Unified Assessment Methodology
Water Quality Control Division
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Compilation of both the Status of Water Quality in Colorado report and the List of Impaired Waters (305b report and 303d list, respectively) require the Water Quality Control Division (WQCD) to assess available information and determine whether water quality standards are attained. Uncertainty currently exists with respect to the status of federal rules and guidance addressing development of the 303d list. Nonetheless, the WQCD is required to proceed with preparation of the 305b report as the submittal deadline of April 1 is set in statute. In order to proceed with the 305b report, the WQCD will perform assessments of water quality utilizing the methodology outlined herein. The WQCD will revisit the 303d listing methodology upon the publication of 303d list guidance by EPA.

I. CREDIBLE EVIDENCE

The water quality assessment process depends on sufficient and reliable data. Assessments not supported by adequate data are potentially flawed. An incorrect finding that standards are attained when in fact they are not, allows potential human health threats or environmental degradation to go unaddressed. Incorrect finding of standards exceedance where standards are actually in attainment results in unnecessary expenditure of resources. In recognition of these problems, it is important that data utilized in assessment decisions be demonstrably credible.

Attainment of water quality standards or designated use support are evaluated based on an evaluation of biological, chemical or physical data. The WQCD will assess a waterbody by considering all chemical, physical, or biological information that meets required sampling, analytical, and interpretive protocols. Considerations may include a review of the sampling and analytical methods employed. Factors to be considered may include analytical detection limits, sample size, spatial and temporal distribution, variability within the data set, and the use of clean methodologies. Representative data of each type will be sought and utilized whenever possible, especially where a determination of non-attainment is the potential outcome. Assessments based upon biological or physical data in the absence of accompanying chemical data requires that such information clearly demonstrate non-attainment of uses.

Waterbodies are assessed to determine where designated uses are supported and standards are attained. The following guidelines are used to evaluate the adequacy of water quality information for that assessment.

1. Information is available to describe the methods used for sample collection, field, and laboratory analysis. The following quality assurance requirements must be met by all data used as a basis to support listing a waterbody. Persons submitting data during the public comment period must either provide the relevant quality assurance documentation with the submittal or assure that the documentation is made available for WQCD review upon request.

2. Chemical data should be supported by a Sampling and Analysis Plan (SAP), which identifies sampling locations, contains analytical method references, and incorporates Quality Assurance/Quality Control (QA/QC) provisions. QA/QC documentation may include references to a standard QA/QC protocol. WQCD QA/QC protocols may be obtained via the WQCD website or as hard copy. During review of chemical data submitted for evaluation, the WQCD may require submittal of the SAP, QA/QC protocols and the results of QA/QC efforts. The WQCD will provide any such information to other parties upon request.

3. In-situ bioassay test results, or other ambient toxicity test results, must demonstrate adverse effects as measured by a statistically significant response relative to a representative reference or control. Inherent variability in bioassay testing results must be adequately taken into account. Use support decisions based upon toxicity test results require that any such results be corroborated by biological information clearly demonstrating impacts to aquatic community health, composition, or productivity. In general, interpretation of toxicity test results will conform with applicable portions of the Laboratory Guidelines for Conducting Whole Effluent Toxicity Tests and the Biomonitoring Guidance Document.

4. Physical and biological assessments must be performed in accordance with scientifically sound methodologies. All such assessments should be performed by an observer who has training and experience in performing such evaluations. Assessment reports must include a statement of the observer's qualifications and should reference the protocols utilized. Any departures from referenced protocols and methodologies should be documented and the basis for any such departure addressed.

   Though currently under review and subject to future revision, a specific method has been developed for use in demonstrating attainment or non-attainment of assigned aquatic life uses due to sediment deposition. The document titled Provisional Implementation Guidance for Determining Sediment Deposition Impacts to Aquatic Life in Streams and Rivers, WQCC Policy 98-1 is available either in hard copy or electronically on the WQCC web site.

   The WQCD will accept other methodologies and protocols for physical and biological assessments based upon the WQCD's review of the methodology and protocol along with its site-specific application. The WQCD will generally accept methodologies and protocols in use by the USGS, USFS, USBLM, USEPA, CDOW, or others, when well documented, widely available and suitable for their intended purpose.

5. In general, information and data should be no older than 5 years. Older data may be used on a case-by-case basis if such data is representative of current conditions and reflects adherence to acceptable protocols, or if the older data is used with newer data to demonstrate water quality trends. Parties submitting older data they wish to be considered should include a discussion explaining why any such data continues to reflect current water quality conditions.

6. Anecdotal information, in the absence of chemical, physical, or biological data, will not in and of itself be adequate to support a non-attainment decision unless such information provides clear and convincing evidence demonstrating non-attainment. Anecdotal information considered includes, but is not limited to fishing logs, field logs, and historical or archival documents.

7. Data collected during or immediately after events that are temporarily impacting a waterbody and which are not representative of normal conditions will not be used to support a non-attainment decision (i.e. storm events which scour a stream, thereby impacting the aquatic life use, or spills resulting in fish kills, should be discounted in making the assessment).

