TONGUE RIVER SALINITY TMDL PROJECT

Stakeholder Meeting

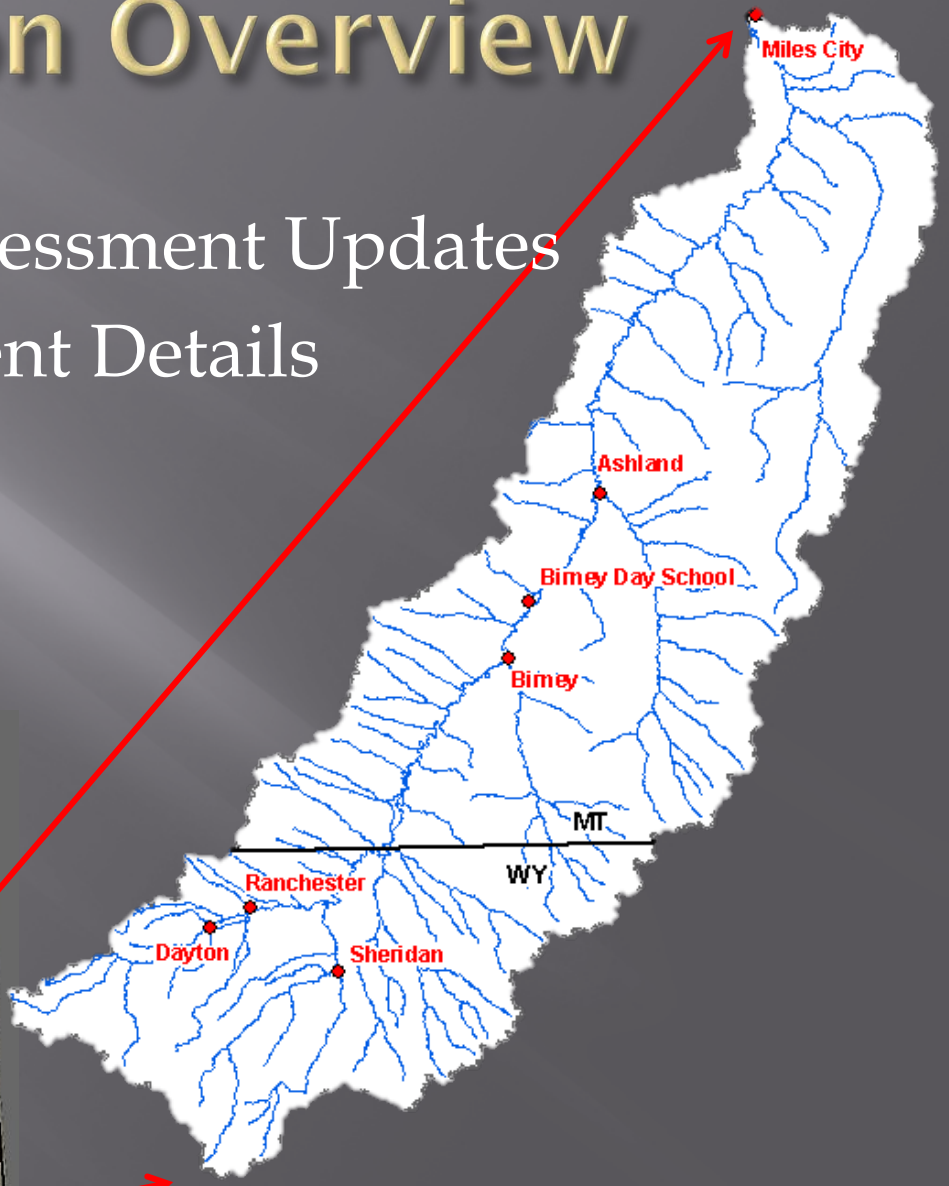
August 29, 2018

Miles City, MT

DEQ Montana Department of Environmental Quality

Presentation Overview

- Modeling/Source Assessment Updates
- EC TMDL Development Details



MODELING/SOURCE ASSESSMENT UPDATES

Erik Makus

Electrical Conductivity

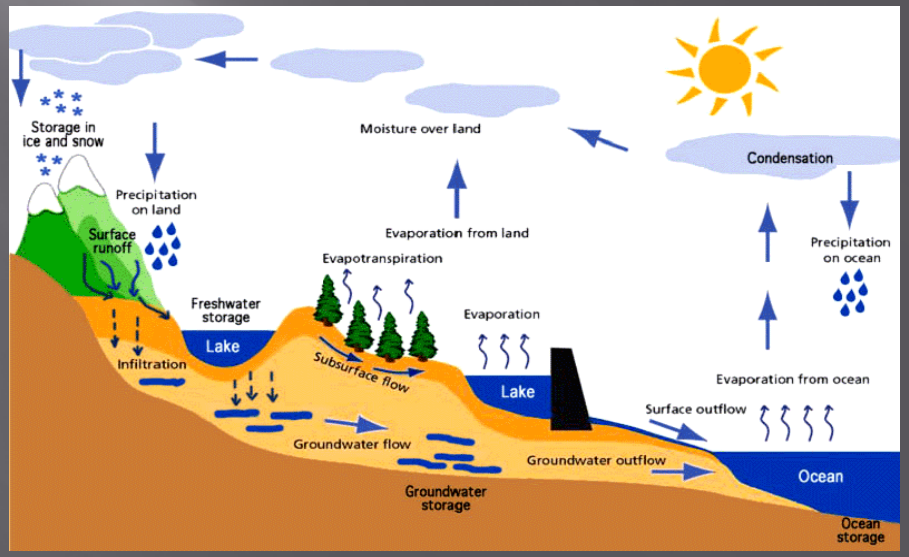
- Electrical conductivity (EC) is a measure of the ability of water to conduct electricity.
  - The more cations (Na^+, Ca^{2+}, Mg^{2+}, etc.) and anions (HCO_3^-, SO_4^{2-}, Cl^-, etc.) that are in the water, the higher the EC
  - Therefore, EC is a *relative* measure of salinity
  - EC is temperature dependent
- Specific conductance (SC) is EC corrected to 25°C.
- EC definition in Montana rules (ARM 17.30.602) matches definition of SC, so

Conductivity = EC = SC

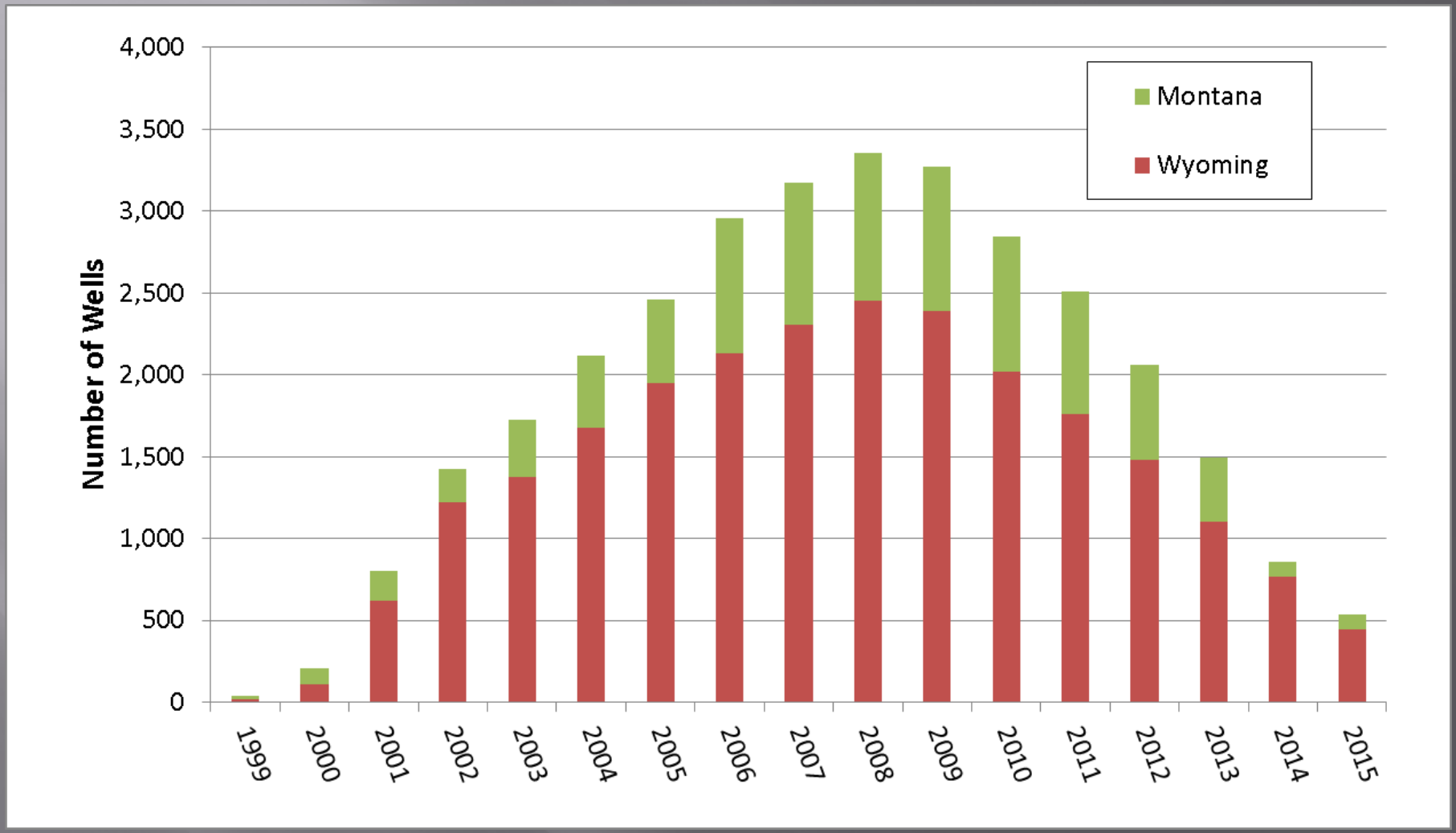
Modeling Period (2003-2013)

- Coalbed Methane (CBM)
- Coal Mines
- Agriculture
- Reservoir Management

SWAT Soil & Water Assessment Tool



Coalbed Methane (CBM)

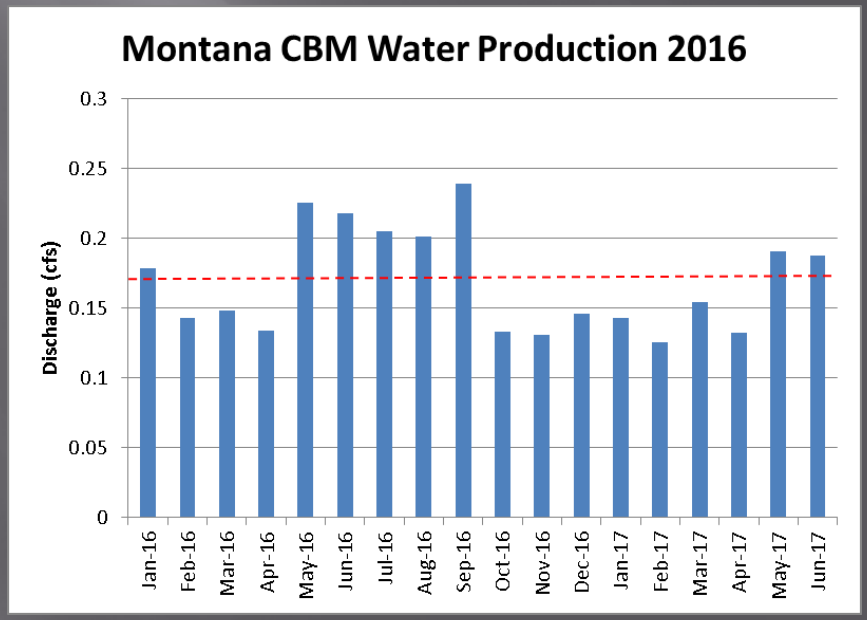


Estimated CBM well distribution during peak of development

- Montana
  - Approximately 12% direct discharge
  - Approximately 10% on-channel ponds
  - Approximately 78% off channel ponds
- Wyoming
  - Approximately 2% direct discharge
  - Approximately 46% on-channel ponds
  - Approximately 52% off channel ponds

CBM Assumptions

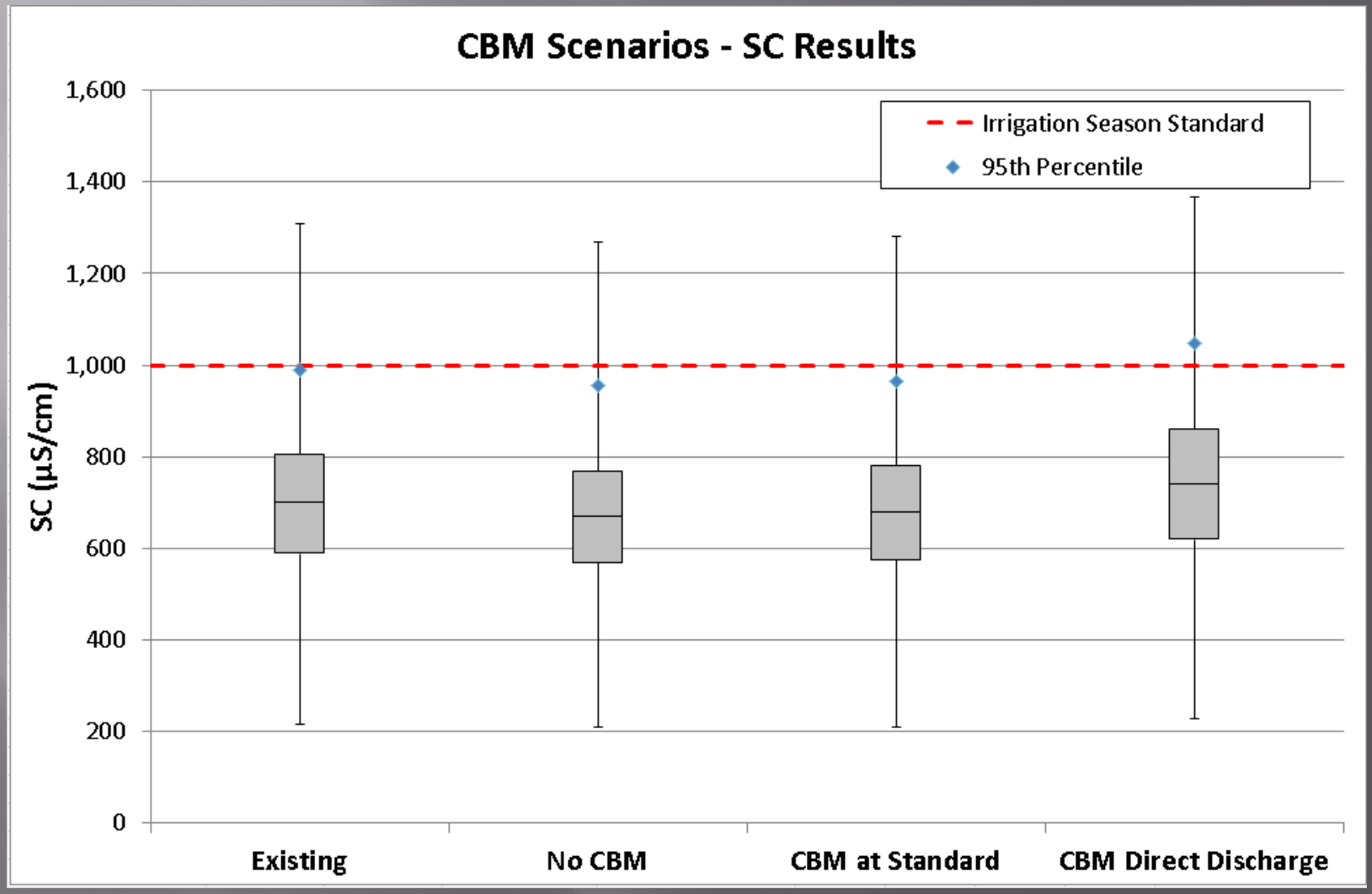
- Model does not consider lag time in CBM ponds.
- Equal distribution across the year for all CBM discharges.
- Average CBM water
  - SC: 2,000 µS/cm
  - SAR: 40



CBM Scenario Summary

- CBM activity has increased average annual SC values by 4%
- Setting existing discharge limits at the irrigation season standards (1000 µS/cm) has nearly the same effect as removing CBM discharges entirely.
- On its own, removing CBM discharges would not result in meeting the SC standard in the spring.

