FALL (1976) WATERFOWL MIGRATION: IMPLICATIONS FOR THE PROPOSED ALASKA HIGHWAY PIPELINE, SOUTHERN YUKON

Prepared for:

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DECEMBER 1976

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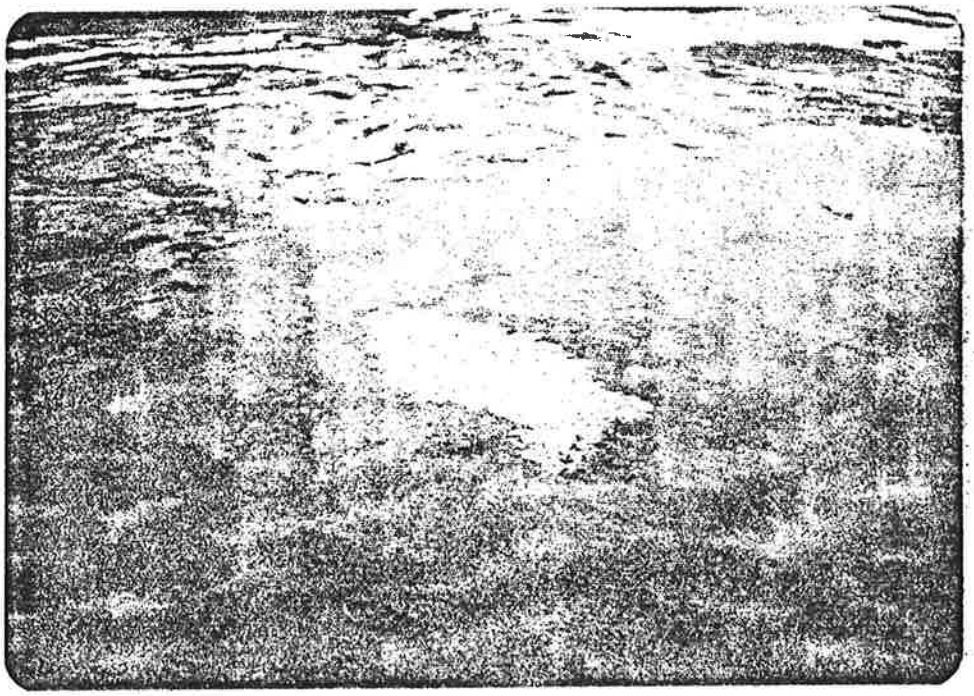
Nisutlin Bay, September 23, 1976, showing extensive mudflats used by staging geese. Colwell Bay is at the top right of the photograph.



Swans in an ice-free pool (light-shaded area) in Colwell Bay, October 14, 1976.

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SUMMARY

This study gathered information on the location of staging areas and timing of peak numbers of migrating waterfowl during fall, 1976, along the proposed Alaska Highway pipeline route in the southern Yukon.

On average, 47 percent of all waterfowl observed along the route were located at Nisutlin Bay. This staging area is easily the most important location. Most waterfowl using it were at least four miles upstream from the proposed pipeline route. The study resulted in an unexpected finding of substantial numbers of ducks staging at the outlet of Squanga Creek into Squanga Lake where a pipeline crossing is planned. Peak numbers of waterfowl occurred between September 18 and October 17, but this may have been abnormally delayed owing to mild fall weather.

Based on the information gathered, fall-migrating waterfowl could be affected by pipeline activites at South end of Kluane Lake/Slims River (Mile 144-147) (swans and ducks), North end of Marsh Lake/Yukon River (Mile 283-293) (primarily ducks), Squanga/Michie Lakes (Mile 318-321) (ducks), Teslin River (Mile 334-337)(swans, geese and ducks) and Smart River Lake (Mile 404-405) (swans and ducks). The following types of impact, ranked in order of magnitude of their potential detrimental effects, are as follows: habitat destruction, aircraft disturbance, visible human presence, blasting and habitat siltation. Recommendations for minimizing impacts are given in the main body of this report.

Habitat destruction is a self-explanatory impact. Given the present pipeline alignment, it will occur at the Squanga/Michie Lakes stream crossing. The duration of the impact depends upon the ability of the habitat to restore itself.

Aircraft disturbance can occur when planes or helicopters fly low over flocks of waterfowl, putting them to flight and causing undue stress and energy loss. Energy stores could be critical in terms of successfully completing fall migration. Displacing waterfowl from a traditionally used staging (gathering) area could also cause failure to complete migration. This impact is possible at South end of Kluane Lake/Slims River, North end of Marsh Lake/Yukon River, Squanga-Michie Lakes and Smart River Lake. Given present projected use of aircraft during pipeline activities, the impact should be temporary at most.

Visible human presence can cause waterfowl to avoid a staging area. The birds may react to a human figure more warily than to a machine, particularly in fall in a hunting area. Where vegetation does not shield pipeline crews from the view of waterfowl, this impact can be expected. It is possible at South end of Kluane Lake/Slims River, and will be temporary.

Blasting disturbance could have much the same effect as aircraft disturbance. It may occur at South end of Kluane Lake/Slims River, and will be temporary.

It is possible that some staging habitat could be affected by siltation if the habitat is downstream from a proposed pipeline crossing. Detrimental effects on food supplies could occur where the river system is not already heavily silt-laden. Locations where it may occur are North end of Marsh Lake/Yukon River (downstream from the M'Clintock River crossing) and downstream from the Teslin River crossing. The impact should be removed by normal stream flow restoration, but its effects are largely unknown.

This study defines habitat use by waterfowl and the critical fall migration period when pipeline construction should be avoided based on observations in 1976. In order to further refine the critical period when construction should be avoided, it is recommended that the study be repeated in the fall of 1977.

The locations where impacts are possible and the nature of the impacts themselves need further study and site-specific evaluation.

INTRODUCTION

Beak Consultants Limited (BEAK) was engaged by Foothills Pipe Lines Ltd. to conduct a study of fall-migrating waterfowl in relation to the proposed Alaska Highway gas pipeline route during September and October, 1976. The objective was to gather information on the timing of fall migration and the use by waterfowl of certain staging areas in order to assess the potential impact of pipeline construction and operation. Field work was commenced on September 16 and terminated on October 21. On October 21, 75 percent of all waterfowl observed were either in areas where waterbodies remain ice-free well into November at least, and where they could stay possibly throughout the winter; or they were at Nisutlin Bay -- an area of major importance to staging waterfowl considered too far from proposed pipeline construction activity to be affected by it.

