

An aerial photograph of a large dam and reservoir in a mountainous region. The dam is a long, low structure with a concrete spillway. The reservoir is a large, irregularly shaped body of water. The surrounding landscape is a mix of dry, brownish hills and green forested areas. The sky is clear and blue.

The Klamath Basin Secretarial Determination: Water Quality Considerations for Decisions about Dam Removal

Chauncey W. Anderson, USGS, Portland, OR

Paul Zedonis, USBR*, Redding, CA

Susan Keydel, USEPA, San Francisco, CA

Outline

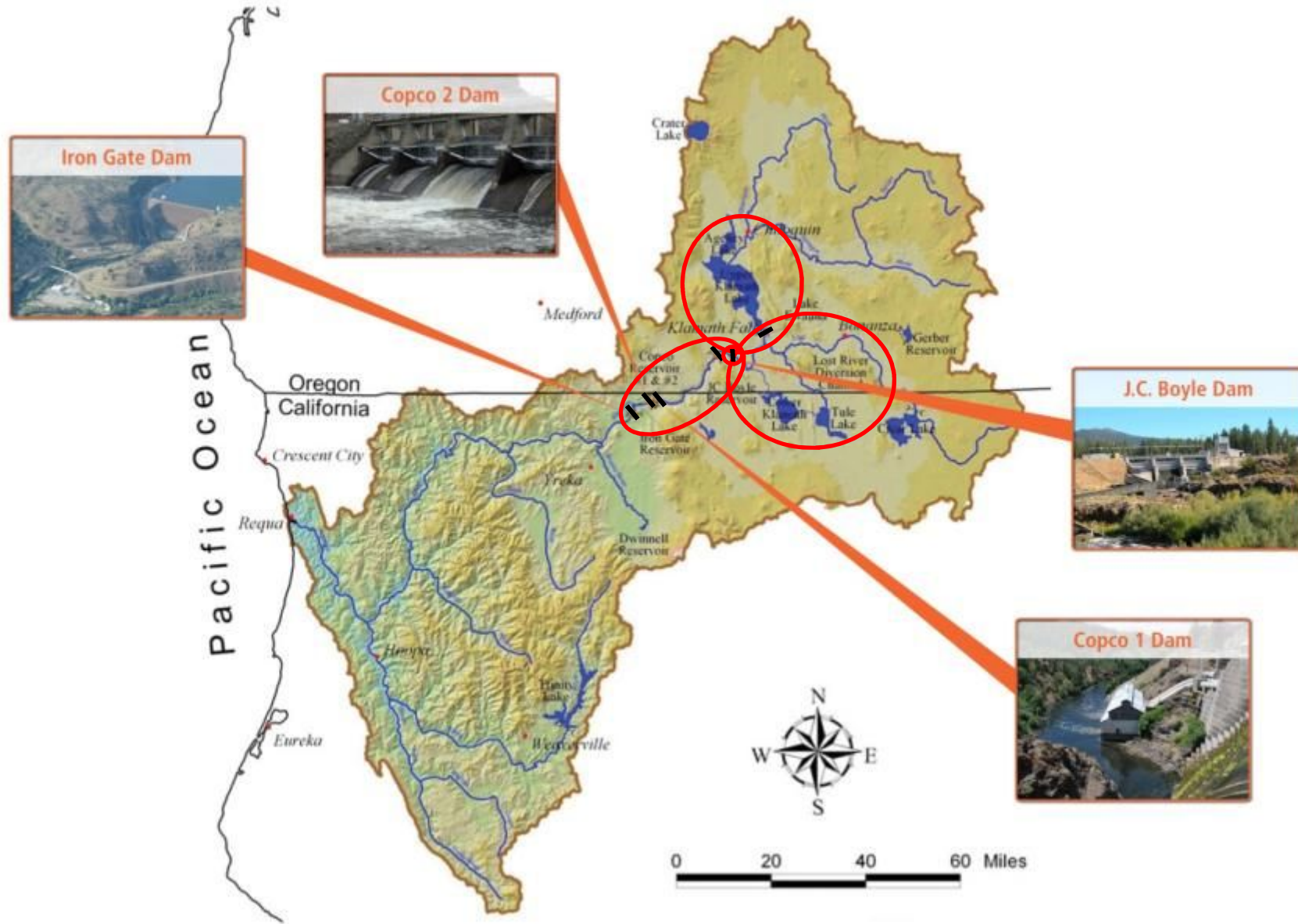
An aerial photograph of a large, blue reservoir nestled in a valley. The surrounding landscape is rugged and mountainous, with patches of green forest and brownish, rocky terrain. The sky is clear and blue, and the overall scene is a natural, scenic view of a water body in a mountainous region.

