Cumulative Impact Analysis

Purpose

This section describes the general State requirements for cumulative impact analysis and discusses the methodology for analyzing potential impacts to Okanogan County shorelines**.** The draft Shoreline Master Program (SMP) proposes changes to the development regulations that encourage shoreline protection and avoidance, minimization and mitigation activities that would cause adverse impacts to shoreline functions and processes. The cumulative impact analysis for the Okanogan County SMP will incorporate the effects of past, present, and future actions within the County's watersheds.

The Shoreline Management Act guidelines require shoreline master programs to regulate new development and to maintain no net loss of shoreline ecological functions. While some impacts are immediate and can be directly addressed through avoidance and mitigation, other impacts are cumulative in nature. The composite of many similar actions over time may lead to a significant cumulative impact to the ecosystem. For example, a small area of impervious surface may have only a negligible impact on the environment. On the other hand, numerous impervious surfaces throughout a watershed over time could lead to significant impacts, such as: channel erosion, water quality degradation, and decreased vegetation.

Key components of the SMP are the development of regulations and mitigation requirements. These requirements are important to achieving no net loss of shoreline ecological functions, but they cannot achieve this goal on their own. Even with mitigation provided, one hundred percent replacement of lost function is difficult if not impossible to achieve. As a result, restoration programs are a key component of achieving no net loss of ecological function.

Assumptions

This analysis is looking at foreseeable impacts over time. These impacts are being looked at by a group of Analysis Units (AUs) that represent a stream or lake reach. This method is consistent with the SMP Shoreline Characterization Report. The analysis focused on areas where greater development and land use change is expected. Site specific impacts are also expected to be addressed on a case-by-case basis during individual future project reviews.

Methodology

The following steps were used to conduct the cumulative impact analysis for no net loss.

Step 1. Group AU's on a common stream or lakeshore

Analysis Units were grouped by a common stream or lakeshore for the no net loss analysis at the scale of a single stream or lake. A total of 233 AUs were identified along Okanogan County shorelines. These were organized into 87 groups. General descriptions of the 87 AU groups are described in Section E.4. Table 1 and Table 2 provide a listing of AUs within each lake or stream group.

Table 1 Lake groups with associated AUs and the number of parcels analyzed per group

Lake Group Name	AU code	# parcels
AENEAS LAKE	L AEN 00	20
ALBRIGHT LAKE	L ALB 00	6
ALKALI LAKE	L ALK 00	31
ALTA LAKE	L ALT 00	75
BIG TWIN LAKE	L BIG 00	35
BLUE LAKE	L BLU 00	33
BLUE LAKE (SIN)	L BLS 01	13
	L BLS 02	
BONAPARTE LAKE	L BON 01	11
	L BON 02	
	L BON 03	
BOOHER LAKE	L BOO 00	3
BROWN LAKE	L BRO 00	18
CHOPAKA LAKE	L CHO 00	12
CRAWFISH LAKE	L CRA 00	32
DAVIS LAKE	L DAV 00	26
DUCK LAKE	L DUC 00	13
EAST OSOYOOS	L OSO 03	130
	L OSO 04	
EVANS LAKE	L EVA 00	4
FANCHER DAM RES	L FAN 00	7
FIELDS LAKE	L FIE 00	1
FISH LAKE	L FIS 00	7
GREEN LAKE	L GRE 00	7
HORSESHOE LAKE	L HOR 00	10
CONCONULLY LAKE	L CON 01	35
	L CON 02	
	L CON 03	
	L CON 04	
SALMON/ CONCONULLY LAKE	L SAL 01	23
	L SAL 04	
LEADER LAKE	L LEA 00	17
LEMANASKI LAKE	L LEM 00	10
LITTLE TWIN LAKE	L LIT 00	14
MEDICINE LAKE	L MED 00	4
MILES LAKE	L MIL 00	9

