What is Clean Water Worth?
Assessing the Economic Benefits of Excess Nutrient Reduction

UTAH DEPARTMENT *of* ENVIRONMENTAL QUALITY
WATER QUALITY

Nicholas von Stackelberg, P.E.

Utah Lake Steering Committee Meeting

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Research Team

Economics and Survey Administration

- ➢ Mary Jo Kealy, Project Manager, CH2M Hill, Inc.
- ➢ Nanette Nelson, Wyoming Survey and Analysis Center
- ➢ Paul Jakus, Utah State University
- ➢ John Loomis, Colorado State University
- ➢ Cody Stanger, Site Specific Tool

Water Quality Data and Analysis

Utah Division of Water Quality

- ➢ Jeff Ostermiller
- ➢ Nicholas von Stackelberg
- ➢ Ben Holcomb
- ➢ Mark Stanger
- ➢ John Mackey

Utah Nutrient Reduction Program

<u>Potential</u> elements of the Nutrient Reduction Plan considered in the economic study:

1) Instream: Site specific numeric nutrient criteria for nitrogen (N), phosphorus (P), and response indicators

2) Wastewater: Technology based limits for N & P

3) Stormwater: Enhanced BMPs for nutrient sensitive waters

4) Agriculture: Additional funding for N & P BMP implementation through sewer fee

Benefit Cost Analysis (BCA)

BCA compares the economic value with the Utah Nutrient Reduction Program to the economic value without program implementation

Benefit Categories

1) **Recreational Value**
2) **Non-Use Value (Quality of Life)**
3) **Property Value**
4) Water Treatment Cost Savings
   a) Drinking Water
   b) Industrial Users
   c) Agricultural Users

Cost Categories

1) Wastewater Treatment Upgrades
   a) Publicly Owned Treatment Works (POTW)
   b) Industial Dischargers
   c) Agricultural Dischargers
2) Stormwater Management
3) Nonpoint Source Pollution
4) Regulatory Administration
   a) TMDL
   b) Site Specific Criteria

Methods for Estimating Economic Benefits

1) ## Conducted two surveys of Utah households

   - Total Economic Valuation (TEV) Survey
     (general - 2,700 surveys – 25% response)
   - Recreation Demand (RD)Survey
     (targeted - 3,600 surveys – 39% response)

2) ## Asked contingent questions on TEV survey

   - Would you be willing to pay $X for cleaner water?

3) ## Asked visitation questions on RD survey

   - How many lake and river trips did you make in past year?
   - Where did you go and how often did you visit each site?

4) ## Developed future water quality scenarios

   - <u>Status quo</u> – degraded future conditions
   - <u>Maintain</u> – maintain current conditions
   - <u>Improve</u> – improved future conditions

