Tongue River Salinity Project

Stakeholder Meeting

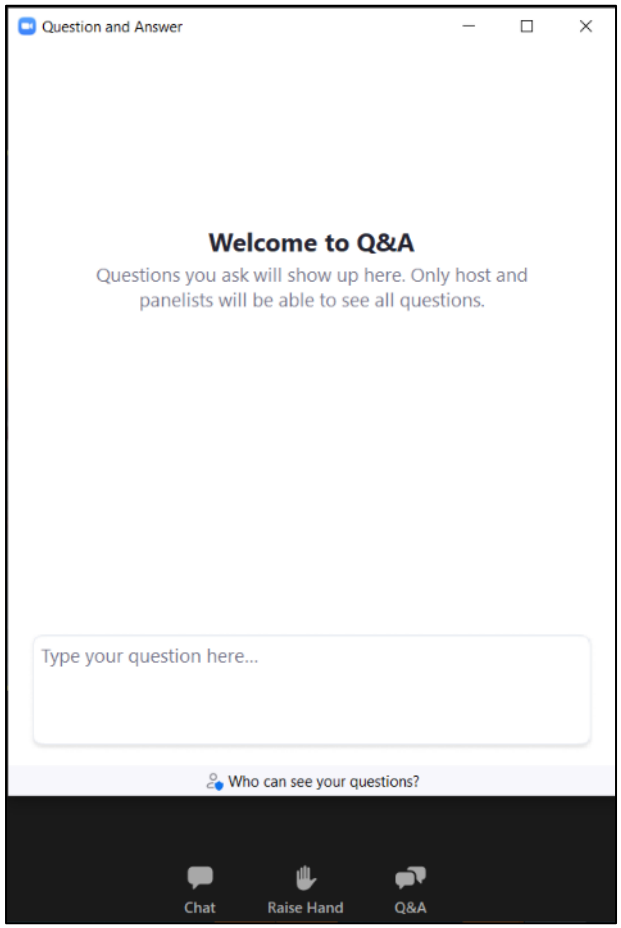
January 11, 2023

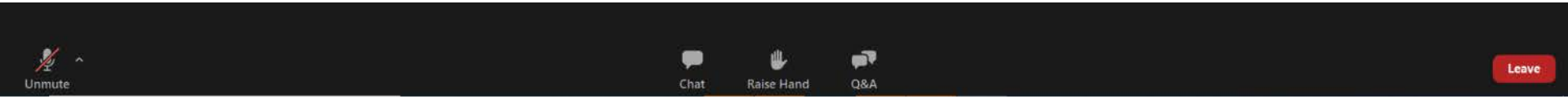
Miles Community College

DEQ MONTANA

Welcome!

- This meeting is also a Zoom webinar
- Please raise your hand or use the Q&A feature to ask a question
- *9 raises your hand if you're on the phone
- *6 unmutes if you're on the phone





DEQ MONTANA

Meeting Purpose

- To provide results of a salinity water quality model and trend analysis for the Tongue River
- To discuss next steps in the water quality planning process

DEQ MONTANA

Introductions – Montana DEQ Staff

- Christina Staten, TMDL Section
- Eric Regensburger, Project Modeler
- Christy Meredith, Water Quality Standards Section
- Kevin Krogstad, Coal Mining Section
- Andy Ulven, Water Quality Planning Bureau Chief
- Lindsey Krywaruchka, Water Quality Division Administrator
- Kevin Stone, Public Information Officer

DEQ MONTANA

Introductions – EPA and Tetra Tech

- Peter Brumm, EPA Region 8 TMDLs (Helena Office)
- Kevin Kratt, Tetra Tech Water Resources Director
- Cole Blasko, Tetra Tech Modeler
- Jon Butcher, Tetra Tech Senior Hydrologist

DEQ MONTANA

Introductions - Attendees

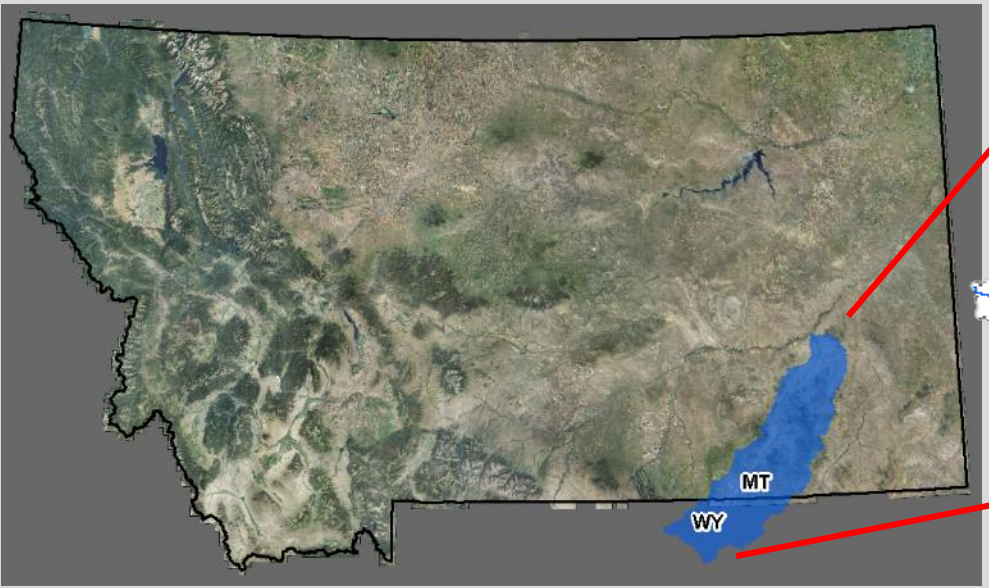
- Please state your name and affiliation
- Please note your travel time to attend this meeting

- Enter your name and affiliation in the Zoom chat box
- Use *6 to unmute if you're on the phone

DEQ MONTANA

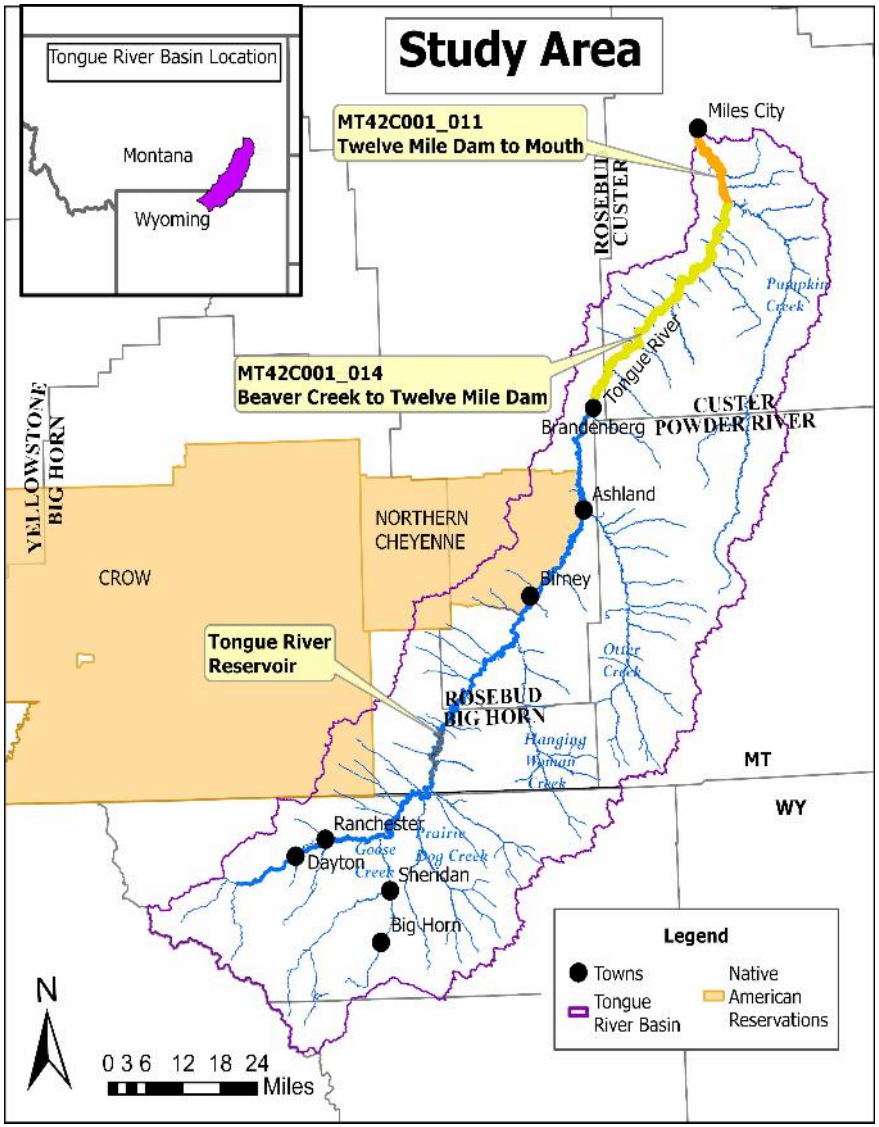
Presentation Outline

- Project Background
- 2018 Stakeholder Meeting Messages
- Where We Are Today
- Modeling Results
- Trend Analysis Results
- Next Steps & Discussion