METHODS

Between September 16 and October 21, 1976, a STOL-equipped Cessna 185 was used to conduct aerial surveys of sixteen waterfowl staging areas along 400 mi (640 km) of the proposed Alaska Highway gas pipeline route through the southern Yukon (Figure 1). All waterbodies believed to be of importance to fall-migrating waterfowl (BEAK 1976) lying within 5 mi (8 km) of the proposed route were surveyed. Surveys were conducted once-weekly over a period of six weeks.

Procedure involved flight at 70-100 mph (112-160 kmph) at 75-150 ft (23-46 m) above ground level. In general, the aircraft followed shorelines in a position that enabled one observer in the front passenger seat to count waterfowl from the shore outwards. Aerial transects were not conducted as most areas surveyed were too confined spatially or topographically. Numbers and (where possible) species of birds were dictated into a tape recorder. Counting techniques varied according to flock size and reactions of waterfowl to the survey aircraft. Waterfowl in small (<50 birds) flocks which remained on the water could be counted to the exact number. Large (>50 birds) flocks which remained on the water were counted in groups of five. If a large flock flew in response to the survey aircraft, the time available to count numbers accurately was short, and therefore birds were counted in groups of ten. Some counts were therefore estimates rather than censuses. Oblique aerial photographs were taken of groups of swans to supplement counts made from the air.

Several difficulties were encountered while collecting data. Many duck species are in a state of indefinite plumage colouration during September and October, making specific identification from the air difficult. When in mixed flocks, even if a duck species was recognizable, accurate counts of its numbers are not possible, particularly when in flight. In this report, the presence of a species whose numbers could not be accurately counted is marked by a "+" sign (Table 1). The traditional procedure of separating diving from surface-feeding ducks by means of take-off behaviour was also difficult. Many groups of ducks were put to flight well in advance of the aircraft's arrival, making distinction between the two groups impossible. Consequently, the majority of observations of both groups are placed in the category "unidentified ducks" (Table 1). These difficulties in data collection are not expected to affect the conclusions on the pipeline's potential impact.

The importance of the Teslin River to staging waterfowl was not realized until September 30. This area therefore lacks two surveys.

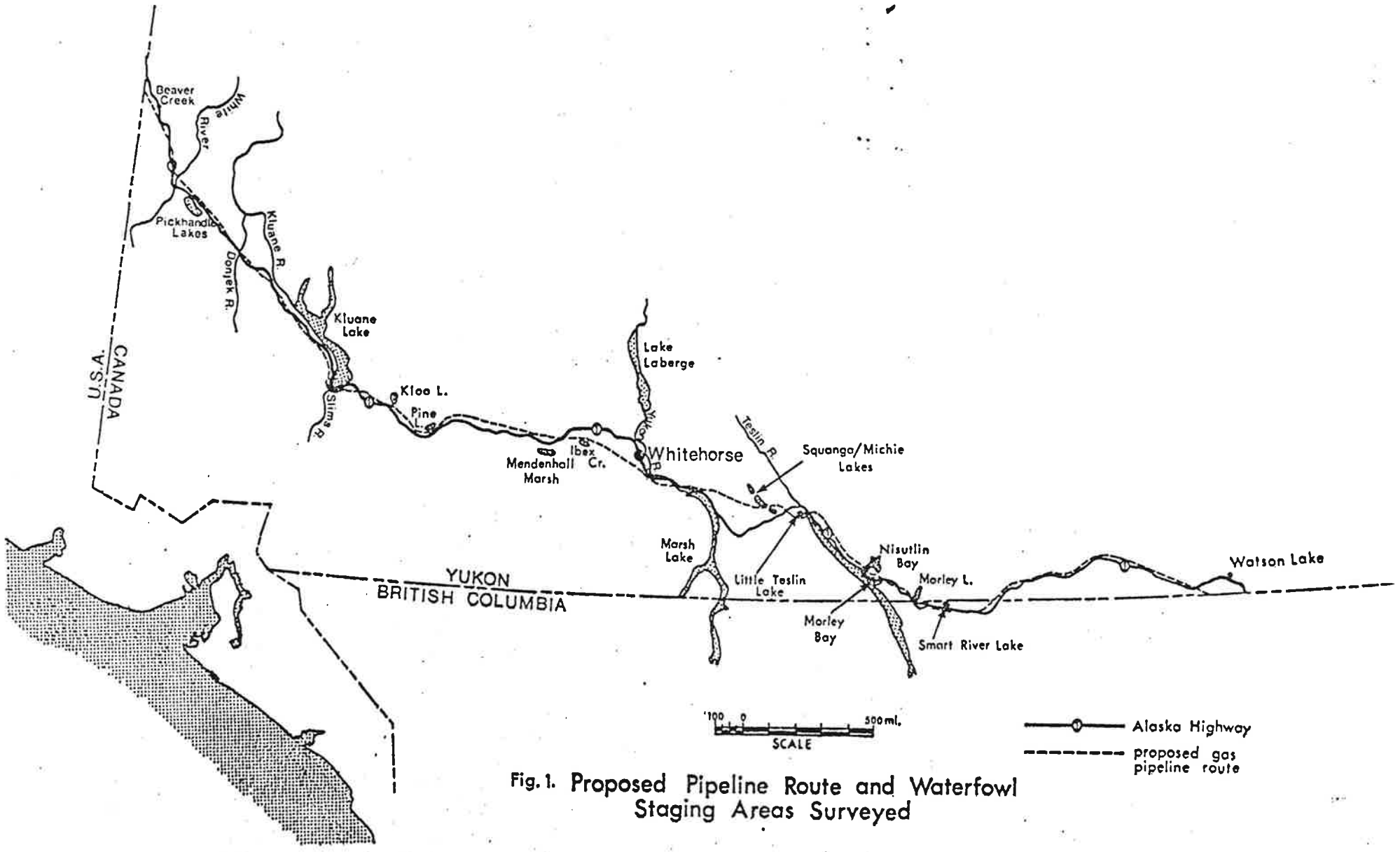


Fig. 1. Proposed Pipeline Route and Waterfowl Staging Areas Surveyed

RESULTS

Most of the areas surveyed are of little importance in terms of overall numbers of waterfowl using them when compared with Nisutlin Bay. On average, 47 percent of all waterfowl counted were at Nisutlin Bay (Table 2). Four other areas had an average of more than 5 percent of the cumulative total: the north end of Kluane Lake/Kluane River, Kloo Lake, the north end of Marsh Lake/Yukon River, and Teslin River. However, the proportion of waterfowl using Nisutlin Bay declined steadily from mid-September to late October, and other areas assumed greater importance. This was particularly the case at the north end of Marsh Lake/Yukon River, where large numbers of ducks were recorded on October 14 and 21.

