

**Audit of Selected Polygons of the Sensitive Ecosystems
Inventory of East Vancouver Island and Gulf Islands,
1999 – 2001**



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Plate 1: Polygon N1400 - Wetland in rural land use category *Disturbed* by cutting of vegetation, fill encroachment and excavation.

Cover photo: Polygon V0923 - Urban development into a Woodland.

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Executive Summary

The following report documents changes to the Sensitive Ecosystems of East Vancouver Island and adjacent Gulf Islands in the past 6-8 years. Between 1993 and 1997, the Ministry of Environment, Lands and Parks and Environment Canada conducted the *Sensitive Ecosystems Inventory of East Vancouver Island and Gulf Islands* (SEI). The SEI identified and mapped the larger remaining areas of seven *Sensitive Ecosystems* (Wetlands, Riparian, Older Forests, Woodlands, Coastal Bluffs, Terrestrial Herbaceous and Sparsely Vegetated) and two *Other Important Ecosystems* (Older Second Growth Forests and Seasonally Flooded Agricultural Fields). Development pressure continues; consequently, a need for this audit.

Utilizing 1999 ortho-photographs, the audit assessed 1,994 (27.0%) of the 7,388 polygons identified in the SEI. Areas of high urban and rural growth were selected for review. Comparisons were made of the degree of disturbance for each SEI ecosystem and broad land use category. The results are expected to be applicable to other areas with similar land use distribution but not to areas with a high forestry component.

Of the 1,994 polygons reviewed, 224 (11.2%) have been disturbed to some degree. The audit suggests that the rate of disturbance was higher towards the end of the study period. The greatest level of disturbance was in Older Second Growth Forests (24.9%). Of the seven Sensitive Ecosystems, the greatest impact was to Older Forests (17.6%). In the analysis of land use categories, 22.8% of all urban polygons demonstrated some degree of disturbance.

The results of the audit suggest that if the present rate of disturbance were to continue, all of the remaining natural Sensitive Ecosystems could be impacted within the next few decades.

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Audit of Selected Polygons of the Sensitive Ecosystems Inventory of East Vancouver Island and Gulf Islands, 1999 - 2001

Introduction

The *Audit of Selected Polygons of the Sensitive Ecosystems Inventory of East Vancouver Island and the Gulf Islands, 1999-2001* ("the audit") was designed to document disturbances due to land development to sites identified in the original SEI. Areas showing a high degree of urban and rural growth were selected for review, as the focus of the study was on changes to the urban/rural landscape rather than areas whose primary land use is forestry. This report correlated these disturbances to the SEI Ecosystems within broad land use categories.

Between 1993 and 1997, the Ministry of Environment, Lands and Parks¹ and Environment Canada conducted the *Sensitive Ecosystems Inventory of East Vancouver Island and Gulf Islands* (SEI). The SEI identified and mapped the larger remaining areas of rare and/or **sensitive ecosystems**² using aerial photographs primarily from 1991-1993. Seven Sensitive Ecosystems and two Other Important Ecosystems were identified and mapped as **polygons**³. The SEI showed that only 7.9% of the study area contained Sensitive Ecosystems. The Other Important Ecosystems accounted for another 11.6% of the land base. See Figure 1 for the study area.

For this report, the nine ecosystem types are collectively referred to as **SEI Ecosystems**. They are described as follows:

There are seven **Sensitive Ecosystems**:

Wetland ecosystems (marshes, swamps, fens, bogs, and shallow open water, etc.) exist where water remains at or near the land surface.

Riparian ecosystems are found beside lakes, streams and rivers, as well as in ravines and gullies, where soil moisture and light conditions support plant communities different from those in the surrounding land and water.

Older Forest ecosystems are coniferous or mixed coniferous/deciduous forests with an average tree age of 100 years or more.

Woodland ecosystems are open forested areas composed of pure stands of Garry oak, mixed stands of Douglas-fir/Garry oak, arbutus/Garry oak or arbutus/Douglas-fir, and, rarely, pure stands of trembling aspen.

Coastal Bluff ecosystems include vegetated rocky islets, rocky shorelines, and coastal cliffs with pockets of grasses and wildflowers.

Terrestrial Herbaceous ecosystems are rare natural grasslands and/or moss-covered rock outcroppings, frequently with scattered shrub.

Sparsely Vegetated ecosystems include sand dunes, sand and gravel spits, and inland cliffs; all with sparse and/or patchy vegetation due to limiting growing conditions.

¹ In 2001 the Ministry of Environment, Lands and Parks was divided into Ministry of Water, Land and Air Protection and Ministry of Sustainable Resources Management

² An **ecosystem** is a community of plants, animals (including humans) and micro-organisms, interacting with each other and their physical environment. An ecosystem can be as small as the spaces between grains of sand on a beach or as large as the entire earth. A **sensitive ecosystem** is one which is rare and/or fragile.

³ A **polygon** is a series of digitized points joined to form the perimeter of an area (e.g. an ecosystem) on a map.

The SEI also mapped two **Other Important Ecosystems** that make important contributions to biodiversity:

Older Second Growth Forest ecosystems are large tracts of 60-100 year old coniferous forests which often act as buffers to Sensitive Ecosystems; have the potential to become future Older Forests; and provide important wildlife habitat.

Seasonally Flooded Agricultural Fields are former wetlands that provide important habitat for mammals and wintering birds.

