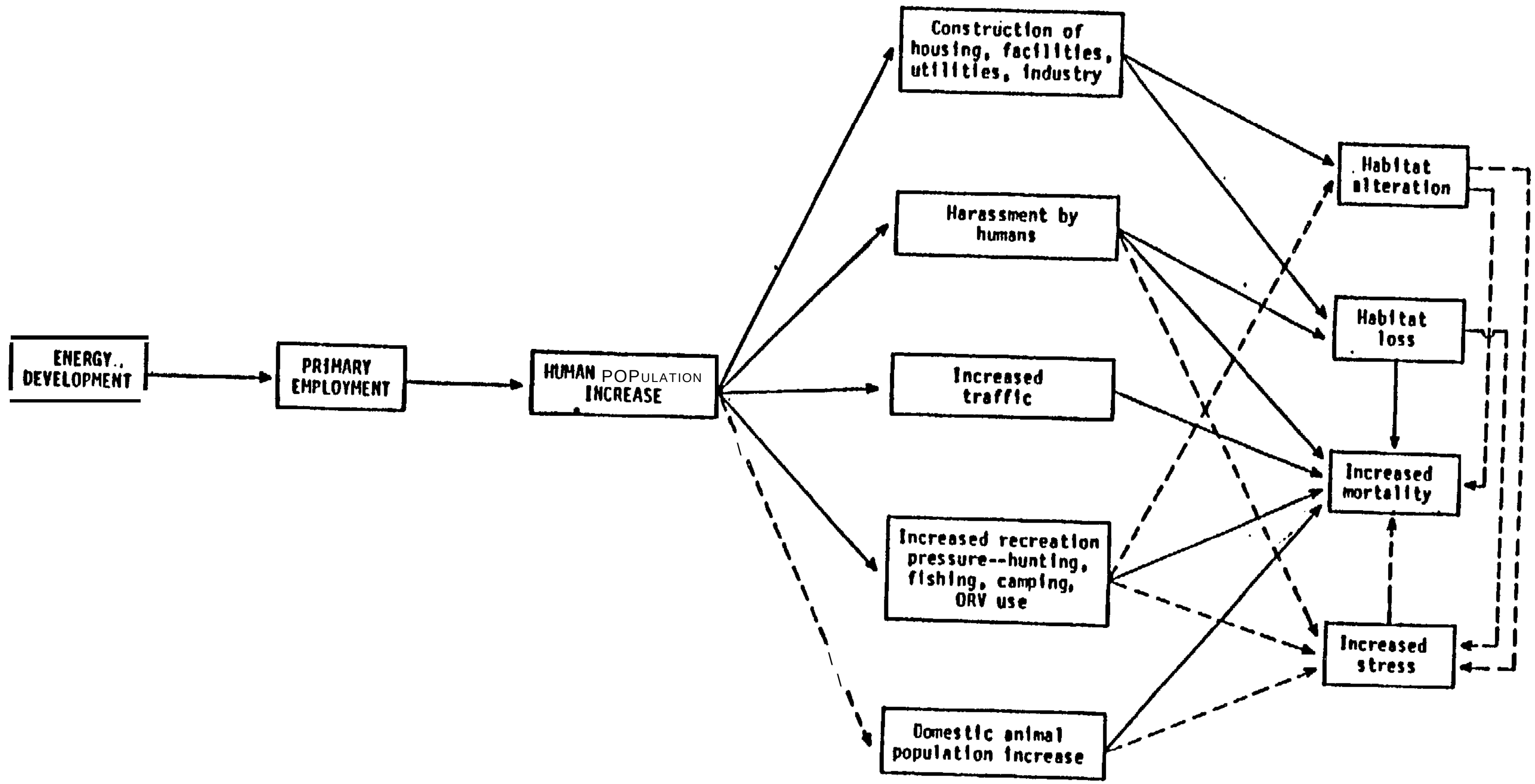
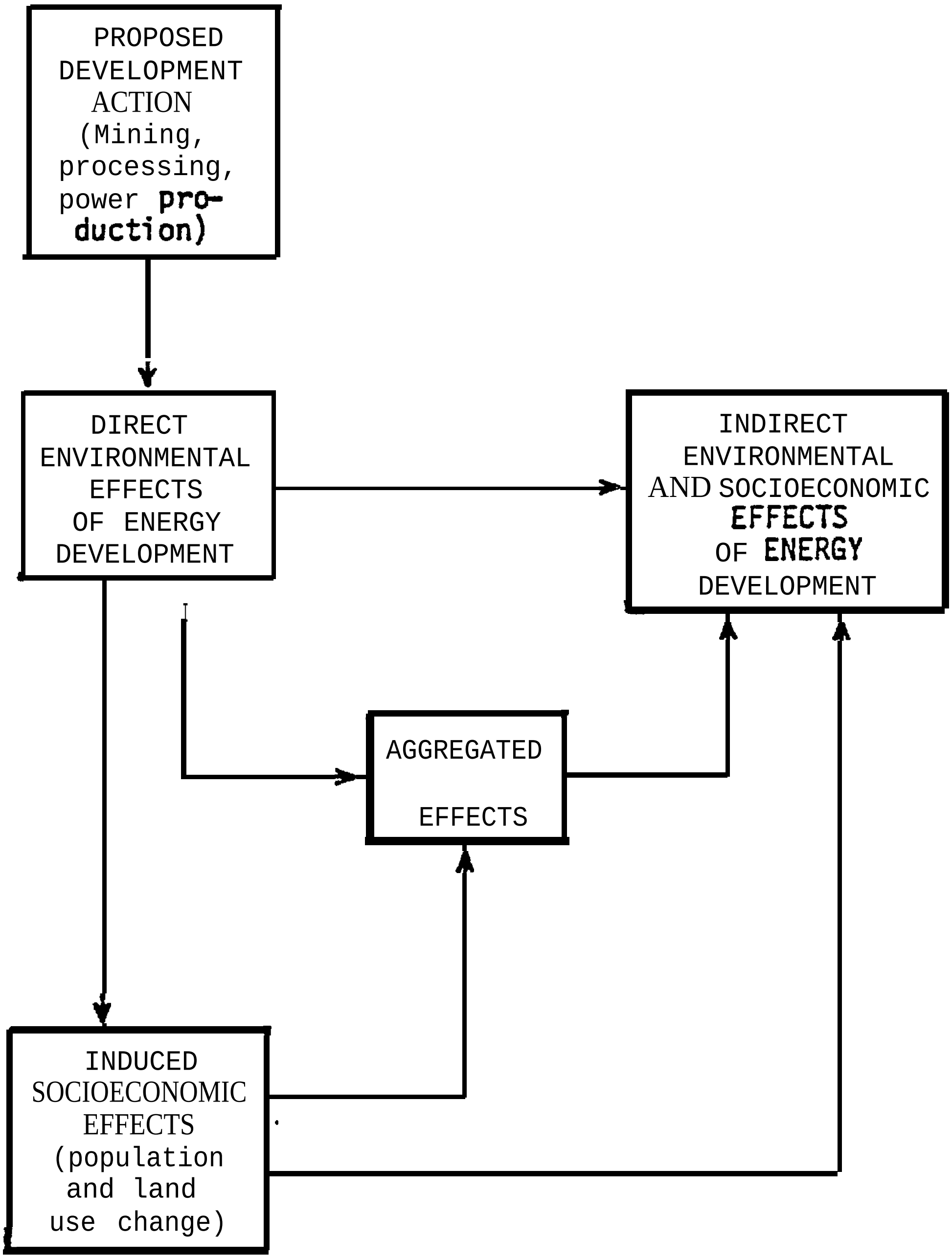


FIGURE 10

Overview of effects on fish and wildlife induced by rural population increase associated with energy resource development (solid lines indicate relationships which have been quantified to some degree).



Conceptual impact model.

FIGURE 11

Power Plant Siting Program. 1982. Power plant cumulative environmental impact report. Maryland Dept. of Natural Resources, Annapolis, MD.

Summary:

This report, required by the Maryland Power Plant Siting Act, is an attempt to consider on a state-wide basis, the cumulative environmental impact of all power plants within the state. Socioeconomic considerations are limited to primary social and economic effects on the impacted communities such as:

- population, housing and school enrollment;
- land use patterns;
- transportation and congestion;
- income, employment and business activity;
- local government spending and tax revenue.

No attempt was made to address the secondary and aggregative socioeconomic impacts. This report has no direct relevance to this study.

Goetz, C.L. and C.G. Abeyta. 1982. Exploration of techniques for separation and quantification of individual coal mine effects from cumulative effect data. Water Resources Div., Dept. of the Interior, U.S. Geological Survey, Albuquerque, N.M.

Summarv:

Legal requirements of regulatory agencies have created a need to evaluate the hydrologic effects of proposed and actual coal mining activities. The situation on the San Juan River in northwest New Mexico offered a promising set of circumstances to determine whether the effects of a single coal mine are large enough to be measured and separated from other natural and cultural effects using the cumulative hydrologic data collected at stream sites by the Water Resources Division. The objective of the study was to investigate various data analysis techniques which can be used to quantify and separate individual coal mine effects on streamflow, water quality, and sedimentation from cumulative natural and cultural effects. This report has no direct relevance to this study.

Osterkamp, W.R. 1982. Cumulative impacts of sediment due to coal mining. Water Resources Div., U.S. Geological Survey, Dept. of the Interior, Reston, VA.

Summary:

The regulatory requirements of the Surface Mining Control and Reclamation Act of 1977 state that an assessment be made of the probable cumulative impacts of all anticipated mining in the area upon the hydrology of the area. Increased sediment yields from mine refuse piles, haul roads and strip-mined and reclaimed areas is one of the largest problems being addressed in the regulations. This study conducted field investigations to evaluate hydrologic, geomorphic and modeling techniques to help predict sediment yields from mining activities. This report has no direct relevance to this study.

Geppert, R.R., C.W. Lorenz and A.G. Larson. 1983. Determination of possible cumulative effects of forest land management activities: a literature review, for Washington Forest Practices Board. Ecosystems, Inc., Lacey, WA.

Summary:

This report deals only with cumulative effects on the natural environment (ecosystems) alone. Definitions of cumulative effects are provided along with impact networks related to forestry practices. This report has no direct relevance to this study.

3.2 Environmental Impact Assessment Literature

A substantial literature has accumulated in the fifteen years since the passage of NEPA concerning methods for conducting environmental impact assessment (EIA). This literature is exceedingly diverse and relatively poorly indexed. The literature is also subject to considerable variation ranging from actual impact assessments to regional environmental planning studies, methodological studies, comparisons of various methodologies, and articles analyzing theoretical, ethical or value perspectives on assessments. Clearly, only a limited review of the available literature could be made given the constraints posed by the available time and budget. Impact assessment methods were screened down to those few which had specific relevance to the assessment of cumulative impacts.

It was quickly obvious from this methodological review that relatively little consideration had been given to concepts of cumulative impact and to the development of methods to assess cumulative impacts within the EIA literature. Nevertheless, those few references were analyzed and evaluated and available methods reviewed in terms of their potential applicability to the assessment of social, economic and cultural impacts of petroleum development in the Alaskan Arctic.

What emerged clearly in a review of the EIA literature was both the diversity of available impact assessment methodologies and the complexities of applying any methodological approach to the comprehensive assessment of both physical and social parameters. Several observers concluded that no generalizable EIA methodology exists due to the need to exercise subjective judgment about predicted impacts. Similarly, others pointed out that EIA methods are only tools which must be selected based on an appropriate evaluation of the situation to be assessed and can only be effectively used if accompanied by the continuous application of professional judgment concerning data inputs and analysis and interpretation of results.

The review also revealed the numerous implicit assumptions, concepts and complexities that underlie environmental assessments. Several authors commented on the difficulty of ensuring that the vantage point of those potentially affected by a project are adequately represented and on the complexity of the concept of “impacts” itself. Other authors discussed the necessity of making subjective and political judgments in EISS that raise ethical issues and value judgments for professionals involved in assessments. Another important point noted by several authors was that impacts, whether beneficial or harmful, are not evenly or homogeneously distributed among social groups or individuals and that an assessment must recognize that everyone affected will not suffer or benefit evenly.

Even when impacts are discerned, evaluated and analyzed, prediction of the likelihood or probabilities of impacts occurring is often impossible. Other issues include measuring the significance and magnitude of impacts and making allowances for reversibility or irreversibility of impacts. Each of these structural or methodological problems of EIA also affects the potential methods for cumulative impact assessment. Based on a review of the available literature, it appears safe to generalize that meeting the requirements of simple, project-level comprehensive environmental and social impact assessment is sufficiently difficult, that despite the fact that concepts of cumulative impact have been recognized , methodologies for their identification and analysis have not been developed.

The following sections review a variety of selected examples from the EIA literature to highlight consideration of cumulative impact concepts and methods. While several methods with promise for application to the Alaskan Arctic were identified, none is readily transferable to cumulative impact analysis without considerable modification and synthesis. In some cases the appropriate methods are merely a framework for analysis rather than an explicit step-by-step method. As in the preceding section the studies reviewed were divided into two categories according to their relevance to this project with those of greatest relevance discussed first.

Of the studies reviewed, those with the greatest relevance to the development of a viable cumulative impact ssessment method for the Alaskan Arctic are the following: Sorenson (1971), State of North Dakota and BLM (1978) , Helling (1980), Erickson (1979), Porter et a?. (1979), Skidmore, Owings and Merrill (1981), Arctic Slope Technical Services (1981), and Jacobs (1981). Of these works, Sorenson's form of network analysis, the State of North Dakota's regional environmental impact study and Helling's adaptive environmental assessment approach appear to offer the greatest potential applicability to the assessment of cumulative impacts. The other works offer important methodological insights, illustrate key problems, or help indicate promising approaches worthy of further development. The studies with no direct relevance are also briefly reviewed.

RELEVANT STUDIES

Sorenson, J.C. 1971. A framework for identification and control of resource degradation and conflict in the multiple use of the coastal zone. Dept. of Landscape Architecture, University of California, Berkeley, CA.

Summary:

This report describes a framework for analyzing the environmental effects of land uses in the coastal zone. The principal method for analysis is a "stepped matrix" designed to network environmental effects and impacts. The approach is especially designed to simulate the linkages between primary, secondary and higher order impacts of development projects. This method identifies the environmental costs of various land uses, but leaves the task of benefit evaluation to the project's proponents. Unfortunately the poor quality, large size and varied type sizes of Sorenson's sample matrices prevent their reproduction in this report. The report was a master's degree thesis. Thus, the stepped matrix form of network analysis can only be outlined in the following text.

Sorenson's thesis represents an extension of previously developed impact assessment frameworks designed to systematically illustrate the linkages of "causes, conditions, and effects" by using "network analysis". Construction of a network diagram is a way of depicting the factors and interrelationships which should be taken into consideration in an impact assessment. Network construction depends on breaking an impact problem into related units through "cause-condition-effect analysis". The results of such analysis are then depicted in a network diagram or a matrix. Sorenson began by listing known examples and types of coastal resource degradation or use conflict in California. Each item on the list was then treated as an impact generated by a resource use. Each impact was traced back logically through "effect-condition-cause factoring" to a resource use and by projecting uses by "cause-condition-effect" to all the impact listings. The format used by Sorenson to organize and portray these interrelationships was a "stepped matrix."

The stepped matrix enables a continuous portrayal of the "use to cause to condition relationship." The linear connection of condition to consequent condition to effect permits the development of a "multiple effect network."

Use of the stepped matrix offers several advantages as compared to branched network diagrams (for example see Skidmore, Owings and Merrill , 1981 or Henderson, 1982). The information and relationships can be directly comprehended without having to rely on involved tracing of pathways or computer manipulation. They also offer advantages in format over the branched network approach. The format of columns between the "condition" and the "effect" in a stepped matrix network permits a descriptive connection of the interrelationship not possible in a branched network. Sorenson's "stepped matrix" approach actually combines both a stepped matrix and a network of columns into one framework that enables "the identification of uses, causes, conditions, effects and description of their interrelationship to be portrayed in one format."

The author identifies 55 coastal zone uses on the basis of their potential for environmental impacts and their generality for regional planning. For each land use type (the rows in the matrix), there are five columns to fill in. The first column contains "causal factors"--specific alterations or activities associated with particular land uses. The possible resulting first-order adverse impacts, "initial conditions," are tabulated in the second column. The third column contains a list of second and third order impacts induced by the initial conditions; these are called "consequent conditions." The next column shows the ultimate environmental "effects." The final column is used to tabulate "corrective actions," "control mechanisms," and "reference indices." A corrective action is a physical measure used to mitigate the adverse effects. Control mechanisms are nonphysical instruments such as licenses, zoning ordinances, and easements. A reference index gives a specific example of a similar use-cause-condition-effect relationship.

So, for example, a given coastal "use" such as offshore oil and gas wells includes a suite of "causal factors" such as: platforms, refineries, well drilling and pipelines, that each are related to a network series of possible adverse environmental impacts. The stepped matrix approach allows each individual causal factor to be separately analyzed and displayed. For example, pipelines may cause the following changes in "initial conditions": blocked or reduced tidal currents, leakage from oil transfer operations, and snagging of trawling gear or anchors. In turn the consequent conditions resulting from each initial condition can be displayed. For example, the blocking of tidal currents can: decrease flushing, change salinity, reduce oxygenation and increase estuarine water temperatures. The final impact assessment column shows the effect or effects of the consequent conditions. For example, decreased flushing reduces the assimilative capacity of the ecosystem and an increase in estuarine water temperature may: stimulate phytoplankton booms, decrease dissolved oxygen, and result in mortality or habitat reduction of heat-sensitive species of biota. The stepped matrix also allows for "corrective actions or control mechanisms" and "references index" to be shown.

Although Sorenson recognizes the probabilistic nature of environmental impacts, this method does not assign probabilities to each impact. The major strength of this form of network analysis is its ability to trace the pathways of occurrence for direct and indirect effects. This method could be adapted to separate short-term and long-term changes by giving the networks a temporal dimension, although Sorenson does not mention this. All possible effects on various objectives can be illustrated in the networks, but Sorenson provides no framework for making tradeoffs across multiple objectives. Sorenson's stepped networks display factual information effectively. However, he fails to suggest a means for going beyond physical, chemical, and biological effects to place values or importance ratings on these effects. The author's matrices are also exclusively oriented to experiences in California's coastal zone through 1970.

In addition, Sorenson's selection of "causal factors" to accompany coastal "uses" in his matrices is weak. Sorenson acknowledges that, "over time the use of an area might remain the same but the 'causal factors' generated would change." He states that, "the dependence of a use on a certain causal factor can vary from an implicit relationship to a frequent relationship, to an infrequent correlation." However, no acknowledgement or assessment of the varying nature of such causal relationships appears in Sorenson's sample matrices. He also fails to distinguish between the temporal aspects of impact chains. For example, there is no comparison or contrasting of construction and operations impacts, or short-term vs. long-term impacts. This absence of a temporal dimension appears to be a major flaw of Sorenson's current approach.

The author also does not explicitly address social, economic and cultural impacts. The key emphasis of the method as developed is on physical, chemical and biological effects. The network approach does not represent a complete assessment method but is a tool which could aid in the assessment of cumulative social, economic and cultural impacts of the North Slope's petroleum development projects. It would be particularly useful for tracing the causal relationships between physical changes and social impacts (i.e. habitat losses that impact subsistence activities). However, Sorenson's stepped matrix approach would still require considerable modification to be adapted to the complexities of cumulative impact assessment and would need to be integrated into a broader methodological approach.

North Dakota, State of, and Bureau of Land Management. 1978. Final West-Central North Dakota regional environmental impact study on energy development. Colorado State University, Ft. Collins.

Summary:

This joint federal-state study, funded in part by the Old West Regional Commission, was designed to be an assessment of the cumulative impacts of proposed coal and energy-related developments in seven counties in west-central North Dakota which have a high potential for energy development due primarily to coal and water resource availability. A cooperative federal-state effort was undertaken due to complex ownership patterns which prohibit any single entity from making unilateral resource planning decisions. This regional impact study is not formally an EIS. However a major objective of the study was to present decisionmakers with "information on the cumulative effects of proposals requiring federal and state actions."

No specific cumulative impact methods were used in the preparation of this study. Rather the several regional coal development projects including gasification plants, electric power plants and proposed synthetic natural gas pipelines were jointly examined in terms of their regional impact over a seven county area including the Fort Berthold Indian Reservation. This was done through a series of alternative development scenarios each embodying a different intensity of timing and development. Although no specific cumulative impact assessment techniques were utilized, considerable emphasis was placed on analysis of indirect impacts including hidden social and economic costs of the proposed projects. However these analyses were basically qualitative owing to the fact that, “basic research is just now beginning to quantify these types of problems.” In addition, the state and federal government indicates in its document a willingness to initiate specific research efforts to monitor and address areas of concern such as the effect of trace elements and radionuclides in coal on human health.

The report’s analysis of social and economic impacts was extensive and relied on several types of methods. The analysis of economic impacts relied on an economic modeling approach. The models used included an input/output model developed by the North Dakota Regional Environmental Assessment Program (REAP); a cohort survival demographic model; a gravity model to distribute population increases within the region’s communities; and a fiscal impact model developed as a part of REAP. The models are component parts of the overall North Dakota REAP Economic-Demographic model which, utilizing the expected settlement patterns from the gravity model and subsequent population changes determined for each area by the economic and demographic models, determines the expected public costs and revenues associated with such changes.

To analyze social impacts an extensive set of studies was undertaken. These included a social psychological research study of potentially affected residents, interviews with landholders in the immediate vicinity of the proposed projects and a series of calculations of certain categories of social impact such as: new housing requirements, changes in student enrollments, plant-related injuries, fatal and non-fatal mine injuries, and disease occurrence. Based on the social research conducted and extrapolations drawn from other research into boomtown situations accompanying rapid energy development, conclusions were drawn regarding adverse social impacts due to the fragmentation of socialization processes such as increased rates of adolescent deviancy, alcoholism, divorce and physical illnesses. Several comments on the draft document point out that the severity of such adverse social impacts will be a function of the rate of population influx into each community and that the best way to mitigate this problem is to control the timing, type and placement of allowable developments.

In conclusion, this report is a thorough documentation of the regional environmental , social and economic impacts of a series of large energy-related development projects proposed for a seven county area of North Dakota. It incorporates the best available methods for assessing the economic and social impacts of such developments on regional communities anlayzing such standard "boomtown" parameters as construction work force increases, fiscal and related service and infrastructure insufficiencies, and derivative social and economic impacts on both new and permanent residents. However, no explicit identification of cumulative impacts was made. An additive approach to cumulative impacts was employed which demonstrates one method which is potentially applicable to the North Slope Borough. This would entail simply conducting a detailed regional impact assessment of different cumulative development scenarios for likely and proposed petroleum development projects in the Alaskan Arctic.

Helling, C.S. ed. 1980. Adaptive environmental assessment and management. International series on Applied Systems Analysis,. John Wiley & Sons, New York.

Summary:

Rather than presenting a "cookbook" methodology, Helling, et al. describe a process for dealing with resource management and environmental quality problems that was developed through a series of workshops held at the International Institute for Applied Systems Analysis. The method presented has a strong mathematical and systems ecology orientation and does not include social systems analysis. The process was designed to re-orient environmental assessment from a "reactive review process" to a process of adaptive environmental management and policy design. While the process is designed to handle indirect effects and feedback and thus might have utility for the study of cumulative impacts, this ability is achieved through a strong emphasis on systems modeling which has much greater applicability to physical and ecological effects and their indirect impacts than to the modeling of social, economic and cultural impacts.

The process of adaptive environmental assessment (AEA) is based on strong interdisciplinary contact and communication resulting in the creation of a systems model depicting the systems under study and their interrelationships. The process begins with a project manager who selects a study team of interdisciplinary experts. A core group from the study team runs workshops, devises models and analyzes alternatives. An early workshop includes decision-makers and managers for a short, intensive session on problem definition and identification of information needs. The initial stage of the process seeks to transfer information among the participants and to prepare a "first-cut" model ready for further refinement. The model need not be a computerized or mathematical representation. It should reflect the important values and attributes of the system. The model is designed to assist in the analysis of the impacts of alternative policies or projects.

During a second workshop, the full team and decision-makers analyze the model's data requirements and select alternative policies to be tested. Following field research, the model is simplified and tested for validity. At a final workshop, convened after detailed investigations by disciplinary specialists are complete, the participants devise final revisions to the model and evaluate policy alternatives through the operation of the model. AEA places special emphasis on sensitivity analysis to explore the implications of varying the model's temporal and spatial resolution, basic assumptions, and the range of uncertainty.

The second part of the book is devoted to presenting five diverse case studies developed through the use of AEA. They include: the spruce-budworm forest management problem, pacific salmon management, development in Austria's high mountain region, regional development in Venezuela, and a wildlife impact information system. One of the most important features of AEA is a set of general principles on ecology, uncertainty and the role of information in decision-making. The adaptive approach suggested in the AEA deals with uncertainty by preserving flexibility. It preserves flexibility by predisposing participants to respond to new information, preliminary failures, and unexpected conditions as an opportunity to further refine the model and policy. AEA strives for a dynamic analysis of natural systems through simulation modeling and graphs showing the behavior of key indicators over time and space. The model does not, however, deal adequately with multiple objectives. Another problem is that the separation of facts and values becomes difficult once a model has been developed. Too much reliance may be placed on numerical solutions without scrutinizing the model's basic assumptions and limitations. However, sensitivity analyses of the model are suggested as a means to uncover weaknesses.

AEA depends heavily on expert opinion and presumes a high degree of consensus among different experts and across disciplines. Although administrators are an integral part of the assessment, the public remains outside the process as an after-the-fact addition. The AEA process is time-consuming and resource-intensive, but can be varied to suit the needs of the problem under study and to meet constraints. This approach appears to have some applicability to conducting cumulative impact assessments of petroleum development projects in the North Slope Borough, although the heavy systems ecology orientation may prove poorly adapted in attempts to analyze social, economic and cultural impacts which are not easily quantified or modeled. The relevance of the AEA approach to cumulative impact assessment on the Alaskan Arctic bears further investigation. The key factors in its applicability to the North Slope Borough will be the ability to quantify social and cultural relationships and to obtain adequate data.

Erickson, P.A. 1979. Environmental impact assessment, principles and applications. Academic Press, New York.

Summary:

This book provides a series of guidelines for designing, conducting and managing environmental impact assessments. In addition to providing general background on the bureaucratic and legal aspects of the NEPA process, the book presents guidelines for assessing the physical environment and the social environment and integrating the two in an assessment of the total human environment. In reporting on Warner and Preston's analysis of impact assessment methodologies, Erickson categorizes methods in five basic categories: ad hoc methodologies, overlay methodologies checklist methodologies, matrix methodologies and network methodologies. Rather than recommend a specific method unilaterally, the author urges that analysts spend "time and effort to simplify and organize the task so as to achieve meaningful analyses and recommendations." In analyzing the physical environment the author points out that, "there is no real dividing line between the physical and social environments in the real world."

In the presentation of guidelines for the review of the physical environment the author discusses cumulative impacts. "In addition to potential direct and indirect impacts of a particular project on ecosystems, there are the so-called incremental impacts to consider. These impacts derive from multiple projects undertaken in a region over a period of time. While an individual project may result in a relatively small and unimportant impact on the physical environment, numerous projects having the same type of impacts can have an important additive effect. For example, land clearing for one project may result in an immeasurably small reduction (e.g., 2%) in the regional carrying capacity for a particular population. However, 5 or 10 additional projects, each having a similarly small impact on carrying capacity, can collectively result in a measurable and important reduction."

"In light of these considerations, it is important that the assessment team take a comprehensive overview of both the proposed project and other actual , proposed, and potential projects in the region. Specific guidelines which might be used for evaluating the comprehensiveness of the team's approach include:

1. All phases of the proposed project should be considered, including early systems planning, design, location, acquisition, construction, and operation and maintenance phases.

2. All project activities in each phase of project development (e. g., blasting, clearcutting, mowing, relocation of residents) should be identified and evaluated for potential impacts on the physical environment.

3. The timing and duration of each project activity should be related to other important events and activities in the general project area and its environs, including seasonal changes in meteorology and hydrology, animal migrations, and patterns of recreational and other uses of natural resources.

4. Cumulative impacts of the proposed project and all other ongoing and potential projects in the general region should be considered."

To accomplish this along with cumulative interrelatedness, a systems approach is suggested. No specific technique is provided however.

A major section of the book is devoted to assessment of the social environment. Within this section guidelines for the conduct of social impact assessment, economic impact assesment, and public health impact assessment are presented. This section emphasizes the "importance of considering the indirect impacts in the assessment of impacts on the social environment." "In assessing social impacts, one cannot, therefore, avoid dealing with human emotions, or with the cognates of human emotions, whether in the form of expressed or in the form of unexpressed attitudes, values and general concerns." In social impact assessment, the following guidelines were presented. They ensure that:

"1. A comprehensive assessment of attitudes and concerns is made in the local project area.

2. Personal, interpersonal, and institutional components and dynamics that influence and/or are influenced by such attitudes and concerns are identified.

3. Direct and indirect impacts of project development on these attitudes and concerns (and/or on related social components and dynamics) are identified.

4. Similar consideration be given to the attitudes and concerns of distantly located regional and extraregional populations, and

5. Interrelationships among local, regional and extraregional dynamics be evaluated in light of project impacts on any one or combination of these dynamics."

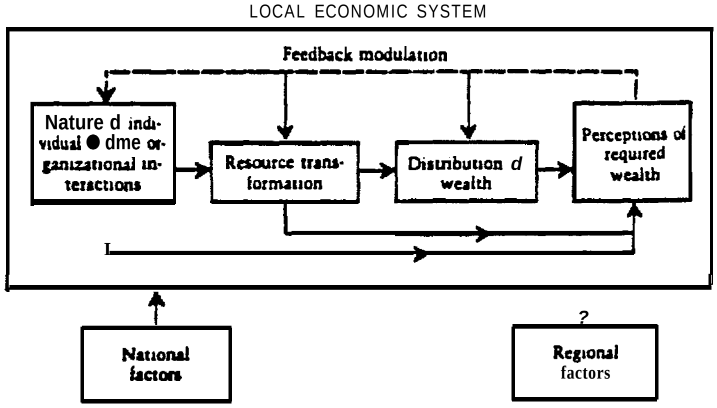
The author also strongly urges that direct involvement of the affected public be a vital part of the assessment process. An assessment team is urged to adhere to this U.S. Forest Service (1974) guideline: "Discard any notion that actions which will affect environmental quality or the public interest can be judged only by professionals. Although a proposed action may be scientifically (or technically) correct, public concern may well outweigh scientific considerations and justify proposal modification." The author also concludes that, "the best analysis of social impacts is totally inadequate if it does not include consideration of the interactions of social and physical components of the total human environment."

The book also reviews techniques and guidelines for the analysis of local and regional economic impacts of projects. Figure 12 shows examples of the general attributes of economic systems to be evaluated and a systems overview of a local economic system respectively. Erickson points out that site-specific evaluation of economic systems and their attributes is not a new problem unique to EIA but one which has been ongoing for several years. He quotes Leclair and Schneider (1968) who state, "There are. ..substantial disputes both in economics and anthropology concerning the proper subject matter of economics, and the nature of economic systems and how they should be studied." The author criticizes cost-benefit approaches and suggests that interdisciplinary assessments include in their review of economic impacts the following:

Some Examples of Dimensions of the General Attributes and Functions of Economic Systems

Some general attributes and functions d economic systems	Some dimensions d attributes and functions cd economic systems
Nature d individual ● d organizational interactions	. dependency relationships among individuals eod organizations • competetive relationships among individuals and organizations . long- and short-term duration of relationships • alternatives to ongoing relationships • mobility d participants • current and projected trends
R-cc transformation into goods, services, and monies	• nature d local resources currently utilized • external sources d resources • availability d manpower • availability d untapped resources • perceived desirability d current and poten-oaf resource utilization • dependability and adequacy d external re-sources • transportation requirements
Distribution of goods, services, and monies	• patterns by sex, age, race, and educational background • population projections • community services • per capita and family income . hiring practices • labor and capital cars • profits
Perceptions d required goods, services and monies	• demographic differences . source of perceptions • reinforcement d perceptions • community values and life @ -

LOCAL ECONOMIC SYSTEM



A systems overview of a local economic system

FIGURE 12

"1. Project impacts on the physical and social environment can result in changes in the short- and long-term economic conditions and structure of local and regional areas.

2. Project impacts on the economic conditions and structure of local and regional areas can result in changes in the physical and social environment."

He suggests that a comprehensive economic evaluation might include such issues as:

"1. Distribution of benefits and costs of alternatives (e.g., subdivision development as opposed to other uses of wilderness areas)

2. Intangible costs associated with subdivision development (e.g., aesthetics)

3. Long-term costs of subdivision development with respect to future needs for water supply, waste disposal, community services, recreation, etc.

4. Intangible costs associated with social disorganization of existing rural life styles (e.g., acculturation of current values and resultant behavioral patterns)"

As guidelines for economic impact analyses he suggests the following:

"1. All direct and indirect project impacts on physical and social components and dynamics should be evaluated for their economic consequences.

2. All direct and indirect impacts on the economic conditions and structure of local and regional areas should be evaluated for their consequences on components and dynamics of physical and social environments.

3. Comprehensive economic analyses of project alternatives (including the no-build alternative) should specify and justify the valuation of intangible costs and benefits, and discuss both short- and long-term projections of allocative and distributional effects of project development.

4. All economic effects of project development should be evaluated in light of the goals and objectives of pertinent federal and state legislation.

5. Economic analyses should be inclusive of all phases of project development, from the earliest planning phase throughout operational and maintenance phases.

6. All assumptions and limitations of economic analyses should be clearly identified and discussed with respect to pertinent federal and state legislation, to available data and information, to local and regional social values and objectives, and to project objectives.

7. No one economic criterion should Explicitly or implicitly be offered as the single most important criterion of the desirability of the proposed project."

In terms of methodologies to conduct economic impact assessment, Erickson states that, "no one analytical methodology is generally accepted as the preferred methodology - each has its limitations with respect to evaluating project impacts on economic components and dynamics."

The book also states that it is important to make a comprehensive assessment of public health considerations and impacts including: physical safety, physiological well-being, and psychological health. Erickson states, "each project impact, whether on the physical or social environment must be evaluated for its direct and indirect influence on public health and well-being." In providing guidelines for the assessment of health impacts he stresses the social nature of contemporary environmental health science which recognizes the social role in disease process and the necessity of integrating into our understanding of the effects of environment on illness the context of their social groups.

In concluding the discussion of the social environment and guidelines for its assessment, Erickson again acknowledges the importance of cumulative impacts. He states, "... a project may indeed be only one of several sources of the same type of social impact in a local or regional area-but NEPA does not exempt decision-makers from considering the incremental contributions from a proposed project, or their cumulative consequences." However, no method is provided for creating such cumulative impact assessments.

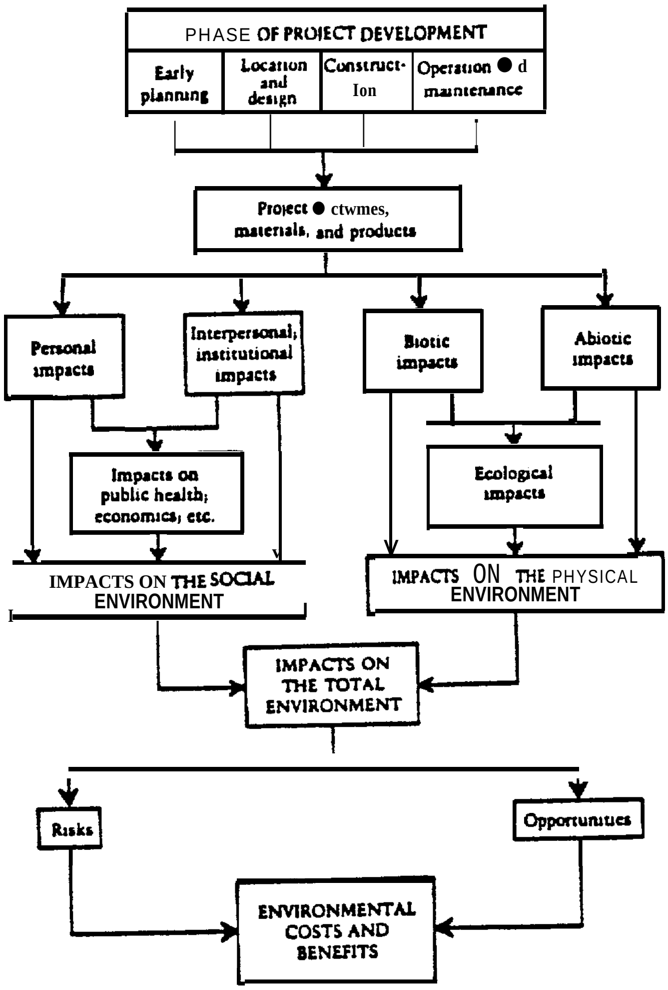
Erickson concludes the book with a section on assessing "the total human environment" which seeks to promote integration by an assessment team of "multidisciplinary and interdisciplinary consideration of interrelationships among different components and dynamic systems." This assessment stresses risk assessment and judgments regarding acceptable risks. This concept is illustrated in Figure 13.

In conclusion, Erickson's book is a comprehensive set of guidelines and suggestions for conducting multidisciplinary environmental impact assessments. However, although cumulative impacts are acknowledged at several places for their importance, no method is provided for their assessment. In the concluding chapter Erickson states, "Current directions in the development and refinement of the impact assessment process clearly reflect a growing national awareness of the intellectual and practical challenges of impact assessment, and include:

- an increasing emphasis on indirect and cumulative impacts of project development; and

- the development of guidelines for evaluating the significance of individual and cumulative impacts."

Although this book does not present a single method of assessing cumulative impacts which can be transferred to Alaskan Arctic settings, it does present a comprehensive and integrated set of guidelines for conducting environmental



Impact assessment as an effort to determine environmental costs and benefits.

FIGURE 13

impact assessments generally. Therefore this book has relevance to the development of an appropriate cumulative impact assessment approach.

Porter, L.R. et al. 1979. Promising methodologies for fish and wildlife planning and impact assessments. U.S. Fish and Wildlife Service, Region 6 Environmental Planning Team, Denver, CO.

Summary:

This study is the documentation of the field testing of a new approach to land and water development project impact analyses undertaken in the Yampa River basin in northwest Colorado. The methods applied consisted of: a computerized Geographic Information System (GIS), conflict mapping, ranking of project impacts, and prediction of fish habitat changes (based on reservoir-streamflow analysis) resulting from multiple water developments. Mapped wildlife data were composite on GIS to determine habitat values of land units in the study area. Proposed locations of coal and water developments were then overlaid on the composite wildlife maps to identify potential conflicts. A method to quantify and compare relative impacts of different development scenarios on wildlife is reviewed. This methodology, while applicable to fish and wildlife cumulative impact assessment, does not have direct applicability to North Slope Borough social, economic and cultural cumulative impact assessment. However, elements of the methodology might be adapted to help analyze indirect subsistence-related impacts. Therefore this study is of interest to this project despite its failure to interlink changes in physical and biological systems to social systems.

Skidmore, Owings and Merrill. 1981. Areawide environmental assessment annotated bibliography. Report prepared for Dept. of Housing and Urban Development, Office of Policy Development and Research, Washington, D.C. PB83-123711.

Summary:

This report presents a methodology to prepare "areawide environmental assessments" as contrasted to "project-level assessment." An areawide environmental assessment attempts to deal comprehensively, both in terms of the impact-

causing actions considered and the geographic area covered, with the assessing of impacts of alternative patterns of urban development or redevelopment in metropolitan-scale impact study areas. The report contrasts areawide environmental assessments with project-level assessments. Areawide assessments are designed to define an overall pattern of development including: housing, employment, community facilities and services, and key infrastructure elements rather than single-action choices characteristic of individual projects.

While pointing out the pitfalls in performing areawide assessment due to, "the difficulties inherent in accurately forecasting future conditions," the authors state that the method provides a mechanism for "assessing the consequences of incremental changes over time." "This approach helps provide a better understanding of the cumulative impact of . . . dynamic conditions." "By dealing comprehensively with overall patterns of urban development, an areawide assessment can compare the cumulative effects of many individual developments to the total resource base which is available to meet the projected demand." "The areawide approach can yield cumulative impact findings which begin to reveal the true dimensions of certain problems and issues which can easily be overlooked at the project level."

The report explains that the areawide assessment concept was developed in response to the CEQ guidelines requiring the consideration of cumulative impacts, and based on the recognition that, "preparation of project-by-project EISS did not adequately address the long-term, comprehensive, and cumulative effects of individual decisions, as required by CEQ regulations." Areawide environmental assessment was thus conceived of as, "an approach which could detect, forecast, evaluate and mitigate the broad range of social and environmental impacts which occur as the result of aggregate and incremental effects of many individual actions over a large area and sustained over a long period of time."

The guidebook asserts that, "the prediction and assessment of cumulative impact is intrinsic to the areawide environmental assessment process, and is one of its most significant products." For the purpose of this guidebook, cumulative impacts refers to, "the significant net effects of urban growth (be they beneficial or adverse) which occur in an areawide geographic context, over an established time period." The areawide assessment process attempts to accommodate three important dimensions of cumulative impacts: geographic summation, temporal change, and synergistic effects.

Geographic summation of areawide development impacts is accomplished by, "aggregating and then comparing the net spatial (areawide) urban development conditions related to the development alternatives undergoing environmental assessment." Temporal change is depicted by, "the evolution of geographic summation patterns due to changing urban and regional development initiatives and resource baseline conditions over a specific time frame." Cumulative impact assessment identifies and measures, "the significant net change in the level of areawide conditions between two or more selected points in time." The method also enables the analyst to address synergistic effects, which are, "spatial and temporal interactions which yield impacts of greater or lesser magnitude than the simple sum of individual changes or actions, and which vary from the projected baseline conditions."

The heart of the assessment method is based on examination of 21 environmental and socio-economic impact components shown in Figure 14. However, in the section that details how step five, environmental analysis, is to be carried out, it is obvious that no explicit method for analyzing or measuring cumulative impacts exists. The authors point out, "there is no set formula for how to spot the interactive effects." It is implied that an "overall impact value" for each of the key impact components and areawide alternatives can be developed to yield "the cumulative impacts of areawide development for each environmental component," but no explicit instruction is provided on how to accomplish this. Network diagrams are recommended as one technique to help predict the interactions among actions and impacts.

Again in step six, the report indicates that one should "compare cumulative impact predictions for the alternative areawide growth and development proposals." However, no explicit method was provided to develop such predictions. It appears that the authors of the method believe that simply by considering an aggregate set of development activities within a defined

Impact Development Criteria and Matrix—This matrix is used to organize the 21 environmental components into a more manageable number (5) of Development Criteria Groupings, reflecting the need to examine changes associated with land development and growth. These criteria and the matrix will be useful to the analyst in the early stages of an areawide environmental assessment as an organizing framework. Note that the 21 environmental components often are classified under more than one Development Criteria.

ENVIRONMENTAL COMPONENTS	Land Capability	Resource/ Hazard	Infrastructure Adequacy	Residuals Generation	Other Community Values	
1. Land Development Suitability						1.
1.A Foundation Support	●					1A.
1.B Slope Stability	●	●				1B.
1.C On-Site Disposal	●		●	●		1C.
1.D Erosion/ Sedimentation	●					1D.
2* Volcanic & Tectonic Activity		●				2.
3. Agricultural Lands		●			●	3.
4. Unique Natural Features		●				4.
5. Water Supply		●	●			5.
6. Water Quality		●	●	●		6.
7* Habitats/Species		●				7.
8. *Flooding*	●	●				8.
9. Climatic Hazards		●				9.
10. Fire Hazards		●				10.
11. Air Quality				●		11.
12. Noise				●		12.
13. Energy		●		●		13.
14. Hazardous Materials		●		●		14.
15. Solid Waste			●	●		15.
16. Community Services			●		●	16.
17. Employment Opportunities					●	17.
18. Social Impacts					●	18.
19. Visual Quality		●			●	19.
20. Historic Resources		●			●	20.
21. Archaeological Resources		●			●	21.

● Consider these Environmental Components when evaluating a growth alternative against the Development Criteria

FIGURE 14

areawide boundary over a projected 5 or 10 year period that all the cumulative impacts will be obvious and easily defined. In fact no method to analyze or measure such impacts is presented. In fact the areawide assessment method is merely a template or framework for impact assessment, not a detailed technique or analytical methodology.

The balance of the guidebook is devoted to sections presenting synopsized techniques for analyzing each of the 21 environmental impact components (i.e. foundation support, slope stability, water supply, climatic hazards, etc.). There are sections on community services, social conditions and archaeological resources that fall within the purview of social and cultural impact assessment. However no discussion of economic or fiscal impact assessment methods is made. None of the foregoing techniques are specifically oriented towards or appropriate to Alaskan Arctic situations.

In conclusion, although this report discusses the relevance and importance of cumulative impact assessment, no readily adaptable method with relevance to the North Slope Borough is presented. In fact, since the areawide assessment method was developed for specific application to urban areas, it is not directly relevant to Alaskan Arctic settings. However, the spatial aspects of the areawide assessment approach do have relevance to the problems faced in "bounding" any North Slope Borough cumulative impact assessment.

Arctic Slope Technical Services, Environmental Systems Research Institute and Research Design Productions. 1981. Toward a geographically-based information system for the North Slope Borough Alaska: conceptual design and implementation plan, North Slope Borough, Barrow, AK.

<u>Summary:</u>

This document provides a conceptual design and plan for implementation for a geographically-based information system for the North Slope Borough designed to accomplish a variety of purposes, including environmental monitoring and project review. The report discusses the advantages of a comprehensive mapping approach to cumulative impact assessment that such a system would allow: "comprehensive mapping could lead to a significant understanding of the cumulative impacts of development throughout the region."

"Planning staff is particularly attuned to the effects of cumulative impacts, not just the impacts of isolated developments, but the grouping of assorted small events may lead to major decay of the ecosystem. Cumulative impact assessment involves a number of complex processes and is not yet a well developed science. Nonetheless, the necessity for cumulative evaluations, especially in the arctic slope environment, is becoming acute. Planning staff, for example, has expressed concern for the tracking and assessment of the broad base patterns of the various North Slope caribou herds. Industrial development at a growing number of sites could significantly affect the caribou and cause the breakup of migration, breeding, feeding, and calving patterns. These and other processes must be understood and the cumulative impacts of gas and petroleum development made clear."

The method presented by this report to measure cumulative impacts is principally aimed at detecting physical indicators of change that can be mapped or aerially photographed. However, these techniques are most applicable to biophysical parameters of change, such as vegetation patterns, wetland alterations or other physical changes occurring over time. These techniques have limited ability to help interpret social changes occurring over time. The report concludes its discussion of cumulative impact assessment by stating: "cumulative impact analysis is a young science and there are few accepted standard methodologies." This report has only limited relevance to this project at the present time. Establishment of a geographic information system by the North Slope Borough would greatly aid MMS in assembling relevant environmental data for proposed regional development projects within the borough's boundaries and might be used to help translate biological impacts (on subsistence resources) into cumulative social impacts. However, the absence of such a method and of a data base renders such an approach infeasible at the present time.

Jacobs, P. 1981. Cultural impacts of environmental assessment. Environmental Impact Assessment Review. 2(3).

Summary:

This article presents an important point of view regarding environmental impact assessment in cross-cultural settings. The author makes the point that environmental impact assessments are culturally bound and "thus not necessarily applicable or appropriate to other cultures without substantial revision." Using examples drawn from impact assessment processes for projects affecting northern Canada's Inuit (i.e. Mackenzie Valley pipeline, Lancaster Sound tanker traffic, etc.), the author demonstrates the culture-bound aspects of the assessment process. The author concludes, "the very manner by which we deal with information is also culturally bound. The acquisition of data, its treatment, and the conclusions which we reach on the basis of this data are unlikely to be universally accepted. The problem is compounded when it is generally accepted that there are important gaps in our understanding even within carefully defined sectors of scientific enquiry."

Jacob's article questions the scientific objectivity of the assessment process and illustrates the value judgments and larger policy decisions (i.e. advancing national energy self-sufficiency at the expense of a regional population). He points out that for the Inuit in Canada, the adverse social costs of northern development were "clearly perceived to be borne primarily by residents of the region, and more specifically by the Inuit. The economic benefits would be shared, however unequally, by the residents of the South."

The author points out that during the Lancaster Sound public hearings the Inuit eloquently defined one of their essential goals for the future: "the maintenance of life style options." "Key strategies in achieving this objective focused on full participation in the planning, management, and decision-making processes that will directly affect those who live within the region." Yet, as Jacobs observes, "this is not in the 'rules of the game' as currently defined by the Canadian government." He uses other examples to illustrate how the differences in Inuit decision-making processes (i.e. consensus rather than majoritarian), and concepts of space and time conflict with western values expressed within the impact assessment process. He concludes that environmental planning and assessment must be, "sensitive to the goals and objectives of those whose survival is both physically and culturally at stake."

This article does not present any useable method for cumulative impact assessment, but it does illustrate the importance of recognizing cultural differences in the process of conducting environmental assessments. Any cumulative impact assessment method developed to be applied to the North Slope Borough must be sensitive to concerns and issues raised in this article.

STUDIES WITH NO DIRECT RELEVANCE

Nessa, S., S. French and G.K. Lowry. eds. 1978. Options for monitoring local permits in the North Carolina coastal area. Dept. of City and Regional planning, University of North Carolina, Chapel Hill.

<u>Summary</u>:

This report describes a series of options for monitoring the implementation of one element of North Carolina's Coastal Management Program. The system will monitor the issuance of minor permits in "areas of environmental concern" (AECs). Monitoring is distinguished from evaluation, and is defined as being concerned with the conformance of program activities with program goals and guidelines. The monitoring program performs three functions. Procedural Monitoring insures that permit issuance complies with procedural requirements developed by the State. "Substantive Monitoring" insures that permit issuance complies with use standards and regulations developed by the State. Cumulative Impact Assessment measures the impact of development against the legislatively mandated goals and objectives for the coast. Several options for achieving each of these monitoring functions are described. Each option differs in breadth and depth, in the types of analysis required, and the amount of effort needed to collect the monitoring data. The final monitoring system would incorporate options from each functional area.

Cumulative Impact Assessment is required under the North Carolina Coastal Management Act of 1974 and this report provides options for identifying and assessing cumulative impacts. The report presents four options for. identifying and analyzing the cumulative impacts of major and minor permit activities in the coastal zone. None of the methods presented has relevance to this project since they focus principally on monitoring the cumulative impacts from numerous permit decisions occurring in the coastal zone. The indicators to be monitored are also oriented towards water quality, air quality, groundwater quality, erosion/soil contamination and biological impacts rather than social, economic and cultural impacts. This report has no direct relevance to this project.

Dajani, J.S. and L. Ortolano. eds. 1979. Methods of forecasting the reciprocal impacts of infrastructure development and land use. Program in Infrastructure Planning and Management, Department of Civil Engineering, Stanford University, Stanford, CA. Report 1PM-11.

Summary:

This report is intended to provide a comparative evaluation of existing and new forecasting methods, and to provide planners and analysts with simple and reliable tools for forecasting the land-use impacts of "infrastructure changes." The report evaluated some 25 selected recent forecasting approaches which are described and classified into six general categories: 1. conventional multiple regression equations; 2. interdependent regression equations; 3. the Lowry model and its derivatives; 4. dynamic land-use models; 5. judgmental methods; and 6. systems of models.

The discussion of each of these approaches is preceded by a brief summary of the general techniques which are involved in the approach, including any basic mathematical or logical concepts that are necessary for an adequate discussion of the subject. The report also attempts to develop criteria for model evaluation and uses these criteria to provide a comparative assessment of the performance and transferability of a particular set of models. Conclusions are also drawn concerning the overall utility of each forecasting approach within the context of infrastructure development and land use planning.

Although this report was cited by Wolf (1983) as a promising source for cumulative impact methods, no direct discussion of cumulative impact concepts or methods was made by the editors. While several of the methods do have as their focus the secondary environmental impacts of major public projects (i.e. wastewater treatment facilities, large residential developments and industrial parks), the methodological approaches used are uniformly mathematical in nature and require considerable computer utilization in their application. Only the Delphi methodology, discussed as a judgmental forecasting technique, has any potential applicability to the qualitative evaluation of cumulative impacts. However, this approach seems less useful for the North Slope Borough than other interdisciplinary impact assessment or regional planning approaches. Therefore this report has no direct relevance to this project.

McAllister. D.M. 1980. Eva' uation in environmental planning. The MIT Press, Cambridge, MA.

Summary:

This book aria" yzed available concepts and systematic methods for evaluating public actions having environmental consequences. The book focused on the process of evaluation and its role in the planning process as an aid to decision-making. Although the book touched on many important issues embedded in environmental impact assessment such as: quantification, the treatment of equity concerns, the representation of future generations, and the role of citizen participation, no attention is paid to the assessment of cumulative impacts. The methods evaluated in this book are cost-benefit analysis, the planning balance sheet, goals achievement matrix, energy analysis, land suitability analysis, landscape assessment, the environmental evaluation system and the judgmental impact matrix. This book has no direct relevance to this project.

Colorado Energy Research Institute. 1981. Water and energy on Colorado's future: the impacts of energy development on water use in 1985 and 2000. University of Denver Research Institute and Dept. of Civil Engineering, Colorado State University, Westview Press, Boulder, CO.

Summary:

This research report designed to consider the cumulative impacts of energy developments on water resources in a semi-arid state, doesn't explicitly discuss cumulative impact concepts or methods. It is rather a regional planning document and limited regional impact assessment that examines the consequences of several different scenarios of levels of energy development and its impact on water resources in 1985 and 2000. While some discussion of primary and secondary social and economic impacts is made, the bulk of the report is devoted to examining energy/water relationships. No methods for conducting cumulative impact assessment applicable to the Alaskan Arctic are reviewed. This report has no direct relevance to this project.

Betson, R. P., J. Bales, and C.H. Deane. 1981. Methodologies for assessing Surface mining impacts. Office of Natural Resources, Div. of Water Resources, Tennessee Valley Authority, Norris, TN.

Summary:

This report presents the development, validation and potential applications of a mathematical model developed by the Tennessee Valley Authority to assist planning activities associated with the determination of the effects of land use change, particularly surface mining on water resources. The model and its submodels are concerned only with simulation of streamflow volumes and peaks, suspended sediments and water chemistry. Methodologies are presented which can be used to assess the probable cumulative impacts of a number of surface mines in a particular basin. However, these methods are only an extension of the previously elaborated water resource models. This report has no direct relevance to this project.

California Energy Commission. 1981. Small scale hydro: environmental assessment of small hydroelectric development at existing sites in California. California Energy Commission for the Governor's Small Hydro Task Force, Sacramento, CA. 'DE-82903674.

Summarv:

This report was prepared to assist developers of small hydroelectric projects through the state's environmental review and assessment process, The significance of the principal impacts including any growth-inducing and cumulative impacts are discussed. California's Environmental Quality Act

(CEQA) requires consideration of cumulative impacts in recognition of the fact that minor individual impacts or projects added to other similar impacts or projects over a period of time may collectively become significant. The CEQA guidelines require that the discussion of such impacts reflect their severity and significance based on a standard of "practicality and reasonableness." Three elements are included in the guidelines for an adequate discussion of cumulative impacts:

1. A list of projects producing related or cumulative impacts, including those projects outside the control of the agency;

2. A summary of the expected environmental effects to be produced by those projects with specific references to additional information where that information is available; and

3. A reasonable analysis of the cumulative impacts of the relevant projects.

In discussing these elements, a mandatory finding of significant cumulative effect must be made if a project has "possible environmental effects which are individually limited but cumulatively considerable." The phase "cumulatively considerable" is described as the condition that exists when the "incremental effects of an individual project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects."

Information on how far from a project site a lead agency should go in developing the list of projects is not covered in the CEQA guidelines. In most cases, lead agencies assess project impacts locally and regionally on the basis of important geographical and/or political boundaries. The scope of the discussion of cumulative impacts also may be influenced by the level of significance given a project by the lead agency. If a project is considered to be of statewide significance then cumulative impacts may also be discussed at that level.

The report’s assessment of the cumulative impacts of small-scale hydro projects reflects two separate concepts -- one which regards” such impacts as those that would exceed the sum of individual project impacts (synergism), and one which regards them as simply the net result of the interaction of all project impacts of a particular kind with all the mitigation measures applied to offset them. In all cases, the determination of cumulative impacts has been based on professional knowledge and experience, not on the use of quantitative indices. This approach was necessary because so little is known about the long-term impacts of small hydropower development over large areas.

This report provides useful insights into how one state, California is implementing Cumulative Impact Assessment requirements. However, no specific method of relevance to this project is available.

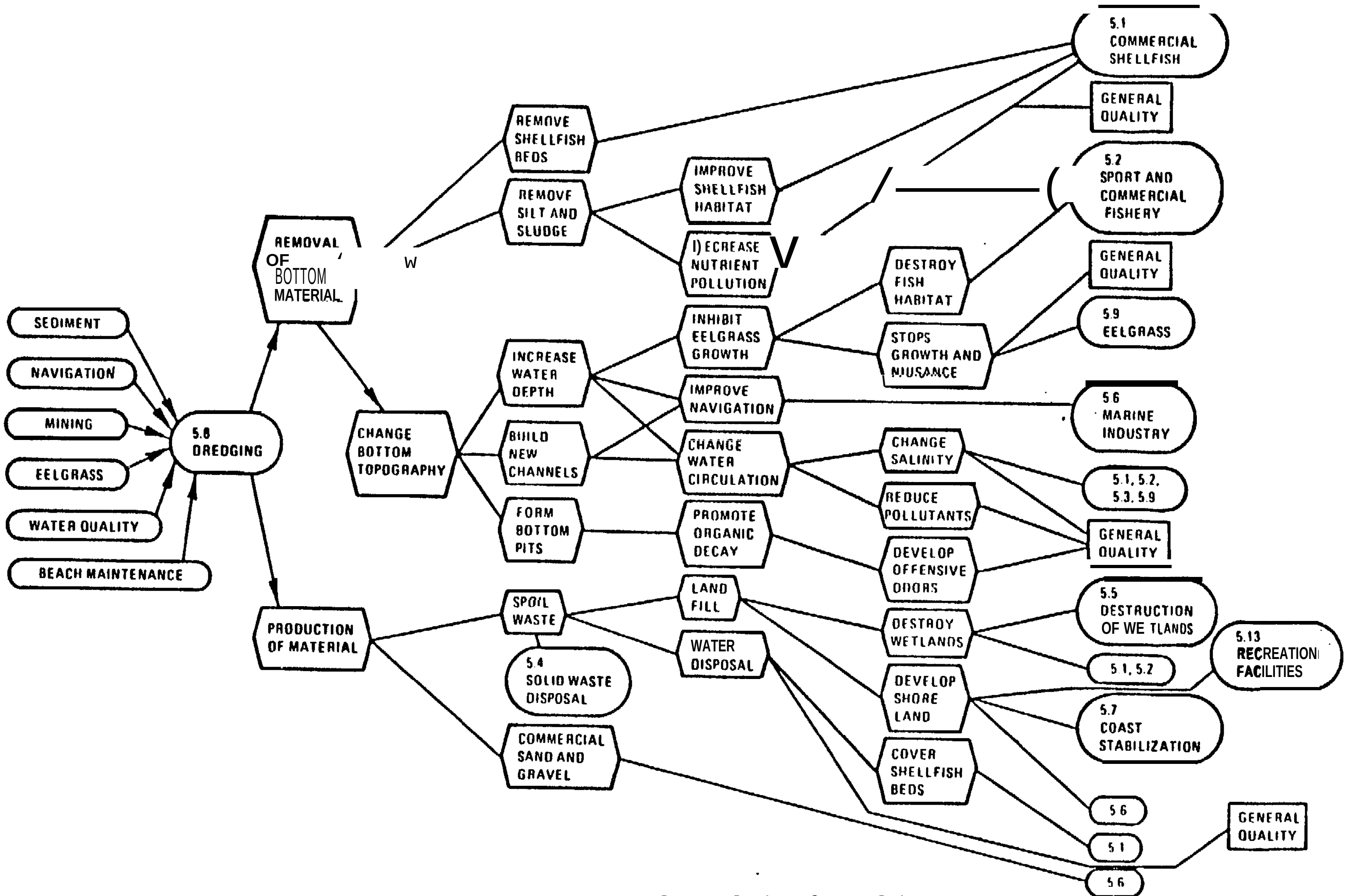
Henderson, J.E. 1982. Handbook of environmental quality measurement and assessment: methods and techniques. Instruction Report E-82-2. U.S. Army Engineering Waterways Experiment Station, Vicksburg, MS.

Summary:

This report summarizes the results of a review and an evaluation of methodologies and techniques for environmental analysis to be used in the Corps of Engineers’ multiobjective planning process. The majority of the methodologies reviewed focus strictly on physical environmental, ecological or wildlife habitat related concerns. The methods reviewed fall into one of six classifications: matrix-based methods, checklists, map/overlay methods, network analysis, comprehensive assessment and evaluation methodologies, and modeling. These types are arranged in order of increasing complexity. In the chapter covering network analysis several sample network diagrams are included. Figures 15, 16 and 17 illustrate three of the network analyses portrayed.

No direct discussion of cumulative assessment techniques was included. The methods reviewed are generally not oriented towards assessment of cumulative impacts but focus largely on primary and secondary water-related ecological impacts. This report has no direct relevance to this project.

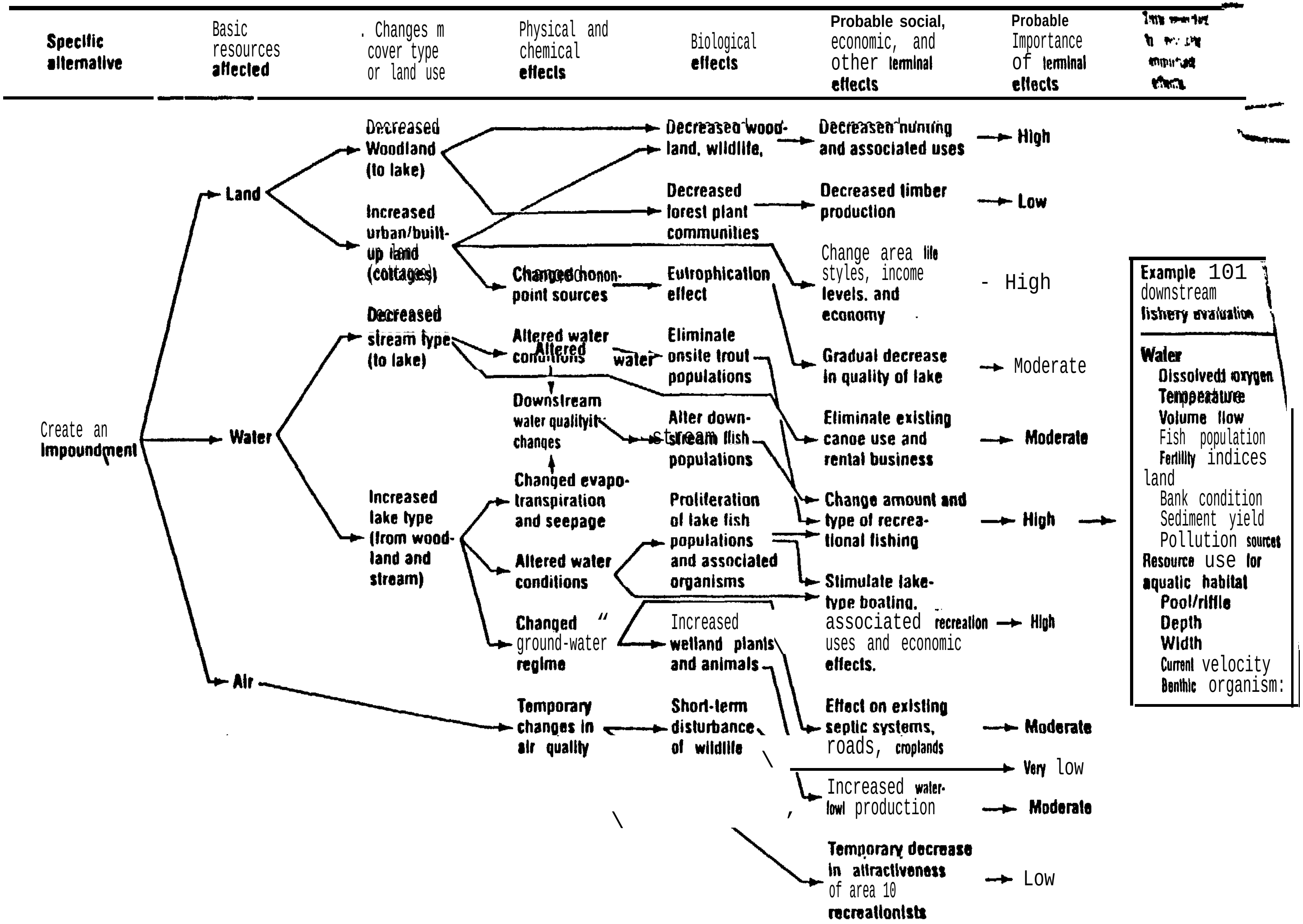
FIGURE 15



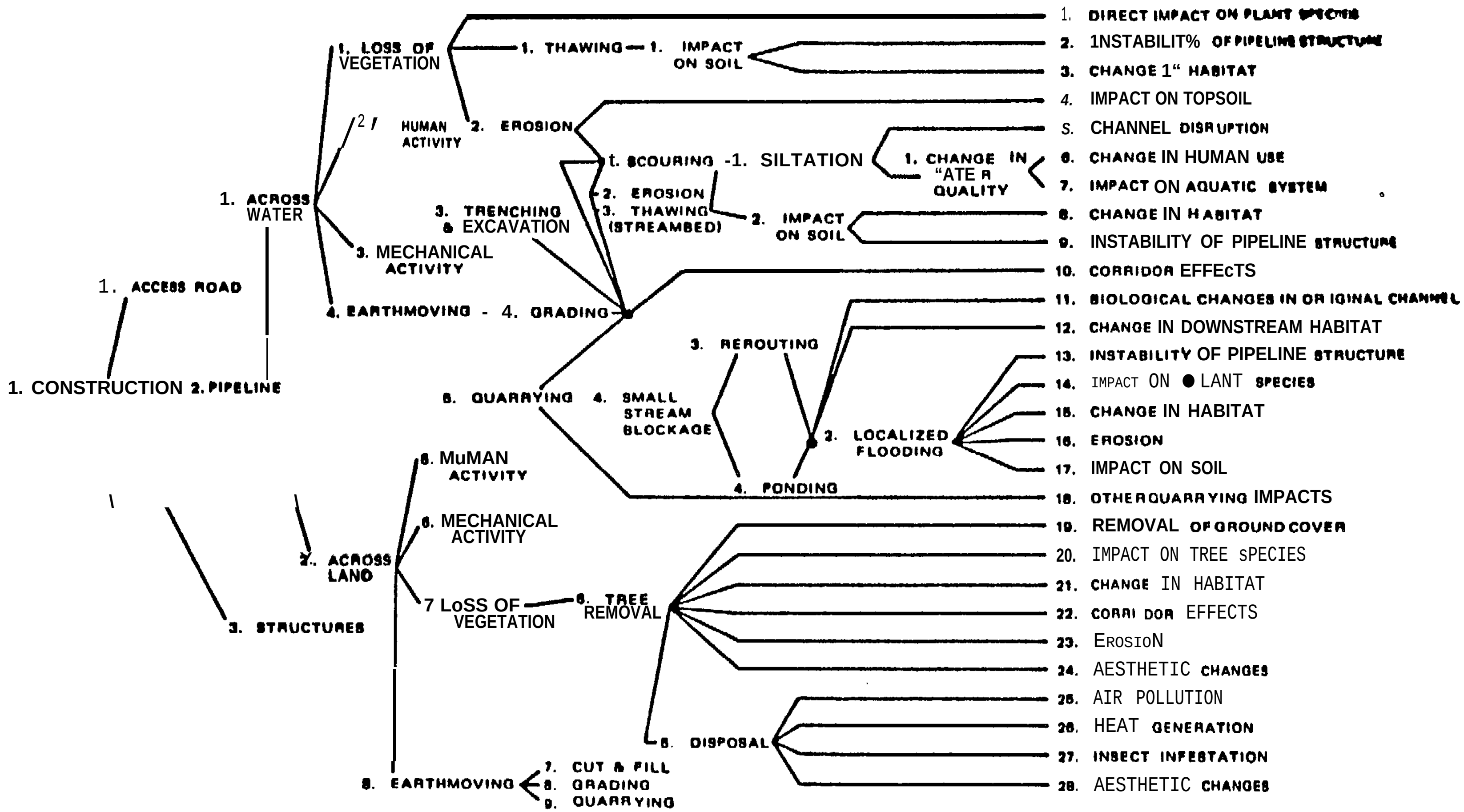
A Network Analysis of Dredging

Source: Henderson, J. E., 1982. Handbook of environmental quality measurement and assessment : methods and techniques.

FIGURE 16



An Example of a Network Diagram for Analyzing Probable Environmental Impacts



Construction Effects Chain

FIGURE 17

PADC Environmental Impact Assessment and Planning Unit, University of Aberdeen. eds. 1983. Environmental impact assessment. Proceeding of the NATO Advanced Study Institute on Environmental Impact Assessment (1981: Toulouse, France). Martin Nijhoff Publishers, Boston, "MA.

Summary:

This collection of articles on environmental impact assessment prepared in connection with a NATO Advanced Study Institute conference on environmental impact assessment (EIA) was held 1981 in Toulouse, France. The collection deals with such topics as: the nature, scope and objectives of EIA methods; the gap between the information needs of decisionmakers and what scientists are" able to provide via EIA; and the limited attention paid to the relationship between "impact prediction" and the actual consequences of development activity.

An article by Ronald Bisset, "Introduction to Methods for Environmental Impact Assessment," mentions cumulative impact assessment in the context of analyzing the synergistic impacts of toxic chemicals. "Many chemicals can interact synergistically - where the combined effect of two toxic chemicals is greater than if their individual toxicities were additive." "Other types of interactions between chemicals also occur, making the cumulative assessment of impacts an important part of EIA." "This type of analysis is very difficult to accomplish, but this does not mean that it should be ignored." Bisset refers the reader to a recent EIA method for considering the spatial dimensions of impacts which involves the use of a number of matrixes and complex qualitative analysis (Voogd, H., "Monitoring Environmental Qualities in Regional Planning" British Section of the Regional Science Association, London, September 1980). The Voogd method deals with both the spatial-aspects of impacts and also with "the cumulative aspect of impact behavior." [It was not possible to locate a copy of the paper documenting this method for the project.]

Larry Canter's article on "Methods for Environmental Impact Assessment: Theory and Application" emphasizes weighting-scaling checklists and network approaches (including energy system diagrams). However, no cumulative impact

assessment methods are presented. He points out in his conclusion that, "research and new methodologies are needed which will enable more systematic evaluation of project boundaries, long-term impact predictions, inclusion of value judgments in the process, analysis of system and cumulative impacts, and evaluation of mitigation measures."

The other EIA techniques presented or reviewed and commentaries contained in this book do not substantively address cumulative impact concepts or methods. The book has no direct relevance to this project.

Nichols, R. and E. Hyman. 1982. Evaluation of environmental assessment methods. East-West Center Environment and Policy Institute, Honolulu. Reprint No. 34.

Summary:

This article analyzes 12 representative methods for environmental assessment. Each of the 12 methods is described, evaluated and compared in terms of the following seven evaluation criteria: treatment of the probabilistic nature of environmental quality, incorporation of indirect and feedback effects, dynamic characteristics, multiple-objectives approach to social welfare, clear separation of facts and values, facilitation of participation, and efficiency in resource and time requirements. The 12 assessment techniques reviewed were classified into one of five basic contextual classes. The typology categorizes impact assessment methods as follows: 1) land suitability analysis; 2) NEPA response methods; 3) decision analysis; 4) resource management approaches; and 5) simulation and mathematical modeling.

The 12 methods reviewed are: McHarg's Map Overlays; the Metropolitan Landscape Planning Model; the Leopold Matrix; the Environmental Evaluation System (EES); the Environmental Quality Assessment (EQA) Methodology; the Water Resources Assessment Methodology (WRAM); the Goals-Achievement Matrix; the Surrogate Worth Tradeoff Method; Applied Decision Analysis; Adaptive Environmental Assessment (AEA); Sorenson's Network Analysis; and the Kane Simulation Model (KSIM). Figure 18 summarizes the extent to which the 12

Summary Evaluation of 12 Environmental Assessment Methods

Criteria (1)	McHarg' map overlay (33) (2)	Met- (9) (3)	Goals-achievement matrix (13) (4)	Surrogate worth trade-off (11) (5)	Decision analysis (25) (6)	.eopold matrix (28) (7)	EES (5) (8)	EQA (7) (9)	[401 (10)	Network real. ysis (41) (11)	AEA (17 (12	ESIM [24) (13)
Explicitly treats the probabilistic nature of environmental effects	N	N	P	N	S	N	N	N	N	N	S	N
Examines indirect and feedback effects	P	P	O	O	O	N	N	N	N	S	S	P
Considers the dynamic nature of environmental systems	N	N	O	O	O	N	N	N	N	P	S	S
Uses a multiple-objective approach	N	N	S	S	S	N	P	N	S	P	P	O
Makes a clear distinction between facts and values	N	P	S	P	S	N	N	S	P	N	P	O
Encourages participation by public and decision makers	N	P	S	P	N	N	N	P	N	N	P	P
Parsimonious in requirements of time and money	P	N	N	N	N	S	?	P	N	•	N	P

Key: S = Satisfied criterion. P = Partially sat es criterion. N Does nc itsi O = lot applicable.

FIGURE 18

methods meet the seven evaluation criteria - fully, partially, or not at all.

The article reports that methods for "environmental assessment" typically include at least two basic steps: 1) the identification of quantitative and qualitative changes resulting from a proposed set of actions; and 2) the attachment of human values to identified changes in environmental quality. "In practice, there are serious methodological difficulties in converting environmental effects to values expressed in either monetary or nonmonetary terms. A third step which we consider desirable and conceptually necessary

for achieving a systemization of the evaluation task, is an explicit ranking or balancing among different values." The authors find that only a few assessment efforts have resulted in generally applicable methodologies, reflecting "the many conceptual and practical difficulties of developing a valid methodology."

In their evaluation of selected methods, the authors utilize a set of criteria that recognize cumulative impacts. The second criteria, "examines indirect and feedback effects" states, "cumulative and indirect effects are important, although there are obviously limits on the extent to which they can be considered. Natural systems are highly interrelated and a series of minor actions may have significant cumulative impact. Indirect effects may be cyclical due to positive or negative feedback." According to the evaluative criteria, only two methods have the capability to treat indirect impacts and cumulative impacts. These are the Adaptive Environmental Assessment (AEA) method (Helling, et al.) and Sorenson's Network Analysis. The methods were each reviewed separately earlier in this section. This book has no direct relevance to this project.

3.3 Social Impact Assessment Literature

Social impact assessment (SIA) and related applied social science impact methods used to perform evaluations of major projects (such as socioeconomic impact assessment and socioeconomic impact management), have developed rapidly over the last ten years. A substantial literature of books, reports, impact assessments, and articles is currently available. Much of the recent methodological development of SIA was advanced through concerns over the effects of major energy development projects (coal mines, power plants, transmission lines, nuclear power plants, and synfuel plants) planned during the mid-1970's in western states. Particular concerns began to be raised over the social effects on established and new, or transient communities of large influxes of construction workers and secondary social and economic impacts of their presence (for example, the demand for schools, housing, and health care; and increases in social fragmentation as evidenced by increased rates of suicide, divorce and child abuse).

Today, while still a relatively young field, SIA has become a reasonably well-established discipline and SIA methods have evolved considerably. Social impact assessment can be defined as the application of social science methodology to assist in social planning. As defined by its major conceptualize and methodologist C. P. Wolf, "SIA aims to increase the role which systematic analysis plays in guiding judgments about the likely social consequences of major technological or program interventions in society."

