Numeric Nutrient Standards and the Methods Montana DEQ Uses to Implement Them

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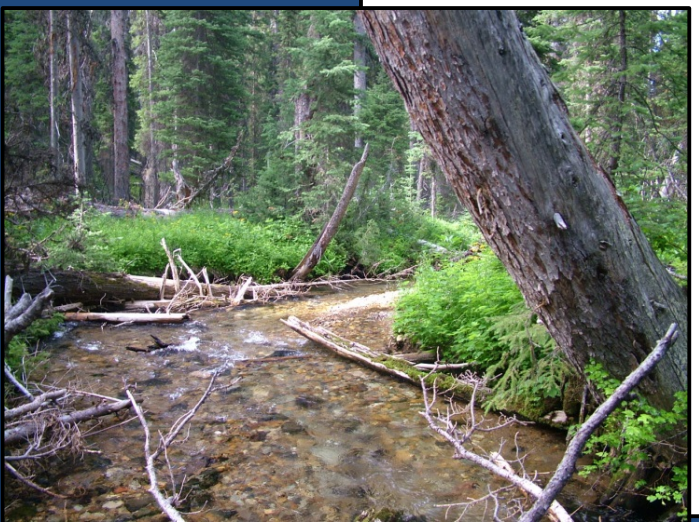
Montana



Overview

- Numeric Nutrient Standards in Montana
  - Which waterbodies, how applied across the landscape
  - Criteria Magnitude, Frequency, and Duration
  - Low-flow Design Flow (14Q5)
- Permitting Numeric Nutrient Standards
  - RP analysis, derivation of a permit limit
- Nutrient Standards Variances
  - Why have a variance?
  - Identifying Highest Attainable Condition (HAC)
  - How variances are applied in permits
- Ongoing Litigation

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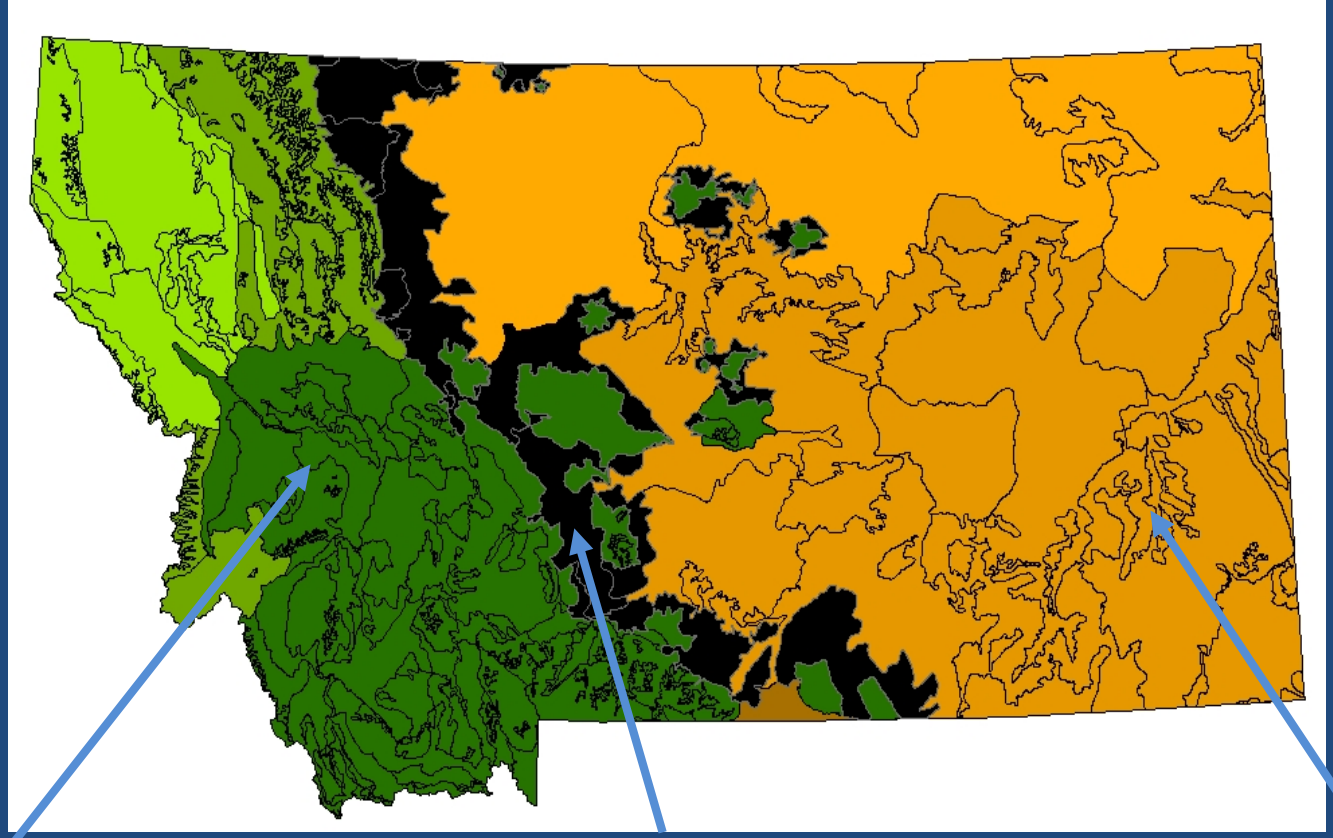
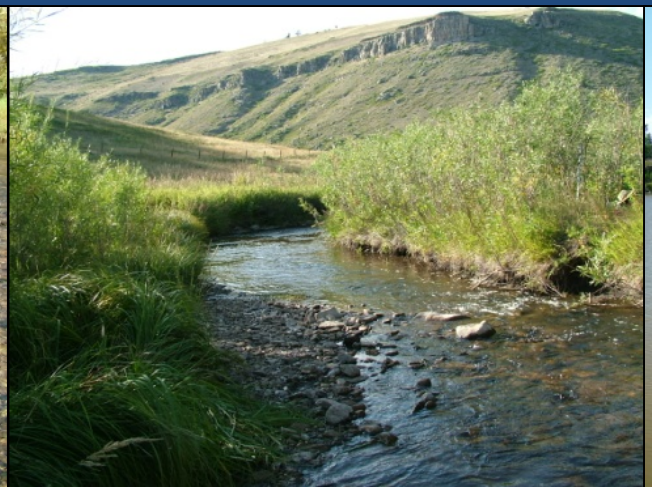
Wadeable Stream Criteria



