The Mackenzie Delta–Beaufort Sea Region

In the preceding chapter, I dealt with the impacts of a pipeline carrying Alaskan gas destined for American markets across the Northern Yukon to the Mackenzie Delta region. In this chapter, I intend to deal with the impact of a pipeline across the Mackenzie Delta and in the Delta region, and the related impact of oil and gas exploration and development in the Delta itself and offshore in the Beaufort Sea.

The Mackenzie Delta and the Beaufort Sea together constitute an area of great importance and sensitivity for wildlife, birds and fish, an area where the land, the water and their renewable resources are still necessary to the life and culture of many native people. The impact of the construction of the pipeline across the Delta will be significant, but even more significant will be the oil and gas exploration and development that will be associated with, and that will follow, the pipeline. There appears to be a major petroleum province in the Delta-Beaufort area. What we do now will largely determine the impact that the development of this province will have on the environment of the region.

I intend, therefore, to discuss at some length the impact that the pipeline and related activities will have on the Delta-Beaufort region, because here the exploration and development activity generated by the pipeline will be most intense.

Arctic Gas propose to lay the pipeline from Alaska across the outer part of the Mackenzie Delta. Both Arctic Gas and Foothills propose to build a pipeline southward from the Richards Island area. Whatever route the pipeline follows will cause major environmental concerns in the Mackenzie Delta region.

The gas plants and the gas gathering lines associated with them will be built in the Delta area by the producer companies, Imperial, Gulf and Shell, not by the pipeline companies, but these plants and gathering lines are so obviously part of the pipeline system that any consideration of the impact of the pipeline must include them as well. After all, if the right-of-way for the gas pipeline is not granted, the gas plants and gas gathering systems will not be built.

The Pipeline Guidelines foresee a whole group of activities within a corridor. If there are pipelines running along an energy corridor from the Arctic to the mid-continent, then there will be a further extension of oil and gas exploration and development into the Beaufort Sea. In fact, Robert Blair, President of Foothills, told us that if a pipeline is built, its principal long-term result will be enhanced oil and gas exploration activity. Roland Horsfield, a spokesman for Imperial Oil, agreed. The Pipeline Guidelines require us to assume that an oil pipeline would follow a gas pipeline across the Northern Yukon, across the Delta, and from the Delta to the South.

The Department of Indian Affairs and Northern Development will assess proposals to build gas gathering lines and gas plants and will determine the extent to which drilling for oil and gas should be allowed in the Mackenzie Delta and the Beaufort Sea. It is up to the National Energy Board to determine the extent of the reserves of oil and gas in the Delta and the Beaufort Sea. But this Inquiry, if it is to do its job, must assess the impact of exploration and development that would follow approval of a pipeline, and explore the penumbra of environmental and social issues that surround such activities. It is from this perspective that the Inquiry must determine the impact that a gas pipeline would have and recommend the terms and conditions under which a right-of-way should be granted, if a pipeline is to be built.

The pipeline cannot be considered in isolation. The environment of the North, the ecosystems of the North, are continuous and interdependent. They cannot be divided. Similarly, we cannot understand the consequences industrial development would have by hiving off a convenient component of it, and examining it in detail, while ignoring the broader implications of the whole range of its effects.

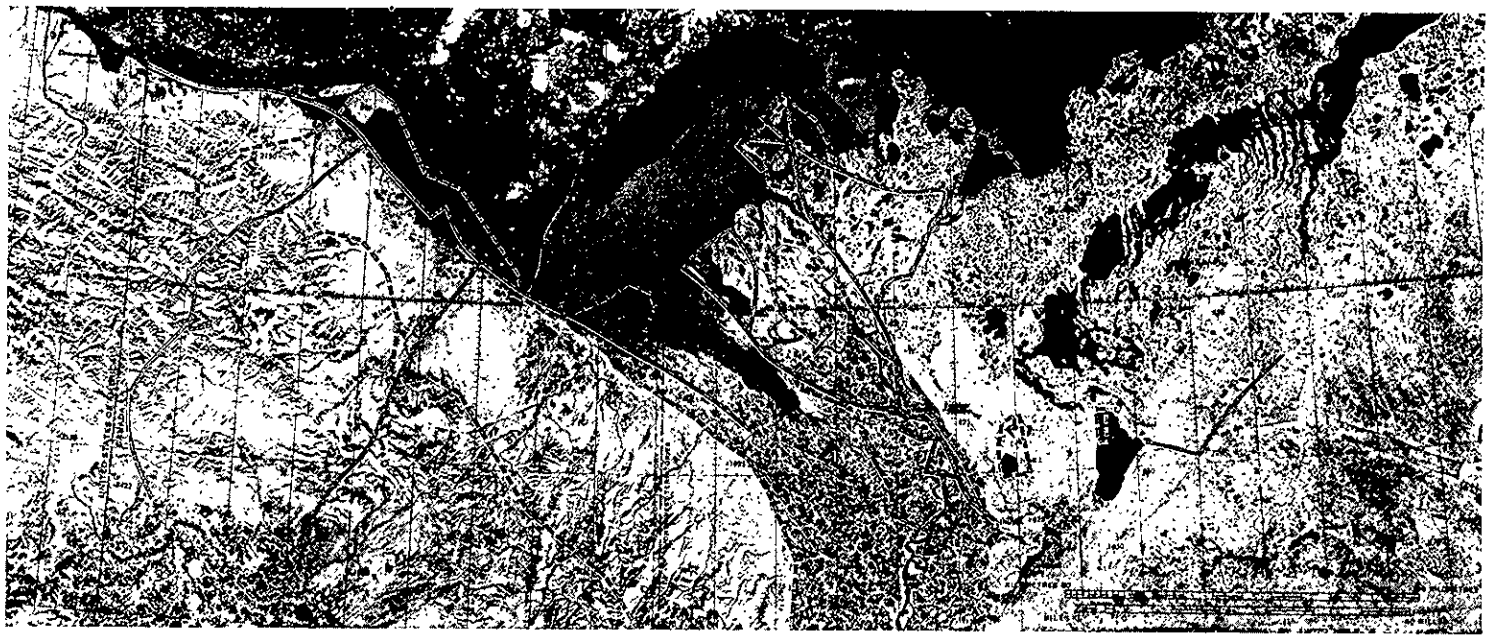
Canada has chosen to pioneer offshore oil and gas exploration in the Arctic. We are in advance of other circumpolar nations on this geographical and technological frontier. The pipeline, once built, will stimulate yet more oil and gas exploration offshore and it will lead toward full-scale development and production in the Beaufort Sea itself.

Canadians have a grave responsibility in this matter. There can be no doubt that the other circumpolar powers – the United States, the Soviet Union, Denmark and Norway – will follow us offshore. What we do there – the standards we set and our performance – will be closely watched.

Man and the Land

The Inquiry held its first community hearing in Aklavik. We went there in early spring, when the nights were still dark and the days were crisp and clear with cold.

While we were at Aklavik, I visited Archie Headpoint's camp, six or seven miles out of town. To get there we drove along the West Channel of the Mackenzie River. (Once the channels have frozen, one pass with a bulldozer will clear an ice road.) Headpoint's



cabin was just above the bank of the Mackenzie. Out on the ice, in the middle of the channel, we could see one of Shell's seismic exploration camps, a series of trailers on runners.

Archie Headpoint's camp is a collection of small, cluttered buildings. In his log cabin, where he and his family have lived for a long time, the skins of muskrats hung to dry. We sat there for a while, talking and drinking tea.

The contrast between the old Arctic and the new, between the northern homeland and the northern frontier, could be seen in the few acres around that cabin. There, the landscape is crisscrossed by seismic trails and vehicle tracks that seem to come from nowhere and to go nowhere – all this right alongside the ponds where the Headpoints have always hunted muskrats in the past. The Headpoints complained that the land was no longer as productive as it had been, that the seismic trails extending from the West Channel up into the foothills of the Richardson Mountains had blocked the streams and polluted the ponds.

Following our visit to Headpoint's camp, we had lunch at the seismic exploration camp. There we met engineers and technicians, men devoted to the task of finding oil and gas – men seeking to make the northern frontier productive for the South. The camp was laid out in neat rows. Its colour – bright orange – contrasted sharply with the cold blue-white of the landscape.

There, above the Arctic Circle, just half a mile from each other, were the two Norths side by side – the North of Shell Canada, with its links to the South and the markets of the world, and the North of Archie Headpoint, with its links to the land and to a past shared by the people who have always lived there.

Can these two Norths coexist in the Mackenzie Delta and the Beaufort Sea? Or must one recede into the past, while the other commands the future? This issue confronted us in the Delta communities – Aklavik, Inuvik and Tuktoyaktuk – and at Fort McPherson and Arctic Red River. And the same issue confronted us at the Inuit settlements on the shores of the Beaufort Sea. I held hearings in all of these places, too: Sachs Harbour, Holman, Paulatuk and North Star Harbour. These settlements are far from the route of the proposed pipeline, but oil and gas exploration in and around the Beaufort Sea concerns the people who live there, because they depend on the fish, seals, whales and polar bears for which the Beaufort Sea is vital habitat.

We may sometimes think that the history of the Delta began with Mackenzie's arrival in 1789, or with the establishment of Inuvik in 1955, or even with the coming of oil and gas exploration in the 1960s. But there were native people in the Delta region when Mackenzie arrived – and they had been there for thousands of years.

Mackenzie's expedition extended the fur trade down the whole length of the Mackenzie River, but the fur trade was conducted on a regular basis in the Delta region only after the establishment of Fort McPherson, on the Peel River in 1840. First the Dene and later the Inuit traded there.

The Dene of the region hunted and trapped during the winter in the Richardson and Ogilvie Mountains, then brought their furs to Fort McPherson in June. They spent the summer at fish camps in the Delta, then returned to Fort McPherson in the fall to trade their dried fish; after that they went back to the mountains for the winter.

It is estimated that there were about 2,000 bowhead whales in the Beaufort Sea before the turn of the century. In 1889 the American whaling fleet, sailing from San Francisco, entered the Beaufort Sea, and they returned each year until 1912. During those 23 years, about 1,500 bowhead whales were killed in Canadian waters. The stock of whales in the Beaufort Sea was virtually exterminated and today only 100 or 200 bowheads summer there.

The Eskimos supplied the whalers with meat, which brought very great pressure to bear on the caribou. Dr. Arthur Martell of the Canadian Wildlife Service believes this pressure drove the Bluenose caribou herd away from the Delta. According to Knut Lang, after the whaling period the native people of the Delta had to travel far inland to hunt caribou. In the late 1920s, caribou began to reappear in the foothills west of the Mackenzie Delta. Until about 10 years ago, the Bluenose herd used to stay east of the Anderson River, but now it appears to be returning to the range it used to inhabit in the Delta region. Since the 1960s, the herd has been expanding westward toward the Mackenzie River.

Not only the caribou of the Delta were affected by the Eskimos, hunting for the whalers. By the early 1900s, the muskoxen were extirpated from the Delta region, and the western boundary of their range lay to the east of the Anderson River.

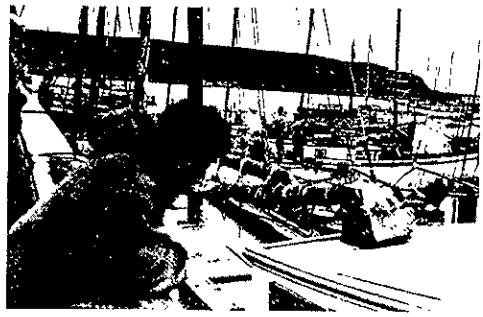
With the collapse of the whaling industry – and with the disappearance of the bowhead, muskox and Delta caribou – the fur trade resumed its role as a vital part of the Inuit economy and the source of guns, ammunition and other trade goods on which they had come to rely. With the rising prices for fur, particularly for white fox, and the emergence of muskrat as an important commercial fur, the Mackenzie Delta became an important centre of the fur trade. In 1911,

The traplines (——) and principal hunting and fishing areas (------) of Ishmael Alunik, in the Northern Yukon and Mackenzie Delta.

The whaling vessel S.S. Belvedere *in Franklin Bay, NWT, 1912.* (Public Archives)

Baleen on board schooner North Star, *Bernard Harbour, NWT, 1915.* (Public Archives)

Herschel Island Harbour, 1930. (Public Archives)



Aklavik was established at a natural camping place in the Delta, which further encouraged the harvesting of muskrats. By the early 1920s, the prices of both muskrat and white fox had increased 20-fold over what they had been at the turn of the century. The Delta trappers, harvesting muskrats by the hundred thousands, attained unprecedented prosperity. Many families bought their own schooners. But in the mid-twenties, high fur prices and an increasing number of both white and Alaskan Inuit immigrant trappers led to overharvesting in the Delta and an expansion of the Inuit trapping areas. Some Inuit moved to Banks Island, where white fox were abundant, and established what has since become the thriving trapping community of Sachs Harbour.

The Delta people remember the 1920s as a period of good times, when the relationship between man and the land was productive. We must remember that, although trapping fur for sale was important, it was, and is, only a part of the native economy. Then, as now, country food – caribou, seal, whale, polar bear, fish, goose – constituted a vital part of the native people's diet.

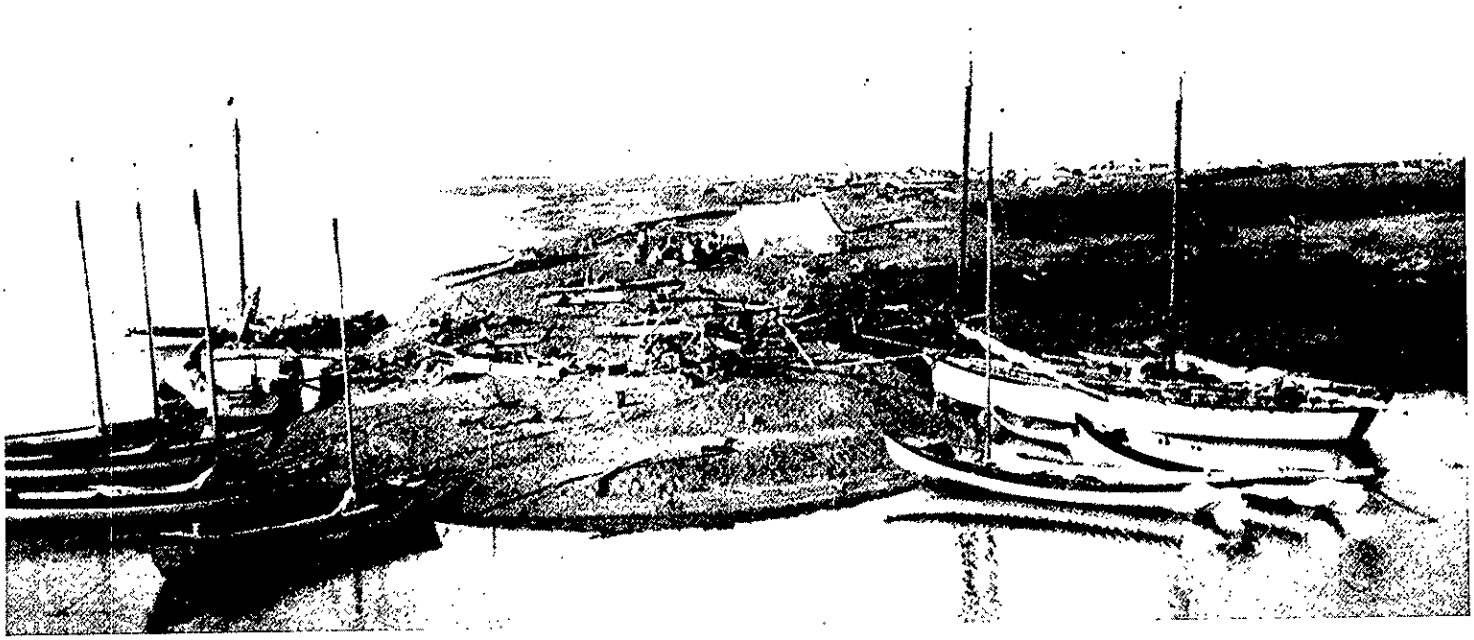
In pursuit of both fur and food, the people of the Delta travelled long distances. It may sometimes be difficult for us in the South to comprehend the vastness of the areas covered by a hunter-trapper and his family in the North. Ishmael Alunik, President of the Hunters and Trappers Association of Inuvik, described for the Inquiry his use of land during this period. It is representative of the experience of many Delta Inuit:

> I was born in the Yukon, and that country we always call it "Myloona;" that means "where I hunted." ... I used to go to the Crow Flats and I used to hunt rats. I was quite a small kid ... but I started hunting when I was about four years old. Not very big, you know, could just pack a trap; then my grandparents used to come to the Crow Flats. This is the way they used the land before my parents, and my parents used the land there too. ... We made friends with the Indians. Because I was born there, I was just like one of them. I hunted all along [the Yukon] coast for white foxes, some place along there we hunted seals. ... There was another river that is called Malcolm River. I hunted caribou around there and I used this Firth River quite a few times to go to hunt [and to] fish. They call it Fish Hole there. ... I went back to Aklavik to go to school in 1936. After I got married I went down there [along the Yukon coast]. I had a camp around King Point and I hunted all along this coast and right here [at Shingle Point]. I trapped out in the sea where the ice doesn't go away; and then all around them years I was hunting right close to the mountains, right to Babbage River where the Fish Hole was, and then this part here, where the mountains are. It looks like it was an unwritten boundary, you know, unwritten law where the Indians and the Eskimos hunted long ago. The Eskimos, the way my grandparents told me, they used to hunt up that way but they don't go across the mountains where the Indian people live. It was just like an unwritten law in between there. ...
>
> We hunted rats on the west side right to Aklavik. ... We used these rivers in summertime for most all them rivers in the Delta got fish in them, and we used them rivers just only in summertime mostly when we travelled from Kendall Island. I went there about two years and I hunted down there to [Pelly] Island. ... I hunted geese around here. ... We went up by the East Channel, and from there again the hunting places they used this for hunting whales. Then another part around there we hunt rats along there inland across Tununuk. Finally in later years I had a cabin right here before I moved to Inuvik. Then from there I hunted from Reindeer Station. I used this trail ... I trapped way up here for marten. While I was at Reindeer Station, I put fish nets along some lakes, there, right to Parsons Lake, I get whitefish, crooked backs and other little blue herrings. Then from there I went hunting caribou [in the Richardson Mountains, near] Fish Hole. [C3769ff.]

