METALS

Beneficial Uses: Aquatic Life/Fishes & Drinking Water

Applicability: All Montana Surface Waters

Method Overview: Using numeric WQS for metals, a single-level process determines whether beneficial uses are being supported. The total recoverable fraction is considered for all metals except aluminum (which is analyzed for the dissolved fraction).

For aquatic life/fishes, a Level I assessment evaluates metals concentration data against acute and chronic aquatic life WQS, using a fixed allowable exceedance rate of 10%. If either of the two following conditions are met within the dataset, the waterbody is not attaining water quality standards for a particular metal: (1) aquatic life WQS exceedance rate > 10% or (2) at least 1 sample exceeds twice the acute aquatic life WQS. If the exceedance rate is >10% but no human-caused metals sources are located in the drainage, the assessor should consult management for a case-by-case review.

For drinking water, a Level I assessment evaluates metals concentration data against human health WQS. The waterbody is not attaining water quality standards if at least 1 sample exceeds the human health WQS.

Metals Core Indicators (Aquatic Life/Fishes)

	Core Indicators	Minimum Sample Size	Analysis of Core Indicators	Index Period	Data Independence
Level I	Metals Concentrations	n ≥ 8 or n = 6 with ≥ 3 exceedances, where necessary	Data (µg/L) are evaluated against aquatic life WQS using allowable exceedance rate (exceedance = 10%)	Year-round (at least 33% of sample set collected during high flow and the rest during baseflow)	≥ 30 days during baseflow; temporal independence is evaluated on a case-by-case basis during high flow and ≥ 1 stream mile

Metals Core Indicators (Drinking Water)

	Core Indicators	Minimum Sample Size	Analysis of Core Indicators	Index Period	Data Independence
Level I	Metals Concentrations	n ≥ 8 or n ≥ 1 with ≥ 1 exceedance, where necessary	Data (µg/L) are evaluated against human health WQS with no allowable exceedances (exceedance = 0%)	Year-round (at least 33% of sample set collected during high flow and the rest during baseflow)	≥ 30 days during baseflow; temporal independence is evaluated on a case-by-case basis during high flow and ≥ 1 stream mile

NUTRIENTS – MOUNTAINOUS AND TRANSITIONAL STREAMS

Beneficial Uses: Aquatic Life/Fishes & Primary Contact Recreation

Applicability: All Montana Surface Waters

Method Overview: Using ecoregion-specific nutrient criteria, a two-level process determines whether beneficial uses are being supported. The Level I assessment considers together the results from two nutrient statistical tests, benthic algal chlorophyll *a* and ash-free dry weight, and diatom metric results, if available (except in the Middle Rockies ecoregion for which there are no validated diatom increaser metrics). The Level II assessment requires both diatom metric results and macroinvertebrate metric results. A Level II assessment is performed only when the Level I assessment conclusions are unclear. When a conclusion for a Level II assessment is unclear, consult management to determine the outcome. An Excel spreadsheet containing the decision matrix is used to arrive at impairment determinations.

