Upper Klamath and Lost River Subbasins Temperature TMDL Development

Technical Approach Overview

Tribal Coordination

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DEQ
State of Oregon
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Environmental
Quality

Presentation Overview

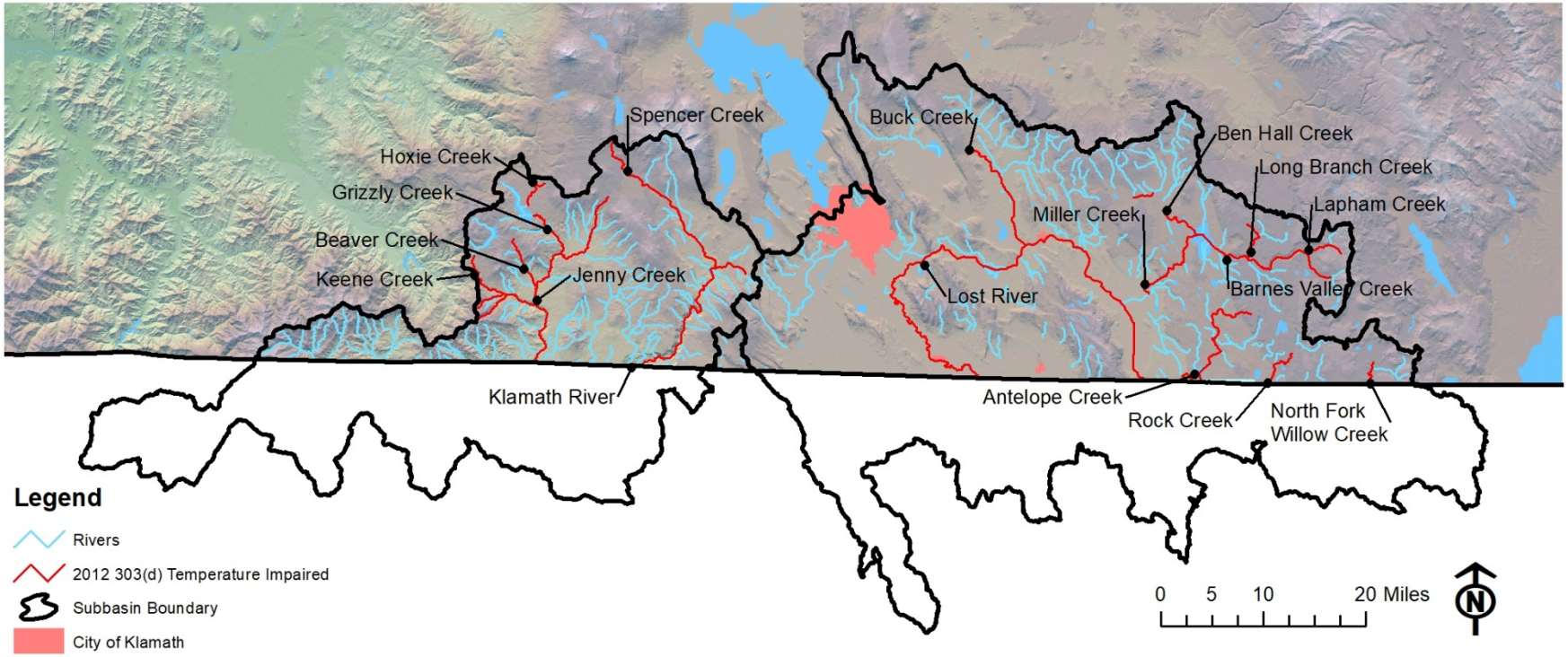
TMDL Elements

Modeling and Analysis

Stage 1 Waterbodies

Stage 2 Waterbodies

303(d) Temperature Impaired Waters

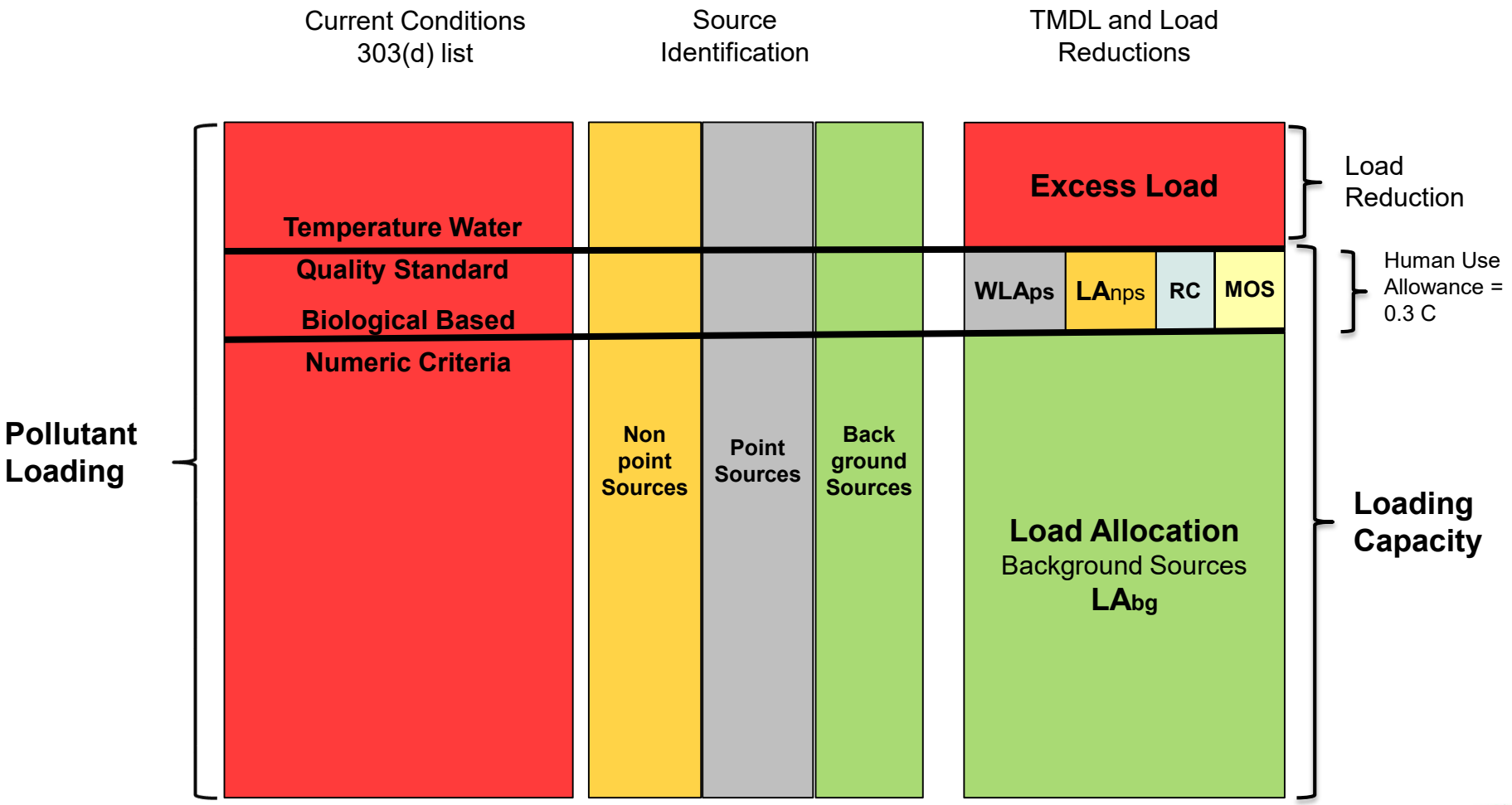


24 impaired segments - 2012 303(d) list

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

$TMDL = WLA_{ps} + LA_{nps} + LA_{bg} + MOS + RC$



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 (°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/°C-ft^3-day) $\frac{1\ m^3}{35.314\ ft^3} \times \frac{1000\ kg}{1\ m^3} \times \frac{86{,}400\ sec}{1\ day} \times \frac{1\ kcal}{1\ kg \times 1°C} = 2{,}446{,}622$

Loading Capacity Stream Flow Ranges

Flow Condition	Statistical Representation	Applicable River Flow Range	Description
Low	7Q10	Q_R < 95th percentile	Lowest 7-day average flow that occurs (on average) once every 10 years (7Q10).
Dry	95th percentile	95th percentile ≤ Q_R < 50th percentile	Flow that is exceeded approximately 95%, or the vast majority, of the time.
Mild	50th percentile	50th percentile ≤ Q_R < 25th percentile	Flow that is considered within the typical or *normal* range; includes the median flow for a stream.
Moderate	25th percentile	25th percentile ≤ Q_R < 10th percentile	Flow that is exceeded only 25% of the time, considered to be *above* the normal range.
High	10th percentile	10th percentile ≤ Q_R < 5th percentile	Flow that is exceeded only 10% of the time, considered to be *far above* the normal range; often associated with the rainy season and higher storm flows.
Very High	5th percentile	Q_R ≥ 5th 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)

