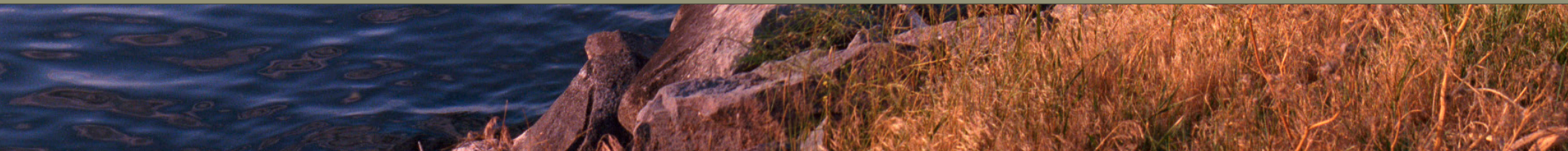




# **WATER QUALITY IMPROVEMENT TECHNIQUES FOR THE UPPER KLAMATH BASIN: A TECHNICAL WORKSHOP AND PROJECT CONCEPTUAL DESIGNS**

**FINAL REPORT | SEPTEMBER 4, 2013**







# **WATER QUALITY IMPROVEMENT TECHNIQUES FOR THE UPPER KLAMATH BASIN: A TECHNICAL WORKSHOP AND PROJECT CONCEPTUAL DESIGNS**

**FINAL REPORT | SEPTEMBER 4, 2013**

## **LOCATION:**

*Klamath River, Oregon & California*

## **FUNDING ENTITIES:**

*California State Coastal Conservancy, PacifiCorp,  
State Water Resources Control Board – Training Academy*

## **PROJECT STEERING COMMITTEE:**

*California State Coastal Conservancy, PacifiCorp, North Coast Regional Water Quality  
Control Board, State Water Resources Control Board – Training Academy, Oregon  
Department of Environmental Quality, U.S. Environmental Protection Agency (Region 9),  
U.S. Bureau of Reclamation, U.S. Geological Survey, U.S. Fish and Wildlife Survey,  
Karuk Tribe, Klamath Tribes, Humboldt State University*

## **PROJECT TECHNICAL TEAM:**

*Atkins, Aquatic Ecosystem Sciences (AES),  
Natural Systems International (NSI)/Biohabitats,  
Riverbend Sciences, Stillwater Sciences, Tetra Tech*

## **REPORT DESIGN AND LAYOUT:**

*Jones and Trimiew Design*

## **SUGGESTED CITATION:**

*Stillwater Sciences, Jones & Trimiew Design, Atkins, Tetra Tech, Riverbend Sciences,  
Aquatic Ecosystem Sciences, and NSI/Biohabitats. 2013. Water Quality Improvement  
Techniques for the Upper Klamath Basin: A Technical Workshop and Project Conceptual  
Designs. Prepared for California State Coastal Conservancy, Oakland, California*



North-facing view from the eastern shore of Upper Klamath Lake. Photo: David Garden.

# CONTENTS

EXECUTIVE SUMMARY    i

SECTION 1: **OVERVIEW AND BACKGROUND**    1

SECTION 2: **WATER QUALITY IMPROVEMENT TECHNIQUES EVALUATED  
AT THE WORKSHOP**    13

SECTION 3: **PILOT PROJECT CONCEPTUAL DESIGNS**    39

**DIFFUSE SOURCE (DECENTRALIZED) TREATMENT WETLANDS**    41

**LARGE WETLANDS**    51

**SEDIMENT REMOVAL (DREDGING)**    65

**SEDIMENT SEQUESTRATION OF PHOSPHORUS AND AERATION/OXYGENATION**    73

SECTION 4: **LINKED TECHNIQUES**    81

CONCLUSION    89