APPENDIX A - REGULATORY FRAMEWORK AND REFERENCE CONDITION APPROACH

This appendix presents details about applicable Montana Water Quality Standards and the general and statistical methods used for development of reference conditions.

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A1.0 TMDL Development Requirements

The Montana Water Quality Act (WQA) (Section 75-5-703, Montana Code Annotated (MCA)) and Section 303(d) of the federal Clean Water Act require development of TMDLs for impaired waterbodies that do not meet Montana water quality standards. Although waterbodies can become impaired from pollution (e.g., low flow alterations and habitat degradation) and pollutants (e.g., nutrients, sediment, metals, pathogens, and temperature), the Clean Water Act and Montana state law (75-5-703, MCA) require TMDL development only for impaired waters with pollutant causes. Section 303(d) also requires states to submit a list of impaired waterbodies to the U.S. Environmental Protection Agency (EPA) every two years. Prior to 2004, EPA and DEQ referred to this list simply as the 303(d) list.

Since 2004, EPA has requested that states combine the 303(d) list with the 305(b) report containing an assessment of Montana's water quality and its water quality programs. EPA refers to this new combined 303(d)/305(b) report as the Integrated Water Quality Report (DEQ 2018). The 303(d) list also includes identification of the probable cause(s) of the water quality impairment (e.g., pollutants such as metals, nutrients, sediment, pathogens, or temperature), and the suspected source(s) of the pollutants of concern (e.g., various land use activities). State law (75-5-702, MCA) identifies that a sufficient credible data methodology for determining the impairment status of each waterbody is used for consistency. The impairment status determination methodology is identified in DEQ's Water Quality Assessment Process and Methods (Montana Department of Environmental Quality, 2011).

Under Montana state law, an "impaired waterbody" is defined as a waterbody or stream segment for which sufficient credible data show that the waterbody or stream segment is failing to achieve compliance with applicable water quality standards (Section 75-5-103(11), MCA of the Montana Water Quality Act). A "threatened waterbody" is defined as a waterbody or stream segment for which sufficient credible data and calculated increases in loads show that the waterbody or stream segment is fully supporting its designated uses, but threatened for a particular designated use because of either: (a) proposed sources that are not subject to pollution prevention or control actions required by a discharge permit; the nondegradation provisions; or reasonable land, soil, and water conservation practices or (b) documented adverse pollution trends (Section 75-5-103(31), MCA of the Montana Water Quality Act). State law and Section 303(d) of the Clean Water Act require states to develop all necessary TMDLs for impaired or threatened waterbodies. None of the waterbodies being addressed within the scope of this document are listed as threatened.

A TMDL is a pollutant budget for a waterbody identifying the maximum amount of the pollutant that a waterbody can assimilate without causing applicable water quality standards to be exceeded (not met). TMDLs are often expressed in terms of an amount, or load, of a particular pollutant (expressed in units of mass per time such as pounds per day). TMDLs must account for loads/impacts from point and nonpoint sources in addition to natural background sources and must incorporate a margin of safety and consider influences of seasonality on analysis and compliance with water quality standards. **Section 4.0** of the main document provides a description of the components of a TMDL.

To satisfy the federal Clean Water Act and Montana state law, TMDLs are developed for each waterbody-pollutant combination identified on Montana's 303(d) list of impaired or threatened waters, and are often presented within the context of a water quality restoration or protection plan. State law (75-5-703(8), MCA) also directs Montana DEQ to "…support a voluntary program of reasonable land, soil, and water conservation practices to achieve compliance with water quality standards for nonpoint source activities for waterbodies that are subject to a TMDL…" This is an important directive that is reflected in the overall TMDL development and implementation strategy within this plan. It is important to note that water quality protection measures are not considered voluntary where such measures are already a requirement under existing federal, state, or local regulations.

A2.0 Applicable Water Quality Standards

Water quality standards include the uses designated for a waterbody, the legally enforceable standards that ensure that the uses are supported, and a nondegradation policy that protects the high quality of a waterbody. The ultimate goal of this TMDL document, once implemented, is to ensure that all designated beneficial uses are fully supported and all water quality standards are met. Water quality standards form the basis for the targets described in **Sections 5.0** and **6.0**. Pollutants addressed in this water quality improvement plan include sediment and temperature. This section provides a summary of the applicable water quality standards for these pollutants.