5) ## Performed econometric modeling

   - Statistical regression to correlate responses to water quality, respondent and site characteristics
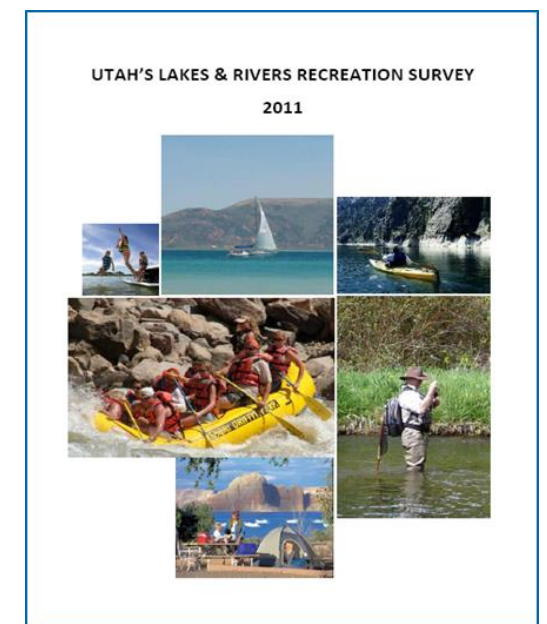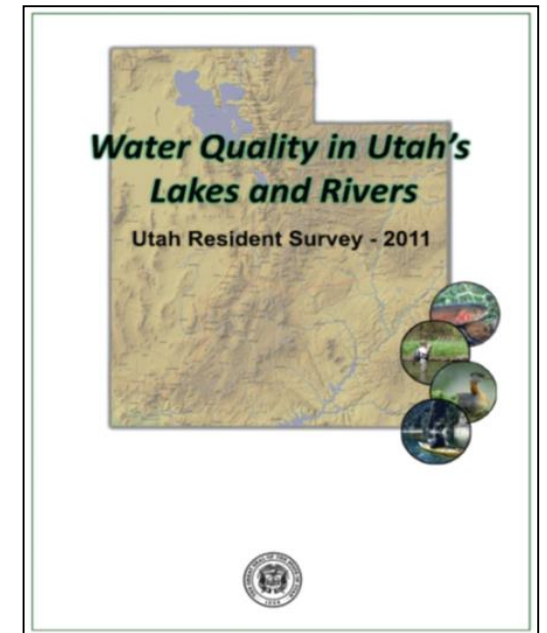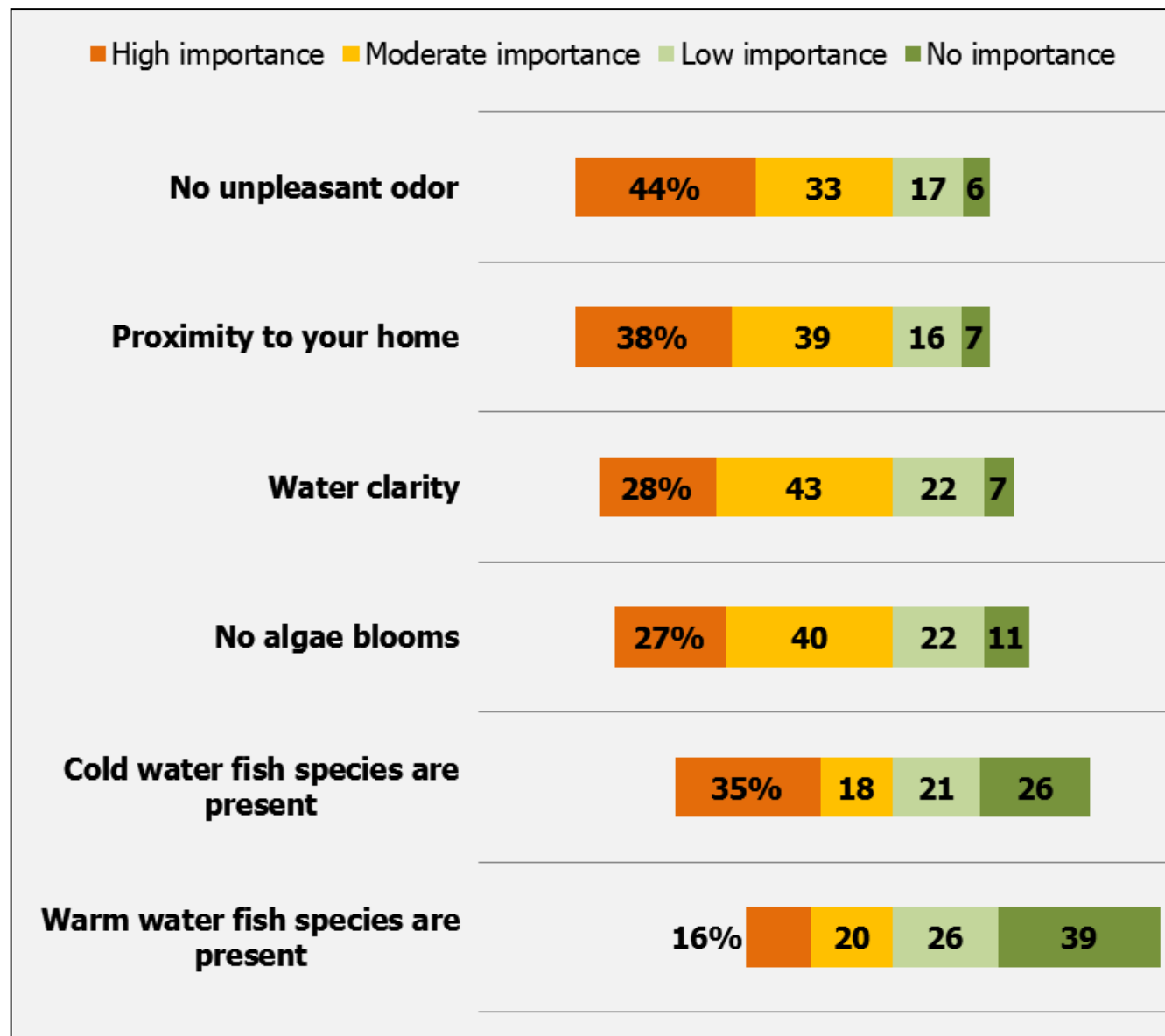
Recreation Economic Benefits

Recreationists Opinion Results

Importance of water quality attributes
when choosing a site to visit (%)
LAKE they visited most often

Legend:
- ■ High importance
- ■ Moderate importance
- ■ Low importance
- ■ No importance

Attribute	High	Moderate	Low	No
No unpleasant odor	44%	33	17	6
Proximity to your home	38%	39	16	7
Water clarity	28%	43	22	7
No algae blooms	27%	40	22	11
Cold water fish species are present	35%	18	21	26
Warm water fish species are present	16%	20	26	39

Lakes

	Lakes
Ave Trips per year	14.3
Primary Activity	
Fishing	39%
Boating	28%
Near-shore	21%

24% of trips are for
more than one day

Lake Recreation Results

Top Five Lakes by Total Trips

Lake Name	# of Day Trips/Year
Utah Lake	**492,000**
Strawberry Reservoir	271,000
Deer Creek Reservoir	240,000
Pineview Reservoir	206,000
Bear Lake	199,000

Lakes Utah Households Did Not Visit Due to Perceived Poor Water Quality

Lake Name	# of Households Listing the Site
Utah Lake	**78**
Mantua Reservoir	10
Great Salt Lake - Willard Bay	10
Strawberry Reservoir	6
Great Salt Lake - Antelope Island	4
East Canyon Reservoir	3
Lake Powell	3
Panguitch Lake	3
Cutler Reservoir	2
Pineview Reservoir	2
Echo Reservoir	2
Matt Warner Reservoir	2
Red Fleet Reservoir	2

