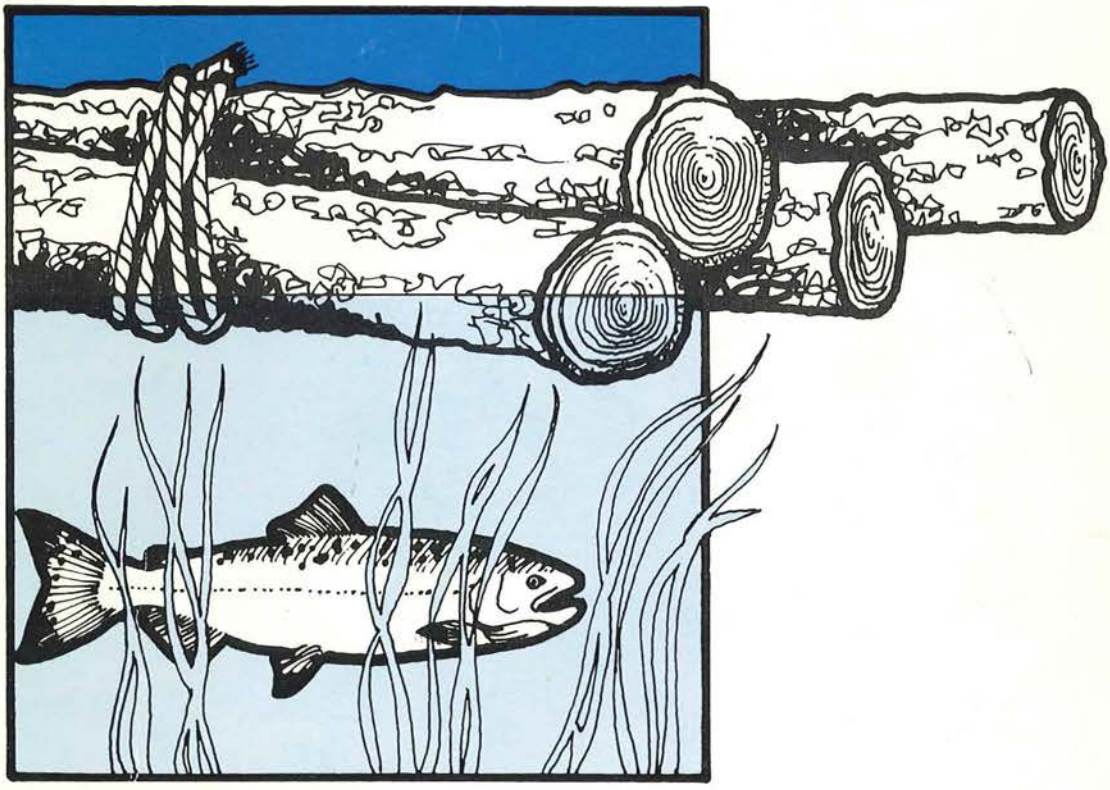
Nanaimo Estuary

Summary Report

Fish Habitat & Log
Management Task Force



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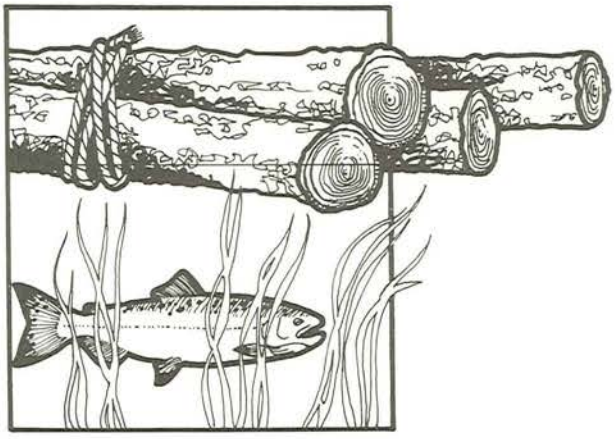

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VICTORIA, BRITISH COLUMBIA
JUNE 1980

Government of Canada
Fisheries and Oceans

Province of British Columbia

Canadian Cataloguing in Publication Data

Nanaimo Estuary Fish Habitat and Log Management Task Force.
Summary report.

ISBN 0-7719-8355-7

1. Log transportation - British Columbia - Nanaimo River estuary. 2. Booms (Log transportation) - British Columbia - Nanaimo River estuary. 3. Estuarine fisheries. 4. Nanaimo River estuary, B.C. I. Canada. Dept. of Fisheries and Oceans. II. British Columbia.

SD540.3.C3N36 634.9'8'2 C80-092102-X

Acknowledgments

The Steering Committee wishes to acknowledge with thanks the many people who contributed to the Nanaimo Estuary Fish Habitat and Log Management Study. Considerable progress in the study was made towards the development of a rational process for resolving fish habitat - log storage issues based on the requirements of both resources, and the valuation of the costs and benefits of feasible alternatives. But before valuation can effectively occur,however, a clear understanding of the essential processes and activities is necessary. This understanding was achieved in the Nanaimo Fish Habitat and Log Management Study, and it occurred only because of the willing co-operation and assistance of many individuals and agencies who participated. Special acknowledgement goes to Mr. Gary Urston,Vice-President of Chemainus Towing Co. who provided essential information on the nature of the towing channels in the study area; Mr. Ken Boyd, Vice President, Logging Research, MacMillan Bloedel Ltd. who provided valuable guidance on the requirements of the Forest Industry. Concerning the review of the Fish Habitat Report, thanks goes also to the biologists under the lead consultants of F.F. Slaney & Co., especially Dr. Glen Geen, and Dr. Tim Parsons. In the formulation of study options, their identification, clarification and valuations, competent professional services were provided by Mr. Clay Anderson, of C.H. Anderson and Associates, Alan Sutton of B.C. Research Council, and Mr. George Nagle of Nawitka Resources, respectively. There were also others too numerous to mention, who provided valuable input in the study process by sharing their expertise and insight.

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1. INTRODUCTION - TASK FORCE OBJECTIVES

Following the initial Environmental Evaluation in 1972, referred to in the report "An Environmental Assessment of Nanaimo Port Alternatives" the Duke Point site was selected for the development of a deep sea shipping facility as well as an Industrial Park, including sawmill site. This was acceptable to virtually all agencies as it locates development outside the sensitive Nanaimo Estuary. In October 1977 the British Columbia Development Corporation (BCDC) presented a more specific proposal to develop an Industrial Park including three deep sea berths, sawmill site(s), possibly a thermo-mechanical pulpmill, a light industrial park, and a tank farm. This proposal was reviewed by a Department of Fisheries and Environment Task Force. As the BCDC proposal broadly conformed to the recommendations of the 1972 study, the proposal was generally accepted, but the log storage proposals were rejected, and the BCDC was advised of this decision in January 1978.

This latter decision prompted an exchange of letters between the Honourable Don Phillips and the Honourable Jack Horner who in turn communicated with the Minister of Fisheries and Oceans the Honourable Romeo LeBlanc. The Minister of Fisheries and Oceans responded to Mr. Horner in March 1978, as follows:

> "My position on log storage in the Nanaimo Estuary is that further damage to highly productive fish habitat will not be permitted, and renewal applications for existing log storage leases will be examined with a view towards re-habilitating areas with potentially high fish habitat value. Without some qualification, this position may appear to be a bit harsh. It does not mean that Fisheries is trying to veto the Duke Point/Jack Point industrial development. ...my position is not intended to mean that all log booming in the Nanaimo Estuary will be disallowed or that it will be phased out. It does however infer that all alternative log supply and management options should be assessed and real needs clarified. Furthermore, my fisheries experts may find that not all parts of the estuary are highly productive fish habitat, and that the low productivity areas could be used for controlled log storage without greatly affecting the fisheries resource base. With these qualifications in mind, the solution to the Nanaimo log storage issue may require the geographical rearrangement of existing or proposed log

booming areas in the estuary, dryland storage, consolidation of estuarine acreage used for wet storage, application of modern booming technology or any combination of these or other measures. In short, a mutually satisfactory solution should be possible which accommodates both logging and fisheries resource interests in the estuary." (Emphasis added.)

Accordingly, the Federal Minister proposed:

"the establishment of a Federal/Provincial Task Force on Fisheries Resources and Log Management in the Nanaimo Estuary. The Task Force could:

a) Review the terms of reference for the log supply and management study to be expedited by B.C.D.C.*
b) Review plans for consolidating existing biological resource base information on the Nanaimo Estuary.
c) Review the findings and recommendations emanating from all the studies and present a unified report with recommendations for Ministerial information and decision.

In order to assist the Task Force, I am proposing the establishment of a working group to carry out a habitat classification review of the estuary, consisting of federal and provincial fish and wildlife representatives. Fisheries and Marine Service will provide the information it has available on this subject. The Service is also prepared to conduct an applied research study concerning the effect of log storage on the fish habitat and aquatic productivity of the Nanaimo Estuary. The Task Force should also review the objectives and plans for the applied research program.

When all the studies have been completed, the Task Force findings and agreement reached by the Task Force members should be submitted to the provincial Ministers who constitute the B.C. Environment and Land Use Committee (E.L.U.C.) and to myself. Our two governments then should take complementary action."

* Asterisk added - B.C.D.C., in a letter to W.J. Schouwenburg, Fisheries and Oceans, dated June 28, 1978, declined proponent status.

Accordingly, the Nanaimo Estuary Fish Habitat and Log Management Task Force was established. A balanced approach was desired, and the members of the Task Force included agencies who could provide the necessary technical expertise to ensure that all the resource requirements and values were fully identified. As the analysis and synthesis of information required specific technical expertise, three consultants were brought in who worked with the Task Force staff in developing the concepts used in this study for evaluating the resource requirements and values. The Task Force authorized had the following structure as shown in Figure 1.

As a consequence the objectives of the Nanaimo Estuary Task Force were well understood. It was to clarify the real needs of the forest industry, and the fisheries resource and to define "a mutually satisfactory solution ... which accommodates both logging and fisheries resource interests in the estuary". The following is the report of the findings of the Task Force, including recommendations.

