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Ecosystem-based Planning Framework and Priority Areas for Action

Pacific and Yukon Region
Environment Canada

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PACIFIC REGION

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Foreword

The public is demanding a more co-ordinated proactive approach from government with less spending and less duplication. At the same time, DOE is recognizing the necessity for more integrated planning and our need to take a leading role in moving government and society towards sustainability. This must be accomplished within the realities of a downsizing department and the sunseting of the Fraser River Action Plan. Thus, in late 1994, the Pacific and Yukon Region undertook to develop an ecosystem-based framework that could be used to set priorities in the Region.

The task was to develop a framework that could provide direction to the Region and remain useful even if the structure and mandate of Environment Canada changed. This discussion paper is a collaborative effort of staff from all Branches (Ecosystem Planning Framework Working Group). Trying to find a framework and method of setting priorities that was holistic and that everyone could identify with and contribute to was not an easy task. This resulting paper describes a framework that all members of the Working Group support. The process helped bring people together and initiated many interesting discussions. It was a departmental first in that committed staff from all Branches shared their perspectives on issues and took the time to understand each others. It reinforced the importance of group dynamics and the need for staff committed not just to accomplishing the task but to doing it co-operatively in a way that works. The Working Group thinks this process has been a very positive one, hopes that this momentum will not be lost, and recommends that the process continue.

In delineating the ecounits we recognize that many programs and projects will cross boundaries. The intention is that this framework be used for planning and co-ordinating major ecosystem initiatives. It therefore, only covers a part of what DOE does. Broad-based programs such as environmental assessment, toxics, enforcement, etc. would of course continue throughout the Region. In addition, the need to address pressing issues in areas outside of the next major ecosystem initiative would continue. Individual projects and programs can also continue to be delivered based on the boundaries and scale that make the most sense for that project. Nevertheless, some programs, including research, may change focus in order to achieve a more integrated approach that helps realize the overall goals of DOE. All projects and programs will certainly benefit from increased communication, co-ordination, and integration.

After many long discussions and several different attempts to prioritize the ecounits, the Working Group selected the method described in this paper. Although it focuses on issues, it tries to tie them together to look at total ecosystem health and risk. The Working Group recognizes that this prioritization exercise is a snap shot based on collective current knowledge of staff. Threats change, issues change, and the level of our knowledge and understanding changes. Because of this, this paper should be seen as the '1996 status report' of an on-going, adaptive process.

Acknowledgements

The Working Group (Appendix A) gratefully acknowledges: Dawna Jones of Stratcom Planning who facilitated the prioritization exercise; Fiona Stott who provided assistance in compilation and summarization of the information from all of the Branches and prepared most of the appendices; Kathleen Connelly who facilitated one of the initial workshops; Chris Kemble and Pam Whitehead who provided technical support in the preparation of many maps; and Shelaugh Bucknell assisted with the word processing of the Appendices.

The priority setting exercise was directed by a subgroup of the Working Group, consisting of: Michael Dunn, Trish Hayes, Bryan Kelso, and Paul Whitfield.

In addition to the Working Group, the following staff attended workshops that identified issues and set the priorities or provided comments on the final draft: Vic Bartnik, Ken Brock, Al Colodey, Mike DeAbreu, George Derksen, Chris Garrett, Benoit Godin, Darcy Goyette, Warren Green, Brian Jensen, Gary Kaiser, Fred Mah, Rob McCandless, Rick McKelvey, George MacKenzie-Grieves, Bev McNaughton, Wendy Nixon, Steve Sheehan, Bob Shepard, Eric Sopovich, Mike Sullivan, Bruno Tassone, Bruce Taylor, Eric Taylor, Taina Tuonimen, Norm Wade, Al Wallace, Al Whitman, and Ed Wituschek.

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Executive Summary

The goal of this paper is to develop an adaptive ecosystem-based planning framework within which DOE can set and evaluate its priorities, and integrate its programs in the Pacific and Yukon Region. The objectives are: 1) to produce a draft map of BC and Yukon dividing the Region into large geographic units; 2) to develop a process for setting priorities for DOE action; and 3) to recommend initial priorities.

The spatial framework selected is based on major drainage basins and divides the Pacific and Yukon Region into ten ecounits:

- Georgia Basin
- Fraser
- Okanagan
- Columbia
- Central Coast and Islands
- Northwestern BC
- Peace/Liard
- Central Yukon
- Northern Yukon
- Offshore

The process for setting priorities for DOE action was based on three key factors: 1) determining the state of the health of the ecounits, including: issues; threats; current initiatives addressing the issues; and forecasted changes over ten years; 2) the mandate and reason for DOE involvement in each ecounit; and 3)

recognition that some issues are driven by the best place to do the work, not by the issue itself. Two sets of recommended priorities are provided. The first guided by the greatest risk to ecounit health, and the second based on the ecounits with the best opportunity to be proactive and work towards preventing stress. The results of the prioritization exercise were:

1. Priorities Guided by Risk to Ecounit Health

- The Georgia Basin emerged clearly as the ecounit most at risk and where efforts need to be focused due to stresses related to urbanization and the significant loss of unique habitat.
- The Okanagan ecounit is also under extreme pressure from urbanization, agricultural practices, and resource development. Unique habitat loss is significant and in some cases irreversible. These combined pressures have reached a high level of intensity driving an immediate need to act.
- The Columbia is also under pressure primarily from past resource development and exploitation.

2. Priorities Guided by Opportunity to Prevent or Reduce Future Loss

- Northwestern BC offers an opportunity to gather important data before the risk to ecosystem health is critical.
- Northern Yukon provides the greatest opportunity to study climate change signals.
- There is inadequate information on the Offshore ecounit. In light of its importance to global systems, overlooking the importance of this ecosystem will only increase the urgency to address impacts in the future.

Summary of Recommended Priorities

	Georgia Basin	Fraser River	Okanagan	Columbia	Central Coast & Islands	North-western BC	Peace Liard	Central Yukon	Northern Yukon	Offshore
<i>Risk to Ecounit Health</i>	High	Medium to High	High	Medium	Medium	Low	Low	Low to Medium	Low	Uncertain, inadequate information
<i>Ranking Based on Role</i>	1	3	2	2	4	4	5	7	6	8
RECOMMENDED PRIORITIES					RECOMMENDED PRIORITIES					
<i>To address risk to ecounit health</i>					<i>To reduce or prevent future risk or vulnerability</i>					
	1	4	2	3	5	1 Establish baseline data			1 Obtain climate change signals	2

The actions recommended below can serve to improve planning, action and cooperation.

1. Develop Strategy/Action Plan for the Georgia Basin Ecounit as the next major ecosystem initiative

This should be carried out by a department wide team in co-operation with partners.

2. Establish Ecounit Teams

Assign small teams to each ecounit to better co-ordinate action in each ecounit. This is most important for: Georgia Basin (as above), Okanagan, Northwestern BC, and Offshore.

3. Develop Action Plans for Cross-cutting issues

Working level regional teams should be established to co-ordinate action on pressing issues not within a major ecosystem initiative.

4. Ensure this is an Iterative Process

It is recommended that:

- 1. a planning group be designated to ensure that this foundation remains current and relevant to the rate of change;*
- 2. the information base be expanded to include other federal government departments, other governments, and relevant non-government groups;*
- 3. the responsibility be built into the departmental planning tables.*

5. Ensure Business Plans reflect this Framework and Process

This planning framework be adopted throughout the department in the Region.

6. Improve Data Management and Integration

It is recommended that a common data dictionary be developed and that data management and its integration across the department be coordinated. participation and input at various stages of preparing this paper.

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1.0 Introduction

Although the necessity of taking a holistic approach towards planning and conservation has long been recognized, developing an appropriate framework within which co-ordinated action can occur is a challenging and ongoing process. Historically, governmental agencies (and others) have tended to take a sectoral and reactive approach to policies, regulations, and management. Each group developed a strategy that best addressed its own needs while seldom incorporating other interrelated features and/or issues. This sectoral approach ignores the interdependence of the components of the environment within which all occur. Although a sectoral approach may remain useful to deal with some issues, it is not an effective approach to broad planning of large programs or to integrated planning. In recognition of this, many new initiatives are underway which attempt to be holistic at a landscape to regional level.

Environment Canada's vision is to provide leadership in building capacity for sustainability that ultimately results in a steady state economy within a healthy environment . Our focus is to be in areas where we can make the largest strategic contribution -- that is at the international level, the level of large, nationally significant ecosystems, and where we can build on the capacity of others. Environment Canada's Action Plan identifies creating partnerships with all sectors of society and strengthening its ecosystem approach to science as an important part of changing the way we do business (Environment Canada 1995a). The Pacific and Yukon Region's vision also states that the Region needs to develop and maintain comprehensive knowledge of regional ecosystems and establish and deliver programs within an ecosystem framework. These visions cannot be achieved without considering all components and interactions of ecosystems.

The goal of this discussion paper is therefore.....

... to develop an adaptive ecosystem-based planning framework within which DOE can set and evaluate its priorities, and integrate its programs in the Pacific and Yukon Region.

The objectives are.....

*...to produce a draft map of BC and Yukon dividing the Region into large geographic units;
...to develop a process for setting priorities, between the units, for DOE action; and
...to recommend initial priorities.*

Although several DOE initiatives take a more ecosystem approach, most DOE programs currently react to issues in isolation as they become problems, and attempt to "cure" them. Although the Fraser River Action Plan is the best attempt at an ecosystem approach by DOE in this Region to date, it has been faced with many obstacles which reflect the inherent complexity of embarking on an ecosystem-based approach. Nevertheless, the Region has learned much from this program. It is now in a position to apply the knowledge gained from the Fraser River Action Plan, and that gained from the development of this framework, to develop new ecosystem initiatives.

An ecosystem approach to planning and conservation will provide direction in the development of business plans and resource allocation that allows us to be proactive, and thereby anticipate and prevent. The result will be integrated planning that permits Branches, and thus programs, to complement each other in an organized manner. Managers can structure their programs and deliverables in a format that contributes to broader goals. This will allow science and research to be directed according to priorities. It will also provide DOE in this Region with a framework within which the sustainability can be monitored. This approach will ultimately lead to: better links among projects; greater understanding of how all the components and stresses of each ecosystem relate; better decision-making capacity; facilitation of environmental technology development and transfer; greater ability to build partnerships and move towards co-ordinated action; greater ability to respond to changing needs; and will provide a logical strategy that guides the Region towards identified goals addressing national and regional priority ecosystems.

This discussion paper is divided into three main sections: the spatial framework; setting priorities; and conclusions and recommendations. The spatial framework will divide the Region into large geographical units (called ecounits). The ecounits will then be prioritized based on a set of criteria to assist in the allocation of resources and determine the degree of effort in each ecounit. This prioritization section will include a description of each ecounit. In this planning framework, the criteria are broad and general in nature; they are certainly not all encompassing. A detailed analysis of each ecounit can occur at later planning stages. Inherent in this process is the fact that the planning framework (including the boundaries and the criteria for prioritization) is flexible and will change as our needs change, as we develop more detailed action plans for ecounits, and as the frameworks of our partners change.

Box 1: Definitions

Ecosystem

- is a functioning, integrated unit comprised of all living things, including humans, and their non-living, spatial and temporal environment. Ecosystems occur at many scales, from a drop of water to the entire biosphere.

Ecosystem-approach to planning and conservation

- promotes long-term maintenance of evolutionary and ecological processes by providing a holistic, systems perspective that: recognizes the interdependence of all levels of ecological relationships (species, communities, populations, landscape) within a complex socio-political framework (Grumbine 1994); predicts the effects and response of the environment to stresses; and then acts to maintain ecological integrity. Taking an ecosystem perspective results in working across administrative and political boundaries, making multi-stakeholder co-operation mandatory. The principles of an ecosystem approach are outlined in Box 2. This approach combines ecology with an understanding of the socio-economic factors that shape human attitudes, perceptions, and behaviour, within an ecological meaningful spatial framework (Ecosystem Initiatives Working Group 1995).

Ecounit

- is the name that will be used to describe each of the large geographical areas of the Pacific and Yukon Region delineated in the spatial framework. The ecounits selected are based on drainages, are hierarchical in nature; represent species and genetic boundaries, are culturally recognized, and capture the main provincial forest and resource planning boundaries. They also tend to have a common economic base.

Framework

- in this paper, a framework will be used as a planning tool to provide structure within which planning in the Region can be organized. In this case, it is comprised of two components: the spatial component that consists of a network of lines on a map based on predefined attributes; and a prioritization component that evaluates the areas based on a set of criteria.

Box 2: Principles of an Ecosystem Approach

1. ecological integrity is maintained;
2. recognizes the dynamic nature of the ecosystem, incorporating concepts of carrying capacity, resilience, and sustainability;
3. humans are part of nature not separate from it and thus socio-economic factors and how they interact with the environment must be considered;
4. based on principles of adaptive management;
5. must take a broad view;
6. interagency co-operation is essential with full participation of all partners;
7. must work within a geographically comprehensive hierarchical context, focusing on all levels of ecology and the connections between them;
8. boundaries should be ecologically based and work across administrative and political boundaries;
9. focus should be on units with similar resource issues to promote local action and involvement;
10. strategies, implementation and conservation must be based on best available science, data and monitoring;
11. implementing this approach may require organizational change;
12. flexibility and innovation should be encouraged in program and project development and delivery; and
13. decisions should be delegated to lowest appropriate level.

(Clayoquot Sound Scientific Panel 1995; Environment Canada 1995b; Grumbine 1994; US Fish and Wildlife Service 1994)

2.0 Spatial Framework

The first step in the development of a spatial framework is selecting boundaries for ecosystem-based units. Different disciplines have been classifying land for decades to satisfy single purpose needs; there are forest regions, climatic regions, biotic regions, soil regions, administrative regions, etc. Early biophysical initiatives were designed to meet the multiple resource needs of the Canada Land Inventory program. They also laid the foundation for the Canada Committee on Ecological Land Classification in 1976. This in turn encouraged the development of an ecosystem classification system. Ultimately, broader use led to a national ecozone system initiated in 1986, which evolved into the hierarchical National Ecological Spatial Framework used today.

British Columbia, the most diverse area in Canada in terms of land forms, topography and biodiversity, was the location of an attempt to combine land classifications into a more holistic system, through the development of the BC Soil Survey and the Biogeoclimatic Ecosystem Classification which considered landforms and climatic factors. These systems formed the basis for the Ecoregion Classification for British Columbia (see Box 3).

It is very difficult to spatially delineate ecosystems because they are open to flows of energy, matter and information that interact with each other. Their component parts are in a constant state of temporal and spatial flux (Dunster and Dunster 1996; Rogers 1994). Nevertheless, it would be ideal if all agencies agreed to use one set of boundaries. Unfortunately, such an ideal system does not currently exist in BC. Several existing systems have value, emphasizing the need to define boundaries based on a system that best fits the task at hand. Ecosystems can be defined by biological features, natural physical units, or any combination of these, but cannot be defined by arbitrary administrative or political boundaries. In addition, it must be remembered that plants and animals are not only

inseparable from their environment, but are inseparable from stresses on their environment. This reinforces the need to consider stresses when delineating ecosystems for planning purposes.

When developing this framework, many existing systems, from biologically based ones to administrative boundaries, to native land claims, to systems used in the United States, were reviewed. First, maps delineating existing boundaries were collected. Each spatial framework has its own use; however, the advantages and disadvantages of each, as they related to our purpose, were discussed.

The systems deemed the most significant to DOE were then mapped to produce overlays of the same scale (approximately 1:11,000,000). (Appendix B describes these systems and how they compare to the Pacific and Yukon Region's spatial framework. Box 3 discusses the two major frameworks considered). Finally, ecounits that best met Regional DOE needs were delineated.

In general, an appropriate framework for our purpose must be:

- ecosystem-based;
- compatible with other relevant spatial frameworks and have support from partners;
- based on an existing hierarchical system from broad level down to site-specific since all methods of classification result in some degree of loss of ecological similarity when they are incorporated into progressively larger units; and to ensure lower level plans meet objectives of broader ones;
- practical for planning of Regional DOE programs;
- manageable in the number of units;
- simple and flexible; and
- culturally relevant and easy to identify with.

