

Upper Klamath and Lost River Subbasins Temperature TMDL Development

Technical Approach Overview

Tribal Coordination

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Presentation Overview

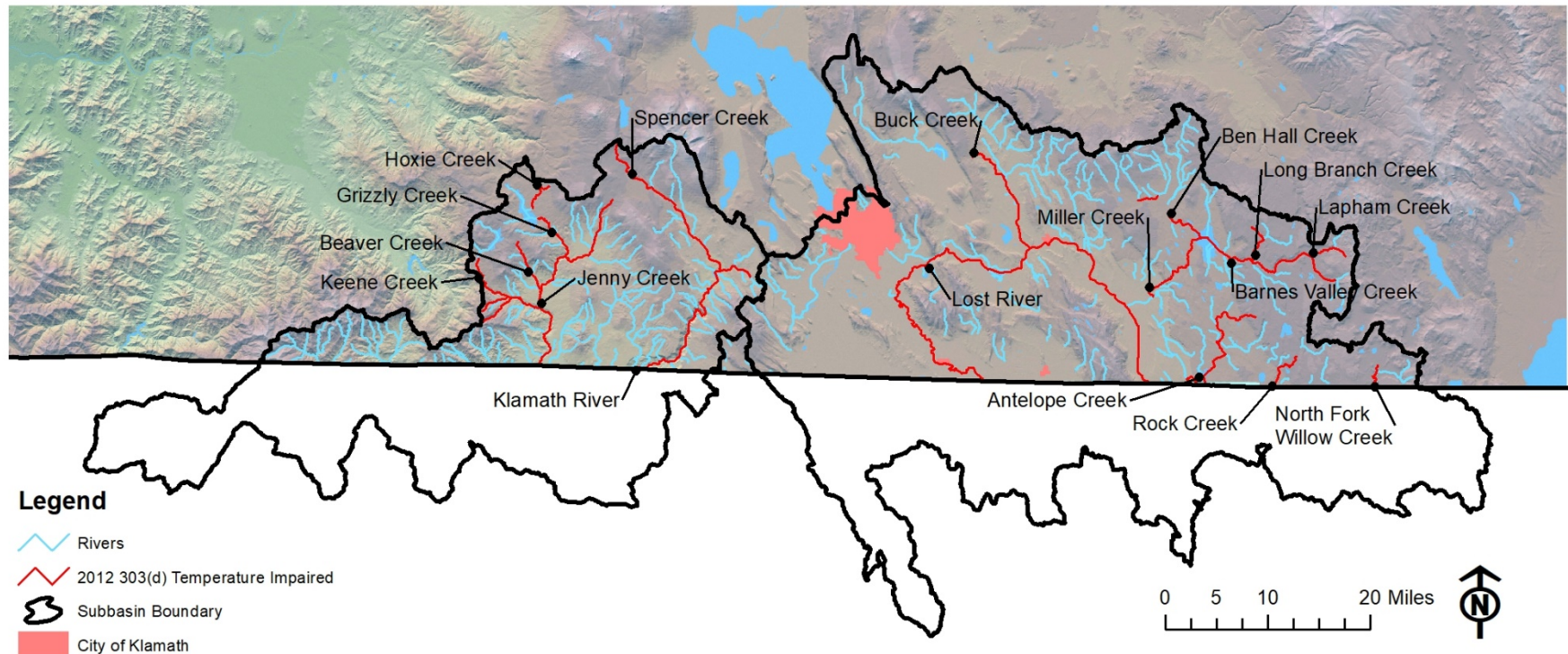
TMDL Elements

Modeling and Analysis

Stage 1 Waterbodies

Stage 2 Waterbodies

303(d) Temperature Impaired Waters



24 impaired segments - 2012 303(d) list

TMDL Elements

Waterbody Name and Location

Pollutant

Water quality standard and beneficial uses

Loading Capacity

Excess Load

Sources or Source categories

Wasteload Allocations

Load Allocations

Margin of Safety

Seasonal Variation

Reserve Capacity

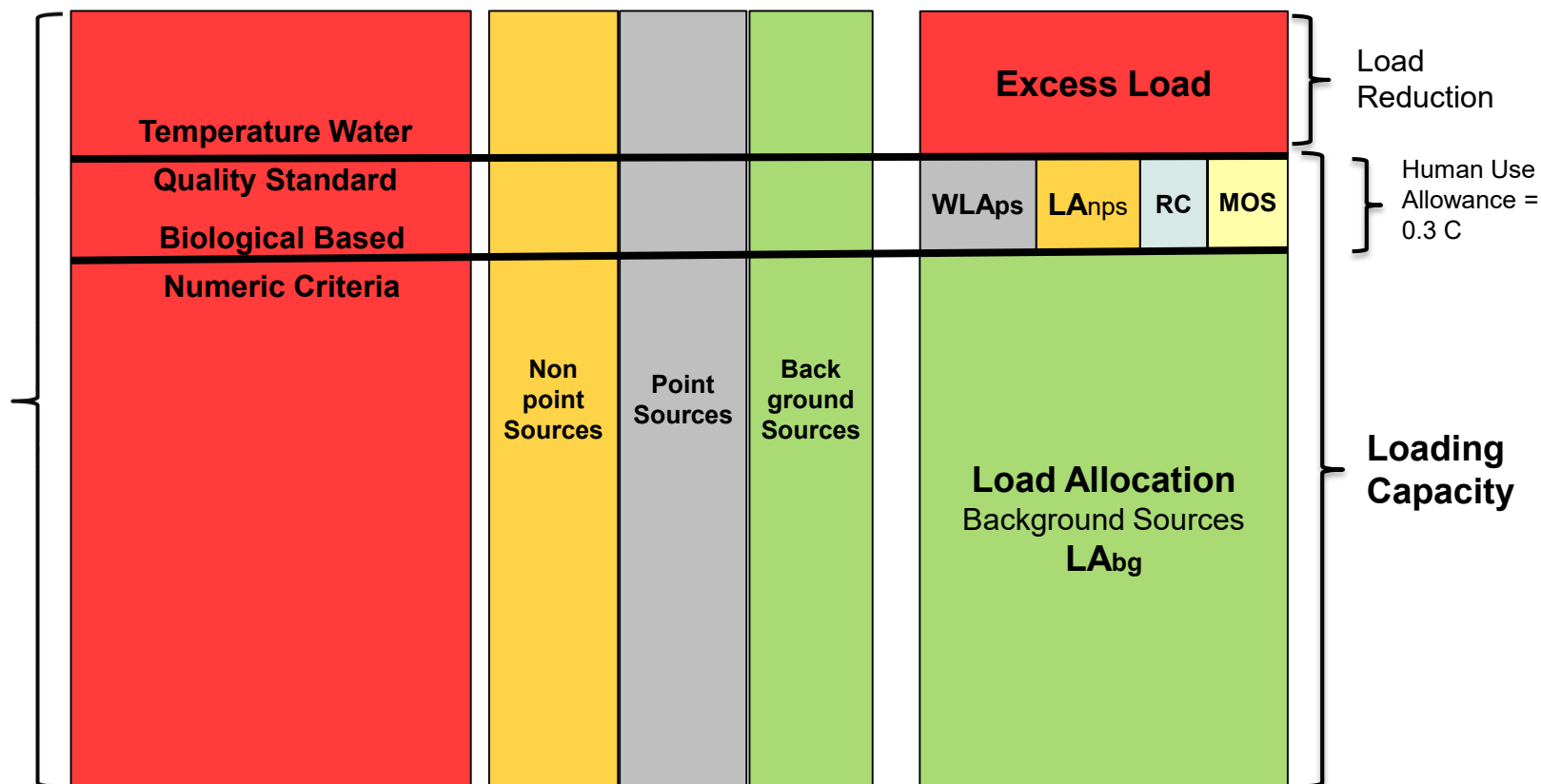
$$\text{TMDL} = \text{WLA}_{ps} + \text{LA}_{nps} + \text{LA}_{bg} + \text{MOS} + \text{RC}$$

Current Conditions
303(d) list

Source
Identification

TMDL and Load
Reductions

Pollutant
Loading



Technical Approach Overview

Technical Approach / Implementation Support	TMDL Development Stage
No modeling (Basic TMDL calculation)	Stage 1
Vegetation Assessment Solar radiation and effective shade modeling	Stage 1
Stream Temperature Modeling Various implementation and TMDL attainment scenarios	Stage1 and Stage 2
Range of conditions analysis/sensitivity analysis (TBA pending resources)	Stage 2

TMDL Loading Capacity Equation

$$LC = (T_C + HUA) \times Q_R \times C_F$$

$LC =$	Loading Capacity (kilocalories/day).
$T_C =$	The applicable temperature criteria ($^{\circ}\text{C}$).
$HUA =$	The 0.3°C human use allowance allocated to point sources, nonpoint sources, margin of safety, or reserve capacity.
$Q_R =$	The daily average river flow rate, upstream (cubic feet per second [cfs]).
$C_F =$	Conversion factor using cfs: (2,446,622 kcal-s/$^{\circ}\text{C}$-ft³-day) $\frac{1 \text{ m}^3}{35.314 \text{ ft}^3} \times \frac{1000 \text{ kg}}{1 \text{ m}^3} \times \frac{86,400 \text{ sec}}{1 \text{ day}} \times \frac{1 \text{ kcal}}{1 \text{ kg} \times 1^{\circ}\text{C}} = 2,446,622$