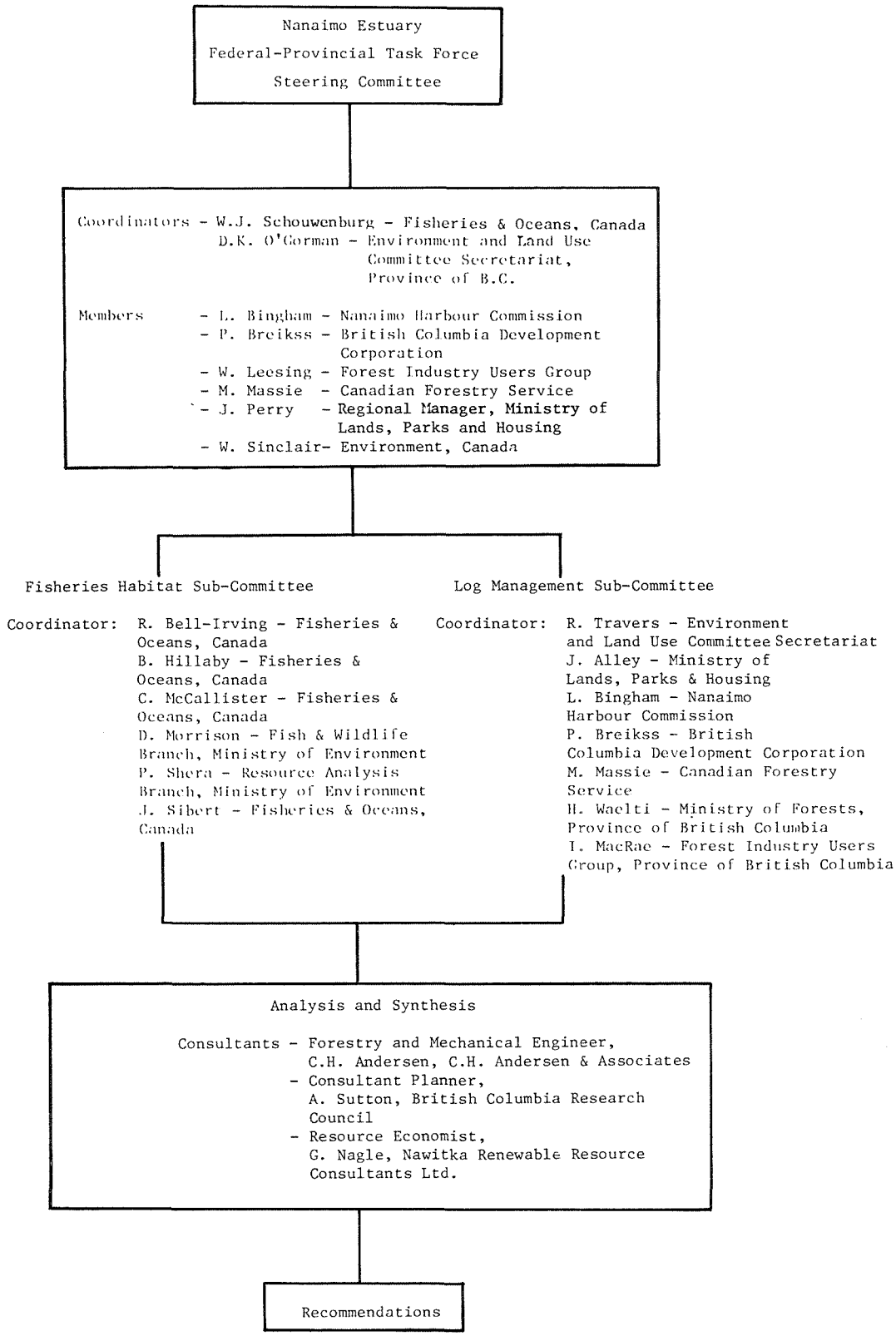


Figure 1. Organizational Structure of the Nanaimo Estuary Fish Habitat and Log Management Task Force

2. Forest Industry Requirements Relevant to the Estuarine Log Storage Issue

Of the total wood logged on Coastal British Columbia, 13% will be processed in Nanaimo mills at full projected capacity. Accordingly, any coastal forest products complex, and its adjacent log storage area must be viewed in the context of the overall log transportation system. First, nearly all logs on the coast are transported by water between the logging operations, which could be located virtually anywhere on the coast, to the mills, most of which are concentrated in the southern end of the Georgia Strait. The primary towing route and distribution of log production and consumption are shown in Figure 2. Second, in sheltered inland water most log transport is by log raft, but on the exposed coast virtually all log transport is by log barge. And third, as continuous log consumption by mills is a requirement of the forest industry, log storage nearby the mills is necessary to prevent mill shutdowns caused by wind, winter shut-down of logging operation, extended fire season, or any other event which causes log production to be interrupted.

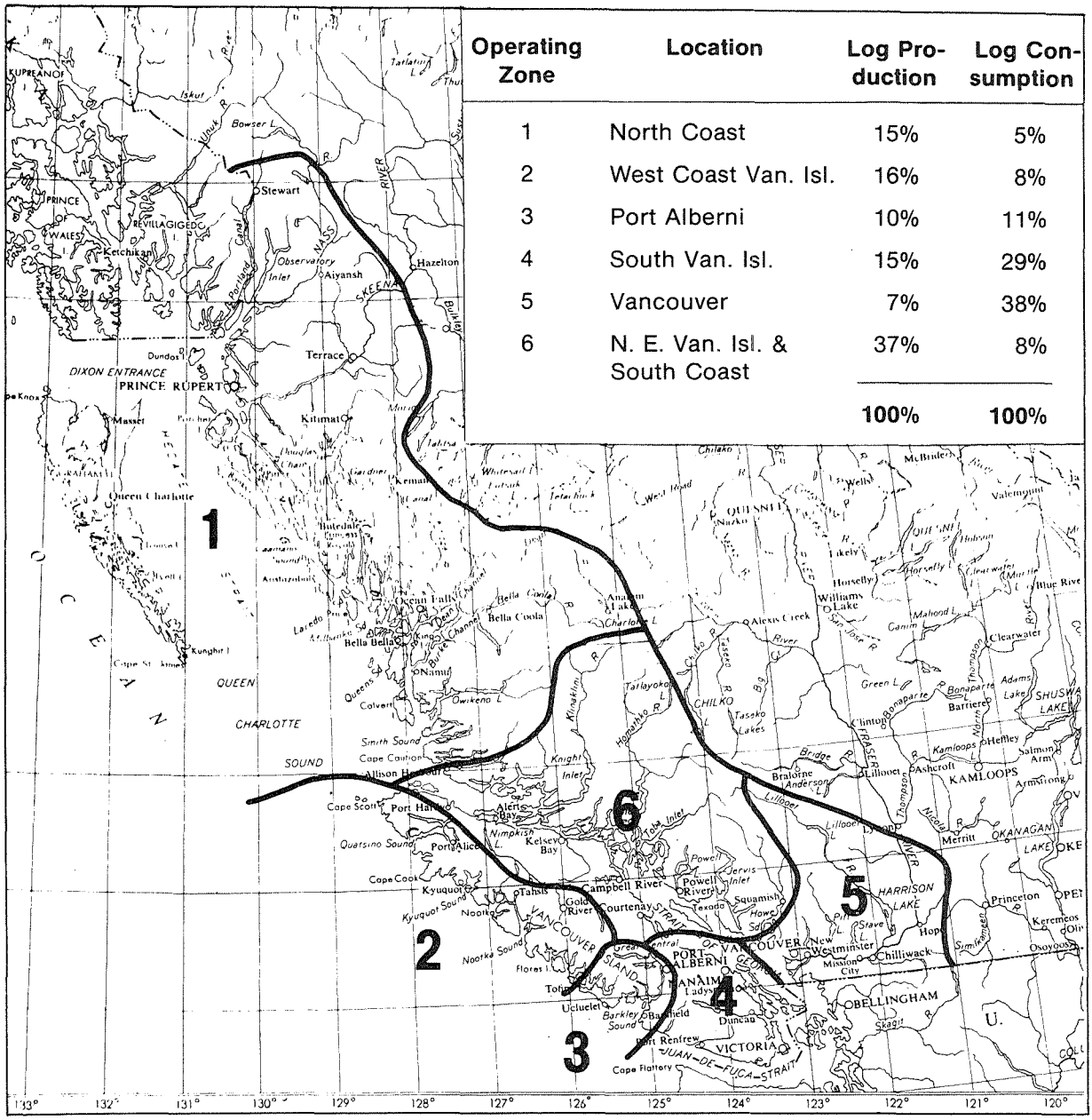
Accordingly, there are three major components of the coastal log transportation process and may be viewed as a dynamic system, where:

Log Production Rate = Log Storage Rate + Mill Consumption Rate.

The storage component nearby the forest products mills must be sufficiently large enough to ensure an adequate supply of logs, especially during the most windy seasons of the year. Log rafts towed by tugs move slowly, about 2 knots. When wind develops, and this is most frequent in winter, towing of log rafts becomes marginal when:

(1) winds exceed 20 knots
(2) fetch (exposed distance in a straight line) exceeds 10 miles
(3) wind duration exceeds 4 hrs.
(4) adverse tidal currents exceed 2 knots

In operating terms, log rafts and barges move from one island cluster to the next with the operators responding to the winds and tides; all these forces affect towing activities.



Operating Zone	Location	Log Production	Log Consumption
1	North Coast	15%	5%
2	West Coast Van. Isl.	16%	8%
3	Port Alberni	10%	11%
4	South Van. Isl.	15%	29%
5	Vancouver	7%	38%
6	N. E. Van. Isl. & South Coast	37%	8%
		100%	**100%**

Figure 2. Distribution of Logging Operations, Major Tow Routes, and Forest Products Mills on the B.C. Coast

In the Nanaimo instance therefore, log storage has both a local and a coastal dimension. Concerning the requirements for log storage it is an accepted forest industry operating principle that a three month log supply should be in the water in transit at all times between the logging operation and the mills. Nearby, at the mills (within a 1.5 day assured tow - 30 nautical miles), a 1.5 month log supply must be available. In other words, continuous mill consumption requires 1.5 months log storage nearby to cover the no-tow periods regularly anticipated outside of sheltered areas adjacent to the mill.

In salt water, another risk is teredoes (a mollusc which destroys wood). Accordingly, log storage areas with sufficient fresh water present to sufficiently reduce teredo activity are sought by the industry. These areas are generally estuarine in nature, though not all estuaries are known to contain sufficient freshwater to provide protection.

To quantify the log storage requirements it was first necessary to define the maximum mill capacity for present and proposed mill requirements in the Nanaimo area. These maximum mill capacities are stated in Table 1.

Assuming 1½ months log storage "nearby", the volume requirement at any one time for log storage in the Nanaimo Harbour Commission area will be 184.1 M cunits (.125 x 1,473). In the Log Management Sub-Committee report, it is noted that all log storage options (1 - 10) might provide this capacity. Contributions to log storage capacity possibly provided by supplementary storage by private foreshore owners might reduce this requirement. However, it must be appreciated that suitable alternative log storage areas are in short supply in the Nanaimo area as many constraints exist. (The constraints are discussed in more detail in Section 5.2 of this report.) There is no easy solution, since recreational use of sheltered areas in the southern end of Georgia Strait continues to grow in popularity. In addition consent from upland owners of foreshore to store logs in strategic locations often may not be forthcoming in many instances.