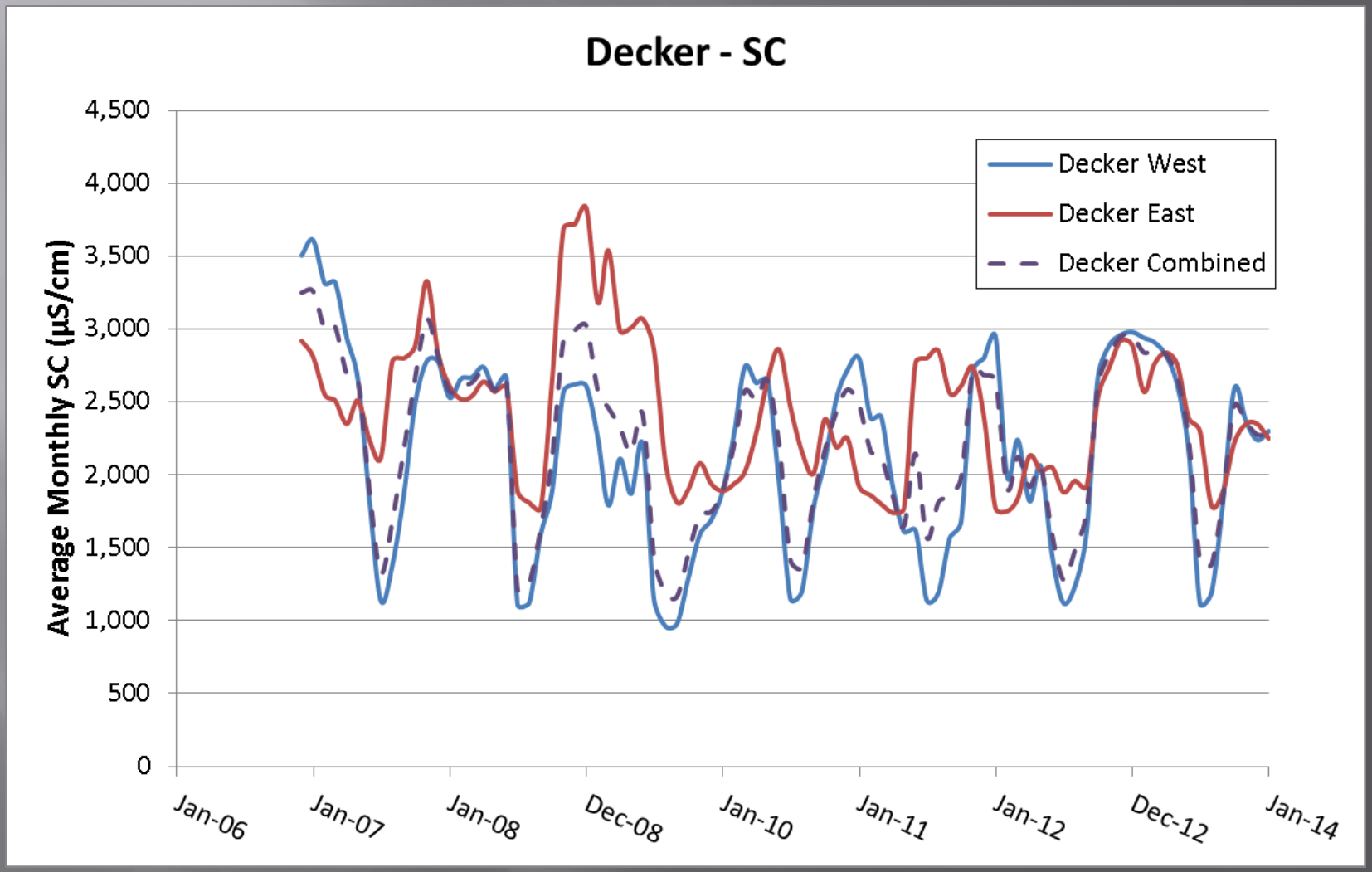
CBM Scenario Summary (Tongue River at T&Y Gage)



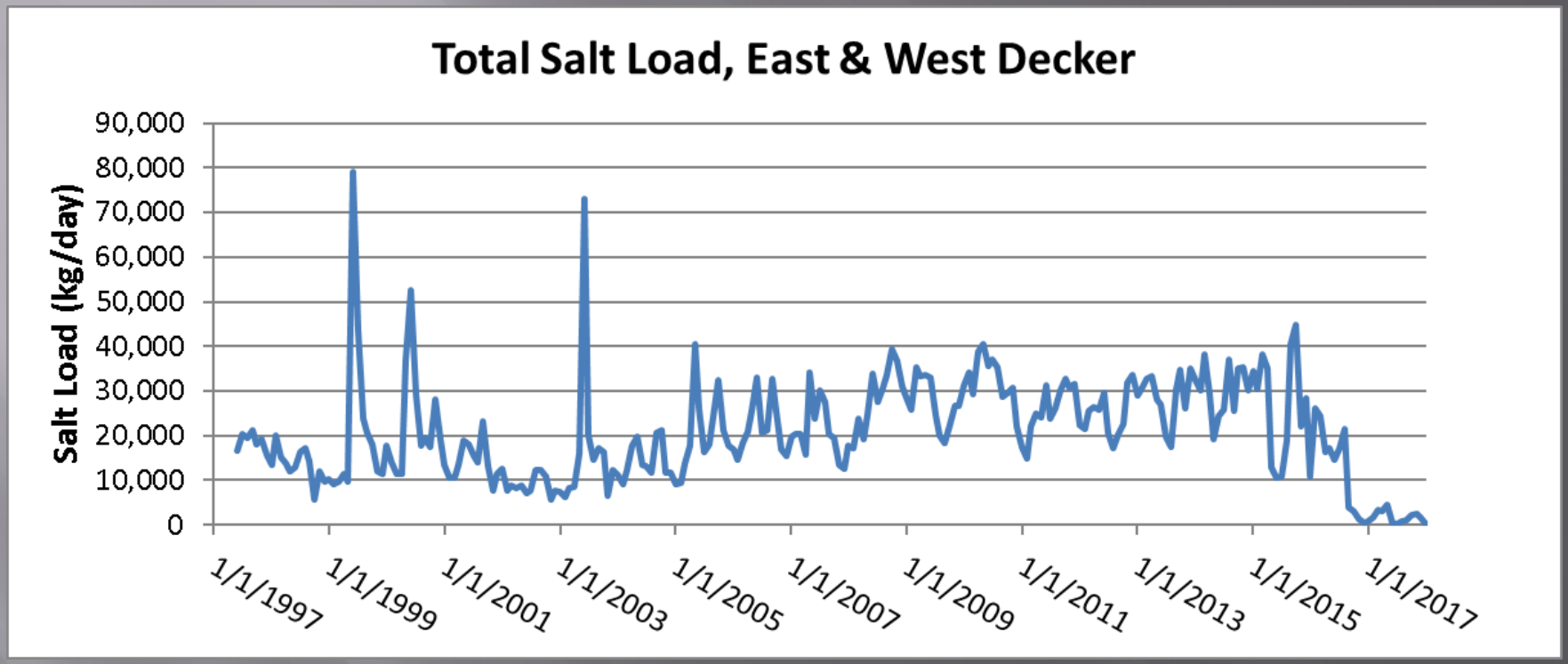
Coal Mines

- Currently three active coal mines in the watershed (Decker East, Decker West, and Spring Creek).
- One (Spring Creek) has no significant discharge.
- Two coal mines in the permitting process in the Tongue River watershed in Wyoming (Brooks and Young's Creek).
- One proposed coal mine in the Otter Creek watershed in Montana (Otter Creek).

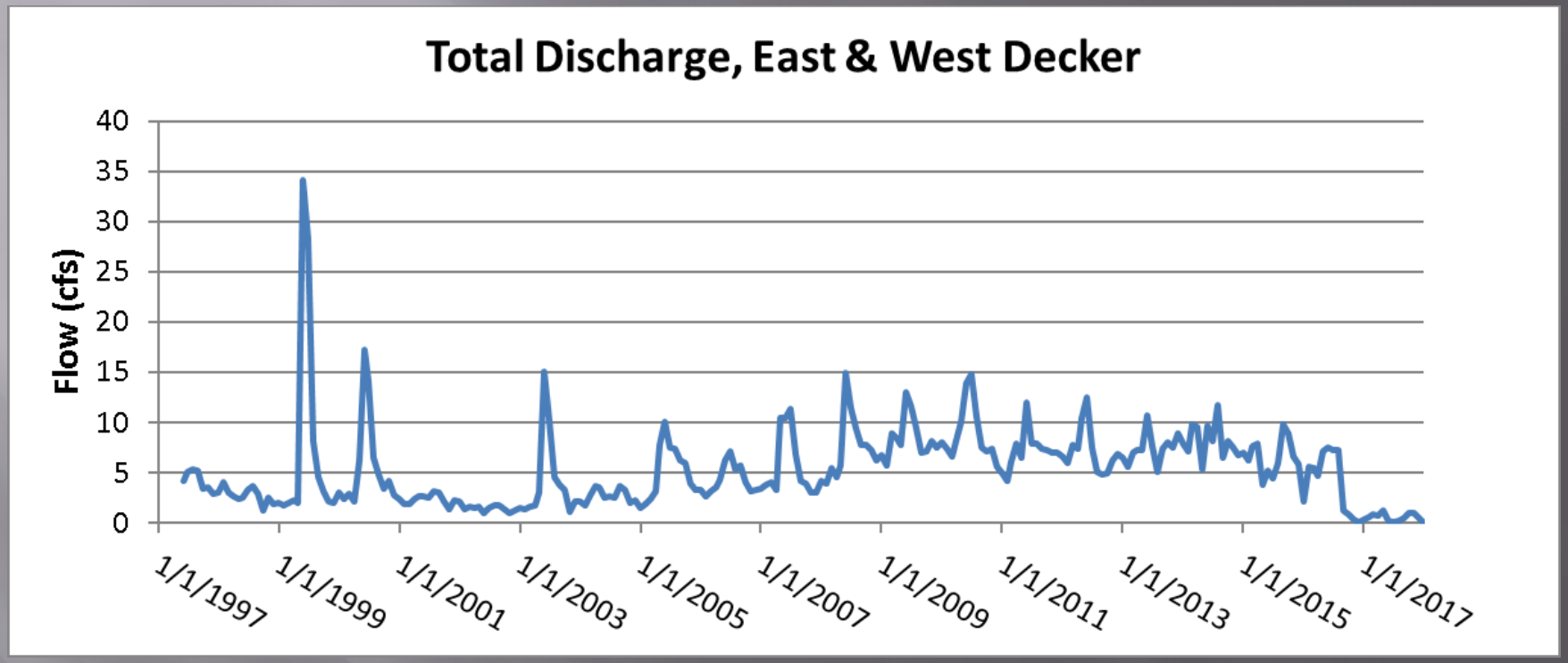
Decker Coal Mine



Decker Coal Mine



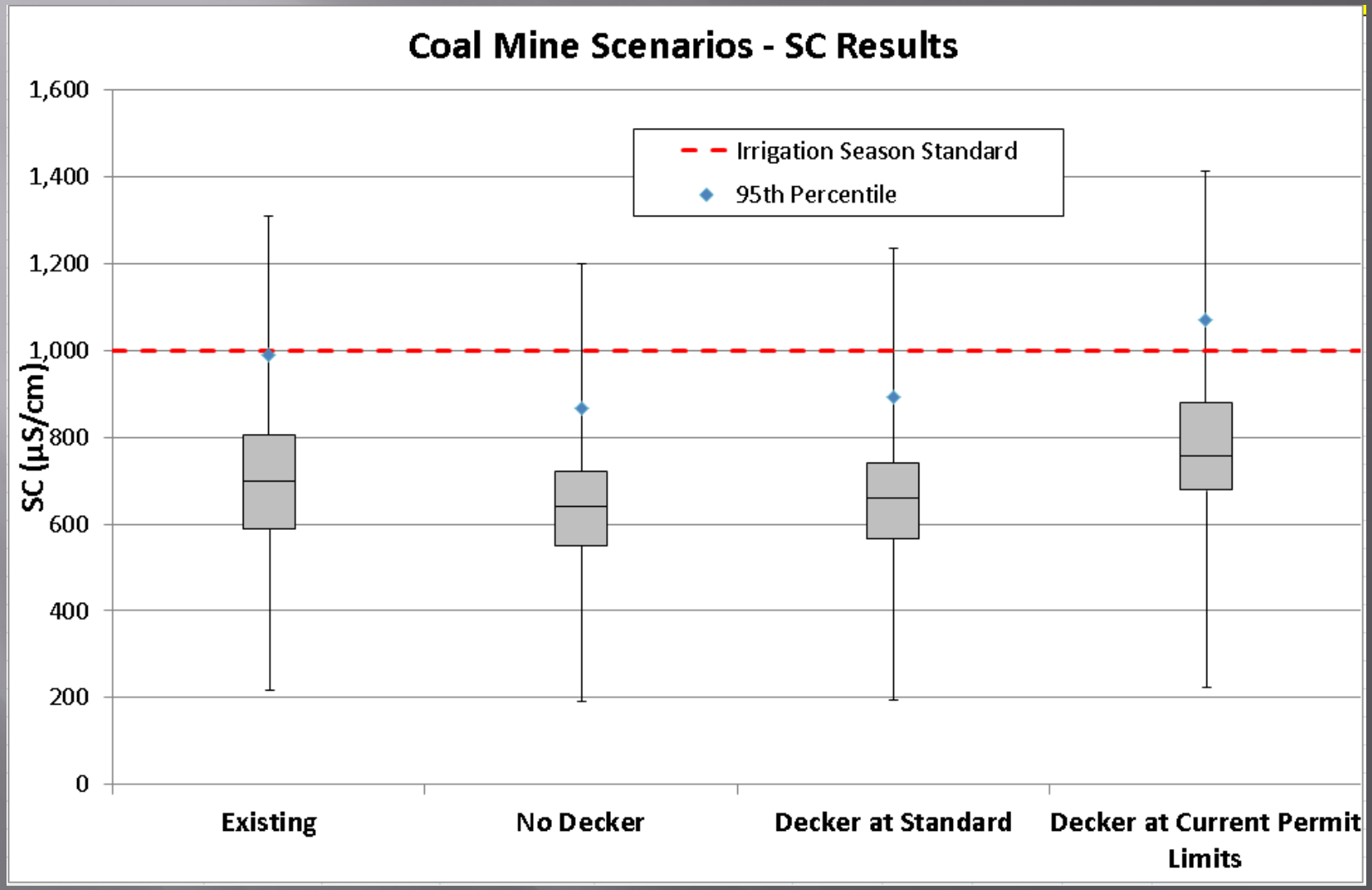
Decker Coal Mine



Coal Mine Scenario Summary

- Decker Coal Mine discharges increase average annual SC by 8%.
  - Some of this is naturally in the system
  - Increase above natural is more like 5%
- Setting discharge limits at the irrigation season standard (1,000 µS/cm) has an effect on SC based on modeling period discharges.
- On its own, removing existing coal mine discharges would not result in meeting the SC standard in the spring.

