

# MP163 Regional assessments of adjacent urbanized watersheds surrounding Bellingham, Washington USA.

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## Introduction

A series of watersheds for 7 creeks (Terrell, Silver, Squilicum, Spring, Baker and Cemetery) and Lake Whatcom are in the increasingly urban area within and surrounding Bellingham Washington. The creeks are spawning habitat for at least one species of anadromous salmonid, and small streams such as these used to account for half the salmon production in the Georgia Basin. Lake Whatcom serves as the reservoir for Bellingham and the adjacent part of Whatcom County. Lands within these watersheds come under the jurisdiction the City of Bellingham, Whatcom County, and the WA Department of Natural Resources. In the creek watersheds we have examined the relationship between land use and smolt production, in addition to a regional risk assessment. Lake Whatcom was the subject of a regional risk assessment incorporating both ecological and human health endpoints.

There are common patterns among the watersheds. Non-point sources are important, but no type of contaminant dominates the system. The Lake Whatcom watershed is listed for phosphorus, but an elimination of phosphorus reduces the total risk by only 20 percent. There is no clear pattern between different types of land use and smolt production in the streams, but the lack of apparent relationship may be due to the lack of appropriate data, or that the numerous blockages in the streams are limiting. In the risk assessment, non-point sources dominate; with no one factor being a key. In contrast, the TMDL process and the activities of planning departments make decisions on a stressor-by-stressor, case-by-case basis. This research demonstrates the disconnect between the reality of increasingly urban watersheds and the management structure for preserving valued ecological services.

## Relative Risk Method

The 10 Steps of the Relative Risk Model (RRM) Landis and Wiegiers (2005).

- 1) List management goals/priorities for the area.
- 2) Make a map of potential sources of stressors and habitats.
- 3) Break the map into regions based on groupings of sources, habitats and endpoints.
- 4) Make a model of hypothesized links between sources, stressors, and endpoints (conceptual model).
- 5) Establish a ranking scheme for each source, stressor, and habitat based on available knowledge and supporting data.
- 6) Calculate relative risks.
- 7) Evaluate uncertainty and do a sensitivity analysis of the relative rankings.
- 8) Generate testable hypotheses for future investigations, to reduce uncertainty and confirm rankings.
- 9) Test the hypotheses by using additional data not used in the original assessment.
- 10) Communicate the results in a way that portrays the relative risks, uncertainty, and management opportunities (based on stewardship) in response to the management goals.

## Summary of the Lake Whatcom Ecological and Human Health Screening Risk Assessment

Endpoints determined by Stakeholder Process  
Human Health

Ecological  
Abiotic (non living)  
Flood Control  
Water Quality

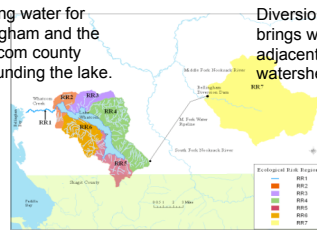
Biotic (living)

Birds: Bald Eagle, Canada Geese  
Fish: Salmonid - Kokanee, Chinook, Cutthroat Trout  
Non salmonid - Smallmouth bass, Yellow Perch

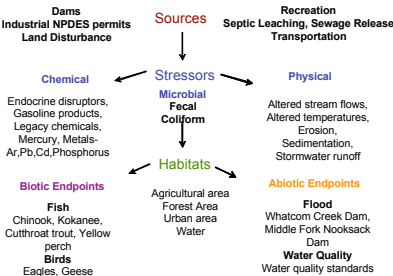
Study Area: Ecological Risk Regions

Lake Whatcom is the drinking water for Bellingham and the Whatcom county surrounding the lake.

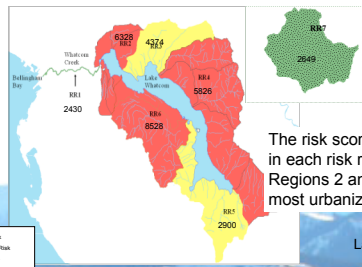
Diversion pipeline brings water in from adjacent watershed.



