



U.S. Fish & Wildlife Service

# Assessment of Fish Movements in Lake Washington using Acoustic Tags *Aquatic Species Conservation*

Fisheries Division, Western Washington Fish and Wildlife Office, Lacey WA

**Project Goal:** Through the use of acoustic tracking technology, describe the movement patterns of juvenile salmon and predatory fishes in order to identify ways to improve fish passage of juvenile salmon through Lake Washington and the Ship Canal. **Project Timeline: 2003-2008**



Chinook salmon



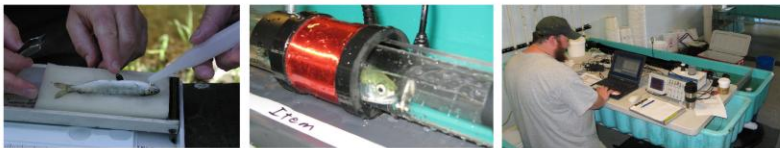
Smallmouth Bass



Prickly sculpin

## Objectives

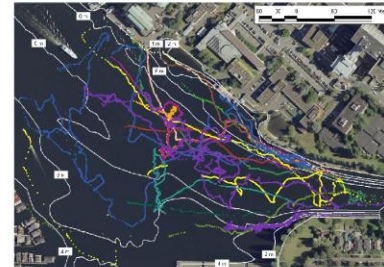
- Describe behavior near the SR 520 Bridge
- Identify fish passage routes at the Ballard Locks
- Describe behavior along different shoreline types
- Estimate residence times in areas of the Ship Canal
- Quantify influence of water temperature on migration
- Determine use of proposed restoration sites
- Determine habitat use, swim speed, and depth selection
- Determine habitat use and seasonal movements of predatory fishes



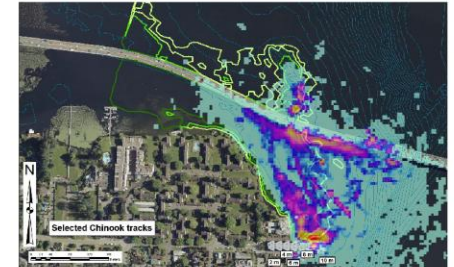
Surgical tag implantation in a Chinook salmon smolt, and post-implantation tag programming.



Surgery of a smallmouth bass to implant acoustic tag and a bass captured one year later.



Pathways of migrating Chinook salmon smolts obtained with acoustic tracking. Each color is a different fish.



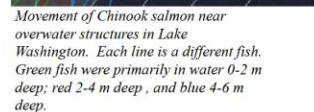
Density plots, or heat maps, are generated in ArcMap GIS to identify areas of high-intensity use. This map was generated from 68 tagged Chinook smolts migrating near the SR 520 Bridge. Reds, oranges and yellows are areas of most intense use. Light blue is lowest intensity use.



Movement of a smallmouth bass displaying the use of rip rap shoreline, overwater structures, and the offshore edge of aquatic macrophytes.



Movement of a Chinook salmon smolt at SR 520 Bridge. Each color is a different time of the day. Green areas are different densities of aquatic macrophytes.



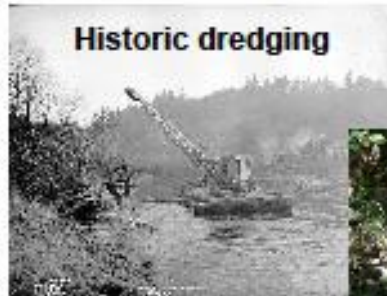
Movement of Chinook salmon near overwater structures in Lake Washington. Each line is a different fish. Green fish were primarily in water 0-2 m deep; red 2-4 m deep, and blue 4-6 m deep.