Land use patterns have changed in the last 20 years, as the people moved from their camps into settlements, but there is a clear continuity between past and present native land use. Muskrats are still important. At Fort McPherson and Arctic Red River, the spring "ratting" season pulls everyone down to the Delta or the Travaillant Lake area. In spring, Aklavik is nearly abandoned because its people are out hunting muskrats, and many wage-earners in Inuvik leave their regular jobs to participate in the hunt. As Annie C. Gordon said at Aklavik:

> At this time of the year [April], the people go out trapping muskrats, and in May and June the people go out to their spring camps. Some stay until June 15 and some come back early. At this time when they are out, they hunt muskrats. It's a good thing, it is a good living, it is good living out there. Every year we go out with the children. We always say that we are going to stay in town for the spring, but when spring comes we always end up going out. We take the whole family out, and sometimes we take other children to enjoy it with our family. It's fun out there. Sometimes we take the whole family out on a hunt, just to go out for fun, and they enjoy doing it. The country is so nice in the spring, it's so quiet. It's hard work when the hunters come back, when you're skinning muskrats. But I enjoy doing that kind of work, and it's fun when you go out and shoot muskrats all night. [C122ff.]

The Delta area is still extremely important for domestic fisheries. An important commercial fishery is located at Holmes Creek on the East Channel, and most of the catch is sold in Inuvik. Native families have fishing camps throughout the Delta, especially around Aklavik. I visited many of these camps, where families spend the summer,



catching fish and drying them for winter use.

I visited Whitefish Station, where native families, many of them from Inuvik, spend the summers harvesting the white whales and preparing the meat for the winter. I visited Holman in winter and watched some recently killed caribou being divided up. At Paulatuk I saw frozen char and caribou stored on the roof of every house.

The Inuit of Tuktoyaktuk, Paulatuk, Sachs Harbour, Holman and Coppermine hunt ringed and bearded seals in the Beaufort Sea, Amundsen Gulf and Coronation Gulf. At Holman – which alone takes as many as 8,000 seals a year – Jimmy Memorana spoke of the importance of the seals to the Inuit:

> ... they are the food of the people and they are the income of the people, and they use [those] seals all year around, for food and for cash. [C3986]

Frank Elanik of Aklavik spoke of the importance of the caribou to the native people, Inuit, Dene and Metis:

> My family eat about 30 caribou a year.... If I had to buy from the Bay, I don't know how I would live. [C24]

Mark Noksana of Tuktoyaktuk spoke of the importance of the whales in the Inuit diet:

> ... the muktuk we [have] eating whales, we can't go without it. If we go without it ... we can't feel good. [C4398]

There is, then, in the Delta, a concentration of concerns, a compression of the social, environmental and economic forces at work elsewhere along the route of the pipeline and the corridor. There in the Delta, and extending into the Beaufort Sea, is a uniquely productive ecological system, a system that is vital to the native people.

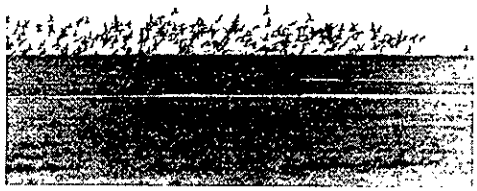
Region and Environment

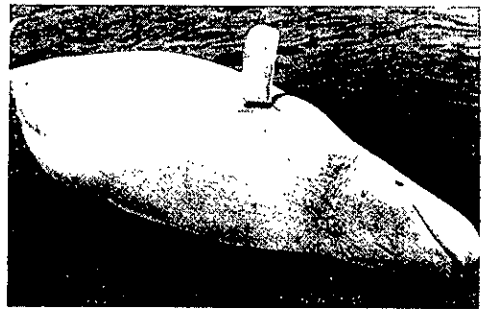
To understand the impact of pipelines and of oil and gas exploration and development in the Mackenzie Delta and the Beaufort Sea, we must have some knowledge of the geography of the three areas in the Delta-Beaufort region: the Mackenzie Delta itself, the Delta region, and the Beaufort Sea.

The Mackenzie Delta (hereafter referred to simply as the Delta) is a maze of islands, channels, lakes and swamps. It is forested except for tundra areas along the coast. In spring, the flood waters of the Mackenzie River cause break-up in the Delta and around the channel mouths earlier than in adjacent parts of the Beaufort Sea. In summer, the warm, turbid river water flows out beyond the Delta in a layer over the colder and denser sea water. Thus, the Delta region has a warmer summer and longer season of open water than the areas just east and west of it. The Delta itself may be likened to a huge, wet sponge. It is one of the most productive areas for wildlife in the Canadian Arctic, supporting innumerable muskrats and substantial populations of other furbearers, such as beaver, mink and marten, as well as fox, bear, moose, and a variety of small mammals. The channels and lakes of the Delta abound with fish. In summer, many thousands of waterfowl and other birds pass through the Delta or nest there. White whales calve in its warm waters. Because of these natural features, the Delta is of special significance to the native people of Aklavik, Fort McPherson and Inuvik, and even of Arctic Red River and Tuktoyaktuk, for trapping, hunting and fishing. The entire Delta lies within a few feet of river level or sea level, and much of it is subject to periodic flooding. The sponge-like nature of the Delta means that waterborne pollution would have far-reaching effects on the Delta, its wildlife, and its people.

The area described here as the Delta region is a largely treeless lowland extending some 100 miles eastward from the Mackenzie Delta, and it includes the area around Tuktoyaktuk, the Eskimo Lakes and Cape Bathurst. This area, which is used extensively by the people of Tuktoyaktuk, supports Canada's only reindeer herd. The Bluenose caribou herd at the northwestern limit of its present range occupies the southern fringe of the area. Arctic fox is an important furbearer in this area, and the coast of the Delta region, like the Delta itself, supports tens of thousands of migratory waterfowl and shorebirds in summer. There are freshwater fish in coastal bays, and white whales spend the summer in the warm waters that border the Delta region and particularly the Delta itself.

In winter, the Beaufort Sea is completely ice covered. A zone of land-fast ice extends outward from the shore for some tens of miles, and is separated from the moving polar pack ice by a narrow shear zone characterized by rapidly deforming, heavily ridged and irregular ice. This zone contains leads of open water in winter, and in spring becomes a belt of discontinuous open leads hundreds of miles long. In summer, the land-fast ice melts, and the polar pack retreats farther offshore, in some seasons to the general vicinity of the edge of the continental shelf. Within the Beaufort Sea region, the principal area of environmental concern is the shear zone and the open leads at the edge of the land-fast ice. This area provides critical habitat for migrating birds in the spring and for polar bears and seals in both winter and spring.





Inuit schooners and whale boats at Kittigazuit, NWT, 1923. (Public Archives)

Flock of shorebirds. (G. Morrison)

Ibyuk Pingo near Tuktoyaktuk. (D. Mackay)

White whale hauled ashore for butchering. (W. Hunt)

Wildlife

FISH

Although fish are present in the streams, lakes and coastal waters throughout the Delta region, they are most abundant and most important for local people in the Delta itself. Native people catch fish for domestic use at many locations within the Delta and in the streams and lakes tributary to it. As some indication of the importance of this resource, the community of Aklavik consumed approximately 294,000 pounds of fish in 1973. The largest commercial fishery in the lower Mackenzie Valley is at Holmes Creek in the Delta.

About a dozen species of fish occur in the Delta, including broad and humpback whitefish, inconnu, cisco, pike, chub, burbot, sucker, grayling, lake trout and arctic char. They live in the main river channels, bays at the river mouth, and small channels and lakes throughout the Delta. Some populations of fish simply pass through the Delta on their way to the sea or to locations back upstream. Others spend most of their life cycle in the Delta. Unfortunately, because of the turbidity of the water, the multitude of channels and small waterbodies, the large size of the main channels and the long period of ice cover, there are critical gaps in our information about these fish resources, and we need that information to assess properly the impact of industrial development on the Delta. There are few details available concerning the location and timing of critical life situations, such as spawning, overwintering and migration, in which the fish populations are at greatest risk from industrial activities.

BIRDS

The Delta, the coast of the Delta region, the coastal waters and the offshore leads of the Beaufort Sea are of very great importance for migratory birds. Every spring millions of geese, swans, ducks, gulls, terns and many other species converge on the Delta-Beaufort region from wintering grounds in Southern Canada, the United States, South America and even the Antarctic. They are an international renewable resource that nature, political boundaries and treaties have made the responsibility of Canada.

In its ornithological relationship to other regions in the Western Arctic, the Delta has been described as a huge funnel. It attracts birds from literally every point of the compass, from Banks Island, Anderson River, Liverpool Bay, the north slope of the Yukon and Alaska, and by way of the Mackenzie Valley from the prairies and Central and South America. Although the Mackenzie Valley is a major flyway, birds also migrate east and west along the Arctic coast of the Beaufort Sea. For example, there is a spectacular spring migration of ducks from the Pacific Ocean, along the south shore of the Beaufort Sea and past the Delta, following the leads in the ice. These leads of open water are crucial habitat for resting and feeding. The coastal bays and lagoons, barrier beaches and islands offer vital nesting and moulting grounds for the birds arriving from all directions.

Dr. Tom Barry of the Canadian Wildlife Service estimates that two million migrating seabirds and waterfowl, representing about 100 species, frequent the Beaufort Sea and its coastal margins. The Mackenzie Delta itself offers nesting ground for a waterfowl population that ranges from 80,000 to 350,000. As I described in the preceding chapter, several hundred thousand snow geese pass through the area in spring and fall, and in some years they use the outer Delta for staging. Spring leads in the ice of the Beaufort Sea at places like Cape Dalhousie may be occupied by 50,000 or more birds at a time. A week later those birds will have moved on, and tens of thousands more will be occupying the same lead. During one fall migration period, from July 10 to September 17, 1972, 240,000 birds, representing more than 50 species, were recorded passing Nunaluk Spit on the north coast of the Yukon. The vitality of the whole region is obvious.

Another area of critical importance for waterfowl and other birds is the outer, treeless part of the Mackenzie Delta, including its bordering bays, inlets and channel mouths. This area is used extensively by nesting and moulting ducks, swans, cranes and various other species, including a small colony of snow geese. In some years, when there is early snow on the Yukon Coastal Plain, the Delta edge serves as the principal fall staging area for the migrating snow geese. I will recommend that this entire area be protected by bird sanctuaries.

MAMMALS

The variety of habitat in the Delta-Beaufort region supports a broad range of mammals, from lemmings to whales. These varied animals have a correspondingly varied sensitivity to industrial development. Many of the mammals could tolerate industrial intrusion, but for others, such activities would be intolerable, and a serious decline in these populations could be anticipated. Perhaps I can explain this diversity by citing a few examples.

The white whales of the Beaufort Sea depend on the warm, shallow waters of Mackenzie Bay. Every summer the whales concentrate there to give birth to their

young. These mammals are wary of man, and if they are disturbed at this time, a year's calves could be endangered or lost. Offshore oil and gas activities within the whale concentration areas during the summer could ultimately lead to a decline in the whale populations. I therefore give special attention to them in this chapter and recommend that a whale sanctuary be established to protect their principal calving area.

Grizzly bears and polar bears are widely distributed in the Delta-Beaufort area. Although their numbers are relatively small, they range over large areas. They are attracted by camps and waste disposal sites, and encounters with man often result in the death of the bear. This kind of encounter, together with the disturbance of denning sites in winter, are threats to the bear populations of this region.

The muskrat is the most important economically of the aquatic furbearers in the Delta region. I have already described the importance of these animals to the native people. The Delta provides abundant habitat for muskrats, so disturbance would have to be widespread before it affected the whole population. Although locally vulnerable, these aquatic furbearers have the potential for relatively rapid recovery and will recolonize disturbed habitats that have not been permanently spoiled. Because of these adaptive features, there appears to be no need for concern over their long-term welfare, so long as short-term damage to habitat is corrected. However, in some areas where they have been traditionally harvested, short-term and local depletion could affect the economic well-being of trappers.

A semi-domesticated reindeer herd ranges east of the Delta. This herd was introduced into the area in 1935, and now its 5,000 animals are managed by local native people as a renewable resource. The herd's range and its seasonal movements have been manipulated by man, so the effects of industrial development may be expected to be less critical to the reindeer than to caribou.

The Bluenose caribou herd ranges east and south of the Delta region. Present oil and gas activity touch only the edge of this herd's range, but successive industrial development, combined with current northwestward expansion of the herd's range, may impose some constraints. But this again is a minor impact, and in marked contrast to the impact that the pipeline and energy corridor would have on the Porcupine caribou herd on its calving grounds in the Northern Yukon.

I think that these few examples indicate that the mammals of the Delta-Beaufort region will respond differently to industrial development. Some, like the white whales, will be very vulnerable at certain times and places. Others, like the muskrats, reindeer and caribou, may be affected but not threatened. This distinction is important because it dictates how impacts should be controlled. In some cases, a species can be protected effectively only by prohibiting industrial activity in critical areas, but in other cases regulation of industrial development may be adequate. The critical consideration in each case is the degree of biological sensitivity.

Biological Sensitivity

THE FOOD CHAIN

Although arctic ecosystems have been described as sensitive, or even fragile, I think it is more accurate to say that they are vulnerable. At the beginning of this report, I quote Dr. Max Dunbar to explain this idea of vulnerability and how it relates to the small number of species in the Arctic and to simple food chains.

The sensitivity of wildlife in the Delta-Beaufort region is not determined simply by assessing the direct effect of industrial impact on large and conspicuous species like the white whales. Dr. Norman Snow of the Department of Indian Affairs and Northern Development reminded the Inquiry that the highly visible components of the ecosystem – the birds, mammals and fish – represent only about five percent of the animal kingdom. The other 95 percent is composed of invertebrates, some of them microscopic in size but exceedingly numerous. These populations are the crucial links in many food chains, and on them the whole ecosystem, therefore, depends.

Biologists who testified before the Inquiry were careful to explain that, despite the relative simplicity of arctic food chains, their nature is not well understood. We have only begun to study them, but we have learned enough to understand their vulnerability. The native people understand this problem very well, and it is, in fact, their concern for the vulnerability of the food chain that underlies many of their fears about the impact of oil and gas exploration and development. At Holman, Simon Kataoyak told the Inquiry:

> You know, we talk about oil spills and so forth. I'd like to say a little bit about it because, if there's an oil spill, it's going to involve Holman Island and all this part of the area because of the currents....
>
> You see, if an oil spill occurs, it's going to spread. That's for sure, you know that. Well, seals are not going to die right away, we know it. It takes a long time to get rid of [them]. The thing we're going to get rid of first is the shrimps [and] what they eat. ... Seals are going to live for a little longer time but what the fish and whales eat are the things that are

Mackenzie Delta. (Native Press)

Polar bear rumaging through garbage dump. (CWS)

Ringed seal. (ITC)

Simon Kataoyak, Holman. (P. Scott)

> going to be first to be killed. Then the seals are going to be killed....
>
> So you see, they have to study hard to prevent these things first before they ever go ahead because there's little – they call them *amogoak*, you know those shrimps, there's a lot of them in the water. That's what the seals [eat], you find them in their stomach, *amogoaks*, and even whales....
>
> But when you [are] travelling in the ocean, something like that – it's nice, it's calm weather. What happens when you look in the water? You could see those little creatures that are this long, they're just like jelly and they've got a red head and they're moving like this all the time. Well, that's what whales and seals eat. So if an oil spill occurs, if that thing slows up or if it's drifting around, that's the first thing that's going to be killed. So they got to know how to prevent those things....
>
> They tell us they know how to drill. Sure, we agree because they're experts. But do they know how to do the safeties? They haven't tried it. [C3943ff.]

Marine biologists from Environment Canada described the Beaufort Sea marine ecosystem. Although complex by arctic standards, it is nevertheless a simple food chain compared to food chains found farther south where the diversity of species is greater and none of them is dominant. The relation between what eats what in the Beaufort Sea is easily illustrated. A typical sequence is diatom-shrimp-fish-seal; another is flagellate-krill-whale. There are, of course, alternative linkages in arctic marine food chains, such as a bird preying on fish or man killing a whale. Nevertheless, as Kataoyak told the Inquiry, a group of shrimp-like creatures underpins most of the food chains in that cold sea.

These shrimp-like creatures depend on the marine equivalent of pastures. Part of this marine pasture, one that is unique to the arctic seas, is an under-ice flora that appears to be an important component of the diatom-shrimp-fish-seal food chain. In late spring, before the ice is thin enough for the light to penetrate to stimulate the growth of the microscopic plants that float in open water, dense concentrations of diatoms grow under the ice. They flourish briefly on the limited nutrients that are available in the ice and with far lower light intensity than other forms of phytoplankton require. They provide a "pasture" for crustaceans on the bottom of the floating ice, and they form the base of the food chains that include arctic cod, seals and whales. It will be seen at once that these under-ice colonies of diatoms peculiar to the Arctic would be highly vulnerable to oil trapped under the ice. Our present scant knowledge of these food chains makes it difficult to assess the extent of the damage that would occur to them, but it is clear that they are highly vulnerable to pollution or disturbance.

