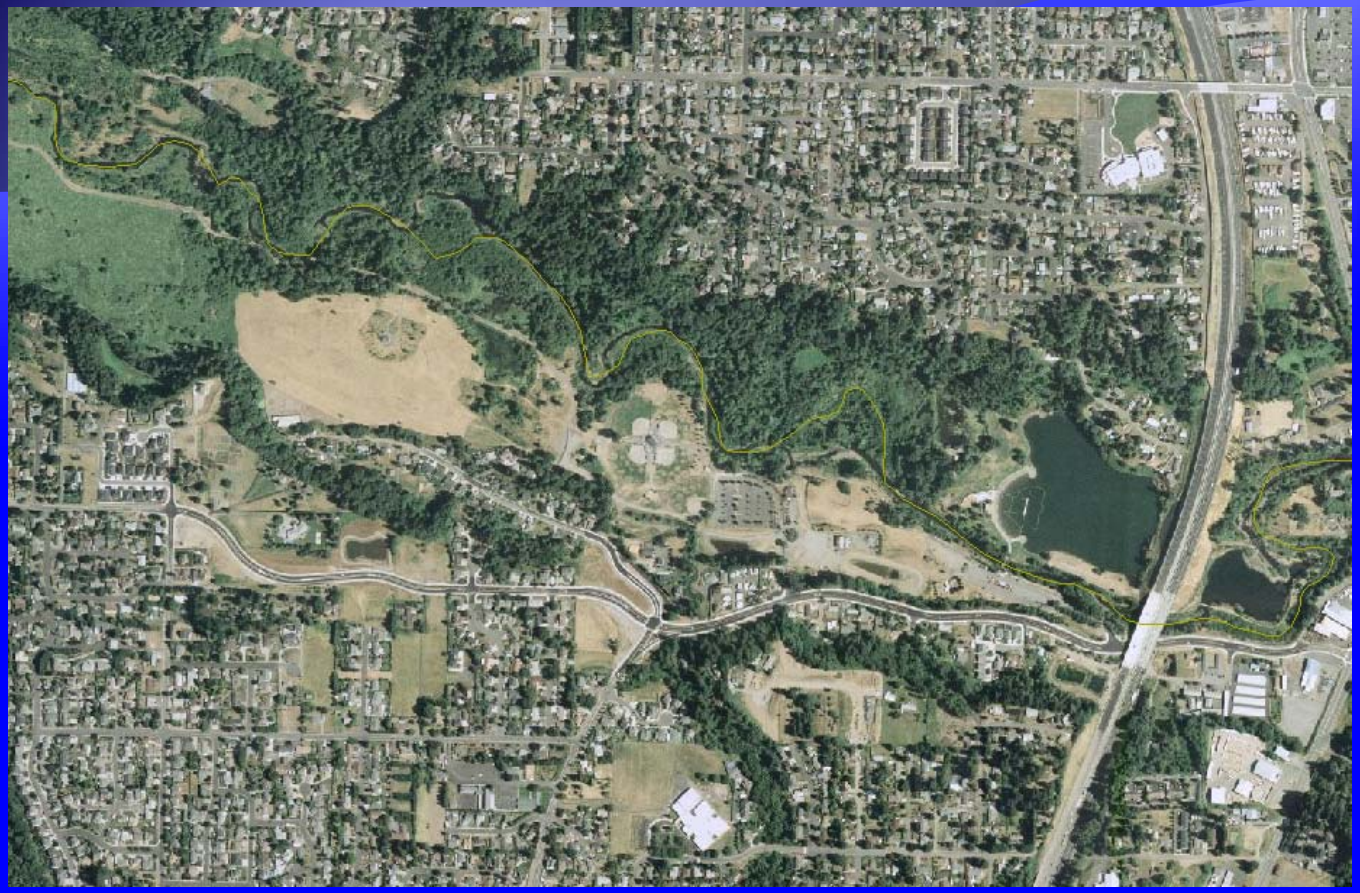
Innovative Temperature Total Daily Maximum Load (TMDL) for Salmon Creek Watershed



Anita Stohr/Tonnie Cummings
Washington State Dept. Ecology
May 21, 2009

Presentation outline

- What do you mean by innovative temperature TMDL
- Why do it here in Salmon Creek (also in Whatcom county)
- Bit of history on temperature TMDLs to date and common results
- How specifically would shade load allocations be established
- How specifically would point source allocations be established
- Questions and comments

What do you mean by an innovative TMDL?

A temperature TMDL that meets all of EPA requirements, but utilizes information learned on past projects to streamline production of a report.

Includes:

- Basin description
- Load allocations for Effective Shade (from Shade Curves)
- Waste Load Allocation if any NPDES dischargers (from standard equation)
- Implementation plan

Criteria for an innovative TMDL project.

- Data already exists, was collected by another agency or additional data not needed
- Active stakeholder group already working on/interested in restoration
- Stakeholder group is reasonably convinced that a full temperature TMDL analysis will show that under critical low flow/ hot climatic conditions that the numeric temperature standard will be exceeded and thus the maximum amount of riparian shade and channel improvements are required; or
    - Not entirely convinced but would rather focus energy/resources on implementing improvements than on study
- Existing Point source discharges can work under the standard Waste Load Equation

TMDL required for all streams that exceed water quality standard

Numeric temperature criteria for Salmon Creek

17.5C (63.5F) downstream of Cougar Creek
16C (60.8F) upstream of Cougar Creek including tributaries

Why temperature is important

•Salmonids need cold water to stay healthy during key life stages.

•Cold water holds more oxygen than warm water. As water temperatures go up, the amount of oxygen in the water goes down and there is *less oxygen for fish.*

• Salmonids have less food in warm water because many of the stream insects they prefer to eat cannot live in warm water.

•Warm water changes salmonids' body processes, making these fish more likely to catch diseases and suffer damage from toxins.

• Barriers to salmon migration occur at 22°C (71.6°F) and If the water gets too warm (77°F, 25°C), many salmonids will become sick or die.