While practitioners of SIA and its related social science disciplines have spent considerable time in refining and applying SIA approaches or traditional disciplinary social science analysis to environmental impact assessments of major energy resource development projects, cumulative impact concepts and methods have been only a peripheral concern in most of this work. The complexities of social systems analysis, the limited theoretical underpinnings for social impact assessment, and the relatively limited resources devoted to SIA within overall environmental impact assessment approaches and resulting EISS have all tended to inhibit the development of viable cumulative impact assessment methods to measure and project cumulative changes in social, economic and cultural characteristics.

Nevertheless, the literature of SIA does provide valuable insights into the limitations of social science analysis as well as the range of appropriate impact parameters and affected aspects of local communities. In addition, some SIA approaches appear to be comprehensive enough to encompass cumulative impact assessments, at least for social and cultural parameters. However, relatively little insight into the assessment of cumulative economic impacts emerged from this literature review.

The large number of bibliographic references originally identified as belonging in this literature was reduced to the handful of studies which appeared most relevant through the screening procedures described earlier. Reflecting the substantial methodological revision which has been occurring within SIA, only the most recent methodological studies were consulted. Each study was reviewed and evaluated. While much of the recent SIA literature has relevance to assessing the social impacts of petroleum development in the Alaskan Arctic, current SIA methods do not generally include consideration of cumulative impacts or cumulative development scenarios. Therefore, there are practical limits to the adaptation of current SIA methods and approaches to cumulative impact assessment.

Of those studies reviewed, those which had the greatest relevance to this project were: Mountain West Research, Inc. (1981), Bowles (1981), Wolf (1983), and Finsterbusch (1983). Of these studies, both Mountain West Research and Wolf provide general approaches which can be expanded to include ‘cumulative impact concerns. Bowles provides useful insights into impact assessment of traditional economies affected by resource development projects, and Finsterbusch's anthology identifies techniques such as survey research and ethnographic research which may aid in cumulative impact assessment.

RELEVANT STUDIES

Mountain West Research, Inc. 1981. BLM social effects project: research priorities. Bureau of Land Management, U.S. Dept. of the Interior, Denver, CO.

Summary:

This report identifies the overall research priorities for the BLM Social Effects Project. The report summarizes the findings of the previous Literature Review and presents the outline of the basic method of social impact assessment developed to assess the social effects of western coal development projects. The report presents the theoretical framework adopted for the project which is social organization, based on community level concepts. "This framework posits that change in the fundamental processes of social organization --differentiation, extra-local linkage, stratification, and integration--are among the most influential social effects of energy development." Figure 19 presents the conceptual model underlying this framework. Figure 20 illustrates the major parameters through which energy development affects community social organization and individual and community well-being.

The"model of social organization adopted for SIA purposes, "is grounded in empirical evidence which allows . ..analysis of the social effects of projects of differing types and sizes in communities of diverse characteristics." The review of the literature also identified the following "community resources" of greatest importance in operationalizing the social organization model :

- historical experiences with development;
- cultural characteristics;
- demographic structure and labor force characteristics;
- public facilities and services;
- economic resources (public and private);
- institutions and organizations; and
- residents' attitudes toward development.

The difficulties associated with collection of this data in a relevant format and in a timely manner is described.

CONCEPTUAL MODEL OF SOCIAL IMPACT

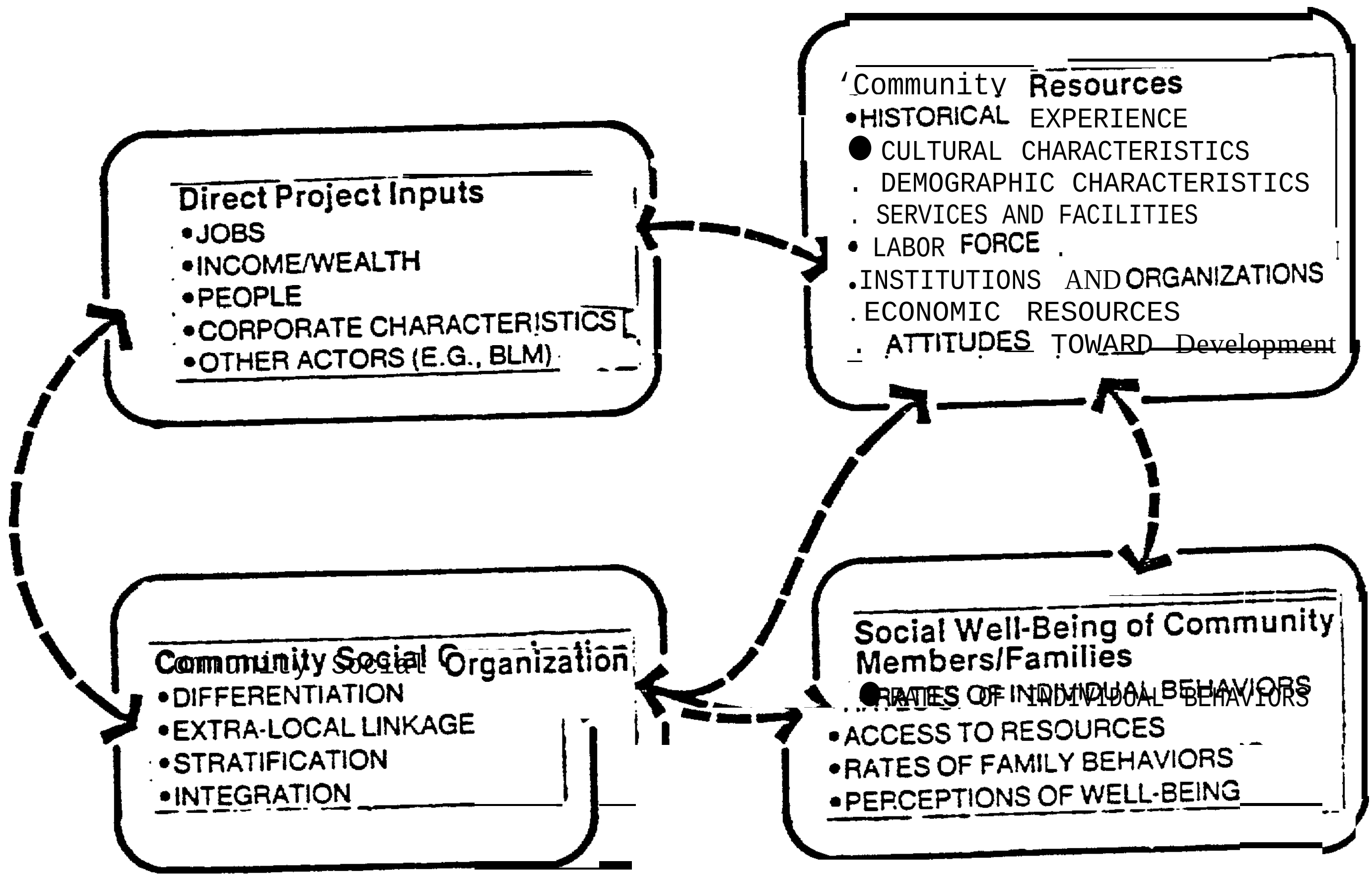


FIGURE 19

Major Parameters Through Which Energy Development Affects Community Social Organization and individual and Community Well-Being

Community Characteristics
1. History
2. Ecology-Demography
3. Culture
4. Interaction Patterns

Interaction Patterns for Project & Community
1. Dissonance
2. Collaboration
3. Dominance/Submission

Project Characteristics
1. Scale
2. Timing
3. Organizational Characteristics

Direct Impacts
1. Demographic--age, sex, ethnic, occupational structure, etc.
2. Economic--Industrial Sector, Capital formulation; Distribution of Costs and Benefits; etc.
3. Cultural--established rules; values, and attitudes, and beliefs; etc.
4. Patterns of Interaction--formal and informal, intensity, duration, etc.

Changes In Community Social Organization
1. Differentiation of Interests, Groups, and Skills
2. Extra-local Linkages
3. Stratification
4. Integration

Source: Mountain West Research, Inc. 1981. BLM social effects project: research priorities.

FIGURE 20

The four processes of social interaction considered by the authors to be most critical to the assessment of social impacts of energy development within the relevant social organization are reviewed more throughly. These are: differentiation (the process of expanding the range of community values and interests); extra-local linkage (the process by which resources and demand flow between the community and the larger society); stratification (the differential distribution among population groupings or access to resources for meeting needs); and integration (the process by which relationships among people in a community are coordinated and interconnected). The authors note that, "research on these processes will not be easy; the relationships are complex, and relatively little groundwork explicity on the effects of energy development has been done."

The other component of the social impact model, social well-being, helps the assessor to evaluate whether project-related changes are positive or negative. Three approaches to incorporate social well-being indicators are suggested and include: rates of behavior (for family and individual behaviors focused on social psychological and medical indicators of social or personal dysfunction); access to resources (aggregate and per capita measures of community resources available and analyses of potential changes); and perceptions of community and individual social well-being (objective and subjective measurements to provide evaluative indicators of well-being).

A section of the report addresses the assessment of cumulative effects. This section describes how the social organization model could be applied to the assessment of cumulative effects. The authors state, "in addressing the problem of cumulative effects, the social scientist's concerns are still the same, as reflected in the four principal components of the model." "Although analysis of the project(s) inputs may be more complex, nothing is changed conceptually in the social organization model when it is applied to the assessment of cumulative rather than single project effects." The authors conclude, "the analysis addressing multiple developments will be more complex due to the increased number of project sponsors involved, the more complex sequence of project inputs, and the increased range of uncertainty." "Over-rail, however, the proposed social organization model appears capable of providing an efficient approach to the analysis of this complex problem."

While the authors claim that the social organization model can be applied to the cumulative impact problem, this is not substantiated by an actual application of the model to a cumulative impact scenario or setting. Also the model is focused on social relationships and does not deal with economic impact assessment. It does seem to have the flexibility to incorporate cultural considerations arising in Native American or Inupiat communities, but no guidance is provided by the authors to reflect the differences in value perspectives and experiences embodied in such communities. This is precisely the same problem described earlier by Jacobs (1981). As a theoretical framework, the social organization model appears to have applicability to the assessment of social and cultural impacts of petroleum development in the Alaskan Arctic. However, it would require considerable effort to convert such a broad and general theoretical approach to an operational method capable of assessing the cumulative social, economic and cultural impacts of petroleum development in the Alaskan Arctic.

Bowles, R.T. 1981. Social impact assessment in small communities, Butterworths, Toronto.

Summary:

This book is an integrative literature review oriented towards "local patterns in small communities and the way in which they are changed by the construction and operation of large projects." The study is particularly focused on communities in Canada's resource hinterland areas located in northern Arctic or subarctic regions. The study attempts to determine: "What are the impacts of large-scale development on community social life?" and "What are the characteristics of a community which affect its capacity to mediate and control such impacts?" The aim of the review is to draw useful insights from the substantive and methodological literature which focuses the above concerns.

No specific cumulative impact assessment methods or definitions of cumulative impact are presented. However, the orientation of the book towards northern resource development projects and "their social impact provides several observations of interest to cumulative impact assessment in the Alaskan Arctic.

The author reviews social impact assessment methods, and compares the theoretical underpinnings and methods of SIA to related fields of social science inquiry such as social indicators research. He next provides discussions on the two aspects of small communities in northern regions most important to their continued social functioning in the event of major resource development projects: community social vitality arid viability of the local economy. Finally, he draws on case study examples to illustrate the principles and guidelines for conducting social impact assessment discussed earlier.

Drawing on the literature of community studies and anthropology, Bowles illustrates how concepts of community disintegration over time parallel cumulative impact concerns. Citing the work of Grasland (1961), Stager (1974) and Elias (1975), he shows how social changes produce the gradual disintegration of small communities. The anthropologist Redfield (1961) attributes the problems to the gradual imposition of "market forces" into traditional economies. "It is the market, in one form or another, that pulls out from the compact social relations of self-contained primitive communities some parts of men's doings and puts people into fields of economic activity that are increasingly independent of what goes on in the local life." "The local traditional and moral world and the wider more impersonal world of the market are in principle distinct, opposed to each other..."

In discussing the viability of local economies, Bowles cites the work of Matthews (1976)' who critiqued the application of conventional economic cost-benefit analysis to rural, traditional communities. "Because of the subsistence nature of their economy, much of the product of rural communities is for home consumption and never enters the marketplace. An input-output type of analysis is likely to underestimate the income generated by such communities." Matthews also draws an important linkage between the maintenance of traditional economic activities and "social vitality," which he uses to encompass the total way of life of community members. This type of interlinkage between the economic and social functioning of traditional communities is often overlooked in conventional impact assessment. Bowles reinforces this point, "the maintenance of a viable local economy which includes diversified sources of household incomes and a significant element of subsistence production requires the continuity of activities related to this local economy. A new resource industry can have a negative impact on the viability of the local economy if it interferes in some significant way with the required patterns of activity."

This is not to imply that resource development in northern regions is always in direct conflict with traditional economic activities. Bowles concludes, "a resource extractive industry can be compatible with the maintenance of a viable local economy if it operates in such a way that the activities and resources necessary to the local economy are maintained, and the motivation for such activities is sustained. A resource industry will be destructive of a local economy if the activities required for participation in it conflict with the activities required of the local economy, or if the motivation to participate in the local economy does not persist, or if the industry itself destroys the local environment and the renewable resources upon which the traditional economy depends."

Bowles also draws from the literature of rural industrialization studies to substantiate" the importance of recognizing and assessing the dynamic processes of social change which have been occuring in rural areas. For example he contrasts the avowed social policies accompanying rural industrialization which are designed to create local employment, increased income, more equitable income distribution, a broadened tax base and a halt to population declines due to urban migration with actual results of such policies to encourage rural industrial development. A study by Summers (1978) shows that the actual effects of rural industrialization are often quite different from the intended effects. This is manifested by the relatively small proportion of jobs filled by local residents, the high rate of in-migrants, and the minimal hiring of local workers by high-skill, high-wage industries in northern development projects. He concludes that, "if the benefits of rural industrialization are to be achieved, while the social and economic costs are to be minimized, there must be effective local control of the pace and direction of growth. There must also be a careful social impact analysis which more critically examines the actual needs and activities of the local population and relates them to the characteristics of the new industry."

In the final section of case study examples, Bowles makes the case that social impact studies should be "made more cumulative" by building on the previous experiences of other similar communities which have faced related concerns. He urges that both pre-impact and post-impact studies be undertaken, that the two types of studies should be coordinated and focused on developments at the local level. The case study materials presented by Bowles also yield valuable insights into incorporating SIA into Arctic development projects. Bowles observes that without systematic empirical analysis of actual patterns of traditional or subsistence economic activity, references to local subsistence and traditional economies are of limited value in guiding policy." He cites the work of Stager (1974), whose comprehensive view of the past, present and future in his pre-impact study of the proposed Northern Gas Pipeline provides a holistic appreciation most useful in social impact assessment.

Bowles critiques Stager's (1977) post-impact assessment of TAPS for its contradictory conclusions in some areas. He cites Stager's "failure to systematically trace the processes by which changes in one part of the environment or social life concretely link to other patterns." Bowles also discusses issues of community consultation, information-sharing and participation in decision-making and the importance of these processes for effective SIA.

Bowles devotes substantial attention to documenting actual social impacts and concerns that accompany northern development. These include such topics as: integration of wage labor and subsistence activities, household cash flow and pressure toward continuous wage labor, employment concerns, alcohol and crime, women in the labor force, school, and outsiders in the community.

Regarding integration of wage labor and subsistence activities, Bowles reports, "substantial evidence indicates that households in many northern communities depend on occupational pluralism or a diversity of income sources (e.g. , subsistence production, trapping, wage labor, and transfer payments). This pattern can be disrupted by a variety of factors such as ecological changes which disrupt game supply, increasing dependence on cash flow and the consequent diversion of time from subsistence activities, and diversion of manpower from subsistence to wage labor." He concludes, "given the importance of subsistence hunting to the northerner's diet and its high dollar replacement value, any decrease will certainly dislocate the economic stability of the current occupational pluralism of the north. The short-term evidence seems to be that, at least in some communities, subsistence production has been altered as to time spent and methods used, but the amount harvested has not been significantly diminished. Longer-term effects of the ecological impacts of development and increased population pressure and the possible loss of skills and interest by the next generation of potential hunters must await further research documentation."

Bowles also cites research documenting the continuing and escalating pressures in many northern settlements toward continuous wage employment. He mentions that the effects of inflation on the subsistence economy should also be considered since it "can affect subsistence activities by raising the cost of supplies and the cost of other goods and services, thus putting pressure to engage in more wage labor."

Bowles concludes by stating that, "It cannot be assumed that all of the negative impacts anticipated by northern residents and researchers will actually occur. Neither can facile assumptions be made about the benefits of moving into a wage economy until secondary and tertiary consequences of such changes are evaluated. Well designed and carefully executed pre-impact studies are needed to permit planners and developers to anticipate the consequences of new resource extractive projects. Such anticipation may permit selection of physical designs and patterns of work organization which will minimize social costs and maximize social benefits. Perhaps the most crucial need, however, is for a systematically planned series of post-impact studies which will provide more adequate knowledge of patterns which will maximize the benefits and minimize the costs of big industries in little communities."

He also makes the important point that local residents may be able to produce better data about life patterns than professional researchers and almost certainly can better identify the importance of such patterns. He strongly urges that local residents in affected northern regions be incorporated into the assessment process as participants to help "protect the outside expert from the errors resulting from his own conceptual specialization." He sums up his book by stating, "a thorough knowledge of community social and economic patterns and a well-informed understanding of the contribution of each aspect of community life to social well-being is necessary if new projects are to be established without unacceptable costs to the local communities and their members."

Although Bowles does not specifically address cumulative impacts within his review or present or analyze methods for assessing such impacts, his integrated literature review provides considerable insight into the secondary and tertiary social, economic, and cultural consequences of large resource development projects in traditional northern communities. As such his study helps identify issues and concerns needing to be incorporated into any cumulative impact assessment of petroleum development in the Alaskan Arctic. Considerations such as: the difficulties of analyzing subsistence activities with traditional economic measures; the need for both pre- and post-impact studies to help reveal cumulative impacts; the need for more systematic empirical analysis of traditional subsistence activities and their linkages to the cash economy; and the importance of allowing local residents to identify the importance of their life patterns in any assessment are all worth considering in developing a viable cumulative impact assessment method for use in the Alaskan Arctic.

wolf, C.P. 1983. Social impact assessment: methodological overview. Environmental Impact Assessment. PADC Environmental Impact Assessment and Planning Unit. eds. University of Aberdeen, Martin Nijhoff Publishers, Boston, MA.

Summary:

This article presents an overview of a basic method to prepare social impact assessments. Wolf states that the analytical problem of SIA can be stated as, "Learning to make public (and private) decisions that will look good in 50 years, after the evaluative criteria by which they are judged have changed." "The 'bottom line' question for SIA is: 'Who benefits and who loses?' (were a proposed action to be implemented)." "Since often these are not the same people, the disassociation of costs (or risks) and benefits creates a problem of equity." "Just what the incidence and distribution of social costs and benefits may be in any particular impact situation is a matter for assessment." Wolf indicates that SIA can only reveal equity concerns and considerations, but not resolve them.

Wolf points out that SIA is a multi-method approach and to complete its major analytical tasks requires assessors to draw selectively from "the full range of social research methodologies and techniques." He adds, "moreover, every impact situation has unique features and general methodologies must be tailored to their dimensions." Figure 21 shows the main steps involved in SIA. This is described as "a rational problem solving schema closely resembling many others in technology assessment, decision analysis and related fields." He mentions that, "instrumenting and implementing this schema also requires the meshing of analytic and institutional systems." Wolf sets out a general approach for accomplishing the major tasks of SIA and indicates some of the methodologies and techniques that can be employed.

In his discussion of the assessment task, Wolf discusses cumulative impacts. He defines the task for assessment as comparing, "the potential impacts of the full set of reasonable alternatives under the range of assumptions about future conditions." "This is done by predicting differential changes in the current values of impact indicators under alternative trend and plan assumptions, including second-order differentials (changes in the rate of change) caused by cross- and cumulative-impacts."

Social Impact Assessment: The Main Pattern

Assessment Steps	*Analytic Operations*
Scoping How big a problem is it? How much is enough?	Set level(s) of assessment (policy/program/ project). Determine impact area boundaries. Establish time horizons. Develop study design.
Problem Identification What is the problem? What is causing it'!	Formulate policy goals, planning objectives. Identify publics and concerns. Perform needs assessment. Determine evaluative criteria.
Formulation of Alternatives What are the alternatives?	Define set of "reasonable" alternatives (corresponding to identified concerns). Determine change agents. instruments. Characterize and describe technical systems; analyze for social (institutional/behavioral) components and correlates. Analyze economic and environmental impacts for secondary social impacts.
Profiling Who is being affected?	Dimensionalize impact categories. Select impact categories. Assign impact indicators. Perform indicator measurements. Compile social profile.
Projection What is it causing?	Explicate "state of society" assumptions. Perform trend impact analysis. Construct dynamic system models. Estimate impact indicator values for alternative plans ("with and without" implementation).
Assessment What difference does it make?	Perform sensitivity analysis for alternative outcomes of alternative plans. Perform cross-impact analysis. Describe and display "significant" impacts.
Evaluation How do you like it ?	Reidentify publics and concerns. Reformulate evaluative criteria. Rank and weight preferences for alternatives. Perform trade-off analysis. Identify preferred alternative.
Mitigation What can you do about it? if you do not like it?	Review unavoidable adverse impacts. Identify possible mitigation measures. perform sensitivity analysis of possible measures.
Monitoring How good are your guesses?	Measure actual versus predicted impacts. Provide feedback of measurements to policy-makers and publics.
Management Who is in charge here?	Devise management plan. Adjust planning objectives. operating procedures. design specifications.
(Bottom Line) Who benefits and who loses?	(All of the above.)

Now, associate and integrate general methodologies. specific techniques. and relevant data.

Source: Wolf, C.P. 1983. Social impact assessment: methodological overview.

FIGURE 21

Wolf indicates that “cross-impact analysis” is the methodological approach for dealing with cumulative impact concerns. Quoting Mitchell (1975) , Wolf states that, “’cross-impact analysis strives to identify interactions among events or developments by specifying how one event will influence the likelihood, timing, and mode of impact of another event in a different but associated field’ --the reciprocal impacts of infrastructure development and land use, for example.” He points out that, “we are typically dealing with mutual causal relations in long chains, where one impact can amplify or dampen the effects of others.” “Second- and higher-order impacts come into consideration here, as do the compound effects, or synergism of cumulative impacts.” Although he does not explicitly explain the method of cross-impact analysis or how it accommodates cumulative impacts, the reader is referred to the works of Mitchell, et al. (1975) for the Corps of Engineers’ Institute for Water Resources, Dajani and Ortolano (1981), and Husky (1979) for further evaluation of cross-impact methods and cumulative impact assessment approaches.

Although Wolf’s insights into cumulative impact assessment are heavily focused on “cross-impact analysis”, the general approach which he presents in Figure 21 does appear to have some utility in and of itself to help reveal the cumulative impacts of several projects within the same region. This conclusion is reinforced by a careful review of those sources to which Wolf refers the reader in search of a cumulative impact method. Nevertheless, Wolf’s SIA approach, although comprehensive, is still only a general framework into which specific information gathering and analysis techniques and available data must be incorporated. Nevertheless, this SIA approach is worthy of more serious consideration in developing a method to assess the social, cultural and economic impacts of petroleum development in the Alaskan Arctic.

Finsterbusch, K. ed. 1983. Social impact assessment methods. Sage Publications, Beverly Hills, CA.

Summary:

This collection of articles presents an inventory and critique of current techniques and methods to accomplish SIA. The book is divided into four main sections: framework and methodological approaches, primary data collection methods, secondary data collection methods, and special methodologies. The first section contains articles by Wolf, Carley, and Flynn et. al. Wolf's article is a revised version of his SIA paradigm reviewed earlier. Carley's article reviews a series of available SIA methods (both numerical and participatory approaches) and critiques each one separately. No cumulative impact methods are reviewed. Flynn and her colleagues provide an in-depth discussion of the mechanics of the Group Ecology Model (GEM) also discussed in the manual by Social Impact Research, Inc. (1983) reviewed earlier. It does not explicitly consider cumulative impacts.

In the second part of the book, Finsterbusch reviews survey research methods and their applicability to SIA and Roper reviews ethnographic research techniques. The use of survey research and ethnographic research both appear to have some revelance to analysis of the cumulative impacts of petroleum developments in the Alaskan Arctic within an appropriate cumulative impact assessment framework. However this issue requires further analysis and empirical verification through incorporation into an appropriate cumulative impact assessment approach.

Part three of this volume has several articles on secondary data collection methods, including historical documentation, demographic change assessment and social indicators research. The final section of the book reviews special methodologies. such as computerized socioeconomic assessment models, community needs assessments and techniques, psychosocial assessment, the role of judgment in SIA, visual quality and visual impact assessment, and evaluation methods. None of these techniques consider cumulative impact concepts.

Although none of the articles in this anthology present a cumulative impact assessment method suited to applications in the Alaskan Arctic, the discussions of survey research methods and ethnographic research are both worthy of further consideration in an appropriate cumulative impact assessment approach.

STUDIES WITH NO DIRECT RELEVANCE

Centaur Management Consultants, Inc. 1976. Managing the social and economic impacts of energy developments. National Technical Information Service, U.S. Department of Commerce Publication TID-27184, Washington, D.C.

Summary:

This handbook was prepared to provide local, regional, state and federal officials with guidance on how to assess, plan, and manage the social and economic impacts of energy developments. It includes coverage of the following impact areas: employment, personal income, transportation, housing, solid waste collection and disposal, water supply, waste water treatment, education, recreation, safety services, and health care. The focus of the handbook is not environmental assessment but rather to provide managers with guidance in areas of concern; parameters to be measured; required information; and relevant methodologies, standards and techniques. This report does not consider the cumulative social and economic impacts of energy development projects. This study has no direct relevance to this project. This is because it is mainly intended to provide specific analytical guidance to local community planning officials in helping to manage important municipal services such as factors for increasing sewage capacity to handle a given population increase.

Branfuran, B.H. 1980. The social impacts of coal development: the fossil energy environmental program 1(4).

Summary:

This article reports on the efforts of the Social Impact Analysis Group at Oak Ridge National Laboratory to incorporate social impact assessment into the Fossil Energy Environmental Program (FEEP) jointly funded by the Department of Energy and various industrial partners. This article presents an overview of the Group's SIAs of five coal conversion demonstration plants. It also reviews the contribution this set of assessments may have made to the conduct of SIA within the EIS process.

The article reports, "the cumulative impact of coal development may have regional impacts that significantly affect individual projects." "Unless cumulative, extra-community activities are examined, assessment of site-specific social impacts may result in a finding of "no effects" where significant impacts are likely to occur." Using an example in Kentucky, the author adds, "thirteen coal fired power plants were scheduled for construction within the same time-frame and within the same 90 minute community zone of Newman, Kentucky." He points out that this "may cause severe impacts on some local jurisdictions." "However, the overall effects cannot be attributed to any single facility." He concludes, "this suggests that regional impacts and regional monitoring are likely to become of critical importance in planning for growth in regions at risk."

Another conclusion is that, "alternative site selection becomes more important as cumulative impacts and technology options increase." "Cumulative impact assessment can show the potential for, severe impacts on selected communities within a region." No method or framework is presented, however, for the conduct of cumulative impact assessment. This report has no direct relevance to this project, despite its strong substantiation of the need for cumulative impact assessments.

Mountain West Research, Inc. 1980. BLM social effects project: literature review. Bureau of Land Management, U.S. Dept. of the Interior, Denver, CO.

Summary:

As part of the BLM sponsored "Social Effects project," a major review and synthesis of the social science literature related to the social effects of coal development was undertaken. The literature review attempted to relate the massive body of literature on social change, modernization theory and theoretical studies concerning cross-cultural social change. The object of the literature review was to identify relevant aspects of existing research and theory which could be incorporated into social impact assessments of coal development projects in the western states.

The review was organized around three conceptual guidelines: research on social organization; policy attention to maintenance or enhancement of quality of social life; and an examination of literature focused on social behaviors, processes, and structures which occur in western towns (ranging in size from a few hundred to 100,000 people) in semiarid or arid agricultural regions of the United States. The review was organized around the following eight major subject areas:

- social organization;
- political organization;
- economic organization;
- population and demographics;
- family;
- attitudes, values, and quality of life;
- Native Americans, women and other specific groups; and
- mitigation.

The report presents synopses of each of the major subject areas investigated along with short analyses of selected references. The theoretical framework, methods and data used in each reference are analyzed. This report was used in conjunction with a conference to generate a report on Research Priorities and Research Design to help guide BLM in conducting Social Impact Assessments for coal projects affecting federal lands. In general, the literature review revealed that, "while analysis of social relationships and social organization forms the crux of much sociological research and theory, inadequate research has been done on the effects of large-scale projects on social relationships or community social organization."

The literature sources reviewed are quite varied. However, no consideration of cumulative impact concepts or methods is provided. This is largely because the literature review is composed of materials drawn more broadly from social science literature, especially sociology, and much of the work has not been applied in an impact assessment setting. The literature review does summarize the findings of the analysis of key references with respect to each of the eight major subject areas to provide perspective for the development of an SIA technique appropriate to western coal development. This report has no direct relevance to this project.

Denver Research Institute. 1982. Socioeconomic impacts of power plants. Environmental Risk and Issues Analysis Program, Energy Analysis and Environment Division, Electric Power Research Institute, Palo Alto, CA.

Summary:

This report summarized the findings of a two-year study of socioeconomic impacts resulting from power plant construction and operation. Research findings based on 12 retrospective case studies of power plants and their impacts on surrounding communities are detailed. Impact assessment models were reviewed and classified. The report concludes that, "no one model appears to be satisfactory for impact assessment in those areas where impacts are likely to be significant." Sensitivity analysis or the simultaneous application of several models is suggested to reflect the range of potential impacts that may result from a project. The project documented the fact that projections of construction employment were considerably different in most cases from actual employment levels. Consequently, it is recommended that several scenarios be included in socioeconomic impact assessments.

The report does not explicitly acknowledge the issues of cumulative impact nor present methods for their assessment. The predominant focus of the socioeconomic impact assessments is on power plant construction and operation and more specifically with power plant construction work force-related issues (boomtowns, fiscal impacts, secondary impacts such as schools, housing, etc.). While numerous single purpose socioeconomic impact models and methodologies are examined and evaluated, none that is explicitly inclusive of cumulative impacts was included. The report does document that at least for power plant projects, current methods of socioeconomic impact assessment have tended to overstate secondary economic impacts. This report has no direct relevance to this project, but is a useful evaluation of currently available socioeconomic impact assessment techniques, including models.

Social Impact Research. Inc. 1983. Socioeconomic impact management. Seattle, WA.

Summary:

This book is a workshop manual and is also designed to serve as a resource guide to provide "an integrated approach to socioeconomic change which results from the development of major projects." The report is based on five years of iteration and integration of the literature on socioeconomic change. The report presents a fully developed generalized approached to conduct project-level socioeconomic impact managment. The manual is divided into two sections. The first section outlines and discusses a method for conducting a socioeconomic impact assessment. The second section outlines and discusses the management application of the assessment, namely how interested parties (i.e. project proponents, government agencies, functional groups, communities, and national/regional interest groups) can productively interact to design needed mitigation or other impact management strategies.

In addition to preparing a project description and bounding the area of impact, the approach developed by Cynthia and James Flynn of Social Impact Research, Inc. requires collection of data in the following areas: economic parameters (employment, income, taxes), demographic parameters, housing and land use, public facilities and services, fiscal characteristics, and social group analysis. The general method to be used in data collection is to compile baseline data to assemble a "without project" estimate, and then prepare "with project" estimates.

Although this methodological approach is adequate to accomplish SIA of major projects, and considered both primary and secondary social and economic impacts, no mention is made of cumulative impacts. It does do a good job of integrating various components of social impact assessment into one overall method along with guidelines and examples of how to prepare an SIA. The overall SIA method described is based upon the premise that changes in an affected area can only be adequately described "when a causal link can be made between the project-related effects and the characteristics of local areas."

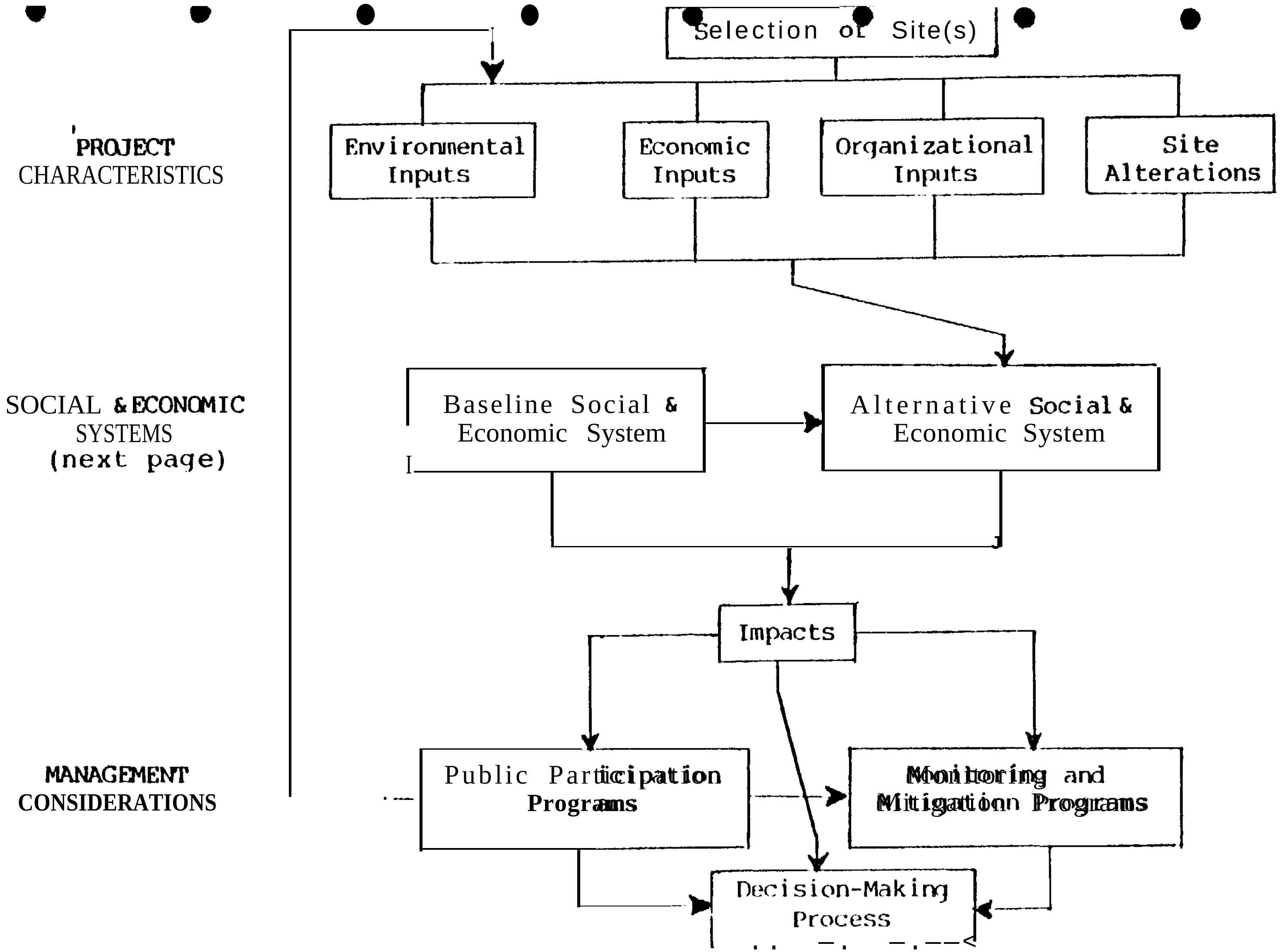
Figure 22 illustrates the Group Ecology Model (GEM) that is the theoretical organization of the author's concepts of socioeconomic impact management. Figure 23 expands on the interrelationships between social and economic systems. However, no mention is made of cumulative impact concepts or of cumulative impact assessment methods. This report has no direct relevance to this project.

3.4 Minerals Management Service Alaska OCS Socioeconomic Studies Program

The Alaska Social and Economic Studies Program (SESP) is an interdisciplinary, multi-year research project designed to evaluate physical, social and economic impacts likely to result from future Outer Continental Shelf (OCS) development. This longitudinal research effort involves a variety of studies (petroleum development scenarios, transportation, fishing, socioeconomic and sociocultural), each focused on different potential consequences of offshore oil and gas development. The research is further focused into geographic areas or "petroleum development regions" which include the identified OCS lease sale basins and the onshore communities/regions which could be directly or indirectly affected. This review briefly considers petroleum development scenarios and discusses in detail the socioeconomic and sociocultural study components of the SESP.

As mentioned above, the SESP includes a broad range of studies including petroleum development scenarios, transportation, fishing, socioeconomic, sociocultural, and statewide demographic and economic analyses. For this project, all of the currently available SESP literature was initially considered. Then the study team selectively screened the available studies to determine which documents might be useful, from a methodological standpoint, to develop a cumulative impact assessment approach appropriate for North Slope Borough petroleum development projects. Hence, the researchers focused on those studies related to local socioeconomic, sociocultural, and economic impact assessment and eliminated annual summary reports, transportation, fishing, petroleum monitoring, unrelated case studies, petroleum development scenarios, petroleum technology assessments and statewide analyses. More attention was given to studies of rural communities than to statewide and

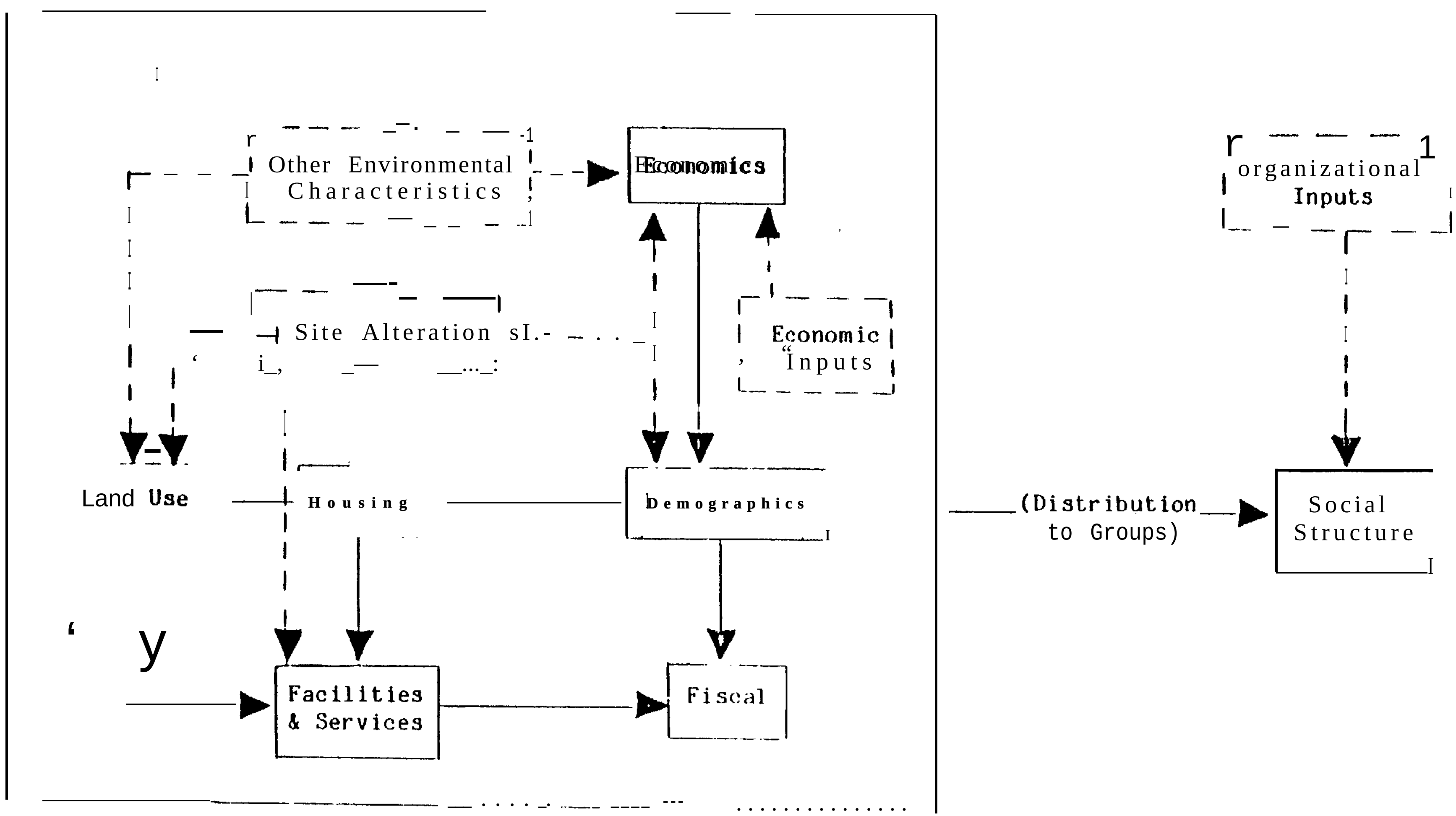
FIGURE 22



GROUP ECOLOGY MODEL
Overview

Source: Social Impact Research, Inc. 1983. Socioeconomic Impact Management.

FIGURE 23



SOCIAL & ECONOMIC SYSTEMS

Source: Social Impact Research, Inc. 1983. Socioeconomic Impact Management.

Anchorage social and economic impact studies. Particular attention was also given to previous studies of the North Slope Borough and its constituent communities.

3.4.1 SOCIOECONOMIC AND SOCIOCULTURAL STUDY COMPONENTS

The socioeconomic and sociocultural SESP components have undergone considerable transformation since the program's initiation in 1978. While the designers of the program recognized that the relatively small size and rural nature of the majority of Alaskan communities results in cultural systems that are economically and socially well-integrated, the early studies were divided between economic and cultural components. This artificial division into distinct socioeconomic and sociocultural studies was not arbitrary; rather, the division was seen as a method of focusing the research. Two simultaneous research programs were initiated, the socioeconomic studies concentrating on the regional centers and the sociocultural studies concentrating on the satellite communities. In each instance, historical and contemporary baseline data were collected and used to forecast future conditions with and without OCS development. The sociocultural studies were dependent on the demographic and employment forecasts performed in the socioeconomic studies. In turn the socioeconomic forecasts were dependent on the petroleum development scenarios prepared by other subcontractors. A brief explanation of the petroleum development scenarios is followed by a description of these early socioeconomic and sociocultural studies.

Forecasting the potential socioeconomic or sociocultural impacts of a given OCS lease sale is highly speculative. Unless accurate resource estimates are available and corporate decisions concerning development schedules and the location of production and support facilities are known, it is impossible to project the impacts that oil development may have on the growth and infrastructure of an individual community or region with exactness. Nonetheless, petroleum development scenarios can be made using preliminary (prelease) resource data and a basic knowledge of the critical factors governing petroleum development decisions (e.g., size and location of reserves, water depth, availability of suitable port sites, etc.). In the SESP, four scenarios were commonly produced. A base or non-OCS case, and three different OCS petroleum development cases: 95 percent probability resource level scenario, 5 percent probability resource level scenario, and mean probability resource development scenario. The base case considers the "most likely" manner in which a certain community would evolve without an OCS lease sale. The 95 percent probability case is the low, or exploration-only scenario where the volume of recoverable resources is so low that there is a 95 percent chance of this being realized. The 5 percent, or high development scenario, considers such a high volume of recoverable resources that there is only a 5 percent chance of it occurring. The mean level scenario is a statistical mean of the high and the low scenarios. While these development scenarios do not represent actual oil development levels they create a framework for the forecasting of socioeconomic impacts. Finally, it should be noted that the accuracy of the socioeconomic and sociocultural forecasts is necessarily dependent on the accuracy of the petroleum development scenarios.

The purpose of the early socioeconomic studies (including SESP Technical Reports Nos. 8, 11, 19, 32, 33, 40, 53, 59, and 69) was twofold. The first purpose was to provide base case forecasts of future demographic and economic conditions in the study communities without OCS development; and second, to forecast future socioeconomic conditions in the study communities based on the different OCS development scenarios. These socioeconomic studies were conducted in regional centers and other communities considered possible staging locations for offshore oil and gas development in the different OCS lease basins.

The socioeconomic studies were prepared by economists and planners who depended on an understanding of present and historic socioeconomic parameters to make future projections. In these studies, two socioeconomic parameters, often considered determinant variables, were of particular importance: population and employment. Demographic variables of population growth, family size, age, sex and racial composition were analyzed. Economic data on employment, seasonality of employment, and current and potential influences on the different sectors of the economy were considered. In some cases economic models were utilized in the socioeconomic analyses. These are described in the following section. An understanding of employment and population trends allowed for forecasting future population and employment levels. Other socioeconomic parameters discussed included: existing and future land use, land ownership, housing, development constraints, and community facilities and infrastructure.

Commonly these reports determined the levels of future growth to be expected for various development scenarios and how this growth would affect community needs and infrastructure. Many of the reports identified the problem of land availability for development as a likely limiting factor for growth. These early socioeconomic studies, while useful tools for assessing OCS impacts, had several limitations. First, there was no consideration of how growth in the regional center would affect the smaller communities within the region. Second, the cultural implications of economic development in the regional center were not discussed.

The early sociocultural studies attempted to assess the potential impacts of OCS development on the subsistence oriented coastal communities by collecting baseline data on the sociocultural systems within the smaller villages. SESP Technical Reports Nos. 9, 22, 36, 39, 41, 47, 54, 64, 67, 70, and 74 provided baseline analyses and, in some instances, non-OCS and several OCS forecasts of sociocultural conditions for a number of communities from the Gulf of Alaska to the Beaufort Sea.

This research, conducted by social scientists, concentrated on the interrelated and interacting elements which defined local cultural systems. Each researcher divided the cultural system into a group of sociocultural subsystems which were subsequently described and analyzed. Although the identified cultural subsystems varied from researcher to researcher, the following components were usually present: social organization and kinship, politics, technology, economics (including subsistence), values and ideology. Most researchers identified a theoretical orientation that guided their analysis and aided in identifying important conditions and trends. The most common theoretical orientation involved the concepts of cultural ecology and historical materialism which consider the techno-economic relationship to the environment as the determinant element in the cultural system. The predominance of this orientation is due to the subsistence-based society present throughout rural Alaska. Other researchers believed that no subsystem should be considered the operant variable unless empirically determined.

Future sociocultural conditions were projected through the identification and monitoring of trends within the sociocultural system. In some studies the researchers relied on the socioeconomic forecasts of other studies, particularly employment and population figures, to aid in the projections of future sociocultural conditions. All researchers were limited to discussing the cultural variables likely to be affected by OCS development.

Through the identification of trends and the forecasts of future sociocultural conditions, the likely effects of potential OCS development were determined. ' Researchers repeatedly identified the importance of locally available renewable resources to both the economy and culture of these rural communities and briefly discussed the effects of altering this resource base. Some researchers forecasted that an increased rate of change, combined with the interaction between the subsistence-based and cash economies would increase pressures on the traditional culture.

While these sociocultural studies produced good ethnographic baseline data, there are a number of inherent limitations. First, with the exception of subsistence activities, socioeconomic aspects of the study communities are not discussed. Second, the number of communities included (as many as 30) and other scope of work requirements often resulted in generalized overviews of many important issues. Third, the qualitative nature of much of the data made the impact of a given effect difficult to trace through the entire sociocultural system.

In summary, the early socioeconomic and sociocultural studies, while fruitful first levels of analyses, have certain limitations. In terms of forecasting future conditions these studies were dependent on the quality of the initial petroleum development scenarios. The early sociocultural studies demonstrated the importance of the economic subsystem within the smaller communities, while at the same time the early socioeconomic studies identified that subsistence production and other sociocultural subsystems are active in the regional centers. For these reasons, and others, there has been a re-emphasis in SESP research. Analysis of the economic and cultural aspects of society have now been united and research efforts are more closely integrated.

The reorganization of the SESP socioeconomic and sociocultural studies is multifaceted. Research efforts have diversified while concentrating on integrating the socioeconomic and sociocultural aspects of society. At the same time efforts continue to establish an appropriate methodology for forecasting future conditions and responses to change in rural Alaska.

Recent efforts have concentrated on the linkages between socioeconomic activities and cultural subsystems at both the village and regional levels. One example of this integrated approach is SESP Technical Report No. 72, prepared by Wolfe. In this study, the mixed, subsistence-based economy of six lower Yukon villages is analyzed. Cultural elements such as land use, exchange networks and extended family harvest groups are considered in the socioeconomic context of the commercial salmon fishery and the need for cash for successful subsistence production.

Other studies have attempted to cluster communities that are linked by similar physical (geographic proximity), cultural (kinship ties, ideologies) and economic (trading networks, resource bases, and employment activities) characteristics. In theory, once these clusters have been established, ethnographic data can be discussed for entire regions or subregions; community level analysis is necessary when an individual village differs from its identified cluster.

Finally, there has been a series of community specific studies that attempt to forecast future social, economic and cultural conditions. These studies are divided into two major categories: those that forecast the effects of disruption on the study villages' subsistence harvests (SESP Technical Reports Nos. 89, 90, and 91), and those that consider the effects of different growth or development scenarios on the study community (SESP Technical Reports Nos.

92, 93, and 104). All of these studies are based on extensive fieldwork and provide substantial ethnographic baseline data. The success of the different forecast methodologies varies and is detailed later in this report.

In conclusion, the socioeconomic and sociocultural studies have undergone substantial transformation during the course of the SESP program. Baseline methods have become more rigorous and defined. At the same time, current research efforts attempt to more fully integrate the economic and cultural aspects of society. Research efforts produce quality analytical baselines, clearly identifying trends of change. However, the methods of forecasting change (especially magnitudes of change) and measuring the effects of OCS development are generally not well developed. While the SESP represents the beginning of a longitudinal baseline for rural communities throughout the state, there are still information gaps in the existing social, economic and cultural data base. With the assistance of a growing longitudinal baseline, the accuracy and reliability of OCS forecasting methodologies will likely improve. To date no formal cumulative impact assessment methods have been developed within this literature although cumulative impacts are a concern identified in several studies.

3.4.2 ECONOMIC MODELS

This section provides an overview of the previous SESP efforts at modeling the Alaska economy with special emphasis on the North Slope economy. It begins with an introduction to the models and their applications. Although many of SESP's Technical Reports deal with economic or economically related social and demographic issues, the economic models on which these reports are based are limited to the Man-in-the-Arctic-Model (MAP), the Smal 1 Community Impact Model (SCIMP), the Rural Alaska Model (RAM), and the Alaska Consultants' Economic Base Model.

A simple "Economic Base" type model is used in several SESP local socio-economic systems analyses, especially those conducted by Alaska Consultants, Inc. This model is founded on the idea that employment and resulting wage income derives from "basic industries," which are those industries providing goods and services to the world outside the local economy. The outside income which these "basic industries" produces permits the employment of service and support workers in the so-called "non-basic" sector. Thus, each job created in a basic industry sector (such as oil and gas development) results in additional non-basic employment. The total number of positions created by increasing the basic sector by one is called the "multiplier." (A thorough discussion of the application of the multiplier to the Alaska economy appears in Technical Report No. 73, Chapter II.)

The MAP model utilizes the economic base approach, but is more sophisticated. MAP disaggregate both the exogenous (basic) and support systems (non-basic) sectors into several sub-sectors. In addition, MAP incorporates demographic and fiscal submodels. Although designed as a statewide model, MAP results can be localized by a regional submodel. This submodel divides impacts based on the historical employment/population ratio within each region.

The SCIMP model is conceptually similar to the MAP model. However, whereas MAP must be run for the entire state, then disaggregate into regional components, SCIMP is built up directly from community or regional data. A second major difference is that whereas MAP derives the multiplier from an historic data base, the labor force participation rates, and other important parameters in SCIMP, these parameters must be supplied by the user. As a result of these differences SCIMP is more flexible than MAP in local planning and policy formulation, because it permits modeling of different local policy alternatives. The local scale of SCIMP also permits modeling of local fiscal policies. Another advantage of SCIMP is that the employment multiplier can be changed over time. Generally, as an economy becomes more developed and diversified, the multiplier increases.

The Rural Alaska Model (RAM) is structurally very similar to SCIMP. Like SCIMP, RAM is a disaggregate economic base model. Population is differentiated between native and non-native, and by age and sex cohorts. The major difference between SCIMP and RAM is the computer language in which they are programmed. SCIMP is programmed in FORTRAN which makes it difficult to restructure without extensive programming and debugging. RAM is programmed in TROLL, a language specifically developed for solving simultaneous equations. Changes in the model structure, which would require extensive FORTRAN reprogramming in SCIMP, can be accomplished by changing a few lines in RAM's program. The RAM model has been specifically adapted to the North Slope conditions by adding a detailed specification of the borough's fiscal situation. The resulting North Slope model is described more fully in Technical Report No. 85.

In conclusion, the socioeconomic modeling efforts developed to date through SESP represent a dedicated effort to measure and forecast the impacts of unique developments on small communities with undeveloped economic structures. The attempts have been at least partly successful. Simple economic base models and attempts to derive regional impacts from unwieldy statewide models have led the way to the more community-specific SCIMP model and its more user-friendly descendant, the RAM model.

However, despite these methodological advances there is still no model which offers a systematic approach to two critical socioeconomic issues related to identifying cumulative economic impacts: structural change and the interactions of the traditional and the cash economies. Ironically perhaps, the two studies which specifically incorporate cumulative economic impacts in their titles, Huskey (1979) and Dames & Moore (1982) do not have applicability to this project due to their respective focus on: statewide economic and population projections inappropriate to the North Slope Borough and cumulative or concurrent economic and labor requirements of Bering Sea petroleum development scenarios. However, this is in fact consistent with experience in reviewing the cumulative impact assessment literature discussed earlier.

3.4.3 REVIEW OF THE LITERATURE

The following section contains brief summaries of SESP Technical Reports deemed likely to contain useful insights or methodological approaches with potential relevance to the development of a cumulative impact assessment method for the North Slope Borough. Reports were also reviewed in order to understand the evolution and development of the SESP program, in order to avoid duplicating previous approaches, and to glean whatever information was available on the analysis of cumulative social, economic and cultural impacts of petroleum development. Of the reports reviewed and presented here, only Alaska Consultants (1978), Worl Associates (1978), Worl Associates (1978), Louis Berger & Associates (1982), Louis Berger & Associates (1983), Kruse, et al (1983), Jorgenson (1984), Luton and Cortese (1984), and Alaska Consultants, et al (1984) were deemed to have limited relevance to this project. Of these studies, only Kruse, et al (1983) presents a method which might be adapted to include cumulative impact assessment in Alaskan Arctic settings. The reports without direct relevance are then presented.

RELEVANT STUDIES

Alaska Consultants, Inc. 1978. Beaufort Sea region - manmade environment. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 8. 282 pp.

Summary:

Technical Report No. 8 provides a general baseline description of the Beaufort Sea region as well as detailed discussions for four communities: Barrow, Kaktovik, Wainwright and Nuiqsut. Specifically, socioeconomic parameters such as population and economy, community facilities and services, local government organization and, for some villages (Wainwright and Nuiqsut), land use, land status, utilities, and transportation facilities are described. Because accurate information on these subjects was not readily available, the researchers relied on field trips to the four communities as well as agency and private company information. This baseline document describes the effects of oil development at Prudhoe Bay and the subsequent establishment of the North Slope Borough on the Inuit inhabitants of the Beaufort Sea region. The baseline data provided in this report is a prerequisite for later discussions of future socioeconomic conditions in the area. No economic modeling is included. No cumulative impact assessment methods are presented. However, the qualitative and quantitative information in this report should be used to help construct an adequate sociocultural monitoring program to establish time series data to use in cumulative impact assessment. Therefore, this report has only limited relevance to this project.

Worl Associates. 1978. Beaufort Sea region - sociocultural systems. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 9. 168 pp.

Summary:

Worl Associates prepared the first sociocultural systems baseline analysis for the Socioeconomic Studies Program. Technical Report No. 9 “attempts to demonstrate that the social, cultural, and psychological values are as important as the economic values of the environment to the regional population" (Worl 1978:9). The document outlines the aboriginal social and cultural organizations of the North Slope Inuit which are considered the foundation of the present society. In addition, baseline information for the historical period (exploration, commercial whaling, fur trade, and NPR-A exploration) is provided.

A description of the contemporary period begins with a detailed account of local and regional political development. The village councils of Wainwright, Point Hope, Kaktovik, Anaktuvuk pass, and Barrow are described. The importance and effectiveness of regional cooperation is demonstrated through descriptions of several important institutions: Arctic Slope Native Association, Arctic Slope Regional Corporation, North Slope Borough, and others.

This baseline report also discusses socioeconomic subsistence patterns. The impact on local residents of restrictive wildlife regulations, local attitudes towards petroleum development, as well as present land use patterns are described. In addition, the economic, social, and cultural importance of subsistence is presented. The final section describes areas of potential conflict between the Inuit and Western cultures, the increased rate of social change, and the negative impacts of this change already being manifested on the North Slope. Worl Associates concludes that despite numerous changes which have occurred and continue to occur in the Beaufort Sea region, the traditional elements of Inupiat culture and society remain intact.

This report identifies a large number of potential sociocultural indicators which might be incorporated into a cumulative impact assessment method. However, these indicators need to be screened and agreed upon by a variety of practitioners before being implemented in a sociocultural monitoring methodology or used in cumulative impact assessment.

Worl Associates. 1978. Assessment of change in the North Slope, Beaufort Sea region, sociocultural systems. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 22. 107 pp.

Summary:

Technical Report No. 22 prepared by Worl Associates, used baseline socio-cultural analysis (Worl Associates, 1978), as well as projected economic and demographic impacts (ISER, 1978), man-made environment impacts (Alaska Consultants, 1978), transportation impacts (Dooley & Associates, 1978), and natural-physical environment impacts (Dames & Moore, 1978) to identify potential sociocultural impacts. These impacts were then matched with six socio-cultural impact categories (see below) so that the overall effects on traditional values and sociocultural systems of a non-OCS scenario and four different OCS scenarios could be forecast.

The six sociocultural impact categories Worl Associates identified as fundamental to the Inupiat sociocultural system are paraphrased here.

- Subsistence. The presence of the socioeconomic subsistence system distinguishes the Inupiat from a westernized society totally dependent on a monetary economy. Although interrelated with other sociocultural impact categories (e.g., cultural values, social health, etc.), the habitation and utilization of the natural environment and its resources for food and clothing are fundamental to the Inupiat sociocultural system.

- Cultural Values. "The intrinsic cultural values of the North Slope indigenous population appear to emanate from their deep emotional attachment to their natural and physical environment and their interaction with it. This value system... gives coherence to their actions relative to their life on the land, their knowledge of the environment, a dependency on traditional skills, and continued reliance on the extended family" (Worl Associates, 1978:7).

- Political. The Inupiat majority control of local and regional government results in these political institutions reflecting values and sociocultural expectations (particularly protection of the environment and subsistence). The North Slope Borough, generating internal changes and responding to external pressures, was the primary institution monitored.

- Interethnic Relationships. Interethnic relationships may influence the patterns of behavior of both the indigenous population and the migrants. The effects on non-Inupiat population increases (particularly in the permanent communities) must be a primary consideration in the sociocultural assessment.

- Social Health. Because social well-being of a population is an indicator of the adjustments a population makes to changes, the presence of social disturbances as reflected in crime, alcoholism, drug abuse, and other forms of destructive behavior were evaluated.

- Family Relationships. Family organization, strengthened by patterns of sharing and cooperation, has been considered the reason for the survival of the Inupiat sociocultural system. Current changes in the political and economic sphere will determine the viability of the extended family and its ability to cope with further changes.

Worl Associates used qualitative analysis of the impacts on these six sociocultural categories to describe the net effect of each different petroleum development scenario. The report concludes that despite 150 years of contact with Western influences, and the incorporation of many Western goods and services, the Inupiat of the North Slope have been able to persist as a cultural enclave within a larger Western society.

While Worl Associates recognize the importance of determining and assessing cumulative impacts (p. 6), no method is presented for undertaking such an analysis. However, the designation of key sociocultural impact categories is helpful in choosing appropriate cumulative impact indicators for a viable cumulative impact methodology. Therefore this report has only limited relevance to this project.

Berger, L. & Associates, Inc. 1982. Forecasting enclave development alternatives and their related impacts on Alaskan coastal communities as a result of OCS development (Final Reort). Anchorage, AK. Report for Minerals Management Service, Alaska OCS Office, Anchorage. Technical Report No. 76.

Summary:

This report presents a model designed to assist MMS in predicting the socio-economic and cultural impacts on Alaskan communities associated with offshore oil exploration and development. The model is divided into three elements dealing with: industry-community decisions, direct impacts and indirect impacts. Twelve categories of direct impacts were identified along with 135 types of potential indirect impacts. Each indirect impact was linked to a category and level of direct impact based on the most recent field research in Alaska. The model was applied to Nome and Dutch Harbor/Unalaska to determine a set of direct and indirect community impacts under alternate siting decisions for OCS-related onshore facilities, located in or near those communities.

Figure 24 is a flow diagram showing the detailed steps of the model. The model's runs are dependent upon information from U.S. Geological Survey reports, SESP reports, SCIMP model runs, other secondary data sources and field work. Depending on the level of activity (i.e. exploration, development or production), the direct impact component of the model converts the output of the Industry-Community analysis into a table of direct impacts of OCS development. These are then used to determine the indirect impacts which the community is likely to experience as a result of OCS development. The effects of development on 36 direct impacts are considered within the following eight categories:

1) local economy
2) local labor force
3) land use patterns
4) utilities
5) community services
6) tax base

BASIC PROCEDURES OF IMPACT ANALYSIS FOR A PARTICULAR PHASE & LEVEL OF FIND

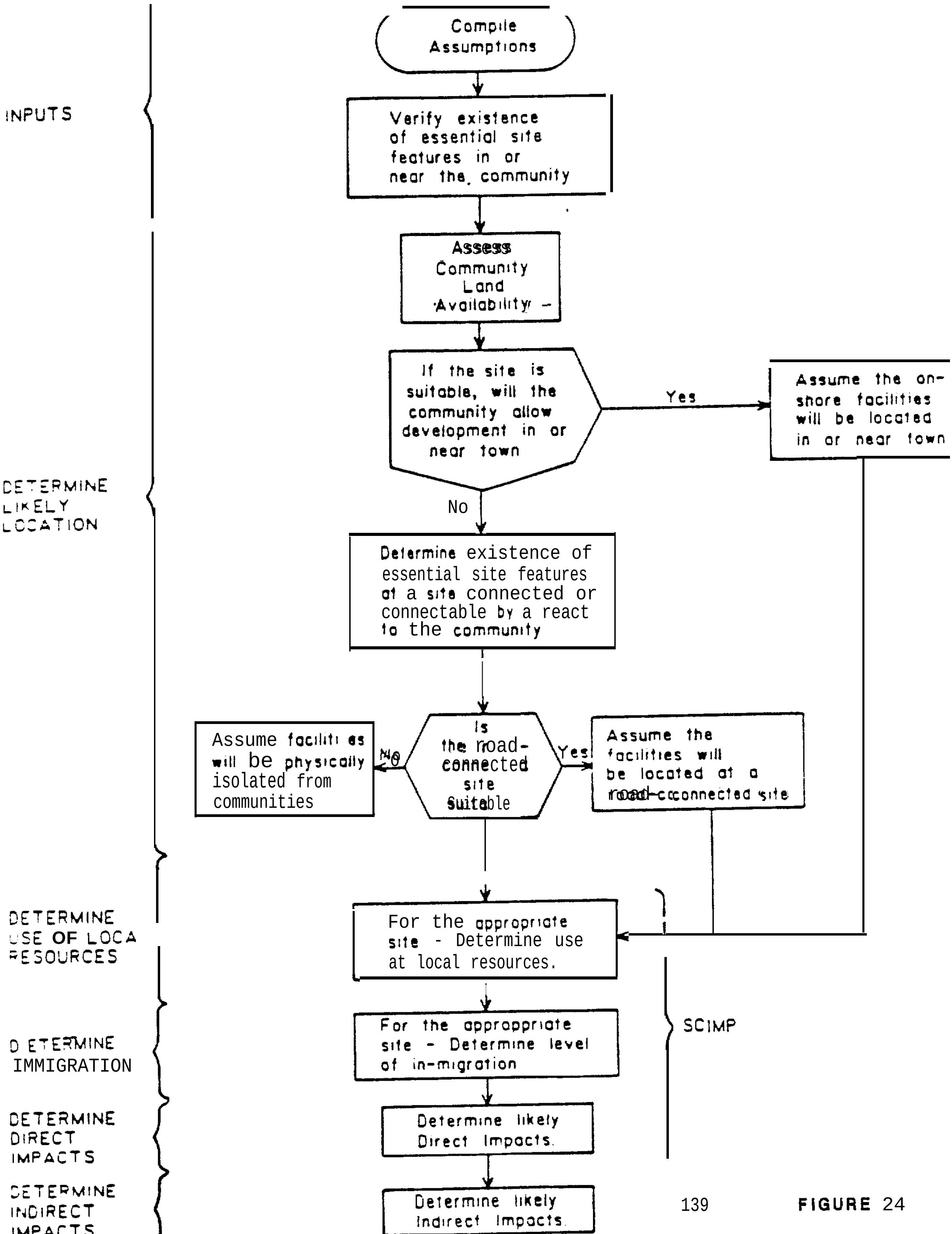


FIGURE 24

Source: Berger, L. & Associates. 1982. Forecasting enclave development alternative: and their related impacts on Alaskan coastal communities as a result of OCS development.

7) transport facilities
8) presence of newcomers

For purposes of this model an indirect impact is defined as "significant change in the economic, social or cultural organization of a community that results from one or more of the direct impacts." The authors note that not all causal relations between direct and indirect impacts have been established, but using Alaskan literature and research, three categories (social, cultural and economic impacts) and 135 separate social, cultural or economic indirect impacts are defined. These indirect impacts are then associated with one or more of the direct impacts so that the likely indirect impacts are determined for each individual direct impact. If the model is to prove effective, these linkages, derived from a wide range of recent impact research should be continually updated as causal relationships within the sociocultural system are determined.

This model and particularly its identification of direct and indirect impacts of specified levels of OCS development, "near a specified community with its particular characteristics, and-with a particular type of onshore industrial presence and interaction with that community" is of potential interest in developing a cumulative impact assessment methodology. However, the model fails to take into account the indirect impacts on social, cultural and economic parameters of physical changes associated with proposed development projects (i.e. habitat loss leading to reduced subsistence harvest). There is also no specification of which indirect impacts are the key cumulative impacts, and no idea is given of their relative importance to maintenance of existing sociocultural and socioeconomic systems. The list of 135 indirect impacts is a useful presentation of likely impact criteria. However, these need to be more closely interrelated to basic social and cultural systems and levels of likely change. The model's generalized nature also tends to ignore or downplay the relative importance of certain aspects or unique features of individual communities. The model also has no way of distinguishing or including the incremental impacts of a variety of present or planned development projects including non-OCS projects.

Berger, L. & Associates, Inc. 1983. Social indicators for OCS impact monitoring. Report for Minerals Management Service, Alaska OCS Region Anchorage. Technical Report No. 77. 3 vols.

Summary:

This report presents the results of a social indicators study designed to define indicators of social well-being, to validate those indicators in subsequent tests, and to design a methodology which MMS may utilize in monitoring the effects of OCS development in potentially affected regions of Alaska. The report uses ethnographic baseline information gathered in two different geographic regions of Alaska to analyze the potential impacts of oil and gas development on the quality of life in Alaskan villages. The primary field research was conducted in Kotzebue, Selawik, Kiana and Noatak in the NANA (Northwest Alaska Native Association) Region and in Unalaska, King Cove, Nikolski and St. George in the Aleutian-Pribilof Region. Research methods included participant observation, the collection of focused responses as well as secondary aggregate data (socioeconomic) collected at the regional and village levels.

The initial social indicators research resulted in the preliminary selection of 13 individual-level, 13 institutional-level variables, and four sets of time-series data, to be potential indicators of community well-being in village Alaska. Because they were defined for only eight communities at one point in time, the authors pointed out that these variables must be validated and, if necessary, revised, in more communities and at one or two additional points in time before they can be utilized in a monitoring program.

To accomplish the objective of the first phase of the social indicators study, the research team first established a sociocultural contextual background for both regions and then collected primary data on a wide range of varibles for the selected communities. This primary data collection lasted for about two weeks in each village and was guided by data collection protocols corresponding to key domestic and institutional topics. Time series of

aggregate secondary data were also collected and analyzed on both the village and the regional levels.

The primary and secondary data were manipulated into matrices, and a smallest space analysis was used to identify conspicuous clusters of variables and to reveal those individual and institutional variables and sets of time series data that served as the best individual indicators of the larger variable clusters. These variables are listed in Table 1 and suggest that social well-being is tied to income levels, village size, subsistence economies and sharing practices of individuals and households, and to the focus of power and the relations among village leaders and institutional employees.

Although the indicators selected by the authors for use in longitudinal monitoring of social well-being are certainly of value in tracing change in Alaskan communities affected by OCS development, they do have certain limitations. Excessive emphasis in the indicators is placed on income-related indicators or other indicators linked to specific data series currently available. Therefore the indicator series is skewed and reflects available data sources and their correlations, rather than being based on new empirical investigations of other aspects of village sociocultural systems. Important aspects of subsistence activities are not included nor are spatial indicators (land use and occupancy patterns, etc.). Nevertheless, the study does provide some valuable guidance in assembling a list of social indicators of use in fashioning a viable cumulative impact assessment method for the Alaskan Arctic. However, the exceptional complexity of the data manipulation and indicator selection techniques render this approach infeasible in most likely cumulative impact assessment applications. Therefore, only limited use of this work will likely be made by those interested in cumulative impact assessment.

When or if a viable time-series monitoring program based on key social indicators is operational (cited here and possibly elsewhere), data from such a source will probably be of greater use to cumulative impact assessment, particularly if such a series reflects the communities likely to be affected by proposed and projected OCS and non-OCS development projects.

TABLE 1

KEY SOCIAL INDICATORS

Individual-level Variables

Household Income
Percentage of Total Income Earned
Percentage of Total Income Unearned
Proportion of Total Earned Income That is Derived from Government (Public) Sources
Stability of Earned Income
Stability of Unearned Income
Income Pooling, Labor, and Resource Sharing
Investment of Percentage of Total Income in Subsistence Harvest Expenses
Household Size
Domestic Functions and Child Rearing Practices
Household Dynamics
Village Size

Institutional-level Variables

Residents' Perceptions of the Locus of Control Over institutions
Native Participation in Formal Village Institutions
Sodality Memberships Overlap Among Institutional and Village Leaders

Time-Series Data

Internal Population Growth
School Enrollment
Government and Private Sector Employment
Welfare Payments

Source: Berger, L. & Associates, Inc. 1983. Social indicators for imPact monitoring.

Kruse, J.A. et al. 1983. A description of the socioeconomic of the North Slope Borough. Institute of Social and Economic Research, University of Alaska, Anchorage, AK. Report for Minerals Management Service, Alaska OCS Regi on. Technical Report No. 85.

Summary:

Technical Report No. 85 describes current social and economic conditions on the North Slope and establishes a pragmatic analytical framework with which to project changes in the sociocultural and socioeconomic systems as a result of OCS Lease Sale 87. Because of numerous recently published baseline descriptions, this report does not contain a comprehensive analysis of social and economic conditions but rather focuses on important social and economic changes that could be affected by OCS development. Six potentially significant economic and/or social factors that could be influenced by continued petroleum development are identified:

- decrease in the net supply of subsistence resources available to Inupiat hunters,
- increased social stress due to perceived threats to subsistence resources,
- enhancement of expected North Slope Borough financial situation in the next decade,
- increased industry employment,
- change in ability of local institutions to influence development activities,
- long-term changes in Inupiat cultural values.

According to the analytical framework presented, the economic and social well-being of North Slope Inupiat is dependent on both external forces of change and internal-induced changes. The external forces of change include

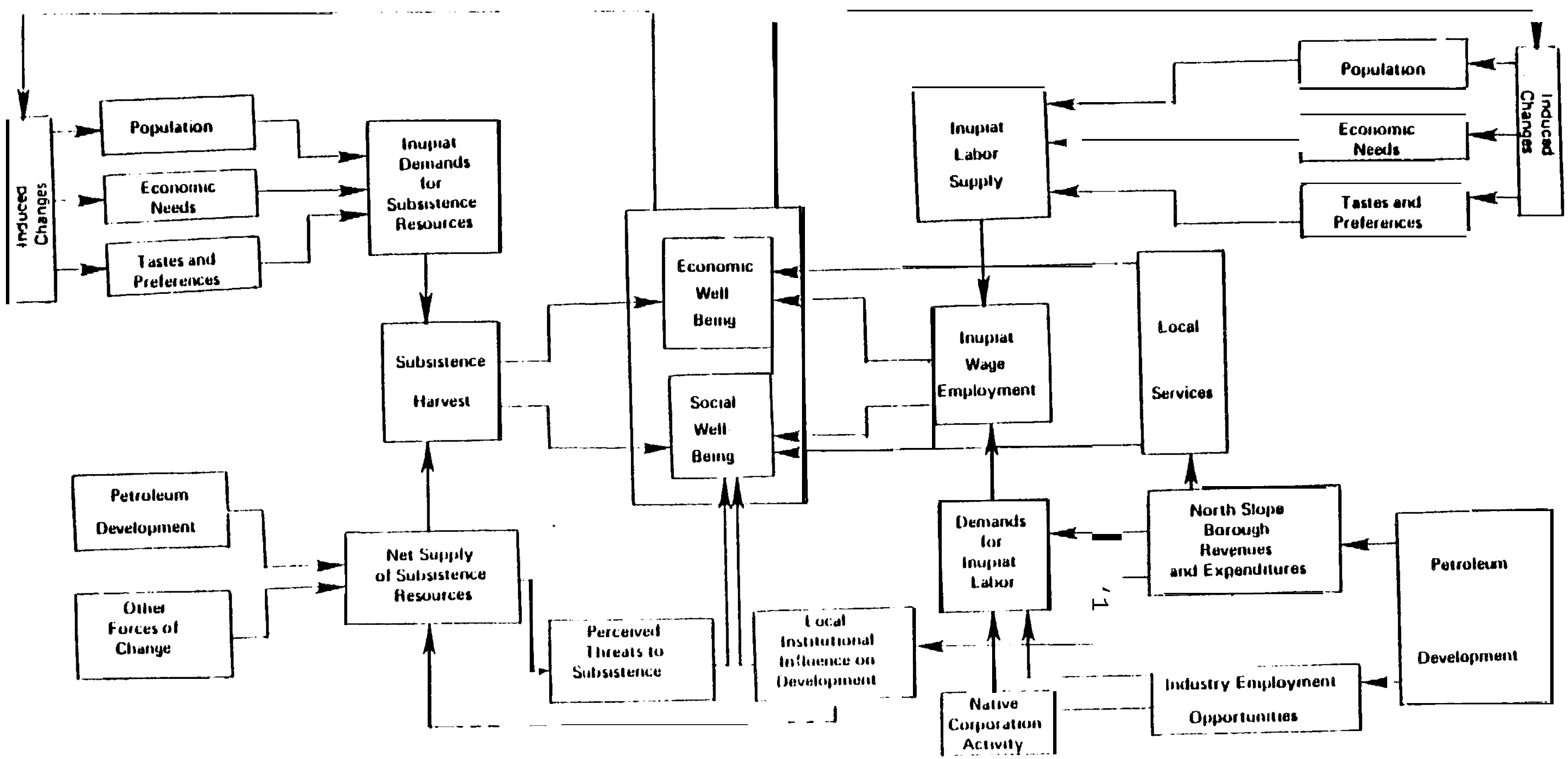
oil development, restrictive fish and game regulations, and changes in federal law. The internally-induced changes include population growth, changing economic needs, and social, cultural, and ideological changes (e.g., food tastes and preferences). The authors note the impossibility of assessing all of these internal changes within the time limits placed on the research.

Based on its use of the North Slope model, an adaptation of the RAM economic model, this report is the most thorough and significant modeling of the economic impacts of OCS development conducted to date. The NSB model has a very detailed specification of the fiscal position of the borough. The basic employment estimates for native participation in the OCS-related work-force and the multipliers used for estimating non-basic impacts are based on historical experience. The increase in government employment forecast to occur due to OCS revenues is based not on an abstract multiplier, but is based on the forecast borough revenues. The analysis concludes that statutory limitations on the borough's taxation authority will minimize future fiscal impacts of further OCS development.