CRITICAL LIFE STAGES

The second concept basic to understanding the sensitivity of arctic species is that of critical stages in the life of a species. This is a fundamental aspect of wildlife sensitivity everywhere, but the highly developed winter-summer seasonality of the arctic environment and the relatively simple nature of the arctic food chains combine to make certain life stages critical to the survival of whole populations of certain species.

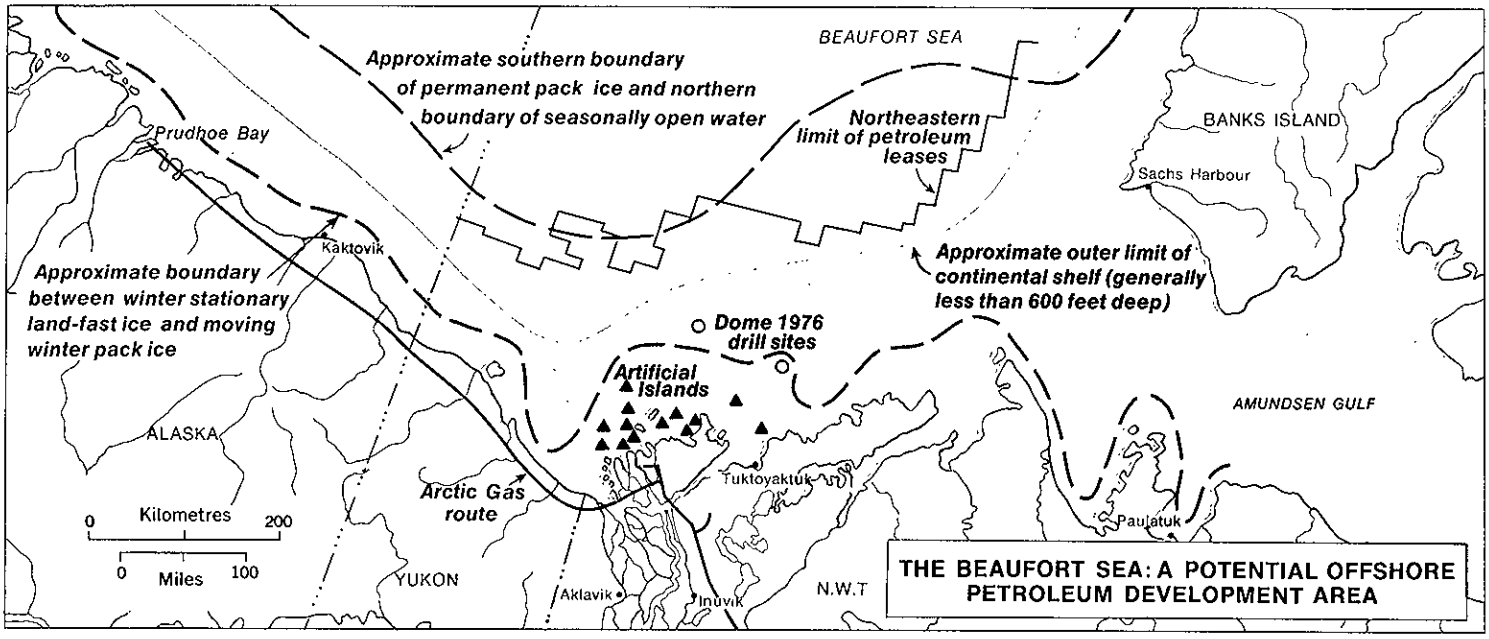
I have described how the calving grounds of the Porcupine caribou herd and the staging areas of the snow geese in the Northern Yukon are critical to the survival of those two populations because almost all the animals are concentrated in small areas at a time when their vulnerability to disturbance is high, and because there are no suitable alternative areas for calving and staging.

In the Delta-Beaufort region there are critical life stage areas that are essential to the survival of other populations. The nesting, staging and moulting areas of the outer Delta are vital to very large populations of various species of birds. The offshore leads are critical for birds, seals and polar bears. The spawning and overwintering waters and migration routes in the Delta region are critical for various fish populations. The calving grounds in the shallow waters of the Delta are critical for the white whales of the Beaufort Sea. Similarly, other mammals of the region have den sites, calving areas, migration routes and wintering areas that are critical.

The most sensitive species are those that concentrate a major portion of the population on very limited habitat during a critical life stage. If industrial development impinges on that habitat, the species will be very vulnerable to impact, either directly through disturbance or indirectly through alteration of habitat or disruption of the food chain.

The State of Environmental Knowledge

Any attempt to assess the environmental effects of industrial development in the Delta-Beaufort region is hampered by the gaps in our knowledge, despite the extensive studies made by industry, by ongoing government programs as well as by the Beaufort Sea Project and the Environmental-Social Program. Both physical scientists and biologists have spoken to the Inquiry of our lack of knowledge about various natural



processes, about reactions to changes induced by man, and about the effectiveness of mitigative measures.

Before assessing change, it is absolutely essential to understand first what is an undisturbed or normal condition. Only then can we adequately appreciate many of the effects of impact. A great deal of work over a period of years and at all seasons of those years is required to demonstrate the range of normal annual and seasonal variations and to define the major factors that make the ecosystem function. Complementary to this work, there should be studies of specific anticipated impacts.

Dr. Art Martell, of the Canadian Wildlife Service, listed some of the important gaps in our knowledge of the biology of species that inhabit the coastal areas and the Delta. He included freshwater fish, birds (particularly waterfowl), certain furbearers, caribou, moose, Dall sheep, bears and whales.

There are even greater gaps in our knowledge of the Beaufort Sea. Dr. Allen Milne, head of the Beaufort Sea Project, and James Shearer, who had conducted research under this program described how little we know of aspects of the physical environment, such as sea-bed scour and sea-bed permafrost. Dr. Douglas Pimlott of the Canadian Arctic Resources Committee told the Inquiry that there is a pronounced imbalance between our knowledge of arctic marine ecosystems and the proposed industrial developments. In his view, our present knowledge approximates to a time base of 1890 as compared to other areas that are experiencing similar development. Dr. Jonathon Percy of the Fisheries and Marine Service, Environment Canada, said our knowledge of the effect of oil on the arctic marine environment is meagre and fragmented and that we have little knowledge of even the most basic ecology and physiology of most of the arctic marine species. Percy testified that our ecological ignorance makes it difficult to sustain or to refute predictions of widespread environmental disaster. Although attempts have been made to determine the impact of oil upon marine mammals and waterfowl, little attention has been paid to smaller organisms on which the larger forms of life depend. Where oil spills have occurred in the Arctic, we have learned very little because there was a complete absence of pre-spill baseline data.

We must learn more about the rates of degradation of oil by bacteria under varying circumstances. Assessment of the degradation rates will require greater knowledge of the populations of bacteria and of their natural variations. In laboratory tests, crude oils inhibit productivity and growth of phytoplankton under many, but not all, circumstances. We need to understand these interactions. We must also learn about effects of oil on the algal bloom that forms on and within the lower surface of ice in spring. This ice flora is an important fraction of the total biological production in the Arctic Ocean.

The gaps in environmental knowledge that I have listed here for the Delta-Beaufort region are complemented by a similar need for environmental information in the other areas that are of concern to this Inquiry: the Mackenzie Valley and the Northern Yukon. Together they underline the fact that present scientific knowledge is inadequate to serve the needs of government in assessing the impact of proposed oil and gas developments in the North. If government is to conduct such assessments effectively, it must undertake the scientific research that is required to provide this information.

Dr. Max Dunbar wrote *Environment and Common Sense* in 1971. What he said then about our knowledge of the North is still applicable today:

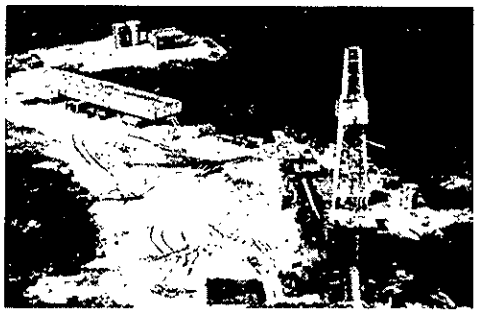
> We have been caught in a state of scientific near-nudity in the particular respect in which we now so urgently need protective covering: namely, knowledge of what the proposed developments will do to the environment, in precise terms, and knowledge of what should be done to conserve and to protect [it]. [p. 53]

Industry's Plans

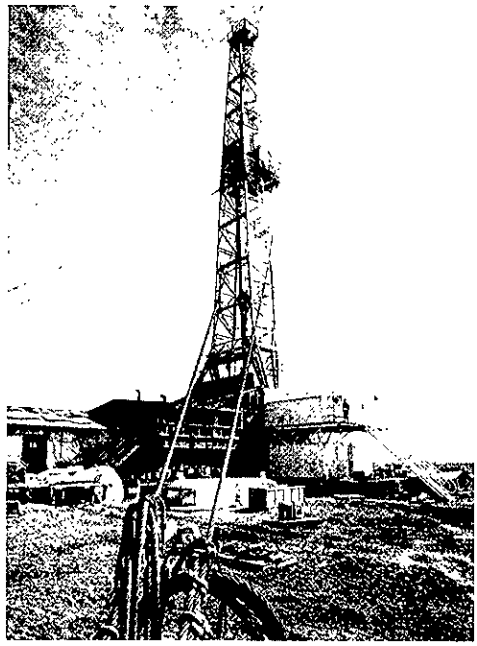
Although the oil reserves at Norman Wells have been known to the industry since 1919, it is only within the last two decades that we have seen oil and gas exploration expand into the Northern Yukon, the Mackenzie Delta and the Beaufort Sea. In 1968, the discovery of gas at Prudhoe Bay in Alaska stimulated activity in the Western Arctic and focused national attention on the Delta-Beaufort region as a potential petroleum-producing area.

Drilling in the Delta region began in the mid-1960s, and Imperial made the first discovery of oil at Atkinson Point in 1970. Other discoveries of oil and gas have followed, and more than 100 holes have been drilled in the Delta region. About three-quarters of the region that is of most interest to the industry lies offshore under the Beaufort Sea. The permits granted so far in the Delta-Beaufort region cover the whole continental shelf out to and even beyond the 600-foot water-depth line.

In 1973 exploratory work began in the shallow waters adjacent to the coast. Artificial islands, built as drilling bases, have all been located within the zone of land-fast ice and in water less than 60 feet deep. Imperial and Sun Oil have already built about 15



Gulf Mobil rig near the Caribou Hills. (L. Bliss)



Oil rig in the Mackenzie Delta. (NFB–McNeill)

Fuel storage bladder. (J. Inglis)

islands, and they expect to build several more.

In the summer of 1976, exploratory drilling began in the deeper water of the Beaufort Sea, when Canadian Marine Drilling Limited (CANMAR), a wholly-owned subsidiary of Dome Petroleum, moved two drill ships into the Beaufort Sea. They began by drilling two holes and made preparations for a further five. The first two holes are in water depths of 85 and 190 feet, and both are in the shear zone between the land-fast ice and the permanent polar pack ice. Moving ice may threaten drilling operations here even in summer.

But exploratory drilling, whether on land or offshore, is only part of the total activity that leads to the delineation of reserves and their eventual production. The Delta-Beaufort region has witnessed more than a decade of all phases of exploratory work. The forested portion of the Delta is a grid of arrow-straight paths bulldozed by seismic crews in their mapping of subsurface geological formations. There is already a major infrastructure of camps, wharves, stockpile sites, airstrips and winter roads to support this exploration. For example, the Gulf base at Swimming Point in the Delta is a self-sufficient distribution centre for men and material. It has a winter airstrip for jet aircraft and crews are rotated in and out directly from Calgary. Imperial and Shell have extensive facilities at Tununuk and Camp Farewell, respectively, and Imperial has a base camp and other facilities at Tuktoyaktuk.

Over the years, the exploration program has produced results; oil and gas have been found. There is a great deal of controversy about the extent of reserves in the Mackenzie Delta and the Beaufort Sea, but they are believed to be large enough to justify the expenditure of millions of dollars.

Now there are two proposals for multi-billion dollar natural gas pipelines before us. Three gas-processing plants are proposed. Exploration has expanded to offshore areas, and discoveries have been made there. Offshore production facilities would involve the creation of islands, and sea-bed pipelines would be needed for production. If a gas pipeline is built, it will probably be looped, and an oil pipeline may follow. Airports, roads, docks, stockpile sites – a whole industrial infrastructure would be needed for production. Tanker terminals and tanker transportation may follow.

These prospects indicate that the Delta-Beaufort region may become one of Canada's major oil and gas producing regions. With this in mind, let me turn to the proposals for a gas pipeline and gas production facilities.

Pipeline Proposals

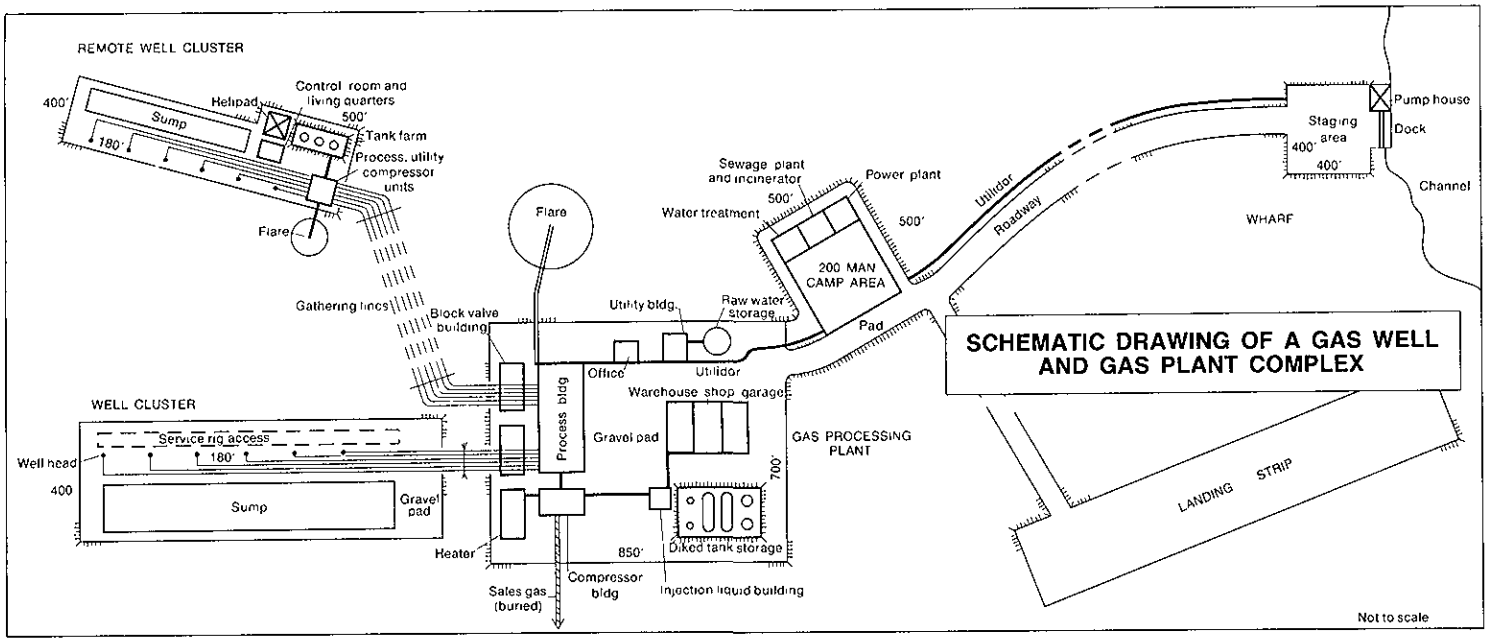
When Arctic Gas first sought a right-of-way in March 1974, they proposed to build a pipeline from Prudhoe Bay, along the north slope of the Yukon, then southwesterly around the head of the Delta, crossing the Peel River near Fort McPherson and the main channel of Mackenzie River at Point Separation. West of Travaillant Lake, it would join the line from the Taglu gas plant on Richards Island, and from there, the main line would run southeasterly, along the east side of the Mackenzie River.

In January 1976, Arctic Gas announced that they would seek a right-of-way to transport Alaskan gas across the northern part of the Delta (the Cross-Delta Route) to join the main line from Richards Island near Tununuk Point. This proposal caused changes in about 150 miles of the route between Taglu and Thunder River. The main reason why Arctic Gas prefer the Cross-Delta Route is that it is about 100 miles shorter, and would thus cost about $180-$190 million less.

The Cross-Delta Route involves about 52 miles of right-of-way across the northern part of the Mackenzie Delta. Of this, 16 miles would be 48-inch-diameter single pipe, and 36 miles would be 36-inch-diameter twinned pipes. The two pipes would normally be laid 50 feet apart on land, 200 feet apart under Shallow Bay and as much as 4,000 feet apart under some of the main channels of the Delta. In crossing the Mackenzie Delta, some 12 miles of the right-of-way would be under water. This includes the 4.5 miles across Shallow Bay and the major crossings of West Channel, Middle (or Reindeer) Channel and Langley Channel. The four major water crossings would be built in summer, but the rest of the construction, including some 35 separate crossings of small channels and lakes, would be done in winter.