Coal Mine Scenario Summary



Colorado River Basin Salinity Control Forum

- Multi-state effort focused on reducing salinity in the watershed (Arizona, California, Colorado, Nevada, New Mexico, Utah, & Wyoming).
- Have successfully reduced salts by 1.3 million tons per year throughout watershed with BMPs.
- Most of these center around two concepts: replacing unlined ditches/canals with lining or pipes, and converting flood irrigation to center pivot.
- https://www.coloradoriversalinity.org/

Canal lining/replacement:

- Improves conveyance of irrigation water
- Prevents waterlogging of land
- Maintains water quality

Canal lining/replacement

- Salt reductions depend on miles of canal, state of canal, distance from rivers/streams, and water quality in canal.
- Currently DEQ does not have a good estimate of number of canals/mileage of canals in the watershed, but there are (at least) one hundred miles of canals throughout the watershed.

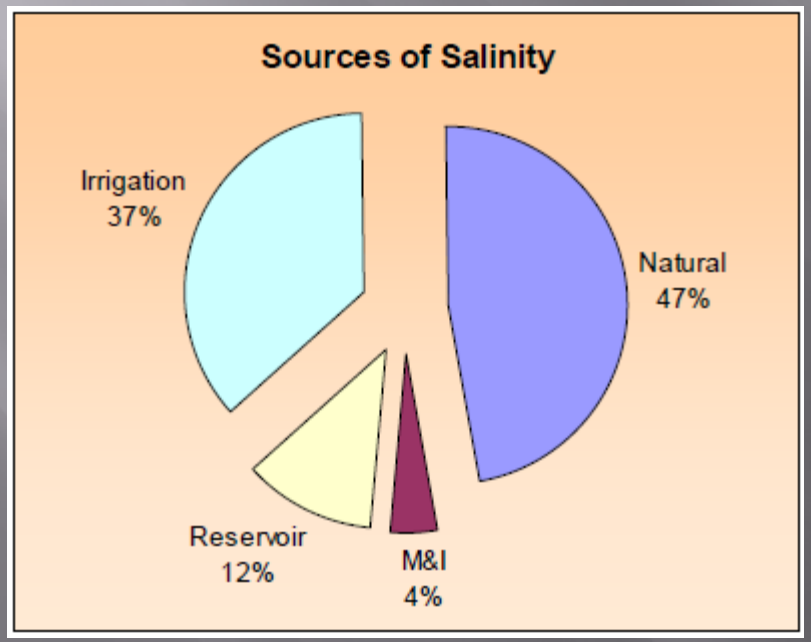
Irrigation Scenarios Summary

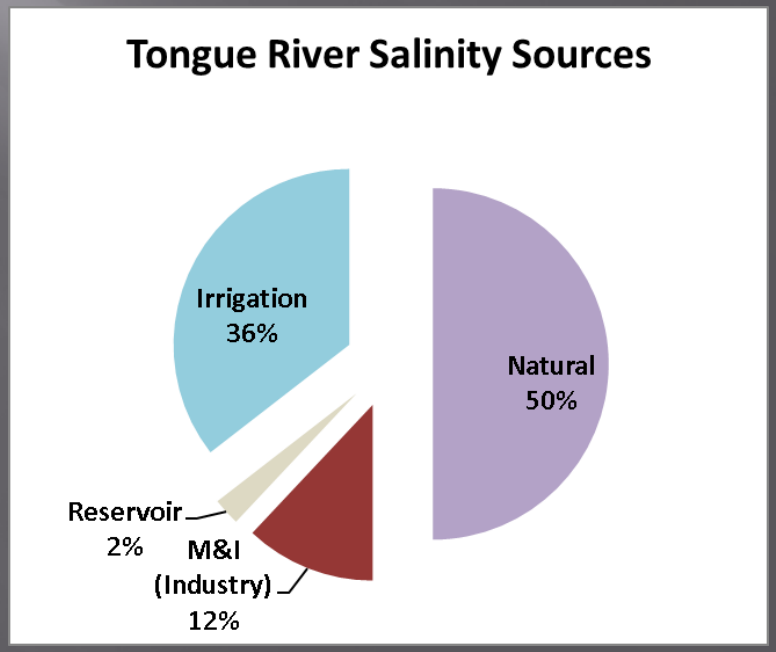
- Complete removal of irrigation reduces salinity (SC) by about 30-40%(annual).
- Salinity reductions achieved through canal replacement are being estimated by other means, but the Colorado River Basin Salinity Control Forum has estimates that show in the neighborhood of 10-15% reductions in loading from many agricultural areas.

The largest contributor of salt in many western watersheds is nature

- The region's unique geology, size, and climate mean that salts are a natural part of the system.

Colorado River Salinity Assessment





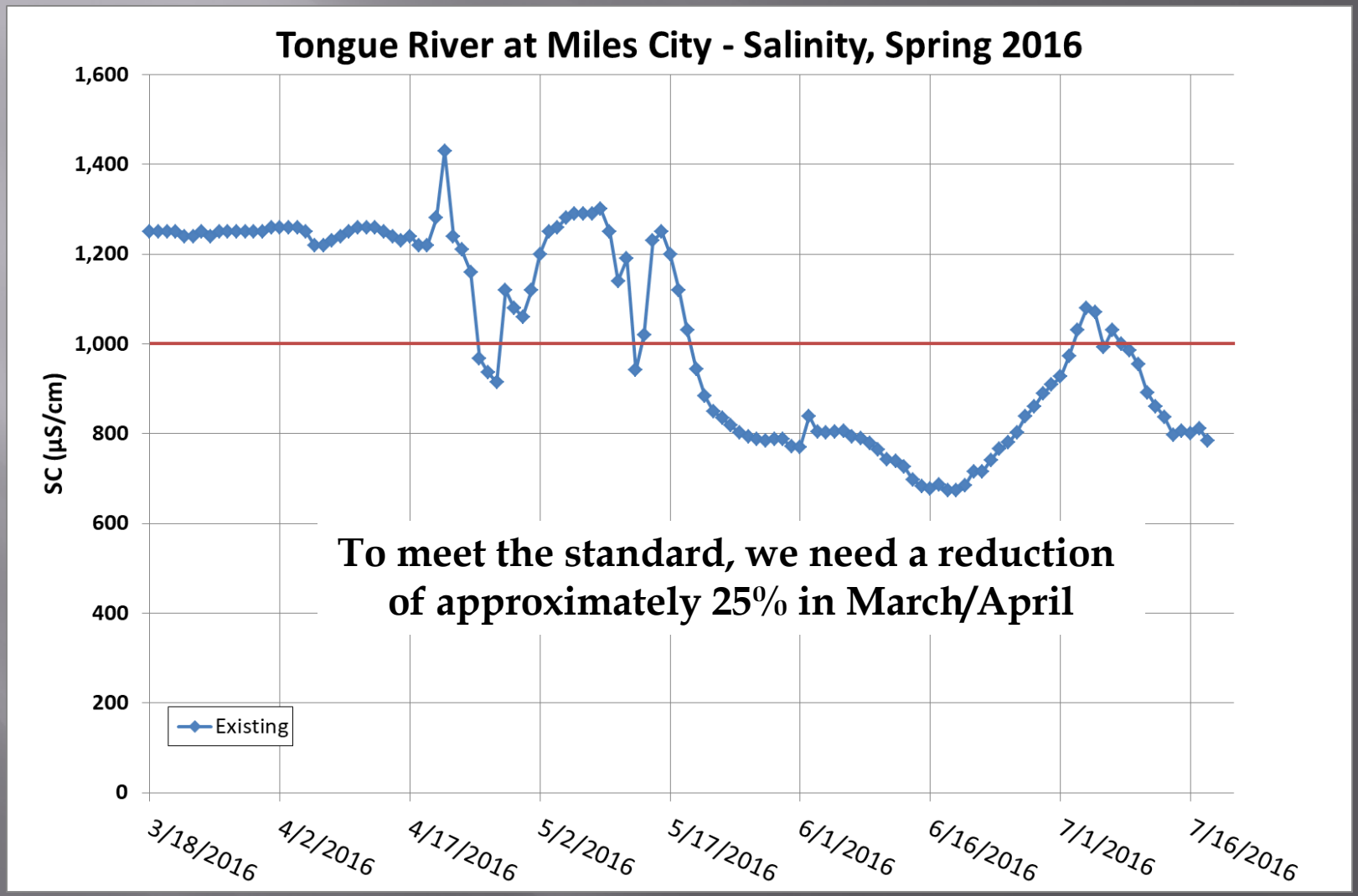
Source: Bureau of Reclamation, 2013

Scenario Summary

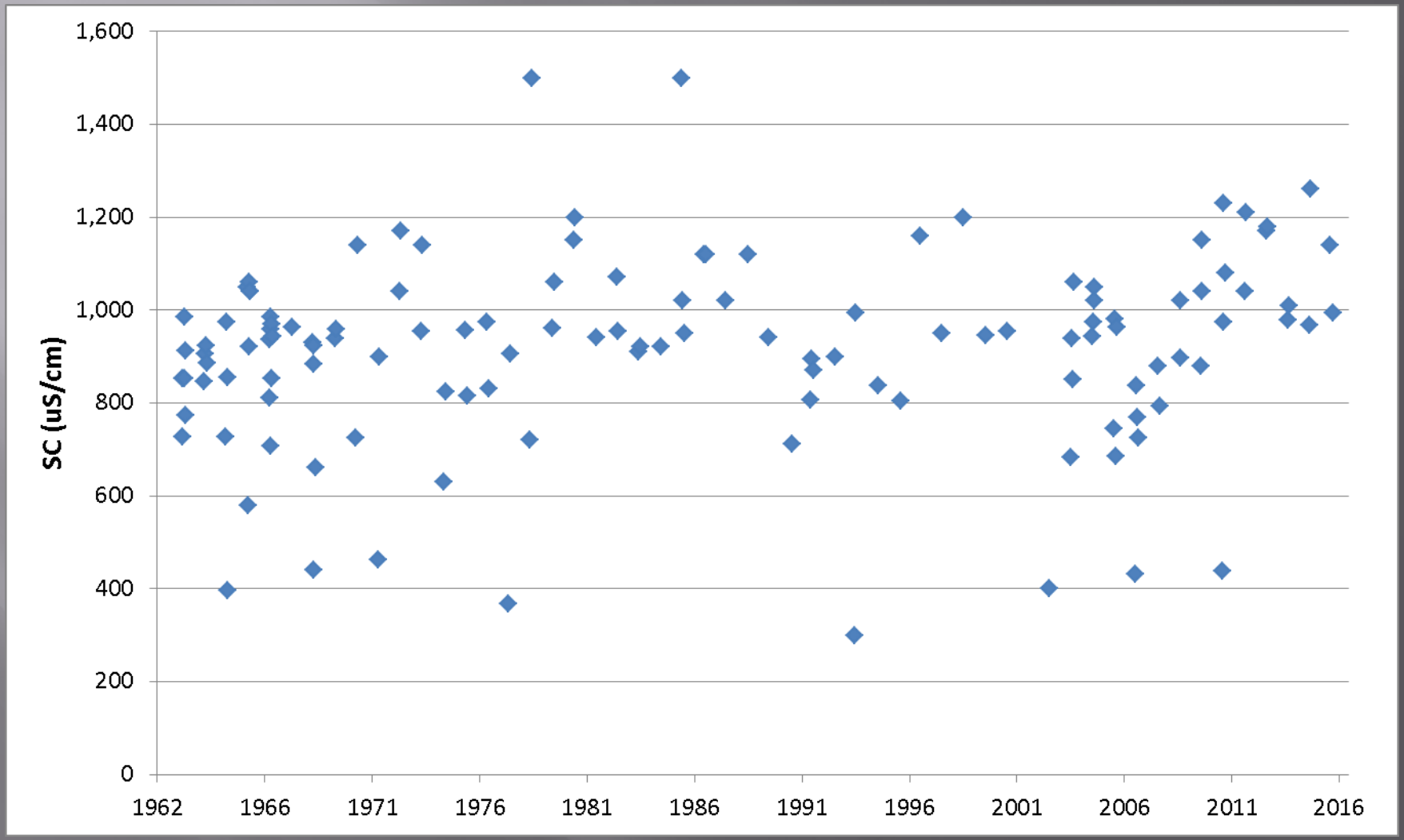
- Scenario results show that it's possible to get a significant reduction in SC **on an annual basis**.
- However, the Tongue River is meeting the SC standard on an annual basis.
- Generally, SC does not meet the standard in the spring months (March - May).