Loading Capacity Stream Flow Ranges

Flow Condition	Statistical Representation	Applicable River Flow Range	Description
Low	7Q10	$Q_R < 95^{\text{th}}$ percentile	Lowest 7-day average flow that occurs (on average) once every 10 years (7Q10).
Dry	95 th percentile	95^{th} percentile $\leq Q_R < 50^{\text{th}}$ percentile	Flow that is exceeded approximately 95%, or the vast majority, of the time.
Mild	50 th percentile	50^{th} percentile $\leq Q_R < 25^{\text{th}}$ percentile	Flow that is considered within the typical or <i>normal</i> range; includes the median flow for a stream.
Moderate	25 th percentile	25^{th} percentile $\leq Q_R < 10^{\text{th}}$ percentile	Flow that is exceeded only 25% of the time, considered to be <i>above</i> the normal range.
High	10 th percentile	10^{th} percentile $\leq Q_R < 5^{\text{th}}$ percentile	Flow that is exceeded only 10% of the time, considered to be <i>far above</i> the normal range; often associated with the rainy season and higher storm flows.
Very High	5 th percentile	$Q_R \geq 5^{\text{th}}$ percentile	Flow that is infrequently exceeded; represents very high flows that do not occur often.

Stream Flow Data Sources

USGS/OWRD Gaged Stream (e.g. Spencer Creek)

Ungaged Sites

- USGS StreamStats - Cooper (2005) and Risley et al. (2008)
- Model Outputs (e.g. Lost River CE-QUAL-W2)

Cooper, R. M., 2005, Estimation of Peak Discharges for Rural, Unregulated Streams in Western Oregon: U. S. Geological Survey Scientific Investigations Report 2005-5116, 134 p.

Risley, J., Stonewall, A., and Haluska, T., 2008, Estimating flow-duration and low-flow frequency statistics for unregulated streams in Oregon: U.S. Geological Survey Scientific Investigations Report 2008-5126, 22 p.

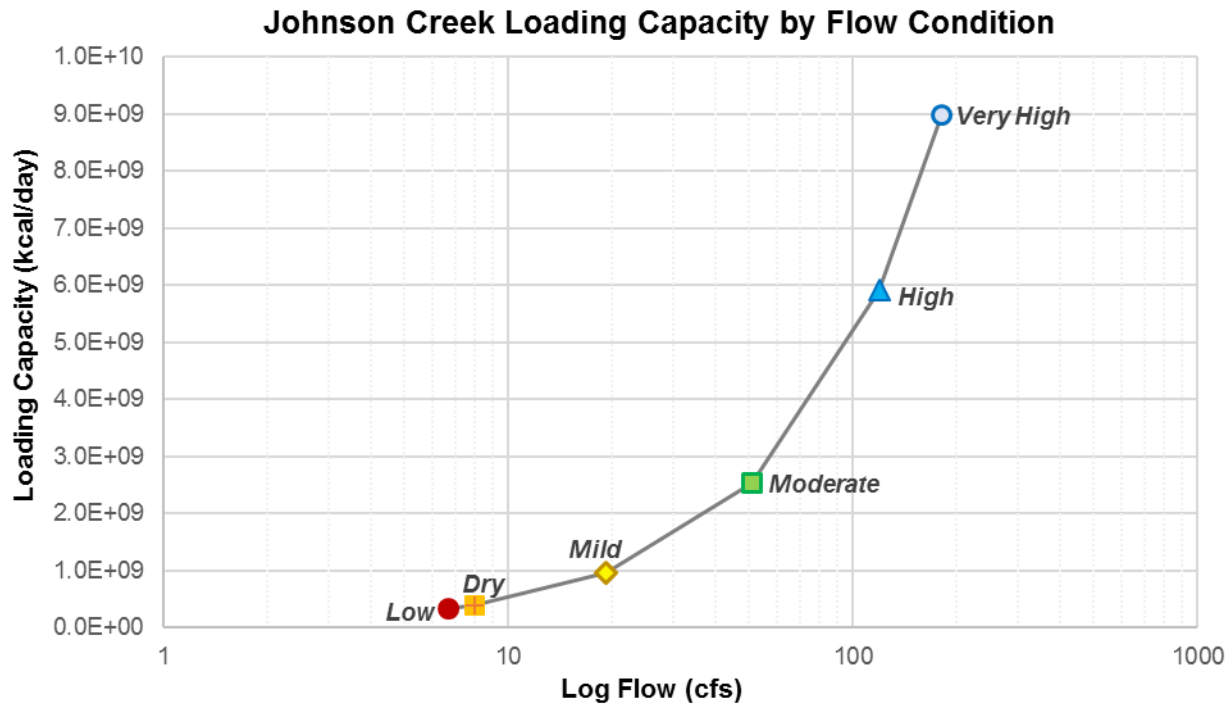
USGS StreamStats

The screenshot displays the USGS StreamStats web application. The browser address bar shows the URL <https://streamstats.usgs.gov/ss/>. The top navigation bar includes links for Apps, DEQ, GIS, Water, Climate, Publications, Models, Sediment, Monitoring Methods, code, python, canopy, and Google Scholar. The USGS logo and "StreamStats" text are prominently displayed. On the right side of the header, there are links for Report, About, and Help.