The Region has begun discussions on ecosystem-based frameworks with the Province of British Columbia in addition to the US Fish and Wildlife Service and the US Environmental Protection Agency. Continuation of these discussions may result in modification to this framework and will ensure that DOE has a framework that facilitates partnership building.

The spatial framework chosen for Pacific and Yukon Region consists of 10 ecounits which are illustrated on Figure 1 and described in Section 3.3. Major drainage basins are the basic building blocks, although some major drainages were modified slightly. Nevertheless, as planning and implementation occur it is necessary to use various systems at different scales depending on the task at hand. The Province of British Columbia also recognized this in the development of the BC ecological framework (a combination of the Biogeographic and the Ecoregion Classification systems). The provincial framework organizes information at a range of scales from the regional level, to individual watersheds, to specific sites. It is used by the Resources Inventory Committee and some land use planning activities such as the Forest Practices Code guidelines (Mah *et al.* 1996). Similarly, in the Pacific and Yukon Region's framework, different classifications can also be used at various scales from the landscape level to site specific. Most data is collected at a fine scale and can be reported in either system.

Although the boundaries of Figure 1 have been selected for ease of planning, there are many issues (both ecological, economic, and political) which do not fit neatly within an ecounit. These issues may be dealt with based on whichever spatial system and scale is appropriate. A more in-depth look at each ecounit is presented in Section 3.3. It is recognized that final ecosystem boundaries for major initiatives must be worked out with all partners.

Box 3: Drainage Basins and Ecoregions

In carrying out this exercise, two existing spatial frameworks were the focus: drainage basins and the Ecoregion Classification System of BC. Although a system based on drainage basins is the most useful for planning for Regional DOE purposes, there are many strengths to the ecoregion framework. This Box describes some of the advantages of each. Because of the importance of both systems, Section 3.3 will describe the ecoregions contained within each ecocount.

Drainage Basins

Drainage basins, the unit of choice of many in the field of conservation biology, are the optimal basis for this planning framework for four main reasons. First, drainage basins are a hierarchical, ecologically based system. On a fine scale, a sub-drainage basin is a functional system with characteristics predictable from its size, geology, climate, vegetation, and history. At a coarse scale, a drainage basin is comprised of many ecosystem types and provides a longitudinal link between these ecosystems and the biological and physical processes that underlie ecological integrity. Drainage basins exemplify the interconnectedness of different levels of ecological organization, thus providing a natural and effective way of containing the environmental variation inherent in a region within a single unit (Rogers 1994). Sub-drainage basins are also the major travel corridor for many terrestrial and all aquatic organisms.

A second advantage is that a drainage basin provides a logical, functional unit to provide the link between environmental stresses and the ecological response over time and space, because stresses on the system (generally caused by human populations and activities) are often contained within the same watershed as the responses to the stresses. This permits an ecosystem approach to be more easily applied than in most other frameworks because it is preferable to link stress and response within the same management unit to maintain the ecological integrity of the system -- for example, toxins from municipal or industrial activities. Cumulative effects of all land-use activities also tend to create stress on ecosystems within individual watersheds. Finally, classification systems based purely on soil, climate, vegetation and land form do not deal satisfactorily with ecosystems that have been altered from their natural state (Chipeniuk 1995).

A third advantage of the drainage-based system is that it more easily accommodates integrated planning. Many established administrative and political boundaries coincide better with this system. Better co-operative planning between jurisdictions is especially necessary where one jurisdiction is upstream of another. Federal flagship programs are established on a drainage basis, recognizing the significance of changing relationships within each basin. The implementation of the BC government's Commission on Resources and Environment regional land use plans are now being undertaken by sub-drainages. The use of drainage basins as boundaries may also accommodate temporal attributes better; for example with climate change, if planning within a drainage system, there will less likely be a need to redraw boundaries.

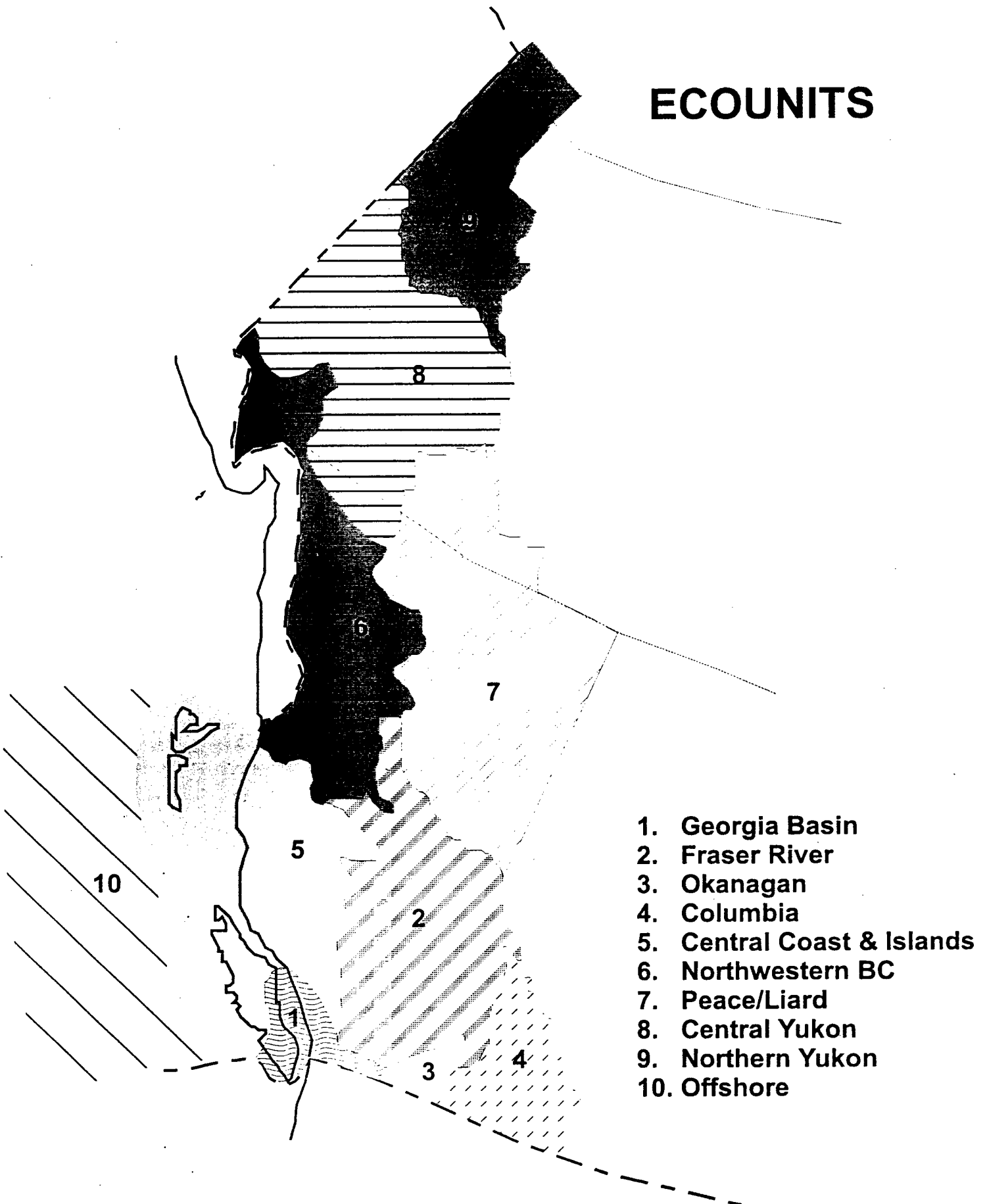
Finally, the public can also identify with units such as drainage basins. According to Chipeniuk (1995), cognitive research indicates that laypersons are unlikely to make much use of scientific ecological concepts and classes in their thinking. Therefore, a boundary system based on science that does not make sense to laypersons is unlikely to be adopted and supported.

Ecoregion Classification/ National Ecological Spatial Framework

The Ecoregion Classification System for BC was originally developed by the Province of British Columbia and is based on the interaction of macroclimatic processes and physiography (Demarchi *et al.* 1990). It is hierarchical and provides a classification system that combines many factors (soil, climate, topography).

The Ecoregion Classification for BC has been further refined and fits within the National Ecological Spatial Framework developed by the federal-provincial Working Group on Ecological Stratification. Major national databases are being integrated to match up with this system (State of the Environment Reporting, Agriculture Canada, Forestry Canada, Canadian Council on Ecological Areas). Although many agencies have adopted this system (at one or another level of the hierarchy) for data collection and reporting, major provincial planning processes such as Commission on Resources and Environment and Land and Resource Management Plans are not delineated by this system (although they can be described in terms of the ecoregions or ecodistricts they contain), nor are large federal initiatives such as the flagship programs (e.g. Fraser River Action Plan) or basin studies (Yukon Basin Study). The major limitation of this system is that it is based primarily on landforms and physical processes and does not incorporate the human element as well as drainage-based systems do. Because of this, cause and effect are often not contained within the same unit.

ECOUNITS



3.0 Setting Priorities

Once the spatial component of the framework had been chosen, the next objective was to identify priority areas for action by DOE in the Region. The initial prioritization described below is intended to provide direction about not only priority ecounits based on DOE responsibility, but ecounits that have emerging issues and may be affected by other processes. This initial prioritization is therefore general in nature and represents a 'rough cut' of priorities. It should not replace a more detailed analysis of specific issues or areas.

This report documents the results of internal consultations merging the expertise from within the following branches of Environment Canada, Pacific and Yukon Region:

- Corporate Branch;
- Environment Conservation Branch;
- Environment Protection Branch;
- Environmental Services Branch;
- Monitoring Systems Branch.

The intent is to provide the department with an ecosystem perspective for long term planning, consistent with the direction towards a team-based approach to how issues and ecosystems will be addressed. The results are only a snapshot within a process which continues to evolve as new knowledge continues to be added to the information base upon which decisions are based. These priorities flag ecounits where DOE needs to focus its collective energy while simultaneously continuing effort on priority issues in other ecounits. The ecosystem planning activities carried out to produce this framework, have only considered DOE's programs and knowledge of DOE staff of other initiatives. Further steps must broaden knowledge and understanding of activities and programs carried out by others and continue to increase the coordination of ecosystem planning efforts.

3.1 The Process

This approach represents the first time that staff from all branches of DOE in the Region have worked together to advise senior management on future directions. The objective was to arrive at ecosystem-based priorities which considered the health of the ecounit and the mandate/roles within the department. The process was not cast in concrete. It was shaped to fit the varied perspectives of the organization. Key elements included:

1. determining the state of the health of the ecounits, including: issues; threats; current initiatives addressing the issues; and forecasted changes over ten years if the status quo were to continue;
2. the mandate and reason for DOE involvement in dealing with issues facing the ecounit either today or in the longer term; and
3. recognition that some work within the department is driven by consideration of the best place to do the work, not by the issue itself.

The priority-setting process followed is illustrated on Figure 2. The criteria used for setting priorities is outlined in Box 4.

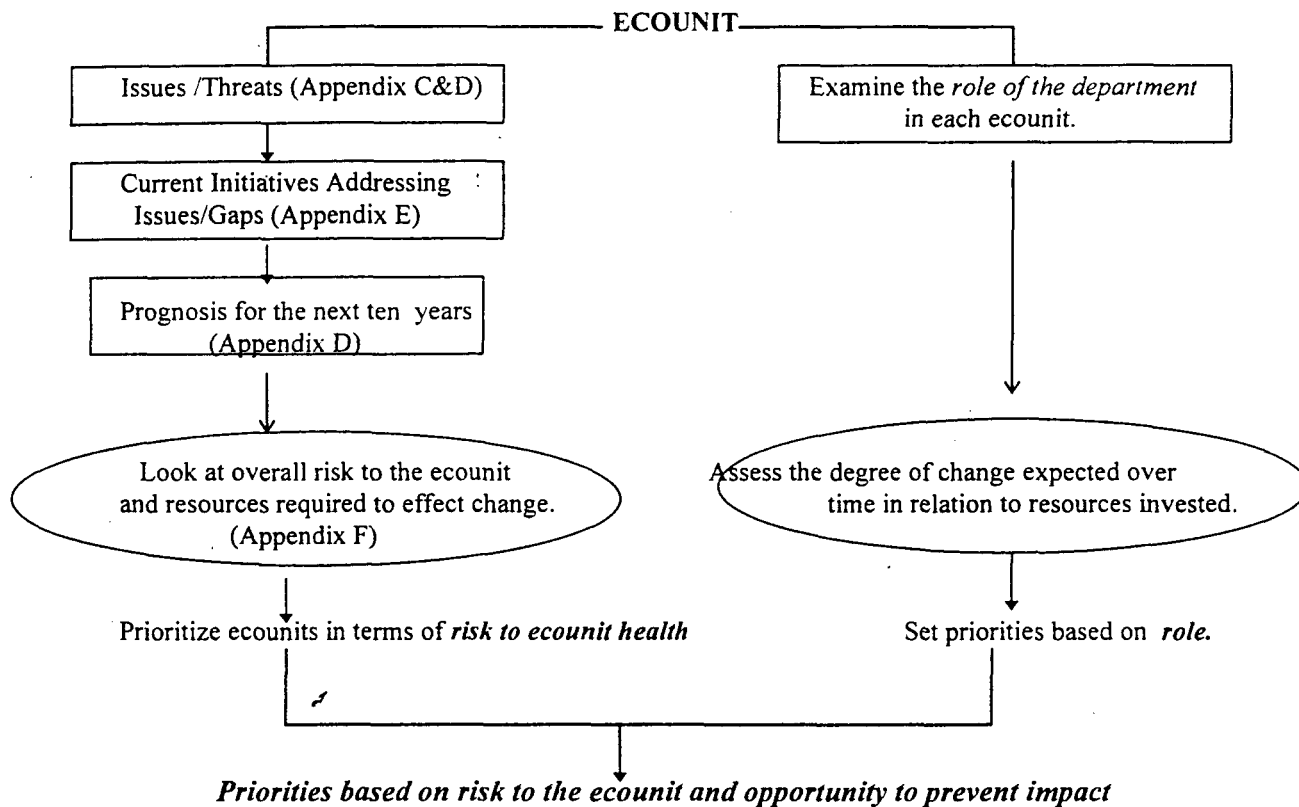


Figure 2: The Process for Setting Priorities

Box 4: Priorization Criteria

Criteria to Assess Risk to Ecounit Health

- **Nature of the Issues/Impact on Environment**
 - complexity
 - magnitude
 - seriousness
- **Adequacy of Information**
 - relative to the perceived risk
 - sufficient to take action
- **Influence (ability of DOE to address issues)**
 - recovery time from point of action
 - preventability
 - correction and mitigation costs

Supported by:

- workshop information (Appendices C & D)
- identification of data gaps for each issue (Appendix C)
- initiatives underway to address threats (Appendix E). identification of data gaps; forecasted prognosis over next 10 years per issue (Appendix D)*
- information gathered at workshops

Criteria to Determine Departmental Role

- **do we have a lead role to play?**
 - regulatory, policy and/or political
- **do we have a strong partnership role/opportunities for partnerships?**
- **do we have a support role?**
 - science, research, data

* The inventory process did not include examination of the status or purpose of each initiative identified. The extent to which the initiatives will result in action that improves the ecounit health was also not assessed. In preparing the 10 year prognosis, contributors took this into account.

The analysis for this report was based on current departmental mandates and responsibilities. If the mandate or responsibilities alter as a result of harmonization or other changes, then the state of each ecounit's health can serve to guide a redefinition of roles. The assessment of each ecounit's health is based on the information assembled to date. As the rate and impact of change affects the ecounits, as more information is gathered, as more partnerships are developed, and as available funding levels change, it will be necessary to revisit the assessment periodically to maintain its validity over time.

Information on issues, threats and data gaps impacting on each ecounit was collected through a set of three workshops. Current initiatives underway, 10-year prognosis, analysis of all information, and setting priorities was carried out at a second workshop. The detailed results of these workshops can be found in Appendices C through F.

3.2 Results

Establishing the priorities has been a shared and constructive process representing an important step in moving towards an integrated approach. Time was invested in understanding the perspectives of other parts of the department. The resulting process found focus on common ground and initiated discussions important to advancing and strengthening a team-based approach.