Because Arctic Gas want to carry Alaskan gas to the main north-south line by either the Cross-Delta or the Circum-Delta Route, their activities in the region would be much more extensive than what Foothills propose. The Foothills route south from the Delta gas plants would not differ substantially from that proposed by Arctic Gas. But their construction plan for the northernmost 50 miles is different in that the pipe would be laid in fall from a gravel work pad instead of during winter from a snow road.

Both pipeline proposals include permanent compressor stations and the construction and maintenance of support facilities. The Arctic Gas Cross-Delta Route would involve a compressor station on the eastern edge of the Delta at Tununuk Junction and



seven construction work pads, three wharf and stockpile sites and one helipad on the Delta. The gravel for the Cross-Delta Route would have to be hauled from west of the Delta or from the Richards Island area to the east.

The Circum-Delta Route, on the other hand, would involve facilities on the west and south sides of the Delta, including three compressor stations, four wharf and stockpile sites, two airstrips and nine helipads. Gravel for this route would be hauled from about 13 borrow pits along it.

Gas Plant Proposals

There are three proposals before the Government of Canada to build facilities in the Delta area to process natural gas for pipeline transmission. These facilities, like the pipeline, tell us something about the broader picture of future industrial development in the Beaufort-Delta region.

The combined output of the three plants would be about 1.25 billion cubic feet per day (bcfd) of gas, yet the sizes of the trunk and lateral pipelines in both the Arctic Gas and Foothills proposals imply much higher throughputs – in the three to four bcfd range. The Taglu and Parsons Lake gas plants have been designed with excess capacity in anticipation of future discoveries. Clearly the industry has great expectations for the future in the Delta and offshore areas.

Two of the proposed gas plants, those of Imperial at Taglu and Shell at Niglintgak, will be in the Delta. Gulf propose to build the third plant at Parsons Lake, east of the Delta proper. Gas gathering systems will bring the gas from the fields to each of the plants. The capital cost of these three gas plants and gathering systems will exceed $1 billion.

To illustrate the way in which these plants will be constructed and operated I will describe the plant that Imperial propose to build at Taglu. The Shell and Gulf proposals differ only in detail.

THE IMPERIAL PLANT AT TAGLU

The Taglu gas field covers about 10 square miles. The plant to tap and process the gas would be built south of Big Lake, west of Harry Channel and would lie within the Kendall Island Bird Sanctuary. It would cover approximately 1,000 acres, including the well clusters, plant site, dock, access roads, airstrip and flow lines. The well heads will be clustered on elevated gravel pads, approximately 500 feet by 1,600 feet, and the pads will have the drilling sump beside them. The wells will radiate outward from each pad, and each well will be drilled to approximately 10,000 feet.

Flow lines from the well heads to the plant will run above ground. They will be supported on piles, frozen into the permafrost, for protection against flooding and to prevent thermal disturbance to the ground. For construction, 1.5 million cubic yards of granular material will be required for the gravel pads. Much of this material will be brought from the Ya Ya Lake esker, 20 miles away, which is accessible by barge in summer and by truck over the frozen river channels in winter. There will be a 2,500-foot STOL airstrip, a dock, and an adjacent staging site reached by barge from the East Channel. Fuel will be delivered to the site in conventional bulk fuel barges.

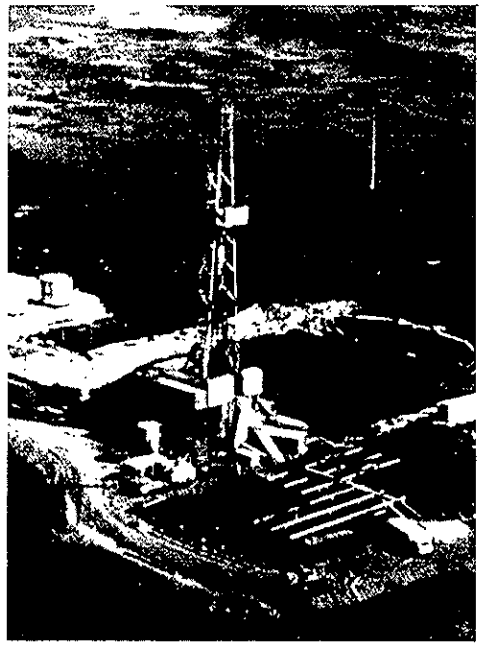
The gas plant will be of modular construction. Ocean-going barges will carry the larger, heavier modules (some of them weighing up to 1,000 tons) from the Pacific coast around Point Barrow to the Mackenzie Delta plant site. At the mouth of the East Channel of the Mackenzie River, in Kugmallit Bay, the barges will be lightened, with cargo transferred to river barges, to reduce draft and enable them to be towed to Taglu. On arrival, the modules will be transferred onto special heavy-load crawler transporters, moved along specially built roads and set on piles at the plant site.

Imperial say that, with maximum use of these modules, site construction will require about 400 specialized tradesmen. Non-modular construction would require about 700 skilled tradesmen working in less shelter and under very difficult physical and climatic conditions. Permanent operating and maintenance staff will number about 65, and they will live in a self-sufficient housing and recreation complex accommodating up to 100 people on the site.

Future Prospects

So here is a large-scale construction program, employing 1,200 men or more to build three gas plants, and these men are in addition to the substantial labour force working on the pipeline in the area. The construction of the three plants and the pipeline will greatly increase barge traffic down the Mackenzie River, along the Arctic coast, and in Kugmallit Bay. When the plants and systems are in place, there will be gas plants, pipelines, compressor stations, flow lines, camps, on-site housing, all-weather roads, airfields, docks and regular passage of aircraft and vehicles across the Delta.

The extent of these operations is apparent, but they may well be only a beginning, for we can expect additional developments in the Delta and the Delta region. If there are pipelines running along an energy corridor from the Arctic to the mid-continent, there



Construction of a drill site pad. (L. Bliss)

Drilling at Taglu. (DIAND)

Recreation room on the Unark offshore island rig. (DIAND)

will be an extension of exploration and development into the Beaufort Sea. Roland Horsfield of Imperial suggested that most of the remaining potential of the Mackenzie Basin lies offshore in the Beaufort Sea. Dan Motyka of Gulf told the Inquiry that the hydrocarbon potential of the area increases farther offshore. What does all this mean for the future of the Beaufort-Delta region?

Industry was unwilling to forecast for the Inquiry its own view of the scope and extent of future oil and gas exploration and production activity in the Beaufort Sea. I suppose that is understandable; their estimates of reserves may be subject to change, and they seek to limit any consideration of impact to the proposals that they have advanced. But even though industry was unwilling to forecast future developments, the Inquiry must attempt to do so. There is a good deal of information to go on. We know, for instance, that over 100 holes have been drilled in the Delta. We know that the larger part of the basin lies under the Beaufort Sea. It seems likely that, in time, as many or more holes will be drilled offshore as have been drilled in the Delta. To bring oil and gas finds into production and to markets in the south would require a network of sea-bottom flow lines, a series of tank farms and processing plants onshore, a system of gathering lines to feed the products into one or more gas pipelines, and possibly an oil pipeline, along the Mackenzie Valley. Such developments would result in a high level of year-round human activity spread over the whole region for a generation or more. There will be areas of concentrated activity in Inuvik, around Tuktoyaktuk and along the coast at gas plants and tank farms.

E.R. Walker in *Oil, Ice and Climate in the Beaufort Sea*, the final report of the Beaufort Delta Project, offered this scenario:

> The sub-sea formations extending under the Beaufort Sea to the edge of the continental shelf are estimated to contain from 3×10^9 (EMR 1973) to as much as 4×10^{10} barrels of recoverable oils according to some oil industry estimates. Industry sources estimate this oil may be accompanied by as much as 50 trillion cubic feet of gas.
>
> Exploration has already commenced and will continue at least through 1980. In the exploration until 1980, approximately 20 wells will be drilled from 20 artificial islands in water depths less than 15 to 20 m. Another 20 wells may be drilled from floating platforms or ships in water depths up to 150 m. If significant quantities of gas and particularly oil are found, the level of exploratory activity may double or triple. If no significant finds are made by 1980, the activity may well taper off. The total number of exploratory wells might range from 40 to 50 by 1980 to as many as 120 to 150 by 1990. . . . The production phase may begin before 1985 and continue at least until 2010. The removal of oil may be as much as 300,000 barrels per day in 1985 and 600,000 barrels per day by 1990. To bring this oil to the surface, from 50 to 200 wells may be producing by 1985 and perhaps 100 to 300 wells may be producing by 1990. The oil will most likely be gathered by sea-bed pipelines. [p. 15ff.]

James Shearer, appearing for the Canadian Arctic Resources Committee, estimated that if total production offshore came to 20 to 30 trillion cubic feet of gas and two to three billion barrels of oil, there might be 300 to 400 exploratory holes offshore. They could be spread over an area 200 miles long, from Cape Bathurst in the northeast to Ellice Island in the southwest, and 80 miles wide from the coast of the Mackenzie Delta and Tuktoyaktuk Peninsula out to the edge of the continental shelf at about the 600-foot water-depth line.

Granted, no one can say for sure what will happen. The whole future of hydrocarbon activity in the region obviously depends on the discovery, and the rate of discovery, of oil and gas. However, it is plain from statements made by both industry and government, and from the extent of the present permits, that there is the potential for a major petroleum producing province in the Beaufort-Delta region.

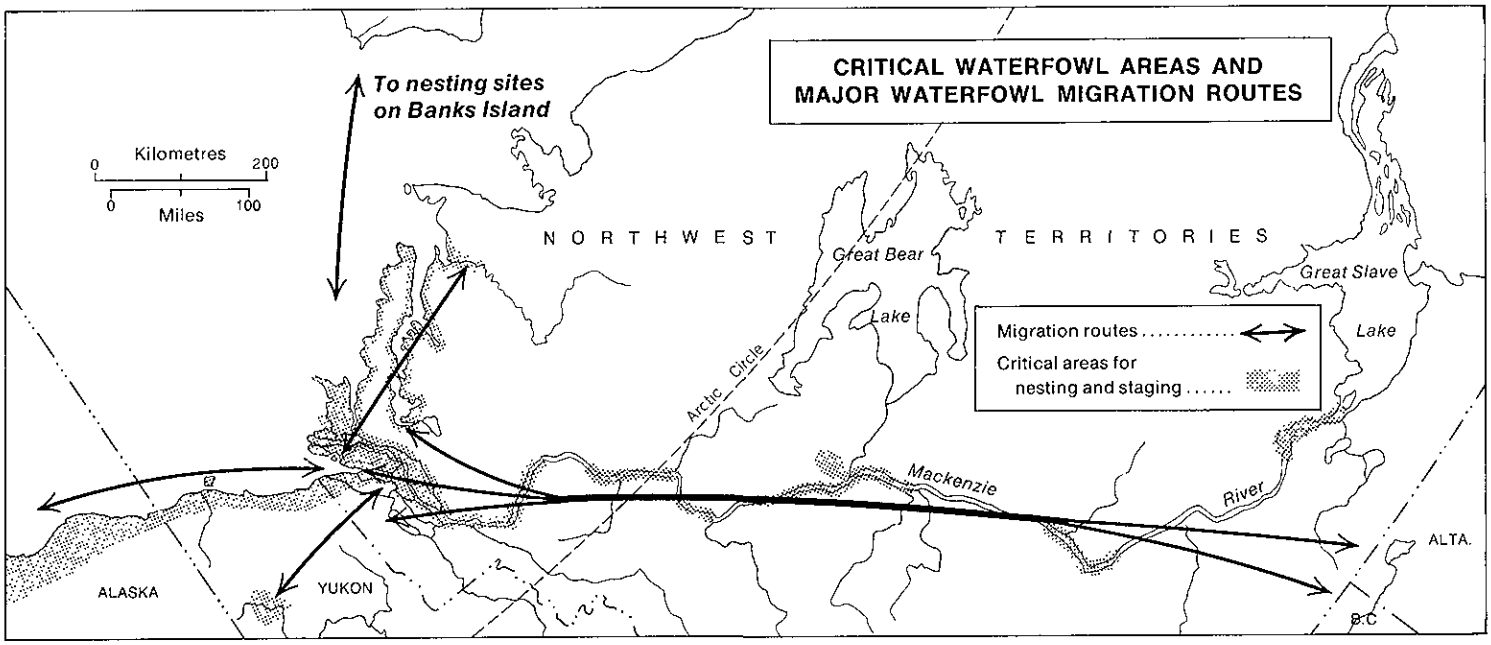
Delta Region Impacts

If we deal with each project piecemeal, we run the risk of missing the point. We are considering the establishment of a major petroleum province in the Delta-Beaufort region, and our predictions of impact will be sound only if we consider them comprehensively. The Delta supports a unique ecosystem and has been aptly compared to the Everglades. The ecosystem must be protected as a unit. However, to illustrate the impact that the pipeline and related activities will have on the Delta region, I shall concentrate on the principal biological concerns, the fish, birds and white whales. I intend to discuss the whales separately in the next section because of the direct threat that oil and gas developments pose to that population as a whole. Impacts on other species such as muskrat, beaver, reindeer, caribou and bear will be limited in extent and can be ameliorated by the kind of measures that I shall advance in Volume Two of this report. Little is said here about oil spills and their impact, because this subject is dealt with in some detail in a subsequent section.

FISH

Arctic Gas say in Section 14d. of their Application:

> The Mackenzie Delta is probably the most important fisheries area along the entire



pipeline route. Fish utilization of the area is extensive. The Delta serves as a spawning, rearing and overwintering area and also as a migratory pathway for many fish species. [*Supplement ... Relative to Alternative Routing for the Alaska Supply Lateral Across the Mackenzie Delta*, p. 27]

Impacts on fish could result from changes in the smaller food organisms and exclusion from important habitats. There may also be changes in the habitats themselves, such as oxygen depletion, and sedimentation of spawning and overwintering areas. As industrial development proceeds, fuel and other toxic substances may be spilled, and, of course, there will be more people in the area to increase sport, domestic and commercial fishing.

I think that it is only realistic to assume that successive developments will progressively alter and perhaps diminish the productivity of the aquatic ecosystem in the Delta. The fish populations will feel this impact directly and indirectly throughout the food chain. The extent of these impacts cannot be calculated, but much will depend on the pace and scope of industrial development, its regulation and, of course, the progress of aquatic research. Concern for this latter aspect is all the greater because of the recent truncation of some government research programs in the area.

Granted, a properly regulated, scheduled and routed gas pipeline project, in itself, will probably have only local and short-term impact on fish, and little or no long-term impact – assuming there are no large spills of toxic materials. But it is not reasonable to consider the pipeline by itself; there will be other projects, and they will pose risks to the fish. The effects will be evident in decreased populations of the most economically important fish species, such as humpback whitefish, broad whitefish, inconnu, arctic char, and arctic and least cisco. Development will also disrupt fishing activities in the area.

The pipeline proposals offer a choice of two routes. The Arctic Gas Cross-Delta Route will cross the outer part of the Delta, and the alternative route circumscribes the Delta. Which is better in terms of impact on fish and fisheries? Dr. Peter McCart, fisheries consultant for Arctic Gas, told the Inquiry:

> It's not possible to distinguish between them. There are advantages to one and disadvantages which are balanced as far as we can see by the advantages and disadvantages of the other. [F20487ff.]

When asked about the possibility of establishing an oil pipeline and an energy corridor along the route (in keeping with the government's 1972 Pipeline Guidelines), McCart said that he would be very reticent about a proposal to put an oil pipeline across the Delta. Jeff Stein of Environment Canada told the Inquiry that the Mackenzie Delta has been designated by the federal Fisheries and Marine Service as an area likely to be sensitive to pipeline construction. He concluded:

> ... the Mackenzie River Delta provides essential habitat for the maintenance of the freshwater, coastal marine and anadromous fish resources in much of the southern Beaufort Sea area and lower Mackenzie River. The inshore zone is an important nursery, feeding and overwintering site for both nearshore and offshore organisms. It is especially important to those anadromous species which form the basis of the domestic and commercial fishery in the Delta; that is, broad whitefish, arctic char, arctic cisco and inconnu. Standing stocks of fish are greatest nearshore, since the anadromous species tend to frequent shallow coastal waters during the summer months rather than moving far offshore. Proposed developments in the Delta region can be expected to adversely affect aquatic resources. [F18436ff.]

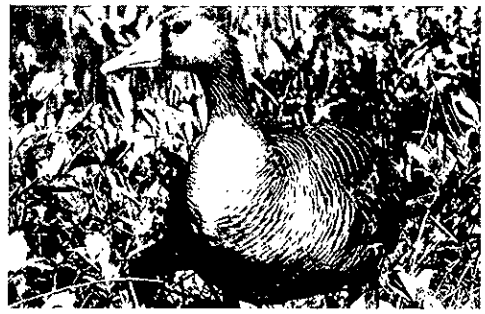
Of course, pipelines are not the only kind of development that can adversely affect fish populations in the Delta. The construction and operation of gas plants, drilling and other exploration activities, and dredging or gravel-pit operations could all have impacts. For example, the plan that Imperial Oil described to the Inquiry for dredging sand at Big Horn Point could cause risks to important fish populations, but insufficient information was then available about the site to predict the magnitude of this concern.

