



The 2013

C O L O R A D O C O L L E G E

STATE OF THE ROCKIES REPORT CARD

Water Friendly Futures for the Colorado River Basin

An Outreach Initiative of Colorado College

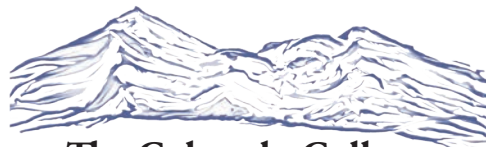
Colorado College's Rocky Mountain Study Region



The Colorado College State of the Rockies Project is designed to provide a thoughtful, objective voice on regional issues by offering credible research on problems faced by the Rocky Mountain West, and by convening citizens and experts to discuss the future of our region. Each year, the State of the Rockies provides:

- Opportunities for collaborative student-faculty research partnerships;
- An annual *State of the Rockies Report Card*;
- A companion State of the Rockies Speaker Series and Conference.

Taken together, these arms of the State of the Rockies Project offer the tools, forum, and accessibility needed for Colorado College to foster a strong sense of citizenship for both our graduates and the broader regional community.



**The Colorado College
State of the Rockies Project**

An Outreach Initiative of
Colorado College



The 2013

C O L O R A D O C O L L E G E
STATE OF THE ROCKIES REPORT CARD
Water Friendly Futures for the Colorado River Basin

Edited By:

Walter E. Hecox, Ph.D.
Rockies Project Director

Brendan P. Boepple
Rockies Project Program Coordinator

Matthew C. Gottfried
GIS Technical Director

A publication of:
The Colorado College State of the Rockies Project
14 E. Cache La Poudre St.
Colorado Springs, CO 80903
www.coloradocollege.edu/stateoftherockies

© April 2013 by the Colorado College State of the Rockies Project. All rights reserved.
Contents may not be reproduced in any manner without prior permission of Colorado College.
ISBN: 978-0-935052-53-4

2012 and 2013 State of the Rockies Project Acknowledgements

The Colorado College State of the Rockies Project would like to thank the following individuals and groups for their generous contributions to help support summer research, publication of *Report Cards*, monthly speakers, conference activities and field expeditions.

General Support

- Colorado College
- Michael B. Slade, Colorado College Class of 1979 and Trustee and Megan G. Slade
- John B. Troubh, Colorado College Class of 1979 and Louisa Troubh
- The Trinchera & Tercio Foundation
- The William and Flora Hewlett Foundation
- The David and Lucile Packard Foundation
- Charles H. "Chip" Collins, Colorado College Class of 1977 and Anne C. Childs, Colorado College Class of 1978
- Jane E.S. Sokolow, Colorado College Class of 1972
- Walter E. and Ann E. Hecox, Colorado College Class of 1964
- Helen and Horst Richardson
- Brian J. and Gretchen Hurlbutt, Colorado College Class of 2004 & 2000
- Brian Hall, Colorado College Class of 2008
- Anonymous (3)

Summer Research and Expedition Support

- The Grant Lyddon Foundation of the Silicon Valley Community Foundation
- Marine Ventures Foundation
- The Ocean Foundation



The Rockies Project Down the Colorado Expedition on their solar raft at Glen Canyon Dam on Lake Powell.

Will Stauffer-Norris

Table of Contents

An Introduction from the President – The Colorado College State of the Rockies Project:

Research, Report, Engage!

Jill Tiefenthaler, President, Colorado College..... 2

Colorado College, The Rocky Mountain West, and The State of the Rockies Project

Walter E. Hecox, Project Director, State of the Rockies Project..... 4

Editors' Preface

Walter E. Hecox, Project Director, State of the Rockies Project

Brendan P. Boepple, Program Coordinator, State of the Rockies Project

Matthew C. Gottfried, Technical Liaison, State of the Rockies Project..... 6

Water Friendly Futures for the Colorado River Basin

Lake Powell to Lake Powell: Portraits of the Upper Colorado River

Zak Podmore, Expedition Manager, State of the Rockies Project..... 12

Overview: Colorado River Basin Water Demand and Supply Imbalance

Shannon Thomas, Student Researcher, and **Walter E. Hecox**, Project Director, State of the Rockies Project..... 28

Agricultural Water Use in the Colorado River Basin:

Conservation and Efficiency Tools for a Water Friendly Future

Case Study: **Deficit Irrigation Helping Farmers Manage Crops in Times of Shortage**

Case Study: **Drought-tolerant Crops Around the World**

Case Study: **The Arkansas Valley Super Ditch**

Case Study: **Arizona Water Banking Authority: Banking Water Now for Arizona's Future**

Nathan Lee and **Alice Plant**, Student Researchers, State of the Rockies Project..... 46

Municipal and Industrial Water Use in the Colorado River Basin:

Moving Towards a Paradigm Shift in Water Reclamation

Case Study: **Lake Powell Pipeline**

Case Study: **Las Vegas: Southern Nevada Water Authority (SNWA)**

Case Study: **Australia**

Case Study: **Front Range Comparison**

Matthew McNerney and **Shannon Thomas**, Student Researchers, State of the Rockies Project..... 60

Water and Watts: How Electrical Generation Has and Will Continue to Shape the Colorado River

Case Study: **Navajo Generating Station vs. Mohave Generating Station**

Henry Madsen, Student Research Assistant, State of the Rockies Project..... 88

Can Renewable Energy Lead the Colorado River Basin into a Water Friendly Future?

Case Study: **Concentrating Solar Power in a Semi-Arid Desert: Nevada Solar One**

Case Study: **Evaporation from Reservoirs in the Colorado River Basin**

Audrey Burns, Student Researcher, State of the Rockies Project..... 104

Additional Acknowledgements and Contributors..... 116