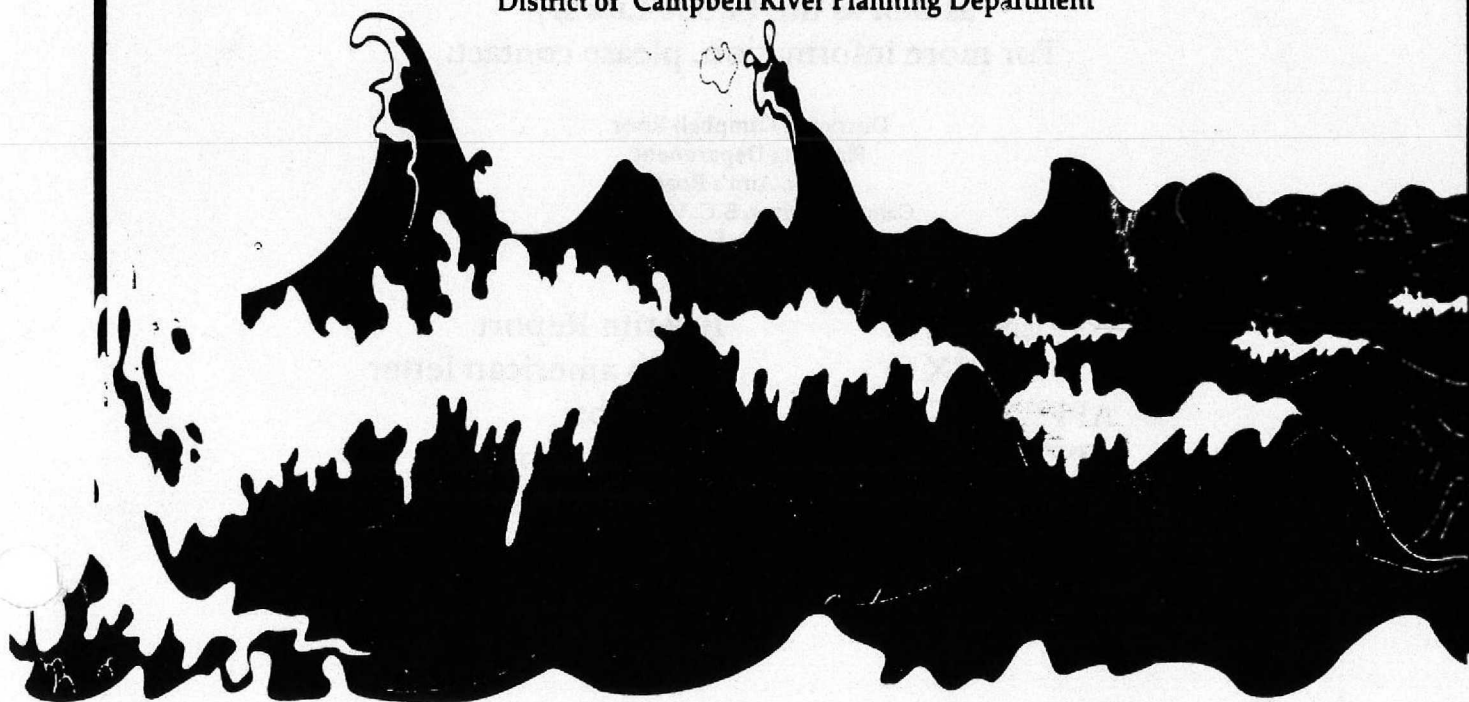


Campbell River Estuary Management Plan

FEBRUARY, 1996

Prepared by:
Witty Planning Consultants Ltd.
In association with Lanarc Consultants Ltd and ESCALA
for the
District of Campbell River Planning Department





Please Note:

The complete copy of the consultant's report containing the Interim Report, Appendix & Bibliography is available in Federal, Provincial and Municipal Offices, as well as the Public Library.

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APPENDIX 1:	Interim Report
APPENDIX 2:	Anglo american letter
APPENDIX 3:	Water lots
APPENDIX 4:	Vision sign-off

TABLE OF CONTENTS

1. Introduction	1
1.1 Terms of reference	1
1.2 Planning principles	3
1.3 Management Committee structure	4
1.4 Management plan process	4
1.5 Organization of this document	6
PART ONE	
1. Plan Recommendations	1-1
1.1 Dredging	1-1
1.2 Habitat restoration	1-1
1.3 Industrial relocation	1-4
1.4 Modification of existing industrial operation	1-6
1.5 Park and interpretation development	1-6
1.6 Tourism development	1-6
1.7 Upland development	1-7
1.8 Tyee Spit	1-7
2. Policies	1-8
2.1 General policies	1-8
2.2 Land development policies	1-10
2.3 Management area policies	1-10
3. Implementation Plan	1-24
3.1 Plan adoption	1-24
3.2 Management structure	1-24
3.3 Authority	1-25
3.4 Monitoring programme	1-25
3.5 Industrial relocation	1-27
3.6 Zoning	1-27
3.7 Water lot leases	1-27
3.8 Campbell River Band	1-28
3.9 Application of policies	1-28
3.10 Plan monitoring and amendment	1-28
3.11 Restoration programme	1-28
3.12 Other studies	1-29
4. Development Plan	1-30

TABLE OF CONTENTS CONTINUED

PART TWO

5. Background	2-1
5.1 Overview of the Campbell River and Estuary	2-1
5.2 Biological considerations	2-7
5.3 Land use	2-14
5.4 Roads	2-18
5.5 Services	2-19
5.6 Proposed dredging	2-19
5.7 Proposed development	2-21
6. Public Input	2-23
6.1 Open houses	2-23
6.2 Questionnaire	2-24
6.3 Interest groups	2-26
7. Issues	2-28
7.1 Planning principles and associated identified issues	2-28
8. Opportunities and Constraints	2-34
9. Vision Statement	2-39
9.1 Vision statement	2-39
10. Alternative Intervention Plans	2-41
10.1 Alternative scenarios	2-41
10.2 Proposed policies	2-42
10.3 Moderate intervention scenario	2-46
10.4 Maximum intervention scenario	2-49
10.5 Evaluation of the alternatives	2-52
10.6 Preferred alternative	2-53

LIST OF FIGURES

Figure 1: Study Area	2
Matrix 1: Industry relocation strategy	1-2
Figure 2: Management areas	1-12
Matrix 2: Management areas: issues, policies and actions	1-14
Development plan	1-31
Figure 3: Drainage basin	2-2
Figure 4: Mean monthly flows	2-6
Figure 5: Habitat	2-9
Figure 6: Land use	2-16
Concept 1: Moderate intervention	2-47
Concept 2: Maximum intervention	2-50

EXECUTIVE SUMMARY

The Campbell River Estuary Management has been completed by the Campbell River Estuary Management Committee. The Committee met over the course of the late summer, fall and early winter of 1995 to consider the future of the estuary. This Management Plan sets out the findings of the Committee.

The Campbell River Estuary is a dynamic ecosystem which has received considerable impact from a variety of industrial uses over the past 75 years. During the past ten years efforts to restore the estuary have gained widespread acceptance from the residents of Campbell River. A major log booming area and dryland sort have been closed on the south side of the estuary. On the north side, however, significant industrial activity in the form of log booming and sawmill operations continues. Those activities are dependent upon water lot leases for access to logs and water transport for access to the majority of the mills' timber stock.

In 1994, the Canadian Coast Guard undertook to explore the possibility of dredging a portion of the estuary to facilitate log transport to the mills. Such dredging was determined to provide significant operational cost savings to industry and extend industry's potential time horizon as a viable operation while not creating significant environmental effects. In response to concerns from citizens of Campbell River and in recognition of the potential cumulative effects of dredging, the Management Plan has explored the potential of accomplishing both estuary restoration and long term industry relocation so that environmental goals could be addressed and socio-economic disruption would be minimized.

The Plan recommends that:

- the Management Committee be structured to continue to implement the Plan;
- an industrial relocation strategy be implemented in a joint effort by industry and the Management Committee;
- dredging be undertaken for one time only so that industry is better able to plan for its relocation out of the estuary;
- restoration of the estuary be a prime objective;
- the estuary be divided into management units to undertake plan implementation; and
- discussions be held with the Campbell River Indian Band to address matters of mutual interest.

The Plan also recommends that the Plan be adopted by Council and provincial agencies and monitored over the course of its implementation.

1. INTRODUCTION

The Campbell River Estuary Management Plan has been prepared under the direction of the Campbell River Estuary Management Committee. The Management Committee was appointed to oversee the preparation of the Plan. The Committee was formed by the District of Campbell River after Coast Guard Canada presented a proposal in the fall of 1994 to implement a dredging programme for the estuary. Because of the mixed response to that proposal, the District concluded that a Management Plan was needed to put in place a long term programme for the restoration of the estuary. This Management Plan addresses that requirement.

1.1 Terms of reference

The terms of reference for the preparation of the Management Plan identified that "the purpose of the plan is to:

- produce a long range strategy to guide development decisions relating to the use of land and water in and around the estuary to accomplish the restoration of the estuary as stated in the Community Plan;
- identify opportunities and programs for restorative/rehabilitative activities throughout the estuary;
- establish an environmental baseline measure from which monitoring can be undertaken. Without restricting the scope of the monitoring, it is expected that this would include water quality, fish habitat, and wildlife;
- define the role and responsibilities of all parties (users, government, public) involved in one way or another with the estuary; and
- produce an up-to-date consolidation of information on the estuary."

The contents of this Management Plan are guided by those requirements.

Campbell River Estuary Management Plan

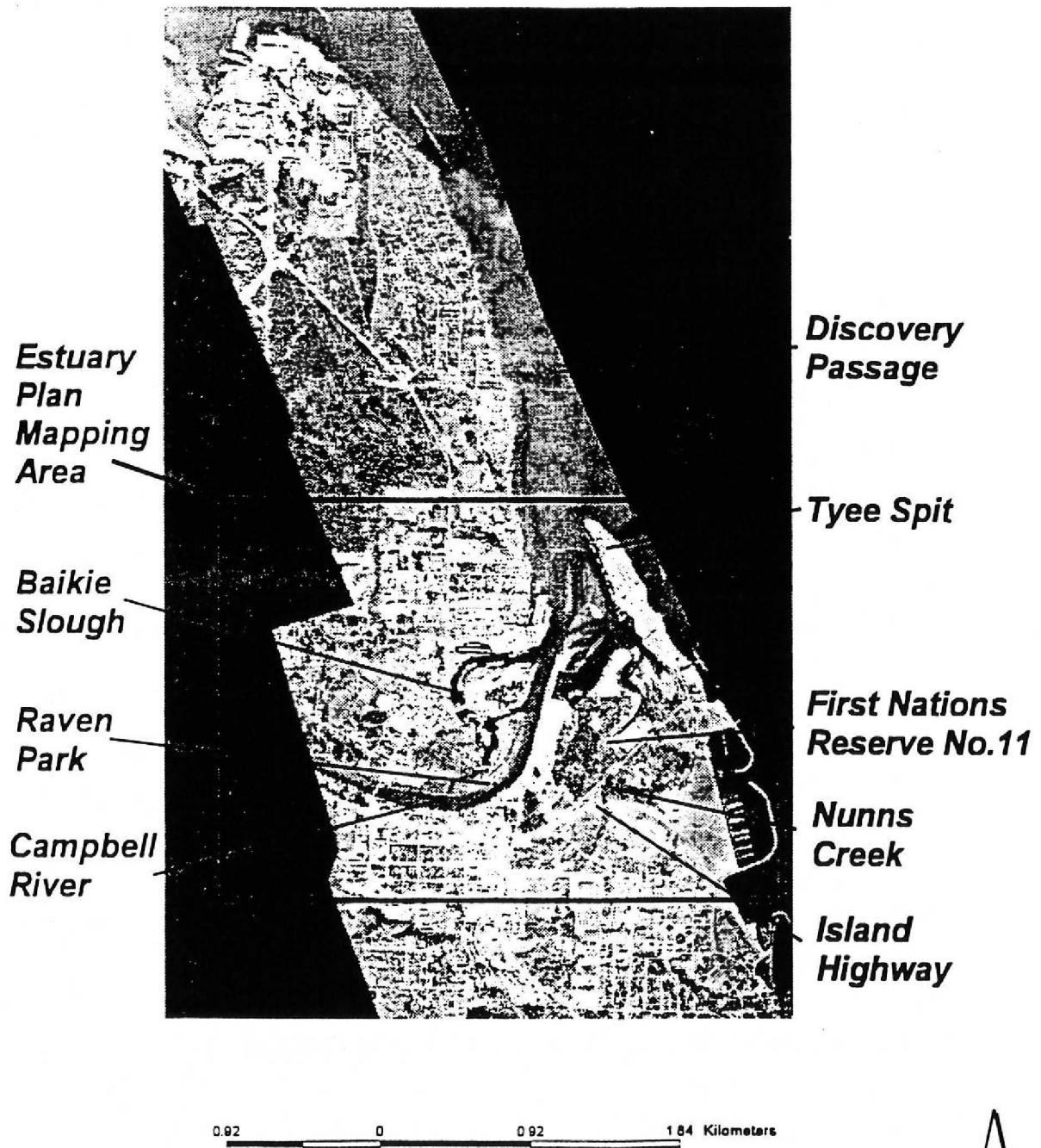


Figure 1: Study Area

1.1.1 Study area

The study area is large, encompassing Orange Point to the Westmin dock up to the Highway bridge and lands generally within the designated Campbell River floodplain (Figure 1). For Management Plan purposes, two sub-areas exist within that broad definition: (a) the immediate area of the estuary; and (b) lands and waters more distant from the estuary proper. The focus of this work is upon the former.

1.1.2 Original research

The terms of reference noted that "the consultant will be provided with data and is not expected to undertake any original research." This report does not include original research.

1.2 Planning principles

The Terms of reference also identified a number of planning principles which were to be reflected in the plan. They are:

- "promote long term benefits to the natural environment over short term gains to any particular agency or user group;
- improve and increase the effectiveness and efficiency of long and short term decision making by regulatory agencies with regard to the management, development and allocation of land and water resources in the estuary;
- shall be dynamic rather than defining an end state; and
- incorporate sustainability principles."

In addition, the Management Committee modified one planning principle to read as two new planning principles as follows:

- " • be founded on inherent biophysical capabilities of the estuary; and

- recognize the long-term socio-economic needs of the community as it relates to land use decisions in the Estuary."

These planning principles have guided the preparation of the Management Plan.

1.3 Management Committee structure

The Management Committee is composed of a diversity of interests, including: Department of Fisheries and Oceans, Quinsam River Salmon Hatchery, District of Campbell River, Canadian Coast Guard, Ministry of Environment, Lands and Parks (two representatives: one from Lands and one from Environment), B.C. Hydro, industry, sport fish user representative, and public interest group representative. The Management Committee met monthly or more often depending upon need.

1.4 Management plan process

The Management Plan was framed by four key determinants: active Management Committee involvement; public/interest group consultation; assessment of habitat and land use considerations; and existing policies and programmes. An Interim Report provided the Management Committee with a summary of the material collected and utilized in the Management Plan (Appendix 1).

1.4.1 Role of Management Committee

The Management Committee had a major role in the development of the Management Plan. The Committee actively participated in the identification and approval of opportunities, constraints and issues. The Committee approved the focus upon two alternatives. The Committee developed and adopted a Vision Statement for the estuary and prepared the two alternative intervention scenarios. The Committee subsequently approved one scenario, completed an issue/policy session, and adopted the Campbell River Estuary Management Plan. This was a very active Committee process.

1.4.2 Public/interest group consultation

Consultation with the general public occurred on two occasions. The public was invited to

attend a public open house at Tyee Spit during early July over two days. Attendees were asked to comment on the state of the estuary by noting the things that they liked and the things that concerned them about the estuary. They did so by identifying those areas on an aerial photograph overlay. In addition, for those who were interested, guided tours of the estuary were provided. Following the tour, individuals were asked to fill in a questionnaire. The questionnaire was made available to the general public in the District planning office. In addition, citizens were asked to attend a second open house to review the preliminary alternative plans and provide their comments.

Two meetings each were held with interest groups (industrial users, Tyee Spit users, and the Estuary Society). Three meetings were held with the business manager of the Campbell River Indian Band. At all these meetings, ideas, issues and concerns were noted. Information was shared and feedback was sought on the appropriate development direction for the estuary.

1.4.3 Assessment of habitat and land use considerations

The consulting team included a wetlands biologist who completed two field visits, met with knowledgeable staff, and reviewed pertinent information. The biologist assisted the planning team in identifying key wildlife and aquatic habitat areas, and in identifying appropriate monitoring programmes for the estuary. Department of Fisheries and Oceans provided 1995 habitat mapping.

1.4.4 Existing policies and programmes

The planning team reviewed existing policies and programmes to determine the degree to which the estuary might be affected by existing land uses, zoning, and development initiatives.

1.4.5 Review of existing reports

The planning team completed a thorough review of the scientific and policy and planning studies that have been completed for the estuary (Appendix 1).

1.5 Organization of this document

This Management Plan has been organized to promote readability of the planning elements of the document. Recommendations are included in Part One. Background information and other items which were considered in arriving at the recommendations are included in Part Two.



Photo 1: Campbell River at the edge of the estuary.

Matrix 1

INDUSTRY RELOCATION STRATEGY

The following describes a proposed industrial relocation strategy for heavy industry located in the Campbell River estuary. The strategy is specifically identified for current timber mills located adjacent to Baikie's slough.

STAGE	TRIGGERS	ACTIONS:	
		On agreement	On disagreement
<u>1. Interim measures</u> by Dec. 31, 1996	<ul style="list-style-type: none"> • Management plan sign-off • industry remedial operation plan accepted • dredging approved 	<ul style="list-style-type: none"> • dredging by Jan. 1997 	<ul style="list-style-type: none"> • no dredging
<u>2. Technical and Financial planning</u> by Dec. 31, 1997 <ul style="list-style-type: none"> • industry relocation plan • shoreline remediation plan • upland redevelopment plan 	<ul style="list-style-type: none"> • joint funding of planning • neutral consultant • certainty/business plan 	<ul style="list-style-type: none"> • shared planning funding • refined Management Plan 	<ul style="list-style-type: none"> • rigorous enforcement • zoning moratorium
<u>3. Advocacy for approvals</u> by Dec. 31, 1999	<ul style="list-style-type: none"> • acceptable development agreement on: <ul style="list-style-type: none"> - zoning - servicing - land dedication - remediation - timelines 	<ul style="list-style-type: none"> • approval of customized land use regulations • continued remediation 	<ul style="list-style-type: none"> • regulatory agency re-evaluation • water lot review • enforcement and compliance review
<u>4. Industry relocation</u> by Dec. 31, 2005	<ul style="list-style-type: none"> • land sale and purchase 	<ul style="list-style-type: none"> • industry relocates • remediation continued • public land improvements 	<ul style="list-style-type: none"> • water lots reassigned • operational efficiency decline • industry assumes remediation costs • land use incentives removed
<u>5. Redevelopment 2006</u> onward	<ul style="list-style-type: none"> • acceptable comprehensive development plan 	<ul style="list-style-type: none"> • permits issued • redevelopment proceeds • remediation completed 	<ul style="list-style-type: none"> • no permits

PART ONE: The Plan

Part One reviews the Plan recommendations and the general and specific policies of the Estuary Management Plan.

1. PLAN RECOMMENDATIONS

The following recommendations have been adopted by the Management Committee. The Campbell River Estuary Management Plan is based upon the following recommendations.

1.1 Dredging

Dredging will be accommodated on a one time only basis as per the attached industrial relocation strategy (page 1-2). Maintenance dredging will not take place.

1.2 Habitat restoration

Habitat restoration will occur in a systematic fashion, following completion of a restoration plan by DFO. For purposes of this Management Plan specific recommendations are detailed below.

1.2.1 Bank Erosion Control.

There is a need to stabilize the bank of the lower Campbell River next to the Dryland Sort. The following stabilization options are identified:

- a. armour with conventional linear riprap along the entire bank from the foot of Maple Street to the east end of the Dryland Sort;
- b. armour with modified linear riprap, to include small pockets or basins for soil and planting of riparian shrubs;
- c. protect bank with a series of overlapping deflection barriers made of rock or pilings, and designed to allow some marsh planting in the back-eddy areas behind the barriers .

1.2.2. Fish Rearing Habitat, Freshwater.

There is a need for freshwater rearing habitat for juvenile salmonids in the lower Campbell River. Identified options include:

- a. create a new rearing channel on the north side of, and parallel to, Fred's Slough, starting in the area below the highway bridge and discharging to the head of the west basin of Baikie's slough.
- b. create a new rearing channel, smaller than (a), above, on the south side of Fred's slough.

1.2.3. Fish Rearing Habitat, Estuarine.

Any increase in the availability of estuarine rearing habitat for juvenile salmonids is considered beneficial because of losses incurred in the past. Space for restoration is available on both the north and south side of the estuary. Identified approaches include:

- a. establish flushing of the Log Pond next to the Dryland Sort, by breaching the spit between the Campbell River and this pond. The preferred location is at the northwest corner of the Log Pond. The new channel can be spanned by a footbridge. The bed elevation of the new channel should be low enough to allow some Campbell River flows to enter the Log Pond during summer low flow.
- b. create a step on one or both sides of this new channel, to planted with estuarine marsh vegetation.
- c. make a marsh planting bench in the NW corner of the Log Pond, using materials excavated from the breach.
- d. create more shallow habitat in the Log Pond. This can be done by using the Log Pond as a designated disposal site for clean dredgate or other material, which can be used as fill to create one or more islands within the Log Pond; a practical starting place (requiring least amount of fill for maximum gain in habitat) would be to extend westward the south end of the existing island on the E side of the pond.
- e. remove log booms from Baikie's slough and adjacent slough to E. In conjunction with flushing, this will improve water quality and allow for natural revegetation by estuarine species.
- f. plant riparian deciduous shrubs and trees along the shoreline of Baikie's slough where existing vegetation is lacking.
- g. create island(s) in Baikie's and adjacent slough to increase marsh habitat (long term option).

1.2.4. Wildlife Habitat.

The following wildlife habitat restoration and conservation options are identified:

- a. provide drainage on the flat upper surfaces of the constructed islands in the inner estuary, in order to arrest the progressive soil salinization and vegetation loss.
- b. create and plant marsh benches in the southern log pond next to the dryland sort; this will benefit wildlife as well as fish.
- c. re-establish riparian shrubs and trees along all areas where riparian vegetation has been lost due to human activity or erosion.
- d. retain all remaining areas of floodplain forest within the estuary area.
- e. re-establish natural vegetation community on the gravel uplands of Tyee Spit in areas vacated by existing human activities.
- f. provide artificial nesting habitat for Purple Martin within the inner estuary; this habitat can consist of nesting boxes on pilings.

Implementation of these options will require further detailed assessments.

1.3 Industrial relocation

Relocation of industry in the estuary has been identified as a policy of the District of Campbell River for a number of years. To facilitate relocation and address policies identified in Section 2, alternative relocation sites will need to be identified at the earliest possible date. The Management Committee should assist industry to identify possible sites and should work with local government to consider banking land for the relocation. The Management Committee has adopted an industrial relocation strategy that identifies the requirements to achieve relocation and associated estuary restoration (Matrix 1).

Two timber operations indicated that they required the following criteria to relocate:

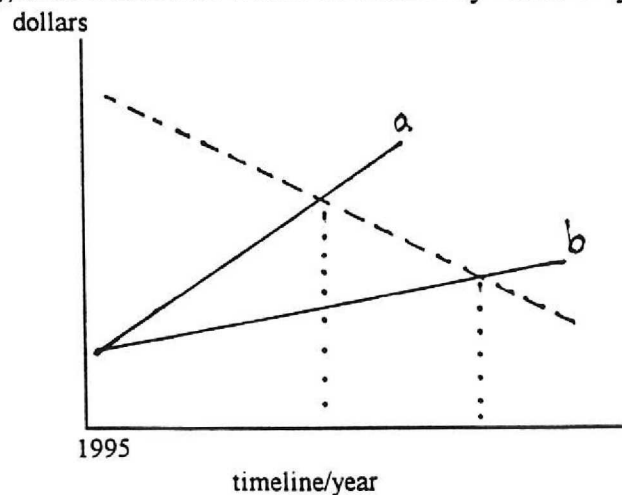
- a. Anglo American Cedar Products: Ocean Cedar Division (see: Appendix 2):
 - water access: sheltered water access with suitable storage area for logs. Access for barges for loading out chips and hog fuel.
 - road access: access and proximity to major highway for transportation of raw material to the mill and finished product and waste from the mill.
 - location: proximity to raw material supply, labour supply, and chip and hog customers (pulp mills).
 - size: two to three acres with adequate chip and log storage areas.
 - power: minimum 3-phase 600 volt power.

b. Campbell River Mills provided a list verbally:

- 80 - 100 acre site
- industrial zoning
- road access
- water access for barges and de-water site
- close to labour supply.

Together, these two companies appear to share similar relocation needs. These criteria should be used by the Management Committee to work with the District of Campbell River and Regional District of Comox-Strathcona to identify potential alternative sites (Note: RD of Comox-Strathcona is currently re-examining its industrial bylaw). When a suitable site is found, consideration should be to option the property or place it in a land bank for use by the relocating companies. Given the fluctuating market conditions for wood products, care will need to be taken to ensure that the companies will relocate and that financial risk to public monies is minimized.

Industrial relocation will occur when two conditions are met: (1) long term lumber market trends indicate that a relocation and associated investment is viable; and (2) the existing land base is more valuable for non-industrial activity (such as housing). The following graph indicates that the second condition will vary depending upon the demand for non-industrial land, population growth, and general economic health. Where the decreasing value of existing industrial land intersects with the increasing value of non-industrial land, it becomes worthwhile (other things being equal) to begin to phase out industry. In particular, where growth is buoyant and demand for land is high (line:a), then relocation would be financially viable in the near future. But, where growth is slow and demand for land is low (line:b), then relocation would be financially viable only in the distant future.



Value of existing industrial lands (----- as industrial; — as non-industrial) p.1-5

An industrial relocation strategy is described in Matrix 1. The strategy is specifically identified for current timber mills located adjacent to Baikie's slough.

The industrial relocation strategy proposes that industry and the Management Committee work closely together to ensure that the relocation is sequenced and occurs in specific steps and within set timelines.

1.4 Modification of existing industrial operations

The existing logging operations need to consider moderation to their existing operations to ensure that they are in compliance with DFO and Environment regulations. The preparation of a remedial operation plan has been recommended by the Management Committee. The logging operations are exploring alternatives (see: Appendix 2).

1.5 Park and interpretation development

Parklands will be primarily developed as corridors, connecting one portion of the estuary to another. These corridors will follow much of the estuary shoreline, riverbank, and Tyee Spit shoreline. Park dedication shall be predominately for environmental reasons and not necessarily for active recreational purposes (e.g. walking trails).

Interpretation opportunities will be promoted by erecting plaques, printing self-guided brochures, and constructing an interpretative facility.

1.6 Tourism development

Active tourism development in the form of on-site facilities will be discouraged. Instead, the estuary will act as a backdrop to the overall tourism development in Campbell River. The estuary will provide opportunities for non-consumptive forms of tourism, including eco-tourism, guided non-motorized tours, and estuary study. Tourism benefits will be considered secondary to estuary ecological and restoration requirements.

1.7 Upland re-development

Upland re-development will focus upon two areas: open space dedication and moderate density mixed use development. The latter will provide a defined urban edge to the upland and the former will protect estuary natural values and will promote habitat restoration and protection.

For areas of the upland that are shown for redevelopment, moderate residential densities of 12 to 15 units to the acre should be considered. For the Campbell River Mills and Ocean Cedar sites, densities may have to be higher to ensure that industrial relocation costs can be largely offset by land development benefits. Comprehensive development plans should be completed for all redevelopment areas.

1.8 Tyee spit

Tyee Spit will be the primary public park site within the estuary area. An interpretative facility should be built to provide an overview of the estuary, the management plan process and timing of plan implementation, and a float plane history of Canadian aviation. **The designated park area would include a large restored natural spit to the north of a float plane base.** Plant restoration, including Balsam Root,* should be given priority.

The Spit will also house an on-going float plane base that serves all operators. A central passenger, parking, storage area should be built. Maintenance should take place off-site. Fueling and other minor operational requirements should be carefully monitored and should occur in an environmentally friendly way.

* There is considerable local knowledge and interest in restoring rare plants on the Spit. The Mitlenatch Field Naturalist Society could offer assistance and advice.

2. POLICIES

Policies are divided into general policies and specific management area policies. These policies complement the recommendations and set out how the recommendations will be given action.

2.1 General policies

The following general policies will guide the Management Plan decision-making process and associated plan implementation. The general policies address the six key management issues identified in the background section: estuary restoration, industrial relocation, dredging, Campbell River Indian Band lands, the interface between development and restoration lands, and economic impact. Additional policies that address land development issues are also noted.

2.1.1 Habitat restoration

2.1.1.1 DFO and BC Hydro, in their establishment of river flow guidelines for the John Hart Hydroelectric Plant, are encouraged to mimic natural flow regimes as closely as possible.

2.1.1.2 Where possible, all undeveloped lands within the main estuary north of Spit Road, including Campbell River Band Lands, are encouraged to remain in their natural state.

2.1.1.3 The restoration or rehabilitation of aquatic, riparian and upland areas that have been lost or degraded by previous land uses, will be promoted to maximize their value as fish and wildlife habitat.

2.1.1.4 The replacement of past habitat losses within the estuary will be promoted, through the creation of new aquatic and terrestrial habitats. To this end, water lot renewals will be required to have a habitat improvement component.

2.1.1.5 Stormwater management plans, incorporating detention and treatment systems to protect water quality in the estuary, shall be required for all development proposals.

2.1.1.6 Further dredging in Baikie's slough and the adjacent log pond shall be prohibited unless undertaken for habitat restoration purposes.

2.1.1.7 Drainage works, which improve the flushing of Baikie's slough, the adjacent log pond and the booming pocket next to the Dryland sort, will be encouraged.

2.1.1.8 Any works designed to improve flushing in the above areas shall incorporate measures to minimize the risk of property damage in the event of flood flows.

2.1.2 Industrial relocation

2.2.1.1 Development of a viable industrial relocation plan, that provides for (a) security of relocation funding and employment and (b) a reasonable time frame for relocation, shall be prepared by the Management Committee in conjunction with industrial operators.

2.1.3 Dredging

2.1.3.1. Existing industrial activity in the estuary will be maintained at current levels over the immediate term by implementing the proposed dredging project on a one time only basis in association with the preparation of an industrial relocation plan and remedial operation plan.

2.1.4. Campbell River Indian Band

2.1.4.1. A dialogue between the Management Committee, the District and Band will be encouraged to identify the needs of each party and to achieve the broad principles identified in the Management Plan and the requirements of the Band.

2.1.4.2 A dialogue between the Band, the Province, the Federal Government, and the District will be encouraged to identify potential alternative Band residential areas that are located away from the estuary.

2.1.4.3 A dialogue between the Band, the Province, the Federal Government and TimberWest will be encouraged by the District to identify measures that would facilitate Band purchase of the dryland sort for residential development.

2.1.5 Identifying the interface between development and restoration lands

2.1.5.1. A policy of net habitat gain within the study area shall be adopted for a combination of estuarine and adjacent uplands.

2.1.5.2 Future habitable development shall be flood-proofed as per existing requirements.

2.1.5.3 Public access to the waterfront will be encouraged (where alignments are along the waterfront, they are to be chosen with respect for estuarine habitat functions).

2.1.6 Economic impact

2.1.6.1 Development and management programmes that minimize net employment loss and social dislocation over the short and long term will be promoted.

2.2 Land development policies

2.2.1 Except for provided elsewhere, a minimum of 30 metre setback from natural boundary or high water mark shall be adopted and implemented.

2.2.2 Land development and management, which meets the objectives of the Land Development Guidelines for the protection of aquatic habitat, shall be adopted.

2.2.3 Land development and management practices, which minimize water contamination from runoff/surface drainage as per the Urban Water Runoff Guidelines, shall be adopted.

2.2.4 Clustering and medium density development of upland land uses shall be encouraged to provide open space while maximizing opportunities from high value land.

2.2.5 Shoreline erosion protection, where private property is threatened and estuarine values are not compromised, shall be promoted.

2.2.6 The development of greenways throughout the study area shall be encouraged.

2.2.7 The assessment of site contamination on former industrial lands and their associated remediation shall be required for all upland development sites.

2.2.8 A stormwater management plan shall be completed for the estuary and surrounding lands.

2.2.9 A habitat compensation trust fund, created from development initiatives, to 'pool' compensation monies shall be promoted.

2.2.10 Development permits and approvals, based upon a set of criteria that include public access considerations, shall be prepared for the estuary.

2.3 Management area policies

The primary study area was divided into 20 management areas. Those study areas correspond to water lot leases, land ownership patterns and natural features. These management areas provide a framework for the discussion of detailed policies that will facilitate estuary restoration.

2.3.1 Broad management areas

Management Area 1 and 2 refer to the broader study area. Management Area 1 refers to the District of Campbell River and Management Area 2 refers to the entire estuary area. Management Area 1 requires that estuary policies be compatible with broader community requirements as set out in the OCP. Management Area 2 requires that adjacent land uses and future development on the periphery of the estuary be undertaken so that the values and policies of the estuary are fully recognized

2.3.2 Detailed management area policies

The Management Committee identified a series of policies for each identified management area (Figure 2, p.1-12). Matrix 2 summarizes: (1) the primary issues requiring resolution for each management area; (2) policy requirements to address those issues for each management area; and (3) the action required to ensure policy implementation. These specific policies by management area should be read in association with Section 7.1.

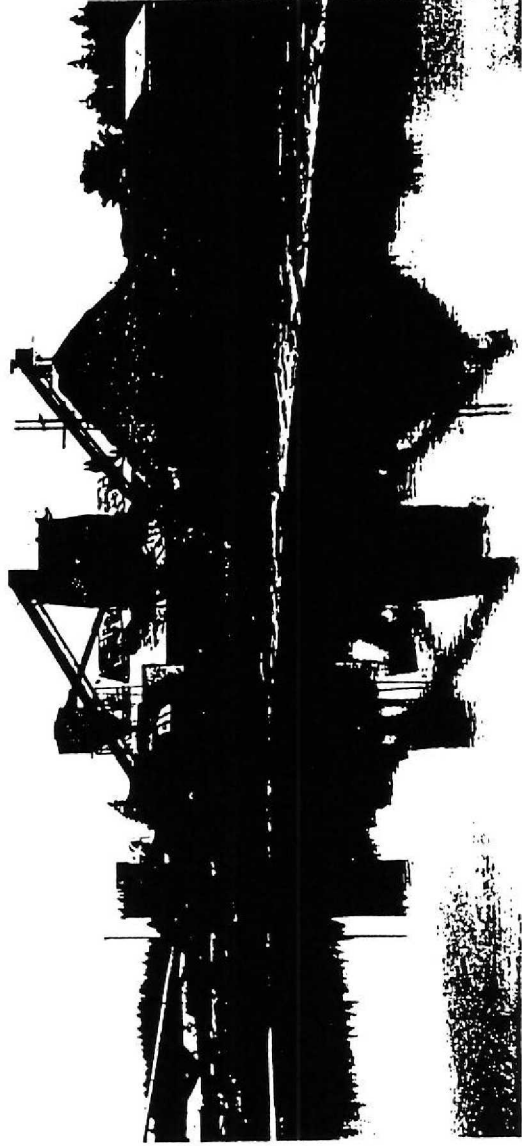


Photo 2 and 3: Industrial activity in Baikie's slough



**Figure 2:
CREMP
Management
Areas**

1. OCf- Area
2. Adjacent Area
3. Maple Street
4. North Riverbank
5. Dredging Channel
6. South Riverbank
7. Estuary Islands
8. North Outside
9. Outside Spit
10. Spit
11. Old Booming Gound
12. Reserve
13. Old Dryland Sort
14. Campbell River Mills
15. Island
16. Baikie's Slough
17. Ocean Cedar Area
18. North of Freshwater Marina
19. North Shoreline
20. Backshore



100 0 100 200 300 Meters

Prepared by
Wemy Planning Consultants /
Laurie T. Campbell Ltd.
January 1976

Campbell River Estuary Management Plan

Matrix 1 continued

Management area	issues	policy statements and actions
• Four: North riverbank	• bridge footing design	<ul style="list-style-type: none"> • Ministry of Highways and Transportation will be encouraged to locate bridge abutment works out of the active river channel. • The Management Committee will monitor the bridge design to determine its affects upon the river and estuary resources.
• Four: North riverbank	• channel flow enhancement	<ul style="list-style-type: none"> • The Management Committee will coordinate the development of a watershed rehabilitation plan. • Department of Fisheries and Oceans and the Ministry of Environment will be encouraged by the Management Committee to undertake joint habitat restoration under the Urban Salmon Habitat Program.
• Four: North riverbank	• habitat protection	<ul style="list-style-type: none"> • The Management Committee will coordinate the development of a watershed rehabilitation plan.
• Four: North riverbank	• public access	<ul style="list-style-type: none"> • Public access will not be encouraged below the bridge right-of-way.
• Five: dredging channel	• dredging	<ul style="list-style-type: none"> • Dredging will be supported on a one time only basis.
• Five: dredging channel	• industry/air transport/recreation conflict	<ul style="list-style-type: none"> • The Management Committee will promote safe use in the estuary through education programs.
• Five: dredging channel	• bundle booms (i.e. logs)	<ul style="list-style-type: none"> • An interim industry sub-committee will be formed to examine industrial log boom uses and effects. • The Management Committee will promote safe use in the estuary through education programs.