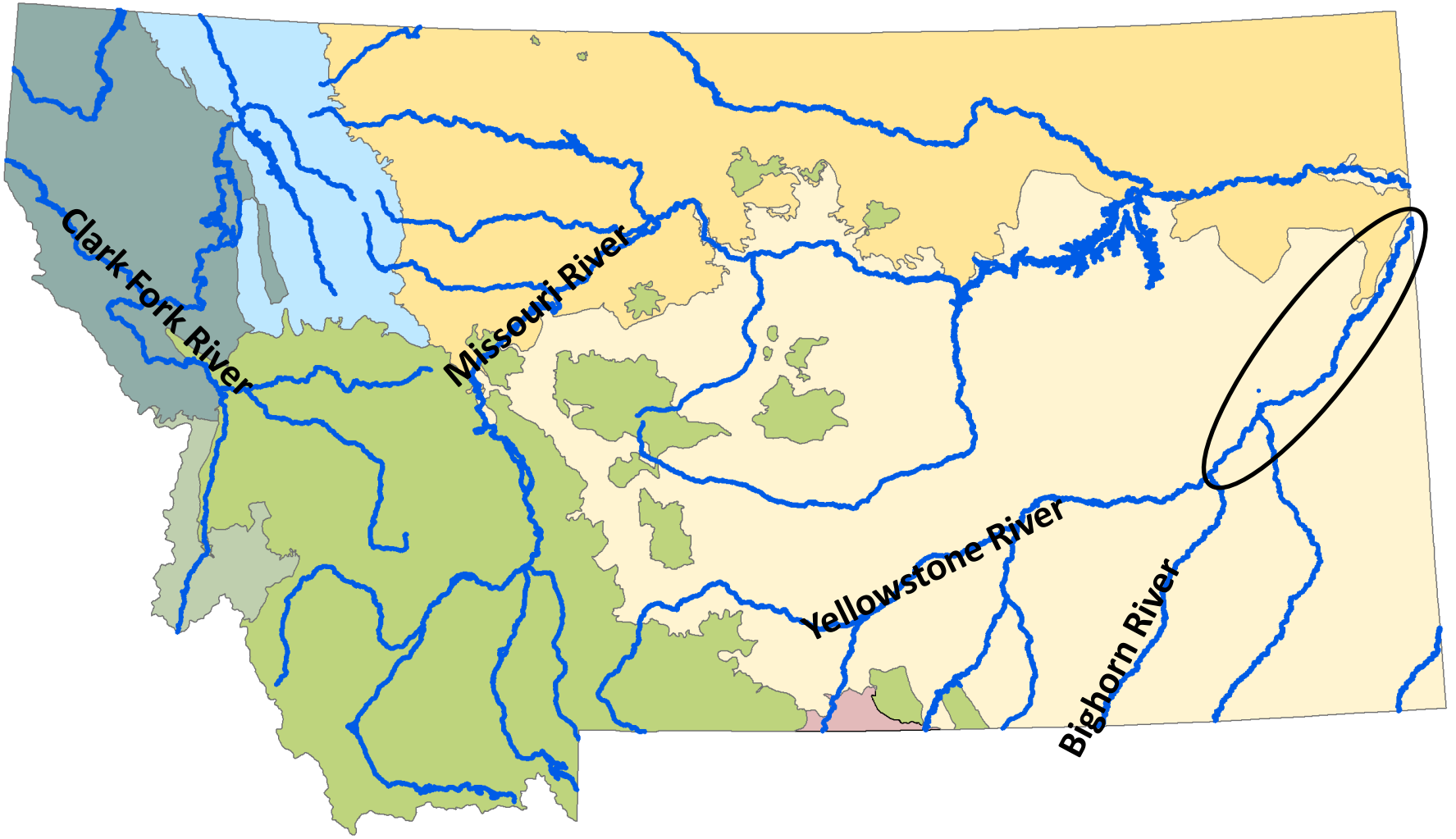
Mountainous

Transitional

Prairie



Nutrient Criteria for Large Rivers



Adopted
July 2014

DEPARTMENT CIRCULAR

DEQ-12A

Montana Base Numeric Nutrient Standards

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Selected MT Numeric Nutrient Standards: wadeable streams and large rivers