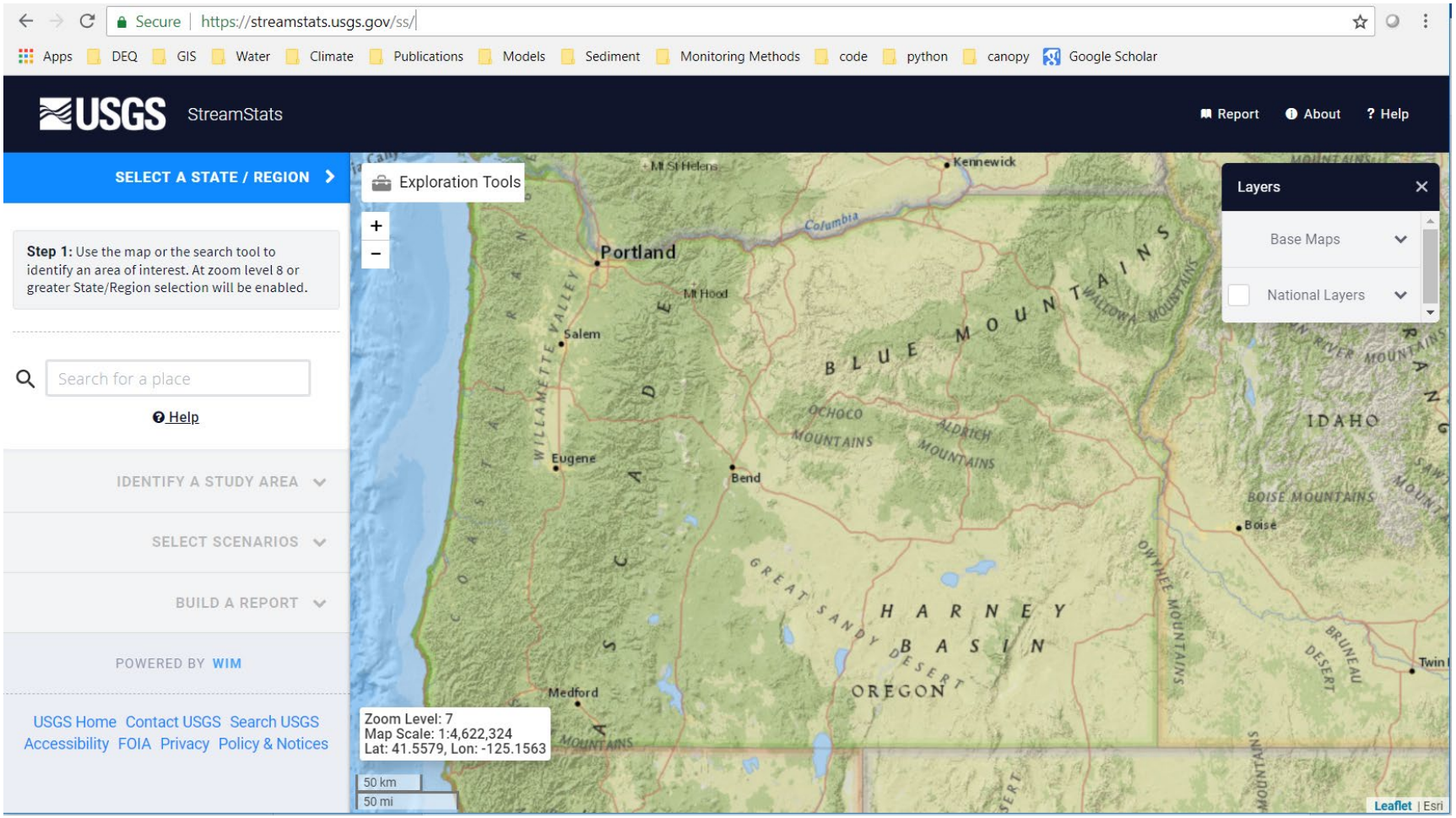
Ungaged Sites

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

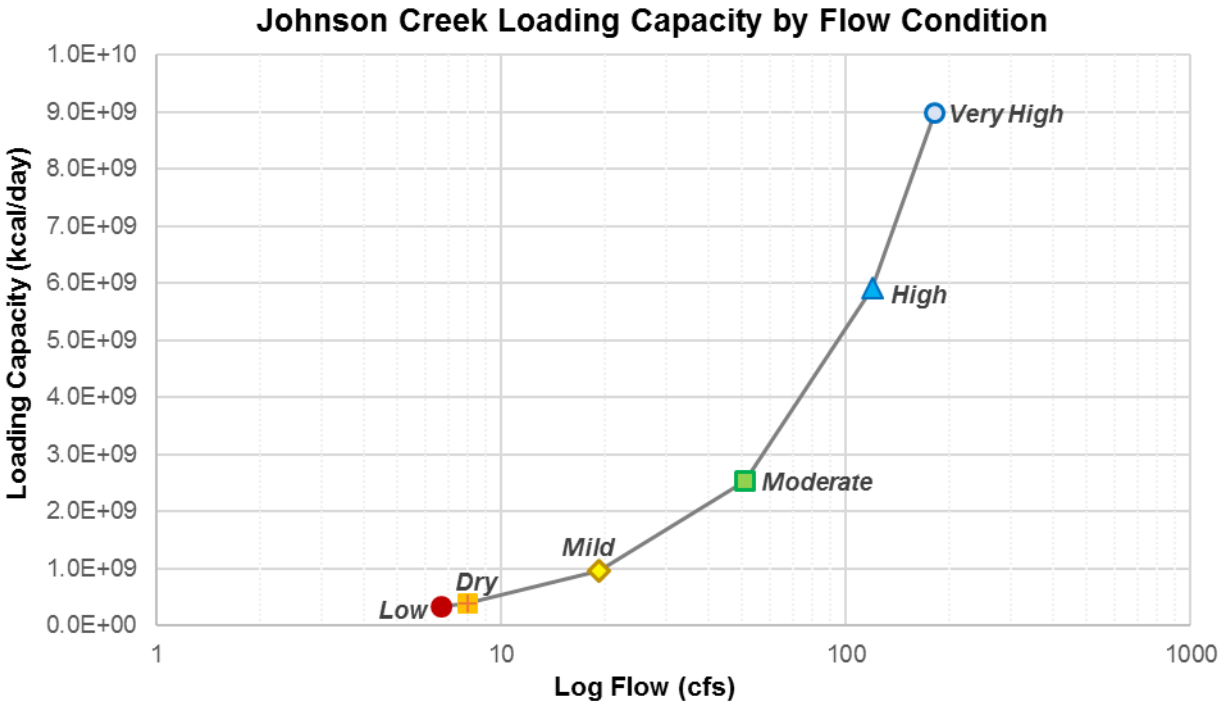
Cooper, R. M., 2005, Estimation of Peak Discharges for Rural, Unregulated Streams in Western Oregon: U. S. Geological Survey Scientific Investigations Report 2005-5116, 134 p.

