SUMMARY

Background

Since European settlement in the mid-1800s, Victoria and Esquimalt Harbours have experienced extensive urban development. Nonetheless, today's harbours still contain important habitats for fish, birds and wildlife and are the centerpiece of the Greater Victoria urban area. The environmental, economic and social value of the harbours to the residents of the Capital Region and to visitors has grown in recent years, making the protection and restoration of harbour ecosystems increasingly important.

In 1997, the Victoria and Esquimalt Harbours Environmental Action Program (VEHEAP) began the Victoria and Esquimalt Harbours Ecological Inventory and Rating (HEIR) project. The intent of the HEIR project was to systematically inventory the ecological features and to rate the ecological value of intertidal, backshore, and subtidal portions of Victoria Harbour, the Gorge, Portage Inlet, Esquimalt Harbour and Esquimalt Lagoon. This report presents the results of Phase 1, which covers the intertidal and backshore portions of the harbours. Phase 2 of the HEIR will inventory and assess the subtidal portions of the harbours.

The purpose of the HEIR is to improve the management of Victoria and Esquimalt Harbours by providing materials to:

a. aid land use and water decisions,
b. support actions to protect against further habitat degradation in the harbours, and
c. improve the effectiveness of efforts to restore and enhance harbour ecosystems.

HEIR information can be used for a variety of purposes, including managing coastal areas, ecological restoration, land use planning, environmental research, parks acquisition, and public education.

Harbours Ecological Inventory and Rating (HEIR) Databases

Phase 1 of the HEIR is based on the shore units from the Land Use Coordination Office's (LUCO) mapping of the BC Coastal Zone and covers the intertidal (high tide to low tide) and backshore areas (roughly 50 m from the high tide line or to the nearest street) around the harbours. The HEIR database includes ecological information and ratings of ecological value. This information is geographically linked to harbour maps. The harbours' shoreline was divided into discrete shore units (based on Land use Coordination Office (LUCO) work), each of which is numbered and linked to the inventory and rating information.

Prior to conducting the inventory, a review of past harbour studies and reports from government and non-government organizations was conducted and potential users of the HEIR products (municipal planners, community and environmental groups, and First Nations) were interviewed to identify data needs. This information guided a field inventory of physical, biological, and land use conditions in the coastal zone.

The inventory database contains three subject-based data sets: intertidal biology, backshore habitat biology, and land use. The intertidal biology data set describes each intertidal habitat type, percent cover of intertidal species, and the physical features of each shore unit. The backshore biology data set describes the types and percent cover of backshore vegetation, surficial material, percent cover of wildlife habitat, and any incidental wildlife sightings. The land use dataset describes backshore land use, the land and water use of the intertidal zone, and the planned land use designations specified in the Urban Capacity Inventory.

A workshop was held to review the inventory database and to discuss methods of rating the ecological value of the shore units. Representatives of municipal, regional, provincial, and federal governments, community and environmental groups, and the academic research community participated in the workshop. A qualitative rating process was developed that applies specified criteria, professional opinion, and interpretation of information available on the ecological character of each unit. This approach, guided by recommendations made at the workshop, provides a better assessment of shore unit values than arithmetic processing of numerical scores. Each shore unit was rated according to its ecological value, its vulnerability to development, and its priority for action as described below.

- Ecological Value. This rating summarizes the overall ecological value of each shore unit, based on interpretation of four supporting biological topics: diversity of obvious species, habitat diversity, naturalness of the habitat, and importance of the unit to key life cycle activities of major species (reproductive areas, food supply, or shelter). To ensure that the rating reflected the full range of ecological value found in the harbours, the panel of experts established subjective upper and lower extremes of ecological value of all shore units within the harbour. Heavily disturbed and polluted industrial shore units were assigned very low ratings, and highly productive natural areas with a variety of habitats and species were given very high ratings. Between these two extremes, three other categories were established, low, medium, and high, reflecting the relative gradation in ecological condition of the shore units. Plates 1 and 2 in the report show the ecological value of the all shore units.

- Vulnerability to Development. This rating assesses the potential for planned or proposed development to affect the ecological value of a shore unit. Vulnerability to development may affect decisions to protect or remediate a shore unit. Ratings of high, moderate and low were assigned, with a rating of high indicating a high likelihood of development and the potential to substantially affect the coastal zone in the near future

- Priority for Action. This rating represents the rating panel's assessment of shore units with characteristics that merit special action such as protection or remediation. Shore units rated as priority for protection have a high ecological value, warranting protection from harmful human activities. In shore units rated as a priority for remediation, substantial improvements in ecological characteristics (species diversity, habitat diversity, natural habitat, or ability to support key life cycle activities) could be obtained at a reasonable cost. Remediation could include control of pollutants, altering land uses along the shore, replanting native vegetation, or other habitat-enhancing initiatives. Specific information on the reasons for protection or remediation is contained within the database. Plates 1 and 2 denote shore units designated for protection or remediation.

Through discussion among members of the rating panel, a consensus was reached on the ratings of each shore unit. A second HEIR workshop was held, with the same participants as the first, to examine and comment on the draft ecological value ratings. Comments from this workshop were incorporated into the final version of the HEIR.

Using the HEIR Information

The HEIR Phase 1 inventory database provides a consistent set of systematically collected information for all intertidal and backshore portions of the harbours. The ratings database provides a comparative rating of the shore units' ecological value and recommendations for protection and remediation. Through the geographical links to the databases, customized maps or reports with specific information may be easily produced. The following HEIR materials are currently available:

- Inventory information on physical, biological, and land use features in the intertidal and backshore portions of the harbours
- Rating information on shore unit ecological value and priorities for protection and remediation
- Maps of the harbours (either digital or paper prints)
- A report describing the HEIR methods and summarizing results, and
- Queries of the database and extraction of specified information.

Used actively and appropriately, the HEIR maps and databases can be powerful tools in managing the harbours and improving their environmental quality. By consulting the HEIR information as a routine part of government planning and management, ecological values can be integrated into decision processes to the benefit of the harbours, management agencies, and the public. Non-government organizations may use the HEIR to guide their plans and actions, and to improve their effectiveness in working with governments and landowners on harbours environmental issues.

The HEIR database can support a variety of planning, scientific, and management initiatives affecting the harbours, including the following:

- Identifying properties to be designated for environmental protection in Official Community Plans or by other government or non-government organizations;
- Designating development permit areas (DPAs) for coastal protection, and preparing DPA guidelines to protect specific coastal features;
- Identifying candidate areas for environmental remediation or setting priorities among candidate sites;
- Determining appropriate land uses, setback, tree retention, storm drainage, and other components of zoning bylaws, other municipal regulations, and development decisions made by federal and provincial government land managers;
- Establishing a framework for a program to monitor environmental conditions in the harbours;
- Assessing potential impacts of proposed shore zone development ; and
- Improving the understanding of the harbour environment among members of the public, business, government, and students.

To Order the HEIR Report

Additional copies of this HEIR report is available at a cost of $10.00 each from:

Capital Regional District Engineering
524 Yates Street, PO Box 1000
Victoria, British Columbia V8W 2S6
Phone: (250) 360-3045
Fax: (250) 360-3047
E-mail: cleahy@crd.bc.ca

To Obtain More Information

This report contains a Query Request Form designed to assist interested parties in obtaining more specific HEIR information than is presented in this report.

Victoria and Esquimalt Harbours Environmental Action Program
Harbours Ecological and Rating Project Final Phase 1 Report: Intertidal and Backshore Inventory and Rating

Contents

Acknowledgements and Preparers of the Report

The Harbours Inventory and Rating Project is the product of a partnership. The Victoria and Esquimalt Harbours Environmental Action Program wishes to acknowledge the support for the Harbours Ecological Inventory and Rating Project provided by its member organizations and by local government partners. Special thanks is accorded to Transport Canada, which earmarked funds specifically for conduct of the HEIR Project and provided detailed technical review of the work program and draft results. The Land Use Coordination Office provided maps and inventory information used in the mapping and field research components of the study, and also provided advice based on their extensive experience in coastal zone management. Capital Regional District Parks supported the acquisition of a digital orthophoto of the harbours, Regional Planning Services provided a digital version of the Urban Capacity Inventory, and municipal planners provided information regarding future development of harbour lands.