Total responses = 144

Recreation Demand Modeling
Lake Characteristics

1) Proximity: Travel Cost

2) Water Clarity: TSI(Secchi Depth)

3) Algae vs. Sediment: TSI(Chl-a) – TSI(Secchi Depth)

Trophic State Index (TSI)

➢ Secchi Depth (SD)
$TSI(SD) = 60 - 14.41\ ln(SD)$

➢ Chlorophyll a (CHLA)
$TSI(CHLA) = 9.81\ ln(CHLA) + 30.6$

Recreation Demand Modeling Statistically Significant Results

Proximity

- People prefer sites that are closer

Water Clarity

- People prefer lakes with better water clarity

Algae

- People have preference for lake water which is a little more green than brown

Nutrients

- People prefer lower levels of nitrogen in rivers
- Phosphorous results were inconclusive for rivers

Recreation Future Scenarios

➢ Predicted water quality parameters for each scenario for each survey segment

- 284 lakes and river segments

➢ Assumptions

- No change to watersheds with < 5% urban + agricultural land
- Approved TMDL waters improve under all scenarios

Scenario	Number of Lakes		
	Degrade	Constant	Improve
Status Quo	46	62	23
Maintain Plan	0	108	23
Improve Plan	0	85	46

Economic Benefits of Alternative Nutrient Reduction Policies

	Status Quo	Maintain WQ	Improve WQ
Annual Net Benefits	-$6.9M	$19.3M	$49.7M
Net Present Value* (20 years)	-$50.8M	$142.0M	$365.7M
Average Annual Benefit (discounted)	-$3.9M	$11.0M	$28.2M

All dollar values in millions.
*Assumes linear change in water quality over 20 years at 2.7% discount rate.

Water-Based Recreation Contribution to Utah's Economy

	Based on Median Trips	Based on Mean Trips
Total Direct Expenditures	$1,370M	$2,336M
Multiplier Effects		
Total Output	$2,449M	$4,177M
Value Added	$1,548M	$2,640M
Labor Income	$922M	$1,573M
Jobs	29,500	50,000
State and Local Taxes	$203.4M	$356.4M