# Bear Creek – Past and Present

Past impacts to the stream degraded habitat



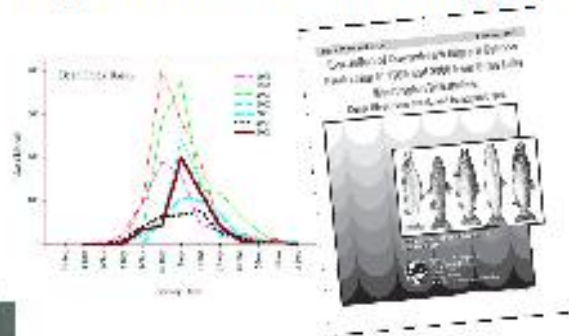


# Bear Creek's Importance

Regionally significant stream for salmon, wildlife & people



## Project rooted in scientific background



Regional plans highlight project as a priority for wild salmon



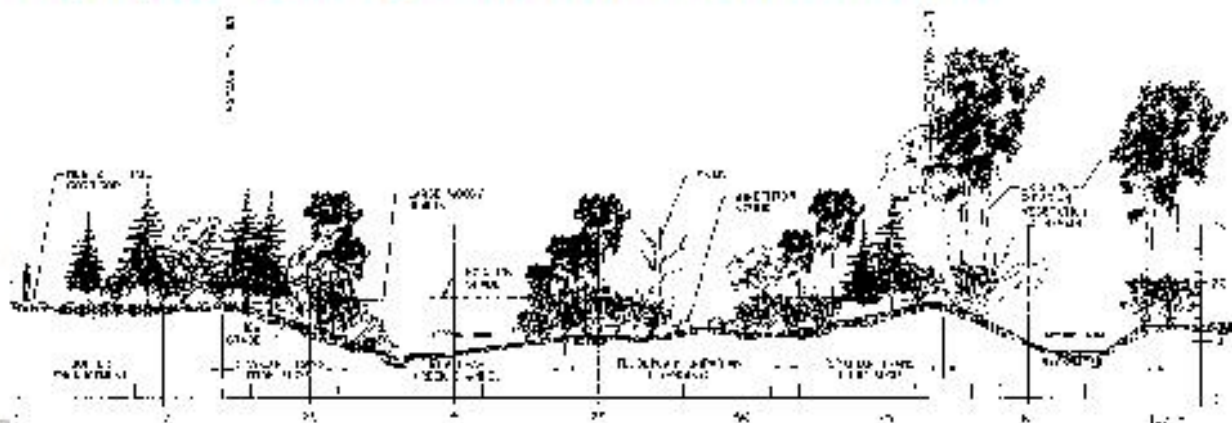


# Restoring Lower Bear Creek

The project: creating habitat for salmon & wildlife

## Bear Creek basin:

- Over 80 miles of streams
- Up to 30,000 salmon returning
- 2,000 acres of headwater wetlands
- Unique freshwater mussels

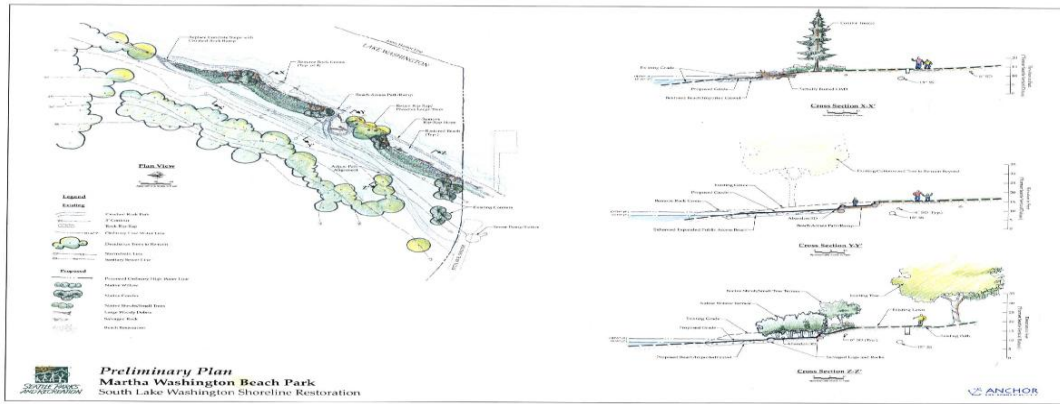


## The project:

- Creates over 4,000 feet of enhanced channel
- Restores natural stream habitat
- Adds logs and spawning gravel
- Restores streamside wetlands and backwater areas
- Restores native trees and shrubs, shading the channel
- Maintains floodplain function