The Harbours Ecological Inventory and Rating Project field work, mapping analysis, and reports were prepared by two Victoria-based consulting firms, Westland Resource Group and Archipelago Marine Research. The main participants from each firm were:

Westland Resource Group

David E. Harper, Ph.D., CPESC, P.Ag., MCIP, Project Manager, Land Use
Wayne G. Biggs, M.Sc., P.Ag., R.P.Bio., Upland Biology
Joseph Boyd, B.Sc., D.P.M., Mapping and Geographic Information System
Robyn J. Wark, M.R.M., Land Use, Photography, Workshop Facilitation
Cindy Marven, B.Sc., Database Creation, Graphics

Archipelago Marine Research

Brian Emmett, M.Sc., R.P.Bio., Marine Biology
Mary Morris, M.Sc., R.P.Bio., Marine Biology, Intertidal Inventory, Database.

The consultants express their gratitude for the support of the members of VEHEAP and their partners in the preparation of the HEIR Project. Their vision of the future of the harbours, and provision of time and funds to conduct this study are evidence of a strong commitment to improve the environmental quality of these wonderful natural features.

Victoria and Esquimalt Harbours Ecological Inventory and Rating Final Report Phase 1: Intertidal and Backshore

Purpose of the Project

Since European settlement in the mid 1800s, Victoria and Esquimalt Harbours have experienced extensive industrial, commercial, institutional and residential development. Today's harbours nonetheless contain important habitats for fish, birds and wildlife. The environmental value of the harbours to residents of the Capital Region and to visitors has grown in recent years, making the protection and restoration of harbour ecosystems increasingly important.

In 1997, Victoria and Esquimalt Harbours Environmental Action Program (VEHEAP) began a project to systematically inventory ecological features and to rate the ecological value of intertidal, backshore, and subtidal portions of Victoria and Esquimalt Harbours. This report documents the methods and results of this Harbour Ecological Inventory and Rating (HEIR) Project. The report describes Phase 1 of the HEIR, covering the intertidal and backshore portions of the harbour. Phase 2 is scheduled for 1999 and will cover sub-tidal portions of the harbours.

The Victoria and Esquimalt Harbours Environmental Action Program (VEHEAP) has embarked on the HEIR project for several important reasons:

- All VEHEAP members share the conviction that action should be taken to preserve and restore the environmental integrity of the harbours;
- Members recognize the need to protect ecologically valuable areas while maintaining opportunities for the harbours= essential commercial function;
- Ecologically valuable areas are critical to the environmental health of the harbours, to the protection of biodiversity, and to the character of Greater Victoria;
- Members agree that further loss of ecologically valuable areas in and surrounding the harbours is unacceptable;
- The harbours are among the Capital Region=s greatest attractions.

The purpose of the HEIR is to:

(a) provide materials to aid land and water use decisions,

(b) support actions to protect against further habitat degradation in the harbours, and

(c) improve the effectiveness of efforts to restore and enhance harbour ecosystems.

This Harbours Ecological Inventory and Rating (HEIR) Project will provide important information to managers and users of the harbours, and can support protection and enhancement of the ecological value of these regionally important assets. The information can be used for a variety of purposes, including managing coastal areas, ecological restoration, land use planning, environmental research, parks acquisition, and public education. The HEIR results can also help to ensure that development occurs in ways that protect the ecological function and character of the harbours.

The HEIR Project covers Victoria Harbour, the Gorge, Portage Inlet, Esquimalt Harbour, and Esquimalt Lagoon (Figure 1).

insert Figure 1--harbours map

The Victoria and Esquimalt Harbours Environmental Action Program

The Victoria and Esquimalt Harbours Environmental Action Program (VEHEAP) is an intergovernmental initiative to improve and protect the environmental quality of Victoria and Esquimalt Harbours.

VEHEAP is comprised of the following member organizations:

Capital Regional District
British Columbia Ministry of Environment, Lands and Parks
Environment Canada
Fisheries and Oceans Canada
Department of National Defence
Transport Canada.

In 1997 VEHEAP published an *Environmental Management Strategy* for the harbours. The *Strategy* establishes one of VEHEAP's major goals, to Aprotect and enhance habitat quality@ in the harbours. To achieve this goal, the *Strategy* notes the need to Aidentify and rate ecologically valued portions of the harbours,@ and then Afacilitate the protection and management" of these areas. The HEIR Project is an important step in implementing VEHEAP's *Strategy*.

Previous Studies

Over the past decade, research has increased agencies' knowledge and understanding of environmental conditions and habitats in the harbours. These studies have included:

< an evaluation and broad rating of the sensitivity of the shoreline to pollutants from stormwater discharge (Aquatic Science 1994);

< a review of existing data on contaminant sources, receiving environments, shoreline and aquatic habitats, and land and water use, including broad rating of the shoreline for habitat quality (LGL 1995);

< detailed mapping of biota in the shorezone (CRD unpublished 1994);

< inventory of bird species and populations in harbours (Shepard 1998);

< detailed ecological assessments of particular portions of the harbours, including Royal Roads Property (Madrone Consultants 1995), Upper Victoria Harbour and Selkirk Waters (Archipelago Marine Research 1996); ongoing risk assessments of Transport Canada properties; and mapping of environmentally sensitive riparian areas (District of Saanich 1998).

Appendix A presents a table that highlights key details of the major environmental studies conducted in the harbours.

The basis for the HEIR Project

In 1996 VEHEAP commissioned a report to investigate *Approaches to Protecting Environmentally Significant Areas in Victoria and Esquimalt Harbours* (Westland Resource Group 1996). The report assessed environmentally significant area (ESA) inventories conducted elsewhere, and recommended methods for consistently and systematically rating habitat values in Victoria and Esquimalt Harbours. The report identified the criteria for identifying areas of ecological value, and reviewed existing harbour area regulations and management. The research found that although many studies of the harbours have been conducted, they fail to provide a uniform database of appropriate inventory information necessary for rating ecological value and, hence, for making management decisions.

The *Approaches* report recommended a process for involving interested parties in an inventory and rating project. The report identified the following five steps to conducting inventory and rating of ecological value in the harbours:

1. Agree on the purpose of the research and appropriate study methods,
2. Implement a process to study harbour ecosystems,
3. Select measures to protect areas identified as having high ecological value, prepare management guidelines and standards,
4. Design and implement an education and public involvement program,
5. Design and implement a monitoring and enforcement strategy.

The HEIR project covers steps 1 and 2 in this recommended process.

During the design of the HEIR, VEHEAP determined that all shore units needed to be inventoried and rated. Hence all harbour shore units have been rated as having high, moderate,

or low ecological value. The HEIR project seeks to identify Aecological value@ of all shore units rather than focusing on environmentally significant areas.

HEIR Goals and Methods

Goals

The goal of the HEIR Project is to develop two major products:

X An **inventory** of ecological characteristics (physical features, marine and backshore biota, and land uses) that is consistent throughout the harbours, and

X A **rating** of the ecological value of the harbour shore units.

These products are intended to support management of Victoria and Esquimalt Harbours. The HEIR maps and databases have been designed to allow information to be shared with other provincial and local environmental management processes (such as those of Land Use Coordination Office, municipalities, and CRD Parks). The local focus of the HEIR may, however, reduce the ability to use the results directly in broader provincial or regional coastal rating and ranking initiatives (such as the Marine Protected Areas Strategy).

An important objective of the HEIR project is to build understanding of the inventory and rating process and products among potential users of the information, primarily local governments and community groups. Involving the broad range of groups and agencies having interests in the harbours improves the quality of the HEIR data and increases the likelihood that the resulting HEIR information will be used to guide decisions.

Objectives and assumptions

The HEIR Project is intended to attain two primary objectives:

X create a comprehensive inventory of ecological characteristics (physical features, marine and backshore biota, buildings, and land uses) in the harbours, and

X support rating of ecological value of the harbour shore units.

The inventory information is likely to be used for a variety of purposes, including planning for purchase or management of coastal areas, ecological restoration, land use planning, environmental research, and public education. In addition to these scientific, management, and planning initiatives, the inventory may be used for other, now unforeseen, purposes in the future. The HEIR database has been designed to support the addition of other data sets as appropriate.