Spring Exceedances

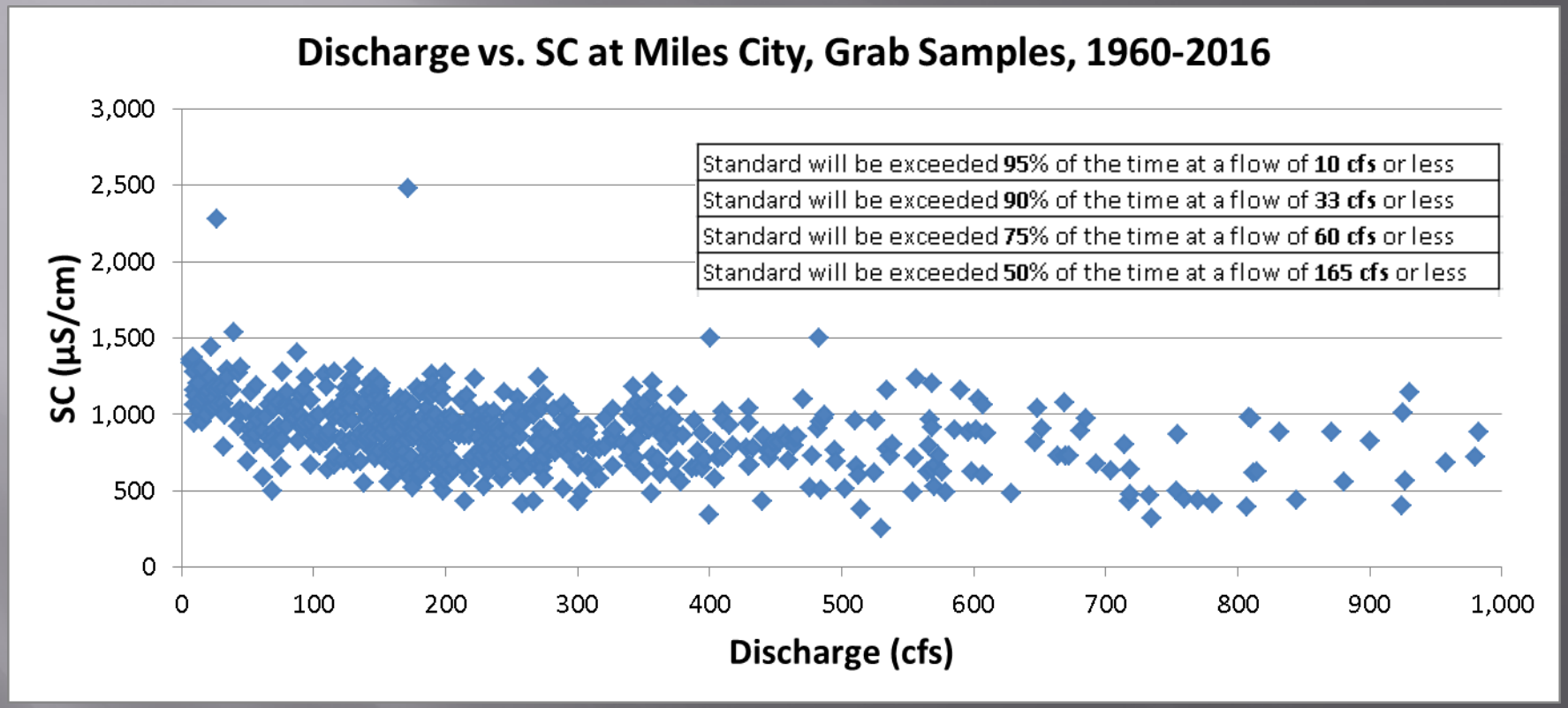
March/April 2016



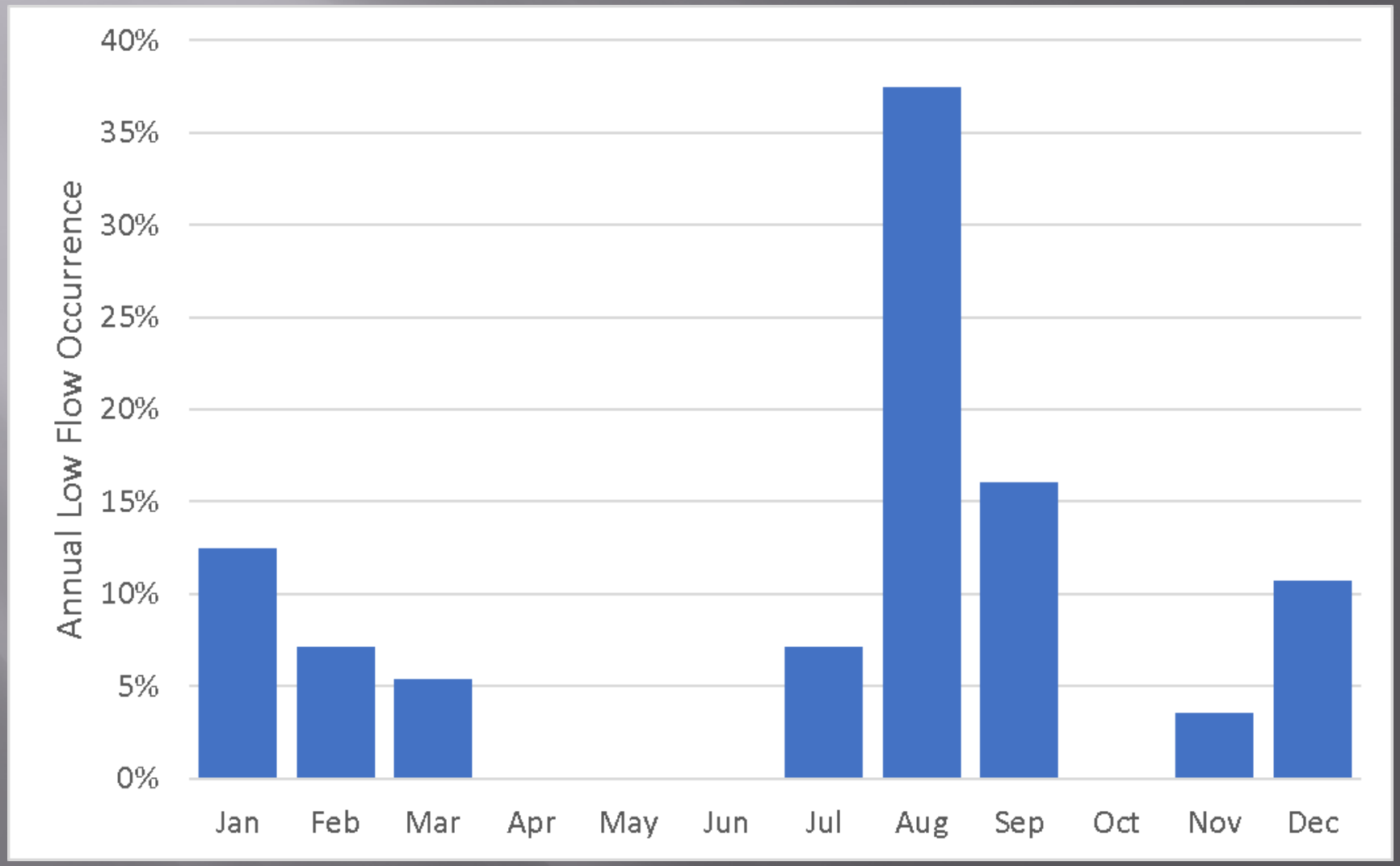
Historic SC at Miles City – March/April values only



