

# DRAFT

## APPENDIX C SHORELINE CUMULATIVE IMPACTS ASSESSMENT October 2007

### 1. Purpose and General Description

This report assesses the potential for cumulative impacts of reasonably foreseeable future development in the shoreline jurisdiction that could result from development and activities over time under the proposed King County Shoreline Master Program. Under State shoreline guidelines, local jurisdictions are required to evaluate and consider cumulative impacts of reasonably foreseeable future development in the shorelines of the state (WAC 17-26-186(8)(d)).

The State's objective in evaluating potential cumulative impacts is to insure that, when implemented over time, the proposed Shoreline Master Program goals, policies and regulations will achieve no net loss of ecological functions from current "baseline" conditions. Current conditions are identified and described in King County's Appendix E: Technical Appendix to the Shoreline Master Program, Shoreline Inventory and Characterization (May 2007). The proposed King County Shoreline Master Program provides procedures to evaluate individual actions for their potential to impact shoreline resources on a case-by-case basis. The purpose of this evaluation is to determine if impacts to shoreline ecological functions would result from the aggregate of activities and developments in the shoreline that may take place over time.

The State's Guidelines require "... no net loss of ecological functions and protection of other shoreline functions and/or uses." Master programs must contain policies, programs, and regulations that address adverse cumulative impacts and fairly allocate the burden of addressing cumulative impacts among development opportunities. Evaluation of such cumulative impacts should consider:

- Current circumstances affecting the shorelines and relevant natural processes;
- Reasonably foreseeable future development and use of the shoreline; and
- Beneficial effects of any established regulatory programs under other local, state, and federal laws." (WAC 173-26-186(8)(d))

This cumulative impacts assessment uses these three considerations as a framework for evaluating the potential impacts to shoreline ecological functions and processes that may result from implementation of the proposed Shoreline Master Program over time.

### 2. Methods and Assumptions

#### Existing Shoreline Conditions

A summary of existing shoreline conditions, based on the characterization of ecological processes in the Technical Appendix (Appendix A), is included to provide context for the impervious surface area discussion in this cumulative impacts assessment.

## Shoreline Land Use and Permit Trends

Existing shoreline land use is discussed. Shoreline permit trends (dating back to 1990) are used as a basis for discussing historic versus expected future shoreline development. Shoreline permits are also included as part of the land use characterization in the Technical Appendix. The number and location of existing docks and piers is discussed.

## Overview of Key Shoreline Protection Standards

Allowable activities and protection requirements under current and proposed shoreline management regulations are summarized and compared. This analysis is done in order to determine how proposed regulations influence potential cumulative impacts. Key regulations are discussed.

King County proposes to use eight designations to regulate uses and modifications within the shoreline zones: Aquatic, Conservancy, High Intensity, Natural, Resource, Forestry, Rural, and Residential. Chapter 5, Shoreline Management, of the King County Comprehensive Plan defines the criteria for assigning these designations. The quantitative element of this cumulative impacts assessment focuses on landward designations. Potential cumulative impacts to the Aquatic designation are qualitatively discussed in this analysis. The amount of shoreline (in terms of shoreline miles, acres and parcels) is defined to provide context for the results of the landscape analysis.

## Review of Best Available Science Analysis and Results

The results of the risk assessment conducted as part of King County's critical areas<sup>1</sup> regulatory update (adopted in 2004) are reviewed. This work is included as part of the shoreline cumulative impact assessment because the County proposes to rely on critical areas regulations to some extent in protecting existing shoreline ecological functions.

## Landscape Analysis: Impervious Surface Area in Shoreline Jurisdiction

An analysis was conducted to describe the existing conditions in shoreline zones within the County. Seven designations were coupled with the shoreline type (i.e. lake, marine, or stream) to generate 18 possible shoreline categories that defined the spatial extent of the analysis. Cumulative impacts were then analyzed for each shoreline category using a generalized estimate of new impervious surface that could occur in the shoreline zone under proposed regulations. Current conditions were compared to a hypothesized worst case scenario of possible future impacts (the maximum potential increase in impervious surface within the shoreline jurisdiction). This worst case scenario is discussed in terms of expected shoreline development.

Because more than 1,900 miles of stream and lake shorelines and 51 miles of marine shorelines within King County's Shoreline Master Program jurisdiction are evaluated, the quantitative analyses are statistically robust (Osenberg 1994). By being comprehensive, this analysis takes into consideration the issues of ecological scale, process and function.

It is assumed that effects of disturbances accrue in a cumulative fashion and that impervious land covers are among the most permanent kinds of disturbances that occur in proximity to shorelines of the county. The County's high-resolution GIS layer (4 feet on-a-side grid cells) of

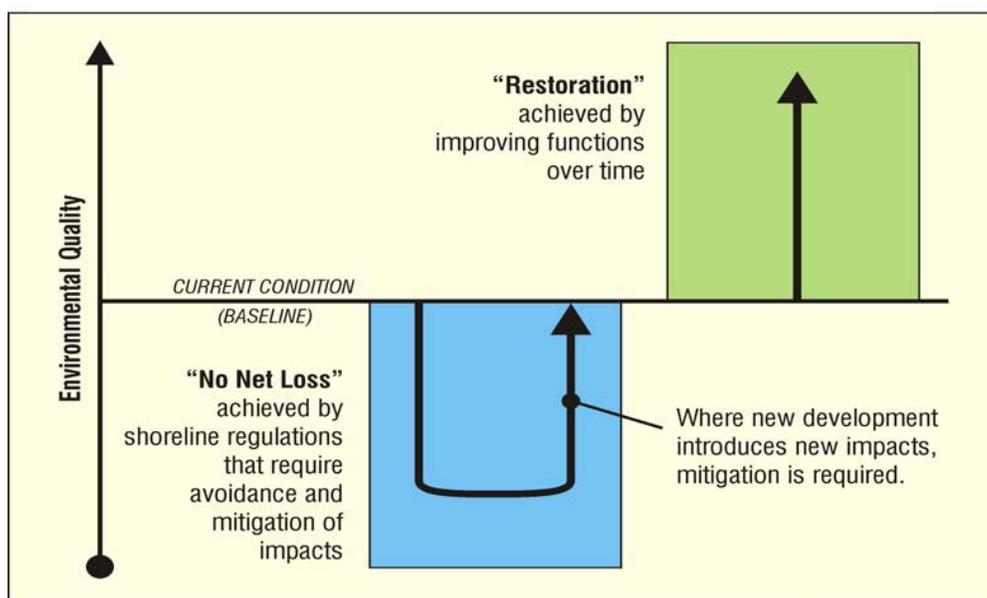
---

<sup>1</sup> Critical areas include wetlands, aquatic areas (including shorelines of the state), wildlife conservation areas, geologic hazards, flood hazard areas, channel migration zones and associated protection areas.

impervious areas provided a quantifiable indicator for cumulative effects (Marshall 2000). The high-resolution dataset allows for the assessment of cumulative effects within shoreline areas.