Ecoregion (level III or IV) and Number	Ecoregion Level	Period When Criteria Apply	Numeric Nutrient Standard	
			Total Phosphorus (µg/L)	Total Nitrogen (µg/L)
Northern Rockies (15)	III	July 1 to September 30	25	275
Canadian Rockies (41)	III	July 1 to September 30	25	325
Idaho Batholith (16)	III	July 1 to September 30	25	275
Middle Rockies (17)	III	July 1 to September 30	30	300
Absaroka-Gallatin Volcanic Mountains (17i)	IV	July 1 to September 30	105	250
Northwestern Glaciated Plains (42)	III	June 16 to September 30	110	1300
Sweetgrass Upland (42l), Milk River Pothole Upland (42n), Rocky Mountain Front Foothill Potholes (42q), and Foothill Grassland (42r)	IV	July 1 to September 30	80	560
Northwestern Great Plains (43) and Wyoming Basin (18)	III	July 1 to September 30	150	1300
River Breaks (43c)	IV	Narrative only	Narrative only	Narrative only
*Non-calcareous Foothill Grassland (43s), Shields-Smith Valleys (43t), Limy Foothill Grassland (43u), Pryor-Bighorn Foothills (43v), and Unglaciated Montana High Plains (43o)**	IV	July 1 to September 30	33	440
Large Rivers:				
Yellowstone River (Bighorn River confluence to Powder River confluence)	n/a	August 1 -October 31	55	655
Yellowstone River (Powder River confluence to stateline)	n/a	August 1 -October 31	95	815

Most Montana Streams Meet the Standards

Based on probabilistic stream survey:

- About 70-80% of stream miles statewide currently meet the TP standards
- About 85-90% of stream miles statewide currently meet the TN standards

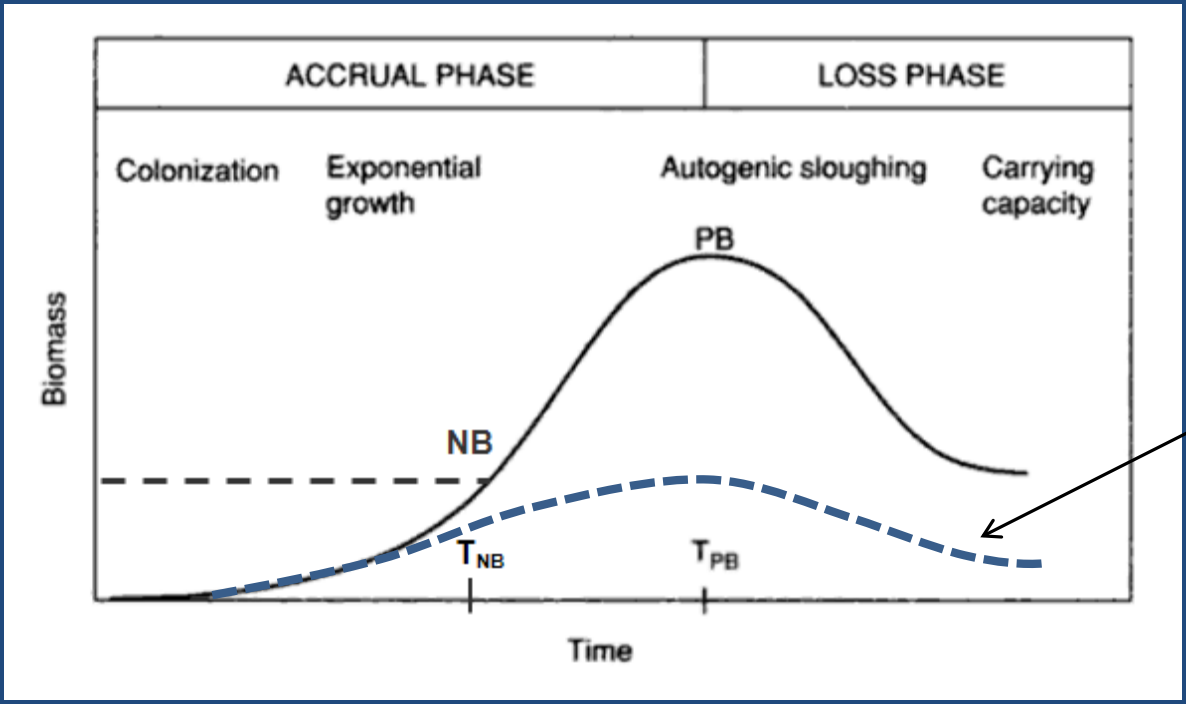
Nutrient Standards: Excursion Frequency

"Most aquatic ecosystems can probably recover from most exceedences in about three years." -EPA 1985

- MT DEQ chose a recurrence frequency 1 in 5 years
  - Similar to EPA's 1 in 3
  - Applicable to rivers and streams

Averaging Duration

- Minimize impacts on recreation and aquatic-life uses caused by excess benthic algae density



Nutrient criteria set at concentrations that should keep algae below nuisance for duration of summer

Estimating Time to Nuisance Algae

$$a_b(t) = \frac{a_{b,\max} \exp^{kt}}{\frac{a_{b,\max}}{a_{b,init}} + \exp^{kt} - 1}$$

$a_b(t)$ = benthic algal biomass (mg Chl*a*/m^2) at a defined point in time after growth initiation