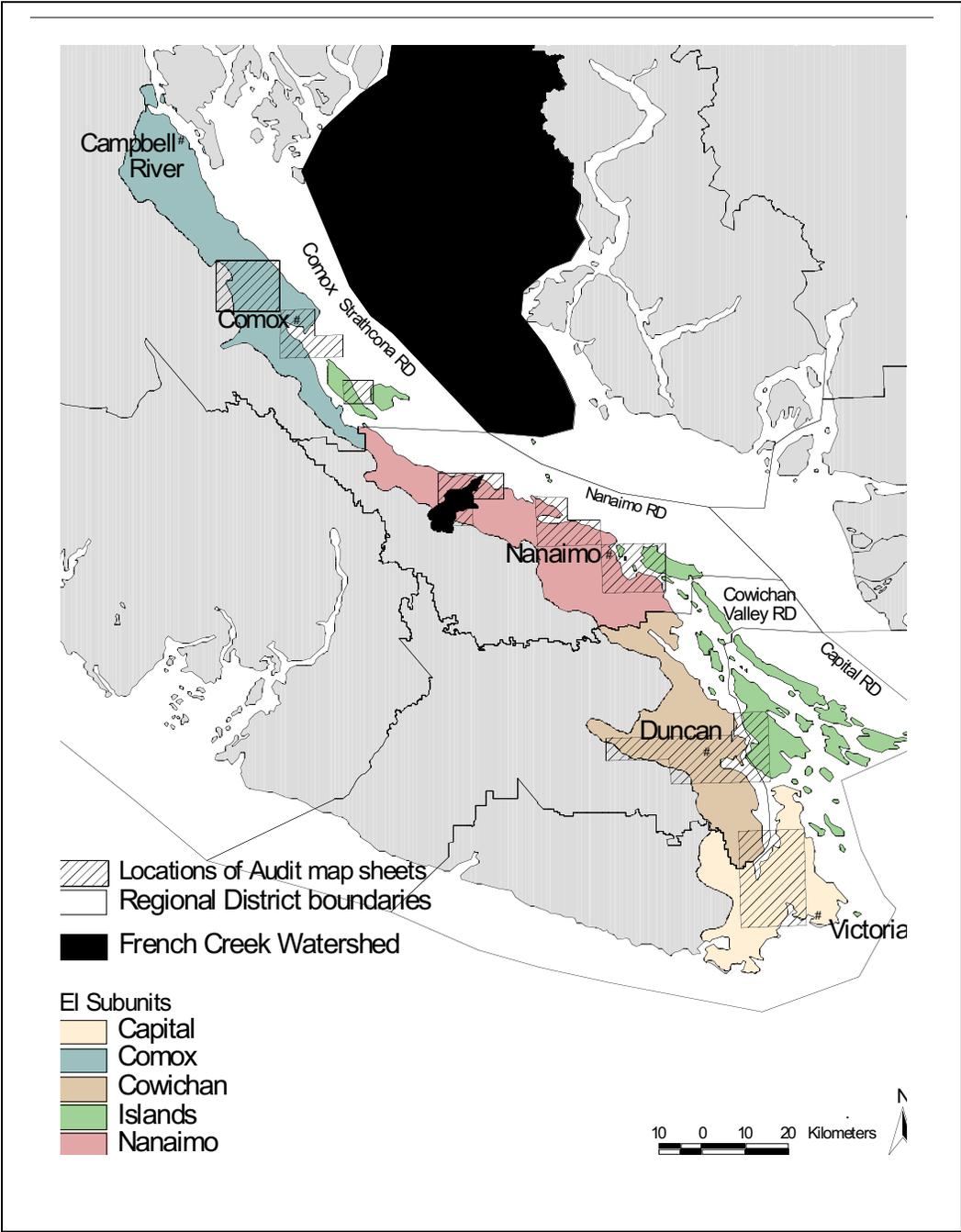


Figure 1: SEI Study Area.

Method and Limitations

The audit was conducted by superimposing SEI polygons onto 1999 **ortho-photographs**⁴. Visual assessments were made to determine whether there was evidence of human disturbance within the polygons. Comparisons were made as to the degree of disturbance for each SEI Ecosystem and major land use category.

Site Selection

The areas selected for this audit were chosen from each of the five geographic sub-units used in the original SEI project. These sub-units are the lowland Vancouver Island portions of the Regional District of Comox-Strathcona (**Comox** Sub-unit), Regional District of Nanaimo (**Nanaimo** Sub-unit), Cowichan Valley Regional District (**Cowichan** Sub-unit), Capital Regional District (**Capital** Sub-unit) and the Gulf Islands (**Islands** Sub-unit).

Two mapsheets were chosen within each sub-unit from the original 66 covering the entire SEI area (see Appendix A for the list of the mapsheets audited). The focus of the study is on changes to the urban/rural landscape rather than areas where the primary land use is forestry. The criteria used in the selection of map sheets included personal knowledge of local development patterns and areas under development pressure, the presence of substantial numbers of SEI polygons, and the absence of large numbers of polygons within the Forest Land Reserve.

The project team also conducted a similar assessment of the French Creek watershed in the Regional District of Nanaimo; consequently the polygons from that study were added to the database of the Nanaimo Sub-unit (see Figure 2 and Appendix A).

Table 1 describes the distribution of audited polygons across the study area and compares the number audited in each sub-unit to those from the original SEI. Coverage was not evenly distributed between the geographic sub-units and direct comparisons between them are not appropriate.

Table 1: Distribution of Audited Sites Compared to Original Sensitive Ecosystem Inventory.

