PROCEDURES FOR ASSESSING WATER QUALITY STANDARDS ATTAINMENT FOR THE STATE OF NEW MEXICO CWA §303(d) /§305(b) INTEGRATED REPORT:

ASSESSMENT PROTOCOL

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

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Supplement: Response to Comments on *Pubic Comment Draft* of "PROCEDURES FOR ASSESSING WATER QUALITY STANDARDS ATTAINMENT FOR THE STATE OF NEW MEXICO CWA §303(D) /§305(B) INTEGRATED REPORT"

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1.0 Assessment Process Overview

Pursuant to Section 106(e)(1) of the Federal Clean Water Act (CWA), the Surface Water Quality Bureau (SWQB) has established appropriate monitoring methods (NMED/SWQB 2007), quality assurance/ quality control (QA/QC) procedures (NMED/SWQB 2008), and assessment methodologies (this document) in order to compile and analyze data on the quality of the surface waters of New Mexico. In accordance with the *New Mexico Water Quality Act* (NMSA 1978), the SWQB has developed and implemented a preliminary water quality monitoring strategy for surface waters of the state (NMED/SWQB 2005). The monitoring strategy establishes methods of identifying and prioritizing water quality data needs, specifies procedures for acquiring and managing water quality data, and describes how these data are used toward three basic monitoring objectives to: develop water quality-based controls, evaluate the effectiveness of such controls, and conduct water quality assessments.

From approximately 1998 to 2007, SWQB has primarily utilized a rotating basin system approach to water quality monitoring similar to several other states (WERF 2007). Using this approach, a select number of watersheds are monitored each year with an established return frequency of approximately eight years. Revisions to the schedule are necessary based on staff and monetary resources that fluctuate on an annual basis. It should also be noted that a watershed is not necessarily ignored during the years in between sampling. The rotating basin strategy is supplemented with other data collection efforts such as the funding of long-term United States Geological Survey (USGS) water quality monitoring stations for long-term trend data.

SWQB maintains current quality assurance and quality control plans that cover all monitoring activities. This document called the *Quality Assurance Project Plan* (QAPP) is updated and approved annually by United States Environmental Protection Agency (USEPA) Region 6 (NMED/SWQB 2008). When an intensive survey is completed, all data are checked against QA/QC measures identified in the QAPP and assessed to determine whether or not designated uses detailed in the current *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMWQCC 2007) are being met. In New Mexico, surface water data are assessed according to this document -- *Procedures of Assessing Standards Attainment for the State of New Mexico CWA §303(d) /§305(b) Integrated Report* (otherwise known as the "assessment protocol"). The results are then made available to the public through the *State of New Mexico CWA §303(d) /§305(b) Integrated Report* (otherwise known as the "Integrated Report"). The Integrated List which details individual water bodies can be found in Appendix B of the Integrated Report. The purpose of this assessment protocol document is to detail the process that the SWQB employs to determine whether or not designated uses are being attained in surface waters of the state. Therefore, these protocols cover the decision making process for both listing and de-listing.

USEPA does not officially approve individual state's assessment protocols, but USEPA does provide review and comment on the protocols and consults the protocols when reviewing the state's draft Integrated List. The assessment protocol is periodically updated and is generally based on current USEPA assessment guidance (USEPA 2005, 2006). For development of the 2010 Integrated Report and List, USEPA recommends that states follow the 2006 Integrated Report guidance (USEPA 2005) which is supplemented by memoranda regarding development of the 2008 Integrated List and Report (USEPA 2006a) and the 2010 Integrated List and Report (USEPA 2009).

Similar to other states, summary assessment data are housed in the USEPA-developed Assessment Database version 2.1.4 (ADB v.2.1.4) by "assessment unit" (WERF 2007). USEPA first suggested the use of this term in their 2002 listing guidance (USEPA 2001, RTI 2002). This term is also utilized in ADB. USEPA listing guidance documents recommend that states organize their respective lists by assessment units and house the information in ADB (USEPA 2001, 2003, 2005, 2006). Assessment units (AUs) can represent a single lake or reservoir, or miles of a stream reach or river. AUs are

generally defined by various factors such as hydrologic or watershed boundaries, water quality standards (WQS), geology, topography, incoming tributaries, surrounding land use/land management, etc. Assessment units are designed to represent waters with assumed homogenous water quality (WERF 2007). With respect to 40 CFR 130.2, New Mexico's use of the term "assessment unit" is equivalent to "water quality-limited segment." New Mexico specifically defines the term "segment" within the state water quality standards at 20.6.4.7.ZZ NMAC. In New Mexico, there are generally many assessment units within a water quality standard segment (20.6.4.97 through 20.6.4.899 NMAC).

Use attainment decisions are then summarized by assessment unit in the *State of New Mexico CWA §303(d)/ §305(b) Integrated Report*. This report is prepared every even numbered calendar year as required by the CWA. Category 5 AUs on this Integrated List (see Section 4.0 for category definitions) constitute the *CWA §303(d) List of Impaired Waters*. The Integrated List portion of the Integrated Report is opened for a minimum 30-day public comment period. Response to Comments are prepared by SWQB and submitted to USEPA Region 6 for review. SWQB also updates and submits the Record of Decision (ROD) document. The ROD is an additional, non-required document that SWQB provides to USEPA and the public which explains why and when a particular assessment unit was added to and, if applicable, why and when it was removed from Category 5 of the Integrated List. An outline of the basic assessment process that SWQB Project Leaders and the Assessment Coordinator follow when performing assessments is contained in Appendix B. All the above-mentioned documents developed and maintained by the SWQB are available on the SWQB web page: http://www.nmenv.state.nm.us/SWQB.

Assessment of data forms the basis of designated use attainment decisions. These assessments are based on data that reasonably reflect current surface water quality conditions. These data are compared to current USEPA-approved WQS for the state of New Mexico (20.6.4 NMAC) regardless of what WQS were in effect at the actual time of sampling. Data types may include chemical/physical, biological, habitat, bacteriological, or toxicological data.

The bulk of the data used for assessments are data collected by SWQB during intensive, rotational water quality surveys. SWQB will also utilize data collected by other entities (partially listed below), provided the entity's sampling methods and data analysis procedures meet QA/QC requirements as detailed in the most recent QAPP (NMED/SWQB 2008). In general, all readily available data that were not assessed for a previous listing cycle will first be collated and assessed. Assessment conclusions will be compared to the conclusions of the previous list. If they have not changed for a given water quality parameter within particular AU, the conclusions of the current assessment will carry over to the current list. If the current assessment indicates a change in attainment status, the current data for that particular water quality parameter at that site will be combined with the most recent five years of data (WERF 2007). The specific years of data to use are defined from the date data were collated for the upcoming listing cycle, typically June 1 of the year before the list is due. For example, data from June 1, 2004, through June 1, 2009, would be collated for development of the draft 2010 Integrated List. This collated data set will form the basis of final impairment decision.

The CWA requires water quality standards protect designated uses during critical conditions such as years with below average stream flow. This distinction is important because it would not meet the intent of the CWA to use data collected in non-drought conditions to draw a conclusion of no impairment when available data collected during low flow conditions indicates impairment. Recent data may take precedence over older data if new data indicate a change to water quality or the older data fail to meet data quality requirements. If several consecutive years of data are available and the most recent data are less than applicable numeric water quality criteria, SWQB may also consider data trends when

determining impairment if the data indicate a clear pattern of recovery after a temporary disturbance. This is consistent with recommendations in USEPA guidance (USEPA 2005).

Outside sources of available data are solicited via public notice of a minimum 30-day period before the draft Integrated List of surface waters is prepared. To be considered for development of the Integrated List, data must, at a minimum, meet the QA/QC requirements described in the SWQB's most recent QAPP. Analytical methods used must meet the requirements specified in the analytical methods section of the QAPP (NMED/SWQB 2008) and the methods of data collection must be the same as, or comparable to, those included in the State's Standard Operating Procedures (SOPs) (NMED/SWQB 2007) referenced in the current QAPP. Additionally, the QC criteria used to verify and validate the data must be the same, or similar, to those listed in the SWQB Field Quality Control Sampling Summary and the SWQB Data Verification and Validation Procedures detailed in the QAPP.

Quality data received through this solicitation may be used to confirm a listing of impairment, confirm the absence of impairment, or initiate a new listing of impairment of a particular AU. Data that do not meet these requirements may be used for screening purposes to determine if additional data collection is warranted. Non-chemical/physical water quality related data (e.g., habitat conditions, field observations, macroinvertebrate, and fish communities) are also solicited and may be useful for characterizing water quality conditions and for water quality standards development and refinement. Data packages submitted after the solicitation period and/or related to other watersheds in the state may be considered during development of subsequent Integrated Lists.

Quality data sources could include, but are not limited, to the following. These data would need to meet QA/QC requirements to be used for assessment as stated above.

- NMED SWQB chemical/physical, biological, habitat, bacteriological, or toxicological data collected during intensive watershed surveys using approved or otherwise accepted quantitative methods;
- Chemical/physical data from recent studies by NMED or other organizations, contractors, tribes, or individuals;
- USGS water quality data (provisional data shall not be used to make designated use support determinations);
- Benthic macroinvertebrate, fish community, and/or fish tissue data collected by NMED or other organizations, contractors, tribes, or individuals;
- EPA-recognized protocols such as Environmental Monitoring and Assessment Program (EMAP), Rapid Bioassessment Protocols (RBP), or other biological/habitat data collected by NMED and other organizations, contractors, tribes, or individuals;
- In-stream (i.e., receiving water) data collected during NMED effluent monitoring efforts;
- NPDES storm water permit compliance monitoring data for receiving waters;
- In-stream water quality data from other NMED bureaus such as the Drinking Water, Ground Water, and/or the Department of Energy (DOE) Oversight bureaus;
- Citizen or volunteer data.