$a_{b,init}$ = initial biomass condition (mg Chl*a*/m^2)

$a_{b,\max}$ = max biomass carrying capacity (mg Chl*a*/m^2)

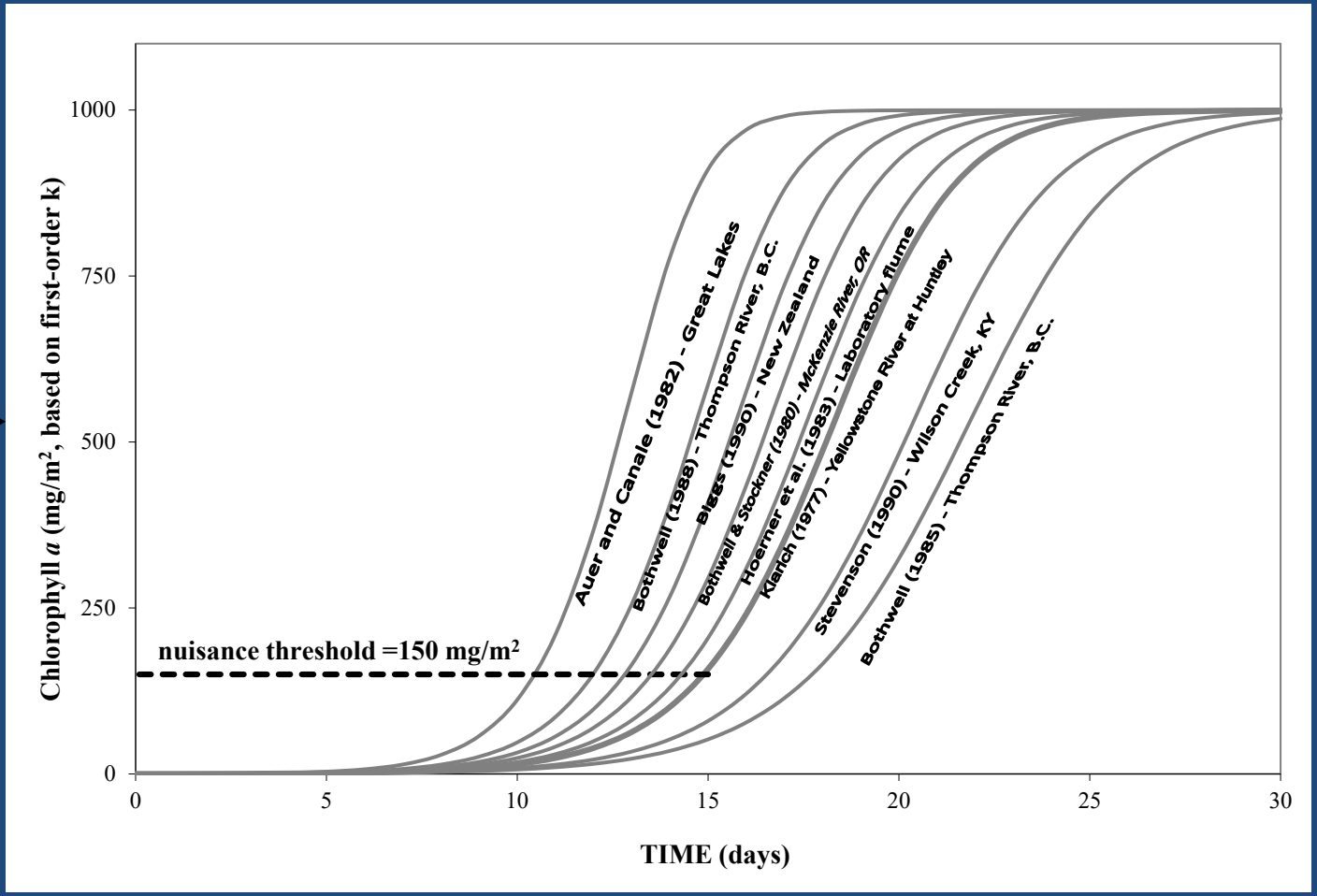
k = temperature dependent 1st order net-specific growth rate (day^{-1})

t = time (days)

Duration

150 mg Chl*a*/m^2: threshold for recreation and aquatic-life impacts

Literature benthic algae growth rates (k, day^{-1}) normalized to 20° C, modeled



0.5 day^{-1} most appropriate for duration, equal to about 14 days to nuisance

Verifying the Duration Period

Quantitative Whole-stream Nutrient Dosing Study

- Observe "time to peak" benthic algal biomass
- Nutrients were added at moderately-enriched levels