Sub-units	SEI 1993-1997	2001 Audit	
	No of sites	No of sites	% of total
Capital	1404	650	46.3%
Cowichan	1284	547	42.6%
Nanaimo	1374	419	30.5%
Comox	1744	220	12.6%
Islands	1582	158	10.0%
Total	7388	1994	27.0%

The audit assessed the SEI Ecosystem types in similar proportions to those identified in the original SEI (see Appendix B). Riparian and Woodland Ecosystems had a slightly greater representation in this audit, while proportionately fewer Coastal Bluff polygons were audited.

Similarly, a proportionate number of SEI polygons which had been originally field checked were included. Thirty-one point three percent of the polygons in the original SEI inventory

⁴ **Ortho-photographs** are images based on air photos that have been joined together into a continuous large 'map' with no apparent seams and which have been adjusted to remove distortions, allowing accurate measurements of distances.

were field checked during the 1994 and 1995 field seasons, compared to 31.6% (631) of those audited.

Ortho Photography

The first step in the audit was an examination of the appropriate 1:10,000 ortho-photographs upon which the digital version of the SEI had been superimposed. The original 1:20,000 SEI mapsheets were used for comparison and orientation.

As the available ortho-photos did not cover the whole of the Islands Sub-unit but only those islands closest to the eastern coast of Vancouver Island, limited coverage of this sub-unit was achieved using portions of Denman, Hornby, Salt Spring and Gabriola islands.

The ortho-photography on which the audit was based was flown in July and August of 1999. Most of the aerial photographs used for the original SEI inventory were taken between 1991 and 1993, with some earlier coverage. Thus the results of the audit reflect changes over time spans ranging primarily from 6 to 8 years.

Disturbance Categories

For this audit, the assessed polygons were designated as follows:

Undisturbed polygons exhibited no obvious human disturbance on the ortho-photographs.

Disturbed polygons showed clear signs of disturbance through changes to the vegetation pattern, but remained substantially intact.

Severely Disturbed/Degraded polygons showed the original ecosystem either totally eliminated or having an undisturbed remnant less than or equal to 50% of the original area.

There is a continuum of degree of disturbance between the *Disturbed* and *Severely Disturbed/Degraded* categories, varying from a minor encroachment along one edge to the total removal of the natural vegetation. The authors felt that any disturbance within or adjacent to an SEI Ecosystem could affect the ecological integrity of the remainder. Hence much of the data were analyzed without distinguishing between the two '*Disturbed*' categories. The term ***Modified*** was used when the data were analyzed combining all *Disturbed* and *Severely Disturbed/Degraded* polygons. Although there may be impacts to the ecosystems mapped in the SEI due to disturbance adjacent to the SEI polygons (see 'Buffers'), this Audit only assessed impacts that were visible within a polygon.

Where disturbance to a polygon was suspected but was not clear on the ortho-photograph, the site was assessed in the field or discussed with MWLAP personnel familiar with the area. Fifty-five of the 1,994 SEI polygons audited were verified through field inspections in 2000-2001. Field inspections allowed for a more accurate determination of change in the polygons than review of the ortho-photographs alone. Some of the polygons were not accessible due to their location or could not be visited due to time limitations. SEI polygons of uncertain status that could not be assessed were not included in the study.

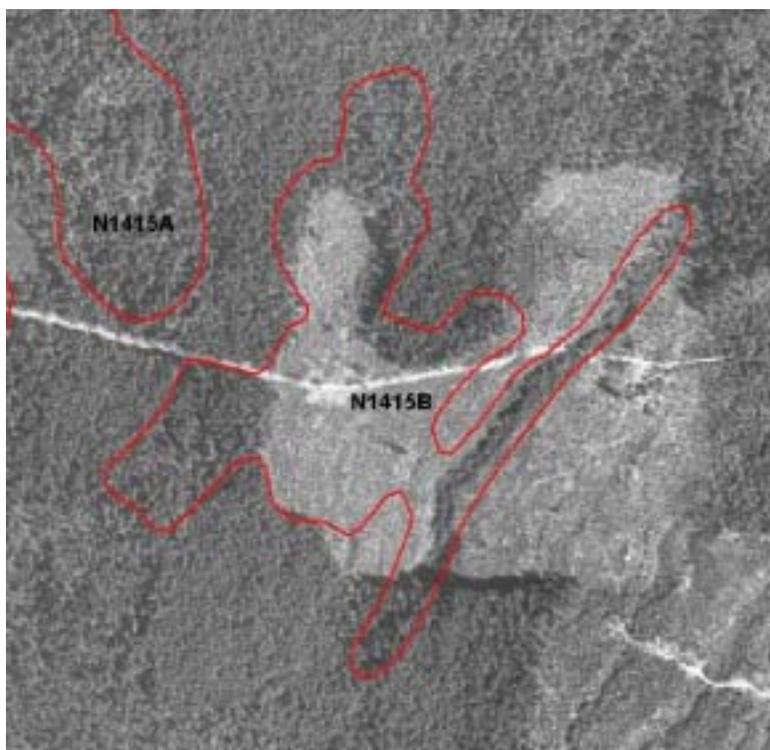


Plate 2: Older Forest Polygons N1415A and N1415B on the 1999 ortho-photo used in the audit. The red line shows the polygon boundaries. The white lines are access roads. N1415B is an example of a *Severely Disturbed/Degraded* polygon while N1415A is *Undisturbed*.

Land Use Categories

Land use categories for each polygon were determined using information from local governments including zoning maps and Official Community Plans, as well as from the activities identified on the ortho-photographs. Where the local governments' map scales differed from those used in this project, identification of land use was accomplished through visual comparison of the land use maps with the SEI mapsheets and/or ortho-photographs.