BIRDS

Dr. William Gunn, ornithological consultant to Arctic Gas, told the Inquiry that the whole of the Delta is important for waterfowl. In June, July and August 1975, he made four aerial surveys along the Arctic Gas Cross-Delta Route and found that the greatest number of nesting waterfowl occurred along the outer Mackenzie Delta section of the route in June. The Cross-Delta Route crosses some prime waterfowl habitats, especially on Ellice Island, where staging geese concentrate and there are important nesting grounds for swans, cranes and ducks. Originally a compressor station was planned for the middle of that area, but Arctic Gas have agreed, on the advice of Gunn, to move the compressor station to the eastern fringe of the Delta. Gunn also found that the Delta habitat may, in a given year, be as vital as the north slope of the Yukon to the snow geese. Normally, the majority of the snow geese stage on the north slope, but in 1975, it was snow-covered in early September when the geese arrived, and most of the geese moved into the Shallow Bay area of the Delta. The peak number of geese there was an estimated 325,000 out of a total of 375,000 in the entire region. These birds are extremely vulnerable to aircraft overflights

Canada geese. (C. & M. Hampson)

Seismic lines across the Delta. (M. Jackson)



White-fronted goose, a common breeding bird of the Delta. (C. & M. Hampson)

and to the kind of disturbance that would be associated with the summer construction of the Shallow Bay crossing as well as the ongoing activity associated with an operating pipeline.

That is why Gunn and Dr. Tom Barry of the Canadian Wildlife Service would prefer a crossing farther upstream than that now proposed by Arctic Gas. They are concerned that the route chosen by Arctic Gas will cross vital nesting and staging areas in the Delta.

The Arctic Gas Circum-Delta Route, although it impinges upon habitat used by a wide variety of birds, avoids the areas of high concentration characteristic of the Delta proper. Granted, it does approach a number of raptor nest sites, and if the pipeline is built, they would have to be protected by rigorous terms and conditions.

Gunn told the Inquiry that from the point of view of impact on birds, the Circum-Delta Route is clearly preferable to the Cross-Delta Route. The possibility of an oil pipeline along the Cross-Delta Route raises extremely important concerns for birds. Both Gunn and Barry spoke at length about the devastating impact of oil spills on birds. Both emphasized the lack of any suitable means of rehabilitating birds that come into contact with oil, even in temperate climates. Oil mats the feathers together so they are no longer able to function for flight, to repel water or for insulation. Once this happens, the birds generally die by drowning or exposure; they are also harmed by the direct toxic effects of oil when ingested through preening their feathers in an attempt to rid themselves of contaminants. When cross-examined about an oil pipeline following a gas pipeline across the Delta, Gunn said:

> My concern is with the possibility of oil leaks or spills along the line, in areas that are of particular importance to birds, since there are numbers of these in the Delta. I feel that it might be difficult to find a suitable route across the Delta on that basis. [F20213]

In his report, *The Need to Preserve the Integrity of the Mackenzie Delta*, Gunn went beyond the pipeline proposals and considered the impact of a broad range of hydrocarbon developments in the Delta. He noted that the pipeline, in itself, and a reasonable number of oil and gas wells would not, in themselves, compromise the integrity of the environment. But he added:

> The problem, however, comes with the establishment of processing plants at or near the wellhead for the purpose of modifying the composition of the gas (or oil) to a form suitable for extended transmission.
>
> If full development of such processing plants were permitted on the Delta, it would entail intensive on-site and support activity during construction, and a fairly high level of human presence, aircraft and vehicular (and perhaps barge) activity during the lifetime of the project. There is also the problem that such plants are much more difficult to maintain as an environmentally "clean" operation than a well site. Of the companies presently known to be planning production in or near the Delta, the Gulf site at Parsons Lake presents no direct threat to the Delta since it is well clear of the Delta. Imperial's site at Taglu and Shell's site at Niglintgak, however, are not only well within the outer Delta but are actually within the confines of the Kendall Island Bird Sanctuary, which is of great importance to geese, swans, and other waterfowl. If Sun Oil were to develop their gas find on or near Garry Island, they would probably wish to have their own processing plant, and the Sanctuary would then be effectively ringed by plants. The proliferation of other plants and sites on the Delta would be difficult to prevent. Although the environmental effects of any one of these plants might individually be acceptable, we are particularly concerned with the combined and cumulative effects. Because we believe that they would unquestionably result in deterioration of the Delta as a viable ecological unit, we are therefore strongly opposed to processing plants on the Delta. In our view, these plants should be located on the "mainland" to the southeast, where they could be connected to Inuvik by a permanent road. [p. 9ff.]

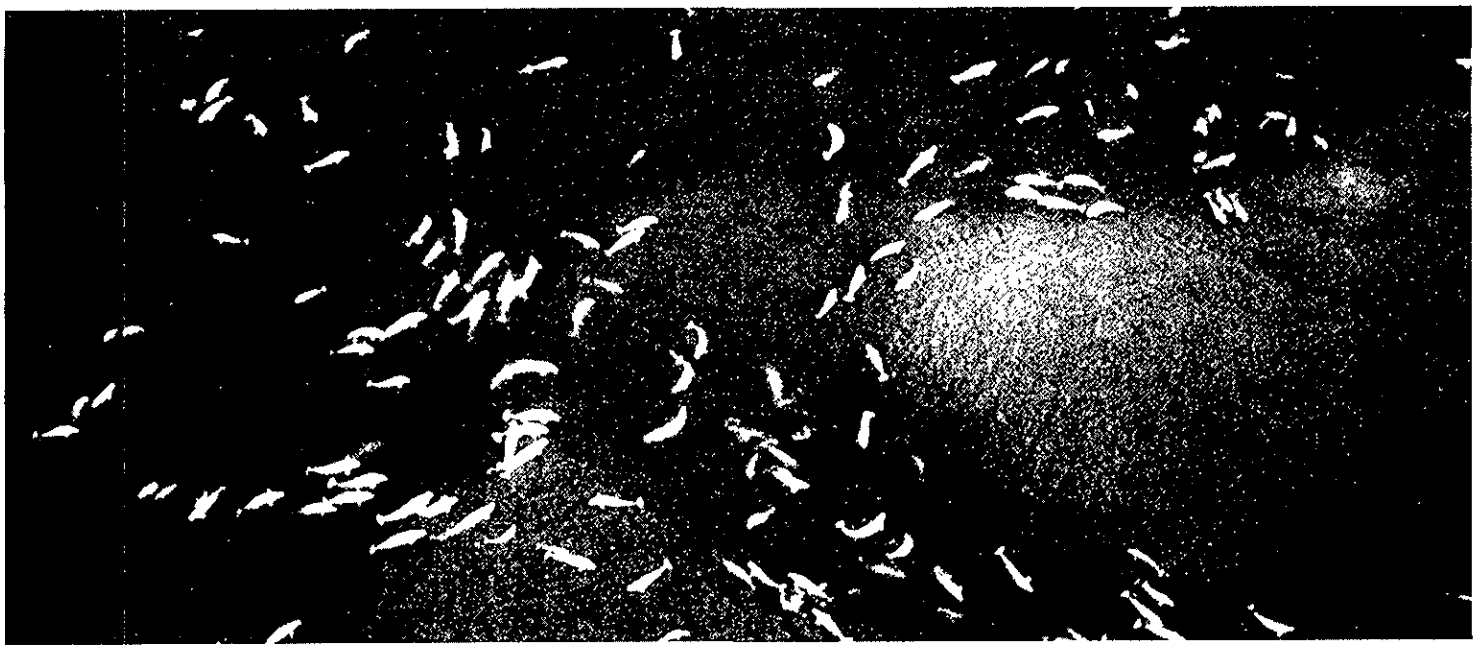
Amelioration of Impacts in the Delta Region

The first condition for the amelioration of impact in the Delta is a requirement that no pipeline be allowed to cross the Mackenzie Delta; that is, if a pipeline is built from Alaska, the Circum-Delta rather than the Cross-Delta Route should be followed. This conclusion is based on the pipeline's impact on birds and fish that I have outlined, the impact on white whales that I will discuss in the next section, and on the overall importance and sensitivity of the outer Delta ecosystem in general.

To protect the fish resources of the Delta, research must keep pace with development activity. It is only by filling in the gaps in our knowledge that effective measures can be instituted to limit impacts to an acceptable level. This can be done on a project-by-project basis.

Such measures will not, however, suffice to protect the birds of the Delta. The migratory birds that use the region are an important international wildlife resource; the whole Delta, and particularly the outer Delta, is critical for them. Gunn has said that the whole Arctic coast from Prudhoe Bay to the Delta is ornithologically sensitive. I have already discussed the importance of the north slope of the Yukon for birds, particularly snow geese. The wilderness park in the Northern Yukon that I have proposed would protect them.

Various witnesses before the Inquiry said



that the boundaries of the Kendall Island Bird Sanctuary are being redrawn. On the basis of the evidence placed before me, I consider it important to extend the sanctuary westward to cover the entire outer Delta across to the wilderness park that I have recommended for the Northern Yukon.

The establishment of such a bird sanctuary, unlike the wilderness park, will not prohibit oil and gas exploration and development. In fact, there already are proposals for two gas plants within the Kendall Island Bird Sanctuary. But a sanctuary does provide protection to the birds by placing regulatory powers in the hands of the Canadian Wildlife Service, which has a statutory mandate to protect migratory birds. I urge that when the sanctuary is established, the means should be provided at the same time to protect the habitat on which the birds depend.

Gunn's report concludes on a note that I endorse:

> We realize that the acceptance of these environmental requirements will require a great deal of additional effort on the part of design engineers representing the producing and transporting companies. We can only say that we think these requirements would receive strong support from biologists who have given serious study to the proposed development. Because the developmental companies have spent an extraordinary amount of time and money in carrying out environmental base-line impact studies, we have the unprecedented opportunity of planning industrial development within one of the world's great deltas before it takes place, and of doing it in such a way that will ensure the preservation of the environmental integrity of the Delta at the end of the process. It would be a pity to throw away our chances for success when we have come so close with such effort. The Delta should be allowed to exist as an example of what can be accomplished if we put our heads together. [op. cit., p. 10ff.]

Whales and A Whale Sanctuary

In summer the white whales of the Beaufort Sea converge on the Mackenzie Delta to calve. The herd – some 5,000 animals – remains in the vicinity of the Delta throughout the summer, then leaves for the open sea. For these animals, the warm waters around the Mackenzie Delta, especially Mackenzie Bay, are critical habitat, for here they have their young. Nowhere else, so far as we know, can they go for this essential part of their life cycle. We must preserve these waters from any disturbance that would drive the whales from them.

Construction of the gas pipeline across Shallow Bay, as proposed by Arctic Gas, and construction of an oil pipeline along the same corridor, together with associated barge and aircraft activity, would have a definite impact on the whale population; but the long-term threat comprises the whole complex of petroleum activities in the coastal waters bordering the Mackenzie Delta, Richards Island and adjacent areas. These activities would include construction of artificial islands or other drilling platforms, associated dredging and barge movements, drilling of wells, construction of flow lines, and blasting. The cumulative and long-term impact would be great.

It is imperative, if we are to protect the whales, to establish a whale sanctuary in Mackenzie Bay and to forbid oil and gas exploration and development and pipeline construction within it.

Our knowledge of the white whales of the Beaufort Sea is limited. We do not even know whether they winter in the Pacific Ocean or remain in the Arctic Ocean. In spring, they migrate along leads in the pack ice into the Beaufort Sea from the west, arriving in May or June. The whales move into the warm, shallow water around the Delta in late June or early July as soon as there are open leads through the ice, and stay around the channel mouths until mid-August. They are there in large numbers: the population was estimated at 3,500 to 4,000 in 1973, 1974 and 1975. Whales have been sighted throughout the Delta, and even as far south as Point Separation.

The Inuit who spoke to the Inquiry at Tuktoyaktuk testified that whales come from Mackenzie Bay into Kugmallit Bay as soon as the ice north of Kendall Island allows them to get around it, in late June or July. Even though they may go back into Mackenzie Bay, they return to Kugmallit Bay and stay there well into September. If summer is late, the whales may not reach Mackenzie Bay until mid-August, and they will then stay in Kugmallit Bay until late September. By the end of September, they can be seen offshore near the pack ice.

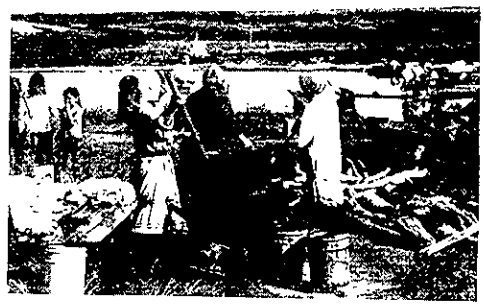
Many Inuit and some Indians regularly go out to hunt whales from camps in the Delta, and the people of Tuktoyaktuk go out from the village daily. Archaeological finds indicate that the Inuit have hunted white whales from Kittigazuit and Radio Creek for at least 500 years. Today, they take about 150 whales a year. It is estimated that they kill about 300, but they are able to recover only about half of that number. This level of hunting does not diminish the herd.

Robert Webb of Slaney and Company conducted a study of white whales for Imperial Oil in the area between Kugmallit Bay and the west side of Mackenzie Bay, and south into Shallow Bay, beyond the proposed pipeline crossing. The purpose of the study was to determine the effect that the

White whales. (R. McClung)

White whale ready for butchering. (W. Hoek)

Preparing "muktuk" for storage. (W. Hunt)



Whale camp at Whitefish Station. (M. Jackson)

construction of offshore islands would have on the distribution of whales in the Delta and on the taking of whales by native people. The study, which began in 1972, continued through the summer of 1975. In two of these four years, apparently few whales entered Shallow Bay; but in the other two years they were observed as far south as the mouth of Reindeer Channel. However, Webb feels that the infrequency of the observations and the turbidity of the Delta water may limit the reliability of these observations. Perhaps whales did enter Shallow Bay in larger numbers, but were simply not observed. It is not known exactly where the whales drop their calves. Newborn calves have been sighted in Shallow Bay and Kugmallit Bay, but their dark colour makes them difficult to see in the turbid water. Probably most calves are born in the main whale concentration area in west Mackenzie Bay-Shallow Bay. The warm river water is essential habitat for the newborn young until they develop enough blubber to survive in the colder oceanic water. If they had to move out earlier, the calves would lose body heat and die in the cold water.

The Long-term Threat

The construction of a pipeline across the Delta may bar the whales' access to Shallow Bay. If it does keep them from Shallow Bay, the herd probably will be diminished only slightly, if we can assume that the crossing would be built in just one summer, and that the only calves lost would be those that would have been dropped in Shallow Bay. Even if the whales were kept right out of Mackenzie Bay by barge traffic and related activity during the period of pipeline construction, and even if the construction took two or three years, the worst that might happen would be the loss of two or three years' calves. These losses could reduce the size of the herd but would not threaten its survival. But a pipeline across Shallow Bay cannot be considered in isolation. It is only a beginning.

If the pipeline is built, there will be increased oil and gas exploration and development in the Beaufort Sea. This development, both nearshore and offshore, will have a large impact on the whale population, greater in the long run than that of a pipeline crossing the Mackenzie Delta.

Although the whales concentrate in west Mackenzie Bay-Shallow Bay, east Mackenzie Bay and Kugmallit Bay, it is the west Mackenzie Bay-Shallow Bay area that is critical. Dr. David Sergeant of the Department of the Environment, who is Canada's leading authority on white whales, says that if calving were seriously disrupted annually, the population could ultimately die out. He is supported by Dr. Paul Brodie, who is also an authority on the subject. Sergeant's view is that the cumulative impact of oil and gas exploration and development may lead to the gradual expulsion of the calving whales from Mackenzie Bay. Sergeant called our attention to the experience at the mouth of Churchill River, at Churchill, Manitoba, which was once a calving ground for white whales. The port facilities there have driven the whales away to calve elsewhere, and their major calving area now is at the mouth of Seal River, about 20 miles to the north which, fortunately, can accommodate them.

