Table 11

ACTIVITIES AND DIRECT EFFECTS — PORT SIMPSON

PORT SIMPSON	LOCATION, DESIGN AND CONSTRUCTION								OPERATION AND MAINTENANCE				OPTIONAL USES			SUMMATION OF MAJOR EFFECTS
	SITE LOCATION		RAILWAY		SHIP ACCESS, MANOEUVRING, ANCHORAGE		CONSTRUCTION FACILITIES	POST-CONSTRUCTION DISPOSITION OF FACILITIES	SITE SERVICES	RIGHT OF WAY MAINTENANCE AND BRUSH CONTROL	MAINTENANCE OF PORT SITE AND NAVIGATION CHANNEL	LEACHATES, FUEL AND CHEMICAL STORAGE	MATERIALS HANDLING	COLLISION AND ACCIDENTAL DISCHARGES	ACCESS TO NEW LAND AREAS	FURTHER DEVELOPMENT		
	Permanent Effects	Temporary Effects	Permanent Effects	Temporary Effects	Permanent Effects	Temporary Effects									SMALL SCALE	LARGE SCALE	
LAND FORMS	4,000,000 Cu. Yd. Rock cut and filled out from shore. Resultant rock face about 40 feet high.		Extensive cut and fill probable along Work Channel.		Shoal areas in Harbour and Inskip Passage to be blasted out.	Under water blasting.	Work camp at Port Simpson for 4 years for site, road and railway. Another work camp at Khyex River for 2 years. Other construction facilities would be on the final port site.	Work camps to be removed. Khyex River camp may become maintenance depot. Construction equipment and material to be removed. Re-vegetation to be permitted.							Terraced level areas north of port site could be used for industry.	More drastic cut and fill likely required for heavy industry.	Extensive cut and fill in solid rock at port site and along Work Channel. Shoals in harbour to be blasted out.
SURFACE MATERIAL	All inorganic material will be incorporated in the fill. Surface gravel from existing commercial pits. Little or no dredging.		Intertidal shelf along west side of Work Channel to be covered and steepened.	500,000 cu. yds. quality gravel needed. No sources known. Stream gravel will not be used.						Road & Railway bed maintenance should require 5,000 cu. yd. gravel annually.	No dredging.				Construction similar to port development.		Large amounts of surface gravel required. Little or no dredging. Some loss of rocky intertidal areas in Port Simpson Harbour and Work Channel.
VEGETATION	100,000 cu. yd. of organic material to be grubbed and burned or disposed of in near-by Land Fill.	100,000 cu. yd. material dumped on existing vegetation off site.	Right of Way Occupies about 650 acres. Stream side vegetation on Lachmach River probably removed.						Power transmission line from Prince Rupert.				Eelgrass beds in harbour are vulnerable.				Removal and disposal of organic overburden Loss of some productive Timber areas. Removal of stream-side vegetation. Pollution danger on eelgrass beds.
SURFACE & SUBSURFACE HYDROLOGY	Possibility of using ground water.	29 Streams crossed and Lachmach River followed for its whole length.					25,000 gal. /day fresh water needed at Port Simpson Camp + 13,000 Gal/day at Khyex River Camp.		Salt water to be used for fire protection. Dust supression and wash water to be recycled. Coal storage, sprinkling and drinking water needed 100,000 GPD fresh water (500,000 GPD peak).	Minor stream siltation from ditch cleaning.							29 Streams crossed or paralleled. 100,000 gal/day taken from Stumaun Creek. Changes in Muskeg drainage possible.
PHYSICAL OCEANOGRAPHY					Minor changes in circulation within the harbour.												No major effects.
PHYSICAL WATER QUALITY	Some coal dust expected over neighbouring intertidal areas.	Some turbidity expected in salt water near site. Organic & inorganic material likely to run-off.	Lachmach River may experience temperature rise.	Turbidity & siltation from construction along Work Channel.					Sedimentation basins for wash water and storm drainage overflow to the sea.								Higher temperatures and turbidity in Lachmach Creek. Minor siltation on other streams may be important during construction.
CHEMICAL WATER QUALITY	Minor discharges from ships in relatively pristine harbour.						Human waste disposal for up to 300 workers at Port Simpson and also at Khyex River.		Sewage disposal by septic tank and tile field.	Brush control with herbicides only if allowed.		Fuel & chemicals to be stored within circle of railway. Leachable material to be stored under cover.		Discharge in harbour would foul harbour. containment possibilities are good.				Oil or other discharges would foul Port Simpson Harbour.
METEOROLOGY & AIR QUALITY													Prevailing wind should blow coal dust away from Community and onto land.			Prevailing winds blow away from populated areas.		No major effects
RESOURCE EXPLOITATION			Economics of transportation improved for related development.															Possible improved economics for logging operations.
UNIQUE ASPECTS OF THE EXISTING ENVIRONMENT	Site is very visible from present community slopping natural vigo would be lost.		Deserted Work Channel will lose its wilderness character.		Anchored and Berthed large ships would have interest value.													Loss of Wilderness areas. Threat to west coast of Tsimpsean Peninsula not likely a major concern as surface water generally flow west and northward.
NOISE	Site is directly across the harbour from community. no noise buffer.	No buffer for construction noise.	No effect on humans.	Railway construction noise in a wilderness area.									No noise buffer between community and equipment noise.					No noise buffer between port site and Port Simpson Community.
HUMAN POPULATION					Ships crews in Port Simpson.		Fluctuating work force up to 300 at Port Simpson & 150 at Khyex River.						Employment for 150-200 generated. Employees to live in Prince Rupert.		Port and industrial facilities at Port Simpson may encourage residential and other development northward.	Prince Rupert would likely remain the residential centre of the Tsimpsean Peninsula, but development would spread northward. A town site in Port Simpson is only likely with major industrial development.		25% temporary increase in Port Simpson population during construction. Northern Tsimpsean Peninsula may be developed.
DISPOSABLE INCOME	Some Port Simpson residents would be employed at the port during operations						25% to 80% increase in local income during construction.											25% to 50% increase in Port Simpson income during construction, dropping to near original level later. Some new permanent employment for local residents.
OTHER INDUSTRIES			Interference with future logging of Work Channel.						Provision of basic services may assist other industries to locate on Northern Tsimpsean Peninsula.						Growth of Prince Rupert as commercial and industrial centre may be impeded.			Growth of Prince Rupert may be impeded with development of second growth centre.
GENERAL COMMENTS					Anchorage on south shore of Harbour. Tugs located in Port Simpson and Prince Rupert								Probability of collision is lower at this site than any other. Policing of discharges should be easier here than at other sites.		Light industry is unlikely to locate in Port Simpson unless a broader-based industrial complex is introduced. Port Expansion to 8 Berths possible.	3,000 acres of back-up land could be developed at moderate cost	Once a railway is built, CNR, as a "common carrier" is required by law to carry all goods they are requested to carry. Also economics will mean CNR will actively encourage new Port Simpson business.