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2.0 DATA USABILITY AND QUALITY DETERMINATIONS

2.1 Data Management Rules

2.1.1 Data qualifiers and validation codes

SWQB has developed an in-house water quality database to house water, sediment, and fish tissue chemical data. These data are available upon request. This database also contains lab data qualifiers and internal validation codes that are added during the data validation process (NMED/SWQB 2008). Chemical/physical data collected by SWQB are eventually uploaded to the national STORET database, which is to be replaced by USEPA's WQX database in September of 2009. The current version of STORET does not have a standard lab remark code field. Per suggestion of the STORET user's group, SWQB has put user-defined information on data qualifiers and internal validation codes into STORET/WQX field entitled "Results Comments." Any data with a qualifier code or data validation code that are used in an assessment should be noted on the respective Assessment Form (see Appendix B for forms). Refer to the current version of the QAPP for the current definition of all data qualifier and data validation codes (NMED/SWQB 2008).

- Lab Qualifier Codes – In the past, sets of qualifier codes have varied between the individual sections at State Laboratory Division (SLD). SWQB has encouraged SLD to determine a unified set of codes that will be reported consistently by all SLD sections. Standard lab qualifier codes for SLD and contract labs, as well as SWQB data validation codes are defined in the most recent QAPP. All data flagged as "rejected" during internal laboratory QA procedures will not be used for assessment purposes. Other flagged results are usable provided the appropriate caveats are documented in the assessment files and uncertainties in the data are discussed.

  Concentrations detected at a level below which an accurate quantification can be given are typically flagged with a "J" qualifier that indicates the reported concentration is an estimated concentration. The concentration is reported as estimated because the concentration being detected is below the lowest concentration on the calibration curve. There is certainty as to the identification of the chemical but uncertainty as to the reported concentration. These reported values may be used in an assessment when the detection limit is greater than the applicable water quality criterion (WQC) because the concentration is known to be greater than the WQC even though it is an estimate. An example would be a parameter with an applicable WQC of 0.5 mg/L, with a detection limit of 1.0 mg/L and quantitation limit of 3.0 mg/L. If the result were 2.0 mg/L with a "J" flag, this data would be used for assessment because although it's an estimate, it is known to be greater than the WQC of 0.5 mg/L because the detection limit is 1.0 mg/L. For calculating total PCB concentration using USEPA Method 1668A or 1668B congener methods, "J" flagged values for individual congeners are to be included in the sum which is used for assessment.

  Results from samples that are flagged by the laboratory as "exceeded holding time" will be considered estimates and may be used during the assessment process unless the result is deemed "rejected" based on best professional judgment in consultation with the QAPP and SOPs (NMED/SWQB 2007, 2008). Method holding times are different for each sample parameter. Sample analysis after the allowable holding time for a sample or sample set may be a result of laboratory oversight, delayed sample shipment, need for reanalysis, or poor planning. The data validator will take into account the nature of the analysis, the extent of the noncompliance (for example, considering the method holding time limit, whether the holding time was exceeded for one day vs. one month, and stability of the parameter in question), the sample matrix, any supporting data, and the purpose and goals of the sampling and analysis program (USEPA 2002d). From USEPA's perspective, the time and expense associated with the sample collection and processing is forfeited when data exceeding the holding time are rejected even though the analytical results may in fact be accurate and usable (USEPA 2002e). Therefore, data exceeding holding time may be considered for use in assessments.

- SWQB Data Validation Codes (internal) – SWQB validates all data for a particular intensive water quality survey. Internal data validation procedures are detailed in the most recent QAPP. All data with internal SWQB validation codes will still be used for assessment purposes except data flagged as "rejected" (typically R, R1, R2, R3, or R4 data validation codes).

2.1.2 Duplicates and compliance monitoring sampling data

There may be cases where there are multiple data values on the same day at the same station within a one hour period. For the purposes of assessment, these are considered duplicate samples. Compliance monitoring of human health criteria requires that three samples be consecutively collected (separated by at least 15 minutes) during the same sampling event at the same location (NMED/SWQB 2003 Work Element 10). Results that indicate two or three exceedences of data taken in this manner will be counted as one exceedence of the criterion for use attainability determinations. The maximum value shall be counted as the one exceedence.

Another example would be when QA/QC duplicates are taken within a one hour time frame. These data are considered replicates for the purpose of assessment and the maximum value should be used for assessment purposes to be conservative.

2.1.3 Continuous recording equipment (thermographs and sondes)

Prior to 1998, water temperature was measured once during each site visit and designated use support status related to temperature criteria was determined by applying a percent-of-exceedences formula to these instantaneous temperature data. Periodic instantaneous temperature data do not provide information on maximum daily temperatures, duration of excessive temperatures, or diurnal fluctuations of water temperature. These aspects of temperature are pertinent to aquatic life use. Continuously recording temperature data loggers (i.e., thermographs) are now readily available and provide an extensive multiple-day record of hourly temperatures over the critical time period when temperatures are generally highest.

The SWQB has been deploying thermographs in streams and applying the temperature assessment protocol since the 2000-2002 CWA §303(d) listing cycle (see Appendix C). SWQB initially developed a temperature assessment protocol that only addressed assessment of thermograph data from streams with high quality coldwater aquatic life (HQCWAL) or coldwater aquatic life (CWAL) designated uses. This approach is more technically sound than simply applying percentages to limited instantaneous temperature data and incorporates magnitude, frequency and duration of exposure into water quality monitoring and assessment. The use of thermographs eliminates the biases introduced when using instantaneous data to assess water quality parameters with significant diurnal fluctuation. For the 2010 listing cycle, this temperature protocol was expanded to cover all temperature assessment scenarios, including procedures for both grab and thermograph data for all types of aquatic life uses in either lotic (e.g., streams or rivers) or lentic (e.g., lake or reservoir) water bodies.

Based on the success of the thermograph-based assessment protocol, the SWQB developed additional large data set protocols to address other parameters with known diurnal fluxes, such as pH and dissolved oxygen (see Appendices F and G). These protocols are used to assess pH and dissolved oxygen data when large data sets are available through the use of multi-parameter, continuously recording devices (i.e., sondes). SWQB typically deploys sondes for seven days set to record hourly dissolved oxygen, pH, specific conductance, temperature, and turbidity values. If sonde pH or dissolved oxygen data are not available, the methods detailed in Table 3.4 in section 3.1.2 below are applied for assessment.

2.1.4 Limited data sets

A minimum of two data points for field and chemical parameters is necessary to apply the procedures in Section 3.0 in order to determine attainment status for an associated designated use in a particular AU. If data from only one sampling event are available (n=1) to assess an applicable designated use, there are insufficient data to determine attainment status for that particular designated use. The use will be noted as will be noted as "Not Assessed" on the list as well as noted in the associated AU Comments field. If there are data from more than one sampling event available (n>1) with one exceedence, the attainment status will be noted as "Full Support" according to the procedures in Section 3.0. The exceedence will be noted in the AU Comments field and additional data will be collected as resources allow to determine impairment status. The exception is the assessment of Domestic Water Supply which only requires one exceedence and therefore one data point to list as impaired (see Section 3.2).

Through the current rotating watershed survey strategy, SWQB strives for a minimum of four to eight chemical data points for core parameters such as metals and nutrients to make designated use determinations. SWQB also uses thermographs and multi-parameter sondes to generate large data sets for temperature, pH, dissolved oxygen, specific conductance, and turbidity. USEPA does not recommend the use of rigid, across the board, minimum sample size requirements in the assessment process (USEPA 2009). Target sample sizes should not be applied in an assessment methodology as absolute exclusionary rules (USEPA 2003, 2005). The use of limited data sets is acceptable to USEPA as limited financial, field, and laboratory resources often dictate the number of samples that can be collected and analyzed (USEPA 2002a).

2.1.5 Application of WQS during low flow conditions

Data collected during all flow conditions (except data collected during unstable conditions when assessing for chronic aquatic life use -- see section 3.1.2.1 below for additional details), including low flow conditions (i.e., flows below the 4Q3), will be used to determine designated use attainment status during the assessment process. 4Q3 values are to be utilized as minimum dilution assumptions for developing discharge permit effluent limitations. In terms of assessing designated use attainment in ambient surface waters, WQS apply at all times under all flow conditions, unless a flow qualifier is specified in a particular section of the WQS.

2.1.6 Multiple stations in one assessment unit

As stated in Section 1.0 above, assessment units (AUs) are designed to represent waters with assumed homogenous water quality (WERF 2007). Section 1.0 also describes the relationship between AUs and "segments" as defined in 20.6.4.7.ZZ NMAC. SWQB typically does not have the resources to establish more than one monitoring station in any particular perennial AU during rotational watershed surveys, but there are occasions where more than one station with available data (typically chemical/physical data) is either established by SWQB or some other data collection agency.

When this occurs, the assessor will first assess data from each station individually to determine impairment(s). Assessment units with homogenous landscape features are likely to have homogenous water quality. However, multiple stations within an AU may indicate otherwise due to point source discharges and/or lack of adequate, or no, best management practices (BMPs) that address non-point source pollution. If conflicts arise and the attainment conclusions for every station in the AU are not in agreement (i.e., either all Full Support or all Non Support), the AU as currently defined may not represent homogeneous water quality. In this case, the AU breaks should be examined and may be split appropriately, including special consideration of NPDES point source discharges or non-point source BMPs. The data will then be re-assessed based on the newly-defined AUs.

In the rare event that there are two or more stations less than 200 yards apart and data for the same parameter are collected within a one hour time frame from these stations, these data are considered replicates for the purpose of assessment and the maximum value should be used for assessment purposes.

2.1.7 Blank-correction for constituents measured using ultra-low level procedures

When a constituent concentration is determined using an ultra-low level method which recommends blank-correction (such as USEPA Method 1668A or 1668B for analysis of PCBs), the result will first be blank-corrected using the procedures in the method assuming adequate data are available to perform the recommended procedure. This blank-corrected value will then be compared against New Mexico's WQS to determine impairment.