Project Background

- A salinity-focused project
- Initial work started by U.S. EPA in early 2000s
- Montana DEQ resumed work in 2016
- Focused on lower segments of the Tongue River that are impaired for salinity-related pollutants
- Excess salt potentially harms crops and the goal is to protect the agricultural water quality beneficial use



DEQ MONTANA

August 2018 Stakeholder Meeting Next Steps

- Complete Modeling Report
- Continue Pursuit of Water Release Agreement with Northern Cheyenne Tribe
- Further Refinement of Potential Allocations & Associated Discussions with Affected Parties
- Development of a TMDL Document

DEQ MONTANA

2018 -2023 Timeline

- 2018 – 2022: DEQ continued to fund USGS gages on Tongue
  DEQ continued discussions with WY and EPA
- 2019: Project Modeler left DEQ
- 2020: Assessment method finalized and Beaver Creek to 12 Mile Dam segment of the Tongue River listed as impaired for specific conductivity (SC)
- 2021: Contract initiated with Tetra Tech to complete modeling work (EPA funding)
- 2022: Modeling work and trend analysis completed
- 2023: Draft modeling report to be complete by March 31 for stakeholder review

DEQ MONTANA

Current Project Status

- Modeling results show that salt concentrations are primarily attributed to natural sources
- A TMDL will not be written at this time
- DEQ is no longer pursuing a water lease with the Northern Cheyenne Tribe to augment flows

DEQ MONTANA

Tongue River Salinity Water Quality Standards in Montana

Christina Staten, TMDL Section

DEQ MONTANA

Salinity

Salinity is a term often used broadly by DEQ to represent one or more related chemical parameters within a waterbody, including:

- EC: Electrical Conductivity
- SAR: Sodium Adsorption Ratio
- TDS: Total Dissolved Solids

DEQ MONTANA

Electrical Conductivity (EC)

- Electrical conductivity (EC) is a measure of the ability of water to conduct electricity
- Over time, high EC irrigation water equates to high EC (salinity) in soils. When EC rises above a species-specific threshold, crop yields decrease
- Specific conductance (SC) is EC corrected to 25ºC.
- EC definition in Montana rules (ARM 17.30.602) matches definition of SC

Conductivity = EC = SC = Salinity

DEQ MONTANA

Sodium Adsorption Ratio (SAR)

- SAR is the ratio of sodium (Na) to calcium (Ca) and magnesium (Mg)
- A high SAR means high amounts of Na compared to Ca and Mg (and vice versa)
- Unitless
- Irrigation water with high SAR causes loss of soil structure (can ruin soil for most agricultural uses)

DEQ MONTANA

Tongue River Water Quality Standards for EC and SAR

Electrical Conductivity (EC)

Season	Monthly Average	No Sample May Exceed
Nov 1 – March 1	1,500 µS/cm	2,500 µS/cm
March 2 – Oct 31	1,000 µS/cm	1,500 µS/cm

Sodium Adsorption Ratio (SAR)

Season	Monthly Average	No Sample May Exceed
Nov 1 – March 1	5.0	7.5
March 2 – Oct 31	3.0	4.5

DEQ MONTANA

How the EC Standard Was Set

- The monthly average electrical conductivity (EC) standard of 1,000 µS/cm for the irrigation season (March 2 – Oct 31) was set to protect the most salinity sensitive crops irrigated in the watershed
- Based on surveys in 2001 that established strawberries, beans, and carrots were the most sensitive crops being grown on the commercial scale

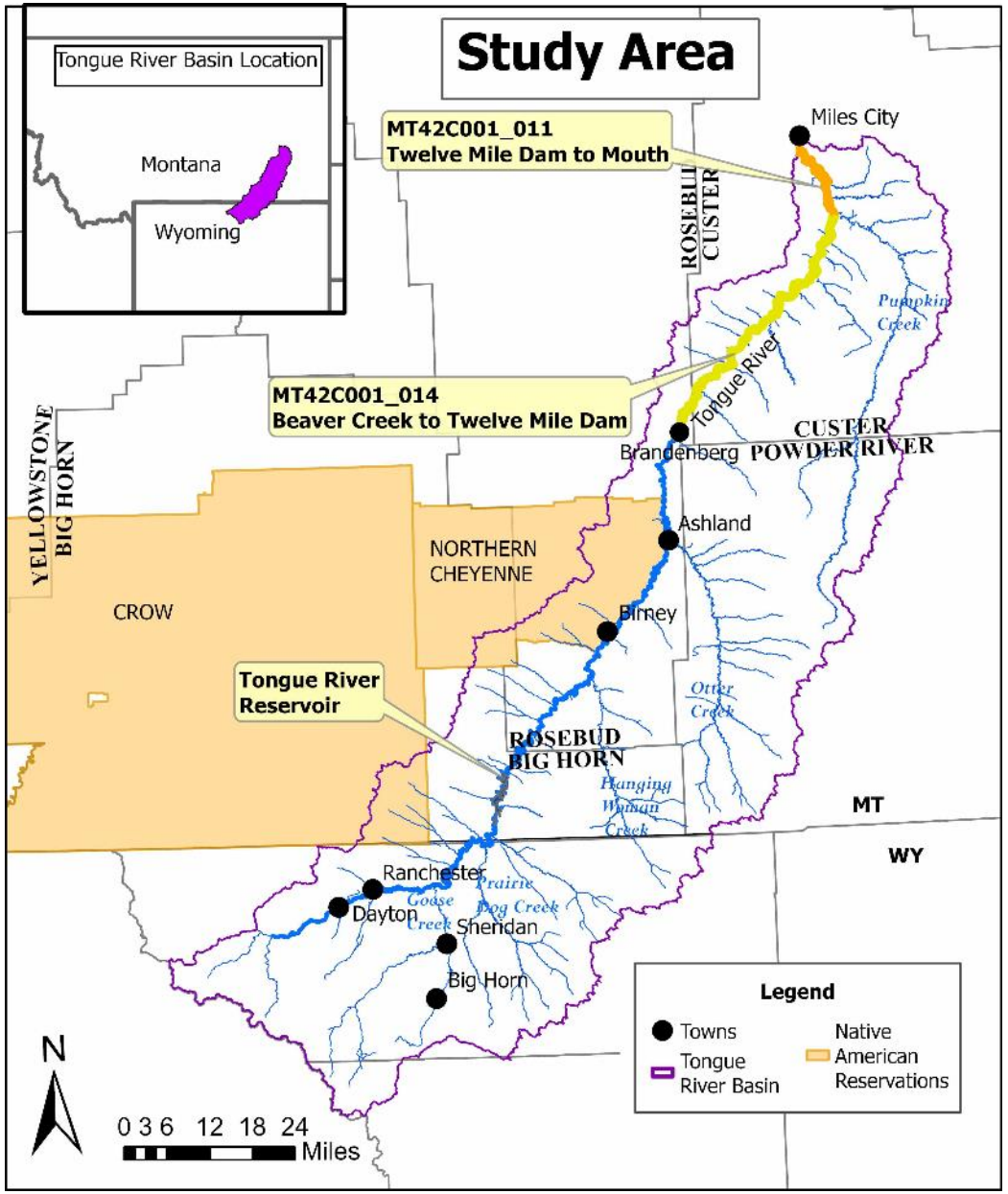
DEQ MONTANA

SWAT–Salt Water Quality Modeling Results for the Tongue River

Eric Regensburger, Project Modeler (Water Quality Standards & Modeling Section)