Where two or more land uses occurred within a SEI polygon, the one that was visually assessed as covering the greatest area was used for the analysis. If the polygon was approximately equally split between two categories, the more intensive use was recorded - for instance, rural over greenspace.

The land use categories selected for the audit were:

Federal - all Crown-owned (federal) lands except parks. This included Indian Reservations and lands leased for institutional purposes.

Forestry - all properties identified as being within the Forest Land Reserve (FLR) and/or having forestry-related land use or zoning.

Greenspace - all parks (federal, provincial and local), large patches of land in private ownership with 'non development' or future park designations, 'green' recreational areas such as golf courses, and coastal marine non-development zones.

Rural - all Agricultural Land Reserve (ALR) lands used for agriculture and non-forestry lands where the minimum parcel size allowed through zoning was 2 hectares.

Urban - this category included all commercial and industrial sites as well as all properties with a land use designation that allowed parcel sizes under 2 hectares.

Vancouver Island Highway Project (VIHP) - all lands affected by the VIHP including secondary developments such as the connector road to the Duke Point/Tsawwassen ferry terminal.

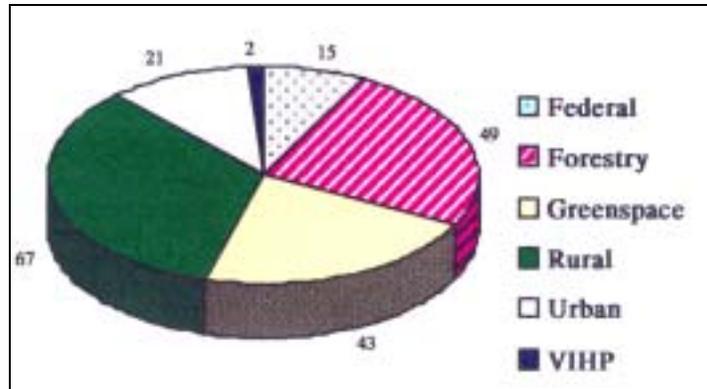


Figure 2: Land Use Distribution of Audited Polygons by Number of Polygons.

There was difficulty in distinguishing between the land use status of certain rural and forestry polygons, due to overlap in land use/zoning designations and the use of some Agricultural Land Reserve lands for forestry purposes. In these cases, the interpretation of land use was based on Forest Land Reserve maps, adjacent land uses and the land activities observed on the ortho-photos.

Database

Information relating to each SEI polygon audited was entered into a database. Data recorded included the following information from the original SEI database: polygon ID #, mapsheet number, dominant and secondary SEI Ecosystem classifications and whether the polygon had been field checked or field verified as part of the original SEI study. For this project, disturbance and land use categories were also entered.

Although **secondary ecosystem**⁵ types were recorded in the database, this information was only used to assist in determining if a polygon had been *Modified*. The audit only analyzed the dominant ecosystem classification.

Analysis for this report was done using the **SEI Ecosystems**⁶ and the land use categories.

Limitations

The focus of the selection process for mapsheets used in this audit was on areas of increasing population growth and non-forestry related land development rather than on areas where the primary land use is forestry. No attempt was made to ensure random sampling or uniformity of sample sizes. Hence comparisons between geographic sub-units or of the SEI Ecosystems within those sub-units are not statistically valid. For this reason, the data were not analyzed by sub-unit for this report.

⁵ **Secondary ecosystems** are SEI Ecosystems that are present in patches covering up to 50% of a polygon but which could not be mapped separately. A **dominant ecosystem** is the ecosystem occupying the greater area within a polygon that contains more than one ecosystem type.

⁶ The 7 Sensitive Ecosystems and 2 Other Important Ecosystems are referred to as **SEI Ecosystems** when discussed collectively in this project.

The results are expected to be representative of the impacts of development in urban and rural landscapes but should not be applied to areas with primarily forestry use.

Some local governments combined forestry and agriculture into a single resource use category. This created difficulty in classifying some rural and forestry polygons, however, the level of error is not expected to be significant

As field inspections, both for the original SEI and for this project, were carried out only on easily accessible polygons, there was some bias due to access limitations. However, fewer than a dozen polygons were deleted from the audit's database due to uncertainty regarding their classification and access limitations.

Much of the analysis in the original Sensitive Ecosystems Inventory was based on the size of the polygons and of the entire study area. The authors were unable to measure the area impacted within each *Disturbed and Severely Disturbed/Degraded* polygon due to time constraints, resources and the map scale available to carry out this project. Hence this audit does not emphasize the same criteria as the original Sensitive Ecosystems Inventory, focusing instead on the numbers of polygons.

Results and Discussion

Of a total of 1,994 polygons reviewed, 224 were disturbed to some degree. The greatest level of disturbance in the SEI Ecosystems was to Older Second Growth Forests (24.9%). Of the seven Sensitive Ecosystems, the greatest impact was to Older Forests (17.6%). In the analysis of land use categories, 22.8% of all urban polygons demonstrated some degree of disturbance (see Table 2).

Overall, 1.3% of the 1,994 polygons audited were classified as *Severely Disturbed/Degraded* and another 9.9% *Disturbed*. Thus, 11.2% of the sites had been *Modified* since the original SEI was carried out, an average of 1.6% per annum. When only the seven Sensitive Ecosystems were considered, these figures became 1.1% *Severely Disturbed/Degraded*, 8.7% *Disturbed*, and 9.8% *Modified*, for an average of 1.4% per annum.