A summary of the analysis of each ecounit according to the criteria outlined in Box 4 is found on Table 1. This table includes the resulting priorities based on risk to ecounit health and DOE's role. The risk to human health was considered to be either directly or indirectly related to the health of the environment. Table 2 combines risk to ecounit health and departmental role. The result is two sets of recommended priorities: 1) priority ecounits at greatest risk requiring action to improve, or at least maintain, the situation; and 2) ecounits that provide the best opportunity to affect future risk by acting sooner rather than later.

The process of identifying the priorities served to tie the parts of the department together with a common process for determining where efforts should be placed. The information presented in the Appendices can be used to provide a briefing on the issues within an ecounit and to identify opportunities for partnerships. The priorities are not intended to restrict regulatory responsibilities. Nor are they intended to exclude responses to specific issues such as environmental emergencies. There is a need to fill data gaps in a number of the ecounits, to carry out research on global issues, and to prevent the extirpation of species residing in specific ecounits. The priorities can, however, guide development of partnership work as well as provide overall direction to securing resources. In formulating the priorities, the issue of accountability for expenditures of public funds in relation to the resulting changes in the ecosystem was considered, yet is not addressed in this paper. Addressing this issue requires additional expertise in light of the range of factors influencing the outcome.

In addition to the results stated on Tables 1 and 2, three other important issues surfaced: 1) the major gaps identified reinforced the need for conservation and protection plans to address growth issues driven by resource development or urbanization; 2) the effect of cumulative impacts on the ecosystem from loss of biodiversity, and contaminant loading in the air, water, soil, and changes in land use are not known; and 3) regional impacts of climate change, population increases, and agricultural practices on water resources are not well known.

Table 1: Determination of Priorities

	Georgia Basin	Fraser River	Okanagan	Columbia	Central Coast and Islands	Northwestern BC	Peace Liard	Central Yukon	Northern Yukon	Offshore
RISK TO ECOCUNIT HEALTH										
<i>Nature of the Issues/ impact on the environment: complexity, magnitude, seriousness</i>	High	Medium to High	Medium to High	Medium to High	Medium to Low	Low to medium	Medium			High
<i>Adequacy of Information: to understand impact; to prevent or reduce loss</i>	Adequate but gaps exist	Adequate but gaps exist	Adequate but gaps exist	Adequate but gaps exist	Adequate but gaps exist	Inadequate	Adequate but gaps exist			Inadequate
<i>Recovery Time: from time of action</i>	Long	Varies	Long to Medium	Medium to Long	Short to Medium	Short	Long			Not known
<i>Easy to Prevent</i>	No	No	No	Yes & No	Yes	Yes	Yes with exceptions			Not known
<i>Correction & Mitigation Costs</i>	High	High	Medium to High	Medium to High	Medium	Low	Low			Not known
<i>Priorities based on risk to Ecocunit Health</i>	High	Medium to High	High	Medium	Medium	Low	Low	Low to Medium	Low	Uncertain; data inadequate
CURRENT DEPARTMENTAL ROLE										
<i>Lead Role</i>	Regulatory, Policy & Political	Regulatory & Policy	Regulatory, Policy & Political	Regulatory, Policy & Political	Regulatory, Policy & Political	Regulatory & trans-boundary	Regulatory	Regulatory policy & political	Regulatory policy & political	Policy and political
<i>Strong Partnership</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Support Role: science, data, research</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Priority Role/Mandate</i>	1	3	2	2	4	4	5	7	6	8

Table 2: Recommended Priorities

	Georgia Basin	Fraser River	Okanagan	Columbia	Central Coast & Islands	North-western BC	Peace Liard	Central Yukon	Northern Yukon	Offshore
<i>Risk to Ecounit Health</i>	High	Medium to High	High	Medium	Medium	Low	Low	Low to Medium	Low	Uncertain, inadequate information
<i>Ranking Based on Role</i>	1	3	2	2	4	4	5	7	6	8
RECOMMENDED PRIORITIES						RECOMMENDED PRIORITIES				
<i>To address risk to ecounit health</i>						<i>To reduce or prevent future risk or vulnerability</i>				
	1	4	2	3	5	1 Establish baseline data			1 Obtain climate change signals	2

3.2.1 Priorities Guided by Risk to Ecounit Health

1. The Georgia Basin emerged clearly as the ecounit most at risk and where efforts need to be focused. Nevertheless, regardless of the level of effort, the rate of habitat loss will likely increase given the intense urbanization and development pressure. This is also an area affected by global influences including climate change.
2. The Okanagan ecounit is under extreme pressure from urbanization, agricultural practices, and resource development. Unique habitat loss is significant and in some cases irreversible. These combined pressures have reached a high level of intensity driving an immediate need to act particularly given the lengthy recovery time.
3. The Columbia is also under pressure primarily from past resource development and exploitation. This, combined with increasing population growth, recreational development pressures and increased accessibility for more resource development, identifies the need to act. With the exception of the areas already lost due to extensive modification, efforts targeted in this area should overall produce positive results.

3.2.2 Priorities Guided by Opportunity to Prevent or Reduce Future Loss

1. a) In Northwestern BC, resource development threatens to open up access to an area where there is insufficient baseline data. There is an opportunity to gather the baseline data to serve as a foundation for the environmental assessment process carried out on a site by site basis. Assembling a comprehensive database will place the department in a better position to proactively address

potential negative environmental impacts by tracking and monitoring changes and therefore enabling early efforts to produce earlier results.

b) Northern Yukon provides the greatest opportunity to sense climate change signals since there is an absence of other pressures on the landscape.

2. The inadequate database for the Offshore ecounit signals a need to gather more information. Environment Canada's mandate in this ecounit is mainly migratory birds and biodiversity. This more restricted mandate, and the difficulty of accessibility for field work, points to a high requirement for partnerships. Little is known about the Offshore, yet in light of its importance to global systems, overlooking the importance of this ecosystem will only increase the urgency to address impacts in the future. The low assessment of the current risk presented in this report reflects the lack of knowledge. The international context and jurisdictional issues add to the barriers to developing an understanding of the Offshore. Given increasing pressure for resource development and exploitation, decision making will be required by government regulators and policy makers in the medium term. These decisions will require an information base which is much better than what currently exists.

3.3 Discussion of Ecounits

This section provides a general overview of each ecounit and its major issues. Ecounits are described in the order they are presented on Figure 1.

1. **Georgia Basin** (eastern Vancouver Island up to and including Campbell River; southern Vancouver Island west to include Port Renfrew; lower Fraser downstream of, and including, Hope; Canadian portion of the Skagit River drainage; coast ranges up to Powell River; east to include Howe Sound, Burrard Inlet and Whistler; and associated marine areas)

Ecoregions	Pacific and Cascade Ranges (part) Eastern Vancouver Island Lower Mainland Strait of Georgia
Marine Regions	Georgia Basin/Puget Sound Juan de Fuca Strait

This area represents a marine/coastal ecosystem at risk. It contains common land use impacts and common climate (this area effectively bounds one airshed). The most important justification for distinguishing this unit from the rest of the Fraser Basin is the rapid urbanization and resource depletion of the area. Major issues and stresses above Hope are somewhat different in nature. The east coast of Vancouver Island contains nationally significant ecosystems at risk. The transboundary issues are complex. The marine components of this area are included, and also have stresses imposed by human population. The lower Fraser River is ecologically linked with estuarine and marine environments. The topography results in capping inversions which concentrate the pollutants within the valley; this is most evident below Hope. The boundaries of this ecounit easily fit with the Georgia Basin Initiative of the BC Round Table. Significant consultation and participation by the interested US and state governments, municipalities and

general public have gone into that initiative and the boundaries are fairly well accepted. Although there are currently many initiatives underway in this ecounit, it is the area considered to be at the greatest immediate risk. A comprehensive plan is needed to help link existing initiatives and promote new ones.

2. **Fraser** (Fraser River basin from the headwaters down to Hope)

Ecoregions	Chilcotin Ranges
	Fraser Plateau
	Fraser Basin (most)
	Columbia Mountains and Highlands (part)
	Southern Rocky Mountains (part)
	Southern Rocky Mountain Trench (part)
	Thompson-Okanagan Plateau (most)

This area has a common interior climate and a south to north precipitation gradient. The resource development north of Hope is similar -- mainly forestry and ranching. The urban centres are isolated from each other but occur on major rivers. Many stresses (i.e. pulp mill discharges) have watershed-based effects (water quality, riparian areas and wetlands). If this area is included with the Georgia-Basin ecounit, it may be overshadowed by the urgency of issues within the Georgia Basin. The Fraser ecounit contains many projects and processes under way, for example the Fraser River Action Plan and the Fraser Basin Management Program, the Fraser River Estuary Management Program, the Commission on Resources and Environment, and the Land and Resource Management Plans. Although the health of this system is still considered at risk, effort can be focused through these programs.

3. **Okanagan** (Okanagan and Similkameen drainages)

Ecoregions	Thompson-Okanagan Plateau (part)
	Okanagan Range

Unique habitat, fauna, vegetation, and climate, and urbanization and transboundary effects are pressing issues in this ecounit. It drains into the Columbia and is, therefore, separated from some of the effects of some stresses of the lower Fraser. This ecounit has been separated from the rest of the Columbia drainage because of its unique biology and because some of the major stresses are different. This area shares high urbanization pressure, high degree of biodiversity at risk, and common sources of air and water. Several environmental stresses affect both the Okanagan and portions of the Fraser ecounits, in particular with respect to grassland ecosystems. Urban and agricultural development are causing increasing stress as they are both intensive and extensive (throughout the ecounit). This is a good example of where cross-ecounit planning will be necessary and some programs and projects will need to be developed (and/or continue) within different boundaries. This ecounit is considered to be at high immediate risk and action needs to be taken since current initiatives may not be sufficient.

4. **Columbia** (Columbia and Kootenay drainages)

Ecoregions Columbia Mountains and Highlands (most)
 Southern Rocky Mountains (most)
 Southern Rocky Mountain Trench (half)
 Thompson-Okanagan Plateau (part)

These valleys, with their bottoms predominated by wetlands, lakes and reservoirs, have major hydro-electric development, common sources of air and water pollution (pulp and paper, smelting, and mining), and there are major transboundary issues associated with water, fish and shared wildlife populations (such as grizzlies). The climate is more continental. This system is considered to be at risk with many issues related to water. There are, however, many initiatives currently underway. In addition, projected population growth is not expected to be as high here as in the Georgia Basin and Okanagan ecounits. It is necessary to ensure that all DOE interests are integrated into the initiatives underway.

5. **Central Coast and Islands** (western and northern Vancouver Island, including Port Alberni; mainland coastal drainage south of Portland Inlet (including Skeena drainage and Prince Rupert), east to Fraser and Peace Basins; Queen Charlotte Islands and other coastal islands up to the Alaskan border; and several marine regions)

Ecoregions Coastal Gap
 Nass Ranges
 Pacific and Cascade Ranges (most)
 Queen Charlotte Lowland
 Queen Charlotte Ranges
 Western Vancouver Island
 Skeena and Omineca Mountains (most)

Marine Regions Dixon Entrance
 Hecate Strait
 Queen Charlotte Strait
 Johnstone Strait
 Vancouver Island Shelf

This area has a significant rich marine component which consists mainly of fjords and open ocean. These marine areas have similar physiography and biophysical components, including significant marine bird habitats. The hydrological features are common (short rivers, sub-set of glacier fed rivers) as is the economic base of the region's communities (fishing, forestry, mining and smelting). There is also potential for future offshore oil and gas exploration in this ecounit. Most of the coastal settlements are south of Portland Inlet. This ecounit contains a large number of Aboriginal Comprehensive Claims, making First Nation issues important. Although this ecounit did not rank as high as the previous four in terms of immediate risk to ecosystem health, there is the potential for the risk to increase over time due to resource development. In addition, some issues still require immediate effort such as estuary protection and marine bird protection.

6. **Northwestern BC** (Nass, Stikine, Taku, and Alsek drainage up to the Alaskan border)

Ecoregions	Boundary Ranges
	Nass Basin
	Tatshenshini Basin
	Northern Mountains and Plateaux (portion)

All the rivers within this ecounit have large interior basins and drain through the Coast Mountain range. They all border on Alaska and all but the Nass drain through Alaska. More frequent precipitation events occur on the north coast. Common issues are hydro and mining development and potential transboundary issues. Aboriginal Land Claims are of major interest in this ecounit. The human population is very low. Although the immediate risk to ecosystem health is lower than many of the other ecounits, the 10-year prognosis is not good due to significant increase in resource development such as mining and forestry if current trends continue. This ecounit could provide good opportunity for preventative action.

7. **Peace/Liard** (includes Peace, Hay and Liard basins)

Ecoregions	Northern Rocky Mountains
	Northern Mountains and Plateaux (part)
	Liard Basin
	Fort Nelson Lowland
	Alberta Plateau
	Central Rocky Mountains
	Fraser Basin (part)
	Skeena and Omineca Mountains (part)
	Hyland

This ecounit has common vegetation, climatic and topographic regimes and a common economic base (forestry, hydro, mining, oil and gas). There are also shared issues with Environment Canada, Prairie and Northern Region. The major threat is from increased resource extraction leading to habitat loss and fragmentation. The prognosis is that these trends will continue. There are, however, some initiatives working in this areas favour.

8. **Central Yukon** (includes Yukon drainage except the Porcupine sub-drainage: Yukon, White, Stewart, Pelly, and Teslin drainages)

Ecoregions	Klondike Plateau
	Central Yukon
	Yukon Plateau
	St. Elias
	Dezadeash
	Southern Lakes
	Northern Mountains and Plateaux (part)

The terrain of this ecounit is similar (rolling hills, plateaux, broad valleys, some grasslands, and glaciers) as is the resource use. Major issues include contaminants, mining, fishing, and water

quality. The native land claim settlement encompasses this ecounit. The human settlement pattern is along rivers and this ecounit includes all major northern communities (e.g. Haines Junction, Champagne, Teslin, Atlin, Carcross and Whitehorse). There are a number of initiatives underway. Environment Canada has offices in Whitehorse which is where co-ordination for the two Yukon ecounits should occur.

9. **Northern Yukon** (includes the Peel and Porcupine drainages and the North Slope; the Ogilvie, Wernecke and Selwyn Mountains form the border between this ecounit and the Central Yukon)

Ecoregions	Coastal Zone
	Old Crow Flats
	British and Richardson Mountains
	Eagle Plains
	Peel River Basin
	Southern Arctic
Marine Regions	Beaufort Sea
	Mackenzie River Plume

This ecounit shares common terrain and climate (permafrost, tundra, tree line), and major transboundary issues with the State of Alaska, in particular, caribou management. Climate change, and associated sea level change, is an issue. The exact division between the Northern Yukon and Central Yukon ecounits, whether mountain ridge, foothills, or strictly by drainage, should be determined by the staff working in these ecounits.

10. **Offshore** (offshore Canadian waters)

Marine Regions	Continental Slope
	Northeast Pacific
	Transitional Pacific

The main issues for this ecounit are transboundary, navigation and shipping, migratory pelagic bird conservation, marine mammal conservation, and fisheries. These issues are expected to become more prevalent and political over time. Little data exists for this area, and there are major global ramifications if the offshore biological communities are seriously damaged. For these reasons, some effort should be expended on understanding the ecology and consequences of increasing threats.

4.0 Conclusions and Recommendations

4.1 Conclusions

The process used to develop this framework was a departmental first in that committed staff from all Branches shared their perspectives on issues and took the time to understand each other. It reinforced the importance of group dynamics and the need for staff committed not just to accomplishing the task

but to doing it co-operatively in a way that works. The Working Group found this process to be a very positive one and hopes that the momentum will not be lost and that the process continues.

Implementation of this framework will require a co-ordinated process, with participation from many stakeholders. Inherent in this process is the fact that the planning framework (including the boundaries, and the criteria for prioritization) is flexible and will change as our needs change, as teams develop more detailed plans, as our relationship with our partners change, and as we acquire new knowledge and understanding.

It is widely accepted that sustainability can only be achieved by taking a holistic approach to resource use and conservation. An ecosystem approach will enable us to do our jobs more effectively and efficiently. Inherent in this approach is recognizing that Environment Canada is only one partner in a great diversity of agencies, publics, and stakeholders necessary in order to achieve sustainability.