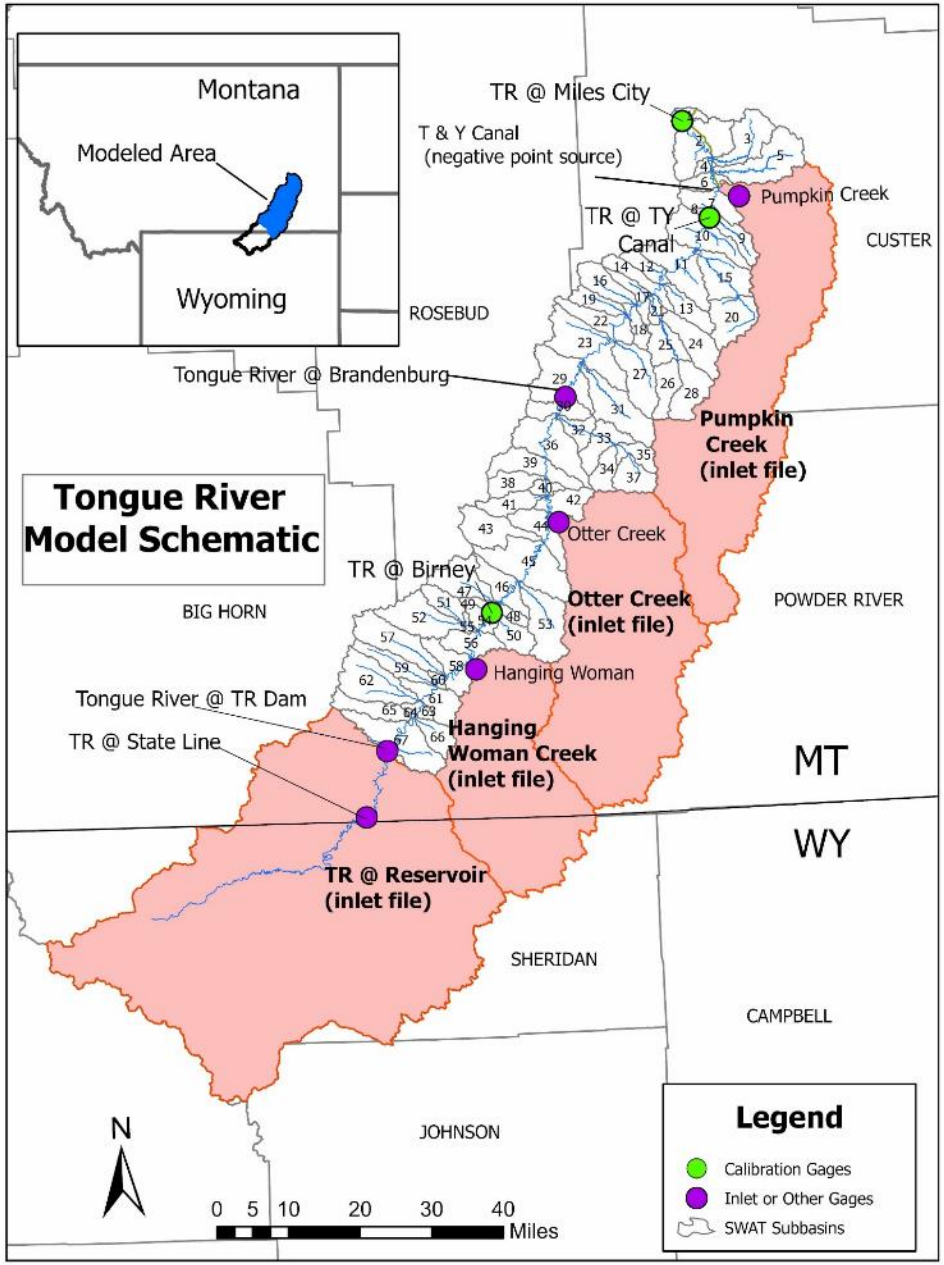
DEQ MONTANA

- Lower two segments (yellow and orange) exceed specific conductance water quality standards during the irrigation season (March 2 – October 31).
- Spring months (March, April, and sometimes May) are typically when monthly specific conductance exceedances occur (1,000 µS/cm).
- Coal and CBM discharges are upstream of Birney.



- Model accounts for the entire Tongue Watershed.

- Measured streamflow and salinity from the following streams (red shading) are added to the modeled area (white):
  - Tongue River Reservoir Dam
  - Hanging Woman Creek
  - Otter Creek
  - Pumpkin Creek
- Tongue River USGS gages shown in purple and green



Model Summary

- Model Period 2005-2013 (corresponds to peak CBM development, high range of precipitation, and better instream measured data at USGS gages.)
- Simulates streamflow, calcium, magnesium, and sodium. Specific Conductance (SC) and Sodium Adsorption Ratio (SAR) are calculated from the calcium, magnesium and sodium concentrations.
- Model calculates SC values on a daily basis. Above Miles City measured SC at USGS gages only exceeds SC standard (1,000 µS/cm) on a monthly basis, not daily.

DEQ MONTANA

Model Landuses / Sources

- Model accounts for salinity from these landuses and sources:
  - natural land uses (forest, rangeland, wetland);
  - human altered land uses (agriculture, stock, urban) that includes land management, for example:
    - TYPE OF CROP GROWN
    - IRRIGATION DETAILS
    - LIVESTOCK GRAZING
  - industry discharges (CBM and Coal)
    - MORE DETAIL TO FOLLOW

DEQ MONTANA

Coal Bed Methane (CBM) Summary

- CBM wells produce groundwater as a byproduct of extracting the gas. The groundwater typically has high salinity concentrations and is discharged directly to surface water or into constructed ponds.
- CBM salt loads based on permit data in WY and MT on a monthly basis.
  - Permit data is the effluent quality monitoring results required to be collected by operators and submitted to MT or WY DEQ.
- MT mostly direct discharge to Tongue River
- WY mostly on-channel and off-channel ponds ...

DEQ MONTANA

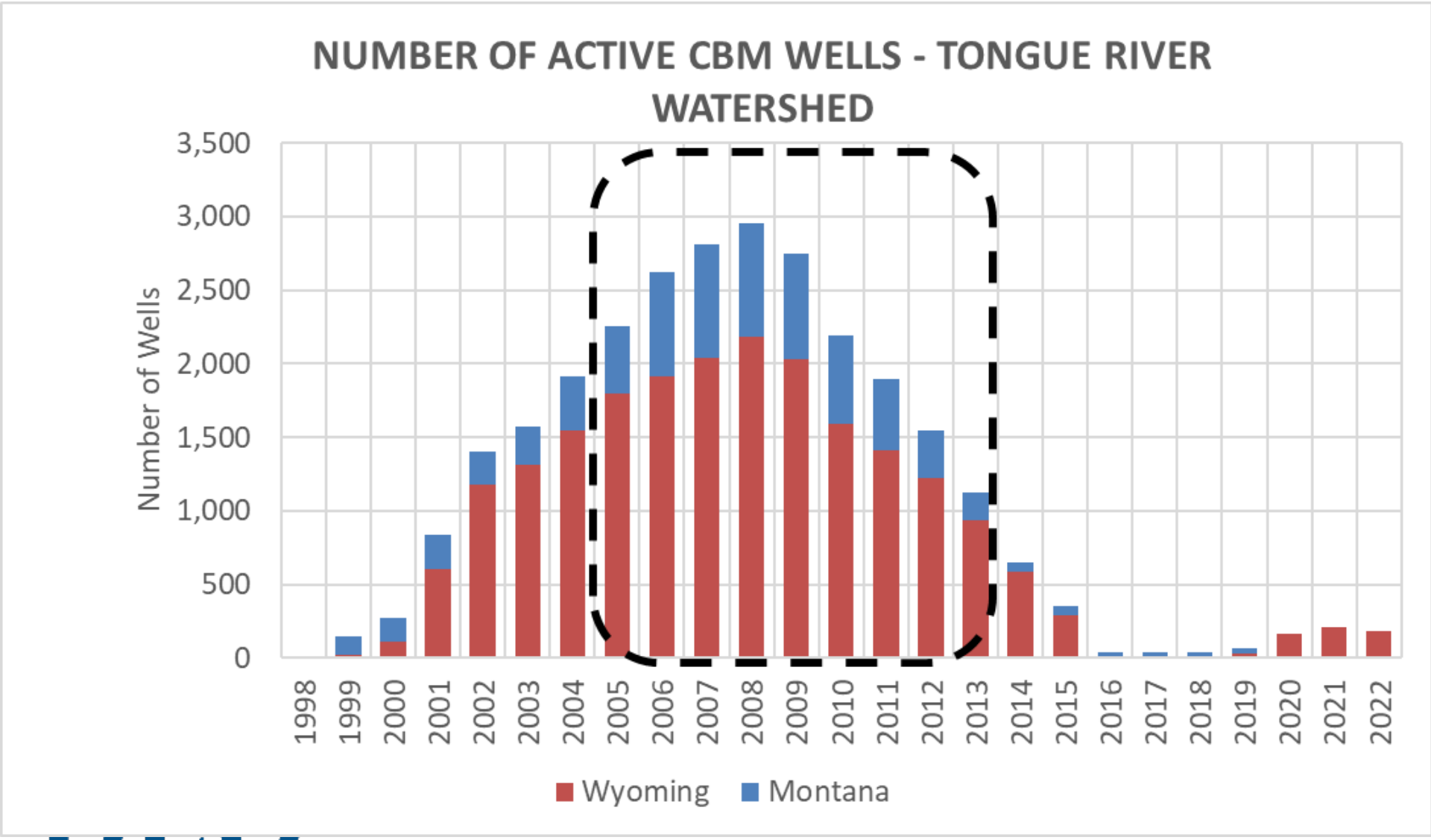
CBM Ponds

- Two types of Ponds:
  - On-channel are typically constructed and are within 500 feet of a water feature or floodplain alluvium. Discharge via overflow during runoff events or via groundwater infiltration.
  - Off-channel are typically constructed and outside the 500-foot distance. Discharge via groundwater infiltration.
- Estimated contributions to Tongue River:
  - Direct discharge: 100%
  - On-channel: 50%
  - Off-channel: 5%
- No delay (lag time) in model for pond discharges