Box Elder Creek, Carter County, MT


07/28/2010: 21 days prior to dosing


08/24/2010: +15 days


08/29/2010: +20 days
Peak Algae Density


09/7/2010: +29 days


09/22/2010: +44 days

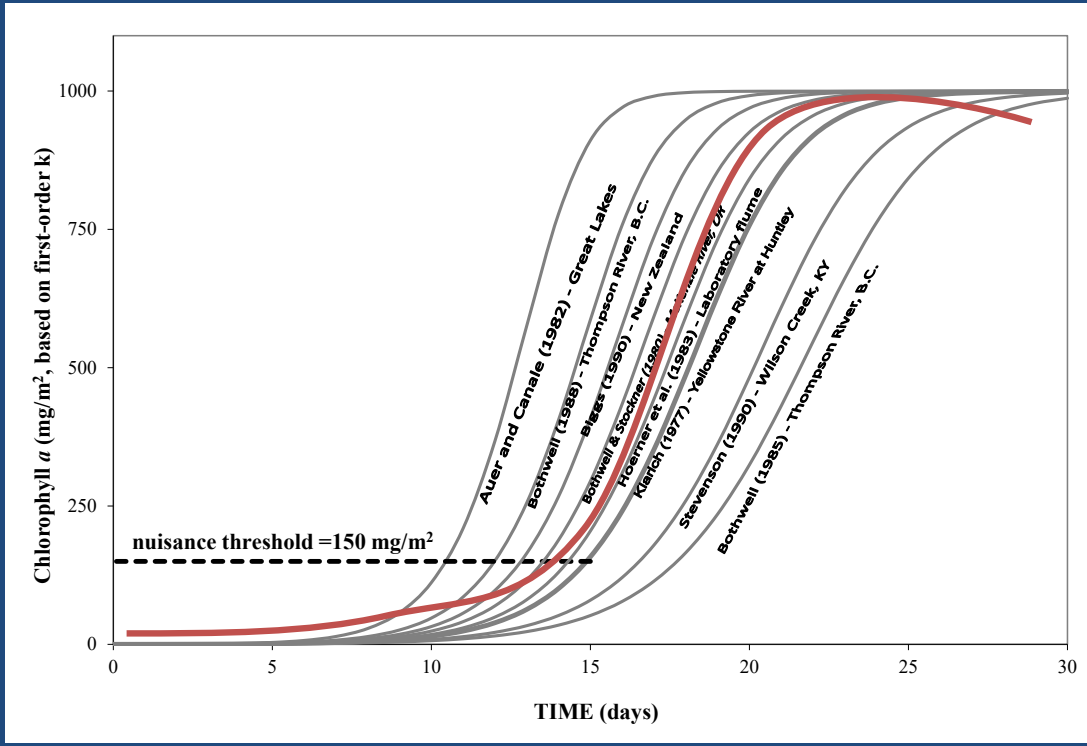
Control Reach (Sept 9, 2010)

+30 days

Dosed Reach (Sept 9, 2010)

Net Specific Growth Rate at 20˚C (k, day^{-1})	Reference
0.50	Klarich (1977)
0.55	Bothwell and Stockner (1980)
0.71	Auer and Canale (1982)
0.52	Horner et al. (1983)
0.42	Bothwell (1985)
0.62	Bothwell (1988)
0.58	Biggs (1990)
0.45	Stevenson (1990)

Dosing study net-specific growth rate at 20°C: 0.42 day^{-1}



Duration, Frequency: Recap

- Averaging duration of 14 days appropriate to prevent stream algae from reaching 150 mg Chl*a*/m^2 in MT
  - A longer averaging duration (90 days--the growing season) could result in nuisance algae because of likelihood that there would be >14 continuous days when flows are below the 90-day average flow

- Once in 5 year recurrence frequency (policy)

Low-flow Design Flow

- Adopted in Rule (ARM 17.30.635): *"Lowest average 14 consecutive day low flow, occurring from July through October, with an average recurrence frequency of once in five years."*

14Q5

- Seasonal 14Q5 flows (July-Oct) available from USGS

Permit Limits for Numeric Nutrient Standards

- Based on *Technical Support Document for Water Quality-based Toxics Control* ("TSD"; EPA 1991)

- Method specific to Montana's nutrient standards:
  - Treated as chronics: average monthly limit, but no max daily
  - Use 95th percentile probability distribution of the effluent
  - Limits apply only during growing season (July through Oct)
  - 100% of the 14Q5 is used for mixing—if dilution available

As MPDES permits are renewed, MT DEQ:

- Determines applicable TN and/or TP standards from Circular DEQ-12A

- Conducts Reasonable Potential (RP) analysis per TSD
  - If RP, will calculate effluent limit(s)

Example RP Analysis – Total Nitrogen

Will the stream concentration after mixing (C_r) be greater than the standard?

$$C_r = [(Q_s \, x \, Cs) + (Q_d \, x \, Cd)] \, / \, Q_r$$

Q_s = 18.4 mgd = seasonal 14Q5

Q_d = 1.8 mgd = average daily design flow

C_s = 0.1 mg/L = 75th percentile background data (i.e., upstream concentration)