- **Introduction to the Klamath Basin and related water quality issues**
- **Overview of Klamath Secretarial Determination and the role of water quality in it**
- **Provide background for talks following, by Singer, Perry, & Asarian**

Take Home Messages

- **Water quality is integral to Klamath Basin decision process regarding dam removal**
 - Physical setting of reservoirs
 - Hydrological and land use modifications upstream
 - Affects on high priority uses downstream
- **Secretarial Determination**
 - Decision process about implementation of local Agreements
- **New water quality studies and reports:**
 - Reservoir sediment contaminants
 - Oxygen demand from resuspended reservoir sediments
 - Water temperature changes from dam removal
 - Qualitative assessment of likely future changes in water quality

The Klamath Basin



JC Boyle Dam 68 ft



Copco 1 Dam 115 ft

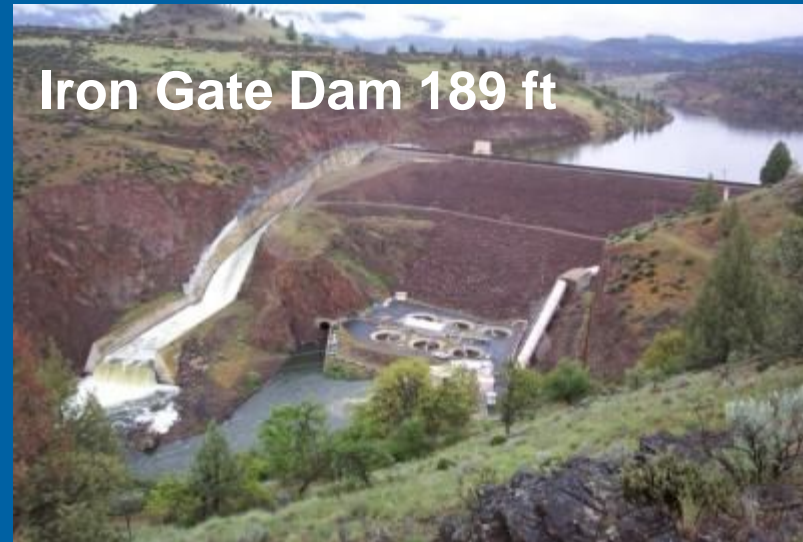


Copco 2 Dam 33 ft