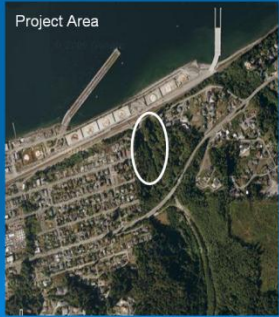


# Martha Washington Park Shoreline Restoration



# City of Mukilteo, Washington Japanese Gulch Fish Passage Project

## Background

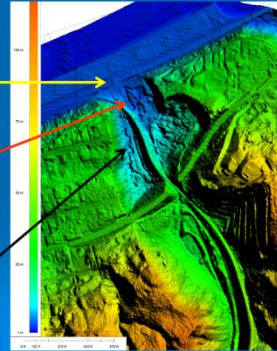


- ILA with Paine Field Airport to mitigate stream impacts on airport land: \$150,000
- City added \$15,000 from Stormwater Funds
- ILA identified the Mt. Baker Street culvert as the fish improvement project.

## Project Components

Three phases:

- **Phase 1:** Add a combination of baffles and boulders in existing culvert to concentrate and deepen the flow of water
- **Phase 2:** Install a "stacked culvert" fish ladder to provide access to the perched culvert under the Boeing RR Spur.
- **Phase 3:** Divert the creek from the existing engineered channel to the historical channel.



## Results



12"-13" long Coho caught in the top pool of the ladder on Oct 13, 2010.

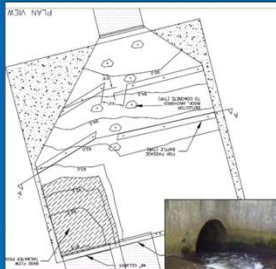
What is more telling is that the little fish in the photo is a coho and it got into the top pool.



Fish Counts:  
September 24, 2010:  
(1) 8-12 inch cutthroat trout,  
(5) 2-4 inch coho, and  
(1) salamander.  
September 27, 2010:  
(2) 2-4 inch coho,  
(3) 6-8 inch cutthroat,  
(11) 3-6 inch cutthroat

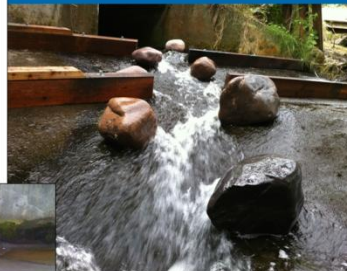


## Phase 1 Baffles Completed



Plan Design

Culvert Before Fish Passage Project



Culvert w/ Completed Baffles And Rock for Fish Passage

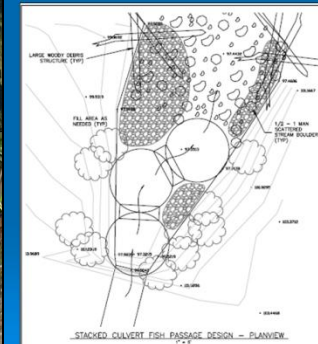
Finished July 23, 2010



Phase 2 Stream Channel

Perched BNSF Culv

## Phase 2 - Stacked Culverts



Design



Completed Project: October 19, 2010

WDFW  
Quote:

The Japanese Gulch Fish Passage Project has exceeded WDFW's expectations and it was a wonderful cooperative effort between the city, Paine Field and WDFW. The fact that fish are already using the enhanced culvert spillway, the fish ladder and the baffled culvert, proves the enhancements are a great resource for the fish and the community.