Table 12

ACTIVITIES AND DIRECT EFFECTS KITSON ISLAND

KITSON ISLAND	LOCATION, DESIGN AND CONSTRUCTION									OPERATION AND MAINTENANCE					OPTIONAL USES			
	SITE LOCATION		ROAD AND RAILWAY		SHIP ACCESS, MANOEUVRING, ANCHORAGE		CONSTRUCTION FACILITIES	POST-CONSTRUCTION DISPOSITION OF FACILITIES	SITE SERVICES	RIGHT-OF-WAY MAINTENANCE & BRUSH CONTROL	MAINTENANCE OF PORT SITE AND NAVIGATION CHANNEL	LEACHATES; FUEL AND CHEMICAL STORAGE	MATERIALS HANDLING	COLLISION AND ACCIDENTAL DISCHARGES	ACCESS TO NEW LAND AREAS	ACCESS TO WATER AREAS	FURTHER DEVELOPMENT	SUMMATION OF MAJOR EFFECTS
	Permanent Effects	Temporary Effects	Permanent Effects	Temporary Effects	Permanent Effects	Temporary Effects												
LAND FORMS	Kitson Island to be leveled. 1,000,000 Cu. yd. of rock used as fill around island.		New Causeway ¼ mile of Lelu Island used as Right-of-Way.				Work camp at Port Edwards for 18 months. Other construction facilities to be located on 100 acre port site.	Work camps to be removed.									Flora Bank could be filled for use by some light industry. Foundation conditions seriously limit the industrial potential.	Kitson Island to be leveled and surrounding area filled.
SURFACE MATERIAL	Approx. 100 acres of Flora Bank to be filled. 7-8,000,000 cu. yd. dredged, filled from surrounding area.	Current changes during dredging. Likely to affect half of Flora Bank until a new equilibrium is established. Hydraulic suction dredges to be used.	20 acres of Flora Bank raised above water line.	Rock fill and dredging likely to cause temporary surface instability on east of Flora Bank.		Minor dredging on the edge of Flora Bank.				Gravel supplied from commercial pits.	Annual Maintenance Dredging likely.							120 acres of Flora Bank raised above waterline. Dredging may cause surface movements over half of Flora Bank during construction. Annual maintenance with hydraulic suction dredge.
VEGETATION	Approx. 100 acres eelgrass permanently removed from production. 25,000 cu. yd. organic material to be burned.									Very minor brush control.				Eelgrass beds of Inner Estuary quite vulnerable.				100 acres eelgrass removed from production. 3-4,000 acres eelgrass vulnerable to local pollution.
SURFACE & SUBSURFACE HYDROLOGY							Estimated 18,000 gal/day fresh water required for work camp.		Salt water to be used for fire protection. Dust supression & wash water to be recycled. Coal storage sprinkling & drinking water need 100,000 gal/day from Alwyn Lake or Wolf Creek.									Average of 100,000 gal/day taken from Alwyn Lake or Wolf Creek.
PHYSICAL OCEANOGRAPHY	Some alterations to local current patterns likely.		80% of Flora Bank cut off from the Skeena River. Significant current shifts likely.															In-shore current pattern altered and 80% of Flora bank cut off from Skeena River fresh water and sediment supply. Change in shape likely.
PHYSICAL WATER QUALITY	Some coal dust expected over neighbouring intertidal areas.	Large amounts of silt likely to be stirred up during dredging.	Increased salinity & temperature over Flora Bank.	Extensive siltation and high turbidity likely during construction		Some siltation & high turbidity during construction			Sedimentation basins for wash water and storm drainage overflow to the sea.		Continual moderate turbidity likely from dredging & Resultant silt movement in altered currents.							High turbidity likely over Flora Bank during construction and maintenance dredging. Increased salinity and temperature over Flora Bank. Some coal dust on inter-tidal areas.
CHEMICAL WATER QUALITY	Main currents influenced by Skeena River will carry any pollutants along west coast of Tsimpsean Peninsula.			Berths and short-term anchorage in main current northwards.		Waste disposal for up to 200 workers at Port Edward.			Sewage disposal by septic tank and tile field.			Fuel and chemicals to be contained within railway circle. Leachable material under cover.		Both temporary anchorage and berths are in main current northwards. Containment extremely difficult.				Any oil spills or operational discharges from ships at anchor or at berths would spread quickly in strong Skeena River current. Containment extremely difficult at this site.
METEOROLOGY & AIR QUALITY	Prevailing winds could carry coal dust onto the edge of Flora Bank. Coal piles not aligned with wind.												Prevailing winds tend to blow coal dust to sea. Some dust expected to fall in Port Edward and fishing towns along Inverness Passage.				Prevailing winds blow generally towards Prince Rupert, although at some distance.	Some coal dust would settle on Flora Bank. Industries located on back-up land may contribute to air pollution in Prince Rupert.
RESOURCE EXPLOITATION			Boat launching facilities likely on the causeway												A land route would be opened up to Flora Bank for nature walks.	New Boat launching facilities likely on causeway.		A new opening to intertidal flats and recreational boating would be created.
UNIQUE ASPECTS OF THE EXISTING ENVIRONMENT			The exact current changes which would occur in the Inner Estuary are unknown, but Inverness Passage, Op Horsey Passage, and Flora Bank should be affected.		20 to 30 large ships per year travelling from Port Simpson to Kitson Island a potential pollution threat to west coast of the Peninsula.									West coast of Tsimpsean Peninsula threatened by both major spills and smaller operational discharges.				West coast of Tsimpsean Peninsula threatened by oil spills or operational discharges at Kitson, as well as by 20 to 30 large ships per year travelling from Port Simpson to Kitson. Inner Estuary would be altered by current change.
NOISE	No nearby major population centres to be effected.																	No major effect.
HUMAN POPULATION					Ships crews in Port Simpson.		Fluctuating work force up to 200 at Port Edwards.						Employment for 150 - 200 generated, employees would likely live in Prince Rupert.					Up to 200 employees, indicating 300 - 600 new residents in Prince Rupert.
DISPOSABLE INCOME							2% increase in local income during construction.						About 1% change in Prince Rupert income base.					Minor community income increase.
OTHER INDUSTRIES													Slight change of coal dust from open trains & Site blowing onto pulp log booms.					No major effect.
GENERAL CONCERNS					Anchorage for ship under 50,000 DWT in Prince Rupert Harbour. Larger ships must use area S.E. of Dat Kinahan Island (short term) or Port Simpson where anchorage must be shared.									Congestion at Kitson better than Ridley, but currents worse. Probability of collision equal to Ridley and greater than Port Simpson.			2,000 acres of poor back up land available at high cost.	

Table 13

RIDLEY ISLAND — ACTIVITIES AND DIRECT EFFECTS

RIDLEY ISLAND	LOCATION, DESIGN, AND CONSTRUCTION								OPERATION AND MAINTENANCE				OPTIONAL USES		
	SITE LOCATION		ACCESS ROAD AND RAILWAY		SHIP ACCESS, MANOEUVRING, ANCHORAGE		CONSTRUCTION FACILITIES	POST-CONSTRUCTION DISPOSITION OF FACILITIES	SITE SERVICES	MAINTENANCE OF FACILITIES	LEACHATES, FUEL AND CHEMICAL STORAGE	MATERIALS HANDLING	COLLISION AND OPERATIONAL DISCHARGES	ACCESS TO LAND AND WATER	FURTHER DEVELOPMENT	SUMMATION OF MAJOR EFFECTS
	Permanent Effects	Temporary Effects	Permanent Effects	Temporary Effects	Permanent Effects	Temporary Effects										
LAND FORMS	2,000,000 cu. yd. bedrock blasted out and used as fill. Resultant rock face about 40' high.		All effects minor except the filling of the passage to Porpoise Harbour				Work camp at Port Edwards for 18 months. Other constructio facilities to be located on the 100 acre site.	Work camp to be removed.							More drastic rock blasting and filling required.	Extensive cut and fill in solid rock at port site. Shoals in Port Simpson Harbour to be blasted out.
SURFACE MATERIAL	Surface gravel to be obtained from commercial pits. Minor dredging may be necessary. Clam shell after underwater blasting.		Cut and fill along beach, tidal flats, and deer winter range, road access through 100 acres of foreshore.													Railway and road construction would cause filling of foreshore fronting half the deer winter range on Kaien Island.
VEGETATION	200,000 cu. yd. organic material grubbed and burned or buried.	200,000 cu. yd. of material to be dumped on existing vegetation.														Removal and disposal of organic material.
SURFACE & SUBSURFACE HYDROLOGY							Estimated 10,000 gal/day fresh water required for work camp.		Salt water to be used for fire protection. Dust supression and wash water to be recycled. Coal storage sprinaling & drinking water need 100,000 gal/day fresh water.							Average of 100,000 Gal/day to be taken from Alwyn Lake or Wolf Creek.
PHYSICAL OCEANOGRAPHY	Some alteration to local currents likely, tidal current at harbour entrance may be affected.		Obstructing tidal flow.													Some alteration incurrent patterns at entrance to Prince Rupert Harbour.
PHYSICAL WATER QUALITY	Some coal dust expected over neighbouring intertidal areas.	Some minor turbidity expected in salt water.							Sedimentation basins for wash water and storm drainage overflow to the sea. Wolf creek temperature should rise as flow drops. Sewage disposal by septic tank and tile field, subject to PCB regulation.							Higher water temperature in Wolf Creek.
CHEMICAL WATER QUALITY	Skeena-influenced northbound currents would carry any pollutants along the west coast of the Tsimpsean Peninsula.			Berths and short-term anchorage in or near main northbound current.		Waste disposal for up to 200 workers at Port Edwards.					Fuels and chemicals to be contained within railway circle. Leachable material under cover.		Temporary anchorage in main northbound current. Flow from berths would go south on ebb tide and into harbour on flood.			Any oil spills or operational discharges from ships at temporary anchorages or berths would spread quickly into strong Skeena current and tidal rip. Containment difficult at this site.
METEOROLOGY & AIR QUALITY	Prevailing winds would tend to blow coal dust onto Southern Kaien Island.														Prevailing winds blow directly into Prince Rupert Harbour. Industry on Ridley would compound air pollution problem from pulp mill.	Industries located on Ridley Island would contribute to air pollution in Prince Rupert.
RESOURCE EXPLOITATION													Ridley Island partly opened, Boat launching facilities likely on the causeway.			A new opening for recreational boaters would be created.
UNIQUE ASPECTS OF THE EXISTING ENVIRONMENT				20 to 30 large ships per year travelling between Port Simpson and Ridley pose a potential pollution threat to the west coast of the Peninsula.									West coast of Tsimpsean Peninsula and part of Rupert Harbour both threatened by spills and leaks.			West coast of Tsimpsean Peninsula is threatened by oil spills or operational discharges at Ridley as well as by 5 to 55 large ships per year travelling from Port Simpson to Ridley.
NOISE	Site is separated from Port Edwards by ridge of hills on Ridley Island.															No major effect.
HUMAN POPULATION					Ships crews in Port Simpson for short periods.	Fluctuating work force for up to 200 at Port Edward.				Should help continue Prince Rupert's development and thus provide a greater range of social and related services.		Employment for 150-200 generated. Employees would likely live in Prince Rupert.				Employment for up to 200 people.
DISPOSABLE INCOME		Increase income in Prince Rupert				2% increase in Prince Rupert income during construction.						Increase real net income and tax base.				Increase disposable income by 1%.
OTHER INDUSTRIES												Some chance of coal dust from open trains and port site blowing onto pulp log booms.				No real effects.
GENERAL COMMENTS				Anchorage for ships under 50,000 DWT in Prince Rupert Harbour. Larger ships must use area S.E. of East Kinahan Island (short term) or Port Simpson (long term) where anchorage must be shared.						All effects should be minor.			Congestion here worst of all sites. Probability of collision equal to Kitson and greater than Port Simpson. Containment difficult.		800 acres on Ridley and 270 acres on Kaien Island available at moderate cost. 250 acres could be developed from shallows at high cost.	