The main interface is divided into a left sidebar and a central map area. The sidebar contains a "SELECT A STATE / REGION" button, a "Step 1" instruction box, a search bar with the placeholder "Search for a place", a "Help" link, and three main navigation buttons: "IDENTIFY A STUDY AREA", "SELECT SCENARIOS", and "BUILD A REPORT". At the bottom of the sidebar, there are links for "USGS Home", "Contact USGS", "Search USGS", "Accessibility", "FOIA", "Privacy", and "Policy & Notices".

The central map area shows a topographic map of Oregon. Key geographical features labeled include the Willamette Valley, Cascade Range, Blue Mountains, Ococho Mountains, Aldrich Mountains, Great Sandy Desert, Harney Basin, and various mountain ranges like the Wallowa, Boise, and Brunau. Cities such as Portland, Salem, Eugene, Bend, Medford, and Boise are marked. A "Layers" panel on the right side of the map allows users to toggle between "Base Maps" and "National Layers". A "Zoom Level: 7" box in the bottom left corner of the map area provides map scale information: "Map Scale: 1:4,622,324" and "Lat: 41.5579, Lon: -125.1563". A scale bar at the bottom left indicates distances of 50 km and 50 mi. The map is powered by WIM (Web Information Manager) and uses Leaflet and Esri mapping services.

Johnson Creek Loading Capacity (Draft)



Flow Condition	Representative Flow Estimate (cfs)	Applicable Flow Range	Thermal Loading Capacity (kcal/day)
Low	7	<8 cfs	3.33E+08
Dry	8	8 cfs to <19 cfs	3.97E+08
Mild	19	19 cfs to <51 cfs	9.54E+08
Moderate	51	51 cfs to <119 cfs	2.54E+09
High	119	119 cfs to <181 cfs	5.91E+09
Very High	181	≥181 cfs	8.99E+09

Modeling Process

Model Development

Data gathering (historic data, field monitoring)

Model input preparation and configuration

Model Evaluation

Calibration / Corroboration (predicted vs. measured conditions)