A2.1 Classification and Beneficial Uses

Classification is the assignment (designation) of a single or group of uses to a waterbody based on the potential of the waterbody to support those uses. Designated uses, or beneficial uses, are simple narrative descriptions of water quality expectations or water quality goals. There are a variety of "uses" of state waters including growth and propagation of fish and associated aquatic life, drinking water, agriculture, industrial supply, and recreation, and wildlife. The Montana WQA directs the Board of Environmental Review (BER) (i.e., the state) to establish a classification system for all waters of the state that includes their present (when the Act was originally written) and future most beneficial uses (Administrative Rules of Montana (ARM) 17.30.607-616) and to adopt standards to protect those uses (ARM 17.30.620-670).

Montana, unlike many other states, uses a watershed-based classification system, with some specific exceptions. As a result, all waters of the state are classified and have designated uses and supporting standards. All classifications have multiple uses and in only one case (A-Closed) is a specific use (drinking water) given preference over the other designated uses. Some waters may not actually be used for a specific designated use, for example as a public drinking water supply; however, the quality of that waterbody must be maintained suitable for that designated use. When natural conditions limit or preclude a designated use, permitted point source discharges or nonpoint source activities or pollutant discharges must not make the natural conditions worse.

Modification of classifications or standards that would lower a water's classification or a standard (e.g., B-1 to a B-3), or removal of a designated use because of natural conditions, can only occur if the water was originally misclassified. All such modifications must be approved by the BER, and are undertaken via a Use Attainability Analysis (UAA) that must meet EPA requirements (40 CFR 131.10(g), (h) and (j)). The UAA and findings presented to the BER during rulemaking must prove that the modification is correct and all existing uses are supported. An existing use cannot be removed or made less stringent.

Descriptions of Montana's surface water classifications and designated beneficial uses are presented in **Table A2-1**. In 2003, Montana added four classes: D, E, F, and G. These classes include ephemeral streams (E-1 and E-2), ditches (D-1 and D-2), seasonal or semi-permanent lakes and ponds (E-3, E-4, E-5) and waters with low or sporadic flow (F-1). All waterbodies within the Madison TMDL Planning Area are classified as B-1.

Table A2-1. Montana Surface Water Classifications and Designated Beneficial Uses

Classification	Designated Uses
A-CLOSED	Waters classified A-Closed are to be maintained suitable for drinking, culinary and food processing purposes after simple disinfection.
A-1	Waters classified A-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment for removal of naturally present impurities.
B-1	Waters classified B-1 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
B-2	Waters classified B-2 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
B-3	Waters classified B-3 are to be maintained suitable for drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-1	Waters classified C-1 are to be maintained suitable for bathing, swimming and recreation; growth and propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-2	Waters classified C-2 are to be maintained suitable for bathing, swimming and recreation; growth and marginal propagation of salmonid fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
C-3	Waters classified C-3 are to be maintained suitable for bathing, swimming and recreation; growth and propagation of non-salmonid fishes and associated aquatic life, waterfowl and furbearers. The quality of these waters is naturally marginal for drinking, culinary and food processing purposes, agriculture and industrial water supply.
I	The goal of the State of Montana is to have these waters fully support the following uses: drinking, culinary and food processing purposes after conventional treatment; bathing, swimming and recreation; growth and propagation of fishes and associated aquatic life, waterfowl and furbearers; and agricultural and industrial water supply.
D-1	Waters classified D-1 are to be maintained suitable for agricultural purposes and secondary contact recreation.
D-2	Waters classified D-2 are to be maintained suitable for agricultural purposes and secondary contact recreation. Because of conditions resulting from low flow regulations, maintenance of the ditch, or geomorphologic and riparian habitat conditions, quality is marginally suitable for aquatic life.
E-1	Waters classified E-1 are to be maintained suitable for agricultural purposes, secondary contact recreation, and wildlife.
E-2	Waters classified E-2 are to be maintained suitable for agricultural purposes, secondary contact recreation, and wildlife. Because of habitat, low flow, hydro-geomorphic, and other physical conditions, waters are marginally suitable for aquatic life.
E-3	Waters classified E-3 are to be maintained suitable for agricultural purposes, secondary contact recreation, and wildlife.
E-4	Waters classified E-4 are to be maintained suitable for aquatic life, agricultural purposes, secondary contact recreation, and wildlife.