In terms of bird groups in this study, swans and geese are considered to be the most important, among which the rare trumpeter swan (*Olor buccinator*) is of greatest concern. There are no published records of this species breeding in the Yukon, but it may migrate through the study area from breeding grounds in southern Alaska (Hansen et al. 1971). Trumpeter swans and whistling swans (*O. columbianus*) could not be distinguished from the air, and are therefore grouped together as "swans" (Table 1,2). Swans were observed at various sites along the proposed pipeline route (Table 1), but were most numerous at north end of Kluane Lake/Kluane River, Kloo Lake and Nisutlin Bay. Significant concentrations were also encountered at Pickhandle Lakes, Mendenhall Marsh, Teslin River and Morley Bay. As these sites may be used traditionally by trumpeter swans, they merit special attention in assessing pipeline impact (see Discussion section).

Geese (mostly Canada geese) were observed at only five of the recognized staging sites along the proposed pipeline route: north end of Kluane Lake/Kluane River, Bock's Creek outlet, Teslin River; Nisutlin Bay and Morley Bay. All of these sites have extensive mudflats with grass or horsetail (*Equisetum* sp.) expanses nearby which the geese feed on. Small flocks were also noted along the east shore of Teslin Lake near Fox Point and on the Morley River.

Ducks were most numerous at Nisutlin Bay, but large (>100 birds) flocks were also observed at south end of Kluane Lake/Slims River (on one survey only), Kloo Lake and Teslin River. They were also numerous but in smaller flocks at north end of Marsh Lake/Yukon River, Squanga/Michie Lakes and north end of Kluane Lake/Kluane River. At Squanga/Michie Lakes, the greatest numbers of ducks were concentrated in the creek inlet at the north end of Squanga Lake at the proposed pipeline creek crossing. The latter finding was unexpected.

TABLE 1. Numbers Of Observations Of Bird Species From Aerial Surveys Of Each Of Sixteen Waterbodies Along The Alaska Highway Pipeline Route, September 16 - October 21, 1976.

SITE	Pickhandle Lakes	North End, Kluane L./ Kluane River	Back's Cr. Outlet	South End, Kluane L./ Slims River	Kloo Lake	Pine Lake	Mendenhall Marsh	Ibex Cr. Potholes	North End, Marsh Lake/ Yukon River	Squanga/Michie Lakes	Little Teslin Lake	Teslin River[a]	Nisutlin Bay	Morley Bay	Morley Lake	Smart River Lake
Pipeline Mile	47-57	93-112	125	142-150	166-168	183-186	223-234	241-242	283-293	312-325	329-331	333	365	371-376	340-395	450
SPECIES[b]																
Unidentified Waterfowl	6				2	27		8		13	2		2		7	
Diving Waterfowl	1				1	1										
Common Loon	2									4	2					
Loon sp.					1					14	6				3	
Grebe sp.	1			35												
Red-necked Grebe	1															
Swan sp.	16	131	1	4	75		14		1			18	524	18		6
Canada Goose		735	145									350	4796	96		
White-fronted Goose		+											+	+		
Unidentified Ducks	649	827		1270	2092	181	604	31	1214	1036	153	999	5720	758	61	294
Dabbling Ducks										4			459			
Mallard	25	5	17		5		7			2			6			15
American Wigeon							4			8			+		4	
Teal sp.					+											
Diving Ducks	31	55			465	58	5	3	291	92		8	189	65		43
Canvasback	40															
Scaup sp.		120			+									+		
Scoter sp.									45							
White-winged Scoter					9				3	18			9			
Surf Scoter						+										
Goldeneye sp.		2													1	+
Bufflehead	1	1			10	7		1	11	17					6	1
Merganser sp.		3														
Common Merganser		1														
Sandhill Crane												1	6			
Eagle sp.	3			1			1					1				
Bald Eagle	2	1								4		5	4	4		
Rough-legged Hawk		1														1
Buteo sp.		1			1									1		
Marsh Hawk	1				1		2		1					1		
American Kestrel															1	
Shorebirds													60			
Gull sp.	1	2							2		3	1	1			
Raven	2	2		1						3		2	5	3	2	
Black-billed Magpie				1									1			
TOTAL	782	1887	163	1312	2662	274	637	43	1568	1215	166	1385	11781	946	85	470

a. Teslin River surveyed four times only, September 30 - October 21.

b. + = species observed but numbers not counted.

TABLE 2. Swans,[a] Geese and Ducks: Timing and Location of Fall Migration Numbers

DATE[b]