Table 1. Maximum Present and Proposed Mill Capacity in the Nanaimo Area
(M Cunits)

Present Mills	Capacity
CIPA	113
MacMillan Bloedel	650
Dorman*	(72)
Mayo #1	100
Sub Total - Present Capacity	863 M Cunits

*Ceased operation (1979) and is being replaced by Mayo #2

Proposed Mills	Capacity
Mayo #2	135
Doman #1	325
Doman #2	Chips only
"X"	150
Sub Total - Proposed Capacity	610 M Cunits

Total Present and Proposed Maximum Annual Mill Capacity - 1,473 M cunits

Source: Table 7, Log Management Sub-Committee Report

3. Fisheries Resource Requirements Relevant to the Estuarine Log Storage Issue

The Nanaimo estuary accounts for about one-quarter of the Georgia Strait fishery which also depends on the Qualicum, Campbell, and Capilano Rivers as well. The salmonid species are chinook, coho, chum and steelhead. A salmon fishery has three major geographic components including the spawning areas in fresh water, the rearing area of fresh - salt water transition in the estuary, and the ocean where the fry juveniles develop into adults. The salmon population too, forms a dynamic system, including out migrant fry, some which grow, develop and survive to be adults, and return to spawn (escapement); or are taken in the commercial, recreational, or the native food fishery. The magnitude of the escapement is a measure of the fisheries production systems ability to cope with the uncertainties associated with over-fishing, destruction of spawning habitat, disease, predation, and significantly suitable rearing habitat in estuaries. Juvenile chinook and chum salmon, in particular, have a high dependency upon the estuary where they may spend from February through July feeding, growing, and adapting physiologically from a freshwater to a marine environment.

For these species, it is essential that the estuarine rearing system be maintained at a high level of productivity to ensure that the fry produced in the freshwater portion of the system have a good chance for survival. Otherwise it is pointless to manage the fishery to increase the escapement for it is not likely to increase the retaining population. (It is also pointless to restrict use of log storage areas in estuaries if upstream capacity to produce fish is limiting.) As the continuous production of the estuary ecosystem is a vital component of the fish production process, the general outline is provided in Figure 3 demonstrating the general kinds of biological complexities which exist.

The basic concept of any ecosystem is that energy flows according to the Laws of Energy Conservation, and matter is recycled. This occurs through a series of production (trophic) levels, with the organisms

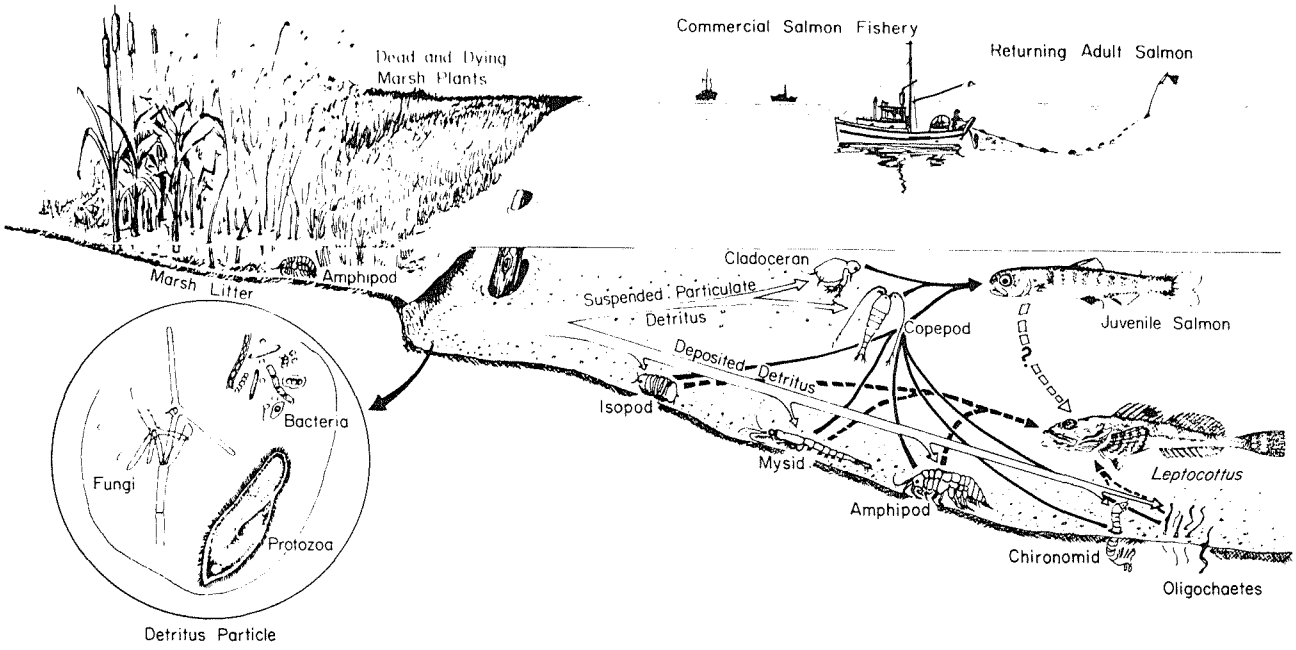


Figure 3. General Structure of an Estuary Ecosystem

Source: Westwater Research Centre, 1978. Similar relationships are known to exist in the Nanaimo River Estuary.

at the lower levels providing the food for the organisms at the higher levels. In the Nanaimo estuary one of the primary sources of food for the juvenile chum salmon has been identified as harpactacoid copepods, a small shrimp like organism.

In specific terms of the Nanaimo estuary the primary production of the bottom (benthic) organisms occurs in the vicinity of the eelgrass beds. The presence of eelgrass itself acts as a collection mechanism for material (mineral and organic) flowing downstream and acts as habitat for fish food organisms. This organic material provides about 90% of the energy flowing into the estuary ecosystem, with only 10% entering through photosynthesis from green plants growing in the estuary. Good fisheries management ensures these biological processes will proceed, and result in the maintainance of highly productive fish habitat.

4. Findings of the Fish Habitat Sub-Committee

The Fish Habitat Sub-Committee identified the location of highly productive fish habitat, and evaluated the impact of log storage activities.

4.1 Fish Habitat Classification

The presence of eelgrass, for reasons noted earlier, is used as an indicator of highly productive fish habitat. The distribution of eelgrass in the Nanaimo Estuary is identified in Figure 4. This map notes only the existing and potential distribution of eelgrass; the map does not identify the density of eelgrass. Eelgrass density and vigor will change in response to a series of biological and physical estuarine processes. Some of these changes are associated with log storage activities.

4.2 Log Impact Processes

A number of impacts occur from log storage activities, but their significance in the Nanaimo situation varies. These are noted in Table 2.

In the Nanaimo Estuary, the log storage activities of most concern to the fisheries resource are the result of propwash from tugs and scouring from log rafts and tugs while operating in the estuary, and from grounding of the log booms resulting from daily changes in the tide levels.

Other processes such as the effect of shading and reduced wave action are also of lesser concern, or their effect in the Nanaimo estuary is uncertain.

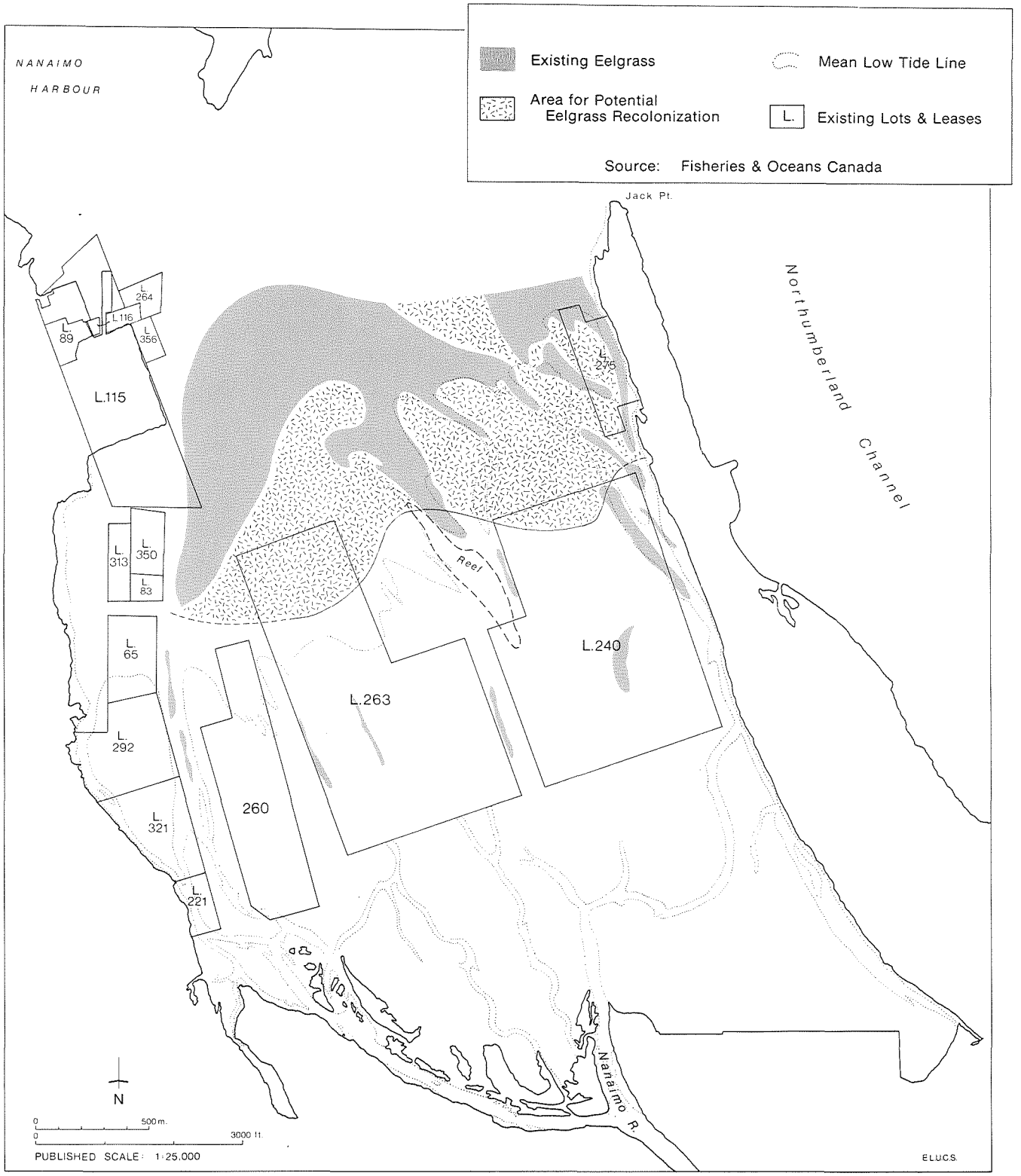


Figure 4. Distribution of Existing and Potential Eelgrass in the Nanaimo River Estuary

Table 2. Checklist of Impacts of Intertidal Estuarine Log Storage to be Expected from Empirical Observations

Primary	Secondary	Tertiary	Expectation General	Expectation In Nanaimo Estuary
Shading	Decreased primary production by microalgae (planktonic, benthic, macroalgae, eelgrass).	Altered food chains.	Less significant.	Less significant.
Grounding, abrasion	Destruction of plants, epifauna, infauna, drainage channels. Sediment compaction.	Destruction of food chains, lost "living space".	Highly significant.	Highly significant.
Reduced current and wave action	Increased sediment disposition, increased fines, debris retention, decreased sediment flushing.	Altered food chains, lost living space, chemical changes.	Significant.	Uncertain.
Leachates, debris	Toxicity, B.O.D.	Decreased, altered flora and fauna.	Highly significant.	Not significant.
Towboat prop. wash in approaches	Disturbance and destruction of flora and fauna	Decreased production. Altered communities.	Highly significant.	Highly significant.