The demographic and employment impacts within the borough are apportioned among the villages based on their 1980 shares of the borough population. This is an oversimplification. However, the model is quite flexible and could easily be adapted to address this and other limitations.

"An elaborate flow chart shown in Figure 25 was developed for the report. It details the interrelationships between the traditional and cash economies and their relationship to population, migration, economic and social well-being. However, these interrelationships are not documented in the report. Rather, the cash economy and demographics are rigorously modeled while the traditional economy and economic well-being aspects of the study are based on a compilation and analysis of testimony presented by natives to interviewers and in official hearing testimonies. Nevertheless, the authors' qualitative insights into projected cumulative impacts of North Slope Borough petroleum development are well-documented and convincing.

DYNAMICS OF SOCIAL AND ECONOMIC CHANGE ON ALASKA'S NORTH SLOPE



Source: University of Alaska, ISER. 1983. Technical Report No. 85. A Description of the Socioeconomics of the North Slope Borough.

FIGURE 25

The overall analytical framework used in this report to forecast economic, social and cultural changes does provide a rational explanation of how the different variables, conceptual components, and subsystems are related. This causal description allows for the forecasting of some subsystems within the framework at the present time (e.g., population, North Slope Borough revenues and expenditures) while providing a framework for the forecasting of other subsystems when viable conclusions about these variables are determined. While the present study does not consider some critical socioeconomic issues (e.g. , the interrelationship between the traditional and cash economies and detailed description of present land use patterns), the flexible nature of this analytical framework for forecasting could be adapted to include other important socioeconomic and sociocultural variables or subsystems. Finally, the subsystems presented as the end-points of the analytic framework, the economic and social well-being of North Slope Inupiat, are poorly defined. However, this report is an important starting point for isolating cumulative social , economic and cultural impacts of petroleum development on the North Slope Borough and the analytical framework or forecast methodology has potential utility as a method to be incorporated into cumulative impact assessment.

Jorgenson, J.G. 1984. Effects of renewable resource harvest disruptions on socioeconomic and sociocultural systems impact analysis: Unalakleet, Norton Sound. Report for Minerals Management Service, Alaska OCS Office. Technical Report No. 90.

Summary:

This report is one of three village studies (the other two being Gambell and Wainwright) designed to assess the potential economic, social and cultural effects of disruption to village subsistence harvest and use of local renewable resources caused by environmental disruptions related to future offshore oil and gas development activities. Based on ten months of fieldwork and literature review, the researchers collected and analyzed baseline ethnographic information on the sociocultural and socioeconomic systems of

Unalakleet. The researchers gathered field data through the use of anthropological observations of daily activities and protocol observations (focused responses to sets of topics resembling open-ended interviews). The ethnographic baseline describes the social, economic and cultural systems in Unalakleet with particular emphasis on their linkages to the harvest of renewable resources. The authors conclude that despite fast-paced technological and economic change in the community, subsistence activities remain integral to the socioeconomic and sociocultural systems of Unalakleet.

Jorgenson (1984:315-322) sets forth a list of eight major impact categories related to subsistence and assumed to be impacted by harvest disruption. The eight major categories are identical to those listed in SESP Technical Reports Nos. 89 and 91 and include:

- Subsistence
- Technology
- Economic Organization
- Ideas and Sentiments Regarding the Importance of Naturally Occurring Species
- Social Organization
- Religion
- Political-Economic Institutions
- Helping Services

He further divides these eight impact categories into 167 subcategories.

In the final chapter of the study, Jorgenson explains the strategy of the report is first to "provide background information for the situational logic" to be used in determining the consequences, and then to propose the consequences of harvest disruption on the cultural system (Jorgenson, 1984:326).

The background information Jorgenson provides consists of two main components. The first one is:

I. A definition of the levels of disruption and rationale for the distinctions between them.

A. In defining levels of disruption, Jorgenson sets forth a ranking of food sources based upon four interdependent factors:

1. Contribution to diet (over past five years)

   Resources identified as either:

   o predominant staple in quantity; or
   o secondary food sources; or
   o tertiary food sources.

2. Efficiency in extracting the resource. Resources are ranked on a scale of one to six depending on the amount harvested in relation to the allocation of labor-time, distances traveled, cash and equipment.

3. Preferences for resources. ranked on a scale of one to three.

4. Resource availability, which ranks the concentration and abundance of resources on a scale of one to three.

Jorgenson concludes that, with a few exceptions, the resources that contribute the most to Unalakleet diets tend to be the most abundant, the most preferred, and the most efficiently extracted (Jorgenson, 1984: 336). Also, in some cases, cultural factors rather than natural factors determine the selection of predominant staples in the diet (e.g., seals and waterfowl).

B. Jorgenson next outlines three harvest disruption scenarios (low, medium and high) which are predicated on the unavailability of certain combinations of primary and secondary resources

   o Low level disruption is the current situation in which yearly variations in weather, ice conditions and resource fluctuation hinder the harvest of some resources at different times.

   o Disruptions to combinations of three predominant staples and secondary food sources (any combination thereof) for two consecutive seasons constitutes a medium level disruption.

- o High level disruption is the condition in which four predominant staples and secondary food sources are unavailable throughout a year.

The second component of Jorgenson's background information is:

11. "A comparative assessment of consequences to Native American culture from rapid, large-scale energy developments--focusing on similarities and differences between Eskimos and Western American Indians" (Jorgenson, 1984:326).

    This comparative discussion is presented because Jorgenson considers it "crucial in anticipating cultural consequences from large-scale, rapid industrial developments in Unalakleet" (Jorgenson 1984:341) and because it "will provide us with a comparative framework from which concluding postulates about the consequences from medium and high levels of disruptions to the harvests. ..can be drawn" (Jorgenson 1984:342).

    These statements suggest a methodology based largely on comparative assessment; however, Jorgenson does not explain how he uses the comparison to generate a harvest disruption impacts assessment for Unalakleet.

Jorgenson then describes the main cultural consequences to Western American Indians and North Slope Inupiat from energy-related developments. He also briefly describes some potential effects of energy-related developments in Norton Sound on Unalakleet, without explaining the purpose or basis of these projections.

Finally, he presents the consequences of medium and high level harvest disruptions. The effects of medium level disruptions include:

- o Pursuit of less preferred and less efficiently harvested resources
- o Increased dependence on welfare programs

- Redistribution of resources within the village
- Requests for assistance from the kinship network extending beyond the village
- Household consolidations
- Increased friction, criticism and confrontation with non-Native users of subsistence resources
- Temporary out-migration
- Search for solutions through lawsuits and social movements

The effects of high level disruptions include:

- Substantial out-migration
- Intensification of all impacts specified for medium level disruptions so as to require major state and federal governmental intervention
- Efforts to have disruptive oil-related activities removed from the region and barred from future return

The consequences described within each of these scenarios emphasize local behavioral reactions, with little mention of the impacts on the cultural components such as the values system, the political system and the sharing networks. Furthermore, the report does not make clear the process by which Jorgenson goes from impact categories to consequence projections. He does outline assumptions in Part III, followed by an extensive list of impact categories believed to be affected by harvest disruptions. However, Jorgenson is not clear in linking the assumptions; the impact categories, the ranking of harvestable resources and the consequences of harvest disruption.

In short, the methodology employed in this study appears to be grounded in comparison. An ethnography of Unalakleet is presented along with an analysis of subsistence resources and levels of disruption. The similarities and differences between Unalakleet natives and Western American Indians are discussed; and then consequences of harvest disruption are presented for Unalakleet, apparently based on the similarities they share with Western American Indians and the documented impacts on the latter group of rapid, large-scale industrial developments. No cumulative impact assessment method

B

is presented. Nevertheless, the consequences illustrated as a result of harvest level disruptions might be cumulative impacts worthy of investigation in a suitable cumulative impact assessment methodology. This report is of limited relevance to this project.

Luton, H.H. and C.F. Cortese. 1984. Effects of renewable resource harvest disruptions on socioeconomic and sociocultural systems: Wainwright, Alaska. Report for Minerals Management Service, Alaska OCS office. Draft Final Report No. 91.

Summary:

This report is one of three village studies (the other two being Gambell and Unalakleet) designed to assess the potential economic, social and cultural effects of disruption to village subsistence harvest and use of local renewable resources caused by environmental disruptions related to future offshore oil and gas development activities. Through six months of fieldwork (1982) and related literature reviews, the researchers collected and analyzed baseline ethnographic information on the socioeconomic and sociocultural systems of Wainwright, an Eskimo community on the Chukchi Sea coast where residents continue to harvest and use local resources. The field methodology consisted of interviews and focused discussions. The researchers had hoped to collect quantitative data on subsistence, but were unsuccessful. Thus, the study became a traditional ethnography relying on a few helpful people and observations. The baseline includes a species-by-species analysis of the collection, distribution, use and importance of local resources.

The baseline describes the social, economic, and cultural systems in Wainwright in terms of their linkages to the harvest of renewable resources. The baseline analysis compares 1982 findings with previous data available from the literature (e.g., 1955 and 1965). The authors conclude that despite historic forces of change (e.g., commercial whaling and fur trading) and more frequent and faster paced change (e.g., new technology, increased wage employment, local construction), hunting and fishing and gathering remain integral to the socioeconomic and sociocultural systems of Wainwright residents.

Following the ethnographic baseline, Luton and Cortese discuss the impacts of harvest disruptions. They outline several assumptions and eight major impact categories of relevance to subsistence and harvest disruption. The major categories are further subdivided, yielding a total of 171 categories. The major ones are identical to those outlined in SESP Technical Reports Nos. 89 and 90 and include:

- Subsistence
- Technology
- Economic Organization
- Ideas and Sentiments about the Importance of Naturally-occurring Species
- Social Organization
- Religion
- Political-Economic Institutions
- Helping Services

Next, Luton and Cortese summarize five principal factors in the well-being of those Wainwright Inupiat that are most dependent on subsistence resource harvest. It is unclear how these five factors are related to or derived from the impact categories outlined above. The five factors which would be adversely affected by a serious disruption of subsistence resources are:

- Food and nutrition
- Illness prevention
- Efficacy and self-esteem
- Social network: family, friendships and community
- The "Eskimo Way"

The authors go on to discuss previous changes in resource availability and the community response in those times to the harvest disruption. They describe seven disruption factors which would affect the ability of the village to cope with shortages. These factors are:

- Magnitude of disruption

- Size of area disrupted
- Number of species affected
- Season of the year “
- Timely availability of alternative species
- Volume of stored subsistence products
- Length of disruption

Lacking validated time-series data, Luton and Cortese state they cannot present scientific predictions of harvest disruption impacts. They define low, medium and high levels of disruption which are followed by “plausible” consequences to Wainwright of medium and high levels of harvest disruption. (Low level is considered to be the current condition of minor and temporary disruptions.)

The method employed by Luton and Cortese appears to be based upon comparison of their ethnographic data with that of prior field investigations. However, the authors do not clarify the process by which they use these comparisons to make their projections. Also unclear is the role of assumptions, impact categories, well-being factors and shortage factors in the specific process of making projections. No cumulative impact methods are presented. However, some of the parameters of harvest disruption may have relevance to cumulative impact assessment. This report has limited relevance to this project.

Alaska Consultants, Inc. C.S. Courtnage, and Stephen Braund & Associates. 1984. Barrow Arch socioeconomic and sociocultural description. Report for Minerals Management Service, Alaska OCS Region, Anchorage. Technical Report No. 101.

Summary:

This report presents a description of current socioeconomic and sociocultural conditions in the Chukchi Sea communities of the North Slope Borough. Recent changes and trends in the economic and cultural structure and organization of the study communities (Point Hope, Point Lay, Wainwright, Atqasuk and Barrow) are analyzed. Previous fieldwork by Alaska Consultants, Inc. provided extensive economic, demographic and infrastructure background information for each community. Therefore, field research for this 'study focused on the subsistence economy and subsistence land use patterns of each study community and the Chukchi Sea region as a whole.

The report includes the first detailed discussion of the interrelationships between the subsistence and cash economies on the North Slope. Topics considered in this discussion include: recent changes in techniques and timing of subsistence harvest activities, the costs associated with subsistence activities, changes in target species, the sharing of subsistence harvest products and equipment, the availability of subsistence leave time, subsistence harvesting scheduling problems and others. In addition, local use of coastal lands and offshore areas for marine oriented subsistence activities are delineated on land use maps for the major marine species harvested in each community. This analysis of the interactions between the traditional and cash economies, in combination with the other socioeconomic and sociocultural data presented, is necessary for forecasting potential impacts and changes resulting from the Barrow Arch lease sale and subsequent oil and gas development.

This report does not present any cumulative impact assessment methods. However the report does provide some useful insights into the requirements and limits of an impact forecasting methodology. This report has limited relevance to this project.

STUDIES WITH NO DIRECT RELEVANCE

B

Alaska Consultants, Inc. No date. Beaufort Sea region socioeconomic baseline. Report for Bureau of Land Management, Alaska OCS Office. Anchorage. Technical Report No. 11.

Summary:

This report describes and provides baseline conditions on the population, economy, services, history, land use, and governmental structure of the North Slope Borough Communities. While providing useful background information, the report does not attempt to model economic interactions either within the Borough or between the Borough and the state. No method is presented to assess the cumulative impacts of multiple development projects. This report has no direct relevance to this project.

Alaska Consultants, Inc. 1978. Beaufort Sea region - manmade environment. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 19.

Summary:

Technical Report No. 19 evaluates the potential impact of OCS development on the population, economy, and infrastructure of four North Slope communities: Barrow, Wainwright, Nuiqsut and Kaktovik. Projections of population and employment were made for a non-OCS case and for four OCS scenarios (Camden-Canning, Large and Small Prudhoe Bay, and Cape Halkett OCS scenarios). In the non-OCS case, community population and employment forecasts were made, regional and community services likely to be affected were described (i.e., education, public safety, recreation, utilities, housing, and local government revenues), and finally, using infrastructure standards, the potential impact of the non-OCS population projections on these community services were assessed. North Slope Borough capital improvement plans were included in this non-OCS case. Using population and employment projections related to each OCS scenario and infrastructure standards, the potential impacts to human services and infrastructure were next made for each of the four communities for each OCS scenario. In each scenario, population and employment projections were used to project North Slope Borough revenues and expenditures as well as changes in the individual communities' infrastructure. These socioeconomic forecasts relied on baseline data and population forecasts from SESP Technical Reports Nos. 8 and 18. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

Alaska Consultants, Inc. 1979. Northern and Western Gulf of Alaska - local socioeconomic baseline. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 32. 539 pp.

Summary:

Technical Report No. 32 is a baseline document of existing (1978) socio-economic conditions in Yakutat, Cordova, Seward and Kodiak. For each community the present status of the following are described: existing population and economic conditions; land use, land tenure, and housing conditions; community facilities and services (including public safety, health and social services, education, recreation, and utilities); and local government organization. In addition, an analysis of the social characteristics of Yakutat are included. These baseline data are a prerequisite for forecasting future socioeconomic conditions in these communities for both a non-OCS and several OCS cases. They are also useful in order to develop realistic standards with which to project potential impacts of OCS Lease Sale 55. The information in the report included data gathered from numerous interviews with government and industry people in all four study communities. This study does not employ any economic or resource modeling. No cumulative impact methods are presented. This report has no direct relevance to this project.

Alaska Consultants, Inc. 1979. Northern Gulf of Alaska petroleum development scenarios, local socioeconomic impacts. Report for peat, Marwick, Mitchell & CO. and Bureau of Land Management, Alaska OCS office, Anchorage. Technical Report No. 33.

Summary:

Technical Report No. 33 analyzes how the proposed Northern Gulf of Alaska Lease Sale 55 would affect the growth and community infrastructure of Yakutat, Cordova and Seward. Lease Sale 55 is a second generation lease sale; the first Northern Gulf of Alaska lease sale, Number 39, took place in 1977. Because of the highly speculative nature of the search for offshore oil and gas, the scenario method was used to account for the likely range of recoverable reserve estimates. This report considers four different growth cases: a base case, or growth without any further OCS development, and low, medium and high petroleum development cases. Alaska Consultants used the economic base method for forecasting growth in the base case (non-OCS) which served as the basis for population forecasts in this report. Once future employment and population figures were established, future needs for land, housing and community facilities and services were determined using a set of uniform standards and assumptions.

This study utilizes a very simple economic base model to forecast income and employment with and without OCS development. The number of existing employees in the basic and non-basic sectors is determined, to derive a multiplier (1.47). This multiplier is held constant over time. To forecast future employment, population projections are used. The apportionment of employment by sector follows from historic trends. To estimate the impact of OCS development, the number of OCS employees forecast for the mean development scenario is considered additions to the basic sector. This number times the multiplier is used to yield the employment forecast. No cumulative impact assessment methods were developed. This report has no direct relevance to this project.

Bennett, M.E., S.O. Heasley, and S. Huey. 1979. Northern Gulf of Alaska petroleum development scenarios, sociocultural impacts. Report for Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 36. 297 pp.

Summary:

Technical Report No. 36, prepared by Bennett et al. , provides baseline information and forecasts future changes in the sociocultural systems of the communities of Cordova-Eyak and Seward. Data was collected through literature reviews, as well as observation of and informal interviews with community residents. The forecasting of future sociocultural conditions relied on the scenario method. Four forecasts were made: a base case, or a projection of future conditions without further OCS development, and three OCS development cases: low, mean, and high. The methodology used was defined as "active-interactive" and included the consideration of fifteen sociocultural impact categories. These categories, as stated by the authors, are all "concerned with the response capacity of . ..social systems to the demands of rapid energy development" and provide a theoretical framework for systematic analysis (Bennett et al. 1979:5). In both communities, baseline data on social structure, social conflict and social change were reviewed prior to making projections. The authors stressed the recent past because local actions and responses to OCS Lease Sale 39 were considered good indicators of future trends. For each forecast (non-OCS and three OCS scenarios), the population, structure of employment and the particular sociocultural impact categories considered most critical were discussed and analyzed. No methods for the analysis of cumulative impacts were presented. Therefore this report has no direct relevance to this project. However, several of the sociocultural impact categories discussed (i.e. community mental health and unemployment levels) have relevance as potential cumulative impact indicators for the North Slope Borough.

Payne, J. 1980. Western Gulf of Alaska petroleum development scenarios - Kodiak non-native sociocultural impacts. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage, AK. Technical Report No. 39. 216 pp.

Summary:

Technical Report No. 39, prepared by Payne, presents projections of both non-OCS impacts and petroleum development related impacts to the sociocultural system of the non-Native community of Kodiak City, Alaska. The document is divided into three sections. First, a baseline description of present socio-cultural conditions in Kodiak is presented. Second, a base case forecast projects the evolution of the sociocultural system from the present to the year 2000. The third and final section uses this base case analysis as the foundation for forecasting petroleum development impacts for three different scenarios: low, mean, and high.

Methods used were primarily qualitative; informal discussions with local residents were the most effective data gathering method. Potential and probable sociocultural impacts were organized into impact categories. These sociocultural impact categories were modified from related studies (Worl Associates, 1978) to fit the particulars of Kodiak, which were identified during the fieldwork. The categories used were: maritime adaptation, cultural values and personality characteristics, political and government organizations, social health, family relations, and town environment. Because the non-Native culture of Kodiak precludes a subsistence socioeconomic system, the usefulness of Worl's report for the present study was limited. No cumulative impact assessment methods are presented. Therefore this study has no direct relevance to this project.

Alaska Consultants, Inc. 1979. Western Gulf of Alaska petroleum development scenarios, local socioeconomic impacts. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 40.

Summary:

Technical Report No. 40 uses the scenario method to construct and compare four different growth cases for the communities of Seward and Kodiak. Specifically, a non-OCS forecast and three distinct petroleum development forecasts (high, medium and low) are used to evaluate how socioeconomic conditions in these two communities could be affected by the then proposed Western Gulf of

Alaska Lease Sale Number 46. The current (1978) baseline of economic, social and community conditions in Seward and Kodiak are presented in Technical Report No. 32.

Using the economic base method described in Technical Report No. 33, and employment and population multiples, future employment and population levels were determined first for the base case and then for each of the three petroleum development scenarios. The impact of OCS developments is based on the forecast of employment for the statistical mean resource development scenario for OCS Lease Sale 46. The OCS employment is differentiated by major operational category. A multiplier of 1.1 to 1.5 was used depending on the category. Population impacts are based on a dependency ratio of 2.0 persons for OCS employees of all categories. The required community services and facilities are scaled up based on population forecasts from existing service levels. The implied revenues and local government employment thus derived are apparently not reconciled with the non-basic employment and revenue impacts derived using the multiplier. Thus the possible local fiscal impacts are not captured.

The future population figures described in each scenario were then combined with a set of uniform standards and assumptions to forecast future land, housing, and public facility needs. It should be noted, that because future employment and population figures were computed using multipliers or ratios that are assumed to be constant, this methodology does not allow for changes in local tax or expenditure decision. Furthermore, because future needs assessment was beyond the scope of this project, long-term capital projects were necessarily omitted. Finally, sociocultural impacts of the forecasted growth patterns are not addressed. No cumulative impact assessment methods are presented. This study has no direct relevance to this project.

Cultural Dynamics, Ltd. 1979. Western Gulf of Alaska petroleum development scenarios, Kodiak native sociocultural impacts. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, OCS Office, Anchorage. Technical Report No. 41.

Summary:

Technical Report No. 41, prepared prior to OCS Lease Sale 46, projects possible sociocultural systems changes for native Kodiak populations likely to occur as a result of OCS development. A combination of library research and "discussion/interviews" were the primary methods of data collection. The report first analyzed present sociocultural systems and compared these systems to the poorly documented past to ascertain possible trends of future variations. The document also provides projections of possible sociocultural impacts in a base case (non-OCS) and low, mean, and high petroleum development cases. While many individual factors within the Kodiak native sociocultural system are reviewed, the author notes the impossibility of assessing the potential impact of oil development on the complete spectrum of human events. Instead, the author chose to focus the analysis of future response to development on only a select number of "theoretical positions". These theoretical positions, though used as guides for the research conducted, are not considered individually in the base analysis or the OCS forecasts. Data in the non-OCS and OCS development projections are summarized by community; and not all of the building blocks of the sociocultural system (e.g., subsistence economy or social health) are addressed for each community. No cumulative impact assessment methods are presented. Therefore this study has no direct relevance to this project.

Alaska Consultants, Inc. 1980. Cook Inlet petroleum development scenarios, local socioeconomic systems analysis. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 46. 2 vols.

Summary:

This document, prepared prior to the second generation Lower Cook Inlet Lease Sale 60, describes and analyzes the economic structure of the Kenai Peninsula Borough and the communities of Kenai, Soldotna and Homer. Volume I provides baseline 'information on present land use patterns, land tenure, housing conditions, utilities, community facilities and local government for the Borough as a whole and for each study community individually. The study concentrates on these three communities because they are the likely support centers for any oil and gas development resulting from Lease Sale 60.

Volume II presents a base case of economic and community changes expected to occur by the year 2000 without further OCS lease sales, as well as the likely changes associated with three Lease Sale 60 petroleum development scenarios: low (exploration only), medium and high. Included in this base case analysis are the economic and community changes expected to occur as a result of the construction of the North Kenai LNG facility and a medium level of development resulting from the 1977 first generation OCS Lease Sale CI. Future employment and population levels for the base case and each development scenario were forecasted using the economic base method. This method, which stresses export activity as the determining factor for economic growth, divides the local economy into two categories: basic industries which bring money into the community by exporting locally produced goods and the non-exporting service industries. Using employment and population multipliers, Alaska Consultants calculated employment and population forecasts for each study community from the regional level basic employment figures prepared by Dames & Moore.

Finally, using a set of uniform standards and assumptions, the future needs for land, housing and community facilities, and services were forecasted for each community and each development scenario. Alaska Consultants did not address either sociocultural impacts in the three study communities or socio-economic or sociocultural impacts for any of the smaller communities potentially affected by this lease sale.

This study is interesting from a cumulative impacts methodology perspective in that it attempts to sort out the effects of OCS Lease Sale 60 from the previous OCS Sale CI and the assumed development of LNG export facilities at North Kenai. A "base case" population forecast is "...derived by adding the non-OCS population estimate in a given year to the Sale CI offshore OCS-related, Sale CI onshore OCS-related and LNG facility related populations in the same year." Employment forecasts are developed in an analogous fashion.

It is interesting to note that the employment multipliers and the dependency ratios are assumed to be unrelated to the cumulative level of development. This assumption effectively assumes away the cumulative effects of the multiple development on the structure of the economy and the public service requirements. No cumulative impact assessment methods are presented. Therefore this report has no direct relevance to this project.

Braund, S.R. and S.R. Behnke. 1980. Lower Cook Inlet petroleum development Scenarios sociocultural systems analysis. Stephen R. Braund & Associates, Anchorage, AK. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 47. 428 pp.

Summary:

This report, prepared prior to Lower Cook Inlet Lease Sale 60, presents a baseline sociocultural description of selected Cook Inlet communities and then projects future sociocultural conditions in those communities with and without OCS oil and gas activities. Communities considered in this report include: Kenai, Soldotna, Homer, and the small coastal fishing communities of Tyonek, English Bay, Port Graham, Ninilchik, and Seldovia. Data for this study were derived from previously published documents and fieldwork (informal interviews). Not all aspects of the sociocultural systems of the Cook Inlet communities are considered, rather only those issues deemed relevant to OCS development.

Braund and Behnke identified three major components of a sociocultural system: techno-economic base, social organization, and ideology. From these major components, five specific impact categories particularly relevant to OCS activities were identified. In addition, the researchers "added cultural values as central to and underlying all impact categories" (Braund and Behnke, 1980). It was determined that because values are generally slow to change, they could be used as subjective standards by which to measure cultural change. The five sociocultural impact categories identified were: economic

adaptations, land and environment, small town relationships, politics and response capacity, and social health.

The following method was used to project future sociocultural system conditions. First, using base case projections of population, employment, land tenure and other independent variables provided by other subcontractors, projections of future sociocultural conditions without OCS development were made. Second, "by tracing the effects of these hypothetical locational and socioeconomic impacts through the key sociocultural categories" (Braund and Behnke, 1980:31), the sociocultural changes caused by each different OCS case were projected. Finally, by analyzing the difference between the base case forecast and each of the OCS scenarios, the future impacts of OCS development on the sociocultural system were projected. A noteworthy consequence of projecting change by the scenario method is the fact that the sociocultural projections depend on the accuracy of the previously prepared socioeconomic and environmental projections, especially population and employment. No cumulative impact methods were presented. Therefore this study has no direct relevance to this project.

Policy Analysts, Ltd. 1980. Bering-Norton petroleum development scenarios: local socioeconomic systems analysis. Report for Peat, Marwick, Mitchell & CO. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 53.

Summary:

Technical Report No. 53 presents a profile of existing socioeconomic conditions in the communities of Nome and Kotzebue and also forecasts future impacts to the community services and infrastructure of Nome with and without projected oil and gas development. The baseline sections of the report offer historical overviews, summaries of past and present population and employment statistics, and a description of government and community services for both Nome and Kotzebue. These baseline data are a necessary prerequisite for forecasting future socioeconomic growth.

Without accurate data concerning the nature and extent of OCS development, the scenario method was used to provide a basic understanding of what socio-economic parameters in Nome are likely to be impacted by oil development. In addition to a non-OCS forecast (changes likely to occur without oil development) high find, mean find, low find and exploration only scenarios were considered. The forecast of Nome's future population, which forms the basis for each of the oil development scenarios, is based on three assumptions: Nome's racial distribution will remain approximately the same; the labor force participation rate will go as high as 39 percent before stabilizing at 32 percent; and the population is assumed to grow in relation to the economic activity and the consequent employment base generated. Once future employment and population figures were determined for the base case and each scenario, future needs for land, housing and community facilities and services were determined using a set of uniform standards and assumptions.

This study utilizes a simplified economic base type model similar to the Alaska Consultants model described earlier. The method used is a heuristic application of the multiplier and labor force participation rate concepts within the specific context of OCS development in Norton Sound. The authors use their judgment as well as limited historical data to select multipliers for onshore employment (1.4 for permanent workers, 1.1 for transients). Population impacts are estimated by labor force participation factor (3.5 for native in-migrants, 2.0 for non-native in-migrants). The increase in the labor force is estimated by assuming that all new OCS labor results in in-migration and that 15 percent of the secondary (non-basic) jobs are filled from the unemployed local labor force.

The public services and facility requirement impacts of OCS development are estimated based on a combination of national standards and existing levels of services. No effort is made to directly relate the projected employment impacts to the employment levels implied by those service requirements. Specific fiscal impact analysis is presented based on the projected costs of public services and likely governmental revenue assumptions. The authors do not present any cumulative impact assessment methods. Therefore this report has no direct relevance to this project.

Ellanna, L.J. 1980. Bering-Norton petroleum development scenarios - socio-cultural systems analysis. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 54. 2 vols.

Summary:

Technical Report No. 54 presents a qualitative analysis of the sociocultural systems of the Bering-Norton region. The study area was divided into three sub-regions: Bering Strait, Norton Sound, and Yukon Delta, and the report includes a historical discussion of the different populations and socio-cultural systems represented by these sub-regions. The baseline portion of the report also describes how the relevant sociocultural systems are functioning today and identifies trends which could influence these systems in the future. Participant observation, informal interviews and the review of previous published and unpublished data sources were the primary methods of data collection. The final chapter of Volume I discusses the contemporary sociocultural systems of the region and divides these systems into six necessarily overlapping impact categories which are then used as the foundation for the forecasting of future conditions in the area.

Volume II begins with a. projection of future sociocultural system changes expected to occur without OCS development between 1980 and the year 2000. This non-OCS or base case forecast is then used to assess the differences among three different petroleum development scenarios (low, mean, and high) so that the varying effects of different levels of OCS development could be measured. The population, employment and economy forecasts provided by other subcontractors were summarized for each forecast (base case and three oil development cases). This data was then synthesized with the impact categories described in Volume I to project future sociocultural change. The author notes that impact projections will differ depending on the value system used and emphasizes the importance of considering local values, because they are most likely affected by the proposed action. No cumulative impact assessment methods were described. Therefore, this report has no direct relevance to this project.

Alaska Consultants, Inc. 1981. St. George Basin petroleum development scenarios, local socioeconomic systems analysis. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 59.

<u>Summary</u>:

Technical Report No. 59 is divided into two major sections: community baseline information and community forecasts. First, baseline Information including population and economy, existing land use, housing and community facilities and services are presented for Unalaska, Cold Bay, and St. Paul. Economic overviews, rather than detailed sector analyses, are provided for the villages of Cold Bay and St. Paul. A sector analysis of fishing and fish processing is presented for Unalaska.

The second section of this report forecasts future socioeconomic growth without any OCS development for all three communities, and a low (exploration only) and a mean petroleum development scenario are also considered for Unalaska. No OCS development forecasts are presented for either Cold Bay or St. Paul. Alaska Consultants used the economic base method to forecast future economic and population levels. The factual data presented are generally current as of August 1980. No cumulative impact assessment methods were presented. This study has no direct relevance to this project.

Nebesky, W. and L. Huskey. 1981. Statewide and regional economic and demographic systems, Beaufort Sea (71) impact analysis. Institute of Social and Economic Research, University of Alaska, Anchorage, AK. Report for Bureau of Land Management, Alaska OCS Office. Technical Report (Memorandum) No. 62.

<u>Summary</u>:

Utilizing the MAP model, this study forecasts employment, population and income with and without high, medium and low find scenarios for development of OCS resources of Lease Sale 71 in the Beaufort Sea. The impacts are analyzed for the state as a whole and are also disaggregate into regions.

North Slope Borough (NSB) regional impacts are fairly small because the OCS employment is assumed to occur in enclaves which do not induce local non-basic employment. The income earned in the basic sector is assumed to be spent elsewhere in Alaska. The impact on the NSB is through increased borough revenues and the consequent impact on NSB employment.

Insofar as MAP is basically a statewide model, the base case forecasts from which regional impacts are measured must reflect all anticipated major development projects including other non-Sale 71 OCS development, major hydroelectric and pipeline projects, etc. Assessing the NSB impact requires the model to disaggregate the region's share of the statewide impacts. These regional data assumptions are incompletely specified in the report. Although this report features analysis of the aggregated economic and demographic effects of a series of major developments, it does not treat the range of cumulative social, economic and cultural impacts likely to be experienced as a result of these projects. Particularly lacking is any analysis of changes in the subsistence economy. This report has no direct relevance to this project.

Worl, R., R. Worl, and T. Lonner. 1981. Beaufort Sea - sociocultural systems update analysis. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 64. 238 pp.

Summary:

Technical Report No. 64 was prepared as an update to previously collected sociocultural systems data for the communities of Barrow and Nuiqsut. It also attempted to "establish an understanding of the cumulative impacts and changes on the inhabitants due to the presence of non-traditional authority and economic development." No scenarios were discussed; rather, this report attempted to project trends in the sociocultural systems of these two communities without OCS development from Sale 71 (i.e., a base case analysis). The researchers noted that "events and changes in the political sphere and institutional development have heeln significantly more evident and extensive than in the social and cultural realm" (Worl et al., 1981), and an analysis of these segments of the sociocultural system comprised the most substantial portion of this report. Social organization and cultural systems were also discussed. Because of previous studies in this region, this report concentrated on the period from 1978 to 1981. The researchers' confidence in the previous research aided in assessing the impacts of economic development on local inhabitants over time. The sociocultural impact categories considered most susceptible to change were: economic systems, social systems, political institutional systems, cultural systems, and interethnic relationships. A set of assumptions concerning each of these different impact categories demonstrated the interactive nature of the cultural system and aided the researchers in projecting future change. Although this report attempts to assess the cumulative impacts of development, no organized method or definition of such impacts is given. Therefore, this report has no direct relevance to this project.

Payne, J.T. and S.R. Braund. 1983. North Aleutian Shelf Basin sociocultural system analysis. Minerals Management Service, Alaska OCS Office. Technical Report No. 67

Summarv:

Technical Report No. 67 presents a baseline description of the sociocultural systems of the Bristol Bay region in 1980. The large study area included all thirty communities within the boundaries of the Bristol Bay Native Corporation. The researchers divided this vast area into seven sub-regions; field research and descriptive community profiles were only completed for selected communities considered particularly important or representative of the different subregions. The report is loosely organized around five sociocultural impact categories: economic systems (subsistence and cash economies), political systems, social health, social organizations, and land and environment. Specifically, economic systems and local social organizations are discussed in the subregion community profiles. The other impact categories (social health, political systems, and land and environment) are discussed under separate chapters at a regional level, with references to specific communities where appropriate. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

Alaska Consultants, Inc. 1982. Western Alaska - local socioeconomic systems analysis. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 69.

<u>Summary</u>:

This document, prepared by Alaska Consultants, Inc., provides baseline data and non-OCS forecasts for the communities of Bethel and Dillingham. Present (1980) baseline information concerning population, economy, land use, land status, housing, constraints on urban development, and community facilities and services are inventoried for each community. This baseline information is a necessary prerequisite for forecasting future socioeconomic growth in Bethel and Dillingham.

The second section of this report forecasts how the growth and community infrastructure of Bethel and Dillingham are expected to evolve over the next twenty years. These forecasts are done under the assumption that no OCS development will occur. Techniques of economic base analysis and employment and population multipliers were used to forecast future employment and population figures for both communities. A set of uniform standards and assumptions were established so that future public service and facility requirements could be projected, and population related community impacts identified. Neither sociocultural baseline information nor forecasts were made. No cumulative impact assessment methods were presented in this study. This report has no direct relevance to this project.

Fienup-Riordan, A. 1982. Navarin Basin sociocultural systems analysis. Report for Bureau of Land Management, Alaska OCS Office. Final Technical Report No. 70. 576 pp.

Summary:

The Navarin Basin Sociocultural Systems Baseline, prepared by Fienup-Riordan, provides a descriptive analysis of human activities potentially affected by OCS development in the Yukon/Kuskokwim delta. The study area includes all the coastal communities between Scammon Bay and Quinhagak, the community of Mekoryuk, all the Kuskokwim River villages as far upriver as Akiak, the tundra villages of Nunapitchuk, Atmautluak and Kasigluk, and in addition, the regional center Bethel. Literature reviews and informal field research were the primary methods of data collection. The report described in detail the pre-contact history, the period of historical contact, and the sociocultural systems prevalent in the villages today. The author stated that this historical analysis is necessary to accurately project future changes in the sociocultural system because, "any predictions as to the potential effects of OCS development on the study area must be well grounded in a fair assessment of past responses of the sociocultural system to situations of impact" (Fienup-Riordan, 1982:180).

The second section of the report provided an analysis of the sociocultural systems of the region. Fienup-Riordan divided the sociocultural systems analysis into four categories: social systems, cultural systems, political systems, and economic systems. The report stated that these categories are inextricably related, and that the interaction over time and at a given time of these sociocultural elements characterize the system. In other words, according to the author, no single element, or group of elements, within the sociocultural system is considered determinant. The report concludes with a discussion of potential impacts of OCS development. This analysis emphasized the use of historical trends and ideological structure to forecast future change. No cumulative impact methods are presented. This report has no direct relevance to this project.

Earl R. Combs, Inc. 1982. Alaska peninsula socioeconomic and sociocultural systems analysis. Alaska OCS socioeconomic studies program. Alaska OCS Office. Prepared for Bureau of Land Management. Technical Report No. 71.

Summary:

Technical Report No. 71 presents a socioeconomic and sociocultural systems analysis of six Alaska Peninsula communities. The six communities, Pilot Point/Ugashik, Port Heiden, Nelson Lagoon, False Pass, King Cove and Sand Point are all highly dependent on seafood production, particularly the harvesting and processing of salmon. This document demonstrates the significance of seafood production to both the socioeconomic and sociocultural structures in these communities. The first section of the report presents an overview of salmon harvesting activities in the region (including locations, gear types, catch, and permits) and then considers catch per unit effort for different gear types for more local districts and statistical areas. The second section of the report contains community specific data. Participation in fishing and fish processing, subsistence and other socioeconomic data are presented, followed by a review of social organization, political organization and cultural values. This method acknowledges that the local economic system has the potential to be critically affected by OCS development and that in rural communities, such as the study villages, there are no clear distinctions between socioeconomic and sociocultural systems. The report concludes with an analysis 'of community linkages, interrelationships and overall trends. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

Wolfe, R.J. 1981. Norton Sound/Yukon Delta sociocultural systems baseline analysis. University of Southern California. Report for Subsistence Div., Alaska Dept. of Fish and Game, and Bureau of Land Management, Alaska OCS Office. Technical Report No. 72. 270 pp.

Summary:

Technical Report No. 72, prepared by Robert Wolfe, presents baseline information on the economy and culture of six villages in the lower Yukon River area. The study communities are: Alakanuk, Emmonak, Kotlik, Mountain Village, Sheldon Point, and Stebbins. Primarily through participant observation and in-depth systematic conversations with residents, Wolfe gathered data on a variety of sociocultural and socioeconomic topics. Primary topics of discussion included: the regional economy, subsistence and commercial harvests of fish and game, kinship systems, salmon fishing, sharing and exchange of food resources, cultural concepts of resource utilization, and finally, the identification of prospective oil development issues. The author notes at the outset that the in-depth systematic interviews, which form the primary data source for this report, were not randomly selected, rather, a 20 percent sample of households known to be more knowledgeable and/or more successful , were chosen. The author defends this bias citing that limited field time prevented a 100 percent household survey and, in order to "document the breadth or extent of land and resource use in the region" (Wolfe, 1981), this bias was necessary. Despite the problem that this quantitative data cannot be used to represent mean household use patterns and harvest levels for entire communities, this report provides a clear baseline description of the study communities. Finally, the analysis of the interdependent and mutually supportive nature of the cash and subsistence sectors of the local economy is the best to date. The author does not present any cumulative impact assessment methods. Therefore, this report has no direct relevance to this project.

Cultural Dynamics, Ltd. 1983. Chukchi Sea sociocultural systems baseline analysis. Report for Minerals Management Service, Alaska OCS Region, Anchorage. Technical Report No. 74

<u>Summary</u>:

Technical Report No. 74 is a sociocultural systems baseline analysis of the eleven villages in the NANA region. The communities considered are: Deering, Buckland, Shungnak, Kobuk, Ambler, Kiana, Selawick, Noatak, Kivalina, and the regional center, Kotzebue. The primary methods used to collect data were literature reviews and field research (primarily informal interviews). Important topics covered included social organization, services and facilities, political organization and economic organization. By documenting recent trends in these important sociocultural categories, important background information is provided for the study of local response to potential oil and gas development. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

Petterson, J.S., L.A. Palinkas and B.M. Harris. 1982. North Aleutian Shelf non-OCS forecast analysis. Impact Assessment, Inc., Anchorage, AK. Report for Minerals Management Service, Alaska OCS Office, Technical Report No. 75, 242 pp.

Summary:

Based primarily on field interviews and secondarily on published ethnographic data, the authors present a baseline sociocultural description of the North Aleutian Shelf area and then forecast future sociocultural conditions without OCS-related activity. The baseline and non-OCS forecast descriptions are set forth at the regional, subregional (village cluster) and individual community levels. Communities discussed include Sand Point, King Cove, Nelson Lagoon, False Pass, Chignik Bay, Chignik Lake, Ivanof Bay, Port Heiden, and Pilot Point/Ugashik.

Petterson et al. set forth a systems model of change as their framework for forecast analysis. The three components of a social system are input, structure, and output. The model describes the interaction between a structure (i.e., patterned behavior in the region or community) and its environment, or input (independent variables both internal and external to the structure). The structure is comprised of a series of social relationships and rules organizing those relationships. The subsystems of the structure correlate to the impact categories of other sociocultural studies (i.e., economic, social, political, religious, educational, health care, and recreational) and are described as patterns of behavior organized around specific tasks.

Change is characterized by the researchers as the response of the social system to input from the environment. The extent to which this response (output) alters the structure of the social system can result in adaptive or radical change. If the structure is not capable of responding to an environmental input, it either must adjust its pattern of behavior to cope with the new circumstance, without changing its values (adaptive change); or it will require such a major modification of behavior that values, too, must be revised, resulting in radical change. Feedback, an extension of output, is the effect that alterations in behavior may have on structure or environment. As presented, the systems model does not define the operative variables of change. Rather, the model assumes that two elements may be simultaneously cause and effect, and the researchers, depending on the research problem, define the operant variables.

Baseline data provides a profile of the community structure, its sub-systems, interrelationships and rules (both normative and pragmatic) as it has functioned in the past and as it currently functions. Through an identification and analysis of baseline trends and past responses to change, the researchers make assumptions to use in forecasts. An analysis of community responses to known or assumed environmental factors forms the basis from which social change is projected. Hence, by assuming changes in the environment (input) of the community over the forecast period, Petterson et al. extrapolate changes that the community will undergo based upon its capacity to respond to the introduced environmental pressures or supports.

Each region, subregion and community is analyzed using the following framework:

I. Input

   A. Ecological
   B. Extrasocietal
      1. External Government
      2. Commerce
   C. Intrasocietal
      1. Demography
      2. Community Facilities

II. Structure

   A. Values
   B. Organization
      1. Economic Organization

a. Commercial
b. Subsistence
2. Social Networks
3. Political Organization
a. Local Activities
b. Social Control
c. External Relations
4. Religious Organization
5. Educational Organization
6. Health Care Organization
7. Recreational Organization

III. output

A. Economic
B. Social
C. Employment Patterns
D. Political
E. Religion
F. Education
G. Health Care

The authors do not present any cumulative impact assessment methods, This report has no direct relevance to this project.

Little, R.L. and L.A. Robbins. 1983. Draft final effects of renewable resource harvest disruptions on socioeconomic and sociocultural systems: Gambell, Alaska. John Muir Institute. Report for Minerals Management Service, Alaska OCS Office. Draft Final Report No. 89.

Summary:

This report is one of three village studies (the other two being Unalakleet and Wainwright) designed to assess the potential economic, social and cultural effects of disruption to village subsistence harvest and use of local renewable resources caused by environmental disruptions related to future offshore oil and gas development activities. Based on six and one-half months of fieldwork and literature reviews, the researchers collected and analyzed baseline ethnographic information on the sociocultural and socioeconomic systems of Gambell. The researchers gathered field data through the use of anthropological observations of daily activities and protocol observations

(focused responses to sets of topics resembling open-ended interviews). The ethnographic baseline describes the social, economic, and cultural systems in Gambell with particular emphasis on their linkages to the harvest of renewable resources. The authors conclude that despite fast-paced technological and economic change in the community, subsistence activities remain integral to the socioeconomic and sociocultural systems of Gambell.

Following the collection of an ethnographic baseline, Little and Robbins make several assumptions about future conditions pertaining to Gambell, after which they set forth a list of eight major impact categories related to subsistence and assumed to be impacted by harvest disruptions (Little & Robbins, 1983:308). The eight major categories are identical to those listed in SESP Technical Reports Nos. 90 and 91 and include:

- Subsistence
- Technology
- Economic Organization
- Ideas and Sentiments Regarding the Importance of Naturally Occurring Species
- Social Organization
- Religion
- Political-Economic Institutions
- Helping Services

They further divide these eight impact categories into 188 subcategories.

In the final chapter of the study, Little and Robbins follow the same format as Jorgensen (1984) in presenting their analysis. First, they discuss sources and types of harvest disruptions and define the conditions constituting low, medium and high levels of disruption for Gambell. They next discuss impacts or large-scale energy developments on Western American Indians because those impacts "provide examples and insights into the likely consequences energy developments hold for Eskimo groups" (Little & Robbins, 1983:334). As a result of the discussion of impacts on Western American Indians, North Slope Inupiats and Gambell Eskimos, "the basis will be formed for a comparative framework from which concluding postulates about consequences of harvest disruptions can be drawn" (Little & Robbins, 1983:343-4). Their analysis of the impacts of harvest disruption is presented in the final pages of the report.

Similar to SESp Technical Report No. 90 (Jorgenson, 1984), the methodology employed in this study appears to be grounded in comparison. An ethnography of Gambell is presented along with an analysis of subsistence resources and levels of disruptions. The similarities and differences between Gambell natives and Western American Indians are discussed; and then consequences of harvest disruption are presented for Gambell, apparently based on the similarities they share with Western American Indians and the documented impacts on the latter group of rapid, large-scale industrial developments. The report does not make clear the process by which the authors use the assumptions and impact categories to make their projections about the impacts of harvest disruption. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

John Muir Institute, Inc. 1983. The regional socioeconomic of Norton Sound. Draft for Minerals Management Service, Alaska OCS Region Leasing and Environment Office. Draft final report.

Summary:

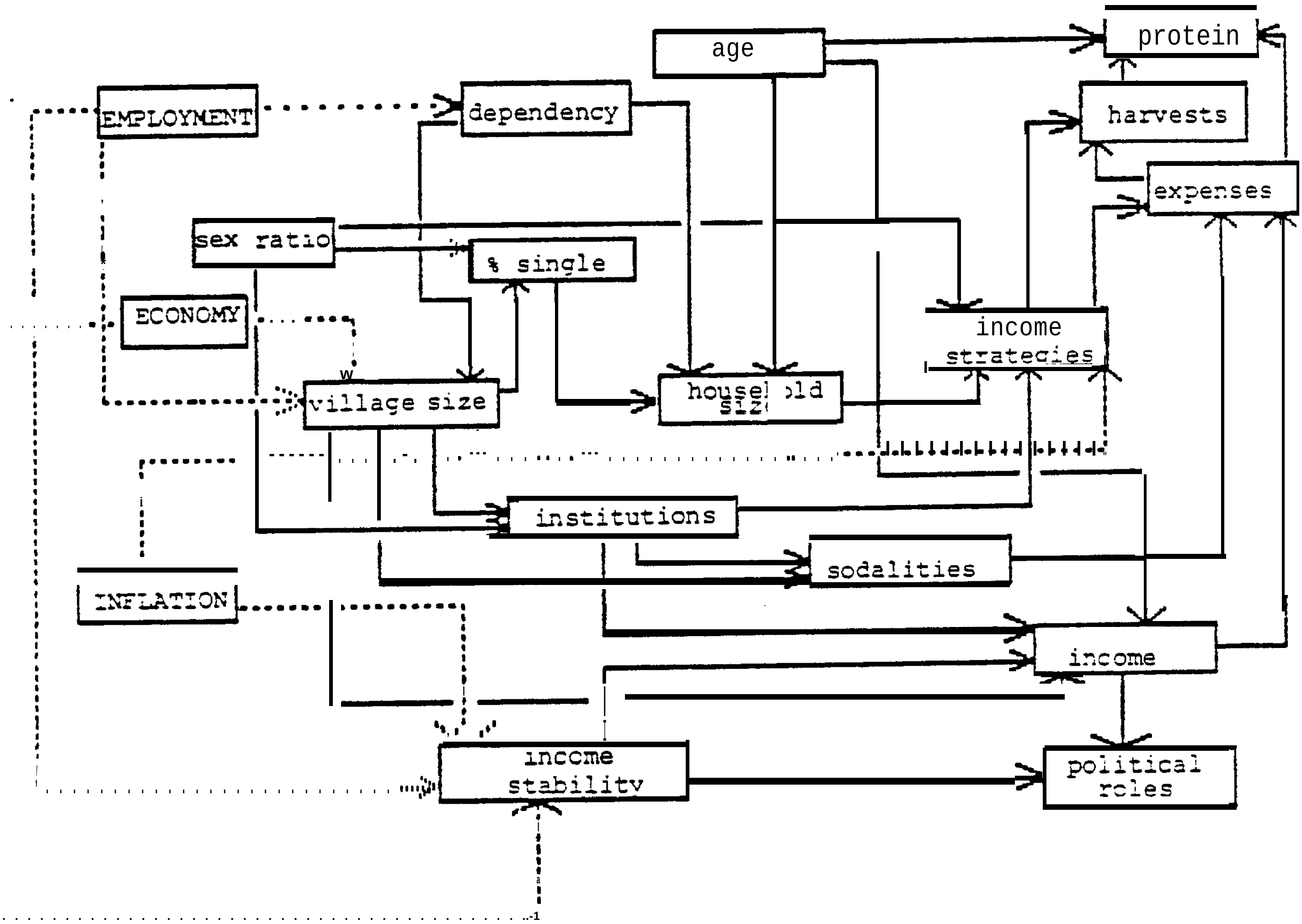
This study presents current socioeconomic conditions and trends of change in the local economic processes of the Norton Sound region. The analysis is descriptive and comparative in nature. Through in-depth study of Emmonak, Golovin, Nome, Savoonga and Unalakleet, historical and contemporary social, economic, and cultural linkages are considered. The method of analysis used in this report purportedly accommodates differential effects of OCS oil development on the different communities or community clusters within the larger region. The ultimate goal of the research and analysis is to determine the consequences of OCS-derived employment opportunities, economic activity, and inflation on the socioeconomic systems of the region.

The researchers focused their analysis by studying empirical or specific topologies within the general socioeconomic system; in this way, patterns or clusters of structural features within the socioeconomic process were discerned and subsequently used in the forecast. Data on the following research categories were collected: demography, economy (traditional and cash), social structure, attitudes and values, infrastructure, and access-exposure. Methods of data collection included interviews with key institutional informants, both primary and secondary aggregate data, and interviews with domestic-family networks. Primary data was collected at the institutional level as well as the domestic-family level. In order to compensate for different field researchers and to standardize the data collected, field protocols were employed.

The institutional protocol includes a matrix of institutional cooperation and coordination, as well as modified applications of the following organizational indices: Hemphill's Index of Group Dimensions, an institution size index; the Hage and Aiken Formalization Inventory; Pugh Index of Centralization; and finally, a simple community solidarity index. Sampling techniques for the domestic networks are equally detailed and include the following grids: income grid, production-distribution-consumption grid, family-residence-composition grid, institutional grid, facilities grid, and a job history and employment attitude grid. In addition, a series of attitude indices and scales are used including the Brayfield-Rothe Index of Job Satisfaction, modifications of the Bogardus Social Distance Scale, Fesslers Community Solidarity Index, and Kahl's Achievement Orientation Index.

Once these data were collected, the researchers compared and contrasted key socioeconomic and sociocultural subsystems and identified key factors influencing the region's engagement in OCS development. Finally, after careful scrutiny in a series of "univariate", "multivariate" and "multidimensional" analyses, a set of generalizations were established to be used in the forecasting model. A path model was formulated that synthesized the many variables, patterns, and relationships of the socioeconomic system in a single structure. The path model shown in Figure 26 is keyed to the effects of the independent variables of increased economic activity, employment opportunity, and inflation. The researchers identified what they considered to be the critical subsystems and how these subsystems were connected in order to analyze the response of these subsystems to changes in the initial key variables.

Norton Sound Path Model



Source: John Muir Institute. 1983. The Regional Socioeconomic of Norton Sound.

FIGURE 26

There are several weaknesses in this path model. First, while the authors identify the possibility of the subsystems influencing the three primary independent variables (feedback), no pathways for this type of influence are considered. Second, besides the three primary independent variables, there are other independent variables within the path model. These variables, considered important influences in the model, are presented without consideration of the processes that affect them. Finally, while the model denotes causality, the data collected on the different subsystems vary so much in type and quantity that in most cases, it is impossible to measure the significance or extent of the relationships between the different subsystems presented. No cumulative impact methods are presented. This report has no direct relevance to this project.

Wolfe, R.J. et al. 1983. Subsistence-based economies in coastal communities of southwest Alaska. Prepared for subsistence Div. Alaska Dept. of Fish and Game, and Social and Economic Studies Program, Alaska OCS Region Leasing and Environment Office, Minerals Management Serivce, Alaska Outer Continental Shelf Region Leasing and Environment Office. Draft Final Report.

Summary:

This study is a descriptive analysis of the role of cash in the subsistence-based economies of four southwestern Alaskan communities. The report presents a baseline description of the hunting, fishing, gathering, and remunerative employment activities presently (1983) occurring in each village. The study attempts to demonstrate the extent to which traditional sociocultural systems have been affected by the market system and its underlying social and political organizations. The four communities, Goodnews Bay, New Stuyahok, Quinhagak and Togiak, were chosen as representative examples of subsistence-based economic systems that demonstrated variable levels of involvement in commercial and wage activities. The analysis of this baseline information is focused in three tiers: extended family, community-region, and the nation-state institutional levels.

The methodological approach was ethnographic. For each community, a field-based researcher gathered data through participant observation and systematic interviews with key knowledgeable residents on a variety of comparative variables. In addition, in each community, households were chosen for in-depth analysis based on participation in the cash economy. Case households were chosen in each of five categories: commodity production at low income levels, commodity production at high income levels, wage employment, wage employment and commodity production, and finally, minimal cash involvement. Secondary published materials for the different communities and the region were also used.

This report does not present, a methodology for forecasting future socio-economic and sociocultural change; however, the authors do provide a general theoretical orientation and corresponding theory of culture change that serve to define the research design and research questions considered. The theoretics? orientation is based on the concepts of "cultural ecology" (Steward, 1955; Sahlins and Service, 1960) and "historical materialism" (Friedman, 1974; Godlier, 1974) and involves a set of theoretical constructs or systems shown in Figure 27. The primary construct is the sociocultural system which is divided into secondary subsystems: forces of production (technology, land, animals and division of labor), social organization of production and distribution, political organization, and ideological belief systems. The authors do not place a causal order on these subsystems; instead they state that the relationships between these categories can only be established empirically.

A major research goal of this report is to develop an understanding of the relation of market involvement and subsistence within the study communities. Consequently, modes of production (as defined by the school of historical materialists) are discussed, most importantly the domestic mode of production and the industrial-capital mode of production. The authors maintain that changes in the organizational forms of subsistence-based economies are responses to external forces in the industrial-capital society. To test this hypothesis, the researchers question whether "changes in subsistence-based economies [can] be understood as resulting from a shift from traditional

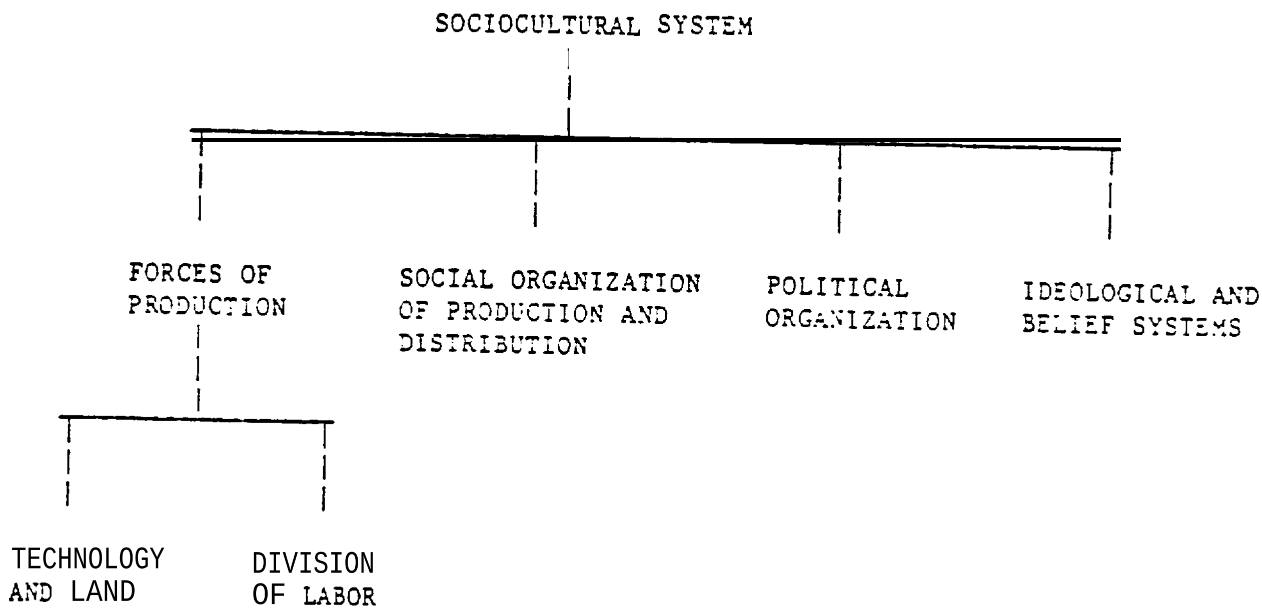


Figure 2-1: Ordering of major theoretical constructs (after Friedman 1972).

Source: Wolfe, et al. 1933. Subsistence-based economics in coastal communities of southwest Alaska.

domestic mode relations to exogenous industrial-capital mode relations?" (Wolfe et al., 1983). This research question is then tested by the use of an extensive list of empirical questions concerning both external (nation-state) and internal (local) mechanisms which could cause or prevent such a transition. The authors conclude that the answers to these theoretical questions support the existence of a viable, mixed, subsistence-based socioeconomic system that is only involved in the market sector to the extent necessary to acquire the important technologies used in the subsistence harvest.

By using "mode of production" as the basis for the theoretical tenet which they test, the authors identify the social organization of production and distribution as the determinant construct in the sociocultural system. However, at the same time, the authors maintain that the structural reorganization of resource rights and land management policies, originating in the external nation-state, have the most potential to disrupt the subsistence-based economies of southwestern Alaska. Although causal order among the other subsystem variables is not directly discussed, it appears in this final statement that the political subsystem has the potential to become the operant variable. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

Pettersen, J.S. et al. . 1983. Unalaska: ethnographic study and impact analysis. Impact Assessment. Inc. Anchorage, AK. Report for Minerals Management" Service,' Alaska OCS Region. Leasing-and Environment Office. Technical Report No. 92. 307 pp.

Summary:

Technical Report No. 92 consists of two parts: An ethnography of Unalaska and an impact analysis comprised of four forecast scenarios for Unalaska. Consistent with the systems approach (cf. SESP Technical Reports Nos. 75, 93, and 104), the ethnography is a descriptive analysis of the input (ecological, historic, extrasocietal and intrasocietal forces) and structure (values and social organization including economic, social and political structures) of

Unalaska's sociocultural and socioeconomic systems and serves as the baseline from which changes (output and feedback) are projected for four scenarios:

1) Groundfish industry development without OCS-related activity.
2) Co-occurrence of groundfish and oil-related development.
3) Groundfish development followed by oil-related development.
4) Groundfish development preceded by oil-related development.

The ethnographic portion of the study is based primarily on field interviews.

As in the North Aleutian Shelf and Cold Bay studies (Technical Reports Nos. 75 and 93), Pettersen et al. employ a systems model as their framework for assessing impacts. Change, or output, is the response of the structure to changes in the environment (input). In this study, the output component of the model is addressed by projecting environmental changes over the next twenty years (based upon assumptions provided by MMS). Given known values and patterns of response (identified in the ethnographic portion of the study), the impact of this input on the structure's subsystems is forecast under each of the four scenarios. The subsystems correlate to impact categories in other studies; included are economic, social , political, religion, education, health care, social services, and recreation subsystems. The standards and assumptions used in these forecasts relate to existing ethnographic parameters of Unalaska and to trends projected to exist in the future.

The authors supplement the systems model (an "etic" model) with the options model in order to address the perspective of the residents, an "emit" approach. The options model evaluates how development will be perceived by the local residents, what decisions will be based on those perceptions, and how those decisions will affect the structure of the community and its response to the environment. The options approach is incorporated into the analysis of impacts. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

Pettersen, J.S. et al. 1983. Cold Bay: ethnographic study and impact analysis. Impact Assessment, Inc., Anchorage, AK. Report for Minerals Management Service, Alaska OCS Region Leasing and Environment Office. Technical Report No.93 (Final Technical Report). 234 pp.

Summary:

Technical Report No. 93 consists of two parts: An ethnography of Cold Bay and an impact analysis comprised of three forecast scenarios for Cold Bay. Consistent with the systems approach (cf. SESP Technical Reports Nos. 75, 93, and 104), the ethnography is a descriptive analysis of the input (ecological, historic, extrasocietal and intrasocietal forces) and structure (values and social organization including economic, social and political structures) of Unalaska's sociocultural and socioeconomic systems and serves as the baseline from which changes (output and feedback) are projected for three scenarios:

1) No OCS-related development.
2) Major oil and LNG facility development in the region, without road access.
3) Major oil-related facilities in the community of Cold Bay itself, with road access.

The ethnographic portion of the study is based primarily on field interviews.

As in the North Aleutian Shelf and Unalaska studies (Technical Reports Nos. 75 and 92), Petterson et al. employ a systems model as their framework for assessing impacts. Change, or output, is the response of the structure to changes in the environment (input). In this study, the output component of the model is addressed by projecting environmental changes over the next twenty years (based upon assumptions provided by MMS). Given known values and patterns of response (identified in the ethnographic portion of the study), the impact of this input on the structure’s subsystems is forecast under each of the three scenarios. The subsystems correlate to impact categories in other SESP sociocultural studies; included are economic, social, political, religion, education, health care, social services, and recreation subsystems.

The standards and assumptions used in these forecasts relate to existing ethnographic parameters of Unalaska and to trends projected to exist in the future.

The authors supplement the systems model (an "etic" model) with the options model in order to address the perspective of the residents, an "emit" approach. The options model evaluates how development will be perceived by the local residents, what decisions will be based on those perceptions, and how those decisions will affect the structure of the community and its response to the environment. The options approach is incorporated into the analysis of impacts. No cumulative impact assessment methods are presented. This report has no direct relevance to this project.

3.5 Canadian Literature

Canada's Northern regions, and the Canadian Arctic in particular, is undergoing a process of relatively rapid urbanization and industrialization in response to major proposed and ongoing resource development projects. A series of oil and gas development and transportation projects ranging from: the Arctic Pilot Project to move natural gas via icebreaking tankers; ongoing exploration and development activities in the Mackenzie river's delta on the Beaufort Sea; hydrocarbon transportation corridors through the Mackenzie river valley or other inland routes; and exploration drilling proposed for Lancaster Sound in the High Arctic, are all currently under consideration at one level of government or another. There is also a series of mine development projects planned or in operation. All of these projects are presently or have the potential for producing social, economic and cultural impacts on the predominantly native (Inuit, Metis, Dene or other Indian tribes) inhabitants of the region.

As a consequence, it was felt that a review of relevant Canadian literature would shed light on the processes of environmental and social impact assessment in settings similar to the Alaskan Arctic and might also reveal consideration of cumulative impacts or effects as well as development of methods for their assessment. A thorough review of the available Canadian literature was made along with an extensive networking effort with professionals in native associations, key government agencies, universities, and environmental interest groups. The process was quite informative and a large volume of literature was reviewed and evaluated and is described here.

In summarizing this literature it is important to note the important differences between the Canadian situation and that in the U.S. generally and in the Alaskan Arctic specifically. Canada utilizes an environmental assessment procedure considerably different than the NEPA process. It is a quasi-judicial review that uses a proponent prepared EIS and other documents as input to an independent government assessment panel that renders deliberative judgments. It is important to point out that the Canadian Arctic falls within the Yukon and Northwest Territories, territorial units of government still subject to federal control rather than having the relative autonomy of provinces. Second, Canada has not yet enacted a native claims settlement policy and the Committee for Original People's Entitlement (COPE) has several claims regarding Arctic lands and resources pending before it. Finally, the Canadian government seems genuinely committed to pursuing a process of regional land use planning for its northern regions to promote the balancing of regional and national interests, and appears to involve independent, non-governmental bodies more fully in its environmental review and assessment process. Nevertheless, the Canadian system has its shortcomings and critics also.

Analysis of the Canadian literature reveals an evolutionary development of social impact assessments and socioeconomic impact assessments oriented towards native communities and unique balance of traditional and modern economic forms occurring on such communities. Paralleling this evolution is a concern with cumulative impact, not only of individual, large, complex projects, but also of the variety of proposed development projects occurring in the northern regions. Attempts to assess cumulative impacts have focused on an extension of traditional assessment techniques and currently reflect such methods as: composite overlay mapping, regional land use planning, and cumulative impact monitoring. However, the majority of Canadian cumulative impact assessment methods are not rigorous and results are difficult to obtain (personal communication, Patrick Duffy, Director, Northern Region, Federal

Environmental Assessment Review Office, 1984). Many assessment techniques utilized in Canada employ informal, process-oriented approaches to social impact assessment rather than formalized, quantifiable methodologies. Nevertheless, there is continuing interest in expanding the impact assessment process to accommodate cumulative impact assessments. This is best represented by the recent work of Carley (1984), Dirschl (1982), Usher (1982) and Brody (1981).

In addition, Berger (1977) uses an approach involving public inquiry which is focused on cumulative social, economic and cultural impacts of major resource development projects. Berkes' (1981) post-project evaluation of the unanticipated cumulative consequences of the James Bay hydroelectric project seems to indicate the value of combining pre-project impact assessment with post-project impact assessment and monitoring to begin to conclusively identify cumulative impacts. Jacobs (1981) reports on use of a regional planning approach to examine planned developments in the Lancaster Sound region that helped identify key cumulative impacts. In his paper, Gibson (1982), points out that values, interests and preferences inevitably accompany the impact assessment process and urges conscious attention to this problem along with use of an open adversarial process and inclusion of the opinions of those affected by a project. These are all considerations which should be taken into account in any cumulative impact assessment method developed for this project. The studies with no direct relevance are grouped together at the end of this section.

P

RELEVANT STUDIES

Berger, T.R. 1977. Northern frontier, northern homeland: report of the Mackenz e Valley pipeline inqu ry. Minster of Supply and Services Canada, Ottawa, Ontario. 2 vols.

Summary

This volume summarizes the results of the massive Mackenzie Valley Pipeline Inquiry, conducted by the Honorable Justice T.R. Berger which was designed to assess the social, economic and environmental impacts of a natural gas pipeline proposed to be built from the western Arctic to southern Canada and the US. The Berger Inquiry developed its own methodology to deal with the numerous competing issues and concerns--technical, environmental, political, social , cultural and economic--that arose during the consideration of the proposed project.

The activities of the Inquiry drew on a massive amount of research and documentation. The Inquiry was preceded by a four-year $17.5 million Environmental-Social Program designed to collect baseline data. The Pipeline Application Assessment Group (PAAG) compiled its own assessment report based on the Environmental-Social Program and other research documentation available at the time. In addition, the project proponent, Canadian Arctic Gas, funded $50 million in environmental and socioeconomic studies of the pipeline's impact and funded a $3.5 million independent review by the Environment Protection Board (EPB). In response to the project proponent's application for a right-of-way permit, the Berger Inquiry was established.

The Inquiry proceeded largely on the basis of testimony received during its various hearings. In addition to preliminary and overview hearings, a series of main hearings were held. The Inquiry's main hearings were conducted as formal hearings to present expert technical testimony and community hearings held in some 35 towns and villages across the region. It is the community hearings which are the most publized aspect of the Berger Inquiry. Nearly 1,000 people testified and testimony was received in eight languages. The formal and community hearings were also broadcast over the radio network of the CBC. Funding was also provided to a variety of interest groups and organizations to allow them to prepare for and participate in the Inquiry.

An important focus of the Inquiry was to assess “the impact of exploration and development that would follow approval of a pipeline, that is, the cumulative effects of the increased activity that would be triggered by the pipeline.” It is stated that to local residents, “the cumulative aspect of development is of the utmost concern. They know that a process once started, always seems to push forward, first by small increments, then by large ones, and that the end result is never what was originally intended.”

The Inquiry is unique, not only in its consideration of both the divergent views of project proponents and those of native communities, but in its balancing of the testimony of highly technical scientific and engineering evidence with the nontechnical presentations of local residents directly affected by the project. The Inquiry process pioneered by Justice Berger is an example of a cumulative impact assessment method. In its integration of expert evidence with the testimony of ordinary citizens, a variety of unanticipated consequences and secondary impacts was revealed. The participatory thrust of the Inquiry seems to be an especially vital ingredient of cumulative impact assessment in the Alaskan Arctic where scientific information is often lacking and local residents have relevant historical experience and the most intimate understanding of potential threats to their economic and cultural livelihood. In discussing cultural change and the cumulative effects on native life, Berger concludes, “... But the proposal to build a pipeline and to establish an energy corridor from the Arctic to the mid-continent will bring changes far greater in magnitude than the examples just mentioned. The pipeline and the energy corridor would change the north, alter a way of life and inhibit--perhaps extinguish--the native people’s choice for the future.”

This report presents the results of a “public inquiry” approach to cumulative impact assessment. Unfortunately, the cost of such an approach is considerable. The public inquiry method also presented its findings in quasi-judicial, qualitative statements. No quantitative documentation of cumulative impacts was prepared. This method has direct relevance to this project. However, its expensive and time-consuming nature will probably limit its applicability in other settings. Nevertheless, elements of the public inquiry approach may be worth incorporating into a viable cumulative impact assessment method for the North Slope Borough.

Federal Environmental Assessment Review Office. 1979. Report of the environmental assessment panel : Lancaster Sound drilling, FEARO, Government of Canada, Ottawa, Ontario.

Summary:

This report presents the results of an environmental assessment of the proposal by Norlands Petroleum Ltd. to explore for hydrocarbons in Lancaster Sound. Although the proposed activity consisted only of a single exploratory well, the assessment did accommodate and include other likely cumulative impacts resulting from exploration and development. The report states, "concern was directed toward the impacts associated with possible extensive exploration and production. Many felt that oil and gas production and attendant transportation facilities will eventually follow the Proponent's one exploratory well. It was pointed out to the Panel that cumulative effects must be considered and that a program once initiated would gain momentum and become increasingly more difficult to stop. It was emphasized that a balanced approach was needed to northern development by recognizing social as well as economic considerations."

In the course of completing the assessment a socioeconomic evaluation was conducted. In addition, a series of community hearings was held in potentially affected Inuit communities. Although the socioeconomic impact assessment section is rather short and merely reports on the testimony given by Inuit residents, it speaks eloquently of the local residents' concerns that exploration is perceived as the forerunner to continued development and that the people of several communities within the region are still attempting to adapt to other resource development projects in their area (i.e., Nanisivik Mine near Arctic Bay). The comments of local residents indicate their concerns:

"We are trying to tell you as concisely as possible that we are trying to develop our own future and handle our own problems with wisdom. We do not want any more problems until we are in firm control of the present ones."
TITUS ALLOLOO, Mayor of Pond Inlet.

"But if Norlands was approved to drill for oil in Lancaster Sound, you would have to answer in the affirmative to . ..other companies that have permits in the area... because Norlands is going to open the door for further activity." JOSHUA KATSAK, Pond Inlet.

"Ift here was an oil spill . ..people would die, spiritually not physically, but their culture would change, the culture he wanted to keep for himself and future generations." M. PIEJAMINI, Pond Inlet.

The Panel heard evidence to the effect that "natural (country) food" was an important component of the local economy in terms of nutritional benefits and costs. "This importance of local foods and the means of obtaining them is further accentuated when one considers the depth of the philosophical and cultural ties most northern residents have to the land. A high birth rate, the apparent inability of many Inuit to adapt successfully to modern society in the south, policies of the Territorial Government that offer the options of a wage economy as opposed to living off the land (or combination thereof) and a real desire by people to participate meaningfully in their future, further emphasize the continued importance of local foods and their management. The Panel sees these resources being further pressured as the population continues to grow rapidly causing hunting areas to be broadened. The established rhythms of migration of sea mammals and birds should be preserved and unplanned, rapid development without local participation should be avoided in order not to frustrate the importance of the above."

The Panel concluded its deliberations by deferring the exploratory well drilling activity and recommending that socio-economic considerations be an important factor in any decision to allow development activity. Although this report does not provide a formal method for ensuring cumulative impact considerations, the concerns of local residents injected consideration of the cumulative impacts of development into the process. This report has limited relevance to this project, mainly in developing descriptions of several key cumulative impacts of northern petroleum development (i.e., accelerating momentum of development projects and foreclosing of native lifestyle choices).

Berkes, F. 1981. Some environmental and social impacts of the James Bay hydroelectric project, Canada. Journal of Environmental Management, 12(2): 157-172.

Summary:

This paper presents some environmental and social impact case studies for the LaGrande complex of the James Bay hydroelectric development project. The environmental impact case study examines the effects of hydrologic and ecological changes in the LeGrande river on the estuarine subsistence fishery in the river. The social impact case study examines the effect of the road network associated with the hydro development on the land tenure system of the native Cree Indians of the area. The article concludes that the development process accompanying this project has, "been resulting in an incremental erosion of the land and resource base of the Cree Indian people."

As a retrospective assessment of the project the article identifies a large number of unanticipated secondary impacts, many of them due to a lack of understanding of the Cree Indian lifestyle, local economy and cultural practices. The author also surmises based on the available evidence that significant ecological and social cumulative impacts did occur, and that the "overall 'effect of the various modifications (of the project) may be greater than the sum of the individual effects."

He also recounts considerable unanticipated social impacts which resulted from the construction of a road network in a previously roadless area. Increased road access affected community traplines, altered traditional and nontraditional hunting patterns, and created potential conflicts among several native communities where none previously existed. The article also recounts the social Agreement between the governmental developers of the project and the Cree Indians of the area and the relationship between trade-offs made in accepting the project (i.e., benefits vs. concessions). The author concludes with an observation about the project's cumulative impacts, finding that, "much more difficult is the study of the cumulative effects of incremental impacts, what Gamble (1979) has called with respect to Arctic offshore oil developments 'destruction by insignificant increments.' The James Bay case is replete with examples. In addition to what has been given up by the natives through the Agreement, the resource base continues to be eroded through a variety of new developments, each of which appears to be relatively innocuous in terms of social and environmental impacts."

The author does not present a method for assessing cumulative impacts. However, one can infer from his approach that post-project impact monitoring provides a way to identify and analyze such impacts, particularly where some pre-project baseline data is available for comparison. This report has only limited relevance to this project.

Jacobs, P. 1981. Lancaster Sound regional study: public review. (People, Resources and the Environment). (Tri-lingual). Minister of Indian Affairs and Northern Development, Ottawa.

Summary:

This report presents the results of a public review process held as part of a regional study process designed to produce a regional plan for the Lancaster Sound region of the Canadian high Arctic. The public review held in communities in the Lancaster Sound region as well as in southern Canada reviewed a draft "Green Paper" prepared by the Ministry of Indian and Northern Affairs as part of the Lancaster Sound Regional Study. The report reviews the perspectives of a broad range of Canadian citizens who responded to the question, "What do you believe would be our best plan for Lancaster Sound?"