Lake Group Name	AU code	# parcels
MOCCASIN LAKE	L MOC 00	1
MOLSON LAKE	L MOL 00	10
MUSKRAT LAKE	L MUS 00	9
PALMER LAKE	L PAL 01	108
	L PAL 02	
	L PAL 03	
	L PAL 04	
PATTERSON LAKE	L PAT 00	45
PEARRYGIN LAKE	L PEA 01	43
	L PEA 02	
RAT LAKE	L RAT 00	9
ROBERTS LAKE	L ROB 00	6
SIDLEY LAKE	L SID 00	50
SPECTACLE LAKE	L SPE 01	109
	L SPE 02	
	L SPE 03	
	L SPE 04	
	L SPE 05	
	L SPE 06	
TALKIRE LAKE	L TAL 00	8
WALKER LAKE	L WAL 00	3
WANNACUT LAKE	L WAN 01	171
	L WAN 02	
	L WAN 03	
	L WAN 04	
LOWER WELLS POOL	S COL 01	62
	S COL 02	
WEST OSOYOOS	L OSO 01	215
	L OSO 02	
WHITESTONE LAKE	L WHI 01	29
	L WHI 02	
	L WHI 03	

Table 2 Stream groups with associated AUs and the number of parcels analyzed per group

Stream Group Name	# parcels	AU Code
ANTOINE CREEK	34	S ANT 01
		S ANT 02
		S ANT 03
BEAVER CREEK	77	S BEA 01
		S BEA 02
		S BEA 03
		S BEA 04
BONAPARTE CREEK	186	S BON 02
		S BON 03
		S BON 04
		S BON 05
		S BON 06
		S BON 07
		S BON 08
		S BON 09
BREWSTER	338	S COL 04
		S COL 05
		S OKA 01
CARLTON LAMIRD	60	S MET 13
CHEWACK RIVER	253	S CHE 02
		S CHE 03
		S CHE 04
		S CHE 05
		S CHE 06
		S CHE 07
		S CHE 08
GOLD CREEK	47	S GOL 01
		S GOL 02
LAKE PATEROS	158	S COL 03
		S MET 01
		S MET 02
LOST CREEK	22	S LOS 01
		S LOS 02
		S LOS 03
		S LOS 04
		S LOS 06
		S LOS 07
LOWER SINLAHEKIN	28	S SIN 01
		S SIN 02
LOWER SIMILKAMEEN	49	S SIM 03
LOWER OKANOGAN	201	S OKA 09
MALOTT LAMIRD	48	S OKA 10

Stream Group Name	# parcels	AU Code
LOWER METHOW	129	S MET 03
		S MET 04
METHOW - CARLTON	308	S MET 06
		S MET 07
		S MET 08
		S MET 09
		S MET 10
		S MET 11
		S MET 12
CARLTON - TWISP	291	S MET 14
		S MET 15
		S MET 16
		S MET 17
		S MET 18
		S MET 19
		S MET 20
		S MET 21
		S MET 22
MAZAMA	302	S MET 31
		S MET 32
		S MET 33
		S MET 34
		S MET 35
		S MET 36
		S WOL 00
WINTHROP TOWN	398	S CHE 01
		S MET 29
		S MET 30
METHOW LAMIRD	137	S MET 05
MIDDLE SINLAHEKIN RIVER	44	S SIN 03
		S SIN 04
MIDDLE METHOW	159	S MET 25
		S MET 26
		S MET 27
		S MET 28
MIDDLE SIMILKAMEEN	120	S SIM 04
		S SIM 05
		S SIM 06
		S SIM 07
LOWER OKANOGAN	201	S OKA 02
		S OKA 03
		S OKA 04
		S OKA 05
		S OKA 06
		S OKA 07
		S OKA 08
MIDDLE OKANOGAN	65	S OKA 11

Stream Group Name	# parcels	AU Code
		S OKA 12
		S OKA 13
OMAK - RIVERSIDE	12	S OKA 20
KEYSTONE CANYON	143	S OKA 23
		S OKA 24
		S OKA 25
		S OKA 26
KEYSTONE - TONASKET	140	S OKA 27
		S OKA 28
		S OKA 29
UPPER OKANOGAN	402	S OKA 33
		S OKA 34
		S OKA 35
		S OKA 36
		S OKA 37
		S OKA 38
		S OKA 39
OKANOGAN CITY	266	S OKA 14
		S OKA 15
		S OKA 16
OMAK CITY	273	S OKA 17
		S OKA 18
		S OKA 19
OROVILLE CITY	288	S OKA 40
		S OKA 41
		S SIM 01
		S SIM 02
PALMER CREEK CONFLUENCE	99	S PAL 00
		S SIM 08
RIVERSIDE TOWN	137	S OKA 21
		S OKA 22
		S SAL 03
		S SAL 04
		S SAL 05
		S SAL 06
LOWER SALMON	27	S SAL 01
		S SAL 02
SINLAHEKIN HEADWATER	23	S SIN 05
		S SIN 06
		S SIN 07
WEST SANPOIL RIVER	100	S SAN 01
		S SAN 02
		S SAN 03
		S SAN 04
		S SAN 05
		S SAN 06
		S SAN 07

