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Urbanization of Seattle



- Population more than tripled 1900–1910 – 81,000 to 237,000
 - Alaska Gold Rush 1897-1903
- WRIA 8 highest population in state
 - Total population of Seattle/Tacoma/Everett
 - Today 3 million
 - Projected 24% increase 2002-2022
 - 90% inside Urban Growth Boundary
 - 55% of land inside Urban Growth Boundary

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Urban/Suburban Creeks (WRIA 8)

- Lake Washington Ship Canal
- Sammamish "River" (Slough)
- **Issaquah Creek (Lake Sammamish)
- Cedar River (**lower & middle)
- Thornton, Taylor (Lake Washington)
- Longfellow, Pipers (Puget Sound)
- **Bear, Cottage Creeks (Sammamish R.)
- Greatest spawning & rearing abundance

 $www.seattle.gov/util/About_SPU/Drainage_\&_Sewer_System/Projects/Creek_Restoration/index.asp$





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2nd verse, same as the 1st

Urban/Suburban

Habitat Factors

Habitat Limiting Factors affecting lakes, rivers and creeks

Altered hydrology	Low base flows, higher peak flows following storms, and increased "flashiness" (more frequent and rapid responses when it rains)
Loss of floodplain connectivity	Reduced access to side-channels or off-channel areas due to bank armoring and development close to shorelines
Lack or riparian vegetation	Due to clearing and development
Disrupted sediment processed	Too much fine sediment deposited in urban streams, or sources or spawning gravel disconnected from the river channel
Loss of channel and shoreline Complexity	Lack of woody debris and pools
Fish passage barriers	Road crossings, weirs, and dams
Degraded water and sediment quality	Pollutants and high temperatures

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- Accidentally, incidentally, intentionally
- Sediments & fluids from roads & parking lots
 - Copper, cadmium, zinc, lead from tire & drive train wear
 - · Gasoline, motor oil, transmission & brake fluid, antifreeze
- Chemicals from lawns & gardens
 - · Fertilizer, pesticides, herbicides



- Prevent water from soaking into soil
- Increases volume & speed of surface runoff
 - "Flashier"—increased flood risk
- Scours out gravel & eggs in streams
- Salmon (spawn in fall when flows are high) replaced by cutthroat trout (spawn in spring when flows are lower)





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- Increased bank erosion
- Widening & deepening channel
- Threat of property loss
- Response is to armor banks

Urban Runoff



• Avoid!

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- Paving driveways
- Clearing & armoring stream banks

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- Building levees
- Filling or degrading wetlands
- Mitigative measures
 - Porous concrete surfaces
 - Flood detention ponds
 - Moving levees back



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- Rain from roofs, streets & parking lots
 - Some goes directly into streams
 - · Contamination, sedimentation, flooding, erosion
 - Most goes into storm sewers

Surface Water Runoff

- Low-rain conditions: flows into sanitary sewers
 - · Then to sewage treatment plants
 - · Treated before discharged to Sound
- High-rain conditions: flow may exceed capacity
 - · Discharged directly to fresh or salt water
 - "Combined Sewer Overflows" (CSO's)

www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Projects/Residential_Stormwater_Control/index.asp

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Salmon-Friendly Gardens

- · Bad:
 - Storm water running off impervious surfaces
 - Residues of fertilizers & pesticides
 - Overwatering
- Good:
 - Use gravel instead of pavement
 - Choose the right plants
 - Water at right times & use right amounts
 - Use minimal & intelligent pest controls

www.seattle.gov/util/Services/Yard/Natural_Lawn_&_Garden_Care/Salmon_Friendly_Gardening/index.asp



- Most residential houses:
 - Water goes from gutter into storm sewers
 - Some goes into sewage treatment
 - But some goes into Combined Sewer Overflows
 - And some directly into streams
- City is exploring alternatives
 - Capturing water on-site in cisterns & gardens
 - Release slowly and/or store until summer

www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Projects/Residential_Stormwater_Control/index.asp

















www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.asp





 $www.seattle.gov/util/About_SPU/Drainage_\&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.aspinality.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.aspinality.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.aspinality.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.aspinality.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.aspinality.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Natural_Drainage_Systems/Street_Edge_Alternatives/index.aspinality.seattle.gov/util/About_SPU/Drainage_Systems/Street_Edge_Alternatives/index.aspinality.seattle.gov/util/About_SPU/Drainage_Systems/Street_Systems/St$



- Regulations on construction erosion
 - No clearing or grading 10/1 3/31 in certain areas unless specific conditions are met
 - e.g. Bear Creek
 - Example regulations
 - Avoid sensitive areas
 - Minimize ground disturbance & vegetation removal
 - Cover/mulch all ground left exposed >2 days
 - No water leaves the site (100% infiltration)
 - · Protect perimeter with silt fence, catch basins
 - Minimize & clean up vehicle traffic areas
 www.metrokc.gov/ddes/lusd/erosion.htm



- Gravel, crushed rock, open/porous pavers
- Rainwater plumbing & cistern system
- Low impact development
 - "mimic a site's predevelopment hydrology by using design techniques that infiltrate, filter, evaporate, store, & detain rainwater runoff close to its source"
 - "open space, vegetated rooftops, reduced street widths and curbs, streetscapes... and other buffer zones using more vegetation... instead of disposing and treating stormwater in large, costly end-of-pipe facilities located at the bottom of drainage areas" http://www.builtgreen.net/features.html

(Industry)

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- Issaquah Highlands example practices
 - Homes clustered to keep open space