Although this report is not an impact assessment per se, it does consider the cumulative economic, social and cultural impacts of petroleum development and other resource development projects in the Canadian Arctic. The method used to review cumulative impacts is a regional planning process. The report points out, "There is a complementary need to coordinate government initiatives with the regulation and control of the full set of developmental impacts that might occur with development of the region and the high Arctic.

Secondary and tertiary impacts, such as supply stations and temporary work sites, may be as important elements of change as the primary proposal itself. The cumulative impact of development north of 60° is also an important factor of concern. It is not clear that project by project review can properly address this latter issue. Consequently the need for an appropriate management framework for northern development was viewed as an essential element of government policy and action in the North."

Although the report was not prepared through a specific cumulative impact assessment methodology, its use of a regional planning approach including considerable public participation in affected communities did identify significant cumulative impacts associated with a variety of proposed development projects. This report has limited relevance to this project.

Dirschl, H.J. 1982. The Lancaster Sound Region: 1980-2000. Green Paper - Issues and Options on the Use and Management of the Region. Minister of Indian Affairs and Northern Development, Ottawa (Canada).

Summary:

This report presents the results of the Lancaster Sound Regional Study, a regional and planning study designed to develop a series of specific resource use options for Lancaster Sound including alternative approaches within a regional planning mechanism. In the context of this regional study and issue evaluation exercise and as a guideline for future regional planning, the report recommends that planning be designed, "to take into account the potential and cumulative impacts of all activities and their interactions in developing management and environmental protection measures." This paper is not a regional plan, however; it merely provides the foundation for a regional planning process. It does, however, "provide the background necessary to gain a regional perspective on alternative uses and an insight into their cumulative effects."

The report's Appendix B Lancaster Sound: Potential and Future Uses examines activities likely to take place in various parts of the Sound over the next 20 years. In addition to considering each proposed activity separately, the report states, "it is also necessary to examine the interactions among various activities, and the cumulative effects that may result from joint implementation of several activities." The Appendix provides a composite map to facilitate this review and considers each of the major areas of renewable and non-renewable resource development separately and interactively.

The approach used in this report's assessment of the cumulative impacts of Lancaster Sound development activities was a systematic mapping and planning approach which allowed for examination of the relationships among biological, physical and socioeconomic factors, and potential activities on the Lancaster Sound Region. The preparation of map overlays and composite maps aided in this process. Projections of potential future development activities were also made such as: oil and gas exploration and development, shipping, mining development, and preservation of natural areas. Changes in the environment, the economy, harvesting patterns, and the communities as a result of each activity were identified by relating the future activities to the existing regional framework. Areas of likely conflict were highlighted when overlays representing potential activities were superimposed upon the regional framework maps.

As an outgrowth of the Lancaster Sound Regional Study, the Canadian Federal Cabinet endorsed a Northern Land Use Planning Policy. Currently, the Minister of Indian and Northern Affairs is instituting the Northern Land Use Planning Program to implement the new Federal policy. However, no more recent documentation on this process is currently available to the public.

This report's creative use of regional planning concepts, including overlay and composite mapping appears to provide a sound initial basis for a method of assessing the cumulative social, economic and cultural impacts of petroleum development in the Alaskan Arctic. This approach will be explored further later in this report.

Gibson, R.B. 1982. Values, interests and preferences: non-factual considerations in the work of the Beaufort Sea Environmental Assessment Panel. Beaufort Sea Alliance, Ottawa, Ontario.

Summary:

This article, prepared for the Beaufort Sea Alliance, presents a compelling brief on the role of non-factual considerations in the environmental impact assessment process for Beaufort Sea oil and gas development. It explores the role of values, interests and preferences in the process of deliberation and evidence-taking of the Beaufort Sea Environmental Assessment Panel. The underlying theme of his paper is that, "decisions on matters of interest and preference, involving choices in the face of ignorance and uncertainty, can be made properly only by those to be affected." Gibson argues that, "non-factual considerations appear whenever analyses are undertaken on conclusions drawn on the basis of uncertain or incomplete sets of background data, and whenever challengeable assumptions are made about the relevance of issues and information, about the degrees of certainty required in specific circumstances, about the value of relevant 'goods' and 'bads', or about the acceptability of risks."

The author states that the entry of values, preferences and interests into assessment and decision-making is unavoidable due to: "the inevitable incompleteness of the information base" and "the fact that evaluation can never rest on factual indicators alone." With regard to the Beaufort Sea, Gibson concludes "Non-factual considerations will be exceptionally significant in the Beaufort case, if only because of the vast scale of the proposed plans and the magnitude of the potential environmental and socioeconomic effects. The very nature of the proposals means that a multitude of general and specific options will have to be weighed. To the extent that for whatever reasons important uncertainties remain about the nature and implications of these options, the role of values, interests and preferences will expand."

Gibson's view of non-factual considerations in the Beaufort case is reflected in the statement that, "the evaluation of Beaufort hydrocarbon exploration involves consideration of mutually exclusive options." In analyzing the research required to support environmental assessment, Gibson finds

that non-factual considerations intrude in several ways: "Two sets of non-factual considerations enter here. The first set comprises the various logical and methodological problems confronting researchers. Aside from epistemological questions about any attempt to describe 'objective reality' on the basis of perceived phenomena, there are barriers (e.g., ecological complexity, limitations of research time and resources, weaknesses of methodologies and techniques) that preclude full and fully accurate descriptions. These barriers are greater where large areas and complex interrelations are involved, where the pre-existing body of data is small or of questionable quality, and where research is particularly difficult or expensive. The second set comprises factors reflecting interest and biases that influence decisions on what research is undertaken and reported, including decisions on which research projects will be funded and to what extent, how much time will be allowed, what boundaries will be imposed, what findings will be followed up with further study, and what findings will be presented in the assessment submissions. The most important operative biases and interests affecting EARP research are those of the government in setting out the mandate and terms of reference of the hearing panel, the panel in deciding what to include and emphasize in guidelines to the proponent for the preparation of an environmental impact statement, the proponent in making decisions on research funding, the hiring and direction of researchers and the presentation of findings, the relevant government agencies in preparing for the carrying out reviews of the proponents' research work, and the interveners in choosing what research (if any) to carry out in support of their submissions."

Biases affecting the analysis of research conclusions are also seen as a problem. Gibson favors an open, adversarial approach which favors, "the influence of uncontested values, interests and preferences." He criticizes the evaluation phase of impact assessment for its failure to make values underlying judgments plain. "Failure to provide explicit discussion of the non-factual considerations in environmental assessment and other evaluations makes it difficult for final decision makers, proponents and interveners to understand the basis for evaluator conclusions and to see the extent to which the conclusions that are drawn by different bodies examining different aspects of a proposed project are based on compatible assumptions." He recommends inclusion of an explicit section on uncertainties and underlying assumptions to give conscious attention to this problem.

Finally Gibson specifically reviews the socioeconomic uncertainties underlying any socioeconomic assessments of the proposed Beaufort Sea hydrocarbon development. He bluntly states, "studies of such issues are inevitably colored by the attitudes, experiences, interests and biases of the observers." He adds, "the findings of 'experts' carrying out narrowly defined studies of relatively simple matters. ..are likely to vary remarkably, in part because of the considerable barriers to accurate intercultural communication and the unsolicited entry of ill-founded assumptions into methodology and interpretation." He concludes that, "the differences of opinions among experts are such that the submissions of the proponents even on some of the more straightforward aspects of existing socioeconomic conditions, may be of use chiefly as a basis for discussion and comment, preferably by the people whose economy is being described." He closes this discussion with a reaffirmation of the role of public input, but that input will only be forthcoming if community perceptions of, "the legitimacy and importance" of impact assessment procedures is supported.

Although this report does not explicitly consider cumulative impact assessment methods or concepts, it does provide important guidance on the role of facts and values in social impact assessment processes. Since cumulative impact assessment will inevitably involve projections of future social, cultural and economic effects, consideration of the role of non-factual considerations must be explicit in any methodology. This issue is worthy of further exploration in any methodology development efforts for the Alaskan Arctic. Therefore, this paper has direct relevance to this project.

Usher, P.J. 1982. Assessing the impact of industry in the Beaufort Sea Region. Beaufort Sea Alliance, Ottawa, Ontario.

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Summary:

This article reviews several topics of importance concerning the assessment of the social, economic and cultural impacts of petroleum development in the Canadian Arctic. In the first chapter the author critiques the Beaufort Sea EIS, Volume 5 socioeconomic effects (reviewed earlier), by constructing an alternative view of native economic issues and the relationship of the native economy and culture to industrial development. The second chapter considers critically the ideas advanced by proponents of industrial development in the north that greater wage employment for natives will actually advantage the traditional economy through improved technologies of harvest and that by being full participants in the Canadian economy, native people will increase their self-reliance and independence. The final chapter examines the implications of this discussion for social impact assessment. It is concluded that, “the regional economy is not inevitably converging with the southern industrial economy, and that SIA must take into account both the locally desired and the probable futures of the regional socioeconomic system.”

Much of the article is a critique of the proponent’s EIS which was found to be deficient by the Beaufort Sea Environmental Assessment Panel and-later amended by the Supplementary Information volume on socioeconomic issues. Usher begins by presenting the data on native employment and income he felt to be missing from the EIS. The data includes: employment and income in the hydrocarbon industry; total community and per capita income by source; and social assistance payments. All of this data are for the native communities only. Usher concludes that while wage employment has provided an increasing proportion of income over a 20 year period, that currently wage labor does not constitute an even greater proportion of personal income, given the wide availability of wage employment currently relative to the period 20 years ago.

He also finds that the low proportion of wage income is not simply counterbalanced by greater levels of transfer payments, for in most cases, “these account for only a few percentage points of personal income above the national average.” He points out the uncertain effects of taxation on native personal income and the lack of data on household income and expenditure patterns. He recommends time budget studies and research on expenditure patterns to improve this situation. He concludes that, "the economy of the Beaufort Sea communities appears to have certain distinctive and enduring features, based on the structure of employment and income. It is neither an aboriginal or an industrial economy." He adds, "Households, and indeed many individuals, derive their income from a strategic mix of land-based activities, wage employment (often seasonal rather than permanent), and transfer payments. Those engaged in non-industrial forms of production are not unemployed, they may in fact be making entirely rational decisions about how best to gain a living." He concludes that there are important "non-economic" reasons for engaging in subsistence harvesting activities.

He analyzes the role of wage employment in the traditional economy as performing a seasonal bridging function between other activities. He also comments on the tendency "to use a substantial proportion of income from employment for the purchase of productive inputs" for subsistence harvesting, and that "there will be a tendency to view wage employment opportunistically in comparison with self-employment or transfer payments, as means to achieve these other ends." He states, "there is an interest in seeing that wage employment does not interfere with other aspects of life, and in particular, the ability to obtain a substantial proportion of household income from the land." Usher concludes that consequently, "the most desirable outcome from the local point of view, is not a dramatic increase in employment opportunities or inducements, but rather the stable provision of existing levels of employment, or only gradual increases."

Usher also strongly differentiates the northern native economy from an industrial one on cultural grounds, that is, "the social relations on which economic activity is organized, and in peoples' ideas about those relations." He argues that for contemporary impact assessment in the Arctic the issue is, "the degree to which these systems and institutions still exist, and the conceptions about them which still prevail among native people." He indicates that little contemporary documentation of these phenomena exist for the Canadian Beaufort region and that extensive field research, including participant observation are required.

Usher characterizes the recent social relations of production of the Inuit and Dene communities as "recently urbanized foraging bands which continue to have ties to specific areas of land." He contrasts the native economic production system with that of fully industrialized production and markets and illustrates the disjunctions between the two systems. He defines the transition from native "merchant capitalism" to "industrial capitalism" as bringing on the "commoditization of land and labor." He adds that the critical question for social impact assessment is "not the so-called modernization of a traditional economy. It is, instead, the nature and consequences of the transition from a predominantly merchant set of socioeconomic relations to a predominantly industrial set, and what elements or features of those relations are significant or incidental with respect to impact."

Usher comments on the implications of such a change for native society indicating that mutual aid and sharing networks are likely to atrophy, that income will be viewed as an individual rather than household resource, and that a greater proportion of household needs will be obtained through the market rather than by household production. He indicates that vulnerability to social forces uncontrollable at the local level is also likely to rise along with personal and household income, and that personal finance will shift to a series of continuing financial obligations (i.e. rent, loans, etc.). He posits the "possessive individualism" of the industrial economy as undermining the bands of social structure and obligation throughout native society. Usher comments that in studying the transformation from merchant to industrial capitalism, "it is essential to identify the milestones that mark the important stages in the process, and to understand how cumulative and synergistic events and decisions set a course not easily altered or reversed."

In the second chapter Usher examines the proposition that one of the advantages of wage employment is its generation of cash to support the traditional sector. Usher concludes that hard evidence does not exist that oil industry labor income actually benefits traditional harvesting activities and that considerable evidence to the contrary exists. He also argues that other means of providing finance to the harvesting sector are available besides wage employment and that these bear examination as their impact on social and cultural patterns may well be less adverse. Finally he questions whether "heavy cash injections are truly necessary to the long term survival of the traditional sector." He argues that overcapitalization of harvesting activities may ultimately ensue, thereby undermining the whole basis of the traditional harvesting economy, as indebtedness drives harvesters out of production or overharvesting depletes available resources. He also hypothesizes that the variety of species harvested may decline along with harvesting skills. He concludes, "This . ..would lead to a significant decline in diversity and flexibility of action--traditionally the hallmarks of the northern hunter. It would also lead to overdependence on a steady and predictable supply of one or a few resources, which is unfortunately an exceptional rather than common characteristic of northern species and populations. This increasing dependence on a few species will also be the result of a growing integration of wage employment and harvesting."

He also points out that several other factors, "arising directly from the larger process of industrial ization," will place, "native people's traditional access to and control over fish and wildlife resources in question." He indicated that the inevitable demands by non-natives and visitors for access to these resources for recreational, commercial and subsistence purposes may result in "native harvesters . ..being reduced to one of several competing 'user groups' whose activities must be increasingly regulated by the state." He concludes, "the cumulative effect of all of these processes could well be to drive out the small producer."

In the final chapter, Usher draws conclusions from his earlier discussions for the process of social impact assessment. He states, "It is therefore essential to consider not simply the nature and impact of a specific industrial development project, even one so complex as the Beaufort Sea producers' proposal. These projects must be seen as part of a larger, overarching project of the industrialization of the North itself. That is why we must consider the impact not only of wage employment income, immigration and infrastructure generated by the project itself, but also the whole array of associated public and private developments that are inseparably linked to such a project."

Usher contrasts the social impact assessment procedures that quantify social phenomena without reference to their centralizing tendency to reduce man to the role of "man the consumer." He proposes an alternative paradigm based on "man as a producer." "If social well-being is perceived as being tied primarily to production rather than consumption, then community solidarity will take precedence over possessive individualism as the primary value to be considered in assessing change." He states that it would result in consideration of a different set of categories namely: "the maintenance of the local resource base, the systems of land tenure and resource access, and the social organization of work, especially as these things serve to reinforce and maintain the solidarity of the community and to socialize the young. They would include the degree of economic integration of the local community and the participation of its members, and the maintenance of the producer's economic and social viability, including the ability of individuals and groups to determine their own method and pace of work, and their own safety, health and comfort."

He concludes that, "Change must be assessed not only in terms of its impact on the ability of people to satisfy themselves as consumers, but also in terms of its impact on their sense of personal satisfaction and autonomy as creative, skilled, self-motivated and self-directed producers, and their sense of integration as valued and productive members of society. To put the 'social' into social impact assessment, we must know something about the social relations, social institutions, and social values of the affected community."

He stresses that traditional impact assessment, to the extent that it rests on conventional economic premises, avoids and ignores such issues. He points out that we have basically two competing interpretations of the massive changes occuring in the North and that the choice of an interpretive paradigm affects one's assessment. He concludes that it is still unclear whether the north is simply in a slow transition to industrialization or whether it is on a separate path which, "although obviously affected by the wider process of industrialization, will not necessarily converge with it." "It would be a hybrid economy, perhaps, but distinctive in the long run as well as the short."

Usher concludes his commentary with this observation, "Social impact assessment requires us to know where we are, where we are going, and where we want to go. That means that we require a sound characterization of both the local economy and society, and of the major project as part of a larger social process. We must also understand the values and perspectives of the affected population, and how these values and perspectives relate to their situation and to the processes they are experiencing. Without these, we do not have a socioeconomic impact statement before us, and we would not be able to formulate and test useful hypotheses about impact. Consequently we would not be able to assess or evaluate the social impact of the project."

Although the concept of cumulative impacts occurs only fleetingly throughout this document, it is obvious that Usher's intent is to produce a socioeconomic impact assessment comprehensive enough to address the cumulative social, economic and cultural impacts of petroleum development in the Arctic. In this end he succeeds although his method is not generalizable and consists of focused, professional judgment informed by previous social research. This paper is of considerable relevance to this project.

Carley, M.J. 1984. Cumulative socioeconomic monitoring: issues and indicators for Canada's Beaufort Region. Ministry of Supply and Services. Northern Economic Planning Branch, Indian and Northern Affairs Canada, Ottawa, Ontario.

<u>Summary:</u>

This report is the result of research on cumulative impact monitoring, funded by the Canadian Government's Department of Indian Affairs and Northern Development and the Government of the Northwest Territories, designed to help better understand issues of social, cultural and economic change in Canada's Arctic region. The report develops a cumulative socioeconomic monitoring program for the Beaufort region. The program was designed as a prototype for other potential monitoring effects, to be easily implemented and cost-effective, and to be policy-oriented. The report is divided into two parts, the first providing perspective on cumulative impact monitoring in the

Beaufort Region and the second discussing issues and indicators for a Beaufort Region Monitoring Program.

Carley begins a justification for cumulative monitoring with reference to the sweeping pattern of regional development occurring in the Canadian Arctic. "Many people and groups recognize that such sweeping change should be carefully monitored to give early warning of unexpected or cumulative changes, and to promote benefits to northern people. Community and native groups, and various government departments, have stressed recently the importance of such monitoring in their submissions to the Beaufort Sea Environment Assessment panel. The Environmental Impact Statement guidelines asked the major proponents to propose a monitoring program, and the proponents' monitoring proposals are complete."

Carley's report addresses two related questions, namely, "what would constitute a realistic, effective socioeconomic monitoring program for the Beaufort region? Second, how would such monitoring best be undertaken, that is, what are the organizational and data problems which would have to be overcome for effective monitoring to take place?"

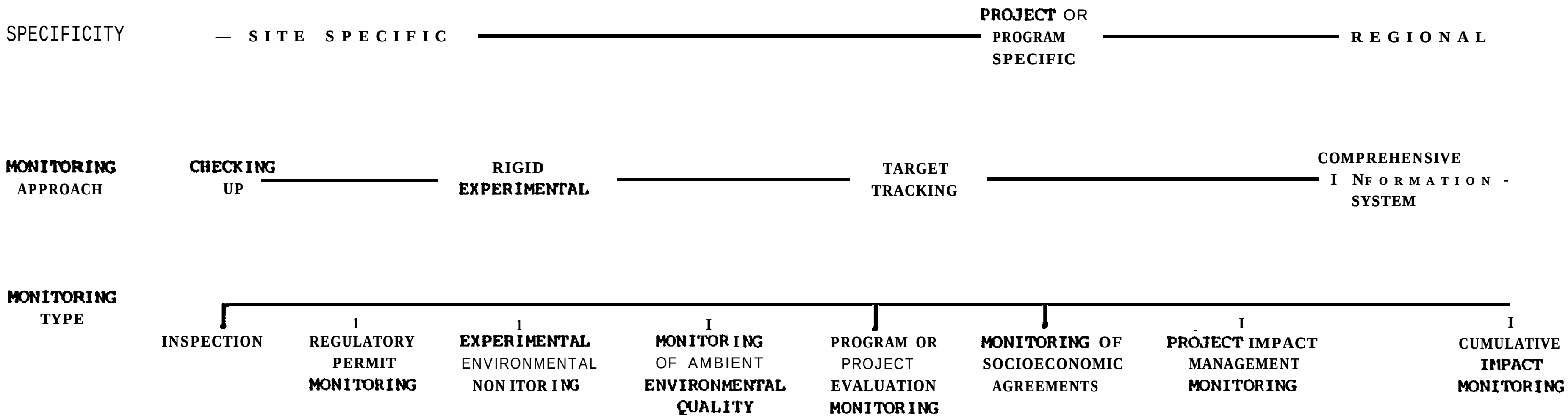
Carley reviews the origins of the cumulative prospective in impact assessment and states, "The cumulative perspective for the human environment considers the social, economic, cultural and political implications of all industrializing projects in the Beaufort Region, with attention to their interrelated effects over time. The sum of these interrelated effects is likely to be greater than those generated by particular projects, considered separately. That is, impacts may have an additive effect: many small, local impacts could be serious when occurring together. At issue are not individual projects whose impacts may be unexceptional, but rather changes wrought by the industrializing process itself. As the Alaska Highway Pipeline Panel recognized, such a cumulative approach is essential to an understanding of the implications of industrialization on the whole of northern life and culture itself, and is not substituted for by attention to particular effects (e.g., native employment) of particular projects, as important as those might be. However, the cumulative perspective is not easy either to conceptualize or to carry out, and in spite of the millions of dollars spent on 'impact assessment', there is as yet little experience of cumulative monitoring."

Carley raises and discusses five broad problem areas relating to a cumulative impact perspective. He defines these as, "(i) the geographic scale of more 'traditional' impact assessment, (ii) the timing of the assessment process, (iii) the difficulty of measuring intangible impacts, (iv) the structural organization of the impact assessment program, and (v) the need to establish the significance of research."

The first problem, related to the "project" approach of traditional impact assessments can be alleviated by a regional approach. He points out that cumulative impact assessments are costly and time-consuming and require a number of years to complete. The third problem, while difficult to resolve, is viewed by Carley as essential to cumulative impact assessment in native communities. He points out the difficulty of ensuring the validity and cumulative perspective in long-range monitoring and finally questions the judgmental and political process inherent in ascribing significance or non-significance to impacts.

In the first section of this report, Carley defines monitoring and discusses eight different types of monitoring. The eight types of monitoring reviewed are: inspection, regulatory permit monitoring, experimental environmental monitoring, monitoring of ambient environmental quality, program or project evaluation monitoring, monitoring of socioeconomic agreements, project impact management monitoring, and cumulative impact monitoring. These are shown as a continuum in Figure 28. Carley defines cumulative impact monitoring as, "monitoring all critical issues or changing patterns in a region, whether they are related to a project or occur independently of a project. Cumulative monitoring also focuses on the interrelated, and additive effects caused by a variety of industrializing projects and government interventions over time. Such monitoring is characterized by a regional, rather than site-specific, perspective; attention to overlapping impacts of different projects and policies; and a time-perspective stressing the long term, incremental and dynamic nature of social change. It is usually carried out by government to provide a regional overview to citizens, and to provide a

FIGURE 28



MONITORING TYPES

Source: Carley, M.J. 1984. Cumulative socioeconomic monitoring.

coordinated and organized flow of information for strategic planning purposes. In addition to documenting non-project-related socioeconomic changes, it also serves to coordinate the variety of information generated by less strategic types of monitoring. It can begin well before decisions on project acceptability are taken, but more likely it will be a component of a regional or strategic planning process, and therefore unrelated to the timing or acceptability of particular projects. Although the need for monitoring is well recognized, there are few examples yet of a cumulative impact monitoring program."

Carley also suggests that the primary audience for cumulative monitoring should be "the public at large, the community, and native groups." Other audiences include government policy-makers, program planners and project proponents in the region. Carley devotes a chapter to dealing with the problem of assessing the significance of information in a monitoring program and the particular problem this represents in a northern setting. He illustrates the difference in value systems between north and south with several quotes, and makes the point that, "the cumulative monitoring program should make an effort to help enlighten us as to these divergent perspectives by ensuring that a wide range of information is collected and transmitted in a readable format to the communities, and that our definition and selection of social indicators is not pre-defined in 'non-Dene' or 'industrial' terms."

He also poses the issue of quantifiable vs. non-quantifiable information and indicates the bias of our system of assessment for the former at the expense of the latter, relegated to "intangibles." He stresses that monitoring can help to overcome these problems, if categories of information or social indicators are defined broadly enough.

Carley also evaluates the establishment and implementation of several monitoring programs including ones for: Project Huntly in New Zealand; TAPS in Fairbanks, Alaska; Revelstoke Dam in British Columbia; the Chartered Institute of Public Finance and Accountancy System of community indicator monitoring in the United Kingdom; and the United Kingdom's "Structure Plan" reports prepared annually at the county council level. Based on the lessons learned from these various monitoring approaches, Carley sets out an

COORDINATING COMMITTEE

Located in Yellowknife

Representatives from DIAND and GNWT

FUNCTIONS :

- provide authority for monitoring
- co-ordinate all NWT monitoring efforts
- identify strategic issues
- co-ordinate intergovernmental and interdepartmental liaison
- review and direct monitoring program
- ensure fiscal and social .responsibility of monitoring program

REGIONAL ADVISORY COMMITTEE

Located in Beaufort Region

Representatives from local communities, GNWT, DIAND

FUNCTIONS:

- identify regional issues
- promote liaison with communities
- assist in interpretation
- review and advise monitoring program
- ensure accountability of monitoring program to regional staff and community groups

MONITORING SECRETARIAT

Located in Yellowknife

Staff

FUNCTIONS:

understand issues
develop measurement rationale
collect data and information
undertake fieldwork in region
provide organization of information
public monitoring reports at suitable intervals

A SIMPLE ORGANIZATIONAL FRAMEWORK FOR MONITORING

Source: Carley, M.J. 1984. Cumulative socioeconomic monitoring.

FIGURE 29

organizational framework for cumulative monitoring in the Northwest Territories. The organizational framework he proposes is shown in Figure 29. This institutional analysis is principally oriented towards existing governmental and non-governmental institutional entities and their potential roles in cumulative monitoring.

Carley concludes the first half of the report with a discussion focused on the issues needing to be included in a Beaufort cumulative monitoring program and a recommendation that an annual social report on the Beaufort Region be prepared based on the results of the cumulative monitoring program. He elaborates the process for selecting indicators for monitoring, stressing the importance of a "measurement rationale" to accompany each selected indicator, discussing its importance and its basis as a valid social variable. Carley recounts the process through which he derived a list of 17 indicators of importance to a Beaufort cumulative impact monitoring program. The process which Carley utilized first identifies the critical "social, cultural and economic concerns facing the people of the Beaufort Region." He adds, "The selection of indicators is then derived from a thorough examination of these issues. In every case, the presentation of an indicator is justified by linking that indicator with critical issues." This selection process is shown in Figure 30.

The second part of the paper presents each of the 17 indicators including their "measurement rationale for inclusion in the monitoring program and to suggest a format for the proposed Annual Social Report. The indicators presented include: demography; mechanization and industrialization; municipal issues; wage employment; business development; prices and incomes; renewable resource harvesting; community control; education; the media; welfare dependency; family life; health; alcohol-related social problems; juvenile mental health and suicide; public safety; and housing. For each indicator the underlying issues demonstrating its importance are reviewed along with the appropriate indicators, their source and a discussion on their validity.

Some of the concerns surrounding individual indicators are briefly reviewed here to help illustrate the cumulative impact perspective underlying the proposed monitoring program. For demography, Carley points out the concern of

SIMPLIFIED STEPS IN THE ISSUE TO REVIEW PROCESS

FIGURE 30

Source: Carley, M.J. 1984. Cumulative socioeconomic monitoring.

native people over alterations in the native/non-native ratio in the region. He indicates also that under most development plans, "the natives risk becoming a minority to what is essentially a rotating non-native population." He also stresses the problems inherent in available census data for native communities and the inappropriateness of five-year sampling increments in a rapidly growing region.

Carley describes urbanization and industrialization as, "the most pervasive cumulative effects in the region." He adds, "many people, native and non-native, are strongly aware that, although these changes, may be incremental from year to year, over the last three decades they have resulted in profound changes in the northern way of life." As measures of this change, Carley cites air, road, and barge traffic volumes; details concerning future development projects; local vehicle trips and vehicle registrations.

For municipal reactions to growth and change, examination of municipal budgets and plans is suggested. For employment a variety of indicators, both for possible employment and training and existing employment and training are recommended. To study the high drop-out rate of native employment, exit interviewing is recommended as a data-gathering tool. Data definition by skill category is recommended. A series of indicators monitoring native business development are also recommended. To account for income and cost of living differences a series of indicators is recommended.

Despite the lack of reliable data on native subsistence harvests, the importance of collecting and analyzing such data is pointed out. The individual variations in harvest patterns of villages and communities are pointed out as a sampling problem. The cultural conflicts accompanying educational policies and practices are also singled out for monitoring, along with indicators related to the media (i.e. hours of regionally oriented programming as a proportion of all programming).

Social indicators are also presented for welfare dependency, family life, health, alcohol related social problems, juvenile mental health and suicide, public safety and housing.

In conclusion, Carley has taken a significant step towards designing a culturally relevant cumulative impact monitoring program designed to accommodate regional changes in social, economic and cultrual aspects of native life arising from the multiple projects projected for or currently occurring in the Canadian Arctic. Much of this approach appears to be readily transferable to the Alaskan Arctic.

B

STUDIES WITH NO DIRECT RELEVANCE

Kupfer, G. and C.W. Hobart. 1978. Impact of oil exploration work in an Inuit community. Arctic Anthropology. 15(1):58-67.

Summarv:

The authors report on an independent assessment of the impacts of an Inuit employment program provided by Gulf Canada for residents of Coppermine on the Canadian Arctic coast. Gulf established a program to hire Inuit residents to participate in a winter exploratory drilling project in the McKenzie Delta. The researchers used focused, saturation interviews to determine the social and economic impacts of the employment program on the community. They characterize their research as "exploratory, suggestive. ..in a hi-cultural situation where misunderstanding is very easy." The researchers attempted to collect data to enable a comparison of Coppermine before and after the Gulf work program. They concede that, "one cannot easily assess changes at the social-psychological level because of the research intricacy in a hi-cultural setting."

The authors assess the economic impact of the employment program, reviewing changing expenditure habits, effects on subsistence hunting, impact on community social life, family impacts and health impacts. They conclude, "our research revealed that the overall effect of the Gulf employment program was positively perceived and assessed by the Inuit and white residents. On a short-term basis, this work program has had many positive features. Only time and future research will reveal the long-term implications of the employment for Coppermine."

This research report illustrates the difficulties of conducting impact assessments of economic changes in Arctic native communities. It has relevance to cumulative impact assessment in pointing out the pitfalls and cultural relativity of research on social and economic change in native communities affected by Arctic oil and gas exploration. However, no cumulative impact methods were presented or utilized. This article has no direct relevance to this project.

Alaska Highway Pipeline Panel. 1979. Initial impact assessment: Dempster Corridor. Prepared for Foothills Pipe Lines (Yukon) Ltd., Winnipeg, Manitoba.

Summary:

This report presents an impact assessment of the biological, physical and social impacts of the planned construction and operation of the Dempster Highway natural gas pipeline. The Alaska Highway Pipeline Panel is an independent panel funded by Foothills Pipe Lines (Yukon) Ltd. The socioeconomic impact assessment singled out six parameters (listed in order of importance) of impact by the project upon the life patterns and economy of the native people of the Mackenzie river delta. These are: emotional well-being (individual and community); government management (local and regional versus 'absentee'); native land use; ownership (of land and resources); native organization or management; and land development and use.

The panel believed that the activities generating impact in order of importance would be: consequential support activities; oil and gas exploration; and pipeline construction and other development. The report states, "if sufficient gas and oil reserves are found to warrant transport to the south, it matters not too greatly to the Delta people whether the Dempster Line as proposed is built. Some mode of transportation will be found. The Delta area will be changed irrevocably, with a complex of gathering lines, gas plants, wharves, roads, airfields and the like. That is the real dilemma that faces the people of the Delta."

In review of emotional well-being, the assessment points to, "pride in one's background, pride in being good at something, and doing it, a belief that one's life has meaning and a belief that there is hope for the future." The report also cites the importance of the feeling of the ability to control change and to control in some measure the direction of one's life. They indicate that the denial of this choice, through the destruction of a way of life, can not be ever adequately compensated.

The authors point out that, "the construction and operation of roads, air-strips, barges, wharves, gravel pits and camps do not lend themselves to ready control. They are widely spread; the activities take place over more continuous and longer time frames and with greater opportunities for human error, disregard or incompetence. Impact upon the natural environment would be very pervasive, with consequently greater possibility for impact upon resources important to the local economy. As oil and gas are found, drilling activities will increase, with significant spin-offs. This activity will have many benefits but it will likely cause substantial problems, mainly for native people arid with respect to land use and reserves."

The report's appendices provide detail on the methods used in preparing the impact assessment. A large number of workshops was held to encourage public participation, to develop and process information independently of any level of government, and to summarize available socioeconomic data by impact class and degree of significance. A detailed study of the impact of the Dempster Corridor project on the Mackenzie Delta was also undertaken. This helped to strongly incorporate the views and perceptions of the region's Inuvialuit and Indian people. The conclusions of this work were summarized in a series of impact matrices. The interesting thing about these summary matrices is that they illustrate that an impact can be simultaneously beneficial for industrial society and adverse for native traditional society. Summary matrices ranking the relative importance of impacts to human environmental parameters (i.e. emotional well-being, etc.) from development activities (oil and gas exploration) were also constructed.

Although this assessment did not avowedly discuss cumulative impacts, its scoping of the project to consider the range of development activities occurring and the range of potential primary and secondary social, economic and cultural impacts of the development activities is significant. However the authors acknowledge, "The socio-economic system within which any intervention occurs is so incredibly complex that the full extent of the intervention's impact upon it eludes assessment. At best, then, one must be content with something less than a complete assessment of socio-economic impact. The approach adopted here to come to grips with this problem has involved progressive disaggregation of the socio-economic system into ever more discrete and comprehendible units...via this process a minimal list of social and economic factors requiring attention was developed. Time militated against our addressing even this minimal list, however, and it proved necessary to prioritize within it and develop a short list of factors to be addressed." The authors thus limited their review to nine key areas of potential socio-economic impact which were investigated more throughly. The authors state, "For the Native Peoples the land is more than simply a source of food or cash. The land itself constitutes a permanent sense of security, well-being and identity. For generations, this land has defined the basis of what the natives are as a people. In their own words, 'Our land is our Life'."

Although lacking a generalizable method, this report does consider the cumulative impacts of potential large-scale oil and gas development on northern native communities. As no cumulative impact assessment method was presented, this report has no direct relevance to this project.

Blishen, B. et al. 1979. Socioeconomic impact model for northern development. Research Branch Corporate Policy, Indian and Northern Affairs, Canada, Ottawa, Ontario.

Summary:

This report provides a model of the socioeconomic impact of industrial development on northern communities. The report is based on work done in a small sample of predominantly native communities in northwest British Columbia. The conceptual model was tested by applying it to these communities. On the basis of experience gained in the tests of the model it was modified. The authors model underpinning their socioeconomic impact assessment technique was designed to be "idiographic" rather than "nomothetic" in character. The model is based on a series of objective indicators related to these aspects of community status: 1) economic viability; 2) social vitality; and 3) political efficacy. The study identified a series of indicators for each of these factors, identifying those which represented key variables, and evaluating community processes in terms of strengths or weaknesses using a scaling technique (polar-ordinates). A community "competency index" is prepared by summing the three key variable values. This report does not present a cumulative impact assessment method. This report has no direct relevance to this project.

Federal Environmental Assessment Review Office. 1979. Alaska highway gas pipeline: Yukon hearings (March-April 1979). FEARO, Government of Canada. Ottawa, Ontario.

Summary:

This report details the findings of the Environmental Assessment Panel's Yukon public hearings on the proposal by Foothills Pipe Lines (South Yukon) Ltd. to develop the Alaska Highway Gas Pipeline Project involving construction of a natural gas transmission pipeline and ancillary structures along a route paralleling the Alaska Highway between the Yukon-Alaska border and the Yukon-British Columbia border. The Yukon public hearings were held to receive comments from individuals and organizations on the EIS prepared by the project proponent, the socio-economic and environmental terms and conditions prepared by the Northern Pipeline Agency and other pipeline-related matters, No review of socio-economic concerns was made in this report. This was largely due to the refusal of affected Indian populations to participate in public hearings until land claims have been settled.

The Panel does recognize the importance of cumulative impacts of associated projects in addition to the pipeline itself. The proponent's EIS is criticized for failing to consider other associated projects and their cumulative effects. The report states, "Where there are interactions between the gas pipeline and such projects as the Dempster Lateral Pipeline, the proposed Foothills oil pipeline, Northern Canada Power Commission power projects, including transmission facilities, the Shakwak Project and Alaska Highway reconstruction, the Panel requires a discussion of potential impacts with particular emphasis on cumulative environmental impacts and suitable " mitigation measures." No methods for such cumulative impact assessments are suggested however. This report has no direct relevance to this project.

Gamble, D.J. 1979. Destruction by insignificant increments. Arctic offshore developments: the circumpolar challenge. Northern Perspectives. 7(6):1-4.

Summary:

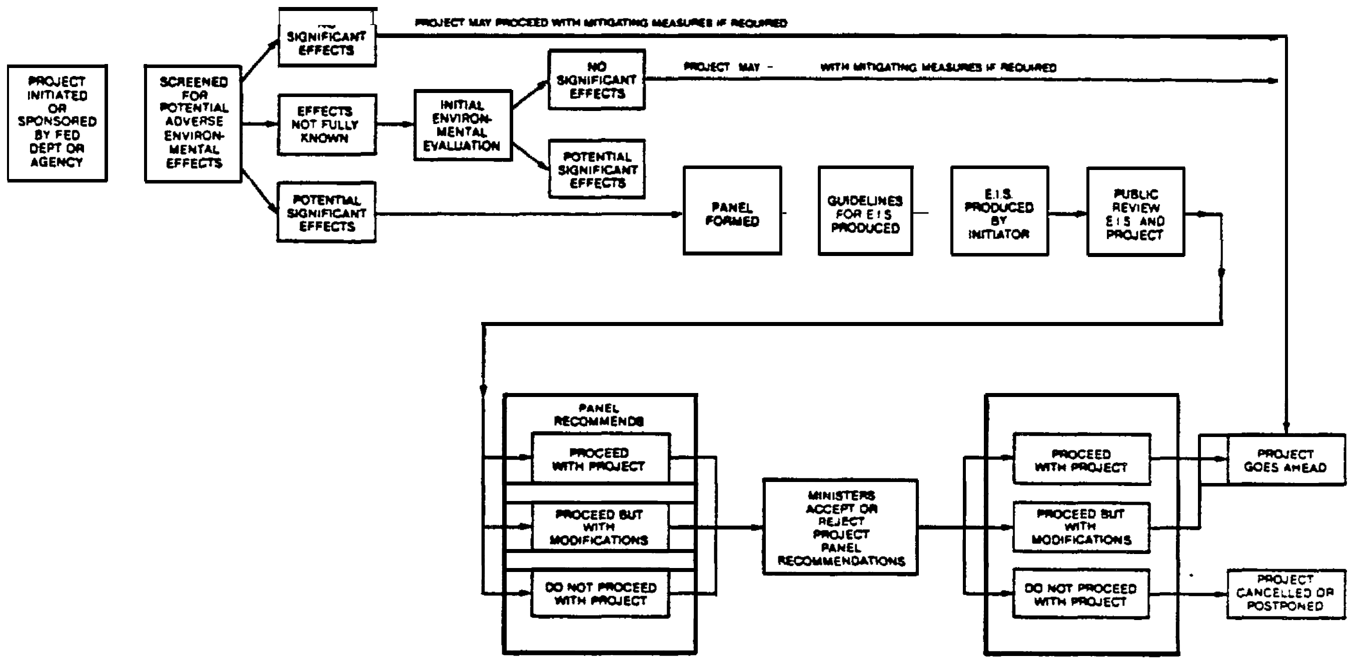
This article urges the Canadian government to establish a long-term research and planning mechanism to assess the environmental impacts of arctic offshore oil and gas exploration and development. The justification for such a program is substantiated by reference to "the multiplier effect of individual industrial developments. Even the most well-studied and reputedly limited projects have a way of growing in their own right and providing spinoff effects. The end result is not what any individual proponent would have forecast." Although cumulative impacts are implicitly the source of concern in this article, no specific methodology is proposed to address them, other than a comprehensive long-term research and planning program. This article has no direct relevance to this project.

Federal Environmental Assessment Review Office. 1979. Revised guide to the federal environmental assessment and review process. Minister of Supply and Services, Canada. Ottawa, Ontario.

Summary:

This document presents an overview of the Canadian environmental assessment and review process. The steps in the process are described and elaborated and shown on Figure 31. The process is a comprehensive one including up to three

SCHEMATIC DIAGRAM OF THE FEDERAL ENVIRONMENTAL ASSESSMENT AND REVIEW PROCESS



Source: Federal Environmental Assessment Review Office. 1979. Revised guide to the federal environmental assessment and review process.

FIGURE 31

sequential review stages--the initial assessment, the formal review and the public review process. Not all of these steps are undertaken for all proposed projects. No mention is made of requirements to consider cumulative impacts or of multiple projects occurring simultaneously in a region. The guidelines do call for review of "any environmentally-related social consequences of the project." This report has no direct relevance to this project.

Federal Environmental Assessment Review Office. 1980. Arctic pilot project (northern component). FEARO, Government of Canada. Ottawa, Ontario.

Summary:

This report summarizes the review of the Environmental Assessment Panel who evaluated Petro Canada and Dome Petroleum Ltd.'s proposed Arctic Pilot Project to produce, liquefy and transport natural gas from the Drake Pt. field on Melville Island in ice-breaking tankers for shipment to eastern Canada. The report presents findings based on a review of Dome's EIS, a socio-economic statement and a series of public hearings in affected communities along the shipping route. The project location itself is 400 km. west of Resolute, the nearest community.

The report includes a section on the human environment that reviews socio-economic impacts. The Panel recommends that more attention be given to assessing the socio-economic impacts of the project and to conducting appropriate long-term research. As the project proponent included in the proposed project a socio-economic policy that includes a stated employment policy encouraging recruitment of Inuit for rotational employment, the Panel concludes that considerable additional study is needed of the positive and negative impacts of Inuit rotational employment, "including related community impacts and the overall effects on Inuit sociocultural preferences and life-styles." The Panel recommends that long-term socio-economic impact studies be carried out with Inuit expertise.

Although this report does not explicitly consider cumulative impacts, it does provide interesting insights into the needs of social, economic, and cultural impact assessments for petroleum development projects in Arctic settings. The activities of Panarctic Oil Ltd., Nanisivik Mines and Arvik Mines taken in conjunction with the Petro Canada Arctic Pilot Project could form a good basis for conducting a cumulative impact assessment on Inuit communities in the vicinity of Resolute on Cornwallis Island. No methodologies for performing cumulative impact assessment are presented. This report has no direct relevance to this project.

Hardy, D.R. 1981. Community Impact Assessment: a perspective on practice. Environmental Impact Assessment Review. 2(3).

Summary:

This article, through a review of the impact assessment process for a uranium mining project near Elliott Lake Ontario, describes the first social and community assessment reports prepared for the project and recommends improvements in the practice of social and community impact assessment. Hardy does not explicitly address the concept of cumulative impact or provide any guidance on cumulative impact methods. This article has no direct relevance to this project.

Federal Environmental Assessment Review Office. 1981. Northern Wells oil-field development and pipeline project. FEARO, Government of Canada. Ottawa, Ontario.

Summary:

This report presents the results of the Environmental Assessment Panel's review of the Esso Resources Canada Ltd. and Interprovincial Pipe Lines (N.W.) Ltd. proposal to expand oil field production at Norman Wells, Northwest Territories (NWT) and to construct a pipeline from there to Zama, Alberta.

The Panel reviewed the EIS and sought comments on the proposed project from the public and technical reviewers in a series of public meetings including ones in 12 communities in the project area. The Panel's assessment included consideration of economic and social concerns of residents of the project area, especially the Dene Indians of the Mackenzie Valley.

Considerable discussion of social, economic and cultural costs and benefits is contained in the report including extensive analysis of the project on the dual society in native communities living partly in the wage economy and partly on the land. The report states in its review of social concerns raised by the project:

"The roots of the Mackenzie Valley society are found both in the native land-based economy and culture, and in the intruded industrial and urban lifestyle and value system of southern Canada. Because of the intrusion, conflict, change and compromise have been imposed on the native people." The result is that in economic and material terms, they are at a disadvantage. Furthermore, they are disproportionately represented in the statistics on medical , mental health, and social problems. The Norman Wells pipeline project is an addition to the intrusion of the industrial and urban system that brings further change and raises social concerns in the native society. Planning and control of the Norman Wells project must work to assign more of the economic benefits and fewer of the social costs to these people."

As a result of a careful analysis of the social and economic costs and benefits of the project the Panel recommends careful management of the project to limit adverse social and economic impacts and to allow native communities to participate to the maximum extent possible in the economic benefits of the project's economic stimulus to the region. A series of specific recommendations is made to address different areas of social, economic and cultural concern arising from the project.

No specific mention of cumulative impacts or methods for their assessment is made in the report. However, the Panel takes both a historical and projective view of social and economic impact assessment and recommends mitigating measures to help cope with most of the foreseeable adverse cumulative social, economic and cultural impacts presented by this and other regional projects. This report has no direct relevance to this project.

Praxis, A Social Planning Company, Ltd. 1982. Resource community study. Canstar Oil Sands, Ltd., Calgary, Alberta.

Summary:

This study was designed to help Canstar Oil Sands, Ltd. prepare and develop its housing policy and corporate community positions regarding a proposed oil sands development project in northeastern Alberta. The study was designed to survey five Canadian "new towns" developed in response to major resource development projects to assimilate and build upon the experience of these communities in helping Canstar establish such a "new town" to house workers in connection with its proposed project. While the report identifies a number of beneficial and adverse impacts associated with such communities, the findings are not directly relevant to North Slope Borough communities or to the assessment of the cumulative impacts of petroleum development. This report has no direct relevance to this project.

Milne, G.G.D., W. Sheridan, and R. Shields. 1982. Government regulatory capability in the Beaufort Sea, Nepean development consultants. Beaufort Sea Alliance, Ottawa, Ontario.

Summary:

This report, commissioned by the environmental interest group, The Beaufort Sea Alliance, was undertaken to review the capability of the Canadian government to respond effectively to recommendations of the Beaufort Sea Environmental Assessment Panel regarding potential hydrocarbon developments in the Beaufort Sea region. No discussion of the concept of cumulative impacts or of methods for the assessment of the cumulative impacts of development is made. This report has no direct relevance to this project.

Dome Petroleum, Ltd. et al. 1982. Hydrocarbon development in the Beaufort Sea-Mackenzie Delta Region. Socioeconomic effects. Vol. 5. Dome petroleum, Ltd. , Calgary, Alberta.

Summary:

This report is one volume of the multi-volume EIS prepared by proponents of oil and gas development in the Beaufort Sea - Mackenzie Delta region. The objectives of the socioeconomic report was: to clarify and predict the possible magnitude and nature of oil and gas generated growth in the northern territories; to demonstrate how such growth may affect northern populations, economic structures and social institutions; and to recommend policies that would enhance the positive and beneficial aspects of oil and gas development and mitigate the negative aspects. The report is divided into 14 chapters that provide a comprehensive view of the socioeconomic aspects of possible oil and gas development on the region.

A background summary of the region's key affected native communities is provided along with a detailed description of the traditional economy. The future of the region without hydrocarbon development "is projected, based mainly on an extension of the renewable resource-based traditional economy. A discussion follows of the various possible development scenarios for hydrocarbon development along with related construction and operations employment effects. Then a chapter is devoted to describing the likely effects of development on the region over a 20 year period including: increases in community capital and human resources; effects on regional employment and income; growth of the business sector; transportation impacts; community level problems; potential conflicts with native harvesting; and government responsibilities.

The report also includes a chapter stating the present and proposed industry socioeconomic policies for the Beaufort region including: interaction with traditional harvesting, local employment and business development, education and human resource planning, and land use planning and coordination.

The report concludes with a series of chapters devoted to other regional areas likely to be affected by the eventual scale of hydrocarbon development including: the inland corridor communities of the Mackenzie Valley, northern supply regions (Yukon, the Great Slave Lake region, and the Northwest Territories), Parry Channel communities, Baffin Bay-Davis Strait communities, and Alaska. This initial EIS was soundly criticized by the Beaufort Sea Environmental Assessment Panel. In its Deficiency Statement, the panel criticized the EIS for, "failure to consider cumulative impacts." This report has no direct relevance to this project.

Canadian Resourcecon Ltd. 1982. A renewable resource compensation program for the Northwest Territories: review of policy options. Department of Renewable Resources, Government of the Northwest Territories, Vancouver, B.C.

Summary:

This paper was prepared to help devise an appropriate compensation policy for the loss of fish and wildlife resources resulting from non-renewable resource developments. Such a process. is required since under existing Canadian legal and political institutions, commercial harvesters are recognized to have no proprietary interest in the land base. Consequently commercial harvesters are unable to pursue compensation through the legal system for environmental damages arising from competing land uses. Continuation of this situation will mean that the social and environmental costs of northern development will be borne by trappers, commercial fishermen, guides and outfitters, rather than by those companies undertaking northern development. This report is an example of the Canadian government's commitment to address the social and economic impacts of northern development projects. It does not, however, address cumulative impact assessment methods. This report has no direct relevance to this project.

White, P.M. 1982. The essential elements of social impact assessment. Beaufort Sea Alliance. Ottawa, Ontario

Summary:

This paper presents the requisites of an adequate EIS and social impact assessment from the standpoint of the Beaufort Sea Alliance, an environmental interest group. The seven essential socioeconomic issues the author believes must be included in an SIA of northern hydrocarbon development are: development and ongoing change, land claims, role of government, public participation, alternative patterns of development, local business and the boom/bust cycle, and amelioration/mitigation strategies. The paper was prepared to aid the Beaufort Sea Environmental Assessment Panel in its guidance to project proponents in preparing its EIS and component SIA.

The article points out the considerable difference that exists between "the concept of the ideal model of SIA and the actual practice of social impact assessment." White points out that SIA involves, "the application of social science theory and methodology to the areas of social planning and social policy." "SIR is not politically neutral nor is it a value-free form of inquiry; nonetheless, SIA is not an arbitary process." She describes SIA as requiring, "both social scientific and social policy judgments as to the magnitude and socioeconomic consequences of externally induced social, cultural and economic change." "Thus, both qualitative and quantitative assessments of change and impact are considered." She also points out that, "public participation and input are crucial components of impact assessment."

She raises several important issues that should be included in the SIA processes surrounding northern development. These are discussed here. She feels that, "issues such as the desire of local residents for the maintenance of the community and regional social, cultural and economic options and the opportunity to develop adaptive strategies which permit access to differing wage and subsistence patterns should be discussed, assessed and evaluated." She criticizes the "engineering approach" to quantification of social phenomena. "This approach leads to social accounting and not to an understanding and appreciation of the complex and interrelated issues of social and economic impacts."

She argues for "community managed development" based on the model of the Shetland Islands. She feels that giving the community the opportunity to make effective input into a project also favors a less confrontative approach to ultimate development. The author's Appendix A reviews several SIA methods including: cost/benefit analysis, risk analysis, participant observation, modeling techniques, and community case studies. The article then reviews in greater detail each of the seven topical areas requiring SIA and the justification for them.

In her discussion of the need for analysis of industrialization, development and ongoing change, the author states, "the assessment of the potential Beaufort Sea Hydrocarbon development impacts should be seen in the light of past and continuing events that have served to constrain the Native way of life and to create socioeconomic tension and problems in northern communities." This concept is certainly broad enough in scope to encompass the cumulative impacts of development. However, none of the methods discussed consider cumulative impacts. The author states, "Analysis of this social impact issue should focus on the components of the native way of life and social relations that differentiate it from the industrial mode of production and social relations. Continued industrial development in the region should be examined in the light of the maintenance of socioeconomic and cultural options: for example, in what areas has the native way of life already been rendered marginal; in what areas has the native way of life developed adaptive strategies; and, what are the probable consequences of the intensification of industrial development. Currently, there appears to be the opportunity of socioeconomic choice and flexibility whereby some individuals can operate within the, native economy and at other times within the industrial system. The continuation of such an availability of options is an important socioeconomic issue for northern residents. Thus, the Impact Statement should demonstrate an understanding of the socioeconomic options, as well as, provide for a strategy for their continuation and enhancement."

While this article addresses several important component areas required for adequate social impact assessment of northern hydrocarbon developments, it merely provides guidelines and areas of concern needing to be addressed in such assessments. It does not, however, supply any methods for conducting cumulative impact assessment although the importance of assessing the cumulative social, economic and cultural impacts of industrial development is alluded to. This report has no direct relevance to this project.

Lawrence, C. ed. 1983. The Beaufort Sea social impact assessment process: an overview. Federal Environmental Assessment Review Office. Vancouver, B.C.

Summary:

This article provides a summary overview of the Canadian Beaufort Sea environmental assessment process and the role of social impact assessment within it. It recounts the history of the Beaufort Sea Environmental Assessment Panel's review of the oil and gas exploration and development process proposed by Dome, Gulf Canada, and ESSO Canada. It describes the uniquely independent character of the Beaufort Sea EARP panel, its guidelines for preparation of an EIS and the panel's review of the industry's draft EIS (reviewed earlier). It details the Statement of Deficiencies issued by the panel in March, 1983, which criticized the EIS for among other things, "failure to consider cumulative impacts." Although the panel did provide additional guidelines for the preparation of a Supplementary EIS, including requirements for the submission of "Zonal Summaries" on each of the distinct socio-cultural communities separately affected by the proposed project, no discussion of cumulative impact assessment methods was made. The article also presents excerpts from the Supplementary Information volume on socioeconomic issues released in June, 1983, and excerpts from a Beaufort Sea Alliance paper prepared by Robert Gibson on "Values, Interests and Preferences: Non-factual considerations in the work of the Beaufort Sea Environmental Assessment Panel." This report has no direct relevance to this project.

Dome Petroleum, Ltd. 1983. The Canada benefits of the Beaufort exploration program, 1982-1987. Final Submission. Dome Petroleum, Ltd., Calgary, Alberta.

Summa ry:

This report outlines Dome petroleum Ltd. 's, commitments to maximize the Canada benefits arising out of exploratory drilling activity in the Beaufort Sea region. It outlines policies and programs including those directed at alleviating or managing the adverse socioeconomic impacts of Dome's activities on Inuit communities. The report discusses Dome's current investment in regional economic development and addressed future commitments to: community liaison and consultation, social and cultural considerations, and a monitoring process. Dome is committed to: hiring local, native workers to fill" 20 to 25% of its employment needs; to give priority to skills training and upgrading to northerners; to continue awareness interface with northern communities and associations; to support northern social and cultural programs; and to establish a socioeconomic monitoring program. No discussion of cumulative impact methods is made. This report has no direct relevance to this project.

Dome Petroleum, Ltd. 1983. Beaufort Sea operations, northern affairs, 1983 socioeconomic action plan. Dome Petroleum, Ltd., Northern Affairs and Socio-economic Programs Group, Calgary, Alberta.

Summary:

This report outlines the policies and programs adopted by Dome Petroleum, Ltd. to fulfill its goals of managing the socioeconomic impacts of its Arctic exploratory drilling program. The prime objective of the program is to develop opportunities for northerners to participate in Beaufort Sea oil and gas development in a variety of ways. It includes a review of such areas as: Northern employment, training and business development, community consultation and information, northern cultural and social programs, environmental protection, and monitoring. It does not assess cumulative impacts per se but rather provides a management policy to help the company address identified areas of social , economic and cultural concern on the part of affected Inuit residents of the Beaufort Sea region. This report has no direct relevance to this project.

Chamberlain, J.E. 1983. Native land claims and northern hydrocarbon development in the Beaufort Sea - MacKenzie Delta Region. Beaufort Sea Alliance, Ottawa, Ontario.

Summary:

This article reviews the interrelationships between the unsettled aboriginal land claims of: the Inuit of the Western Arctic; the Dene Nation and Metis Association of the Mackenzie Valley; by the Council for Yukon Indians; and by the Inuit Tapirisat of Canada in behalf of the Inuit of the Central and Eastern Arctic and the proposal for hydrocarbon exploration, development and transportation made by oil companies. The paper urges the Canadian government and the Beaufort Sea Environmental Assessment Panel to accord political priority to the native people's unsettled claims and to also include the concept of "community risk" in the socioeconomic assessment process. No mention is made of cumulative impact assessment methods or concepts. This report has no direct relevance to this project.

Dome Petro"lcum, Ltd. 1984. 1983 socioeconomic evaluation (draft), Calgary, Alberta.

Summary:

This document reviews the actual accomplishments of Dome under its Socio-Economic Action Plan during 1983. The report details activities in: northern training; northern business development, social and cultural support; and consultation and information. No cumulative impact methods are presented. This report has no direct relevance to this project.

Couch, W.J., J.F. Henity and R.E. Munn. 1983. Environmental Impact Assessment in Canada. In Environmental Impact Assessment. PADC Environmental Impact Assessment and Planning Unit (cd.). University of Aberdeen, Martin Nijhoff Publishers, Boston, MA.

Summary:

This paper presents an examination of Canadian approaches to environmental impact assessment (EIA). It includes discussion of the key factors of the Canadian EIA processes, from project screening to formal public review, the relationship of EIA to planning and regulatory activity, the status of the scientific method, and the related issues of social impact assessment and public participation. The article discusses the growing role of EIA in land use and resource planning, citing the Lancaster Sound Regional Study as an example. It also reviews recent research into the scientific bases underlying EIA - one important conclusion of research undertaken by Burton and Whyte at the University of Toronto is that "different groups may perceive benefits and disbenefits quite differently, even when they have used the same data." No discussion is made however of the concepts of cumulative impact or of methods for their assessment. This article has no direct relevance to this project.

3.6 Native American Literature

A review of the available literature concerning the impact of energy development on Native Americans confirmed the earlier finding reported by Mountain West Research (1981) and Jorgenson, et al. (1978) that there are relatively few studies which address the impact of energy development on Native Americans and the focus of this work is on reservation residents. Much of the work that has been done is by anthropologists and has an ethnographic character. In general, much of the anthropological literature lacks general inability and much of it does not focus on what are now considered the standard techniques of social impact assessment.

Most recently, a uniquely Indian SIA has been evolving. However, it should be pointed out that what constitutes an SIA may vary greatly from setting to setting and that indeed the Native American cultures still active today are diverse and vary greatly from tribe to tribe so that generalization is difficult. Attitudes towards development also vary greatly as do the parameters and boundaries of the development situations themselves.

While a review of the Native American impact assessment literature was of value to this project, little emphasis has been placed on cumulative impacts in the sources reviewed. The nature of development projects appears to have been rather singular in some cases (i.e., coal mine development) but in others significant numbers of projects suitable to cumulative impact assessment were proposed. Nevertheless, no generalizable or readily apparent approaches to cumulative impact assessment were discovered. It is recognized however that the concepts underlying cumulative impact have tremendous importance to Native Americans despite the fact that methods for their operational ization may not be available.

Although this literature review revealed no viable cumulative impact assessment methods, two studies, Boggs (1978) and Geisler et al. (1982), provide valuable insights into current tribal involvement in and management of American Indian SIA for major resource development projects on reservations.

RELEVANT STUDIES

B

Boggs, J.P. 1978. Relationships between Indian Tribes, science and government in preparing environmental impact statements. Northern Cheyenne Research Project Paper Series, Lame Deer, Montana.

Summary:

This paper is important because it describes the failure of environmental impact statements (EISs) as proposed under NEPA, to meet the needs of Indian tribes. It provides an extended example of how EISS are inappropriate and consequently doomed to failure for major policy roles on reservations. Reservations are unique in numerous respects. They are somewhat independent political and enonomic entities, yet remain vulnerable to regional social change and to decisions arrived at in other locations. They are culturally distinct from each other as well as from the larger society, hence generalizations are not always universal or applicable to any particular reservation. However, the law attempts to make EIS information universal, applicable, and legally binding even in conditions where it is inappropriate.

Boggs proposes a special variety of EIS on reservations which is tailored to the unique meanings of the tribe. Tribal members' interpretations of land, resources, and way of life must be taken into account on their own grounds, not from formalized definitions provided by other interpretive systems, Boggs maintains. Moreover, the effects of off-reservation development upon tribes must be provided in the EIS, since the long-term impacts of adjacent development may be potentially devastating to tribes. Boggs calls for a close coordination of scientific and legal analyses. Although this paper does not present any cumulative impact assessment methods, it does underscore the important role which tribal members should play in any impact assessment. This article has limited relevance to this project.

Geisler, C.C. et al. eds. 1982. Indian SIA: the social impact assessment of rapid resource development on native peoples. University of Michigan Natural Resources Sociology Research Lab Monograph #3 (Ann Arbor).

B

Summary:

This book is a compilation of papers from a conference held in 1980 on Indian SIA. The participants shared SIA experiences related to a host of rapid resource developments: pipelines, powerlines, impoundments, jetports, mines, tourism, power plants, waste disposal sites, and highway extensions. The book is organized as several clusters of regional case studies, preceded by general perspectives on SIA in the U.S. and Canada. Section I deals with adopting SIA to unique Indian circumstances, Section II with U.S. Indian SIA case studies, Section 111 with Canadian SIA case studies and Section IV with Native American SIA case studies. Despite its focus on SIA, the book also discusses other options for empowering Indian Tribes in resource development processes. Some of these are summarized in Table 2.

It is obvious from reviewing the case studies contained in this book that Indian SIAS are very recent. The process of incorporating Indian values and credibility into environmental and social impact assessment processes is now rapidly evolving in numerous settings among indigenous peoples of North and South America. One is impressed with the diversity of ongoing Indian-controlled assessments of development activities occurring on their lands and of their resources. These projects demonstrate, as Green points out in her introduction to Section I, "that technology can be subject to human needs and that the traditional peoples can be the engineers, rather than the recipients of social change. These projects insist that tribal people should be the primary participants in the evaluation process and that nontribal specialists should be brought in only when necessary." She points out, "self-determination for Native peoples is the controlling assumption in these efforts, and conflict resolution, rather than exacerbation, is the mode of assessment." She stresses, "no single impact assessment model is appropriate for all communities."

The article by Craig and Tester urges that institutional analysis be a basic part of SIA since "SIAs which do not include the assessment of institutions which effect outcomes are a perpetration of empty promises and false hopes." "SIA must examine the 'buffering capacity' of Native communities themselves." They conclude that SIAS must pay more attention to "Native

TABLE 2
INDIAN RESPONSES TO RAPID RESOURCE DEVELOPMENT PROPOSALS

	Strengths	Weaknesses
1. Legal Assistance	a. Protection in signing vital documents (*e.g.*, **leases**) b. Litigation a strong "back-up" cool c. Tribe probably better equipped to deal with government and corporations	a. Expensive b. Few non-Indians really good at law c. Can subvert more sustained reservation organizing efforts (i.e.. "leave it to the legal experts")
Examples:	Successful use of Class I air quality zone by Northern Cheyenne; Navajo suit against United Nuclear Corporation for radioactive contamination of Rio Puerto.	
2. Mediation and Review Commissions	a. Helpful in breaking deadlocks b. Can help equalize power where it has been imbalance	a. Few precedents for tribes to examine b. "Expert syndrome" (see "C" above)
Examples:	Successful resolution of Lake Superior fishing dispute between Red Cliff Chippewa and Wisconsin Department of Natural Resources; the Berger Commission review and postponement of Mackenzie Valley Pipeline; Native American Heritage Commission of California with override authority on state development projects in California.	
3. Networking and Coalition Building Among Indians	a. Share research and legal expenses; often of benefit to non-member tribes b. Present united front in imposing assorted taxes or in setting prices c. Strong negotiating position vis-a-vis corporations for job training programs, high environmental standards, services, etc.	a. Can become exclusionary and widen gap between resource-rich and resource-poor tribes c. Can reduce power of individual tribes or minority factions within the tribes
Examples:	American Indian Environmental Council; Indian Brotherhood of the Northwest Territories; Council of Energy Resource Tribes; Inter-tribal Councils; Indian Planning Consortium of Central California; Six Nation Iroquois Confederacy; Committee for Original Peoples Entitlement; Inuit Tapirisac of Canada; American Indian Movement; Consejo Indio de Sud America.	
4. Networking and Coalition Building With Non-Indians	a. United fronts are effective in passing and amending legislation, in influencing hearing examiners and in sharing organizing and publicity costs b. Can deepen dialogue and reciprocal respect among Indians and non-Indians	a. Ephemeral and often oriented to single issues b. Require certain compromises--usually more by weakest coalition members
Examples:	Utah and Nevada Tribes working with Mormons and conservationists in opposition to MX; Upper Skagit Coalition Opposed to Upper Skagit Nuclear Plant; American Friends Service Committee in Pacific Northwest; Black Hills Alliance.	
5. University\. Joint Research Efforts	a. Subsidized research and planning assistance b. Practical reservation experience and exposure for Indian and non-Indian students c. Expanded Indian sophistication within the academic community	a. Research is preprofessional and requires supervision. b. Students may be intrusive with respect to private or sacred matters c. Academic pressures to publish may confuse research priorities
Examples:	Field programs offered by Navajo Community College at Shiprock; Colville-SIA project through Native American Studies Program, Washington State University at Pullman; UCLA M.A. program in Native American Studies an-d Planning; University of Oregon graduate program in Community Service and Public Affairs for Native Americans; Gitskan-Carrier Indian Land Claims Training Program at Carleton College; Dartmouth College's Native American Science Resource Center; Economic Planning Workshops for Indian Planners at University of New Mexico.	
6. Joint Economic Ventures	a. Provide (potentially) revenues, jobs, income equity (may be controlling) and technology transfers b. Depending on planning and investment strategies, tribe may be able to enjoy long-term dividends and diversify economic base	a. Such venturea can lead to boom-bust conditions and short-lived economic gains b. Faster assimilation and abandonment of traditional culture C. Land and resource base permanently changed and reduced control over residual land base
Examples:	Coal contract with Utah International, Inc.; Colville Confederated Tribes 50/50 joint venture with AMAX at Mt.Tolman, Washington; Northern Cheyenne oil and gas lease agreement with ARCO; Blackfeet Tribe and Dawson Oil joint venture oil exploration agreement.	

TABLE 2 CONTINUED

	Strengths	Weaknesses
7. Self-Management of Native Resources	a. Local economic control and discretion over rate of development, distribution of benefits and diversification planning	a. Tribal welfare may become overly dependent on single source of income generation b. Demands for range of technical and business skills may exceed tribal supply, possibly causing dependence on outside consultant

Examples: Papago copper development in Arizona; Uppar Skagit Salmon Cooperative in Washington; Lummi aquiculture enterprise in Washington; Passamaquoddy tidal power or Papago photovoltaic projects for generating electrical power; Navajo timber enterprises; and Quinault timber and fisheries operation in Washington.

	Strengths	Weaknesses
8. Indian Social Impact Assessment	a. Establishes a data base for tribal use in other program evaluations, law suits or land and water claims b. Expands tribal planning capabilities (social, economic, land use and other resource plans) c. Can train tribal members in research documentation useful in focusing both traditional and modern tribal value systems d. Complements other tribal agendaa of slowing, stopping or advancing rapid resource developments e. Serves to force agency disclosure of treaty or other legal rights chat can then be better defended in the courts	a. Can misrepresent (or not represent at all) Indian values if done without Indian input and consultation; local values simplified and/or distorted as market values b. May reduce tribal sovereignty and control if performed by non Indians c. Native language barriers to 51A concepts and technical language d. Expensive quality data gatherin and analysis costly and time-consuming e. Review of "alternatives" often very circumscribed

Examples: Bad Lake Reserve's 25-year master plan used to generate SIA material; Northern Cheyenne Research Project as a tribally controlled SIA initiative; Mole Lake Chippewa self-initiated SIA of mining developments in Wisconsin; U.S. Air Force SIA of MX missile proposals.

groups as minorities within North American society, recognize their unique relationship to social and political structures, and that project and policy outcomes are functions ultimately of institutional arrangements."

Smith's article urges that tribes adopt an integrated planning approach to select resource development projects that optimize social and economic benefits to tribal members and minimize environmental and other adverse social and economic costs. Boggs presents a case study regarding the role of tribes in NEPA derived SIA based on his experiences with the Northern Cheyenne Tribe. Concerning the need for SIA related to massive planned coal developments on the reservation, Boggs writes, "Many of the most desirable and profitable energy resources are on or near reservations, so questions of Indian cultural heritage and distinctiveness, tribal sovereignty and jurisdiction, and the potential of such projects for relieving reservation joblessness and often desperate poverty also enter the picture. No one should advocate making reservations into museums for preserving quaint but currently anomalous customs at the expense of grinding poverty. But the real issues are much less simplistic. Energy developments may do little to relieve Indian poverty (Owens, 1979; Mooney, 1976), or may actually increase tribal dependency and political incapacity (Cornell, 1980). And it needs to be recognized that currently viable and vital traditional social and cultural forms, and the very existence of tribes as unique local social communities, may be threatened."

Boggs also reviews issues of extension of tribal participation, lack of scientific integrity of government agency and company representatives and general issues of political control of scientific judgments in policy research. He also discusses issues of confidentiality of Indian-related research findings and the need for their control by Indians. He criticizes the role of partisan, politically manipulated research in EISS and concludes that it subverts the intent of NEPA.

West's article reviews what he calls "the identity-poverty dilemma." The dilemma arises in American Indian life when, "a community rejects economic development projects in order to retain cultural identity." He adds that "such adaptive strategies are functional to retention of traditional solidarity but dysfunctional to economic development and release from oppressive poverty." West reviews the attitudes of Indian tribes to provide on-reservation employment opportunities and to limit non-Indian access to the reservations and concludes that greater tribal control over development projects provides a partial answer to resolving the "identity-poverty dilemma."

The various American Indian case studies provided strengthen the case made earlier that Indian SIA controlled by Indians is a valuable management tool for planning for the processes of continuous social and economic change affecting American Indians. The concept of cumulative impact assessment is not directly discussed although responsiveness to energy development in the context of current Indian reservation politics and life often implies cumulative impact assessment of social, economic and cultural impacts prior to the initiation of major development projects. This book is of limited relevance to this project.

STUDIES WITH No DIRECT RELEVANCE

Hackenberg, R. A., and M.M. Gallagher. 172. The costs of cultural change: accidental injury and modernization among the Papago Indians.

Summary:

Using data gathered from tribal records and the Indian Health Service, the authors seek to establish a causal chain which argues that modern environments are more stressful, and that stress causes accidental injury. By assuming accidental injury indexes stress, they proceed to show that in "modern" (i. e., non-traditional) communities, Native Americans are more prone to accidental injury and, therefore, must be more subject to stress than Indians living in more traditional communities. Their argument is that the alien character of modern communities is stressful to Native Americans accustomed to a traditional lifestyle.

The authors are unable however, to measure stress, as distinct from accidental injury. No theoretical framework relevant to cumulative impact assessment is presented. This article has no direct relevance to this project.

Hackenberg, R.A. 1972. Restricted interdependence: the adaptive pattern of Papago Indian society. Human Organization 31:113-125.

Summary:

This study reports the findings of an extensive investigation into the consequences of cultural change and adaptation among the Papago Indians. In this particular paper, Hackenberg attempts to elucidate, very generally, the adaptive strategies with which the Papago have come to grips with the intrusion of non-Indian society into their culture. An analytic distinction is made between two types of adaptive strategies. One is a "centrifugal" strategy which establishes ties to resources and institutions outside the tribal community. The centrifugal strategy is favored by traditionalists because of the values of village independence and geographic mobility. The other adaptive strategy s "centripetal" because it emphasizes cooperation between

villages and includes active partipation in the tribal government established by the Indian Reorganization Act of 1934. Tribal members favoring the centripetal strategy are less traditional and desire to "modernize" the reservation, while centrifugalists are more traditional and tend not to recognize the legitimacy of the tribal government's authority over the village. Using data from tribal records, Hackenberg tests the validity of the distinction between centrifugal and centripetal adaptive patterns. He hypothesizes that traditionalists should exhibit more mobility and be more involved in farmwork than non-traditionalists. The tribal villages are divided into traditional and non-traditional categories, and the rates of mobility and occupational distributions for villagers are examined. He finds that persons from traditional villages are more mobile and more likely to be farmworkers than persons from non-traditional villages. While this study is of theoretical interest to the assessment of the cumulative impacts of development in Native communities, the study has no direct relevance to development of an impact assessment methodology. Therefore, this article has no direct relevance to this project.

Hackenberg, R.A. 1976. Colorado River Basin development and its potential impact on tribal life. Human Organization 35:303-311.

Summary:

The Colorado River Basin is the geographic home of more than one-fourth of all Indian people in the U.S. Therefore, the development of energy resources within the Basin has important implications for the Native American population. However, Hackenberg argues that Native Americans have failed to derive permanent benefits from previous development activities.

Hackenberg is particularly concerned that future energy development will have little more benefit for the Indians than have past water argicultural projects. More particularly, highly technical, capital-intensive, corporate enterprises with low labor requirements will exploit the resources and will create substantial amounts of wealth. However, few of the benefits are likely to go to the individual Native Americans who are most in need. However, tribal corporations which are the counterparts of external corporate enterprises, rather than individual Indians, will be beneficiaries. This article does not present any cumulative impact assessment methods. This article has no direct relevance to this project.

Gray, J.R. et al. 1977. Socioeconomic impacts of coal mining on communities in northwestern New Mexico. Agricultural Experiment Station. Bulletin 652, Las Cruces, N.M.

<u>Summary</u>:

This report examines the socioeconomic impacts of coal development on northwestern New Mexico. The emphasis of the report is on regional impacts, but impacts on the communities of Farmington, Aztec, and San Juan are also described. The analysis concentrates on the economic, demographic, public service, and fiscal impacts of coal development. Relatively little attention is given to the description of social impacts.

The report, however, provides an excellent discussion, and one of the few available in the literature, of the possible impacts of such a development on Native American-white relationships. The author notes a likely increase in conflict as a result of increased white worker settlement on reservation lands. The report thus gives concerted attention to potential Native American-white conflict and describes the perspective of Native Americans toward development. No cumulative impact methods are presented. This report is of no direct relevance to this project.

Jorgenson, J.G. et al. 1978. Native Americans and energy development. Anthropology Resource Center, Cambridge, MA.

Summary:

This is an anthology of articles related to the issues of Native Americans and energy resource development. In the preface, written by Harris Arthur, a member of the Navajo tribe and a former Interior Department official, mention of the importance of cumulative impacts is made. He states, “the combined effects of such issues as Indian water rights, the nation’s energy situation, and the economically depressed conditions of most Indian reservations have accelerated the exploitation of Indian resources in the last two decades. The cumulative effects of these factors have put the Indian people in a dilemma.” However, no method is presented for assessing the net effect of such impacts.

The article by Jorgenson and others points out that EISS concerning projects on Indian lands have not adequately addressed the cultural and social “fabric” and the effects that proposed projects would have. Clemmer's essay on the Muri and coal development on Black Mesa is an informed first person account of possible effects of energy development on Hopi culture. Robbins' article on energy developments and the Navajo nation recounts historical data and is a social impact assessment with cumulative impact overtones. Owens’ article deals with options for exercising tribal control over energy development and to attempt to maximize the positive benefits while minimizing social and economic costs. Little’s article reviews social research on “boom-towns” in western energy development. This book has no direct relevance to this project.

West-Central North Dakota Regional Environmental Impact Assessment Team. 1978. Coal-related impacts to the Fort Berthold Reservation. State of North Dakota, Bureau of Land Management, U.S. Department of the Interior, Bismark, N.D.

Summary:

This technical supplement to a regional EIS (reviewed earlier) attempted to assess the regional cumulative impacts of a variety of coal-related development projects having the potential to impact the Fort Berthold Indian

Reservation. The seven county study area is potentially affected by nine coal mines, three electric power plants, two coal gasification plants and several transmission lines. Although no energy development is proposed for the reservation itself, this study addresses the potential cumulative impacts of off-reservation developments on the reservation's residents, the Three Affiliated Tribes (the Mandars, Arikara, and Hidatsa). The report reviews economic conditions, social conditions and land use. The cumulative impacts of the various projects are not described additively, but as part of development scenarios. Only general qualitative description of most impact is made. No generalized cumulative impact assessment method was used. This report has no direct relevance to this project.