Salmon Creek Watershed: Summer 2003 Stream Temperature

By Jeff Schnabel Clark County

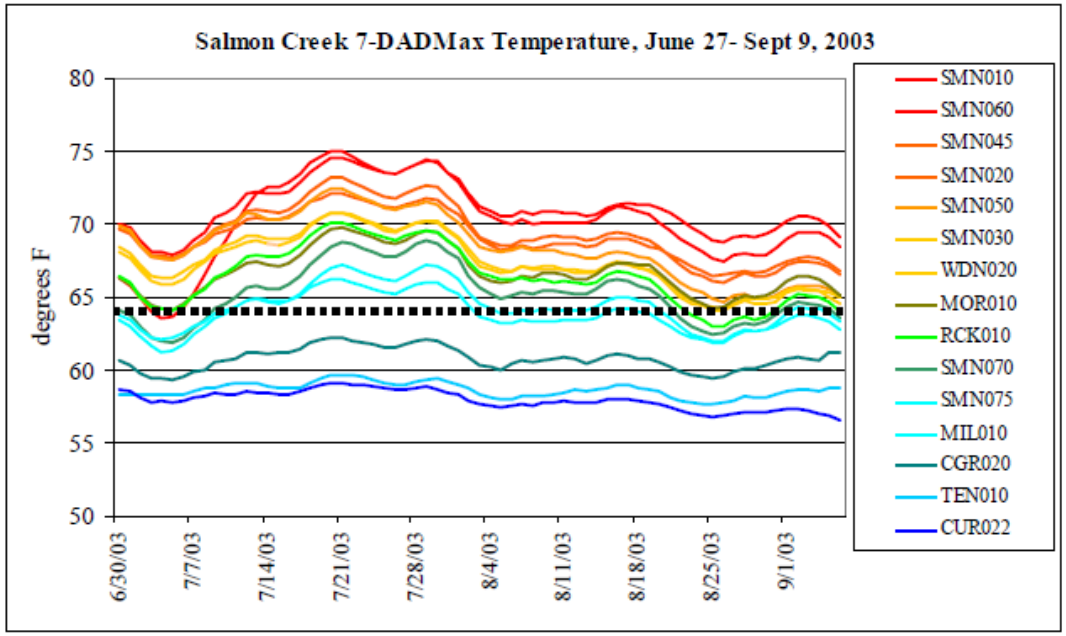
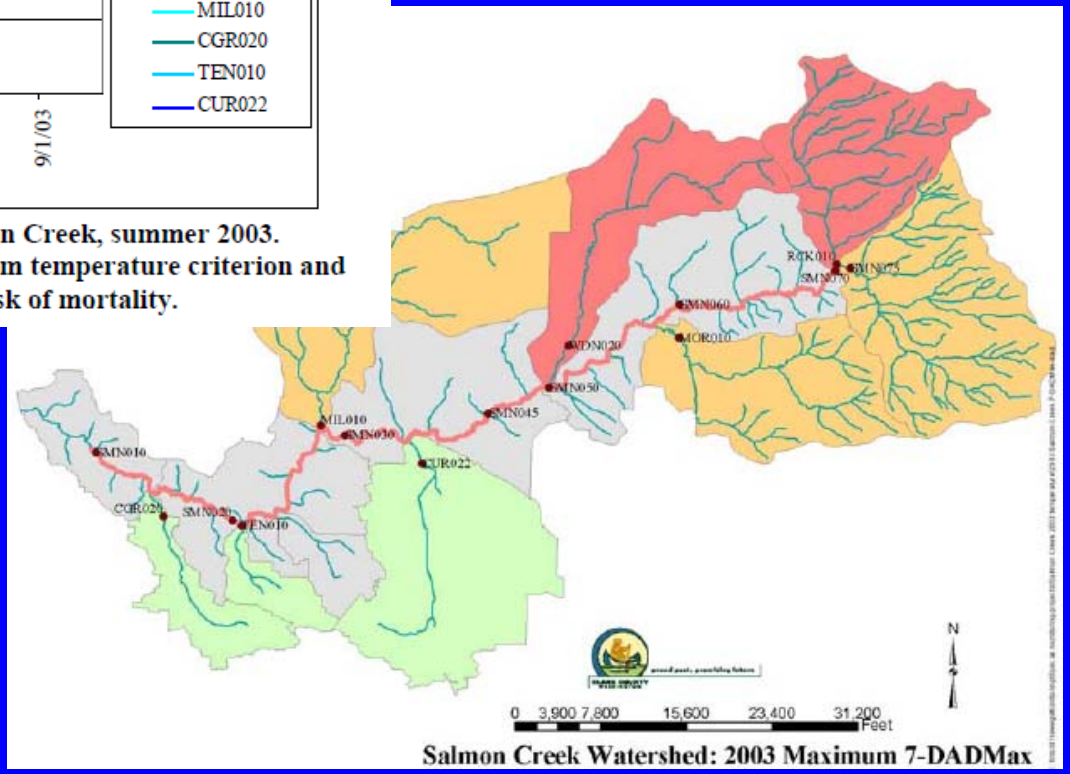


Figure 3. Time-series plot of 7-DADMax temperatures, Salmon Creek, summer 2003. The dotted line at 64° F represents the Washington state stream temperature criterion and the sub-lethal limit above which salmonids are at increased risk of mortality.

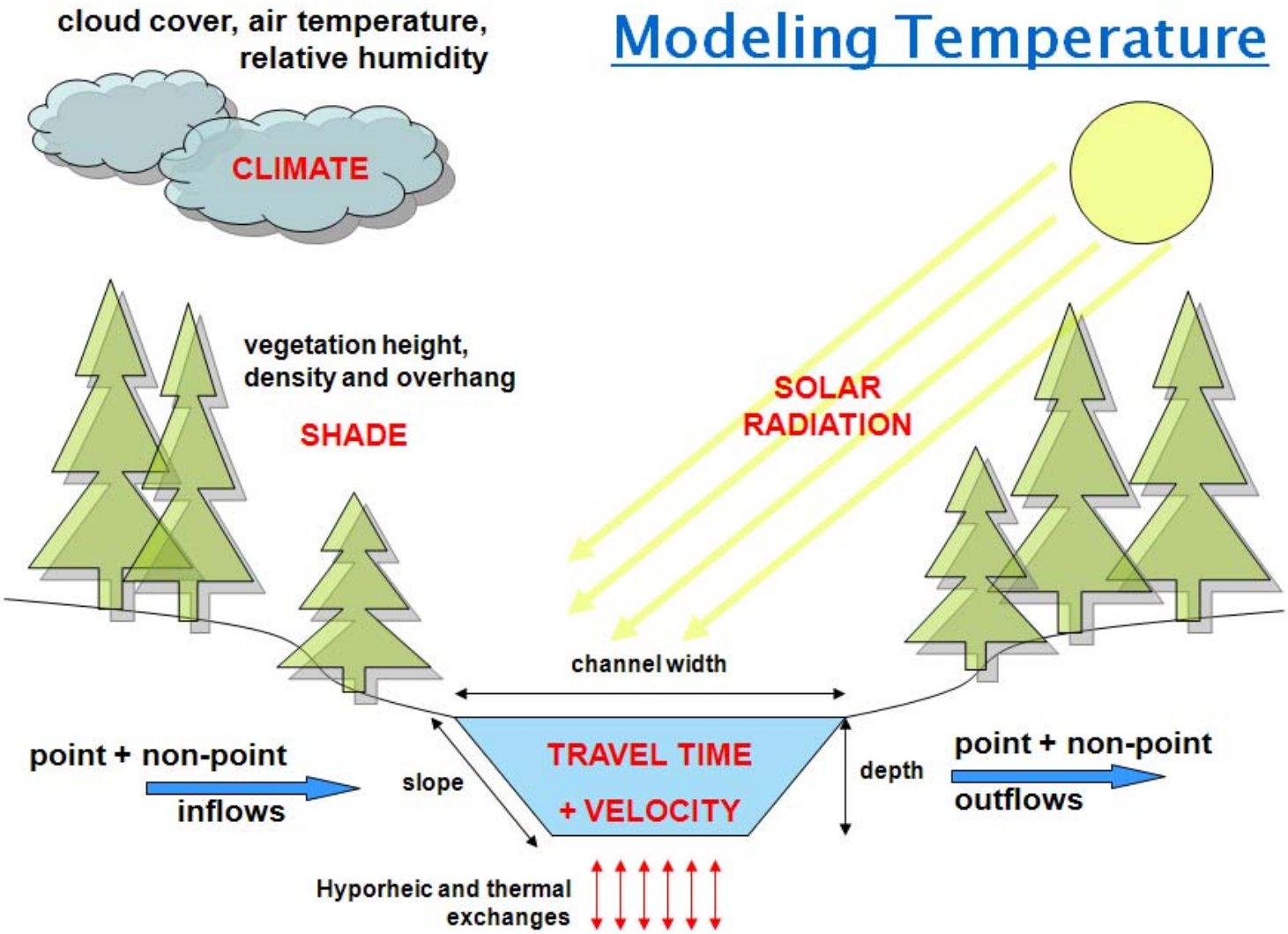
Data exists to show that water temperatures are in exceedance of the Water Quality Standard