SITE	SEPTEMBER 16				SEPTEMBER 22/23				SEPTEMBER 29/30				OCTOBER 7				OCTOBER 13/14				OCTOBER 21				Mean % of Cum. Total
	Swans	Geese	Ducks	% of Cum. Total	Swans	Geese	Ducks	% of Cum. Total	Swans	Geese	Ducks	% of Cum. Total	Swans	Geese	Ducks	% of Cum. Total	Swans	Geese	Ducks	% of Cum. Total	Swans	Geese	Ducks	% of Cum. Total	
West Of Whitehorse:																									
Pickhandle Lakes			102	3	2		284	5	4		136	5	4		145	3	6		62	1			17	<1	2.9
N. End Kluane L./ Kluane River			180	6		100	310	7		25	15	1	10	590	126	14	110	20	126	5	11		257	8	6.8
Bock's Cr. Outlet						60		1		35		1		50		<1					1		17	<1	0.5
S. End Kluane L./ Slims River	4		90	3			1125	19			40	1							15	<1					3.9
Kloo Lake			290	9			587	10			588	19			372	7	75		527	13			217	7	10.8
Pine Lake							90	1			25	1			22	<1			42	<1			67	2	0.8
Mendenhall Marsh			94	3			36	<1			132	4	1		125	2	13		233	5					2.4
Ibex Cr. Potholes							23	<1			7	<1							3	<1			2	<1	0.3
East of Whitehorse:																									
N. End Marsh L./ Yukon River			53	2			78	1			82	3			60	1	1		606	13			685	21	6.8
Squanga/Michie Lakes			45	2			116	2			143	5			114	2			433	9			326	10	5.0
Little Teslin Lake			24	1			46	<1			77	3							4	<1			2	<1	0.9
Teslin River (Tes Upper)										110	140	8		240	530	15	12		83	2	6		252	8	8.2
Nisutlin Bay		897	1367	71		1187	1390	44		880	390	41	44	1492	1041	50	420	340	1016	38	60		1179	38	47.0
Morley Bay			4	<1		51	205	4	4	45	120	5			69	1	14		394	9			31	<1	3.3
Morley Lake			12	<1			9	<1			7	<1			4	<1			9	<1			31	<1	0.5
Smart River Lake			15	<1			122	2			51	2			62	1	6		136	3			83	2	1.7
TOTAL	4	897	2276		2	1398	4421		8	1095	1953		59	2372	2670		657	366	3689		78	0	3166		
% OF CUM. TOTAL	<1	28	71		<1	24	75		<1	36	63		1	46	52		14	7	78		2	0	98		
CUMULATIVE TOTAL	3177				5821				3056				5101				4696				3244				

a. Species are not differentiated. Trumpeter or whistling swans could not be distinguished from the air. Geese are mostly Canada Geese, with some white-fronted geese. Ducks include all diving and surface-feeding species.

b. All sites surveyed on Sept. 16, Oct. 7 and 21. Sites west of Whitehorse surveyed on Sept. 22, 29 and Oct. 13; sites east of Whitehorse surveyed

Peaks in numbers of swans, geese and ducks occurred at different times. Ducks peaked on the September 22/23 survey, in part owing to the large flock observed at south end of Kluane Lake/Slims River. Geese peaked on the October 7 survey when 39 percent of the total number counted during all surveys were observed. Swans peaked on the October 13/14 survey, when 81 percent of the total number counted during all surveys were observed. The overall peak in numbers occurred on September 22/23, coinciding with the peak in duck numbers, but after declining on September 29/30, it peaked again on October 7 when the numbers of geese were at their greatest (Table 2).

Numbers of all waterfowl were still fairly high on the date of the last survey (October 21), but at this time 75 percent were either at Nisutlin Bay or at sites where water may remain open until December. Ducks and swans may linger at such sites as long as they can (i.e. until the water freezes), and overall numbers may not decline until freeze-up occurs. Sites in this category are all where rivers drain large lakes, such as north end of Kluane Lake/Kluane River, north end of Marsh Lake/Yukon River, and Teslin River. Waterfowl using Nisutlin Bay were mostly concentrated in areas which were 6 mi (9.6 km) from the proposed pipeline route.

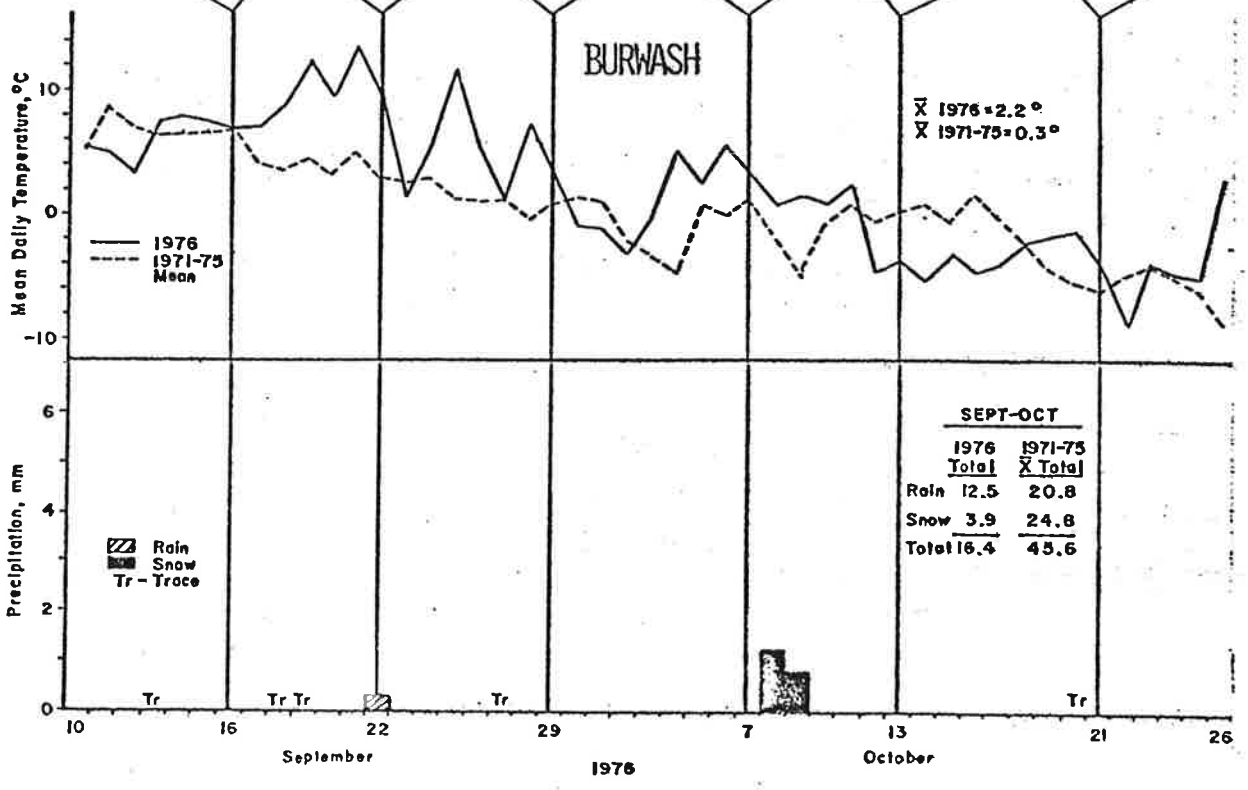
The timing of fall waterfowl migration in southern Yukon in 1976 may have been influenced by mild weather (Tables 3,4,5). Temperatures at Burwash, Whitehorse Airport and Teslin averaged 1.6°C warmer than means calculated from the same period in the years 1971-75. Similarly, precipitation totals averaged 1 in (25.4 mm) less than the 1971-75 means. Ice coverage of the major staging areas surveyed (Tables 3,4,5) may have been delayed by the mild temperatures. Consequently, the peak in numbers of fall-staging waterfowl may normally be earlier than was observed in 1976.