PacifiCorp Hydroelectric Dams

Iron Gate Dam 189 ft



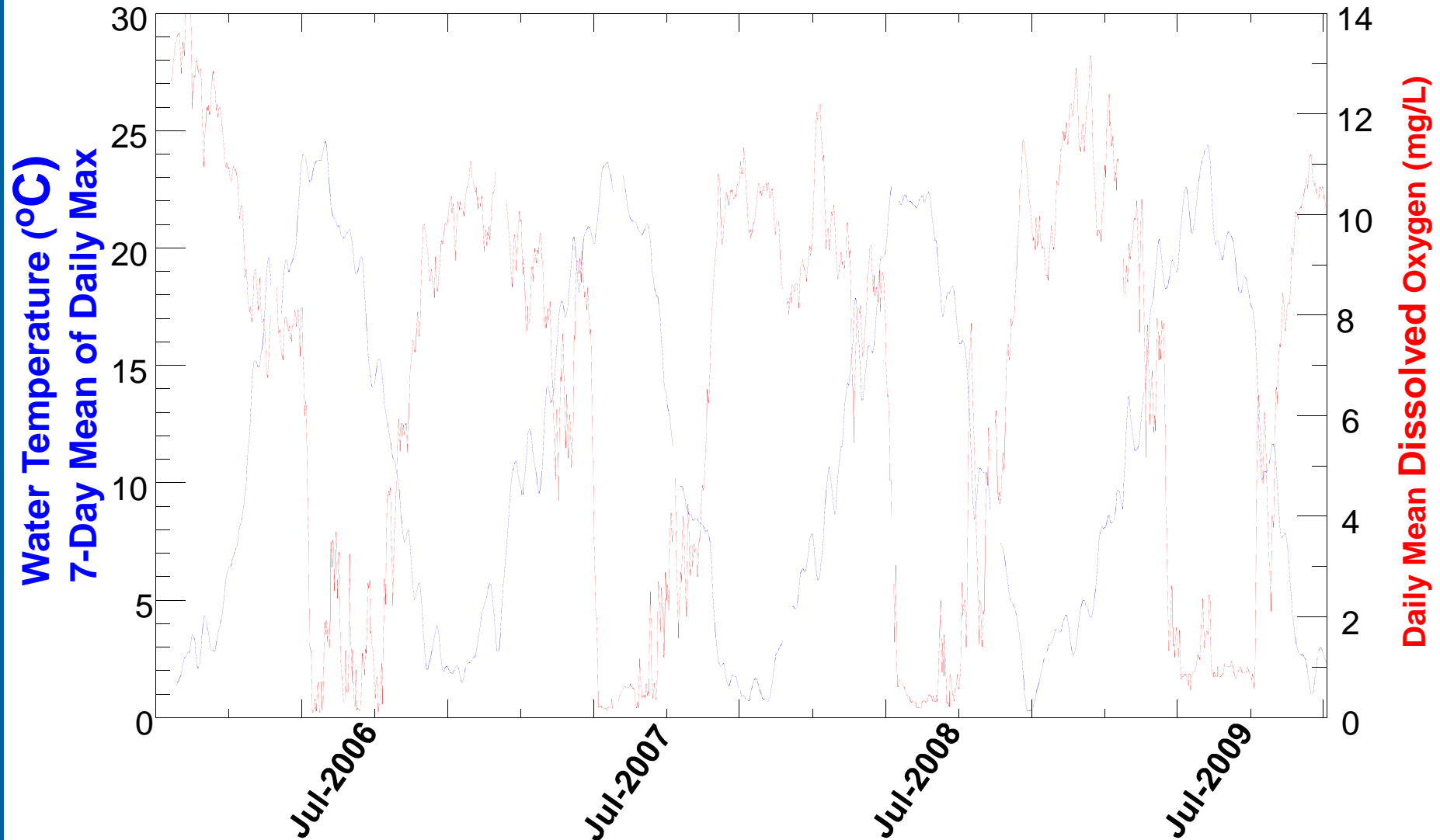
- 82 megawatts (70,000 homes)
- No irrigation / drought relief
- Minimal flood benefit
- ~13,000,000 cubic yards sediment
- FERC Relicensing
 - Inadequate fish passage
 - Clean Water Act Requirements

The Secretarial Determination

- Decision by Secretary of Interior on implementation of two Agreements
- *Klamath Hydroelectric Settlement Agreement (KHTSA)*
 - Proposal to remove 4 PacifiCorp dams in 2020
 - Interim Measures to improve water quality and habitat
- *Klamath Basin Restoration Agreement (KBRA)*
 - Restore streams, provide reliable water supplies
 - Basin-wide approach (upstream, downstream, tribs)
- Complementary, “Connected” actions
- Key questions: costs, risks & liabilities, restoration of salmonid fisheries, public interest
- Formal EIS / EIR process, 50-year period of analysis
- Multidisciplinary Federal Team, technical subteams