2.1.8 "Non detects" from a method with a detection limit greater than the criterion

If the detection limit is above the applicable criterion and the laboratory result is reported as below this limit, the result cannot be used for a listing decision (for example, when the detection limit is 8.0 mg/L, the result is reported as <8.0 mg/L, and the criterion is 5 mg/L). In this situation, this datum contains no information about the magnitude relative to the applicable water quality criterion.

2.2 Data Quality Levels

2.2.1 Aquatic life use data types

As stated in Section 1.0 above, data must, at a minimum, meet the QA/QC requirements described in the SWQB's most recent QAPP to be considered for development of the Integrated Report (NMED/SWQB 2008). In some cases, more than one type of data can be used to determine aquatic life use attainment. It is recognized that not all data are of equal quality or rigor. The following tables describe defined levels of data quality for each type of data recognized in making aquatic life support determinations. These tables contain both elements of data quality as well as quantity. These tables are adapted from the *Consolidated Assessment and Listing Methodology: Towards a Compendium of Best Practices* guidance document (USEPA 2002a). Tables for determining the level of data quality for biological, habitat, chemical/physical, and toxicological data types are presented. It is important to evaluate data quality when an assessment performed with more than one data type results in conflicting use attainment decisions (see Section 3.1.5 for more detail). These tables are included only for aquatic life use determinations because it is the only use for which multiple data types are currently recognized and utilized.

Tables 2.1 through 2.4 classify the data level or rigor of a data type by its technical components and describe the level of effort (spatial or temporal coverage) necessary to achieve each level as defined by USEPA with minor modifications specific to New Mexico (USEPA 2002a). Although the table structures imply that data at Level 2 (Fair) level of information, for example, would have the technical components, spatial/temporal coverage, and data quality listed for that data level, it is possible to have different levels of information for each of the three components. Level 4 represents data of the highest rigor and the highest level of quality while Level 1 represents the lowest level of quality.

Table 2.1 Hierarchy of bioassessment approaches for evaluation of aquatic life use attainment

LEVEL OF INFO	TECHNICAL COMPONENTS	SPATIAL/TEMPORAL COVERAGE	DATA QUALITY
1 LOW	Visual observation of biota; reference conditions not used; simple documentation	Limited monitoring; extrapolation from other sites	Unknown or low precision and sensitivity; professional biologist not required.
2 FAIR	One assemblage (usually invertebrates); reference conditions pre-established by professional biologist; biotic index or narrative evaluation of historical records	Limited to a single sampling; limited sampling for site-specific studies; identifications to family level	Low to moderate precision and sensitivity; professional biologist may provide oversight
3 GOOD	Single assemblage usually the norm; reference conditions may be site specific, or composite of sites; biotic index (interpretation may be supplemented by narrative evaluation of historical records)	Monitoring of targeted sites during a single season*; may be limited sampling for site-specific studies; may include limited spatial coverage for watershed-level assessments; identifications to genus and species level	Moderate precision and sensitivity; professional biologist performs survey or provides training for sampling; professional biologist performs assessment
4 EXLNT	Generally two assemblages, but may be one if high data quality; regional (usually based on index sites) reference conditions used; biotic index (single dimension or multi metric index)	Monitoring during 2 sampling seasons*; broad coverage of sites for either site-specific or watershed assessments; identifications to genus and species level; conducive to regional assessments using targeted or probabilistic design	High precision and sensitivity; professional biologist performs survey and assessment

NOTES: *Seasons are defined as October – December, January – March, April – June, and July – September.

Table 2.2 Hierarchy of habitat assessment approaches for evaluation of aquatic life use attainment

LEVEL OF INFO	TECHNICAL COMPONENTS	SPATIAL/TEMPORAL COVERAGE	DATA QUALITY
1 LOW	Visual observation of habitat characteristics; no true assessment; documentation of readily discernable land use characteristics that might alter habitat quality; no reference conditions	Sporadic visits; sites are mostly from road crossings or other easy access	Unknown or low precision and sensitivity; professional scientist not required.
2 FAIR	Visual observation of habitat characteristics and simple assessment; use of land use maps for characterizing watershed condition; reference conditions pre-established by professional scientist	Limited to annual visits non-specific to season; generally easy access; limited spatial coverage and/or site-specific studies	Low precision and sensitivity; professional scientist not involved, or only by correspondence
3 GOOD	Visual-based habitat assessment using SOPs; may be supplemented with quantitative measurements of selected parameters; conducted with bioassessment; data on land use may be compiled and used to supplement assessment	Assessment during single season usually the norm; spatial coverage may be limited sampling or broad and commensurate with biological sampling; assessment may be regional or site-specific	Moderate precision and sensitivity; professional scientist performs survey or provides oversight and training
4 EXLNT	Assessment of habitat based on quantitative measurements of in-stream parameters, channel morphology, and floodplain characteristics; conducted with bioassessment; data on land use compiled and used to supplement assessment; reference condition used as a basis for assessment	Assessment during 1-2 seasons; spatial coverage broad and commensurate with biological sampling; assessment may be regional or site-specific	High precision and sensitivity; professional scientist performs survey and assessment

Table 2.3 Hierarchy of chemical/physical data levels for evaluation of use attainment

LEVEL OF INFO	TECHNICAL COMPONENTS	SPATIAL/TEMPORAL COVERAGE	DATA QUALITY
1 LOW	Any one of the following: • Water quality monitoring using grab sampling • Water data extrapolated from up stream or downstream station where homogeneous conditions are expected • BPJ based on land use data, location of sources	Low spatial and temporal coverage: • Quarterly or less frequent sampling with limited period of record (e.g., 1 day) • Limited data during key periods or at high or low flow (critical hydrological regimes) • Data are >5 years old and likely not reflective of current conditions	Approved QA/QC protocols are not followed or QA/QC results are inadequate Methods not documented Inadequate metadata
2 FAIR	Any one of the following: • Water quality monitoring using grab sampling • Rotating basin surveys involving single visits • Synthesis of existing or historical information on fish tissue contamination levels • Screening models based on loadings data (not calibrated or verified) • Verified volunteer data	Moderate spatial and temporal coverage: • Bimonthly or quarterly sampling at fixed stations • Sampling during a key period (e.g. fish spawning seasons, high and/or low flow) • Stream basin coverage, multiple sites in a basin	Low precision and sensitivity QA/QC protocols followed, QA/QC results adequate Approved SOPs used for field and lab; limited training Adequate metadata
3 GOOD	Any one of the following: • Water quality monitoring using grab sampling • Rotating basin surveys involving multiple visits or automatic sampling • Calibrated models (calibration data <5 years old) • Limited use of continuous monitoring instrumentation	Broad spatial and temporal coverage of site with sufficient frequency and coverage to capture acute events: • Monthly sampling during key periods (e.g. critical hydrological regimes and fish spawning seasons), multiple samples at high and low flows • Period of sampling adequate to monitor for chronic concerns* • Lengthy period of record for fixed station sites (sampling over a period of months)	Moderate precision and sensitivity QA/QC protocols followed, QA/QC results adequate Approved SOPs used for field and lab Adequate metadata
4 EXLNT	All of the following: • Water quality monitoring using composite samples, series of grab samples, and continuous monitoring devices • Follow-up sediment quality sampling or fish tissue analyses at sites with high probability of contamination	Broad spatial coverage (several sites) and temporal (long-term, e.g. 5-years) coverage of fixed sites with sufficient frequency and coverage to capture acute events, chronic conditions, and all other potential chemical/physical impacts: • Monthly sampling during key periods (e.g., spawning, critical hydrological regimes) including multiple samples at high and low flows • Continuous monitoring (e.g. use of thermographs, sondes, or similar devices)	High precision and sensitivity QA/QC protocols followed, QA/QC results adequate Approved SOPs used for field and lab; samplers well trained Adequate metadata

NOTES: *See section 3.1.2.1 for additional information.

Table 2.4 Hierarchy of toxicological approaches and levels for evaluation of aquatic life use attainment

LEVEL OF INFO	TECHNICAL COMPONENTS	SPATIAL/TEMPORAL COVERAGE	DATA QUALITY
1 LOW	Any one of the following: • Acute or chronic WET for effluent dominated channel • Acute ambient water	One (1) ambient water sample tested in an assessment unit or site	Unknown/Low; minimal replication used; laboratory quality or expertise unknown
2 FAIR	Any one of the following: • Acute and chronic WET for effluent dominated channel	Two (2) ambient water samples tested in an assessment unit or site on 2 different dates	Low/moderate; little replication used within a site; laboratory quality or expertise unknown or low
3 GOOD	Any one of the following: • Acute and chronic WET for effluent dominated system • Acute or chronic ambient water	Three (3) ambient water samples tested in an assessment unit or site on 3 different dates	Moderate/high; replication used; trained personnel and good laboratory quality
4 EXLNT	Both of the following: • Acute and chronic ambient water	Four or more (≥ 4) tests in total based on samples collected in a assessment unit or site on 4 different dates	High; replication used; trained personnel and good lab quality

2.2.2 Contact use data type

Pathogen data are needed to determine use support for Primary Contact and Secondary Contact designated uses. Pathogen data typically consists of fecal coliform and/or E. coli data. The Consolidated Assessment and Listing Methodology (CALM) guidance does not contain any examples of data quality criteria to discern low to excellent data quality for parameters related to contact use (USEPA 2002a). Currently, the only data type used to make contact use attainment decisions in New Mexico is pathogen data because there are no contact use water quality standards for non-pathogen data. Therefore, there cannot be conflicting contact use attainment conclusions from various types of data as there can be in aquatic life use attainment decisions, therefore, this protocol does not need to include criteria to evaluate pathogen data quality.