All dollar values in millions

Total Economic Benefits

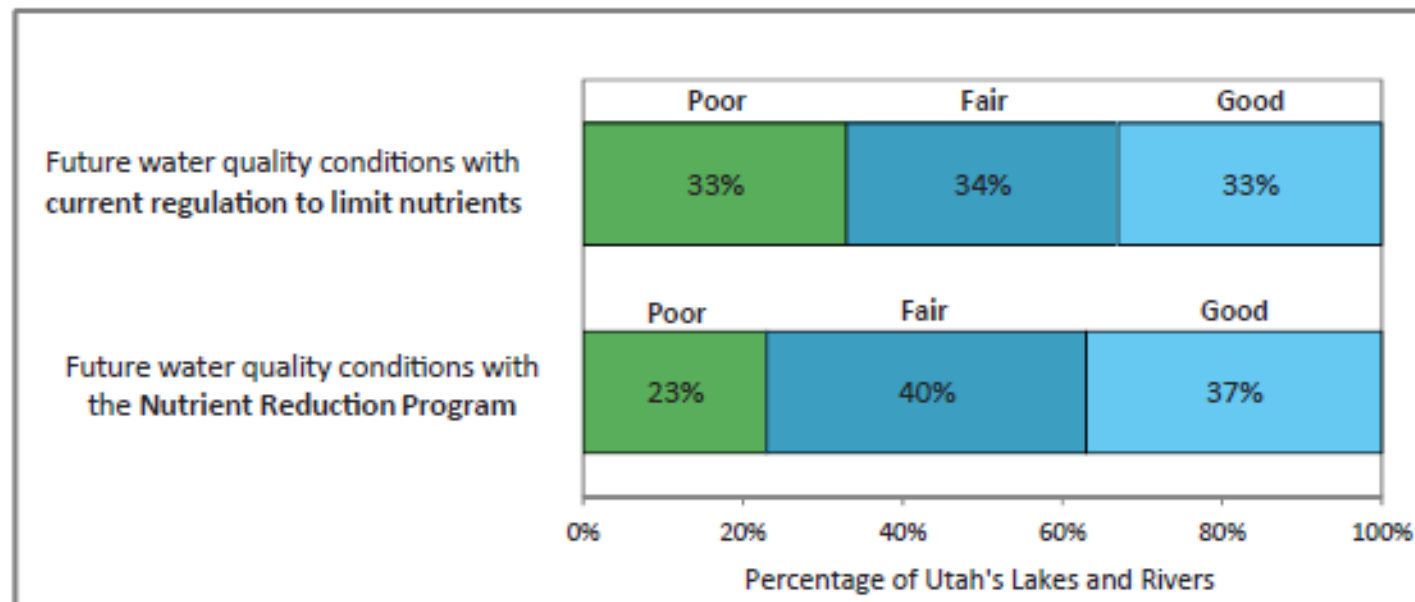# Utah Public Opinion Results

Importance of factors related to preventing
impacts from excess nutrients (%)
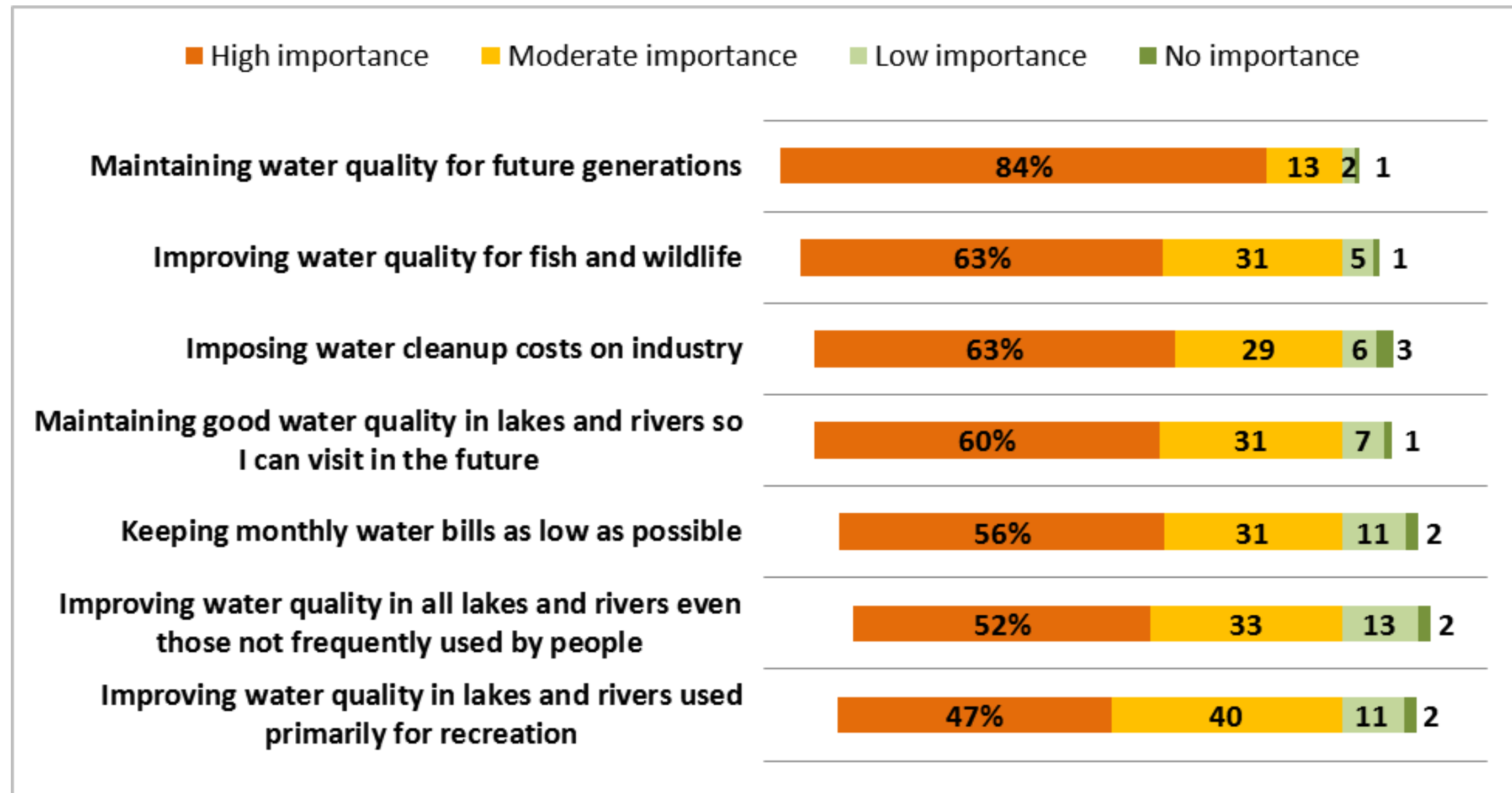
Total Economic Value Survey Design

The **Nutrient Reduction Program** will reduce the percent of waters in the **Poor** category from 33% down to 23% and increase the percent of waters in **Good** condition from 33% to 37%. Implementation of the program would start next year and be phased in over 20 years. In some cases, complete clean up may take longer than 20 years.

Future water quality conditions with current regulation to limit nutrients

Poor	Fair	Good
33%	34%	33%

Future water quality conditions with the Nutrient Reduction Program

Poor	Fair	Good
23%	40%	37%

Percentage of Utah's Lakes and Rivers

The costs of the program will be shared between households, businesses, and industry in proportion to their share of total nutrient discharges. Based on these proportions, the share of the cost for each Utah household will be an additional $2 per month.

3. Which one of the following two options regarding your household's monthly water and sewer bill would you choose? Please do NOT consider what other people could or could not afford.