Water Quality in Keno Reach is inhospitable to fish during summers

Klamath R. at Miller Island Boat Ramp



Effect of Reservoirs on Water Quality

- Receive water from upstream with poor quality
- Large cyanobacterial blooms (AFA, MSAE)
- Modify annual and seasonal nutrient dynamics
- Violations of water quality standards (in-reservoir and downstream)
- Shifts in timing of water temperature patterns
- Modified discharge patterns within Hydroelectric Area and downstream
- Sediment interception

Water Quality Subteam

New Investigations / Reports

- Added to large body of water-quality literature for the Klamath Basin
- Sediment chemistry & toxics (summarized here)
- Oxygen demand from mobilized reservoir sediment (See Maia Singer's talk, this session)
- Water temperature modeling & climate change (See Russell Perry's talk, this session)
- Anticipated future water quality conditions
- Final reports are on KlamathRestoration.gov

Reservoir Sediment Chemistry

CDMSmith, 2011, *Screening-Level Evaluation of Contaminants in Sediments from Three Reservoirs and the Estuary of the Klamath River, 2009-2011*, prepared for the Water Quality Subteam of the Klamath Secretarial Determination, 164 pp + Appendixes, <http://KlamathRestoration.gov>



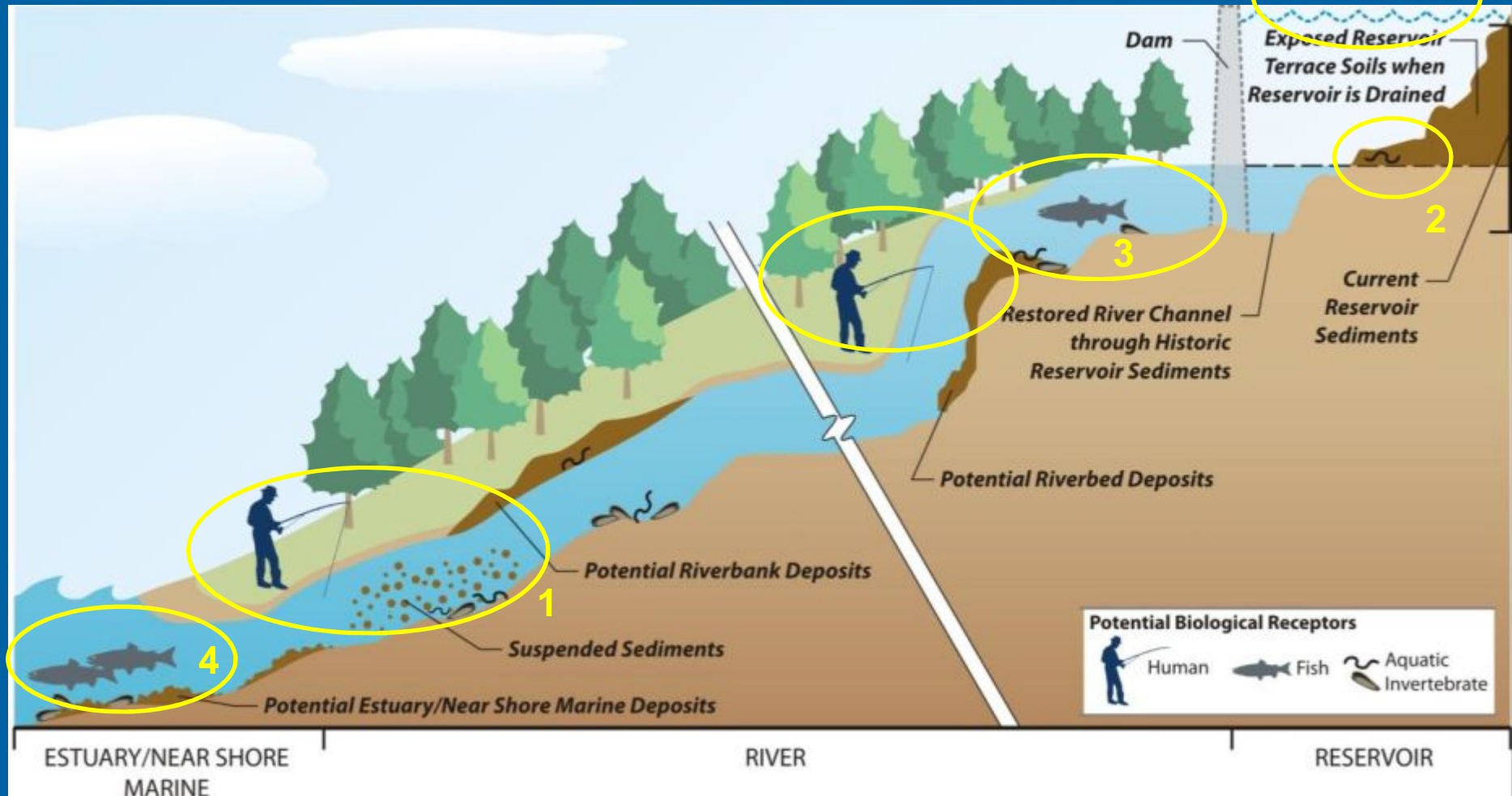
Sediment Evaluation Framework

- Multi-level decision making process
- Common approach to sediment disposal around the Pacific Northwest (e.g., dredging operations)
- Comparison with established guidelines, evaluation of toxicity tests
- Adapted for Klamath Basin needs with added studies

Sediment Chemistry Study, 2009-2010

- **Input from States & other agencies**
 - Informed by results from preliminary study in 2006
- **77 samples from reservoirs + Estuary**
- **Broad range of chemicals analyzed**