DEQ MONTANA

DEQ MONTANA

CBM Development Timeline

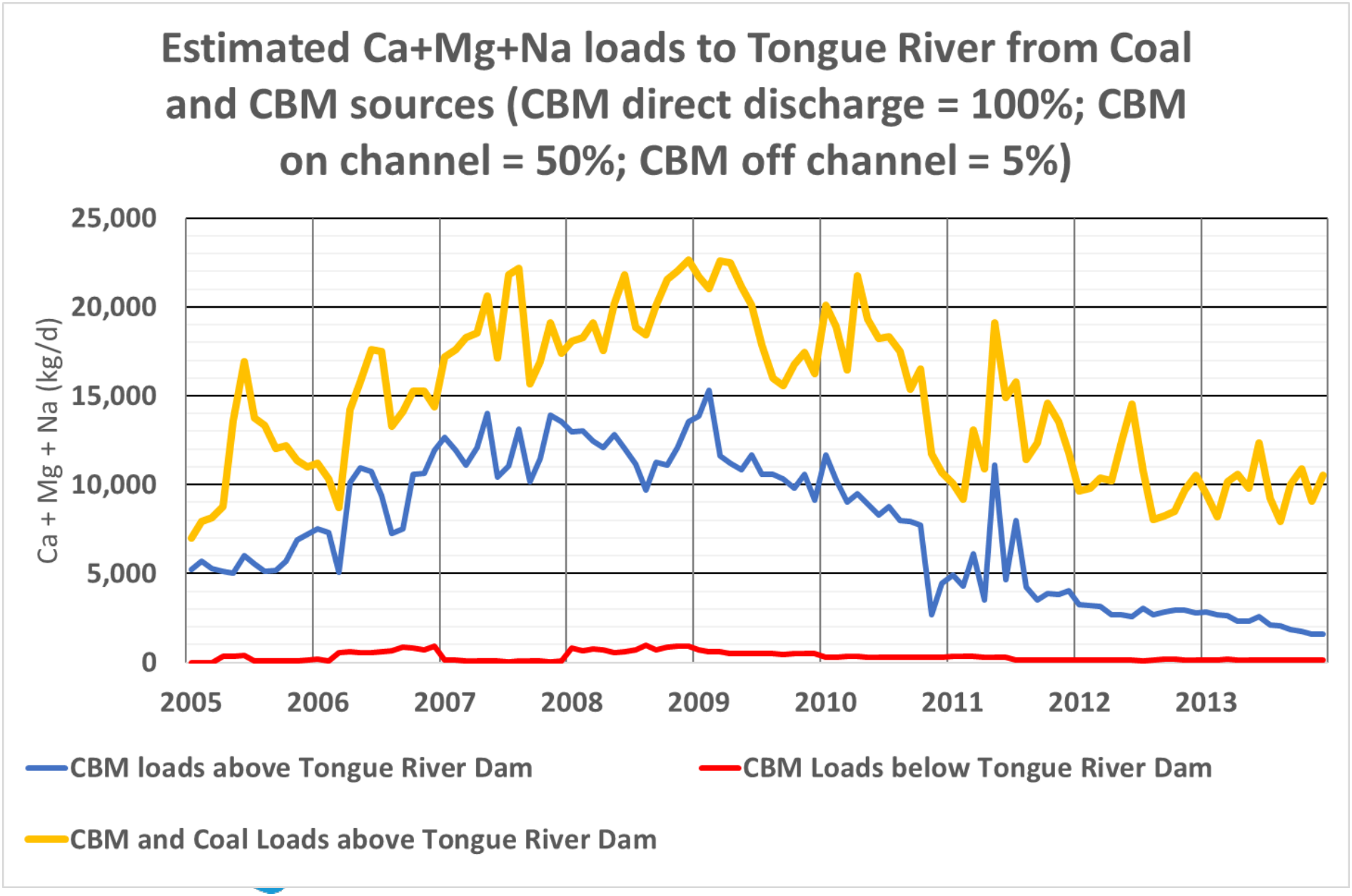


Coal Source Summary

- Coal salt loads determined from 100% of MPDES permit data on a monthly basis
- Coal sources include West Decker and East Decker (Spring Creek and Wolf Mountain had no permitted discharges during model period)
- Wastewater discharges from coal mines include precipitation and groundwater infiltration into the pit. Salinity concentrations of the effluent is dependent on groundwater quality and any salt entrained in stormwater runoff.

DEQ MONTANA

CBM and Coal - Model Salt Loadings

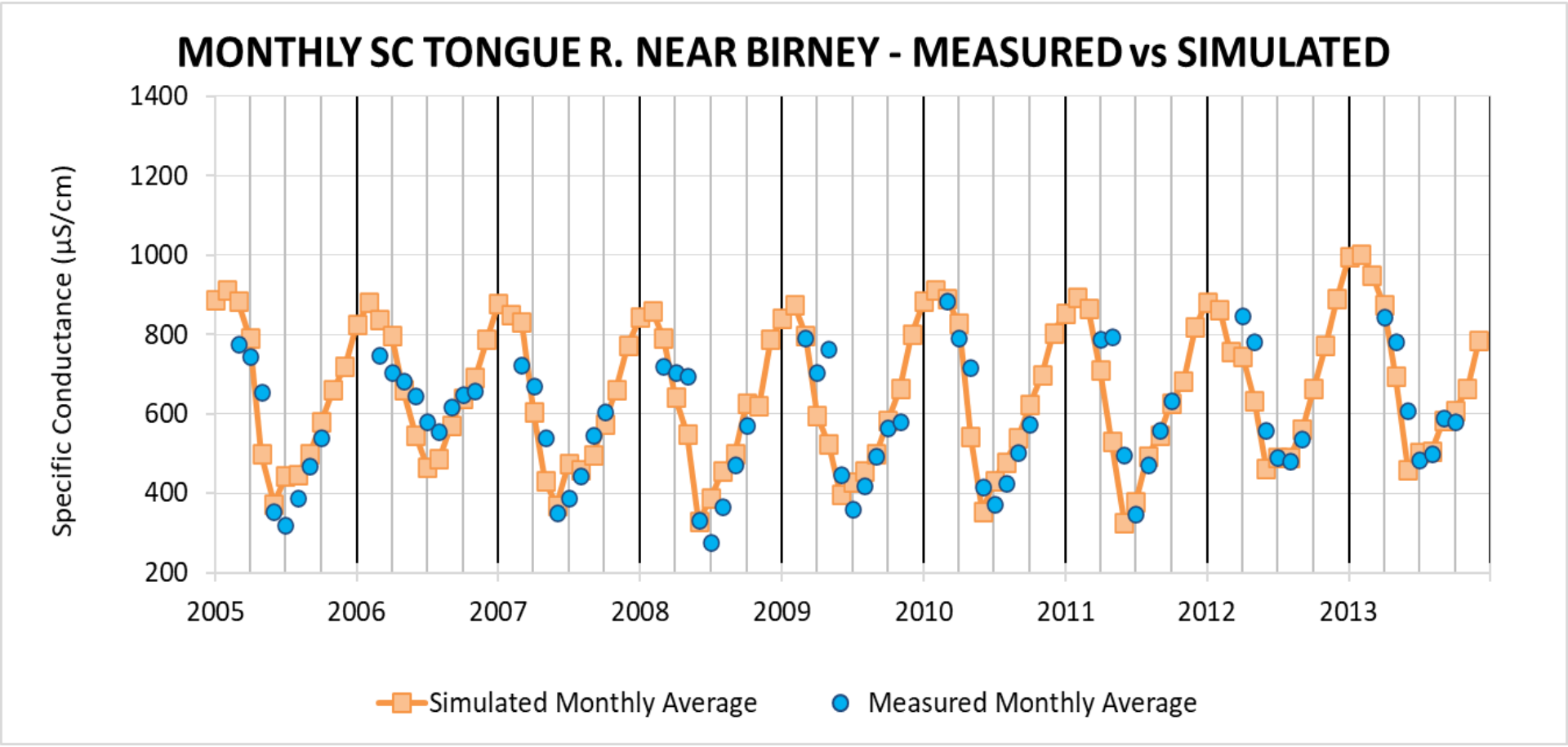


Model Calibration and Scenario Results

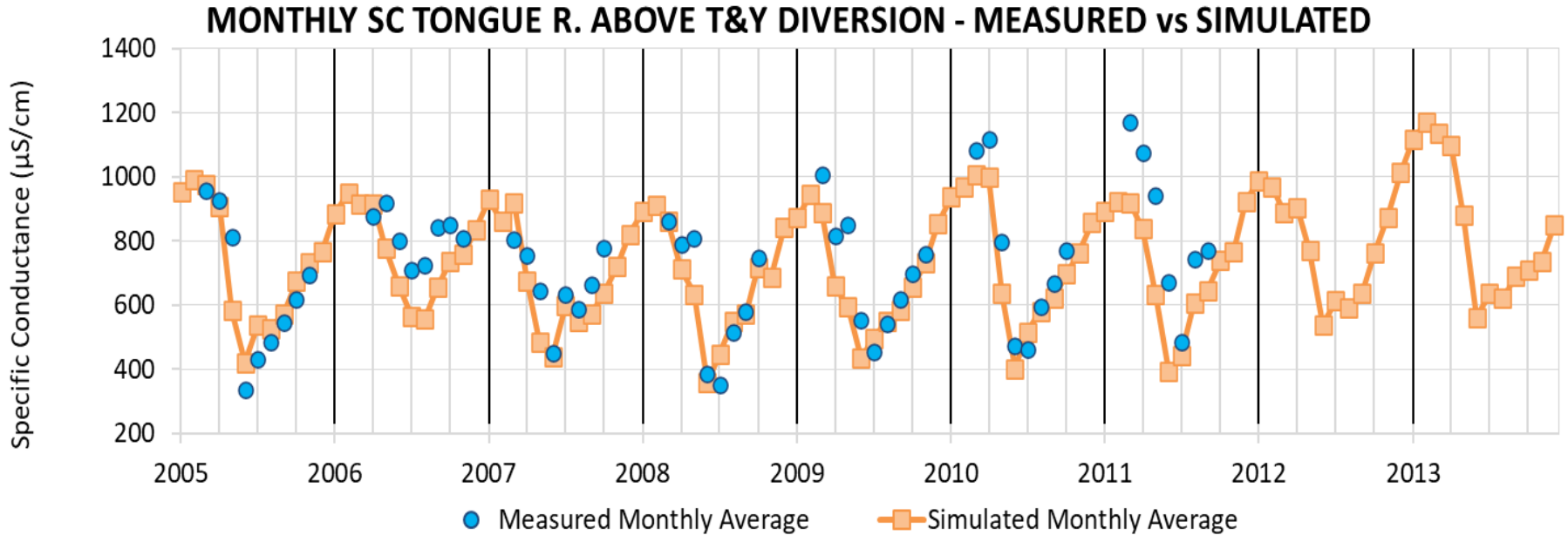
- Focus on comparing monthly results for modeled and measured concentrations
- Used 3 USGS gages for the salinity calibration:
  - Tongue River near Birney
  - Tongue River above T&Y Diversion
  - Tongue River at Miles City
- Scenarios indicate that while coal and CBM discharges did contribute to SC loads, SC cannot be reduced below monthly SC standard by removing those sources (more details to follow)