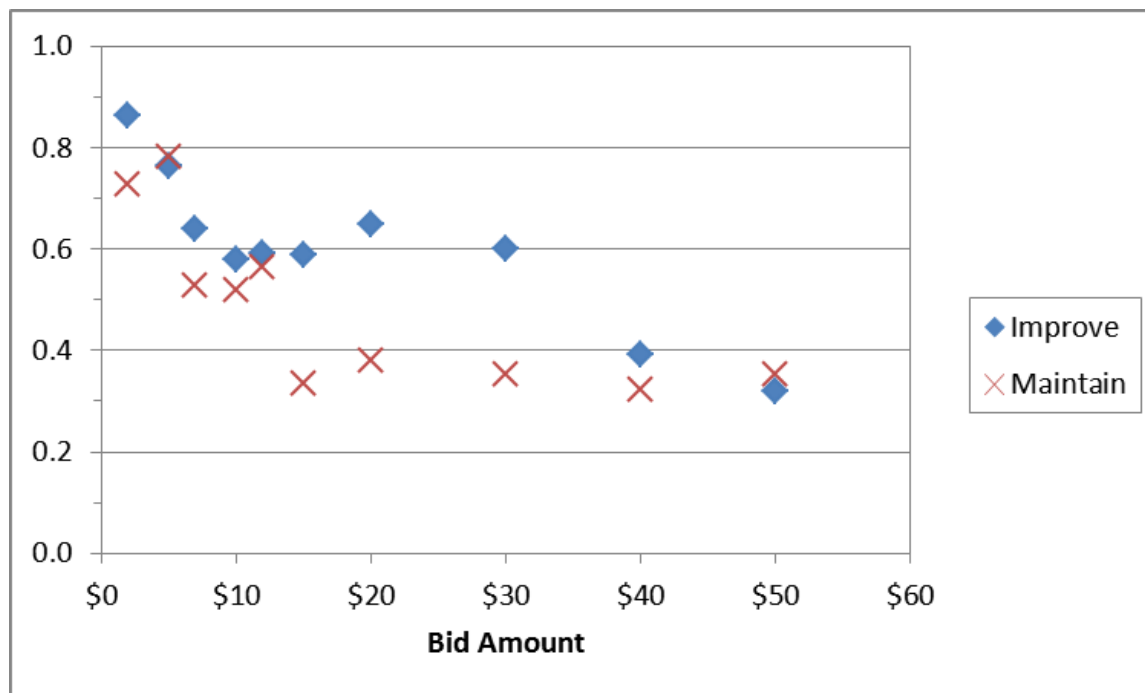| Under current regulations to limit nutrients	Under the Nutrient Reduction Program
$0 increase	$2 increase
○	○

➤ Two scenarios with Nutrient Reduction Program: Maintain and Improve

➤ Bid vectors per month: $2, $5, $7, $12, $15, $20, $30, $40, $50

Bid Response

Nonusers
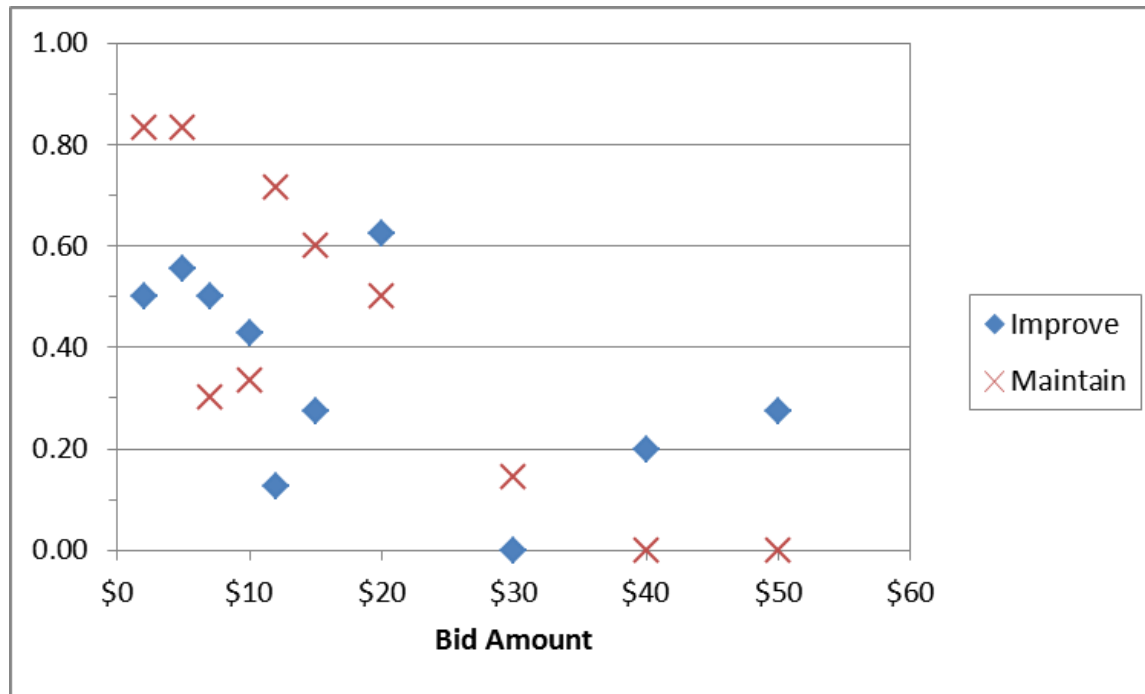
Users

All Respondents

Bid	Maintain (% Yes)	Improve (% Yes)
$2	76%	75%
$5	77%	68%
$7	42%	62%
$10	44%	54%
$12	63%	50%
$15	41%	47%
$20	40%	62%
$30	31%	51%
$40	29%	32%
$50	26%	31%

Utah Household Willingness to Pay
Maintain or Improve Water Quality Due to Nutrient Reduction

Recreation Group	Future Water Quality Scenario	Monthly		Annual	
		Lower Bound	Upper Bound	Lower Bound	Upper Bound
User	Maintain	$3.13	$13.61	$37.56	$163.36
	Improve	$8.11	$31.97	$97.37	$383.64
Non-User	Both	$2.19	$7.05	$26.33	$84.64