Numeric standard was lowered in 2006 to 17.5C (63.5F) downstream of Cougar Cr. and 16C (60.8F) for majority of watershed

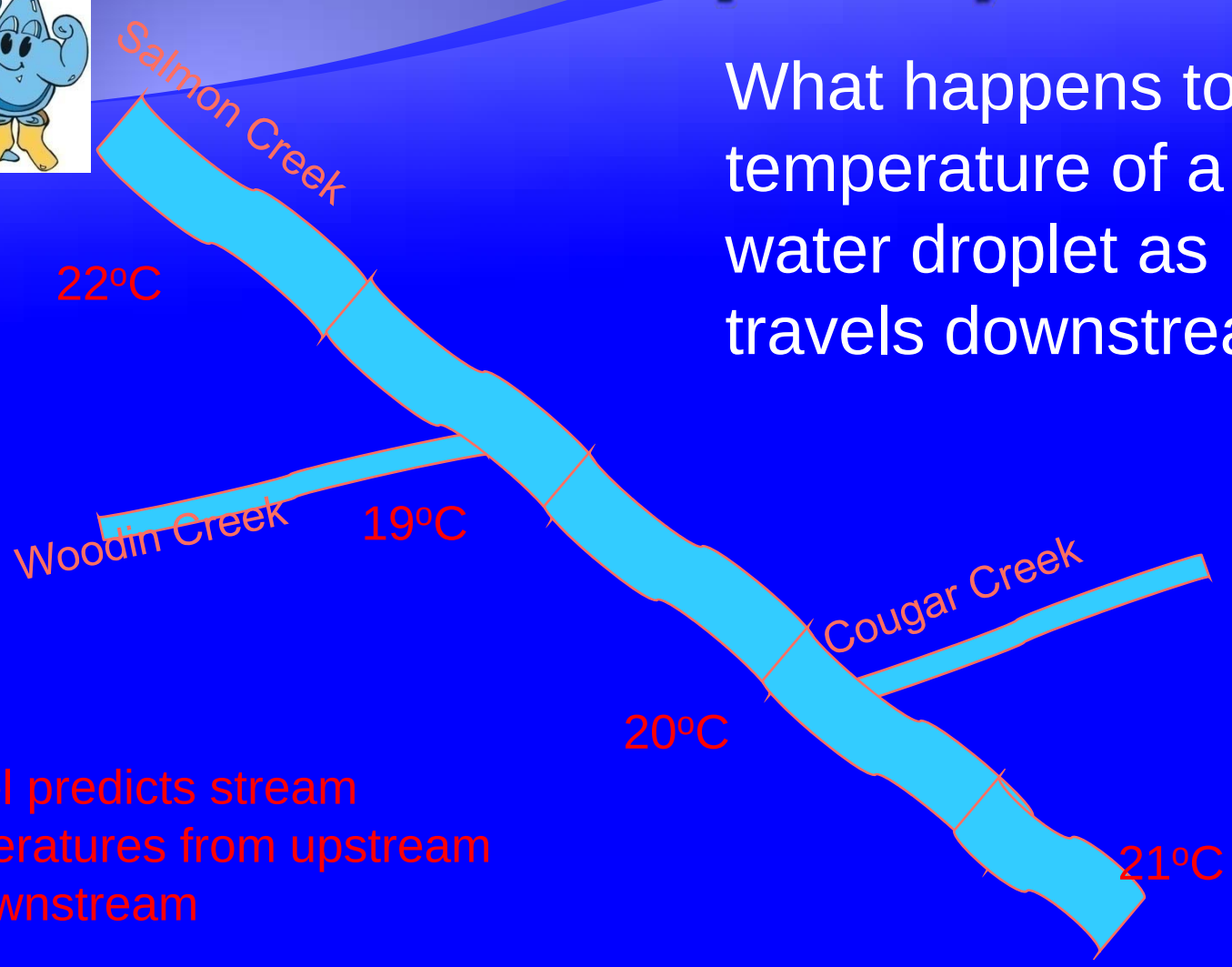


Salmon Creek Watershed: 2003 Maximum 7-DADMax

Modeling Temperature



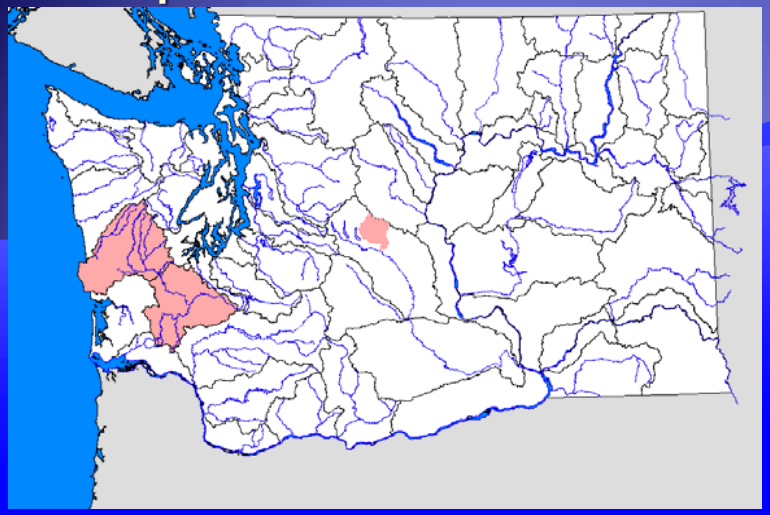
What is a **water quality model?**



What happens to the temperature of a water droplet as it travels downstream?

Model predicts stream temperatures from upstream to downstream

Temperature TMDLs - bit of history



First Temperature TMDLs (1998)

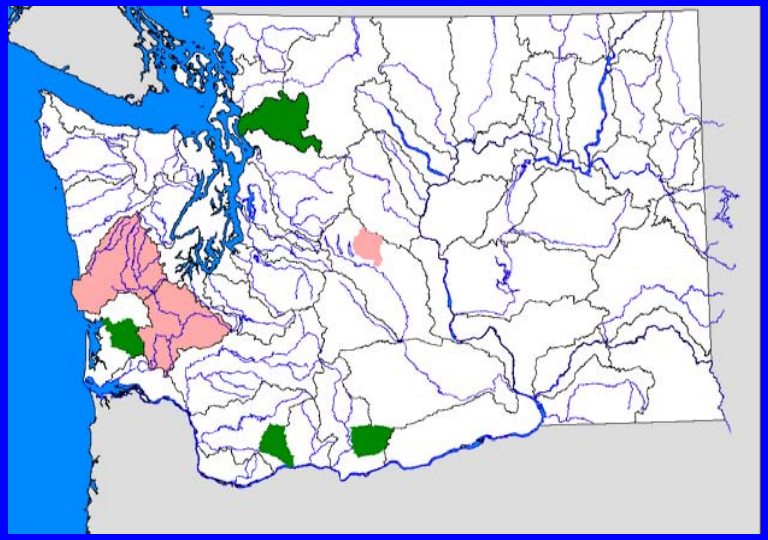
(Chehalis, Teanaway)