 - Dioxins/Furans, PCBs, OCs, VOCs, SVOCs, PAHs, PBDEs, Metals, Hg, Conventionals (TOC, Nutrients, Grain size)
- **Elutriates, toxicity bioassays, bioaccumulation in lab tests, reservoir fish**

Five Potential Exposure Pathways Evaluated



Summary of Sediment Chemistry Effects for Five Exposure Pathways

Exposure Pathway		Aquatic Biota	Marine Biota	Terrestrial Biota	Humans
1	<u>Short term</u> ; suspended sediments	●	●	--	--
2	<u>Long term</u> ; exposed river bank or flood plain trace deposits	--	--	●	●
3	<u>Long term</u> ; new river channel exposed deposits	●	--	--	●
4	<u>Long term</u> ; marine near shore deposits	--	●	--	--
5	<u>Long term</u> ; reservoir sediments (Dams-In)	●	--	--	●

- No Adverse Effects
- One or more chemicals present, adverse effect unlikely
- One or more chemicals present, limited adverse effect possible
- At least one chemical detected with potential for significant adverse effect
- Exposure pathway incomplete or insignificant

Bottom Line – No Red Dots

Anticipated Future WQ Conditions

- **Dams in place**
 - Slower progress towards solutions
 - Mechanisms and implementation actions for TMDLs are unknown
- **Dams removed + KBRA**
 - Algal toxin issue largely eliminated in the lower Klamath River
 - Improved ability to meet TMDL targets for nutrients, chl – a, dissolved oxygen
 - Water temperature changes and flow variability help accelerate improvements

Wrap Up

- **Water quality is integral to Klamath Basin decision process regarding dam removal**
 - Physical setting, hydrological and land use modifications
 - Importance of looking upstream
- **Secretarial Determination**
 - Decision about implementation of locally derived Agreements (KHSA + KBRA)
 - Focused on critical questions for decision making
- **Studies and reports available online**

Questions and Comments?

KlamathRestoration.gov