There are other obvious landcover alterations that are correlated with impervious surfaces that affect ecological process and function (e.g. loss of natural vegetation and soil compaction associated with land clearing, riparian encroachment, and other direct hydrologic modifications). Therefore, for this analysis it is assumed impervious surfaces are a suitable indicator of cumulative effects (May 1997; Wissmar 2000). Impervious surface data was used as a major factor in determining the degree of alteration of each shoreline reach (see the Technical Appendix).

Mitigation is required when new impervious surface is developed in aquatic area buffers, and must achieve equivalent or greater ecological functions (per current King County critical areas regulations). Although mitigation is expected to be effective at achieving the shoreline management goal of no net loss of ecological function (Figure 1), this requirement is not quantitatively evaluated.



**Figure 1.** Environmental condition relative to disturbance. The blue square represents a disturbance and decreased environmental condition at the bottom of the arrow followed by mitigation of the impacts that returns the system's ecological function to its pre-disturbance condition. The green square represents improved environmental function following restoration actions. ( Source: Department of Ecology)

All shorelines within the county were analyzed by parcel because county regulations operate at the parcel level. The current and hypothesized maximum impervious coverage is calculated for each shoreline parcel, and the regulatory buffers associated with each parcel. The future cumulative effects scenario was estimated by increasing each parcel's buffer impervious surface coverage by the amount that would be allowed under proposed shoreline regulations. Estimates of impervious area (i.e. potential cumulative impacts) were then averaged by shoreline type and designation.

To measure the differences between current conditions and possible future scenarios, a comparison of mean conditions was performed. Tests for statistical normality were performed to determine which statistical tests were appropriate for the analysis of the data. The nonparametric statistical comparison of means test (Kruskal-Wallis) was used to compare the average impervious surface coverage of each category (i.e. the entire parcel, the buffer of each parcel, and the potential future impervious surface).

### 3. Shoreline Land Use and Permit Trends

The 2007 King County Buildable Lands Report states that the urban area of King County contains almost 22,000 net acres of vacant or potentially redevelopable residential land. However, twenty-five percent of the County-wide land supply in single-family zones and 10% of the land in multifamily and mixed use zones are considered unbuildable due to critical areas. In addition, analysis of building permits issued from 1990 to 2004 within the shorelands of King County indicates that 2,019 County permits were issued (Table 1). Of those, 562 were for single family homes; 355 permits were issued for a variety of new shoreline development including trails, utilities, docks, and other miscellaneous structures. More than half (1,013) of the permits that were issued did not result in new impervious areas; these permits were issued for maintenance and repair of existing shoreline structures, timber harvest, or stormwater management. There was potentially some short-term impact associated with these permits, but they may not have resulted in a permanent loss of ecological function along King County shorelines.

**Table 1.** Numbers of Shoreline building permits by proposed Designation issued during 1990-2004.

<b>Designation</b>	<b>Building Permits 1990-2004</b>
Conservancy	228
Forestry	23
High Intensity	7
Natural	27
Residential	162
Resource	104
Rural	186

King County compiled new data on the location of shoreline docks as part of the inventory and characterization (Appendix A). The greatest current concentration of docks is in the conservancy, rural and residential proposed designations. However, the overall concentration of existing docks in these designations is minimal: about 1 dock per conservancy shoreline mile, 4 docks per rural shoreline mile and 16 docks per residential shoreline mile (Table 2). Under proposed standards, any new docks in the conservancy designation would have to be located 250 feet from another dock and in all cases it must be demonstrated that other options are not available (see discussion under Shoreline Master Program in this document).

**Table 2. Existing docks by proposed upland shoreline designation and water type.**

<b>Designation</b>	<b>Freshwater Docks</b>	<b>Marine Docks</b>
Conservancy	379	12
Resource	0	1
Forestry	11	0
Natural	0	10
Rural	242	84
Residential	438	0
High Intensity	0	5

Major existing land uses and land use patterns along King County shorelines are summarized and in Appendix E and displayed geographically in the Map Folio.

#### **4. Overview of Key Shoreline Protection Standards**

##### State and Federal Regulations

In addition to local regulations, a number of state and federal agencies have regulatory jurisdiction over resources in the County's shoreline jurisdiction. As with local requirements, state and federal regulations apply throughout the County and significantly reduce the potential for cumulative impacts to shorelines. The major state and federal regulations affecting shoreline-related resources include, but are not limited to:

- **Endangered Species Act (ESA):** The federal ESA addresses the protection and recovery of federally listed species. The ESA is jointly administered by the National Oceanic and Atmospheric Administration Fisheries and the United States Fish and Wildlife Service.
- **Clean Water Act (CWA):** The federal CWA requires states to set standards for the protection of water quality for various parameters, and it regulates excavation and dredging in waters of the U.S., including wetlands. Certain activities affecting wetlands in the County's shoreline jurisdiction or work in the adjacent rivers may require a permit from the U.S. Army Corps of Engineers and/or Washington State Department of Ecology under Section 404 and Section 401 of the CWA, respectively.
- **Hydraulic Project Approval (HPA):** The Washington Department of Fish and Wildlife regulates activities that use, divert, obstruct, or change the natural flow of the beds or banks of waters of the state and may affect fish habitat. Projects in the shoreline jurisdiction requiring construction below the ordinary high water mark of Puget Sound or streams in the County could require an HPA. Projects creating new impervious surface that could substantially increase stormwater runoff to waters of the state may also require approval.
- **National Pollutant Discharge Elimination System (NPDES):** Ecology regulates activities that result in wastewater discharges to surface water from industrial facilities or municipal wastewater treatment plants. NPDES permits are also required for stormwater discharges from industrial facilities, construction sites of one or more acres, and municipal stormwater systems that serve populations of 100,000 or more.