Reactions of Waterfowl to the Survey Aircraft

In 16 of 22 observations, swans did not react by flying from the survey aircraft (Table 6). There was no distinct pattern relating a flying reaction to the estimated lateral distance of the aircraft, but no swans flew before the aircraft was within 1.5 mi (2.4 km). Geese invariably flew at the approach of the aircraft, but not before the aircraft was within 1.5 mi (2.4 km). Ducks varied in their reactions, appearing to fly more readily when in flocks of more than 25 birds. They could be approached closer than geese before flying.

TABLE 3. Weather and Ice Conditions Related to Numbers and Distribution of Waterfowl Near Burwash

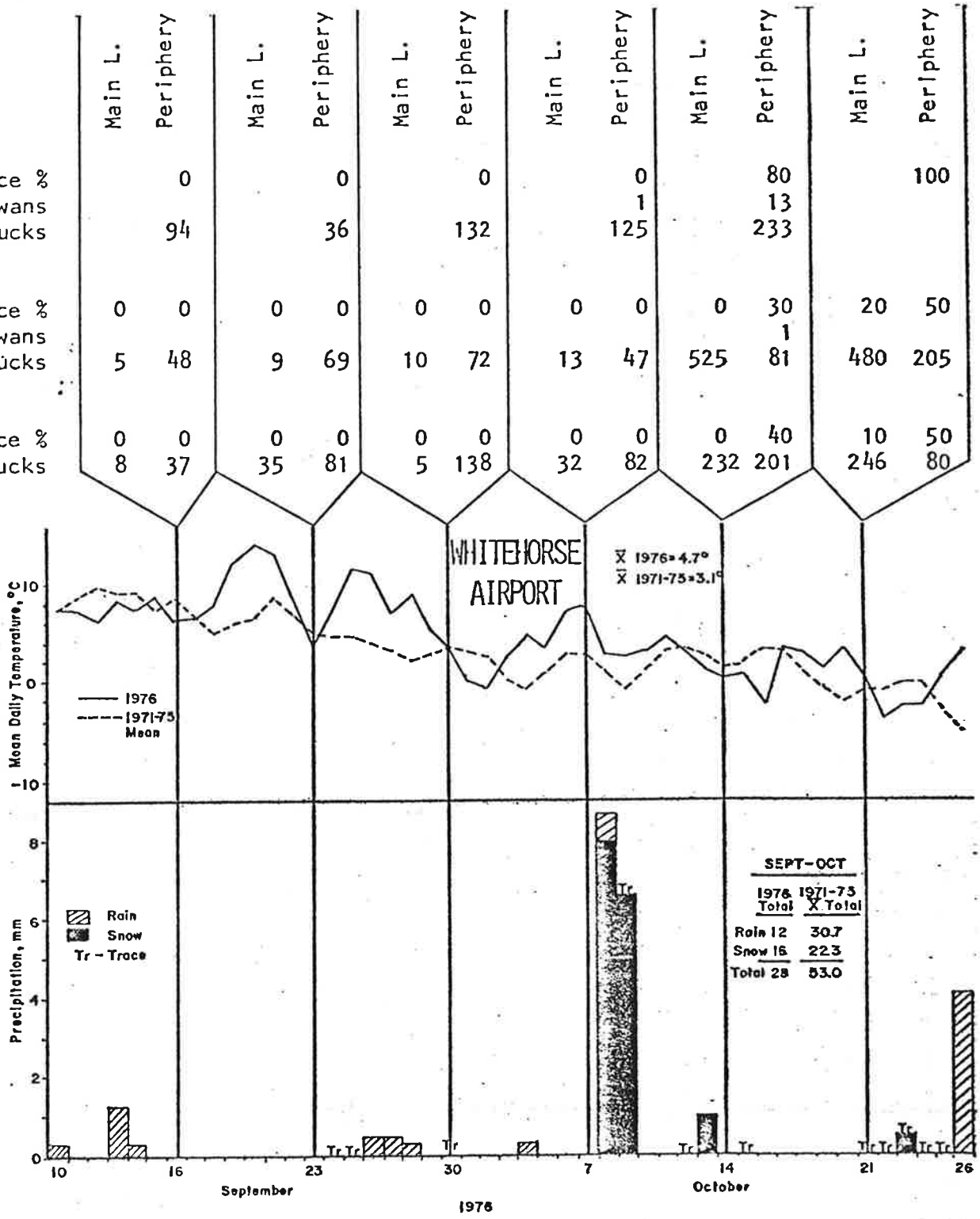
		Sept 10		Sept 16		Sept 22		Sept 29		Oct 7		Oct 13		Oct 21	
		Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery
Pickhandle	Ice %[a]	0	0	0	0	0	0	0	60	10	90	75	100		
	Swans				2		4	4		6					
	Ducks	11	91	12	272	25	111	35	110	30	32	17			
N. Kluane L.[b]	Ice %	0	0	0	0	0	0	0	0	10	0	20	0		
	Swans							10		110		11			
	Geese				100	25		590		20					
	Ducks	168	12	310		15		126		75	51	225	32		
S. Kluane L.[c]	Ice %	0	0	0	0	0	0	0	0	0	60	0	75		
	Swans		4												
	Ducks	90		1125		40				15					
Kloo L.	Ice %	0	0	0	0	0	0	0	20	15	95	50	100		
	Swans									75					
	Ducks	45	245	90	497	210	378	124	248	513	14	217			



a. Estimated coverage. b. Periphery = Kluane R. c. Periphery = Slims R.
Weather data from Canada (1971-1976).