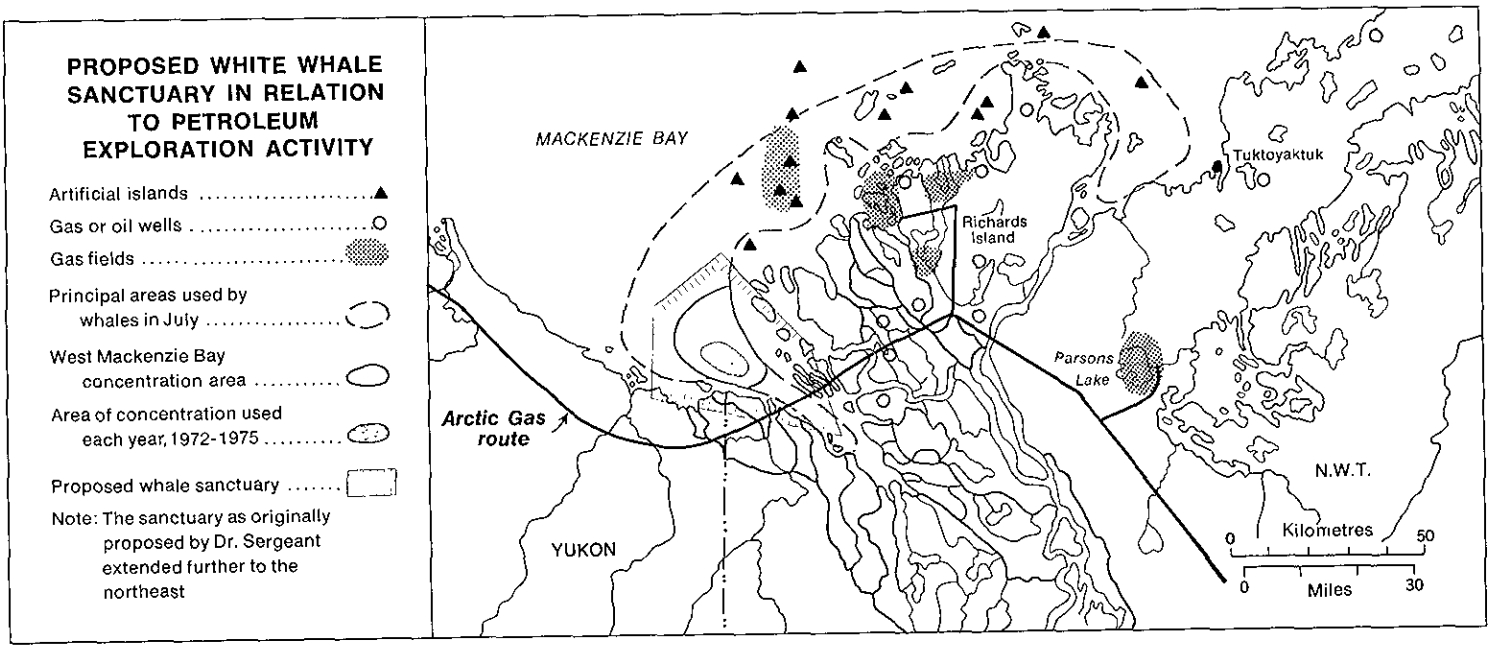
Sergeant cannot see any other river mouths in the neighbourhood of the Mackenzie Delta that could receive a large number of whales for calving. None receive them now. A few whales move into Liverpool Bay and around the mouth of the Anderson River in late July, after they have left the Delta. But these waters become free of ice later than those around the Delta, and to reach them the whales would have to postpone calving. That may or may not be possible. In any event, the warm water available at the mouth of the Anderson River could not support the herd that now calves around the Mackenzie Delta, and the seasonal variation of ice conditions might well close off that estuary in some years. Sergeant, summarizing his evidence, stated:

> ... the population of white whales which calves in the Mackenzie is virtually the whole of the population in the Beaufort Sea. I postulate that simultaneous oil and gas activities throughout the whole Delta in July each year could so disturb the whale herd that they would be unable to reproduce successfully. In time, the herd would die out. If we wish to maintain the herd, we must initiate measures now [for example, establish a special reserve for calving whales] which we can be certain will allow its successful reproduction annually. [F18496ff.]

A Whale Sanctuary

I think a whale sanctuary should be established in west Mackenzie Bay, where the main mass of white whales gather in July, and where the main calving area is located. No oil and gas exploration should be allowed there, no artificial islands built there, no wells drilled there, and no pipelines allowed to cross it.

Sergeant and Webb agree that, of the three areas where the whales are found in concentrations between June 20 and August 15, west Mackenzie Bay is the most important area because it is the main calving area. The sanctuary should be the same size or greater than the area used by the main herd of whales in west Mackenzie Bay in most years.



In recommending a whale sanctuary, I have relied upon the evidence of Sergeant and Brodie. Their views on the long-term threat that oil and gas exploration and development in the Mackenzie Delta hold for the white whales were not challenged by Arctic Gas or Foothills. Neither were they challenged by Imperial, Gulf and Shell, all of whom were represented by counsel when the evidence was heard. I have relied also on the evidence given by Inuit hunters at the hearings held in the Delta communities.

Is there any alternative to a whale sanctuary? It could be argued that, if oil and gas exploration and development were suspended in the summer, to be resumed again in winter when the whales are out at sea, the sanctuary would not be necessary. I think this idea is impractical. Once you permitted exploration of the waters of the sanctuary, even if you began by restricting such activity to the winter, you would inevitably find that certain activities must go on in summer. If industry is permitted to explore in these waters, there may be a need for summer seismic exploration, artificial islands for drilling platforms, and barge traffic during the short ice-free season. If oil or gas is discovered, then flow lines will be built. There are, in fact, a multitude of activities that can be carried out efficiently and economically only in summer.

Sergeant has proposed a sanctuary in which not only oil and gas exploration and development but also whale hunting by native people would be prohibited. There is an irony here. Many native people in Aklavik, Tuktoyaktuk, Sachs Harbour, Holman, Paulatuk and Inuvik told the Inquiry that they oppose oil and gas exploration and development in the Mackenzie Delta and the Beaufort Sea because of the impact they fear it will have on whales. A sanctuary would offer a measure of protection to the herd, and it would coincide with the wish of the native people to protect the herd. But if, at the same time, they are denied the right to hunt whales, what I regard as one of the main purposes of the sanctuary would be undermined.

I do not advocate a sanctuary in which native people are forbidden to hunt: I think their claim on these animals is fundamental. I think native hunting can be permitted without endangering the herd. Hunting is heaviest in Kugmallit Bay, and east Mackenzie Bay, which are remote from the proposed sanctuary. If hunting pressure appeared to threaten the herd, it could be reduced or even prohibited. But no such check could be imposed upon oil and gas exploration and development in the sanctuary, once a pipeline is built and the corridor established.

Is a whale sanctuary in west Mackenzie Bay a practical proposition? What will its effect be on future oil and gas exploration? Will it impose an unacceptable check on oil and gas exploration and development in the Mackenzie Delta and the Beaufort Sea? These are very difficult questions to answer. However, I note that the areas of intense petroleum exploration, to date, lie east of the proposed whale sanctuary, both offshore and onshore. Moreover, there has been substantially less seismic work in the sanctuary area than in adjoining areas to the east. If this trend continues, and if it reflects a difference in petroleum potential, then a whale sanctuary can be set aside, and oil and gas activity can be forbidden there without impairing industry's ability to tap the principal sources of petroleum beneath the Beaufort Sea.

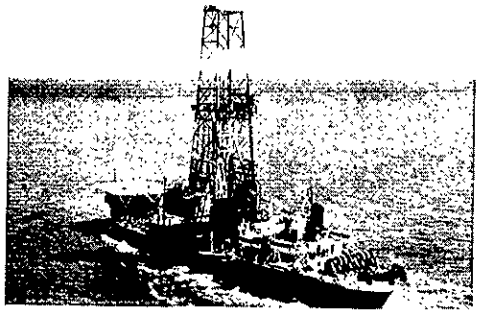
Let it be understood that the proposed sanctuary is itself a compromise. The evidence shows that in past years there have been whale concentrations northeast of the proposed sanctuary, in an area where a number of artificial islands have recently been established. I am not proposing that the sanctuary extend that far: that area has already, in a sense, been given over to industrial use. I should draw the northern boundary of the sanctuary south of the Adgo field, where gas and oil have been found. This seems to me a reasonable compromise between the competing uses. The sanctuary would not then deny industry access to any waters where discoveries have been made, and yet it would retain within its waters the areas where most calving occurs.

The trend of exploration appears to offer us an opportunity to set aside certain offshore waters as a whale sanctuary, but this trend is by no means a certainty. In the final analysis, the Government of Canada will have to decide whether or not to protect this herd of whales. If we decide to protect them, we must establish a sanctuary that will be inviolate regardless of the prospects for oil and gas discoveries. Once a discovery has been made within the sanctuary, it would be difficult to resist the urge to look for other reserves near it. We must decide whether we are going to protect these animals or not. If we are going to protect them, we must establish a whale sanctuary now.

Offshore Concerns

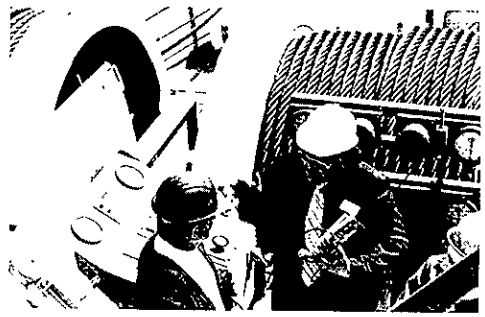
The Move Offshore

Exploration has now moved offshore. Permits granted cover the whole continental shelf of the Beaufort Sea. Spokesmen for the industry told the Inquiry that the greatest potential reserves are thought to be there. Ten wells have already been drilled offshore



CANMAR drillship Explorer. (DIAND)

Vince Steen, of Tuktoyaktuk. (M. Jackson)



Reporter and crew member aboard drill ship. (Native Press)

from man-made islands. Dome Petroleum, through its subsidiary CANMAR, has begun a 16-hole deep-water exploratory program from drill ships. Two wells were drilled in the summer of 1976.

Offshore petroleum development in the Beaufort Sea is in its infancy. But if the pipeline were approved and industry were assured of a transportation system for gas and a corridor for oil, both onshore and offshore exploration would be intensified. Flow lines, pipelines, oil and gas processing facilities, delineation drilling and related logistics and support activities would expand beyond the Delta and the man-made islands already built.

The Beaufort Sea offers one of the world's most hostile marine environments to oil and gas exploration. Much of it is covered by the permanent polar pack ice, which circulates slowly around the Polar Basin. The area between the polar pack and land is seasonally covered by ice. Land-fast ice forms during the fall along the shoreline and shallow water areas, and drilling from man-made islands has taken place in this zone. Between the land-fast ice and the polar pack is the shear zone, where currents and other forces cause the ice to move, forming huge pressure ridges with intermittent leads of open water. It is in this shear zone that Dome Petroleum's wells are located. In summer, when CANMAR drills these wells, ice flows moving across this area are a hazard to the ships and drilling operations.

The industry's ability to do this work under these formidable conditions represents a major achievement, and it has taken us across a technological and geographic frontier that no other nation has yet crossed. It is, nevertheless, a pioneering venture that entails serious short-term and long-term environmental risk. Vince Steen, in speaking to the Inquiry, voiced the concern of many Inuit people:

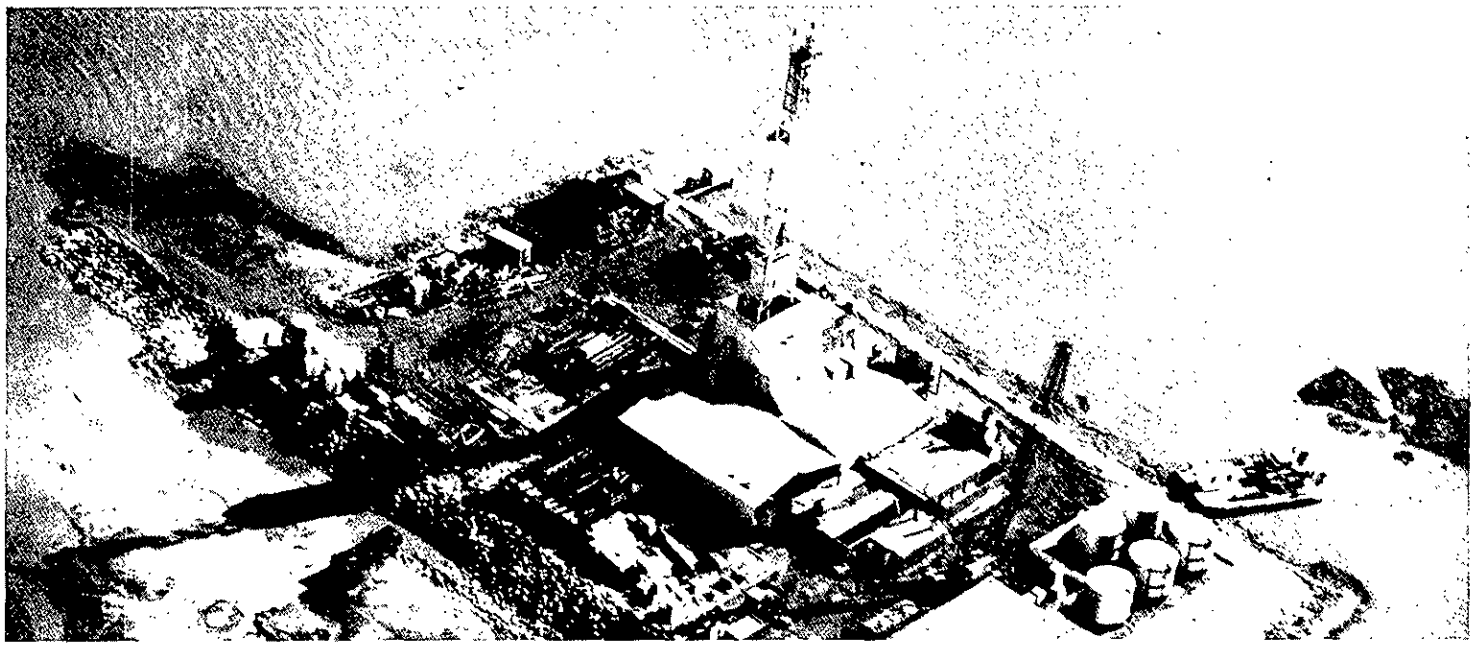
> Now they want to drill out there. Now they want to build [a] pipeline, and they say they're not going to hurt the country while they do it....
>
> If they drill out there, if they finish off what little whales are left, what little seals are left, what little polar bears are left, with one oil spill of any size big enough to hurt those animals, we're finished. The Eskimo population and culture is finished, because you [will] have to live as a white man and you [will] have nothing left. You have no more seals to feed the foxes. You've got no more fish to feed the seals, and you've got no more seals to feed the polar bears, and the polar bears are going to go looking for some white men then, because they've got nothing left to eat.
>
> Already in the Eastern Arctic there are Eskimos getting seals covered with oil, and there's no oil work there yet, just from ships spilling their used oil: and seals, because they're covered with oil, they've got no more hair on their heads, no more hair on their body, and they're starving. That's on record in Yellowknife the last two weeks or so.
>
> If they get ... an oil spill out there in that moving ice where they can't control it, that's the end of the seals. I think that not only will this part of the world suffer if the ocean is finished, I think every [Eskimo, from Alaska] all the way to the Eastern Arctic is going to suffer because that oil is going to finish the seals. It's going to finish the fish, and those fish don't just stay here, they go all over. Same with the seals, same with the polar bears, they go all over the place, and if they come here and get soaked with oil, they're finished.
>
> For the Eskimo to believe now that the white man is not going to do any damage out there with his oil drilling and his oil wells is just about impossible, because he hasn't proven himself, as far as I'm concerned he hasn't proven himself worthy of being believed any more. That includes the federal government because I know I've worked with them, and I've done seismic work for them where they just blew up fish, and they had to be shut down by the federal Fisheries, there were so many fish killed. But he was not going to shut himself down, not as long as there was nobody seeing him doing it. ... So how can you just blame the oil company or the average white man? It's the government. The government is not running things – they're not even controlling themselves, how can they control anybody else? [C4201ff.]

The move to drill offshore began in 1971, when Imperial Oil applied for permission to build an island to use as a drilling platform in the Beaufort Sea. The Government of Canada granted that permission in 1973, and the artificial island, called Immerk, was built in shallow coastal waters with material dredged from the sea floor.

In the winter of 1973-1974, Panarctic drilled their first well in the high Arctic from reinforced ice in Hecla and Griper Bay, near Melville Island. This and subsequent offshore wells in the high Arctic have been drilled from ice-thickened pads on sea ice. The drilling is done in late winter and early spring, but it must stop while there is still enough time in the season to drill a relief well, should one be required to control a blowout.

The drilling in Hecla and Griper Bay and from Immerk set a precedent of great importance; it marked the transition from land to marine operations in the Arctic and the first move toward a new frontier of exploration. This frontier was extended when, on July 31, 1973, the Cabinet gave approval in principle to Dome's drilling program in the Beaufort Sea.

Because Dome's program is in the shear zone, drilling from the ice is impossible; it must, therefore, take place during the short summer season from ships. Special safety precautions and quick evacuation measures have been developed in case ice threatens the



drill sites. But the summer season of open water is very short, and, if there were a blowout, the time available to drill a relief well would be severely limited. If a blowout occurred late in the season, it might not be possible to control it with a relief well until the following summer.

Although drilling from artificial islands poses similar problems, the risks are not of the same order of magnitude. If another island had to be built to control a blowout, that could be done in summer and winter, although break-up and freeze-up might prolong the construction period. Artificial islands in deep water may create further problems because of the long time required to build the island needed for the relief well.

After the Cabinet's approval in principle of offshore drilling, the government initiated the Beaufort Sea Project. This joint government-industry venture was planned as a two-year program, and much of the work took place during the season of open water, which usually lasts about two and one-half months.

I have examined the reports of the Beaufort Sea Project and have heard evidence from many of the scientists that took part in it. Indeed, that evidence has been the basis of my analysis of the impacts of offshore drilling. The government established the project to assess the impact of a limited program of drilling from drill ships in the Beaufort Sea. On the basis of that work, the government decided that Dome's drilling program could proceed. It is not for me to express an opinion on that decision. The government obviously weighed all the issues carefully. But it is the Inquiry's task to consider the long-term consequences of an expanded program of exploratory drilling and gas and oil field development in the Beaufort Sea. If a pipeline is built, the industry will be eager to proceed with a drilling program going far beyond Dome's 16 wells. It is the risks of this expanded program that concern me.

Sea-bed Permafrost and Ice Scour

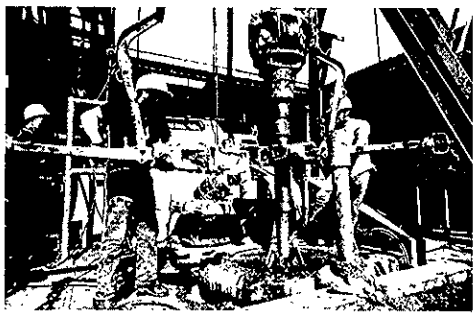
To illustrate the novel technological challenges that lie ahead in petroleum development in the Beaufort Sea and the risks that may lead to oil spills, let me describe briefly some problems created by sea-bed permafrost and ice scour. According to James Shearer, *floating ice in the Beaufort Sea* scours the sea floor out to about the 100-foot contour, although most recent scouring is thought to be within water depths of up to 60 feet. The depth of scour penetration into the sea floor varies: most are less than 10 feet, but some scours 25 feet deep have been noted. This ice action obviously poses real threats for platforms and sea-bed installations, such as pipelines or flow lines connecting wells to offshore and onshore production facilities.