MATRIX 2
Management areas: issues, policies and actions

Management area	issues	policy statements and actions
<ul style="list-style-type: none"> Three: Maple Street area 	<ul style="list-style-type: none"> stormwater run-off 	<ul style="list-style-type: none"> Municipal wastes will be monitored and infractions penalized. As industrial development or redevelopment occurs, appropriate waste standards will be enforced. A public education program will be initiated to discourage industrial and chemical runoff.
<ul style="list-style-type: none"> Three: Maple Street area 	<ul style="list-style-type: none"> existing rip-rap 	<ul style="list-style-type: none"> Ways of improving the existing rip-rap will be explored and implemented where financially feasible. The feasibility of placing deflector booms/fins/groins will be explored.
<ul style="list-style-type: none"> Three: Maple Street area 	<ul style="list-style-type: none"> flood proofing 	<ul style="list-style-type: none"> The Ministry of Environment will be encouraged to examine the implications of its standards upon any redevelopment of the area.
<ul style="list-style-type: none"> Three: Maple Street area 	<ul style="list-style-type: none"> bridge abutment 	<ul style="list-style-type: none"> The Ministry of Highways and Transportation will be encouraged to review the bridge abutment design to minimize potential affects upon fish habitat and river flows. The proposed bridge crossing should be referred to the Navigable Waters Protection Act.
<ul style="list-style-type: none"> Three: Maple Street area 	<ul style="list-style-type: none"> public access 	<ul style="list-style-type: none"> Public access will be provided at the end of public roads or when land use change or rezoning occurs.

Matrix 1 continued

Management area	issues	policy statements and actions
• Seven: estuary islands	• maintenance of habitat	<ul style="list-style-type: none"> • The Management Committee will request that Department of Fisheries be encouraged to undertake on-going enhancement and contour re-shaping as part of their normal activities. • The Management Committee will encourage partners to become active participants in island enhancement.
• Seven: estuary islands	• recreational use of islands	<ul style="list-style-type: none"> • The Management Committee will encourage Ducks Unlimited to become active participants in island protection by erecting educational signage. • The Ministry of Lands will be encouraged to establish an environmental reserve over this part of the estuary.
• Eight: north outside	• sewer outfall	<ul style="list-style-type: none"> • The Management Committee will examine the additional work being done to determine an appropriate response.
• Eight: north outside	• creation of islands	<ul style="list-style-type: none"> • The Management Committee will examine the dredging proposal further to determine an appropriate response.
• Eight: north outside	• shoreline channel	<ul style="list-style-type: none"> • No action will be taken.
• Nine: outside Spit	• access (boat and foot)	<ul style="list-style-type: none"> • The District of Campbell River will seek water lot lease termination. • The District of Campbell River boat launch will be retained. • Foot access will be encouraged along the shoreline.
• Nine: outside Spit	• boat lines cutting off access and 'clothes-lining' other boats	<ul style="list-style-type: none"> • The District of Campbell River will terminate water lot leases. • Existing boat owners will encouraged to relocate to another area. • Non-motorized vessels will be encouraged.
• Ten: Spit	• restoration of natural vegetation	<ul style="list-style-type: none"> • The District of Campbell River in association with local interest group(s) should complete a vegetation management plan. • Balsum root and other rare plant species should be encouraged to become established on the spit.

Matrix 1 continued

Management area	issues	policy statements and actions
• Six: south riverbank	• bank stabilization (cost and rate)	<ul style="list-style-type: none"> • Design and construction of an approved bank stabilization program will be required as a condition of Comprehensive Development Plan approval. • Any proposal for bank stabilization will be referred to the Department of Fisheries and Oceans for review and approval.
• Six: south riverbank	• habitat improvement	<ul style="list-style-type: none"> • The Management Committee will coordinate the development of a watershed rehabilitation plan. • Department of Fisheries and Oceans and the Ministry of Environment will be encouraged by the Management Committee to undertake joint habitat restoration under the Urban Salmon Habitat Program.
• Six: south riverbank	• need for increased flow to old log boom area.	<ul style="list-style-type: none"> • The Management Committee will request that Department of Fisheries be encouraged to undertake flow modification as part of their normal activities.
• Six: south riverbank	• public access to point	<ul style="list-style-type: none"> • The Ministry of Lands will be encouraged to dedicate the existing Crown Land as a municipal park.
• Seven: estuary islands	• maintenance of habitat	<ul style="list-style-type: none"> • The Management Committee will request that Department of Fisheries be encouraged to undertake on-going enhancement and contour re-shaping as part of their normal activities. • The Management Committee will encourage Ducks Unlimited to become active participants in island enhancement.
• Seven: estuary islands	• recreational use of islands	<ul style="list-style-type: none"> • The Management Committee will encourage Ducks Unlimited to become active participants in island protection by erecting educational signage. • The Ministry of Lands will be encouraged to establish an environmental reserve over this part of the estuary.

Matrix 1 continued

Management area	issues	policy statements
• Ten: Spit	• public access (long term)	<ul style="list-style-type: none"> • The District of Campbell River should complete a park and recreation component to the proposed Spit management plan. • The District of Campbell River should be granted a head lease over existing lease areas on the Spit for purposes of managing water uses and restoration of habitat. • The spit should be developed for low impact recreation with an emphasis upon natural restoration and associated interpretation. • The District of Campbell River should complete an open space plan for all public areas and dedicated private lands.
• Ten: Spit	• public access (interim)	<ul style="list-style-type: none"> • The District of Campbell River should identify public areas for immediate use. • The District of Campbell River should complete an open space plan for all public areas and dedicated private lands.
• Ten: Spit	• float plane base	<ul style="list-style-type: none"> • The float plane base should be consolidated into one location near the south end of the spit. • The District of Campbell River should complete a float plane component to the proposed Spit management plan.
• Eleven: old log boom	• sub-surface restoration	<ul style="list-style-type: none"> • Department of Fisheries and Oceans and the Ministry of Environment will be encouraged by the Management Committee to undertake joint habitat restoration under the Urban Salmon Habitat Program.

Matrix 1 continued

Management area	issues	policy statements and actions
• Eleven: old log boom	• shoreline restoration	• Department of Fisheries and Oceans and Ministry of Environment will be encouraged by the Management Committee to undertake joint habitat restoration under the Urban Salmon Habitat Program.
• Eleven: old log boom	• increased water flows	• The Management Committee will request that Department of Fisheries be encouraged to undertake drainage modifications as part of their normal activities.
• Eleven: old log boom	• public access	• The District of Campbell River should complete an open space plan for all public areas and dedicated private lands.
• Eleven: old log boom	• barges and float house	• The Management Committee should approach the Lands Branch to cancel all water lot leases and monitor trespassers. • Existing barges and float house should be forced by regulation to relocate out of estuary.
• Twelve: Reserve	• other jurisdiction	• The Management Committee should encourage District, Band, federal and provincial governments to establish a Native Liaison Group. • A formal agreement should be sought on the future development/conservation of the estuary lands.
• Thirteen: old dryland sort	• quality of runoff	• The District of Campbell River should require that roof drains be directed out to estuary • The District of Campbell River should require catchment basins, detention and oil separators.
• Thirteen: old dryland sort	• maintaining public access	• The District of Campbell River should prepare a comprehensive development plan

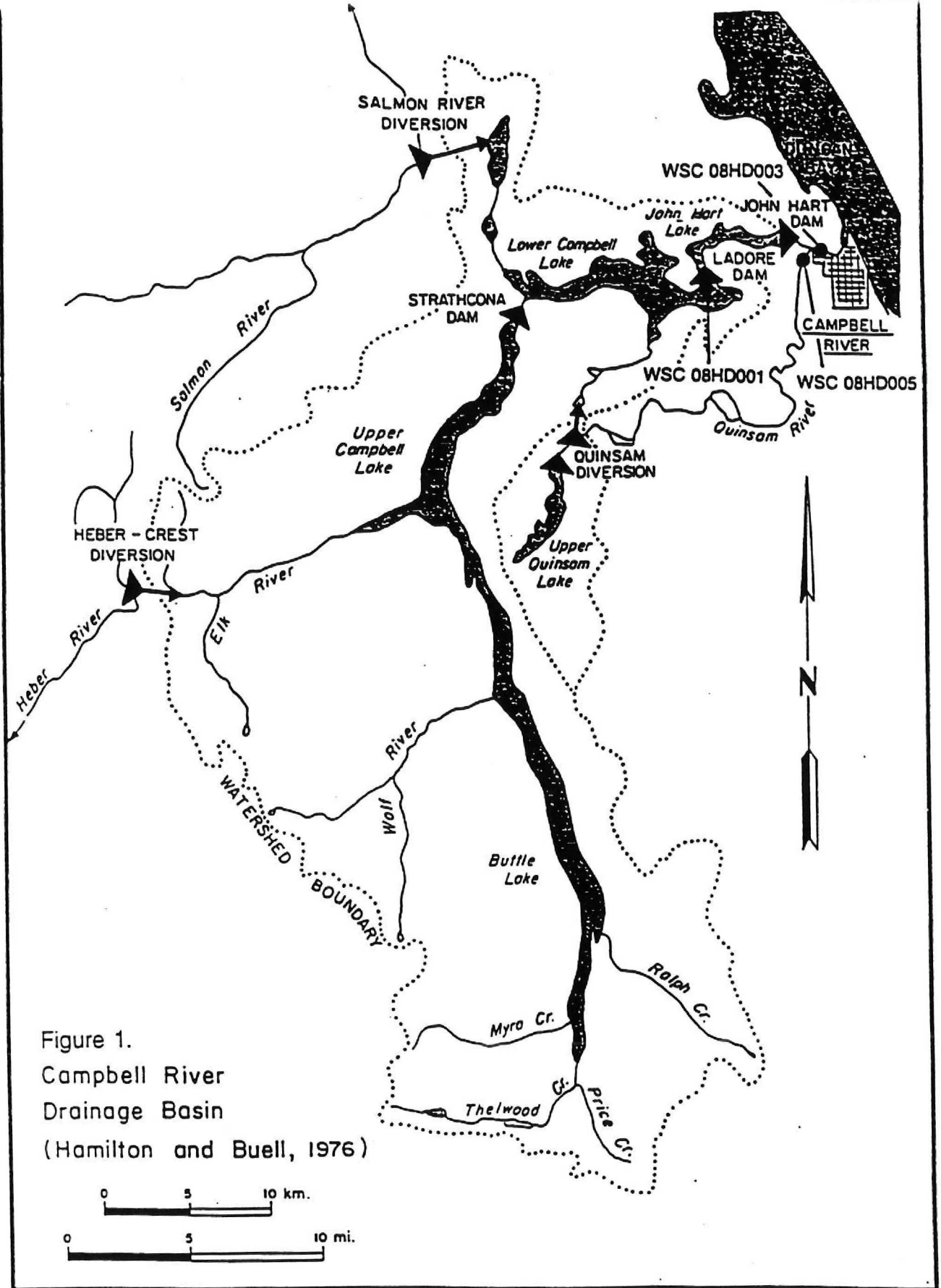


Figure 3: Campbell River Drainage Basin

Matrix 1 continued

Management area	issues	policy statements and actions
• Thirteen: old dryland sort	• quality of runoff	<ul style="list-style-type: none"> • The District of Campbell River should require that roof drains be directed out to estuary • The District of Campbell River should require catchment basins, detention and oil separators.
• Fourteen: Campbell River Mills	• industry relocation	• The Management Committee should coordinate the implementation of the Industrial Relocation Strategy.
• Fourteen: Campbell River Mills	• soil contamination	• Provincial regulations will apply.
• Fourteen: Campbell River Mills	• highway access	<ul style="list-style-type: none"> • The Management Committee should explore highway access alternatives with MOTH. • The District of Campbell River should develop a highway access plan for Highway 19 in the vicinity of the bridge. • The District of Campbell River will require completion of a comprehensive development plan.
• Fourteen: Campbell River Mills	• timing	• The Management Committee should implement the Industrial Relocation Strategy.
• Fourteen: Campbell River Mills	• shoreline restoration	• Over the short term, the Management Committee will work with industry to develop industrial practices that are more suitable.
• Fifteen: Island	• access	• The District of Campbell River will require completion of a comprehensive development plan.
• Fifteen: Island	• industry relocation	• The Management Committee should coordinate the implementation of the Industrial Relocation Strategy.
• Fifteen: Island	• soil contamination	• Provincial regulations will apply.
• Fifteen: Island	• timing	• The Management Committee should implement the Industrial Relocation Strategy.

Matrix 1 continued

Management area	issues	policy statements and actions
• Sixteen: Baikie's slough	• increased water flow	• The Management Committee will request that Department of Fisheries be encouraged to undertake drainage modifications as part of their normal activities.
• Sixteen: Baikie's slough	• industry relocation	• The Management Committee should coordinate the implementation of the Industrial Relocation Strategy.
• Sixteen: Baikie's slough	• slough restoration	• Department of Fisheries and Oceans and the Ministry of Environment will be encouraged by the Management Committee to undertake joint habitat restoration under the Urban Salmon Habitat Program.
• Sixteen: Baikie's slough	• shoreline restoration	<ul style="list-style-type: none"> • The Management Committee will encourage partners to become active participants in island habitat restoration. • Department of Fisheries and Oceans and the Ministry of Environment will be encouraged by the Management Committee to undertake joint habitat restoration under the Urban Salmon Habitat Program.

Matrix 1 continued

Management area	issues	policy statements and actions
• Seventeen: Ocean Cedar area	• industry relocation	• The Management Committee should coordinate the implementation of the Industrial Relocation Strategy.
• Seventeen: Ocean Cedar area	• soil contamination	• Provincial regulations will apply.
• Seventeen: Ocean Cedar area	• shoreline restoration	<ul style="list-style-type: none"> • Over the short term, the Management Committee will work with industry to develop industrial practices that are more suitable. • Over the long term, Department of Fisheries and Oceans and the Ministry of Environment will be encouraged by the Management Committee to undertake joint habitat restoration under the Urban Salmon Habitat Program.
• Seventeen: Ocean Cedar	• timing	• The Management Committee should implement the Industrial Relocation Strategy.
• Seventeen: Ocean Cedar	• highway access	<ul style="list-style-type: none"> • The Management Committee should explore highway access alternatives with MOTH. • The District of Campbell River should develop a highway access plan for Highway 19 in the vicinity of the bridge. • The District of Campbell River will require completion of a comprehensive development plan.
• Eighteen: north of Freshwater Marina	• stormwater	• The District of Campbell River will require the completion of a comprehensive development plan.
• Eighteen: north of Freshwater Marina	• contaminated soils	<ul style="list-style-type: none"> • The Management Committee will seek to determine the status of the soil contamination and seek assistance of the Waste Management Branch to identify a clean-up schedule. • Industry will be required to clean up soils prior to development approval.

Matrix 1 continued

Management area	issues	policy statements and actions
• Eighteen: north of Freshwater Marina	• water lots	• The Management Committee will petition Lands Branch to consider termination of water lot leases where existing development operations are detrimental to the restoration of the estuary.
• Eighteen: north of Freshwater Marina	• bylaw compliance	• The Management Committee will petition Lands Branch to consider termination of water lot leases where existing development operations are in contravention of municipal bylaws.
• Nineteen: north shoreline	• public access	• Additional public access will be considered upon future development applications
• Twenty: backshore	• long term growth	<ul style="list-style-type: none"> • The District of Campbell River should consider a comprehensive development plan for this area. • Long term growth should be postponed until the estuary redevelopment areas are built out.

3. IMPLEMENTATION PLAN

The Management Plan will require concerted effort and on-going monitoring to ensure that it is implemented. Given the conflicting interests that have been competing for the estuary and its resources over the past fifty years, there will likely be continued inertia to moving ahead with the implementation of the Plan. This section recommends several items to help move the Management Plan forward to realization.

3.1 Plan adoption

The Management Committee should 'sign-off' on the Plan by meeting to review the final plan, coming to agreement on its content, and formally signing the Plan. Each federal and provincial agency represented on the Management Committee should seek their respective ministry endorsement of the plan and its policies. The Management Committee should then meet with special interest groups and then present the Plan with interest group comments noted for Council's consideration. Following a motion of Council to adopt the Plan, the OCP should be modified to reflect the intent of the Estuary Management Plan.

3.2 Management structure

A number of structures were reviewed by the Management Committee to determine the most appropriate body to oversee the on-going implementation of the Management Plan. Three alternatives were explored: a government agencies body; a partnership of landowners/government agencies/interest groups/industry; and an Authority created by Order-in-Council. The existing Management Committee was also examined. A review of all of these groups suggested that the current Management Committee could reflect a partnership model with direct local, provincial and federal government involvement to monitor the implementation of the Plan. That model should include representation from industry. At the very least, the existing Management Committee could provide a transition role if a more appropriate model was identified in the future.

A Secretariat will need to be appointed to support the work of the Management Committee. That requirement could be provided by the District of Campbell River on a part time secondment basis.

Recommendation:

- (1) that the principle of a partnership committee representing all interest groups existing be re-confirmed as the body best able to oversee implementation of the Management Plan;
- (2) that a part time Secretariat be staffed;
- (3) that the District of Campbell River establish the Management Committee as a Commission of Council with appropriate delegated representation;
- (4) that terms of reference be drafted for the role and function of the Management Committee and endorsed by the District of Campbell River; and
- (5) that terms of reference for a Secretariat be drafted by the Management Committee and endorsed by the District of Campbell River.

3.3 Authority

A Memorandum of Understanding (MOU) should be signed by the District of Campbell River and appropriate federal and provincial agencies to guide the implementation of this plan. The MOU should identify the responsibility for the review and recommendation procedures for all decisions made by local, provincial and federal governments as those decisions affect the estuary. That MOU could form the basis for a protocol agreement.

3.4 Monitoring programme

There are two components to a monitoring programme. Each is discussed below.

3.4.1 Clearing house

There needs to be identified a clearing house for public concerns about pollution, uses and other matters that may occur within the estuary and need to be monitored and addressed. The public indicated a desire to have a central location where calls to be placed and action taken. The Management Committee through the Secretariat should consider the development of such a operational tool.

3.4.2 Biological monitoring

The Campbell River Estuary Management Plan is founded, in part, on the principle that the estuary is a dynamic system. Therefore, monitoring is essential to evaluate the success of the estuary management plan's implementation over time. The results of monitoring enable the management plan to evolve in response to the changing conditions in and around the estuary. A certain level of ecological monitoring is already taking place under the auspices of federal and provincial government agencies (DFO, CWS, BC Environment) as well as community naturalist groups and individuals. This effort is largely dispersed, based on widely differing resources and methodologies, and the information obtained is not always readily available to decision makers.

A coordinated ecological monitoring programme for the estuary is therefore proposed. This plan will be based on specialist input from the agencies, groups and individuals mentioned above. Leadership and coordination of the monitoring programme will be provided by the estuary management committee.

Based on the experience to date with habitat creation on the constructed islands, it is evident that useful measurement and evaluation of ecological change for management purposes must be based on methodical, long term monitoring. It is therefore proposed that ecological monitoring of the estuary be planned over a 10 to 20 year period, with review and evaluation every 3 to 5 years.

Available ecological information on the estuary is varied. There is significantly more information available on fish, mainly salmonids and their habitat, than on other aquatic and especially terrestrial species. It is therefore important that the initial stage of the monitoring programme have as its main goal to establish a comprehensive ecological baseline against which changes into the future can be measured and assessed. This baseline should encompass the full range of flora and fauna, both aquatic and terrestrial, as well as water quality.

The Management Committee should produce a yearly environmental report card on the estuary.

3.5 Industrial relocation programme

In order to facilitate an on-going dialogue with industry, a special sub-committee composed of vested interests, including land owners and industrial producers, should be formed to liaise with the Management Committee and provide input to the implementation process.

The proposed Industrial Relocation Strategy should be presented to selected federal and provincial government agencies who may have a direct bearing on the degree to which industrial relocation may occur. For instance, Western Canada Economic Diversification Fund (for potential relocation study funding), Lands Branch (for potential reconsideration of tenures and enforcement issues), Ministry of Forests (for potential alternative truck access timber supply), Waste Management Branch (for description of soil reclamation requirements), Regional District of Comox-Strathcona (for possible alternative industrial sites), and Ministry of Environment (for enforcement of regulations).

3.6 Zoning

Upland and foreshore re-zoning should occur only after comprehensive development plans have been completed and there is a legal agreement on cost of services, development cost sharing and public open space maintenance requirements.

3.7 Water lot leases

The Management Committee should meet with Lands Branch personnel at the earliest opportunity to discuss management enforcement and tenures. It may be necessary to modify some water lot leases to achieve a balance between the implementation of industrial relocation and lease expiration (e.g. Anglo American recently received a five year lease while Campbell River Mills recently received a 30 year lease). In this case, Anglo American's lease will likely have to be extended by a few years and Campbell River Mills may have to be reduced to maintain a common relocation initiative.

3.8 Campbell River Band

The Campbell River Band has indicated that it is very interested in the work of the Management Committee. The Band has a number of priorities which could conflict with the Management Plan. Discussion between the Band and the Committee is required to determine areas of mutual interest and concern.

3.9 Application of policies

The proposed policies should apply to the estuary as part of the District of Campbell River OCP. Each regulatory agency should apply the policies of the plan as they administer their respective responsibilities. Ultimate responsibility, however, for the application of the policies should rest with the Management Committee.

3.10 Plan monitoring and amendment

The Estuary Management Plan should be reviewed every five years. Every year the Management Committee should review the progress of plan implementation, issues and coordination activities of all levels of government. Amendments should be proposed by the Management Committee to Council. Such amendments should receive the same notice period and process as that applied to amendments to the OCP. Amendments should be based primarily upon matters of public safety, technical changes to the operation of industry or community needs.

3.11 Restoration programme

The selected restoration measures for the estuary will be implemented on a priority basis. Implementation will begin as soon as practicable and, generally, only after the source of habitat degradation is removed. Recommended priorities for implementation are as follows:

1. reduce the risk of property damage from erosion, flood or contamination;
2. re-establish natural hydrology and flushing of areas with degraded water quality;
3. rehabilitate moderately degraded aquatic and riparian habitats;

4. rehabilitate moderately degraded terrestrial habitats;
5. restore severely degraded aquatic habitats;
6. restore severely degraded terrestrial habitats;
7. create new aquatic habitats;
8. create new terrestrial habitats.

3.12 Other studies

The Management Committee will very likely identify additional study requirements over the life of the Plan. For now, three additional studies are recommended: (1) an industrial relocation study as per the industrial strategy; (2) a landfill and soil contaminant study; and (3) a study to review the implications of the Westmin Mine operation on the water quality of the Campbell River.

4. Development plan

The Development Plan for the Campbell River Estuary, which outlines the desired broad land use types for the estuary, has a potential development timeframe of 20 years.

Detailed area plans should be prepared for the estuary, based upon the attached Development Plan and the recommendations of Part One of this document.

Prerred Concept

- Aquatic Linkage
- Walkway Access
- Alternative Walkway Access
- Greenspace
- Redevelopment Area
- Marina
- Aquatic Habitat



Campbell River Estuary Management Plan

PART TWO

Part Two reviews the background material that has informed the plan recommendations.

5. BACKGROUND

This section reviews the background material that contributed to the completion of the Estuary Management Plan. It provides an overview of the primary issues that affect the estuary.

5.1 Overview of the Campbell River and Estuary

In terms of mean annual discharge, the Campbell River is the third largest river on Vancouver Island. It drains an area of 1460 km sq. (Figure 3 [after Burt and Burns]). A large portion of the drainage basin is over 2,220 metres in elevation amongst rugged mountains. The Campbell River has three impoundments and a number of water diversions feeding hydro-electric generating stations. The River enters Discovery Passage in the north end of the District of Campbell River.

The Campbell River and environs has been the home to the Kwatiutl First Nation for many centuries. The River and estuary were used by the Kwatiutl and Eiksan/Salish First Nations to harvest migrating salmon. These people used nets and weirs to capture the fish and developed a very sophisticated society around that lifestyle. Within the study area there are known archaeological sites such as fish weirs and traps at the Campbell River estuary mouth, net stations on the islands in the estuary, fortifications on the Tyee Spit, and an historic village site near Baikie's slough.

5.1.1 The estuary

The estuary covers approximately 100 hectares (250 acres). It consists of a mix of industrial, commercial, recreational and residual natural estuary features which indicate an environment that has been severely modified by human intervention.

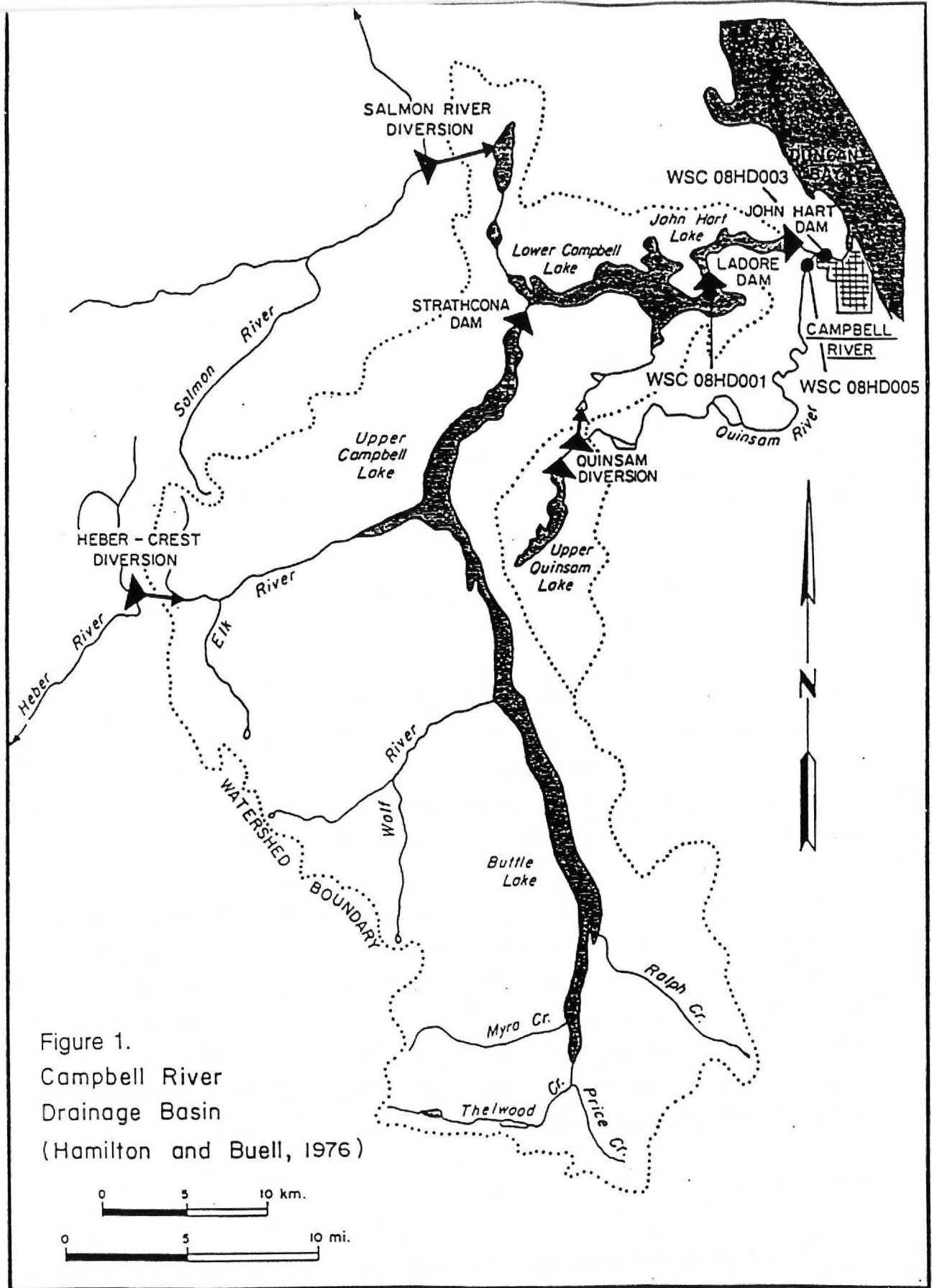


Figure 3: Campbell River Drainage Basin

The estuary receives the outflow of waters from the Campbell River drainage basin. Since much of the Campbell River is controlled by dams which regulate flows, sediment discharge to the estuary has been significantly modified over the past fifty years. The estuary and portions of the river below the hydro dams is sediment starved. Only the Quinsam River continues to provide direct sediment to the estuary. Even so, sediment deposition comes from two other sources: erosion of the river channel and riverbanks below the hydro dam, particularly along the old dryland sort, and sediment deposited and carried away by coastal tides and flows. As the Public Works (August 1995) draft report which was prepared for Canadian Coast Guard noted:

It is suggested that regulation has had a minor impact on sediment supply since the upper lakes naturally act as sediment traps. However, a reduction in river flows would reduce the ability of the river to transport sediment supplied by the Quinsam River. Regulation would therefore be expected to result in a net bed aggradation in the lower reaches of the Campbell River (Hay, 1994). Sedimentation in the Campbell River Estuary has also been affected by the removal of log storage facilities near the mouth and the creation of habitat islands; these changes have resulted in the redirection of flow that have increased depths in some areas and produced shoals in others (p.2).

Within the estuary, tidal currents are weak. This compares dramatically with the strong tidal flows in Discovery Passage.

The estuary is composed of the main channel area formed by the combined flows of the Campbell River and Quinsam River. Old meander stream beds appear to have been abandoned as flows are regulated, extreme highs reduced and adjacent land uses modified landscapes. Nunn's Creek was formerly a significant small tributary with considerable fish and upland habitat extending well into present day Campbell River. Over time the stream has been severely modified. The most natural habitat remains within the Campbell River Indian Reserve. For the most part, where the marsh lands of Nunn's Creek are bisected by Spit Road (which has 'flap gates' at two locations preventing flows from backing into the old marsh areas) little natural marsh ecosystem remains. North of Spit Road Nunn's Creek remains an active and important tidal marsh area.

Baikie's slough on the northwestern portion of the estuary has been heavily and seriously impacted by industrial activity. Industrial dredging has created a man-made slough and has expanded the natural slough. There is very little evidence of any natural estuary ecosystem remaining in this area.

The dryland sort dewatering area and abandoned log storage area has also been significantly affected as a result of dredging. Nearby, bottom sediments were removed in support of a cement operation on the spit. All in all, the estuary has been dramatically and significantly affected by modern human intrusion. The largest remaining natural estuary area is found today on the Campbell River Indian Reserve. Unfortunately, that remaining area is also under extreme pressure for Band-related development.

5.1.2 Hydrology

The estuary is positioned between the main river basin and Discovery Passage. The Campbell River descends rapidly toward the sea before entering a large floodplain that includes the estuary. The estuary is composed of several historic channels and stream beds that have carried flows toward Discovery Passage. This dispersal of flow over a large area creates the estuary effect.

a. Flows

Since 1947 Campbell River flows have been affected by hydro-electric development. Three dams hold water back in three impoundments; two of which are large bodies of water (Figure 3). In addition, the original Campbell River flows have been augmented by diversions from the Heber River, Salmon River and Quinsam River. Thus, the hydrology of the Campbell River has been altered significantly by recent developments.

Average discharge rates of the River are about 100 m³/sec but winter rains can increase river flows considerably. Before construction of the dams upstream, the peak recorded flow was 857 m³/sec on November 16, 1939. Since construction of the dams, the peak recorded (average) discharge rate is 381 m³/sec (p. 2-10, Lauga & Associates n/d).

The recorded Campbell River flows have varied greatly. For instance, between 1984 and 1992 the maximum daily flows have varied between 103.8 m³/sec in 1985 to 706.9 m³/sec in 1990 (after Hay & Company 1994). Hay & Company concluded that the mean annual flood estimate for the Campbell River is 353 m³/sec and 682 m³/sec in a ten year flood period. As Hay & Company noted: " The John Hart Dam releases represent a system with a great deal of storage which attenuates flood peaks and delays the peak outflow" (p.7).

Even so, the John Hart Generating Station does "spill" excess water from time to time. As noted by Burt and Burns (1995), "spill events have occurred throughout most months in the year with the exception of April and September" (p.4). *

B.C. Hydro and Department of Fisheries and Oceans have an informal agreement to protect fish and fish habitat. "The terms of this agreement (Local Operating Order 3P05-03C for John Hart Generating Station) include:

- a minimum total release at all times of 34 m³/s (1200 cfs)
 - a preferred minimum flow of 51 m³/s (1800 cfs)
 - ramping up and down between 34 to 51 m³/s to be done over an 80 minute period"
- (Burt and Burns, p.5).

Figure 4 provides a summary of the variance between pre and post operating mean monthly flows (after Burt and Burns, p.7). Regulated flows have resulted in increased flows in late winter, lower flows in late spring and early summer, increased flows in early fall and near normal high flows in late fall and early winter. The diversion of waters from outside the Campbell River natural catchment area has increased natural mean average discharge by 4.2 %. More importantly, "the salient feature in the daily flow regime is that regulation has resulted in wide fluctuations from day to day throughout most of the year" (op. cit.).

b. Tidal influences

The estuary is influenced by diurnal tide. In the winter the tides are predominately highest in the day time. In the summer, the lowest tides occur during the morning. Yearly, the largest tides occur during the solstices and the smallest tides occur during the spring and fall equinoxes. The tidal range at Argonaut Wharf near the base of Tyee Spit is 4.8 metres

* Note: During November 1995, at the time of writing, several large rainfalls occurred along the entire coast. Evidence suggests that there was an exceptionally high river flow, partly in reaction to a release of excess water by BC Hydro from its impoundment(s). This flow has affected the river bottom. Details were not available at time of writing, but point to the need to give management of hydro works considerable attention.