Suburban Developers

- Native droughttolerant plantings
- <10% impervious surface, porous pavings
- Filter strips, infiltration basins, detention ponds



http://www.builtgreen.net/studies/1051.html





- Thornton Creek, Seattle
 - 100% wetland loss
 - 60% reduction in channel complexity
 - Banks heavily armored
 - Extensive culverts & pipes
 - Loss of native riparian vegetation
 - Low salmon survival despite planted fry











- To demand Simon "daylight" creek as part of its development
- Include detention pond to reduce creek flooding
 - Replace function of destroyed wetland
 - Capture & decontaminate runoff from parking lots
- Salmon once thrived in creek
 - Fished in 1960s, some still observed

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"Daylighting" Thornton Creek (Williams)



- Would it help salmon?
 - Daylighting alone would not really
 - Few fish would reach so high in watershed
 - Other factors more important for mortality
 - Flooding & contaminants
 - · Lower Creek habitat conditions
- More for raising awareness of water & fish
 - Very expensive, \$ could be spent on other restoration with more effect on fish
- Water detention the critical function



• Clean, infiltrate, & slow





- Artist's conception
 - "Daylighted" Creek to be a residential amenity



www.seattle.gov/util/About_SPU/Drainage_&_Sewer_System/Projects/COS_002477.asp









- Maintain intact habitat values in upper suburban watersheds
 - Cedar, Bear, Issaquah
- Direct growth into existing urban areas
 - & Minimize impacts there
- Manage rural development to avoid or reduce impacts
 - Critical Areas Ordinances
 - Flood control
 - Property acquisition



- Add rearing habitat
- Cedar chinook stock most threatened
- Improve habitat in Lake Washington & Ship Canal where possible
 - Improve nearshore habitat & tributaries
 - Try experiments
 - N. L. Washington stock 2nd most threatened
 - Restore productivity in Sammamish R.
 - 90% originate in Bear Creek

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How to Restore Bear Creek?



- Protect existing forested areas
- Riparian vegetation & LWD
- Meanders & channel complexity - 2 large-scale projects identified
- Remove bank armor & restore flood plain
 - 1 projects identified
- Reduction in fine sediment input
 - 2 farms identified; restore riparian vegetation

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How to Restore Sammamish River?

- Create flood benches & restore riparian vegetation
 - Replace non-native with native vegetation
 - 2 locations identified
- Meanders & channel complexity
 - Below L. Sammamish wier
- Enhance & reconnect wetlands 4 locations identified
- Restore mouths of 10 small tributaries
 - Cool-water refuge sites for juveniles

Ocean/ENVIR 260 Winter 2006 Lecture 5 © 2006 University of Washington Chinook Use of Lake Washington



- Corridor for upstream spawner migration - Little spawning in lake (seen elsewhere)
- Habitat for juveniles (fry/parr)
 - Shallows in undeveloped areas, creek mouths
 - Sand & fine gravel
 - Derived from bank erosion & streams
 - LWD & vegetation support food chain
 - Feed on insects first, then zooplankton
 - Preved on by bass & trout
 - Prefer LWD & vegetation (but so do predators) www.cityofseattle.net/salmon/blueprint.htm



- Lake Washington Ship Canal (WRIA 8)
 - Built 1916 through existing minor drainage path from Lake Washington to Puget Sound
 - 8.6 miles long
 - Ballard locks constructed
 - Eliminated existing estuary
 - Lowered lake level ~9 feet
 - · Loss of wetlands, rerouting of tributaries
 - Previous outlet was through Black River (Renton) into Duwamish
 - · Cedar River routed into Lake Washington













- Cuts off sediment supply, deepens water
- L. Sammamish similar
- 80-90% loss of LWD & natural vegetation
- Shading by docks, piers, boats
 - 4% of lake area 100 ft from shore
 - Affects food sources
 - Increases predation on juv. chinook by bass
- Water quality
 - High temperatures & low dissolved oxygen



- - Restore shoreline vegetation
 - Milfoil a problem
 - Limited opportunities due to lowered lake level
 - Removing armoring alone may not help
- Management of lake level for recreation
 - Lower in winter to reduce storm damage to shore
 - Higher in summer for boats through the locks

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How to Restore Lake Washington?



- Salmon-friendly docks & shorelines
 - Regulations
 - Incentives
 - Targeted educational programs
- Remove armoring
 - Restore shoreline vegetation & nearshore habitat
 - · Especially south end of lake
- Mouths of 7 small tributaries
 - Refuge areas for juvenile chinook



- restoration projects
 - Arboretum
 - www.cityofseattle.net/salmon/salmonmaps/ map9.htm#
 - Sand Point & Matthews Beach
 - www.cityofseattle.net/salmon/salmonmaps/ map6.htm
 - Other projects
 - www.cityofseattle.net/salmon/salmonmaps/ project.htm

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www.cityofseattle.net/salmon/blueprint.htm
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- rivers?
 - e.g., Duwamish
- Or put resources into improving more healthy rivers?
 - e.g., Snogualmie



- "Top-down" experts decide & enforce
- Can provoke resentment & resistance
- Incentives ("Carrot")
 - Offer voluntary tax breaks, etc.
- Acquisitions
 - Buy the property or development rights
- Education
 - No carrot or stick, just persuasion

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Urban/Suburban "Buzzwords"



- Comprehensive plan updates
- Critical areas ordinances
- Best available science
- Shoreline master programs
- NPDES municipal stormwater permits
- Urban Growth Boundary



Minimizing Urban/ Suburban Impacts

- Hold UGB firm
- Low-impact development techniques
- Clustering of buildings
- Minimize new road crossings
- Stormwater management



- Dept. Construction & Land Use
 - www.cityofseattle.net/salmon/cityactions.htm
 - www.ci.seattle.wa.us/dclu/
- Land-disturbing activities (e.g. grading)
- Storm water management
- Shoreline development