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



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

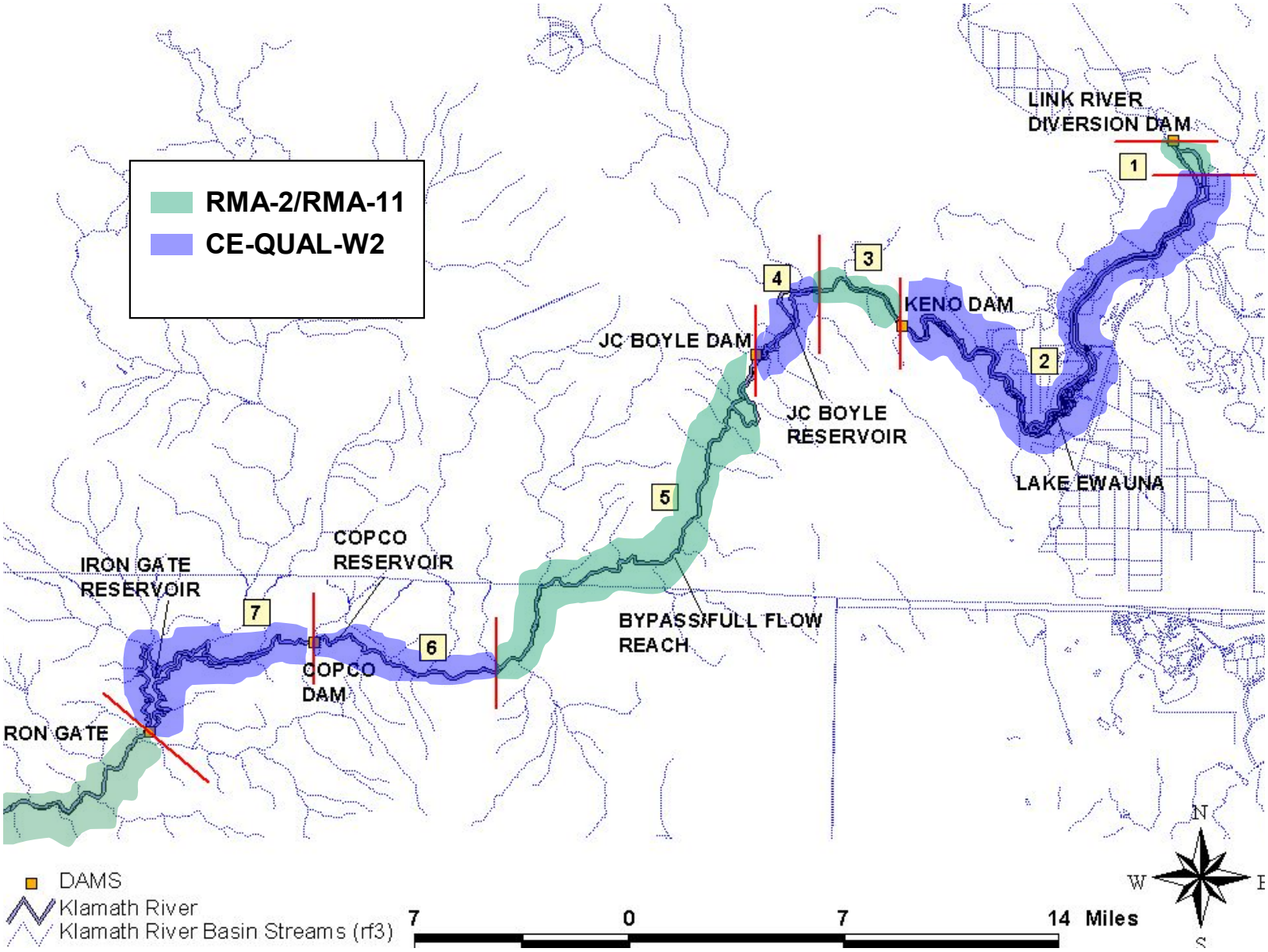
Model Scenarios