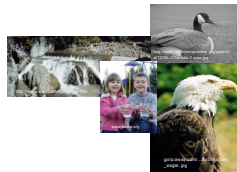
Ecological Conceptual Model based on the RRM



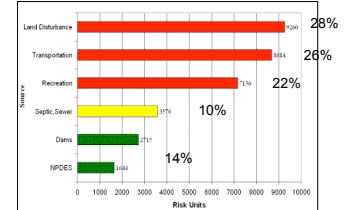
Spatial Distribution of Ecological Risk



The risk scores are listed in each risk region. Risk Regions 2 and 6 are the most urbanized areas.



Sources and Contribution to Ecological Risk

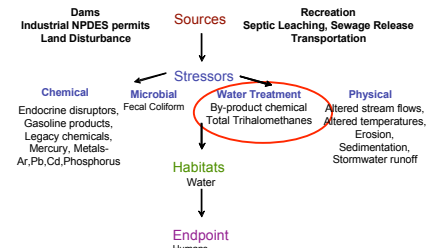


The major contributors to risk are non-point sources that are features of the watershed, not a point source contaminant.

Human Health Risk Regions

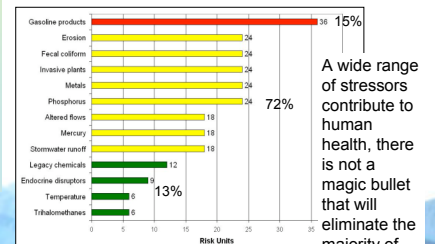


Human Health Conceptual Model



The conceptual model for human health parallels that of the ecological risk assessment.

Human Health Risk from Stressors



A wide range of stressors contribute to human health, there is not a magic bullet that will eliminate the majority of the risk.

Lake Whatcom Research-City of Bellingham, WA Grant 55831

## Summary-Lake Whatcom

### Ecological

Sources - Land Disturbance, Transportation, Recreation

Stressors: Phosphorus, Mercury, Erosion

Habitats at risk: Water, Urban areas

Endpoints at risk: Water Quality

Risk Regions with highest risk scores:

Risk Regions 6, 4 and 2

### Human Health

Stressors: Gasoline products

Regions: Direct Draw, Human Contact

## Integration of Ecological Risk Assessment and the GAP Analysis Program to Assess Risk to Smolt Production

### Background

- Historically, small streams in Whatcom County have provided important habitat for salmonid reproduction (WDFW, 2006).
- There is a high level of local interest in rehabilitating and protecting these habitats in order to preserve natural salmon populations (NSEA, 2007).
- Effective rehabilitation and protection of streams requires knowledge of the factors that are causing stress to the system.
- An integration of the Relative Risk Model (RRM) and Gap Analysis Program (GAP) methodology can provide this knowledge and help guide conservation efforts.

### Objectives

- Develop framework for the integration of the Relative Risk Model and the Gap Analysis Program (GAP).
- Evaluate risk to salmonid smolt production in the study area.
- Identify correlations between smolt production and landscape characteristics.
- Use the integrated framework to communicate stewardship and management opportunities.

### What is GAP?

- Intended to help prioritize protection and rehabilitation efforts.
- Three map layers: Land cover, habitat, stewardship (presence of legal protection).
- Looks for "gaps" in protection – areas where there is habitat, but stewardship is low (GAP, 2007).