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3.0 INDIVIDUAL DESIGNATED USE SUPPORT DETERMINATIONS

Water Quality Standards (WQS) are a triad of elements that work in concert to provide water quality protection. These three elements are: designated uses, numeric and narrative criteria, and an antidegradation policy. Designated uses are the defined uses of a particular surface water body. Each water body will have one or more designated uses. For example, Domestic Water Supply is a designated use. Designated use definitions and their assignment to various stream segments in New Mexico can be found in the *Standards for Interstate and Intrastate Surface Waters* published in the New Mexico Administrative Code (NMAC) at 20.6.4 NMAC (NMWQCC 2007). The New Mexico Water Quality Control Commission (NMWQCC) adopted numeric and narrative criteria to protect these designated uses. There are both segment-specific criteria (detailed in 20.6.4.97 through 20.6.4.899 NMAC) and designated use-specific criteria (detailed in 20.6.4.900 NMAC) in New Mexico's WQS. All references to narrative or numeric criteria throughout this document refer to criteria found in 20.6.4 NMAC. The antidegradation policy ensures that existing uses[1] and levels of water quality necessary to protect these uses will be maintained and protected (20.6.4.8 NMAC).

WQS segments defined in 20.6.4 NMAC are further divided into assessment units (AUs) for use impairment determination and linked to the National Hydrographic Dataset (NHD) for national electronic reporting requirements. AUs are stream reaches, lakes, or reservoirs defined by various factors such as hydrologic or watershed boundaries, WQS, geology, topography, incoming tributaries, surrounding land use/land management, etc. Assessment units are designed to represent waters with assumed homogenous water quality (WERF 2007). As stated in Section 1.0, data collected at representative stations during SWQB water quality surveys along with acceptable external data form the basis of use support determinations for each AU. Stream or river AUs are typically no more than 25 miles in length, unless there are no tributaries or land use changes to consider along the reach. Multiple stations in one AU warrant special consideration as detailed in Section 2.1.6 above.

The following subsections provide guidelines used to interpret available data. These guidelines will be used to make determinations of use support for each designated use in each AU, utilizing the previously described datasets. Some level of flexibility is built into these guidelines to account for uncertainties such as the natural variability of water quality, the lack of extensive data necessary to make more definitive assessments, and the transitory nature of many pollutants. Each designated use has one or more tables with specific requirements for determining use attainment based on the type of data being evaluated. When determining aquatic life use support, each type of data is first evaluated separately. Guidance on how to reconcile two or more data types with differing aquatic life use attainment determinations is found in Section 3.1.4. In addition to the following subsections, several specific assessment protocols for temperature, sedimentation/siltation (also referred to as "stream bottom deposits") in perennial wadeable streams, excessive nutrients in perennial wadeable streams, dissolved oxygen, and pH have been developed. These protocols are included in appendices C through G.

In previous New Mexico §305(b) reports and §303(d) lists, five designated use determinations were possible according to earlier versions of the SWQB assessment protocol: Full Support, Full Support Impacts Observed, Partial Support, Not Supported, or Not Assessed. These determinations were modified from recommendations in the §305(b) report guidance (USEPA 1997). Guidance from USEPA recommends the following use attainment categories (USEPA 2001, USEPA 2002a, USEPA 2003, USEPA 2005): **Fully Supporting, Not Supporting, Insufficient Information, and Not Assessed.** For every AU detailed in the Integrated List, one of these four categories is assigned to every

[1] "Existing use" (defined at 20.6.4.7(Y) NMAC) means "a use actually attained in a surface water of the state on or after November 28, 1975, whether or not it is a designated use." An existing use may be identified by SWQB staff or other sources based on observation, data, and/or documentation.

designated use as stated in the applicable section of 20.6.4 NMAC, or identified existing use.

A determination of Fully Supporting or Not Supporting should not be made in the absence of data. It is understood that any assessment may involve some level of best professional judgment (BPJ). However, evaluations based on BPJ, literature statements, or public comments without data to support the decision shall not be the only basis for a listing or de-listing. To those AUs for which there are no available data that meet the QA/QC requirements for any criteria within an applicable designated or existing use, a designation of Not Assessed will be assigned that use.

3.1 Assessing Aquatic Life Use Support

Use assessment decisions should consider and integrate, whenever possible and appropriate, results of various data types. These include biological, chemical/physical, and toxicological data. Data quality associated with these types can be found in Section 2.2.1.

3.1.1 Biological data

Currently, benthic macroinvertebrate sampling is the primary form of biomonitoring utilized by New Mexico. SWQB also monitors fish assemblages and algae in an increasing number of streams. Two biological assessment approaches are used in NM at this time for determining aquatic life use attainment, the reference condition approach and the reference site approach. Both approaches are based on the concept of comparing actual condition of a specific waterbody to a reference condition, if developed, or a reference site, if available. Currently NM has only developed a reference condition for wadeable, perennial streams in the Mountain ecoregions. Wadeable, perennial streams located outside of the Mountain ecoregions are assessed using the reference site approach from the Rapid Bioassessment Protocol approach (RBP) (Plafkin et al, 1989) described in more detail below. SWQB does not apply this method to large non-wadeable rivers, lakes and reservoirs, or non-perennial streams at this time.

When the Rapid Bioassessment Protocol (RBP) method was first introduced, the concept of reference condition was typically limited to pristine streams (Plafkin et al. 1989). This concept was updated to acknowledge the reality of a wider range of aquatic conditions that reflect more than minimal impacts, including historic and dominant land and water use activities (Barbour et al. 1999, Stoddard et al. 2006). This broader concept of reference condition allows for the definition of reasonable and attainable targets or goals to assess potential impairment to the aquatic community. SWQB is exploring the development of a Human Disturbance Gradient through GIS and by on-site verification through the use of the Site Condition Class Verification and Probable Source Field sheet to better determine reference conditions following methods modified from Drake (2004). SWQB is refining current biological and habitat monitoring and assessment protocols and incorporating new data for analyses. These new analyses will aid us in determining appropriate numeric thresholds which may eventually be proposed as numeric biological criteria.

SWQB has been collecting benthic macroinvertebrate data since 1979. The formal process of developing biological criteria began in 2002 with assistance from USEPA Region 6 and Tetra Tech, Inc., Ecological Services Division. As of 2006, New Mexico, in collaboration with Drs. Jacobi and Tetra Tech, has developed a regional Mountain Stream Condition Index (M-SCI) to determine Aquatic Life Use attainment for the Mountain biological region which consists of Ecoregions 21 and 23 (Southern Rockies and AZ/NM Mountains) (Jacobi et al. 2006, Griffith et al. 2006). This approach is similar to the approach currently utilized in Wyoming and Colorado.

The M-SCI was developed based on reference condition as determined by a number of reference sites. The Jacobi et al. (2006) report describes indices for three classes (bioregions) of streams based on

elevation and watershed size. However, SWQB uses only the High Small Index applied to the Mountain biological region which consists of Ecoregions 21 and 23 (Southern Rockies and AZ/NM Mountains). The available dataset, stream classification system, and reference site selection process did not sufficiently partition the variability and select an adequate number of sites to define the "reference condition" and a departure from this condition for the Low Large and Low Small bioregions. Application of the High Small (elevation and watershed, respectively) SCI in the Jacobi report places study reaches in the same condition category for all tested streams in the Mountain region regardless of elevation or watershed size. Therefore, SWQB applies the M-SCI (i.e., the "High Small SCI" in the Jacobi et al. (2006) report to determine Aquatic Life Use attainment of all wadeable perennial streams in the Mountain region and refers to this as the mountain stream condition index (M-SCI). Any study site within approximately 20 kilometers of the boundary of ecoregions 21 and 23 should be compared to the definitions for the various ecoregions to determine the proper ecoregion designation for that site.

The M-SCI is composed of metrics from five categories representing community and species attributes including Taxonomic Composition, Taxonomic Richness, Tolerance, Habit, and Functional Feeding Group. Individual metrics are listed in Table 3.1.

Table 3.1 Metrics included in the M-SCI

TAXONOMIC COMPOSITION	TAXONOMIC RICHNESS	TOLERANCE	HABIT	FUNCTIONAL FEEDING GROUP
Shannon Diversity (log_2)	Ephemeroptera Taxa	% Sensitive EPT	Clinger Taxa	% Scraper
Pielou's Evenness	Plecoptera Taxa	% Intolerant	Sprawler Taxa	Scraper Taxa
% Plecoptera			Swimmer Taxa	

M-SCI scores are normalized according to the formulas in Table 3.2 utilizing the 95th percentiles associated with each metric. Each metric is first calculated and normalized. All metrics are then summed and averaged to produce an M-SCI score between 0 and 100. The resulting score is then placed in a condition category of Very Good (100 – 78.35), Good (78.35 – 56.70), Fair (56.70 – 37.20), Poor (37.20 – 18.90), Very Poor (18.90 – 0) based on the distribution of reference site scores. Sites with M-SCI ranking of fair, poor or very poor are considered to not supporting of an aquatic life use.

Table 3.2 Metric formulas and 95th percentiles for calculating the M-SCI score

METRIC	95th PERCENTILE	FORMULA
Shannon Diversity (log_2)	3.89	if $X > X_{95}$, score = 100 if $X \leq X_{95}$, score = $100 \times X/X_{95}$
Pielou's Evenness	0.50	
% Plecoptera	26.67	
Ephemeroptera Taxa	7.00	
Plecoptera Taxa	7.00	
% Sensitive EPT	78.46	
% Intolerant	57.17	
Clinger Taxa	17.00	
Sprawler Taxa	6.00	
Swimmer Taxa	4.00	
% Scraper	43.78	
Scraper Taxa	4.00	

NOTES: X = metric value; X_{95} = 95th percentile of respective metric

Table 3.3 explains how to interpret macroinvertebrate data to assess aquatic life use support. Biological regions outside of the Mountains region will be assessed using the RBP approach as detailed in Plafkin et al. (1989) until SCIs can be developed for the Xeric and Plains regions. New Mexico plans to add data from Ecoregions 22, 24, 25, and 26 to develop these additional regional SCIs as data and resources become available. Based on the results of the initial report (Jacobi et al. 2006), these ecoregions may be combined such that New Mexico will consist of three biological regions, Mountains, Plains, and Xeric.

This approach is similar to SCI development for Wyoming and Colorado and generally follows the Level II ecoregions (Commission for Environmental Cooperation. 1997, 2006).