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



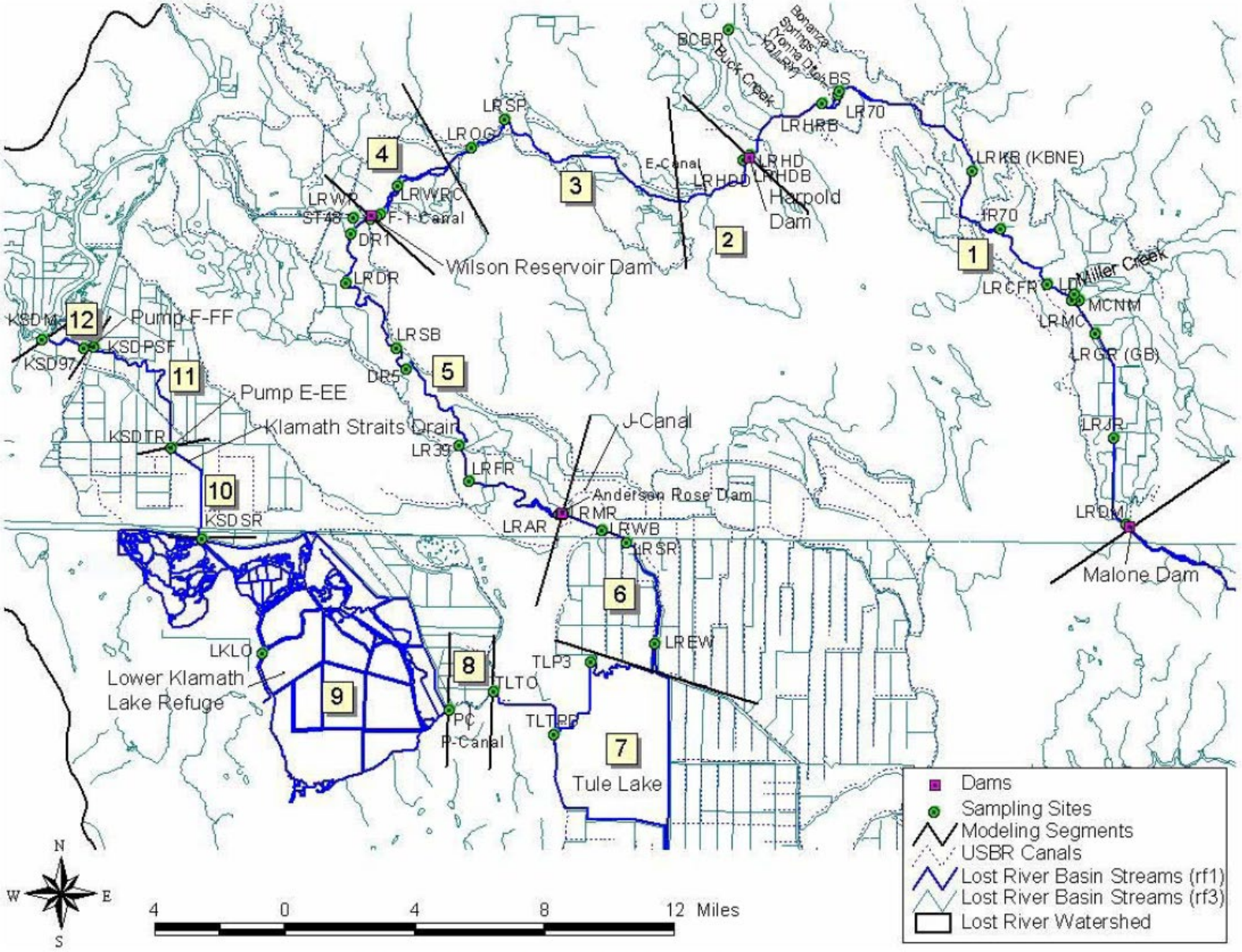
Klamath River Model Scenarios

Current Condition (2000, 2002)