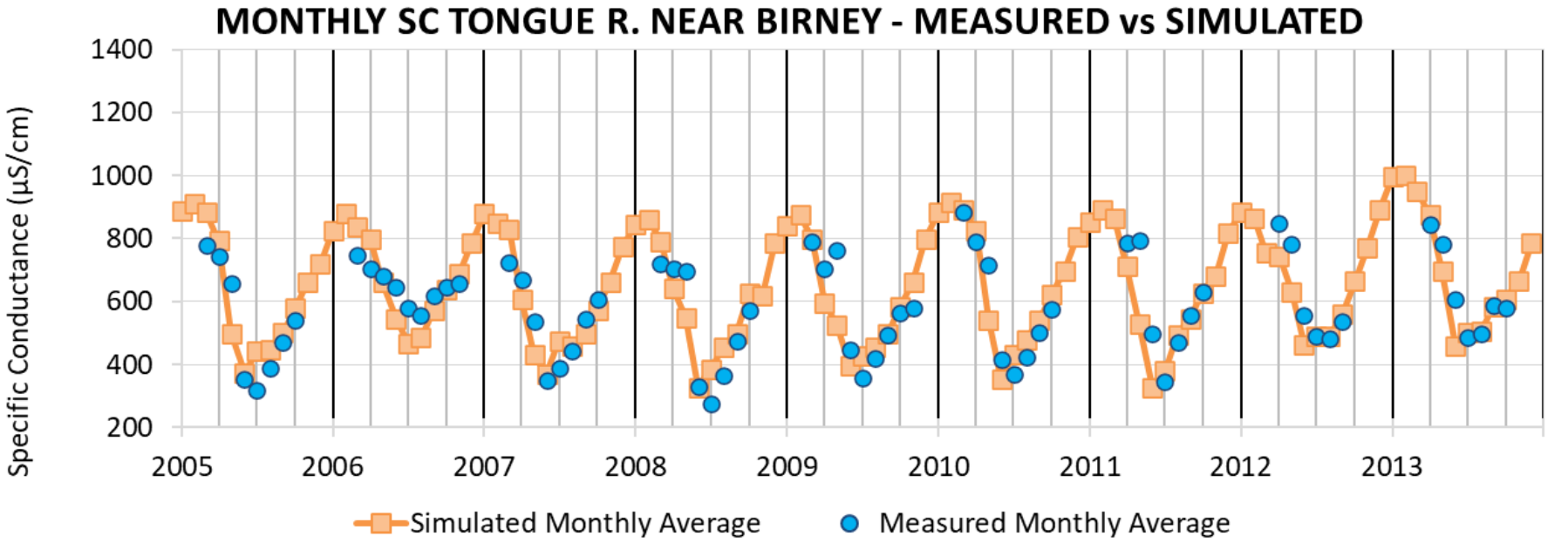
DEQ MONTANA

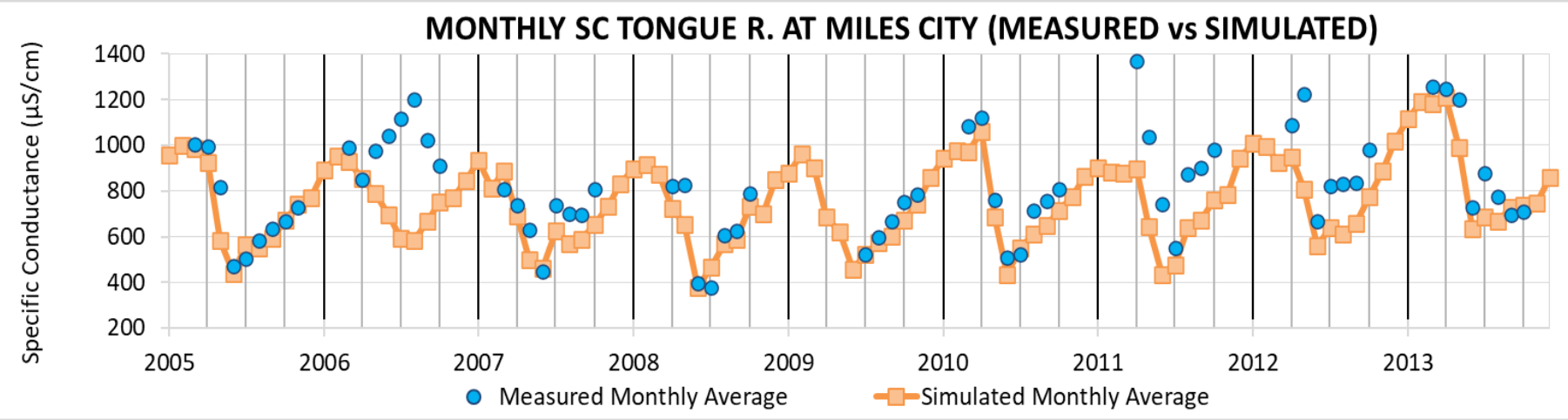
Model Calibration vs Measured Data

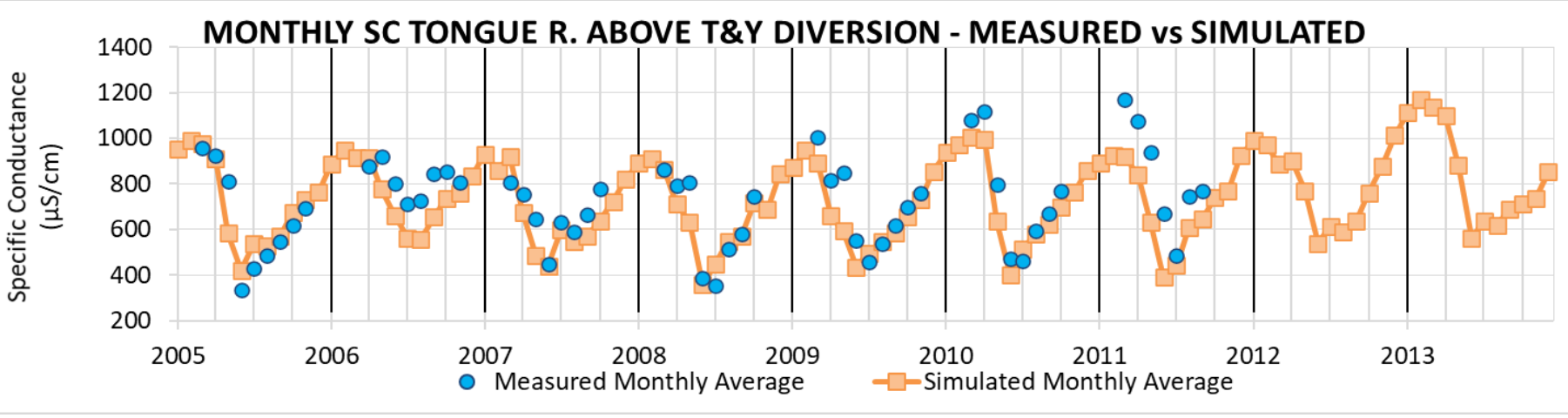


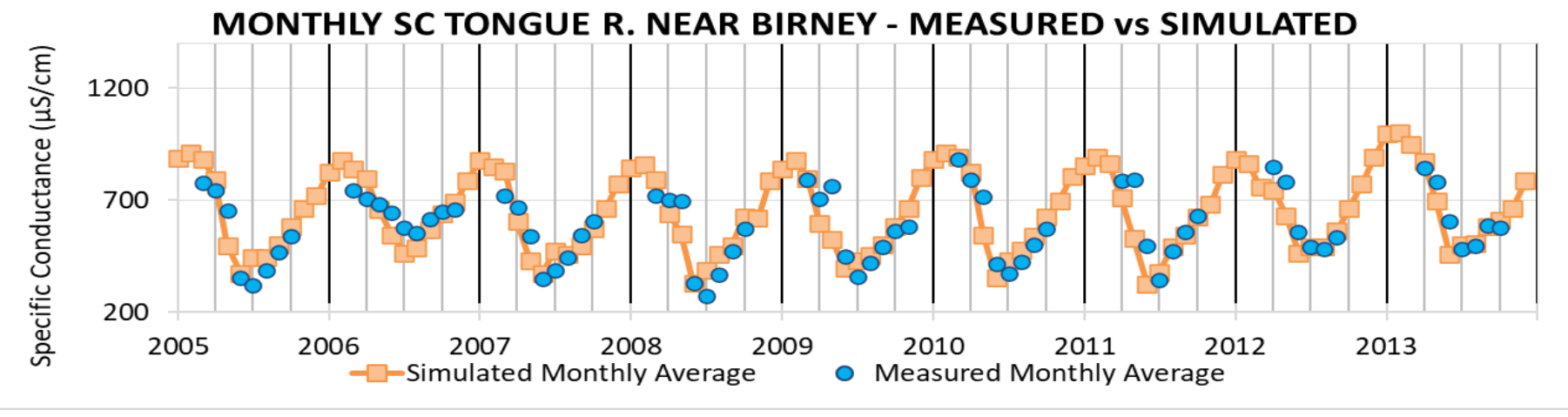
DEQ MONTANA


MONTHLY SC TONGUE R. ABOVE T&Y DIVERSION - MEASURED vs SIMULATED
Specific Conductance (µS/cm)
1400
1200
1000
800
600
400
200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Measured Monthly Average
Simulated Monthly Average

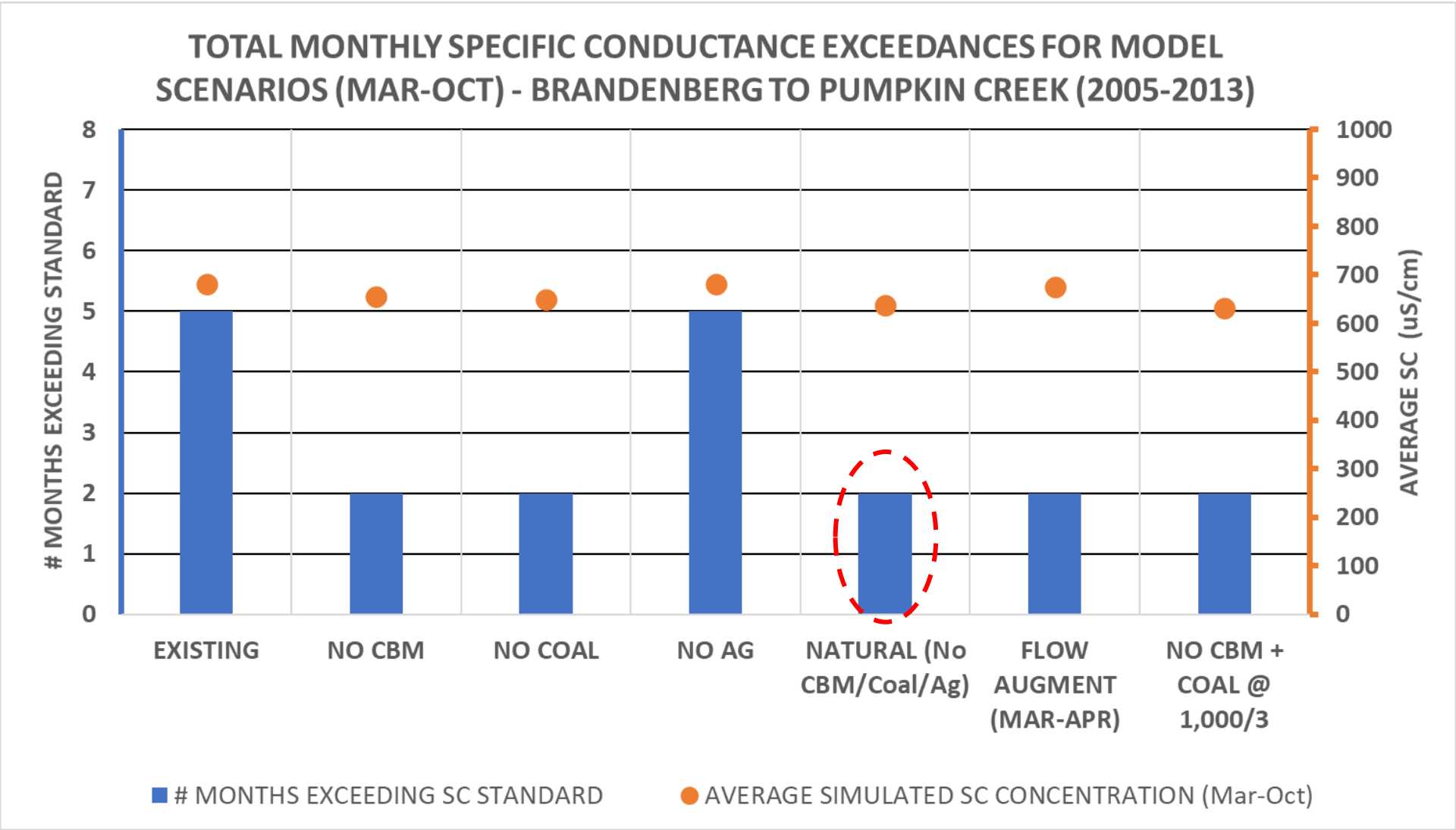

MONTHLY SC TONGUE R. NEAR BIRNEY - MEASURED vs SIMULATED
Specific Conductance (µS/cm)
1400
1200
1000
800
600
400
200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Simulated Monthly Average