Table 3.3 Interpreting macroinvertebrate data to determine Aquatic Life Use Support in wadeable, perennial streams

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
Macroinvertebrate assemblages in Ecoregions 22, 24, 25, and 26; large non-wadeable or non-perennial waterbodies using RBP Index	Reliable data indicate functioning, sustainable macroinvertebrate assemblages not modified significantly beyond the natural range of reference condition (>83% of reference site(s)).*	Reliable data indicate macroinvertebrate assemblage with moderate to severe impairment when compared to reference condition (≤79% of reference site(s)). *	Reference condition is defined as the best situation to be expected within an ecoregion. Reference sites have balanced trophic structure and optimum community structure (composition & dominance) for stream size and habitat quality.
Macroinvertebrate assemblages in Ecoregions 21 and 23 using M-SCI	Reliable data indicate functioning, sustainable macroinvertebrate assemblages not modified significantly beyond the natural range of reference condition (> 56.70 score). **	Reliable data indicate macroinvertebrate assemblage with moderate to severe impairment when compared to reference condition (<56.70 score). **	

NOTE: *Percentages are based on Plafkin et al. (1989). The 4% gap allows for some best professional judgment.
** Percentages based on Jacobi et al. (2006).

An expanded assessment protocol for sedimentation/siltation (also referred to as "stream bottom deposits") that incorporates benthic macroinvertebrate monitoring and assessment can be found in Appendix D.

3.1.2 Chemical/physical data

WQS Section 20.6.4.900 NMAC provides numeric criteria related to various chemical/physical parameters. Table 3.4 explains how to interpret chemical/physical grab data relative to these standards to assess aquatic life use support. This table is divided into conventional parameters, which includes field measurements as well as major ions and nutrients, and toxic substances such as trace metals and priority pollutants. Refer to the appropriate water quality standard segment number (20.6.4.97 through 20.6.4.806 NMAC) of the WQS for numeric criteria for conventional chemical/physical parameters that may differ from those listed in 20.6.4.900 NMAC.

Conventional parameters monitored to determine aquatic life use support include: temperature, turbidity, pH, dissolved oxygen, specific conductance, and total phosphorus. Assessment protocols for temperature, as well as large data set protocols for dissolved oxygen (DO), and pH, are found in Appendices C, F, and G respectively. SWQB has developed an interim turbidity assessment protocol (Appendix H) to assess turbidity data from listing cycles 2006, 2008, and 2010. SWQB plans to develop a revised turbidity assessment protocol for the future listing cycles. Prior to the 2005 triennial review of water quality standards, New Mexico had established segment-specific numeric turbidity values for all water quality standard segments detailed in 20.6.4 NMAC. In 2005, the NMWQCC amended the WQS to remove all the segment specific turbidity values and revise the turbidity subsection under the General Criteria section (20.6.4.13.J NMAC). All other parameters, as well as the assessment approach for DO

and pH grab data, are detailed in Table 3.4 and discussed below.

Table 3.4 Interpreting chemical/physical data to assess Aquatic Life Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•**Conventional parameters** (e.g., pH, DO, specific conductance, total phosphorus*) **A)** 1 to 10 samples **B**) >10 samples	**A**) For any one pollutant, no more than one exceedence of the criterion. **B**) For any one pollutant, criterion exceeded in <10% of measurements.	**A**) For any one pollutant, more than one exceedence of the criterion. **B**) For any one pollutant, criterion exceeded in ≥ 10% of measurements.	All temperature assessment protocols are described in Appendix C. Turbidity assessments are described in Appendix H. Biases in DO, pH, and temperature sampling (such as diurnal flux) should be addressed by sampling with continuously-recording sondes and thermographs whenever possible.** The index period for temperature assessments is June – August.
•**Toxic substance** (e.g., priority pollutants, ammonia***, chlorine, metals, cyanide)	For any one pollutant, no more than one exceedence of the **acute** criterion, and no more than one exceedence of the **chronic** criterion in three years.	For any one pollutant, more than one exceedence of the **acute** criterion, or more than one exceedence of the **chronic** criterion in three years.	The **chronic criterion** shall be applied to either 1) the arithmetic mean of the analytical results of consecutive-day samples when available, or 2) the result of individual grab samples. Samples should be taken during hydrologically stable conditions to be representative of the averaging period (see Section 3.1.2.1 below for additional discussion).

NOTES:
*Only for segment-specific total phosphorus values. Otherwise, see the nutrient assessment protocol in Appendix E.
**See appendices C, F, and G.
***New Mexico's WQS require consideration of the presence of salmonids to assess against acute ammonia criteria, and the presence of fish in early life stages to assess against chronic ammonia criteria. To apply Table K of 20.6.4.900 NMAC for assessment purposes, all waters designated as HQCWAL or CWAL will be assumed "Salmonids Present," while all other AL uses will be assumed "Salmonids Absent." If actual or historic fisheries documentation indicates the presence of salmonids, the "Salmonids Present" column will be used regardless of the designated AL use. To decide whether to apply Table L or M 20.6.4.900 NMAC for assessment purposes, "Fish Early Life Stages" will be assumed present from November 1 to June 30 for HQCWAL and CWAL. "Fish Early Life Stages" will be assumed present from March 1 to August 31 for all other AL uses. If actual fisheries documentation generated during the time of ammonia sample collection, or historic fisheries documentation generated during the same date in a previous year, indicate the presence of early life stages outside of these date ranges, the criteria in Table L of 20.6.4.900 NMAC will be applied regardless of the date of collection. If the applicable uses translate to different criteria values, the most stringent criteria is used per 20.6.4.11.F NMAC.

3.1.2.1 Assessing chronic aquatic life WQS

The acute and chronic aquatic life criteria established in the WQS are based upon the nationally recommended criteria developed by USEPA (USEPA 2006b). The acute criteria are intended to protect against short-term effects and are derived from tests of lethality or immobilization. The chronic criteria are intended to protect against long-term effects and are derived based upon longer term tests that measure survival, growth or reproduction. USEPA recommends a one-hour averaging period for the acute criteria and a four-day averaging period for the chronic criteria. That is, the 4-day average exposure of aquatic life to a pollutant should not exceed the chronic criterion (USEPA 1994).

During the 2000 and 2001 SWQB intensive watershed surveys, the sampling regime generally consisted of two consecutive days of sampling in the spring, three days in the summer, and three days in the fall in order to gather consecutive day data. Starting with the 2002 SWQB intensive watershed surveys, the sampling regime was adjusted to sample once per month over an eight-month period in order to 1) better characterize the waterbody throughout the annual hydrograph, and 2) acquire data points that are more likely to be statistically independent with respect to time. Because of this sampling scheme, consecutive-day data are usually not available to calculate 4-day averages. Few states and tribes are obtaining composite data over a 4-day sampling period for comparison to chronic aquatic life criteria due primarily to budget and staff time constraints. USEPA believes that 4-day composites are not an absolute requirement for evaluating whether chronic criteria are being met (USEPA 1997). Grab and composite samples can be used in water quality assessments if taken during stable conditions (USEPA 1997). Available sample results should be representative of average conditions over the 4-day period for assessment of chronic aquatic life.

New Mexico has developed a three-step process for assessing attainment of chronic aquatic life criteria (Figure 3.1). The first step is to average the results of any samples collected within a 4-day period. These averaged data as well as any individual grab samples are then assessed against the chronic aquatic life WQS. If a datum to be averaged was reported as less than the detection limit and the WQC is greater than this limit, a value of ½ of the detection limit should be used to calculate the average value (Gilbert 1987). If the WQC is less than the detection limit, this datum would not be used for assessment (see section 2.1.8).

If two or more samples represent an exceedence of a given criterion, these data are evaluated to determine if the samples were collected during hydrologically stable conditions considered to be representative of the 4-day averaging period; this process is detailed below. If conditions were unstable during the time of sampling, the data are not assessed. If sample collection methodology was specifically designed to capture data from storm flow events (e.g., through the use of single stage or automated samplers deployed to capture storm events only), these data should not be used to assess chronic aquatic life criteria. Note that above statements and data process only applies to chronic criteria and that all grab samples will be used to assess acute criteria regardless of hydrologic conditions.