TABLE 14

IMPACT OF DEVELOPMENT AT PORT SIMPSON ON AQUATIC RESOURCES

PORT SIMPSON	SURFACE MATERIAL	VEGETATION	HYDROLOGY	QUALITY	WATER QUALITY	EXPLOITATION	UNIQUE ASPECTS	AQUATIC FAUNA
DIRECT EFFECTS / AQUATIC ENVIRONMENT	1. U/W Blasting 2. loss of rocky intertidal 3. gravel removed from stream beds	1. removal of stream-side vegetation 2. loss of eelgrass beds	1. 47 streams crossed or parallelled 2. 100,000 gal./day removed from Stu.Cr. 3. changes in Muskeg drainage	1. higher temp. in Lachmach River 2. siltation during construction 3. increased velocity by channelization	1. Herbicides 2. oil & other discharges in Bay 3. coal dust on Neaxtoalk drainage	1. increased exploitation on fish 2. increased logging 3. fishing by const. personnel	1. loss of wilderness 2. loss of unique biota in Neaxtoalk 3. productivity of outer coast reduced	1. obstruction of fish in Stumaun Cr. 2. mortality of salmonids in Lachmach & others 3. removal of fish by heavy angling
FRESHWATER PLANTS: ALGAE, ROOTED FRESHWATER INVERTEBRATES	3. loss of gravel habitat by removal and by siltation.	1. gain in light available to aquatic plants, loss of allochthanous material.	2. increased growth of algae below intake; 1. reduction of habitat, increased (algae), loss of allochthanous material to invertebrates.	1. increased plant growth; 1.2. decrease in production from temp. & siltation in invertebrates; 3. increase in invertebrate population in lighter velocities.	1.3. loss of production in Lachwack and Nontoalk systems, change in rel. abundance in invertebrate populations.	2. reduced production by siltation. 1.3. reduced predation on drifting invertebrates.	2. muskeg growth replacing freshwater marsh; loss of production in littoral zone. 2. change in invertebrate populations.	1.2.3. increased invertebrate populations.
FRESHWATER FISHES WHITEFISH, DOLLY VARDEN, RAINBOW, CUTTHROAT	3. loss of spawning habitat; siltation	1. loss of cover terrestrial insects.	1. loss of habitat by channelization, 2. by withdrawal.	habitat degradation, 2. reduced egg survival, 3. reduced holding areas.	1.3. loss of habitat by coal siltation and reduction of food sources.	1.3. local extinction; continued reduction in stock size.	2. possible extinction of local trout stocks.	3. local extinction of stocks; 3. loss of year-class by siltation.
ANADROMOUS FISHES STEELHEAD CHUM & PINK CHINOOK & COHO SOCKEYE EULACHON	3. loss of spawning habitat, mortality by siltation. 1. some mortality by blasting. 2. some loss of habitat.	1. loss of cover, increased vulnerability, 2. loss of juvenile habitat and food protection.	1. loss of habitat by channelization; 2. increased mortality of eggs and young by low water levels.	1.2. increased mortality in eggs & fry; 2. decreased production; 3. loss of gravel, pool habitats; drop in capacity for fish production.	1. herbicide mortality via food chains, to coho, steelhead, chinook. 3. coal siltation, reduction in egg to fry survival; 2. oil toxicity, loss of growth area for juveniles.	1.3. reduced escapement, reduced recruitment; 2. increased mortality from siltation. 2. reduced production of coho, steelhead from habitat degradation.	reduced salmonid production on outer coast if productivity reduced by spills, development.	1. loss of spawning, nursery habitat accessible to runs. 3. destabilization in stock size (poss. loss of year) 1.2. increased vulnerability to overfishing and bad weather.
MARINE FISHES HERRING COD HALIBUT ROCKFISH INTERTIDAL FISHES	1. possible loss of local herring if blasting in spring; 2. loss of spawning habitat. decrease in population numbers with loss of habitat.	2. loss of nursery areas, cover, food production.			1. reduction in fertility due to herbicide concentration; 2. loss of herring spawn and loss of intertidal fishes where slick collected on beach. Reduced production of juvenile groundfish.	1.3. gradual decline in stocks and fishing success; 2. habitat degradation from increased log shortage.	1.3. gradual loss of wild beach, loss of spawning and juvenile habitat.	1.2.3. increased herring if salmon stocks decline.
MARINE INVERTEBRATES CLAMS CRAB SHRIMP AMPHIPODS COPEPODS OTHER FAUNA	1. local mortality from blasting. 2. local loss of habitat. 1. slight increase in octopus habitat.	2. loss of primary source of organic material. 2. loss of habitat and food.			1. concentration of harbicides slowly over years; 2. mortality from chemical spills; 2. reduction in productions from habitat degradation	1.3. decrease in population size; local crab depletion. 2. increased log storage, decreased intertidal habitat.	1.3. change in relative abundance of invertebrate populations with harvesting, spills, disease; only tolerant species remaining. 3. possible introduction of exotic species.	1.2.3. increased invertebrate population if predators decline.
MARINE PLANTS PHYTOPLANKTON INTERTIDAL ALGAE KELPS EELGRASS	2. release of nutrients from intertidal plants; 1. kelp damaged by blasting.	2. release of nutrients to other areas.			2.3. decrease in production from darkening by oil or coal dust.	2. increased log storage, decrease in production.	3. disappearance of pollution-intolerant species; overgrazing by unchecked sea-urchin population?	