C_d= 54.6 mg/L = 39 mg/L TN max observed x 1.4 Table 3-2 multiplier in TSD

$$C_r = [(18.4 \, x \, 0.1) + (1.8 \, x \, 54.6)] \, / \, (18.4 + 1.8)$$

$$C_r = 4.95 \text{ mg TN/L} > 0.3 \text{ mg TN/L standard}$$

→ **RP exists, so TN effluent limit will be developed**

Permitting Effluent Limits

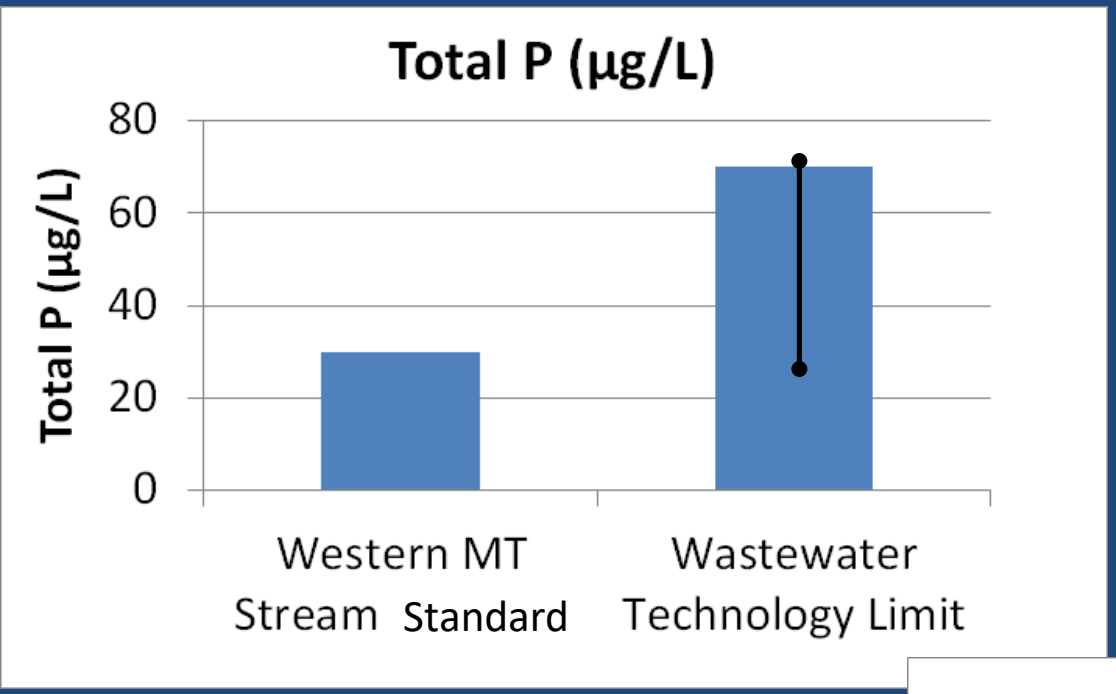
1. Calculate Wasteload Allocation (WLA) via mass-balance (or TMDL WLA if applicable)
2. Calculate chronic Long-term Average (LTA)
3. Calculate Average Monthly Limit (AML) as concentration
4. Calculate AML as load

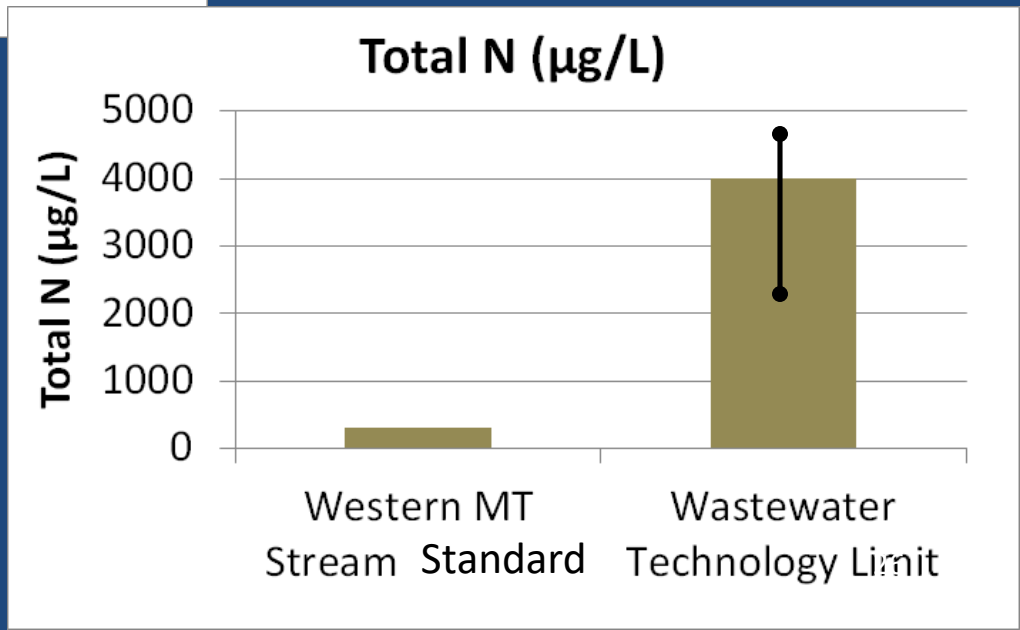
Effluent limits are expressed on a monthly average basis, as <u>both:</u>

- Concentration (mg/L), and Load (lb/day)

Implemented immediately (or by compliance schedule) UNLESS the facility is eligible to request a variance from the numeric nutrient standards…

The Implementation Challenge





Water Quality Standards Variances

- A variance is designed to encourage compliance with the Clean Water Act within a reasonable timeframe
- An alternative to beneficial use downgrade or removal on the receiving stream
- Time limited, provides dischargers time to come into compliance with the standards

2014: MT Nutrient Standards Variances

- Due to gap between scientifically-defensible nutrient standards and wastewater technology, variances were considered critical to implementation
- MT DEQ considered 20 years to be a reasonable timeframe to determine if a water quality problem was correctable or not
  - 20 years established in authorizing statute (75-5-313, MCA)
- General variance was available for three groups of dischargers:
  - ≥1 MGD
  - <1MGD
  - Lagoons
- Montana statute also allows individual variances
- Variances implemented through the discharge permit