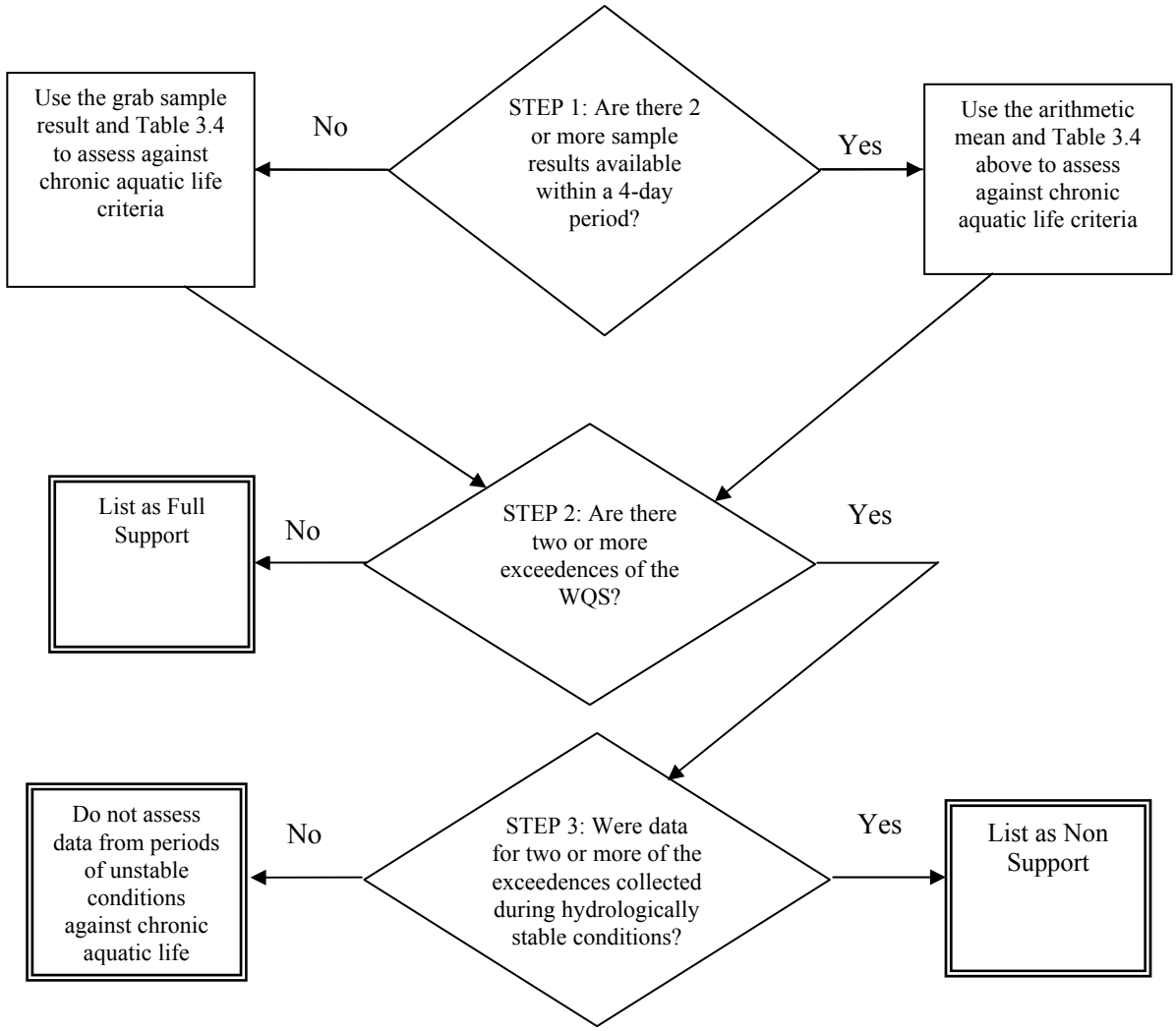


Figure 3.1 Decision process for assessing against chronic aquatic life criteria

Determining the representativeness of a sample is a qualitative assessment and is addressed primarily in the sample design, through the selection of sampling sites, and through use of procedures that reflect the project goals and environment being sampled (NMED/SWQB 2008). These procedures ensure that a given sample represents a characteristic of a population, in this case the water in a given AU at the time of sampling. The assessment of chronic aquatic life criteria adds an additional constraint that the sample(s) must be representative of a 4-day period. As such, these samples must be collected during periods when the water is well mixed and reasonably expected to represent conditions during the averaging period. Specifically, lakes or reservoirs, as stated in Paragraph 3 of Subsection C of 20.6.4.14, will be assessed for attainment of criteria for toxic pollutants using data that were collected during periods of complete vertical mixing. With respect to stream or river chronic aquatic life assessments, grab samples are deemed representative for this application when there is an absence of contextual information indicating unstable hydrologic conditions. Examples of contextual information to be considered include but are not limited to: 1) stream flow, 2) precipitation, 3) location of point source discharges in relationship to the monitoring site, and 4) the occurrence of a chemical spill or other unusual event (USEPA 2005).

Specifically, if there are <u>two or more</u> exceedences of applicable chronic aquatic life criteria based on grab or arithmetic mean data, SWQB will consider the following information to determine whether conditions were stable at the time of data collection:

- Point source discharge records in the reach or immediately upstream (if one or more point source discharges provide a significant contribution to the receiving water)
- Field notes and weather records regarding precipitation and runoff
- Flow measurements taken at the time of sampling

- Gage station records (when available)
- Land uses in the vicinity
- Records of chemical spills or other unusual events; and
- Historic patterns of pollutant concentrations when available

If readily available contextual information indicates that the pollutant concentration and the stream flow likely remained generally constant over a four-day period surrounding the sampling event, SWQB will conclude that the result of the grab sample, or the average of multiple day sampling events, is valid for assessing chronic aquatic life criteria.

Alternatively, these data will not be used for assessing attainment of chronic aquatic life criteria when contextual data indicate unstable conditions. Examples of unstable conditions may include, but are not limited to, samples being collected during:

- A precipitation event with runoff lasting shorter than 4-days (NOTE: If the data were collected during several days of high flow, the sample would be assumed representative of the 4-day average condition to assess chronic aquatic life uses. If continuous gage data are available, the procedure in the below paragraph would be performed vs. making assumptions about the longevity of the storm event)
- The first flush of a precipitation event
- A short-lived but high flow monsoon

One way to determine stable conditions is to examine the coefficient of variation (CV). When exceedences occur at or near a continuous flow gaging station and mean daily flow data are available, a stream may be considered hydrologically stable if the CV of the mean daily flow for a 4-day period surrounding the sampling collection is at or below 0.2. The CV is determined by dividing the standard deviation of the values by the mean of the values. This is a common statistical method to evaluate variability in datasets relative to the mean, and 0.2 is a common threshold number below which data are considered to have minimal variability (ADEQ 2008).

The 4-day window that produces the lowest CV should be determined vs. always using a predetermined number of days before or after the sampling event. See table 2.1 below for an example using available gage data for a grab sample collected on 8/2/07. In this example, the CV of the mean daily flows from 7/30/07 to 8/2/07 produced the lowest CV and is below 0.2, so this 4-day period surrounding the sampling event is determined to be stable. The hydrologic stability inference is about the entire 4-day period vs. just the sampling event. Utilizing the mean daily flow from 7/31/07 to 8/3/07 produces a CV of 0.22.

Table 3.5 Example of Stable Flow Determination using Gage Data

Date	Mean Daily Flow (cfs)	Mean *	Standard Deviation (SD) *	CV (SD / Mean) *
7/30/07	6.0	**7.7**	**1.3**	**0.17**
7/31/07	7.5			
8/1/07	9.2			
8/2/07	**8.1**			
8/3/07	12.0			
8/4/07	11.3			

NOTES: * = for 7/30/07 – 8/2/07

If one or more point source discharges provide a significant contribution to the receiving water, the facility discharge record(s) should be reviewed to determine whether flow and associated pollutant discharges were relatively consistent during the four-day period when the exceedence occurred. Other evidence concerning unstable flow or pollutant discharges can be provided by the facility.

3.1.3 Toxicological data

Table 3.6 explains how to interpret toxicological data to assess aquatic life use support. Refer to 20.6.4.13.F NMAC for the narrative general standards which states "Surface waters of the state shall be free of toxic pollutants from other than natural causes in amounts, concentrations or combinations which affect the propagation of fish…" Results from ambient toxicity testing are a valuable indicator for assessing and protecting against impacts on water quality and designated uses caused by the aggregate toxic effect of pollutants. Contaminants may flow directly from industrial and municipal waste dischargers, may come from polluted runoff in urban and agricultural areas, or may collect in the sediments. Toxicity evaluations can be used to assess the type and extent of degraded water quality (USEPA 2002a). Acute toxicities of substances are determined using at least two species, one vertebrate and one invertebrate, tested in whole effluent and/or ambient stream water as well as a series of dilutions. The reason for two distinctly different species is to account for the diverse species that inhabit waterbodies. In general, fish and other vertebrates are sensitive to many compounds such as those similar to their waste material, namely ammonia or ammonium complexes. Although ammonia is toxic to invertebrates, not all invertebrates are as sensitive as fish species in general. Similarly, invertebrates are generally more sensitive to pesticides than fish. Toxicological data for New Mexico can be downloaded from http://www.epa.gov/earth1r6/6wq/ecopro/watershd/monitrng/toxnet/index.htm.

While ambient toxicity testing results are a valuable indicator, they are only the first step towards identification of a water quality concern. The particular pollutant(s) leading to the toxicity must be identified in order to take the next steps, such as development of total maximum daily load (TMDL) documents to develop a plan to address the problem. In past surveys, the SWQB collected water and sediment samples that were subjected to the USEPA toxicity tests during the survey year for a particular watershed, while concurrently sampling surface waters for a variety of chemical constituents. SWQB has found that where there is nothing in the chemical data to indicate the source of toxicity, a false positive result from the toxicity test must be considered. There are also instances where toxicity tests fail in receiving waters due to a known issue with an upstream discharger. Once the permittee corrects the issue/malfunction, repeat toxicity testing is necessary to determine whether the impairment still exists. For these reasons, repeat toxicity testing is necessary to verify that the water is correctly listed due to acute or chronic toxicity. In the event that re-testing again provides a conclusion of non-support, SWQB will evaluate available benthic macroinvertebrate data using the factors in Table 3.3.

Table 3.6 Interpreting toxicological data to assess Aquatic Life Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•**Acute and/or chronic toxicity testing**	Significant effect noted in no more than one acute water test as compared to controls or reference conditions, and in no more than one chronic water test in three years as compared to controls or reference conditions.	Significant effect noted in more than one acute water test as compared to controls or reference conditions, or in more than one chronic water test in three years as compared to controls or reference conditions.	Significant effect refers to a statistically significant difference in a primary endpoint as defined in the latest USEPA procedures documents for acute and chronic toxicity testing in water (USEPA 2002b, 2002c). Reference controls will be used to compensate for possible toxic effects from naturally occurring conditions (i.e. high salinity). If toxicity testing results are from multiple years, the most recent results will be used to make the final impairment determination for the reasons stated in Section 3.1.3.

3.1.4 Fish consumption advisories

Per USEPA guidance, USEPA generally considers fish or shellfish consumption advisories with supporting fish tissue data to be existing and readily available data that demonstrate non-attainment of CWA goals stating that waters should be "fishable" (CWA Section 101(a)(2), USEPA 2000, USEPA 2005). USEPA also acknowledges that in some cases, fish and shellfish consumption advisories may not demonstrate that a section 101(a)(2) "fishable" use is not being attained in an individual segment when, for example, a state uses a higher fish consumption value in determining the need for an advisory compared to the value used in establishing water quality criteria for the protection of human health (USEPA 2000, USEPA 2005). Therefore, all water bodies for which an advisory has been issued are listed as impaired due to the specific fish tissue contaminant on the Integrated List except in cases where there is a consumption advisory due to mercury but fish tissue data indicate the methylmercury criterion of 0.3 mg/kg in fish tissue is not exceeded.