Table A2-1. Montana Surface Water Classifications and Designated Beneficial Uses

Classification	Designated Uses
E-5	Waters classified E-5 are to be maintained suitable for agricultural purposes, secondary contact recreation, saline-tolerant aquatic life, and wildlife.
F-1	Waters classified F-1 are to be maintained suitable for secondary contact recreation, wildlife, and aquatic life, not including fish.
G-1	Waters classified G-1 are to be maintained suitable for watering wildlife and livestock; aquatic life, not including fish; secondary contact recreation; marginally suitable for irrigation after treatment or with mitigation measures.

A2.2 Standards

In addition to the use classifications described above, Montana's water quality standards include numeric and narrative criteria, as well as a nondegradation policy.

Numeric Standards

Numeric surface water quality standards have been developed for many parameters to protect human health and aquatic life. These standards are in the Department Circular DEQ-7 (Montana Department of Environmental Quality, 2019) and Circular DEQ-12A (DEQ 2014). The numeric human health standards have been developed for parameters determined to be toxic, carcinogenic, or harmful, and have been established at levels to be protective of long-term (i.e., lifelong) exposures, as well as through direct contact such as swimming.

The numeric aquatic life standards in Circular DEQ-7 include chronic and acute values that are based on extensive laboratory studies including a wide variety of potentially affected species, a variety of life stages, and durations of exposure. Chronic aquatic life standards are protective of long-term exposure to a parameter. The protection afforded by the chronic standards includes detrimental effects to reproduction, early life stage survival, and growth rates. In most cases the chronic standard is more stringent than the corresponding acute standard. Acute aquatic life standards are protective of short-term exposures to a parameter and are not to be exceeded.

High quality waters are afforded an additional level of protection by the nondegradation rules (ARM 17.30.701 et. seq.,) and in statute (75-5-303, MCA). Changes in water quality must be "non-significant", or an authorization to degrade must be granted by DEQ. However, under no circumstance may standards be exceeded. It is important to note that waters that meet, or are of better quality than a standard, are high quality for that parameter, and nondegradation policies apply to new or increased discharges to that the waterbody.

Narrative Standards

Narrative standards have been developed for substances or conditions for which sufficient information does not exist to develop specific numeric standards. The term "Narrative Standards" commonly refers to the General Prohibitions in ARM 17.30.637 and other descriptive portions of the surface water quality standards. The General Prohibitions are also called the "free from" standards; that is, the surface waters of the state must be free from substances attributable to discharges, including thermal pollution, that impair the beneficial uses of a waterbody. Uses may be impaired by toxic or harmful conditions (from one or a combination of parameters) or conditions that produce undesirable aquatic life. Undesirable aquatic life includes bacteria, fungi, and algae.

The sediment and temperature standards applicable to the list of pollutants addressed in the Madison TMDL Planning Area TMDLs are summarized below. In addition to the standards below, the beneficial-use support standard for B-1 streams, as defined above, can apply to other conditions, often linked to pollution, limiting aquatic life. These other conditions can include effects from dewatering/flow modifications and effects from habitat modifications.

A2.2.1 Sediment Standards

Sediment (i.e., coarse and fine bed sediment) and suspended sediment are addressed via the narrative criteria identified in **Table A2-2**. The relevant narrative criteria do not allow for harmful or other undesirable conditions related to increases above naturally occurring levels or from discharges to state surface waters. This is interpreted to mean that water quality goals should strive toward a condition in which any increases in sediment above naturally occurring levels are not harmful, detrimental, or injurious to beneficial uses (see definitions in **Table A2-2**).