3. Change in Muskeg drainage = effects unknown.

	1. 100 acres fill plus causeway 2. possible landfill of total Flora Bank	Dredging _____ acres Surface instability during construction	100 acres eelgrass lost under fill	100,000 gal/day withdrawn from Wolf Creek	Alteration of currents along const., inshore 80% of Flora Bank cut from fresh water and sedimentation	coal dust onto Flora Bank heavy siltation during construction increased temp. on Flora Bank increased salinity on Flora Bank storm drainage overflow to sea continual moderate turbidity from maintenance dredging probability of uncontrolled spill	new access to Flora Bank	large ships along coast - accident threat	loss of 420 acres of invertebrate populations loss of major portion of local herring (spill) continuing removal of fauna in dredging
FRESHWATER PLANTS: ALGAE : ROOTED INVERTEBRATES				increased algae production & grazing invertebrates increased.		2. temporary mortality and displacement of Wolf Creek invertebrates.			
FRESHWATER FISHES: WHITEFISH, DOLLY VARDEN RAINBOW, CUTTHROAT				loss of stream habitat; rise in downstream temperature.	2. increased pops. of resident salmonids if Skeena salmon, steelhead decline.	2. displacement of small resident trout population in Wolf Creek; increased numbers of resident species in Skeena if production of anadromous species drops, especially if angler use drops.			
ANADROMOUS FISHES STEELHEAD CHUM & PINK CHINOOK & COHO SOCKEYE EULACHON	1. loss of 100 acres of juvenile feeding & acclimation area; 2. loss of most of Skeena estuary; serious reduction in stock sizes.	1. loss of 300? acres of nursery areas, likely permanent reduction in capacity of Skeena for fish; 2. disturbance to invert. prod. food supply.	loss of cover, drop in available food, decreased carrying capacity of Skeena estuary.	loss of potential for future reestablishment of anadromous runs.	1. some disorientation of spawners, possible delay in migration, 2. decline of productivity in flora bank: loss of capacity for salmonid production: possible loss of Skeena runs in bad weather year; extreme impact on fish, P. Rupert fishery; loss of enhancement potential in Skeena	7. possible loss of large portion of salmon year-class, long-term imbalancein age structure and in commercial fishery. 1.5.7. loss of food species and concentration of toxic materials, possible degradation of quality and losses to fishery, public health hazards. 2. displacement of juveniles to less desirable areas, drop in production. 3. loss of large part of estuary to cold water fish, drop in production of pink salmon in particular. 4. loss of large area of moderate salinity, drop in salmon production, serious limitation to capacity of Skeena for salmon due to loss of acclimation zone.	increased angler catch of incoming salmon & steelheads; possible interference with commercial fishing.	possible loss of large portion of salmonid year-class by mortality in juveniles.	1. incremental loss of food supply for seaward migrants. 2. serious loss of food supply for chinook salmon, drop in salmon production. 3. loss of food supply for salmon and salmon prey species especially herring and eulachon.
MARINE FISHES: HERRING COD HALIBUT ROCKFISH INTERTIDALS	1. loss of 100 acres of feeding areas esp. for juveniles; 2. loss of 2000 acres of feeding & nursery areas possible reduction in stock sizes.	1. loss of 300? acres of feeding & nursery areas. 2. widespread disturbance to prey organisms, juv. halibut possible drop in numbers.	loss of cover, juvenile nursery area. drop in carrying capacity of estuary.		1. possible increased herring spawn mortality. 2. decline in productivity of flora Bank: drop in production of halibut juveniles, cod, rockfish. possible effects on P. Rupert fishery.	7. possible loss of major portion of herring spawn along river coast; probable drop in production of herring and groundfish; possible serious effects on juvenile halibut and cod, long-term imbalance in year-class structure and commercial fishery. 2. temporary displacement of mid-estuary species. 1.5.6.7. continuing minor discharges would lead to accumulation of toxic materials, concentrated up food chains, increased hazard to human consumption, possible impact on local fisheries. 3. displacement of cold-water species. 4. shift to coastal species; loss of areas of moderate salinity result in some drop in production of some species.	increased angler catch of cod rockfish, slight decline in population size.	possible loss of large portion of herring spawn; mortality to juvenile halibut, cod; loss of intertidals along coast.	2. serious loss to north coast herring stocks, long-term imbalance in age structure of population, drop in commercial harvest, increased vulnerability to future losses, overfishing, bad weather, etc. 1.3. drop in available food, drop in production of groundfish juveniles.
MARINE INVERTEBRATES: CLAMS CRAB SHRIMP AMPHIPODS COPEPODS OTHER FAUNA	1. loss of 100 acres of important crab fishery. 2. loss of 2000 acres (entire) crab fishery. 4. loss of most of estuarine crustacean production.	1. loss of 300? acres clams & other fauna habitat. 2. widespread disturbance to infauna.	loss of 1° source of organic material; drop in production of decay, filter-feeding inverts.		1. possible disturbance to shrimp & plankton production. 2. decline in clam and crab production of flora bank: possible loss of P. Rupert crab fishery or relocation with higher costs	7. possible mortality of most types over wide areas. 1.5.7. loss of sensitive species esp. filter-feeders; uptake of toxic materials, concentrated up food chain. 2. temporary degradation or displacement of some communities. 4. shift to temperature-tolerant coastal species. 3.6. displacement of middle-estuary communities outward, loss of some species probable in some areas. 7. possible introduction of exotic disease or other pollution tolerant organisms; possible epidemic or major ecological disturbance.	increased recreational harvest of clams and crabs; decline in more sensitive species from traffic, outboard motor pollution.	possible loss of productive coastal areas for clam, crabs fisheries; loss of unique associations and sensitive species along coast.	1. some loss of diversity, resilience of flora bank fauna to bad weather, etc. 2. removal of herring predation would result in increased survival of larval stages, changes in relative abundance through increased competition. 3. drain on local populations, shift in abundance to pioneering or colonizing species.
MARINE PLANTS PHYTO PLANKTON INTERTIDAL ALGAE KELPS EELGRASS	1. 100 acres eelgrass lost: 2. 2000 acres eelgrass lost. release of nutrients, increased phytoplankton.	1. loss of 300? acres vegetation including eelgrass. 2. widespread disturbance to rooted plants.	release of nutrients to other types of vegetation.		2. loss of eelgrass production, shift to less desirable species, possible increase in pollution-tolerant algae.	3.1.6.5. drop in production by shading; 3. increase algal production; 4. shift in species from estuarine to inner coastal; 7. loss of eelgrass and macro algae over large areas down current from spill site; unknown effects of cleanup operations; 1.5.7. loss of sensitive species, shift to pollution tolerant types.	decrease in production by physical disturbance, outboard motor pollution.	loss of sensitive species, damage in cleanup operations	1. possible decrease in herbivores greater than decrease in vegetation, hence increased plant growth.