One concern expressed about the trend towards ecosystem approaches is that the in-depth capacity of the organization to deal with any one component of the ecosystem, i.e. water, may be weakened significantly. Also, it may add to the confusion of the public in their attempts to get information on the specifics; that is they won't know where to go. The concern some have is that it will be too superficial. We must ensure that this does not happen and show that a good balance of the two approaches can be achieved.

4.2 Recommendations

Given the size and rate of change for the issues and threats, it is not feasible to work in isolation either within or outside the department. Much was learned from the partnership experience gained from the Fraser River Action Plan. Applying knowledge gained from that experience will increase the effectiveness of partnership relationships whether they are internally or externally focused. The actions recommended below can serve to improve planning, action, and cooperation.

1. Develop Strategy/Action Plan for the Georgia Basin Ecounit

A detailed action plan should be developed for the Georgia Basin as the next major ecosystem initiative. A team representing all parts of the department should be assigned to develop the plan. This should be done co-operatively with partners.

This strategy should follow the principles set out in *Guiding Principles for Ecosystem Initiatives*. That is: it should use an ecosystem approach; be designed and implemented with partners; provide information to citizens so they can make informed decisions; use not only pure science but the broadest possible range of disciplines when making decisions; and provide leadership in promoting sustainability (Environment Canada 1995b). The level of skills/expertise required from within the department should be assessed. The gaps in this expertise should be balanced with talent brought in from outside.

2. Establish Ecounit Teams

Assign small teams of experts and integrators to each ecounit to better co-ordinate action and to develop a co-ordinated strategy for that ecounit. This is most important for the following ecounits: Georgia Basin (as outlined above), Okanagan, Northwestern BC and Offshore.

The team should be comprised of a leader and others from disciplines that are appropriate to the ecounit i.e. other agency staff, landowners, industry, technical personnel, communications staff, etc. Depending on priorities, one team may be responsible for more than one ecounit. In addition, some individuals will be involved in more than one team.

Teams should develop a strategy or plan that:

- looks at the boundaries of ecounit in more detail, makes any adjustments, and selects subunits as appropriate;
- establishes baseline information (existing) and identifies important data gaps;
- identifies needs (including, issue scanning, stressor identification, identifying potential partners, determining roles and resource needed);
- establishes goals and objectives (broad long-term goals first then subunit and local goals after with activities linked because objectives for one ecounit at a particular time and space have consequences for others);
- implements plan through integration, leveraging and partnerships;
- identifies potential candidate criteria to be used as indications of the sustainability of ecounits;
- and includes mechanisms for monitoring and feedback and reassessment and adjustments.

3. Develop Action Plans for Cross-cutting issues

There are many issues that are priorities regardless of which planning framework is used. Many of these, such as climate change, cut across all ecounits. Others, such as endangered species, occur where the species lives. Departmental and Regional Issue tables exist for: toxics and atmospheric change; enforcement; emergency preparedness; technology and know-how; environmental preparedness and warning; information products and services; biodiversity/wildlife; sustainable development; ecosystem sustainability; and administration. Information exchange between the Tables and the staff needs to ensure staff working on these issues need a forum to work together.

It is recommended that working-level regional issue-based teams should be established on cross-cutting issues.

4. Ensure this is an Iterative Process

The priorities identified in this paper are a product of information presently available within the department. As more people provide input, new information is available, more initiatives and projects start, and mandates change, the priorities may change. For this reason, it is recommended that steps be taken to ensure that decisions remain fluent with the changing state of knowledge as well as the dynamics of natural systems. To do this, a long-term mechanism is needed that will allow continued discussions on an on-going basis that will provide feedback and analysis of priorities. It is important that the department continue this process to involve more people in advancing this work. Subsequent

work must engage those who are committed to working with others and to achieving an integrated and coordinated approach. As the results illustrate, the effectiveness and efficiencies gained through a team based approach reinforce the benefits of coordination, and facilitate building broader understanding of the departmental contribution beyond a regulatory role.

It is recommended that:

1. *a planning group be designated to ensure that this foundation remains current and relevant;*
2. *the information base be expanded systematically to include other federal government departments, other governments, and relevant non-government groups; and*
3. *responsibility be built into the departmental planning tables.*

5. Ensure Business Plans reflect this Framework and Process

This planning framework should be adopted throughout the department in the Region.

The annual business planning processes should set and approve priorities and approve levels of effort in each ecounit. Managers should set overall management objectives and questions with the involvement of staff.

6. Improve Data Management and Integration

Data is a corporate resource. Science generates the data supporting the information base upon which decisions are made. There is a need to integrate the process of data collection and analysis with decision making both on the short and long term. There is also a need to improve access to the data so that the information exists for decision making.

It is recommended that a common data dictionary be developed and that data management and its integration across the department be coordinated.

Box 5: Summary of the Planning Framework

1. establish boundaries
2. identify issues and stressors
3. set preliminary priorities based on current knowledge
4. establish ecounit teams
5. establish partnerships
6. determine details of ecounit in greater detail
7. set goals and objectives for each ecounit
8. determine DOE role and responsibilities
9. develop strategies, business and action plans
10. implement
11. monitor, evaluate and feedback

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Appendices

Appendix A

Ecosystem Planning Framework Working Group Members

The Working Group consisted of the following individuals:

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Appendix B

Other Relevant Spatial Frameworks

Many spatial frameworks exist in BC. Those considered most important to DOE are those that either greatly affect federal interests, or those that we need to interact with on an ongoing basis, in particular for planning purposes. In this Region, the following other frameworks are of greatest significance and were considered in the selection of P&Y's framework:

Federal

National Ecological Spatial Framework

This national system corresponds with the Ecoregion Classifications of BC. The Pacific and Yukon Region's framework makes use of the ecoregions¹ of the Ecoregion system. Most of the terrestrial ecoregions, and all of the marine regions, fit entirely within one ecounit. As national data collected by Statistics Canada and SOE is often reported to the Ecoregion level, it is relatively simple to go back and forth between the two frameworks. For the eight ecoregions that cross two or more ecounits, the data can either be used for both ecounits or the teams responsible for the ecounits can discuss how they will use the data. Some issues will definitely lend themselves to discussion based on ecoprovinces.

First Nations

Boundaries between First Nations areas are difficult to define. Both major linguistic family areas and the comprehensive claims areas were considered. DOE recognizes that the lines on this map are not definitive and may change frequently. DOE is also prepared to consider other types of boundaries used by the Aboriginal Peoples. Nevertheless, using the claims and linguistic areas as a indication, many fall entirely within one ecounit. The native issues that do not fall completely within an ecounit will be dealt with in the same way as other issues which span more than one ecounit. The First Nations map will be adjusted as more appropriate boundaries become available. This ecosystem-based framework is being used to assist in DOE's negotiations with the First Nations, as it will allow a more comprehensive approach to determining DOE's and First Nation's responsibilities and help move forward from an issue-by-issue approach on both native land and claim areas.

Prairie and Northern Region (DOE)

The ecosystem units selected by the Prairie and Northern Region correspond with the ecozones. The nine ecozones of their region have been grouped into five major regional ecosystems. Their framework was first illustrated in 1991. Since this time the boundaries of the national ecozones have changed slightly. This system has been finalized in 1994 (Environment Canada 1994).

¹ Terminology used in this paper will correspond to that of the Ecoregion Classifications of BC if it differs from that of the National Ecological Spatial Framework.

Provincial

The main provincial ecosystem-based system is the hierarchical ecoprovince system. It fits directly into the national SOE ecozone hierarchy. Although much data and many programs are based on the ecoprovince system, the BC government's main planning processes do not correspond to it directly. The Land and Resource Management Plans and Commission on Resources and Environment units correspond most closely with timber supply areas, and Commission on Resources and Environment plans are being implemented on a sub-drainage basis. The Protected Areas Strategy boundaries correspond with groupings of the ecoregions, but not ecoprovinces or ecozones.

Regional Districts

Although regional district boundaries are strictly administratively determined, most fall completely within one ecounit. This will help make partnerships easier to forge.

International

The Americans have as many systems of classifying their land as Canada does; however the US Fish and Wildlife Service (1994), the US Department of Interior (1994), and the North American Ecozone Classification (SOE 1993) to be used for NAFTA are the frameworks that are most likely to influence DOE in the Region. Although all three of these are distinctively different, they all appear to cross the southern BC border at the same place. This matches with the Pacific and Yukon framework and will allow for easy collaborative work. The US Fish and Wildlife framework, based entirely on watersheds, matches up with Pacific and Yukon's at the Alaska/Yukon border as well. The NAFTA framework corresponds with the national ecozones.

Copies of the boundaries of these frameworks can be obtained from the Environmental Conservation Branch.

Appendix C

Issues, Threats, and Data Gaps of Each Ecounit

(Transcripts from first series of workshops)

The following tables, arranged in order of ecounit, identify the key issues that are currently impacting (or likely to impact) each of the 10 ecounits. The list of issues represents the collective input of Pacific and Yukon Region staff at the Branch level.

Georgia Basin		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Air Pollution	<p>Pulp and paper mills on Georgia Strait and Howe Sound; shellfish closures due to dioxin and furans. Downward trend in dioxins and furans but still need to monitor for 10-15 yrs.</p> <p>Greenhouse gases; need controls</p> <p>Smog/particulate matter; concentration of ground level ozone results in seasonal and episodic behaviour; impact to human health, vegetation and structures; expected to increase with urban development; chemical processes also generate particulate matter; also a transboundary issue</p> <p>Concentration/ distribution/ deposition of toxic chemicals through atmospheric pathway; impacts visibility, human health and ecosystem health; provides pathway from sources to receptor; increases with urban growth; also a transboundary issue.</p> <p>Atmospheric pathways; need to describe/ understand wind flow patterns which move weather disturbances and pollution throughout the Georgia Basin and their impact on concentrations/ deposition patterns of precipitation and pollution on other ecosystems.</p>	<p>Need to collect data on combustion sources of dioxins and furans (e.g. hospital incinerators)</p> <p>Need to assess heavy metal air contamination</p> <p>Need more information on methane emissions from landfills</p> <p>Revolitization of herbicides and pesticides and subsequent atmospheric transport and deposition; includes short, medium and long range transport.</p> <p>Thermal reduction of solid waste and air emissions are spreading toxics (Cadmium, lead, etc.) via air versus water from landfill leachate; impacting on human health</p>
<p>Industrial contaminants</p> <ul style="list-style-type: none"> • depends on discharge • type of contaminant 	<p>PAHs in sediment and biota in Vancouver harbour as well as other organochlorins and heavy metals; the impact is there but there is no data on a site specific basis; control and data issue</p> <p>TBT antifoulants, dredging and ocean dumping; current regulations may not be effective for harbour areas; need to assess whether preliminary data adequately reflects inadequacy of the regulations; should also assess synergistic effects of multiple contaminants</p> <p>Gravel washing operations on Coquitlam R. system causing fish kills because of sedimentation and siltation effects; need code of practice; control issue</p>	<p>Discharge of dichloromethane and PCLII; need to assess sources</p> <p>Dewdney Allouette Regional District; use of organichloramine as drinking water disinfection causing fish kills; need to find alternative methods for disinfection; control use of organichloramine</p> <p>Need to assess pulp and paper mill loadings</p> <p>PEC site contamination</p>

Georgia Basin con't..		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Municipal contaminants	<p>Municipal discharges (i.e. sewage, stormwater, CSOs); need adequate controls</p> <ul style="list-style-type: none"> • CSO primarily GVRD problem due to excessive water consumption; GVRD has highest water use per capita; control water use and this will reduce the need for water and sewage treatment thereby reducing CSOs • Toxicity of sewage discharges; need to control; assess the risk of not treating at a particular level • Stormwater a major contaminant source from all urban areas; long term contamination issue 	<p>Nonylphenols - estrogen mimicking compounds; (sources include municipal loadings and pulp and paper mills); they have been identified as a risk in the Great Lakes but are they a risk here?; need research</p>
Non-point sources	<p>Nox and VOC (urban smog); need controls</p> <p>Bacterial contamination of shellfish mainly due to non-point sources such as sewage ground disposal system and agricultural runoff; need to control bacterial sources</p> <p>Contamination of Lower Fraser by ground disposal septic systems; need research, monitoring and groundwater assessment</p> <p>Drycleaning solvents producing air emissions of perchloroethylene; need code of practice and controls</p> <p>Oil spillage causing contamination of breeding and philopatric wintering bird populations in increasingly industrialized areas (i.e Burrard Inlet).</p> <p>Bulk oil spillage threatens significant numbers of birds.</p> <p>Groundwater contamination by nitrates and pesticides affecting human health; nitrate values in many wells, especially Abbotsford area, exceeding allowable guidelines</p>	<p>Need updated inventory of use and sales of pesticides in Lower Fraser; need better understanding of how pesticides are being used</p> <p>Fraser sediment plume; need information on how river disperses contaminants and their impact on the Georgia Strait</p>
Agricultural practices/impacts	<p>Discharges from agricultural practices; need to address options; currently a group looking at this</p> <p>Residual pesticides in Lower Fraser Valley impacting bird populations (ducks and raptors); need research on pesticide management</p>	<p>Need to assess and control ammonia releases from agricultural practices; airshed monitoring currently ignores agricultural contributions</p> <p>Agricultural activities are impacting small streams; eutrophication and input of pesticides affecting stream ecosystems.</p>

Georgia Basin con't..		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
	<p>Agricultural land degradation; over exploitation of land's crop carrying capacity and intensification of use causing soil health decline and organics in water.</p> <p>Food chain bioaccumulation.</p> <p>Decline of soil based agriculture</p>	
Degradation of coastal habitats and water quality	<p>Marine development pressures on coastal zone (i.e logging, marinas, docks, terminals, aquaculture) is impacting sensitive areas for birds.</p> <p>Marine vessel discharges and air emissions (ie. ballast water, oil, sulphur dioxides, oxides; controls needed).</p>	<p>Groundfish fishers reporting fewer catches of rexsole; catches in Georgia Strait show surficial tumors.</p> <p>Degradation of coastal habitats and water quality affecting the integrity of the ecosystems that support wintering water birds (international significant resource) and Marbled Murrelets.</p> <p>Need to maintain sand lance stocks to support Marbled Murrelets, salmon and sea lions.</p> <p>Aquaculture -Impacts on habitat alienation and potential for interaction between aquaculture (particularly shellfish culture) and diving ducks</p> <p>Need coastal zone management plan to protect sensitive areas for waterfowl</p>
Mining clean up issues		<p>Britannia Mine; release of heavy metals (Ca and Zn); effects on salmon may be severe; control issue</p> <p>Mt. Washington Mine; Tolsum River at Courtney has been sterilized due to acid rock drainage; quantifiable salmon losses exist; control issue</p>
Overfishing/impact on marine resources	Declining population of chinook salmon in Georgia Strait, rock fish and cod due to overfishing and loss of habitat.	Over exploitation of littoral fisheries; population decline showing in Ling cod, rock fish, crab etc.; need controls
Urbanization; population pressure	<p>Agricultural land base is being threatened; increasing runoff, etc.</p> <p>Urbanization creating heavy impacts on estuaries, green spaces and sensitive species (i.e. Garry Oak trees on Vancouver Island).</p>	Increased urbanization pressure on habitat

Georgia Basin con't..		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
	Urbanization causing wildlife and aquatic habitat loss in Fraser estuary.	<p>Overpopulation and use of parks is affecting terrestrial wildlife and their territorial requirements.</p> <p>Shellfish closures increasing due to sanitary contamination.</p> <p>There is little or no recognition that there are limits to the number of people that an area can hold while still preserving a quality of life based on current levels of habitat loss and biodiversity.</p> <p>Expanding gull populations breeding on city runoffs pose threat of structural damage and disease risk.</p> <p>Urban growth along east coast of Vancouver Island will bring increased concentration of particulates/aerosols and airborne toxics.</p> <p>Domestic cat populations increasing and destroying large numbers of songbirds in suburban settings which may have become population sinks.</p> <p>Intense pressures for recreational use</p>
Wetland and riparian habitat loss	Loss of wetland and riparian habitat occurring due to urban, agricultural and forestry stressors; affecting coho salmon in particular.	<p>Many key wetland habitats lack adequate protection.</p> <p>Inventories of certain habitats incomplete (eg. lowland forests in Fraser Valley); result is poorly stated conservation and biodiversity objectives for these areas.</p> <p>Rise in sea level impacting estuarine habitat.</p> <p>Increased risk of birdstrikes on aircraft due to increases in populations of snow geese and trumpeter swans which will be forced to move further afield for marsh habitats (i.e. in front of the airport).</p>
Endangered Species/Species conservation	Spotted owl old growth habitat loss and species loss; only some 50 pairs of spotted owl in BC remain.	Nooksak Dace and Salish Sucker, Enois Lake Stickleback, Maccoon Metrofoam