TABLE 4. Weather and Ice Conditions Related to Numbers and Distribution of Waterfowl Near Whitehorse

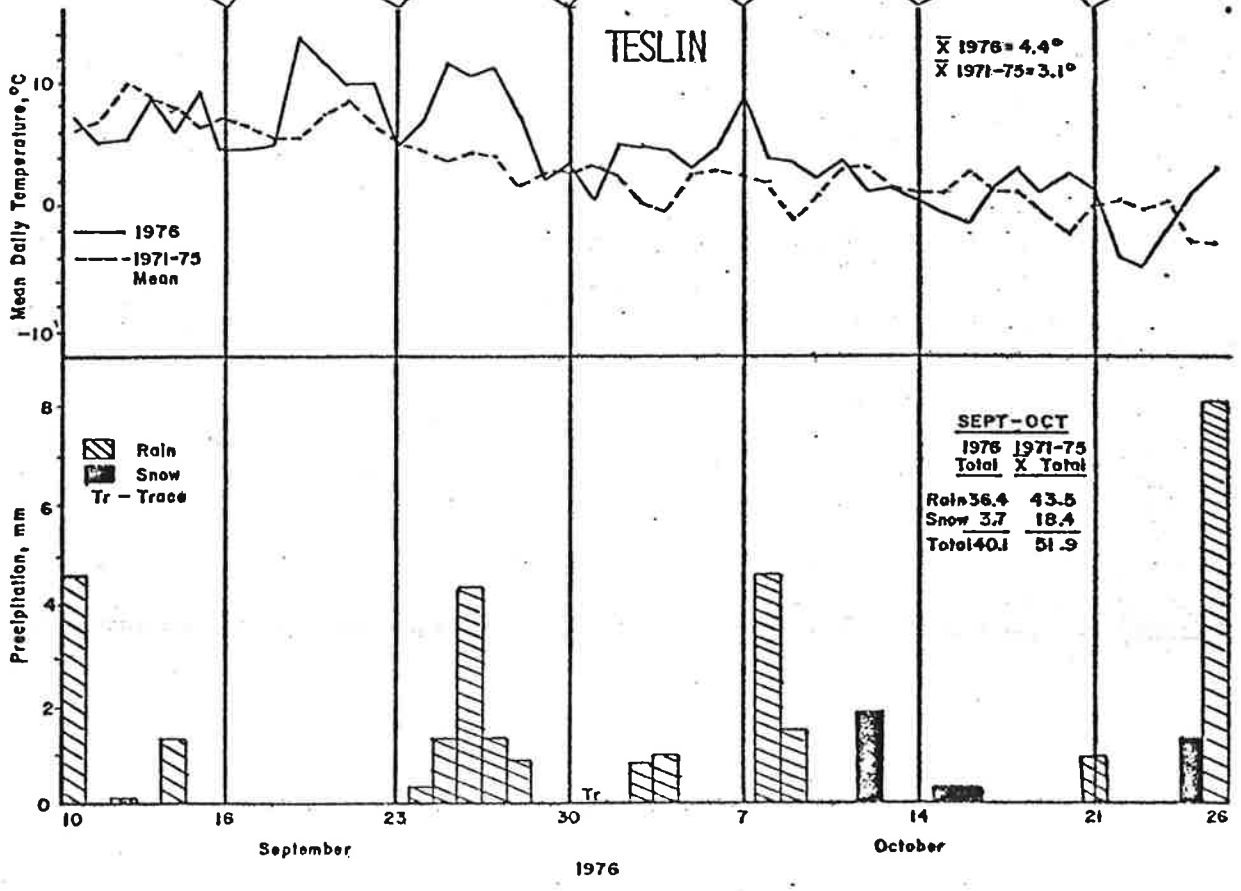
		Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery
Mendenhall[a]	Ice %		0		0		0		0		80		100
	Swans								1		13		
	Ducks		94		36		132		125		233		
Marsh L.[b]	Ice %	0	0	0	0	0	0	0	0	0	30	20	50
	Swans										1		
	Ducks	5	48	9	69	10	72	13	47	525	81	480	205
Squanga	Ice %	0	0	0	0	0	0	0	0	0	40	10	50
	Ducks	8	37	35	81	5	138	32	82	232	201	246	80



a. No main lake. b. Periphery = Yukon R.

TABLE 5. Weather and Ice Conditions Related to Numbers and Distribution of Waterfowl Near Teslin

		Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery	Main L.	Periphery
Teslin R.[a]	Ice %	-	-	-	-	0		0		0		10	
	Swans	-	-	-	-					12		6	
	Geese	-	-	-	-	110		240					
	Ducks	-	-	-	-	140		530		83		252	
Nisutlin B.[b]	Ice %	0	0	0	0	0	0	0	10	0	40	30	95
	Swans							44		340	80	60	
	Geese	687	210	247	940	767	113	1102	390	340			
	Ducks	667	700	1100	290	370	20	841	200	820	196	1179	
Morley B.[c]	Ice %	0	0	0	0	0	0	0	10	5	20	20	20
	Swans					4				14			
	Geese			51		25	20						
	Ducks	4		200	5	120		27	42	394		31	



a. No periphery. b. Periphery = Colwell Bay, Eagle Bay. c. Periphery = Morley R.

TABLE 6. Reactions of Swans to a Cessna 185 Fixed-wing Aircraft Flying at 75-150 ft (23-46 m) Above Ground Level at 65-80 mph (104-128 kmph)

Date	Site	Total	Adult	Young	Uncl.	Reaction (%) Flew	Reaction (%) Did Not Fly	Estimated Lateral Distance (m)
Sept 16	S. Kluane L.	4	2	2			100	200
Sept 22	Pickhandle	2	2				100	300
Sept 29	Pickhandle	4	4			100		200
Sept 30	Morley B.	4	4				100	300
Oct 7	Pickhandle	4	4				100	150
	N. Kluane L.	10	6	4			100	300
	Mendenhall M.	1	1				100	150
	Nisutlin B.	44	41	3			100	300
Oct 13	Pickhandle	6	6				100	150
	N. Kluane L.	110	6	11	93	90	10	300
	Kloo L.	75	70	5			100	150
	Mendenhall M.	13	7	6			100	400
Oct 14	Marsh L. /Yukon R.	1	1				100	450
	Teslin R.	12	9	3		100		300
	Teslin L.	10	6	4			100	100[a]
	Nisutlin B.	420	12	12	396	30	70	100-400
	Morley B.	14	11	3			100	300
	Smart R.L.	6	2	4		100		200
Oct 21	N. Kluane L.	11	4	7			100	300
	Bock's Cr. Outlet	1	1				100	150
	Teslin R.	6	2	4			100	150
	Nisutlin B.	60	4	8	48	75	25	250

a. Aircraft altitude = 500 ft (152 m), air speed 110 mph (176 kmph).