II. DATA INTERPRETATION

The water quality assessment process considers the numeric and narrative standards assigned to a segment, as well as the assigned use classifications. Numeric standards are identified for a given pollutant and are expressed as a maximum value or as an acceptable range of values. Determination of attainment/non-attainment of pollutant specific numeric standards is a relatively straightforward statistical process.
Narrative standards describe threshold conditions, which, if exceeded, result in unacceptable water quality conditions. Narrative standards that are applied to all surface waters in Colorado address sediment, floatables, film, odor, taste, color, toxins, and excessive undesirable aquatic life. Exceedance of narrative standards is more difficult to ascertain, as there are typically no quantifiable expressions of parameter concentration or loading that result in non-attainment. It is often the impact of pollution, or of a pollutant, and not the pollutant itself, which is observed.

Use classifications identify historic or potential uses of the surface water segment. These include aquatic life, water supply, recreational and agricultural uses. Assignment of an aquatic life use classification to a segment typically results in assignment of a related suite of numeric standards. Previously, attainment of numeric standards has served as a surrogate measure indicating attainment of the assigned use classification. However, non-attainment of an assigned use classification, as with narrative standards, may result from causes or parameters other than those assigned numeric standards.

A. CHEMICAL DATA - GENERAL

The WQCD document Guidance on Data Requirements and Data Interpretation Methods Used in Stream Standards and Classification Proceedings will be used for data assessment for list development. Data considered in assessment decisions must be representative of the waterbody and account for seasonal and diel variation. When the assessment utilizes third party data, the WQCD may require submittal of a SAP, or other documentation, to assure sample results are representative for these conditions.

1. Attainment of chronic chemical standards, in both lotic (streams and rivers) and limnic (lakes and reservoirs) systems, is based upon the 85th percentile of the ranked data, except as otherwise noted below. Percentile values are calculated by ranking individual data

points in order of magnitude). Hardness based metal standards are evaluated by comparing the 85th percentile against the assigned hardness based equation using either the mean hardness at low flow or, when available, paired hardness and flow data. Total recoverable iron is evaluated against the median value, or the 50th percentile. Dissolved oxygen is evaluated at the 15th percentile. Minima pH is evaluated against the 15th percentile, maxima at the 85th.

2. Acute standards are evaluated by comparison of raw values against the standard.

3. Sample data that are below detection limits will, in general, be treated as zeroes for assessment of attainment of chronic standards.

4. Attainment of coliform standards is assessed using the geometric mean. Notwithstanding the criterion at item 3. above, coliform data which is reported as less than detect will be treated as a value of one to allow calculation of a geometric mean.

B. CHEMICAL DATA – LIMNIC SYSTEMS

1. Assessment of dissolved oxygen ("DO") will generally require that vertical profile data be developed for DO and temperature. Vertical profile data for temperature will be used to determine thermal stratification. DO criteria are applied to the epilimnion and metalimnion strata in lakes and reservoirs, unless otherwise stated in applicable control regulations. DO in the hypolimnion may, due to natural conditions, be less than specified criteria. Only one exceedance is counted where more than one DO measurement in the profile does not meet the criterion.

2. DO measurements from the entire water column (except for the bottom measurement, generally, the lowermost meter of the profile) will be used in a mixed lake or reservoir. Individual DO measurements are compared to the criterion.

3. Individual pH measurements are compared to min/max criteria

4. Individual measurements for all other chemical parameters are compared to the appropriate numeric standards. When available, volumetrically weighted measurements will be utilized.

C. BIOLOGICAL AND PHYSICAL DATA

Biological and/or physical assessment protocols may support a determination of non-attainment of numeric standards or, alternately, non-attainment of narrative standards and classified uses. The WQCD, in interpreting physical and biological information, will give site-specific consideration to the applicability of the protocols in use and available metadata gathered to validate the information generated, the extent and nature of expertise of the observer, and the relative weight of the evidence presented.

Physical and biological assessments will typically consider measurable conditions or features within an affected segment in comparison to the selected reference condition. Identification of reference conditions requires consideration of the level of disturbance (minimal), location (upstream, downstream, or within a separate drainage), historical condition, expected condition based on modeling or general expectations for highly managed systems, or other fair and reasonable comparison. Determination of reference conditions based upon sampling/assessment of multiple reference sites, when possible, is preferable but not required.

Assessment of attainment of narrative standards for bottom deposits detrimental to beneficial uses will be conducted as outlined in the Provisional Implementation Guidance for Determining Sediment Deposition Impacts to Aquatic Life in Streams and Rivers, WQCC Policy 98-1.

III. DETERMINATION OF USE SUPPORT

Sufficient information and data should be available to indicate that measurements are representative of existing conditions. Assessments based upon limited data must provide clear and convincing evidence to support a determination of non-attainment.

Application of chemical, physical and biological information in assessment determinations requires consideration of the scientific rigor of the methodologies utilized to develop any such information, and the strength of that information. The WQCD will consider the rigor and strength of chemical, physical and/or biological information. Rigor refers to the demonstrated validity of sampling, analytical, and assessment protocols and the availability of meta-data in support of those protocols. Strength refers to the quantity of data and the extent to which such data demonstrates clear and convincing evidence of attainment or non-attainment of standards.