Natural Condition Baseline (T1BSR)

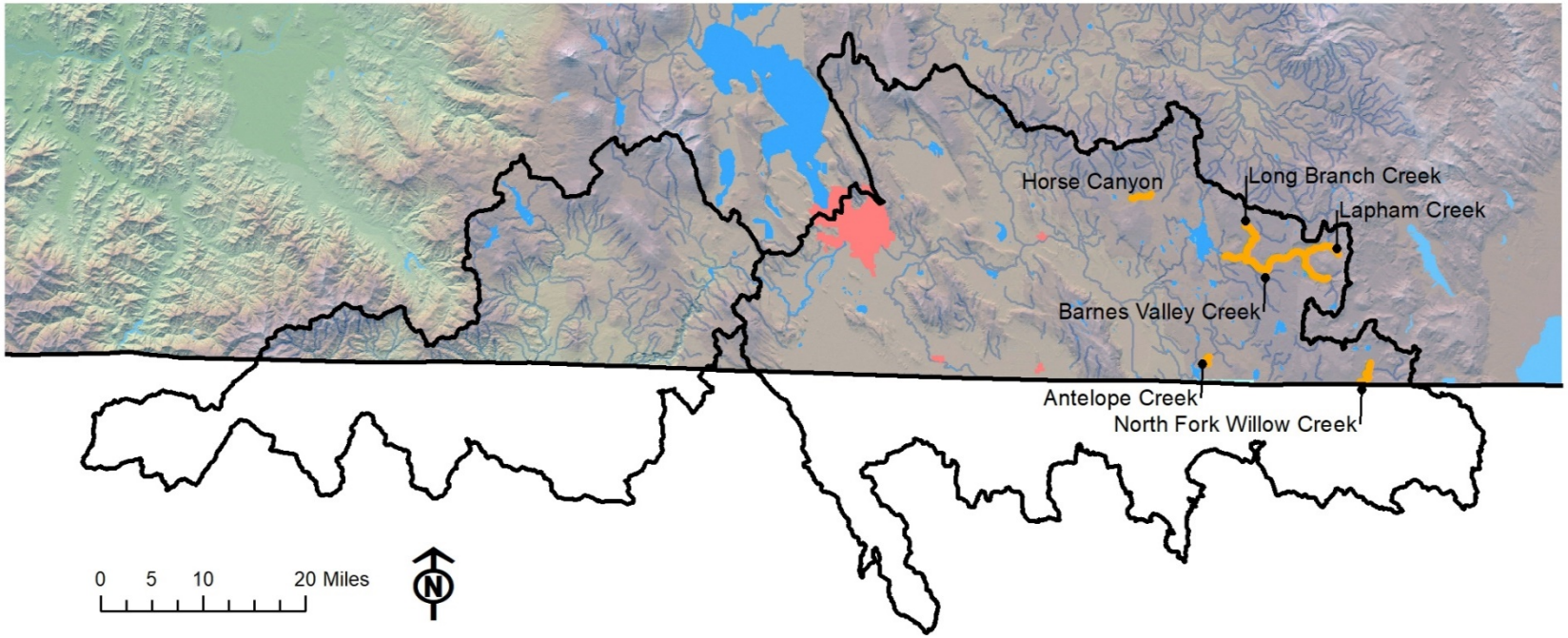
- Dams and reservoirs removed
- Point sources removed
- Upstream boundary based on Upper Klamath Lake
- Everything else same as current