Of the 631 polygons that were field checked during the original SEI and subsequently reviewed in this audit, 77 (12.2%) were *Modified*. As the boundaries of these polygons were confirmed in 1994 (when the majority of the SEI polygons were field checked), this figure equated to an average annual loss of 2.4% in the five years ending in 1999 (when the ortho-photos used in this audit were taken). This suggests that the rate of *Modification* was higher in the late 1990's than earlier in the decade.

The results of the audit suggest that if the present rate of disturbance were to continue, all of the remaining Sensitive Ecosystems could be impacted within the next few decades.

Table 2: Level of Disturbance, by SEI Ecosystem and Land Use.

Sensitive Ecosystem	Federal	Forestry	Green space	Rural	Urban	VIHP	Total
Wetland <i>Disturbed</i>	1	9	1	11	16	6	44
<i>Severely Disturbed/Degraded</i>	1	2	0	1	3	1	8
% Modified	8.7	5.1	0.8	5.7	22.5	100	7.8
<i>Total number of sites audited</i>	23	215	121	212	85	7	663
Riparian <i>Disturbed</i>	4	7	0	12	6	4	33
<i>Severely Disturbed/Degraded</i>	1	0	0	0	0	1	2
% Modified	8.8	14.6	0	7.7	18.2	100	10.2
<i>Total number of sites audited</i>	57	48	44	155	33	5	342
Terrestrial Herbaceous <i>Disturbed</i>	4	6	1	3	4	1	19
<i>Severely Disturbed/Degraded</i>	2	0	0	1	0	0	3
% Modified	37.5	5.2	1	7.4	15.4	100	7.1
<i>Total number of sites audited</i>	16	116	97	54	26	1	310
Older Forest <i>Disturbed</i>	0	11	3	4	2	2	22
<i>Severely Disturbed/Degraded</i>	0	4	0	0	0	0	4
% Modified	0	26.8	6.5	13.8	50	100	17.6
<i>Total number of sites audited</i>	11	56	46	29	4	2	148
Woodland <i>Disturbed</i>	2	0	2	13	8	2	27
<i>Severely Disturbed/Degraded</i>	0	0	1	0	1	0	2
% Modified	6.9	0	5.2	16.9	25	100	13.6
<i>Total number of sites audited</i>	29	11	58	77	36	2	213
Coastal Bluff <i>Disturbed</i>	2	0	0	0	3	0	5
<i>Severely Disturbed/Degraded</i>	0	0	0	0	1	0	1
% Modified	28.6	0	0	0	30.8	0	10.5
<i>Total number of sites audited</i>	7	7	15	15	13	0	57

Sparsely Vegetated							
<i>Disturbed</i>	1	0	0	0	0	0	1
<i>Severely Disturbed/Degraded</i>	0	0	0	0	0	0	0
% Modified	100	0	0	0	0	0	8.3
<i>Total number of sites audited</i>	1	2	7	1	1	0	12
Total Sensitive Ecosystems							
Number Disturbed	14	33	7	43	39	15	151
<i>Severely Disturbed/Degraded</i>	4	6	1	2	5	2	20
% Modified	12.5	8.6	2.1	8.3	22.2	100	9.8
<i>Total number of sites audited</i>	144	455	388	543	198	17	1745

Other Important SEI Ecosystems	Federal	Forestry	Green space	Rural	Urban	VIHP	Total
2nd Growth Forest							
<i>Disturbed</i>	2	13	6	13	4	0	38
<i>Severely Disturbed/Degraded</i>	0	3	0	1	0	0	4
% Modified	25	45.7	14	21.2	23.5	0	24.9
<i>Total number of sites audited</i>	8	35	43	66	17	0	169
Seasonally Flooded Field							
<i>Disturbed</i>	0	0	0	4	2	3	9
<i>Severely Disturbed/Degraded</i>	0	0	0	1	0	1	2
% Modified	0	0	0	8.2	50	100	13.7
<i>Total number of sites audited</i>	2	2	7	61	4	4	80

All SEI Ecosystems	Federal	Forestry	Green space	Rural	Urban	VIHP	Total
Number Disturbed	16	46	13	60	45	18	198
<i>Severely Disturbed/Degraded</i>	4	9	1	4	5	3	26
% Modified	13.0	11.2	3.2	9.6	22.8	100	11.2
<i>Total number of sites audited</i>	154	492	438	670	219	21	1994

Rate of Modification by Ecosystem Type

Figure 3 shows the percentage of *Modification* for each SEI Ecosystem type. Of the Sensitive Ecosystems, the greatest impact occurred in the Older Forest polygons, followed by Woodlands. Of the Other Important Ecosystems, almost one quarter of the Older Second Growth Forest polygons showed some level of disturbance.

