Bear River - Cutler Reservoir TMDL

US EPA Nutrient TMDL Workshop
Feb 15-17, New Orleans

Michael Allred
Project Manager/ Utah Division of Water Quality
History

- Original Bear River TMDL approved in 1997 established phosphorus endpoint of 0.05 mg/l for Cutler

- Lower Bear River TMDL approved in 2002 identified phosphorus endpoint of 0.075 mg/l below Cutler

- Currently revised TMDL approved in 2010 with endpoint of 0.09 mg/l.

- Advisory committee formed in 2004
Process

- Representative and engaged technical committee
  - 69 advisory committee meetings over 5 years
  - Representation from diverse constituencies

- Comprehensive data collection
  - Supplemental data and studies completed at request of advisory committee
  - Data from Logan City, PacifiCorp and USU
    - 1,498 TP data points
    - 114 Chlorophyll a data points
    - 3,584 dissolved oxygen data points
    - 33 sites

- Thorough public review process
  - 21 comment letters (157 comments)
  - Substantive changes to analysis and TMDL as a result of public comments
Fishery Use is Impaired

**Primary Evidence**

- Continuous data collected at 9 locations over 6 sampling periods (163 days)
- 25% of samples violate early life-stage DO standard
- 15% of samples violate all life-stage DO standard
- Follows removal of disputed data

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**Benson Marina (Aug 12 - Aug 20 2003)**

- Dissolved Oxygen
- Temperature
- pH
- Dissolved Oxygen Saturation

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Cutler Reservoir is hypereutrophic

Fish study indicates low recruitment

Low DO has largest impact on young fish.

Reservoir is dominated by species that are degraded water quality tolerant of native species.
DO concentrations in Cutler Reservoir and Fish Spawning Periods

1-day early life stage criteria (5 mg/l)

Carp, Rainbow trout, Walleye → Black crappie → Black bullhead

Bluegill and Green Sunfish

Channel catfish → Fathead minnow

Largemouth, Smallmouth bass → Utah sucker
Recreational Use is Impaired

- **Primary evidence**
  - 26% of chlorophyll a data in Cutler Reservoir are $>30 \mu g/L$
  - Recreation user surveys: Half consider water quality in Cutler to be a moderate to big problem

- **Additional concerns**
  - Possibility of blue-green algae further threatens this use

East Canyon Reservoir Littoral Zone. Photo: Wayne Wurtsbaugh.
Water-oriented wildlife (3D)

- **Primary evidence**
  - 15% of samples exceed dissolved oxygen standard for aquatic life specific to 3D use

- **Importance of Cutler wetlands**
  - Wetlands around Cutler nominated by the Audubon Society as an Important Bird Area (IBA)
  - 25 bird species at Cutler feed on taxa that are NOT tolerant of hypereutrophic conditions
  - Cutler Reservoir is dominated by macroinvertebrate taxa tolerant of eutrophic conditions
- **Dissolved oxygen impairment** (25% of data violate standard)
- Diurnal pattern of DO indicates nighttime algal respiration
- High algal concentrations in Cutler Reservoir (max over 1,000 ug/L chlorophyll a)

*Valley View (Aug 20 - Aug 28 2003)*

![Graph showing dissolved oxygen, temperature, pH, and dissolved oxygen saturation over time.](chart.png)
Current Sources

**Current Total Phosphorus Load Distribution**

**Southern Reservoir: Summer Season**
- Internal Load: 23%
- Other NPS: 1%
- Developed NPS: 5%
- Agricultural NPS: 9%
- Background NPS: 2%
- AFO/CAFO: 1%
- Point sources other TMDLs: 17%
- Logan City WWTP: 16%
- Fisheries Exp Station: <1%
- Irrigation return flow from WWTP irrigated lands: 25%

**Southern Reservoir: Winter Season**
- Internal Load: 17%
- Other NPS: 4%
- Developed NPS: 2%
- Agricultural NPS: 17%
- Background NPS: 1%
- AFO/CAFO: 1%
- Point sources other TMDLs: 20%
- Logan City WWTP: 35%
- Irrigation return flow from WWTP irrigated lands: 3%
- Fisheries Exp Station: <1%
### Evidence used to Select Phosphorus Endpoints (Summer Season)

#### Total Phosphorus (mg/l)

<table>
<thead>
<tr>
<th></th>
<th>0.0</th>
<th>0.01</th>
<th>0.02</th>
<th>0.03</th>
<th>0.04</th>
<th>0.05</th>
<th>0.06</th>
<th>0.07</th>
<th>0.08</th>
<th>0.09</th>
<th>0.1</th>
<th>0.11</th>
<th>0.12</th>
<th>0.13</th>
<th>0.14</th>
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</thead>
<tbody>
<tr>
<td>Northern Reservoir</td>
<td>0.13 – 0.66 mg/l</td>
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<tr>
<td>Southern Reservoir</td>
<td>0.28 mg/l</td>
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<tr>
<td>Current Conditions</td>
<td>Nutrient criteria</td>
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<td>(0.075 \text{ mg/l as eutrophic boundary} (\text{Dodds et al. 1998}))</td>
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<td>(0.06 – 0.15 \text{ mg/l for fish assemblages} (\text{Weigel and Robertson 2007}))</td>
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<td>(0.08 – 0.09 \text{ mg/l} \text{ macroinvertebrates} (\text{Wang et al. 2007}))</td>
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#### Statistical Method