Georgia Basin con't..		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
	<p>Loss of salmon stocks, particularly coho, due to destruction of streams and rivers on Vancouver Island and Lower Mainland.</p> <p>Sensitivity of world's largest concentrations of bald eagles in Squamish area.</p> <p>The international significance and sensitivity of the Fraser Estuary for snowgeese, western sandpiper and numerous other species, both migratory and resident.</p>	<p>Threat of exotic species introduction into the foreshore/ estuary/ intertidal areas impacting on resident species important in the food chain supporting commercially important species.</p> <p>Establishment of the ferret on southern Vancouver Island.</p>
Forestry	<p>Loss of remnant old growth forest</p> <p>Forest practices threaten to eliminate nesting habitat for Marbled Murrelets.</p>	<p>Timber resource use of forest (i.e mushroom and bark harvesting)</p> <p>Forest productivity; rapid crop rotation causing air pollution; tree growth rate decline impacting water quality and quantity.</p>
Lack of vision and integrated planning in Georgia Basin		<p>Wildlife population objectives not clear or complete.</p> <p>Limited understanding by the population of what the issues are and a lack of land ethic.</p> <p>Lack of knowledge in the planning and development as to what habitats are sensitive and how they should be protected.</p> <p>"Trendiness" of environmental issues and poor understanding of public or changing public values which translate or lack of political support; DOE should be proactive and guide public opinion.</p>
Climate change		<p>Climate change is impacting quantity and quality of water resources, timing and intensity of spring freshet; extended summer drought having an agricultural impact as well.</p> <p>Climate change impacts to sea surface temperatures in North Pacific could result in significant reduction of salmon production; this will impact the human population in Georgia Basin.</p> <p>Emissions of ozone depleting substances.</p>

Georgia Basin con't..		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Cross boundary issues	<p>Need to develop standards for air emissions PM10 or less; long term issue; data is required on how the particulates are formed</p> <p>Transboundary air/water issues; put systems in place to ensure the data gets to the right people in Canada and US</p> <p>PCBs; coplanar compounds may be persisting despite overall concentrations decreasing; long term impacts; need to collect data and assess impacts</p>	International conflicts due to export of contaminants.

Fraser River		
Issues	Specific Examples	Specific Examples
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Industrial contaminants	<p>Pulp mills need continued environmental monitoring</p> <p>Need to project urban growth impacts to determine increases in toxic and chemical loading</p> <p>Consider toxic contaminants from pulp mills and their impact on water quality and downstream ecounits and the foodchain</p>	<p>Reclamation of Highland Valley copper mine; largest area of disturbed mining land in Canada; battle over end use - cattle (grasslands) versus forest; need controls</p> <p>Need an assessment of the aquatic effects of molybdenum at the Endako mine; no fish toxicity, but it could be a problem; part of focus on Nechakor and Francois Lakes</p> <p>What is the effect of the new bleaching techniques in pulp mills?</p>
Municipal contaminants	Municipal discharges (i.e. CSOs, stormwater runoff, sewage); need adequate controls	
Non-point sources	Increased non-point source nutrient and contaminant loading in the Shuswap system	<p>Need to assess placer mining sediment releases into Fraser River tributaries; also need monitoring</p> <p>Contaminated sites; literally hundreds of sites; problem not well defined; need assessment</p> <p>Land use practices affecting water quality</p>
Air quality	Should consider impact of atmospheric pathway on distribution and loading of precipitation and air pollutants; also consider transboundary flows	<p>Smog, air toxics and particulates/aerosols; tend to be localized around urban/industrial developments; particulates and aerosols the most important issue</p> <p>Woodburning impacts on local areas affecting human health</p>
Forestry	<p>Logging and soil erosion and stream sedimentation impacting stream habitats</p> <p>Cutting of too many large trees needed as nesting habitat by Barrow's Goldeneye and Pileated woodpeckers as well as other cavity nesting birds</p>	<p>Is the forest in the Upper Fraser sustainable and can it become so?</p> <p>Will the new forest practices code be enforced?</p> <p>"End runs" on sustainable forestry practices code in the name of disease control</p>

Fraser River, con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
		Encroachment of forest land onto grasslands due to fire control
		Lodgepole pine mining
Wetland and riparian habitat loss	Conversion of wetland and riparian habitats for agricultural, urban and semi-urban land use is impacting fish and wildlife populations	Ranching, grazing is having an impact on streams and riparian habitat
	Heavy grazing removing most cover need by dabbling ducks	Loss of natural grassland by introduced species (e.g. knapweed, cows tongue - latter is poisonous to cattle)
Water quality and quantity		Municipal sewage discharge
		Access/resource roads
		Landfilling in Hat Creek
		Lakes in Kamloop are increasing in alkalinity which is having an impact on native trout species
		Recreational use of the river for rafting
Water supply/flow regimes	Consider the effect of diversions caused by logging and urbanization on water quality and quantity in the upper Fraser and the impacts on sustainable anadromous fish stocks	Nechako River and Kemanos diversions impacting fish and wildlife
	Diversions impacting water quality and quantity, water temperature, water flow and rearing habitat	
	Need to assess hydroelectric power and irrigation needs in the future	
Continuation of FRAP work		Who and how will FRAP work be carried on?
Agricultural practices	Eutrophication of tributaries due to agricultural runoff (cattle access to tributaries)	Agricultural practices - are the guidelines going to be used?
		Soil erosion from overgrazing
Endangered species/Species conservation	Introduction of trout in critical habitat for breeding ducks	Introduction of new species impacting native species

Fraser River, con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
	<p>Policy of destroying "amarilia" infected trees reduces nesting opportunities for important insect eating birds (chickadees, nuthatches) which eat the disease vectors (beetles)</p> <p>Pulp mill effluents can add large volumes (up to 1/3) during low flow conditions</p>	<p>The Fraser River is the most significant salmon producing river in the world and an economic pillar for BC and its aboriginal peoples</p> <p>Expansion of Eurasian milfoil infestations is causing an impact on sockeye (lake rearing) stock, especially in Shuswap system</p> <p>Species extinction - Pollution and over-exploitation impacting fish and wildlife (i.e. sturgeon)</p>
Climate change (also a cross boundary issue)	<p>Climate change impacting forestry regeneration as climate warms</p> <p>Impacts on temperature and river flow in Fraser</p>	<p>Climate change impacts on migratory bird habitat, e.g. Riske Creek area</p> <p>Climate change impact will result in significant changes on salmon and similar fisheries and water quality, especially in southern areas</p> <p>Lack of effective biological indicators (early warning)</p>
Cross boundary issues	see climate change	<p>Lack of knowledge with which to develop effective conservation plans for species sensitive to human activity (i.e. sandhill cranes; common loon, red-necked, horned and eared grebes)</p> <p>Increased impact of ultraviolet radiation on terrestrial and aquatic organisms and plants</p> <p>Population growth</p> <p>POPS</p> <p>GHG</p>

Okanagan		
Issues	Specific Examples	Specific Examples
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Air quality/pollution	<p>Urban development enhancing concentrations of smog; also particulates/ aerosols from biomass burning</p> <p>Revolitization of pesticides and herbicides and subsequent atmospheric transport and redeposition; includes short, medium and long range transport</p>	
Habitat loss	<p>Uniqueness of the ecounit supporting many species not occurring elsewhere in Canada; Ecounit has unique habitat (grasslands and semi-desert)</p>	<p>Expansion of urban areas and agricultural intensification resulting in wetland and riparian habitat loss</p> <p>Habitat loss occurring due to forestry practices and grazing</p>
Mining	<p>Metal loadings from mining operations; Princeton to Hedley area; concern with cyanide leaching from gold mine operations</p>	<p>Revival of old mining activities</p> <p>Mining impacts in Similkameen</p> <p>Mining of groundwater will have long term impacts on the region and short term impacts for adjacent well users</p>
<p>Non-point source contamination</p> <ul style="list-style-type: none"> Pesticide useage/ management 	<p>Impact of residual DDT and DDE on resident and migratory birds' reproductive capabilities</p> <p>Residual lead and arsenic levels quite high but effects on wildlife are poorly understood</p> <p>Effects of organophospates, organochlorines and carbomates on birds</p>	<p>Loading from non-point sources contributing to eutrophication and contaminant build up in lakes</p> <p>Cyanide contamination and long term impacts from heap leaching operation (also a transboundary threat)</p> <p>Pesticides from orchard industry contaminating surface and groundwater</p> <p>Bioaccumulation in food chain</p> <p>Pesticide spraying is a threat to human health; also leads to subsequent contamination of potable water sources</p>

Okanagan con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Water Use/Water supply	Proposed hydroelectric development in Similkameen (near Princeton)	<p>Water levels generally low; this is affecting nutrient levels and increasing contamination; result is decline in water clarity, declines in fish population and changes in fish community structure</p> <p>Population explosion impacting water quality and quantity and placing increasing demands on water supply</p> <p>Dams restricting salmon returns; Kinbasket Tribal Council wants salmon to be returned to the system</p>
Water quality and quantity		<p>Groundwater contamination from pesticides and mining operations</p> <p>Eutrophication of lakes from waste water disposal</p> <p>Population explosion impacting water quality and quantity</p> <p>Recreational boating and pipelines are a concern; sensitive waterfowl in Okanagan and Vaseaux Lakes in particular</p>
Endangered species/Species conservation	<p>Threatened/ endangered species in Okanagan include: yellow breasted chat white headed woodpecker burrowing owl sage thrasher peregrine falcon</p> <p>Decline in Kokanee populations in Okanagan Lake</p> <p>Shrinking scorpion population</p> <p>Significant decline in salmon population in Okanagan River since 1970s due to anglers, water level changes and destruction of spawning habitat due to development</p> <p>Recreation users continue to spread Eurasian milfoil</p>	<p>Several species reach their northern limit in the Okanagan and are, in fact, endangered or threatened in Canada</p> <p>Disease in US salmon stock may threaten whatever is coming up the Okanagan and Similkameen rivers</p> <p>Domestic cats impacting on suburban populations of songbirds</p> <p>Overuse of grasslands impacting biodiversity</p>

Okanagan con't		
<i>Issues</i>	<i>Specific Examples</i>	<i>Specific Examples</i>
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Climate change		Long term impacts due to reduced snowpack and extended summer drought Climate change impacting forestry (fire frequency, intensity and spread of pests and disease)
Cross boundary issues		POPS GHG

Columbia		
Issues	Specific Examples	Specific Examples
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Municipal contaminants		Sewage spills
US mine impact on Kettle Valley watershed		New US Crown Jewel project could impact transboundary waters; need monitoring and controls
Water flow regimes/ regulations	<p>Several new river projects proposed that could result in unfavourable water levels; logging in area will have similar impact</p> <p>Water flow regulation impacting downstream ecosystems; need continued DOE involvement in Columbia River. Integrated Environmental Monitoring Program (CRIEMP); sensitive transboundary issues</p>	<p>BC Hydro dam changes affecting water quality and quantity and resulting in habitat loss and species decline</p> <p>Regulation changes to Libby Dam impacts littoral zone of Lake Kookanusa, affecting fish and recreational use of the lake.</p> <p>Nutrient starved lakes due to reservoirs; impacting fisheries</p> <p>No free flowing rivers</p>
Air pollution	Atmospheric pathway; flow patterns and long range transport of air pollutants and distribution of precipitation /air pollutants	<p>Long range transport of particulates/aerosols and air toxics; local deposition of air pollutants in vicinity and downwind of industrial/urban development</p> <p>Dioxin and furan issue from Celgar pulp and paper mills impacting water quality and biota; also a transboundary concern</p>
Aquatic ecosystem health	Declining fish population (Rainbow trout, Kokanee) in Kootenay lake as a result of decreasing productivity and competition for food by Mysis.	<p>Agricultural runoff from Kettle Valley impacting water quality and quantity</p> <p>Decrease in Kokanee and gerrard rainbow</p> <p>Declining populations of sturgeon due to water flow regime</p> <p>Impacts on aquatic ecosystems from increased ultraviolet radiation</p>
Habitat loss	Conservation of upper Columbia as most important riparian lowland still in "natural" condition in Southern BC; only overlapping breeding area for cavity nesting ducks - barrows and common goldeneye, bufflehead, common and hooded merganser and wood duck.	<p>Defacto management of migratory birds by National Parks</p> <p>Possible extraction of rare duck habitat (alkaline sloughs)</p> <p>Possible extraction of rare duck habitat (alkaline sloughs)</p> <p>Overgrazing impacting biodiversity</p> <p>Fragmented habitat is extreme</p>

Columbia con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
		Building of resource roads and bridges for resource extraction and recreation
Transboundary air and water quality	<p>Transboundary inputs from Celgar; impacts to walleye fish stocks on Roosevelt Lake</p> <p>Toxic inputs from Cominco; exceed water quality guidelines and affect transboundary water quality and air quality</p>	<p>US request for IJC reference due to Cominco air and water pollution</p> <p>Hanford transboundary input of radioactive material through air transport</p> <p>POPS</p>
Forestry practices	Unsustainable logging practices	Fire and disease disturbances
Climate change		<p>Climate change may impact future water quantity demands from US leading to increased water diversions</p> <p>Impacts on forestry and biodiversity</p> <p>Impacts on water resources and on fisheries due to increased water temperature and reduced flows</p>
Endangered species/Species conservation	<p>Conservation of neotropical migrants; monitoring of populations by banding along Rocky Mountain Trench.</p> <p>Impact of recreation (rafting, fly fishing) on very sensitive populations of Harlequin Ducks</p> <p>Hunting and development pressures a threat to grizzly bear and wolf population in Waterton National Park; transboundary issue</p>	<p>Tourism an increasing threat to wildlife and wildlife habitat in river</p> <p>Introduction of exotic species</p>
Industrial Contamination	<p>Celgar Pulp and Paper Mill at Castlegar; organochlorines, dioxins, furans</p> <p>Cominco lead-zinc smelter/fertilizer complex at Trail; contamination by various heavy metals and discharges from fertilizer operation (ammonium phosphate and nutrients)</p> <p>Slag discharges into river by Cominco complex in Trail; barriers to fish migration, loss of fish habitat; dissolved gas and supersaturation</p>	<p>Heavy metal loadings to Columbia River from Trail area</p> <p>Coal projects proposed along Fording and Elk Rivers; Coal mining fugitive dust and leachates impacting biota and human health</p>

Central Coast and Islands		
Issues	Specific Examples	Specific Examples
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Kitimat	<p>Estuary management plan needed for Kitimat; would likely have high probability of success because its relatively uncomplicated; must include the airshed; plan would include all factors you normally have to deal with</p> <p>Kitimat; impact to fish from Eurocan pulpmill releases; need control and solutions to the problem</p> <p>Kitimat; elevated levels of PAHs and negative biological effects in Kitimat Harbour; need habitat management plan, need control; access to power generates interest in port and other development in the area</p> <p>Need monitoring of industry in Kitimat and Prince Rupert; shellfish contamination</p>	
Development of water quality objectives	Need to develop water quality objectives for environmental impact assessment of abandoned mine sites	Skeena - Babine Lake; reclamation plans for Bell Mine and Granisle; need to develop water quality objectives for Babine Lake; need assessment of copper levels in lake
High opportunity for ecosystem recovery research; Alice Arm, Quatsino, Anyox, Tasu	Need to study environmental recovery of Quatsino Sound from mining and pulp mill discharges; suggest 15 year monitoring program	<p>Good opportunity to develop ecosystem planning framework - covers all the factors</p> <p>Kemano Reservoir; need mercury level study in fish</p> <p>Island Copper; this area is a natural lab for following ecosystem response (i.e. ecosystem impact and recovery)</p> <p>Skeena - Alice Arm; need to assess how area has recovered (study recolonization of tailings in inlet)</p>
Non-point sources of contamination	Contaminants in shellfish (common to all marine areas in Islands) (see Georgia Basin)	Kitimat airshed; need to assess receiving capacity for future development