# City of Redmond - Sammamish River Projects

**BEFORE;  
Pre-Project  
Condition**



**1997**



**2006**



**2004**



**AFTER;  
Post-Project  
Progress**



**2010**



**2009**



**2008**

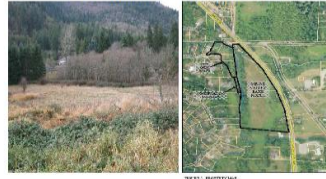


# SQUAK VALLEY PARK RESTORATION ISSAQUAH

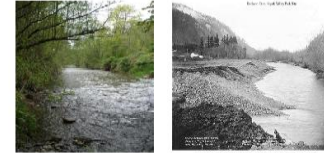
## SCOPE

- On WRIA 8 3-year Implementation Plan list.
- Construction completed in Fall 2010 at a total cost of \$1.4 million.
- Encompasses over 8 acres and 1,100 feet of Issaquah Creek, the largest restoration project undertaken by the City.
- Benefits Chinook, Coho and Sockeye salmon; cutthroat and steelhead trout.

Squak Valley Park Prior to Restoration



Issaquah Creek (Looking South)



## Project Features

- Instream enhancements to restore habitat for both fish and wildlife, including 19 log structures consisting of over 100 logs and stumps.
- Removed portions of a levee to reconnect Issaquah Creek to the floodplain and reduce flooding.
- Acquisition of 4 single family residential vacant lots.
- Removal of invasive plants and replanting with over 6,000 native trees and shrubs with assistance of 2,753 volunteer hours.



100 pieces of Wood Placed in the Creek

## Funding and Partners

- King Conservation District (\$320,862).
- Washington Wildlife and Recreation Program – Riparian Account (\$450,000).
- Salmon Recovery Funding Board (\$250,000).
- King County Flood Control District (\$70,000).
- City of Issaquah (\$350,000).
- Mountains to Sound Greenway Trust (volunteer coordination).



# Mapes Creek Mouth Daylighting Project – City of Seattle

## Purpose

To re-establish the mouth of Mapes Creek in southern Lake Washington for rearing and migrating juvenile Chinook salmon.



Create stream mouth delta



Install a dedicated pipe for creek water

Daylight 300 feet of creek through Beer Sheva Park



# Chinook Beach Shoreline Restoration Project – City of Seattle

## Purpose

To increase the amount and quality of littoral habitat in southern Lake Washington for rearing and migrating juvenile Chinook salmon.



### Project activities:

- remove bank armoring,
- regrade the banks
- remove in-water debris;
- improve riparian conditions; and
- convert a defunct marina to prime shallow water habitat.



### Why this project?

- Juvenile Chinook can spend up to 3 months in the lake
- Rearing habitat is extremely limited
- Chinook use the site – before and after