To be effectively used, the characteristics and limitations of the HEIR database need to be understood. A variety of assumptions and caveats apply to the inventory:

- X biotic communities in the intertidal area change composition only slowly, so that information collected now will have value for many years,
- X backshore areas near to the shore have greater influence over environmental conditions than areas further inland,
- X a coastal inventory prepared by trained observers forms a legitimate basis for identifying ecologically significant areas, and
- X rating of ecological value should be based primarily on biological and physical characteristics of the coastal zone, rather than cultural or social considerations (recreational or historic value).

Method used to conduct the Inventory

Phase 1 of the HEIR inventory covers intertidal (high tide to low tide) and backshore areas (roughly within 50 m of the high tide line or to the nearest street). Phase 2 will examine the subtidal parts of the harbours. The following steps were used to conduct the inventory.

1. **Assemble coastal research information**. VEHEAP provided the inventory consultants with reports containing information on biotic and physical conditions in the harbours. In addition, Westland compiled other coastal data from local governments and nongovernmental organizations

   A major source of information was the Land Use Coordination Office (LUCO), which holds mapping and biophysical information on the British Columbia coastal zone. LUCO generously provided digital files on coastal form and substrate, biota, and shore configuration. Land use information was obtained from the Capital Regional District=s Urban Capacity Inventory, provided in digital form by the CRD=s Regional Planning Services Department.

2. **Interview potential users of a harbours inventory to identify data needs**. Telephone interviews were conducted with planners from municipalities in the Capital Regional District, with community and environmental groups, and with First Nations. The interviews were intended to describe the proposed HEIR initiative, to identify research undertaken by the contact groups, and to discuss ways in which HEIR data could support contact groups= needs and activities. Participants in the interviews and subsequent workshops are listed in Appendix B.

3. **Prepare maps of the harbours**. Mapping a coastline is always a challenge. Questions of tide height, scale, and mapping methods combine to confound reliable mapping. For the HEIR field inspection, maps were prepared at a scale of 1:2,500 showing both the LUCO coastline (with coastal form and shore unit designations), and the CRD=s Urban Capacity Inventory (showing categories of planned land use). The LUCO coastline is reportedly consistent with the provincial TRIM coastline, and the CRD coastline is, at least in part, based on hydrographic charts. The coastlines from the two data sets are not coincident, but were adequate to support mapping of features and conditions in the field. Disparities of coastline representations generally ranged between 10 and 30 m.

   To improve coastline accuracy, VEHEAP and CRD parks jointly obtained 1:5,000 scale aerial photographs, which were subsequently digitized and orthorectified. The resulting photograph of the harbours was used to digitize a shoreline that accurately represents the high tide line. The tidal stage when the aerial photos were taken was 2.0 m, just below the 2.5 m typically accepted as high tide. The HEIR coastline is based on this photographic process.

4. **Design field record sheets**. To facilitate consistent recording of critical information in the field, data sheets were formulated for the intertidal physical and biological component, the backshore physical and biological component, and the intertidal and backshore land use component. Examples of these data sheets are appended to this report (Appendix C).

5. **Conduct the field inventory**. The field inventory of the harbours was conducted during low tides at the end of August and early September 1998. Except in Portage Inlet (where the tidal range is small), the tidal elevations ranged between 1.0 m and 1.5 m above chart datum during most of the field investigations.

   The field work in Victoria and Esquimalt Harbours was conducted entirely from a small boat with outboard motor. The boat=s shallow draft allowed the researchers to conduct

work in water as shallow as 50 cm. Field inspection of Esquimalt Lagoon was conducted on foot around the perimeter of the water body.

The field inspections involved observing and recording physical, biological, and land use conditions in the coastal zone. The location and character of the LUCO shore unit divisions were checked. In many cases, A**subunits**@ were created to record more detailed information than was available from LUCO. Boundaries of subunits were based on coastal physical characteristics (primarily form and substrate). A separate data sheet was completed for each shore unit and subunit. In addition to observation and data sheet completion, a photographic record was made of notable features, shore unit divisions, and characteristic physical or biological conditions.

6. **Review aerial photographs**. Aerial photographs flown in 1997 and printed at a scale of approximately 1:5,000 were used extensively to confirm information about the harbours. The photos were annotated by hand to show shore units. Where backshore areas could not be clearly observed from the boat during field inspections, land use and biological information was recorded on the basis of the aerial photographs.

   Oblique ground-level photos taken during the field inspections were indexed using shore unit numbers and identifying key elements of the photo, and then catalogued in a binder. These photos provide an excellent visual record of harbour features and conditions at the time of the field inspection, and were used by the field observers during review of field data forms and the rating process. The photos will also prove to be a valuable long-term resource for identifying changes in shore conditions over time.

7. **Review and refine shore units**. The usefulness and accuracy of the environmental inventory database depends on clear and precise identification of the shore units. The field researchers carefully reviewed their field assessment of shore unit and subunit location and numbering, both during the field inspections and in the office using aerial and oblique photographs. During this review, it was decided that all islets would be assigned a subunit number to allow their characteristics to be analyzed separately from their associated Amainland@ shore unit (LUCO assigned the same identifying number to islets and their nearest shore unit).

   The width of the intertidal zone was mapped using Canadian Hydrographic Service (CHS) charts. The lower boundary of the intertidal zone was set at zero chart datum (zero tide level) and high tide was represented by the HEIR photo-based shoreline.

Chart datum was obtained from digital CHS information for Victoria and Esquimalt Harbours, and was hand digitized from a paper chart for Esquimalt Lagoon.

8. **Review and refine field record sheets**. The researchers spent considerable time reviewing their field record sheets for accuracy and completeness. New and revised information was added to the sheets, such as results of the CRD=s field inventory and the Urban Capacity Inventory land use codes. Sub-unit numbers were added, if necessary.

9. **Design the database**. The database for the physical, biological, and land use data was designed to allow flexibility in data entry and extraction, recognizing the need to cross-tabulate information among fields and to link the results to the ArcInfo mapping of the harbour shore units. The Geographic Information System specialist for the project developed the database after consultation with each field observer.

10. **Input the datasheet records and verify data**. A data entry specialist entered the coded information and memo fields from the field data sheets into the database. The resulting electronic database was checked against the data forms for accuracy.

11. **Review results**. The results of the database entry were reviewed by each field observer. Any corrections were made to the electronic database. A summary report was distributed to local planners, interested environmental groups, and senior government agencies for review can comment. The draft inventory results were presented and discussed at a workshop held in October 1998 and attended by municipal, provincial, and federal government staff and representatives of nongovernmental organizations.

12. **Update the database**. Any corrections resulting from the review were made to the inventory database.

Database Structure and Contents

The HEIR database has been built around a map and three subject-based data sets. Field observations were organized under three subjects: intertidal biology, backshore habitat biology, and land use. As discussed previously, a field record was completed for each subject and for each shore unit, and the data were keyed into a database.

HEIR data sets are based on unique shore unit identifiers based on the LUCO database and map. Each shore unit identifier, or Unit Key, provides a link to all other databases developed through field observation. Because each shore unit has a common Unit Key identifier, all HEIR information can be geographically linked to the harbours map.

Table 1 shows the kinds of information contained in the HEIR database. The intertidal and backshore biology datasets are based on HEIR project field observations and on review of other harbours research (Appendix A). The land use datasets include field observations of actual land uses, and the planned land use codes obtained from the Capital Regional District's Urban Capacity Inventory (1997).

Table 1
HEIR Database Structure and Content

Subject	Data Sets	Contents
Shoreline Map	Map Attributes	-Shore unit key (unique numeric identifier) -Shore unit location (land marks, cartographic place names) -Observation date, time
Intertidal Biology	Intertidal Habitat Types Intertidal Species Physical Descriptions	-Percent of each habitat type for each Unit -Species and percent cover for each Zone -Physical form and material for each Zone
Backshore Biology	Backshore Vegetation Backshore Physical Descriptions Backshore Habitat Rating Backshore Wildlife Habitat	-Vegetation type and percentage of ground cover -Backshore surficial material and percent cover - Regional significance of backshore habitat -Wildlife habitat, percent coverage, and wildlife observations
Land Use	Backshore Land Use Intertidal Uses UCI Designations	-Backshore land use -Intertidal uses of land and water (e.g. commercial marinas) -Land use designations specified in the Urban Capacity Inventory (CRD, 1997)

The HEIR database is electronic and geographically referenced. Figure 2 shows the relationship between a shore unit and the various data sets in the database. From the original Shore Unit Key, the data user can gain access to all other data sets. Queries can be conducted and reports prepared using ArcView and various database software programs. Details of the database structure and data fields are provided in Appendix D. The database has been designed to accommodate Phase 2 data on subtidal substrate and biota.