Central Coast and Islands con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Industrial contamination	Pulp mill effluents and smelter slag impacting fish/crab consumption and causing eutrophication of fjords	<p>Need to assess impacts to commercial salmon industry (high investment; high commercial value), especially Babine Lake</p> <p>Assess pulp mill/mining impacts on coastal salmon stocks and shellfish; monitor dioxin levels</p> <p>Skeena - Anyox Mine; heavy release of metals to Observation Inlet; need assessment and controls</p> <p>Huckleberry Copper Project; proponent Princeton Mining Corporation; watersheds include Ootsa Lake and Kitimat; need follow up and assessment of EA</p> <p>Competition between Prince Rupert and Kitimat for port development; need planning strategy</p> <p>Pulp mill production of PAHs</p> <p>Pulp mill inputs impacting traditional food sources for aboriginals</p> <p>SF⁶ one of the most effective greenhouse gases from Kitimat smelter</p>
Forestry issues		<p>Loss of old growth temperate forest</p> <p>Sedimentation releases from forestry practices on QCI</p>
Estuary habitat loss	<p>Sensitivity of marine shore habitat to oil spills and marine traffic</p> <p>Port activity at Kitimat causing possible contaminant issues and habitat alteration</p>	<p>Urban and industrial development is on the only flatland at the head of the fjords; studies showing decline in wildlife and fish population</p> <p>Transport corridors are creating potential for oil spills</p>
Aquaculture	<p>Aquaculture destroying sea duck habitat</p> <p>Potential for interaction between sea ducks and shellfish culture</p>	

Central Coast and Islands con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
	Aquaculture impact from fish (Atlantic salmon) and disease/parasites introduction from reared species; local eutrophication problems with fish food and fish farms	
Aquatic ecosystem health	<p>Herring population threatened long term water export could impact oyster rearing areas</p> <p>Proposed power developments will impact fish</p> <p>Mackeral distribution limits expansion and predator pressures for salmon stocks</p> <p>Declining coho stocks and groundfish</p> <p>Declining steelhead stocks</p>	<p>Decreasing cormorant population in Queen Charlotte Islands</p> <p>Overfishing of returning salmon</p>
Hydro electric developments		<p>Long term water export could impact oyster rearing areas</p> <p>Proposed power developments will impact fish</p>
Protection and conservation of seabird populations	<p>Recreational activities impacting bird colonies</p> <p>Conservation of 70% of world's ancient murrelets, 80% cassin's auklets and 50% of world's Rhinoceros auklets</p> <p>Introduced racoons and rats destroying native seabird colonies</p> <p>Seabirds offer excellent opportunity to monitor annual changes in marine environmental quality</p>	<p>Need compatible management plans from DOE and Parks Canada</p> <p>Lack of knowledge on sand lance-the major prey species for seabirds</p>
Mining in Queen Charlottes		Proposed mine in QCI
Air quality/pollution	Local particulate/aerosol problems from biomass burning; local deposition of toxic chemicals from industrial complexes; long range transport of pollutants	Air borne contaminants from Asia, POPS
Climate change		Marine environmental changes due to climate change and marine pollution impacting salmon and other fish

Central Coast and Islands con't		
<i>Issues</i>	<i>Specific Examples</i>	<i>Specific Examples</i>
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Cross boundary issues		POPS Need water quality objectives for Salmon River; need US input because of US /Canada transboundary agreement

Northwestern BC		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Environmental assessment and long term monitoring of several large mining properties		<p>Tulsequah Chief; proponent Redfern Resources; base metal mine; Tulsequah and Taku watershed</p> <p>Red Chris; proponent American Bullion; major copper project; Iskut watershed</p> <p>Bronson Slope; proponent International Skyline; base metal mine; Iskut watershed</p> <p>Polaris Taku; proponent CANARC; mid-size gold deposit; Tusequah watershed</p> <p>Golden Bear Mine; proponent North American Metals; small gold mine (hemp leach); Iskut watershed</p>
Lack of planning and coordination		<p>Need overall plan to provide power, access , transportation, power for development, etc.</p> <p>Need federal and provincial involvement</p> <p>Need Stewart estuary management plan (Nass) for mining and port development</p>
Climate change		Impacts on glacier size and thus water flow and temperature regimes
Habitat loss		<p>Urbanization of upper lakes (i.e. Babine); with climate change these low elevation lakes will attract population increases; this will affect loss of riparian and littoral wetland and cause pollution of foreshore area</p> <p>Forestry practices producing fragmentation of habitat on forest birds; enhanced access for parasites and predators</p>
Hydroelectric developments		<p>Proposed developments (Stikine)</p> <p>Impact on riparian habitat and estuaries</p>

Northwestern BC con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
		Reservoir and power line developments will affect habitat loss and dynamic changes in estuarine habitat
Mining	Mining in river basins and potential effects on aquatic ecosystem; not entirely understood because of naturally high background levels in river; research required; transboundary issue	<p>Need to learn more about the effects of mining including, tailings, water quality, habitat loss, reclamation, access, transboundary shipment and power lines on migratory birds</p> <p>Impact on water quality and salmon populations; transboundary concern</p> <p>Need Anyox mine recovery plan</p> <p>Alice Arm disposal; heavy metal contaminant issue remains a threat to Nishga people</p>
Long range transport of air pollutants		Will introduce air toxics to the ecosystem (pesticides and heavy metals)
Need for baseline studies		Lack of knowledge about indigenous populations in the aquatic system
Endangered species/Species conservation		Khutzeymateen grizzly bears preserved but now concern over adjacent development

Peace/Liard		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Pollution effects from Williston Reservoir	Pulp Mill impacts - Williston Reservoir	Mercury in Williston Lake Methane emissions from rotting wood Williston Reservoir downstream impacts the largest estuary in Alberta Lake, Athabasca and Wood Buffalo National Park
Forestry	High levels of DDT in fish livers; increased sedimentation from logging Forest management inadequate and logging is occurring at an accelerated rate; most desired timber is the riparian white spruce forests which is limited in distribution to lowest elevations; loss of deciduous forest has implications to species in those habitats Productivity of lowland spruce compromised due to inadequate site data and long rotational age	Pulping hardwoods a new impact; affecting rare warbler species
Habitat loss	Access/tourism impacts to existing habitats	Habitat loss due to hardwood pulp extraction, gas exploration, processing and pipelines and potential hydro developments
Endangered species/Species contamination		Disappearance of grayling at Williston Lake Endangered species: <ul style="list-style-type: none"> • trumpeter swan • magnolia warbler • Cape May warbler • western tanager • pileated woodpecker • black-backed woodpecker Red list includes: <ul style="list-style-type: none"> • northern goshawk • bay-breasted warbler Blue list: <ul style="list-style-type: none"> • Philadelphia verio Increased activity and wilderness access may impact productivity of dolly varden fish

Peace/Liard		
Issues	Specific Examples	Specific Examples
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Water quality/supply	<p>Potential hydro development (Site C) on Peace River</p> <p>Site C will have downstream impacts to Athabasca delta where vegetative succession is occurring</p> <p>North east coal development area impacting water quality and terrestrial habitat</p>	<p>Flow regime impacting water quality and quantity; causing transboundary impacts as well</p> <p>Potential impacts associated with major copper project; proponent-Royal Oak; project-Kemess South; watersheds - Sustet River and Peace River</p>
Air quality/pollution	Long range transport of air toxins and particulates from industrial activity and urban developments	<p>Air quality problems in areas like Dawson Creek</p> <p>Air quality impacts from gas plant and pipeline expansion</p>
Seismic exploration work	Access and energy corridors are contaminants to air and water, fish and wildlife population suffering	Oil and gas exploration impacting habitat
Climate change impacts		<p>Agricultural potential of area could improve as summers lengthen</p> <p>Climate change and resulting impact on water quantity may induce development of another hydro dam on Site C or Laird River; will impact fish migration and cause habitat loss</p>
Cross Boundary Issues	Parasite transfer from Arctic to Pacific drainage identified as high risk	Use of pesticides by the forest industry is impacting on aboriginal traditional food sources

Central Yukon		
Issues	Specific Examples	Specific Examples
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Mining	<p>Lake Laberge shows high toxaphene levels in turbot livers; high background levels of Cd and Za in Tintina trench</p> <p>Increased mining activity will increase heavy metals in aquatic ecosystem</p> <p>Increased mining activity and contaminant levels due to LRTAP</p> <p>Increased fish contamination</p>	
Forestry		<p>Loss of riparian white spruce forests which is limited in distribution to lowest elevations; implications to species in those habitats</p> <p>Golden crown kinglet at edge of range and is dependent on white spruce forest</p> <p>Higher temperatures may alter forest ecosystem; while tree growth may increase, incidents of forest fire and invasion of forest pests may impact productivity</p>
Endangered species/Species conservation	<p>Increased recreational activity poses contaminant problem and productivity risk</p> <p>Recreational pressures encroaching on forest; causing habitat damage; species productivity at risk</p>	<p>Sharp tailed grouse largely dependent on grassland habitats; species at risk</p> <p>Endangered species; short-eared owls</p>
Habitat loss	Access, tourism impacts	Loss of riparian white spruce forests which is limited in distribution to lowest elevations; implications to species in those habitats
Contamination (air and water)	Woodsmoke and increased vehicular activity a risk to human health during winter due to arctic inversion trapping particulates in urban environment	<p>Increased resource extraction, especially mineral exploration, poses contaminant problem</p> <p>High background levels of Cd and Za in Tintina trench; increased fallout from coal plants</p>

Central Yukon con't		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Climate change	<p>Long term increased precipitation will change hydrology of aquatic ecosystems and aquatic habitats may be adversely affected:</p> <ul style="list-style-type: none"> • increased flooding/erosion may result in increased sediment load; • expansion of wetlands in riparian vegetation may alter water chemistry (increased acidity) for a time <p>Higher temperatures may alter forest ecosystem; while tree growth may increase, incidents of forest fire and invasion of forest pests may impact productivity</p> <p>Increased risk of forest fire may reduce encroachment of forest on grassland ecosystem</p>	

Northern Yukon		
Issues	Specific Examples	Specific Examples
	Data Exists	Data Required/Gaps
Contaminants	<p>Long range transport of Cs and Cd, particularly in forest ecosystem</p> <p>Bioaccumulation impacts- lichen/caribou and human linkages</p>	<p>Potential for Beaufort Sea blowout - organochlorines/ nuclear waste: significant threat to marine habitat/communities; sustainability of productivity in marine estuarine ecosystem at risk</p> <p>Thermal (coal) development in Peel watershed; potential for heavy metal contamination - airborne and site specific</p> <p>Oil and gas development in Eagle Plains- potential for site specific spills</p>
Habitat loss	Habitat, species and productivity at risk because of resource extraction activities, access, etc.	
Endangered species	<p>Marine- polar bear, bowhead whale</p> <p>Alpine/tundra- muskox, peregrine, gyrfalcon, short-eared owl</p>	
Access/tourism	<p>Reduction of Arctic char due to harvest pressures</p> <p>Importance of summer range for Porcupine Caribou Herd- decreased carrying capacity due to Alaska National Wildlife Refuge development</p>	
Climate change		<p>Melting permafrost will drastically affect integrity of the Old Crow Flats - many of these lakes are maintained by ice wedges</p> <p>Increased risk of forest fires under projected climate change</p>
Cross Boundary Issues		<p>Atmospheric transport of contaminants</p> <p>POPS</p>

Offshore		
Issues	Specific Examples	Specific Examples
	<i>Data Exists</i>	<i>Data Required/Gaps</i>
Lack of access to offshore ecosystems	Lack of access to offshore ecosystems to detect problems or formulate responses to issues	
Migration of world population of shearwaters from Australia to New Zealand but no way to identify issue • other pelagic birds as well		
Climate change		Increases in UVB, global warming, ozone depletion Effects on primary production Change in oceanic trophic conditions
New ocean fisheries	Proposed deep sea mining impacts on fish and wildlife	
Fish management	Bicatch effects on community structure and survival	Overfishing effects on populations and biodiversity
Long range transport of air pollutants	Elevated levels of DDT and DDE in albatross, storm-petrels Pesticides/heavy metals, particularly from Asian countries	

Appendix D

Key Issues, Threats, and 10-year Prognosis

(Summary from first series of workshops)

The following tables summarize the underlying threat and prognosis for each key issue in each ecounit.

Georgia Basin		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Air Pollution <ul style="list-style-type: none"> • Dioxin and furans - combustion sources include hospital incinerators. • Methane emissions from landfills • Nox and VOC (urban smog) • Drycleaning solvents producing air emissions of perchloroethylene • Revolatized herbicides and pesticides 	Urbanization, Industrial contamination:	Worse Population is increasing even if we produce cars that pollute less
Agricultural land degradation: <ul style="list-style-type: none"> • over exploitation of land's crop carrying capacity and intensification of use • decline of soil based agriculture • top soil loss • land conversion • land economics 	Urbanization; Agricultural intensification/practices	Worse Intensification can only increase with population pressure
Industrial contaminants: <ul style="list-style-type: none"> • organochlorins and heavy metals, pulp and paper mill loadings, dichloromethane and PCLII, ammonia releases from agricultural practices, TBT antifoulants from dredging, ocean dumping and boats • Gravel washing operations 	Urbanization, industrial and marine development	Better regulation and control May have more contamination on the whole though Better
Municipal contamination: <ul style="list-style-type: none"> • Water and sewage treatment; • Stormwater runoff • Expanding gull populations • Non-point source fecal contamination 	Urbanization, industrial development	Better May have more contamination on the whole though due to population increase
Pesticide/herbicide management <ul style="list-style-type: none"> • Bioaccumulation • Organosphospates, organochlorines and carbomates 	Agricultural intensification, unregulated homeowner use	Same or Better Unregistered use by increasing population could offset any gains because of BC Pesticide Management Plan
Impact on marine resources <ul style="list-style-type: none"> • Overfishing 	Urbanization; recreational pressure on marine resources	Worse

Georgia Basin con't		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
<ul style="list-style-type: none"> Contaminants from recreational/tour & commercial vessel traffic Sewage contamination Need for coastal zone management plan to protect sensitive areas for waterfowl Aquaculture operations and introduction of antibiotics 	<p>Marine vessel discharges and air emissions (ie. ballast water, oil, sulphur dioxides, oxides)</p> <p>Sewage</p> <p>Marine development pressures on coastal zone (i.e logging, marinas, docks, terminals, aquaculture, residential)</p> <p>Rising sea level</p>	<p>Increased shoreline fishing</p> <p>Sewage contamination might be reduced in some areas but it is still a big problem for shellfish growing</p>
<p>Mining clean up issues</p> <ul style="list-style-type: none"> Britannia Mine Mt. Washington Mine 	<p>Resource development</p> <ul style="list-style-type: none"> inaction 	<p>Same or Worse</p>
<p>Habitat loss and biodiversity</p> <ul style="list-style-type: none"> Threat of exotic species introduction into the foreshore/ estuary/ intertidal areas Incomplete inventories of certain habitats; result is poorly stated conservation and biodiversity objectives for these areas Wetland and riparian habitat loss Ecosystem types found nowhere else in Canada Fragmentation 	<p>Urbanization, Agricultural intensification, Resource development, Shipping traffic (ballast water), Unregulated recreational harvesting</p>	<p>Worse</p>
<p>Degradation of water quality</p> <ul style="list-style-type: none"> Groundwater contamination from Fraser R. Water quantity 	<p>Urbanization, Agricultural intensification:</p> <ul style="list-style-type: none"> Septic disposal systems Agricultural runoff (nitrates and pesticides) <p>Climate change</p>	<p>Worse - Water quality and quantity</p> <p>Better at entrance to Fraser River</p>
<p>Forestry:</p> <ul style="list-style-type: none"> Loss of old growth forest Timber management forest practices - impact on air pollution; tree growth rate and water quality and quantity 	<p>Resource development.</p>	<p>Better for areas subject to Forest Practices Code</p> <p>but...</p> <ul style="list-style-type: none"> old growth forest is lost for good the code does not apply to private land holders