RIDLEY ISLAND DIRECT EFFECTS AQUATIC ENVIRONMENT	LANDFORMS 1. 2,000,000 cu. yds. rock fill	LANDFORMS 2. underwater blasting*	VEGETATION fill dumped on inter- and sub-tidal plant communities	HYDROLOGY 100,000 gal. per day out of Wolf Creek	PHYSICAL OCEANOGRAPHY some increase in current in P.R. Harbour entrance	PHYSICAL WATER QUALITY higher temp. in Wolf Creek	CHEMICAL WATER QUALITY spills into Pr. R. Harbour and up west coast of pen insula	AIR QUALITY industrial pollution to surrounding watersheds	RESOURCE EXPLOITATION increased access to angling, etc.	UNIQUE ASPECTS risk of massive pollution to coast and P.R. Harbour	GENERAL COMMENTS further 250 acres of shallows filled-optional	AQUATIC FAUNA removal of 30 acres of invertebrate communities	AQUATIC FAUNA continuing minor destruction of invertebrates
FRESHWATER PLANTS: ALGAE : ROOTED INVERTEBRATES:				increased growth of periphyton from increased light on substrate		increased growth of periphyton, increased density of invertebrates		change in species abundance from changes in watar quality.					
FRESHWATER FISHES: WHITEFISH, DOLLY VARDEN RAINBOW, CUTTHROAT				loss of stream habitat if impounded, reduced numbers		degradation of habitat, increase in food supply.		possibly loss of headwater populations					
ANADROMOUS FISHES STEELHEAD CHUM & PINK CHINOOK & COHO SOCKEYE EULACHON	2. local mortality of adults between July-November; juveniles April-August. 1.2. incremental loss of estuarine habitat, constraint on capacity of Skeena.		loss of cover for juveniles, feeding habitat.	increased mortality from drought, loss of access to upstream areas would result in constraints on future re-establishment (none present now).		degradation of habitat for spawners juveniles; constraint on potential for re-establishment.	possibly disastrous to juvenile survival if spill occurs in summer or fall.	possible severe degradation of habitat	increased catch on flora bank and in harbour mouth by recreation	disastrous to salmon stocks by direct toxicity, anoxia and consumption of toxic prey; esp. summer, fall.	small loss in feeding habitat; small constraint on capacity of Skeena	small loss in available food for salmon; constraint on Skeena capacity.	
MARINE FISHES HERRING COD HALIBUT ROCKFISH INTERTIDAL FISHES	2. local mortality from blasting; 1.2. loss of shallows for feeding habitat. 1. loss of habitat.		loss of feeding areas and cover.				possible loss of major portion of herring stocks; reduced number of ground fish, intertidals		increased recreational catch, local depletion of stocks.	loss of major portion of local herring stocks; reduced number of ground fish etc.	incremental loss of habitat; slight decrease in area's capacity.		
MARINE INVERTEBRATES CLAMS CRAB SHRIMP AMPHIPODS COPEPODS OTHER FAUNA	1.2. loss of habitat, reduction in numbers. 1.2. increase octopus habitat.		loss of major source of organic material.		some changes in relative abundance of species toward current-dwelling communities.		possible widespread mortality and sublethal toxicity; possible introduction of exotics, diseases.		increased recreation and domestic catch, local depletion of stocks.	widespread mortality and sublethal toxicity; permanent changes in community, loss of sensitive species.	incremental loss of sessile populations.	reduced diversity of communities along coast.	reduced numbers available for human & salmon consumption
MARINE PLANTS: PHYTOPLANKTON INTERTIDAL ALGAE KELPS EELGRASS	1. loss of 30 acres of habitat (less for kelp)				some changes in relative abundance to kelps, etc. (current-tolerant)		loss of pollution-intolerant species along coast.			loss of sensitive species, widespread reduction in productivity	small loss of intertidal algae	reduced grazing on reduced plants?	

(*blasting shoals in Port Simpson Harbour treated in Port Simpson matrix)

IMPACTS OF PORT DEVELOPMENT OPTIONS ON THE "TERRESTRIAL" ENVIRONMENT

	Soils and Vegetation	Forestry	Archaeology	Upland Wildlife	Waterfowl	Indirect Effects
Port Simpson (Site Only)	Loss of 145 acres of fibrisols (mainly lithic), including 42 acres of coastal muskeg and 16 acres of riparian forest. Possible effects on tidal marsh and shingle beach in Stumaun estuary as well as freshwater marsh in Neaxtoalk Lake.	One booming area in Stumaun Bay.	Two salvagable sites may be affected, although avoidance is possible.	Loss of 179 acres of limited to high capability deer winter range. Loss of seal haul-out area on harbour reefs. High capability deer winter range in lower reaches of Stumaun Creek would be interrupted.	Loss of 156 acres of limited capability waterfowl habitat and harbour reefs. Moderate valuable areas of Neaxtoalk Lake, Stumaun Bay, and Rushbrook Passage may be indirectly affected.	Conflict with local recreationists who value Stumaun Bay waterfowl. Impacts on herring and invertebrates would affect waterfowl, harbour seals, and porpoise.
Port Simpson (rail access)	Some possibility of debris slides. Loss of substantial acreage of riparian forest, some coastal muskeg, small tidal marsh areas, and some shingle beach vegetation. Several rare species of vegetation in Khyex marsh.	Interference with future logging along Work Channel. Loss of $1,024 per year in mean annual increment. Salvage value during construction appraised at $110,000.	Seven "preservation" sites and five salvagable sites nearby. Not likely to be affected if railway carefully constructed.	Possible interference with deer winter range around lower reaches of Lachmach and Khyex Rivers as well as small tidal marsh areas along Work Channel. Low acreages of good deer winter range may be affected.	Loss of marsh at the head of Work Channel likely, as is some interference with Khyex marsh.	Severing of numerous aquatic/littoral/ terrestrial links in energy and food webs along the whole west side of Work Channel. Effects are difficult to evaluate but amount to a large local impact (not really important in regional human-oriented values, however).
Kitson Island	Loss of 40 acres of fibrisols, seven acres of gleysols. Affects seven acres of tidal marsh directly and five acres of coastal muskeg.	No effect.	No effect	Loss of 78 acres of moderate deer winter range. Introduction of stable vegetation and a new shoreline may aid ducks. Little or no effect on seal haul-out area.	Loss of 199 acres of highly valuable waterfowl habitat. Remaining habitat may be slightly improved for some species because of new shoreline and stable vegetation. Possible pollution danger to Venn Passage, Big Bay, and Pearl Harbour. (This would be a major impact).	Consequences of causeway interrupting food chains, etc. cannot be evaluated. Local marine pollution would have serious consequences for waterfowl, harbour seals, and porpoises.
Ridley Island	Loss of 101 acres of fibrisols and 25 acres of gleysols. Affects 37 acres of coastal muskeg and two acres of tidal marsh.	Some problem possible from coal dust blowing onto pulp logs.	Two salvagable sites directly under development.	Loss of 72 acres of deer winter range and interruption of about 150 acres of good to excellent winter range in wildlife reserve. Deer access from Kaien to Ridley Islands must be maintained.	Loss of 142 acres of moderately valuable waterfowl habitat. Possible pollution danger to Digby Island, Venn Passage, Big Bay, and Pearl Harbour. (This would be a major impact).	Very close to Digby Island and Venn Passage.

Port Simpson — Socio-Economic Impact — Table 18

	Construction	Permanent
Population	- peak 300 jobs - favorable economic impact on Prince Rupert - adverse impact on Port Simpson can be avoided	- 200 jobs - creation of town-site on subsequent development problems - change entire social and economic structure of Port Simpson
Income	- increase total yearly income of area - money spent in Prince Rupert will produce favorable impact - boom and bust in Port Simpson unless controlled	- up to 6.8% increase in total area income - with controls, most of the money should go to Prince Rupert - change physical and cultural structure of Port Simpson
Economic Development	- reduce unemployment in Port Simpson	- diversifying income base - stabilize employment - create demand for goods and services in Port Simpson - adverse impact on Prince Rupert may be avoided with controls - major industrial complex possible
Community Psychology	- raise Port Simpson morale	- acceptable development in Prince Rupert - lower morale in Prince Rupert possible

Ridley/Kitson — Socio-Economic Impact — Table 19

	Construction	Permanent
Population	- peak 140 to 280 jobs - favorable impact on Prince Rupert - no effect on Port Simpson	- 200 jobs created - no impact of social or economic structure - more pressure on housing
Income	- increase total yearly income of area - no "boom and Bust" syndrome expected in Prince Rupert	- up to 6.2% increase in total area income less losses in fishing income - help justify present over-supply of retail and commercial infrastructure
Economic Development	- reduce unemployment in Prince Rupert -	- diversify and stabilize economic base - may stimulate other industrial development
Community Psychology	- raise Prince Rupert morale	- acceptable development in Prince Rupert - increase community spirit

No Port — Socio-Economic Impact — Table 20

	Construction	Permanent
Population	- relatively high unemployment continued	- reduce projected population by 450 persons - young people will continue to leave area
Income	- no construction wages	- reduce total area income
Economic Development		- reduce job opportunities - high vacancy in retail and commercial space - economic recession in service industries - slow down in construction industry possible - some industries or businesses will move out
Community Psychology		- reduction of community morale and drive - feeling of being sold out - fostering of recession psychology

CHAPTER 8

Consideration of Economic Factors

8.1 Development of a Discount Rate

All investment projects, public and private, involve the measurement of costs and benefits over a specified time period. The function of the discount rate is to bring these benefits and costs, which occur at varying times, to present value equivalents, and thus compare these costs and benefits in terms of current dollars.

There are two basic approaches to this problem. One is the "social time preference doctrine", which contends that public investment should be made in accordance with an estimate of society's general preference for current versus future consumption (a dollar today is worth more than a dollar tommorow even in a non-inflationary world). The second approach is the opportunity cost of capital (if the return is not sufficiently high in this project, the capital will go elsewhere). For the type of project being examined here, several alternatives exist for capital investment, and the option of no port at all is a real possibility. For these and other technical reasons, we intend to use the opportunity cost approach.