Utah monthly sewer rates (2013):
    Median $18.97
    ERU-Normalized Average $15.82

Property Value Benefits

Property Value Impacts

➢ Objective

Estimate the impacts of nutrient enrichment on the value of properties adjacent to lakes and reservoirs

➢ Approach

Combine literature valuation studies with Utah property and water quality data

➢ Limitations

- Lakefront property only – does not consider near lake or view shed properties
- Does not consider harmful algal blooms

Utah Lake-Front Property Value Impacts
Due to Changes in Water Clarity

	Status Quo Policy	Improve WQ Policy
Water Clarity Change (m)	-0.05	0.25
Cost/Benefit Total ($)	-$ 279,000	$ 817,000
Cost/Benefit per Parcel ($)	-$ 860	$ 2,500

2011 summer water clarity = 0.2 m
Number of undeveloped parcels = 248
Number of developed parcels = 77

Additional Information

https://deq.utah.gov/legacy/pollutants/n/nutrients/index.htm
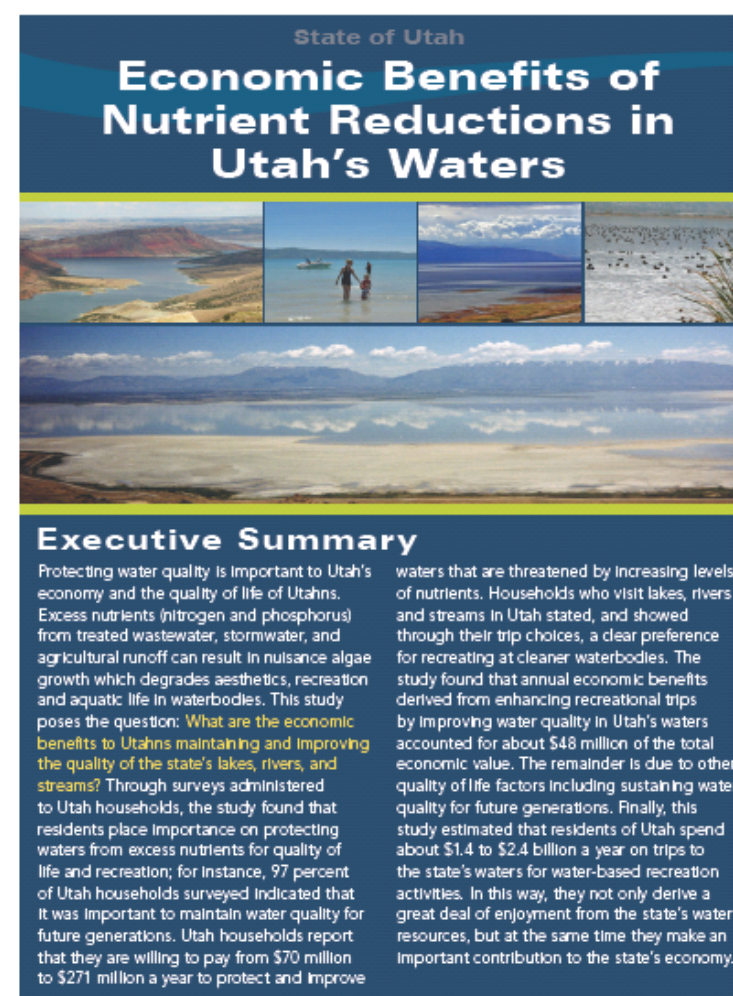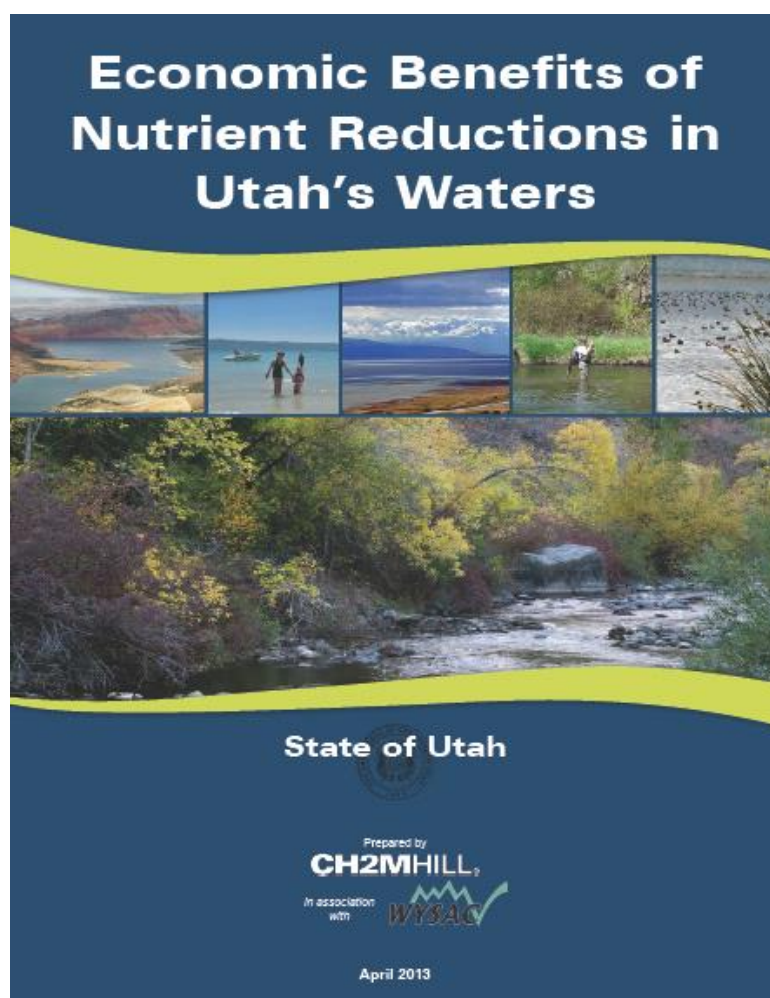
Potential Future Investigations