Peer review

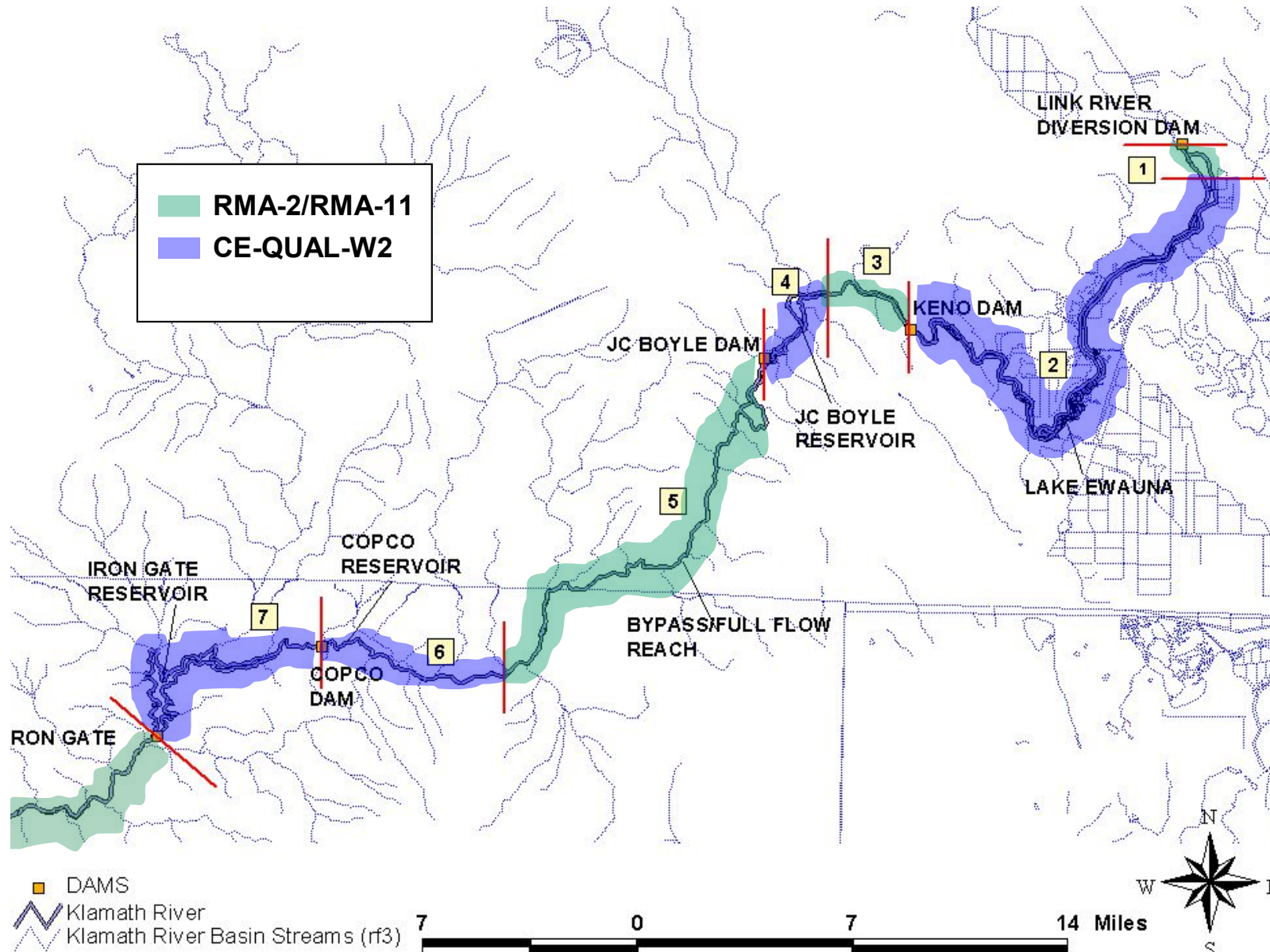
Model Scenarios

Analysis of TMDL Alternatives – Compliance Scenarios

Model Overview

River	Klamath River	Lost River	Tributaries
Model Extent	Upper Klamath Lake to Pacific Ocean	Malone Dam to Klamath Straits Drain	See slide 17
Model	CE-QUAL-W2, RMA, EFDC	CE-QUAL-W2	Heat Source
Model Period	2000 and 2002	1999 and 2004	July 2001, July 2005
Model Developer	Tetra Tech	Tetra Tech	ODEQ

Klamath River Model Overview



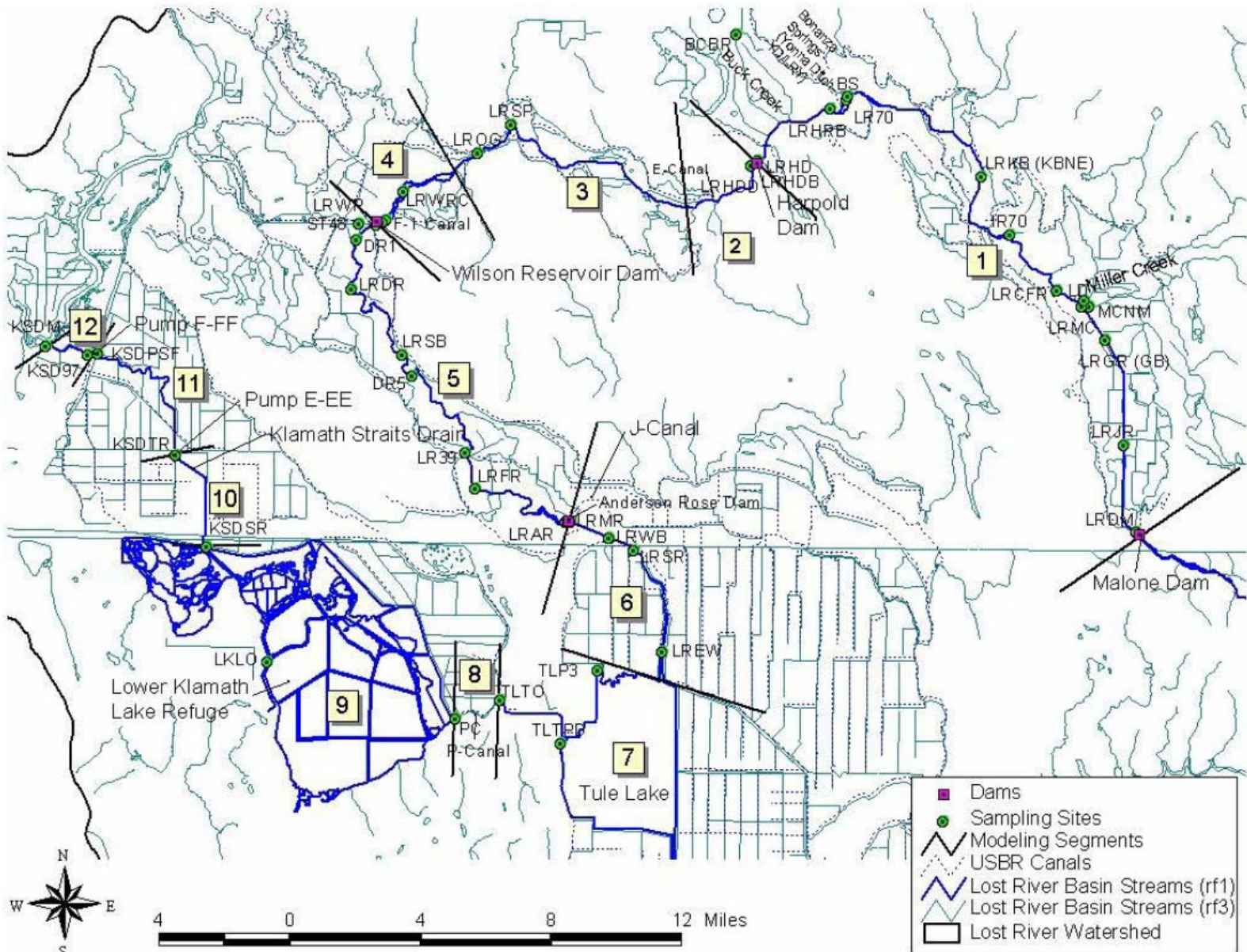
Klamath River Model Scenarios

Current Condition (2000, 2002)