Lost River Model Overview



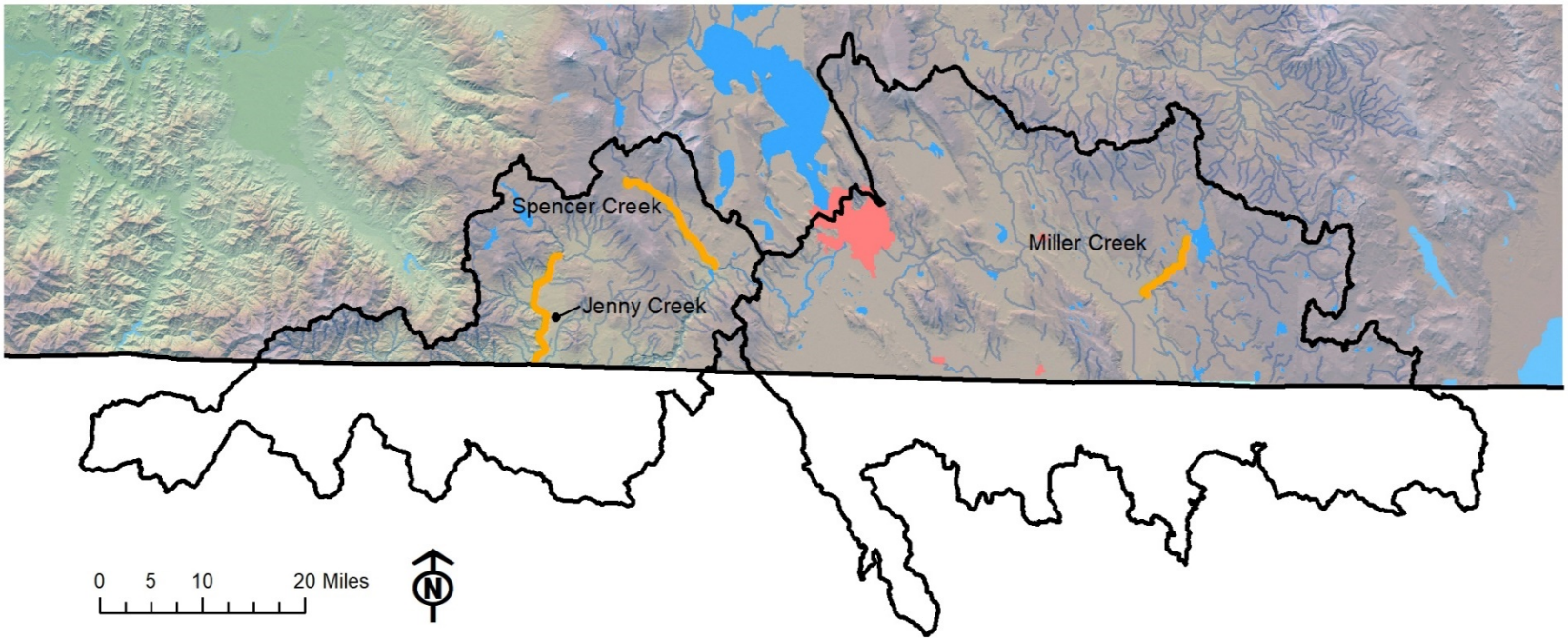
Tributary Solar Only Models

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

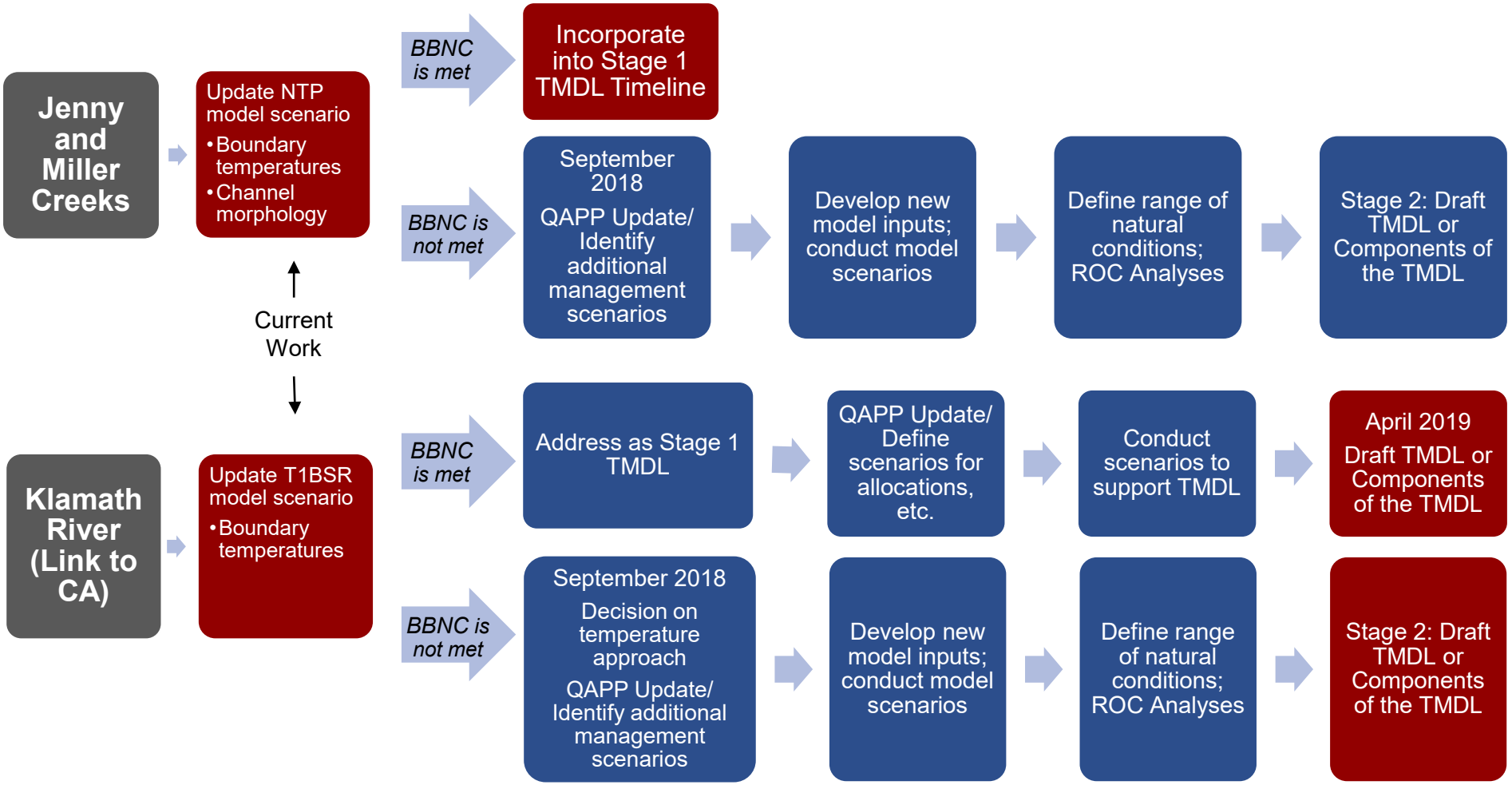
No dams or modified dam management

Channel morphology improvements

No point sources discharges to waterbody

Climate change factors (e.g. air temperatures)

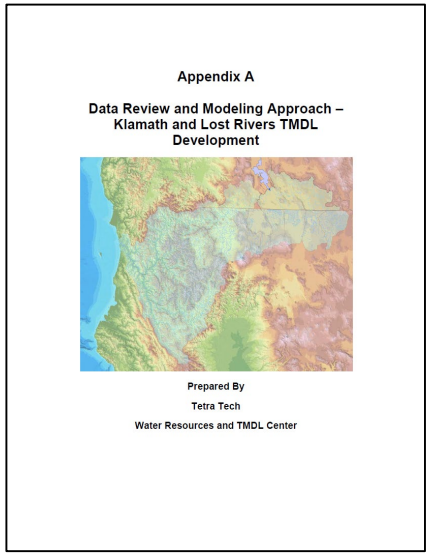
Stage 2 Waterbodies Next Steps