Nutrients – Mountainous and Transitional Stream Core Indicators

	Core Indicators	Minimum Sample Size	Analysis of Core Indicators	Index Period	Data Independence
Level I	Nutrient Concentration (TN, TP)	n ≥ 13 (listed) n ≥ 12 (unlisted) n = 7 (with ≥ 4 exceedances)	Data (mg/L) are evaluated against nutrient criteria using two statistical tests	Ecoregion – Specific Growing Season	≥ 30 days and ≥ 1 stream mile
	Benthic Algal Chlorophyll *a*/Ash-Free Dry Weight	n ≥ 3	Data are evaluated against recommended threshold values = 120 mg Chl *a*/m2 or = 35 g AFDW/m2		
	Diatoms (must be included if data are available)	n ≥ 2 (n = 0 in Middle Rockies ecoregion)	Data are evaluated using an "increaser taxa probability of impairment" Threshold value = 51%		
Level II	Nutrient Concentration (TN, TP)	n ≥ 13 (listed) n ≥ 12 (unlisted) n = 7 (with ≥ 4 exceedances)	Data (mg/L) are evaluated against nutrient criteria using two statistical tests	Ecoregion – Specific Growing Season	≥ 30 days and ≥ 1 stream mile
	Benthic Algal Chlorophyll *a*/Ash-Free Dry Weight	n ≥ 3	Data are evaluated against recommended threshold values = 120 mg Chl *a*/m2 or = 35 g AFDW/m2		
	Diatoms	n ≥ 2 (n = 0 in Middle Rockies ecoregion)	Data are evaluated using an "increaser taxa probability of impairment" Threshold value = 51%		
	Macroinvertebrates	n ≥ 2 (n ≥ 3 in Middle Rockies ecoregion)	Data are evaluated using the Hilsenhoff Biotic Index (HBI) score threshold value = 4		

NUTRIENTS – PRAIRIE STREAMS

Beneficial Uses: Aquatic Life/Fishes & Primary Contact Recreation

Applicability: Wadeable Streams (perennial or intermittent; Strahler Order ≤6)

Method Overview: Using ecoregion-specific nutrient criteria, a two-level process determines whether beneficial uses are being supported. The Level I assessment considers together the results from two nutrient statistical tests, diatom metric results, and dissolved oxygen delta values (either instantaneous or long term). The Level II assessment incorporates biochemical oxygen demand and visual field assessments (Fish Cover/Other Form). A Level II assessment is performed only when the Level I assessment conclusions are unclear. When a conclusion for a Level II assessment is unclear, consult management to determine the outcome. An Excel spreadsheet containing the decision matrix is used to arrive at impairment determinations.

Nutrients – Prairie Stream Core Indicators

	Core Indicators	Minimum Sample Size	Analysis of Core Indicators	Index Period	Data Independence
Level I	Nutrient Concentration (TN, TP)	n ≥ 13 (listed) n ≥ 12 (unlisted) n = 7 (with ≥ 4 exceedances)	Data (mg/L) are evaluated against nutrient criteria using two statistical tests	Ecoregion – Specific Growing Season	≥ 30 days and ≥ 1 stream mile
	Diatoms	n ≥ 2	Data are evaluated using an "increaser taxa probability of impairment" Threshold value = 51%		
	Dissolved Oxygen (DO) delta	n ≥ 3	DO delta (i.e., the daily DO maximum minus the daily DO minimum) are evaluated against a concentration threshold value = 5.3 mg/L		
Level II	Nutrient Concentration (TN, TP)	n ≥ 13 (listed) n ≥ 12 (unlisted) n = 7 (with ≥ 4 exceedances)	Data (mg/L) are evaluated against nutrient criteria using two statistical tests	Ecoregion – Specific Growing Season	≥ 30 days and ≥ 1 stream mile
	Diatoms	n ≥ 2	Data are evaluated using an "increaser taxa probability of impairment" Threshold value = 51%		
	Dissolved Oxygen (DO) delta	n ≥ 3	DO delta (i.e., the daily DO maximum minus the daily DO minimum) are evaluated against a concentration threshold value = 5.3 mg/L		
	Biochemical Oxygen Demand (BOD)	n ≥ 3	Data are evaluated against a concentration threshold value = 8 mg/L		
	Visual Field Assessment	n ≥ 2 (during diatom sampling and at least once per site per reach)	Observations of high levels of benthic algae or macrophytes may indicate nitrogen or phosphorus pollution (i.e., excess nutrients)		

SEDIMENT

Beneficial Uses: Aquatic Life/Fishes

Applicability: Western Montana Streams (perennial or intermittent; Strahler Order ≤4) in Northern, Middle, Canadian Rockies, Idaho Batholith Level III Ecoregions

Method Summary: Using narrative WQS for sediment, a two-level process determines whether beneficial uses are being supported. The Level I assessment includes percent riffle fines (<5.7mm and <2mm), percent pool tail fines (<6mm), residual pool depth, and pool frequency data. When one to three physical parameter values are outside the reference range, biological measures, diatoms and macroinvertebrates, are evaluated. A Level II assessment is performed only when the Level I biology does not indicate impairment and assessment conclusions are unclear. The Level II assessment incorporates additional data collected for each core indicator; additional parameters are optional.