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DEQ-12A

Montana Base Numeric Nutrient Standards

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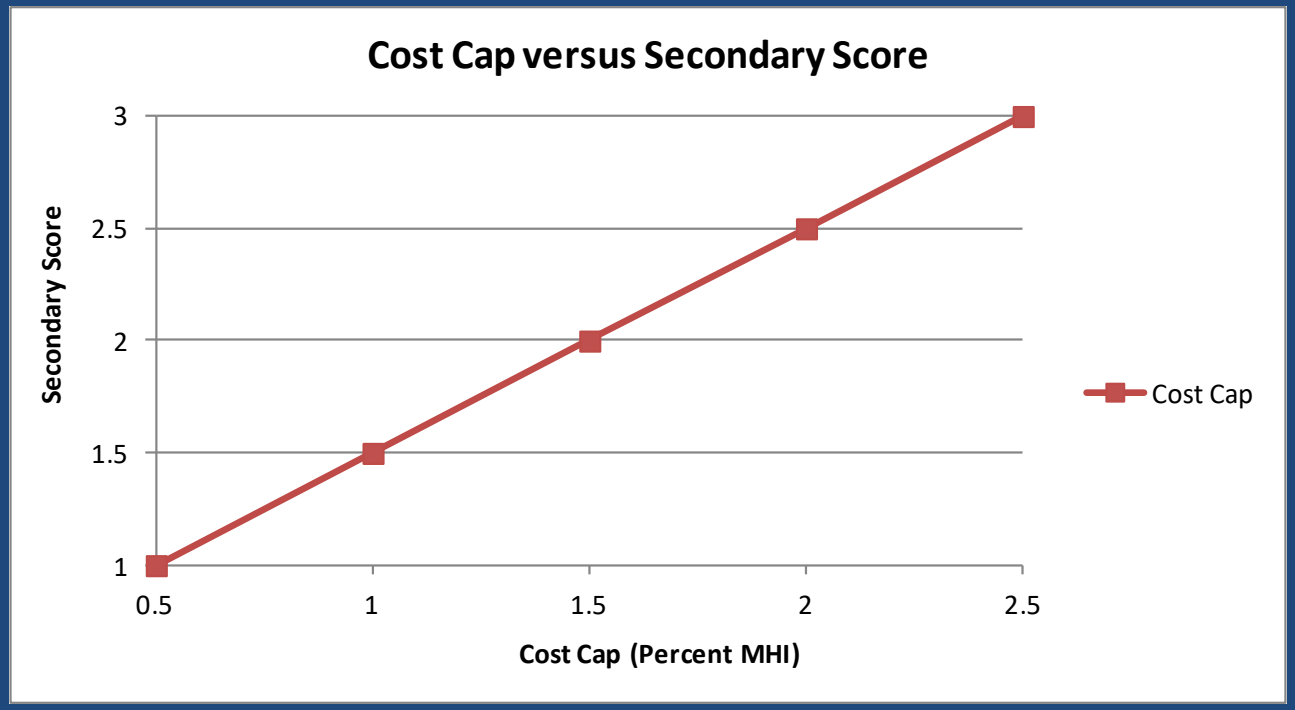
DEQ-12B

Nutrient Standards Variances

MAY 2018 EDITION

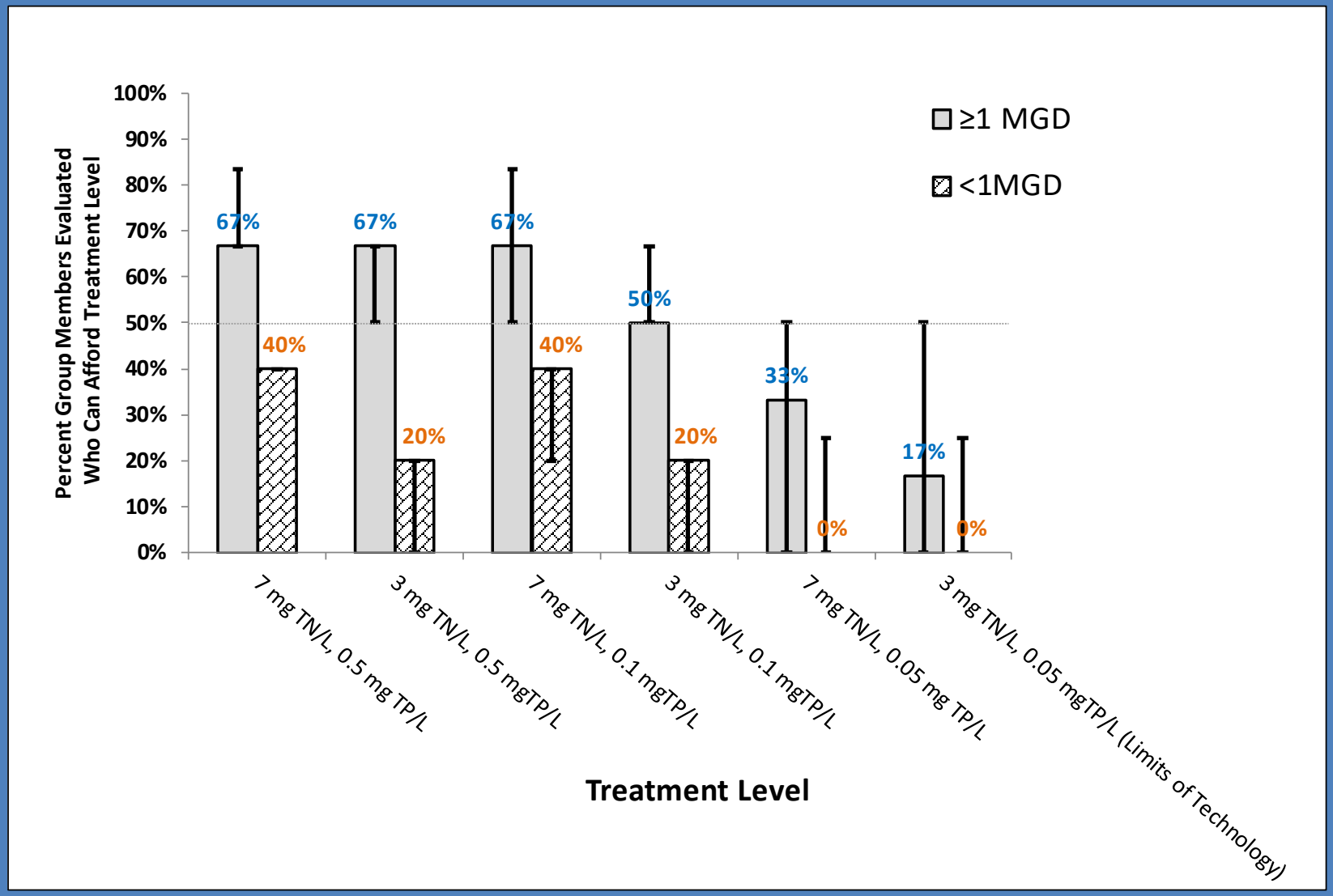
Identifying Highest Attainable Condition (HAC)