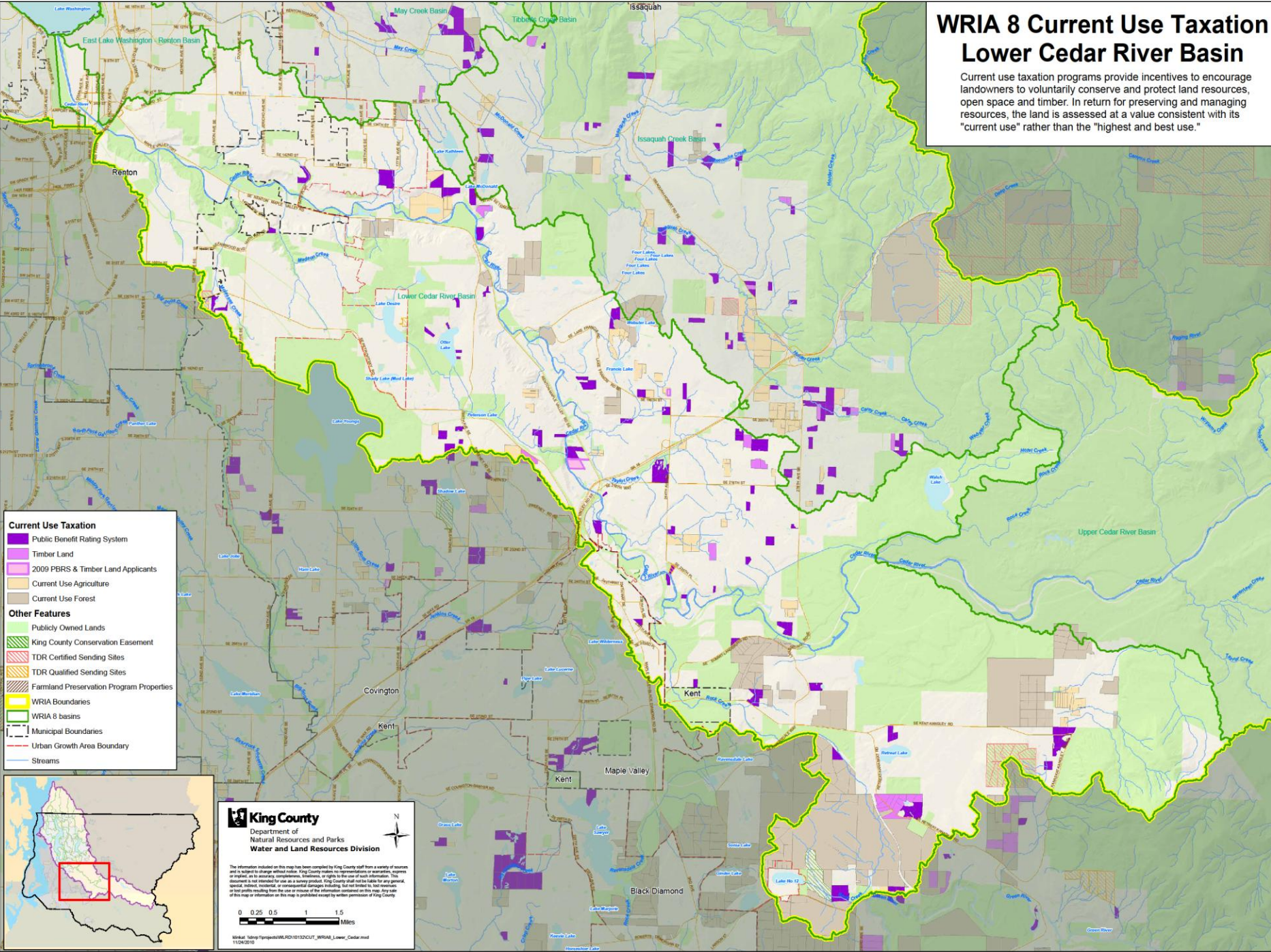
Night snorkel survey data from Roger Tabor, USFWS in 2006. Control site is the vegetated shoreline at the south end of the project site. Restoration site is the previous marina area.

**Project completed in 2006:** Chinook have been seen using the restored shoreline in spring of 2006 through 2008.



# WRIA 8 Current Use Taxation Lower Cedar River Basin

Current use taxation programs provide incentives to encourage landowners to voluntarily conserve and protect land resources, open space and timber. In return for preserving and managing resources, the land is assessed at a value consistent with its "current use" rather than the "highest and best use."



**Current Use Taxation**

- Public Benefit Rating System
- Timber Land
- 2009 PBRS & Timber Land Applicants
- Current Use Agriculture
- Current Use Forest

**Other Features**

- Publicly Owned Lands
- King County Conservation Easement
- TDR Certified Sending Sites
- TDR Qualified Sending Sites
- Farmland Preservation Program Properties
- WRIA Boundaries
- WRIA 8 basins
- Municipal Boundaries
- Urban Growth Area Boundary
- Streams