Results of Discussions with Interested Parties

Interviews were conducted in person or on the telephone with municipal, First Nations, and VEHEAP members. A list of people contacted is presented in Appendix B. Results of the discussions are presented in this section.

Municipal Representatives

Municipal representatives provided favourable comments on the HEIR design and several staff attended the HEIR workshops. They noted that HEIR could be used to:

X strengthen the environmental section of plans and zoning bylaws (e.g., Victoria Harbour Plan: Urban Design Principles and Guidelines, Town of View Royal OCP review);

X provide background information during review of redevelopment applications, development permit applications and for comments on BC Lands foreshore leases; and

X provide background ecological information for Parks Department plans (e.g., Esquimalt Parks Department plan for a continuous walkway along the Gorge).

Municipal representatives hoped that HEIR would be compatible with municipal GIS systems. They noted the importance of mapping restoration potential of lands and ecosystem function, as well as habitat values. They emphasized that the Harbours Authority working group should be contacted as part of the partnership building process. Municipal representatives gave examples of properties using appropriate design for foreshore development (e.g., Canoe Club in the Gorge).

Insert figure 2-- relationships among data sets and the harbours shoreline map

First Nations

The consultant discussed the project design and sent background information to the band managers from the Esquimalt and Songhees Bands and Chief Robert Sam from the Songhees Band. The Bands did not submit any comments, although Chief Sam attended the workshops.

VEHEAP Members

The Canadian Wildlife Service representative noted that the HEIR might be useful in identifying potential bird habitats to support the ongoing Harbours Bird Census.

Transport Canada and Fisheries and Oceans Canada noted that the HEIR might provide important habitat information and a larger ecological context for the environmental and health risk assessments of Transport Canada properties.

DND noted that HEIR information could support development planning decisions. A representative from Royal Roads University similarly noted that HEIR could aid DND's development decisions at Royal Roads (DND is the land manager for the University).

The CRD noted that HEIR will support ongoing VEHEAP work, including both protected area projects and environmental management work.

Results of the inventory

Intertidal biology

The shoreline of the Victoria and Esquimalt Harbours and Esquimalt Lagoon is a diverse complex of intertidal structure, substrates, and species. Gradients of marine influence extend across the study area. For the intertidal biology database, researchers identified *intertidal habitat types*. The habitat types summarize the biophysical shore-zone characteristics from the field observations (Table 2).

To determine the shoreline habitat types in the study area, the field data were analyzed in a database. Data sets included the physical descriptors of the shore-zone "form" and "material." Codes for the shape and origin of the shoreline morphology, and a description of the substrate were noted for each shore unit. For example, the form of a natural bedrock shore unit might be

described as “cliff”or “ramp,” and the material as “bedrock.” The form of a man-made seawall could be “anthropogenic” and material “concrete” or “riprap.” Many units had more than one kind of form and material. The physical description for each unit was used as the framework for recording the observations of the associated biota.

The intertidal species present (mainly algae and invertebrates) were noted in each unit during field reconnaissance. These biological data included general description of the shore-zone “bio-banding.” Observable bands are species assemblages, usually with one or two indicator species being the most abundant and most visible. Individual species observed were also noted, in addition to the assemblages characterizing the bands. Some units displaying diverse physical characteristics had five or more bands and a variety of associated species. Other units were barren and few intertidal organisms were observed.

Biophysical features of the shore-zone vary from the highest high tide line to the lowest low tide (called “zero chart datum”). Because this variation is important to the description of coastal habitats, data were recorded for each of three across-shore zones :

X “A” zone --the upper intertidal splash-zone
X AB1" zone--the mid-intertidal
X AB2" zone--the lower intertidal.

Species assemblages have a diagnostic geographic spatial distribution throughout the harbours, reflecting gradients in marine characteristics of the shore units. Generally, the outer harbour units have higher wave exposure and display more marine influence than units closer to the head of the harbours. Species assemblages in the “more-marine” waters differ from those in the wave-sheltered, less-marine-influenced waters of the inner harbours. The geographic location of each unit, therefore, provides a relative index of the physical characteristics of wave exposure, salinity, and tidal flushing.

From the summaries of the physical and biological characteristics recorded for each shore unit, the >habitat type= for each unit was determined. These habitat types provide a simple unit-by-unit summary of biophysical characteristics and supported the rating of units= ecological value. The summaries of shoreline length in each of the physical types, of different combinations of bio-bands, and of the occurrence of habitat types (Table 2) also aided the rating of the units’ ecological value.

Table 2
Summary of the characteristics of the Intertidal Shoreline Habitat Types for the VEHEAP Study Area

Habitat Type	Relative marine influence	Typical substrate	Typical bands *	Other associated species	% of total shore-line length with this as primary habitat	Comments
SEAWALLS and EMBANKMENTS man-made	H and M (Habitat type 1)	Riprap, rubble, concrete	BAR, FUC, ULV, BKS or SAR, NER	Blue mussel, purple sea star	10	Diversity decreases with less proximity to harbour entrances
	L (Habitat type 2)	Riprap, rubble, concrete	BAR	Nearshore subtidal species visible: eelgrass, clams and diatom mat on muds	14	Many units bare, sparse barnacle band and diatom haze
PILINGS, WHARVES and FLOATS	H and M and L (esp. with current) (Habitat type 3)	Pilings and floating docks	BAR, ULV, BMU	Plumose anemone, giant feather duster tubeworms orange sponges, orange encrusting bryozoans	16	Diversity of encrusting biota greater than on adjacent riprap
BEACHES natural	L and M (Habitat type 4)	Pebble, cobble, sand	GRA, SAL, ULV or DIA	Pickleweed, dune grass, other marsh sedges and grasses	15	
BEDROCK CLIFF, RAMPS OR PLATFORMS natural	H and M (Habitat type 5)	Bedrock, often with pocket beaches of Habitat type 7	VER, BAR, FUC, ULV, BKS or SAR, NER, RED	Thatched barnacle, purple sea star, sparse rockweed, diverse red algae, diverse bladed kelp, feather boa kelp, surfgrass	16	Units with highest species diversity are in this type and occur nearest to harbour mouths. Many units include small pocket beaches.
	L and M (Habitat type 6)	Bedrock, often with pocket beaches of Habitat type 7	VER, GRA, BAR, DIA	Purple seastar, sparse rockweed, Japanese oyster, and native oyster. Eelgrass in nearshore subtidal in Gorge units & Portage Inlet.	18	Sparse macro-biota, low diversity. Often fines and mud in B2 and nearshore subtidal. Many units include small pocket beaches.

Habitat Type	Relative marine influence	Typical substrate	Typical bands *	Other associated species	% of total shoreline	Comments
POCKET BEACHES natural	H and M and L (Habitat type 7)	Pebbles, cobbles, fine sediments. Some shell hash in H sites	GRA, ULV or DIA	Presence of pocket beaches indicates habitat heterogeneity. Small size of these beaches is implied by definition and they are not measured separately from the *primary unit length.	Pocket beaches occur as secondary habitat types in 12% of man-made shorelines and 43% of natural bedrock shorelines	Always a secondary habitat type in large units of bedrock or man-made shoreline
MUDFLATS (tidal flats)	L and M (Habitat type 8)	Wide sand or mud terrace in lower intertidal	BAR or GRA, DIA	Salt-tolerant grasses and sedges, diatom mat on tidal flats	11	Describes large estuary units at heads of Portage Inlet and Esquimalt Harbour, and a few other units with seawall or bedrock in upper intertidal and wide tidal flats in the lower intertidal

* The Bio-bands observed: BAR - acorn barnacle, FUC - brown rockweed, *Fucus*, ULV - green sea lettuce, *Ulva*, BKS - bladed kelps, primarily *Laminaria spp.,* SAR - the brown alga, *Sargassum*, NER - bull kelp, *Nereocystis*, BMU - blue mussel, *Mytilus trossulus*, GRA - salt-tolerant dune grass, marsh grass, SAL - pickleweed *Salicornia,* DIA - diatom mat, RED - mixed red algae

Description of Habitat Types

Based on analysis of the HEIR mapping, the study area includes approximately 67 km of shoreline and 107 ha of intertidal area. The intertidal zones contain a variety of habitat types, which are summarized in this section.