Robbins, L.A.. 1980. Native American experiences with energy developments. The boom town: problems and promises in the energy vortex. University of Wyoming, Laramie, WY.

Summary:

This article reviews some examples of Native American experiences with major energy developments in the recent past. Robbins recounts the sad history of exploitation of American Indians and their resources, and provides brief case studies of current resource development issues affecting: the Navajo tribe, other research organizations and new directions in Native American planning (office of Crow Coal Research, Northern Cheyenne Research Project, CERT), and uranium developments and Native Americans. Although not specifically oriented to social impact assessment, the case examples do illustrate the growing sophistication of affected Indian Tribes in managing adverse social, economic and cultural impacts. He concludes, "the most heartening aspect of today's Native American relationship with their energy resources is that the people are quick to consider their traditional, long-held cherished belief in tribal integrity, family life, community solidarity and profound respect for their lands. These values will remain the central guiding principles of Native American conduct toward energy and technology for a long time to come." No cumulative impact methods are presented. This article has no direct relevance to this project.

Stoffle, R.W. et al. 1981. Establishing Native American concerns in social impact assessment. Social Impact Assessment. 65/66.

Summary:

This paper sets out some methodological considerations in incorporating Native Americans' concerns into social impact assessments of proposed energy development projects. It deals principally with the regulatory mechanisms available to review potential impacts to native cultural and historical resources under NEPA, the Historic Preservation Act and the American Indian Religious Freedom Act. It is focused on tribal settings in the Lower 48 states and problems with incorporating the concerns of non-reservation status tribes into SIA.

The article presents a methodology of "triangulation" using multiple data sources (such as archaeology, documents and oral history) to test the accuracy of research findings. A "mini-survey" technique is also evaluated to help overcome the general distrust of surveys by Native Americans. The authors recommend use of this tool to increase the portion of potentially impacted tribal groups that can participate in a social impact assessment of a development project. The article concludes: "the response of any Native American people to a specific development proposal will be influenced by the group's level of sovereignty, its local history of interethnic competition and its relationship with the Bureau of Indian Affairs." No cumulative impact methods are presented. This article has no direct relevance to this project.

Stoffle, R.W., ad H.F. Dobyns. 1983. Nuvagantu: Nevada Indians comment on the intermountain power project. Bureau of Land Management, Reno, NV. Cultural Resource Series No. 7.

Summary:

This document presents a review of cultural, religious and historic concerns of the Southern Paiute in connection with proposed construction of a power

transmission line across lands of Indian significance. As such it represents a very recent SIA conducted in compliance with NEPA and the American Indian Religious Freedom Act of 1978. Its approach is based on ethnographic research, historical documents and field interviews. It reviews regional Paiute ethnohistory from the precontact period, through Spanish colonialism and early U.S. history. It documents Paiute cultural values and sacred places, reviews their relation to the proposed project and recommends mitigation measures. No discussion of cumulative impact methods is made. This report is of no direct relevance to this project.

3.7 International Literature

A large number of sources were consulted in an attempt to identify books, reports and articles analyzing the cumulative social, economic and cultural impacts of major resource development projects in developing countries in the Third World, particularly in settings where projects may affect or are affecting indigenous or aboriginal peoples. The expectation was that studies conducted in such settings might yield methodological insights into the effects of modern industrial development projects in other "non-western" cultures which might in turn be used to analyze the cumulative impacts of Arctic petroleum development on Inupiat communities of the North Slope Borough. For a number of reasons this was not possible.

When dealing with such a vast, heterogeneous area as the Third World (consisting of over a hundred sovereign political states, with extreme variety in levels of economic development, cultural and physical characteristics) enormous difficulties exist in extracting common lessons to make relevant observations on environmental impact assessment methods. Nevertheless, this process was initiated and completed through a thorough review of the available literature and through networking with social scientists and others interested in environmental impact assessments for developing countries.

While a great deal of institutionalization of environmental policy has occurred in the last decade within developing countries in the Third World and among international organizations (i.e. the World Bank, U.N. Environmental Programme, U.N. Food and Agricultural Organization, U.N. Development Programme, etc.) and bilateral donor aid organizations (U.S. Agency for International Development, GTZ, NORAD, CIDA), the state-of-the-art of environmental impact assessment for projects in developing countries is still considerably less developed than assessment methods and techniques developed in industrialized countries. While the value of environmental assessment and analysis is now widely recognized, a variety of constraints limit its widespread adoption and application in developing countries.

Currently over 50 countries (developed and developing) have legislative requirements for the preparation of environmental impact statements or environmental assessments. However, relatively few developing countries have such requirements and, for those who do require environmental assessments, implementation is a pressing problem. In the absence of an enforced national policy that makes such analysis mandatory in specified situations, actual assessment efforts are either superficial or nonexistent. For those developing countries which do have impact assessment requirements, a variety of factors constrain implementation.

The first constraint is the lack of financial and technical resources to undertake impact assessment. This in turn is compounded by the vast information gaps in many developing countries which hinders effective assessment of the environmental impacts of major development projects. Finally, within impact assessments themselves, relatively little attention has been paid to the analysis of the social, economic and cultural impacts of projects. This is often due to the overtly political nature of social analysis and the fact that most development projects are viewed by government officials as beneficial. Thus any analysis of adverse impacts is discouraged in order to allow desired projects to proceed unimpeded.

Aside from developing countries themselves, international institutions have become more active in recent years in requiring environmental impact assessment for projects in developing countries. For example, the World Bank requires environmental impact studies for major projects financed by its organizations. Another example is U.S. AID, which has established environmental guidelines designed to ensure that environmental factors are integrated into agency decision-making and to assess the environmental impact of the agency's programs. The methods used to carry out such assessments are generally derived from fairly simple environmental review procedures originally designed and first carried out in the U.S. In contrast to elaborate analyses of secondary and cumulative impacts that now characterize state-of-the-art American EISs, analyses prepared by international agencies or consulting organizations are less complex and have less available data on which to base assessments. Consequently, cumulative impacts are occasionally recognized as a problem but have not been studied.

Congressional concern over the adverse environmental impacts of large development projects and the inadequacy of current impact assessment procedures culminated in a series of recent hearings. In June 1983 and again in March 1984, the House Subcommittee on International Development Institutions and Finance held hearings on the social and environmental impacts of development projects funded by multilateral development banks. A particular concern of the hearings was the effects of international large-scale hydroelectric and water diversion projects on indigenous peoples. Proposals were made at the hearings to impose mandatory social and environmental impact assessments on development bank-funded water projects.

Within impact assessments carried out by international organizations, there is, generally, consideration of the human environment. However, analysis of social, economic and cultural impacts is generally limited to primary impacts and relatively little attention has been given to secondary impact assessment, cumulative impact assessment or cumulative impact monitoring.

Despite the lack of available published literature on cumulative impact assessment in international settings and the relatively limited available information on environmental impact assessment for developing countries, there is growing interest among impact assessment professionals in assessing the cumulative impacts of international development projects. Much new interest exists in the international exchange of information on impact assessment methods and on conducting post-project environmental and social impact analyses. These current research efforts have yet to yield any readily accessible published results. Nevertheless, this section reviews a wide-ranging representative sample of the available international literature. Only two of the studies reviewed, Tippetts-Abbett-McCarthy-Stratton (1980) and Dames & Moore (1982) had even limited relevance to this project. These studies were of particular interest not because they utilized viable cumulative impact assessment methods but rather because they validate the need for integrated assessment and monitoring approaches to validate and mitigate predicted impacts. This concept is of importance in cumulative impact assessment also.

RELEVANT STUDIES

Tippetts-Abbett-McCarthy-Stratton. 1980. Environmental assessment: accelerated Mahaweli development program. Ministry of Mahaweli Development, Democratic Socialist Republic of Sri Lanka, U.S. Agency for International Development, New York.

Summary:

This report details an environmental assessment of the proposed accelerated Mahaweli Development Program, a massive 30-year program to create several new reservoirs, thereby generating hydroelectric power, providing irrigation for development of an unutilized dry zone and a massive program of population resettlement. In general, the project is viewed positively from a socioeconomic perspective since it will improve national foreign exchange balances and increase local industrial and agricultural production. The project was also viewed as reducing uncontrolled land clearing and utilization by "shifting cultivation" farmers which would occur in the absence of the project.

Since settlement issues were a major project concern, most of the project's socioeconomic impact assessment is focused on those issues. An estimated 25,000 people must be relocated from their current homes in proposed reservoir sites, and the population in the project area is expected to increase by about one million people. The impact assessment mainly discusses primary social impacts, both beneficial and adverse. Secondary impacts are only briefly acknowledged. The assessment concludes that:

> "a major social impact of the Accelerated Program will involve the transition from small isolated village societies to production oriented large scale colonization schemes. Implicit in the model of transition is the modernization of rural society with the attendant loss of traditional values and social cohesion within small, kinship based villages."

No explicit methods are discussed. Impact assessment is based on professional judgment rather than rigorous methodology-oriented research. Cultural, ethnic and religious impacts are acknowledged but not explicitly reviewed. Public health and nutritional impacts of the project are also evaluated. While no assessment of cumulative impacts is explicitly made, the report

recommends establishment of a series of socioeconomic monitoring programs and special studies to cope with the cumulative social impacts of the project. This project has only limited relevance to this project, mainly because it helps underscore the need for socioeconomic monitoring to validate impact assessment projections.

Dames & Moore. 1982. Environmental review and management 'program Argyle diamond project. South Perth, Western Australia.

Summary:

This report is an environmental review of a diamond mining project in an aboriginal area of western Australia. It included extensive analysis of social and economic impacts. The report's social impact assessment focused almost exclusively on impacts to Aborigines since they constituted the socio-cultural grouping most vulnerable to changes produced by the project. No attempts were made to consider the cumulative impacts of development on aboriginal populations. The report concluded that negative social and cultural impacts will be minimal due to the small size of the project, its relatively small demands on land and the decision to enclave project workers and to pursue vigorous management policies.

The method used in the report to assess social and cultural impacts on Aborigines consisted of: a) review of the area's history and culture, b) review of the current demographic and economic environment, c) assessment of economic impacts (using multiplier approaches to quantify impacts in terms of jobs generated and value of output generated), d) review of the area's existing social environment based on a household survey, e) a review of contemporary aboriginal culture and communities and, f) an assessment of social impacts.

Detailed discussions with Aboriginal communities in the area showed they were not opposed to the mine development proceeding. However, they were concerned about the following possible adverse impacts:

- Damage to Aboriginal sites
- Limited Aboriginal access to land
- Competition for use of fishing holes, swimming holes, camp sites and hunting locations
- Intrusion on community life
- Increased road traffic and associated risk of accidents
- Aboriginal exclusion from improved urban activities
- Social disruption following overly easy access to alcohol.

In the report, impacts are assessed in terms of effects generated by the project on three "clusters" of socio-cultural values held by members of the affected community at large.

Two of these value clusters apply only to assessment of impacts on Aborigines and Aboriginal communities. These are:

- Values related to access to land, accompanied by an interest in the establishment of outstations. Land for residential and farming purposes is an important issue for Europeans in Kununurra. However, it is discussed in a different cultural context.

- Values related to the desire to retain selected aspects of Aboriginal culture.

The categories of impact considered included: the importance of land and likely effects on Aborigines; impacts of money on Aboriginal communities; effects on Aboriginal employment, consultation and administrative impacts (relations between government and company officials and Aboriginal communities); effects on Aboriginal leadership; impacts on Aboriginal health and education; indirect effects on tourism and Aborigines; and effects on Aboriginal culture.

Although the report did not consider cumulative impacts explicitly, it considered the cultural, economic and social impacts of the project on the region's Aborigines in the context of an ongoing process of historical change and interaction with European society. Some examples of the report's findings are as follows:

"As regards mining, Aborigines at Kununurra were much more cautious, indeed distrustful, of mining developments in the region than were the majority of non-Aborigines in the town. They were less inclined to see benefits flowing in their direction and underlined the possible disadvantages. With the expansion of the town, there were fears of being 'squeezed out' and of possible encroachment on living areas already allocated to them. A few of the youths were making enquiries about the possibility of work with mining companies, but at the time they had little information about such prospects."

"Aborigines do not see any necessary incompatibility between the continuity of Aboriginal culture and the acquisition of European skills, goods, and knowledge. Some syncretism is evident already. They hope that by having the ability to choose, they can maintain their identity and an integrity of their own culture. However, one major choice that they perceived as being blocked at present is their access to land."

"The settlement is situated near important mytho-totemic sites, which the elders keep under surveillance. There is concern about protecting such sites from inadvertent destruction. Dealings with mining companies are viewed in this context. However, like other Aboriginal groups in the region the residents were not against mining as such."

In order to minimize adverse social impacts on Aboriginal life, the project sponsor has adopted strict policies related to housing and behavior of non-Aboriginal workers. A policy encouraging the training and employment of Aborigines was also adopted along with offering financial counseling services and allowing Aborigines a special leave policy to pursue cultural activities. The report concludes by saying, "there is a need for monitoring of social and economic changes in the region. It is in the [company's] own interests to cooperate with and participate in this monitoring process, in conjunction with government departments, agencies and other authorities with responsibility in this area." Although this report does not explicitly consider cumulative impact assessment methods, it does demonstrate the possible integration of: impact assessment, mitigation, socioeconomic monitoring and socioeconomic impact management. This report has limited relevance to this project.

STUDIES WITH NO DIRECT RELEVANCE

Inkeles, A. 1969. Making men modern: on the causes and consequences of individual change in six developing countries. American Journal of Sociology. 75 (Sept.) :208-225.

Summary:

This paper reports on the results of a long-term project to evaluate the social and cultural aspects of economic development on men from six developing countries. The research was based on interviews with some 6,000 individual men in Argentina, Chile, India, Israel, Nigeria and EastPakistan. The project was not oriented towards assessing the impacts of large development projects on indigenous populations, but rather on analyzing a series of issues relating to the psychological transformation of individuals from traditional cultural and social settings into modern ones. Its principal focus was on understanding the impact on the individual of his participation in the process of modernization.

The method utilized was in-depth interviewing that included various tests of verbal ability, literacy, political information, intelligence, and psychic adjustment. This research project's findings are not directly applicable to cumulative impact assessment. The research does present data based on administration of the Psychosomatic Symptoms Test which indicates that among those tested, no statistically significant evidence of psychic stress was associated with such modernizing experiences as urban residence or factory employment. The research does not, however, address the question of whether the process of social modernization in general increases social disorganization and increases psychic tension for those experiencing such disorganization. This research has no direct relevance to selecting methods for cumulative impact assessment.

El-Hakim, S.M. 1973. Some socioeconomic consequences of the Libyan oil discovery on the Zeyadiya Nomas of Darfur, Sudan. Sudan Notes and Records. Khartoum, Sudan.

Summary:

This paper examines sociological and economic consequences of the discovery of oil in Libya on a remote, rural community in the neighboring country of Sudan. The author examines the externalities produced by the rapid economic expansion of Libya on the pastoral Zeyadiya tribe of Northern Darfur in Sudan. The paper illustrates the changes occurring in nomadic-sedentary interactions between the tribe and neighboring communities. The paper analyzes the interactions between the pastoral livestock-raising nomads and the cash economy of Sudan and examines changes in distribution of wealth resulting from trade transactions with neighboring Libya. As a result of Libyan petroleum exports personal income rose rapidly, increasing market prices for livestock and making available luxury goods unknown in western Sudan. Consequently, new patterns of trade and regional employment emerged, which have produced significant social, economic and geographic changes in the Zeyadiya tribesmen. This paper deals with cumulative social and economic effects of oil development in a remote, rural, nomadic culture. However, no general methods of cumulative impact assessment applicable to the Alaskan Arctic are presented in this research monograph. This article has no direct relevance to this project.

Aiken, S.R., M.R. Moss. 1976. Man's impact on the natural environment of peninsular Malaysia: some problems and human consequences. 3(4):273-284.

Summary:

This paper describes a number of environmental problems that have emerged in peninsular Malaysia in recent years. Man's impact on the natural environment is viewed within the framework of a set of case studies which emphasize the human and environmental consequences of different activities. The case studies include: oil pollution in the Straits of Malacca and Singapore; discharges of oil-palm effluent into rivers and streams; natural health hazards such as mosquito-borne diseases; and destruction of a sacred cultural site and natural phenomenon, the limestone Batu caves.

While no cumulative impact assessment methods are presented, the authors point out that "man's activities in the natural environment tend to have a cumulative impact on land and life." The article argues that within Third World countries "social and economic problems are of foremost importance and that the priorities of raising levels of human welfare and self-respect should not be achieved at the expense of the natural environment." The article concludes that, "raising levels of human welfare through development without giving due consideration to environmental impact may be a self-defeating process. Perhaps only when the cumulative environmental individual impact of human activities is appreciated at local, regional and national scales will effective legislative controls be introduced." This article has no direct relevance to this project since methods for analyzing cumulative impacts are not presented.

Tahir, A.A. and M.O. El Sammani. 1978. Environmental and socioeconomic impact of the Jonglei Canal project. Executive Organ, National Council for the Development of Jonglei Canal Area, Khartoum, Sudan.

Summarv:

This report concerns environmental and socioeconomic studies conducted in preparation for the construction of the Jonglei Canal, a major (2,000 mile) canal to enlarge the flow of the White Nile River through a presently un-navigable swamp (the Sudd). The socioeconomic research was not only oriented towards impact assessment but also to improve project planning, to help formulate social and economic policies and to design appropriate development programs to accompany the canal's construction. The affected population are Nilotic tribes (the Dinka, the Nuer and the Shilluk) who are pastoral nomads. The studies reveal that much social change has already been occurring in the affected area (as evidenced by cattle vaccination, education and health innovations, and migration to other areas of the country), and that people are dissatisfied with their present conditions and desire change. They also see the canal project as largely beneficial.

While no direct analysis of the cumulative impacts of the canal's construction is carried out in this research, the research has as its justification the fact that the canal will produce profound changes in the local economy and social relationships. It thereby anticipates adverse cumulative impacts and is aimed at devising policies and programs to counter adverse cumulative impacts. However, no methods for assessing cumulative impacts are presented. This report has no direct relevance to this project.

Cochrane, G. 1979. The cultural appraisal of development projects, Praeger Publishers (Praeger Special Studies). New York.

Summary:

This book, 'which formed the basis for the "social soundness analysis" adopted by U.S. AID in its Project Manual, is primarily designed to rationalize the analysis of cultural factors in order to help successfully implement development aid projects. The focus of the book is not, however, on the process of assessing the cultural impacts of large-scale industrialization or other development projects analagous to those occurring on the Alaskan North Slope. The book does present a methodology for cultural appraisal of projects that is built around collection of data on social and cultural characteristics of affected populations by interdisciplinary teams of social scientists (anthropologists, economists, geographers, political scientists, public administrators, social psychologists, and sociologists).

The method presented includes social mapping techniques, a set of criteria for incorporating cultural factors into project design, and a set of criteria for evaluating project implementation. The book also discusses data requirements for cultural appraisal. The stress in data collection is on contextual and incremental approaches rather than sophisticated mathematical analyses. The methods reviewed are such standard social science techniques as questionnaire surveys and participant observation. This book is not directly relevant to this project since it was not oriented towards presenting methods for cumulative impact assessment of major development projects.

International Institute for Environment and Development. 1981. Legal, regulatory, and institutional aspects of environmental and natural resource management in developing countries. U.S. Agency for International Development, National Park Service, Washington, D.C.

Summary:

This report details the findings of a project jointly sponsored by the U.S. Agency for International Development and the National Park Service which reviewed the evolution of some of the different approaches used by developing countries to conduct environmental assessment and to perform natural resource management. The bulk of the report is extrapolated from research findings from Ghana, Malaysia, the Sudan and Venezuela. However, the report does not review environmental assessment methods.

This report demonstrates that developing countries are just beginning to implement environmental policies. Such policies focus on environmental quality, pollution control and natural resource management and conservation. In general, little institutionalized assessment activity exists. In the absence of formalized assessment activities, little methodological development has taken place. This is in part due to lack of appropriate policy, lack of adequate legislation or its enforcement and the harsh realities of economic technical and manpower limitations. This report has no direct relevance to this project.

National Research Council. 1982. Ecological aspects of development in the humid tropics. National Academy Press, Washingon, D.C.

Summary:

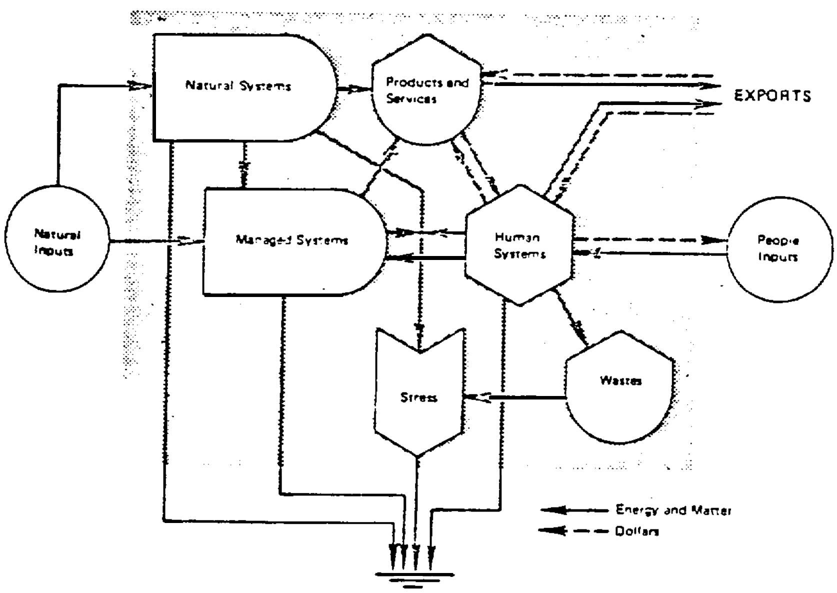
This book presents an integrated planning approach to development projects occurring in tropical forests in the humid tropics. The focus of the method is on ecosystem analysis to enable sound environmental management and conservation practices to be developed. While this book does not directly

address the analysis of cumulative impacts, its utilization of ecological principles and ecosystem analysis illustrates one systematic approach to impact assessment. However, it is more valid for determining ecological changes than social, economic or cultural changes.

The book points out that it is imperative that the negative aspects of development be identified, their effects on tropical ecosystems cataloged and understood, and alternative strategies sought in order to minimize them. The principles here set forth apply generally because, even though different ecosystems have different degrees of fragility and stresses are of different quality and intensity, the responses of ecosystems to stressors follow predictable patterns. In fact, these are by their very nature ecosystem issues; efforts toward their resolution must address ecosystem levels of function and organization.

To analyze regional impact, one must know what kinds of ecosystems make up the region and how they interact. A conceptual model of the region should be formulated by way of gaining a perspective of the situation with and without an array of development projects. From the model, one can then infer a number of important ecological concepts that are applicable. These concepts are addressed in the book and include: coupling of ecosystems, relationship between stress and stressors, transient and steady-state conditions, ultimate state of a region, and value of natural ecosystems. The overriding consideration in attempting regional analysis is that the landscape is a living unit and that changes in one sector will affect (in positive or negative ways) other sectors.

The method suggested employs simplified modeling of regional systems to help identify regional carrying capacity, to illustrate couplings between natural and social systems and to analyze such systemic activities as stress and stressors. Figure 32 shows a simplified model of a regional system, using symbols developed by the ecologists Eugene and Howard Odum. The solid lines represent the flows of energy and matter; the dotted lines illustrate flows of dollars. The box symbolizes the boundaries of a particular region or country. The circles represent the external forces that drive the systems.



Conceptual model of a region or country

Source: National Research Council. 1982. Ecological aspects of development in the humid tropics.

FIGURE 32

Both natural ecosystems and managed systems are driven by natural forces, but people impose additional forces on managed systems. Both types yield products and services that people use or export. People manage the landscape and import energy in a wide variety of forms (shown as “people-inputs”); they export goods and services and produce wastes. Wastes and human-induced impacts stress managed and natural ecosystems, thereby reducing their productive potential; they also stress people themselves. The “balance of payments" can be thought of as the difference between inputs and exports.

Development is defined in this method as the intensification of the flow of energy, matter, and money through a region. Developmental activities set in motion processes of change (succession) in natural ecosystems. In large regions, different types of ecosystems are coupled and interdependent. Thus, analysis of the impacts of development at a regional scale requires ecosystem-level scrutiny. This is best accomplished by devising models of regional or countrywide systems and using them to facilitate data collection and to analyze ecosystem-level interactions and change.

Because ecosystem structure and functioning (including human systems) are highly sensitive to changes in external driving functions and because development involves the manipulation and change of these functions, it is important to evaluate impacts in relation to them. The intensity of development that is possible in a region is dictated by: (1) the carrying capacity (the state of development when the flows of money, energy, and matter are at rates that support the maximum amount of useful value without causing long-term harm); and (2) the capacity of the natural environment to absorb stress and match human needs. It is proposed that end points of development be determined that will avoid long-term degradation of the environment’s carrying capacity. This book has no direct relevance to development of cumulative impact assessment methods.

Gilbert, J.T.E. ed. 1982. Environmental planning guidelines for offshore oil and gas development. East-West Environment and Policy Institute, East-West Center, Honolulu, HI.

Summary:

This book develops very general guidelines for planning to cope with the environmental aspects of offshore oil and gas development. The planning guidelines touch on socioeconomic impacts but no methods for assessing cumulative impacts were presented. This report has no direct relevance to this project.

World Bank. 1983. The environment, public health and human ecology: considerations for economic development, Washington, D.C.

Summary:

This handbook is designed to provide guidance in the identification, detection, measurement and control of the adverse environmental effects of development projects. It provides a general overview of environmental, health, and human ecologic considerations in the development process. The handbook contains a very limited section on the socioeconomic impact assessment of oil development projects. However no methods appropriate to cumulative impact assessment are presented. This report is of no direct relevance to this project.

Appasamy, P. 1983. Impact assessment of international development projects. Impact Assessment Bulletin, 2(2):173-186.

Summary:

The purpose of this paper is to discuss in broad terms the assessment processes for impacts that result from international development project-related aid. The article subdivides impacts of development projects into two categories: 1) impacts on the natural and physical environment, and 2) impacts on the human environment. The article focuses on the assessment procedures of multilateral and bilateral aid institutions conducted as part of the project appraisal process. The article concludes that mechanisms do exist for the assessment of environmental and economic impacts of major development projects in most aid institutions. However, it points out the inadequacy of assessment tools for considering social, cultural and political impacts. It also stresses that in the case of economic impacts, traditional analytical tools do not work very well since "not all impacts are amenable to quantification, much less to monetization."

The article also briefly reviews the inadequacy of social impact assessments for development projects. "Anthropologists have strong convictions about preserving the cultural integrity of a particular society. Economic development on the other hand implies change. Most of the social damage produced by projects in the past were routinely dismissed as 'growing pains' of development, which would disappear once the economy and standard of living reached a certain level." The article points out that it is now apparent that the process of development and technology transfer has created severe social problems in many developing countries.

In reviewing potential political impacts of development projects the article touches on the recurrent dependency theme. "Development projects potentially contribute to a dependency relationship between the donor and the client. Projects invariably take on a life of their own." The article concludes with regard to impact assessment of international development project-related aid: "There is a growing body of literature on social and cultural impacts, but no consensus on methodology to carry out actual assessments.". No direct discussion of cumulative impact assessment is made nor are any methods presented. This article has no direct relevance to this project.

Dames i? Moore, 1983. Sudan petroleum development project, environmental assessment/environmental protection specifications. Chevron Overseas Petroleum Limited, San Francisco, CA.

Summary:

This report consists of an environmental assessment of Chevron's Sudan Petroleum Development Project, composed of production field facilities, construction of a 900 mile pipeline across the country to the Red Sea and construction of a marine terminal to transship produced oil. Field surveys on terrestrial ecology, marine biology, surface and groundwater hydrology and archaeology were carried out. The study also included some analysis of the social , cultural and economic impacts of the project on the diverse Sudanese inhabitants potentially affected by the project, many of whom are pastoral nomads. The cumulative impacts of the project were assessed qualitatively by each principal investigator based on his own professional experience and expertise. No formal methodology was employed. This report is of no direct relevance to this project.

Carpenter, R.A. et al. 1983. A summary of work on natural systems assessment with economic valuation: East-West Center, Environmental and Policy Institute, Honolulu, HI.

Summary:

This report presents a summary of work completed to date by the East-West Center's Environment and Policy Institute program, the Natural Systems Assessment for Development (NSAD). This interdisciplinary, multinational collaborative effort is aimed to improve assessment methodologies for natural systems and their economic use by society. The natural systems assessment method developed by the NSAD program consists of two components: (1) an analysis of the physical dimensions of a project's effects and the economic valuation of these effects for inclusion in project design, appraisal, and (2) evaluation. The physical assessment of natural systems is based on land capability assessment (land-use planning and siting) and the prevention, amelioration and remedy of degradation associated with site-specific development activities. The economic valuation of environmental effects is based on benefit-cost analysis.

Within the physical assessment method as presented, attention is focused on secondary effects. However, no explicit methods are presented to bound such an analysis, or to measure indirect or secondary effects. Cumulative impacts are not explicitly considered. The report does acknowledge that "site-specific assessments are likely to ignore off-site effects that take place at a distance or at some future time."

Within the economic valuation method, both market-oriented and survey-oriented valuation techniques are briefly summarized in Table 3. However, the focus in these techniques is on evaluating the costs and benefits of environmental protection measures, rather than on social impacts or local economic impacts. Therefore the methods have no potential application for cumulative impact assessment in the Alaskan Arctic. This report is of no direct relevance to this project.

Simpson-Hebert, M. 1983. Methods for gathering sociocultural data for water supply and sanitation projects. U.N. Development Programme. The World Bank, Washington, D.C.

<u>Summary:</u>

This report was prepared to help guide engineers who need to obtain socio-cultural data in the course of planning and designing low-cost water supply and sanitation projects in developing countries. It describes data requirements, key data-gathering techniques (observer participation; key informant interviewing; open-ended questionnaires; and surveys), and how these techniques can be modified to suit particular circumstances. It is not an impact assessment manual but rather is aimed at helping engineers design projects that accurately account for local values, beliefs and practices. This report is of no direct relevance to this project.

Sisler, D.G. 1983. Analysis of direct and indirect effects of technological change in agriculture. U.S. Department of Agriculture, State Agricultural Experiment Station. Cornell University, Ithaca, N.Y.

TABLE 3

ssification of Cost and Benefit Valuation Techniques for Assessing Effects on ·ironmental Quality

Valuation technique	Examples of application: Producer goods and services	Examples of application: consumer goods and services
Market oriented		
ınefit valuation using actual market prices of oductive goods and services		
) Changes in value of output	Loss of value of agricultural cmpa caused by seepage of toxic chemicals	
) Loaa of earnings	Value of productive services lost through increased illness and death caused by air pollution	
ıst valuation using actual market prices of :ironmental protection inputs		
) Preventive expenditures	Coat of environmental safeguards in project design	Cost of noise insulation; cost of intake water treatment
ı) Replacement cost	Cost of replacing structures damaged by acid rein	Cost of additional painting of houses damaged by air pollution
:) Shadow project	Cost of restoring commercial fresh-water fisheries damaged by discharges	Costs of supplying alternative sport fishing and recreational facilities destroyed by development project
. Cost-effectiveness analysis	Costa of alternative means of disposing of waste-water from a geothermal energy project	
enefit valuation using surrogate markets		
ı) Marketed goods as environmental surrogates	Coat of sewage treatment processes as proxy for water purification by ecosystems	Price paid for visits to private parks and entertainment aa proxy for value of visits to wilderness area
ɔ) Property value approach	Changes in commercial property value as e result of water pollution	Changes in residential property value from air pollution
:) Other lend value approaches		Prices paid by government for land reserved for national perks
ł) Travel cost		Valuation of recreational benefits of a public perk
ı) Wage differential approach		Estimation of willingness of workers to trade off wages for improved environmental quality
ı Acceptance of compensation	Compensation for damage m crops	Compensation for adverse health effects, e.g., Minamata disease
Survey Oriented (hypothetical valuation)		
irect questioning of willingness to pay		
·¹ Bidding games		Estimate of willingness to pay for access to an urban park
irect questioning of choices of quantities		
a) Costless choice method		Hypothetical applications to air pollution

…n Environment, Natural Systems, and Development: An Economic Valuation Guide, Maynard M. Hufschmidt et al. Baltimore, Maryland: The Johns Hopkins iversity Press, 1983.

Summary:

The basic purpose of this research was to examine the ways in which technical change in agricultural production technologies influences income distribution in developing countries. Research was conducted in Bangladesh, India, Nepal, Thailand, the Philippines, Western Africa, and Brazil on relationships between agricultural technology and employment of labor, changes in income and distribution of income. No cumulative impact assessment methods were presented. It has no direct relevance to this study.

4.0 RESULTS OF THE LITERATURE REVIEW

This chapter summarizes the literature review of cumulative impact assessment methods undertaken in the preceding chapters. It first presents an overview of the six most promising cumulative impact assessment approaches or methodologies revealed in this project. Finally, it provides a brief synopsis of the key observations concerning cumulative impact assessment and cumulative impact assessment methods made in the course of preparing this literature review.

4.1 Review of Promising Cumulative Impact Assessment Methodologies

Based on the results of the literature review and evaluation process, the available methodologies, frameworks, and general approaches to conduct cumulative impact assessment were scrutinized. This process, conducted in consultation with MMS, narrowed the range of applicable approaches to six. These six general approaches to cumulative impact assessment were further reviewed and evaluated.

None of these six general approaches constitutes a methodology or a set of methodologies *per se*. Rather, each represents an analytical framework which might be used in organizing and structuring a cumulative impact assessment. The data to be analyzed or collected, appropriate methods for its collection, and most importantly, judgments on the identification, measurement, and significance of cumulative impacts are all still important variables to be addressed prior to the initiation of an actual cumulative impact assessment.

The six general approaches selected for further consideration were:

- Regional or Area-Wide EIS's;
- Comprehensive EIS's;
- Regional Planning Studies;
- Longitudinal Monitoring; and
- Public Inquiries
- Fiscal Analysis

In a sense, none of these are "new" or uniquely cumulative impact-oriented approaches. However, the results of the literature review demonstrate the difficulties of transferring any generalized cumulative impact assessment approach to an Alaskan Arctic setting. Cumulative impact assessment is still a relatively new and evolving concept with intellectual and ideological appeal but little demonstrated practical application. Thus, the proposea use of a general framework or frameworks appears to be the appropriate way to conduct social, economic, and cultural impact assessment of cumulative development scenarios in the North Slope Borough.

The challenge in conducting a cumulative impact assessment is to adequately identify and characterize known and possible "present and future actions" in addition to the proposed action. For the Alaska OCS Region, this task is complicated by the fact that the "proposed action" for most current EIS's, an oil and gas lease sale, is itself only a legal and economic transaction which may induce a range of possible activities. Thus, any cumulative impact assessment method must first be able to accommodate various aspects of potential future activities resulting from a lease sale, along with the range of other known development projects or firm proposals within a region. The method must also recognize the contributions of past actions tc the current impact assessment setting, in this case the North Slope Borough. Each of the six general approaches presented here appears to be capable of satisfying these criteria.

4.1.1 Regional or Area-Wide EIS's

Preparation of a regional EIS that incorporates substantial social, cultural and economic effects analysis for "projects considered is one route to analyze the cumulative impacts of development within a region. However, this rather broad approach requires considerable attention to construction of a well-defined set of development scenarios and a carefully selected set of cumulative impact parameters. These scenarios and impact parameters are then used to project or forecast the timing, intensity, characteristics and geographic distribution of projects in terms of key cumulative impact parameters (i.e., land area, employment, economic costs and benefits, etc.)

Then the cumulative impacts of these projected scenarios are assessed, generally over a range of time horizons varying from one to twenty years.

Most regional EIS's rely on an initial set of scenarios or an analytical framework or model specifically developed to “create” the series of alternative development scenarios from which impact predictions are derived. These scenarios or models are in turn composed of the projects which represent the range of past, present and potential future development that is occurring or might occur in a region. Rather than focusing on each project’s constituent primary and secondary impacts in an additive sense, the regional or area-wide EIS generally starts from the regional boundaries and focuses on those social or economic impacts likely to affect regional systems (i.e., transportation, health, school, and economic networks) as each of the various development scenarios are played out. The challenge in using regional assessments as a tool to accomplish cumulative impact assessment is to not overlook the actual social, economic and cultural impacts on the community, neighborhood, family or individual as the scale of analysis is enlarged. This challenge has not generally been met. In the absence of credible supporting documentation and data, the approach tends to aggregate data on a number of specific developments in a region and thereby create a more abstract regional picture of impacts.

Another limitation of the regional or area-wide EIS approach is the ccst associated with its development. In some cases, millions of dollars may be required to develop forecasting models and to collect and analyze input data, project variables, and impact parameters. In addition, cultural and social impacts not easily quantified have generally been ignored in such assessments. Finally, neither the State of North Dakota and BLM (1978) , Skidmore, Owings and Merrill (1981) or other authors who have utilized the regional or area-wide EIS approach to assess cumulative impacts specified any explicit methods to actually measure or analyze cumulative impacts. These examples show how assessment of cumulative impacts is usually a subjective, professional judgment made by the practioner carrying out the assessment.

4.1.2 Comprehensive EIS's

It is commonly argued by preparers of impact statements that in order to capture and portray cumulative impacts, one either has to invest more energy in the additive analysis of the impacts, or measure the aggregate impacts within each appropriate impact parameter selected from a series of existing planned and proposed projects. However, the results of these cumulative impact assessments have generally not been given favorable reviews by impact assessment professionals, although they do serve to satisfy the procedural requirements of NEPA and the CEQ guidelines (see Merson and Easton, 1980 and Murdock, Leistritz and Harem, 1982).

This is the approach that MMS and most other federal agencies have taken. In these EIS's assertions that a significant cumulative impact is or is not likely to occur are rarely substantiated. These are also subjective, professional judgments that cannot be related to any quantifiable or measured relationship. The courts have ruled that "cumulative environmental impacts are what require a comprehensive impact statement". However, the courts have not challenged the competency of the agencies conducting the impact assessment in the "determination of the extent and effects of these factors" (see Kleppe v. Sierra Club cited in Merson and Eastman, 1980).

In these more comprehensive EIS's, the causal connection between primary and secondary or higher order impacts and their often synergistic interactions are not usually traced. Given the normal constraints on EIS preparation of limited time and staff resources and inadequate methodological tools for analysis, cumulative impact assessments have been qualitative and brief. The courts, in reviewing EIS's in recent lawsuits, have recognized the need for more comprehensive EIS's capable of including cumulative impacts. As described in Merson and Eastman (1980), in the case of North Slope Borough v. Andrus, the District Court reviewing the case looked sympathetically upon the need for a comprehensive EIS to examine cumulative impacts of oil and gas leasing in the Beaufort Sea. The court found considerable support for contentions that the EIS prepared by MMS failed to "adequately analyze the cumulative impact of the Beaufort Sea project and other major federal and state projects in the area." It is unclear how MMS's treatment of cumulative impacts in current EIS's might be evaluated.

Nevertheless, adopting a more comprehensive approach to the additive impact analysis of individual projects can lead to cumulative impact assessment if more attention is paid to identifying indirect effects ana the interactions of the impact streams from individual projects. However, this analytical exercise has not been well-documented nor have its results been accepted as conclusive or adequate by impact assessment professionals. Application of the Adaptive Environmental Assessment approach developed by Helling (1978), or the analytical framework designed by Kruse et al. (1983) may be possible ways to extend the precision of such efforts,

4.1.3 Regional Planning Studies

Regional planning encompasses a variety of techniques and methods, but usually includes analysis of the spatial aspects of development through creative use of constraint, composite or overlay mapping and other techniques. Regional planning can also include participatory processes which involve local residents to define important cumulative impact parameters. It is also important to note that regional planning at the appropriate institutional level can help to create an ongoing process for impact management that has considerable advantages over serial, deadline-bound EIS's.

The growing base of spatial, geographic information on the North Slope Borough can help regional planning techniques assess cumulative impacts of development projects. However, tools to link physical environmental changes to induced social, economic and cultural effects are still lacking.

Regional planning approaches have been proposed or utilized for cumulative impact assessment in many situations. Chapter 3 discussed the use of such approaches by Dirschl (1982), and the U.S. Army Corps of Engineers in its discontinued "Wetland Reviews." The recent development of computerized geographic information systems lends new support for the use of regional planning approaches in cumulative impact assessment. As discussed in Porter, et al. (1979) and Arctic Slope Technical Services (1981), computerized geographic information systems are being developed to support regulatory decision-making, impact assessment, regional planning, and other processes. The North Slope Borough's Geographic Information System (GIS) may eventually be a crucial tool in completing valid cumulative impact assessments. The U.S. Fish and Wildlife Service and the U.S. Environmental Protection Agency are using GIS maps and data to conduct an ecological cumulative impact study of vegetation changes in the Prudhoe Bay area since 1942.

4.1.4 Longitudinal Monitoring

Perhaps the greatest promise in illuminating cumulative impacts lies in the development of an appropriate longitudinal monitoring program. such programs, in conjunction with integrated pre-project and post-project impact monitoring represent an excellent opportunity to begin to measure and trace patterns of cumulative social, economic and cultural change associated with development projects. Of the studies reviewed in this report, Carley (1984), Berkes (1981) and Bowles (1981) support this view.

Data is collected on a few selected, key indicators of cultural, social and economic change. The main emphasis in monitoring is on updating the statistics or other indicators at regular intervals (i.e., every year, two years, or five years), and measuring changes against the initial conditions or values. Theoretically, monitoring can help to distinguish causality in relationships, although such correlations must be carefully made to avoid misleading judgments or conclusions.

The process of monitoring social change is a reasonably straightforward one and in some cases readily available indicators exist. However, problems may still exist with such approaches, both in terms of selecting appropriate social , economic and cultural indicators for monitoring and in distinguishing impacts due to development projects from the background of ongoing change. For more subjective or psychological aspects of impacts, easily quantified measures are not available. Nevertheless, longitudinal monitoring appears to be a promising avenue of inquiry to help identify areas of cumulative social, economic and cultural impact. Several sociocultural parameters that could be in corporate in a longitudinal monitoring system are described below.

Analysis of Key Sociocultural Parameters.

Community well-being is comprised of both:

- o Universal dimensions or parameters of well-being (including health, housing, education, employment, publ ic safety, social relationships); and

- o Regionally or culturally specific dimensions of well-being (including subsistence activities, extended family ties, kinship, and sharing in the North Slope).

Both the universal and culturally-specific dimensions of well-being represent social goals or values. Analysis of selected key sociocultural parameters should be principally oriented towards elements of Inupiat community well-being.

In order to identify the culturally specific social goals, it may be necessary to empirically analyze the major traditional and contemporary concerns, issues, social goals, and values of a particular society such as the North Slope Inupiat. The most important of these social goals are then treated as key parameters of the quality of life. This procedure is similar to that used by Carley (1984) to develop a cumulative socioeconomic monitoring program for the Canadian Beaufort region.

It is assumed that in most cases, cumulative impacts primarily represent different magnitudes of the same kind of effect (or on the same category of social well-being). The focus is on the magnitude of change occuring in particular areas of cultural importance; the number of projects generating the impacts generally should not affect the choice or validity of the categories or parameters of the quality of life as long as the nature of the projects remains the same. Hence, the general list of potentially affected categories of social well-being will remain essentially unchanged as more OCS projects are added.

However, in two cases, the cumulative effects and hence the categories of social well-being may be qualitatively different:

a) Where the development projects are qualitatively different (i.e., offshore oil and gas development vs. hydroe"lectric development vs. large-scale open pit mining); and

b) Where the magnitude of change cause by multiple projects is so great the industrialization or urbanization is occurring. Although social goals or values are slow to change, there is likely a certain point or threshold level where they do begin to permanently alter. As a rural area becomes more and more urbanized through numerous development projects, important issues related to differing ways of life and goals emerge. Changes in values or the addition of new values are often associated with these issues. This result of industrialization may be the most important cumulative effect of numerous projects.

The following sociocultural parameters of well-being are representative examples of the regionally and culturally specific dimensions of social ana economic well-being in the NSB which potentially could be affected by cumulative petroleum development projects. These parameters include:

o Subsistence harvest of renewable resources
o Whaling and traditional ceremonies and beliefs
o Kinship and the extended family
o Sharing
o Social roles and organization
o Land values
o Demography
o Wage employment

Each of these selected sociocultural parameters is discussed in the following subsections. These discussions are intended to help focus the efforts of the MMS impact analysts in incorporating additional effort intc future EIS's.

Subsistence Harvest Parameters - The practice of and desire to harvest renewable wildlife resources for subsistence purposes is a primary culturally specific parameter of community well-being on the North Slope. Subsistence activities are integral to the cultural continuity of North Slope residents and will consequently be reflected in many of the culturally specific dimensions of well-being discussed below. This discussion considers only those aspects of subsistence related to the actual harvest process that have the potential to be affected by cumulative resource development projects in the North Slope Borough.

The Eskimos of the North Slope rely primarily on a combination of three major renewable resource groups each of which occupies a different niche within the North Slope's ecosystem. These groups are sea mammals, fish and caribou. Eskimo hunters target a species or a species group during specific seasons and in specific locations which vary from community to community and year to year. Because of their different biophysical requirements, it is rare for all of these species groups to suffer natural population declines during a single year. By maintaining flexibility, North Slope hunters have in the past demonstrated the ability to compensate for naturally occurring harvest disruptions in one or even two the species groups by concentrating harvest efforts on the unaffected species group or groups. Similarly, a single site specific OCS project would not necessarily compromise total subsistence production. Rather it might simply exercise the flexibility inherent in the harvest process by redirecting hunting efforts or cropping the other unaffected species groups more heavily. For example, if fishing were detrimentally affected during a specific season or at a specific location, Eskimo hunters may be able to compensate by harvesting fish at different times and locations or concentrate more effort on caribou and marine mammals if available. However, this flexibility may not be possible if multiple projects are involved in addition to natural population variability and variations on seasonal distributions and abundance of key species groups.

Subsistence Parameter Implementation - When considering how subsistence activities potentially could be affected by cumulative OCS development, three components of successful subsistence production should be considered:

a) The "renewable" and naturally fluctuating nature of the resource base;
b) The seasonality of resource availability; and
c) The site-specific nature of many harvest activities.

Each proposed development activity would have specific characteristics with the potential to affect one or more of these components. For example, seismic testing in OCS waters or on the ice, if occurring concurrently at harvest sites or in important wildlife habitat could alter subsistence harvest success. Each additional petroleum development project or project activity may further reduce the flexibility intrinsic to maintaining a viable subsistence economy.

The cumulative impact of OCS or other project development activities on the available land base must be considered. Each additional proposed development activity (drilling islands, onshore service bases, or pipelines) may reduce the area of productive marine and terrestrial wildlife habitat and the area suitable for subsistence hunting activities. The effects of reducing the available "land base" on both wildlife populations and hunter success must be addressed.

In order to measure changes in subsistence production caused by reduced habitat or hunter access, quantitative subsistence harvest data ever time is needed. Similarly, to avoid impacts and to measure the effects of multiple projects on subsistence activities, local long-term mapping of community harvest areas by species, season and intensity is recommended. While such analytical activity is beyond the scope of present EIS preparation efforts, it is recommended to be included as an element of the longer-term continuous monitoring effort.

Whaling and Traditional Ceremonies and Beliefs - Of all subsistence activities, bowhead whale hunting continues to have the most cultural and social significance in the coastal communities of the North Slope. In an era of rapid change, whaling has servea as a cultural force and a means of reinforcing traditional values, ceremonies and beliefs. The collective effort necessary for a successful whale harvest, combined with the ritual division, distribution and sharing of the bowhead whale at ceremonies throughout the year remains an important unifying force in the Inupiat communities of the North Slope.

Whaling Parameter Implementation - The potential effects of offshore oil development activities on bowhead whales includes noise and disturbance leading to the possible displacement of migrating whales caused by seismic activity on the ice, vessel traffic in the leads, drilling activities, as well as the risks of spilled oil producing adverse ecological effects when the bowhead is most vulnerable while moving through the spring leads and during return migrations in the fall. As seismic activity, vessel traffic, drilling activities, and oil spill potential risk increase as the number of OCS projects increase, the potential adverse effect on the bowhead whale increases. This, in turn, may have important indirect effects on Inupiat subsistence whaling activities and other sociocultural parameters. Because of the bowhead's importance to cultural traditions and beliefs, the whaling complex on the North Slope should be monitored.

Kinship, Sharing and Social Organization - Generally, a single petroleum development project would not cause major changes in traditional kinship, sharing patters or social organization. This is particularly true for projects that are enclaves and thus somewhat isolated from Inupiat communities. However, where the magnitude of change caused by multiple projects is so great that broader-scale industrialization or urbanization in Inupiat communities is occurring, changes in traditional social patterns are evident. Both industry (oil and gas development, transportation infrastructure, pipelines, new business, more air traffic, and increased non-Native transients) and government (NSB CIP projects, education and health programs, housing projects, and other infrastructure improvements) contribute to this phenomenon of accelerated modernizing social change.

Traditionally and currently, the extended family, kinship, and sharing networks are important to North Slope Eskimos. Extended families often lived in the same dwelling with sharing networks primarily organized around relatives and friends both in the same and other villages. As in the past, subsistence products continue to be shared primarily among kin groups.

Traditional social and leadership roles were oriented mainly around subsistence activities; successful hunters and whaling captains were community leaders, mothers taught daughters the women's roles in food processing, and young boys continually learned hunting skills from older men in the community. Different task groups evolved by age and sex (i.e., young boys hunt ducks, men generally comprise the whaling crew, and women play an important role in food processing).

Although these statements are still true of the North Slope, the cumulative effect of numerous industrial projects as well as governmental (local, state and federal) programs have caused noticeable changes in North Slope social organization. For example, due to state and Borough housing programs, extended families that once lived in single dwellings now live in numerous separate houses. The increased availability of housing has resulted in conjugal-natal families rather than extended families living in a single dwelling. An emerging value among North Slope Eskimos is the desire for private housing for different age groups of the same extended family (i.e., grandparents, parents, and married children).

Similarly, although traditional hunters and whaling captains are still highly respected and are often village leaders, new social roles and leaders have emerged. Employers and elected representatives associated with the NSB and village corporations make important decisions and are community and regional leaders. Local businesses are expanding, especially in Barrow. In short, wealth and authority are not necessarily flowing along traditional channels. These occurrences are not attributable to any one project, rather they are the result of the cumulative effect of resource development, governmental policies and capital inflows.

Social Organization Parameter Implementation - In order to account for the possible cumulative effects of petroleum development activities and other ongoing processes of social change on NSB communities, MMS might devote more analysis in its EIS's on potential changes in social organization and their indirect effects. For example, changes in social organization may be responsible for a decline in subsistence hunting skills or the outmigration of young men who would have formerly taken key roles in subsistence hunting groups. Such social and cultural interrelationships should be further examined from the standpoint of multiple petroleum development projects occurring within the North Slope Borough. In the absence of systematic long-term sociocultural data collection, MMS might attempt to find demographic statistics (e.g., population, out-migration by age-cohort groups, and average household size) which correlate with a changing social organization. If past trends are evident in response to previous development, forecasts of proposed project impacts might be possible. However, it has to be recognized that the literature reviewed does not provide any sound basis for establishing cause and effect relationships between project activities and social organization.

Land Value Parameters - Traditional Eskimo land values do not include the concept of private ownership. The Eskimos of the North Slope commonly speak of the land being held in trust by all people for all people. This attitude toward the land, fashioned during centuries marked by small populations living in nomadic lifestyle in a relatively extensive area, is in direct conflict with western attitudes toward land ownership. Federal legislation during the past 15 years, specifically ANCSA and ANILCA, has brought the concept of private ownership into every North Slope community. Land selections, including those by regional corporations, village corporations, individuals (Native allotments), the State of Alaska, and federal parks and preserves have created a patchwork of land ownership on the North Slope. As stated previously, numerous resource development projects could result in a reduction in the land available for subsistence activities causing increased competition for suitable harvest locations. This increased pressure could have significant social implications if property boundaries are enforced and federal and state regulation of fish and wildlife populations intensified.

Land Value Parameter Implementation - The effect of reducing the available land base on traditional land use values should be monitored. The geographic database management system provides a tool for monitoring the North Slope Borough land base to help maintain traditional uses over time.

Demography Parameter - The traditional villages of the North Slope grew 24.5 percent during the 1970-80 decade (Alaska Consultants, Inc. and Stephen R. Braund & Associates, 1984, p. 25). The population continues to grow and was estimated at over 5,000 persons in 1983. Capital improvement projects sponsored by the North Slope Borough are one of the major factors encouraging this growth. Concurrent with this growth has been an increase in the non-Native population which as of 1980 represented 23.1 percent of the total traditional villages' population (Alaska Consultants, Inc. and Stephen R. Braund & Associates, 1984, p. 17). Implementing numerous petroleum development projects would likely increase the percentage of non-Natives living in or near the traditional communities at a greater rate than that which would occur with single or a few isolated development projects. The proximity of onshore facilities to existing communities, the rate of development, and the degree to which non-Native populations are enclaved would all tend to influence this phenomenon.

Demographic Parameter Implementation - Consideration in future EIS's should be given to analysis of the ratio of non-Natives to Natives in the traditional communities as well as to the pattern of interrelationships between these two groups. The MMS EIS process should document the baseline Native non-Native ratios by community and project impacts of the anticipated effect of projects on future ratios. Attempts should be made to predict the effects of changing ratios on other social and cultural parameters. Distinctions should be made between non-white populations in enclaves versus those in the villages. Induced demographic effects (especially via the NSB capital improvement plan) should also be considered.

Wage Employment Parameter - Currently, most of the wage employment in local villages (including Barrow) is either the result of contracted construction activities related to the North Slope Borough CIP or direct employment provided by the NSB. As discussed in SESP T.R. 101 (Alaska Consultants, Inc. , and Stephen R. Braund & Associates, 1984) , the cash income provided by these employment opportunities has greatly contributed to villagers' ability to obtain, maintain and operate their hunting equipment. The NSB has a generous leave policy for permanent employees which allows them time to pursue subsistence interests. Local construction jobs are generally high paying, seasonal, and temporary, allowing villagers time for subsistence activities. Considering the cash requirements for contemporary subsistence activities, the availability of local jobs, the seasonal and/or temporary nature of much of the employment, and the generous policies related to annual and subsistence leave for permanent workers, the recent employment opportunities in the North Slope remain compatible with current subsistence activities.

However, this phenomenon may change once the CIP is completed and local wage employment opportunities decrease. Although Native employment on oil and gas development activities is currently quite low for a variety of reasons, pressures to increase training and employment of NSB Natives for petroleum development is likely to rise in the future. If local Eskimos seek employment in the oil industry either in existing facilities or those associated with future developments, the impact of such wage employment and its compatibility with local subsistence activities should be analyzed. As one project is unlikely to accommodate large numbers of Native workers, any significant employment effects will be associated with numerous petroleum development projects. To date, few North Slope Eskimos have worked in oil related jobs, preferring instead local employment in villages where they can ccmbine jobs with village life (including subsistence pursuits and kinship ties). When local construction related employment opportunities decline, this may change, with unknown effects on subsistence practices.

Wage Employment Parameter Implementation - The important effects of wage employment on subsistence activities emphasizes the need for careful analysis of cumulative development impacts on the NSB budget. Implementation of this parameter is discussed in Section 4.1.2. Specifically, it would be desirable to analyze the number of local people who enter industry jobs and the effects of different types and locations of jobs on local subsistence activities and social relations.

4.1.5 Public Inquiries

Another approach to identifying and assessing the cumulative social, economic and cultural impacts of petroleum and other North Slope Borough development projects is to initiate a process of “Public Inquiry”. A “Public Inquiry” is designed to be a quasi-judicial review of evidence on project impacts. Typified by the Berger Inquiry in Canada (1977), a “Public Inquiry” stresses active participation in the assessment process by the affected communities. It, in essence, allows the communities to define for themselves what the important cumulative social, economic and cultural impacts are. Canadian public inquiries conducted in conjunction with environmental assessments tend to be’ considerably more involved than MMS' scoping process cr public hearings and have often included financial support to participants to enable them to prepare supporting materials.

The “Public Inquiry” process relies on an open, adversarial framework to let competing views and interpretations of available facts be aired, along with subjective impressions, feelings and other non-quantifiable and non-factual evidence. Social Impact Assessments, particularly those involving Native Americans or other indigenous peoples are being particularly sensitive to this point of involvement and participation in the assessment. process at more than tokenistic levels (Boggs, 1978 and Geisler et al., 1982). The drawbacks of this approach relate to its tedious and lengthy nature, its requirements for a reasonably independent arbiter, and the need to reach some final defensible decision regarding the available testimony. Nevertheless, the process of Public Inquiry epitomizes the democratic process, and with appropriate modification might serve as a framework for establishing a first-hand assessment of cumulative impacts.

4.1.6 Fiscal Analysis for the North Slope Borough

Much of the MMS Socioeconomic Studies Program literature, especially Technical Reports No’s. 62 and 85 (Nebesky, 1981 and Kruse, 1983) highlights the importance of the fiscal impacts of development projects on the North Slope Borough. The Prudhoe development project in particular has had an enormous impact on NSB finances, providing the tax revenue and tax base on which the billion-plus dollar NSB capital improvement program was funded. It can be argued that the indirect social, economic and cultural impacts which development projects have (through their impacts on borough finances). may outweigh their other direct effects. Therefore, it is important that future

EIS's contain a detailed analysis of the proposed project's impact on NSB finances.

The cumulative effects aspect of this recommendation may not be obvious. The fiscal effects on social, economic and cultural resources depend not on a single proposed project, but on the new effect of all development projects. Ideally, any impact analysis considers the future with and without the proposed development. However, with respect to NSB finances, the assumptions about which projects are included in a cumulative scenario is especially critical but highly uncertain. It is therefore important to perform a sensitivity analysis under alternative scenarios without the proposed project to determine the potential range of impacts. It is this multi-project perspective which brings out the cumulative aspects of this issue. This type of analysis is best accomplished in a regional EIS context.

Analysis and forecasting of the NSB fiscal impacts requires knowledge of political choices and legal constraints, both of which are subject to change over time. Legal considerations, specifically state mandated limits on bonded indebtedness and use of the revenues for meeting operating expenses constrain how project-related contributions to NSB finances can be used. Political choices and changing priorities also affect the uses of project induced funds. However, since a large part of the Borough's planned improvements are already in the advanced planning or implementation stage, reasonable assumptions about the uses of funds can be made. As to the legal constraints on sources of funds, the range of possible or likely outcomes can be handled by sensitivity analysis. Periodic updates of the prc.jetted impacts are important if major legal changes occur.

The North Slope Borough fiscal model , described in ISER (1983) provide an excellent means of analyzing and forecasting future NSB finances with and without the proposed project. In ISER (1983), a strong case is made that future OCS development impacts on NSB finances will be minimal, because expenditures are limited not by the tax base, but rather by the revenues available for operating expenses which are limited on a per capita basis. Due to the high political visibility of the NSB financial position, state-imposed 1 egal limits are a distinct possibility. (ISER 1983 P-80-81 lists six such possible legal changes and their impacts.) If and when these changes occur and/or if and when major development decisions within the NSB are made, the fiscal analysis needs to be updated. This again argues in favor of a periodic regional EIS policy.

4.2 Observations Developed During the Literature Review

Clearly each of the six general approaches discussed here are merely points of possible departure for conducting cumulative impact assessments in the Alaskan Arctic. Considerable effort is still required to devise an appropriate range of specific methods and impact parameters tailored to the relevant social, economic, and cultural conditions of the North Slope Borough, the likely development projects, and the direction and shape of future social and economic change. Nevertheless, each of the approaches discussed appears to have valid application to the assessment of the cumulative impacts of petroleum development in the Alaskan Arctic. However, the potential of such methodological approaches still remains to be demonstrated.

Environmental impact assessment appears to be a relatively simple and straightforward exercise that attempts to forecast changes that are likely to occur and then to provide an indication of their significance. However, impact assessment of large, technologically complex projects in a rapidly changing and relatively poorly understood human environment borders on futures forecasting. Development arises from the interplay of environmental and social systems. The latter are difficult to define and difficult to integrate with environmental variables. Despite the increasing sophistication of environmental impact assessments and social impact assessments, the parameters of significant cumulative impacts and how to assess them remain obscure. This is in large part due to the fuzzy and inexact nature of the concept of cumulative impact, the proliferation of different definitions and applications of cumulative impacts and the considerable difficulties in operationalizing cumulative impact assessments methodologies.

To be sure, definitions of cumulative impact exist (Stakhiv, 1978; Stakhiv, 1980; Merson and Eastman, 1980; and Dames & Moore 1981). However, these definitions by their nature are expansive and judgmental. In some applications, cumulative impact assessment has expanded from the relatively simple task of reviewing the incremental impacts of a series of relatively minor projects (Mitre, 1975) to assessment of the complex of activities represented in the ongoing processes of urbanization and industrialization (Science Applications, Inc. , 1983; Skidmore, Owings, and Merrill , 1981; and Dirschl , 1982). Much of the early cumulative impact literature postulates that all that is required to conduct cumulative impact assessments is a holistic view of systems and their evolutionary trends, rates of change, structural characteristics, and functions (Stakhiv, 1978). However, this broad perspective assumes that practitioners of the social and natural sciences have an adequate knowledge of such systemic factors, Such is obviously not the case, particularly for analysis of the complex and dynamic processes of relatively rapid social, cultural and economic change such as that which has been occurring in the North Slope Borough (Worl Associates, 1978; and Alaskan Consultants, et al., 1984).

Consequently, in approaching the notion of cumulative impact assessment one needs to be pragmatic. There is a need to distinguish between the ongoing process of secularized change occurring in the traditional change associated with individual projects. The measurement and distinguishing of these two causative change processes lies at the heart of cumulative impact assessment and yet may ultimately not be measurable given current methodological tools, available data, intercultural differences and political attitudes. There is also a need to be sensitive to the distinctions between the massive impacts associated with large-scale projects and the incremental and interactive impacts associated with a large number of such projects occurring on related but independent time lines.

In order to overcome the considerable methodological difficulties associated with cumulative impact concepts and the lack of readily available cumulative impact assessment methods, a realistic approach to current cumulative development scenarios on the North Slope Borough appears to be required. Thought needs to be given to the significant cumulative social, economic, and cultural impacts of development in the Arctic, and the methods available to predict, measure, and assess such impacts. Any cumulative impact assessment approach must be able to include the analysis of the integrated effects of a large number of diverse but interactive projects, both industrial and non-industrial in nature.

Several authors have also pointed out the central role which subjective judgments and values play in impact assessments (Usher, 1982; Gibson, 1982; and White, 1982 among others). This is an exceedingly thorny methodological issue and must be considered in any cumulative impact assessment method.

Ultimately, social, economic and cultural impacts may not be amenable to direct quantification. Nevertheless, it appears that to be adequate, a cumulative impact assessment must include the life-cycle impacts of a project as well as the effects of its closure. Therefore, accurate assessment of cumulative social, economic and cultural changes is dependent upon attempting to better organize available information, to pose a different set of questions, and to initiate a process of long-term regional monitoring of selected parameters related to impact and change (Carley, 1984). The absence of existing longitudinal data for North Slope Borough communities (Kruse et al., 1983), the relatively small size of the communities involved, and the massive process of ongoing social, cultural and economic change combine to make the assessment of cumulative impacts a challenging undertaking.

5.0 DESCRIPTION OF HISTORICAL AND PROPOSED DEVELOPMENT IN THE NORTH SLOPE BOROUGH

Section 5.1 Introduction

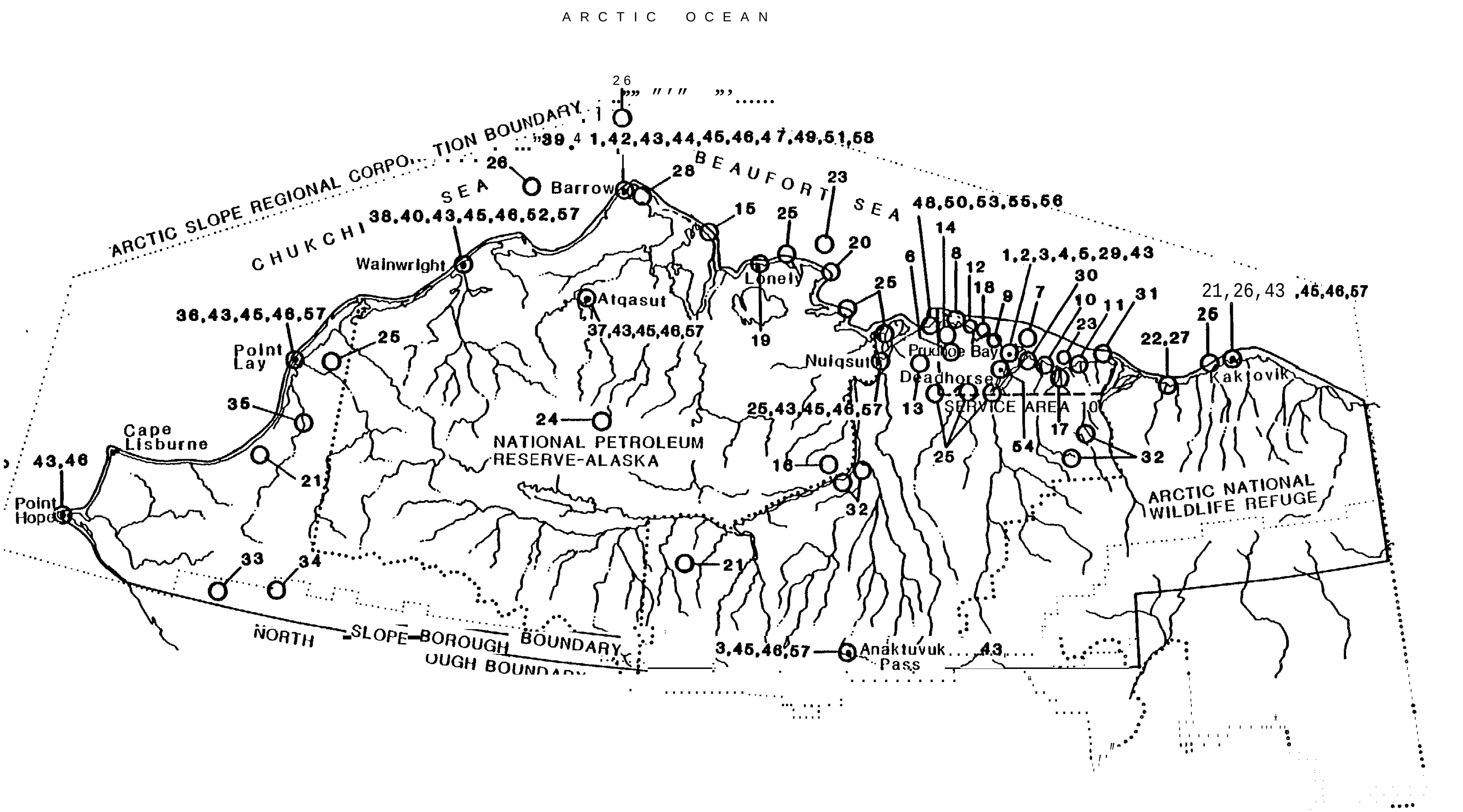
The principal purpose of this chapter is to identify a selected series of North Slope Borough Area development projects and examine their characteristics as to timing, location, employment, capital cost, operating costs, and data sources, to help bound the range of expected development futures and their cumulative social and economic impacts. Eighteen categories of development projects have been identified that occur as a result of actual or prospective oil/mining development in the North Slope Borough area.

Sections Two (2.0) through Seven (7.0) focus on mineral resource developments representing the range of project evolvement from leasing and early exploration to advanced production activities. Sections Eight (8.0) through Nineteen (19.0) identify and profile significant infrastructural developments that support human habitation and the operating requirements of resource development on the North Slope. These projects, fifty-eight in number, have emerged due to stimulation from private and public sector initiatives such as the discovery of oil (1968) or the creation of the North Slope Borough capital improvements program (1974). The sequence of project development activities, past, present, and potential future, create impacts that vary with time and location throughout the area.

The North Slope Borough capital improvements program embraces six fiscal years with the current program covering the period 1983-1989. The program provides facilities for the cities of Barrow, Anaktuvuk Pass, Atqasuk, Nuiqsut, Kaktovik, Pt. Hope, Pt. Lay, Wainwright, Service Area 10 at Prudhoe Bay and the Kuparuk Industrial Center. Facilities provided under the program include education, public roads and streets, housing, water and sewer, solid waste disposal, health, libraries, power, public safety, airports, communications, industrial development, and administration. At the close of the current program period June, 1989, the borough will have committed approximately 1.5 billion for facility developments.

Mineral developments, particularly oil and gas, have a unique shorthand technical vocabulary, the understanding of which will aid the reader immeasurably in reviewing project descriptions. Definition of terms include the following: B/D - barrels per day; TCF - trillion cubic feet; API - American Petroleum Institute measure of thickness (gravity); pour point - the lowest temperature at which oil flows under specified conditions; MD - measure of depth; TVD - true vertical depth, EOR - enhanced oil recovery activities also known as tertiary recovery. A number of additional abbreviations and definitions are provided with the abbreviations list at the beginning of the report.

Each section of this chapter provides introductory background appropriate to the respective categories of project developments. A complete list of references for each section is included in the bibliography; Appendix A identifies individuals contacted during the course of data collection. The map on the following page identifies the location of each development project throughout the North Slope area. The data in this chapter is current through June 1984.



DEVELOPMENT PROJECT LOCATIONS

Assessment of Cumulative Impacts of Petroleum Development on the Alaska Arctic

SYMBOLS :

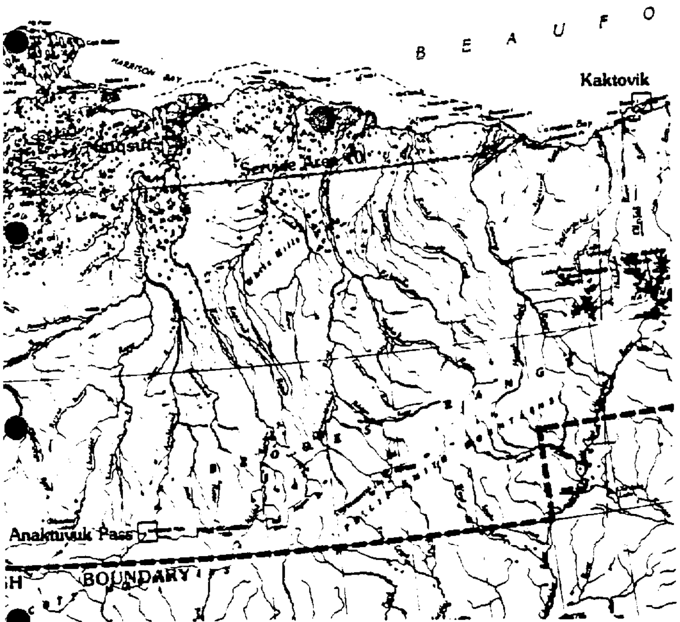
Project Number 9

Project Location

0 25 50 100

5.2 OIL DEVELOPMENT PROJECTS

The projects described within this category are related to oil development activities which have already been found to be commercial (i. e., economically feasible). The Prudhoe Bay primary production, waterflood, and enhanced recovery activities (EOR), as well as the Milne Point and Kuparuk River fields are already under construction or substantially completed. The Endicott development project and West Sak sands are in the detailed planning stage. The Lisburne oil reservoir project has been determined to be commercial by ARCO but has not yet received financial commitments from the other owners of the field. Consequently, its development is still not certain. With the exception of the Endicott project, all of the activities discussed in this category are onshore. The Endicott Project represents industry's first step offshore with a commercial oil development.



Category: Oil Development Projects

Project: 1 Prudhoe Bay Unit (Primary Recovery)

Location(s): Prudhoe Bay Onshore

Time Frame: Ongoing through 2007

Sponsor: Sohio, ARCO (Operators)

Contact/ Source: Mr. Dennis Helfand, ARCO (907) 276-1215
Mr. Paul Martin, Sohio

Capital Costs: $10 Billion (estimate)

Operations costs: $250 Million/year

Employment Characteristics:	Local Non Local	
ARCO	1500	Local/Nonlocal breakdown
Sohio	1800	Not Available
Drillers (3 rigs)	180(e)	
Service Companies	800(e)	(e) = Estimate
TOTAL	4280(e)	

Project Description:

Primary recovery from the Prudhoe Bay Unit (PBU) has been ongoing since 1977. Tapping the Sadlerochit sand formation at about 8,000-9,000 feet, the field now produces 1.5 million B/D. from 550 wells. Out of an estimated 22-25 billion barrels in place, primary recovery methods would produce about 6 billion. However, a waterflood program and other enhanced oil recovery projects (described on separate data sheets) will significantly increase the amount of oil ultimately recovered. By the end of 1983, about 3.2 billion barrels had already been produced at the PBU. In addition to oil, there exists about 26 TCF of proven gas reserves. Because there is no transportation system for delivering it, associated gas is reinfected through 18 injection wells (except for a small portion used as a local energy source).

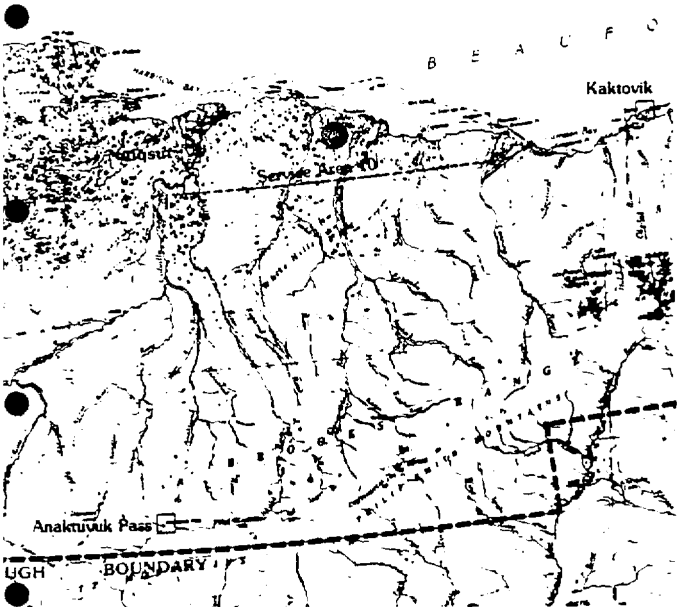
Apart from the secondary (waterflood) and tertiary (enhanced) recovery programs, construction activities are complete at Prudhoe. The existing facilities are divided between the ARCO (east) side and the Sohio (west) side of the field. Each side has its wells arrayed on gravel pads typically 150 feet by one-quarter mile long. Up to 40 wells per pad are enclosed in individual wellhead housings to protect them from the weather. The gravel pads maintain the permafrost in a frozen state. The production from several pads is combined in gathering centers which strip off the gas and formation water and stabilize the crude. The crude is piped to the port of Valdez through the Transalaska Pipeline. Both Sohio and ARCO maintain permanent service/housing facilities for their workers and dock for sealift of equipment and support of Beaufort Sea activities. An industrial subdivision (on state land) provides facilities for the contractor servicing the PBU (drillers, well loggers, oil field supply companies, etc.).

The workforce present at the PBU at any given time totals roughly 4,000 although some of this workforce employed for the PBU is almost twice that number, because workers typically rotate two weeks on and two weeks off. Since the PBU is operated as an enclave, workers return home (elsewhere in Alaska or the Lower 48) on their weeks off.

A very small percentage of the PBU workforce is local to the North Slope Borough. An earlier MMS report (Technical Report #85) estimates that the number of NSB residents employed in the oil industry is probably less than 30 (p. 127). A census conducted by the Alaska Department of Labor in 1984 indicated that 178 workers either lived in the NSB or did not report a residence. The latter category (no reported residence) probably accounts for the majority of the 178 workers.

Another estimate of the total PBU workforce is available frcm the Alaska Department of Labor Statistics on the North Slope Borough employment. The employment category mining (essentially related in the NSB) averaged *3,860, 3,700, and 3,358 in years 1981, 1982, and 1983, respectively. Again, the actual number of persons employed is almost double this figure due to crew rotations. These figures include exploration employment as well as PBU employment, but does not include employment for jobs such as catering which do not fall into an oil or mining category. Construction workers not associated with an oil-related company are also excluded from these data.