The native people who live in the Beaufort region are well aware of this problem and are therefore quite anxious about offshore development. Here is what Sandy Wolki told the Inquiry when we visited North Star Harbour:

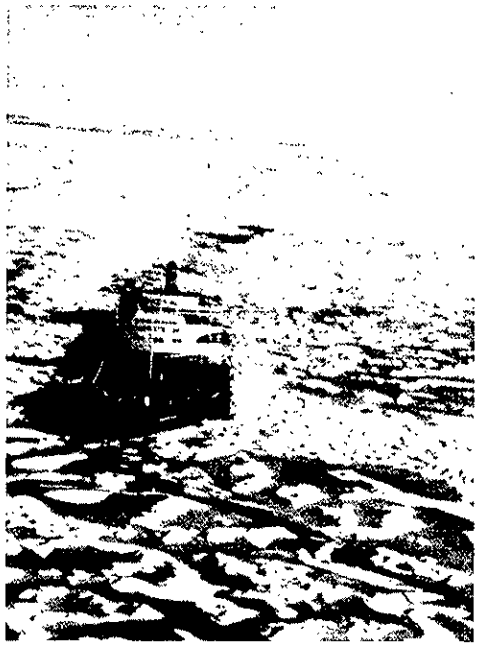
> I am concerned about the drilling offshore ... it may be disaster for sure.... At one time ... I was chasing a polar bear along the ridges and I had to jump from one ridge to another because they were like huge mountains ... I got among those pressure ridges, it's way out and it's very deep, but in the gouges from that pressure it was bringing some mud up and [I] saw some earth on top of the pressure ridge that was almost unbelievable because it was in the deep water....
>
> If they build a pipeline from the Beaufort Sea to the mainland, if that type of pressure starts to build up [it doesn't matter how] much protection or no matter how well you put it in, it will have some effect on the pipeline because of the ice and the gouges that it worked with. Taking mud from the bottom is something that we haven't studied yet.
>
> ... even the scientists or whoever is studying that area ... haven't done enough studies or don't know enough about it because when [I] was out there ... the pressure ice was so heavy that it was just like mountains ... that's just the surface part. What about the bottom part? ... [I] know the large percentage of ice is in the bottom and when [I saw] this mud coming up from the deep water [I am] really concerned because nobody really has studied it or made any true look at it.... [I've] seen it with [my] own eyes and if they can do that gouging way out down deep, there must be some ... heavy or strong pressure ... somewhere in order to develop this type of mud. Because of the rolling, I guess it starts to build up pressure, the ice starts to build up pressure. [I] saw some thickness of the ice ... it's not just thin ice, it's all heavy ice.
>
> [I am] concerned about it because nobody really knows anything about that pressure ridge. It's really strange to see it, and if they build a pipeline anywhere in the Beaufort Sea and this type of thing should happen to occur there's bound to be some damage or disaster within that time. [C4151ff.]

There is permafrost in the ground below the Beaufort Sea. In some places the frozen soils seem to be very close to the surface, but we do not know how much ice they contain. If, as appears likely, the offshore flow lines must pass through frozen ground, it will be important not to melt the permafrost, in order to prevent subsidence and damage to the flow lines. The same kinds of problems that we discussed earlier in connection with a buried refrigerated gas pipeline are present here: the melting of permafrost and the possibility of creating frost heave.

When I discussed frost heave, I said that



Sun Oil rig on artificial island, Beaufort Sea. (W. Hock)



Workers on arctic drill rig. (NFB–McNeill)

Sea ice and tanker Manhattan. (GNWT)

Mackenzie Delta. (NFB–McNeill)

the Government of Canada has a fundamental responsibility to undertake independent research into the problems that face oil and gas exploration and development projects in Northern Canada. Questions relating to offshore permafrost, ice scour and offshore production and transportation of hydrocarbons cannot be left for industry alone to solve. I therefore urge again that the Government of Canada establish a northern research program into these basic problems to provide the knowledge it will require concerning industrial development in the North.

Spills and Blowouts

One of the major risks in an expanded program of offshore exploration and development is an oil spill. I am talking here about a major oil spill, such as from a blowout beneath the sea or the sinking of an oil tanker. The chances of such a spill are difficult to calculate and different estimates of the probability have been quoted. But this much is clear: increased activity increases the possibility of such a spill. The consequences of a major oil spill would be catastrophic.

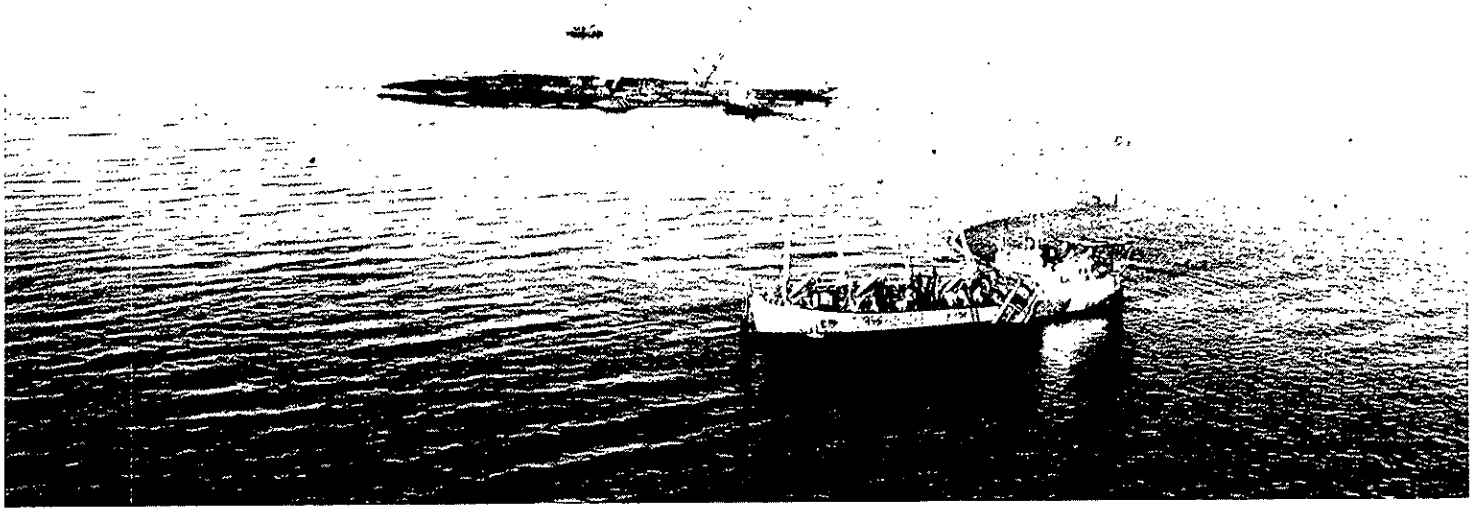
How much oil might be released from a blowout on the sea bottom? Dr. Allen Milne said that, if an undersea blowout ran wild for a year, the volume of oil discharged under the ice would be comparable to that carried by a supertanker. E.R. Walker, in his report *Oil, Ice and Climate in the Beaufort Sea*, offered these estimates:

> The oil industry believes the possibility of a subsea well blowout with a significant escape of oil is very small. If we postulate one blowout which runs wild for one year, then if the release rate is 2,500 barrels per day at the start, and 1,000 barrels per day after the first month, the blowout will release 382,500 barrels of oil. ... Each barrel of oil will be accompanied by 800 cubic feet of free gas. This blowout could occur anytime during the exploration phase. We may expect additional small releases of fuel oil throughout the exploration phase because of minor spills. We may roughly estimate those as being less than 1,000 barrels per year. We might expect losses of oil from artificial islands to occur all around the year. Most releases from ships will probably occur in summer....
>
> Although the terms of reference of these Beaufort Sea studies cover only the exploration phase, it is interesting to speculate upon the amounts of crude oil likely to be released if exploration proves reserves of the size estimated above [up to 40 billion (4×10^{10}) barrels of oil and 50 trillion cubic feet of gas]. ... To estimate the releases of oil during the production phase in a crude way, we may assume a loss factor (for all causes) of the total oil likely to be produced. There is considerable dispute about the appropriate loss factor [ranging from] 0.1 percent [to] 0.001 percent [the latter figure being supplied by the oil industry]....
>
> If we use the (perhaps high) figure of 1×10^{10} barrels of oil in the Beaufort Sea, then for the loss factors of 0.1 percent and 0.001 percent, the total loss of oil would be 10^7 and 10^5 barrels respectively, or 4×10^5 barrels per year and 4×10^3 barrels per year if the oil release is spread evenly over a production phase of 25 years. The assumption of uniform release rate seems reasonable since the losses during the production phase will probably be small spills with a remote chance of a larger accident....
>
> We assume that a blowout on man-made islands is equally likely at any time of year. In summer, oil will presumably escape into open water. In winter, it will probably run out on the top of ice, probably land-fast first-year ice. With some luck and forethought, oil escaping in the winter could be collected or burned.
>
> Blowouts of wells drilled from floating platforms or ships are most likely to occur over the period August to October. The probabilities of stopping the flow of oil from blowouts in this situation (if natural bridging-over does not occur) are hard to gauge. They are probably less in incidents occurring toward the end of the season, and presumably a blowout could continue to emit oil and gas from one autumn to the next summer.
>
> Oil from such a blowout will initially be released into open water or loose pack ice. Heavier pack ice could move over the site. Depending on the location of the blowout, the winter situation could include ice cover ranging from land-fast annual ice to polar pack ice. [p. 15ff.]

There have been blowouts in the Arctic, but fortunately, none has involved oil. Of the two gas wells that have blown out in the high Arctic, one ran wild for nine months, discharging gas into the air. Dome Petroleum had trouble with the two wells drilled in the Beaufort Sea in 1976: one well had a blowout involving fresh water, the other had an underground blowout in which gas escaped from the well into a porous rock formation before it reached the surface. Both were said to be under control by the end of the 1976 drilling season.

When you consider the industry's high hopes and, indeed, their oft-stated expectations of substantial oil and gas reserves under the Beaufort Sea, you see that the chances of an oil blowout in these hazardous waters cannot be discounted. There is much to be said for a very conservative approach in these matters.

Dome's drilling program has made us all aware that blowouts are one source of an oil spill, but there are other possibilities, too. Once offshore discoveries are made, production, storage and transportation facilities will be required, and they offer a variety of risks for spills of their own. But the origin of the spill is of little consequence once it has happened. At that point our concern will be the magnitude of the spill and its impact.



We should not forget that the people who are most concerned are the native people. Here is what Sam Raddi, President of the Committee for Original Peoples Entitlement, told me in Inuvik:

> For the people that want to drill on Beaufort Sea, Mr. Berger, I want you to take note of this. I spent a lot of time with my father – he is 74 years old – and his cousin, Phillip Nuviak, who is 84 years old. . . . They tell me in their stories that the old-timers, their great-grandfathers, would tell them that one day, if the ocean, the Beaufort Sea ever loses its fish and wildlife, the whales, the fishes, the seals, the polar bears, if the Beaufort Sea will lose that, the natives – the Eskimos – will have very little chance to survive. They said the main source of food comes from the ocean and they always tell us to respect the whole Beaufort Sea.
>
> So we have been trying all these years to protect the whole Beaufort Sea, and also the animals on the land, respect the land and the animals, not to overkill them. Now, Mr. Berger, it seems like this is the end of a lot of food for us. If they ever drill in the Beaufort Sea, if they ever have an accident, nobody really knows how much damage it will make on the Beaufort Sea. Nobody really knows how many fish it will kill, or whales, polar bears, the little whales and the bowheads.
>
> These people that did research on the Beaufort Sea will never be able to answer these things. When will the fish and the whales come back? They got no answer, and yet they want to go ahead and drill on the Beaufort Sea. It's the Eskimos that will pay for any damage, any oil spills, any damage to wildlife, it will be us that will be paying for it the rest of our lives. God knows if the fish and the whales will ever come back. We don't know.
>
> Mr. Berger, I hope you take note of this and it's unfair to us because there's very little research done on the Beaufort Sea. Two years of research and they feel they have enough information to give a permit to go out and drill. That's not true because we lived here millions of years, and we know in two years they cannot get all the answers to what they are trying to achieve. [C3458ff.]

Spill Clean-up

Throughout this report I have stressed the need to examine the proposals before us in the context of the Pipeline Guidelines. They specify that effective plans be developed to deal with oil leaks, oil spills and pipeline rupture. In my opinion, the long term, principal concern is for oil spilled in the course of drilling, and from production and transportation of hydrocarbons originating in the area. Blowout spills are of this kind and such spills can occur onshore as well as in the sea. On a more limited scale, I am also concerned over spills of fuel brought into the area for use in connection with one or other of the large projects involved in petroleum development. The importance of fuel spills should not be underestimated, particularly if the fuel gets into water. There is a tendency to understate concerns over spills connected with a gas pipeline or gas producing facilities when compared with an oil pipeline and oil wells. But, nonetheless, there are real and major concerns over fuel spills connected with construction of the gas facilities because of the very large quantities of fuel that are involved. Arctic Gas say that 2.6 million gallons of fuel will be stored at a typical wharf and stockpile site during construction. Foothills' requirements are somewhat less, but they are of the same order of magnitude. Foothills are considering using a 35,000-ton tanker to carry fuel through the Bering Strait and into the Beaufort Sea to supply their construction sites in the Delta. Imperial, Gulf and Shell will also require large quantities of fuel during the construction of their gas plants: Taglu, located in the heart of the Delta and subject to seasonal flooding, will require 12 million gallons; construction of Niglintgak will require about 4 million gallons; Gulf's plant at Parsons Lake will require about 9 million gallons. Volume Two of this report will offer specific recommendations that are designed to reduce risk of fuel spills from the pipeline. But no matter what design and inspection measures are taken, the risk of spills will always be present. Commission Counsel submitted that industrial development on the scale proposed will render spills inevitable. I concur with that view.

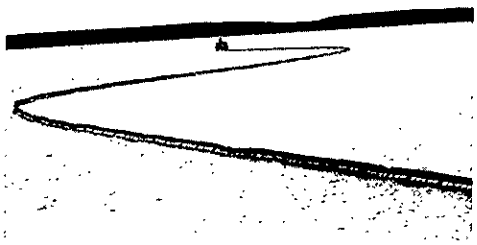
Delta Spills and Clean-up

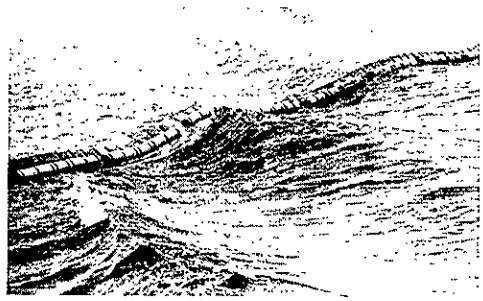
A spill within the Delta would quickly spread through its myriad channels, subchannels, swamps, bogs, lakes and mud flats. Although the degree of pollution would vary with the site of the spill and the river level at the time, it is physical conditions such as these that led Dr. Norman Snow, a biologist with the Department of Indian Affairs and Northern Development, to conclude:

> . . . the Mackenzie Delta and its immediate adjacent offshore area represents a set of conditions which would tend to maximize the adverse effects of an oil spill if one were to occur there. [F19125ff.]

Spills on land are relatively easy to manage. The main concerns and problems arise when a spill reaches water. If there is a major spill in the Delta, it is highly probable that it will get into the water, because of the myriad channels and lakes that make up the Delta and because of the extent of seasonal flooding.

But it is not just a spill within the Delta that would threaten it. A spill anywhere along the lower Mackenzie River could be





Dredging to construct an artificial island. (J. Inglis)

CANMAR testing oil spill cleanup techniques. (GNWT)

Sam Raddi. (DIAND)

Oil spill containment boom. (GNWT)

carried into the Delta. Oil spilled in the Beaufort Sea could be carried along the coast into the waters bordering the Delta and, through the action of storm surges and reversing currents, onto the Delta itself. If an oil spill did spread through the Delta, the possibilities of cleaning it up are minimal. The oil would remain for a long time.

An oil spill in the Delta could seriously impair the productivity of its wildlife resources. Chemical pollutants in the water could alter the food chain. Valuable habitat could be lost. Salt marsh grasses, seaweeds and other aquatic vegetation could be destroyed. If such damage is extensive, sediments normally held stationary by the roots of these plants could be eroded. Vegetation so polluted generally takes two or three years to recover. We know from an oil-spill experiment in Caribou Bar Creek that a small quantity of crude oil reduced the zoobenthic organisms to one-third of their previous abundance. Snow said that successive spills or heavier contamination would produce an even greater decrease, thereby impairing a stream's capacity to sustain fish. He summarized the effects of an oil spill on birds in these words:

> Seabirds are probably the most obvious casualties of oil spills. Mortality usually results from the destruction of the water-proofing and heat-insulation ability of their feathers and also from oil ingestion during preening. The Delta and offshore areas are utilized extensively by many bird species ... [and] apart from the direct mortality from oil spills, [there is] the additional long-term component which may result from the loss of nestlings, the nest sites themselves being rendered useless for future generations, by oil contamination, and the threat of degrading feeding, brood-rearing and staging areas. [F19127ff.]