Physical or biological data may support a finding of non-attainment when chemical data is otherwise insufficient in and of itself. Greater weight is given data that provides direct, quantifiable documentation of non-attainment as opposed to data developed using surrogate indicators or parameters. Given the absence of duly promulgated biological and physical criteria within Colorado, and the need to avoid regulatory use of criteria which has not been subject of a properly noticed administrative rulemaking proceeding, the WQCD will base a finding of non-attainment based solely upon physical or biological information only where there exists clear and convincing evidence of such non-attainment.

A. ATTAINMENT OF NUMERIC STANDARDS

Attainment of numeric chemical standards is assessed by comparison of ambient water quality against assigned standards. Assessment of chemical data considers attainment of both chronic and acute chemical standards, where both chronic and acute standards have been assigned to a given waterbody.

Values that fall outside of the percentile ranges described at **Data Interpretation - Chemical**, paragraph1, indicate non-attainment of chronic standards.

Acute standards are assessed by comparison of individual sample values against the standard. In general, data indicates non-attainment of an acute standard if the standard is exceeded more frequently than once in three years, or if more than five percent of the individual data points exceed the acute standard.

When attainment of lakes and reservoirs is assessed using vertical profile data, as for DO, each sampling event, i.e. all profiles sampled during a single day, will be treated as a single sample. If vertical profile data are not provided, the data from individual samples will be pooled. A single exceedance representing that sampling event is counted regardless of the number of individual DO or pH measurements exceeding numeric criteria.

Some lakes and reservoirs have been assigned site-specific standards for nutrients (total phosphorus), dissolved oxygen, and chlorophyll *a*. These presently include Dillon Reservoir, Cherry Creek Reservoir, Chatfield Reservoir, and Bear Creek Reservoir. Lakes and reservoirs are evaluated on an annual basis for compliance with site-specific standards. The period for application of site-specific standards usually is defined as the growing season, and is described in the statement of basis and purpose for that standard. For example, growing season data are used to determine compliance with standards for phosphorus. Any determination of site-specific standards attainme nt must be based upon application of such standards in a manner consistent with the applicable control regulation.

If evaluation of a data set for an entire segment indicates attainment, but specific location(s) within the segment consistently exceed acute or chronic standards, the specific portion of the segment may be identified as not attaining standards.

Data sets comprised of ten or fewer samples will not result in a determination of non-attainment unless there is clear and convincing evidence of non-attainment or data is supported by biological or physical evidence indicating non-attainment. Clear and convincing evidence is sufficient and credible data that clearly demonstrate that a water body's designated beneficial uses are not supported. Clear and convincing evidence is generally demonstrated when representative data (data that accounts for temporal and spatial variation) indicates an exceedance of numeric water quality standards by more than 50 percent.

When temporary modifications of numeric standards have been adopted, attainment is assessed against the underlying standard.

Data demonstrating non-attainment of numeric standards in lakes and reservoirs must typically include at least two years of sample results (12 sampling events minimum) representative of seasonal and diel variation. Non-attainment may be demonstrated with a lesser data set in instances where acute conditions result in clear and convincing evidence of non-attainment (major fish kills, etc.).

B. ATTAINMENT OF NARRATIVE STANDARDS AND CLASSIFIED USES

Attainment of narrative standards and classified uses may be supported by chemical data and/or information generated by biological and/or physical assessments. In instances where a

determination of non-attainment is based solely upon biological and/or physical assessments, such assessments must provide clear and convincing evidence of non-attainment. For aquatic life uses, the WQCD will generally consider non-attainment to be demonstrated when either the physical/habitat data or the biological community data reflects a condition that is significantly less than the reference condition. For water supply uses, the WQCD will consider chemical, physical or biological assessments which provide clear and convincing evidence of non-attainment. Exceedance of standards may be demonstrated by chemical data documenting levels of chemicals at levels toxic to humans. The WQCD will utilize Commission Policy 96-2, Human Health-Based Water Quality Criteria and Standards, in any determination of non-attainment based upon such information. Non-attainment may also be based upon biological and physical data presenting clear and convincing evidence of color, taste and odor.

In-situ bioassay, or other ambient toxicity test results which demonstrate statistically significant lethal or sub-lethal adverse effects and which are supported by biological information demonstrating adverse impacts to aquatic community health, composition, or productivity, in comparison to an appropriate reference condition will result in a decision to list. In general, interpretation of toxicity test results will conform with applicable portions of the Laboratory Guidelines for Conducting Whole Effluent Toxicity Tests and the Biomonitoring Guidance Document.

For lakes and reservoirs, non-attainment may be demonstrated where acute conditions (typically low DO levels) result in major fish kills. Fish kills associated with spills or unauthorized discharges of toxics will not support a determination of non-attainment.

Non-attainment of the narrative free from toxics standard, with respect to human health, will be documented by presence of a fish consumption advisory, when issued by the Colorado Division of Wildlife in consultation with the Department of Public Health and Environment.