•Lower cost

•10 sample sites

•SStemp and SNtemp stream models

Criticisms-not accurate enough. Error bars too large. Model predicts daily mean but not daily maximum temperature



Next Temperature TMDLs (2000-2003)

(Stillaguamish, Willapa, Little Klickitat, Wind, South Prairie Creek)

•More sample sites

•More flow stations

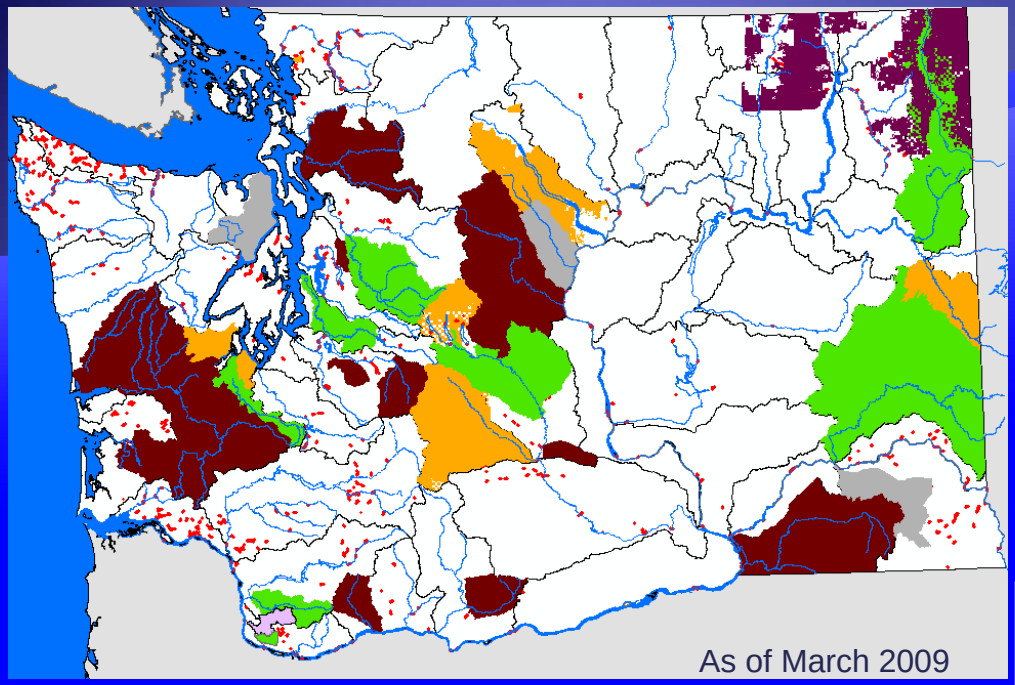
•Qual2kw model

•Some Thermal Infrared flights

Comments- Accurate +/- 1C

Better GW evaluation will be needed in areas with higher water withdrawals/irrigation

Current Temperature TMDLs



Green-TMDL underway

Orange-TMDL Technical Report complete

Brown- EPA approval

- TMDLs are underway or complete in most Ecoregions of the state
  - East Cascade drainage
  - West Cascade drainage
  - Coastal
  - Arid
  - Columbia

Project scoping is dependent on basin

May include:

Ecology sampling (temperature, channel, flow)