Source: Fish Habitat Sub-Committee Report

4.3 Historical Escapement Trends

Escapement trends for chum, coho, chinook and pink salmon for the Nanaimo estuary have been identified in Figure 5. The trends show an earlier time period prior to 1956 where escapements were higher, a low period between 1957 - 1966 and a recent slightly upward trend principally for chum.

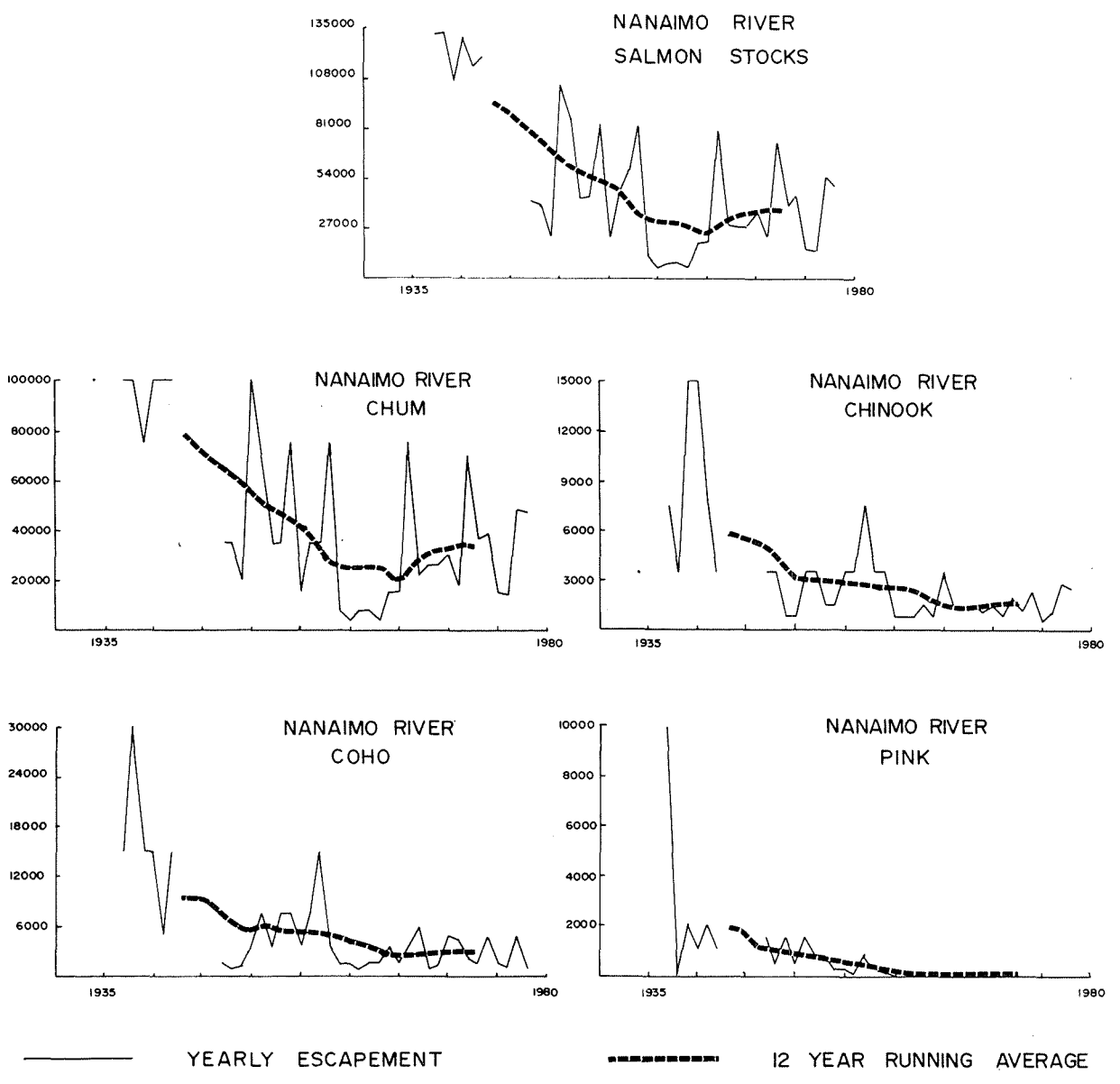


Figure 5. Nanaimo River Salmon Escapements, By Year and Twelve Year Running Average

Interpretation of the trend, and relating it to overall fisheries production is difficult. For instance, the original log storage leases were granted in 1950, after the apparent downward trend was underway. Further, the recent upward trend for chum may be the result of greater restrictions on fish catch. Therefore how far the upward trend may ultimately go for chum without measures to protect highly productive fish habitat is uncertain. Restricting disturbance from log storage activities to allow the biological processes in the estuaries to proceed unimpaired is a positive move towards increasing the escapement trend. Monitoring to record the changes in habitat and fish production is essential.

4.4 Productivity Ratings

Fish habitat productivity will vary according to the condition and quality of the habitat. To express this variation and to enable economic evaluation of the changes in productive fish habitat which occur as a result of removing logs from eelgrass areas and storing elsewhere, it was necessary to make two assumptions. The first is that a non-eelgrass area not used for log storage has a productivity index of 1, and a high productivity area not used for log storage has an index of 10. The second assumption states that for each unit of presently impacted high productivity area (acre) released from log storage there would be one acre of productive fish habitat directly created. The detailed productivity indices identified for this study are noted in Table 3. These ratings form the basis for the valuation of the fisheries benefits in the Benefit-Cost Analysis in Section 6.2 of this report. It must not be concluded that biological productivity, in fact, related directly to these arbitrary values. The values simply express points in a continuum of productivity in the correct sequence, and in so doing provide a starting point for assigning values to a range of conditions of fish habitat productivity.

Table 3. Estimates of the Variation in Salmonid Productivity By Habitat Type and Usage

	PRODUCTIVITY INDEX
HIGH PRODUCTIVITY AREAS (Eelgrass)	
-free of log traffic/storage.....	10
-log traffic only.....	5
-intensive log storage/traffic.....	2
LOW PRODUCTIVITY AREAS (Non eelgrass)	
-free of log traffic/storage.....	1
-intensive log storage/traffic.....	0

Source: Table 2, Economic Evaluation

5. Findings of the Log Management Sub-Committee

The Log Management Subcommittee provided information necessary to identify alternative methods of storing logs for the maximum annual mill capacity for the Nanaimo area and the associated costs. As noted in Section 2, of this report, the log storage required is 184.1 M cunits at any one time. Altogether ten potential log storage options and their costs were evaluated.

5.1 The Ten Potential Log Storage Options

A very broad view of potentially feasible alternatives were identified by the Log Management Sub-Committee. In brief, the options for log storage are outlined in Table 4.

Table 4. Potential Log Storage Alternatives

Option	1	Status quo
	2	Redistribution of leases
	3	Redistribution with dredging
	4	Northumberland Channel
	5	Valdes Bluff
	6	Dry - wet storage in Estuary
	7	Dry - wet storage outside Estuary
	8	Dryland storage in Estuary
	9	Dryland storage outside Estuary
	10	Millsite log storage

Source: Log Management Sub-Committee Report

It should be noted at the outset that the Status Quo cannot continue as new mills are currently under construction. The value in identifying the Status Quo is to assist in the establishment of base for comparing Options 2 - 10.

It is essential to note and understand the constraints which exist, for these greatly reduce the number of feasible alternatives.

5.2 Constraints to Implementing Potential Log Storage Alternatives

As stated, a very broad view of potential alternatives was adopted by the Log Management Sub-Committee. Careful analysis indicates that many difficulties exist.

5.2.1 Shelter

The primary physical constraint is the need for shelter from wind and the associated wave action. Without adequate shelter logs cannot be stored. Locations outside estuaries especially need better data on wind or detailed engineering analysis to determine their suitability for log storage.

5.2.2 The Overall Coastal Log Transportation System

As logs proceed from the woods to the mills, sorting, scaling and with increasing frequency, bundling activities occur. The fundamental constraint on the log transport system is that logs must be loose and visible while sorting and scaling occurs, to ensure logs are directed to their best end use. Accordingly, the location of the sorting area is vital to ensure the log transportation pattern fits the industrial structure of the operator, and is consistent with physical constraints imposed by the nature of the operating conditions. These factors must be taken into account when changes are contemplated. Merely shifting log storage from one estuary to another in isolation can have negative overall consequences.

For this and other reasons an overall coastal study of log transport and storage is required.

5.2.3 Upland Owners Consent

Where log storage occurs adjacent to foreshore, the consent of the upland owner is required. The requirement for consent of upland owners for use of foreshore accrues from recognition of riparian rights of waterfront property. The Lands Branch of the Province of British Columbia respects this interpretation in its management policy for crown owned foreshore.

The increasing use of the southern Georgia Strait region through subdivision of shoreline lots, as well as increasing recreational use of water, aquaculture and oyster farming, which also concentrates in sheltered areas, is a continuing trend which is having the effect of making it more and more difficult to ensure that strategic locations continue to be available for log storage for the forest industry. Should any one of the upland owners in a strategic location refuse their permission for use of the foreshore or demand an unreasonable price, that owner can effectively prevent the use of that area for log storage or even for improvements such as buildings, required for other uses such as management of oyster leases.