The majority of New Mexico's current fish consumption advisories are based on mercury levels in fish (NMDOH 2009); however, there are also listings for PCBs, DDT, or some combination thereof, in fish tissues. The current fish consumption advisory can be found at: http://www.nmenv.state.nm.us/swqb/advisories/index.html. Fish tissue advisories for other parameters of concern may be forthcoming. The Integrated List will be updated whenever the advisory is revised.

3.1.5 Special considerations for lake data

Lentic waterbodies in New Mexico have historically been, and continue to be, studied following methods and approaches specified in the *Clean Lakes Program Guidance Manual* (USEPA 1980). For purposes of consistency and comparability, classic limnological methods for water quality standards attainment continue to be used in monitoring practices. For purposes of this document, the term "lake" shall include natural lakes as well as reservoirs, impoundments, and any other human-made lentic waters.

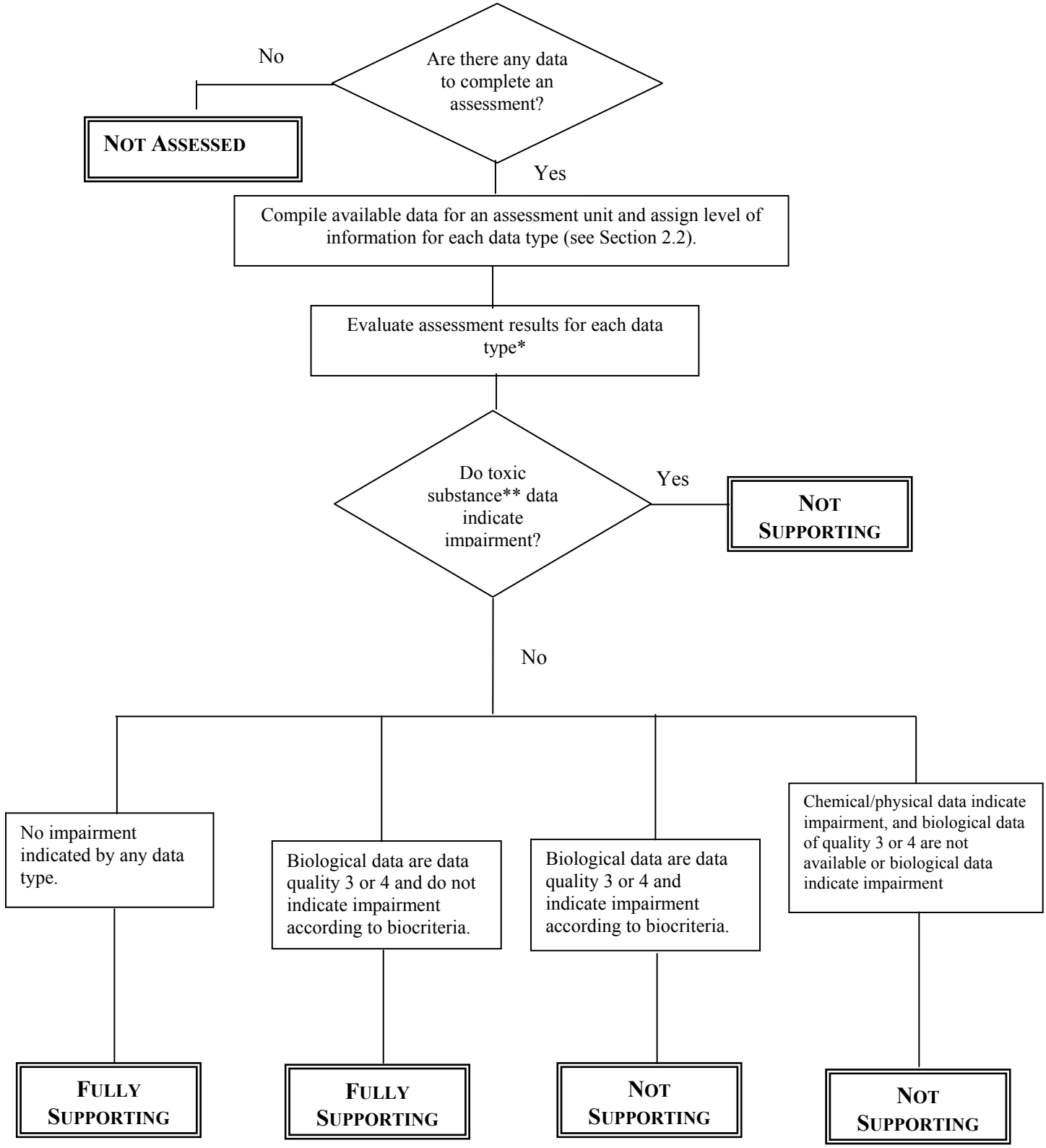
Typical lake water quality surveys consist of two sampling stations for large lakes (> 100 acres) and one sampling station for small lakes (< 100 acres) and playa lakes. However, during any water quality survey, additional stations may be established to evaluate conditions of concern. At each station, a field-calibrated multi-parametric sonde and data logger are used to measure dissolved oxygen concentration, specific conductance, temperature, and pH at one-meter intervals. Additionally, at each station, depth-integrated composite samples of the water column are collected for various water quality analyses, such as nutrients, metals, and radionuclides. Water quality measurements taken at intervals are averaged for the epilimnion, or in the absence of an epilimnion, for the upper one-third of the water column of the lake to determine attainment of criteria (20.6.4.14.C(3) NMAC). The attainment of criteria for all other pollutants (e.g., nutrients, metals, radionuclides, semi-volatile and volatile organics compounds) is assessed using the depth-integrated composite samples.

If multiple stations exist on a lake, they are usually sampled on the same day or within the same seven-day period. When data from multiple stations are used to assess a lake, regardless of whether they were collected in the same week or not, the data are considered independent and are not averaged.

3.1.6 Conflicting aquatic use support determinations

For aquatic life use assessments, it is possible that data of differing types may lead to differing use attainment determinations for the same assessment unit. For example, there may be chemical/physical

data that indicate **Not Supporting** and biological data that indicate **Fully Supporting**. If more than two data types are available for assessment, a weight-of-evidence approach should be adopted. This approach should consider data type, quality, and quantity in reaching a final aquatic life use determination. Generally, data types with higher data quality should be given more weight. Figure 3.2 displays a generalized flowchart for considering different data types when determining aquatic life use support. The ultimate goal is to develop specific, regional macroinvertebrate indices to identify non-toxicant stressor such as turbidity and sedimentation. Biological assessments provide an integrated assessment of ecological health and have the potential to provide a direct measure of the designated goal of providing for the protection and propagation of aquatic life uses.



NOTES: * Per Tables 3.3 through 3.6.
**See Table 3.4 for description of toxic substances.

Figure 3.2 Generalized flowchart for determining Aquatic Life Use Support

3.2 Assessing Domestic Water Supply Use Support

Table 3.7 explains how to interpret chemical/physical data to assess domestic water supply use support Refer to Subsections B and J of 20.6.4.900 NMAC of the WQS for the numeric criteria for domestic water supply.

Table 3.7 Interpreting chemical/physical data to assess Domestic Water Supply Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•**Toxic substance** (e.g., radionuclides*, priority pollutants, metals, cyanide)	For any one pollutant, no exceedence of the criterion.	For any one pollutant, one or more exceedence(s) of the criterion.	
•**Nitrate**	No exceedence of the criterion.	One or more exceedence(s) of the criterion.	

NOTES:
*When radionuclides are analyzed using EPA Method 900.0 (recommended), gross alpha and gross beta results generated using an Am-241 reference and a Sr/Y-90 reference, respectively, will be used for purposes of assessing standards attainment because these references are prescribed in the method description. If the information is not available for the type of reference used to generate a reported value, the highest value available will be assessed. Also, the water quality criterion in 20.6.4.900.J is for "adjusted gross alpha." Gross alpha data must be adjusted by subtracting contributions from natural uranium, as well as any measured special nuclear and by-product material, as called for in the definition in 20.6.4.7.B NMAC. To convert uranium concentrations reported in ug/L to pCi/ug a conversion factor of 0.67 is used. In the absence of U-mass to correct for adjusted gross alpha, U-238 can be used because this is the most common form of uranium radiation in the natural environment In the event that negative values are reported for special nuclear materials are reported, zero will be substituted for purposes of adjusting gross alpha radiation.

3.3 Assessing Primary and Secondary Contact Use Support

Refer to Subsection B under the appropriate stream segment number and to Subsections D and E of 20.6.4.900 NMAC of the WQS for criteria to determine use support for primary and secondary contact recreation. Table 3.8 explains how to interpret bacteriological data to assess recreational contact use support. The associated water quality criteria for contract use support were changed from fecal coliform to *E. coli* during the 2005 triennial review of New Mexico's WQS. Assessment units determined to be impaired prior to the 2006 listing cycle due to fecal coliform data will continue to be noted as impaired for fecal coliform, with a note indicating the change in WQS and need to collect *E. coli* data as there is no direct translator available to convert fecal coliform data to *E. coli* data.

Table 3.8 Interpreting bacteriological data to assess Contact Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•Bacteria **A)** 1 to 10 samples **B**) > 10 samples	**A**) No more than one exceedence of the single sample criterion. **B**) Single sample criterion is exceeded in <10% of samples and/or geometric mean criterion is met	**A**) More than one exceedence of the single sample criterion. **B**) Single sample criterion exceeded in ≥ 10% of measurements and/or geometric mean criterion is not met.	The monthly geometric mean shall be used in assessing attainment of criteria when a minimum of five samples is collected in a 30-day period (20.6.4.14.B NMAC).