Local sampling

Groundwater piezometers

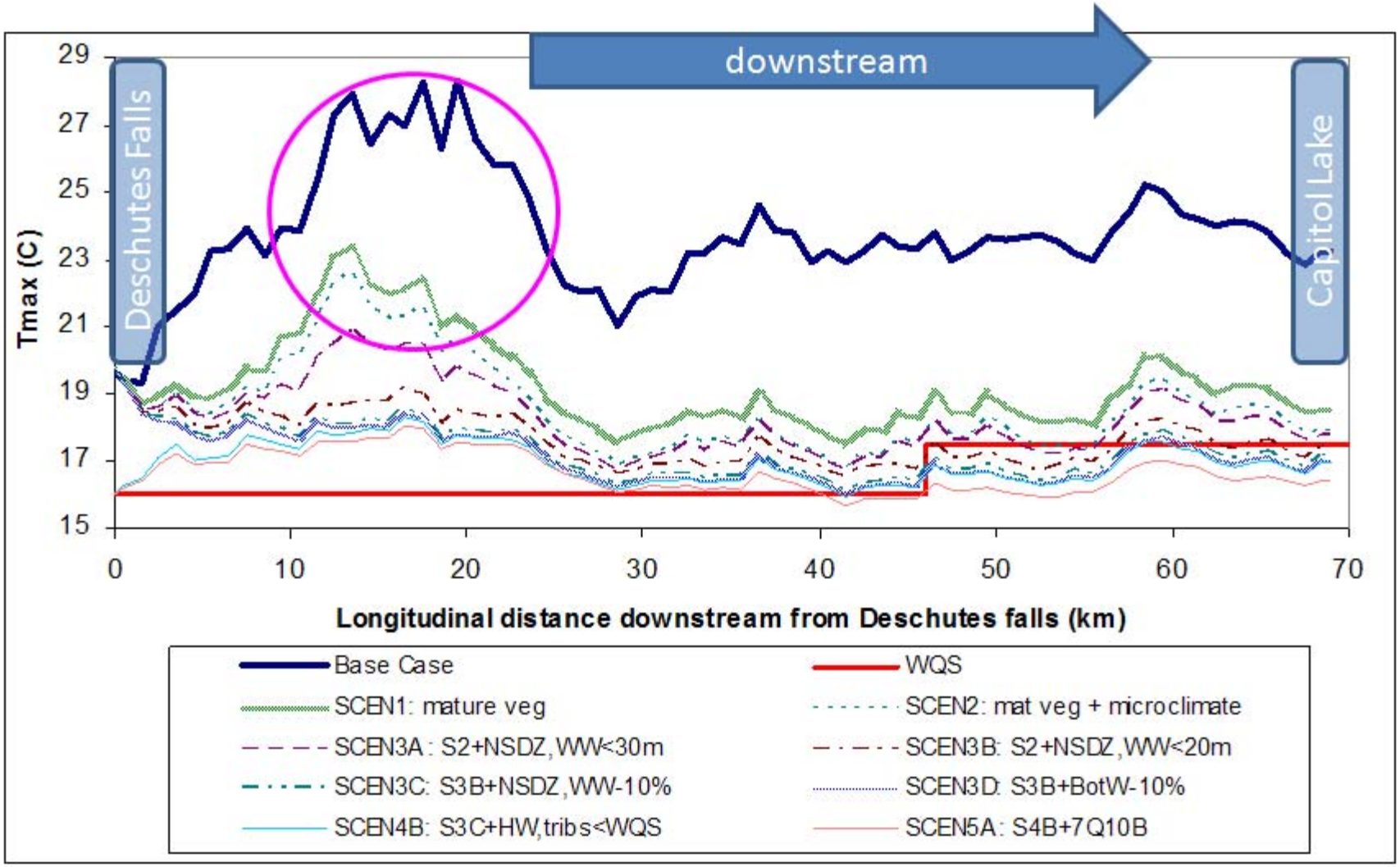
Thermal Infrared flight

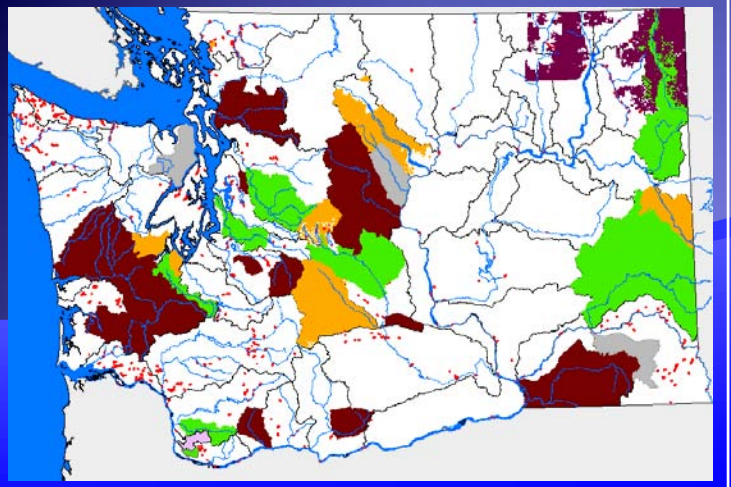
Qual2kw modeling

Multiparameter analysis, DO, nutrients

Criticisms: technical work generally considered very good-but takes lot of time and money

Temperature benefits of management actions





Almost all temperature TMDL analysis in the state has resulted in load allocation targets that are:

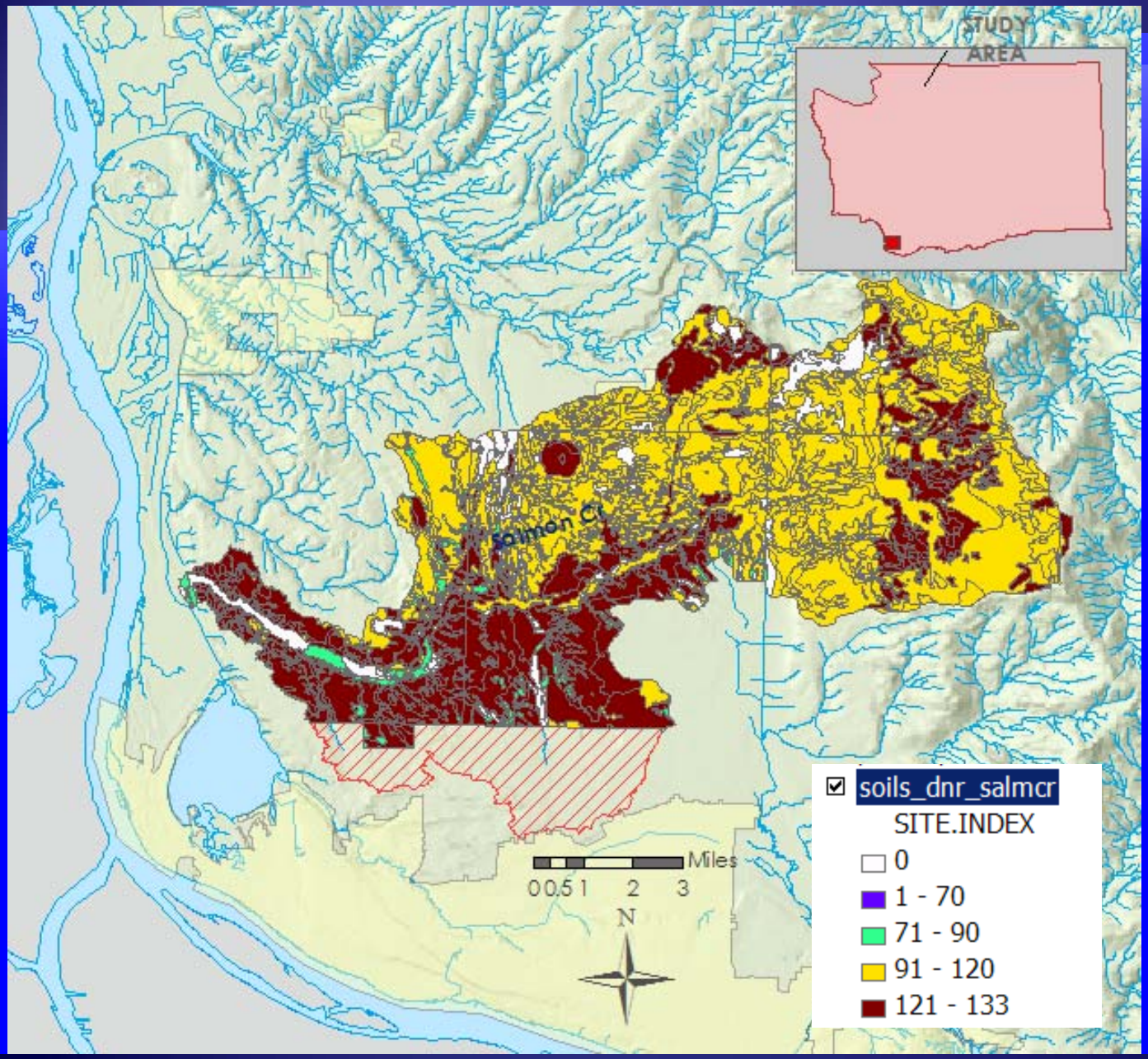
Equal to system potential shade (need for mature riparian buffers along the entire length of the stream)

in order to not exceed the 7-day maximum temperature standard more often than one time in ten years.

The assumption for Salmon Creek also would be that there is a need for system potential shade. So the next steps would be to determine what that was.

Note: Along with riparian vegetation improvement. Expect improvement in channel width/depth, channel roughness (large woody debris)