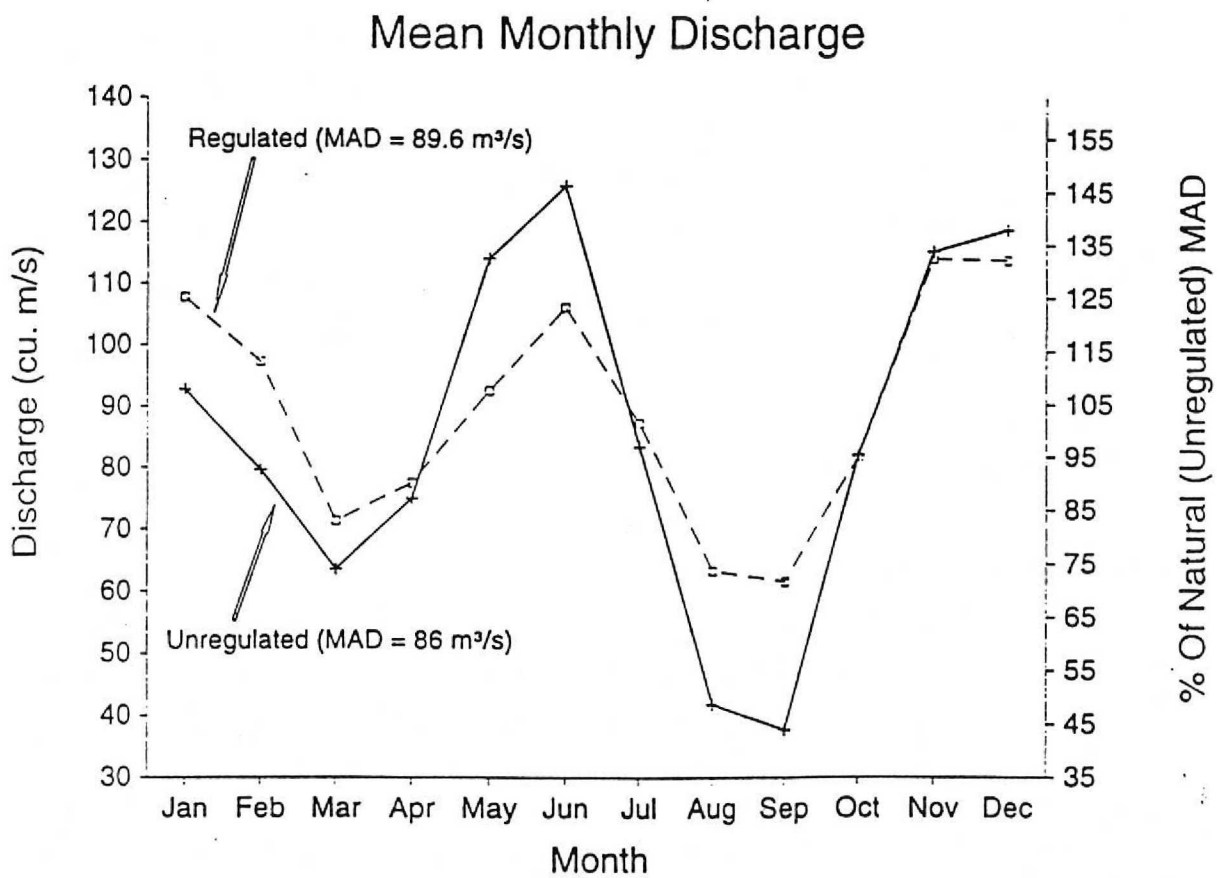


Figure 4: Mean monthly flows for the Lower Campbell River before and after regulation.

with a mean tide range of 2.9 metres. There is also a 19 year tide cycle with a variation of approximately 0.09 metres. The estuary is now entering the minimum of that cycle, so that tides over the next few years will experience the low end of the cycle.

In spite of strong tides, the tidal influence extends only 2.5 km up the river because the relatively steep gradient of the Estuary creates strong outward river flows. As a result, bottom sedimentation is mainly gravel rather than the predominant sand and mud of the slower Fraser River. The elevation change of 4 metres over the last 2.5 km of the river prevents the surface flow of the river from changing to flood at any time during the tide cycle" (Lauga & Associates, p.2-11).

5.2 Biological considerations

Estuaries are among the most biologically productive and diverse ecosystems on the planet. Because estuaries are transitional between fresh and salt water, biodiversity is very high. Factors that contribute to this include the combination of terrestrial, riverine and marine habitats, tides and currents, and sediment and nutrient inputs from the watershed. Plants and animals that inhabit estuaries are typically adapted to wide variations in salinity, temperature, inundation, and water velocity and other environmental conditions. Estuaries can, at various times, support freshwater or marine species, as well as species that migrate between fresh and saltwater. By their location at the downstream end of the catchment basin, estuaries are also exposed to potentially adverse changes in water flow and water quality due to upstream human activity.

The federal Department of Fisheries and Oceans has established that the area of estuarine influence at Campbell River has been reported to extend from the B.C. Ferries terminal to the vicinity of the Dolphin Resort in North Campbell River (District of Campbell River et al. 1983). However, for present purposes, the information review centres on the area between the Westmin wharf to the south and Painters Lodge to the north. Figure 5 shows the distribution of aquatic habitats within the estuary in July 1995.

5.2.1 Fish habitat

Aquatic habitat in the Campbell River estuary supports an abundance of wild and hatchery-raised fish species. Freshwater, marine and anadromous species known to occur in the estuary are listed in Table 1.

Table 1. Fish species known to use the Campbell River estuary
(after Bell & Thompson 1977)

Habitat	Common name	Scientific name
Freshwater species:	coastal cutthroat trout	<i>Salmo clarki clarki</i>
	Dolly Varden char	<i>Salvelinus malma</i>
	prickly sculpin	<i>Cottus asper</i>
	rainbow trout	<i>Salmo gairdneri</i>
	three-spine stickleback	<i>Gasterosteus aculeatus</i>
Anadromous species:	chinook salmon	<i>Oncorhynchus tshawytscha</i>
	coho salmon	<i>Oncorhynchus kisutch</i>
	chum salmon	<i>Oncorhynchus keta</i>
	pink salmon	<i>Oncorhynchus gorbuscha</i>
	sockeye salmon	<i>Oncorhynchus nerka</i>
	steelhead trout	<i>Salmo gairdneri</i>
	coastal cutthroat trout	<i>Salmo clarki clarki</i>
	lamprey	<i>Lampetra tridentatus</i> ?
	three-spine stickleback	<i>Gasterosteus aculeatus</i>
Marine species:	sculpin	
	gunnel	
	blennie	
	needlefish	
	herring	<i>Clupea harengus pallasii</i>
	perch	

Campbell River Estuary Management Plan

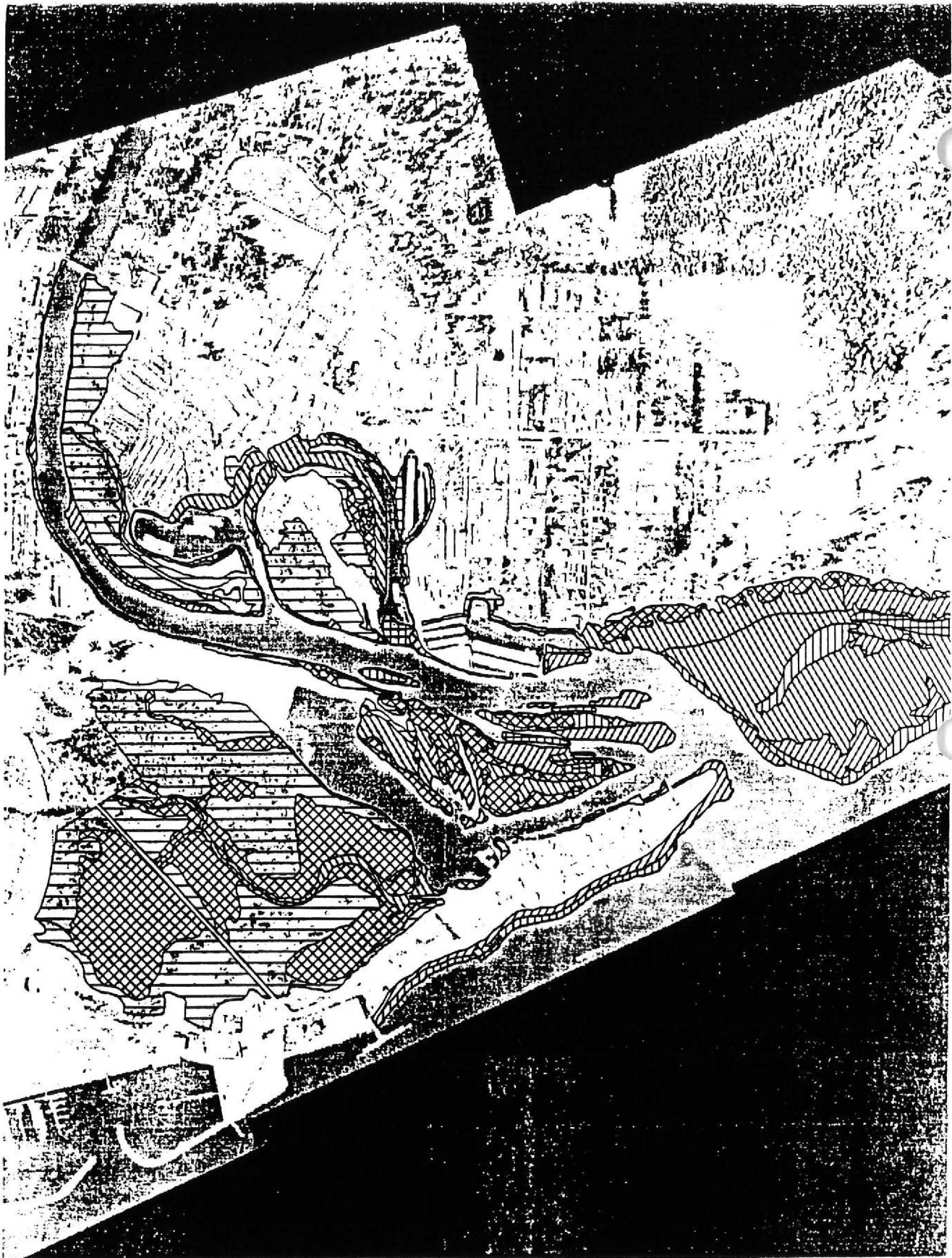


Figure 5:
CREMP
Habitat
Areas

 EEL GRASS
 INTERTIDAL ALGAE
 MARSH
 MUDFLAT
 RIPARIAN
 ROCK GRAVEL

Estuary habitat data provided
 by the Department of Fisheries
 and Oceans and is intended
 for use in the development of
 the Campbell River Estuary
 Management Plan



100 0 100 200 300 Meters

Prepared by
 Wany River Environmental Inc.
 January 1996

The Campbell River area is renowned especially for the economically important salmonid species; because of their importance, these species are emphasized in the discussion that follows.

All five species of salmon (chinook, coho, pink, chum and sockeye) as well as sea-run trout (steelhead and cutthroat) are known to use the estuary at some stage during their life cycle. Types of fish habitats in the estuary include adult holding pools, migration corridors, spawning beds, and rearing areas. The locations of these habitat types in the estuary are shown in Figure 5.

Holding pools

Adult salmon returning to spawn in the Campbell-Quinsam River and other nearby systems are known to congregate in "holding pools". Such areas of fish concentration are known to exist at Tyee pool and Frenchman's pool on the seaward side of Tyee Spit and at Nunns Pool on the landward side, in an area that was previously dredged for gravel extraction at the mouth of Nunns Creek. Other holding pools exist elsewhere in Discovery Passage.

Migration corridors

Migration corridors include all the waters through which fish migrate between fresh and salt water. This habitat type is used either by adult fish returning to spawn or by juvenile fish during their outmigration from freshwater to rearing habitat in the estuary or coastal areas beyond the river mouth.

Spawning habitat

The estuary contains spawning habitat for salmon (Table 2) and, potentially, herring and other species. Pink, chum and some chinook salmon are known to spawn in a 1.4 ha of gravel bed on the right side of the river (looking upstream), between approximately 75 m and 575 m downstream from the Highway 19 bridge. An estimated 7,608 m² or 53% of the bed contains suitable spawning gravel. This bed is rated as a marginal spawning habitat because the available gravel tends to be large, moderately compacted (making digging difficult), and shallow (Burt and Burns 1995).

Table 2 Spawning habitat capacity in the Campbell River Estuary below the Highway 19 bridge. (Burt and Burns 1995)

Species	No. of female spawners
pink	5,072
chum	827
chinook	10

Herring typically spawn in beds of eelgrass or other macro-algae. Significant beds of eelgrass and macroalgae have been mapped in both the inner and outer estuary (Figure 5). Although spawning by herring in these areas has not been confirmed, these areas are considered to have value as potential spawning habitat.

Rearing habitat

The importance of the Campbell River estuary as rearing habitat for juvenile salmonid fish is well recognized, though insufficiently understood (Burt and Burns 1995). The estuary is known to be a particularly important nursery habitat for chinook, coho and chum salmon. After emerging from the gravel in the spring, the juveniles of these species rear in fresh and estuarine water for varying lengths of time before outmigrating to Discovery Channel. The most important freshwater rearing habitats are the shallower, slower-flowing river margins and side channels such as Fred's slough. The availability of this type of predominantly freshwater rearing habitat is limited in the lower Campbell River. Within the lower estuary, the most valuable habitats include the tidal marshes of lower Nunns Creek, Nunns island and the adjacent constructed islands. The sedge *Carex lyngbei* is the predominant marsh vegetation at elevations frequently inundated by the tides. Additional estuarine marsh habitat is also available in Baikie's slough, although its condition is degraded at present due to adjacent industrial activity.

The estuary is especially important for chinook because most of the fry spend little time in mainly freshwater areas and migrate to the estuary soon after emergence. Studies of

juvenile salmonids in the 1970s and 1980s have shown that a major portion of their food consists of crustaceans that live in the estuarine marshes (Goodman and Vroom 1974; Levings et al. 1986; MacDonald et al. 1987). The results of more recent studies suggest that there may be insufficient estuarine habitat to adequately support the numbers of juvenile salmon utilizing the estuary in some years (Burt and Burns 1995; Korman et al., in press; McAllister and Brown, in press). This is thought to be, in part, due to the presence of large numbers of hatchery-produced fish. There are also indications that the estuarine carrying capacity has increased in recent years as a result of the construction of the man-made islands.

5.2.2 Wildlife habitat

All habitat types in the estuary, both terrestrial and aquatic, are used by some form of wildlife, whether resident or migratory. However, information on wildlife and related habitat in the Campbell River estuary is very limited, compared to that on fish. A comprehensive, if dated, list of plant and animal species is provided by Bell and Thompson (1977). Studies of plant communities and productivity have been undertaken by Kennedy (1979) and the Canadian Wildlife Service (Dawe et al., in prep.). Wildlife that utilize the estuary include many species of waterfowl, shorebirds, upland birds, marine and terrestrial mammals, as well as amphibians, reptiles and invertebrates (Bell and Thompson 1977; CBA Engineering, et al. 1980; Neil Dawe, Canadian Wildlife Service, and Al Caverly, B.C. Environment, personal communications).

Habitat distribution in the Campbell River Estuary is shown in Figure 4. The aquatic zones are frequented by marine mammals such as river otter and harbour seals, which use the areas for feeding. During low tide, the exposed intertidal areas are intermittently available for shorebirds, gulls and other waterfowl, as well as non-aquatic species. These areas, which include mudflat, rock and gravel (including riprap), intertidal algae, marsh, and eelgrass (exposed during the lowest tides only) are used for feeding and/or resting by both resident and migratory bird species. Several Trumpeter Swans (*Olor buccinator*), a threatened migratory species, are known to feed during winter in the inner estuary near the mouth of Nunns Creek and along the foreshore on the west side of the river mouth. (R. Davies, BC. Environment, personal communication).

The terrestrial habitats include meadow, shrubland and floodplain forest. Because of their proximity to the estuary and their location in the floodplain, most of these areas are considered riparian habitat. By far the greatest extent of vegetated terrestrial habitat in the estuary is located within the Indian Reserve, with lesser portions in the Fletcher Challenge lands and along the north bank from the highway bridge to Baikie's slough. The estuary provides the only remaining stands of mature floodplain forest, which provides nesting and/or roosting habitat for Bald Eagle, Great Blue Heron and many other species. At least one eagle nesting tree is known to exist in the forest on the south side of the estuary (Al Caverly & Rick Davies, B.C. Environment, personal communications). Pilings within the estuary (since removed) have historically provided nesting habitat for the Purple Martin, a bird that is considered threatened in British Columbia (Neil Dawe, Canadian Wildlife Service, pers. comm.).

The sparsely vegetated sand and gravel uplands of Tyee Spit are a unique habitat that occurs infrequently on the east coast of Vancouver Island. The undeveloped uplands near the Westmin facility support the only known occurrence of the Balsamroot (*Balsamorhiza deltoidea*) on the east coast of Vancouver Island (Neil Dawe, CWS, pers. comm.).

5.2.3 Critical habitat

Critical habitats are those areas which are essential to the survival and sustained production of a fish or wildlife population.

Critical fish habitats in the Campbell River estuary include salmonid spawning and rearing areas. (As indicated above, herring spawning areas may also exist in the outer estuary, but have not been confirmed.) Given the greater availability of suitable gravel upstream, the relative lack of salmonid spawning habitat is considered less important than estuarine rearing habitat. The following areas are considered critical to the survival of juvenile chinook, chum and to a lesser extent coho, and are therefore designated as key environmentally sensitive areas of the estuary:

The tidal marshes and adjacent shallow water habitat of the lower estuary, including Nunns Creek below Spit Road, the islands, and the foreshore between the Freshwater Marina and Painters Lodge;

the side channel known as Fred's slough, upstream of Baikie's slough.

There is insufficient information at present to designate specific critical wildlife habitats in the Campbell River estuary. However, despite the lack of definitive information, the following conclusions can be made:

heaviest use by aquatic wildlife occurs in the lower estuary, north of Nunns Creek mouth and generally seaward of the Freshwater Marina;

undeveloped terrestrial habitats surrounding the estuary can be considered important if not essential to sustaining certain plant species, such as the Balsamroot mentioned above, as well as resident birds, mammals and other wildlife;

critical nesting habitat for the Purple Martin has been lost in the estuary due to the removal of old pilings.

5.3 Land use

The estuary has been used in historic time primarily as a location for industrial activities. In the early 1900's, logging camps were developed in the estuary. As early 1904, log shipping began and the earliest water lot lease was created in 1905. Both are forerunners of today's logging operations. In 1924 International Timber Company acquired an area known today as the dryland sort. That site served as a major logging operation site. In 1989, the dryland sort ceased operation. The northwestern portion of the estuary remains in active logging operation (Figure 6). Baikie slough serves as a de-watering site for a large volume of wood for Campbell River Mills and Ocean Cedar. Along the north arm of the estuary, other industrial and recreational boating activities predominate (Photo 4). The southeastern portion of the estuary is largely within the Campbell River Indian Reserve (Figure 6). That part of the estuary has remained primarily in a natural state (Photo 5).

5.3.1 Zoning

The majority of the immediate study area within the District of Campbell River is covered by four zones (from largest to smallest: RU2: Rural 2, I3: Industrial, C3: Service Commercial, RM1: Low Density Multiple Family, CR6: Country Residential, R1: Rural, MHP: Mobile Home Park, and C1: Neighbourhood Commercial). The overall estuary study area is dominated by the RU1 and CR1 to the north.

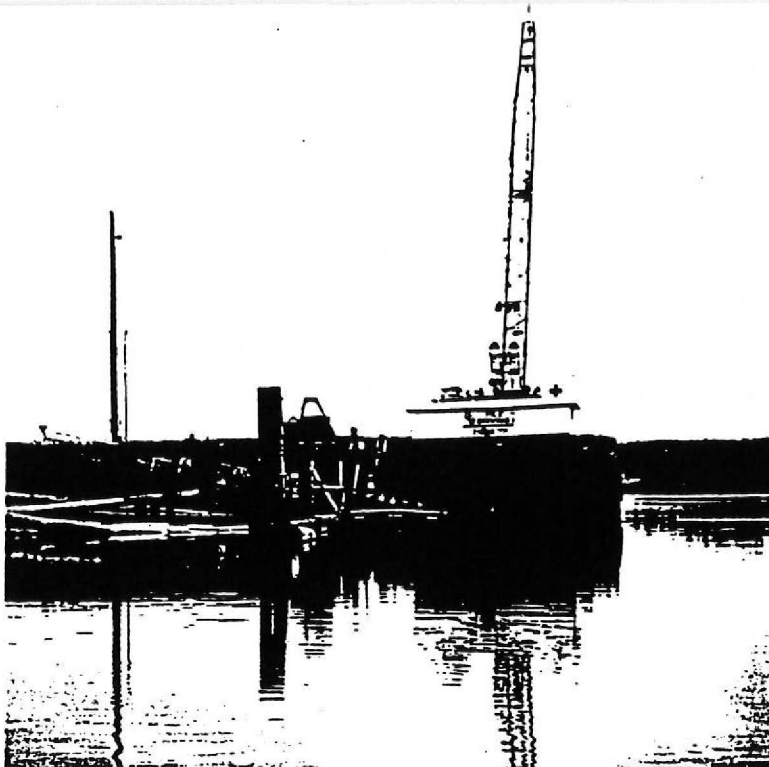
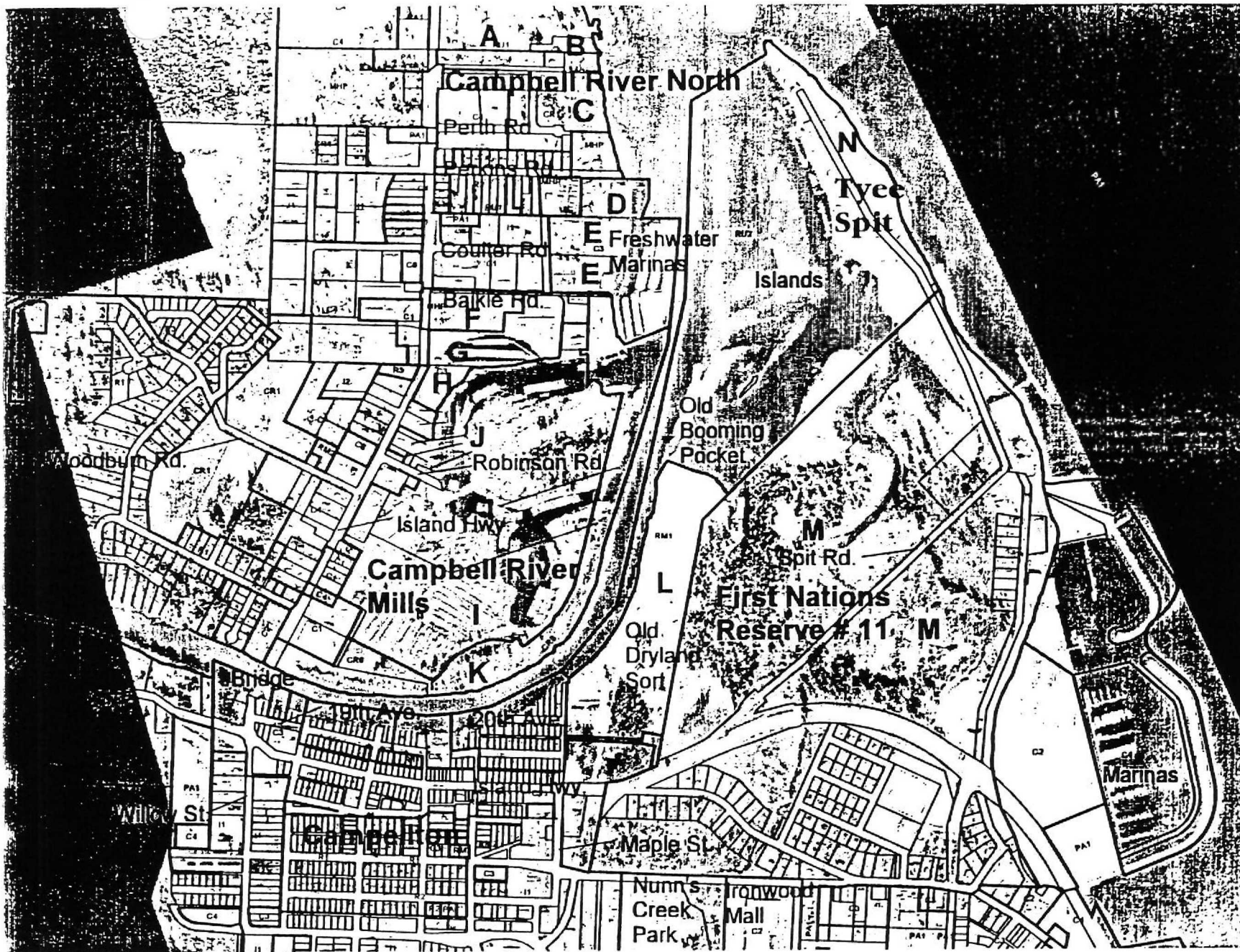


Photo 4 an 5



**Figure 6:
CREMP
Tenure
&
Zoning**

Property Owners

- A - Keith Hudson
- B - Daryn Vanstone
- C - George Uzzell
- D - Mercury Marina & Trailer Park Ltd
Cameron's Mobile Home Park
- E - 462731 BC Ltd
J W Timber Co. Ltd
Campbell River Net Loft Aqua Ltd
Freshwater Marina
Marina Gardens Trailer Park
- G - J W Timber Co. Ltd
North Island Propeller, The Bikesmith
- H - Adam Robinson
E&B Helicopter Ltd
Boatland
- I - Raven Industries
- J - Anglo American Cedar Products
- K - District of Campbell River (Raven Park)
- L - TimberWest
- M - First Nations Reserve No. 11
- N - District of Campbell River

Bylaw 788

- RU-1 Rural Zone
- RU-2 Agriculture Zone
- R-1 Single Farm Res.
- R-2 Single Farm Res. Second Split
- R-1-648 Single Farm Res. Second Split
- R-3 Single Farm Duplex Zone
- R-3 Single Farm 1 Estate Res.
- RM-1 Low Density Urban Farm Zone
- RM-2 Medium Density Urban Farm Zone
- RM-3 High Density Urban Farm Zone
- MO-1 Mobile Home Park Zone
- C-1 Neighbourhood Commercial Zone
- C-2 Central Commercial Zone
- C-3 Services Commercial Zone
- C-4 Medium and Transit Zone
- C-5 Highway Commercial Zone
- C-6 Road Landscaping Zone
- C-7 Services Station Zone
- I-1 Light Industrial Zone
- I-2 Dark, Heavy Processing Zone
- I-3 Resource Industrial Zone
- PA-1 Park & Public Services Use Zone
- RR-1 Rural Recreation Zone
- WI-1 Waterfront Industrial Zone
- ES-1 Emergency Services Zone

Bylaw 854 (North Campbell River)

- R-1 Residential One A
- R-2 Residential Two
- R-3 Residential Three
- R-3A Residential Three A
- R-3B Residential Three B
- CR-1 Country Residential One
- CR-2 Country Residential Two
- CR-3 Country Residential Three
- CR-4 Country Residential Four
- CR-5 Country Residential Five
- CR-6 Country Residential Six
- RU-1 Rural One
- RU-2 Rural Recreation 1
- RU-2A Residential Multiple
- MO-1 Mobile Home Park
- C-1 Commercial One A
- C-2 Commercial Two
- C-3 Commercial Three
- C-4 Commercial Four
- C-5 Commercial Five
- C-6 Commercial Six
- I-1 Industrial One
- I-2 Industrial Two
- I-3 Industrial Three
- I-4 Industrial Four
- PA-1 Public Assembly One



0 100 200 300 Meters

Campbell River Estuary Management Plan

Prepared by
City Planning Consultants /
Laurier Consultants Ltd
January 1996

5.3.2 Industry

The on-going logging operations in the estuary are very dependent upon access to the sea. Logs are hauled from Gowlland Harbour on Quadra Island (and other locations) to Baikie slough where they are de-watered. In 1950 the Baikie Brothers built a sawmill in the estuary. Today, the site is owned by Raven Forest Products Ltd. who lease the site to Campbell River Mills. Campbell River Mills carry on a sizable sawmill operation, employing approximately 150 people. The mill serves markets in Asia and Europe as well as North America. Campbell River Mills has recently expanded their operation to include a wood-chipper. Ocean Cedar Division of Anglo American Cedar Products employs approximately 20 people and produces cedar wood products. Algoma Cedar Shake employs up to 10 people during peak periods.

A small boat repair operation occurs at the base of Perkins Road in the northeastern portion of the estuary.

A mixture of highway commercial, light industry and heavy industry are located along Highway 19 north of the river (Figure 6). This mix of uses restricts public access to the river and along most of the northern portion of the estuary.

5.3.3 Commercial

There are a number of medium sized commercial businesses located in the large commercial area north of the estuary (Figure 6). These operations include car dealerships, heavy equipment sales and service and boat storage, sales and repairs.

5.3.4 Tourism and recreation

The primary direct recreational user of the estuary is the two freshwater marinas (Figure 6). The marinas provide mooring in freshwater for boats. The majority of boats are stored under protected cover. A few kayakers and canoeists use the estuary as do birders and naturalists. However, much of the estuary is inaccessible. Fishing is not permitted in the estuary.

5.3.5 Tyee spit

Tyee Spit is home to a number of light industries some of which are seasonal and tourism-based. The spit is a major float plane base. Two helicopter operations also function out of the spit. The District of Campbell River recently obtained the spit and has indicated that it will terminate most of the current leases in 10 years. In recognition of the unique qualities of the spit location, the float plane operations will remain in a consolidated form so that they can be operated safely from the spit.

5.3.6 Campbell River Indian Reserve

The Campbell River Band has approximately 70 hectares (170 acres) of reserve adjacent to the estuary (i.e. between Spit Road and the north boundary of the reserve). Much of the estuary's remaining natural condition is due to the large undeveloped portion of the estuary. The Band is in need of housing and economic development land. A large part of the reserve has been dedicated to revenue generation through property development. The Band has estimated that they require 225 housing units by the year 2020. The Band estimates that there is an immediate housing shortage of 40 units. Land adjacent to the existing Band housing area will be developed in the near future. Nunn's Creek cuts through that area. The Band has also identified that the estuary may be required for future housing.

5.3.7 Water lots

There are 14 water lot leases within the study area (Appendix 3). They vary in length from a few years to 25 in remaining tenure. Water lots are held by the Crown through the Ministry of Environment, Lands and Parks. Water lot leases are issued on a fee basis to adjacent upland owners or others (with the upland land owners consent) for specified periods of time.

5.4 Roads

Highway 19 currently borders the western edge of the study area. A bypass of most of

Campbell River will be completed by 1996 and will join up with the existing alignment at the Campbell River bridge crossing. Spit Road crosses part of the estuary and isolates some of the estuary marsh located on the Campbell River Indian Reserve (see: Figure 6). Several roads provide direct access to the edge of the estuary along its northern limit. Baikie Drive provides access to the freshwater marinas. Perkins Road provided access to the boat repair and a boat launch site.

All roads north of the estuary have open ditches which drain surface runoff from residential, commercial and industrial areas into the northern edge of the estuary.

5.5 Services

The study area can be divided into three service areas. The first area lies north of the Campbell River and estuary. It is not serviced by sewer or storm drains. Surface runoff occurs directly into local open ditches. Residential development use septic fields for sewage disposal. South of the Campbell River surface development is connected to storm drains which dump into the river. This area is serviced by sewers. Although Reserve land near Discovery Passage is not serviced currently by sewer lines sewer lines will be installed in the near future.

5.6 Proposed dredging

There are 16 commercial marine businesses using the estuary. Those businesses include logging operations and float plane operators. In particular, restricted draft from deposition of sediment materials has begun to place severe limitations on the ability of Campbell River Mills and Ocean Cedar to access log supplies. In a benefits analysis study related to the proposed dredging project commissioned by the Canadian Coast Guard, Lauga & Associates determined that a "small decrease in water depth will substantially increase the number of days when high tide would not be high enough to allow the primary commercial users of the estuary to operate" (Public Works and Government Services Canada, 1995 p.1). The Lauga study noted that there are currently 80 days a year when the tide is not of sufficient height to accommodate marine users. The number of inaccessible days is continuing to increase. For instance, the Lauga study confirmed that "with only a 0.076 metre (0.25 foot) loss of water depth, the number of days when tides are of insufficient height would rise sharply . . . to 135 days per year" (Lauga & Associates, p.1-1).

Lauga estimated that the cost to industry from operational delays was currently \$435,000.00 per year. Most of the benefits from dredging will accrue to Campbell River Mills due to "towing bundled hemlock logs up the estuary into a log pond near its sawmill" (Lauga & Associates, p.1-1). Further, the Lauga Study identified that total costs to industry could rise to \$1.9 to \$2.1 million per year if water depths became 0.3 metres less than they are now. Hay noted that, based upon the current sediment rates, the proposed dredged channel would likely infill within 5 to 10 years time. If the river experienced a flood flow, sediment infill of a dredged channel could occur at a faster rate.

As noted in the Lauga study:

dredging benefits are extremely sensitive to water depth changes because estuary access is dependent on the peak of high tides providing just enough water for a 1.5 to 2 hour operating window once a day on average. A feasible dredging program would not eliminate the need to wait for high tides. A feasible dredging program would reduce the number of days when the highest tide was not high enough for operations, lengthen the high tide operating window and allow deeper draught vessels and tows (p.1-1).

A dredging proposal has been completed under the auspices of the Canadian Coast Guard. An area about 550 metres (1,800 feet) long and 45 metres (150 feet) wide would be dredged to remove about one metre of gravel materials at the shallowest point to little or no material removal at the deepest point. The 22,000 cubic metres is proposed to be deposited to form islands, similar to the islands constructed in the 1980's.

The work undertaken on behalf of the Coast Guard includes an environmental assessment. The assessment found that "the degree of environmental impact associated with the maintenance dredging project is not expected to be significant" (Environmental Services, Public Works and Government Services Canada, 1994, p.28).

That report went on to note:

Some minor loss of fisheries habitat will occur through removal of gravels from the river, but the negative aspects of this impact will be mitigated by keeping the gravels in the estuarine system and by the placing of all dredged gravels near the navigation channel (p.28).

Environmental Services concluded that "no further environmental studies are recommended for this project at this time" (p. 28).

The proposed dredging channel was revised in August 1994 to address Department of Fisheries and Oceans (DFO) concerns about the disturbance of eel grass beds. Although DFO has expressed concerns about the implications of dredging upon the viability of industrial users and the associated potential for those users to remain in the estuary, DFO has not indicated that it opposes the dredging on technical grounds. At a public meeting held to review the proposal in Campbell River in October 1994, 24 residents attended. "Strong opposition was voiced from certain members of the audience however considerable support for the project was also expressed. Any concerns expressed (sic) during the public meeting were deemed to be mitigable" (Environmental Services, p.11). Following that meeting, Canadian Coast Guard, the proponent of dredging, met with Mayor and Council who indicated that they could not support dredging until a management plan had been completed for the estuary. It is from that decision of Council that this management plan and the Campbell River Estuary Management Committee took direction.

5.7 Proposed development

The Campbell River Estuary has had a history of significant industrial development. Like many urban centres which have experienced growth and an emerging environmental awareness, Campbell River* is now considering new forms of development near the estuary. That new development includes residential uses and park and recreation development.

5.7.1 Old dryland sort

TimberWest owns approximately 11.5 hectares (28 acres) of property zoned RM2 located adjacent to the Campbell River and the old log booming area. It is known locally as the old dryland sort. Most of the site is above the floodplain and is highly suitable for development. The District and TimberWest entered into an agreement to rezone this property from industrial to residential as part of the District's purchase of Tyee Spit.

* Campbell River has completed significant waterfront redevelopment over the past few years in the downtown. That trend is typical of many communities which have prime waterfront development potential. The focus upon re-examination of the estuary is a continuation of that trend.

The TimberWest property could support 336 units under the current zoning. A 30 metre green belt along the Campbell River has been identified by the District as part of any development plan. The riverbank is under threat from erosional forces. Approximately 350 metres (1100 feet) is eroding, primarily as result of a combination of the 1990 flood event and required decommissioning and removal of an old timber retaining wall. The current erosion is taking place on provincial Crown land which abuts the TimberWest property.

TimberWest also owns a 2 hectare (5 acre) highway commercial site between the dryland sort and Highway 19.

5.7.2 Tyee spit

The District of Campbell River acquired the spit recently from TimberWest. The spit is largely developed through leases to a number of tourist related businesses. The District has indicated that the leases will be honoured for ten years, by which time businesses will need to relocate (note: the float plane operations will remain and will be consolidated on the spit).

6. PUBLIC INPUT

Public input was sought on two occasions as the management plan was being developed. In addition, citizens were asked to participate by completing a questionnaire on the significance of the estuary and a feedback sheet on views about the proposed alternative plans prepared by the Management Committee. Details of the public process is included in Appendix 1. The following summarizes those findings.