Sediment Core Indicators

	Core Indicators	Minimum Sample Size	Analysis of Core Indicators	Index Period	Data Independence
Level I	Riffle Fines (< 5.7mm)	n ≥ 1 site (reference) or 3 sites (literature); ≤ 4 riffles; 400 particles	Data are evaluated against a reference dataset or literature/TMDL target values using one of two statistical tests. During Level II assessment, both years' data will be combined unless conditions have changed sufficiently since first year.	Baseflow	Hydrologic water year and ≥ 5 stream miles if homogenous; or 1 per channel type transition if heterogenous
	Riffle Fines (< 2mm)				
	Pool Tail Grid Fines (< 6mm)	n ≥ 1 site (reference) or 3 sites (literature); ≤ 10 scour pool tails; 3 grid tosses per pool tail			
	Mean Residual Pool Depth (RPD)	n ≥ 1 site (reference) or 3 sites (literature); ≤ 20 scour pools			
	Pool Frequency	n ≥ 1 site (reference) or 3 sites (literature)			
	Diatoms	n ≥ 2 (for each metric)	Data are evaluated using a sediment "increaser taxa probability of impairment" metric value	Ecoregion-Specific Growing Season	≥ 30 days and ≥ 1 stream mile
	Macroinvertebrates		Data are evaluated using Observed/Expected (O/E) metric values		
Level II	Riffle Stability Index (RSI)	These additional parameters may be (but are not required to be) analyzed during Level II when core indicators do not yield a straightforward sediment impairment determination. When planning the additional data collection, a local biologist and/or hydrologist should be contacted (if feasible) to determine which of these additional parameters should be collected to appropriately address particular issues.		
	Subsurface Fines			
	Intragravel Dissolved Oxygen and Flow			
	Residual Pool Volume (V*)			

TEMPERATURE

Beneficial Uses: Aquatic Life/Fishes

Applicability: Wadeable Streams (perennial or intermittent)

Method Summary: A two-level process may be used to determine whether acute and chronic harm-to-use temperature thresholds are being met for the most sensitive fish species in the level IV ecoregion. The Level I assessment first compares temperature data against fish tolerance thresholds. If thresholds are not exceeded, the waterbody is supporting its beneficial use. If thresholds are exceeded, decisions of impairment are not completed without determining that a significant increase of water temperature is likely caused by human influences.

The Level II assessment is used when the Level I assessment conclusions are unclear (i.e., fish tolerance thresholds are exceeded but the significance of human influence is uncertain). The Level II assessment will use a model to determine the level of significance for human-caused effects to make a decision.

Temperature Core Indicators

	Core Indicators	Minimum Sample Size	Analysis of Core Indicators	Index Period	Data Independence
Level I	Continuous Temperature	n ≥ 2 continuous data sets (above and below human influence)	Temperature data are evaluated against fish tolerance thresholds	July 1 – September 15, at a minimum	≤ 30-minute time step and ≥ 1 stream mile
Level II	Continuous Temperature	n ≥ 2 continuous data sets (above and below human influence)	Temperature data are evaluated against fish tolerance thresholds	July 1 – September 15, at a minimum	≤ 30-minute time step and ≥ 1 stream mile
	Model Input Variables (Shading, Hydrology, Channel Geometry, Meteorology)	Minimum sample size for input variables for hydrology, shading, channel geometry, and meteorology are determined by model	Empirical data are evaluated against reference site data via a model to determine departure from "naturally occurring" condition and significance of human influence	Represent July 1 – September 15 conditions	Data independence for input variables for hydrology, shading, channel geometry, and meteorology are determined by model