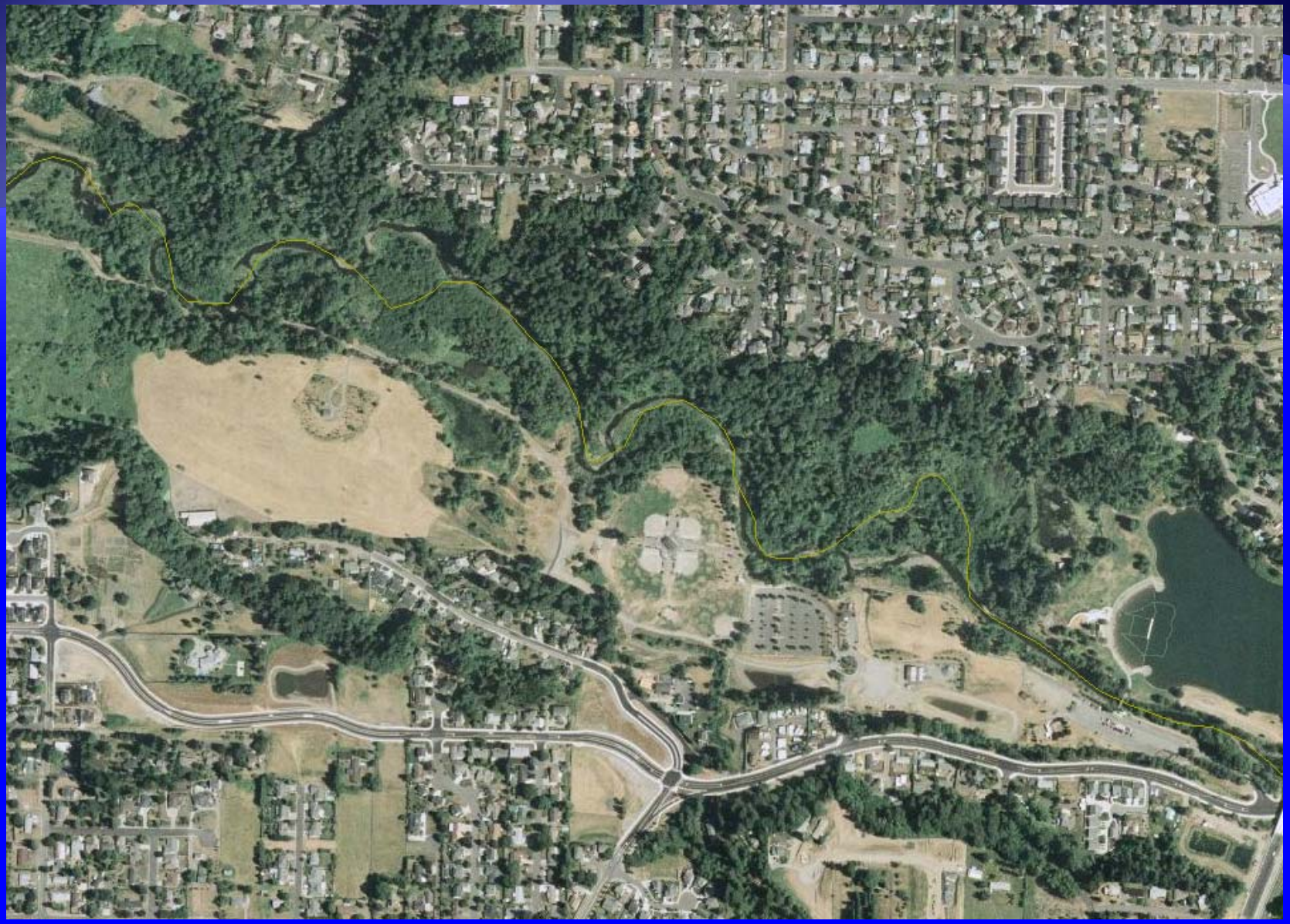
Soil Survey 50- year tree height values for Salmon Creek Watershed



Two common methods of determining system potential vegetation

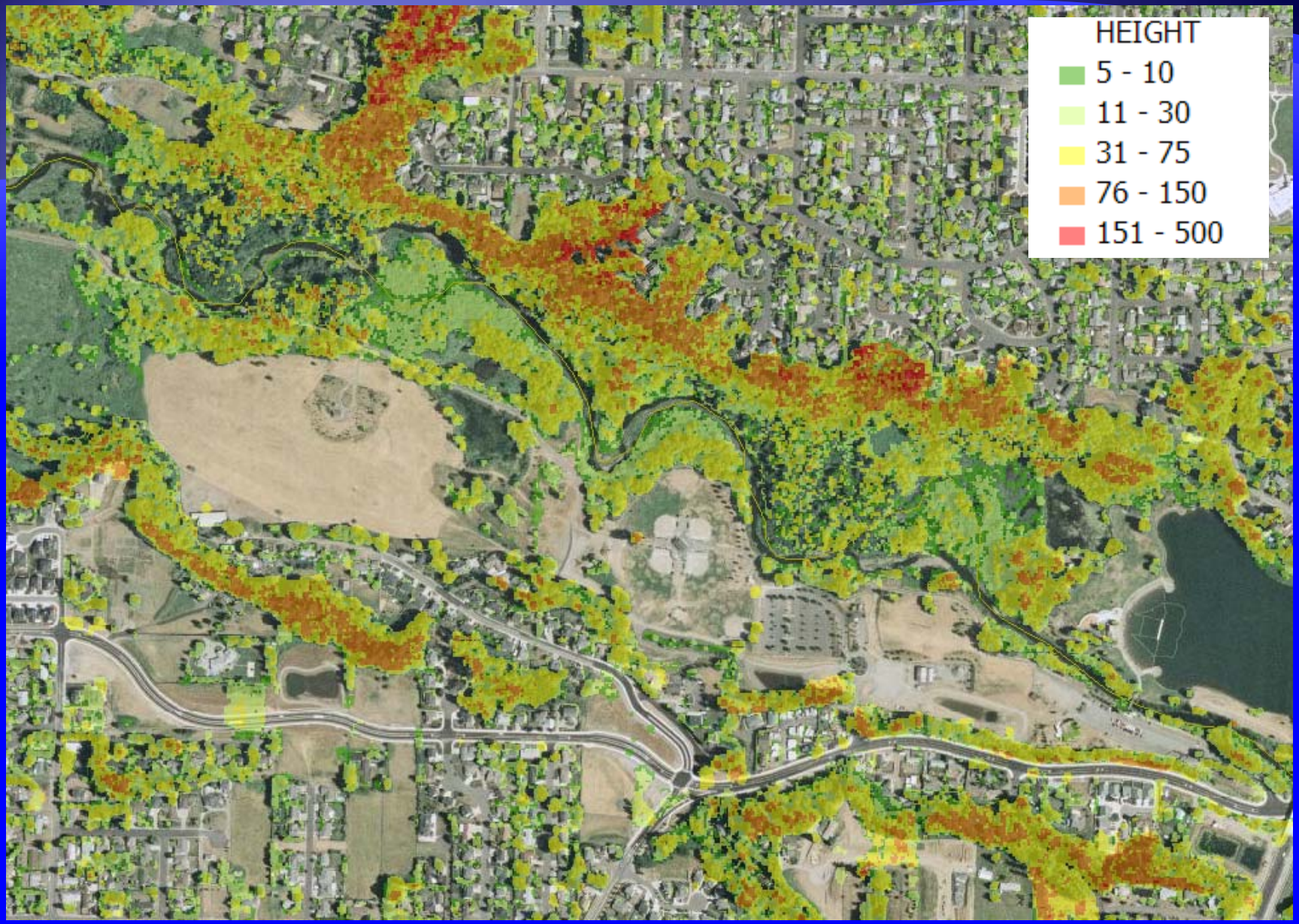
- Soil surveys (USDA and DNR)
- Current vegetation heights (LiDAR or field measurements)