Georgia Basin con't		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Lack of vision and integrated planning: <ul style="list-style-type: none"> • Growth management strategies • DOE needs to be involved in assessment of developments • Need to link federal and provincial data systems; harmonize and coordinate data collection and distribution; remove administrative barriers to transferring data • No committment to change or share knowledge 		Better Agencies and communities starting to communicate better
Increased risk of birdstrikes on aircraft due to increases in populations of snow geese and trumpeter swans which will be forced to move further afield for marsh habitats (i.e. in front of the airport).	Urbanization	Worse

Fraser River		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Industrial contamination <ul style="list-style-type: none"> Impact of placer mining on tributaries (sediment control and water runoff) Pulp mills 	Urbanization, resource development	Same - placer mining Worse - sediment control Better - pulp mill effluents
Municipal contamination <ul style="list-style-type: none"> parasite contamination 	Urbanization <ul style="list-style-type: none"> water and sewage treatment; stormwater runoff increased septic systems 	Worse Stormwater runoff increasing Septic sources reaching super saturation; increasing population
Air pollution <ul style="list-style-type: none"> Smog, air toxics and particulates/aerosols 	Urban/industrial developments, land clearing and burning, topsoil erosion	Better - with cogeneration, etc. Worse - domestic wood smoke
Forestry <ul style="list-style-type: none"> Sustainability of forestry practices and their impact on fish and wildlife and biological diversity Logging impacts and soil erosion on water quality and quantity Enforcement of new forest practices code Encroachment of forest land onto grasslands due to fire control Impacts on forestry revegetation due to climate change Disease control Impacts from utility/transportation corridor 	Resource development, forest practices Climate change	Better - if Forest Practices Code enforced Worse for areas not managed according to Code Encroachment of forest land on to grassland will increase
Loss of wetland and riparian habitat <ul style="list-style-type: none"> Conversion of wetland and riparian habitats for agricultural, urban and semi-urban landuse including ranching, grazing Introduction of new species 	Population pressures Climate change (impacting migratory bird habitat)	Worse Climate change and increased ground water pumping
Water quality impacts	Urbanization/recreational demands: <ul style="list-style-type: none"> Municipal sewage discharge Building of resource roads Recreational use of the river for rafting Eutrophication from septic discharges 	Worse
Water supply /flow regimes <ul style="list-style-type: none"> impact of water diversions on quality and quantity, water temperature, water flow and rearing habitat 	Urbanization Climate change	Same or better for water flow Same or worse overall

Fraser River con't		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Agricultural practices <ul style="list-style-type: none"> • Eutrophication of tributaries • Wetland degradation • Soil erosion • Ammonia emissions in Upper Valley 	Agricultural intensification <ul style="list-style-type: none"> • agricultural runoff • overgrazing 	Worse - topsoil erosion, expansion of ginseng operations Better - PAS, Forest Practices Code
Future of FRAP		Not sure
Overfishing	Population growth, recreational pressure, resource road access	Worse - depends on resource access roads and native land claim issue

Okanagan		
Key Issues	Threats Working Against Ecounit Health	10 year Prognosis
Air pollution <ul style="list-style-type: none"> • Revoltization of pesticides and herbicides • smog • particulates/aerosols 	Urban development; Agricultural intensification	Worse Increasing population
Habitat loss <ul style="list-style-type: none"> • Endangered species hotspot for Canada • Only ecosystem of its type in Canada 	Urbanization, agricultural intensification, resource development <ul style="list-style-type: none"> • Population growth and development along lakes • Poor forestry practices • Overgrazing • Conversion of native grasslands 	Worse only 6% of area is in its natural state
Impacts on biodiversity <ul style="list-style-type: none"> • Includes fish populations 	Urbanization, Recreational pressures, Agricultural pressure <ul style="list-style-type: none"> • Overuse of grasslands • Introduction of non-native species • Exotic species 	Worse Some recovery of specific species and habitat if Forest Practices Code implemented Fish levels will decrease because of lake levels temperature and shoreline; fishing pressures will increase; increasing degradation of habitat in tributaries
Mining impacts <ul style="list-style-type: none"> • groundwater contamination • acid mine drainage 	Resource development pressures and policies	Better No developments; heavy regulations for water quality
Pesticide management <ul style="list-style-type: none"> • eutrophication • pesticides from orchard industry contaminating surface and groundwater • bioaccumulation 	Urbanization; Agricultural intensification (non-point sources)	Better Less agricultural area to be concerned about; ability to detect contmination will get better
Water supply/flow regimes <ul style="list-style-type: none"> • Water levels generally low; this is affecting nutrient levels and increasing contamination; result is decline in water clarity, declines in fish population and changes in fish community structure • Salinization 	Urbanization Climate change	Worse Increasing urbanization
Impacts on water quality and water quantity <ul style="list-style-type: none"> • Eutrophication 	<ul style="list-style-type: none"> • Pipeline development • Overuse Climate change	Worse

Columbia		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Water supply/ flow regimes/quality <ul style="list-style-type: none"> • need for continued DOE involvement in Columbia R. Integrated Environmental Monitoring Program (CRIEMP) • unfavorable water levels changes water quality and quantity and resulting in habitat loss and species decline • metals contamination • number and size of dams 	Urbanization; resource development Transboundary water issues	Worse
Continued DOE involvement in environmental assessment of all major projects		Better Harmonization results in DOE participation in more Eas
Endangered species <ul style="list-style-type: none"> • Conservation 	Urbanization; Tourism, Recreation (rafting, fly fishing)	Same or worse
Air pollution <ul style="list-style-type: none"> • Long range transport of particulates/aerosols and air toxics • Dioxin and furan issue from pulp and paper mills • Domestic wood smoke 	Urbanization, resource development; industrial development	Better
Aquatic ecosystem health	Agricultural runoff Changes in water flow regime	Same or better, with respect to water quality (if the major stress is on flow and we can remove the contaminants then all the better)
Habitat loss and biodiversity <ul style="list-style-type: none"> • Defacto management of migratory birds by National Parks • Conservation management • Introduction of exotic species 	Overgrazing Fragmented habitat Agricultural runoff Building of resource roads and bridges for resource extraction and recreation	Worse
Forestry practices <ul style="list-style-type: none"> • Fire and disease disturbances • Unsustainable logging rates 	Effect of forest practices on bird populations and other parts of the environment	Worse

Columbia con't		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Industrial Contamination <ul style="list-style-type: none"> • organochlorines, dioxins, furans • ammonium phosphate and nutrients • loss of fish habitat; dissolved gas and supersaturation (DGS) 	Urbanization, industrial development, resource development	Better
Municipal contaminants	Urbanization <ul style="list-style-type: none"> • Sewage spills 	
New hydro projects: <ul style="list-style-type: none"> • Cumulative impacts • Revisions to hydrotransmission corridor 	Resource development	

Central Coast and Islands		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Estuary habitat loss <ul style="list-style-type: none"> • Estuary management plan for Kitimat harbour • Hog handling • Impacts of water export 	Urban and industrial development (port development) Forestry practices Aquaculture	Same - given the rate of loss
Industrial contaminants: <ul style="list-style-type: none"> • Impact of pulp mill/mining impacts on coastal salmon stocks and shellfishery • Contamination of aboriginal traditional food sources • Pulp mill effluents and smelter slag impacting fish/crab consumption and causing eutrophication of fjords 	Industrial development, resource development, urban settlements	Better
Need to set water quality objectives for mine sites (active/abandoned)	Resource development	no rating
High opportunity for ecosystem recovery research in Alice Arm, Quatsino, Anyox, Tasu	Industrial development, resource development	Opportunity will be the same
Forestry issues <ul style="list-style-type: none"> • Loss of old growth forest • Sedimentation releases from forestry practices on QCI 	Resource development	Same - over the next 10 years Pronosis better over 10-20 year period once the Forest Practice Code guidelines have taken effect
Need environmental impact assessment and controls for hydro, mine and port developments <ul style="list-style-type: none"> • Long term water export could impact oyster rearing areas 	Industrial development, resource development	Worse - because of environmental controls not because of environmental impacts There are process triggers in place to deal with long term water export impact on oyster rearing areas
Endangered species <ul style="list-style-type: none"> • Protection and conservation of seabird populations • Fisheries • Introduction of new species destroying native colonies 	Industrial developments, resource development Overfishing Introduction of new species (i.e rats, raccoons) destroying native colonies	Worse - except for specific species
Aquaculture impact <ul style="list-style-type: none"> • disease/parasites introduction from reared species • local eutrophication problems with fish food and fish farms 	Resource development	Worse Agricultural intensification increasing
Degradation of marine shore habitat <ul style="list-style-type: none"> • Port activity at Kitimat causing possible contaminant issues and habitat alteration 	Urban and industrial development <ul style="list-style-type: none"> • Transport corridors are creating potential for oil spills 	Same -although localized impacts will get worse

Central Coast and Islands con't

<i>Key Issues</i>	<i>Threats Working Against Ecounit Health</i>	<i>10 Year Prognosis</i>
<ul style="list-style-type: none"> Seabirds offer excellent opportunity to monitor annual changes in marine environmental quality 		
Air pollution <ul style="list-style-type: none"> Local particulate/aerosol problems from biomass burning Industrial contaminants Long range transport pollutants 		Same
Inside Passage transportation corridor <ul style="list-style-type: none"> oil spill risk, toxic spills 	Urban and industrial development	
Offshore oil, gas and mining <ul style="list-style-type: none"> Priority interest area 	Exploration and extraction	Worse

Northwestern BC		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Climate change <ul style="list-style-type: none"> Impacts on glacier size and thus water flow and temperature regimes 		Same - over the next 10 years Issue has a long term context (i.e. 50yrs); need to study this issue in the context of the ecounit environment (ie. impact of climate change on glaciers versus grassland)
Habitat loss <ul style="list-style-type: none"> Reservoir and power line developments will affect habitat loss and dynamic changes in estuarine habitat Resource road access Low elevation lakes (caused by climate change) will attract population increases; this will affect loss of riparian and littoral wetland and cause pollution of foreshore area mining 	Industrial and resource development Climate change	Worse More development overall
Lack of planning <ul style="list-style-type: none"> Need overall resource management plan to provide power, access, etc. for hydro, mining and port developments need federal and provincial involvement 		Better There will be federal/provincial harmonization over time as communication improves Cumulative impacts need to be addressed
Mining <ul style="list-style-type: none"> Environmental assessment and long term monitoring of several large mining properties Need Anyox mine recovery plan Need to learn more about the effects of mining and reclamation on migratory birds, water quality and habitat loss. Heavy metal contaminant issue remains a threat to Nishga people 		Worse - from a habitat/environment perspective because of access issue and associated development Better - on a site specific basis in terms of the development of a recovery plan and effluent quality
Forestry issues <ul style="list-style-type: none"> Effect on fragmentation of habitat on forest birds; enhanced access for parasites and predators Logging roads 		Worse Fragmentation due to access and increased amount outweighs benefits due to Forest Practices Code

Northwestern BC con't		
<i>Key Issues</i>	<i>Threats Working Against Ecounit Health</i>	<i>10 Year Prognosis</i>
Good opportunity for baseline studies <ul style="list-style-type: none"> • Region relatively unaltered even though they are looking at opening up this part of the province for development 	Resource consumption rates	no rating - need more baseline studies

Peace/Liard		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Forestry: <ul style="list-style-type: none"> • Loss of deciduous forest has implications to species in those habitats • Reduced fish productivity due to increasing sedimentation levels • Inadequate forestry management plan • Use of pesticides by the forest industry is impacting on aboriginal traditional food sources • Forestry effects on stands of regrowth of northern forest • Rate of cut 	Resource extraction	Worse The demand for fibre is driving the forest industry north; the growing rates are different and unsustainable logging practices will occur
Endangered species	Access/tourism Resource extraction Climate change	no rating - not sure
Habitat loss/fragmentation	Hardwood pulp extraction, gas exploration (processing and pipelines) and potential hydro developments Tourism Agricultural land clearing Climate change	Worse Large areas of reserve land may be cleared for agriculture (especially in long term, due to climate change)
Species productivity at risk	Access/tourism Resource extraction Climate change	move to above
Long range transport of airborne pollutants	Urban and industrial development	Same
Climate change: <ul style="list-style-type: none"> • Long term increased precipitation will change hydrology of aquatic ecosystems and aquatic habitats may be adversely affected: <ul style="list-style-type: none"> ⇒ increased flooding/erosion may result in increased sediment load; ⇒ expansion of wetlands in riparian vegetation may alter water chemistry (increased acidity) for a time • Increased precipitation and higher temperatures may alter forest ecosystem - while tree growth may increase, incidents of forest fire and invasion of forest pests may impact productivity 		Longer term issue - will not be able to measure impacts in the 10 year time frame

Peace/Liard con't		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
<ul style="list-style-type: none"> Increased precipitation and higher temperatures may alter alpine and tundra ecosystems- tree line may extend higher but alpine vegetation would be restricted Parasite transfer from Arctic to Pacific drainage identified as high risk Potential increase in water quantity may induce development of hydroelectric projects; will impact fish migration and habitat loss 		
Industrial contaminants: <ul style="list-style-type: none"> Need to monitor/control contaminants from pulp mills, mine developments and pipeline and gas plant expansions 	Industrial development, resource development	Better
Water quality and quantity <ul style="list-style-type: none"> Flow regime impacting Pulp and Paper Mill effluents Agricultural runoff 	Urbanization, resource development, industrialization	Same - for effluent Uncertain - for flow; could be worse if new hydro projects move ahead

Central Yukon		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Forestry: <ul style="list-style-type: none"> • Loss of deciduous forest has implications to species in those habitats • Reduced fish productivity due to increasing sedimentation levels • Inadequate forestry management plan 	Resource extraction, lack of science knowledge of long term effects	
Mining: <ul style="list-style-type: none"> • Increased mining activity and contaminant levels due to LRTAP • increase in heavy metals in aquatic ecosystem 	Resource extraction	
Endangered species	Access/tourism Resource extraction Climate change	
Habitat loss	Access/tourism Resource extraction Agricultural development Climate change	
Species productivity at risk	Access/tourism Resource extraction Climate change	
Contaminants: <ul style="list-style-type: none"> • Woodsmoke and increased vehicular activity a risk to human health during winter due to arctic inversion trapping particulates in urban environment • Increased heavy metal contamination 	Access/tourism Resource extraction	
Climate change: <ul style="list-style-type: none"> • Long term increased precipitation will change hydrology of aquatic ecosystems and aquatic habitats may be adversely affected: <ul style="list-style-type: none"> ⇒ increased flooding/erosion may result in increased sediment load; ⇒ expansion of wetlands in riparian vegetation may alter water chemistry (increased acidity) for a time ⇒ releases of methane 		

Central Yukon con't		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
<ul style="list-style-type: none"> Increased precipitation and higher temperatures may alter forest ecosystem - while tree growth may increase, incidents of forest fire and invasion of forest pests may impact productivity Increased precipitation and higher temperatures may alter alpine and tundra ecosystems- tree line may extend higher but alpine vegetation would be restricted UVB effects 		
Global transport of contaminants <ul style="list-style-type: none"> toxophene 		

Northern Yukon		
Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Contaminants: <ul style="list-style-type: none"> • Long range transport of Cs and Cd, particularly in forest ecosystem • Toxophene, radionuclides • Bioaccumulation impacts of heavy metals contamination from mineral exploration/development- lichen/caribou and human linkages • Potential for Beaufort Sea blowout - organochlorines/ nuclear waste: significant threat to marine habitat/communities; sustainability of productivity in marine estuarine ecosystem at risk 	Access/tourism Resource extraction Climate change	
Endangered species	Access/tourism Resource extraction Climate change	
Climate change: <ul style="list-style-type: none"> • Melting permafrost will drastically affect integrity of freshwater aquatic ecosystems • Increased risk of forest fires under projected climate change • UVB effects 		
Habitat loss/biodiversity	Access/tourism Resource extraction	
Sustainability of species productivity	Access/tourism Resource extraction Climate change	

Offshore

Key Issues	Threats Working Against Ecounit Health	10 Year Prognosis
Lack of consistent access to offshore ecosystems		Same
Migration of world population of shearwaters from Australia to New Zealand plus other pelagic birds offshore		Worse Fishing practices not expected to improve
Climate change <ul style="list-style-type: none"> • Change in oceanic trophic conditions and effects on primary production • UVB effects 		Long term issue
New ocean fisheries <ul style="list-style-type: none"> • Squid fishery and impacts 		Worse An increase in new species will impact existing ecological integrity
Fishing practices/policies <ul style="list-style-type: none"> • Bicatch effects on community structure and survival • Overfishing effects on populations and biodiversity • Bilateral and multilateral fishing management agreements • International agreement on high seas fisheries 		Worse Increasing pressure to regulate; if we reduce the fishing fleet then maybe conditions will improve
Proposed deep sea mining impacts on fish and wildlife		Same - because of moratorium <ul style="list-style-type: none"> • If lifted, expected impact from granulars
Long range transport of air pollutants		Worse - no action being taken; development in Asia is increasing
Marine debris/plastics		
Hydrocarbon discharges		

Appendix E

Current Initiatives Working for the Ecounits

(Brainstorming from second workshop)

These tables are the result of a brainstorming session on current initiatives underway that are working towards improving ecounit health.