Measured Monthly Average


MONTHLY SC TONGUE R. AT MILES CITY (MEASURED vs SIMULATED)
Specific Conductance (µS/cm)
1400
1200
1000
800
600
400
200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Measured Monthly Average
Simulated Monthly Average


MONTHLY SC TONGUE R. ABOVE T&Y DIVERSION - MEASURED vs SIMULATED
Specific Conductance (µS/cm)
1400
1200
1000
800
600
400
200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Measured Monthly Average
Simulated Monthly Average

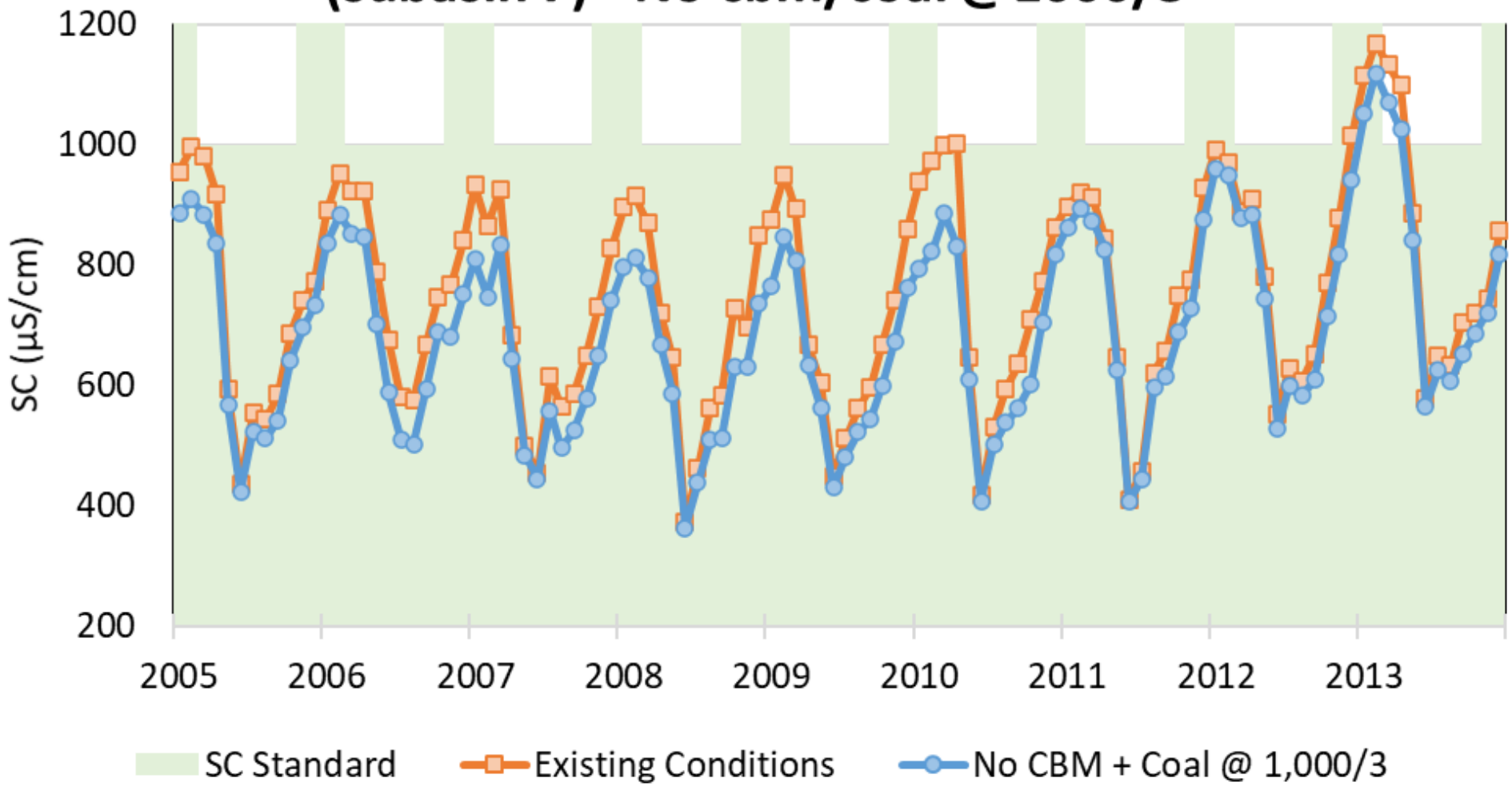

MONTHLY SC TONGUE R. NEAR BIRNEY - MEASURED vs SIMULATED
Specific Conductance (µS/cm)
1200
700
200
2005
2006
2007
2008
2009
2010
2011
2012
2013
Simulated Monthly Average
Measured Monthly Average