##### King County Plans and Regulations Relevant to Shoreline Protection

Attachment 1 presents a specific comparison of existing shoreline regulations to the proposed Shoreline Master Program (September/October 2007 Draft).

## *King County Comprehensive Plan*

The Comprehensive Plan (currently being updated) seeks to balance social, environmental, and economic goals through land use and zoning regulations, critical areas regulations using best available science, and other development standards. Updated shoreline management goals and policies are proposed as Chapter 5 in the October 2007 Draft Comprehensive Plan. King County shoreline goals and policies are consistent with the State's goal to prevent a net loss of shoreline processes and functions and to restore shorelines over time.

### *King County Code Chapter 21A: Zoning*

The County Code establishes land use zones which implement the Comprehensive Plan's vision for future land use. Zoning designations near shorelines include agriculture, mining, forestry, open space, residential, office, commercial and industrial. (Proposed shoreline designations are consistent with underlying zoning – see Chapter 5 of the October 2007 Draft Comprehensive Plan.) King County zoning was developed considering the results of basin plans that were developed to protect water resources and habitat.

### *King County Code, Chapter 21A.24: Critical Areas*

This Code chapter establishes development standards, buffers and permitted uses in critical areas. Standards in this chapter are designed to protect natural resources from adverse impacts and to protect public safety. The County adopted new critical areas regulations in 2004. The proposed Shoreline Master Program incorporates shoreline protection standards that are equal to critical areas standards outside of the shoreline jurisdiction.

Critical areas regulations establish buffer widths and limit uses within buffers. Shorelines of the state are protected by a 115- to 165-foot buffer. Those activities that are allowed often require the applicant to prepare a critical areas report, including an analysis of the impact of the activity on the aquatic area and its buffer.

Under current King County critical areas regulations, existing residential structures in aquatic areas buffers (outside of severe channel migration zones and landslide hazard areas) may be expanded by up to a maximum of 1,000 square feet of development under certain conditions. This expansion may be allowed within the aquatic area buffer only if there is no other alternative, and if mitigation is provided such that equivalent or greater ecological functions are achieved. Further, King County regulations are designed to minimize construction in regulatory buffers by requiring that a specific decision sequence be used. This sequence requires that impacts to the shoreline be avoided, minimized and mitigated to the maximum extent practical.

King County conducted a risk assessment of critical areas regulations considering best available science, as required by the State. See Best Available Science Volume II: Assessment of Proposed Ordinances (February 2004 available at [www.metrokc.gov/ddes/cao](http://www.metrokc.gov/ddes/cao)). The conclusion of the analysis for aquatic areas (including shorelines of the state), was that the critical areas standards and the broader institutional context in which they are implemented are highly consistent with aquatic area protection best available science. The only departure from best available science relevant to the Shoreline Master Program is that buffers do not adequately address microclimate control. The conclusion further states that there is a relatively low incremental risk associated with the County's critical areas standards, while acknowledging that there is uncertainty and potential risk associated with highly sensitive species and depending on localized conditions.

### *King County Code, Chapter 9.0: Surface Water Management*

King County reviews development proposals to ensure that surface water management standards are met. The County also promotes the preservation of natural drainage systems, protection of fishery resources and wildlife habitat.

The County's Capital Improvement Program also identifies, funds, and implements site-specific projects intended to provide flood control or alleviation, improve and enhance riparian habitat, replace culverts to improve fish passage, and improve water quality from stormwater runoff.

The main objective of surface water management requirements is to promote public health, safety and welfare by establishing and operating a comprehensive approach to surface and storm water problems which would reduce flooding, erosion and sedimentation, prevent and mitigate habitat loss, enhance groundwater recharge and prevent water quality degradation. This comprehensive approach includes the following elements: basin planning, land use regulation, construction of facilities, maintenance, public education, and provision of surface and storm water management services. The County requires that impervious surfaces be minimized and runoff controlled and/or treated.

### *King County Code, Chapter 16.0: Clearing and Grading Standards*

This Code chapter defines the Clearing and Grading Standards for development within the county. The code regulates clearing and removal of vegetation, excavation, grading and earthwork construction including cuts and fills, gravel pits, dumping, quarrying and mining operations within King County in order to protect public health, safety and welfare by:

1. Requiring significant tree retention;
2. Minimizing adverse stormwater impacts generated by the removal of vegetation and alteration of landforms;
3. Protecting water quality from the adverse impacts associated with erosion and sedimentation;
4. Minimizing aquatic and terrestrial wildlife habitat loss caused by the removal of vegetation;
5. Protecting sensitive areas from adverse clearing and grading activities;
6. Facilitating and encouraging long term forest practice and agricultural production operations where appropriate;
7. Minimizing the adverse impacts associated with quarrying and mining operations; and
8. Preventing damage to property and harm to persons caused by excavations and fills.

### *Shoreline Master Program*

King County adopted its Shoreline Master Program in 1978 and has not been significantly updated since then. The County's existing Shoreline Master Program goals and policies are included as an element in the land use chapter of the County's current Comprehensive Plan. These goals and policies are consistent with State guidelines. The Comprehensive Plan establishes King County's shoreline jurisdiction and environment designations.

Shoreline development regulations and permitting procedures are codified in Chapter 25 of the King County Code. The County's Shoreline Master Program established a system of "shoreline environment designations" that provide a uniform basis for applying policies and use regulations within distinctly different shoreline areas. Generally, environment designations are based on existing and planned development patterns, biological and physical capabilities and limitations of the shoreline, and a community's vision or objectives for its future development. The County's

existing Shoreline Master Program uses four shoreline environment designations: urban, conservancy, rural, and natural.

The proposed Shoreline Master Program (September/October 2007) proposes a new system of environment designations, in compliance with State guidelines (WAC 173-26-211). The new system applies designation criteria and management policies consistently across areas with similar current and planned land uses and ecological characteristics. The proposed Shoreline Master Program environment designations include high intensity, residential, rural, conservancy, forestry, resource, natural and aquatic (Table 3). The criteria for these shoreline designations are described in detail in Chapter 5 of the Comprehensive Plan (October 2007 Draft).