Georgia Basin	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • BC/Washington Environmental Accord • Georgia Basin Initiative • N.W. Pacific Group - working on environmental indicators • Pacific Coast Joint Venture • Lower Fraser Valley Air Quality Management Plan • CCME NOx, VOC Management Plan • Fraser River Environmental Management Plan • BIEMP • Victoria Harbour Environmental Action Plan • Bayne Sound • Howe Sound Round Table • Ecological and Monitoring Assessment Network (EMAN) to be established • Sensitive Ecosystem Inventory • Wetlands Planning Group • Biomonitoring Network (acid rain/early warning) • Fraser River Action Plan • Stewardship Series • GVRD ad CRD Sewage Negotiations • Dewdney Allouette Regional District Chloramine and Sewage Initiative • Pacific Estuary Conservation Program • GVRD Green Zone • CRD Green Zone • Saanich Inlet Environmental Quality Planning • Tributaltin study - effects of anti-fouling coating used on ship hulls • Creosote study - effects of creosote treated wood products on aquatic environment • Pacific Marine Heritage Legacy • BC Greenhouse Gas Action Plan • Vancouver Island CORE Plan and Resource Targets Exercise • Private Land Stewardship programs (Delta, Comox) • Recreation fisheries initiatives (i.e. Ling Cod Nest Program) • Mill Watch Program • Centre for Coastal Health - UBC, Vancouver Aquarium, West College of Veterinary Science study on coastal marine mammals and link to human health • Tri Council Study - future ecosystem picture • Lions Gate Bridge Study (EA) 	<ul style="list-style-type: none"> • Tributaltin studies • Carrying capacity of the Georgia Strait • Future of Burns Bog • Health impact of air pollution in the Fraser Valley • Unknown biology of the fish in the Georgia Strait • Hanford Nuclear facility - air transport of radioactive toxics

Georgia Basin con't	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • Growth Management Strategies <ul style="list-style-type: none"> • GVRD-"Creating Our Future" • Nanaimo Regional District • Capital Regional District • Island Highway • Robert Bank Environmental Review Committee • BC Ferry Transport Committee • BC Transport 2021 	

Fraser River	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • Fraser River Action Plan- future of FRAP and the development of ecosystem objectives • Fraser Basin Management Plan • CORE Caribou-Chilcoten • Land Resource Management Plan • Alcan/Nechako R. - Kenny Dam cold water release facility study • Interior Wetlands Program • Long term monitoring and trend assessment program by EC (federal/provincial water quality monitoring agreement) • Global Environmental Monitoring Program • McGregor Model Forests • DFO Fish and Forestry study of the Stuart Nechako river system • Air quality- studying toxic air pollutants and PM10 particulate • Forest Renewal BC 	<ul style="list-style-type: none"> • Use of the Fraser R. (finite space for transportation corridor because of nature of the river) • Land conversion to urban and suburban use • Lack of groundwater allocation proces • Cumulative impacts at the ecosystem level • Hanford Nuclear facility - air transport of radioactive toxins • Parks Canada- Churn Creek Park • Future of FRAP • Environmental impact of ginseng operations (groundwater, irrigation supply, soil degradation) • How will the Fraser R. flow and temperature regimes change over time; what impact will these changes have on the salmon and wetland complexes?

Okanagan	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • Okanagan Water Quality Task Group • South Okanagan Conservation Strategy • Bioaccumulation research - pesticides in orchids • Burrowing Owl re-introduction program • Eurasian Milfoil Control Program (BC/Municipal support) • Okanagan Airshed Management Board • Brenda Mine Reclamation • Crown Jewel Mine development on US side (Environmental Assessment) • Recovery planning for Sage thrasher and white beaked woodpecker • Protected Areas Strategy • Okanagan Basin Water Management Board (defunct?) • Conservation of rare antelope brush and sage brush • Bi-national water quality objectives for Smilkameen and Okanagan Rivers 	<ul style="list-style-type: none"> • Hanford Nuclear facility - air transport of radioactive toxics • How will air quality change in airshed over the next decade? • EC needs to be more involved in Crown Jewel Mine Environmental Assessment • Cumulative impacts of riparian habitat loss and fragmentation • Potential air pollution effects on forests • How will climate change , population increases and agricultural practices impact water resources? • Viability of remnant habitats to support species

Columbia/Kootenay	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • Columbia River Integrated Environmental Monitoring Program (CRIEMP) • DOE/MELP/Cominco negotiations for smelter cleanup and rebuilding • Trail, BC - blood lead study • Columbia River Basin Treaty (BC Hydro project) • Columbia Basin Trust • US/Canada Clean Air Accord - EC study on wood smoke dispersion • Environmental assessments for new hydro projects • CORE process - implementation of the plan • Bi-national objectives - Environmental Quality Objectives (for aquatic ecosystems) • Review of the Bonneville Power Project (Washington State) • Sturgeon - initiative at Keely Dam to maintain water flows and turbidity downstream of the dam • International Joint Commission • Forest Renewal BC • BC/Washington State MOU on transboundary air quality issues • Fisheries Act - DOE Fish Act Health Program • National Energy Board - Environmental Assessments • Kootenay Lake Fertilization Program (BC Hydro) 	<ul style="list-style-type: none"> • Hanford Nuclear facility - air transport of radioactive toxics

Central Coast and Islands	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • Development of Cimula Mine • South Moresby Park Assessment • Pacific Rim LNG process • North Coast Wetlands Program • Pacific Coast Joint Venture • Pacific Estuary Conservation Program • Vancouver Island CORE implementation process • FRBC restoration process • Watershed Management Plans (i.e Clayquot) • Coastal Waterfowl Inventory • Aquaculture capability studies • Protected Areas Strategy • MAMU recovery implementation plan • QCI rat eradication project • QCI research on introduction of deer • Raccoon control program for protection of coastal seabird colonies • Deer Management program at Moresby National Park • Langara Island Seabird Colony Restoration • Kelp harvest survey • Protected Areas Strategy • CORE process Vancouver Island • Marine Protected Areas Initiative • Gwaii Haanas National Parks Marine Reserve • Du Goust Trial Park 	<ul style="list-style-type: none"> • Use of biocides and antibiotics on local species • Cumulative impact of the loss of fjord head estuaries on the marine ecosystem • Anyox Mine cleanup • Basic gaps in ecosystem knowledge • Impacts of water export on estuaries

Northwestern BC	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • BC/Alaska Panhandle roadlink • Canada/US EA consultation • Protected Areas Strategy • LRMP - Kispiox • Nishga's land claims • Gitskan land claim? 	<ul style="list-style-type: none"> • Mining and associated transboundary impacts • Anyox Mine - no cleanup initiatives • Lack of development plans for mining activities

Peace/Liard	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • LRMP - Fort St. John area • Protected Areas Strategy • Migration monitoring station - network to look at neotropical songbirds • Gas field development and associated pipe link • Boreal Forest and Ecosystem Study • Northern Basin Research Initiative - Saskatoon; Study of the environmental effects of river ice • Arctic Environment Strategy • Federal Territorial Water Quality Agreement • Prairie and Northern Region's Boreal Ecozone Plan • Prairie Climate Change Impacts Study - several year study 	<ul style="list-style-type: none"> • Impact of fluctuating water levels at Williston Reservoir on aquatic ecosystem • Lack of mining development plans

Central Yukon	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • Arctic Contaminants Program • Green Plan - DIAND, DFO, DOE • White Pass Pipeline Abandonment • Controls for wood smoke contamination • Arctic Environment Strategy • Federal Territorial Water Quality Monitoring Agreement • Study of the transport of toxics into the Yukon (study supported by AES) • EMAN node at Wolfcreek Basin near Whitehorse • Boreal Forest Ecosystem Study • International Long Range ? being developed on meals and persistent organic metals • DIAND Yukon River Water Quality Study - due to be completed end of fiscal year 1997 • Forest management practices in S.E. Yukon • Birds of Yukon study • Trumpeter Swan Management Plan • Arctic Goose Joint Venture 	<ul style="list-style-type: none"> • Mining clean up issues

Northern Yukon	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • Arctic Environmental Strategy • Federal Territorial Water Quality Agreement • Arctic Contaminants Program • Green Plan - DIAND, DFO, DOE • Anwar Initiatives - Porcupine Caribou Herd • US Beaufort Offshore development • Prairie and Northern Research management/action plan for arctic ecozone • Porcupine Caribou International Management Board • Northern Yukon National Park • Old Crow Flats Co-Management Agreement • Nisulthin Delta Co-Management Agreement • Inuvait Agreement? • Circumpolar/International Initiative on the status of arctic flora and fauna • EMAN node -porcupine caribou herd 	<ul style="list-style-type: none"> • none identified

Offshore	
Initiatives Working for Ecounit Health	Gaps in Initiatives
<ul style="list-style-type: none"> • PICES - International oceanography and fish and wildlife group • Marine Protected Areas Initiative • CWS Marine National Wildlife Areas of Interest • SPARKS Ocean Initiative • MASS Initiative - La Perouse Bank • Canada/BC exploring a fisheries initiative • Offshore Exploration Moratorium Review (inside passage of QCI) • Offshore Resource Assessment • Arctic Environment Strategy (management of marine mammal contaminants in Beaufort Sea) • World Offshore Sea Circulation Experiment • Westwater Institute - biophysical control of salmon migration trends • Declaration of Canada O Economic zone • All bilateral and multilateral Fishery Commissions (Pacific, Salmon, Halibut and others) • Deep Sea Exploration Program- NRC • Pelagic bird surveys - CWS 	<ul style="list-style-type: none"> • Evaluation of the combined effects of: <ul style="list-style-type: none"> • offshore fisheries • non-traditional fish species • transport of contaminants from Japan and China • effects of climate change and UVB rays on marine fish habitats • predictability of marine winds and waves for marine vessels • rudimentary understanding of the interaction of biological and physical processes in fish

Appendix F

Overall Risk to Ecounit Health

(Consensus from second workshop)

The following tables used information presented in previous appendices to analyze the overall risk to ecounit health by looking at: the nature of the issues; the adequacy of information; the recovery time; preventability; and correction and mitigation costs.

Georgia Basin		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	High	
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Adequate but gaps exist	high frequency of gaps inadequate information on: impacts of fragmentation on landscape of this scale; the capacity of the ecosystem (i.e. how do coastal streams react to the effect of urbanization?); the effects of synergistic chemicals in the basin; impacts of poor air quality on human health
Recovery time (starting from when action is taken)	Long term	Irreversible: impacts to tidal wetlands due to land conversion; acid generation on sq km of Howe Sound floor High: don't really know the impacts Medium: air quality can be reversed in medium term as per water quality; some reversal of aquatic toxic contamination
Easy to prevent	No	
Correction and mitigation cost	High	Medium: some initiatives have begun but there won't be results for some time

Fraser River		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	Medium to High	High- because of complexity of issues and population pressures
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Adequate but gaps exist	
Recovery time (starting from when action is taken)	no consensus	Short - FRAP contaminants Medium - contaminants only now being addressed Long: results of initiatives likely over the long term
Easy to prevent	Yes and No	yes: most of the issues are resolvable except climate change, population explosion and current economic practices No- because of population explosion
Correction and mitigation cost	Medium - High	Medium: based on gut feel and comparative costs in other ecounits High: multi-year, multi-disciplinary, multi-government approach requires a lot of money

Okanagan		
Given:	Overall Rating	Comments/Rationale
<p>The nature of the issues in terms of their impact on the environment:</p> <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	Medium - High	<p>High: in valleys; water quality and quantity impacts due to flushing action in this ecounit</p> <p>Medium: in mountains and plateaus</p> <p>Low: most impacts are human related; taxing people for these impacts should help change behaviour</p>
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Adequate but information gaps exist	
Recovery time (starting from when action is taken)	Long to Medium term	<p>Irreversible: urbanization and land conversion; habitat loss significant</p> <p>Short term; a 10 yr action plan would have short term results</p> <p>Medium - long term: mainly water quality issues because of population explosion</p> <p>Long term: because of the multi-stakeholder involvement required to change things</p>
Easy to prevent	No	<p>yes: if you negotiate water pricing but political will is not there to do so; public involvement will increase pressure to preserve water quality</p> <p>No: population; resource pricing; easy if political will is there</p>
Correction and mitigation cost	Medium to High	Low: taxpayers to pay for their own sewage treatment plant

Columbia		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	Medium to High	transboundary issues increases complexity of what is doable and what is not
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Adequate but gaps exist	Gaps: significance of wetlands to migratory birds; large complex of potential development; different from rest of the province
Recovery time (starting from when action is taken)	Medium to Long term	Irreversible: effects of the dam Med-long term: much has already been done to remediate soil at Trail; impact of urbanization; stabilization of dam and effects on migration
Easy to prevent	yes and no	yes: optimal gas pressure design no: urbanization and reservoir effects
Correction and mitigation cost	Medium to High	

Central Coast and Islands		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	Medium - Low	
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Adequate but gaps exist	Inadequate marine and terrestrial baselines; may be adequate in specific areas
Recovery time (starting from when action is taken)	Short to Medium term	Hard to reverse estuary impacts at Kitimat and Alberni Difficult to rate given inadequacy of information Relatively pristine area
Easy to prevent	Yes	
Correction and mitigation cost	Medium	Significant mitigation and ongoing costs but low relative to others

Northwestern BC		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	Low to Medium	Low: no air quality initiatives (other than local); major stressors are logging and mining (not much going on there today) High: relatively undeveloped area undergoing change (mining, access routes, etc)
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Inadequate	Inadequate: given the opportunities for baseline studies; EC knowledge could trail behind the knowledge of the industry that it is regulating
Recovery time (starting from when action is taken)	Short term	Irreversible: Cassier Mine Short term: there is not much recovery outside of logging impacts
Easy to prevent	yes	
Correction and mitigation cost	low	

Peace/ Liard		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	Medium	
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Adequate but gaps exist	Gaps - particularly with respect to forestry issues
Recovery time (starting from when action is taken)	Long term	Irrversible: Williston Reservoir Long term: gaps in information on forestry issue (currently applying values from different forest systems in Peace Liard)
Easy to prevent	Yes (except the impact of the dams)	
Correction and mitigation cost	Low	Natural gas developments designed for mitigation One participant indicated uncertainty as to the cost

Central Yukon		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 		
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.		
Recovery time (starting from when action is taken)		
Easy to prevent		
Correction and mitigation cost		

Northern Yukon		
Given:	Overall Rating	Comments/Rationale
The nature of the issues in terms of their impact on the environment: <ul style="list-style-type: none"> • complexity • magnitude • seriousness 		
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.		
Recovery time (starting from when action is taken)		
Easy to prevent		
Correction and mitigation cost		

Offshore		
Given:	Overall Rating	Comments/Rationale
<p>The nature of the issues in terms of their impact on the environment:</p> <ul style="list-style-type: none"> • complexity • magnitude • seriousness 	High	<p>High: inadequate information to non-existent; international context makes it more complex</p> <p>Medium: sockeye habitat is changing</p> <p>Low: main issues include fishing, migratory birds and climate</p> <p>Not sure: think there is a lot of ocean dumping occurring but there is no monitoring or measurement.</p>
Adequacy of the information: to understand the impacts, prevent loss, reduce chances of loss.	Inadequate	<p>Non-existent</p> <p>Adequate: in terms of ocean currents and sea surface temperatures</p>
Recovery time (starting from when action is taken)	-	-
Easy to prevent	-	-
Correction and mitigation cost	-	-