* Annual average of quarterly data from Alaska Department of Labor Statistics.



Category:	Oil Development Projects
Project: 2	Prudhce Bay Waterflcod
Location(s):	Prudhoe Bay Unit
Time Frame:	Construction: 1981-84 Operation: Mid-1984
Sponsor:	ARCO and Sohio, (Operators)
Contact/ Source:	Dennis Helfand, Asst. Dir., Gov't Relations, ARCO (907) 276-1215
Capital Costs:	($1.5 -$2.0 billicn)
Operations costs:	Not Available

Employment Characteristics: Local **Non Local**

Construction: 900 Local/Non Local breakdown not available

Operation: 300

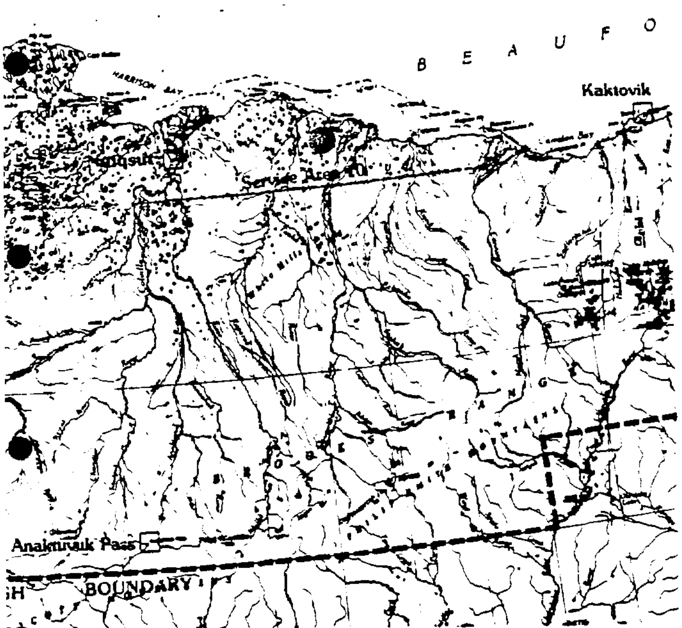
reject Description:

A waterflood program, now substantially completed, is expected to increase oil recovery at Prudhoe Bay by 1.1 billion barrels. The water flood system consists of injecting water under high pressure into the producing formation in order to maintain reservoir pressure and to force oil toward the producing well. ARCO and Sohio will operate the system in the eastern and western operating areas, respectively.

The waterflood program was completed in Summer, 1984. The project will inject up to 2 million B/D of Beaufort Sea water into the reservoir. Most of the capital cost of this program was entailed in the fabrication of a massive seawater treatment plant. This plant was designed by Bechtel and constructed in South Korea. Built on a barge this eleven-story-high structure was completely assembled in Korea and towed to Prudhoe in the summer of 1983. At 26,000 tons, the unit is the world's largest seawater treatment plant and the largest module transported to Prudhoe.

The treatment facility (operated by ARCO) withdraws seawater, and diverts marine life back into the sea. The seawater is filtered, heated and deaerated to minimize corrosion. The plant provides injection water to both the ARCO and Sohio sides of the field. Up to 1.2 million B/D of water can be delivered through a 13-mile 40-inch low pressure pipeline to the East Injection Plant. The remaining 1.0 million B/D is delivered through an n-mile 36-inch pipeline to the West Injection Plant. When completed, about 120 miles of feeder lines will distribute the water to the injection well sites. The plant is located at the end of a gravel causeway built off the end of an existing causeway at Prudhoe Bay west dock. The causeway is breached to permit fish to migrate through, rather than around, the artificial point created by the causeways.

When operating, the waterflood system (both phases) will increase employment at Prudhoe by about 300 workers.



Category: Oil Development Projects

Project: 3 Prudhoe Bay Unit Enhanced Oil Recovery

Location(s): Prudhoe Bay Unit

Time Frame: Ongoing through 1990

Sponsor: ARCO (Operator), Sohio

Contact/ Source: Dennis Helfand
(907) 276-1215

Capital Costs: Miscible gas: $0.75 billion
LPS: $1 billion
Art. Lift: $1 billion
In-filling: $2-3 billion
Well Pad Manifold:
Net Available
Total : $10.5 billion

Operations Costs: Operations Not Available

Employment Characteristics: Local Non Local

Construction:	2000 (e)	Local/Non Local
Operation:	1800 (e)	breakdown not available
Drilling:	150-240 peak	(e) = Estimate

Project Description:

An extensive program is presently underway to increase the recovery of oil from the existing Prudhoe Bay pay zone (the Sadlerochit Formation). This program, operated primarily by ARCO, will help to maximize recovery of oil in place at a cost of $10.5 billion. Primary recovery methods alone would have produced only approximately 6 billion barrels. Together, the enhanced recovery project plus waterflood will allow ultimate recovery of about 9.6 billion barrels from the Sadlerochit. The program consists of four components: in-filling, manifolding, miscible gas injection, low pressure separation (LPS), and artificial lift.

In-filling: The wells at Prudhoe Bay were originally drilled at 160 acres spacing (each well drains 160 acres of reservoir). An in-filling program to reduce spacing to 80 acres has been ongoing since 1981. This program is nearing completion but will entail full-time operation of 3 to 4 rigs through year 1987. New operational employment due to in-filling is negligible. In-filling is expected to produce a 4 percent increase in recovery at a cost of $2-3 billion. This program is being conducted by both Sohio and ARCO.

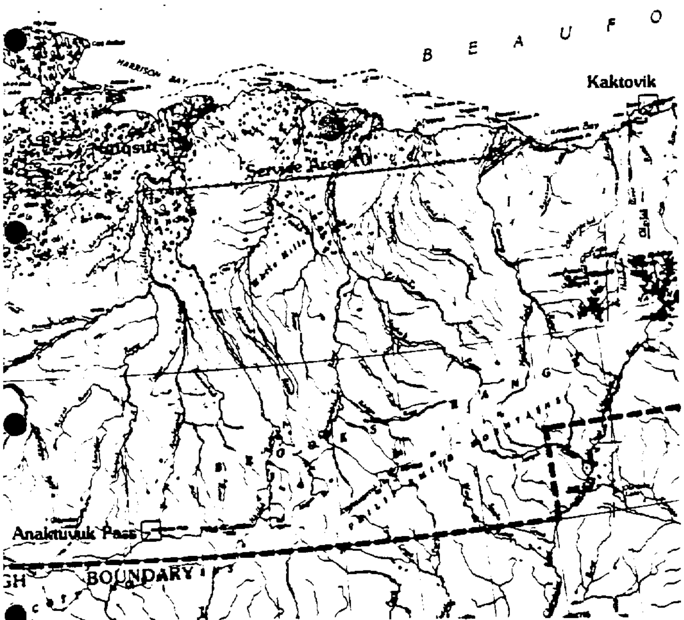
Well Pad Manifolding (WPM) and Drill Site Expansion (DSX): The Sohio WPM program allows the existing flowlines to accommodate the production from the increased number of wells from the in-filling project. Although new flowline could have been laid for the new wells, this would have been more costly than the WPM project. Begun in 1981, the first phase calls for installing manifolds on 7 well pads at a cost of $135 million. By the 1985 completion, manifolds will be installed at 17 pads and test separators on 14 pads. The size of the construction labor force in 1984 and 1985 was not available. The operations labor force will be essentially unaffected. In addition, ARCO is now constructing a Drill Site Expansion Program.

Miscible Gas Injection: In March 1984, the Alaska Oil and Gas Conservation Commission approved the miscible gas injection program to be operated by ARCO. This $750 million program injects a mixture of gas and water through 42 injection wells in order to enhance production at 152 production wells. Part of the additional 115 million barrels produced by this project will be natural gas liquids and part will be additional petroleum released from the Sadlerochit Formation. Construction for the program will extend from 1984 through 1986, employing 30 workers. The injection start-up in 1987 will add an as yet to be determined additional number of employees to ARCO's present 1500-person work-force.

Low Pressure Separation (LPS): As the Sadlerochit Reservoir approaches decline, formation pressures decrease. As a result, it is desirable to separate the gas from the crude at a lower pressure (150 psi versus 600-620 psi). By installing LPS systems at each of the gathering systems, ultimate recovery will be increased by about 3 percent at a cost of $1.5 to S2.0 billion. The first three LPS units for ARCO's flow stations and one for Sohio's Gathering Center 2 are operational. The remaining gathering center's LPS units are now being installed and will be operational in 1985. The size of the construction workforce for 1984 and 1985 was not available. Operational workforce will be unchanged.

e

Artificial Lift: The $1 billion artificial lift program consists of injecting gas into selected wells to lift oil out of the formation. This project is expected to increase recovery by about 500 million barrels or approximately two percent of additional recovery. This system is presently under construction and will be completed by 1987. No estimates of the construction workforce were available. When operational, this program will net require additional workers.



Category: Oil Development Projects

Project: 4 Lisburne Oil

Location(s): E. side of Prudhoe Bay Unit

Time Frame: Construction: 1984
Production: 1987-2020

Sponsor: ARCO, Exxon, Sohio (Operators)

Contact/ Source: Dennis Hefland, ARCO
(907) 276-1215

Capital Costs: $575 MM Phase 1 (ARCO's share)
S1.4-2.0 billion total

Operations costs: Not Available

Employment Characteristics: **Local Non Local**

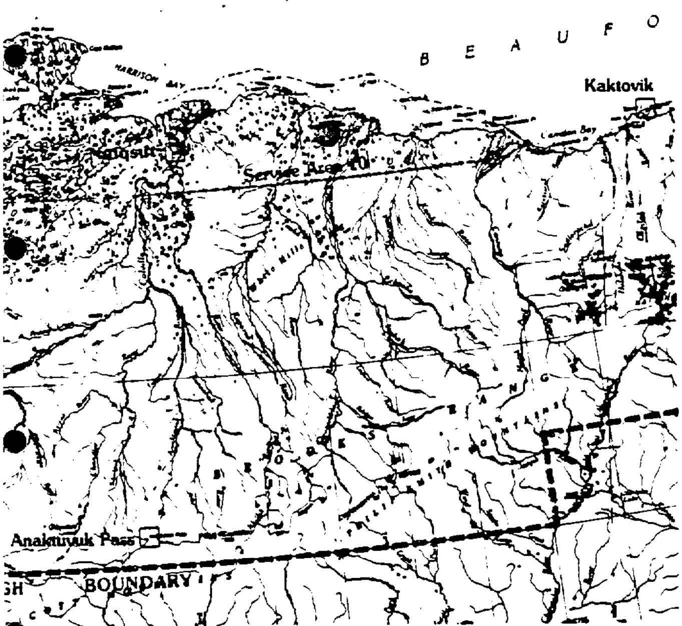
Construction :	1000	Local/Non Local
Operation:	100	breakdown not available
Drilling:	100-240	

Preject Description:

The Lisburne Oil Reservoir underlies the presently producing Sadlerochit formation in the northeastern part of the Prudhoe Bay Unit. Although discovered at the same time as the Sadlerachit formation, the Lisburne was net deemed economic to produce until recently due to uncertainties concerning reservoir extent and producibility. In early 1984 ARCO, which owns a major interest in the reservoir, announced a commitment to a $575 million plan for the first phase of commercial development of the Lisburne. The ether two owners of the field, Exxon and Sohio, have not yet decided whether they will participate in the project. It is estimated that the Lisburne contains from 2.0 to 3.0 billion barrels of oil.

The initial development plan entails the drilling of 180 wells on 6 pads for an initial production rate of 100,000 barrels per day in 1987. Independent facilities will also be constructed to handle the oil and gas produced. Produced gas will be reinfected into the reservoir until a major gas sales outlet is available. Waterflood feasibility is in the early stages of evaluation, and would not be in place until the 1990's.

The numbers of new wells needed to develop the Lisburne will necessitate full time operation of approximately 3-4 drill rigs from 1985 to 1991. The depth of the Lisburne pay zone ranges from 8,600 to 9,150 feet below sealevel. Each well will take longer to complete. This is a considerably larger drilling time than is typical of Sadlerochit wells due to the complications of drilling through the Sadlerochit gas cap and the difficulty of drilling in the relatively harder carbonate rock in the Lisburne. In addition to the production equipment, the housing and support facilities at the ARCO camp will have to be expanded to accommodate 300 new operations workers.



Category: Oil Development Projects

Project: 5 West Sak Sands

Location(s): SE Corner of Kuparuk River Unit

Time Frame: 1983-1990's

Sponsor: ARCO

Contact/ Source: Leland Tate

Capital Costs: $58 Million (Pilot Project)

Operations costs: Not available

Eemployment Characteristics: **Local Non Local**

Workforce estimates not yet available, as planning has not advanced past the pilot project stage.

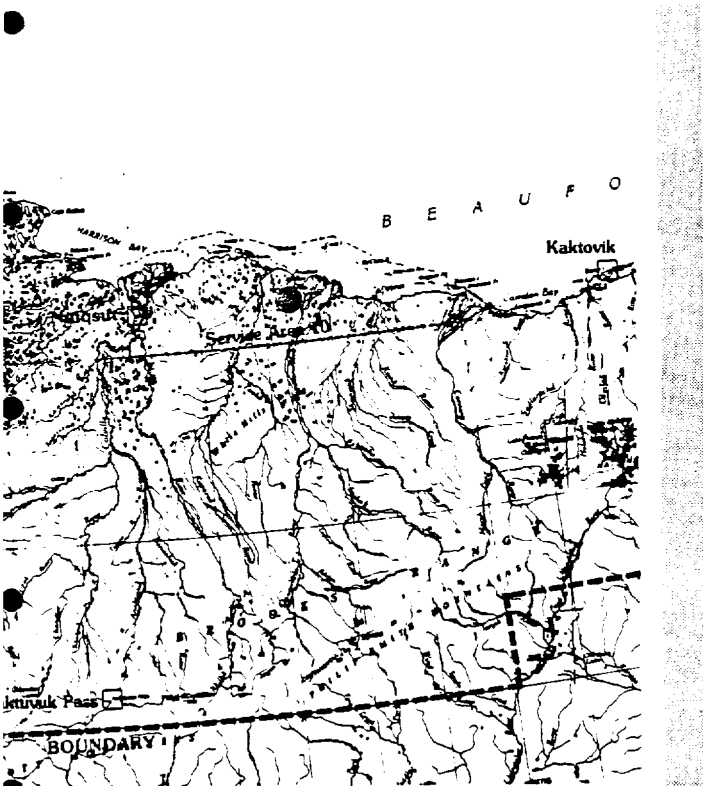
Project Description:

The West Sak sand formation contains an estimated 15 to 25 billion barrels of oil in place. This thin cretaceous formation covers about 250 square miles of the Kuparuk River unit, west of Prudhoe Bay. Although discovered in the early 1970's, the deeper pay zones of the Kuparuk were developed rather than the West Sak sands because the West Sak oils are heavier (16° to22° API gravity) and the formation is too tight to permit conventional recovery methods. ARCO is presently implementing plans for a thermal heavy oil pilot project. If the pilot project is successful, the West Sak might produce as much as 2 billion barrels at a peak rate of up to 200,000 B/D, rivaling the output of the existing Kuparuk pay zone.

The West Sak pilot project consists of 13 wells of which 8 are producers and 5 are injectors. Hot water (200°-250°F) will be injected in order to determine if reservoir pressures and heat energy can be maintained while producing up to 2,500 B/D. Initially, Sadlerochit formation water will be used although eventually shifting to the less corrosive Beaufort Sea water. Drilling activities were completed early in 1984 followed shortly by the thermal flooding operation. The reservoir response is expected in one year, although the response will be evaluated for several years.

Commercial scale recovery, which would begin post 1986, would involve a very extensive drilling operation as wells must be drilled at close spacings (20 acres or less). Since the formation covers about 250 square miles, development of even 20 percent of the formation implies more than 2,000 wells. Although the formation is shallow (about 4,000 feet), commercial development implies many rig-years of continuous drilling. This drilling effort, plus the employment generated by the operation of a large complex recovery operation, will result in a very large employment impact.

Commercial feasibility of West Sak would enhance the commercial viability of the marginal Milne Point field which is also underlain by West Sak sands.



Category: Oil Development Projects

Project: 6 — Kuparuk River Unit

Location(s): 40 miles west of Prudhoe

Time Frame: Construction: 1981-1983
Operation: 1982-2002+

Sponsor: ARCO (Operator), Amoco

Contact/ Source: Dennis Hefland, ARCO
(907) 276-1215

Capital Costs: $7.2 billion

Operations costs: Not available

Employment Characteristics: **Local Non Local**

Construction:	300	Local/Non Local breakdown not available.
Operation:	250 (1984) Up to 481 by 1987	
Drilling:	100-120 (through 1985), 200-240 (1985-1526)	

Project Description:

The Kuparuk Unit, located about 40 miles west of Prudhoe Bay, is soon to become the second largest producing field in the U.S. Kuparuk's recoverable reserves (primary and secondary) are estimated to be 1.6 billion barrels. Production will peak at 250,000 B/D in the late 1980's. This peak meshes well with the decline in Prudhoe Bay Unit production slated for that time. The Kuparuk production is delivered to Pump Station 1 of TAPS via a 26 mile 16 inch pipeline to TAPS. The capital cost of the three-phase production plan is $7.2 billion.

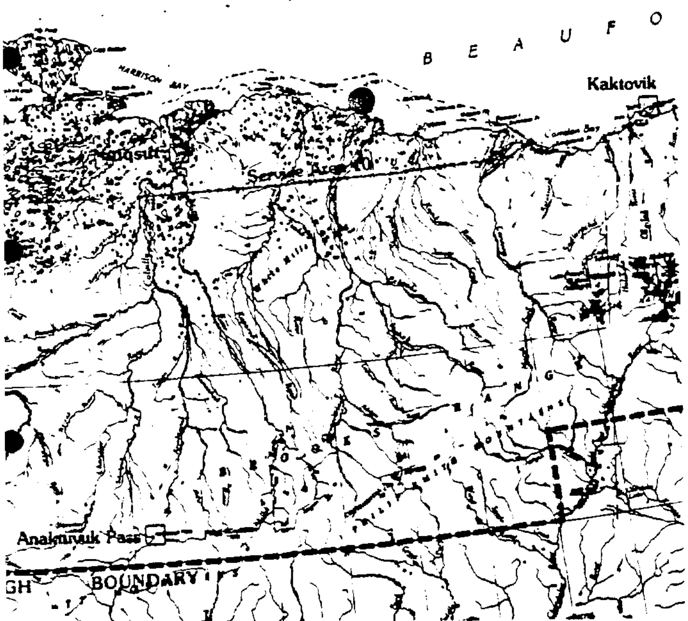
The field is currently (Spring, 1984) producing at 115,000 B/D. Production facilities include 81 production wells and 27 injection wells at 12 pads, which produce to a central production facility (CPF-1). About 150 workers are housed at a permanent' camp at Kuparuk. A total of 250 employees rotate in to Kuparuk on one-week shifts. Kuparuk support facilities include living and dining quarters, a water and sewage treatment plant, warehouses, offices, and a 1,700 foot gravel airstrip.

The utilities section for the second central production facility (CPF-2) arrived on last summer's sealift and is now being installed. The production modules were sealifted in the summer of 1984 and installed in fall 1984. The start up of CPF-2 will add 88 wells at 7 drill sites. A 650-man construction camp and two more 96-person permanent camp wings have been completed in 1984. This will add another 90-120,000 B/D initially. Two drill rigs and a completion rig are currently operating at Kuparuk. Continued expansion of those two areas will add 80 wells at five drill sites in 1985.

Development plans also call for expansion to the northwest and a third central processing facility. The planned 160 producing wells will be located at 10 pads and are expected to produce as much as 80,000 B/D. The production start-up is scheduled for 1987.

Peak production will exceed the capacity of the present 16 inch line to TAPS. In 1985 a new 24 inch line will start up. This line will add sufficient capacity for the nearby Milne Point production as well.

Drilling activity will be quite intense, with a planned 750-800 total wells. Although wells can be completed in only 10 days because of the soft sand composition of the formations, it is expected that by 1985 four drill rigs will be operating at Kuparuk. This level of activity will continue through 1986". At full production, permanent operation employment will total 481.



Category: Oil Development Projects

Project: 7 Endicott Sag/Duck (Oil)

Location(s): Prudhoe Offshore, 5 miles of Prudhoe Bay Unit

Time Frame: Construction - 1985
Production - 1988-2008+

Sponsor: Sohio (Operator), Exxon, CIRI, Amoco, Doyen, Ltd., NANA, Union

Contact/ Source: David Pritchard
(415) 979-5000

Capital Costs: $2-2.5 Billion

Operations Costs: Not available

Employment Characteristics: **Local Non Local**

Construction:	100-130	(includes drilling)
Operation:	200	

Local/Non-local breakdown not available

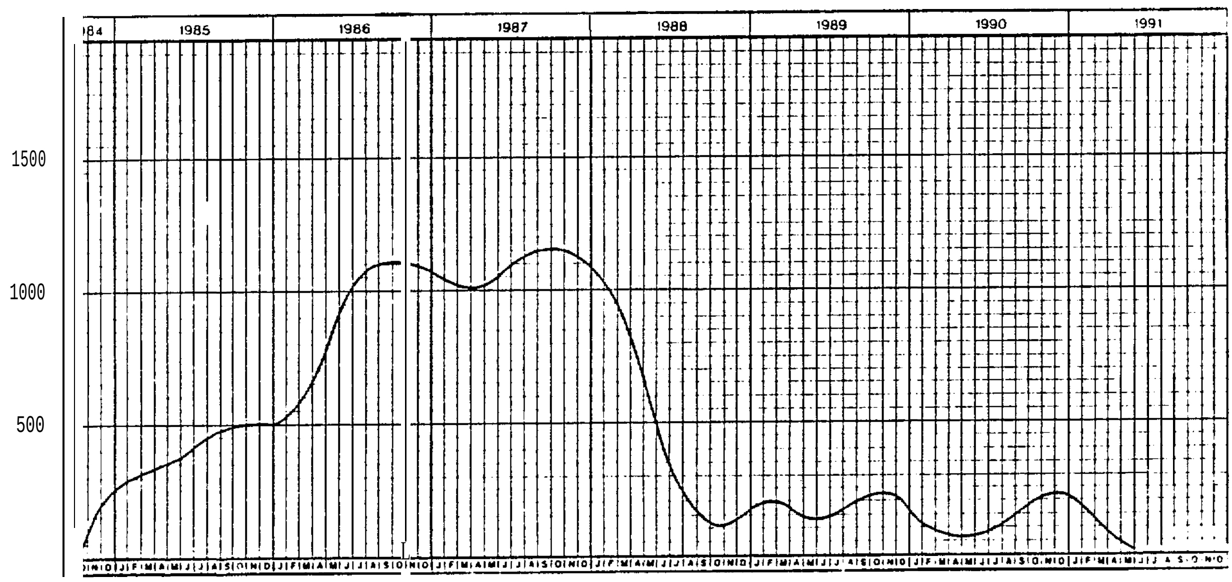
Project Description:

If plans for commercial production of the Endicott proceed on schedule, the project will be the world's first offshore Arctic oil field in 1988. The Endicott field will consist of two gravel islands located in the Beaufort Sea just offshore of the Sagavanirktok River Delta (Sag Delta) 2 to 4 miles north-east of Prudhoe Bay. The field is expected to produce about 100.000 B/D of 22-23° API gravity crude and 250 million cubic feet per day of gas. Ultimate recovery is estimated to exceed 300 million barrels of oil. The gas would be reinfected until such time as a pipeline south is built. The reinjection will assist in lifting the produced fluids.

The gravel islands will be constructed in water 4 to 18 feet deep. A central island will produce and process oil, water and gas, generate power, and provide support equipment and pipeline links to the ether islands. A permanent camp housing 100-160 will be located on the islands. One other gravel island will be built as a production satellite, with only drilling and production equipment. The islands will be connected by pipelines carrying gas for artificial lift, injection water, utilities, and produced fluids. A pipeline from the central island will deliver the field's production to TAPS. Development costs are estimated at $2.0-2.5 billion.

If a decision to develop is reached this year which is expected) production could be expected by 1988 because permitting activities and environmental studies are already well advanced. Island construction could begin in the winter of 1984-85 with development drilling in 1985 to 1986. The Preliminary Engineering Overview calls for up to 80 wells per island for each of the three producing islands. Facilities and pipelines could be installed in 1986 and 1987 for production startup in 1988. This schedule assumes permits are approved and a decision to develop is reached by mid-1984.

FIGURE 34- Endicott North Slope Construction Manpower



i. Department of the Army Corps of Engineers Alaska District, Environmental Research and Technology, Inc; Endicott Development Project' Draft Environmental Impact Statement; for the Alaska District Corps of Engineers; January 1984. p. 2-60.

TABLE 4

PROJECT MANPOWER ESTIMATES [2]

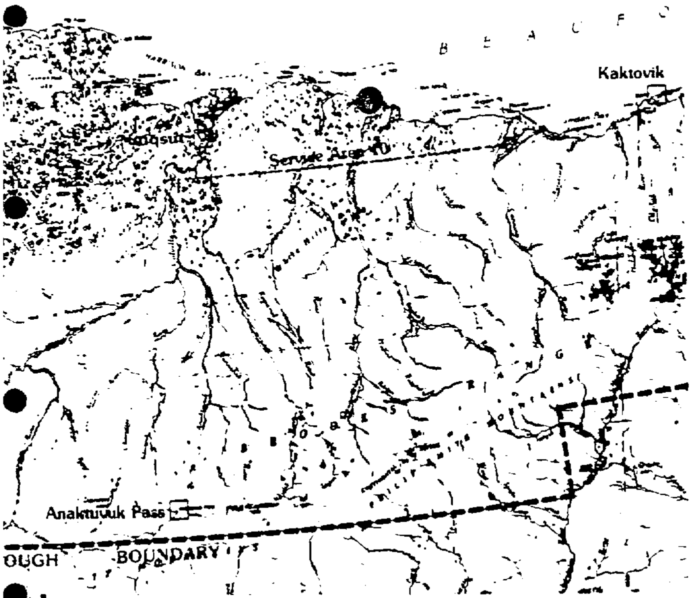
Year-End	Number of People: Construction	Operation	Drilling[1]
1984	0-250		
1985	100-500		
1986	500-1,200	20	220
1987	1,000-1,300	80	220
1988	50-600	154	220
1989	50-300	164	220
1990	25-250	164	220±
1991	35-150	164	110
1992 and through the end of the Project		164	110

[1] Does not include service company personnel.

[2] Department of the Army Corps of Engineers, Alaska District, Environmental Research and Technology, Inc.; Endicott Development Project Draft Environmental Impact Statement; for the Alaska District Corps of Engineers; January 1984. p.2-61.

Category: Oil Development Projects

Project: 8 Milne Point Oil Field



Location(s): 35 miles N.W. of Prudhoe Bay

Time Frame: Construction: 1982-1984
Production: 1985-2000+

Sponsor: CONOCO (Operator) + Champl in, Cities Service, Reading Bates, Chevron

Contact/ Source: Production Supt. Al Hastings

Capital Costs: $312 MM Initial
$787 MM Ultimate

Operations costs: Not available at this time.

Employment Characteristics:	Local Non Local
Construction:	300
Operation:	80
Drilling:	120

Local/Non-Local breakdown not available.

reject Description:

Conoco's Milne Point Field,. located on the shore of the Beaufort Sea 35 miles northwest of Prudhoe Bay, is expected to begin producing 30,000 B/D (22 API) in 1986. This field, although discovered in 1970, was not considered economic until recent oil price increases. The development of the nearby Kuparuk field also enhances the feasibility of Milne Point, due to opportunities for shared infrastructure.

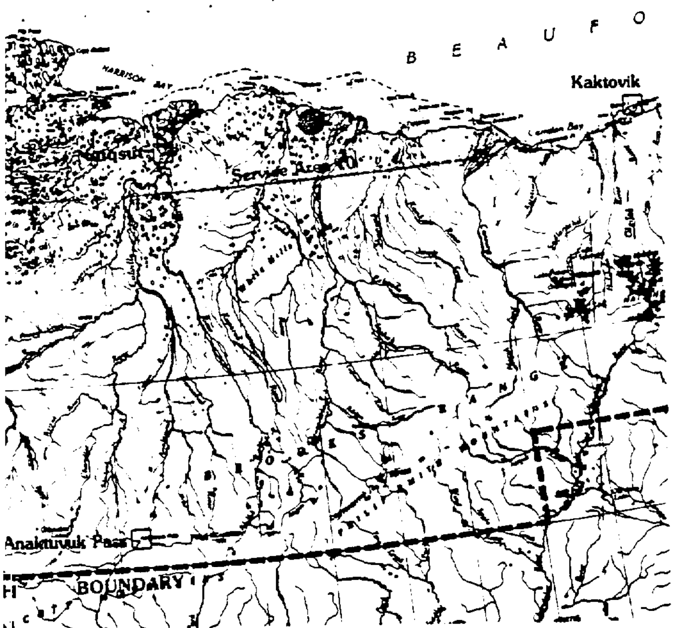
Development will take place in four phases allowing full production to continue until 2000. Phase I, now under way, will add 24 wells ontwo pads to the 19 already drilled delineation. A production facility with capacity for 32,000 B/D, a permanent camp for an estimated 40 employees and an 11½ mile 14 inch pipeline to tie into the West Kuparuk pipeline to TAPS. Each phase of development will require about 30 new wells which will keep two drill rigs operating full time.

The third and fourth development phases will produce from a shallower Cretaceus sand formation.

Completion of the first phase will require a construction workforce of about 300 plus 100 drilling related workers. The operating workforce will consist of about 80 employees (40 per rotation) at Milne Point and 40 in Anchorage.

5.3 ANNOUNCED OIL DISCOVERIES/POTENTIAL DEVELOPMENT PROJECTS

A number of small oil discoveries have been made on the North Slope, Many of these are large enough for potential production development but are uneconomical at present oil prices. For each individual project a reserve of approximately 300 million barrels of oil (Blair Wondzell, Alaska Oil and Gas Conservation Commission) is necessary fcr economical development at this time. The reserves of the projects discussed in this section range from 66 million (Umiat Field) to a possible 6 to 11 billion barrels (ARCO's Ugnu). Because of their current uneconomical nature, a significant portion of the small discovery wells have been suspended or shut-in. As the larger oil reserves are depleted, as technology advances and as infrastructural systems expand, the developability of these small fields could very well be enhanced. For the foreseeable future, the potential of these fields as significant development and employment centers is extremely limited.



Category: Announced Oil Discoveries/ Potential Development Projects

Project: 9 Gwydyr Bay Unit

Location(s): East of Milne Pt., 10-12 miles NW of Prudhoe Bay on Kuparuk Delta

Time Frame: 1969-1981

Sponsor: Conoco

Contact/ Source: Al Hastings, Conoco, 279-0611; AOGCC, 279-1433.

Capital Costs: 20 million

Operations *costs:* none

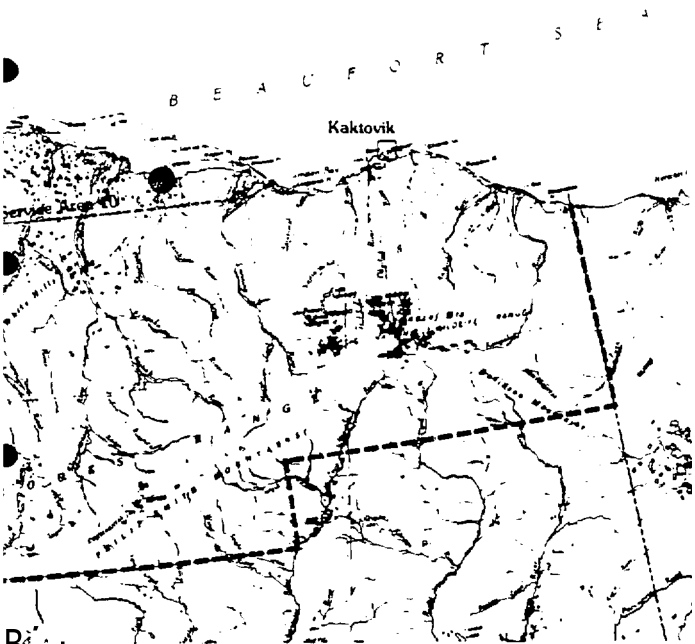
Employment Characteristics: **Local Non Local**

Approximately 20 people per well with 2-3 of this number being from Conoco.
Local/Non Local breakdown not available.

Preject Description:

Gwydyr Bay is a part of the Arctic Subregion which includes the Beaufort Sea (Diapir Field) and the Chukchi Sea (Barrow Arch). State lease Sale 23 occurred on September 10, 1969 and was comprised of the North Slope Uplands and the North Slope offshore. Included in this sale was the 27,160 acres (10,991 - hectares) of Gwydyr Bay. The first discovery here was announced in 1970. A second discovery was announced in 1981.

Since its sale, Gwydyr Bay has been unitized by Conoco and the corporation has been named operator. Currently, plans for further drilling or production are not anticipated. The State of Alaska has estimated the reserves of this discovery to be between 50 and 120 million barrels (7,945,000 - 19,068,000 m^3). After drilling, the 2A Gwydyr Bay state well was tested in two zones. One zone flowed at a rate of 3,000 barrels/day with 37-degree API gravity oil. The second zone flowed at a rate of 740 barrels/day with 19-degree API gravity oil. This well is just north of the Prudhoe Bay field and is located 35 miles east of the two Milne point wells. Conoco found the one Gwydyr Bay state well to be a dry hole while drilling in 1979-81. This well is located four miles west of Prudhoe Bay.



Category: Announced Oil Discoveries/ Potential Development Projects

Project: West Mikkelsen Unit

10

Location(s): Approximately 20 miles due east of Prudhoe Bay Airport

Time Frame 1970 - Present

Sponsor: Shel 1

Contact/ Source: AOGCC (279-1433); Ted Bond, DNR (265 -425 C);

Capital Costs: Not Available at this time

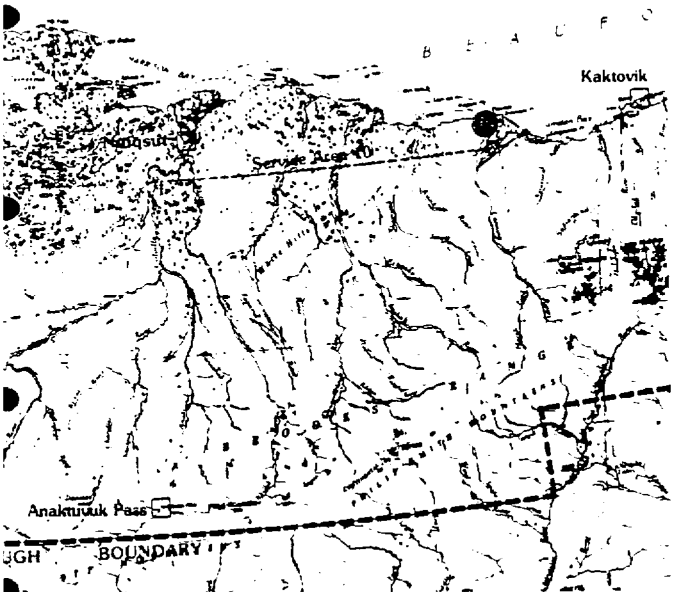
Operations costs: Not Available at this time

B

Employment Characteristics: Local Non Local
40 - 60/exploratory camp, 99% non-local

Project Description:

The West Mikkelsen Unit is an exploratory drilling operation and no official discovery has been announced to date. The Unit encompasses 38,213 acres or 15,465 hectares and is covered by 18 State leases. ARCO was the original unit operator and drilled two wells in the area. Shell has since taken over operations of blest Mikkelsen and was recently granted (Summer 1983) a 6-month extension on the unit by Alaska Division of Minerals and Energy Management. Shell has also drilled two wells in the area with the most recent one being on Goose Island. This is located in the western part of the unit and the well depth reached 13,060 feet (4,000 m). It was completed in the Spring of 1983.



Category:	Announced Oil Discoveries/ Potential Development Projects
Project: 11	Pt. Thomson Unit/Flaxman Island
Location(s):	On the coast of the Beaufort Sea, 50 miles east of the Prudhoe Bay field
Time Frame:	1975 - present
Sponsor:	Exxon
Contact/ Source:	ASR 1/83; Exxon press release, 2/27/84
Capital Costs:	$350,000,000 (wells and leases for oil and gas)
Operations costs:	Proprietary Information

Employment Characteristics: Local Non Local
Proprietary Information

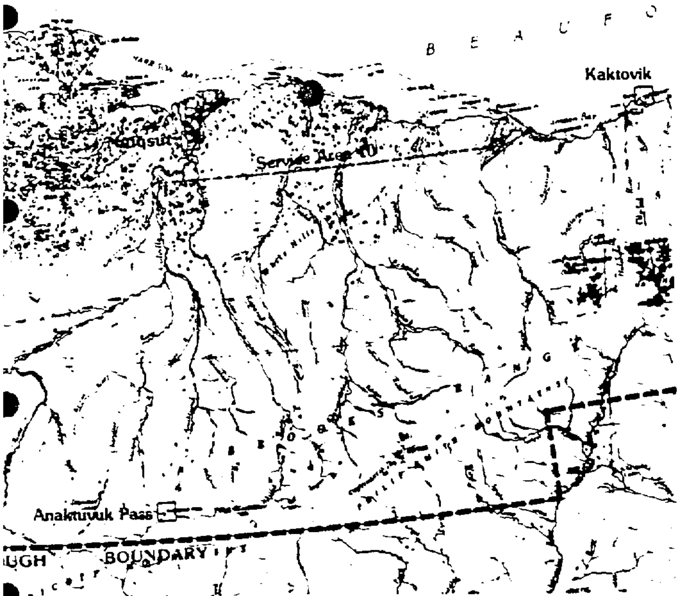
Project Description:

Exploration of the Point Thomson area began in 1975 with the Flaxman Island Alaska State "A" well no. 1 located there. Exxon's first announced discovery in this area was in 1977 and in July 1981, another discovery was announced at their Alaska State C-1 well. This well is located in an area adjacent to tracts leased in the joint Beaufort Sea sale. Preliminary analysis of data from wells in the latter sale suggest a significant hydrocarbon potential in the point Thomson-Maguire Island area. The C-1 well test results showed 3.4 million cubic feet of gas and 874 barrels ($139 m^3$) of condensate. A total of nine wells have been drilled in the area by Exxon with six additional wells drilled by other companies.

The Point Thomson Unit/Flaxman Island area seems to be focused mainly on gas development, though tests have been made showing minor amounts of oil.

Category: Announced Oil Discoveries/ Potential Development Projects

Project: 12 Seal Island



Location(s): Unit: Township 13 & 14 N, Range 13 & 14 E. Well: Township 13 N, Range 13 E.

Time Frame: 1982-present

Sponsor: Shell

Contact/ Source: Susan Just, P.I. 561-5432; Anchorage Times, 6/25/84 Wayne Simpson, Shell (276-2545) Renee Miller, Brinkerhoff Signal Inc. (344-2555)

Capital Costs: 70 million

Operations costs: Not available

Employment Characteristics: Local Non Local

55 people (total). No local hires.

Project Description:

Construction began on Seal Island in 1982. The ±400 foot diameter gravel island was fabricated in 39 feet of water; 750,000 cubic yards of gravel were necessary for its completion at a cost of approximately $30 million. Two wells, BF47 and BF25, have been drilled with a third well, BF57, in the process of being drilled. Each well was drilled at approximate cost of $20 million. Shell announced discovery at Seal Island of a commercial nature that should lead to recovery of 300 million barrels of oil .

The discovery well, BF47, was spudded on June 1, 1983. It was directionally drilled to a bottom hole location 6,000 feet northwest of the island and flowed at a rate between 600 and 5,000 B/D between depths of 12,750 and 13,152. These results were announced in January, 1984.

The confirmation well, BF25, was directionally drilled to a bottom hole location 5,300 feet east of Seal Island. Oil was discovered at the 12,700 foot level. This well was tested at a stabilized rate of 5,000 B/D, 40° gravity oil. This well is drilled in an area managed by the federal government but ownership is claimed by both the state and federal governments.

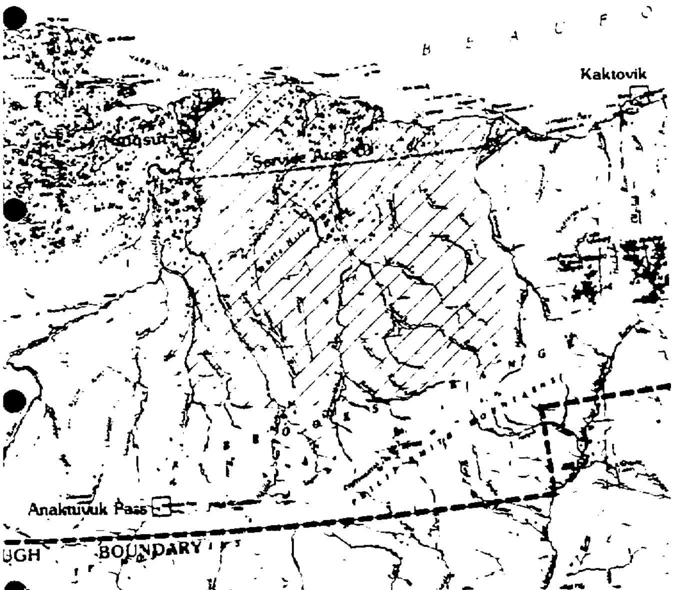
The third well, BF57, is being drilled to further delineate the size of the field. Its bottom hole location is approximately 1½ miles south of the island.

Brinkerhoff Signal Incorporated rig number PNJV#1 is the driller for all three wells. Seal Island is currently managed by the state and operated by Shell Oil Company.

ategory: Announced Oil Discoveries/ Potential Development Projects

roject: The Ugnu

13



ocation(s): Between the Colville and the Canning Rivers

Time Frame: 1968 - To future date unknown

Sponsor: See narrative below

Contact/ Source: Scott Ronzio, ARCO (265-6951)

Capital Costs: Unknown

Operations costs: none at present time

E nployment Characteristics: Local Non Local

(See Below) Local/Non-Local breakdown not available.

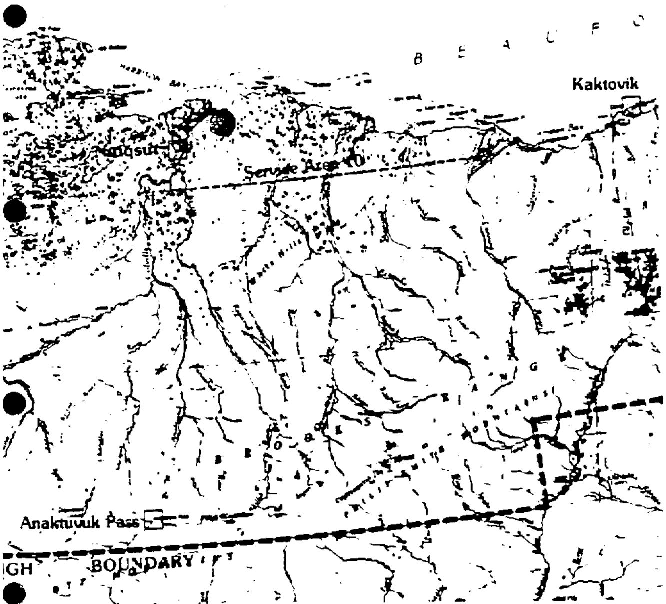
o

reject Description:

The lower Tertiary sands identified as the Upper Ugnu and the Lower Ugnu contain substantial amounts of heavy oil. This viscous oil is found in shallow deposits in the northern part of the Kuparuk River Unit and the Milne Point Unit, both of which are located between the Colville and Kuparuk Rivers. Because of the extremely high viscosity of this oil, there are no current plans to produce it on a commercial basis. The Ugnu is being thoroughly studied, however, ana a limited amount of drilling and testing is planned.

If the Ugnu can be developed using some type of improved production technology, it will probably require a large number of wells and extensive surface facilities for production. No well specifically aimed at this strata has been drilled. Also, no precise employment statistics area available for this as it, is not a project nor under development. If the Ugnu horizon was ever to reach this stage, approximately 60 people (total) would be necessary to operate a flow station or gathering center. As the Ugnu is spread between the Kuparuk and Canning Rivers, there are a number of different oil companies that could be involved in the extraction of oil from this horizon. ARCO has identified a possible six to 11 billion barrels of oil in their Ugnu sands area.

Category:	Announced Oil Discoveries/ Potential Development Projects
Project: 14	Simpson Lagoon Field
Location(s):	Within the Kuparuk River field, SW of Milne Point (See Below)
Time Frame:	1969
Sponsor:	SoCal
Contact/ Source:	Chat Chatterton, AOGCC Public Files (279-1433)
Capital Costs:	$100,000 (for well 3 2-14 only) 1969
Operations costs:	none



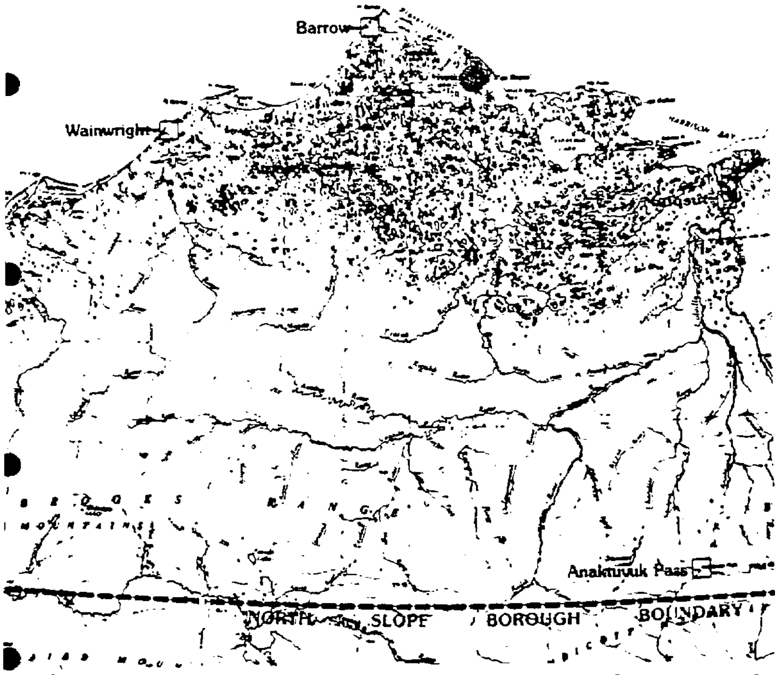
Employment Characteristics: Local Non Local

50 people (approximate total) on drilling site
Local/Non-Local breakdown not available.

Project Description:

Simpson Lagoon Field consists of two wells drilled by SoCal in the late sixties. Well 32-14 is located in Section 14, Township 13 North, Range 9 East, Umiat Meridian. It was a wildcat well and an exploratory operation. The total depth of the well reached 10,483 feet with a plug-back of 2,700 feet. It is a straight hole well. Located 100 air miles from Umiat, the well has been adandoned since 1969.

Well 32-14A is located in Section 23, Township 13 North, Range 9 East. Umiat Meridian. Both wells are located in what is now the Kuparuk River Field. After the plugging of 32-14, 32-14A was directionally drilled to 8,049-8,666 feet, plugged back to 7,935+ feet and redrilled. Severe doglegging was encountered between 8,049-8,363. The well was plugged between 8,116 feet and 7,936 feet with 132 sacks of class “G” cement. It was again directionally drilled reaching a final depth of 12,475 feet. Electric logs and electric induction logs were used as a means of testing this exploratory well. Oil was found but the well has been shut-in since 1969.



Category: Announced Oil Discoveries/ Potential Development Projects

Project: 15 Simpson Field

Location(s): Onshore of Cape Simpson Township 17 N - 20 N, Range 10W - 14W

Time Frame: 1944-1953

Sponsor: Navy

Contact/ Source: Susan Just, PI (561-5432); Chat Chatterton, AOGCC (279-1433) History of Exploration, NPR No. 4.

Capital Costs: See Below

Operations costs: Not Available

Employment Characteristics: **Local Non Local**

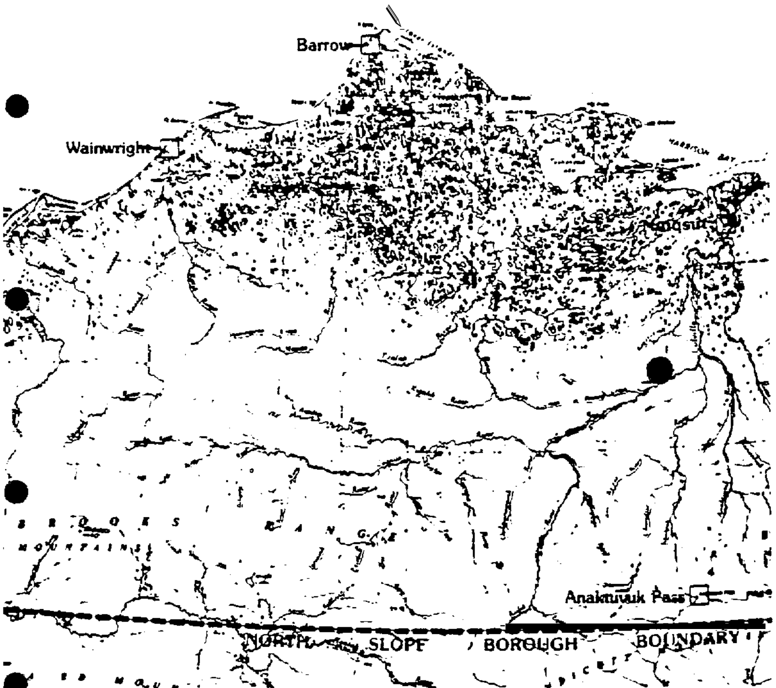
See Below

'reject Description:

Simpson Field was part of both the Naval Petroleum Reserve and the Pet-4 oil exploration project. In the Simpson area, 35 wells were drilled with 33 being cored. An estimated 12 million barrels are in place, though the reserve is not large enough for economical commercial production. Oil seepages in the area led to an initial interest and 10 pits from 9-13 feet deep were dug by Field Survey Party #1 in 1948. Geological testing, exploratory activities and drilling all took place between 1944 and 1953 for the project as a whole and for Simpson Field. 13,660 feet was drilled in 1949 for Simpson alone.

The oil discovered at Simpson field had a paraffin base of 19° API gravity. This type of oil has a high pour point and cannot be readily handled at lower temperatures. Small amounts of gas were found in the area, also, though the volume was thought to be minimal.

The Pet-4 project was brought to a close in 1953. Total costs for all the development, surveys, equipment, etc., incurred by the Navy for this program included $47,615,255 (drilling test wells, coring holes, geophysical and geological exploration, maintenance of camps, airway facilities, air-lifting and miscellaneous expenses), $896,999 (value of Barrow camp), $99,000 (value of Fairbanks installation), and $11,944,000 (uninstalled equipment, general stores and food). Personnel for the operation as a whole (not just Simpson Field) often exceeded 500, with up to 125 local hires (Eskimos). The development of NPR-4 was one the the longest and most difficult activities undertaken on the Alaskan Arctic. Simpson Field was an important component of this.



Category:	Announced Oil Discoveries/ Potential Development Projects
Project: 16	Umiat Field
Location(s)	National Petroleum Reserve in Alaska; Township 1 N, Range 1 W
Time Frame:	1945 - 1952
Sponsor:	Navy
Contact/ Source:	Susan Just, PI (561-5432); Incentives for Explor. & Devel. on Alaska's North Slope AOGCC; 1983 Statistical Report
Capital Costs:	Not Available
Operations costs:	Not Available

Employment Characteristics: Local Non Local

Not Available

Project Description:

Umiat is a small oil field on NPR-A that was discovered by the Navy in 1945. It contains a possible 66 million barrels of oil though thereserves are too small for economical commercial production. It is probable that this will remain the same at current and reasonably forecasted future oil prices. though the reserves could become marketable if oil prices were to double.

Eleven wells have been drilled at Umiat with the discovery well being the U.S. Navy, Umiat Test No. 3. The producing formation is "Grandstand" with the deepest test being performed at Umiat Test Men No. 1. The relevant statistics here are a well depth of 6,212 feet MD and TVD. There are three oil producing wells at Umiat and the method of operation has been shut in since 1951.

A number of estimates have been received for the amount of reserves in place here. These include 122-151 million barrels by the Bureau of Mines, 29.4 million barrels by Union Oil Company, 18.8-37.6 million barrels by DeGolyer and MacNaughton and finally 70 million barrels by the Navy. The figure of 66 million barrels used earlier in this test is the median of all four estimates.

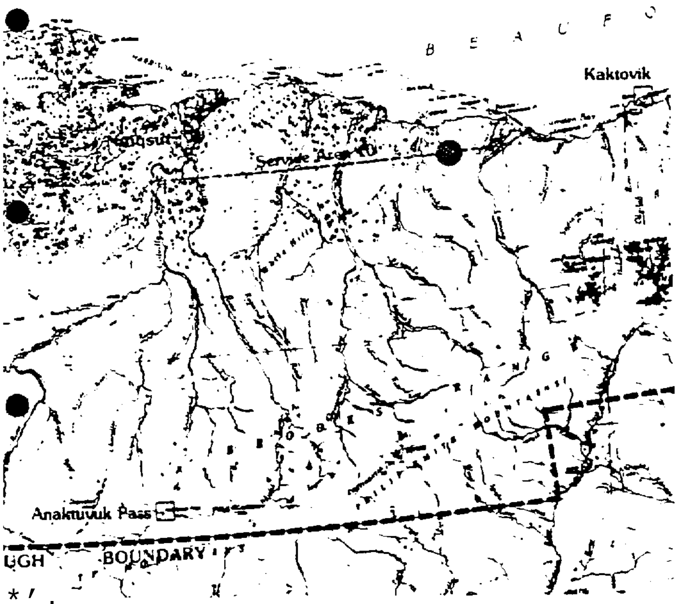
5.4 EXPLORATION PROJECTS

Exploratory wells on the North Slope are a routine operation. Preliminary studies including engineering and seizmic work are executed prior to the drilling of any well. This is a standard in the industry.

The beginning stages of exploration encompass geological work. Providing sufficient geological evidence is found, this may lead to the spudding of a well. Often testing is carried out after a show determining approximate amounts of oil or gas reserves when present.. From here a well may go into production, become shut-in, or plugged and abandoned. These types of exploratory work are absolutely essential to the oil industry and are occurring in a variety of places and offshore of the North Slope.

Currently the industry as a whole is spending approximately $30 million per exploratory well (Arctic Summary Report Update, September 1983). Employment estimates for a drilling rig range from 40-50 people. Providing the rig is owned and operated by a native corporation, 5-6 natives are included in the estimate. When the rig is owned and operated by a party which is not native this number may be 3-4 (Blair Wondzell, Alaska Oil and Gas Conservation Commission),

The following section includes projects in various states of exploratory development. A portion are in the seizmic phase, some are planned wells, others have been drilled and are now shut-in, suspended, or plugged and abandoned.



Category:	Exploration Projects
Project: **17**	Prudhoe Bay Uplands Sale 34
Location(s):	East of Prudhoe Bay Unit near ANWR, 10-12 miles south of Point Thomson
Time Frame:	1982 - present
Sponsor:	Exxon and Union Oil
Contact/ Source:	Bill VanDyke (276-2653), DNR; ASR 1981, January 1983
Capital Costs:	Proprietary Information
Operations costs:	Proprietary Information

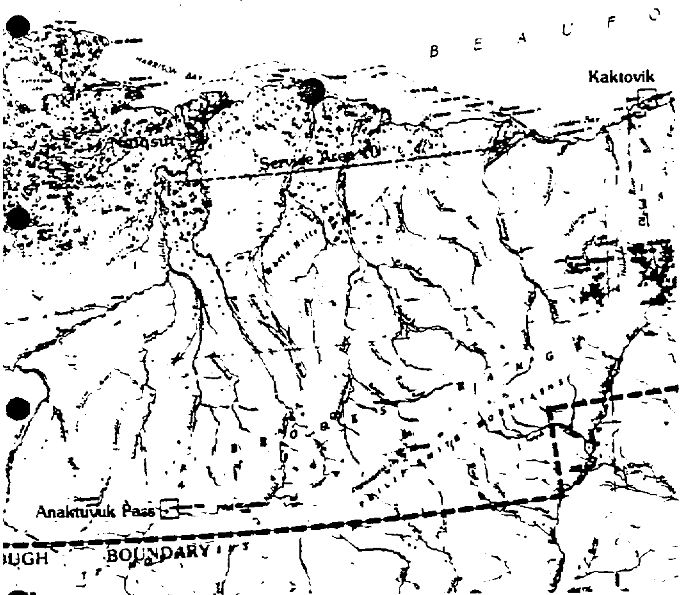
Employment Characteristics: Local Non Local

Proprietary Information

reject Description:

Lease Sale 34, Prudhoe Bay Uplands, occurred on September 28, 1982. In this sale, 216 tracts were offered of which 119 received bids. The total acreage proposed in the sale was 1,231,517 acres or 498,267 hectares. The tracts located southwest of the Flaxman Island/Point Thomson unit earned the highest bids.

Wells had been drilled in the area before the lease sale, but this occurred many years ago and the wells have long since been capped and abandoned. After the occurrence of lease Sale 34, two new wells have been drilled, one each by Exxon and Union. These are exploratory operations only with the wells being drilled in February 1984 and March 1984 respectively. This is a lease sale area only and not unitized thus it has no designated operator.



Category: Exploration Projects

Project: 18 Long Island

Location(s) On Long Island, Section 15, Township 13 North, Range 12 East

Time Frame: February 1-March 12, 1984

Sponsor: Sohio

Contact/ **Source:** Sohio, Bruce Clardy (564-5473) Alaska United Drilling (561-1265) Al Burnhardt

Capital Costs: Proprietary Information

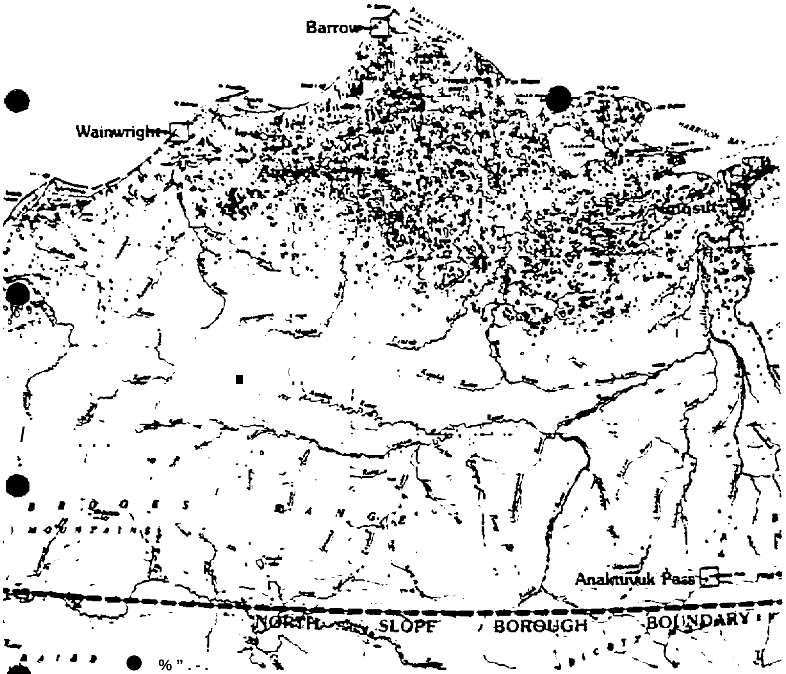
Operations costs: Proprietary Information

Employment Characteristics: Local Non Local

43 on location, no local hires

reject Description:

Long Island was an exploratory well drilled by Sohio in the winter of 1984. It was spudded, plugged and abandoned in the same year. The operation was routine and the depth of the well went below 11,000 feet. No drill stem tests were made and the electrical log indicated no commercial quantities of oil or gas. Much of the technical data on th s project is being held as proprietary information for the next two years. The drilling contractor for the operation was Alaska United Drilling Company, Anchorage.



Category: Exploration Projects

Project: Pt. Lonely/Antares

15

Location(s): Pt. Lonely Camp: T18N, R5W; Antares: T20N, R3W

Time Frame: 1976 - 1979 (Camp Lonely) 1984 (Antares)

Sponsor: **Exxon**

Contact/ Source: **Susan** Just., P.I. 561-5432; Max Brewer, USGS (786-7429); Bill Vandyke, DNR (276-2653); Frank McCollum, Exxon (564-3738)

Capital Costs: Not available

Operations costs: Not available

Employment Characteristics: Local Non Local

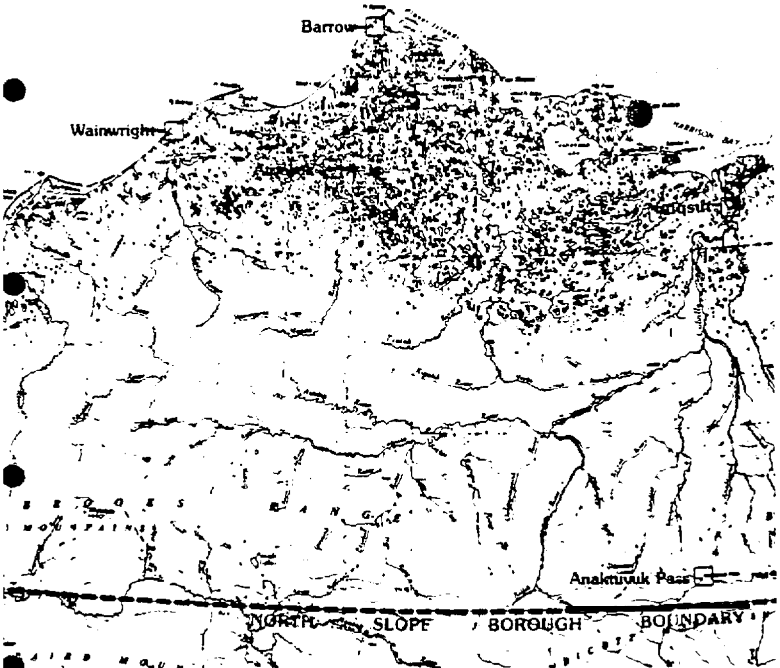
Not available at this time.

Project Description:

Antares is an exploratory well planned by Exxon for Fall 1984. It will be drilled **in Federal waters offshore of the** National Petroleum Reserve-Alaska in the Beaufort Sea. The existing Camp Lonely facilities could be rented by Exxon from the current owners, the Cook Inlet Regional Corporation, for use in conjunction with this exploratory project. No utilization of Camp Lonely is **planned at this** time.

Camp Lonely itself consists of Atco trailers which rest on pilings. It is a 100-man camp with provisions for housing, recreational space, a mess hall and **office space. Also,** five **40 x 100 foot Butler** buildings **provide warehousing and shop areas with one building accommodating** sewage treatment, **an incinerator and three 250** KW **generators. Storage tanks for** motor fuel and JP5 are included on the grounds.

A large amount of stacked storage space is available on site. The gravel pad and the initial rudiments of the camp were built by J.W. Dalton under Navy contract in 1976. In December 1976, Husky Oil took over operations of the Camp and began construction of the “modern” facilities (i.e., buildings, etc.) in the Spring of 1977. Employment statistics for construction of the facility are unavailable as" it was built in stages during 1977-1979 using on-site personnel and not a project specific construction crew. Costs for operating such a facility vary greatly between summer and winter and the function of the camp. Costs were not available for operations at this time.



Category: Exploration Projects

Project: Cape Halkett

20

Location(s): Range 17N, Range 2W

Time Frame: 1982 - present

Sponsor: Amoco

Contact/ Source: Mike Golas, Amoco (303) 830-4628 (Denver) ; Susan Just, P.I. 561-5432

Capital Costs: Proprietary Information

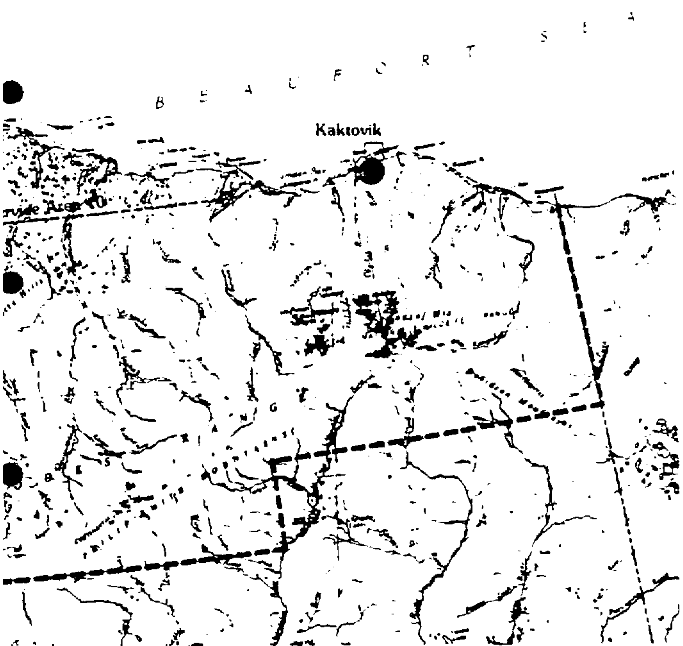
Operations costs: Proprietary Information

Employment Characteristics: Local Non Local

Proprietary Information

Project Description:

Amoco acquired their leases on the Cape Halkett area during lease Sale 71 in October, 1982. At the present time, basic preliminary work. and engineering is being carried out in the event Amoco decides to opt for development of the area. This work is only preliminary and a standard practice in the industry. It must be stressed that Amoco has not made a decision either for or against development of their Cape Halkett leases.



Category: Exploration Projects

Project: **21** Arctic Slope Regional Corporation Lands: Kaktovik, Chuckchi Sea Coast, North of the Gates of the Arctic National Park

Location(s): Kaktovik; R33-38E, T8-9N, Chukchi Sea; R15-31W, T8-14S, Gates of the Arctic; R14-25E,R1-5W, RI-ICE, TIN, T1-13S

Time Frame: 1984

Sponsor: Arctic Slope Regional Corporation (ASRC)

Contact/ Source: Bill Thomas, ASRC (852-8633) , Susan Just, P.I. (561-5432)

Capital Costs: Proprietary Information

Operations costs: Proprietary Information

Employment Characteristics: Local Non Local

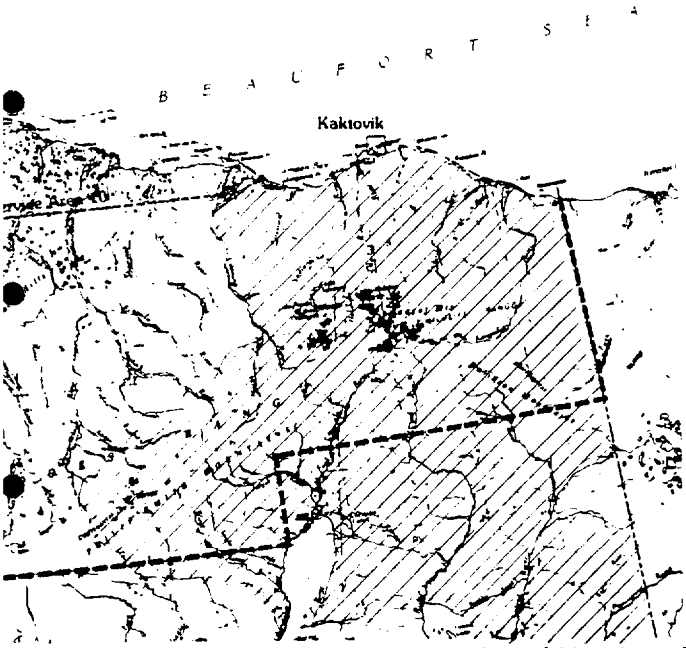
60-70 people (total) on three seismic crews.

No local/non-local breakdown available

reject Description:

Of the three ASRC land areas dealt with in this project, only Kaktovik is involved in exploratory operations. The Chukchi Sea coast and the lands north of the Gates of the Arctic National Park are not linked to any activity at this time. Currently no drilling of exploratory wells is planned for any of these lands. The exploratory work includes only seismic studies.

Three seismic crews are performing tests on the 92,000 acres of the Kaktovik area. ASRC has entered into lease and exploration contracts with a number of companies with Chevron, USA as the operator, Chevron is in charge of these crews and vibrosis surveys are being undertaken. Geophysical Service, Inc. (GSI) has been contracted for the seismic work. The other companies involved in the lease and exploration contracts with Chevron are Union/Amoco, Shell Oil Company, and British Petroleum/ARCO. ASRC explicitly asks for local hires wherever possible, but aside from the general 60-70 person employment figure, no statistics were available.



Category: Exploration Projects

Project: 22 Arctic National Wildlife Refuge

Location(s} Extreme Northeastern Alaska

Time Frame: 1980-1986+

Sponsor: Department of the Interior

Contact/ Source: Doug Fruge, U.S. Fish & Wildlife (Fairbanks 456-0250) ASR (1/83) ASR Update (9/83)

Capital Costs: Not Available

Operations costs: Not Available

'mployment Characteristics: Local Non Local

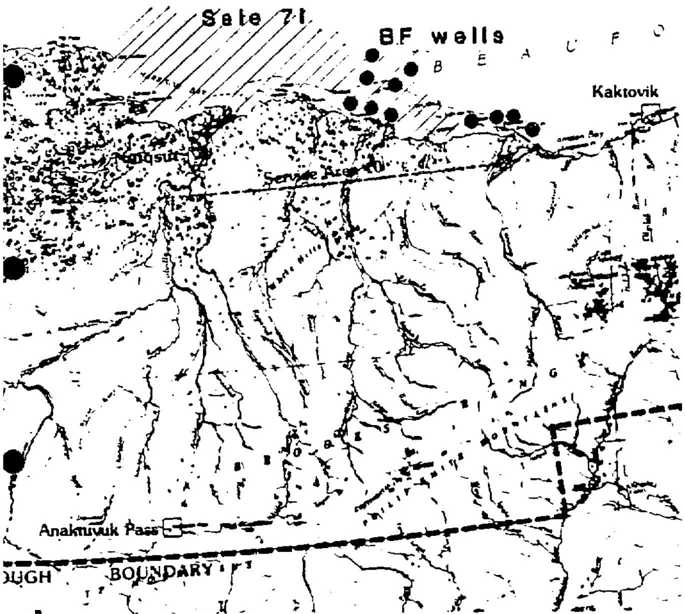
20 people (staff total for refuge only)

All non-local hire.

reject Description:

Section 10-02 of the Alaska National Interest Lands Conservation Act (AN ILCA) requires a base-1 ine study of the fish and wildlife in the coastal plain portion of the Arctic National Wildlife Refuge. This area encompasses 1.5 million acres from the foothills to the coast between the Canning and Aichilik Rivers. The U.S. Fish and Wildlife Service is currently researching and compiling information for the study which is due to Congress in final report form September 2, 1986. In addition, Section 10-02 provides for oil and gas exploration of the area exclusive of drilling operations. Included in this exploration is examination of surface geology, an activity which actually predates the establishment of the Lands Act. Rock samples are being gathered and formations are being checked. Also, seismic information collection began on the Refuge in January (1984) and will continue through April or May. There is a potential for additional seismic exploration next winter, though it is a very controversial issue.

The eventual outcome of future exploratory activities aria/or development of ANWR will be decided by Congress. In September 1986, this governing body will have access to the seismic data collected along with the baseline study of fish and wildlife for the area. No time limit has been set for the decision from Congress on which all further plans will be pending.



Category: Exploration Projects

Project: 23 Sale 71 & BF Exploratory Wells

Location(s): Sale 71: R14N - 21N, R1W-8E BF **Wells:** Offshore **in the** Beaufort **Sea between the** Kuparuk & **Canning Rivers**

Time Frame: **1979-present**

Sponsor **See Below**

Contact/ Source: **Susan** Just, P.I. 561-5432; Diapir Field DEIS - Lease Sale 71: ASR Update, 9/83 Hugh DePland, Sohio PR, 561-5111

Capital Costs: $1.059 billion (Beaufort leases) $2.06 billion (Sale 71 leases)

Operations costs: Not Available

Employment Characteristics: Local Non Local

Lease Sale 71: (based on minimum reserves) Exploratory: 164 people/year
Peak Production: 422 people/year
(based on maximum reserves) Exploratory: 322 people/year
Peak Production: 4.650 people/year

Local/non-local breakdown not available

'eject Description:

The Joint Federal/State Beaufort Sea lease sale occurred on December 11, 1979. This was the first offshore lease of the Arctic Subregion and was conducted by the State of Alaska and the Department of the Interior. 117 tracts were offered and 86 bids were accepted for a total of S1.059 billion. Exploration began in the area during the 1980-81 drilling season. By the conclusion of the 1982-83 drilling season, 15 wells had been completed. 11 of these were located on State managed lands, while the remaining four were on federally managed tracts.

Of the wells drilled on State lands, three were completed in the 1980-81 season (all by Sohio). The 1981-82 season saw eight wells completed with Exxon, Shell, Amoco, Sohio and Chevron all as individual unit operators. Further development is planned and has taken place with drilling on tract 47, Shell's Seal Prospect and on tract 54 by Gulf and Tenneco (co-owners). The latter well is located on a gravel island near Cross Island and is expected tc reach 15,500 feet at a cost of 35 million.

The four wells developed on federal lands include two wells drilled by Shell in their Tern Prospect area (tracts 41 and 42). The first well was spudded in May 1982 and was then temporarily abandoned in September 1982. The well reached a depth of 13,176 feet and was later deemed producible by the MMS District Supervisor of Field Operations (Flay 1983). The second well was drilled from an artificial gravel island on tract 41 to tract 42. It was spudded in October 1982 and temporarily abandoned in March 1983. It had a final depth of 13,399 feet. Further development is planned by Shell with drilling occurring on Seal Island, an artificial gravel island, in State managed tract 47. Wells will be directionally drilled here and to one or mere of federally managed tracts 2, 23, 24 and 25.

Tentative plans by Sohio and Exxon for the development of the Sag River/Duck Island area were announced on May 5, 1982. This would be accomplished by tapping the Endicott Reservoir. No final decision has been made pending the completion of the FEIS. Initial plans foresee construction beginning in 1984 followed by drilling in 1986. Actual production could commence in 1988. Ideally, the Endicott facilities will include two offshore islands capable of sustaining 200 production wells over the life of the field. An estimated 75,000-150,000 barrels of oil and 250 million cubic feet of "natural gas could be produced daily. The facility would be the-first production unit in the Beaufort Sea with an expected cost of ever $1 billion dollars.

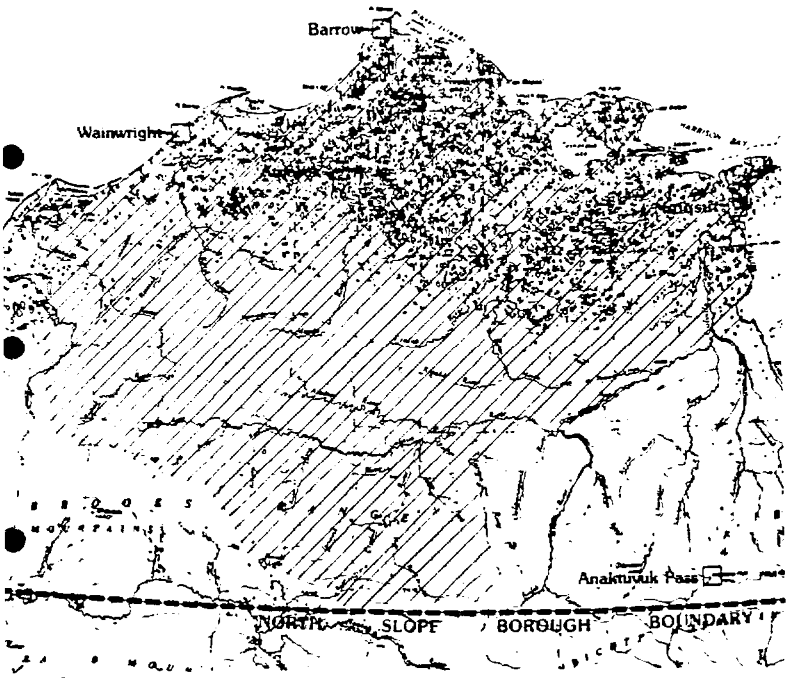
Lease Sale 71 occurred on October 13, 1982 and was comprised of parts of the Diapir Field near Harrison Bay. 338 tracts were offered with 121 bids accepted for $2.06 billion dollars. This sale was the second held for offshore areas of the Beaufort Sea. The high bidder was Sohio with $900 million submitted for their interest in a cluster of 12 Mukluk tracts. The Mukluk structure trends northwest-southeast in Harrison Bay and has the same source rock, reservoir rock and geological history as Prudhoe Bay. Exploration of this area began in 1983 with the construction of a gravel island 22 miles offshore of the Colville River Delta in 48 feet of water and in tract 191. Drilling was expected to commence in November 1983. The well and island had a projected cost of over $100 million dollars, though, no actual costs have been released by Sohio. The well resulted in a dry hole and has since been plugged and abandoned.