In principle, the choice of this rate will guide public investments into areas of high return on capital investments. Furthermore, it is felt that public projects, which remove funds which would be invested in the private sector, should not be undertaken unless they generate a rate of return higher than or equal to the net rate which could be earned in the private sector. This rate of return should include social and environmental costs as well as direct financial return to the investor.

In order to establish an estimate of an appropriate discount rate, we examined empirical evidence relating to rates returned in the private sector. We feel the appropriate rate should be the weighted average of all private sectors. In developing this average, the effects of tax rates and inflation should be removed, and an adjustment for external costs has to be made. Research pertaining to both Canadian and American investments was examined, with specific attention being given to Canadian data. We believe the research most applicable to discount rates for Canadian public investments is summarized in an article by Jenkins (1972). The research by Jenkins dealt entirely with the Canadian private sector, but results were closely correlated with recent similar studies which examine American data. This particular research examined both the rates of return received by the owners of capital assets

and the income generated by this capital which was collected by governments through taxation. The investment considered was the total of fixed assets plus working capital of the ventures examined.

Jenkins found the financial rate of return to the investor averaged 5.82% during 1965 to 1969. To arrive at this figure, industries were examined by standard industrial classifications, and data sets disaggregated at the two and three digit levels. Effects of inflation were removed by using a perpetual inventory process which recorded values for the assets by original costs, current replacement costs, and constant dollar prices. A further adjustment was made to change the tax depreciated values to real depreciated values.

In addition to this return, society as a whole receives other benefits from industrial development and incurs other costs (known as "external" benefits and costs as they are external to the industry itself). By and large, the external benefits are generally reflected in financial returns to society in the form of taxes paid by the industry. Jenkins found the average social financial return in taxes from the assets of industry was as follows:

Property Taxes	1.49%
Income Tax	1.13%
Sales Taxes	1.11%
	3.73% of total industrial assets

Some of the external costs are also financial in nature. Typical of these are water, sewer, and electrical services supplied by the municipality, community recreational services provided for the industry's employees. Without a detailed analysis, it would seem reasonable that the municipal property taxes paid by the industry should approximate these external costs borne by the community. Thus, only income tax and sales taxes represent a net financial return to society, indicating society receives a total financial return (including the investors return) of 8.06%.

However, some of the external costs are not financial in nature. An excellent example of this type of cost is pollution. Until recently, society has had to put up with pollution as a hidden cost of industrial development. In the last few years in particular, society has attempted to internalize this cost by forcing industry to spend part of its profits on pollution control equipment. Some tax revenue has also been spent in subsidization of such measures (usually in the form of tax rebates or fast depreciation allowances), and more tax revenue has been spent on government regulatory agencies.

Similar external costs, particularly as related to Prince Rupert, were rather well put in a recent editorial from the Prince Rupert Daily News (January 31, 1975). This article is quoted in part below:

> *" Would it be conceivable, that instead of waiting until an unjustice is done -- then reacting to stop it, the public could develop a pattern of looking ahead and thinking ahead to prevent the injustice from taking shape, in the first place?*
>
> *There are, already, good indications that such a change is actually underway.*
>
> *Rather than wait until harmful effects of pollution, ecological damage to the land, sea and air of the Northwest results from the muti-billion dollar Northwest Development plan, some citizens in the northwestern B.C. area have already banded together and are insisting that a thorough, full length, study be made on all the possible harmfull effects by such a development plan; that full thought be given to the whole idea and a rethinking as to whether or not the damages it would wreak on our land would possibly more than outweigh the advertised advantages.*
>
> *If the public were to constantly question every major move made by civic, provincial and federal authorities, as well as by every major project undertaken by private capital, then we should be making true 'progress' indeed.*
>
> *When a well-known lead battery industry started up in an an eastern province several decades ago, the company officials stressed the favorable impact the plant would have on the local economy. They mentioned the huge payrolls, the amount of taxes, the number of families the plant would bring to the community. Nowhere was any mention made of the housing shortage, the school shortage, the water shortage, the parking space shortage, the hospital bed shortage, etc., that would result from the indutry's locating within the city limits. This was something that far-sighted forward thinking community members should have thought about. Nor was any mention or study made on the awful health hazard that would occur once the industry began its lead battery manufacture, that eventually is being held responsible for scores of deaths it caused by lead poisoning.*

"Alert, forward thinking and looking citizens could have prevented the tragedy that occurred whereby many persons are now believed to have died from lead poisoning produced by that one factory.

Had our local citizens been on their toes years ago, the ugly landscape brought about by what is now called CanCel, and the poisoning of the waters, polluting the beaches, and putrefying the breezes for miles around would not have happened. ---

The public is awake- at last. Only a short time ago, on these very pages, previous editors and writers and critics were lambasting the people of Rupert for being "apathetic". Well, apathetic they may have once been. Not anymore!"

To allow for this sort of non-financial external cost, we suggest the social financial rate of return of 8.06% should be reduced. On the other hand, if we acknowledge that society perceives some net benefit from industrial expansion, the net society rate of return should be somewhat above the investor's return of 5.82%. It would seem reasonable, therefore, to adopt a median rate of 7% as the net social rate of return of all industrial projects in Canada, and to use this as the discount rate for projects in the public sector.[1]

8.2 Environmental Costs of Top Ranked Sites

As it is very difficult to accurately project the environmental risk that might be involved in particular projects, these environmental costs will not be added to the cost of the project itself. Instead, the alternative projects and their differential costs will be examined and compared to the environmental risks to decide whether, intuitively, the costs are comparable to the risk. Using a 7% discount rate, the costs of the three top ranked options as estimated by the engineering consultant are shown in Table 21. As Kitson Island is environmentally unacceptable and has no cost advantage over Ridley Island, there would seem to be no reason to continue an assessment of that site. Accordingly, we shall compare just Port Simpson and Ridley Island. As shown in Table 21, Port Simpson has a large cost disadvantage when compared to Ridley Island. However, virtually all that cost disadvantage is connected with the rail access to the site. Other differential costs involved with Port Simpson include mainly the tug and employee transportation from Prince Rupert, and would therefore not be applicable if Port Simpson was developed as a community in itself. Nevertheless, these costs are included in our analysis, assuming such community development would be discouraged in favour of developing Prince Rupert.

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[1] A 7% discount rate has also been used on three major public studies recently conducted in British Columbia, including the B.C. Energy Board Study of power resources and the federal/provincial Okanagan Basin Study.

Table 21

DEVELOPMENT COST OF ALTERNATIVE SITES*

	CAPITAL COST	PRESENT VALUE OF OPERATING DIFFERENTIAL	TOTAL
Port Simpson			
Railway	30	68.1	98.1
Others	64	81.6	145.6
Total	94	149.7	243.7
Ridley Island	61	71.4	132.4
Kitson Island	61	75.5	136.5

Differential cost (capital plus present value of annual) between Ridley and Port Simpson = $111.3 million.

* All figures in millions of 1974 dollars

Some environmental costs show up in hard dollar terms. Specifically, the impact on the $40 million per year fishery can be counted in dollars. Figure 4 shows the changes in the wholesale value of all fish and fish products produced in British Columbia in constant 1961 dollars (deflater indices from Statistics Canada) for the last ten years.