Table A-2. Applicable Rules for Sediment Related Pollutants

Rule(s)	Standard or Definition
17.30.622(3), 623(2), 624(2), 627(2)	No person may violate the following specific water quality standards for waters classified [A-1, B-1, B-2, C-2]:
17.30.622(3)(f) [A-1], 17.30.623(2)(f) [B-1], 17.30.624(2)(f) [B-2], 17.30.627(2)(f) [C-2]	No increases are allowed above naturally occurring concentrations of sediment or suspended sediment (except a permitted in 75-5-318, MCA), settleable solids, oils, or floating solids, which will or are likely to create a nuisance or render the waters harmful, detrimental, or injurious to public health, recreation, safety, welfare, livestock, wild animals, birds, fish, or other wildlife.
17.30.622(3)(d) [A-1 classification]	No increase above naturally occurring turbidity or suspended sediment is allowed except at permitted in 75-5-318, MCA. Note: 75-5-318, MCA allows for short term variances linked to construction activities, etc.
17.30.623(2)(d) [B-1 classification]	The maximum allowable increase above naturally occurring turbidity is five nephelometric turbidity units except at permitted in 75-5-318, MCA. Note: 75-5-318, MCA allows for short term variances linked to construction activities, etc.
17.30.624(2)(e) [B-2], 17.30.627(2)(d) [C-2]	The maximum allowable increase above naturally occurring turbidity is 10 nephelometric turbidity units except as permitted in 75-5-318, MCA.
17.30.637(1) (a & d) [applies to all streams discussed in this document]	State surface waters must be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will: (a) settle to form objectionable sludge deposits or emulsions beneath the surface of the water or upon adjoining shorelines; … and (d) create concentrations or combinations of materials that are toxic or harmful to human, animal, plant, or aquatic life.
17.30.602	DEFINITIONS
	"Sediment" means solid material settled from suspension in a liquid; mineral or organic solid material that is being transported or has been moved from its site of origin by air, water, or ice and has come to rest on the earth's surface, either above or below sea level; or inorganic or organic particles originating from weathering, chemical precipitation, or biological activity.
	"Naturally occurring" means conditions or material present from runoff or percolation over which man has no control or from developed land where all reasonable land, soil, and water conservation practices have been applied. Conditions resulting from the reasonable operations of dams in existence as of July 1, 1971, are natural.

Table A-2. Applicable Rules for Sediment Related Pollutants

Rule(s)	Standard or Definition
	"Reasonable land, soil, and water conservation practices" means methods, measures, or practices that protect present and reasonably anticipated beneficial uses. These practices include but are not limited to structural and nonstructural controls and operation and maintenance procedures. Appropriate practices may be applied before, during, or after pollution-producing activities.

A2.2.2 Temperature Standards

Montana's temperature standards were originally developed to address situations associated with point source discharges, making them somewhat awkward to apply when dealing with primarily nonpoint source issues. In practical terms, the temperature standards address a maximum allowable increase above "naturally occurring" temperatures to protect the existing temperature regime for fish and aquatic life. Additionally, Montana's temperature standards address the maximum allowable decrease or rate at which cooling temperature changes (below naturally occurring) can occur to avoid fish and aquatic life temperature shock.

For waters classified as B-1 (ARM 17.30.623(e)), B-2 (ARM 17.30.624(e)), and C-2 (ARM 17.30.627(e)): A 1^o F maximum increase above naturally occurring water temperature is allowed within the range 32^o F to 66^o F; within the naturally occurring range of 66^o F to 66.5^o F, no discharge is allowed which will cause the water temperature to exceed 67^o F; and where the naturally occurring water temperature is 66.5^o F or greater, the maximum allowable increase in water temperature is 0.5^o F. A 2^o F per-hour maximum decrease below naturally occurring water temperature is above 55^o F. A 2^o F maximum decrease below naturally occurring water temperature is allowed within the range of 55^o F to 32^o F.

A3.0 Reference Conditions

A3.1 Reference Conditions as Defined in DEQ's Standard Operating Procedure for Water Quality Assessment

DEQ uses the reference condition to evaluate compliance with many of the narrative water quality standards (Montana Department of Environmental Quality, 2011). The term "reference condition" is defined as the condition of a waterbody capable of supporting its present and future beneficial uses when all reasonable land, soil, and water conservation practices have been applied. In other words, reference condition reflects a waterbody's greatest potential for water quality, given historic land use activities.