Habitat Type 1. Seawalls and Embankments

The man-made shoreline habitats included in Type 1 units have relatively high to moderate marine influence. Most sites are riprap or boulder rubble embankments or vertical concrete or rock seawalls. Pile wharves or floating docks are often associated with these hardened shorelines. Species diversity on these sites decreases from harbour mouths to inner harbours. Characteristic units are 1863, at Laurel Point and 1642.01, the Fisgard Light causeway.

Habitat Type 2. Seawalls and Embankments in protected waters

Similar to the shorelines in Type 1, these man-made shorelines occur throughout the upper harbours in the study area. Below the seawalls, this type often has shallow nearshore zones or narrow inclined beaches in the lower intertidal zone. These habitat types are common in the Gorge and Portage Inlet and are characterized by bare-looking upper intertidal bands and extensive eelgrass beds in the nearshore subtidal. Characteristic units are 1873.05 at the Gorge Park, and 1629 at DND in west Esquimalt Harbour.

Habitat Type 3. Pilings, Wharves and Floats

A significant amount of the shoreline of the study area is classified as primarily pilings and floats. Although the habitat is not "natural," the biological diversity is often high, with rich communities of encrusting biota. Pilings and wharves often occur in with other man-made shoreline types as the secondary habitat. A characteristic unit is 1861, Fishermen's Wharf, where the floating docks and pilings of the marina are built offshore from a riprap embankment.

Habitat Type 4. Beaches

Units where beaches are the primary shoreline form in the study area are of two types: the relatively long shore units at Esquimalt Lagoon, and shorter, narrower beaches in protected upper harbours. Beaches appear to have low diversity of macrobiota on the beach face and are most often characterized by salt-tolerant grasses or sedges in the upper intertidal. Low banks in the upper intertidal provide easy access to the shoreline (unlike vertical seawall or rock cliff habitats), which contributes to the human-use value. Seawalls or bedrock outcrops in the upper

intertidal are sometimes associated with beaches. A few beaches are associated with mudflats in the lower intertidal. A characteristic narrow beach unit is 1873.04, Gorge Park. A beach with lower intertidal mudflats occurs at unit 1619.01, Thetis Cove.

Habitat Type 5. Bedrock shorelines with marine influence

Bedrock shorelines are natural coastal features in the study area and occur in medium or high marine influence sites in the outer and middle harbours. About half of the units in this bedrock type are combined with pocket beaches (habitat type 7), a combination that increases habitat diversity. About one-third of the units in this type are natural offshore islets. Species diversity tends to be high on these marine-influenced shorelines. A typical unit of a bedrock ramp is 1615, McLoughlin Point, and a combination unit with bedrock platform and pocket beaches is 1622.01, View Royal's waterfront in Esquimalt Harbour.

Habitat Type 6. Bedrock shorelines with low marine influence

Natural bedrock shorelines in the protected upper harbours show low species diversity and appear barren in the intertidal. Fine substrate was often observed in the nearshore subtidal. An example of this type of unit is 1886, Christie Point in Portage Inlet. Several of these natural bedrock shores have pocket beaches as secondary habitat types, such as unit 1868 at Point Ellice House.

Habitat Type 7. Pocket Beaches

The pocket beach habitat type is characterized by small beaches between bedrock outcrops or seawalls. Species diversity is generally low, and indicator species are similar to those identified in the Beach Habitat (Type 4). Pocket beaches were only designated as secondary habitat types associated with Habitat Types 5 and 6.

Habitat Type 8. Tidal flats

A few units were determined to be primarily tidal flat habitats, mostly occurring in upper Esquimalt Harbour (1624, at the Millstream estuary) and in Portage Inlet (1879, at Colquitz Creek). The most common associated habitat was seawalls. Shoreline width is a significant attribute of this habitat type. These habitats can form the widest intertidal areas of any of the types in the study area, such as the 350 m wide flats between Parsons Bridge and Coal Island in Esquimalt Harbour. Few algae species were observed on the surface of the flats. Invertebrate species are often common in the soft sediment. Many birds feed and rest in the tidal flats. Mud

flats in the upper Portage Inlet were associated with eelgrass. In the upper intertidal, mudflats are characterized by marsh grasses and sedges.

The summaries of shoreline lengths in each of the habitat types (Table 3) help to characterize shore-zone habitats in the harbours. Some of the habitat combinations occur only once or twice, and are therefore "unusual" in the study area. Seventeen units are offshore islets, all of which

Table 3
Summary of Primary and Secondary Habitat Types
(Refer to Table 2 for description of habitat types and secondary type numbers)

Habitat Type		Length (m)	% of shoreline	Shore unit count
Primary Type	**Secondary**			
1. Outer seawalls and embankments		3,517	5	10
	3	1,863	3	2
	7	769	1	1
	8	334	0	1
2. Protected seawalls and embankments		4,741	7	9
	3	2,994	4	4
	4	691	1	2
	6	251	0	1
	8	806	1	1
3. Pilings, wharves, floats		1,307	2	3
	1	5,719	9	1
	2	3,787	6	3
	6	222	0	1
4. Beaches		5,148	8	8
	2	2,973	4	4
	5	65	0	1
	6	513	1	1
	8	1,199	2	3
5. Marine influenced bedrock		3,181	5	12
	3	1,220	2	1
	4	272	0	1
	7*	5,812	9	6
	8	433	1	1
6. Low marine influence bedrock		5,211	8	14
	2	902	1	1
	4	156	0	1
	7*	3,982	6	8
	8	1,500	2	2
8. Tidal flats		5,497	8	5
	2	2,101	3	1

* Secondary type "7" indicates presence of a pocket beach in a shore unit.

are natural bedrock ramps or platforms except one in Esquimalt Lagoon. Only three islets have associated pocket beaches. The longest islet shoreline is on the Inskip Islands in Esquimalt Harbour.

Table 4
Summary of Key Harbour Features

Shore Unit Characteristic	Shoreline Length	
	Kilometres	% of Length
Physical		
Anthropogenic (seawall, riprap, piers)	24.7	37
Natural (bedrock, pebble, cobble, mud, sand beach)	29.9	44
Bedrock	6.7	10
Pebble, sand beach	5.4	8
Mixed anthropogenic and natural	12.6	19
Intertidal habitat types		
Seawalls, embankments	16.1	24
Pilings, wharves	10.7	16
Beaches	10.0	15
Bedrock	22.8	34
Pocket beaches (secondary type only)	n/a	n/a
Mudflats	7.4	11
Backshore habitat (vegetation types)		
Coniferous forest (Douglas fir, redcedar, Grand fir)	12.2	18.3
Deciduous forest (Alder, Garry oak, maple)	10.2	15.2
Shrub (Thimbleberry, oceanspray, salal)	9.3	13.9
Invasive plants (non-native—broom, blackberry)	8.8	13
Grass (native and non-native)	3.2	5.0
Marsh (wetland vegetation—sedges, cattails, willow)	1.9	2.9
Bare ground (less than 40% vegetated)	9.1	13.5
No vegetation	6.3	9.4
Landscaped	9.5	1.4
Land use (backshore only, excludes marinas and other intertidal uses)		
Natural Park	8.3	12.3
Boardwalk, active park	5.3	8.0
Vacant open space	7.9	11.8
Residential	19.1	28.5
Commercial	4.5	6.7
Industrial, docks, and wharves	3.8	5.7

Table 4 presents the length and proportion of total shoreline length for various key variables measured during the study. Natural shore types (bedrock, pebble and sand beaches) are the most

common type (44%) followed by anthropogenic (37%) and mixed (19%). Bedrock is the most common intertidal habitat type, followed by seawalls.