To reconcile these competing uses, innovative approaches to maximize the overall net benefits for the use of these properties are urgently needed.

5.2.4 The Threat of Teredos in Salt Water

Teredos (Bankia setacea) are molluscs and pose a constant threat to logs stored in salt water. Teredos bore into the wood and can cause severe loss in value to high quality logs. For this reason forest industry operators seek out estuaries which, providing the saline content is low enough, prevent or retard the growth and development

of the teredos. Long term salt water storage, especially of high quality logs, is not an option.

5.2.5 Cost

Some of the options identified in the Log Management Report require substantial capital investment, especially if an operator is considering creation of deep water log storage or centralized dryland log storage. In such instances, investments require many millions of dollars and would require in order of 15 - 25 years to ensure an acceptable amortization rate. The effect of the incremental cost of the identified options is evaluated in the Benefit - Cost analysis in Section 6.2 of this report.

5.3 Synthesis of Findings with the Fish Habitat Report

A synthesis of the findings of both the Fish Habitat Sub-Committee and the Log Management Sub-Committee at this time during the study gave a strong indication that Option 2 was a very viable alternative. It has three very attractive characteristics:

- it will meet the requirements of the Federal Minister of Fisheries and Oceans;
- it will provide enough log storage to meet the full requirements for Nanaimo area mills;
- its incremental cost, relative to the other log storage options, is small.

To ensure an objective evaluation of these findings ,the benefit - cost analysis included in the report was undertaken. The purpose of the benefit-cost analysis is to compare the incremental costs of reassigning the log storage leases from the status quo to other configurations with the increased benefits in fisheries production from anticipated recovery in fish habitat productivity.

5.4 Option 1 - Status Quo

Since new mills are under construction, the present log storage requirement at Nanaimo is changing and the status quo cannot continue. It does,

however, provide a starting point for analyzing the proposed changes. The following table and figures defines the ownership and size of existing log storage leases.

Table 5. Ownership and Size of Existing Log Storage Leases in the Nanaimo Area

Estuary*

MacMillan Bloedel	Acres under lease
Lot 240	232
" 263	229
" 275	18
	479 acres
Pacific/Mayo/Dorman* **	
Lot 65	18
" 83	6
" 221	9
" 260	80
" 292	40
" 313	8
" 321	33
" 350	10
	204 acres
SUB TOTAL	683 acres

Northumberland Channel**

MacMillan Bloedel	
Lot 86	7
" 217	36
" 219	28
" 220	20
" 236	17
" 326	9
	117 acres
GRAND TOTAL	800 acres

* Administered by the Nanaimo Harbour Commission.
** Administered by the Ministry of Lands, Parks and Housing.
*** Since November 1979, known as Mayo Forest Products.

Source: Table 8.3, Log Management Sub-Committee Report.

5.5 Option 2 - Redistribute Leases in the Estuary

The forest companies in the Nanaimo area are represented on the Task Force. In consultation with the other agencies on the Log Management Sub-Committee, the companies (known as the "Users Group") proposed a redistribution of leases west of the reef (see Figure 6) which avoids a very high proportion of the highly productive fish habitat, but which is large enough to meet anticipated log storage demand (1.5 months log storage, which is 184.1 M cunits). The redistribution proposed is stated in Table 6 and Figure 8. Note that no change is anticipated in Northumberland Channel.

5.6 Supplementary Log Storage

Evaluation of small log storage areas was not possible in this study. Constraints identified earlier,such as the requirement for the consent of the upland owner,strongly suggest supplementary log storage will occur only in small, probably scattered locations and may be very costly. One upland owner did come forward with a proposal for log storage to the Log Management Sub-Committee. This proposal was evaluated and is recorded in the report of the Log Management Sub-Committee. Concerning supplementary log storage, the Task Force encourages continued discussion between the forest industry and upland owners of foreshore. Similarly,the Federal Department of Fisheries and Oceans is conducting a preliminary biological assessment of southern Vancouver Island areas with a view to identifying biologically acceptable areas for storing logs. Such areas would require assessment of their log storage features before they can be considered.