DEQ applies the reference condition approach for making beneficial use-support determinations for certain pollutants (such as sediment) that have specific narrative standards. All classes of waters are subject to the provision that there can be no increase above naturally occurring concentrations of sediment and settleable solids, oils, or floating solids sufficient to create a nuisance or render the water harmful, detrimental, or injurious. These levels depend on site-specific factors, so the reference conditions approach is used.

Also, Montana water quality standards do not contain specific provisions addressing detrimental modifications of habitat or flow. However, these factors are known to adversely affect beneficial uses under certain conditions or combination of conditions. The reference conditions approach is used to determine if beneficial uses are supported when flow or habitat modifications are present.

Waterbodies used to determine reference condition are not necessarily pristine or perfectly suited to giving the best possible support to all possible beneficial uses. Reference condition also does not reflect an effort to turn the clock back to conditions that may have existed before human settlement, but is intended to accommodate natural variations in biological communities, water chemistry, etc. due to climate, bedrock, soils, hydrology, and other natural physiochemical differences. The intention is to differentiate between natural conditions and widespread or significant alterations of biology, chemistry, or hydrogeomorphology due to human activity. Therefore, reference conditions should reflect minimum impacts from human activities. It attempts to identify the potential condition that could be attained (given historical land use) by the application of reasonable land, soil, and water conservation practices. DEQ realizes that pre-settlement water quality conditions usually are not attainable.

Comparison of conditions in a waterbody to reference waterbody conditions must be made during similar season and/or hydrologic conditions for both waters. For example, the total suspended solids (TSS) of a stream at base flow during the summer should not be compared to the TSS of reference condition that would occur during a runoff event in the spring. In addition, a comparison should not be made to the lowest or highest TSS values of a reference site, which represent the outer boundaries of reference conditions.

The following methods may be used to determine reference conditions:

Primary Approach

- Comparing conditions in a waterbody to baseline data from minimally impaired waterbodies that are in a nearby watershed or in the same region having similar geology, hydrology, morphology, and/or riparian habitat
- Evaluating historical data relating to condition of the waterbody in the past
- Comparing conditions in a waterbody to conditions in another portion of the same waterbody, such as an unimpaired segment of the same stream

Secondary Approach

- Reviewing literature (e.g., a review of studies of fish populations, etc. that were conducted on similar waterbodies that are least impaired)
- Seeking expert opinion (e.g., expert opinion from a regional fisheries biologist who has a good understanding of the waterbody’s fisheries health or potential)
- Applying quantitative modeling (e.g., applying sediment transport models to determine how much sediment is entering a stream based on land use information, etc.)

DEQ uses the primary approach for determining reference condition if adequate regional reference data are available and uses the secondary approach to estimate reference condition when there is no regional data. DEQ often uses more than one approach to determine reference condition, especially when regional reference condition data are sparse or nonexistent.

A3.2 Use of Statistics for Developing Reference Values or Ranges

Reference value development must consider natural variability as well as variability that can occur as part of field measurement techniques. Statistical approaches are commonly used to help incorporate variability. One statistical approach is to compare stream conditions to the mean (average) value of a reference data set to see if the stream condition compares favorably to this value or falls within the range of one standard deviation around the reference mean. The use of these statistical values assumes a normal distribution; whereas, water resources data tend to have a non-normal distribution (Helsel and Hirsch, 1995). For this reason, another approach is to compare stream conditions to the median value of a reference data set to see if the stream condition compares favorably to this value or falls within the range defined by the 25th and 75th percentiles of the reference data. This is a more realistic approach than using one standard deviation since water quality data often include observations considerably higher or lower than most of the data. Very high and low observations can have a misleading impact on the statistical summaries if a normal distribution is incorrectly assumed, whereas statistics based on non-normal distributions are far less influenced by such observations.