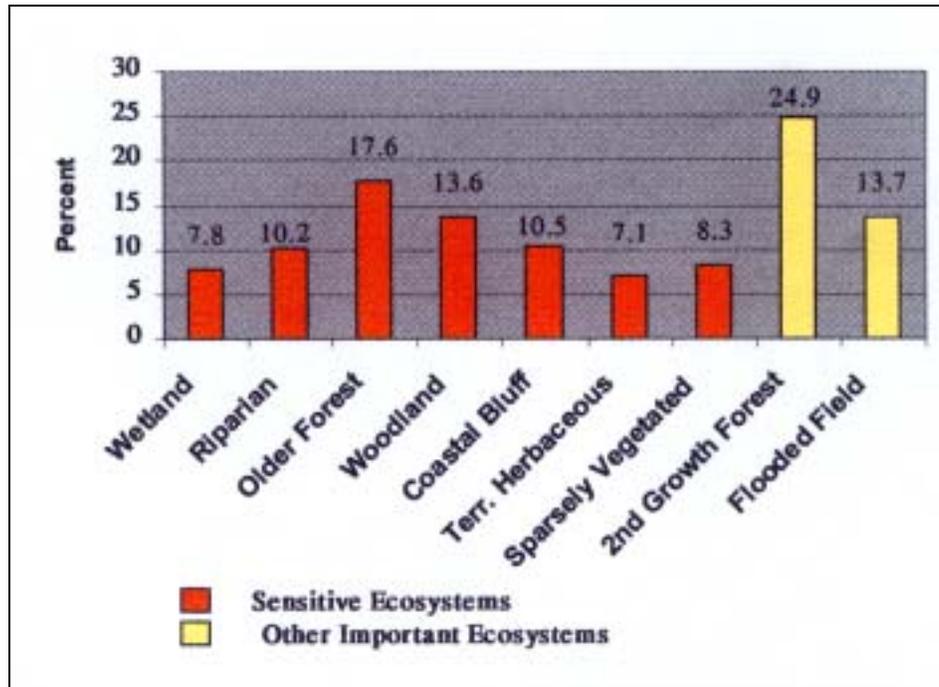


Figure 3: Percentage of *Modified* Polygons within each SEI Ecosystem Type.

Although only 7.8% of the wetlands audited showed disturbance, their *Modification* is of concern due to the relative rarity of wetlands in the study area (1.7% of the land base).

The tendency of people to build their homes close to water is affecting both Riparian and Coastal Bluff ecosystems. 'Viewscapes' are created by clearing the trees, and the natural contours are modified to provide all-weather water accesses and/or to stop natural erosion. Again, native vegetation is replaced by cultivated varieties.

The high level (17.6%) of disturbance of Older Forest ecosystems leads to concerns that most of the remaining sites except those in parks could be lost in the next few decades. The Nanaimo Lowlands supports species of birds such as Pileated Woodpecker, Marbled Murrelet and Northern Goshawk that require large patches of Older Forest for their survival – these birds will become rarer as their habitat diminishes.

Although there has been a lot of increased focus by the public regarding the uniqueness of Garry oak trees, public awareness has not yet expanded to recognize that the other natural vegetation of Woodland and Terrestrial Herbaceous ecosystems is also of conservation concern. There have been many recent cases of houses being constructed in Woodlands or on Terrestrial Herbaceous rocky outcroppings – preserving most of the trees but exchanging the natural undergrowth for lawns and other cultivated plants.

Sparsely Vegetated ecosystems are of particular concern due to their rarity (1.2% of the original SEI polygons; less than 0.1% of the land base) and their vulnerability to disturbance. In this audit, an additional 8.3% has been *Modified*. Much of the vegetation is so fragile that even walking over it may destroy it, yet sand dunes and spits are attractive for picnicking and off-road vehicle recreation.

As mentioned previously, although Older Second Growth Forest and Seasonally Flooded Agricultural Field ecosystems were included in this audit, they were mapped in the original SEI for their general biodiversity values rather than as rare and/or sensitive ecosystems. The protection and management of Older Second Growth Forest ecosystems needs to be considered from the broader landscape management scale with less emphasis on the protection or loss of specific units. However, if the current rate of *Modification* continues, all Older Second Growth polygons could be affected within the next three decades. Many of the *Modified* Older Second Growth polygons are logging patches on parcels of federal land which are exempt from local government regulations.

Seasonally Flooded Agricultural Fields have high wildlife values, especially for over wintering waterfowl. The *Modification* of these polygons by changing agricultural practices and by encroaching urban development will result in the loss of waterfowl feeding areas and extra stress for the many species which breed in remote and unpopulated areas. This has global implications because Canada has a role in maintaining the Pacific Flyway, an important migratory bird route.

Plates 1 - 8 show *Modified* SEI Ecosystem polygons which were reviewed in this study.



Plate 3: Polygon N0342C - This Coastal Bluff ecosystem has been *Severely Disturbed/Degraded* by urban development.

Rate of Modification by Land Use and Ecosystem Type

Table 2 shows the actual numbers and percentage of *Modification* of the various ecosystem types, by land use. Other than the VIHP, a special case, urban polygons had the highest percentage of impact in all Sensitive Ecosystems except Terrestrial Herbaceous and Sparsely Vegetated. Wetland and Terrestrial Herbaceous Ecosystems were impacted in all land use categories.

Figure 4 shows the percentage of *Modified* polygons within each land use category. The urban land use was the highest overall (except for the VIHP) and Greenspace showed the lowest level of disturbance.