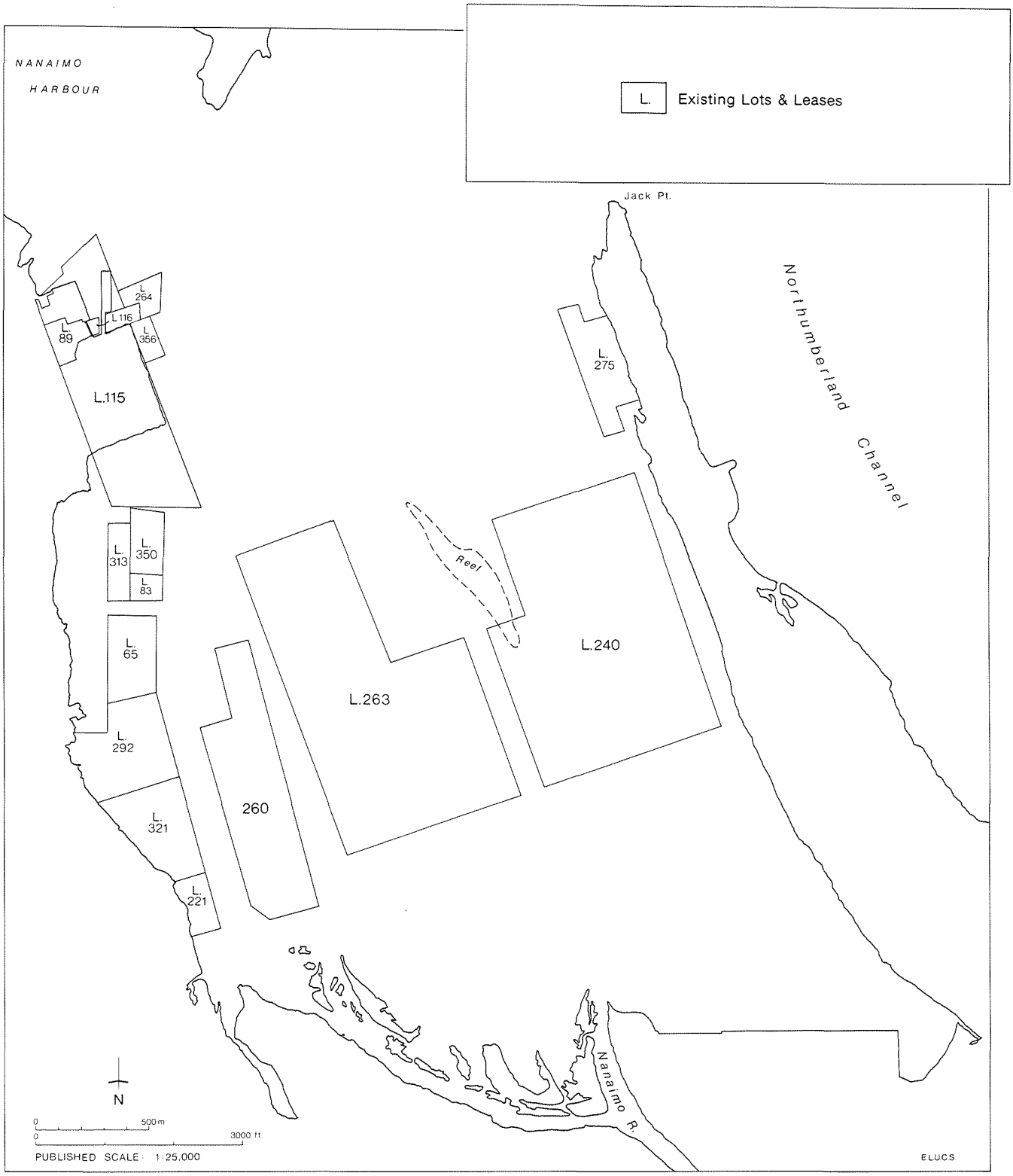


Figure 6. Location of Existing Nanaimo River Estuary Leases

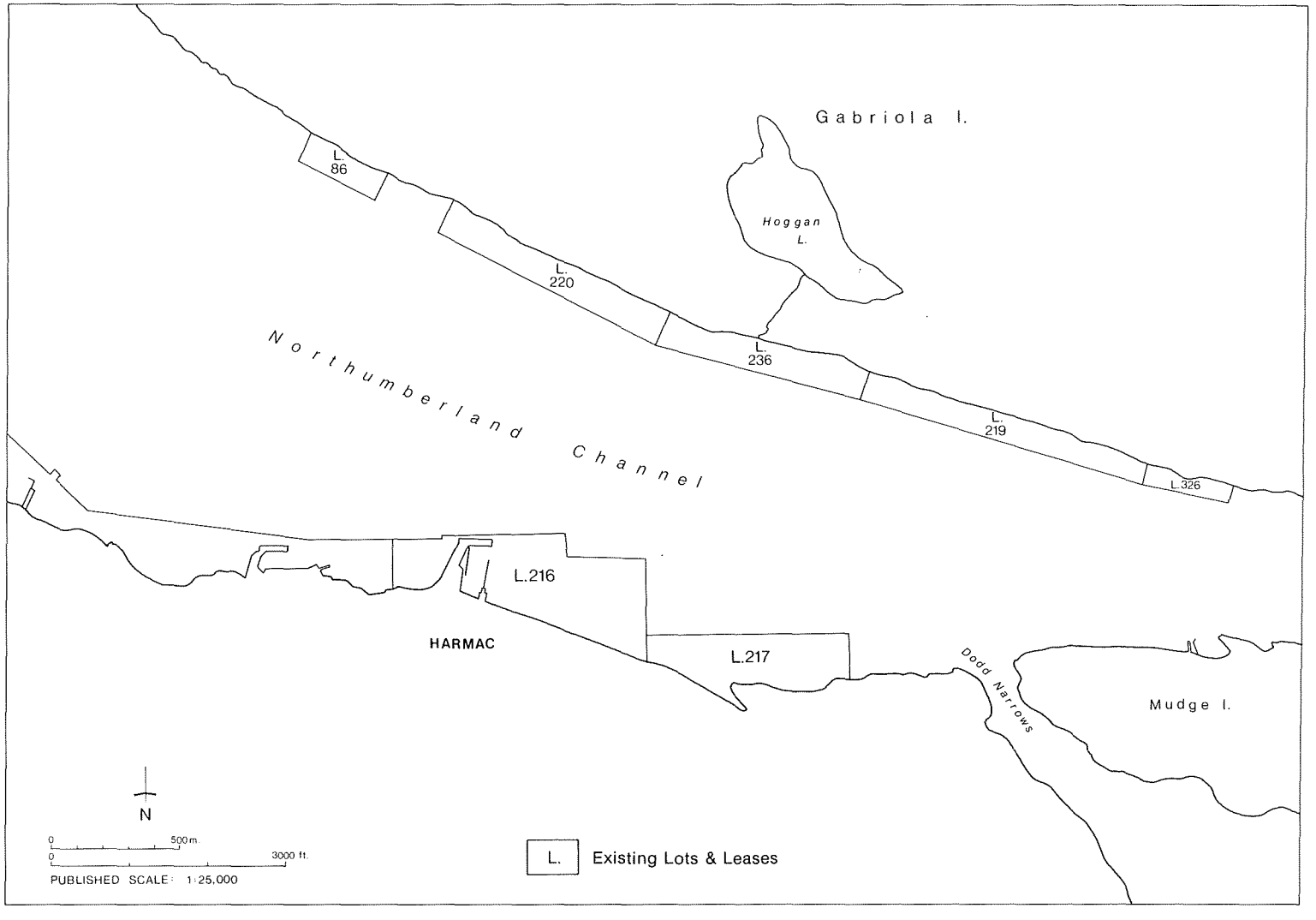


Figure 7. Location of Existing Northumberland Channel Leases

Table 6. Option 2 - Proposed Redistribution of Leases, By Company

PRESENT DISTRIBUTION of Leases			REDISTRIBUTION/CHANGE OF LEASES		
Used	Not Used For Log Storage	Total	Total	Increase	Decrease
1. Present Users					
MacMillan Bloedel	18.0	479.0	208.0	-	271.0
Mayo* Forest Products Ltd.	36.3	204.1	136.0	-	68.1
CIPA	-	-	64.0	64.0	-
Sub Total	54.3	683.1	408.0	64.0	339.1
2. Duke Point Dev.					
Sites 1 & 2	-	-	88.0	88.0	-
Site 3	-	-	42.0	42.0	-
Total Present and Duke Pt.		683.1	538.0	194.0	339.1
3. NHC Unallocated	-	-	32.0	32.0	-
Totals	54.3	683.1	570.0	226.0	339.1

*Includes 20.3 acres for millpond. Total Change - 113.1 Acres

Source: Table 8.9, Log Management Sub-Committee Report

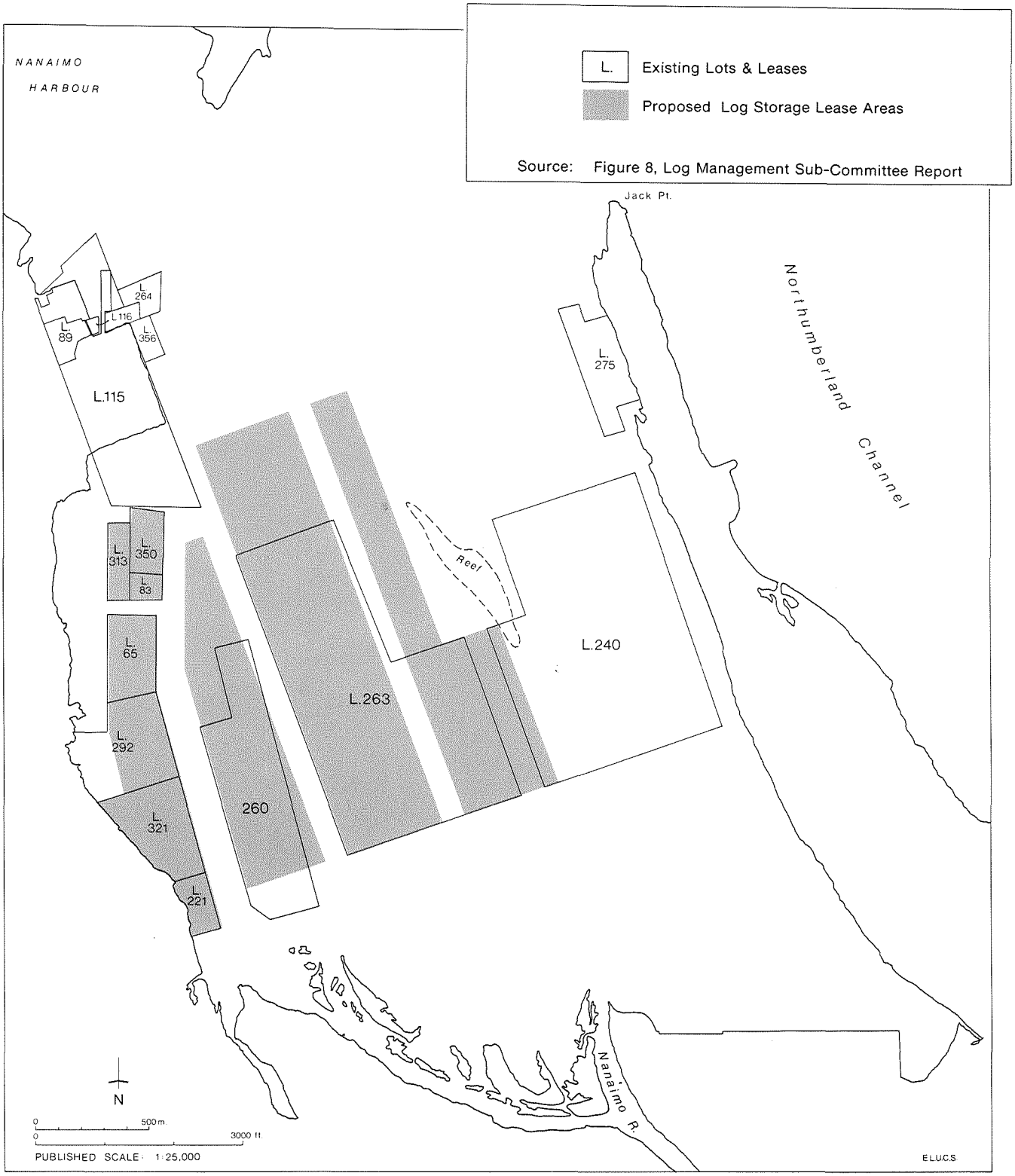


Figure 8. Option 2 - Location of Proposed and Existing Log Storage Leases in the Nanaimo Estuary

6. Economic Evaluation

The purpose of the economic evaluation is to accurately identify, insofar as the documentation of the relevant processes permits, the economic efficiency of the incremental costs of log storage alternatives relative to the anticipated increases in value to fisheries production. Simply stated this is measured by the ratio of:

$$\frac{\text{Value of Benefits}}{\text{Value of Costs}}$$

When the ratio is 1.0 or greater, the analysis indicated a worthwhile strategy has been identified.

The source of the incremental costs used in this analysis for the log storage alternatives is the Log Management Report. The actual data was provided by C.H. Anderson, Forestry and Mechanical Engineer, of C.H. Anderson and Associates. The source of the values for increased fisheries benefits is the "Economics Issues" report prepared by G. Nagle, of Nawitka Renewable Resource Consultants Ltd. The key tables defining fisheries values reported here were derived from the latter report, but the key assumptions for defining habitat productivity (see Section 4.4 of this report) were provided by the Federal Ministry of Fisheries and Oceans.

The relevant details of the procedure used in the analysis valuing the increased fisheries benefits and the comparision to the incremental costs for the log storage options are provided in the discussion which follows. It should be noted that the ratios used in the analysis suggest a high level of accuracy, but it must be appreciated the present state of the art does not permit the indicated degree of precision; Accordingly, the estimated present values in the Benefit-Cost ratios are rounded to the nearest $1,000.

6.1 Productivity of Areas Released Using the Productivity Indices Provided

The economic gains attributed to the fisheries resource were calculated

on the basis of acreage of potentially high productivity habitats recovered as a result of log storage relocation and exclusion of towboat traffic. This is a more conservative approach than that which would accrue if fresh water fish producing capability alone were utilized to describe economic benefits gained.

Using the Productivity Indices provided by the Fish Habitat Sub-Committee in Section 4.4 the areas of productive fish habitat (Productivity Types) for Options 1 - 10 are noted in Table 7. The Option 1(a) (Expanded Status Quo) referred to in the table is identified only as a theoretical base for calculating incremental log storage costs. The only purpose of Option 1(a) is to identify (theoretically) where the Duke Point sawmills would store their logs assuming no fisheries constraint. In this way the analysis

Table 7. Expected Salmonid Productivity of Each Log Management Option

OPTION	PROD. INDEX:	AREA IN DEFINED PRODUCTIVITY TYPES[1] HIGH 10	5	2 (acres)	LOW 1	0	TOTAL INDEX	Maximum Escapement After Recovery[2] (rounded)
Status Quo		440	320	750	30	760	7,530	39,000
1(a) Expanded Status Quo		440	230	840	20	770	7,250	38,000
2,3 Redistribution, Dredge		1,090	70	350	20	770	11,970	62,000
6,8 Dry-wet, Dryland inside NRE[3]		1,140	350	20	690	100	13,880	72,000
4,5,7,9,10 all logs outside NRE		1,510	-	-	790	-	15,890	83,000

[1]Table 3 defines productivity index.

[2]Proportional to productivity change from the status quo, using 12 year average escapement 1966-77 as the status quo escapement (39,278). Management practices assumed constant.

[3]There were minor differences in the expected habitat usage of 6 and 8. Areas shown are the maximum usage expected.

Source: G. Nagle, Economic Issues, Nawitka Renewable Resource Consultants Ltd.

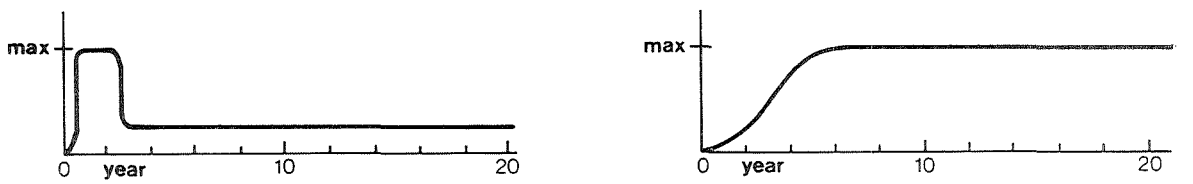
can identify the additional cost required to meet the fisheries constraint in Option 2 (like is compared with like). Option 1(a) has no other purpose.

6.2 Benefit - Cost Analysis

To assess the economic impact of each new log management option, it was necessary to calculate the expected change in net benefits in each sector in forestry and fisheries. The extra costs in forestry directly give the (negative) change in net benefits, other things remaining equal. Similarly in fisheries, the net value of extra fish catch which is expected due to habitat release, directly gives the net change in sector benefits, other things remaining equal.