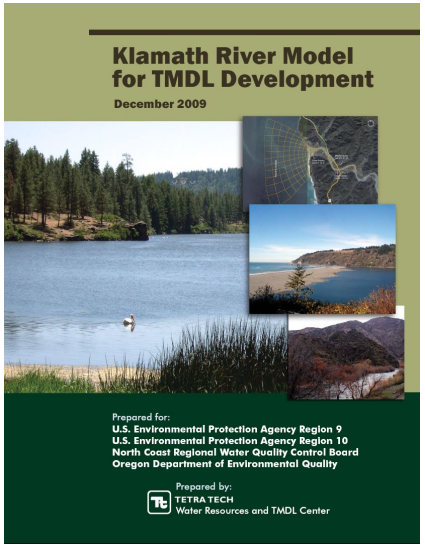


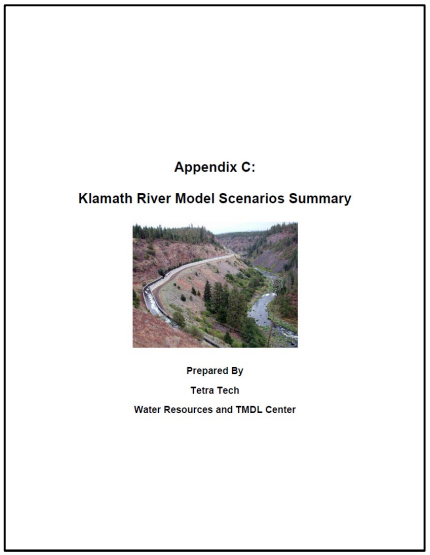
Additional Background Information

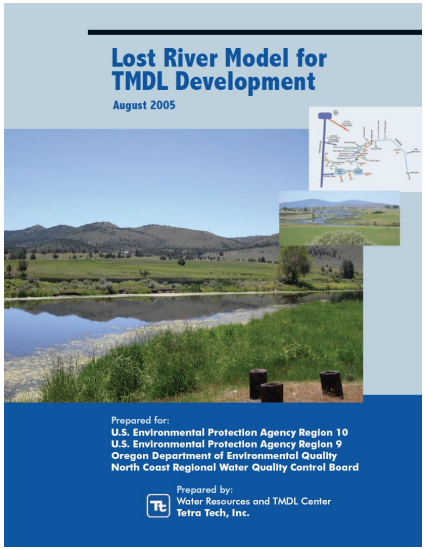
Upper Klamath and Lost River Subbasins
Nutrient TMDLs (2017)
Appendix A, B, C, F

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









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Thank you!

Extra Slides

Lost River Model Overview