Natural Condition Baseline (T1BSR)

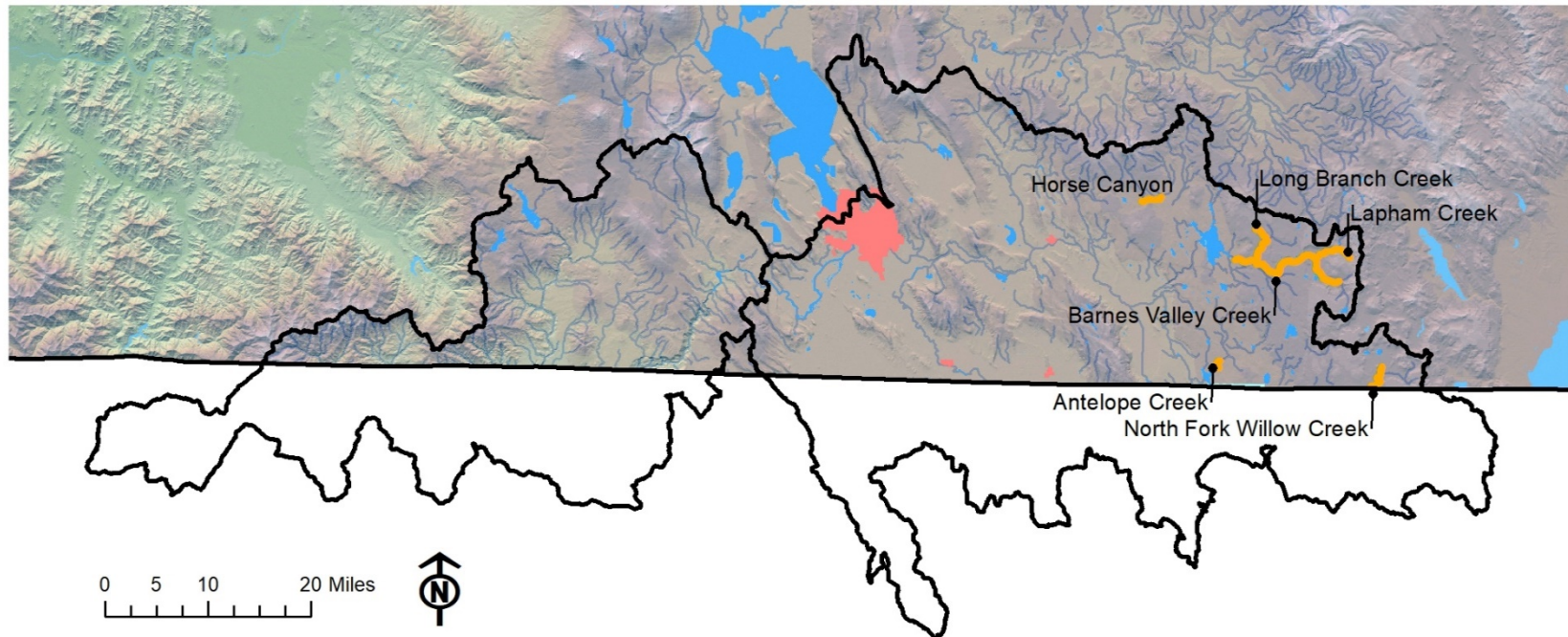
- Dams and reservoirs removed
- Point sources removed
- Upstream boundary based on Upper Klamath Lake
- Everything else same as current