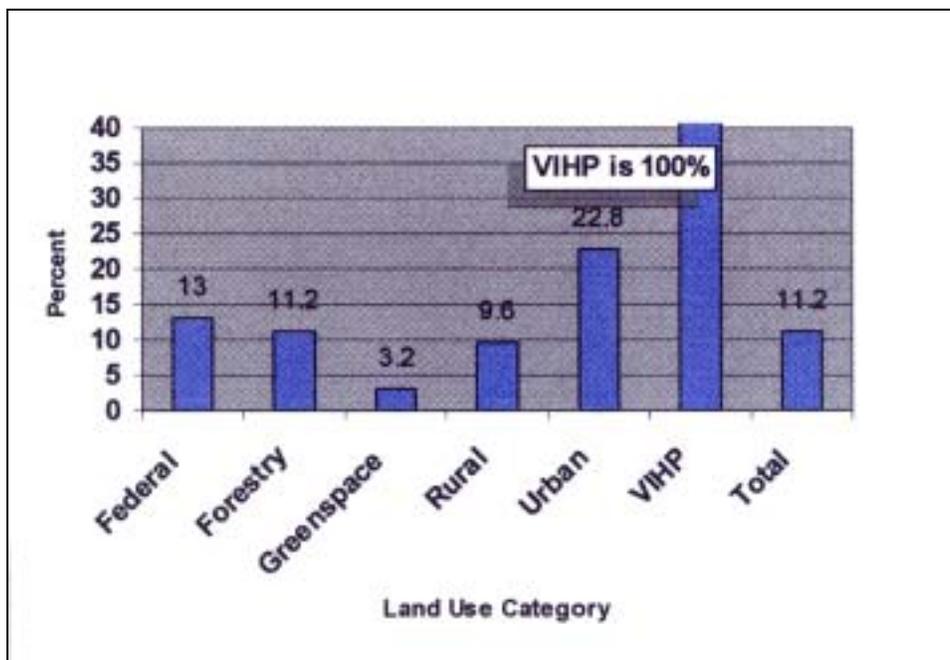


Figure 4: Percentage of *Modified* Polygons by Land Use Category.

Federal Land Use

Polygons designated as federal land use showed a high rate of *Modification* of Sparsely Vegetated, Coastal Bluff, Terrestrial Herbaceous and Older Second Growth Ecosystems, although the Sparsely Vegetated figure is based on a single site. Many federal government establishments are located along the foreshore and on adjacent uplands. Hence any expansion would be likely to impact Coastal Bluffs and Terrestrial Herbaceous sites.

Forestry Land Use

Understandably, lands designated for forestry land use showed a high level of disturbance on Older Second Growth, Older Forest, and Riparian Ecosystems. There were also disturbances on Wetlands and Terrestrial Herbaceous ecosystems, often from the development of accesses into adjacent forested areas.



Plate 4: Polygon S1185B - This Sparsely Vegetated ecosystem has been *Severely Disturbed/Degraded* by access road development and expansion of a federal facility.

Greenspace Land Use

Greenspace land use showed the least impact overall, although many Older Second Growth, Older Forest and Woodland polygons showed encroachment –often for the development of new trails and tourist facilities.

Rural Land Use

The highest level of impact in those areas designated as rural land use occurred in Older Second Growth ecosystems (and third highest in Older Forest ecosystems), partly due to clearing for activities such as farming, and/or logging for property income. Many of the *Modified Woodlands* showed residences within the polygons.

Urban Land Use

Excluding the Vancouver Island Highway Project (VIHP), the urban land use category demonstrated the greatest level of disturbance in 6 of the 9 SEI Ecosystem types (see Table 2). This is an indication of the impact of urban land development and emphasizes the need for effective protection through local government bylaws, conservation covenants and other mechanisms.⁷

Vancouver Island Highway Project

The VIHP must be considered from a different perspective than the other land uses. Because it was a major construction project, any SEI polygon within the road development corridor would likely have been affected. However, because of their location, some SEI

⁷ For a detailed discussion on Sensitive Ecosystem protection mechanisms, refer to the “Sensitive Ecosystems Inventory: East Vancouver Island and Gulf Islands 1993-1997 Volume 2:Conservation Manual”

Ecosystem types (e.g. Coastal Bluff) were not represented within the VIHP corridor. This explains the variation in rating between 100% and 0% shown in Table 2.



Plate 5: Polygon C0724 - Wetland *Disturbed* by boardwalk in greenspace. Note the trimming that occurred when the boardwalk was built. The boardwalk also creates a patch of shade which will inhibit the growth of some plant species and may act as a barrier to the passage of some animals, especially when the boardwalk is heavily used by people. However, utilization of a boardwalk does minimize uncontrolled access which could be even more damaging.

Implications of Sensitive Ecosystem Disturbance

Species Loss

The east coast of Vancouver Island has experienced the loss of several species of plants and animals primarily due to habitat loss and/or the introduction of exotic species that displaced native ones. Among those lost are the moss species *Micromitrium tenerum* and *Physcomitrium immersum* and the vascular plant *Ranunculus lobbii* (Lobb's water-buttercup), now eliminated from British Columbia due to habitat loss (Fraser, 1999). Lewis'

Woodpecker, Streaked Horned Lark, Western Meadowlark and Roosevelt Elk are no longer found in Garry Oak Woodlands, although they are still present in other habitats around the province. The local subspecies of Gopher Snake is also gone. The Island Marble and the Perdiccas Checkerspot, butterfly species known in British Columbia only from southeast Vancouver Island and/or the Gulf Islands, have also disappeared, due to the displacement of their native food plants by introduced species (Fraser, 1999).



Plate 6: Polygon C0667 - This Terrestrial Herbaceous Ecosystem has been *Severely Disturbed/Degraded* by the Vancouver Island Highway Project and a large commercial development (urban land use - background).

Impacts of Ecosystem Modification

The Sensitive Ecosystems Inventory showed that most of the original landscape was already modified. This audit documents the continued *Modification* as development expands into the remaining habitats. As discussed above, these ecosystems provide living space for many organisms that are rare or threatened and which cannot survive in *Modified* environments. Encroachment, whether the development of housing in one corner or a trail through the centre of a polygon, reduces the size of the undisturbed portion and may result in the loss of other species which no longer have the space needed to survive.