**Table 3.** Proposed shoreline designation miles, acres and parcels.

**Part A.**

Current Designation	Proposed Designation	Current Program		Proposed Draft Program	
		Miles	Acres	Miles	Acres (% of total)
Conservancy	Conservancy	897	21,755	355	11,556 (19.4%)
	Resource			116	15,338 (25.7%)
Natural	Forestry	109	2,640	973	20,365 (34.1%)
	Natural			339	7,247 (12.1%)
Rural	Rural	108	2,620	82	3,567 (6.0%)
Urban	Residential	13	324	28	1,177 (2.0%)
	High Intensity			6	428 (0.7%)
	Aquatic	NA	NA	NA	NA

**Part B.**

Proposed Designation	Shoreline Type	Parcels*
Conservancy	Lake	437
	Marine	168
	Stream	1294
Resource	Marine	2
	Stream	218
Forestry	Lake	41
	Stream	316
Natural	Lake	7
	Marine	150
	Stream	80
Rural	Lake	336
	Marine	994
	Stream	398
Residential	Lake	481
	Stream	153
High Intensity	Lake	1
	Marine	11
	Stream	16

\*Due to spatial inconsistencies among data layers, there is some error in determining the exact number of parcels in each designation.

The draft Shoreline Master Program proposes changes to the development regulations that encourage shoreline conservation and prohibit activities that would cause adverse impact to shoreline functions and processes (see Attachment 1). Key changes include: incorporation of critical areas protections into the shoreline regulations, and updated standards for shoreline stabilization, docks and piers, and trails in shorelines. The proposed changes to development

standards and use regulations are more protective than the existing Shoreline Master Program in large part due to formal inclusion of critical areas protections into the shoreline regulations.

King County is proposing to modify shoreline regulations to allow new rural residential docks and piers where appropriate. The County's proposed changes would protect the most environmentally sensitive habitats along a shoreline, while allowing construction of docks and piers in those shoreline areas that have been legally altered in the past and that currently provide less significant habitat. The proposed changes would allow fixed docks or piers along lake shorelines, except for those shorelines with significant wetland vegetation. The existing or zoned density around a lake would no longer be a criterion for allowing docks and piers. On the marine shoreline around Vashon/Maury Island, nearshore environmental conditions would be evaluated for potential impacts prior to approval of new docks or piers. King County's existing shoreline program requires a property owner to explore other options for access to the water, such as sharing a neighbor's existing dock, using a nearby boat launch or marina, or installing a moorage buoy before constructing a new residential dock or pier. This requirement would continue to apply. The proposal would require a shoreline Conditional Use Permit to construct a new dock or pier in the natural and natural resource environments.

Consistent with state guidelines (173-26-186), the proposed Shoreline Master Program includes new goals and policies addressing shoreline restoration within King County. The goals and policies for restoration acknowledge that the County's intent is to meet the "no net loss" standard, and result in an overall improvement to the condition of the habitat and resources within the shoreline jurisdiction of the County. The draft Shoreline Protection and Restoration Plan specifically identifies restoration opportunities that include programmatic regional plans and policies for restoration, and potential funding and partnership opportunities. The Plan acknowledges areas where shoreline functions have been degraded by past development activities and flood hazard reduction efforts (e.g. bank armoring and levee building) and recommends actions appropriate for existing conditions and constraints to ecological processes. Implementation of the Protection and Restoration Plan is expected to improve shoreline ecological functions within the County over time.

## **5. Existing Shoreline Conditions**

As part of the County's Shoreline Master Program update process, the County completed a shoreline inventory and characterization (Appendix E). The inventory and characterization identifies existing conditions and evaluates the ecological functions and processes in the County's shoreline jurisdiction and rates each shoreline reach. A summary of existing shoreline conditions by reach rating and ecological process is provided for each shoreline geographic area in Table 4 (L=low, ML=medium low, M=medium, MH=medium high, H=high). Shoreline geographic areas include the unincorporated lowland (western third) of the County that primarily supports residential, commercial, and agricultural use; the privately managed Forest Production District (FPD Non-Federal Lands); and the state and federal forest lands and wilderness areas (FPD Federal Lands). In general, the analysis indicates that the majority of King County shorelines are in medium to high condition (relatively unaltered).

**Table 4.** Alteration Analysis Summary: Average Reach Ratings for Unincorporated King County For each process, the average rating for all reaches in each location is reported. Average ratings for all shoreline types and ecological processes are presented for each shoreline type. A summary of the percent of reaches within rating categories is also presented.

Ecological Process	Marine	Lake scores by geographic location			River scores by geographic location		
	Vashon/Maury	Lowland	*FPD Federal lands	FPD Non-Federal Lands	Lowland	*FPD Federal lands	FPD Non-Federal Lands
Light	M	MH	H	H	MH	H	H
LWD	M	MH	MH	MH	M	MH	M
Nitrogen	MH	H	H	H	MH	H	H
Phosphorus	MH	MH	H	H	MH	H	H
Pathogens	MH	MH	H	H	MH	H	H
Toxins	M	MH	H	H	MH	H	H
Sediment	ML	MH	MH	MH	M	H	MH
Water cycle	M	M	H	MH	M	H	MH
Wave energy	M	MH	H	H	N/A	N/A	N/A
Tidal influences	MH	N/A	N/A	N/A	N/A	N/A	N/A
<b>OVERALL</b>	<b>M</b>	<b>MH</b>	<b>H</b>	<b>H</b>	<b>MH</b>	<b>H</b>	<b>H</b>

**Percentage of reaches in each rating category:**

Low	2.9	0.0	0.0	0.0	0.0	0.0	0.0
Medium Low	23.7	1.0	0.0	0.0	2.2	0.0	0.0
Medium	31.7	1.1	0.0	0.0	34.6	0.0	0.1
Medium High	15.6	78.9	9.5	3.1	45.7	2.0	11.1
High	26.1	19.1	90.5	96.9	17.6	98.0	88.8

\*FPD = Forest Production District.

Impervious surfaces, among other data, is used to evaluate the degree of alteration of all of the ecological processes listed in Table 4, with the exception of wave energy. Discussion in the shoreline characterization recognizes the direct relationship between impervious surface and the status of ecological processes (Appendix E).