Lost River Model Overview



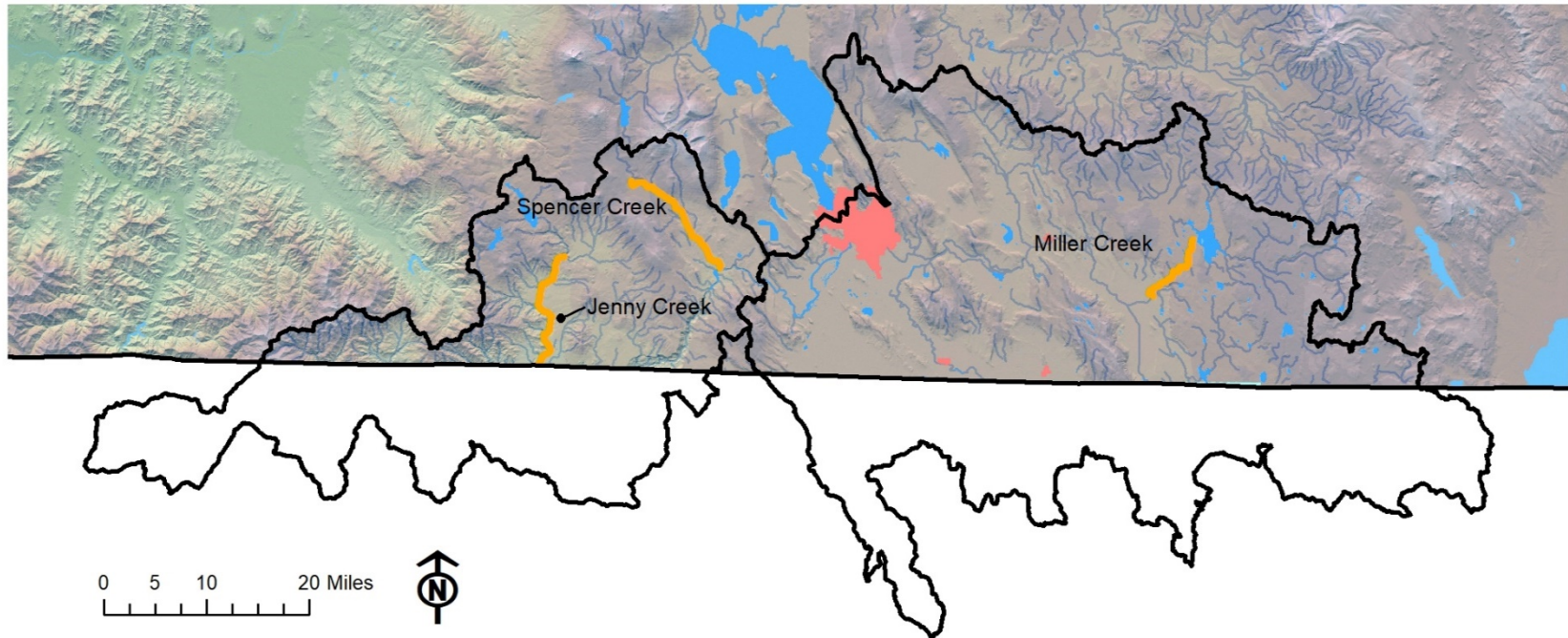
Tributary Solar Only Models

Model Output	Stream	Simulation Period	Simulation Extent
Solar Radiation and Effective Shade	Antelope Creek	July 15, 2005	1.77
	Barnes Valley Creek		23.9
	Horse Canyon		3.81
	Lapham Creek		7.44
	Long Branch		8.11
	North Fork Willow Creek		5.43



Tributary Temperature Models

Model Output	Stream	Simulation Period	Simulation Extent
Temperature	Jenny Creek	July 2001	Confluence with Johnson Creek to OR/CA border: 23.7 km
	Spencer Creek	July 2001	Headwaters to mouth: 25.2 km
	Miller Creek	July – Early August 2001	Gerber Reservoir to mouth: 14.57 km



Stage 1 Temperature Impaired Waters

Subbasin	303(d) ID	Stream Name	Length (River Miles)
Lost River	24458	Antelope Creek	14.1
	2182	Antelope Creek	1
	12738	Barnes Valley Creek	14
	12737	Ben Hall Creek	8.7
	12766	Buck Creek	12.8
	24459	East Branch Lost River	2.4
	2166	Horse Canyon Creek	2.2
	12726	Lapham Creek	4
	12732	Long Branch Creek	4.6
	24463	Lost River	60.6
	1994	North Fork Willow Creek	2.3
	12729	Rock Creek	4.3
Upper Klamath River	12872	Beaver Creek	5.5
	2158	Grizzly Creek	3
	2180	Hoxie Creek	3.6
	2159	Johnson Creek	9.4
	2163	Keene Creek	7.2
	2178	Keene Creek	2.2
	2168	Mill Creek	3.9
	2181	South Fork Keene Creek	3.1
	12815	Spencer Creek	18.9

Stage 1 Waterbodies

No temperature modeling – basic TMDL calculation

Modeling of management scenarios shows attainment of applicable criteria (e.g. Spencer Creek)

Stage 1 Waterbodies Next Steps

Allocations and Human Use Allowance

Complete TMDL and WQMP Draft Document

Stage 2 Temperature Impaired Waters

Subbasin	303(d) ID	Stream Name	Length (River Miles)
Lost River	1993	Miller Creek	9.6
Upper Klamath River	1984	Jenny Creek	17.8
	12840	Klamath River	24.1

Additional modeling required

Potential Management Strategies Considered for Revised model scenarios

Streamside vegetation (site potential)

Natural flows for headwaters and tributaries (surface withdrawals returned, no groundwater pumping, no diversions), including associated temperature changes