Stream Group Name	# parcels	AU Code
		S SAN 08
		S SAN 09
		S SAN 10
		S SAN 11
		S SAN 12
TOATS COULEE	33	S TOA 01
		S TOA 02
TONASKET CITY	265	S BON 01
		S OKA 30
		S OKA 31
		S OKA 32
TORODA CREEK	52	S TOR 01
		S TOR 02
TWISP TOWN	359	S MET 23
		S MET 24
		S TWI 01
TWISP RIVER	258	S TWI 02
		S TWI 03
		S TWI 04
		S TWI 05
		S TWI 06
UPPER METHOW	316	S EAR 01
		S EAR 02
		S MET 37
		S MET 38
		S MET 39
		S MET 40
UPPER SIMILKAMEEN	55	S SIM 09
		S SIM 10

Step 2. Existing Shoreline Conditions

As part of the County's Shoreline Master Program process, a shoreline inventory and characterization report was completed which assessed the degree to which ecological functions and processes in the shoreline jurisdiction have been altered. In general, the majority of Okanogan County shorelines are in a relatively unaltered condition. Since ratings were identified for individual AUs, the following steps describe the method to determine ratings for each stream and lake group.

1) The resource and condition indices for each AU were disaggregated into component parameters which were combined to create the index. For detailed methods, see Section 3 of the Shoreline Characterization Report.
2) For each stressor and resource parameter, scoring curves based on histograms were subdivided into ranges that reflect severity of effects, following a simple "high/medium/low" division.
3) Parameter scores were sorted by each stream and lake group and the results plotted using GIS to indicate where high, medium and low trends occurred

within each group. Parameter trends were summarized for each group to represent current impact to the existing shoreline condition. Data is presented in the summary table (Appendix E.4) of potential cumulative impacts associated with the proposed Shoreline Master Program.

4) Existing shoreline conditions were mapped in terms of ecosystem-wide processes and functions based on SMP characterization. The method to highlight ecosystem key processes was based on Ecology's guidance, Chapter 17. This analysis identified and mapped areas important to sustain shoreline functions and determined the degree of alteration to key processes. Table 2 lists the indicators used to evaluate impacts to key ecosystem processes.

Table 3 Indicators to evaluate impacts to key ecosystem processes

Ecosystem processes	Key areas	Alterations
Sediment delivery and supply	Floodplains (slopes <4%) (movement, storage); lakes (storage); landslide hazard areas; highly erodible steep slopes (mass wasting delivery)	Roads within 200ft of shorelines; non-forested land cover on erodible slopes; non-forest land cover on mass wasting areas; roads within mass wasting areas; urban land cover
Water movement and storage	High permeability areas (sub-surface movement); low gradient floodplains (<4%) (storage, movement); high precipitation areas (delivery); lakes (storage)	Non-forested land cover on high permeable soils; impervious surfaces
Riparian inputs	Mass wasting areas directly upslope (delivery LWD); windthrow potential (delivery LWD within 75' of shoreline); unconfined channels (<4% slope) (storage)	Non-forested land cover in floodplains within 75ft of shoreline; non-forested land on mass wasting areas
Nutrient key delivery	Steep slopes with highly erodible soils	Agriculture and urban land cover

The indictors of key processes were overlaid spatially to highlight minimally altered areas and impaired areas. The results are presented both spatially and in summary form (Appendix E.4 and E.3).

Step 3. Identify and map proposed shoreline designations and Projected build-out and Reasonable Foreseeable Future Actions (RFFAs)

Allowable activities and protection requirements under proposed shoreline regulations are summarized and compared. Okanogan County proposed to use ten designations to regulate uses and modifications within the shoreline zones: Aquatic, Natural, Riverine/Lacustrine, Conservancy, Rural Resource, Rural Residential, Shoreline Recreation, Urban Conservancy, Shoreline Residential, and High Intensity. Potential cumulative impacts to the Aquatic, Natural, and Riverine/Lacustrine designation are qualitatively discussed in this analysis.