Present values of a stream of each of the annual net sector changes can be compared to derive a benefit/cost ratio which will be useful in decision makings. The ratio in no way precludes the consideration of other factors -- e.g., longrun biological strategies, aesthetics, etc.

A period of 20 years is deemed most relevant to the analysis cost and benefit streams, after the period of construction/conversion to new log management systems. In the analysis, the estimated present value (E.P.V.) are projected for the next 23 years (3 years to recover and 20 years at fully recovered levels of fish production). The general time pattern of these values are shown in Figure 9. A discount rate of 10% per annum is used for all costs and benefits.



EXTRA LOG MANAGEMENT COSTS

FISHERY BENEFITS DUE TO HABITAT RELEASE

Figure 9. Generalized Time Pattern of Costs and Benefits

Source: G. Nagle, Economic Issues, Nawitka Renewable Resource Consultants Ltd.

For log storage the extra operating cost per cunit and the extra capital costs are noted in Table 8 below.

Table 8. Estimates of Extra Log Storage Cost Per Cunit and Total Present Value of Extra Cost

OPTION	AVERAGE EXTRA OPERATING COST[1]	E.P.V. OF TOTAL EXTRA COST[2] (000 $)
1 Status Quo	0.22[3]	
2 Redistribution	0.29	1,065
3 Redist. & Dredge	0.22	6,394
4 Northumberland Str.	0.10	22,993
5 Valdes Bluff	1.45	15,809
6 Dry-wet in NRE	3.31	16,097
7 Dry-wet Outside NRE	2.80	17,420
8 Dryland in NRE	3.44	11,483
9 Dryland Outside NRE	4.48	11,191
10 Mill Storage	1.52	8,513

[1] See C.H. Anderson Report, average volume assumed: 1,336 M Ccf/annum.

[2] Base cost of $2.22 used, having been revised for impact of Duke Point additions to present system.

[3] Option 1(a) or roughly, the minimum cost solution without fishery constraints.

Source: G. Nagle, Economic Issues, Nawitka Renewable Resource Consultants Ltd.

The expected gains in fish escapement and fish catch are noted in Tables 9 (not rounded) and Table 10 (rounded).

Table 9. Expected Gain in Fish Escapement After Full Recovery

	ANNUAL ESCAPEMENT BASIS		GAIN IN ANNUAL ESCAPEMENT OVER OPTION 1(a)		
SPECIES OPTION:	Status[1] Quo	Expanded[2] SQ (1a)	2,3	6,8	4,5,7, 9,10
Chum (.886)	34,790	33,400	21,911	30,735	40,021
Chinook (.037)	1,469	1,410	915	1,284	1,671
Coho (.077)	3,017	2,896	1,904	2,671	3,478
TOTAL (1.000)	39,278	37,706	24,730	34,690	45,170

[1] 12 year average escapement 1966-77 inclusive.

[2] The loss of 1,076 fish is expected due to further encroachment on productive habitat (Table 3) due to the addition of Duke Point logs.

Standard catch: escapement ratios for each species in the Georgia Straits fishery are used to estimate the expected gain in catch, shown in Table 5.

Table 10. Expected Gain in Fish Catch After Full Recovery[1]

	GAIN IN ANNUAL CATCH OVER OPTION 1(a)		
SPECIES OPTION:	2,3	6,8	4,5,7, 9,10
Chum	17,000	25,000	32,000
Chinook	5,000	7,000	9,000
Coho	10,000	13,000	18,000
TOTAL	32,000	45,000	59,000

[1] Chum catch: escapement ratio 0.8 : 1 (Fish Habitat Sub-Committee Report)
Chinook catch: escapement ratio 5.5 : 1
Coho catch: escapement ratio 5.0 : 1

Source: G. Nagle, Economic Issues, Nawitka Renewable Resource Consultants Ltd.

The total value of expected catch each year after full recovery is defined in Table 11.

Table 11. Total Value of Expected Extra Catch After Full Recovery

SPECIES OPTION:	2,3	6,8	4,5,7, 9,10
Chum	246,000	345,000	449,000
Chinook	127,000	179,000	232,000
Coho	195,000	274,000	357,000
TOTAL	568,000	798,000	1,038,000

Source: G. Nagle, Economic Issues, Nawitka Renewable Resource Consultants Ltd.

Table 12 summarizes the benefits and costs of each option, as expressed in the net present worth of extra log storage costs and fishery gains, over the period.

Table 12. Benefit/Cost Relationships

OPTION	E.P.V. OF EXTRA LOG MANAGEMENT COST OVER OPTION 1(a) (000 $)	E.P.V. OF EXTRA FISH CATCH EXPECTED OVER OPTION 1(a) (000 $)	B/C RATIO (000 $)
2 Redistribution	3,650	3,553	0.97
3 Redist. & Dredge	7,180	3,553	0.49
4 Northumberland Str.	19,914	6,490	0.33
5 Valdes Bluff	25,580	6,490	0.25
6 Dry-wet in NRE	41,627	4,985	0.12
7 Dry-wet Outside NRE	38,366	6,490	0.17
8 Dryland in NRE	38,913	4,985	0.13
9 Dryland Outside NRE	47,558	6,490	0.14
10 Mill Storage	20,044	6,490	0.32

Source: G. Nagle, Economic Issues, Nawitka Renewable Resource Consultants Ltd.

Of the defined log management options, the simple redistribution of leases (option 2) with minimum capital works, is the most desirable.

The estuarine environment is enhanced by clearing logs off most sensitive areas. The expected present worth of extra fish due to the changes is approximately equal to the present value of extra log storage costs.

Several equity considerations remain unanswered in detail. This should be handled by the agencies responsible for the management of the resources involved, including the Nanaimo Harbour Commission, the Ministry of Fisheries and Oceans and the forest industry companies. This topic is dealt with in the recommendations (Section 8.7). As stated earlier, this analysis (and any other like it) is constrained by the quality of the available data. If it were possible to compare the present condition of the estuary, compared to condition of the estuary prior to any industrial activity; which has included more than log storage (e.g. dumping of coal mine tailings prior to 1950, the beginning of log storage activity), the analysis could be more definitive. The simple fact however is, this analysis can only compare the present condition with historical escapement trends without precise knowledge of the condition of the estuary prior to 1950.

Despite these analytical difficulties, however, Option 2 besides achieving the desirable physical objectives stated in Section 5.3, is supported by the Benefit-Cost Analysis, since the value of increased fisheries production closely approximates the incremental costs to log storage.

7. A Working Solution

The valuation of incremental log storage costs and anticipated increases in fisheries benefits supports the conclusion that Option 2 is a viable alternative. Altogether 10 potential log storage alternatives were identified. As a result of the constraints identified in Section 5.2 of this report Options 6 - 10 can be eliminated from consideration at this time as their merits can only be assessed when considered in the

broader coastal log transportation context. (See Section 8.2 of the recommendations). With respect to the benefits of dredging, the Log Management Sub-Committee determined that sufficient bundle storage (deepdraft) existed without dredging and all-tide access was not a high priority; this eliminates Option 3. Concerning Options 4 and 5, designed to provide large deep water storage facilities in the adjacent Gulf Islands; these options, besides being very costly, require additional and detailed engineering evaluation to determine their feasibility. There are of course also, with options 4 and 5, the questions related to riparian rights identified also in Section 5.2.

In conclusion, option 2 is a viable alternative. It is the "working solution" requested by the Federal Minister of Fisheries and Oceans. Option 2 will:

- remove log storage activities from the eastern part of the estuary. Towboat activity, specifically the effect of propwash on eelgrass beds, can be eliminated as well. This amounts to 610 acres, and will permit about 75% recovery of highly productive fish habitat in the Nanaimo River Estuary which is presently impacted by log storage activities.

- permit log storage to be reassigned to other locations within the estuary, while at the same time providing 1.5 months log storage (184.1 M cunits) within the Nanaimo Harbour Commission area (includes Northumberland Channel). The amount of log storage is adequate to meet the requirement of present and proposed forest products mills in the Nanaimo area. The incremental costs for implementing this option result from the capital costs for driving piling in the proposed configuration, clean-up costs of the abandoned component of the existing configuration, and the operating costs of more congested operation in the operating area designated in option 2.

- can be economically defended because the incremental costs of more congested log storage are equal to the anticipated benefits from increased fisheries production.

Accordingly, the Steering Committee recommends acceptance of Option 2, which is defined in Figure 10.