Aerial (Ortho) Photography 2006 NAIP for Salmon Creek Watershed

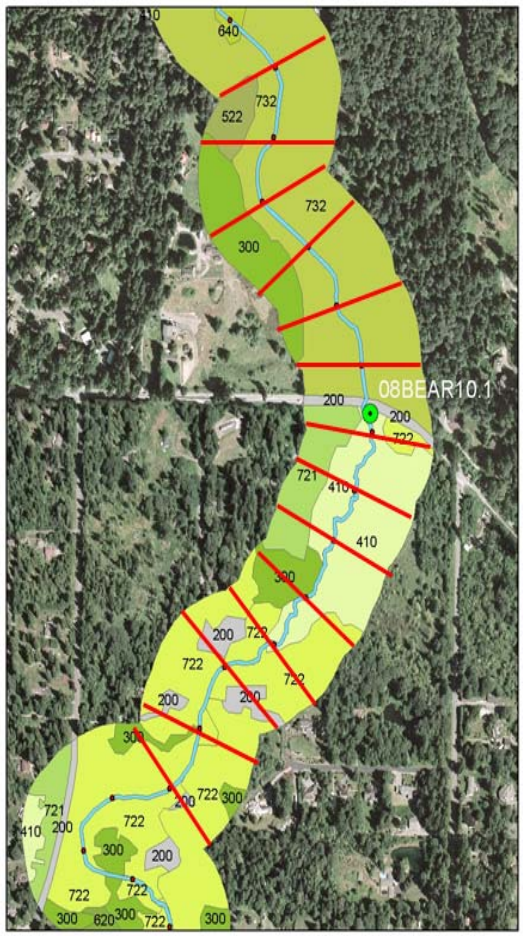


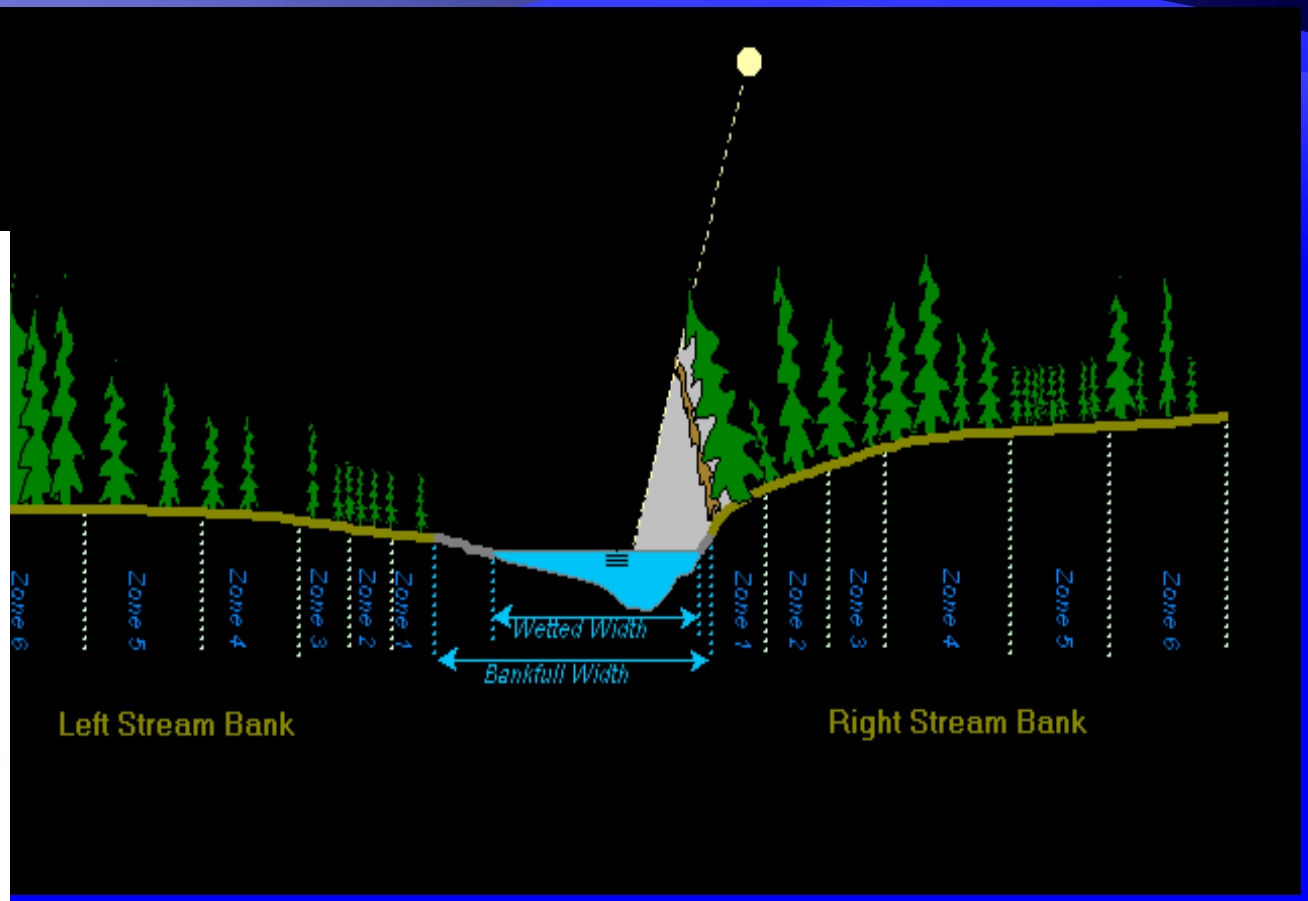
National Agriculture Imagery Program (NAIP)-Entire WA state covered in 2006 with either 36” or 18” pixel

Clark County Canopy Heights (ft) from 2002 LiDAR flight



Ecology's Shade model is used to Calculate Effective Shade





Effective Shade = fraction of sunlight that is blocked from reaching the stream

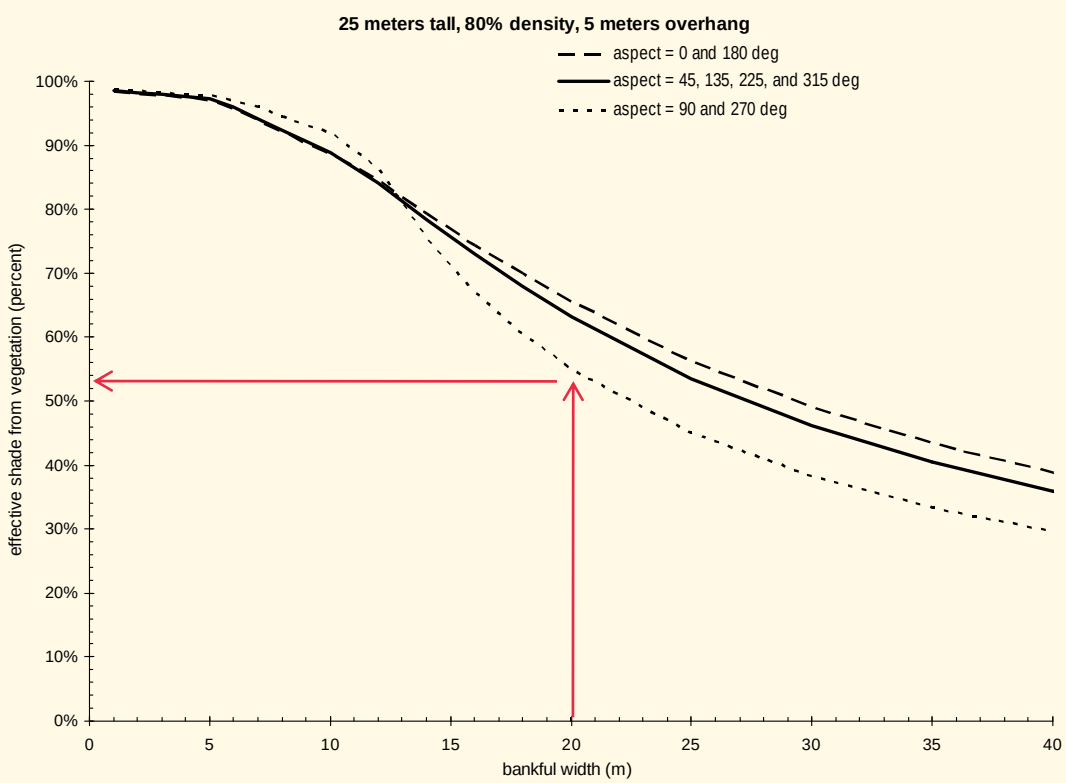
Calculated and summed for every hour of the day

TMDL submittal

- Assign shade **load allocation** for basin depending on vegetation and soil types and submit to EPA
- Calculate **waste load allocation** for point source effluent temperature using standard equation