Coniferous forest is the most common backshore habitat (19%), followed by deciduous forest, shrub, invasive plants, and ornamentals (all between 12% and 15% of the shoreline). Among backshore land uses, residential uses are the most common (29%), followed by natural park and vacant open space (both at 12%). Relatively small proportions of the harbours are industrial (6%) or commercial (7%), although these uses are most prevalent in outer harbours, which also have high biological productivity.

Limitations to the HEIR inventory

Users of the HEIR database should be aware of the following limitations of the data.

- The distribution of individual species is not included in the database, nor was this information collected in the field. A more intensive sampling program is needed to determine the spatial distribution, populations, and other species characteristics.

- Temporal change in species distributions is not included. Field investigations were undertaken in August and September. At a different time of year, different species may have been observed.

- Percent cover estimates for biological features were based on visual estimates from a boat. Backshore areas and portions of intertidal zones that were inundated during inspection were difficult to assess and results should be used with caution.

- Land uses can change quickly and the database entries for specific properties may become outdated more rapidly than other fields.

- The HEIR shoreline is based on digitizing a large scale orthorectified aerial photograph. The resulting shoreline is the most accurate available for local planning and management. The shoreline configuration, however, does not match those created using other methods or other scales (e.g., LUCO, CRD mapping, federal hydrographic charts). This discrepancy does not affect the accuracy of the HEIR data, but overlaying thematic map layers from the various sources would probably produce unsatisfactory results.

- Information and ratings are assigned to whole shore units. Characteristics of portions of shore units are not represented in the HEIR databases. Information on coastal segments shorter than the HEIR shore units, therefore, is either lost or Ablended@ with information on the rest of the shore unit.

Methods for rating ecological value of shore units

Rating the ecological value of shore units enables harbour managers to strategically allocate limited financial and personnel resources to achieve maximum environmental benefit. The rating information can guide land owners and users of the harbours in their personal and business decisions.

In October 1998, VEHEAP convened a workshop of interested parties to review HEIR inventory findings and to discuss methods of rating the ecological value of the shore units. The workshop was attended by representatives of municipal, regional, provincial, and federal governments, and community-based natural history and environmental groups.

After reviewing summaries of the HEIR Inventory and alternative methods of rating shore units, participants worked in small groups to recommend actions for completing the HEIR. The participants made the following main recommendations to VEHEAP.

X The HEIR results should be presented to municipal staff and councils, industrial users of the harbours, Transport Canada and the new Victoria Harbour entity, Department of National Defence, harbour tenants (fishermen, adjacent and liveaboard residents), recreational users, community associations, watershed groups, and schools.

X A system of rating shore units for ecological value should be prepared because ratings can be important planning tools, informing discussions and providing a basis for monitoring.

X The rating system should avoid summaries that Aaverage@ subsequent scores because such numerical approaches can mask underlying values.

X Results should include explanations of reasons for assigning a rating. The harbours inventory data should be made available to help interpret ratings.

X Separate ratings should be prepared for intertidal and backshore areas. Ecologically important sites should be Ared flagged.@

X Avoid using Ared-yellow-green@ rating schemes, which can send confusing messages to readers.

X Participants were concerned about the misuse of rating scores, especially if low-scored shore units are deemed suitable for development or damaging use.

In summary, Workshop participants supported the rating of shore unit, and recommended that VEHEAP and its consultants prepare a process for rating the shore units and conduct the work.

General characteristics of the rating process

A qualitative process. The environmental scientists involved in preparing the HEIR inventory convened to review the characteristics of each shore unit. Rating forms were completed for each shore unit (see example in Appendix C). The ratings are based on application of criteria for each topic, professional opinion, and interpretation of information available on the ecological character of each shore unit. This "rule-based" approach, guided by recommendations of the October HEIR Workshop, provides a better assessment of shore unit values than arithmetic processing of numerical scores. Through discussion among members of the rating panel (comprised of senior consultants with qualifications as biologists and environmental planners), a consensus was reached on the ratings of each shore unit.

Three categories of ratings. Each shore unit is rated according to the following three rating categories and subtopics.

1. **Ecological value**
    a. Diversity of obvious species
    b. Habitat diversity
    c. Natural habitat
    d. Key life cycle areas

2. **Vulnerability to development**

3. **Priority for action**
    a. Priority areas for protection
    b. Priority areas for remediation

The following section provides details on these categories and on the criteria and rating system used to rate the shore units.

Establishing the Range of Rating Categories. To ensure that ratings reflect the full range of ecological values present in the harbours, the rating panel established subjective upper and lower extremes of ecological value of all shore units in the harbours. Heavily disturbed and polluted industrial shore units were determined to have **Very Low** ratings, and highly productive natural areas with a variety of habitats and species were determined to have **Very High** ratings. Between these two extremes, three other categories were established, **Low**, **Moderate**, and **High**, reflecting the relative gradations in ecological condition of the shore units.

For each category, intertidal and backshore portions of shore units are rated according to the following five categories:

Very High the most ecologically valuable shore units in the harbour, with very little human alteration and high diversity and importance to species,

High highly diverse shore units, high ecological value, important to the region, and shows little human alteration,

Moderate represents an "average" site in the harbours, usually with some human alteration of the coastal zone, but still retains a functioning ecosystem that has ecological value,

Low intrinsic ecological value has been substantially reduced through human action, or the character of the site supports limited diversity or productivity,

Very Low the shore unit has been extensively altered, with accompanying significant degradation of ecological potential either through habitat destruction or pollution.

It is important to note that a **Low** or **Very Low** rating does not imply that development of a shore unit should occur without regard to its ecological value. Even low-rated shore units may have valuable components (species diversity sustained by pilings, for instance) or may be adjacent to high-valued units. All shore units contribute to the harbour ecosystem, and any coastal development should minimize potentially harmful environmental effects. Preferably, human actions should contribute to an improved harbour ecosystem.

Geographic area of comparison. The rating panel considered each shore unit relative to other units in Victoria and Esquimalt Harbours. That is, a unit may be rated **High** for **habitat diversity** in Victoria Harbour, although it might be only **Moderate** from a provincial perspective.

The local focus of the HEIR ratings reduces the transferability of the rating results to other regions. The approach to the study and the process followed, however, may be transferable to areas having similar physical settings, harbour management issues, and levels of staff and funding available to support harbour studies. The inventory results (habitat types, species, shore material and structure, land use) can also be compared with biophysical conditions in other places.

Intertidal-Backshore emphasis. The HEIR is a harbour-oriented study, so the ecological value of intertidal areas is given more weight than backshore areas. For instance, if a shore unit is

rated **High** for intertidal habitat diversity and **Moderate** for backshore diversity, it would have an overall diversity rating of **High**.

Quality control. The rating process involved the use of clearly stated and carefully crafted criteria and assessment categories, applied and interpreted in a qualitative manner. This approach, although appropriate for assessing ecological value, has limitations in terms of replicability.

The qualitative nature of the assessment precludes the use of peer review or similar quality assurance testing of results. Debate among rating panel members ensured that each rating was carefully considered, defensible, and consistent. The resulting rating forms were checked before entry in the database, and database records were checked against the rating forms to control data entry errors. Participants at a second HEIR workshop held in April 1999 examined the draft ecological value ratings and provided comments.

Other trained reviewers, using the same available information and the same criteria as the HEIR would be likely to rate the shore units similarly, especially for **Very High** and **Very Low** ratings. Some differences in rating assignments could be expected among the middle three ratings (**High** to **Moderate**, and **Moderate** to **Low**), but such differences are unlikely to affect the usefulness of the results.

Rating topics and specific criteria

Ratings were applied to the following categories and topics, using the criteria described.

1. Ecological value

This rating summarizes the judgement of overall ecological value of each shore unit, based on interpretation of four supporting biological topics. The ecological value rating is not the result of an arithmetic process, but rather of an interpretation of the relative value of a shore unit compared to other units in the harbours.

A single Acombined" descriptive rating of the ecological value of each shore unit in the context of the ecological character of Victoria and Esquimalt Harbours was determined. Table 5 outlines the method used to assign and interpret ecological value ratings. Typically the ratings apply to entire shore units.