DISCUSSION

Importance of the Study Area to Fall-Migrating Waterfowl

Data collected during this study are apparently the first of their kind for the southern Yukon. A few references to Nisutlin Bay during fall occur in published literature. Conover reported 100 "swans" in Nisutlin Bay on October 3, others flying high over Teslin Lake on October 3, and a group of 15 on Teslin River on October 8, all in 1919 (Rand 1950). The same source reports 50 Canada geese on October 3 and 400 on October 4, 1919, in Nisutlin Bay.

Comparing regions, Salter's (1974) aerial surveys (Table 7) show that staging areas at a similar latitude in Mackenzie District were used by many more swans and ducks than were the two most-used areas in this study. However, numbers of dark-coloured geese using Nisutlin Bay were comparable with Salter's findings.

These figures suggest that, in terms of overall numbers, fall staging areas in the southern Yukon are used much less than those in southern Mackenzie District. Also, they suggest that the southern Yukon is comparatively unimportant as a waterfowl migration route, but that the numbers of geese using Nisutlin Bay are equal to those encountered at staging areas of recognized importance in southern Mackenzie District.

On the other hand, Bellrose (1976) outlines two migration corridors for populations of whistling swans through the southern Yukon, each population estimated to be between 50 and 490 birds. If this is accurate, then the total of 420 swans observed at Nisutlin Bay on October 14 may represent the entire population using the western migration corridor, assuming that none of the swans were trumpeters. It is probable that both species of swans use Nisutlin Bay, but that the large majority are whistlers. Trumpeters average 6 in (15.2 cm) greater in total length than whistlers (Bellrose 1976); on October 14, there appeared to be size differences of about this magnitude between some adult swans. Trumpeters are likely to be found in smaller groups than whistlers during fall migration owing to their smaller population status. Since trumpeters are still considered "rare" as a species, and since it is highly likely that some movement occurs through the southern Yukon, sites where "swans" were observed in small groups during this study merit protection from pipeline impact.

TABLE 7. Mean Numbers of Waterfowl Using Staging Areas in Southern Mackenzie District[a] Compared to Southern Yukon Territory[b] From Aerial Counts

Southern Mackenzie District	Survey Period	Total No. of Counts	Swans (n)[c]	Dark Geese (n)	Ducks (n)
Mills Lake	Sept 10-Oct 9	11	850 (10)	5010 (7)	8710 (10)[d]
Beaver Lake	Sept 14-Oct 10	7	1543 (7)	20 (5)	6283 (7)
Mink Lake	Sept 14-26	3	603 (3)	822 (2)	1007 (3)
Southern Yukon					
Nisutlin Bay	Sept 16-Oct 21	6	174 (3)	959 (5)	1064 (6)
North end, Kluane Lake	Sept 16-Oct 21	6	44 (3)	184 (4)	169 (6)

a. Data from Salter (1974)
b. Data from this study
c. Number of counts on which members of the group observed
d. Total number of counts for ducks = 10

Spatial Relationships of the Pipeline Route and Fall-Migrating Waterfowl

In this study, the most important sites are taken to be those where swans were observed, where geese were observed, or where the total number of ducks observed exceeded 1,000. By this definition, the following sites were the most important: Pickhandle Lakes, north end of Kluane Lake/Kluane River, Bock's Creek outlet, south end of Kluane Lake/Slims River, Kloo Lake, Mendenhall Marsh, north end of Marsh Lake/Yukon River, Squanga/Michie Lakes, Teslin River, Nisutlin Bay, Morley Bay, and Smart River Lake. The other sites surveyed are not considered to be important on the basis of this year's (1976) findings.

Given these types of waterfowl use, which of the sites considered important could be affected by pipeline construction and operation activities? Three basic types of disturbance to fall-migrating waterfowl are possible: habitat alteration, noise, and visible human presence.

Habitat alteration will occur on sites downstream from pipeline construction as a result of water contamination or siltation. Also, alteration will occur if construction takes place directly through a site, or upstream from a site if water levels are altered by impaired drainage. The taking of borrow material from staging sites and the construction of communication towers and wires are also potential habitat alterations. There have been no studies of the effects of habitat alteration on fall-migrating waterfowl in northern Canada. Therefore, impact predictions in this study are made on the basis of topography and probable effects of drainage alteration.

Noise disturbance from aircraft, compressor stations, construction machinery, and blasting operations will affect waterfowl within certain ranges. Studies of waterfowl on the Yukon and Alaska north slope have indicated some levels of noise tolerance exhibited by fall-migrating waterfowl. It should be noted that the majority of these findings pertain to snow geese (*Chen caerulescens*), which were not observed during this study and are only occasional fall migrants in the area (Foothills Pipe Lines (Yukon) Ltd. 1976).

Davis and Wiseley (1974) found that snow geese were affected by aircraft flying at 500 ft (152 m) up to 4 mi (6.4 km) distant, and that helicopters flushed snow geese at greater distances than fixed-wing aircraft. Salter and Davis (1974) found that Cessna 185 aircraft disturbed all nesting snow geese when flying over them up to an altitude of 10,000 ft (3,048 m), and flushed geese when flying at under 1,000 ft (305 m) as much as 9 mi (14 km) distant. Wiseley (1974) found that whistling swans and snow, white-fronted and Canada geese all reacted similarly to gas compressor sound simulators. In flight, snow geese

reacted at a mean altitude of 185 ft (56 m) and did not react at a mean altitude of 417 ft (127 m); on the ground, they stayed at least 2,625 ft (800 m) from the area of most intense sound. Both Wiseley (1974) and Davis and Wiseley (1974) found that topography, weather and other factors can affect the distances involved, and accommodation to noise disturbance can take place.