**King County**  
Department of Natural Resources and Parks  
Water and Land Resources Division

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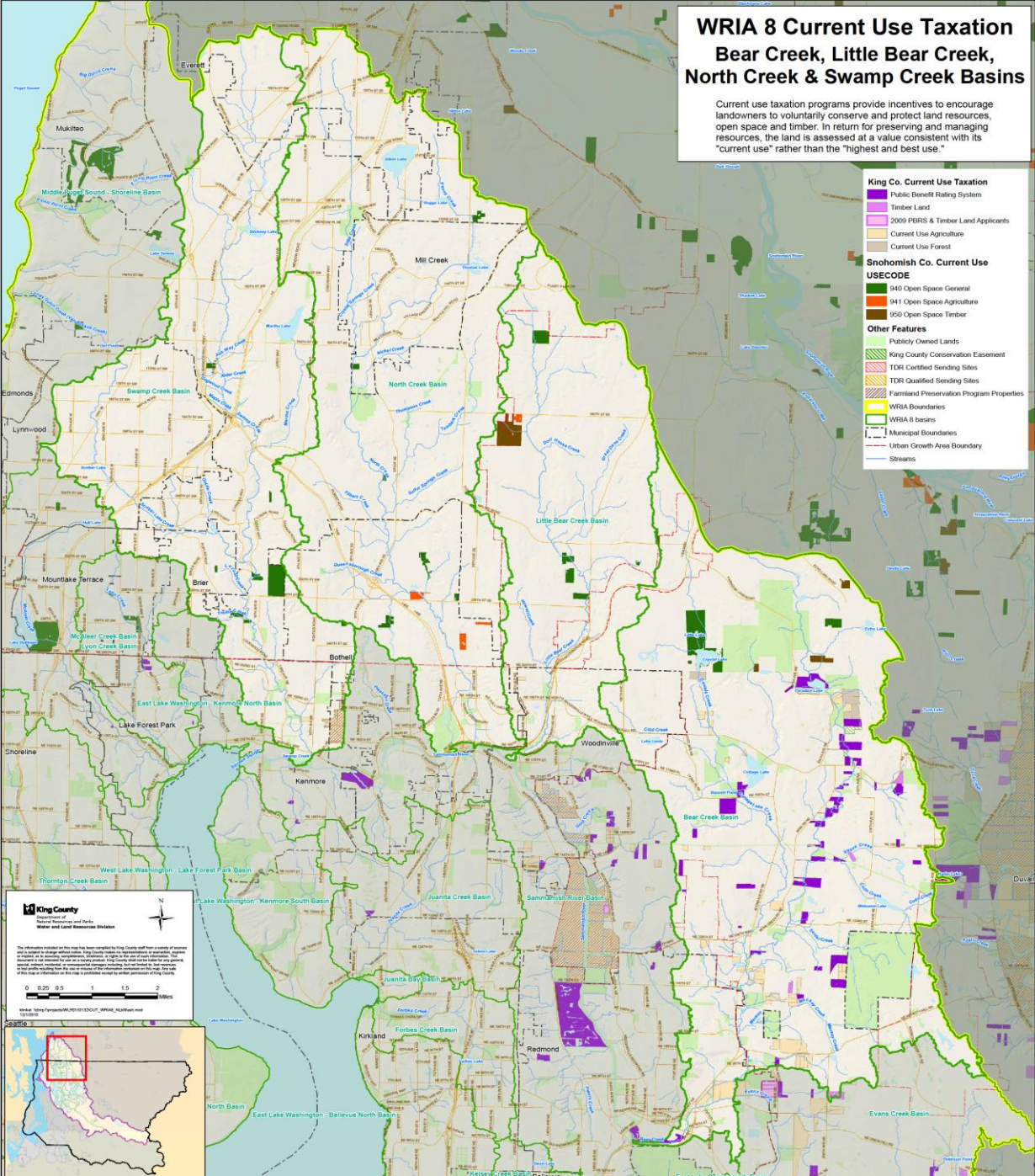
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# WRIA 8 Current Use Taxation

## Bear Creek, Little Bear Creek, North Creek & Swamp Creek Basins

Current use taxation programs provide incentives to encourage landowners to voluntarily conserve and protect land resources, open space and timber. In return for preserving and managing resources, the land is assessed at a value consistent with its "current use" rather than the "highest and best use."