6.1 Open houses

Two open houses were held to gather opinions and feedback from interested citizens. The open houses provided citizens with an opportunity to comment on their views about the estuary and provide feedback on the plan alternatives.

6.1.1 First open house

The first open house was held on Tyee Spit adjacent to the estuary in early July. At that open house, information on the study purpose and process was provided. People were invited to provide their ideas for the restoration of the estuary and to tour the estuary by boat. Following their tour, people were invited to sketch on two separate overlays those features likely to (1) contribute to or (2) inhibit the long term overall goal of restoration of the estuary (see: Appendix 1 for details). Sixty five people spent an average of 1/2 to one hour on the site.

In summary, it was apparent that many people shared a concern about a few key items: (1) the state of log booming and associated activity in the estuary; (2) surface drainage into the estuary; (3) industrial pollution; and (4) industry location in the estuary. Many also felt that estuary restoration was important.

6.1.2 Second open house

Almost 100 people attended the second open house which was held to review the two

intervention alternatives, the dredging options and the vision statement. An exit questionnaire summarized views of those attending. It noted: (a) that the majority favoured the moderate development option, (b) that there was an even split between those who favoured one time only dredging without qualifications (16 respondents) or with qualifications (5) and those who opposed dredging (21) [note: 10 respondents thought that dredging should occur every year), and (c) that a majority agreed with the vision statement. Many people expressed concerns about loss of jobs if industry was forced to relocate. Some others were concerned about the effects of dredging upon the 'hard-pan' gravel in the river bottom.

6.2 Questionnaire

A questionnaire was distributed at the first open house and made available to those who dropped into the District office. The questionnaire sought to gain an understanding of the views held by the public about the estuary. The following summarizes that feedback.

Question 1: What are the things you enjoy most about the estuary?

Response grouping	responses	% of responses
birds/wildlife/waterfowl/fish	22	64
plant species/vegetation	11	37
birds/wildlife/waterfowl/fish habitat	10	30
natural beauty/tranquillity/viewing	10	30
micro climate	1	3
navigable waters	1	3

Question 1: What things should be protected in the estuary?

Response grouping	responses	% of responses
ecology/habitat/whole estuary	19	55
water quality	13	39
birds/wildlife/waterfowl/fish	11	33
plant species/vegetation	6	18
foreshore	1	2

Question 3: What do you believe are the key issues detrimentally affecting the estuary?

Response grouping	responses	% of responses
industrial development/activities	17	52
industrial pollution	9	27
water flow manipulation/erosion	7	21
log handling in the estuary	6	18
urban encroachment/over development sewage	3	9
accommodating industrial relocation	1	2

Question 4: Do you believe the estuary is (please check only one)

Response option	responses	% of responses
one of Campbell River's most important natural resources	29	85
a fairly important natural resource	3	9
not an important natural resource	0	0
no response	2	6

Question 5: Do you believe the estuary is (please check only one)

Response option	responses	% of responses
is under serious threat, or	30	91
is not under serious threat	3	9
no response	0	0
requires immediate attention to protect it, or	24	73
does not require immediate attention to protect it	2	6
no response	7	21
should be saved, or	28	85
is not worth saving	0	0
no response	5	15

It is clear from the foregoing that the vast majority of those who took the time to fill in the questionnaire believe that the estuary's chief attributes are its natural features. As well, they believe that the estuary is under threat. Many believe that the estuary is one of Campbell River's primary natural resources which requires immediate attention through a public and private action plan.

6.3 Interest groups

Special meetings were held with industrial users, members of the Estuary Society, and the Campbell River Indian Band. At those meetings participants commented on the purpose and process for the preparation of the Management Plan, the concerns each group had and methods to address common issues.

6.3.1 Industrial users

The industrial users were coordinated by a representative from Campbell River Mills. Those in attendance at both meetings included representatives of Campbell River Mills, Ocean Cedar, Algoma Cedar Shake and Freshwater Marina. Three industrial owners (Campbell River Mills, Ocean Cedar, and Algoma Cedar Shake) agreed to identify some immediate actions and operational modifications that would contribute to the well-being of the estuary. At another meeting held on October 11th, 1995, the industrial users agreed in principle with the Vision Statement (see below) subject to the details of implementation. Those who would be facing relocation also agreed to provide criteria for the selection of a new alternative site.*

6.3.2 Estuary Society

A few members of the Campbell River Estuary Society attended two meetings. At both meetings concern was expressed for the short term and long term well-being of the estuary. In particular, those in attendance expressed concern about the need for dredging and the on-going log sorting in Baikie's slough. Even so, those attending expressed concern about the impact of industrial relocation upon employment and the need to accommodate fellow Campbell River residents to the extent possible without jeopardizing the estuary's potential for restoration.

* A letter was sent to the three wood fiber industrial users in mid-November reminding them of the need to submit their plans for short operational change and relocation criteria. At time of writing, only Algoma American Cedar Products Ltd., Ocean Cedar Division had responded in writing (Appendix 2).

6.3.3 Campbell River Indian Band

The Band is concerned that it has been expected to maintain the natural qualities of the estuary while others have exploited the estuary through industrial development. The Band is desirous of ensuring that the key attributes of the estuary are maintained while balancing such action with the critical social (primarily housing) and economic needs of the Band. The Band has identified a serious shortfall in housing and the need to commit a large area south of Spit Road to economic development. The Band would like to develop the old dryland sort for housing.

7. ISSUES

The following issues, which have been placed in a Major Issues Document, have been identified and confirmed by the Campbell River Estuary Management Committee, August 28th, 1995 and subsequently modified on October 2nd, 1995. The issues are derived from a review of background material, discussions with interest groups, field work, and review by the Management Committee. Major issues have been associated with planning principles identified in the Management Plan Terms of Reference. That grouping provides a sense of the degree to which planning principles might be affected by identified issues. All of the following identified issues will need to be addressed in the Management Plan.

7.1 Planning Principles and Associated Identified Issues

Planning Principle 1: promote long term benefits to the natural environment over short term gains to any particular agency or user group.

Issues:

Land use: general

- industrial/commercial activities directly use and rely upon the estuary for transport of goods/supplies/clients;
- industrial/commercial activities directly use and rely upon the estuary for storage of materials;
- industrial/municipal direct surface run-off to the Campbell River;
- little apparent public awareness of current use practices in the estuary;
- lack of implementation of past recommendations about industrial uses in the estuary;
- Campbell River Band may have an historic interest in much of the estuary, including the dry land sort site;
- most industrial users will have significant difficulty to relocate out of the estuary;
- proposed dredging has created an expectation that industrial/commercial activities that rely on water transport will be assisted;
- little area of estuary remains undeveloped and in non-Band ownership.

Land use: spit

- timing of relocation of existing leases who will move;
- identifying mix of remaining users.

Hydrology

- bank erosion is seriously impacting available land and estuary dynamics;
- lack of flushing of log sort areas is reducing environmental quality of those areas and their potential for restoration;
- Hydro regime affects the estuary;

- flushing of all materials and subsequent deposition in the mouth of the estuary;
- potential for dredging alters the natural flow regime of the river.

Estuary ecology

- lack of juvenile rearing habitat;
- lack of holding pools for returning fish;
- maintaining wildlife diversity;
- by its very nature, the estuary is a dynamic process;
- on-going toxic loading;
- toxic sedimentation (PAH's and heavy metals);
- low dissolved oxygen in Baikie slough;
- dredging may alter ecological processes in unknown ways.

Socio-economic

- building broad community knowledge of existing use affects upon the estuary;
- current inadequate financial mechanisms to address estuary clean-up;
- building broad community support/participation for enhanced estuary restoration;
- lack of formal community access to estuary;
- Campbell River Band's need for more residential development.

Planning Principle 2: be founded on inherent biophysical capabilities and long-term socio-economic needs of the Study Area.

Issues

Land use: general

- industrial/commercial activities directly use and rely upon the estuary for transport of goods/supplies/clients;
- industrial/commercial activities directly use and rely upon the estuary for storage of materials and reduced cost of operation;
- industrial/commercial activities appear to be marginal operations whose economic advantage is direct sea access and use of estuary waters for transport and storage;
- cost of redirecting municipal surface run-off to the Campbell River;
- little apparent quantification of industrial economic benefits of existing estuary uses;
- Campbell River Band may have an historic interest in much of the estuary, including the dry land sort site;
- Campbell River Band have identified interest in developing part of estuary for residential purposes;
- most industrial users will have significant difficulty to relocate out of the estuary;
- proposed dredging will help to maintain the industrial/commercial operations;

- dredging is required on cyclical basis to address long term industrial user economic needs;
- proposed dredging has created an expectation that industrial/commercial activities that rely on water transport will be assisted.

Land use: spit

- timing of relocation of users will affect investment and use;
- identifying mix of remaining users.

Hydrology

- bank erosion is seriously impacting the dry land sort and may be affecting land values;
- Hydro depends upon current flows and regimes to maintain efficiency;
- flushing of all materials and subsequent deposition in the mouth of the estuary may reflect a transfer of costs;
- dredging is required on cyclical basis to address long term industrial user economic needs.

Estuary ecology

- lack of adequate juvenile rearing habitat;
- current industrial activity is in competition with natural ecological processes;
- lack of adequate holding pools for returning fish;
- cost of clean-up of on-going toxic loading;
- cost of clean-up of toxic sedimentation (PAH's and heavy metals);
- cost of rehabilitating Baikie slough;
- dredging may alter ecological processes in unknown ways.

Socio-economic

- potential loss of employment if industry/commercial operators forced to move because of no dredging;
- current inadequate financial mechanisms to address estuary clean-up;
- difficulty of relocation for some industrial/commercial users;
- economic benefit of fisheries (tourism, recreational, commercial) resource not being maximized due to detrimental habitat impacts;
- Campbell River Band's need for more residential development.

Planning Principle 3: improve and increase the effectiveness and efficiency of long and short term decision making by regulatory agencies with regard to the management, development and allocation of land and water resources in the estuary

Issues:

Land use: general

- industrial/commercial activities can not plan in climate of uncertainty;
- lack of public contact point for estuary concerns;

- lack of monitoring and policing of estuary activities;
- most industrial users will have significant difficulty to relocate out of the estuary;
- in the past, proposals to relocate industrial users have not been implemented;
- proposed dredging has created an expectation that industrial/commercial activities that rely on water transport will be assisted;
- industrial/municipal direct surface run-off to the Campbell River;
- little apparent public awareness of current use practices in the estuary;
- Campbell River Band may have an historic interest in much of the estuary, including the dry land sort site;
- little area of estuary remains undeveloped and in non-Band ownership.

Land use: spit

- identifying mix of remaining users;
- timing of relocation of users will affect investment and use.

Hydrology

- bank erosion is seriously impacting available land and estuary dynamics;
- Hydro regime affects the estuary;
- flushing of all materials and subsequent deposition in the mouth of the estuary;
- potential for dredging alters the natural flow regime of the river.

Estuary ecology

- on-going toxic loading from a number of sources;
- toxic sedimentation (PAH's and heavy metals);
- by its very nature, the estuary is a dynamic process;
- current industrial activity is in competition with natural ecological processes;
- dredging may alter ecological processes in unknown ways.

Socio-economic

- building broad community knowledge of existing use affects upon the estuary;
- building broad community support/participation for enhanced estuary restoration;
- lack of formal community access to estuary;
- Campbell River Band's need for more residential development.

Planning Principle 4: shall be dynamic rather than defining an end state

Issues:

Land use: general

- in the past, proposals to relocate industrial users have not been implemented;
- inability of government to rapidly adjust to new management requirements;
- Campbell River Band may have an historic interest in much of the estuary, including the dry land sort site;

- little area of estuary remains undeveloped and in non-Band ownership.

Land use: spit

- identifying mix of remaining users;
- timing of relocation of users.

Hydrology

- potential for dredging alters the natural flow regime of the river.

Estuary ecology

- by its very nature, the estuary is a dynamic process;
- current industrial activity is in competition with natural ecological processes;
- dredging may alter ecological processes in unknown ways.

Socio-economic

- building broad community support/participation for enhanced estuary restoration;
- Campbell River Band's need for more residential development.

Planning Principle 5: incorporate sustainability principles

Issues:

Land use: general

- lack of sustainable planning practice and experience;
- available mechanisms for incorporation of sustainable development principles;
- industrial/commercial activities directly use and rely upon the estuary for transport of goods/supplies/clients;
- industrial/commercial activities directly use and rely upon the estuary for storage of materials;
- industrial/municipal direct surface run-off to the Campbell River;
- little apparent public awareness of current use practices in the estuary;
- lack of implementation of past recommendations about industrial uses in the estuary;
- most industrial users will have significant difficulty to relocate out of the estuary;
- proposed dredging has created an expectation that industrial/commercial activities that rely on water transport will be assisted;
- little area of estuary remains undeveloped and in non-Band ownership.

Land use: spit

- timing of relocation of users;
- identifying mix of remaining users.

Hydrology

- bank erosion is seriously impacting available land and estuary dynamics;
- lack of flushing of log sort areas is reducing environmental quality of those areas and their potential for restoration;
- Hydro regime affects the estuary;
- flushing of all materials and subsequent deposition in the mouth of the estuary;
- potential for dredging.

Estuary ecology

- lack of adequate juvenile rearing habitat;
- lack of adequate holding pools for returning fish;
- on-going toxic loading;

Estuary ecology

- by its very nature, the estuary is a dynamic process;
- current industrial activity is in competition with natural ecological processes;
- toxic sedimentation (PAH's and heavy metals);
- low dissolved oxygen in Baikie slough;
- dredging may alter ecological processes in unknown ways.

Socio-economic

- building broad community knowledge of sustainable development principles in the estuary;
- building broad community support/participation for enhanced estuary restoration;
- Campbell River Band's need for more residential development.

The identified issues will be addressed directly or indirectly by the management plan.

8. OPPORTUNITIES AND CONSTRAINTS

This section identifies opportunities and constraints which have been identified and confirmed by the Campbell River Estuary Management Committee, August 28th, 1995. The opportunities and constraints are derived from a review of background material, discussions with interest groups, field work, and review by the Management Committee. Opportunities and constraints have been associated with planning principles identified in the Management Plan Terms of Reference. That grouping provides a sense of how various opportunities and constraints will affect the identified planning principles.

Planning Principles

Planning Principle 1. promote long term benefits to the natural environment over short term gains to any particular agency or user group.

Opportunities:

- most major interests are at table;
- industrial and commercial users have indicated a willingness to work with Management Committee and to enhance estuary values;
- acquisition of Tyee Spit presents potential central redevelopment area in the estuary and potential for non-consumptive tourism and recreation options;
- flushing of booming pocket and Baikie slough would enhance fish stocks;
- relocation of industrial uses would open-up large areas of the estuary for public uses and habitat restoration;
- potential to market the estuary as a key cornerstone of a natural area system;
- requirement for dredging forces issue of long term industrial use of the estuary;
- interim measures and a commitment to implementation of a long term plan could ease the transition for non-compatible uses;
- potential to undertake a careful design of the dry land sort site for public benefit;
- some industrial users are self-monitoring and cleaning-up their sites.

Constraints:

- bank erosion of the old dry land sort site;
- lack of Campbell River Band's participation in the Management Committee;
- sporadic attendance of Province of BC representatives;
- illegal uses of the estuary and lack of enforcement (e.g. barge repairs and floats);

- threat of loss of jobs for some industrial users may cause focus upon the short term;
- currently licensed Hydro flows and water regime creates impression that Hydro an 'advantaged user';
- lack of community awareness of type, and degree, of current industrial activities in the estuary;
- presence of toxins over the long term;
- on-going surface run-off into Campbell River from residential, commercial and industrial users;
- potential pollution from Westmin operation in watershed.

Planning Principle 2: be founded on inherent biophysical capabilities and long-term socio-economic needs of the Study Area.

Opportunities

- most major interests are at table;
- public interest in stewardship is increasing;
- industrial and commercial users have indicated a willingness to work with Management Committee and to enhance estuary values;
- acquisition of Tyee Spit presents potential central redevelopment area in the estuary and potential for non-consumptive tourism and recreation options;
- restoration islands have created significant enhanced wild fish stock habitat;
- Quinsam Hatchery adds significant value to commercial and sport fisheries;
- relocation of industrial uses would open-up large areas of the estuary for public uses and habitat restoration, thereby enhancing eco-tourism, nature interpretation and associated economic activities;
- potential to market the estuary as a key cornerstone of a natural area system;
- interim measures and a commitment to implementation of a long term plan could ease the transition for non-compatible uses;
- increased habitat areas and restoration creates potential for retention/improvement of wild stocks;
- dry land sort site could help resolve Campbell River Band residential demand;
- increased community access may occur with modifications in current land use patterns;
- major restoration and mitigation programmes would enhance commercial and sport fishing returns.

Constraints:

- potential for marina at booming site;
- lack of full cost accounting in analysis of dredging benefits;
- lack of Campbell River Band's participation in the Management Committee;

- sporadic attendance of Province of BC representatives;
- relocation/closure of some users who are dependent upon dredging to maintain access to materials/clients;
- threat of loss of jobs for some industrial users may create immediate hardship for some residents;
- currently licensed Hydro flows and water regime creates impression that Hydro an 'advantaged user';
- lack of community awareness of type, and degree, of current industrial activities in the estuary;
- toxic discharge could be costly to reduce;
- on-going surface run-off into Campbell River from residential, commercial and industrial users could be costly to mitigate;
- potential pollution from Westmin operation in watershed.

Planning Principle 3: improve and increase the effectiveness and efficiency of long and short term decision making by regulatory agencies with regard to the management, development and allocation of land and water resources in the estuary

Opportunities:

- most major interests are at table;
- estuary now under one local government;
- installation of sewage collection system in North Campbell River;
- industrial and commercial users have indicated a willingness to work with Management Committee and to enhance estuary values;
- acquisition of Tyee Spit presents potential central redevelopment area in the estuary;
- relocation of industrial uses would open-up large areas of the estuary for public uses and habitat restoration;
- requirement for dredging forces issue of long term industrial use of the estuary;
- interim measures and a commitment to implementation of a long term plan could ease the transition for non-compatible uses;
- involvement in Campbell River Band in finding alternative housing sites;
- potential to undertake a careful design of the dry land sort site for public benefit;
- some industrial users are self-monitoring and cleaning-up their sites.

Constraints:

- bank erosion of the old dry land sort site;
- illegal uses of the estuary and lack of enforcement (e.g. barge repairs and floats);
- current Hydro flows and water regime;

- lack of community awareness of nature and degree of current industrial activities in the estuary;
- Campbell River Band's need for additional residential development and lack of alternative space to provide same (except on estuary);
- on-going surface run-off into Campbell River from residential, commercial and industrial users;
- potential pollution from Westmin operation in watershed.

Planning Principle 4: shall be dynamic rather than defining an end state

Opportunities:

- industrial and commercial users have indicated a willingness to work with Management Committee and to enhance estuary values;
- interim measures and a commitment to implementation of a long term plan could ease the transition for non-compatible uses;
- increased community access could occur with modifications in current land use patterns/operations;
- setting specific short term, intermediate and long term targets could facilitate ease of transition to a natural state.

Constraints:

- threat of loss of jobs for some industrial users may create immediate hardship for some residents and focus attention on the immediate.

Planning Principle 5: incorporate sustainability principles

- industrial and commercial users have indicated a willingness to work with Management Committee and to enhance estuary values;
- public interest in stewardship is increasing;
- estuary now under one local government;
- acquisition of Tyee Spit presents potential central redevelopment area in the estuary and potential for non-consumptive tourism and recreation options;
- restoration islands have created significant enhanced wild fish stock habitat;
- fishery resource of Campbell/Quinsam Rivers adds significant value;
- assisting Campbell River Band to find alternative housing sites away from the estuary;
- relocation of industrial uses would open-up large areas of the estuary for public uses and habitat restoration, thereby enhancing eco-tourism, nature interpretation and associated economic activities;

- potential to market the estuary as a key cornerstone of a natural area system;
- interim measures and a commitment to implementation of a long term plan could ease the transition for non-compatible uses;
- increased habitat areas and restoration creates potential for retention/improvement of wild stocks;
- increased community access could occur with modifications in current land use patterns/operations;
- current industrial operations could be modified to reduce detrimental affects upon fish habitat;
- major restoration programmes would enhance commercial and sport fishing returns.

Constraints:

- lack of full cost accounting in analysis of dredging benefits;
- current Hydro flows and water regime;
- lack of Campbell River Band's participation in the Management Committee;
- Campbell River Band's need for additional residential development and lack of alternative space to provide same (except on estuary);
- lack of community awareness of nature and degree of current industrial activities in the estuary;
- toxic discharge could be costly to reduce;
- on-going surface run-off into Campbell River from residential, commercial and industrial users could be costly to mitigate;
- potential pollution from Westmin operation in watershed.

The foregoing opportunities and constraints will inform the Vision Statement and the development of the management plan.

9. VISION STATEMENT

The Management Committee completed a visioning session to identify a desired end state for the estuary. All members participated in that session.

9.1 Vision statement

On August 28th 1995, the Campbell River Management Committee completed a visioning process for the Campbell River Estuary. The Vision Statement established a preferred vision of the estuary in the year 2010. This document reviews the product of that visioning. It also provides a concise vision statement that will provide the foundation for the development of alternative plans for the estuary.

The visioning process involved three major components: (1) overview of the world of Campbell River in 2010; (2) overview of the preferred image of the estuary in 2010; and (3) details of the estuary as it should appear in 2010. Each step lead to the preparation of the Vision Statement. A summary of the visioning process is included in Appendix 4.

9.1.1 Proposed Vision Statement

A vision statement describes what is expected or preferred for a given area. It sets out the foundation for the development of detailed long term plans for action. A vision is nothing more but nothing less than the articulation of a commonly held desirable end state for the Campbell River Estuary.

The following vision statement has been prepared by combining the key words and phrases developed by the Campbell River Management Committee at the August 28th visioning session. Management Committee members reviewed a draft of the vision statement and modified it to their satisfaction, as follows:

Proposed Vision Statement for the Campbell River Estuary in the Year 2010

The Campbell River Estuary will exhibit:

(1) a mix of rehabilitated and revegetated natural upland, shoreline setbacks, and foreshore which will primarily support:

- improved fish and wildlife habitat;
- park areas which will support active and passive forms of low impact recreation; and

(2) selected upland areas of well planned compatible residential/mixed use development.

Subsequent plans must be compatible with this overall vision.

9.1.2 Vision statement sign-off

All but one member of the Management Committee adopted this vision statement and 'signed-off' on it (see: Appendix 4). Following the Committee's adoption of the vision statement, a meeting was held with the industrial sub-committee on October 11th. At that meeting all of the industrial users approved the vision statement *in principle* subject to the details of relocation (Subsequently, one industrial user "endorse(d) the Vision Statement that has been adopted by the Management Plan committee" (see: Appendix 2).

10. ALTERNATIVE INTERVENTION PLANS

The Management Committee considered three alternative estuary management scenarios. This section examines those scenarios and explores the alternative plans which the Management Committee prepared to address the adopted vision statement.

10.1 Alternative scenarios

Three alternative management scenarios were considered in the Campbell River Management Plan process. Those three scenarios are: (1) Minimum intervention scenario, (2) Moderate intervention scenario, and (3) Maximum intervention scenario. Each scenario was reviewed by the Campbell River Estuary Management Committee on August 29th, 1995. The following summarizes the findings of that review.

1. Minimum intervention scenario *< \$100,000*

- where little new effort would be undertaken to address the restoration of the estuary beyond the day-to-day programmes of government.

This scenario is unacceptable due to:

- 20 years of consistent reports and plans calling for major changes to the way the estuary is managed;
- broad public concern about the current state of the estuary;
- evidence of continued degradation of the estuary through existing land use practices.

2. Moderate intervention scenario *\$100,000 - 500,000*

- where a combination of government and private sector action would be undertaken to restore the estuary while being cognizant of budgetary constraints.

This scenario requires further consideration due to:

- public concern about forcing current users out of business;
- evidence that past rehabilitation efforts (e.g. islands) have resulted in significant improvements for salmonid populations;
- potential socio-economic costs of complete relocation of all businesses;
- potential to develop alternative employment options that build upon the natural character of the estuary;
- potential to identify intensive management programs for selected sites; and
- potential limited availability of funds for rehabilitation.

3. Maximum intervention scenario >\$500,000

- where a combination of government and private sector action would be undertaken to restore the estuary.

This scenario requires further consideration due to:

- significant interest in, and expectation by, the public in estuary rehabilitation;
- critical importance of the estuary for the on-going health of the salmonid stocks;
- growing importance of various forms of tourism based upon natural systems;
- potential on-going threats to resource stocks from adjacent uses;
- need to address large geographic area of upland uses as well as foreshore activities;
- the cumulative effects of a variety of activities and uses; and
- significant unrealized capability of the estuary for salmonid.

The Management Committee adopted a recommendation on August 28th to give detailed consideration to a moderate intervention scenario and a maximum intervention scenario.

As result of the preceding information, the Management Committee considered the development of two intervention alternatives. Intervention is required to undertake the restoration efforts needed to bring the estuary back to a more natural state. Intervention includes plans and programmes that will assist relocation of industry, designate shoreline easements, restore foreshore and tidal zones, and encourage public recreation that is sympathetic to fish and wildlife values. The two proposed alternatives address those intervention requirements. This section examines policies that will: (1) set direction for the two alternatives; and (2) outline the details of the alternatives.

10.2 Proposed policies

A set of policies were developed to guide the preparation of the Management Plan. The following policy proposals are based upon: (1) confirmed issues and opportunities and constraints; (2) the Vision Statement; and (3) knowledge of the ecosystem. These policies have been reviewed by the Management Committee at the October 2nd meeting and modified based upon member comments.

10.2.1 General policies

A number of key issues were identified which required policy action. Those issues were determined to have significant affect upon the ability to achieve estuary rehabilitation.

General policies have been identified to address those issues. General cost implications of the proposed alternative policy actions required to address the key issues are identified. Where alternative policies are noted, an adopted policy is identified to give clear direction to the development of the alternatives.

The key issues are:

- industrial relocation (timing, dredging, location, costs, type);
- Band land (residential need, economic development, preservation, alternative location);
- dredging (timing, degree, frequency);
- demarcation of development/rehabilitation lands (biophysical and political);
- accomplishing integrated management vis a vis vision statement (financial incentives, regulations, who pays);
- balancing economic benefits and needs with ecological needs (phasing, alternatives, continuity of economic benefits, social impact);
- addressing the details through design and implementation.

Each of those major issue areas has been addressed in the following policy statements. For industrial relocation, dredging and Band land issues, several alternatives have been proposed for consideration by the Management Committee. For purposes of cost comparison, a minor cost is assumed to be less than \$100,000, a moderate cost is assumed to be between \$100,000 and \$500,000, and a major cost is assumed to be greater than \$500,000.

a. Industrial relocation

It is essential that industry feel comfortable with any proposed relocation plan. Timing and costs are of critical importance. Industry has indicated that it requires as much time as possible to formulate a relocation strategy that will have minimal cost implications. At the same time, the requirement to restore the estuary remains as a prime principle. Therefore, the following policy is proposed:

a.1: allow for the development of a viable relocation plan and for security of relocation funding and employment, provide heavy industry with a reasonable time frame for relocation: Cost implication reduces cost to industry and government.

b. Dredging

There are three alternatives that might be possible. They are:

Alternative one: allow natural forces to prevail so that navigable water access becomes increasingly dependent upon tides: Cost implication major increased operational cost to industry.

Alternative two: maintain existing industrial activity in the estuary over the immediate term by implementing the proposed dredging project on a one time only basis: Cost implication moderate increased capital cost to government and major decreased operational cost to industry.

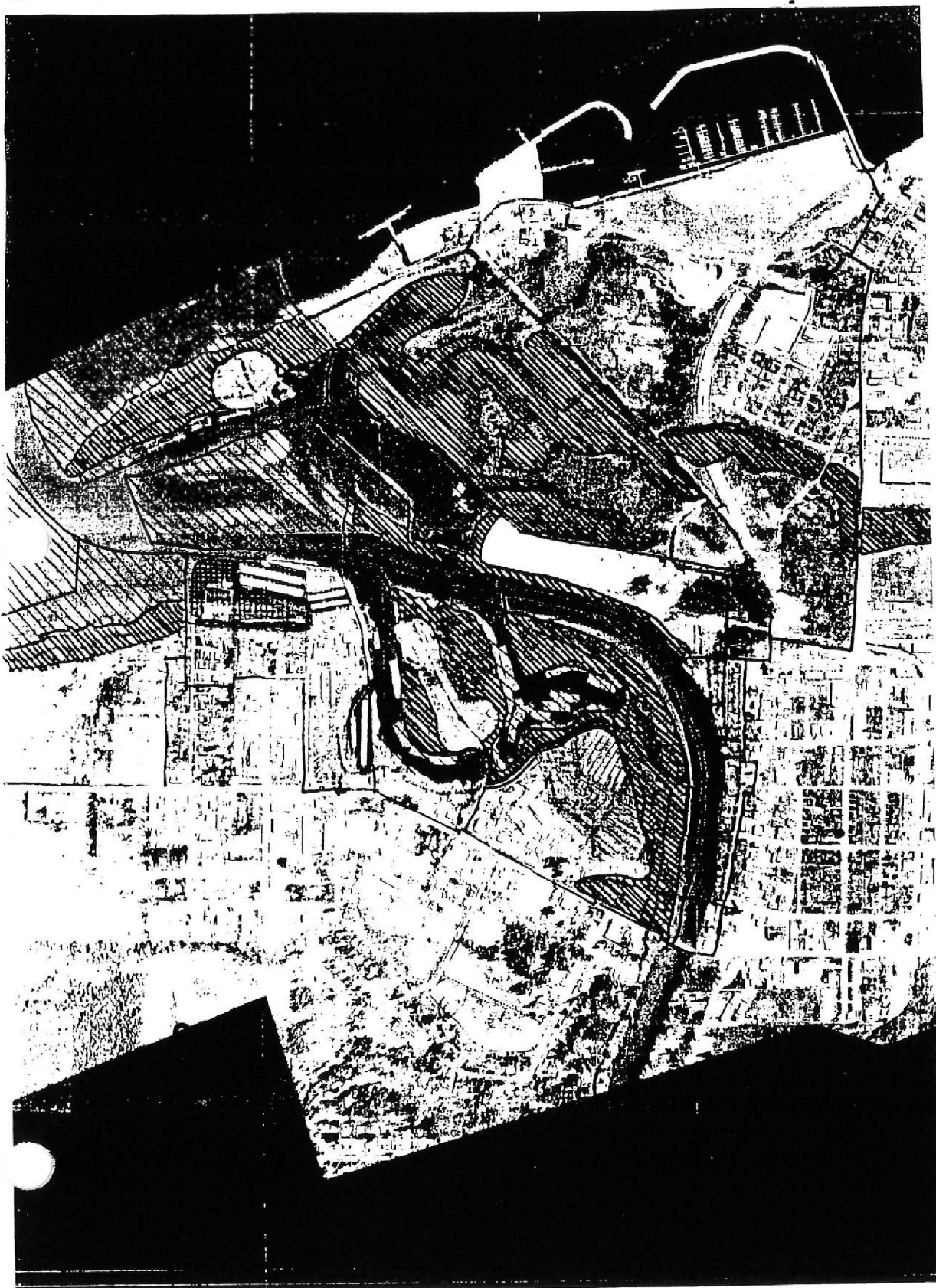
Alternative three: undertake on-going dredging.

Dredging has been proposed by the Coast Guard. On-going dredging is rejected due to widespread public opposition to on-going dredging and the cumulative effects of dredging and associated implications of on-going dredging decreasing the likelihood of relocating industry over the long term. No dredging would threaten the viability of industry and possibly force it to shut down. That alternative is not acceptable given the planning principles and socio-economic implications of such an effect. One time dredging appears to be a reasonable option that provides industry with a fixed time horizon while minimizing environmental impacts. Therefore, alternative two is proposed as the dredging policy:

b.1 maintain existing industrial activity in the estuary over the immediate term by implementing the proposed dredging project on a one time only basis: Cost implication moderate increased capital cost to government and major decreased operational cost to industry.

c. Band land

The Campbell River Band has identified that it must have more development land to accommodate the housing and economic needs of its members. It has also indicated that, while it is willing to do its share to protect the estuary, it will not sacrifice its authority to manage its lands. Therefore, all three policies seem appropriate to guide the work of the Management Committee in terms of recognizing the interests of the Campbell River Band.



- ☐ Management Area
- ☐ Boundary
- ☐ Green Space
- ☐ Walkway Access
- ☐ Redevelopment Area
- ☐ Marina
- ☐ Aquatic Habitat
- ☐ Aquatic Linkage

Prepared by:
Vancouver Coastal University
Campbell River, B.C.



1:5000

Campbell River Estuary Management Plan

The three policies are:

c.1 encourage a dialogue between the Management Committee, the District and Band to identify the needs of each party and to achieve the broad principles identified in the Management Plan and the requirements of the Band: Cost implication minor over the short term.

c.2 encourage a dialogue between the Band, the Province, the Federal Government, and the District to identify potential alternative Band residential areas that are located away from the estuary: Cost implication minor over the short term.

c.3 encourage a dialogue between the Band, the Province, the Federal Government, the District and TimberWest to identify measures that would facilitate Band purchase of the dryland sort for residential development: Cost implication moderate to major to government and major to the Band.

d. Identifying the interface between development and restoration lands

d.1 adopt a policy of net habitat gain within the study area for a combination of estuarine and adjacent upland: Cost implication moderate to major.

d.2 encourage public access to the waterfront (where alignments are along the waterfront, they are to be chosen with respect for estuarine habitat functions): Cost implication moderate.

d.3 require future habitable development be flood-proofed as per existing requirements: Cost implication major.

e. Economic impacts

e.1 encourage development and management programmes that minimize net employment loss and social dislocation over the short and long term: Cost implication planning costs minor and implementation costs unknown.

The Management Committee reviewed these policies and modified them. The development of the two intervention alternatives was based upon and informed by these policy considerations.

10.3 Moderate intervention (concept 1)

The moderate intervention alternative has as its primary focus full estuary restoration while recognizing that some intervention initiatives need to be modified to provide industry with viable relocation options.

The moderate intervention alternative has five primary areas of focus: the Campbell River Mill site; Tyee Spit; Freshwater marina area; dryland sort and reserve lands; north to Painters Lodge area.

10.3.1 Campbell River Mill site

Approximately 16.5 hectares (40 acres) is proposed for redevelopment into moderate density mixed use residential. The largest area proposed for redevelopment (12 hectares) is on the existing footprint of the Campbell River Mill. A smaller area (4.5 hectares) of redevelopment is proposed on the island where wood products are stored and Algoma Cedar Shake operates. Another smaller area where Ocean Cedar operates is also proposed for redevelopment.

Along the southern portion of the site, natural habitat restoration is proposed. Here, channelization to encourage historic stream flows and protective cover are recommended.

10.3.2 Tyee Spit

The spit is proposed for major redevelopment in 10 years when the existing leases expire under a District/leasee agreement. The spit would be returned to a natural state, including the planting of native plant material that is indigenous to such sites. Complementary interpretive facilities would be provided.

A central float plane base would be developed by the float plane operators. That redevelopment would centralize fuel storage, minor on-site repairs and passenger terminal.

10.3.3 Freshwater marina area

The Freshwater marina area refers to a varied land base with a number of different owners. This area would be largely redeveloped on the land side into mixed use residential and commercial development serving on-site residents and visitors to the area. The existing marina sites would be retained or modified to provide centralized boating storage to the new residents of the area.

10.3.4 Dryland sort and Reserve lands

This area has few options. The dryland sort is currently zoned for medium density residential (12 units/acre). The Reserve falls under the jurisdiction of the Campbell River Indian Band. Within the Reserve, lands shown as open space are those that generally fall below the tidal influence and would not be suitable for development. Above those areas, the Band will have considerable say in what development might take place and how that development would be framed.

10.3.5 North to Painters Lodge area

The area north to Painters Lodge is proposed for on-going semi-rural development with a green buffer along the shoreline that would enhance the existing open space corridor. The ALR would be protected in this scenario.