➢ Use existing survey results to build Utah Lake specific recreational demand model to improve estimate of response to poor WQ conditions in Utah Lake

➢ Use RD model to estimate response to 2016 and 2017 HAB events

➢ Improve estimate of property value impacts

➢ Estimate impacts on downstream water users

Economics
Dr. Paul Jakus
Utah State University
Applied Economics
(435) 797-2309
paul.jakus@usu.edu

Water Quality
Nicholas von Stackelberg, P.E.
Utah Dept of Environmental Quality
(801) 536-4374
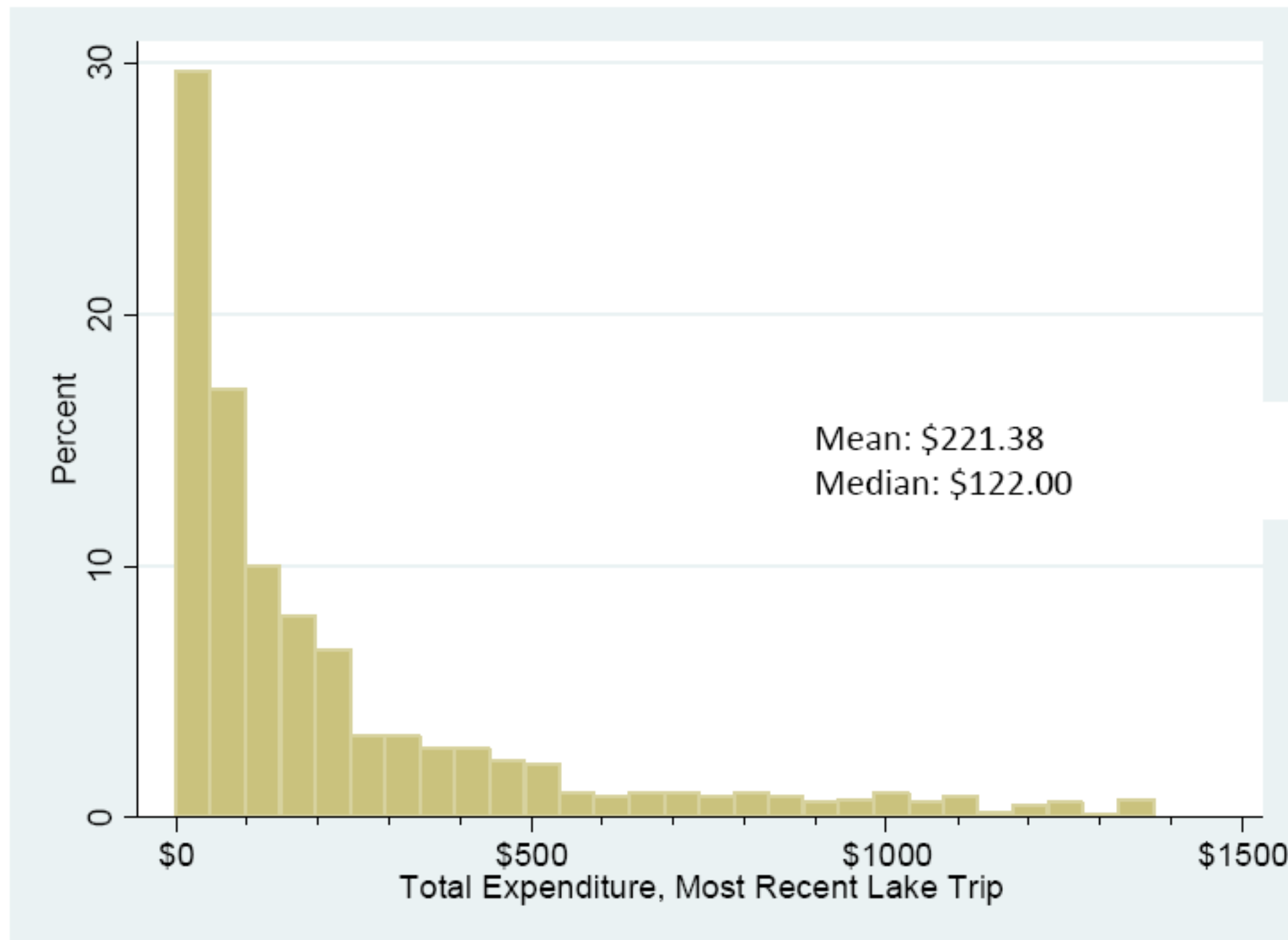nvonstackelberg@utah.gov