## 6. Landscape Analysis: Impervious Surface in Shoreline Jurisdiction

This analysis integrated the proximity of existing impervious surface within shoreline parcels to the water to generally consider the pattern of development. High-resolution spatially explicit analyses of current shoreline impervious areas indicates that historical development has tended to be more intense immediately adjacent to aquatic resources of King County shorelines (Table 5, Figure 2). Overall, parcels contiguous with King County shorelines are 17.4% impervious on average while the average impervious fraction of the portion of shoreline lots that are currently protected within the proposed regulated buffer is approximately 21.1%. Although, this result indicates that development along King County shorelines has historically occurred near the water, shorelines in general are in medium-high condition (Appendix E).

Second, the analysis estimated potential expansion of existing impervious surfaces along the shoreline. The analysis of potential future cumulative impacts assumes that 1,000 square feet of new impervious surface is built on every shoreline parcel. This is a very conservative worst case scenario because there is not an existing residence or accessory structure (that could be expanded) on every parcel, and on large rural parcels new impervious surface could be sited

outside of the shoreline jurisdiction. This scenario was developed to generally identify the extent to which shoreline designations may be at risk from future development and to help guide protection and restoration efforts. This hypothetical maximally-built future scenario of cumulative impacts does show a potential statistically significant increase in the percent impervious for shoreline buffer areas.

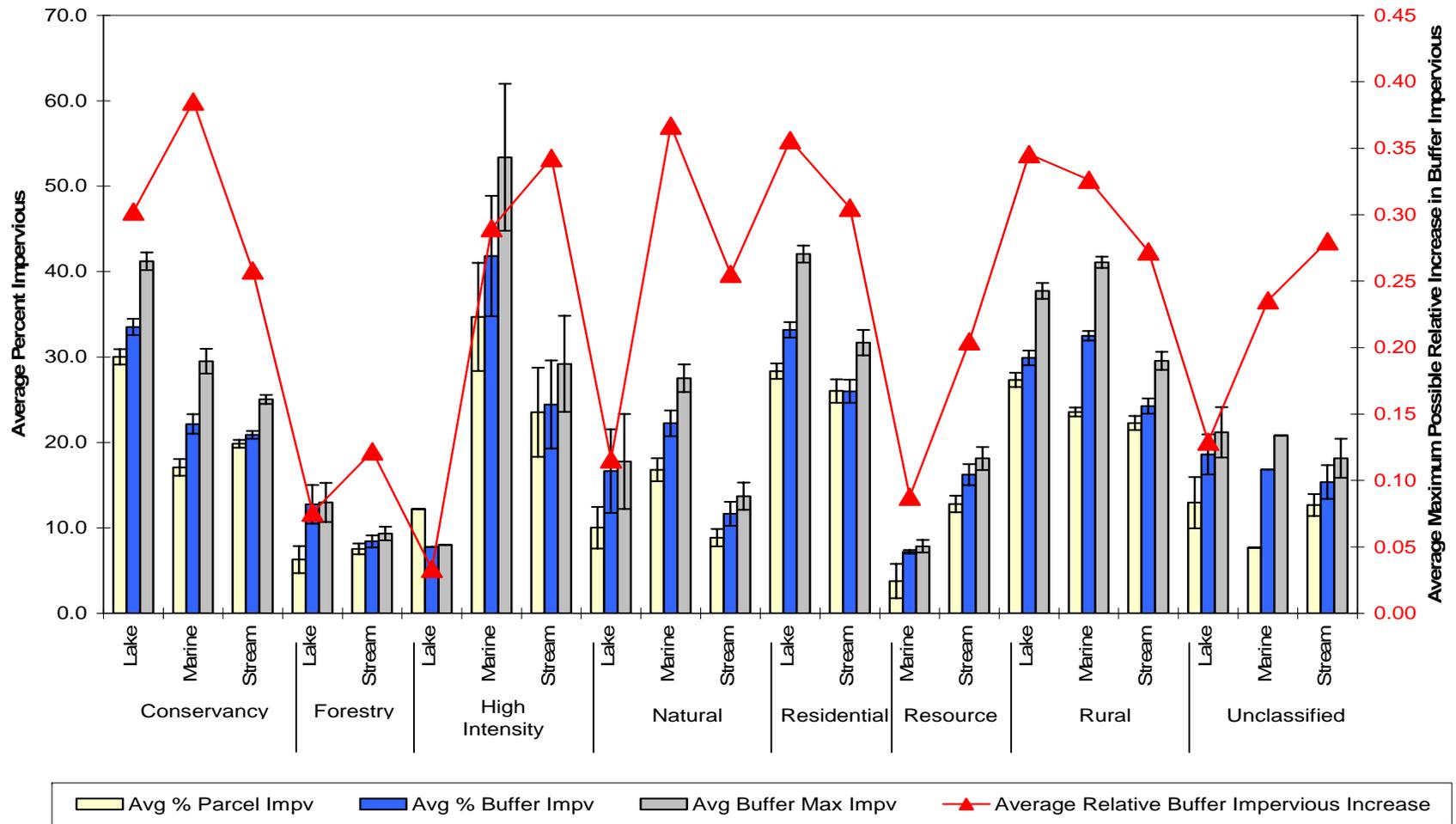
It is important to consider the extent of each shoreline designation when predicting potential ecological impact associated with shoreline development (Table 3). For example, the total area covered by the high density and residential designations actually makes up only a small fraction of King County shorelines. Although the analysis indicates that there is potential for a significant increase in percent impervious (Table 5) and these designations have seen significant permit activity in the past, any associated impacts would occur in a minimal area (2.7%) of the total shoreline. Shoreline areas that are proposed to be designated conservancy and resource show the high past permit activity and a potential significant increase in impervious surface. These designations make up approximately 45% of the total County shoreline area. Note that this 'highest amount of permit activity' amounts to less than 1 permit per shoreline mile over about a 15-year period. Conservancy and Resource, Residential, and High Intensity designations have received building permits on the order of tens of permits per year. Forestry, Natural, and Resource designations have seen only minimal development pressure during 1990 - 2005 suggesting that the maximum future impervious area in the regulatory buffers of the County's shorelines will be much lower than the worst-case scenario presented here.