Figure A3-1 is an example boxplot-type presentation of the median, 25th and 75th percentiles, and minimum and maximum values of a reference data set. In this example, the reference stream results are stratified by two different stream types. Typical stratifications for reference stream data may include Rosgen stream types, stream size ranges, or geology. If the parameter being measured is one where low values are undesirable and can cause harm to aquatic life, then measured values in the potentially impaired stream that fall below the 25th percentile of reference data are not desirable and can be used to indicate impairment. If the parameter being measured is one where high values are undesirable, then measured values above the 75th percentile can be used to indicate impairment.

The use of a non-parametric statistical distribution for interpreting narrative water quality standards or developing numeric criteria is consistent with EPA guidance for determining nutrient criteria (Buck et al., 2000). Furthermore, the selection of the applicable 25th or 75th percentile values from a reference data set is consistent with ongoing DEQ guidance development for interpreting narrative water quality standards where it is determined that there is "good" confidence in the quality of the reference sites and resulting information (Suplee, 2004). If it is determined that there is only a "fair" confidence in the quality of the reference sites, then the 50th percentile or median value should be used, and if it is determined that there is "very high" confidence, then the 90th percentile of the reference data set should be used. Most reference data sets available for water quality restoration planning and related TMDL development, particularly those dealing with sediment and habitat alterations, would tend to be "fair" to "good" quality. This is primarily due to the limited number of available reference sites/data points available after applying all potentially applicable stratifications on the data, inherent variations in monitoring results among field crews, the potential for variations in field methodologies, and natural yearly variations in stream systems often not accounted for in the data set.

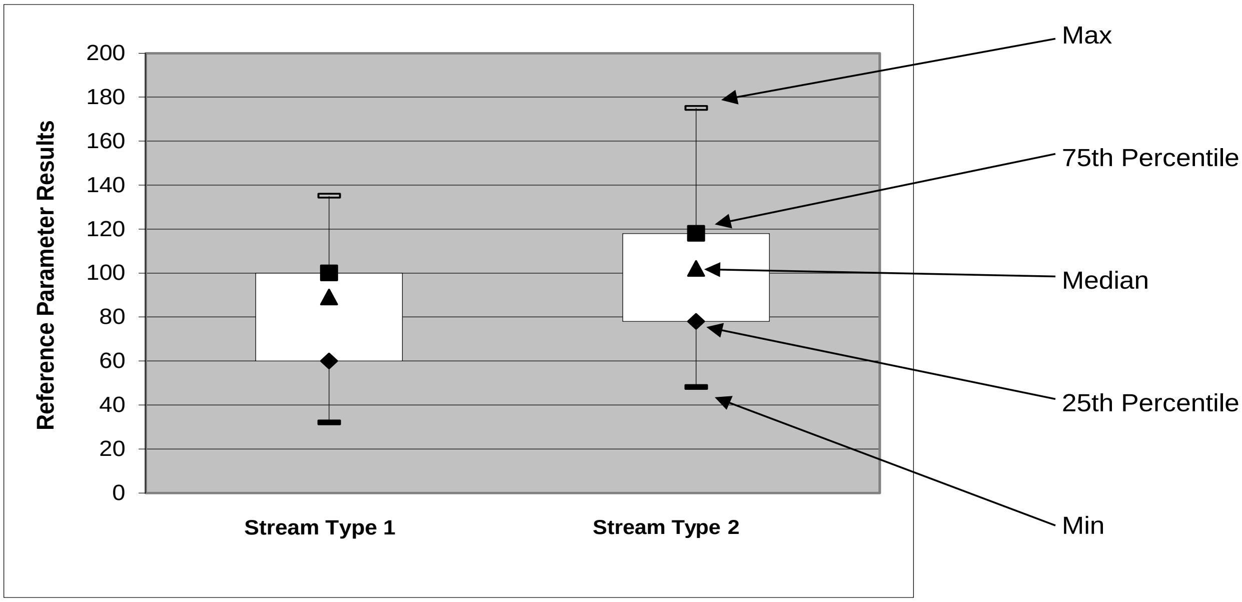

Figure A3-1. Boxplot Example for Reference Data

The above 25th – 75th percentile statistical approach has several considerations:

1. It is a simple approach that is easy to apply and understand.
2. About 25% of all streams would naturally fall into the impairment range. Thus, it should not be applied unless there is some linkage to human activities that could lead to the observed conditions. Where applied, it must be noted that the stream's potential may prevent it from achieving the reference range as part of an adaptive management plan.
3. About 25% of all streams would naturally have a greater water quality potential than the minimum water quality bar represented by the 25th to 75th percentile range. This may represent a condition where the stream's potential has been significantly underestimated. Adaptive management can also account for these considerations.
4. Obtaining reference data that represents a naturally occurring condition can be difficult, particularly for larger waterbodies with multiple land uses within the drainage. This is because all reasonable land, soil, and water conservation practices may not be in place in many larger waterbodies across the region. Even if these practices are in place, the proposed reference stream may not have fully recovered from past activities, such as riparian harvest, where reasonable land, soil, and water conservation practices were not applied.
5. A stream should not be considered impaired unless there is a relationship between the parameter of concern and the beneficial use such that not meeting the reference range is likely to cause harm or other negative impacts to the beneficial use as described by the water quality standards in **Table B2-2**. In other words, if not meeting the reference range is not expected to negatively impact aquatic life, coldwater fish, or other beneficial uses, then an impairment determination should not be made based on the particular parameter being evaluated. Relationships that show an impact to the beneficial use can be used to justify impairment based on the above statistical approach.

As identified in (2) and (3) above, there are two types of errors that can occur due to this or similar statistical approaches where a reference range or reference value is developed: (1) A stream could be considered impaired even though the naturally occurring condition for that stream parameter does not meet the desired reference range or (2) a stream could be considered not impaired for the parameter(s) of concern because the results for a given parameter fall just within the reference range, whereas the naturally occurring condition for that stream parameter represents much higher water quality and beneficial uses could still be negatively impacted. The implications of making either of these errors can be used to modify the above approach, although the approach used will need to be protective of water quality to be consistent with DEQ guidance and water quality standards (Suplee, 2004). Either way, adaptive management is applied to this water quality plan and associated TMDL development to help address the above considerations.

Where the data does suggest a normal distribution, or reference data is presented in a way that precludes use of non-normal statistics, the above approach can be modified to include the mean plus or minus one standard deviation to provide a similar reference range with all of the same considerations defined above.

Options When Regional Reference Data is Limited or Does Not Exist

In some cases, there is very limited reference data and applying a statistical approach like above is not possible. Under these conditions, the limited information can be used to develop a reference value or range, with the need to note the greater level of uncertainty and perhaps a greater level of future monitoring as part of the adaptive management approach. These conditions can also lead to more reliance on secondary type approaches for reference development.

Another approach would be to develop statistics for a given parameter from all streams within a watershed or region of interest (Buck et al., 2000). The boxplot distribution of all the data for a given parameter can still be used to help determine potential target values knowing that most or all of the streams being evaluated are either impaired or otherwise have a reasonable probability of having significant water quality impacts. Under these conditions you would still use the median and the 25^{th} or 75^{th} percentiles as potential target values, but you would use the 25^{th} and 75^{th} percentiles in a way that is opposite from how you use the results from a regional reference distribution. This is because you are assuming that, for the parameter being evaluated, as many as 50% to 75% of the results from the whole data distribution represent questionable water quality. **Figure A3-2** is an example statistical distribution of an entire dataset where lower values represent better water quality (and reference data are limited).

In **Figure A3-2**, the median and 25^{th} percentiles of all data represent potential target values versus the median and 75^{th} percentiles discussed above for regional reference distribution. Whether you use the median, the 25^{th} percentile, or both should be based on an assessment of how impacted all the measured streams are in the watershed. Additional consideration of target achievability is important when using this approach. Also, there may be a need to also rely on secondary reference development methods to modify how you apply the target and/or to modify the final target value(s). Your certainty regarding indications of impairment may be lower using this approach, and you may need to rely more on adaptive management as part of TMDL implementation.