Example (Community X):

Estimated cost to upgrade to 7 mg TN/L, 0.1 mg TP/L: $389,927.00
Upgrade cost, as % of MHI (including current sewer bill): 2.3%
Community economic evaluation (i.e., secondary score): 2.6
Cost Cap (per graph, above), as MHI: 2.1%
Can treatment level be afforded? NO (2.3% > 2.1%).

≥1MGD, <1MGD Mechanical Categories



Percent of Members in a Discharger Group (≥ 1MGD, <1MGD) Who Can Affordably Meet (Per DEQ Methods) a Specified Wastewater Treatment Level. Only POTW group members are shown, and, among them, only those that will probably need a variance. Error bars are the % of members who can afford a treatment level, based on a range of cost estimates for the facility upgrades (per class 5 engineering planning estimates).

2017: Treatment Requirements (HAC) adopted in Circular DEQ-12B

- ≥1MGD Category: 6mg TN/L, and 0.3 mg TP/L
- ≤1MGD Category: 10 mg TN/L, and 1.0 mg TP/L
- Lagoons: Maintain long-term average and implement the PMP/optimization
- Recipients of variances required to carry out facility optimization for nutrient removal

Variance Permitting Process

- To MT DEQ, treatment requirements (HAC) are long term averages (LTA), limits are expressed as Average Monthly Limit (AML), so:

Permitted Load Limit

HAC (mg/L) * Table 5-2 $value_{95th}$ * Design Flow * conversions = (lb/day)

From TSD (EPA, 1991)—based on coefficient of variation (CV; SD/mean) calculated from samples from discharger's effluent

If a permittee is already meeting a lower load limit from an existing permit, they must continue to meet that limit

EPA Review of Montana Nutrient Standards Variances (2017)

- EPA review carried out under the 2015 variance regulations (40 CFR 131.14)

- EPA approved only some of Montana's variance procedures
  - 36 facilities were considered eligible for the general variance for Clean Water Act purposes

- Individual variances
  - One completed, EPA approved
  - Others (private, public) in development

Ongoing Litigation

- 2016: EPA sued by *UMWK* in U.S. District Court (District of Montana) for having approved MT DEQ's nutrient standards variance
  - Suit primarily based upon challenge to the use of economic and social factors to grant a WQS variance

- 2019 (March): Court finds EPA's use of economic and social factors to approve a WQS variance is consistent with the Clean Water Act. Court upholds the Current Variance Standard (i.e., HAC) and EPA's approval of Montana's economic and social impacts analysis results.
  - Court also finds EPA's regulations contradicted themselves, and specifically finds EPA's approval allowing time to achieve merely the interim treatment requirements to be unreasonable

Ongoing Litigation

- 2019 (July 16): Court orders MT DEQ to address:
  - (1) time to meet interim treatment requirements (HAC)
  - (2) time to meet base numeric nutrient standards
  - DEQ given 120 days. Because the Court stayed its partial vacatur, EPA's approval of Montana's general variance is still in place.

- 2019 (October): EPA requested a motion to alter or amend judgement, while Defendant-intervenors request stay, pending appeal to 9th Circuit Court of Appeals

Summary

- Montana has had numeric nutrient standards and a variance process since 2014
  - Magnitude, frequency, and duration of the standards adopted in rule
- General and individual variances have been granted to permittees through the permit program
- Montana DEQ completed its first triennial review in 2017 (next one: 2020)
- Ongoing litigation will undoubtedly affect Montana's variance process going forward

Acknowledgments

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- Members of the Nutrient Work Group

Thank You

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Rock Creek, in eastern Montana

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