Predicted Causes of Impact

Given (i) the above findings,
(ii) the present proposed pipeline alignment,
(iii) the restriction of aircraft flights to a 1-mi (1.6 km) wide corridor along the alignment,
(iv) the present proposed compressor station locations, and
(v) the findings of this study,

impacts on fall-migrating waterfowl resulting from spatial proximity of construction activities could be caused as follows:

Site	Mile	Agent of Impact	Mitigating Measures
*Pickhandle Lakes	47-57	Aircraft, blasting disturbance, compressor station noise, visible human presence, affecting swans. Noise magnified by topographic confinement.	(i) Relocate pipeline route and compressor station north of peak overlooking the lakes; or (ii) restrict aircraft and human activity to minimum necessary; relocate compressor station a minimum of 5 mi (8 km) east of proposed location.
South end Kluane Lake /Slims River	144-147	Aircraft, blasting disturbance, visible human presence affecting swans and ducks.	Restrict aircraft and human activity to minimum necessary; avoid river crossing during staging period. Best time probably June.

*Due to recent adoption of mitigating measure number (i), the impacts described above for Pickhandle Lakes are no longer expected.

North end Marsh Lake /Yukon River	283-293	Aircraft disturbance, habitat siltation from M'Clintock River crossing, affecting ducks and swans.	Restrict aircraft activity to minimum necessary; avoid river crossing during staging period. Best time probably June.
Squanga /Michie Lakes	318-321	Aircraft disturbance, direct destruction of habitat, affecting ducks.	(i) Relocate pipeline west of Squanga Lake. (ii) Restrict aircraft activity to minimum necessary; avoid river crossing during staging period. Best time probably early August.
Teslin River	334-337	Habitat siltation from Teslin River crossing affecting swans, geese and ducks.	Avoid river crossing during staging period. Best time probably June.
Smart River Lake	404-405	Aircraft disturbance affecting swans.	Restrict aircraft activity to minimum necessary.

At Nisutlin Bay in 1976, the large majority of waterfowl observed and the most favourable staging habitat were at least 4 mi (6.4 km) from the present proposed pipeline route, and hence no impact is predicted if this pattern of habitat use continues. The major area of waterfowl concentration at Teslin River is approximately 3-4 mi (4.8-6.4 km) downstream from the proposed river crossing; hence, no impact from aircraft disturbance is foreseen if the aircraft remain in the 1-mi wide corridor. All other areas of waterfowl concentration are considered too far away from the proposed pipeline route to be affected by the nearest construction activity, and too far downstream from proposed river crossings to be substantially affected by siltation or drainage impairment.

While no observations of migration routes could be made during this study, all the evidence points to substantial use of Teslin Lake and Teslin River as a flyway by swans and geese. Kluane River, Kluane Lake and Slims River may also be used in this way. Communication wires and towers with which waterfowl could collide should not be erected close to staging areas along these routes, particularly at Slims River, Teslin River and the entrance to Nisutlin Bay from Teslin Lake.

Timing Factors

A combination of factors influence the presence and passage of fall-staging waterfowl in the study area. These are:

1. Weather conditions
2. Ice conditions
3. Local breeding or moulting populations
4. Weather and ice conditions in areas further north

When the study commenced, substantial numbers of ducks were distributed on most lakes and ponds surveyed, with a large population of the total number observed at Nisutlin Bay. The peak in numbers occurred in the second week of the study (September 22,23). Peak numbers of geese occurred between the peak in ducks and the peak in swans (October 13,14). Therefore, according to this study, the most critical time when pipeline construction should be avoided near the staging areas listed in the preceding section is approximately September 18-October 17. This time period may vary slightly according to conditions in other years. September 10-October 10 may be the more usual peak staging period if, as 1976 figures suggest, the weather during this study was warmer and milder than normal. A repeat of the study is recommended for fall 1977, in order to further refine knowledge of the timing and staging area use by migrating waterfowl.

As a result of mild weather, ice conditions were correspondingly benign, perhaps causing waterfowl to remain in the study area longer than normal. Nevertheless, at the end of the study, waterfowl had begun to concentrate in areas which remain ice-free through November. Sometimes the ice-free period continues throughout the winter months, causing substantial numbers of ducks and a few swans to remain there until spring (D. Mossop, pers. comm.). Examples of such areas are north end of Kluane Lake/Kluane River, north end of Marsh Lake/Yukon River, and Teslin River. If pipeline construction continues past mid-October, these areas take on added sensitivity. Waterfowl displaced from them would probably have to seek the few other such areas in southern Yukon, or else migrate across the St. Elias mountains to the Alaska coast under very rigorous conditions.

According to Verschuren and Nuttall (1973), freeze-up occurs in the following Way:

DATES

	Earliest	Average	Latest
North end, Kluane Lake /Kluane River	Oct. 28	Nov. 12	Dec. 10
Yukon River, Whitehorse (N. end Marsh Lake)	Oct. 27	Nov. 18	Dec. 19
Teslin River	Oct. 29	Nov. 27	Dec. 18

These figures indicate the normal time range within which overwintering waterfowl populations might be affected by fall pipeline construction.

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APPENDIX I

LIST OF SCIENTIFIC NAMES OF BIRDS OBSERVED

Common Loon	*Gavia immer*
Loon sp.	*Gavia* sp.
Red-necked Grebe	*Podiceps grisegena*
Swan sp.	*Olor* sp.
Canada Goose	*Branta canadensis*
White-fronted Goose	*B. albifrons*
Mallard	*Anas platyrhynchos*
American Wigeon	*A. americana*
Teal sp.	*Anas* sp.
Canvasback	*Aythya valisineria*
Scaup sp.	*Aythya marila* or *affinis*
White-winged Scoter	*Melanitta deglandi*
Surf Scoter	*M. perspicillata*
Goldeneye sp.	*Bucephala* sp.
Bufflehead	*B. albeola*
Merganser sp.	*Mergus* sp.
Common Merganser	*M. merganser*
Sandhill Crane	*Grus canadensis*
Bald Eagle	*Haliaeetus leucocephalus*
Rough-legged Hawk	*Buteo lagopus*
Marsh Hawk	*Circus cyaneus*
American Kestrel	*Falco sparverius*
Gull sp.	*Larus* sp.
Common Raven	*Corvus corax*
Black-billed Magpie	*Pica pica*