Estimated reserves for Lease Sale 71 range from 500 million barrels tc 4.73 billion barrels of oil and from 370 billion cubic feet to 3.55 trillion cubic feet of gas. More exploration is expected and a peak yearly production level (maximum) for the area as forecased at 758 million barrels of oil and 568 billion cubic feet of gas in 1996. Based on the assumption of maximum reserves, the resources are expected to be depleted 32 years after the sale (2015).

5.5 FUTURE OIL AND GAS LEASE SALE ACTIVITY

Future lease activity is very important to further petroleum development on the North Slope. This section deals with four major geo-administration areas included in the Borough which may have potential for prospective lease sales or have been incorporated into planned future sales. The Arctic National Wildlife Refuge, one of the areas, is unique in that no decision has been made as to whether lease sales will even be permitted. This is a very controversial issue and is currently being studied by the Department of the Interior.

As this section deals with events of the future, no attempt was made to project the outcome or impacts of upcoming lease sales. At this time, cost and employment statistics are generally not applicable and are noted as such. Certain information on past NPR-A leases as well as forthcoming sales are included in this particular project as background.



Category: Future Oil & Gas Lease Activity

Project: 2-4 NPRA Lease Sales

Location(s): In the Western partof th North Slope between the Brooks Range & the Arctic Ocean

Time Frame: 1982 · 1987+

Sponsor Bureau of Land Management, Department of the Interior

Contact/ Source: Horace Sanders, BLM (271-3114) ASR (1/83) & ASR Update (9/S3)

Capital Costs: $82,846,483 (leasing costs only)

Operations costs: Not applicable at this time

Employment Characteristics: **Local Non Local**

Not applicable at this time

'roject Description:

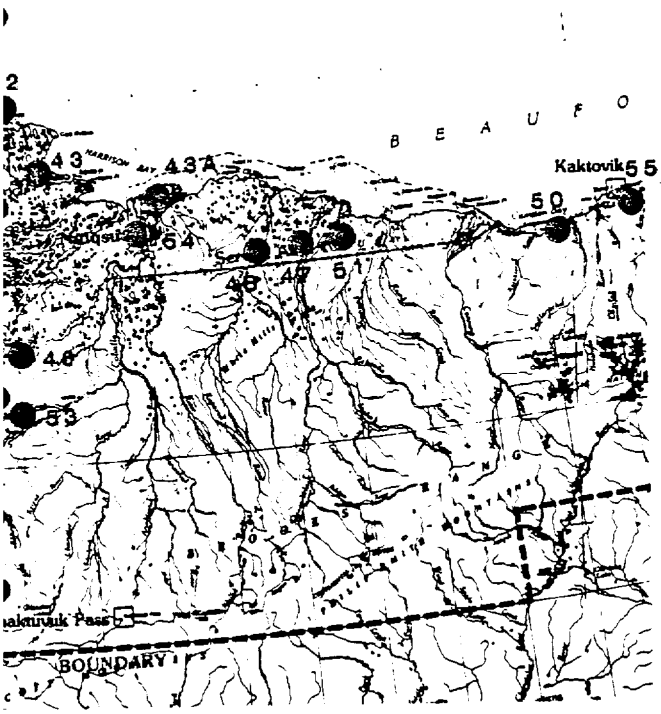
23.7 million acres within 37,000 square miles make up the National Petroleum Reserve in Alaska. This area was originally established as the Naval Petroleum Reserve Number 4 (NPR-4) in 1923 by President Harding. Subsequent transfer of these lands from the Navy to the Department of the Interior occurred in the late seventies. The reserve has never been open to private industry for oil development until Lease Sale 8.21 in January 1982. 1.5 mill ion acres and 59 tracts were offered "at this time. Twenty-five bidswere accepted by the Department of the Interior for a total of $57,146,483. Sohio's application to drill on their tract #3 in September 1982 was the first action of this type for Lease 821.

On May 26, 1982 3.5 million acres and 209 tracts were offered in Lease Sale 822. Twelve bids were received and accepted for a total of 9.7 million. These bids were quite low, the highest being $49.52/acre as compared to $477. 80/acre in Lease Sale 821. Lease Sales 821 and 822 have a combined leased acreage of 905,585 acres (366,490 hectares).

The third lease sale of NPR-A occurred in July 1983. This was the first sale under the new 5-year leasing schedule. 2.2 million acres and 84 tracts were offered with 10 year terms. 18 bids were received and accepted for a total of 16.7 million. Eleven companies participated with "ARCO submitting seven high bids and being the most active of those companies involved.

The FEIS for the development of the NPR-A adopted by the BLM in April 1983 is the document on which the current 5-year leasing schedule is based. Several lawsuits were leveled against the project before the July 1983 lease sale took place. In the schedule, a lease sale of approximately 2 million acres is planned for every July in the years 1983-1587. As a result of the lawsuits, the contention of the inadequacies of the FEIS and the subsequent injunction request, no leases for the July 1983 sale have been executed pending further hearings.

The BLM estimates a reserve of 1.4 billion barrels in three fields on NPR-A. All lands are considered for future oil and gas leases excepting those leased in the initial sales (821 and 822) and excluding the calving area of the Western Arctic Caribou herd and the area used for molting black brant near Teshekpuk. An estimated 80% probability for the discovery of commercial quantities of oil was set forth by the Department of the Interior in 1981. Leasing schedule reviews are planned for every five years in the future, continuing beyond the current 5-year leasing program.



Category: Future Oil and Gas Lease Sale Activities

Project: 25 State Oil and Gas Lease Sales #43, 43A, 47, 45, 48, 50, 51, 52, 53, 54, 55

Location(s) See narrative below

Time Frame: 1984 - 1988

Sponsor: State of Alaska

Contact/ Source: 5-year Oil & Gas Leasing Program
Ted Bond, DNR 265-4250

Capital Costs: Not applicable at this time

Operations costs: Not applicable at this time

"Employment Characteristics Local Non Local

Not applicable at this time.

Project Description:

The acreage of Sale 43, Beaufort Sea, includes State owned submerged lands which stretch between the western edge of lease Sale 39 and a point nine miles (approximately) west of Pitt Point. The lands in Harrison Bay and those near NPRA which are presently under dispute will not be offered.

The petroleum potential here is considered moderate to high. The area is important to the subsistence of the Nuiqsut and Barrow residents and supports freshwater, anadromous and marine fish, seals, bowhead and belukha whales, polar bears and water fowl. If this lease sale is found to be most beneficial to the interests of the State, a written decision and notice of sale will be issued in April 1984.

The North Slope's "exempt" acreage is included under Alaska Statute 38.05.180(d)(2) in Sale 43A. These lands are contiguous to lands already under lease. When such a case occurs, a provision in the State Oil and Gas Leasing statutes allows the Commissioner of the Department of Natural Resources to lease such lands even though they are "exempt" and not included in the prevailing five year leasing schedule. Sale 43A includes 46,080 acres of land on the Colville River Delta. It may also include a present on-shore lease providing the lease expires on time. Finally, 30,720 acres in the Prudhoe Bay uplands will be offered. The petroleum potential is thought to be moderate to high in both areas. The Colville River Delta is important to freshwater, anadromous, and marine fish, bowhead and belukha whales, polar bears, water fowl and seals. The uplands of Prudhoe Bay provide a habitat for a variety of terrestrial mammals and birds. A notice of sale and a written decision will be handed down in April 1984 providing the lease serves the best interests of the State.

Sale 45 includes Hope Basin in Kotzebue Sound and is approximately defined by the limits of the Hope geological basin. The State owned lands here are submerged and the petroleum potential is speculated as low. The area is important to the nesting and life cycle of hundreds of thousands of birds which utilize the various coastal habitats available. Also, the harvesting of anadromous fish is an important industry to the area as it is the largest commercial fishery north of the Yukon River. Providing this lease is determined to be in the best interest of the State, a written decision and notice of sale is scheduled for July 1985.

The Kuparuk Uplands, Sale 47, include the State owned lands south of the Kuparuk River oil field, plus previously leased lands due to expire. They are between the Kuparuk River (west) and the Sagavanirktok River (east) extending downward from a line nine miles south of Deadhorse to a line six miles north of Sagwon (approximately). The petroleum potential here is considered moderate to high. Terrestrial mammals and birds utilize these uplands including the Central Arctic caribou herd which uses the drainages of the two rivers as migratory corridors. Freshwater fish are also found in the area. A written decision and notice of sale will be issued in March 1985 providing this lease is in the best interest of the State.

Sale 48 includes additional lands in the Kuparuk Uplands. Here, the area extends between the Itkillik and Kuparuk Rivers (west and east), down from land leased by the State bordering the Kuparuk River oil field to a line approximately 18 miles north of the Umiat Meridian. The petroleum potential here is considered moderate to high. The area is used by Nuiqsut residents for fishing and for hunting caribou and small mammals. The Kuparuk River is again used as a migratory corridor for Caribou. November 1985 is the target date for a written decision and notice of sale providing the lease is in the best interest of the State.

Camden Bay, Sale 50, extends three miles from Flaxman's Island seaward to a point west of the Hulahula River. The title for the submerged lands between the barrier islands and the mainland are under dispute as they border the Arctic National Wildlife Refuge (ANWR). A decision on future oil and gas exploration in ANWR will occur in September 1986. As this could affect on shore activities of Sale 50, the notice of sale and written decision are not planned until March 1987. The marine environment in this area is very important to the reproduction of polar bears, ringed seals, and shore and sea birds. Peregrine falcons and bowhead whales migrate through here also. The fish and wildlife of the area is used for subsistence by the Kaktovik residents.

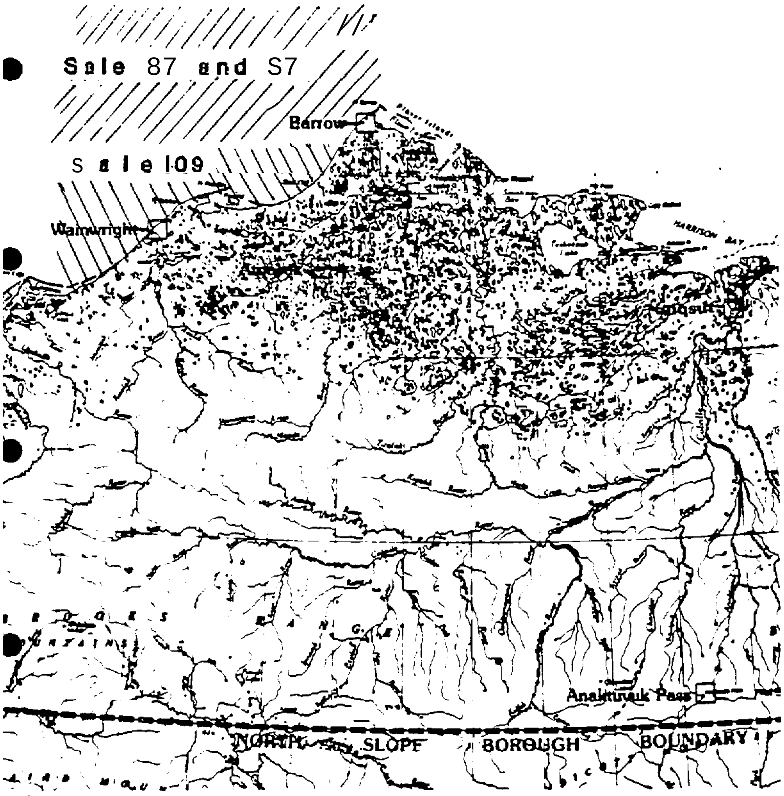
Sale 51, Prudhoe Bay Uplands, is approximately 20 miles southeast of Prudhoe Bay itself. It consists of 550,000 acres of State owned land spreading westward from the Canning River to the Colville River Delta. A moderate petroleum potential is found here. The Canning River supports in excess of 100,000 caribou of the Porcupine Herd along with a variety of freshwater fish. Many terrestrial mammals and birds also utilize the area. A written decision and notice of sale is expected in November 1986.

Beaufort Sea, Sale 52, includes submerged lands stretching offshore from the National Petroleum Reserve in Alaska between Pitt Point and Tangent Point. A moderate to high petroleum potential is estimated. The area is utilized by Nuiqsut and Barrow residents for subsistence and supports marine, freshwater andanadromous fish along with seals, waterfowl, polar bears and bowhead and belukha whales. The original target date for notice of sale and a written decision was May 1987, but this was moved to September 1986 to allow the re-scheduling of Camden Bay Sale 50. Providing the lease is found to be in the best interests of the State, the 1986 date is expected to be met.

Icy Cape, Sale 53, consists of the 261,000 acres of State owned uplands between Icy Cape and Cape Beaufort. It is west of the National Petroleum Reserve - Alaska and the petroleum potential is thought to be low to moderate. The uplands provide a habitat for black brant when molting and an insect relief habitat for the Western Arctic caribou herd. During some years, the caribou calve along the Kokolik River and Kasegaluk Lagoon is home to many belukha whales, spotted seals, and sea ducks. Providing this lease is found to be most beneficial to the State's interests, a notice of sale and a written decision will be handed down in July 1987.

Sale 54, Kuparuk Uplands, includes 510,000 acres onshore between State lease Sale 48 and the National Petroleum Reserve in Alaska boundary. This land is immediately east of the Colville River and two townships on its delta have been deleted from the August 19, 1983 map released in the "Call for Comments on State of Alaska Oil and Gas Lease Sales Proposed for 1988." It is hoped to be included in Sale 43A, but if this does not come about, the townships will be re-incorporated into Sale 54. The petroleum potential here is estimated between moderate and high. Millions of birds, terrestrial mammals and fresh water fish are all found in the area and the residents of Nuiqsut utilize the area for fishing and hunting. November 1987 is the expected date for a written decision and notice of sale providing the lease is found to be in the State's best interests.

Demarcation Point, Sale 55, includes submerged and tidal land offshore of the Arctic National Wildlife Refuge. The 200,000 acres lies between the Hulahula River and the Canadian border and is directly east of the proposed Sale 50. Currently, title to submerged lands between the barrier islands and the coastline are in dispute as are U.S. - Canadian waters. The coastal areas are once again important to the reproduction of polar bears, ringed seals, water fowl, shore ducks and sea birds. Also, bowhead whales and peregrine falcons migrate through this area. Kaktovik residents subsist on the wildlife and fish of this sector. Providing the lease is in the best interests of the State, a written decision and notice of sale is scheduled for March 1988.



Category: Future Oil & Gas Lease Sale Activity

Project: 26 Federal OCS Oil & Gas Lease Sales 87, 97, & 109

Location(s): See Below

Time Frame: 1984 - 1987

Sponsor: Dept. of the Interior

Contact/ Source: ASR Update 5/1/82; ASR 1/83; Maureen McCrea, MMS; Tentative Milestones For 5-Year Offshore Leasing Schedule

Capital Costs:

Operations costs: Capital and Operating Costs not applicable at this time

Employment Characteristics: **Local Non Local**

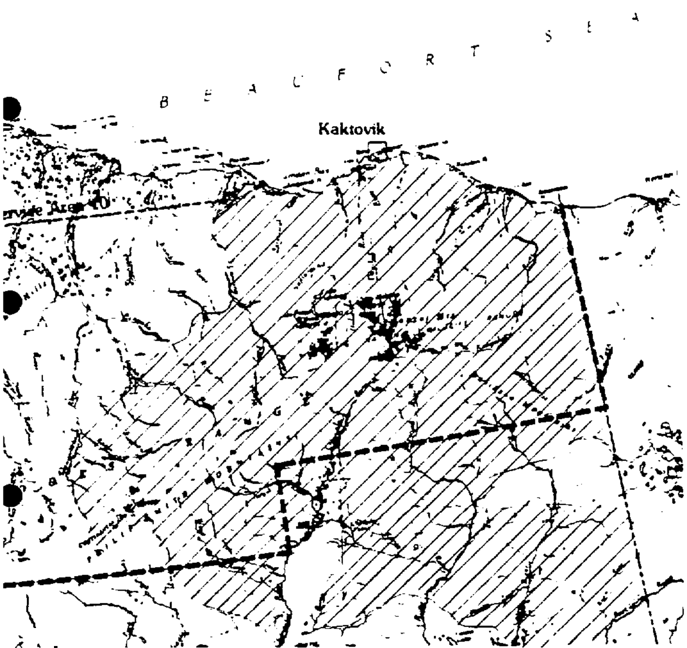
Not applicable at this time.

Project Description:

Federal OCS Lease Sale 87 was originally scheduled for June 1984, however was postponed until August 22, 1984. This OCS oil and gas sale for the Arctic subregion was located in the Diapir Field, Beaufort Sea. Sale 87 was the first in this subregion to fall under the new streamlined regulations of the Department of the Interior. The EIS for the Sale assumed that a shore base will be located at one of three potential sites -- Camp Lonely, Oliktok Point, or Bullen Point. Five platforms for the main case are expected. On November 23, 1982 a Call for Information was issued for this sale.

Lease sale 97, Diapir Field, is scheduled for August 1986. The Call for Information was scheduled for August 1984, and was due in September. The Area Identification will occur in November 1984 with the NEPA Draft Document to be completed in September 1985. A Public Hearing is set for October 1985 and the NEPA Final Document is due in March 1986. The Proposed Notice of Sale should occur in February and the Governor's Comments will be due in June 1986. The Notice of Sale will occur in July and the sale itself in August 1986.

The chronology of events for Lease Sale 109 follows: the Call for Information in January 1985, due in February 1985; the Area Identification in April 1985; NEPA Draft Document in March 1986; Public Hearing in April 1986; Final NEPA Document in September 1986; Proposed Notice of Sale in October 1986; Governor's Comments due in December 1986; Notice of Sale January 1987, and Lease Sale in February 1987.



Category: Future Oil & Gas Lease Sale Activity

Project: **27** Arctic National Wildlife Refuge Lease Sale

Location(s): Extreme Northeastern Alaska

Time Frame: unknown

Sponsor: Bureau of Land Management, Dept. of the Interior

Contact/ Source: Doug Fruge, U.S. Fish & Wildlife (Fairbanks 456-0250) ; ASR (1/83); ASR Update (9/83)

Capital **Costs:** Not Available

Operations costs: Not Available

Employment Characteristics: Local Non Local

Not Available

'reject Description:

18 million acres (7.3 million hectares) are included in the Arctic National Wildlife Refuge. Of this, 1.5 million acres of the coastal plain area is being researched for possible oil and gas development. This is provided for by ANILCA (The Alaska National Interest Lands Conservation Act, 1980), or the Lands Act. Currently, leasing of ANWR lands is prohibited and changes in this policy can only be authorized by Congress.

An estimated 4.4 billion barrel oil reserve and 18.1 trillion cubic feet gas reserve (USGS 1981) is believed to be located almost entirely on ANWR's coastal plain. This represents 64% and 49% respectively of Alaska's projected recoverable oil and gas reserves. Obviously this could be quite substantial to the industry. Leasing is still highly uncertain and will not be determined until after Congress reviews seismic data and reports on the fish and wildlife in the region which are due to them by September 2, 1986.

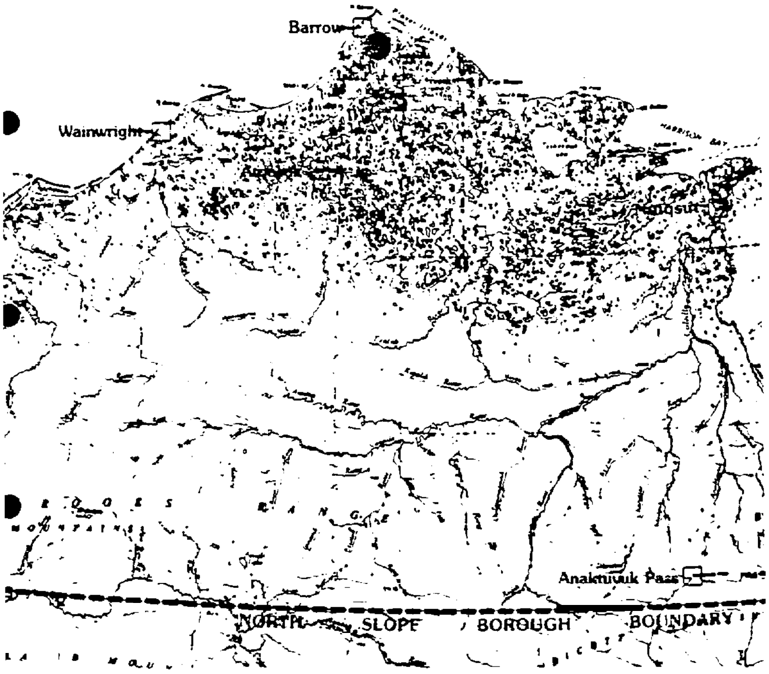
The only exception to the leasing policy lies with the Arctic Slope Regional Corporation. In August 1983, this group and the Department of the

Interior participated in a land swap. In this, the DOI secured surface rights for 100,000 acres around Chandler Lake in the Gates of the Arctic National Park. In exchange, the ASRC obtained sub-surface rights for 92,000 acres below ANWR's coastal plain. The Kaktovik Village Corporation acquired surface rights to this same 92,000 acres through the Alaska Native Claims Settlement Act (1971) and through ANILCA. In addition to sub-surface rights, ASRC may drill up to three exploratory wells on the coastal plain before 1986.

5.6 ACTIVE/POTENTIAL GAS DEVELOPMENT PROJECTS

A number of gas fields have already been identified on the North Slope. Those that are in production are being tapped for ocal use. Many have been capped and are awaiting the development of a transportation network. A large amount of known natural gas reserves exist but their development is currently uneconomical as a result of the almost prohibitive cost involved in the construction of a network such as ANGTS. Present domestic and export markets are not firm, thus lessening the need for production of known gas supplies. The situation could very well remain as such through the end of this decade.

A variety of projects are addressed in this section. Their reserves range from very large to very small. A few are under production while most are simply capped and waiting until gas development becomes economically feasible.



Category: Active/Potential Gas Development Projects

Project: **28** South Barrow Gas Field Project

Location(s): 5 miles SE of Barrow

Time Frame: 1948 - Present

Sponsor: Federal Gov't (1948-1977) DOI (1977-Present)

Contact/ Source: Ralph Anderson, Barrow Mayor's office 852-2611; Max Brewer USGS, 786-7429; The Arctic Policy Review,

Capital Costs: Not Available

Operations costs: $6,000,000/year (for south and east)

Employment Characteristics: Local Non Local

4-5 when developed with larger project (i.e. , subsidiary to larger oil development)

30+ when developed as a separate gas program

Local/non-local breakdown not available

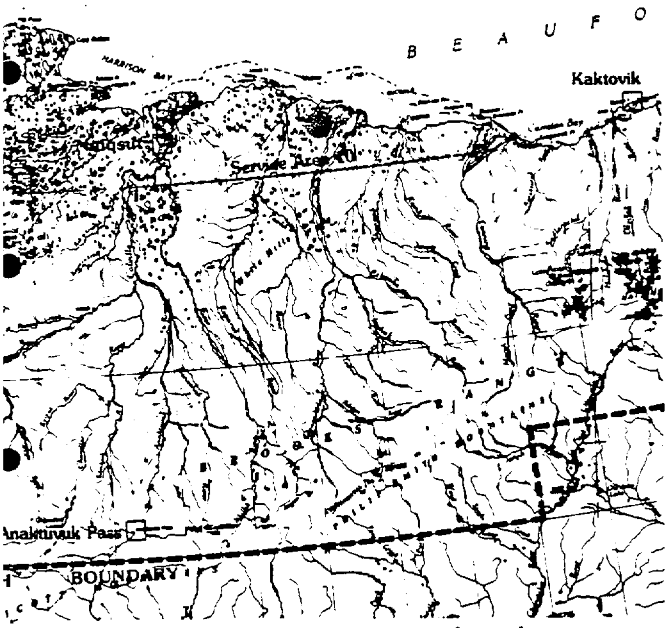
Project Description:

The South Barrow gas field project began in 1948 with its discovery and development by the Navy. By 1949 the first well was in production and gas had been piped to the Navy Oil and Gas Exploration Camp (now the NARL site) four miles northeast of Barrow. The random construction of gathering systems, regulating buildings, the placement of new wells and their connection was a result of unplanned production. The original wells were intended for research and exploration only. Many of the materials used in the production network were left-overs from the original NPRA drilling and as a result, much of South Barrow field does not conform to government and industry standards,

In 1958, use of the gas was extended into the City of Barrow for use by government agencies only. In 1962, Congress passed a law enabling the Navy to sell gas to the residents of Barrow and by the winter of 1'364 a gas distribution system had been installed for power and light. On June 1, 1977, Congress transferred the Naval Petroleum Reserve 4 to the Department of the Interior and created the National Petroleum Reserve in Alaska (NPR-A).

Relieved of this responsibility, the Navy abandoned NARL and thus removed the primary reason for federal subsidies of the Barrow gas field. In response to this, the Department of the Interior felt the need to either raise rates to counteract the loss of subsidies, or to transfer the fields to a local entity. Negotiations began in 1982 between the North Slope Borough and the Department of the Interior to transfer the title. Congress passed the Barrow Gas Fields Transfer Act in July, 1984. The Act gives the Borough 30 million with which to startup its operations. The U.S. Geological survey will help the Borough operate the field until March 31, 1985.

The production of gas has been necessarily increased by the development of the East Barrow gas field in 1981. They are considered one unit and have produced 15 billion cubic feet of gas (approximately) to date. The requirement for the upcoming year is expected to be 1.5 billion cubic feet with the City of Barrow consuming 75% of that. The South Field has been developed as needed over many years and was oftentimes part of larger projects.



Category:	Active/Potential Gas Development Projects
Project: 29	Prudhoe Bay Unit Sales Gas Conditioning Facility and ANGTS
Location(s):	R12E - 17E, T12N - 10N
Time Frame:	1968 - present
Sponsor	ARCO, Sohio, Exxon
Contact/ Source:	Susan Just, Petro. Info. 561-5432; Scott Ronzio, ARCO (265-6951); Public Policy & Petro. Dev.; the Alaskan Case ASR (1/83)
Capital Costs:	$43 billion (ANGTS only)
Operations costs:	Not applicable at this time

Employment Characteristics: **Local Non Local**

Employment for ANGTS has occurred only in the basic preliminary design work necessary for cost estimates. All employees are non-local hire; the actual figures are not available.

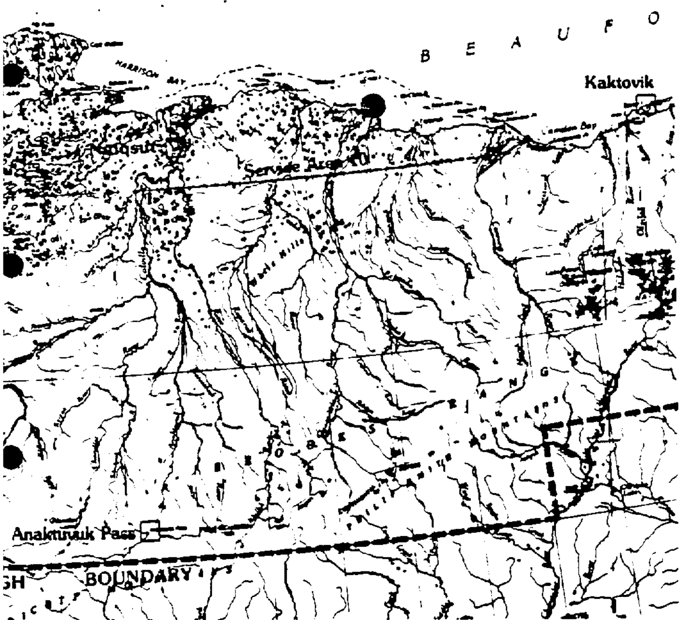
Project Description:

The Prudhoe Bay Gas Cap contains a proven reserve of 28,183 billion cubic feet. At the present time it is not exported, but is used instead for electrical power and fuel at Prudhoe Bay, reinfected into the gas cap to retain reservoir pressure, and used in the artificial lift production method. It is estimated that 2 billion cubic feet per day could be extracted for 25 years without substantially affecting the current production level of oil. The gas presently does not have a market due in part to the lack of a transportation network.

In answer to this, the Alaska Natural Gas Transmission System (ANGTS) was proposed and in October 1976, Congress passed the Alaska Natural Gas Transportation Act. Three possible routes for the new pipeline were originally suggested and this law provided a request for presidential advice in the first selection. The Alaska Highway route was approved by Congress in 1977 on the recommendation of President Carter. This particular route stretches across Alaska, through Canada and empties into the mid-west (Chicago area). Parts of the Canadian segments have already been constructed while no financial package has been decided upon for the U.S. segment. Private, State and traditional methods are all being considered though in no particular combination. Also, Congress has provided a “roll-in” system where by the more expensive Alaskan gas can be mixed with a less expensive gas from another source increasing its competitiveness. Additionally, requests have been made by the corporations for an all-events tariff which would transfer the cost of the project to the consumer even if the natural gas should not be delivered. Federal loan guarantees are also being requested.

The risks involved in the construction of the gas pipeline seem great and private credit markets are wary. Currently, there is not a high market value for Alaskan natural gas as a large quantity is being produced from other sources and shipped through existing facilities in the Lower 48. Potential cost overruns, unknown factors which could increase costs during construction and/or operations in combination with an initial investment of 43 billion, appear to make the ANGTS project economically unfeasible. Many technical problems have been encountered during the preliminary design necessary to establishing initial costs of the project. Already changes have been made and they will continue including those provided for on the planned Sales Gas Conditioning Facility. A site at Prudhoe Bay has been chosen and here gas would be treated before reaching the pipeline. Present plans for the facility require 200 acres and housing for 300 personnel. The plant should process 2.7 billion cubic feet of raw gas per day.

The future of ANGTS and other gas pipeline proposals and/or projects is proving to be highly unstable. The economic risks are still very great and the current status of ANGTS does not look promising.



Category: Active/Potential Gas Development Projects

Project: 30 Endicott Reservoir (Gas)

Location(s): 2-4 miles off Sag River Delta, 15 miles E. of Prudhoe Bay, 50 miles due W. of the Arctic National Wildlife Refuge

Time Frame: 1976 - present

Sponsor: Sohio

Contact! Source: Richard Gutleber, Army Corps of Engineer (552-4310); DEIS Endicott Development Project

Capital Costs: $2 Billion (Sohio Estimate)

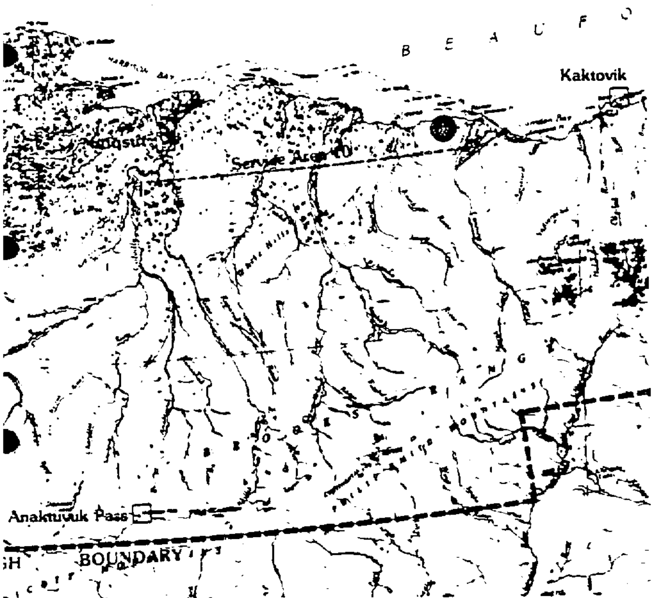
Operations costs: $100,000,000/year (Sohio Estimate)

Employment Characteristics: **Local Non Local**

See Table 4, page 319. Local/Non-local breakdown not available.

Project Description:

The Endicott Gas Reservoir project is a proposal, backed by eight companies, for the development of oil and gas in the Alaskan Beaufort Sea, just off the Sag River Delta. Facilities will include two gravel islands located 2-4 miles offshore in up to 14 feet of water. The main production/drilling island will be located to the west and will have a dimension of 2,200 feet by 1,300 feet. To the southeast, a satelite drilling island will be located and will have dimensions of 800 feet by 1,100 feet. A 4.8 mile (total length) causeway will connect the islands to onshore facilities. These facilities will include a gravel access road, gravel mine sites, oil and gas sales pipelines and construction camps. The unit operator for this development project is Sohio with Amoco, ARCO, Exxon, Union, Doyon Limited, Nana Development Company and the Cook Inlet Regional Corporation all collaborating. The initial production level for gas at Endicott could be up to 250 million cubic feet per day with production beginning in 1988 and continuing for 20-30 years. Geophysical activity and exploration began in the area in 1976. Initial tests show the natural gas as having a content of primarily methane (CH_4) with a trace of hydrogen sulfide (H_2S) and 10-20% carbon dioxide (CO_2). The oil and gas field is approximately 10,400 feet below the Beaufort Sea and makes the industry’s first step towards offshore commercial oil and gas development.



Category: Active/Potential Gas Development Projects

Project: 31 Point Thomson Unit Gas Field

Location(s): On the coast of the Beaufort Sea, 50 miles east of the Prudhoe Bay field

Time Frame: 1975 - present

Sponsor: Exxon

Contact/ Source: Exxon press release, 2/27/84 Bill VanDyke (276-2653), DNR

Capital Costs: $350,000,000 (wells and leases for oil and gas)

Operations costs: Proprietary Information

Employment Characteristics: Local Non Local

Proprietary Information

reject Description:

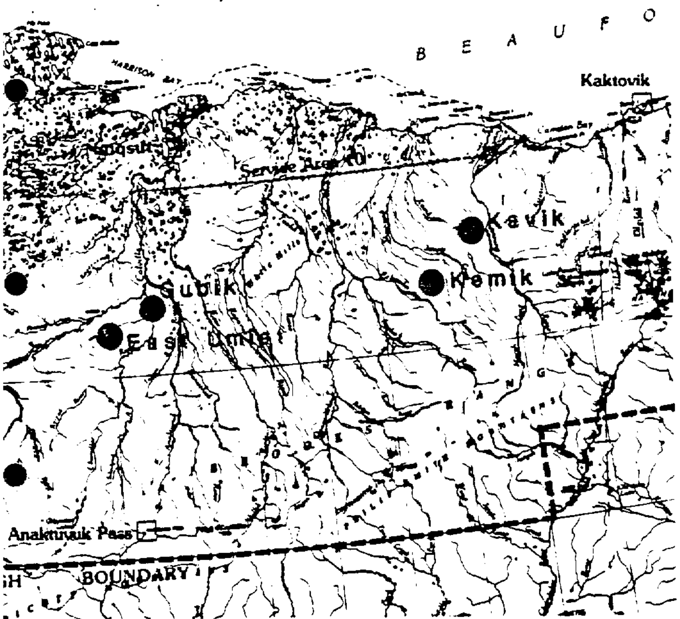
Exxon began their exploration of the Point Thomson area in 1975 when they drilled the Alaska State "A" well no. 1. This well is located on Flaxman Island just offshore in the Beaufort Sea. Exxon has drilled a total of nine wells in the area while other companies have drilled six. The results from Exxon's wells plus information available on the wells drilled by ether companies suggests a possible five trillion cubic feet of recoverable gas. In addition to this 350 million barrels of condensate may be present.

The future development of this field largely depends on the construction of a gas pipeline from the North Slope to the Lower 48. Exxon will concentrate its future efforts on determining the commercial feasibility of the gas reserve of which one-half (approximately) is under Exxon leases.

Category: Active/Potential Gas Development Projects

Project: **32**

Other North Slope Gas Fields, Kemik, Kavik, Gubik, East Umiat



Location(s): See below

Time Frame: 1951 - 1975

Sponsor: See below

Contact/ Source: Incentives for Explor. & Develop. of Alaska's North Slope, Ted Bond, DNR (265-4250) 1983 Statistical Report (AOGCC)

Capital Costs: Not Available

Operations costs: Not Available

Employment Characteristics	Local	Non Local

Not Available

Project Description:

Kemik and Kavik are two unitized fields with small accumulations of gas which could be commercially producible only if a gas pipeline was constructed near them. Neither field has seen activity in the last five-six years. The discovery well at Kavik is Kavik No. 1 located in Section 7, Township 3 North, Range 23 East, Umiat Meridian. Exploration occurred here during the period of 1969 - 1974. The deepest well test was 9,564 feet MD and TVD. The producing formation is Sag River/Sadlerochit with the production of gas being suspended. Two wells have been drilled at Kavik with one being recently abandoned. The sponsor of this unit is ARCO Alaska.

Kemik was explored in 1971 - 75 with the first discovery being Kemik Unit No. 1 (1972) well drilled by Forest Oil Corporation, the unit's operator. This well is located in Section 17 North, Township 1 North, Range 20 East, Umiat Meridian. The deepest test performed was at 16,073 feet MD and TVD with a Shublik producing formation. There is only one well in the area and the production has been shut-in since 1972.

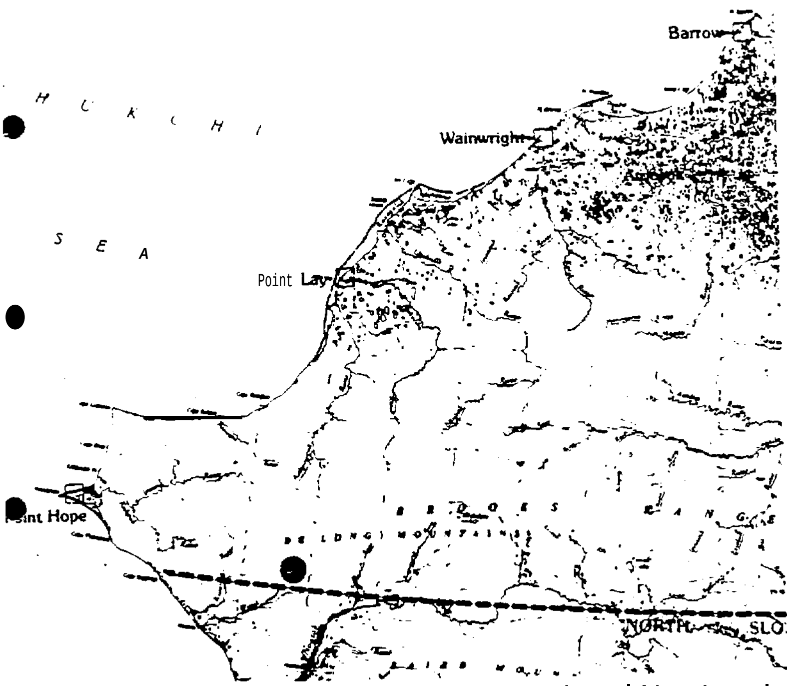
Gubik lies in Arctic Slope Regional Corporation Lands near the eastern border of NPRA and has a potential of 317 billion cubic feet of gas. It could be commercially marketable if a gas pipeline were constructed. It was discovered by the Navy in 1981 and tests show 22 billion cubic feet in tested sands with 295 billion cubic feet in similar untested sands. A flow-50 MMCF/D is also shown.

East Umiat is a small non-commercial gas field discovered and explored by the British Petroleum Exploration Company (Alaska) in 1963 - 1970. It began with the East Umiat well No. 1 and is located in Section 19, Township 1 South, Range 2 East, Umiat Meridian. The deepest test of this well was 3,347 feet MD and TVD. The producing formation is Ninuluk/Chandler and two producing wells have been drilled. One of these has been shut-in since 1964 and the other is suspended.

5.7 OTHER RESOURCE DEVELOPMENT PROJECTS

The projects discussed in this category are all prospective mining ventures whose commercial status is uncertain. All have excellent quality resources in large quantities. Despite these advantages, the harsh conditions, remoteness and lack of existing infrastructure make determination of economic feasibility uncertain. The Red Dog project is close to being considered economic. Several years of planning and design by a major mining company, the cooperation with a politically powerful partner (NANA Regional Corporation), a good progress in obtaining permits, and firming of zinc prices are all working in the project's favor at present. An announcement that the project will enter production/construction may come within the next year. The Lik project is less certain, since it is not as large or rich a deposit and depends on the development of Red Dog, as well as the terms which can be reached for sharing transportation infrastructure.

The Arctic Slope coal deposits, while vast, are largely unexplored and unproven. Their eventual economic development depends on many presently unknown factors, including mineability, development of transportation facilities, world coal prices and markets, and capital available for exploration and development.



Category: Other Resource Development Projects

Project: Red Dog Mine

33

Location(s): Mine: 50 miles NE of Kivilina; Port: 15 miles .s. of Kivilina Haul Road: N. Border Cape Krusenstern Nat. Mon.

Time Frame: Start Const. 1984
Start Production 1988

Sponsor: Cominco/NANA Joint Venture

Contact/ Source: Mr. H.M. Geigerich, President, Cominco Alaska, Inc.

Capital Costs: Not Available

Operations costs: Not Available

Employment Characteristics: Local Non Local

construction: 372
Operation: 376-424 (start-up/ultimate)
Local/Non-local breakdown not available.

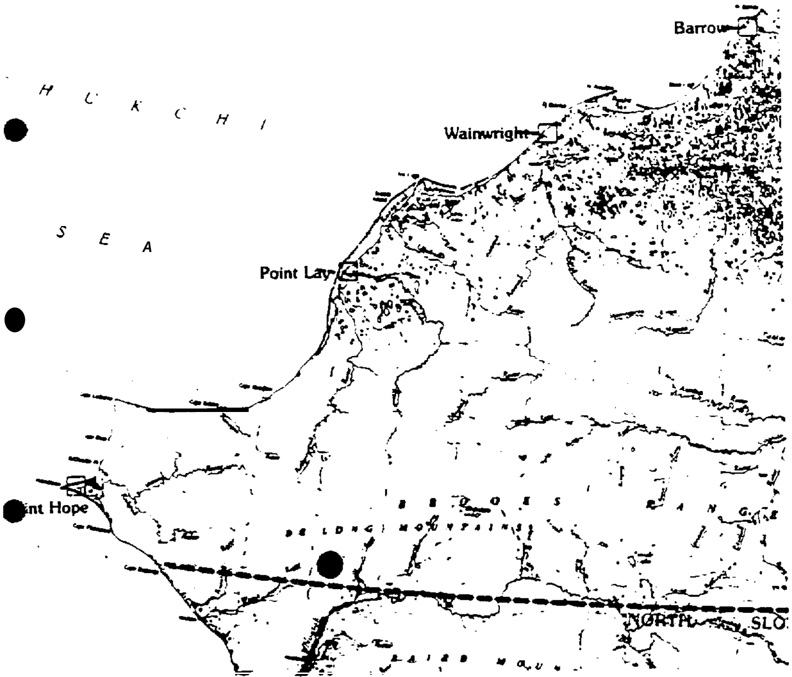
Project Description:

Cominco, in a joint venture with the NANA regional native corporation, is rapidly proceeding with plans to develop a world class lead/zinc mine in the DeLong Mountains about 50 miles east of Kivilina. The proposed open pit mine would produce Up to 750,000 tons per year of concentrate which would be trucked to a new port site south of Kivilina. Mining is scheduled to start up in 1988.

The project will consist of a large open pit mine in the 85 million ton deposit. The polymetalic sulfide ore is extremely rich--5.0 percent lead, 17.1 percent zinc, 214 ounces per ton silver. There are reserves for at least a 40 year project life. Also at the mine site will be a permanent camp, a crushing and flotation mill, a 585 acre trailings pond, a 20 megawatt plant, and a 63 acre water storage reservoir. The ore will be mined year round and trucked ever a 56 mile gravel road to the port site. Both the road and the port will be con-strutted as part of the project.

At the port site, the ore will be stockpiled in a covered enclosure for shipment during the roughly 3 month ice-free season. The concentrates will be reclaimed from the stockpile and conveyed over a 400 foot causeway/dock. From the dock, the concentrate will either be lightered to oreships moored in deep water or to an offshore "island" made by ballasting to the seafloor a specially adapted tankship.

The current schedule calls for a two year construction period beginning in winter 1985 with first production in early 1988. During construction the 372 (average annual) workers will be housed in barge camps, and in both temporary and permanent onshore camps. The initial production of about 500,000 tons per year will employ about 392 people. In about 5 years (1993) production is slated to rise to 750,000 tons per year. An additional 50 employees will be needed tc handle the increased output. According to the EIS, about one-third of the construction workforce and from 40 to 60 percent of the operational workforce will consist of NANA region residents. Although the mine is located in the North Slope Borough, only a small percentage of the local-hire workforce will be Borough residents.



Category: Other Resource Development Projects

Project: Delong Mountains Lead-Zinc Deposit (Lik Mine)

34

Location(s): Mine: 60 miles NE of Kivilina, 12 miles E. of proposed Red Dog Mine

Time Frame: Early 1990's

Sponsor: GCO Minerals

Contact/ Source: Joe Britton (907) 274-9541

Capital **Costs:** Unknown

Operations costs: Unknown

Employment Characteristics: Local Non Local

Information not available at this time. Assumed to be proportional to the requirements of Red Dog Mine.

'reject Description:

The proposed Lik mine, owned by GCO Minerals, would be a very similar operation to the proposed Red Dog Mine which is located 12 miles to the west. Like Red Cog, the Lik would open pit mine lead zinc polymetallic sulfides. However, the Lik prospect is neither as large (25 million tons) nor as rich (9 percent zinc, 3 percent lead) as the Red Dog Mine. As a result the project feasibility is dependent on the prior development of infrastructure (haul reed and port). Because the commercial status of Lik is questionable, the specifics of the project are still being worked out. The project manager estimated that Lik could follow Red Dog's schedule at a 2 to 5 year lag. This would mean (optimistically) production in the early 1990's.

The Lik project would most likely use the same haul road (extended 12 miles) as the Red Dog, and would also share the port facilities. The ccst of the project and the projected employment depend on the scale of operation. Because the Lik deposits are not as rich as Red Dog, it must mine about 40 percent greater tonnage to obtain the same amount of concentrate. Tonnages in the 0,5 to 2.0 million tons per year range are under consideration (for

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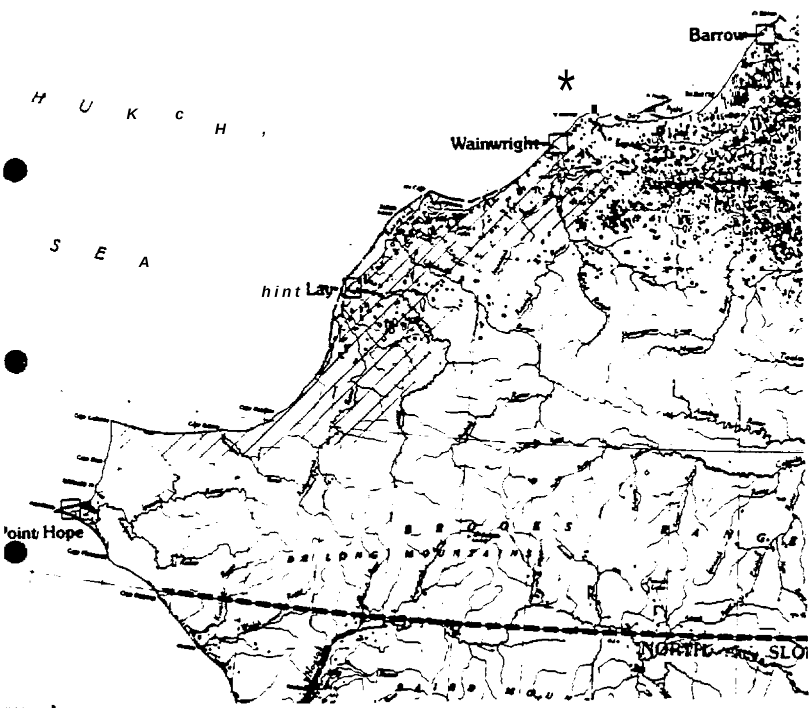
comparison Red Dog plans to mine about 1 million tons per year). If development does take place it will employ fewer people during the construction phase (due to preexisting port and road). Operational employment will be on the order of 400, more or less depending on the scale of operations:



Category: Other Resource Development Projects

Project: 35 Chukchi Sea/Western Arctic Slope Coals

Location(s} Chukchi Sea Coast from Cape Lisburne to Wainwright

Time Frame: 1990 or later

Sponsor: Arctic Slope Regional Corp, Morgan Coal Co.

Contact/ Source: Kent Grinage
Arctic Slope Consulting
(907) 276-0517

Capital Costs:

	100MT/Yr	500MT/Yr	1000MT
Mine	16.5	88.9	250.0
Port	8.8	44.3	126.0

($ Million)

Operations costs: Not Available

Employment Characteristics: Local Non Local

Construction: Not estimated
Operation: 376/424 (Startup/ultimate) Range: 79 @ 5G0 MT/YR
307-437 @ 100C MT/YR
Local/Non-local breakdown not available

Project Description:

A world class coal deposit is known to exist on the North Slope, This deposit extends 600 miles from the NPRA (National Petroleum Reserve in Alaska) to the Chukchi Sea and from Cape Lisburne to Wainwright. Official state resource estimates are 150 billion tons (identified resources) and up to four trillion tons of undiscovered resources. Although only the westernmost portion of this vast deposit (near tidewater) has any economic potential at present, even this fraction contains very large resources of low sulfur, high BTU (10,000 to 14,000 BTU per pound) sub-bituminous to bituminous coal. The coal, which is owned by the Arctic Slope Regional Corporation (ASRC) and Morgan Coal Company, is of limited value despite its high quality and quantity due to the extreme remoteness of the site, and the depressed coal prices which have prevailed for several years.

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* MT/Yr = Thousand Tons Per Year

Five sites with identified thick surface mineable beds include Cape Beaufort, Howard, Syncline, Deadfall Syncline and Kukpaowruk River. Geological surveys conducted by the Alaska Division of Geological and Geophysical survey in 1983 verify the existence of thick seams of high quality coal. (No published reports of this study are available yet.)

The economic status of the coal is questionable at the present time. Mining in the remote arctic conditions is costly, as is transporting coal to market. Shipping, the only feasible transport mode, is only available during the three ice-free months. Port facilities to load ships or barges would have to be built for the project. The capital and operating costs shown above were developed by a 1982 Arctic Slope Consulting Engineers study and refer to a Cape Beaufort site. These costs result in a cost per ton of $103 (at 100,000 tons per year), $62.30 (at 1 million tons per year) and $34.26 (at 5 million tons per year). Obviously, economies of scale have a marked effect on price. A small scale mine could serve domestic demand in western Arctic Alaska, if existing diesel heating were replaced by coal. The Red Dog mining project is considering a coal-fired electrical supply which could use Arctic Slope coal. But at the 100,000-ton per year scale coal could be barged in from British Columbia at lower cost. Only the medium and large scale operations produce cost-effective coal (Feldman, 1983). However, the existence of sufficient coal reserves which are easily mineable, (low stripping ratios, large tracts), has not yet been firmly established. Detailed mine concepts have not yet been formulated. Even under optimistic assumptions, it is not likely that arctic slope coal will be commercially developed at a small scale before 1990 and at a large scale before 1995.

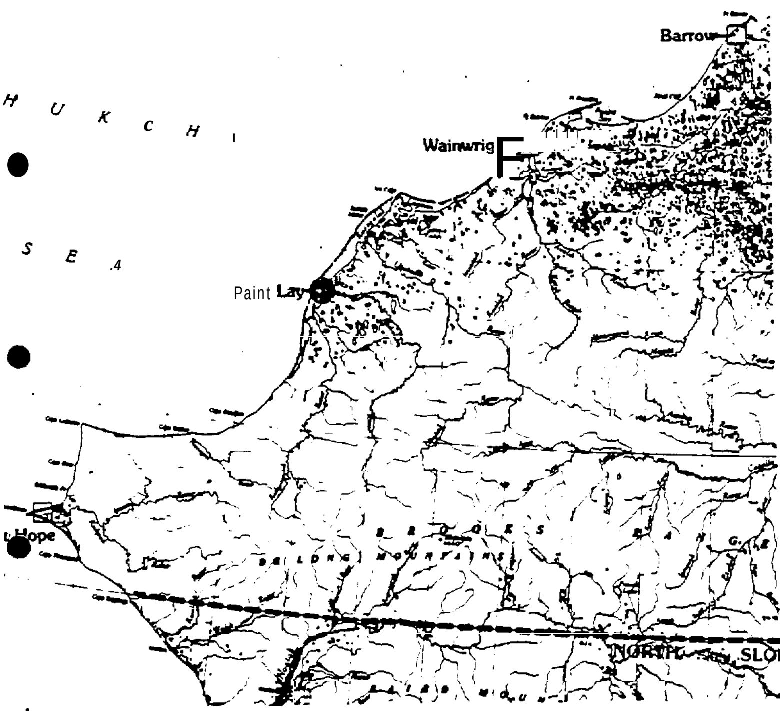
The Alaska Department of Community and Regional Affairs and the Alaska Native Foundation are sponsoring a new study of Western Arctic Coal Development to be completed in 1985. The study is looking at the viability of smaller scale coal mining operations below 500 m tons per year.

5.8 EDUCATION AND SERVICE CENTER FACILITIES

From the moment of incorporation in 1972, the North Slope Borough has pursued a consistent goal to improve education facilities through replacement of temporary units. Both areawide and community specific facilities have been constructed or scheduled that will, at the end of the current six year program (1982-83 - 1988-89), represent an investment of $230,000,000.00.

Each local community has received new permanent school facilities that replaced temporary units with short life cycles. The new facilities also include important special features such as libraries, multi-purpose rooms, gymnasiums, swimming pools, wood and metal shops, home economics centers, small engine repair and welding shops, and food service kitchens.

These facility developments were part of the overall community improvement program that also provided local construction employment opportunities in each community.



Category: Education and Service Center Facilities

Project: **36**

Pt. Lay Education Facilities (CIP Project No. 06-06)

Location(s): Pt. Lay, on Kasegaluk Lagoon, 188 miles SW of Barrow

Time Frame: 1982-1983

Sponsor: NSB Capital Improvement Program

Contact/ Source: Irving Igtanloc
Morrie Lemen Sr.
(907) 852-2611

Capital Costs: $12,800,000

Operations costs: **$365,500** Annually

Employment Characteristics: **Local Non Local**

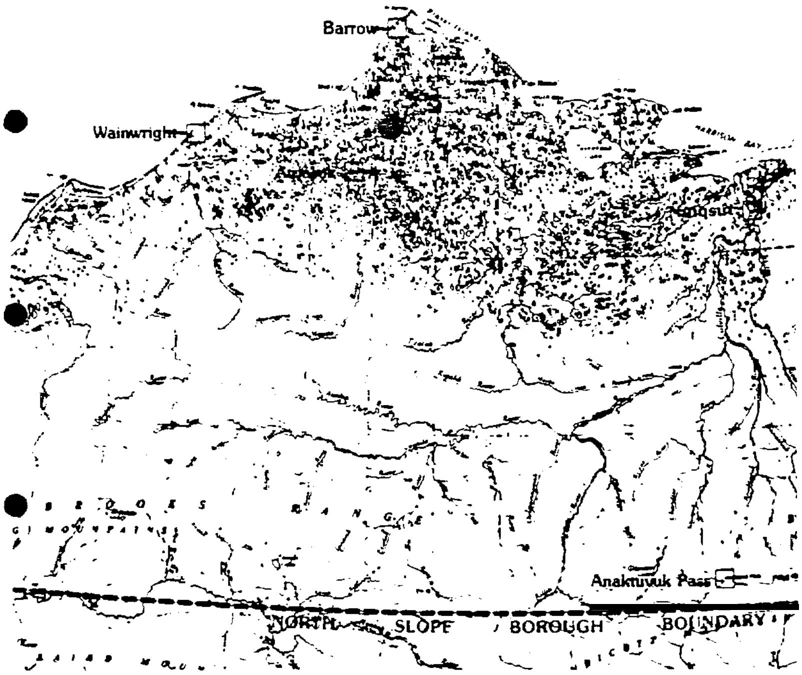
6 Local/ 10 Nonlocal During Construction	5 Local personnel full time For Operations

Project Description:

Within the 14,000 sq. ft. Cully School complex are two buildings designed for 50 students. These structures include provisions for future expansion of the classroom and multipurpose area. The larger building houses two elementary classrooms, an ECE/Kindergarten room, a secondary classroom, a multi-service room for science and business classes, a library/media center, administration offices, and a special education/conference room. The smaller building includes a vocational shop for wood and metal, and a second shop for welding and small engine repair.

Mechanically the school is equipped with a 6,200 gallon tank for sewage and a 16,200 gallon tank for water storage. Installed in the complex is an emergency sprinkler system and on site are four fuel storage tanks with a 41,900 gallon capacity. These fuel tanks are piped into the schools furnace system. A play area has been constructed across Ugruk Avenue and services the new school complex.

The new structures were required as a result of an earlier inadequate facility in poor condition. $4,542,000 of federal funds have been received for the project as a whole.



Category: Education and Service Center Facilities

Project: **37** Atqasuk Education Facil
(CIP No. 06-12)

Location(s): Atqasuk is on Meade Rive
60 miles south of Bat-row

Time Frame: 1982-1984

Sponsor: NSB Capital Improvements Program

Contact/ Source: Irving Igtanl oc
Morrie Lemen Sr.
(907) 852-2611

Capital Costs: $23,375, COO

Operations costs: S271,600 Annually

Employment Characteristics: Local Non Local

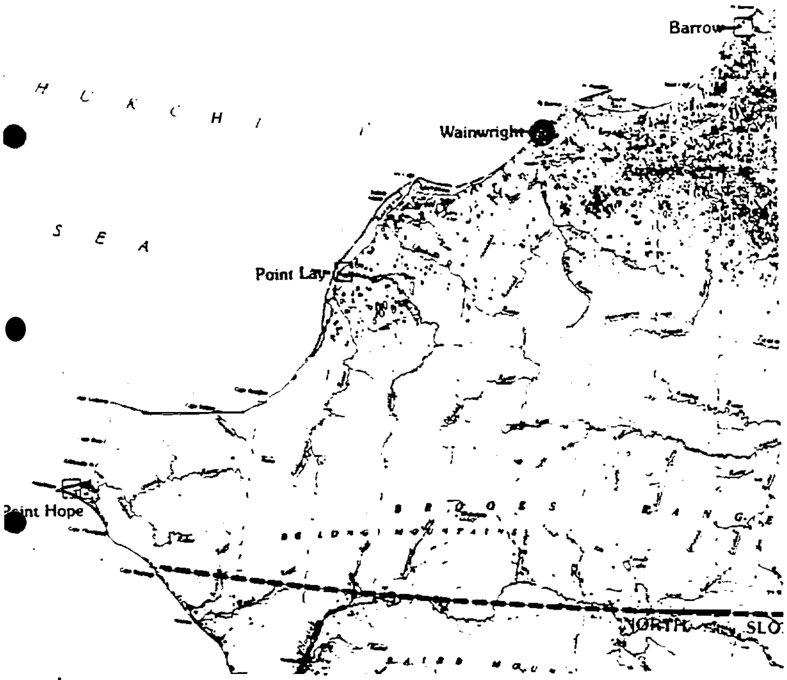
15 Local/5 Nonlocal During Construction

3 local personnel full time During Operations

Project Description:

The new school facility at Atqasuk includes approximately 27,600sq. ft. of floor space. There are two buildings, the larger housing the classroom wing and activity center. Extending out from the classrooms is a play deck. The smaller building contains vocational shops and the mechanical/boiler systems. There are also areas for water storage, sewage retention tanks, and a fenced area for four fuel storage tanks (40,000 gallon combined capacity).

Within the classroom wing are an administration area, science and home economics rooms, library/resource area, and a photo laboratory. The activity center is comprised of an exercise room, boys and girls locker areas, a full gymnasium, kitchen and laundry facilities, and two mezzanines in the gym for storage. The second building will house a 28 X 64 foot weed and metal shop plus the mechanical systems for the buildings. This new complex not only eliminates overcrowded conditions present. at the previous school structure, it provides better quality educational facilities and can accommodate adult education. The population of Atqasuk in 1983 was 231 persons.



Category:	Education and Service Center Facilities
Project: 38	Wainwright Education Facilities (CIP No. 06-23 and 06-67)
Location(s):	Wainwright, on the Chukchi Sea, 100 miles SW of Barrow
Time Frame:	1982-1983
Sponsor:	NSB Capital Improvements Program
Contact/ Source:	Irvine Igtanloc Morrie Lemen Sr. (907) 852-26
Capital Costs:	$13,230,000
Operations costs:	$965,800 Annually

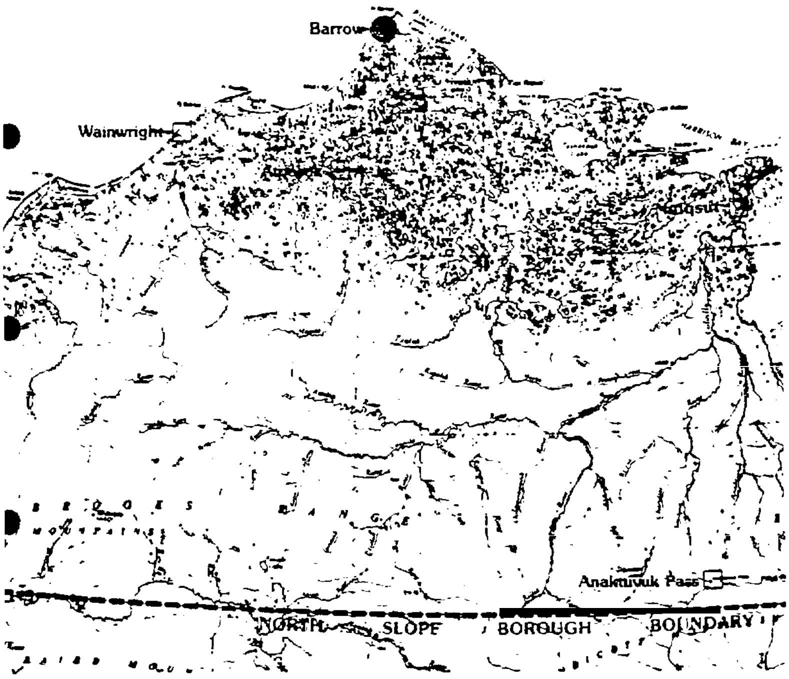
Employment Characteristics: Local Non Local

8-10 Local/15 Nonlocal During Construction	9 local personnel full time During Operations

Project Description:

The expansion and updating of the Wainwright Education Facilities (CIP No. 06-23) included construction of an addition to Alak High School, a new elementary school, activities building, and modifications to an existing vocational education facility (CIP No. 06-67). Within the 9,248 sq. ft. of the elementary school, five full size classrooms are included. Also, a library, special education room, work room, an office, and storage are contained in the elementary facility. The high school addition is 10,307 sq. ft. and includes an arts and crafts room, a student core area, a swimming pool, a weight lifting room, gym storage, public restrooms, and additional kitchen storage. The new utility building has the potential of serving the entire school with a 300 kw generator, water storage tanks and treatment system, sewage storage, and separate water storage for the schools sprinkler system. This building is 2,160 sq. ft. and is tied to an existing community water treatment plant, The vocational shop facility requires modification to meet health safety standards. This includes installing a dust collector, a fire retardant floor, and a covered walkway from the existing school.

The final enrollment for the 1983-84 school year was 101 students in grades K-12. The facility, with the above additions, is expected to adequately serve Wainwright for the next 20 years.



Category:	Education and Service Center Facilities
Project: **39**	Barrow High School Complex (CIP No. 06-43)
Location(s):	Barrow, on the Chukchi Sea 7½ miles SW of Point Barrow
Time Frame:	1980-1983
Sponsor:	NSB Capital Improvements Program
Contact/ Source:	Irvin Igtan ICC Morrie Lemen Sr. (907) 852-2611
Capital Costs:	$67,942,000
Operations costs:	$1,225,400 Annually

Employment Characteristics: Local Non Local

60 Local/15 Nonlocal During Construction	10 Local personnel full-time During Operations

Project Description:

The new high school facility required at Barrow consists of four wood framed buildings. Each building has a specific purpose. In the academic facility are 17 classrooms and two laboratories. The "hub" building consists of a raised platform auditorium with seating capacity of 300, cafeteria kitchen, home science department, a band/chorus department, library, and an administration area. The sports complex is comprised of a gymnasium with a seating capacity of 1,000, a swimming pool, showers, lockers, and a weight lifting room with a wrestling/gymnastics area. The last of the structures is the utility building which houses mechanical systems (boilers, generators), water storage, and includes space for the Barrow training facility (see CIP 13-19).

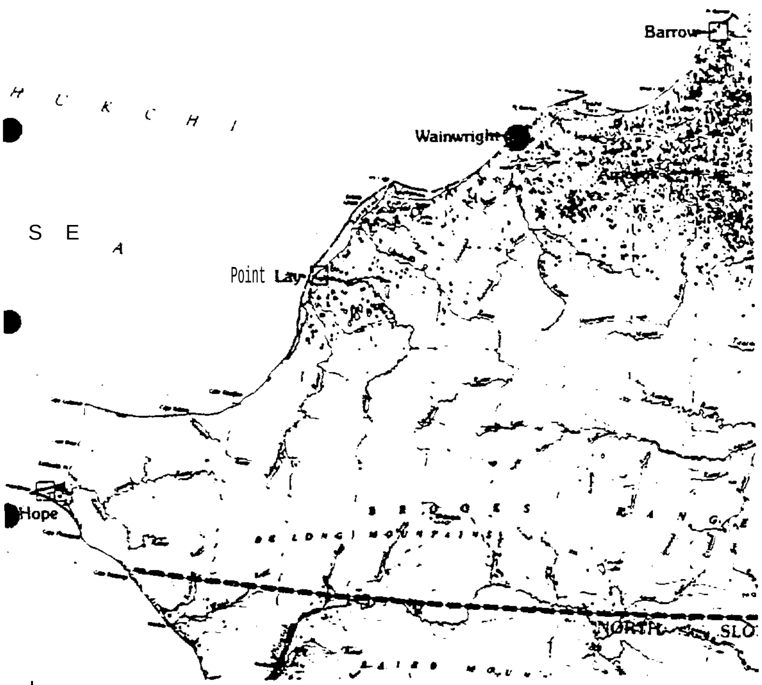
In addition to these new facilities the project also involves the renovation and remodeling of an existing vocational education building. Features include a mezzanine that accommodates a small TV room, a photo lab, arts and crafts room, drafting area, and drivers training room. The lower floor includes a construction shop, classrooms, metal shop, auto repair and small engine shop, plus warehouse space.

This facility was required because the original high school was temporary and housed within the elementary school. The population of Barrow was 2,882 in 1983 and has projected growth through the end of the century. In the 1983-84 school year, 633 students were enrolled in grades 1-12.

5.9 PUBLIC ROADS AND STREETS

The trail network that formerly characterized the typical village site in the North Slope has been transformed by the public roads and streets program of the North Slope Borough. Initial development projects have centered on the acquisition of heavy equipment; construction of mobile equipment storage buildings, the identification, acquisition, dredging, crushing, and stockpiling of gravel resources; land and right-of-way acquisition; and close coordination with watercourse and flood control projects, which collectively have given the borough the resources required to implement the public roads and streets program.

The project descriptions that follow are of the largest scale within the public roads and streets program. Representing an investment of $115 million from the Capital Improvement Program, the projects best exemplify the extraordinary complications involved with developments in North Slope arctic conditions including competition for resources, e.g. gravel, essential for project accomplishment. Each project also provided local employment opportunities not otherwise available.



Category:	Public Roads and Streets
Project: 40	Wainwright Community Roads Phase I (07-21), II (07-22) & III (07-142) Road to Sanitary Landfill (07-106) Recreational Road (07-143)
Location(s):	Wainwright, on the Chukchi Sea, 100 miles SW of Barrow
Time Frame:	1979 - 1985
Sponsor:	NSB Capital Improvement Prog.
Contact/ Source:	Irving Igtanloc; Morrie Lemen, Sr. (907) 852-2611
Capital Costs:	$7,935,000
Operations costs:	$331,185.00

Employment Characteristics: **Local** Non Local

10 Local/3 Nonlocal During Construction

3 Local part-time for maintenance

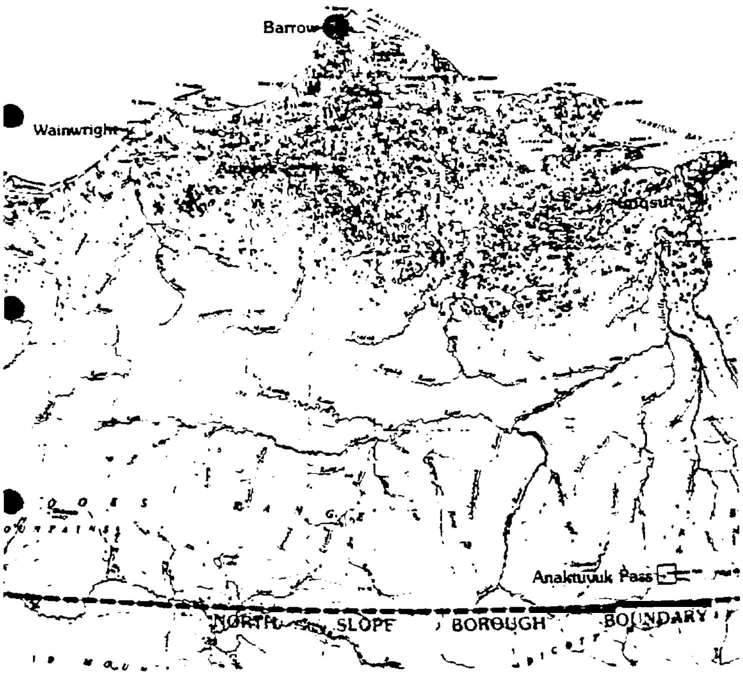
Project Description:

Wainwright Community "Roads Project Phase I, includes both upgrading of existing roads and construction of new ones. Phase II provides further upgrading of existing roads, plus the extension of roadways to the new housing expansion and to fuel storage areas. S225,000 in state funding for the upgrading of culverts has been applied to Phase II. Phase III encompasses 3,950 lineal feet of new roadway. This is required for the planned expansion of the village. In this phase, Ahioakageak Road extends eastward towards the airport. Platted roads east of the school will also be developed. Gravel requirement estimates are at 22,000 cubic yards with the new roads being 20 feet wide,.5 feet deep, with 2:1 side slopes.

The road to the sanitary landfill is yet another expansion. This project, provides 2.4 miles of road, stretching from the edge of town to the existing Wainwright dump site. Turn outs for two-way traffic are provided and the gravel estimates are at 60,000 cubic yards. This road will be 15 feet wide and 5 feet deep with 2:1 side slopes. Year round access to the dump will be possible upon completion. The Wainwright recreational road project provides 1,000 feet of roadway extending from the southwest end of the runway to

Wainwright Inlet. This road which is entirely State funded, is 20 feet wide and 5 feet deep with 2:1 side slopes.

Problems occur in road development at Wainwright as a result of lack of gravel and poor natural surface drainage. Also, older existing roads with irregular courses and narrow rights of way have combined with the former items to hamper road development efforts in the past.



Category: Public Roads & Streets

Project: **41** Barrow Equipment Storage (CIP No. 07-37, 07-57, 07-57)

Location(s): Barrow on the Chukchi Sea, 7.5 miles SW of Pt. Barrow

Time Frame: 1981 - 1985

Sponsor: NSB Capital Improvements Program,

Contact/ Source: Irving Igtanloc, Morrie Lemen, Sr. (907) 852-2611

Capital Costs: $6,413,000

Operations costs: $3,500,000

Employment Characteristics: Local Non Local

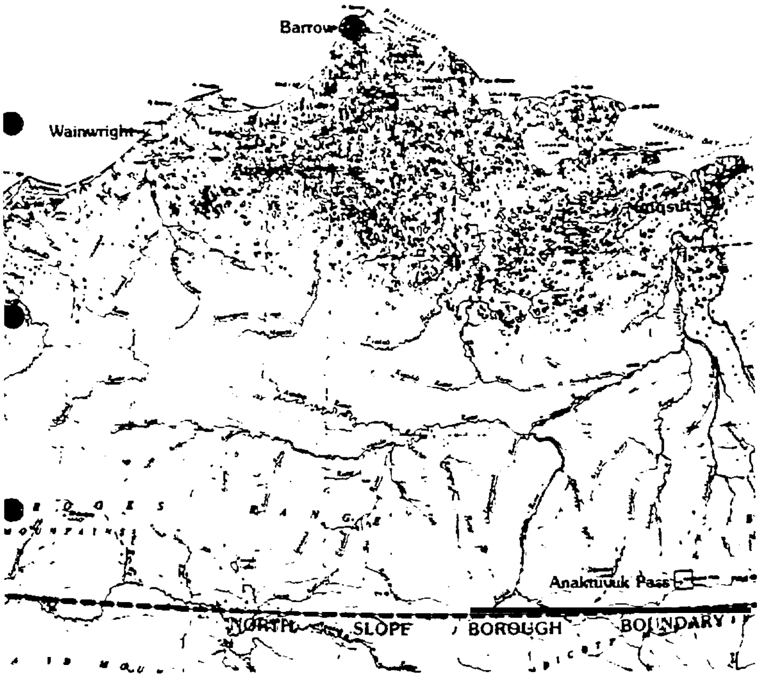
20 Local/3 Nonlocal During Construction

39 Local for Operation: and Maintenance (includes Barrow and Browerville)

Project Description:

Heavy equipment is necessary in Barrow for road maintenance and construction. As a result of the acquisition cf such needed items, the first Barrow equipment storage building was constructed (CIP project no. 07-37). In 1981, the second building of this type was erected (CIP project no. 07-57). This facility provided warm storage for equipment and areas for repair work, maintenance, and storage space. Support offices were provided as was the equipment necessary to perform required maintenance on the machinery.

The original storage facility is slated for renovation beginning in 1985, (CIP project no. 07-97). The structure is wooden framed with 8,400 square feet including four maintenance stalls. It was constructed with a concrete floor and upgrading includes the replacement of damaged structural columns and the reinforcement of others. Existing lighting, heating and sewage systems will also be improved and a new auto repair area will be added to the existing facility. This renovation is essential to meet the growing needs of the Borough for vehicle maintenance and to help better accommodate heavy equipment.



Category:	Public Roads and Streets
Project: **42**	Browerville Subdiv. Roads and Pads Phase I (07-84), Phase II, Barrow Subdiv. #3 Roads (07-R)
Location(s):	Barrow, on the Chukchi Sea, 7.5 miles SW of Barrow
Time Frame:	1982 - 1984
Sponsor:	NSB Capital Improvement Program
Contact/ Source:	Irving Igtanloc Morrie Lemen, Sr. (907) 852-2611
Capital Costs:	$8,973,000
Operations costs:	$1,750,000

Employment Characteristics: Local Non Local

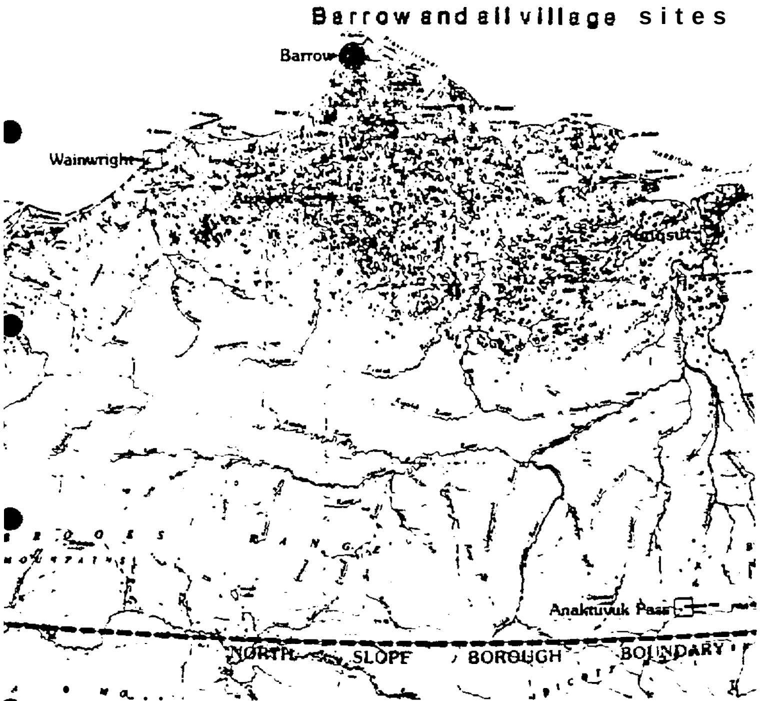
6-8 Local/l Nonlocal During Construction

Data aggregated as part of City of Barrow for Maintenance.