#### Water Quality Model Linkage algae

- Aquatic life thresholds
- Nutrient criteria

#### Other shallow, warm lakes/reservoirs

- Snake River – Hells Canyon, ID (0.07 mg/l)
- Long and Farquar Lakes, MN (0.09 mg/l)

#### Phosphorus limited system to prevent blue-green algal growth

- Cutler Reservoir (analyzed dissolved N data for Cutler)
  - Aim to attain a 10 to 15 N:P ratio in
- Reference condition (historical data)
- Northern Reservoir reference condition (historical data)
## Phosphorus Endpoints

<table>
<thead>
<tr>
<th></th>
<th>Winter</th>
<th>Summer</th>
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<tbody>
<tr>
<td>Middle Bear River</td>
<td>0.05 mg/l</td>
<td>0.05 mg/l</td>
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<tr>
<td>Southern Reservoir</td>
<td>None</td>
<td>0.09 mg/l</td>
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<tr>
<td>Northern Reservoir</td>
<td>0.075 mg/l</td>
<td>0.07 mg/l</td>
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</tbody>
</table>

- **Middle Bear River TMDL set endpoint for Bear River above Cutler at 0.05 mg/l**
- **Lower Bear River TMDL set endpoint of 0.075 mg/l at Cutler Dam year round**
- **Summer endpoints derived from multiple lines of evidence**
TMDL Conclusions and Current Status

- Cutler Reservoir’s beneficial uses are impaired
- Linkage between DO and TP is well established, despite some uncertainty
- TMDL analysis was scientifically credible and rigorous
- Process included multiple stakeholders with extensive involvement
- Phased TMDL approach was selected to address uncertainty
- Monitoring plan has been developed to better define water quality endpoints
- Adaptive implementation efforts have begun to control pollutant sources
Uncertainty

- **Uncertainty and TMDLs**
  - All TMDLs and all scientific analyses have uncertainty
  - Good science acknowledges and discloses complexity and uncertainty
  - Water quality models are more ‘precise’ and quantitative but not necessarily more accurate
  - Margin of Safety (MOS) in TMDLs accounts for uncertainty
  - Cutler TMDL selected a Phased Approach to avoid ‘over-regulating’ during this iteration
**Cutler Uncertainty**

- **Sources of uncertainty in Cutler Reservoir**
  - Lack of paired TP-Chl a – DO datasets to quantify Cutler specific TP – DO linkage
  - Unique nature of Cutler Reservoir system:
    - Shallow depth and wetland habitat
    - Turbidity interference with algal growth
    - Tributary TMDL attainment (5 in watersheds)

- **Phased Approach and Adaptive management**
  - Continue to monitor the system
### Cutler TMDL Load Analysis

<table>
<thead>
<tr>
<th>All units Kg/Season</th>
<th>Current Load</th>
<th>TMDL Allocated Load</th>
<th>Load Reduction</th>
<th>Percent Reduction</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Summer</td>
<td>Winter</td>
<td>Summer</td>
<td>Winter</td>
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<tr>
<td>Logan WWTP</td>
<td>11,236</td>
<td>21,597</td>
<td>4,405</td>
<td>11,831</td>
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<tr>
<td>Irrigation flow to</td>
<td></td>
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<tr>
<td>Cutler from WWTP</td>
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<tr>
<td>effluent</td>
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<tr>
<td>Total Southern</td>
<td>18,062</td>
<td>1,953</td>
<td>7,082</td>
<td>1,070</td>
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<tr>
<td>Reservoir</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Northern</td>
<td>71,201</td>
<td>62,622</td>
<td>25,539</td>
<td>28,986</td>
</tr>
<tr>
<td>Reservoir</td>
<td>127,402</td>
<td>119,829</td>
<td>62,103</td>
<td>63,461</td>
</tr>
</tbody>
</table>
Logan City

- **Largest discharger of TP in Bear River basin**
  - Hyrum, Richmond, and Lewiston upgraded
  - Idaho municipalities are in compliance
  - TP loads at stateline are in compliance

- **TMDL effluent limits**
  - Effluent concentration of 1.3 to 1.9 mg/l (from 3.4 – 3.7 mg/l)
  - Water quality trading during the winter is permitted
  - Other WWTP in the state meet a 0.1 mg/l effluent target

- **Costs of compliance**
  - Tertiary treatment is NOT required to meet TMDL
  - Estimated cost to comply is $5 million (CH2M Hill 2010)
  - Agriculture has spent more than $10 million since 1990

- **Logan City is moving forward**
  - Retained a design engineer to upgrade WWTP
COMPLAINT DEPARTMENT
PLEASE TAKE A NUMBER
The End