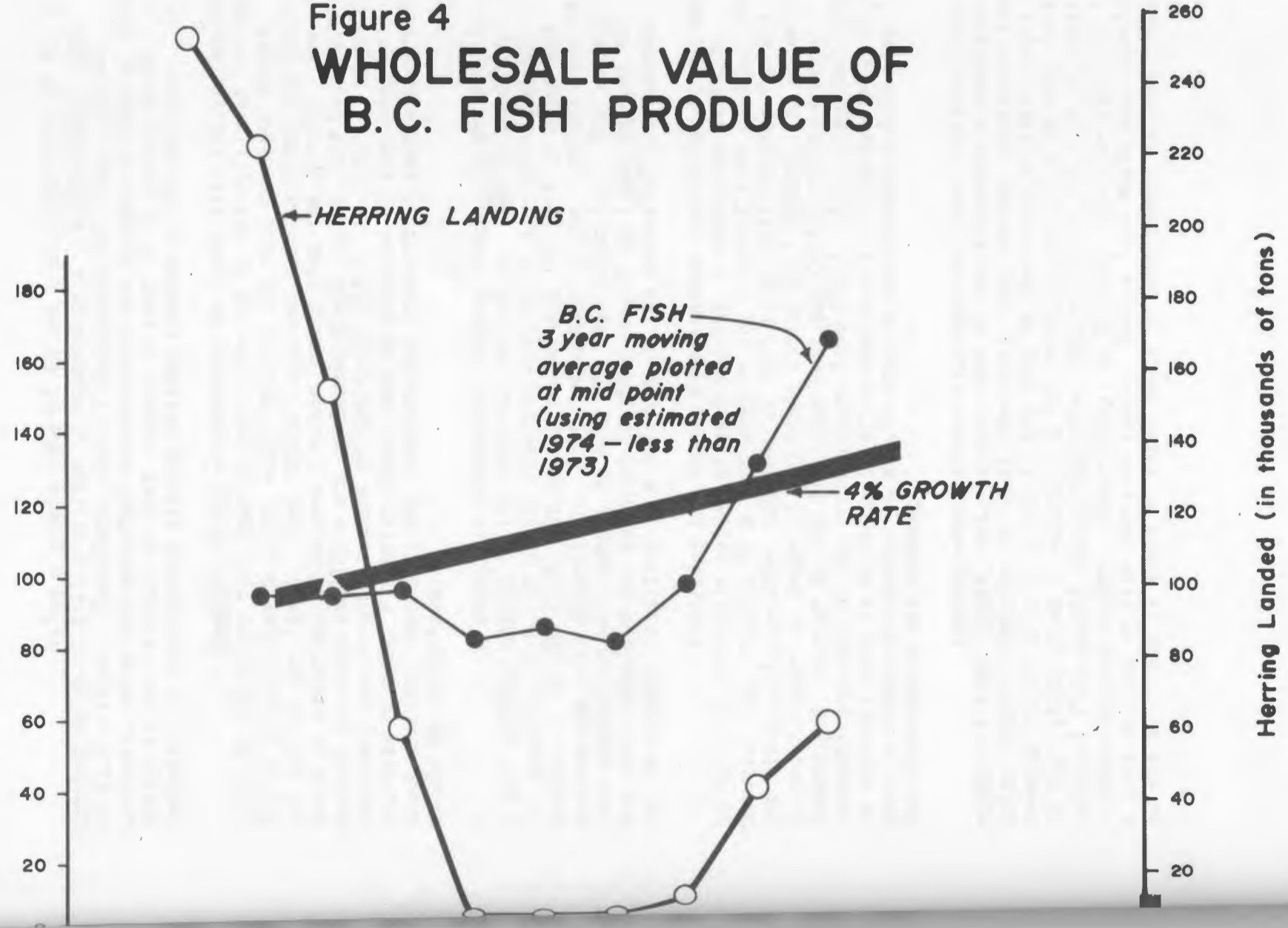
Salmon landing have accounted for up to 90% of this value in some of the last ten years as a result of the collapse of the herring population from 1967 to 1971. Careful management has built herring back up to the point where, in 1973, it accounted for 12.2% of the wholesale catch value (halibut amounted to 4.5%, salmon 77.8%, and "others" 5.5%).

As can be seen from Figure 4, the value of B.C. fish and fish products has been rising at an average rate of well over 4% annually in real dollar terms, assuming the herring fishery can be managed. The degree to which the value of B.C. fish products can continue this growth is uncertain, so we propose to use a growth figure of just 4% in real dollar terms for the following calculations.

NEAT

Figure 4

WHOLESALE VALUE OF B.C. FISH PRODUCTS



Using a growth rate of 4% and a discount rate of 7%, a present value of $111.3 million is equaled by a present annual cost of $3.2 million. Therefore, even if non-commercial items such as aesthetic value and waterfowl preservation are assumed to have no value, Ridley Island is equal to Port Simpson in cost if it causes an 8% reduction in the current fishing related revenue of $40 million.

Because of the differences in their life cycles, herring would be the major fish species most affected by oil spills at or near Ridley Island, Skeena salmon would receive the next greatest impact, and halibut the least. Some "other" species, such as clams and crabs, would be subjected to an even greater impact than the herring. Because most of the data available are on Skeena River salmon, and because they represent the largest segment of the total catch, an order of magnitude estimate of total fisheries impact can be obtained by examining only those species. However, the inaccuracies inherent in such a generalization should be recognized.

A change in commercial fishing revenue is achieved by a much smaller change in the survival rate of the fish in question. For example, if a run of 100 spawners results in a returning adult population of 200 fish, 100 may be caught and 100 left to spawn and produce the next generation. A 10% reduction in the survival rate of this population will result in only 180 fish returning. One hundred are still required for spawning or the run will decline, so just 80 can be caught, resulting in a 20% drop in the number of fish caught.

Examining the Skeena River salmon population on the basis of relative wholesale values of each species, a reduction of 1% in survival rate results in a 1.9% drop in the value of fish caught. There are little data on other species, so this ratio will be used for all fish in order to get an order of nagnitude estimate of impact. As shown in Appendix B, Chapter 6, the fishermen must pay certain fixed costs (amounting to 47% of the gross return from fish). As a very small drop in survival rate is unlikely to drive anyone out of the business, this cost is likely to remain, so a 1.9% drop in catch means a 3.6% drop in the fishermen's net revenue.

Cannery wages should fluctuate in direct ratio to the number of fish caught, and, because much of the fishermen's operating costs involve payments to local merchants, the service industry's lost revenue should also be close to the drop in the value of fish caught. In the ratios shown in Appendix B for Prince Rupert, a 1.9% drop in the value of fish caught should therefore result in a 2.35% loss in total fishing related income. Accordingly, an 8% loss should be realized from a 3.4% decline in fish survival rates. Such a loss would mean development at Ridley Island is equal in total costs to development at Port Simpson.

Considering the potential value of the Ridley Island area for rearing fish, is an average of less than one spill per year at Ridley Island combined with a very infrequent large spill sufficient to cause such a decline? Probably not, but it is impossible to make such an estimate with the available data. Even with far more refined environmental information, the best guess which could be hazarded may be that the impact will amount to from 0.1% to 5% decline in average survival rate.

As a result, a cost comparison of the two sites cannot be made in the traditional fashion. Instead, we intend to examine the implications for certain specific interest groups.

8.3 The Sectors of Society Which Have an Interest in Costs

There are four main segments of society which should be examined separately to get an appreciation of what the total costs imply. These segments are the Canadian National Railway, the port developer, (assumed to be the same party as that selling coal), and the communities of Prince Rupert and Port Simpson.

8.3.1 The Canadian National Railway

As noted above, the major difference between port developments at Port Simpson and Ridley Island in direct costs is absorbed by the railway. This amounts to a capital cost for road construction of $30 million (less the $1 million that it would cost at Ridley), an expenditure of $10.8 million for locomotives, and an operating and maintenance expenditure of $2.5 million (less the $0.4 million per year experienced at Ridley). Amortizing the railway construction costs and the cost of extra locomotives, this works out to a cost of $2.9 million per year plus 31 cents per ton of material moved. Assuming the port is operating at full capacity, this means a full extra cost of 55 cents per ton moved.

Acknowledging the extra operational and administrative problems inherent in operating a rail system with two ends (at Port Simpson and Prince Rupert) and a governing grade twice the maximum grade on the rest of the line, we would assume for the sake of discussion that the CNR would charge a differential cost of about one dollar per ton for shipping to Port Simpson as opposed to shipping to Ridley Island.

8.3.2 The Port Owner and User

The non-coal products which are noted for this project are typically high value/low volume products. Accordingly, slight differences in transportation rates make very little difference to the

profitability of the companies mining and selling the product. On the other hand, coal is typically a very high volume and low profit commodity. Accordingly, transportation costs become an important item when examining coal shipment. The going world price for free market coal at the moment is about $30 per ton, but for longer term contracts the price is normally based on the costs of the producer more than the alternative price for the purchaser. An excellent example of such a contract is the Kaiser Resources contract with its Japanese customers, which contains escalator clauses for increased costs and also involves debt and equity financing by the purchasers of the coal.