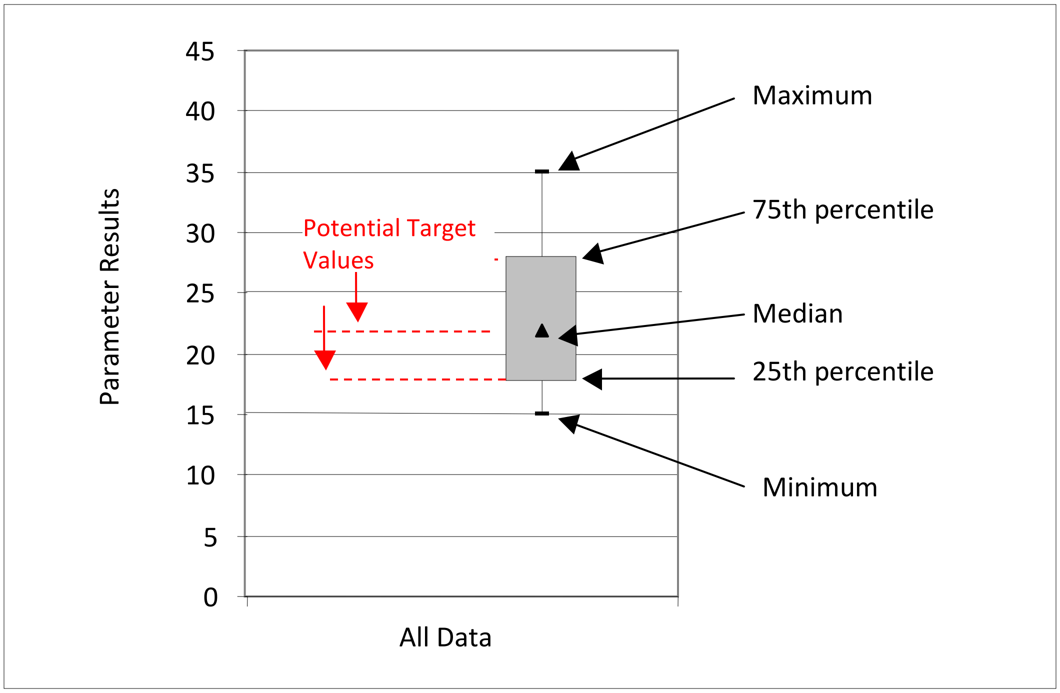

Figure B3-2. Boxplot example for the use of all data to set targets

A4.0 REFERENCES

Buck, Sharon, Walter K. Dodds, Jen Fisher, David A. Flemer, Debra Hart, Amanda K. Parker, Jan Stevenson, Vicki Watson, and Eugene B. Welch. 2000. Nutrient Criteria Technical Guidance Manual, Rivers and Streams. Washington, D.C.: U.S. Environmental Protection Agency. EPA-822-B00-002. http://www.epa.gov/waterscience/criteria/nutrient/guidance/rivers/index.html.

Helsel, Dennis R. and Robert M. Hirsch. 1995. Statistical Methods in Water Resources Studies in Environmental Science, Vol. 49, Amsterdam, The Netherlands: Elsevier Science Publishers B.V.

Montana Department of Environmental Quality. 2018. Final 2018 Water Quality Integrated Report. Helena, MT: Montana Dept. of Environmental Quality.

Montana Department of Environmental Quality. 2019. Circular DEQ-7: Montana Numeric Water Quality Standards. Helena, MT: Montana Department of Environmental Quality. https://deq.mt.gov/Portals/112/Water/WQInfo/Documents/Circulars/Circulars/DEQ7.pdf. Accessed 7/16/2020.

-----. 2014. Circular DEQ-12A. Montana Base Numeric Nutrient Standards. http://deq.mt.gov/wqinfo/Circulars.mcpx. Accessed 8/5/2014.

Montana Department of Environmental Quality, Planning, Prevention and Assistance Division, Water Quality Planning Bureau. 2011. Water Quality Assessment Method. Helena, MT: Montana Department of Environmental Quality. Revision 3.0.

Suplee, Michael W. 2004. Wadeable Streams of Montana's Hi-Line Region: An Analysis of Their Nature and Condition With an Emphasis on Factors Affecting Aquatic Plant Communities and Recommendations to Prevent Nuisance Algae Conditions. Helena, MT: Montana Department of Environmental Quality, Water Quality Standards Section.