10.3.6 Summary

The moderate intervention alternative provides an opportunity to achieve:

- ◆ full restoration of the estuary;
- ◆ relocation of industry out of the estuary;
- ◆ a partnership of public and private financial investment to achieve planning principles;
- ◆ moderate dedication to park and open space; and
- ◆ encouragement of selected upland residential development to offset industrial relocation costs.

10.4 Maximum intervention (concept 2)

The maximum intervention alternative has as its primary focus full estuary restoration in association with significant open space dedication.

The moderate intervention alternative has six primary areas of focus: the Campbell River Mill site; Tyee Spit; Freshwater marina area; dryland sort; reserve lands; and north to Painters Lodge area.

10.4.1 Campbell River Mill site

Approximately hectares is proposed for redevelopment into moderate density mixed use residential. The largest area (hectares) proposed for redevelopment is on the existing footprint of the Campbell River Mill. No redevelopment is proposed in this alternative for the Island formed by Baikie's slough or the area where Ocean Cedar operates.

10.4.2 Tyee Spit

The spit is proposed for major redevelopment in 10 years when the existing leases expire under a District/leasee agreement. The spit would be returned to a natural state, including the planting of native plant material that is indigenous to such sites. Complementary interpretive facilities would be provided.

A small central float plane base would be developed by the float plane operators. That operation would centralize fuel storage, minor on-site repairs and passenger terminal.

10.4.3 Freshwater marina area

The Freshwater marina area refers to a varied land base with a number of different owners. This area would be largely redeveloped on the land side into mixed use residential and commercial development serving on-site residents and visitors to the area. One of the existing marina sites, nearest Discovery Passage, would be retained to provide centralized boating storage to the new residents of the area.

Campbell River Estuary Management Plan

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- ☐ Management Area
- ☐ Boundary
- ☐ Green Space
- ☐ Walkway Access
- ☐ Redevelopment Area
- ☐ Marine
- ☐ Aquatic Habitat
- ☐ Aquatic Linkage

Prepared by:
with planning to a limited
limited consultation

Maxi
Intervention
native

10.4.4 Dryland sort

This area has few options. The dryland sort is currently zoned for medium density residential (12 units/acre). This alternative suggests that the Highway Commercial property adjacent to Highway 19 be rezoned as parkland.

10.4.5 Reserve lands

Although the Reserve falls under the jurisdiction of the Campbell River Indian Band, this alternative suggests that the Reserve between Spit Road and the foreshore be dedicated as open space to protect the remaining natural portion of the estuary.

10.4.6 North to Painters Lodge area

The area north to Painters Lodge is proposed for on-going semi-rural development with a green buffer along the shoreline that would enhance the existing open space corridor. The ALR would be protected in this scenario.

10.4.7 Summary

The maximum intervention alternative provides an opportunity to achieve:

- ♦ full restoration of the estuary;
- ♦ relocation of industry out of the estuary;
- ♦ major public and moderate private financial investment to achieve planning principles;
- ♦ major dedication to park and open space; and
- ♦ less dedication of upland to residential development .

The maximum intervention alternative also places major restrictions upon the Campbell River Band and the industrial private lands.

Both alternatives will be evaluated in the next section to determine the alternative most appropriate for implementation (and modification).

10.5 Evaluation of the alternatives

The following reviews the key variables which determine the preference for one alternative over another.

10.5.1 Relationship to planning principles

Each of the two alternatives has been evaluated to determine the extent to which it addresses the planning principles adopted for the management plan. This section reviews that relationship.

<i>Planning principle</i>	<i>Moderate Intervention Alternative</i>	<i>Maximum Intervention Alternative</i>	<i>Comments</i>
promote long term benefits to the natural environment	major fulfillment	major fulfillment	both alternatives achieve this principle
recognize the long-term socio-economic needs of the community as it relates to land use decisions in the Estuary	major fulfillment	moderate fulfillment	the moderate alternative best addresses this principle
be founded on inherent biophysical capabilities of the estuary	addresses the biophysical element fully	addresses the biophysical element fully	both alternatives achieve this principle
improve and increase the effectiveness and efficiency of long and short term decision making by regulatory agencies	major fulfillment	major fulfillment	both alternatives achieve this principle
dynamic rather than defining an end state	major fulfillment	major fulfillment	both alternatives achieve this principle
incorporate sustainability principles	major fulfillment	major fulfillment	both alternatives achieve this principle

Both alternatives appear to fulfill most of the planning principles, although the moderate alternative addresses socio-economic needs of industry more fully.

10.5.2 Relationship to proposed policies

While both alternatives have been developed to address the proposed policies, the moderate intervention alternative best achieves the proposed identified policies, particularly policies c.1 and e.1.

10.5.3 Determination of Costs

Costs to implement each of the two alternatives have been estimated in a very general way. Nevertheless, the order of magnitude projection of costs indicates that the moderate intervention alternative will be less costly to achieve because it requires less public intervention and less private sacrifice to achieve the overall planning principles.

10.5.4 Biological considerations

Both alternatives have been based upon optimization of biological considerations. Therefore, each alternative equally addresses this requirement.

10.5.5 Public feedback

At the October 25th open house held to review the two alternatives, public reaction was generally more favourable toward the moderate intervention alternative. For instance, of the total (40) who indicated a preference for an alternative, 58% preferred the moderate intervention alternative.

10.6 Preferred alternative

The foregoing suggests that the moderate intervention alternative is generally more acceptable in terms of: (a) recognizing the importance of balancing environmental concerns with socio-economic concerns, (b) addressing the sensitivity of Band lands and private development rights, (c) minimizing development costs, and (d) addressing public feedback. In addition, while both alternatives place considerable value on biological considerations, the moderate intervention alternative is able to achieve both biological well-being and an overall socio-economic balance. Therefore, the moderate intervention alternative is proposed for implementation.

The preferred plan (moderate intervention alternative) was modified following the public open house. Two minor modifications were identified: a slight increase in the developable area at Baikie's slough and adjacent to the highway right-of-way; and a firmed-up greenway linkage along the north of Baikie's slough toward Perkin's Road. The slightly modified version of the moderate intervention alternative was adopted on November 14th by the Management Committee.

APPENDIX 1: Interim Report

INTERIM REPORT # 1

Campbell River Estuary Management Plan

Prepared for
Campbell River Estuary Management Committee

Prepared by
Witty Planning Consultants Ltd.

August 8, 1995

Campbell River Estuary Management Plan

***Interim Report #1:
Community Open House, Interviews and
Summary of Existing Information***

Witty Planning Consultants Ltd., August 1995

TABLE of CONTENTS

	Page
1.0 Introduction	
1.1 The Campbell River Estuary Management Plan	1
1.2 First Interim Report	2
2.0 Results of the Campbell River Estuary Management Plan Open House	
2.1 Open House Format	3
2.2 Open House Comments	3
2.3 Open House Overlay Notations	4
2.4 Open House Questionnaire Responses	5
2.5 Implications	8
3.0 Steering Committee Issues	
3.1 The CREMP Steering Committee	9
3.2 Issues Identified by the Steering Committee	9
3.3 Implications	10
4.0 Interest Group Interviews	
4.1 Estuary Interest Groups	11
4.2 Issues Identified by Interest Groups	11
4.3 Implications	14
5.0 Summary of Campbell River Estuary Studies: District of Campbell River	
5.1 Cross-reference of Study Recommendations	15
5.2 Annotated Bibliography	15
5.3 Implications	15
6.0 Summary of Campbell River Estuary Studies: Department of Fisheries and Oceans	
6.1 Discussion of DFO Scientific Findings	17
6.2 Annotated Bibliography	1
	7
6.3 Implications	18
7.0 Conclusion	18
List of Appendices	ii

LIST of APPENDICES

	PAGE
Appendix A Terms of Reference	19
Appendix B Management Plan Timeline	22
Appendix C Management Plan Process	23
Appendix D Estuary Questionnaire	24
Appendix E Estuary Steering Committee	26
Appendix F Cross-Reference of Planning Studies	27
Appendix G Bibliography: Estuary Planning Studies	30
Appendix H Bibliography: Estuary Fisheries Studies	36

1.0 INTRODUCTION

This is the first interim report concerning the development of the Campbell River Estuary Management Plan. Following is an introduction to the plan and plan process, as well as an outline of this report. The final report is due for completion in October 1995.

1.1 The Campbell River Estuary Management Plan (CREMP)

Over the years, the Campbell River estuary has been the subject of much study in ecological, social and economic terms. A recurring theme has been the need to relocate industrial uses from the estuary (at such time as economically feasible alternative sites became available) as an initial step toward its rehabilitation. This objective has never been realized.

The most recent study of the estuary has served as a catalyst for the Campbell River Estuary Management Plan. A Canadian Coast Guard dredging analysis outlined the economic benefits which would accrue to industrial users of the estuary by improving access through channel deepening. A steering committee of stakeholders making decisions affecting land use and foreshore leases in and around the estuary was struck to determine if the proposed dredging was indeed the desired course of action for the estuary. The committee agreed to develop a management plan which would serve as a consensus document for decision-making regarding land and water use in and around the estuary.

The long range purpose of the plan is the restoration of the Campbell River estuary to a condition of ecological sustainability (Appendix A - Terms of Reference). The principles underlying the plan include maintaining the social and economic vitality of the study area within the larger framework of estuary restoration. The study area, in general terms, includes lands within the designated flood plain of the Campbell River. The timeframe for plan development is June through October 1995 (Appendix B - Plan Timeline). The major contributors to plan development will be: the citizens of Campbell River, groups with a specific interest in the estuary, the estuary steering committee, and the substantial body of accumulated knowledge concerning the estuary.

The management plan process (Appendix C - Plan Process) outlines four main stages of plan development. In the first stage, information from the public, interest groups, steering committee and existing documentation is gathered and analyzed. In stage two, articulation of estuary issues and options leads to an overall vision for the estuary which then becomes the basis for preparation of policy options. In stage three, the vision and policy options are developed into three substantively different management scenarios which present the community with real choices concerning the future of the estuary. In the final stage, the preferred management option is identified and refined along with recommendations for action and implementation.

A successful management plan must be actionable while moving the community toward its goals for the estuary.

1.2 First Interim Report

This first interim report focuses on stage one of the plan development process, that is, on information collection from the community and summary of existing documentation. The report is divided into sections representing differing types of information inputs to the planning process.

Findings from the community open house, held on July 8th-9th on Tyee Spit adjacent the estuary, are reported in Section 2. Generally, findings of earlier planning studies concerning the community's desire to rehabilitate the estuary and enhance public access to the area have been confirmed. Specifically, the questionnaire (Appendix D - Estuary Questionnaire) confirms that it is the natural and ecological aspects of the estuary which the community enjoys and wishes to preserve, and that industrial activity and water pollution are perceived as the greatest threats to those wishes. The large majority feel the estuary is worth saving and that immediate and concerted public and private action will be required to do so. Many issues were raised and suggestions made; all are duly noted.

Issues as identified by the steering committee (Appendix E - Estuary Steering Committee) are presented in Section 3. These can be characterized as both reflective of the organizational mandates which the individuals represent and as constructive, solution-seeking perspectives on the difficulties facing any estuary rehabilitation effort. Interviews with interest groups, framed in terms of issues, can be found in Section 4.

The final two sections summarize existing information concerning the estuary. In Section 5, recommendations from past planning studies of the Campbell River estuary are cross-referenced in tabular format (Appendix F - Cross-reference of Planning Studies) for purposes of comparison. These are also described in an annotated bibliography of estuary planning studies (Appendix G - Bibliography: Planning Studies). A summary discussion of DFO scientific findings concerning the estuary is found in Section 6. An annotated bibliography of scientific references from the Department of Fisheries and Oceans regarding the Campbell River estuary is also provided (Appendix H - Bibliography: Fisheries Studies).

2.0 RESULTS of the CAMPBELL RIVER ESTUARY MANAGEMENT PLAN OPEN HOUSE (JULY 8th-9th, 1995)

A community open house was conducted on-site at the estuary in order to both familiarize the public with the issues and facilitate their input to the management plan at the earliest possible stage in the process. The open house format, results and implications are discussed below.

2.1 Open House Format

The Campbell River Estuary Management Plan open house was conducted over two days (Saturday and Sunday, July 8th and 9th, 1995, 10:00am - 4:00pm) on a site adjacent to the estuary itself. Notification of the Open House was provided in several editions of two local newspapers in the two weeks preceding the event. The exhibit included display sheets outlining the purpose of the plan, the major components of plan input, a detailed outline of the plan process, and the purpose of the open house as well as composite air photos of the study area. Sixty-five participants spent an average of 1/2 to 1 hour at the exhibit and demonstrated a great deal of interest in the future of the estuary. Boat tours of the estuary were provided by staff from the Quinsam River Hatchery, Department of Fisheries and Oceans.

Participants were able to provide input to the Plan process through a variety of means including a general comment sheet, drawing on acetate overlays (underlain by composite air photo) of the study area, and exit questionnaires. The overlays and comment sheet were cumulative documents on display for the duration of the open house, while the questionnaire could be completed anonymously. The many issues raised and suggestions made are listed below.

2.2 Open House Comments

Participants of the open house were asked to provide comments regarding their concerns, ideas and preferred future for the Campbell River estuary. Comments from the Campbell River Estuary open house are provided below.

Estuary Ideas...

- build trails into estuary
- use new bridge construction as opportunity to clean up along river
- keep float plane base (2)
- remove floatplane/helicopter base from spit
- restore salmon stream near bridge
- dig out causeway between booming pocket and river and replace with footbridge
- prevent long term moorage in booming pocket
- make allowance for archaeological sites
- consider broader impacts/implications upon fishery (estuary restoration a partial solution)
- establish awareness of marine pollution and recycling depot for pollutants (2)

- discontinue barge use of spit
- protect watershed... implement 1991 hydrology study
- identify office/person to notify when witness surface pollution
- prepare awareness/information package for educators
- instill public awareness of, sense of responsibility for estuary
- check on Westminster Bonding
- create non-recreational wildlife refuge
- clean up wood and toxic sediment "souring" estuary bottom

Estuary Concerns...

- industrial pollution; floathouse pollution
- plane maintenance (ie. oil/fuel spills)
- upstream pollutants more of a concern than local pollutants
- potential for native land development on grasslands
- storm water runoff (2)
- disruption of salmon habitat by highway by-pass
- effect of planes and boats on estuary (ie. spills; anti fouling)
- log handling area (2)
- lack of policing and enforcement

2.3 Open House Overlay Notations

Participants of the open house were asked to sketch on two separate overlays those features likely to (1) contribute to or (2) inhibit the long term overall goal of restoration of the Campbell River estuary. Descriptions of study area overlay notations from the Campbell River Estuary Management Plan open house are provided below.

Contributing Features...

- archaeological site (Indian weir) off the tip of Tyee Spit
- maintain floatplane base on Tyee Spit (2)
- archaeological site on Baikie Island
- bird habitat on artificial islands
- waterfowl and fish habitat on artificial islands (2), booming pocket spit, Nunn's Creek, Baikie Island, north bank of river bend, and Indian Reserve lands
- Nunn's Creek important as habitat area (2)
- rare plants at base of Tyee Spit south of Spit Road
- Dryland Sort area in its former use as an active recreation area/park
- habitat complexity of flats at mouth of Campbell River
- increase water flows to booming pocket; dig out causeway between pocket and river
- complete high water mark surveys
- create 30 metre setbacks/walkways along river/estuary embankments
- control erosion undercutting south bank at Dryland Sort
- create fish friendly cover along south bank of river bend
- move industry back from the river/estuary
- move businesses along south side of highway (east of bridge) to another location
- have Ministry of Highways help pay for a natural spawning channel beginning under old bridge and going through parkland adjacent Campbell River Mills

Inhibiting Features...

- stormwater runoff/drainage entering river/estuary (2)
- sewage outfall at Orange Point (should be extended)
- sewage outfall at Orange Point (should be relocated) (2)
- trailer parks on Tyee Spit (should be removed)
- floatplane and helicopter bases on Tyee Spit
- barging and aquaculture on Tyee Spit
- barging and floats in booming pocket (should be removed) (2)
- remove boat repair adjacent marina
- check soils at boat repair adjacent marina
- marinas on estuary and in Baikie Slough (should be removed)
- storage area along Baikie Slough at Freshwater Marina
- wood debris and contaminated sediment in Baikie Slough (should be monitored and cleaned up)
- log handling, storage, milling on Baikie Slough (should be removed) (2)
- logs for mills on Baikie Slough should be trucked in and dryland sorted (4)
- upstream pollution from Westmin
- barging operations on Baikie Slough (should remove and clean up)
- erosion of south bank of river at river bend
- potential for noise conflict between any residential development on Dryland Sort and the floatplane and helicopter bases
- check fuel tanks and toilet outflows at Freshwater Marina
- multiple unit residential or commercial development on Dryland Sort area
- plugged culvert between river and booming pocket
- business along south bank of river at river bend (should be removed)
- lack of high water mark surveys
- drainage flaps along Spit Road draining area to south of road

2.4 Open House Questionnaire Responses

Participants of the open house were asked to fill out a questionnaire (Appendix D - Estuary Questionnaire) designed to determine valued features within the estuary, key issues detrimentally affecting the estuary, the importance of the estuary resource to the local community, the perceived need for remedial action, and the desire for an organized response to estuary issues. A summary of questionnaire responses from the Campbell River Estuary Management Plan open house is provided below.

Table 2.1 Question 1: What are the things you enjoy most about the estuary?

response grouping	responses	% of resp.
birds/ wildlife/ waterfowl/ fish	18	64
plant species/ vegetation	10	35
birds/ wildlife/ waterfowl/ fish habitat	9	32
natural beauty/ tranquility/ viewing	9	32

Table 2.2 Question 2: What things should be protected in the estuary?

response grouping	responses	% of resp.
ecology/ habitat/ whole estuary	16	57
water quality	11	39
birds/ wildlife/ waterfowl/ fish	8	28
plant species/ vegetation	6	21

Table 2.3 Question 3: What do you believe are the key issues detrimentally affecting the estuary?

response grouping	responses	% of resp.
industrial development/ activities	17	61
water flow manipulation/ erosion	7	25
industrial pollution	7	25
log handling in estuary	6	21

Table 2.4 Question 4: Do you believe the estuary is: (please check only one)

response option	responses	% of resp.
one of Campbell River's most important natural resources	23	82
a fairly important natural resource	3	11
not an important natural resource	0	0
no response	2	7

Table 2.5 Question 5: Do you believe that the estuary: (check as many as needed)

response option	responses	% of resp.
is under serious threat, or	20	71
is not under serious threat	2	7
no response	6	21
requires immediate attention to protect it, or	23	82
does not require immediate attention to protect it	1	4
no response	4	14
should be saved, or	23	82
is not worth saving	0	0
no response	5	18

response option (Table 2.5 cont'd)	responses	% of resp.
requires a concerted public and private action plan, or	24	86
should be left to evolve on its own	0	0
no response	4	14
can be properly managed, or	24	86
can not be properly managed	0	0
no response	4	14

Question 6: Any other thoughts? (responses listed)

- plan requires to balance required economic base with natural uses - alternatives to using the estuary need to be found
- allowing sewage effluent to be dumped into the mouth of the estuary negates most efforts to rehabilitate
- concerned about runoff from pavement surfaces with respect to the new highway - ie. runoff from below proposed catchment ponds
- identification of archaeological sites
- restoration of old swimming hole
- horses and dogs banned
- preserve deltoid balsam root through transplant from Native commercial development area
- upgrading and landscaping of seaplane base
- possibility of sewage from outfall getting into estuary
- removal of helicopter base
- concerned about the impact on the estuary and fish rearing areas from the proposed outfall at the end of MacDonald Road
- the estuary should become a model for restoration and maintenance for fish and wildlife habitat
- film the whole process for future teaching
- low impact users which do not effect the natural habitat in a detrimental way could stay (ie. seaplanes)
- an education program focusing on the ecological and historical importance of the estuary including information packages, videos or films, field trip opportunities, resource personnel etc. should be assembled for use in local schools
- promote estuary as a point of interest for tourists
- heavy metals from Westmin mine are a very long lasting threat to water quality... as this threat will outlive the life of the mine, arrangements are needed to control this problem into the future
- any plans for condominiums on the Timberwest property should be dropped... the area should be naturalized or made into playing fields and a park trail
- need to protect creeks and area around the estuary... they are almost as important as the estuary itself
- areas feeding the estuary also need attention... large developments along the estuary should be avoided
- "heavy industry" is not compatible with the estuary and should be removed a.s.a.p.
- estuary and surrounding areas should be preserved and protected for the people to

- enjoy - not just a limited few - a wholehearted endorsement for restoration
- as an operator on the spit I believe that each operation should be looked at on an individual basis to determine if they should be allowed to stay
- need for trails
- don't turn whole area into a park with only walking access
- build a natural spawning channel under the Highway Bridge and through the park
- erect a predator control fence around the park area to enhance wildlife
- clean up Nunns Creek
- my fear is too much management - we can't even manage ourselves

2.5 Implications

Judging by the numbers of participants, the average length of time spent at the exhibit, and the quality of information and suggestions received, the open house should serve as a good reference point for community concerns about, and aspirations for, the Campbell River estuary. The questionnaire confirms that it is the natural and ecological aspects of the estuary which the community enjoys and wishes to preserve, and that industrial activity and water pollution are perceived as the greatest threats to those wishes. The estuary is valued as one of Campbell River's most important natural resources, and at the same time is considered to be seriously threatened. The large majority feel the estuary is worth saving and requires immediate attention in order to protect it. It is generally agreed that estuary restoration will require concerted public and private action, and that the estuary can be properly managed as a natural and community resource.

Two general findings from previous planning studies are confirmed: (1) the community wants the estuary rehabilitated in order to restore and enhance its function as fish and wildlife habitat - as an ecosystem - and (2) the community would like to enhance access to the estuary for the purposes of public enjoyment. Certainly, the community of Campbell River is knowledgeable and opinionated about the estuary to a degree that is both laudable and reassuring.

3.0 STEERING COMMITTEE ISSUES

The estuary Steering committee was struck in order to guide the development of the Campbell River Estuary Management Plan toward the long term restoration of the estuary. The purpose and composition of the committee, as well as estuary issues identified by the committee, are presented below.

3.1 The CREMP Steering Committee

The steering committee for the Campbell River Estuary Management Plan was formed for the purpose of developing a consensus planning document which would guide and co-ordinate future land and water use decisions concerning the estuary area. The steering committee is comprised of representatives from the Department of Fisheries and Oceans (habitat and enhancement), the Ministry of Lands, BC Hydro, the Fisheries Coalition, the Ministry of Environment, the Coast Guard, the District of Campbell River, and representatives for both business and public interest groups (Appendix E - Estuary Steering Committee).

3.2 Issues Identified by the Steering Committee

Issues surrounding the development of the Campbell Estuary Management Plan as identified by the committee in its meeting of June 20, 1995, read as follows:

- need for balancing of dollar values between economic and environmental concerns
- critical to have Ministry of Lands and Environment (Water Management Division) at table for purposes of buy-in/commitment so that process isn't scuttled in end
- quantitative versus qualitative data gathering and analysis... have to watch for tendency to rely too heavily on quantitative analysis as it lends itself to economic benefits while ecological/public benefits tend to be expressed in qualitative terms
- need to detail management system and enforcement measures to make plan effective... how to implement
- water quality is of primary importance to the protection of the sport fishing industry
- need to identify the long term benefits of returning the estuary and spit to a natural state
- need to identify the real conflicts of use (as opposed to perceived)
- wildlife must be represented as well as fish
- the time frame for plan development (proposed October completion) is critical as management decisions (ie. dredging) are pressing
- need to develop alternatives for industry/commerce to continue to operate but in different capacities
- restoration of the estuary is the overarching goal
- operating/management issues... are operating procedures up to date and sensitive to the area
- need to be aware that community views likely to have emotional underpinnings
- need to accurately define the floodplain
- what is the carrying capacity of the estuary?... must identify bottlenecks (ie. vulnerable ecosystem elements) to ensure fisheries component survives

- plan must address a changing world (ie. be flexible enough to allow for adaptation)
- support/non-support for proposed sewer outfall and treatment plant location

3.3 Implications

Issues raised by the steering committee suggest achievement of a consensus planning document for the estuary will involve substantial compromise on the part of the competing land use interests. The overall goal of estuary restoration does not appear to be in question. Grey areas tend to centre upon the level of industrial and commercial activity the estuary can tolerate, determining the relative value to the community of ecological and economic benefits, how companies can reduce impacts upon the estuary in the short to medium term, and whether industrial access to the estuary should actually be enhanced. There seems to be agreement on the long term goal of relocating industry from the estuary, although not before viable alternate sites become available or a given business becomes non-viable.

4.0 INTEREST GROUP INTERVIEWS

Interviews were conducted with those interest groups with a direct interest in the Campbell River estuary. Interest groups are identified below and interviews are then framed in terms of issues and their implications with respect to the management plan.

4.1 Estuary Interest Groups

Meetings were held with four groups who have displayed a direct interest in the estuary. Those groups were: Campbell River Estuary and Watershed Society, Campbell River Band, industrial users (Freshwater Marina, Anglo American [Ocean Cedar], Campbell River Mills, Quinsam Marina, and Algoma Shake and Shingle), and Tyee Spit businesses (Marine Link, Holiday Shores RV Park, Canadian Helicopters, Silver King Lodge, Coval Air, and Vancouver Island Air). Discussions with each group focused upon its primary interests in the estuary, issues and concerns about the estuary and thoughts about the long term management of the estuary.

4.2 Issues Identified by Interest Groups

The following summarizes the interest group meetings.

4.2.1 Campbell River Estuary and Management Society (Catherine Painter; note Joe Painter attended as an interested party)

Background...

- small group now, but represents whole community and variety of interests (25 years in existence), was involved in Spit acquisition

Interests/ideas...

- dryland sort should be a new location for the floatplane base (with terminal building)
- would like to see Campbell River Mills move out; don't want marine highway because the estuary is too sensitive
- need better log loading facility such as crane; stop loaders from entering water
- turn Spit back into natural environment with wild plants for fish watching/educational location as per Rebecca's Spit on Quadra
- move industrial before they invest in new development; provide supporting zoning at Middle Point for relocation
- Tyee don't hold in old dry land sort site due to lack of flow exchange
- don't allow anymore boats or industrial users
- need a watchdog to monitor estuary uses
- move helicopters to industrial park
- "health of river is the most important thing followed by aesthetics"

Concerns...

- oppose dredging; dredging would increase bottom erosion by disturbing conglomerate; the narrow passageway at mouth acts as a dam holding back river

flow

- don't want marine highway because the estuary is too sensitive
- potential for conflict between residential and float planes

4.2.2 Campbell River Band (Robert Duncan)

Background...

- Band growing rapidly, but little room left to grow (a housing demand list of 40 exists)
- Band records show that Spit and land down to river were once Band land (i.e. including the dry land sort); records show those lands sold for \$12,000 in 1922
- Band currently contesting two land allotments before courts and may then have enough land to permit development
- have completed studies of estuary (biophysical and engineering) which confirm some land can be developed

Interests/ideas...

- require land to expand for housing
- desire to acquire the Timber West dry land sort
- want equal opportunity for economic development
- some interest in doing cultural activity on Spit

Concerns...

- upland water along Nunn's Creek has flooded reserve lands
- Timber West lands may go to developer (has put out calls?)
- may have to develop estuary area for housing

4.2.3 Industrial users (as noted above)

Background...

- many of these users have been in estuary for a number of years (some over 30 years)
- all users dependent on access to the ocean
- hauling would add 15% to costs and make operations unprofitable
- Campbell River Mills uses 500,000 cu. m. /yr. (50% boomed in) (175,000 cu. m./yr. of boomed wood consumed on site) and booming out wood (150,000 cu. m. /yr.) for trade on the market
- trucking wood adds \$6/cu.m
- store in water due to insect problems
- little bark comes out in water
- indicate that they have been undertaking enhancement of areas (e.g. Algoma has been planting trees and grass)

Interests/ideas...

- estuary a sensitive area
- expressed desire to work with Management Committee and clean-up operations
- strongly favour dredging and believe that dredging will not affect fishery
- suggestion of placing dredge spoil in an artificial island
- possibility of modifying operational practices (hard top apron, lacurno ramp)

- dredge regularly to remove residue bark
- want to co-exist and support plan but must recognize the users

Concerns...

- believe that much of depositional material from BC Hydro operation (i.e. higher flows have caused bank erosion upstream
- bank erosion a problem at old dry land sort
- past road and urban development has filled-in much of natural estuary creating loss of habitat
- freshwater numbers down by 50% because of new marina and inability of clients accessing big water when they want (impact on tourism)
- Ocean Cedar has no dry land storage capability and needs large storage area because of need to use mix of wood
- if go to truck in/out, would add significant truck volume to local area
- log boom area near Campbell River Mills was never a fish production area
- Campbell River has made booms as small as possible to mitigate low water
- both marinas are losing significant business due to lack of access to deep water
- rules for foreshore uses are not well known
- dangerous condition exists as 2/3's of boats work on sandbar

4.2.4 Tyee Spit businesses

Background...

- variety of businesses who appear to have considerable inter linkage
- all are in discussions with District concerning relocation/termination of leases
- have seen an increase in number of species after booming moved
- estuary considered to be one of most important harbours on east coast of Vancouver Island
- the trailer park has seen some users move to permanent summer accommodation in Campbell River
- estuary very important part of marine (air/water) highway along coast from Gervis Inlet to Prince Rupert
- approximately 50% of all air traffic through Spit (50,000/yr.)
- many of the businesses see themselves as "life lines" to coastal industry and communities

Interests/ideas....

- need for maintenance dredging along floats
- shallow dredging should be considered (i.e. 12" vs. 30' of dredge quite different)
- develop walkways along Spit Road for interpretive purposes
- need for more than fishing and should build onto new opportunities (i.e. diversify)
- need recognition that are responsible citizens
- helicopters and float planes are an interest for tourists
- consolidate businesses and public use in long term
- consider dredging along west shoreline between Painters and Dolphins
- build a vision of diversified activities as a show piece of cooperation and co-existence
- need time to conform or relocate
- need rule and regs and if can't meet then relocate

Concerns...

- recent gravel placement between dam and estuary and potential for runoff that will carry gravel downstream and increase sedimentation
- for some operators, if no dredging will have to move operations
- estuary is an ever-changing natural process and hard to monitor or predict
- Spit banks are eroding and building up in different patterns from past
- important to have interests acknowledged and recognize that an important business district
- need to know length of leases and give fair warning for plans
- since operations day-by-day operation and banking affected
- decreasing investment
- several businesses may fold if forced off Spit (e.g. Canadian Helicopters and Trailer Park)
- airport restrictions will limit helicopter operation ability
- if businesses leave Spit may migrate north and leave Campbell River

4.3 Implications

There exists a significant difference of opinion between those groups who rely upon the estuary for their industrial purposes or other business purposes and those who rely upon the estuary for sport fishing or environmental enjoyment. Yet, there is considerable commonality of view about the importance of the estuary and the need to protect it.

Given the range of views, it will be a major challenge to build a coalition of common interests around the management plan.

5.0 SUMMARY of EXISTING CAMPBELL RIVER ESTUARY PLANNING STUDIES

A number of planning studies has been undertaken by various agencies within the region and district of Campbell River pertaining, in whole or part, to the Campbell River estuary. Recommendations of these studies pertaining to the estuary are cross-referenced below. Also provided is a brief description of an annotated bibliography of planning studies pertaining to the Campbell River estuary.

5.1 Cross-Reference of Study Recommendations

A cross-reference of past estuary planning study recommendations over the years (Appendix F - Cross-reference of Planning Studies) reveals an interesting trend. The majority of studies, despite a variety of mandates and perspectives (ie. ports, waterfront, community, foreshore, marina), conclude that the estuary is an exceptional environmental resource for which the primary use should be environmental protection and enhancement. With the exception of a DFO salmonid habitat enhancement project, environmental objectives for the estuary have not been realized.

Some mixed uses have been encouraged on Tyee Spit (public and commercial recreation) and, in more recent years, on the site of the former Dryland Sort (residential, institutional/community). With the exception of the floatplane base, existing commercial and industrial uses in the estuary and on the Spit have been encouraged (in the long run) to relocate. In the short run, they are encouraged to clean up and maintain facilities, mitigate impacts through operational improvements, and undertake environmental rehabilitation.

Over time, recommendations encouraging environmental protection have increased in both strength and detail and have been incorporated into Campbell River's Official Community Plan. The two studies running counter to this trend are the Foreshore Road Feasibility Study (1983) and the Estuary Haudraulic Study (1994) which recommended road construction adjacent the estuary and dredging of the Campbell River channel respectively.

5.2 Annotated Bibliography of Planning Studies

An annotated bibliography of District of Campbell River planning studies pertaining to the Campbell River estuary has been included as an appendix to this report (Appendix G - Bibliography: Planning Studies). The format for annotation includes the bibliographic reference, an abstract of the document, and a listing of key findings and implications.

5.3 Implications

Planning studies over the years have consistently identified environmental protection and enhancement as an appropriate long term use for the Campbell River estuary. Despite a consistent planning vision, developments in estuary use appear incremental,

disjointed, and often informal. A danger exists that the cumulative effects of incremental development will preclude the achievement of environmental objectives. Rather than a lack of direction, the difficulty seems to be the lack of an overall implementational plan, defining roles and responsibilities and co-ordinating decision-making and action.

Industrial activity in the estuary continues and a proposed capital dredging project suggests that industry does not plan to relocate any time soon. It seems likely that short to medium term change for industrial and commercial users of the estuary will focus operational improvements, impact mitigation, and water quality and habitat enhancement projects (rather than relocation). A high degree of consensus and a new spirit of commitment will be required on the part of estuary stakeholders to achieve environmental objectives within such a land and water use context.

6.0 SUMMARY of EXISTING CAMPBELL RIVER ESTUARY FISHERIES STUDIES

The Department of Fisheries and Oceans has undertaken a number of scientific studies of the Campbell River estuary through an initiative known as the Campbell River Project. General findings of these studies are provided below along with a brief description of an annotated bibliography of DFO studies pertaining to the Campbell River estuary.

6.1 Summary of DFO Scientific Findings

DFO references to the Campbell River Project pertain largely to a detailed five year evaluation (initiated in 1982) of the biological response to physical changes brought about by rehabilitative activities in the Campbell River estuary involving the construction of four islands. In 1981, British Columbia Forest Products built a dry land log sort and dredged a booming pocket on the southwest side of the estuary. Four intertidal islands were built with the dredgate and planted with sedge grass from the dredged area to compensate for lost marshes.

Project investigations include: the extent of colonization and utilization of the new islands and marsh habitat by juvenile salmonids; the design and assessment of experiments involving the release of chinook smolts directly into river, estuarine, transition and marine habitats; the comparison of estuarine dependency between wild and hatchery chinooks; and, the degree of use of estuarine and "alternate" habitats by juvenile salmonids.

In terms of findings to date: the colonization and utilization of the new islands and marsh habitat by juvenile salmonids, vegetation and benthic organisms appeared to be complete (ie. no appreciable difference from reference habitats) after 5 years; release of chinook smolts into a variety of habitats indicates a positive correlation between an estuarine residency period and the survival rate of juvenile chinook; hatchery chinook were less abundant in, and potentially less dependent upon, the created habitat than wild chinook; and, the degree of use of "alternate" (ie. created) estuarine habitats by juvenile salmonids appears to be equal to or greater than use of reference (ie. natural) habitats.

6.2 Annotated Bibliography of Fisheries Studies

An annotated bibliography of approximately 100 Department of Fisheries and Oceans references to the Campbell River estuary has been included as an appendix to this report (Appendix H - Bibliography: Fisheries Studies). The format for annotation includes the bibliographic reference, an abstract of the document, and a listing of key findings and implications. DFO studies to be published in the near future include an assessment of salmonid habitat in the lower Campbell River, and a study of the effects of hatchery production on wild chinook fry in the Campbell River estuary.

6.3 Implications

DFO studies have shown The Campbell River Project to be a success. The habitat rehabilitation effort has resulted in a net gain of the capability of the Campbell River estuary to support fish production. The project shows that estuary rehabilitation initiatives can result in the creation of high quality habitat - that investment in environmental enhancement can result in real public benefits. The artificial islands have now become an integral part of the estuary and represent an investment worth protecting.