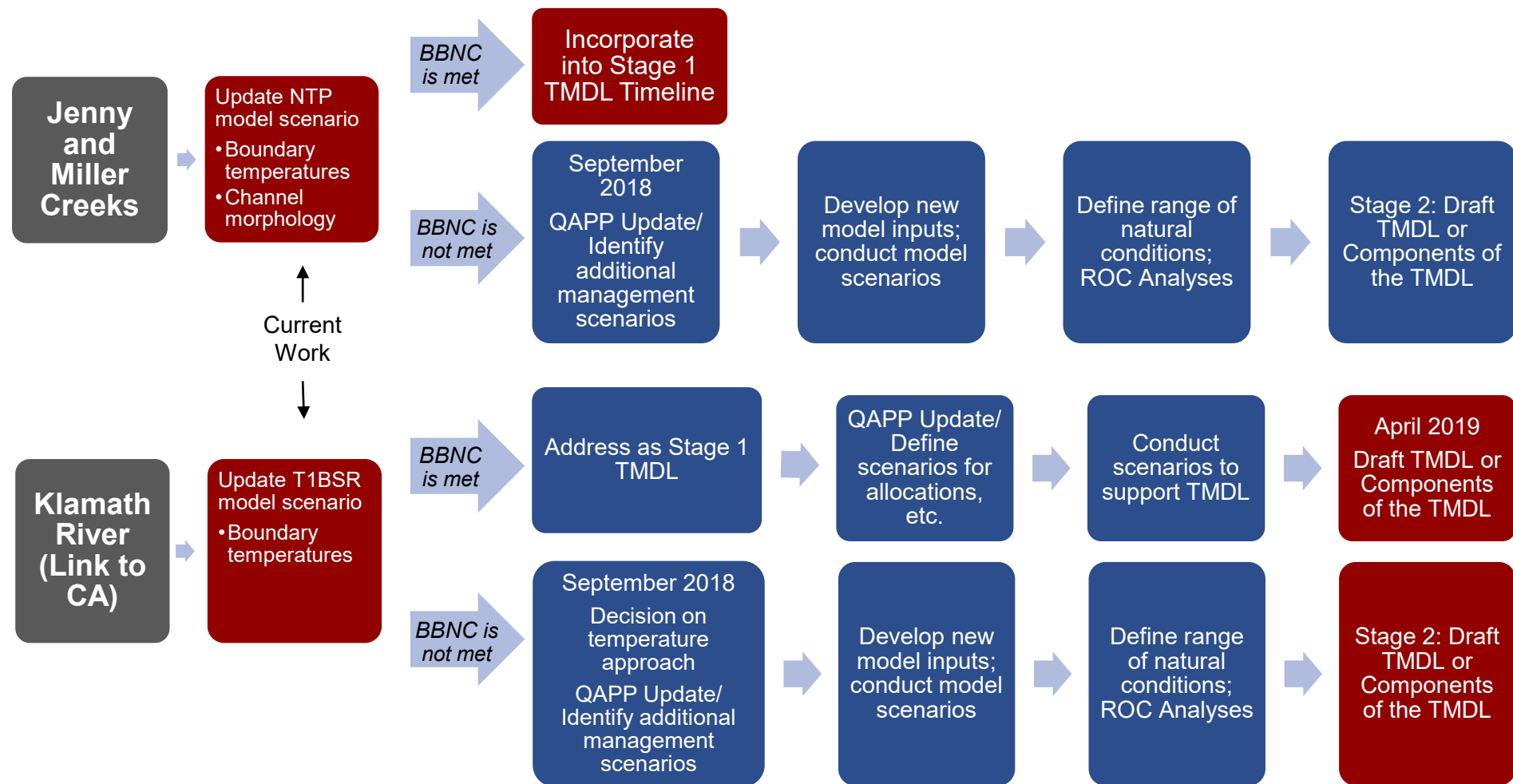
No dams or modified dam management

Channel morphology improvements

No point sources discharges to waterbody

Climate change factors (e.g. air temperatures)

Stage 2 Waterbodies Next Steps



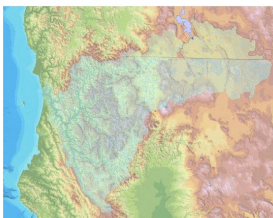
Additional Background Information

Upper Klamath and Lost River Subbasins Nutrient TMDLs (2017) Appendix A, B, C, F

<https://www.oregon.gov/deq/wq/tmdls/Pages/TMDLs-Klamath-Basin.aspx#klamath2017>

Appendix A

Data Review and Modeling Approach – Klamath and Lost Rivers TMDL Development



Prepared By
Tetra Tech

Water Resources and TMDL Center

Klamath River Model for TMDL Development

December 2009



Prepared for:
U.S. Environmental Protection Agency Region 9
U.S. Environmental Protection Agency Region 10
North Coast Regional Water Quality Control Board
Oregon Department of Environmental Quality

Prepared by:
TETRA TECH
Water Resources and TMDL Center

Appendix C:

Klamath River Model Scenarios Summary



Prepared By
Tetra Tech

Water Resources and TMDL Center

Lost River Model for TMDL Development

August 2005



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Oregon Department of Environmental Quality
North Coast Regional Water Quality Control Board

Prepared by:
TETRA TECH
Water Resources and TMDL Center
Tetra Tech, Inc.



Thank you!

Extra Slides

Lost River Model Overview