Scenario Results



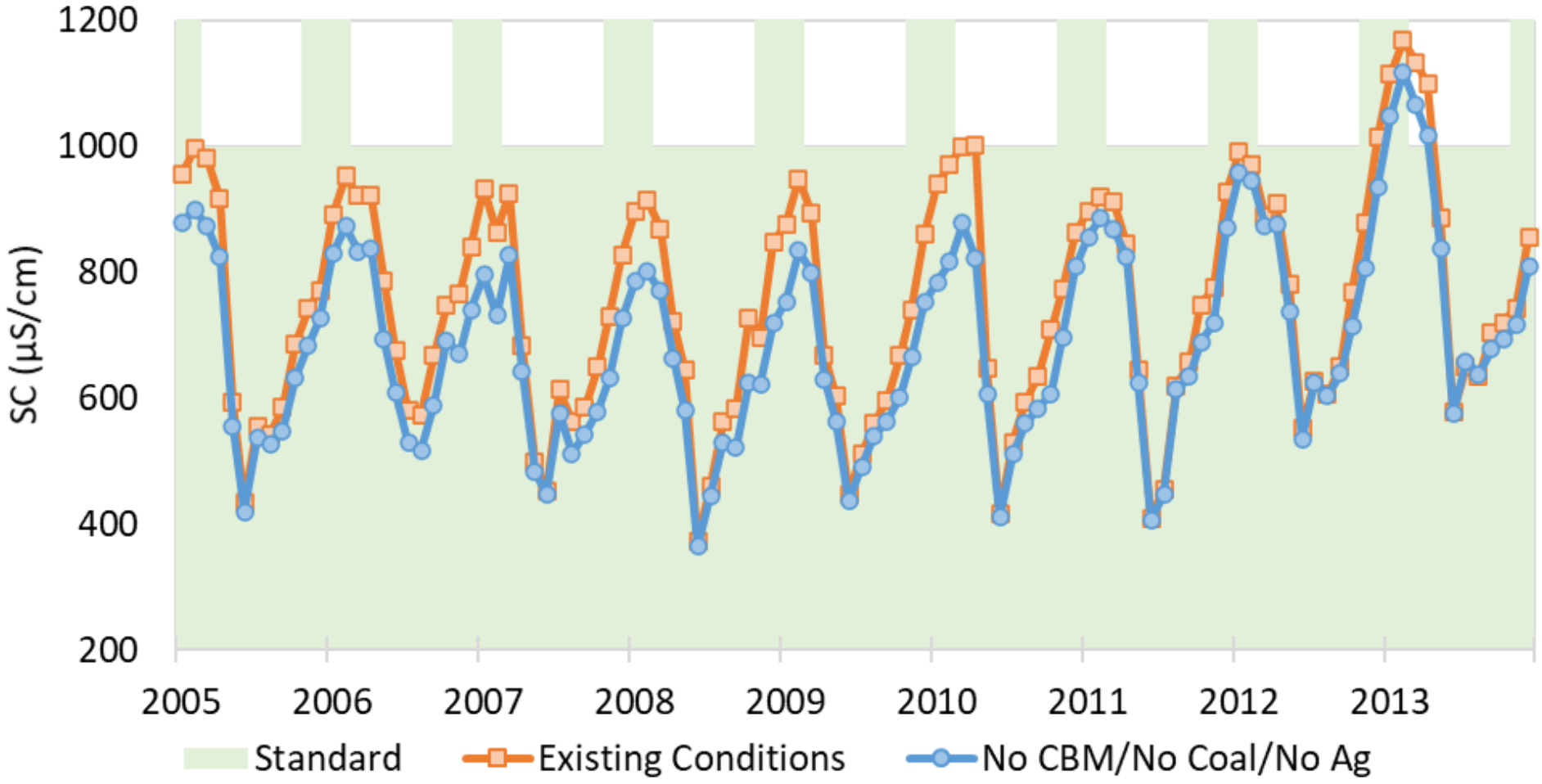
DEQ MONTANA

Monthly SC Model Results Above T&Y Diversion (subasin 7) - No cbm/coal @1000/3



DEQ MONTANA

Monthly SC Model Results Above T&Y Diversion (subasin 7) - Natural (No cbm/coal/ag)



DEQ MONTANA

Model Scenarios Summary

- CBM and Coal development discharges do increase SC levels in the Tongue River.
- Reducing or removing CBM and Coal sources will not reduce water quality to below the SC standard.
- Increasing discharges from the Tongue River Dam during low flow periods (March-May) will reduce SC levels in Tongue River.
- SC levels in the Tongue exceed the water quality standard under simulated natural conditions.

DEQ MONTANA

Tongue River Trend Analysis Results

Christy Meredith, Water Quality Standards & Modeling Section

DEQ MONTANA

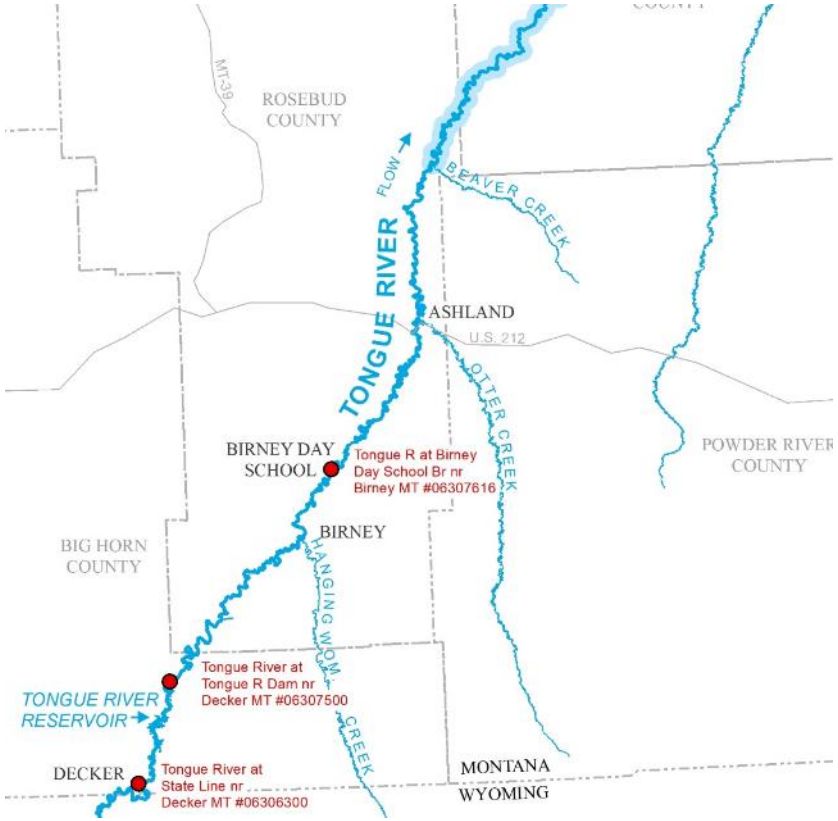
DEQ TREND ANALYSIS SUMMARY

- Independently contracted to HydroSolutions in 2021

Conducted at three Tongue river USGS gages:

- Tongue River near State line
- Tongue River below Tongue Reservoir Dam
- Tongue River near Birney

- Time period: 2000-2020
- Looked at patterns instead of more additive and process-based approach of SWAT model
- What were patterns in SAR and SC during this time period, and did they coincide with CBM activity?



DEQ TREND ANALYSIS SUMMARY

- **Take-aways:**
  - At the stateline station, with only on channel and off channel ponds upstream, there was no correlation between either SAR or specific conductivity and CBM discharges
  - At the two Montana stations with direct discharges upstream, SAR correlated with amounts and timing of CBM discharges. Measures of specific conductivity did not correlate with CBM discharges

Tongue River near the Montana State Line

DEQ MONTANA

DEQ TREND ANALYSIS SUMMARY

Results Compared to DEQ SWAT Model

Comparison to SWAT Model:

- Both models indicate an impact of CBM on SAR concentrations
- SC impacts are different but both low: the trend analysis found no correlation between SC and patterns of CBM, while the SWAT model found about a 5% contribution of CBM to SC for Montana during height of CBM.
- The trend analysis supports the results of the SWAT model

Tongue River near Ashland (NRCS)

DEQ MONTANA

DEQ TREND ANALYSIS SUMMARY

Why Do Results Differ?