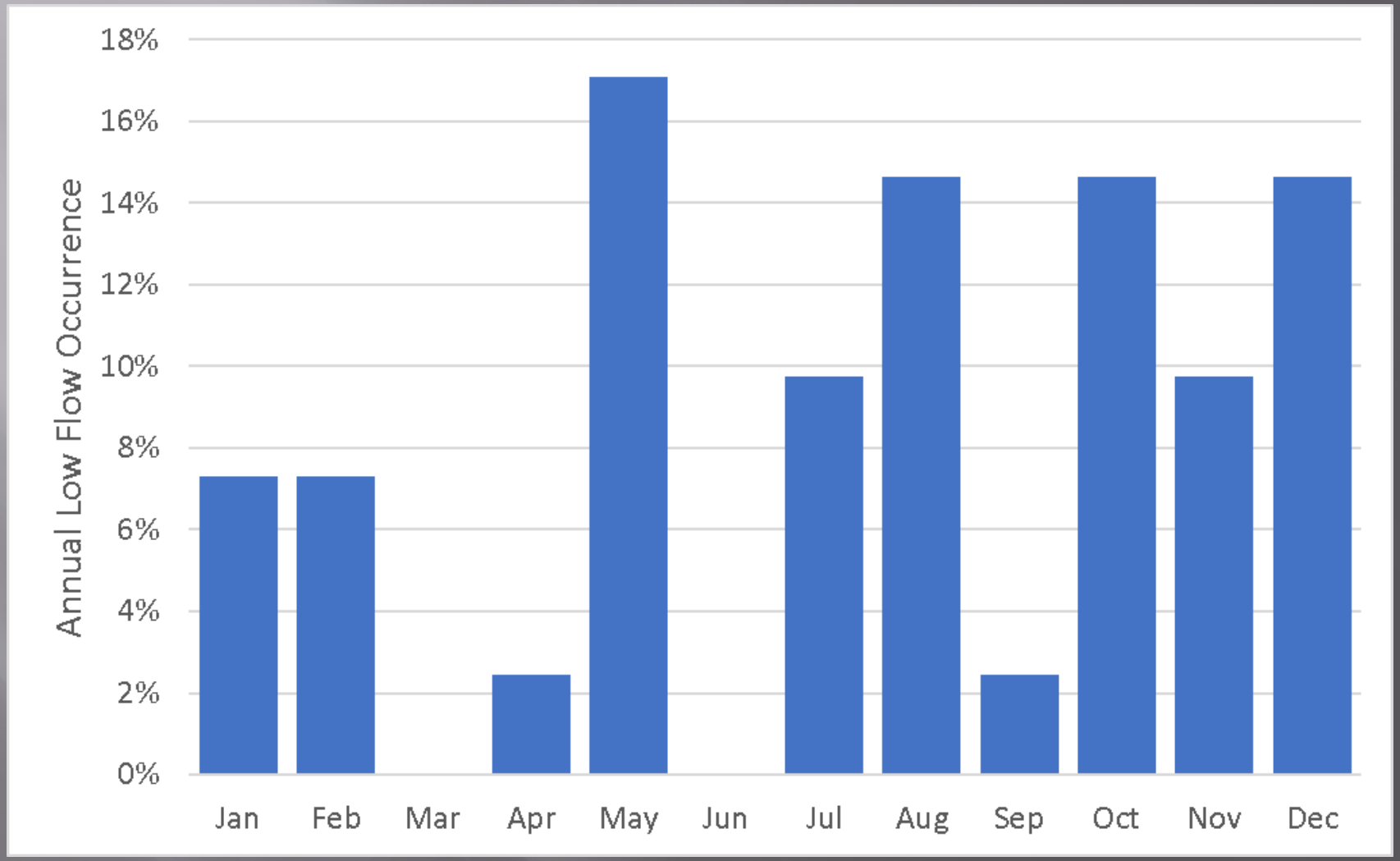
Discharge and SC at Miles City



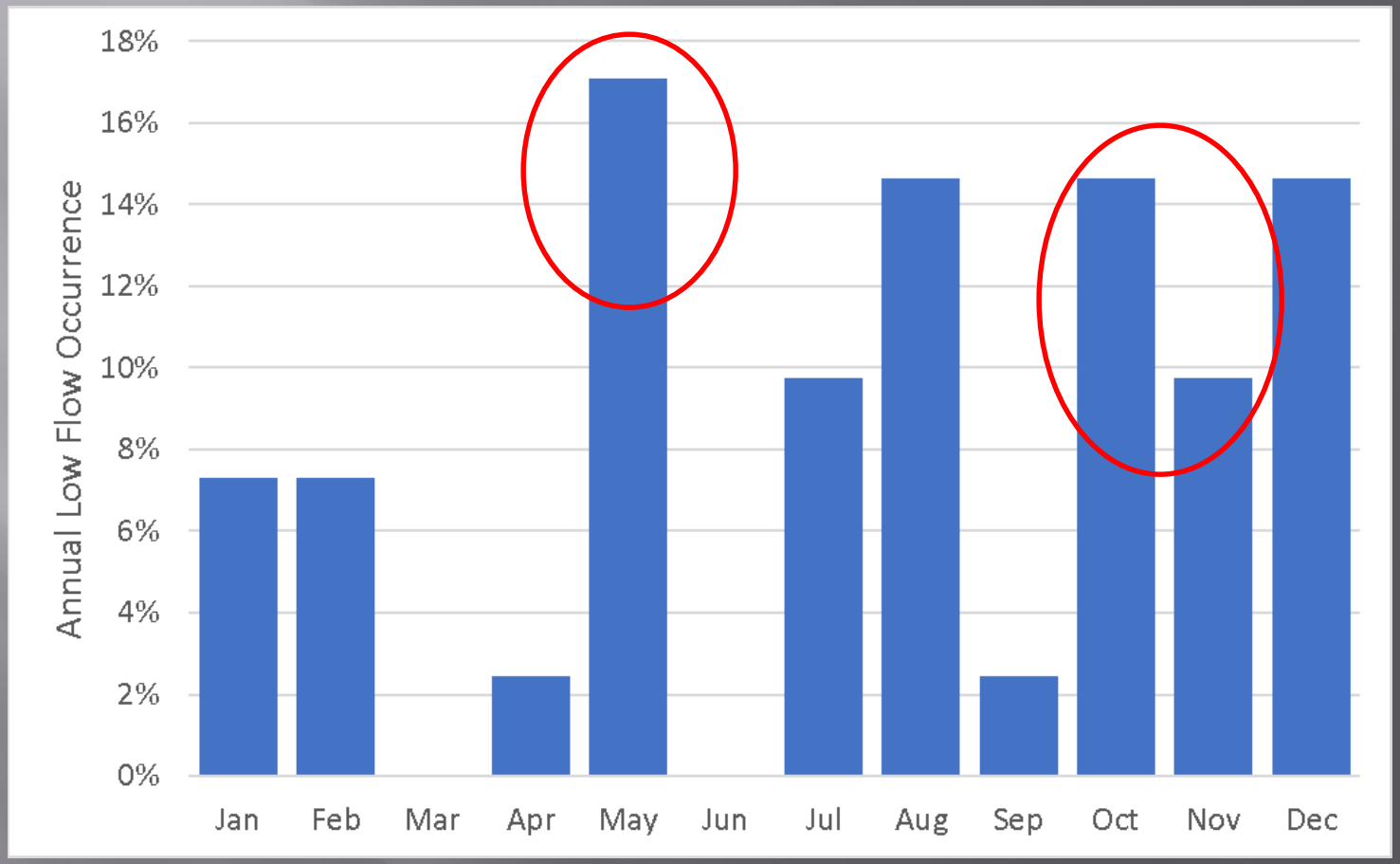
Low Flows at State Line



Low Flows at Miles City

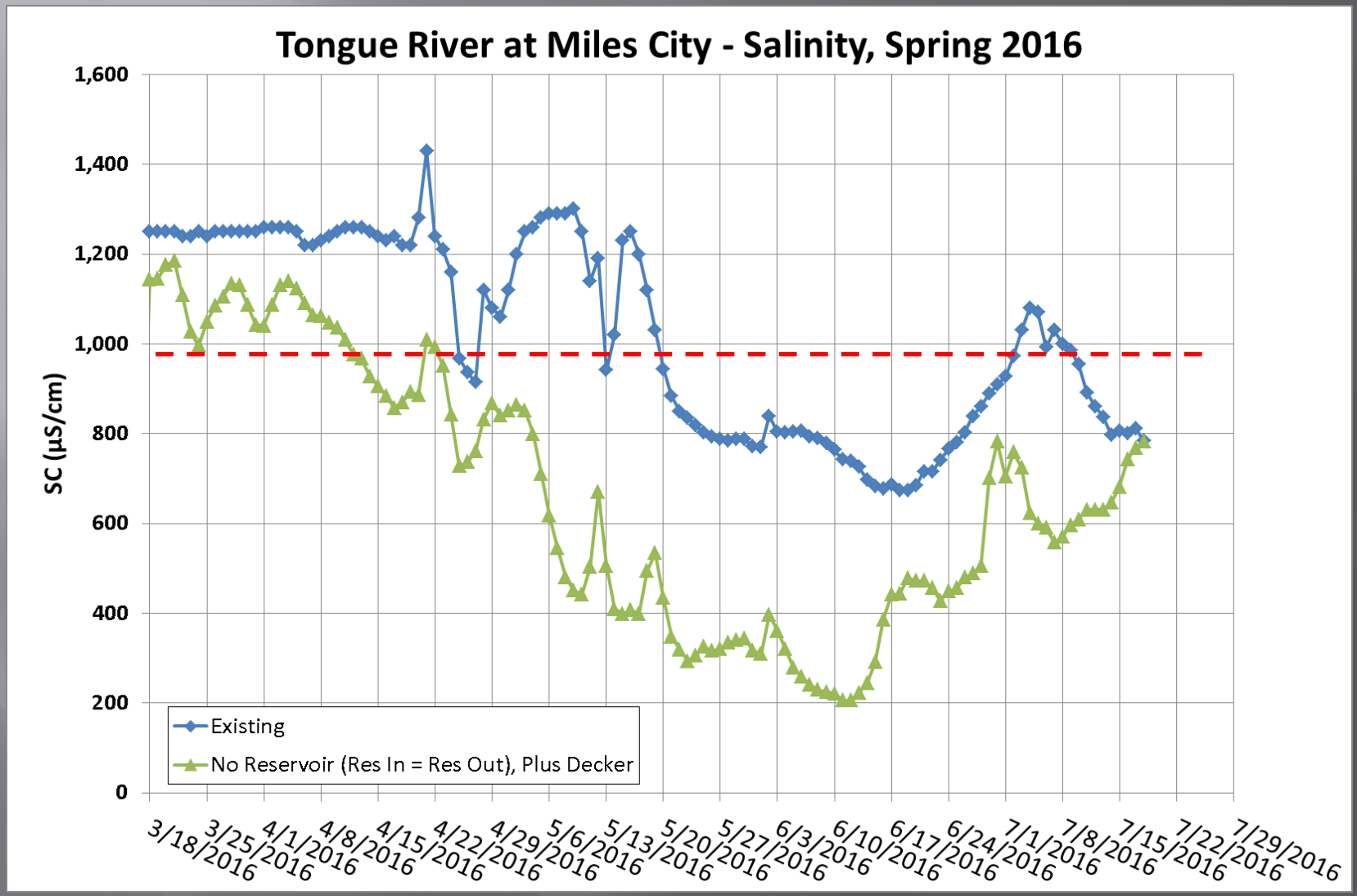


Low Flows at Miles City



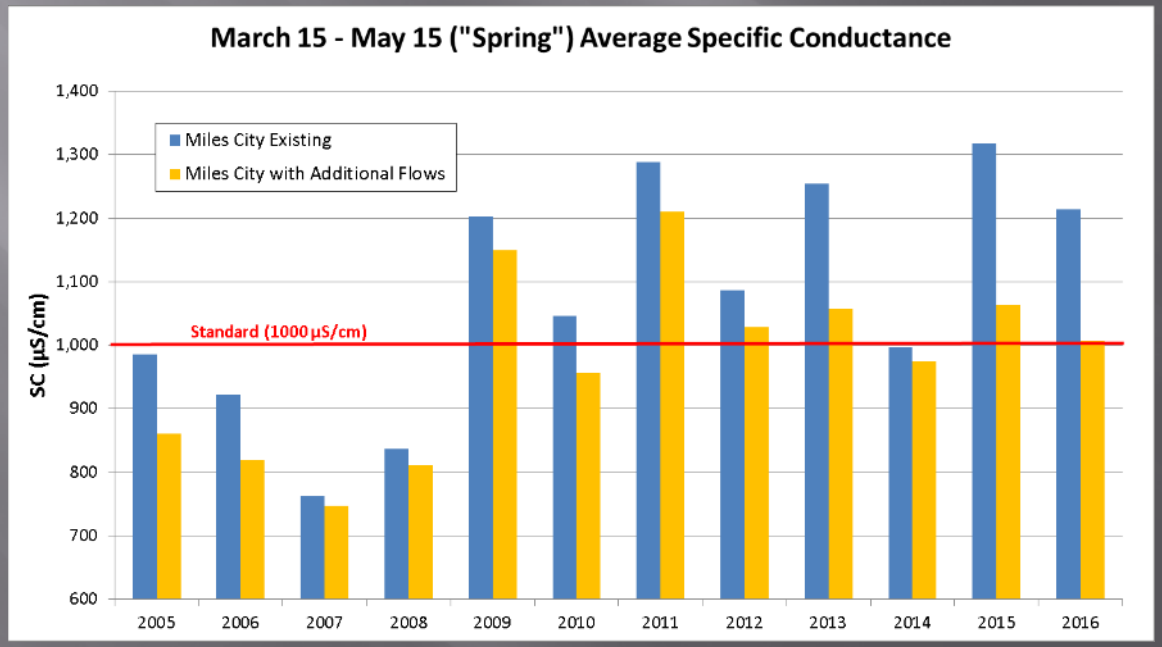
Reservoir Management Scenarios

Reservoir Operations

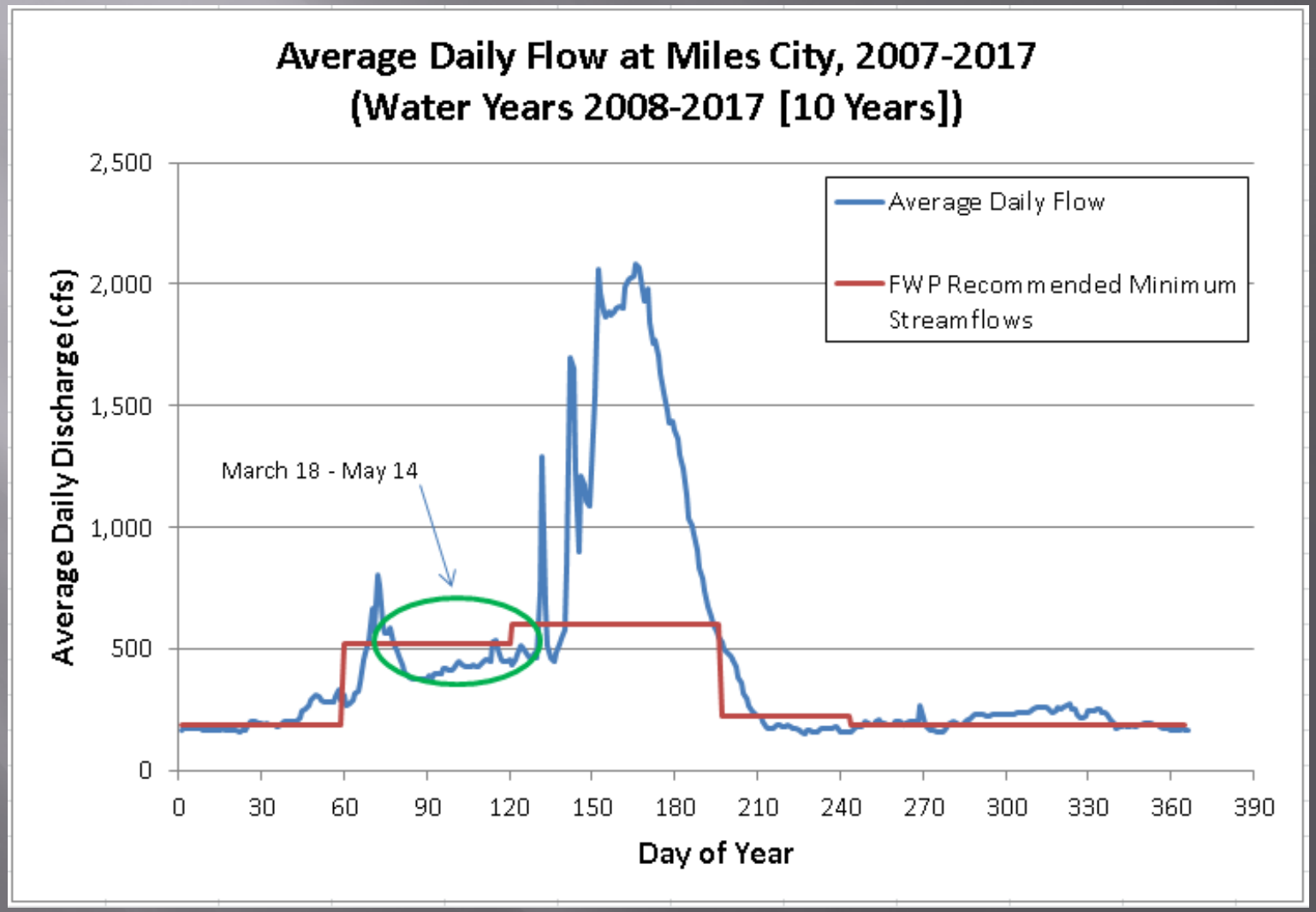


Acquiring additional storage to improve spring SC values

- Using 10,000 acre-feet of storage to increase flows in the March 15 – May 15 timeframe.
- Results in 80 cfs.
- Exceedances are reduced from 7 years to 5 years



Additional flows in spring may help aquatic life as well



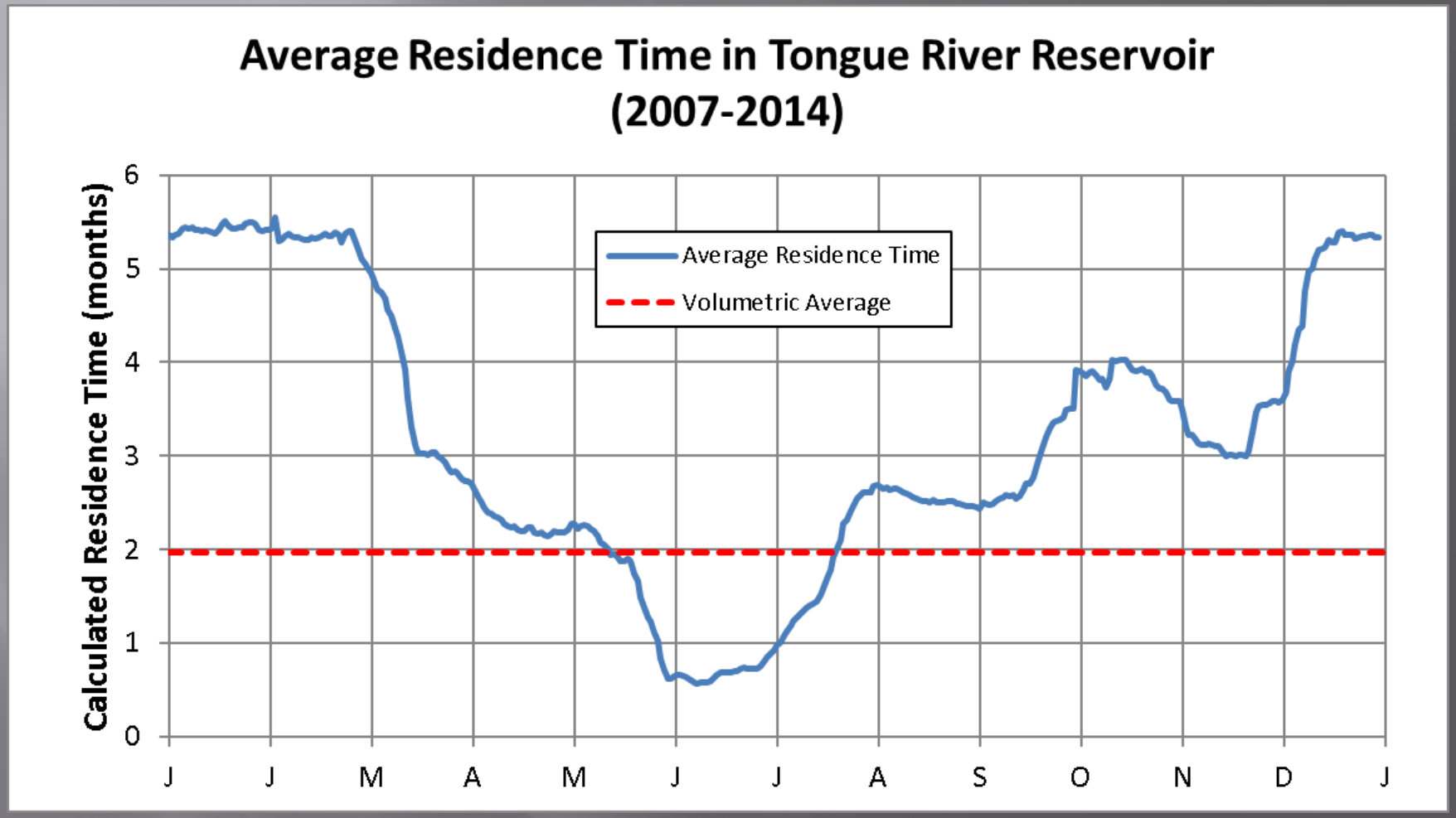
Additional Flows have potential to help meet the TMDL

- Several assumptions and unknowns
  - Dam releases make it to the mouth
  - Bank storage
  - Water availability
- DEQ is pursuing a 10 year lease for 10,000 acre-feet of water with the Northern Cheyenne Tribe.