Overall, when shoreline permits are analyzed (Table 1), it becomes clear that even though there could be a substantial change in developed areas of County shorelines, the permit history suggests that development will likely affect a relatively small proportion of shoreline parcels and these effects would have to be fully mitigated.

**Table 5.** Imperviousness of King County shorelines. Percent impervious areas are estimated from averages of all parcels within each category. Average Buffer % Impervious indicates the current average impervious fraction for the buffered area among all parcels for each shoreline area and the average Maximum Future Potential % Impervious represents a future worst-case scenario for shoreline buffers under current county regulations. Average Relative Increase in Impervious Area\* summarizes average existing impervious fractions under the maximally built worst case scenario.

Designation	Shoreline Type	Average Parcel % Impervious	Average Buffer % Impervious	Average Maximum Buffer Future Potential % Impervious	Average Relative Increase in Impervious Area*	Number Parcels each Category (N)
Conservancy	Lake	30.0	33.5	41.2	0.30	437
	Marine	17.1	22.2	29.5	0.39	168
	Stream	19.9	20.9	25.0	0.26	1294
Forestry	Lake	6.3	12.8	13.0	0.08	41
	Stream	7.5	8.4	9.3	0.12	316
High Intensity	Lake	12.2	7.8	8.0	0.03	1
	Marine	34.7	41.8	53.4	0.29	11
	Stream	23.5	24.4	29.2	0.34	16
Natural	Lake	10.0	16.6	17.8	0.12	7
	Marine	16.8	22.2	27.5	0.37	150
	Stream	8.9	11.6	13.7	0.26	80
Residential	Lake	28.4	33.2	42.1	0.36	481
	Stream	26.0	26.0	31.7	0.31	153
Resource	Marine	3.8	7.2	7.9	0.09	2
	Stream	12.8	16.2	18.1	0.20	218
Rural	Lake	27.3	29.9	37.7	0.35	336
	Marine	23.6	32.5	41.1	0.33	994
	Stream	22.3	24.3	29.6	0.27	398

\* Average Relative Increase in Impervious Area estimates were made by calculating the difference between maximum worst case future impervious conditions and current impervious buffer conditions and dividing that quantity by the current impervious conditions of each parcel. These estimates were then averaged for each combination of Designation and Shoreline Type.



**Figure 2.** Average percent impervious for shoreline parcels and buffer areas under current conditions and under hypothetical maximally built conditions. The primary Y axis represents that average percent impervious for parcels averaged across categories of Designation and Shoreline Type. 'Avg % Parcel Impv' represents the average impervious fraction for each parcel; 'Avg % Buffer Impv' represents the impervious fraction of the buffer area of each parcel; 'Avg Buffer Max Impv' represents a worst case future scenario of impervious area within the buffer. The triangles related to the secondary Y axis and represent an average relative increase in impervious area under the maximally built worst case scenario. Error bars represent +/- 1 standard error.

## Conclusion

The proposed Shoreline Master Program proposes new shoreline environment designations, updated development standards and regulations for shoreline modifications and uses and better protection for shoreline processes – consistent with State goals. The updated standards and regulations are generally more protective of the shoreline environment and were determined to be consistent with best available science in protecting aquatic areas. While allowing development of new impervious surface in buffers and new docks under certain conditions, proposed development and mitigation standards ensure that new structures do not cumulatively affect shoreline ecology. The Shoreline Protection and Restoration Plan identifies opportunities to improve or restore ecological functions that have been impaired as a result of past development activities. In addition, the proposed Shoreline Master Program augments several County, state and federal efforts that already protect shoreline functions and values for a variety of goals, including salmon recovery and Puget Sound restoration.

The King County shoreline is generally in good condition while including a variety of existing land uses. There are opportunities for new shoreline development on vacant lots or by expanding existing structures. However, it is reasonable to conclude that much less than the maximum possible development or expansion will actually occur, given shoreline development trends since 1990.

The cumulative actions taken over time in accordance with the provisions of the updated Shoreline Master Program are not likely to result in a net loss of shoreline ecological functions from existing baseline conditions, and may result in an increase in shoreline ecological functions.

## References

- Allen, T. F. H. 1998. The Landscape "Level" is Dead: Persuading the Family to Take it off the Respirator. Pages 615 *in* D. L. P. a. V. T. Parker, editor. *Ecological Scale: Theory and Applications*. Columbia University Press, New York.
- Forman, R. T. T., and M. Godron. 1986. *Landscape Ecology*. John Wiley & Sons, New York.
- Frissell, C. A., W.J. Liss, C.E. Warren, and M.D. Hurley. 1986. A heirarchical framework for stream habitat classification: viewing streams in a watershed context. *Environmental Management* 10:199-214.
- Gardner, R. H. 1998. Pattern, process, and the analysis of spatial scales. Pages 17-34 *in* a. V. T. T. P. D.L. Peterson, editor. *Ecological Scale: Theory and Applications*. Columbia University Press, New York.
- Li, H. W., G.A. Lamberti, T.N. Pearsons, C.K. Tait, and J.L. Li. 1994. Cumulative effects of riparian disturbances along high desert trout streams of the John Day basin, Oregon. *Transactions of the American Fisheries Society* 123(4):627-640.
- Marshall and Associates. 2000. Anthropogenic impervious surface data in 4x4 grid cells derived from aerial photo analysis.
- May, C. W., R.R. Horner, J.R. Karr, B.W. Mar, E.B. Welch. 1997. Effects Of Urbanization On Small Streams in the Puget Sound Ecoregion. *Watershed Protection Techniques* 2(4):483-494.