Table 5 Guidelines Used in Rating Shore Unit Ecological Value[1]	
Rating	**Interpretation**
Very High or **High**	➢ **High** or **Very High** rating for either species diversity, habitat diversity, or key life cycle areas ➢ **High** or **Very High** rating for natural habitat plus one other criterion
Moderate	➢ **Moderate** ratings for one or more criteria (no **High** or **Very High** ratings) ➢ a **High** or **Very High** rating for natural habitat and no other **High** or **Very High** ratings
Low or **Very Low**	➢ **Low** or **Very Low** ratings for all criteria

a. Diversity of obvious species. This category rates the number of easily-observed or abundant species of macrobiota catalogued in a shore unit. The species listed in the HEIR database serve as a surrogate index of the total species diversity in each shore unit, rated as follows:

High or **Very High** many species observed

Moderate some diversity of species

Low or **Very Low** few or no species observed.

The known presence of intertidal species of special interest (e.g., rare species) triggers a rating of **High**. Marine influence (wave exposure, flushing, and salinity) tends to increase the diversity of observed species.

b. **Habitat diversity**. The number of distinct habitat types observed in a shore unit is the basis of assigning a rating.

High or **Very High** habitat heterogeneity is high throughout the unit, either along-shore or across-shore

[1] Professional judgement was sometimes used to override a shore unit=s rating if, in the opinion of the rating panel, using the guidelines would result in a rating that incorrectly represented the parameter under consideration.

Moderate	modest levels of habitat heterogeneity throughout the unit
Low or **Very Low**	homogeneous habitat type throughout the unit.

Large shore units are more likely to have high habitat diversity simply due to their size.

The presence of special habitats triggers a rating of **High** or **Very High**. Special habitats include regionally unusual habitat types such as pocket beaches, estuaries, and low-tide flats.

c. Natural habitat. This category rates the presence of undisturbed habitats characteristic of this region, and the lack of modification of the shore unit.

High or **Very High**	most or all of shore unit total length is in an undisturbed or near-natural condition
Moderate	about half of the length of the shore unit undisturbed
Low or **Very Low**	much less than half of the shore unit length undisturbed.

d. Key life cycle areas. This category rates the importance of a unit to important life cycle activities of major species, e.g., areas for reproduction, food supply, shelter, spawning, rearing, or nesting. Examples of key life cycle areas in the harbours are seal haulouts, bird refugia or nesting areas, and estuarine areas. Key life cycle areas are habitats with special characteristics that are not reflected in the habitat diversity category, which reflects the number of different habitats in a shore unit.

High or **Very High**	presence of critical life cycle areas of substantial size, diversity, or importance (e.g., islets used by a variety of marine species),
Moderate	areas of limited life cycle value present (e.g., logs used as seal haulouts)
Low or **Very Low**	slight or no life cycle value.

2. Vulnerability to Development

The preceding ratings apply to the assessed ecological value of shore units. The following ratings help to identify priority units for protection and remediation. In areas that could experience urban development, these ratings may assist policy makers in making planning decisions.

Ecological value of a shore unit can be negatively affected by development. Vulnerability to development may affect decisions to protect or remediate a shore unit. Properties subject to rezoning for more intensive use, or sites already zoned and awaiting development permit issuance or other land use approvals are considered vulnerable to development.

Very High or **Very Low** ratings are not applied to this topic; the **High-Moderate-Low** scale adequately represents vulnerability to development.

High development with the potential to substantially affect the coastal zone is pending in the next 1-2 years,

Moderate development is likely in the next 3-10 years, and potential effects on the coastal zone are modest or unknown,

Low no development is foreseeable or potential effects on the coastal zone are slight.

Information on planned or proposed development was obtained from local planning departments, the Department of National Defence, Parks Canada, and the Songhees First Nation. The draft Victoria *Harbours Plan* was used to identify development potential in the City of Victoria. The pending Transport Canada divestiture of the harbours and the creation of a harbour authority could affect the rate and kinds of development affecting properties in the harbours.

3. Priorities for Action

The following descriptions represent the rating panel=s assessment of sites having characteristics that merit special actions.

a. **Priority Areas for Protection** are shore units that have high ecological value and deserve protection from harmful human activities. Shore units are rated as **Yes** or **No** for protection. Areas having **Very High** or **High** ratings for both ecological value and vulnerability to development are usually priority areas for protection. The database includes a summary of reasons used for assigning **Yes** ratings. The HEIR does not

contain recommendations for specific protective actions; such decisions should be made by regulatory authorities, land owners, or other interested parties.

A shore unit in a designated park is not automatically disqualified from being a **Yes** priority for protection, because ecological values may not be retained in parks due to development of park facilities or human use. Hardened shorelines associated with public walkways in the Gorge, Songhees, and Inner Harbour areas, for example, have significantly reduced ecological values in intertidal and backshore areas.

Fourteen of the sixteen islets in the harbours are rated as Priority Areas for Protection (two small islets are heavily degraded by industrial activity). Islets received this priority rating because they serve as refugia for wildlife (and hence have high life cycle value), often have remnant natural ecosystems, and have a large intertidal perimeter relative to their area.

b. **Priority Areas for Remediation** are shore units where obvious improvements in ecological characteristics (species diversity, habitat diversity, natural habitat, or ability to support key life cycle activities) could be obtained at a reasonable cost. Remediation could include control of pollutants, altering land uses along the shore, replanting native vegetation, or other habitat-enhancing initiatives.

Shore units recommended for remediation are primarily sites where human activity has harmed the ecological functioning of the intertidal or backshore areas, but where the physical character of the shore unit is still evident. Using the stated criteria, Rock Bay and the Inner Harbour, for example, are not designated as priority areas for remediation because substantial and costly efforts would be required to achieve even minimal improvements in ecological value. Shore units that are undisturbed by human activity typically would not require remediation. Shore units with **Moderate** ecological value ratings often proved to be the best candidates for remediation.

For shore units rated as priority areas for remediation (and for some units that were not), the HEIR database contains brief descriptions of features to be remediated. Remediation may improve the ecological value of nonpriority sites, but the priority designation is intended to highlight shore units where remediation would be most effective. Prior to undertaking remediation work on a designated shore unit, more detailed review of the HEIR database and site-specific investigations should be undertaken.

Results of the ecological rating

The results of the rating process are contained in the HEIR database. The database allows access to detailed rating information and comments for each shore unit. Although the database is best used in its electronic format, Appendix E contains a hard copy version of a typical shore unit rating report. As with the Inventory Database, the Rating Database is linked to a map of the harbours through a Shore Unit Key identifier. Table 6 summarizes the shore unit ratings for the major ecological criteria and for vulnerability to development.

Ecological Value. Plates 1 and 2 show the ecological value ratings of shore units in the harbours. As could be expected, **Very Low** ratings are common in shore units where industrial and commercial development has substantially modified the natural intertidal and backshore zones. Even where some natural backshore exists, the overall ecological value ratings reflect the emphasis on intertidal values.

The wharves and ship repair facilities of Esquimalt and Victoria Harbours, Rock Bay, and the old plywood mill site north of Plumper Bay have **Very Low** ecological value ratings (as do most shore units where fill has been placed in the intertidal zone). The manicured backshore and sheer rock wall of Gorge Park in Saanich also have **Very Low** ecological value. **Low** ecological ratings are found on the Esquimalt side of the Gorge and the western shore of Portage Inlet, where human activities have altered the backshore and intertidal habitats. Some heavily altered shorelines in Victoria Outer Harbour have **Low** rather than **Very Low** ecological value due to marine-influenced species and habitat diversity in the intertidal zone.

Shore units with **High** or **Very High** ecological value are found in all harbours. In the Victoria Outer Harbour, four groups of islets have **Very High** ratings, as do marine-influenced rocky shorelines having high habitat diversity and life cycle values. On the northern side of West Bay, combined values of natural backshore and undisturbed intertidal areas with bedrock, beaches, and tidal flats create **Very High** ecological value. Other **Very High** ecological values are found at Cecelia Creek estuary, the Saanich side of Gorge Narrows, and the estuaries of Colquitz Creek and Craigflower Creek. At Point Ellice, the combination of diverse natural intertidal and backshore habitats surrounded by urban development justified a **Very High** rating.

In Esquimalt Harbour, seven sets of islets have **Very High** ecological value ratings. Millstream estuary and adjacent mudflats have **Very High** ratings, as does Fisgard Island, with its high life cycle values and marine-influenced habitat diversity. All of Esquimalt Lagoon has **Very High** ecological value except the Portsmouth Drive shore unit, where suburban development has degraded backshore and intertidal habitats.