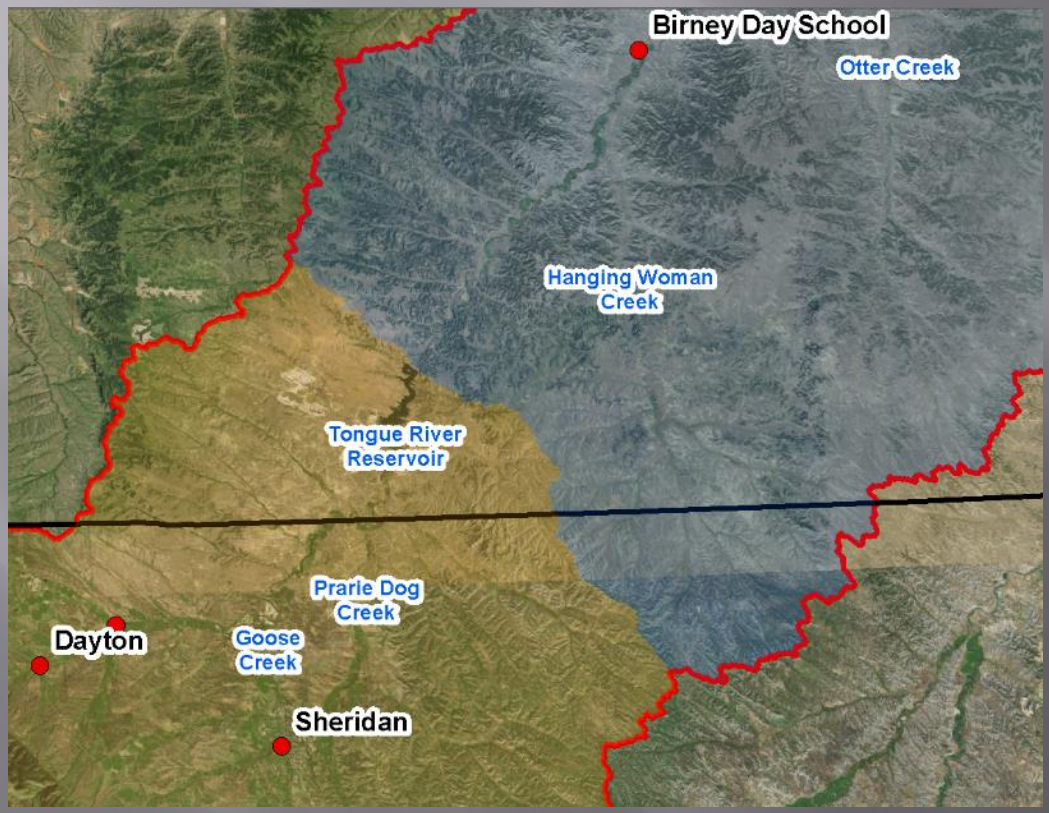
Full Range of SC Load Reductions from Model

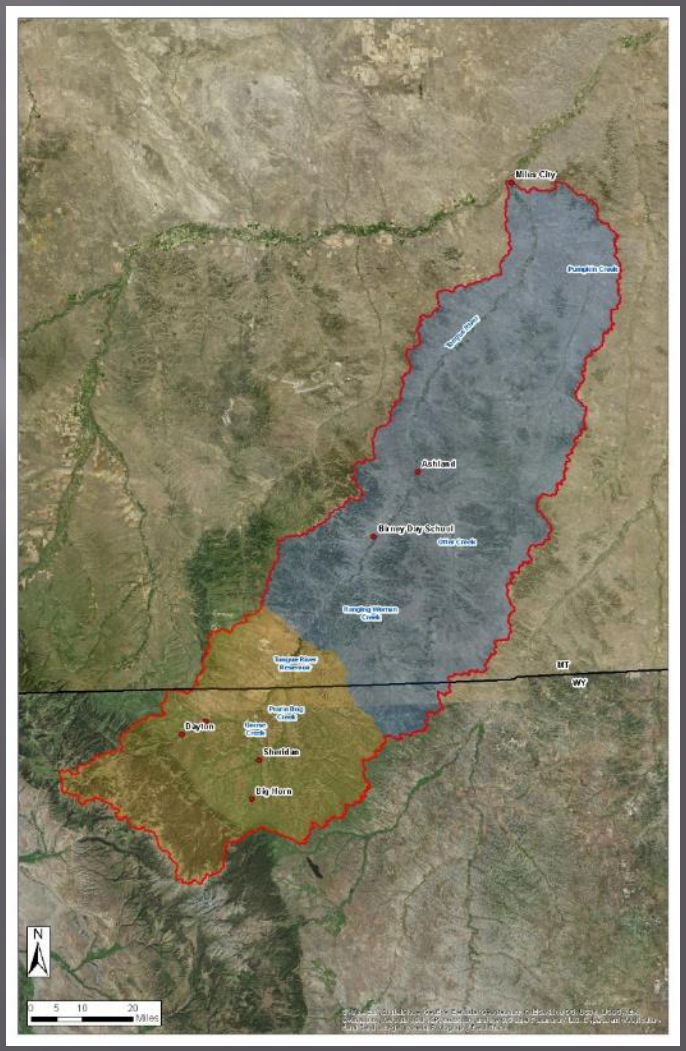
- CBM: 0-5% reduction
- Coal mines (Montana): 0-8% reduction
- Irrigation: 0-35% reduction
- Reservoir Management: May provide additional dilution in the equivalent order of 10-20% in the spring.

Tongue River Reservoir Residence Time



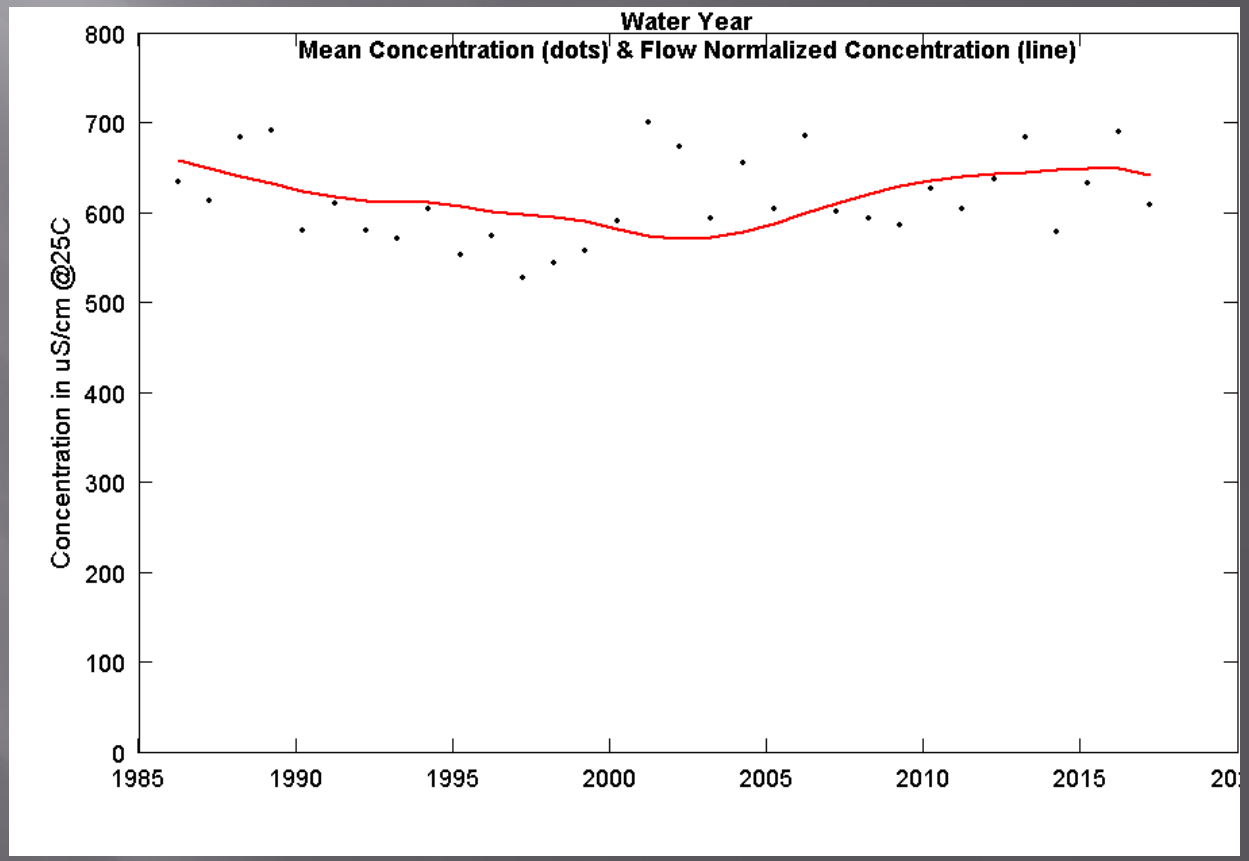
Sources Above the Dam tend to be more spread out throughout the year





Weighted Regressions on Time, Discharge, and Season (WRTDS)

- Part of the R statistical package
- Flow-normalized EC values at USGS 06306300 – Tongue River at State Line.



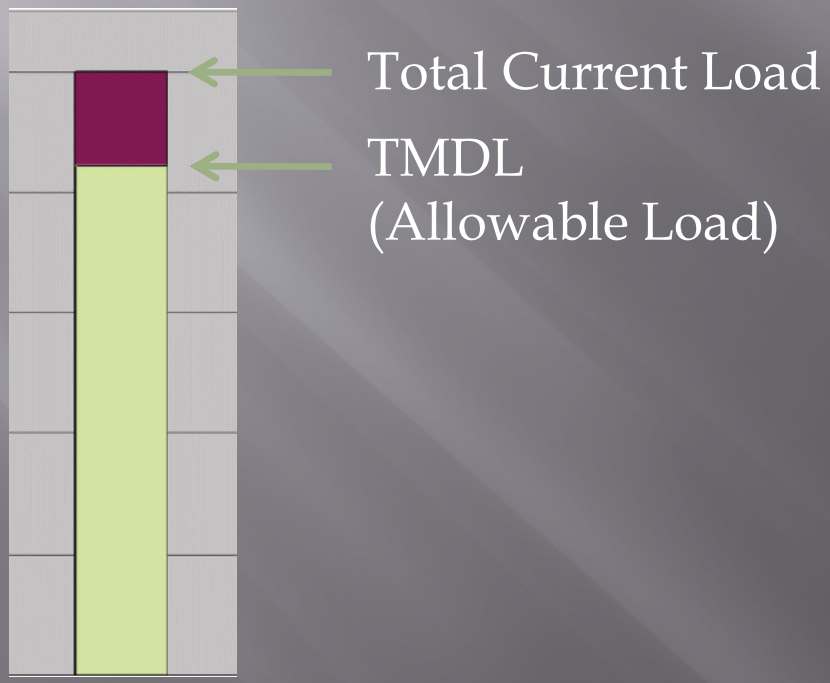
Questions?

SALINITY TMDL DEVELOPMENT DETAILS

Dean Yashan

What is a TMDL?

Total **M**aximum **D**aily **L**oad is the amount of a pollutant that a waterbody (stream or lake) can receive from all sources and still meet water quality standards



What is a TMDL?

Total **M**aximum **D**aily **L**oad can be equated to an allowable load limit, whether instantaneous or over a period of time.

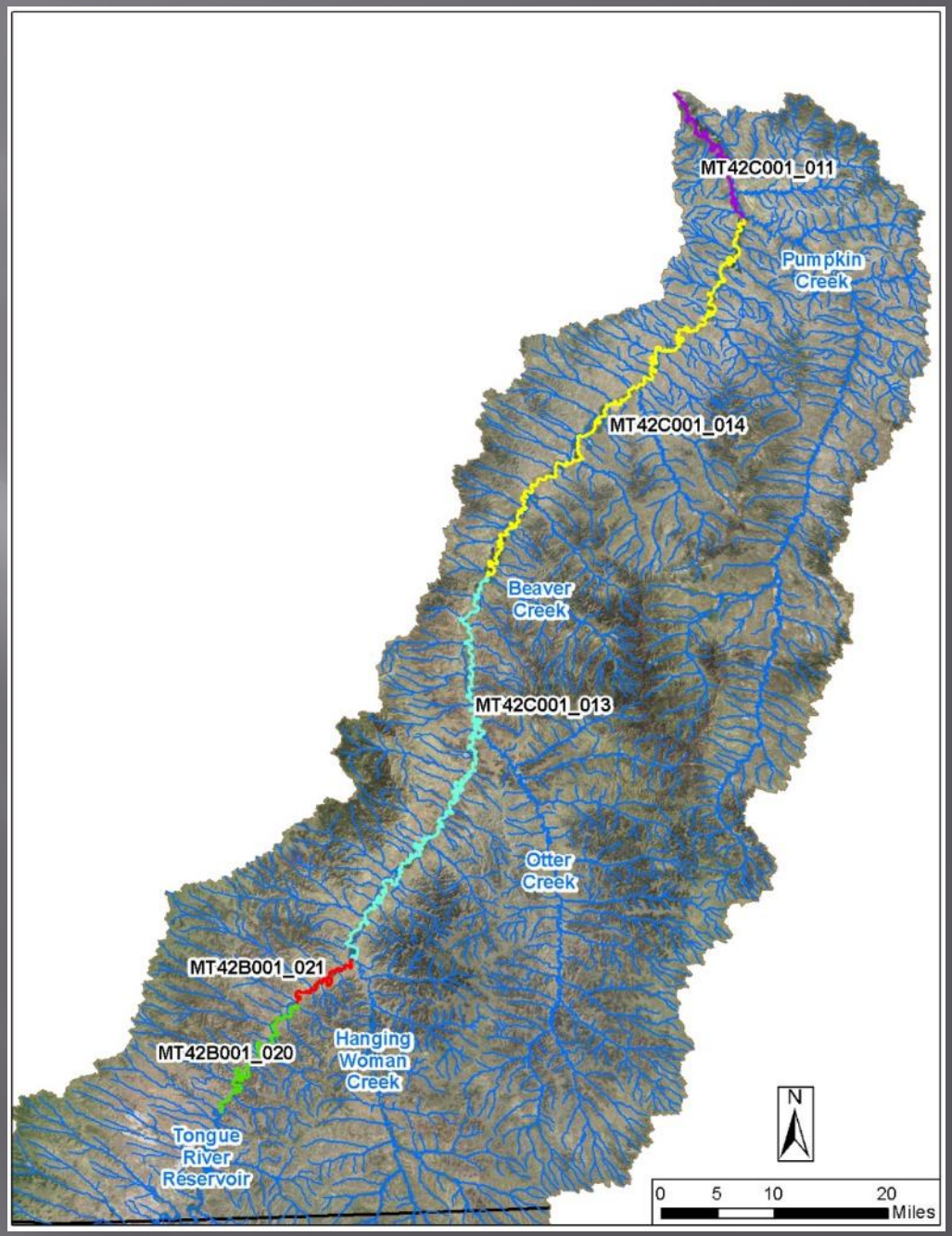
Tongue River EC TMDL Development Steps

1. Defining the TMDL water quality target and comparison to existing data
2. Defining the TMDL (allowable loading rate)
3. Determining sources of EC loading
4. Determining the TMDL allocations