What response could be made to an oil spill in the Delta? If it were a major spill, there is very little that could be done. If a major spill cannot be efficiently cleaned up – and we know it cannot be – in the more favourable conditions of the temperate latitudes, one certainly could not be cleaned up in the harsher and remoter northern environment.

Arctic Gas, Foothills and the three gas producers, Imperial, Gulf and Shell, have developed plans to prevent and control spills. In the Delta, the Arctic Petroleum Operators Association have stockpiled petrochemical spill contingency equipment and have undertaken the training of manpower to develop what they call the Delta Environmental Protection Unit (DEPU). But DEPU and the contingency plans that the pipeline companies brought before the Inquiry will be of limited effectiveness if a major spill occurs. From the evidence brought before me, it is apparent that we do not have the technical ability to clean up a major spill in the Delta, especially if it is spread through the maze of channels and mud flats.

Beaufort Sea Spills and Clean-up

In discussing oil spills in the Beaufort Sea, I want it to be understood that I am not in any way suggesting the Government of Canada ought to reconsider its decision to allow Dome to drill 16 exploratory wells in the deep water of the Beaufort Sea. I simply believe that it is essential for the government to consider the risks entailed in proceeding with a full-scale program of oil and gas exploration and development there subsequent to the Dome program.

Spills of oil in the Beaufort Sea, whether from a blowout or from another source, may be caught up in the sea ice, dispersed in the water column, absorbed into bottom sediments and spread along the coast. The oil and ice interaction may take many forms. Oil could be encased in growing seasonal ice and could move long distances in that form before being released in the spring melt. Or it might be incorporated into the polar ice pack, where it would be retained for many years. Oil could accumulate under the floating ice or spread along open water leads.

The spread of oil in the vicinity of the Delta would be enhanced by the movement of the river water in rapidly changing patterns over the denser and colder sea water. Our knowledge of these water movements is limited.

In the spring, the higher forms of marine life, such as seal, polar bear and white whale, migrate along the open leads in the ice. Oil would also move along these leads as they open up in the spring. As the band of open water in the shear zone expands, oil will move closer to shore and, finally, when the land-fast ice melts, oil will move freely about and reach the shoreline.

Birds that migrate to the Arctic in spring seek out these areas of open water. Landing on oiled water is likely to be fatal for them. According to Dr. Tom Barry of the Canadian Wildlife Service, a lead of open water in the ice off Cape Dalhousie, at the tip of Tuktoyaktuk Peninsula, may be occupied by 50,000 birds at any one time in the late spring. These birds are replaced in a few days by 50,000 others, who need the open water to feed and rest, and so on through the migration period. The possibilities for enormous losses of bird life are obvious.

A spill of oil could work right through the food chain. I have described the under-ice biota in the Beaufort Sea. If oil reduces the food supply of benthic invertebrates and fish, the seals will be affected, and through

them the polar bear is threatened. Even though the polar bears might not be threatened directly by an oil spill, they might well be threatened indirectly.

Dr. Allen Milne, head of the Beaufort Sea Project, testified that the consequences would be very serious if a major oil spill occurred in the Beaufort Sea. The Project's environmental assessment indicates that recovery of the Beaufort Sea marine ecosystem from even a single major spill could take as long as a decade.

Given the scale of hydrocarbon development that is envisaged for the Delta-Beaufort region, a major spill is not only likely, it is inevitable over time. That must be our assumption, and it is based on the experience of spills elsewhere during exploration, and during production, transportation, handling and storage. We have not yet developed clean-up techniques adequate for major spills in temperate or tropical waters. We simply are not prepared for a major spill in the Beaufort-Delta region. The equipment we do have will not be effective; our present knowledge of the marine ecosystem, of ice conditions and of the behaviour of oil in arctic waters is quite insufficient to provide the information that is needed. What we do know simply reinforces this conclusion: we could not clean up a major oil spill in the Beaufort Sea.

There has been no experience with the problem of cleaning up a large oil spill in arctic waters. We can, however, look elsewhere to get some idea of the general sort of problems we might face if we did have a major spill.

In late December 1974, a storage tank at the Mizushima Refinery in Japan containing 11 million gallons of bunker C oil broke and the escaping oil breached a dike, and spread into the adjacent harbour. Clive Nichol of Environment Canada's Environmental Emergencies Branch told the Inquiry that the spill could not be contained, despite the immediate availability of men and equipment and a relatively benign climate. The deployment of 30,000 metres of boom, 738 boats, 153 aircraft and 8,189 workers had little success. Within a week, between 1.6 and 2.1 million gallons of oil had spread through the Inland Sea of Japan. Over 290 miles of coastline were polluted. The spill is estimated to have cost over $160 million. This all happened despite the existence of contingency plans, a well-drilled spill-contingency team and almost unlimited manpower and equipment. The process of clean-up eventually had to rely on thousands of people using long-handled bailers and empty 45-gallon drums. The handling and disposal of the spilled oil and polluted material, once it was picked up, posed an additional problem. For each gallon of crude oil spilled, about five gallons of oil-sludge-water debris was recovered.

The Mizushima incident is a dramatic but not unusual example. We are reminded almost every month of our complete inability to cope with spills even under favourable circumstances. The barge *Nepco 140,* which grounded in the St. Lawrence River in June 1976, spilled about 240,000 gallons of oil, and attempts to clean it up cost $8 million. Other recent disasters include the 108,000-barrel *Arrow* spill in Chedubucto Bay and the *Argo Merchant* spill off New England. Major spills have resulted from drilling activity in the Mississippi Delta and the Gulf of Mexico. In the Santa Barbara spill off the California coast, 100,000 or more barrels were lost in a well blowout.

These experiences amply demonstrate that, despite our advanced exploration and development technology, we cannot handle large oil spills in areas of winds, waves and currents. These conditions are characteristic of the Delta-Beaufort region, and they are further complicated by isolation, low temperatures and moving ice. The deployment of the men and equipment necessary to deal with a major oil spill in the Beaufort Sea would be an awesome task and extremely costly. We might be tempted – or even forced – to follow the example of Chile, when oil spilled from the tanker *Metula* near the Strait of Magellan. The Chileans decided the area was too remote and difficult to warrant clean-up of any kind.

The Pipeline Guidelines require the pipeline companies:

> ... to provide documented evidence that they possess not only the necessary knowledge, but also the capability to carry out specific proposals. [p. 13]

Environmental Guideline 8 requires:

> ... that effective plans be developed to deal with the oil leaks, oil spills, pipeline rupture, fire and other hazards to terrestrial, lake and marine habitats, that such plans be designed to minimize environmental disturbances caused by containment, clean-up, or other operations and to bring about adequate restoration of the environment, that they be designed to deal with minor and major incidents, whether they are single-event or occur over a period of time and that they include contingency plans to cope with major hazards or critical situations. [p. 15-16]

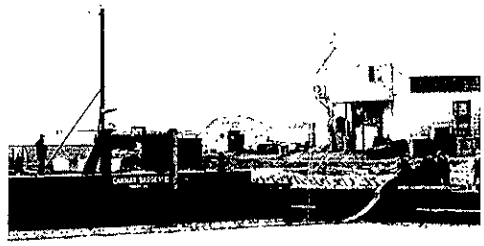
Although these requirements are clearly the obligations of the pipeline companies, they also have some bearing on the industry as a whole. Is clean-up technology adequate? Is the equipment available? Are the deployment plans sufficient? In the final analysis, we must determine whether or not the industry – or the government for that matter – has the capacity to control and

Polar bears of the Beaufort Sea. (GNWT)

Biologists collecting fish in an arctic river. (Arctic Gas)

Diver carrying out underwater tests on Cornwallis Island, NWT. (NFB–McNeill)

CANMAR base near Tuktoyaktuk. (GNWT)



clean up a major spill. Today neither of them has.

Albedo, Climate and Research

On April 15, 1970, Parliament passed the Arctic Waters Pollution Prevention Act, a landmark in the development of legislation to protect the ecology of arctic waters. On that occasion, Prime Minister Trudeau used these words:

> The Arctic ice pack has been described as the most significant surface area of the globe, for it controls the temperature of much of the Northern Hemisphere. Its continued existence in unspoiled form is vital to all mankind. The single most imminent threat to the Arctic at this time is the threat of a large oil spill ... [which] ... would destroy effectively the primary source of food for Eskimos and carnivorous wildlife throughout an area of thousands of square miles. ... Because of the minute rate of hydrocarbon decomposition in frigid areas, the presence of any such oil must be regarded as permanent. The disastrous consequences which its presence would have on marine plankton, upon the process of oxygenation in Arctic North America, and upon other natural and vital processes of the biosphere, are incalculable in their extent. [p. 5ff.]

What did the Prime Minister mean when he said that the arctic ice pack controls the temperature of much of the northern hemisphere? What did he mean when he said its continued existence in unspoiled form is vital to all mankind?

He was referring to albedo, that is, to the reflective capacity of ice. The presence of oil would darken the ice, and lower its capacity to reflect light. More solar energy would be absorbed, which could lead to the ice melting earlier than usual. This change would enlarge the area of open water in the Arctic Ocean and lengthen the open water season to some degree, which in turn could bring about changes in climate. Whether a reduction of the ice pack by this means would ultimately have an effect on the climate that would exceed the effect from natural fluctuations in ice cover is something we do not know.

The Beaufort Sea Project considered this very question when it examined the risks of the Dome drilling program. E.R. Walker wrote:

> The effects of oil on the large-scale heat budget of the Beaufort Sea and Arctic Ocean are dependent on the scale of oil release. For the scenario for exploratory drilling, of one blowout, or even for a much larger release of oil, the area covered by oil would be too small to affect the large-scale heat budget of the Beaufort Sea, let alone of the Arctic Ocean as a whole. [*Oil, Ice and Climate in the Beaufort Sea*, p. 35]

However, the Beaufort Sea Project's terms of reference were limited to only the exploratory phase of Dome's drilling program. Walker was not prepared to say that he was certain there would be no impact on climate in the production phase. He put it this way:

> ... it is certain that during the exploration phase of Beaufort Sea operations not enough oil is likely to be released to affect even local climate.
>
> The effect of oil release upon climate during a possible production phase is less certain. The writer's opinion is that while sizeable volumes of oil may be released, this oil will probably not spread over a sufficient area to affect anything but local climate. However as noted above several uncertainties remain. [p. 34]

These uncertainties relate to behaviour of oil in the ice, the migration of oil to the surface of the ice, the rate at which it evaporates, the rate at which it degrades, the circulation of the ice, the impact of open water on the weather and so on.

Milne felt that one major spill would not have any effect on the climate:

> ... it is unlikely that oil discharged into the Beaufort Sea from a single oil well blowout running for several years would have any effect whatever on global or even local climate. [F18988]

But he entered a caveat:

> This is not to discount the possible climatic effects which might occur from a continuation of oil spills which might result from more wells being drilled and offshore production, and production spills and pipeline breaks. Now we're getting into a different order of magnitude there. [F19011]

Arctic oil and gas exploration and production would not be limited to the Beaufort Sea. Drilling is also going on in the high Arctic, and there are plans for offshore drilling in the Eastern Arctic. The Americans are planning to drill offshore from Alaska's north slope. The Soviet Union may soon be drilling off its immensely long arctic coastline. Drilling may also take place off the Arctic coast of Norway and off the coast of Greenland. Do we have any idea of the impact of several major spills in arctic waters around the globe? These events may be only five, 10 or 15 years away.

Through the Beaufort Sea Project we now have assessed the risks faced by an initial exploration of Canadian waters in the Beaufort Sea. We are uncertain about the extent of the risks that production would cause in those waters, and we have not yet attempted to appraise the risks of simultaneous oil and gas exploration and development in arctic waters by all the circumpolar countries.

To what extent might the climate be affected by a series of major spills in arctic waters? No one can say. And no one is investigating the matter. The Beaufort Sea Project has been terminated. There is no

Sattelite photo mosaic showing lower Mackenzie River, Mackenzie Delta and adjacent parts of the Northern Yukon and Beaufort Sea.

Dogs and sleigh on arctic ice. (ITC)

international program underway to investigate this phenomenon. Canada, as the pioneer of arctic offshore drilling, ought to take the initiative.

A study must be made of the interaction of ice and oil, of the biological degradation of oil in icy waters, and of the possible influence of the loss of the polar pack on climate. Who should carry out this research? I say it should be fully funded by government, and carried out under government auspices. The Beaufort Sea Project will not do as a model. That project was jointly sponsored by government and industry. That kind of arrangement mixes up the functions of government and the goals of industry.

The Prime Minister referred in 1970 to the critical role of the polar ice pack in the world's weather system. Canada, having been the first to warn of the risks that are involved in spilling oil in arctic waters, and having been the first to drill in these ice-infested waters, should now lead the way in calling for an international program of research. Canada should propose that research should be undertaken jointly by the circumpolar nations into the risks and the consequences of oil and gas exploration, development and transportation activities around and under the Arctic Ocean.

The question of what effect oil spills in arctic waters will have on albedo and climate is one that is surrounded by controversy. I have cited the views of two Canadian scientists who take a conservative approach in the matter. It illustrates once again my general concern over the adequacy of scientific knowledge relating to oil and gas development in the North. It demonstrates the need for fundamental and applied research.

The albedo question is only one of a number of gaps in our knowledge that have hampered this Inquiry in conducting its assessment and in making the judgment that it has been called upon to make. Undoubtedly similar gaps in our knowledge will hamper the government's assessment of future petroleum development in Northern Canada for years to come.

I take as a basic principle that government ought to be in a position to make independent and enlightened judgments about engineering and environmental aspects of proposals advanced by industry for northern development. To be able to make such judgments, government must be capable of assessing the scientific and engineering research that industry has carried out. When fundamental questions of environmental impact are involved, government cannot leave it to industry to judge that impact. That is government's job and, to do this job, it must have advice of its own and competence of its own in the field concerned. Government must undertake whatever research is required to attain this competence.

It is my opinion, therefore, that government should initiate, plan and finance a continuing program of research to provide the knowledge that it requires and will require about northern development. Instant or crash programs will not adequately serve this need. Rather, such a program will require a continuity of support adequate to yield answers when they are needed. Although this research will necessarily deal with questions raised by individual projects, it should have the breadth and depth to deal also with the cumulative effects of successive developments and with questions of national or international importance.

Summary

In this chapter I have dealt with the implications and impacts of petroleum exploration, production, transportation and other activities that would accompany major oil and gas development in the Delta-Beaufort region, onshore and offshore. The Mackenzie Valley gas pipeline is viewed by many as the trigger that would bring about an abrupt transition in this spectrum of development.

As I see it, large-scale oil and gas development in this area is inevitable, whether a gas pipeline is built now or is postponed. Notwithstanding the disappointing level of discoveries in the Delta so far, the area has been rated by the federal Department of Energy, Mines and Resources as one of three frontier areas in Canada that potentially contain major undeveloped reserves of oil and gas.

Assuming then that large-scale petroleum development does go ahead, I urge the Government of Canada to adjust the pace of development and the conditions under which it is permitted so as to protect the environment and the renewable resources upon which the native people depend.

The Mackenzie Delta is environmentally sensitive and highly important for the native people. I urge, therefore, that no pipeline – either gas or oil – should be routed across the Delta, and that strict limitations be placed on locating other major oil or gas facilities on the Delta, particularly on its outer part. I recommend that special measures be taken to avoid disturbance of fish populations within the channels and lakes of the Delta and that sanctuaries be extended across the outer part of the Delta to protect migratory waterfowl. In order to preserve the white

Caribou Hills, Mackenzie Delta. (D. Mackay)

whale population of the Beaufort Sea from declining in the face of cumulative stresses imposed by ongoing petroleum exploration and production, I also urge the establishment of a whale sanctuary excluded from all industrial development, covering the principal whale calving area in the shallow water bordering the Delta.

Much of the oil and gas potential of the area is believed to lie offshore beneath the Beaufort Sea. The prospect of major exploration programs and production activities in the Beaufort Sea over a period of many years raises serious concerns for the environment and the native people. In permitting drilling in the Beaufort Sea from man-made islands and drill ships and in the high Arctic from ice platforms, Canada has become the first country in the world to embark upon petroleum exploration in arctic and ice-covered waters. We should proceed only with due care and caution.

The greatest concern in the Beaufort Sea is the threat of oil spills. In the long term, such spills could emanate from blowouts in exploration or production wells, production accidents, tankers, offshore pipelines or coastal facilities. Spills could pose a threat to mammals, birds, fish and the small organisms upon which they depend, in the Beaufort Sea, in leads in the ice, and along the coast. There is a possibility, too, that accumulation of oil in the Arctic Ocean from offshore petroleum development by all the circum-polar countries could decrease the ice cover on the ocean and bring about climatic change. In my opinion the techniques presently available are not likely to be successful in controlling or cleaning up a major spill in this remote area, particularly under conditions involving floating ice or rough water. Therefore, I urge the Government of Canada to ensure that improvements in technology for prevention of spills and development of effective technology for containment and clean-up of spills precede further advance of industry (beyond the current Dome exploratory program) in the Beaufort Sea. I further urge that advances in knowledge of the environmental consequences of oil spills should likewise keep ahead of offshore development. To meet this and other needs for new scientific information relating to petroleum development and its impact, and to ensure that government is equipped to assess the development proposals of industry, I recommend that government should undertake an ongoing program of northern research.