- Naiman, R. J., H. Decamps, and M. E. McClain. 2005. *Riparian*. Elsevier Academic Press, Amsterdam.
- Osenberg, C. W., R.J. Schmitt, S.J. Holbrook, K.E. Abu-Saba, and A.R. Flegal. 1994. Detection of environmental impacts: natural variability, effect size, and power analysis. *Ecological Applications* 4(1):16-30.
- Timm, R. K., R.C. Wissmar, J.W. Small, T.M. Leschine, and G. Lucchetti. 2004. A Screening Procedure for Prioritizing Riparian Management. *Environmental Management* 33:151-161.
- Watson, M. K. 1978. The scale problem in human geography. *Geogr. Ann.* 60B:36-47.
- Wiens, J. A. 1976. Population responses to patchy environments. *Annual Review of Ecology and Systematics* 7:81-120.
- Wiens, J. A. 1989. Spatial scaling in ecology. *Functional Ecology* 3:385-397.
- Wiens, J. A., J.F. Addicott, T.J. Case, and J. Diamond. 1986. Overview: the importance of spatial and temporal scales in ecological investigations. Pages 145-153 *in* J. D. a. T. J. Case, editor. *Community Ecology*. Harper and Row, New York.
- Wissmar, R. C., D.C. Pflugh, and R.K. Timm. 2000. Changes in developed land cover (1991–1998): Cedar River, Washington. Pages 616 *in* a. R. L. B. P. J. Wigington, editor. *Riparian ecology and management in multi-land use watersheds*. American Water Resources Association, Middlesburg, Virginia.

**Attachment 1.** Comparison of Title 21-A, Zoning regulations, Title 25, CAO regulations, and proposed changes under September/October 2007 Draft Shoreline Master Program. Development regulations are compared by permitted uses.

<b>Comparison of Current and Proposed Shoreline Regulations</b>			
<b>Development Regulations</b>	<b>Title 21A, Zoning</b>	<b>Title 25</b>	<b>Changes</b>
<b>Permitted Uses</b>			
Residential Uses	<ul style="list-style-type: none"> <li>Residential uses are not allowed in mining and industrial zones.</li> <li>Allowed in other zones within shorelines if they are outside the buffers for critical areas.</li> <li>Single detached homes are not allowed in business and office zones, except for the Neighborhood Business zone in rural areas.</li> <li>Townhouses and apartments are allowed in urban residential zones</li> <li>Townhouses, apartments and group residences are allowed in the rural zones only if within historic buildings.</li> <li>Townhouses, apartments and group residences are allowed in commercial/industrial zones if part of a mixed use development.</li> <li>Hotels and motels are only allowed in larger business and office zones.</li> <li>Bed and Breakfast allowed in agriculture, rural and urban zones and larger business zones as part of a mixed use</li> </ul>	<p>Same as Title 21A. except as follows:</p> <ul style="list-style-type: none"> <li>Residential development is prohibited waterward of the ordinary high water mark.</li> <li>Multifamily dwelling units are prohibited in the conservancy environment and natural environment.</li> <li>Accessory residential uses are prohibited in the natural environment.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>Residential development must assure no net loss of ecological functions.</li> <li>Residential development is not allowed in the aquatic environment.</li> <li>Residential development is only allowed in the high intensity environment as part of a water-oriented, mixed-use development.</li> <li>Public access is required as part of mixed-use, attached dwelling units, group residences, and temporary lodging residential development.</li> <li>A shoreline conditional use permit is required for single detached residences in the Natural Environment. No other residential development is allowed in the Natural Environment.</li> <li>Group residences are allowed in all environments except for the natural and aquatic environments.</li> </ul>

<b>Comparison of Current and Proposed Shoreline Regulations</b>			
<b>Development Regulations</b>	<b>Title 21A, Zoning</b>	<b>Title 25</b>	<b>Changes</b>
	<p>development.</p> <ul style="list-style-type: none"> <li>• Accessory dwelling units are allowed if there is an owner-occupied single detached dwelling unit.</li> <li>• Home occupations are allowed in zones that allow residential uses.</li> <li>• Home industries are allowed as a conditional use in the agriculture, rural and urban zones.</li> </ul>		<ul style="list-style-type: none"> <li>• Hotels, motels and lodging houses are allowed only in the High Intensity Environment as part of a water-oriented, mixed-use development.</li> </ul>
Recreational/Cultural Uses	<ul style="list-style-type: none"> <li>• Parks and trails are allowed in most zones</li> <li>• Campgrounds are limited to forest, mineral, rural, urban reserve and industrial zones</li> <li>• Destination resorts and ski areas limited to forest and rural zones</li> <li>• Marinas are allowed in all zones except the agriculture and mineral zones and in some areas, limited to day moorage</li> <li>• Amusement, entertainment and cultural uses are allowed primarily in the residential and commercial/industrial zones and under limited circumstances in the rural zone.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Nonwater related development is prohibited waterward of the ordinary high water mark.</li> <li>• Piers, moorages, floats and launching facilities are allowed when accessory to commercial and residential development in the urban, rural and conservancy environments, subject to conditions, and are not allowed in the natural environment.</li> <li>• Recreational uses are allowed in the urban, rural, conservancy and natural environments, subject to conditions.</li> <li>• Marina facilities are</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Only water-oriented parks and recreation uses, except marinas, are allowed in shoreline environments, except public parks are allowed in all shoreline environments.</li> <li>• A destination resort is allowed only as a shoreline conditional use in the natural environment.</li> <li>• Marinas are a conditional use in the high intensity, residential, rural and aquatic environments.</li> <li>• Amusement/Entertainment and Cultural uses are allowed only as part of a water-oriented use in the high intensity, residential,</li> </ul>

<b>Comparison of Current and Proposed Shoreline Regulations</b>			
<b>Development Regulations</b>	<b>Title 21A, Zoning</b>	<b>Title 25</b>	<b>Changes</b>
		prohibited on Class I beaches.	rural and conservancy environments. •
General Services Uses	<ul style="list-style-type: none"> <li>• Personal Services are generally allowed in the commercial/industrial zones and smaller-scaled personal services in the residential zones.</li> <li>• Health Services are generally allowed in the commercial/industrial zones or in residential zones in existing buildings.</li> <li>• Educational Services are generally allowed in the residential zones except for the rural zone, and in the commercial/industrial zones, where Educational Services are only allowed in existing buildings.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Nonwater related development is prohibited waterward of the ordinary high water mark.</li> <li>• General Services uses are permitted in the urban and rural environments</li> <li>• General Services uses are not permitted in the conservancy and natural environments.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• General Services are permitted as part of a water-oriented use only in the high intensity, residential, rural, and conservancy environments.</li> <li>• Personal services are allowed as a water-oriented use in the resource and forestry environments.</li> </ul>
Government/Business Uses	<ul style="list-style-type: none"> <li>• Government Services are generally allowed in the residential and commercial/industrial zones with limitation on scale in the rural zone.</li> <li>• Utilities appropriate for resource land uses are allowed in the resource zones.</li> <li>• Business Services are allowed primarily in the Commercial/Industrial zones</li> </ul>	<p>Same as Title 21A. except as follows:</p> <ul style="list-style-type: none"> <li>• Nonwater related development is prohibited waterward of the ordinary high water mark.</li> <li>• Government/Business uses are permitted in the urban and rural environments</li> <li>• Government/Business uses are not permitted in the conservancy and natural</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Government services are permitted as part of water-oriented uses in all shoreline environments except only stormwater and sewage outfalls, water intake, desalinization facilities and cable crossing are allowed in the aquatic environment.</li> <li>• Public roads and utility</li> </ul>