The addition of a transportation cost amounting to $1 per ton is not a large item in coal selling for $30 per ton. However, this difference of 3% of the selling price may have a major impact on the profitability of the operation. Once again turning to Kaiser Resources as an example, it is noteworthy that their latest financial report details the 1973 net earnings before extraordinary items to be 2.9% of sales. Therefore, a transportation surcharge of 3% of sales eliminates all profit in the operation. However, as stated above, this profit is based on a long term fixed price contract with built in escalator clauses. Rather than being at the mercy of the current fluctuations in energy prices, it is quite possible the purchaser may be willing to arrange such a long term contract with a shipper from the Prince Rupert area which will involve a selling price to yield a similar profit in spite of transportation costs.

One must acknowledge, however, that world coal prices are quite competitive, and this 3% differential at the purchaser level may be sufficient to send the purchasers to other countries, or to convince the developer not to build a coal port in Canada. A decision not to construct a port in the study area would cause important socio-economic effects in Prince Rupert.

8.3.3 The Community of Port Simpson

As stated above, a road is about to be built from Prince Rupert to Port Simpson. Accordingly, the local cultural implications of a road connection cannot be charged against the port development itself.

However, the introduction of a major port development in the beautiful natural harbour of Port Simpson directly across from the community, and the resultant automobile, train and ship movement is still a very large change in the local situation. Some local employment would be generated, including service facilities, but it is difficult to foresee

whether this would offset the loss of their existing life style for the local inhabitants.

We would suggest this is a question which can be answered only by the people of Port Simpson after they have been presented with the options and the information contained in this report.

Furthermore, it should be recognized that, if Ridley Island was chosen as the port site, there would be some small adverse effect on the fish and wildlife used by the people of Port Simpson. Accordingly, the people of the community must chose between a small loss for no gain (Ridley Island), or an important change in their current life style for a significant economic gain (Port Simpson). The fact that a rail line to Port Simpson removes any economic disadvantage from future development of heavy industry in Port Simpson should also be recognized, as should the fact that related community development would, of necessity, take place on the present Indian reserves of the Coastal Lowland.

8.3.4 The Community of Prince Rupert/Port Edward

The people of Prince Rupert have been promised port development for decades and the failure of these promises to materialize is one of the major items of dissatisfaction in the community. The details of the effects of such development are not apparent to most people, and we would hope this report will provide some information to permit the community to decide its priorities.

It appears to us that the choice of Ridley Island may result in no real gain to Prince Rupert unless it further stimulates local growth. The choice of Port Simpson provides more net income directly, and retains the option of major industrial expansion at a nearby location which will not really affect the natural environment of Prince Rupert, but will greatly enhance the community's economic health. However, the choice of Port Simpson carries with it the risk that the high cost of development (related to rail access) may be prohibitive to any private developer, and therefore no port at all may be built in the study area.

It is estimated that in 1974 the total gross income in the study area was about $87,500,000. The gross income during construction is estimated to be about 1.6% of that (peaking at 2.5%) for the Ridley Island site and 2.5% (peaking at 4.5%) for the Port

PART 4

CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 9

Conclusions

9.1 Because port development at Kitson Island involves a large impact on anadromous fish and a major potential impact on both fish and wildlife, it is considered environmentally unacceptable.

9.2 On a strictly environmental basis, Port Simpson is quite clearly the best site in the study area for port development alone or with related industrial development.

9.3 Including the difficulties and costs of railway access to Port Simpson, port developments at Port Simpson, Ridley Island, or Ridley/Fairview seem to be equal overall, although their characteristics are quite different.

9.4 Considerations of further related industrial developments overshadow the direct effects of the port development itself. This study was not aligned to examine such related developments in detail.

CHAPTER 10

Recommendations

10.1 The choice of a port site in the Prince Rupert area should await the outcome of current province-wide studies of the best locations for heavy industry in the province. For the Prince Rupert area, the working assumption should be that an integrated port and industrial complex will be centred on Port Simpson, with the access railway and road constructed as a public undertaking.

10.2 If no major heavy industrial complex is envisioned for Prince Rupert, the choice of the bulk-loading site within the study area should depend upon the opinions of the people of the study area (particularly those in Port Simpson) after they have been presented with the available options and impact projections. The working assumption should be that a bulk-loading facility will be constructed at Ridley Island, and that further industrial development in the area will not include major heavy industry.

CHAPTER 11

Recommended Terms of Reference for Phase 3

In accordance with our terms of reference, which include the "Specification of investigations required to appropriately detail recommended mitigating measures", we recommend the following terms of reference for Phase 3 - "Development of Detailed Environmental Design Criteria".

Two sets of recommended Terms of Reference are included, as the problems to be studied vary depending upon whether Ridley Island or Port Simpson is the site selected for a bulk-loading facility. The recommended terms of reference do not address the question of further related industrial development.

TERMS OF REFERENCE

PHASE 3 - DEVELOPMENT OF DETAILED ENVIRONMENTAL DESIGN CRITERIA

RIDLEY ISLAND BULK LOADING FACILITY

A. Assessment of Regional Impacts

The most important question in regard to port development at Ridley Island involves the probability of oil spills and operational discharges. Part A of this study involves a statistical analysis of the frequency, location and size of such incidents based on experience at similar facilities elsewhere in the world and on the local navigational characteristics of Ridley Island and its approaches.

In addition, an assessment of the movement and extent of such discharges is required. This aspect will involve the gathering of current data as well as wind, wave, and tide information, and a statistical correlation of these factors with the spill probabilities as developed above. This correlation will then be used to establish the parts of the study area including all of Chatham Sound, which are most threatened by these risks, as well as the magnitude of the risk.

Biological studies will be carried out over at least a twelve month field season to define ecologically valuable areas. Particular attention should be paid to areas used by waterfowl, spawning herring, and rearing salmon.

Based on all the above, the environmental risk will be evaluated, and various types of navigational aids and restrictions as well as pollution control measures and facilities will be assessed for their cost effectiveness in reducing the environmental risk. Unacceptably high risks which may exist will be identified, as well any "break-points" in the cost effectiveness curve.

B. Assessment of Site-Specific Impacts

This part of the study involves environmental input to the detailed engineering design. There is little flexibility in the actual location of the facility and its access, but the specific location should recognize the need to minimize disruption of deer winter range (including the access from Kaien Island to Ridley Island) and of

waterfowl habitat between the islands. In addition, every effort should be made to preserve the area just off Ridley Island for future fish rearing. The latter aspect will involve inshore water quality and fish utilization studies, with a view to establishing overall water quality objectives to be met jointly by the bulk loading terminal and the pulp mill.

All locational design work by the engineering designers must be carried out jointly with the environmental study team to produce an optional design which minimizes both cost and impact. Close cooperation on all phases is essential.

In addition, navigational and operating experts will work jointly with the environmental team to produce an operating manual for port uses with detailed guidelines for sound operating practice. Responsable agencies for normal operation and emergency operations (for example, during spills) will be detailed, as will emergency stand-by equipment. In particular, responsibility for control and clean up of oil spills and coal dust will be given to specific bodies so that both authority and responsibility will be quite clear.

C. Assessment and Monitoring of Construction Impacts

In conjunction with the engineering team, the environmental study group will also develop a manual of construction techniques and procedures to be used, including restrictions on types of equipment, timing, and location of temporary access and facilities.

In close cooperation with government regulatory agencies, the construction will be monitored by the same environmental personnel who set up the construction manual, to ensure the "spirit" of the manual is followed, rather than the "latter".

D. Post-Construction Surveillance of Operations

During normal and emergency operations, surveillance of the effectiveness of the environmental control measures will be carried out, and any modifications deemed necessary will be made if the original measures do not have the desired effectiveness.

TERMS OF REFERENCE

PHASE 3 - DEVELOPMENT OF DETAILED ENVIRONMENTAL DESIGN CRITERIA

PORT SIMPSON BULK LOADING FACILITY

Parts B, C, and D of the terms of reference for the Ridley Island facility also apply to Port Simpson. However, special attention must also be given to minimizing the impacts of location, construction, and operation on fish-bearing streams, including establishment of artificial enhancement facilities as compensation for losses incurred.

In addition, expansion of the details of socio-economic mitigation measures as contained in the phase 2 report will also be carried out.

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