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QUALITY**

Extra Slides not in Presentation

Water-Based Recreation Contribution to Utah's Economy

Mean: $221.38
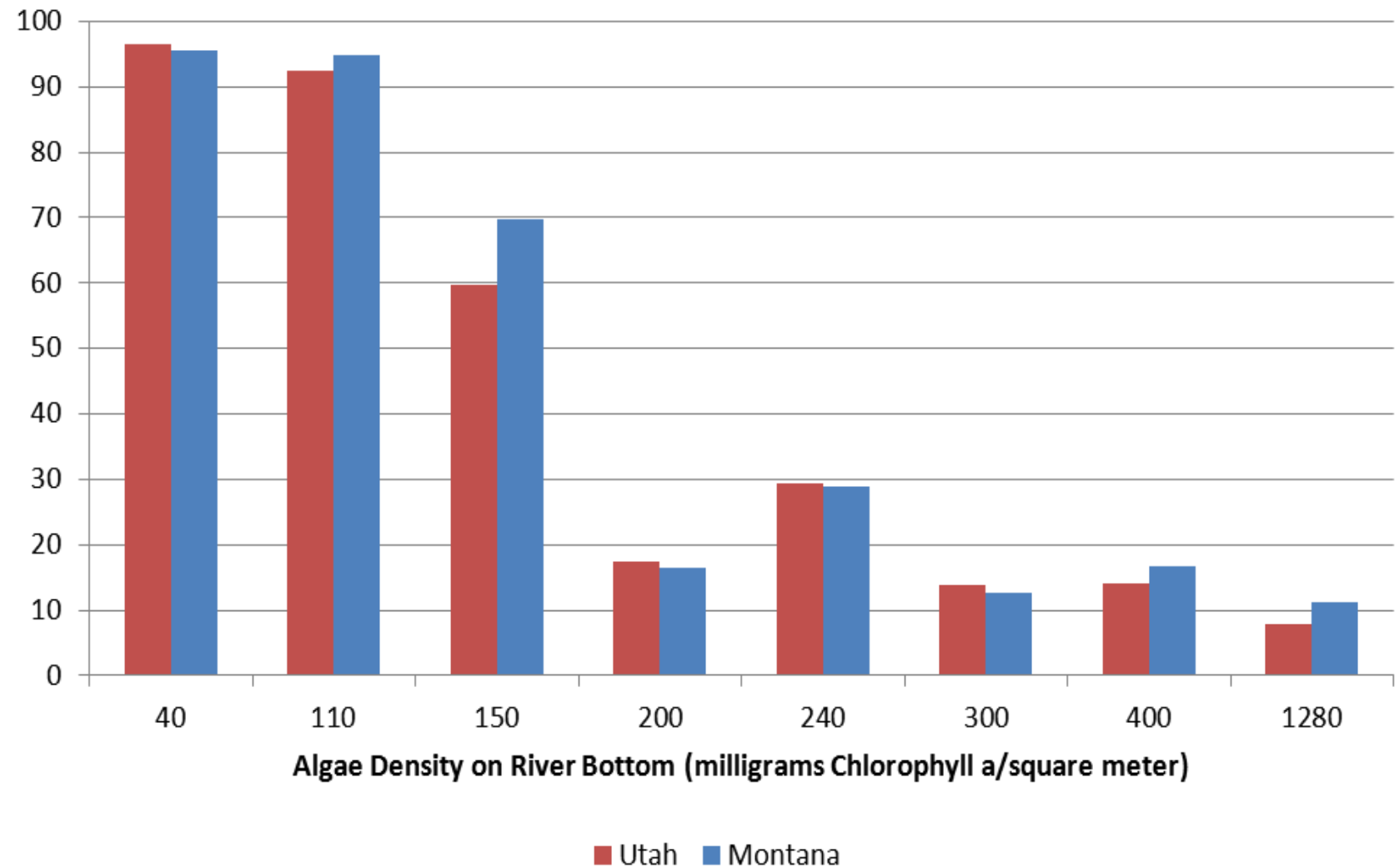Median: $122.00

Recreation and Aesthetics

150 mg Chla/m^2

200 mg Chla/m^2

Percent of Respondents Who Found Algae Condition Desirable

Algae Density on River Bottom (milligrams Chlorophyll a/square meter)

■ Utah ■ Montana

Aesthetic breakpoint at benthic algae between 150 to 200 mg Chla/m^2

Recreation Value vs. Total Economic Value

	Maintain WQ	Improve WQ
Annual Net Recreation Benefits	$19M	$50M
Annual Aggregate Total Value (Lower Bound – Users Only)	$ 30M	$ 69M
Annual Aggregate Total Value (Upper Bound – Users Only)	$125M	$266M

All dollar values in millions.

Study Conclusions

1) Utahans place most importance on bequeathment and fish & wildlife support for why they value water quality

2) Recreationists tend to choose the sites that are consistent with their stated water quality preferences

3) Utahans are willing to pay an additional $2 - $14/month to maintain water quality and $8 - $32/month to improve water quality associated with excess nutrients

Water Treatment Cost Savings

➢ Problem: Excess nutrients cause increased algal growth
- Intake clogging
- Taste and odor issues
- Disinfectant byproducts with potential human health effects
- Nitrate – blue baby syndrome

➢ Objective:

Estimate the water treatment costs associated with excess nutrients

➢ Approach:

Survey of Utah water purveyors