7.0 CONCLUSION

This document provides a comprehensive summary of information concerning the Campbell River estuary in terms of public and stakeholder issues, and of existing planning and fisheries research. While not intended to provide detailed analysis and synthesis of the information collected, implications of the findings are discussed. The process to date has been well documented in the hope that this report will prove a valuable reference in this and future efforts concerning the estuary.

CAMPBELL RIVER ESTUARY MANAGEMENT PLAN

Terms of Reference

The Federal, Provincial and Municipal government are all desirous of creating an Estuary Management Plan Study. Proposals based on the following terms will be received up to and including Thursday, May 25th, 1995 by the undersigned. Proposals should include qualifications and experience of the study team, study timetable and estimated cost of preparing a plan.

1. Plan Purpose

The purpose of the plan is to:

- produce a long range strategy to guide development decisions relating to the use of land and water in and around the estuary to accomplish the restoration of the estuary as stated in the Community Plan;
- identify opportunities and programs for restorative and rehabilitative activities throughout the estuary
- establish an environmental baseline measure from which monitoring can be undertaken; without restricting the scope of monitoring, it is expected that this would include water quality fish habitat and wildlife;
- define the role and responsibilities of all parties (users, government, public) involved in one way or another with the estuary; and,
- produce an up-to-date consolidation of information on the estuary.

2. Planning Principles

The plan shall reflect the following principles:

- promote long term benefits to the natural environment over short term gains to any particular agency or user group;
- be founded on inherent biophysical capabilities and long-term socio-economic needs of the Study Area;
- improve and increase the effectiveness and efficiency of long and short term decision making by regulatory agencies with regard to the management, development and allocation of land and water resources in the estuary;
- shall be dynamic rather than defining an end state; and,
- incorporate sustainability principles.

3. Study Area

The study area is defined as the water extending from Orange Point to Westmin Docks and up river as far as the Highway Bridge and includes all uses and activities that front on the estuary or affect it significantly and, more generally, lands within the designated flood plain of the Campbell River.

Appendix A

4. Plan Approach/Process

Management of the Plan preparation will be the responsibility of the Steering Committee (composed of representatives of government including First Nations, industrial and commercial users and public interest groups). The consultant shall submit a workplan for the approval of the Steering Committee and provide regular progress reports. The consultant is expected to be a facilitator to the Steering Committee.

The consultant shall also design with the Steering Committee a process for ensuring public involvement in the preparation of the Plan. A minimum of two public involvement events is expected. These would involve the community in identifying issues and reviewing and commenting on alternatives.

Decisions leading to this final draft plan shall be consensus based. In the event that the Steering Committee is unable or not prepared to make a key decision, the Plan shall identify options and list pertinent information regarding each option. The document will then be submitted to the various levels of government for resolution of any outstanding issues.

5. Plan Content

5.1 Data

The draft Management Plan shall include or elevate the following data, namely:

- the existing physical attributes of the Study Area including:
 - climate;
 - hydrology and oceanography;
 - water quality;
 - physiology and foreshore morphology; and,
 - flood risk and mapping based on provincial flood plain analysis.
- the existing biological resources of the Study Area including:
 - vegetation;
 - fisheries species and habitat capability;
 - shellfish and other marine resources; and,
 - wildlife and waterfowl and their habitat capability.
- the existing foreshore utilization within the Study Area including:
 - environmentally sensitive areas requiring special protection;
 - log storage;
 - industrial;
 - commercial;
 - recreational;
 - transportation;
 - hazardous areas;
 - residential uses; and,
 - outfalls, including proposed municipal outfall

Appendix A

The consultant will be provided with this data and is not expected to undertake any original research except as is proven as necessary during the preparation of the plan.

5.2 Data Analysis

The consultant will, as part of the Draft Management Plan, provide an analysis of the data identified in Section 5.1, such analysis to include:

- a series of maps or map overlays in a suitable GIS or other electronic format; and
- a written report complete with calculations and quoted sources identifying any significant data gaps.

The Consultant will utilize the expertise of the various agencies familiar with the estuary for direction on data analysis

5.3 Issues Analysis

The Consultant will, as part of the draft Management Plan:

- analyze and project potential resource uses for the estuary or adjacent upland for the next 10 - 20 year period;
- identify existing resource conflict areas and their relative importance/priority;
- provide policy alternatives for the resolution of conflicts in a priority manner; and
- provide policies for the management, allocation and development of the land and foreshore.

5.4 Future Analysis

The Consultant will, as part of the draft Management Plan, develop a minimum of three alternative plans or scenarios for the Study Area based on:

- the data analysis, projections, objectives and policies (pursuant to Sections 5.2 and 5.3);

5.5 Future Strategy

Upon receipt of the draft Management Plan, the Steering Committee will select one of the three alternative future plans or scenarios set out in the Draft Management Plan to form the basis of the Final Management Plan.

The final Management Plan shall include a strategy (based on the selected scenario) containing projected timelines for various issues to be resolved and/or remediation measures to be initiated or completed.

6. Submissions

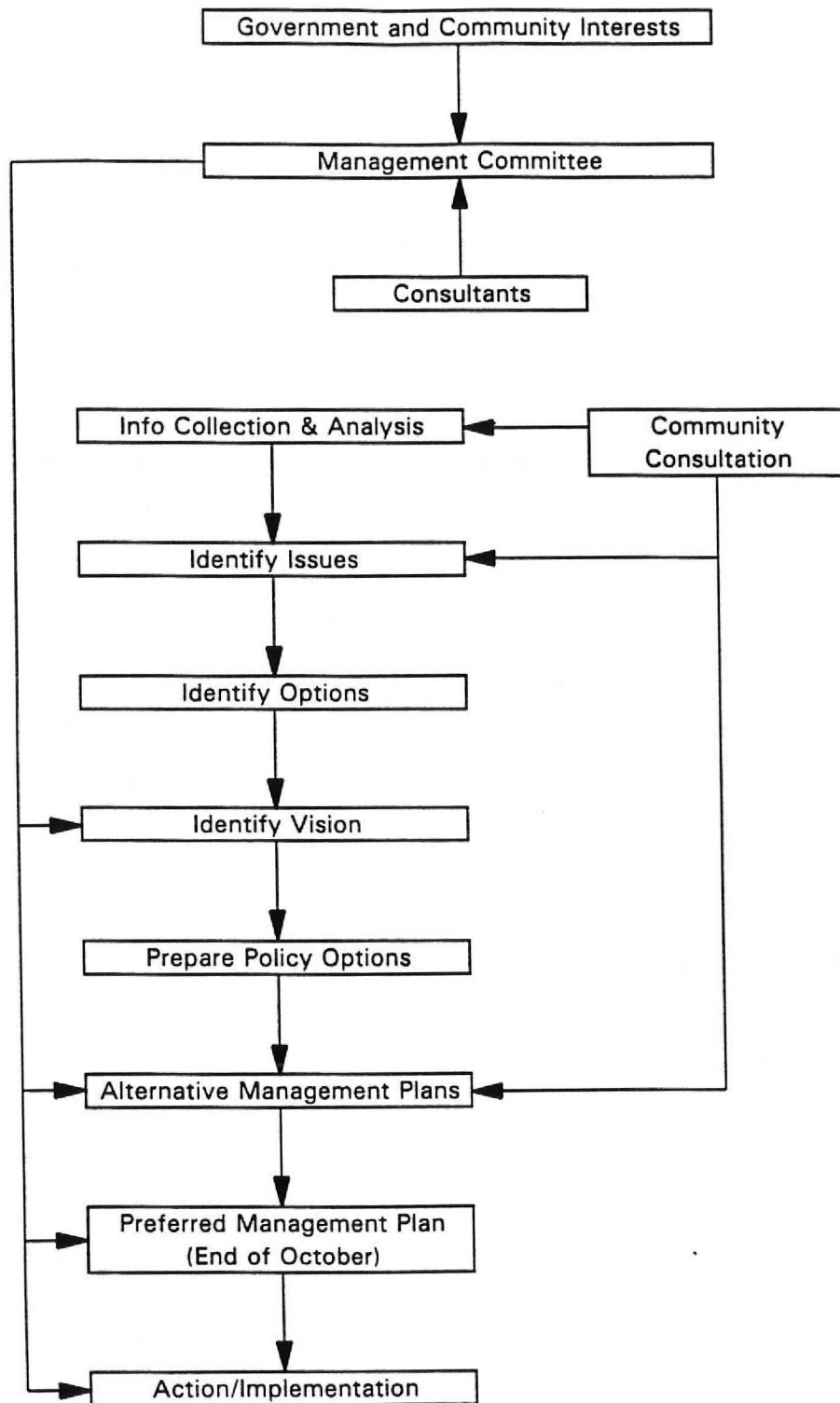
Please submit 10 copies of your proposal to Chris Hall, 301 St. Ann's Road, Campbell River, British Columbia, Canada, V9W 4C7.

Appendix B

PROPOSED TIMELINE: Campbell River Estuary Management Plan																		
Study Phase/Study Tasks	JUNE		JULY				AUGUST				SEPTEMBER				OCTOBER			
	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8	Wk9	Wk10	Wk11	Wk12	Wk13	Wk14	Wk15	Wk16	Wk17	Wk18
2.1 Start-up																		
2.1.1 Site Visit																		
2.1.2 Workplan																		
2.2 Information Collection & Analysis																		
2.2.1 Existing Information Retrieval																		
2.2.2 Information Analysis																		
2.2.3 Public Involvement																		
2.2.4 Review Meeting																		
2.3 Identification of Issues & Policy Approaches																		
2.3.1 Issue Identification:																		
(a) existing issues																		
(b) future management scenarios																		
(c) preferred scenario & vision																		
(d) future issues identification																		
2.3.2 Proposed Policy Approaches																		
2.4 Definition of Alternatives																		
2.4.1 Evaluation Criteria																		
2.4.2 Preparation of Alternative Plans																		
2.4.3 Public Review																		
2.5 Management Plan																		
2.5.1 Preferred Management Plan																		
2.5.2 Final Management Plan																		

Appendix C

Campbell River Estuary Management Plan Process



CAMPBELL RIVER ESTUARY MANAGEMENT PLAN

-QUESTIONNAIRE-

This questionnaire will provide advice to the Campbell River Management Committee. The Committee is coordinating the preparation of a Management Plan for the Campbell River Estuary.

PLEASE TAKE A FEW MINUTES TO FILL IN THIS QUESTIONNAIRE. PLEASE DROP-OFF AT THE DISTRICT PLANNING OFFICE (or mail to Witty Planning Consultants G-30, Bowen Island, VON 1G0).

1. What are the things you most enjoy about the estuary? Please write them out:

2. What things should be protected in the estuary? Please list them:

3. What do you believe are the key issues detrimentally affecting the estuary? Please write-in the key issues:

please turn over

Appendix D

4. Do believe that the estuary is: (please check only one)

☐ one of Campbell River's most important natural resources, or

☐ a fairly important natural resource, or

☐ not an important natural resource.

5. Do you believe that the estuary: (please check as many as you want)

☐ is under serious threat or

☐ is not under serious threat.

☐ requires immediate attention to protect it or

☐ does not require immediate attention to protect it.

☐ should be saved or

☐ is not worth saving.

☐ requires a concerted public and private action plan or

☐ should be left to evolve on its own.

☐ can be properly managed or

☐ can not be properly managed.

6. Any other thoughts? Please write them out here:

7. I would like to receive updates on the progress of the Management Plan



Name: _____

Address: _____

Appendix E

Campbell River Estuary Management Plan: Steering Committee Members

- Al Caverly, Ministry of Environment, tel: 286-7630, fax: 287-9516
- Kevin Conlin, DFO (enhancement), tel: 666-3907, fax: 666-0292
- Kathy Eichenberger, Public Works Canada, tel: 623-6247, fax: 623-6262
- Harry Elias, representing the fisheries coalition, tel: 286-1102, fax: 286-0158
- Mike Gage, representing public interest groups, tel: 282-3115, fax: 282-3636
- Chris Hall, Director of Planning, DCR, tel: 286-5730, fax: 286-5761
- Bruce Hillaby, Nicola Furlong, DFO, tel: 756-7275, fax: 756-7162
- Goff Longworth, BC Hydro, tel: 755-7173, fax: 755-4731
- John McFarland, representing business interests, tel: 287-7626, fax: 287-2327
- Gordon Smaill, Ministry of Lands, tel: 356-2736, fax: 756-1871
- Fred Stepchuk, Coast Guard, fax: 631-3747
- Jim VanTine, DFO, tel: 287-9564, fax: 286-0261
- Frank Voysey, DFO, tel: 287-2103, fax: 287-4899

Appendix F

Cross-reference of Campbell River Estuary Planning Study Recommendations (1974-1994)

Planning Study	Land and/or Water Use Recommendation				
	<i>Environmental Protection and Enhancement</i>	<i>Recreation and Public Use</i>	<i>Mixed Uses</i>	<i>Commercial</i>	<i>Industrial</i>
Campbell River Estuary Hydraulic Study (January, 1994)	<ul style="list-style-type: none"> • need to address environmental concerns including: removal of the river bed substrate; disposal alternatives for the dredged material; quality of the dredged material; possible changes to the river current/erosion/ sedimentation/deposition pattern; timing in relation to fisheries resources; possible archaeological impacts; and, general public sensitivity to industrial activity in the estuary 				<ul style="list-style-type: none"> • undertake initial capital dredging program to establish design channel width, alignment and grade (Main Channel) • dredged channel should be surveyed annually to monitor rate and location of infill
Campbell River Estuary Study (September, 1990)	<ul style="list-style-type: none"> • protection of the estuary habitat • designate perimeter of Spit a conservation area (30m setback) • rehabilitate Spit shoreline on inner side of estuary • designate Campbell River shoreline and land area abutting estuary (including artificial islands and finger of Dryland Sort) as conservation areas • stabilization and revegetation of Campbell River embankment, including basin edge of booming pocket • environmental and design review of proposed development 	<ul style="list-style-type: none"> • acquisition and improvement of recreational assets of Spit shoreline and Campbell River shoreline surrounding Dryland Sort property • establish walking/cycling trail with picnic areas at intervals along its length • establish 2 park sites on the Spit (1) at entrance to Spit incorporating boat launch and parking and (2) at outer end of Spit having pedestrian access only • park site end of Maple Road with picnic and parking areas, and start point for river trail • establish river walkway along Dryland sort (30m setback) starting at Maple Road site • restrict foreshore leasing to boat ramp 	<ul style="list-style-type: none"> • Dryland Sort suitable site for mixed use development including upscale townhomes, senior's village, community or institutional uses complementary to environmental protection 	<ul style="list-style-type: none"> • small tourist commercial designation adjacent float plane base permitting resort hotel, restaurant/pub, marine tourist attraction, canoe/kayak rentals • retain floatplane base on Tyee Spit with consolidation and cleanup of operations • possible relocation of floatplane base to booming pocket • designate portions of Dryland Sort site adjacent Island Highway for Service Commercial uses • booming pocket not appropriate for future marina uses • limit commercial foreshore leases to floatplane facilities • relocation from Spit of floatplane servicing and maintenance areas 	<ul style="list-style-type: none"> • Dryland Sort not considered appropriate for future industrial use • dredging of river mouth to allow for high tide access is not supported • industrial use of estuary generally inappropriate

Appendix F

Cross-reference of Campbell River Estuary Planning Study Recommendations (1974-1994)

Planning Study	Land and/or Water Use Recommendation				
	Environmental Protection and Enhancement	Recreation and Public Use	Mixed Uses	Commercial	Industrial
<i>Campbell River OCP (November, 1990)</i>	<ul style="list-style-type: none"> • all development subject to permitting to protect natural environment and/or area character • shoreline, inner estuary islands, and fingers of land to be set aside as conservations areas • 30m setback from water in accordance with floodplain restrictions • use of 30m setback for edge rehabilitation • waterlot lease renewals will include provision for cleanup, rehabilitation, and impact mitigation 	<ul style="list-style-type: none"> • transformation of Spit into public recreational zone • park sites to be developed at road ends, particularly on Maple Street • use of 30m setback for public walkways 	<ul style="list-style-type: none"> • properties abutting estuary may be considered for community or institutional uses and/or certain commercial and residential uses 	<ul style="list-style-type: none"> • commercials lease renewals will not be supported when alternate sites available • limited commercial activity on Spit in support of recreation or float plane use • relocation from Spit of floatplane servicing and maintenance areas 	<ul style="list-style-type: none"> • existing industrial uses to be designated non-conforming • new industrial activities and water lot lease applications will not be supported • industrial lease renewals will not be supported when alternate sites available • no dredging or filling unless associated with environmental benefit
<i>Campbell River Foreshore Road Feasibility Study (August, 1983)</i>	<ul style="list-style-type: none"> • mitigate adverse impacts to stream hydrology and tidal interchange; some significant habitat impacts not mitigable 		<ul style="list-style-type: none"> • construction of proposed Foreshore Road to handle existing traffic and increasing future traffic loads • promote alternative routes to South Campbell River by constructing Elm Street extension 		<ul style="list-style-type: none"> • adequate bridge clearances for milling operations to mitigate impact on log handling activities
<i>Campbell River Foreshore Plan (September, 1983)</i>	<ul style="list-style-type: none"> • shift to environmental protection and management designation through protection and rehabilitation of marshes, wetlands and other habitats • prevent interference with tidal flows 	<ul style="list-style-type: none"> • Tye Spit proposed as public/commercial recreation zone, forming an extension of the downtown commercial area by: increasing public access and public recreational opportunities; encouraging the relocation of non-recreational uses; preventing the disruption of environmental resources; and, upgrading and improving of services to the Spit 	<ul style="list-style-type: none"> • long term uses for the spit include active and passive recreation, commercial and public recreation activities and structures, environmental protection and management, and navigation channels • long term uses for the estuary include environmental protection and management, navigation channels and passive recreation 	<ul style="list-style-type: none"> • encourage relocation of commercial uses on Spit when feasible • encourage cleanup and facility maintenance • existing commercial uses would be conditional until phased out or relocated 	<ul style="list-style-type: none"> • encourage relocation of industrial and commercial uses in estuary to Middle Point/Duncan Bay when feasible • encourage facility cleanup and maintenance, environmental rehabilitation, and changes in operations to reduce environmental impacts • existing industrial uses would be conditional until phased out or relocated

Cross-reference of Campbell River Estuary Planning Study Recommendations (1974-1994)

Planning Study	Land and/or Water Use Recommendation				
	Environmental Protection and Enhancement	Recreation and Public Use	Mixed Uses	Commercial	Industrial
Master Plan for Port of Campbell River (February, 1980)	<ul style="list-style-type: none"> the estuary is a valuable ecological resource... present heavy use as a booming ground is detrimental and should be discontinued 		<ul style="list-style-type: none"> the existing coastal island highway should be maintained at its present standard as four-laning along the coast will tend to alienate the coast, particularly recreational areas, from the remainder of the community 	<ul style="list-style-type: none"> the floatplane base should be permitted with provision for controlled expansion the marina usage in the estuary should not expand, rather these activities should gradually diminish through attrition 	<ul style="list-style-type: none"> the industrial usage in the estuary should not expand, rather these activities should gradually diminish through attrition Middle Point is an acceptable sit for a roll-on-roll-off barge facility
Assessment of Impact of Proposed Marina Development (1974)	<ul style="list-style-type: none"> alternate marina locations with reduced environmental impacts should be fully investigated 			<ul style="list-style-type: none"> marina should not be located at site proposed (area of mouth of Nunns Creek) as it would eliminate significant fish rearing and food producing habitat 	

Appendix G

Annotated Bibliography of Estuary Planning Studies: Campbell River Estuary (1974-1994)

1. Campbell River, District of. 1983. Campbell River and Crown Foreshore Plan. with: Planning Collaborative Inc. & R.U. Kistritz and Associates. Campbell River, British Columbia, Canada.

The document identifies the plan's scope, mandate and planning process, and identifies foreshore planning issues. Biophysical conditions and human uses of the foreshore are examined and summarized, including visual resources of the coastal edge. Area trends and management objectives lead to development of a Concept Plan which in turn leads to development of a Management Plan. The plan establishes a series of use designations for the foreshore and describes the range of permitted and restricted activities which accompany each one. Guidelines and development controls are identified in addition to government responsibilities and administration. Plan amendment and review recommendations are also provided. Appendices include design suggestions pertaining to coastal edge development and management.

findings... (with respect to the estuary proper)

existing uses in the Estuary are deemed to be inappropriate and a shift to an Environmental Protection and Management designation is proposed by: protection and rehabilitation of marshes, wetlands and other habitats; encouraging cleanup and facility maintenance; encouraging relocation of industrial and commercial uses; and, preventing interference with tidal flows and navigation

it is suggested that industrial uses in the estuary be encouraged to relocate to the Middle Point/Duncan Bay area

Tyee Spit is proposed as a public/commercial recreation zone, forming an extension of the downtown commercial area by: increasing public access and public recreational opportunities; encouraging the relocation of non-recreational uses; preventing the disruption of environmental resources; and, upgrading and improving of services to the spit

implications...

existing development lessees in the estuary are encouraged to: relocate when it is economically feasible and alternative sites are available; cleanup and maintain facilities; rehabilitate the environment; and change operations to reduce environmental impacts

long term uses for the estuary include environmental protection and management, navigation channels and passive recreation... existing industrial and commercial uses would be conditional until phased out or relocated

existing lessees on the spit, upon renewal, will be encouraged to: relocate, if it is economically feasible and alternate suitable sites are available; to clean up and repair facilities; and, to provide public access to and along the foreshore

long term uses for the spit include active and passive recreation, commercial and public recreation activities and structures, environmental protection and management, and navigation channels... existing industrial and commercial uses would be conditional until phased out or relocated

2. UMA Engineering Limited. 1990. Campbell River Estuary Study. District of Campbell River, Campbell River, British Columbia, Canada.

The study evaluates physical development constraints, reviews environmental values and current use patterns of the Campbell River estuary and adjacent Spit and Dryland Sort upland areas. These analyses are then used to determine appropriate uses for the above mentioned lands given site characteristics, potential uses and site constraints.

findings...

the study identified two essential public values... (1) protection of the estuary habitat, and (2) acquiring and improving the recreational assets of the Spit shoreline and Campbell River shoreline surrounding the Dryland Sort property

implications...

no private or commercial uses are recommended which are considered incompatible with public uses or have serious negative impacts on the estuary habitat... the exception being the float plane base, in which case the economic benefits and lack of alternative site are considered to outweigh the disadvantages of the Spit location

the recommended land use strategy for Tyee Spit and its surrounding foreshore provides for a limited mix of land uses with the emphasis on public use along the shoreline... a limited amount of tourist commercial is recommended, with the

Appendix G

remainder of the site used for conservation and public park/recreation the recommended land use strategy for the Dryland Sort and its surrounding foreshore provides for a linear park/walkway along the river/estuary shoreline, and a range of uses (picnic/parking area, mixed residential development, highway service commercial) for the remainder of the site (as it has no particularly scenic or biological values)... such uses should not compromise the public value of the riverside walkway

3. British Columbia Harbours Board. 1980. Master Plan for the Port of Campbell River. CBA Engineering Limited. Vancouver, Canada.

The study area comprises 27 km of coastline between Race Point and Oyster Bay, is within the boundaries of the Regional District of Comox Strathcona and includes the coastline of the District of Campbell River. The study is divided into three parts. Part one describes the present state of the study area including physical geography, the biological environment and the present state of development. Part two describes potential port demand and in part three, development potential is discussed and the Master Plan established.

findings...

- the local economy is resource based depending mainly upon forestry with significant contributions from mining, commercial fishing and tourism
- forestry and mining account for the majority of cargo movement through the mainly private port facilities
- strong tidal streams (up to 10 knots) in Discovery Passage make handling of deep sea vessels difficult north of Willow Point
- the study area was divided into 12 ecological units and rated in terms of sensitivity to human disturbance
- sensitivity is low to moderate for most of the marine foreshore with the exception of the Campbell River estuary where the sensitivity is extremely high
- existing port uses include bulk facilities for forest products and minerals, a ferry terminal, an oil terminal, facilities for commercial and recreational fishing and a floatplane base
- the only large undeveloped areas of land within the study area lie to the north of Duncan Bay, at the southern end of Oyster Bay, and on the Indian reserve at the mouth of the Campbell River
- incremental increases in port demand are expected for ferry, commercial and residential fishing, and floatplane operations
- usage for which increased demand is not anticipated include mineral exports, oil imports and log booming
- the only major new development for which demand was established is a marine terminal for coal exports

implications...

- the Campbell River estuary is a valuable ecological resource and it is believed that present heavy use as a booming ground is detrimental... the industrial and marina usage in the estuary should not expand, rather these activities should gradually diminish through attrition (except the floatplane base, where controlled expansion should be permitted)
- southern Oyster Bay is the only site in the study area that could physically accommodate a major coal terminal... however other sites outside the study area should be evaluated relative to locations of known coal reserves on the island before creating a facility based on the needs of one operator
- Middle Point is an acceptable sit for a roll-on-roll-off barge facility
- the existing coastal island highway should be maintained at its present standard as four-laning along the coast will tend to alienate the coast, particularly recreational areas, from the remainder of the community

4. British Columbia Ministry of Transportation and Highways. 1983. Campbell River Foreshore Road: An Environmental, Socio-Economic, Engineering Feasibility Study. T.M. Thomson & Associates Ltd., Victoria, Canada.

This study evolved from previous work on alternatives designed to reduce traffic congestion in Campbell River. The objective of this study on the Campbell River Foreshore Road is to (1) describe and recommend an alignment that has minimum adverse impact upon the area and its resources, and (2) identify and present methods to mitigate, enhance or (where necessary) compensate for adverse impacts and recommend methods to enhance beneficial impacts.

findings...

- there is a need for improvement to the Campbell River road system to handle future traffic
- traffic would be reduced by forty per cent on Highway 19 from Discovery Crescent to North Campbell River
- many of the adverse impacts of the foreshore road are mitigable (such as the use of large arch culverts to reduce

Appendix G

- interference with stream hydrology and tidal interchange)
- some significant impacts cannot be mitigated, namely: reduction of the effective size of the estuary through noise intrusion into wildlife habitat and the disturbance of 1ha of highly productive soil and 3ha of rare estuarine soils; about 2ha of sensitive intertidal vegetation would be disturbed on the foreshore; and, the road could result in more erosion north of the embankment
- diverting up to 40% of through-traffic away from Campbellton would reduce trade for about 25 businesses
- the road should provide clearances for BC Forest Products and Raven Lumber to mitigate economic impacts on the dryland sort and Baikie Island operations
- the proposal conflicts with recommendations of the Regional District of Comox Strathcona and the OCP of the District of Campbell River as well as recent land use planning reports
- IR 11 would benefit from increased commercial use within the marina and better vehicular access to undeveloped reserve land, however, the reserve would be further fragmented thereby reducing development options

5. Campbell River Mills. 1994. 1994 Dioxin and Furan Monitoring Program. by: Envirochem Special Projects Inc. Campbell River, Canada.

The purpose of the 1994 Dioxin and Furan Environmental Monitoring Program is: to gather information for the Department of Fisheries and Oceans (DFO), Environment Canada and Health Canada for assessing dioxin and furan levels in crab and sediment; to update data collected in 1992; and, to incorporate the 1994 data within the trend analysis study initiated in 1990.

The program was established in 1990 by the federal government because of concerns about dioxin and furan releases into the environment. The program focussed on receiving environments in the vicinity of effluent discharges resulting from pulp mills, which used chlorine bleaching of pulp in the vicinity of sawmills, which previously used chlorophenols for wood protection. Campbell River Mills and the Fletcher Challenge pulpmill have undertaken organochlorine monitoring programs of the Campbell River estuary.

Based upon previous data obtained from this program, the DFO has closed commercial crab fishing in Baikie Slough and the Campbell River Estuary. The data in this report will be used to assess the potential for reopening current fisheries closures and modifying consumption advisories.

findings...

- the sample crab populations were not significant as only three crabs were observed and captured at one sampling location and none observed or captured at another
- the analysis of sediment and crab samples indicated the lowest results for the locations sampled since program initiation... some toxins (chlorinated phenols in sediment) were below detectable levels, others (dioxin/furan residue in crab tissue) were below federal guidelines, and others (dioxin/furan residue in sediment) were simply the lowest levels recorded

6. Canadian Coast Guard. 1994. Benefit Analysis of Dredging the Campbell River Estuary. by: Lauga & Associates Consulting Ltd. West Vancouver, Canada.

The Canadian Coast Guard (CCG) is evaluating a proposed dredging program in the Campbell River estuary and other locations. The study determines the economic benefits of channel improvements that would accrue to qualifying CCG commercial channel users (ie. commercial shippers and carriers of goods excluding pleasure craft, commercial fishing vessels and seaplanes). The study at Campbell River shows how qualifying users are affected by channel limitations, shows the impact of the do nothing option, and discusses other options to a dredging solution. The impact on non-qualifying vessels and an overview of environmental issues is indicated as well.

findings...

- quantified benefits of dredging are estimated at \$435,000/yr, accruing in large part to the largest user... Raven Lumber
- a feasible dredging program would not eliminate the need to wait for high tides but, rather, would increase the number of viable operating days and lengthen the high tide operating window
- a .076m (0.25ft) loss of water depth would increase the number of days inoperable at high tide from the present 80 days/yr to 135 days/yr

Appendix G

- tidal delays are expected to increase due to sedimentation and tidal cycles (the minor tidal cycle has just peaked and will average 0.09m lower for the next eight years)
- other commercial users would be seriously affected with a 0.3m (1ft) loss in water depth as this would render forestry activity in the estuary uneconomic... the quantified benefits to dredging would be \$1.9-\$2.1 million/yr
- benefits to non-qualifying users (recreational vessels and seaplanes) would rise by about 30% over existing conditions if the estuary became 0.076m (0.25ft) more shallow
- the economic benefits to Campbell River of 16 inter-related commercial marine businesses generating \$58 million in revenues and employing 490 people, and of recreational boating and seaplane operations generating \$15 million in revenues, would be substantially lowered
- faced with relocation, most industries in the estuary would be unable to replace the logistical advantages that the estuary now provides
- the current Campbell River Community Plan has an objective of relocating inappropriately located water-based industrial operations from the estuary and Spit
- the current Campbell River Community Plan states that dredging and filling will not be permitted unless associated with a project of long term environmental benefit and accompanied by a detailed impact assessment

options to dredging...

- bearing the costs and inefficiencies; probably tolerable if marine conditions deteriorate no further
- industry funded dredging (may be infeasible regardless of benefits)
- use of flat bottom tows instead of bundle booms; tow losses and escaped log hazards are unacceptable
- river training to encourage self scouring of channels... feasibility unknown
- increased storage density to ensure adequate log supply during multi-day tidal delays
- widening and/or increase of curvature in addition to deepening of estuary channels to increase towing capacity

environmental issues...

- the estuary and sea waters near its mouth are important feeding areas for chinook salmon raised upstream in the hatchery
- Campbell River's important sport fishing industry is based upon the salmon as well as steelhead and cutthroat trout
- dredging impacts can be expected in the form of water quality changes with subsequent effects on estuarine ecology... ie. the release of hydrogen sulphide
- other environmental changes could include salinity, temperature, turbidity, suspended solids, nutrients, dissolved oxygen and toxic organics
- care must be taken in the timing of dredging, the disposal of dredgate, the avoidance of sloughing of environmental reclamation areas, and the prevention of upstream gravel depletion
- in previous dredging of a boat harbour (1977) in the estuary, caged salmon did not appear to be disturbed by toxic effects from wood debris
- salinity and temperature are likely to change little with dredging as strong currents should prevent the salt wedge from travelling very far upstream

implications...

- the most striking feature of the consultants' investigations is that the navigability of the estuary is sensitive to very small changes in water depth... small decreases and increases in channel depths can make operations infeasible or feasible respectively for industry located on the estuary
- due to the above sensitivity, the design of a cost effective dredging program probably requires (1) a study of the hydraulic characteristics of the estuary and accurate information about water depths, and (2) careful observation and measurements of the users' vessels, tows and operating methods

- Public Works Canada. 1994. Campbell River Estuary Hydraulic Study. by: Hay & Company Consultants Inc. Vancouver, Canada.

Sedimentation processes in the Campbell River Estuary have led to shoaling in the river channels, limiting navigational access to commercial facilities. Public Works Canada (PWC) on behalf of the Canadian Coast Guard, is undertaking an engineering and environmental evaluation of the requirements to develop and maintain a viable commercial navigation channel in the estuary. The hydraulic study was undertaken in support of this initiative.

The objectives identified for the study were to: establish backwater curve, use of intertidal aid, design tide; establish design criteria for channel alignments, widths and depths; estimate infill rate and dredging requirements by channel

Appendix G

segment; and, investigate feasibility of remedial options (eg. sediment diversion structure) to minimize dredging.

findings...

- the estuary is a dynamic system, however, it also has characteristics of a regulated system with a limited supply of sediment
- sediment transport in the system is due both to riverine and coastal transport processes
- design of a navigation channel which incorporates tidal assistance will require only limited dredging in the channel and none in the vicinity of the Tyee Spit
- the mouth of Baikie Slough was identified as a depositional zone
- a channel 45m in width and with 4.0m design draught would be suitable for navigation, with the expectation of maintenance dredging every four to five years
- the rate of infill depends upon an unknown supply of sediments as well as the frequency of large flow events... it is possible that the dredged channel could infill after a single year of large flows
- the site is not amenable to river training
- beyond growing concern over log storage in the estuary, and potential threats to artificial islands constructed by DFO in the mid 1980's, environmental concerns include: removal of the river bed substrate; disposal alternatives for the dredged material; quality of the dredged material; possible changes to the river current/erosion/ sedimentation/deposition pattern; timing in relation to fisheries resources; possible archaeological impacts; and, general public sensitivity to industrial activity in the estuary

implications...

- it is recommended that the initial capital dredging program be undertaken and that the dredged channel be surveyed annually to monitor the rate and location of infill

8. Goodman, D. 1974. As assessment of the impact of proposed marina development on the fisheries resources of the Campbell River estuary. 1974. Fisheries and Marine Service, Southern Operations Branch, Tech. Rept. Series PAC/T-74-13: 26 p.

In January 1972, the Campbell River Indian Band represented by Chief W. Roberts, presented a plan to develop a marina at a site adjacent to the Campbell River Indian Reserve. The proposed site was approximately 3 acres of vegetated intertidal area lying between the mouth of Nunn's Creek and Spit Road. This study is designed to evaluate the effects of the proposed marina development on the fisheries resources of the Campbell River. This report reviews the fishery resources of the Campbell River system, describes methods used to determine the use of the estuary by salmon and other fishes, presents and summarizes data resulting from sampling in 1972 and 1973, and provides conclusions with respect to the degree of fish utilization.

findings...

- the estuary serves as a rearing area for numerous fish species including juvenile coho, chinook and chum salmon
- juvenile coho, chinook and chum salmon are distributed throughout the estuary including the area adjacent to Nunn's Creek and Baikie Slough
- substantial numbers of coho, chinook and chum salmon use the near shore marine environment adjacent to the estuary
- within the estuary, the gravel-cobble beach produced mainly chinook; pond-type habitat produce mainly coho; vegetated intertidal areas produced large catches of coho, chinook and chum salmon
- length and weight data for juvenile chinook and chum salmon within the estuary indicated substantial growth
- organisms associated with the intertidal and shallow subtidal portions of the estuary represented the major portion of juvenile salmon food sources
- the variety of food organisms in the stomachs of juvenile salmon caught at stations outside the estuary indicate that the fish move in and out of the estuary or the food organisms produced in the freshwater and estuarine environments are exported outside the estuary, or both
- the above findings are supported by studies in the Squamish and Nanaimo estuaries

implications...