- Differences due to data used, method, seasons, and locations investigated
- Some CBM water has higher SC and SAR than the stream it flows into, and other CBM water has lower SC and SAR
- Overall, studies by DEQ and others for the Tongue River show SC increased between 0-5% and SAR increased up to 17% during height of CBM
- The greatest documented effects for the Tongue River were from direct discharges on the Montana side during the height of CBM activity

For questions contact Christy Meredith
Christy.Meredith@mt.gov

DEQ MONTANA

Brief Q&A

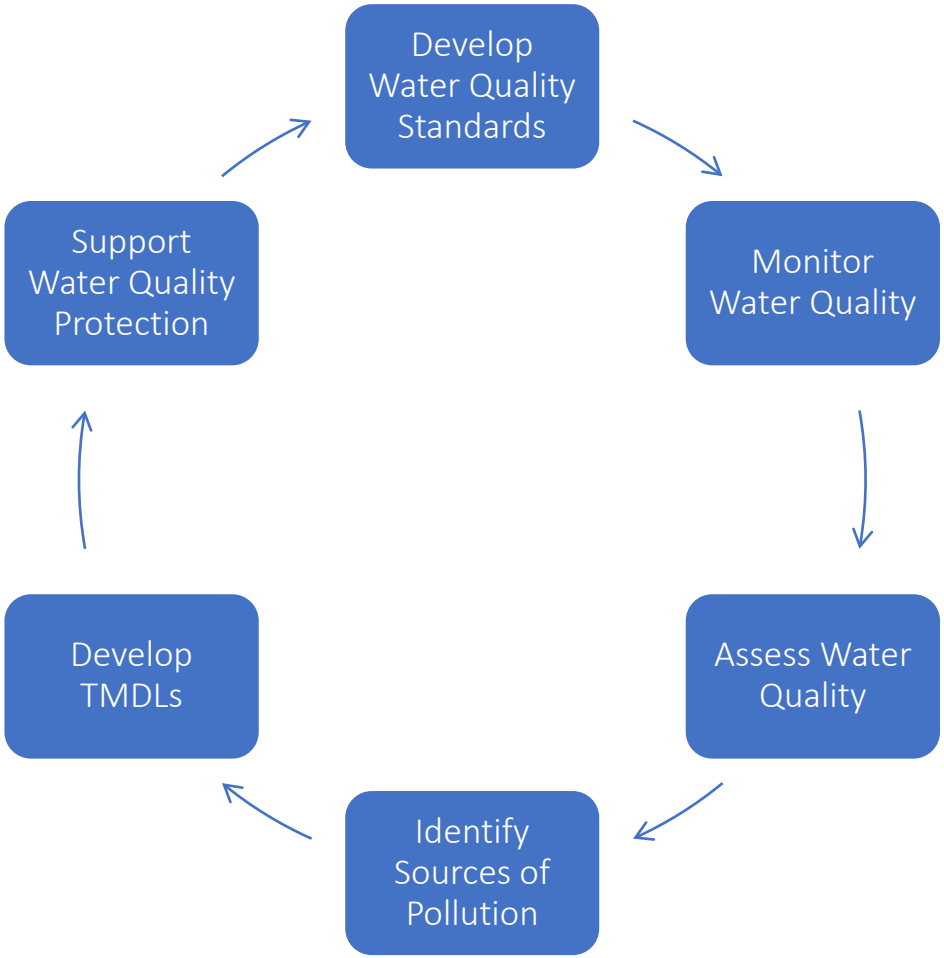
*6 unmutes if you're on the phone

Current Project Status and Next Steps

Andy Ulven, Water Quality Planning Bureau Chief

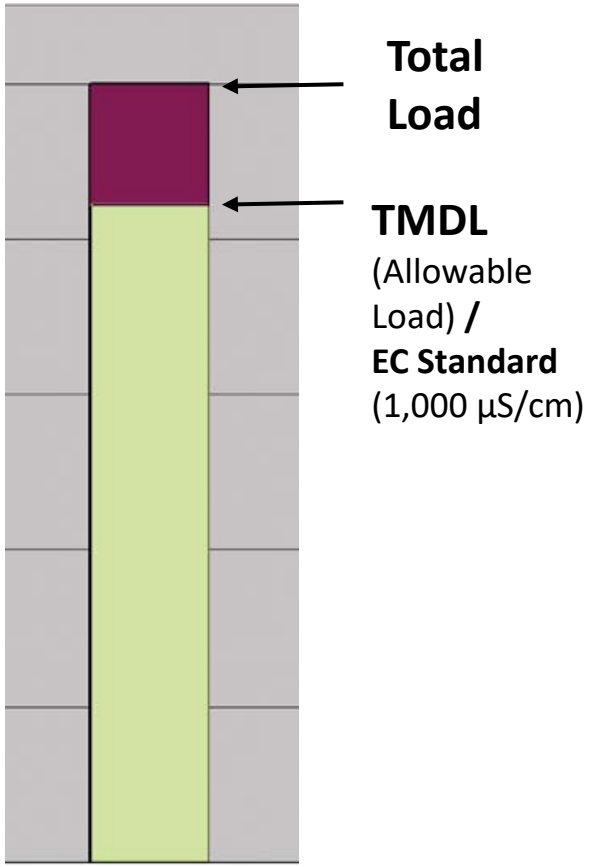
DEQ MONTANA

Water Quality Planning Process



DEQ MONTANA

TMDL Development



- A total maximum daily load (TMDL) is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards
- Think of it as a pollution budget or diet
- TMDLs are developed for pollutant causes of impairment (e.g., electrical conductivity)
- TMDLs determine impairment sources and allocate reductions to identified significant sources in order to meet water quality standards

DEQ MONTANA

TMDL Development

A TMDL is not being written at this time for either salinity-impaired segment of the Tongue River. The model shows that sources are predominantly naturally occurring, and the total natural salinity concentration is over/higher than the allowable concentration of 1,000 µS/cm for the Spring months (modeled reduction scenarios do not meet the standard and this would not be an approvable TMDL).

DEQ MONTANA

Flow Augmentation

- Modeled scenarios included flow augmentation – mixed results
- DEQ is not pursuing flow augmentation
  - Yellowstone River Compact precludes dam operation changes for water quality benefit
  - Northern Cheyenne water lease is unrealistic to DEQ due to associated costs

DEQ MONTANA

Next Steps

2023 +

- Continue to fund USGS gages for SC and flow monitoring

2023

- Complete modeling report
- Reevaluate EC water quality standards for the Tongue River

2024 +

- Based on 2023 reevaluation, may or may not develop a new EC standard for the Tongue River
- Conduct a new impairment determination
- Develop a TMDL or Protection Plan

DEQ MONTANA

What Might a Standards Evaluation Entail?

- The irrigation season could be adjusted for the standard (starting later than March 2)
- The irrigation season (March 2 – Oct 31) criteria of 1,000 µS/cm could be adjusted to reflect known commercial crop production using Tongue River water
  - Based on future survey results
- A nonanthropogenic standard could be set for the lower segment(s) of the river
  - Based on modeling results
  - Standards and permit limits would be similar to current levels, but the method for evaluating impairment would consider natural variation
  - Has been completed for arsenic in the Yellowstone River

DEQ MONTANA

Tongue River Irrigator Survey

- Do you irrigate from the Tongue River or the T&Y Canal?
- What month do you usually begin irrigating?
- Do you use flood or pivot irrigation?
- What crops do you grow?

DEQ MONTANA

Protection Plans

- Montana's Constitution states "the state and each person shall maintain and improve a clean and healthful environment"
- Written to protect beneficial uses for waterbodies which are not impaired and therefore do not need a TMDL
- Point and nonpoint source reduction strategy recommendations to prevent degradation
- Stakeholder engagement incorporated

DEQ MONTANA

Permitting Strategy

- DEQ will protect downstream uses when issuing permits for new MPDES surface water discharge permits
- Effluent limits would be determined using a process that takes the existing water quality standard into consideration, as well as whether the waterbody is impaired for salinity or EC
- All permit limits are set to protect water quality beneficial uses

DEQ MONTANA

Takeaways

- DEQ is committed to developing solutions that protect water quality
- The EC standard cannot currently be met, even with combined reductions of salinity loads from all human-caused sources
- DEQ needs your help to determine the best path forward:
  - Please participate in any future surveys and upcoming meetings
- DEQ will write a salinity protection plan or a TMDL, depending on the outcome of the water quality standards evaluation and reassessment

DEQ MONTANA

Discussion

*6 unmutes if you're on the phone

Thanks for Joining Us!

Christina Staten:
CStaten@mt.gov

Eric Regensburger:
ERegensburger@mt.gov

Christy Meredith
Christy.Meredith@mt.gov

Lindsey Krywaruchka:
LKrywaruchka@mt.gov

Andy Ulven:
Andrew.Ulven@mt.gov

DEQ MONTANA