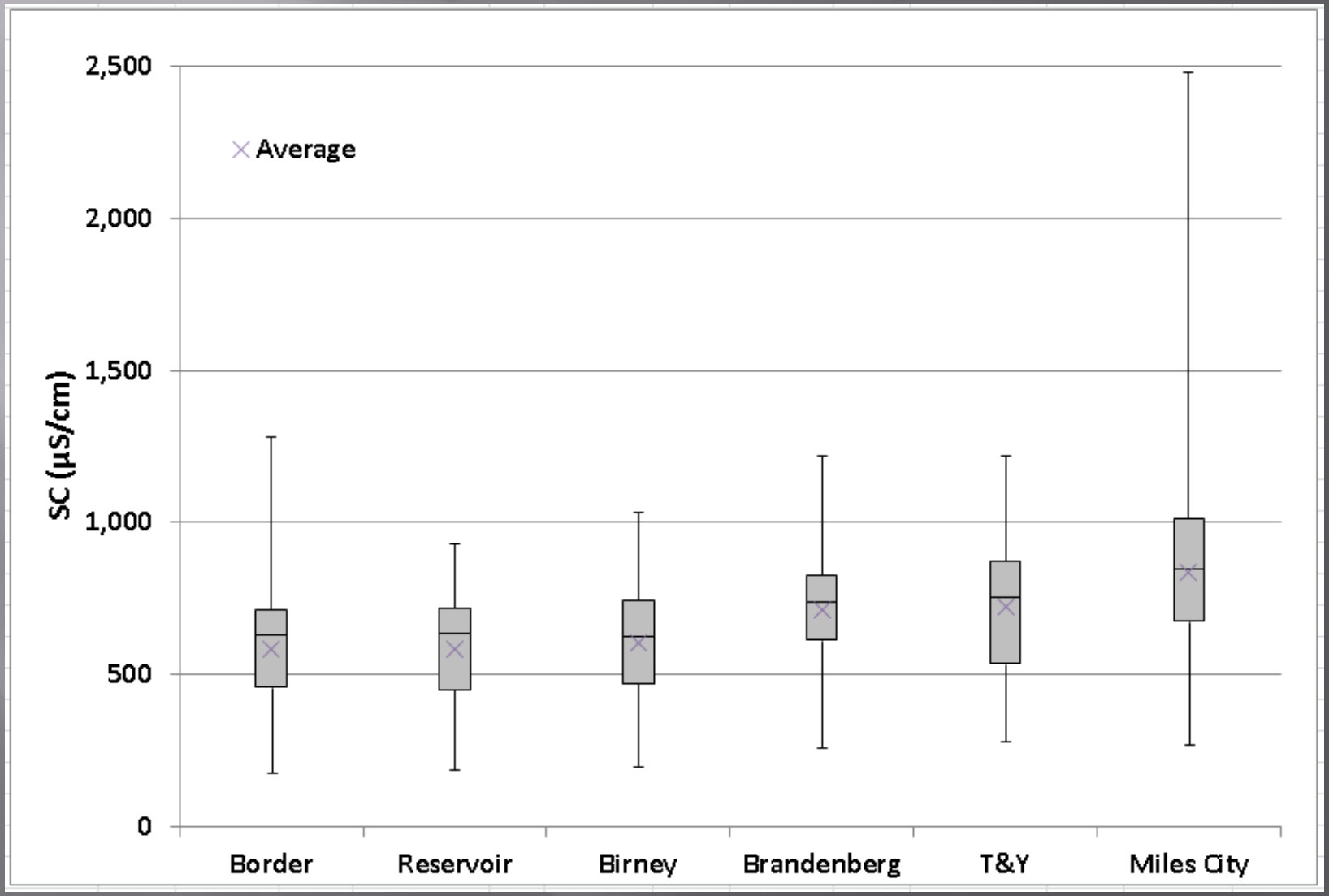
1. Tongue River EC Targets = Numeric EC Standards

- Maximum monthly average:
  - March 2 – October 31: 1,000 µS/cm EC
  - November 1 – March 1: 1,500 µS/cm EC
- "No sample may exceed":
  - March 2 – October 31: 1,500 µS/cm EC
  - November 1 – March 1: 2,500 µS/cm EC

Tongue River Segments (also called assessment units)



SC/EC River Profile (1985-2016)



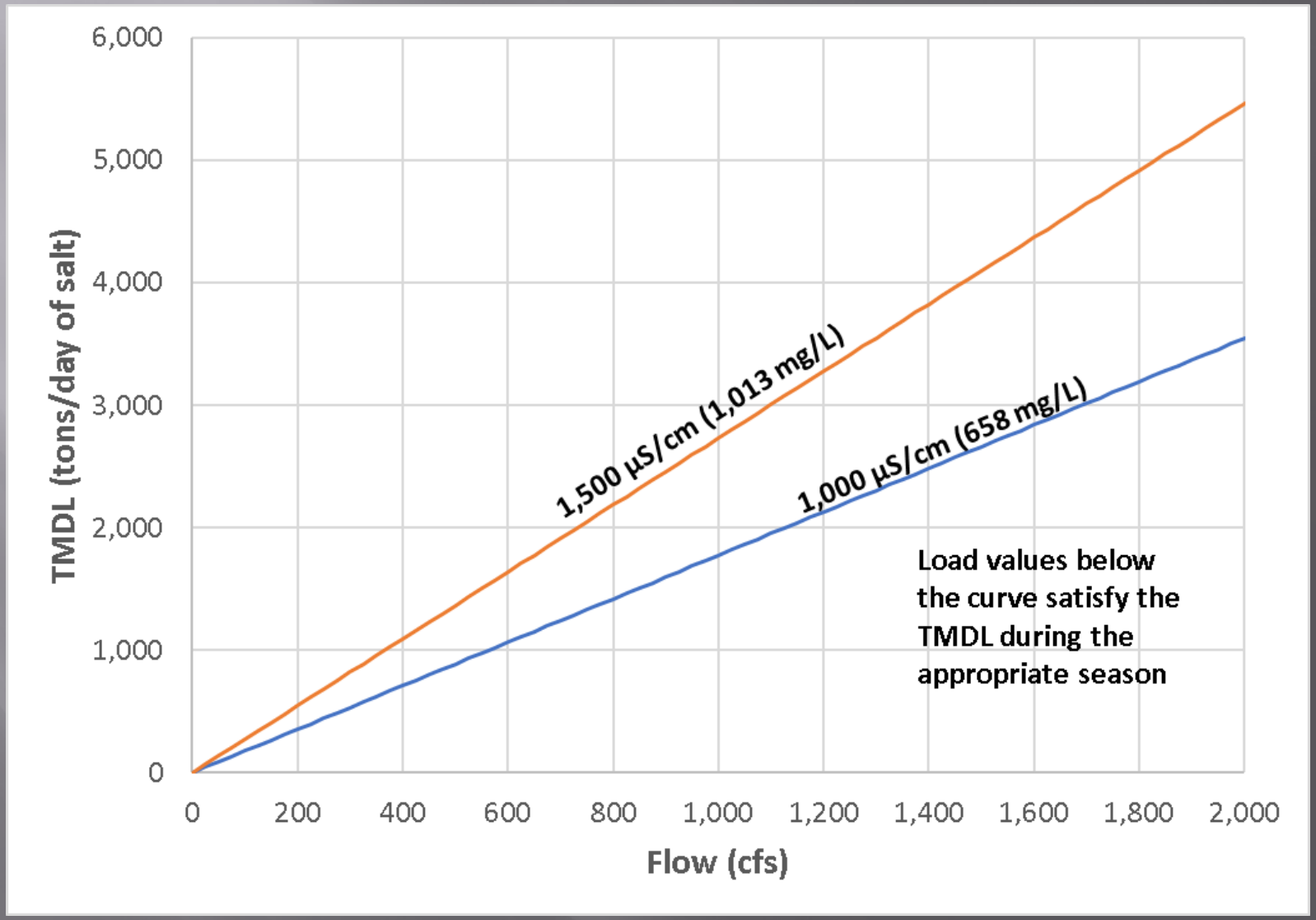
2. Defining the TMDL

- For streams, the TMDL can usually be determined using the target concentration and stream flow

  TMDL (lb/day) = (Stream flow) X (target concentration) x (conversion factor)

- EC target multiplied by flow provides a TMDL surrogate.
- Normally apply using most restrictive (protective) target

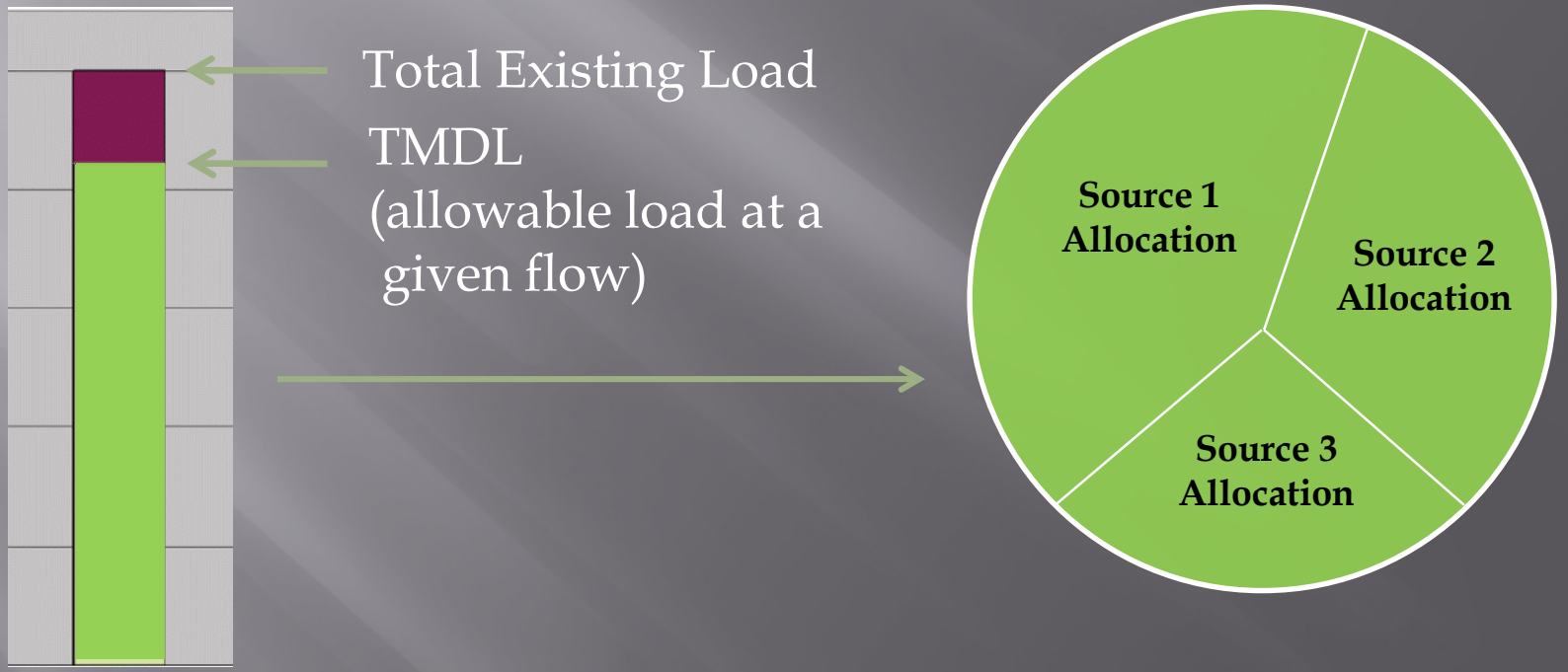
Total Maximum Daily Load: Seasonal Curves



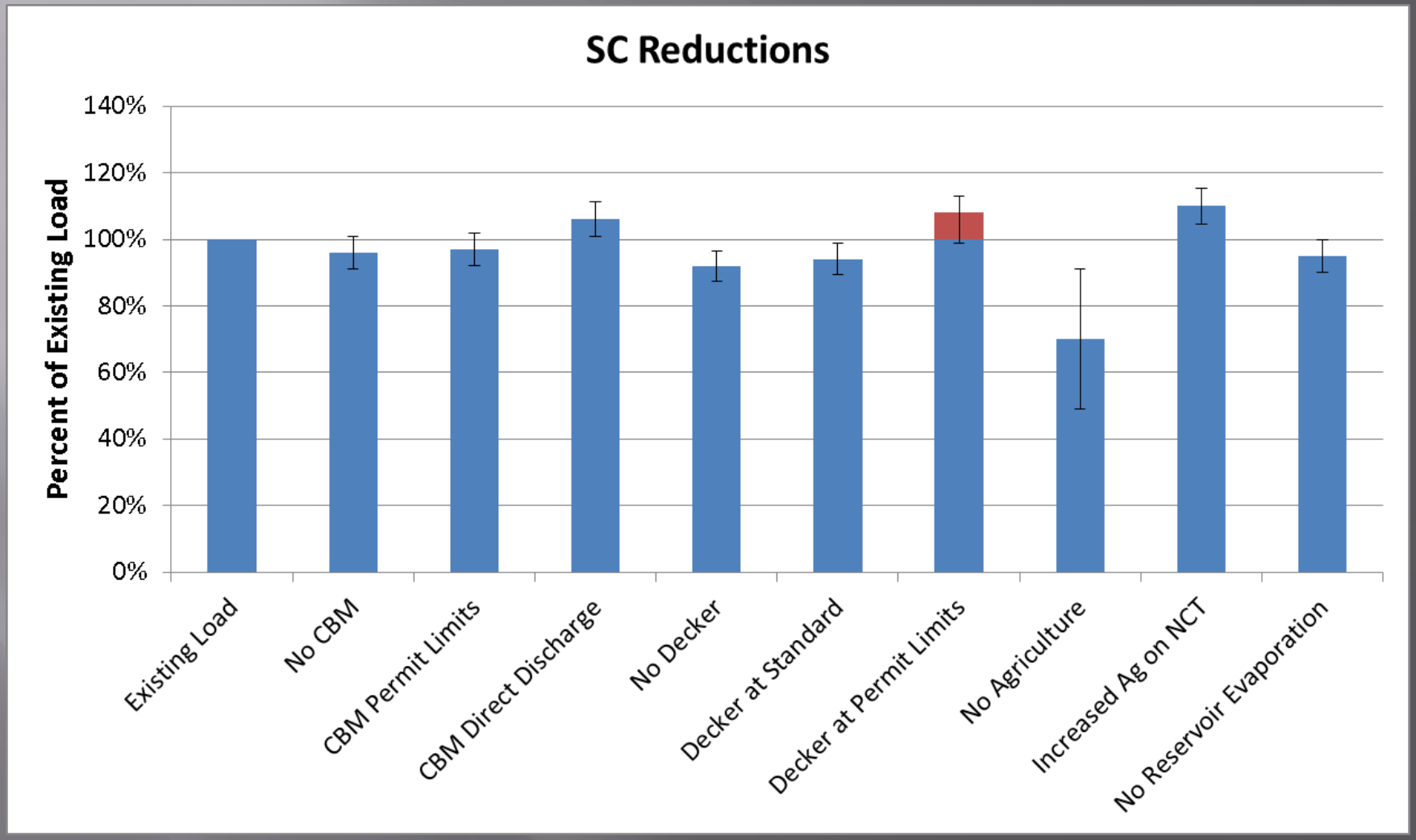
3. EC Loading Sources – Source Assessment