- the vegetated intertidal portions of the estuary are of primary importance in terms of food chains leading to juvenile salmon
- development of the marina as proposed would eliminate a significant rearing and food producing area for these fishes
- the area lying between the mouth of Nunn's creek represents the only remaining relatively undisturbed vegetated intertidal area in the estuary... degradation of this area will reduce the production of benthic organisms (the major food

Appendix G

- component of juvenile salmon) both within and outside the estuary
it is recommended that the Campbell River Indian Band marina not be located at the site proposed, and that alternate locations with reduced environmental impacts be fully investigated

Appendix H

Annotated Bibliography of Estuary Fisheries Studies: Campbell River Estuary (1953-1993)

NOTE:

References to the Campbell River Project pertain to a detailed five year evaluation (initiated in 1982) of the biological response to physical changes brought about by rehabilitative activities in the Campbell River estuary involving the construction of four islands. In 1981, British Columbia Forest Products built a dry land log sort and dredged a booming pocket on the southwest side of the estuary. Four intertidal islands were built and planted with sedge grass from the dredged area to compensate for lost marshes.

The project includes studies of water quality, currents and salt wedge intrusion, vegetation, benthic communities, epibenthic and planktonic communities, and salmonid utilization were initiated for the project. Three habitat areas were sampled: the estuary zone consisting of the intertidal area at the mouth of the Campbell River, the transition zone immediately offshore of the river, and the marine zone in Discovery Passage and Seymour Narrows.

Investigations include: the extent of colonization and utilization of the new islands and marsh habitat by juvenile salmonids; the design and assessment of experiments involving the release of chinook smolts directly into river, estuarine, transition and marine habitats; the comparison of estuarine dependency between wild and hatchery chinooks; and, the degree of use of estuarine and "alternate" habitats by juvenile salmonids.

1. Burt, D. W. and T. Burns. 1994 (Draft). Assessment of salmonid habitat in the lower Campbell River. Prepared for B. C. Hydro Environmental Affairs, Burnaby, B. C. 53 p. + 3 appendices.
2. Mc Allister, C. D. and T. J. Brown. (in press). Effects of hatchery production on wild chinook fry in the Campbell River estuary, British Columbia. Proceedings of the International Symposium on Biological Interactions of Enhanced and Wild Salmonids, Nanaimo, B. C. September 1991. Can. Spec. Publ. Fish. Aquat. Sci.
3. Frith, H. R. 1993. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam rivers, 1992. Can. Man. Rept. Fish. Aquat. Sci. 2207: 64p.

Estimates of escapement were derived for the Campbell/Quinsam river system for 1992 using carcass tagging as part of the chinook key stream program. The Petersen estimate of chinook escapement was 4782 in 1992. Both males and females were predominantly age 4 and 5 but the age structure varied between the Campbell river, and the Quinsam river and hatchery. Escapement estimates are presented by river, sex and age.

findings...

- total escapement estimates for chinook salmon in the Campbell/Quinsam rivers system was 4782 for 1992
- the age composition of chinook varied between males and females and between the Campbell and Quinsam rivers and the Quinsam Hatchery
- females were more abundant in the river populations while males and females were equally abundant in the hatchery returns
- the mean length of chinook salmon was greatest in the Campbell River, and smallest in the Quinsam hatchery returns; females tended to be significantly larger than males
- there was a higher proportion of hatchery reared fish in the Quinsam River and at the hatchery than in the Campbell River... a pattern observed in previous years
- the number of recoveries for both adipose clips and decoded CWTs was low

implications...

- stratification of escapement estimates by sex and river on the Campbell/Quinsam rivers system should continue in order to minimize error in population estimates
- the low number of recoveries may make the precision of the estimates so low as to bring their usefulness into question
- the total estimated hatchery contribution to the chinook escapement, based on adipose clips (Method A), was 3878 (81.1%) in 1992; the contribution estimate derived using the adjusted CWTs recovered (Method B) was lower: 3750 (78.4%)

Appendix H

4. Frith, H. R., B. L. Nass and T. C. Nelson. 1993. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam Rivers, 1991. *Can. Man. Rept. Fish. Aquat. Sci.* 2199:65 p.

Estimates of escapement were derived for the Campbell/Quinsam river system for 1991 using carcass tagging as part of the chinook key stream program. The Petersen estimate of chinook escapement was 8012 in 1991. Both males and females were predominantly age 4 and 5 but the specific age structure varied between the Campbell river, Quinsam River and Quinsam Hatchery. Escapement estimates are presented by river, sex and age.

findings...

- total escapement estimates for chinook salmon in the Campbell/Quinsam rivers system was 8012 for 1991
- the age composition of chinook varied between males and females and between the Campbell and Quinsam rivers and the Quinsam Hatchery
- females were more abundant in the river populations while males were generally more abundant in the hatchery returns
- the mean length of chinook salmon was greatest in the Campbell River, and smallest in the Quinsam hatchery returns; females tended to be significantly larger than males
- there was a higher proportion of hatchery reared fish in the Quinsam River and at the hatchery than in the Campbell River... a pattern observed in previous years
- the number of recoveries for both adipose clips and decoded CWTs was low

implications...

- stratification of escapement estimates by sex and river on the Campbell/Quinsam rivers system should continue in order to minimize error in population estimates
- the low number of recoveries may make the precision of the estimates so low as to bring their usefulness into question
- the total estimated hatchery contribution to the chinook escapement, based on adipose clips (Method A), was 5433 (68.7%) in 1991; the contribution estimate derived using the adjusted CWTs recovered (Method B) was lower: 5119 (64.7%)

5. Whitehouse, T. R., C. D. Levings and J. S. Macdonald. 1993. Chironomid (diptera) insects from natural and transplanted estuarine marshes in British Columbia. *Proceedings of the 1993 Canadian Coastal Conference Vol 2, May 4-7 1993, Vancouver, B. C. Coastal Zone Engineering Program, National Research Council Canada, Ottawa, Ontario.*

findings...

- adult insects caught in emergence traps at transplanted and natural marshes at two British Columbia estuaries were dominated by chironomids, and abundance was related to vegetation density
- abundance of chironomids in natural marshes was comparable to values from non-tidal marshes in North America
- in the Fraser River estuary, chironomid abundance at two stations within a transplanted marsh was similar to a reference station, but was lower at a third station within the man-made marsh; abundance at a station where the transplants failed was consistently lower in comparison to reference stations within a natural marsh
- at the Campbell River estuary there were significant interannual differences when abundance at stations within transplanted and reference marshes was compared
- it is clear that more chironomid adults were found in marshes with successfully transplanted vegetation communities relative to wetlands characterized by sparse vegetation where transplants failed, or sand/mud habitats

implications...

- further detailed studies are needed on estuarine chironomids to determine the relative importance of physical and biological factors (ie. vegetation density, food supply, tidal rhythms water temperature, salinity, flow and sediment type) in abundance and emergence patterns
- in order to provide additional food for juvenile salmonids in the Fraser and Campbell River estuaries and other degraded estuaries, continuing restoration management is recommended as a habitat management strategy

6. Saki, H. 1992. Microbial uptake kinetics in Pacific coastal waters of different degrees of eutrophication. *Symposium on Marine Coastal Eutrophication, Bologna (Italy), 21-24 Mar 1990. Marine Coastal Eutrophication. Vollenweider, R. A., R. Marchetti and R. Viviani Eds. p. 957-972.*

The uptake kinetics of amino acids by natural microbial communities in Northern Pacific coastal waters were studied based on Michaelis-Menten kinetics. Models of the uptake kinetics were statistically generalized with special reference to the eutrophication characteristics of each water type. The warm waters examined were the eutrophic bay waters of Tokyo and

Appendix H

Shimoda, the mesotrophic Kuroshio Counter Current, and the oligotrophic Kuroshio Current of the Japanese coast. The cold waters examined were the mesotrophic waters of Discovery Passage in the Strait of Georgia, Patricia Bay of Saanich Inlet, and Alberni Inlet, all located off the west coast of Canada. The estuarine waters examined were mesotrophic waters of the Campbell River Estuary and its adjacent area, and mesotrophic and eutrophic waters of the Fraser River Estuary.

findings...

the microbial uptake kinetics in different water masses of the Canadian Pacific coast were highly diverse, probably because they are controlled primarily by different degrees of freshwater influence on these different water masses

7. Ages, A. B. and A. L. Wollard. 1991. Flow dynamics of the Campbell River estuary. Can. Tech. Rept. Hydro. Ocean Sci. 130: 104 p.

An analysis of the physical oceanography in the Campbell River estuary was carried out to support a habitat assessment for juvenile salmon. In this report, we discuss the interaction between tides and discharges and their effect upon the movement of the salt wedge, and examine conditions which would generate mixing across the halocline. Other aspects of the salinity intrusion such as its upstream limit and the effect of the topography upon the salinity distribution are discussed. The authors present a method to compute volume transport of salt water by combining a split one-dimensional numerical model with observed salinity profiles.

8. Bocking, R. C. 1991. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam rivers, 1989-1990. Can. data Rept. Fish. Aquat. Sci. 2124: 119 p.

Estimates of escapement were derived for the Campbell/Quinsam river system for 1989-90 using carcass tagging as part of the chinook key stream program. The Petersen estimate of chinook escapement was 14825 in 1989 and 15538 in 1990. Both males and females were predominantly age 4 and 5 but the specific age structure varied between the Campbell river, Quinsam River and Quinsam Hatchery. Escapement estimates are presented by river, sex and age.

findings...

- total escapement estimates for chinook salmon in the Campbell/Quinsam rivers system using carcass tagging were 14825 in 1989 and 15538 in 1990
- Population estimates based on live tagging in 1989 were almost double the carcass tagging estimate and were considered unreliable because of heavy predation on tagged chinook in the estuary by seals
- the age composition of chinook varied between males and females and between the Campbell and Quinsam rivers and the Quinsam Hatchery; the overall age return was lower in 1990 than in 1989
- females were more abundant in the river populations while males were generally more abundant in the hatchery returns
- the mean length of chinook salmon was greatest in the Campbell River, and smallest in the Quinsam Hatchery returns; females tended to be significantly larger than males
- there was a higher proportion of hatchery reared fish in the Quinsam River and at the hatchery than in the Campbell River, a pattern observed in previous years
- the number of recoveries for both adipose clips and decoded CWTs was low

implications...

- stratification of escapement estimates by sex and river on the Campbell/Quinsam rivers system should continue in order to minimize error in population estimates
- the low number of recoveries may make the precision of the estimates so low as to bring their usefulness into question
- the total estimated hatchery contribution to the chinook escapement, based on adipose clips (Method A), was 14327 (96.0%) in 1989 and 8969 (57.7%) in 1990; the contribution estimates derived using the adjusted CWTs recovered (Method B) were lower: 11797 (79.6%) in 1989 and 8218 (52.9%) in 1990
- the drop in total contribution of hatchery chinook to the Quinsam river system escapement from 1989 to 1990 was likely due to poor smolt to adult survival of the 1985 brood year

9. Levings, C. D., and J. S. MacDonald. 1991. Rehabilitation of estuarine fish habitat at Campbell River, British Columbia. pp. 176-190 in J. Colt and R. J. White (eds.). Fisheries bioengineering symposium. Am. Fish. Soc. Symp. 10.

This study, at the Campbell River estuary in British Columbia, involved a detailed evaluation of the use of artificial islands

Appendix H

the vicinity of Campbell River, B.C. The experiment was designed to provide data on survival to catch and escapement, of chinook deprived of estuarine habitat. Results up to mid March 1988 from returns to the commercial and sport fishery ($n = 365$) and returns to the river ($n = 273$) are evaluated.

16. Macdonald, J. S., C. D. Levings, C. D. McAllister, U. H. M. Fagerlund and J. R. McBride. 1988. A field experiment to test the importance of estuaries for chinook salmon (*Onchorynchus tshawytscha*) survival: Short term results. *Can. Jour. Fish. Aquat. Sci.* 45 (8): 1366-1377.

In late April of 1983, 1984, and 1985, 140,000 marked chinook salmon were transported by helicopter from Quinsom Hatchery to four release sites (river, estuarine, transition and marine) near Campbell River, BC, in an experiment to test the importance of estuarine residency to chinook survival.

findings...

fish at the marine site (released into seawater) experienced some transitory stress but little direct mortality or osmoregulatory shock

- marine fish were exposed to more bird and fish predators
- mortality of caged chinook at the marine site was higher than at all other sites despite seawater tests indicating they were smolted and ready for sea
- fish released into marine waters rarely dispersed to the Campbell River estuary
- fish released immediately adjacent to the estuary mouth (transition zone) had the highest dispersal pattern, with many returning to the estuary
- estuarine zone fish displayed the most restricted distribution
- fish released to the river and estuary remained in the sampling area for a longer period than those released to the marine and transition zones

implications...

- short term results suggest that an early estuarine phase in the life cycle of chinook salmon can have a positive effect on survival, possibly due to benefits relating to predation, feeding, osmoregulation and reduction in stress
- study results support the hypothesis that it is advantageous for juvenile chinook salmon to remain in estuaries for an extended period... lack or curtailment of estuarine residency due to estuarine degradation or overcrowding will likely reduce juvenile survival
- further understanding of the importance of estuaries to salmonids awaits the return of fish to the hatchery or recoveries by commercial and sports fishers

17. Andrew, J. H., M. Lightly and T. M. Webb. 1988. Abundance, age, size, sex and coded wire tag recoveries for chinook salmon escapements of Campbell and Quinsam rivers, 1985. *Can. Man. Rept. Fish. Aquat. Sci.* 2007: 53 p.

Intensive spawning ground surveys were conducted on the Campbell and Quinsam Rivers in 1985 as part of the chinook key stream program. Total hatchery contribution to the escapements were estimated using coded wire tagged/adipose mark rates at release. Estimated escapements by age are presented.

findings...

- the Petersen carcass tagging estimate of chinook escapement to the Campbell River was $1,427 \pm 201$ fish (95% CL) and to the Quinsam River was $1,590 \pm 175$ fish (95% CL)
- in both rivers, males predominated at age 4 and females at age 5
- escapements of adipose clipped chinooks were 160 to the Campbell and 393 to the Quinsam
- hatchery contributions to chinook escapement were 38.9% of males and 50.3% of females in the Campbell, and 72.2% of males and 80.3% of females in the Quinsam
- the number of recoveries for both adipose clips and decoded CWTs was low

implications...

- stratification of escapement estimates by sex and river on the Campbell/Quinsam rivers system should continue in order to minimize error in population estimates
- the low number of recoveries may make the precision of the estimates so low as to bring their usefulness into question
- the higher proportion of chinook of hatchery origin in the Quinsam River is almost certainly attributable to the release of artificially propagated fish from the Quinsam Hatchery

Appendix H

- all zones showed seasonal fluctuations in abundance, the overall means typically being the highest in the transition and marine zones
 - for all years sampled, 1983 produced the highest densities
 - counts were the lowest in 1984 in the transition and marine zones
20. Levings, C. D. 1988. Results of salmonid fish habitat restoration with dredged material in the Campbell River estuary, British Columbia, Canada. pp.100-104 in M. C. Landin (ed.). Inland waterways: proceedings of a national workshop on the beneficial uses of dredged material, 27-30 October 1987, St. Paul, Minnesota. Environ. Lab. US Army Eng. Waterways Exp. Stn. Tech. Rep. D-88-8.
21. Prentice, C. A. and W. S. Boyd. 1988. Intertidal and adjacent upland habitat in estuaries located on the east coast of Vancouver Island - a pilot assessment of their historical changes. Can. Wildlife Serv., Pacific and Yukon Region, Tech. Rept. Series No. 38.
22. Brown, T. J., C. D. McAllister, and B. A. Kask. 1987. Calanoid and cyclopoid copepods from nearshore epibenthic sled samples taken at Campbell River estuary and Discovery Passage in 1982. Can. MS Rep. Fish. Aquat. Sci. 1935:37 p.
- One hundred and forty-six epibenthic samples were collected from 18 sites in the Campbell River estuary and Discovery Passage. The calanoid copepods in the estuarine samples were dominated by Cyclops sp. Unidentified copepodites and Pseudocalanus minutus appeared numerically dominant in the few samples from the transition zone while unidentified copepodites and Cyclopina gracilis were dominant in the marine zone.
- The examination of 164 wild and 191 hatchery chinook stomachs indicated a seasonal preference for calanoids which ended in June. The loss of calanoids as a major dietary item for juvenile chinook corresponded to the disappearance of Neocalanus plumchrus from the marine zone sled samples. This is in accordance with Neocalanus plumchrus' life cycle in which the stage V copepodites migrate to deeper water in June and July.
23. Brown, T. J., C. D. McAllister, and B. A. Kask. 1987. Plankton samples in Campbell River and Discovery Passage in relation to juvenile chinook diets. Can. MS Rep. Fish. Aquat. Sci. 1915: 42p.
- Zooplankton sampling was carried out in the Campbell River estuary and Discovery Passage using Miller nets in 1983 and 1984. Five hundred sixty-four samples were collected from 9 stations over 33 sampling periods.
- The estuarine zone macro-zooplankton was dominated by cladocerans and calanoid copepods while calanoid copepods and copepod nauplii were dominant in the transition zone. The marine zone was dominated by calanoids and eggs. The micro zooplankton was dominated calanoid copepods and copepod nauplii in all three zones.
- The juvenile chinook salmon examined from the Campbell River area utilized four important food categories. Calanoids, amphipods, harpacticoids, and cladocerans were consumed by both the hatchery and wild chinook. The hatchery fish also ate cumacea while insects and decapod zoea were important in the wild chinook diets.
24. Brown, T. J., C. D. McAllister, and M. S. Kotyk. 1987. A summary of the salmonid catch-data from Campbell River estuary and Discovery Passage for the years 1982 to 1986. Can. Data Rep. Fish. Aquat. Sci. 650:103 p.
- The salmonid catch data was obtained by beach seining at 58 sites during 80 trips to Campbell River from March 1982 to August 1986. A total of 6,223 sets were made capturing 366,916 juvenile salmonids. Summary data is presented in chronological order.
- This report summarizes data pertaining to the Campbell River project, a five year program to evaluate the response of juvenile salmonids to estuarine rehabilitation, initiated using beach seine in 1982. In 1981, British Columbia Forest Products built a dry land log sort and dredged a booming pocket on the southwest side of the estuary. Four intertidal islands were built and planted with sedge grass from the dredged area to compensate for lost marshes.

Appendix H

25. Kotyk, M. S., T. J. Brown, B. A. Kask, C. D. Levings, C. D. McAllister, and J.S. Macdonald. 1987. Length, weight and coded wire tag data for juvenile salmonids sampled in the Campbell River Estuary and Discovery Passage, 1986. *Can. Data Rep. Fish. Aquat. Sci.* 630:27 p.

26. Levings, C. D., C. D. McAllister, and J. S. Macdonald. 1987. Capacity of estuarine wetlands for juvenile salmonid production - Campbell River estuary, British Columbia, Canada. *Northwest Environ. Jour.* 3:145-146.

Research notes highlighting estuarine and wetlands research in northwestern North America. Profile of the Campbell River estuary study (1982-1986) indicating focus of research (1) experimental releases to test the fry-to-smolt survival of fish deprived of estuarine residency/transition period through direct release to the sea; (2) evaluation of interactions and possible competition between wild and hatchery reared juvenile salmon; and (3) documentation of the feasibility of estuarine habitat restoration and its potential for increasing or maintaining Chinook production levels.

Preliminary results suggest that chinook released to the estuary survived best; possible competition is most likely in the foreshore regime; and man-made islands in a restored part of the estuary were used by juvenile salmonids.

27. Macdonald, J. S., I. K. Birtwell, and G. M. Kruzynski. 1987. Food and habitat utilization by juvenile salmonids in the Campbell River estuary. *Can. J. Fish. Aquat. Sci.* 44:1233-1246.

Salmonid behaviour and abundance in several microhabitats within the Campbell River estuary was observed monthly, from May to July, by divers. Concurrent vertical profiles of physical and biological parameters at each microhabitat were taken to characterize habitats frequented by the fish. Data were collected at high and low tide to record behavioral reactions to changes in water velocity, salinity, and temperature associated with tidal height and salt wedge intrusion. Samples of plankton collected at each microhabitat were compared with stomach contents of salmonids caught nearby to determine if interspecific differences in diet could be correlated with differences in the habitats they occupied.

findings...

- fish occurred in loose assemblages, aligned with the current, feeding near estuarine banks
- as water velocities increased with the ebbing tide, the fish concentrated in a shear region near the mouth of a slough, and behind large rocks and submerged vegetation
- at both low and high tide, larger coho and chinook salmon were in deeper, frequently more saline water and further from shore than the smaller conspecifics
- hatchery chinook were also seen in sloughs where water velocity was low
- marine influence as reflected in plankton composition and salmonid diet was greater in the outer estuary and in the deep salt water that intrudes the inner regions of the estuary
- differences in the habitats occupied by the fish were reflected in differences in their diets

implications...

- this study emphasizes the importance of maintaining diverse and complex estuarine habitat for the benefit of juvenile salmonids, and the perpetuation of salmon stocks
- during estuarine residency, salmonids utilize regions of moderate current for feeding, slough regions, stream margin cover, and back eddies for refuge and zones of increasing salinity which expose them to marine food and facilitate physiological adaptation to seawater
- the importance of specific habitat cannot always be measured by the amount of time it is occupied by fish
- high currents in areas where salmonids were rarely seen may act to dislodge benthic animals, thus making this food available to salmonids elsewhere
- infrequently used slough zones may not always have the water quality required to support salmonids but may support the marsh vegetation on which the salmonid detrital food chain is based

28. McPhail, J. D. 1987. Status of the salish sucker, *Catostomus* sp., in Canada. *Can. Field Nat.* 101 (2): 231-236.

The salish sucker, *Catostomus* sp., is an undescribed fish closely related to the longnose sucker, *Catostomus*. The species is part of the Chehalis fauna, and in Canada its distribution is restricted to the headwaters of the Campbell and Salmon rivers and Bertrand, Pepin and Salwein creeks in the lower Fraser River valley. Numbers have declined in all populations over the last decade and it may already be extirpated in the Campbell River. The main cause of the decline

Appendix H

of the nearshore habitats in providing food for the you fish was also monitored using an epibenthic sled.

From March to December 1982, 146 near shore samples were collected from the estuarine, transition and marine zones. Copepods nauplii, nematodes and harpacticoids dominated the estuarine and transition zones; harpacticoids, copepod nauplii, and amphipods the marine zone. Densities of nearshore epibenthos were highest in the marine zone and lowest in the estuarine zone.

The juvenile chinook were found to consume prey items from the freshwater and terrestrial, estuarine and nearshore epibenthic and marine pelagic (planktonic) environments. The nearshore epibenthos comprised the largest part of the diet in the transition zone.

40. Kennedy, K. A. and V. C. Brink. 1986. Differences in standing live and dead crops in estuarine marshes on Vancouver Island. Can. J. Bot. 64:322-325.

The purpose of this study was to determine the standing crops of vascular plants in estuaries on the east of Vancouver Island, BC. Standing crop measurements are the principal means of assessing the vascular plant contributions to the detrital food web in estuaries.

findings...

- there was a marked variation in the dynamics of the standing crops of tidal marshes on the east coast of Vancouver Island
- considerable variation was evident in the export of particulate organic matter from tidal marshes to the detrital food web of estuaries
- frequent tides of large amplitude removed large amounts of organic matter from stands at low elevations in marshes, while infrequent and shallow tides removed small amounts of matter from stands at higher elevations
- variations were most pronounced in the salt marsh stands where it appears from the persistence of standing dead crops in the *Salomica virginica* and *Distichlis spicata* - *Grindelia integrifolias* stands that higher salinities produce hard or "woody" stems resulting in decreased export of matter

implications...

- water action and species anatomy appear to explain differences in the amount of dead matter exported from tidal marshes to the detrital food web of estuaries

41. Kotyk, M. S., T. J. Brown, B. A. Kask, C. D. Levings, C. D. McAllister, J. S. Macdonald, and B. D. Chang. 1986. Length and weight data for unmarked juvenile salmonids sampled in the Campbell River estuary and Discovery Passage, 1984. Can. Data Rep. Fish. Aquat. Sci. 513:54 p.

42. Kotyk, M. S., T. J. Brown, B. A. Kask, C. D. Levings, C. D. McAllister, and J. S. Macdonald. 1986. Data record on coded wire tags recovered from juvenile salmonids at Campbell River estuary and Discovery Passage, 1985. Can. Data Rep. Fish. Aquat. Sci. 581:19 p.

Data are presented on lengths, weights and coded wire tags of juvenile salmonids salmon (Salmonidae) sampled by beach seine in the Campbell River Estuary location, date, and time of capture.

43. Kotyk, M. S., T. J. Brown, B. A. Kask, C. D. Levings, C. D. McAllister and J. S. Macdonald. 1986. Length and weight data for unmarked juvenile salmonids sampled in the Campbell River estuary and Discovery Passage, 1985. Can. Data Rept. Fish. Aquat. Sci. 616: 29 p.

44. Kotyk, M. S., T. J. Brown, B. A. Kask, C. D. Levings, C. D. McAllister, and J. S. Macdonald. 1986. Length, weight and coded wire tag data for juvenile salmonids sampled in the Campbell River estuary and Discovery Passage, 1986. Can. Data Rep. Fish. Aquat. Sci. 630:27 p.

45. Levings, C. D. 1986. Fish and invertebrate utilization of Campbell River Estuary Islands. P. 16-19 in J. H. Patterson (ed.) Proceeding of the Workshop on Habitat Improvements, Whistler, B.C., 8-10 May, 1984. Can. Tech. Rep. Fish. Aquat. Sci.

Appendix H

1483

This discussion refers to the artificial islands created as part of the Campbell River estuary habitat restoration project.

findings...

- juvenile chinook catches peak first in estuary habitat followed by transitional and marine
- wild chinook use of islands fluctuated from year to year
- the important factor in island configuration appears to be proximity to river channels
- chinook fry were scattered throughout the islands
- there was no statistical difference between the four islands in terms of insect larvae abundance
- cluster analysis showed that the natural and island communities in 1983 were not converged as of that time

implications...

- believe that the time difference between peak catches are evidence of residency time
- for chinook, at least, proximity to the river is highly relevant, perhaps more than channel orientation
- the invertebrate communities are not yet convergent with the reference sites but colonization of some species did occur rapidly and the animals appear to be used by the fish in the islands
- the fish stock of these islands is related to the overall abundance of wild stock in the estuary... when there are more fish there will be heavier use of the islands

46. Levings, C. D., C. D. McAllister, and B. D. Chang. 1986. Differential use of the Campbell River estuary, British Columbia, by wild and hatchery-reared juvenile chinook salmon (*Oncorhynchus tshawytscha*). *Can. J. Fish. Aquat. Sci.* 43:1386-1397.

From March 1982 to December 1983, juvenile chinook salmon were sampled by beach-seine in the Campbell River estuary and adjacent waters of Discovery Passage in order to examine estuarine use by wild and hatchery stocks. Studies are in progress to further examine interspecific interactions (ie. with pink and chum salmon) in this heavily used area of the coastal waters.

findings...

- wild juvenile chinook entered the estuary as migrant fry and were present in the estuarine zone mainly from late April to June, in the transition zone in mid-May to July, and in the marine zone in July
- hatchery fish were released from early May to early July
- maximum catches of wild stocks were similar in the estuarine and transition zones, while maximum catches of most hatchery stocks were higher in the transition zone
- for both wild and hatchery chinook, catches in the marine zone were much lower than in the estuarine and transition zones
- wild fry resided in the estuary for 40-60 days while most hatchery fish used the estuary for about half this period
- wild stocks showed a relatively constant increase in mean size from May to September
- higher rates of increase in the mean size of hatchery fish were shown by groups with earlier release dates and smaller mean sizes
- residency time and growth rates for wild fish were comparable with those observed in an estuary without hatchery fish
- potential for interaction between wild and hatchery stocks was greatest in the transition zone, where hatchery fish were most abundant and as hatchery releases coincided with wild stock occupation of this area

implications...

- chinook food limitations and interspecific and intraspecific interactions may be most significant in the transition zone

47. Patterson, J. H. 1986. Proceedings of the workshop on habitat improvements, Whistler, B. C., 8-10 May 1984. *Can. Tech. Rep. Fish. Aquat. Sci.* 1483:219 p.

The workshop on habitat improvements provided information on a variety of improvement activities, techniques and concepts for a wide range of aquatic habitats (estuaries, lakes, streams and rivers). The presentations from a broad spectrum of professions (federal and provincial biologists, consulting biologists and engineers, economists, research scientists) representing Ontario, British Columbia, Washington and Oregon, addressed "state of the art" techniques and presented results from projects designed to restore and develop habitats. Participants described techniques that worked, and in some cases outlined how habitat manipulations affected fish production.

Appendix H

findings...

- estuaries have received less study than freshwater habitats and are therefore not as well understood
- the research link is essential to understanding the relationship between habitat type and fish production... to understand what we are doing in habitat manipulation and why it works
- we have a strong obligation to evaluate improvement projects
- improvement activities should be tied to a co-operatively developed production plan (district or watershed basis) and specific management strategies
- individual projects should be part of a larger (holistic watershed) picture, as activities upland, on stream banks and upstream may affect project design and effectiveness and should be considered in project development
- communication within departments, between colleagues, agencies, provinces and states is essential both in the planning of improvement projects as well as in reporting results of project assessments

48. Anderson, E.P., and M. Galbraith. 1985. Use by juvenile chinook salmon of artificial habitat constructed from dredged materials in the Campbell River estuary. - Edward Anderson Marine Services, Victoria, British Columbia: - 93p. + appendices (various pagings): ill. Prepared for / prepare pour DFO. Title in abstract differs: Use by juvenile chinook salmon of artificial islands constructed from dredged material in the Campbell River estuary. Manuscript report. SH224.5 P11 85-06

This study pertains to the Campbell River Project. In May 1983, 15 months after the islands were completed, the consultant conducted a study of the development of benthic faunal communities on the islands as well as the use of the islands by fish. The islands, constructed on the site of the former British Columbia Forest Products booming grounds, are gravel platforms situated at 3-4m above chart datum, in the upper intertidal zone.

findings...

- benthic communities were in an early stage of succession
- communities of planted plots resembled those of unplanted areas but were different from those of the natural reference marsh at equivalent elevation
- insects, a broad common category of food items in juvenile salmon stomachs, were about as numerous in planted plots as in unplanted plots
- in contrast, cove and groove indentations of island shores, which collected fine sediments and detritus, supported communities which had converged toward those of their natural reference areas
- wild chinook salmon used shallow water among the islands more than did hatchery chinook or coho juveniles

implications...

- the as yet thin cover provided by the planted sedge and rush sod plugs did not appear to reduce the value of the artificial island platforms as a food source for juvenile chinook
- the shallow habitats may have afforded greater refuge from competition to the wild juveniles as they were smaller than hatchery fish
- the distribution of chinook juveniles in the experimental area and their feeding success could be related to small variations in elevation and the interaction of local topography with currents
- small-scale features of contour shape (coves, grooves, obstructions causing back eddies) can be designed to direct benthic faunal community development, to promote occupation by migrating juvenile salmonids, and to provide feeding opportunities for those fish

49. Brown, T. J., R. F. Clarke, and B. A. Kask. 1985. Meiofauna sled samples from Campbell River estuary and Discovery Passage, 1982: calanoid copepod species identification. Can. Data Rep. Fish. Aquat. Sci. 483: 22 p.

50. Brown, T. J., B. A. Kask, B. D. Chang, M. Kotyk, C. D. McAllister, J.S. Macdonald, and C. D. Levings. 1985. Salmonid catch data from Campbell River and Discovery Passage, 1984. Can. Data Rep. Fish. Aquat. Sci. 497: 79 p.

The salmonid catch data were obtained by beach seining during 17 trips to Campbell River from January to September 1984. This report presents the data in order sorted by trip.

51. Brown, T. J., and B. A. Kask. 1985. 1984 Campbell River zooplankton samples. Can. Data Rep. Fish. Aqua. Sci. 516: 69 p.

Appendix H

In 1984, 293 zooplankton samples were collected from Campbell River estuary and Discovery Passage using dual miller nets. These samples have been counted to major taxa and sorted by station and arranged chronologically. The data are presented.

These data pertain to the Campbell River Project, a detailed evaluation of the biological response to physical changes brought about by rehabilitative activities in the estuary involving the construction of four islands. Studies of water quality, currents and salt wedge intrusion, vegetation, benthic communities, epibenthic and planktonic communities, and salmonid utilization were initiated for the project. Investigations included the extent of colonization and utilization of the new islands by juvenile salmonids and the comparison of estuarine dependency between wild and hatchery chinooks.

52. Brown, T. J., M. Kotyk, B. A. Kask, C. D. Levings, C. D. McAllister and J. S. Macdonald. 1985. Salmonid catch-data from Campbell River and Discovery Passage, 1985. Can. Data Rept. Fish. Aquat. Sci. 554: 81 p.

The salmonid catch data was obtained by beach seining at 42 sites during 13 trips to Campbell River from January to August 1985. During the 1985 season, 924 sets were made and 108,317 salmonids were identified and counted. This report presents the data in order sorted by trip.

These surveys, a component of the Campbell River Project, were also used to provide data on the dispersal of marked hatchery chinook released into the river, estuary, transition and marine zones. These experiments were designed to compare the survival of juvenile chinook salmon released into different habitats (Levings et al. 1984). The beach seine surveys have been conducted yearly since 1982 and are reported in Brown et al. 1983, 1984a, b.

53. Brown, T. J., B. A. Kask, C. D. McAllister, M. Kotyk, C. D. Levings, and J.S. Macdonald. 1985. 1985 Campbell River zooplankton samples. Can. Data Rep. Fish. Aquat. Sci. 572: 45 p.

In 1985, there were 2 estuarine, 2 transition and 1 marine station sampled routinely producing 126 zooplankton samples. These samples have been counted to major taxa and sorted by station and arranged chronologically. The data presented includes date, time, station number, net type, tide, temperature, salinity, and volume filtered.

These data form a component of the Campbell River Project.

54. Cross, S.F. 1985. Analysis of 1984 chinook fry and smolt samples from Campbell River estuary and Discovery Passage. – E.V.S. Consultants Ltd, Sidney, British Columbia: – 1v. (unnumbered) Prepared for / Prepare pour DFO. SH224.5 P11 85-02.

This document represents a summary of the chinook fry and smolt gut analysis data collected as part of the habitat assessment and salmonid prey utilization project at the Campbell River estuary during 1984. Of 305 fish examined, 183 represented unmarked individuals while the remaining 122 had been marked prior to capture. Data is presented by fish, station date and time of sample collection. Meristic data and numbers of each type of prey were also compiled.

55. Kask, B. A., and T. J. Brown. 1985. Meiofauna sled samples from Campbell River estuary and Discovery Passage. 1983. Can. Data Rep. Fish. Aquat. Sci. 499: 207 p.

This is the second in a series of data records on the epibenthic nearshore community of the Campbell River estuary and Discovery Passage. The epibenthic meiofauna community was sampled in conjunction with beach seining on eighteen trips to the Campbell River area from January to December 1983. Stations were sampled in the estuarine, transition and marine zones. The data from these samples are presented here.

These data form a component of the Campbell River Project.

56. Kotyk, M. S., T. J. Brown, B. A. Kask, C. D. Levings, C. D. McAllister, J. S. Macdonald, and B. D. Chang. 1985. Length and weight data for unmarked juvenile salmonids sampled in the Campbell River estuary and Discovery Passage, 1984. Can. Data Rep. Fish. Aquat. Sci. 513: 54 p.

Appendix H

This data was collected to determine the importance of estuarine habitats to juvenile salmonids. Data are presented on lengths and weights of unmarked juvenile pink, chum, coho, and chinook salmon along with steelhead trout sampled by beach seine in the Campbell River estuary and Discovery Passage in January to September 1984. Data are also provided on location, date, and time of capture. Length and weight data for marked juvenile chinook salmon sampled in this study are presented in Kotyk et al. (1985).

57. Kotyk, M. S., T. J. Brown, B. A. Kask, C. D. Levings, C. D. McAllister, J. S. Macdonald, and B. D. Chang. 1985. Data record on coded wire tags recovered from juvenile salmonids at Campbell River estuary and Discovery Passage, 1984. Can. Data Rep. Fish. Aquat. Sci. 527: 17 p.

Data are presented on lengths, weights and coded wire tags of juvenile salmonids salmon (Salmonidae) sampled by beach seine in the Campbell River estuary and Discovery Passage in January to August 1984. Data are also provided on location, date, and time of capture.