Project Description:

Phase I, Browerville Subdivision Roads and Pads, include developing and subdividing residential lots and provides roads, building pads, and drainage control to the Browerville Addition. Phase II involves the completion of the roads constructed under Phase I. Also included here is the placing of crushed rock surfacing on the roads, and the construction of the remaining pads in Browerville Addition #2. In the Barrow Subdivision #3 Roads project, 4.7 miles of new roadway will be constructed in the Browerville Addition #3. The gravel requirements for this project are estimated at 140,000 cubic yards with the roads being 20 feet wide, 5 feet deep, with 3:1 side slopes.

These projects have became necessary as the Barrow residential sectors have expanded and overcrowded housing conditions could be reduced. Proper drainage measures and culverting are important here, as in other arctic communities, to avoid diking and pending of surface water. The basic roadway system in Barrow is an exception when compared to other smaller villages as it was already well developed before the incorporation of the North Slope Borough in 1972.



Category: Publ ic Roads and Streets

Project: 43
Gravel Acquisition, Dredging, Crushing and Stockpiling Phase I (07-9 0), Phase II (07-105)

Location(s): Areawide

Time Frame: 1979 - Present

Sponsor: NSB Capital Inprovement Prog.

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $26,635,000

Operations costs: No Operations and Maint. Expense

Employment Characteristics: Local Non Local

15 Local/5 Nonlocal

During seasonal production

‘reject Description:

The areawide Gravel Acquisition, Dredging, Crushing and Stockpiling Phase I provides funding for a number of activities which are continued ir Phase II. Included in these activities are the preparation cf resource inventories, gravel source surveys, and environmental reports. Also included are the development and operation of a program which enables the villages tc meet the gravel requirements for capital improvement projects,

Gravel acquisition is an ongoing problem in most villages. Upland gravel sources are in extremely short supply in nearly all North Slope settlements. This shortage of gravel often creates delays and may increase construction costs . Dredging and stockpiling have been introduced to help alleviate these problems. The need for additional gravel is important to the further development of most villages. This program addresses these needs and is funded on an areawide rather than on an individual village basis,

The gravel reserves developed under this program are available to all village facility development programs providing timely supplies at reduced costs.

5.10 WATERCOURSE AND FLOOD CONTROL

In the wet tundra environment of the North Slope, the development of a positive drainage system, including flood control, is a problem that challenges all communities. With the possible exception of Anaktuvuk Pass, surface drainage conditions in North Slope Borough villages have been difficult and, when combined with a vast program of developments. create an extreme need for watercourse, erosion, drainage, and flood control projects.

As residential and facility developments occurred in the villages, the construction of high road beds and building pads created unintended diking or damming of the limited natural surface drainage. Proper culverting and drainage structures can relieve most such problems, however, the required technical solutions are in some instances both complex and expensive. Also, natural phenomena, such as flooding or beach erosion, can encroach on man-made facilities with the occasion of extensive damage.

The project descriptions that follow deal with the most significant examples of related development impact on natural conditions in a seasonally wet arctic environment.

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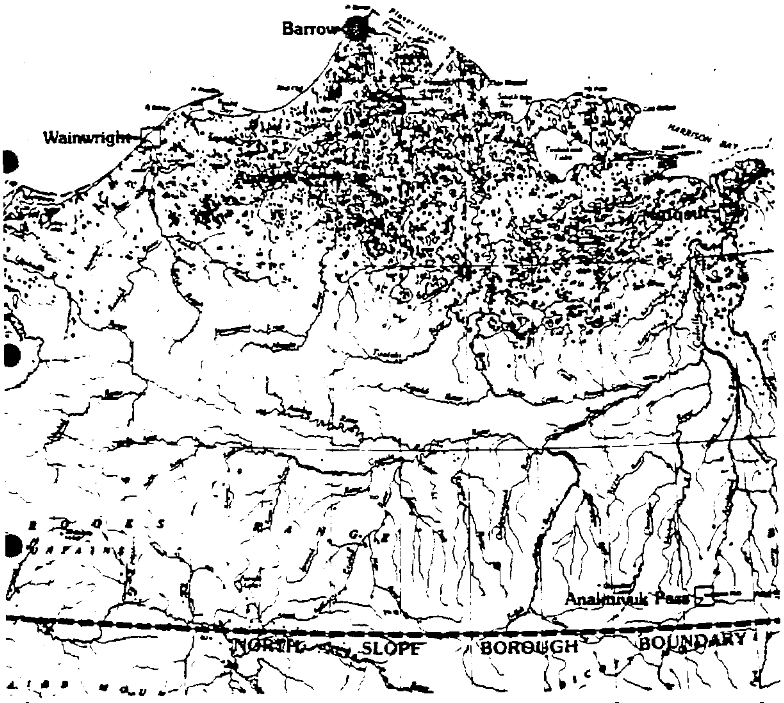


Category: Watercourse and Flood Control

Project: 44 Barrow Dredge, Excavation and Reclamation (CIP Project No. 07-136)

Location(s): Barrow, on the Chukchi Sea, 7.5 miles SW of Point Barrow

Time Frame: 1984

Sponsor: NSB Capital Improvement Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $1,800,000

Operations costs: NO Operations and Maint. anticipated

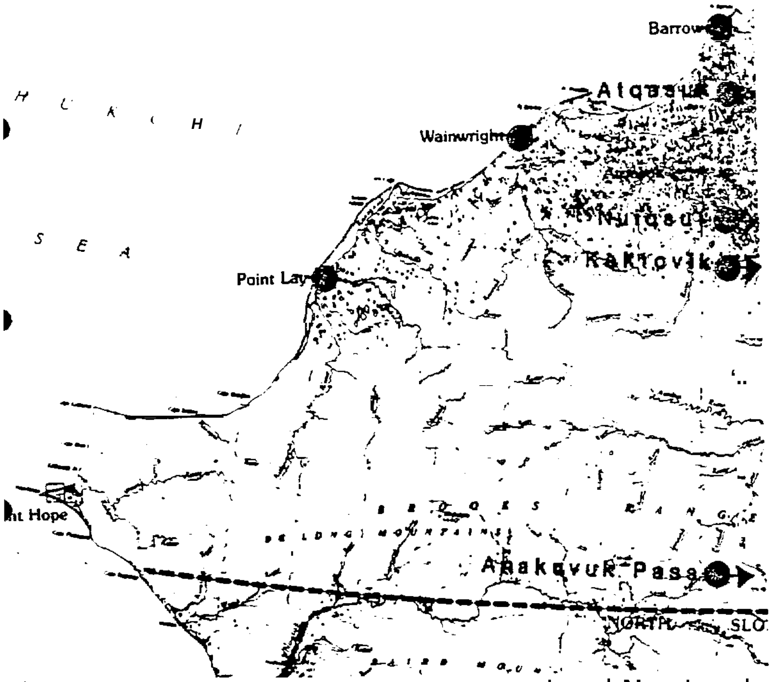
Employment Characteristics: **Local Non Local**

15 Local/5 Nonlocal
During Construction

Project Description:

This project involves dredging in Isatkoak Lagoon. The activity was scheduled to take place in the summer months (June - October) of 1984 and is important in the reinforcement of the upper dam located on the Lagoon. Material from this dredging operation will be used for reinforcement and stabilization against further erosion to the dam. The dredging is necessary to assist in the construction of a new waterline which will run across the Lagoon from the intake facility on the dam to the water treatment plant. This new line is required due to the poor conditions of the existing waterline.

A number of other related capital improvement projects sponsored by the North Slope Borough are under construction or have been completed including a community wide piped water and sewer system, a safe water source, health center, public safety building, and a new high school. All of these facilities have utility requirements that are connected to the water distribution system and are affected by the excavation and reclamation project.



Category: Watercourse and Flood Control

Project: 45 — Drainage Control Areawide (07-100) Barrow (07-L), Atqasuk (07-K), Pt. Lay (07-N) Wainwright (07-120) Anaktuvuk Pass (07-128), Kaktovik (07-MO, Nuiqsut (07-129)

Location(s): Areawide

Time Frame: 1985 -

Sponsor: NSB Capital Improvement Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $3,042,000 (total)

Operations costs: No operations and Maintenance Funds

Employment Characteristics: Local **Non** Local

6-8 Local/1 Nonlocal at each village site
During construction season

'eject Description:

Areawide drainage and culverts are provided under CIP project #07-100. S250,000 of funding is allotted for the upgrading of existing roads and the installation cf culverts. This supplemental funding provides drainage measures for roads as is necessary in the various North Slope Villages.

A number of villages have drainage control projects of their own. Atqasuk's drainage Control Plan includes the installation of culverts across north-south oriented streets for drainage into Imagruaq Lake. Also included are erosion control measures needed to restrain erosion of the lake near the village. Gravel requirement estimates are at 2,600 cubic yards for this project.

The Barrow Drainage control program provides funding for the construction of adequate drainage measures throughout the village. The installation of culverts and the upgrading of existing roadways are also provided for. In Wainwright, approximately 500 lineal feet of culvert will be installed to provide adequate drainage where necessary. Erosion control measures are also important for the village. Gravel requirement estimates are at 2,600 cubic yards and $60,000 of State funding has been received. At Point Lay, measures to prevent further erosion of the beach at Kasegaluk Lagoon will be undertaken as will miscellaneous berming and grading in various areas of the village. The project provides for the installation of approximately 1,500 linear feet of 12 inch and 24 inch culvert to promote proper drainage primarily across Qasigialik Street into the lagoon.

Included in the Anaktuvuk Pass Drainage Control project are provisions for improved drainage and the installation of approximately 1,300 lineal feet of 12 inch and 18 inch culvert. This piping is necessary to the new housing being developed across Contact Creek. Between the school and Illinois Avenue, gravel fill is necessary. The gravel requirement estimate is 1,900 cubic yards with 1,460 cubic yards of this figure to be crushed or screened. The village of Kaktovik has a serious erosion problem and control is an important part of their drainage project. The north-west side of the settlement borders Kaktovik lagoon and a good deal of erosion has taken place here. With the stabilization of this shore bank and the elimination of further deterioration, a road can be built along the edge of the village providing through access for emergency and maintenance vehicles. Along with erosion control, a drainage system, including culverts, will be established for the village. The overall gravel requirements for the project are estimated at 6,600 cubic yards.

Finally, the Nuiqsut Drainage control project addresses pending problems at various sites within the village. The upgrading of existing culverts and the addition of new culverts are included where necessary. The gravel requirement estimate at Nuiqsut is 2,600 cubic yards.

5.11 PUBLIC HOUSING

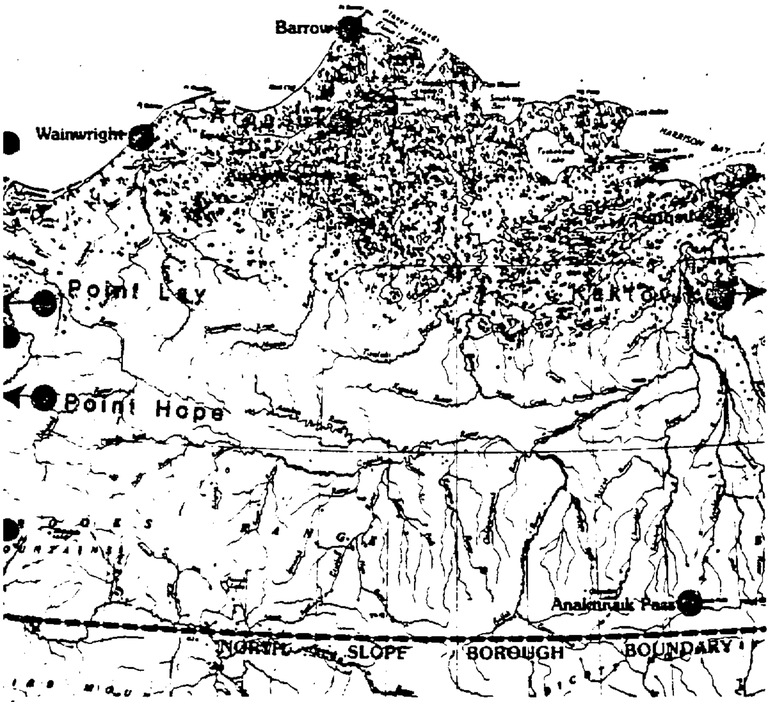
Prior to the construction of housing by government agencies, first by the Alaska State Housing Authority and more recently by the North Slope Borough, most people in the villages lived in sod or earthen homes or units built from other makeshift or salvaged materials,

A quantitative indication of the impact of the borough's housing policy is shown in the table following wherein approximately 50% of all housing units are indicated as having been constructed as part of the borough's Capital Improvement Program. In the aggregate the 662 units represent an investment of approximately $220 million in the decade since the borough was chartered.

NORTH SLOPE BOROUGH
Housing Inventory
(1982)

Community	Units: Borough Built	Units: Total Inventory
Anaktuvuk Pass	47	91
Atqasuk	45	45
Barrow	354	747
Kaktovik	30	61
Nuiqsut	36	65
Pt. Hope	78	162
Pt. Lay	12	30
Wainwright	60	146
	662	1,347

North Slope Borough Housing Survey, 1982.



Category:	Public Housing
Project: 46	Housing Construction Areawide
Location(s):	Areawide
Time Frame:	1974 - 1989+
Sponsor:	NSB Capital Improvement Program
Contact/ Source	Irving Igtanloc Morrie Leman, Sr. (907) 852-2511
Capital Costs:	$219,074,000 (incl. approximately $13,000,000 in Federal Funding), $1'3,567,000 (deferred to next CIP Program)
Operations costs:	Not Applicable

Employment Characteristics: **Local Non Local**

10-15 Local /1-3 Nonlocal at each village site when local units are under construction.

Project Description:

Since 1974-75 and the inception of the Capital Improvement Program, a number of construction projects have been completed in the category of Public Housing. Included also is the acquisition of furnishings for Borough-constructed housing units, modifications on units to meet HUD requirements and provisions for subsequent late billings. Areawide projects that are presently under construction or planned for include land acquisition, the standardization of housing glycol systems, the acquisition and shipment of furniture for Borough-constructed housing, and provisions for late billings. An assembly reserve account has been established to address the funding needs of Public Housing in general. The capital costs include completed CIP housing projects, CIP housing projects currently underway, and housing projects planned for in the present six-year CIP period. Projects which were planned for but deferred after the current six-year CIP period are separate. Included in this last category is a program involving the upgrading, as required, of Borough owned housing in villages outside of Barrow.

In the past, Anaktuvuk Pass residents resided in sod huts. or homes constructed of salvaged and makeshift materials. Construction of new housing for them began with the Alaska State "Housing Authority followed by the North Slope Borough. In October 1982, Alaska Consultants conducted a survey of housing, finding 91 total units with 70 occupied. Generally, the unoccupied' structures were older and sub-standard. The 30 non-employee units built by the Borough here are covered by a HUD commitment. They will eventually become Mutual Help housing. An additional 11 units of Borough housing are reserved for its employees, mainly school staff. The CIP housing in Anaktuvuk Pass includes 12 3-bedroom units, 10 4-bedroom units, four public employee units and 14 general units.

The Borough's Capital Improvement Program is responsible for all of the existing housing in Atqasuk. Of the 45 units in the village, (August 1982 - Alaska Consultants), 23 units have obtained HUD commitments and will become Mutual Help housing. In 1983, nine more units were added to the Mutual Help housing program. Included in the village CIP housing projects are 17 federal aid units, 10 4-bedroom units, six 3-bedroom units, two public employee units, and four general units.

Barrow has a diverse range of housing units for the North Slope. In 1980, a comprehensive housing survey was undertaken for the Borough and a total of **747 units** existed in Barrow. Just over one-third of this number was taken up in multi-family structures. The unusually high proportions of whites in Barrow who wish to rent and not buy may account for this. 44 single family units, five 4-plexes, nine 12-plexes, one 8-plex, two 29-unit apartment buildings have been completed thus far. Projects planned or in construction include one 8-plex, two 32-unit apartment buildings, 38 4-bedroom units and 38 3-bedroom units. Another housing census is necessary to re-assess the needs of a changing social climate. After this time, the 48units of federal aid housing that has been deferred will be re-evaluated. Two other projects have been deferred, the central housing warehouse and shop facility and the renovation of North Slope Borough housing in Browerville.

Before the construction of housing by the Alaska State Housing Authority and then by the North Slope Borough, residents of Kaktovik lived in makeshift homes of salvaged materials. Sixty-One (61) housing units were identified by Alaska Consultants in October 1982. Thirty (30) of these were built by the Borough and 15 of the 30 are being purchased under the Mutual Help program. Nine more were rented to low income families while six were reserved for employees. The number of homes covered by the HUD Mutual Help program grew from 13 in 1982 to 21 in 1983. An additional 10 units will be built here in the current CIP period.

Twenty-Seven (27) Barrow families originated Nuiqsut in 1973. For 18 months they lived in tents while housing was built with funds advanced to them from the Arctic Slope Regional Corporation. Since this original housing development, most units have been built by the Borough. An August 1982 housing census showed a total of 76 units of which 69 were occupied. At this time, 36 units were of Borough construction and 18 were covered by the HUD Mutual Help program. In 1983, another commitment was obtained from HUD and the Mutual Help program to purchase 19 more units. Twenty-two (22) additional single family homes are to be built in the current CIP period.

In September 1982, Point Hope had a total of 162 housing units of which 136 were occupied. The majority of the 26 vacant homes were privately owned and substandard. Seventy-eight (78) units of the total number were constructed by the Borough and 43 of these were covered by the HUD Mutual Help Program. The remaining 35 units included 25 rentals and 10 Borough employee units. ‘wo more housing additions are planned with the construction of 36 new single family homes.

Point Lay was relocated from Kokolik River Delta to its present site. Concurrently, existing homes were moved and in October 1982 30 housing units were tabulated (Alaska Consultants). Only 12 units of this figure were constructed by the Borough and all of these were single family homes. The remaining structures were funded by the Arctic Slope Regional Corporation or the Cully Corporation and the Bureau of Indian Affairs. Of the 12 Borough units, eight were rented to residents of the village and four were allotted for Borough employees. Eight additional units are planned for in the current CIP period with one project deferred. This project consists of 10 new federally funded single family structures. A re-evaluation of housing needs is necessary after the new housing projects (eight unit total) are completed to ascertain whether the 10 federal units are really required.

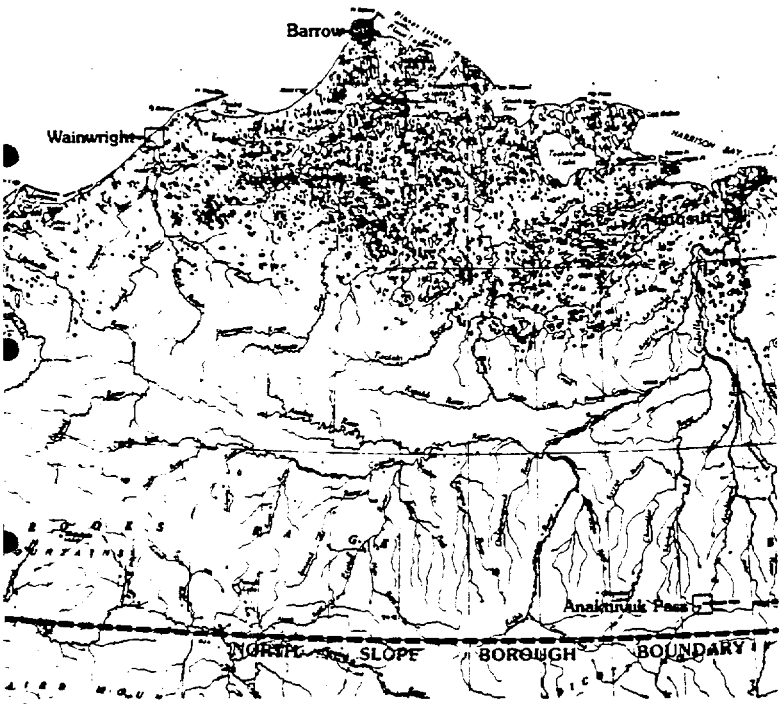
The village of Wainwright was founded in 1904 with the erection of a federal school. Obviously, some of the village housing is quite old. In August 1982, a housing census was performed by Alaska Consultants and 146 units were identified. 112 of these were occupied with 16 being privately constructed and substandard. Of the unoccupied structures, 19 were considered substandard. At this time, 60 units had been constructed by the Borough and 28 of these had received commitments from the HUD Mutual Help program. Seven units were reserved for Borough employees while the remaining 25 units were rentals. A 14 unit single family project will complete Wainwright's housing program for the current CIP period.

5.12 WATER FACILITIES

Mater supply has been and will continue to be a constraint to development in the North Slope Borough. Winter freezing of surface and ground water supplies necessitates the use of storage facilities to maintain adequate winter supplies. Unfortunately supplies are often a long distance from village locations and transporting water via pipeline to a storage tank can be cost prohibitive. Historically the way of life of the North Slope natives has been adapted to fit the general difficulty of obtaining water and water use was conservative. With the current upgrading of facilities in the communities, however, water use has increased. Showers, washeterias, and flush toilets are commonplace and schools are being equipped with swimming pools.

The community specific water facilities require evaluations to determine 1) quantities of water needed to support development, 2) locations of potential water sources, 3) impacts of water withdrawal and waste discharge on nearby aquatic systems, 4) methods for insuring adequate year-round water supplies.

The project descriptions following incorporate those considerations as part of overall capital improvement program strategies.



Category: Water Facilities

Project: 47 Barrow Water Distr. Constr. & Design Phase I (09-08), II (09-46), III (09-47), IV (09-49), V (09-50), VI (09-51)

Location(s) Barrow, on the Chukchi Sea, 7.5 miles SW of Point Barrow

Time Frame: 1982 - 1988

Sponsor: NSB Capital Improvement Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $137,279,000

Operations costs: Not in operation as of this date

Employment Characteristics: **Local Non Local**

60 Local/10 Nonlocal
During Construction

Project Description:

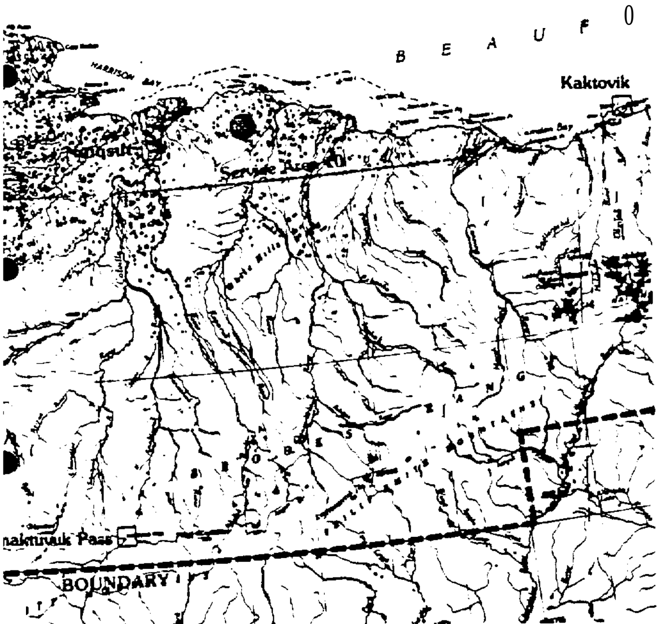
This is an extensive capital project to be completed in six phases. Basic elements of the development involve a community water distribution: system which will consist of 38,000 lineal feet of utilidor (approximately), a central water heating and circulation plant, and pump stations. The buried utilities system will provide piped/pumped water delivery from the water treatment plant to the village. Water, sewer, piping, force mains, electrical service, telemetry and water for fire hydrants will all be included in this underground system. A continuous flow of heated water through the system will be accomplished by the water recirculation plant. Service connection boxes and lateral utiliducts will be constructed as the sections of the utilidor system are installed.

Phase I includes the design and construction of the above mentioned items with installations and service connection to the hospital, the Borough administration building, BUECI, the schools, two 29-unit apartments, new housing in Block A, the commercial core area plus 34 houses, Some connections in Browerville will also be made. Essentially, Phase I deals with the construction of the buildings necessary to the system including a fabrication plant plus the initial installations of the utilidor system. The following five phases will complete service to the various sectors in Barrow.

Phase 11 includes completing both the raw water supply line replacement and the access road to the trucked sewage disposal building along with the upgrading of Stevenson Street. Installation of the utilidor is planned for portions of Browerville, excluding Addition 3. Service connections will be available for 100 homes in Browerville and also for those new homes in Block A. Re-vegetation occurs throughout the project where necessary. Phase III includes the installation of additional pumping systems in the recirculation operation, utilidor installation in Browerville Addition #2, and the completion of 144 service connections in Browerville. In Phase IV, the utilidor system extends down Ahkovak Street and into residential areas off Momegana Street. 175 service connections in Barrow and Browerville will be completed. Phase V continues the process with 120 service connections completed. Phase VI, the final phase, completes the installation of the remaining utilidor sections and their service connections. Service will also be extended to any new housing.

Immediately tied to the Barrow Water Distribution System is the Barrow Water Treatment Expansion and Upgrading project. Equipment necessary in the operation of a 150,000 gallon/day water treatment plant will be purchased and installed. The new treatment plant will be housed in the existing BUECI filtration plant with needed modifications provided for a 600,000 gallon storage tank to be added.

Funding equal to each phase of the water distribution system is provided by the Sewage Treatment Disposal Facilities Fund (CIP project no.'s 10-40, 10-41, 10-43, 10-44, 10-45) . This funding is separate from capital costs for the water project. Please refer to the Barrow Sewage Disposal program for more information as the two projects coincide directly.



Category: Water Facilities

Project: 48 — Kuparuk Water Treatment and Distribution System (09-35)

Location(s): 40 miles NW of Prudhoe Bay Facility

Time Frame: 1983-1984

Sponsor: NSB Capital Improvements Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $1,834,000

Operations costs: $172,400 Annually

Employment Characteristics **Local Non Local**

4 Local for operations.

Project Description:

Kuparuk Industrial Center was conceived by the North Slope Borough as a result of the planned large scale development of the Kuparuk River oil field. The center is a service facility with all operators based therein. The complex is close to the developing oil site.

The Water Treatment and Distribution System for, the Industrial Center includes a 95 million gallon pit reservoir engineered for the annual fill 'rem the Ugnaravik River at break-up. A water storage reservoir and treatment plant provides service for a 240-man construction camp and has the potential of servicing a 400-man industrial plant. Submersible turbine pumps, located in the middle of the reservoir, pump water from the reservoir through an overhead pipeline to the treatment facility. At the facility the water is divided in quantity with part remaining raw and a portion treated for human consumption. The raw water is necessary for fire suppression but it is net fit for human consumption without treatment. At the plant, the consumable water to be treated is processed chemically through filtration, with a pH adjustment, and diverted to tank storage.

5.13 SEWAGE TREATMENT/DISPOSAL

Sewage treatment and disposal will continue to be a problem in the North Slope Borough. Both winter and summer conditions create unique climatic and environmental circumstances that constrain collection and disposal options. The following systems are currently in use in North Slope communities:

Communitv:	Collection/Disposal :

Anatuvuk Pass - Honey buckets are used with each resident responsible for removing waste to the dump site.

Atqasuk - Sewage collection from residences is accomplished by a Borough supplied Bombardier track utility vehicle. 55 gallon drums are hauled to the waste disposal site.

Barrow - See project description on pages following.

Kaktovik - Village wide sewage waste collection and disposal service operated by Borough.

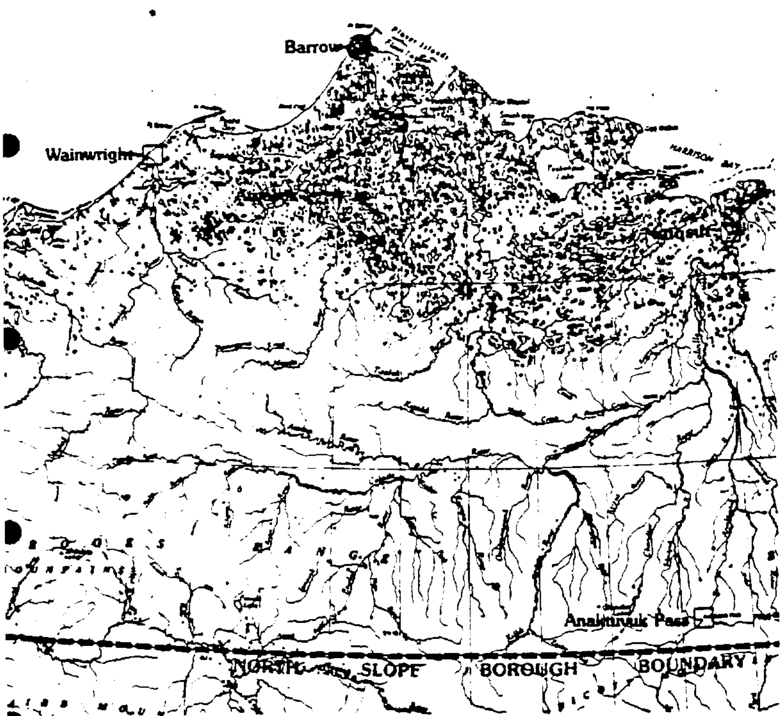
Nuiqsut - Village wide sewage waste collection and disposal service cperated by Borough.

Pt. Hope - Sewer system constructed by the Public Health Service and operated and maintained by the Borough.

Pt. Lay - Sewage waste pick-up services with honey buckets and 55 gallon drums.

Wainwright - (Two systems) . Sewage treatment facilities serve new school , old elementary school and washeteria. Remainder of village uses honey buckets.

The North Slope Borough Capital Improvement Program has initiated large scale sewage collection, treatment and disposal projects at Barrow and the Kuparuk Industrial Center. These projects deal with the complex technical issues of sewage disposal in arctic conditions that have a bearing on development activities.



Category: Sewage Treatment/Disposal

Project: 49 Barrow Sewage Disposal Phase I (10-09), Phase II (10-40, Phase III (10-41), Phase IV (10-43), Phase V (10-44), Phase VI (10-45) , outfall line and lagoon (10-16)

Location(s): Barrow. on the Chukchi Sea, 7.5 miles SW of Point Barrow

Time Frame: 1983 - 1988

Sponsor: NSB Capital Improvements Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $162,017,000

Operations costs: Limited operation as of this date

Employment Characteristics: **Local Non Local**

60 Local/10 Nonlocal

During Construction

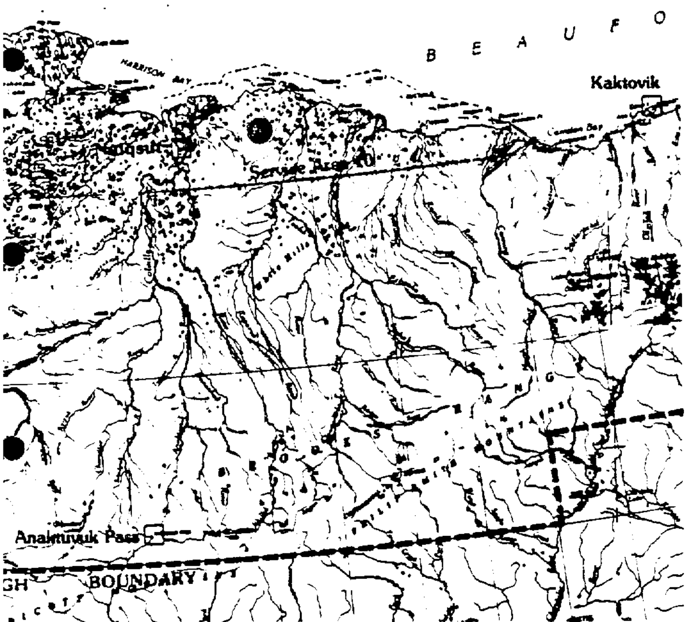
Project Description:

The Barrow Sewage Disposal project is concerned with the development of a community sewer system. This is a six phase project developing concurrently with the new Barrow Water Distribution System (CIP project no.'s 09-08, 09-46, 09-47, 09-49, 09-50, 09-51) similarly divided into six phases.

The project consists of approximately 38,000 lineal feet of utilidor, pump stations and a buried outfall line to the facultative sewage lagoon. Also, a sewage disposal building will be constructed for the dumping of honey-bucket pick-up trucks which may be quite necessary for a period of time as the majority of the village currently utilize honey buckets. This disposal facility will be linked to the sewage lagoon by means of the outfall line. The buried utilidor system will include water and sewer piping, force mains, electrical service and telemetry and water for fire hydrants. In conjunction with the utilidor construction, lateral utiliducts and service connection boxes will be installed.

Phase I will include the design and construction of a fabrications plant which will be in operation through much of the project, construction of the above ground dam crossing and the installation of the buried outfall line to the sewage lagoon. Also, four sewage pump stations will be constructed as will the sewage disposal building. Parts of the utilidor system will be installed and connections made to a number of public, commercial and residential structures. The remaining five phases all follow the same outline as found in the Barrow Water Distribution project, Phases II-VI.

Important to Phase I and II of the Sewage Disposal Project is the Barrow sewer outfall line and lagoon, (CIP project no. 10-16). Provided for here are the design and construction of the outfall line, the purchase and installation of aeration equipment plus an aeration blower house and laboratory. Additionally, provisions are made for the construction of the three cells in South Salt lagoon necessary for sewage treatment and the construction of the sewage disposal building. The second phase of this project completes earlier construction of the outfall line and lagoon in addition to contributing funds for the completion of the access road to the truck-hauled sewage treatment facility which was developed as part of Barrow's overall water/sewage project.



Category: Sewage Treatment/ Disposal

Project: **50** Kuparuk Treatment/ Discharge

Location(s): 40 miles NW of Prudhoe Bay Facility

Time Frame: 1982 - 1984

Sponsor: NSB Capita? Improvement Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $1,975,000

Operations costs: $1,200,000 Per Annum

Employment Characteristics: **Local Non Local**

8 Local during operations.

Project Description:

The Kuparuk Sewage Treatment/Discharge facility is located in the utility plant building of the Kuparuk Industrial Center. The designed capacity of the system is 50,000 gallons per day of domestic sewage. The system also has a sand trap oil separator and can thus handle some minor amounts of industrial waste.

The sewage system is comprised cf clarifiers which settle and clarify the influent sewage. The product of this process is clarified sewage which is then transported to a biological treatment plant where a biological tree aerates and treats the wastewater. From here the water flows to a chemical flocculation basin and certain chemicals precipitate out as flocculent. The flocculent is then incinerated. The water continues on to be chlorinated and finally conveyed to a treatment or polishing pond on site. Approximately two years of effluent discharge may be contained here. During the summer at certain intervals, water from this lagoon is discharged into the Ugnaravik River. From here it continues on to the sea. The quality of the water is expected to be 20/20 effluent. It should contain no more than 20 milligrams per liter for both biological oxygen demand and chemical oxygen demand. The remaining sludge and screening material from the sewage will be hauled to service area 10 by truck to be incinerated.

5.14 AIRPORTS AND AIRPORT TERMINALS

Aviation services and facilities are key to North Slope Borough community development. Many communities are totally dependent on air transport for fuel oil, general supplies, medical evacuation and general transportation requirements. The status of existing facilities is summarized as follows:

Community: Air Facility Status:

Anaktuvuk Pass - The airport was upgraded in 1980 by the North Slope Borough capital improvement program. The project extended the runway to 5,000 feet, provided runway lighting and constructed an airport terminal building.

Atqasuk - New airport construction now underway consisting of a 5,000 foot runway designed for heavy aircraft (Hercules), taxiways, a parking apron, runway lights, terminal building and non-directional beacon.

Barrow - See project description following.

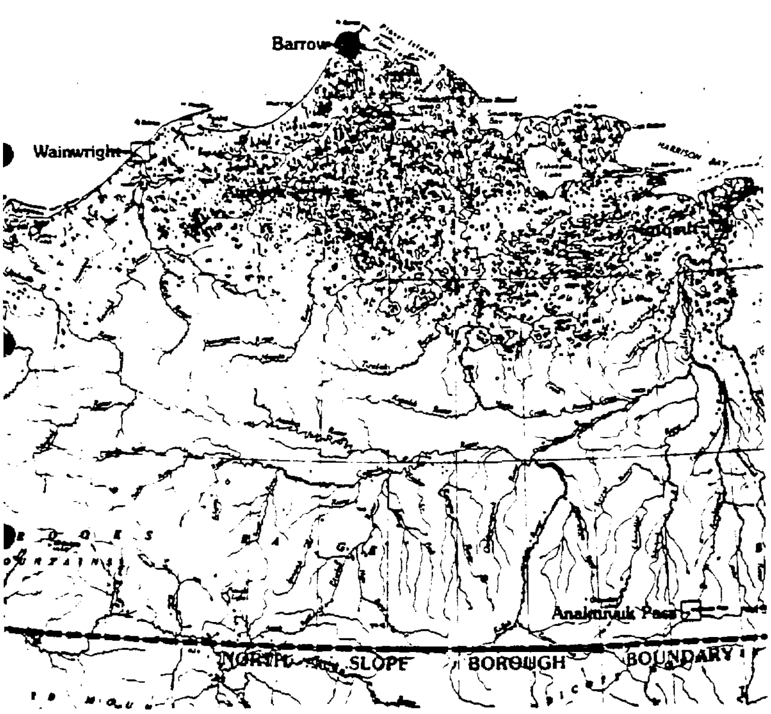
Kaktovik - The gravel runway is 5,000 feet long and capable of accommodating fully loaded C-130 Hercules. The facility has runway lighting and non-directional beacon. The facility is operated by the Air Force.

Nuiqsut - New airport under construction by Borough. Project includes 5,000 foot runway, taxiway and parking area, runway lighting, terminal building and non-directional radio beacon.

Pt. Hope - The Pt. Hope airport is owned by the State of Alaska and is maintained by the North Slope Borough. The airstrip is 4,000 feet long and can accommodate heavy aircraft.

Pt. Lay - The village of Pt. Lay has access to an adjacent Dew Line airstrip by agreement with the Air Force. The 3,500 foot strip is lighted and has a non-directional radio beacon.

Wainwright - See project description following.



Category:	Airports and Airport Facilities
Project: **51**	Barrow Airport Facilities (CIP Project No. 11-01)
Location(s)	Barrow, on the Chukchi Sea, 7.5 miles SW of Point Barrow
Time Frame	1983 - 1984
Sponsor:	NSB Capital Improvements Program
Contact/ Source	Irving Igtanloc Morrie Lemen. Sr. (907) 852-2611
Capital Costs:	**$7,** 596,000
Operations Costs:	**No** operations and maintenance at this time

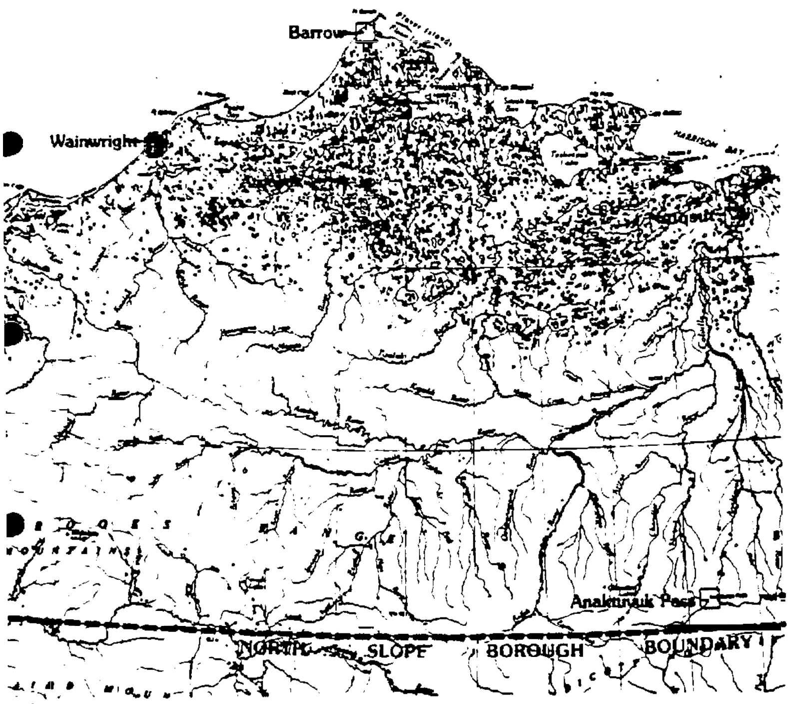
Employment Characteristics: **Local Non Local**

15 Local/8 Nonlocal

Project Description:

This project encompasses the construction of a hangar for the search and rescue helicopters and aircraft of the North Slope Borough. The facility also houses a maintenance shop, conference room, administrative offices, a communications center, and auxiliary power generator. The facility is protected by a sprinkler fire suppression system. The structure is to be a prefabricated metal building and is being constructed at the east end of the runway. It will be adjacent to the Borough shipping and receiving terminal and will contain approximately 12,672 square feet of floor space. The remaining facilities at the Wiley Post-Will Rogers Memorial Airport are State owned and operated. One exception is the Wien Air Alaska terminal which is owned by the airline itself. Smaller terminals in the complex are used by air taxi operators. The facilities at the airport are generally excellent and the Borough has no plans for becoming involved in its operation. However, the hangar being constructed at the airport for Borough search and rescue aircraft was found to be necessary for convenience purposes. The original hangar was located at NARL.

The Barrow airport has a paved east/west runway, 6,500 feet long, 150 feet wide, with 200 feet of unpaved overrun at each end. Aprons in the vicinity of hangars are paved.



Category: Airports and Airport Terminals

Project: 52 Wainwright Airport Upgrade (11-14) and Terminal Building (11-21)

Location(s): Wainwright, on the Chukchi Sea, 100 miles SW of Barrow

Time Frame: 1983 - 1989

Sponsor: NSB Capital Improvements Proc.

Contact/ Source: Irving Igtanloc, Morrie Lemen, Sr. (907) 852-2611

Capital Costs: $14 ,330,000

Operations costs: Not yet in operation

Employment Characteristics: **Local Non Local**

6-8 Local /1-2 Nonlocal during construction season.

Project Description:

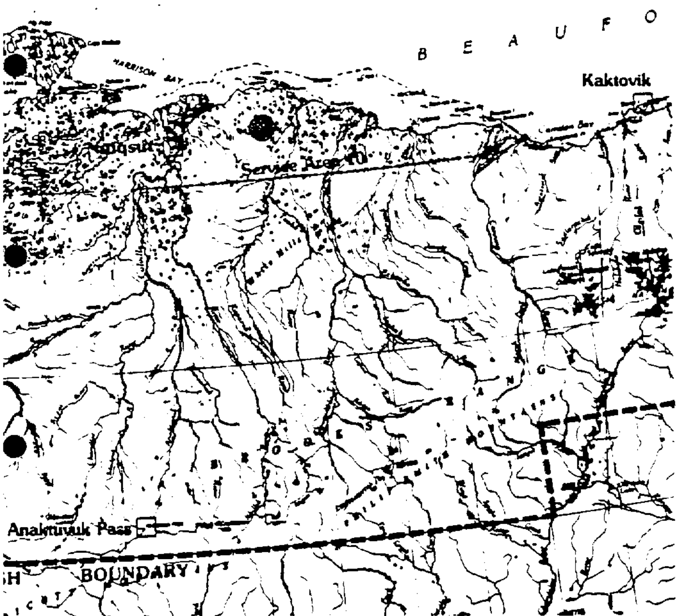
Presently, the airstrip at Wainwright is 2,200 feet long and was built by the State under their secondary airports program. Wainwright depends heavily on air travel for ‘both passengers and cargo shipments. Barges are able to service the village in the summer months, but ice restricts this during the winter. The current airstrip is not long enough to accommodate heavy cargo planes, thus winter ice strips are often constructed. These are expensive, however, and are not a permanent solution.

The Wainwright airport upgrade provides a new 5,000 foot runway. This is long enough to handle Hercules-type planes and their cargo deliveries. The airstrip will be 150 feet wide with a new taxiway of 900 feet by 70 feet. The runway apron is 550 feet by 350 feet. Incorporated within the new taxiway and off-loading area is the old air strip. Navigational aids and runway lighting are also included. Gravel requirements estimated at 300,000 cubic yards, will be acquired through dredging operations in Wainwright Inlet.

A new terminal i’s also planned for Wainwright. Warm storage, cold storage, an emergency generator, offices, and a waiting area will all be “housed in the 1,800 square foot facility. With the upgrading of the airport and the addition of the terminal, Wainwright's needs should be met through the foreseeable future.

5.15 LIGHT, POWER AND HEATING

The light, power and heating systems in North Slope Borough developments are among the most necessary and capital intensive facilities required for survival. The North Slope Borough Capital Improvements Program has recognized this need through a range of electric power and heating systems projects including the acquisitions of mobile generators for emergency use in the smaller villages, investigations of alternate energy sources and energy conservation measures, upgrading of bulk fuel storage, and land acquisition for new facility sites. Among the large scale special projects is the Kuparuk Industrial Center, a service base complex currently under construction. The facility is designed to provide rental office space and camp accommodations plus a range of utility services to industrial operators in the Kuparuk River oil field. The Industrial Center is being developed as a single unit with power and other utilities scaled to meet full projected demands. The initial phases of the project represent an investment of over $52 million in project improvements. The description of the Kuparuk Power generation project follows.



Category: Light, Power and Heating

Project: 53 Kuparuk Power Generation (13-71)

Location(s): 40 miles NW of Prudhoe Bay Facility

Time Frame: 1982 - 1984

Sponsor: NSB Capital Improvements Program

Contact/ Source Irving Igtanloc, Morrie Lemen, Sr. (907) 852-2611

Capital Costs: $7,630,000

Operations costs: $1,200,000

Employment Characteristics: **Local Non Local**

4 local personnel.

P'reject Description:

The Kuparuk Power Generation Facility is the power source for the whole of the Kuparuk Industrial Center. It contains four solar saturn turbines. two of which burn natural gas with the other two being multi-fuel turbines burning either natural gas or diesel. In addition to the multi-fuel turbines, which would burn diesel in emergency situations, there is an emergency back-up, 850 KW reciprocating generator. The natural gas diesel turbines and emergency backup generator will power essential life support systems and maintenance facilities at the camp.

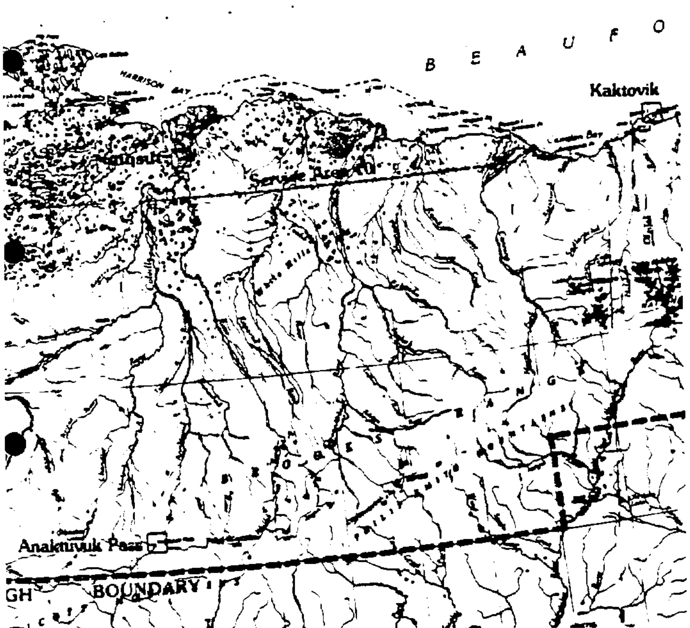
The Industrial Center requires approximately 1,000 KW per hour of power. The generation capacity of the solar turbines, not including the 850 KW generator, is 3,200 KW ground. The solar turbines are also equipped with heat recovery units which recover stack heat from the solar generators. This then provides glycol heat for the living quarters and industrial spaces within the complex.

The main fuel source for this complex is provided by ARCO's natural gas pipeline on Pad H Road. Should this supply be disrupted for any reason, an emergency stand-by diesel fuel supply will be utilized. Required loads may be operated on the two multi-fuel turbines with the 850 KW generator as back-up.

Also included in this project are portions of the utility structure's main power distribution lines and the main glycol lines for heat distribution.

5.16 SANITARY FACILITIES (Solid Waste)

As in the case of sewage disposal, solid waste collection, processing and disposal are complex problems due to climatic extremes on the North Slope. In an effort to deal with these environmental constraints, the North Slope Borough has provided special entities, Service Area 10 and the Kuparuk Industrial Park, to meet the sanitation and utility requirements in the Prudhoe Bay and Kuparuk industrial areas. Currently, the Borough provides water, sewer and solid waste services in Service Area 10. At Kuparuk, the Borough provides water, sewer, solid waste and power generation. The sizing of the service facilities and the timing of their construction or expansion has been directly linked to industrial demands. The North Slope Borough Capital Improvements Program has committed over $20 million toward the correction and upgrading of solid waste incineration and disposal capabilities in these industrial service areas. In the project descriptions that follow the characterization of the facilities reflects the experience gained from more than a decade of arctic industrial utility operations so important to successful development.



Category: Sanitary Facilities (Solid Waste)

Project: 54 Service Area 10 Expansion (15-15), Power Generation & Utilities Development (15-31)

Location(s) Close to Saganavirktok River, about 1 mile from Deadhorse Airport

Time Frame: 1981 - 1984

Sponsor: NSB Capital Improvements Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $39,442,000

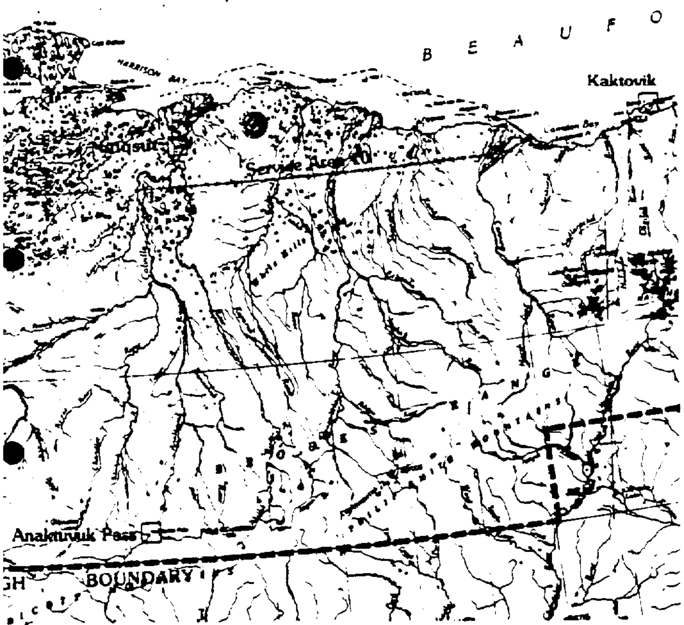
Operations costs: $172,400

Employment Characteristics	**Local Non Local**
11 - 13 Local/6 - 8 Nonlocal During Construction	4 local personnel during operations

Preject Description:

The original waste disposal system at the Service Area 10 utility complex has proven to be inadequate. The system has since been re-designee and now includes a larger shredder with accompanying conveyors. This is a small portion of the Power Generation and Utilities Development Project (CIP project no. 15-31). Also included is an evaluation of utility plant requirements, an evaluation of the master plan, the expansion of Tract 74 gravel pad, a road crossing for the sewage treatment plant effluent line, and a new boiler room with two new 4 million BTU/h cur oil fired boilers for back-up heat requirements. A number of other items complete the scope of this project including: the expansion of sewage and water treatment plants, the construction of an effluent pipeline, expansion of fuel oil storage, a dust collection system, plant offices, parts storage, stand-by generators, an electrical room, and the demolition of decommissioned incinerators, materials handling systems, heat recovery units and shredders.

The Service Area 10 Expansion project (CIP project no. 15-15) covers the addition to the regional utilities building. This is necessary to house the enlarged utilities systems. It will be accomplished in two phases. Phase I includes the foundation and ramp construction, electrical and fuel supply modifications,' and the supplies for both the building and a crane, plus their partial erection. Phase II completes the building, the electrical and mechanical systems, and installs the Basic 5000 incinerator with its electrical and mechanical systems. Funding also provides a fire protection system, a catwalk and cage safety addition, pollution control equipment, and a power monitoring system.



Category: Sanitary Facilities (Solid Waste)

Project: 55 Kuparuk Solid Waste (CIP proj. no. 15-36)

Location(s): 40 miles NW of Prudhoe Bay Facility

Time Frame 1983 - 1984

Sponsor: NSB Capital Improvements Program

Contact/ Source: Irving Igtanloc
Morrie Lemen, Sr.
(907) 852-2611

Capital Costs: $6,435,000

Operations costs: Not available at this time

Employment Characteristics: Local **Non Local**

No Local/5 - 8 Nonlocal
During Construction

Project Description:

The Kuparuk Solid Waste Facility provides a natural gas fired incinerator to handle the solid waste needs of the industrial camp. It is located in the utility building on site and handles a variety of waste types. These include waste paper and garbage from the service base operations kitchen, waste from dormitory facilities, and other non-industrial wastes generated in the camp. Oil and flammable wastes which may be created by tenants at the facility may also be accommodated.

Included in the development program are provisions for a structure and materials conveying system, a waste heat recovery system, a small lift on the loading facility and also on the material transport vehicles. A stack scrubber is included for compliance with EPA requirements. The solid waste project is a part of this overall utility facility and necessary to the development of the Kuparuk Industrial Center.

5.17 INDUSTRIAL PARK

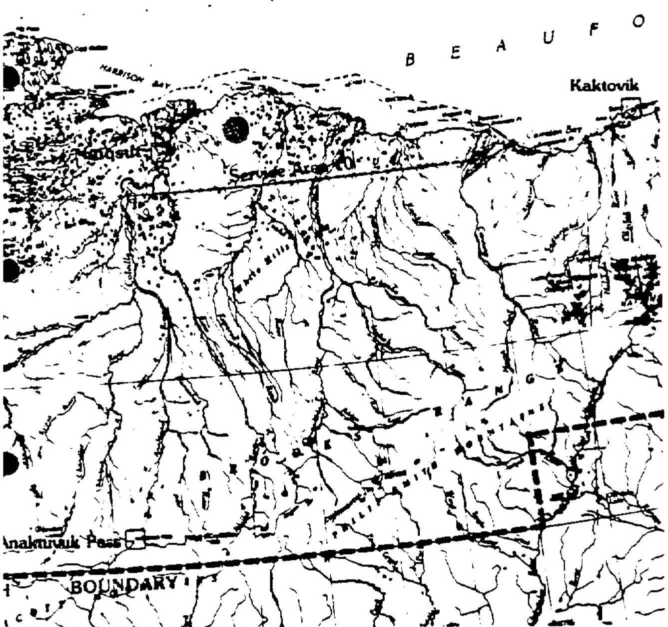
The North Slope Borough provides specialized facilities and services for two industrial areas within its boundaries, Service Area 10 extending throughout the Prudhoe Bay area, and the Kuparuk Industrial Center which is a service base complex currently under construction to serve the Kuparuk River oil field.

Approximately 900 wells are planned in conjunction with the development of this field. The North Slope Borough believed that the feasibility of using existing industrial service infrastructure at the remote Prudhoe Bay/Deadhorse Area was not viable. The Borough preferred a service base approach close to the Kuparuk development area.

The Kuparuk Industrial Center is presently under construction and has proceeded ahead of schedule . When complete, the facility will consist of a 55-acre gravel pad with developed roads; complete dormitory facilities, including kitchen and recreation areas; shop and warehouse facilities for industrial tenants; utility systems, including water treatment and distribution, sewage collection and treatment, electric power generation and solid waste incineration. Development costs will exceed $65 million.

Kuparuk Industrial Park

Project Element	Estimated Cost
Planning and Feasibility	$ 1,800,000
Industrial Park Phase I	11,142,000
Water Treatment	1,834,000
Sewage Treatment/Disposal	1,975,000
Power Generation	7,630,000
Solid Waste Disposal	6,435,000
Housing, Kitchen, Recreation Facility	13,490,000
Shop and Warehouse Facilities	25,660,000
	$69,966,000



Category:	Industrial Park
Project: 56	Kuparuk Industrial Park (CIP project no. 16-02)
Location(s)	40 miles NW of Prudhoe Bay Facility
Time Frame:	1982 - 1988
Sponsor:	NSB Capital Improvements Program
Contact/ Source:	Irving Igtanloc Morrie Lemen, Sr. (907) 852-2611
Capital Costs:	$11,142,000
Operations costs:	No operations and maintenance at this time

Employment Characteristics **Local Non Local**

Capital construction using contractors - no specific local/non-local data available.

Project Description:

Kuparuk Industrial Center Phase I provides a 55 acre gravel pad which includes 27 acres of rentable pad space, 18 acres of core pad for structures, and 18 acres for roads and parking. This is the basic starting package and the figures above reflect only this portion of the program. From here, through other capital improvement projects, housing, kitchen and recreational facilities will be provided to accompany a complete dormitory facility for 240 occupants (CIP project no. 16-08). Shop and warehouse facilities will also be provided (CIP project no. 16-09) including three 20,000 square foot arctic structures for heavy industrial use.

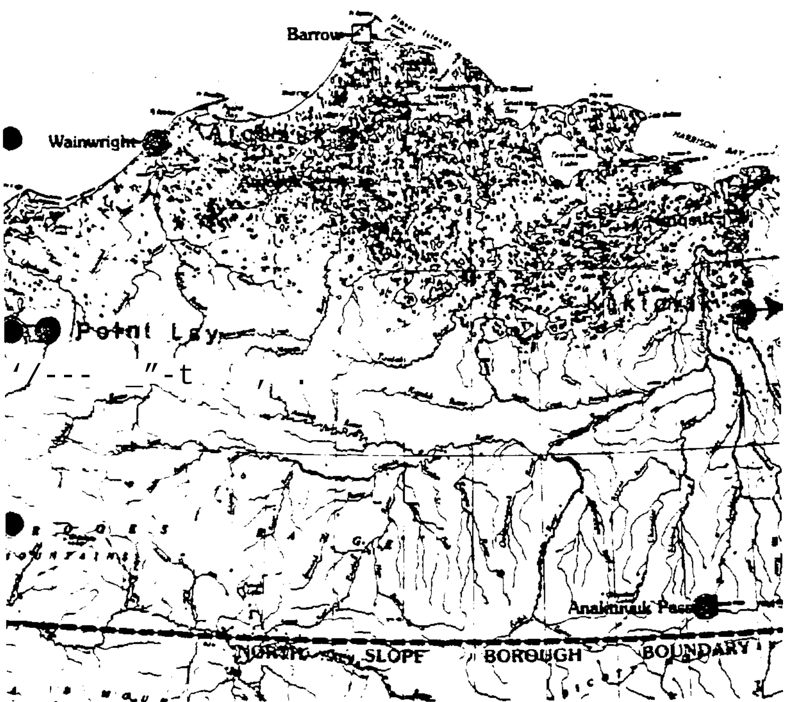
The development of utilities is another aspect of the industrial center, A 95 million gallon storage reservoir and water treatment plant to handle the needs of a 240 man camp is being developed in CIP project No. 09-35. A sewage treatment plant accompanies this (CIP project no. 10-33) and has a processing capacity of 50,000 gallons of domestic sewage daily. Also included is a power plant with a combined generation of 3,200 KW ground plus an 850 KW back-up generator (CIP project no. 13-71). Finally, an incinerator system for camp solid waste is included in CIP project no. 15-36.

The Kuparuk Industrial Center project emerged in response to the planred major developments of the Kuparuk Oil fields. It is being develcped as a single unit comprised of a variety of individual capital improvement projects. No other capital improvements projects are planned for this complex during the current six year CIP period.

5.18 HEALTH FACILITIES

In the North Slope Borough modern health clinic facilities are, or have been, constructed in each community outside of Barrow. Each facility is equipped with narrow band video telehealth equipment to further improve the quality of medical care available to village residents.

The new clinics are 50 x 88 foot structures providing 4,400 square feet of floor space. The clinic portion of the building includes four examination rooms, a laboratory, film processing room, a secured medicine storage room, a 15 x 29 foot waiting/training area, consulting/telehealth room, office space, toilet facilities and general storage area. The itinerant quarters of the facility include two double bedrooms, a kitchen/dining space combined with a general living area, and a bathroom. A garage/storage area provides protection for the sheltered transfer of patients between the ambulance and the clinic. One examination room has dental equipment and provisions for eye, ear and pediatric concerns. The Borough is also establishing a computerized diagnostic system that will tie into the Barrow Hospital, and the Public Health Service hospital in Anchorage. These facilities and technology represent an investment of $25 million by the Capital Improvements Program.



Category: Health Facilities

Project: **57** Health Facilities and Equipment (CIP project no. 19-20, 15-23, 19-25, 19-26 19-28)

Location(s): Areawide Clinic System - **6** villages

Time Frame: 1982 - 1985

Sponsor: NSB Capital Improvements Program

Contact/ **Source:** Irving Igtanloc Morrie Lemen, Sr. (907) 852-2611

Capital Costs: $25,191,000

Operations costs: $1,100,000 Annually

Employment Characteristics: Local Non Local

8 - 16 Local/1.5 Nonlocal Curing Construction

23 part-time local personnel during operations

Project Description:

A number of projects are planned for upgrading the health care facilities in six of the borough's smaller villages. CIP project no. 19-23 provides for modern health clinics in Atqasuk, Anaktuvuk Pass, Kaktovik, Nuiqsut, Point Lay and Wainwright. These new clinics include four examination rooms, a laboratory, secured medicine storage, film processing, consulting/telehealth; room, a 15 foot by 29 foot waiting/training area, offices and general storage. Also included in the **50 foot by 88** foot structure is a mechanical room and an itinerant area comprised of two double bedrooms, kitchen/dining, living areas and a bathroom. $7,000 in State funding has been appropriated for this project.

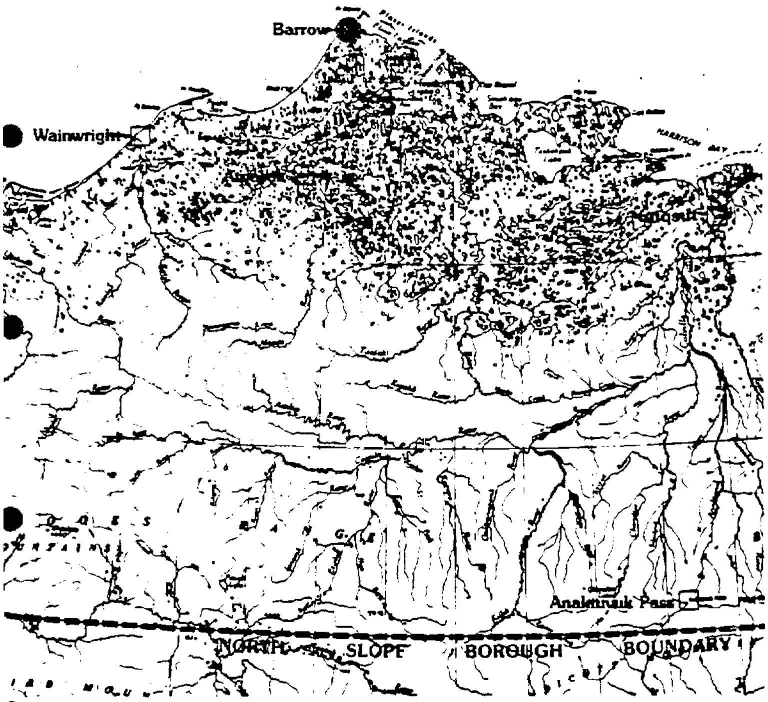
A narrow band video telehealth system (CIP project no. 19-25) is planned for Atqasuk, Anaktuvuk Pass, Kaktovik, Nuiqsut, Point Hope, Point Lay and Wainwright. Audio telehealth diagnostic and conferencing equipment will also be installed here. Both systems will be set up in the Barrow Hospital, the North Slope Borough Health and Social Services Administration Building, and in the Anchorage Public Health Service hospital. This will provide a link from the remote village to better improve health care quality through diagnostic and extent of injury confirmation and through step-by-step treatment instruction.

Three other projects are included in the health care package. CIP project no. 19-20 provides funding for the first phase of the computerized diagnostic system. CIP project no. 19-26 provides funding for an automated comprehensive patient record keeping system (PRKS). Funding for late billing received after project close out is provided under CIP project no. 19-28.

5.19 ADMINISTRATION

The existing North Slope Borough administrative building was completed in 1975 and is currently much too small to house all borough administrative employees. As originally designed, the facility contains 24,000 square feet of floor space consisting of offices and meeting rooms. Several Borough departments have had to find alternate accommodations n various buildings around Barrow.

Dealing with the inevitable inefficiencies brought the Borough to conclude that there was a need for a new administration building to be planned and built in three phases. Although still under design the new structure is expected to be a four story steel frame structure of 106,000 square feet. The details of internal functional space allocations are described in the profile following. Construction cost is estimated at $50 million for completion in 1986.



Category: Administration

Project: **58** Barrow Admin. Build. Replacement Phase I (22-01) Phase II (22-10) Phase III (22-11)

Location(s): Barrow, on the Chukchi Sea, 7.5 miles SW of Point Barrow

Time Frame: 1982 - 1986

sponsor NSB Capital Improvements Program

Contact/ **Source:** Irving Igtanloc, Morrie Lemen, Sr. (907) **852-2611**

Capital Costs: $48,740,000

Operations costs: Not in operation as of this date

Employment Characteristics: **Local Non Local**

No construction employment figures (construction to begin 1985).

Project Description:

The existing Borough Administrative Building is much too small to house all borough administrative employees, and several departments have had to find alternate accommodations in buildings around Barrow. The original structure was completed in 1975 and contains only 24,000 square feet of floor space. A new building is planned to be completed in three phases. When the new structure is completed, the existing facility is planned to be converted for use as a library and museum.

Phase I includes funding for the project's design and funding for related borough administration expenses. Phase II funding includes the purchasing and acquisition of materials. Phase III funding covers the facility's construction. The structure itself will have approximately 105,840 square feet of office space, 23,232 square feet of parking below the building (40 vehicle capacity), and is expected to be four stories in height. A 300 seat borough assembly/meeting room will be provided and all but 23,000 square feet of the available office space will be occupied by the Borough. The remaining office space will be leased to the State for the court system and administration offices.

APPENDIX A

INDIVIDUALS CONTACTED

Benton, David; Anchorage, Alaska

Canter, Larry; University of Oklahoma, Norman, Oklahoma

Carpenter, Richard; East-West Environment and Policy, Institute, Honolulu, Hawaii

Cattanach, Rory; Dome Petroleum, Ltd., Calgary, Alberta

Carley, Michael; Policy Studies Institute, London, United Kingdom

Coates, Vary; J.F., Coates, Inc., Washington, D.C.

Cortese, Charles; University of Denver, Denver, Colorado

Courtnage, Clyde; Alaska Consultants, Inc., Anchorage, Alaska

Dirschl, Herman; Indiana and Northern Affairs Canada, Ottawa, Ontario

Duffy, Partick; Federal Environmental Assessment Review Office, Hull, Quebec

Donihee, Hohn; Department of Natural and Cultural Affairs, Yellowknife, Northwest Territories

Fenge, Terry; Canadian Arctic Resources Committee, Ottawa, Ontario

Flynn, Cynthia; Social Impact Research, Inc., Seattle, Washington

Fuller, Stephan; Cordillera Environmental Projects, Ltd., Vancouver, British Columbia

Gamble, Don; Alaska Native Review Commission, Anchorage, Alaska

Golden, Fritts; Rogers, Golden and Halpern, Philadelphia, Pennsylvania

Horowitz, Michael; Institute of Development Anthropology, Binghamton, New York

Inglis, Julian; Indian and Northern Affairs, Canada, Ottawa, Ontario

Knapp, Gunnar; ISER, Anchorage, Alaska

Kolash, Karla; North Slope Borough, Barrow, Alaska

Kruse, John; ISER, Anchorage, Alaska

Lawrence, Charles; Social Impact Assessment Center, New York, New York

Lonner, Thomas; Anchorage, Alaska

MacLachlan, Letha; Dene Nation, Yellowknife, Northwest Territories

McPherson, Nancy; Yukon Conservation Society, Whitehorse, Yukon

Meehan, Rosa; U.S. Fish and Wildlife Service, Anchorage, Alaska

Mintz, Robert; Anchorage, Alaska

Moen, Elizabeth; University of Colorado, Boulder, Colorado

Pease, James; Oregon State University, Corvallis, Oregon
Porter, Alan; Georgia Institute of Technology, Atlanta, Georgia
Ralston, Sandra; University of Aberdeen, Old Aberdeen, Scotland
Rees, William; University of British Columbia, Vancouver, British Columbia
Simmons, Gail; Wm. Bergman Associates, Washington, D.C.
Smythe, Gillian; Alaska Consultants, Inc., Anchorage, Alaska
Stakhiv, Eugene; Institute for Water Resources, Ft. Belvoir, Virginia
Stoffle, Richard; University of Wisconsin-Parkside, Kenosha, Wisconsin
Stuart, David; Canstar, Oil Sands, Ltd., Calgary, Alberta
Vlachos, Evan; Colorado State University, Ft. Collins, Colorado
Wallis, Maria; Salve River Development Impact Zone Society, Fort Smith, Northwest Territories
Washington, Susan; Banff Centre School of Management, Banff, Alberta
Webber, Pat; Institute of Arctic and Alpine Research, Boulder, Colorado

The individuals contacted for each category of development projects are shown by section following.

5.2 Oil Development Projects

Alaska Department of Labor; Personal Communication with Neal Fried; 907-264-2400; regarding North Slope Employment.
Additional information was obtained from personal communication with the listed contacts for each project.

5.3 Announced Oil Discoveries/Potential Development Projects

Blair Wondzell, 1984, Alaska Oil and Gas Conservation Commission, Telephone Conversation and Meeting, Anchorage, Alaska.
Wayne Simpson, 1984, Shell Oil Company, Telephone Conversation, Anchorage, Alaska.
Ted Bond, 1984, Department of Natural Resources, Telephone Conversation, Anchorage, Alaska.
Bill Vandyke, 1984, Department of Natural Resources, Telephone Conversation and Meeting, Anchorage, Alaska.

Scott Ronzio, 1984, ARCO Alaska, Inc., Telephone Conversation and Meeting, Anchorage, Alaska.

Chat Chatterton, 1984, Alaska Oil and Gas Conservation Commission, Telephone Conversation and Meeting, Anchorage, Alaska.

Al Hastings, 1984, Conoco Incorporated, Telephone Conversation, Anchorage, Alaska.

Susan Just, 1984, Petroleum Information, Telephone Conversation, Anchorage, Alaska.

Kevin Waring, 1984, Kevin Waring & Associates, Correspondence, Anchorage, Alaska.

Renee Miller, 1984, Brinkerhoff Signal Incorporated, Telephone Conversation, Anchorage, Alaska.

5.4 Exploration Projects

Bill Vandyke, 1984, Department of Natural Resources, Telephone Conversation and Meeting, Anchorage, Alaska.

Max Brewer, 1984, Department of the Interior, Telephone Conversation, U.S. Geological Survey, Anchorage, Alaska.

Doug Fruge, 1984, Department of the Interior, Telephone Conversation, U.S. Fish and Wildlife Service, Fairbanks, Alaska.

Frank McCollum, 1984, Exxon Company USA, Telephone Conversation, Anchorage, Alaska

Mike Golas, 1984, Amoco Production Company, Telephone Conversation, Denver, Colorado.

Bruce Clardy, 1984, Sohio Alaska Petroleum Company, Telephone Conversation, Anchorage, Alaska.

Al Burnhardt, 1984, Alaska United Drilling, Telephone Conversation, Anchorage, Alaska.

Susan Just, 1984, Petroleum Information, Telephone Conversation, Anchorage, Alaska.

Hugh DePland, 1984, Sohio Alaska Petroleum, Telephone Conversation, Public Relations Department, Anchorage, Alaska.

Bill Thomas, 1984, Arctic Slope Regional Corporation, Telephone Conversation, Lands Department, Barrow, Alaska.

5.5 Future Oil and Gas Lease Sale Activity

Ted Bond, 1984, Department of Natural Resources, Telephone Conversation, Anchorage, Alaska.

Doug Fruge, 1984, Department of the Interior, Telephone Conversation, U.S. Fish and Wildlife Service, Fairbanks, Alaska.

Horace Sanders, 1984, Department of the Interior, Telephone Conversation, Bureau of Land Management, Anchorage, Alaska.

Maureen McCrea, 1984, Department of the Interior, Telehpone Conversation, Mineral Management Service, Department of Leasing and Environment, Anchorage, Alaska.

5.6 Active/Potential Gas Development Projects

Blair Wondzell, 1984, Alaska Oil and Gas Conservation Commission, Telephone Conversation and Meeting, Anchorage, Alaska.

Ted Bond, 1984, Department of Natural Resources, Telephone Conversation, Anchorage, Alaska.

Bill Vandyke, 1984, Department of Natural Resources, Telephone Conversation and Meeting, Anchorage, Alaska.

Ralph Andersen, 1984, North Slope Borough, Telephone Conversation, Office of the Mayor, Barrow, Alaska.

Max Brewer, 1984, Department of the Interior, Telephone Conversation, U.S. Geological Survey, Anchorage, Alaska.

Scott Ronzio, 1984, ARCO Alaska, Inc., Telephone Conversation and Meeting, Anchorage, Alaska.

Richard Gutleber, 1984, Department of the Army Corps of Engineers Alaska District, Telephone Conversation, Anchorage, Alaska.

Susan Just, 1984, Petroleum Information, Telephone Conversation, Anchorage, Alaska.

5.7 Other Resource Development Projects

Information was obtained by personal communication with the contacts listed for each project.

5.8 through 5.19 North Slope Borough Capital Improvements Program 1974-1989 -

Irving Igtanloc, 1984, North Slope Borough Capital Improvement Program, Telephone Conversation and Correspondence, Director of Public Works, Barrow, Alaska.

Morrie Lemen, Sr., 1984, North Slope Borough Capital Improvement Program, Telephone Conversation and Correspondence, Department of Public Works, Operations and Maintenance, Barrow, Alaska.

Keith Livingstone, 1984, North Slope Borough Capital Improvement Program, Telephone Conversation and Correspondence, Department of Public Works, Barrow, Alaska.

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Alaska Consultants, Inc. C.S. Courtnage, and Stephen Braund & Associates. 1984. Barrow Arch socioeconomic and sociocultural description. Report for Minerals Management Service, Alaska OCS Region, Anchorage. Technical Report No. 101.

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________ 1981. St. George Basin petroleum development scenarios, local socioeconomic systems analysis. Report for Peat, Marwick, Mitchell & Co. and Bureau of Land Management, Alaska OCS Office, Anchorage. Technical Report No. 59.

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Arnold, R.D., et al. 1978. Alaska native land claims. The Alaska Native Foundation, Anchorage, AK. 367 pp.

Bayly, J.U. (for) Dene Nation. 1983. An example from the Normal Wells experience: 'handling and storage of fuels, "lubricants and other toxic substances, including spill contingency plans. Beaufort Sea Environmental Assessment Review Panel, Yellowknife, NWT.

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Canada, Government of. Environmental Assessment Panel. 1981. Norman Wells oil field development and pipeline project. Federal Environmental Assessment Review Office Report No. 16, Vancouver, B.C.

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Carpenter, R.A. et al. 1983. A summary of work on natural systems assessments with economic valuation. East-West Center, Environmental and Policy Institute, Honolulu, HI.

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