To determine shade allocation for your site from a curve:

Figure 1. Example Shade Curve



Mixed Deciduous/ Conifer Zone see Map Figure 25

- Find your stream aspect by facing downstream and using a compass
- Find the bankfull width
- Find the corresponding effective shade value on the graph

TMDL submittal

- Assign shade **load allocation** for basin depending on vegetation and soil types and submit to EPA
- Calculate **waste load allocation** for point source effluent temperature using standard equation

Class 'Salmonid Rearing and Migration':
TNPDES = [17.5 ºC-0.3ºC] + [chronic dilution factor] * 0.3 ºC

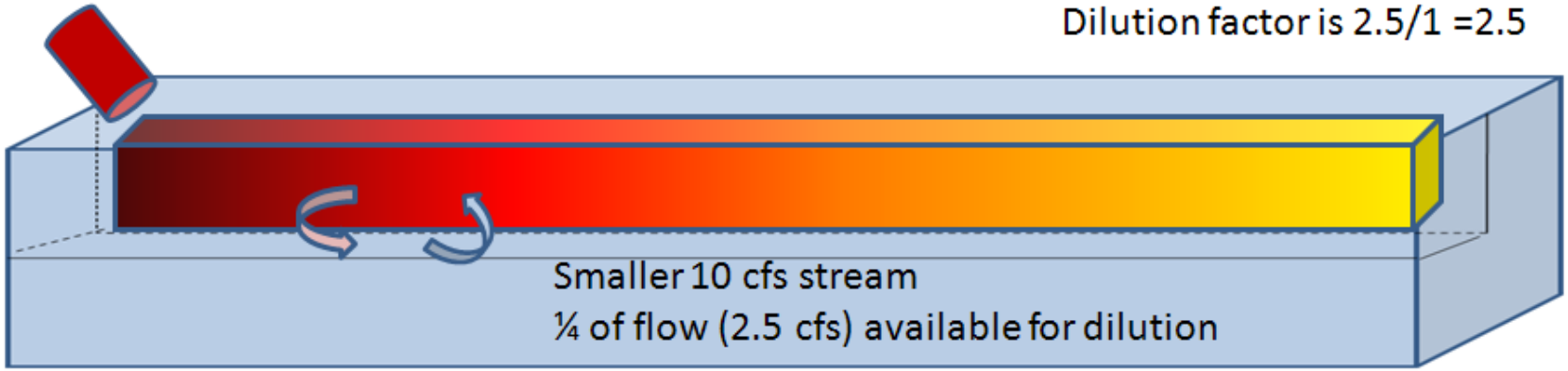
Class 'Core Summer Habitat':
TNPDES = [16.0 ºC-0.3ºC] + [chronic dilution factor] * 0.3 ºC

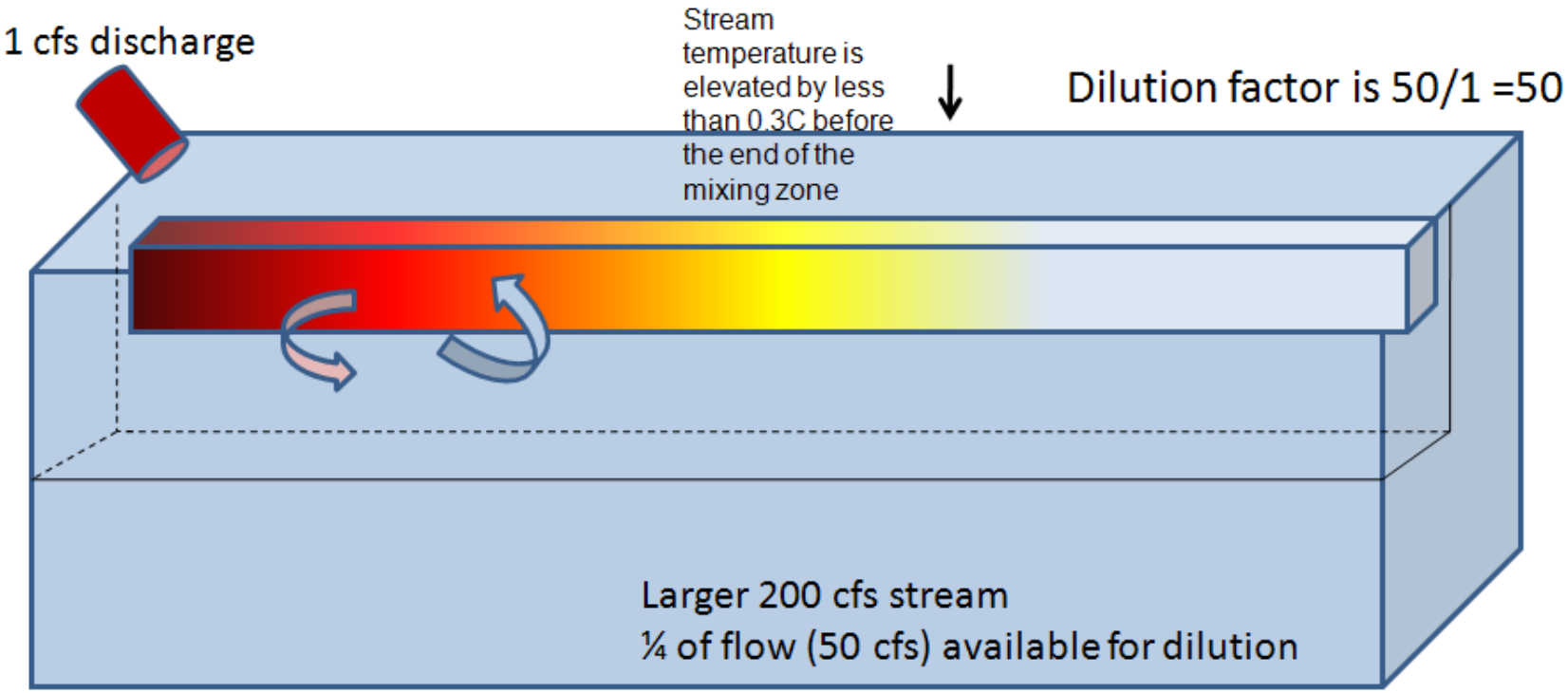
Table 15. Wasteload allocation (WLA) for effluent temperatures for selected NPDES dischargers in the Wenatchee River basin for the revised standard.

NPDES Facility	Chronic dilution factor	Water quality standard for temperature (deg C)	Allowable increase in temperature at the mixing zone boundary (deg C)	T_{NPDES} = Maximum allowable effluent temperature WLA (deg C)
Lake Wenatchee	214	16	0.3	33.0
Stevens Pass	1	16	0.3	16.3
Cashmere	100	17.5	0.3	33.0
Leavenworth	37.1	17.5	0.3	28.6
Peshastin	331.7	17.5	0.3	33.0
National Fish Hatchery	1	17.5	0.3	17.8

Note: the above equations apply when waters are warmer than the numeric criteria, consult WAC 173-201A-200(1)(c) (i) – (vii) for more complete information

Dilution Factors and Stream Size





Timeline

November 2009 Technical Analysis available to Advisory Committee

May 2010 Ecology submits Water Quality Improvement Report to EPA

November 2010 Final Approval of TMDL and Implementation Plan from EPA

Questions

Project Plan available at:
http://www.ecy.wa.gov/biblio/0903105.html