### Integration of GAP and Risk Assessment

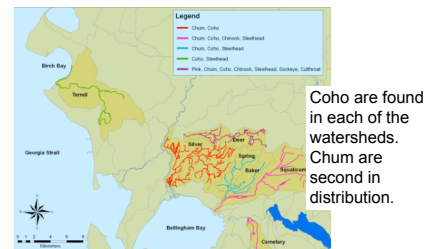
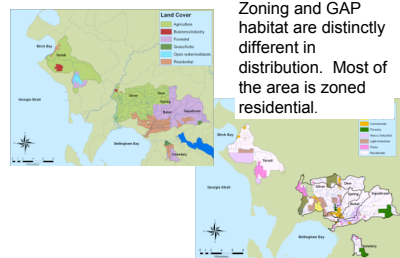
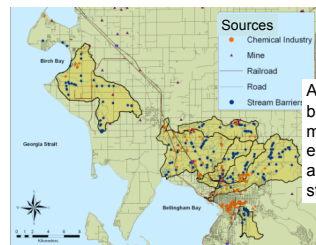
- Add a stewardship element to the risk assessment output to allow managers to prioritize efforts based on management opportunities.
- Adapt methods of using habitat and stewardship data to be relevant at multiple scales.

GAP Risk Assessment - U.S. Geological Survey Grant 1-54089

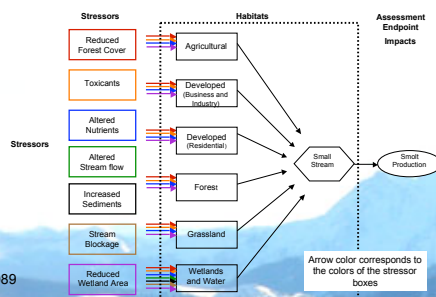
### Study Area



### Problem Formulation

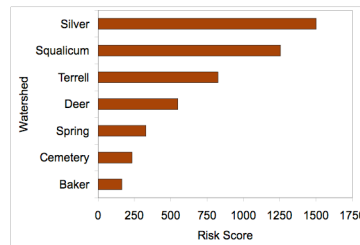


### Conceptual Model



### Risk Calculations

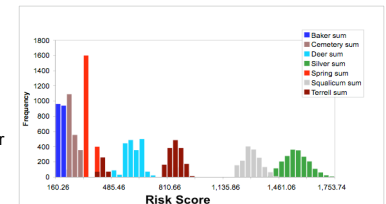
#### Total Risk to Watersheds



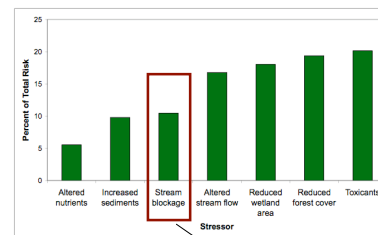
These are the risk relationships without uncertainty and include all stressors and habitats to Salmonid production. Without an uncertainty estimate the relationships between the risk in each watershed is not clear.

#### Total Risk-Monte Carlo Simulation with Uncertainty

An estimate of uncertainty indicates that Silver and Squalicum Creeks are at the highest risk, and may even overlap. Terrell and Deer and intermediate and the remainder are at a lower risk.

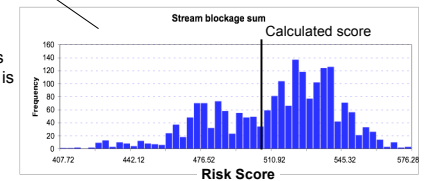


### Risk due to Stressors



It is also possible to look at the risk due to stressors. In this study toxicants, reduced forest cover, wetland area and altered stream flow account for a large percentage of the risk score. Next, let's look at the uncertainty of the stressor Stream Blockage.

An analysis of the uncertainty demonstrates that the calculated score is not the most likely, but appears to be near the midpoint of the distribution.



### Conclusions GAP Risk Assessment

- A wide variety of stressors, chemical, physical and habitat, contribute to risk.
- A great deal of uncertainty exists because of the lack of data obtained to answer the specific wildlife management question.
- In order to make GAP work effectively, there needs to be research that directly supports the management question. Baseline monitoring or irregular counts of fish or other species are not informative.

### Overall Conclusions

- The types of stressors are more varied than in conventional regulatory ecological risk assessments.
- Risk assessment for natural resource management is clearly possible for a variety of different scenarios, including human health.
- The management goals are more varied than setting clean up goals; harvest or productivity for a stream reach, "historical range of variability", or keeping "common species common" that need to be turned into quantifiable entities.