RFFAs are based on shoreline designations (see 14.15 for details). RFFAs for each AU group were derived by analyzing data at the parcel scale and then calculating percent of each type at the stream and lake scale. A count of the total number of parcels per RFFA was calculated for each group. Next, the area percentage of total parcels assigned to the RFFA was calculated per group. For example, Aeneas Lake Group had 13 parcels assigned as medium intensity residential for a potential future land use, totaling an area of 14.66 acres. This area was divided by the total area of the Aeneas Lake group to calculate this RFFA type which was 26.5 percent of the entire group. This same process was calculated for all RFFAs. Those RFFAs with the highest percent per group was used to determine projected major types of development likely to affect shoreline condition. See Appendix G for data tables.

Due to spatial differences between the parcel and AU group data layers, those parcels that were split between two groups were placed into the group that contained greater than 25 percent of the entire parcel. For this reason, the RFFA area percents do not add up to 100 percent as represented in the data tables provided with this analysis.

Step 4. Illustrate the projected future under the proposed Program.
The timeframe is a maximum buildout potential based on an assumed future buildout according to proposed shoreline designations and associated development standards. The development of this analysis was to generally identify the extent of shorelines within each group that may be at risk from future development and to help guide restoration/enhancement efforts. Impervious surface was chosen to reflect an assumed future, factoring in required setbacks, buffers, and percent lot coverage. The maximum lot coverage per parcel (based on proposed shoreline designation type) was used as an estimate of potential future cumulative impact. Lot coverage is the percentage of the parcel within shoreline jurisdiction, less the required Zone 1vegetation and Zone 2 use buffers (as outlined in 14.15.120(E)) to be covered with impervious surfaces.

Other alterations that affect ecological processes and function are also correlated with impervious surfaces (e.g. vegetation removal, land clearing, and soil compaction). Impervious surfaces were chosen for this analysis because the concept has been a good indicator of cumulative impacts on the landscape (May et al. 1997, Stanley et al. 2005).

Step 5. Cumulative impact analysis for each group under proposed regulations.
This analysis determined which shorelines may be at risk from future developments. Only parcels that are located within the shoreline jurisdiction boundary are included. Existing impervious and potential future impervious surfaces were determined for shoreline parcels and the setback buffers associated with each parcel's shoreline designation. The National Land Cover Dataset (NLCD 2001) was used to determine impervious surface percent per AU group. Detailed GIS methods used to perform the

impervious analysis are provided in Appendix E.5.

Current impervious surface percent per group were compared to a hypothesized worst case scenario of possible future impacts (the maximum potential increase in impervious surface within the shoreline jurisdiction). To measure the difference between current and potential future conditions, a comparison of the percentage of impervious surface area per group was performed. The difference between scores revealed the potential positive or negative changes in shoreline conditions. Appendix E.2 contains the Summary table.

Conclusions

This scenario shows a potential increase in the percent impervious surface for shoreline areas. Cumulative impacts to the shoreline may result from a wide range of possible actions. The focus of foreseeable development is on those actions that have been identified as potential impacts to the shoreline and that are or would be foreseeable based on past development patterns and shoreline regulations.

The Okanogan shoreline is unlikely to experience much more development, as much of the property in public ownership is currently buildout. Under the maximum future buildout, several AU groups show an increase in development along their shoreline. Focus on permit mitigations should be a major part to protect these shorelines from future impacts and achieve no net loss of functions. Net loss in one stream or lake will not be offset by mitigation/enhancement in another. Mitigation must be carried out within the same stream or lake. Under the current program two main types of permits exist to mitigate changes to shorelines, the Shoreline Substantial Development Permit and the Shoreline Conditional Use Permit. All activities and uses must comply with the current SMP provisions. Those that are not stated in Section 14.15 may be allowed (with a permit) and subject to approval.

The greatest percent of the shorelines are designated as Conservancy, River/Lacustrine, Aquatic, and Rural Residential. The designations with greatest development intensity (Shoreline Recreation, Shoreline Residential, and High Intensity) are concentrated within currently developed areas within the County.

Net increase in impervious surface, per group, shows the amount, in acres, that has the potential to be developed. This represents the worst case scenario or a 100 percent maximum buildout potential. Due to data inconsistencies, 13 AU groups could not be addressed in the impervious analysis. They are addressed qualitatively in Appendix E.1, the summary of potential cumulative impacts. However, the bulk of the shorelines were analyzed. This data provides detailed information on where, spatially, potential future development may occur within the County's shorelines. When combined with the potential future land use designation, the County could further verify the amount of potential future development on a site-specific scale (e.g. at the parcel scale for program permits).

References

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