The range of ecological value ratings reflects the variety in the character of shore units in the harbours (Table 6). Although 37% of the shoreline length has **Low** or **Very Low** ecological

value, reflecting the degree of human disturbance that has occurred over the past 150 years, nearly 48% is rated as retaining **High** or **Very High** ecological value. Hence, opportunities exist for protecting and enhancing the ecological functioning of the harbours while accommodating human activities that are sensitive to the value of the harbour environment.

Habitat or species diversity. Overall, relatively few shore units exhibit diverse habitats or species. Only 9% of the shoreline has **Very High** species diversity ratings, versus 34% with **Very Low** ratings. Just about as much shoreline has **Very High** or **High** habitat diversity (45%) as has **Low** or **Very Low** habitat diversity (42%). Small shore units could not accommodate much diversity of either habitats or species.

Table 6
Summary of Shore Unit Ratings: Ecological Value and Development Vulnerability

Characteristic	Percent (length, m) of total Shoreline Length rated as:				
	Very High	High	Moderate	Low	Very Low
Habitat Diversity	20% (13,500)	15% (9,900)	20% (13,300)	12% (7,800)	30% (20,200)
Species Diversity	9% (6,200)	12% (8,000)	22% (14,700)	20% (13,000)	34% (22,800)
Naturalness	41% (27,300)	2% (1,600)	19% (12,800)	1% (800)	33% (22,300)
Key Life Cycle Areas	23% (15,600)	2% (1,600)	21% (14,000)	1% (700)	49% (32,900)
Overall Ecological Value	27% (18,200)	21% (14,300)	15% (9,800)	11% (7,300)	26% (17,100)
Vulnerability to Development	n/a	18% (11,800)	23% (15,400)	58% (39,000)	n/a

Victoria and Esquimalt harbours are fortunate to have a relatively large proportion of natural shoreline. More than 41% is rated **Very High** for naturalness, compared with 33% rated **Very Low**. Maintaining these shore units in their natural states helps to sustain the ecological functioning of the harbours and provides a variety of social benefits as well.

Key life cycle areas. Key life cycle areas are relatively rare in the harbours. River estuaries, islets, and selected undisturbed areas of native backshore vegetation account for most of the 23% of shoreline rated as having **Very High** life cycle values. Nearly 50% of the shoreline has **Low** or **Very Low** life cycle value.

Vulnerability to development. The review of vulnerability of the harbours to development reveals that 58% of the shoreline is rated as **Low**, either because it is already developed or is protected in parks. New development or redevelopment is likely in the next two years on 18% of the shoreline, most of it in Victoria's Inner Harbour or in Esquimalt Harbour. Another one-fourth of the shoreline faces development that could affect its coastal character in 3-10 years.

Priority for Protection. Plates 1 and 2 show green flags on shore units identified as priorities for protection. These shore units are deemed to have ecological value that merits action to ensure that they are not harmed by development or human use. Protection could include park designation, consultation with owners or users to ensure improved stewardship of the shore unit, or registration of conservation covenants to protect identified values.

Table 7 shows that about one-third of the total length of harbour shoreline is a priority for protection[2]. Sixteen of the 30 shore units included in this length are islets. Of the 14 non-islet units, most have **Very High** or **High** ecological value, and include Esquimalt Lagoon and estuarine units. Some units in Victoria Inner Harbour that have **Moderate** ecological value are rated as priorities for protection because they are remnant natural shorelines in a heavily-developed area. The shore unit containing the Bayside Lands site is a priority for protection because the foreshore and intertidal flats have significant ecological value.

Table 7
Summary of Shore Unit Ratings: Priorities for Protection, Remediation

Characteristic	Percent (length in m) of Shoreline length rated as:	
	Yes	No
Priority for Protection	33% (22,200)	67% (44,500)
Priority for Remediation	17% (11,600)	83% (55,200)

2 The shoreline length represent the total length of shore units in which a portion of the area has the stated protection rating. In some cases, only a portion of a shore unit requires protection, but partial length is not represented in the totals.

Priorities for remediation. Cost-effective ecological remediation might be undertaken on only a small proportion of the shoreline (17%), although this still accounts for more than 11 km of shoreline length.

Purple flags on Plates 1 and 2 show the locations of shore units rated as priorities for remediation. Priority areas for remediation include portions of Esquimalt Lagoon (affected by residential development and pollution) and selected industrial properties in Esquimalt Harbour slated for redevelopment. Some small shore units with remnant natural features in Victoria Inner Harbour are priorities for remediation. Further upstream, the Cecelia Creek estuary, Colquitz River estuary, Bayside Lands, and Ministry of Transportation and Highways properties are priorities for remediation.

The database contains suggested remediation actions for shore units where such work would be beneficial. The recommended remediation includes cleaning up runoff from stormdrains, preventing further contamination of ecologically important shore units, or planting native vegetation in the backshore to improve habitat quality. Where reconfiguration of the upper intertidal or backshore areas has occurred, remediation may include lowering beach slopes to emulate natural shore zones.

Using the HEIR inventory and ratings

The HEIR Phase 1 Inventory Database provides a consistent set of systemically collected information for all intertidal and backshore portions of the harbours. The Rating Database provides a comparative rating of shore units' ecological value and recommendations for protection and remediation. The HEIR information is intended to support planning, scientific, and management decisions affecting the harbours.

Applying HEIR results to harbours planning and management

The HEIR database can support a variety of planning and management initiatives affecting the harbours, including the following:

- Identifying properties to be designated for environmental protection in Official Community Plans,

- Designating development permit areas (DPAs) for coastal protection, and preparing DPA guidelines to protect specific coastal features,

- Identifying candidate areas for environmental remediation or setting priorities among candidate sites,

- Determining appropriate land uses, setbacks, tree retention, storm drainage, and other components of zoning bylaws, other municipal regulations, and development decisions made by federal and provincial government land managers,

- Preparing lists of prospective shore units for purchase or other protective actions by government or nongovernmental organizations,

- Establishing a framework for a program to monitor environmental conditions in the harbours,

- Providing base mapping to support other harbours studies or planning initiatives,

- Assessing potential impacts of proposed shore zone development (under municipal, provincial, or federal environmental assessment guidelines), and

- Improving the understanding of the harbour environment among members of the public, business, government, and students.

Ecological inventory data and ratings provide only part of the information needed to plan for and manage the harbours. Other useful information to complement the HEIR could include:

- Land ownership and tenure, which could affect protection or management approaches,

- Existing regulations or management actions affecting shore units that could complement or conflict with HEIR ratings and priorities for protection and remediation,

- Social information (e.g., recreational use and potential, viewsheds) and historic information (heritage buildings, archaeological sites),

- Community perspectives on appropriate land use and environmental management of the shore zone,

- Ecological linkages among backshore, intertidal, and subtidal portions of the harbours (once Phase 2 of the HEIR is completed),

- Site-specific remediation plans and associated cost of such actions, and

- Study of the impacts of offsite phenomena (especially storm drainage) that could affect environmental quality of the coastal zone.

Communications and updating

To adequately support decisions affecting the harbours, the HEIR needs to be effectively communicated to planners and other harbour managers. VEHEAP and its partners should develop a communications strategy to ensure that the HEIR results are distributed in a clear and timely manner. Two-way communications should be encouraged, allowing information to flow from harbour users and managers to VEHEAP, as well as from VEHEAP to harbour users and managers through the HEIR.

An effective system of updating the HEIR is also necessary to ensure that its information is timely. Land use changes, improved environmental information, and mapping updates need to be reflected in the database. Such updating need not be a continuous process, but should be conducted at regular intervals (once or twice per year). Responsibility for this function has yet to be determined.

Used actively and appropriately, the HEIR maps and databases can be powerful tools in managing the harbours and improving their environmental quality. By consulting the HEIR information as a routine part of government planning and management, ecological values can be integrated into decision processes to the benefit of the harbours, management agencies, and the public. Nongovernment organizations may use the HEIR to guide their plans and actions, and to improve their effectiveness in working with governments and landowners on harbours environmental issues. As the HEIR database is expanded and refined, its applicability and value can be expected to increase.