<b>Comparison of Current and Proposed Shoreline Regulations</b>			
<b>Development Regulations</b>	<b>Title 21A, Zoning</b>	<b>Title 25</b>	<b>Changes</b>
	with some provisions made for resources land uses, such as farm product warehousing.	environments.	<p>facilities are allowed in all environments.</p> <ul style="list-style-type: none"> <li>Public access is required for government services uses unless public access would create a public safety risk.</li> <li>Business services are allowed as part of a water-oriented use in all shoreline environments except for the natural and aquatic environments.</li> </ul>
Retail Uses	<ul style="list-style-type: none"> <li>Generally limited to the Commercial/Industrial zones, although small-scale retail uses are allowed in urban residential zones.</li> <li>Limited retail sales of products produced from, or in support of, resource land uses are allowed in the rural and resource zones.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>Nonwater related development is prohibited waterward of the ordinary high water mark.</li> <li>Retail uses are permitted in the urban and rural environments</li> <li>Retail uses are not permitted in the conservancy and natural environments.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>Retail uses are allowed as part of a water-oriented use in all shoreline environments except for the natural and aquatic environments.</li> </ul>
Manufacturing Uses	<ul style="list-style-type: none"> <li>Limited primarily to the industrial zone.</li> <li>Some manufacturing uses allowed in the Regional business zone subject to a conditional use permit.</li> <li>Small-scale manufacturing of resource products are allowed in the resource lands and rural</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>Nonwater related development is prohibited waterward of the ordinary high water mark.</li> <li>Manufacturing is allowed in the urban and rural environment provided</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>Manufacturing is allowed only in the high intensity environment with preference given to water-related manufacturing uses.</li> <li>Nonwater-oriented uses are allowed only as part of a</li> </ul>

<b>Comparison of Current and Proposed Shoreline Regulations</b>			
<b>Development Regulations</b>	<b>Title 21A, Zoning</b>	<b>Title 25</b>	<b>Changes</b>
	zone.	<p>contaminants are controlled.</p> <ul style="list-style-type: none"> <li>• Manufacturing is not allowed in the conservancy and natural environments.</li> <li>• Port facilities designed to load or unload ships 125,000 dead weight tons or larger is not allowed.</li> </ul>	<p>mixed-use development that includes water-dependent uses or on sites separated by another parcel or public right-of-way.</p> <ul style="list-style-type: none"> <li>• Public access is required unless the public access would result in a safety risk.</li> <li>• Boat repair facilities are not permitted in the Maury Island Aquatic Reserve, but some boat maintenance is allowed.</li> </ul>
Resource Land Uses	<ul style="list-style-type: none"> <li>• Agricultural uses are allowed in the resource zones, except for the mining zone, and in the rural zone, low-density urban zones, and industrial zone.</li> <li>• Forestry uses are allowed in resource zones, rural zone, low-density urban zones and the industrial zone.</li> <li>• Fish and wildlife management is allowed in resource zones, except for the mining zone, and in the rural zone, low-density urban zones, and industrial zone.</li> <li>• Mineral uses are allowed only in the mineral and forestry zones.</li> <li>• Resource accessory uses are limited to accessory dwelling units in the agriculture, rural and urban reserve zones and</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Nonwater related development is prohibited waterward of the ordinary high water mark.</li> <li>• Agriculture is permitted in the urban environment and must conform with the Federal Water Pollution Control Act of 1972 adopted by the King County Soil Conservation Service.</li> <li>• Forestry uses are not allowed in the urban environment.</li> <li>• Excavation, dredging and filling is allowed in all environments only if all environmental impacts are mitigated.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Agriculture is permitted in all shoreline environments except the high intensity and natural environments.</li> <li>• Forestry is allowed in all shoreline environments when conducted in accordance with the state forest management practices, except is not allowed in the high intensity environment.</li> <li>• Fish and Wildlife Management is allowed in all shoreline environments with special provisions established for aquaculture in the aquatic environment..</li> <li>• Mineral uses are only allowed in the rural, conservancy, resource,</li> </ul>

<b>Comparison of Current and Proposed Shoreline Regulations</b>			
<b>Development Regulations</b>	<b>Title 21A, Zoning</b>	<b>Title 25</b>	<b>Changes</b>
	<p>maintenance or storage facilities for mineral extraction in the mineral zone.</p>		<p>forestry and aquatic environments on lands designated for mineral extraction under GMA.</p> <ul style="list-style-type: none"> <li>• Resource lands accessory uses are allowed where primary uses are allowed.</li> </ul>
<p>Regional Land Uses</p>	<p>Regional land uses are allowed in residential and commercial/industrial zones, and are limited in the resource zones, but wherever located, generally require a Special Use Permit.</p>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Nonwater related development is prohibited waterward of the ordinary high water mark.</li> <li>• Shoreline protection is allowed when it is replacing existing shoreline protection or when it is connecting two adjacent bulkheads that are no more than 100-feet apart.</li> <li>• Shoreline protection is only allowed when it has been demonstrated that it is needed to protect existing legally established structures and public improvements or to protect agricultural land.</li> <li>• Breakwaters are not permitted in the rural and conservancy environments.</li> <li>• Shoreline protection is not allowed in the natural environment.</li> </ul>	<p>Same as Title 21A except as follows:</p> <ul style="list-style-type: none"> <li>• Regional uses are allowed in all shoreline environments subject to a shoreline conditional use permit....</li> </ul>