Wetlands in particular are vulnerable to disturbance. They are important as natural biological filters, and may serve to moderate some of the changes to the hydrological cycle caused by increased development. However, in the process of being used as filters, wetlands themselves are altered. There is also a tendency to view wetlands as being in need of 'improvement' to create something more 'useful' – such as dredging to create ponds or draining for agricultural production.



Plate 7: Polygon C0391 - Woodlands in Rural settings are attractive as house sites.

Buffers

Although not documented in this audit, development has taken place to the edge of many of the *Modified* and *Undisturbed* polygons. Buffers are important to protect SEI Ecosystems from surrounding land uses. The loss of the physical vegetated cover, for example, around a wetland has a long-term impact on the plant species and water levels therein. Factors involved may include the change in hydrology associated with removal of the trees, increased solar radiation over the wetland and correspondingly warmer water, changes in nutrient input and increased sediment erosion into the wetland, and changes in stormwater surface flows due to roads and landscaping.

Similar impacts may occur to other ecosystems when their buffers are removed. Buffers also help limit the invasion of non-native species into an ecosystem.

Other changes which occur adjacent to Sensitive Ecosystems, such as the diversion of storm flows which naturally flowed through a site, can significantly affect the native vegetation and wildlife which live there.



Plate 8: Polygon C0848 - Urban development is encroaching into this Terrestrial Herbaceous ecosystem. Impacts include the physical presence of the residences and the use of the fragile moss/grass area as an expanded 'backyard'.

Landscape Fragmentation and Connectivity

Landscape fragmentation reduces the amount of land available to support functioning ecosystems and limits the ability of species to move between or colonize into available habitat. Fragmentation also increases edge effects and makes ecosystems more susceptible to the introduction of non-native invasive species such as Scotch Broom, English Ivy, American Bullfrogs and Gray Squirrels. Such species are a threat to the integrity of native ecosystems. They may out-compete native plants and animals by growing faster and shading them out; by eating all of the available food supply; or even by eating the native species. In the already fragmented landscape of eastern Vancouver Island, connectivity between SEI Ecosystems allows for the dispersal of both plant and animal species and reduces the impact of habitat fragmentation.

Potential impacts of the ongoing destruction or disturbance of Sensitive Ecosystems are not just biological. There are economic implications including the loss of stormwater buffering, ecological benefits (clean air, clean water, productive soil, pollution dilution), aesthetic benefits including enjoyment of greenspace and biodiversity, and higher potential property values adjacent to natural ecosystems.

For more information on these ecosystems, their value and the implications of their losses, please refer to the SEI Conservation Manual (McPhee, 2000).

Conclusions

This audit was designed to assess and document the disturbances and/or losses that have occurred to SEI Ecosystems through urban/rural land development since the original SEI. There is a significant *Modification* of SEI Ecosystems associated with increased land development on eastern Vancouver Island. More than **one in nine** SEI polygons showed some measure of disturbance in a period of six to eight years. If the present rate of disturbance continues, all of the remaining natural Sensitive Ecosystems could be impacted within the next few decades.

Of the total 1,994 polygons reviewed, 224 showed some level of disturbance. The greatest level of disturbance in the SEI Ecosystems was to Older Second Growth Forests (24.9%). Of the seven Sensitive Ecosystems, the greatest impact was to Older Forests (17.6%). In the analysis of land use categories, 22.8% of all urban polygons demonstrated some degree of disturbance.

Because so much of the landscape on the east coast of Vancouver Island has been historically altered, conservation of these remnant natural ecosystems is critically important to maintain native plants, animals, and plant communities. The mechanisms for accomplishing this goal are vested in local government tools and stewardship initiative options.

There is an ongoing need for further audits of the Sensitive Ecosystems on East Vancouver Island and the Gulf Islands, ideally covering the entire study area and looking at the actual land area *Modified* and its implications. Future work could also focus on how effective the current habitat protection mechanisms are.

Sound conservation-based land use planning that reflects an understanding of ecosystem processes will ensure that natural ecosystems remain intact, and that the needs of future generations of both human and non-human organisms are not compromised.

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This document is available through the regional MWLAP website at:
<http://wlapwww.gov.bc.ca/vir>

APPENDIX A: Mapsheets Audited

92B 043	1,2,3,& 4	92F 030	1,2,& 3
92B 053	1,2,3,& 4	92F 038	2*
92B 071	3 & 4	92F 039	1*
92B 072	1,2,3 & 4	92F 057	1
92B 073	1 & 3	92F 066	1,2,& 3
92B 083	1	92F 075	1,2,3,& 4
92F 028	4*	92G 011	1,2,3,& 4

* Only those polygons within the French Creek watershed were assessed.

APPENDIX B: Numbers of Polygons of each SEI Ecosystem Type Audited, compared to Original SEI Data

SEI ECOSYSTEM	ORIGINAL SEI DATA		2001 AUDIT	
	# of Polygons	Percentage	# of Polygons	Percentage
Wetland	2645	35.8	663	33.2
Riparian	960	13.0	342	17.2
Terrestrial Herbaceous	1135	15.4	310	15.5
Older Forest	470	6.3	148	7.4
Woodland	613	8.3	213	10.7
Coastal Bluff	591	8.0	57	2.9
Sparsely Vegetated	86	1.2	12	0.6
Older 2 nd Growth Forest	614	8.3	169	8.5
Seasonally Flooded Field	274	3.7	80	4.0
TOTAL	7388	100	1994	100