- King Co. Current Use Taxation**
- Public Benefit Rating System
  - Timber Land
  - 2009 PFRS & Timber Land Applicants
  - Current Use Agriculture
  - Current Use Forest
- Snohomish Co. Current Use**
- USECODE**
- 940 Open Space General
  - 941 Open Space Agriculture
  - 950 Open Space Timber
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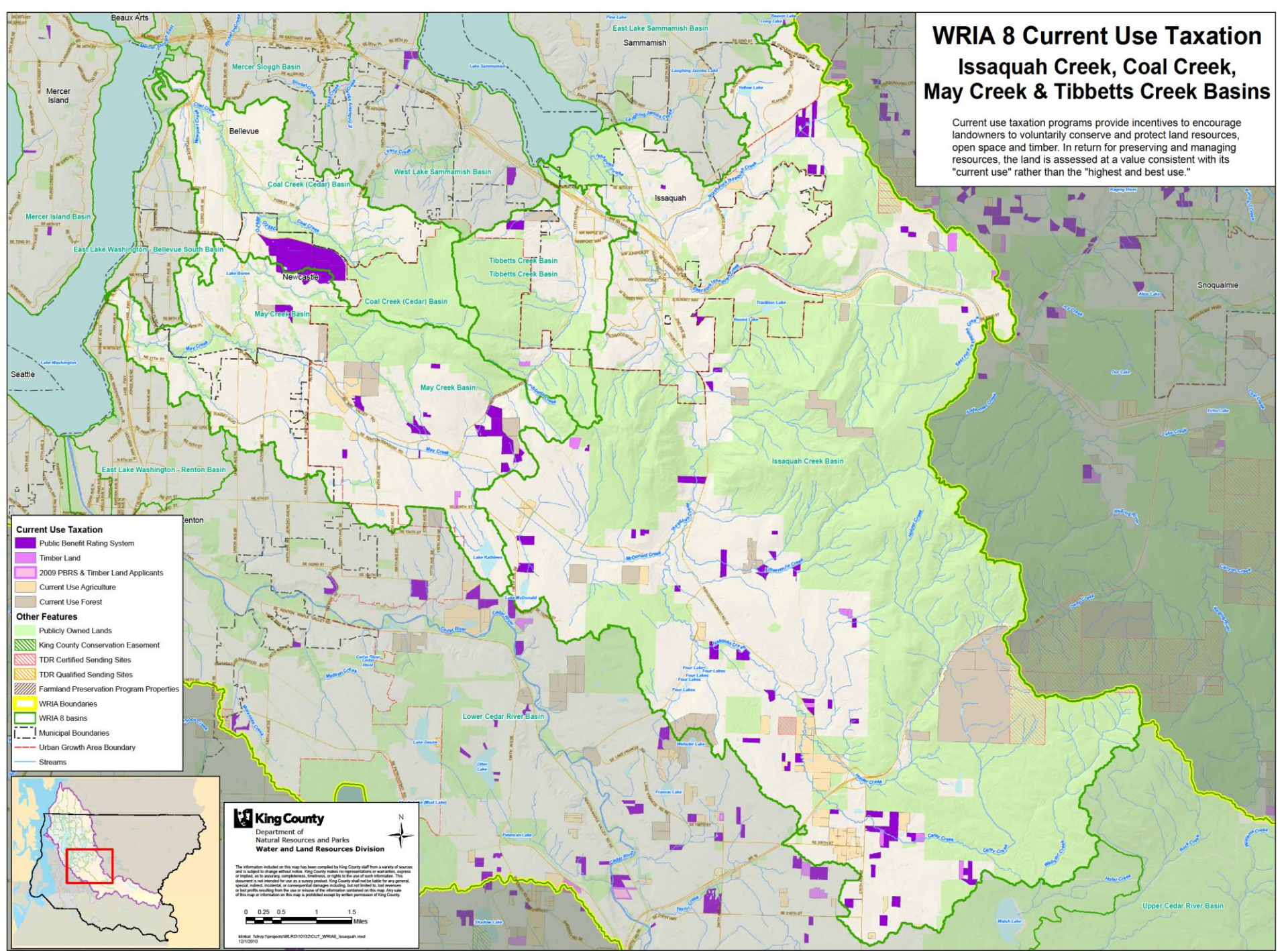
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# WRIA 8 Current Use Taxation

## Issaquah Creek, Coal Creek, May Creek & Tibbetts Creek Basins

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- Current Use Taxation**
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