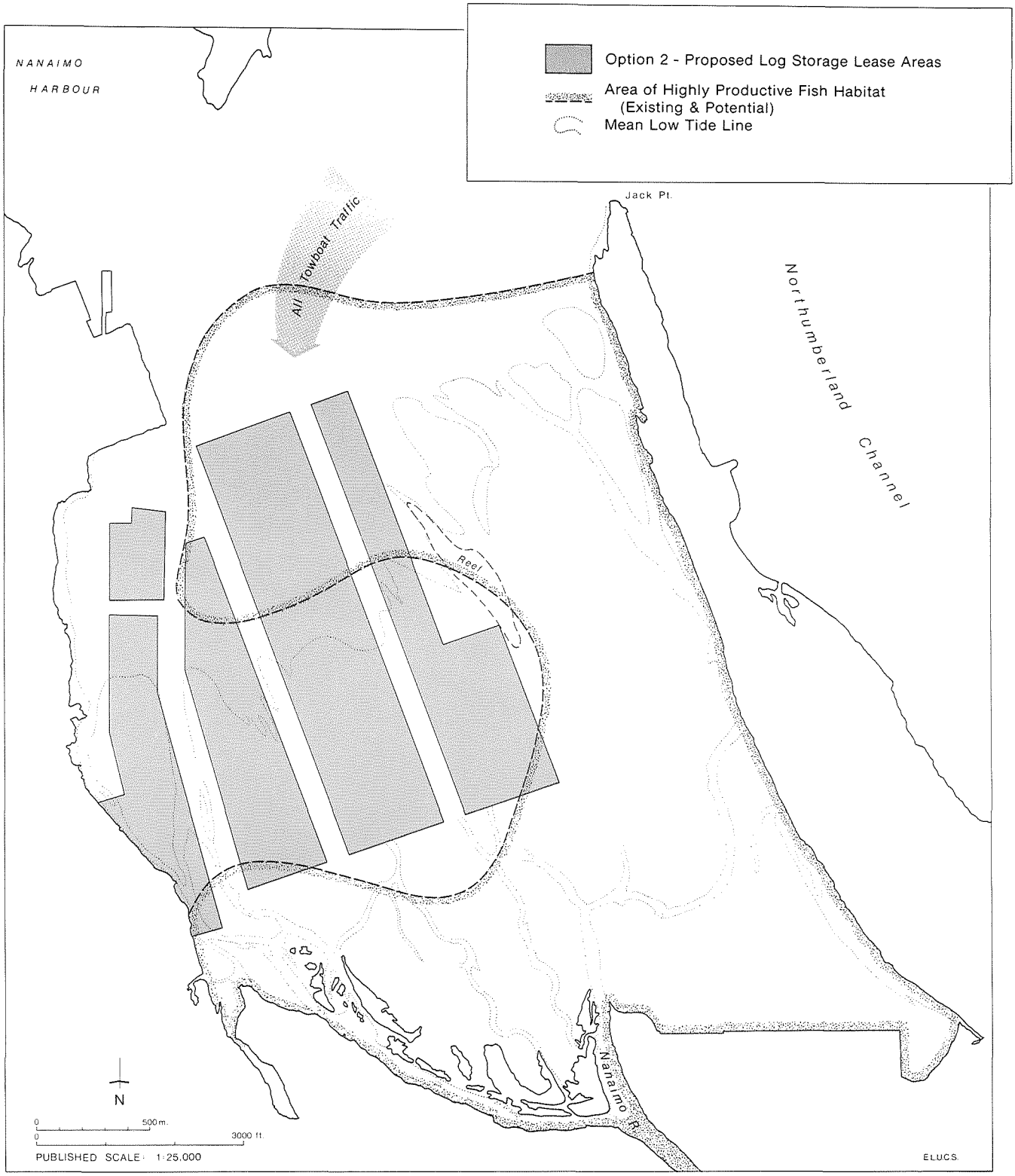


Figure 10. The Recommended "Working Solution"

8. Recommendations of the Nanaimo Estuary Fish Habitat and Log Management Task Force

8.1 It is recommended that Option 2 be accepted as the "working solution" requested by the Federal Minister of Fisheries for accommodating both the requirements the log storage needs for Duke Point sawmills and existing mill users, as well as ensuring protection of a large portion of highly productive fish habitat. The full rationale is stated in Section 7.

8.2(a) It is recommended that monitoring of fish habitat released in Option 2 be conducted for not less than 4 years (one complete salmon cycle) for the objective of measuring the biological response to removal of log storage activities.

8.2(b) It is also recommended that industrial monitoring of teredos (Bankia sectacea) be carried out in the Nanaimo River Estuary. Since specific data on teredos is not available for the Nanaimo River Estuary, the study was not able to be conclusive about the degree of protection from teredos, understood to be present by some, in this area. Monitoring of teredos using the standard test block procedure would provide valuable guidance for estuary managers in Nanaimo.

8.3 It is recommended the hydrological regime of the Nanaimo River be evaluated to ensure that all current demands for water can be met, including industrial, domestic, and marine and recreational resources. Simply stated, this study assumes fish, and sustaining the fish population requires continued availability of fresh water. A hydrological evaluation would help ensure that managers continue to be able to meet the anticipated needs for fresh water in the Nanaimo River Estuary.

8.4 It is recommended innovative approaches to management of Crown owned foreshore be developed to ensure the maximization of overall net benefits of this valuable foreshore resource. In developing this

overall strategy for administration of Crown owned log storage leases, it will be necessary to ensure:

(a) Strategic log storage areas are identified, and available, for use by the forest industry, especially in the southern Georgia Strait region.

(b) Strategic fish habitat (and oyster growing and spawning) are similarly identified and reserved from forms of alienation which destroy highly productive fish habitat.

(c) Regulations and legislation be considered which will ameliorate the negative effects resulting from the exercising of riparian rights accruing adjacent upland property has on areas designated in (a) and (b) above.

(d) The environment is protected and overall costs are minimized.

8.5 It is recommended the log storage potential of the Gulf Islands (35 miles, or the critical 1.5 day tow) be analyzed in detail. Even though supplementary log storage areas may be small, they could be valuable in removing more logs from highly productive, biologically sensitive fish habitat. Obviously other land use considerations would also have to be included in the analysis.

8.6 During the course of this study it became apparent that the overall log transportation system is influenced of available local log storage areas. To the extent that solutions to the fish habitat, log storage conflict may not be so readily available, it is recommended the Estuary, Foreshore and Water Log Handling and Transportation study be supported. This study merits support since its purposes are to ensure that overall sufficient log storage areas are available in strategic locations, as well as ensuring productive marine habitats are protected. Without the benefit of the larger coastal view, as pressures continue for reduction of log storage in one area such as the Nanaimo River estuary the result can be increased pressure in others. The preferred overall approach is to ensure that all requirements are equitably met, and the benefits and costs equitably shared.

8.7 It is recommended that the Nanaimo Harbour Commission be requested to implement Option 2 through its normal administrative activities. It will be necessary for the Commission to work out an equitable sharing of implementation costs between the directly affected parties on or before 1982, at which time new leases are due for renegotiation.

Appendix - Task Force Terms of Reference

AUTHORITY

On March 16, 1978, the Minister of Fisheries and Environment instructed the Fisheries and Marine Service, Pacific Region, to establish, in co-operation with the Environment and Land Use Committee Secretariat, a federal/provincial task force to examine the matter of log and fisheries habitat management in the Nanaimo Estuary. This action was the result of the Federal Department of Fisheries and Environment's previous decision to accept the British Columbia Development Corporation proposal to develop port and industrial development sites on the Duke Point - Jack Point area near Nanaimo but at the same time to reject the Corporation's proposals for log storage on the estuary.

Under the authority in Section 33.1 of the Fisheries Act the Minister decided to require the log supply and management information in order to properly adjudicate proposals that may involve alienation of fish habitats protected under Section 31 of the same Act.

GENERAL OBJECTIVES

The primary role of the Task Force is to advise the Minister of Fisheries and Environment on the nature and extent of potentially conflicting demands for estuarine lands emanating from the requirements for fish habitat preservation to sustain the salmonid productive capacity of the Nanaimo River and the requirements of present and proposed Nanaimo based forestry operations for log storage space. The Task Force

objective is to develop consensus on recommendations for future log storage in the Nanaimo River Estuary compatible with fishery management requirements. The prime focus of this study is the Nanaimo River Estuary but in order to explore workable solutions, it is necessary to consider alternatives in the general context of the Nanaimo Harbour Commission area. The study will assist in defining a log storage policy for the Nanaimo River Estuary by creating an analytical basis for guiding the management of log storage in the Nanaimo Harbour.

PARTICIPATION AND CO-ORDINATION

The Task Force will be organized into a Steering Committee, a Habitat Sub-Committee and a Log Management Sub-Committee. Representation to the Task Force has been sought and obtained from the federal and provincial governments and from the affected industrial sector. The representation on these three committees is as follows:

Representation	Steering Committee	Log Mgmt. Sub-Cttee.	Habitat Sub-Cttee.
A. Department of Fisheries & Environment			
- Fisheries & Marine Service	X		X
- Canadian Forestry Service	X	X	
B. Nanaimo Harbour Commission	X	X	
C. Environment and Land Use Committee Secretariat	X	X	
D. Ministry of Forests		X	
E. Ministry of Environment			
- Land Management Branch	X	X	
- Resource Analysis Branch			X
F. Ministry of Recreation and Conservation			X
G. British Columbia Development Corporation	X	X	
H. Local Forest Industry Representative		X	

The Task Force will be chaired jointly by representatives from the Fisheries and Marine Service and the Environment and Land Use Committee Secretariat. The Habitat Sub-Committee will be chaired by the Fisheries and Marine Service and the Environment and Land Use Committee Secretariat will chair the Log Management Sub-Committee.

Although the local forestry firms have agreed to nominate a single representative on the Task Force, direct consultation with representatives from each individual firm can be arranged by the Task Force on an as-required basis. This is considered to be a necessity for the Log Management Sub-Committee particularly. The firms involved at this point are: MacMillan Bloedel Ltd., Pacific Logging Ltd., Mayo Lumber Co. Ltd., G.W. Dorman Ltd., and Doman Industries Ltd. and CIPA Lumber.

FINANCING

Since the Task Force was formed at the request of the Minister of Fisheries and Environment, the Fisheries and Marine Service will absorb the costs associated with typing, illustrating and printing of all Task Force reports. In addition the Fisheries and Marine Service will absorb the costs associated with collation and preparation of the report of the Habitat Sub-Committee. The costs associated with retaining consultant assistance will be borne by the B.C. Development Corporation, the Nanaimo Harbour Commission and ELUCS.

SCOPE

Within the general objective of providing advice to the Minister of Fisheries and Environment, the efforts of the Task Force shall include these basic aspects:

A. Log Management Component

Development of a study outline for examination of log storage and management for existing and proposed Nanaimo area sawmills. This study will include, but not necessarily be limited to, the following aspects:

-magnitude of forest industry in the regional context
-present use of the estuary including background information
-mill capacities and basic log requirements
-proposed additional use
-present handling systems and costs
-technological trends and costs
-alternative approaches (sites and technology)
-formulation of recommendations

Implementation of this study to be accomplished by the Log Management Sub-Committee with the aid of a consultant with raw data information supplied by each member agency or industrial representative.

B. Habitat Component

Development of a format for presentation of existing habitat and resource information in a report which will include, but not necessarily be limited to, the following aspects:

-description of various biological and chemical processes active in the estuary
-fish and shellfish production from the river and estuary including commercial and recreational values
-habitat utilization by species
-description and classification of various productive capability
-effects of log storage and impacts on productive capability
-changes to system over time
-opportunities for rehabilitation
-requirements for maintaining fish production capability
-examination of alternative approaches to maintain fisheries production
-formulation of recommendations

The Habitat Sub-Committee will be responsible for the preparation of this report.

C. Final Task Force Consolidation Component

The two sub-committee reports will require consolidation and integration into a single report which will:

- -identify the log storage requirements for existing and proposed Nanaimo area sawmills and describe the alternative storage options available to them
- -illustrate and describe the existing fisheries habitat and the zones of relative productivity and define the requirements for maintaining fisheries resource production
- -define those areas where logs may be stored without significantly affecting the fisheries resources
- -define those areas where the requirements for log storage and for fish production are in conflict or where such conflicts may develop
- -recommend how these conflicting requirements may be resolved in the interests of the fisheries and forestry resources and prepare a related action plan.

The Task Force Steering Committee will be responsible for the preparation of this report.

REPORTING AND PUBLICATION INFORMATION

Interim reports to the Minister of Fisheries and Environment and to the Environment and Land Use Committee will be submitted on an irregular and as-required basis by the Chairmen.

Public statements will be prepared and issued by the Steering Committee Chairmen. Advice on the contents of such statements will be sought from the Steering Committee members when circumstances permit.