58. Kotyk, M. S., C. D. Levings, T. J. Brown, C. D. McAllister, J. S. Macdonald, J. R. McBride, and U. H. M. Fagerlund. 1985. An account of an experimental release of marked juvenile chinook to freshwater, estuarine, and marine habitats near Campbell River, B.C., 1984. Can. Tech Rep. Fish. Aquat. Sci. 1397: 31 p.

Smolt to adult survivorship of juvenile chinook was tested by releasing hatchery reared fish into four contrasting (river, estuarine, transition and marine) habitats. Transport of 142,000 marked chinooks smolts (3g) by helicopter from the Quinsam Hatchery to the four release sites near the Campbell River did not unduly aggravate the state of stress already induced during holding in painted troughs after marking.

findings...

- seawater challenge tests showed that the chinook were smolted and thus were "seawater ready"
- there was no evidence of immediate direct mortality or osmoregulatory shock
- observations showed that the fish schooled and aggregated near surfaces and suggested the marine release fish were exposed to more bird and fish predation
- feeding may have been re-initiated more slowly at the marine and transition sites as compared to estuarine locations
- the forage ratio at the marine site surpassed all other locations after a three week period
- mortality of cage held chinook was very low (<1%) at all sites
- beach seining up to 10 weeks following release showed that marine fish did not disperse into the other release zones and were not found after one week following release
- recaptures of chinook from other releases also suggest rapid and wide dispersal

implications...

- the helicopter transport of 142,000 marked chinook from Quinsam Hatchery to four contrasting habitats was performed without major problems
- returns of marked fish will be monitored making it possible to compute mortality rates for the marked groups released to the various habitats

59. Leigh-Spencer, Sally. 1985. Campbell River estuary benthic quadrat results 1984. British Columbia Forest Products, Resources Planning Group, Crofton, B. C. 47 p.

60. Macdonald, J. S., G. M. Kruzynski, I. K. Birtwell, K. D. Seaman, L. Del-Mistro and M. Kotyk. 1985. Juvenile salmonid food and plankton samples from an inner and outer estuarine station in the Campbell River Estuary, British Columbia, 1984. Can. Data Rept. Fish. Aquat. Sci. 520: 30 p.

Data are presented from stomach analysis of fish sampled with a beach seine and from plankton tows carried out during three trips to the Campbell River Estuary in the spring and summer of 1984. Juvenile salmonid prey and planktonic organisms are chronologically itemized.

61. Piercey, G. E., I. K. Birtwell, H. Herunter, M. Kotyk, G. M. Kruzynski, J. S. Macdonald, and K. Seaman. 1985. Data report on physical aquatic habitat characteristics and observations of fish at two regions in the estuary of the Campbell River,

Appendix H

British Columbia, 1984. Can. Data Rep. Fish. Aquat. Sci. 55l: 107 p.

Data are presented on the physical characteristics of two contrasting regions in the estuary of the Campbell River as part of a study to characterize juvenile salmonid habitats. On three occasions, temperature, conductivity, salinity, pH, oxidation-reduction potential, dissolved oxygen, water velocity and direction, and light intensity were determined at precise depth intervals in the water column. Subjective assessments of weather conditions were made at the time of these determinations. Observations of juvenile salmonids (species, depth occupied) were made by divers just before physical measurements were taken

62. Raymond, B. A., M. M. Wayne and J. A. Morrison. 1985. Vegetation, invertebrate distribution and fish utilization of the Campbell River Estuary, British Columbia. Can. Man. Rept. Fish. Aquat. Sci. 1829: 50 p.

The purpose of this report is to describe and map habitats of the Campbell River Estuary in terms of water quality, vegetation, and invertebrate microfauna; and to present information on fish utilization of these habitats. Water quality, vegetation, invertebrate and fish resources of the Campbell River Estuary were examined from April to August 1980.

findings...

- water quality was within normal ranges
- relative abundance of seagrasses and benthic macroalgae were noted
- five brackish marsh communities were identified
- a total of 42 taxa of benthic macrofauna were identified
- common prey species for juvenile salmon were copepods, mysids, aquatic and terrestrial insects, planktonic crustaceans and cladocerans

implications...

- this study provides a baseline for evaluation of habitat restoration work initiated in 1981

63. Woods, S. M. 1985. Report on ocean dumping R and D Pacific Region: Department of Fisheries and Oceans, 1983-1984. Canadian contractor report of hydrography and ocean sciences 20: 53 p.

Ocean dumping research conducted in the Pacific Region during 1985-1986 was reviewed at a workshop held on 5 December 1986 at the Institute of Ocean Sciences; the proceedings have been summarized in extended abstract form for publication. RODAC-funded studies presented at the workshop include feasibility assessment of sediment toxicity tests suitable for ODCA application review, review and analysis of historical environmental data from the Point Grey ocean dumpsite, a literature review of representative sediment sampling and sub-sampling, and development and testing of a free-vehicle experimental platform (the Benthic Lander).

64. Bilton, H. T., R. B. Morlet, A. S. Coburn and D. Brouwer. 1984. Time and size at release experiment: Four releases of three size categories of juvenile chinook salmon from the Quinsam Hatchery in the spring of 1983. Can. Data Rept. Fish. Aquat. Sci. 463: 27 p.

This report provides, in readily accessible form, background information required to assess the results of an experiment in progress at the Quinsam River production hatchery, Campbell River, B.C. The experiment is designed to measure the effects of time and size at release of juvenile chinook salmon (*Oncorhynchus tshawytscha*) on their subsequent survival, growth, distribution, and age at maturity. In the spring of 1983, four releases (May 5, May 26, June 16, and July 7) of juvenile chinook salmon, each comprised of three size groups, were released from the Quinsam River hatchery, representing a combined total of 359,514 marked and tagged fish. Information from samples collected just prior to release on lengths, weights, sex composition, health, body composition, and ability of released fish to adapt to sea water is given.

65. Brown, T. J., and B. A. Kask. 1984. 1983 Campbell River Miller net samples. Can. Data Rep. Fish. Aquat. Sci. 471: 73 p.

In 1983, 274 zooplankton samples were collected at Campbell River and Discovery Passage using dual miller nets. The data on fish population and movements was collected using a 15m beach seine in the estuary and Discovery Passage.

Appendix H

The 1983 fish catch data are presented in Brown et al. 1984 while the CWT data and length weight data are presented separately (Kotyk et al. 1984 and Chang et al. 1984).

These data form a component of the Campbell River Project.

66. Brown, T. J., R. F. Clarke, and B. A. Kask. 1984. Meiofauna sled samples from Campbell River estuary and Discovery Passage 1982: calanoid copepod species identification. *Can. Data Rep. Fish. Aquat. Sci.* 483: 22 p.

Between March and December 1982 twenty sampling trips were made to the Campbell River estuary and Discovery Passage area. One hundred and forty six epibenthic sleds were collected from eighteen sites and the calanoid copepods were identified to species. This report presents these data sorted by station and date.

The epibenthic sled samples were taken as part of a project to evaluate the importance of estuarine and alternate habitats to juvenile wild and hatchery salmonids. Data from coded wire tags (CWT) obtained from 1982 samples of juvenile chinook salmon taken during the previous survey are recorded by Gordon et al. (1983). For 1983 CWT see Kotyk et al. (1984), and for length-weight data Chang et al. (1984).

These data form a component of the Campbell River Project.

67. Brown, T. J., B. A. Kask, B. D. Chang, M. S. Kotyk, C. D. McAllister, J. S. Macdonald, and C. D. Levings. 1984. Salmonid catch data from Campbell River and Discovery Passage, 1984. *Can. Data Rep. Fish. Aquat. Sci.* 497: 79 p.

The salmonid catch data were obtained by beach seining during 17 trips to Campbell River from January to September 1984. This report presents the data in order sorted by trip.

68. Brown, T. J., C. D. McAllister, C. D. Levings, M. S. Kotyk, B.D. Chang, and J. S. Macdonald. 1984. Salmonid catch-data from Campbell River and Discovery Passage 1983. *Can. Data. Rep. Fish. Aquat. Sci.* 444: 97 p.

The salmonid catch data was obtained by beach seining during 19 trips to Campbell River from January to December 1983. This report presents the data in chronological order sorted by species and group codes.

69. Brownlee, M. J., E. R. Mattice, and C. D. Levings (comps.) 1984. The Campbell River estuary: a report on the design, construction, and preliminary follow-up study findings of intertidal marsh islands created for purposes of estuarine rehabilitation. *Can. MS Rep. Fish. Aquat. Sci.* 1789: 54 p.

This report focuses on the co-operative efforts of agency staff, members of industry and the public in developing and constructing a new log handling facility and rehabilitating an industrialized estuarine area of approximately 32 hectares that had been intensively utilized for log handling activities for over 75 years. Reported are the planning and construction of the new dry land log sorting facility and the rehabilitative measures, design details and preliminary results of the first year's studies of a longer term program being undertaken to assess the stability and biological implications of the rehabilitative measures, and future studies. All studies are continuing.

findings...

- preliminary follow up study results indicate that the intertidal islands are stable
- 93% of the 23,302 marsh cores transplanted are growing
- invertebrate colonization is still incomplete
- juvenile wild chinook and chum salmon utilize the islands in proportion to the abundance of salmon fry in the estuary
- hatchery reared juvenile salmon do not make extensive use of the islands
- migratory bird use of the islands has been recorded

70. Chang, B. D., M. S. Kotyk, T. J. Brown, C. D. Levings, C. D. McAllister, and J. S. Macdonald. 1984. Length and weight data for unmarked juvenile salmon sampled in the Campbell River estuary and Discovery Passage, 1983. *Can. Data. Rep. Fish. Aquat. Sci.* 446: 39 p.

Appendix H

Data are presented on lengths and weights of unmarked juvenile pink (*Oncorhynchus gorbusha*), chum (*O. keta*), coho (*O. kisutch*), and chinook (*O. tshawytscha*) salmon sampled by beach seine in the Campbell River estuary (B.C., Canada) and Discovery Passage from January to December, 1983. Data are also provided on location, date, and time of capture.

71. Kask, B. A., and T. J. Brown. 1984. Meiofauna sled samples from Campbell River estuary and Discovery Passage 1982. Can. Data Rep. Fish. Aquat. Sci. 476: 157 p.

The epibenthic meiofauna community was sampled in conjunction with beach seining on twenty trips to the Campbell River area from March to December 1982. The data from these samples are presented here.

These data form a component of the Campbell River Project.

72. Kotyk, M. S., B. D. Chang, T. J. Brown, C. D. Levings, C. D. McAllister, and J. S. Macdonald. 1984. Data record on coded wire tags recovered from juvenile chinook at Campbell River estuary and Discovery Passage, 1983. Can. Data Rep. Fish. Aquat. Sci. 457: 27 p.

Data are presented on lengths, weights and coded wire tags of juvenile chinook salmon *Oncorhynchus tshawytscha* subsampled from beach seine catches in the Campbell River Estuary and Discovery Passage from January to December, 1983. Data are also provided on location, date, and time of capture

73. Levings, C. D., M. S. Kotyk, T. J. Brown, C. D. McAllister, J. S. Macdonald, U. Fagerlund, and J. McBride. 1984. An account of an experimental release of marked juvenile chinook to freshwater, estuarine, and marine habitats near Campbell River, B. C. Can. Tech. Rep. Fish. Aquat. Sci. 1269: 35 p.

Smolt to adult survivorship of juvenile chinook was tested by releasing hatchery reared fish into four contrasting (river, estuarine, transition and marine) habitats. Transport of 142,000 marked chinooks smolts (3g) by helicopter from the Quinsam Hatchery to the four release sites near the Campbell River did not unduly aggravate the state of stress already induced during holding in troughs after marking.

findings...

- seawater challenge tests showed that the chinook were smolted and thus were "seawater ready"; but evidence from other sources (caged fish studies and histological data) suggested smoltification was incomplete
- there was no evidence of immediate direct mortality or osmoregulatory shock
- observations showed that the fish schooled and aggregated near surfaces and suggested the marine release fish were exposed to more bird and fish predation
- feeding may have been re-initiated more slowly at the marine and transition sites as compared to estuarine locations
- mortality of cage held chinook was very low (<1%) at all sites
- beach seining up to 4 days following release showed that marine fish did not disperse into the other release zones
- transition zone fish had the widest apparent dispersal pattern, while estuarine zone fish displayed the most restricted distribution

implications...

- the helicopter transport of 142,000 marked chinook from Quinsam Hatchery to four contrasting habitats was performed without major problems
- returns of marked fish will be monitored making it possible to compute mortality rates for the marked groups released to the various habitats

74. McAllister, C. D., C. D. Levings, T. J. Brown, and B. D. Chang. 1984. Juvenile chinook salmon in relation to new island habitat, Campbell River Estuary, 1982, p. 20-23. In M. J. Brownlee, E. R. Mattice, and C. D. Levings [eds.] The Campbell River estuary: a report on the design, construction, and preliminary follow-up study findings of intertidal marsh islands created for purposes of estuarine reclamation. Can. MS Rep. Fish. Aquat. Sci. 1789: 54 p.

NOTE: See item #s 69 and 77

Appendix H

75. Marvin Shaffer and Associates. 1984. Benefit cost analysis of proposed harbour development on Campbell River Indian Reserve No. 11. Canada, Small Craft Harbours Branch.

NOTE: See item # 98.

76. Nordin, R. N., C. J. P. McKean and M. Roch. 1984. Phytoplankton, zooplankton and dissolved metals in the lakes of the Campbell River watershed, Vancouver Island. Abstracts of papers presented at the 11th Annual Aquatic Toxicity Workshop, Richmond, B. C. November 13-15, 1984.

Four lakes on Vancouver Island were investigated to determine the effects of increased concentrations of zinc, copper, lead and cadmium from a mining operation on the aquatic biota of the lakes.

findings...

overall evidence indicates that more severe effects have occurred in phytoplankton and zooplankton than the fish community

implications...

the lower trophic levels appear to be more sensitive indicators of the effects of metals

77. Raymond, B., and C. D. Levings. 1984. Benthic invertebrates associated with the islands in the Campbell River estuary: a preliminary report, p. 17-19. In M. J. Brownlee, E. R. Mattice and C. D. Levings (eds.) The Campbell River estuary: a report on the design, construction, and preliminary follow-up study findings of intertidal marsh islands created for purposes of estuarine rehabilitation. Can. MS Rep. Fish. Aquat. Sci. 1789: 54 p.

NOTE: See item #s 69 and 74

78. Seki, H., A. Otsuki, S. Daigobo, C. D. Levings and C. D. McAllister. 1984. Microbial contribution to the mesotrophic ecosystem of the Campbell River Estuary during summer. Arch. Hydrobiol. 102 (2): 215-228.

The microbial role in the maintenance of a mesotrophic environment was studied during summer at the Campbell River Estuary, B.C., Canada. The system represents one common type of small complex partially modified estuaries in the subarctic region.

findings...

the intricate topography of this estuary was shown to have a reasonable relation with groupings of various small-scale habitats from the oligotrophic to eutrophic ends of the mesotrophic range

implications...

such high diversities in environmental conditions were suggested to be favourable for efficient trophodynamics in the estuarine ecosystem, supporting production of juvenile salmon migrating to the sea.

79. Bilton, H. T., A. S. Coburn and R. B. Morley. 1983. Time and size at release experiment: Four releases of three size groups of juvenile chinook salmon from the Quinsam Hatchery in the spring of 1982. Can. Data Rept. Fish. Aquat. Sci. 397: 22 p.

This report forms part of an ongoing experiment at the Quinsam Hatchery to measure the effects of time and size release of juvenile chinook salmon on their subsequent survival, growth, distribution and age at maturity. In the spring of 1982 four releases of juvenile chinook salmon, each comprised of three size groups, were released from the Quinsam Hatchery, representing a combined total of 315,986 marked and tagged fish. Prior to release, samples of smolts were examined for disease, proximate analysis, and sea water challenge tests. Specific information on lengths, weights, sex, health and ability to adapt to sea water is given.

80. Brown, T. J., C. D. McAllister, C. D. Levings, and M. Kotyk. 1983. Salmonid catch-data from Campbell River and Discovery Passage, 1982. Can. Data Rep. Fish. Aquat. Sci. 416: 97 p.

Appendix H

The salmonid (Salmonidae) catch data was obtained by beach seining during 20 trips to Campbell River from March to December 1982. This report presents its data in chronological order sorted by species and group codes.

81. Gordon, D. K., M. Kotyk, T. Brown, C. D. Levings, and C. D. McAllister. 1983. Data record on coded wire tags recovered from juvenile chinook at Campbell River estuary and Discovery Passage, 1982. Can. Data Rep. Fish. Aquat. Sci. 403: 57 p.

Data are presented on lengths, weights, and coded wire tag readings from juvenile chinook taken in beach seines at Campbell River estuary and Discovery Passage in 1982. Sampling was conducted at 55 stations over the period May to December 1982. Data are provided on location, date, and time of capture.

82. Kotyk, M., B. D. Chang, T. J. Brown, C. D. Levings, and C. D. McAllister. 1983. Length and weight data for unmarked juvenile salmon sampled in the Campbell River estuary and Discovery Passage, 1982. Can. Data Rep. Fish. Aquat. Sci. 408: 61 p.

Data are presented on lengths and weights of juvenile pink, chum, coho and chinook salmon sampled in beach seines in the Campbell River estuary and Discovery Passage in March to December, 1982. Data are also provided on location, date and time of capture.

83. Levings, C. D. and M. Kotyk. 1983. Results of two boat trawling for juvenile salmonids in Discovery Passage and nearby channels, northern Strait of Georgia. Can. Man. Rep. Fish. Aquat. Sci. 1730: 55 p.

Chum, pink, coho, chinook, steelhead, and sockeye juveniles were sampled with a two boat trawl in channels leading off the northern Strait of Georgia in 1982 and 1983. Length and frequency data are given for fish subsampled from the trawls.

findings...

- Chum dominated the catches and peaked in abundance in late June, as did pinks; it is probable that the majority of the Chum were from the Fraser River system
- Chinook and Coho were less abundant and were primarily fish from the Quinsam Hatchery
- Steelhead and Sockeye were uncommon
- Judging from data obtained in June 1983, most of the Chum migrating to sea from the northern Strait of Georgia use Discovery Passage

implications...

- If stock composition were determined, Discovery Passage could be a useful monitoring location for migrating juvenile Chum salmonids.

84. Scubert, N. D. 1983. Trapping and coded wire tagging of wild coho salmon smolts in the Campbell River (Semiahmoo Bay), 1982. Can. Man. Rept. Fish. Aquat. Sci. 1738: 31 p. **NOTE: this is the Fraser River estuary**

85. Waddell, B., and S. Markowski. 1983. Campbell River foreshore biophysical inventory. /prepared for Water Use Unit, Habitat Management Division, Department of Fisheries and Oceans. – Water Use Unit, Habitat Management Division, Department of Fisheries and Oceans, Vancouver, British Columbia: – 153p.: ill. SH349 A5 85-05

86. Alderdice, D. F. and W. E. McLean. 1982. A review of the potential influence of heavy metals on salmonid fishes in the Campbell River, Vancouver Island, British Columbia. Can. Tech. Rept. Fish. Aquat. Sci. 1104: 67 p.

Potential joint toxic effects of dissolved and extractable zinc, copper and cadmium levels in water samples taken from the Campbell River over the past 12 years (1971-1982) are assessed for three salmonids native to the river – the chinook and coho salmon and the steelhead trout. As little direct evidence is available regarding toxicity of Campbell River water, the assessment is based on relevant data from the current toxicological literature.

findings...

Appendix H

- there has been a consistent increase in zinc levels in river water, rising from about 0.007 mg/L in 1971 to about 0.048 mg/L at the end of 1980
- no consistent rise in copper concentrations could be demonstrated in the above period
- at mean water hardness of 21.5 (as mg/L CaCO₃) (1971-1982) mean metal levels in the river in recent years have been 0.0464 mg/L zinc (1981-1982) and 0.0021 mg/L copper (1980-1982), while cadmium has been below detection limits
- in the last few years (1980-81) "spikes" of high concentration have reached a maximum of 0.066 mg/L zinc and 0.0035 mg/L copper

implications...

- assuming additivity of toxic effects and average heavy metal loads, Campbell River water is calculated to have been toxic to non-exposed juvenile steelhead and chinook for most of the period 1980-81
- pre-exposed juvenile salmonids, incubated and hatched in the river, are judged to be more resistant to heavy metals making Campbell River waters non-toxic for this group (although the extent of risk cannot be quantified at this time)
- the Zn+Cu loads appear to have become critical to non-exposed (feeder stream and hatchery juveniles) within the last two years (1980-81)
- despite differences in susceptibility of pre-exposed and non-exposed fish, small differences in water characteristics due to upstream conditions (eg. decreases in hardness or pH) could increase the toxic potential of current heavy metal loads in the river water
- with respect to salmonid well-being, water quality in the Campbell River has reached a critical state and it is recommended that (1) immediate remedial action be taken to reduce Zn and Cu concentrations, and (2) investigations be commenced to determine maximum acceptable heavy metal loads (Zn+Cu+Cd) for both salmonids and representative organisms in the supporting food web

87. Bilton, H. T., A. S. Coburn and R. B. Morley. 1982. Time and size at release experiment: four releases of three size groups of juvenile coho salmon from Quinsam Hatchery, spring of 1981. *Can. Data Rept. Fish. Aquat. Sci.* 329: 25 p.

This report forms part of an ongoing experiment at the Quinsam Hatchery to measure the effects of time and size release of juvenile chinook salmon on their subsequent survival, growth, distribution and age at maturity. In the spring of 1981 four releases of juvenile coho salmon, each comprised of three size groups, were released from the Quinsam Hatchery, representing a combined total of 135,634 marked and tagged fish. Prior to release, samples of smolts were examined for disease, proximate analysis, and sea water challenge tests. Specific information on lengths, weights, sex, health and ability to adapt to sea water is given.

88. Clark, M.J.R. 1982. Impact of the Westmin Resources Ltd. mining operation on Buttle Lake and the Campbell River watershed. - British Columbia Ministry of Environment, Victoria, B.C.: - 2v.: ill. Nanaimo has: Microfiche - v.1 4 fiche; v.2 14 fiche. TD195 M5 C52

89. Edward Anderson Marine Sciences Ltd. [1982]. Stomach contents of juvenile chinook salmon from the Campbell River estuary, March - November 1982. - Edward Anderson Marine Sciences Ltd, Vancouver, British Columbia: - 1v (various pagings). Prepared for/Prepare pour DFO. SH224.5 P11 82-06

This data report presents the results of stomach contents of 378 juvenile chinook salmon taken from the Campbell River estuary and nearby marine waters during the spring, summer, and fall of 1982. Both wild fish and marked hatchery fish are represented.

90. Kennedy, K. A. 1982. Plant communities and their standing crops on estuaries of the east coast of Vancouver Island. M. Sc. thesis, University of British Columbia.

The purpose of this study was to determine the standing crops of vascular plants in estuaries on the east of Vancouver Island, BC. Standing crop measurements are the principal means of assessing the vascular plant contributions to the detrital food web in estuaries.

Appendix H

implications...

- clearly the fish resource is small relative to that of the Fraser River, however, more Campbell River residents are active fisherman or economically involved with the area commercial and sports fisheries, meaning a higher relative dependency on the fishery than in the Fraser Basin
- awareness of the local resource is much higher than would be expected of the residents of the Fraser Basin, suggesting a high preservation value placed by local residents upon the Campbell/Quinsam system

94. Bilton, H. T. and A. S. Coburn. 1981. Time and size at release experiment: four releases of three size categories of juvenile coho salmon from the Quinsam hatchery in the spring of 1980. Can. Data Rept. Fish. Aquat. Sci. 252: 23 p.

This report forms part of an ongoing experiment at the Quinsam Hatchery to measure the effects of time and size release of juvenile coho salmon on their subsequent survival, growth, distribution and age at maturity. In the spring of 1980 four releases of juvenile chinook salmon, each comprised of three size groups, were released from the Quinsam Hatchery, representing a combined total of 132,056 marked and tagged fish. Prior to release, samples of smolts were examined for disease, proximate analysis, and sea water challenge tests. Specific information on lengths, weights, sex, health and ability to adapt to sea water is given.

95. Hooton, R. S. 1978. Campbell/Quinsam creel survey report. British Columbia Fish and Wildlife Branch. Fish. Tech. Circ. 35: 10 p.

96. Bell, L.M., and J.M. Thompson. 1977. The Campbell river estuary: status of environmental knowledge to 1977. / report of the Estuary Working Group, Department of Fisheries and the Environment, Regional Board Pacific Region. - Fisheries and Marine Service, Pacific Environment Institute, West Vancouver. - 346p.: ill. - (Special estuary series; no.7) Filed as Canada. Estuary Working Group. Special estuary series; 7 Bibliography Collection

97. Hamilton, R. and J. W. Buell. 1976. Effects of modified hydrology on Campbell River salmonids. Tech. Rept. Series PAC/T-76-20: 177 p.

The object of the study was to determine possible effects to the Campbell River fishery from the proposed John Hart hydroelectric power plant expansion. Despite time limitations, it was intended to gather sufficient data to determine the possible consequences of three expansion alternatives on the fisheries resource, enabling BC Hydro to assess the engineering and economic feasibility of these alternatives before proceeding with final design. Recommended operating schedules and special conditions for the hydroelectric facility commensurate with the maintenance of the Campbell River fisheries resource are provided.

findings...

- anadromous fish stocks in the lower Campbell River are profoundly affected by the modified hydraulic conditions produced by the operation of the existing John Hart hydroelectric facility
- they are affected both by river discharge levels and by large and rapid fluctuations in discharge levels
- low discharge levels reduce available spawning habitat, rearing area and protective producing area as well as exposing reeds dug during periods of greater discharge
- high discharge levels reduce available spawning area, dislodge and deplete the standing crop of benthos and supportive organic detritus, scour and remove gravel from spawning areas and limit available rearing habitat
- large rapid fluctuations in river discharge disrupt spawning salmonids, displace and stimulate the premature downstream movement of juveniles, greatly deplete the benthic standing crop of insects, and lead to the stranding of large numbers of rearing juveniles

implications...

- discharge levels should be kept above 2,500 cfs and below 3,500-4,000 cfs
- fluctuations in discharge should be kept to a practical minimum and increases and decreases should be gradual

98. Goodman, D. 1974. As assessment of the impact of proposed marina development on the fisheries resources of the

Appendix H

Campbell River estuary. 1974. Fisheries and Marine Service, Southern Operations Branch, Tech. Rept. Series PAC/T-74-13: 26 p.

In January 1972, the Campbell River Indian Band represented by Chief W. Roberts, presented a plan to develop a marina at a site adjacent to the Campbell River Indian Reserve. The proposed site was approximately 3 acres of vegetated intertidal area lying between the mouth of Nunn's Creek and Spit Road. This study is designed to evaluate the effects of the proposed marina development on the fisheries resources of the Campbell River. This report reviews the fishery resources of the Campbell River system, describes methods used to determine the use of the estuary by salmon and other fishes, presents and summarizes data resulting from sampling in 1972 and 1973, and provides conclusions with respect to the degree of fish utilization.

findings...

- the estuary serves as a rearing area for numerous fish species including juvenile coho, chinook and chum salmon
- juvenile coho, chinook and chum salmon are distributed throughout the estuary including the area adjacent to Nunn's Creek and Baikie Slough
- substantial numbers of coho, chinook and chum salmon use the near shore marine environment adjacent to the estuary
- within the estuary, the gravel-cobble beach produced mainly chinook; pond-type habitat produce mainly coho; vegetated intertidal areas produced large catches of coho, chinook and chum salmon
- length and weight data for juvenile chinook and chum salmon within the estuary indicated substantial growth
- organisms associated with the intertidal and shallow subtidal portions of the estuary represented the major portion of juvenile salmon food sources
- the variety of food organisms in the stomachs of juvenile salmon caught at stations outside the estuary indicate that the fish move in and out of the estuary or the food organisms produced in the freshwater and estuarine environments are exported outside the estuary, or both
- the above findings are supported by studies in the Squamish and Nanaimo estuaries

implications...

- the vegetated intertidal portions of the estuary are of primary importance in terms of food chains leading to juvenile salmon
- development of the marina as proposed would eliminate a significant rearing and food producing area for these fishes
- the area lying between the mouth of Nunn's creek represents the only remaining relatively undisturbed vegetated intertidal area in the estuary... degradation of this area will reduce the production of benthic organisms (the major food component of juvenile salmon) both within and outside the estuary
- it is recommended that the Campbell River Indian Band marina not be located at the site proposed, and that alternate locations with reduced environmental impacts be fully investigated

99. Kennedy, K., and B.R. Waters. 1974. Campbell River estuary. - British Columbia. Fish and Wildlife Branch, Nanaimo, British Columbia: - 23p.: ill. SH224 B8 74-01

This study of the Campbell River estuary was undertaken to compile a data base for the development of recommendations for the preservation of the fish and wildlife resources. The aquatic and terrestrial vegetation, birds, fish, mammals, substrate and land utilization observed on the estuary and contained in the literature are noted.

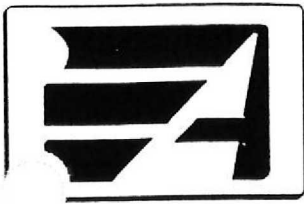
findings...

- dredging leads to an altered substrate, high turbidity and salinity changes and the influx of less desirable species
- dredging results in decreased estuary productivity as bacteria, benthic invertebrates, and fish are lost due to destruction of habitat
- boom logs stored in inter-tidal zones destroy the benthic organisms, vegetation and substrate through gouging, bark and fibre deposition, chemical reactions and screening of sunlight
- raw sewage discharged into Nunn Creek and Campbell River degrades water quality, decreases available oxygen, and changes water colour and clarity
- development and filling of the marshlands reduces estuary productivity and destroys resident and migratory bird habitat

implications...

- all dredging should be discontinued in the Campbell River
- all log handling operations in the estuary should be phased out and cleaned up
- landfill operations should be terminated
- primary sewage disposal within the Campbell River system should be halted

APPENDIX 2: Anglo American letter



Anglo American Cedar Products Ltd.

November 17, 1995

Witty Planning Consultants Ltd.
R.R. 1 G-30
Bowen Island, B.C.
V0N 1G0

Attn: Mr. D. R. Witty

Dear David,

I'm not sure where the other Industrial users of Baikie's Slough are with respect to the criteria for relocation and interim log dewatering plans, so we are submitting our own independently.

INTERIM DEWATERING ALTERNATIVES

Currently our Ocean Cedar Division dewaterers using a Caterpillar 950F Wheel Loader that drives into the water, lifts the logs in its grapple, and backs out of the water. The water level often reaches half way up the loaders tires. The perception is that environmental harm is caused by the loader in the water.

We have looked at several alternatives to this method, including the following:

1. Alternate site. This alternative has shown to be financially prohibitive. The additional cost to have the wood dewatered and trucked to our site is greater than our current gross profit.
2. "A-Frame" and log slip. This method involves positioning the logs in front of the mill with a small boat and dragging the logs, one at a time, up a wood and metal slip with a large wire cable. This is the most common method of dewatering along the Fraser River and other areas, and is the most economical. However, due to the large, deep 'pond' that is required by the boat in which to store and maneuver the logs, it is unlikely to be acceptable in the estuary.
3. Hydraulic or cable log loader. A large loader with a grapple is positioned on the bank of the estuary between the mill and the water and reaches down into the water, picks the logs up, and places them on the existing log deck. This method is more costly than our current method and the A-frame mentioned above, but is less expensive than dewatering off site and trucking. Some limited dredging immediately in front of the mill would be required, but not to the same extent as in 2. above. It would necessitate acquiring a loader as well as negotiating an early return of the recently leased new Cat 950F loader. With limited dredging, this method is viable and would be acceptable to us.

7160 Beatty Street, Mission, British Columbia V2V 6B4 CANADA
US Address: P.O. Box 351, Sumas, Washington 98295 USA

Telephone: (604) 826-7185 (604) 462-8288 1-800-826-7185 • Facsimile (604) 826-8594



World Suppliers of Western Red Cedar Shingles & Shakes

RELOCATION CRITERIA

Following are the criteria necessary for a new location:

1. Water access. Sheltered water access with suitable storage area for logs is a necessity. Access for barges for loading out chips and hog fuel would also be beneficial.
2. Road access. Access and proximity to major highway for transportation of raw material to the mill and finished product and waste from the mill.
3. Location. Proximity to raw material supply, labour supply, and chip and hog customers (pulp mills).
4. Size. Two to three acres is necessary for an efficient operation, with adequate chip storage and log storage areas.
5. Power. Minimum 3-Phase, 600 volt power is required.

As we have discussed, Anglo American endorses the Vision Statement that has been adopted by the Management Plan committee.

If you require any additional information, please contact me at my office in Mission.

Yours truly,



Kevin Redl
President



APPENDIX 3: Water lots

Estuary Inventory Spreadsheet

Water 10-11-2010

File #	Lease #	DL	Tenure	Expires	Purpose or use	Name on Register	Area	Proposed use
1407897		1573	vacant		commercial boat, plane moorage	crown (tyee trailer park)		
1407898		1573	vacant		commercial boat, plane moorage	crown (cox logging)		
1407899		1532	vacant		commercial boat, plane moorage	crown (coval)		
1407900		1527	vacant		commercial boat, plane moorage	crown (rush air, coval)		
1407901	105080	1588, 1527???	vacant		commercial boat, plane moorage	crown (rosmar holdings)		
1407902		296	vacant		commercial boat, plane moorage	crown (rosmar holdings)		
1407903		300	vacant		commercial boat, plane moorage	crown (holiday shores)		
1405811		1486 portion	map reserve	1999 12 31	fish and wildlife management	ministry of environment, lands & parks		
1402631	102277	1509 Blk A	lease	2015 05 23	marina	J.W. Timber Co. Ltd.		
1402631	102277	1509 Blk B	lease	2015 05 23	marina	J.W. Timber Co. Ltd.		
1402631	102277	1509 Blk C	lease	2015 05 23	marina	J.W. Timber Co. Ltd.		
		1440	vacant			crown		
0217510	102687	1549 Blk B	lease	2019 04 03	commercial marina	mercury marina trailer park ltd		
1402631	102277	1217 Blk A	lease	2015 05 23	commercial marina	J.W. Timber Co. Ltd.		
0336299	101444	1217 Blk B	lease	2017 03 18	log handling	raven industries ltd		

[illegible]

APPENDIX 4: Vision sign-off

Campbell River Estuary Management Plan

PROPOSED VISION STATEMENT

A vision statement describes what is expected or preferred for a given area. It sets out the foundation for the development of detailed long term plans for action. A vision is nothing more **but nothing less** than the articulation of a commonly held desirable end state for the Campbell River Estuary.

The following vision statement has been prepared by combining the key words and phrases developed by the Campbell River Management Committee at the August 28th visioning session. It was reviewed at the October 2nd meeting.

PROPOSED VISION STATEMENT FOR THE CAMPBELL RIVER ESTUARY IN THE YEAR 2010

The Campbell River Estuary will exhibit:

- (1) a mix of rehabilitated and revegetate natural upland, shoreline setbacks and foreshore which will primarily support:
 - improved fish and wildlife habitat;
 - park areas which support active and passive forms of low impact recreation; and
- (2) selected upland areas of well planned compatible residential/mixed use development.

Accepted by:

Mr. John McFarland
Campbell River Mills Ltd.

Mr. Harley Elias
Painter's Lodge

Mr. Bruce Hillaby
Department of Fisheries & Oceans

Mr. Goff Longworth
B.C. Hydro

Mr. Jim van Fine
Quinsam River Salmon Hatchery

Mr. Dave Witty
Witty Planning Consultants

Mr. Mike Gage
MacMillan Bloedel Ltd.

Mr. Fred Stepchuk
Canadian Coast Guard

Mr. Gordon Smail
Ministry of Environment, Lands

Mr. Alan Caverly
Ministry of Environment, Lands

Kathy Eichenberger
Public Works & Government Services Canada

Mr. Chris Hall
District of Campbell River

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(also see Interim Report 1)

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