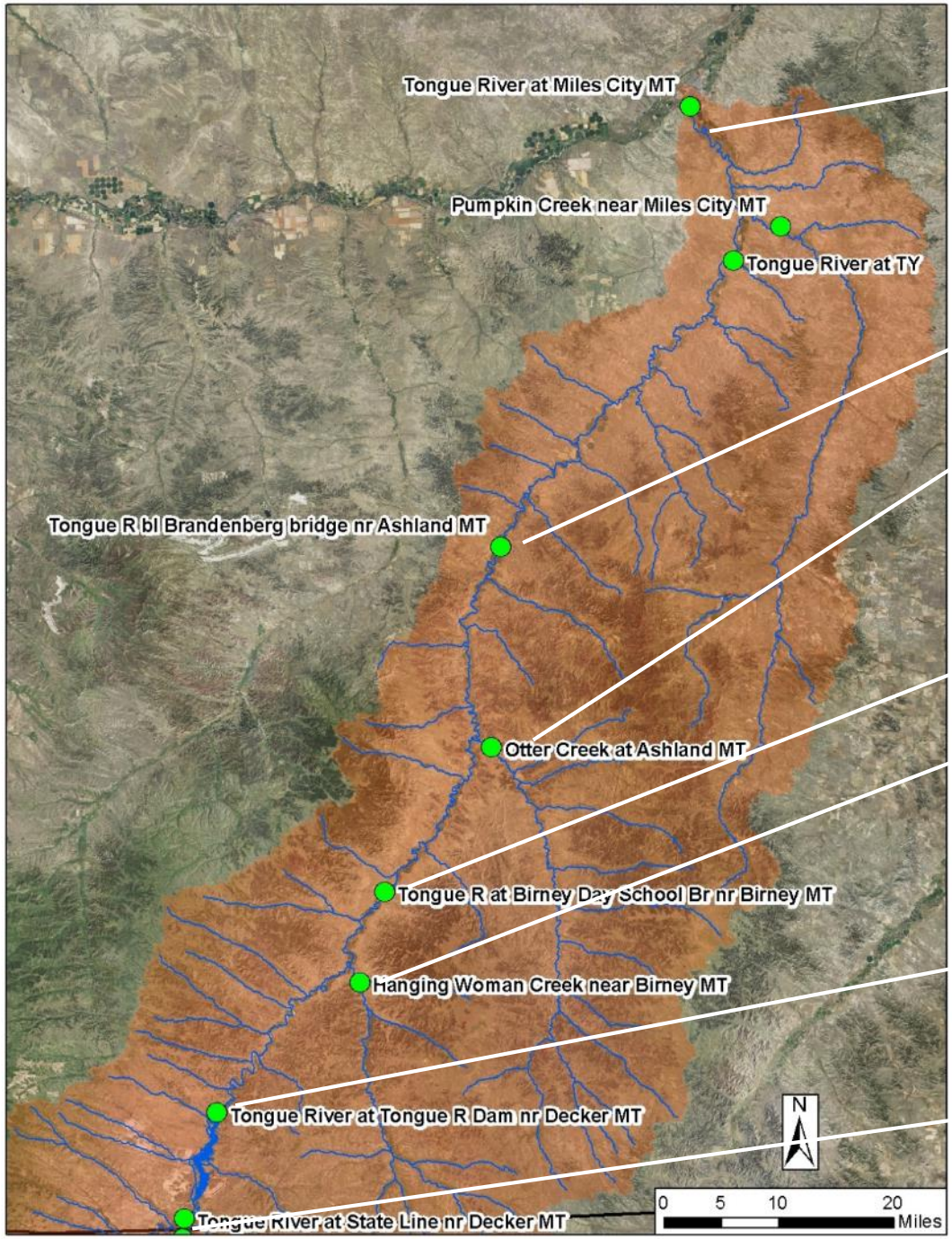
- Where is the total existing load coming from?
- Modeling results, modeling scenarios
- Sampling results (model calibration, individual sampling dates upstream to downstream, etc.)

4. EC TMDL Allocations: Conceptual Diagram



Modeled Reductions





EC Meter: 12 years
EC: 714 'grab' samples

EC Meter: 3 years
EC: 231 samples

EC Meter: 14 years
EC: 310 samples

EC Meter: 10 years
EC: 353 samples

EC Meter: 9 years
EC: 307 samples

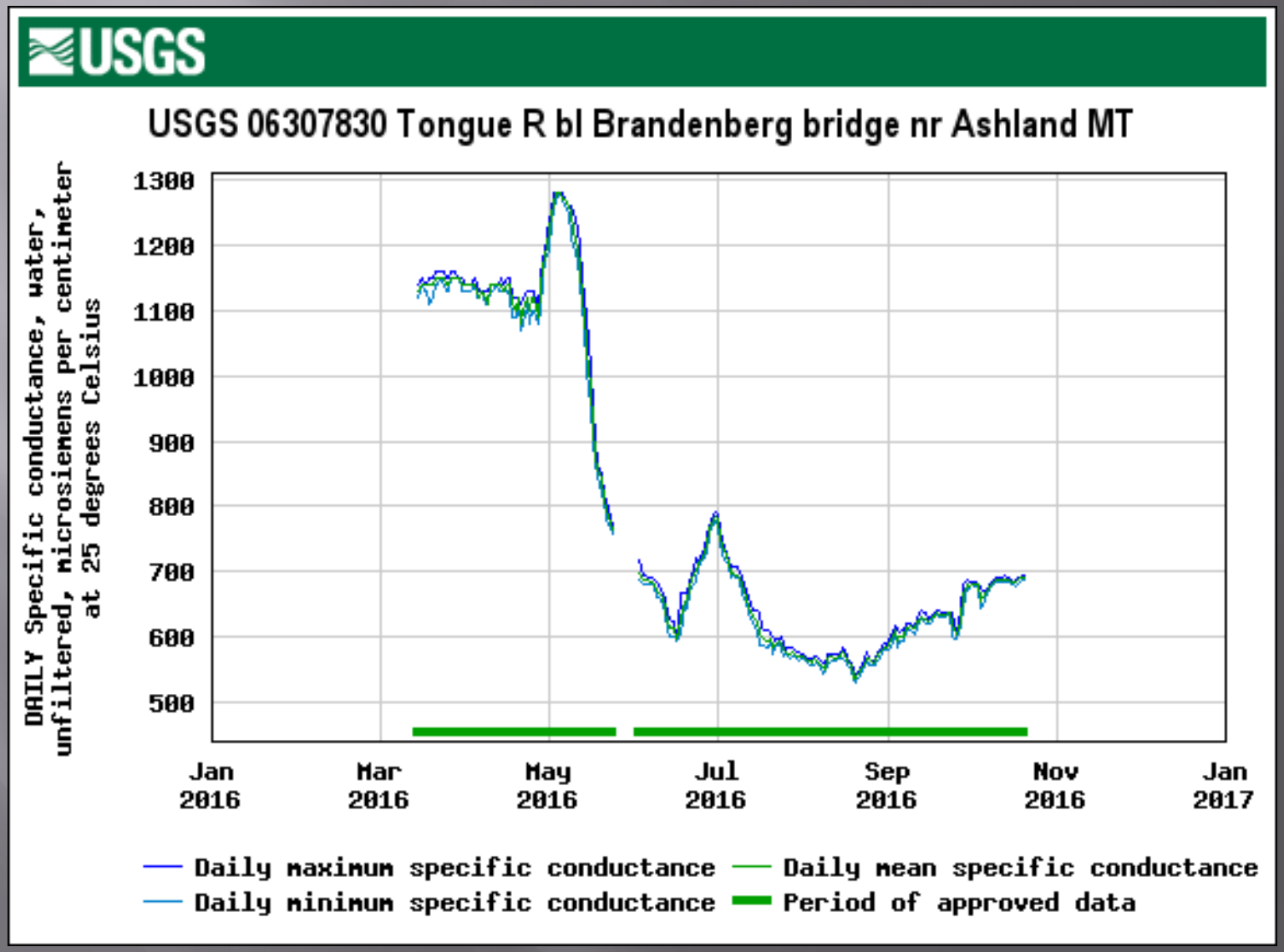
EC Meter: 14 years
EC: 402 samples

EC Meter: 14 years
EC: 383 samples

Potential Allocation Approach Using Sample Results

- Important concept: reduction in EC loading to meet the TMDL is same as reduction in EC concentration needed to meet the standard

2016 EC Curve at Brandenberg



Data from May 3-6, 2016

- Reservoir Outlet Flow = 80 cfs
- Reservoir Outlet Flow EC = 700 µS/cm
- Brandenburg Flow = 111 cfs
- Brandenburg EC = 1,275 µS/cm
- Calculated Additional Inflow (tribs, etc) Between Dam and Brandenburg = 111 – 80 = 31 cfs
- Calculated Average EC of Additional 31 cfs Inflow = [(80)(700) + (31)(X)] = (111)(1,275)
  - X = 2,759 µS/cm EC

Needed Reduction from Existing Load (using EC surrogate values)

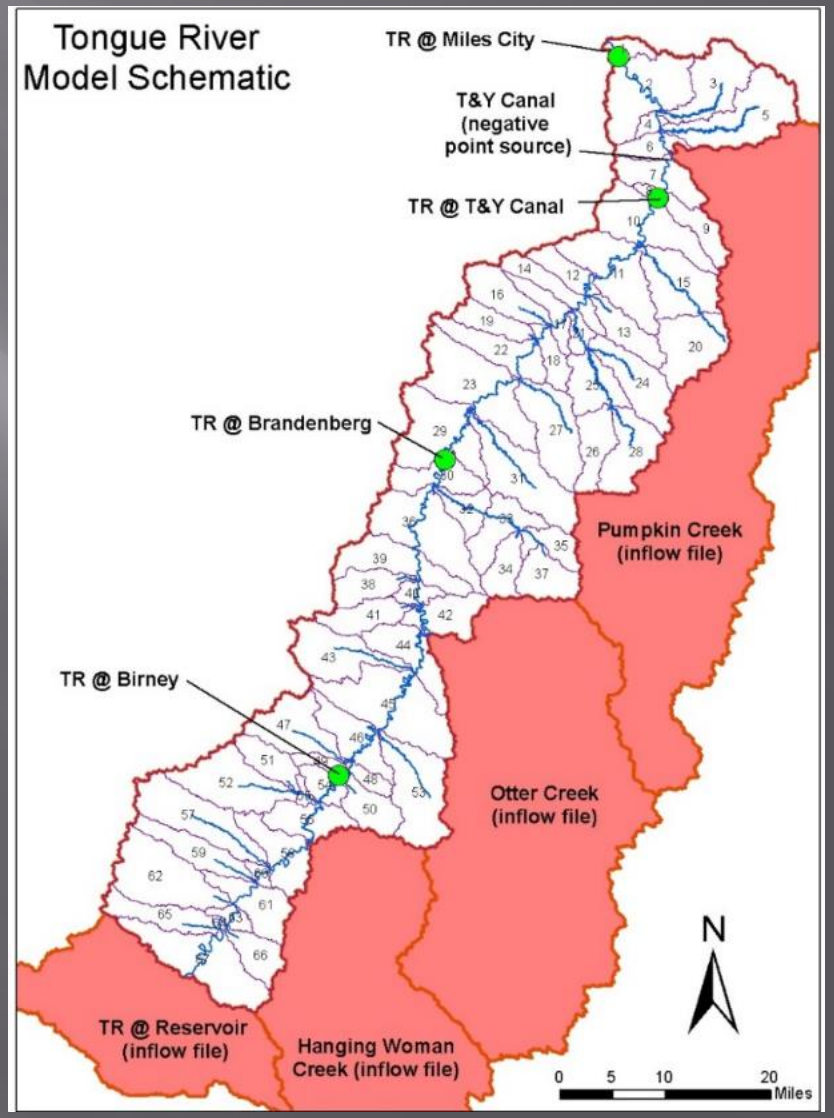
- TMDL = (111 cfs)*(1,000 µS/cm) = 111,000 units
- Existing load = (111)*(1,275 µS/cm) = 141,525 units
- Percent Reduction Needed:
  - By load surrogate:
    [(141,525 – 111,000)/141,525)]*100 = 21.5%
  - By concentration:
    [(1,275-1,000)/(1,275)]*100 = 21.5%

Potential Tongue River EC TMDL Allocations and Flow Modification; Example Based on Data from Early May, 2016

Scenario	Source Loading Change	Tongue River Salinity Loading Impact	% Reduction at Brandenberg	Brandenberg EC (µS/cm)
Baseline - Actual Data (5/3/2016)	No Changes	Baseline	Baseline (0%)	1,275
Wyoming Reduction at the Border	8 to 10%	7-9% reduction from reservoir	3.2%	1,235
Decker Discharges Reduction	50%	3% reduction from reservoir	1.2%	1,260
Montana CBM Reduction	25 to 75 %	0.5% reduction from reservoir	0.2%	1,272
Agriculture in Montana Reduction	6 to 10 %	1.5% reduction below reservoir (Spring)	0.9%	1,263
City of Ashland Wastewater Reduction	75 to 100% (Spring)	1% reduction below reservoir (Spring)	0.6%	1,267
Northern Cheyenne Agriculture Increase	Currently no load	0.5% increase below reservoir (Spring)	-0.3%	1,279
All Load Changes Combined	Varies by source	Combination of reductions from and below reservoir	5.8%	1,202
Increased Reservoir Release Flow of 80 cfs; No Reductions (Baseline Loading Condition)		Increase of "cleaner" water from reservoir, dilutes high EC inputs downstream	16.2%	1,034
All Load Changes Combined with Increased Reservoir Release Flow			24.9%	958

Additional Allocations

Hanging Woman Creek and Otter Creek Watersheds = No Change



Future Montana EC Sources Permitting Strategy to Protect Downstream Uses

- CBM & Coal Mines
  - CBM ponds located out of drainages (including ephemeral)
  - Follow-up inspections for non-discharge aspects CBM operations
  - Consideration of all potential pathways during operation and post reclamation of new coal mines

Future Montana EC Sources Permitting Strategy to Protect Downstream Uses

CBM & Coal Mines

- MPDES surface water discharge permits: proposed non-degradation computation approach
  - Assume any discharge in a tributary is functional equivalent of a direct discharge to the Tongue River where the tributary enters the Tongue

Agriculture Considerations

- Seasonality
- Irrigation Approaches
- Distance from River
- Some existing BMPs in place
- Can be very site specific

Tongue River Reservoir Discharge Flows

- DEQ is working with the Northern Cheyenne Tribe on a compact water lease agreement
- Looking at a 10 year lease; release timeframe would be intended for March thru early May
- Opportunity to monitor and evaluate results
- Goal is for released water to remain in the stream to the mouth of the Tongue River
- Can also provide an aquatic life benefit

Next Steps

- Complete Modeling Report
- Continued Pursuit of Water Release Agreement with Northern Cheyenne Tribe
- Further Refinement of Potential Allocations & Associated Discussions with Affected Parties
- Development of TMDL Document
  - Watershed Advisory Group Initial Draft Reviews
  - Public Comment Period
  - EPA Approval

QUESTIONS & DISCUSSION