3.4 Assessing Irrigation Use Support

Table 3.9 explains how to interpret chemical/physical data to assess irrigation use support. Refer to Subsections C and J of 20.6.4.900 NMAC of the WQS for the numeric criteria for the protection of irrigation use.

Table 3.9 Interpreting chemical/physical to assess Irrigation Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•Toxic substance (e.g., metals)	For any one pollutant, no more than one exceedence of the criterion.	For any one pollutant, more than one exceedence of the criterion.	
•Salinity parameters (e.g., total dissolved solids, sulfate, chloride) **A)** 1 to 10 samples **B**) > 10 samples	**A**) For any one pollutant, no more than one exceedence of the criterion. **B**) For any one pollutant, criterion exceeded in <10% of measurements.	**A**) For any one pollutant, more than one exceedence of the criterion. **B**) For any one pollutant, criterion exceeded in ≥ 10% of measurements.	Salinity parameters are segment-specific criteria included in a few individual WQS segments based on flow qualifiers.

3.5 Assessing Livestock Watering Support

Table 3.10 explains how to interpret chemical/physical data to assess livestock watering use support. Refer to Subsections F and J of 20.6.4.900 NMAC of the WQS for the numeric criteria for the protection of livestock watering.

Table 3.10 Interpreting chemical/physical data to assess Livestock Watering Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•**Conventional parameters** (e.g., nitrite + nitrate) **A)** 1 to 10 samples **B**) > 10 samples	**A**) For any one pollutant, no more than one exceedence of the criterion. **B**) For any one pollutant, criterion exceeded in <10% of measurements.	**A**) For any one pollutant, more than one exceedence of the criterion. **B**) For any one pollutant, criterion exceeded in ≥ 10% of measurements.	
•**Toxic substance** (e.g., radionuclides*, priority pollutants, metals)	For any one pollutant, no more than one exceedence of the criterion.	For any one pollutant, more than one exceedence of the criterion.	

NOTES:
*When radionuclides are analyzed using EPA Method 900.0 (recommended), gross alpha and gross beta results generated using an Am-241 reference and a Sr/Y-90 reference, respectively, will be used for purposes of assessing standards attainment because these references are prescribed in the method description. If the information is not available for the type of reference used to generate a reported value, the highest value available will be assessed. Also, the water quality criterion in 20.6.4.900.J is for "adjusted gross alpha." Gross alpha data must be adjusted by subtracting contributions from natural uranium, as well as any measured special nuclear and by-product material, as called for in the definition in 20.6.4.7.B NMAC. To convert uranium concentrations reported in ug/L to pCi/ug a conversion factor of 0.67 is used. In the absence of U-mass to correct for adjusted gross alpha, U-238 can be used because this is the most common form of uranium radiation in the natural environment In the event that negative values are reported for special nuclear materials are reported, zero will be substituted for purposes of adjusting gross alpha radiation.

3.6 Assessing Wildlife Habitat Use Support

Refer to Subsection 20.6.4.900.G NMAC of the WQS for narrative criteria and Subsection 20.6.4.900.J NMAC for numeric criteria for the protection of wildlife habitat use. Table 3.11 explains how to interpret chemical/physical data to assess wildlife habitat use support.

Table 3.11 Interpreting chemical/physical data to assess Wildlife Habitat Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•Toxic substance (e.g., PCBs, DDT, cyanide, chlorine, metals)	For any one pollutant, no more than one exceedence of the criterion.	For any one pollutant, more than one exceedence of the criterion.	

3.7 Assessing Human Health Criteria

Human health is not defined as a designated use according to the current version of 20.6.4 NMAC. Instead, human health criteria apply to all waters with a designated, existing or attainable aquatic life use. Human health criteria for persistent toxic pollutants as identified in 20.6.4.900.J NMAC also apply to all tributaries of waters with a designated, existing, or attainable aquatic life use (20.6.4.11.G NMAC). Refer to Subsection 20.6.4.900.J NMAC of the WQS for the numeric criteria related to human health. Human health criteria proposed by the USEPA are presumed to have exposure durations of a year or more (USEPA 2005), and were generally established to protect for exposure over the period of a human lifetime. Table 3.12 explains how to interpret chemical/physical data to determine if these criteria are met.

Table 3.12 Interpreting Chemical/Physical Data to Assess Human Health Criteria

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•Toxic substance (e.g., cyanide, PAHs, pesticides, PCBs, metals) **A)** 1 to 10 samples	**A)** For any one pollutant, no more than one exceedence of the criterion.	**A)** For any one pollutant, more than one exceedence of the criterion.	
B) >10 samples	**B**) For any one pollutant, criterion exceeded in <10% of measurements.	**B**) For any one pollutant, criterion exceeded in ≥ 10% of measurements.	

4.0 ASSESSMENT UNIT CATEGORY DETERMINATIONS FOR INTEGRATED LIST

The determination of use support using Section 3.0 and other specified protocols are combined to determine the overall WQS attainment category for each AU (USEPA 2001). The unique attainment categories for New Mexico are described as follows (see also Figure 4.1):

1. **Attaining the water quality standards for all designated and existing uses.** AUs are listed in this category if there are data and information that meet all requirements of the assessment and listing methodology and support a determination that the water quality criteria are attained.

2. **Attaining some of the designated or existing uses based on numeric and narrative parameters that were tested, and no reliable monitored data are available to determine if the remaining uses are attained or threatened.** AUs are listed in this category if there are data and information that meet requirements of the assessment and listing methodology to support a determination that some, but not all, uses are attained based on numeric and narrative water quality criteria that were tested. Attainment status of the remaining uses is unknown because there is no reliable monitored data with which to make a determination.

3. **No reliable data and/or information to determine if any designated or existing use is attained.** AUs are listed in this category where data to support an attainment determination for any use are not available, consistent with requirements of the assessment and listing methodology.

4. **Impaired for one or more designated uses, but does not require development of a TMDL because:**

   A. **TMDL has been completed.** AUs are listed in this subcategory once all TMDL(s) have been developed and approved by USEPA that, when implemented, are expected to result in full attainment of the standard. Where more than one pollutant is associated with the impairment of an AU, the AU remains in Category 5A (see below) until all TMDLs for each pollutant have been completed and approved by USEPA.

   B. **Other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future**. Consistent with the regulation under the Clean Water Act 130.7(b)(i),(ii), and (iii), AUs are listed in this subcategory where other pollution control measures required by local, state, or federal authority are stringent enough to implement any water quality standard (WQS) applicable to such waters.

   C. **Impairment is not caused by a pollutant.** AUs are listed in this subcategory if a pollutant does not cause the impairment. For example, USEPA considers flow alteration to be "pollution" vs. a "pollutant."

5. **Impaired for one or more designated or existing uses**. The AU is not supporting one or more of its designated uses because one or more water quality standards are not attained according to current water quality standards and assessment methodologies. **This category constitutes the *CWA §303(d) List of Impaired Waters*.** In order to relay additional information to stakeholders

including SWQB staff, Category 5 is further broken down into the following categories:

A. **A TMDL is underway or scheduled.** AUs are listed in this category if the AU is impaired for one or more designated uses by a pollutant. Where more than one pollutant is associated with the impairment of a single AU, the AU remains in Category 5A until TMDLs for all pollutants have been completed and approved by USEPA.

B. **A review of the water quality standard will be conducted.** AUs are listed in this category when it is possible that water quality standards are not being met because one or more current designated uses are inappropriate, or if available data indicate background processes are causing criteria exceedences. After additional reviews of available data and the water quality standard are conducted, a Use Attainability Analysis (UAA) will be developed and submitted to USEPA for consideration, or the AU will be moved to Category 5A and a TMDL will be scheduled.

C. **Additional data will be collected before a TMDL is scheduled.** AUs are listed in this category if there is not enough data to determine the pollutant of concern or there is not adequate data to develop a TMDL. For example, AUs with biological impairment will be listed in this category until further research can determine the particular pollutant(s) of concern. When the pollutant(s) are determined, the AU will be moved to Category 5A and a TMDL will be scheduled. If it is determined that the current designated uses are inappropriate, it will be moved to Category 5B and a UAA will be developed. If it is determined that "pollution" is causing the impairment (vs. a "pollutant"), the AU will be moved to Category 4C. AUs that are suspected of being impaired due solely to natural causes, but which lack sufficient data to make this determination, will be placed in Category 5C with a note that additional information is needed.

This present reporting approach was developed in response to a recent National Research Council (NRC) report and a desire to provide a clearer summary of the nation's water quality status and management actions necessary to protect and restore them (NRC 2001, USEPA 2001, WERF 2007). With a few additions and minor changes in terminology, the information requested in the *Integrated Listing* guidance (USEPA 2001) and CALM guidance (USEPA 2002a) were previously suggested in earlier 305(b) reporting guidance (USEPA 1997). The earlier guidance formed the basis of previous SWQB assessment protocols.

Assessment information is housed in ADB v.2.1.4 (RTI 2005). This database was designed to help states implement suggestions in the *Integrated Listing* guidance (USEPA 2001, USEPA 2005, USEPA 2006a). The database is first populated with AU information, associated designated uses, comments, and any supporting documentation. Individual designated use attainment decisions (i.e., Full Support, Non Support, or Not Assessed) are then entered for each AU. ADB v.2.1.4 then automatically determines the water quality standards attainment category for each AU based on the information entered for each applicable designated use.

Section 303(d)(1) requires states to establish a priority ranking for AUs determined to be impaired, and to schedule TMDL development in accordance with the priority ranking. New Mexico expresses this ranking, including indicating which waters bodies are targeted for TMDL development in the next two years, in the form of a scheduled TMDL completion date per USEPA's recommendation (USEPA 2005). This information is housed in ADB v.2.1.4 and reported within the Integrated List under "TMDL Schedule" for all individual Category 5A waters.

years, in the form of a scheduled TMDL completion date per USEPA's recommendation (USEPA 2005). This information is housed in ADB v.2.1.4 and reported within the Integrated List under "TMDL Schedule" for all individual Category 5A waters.

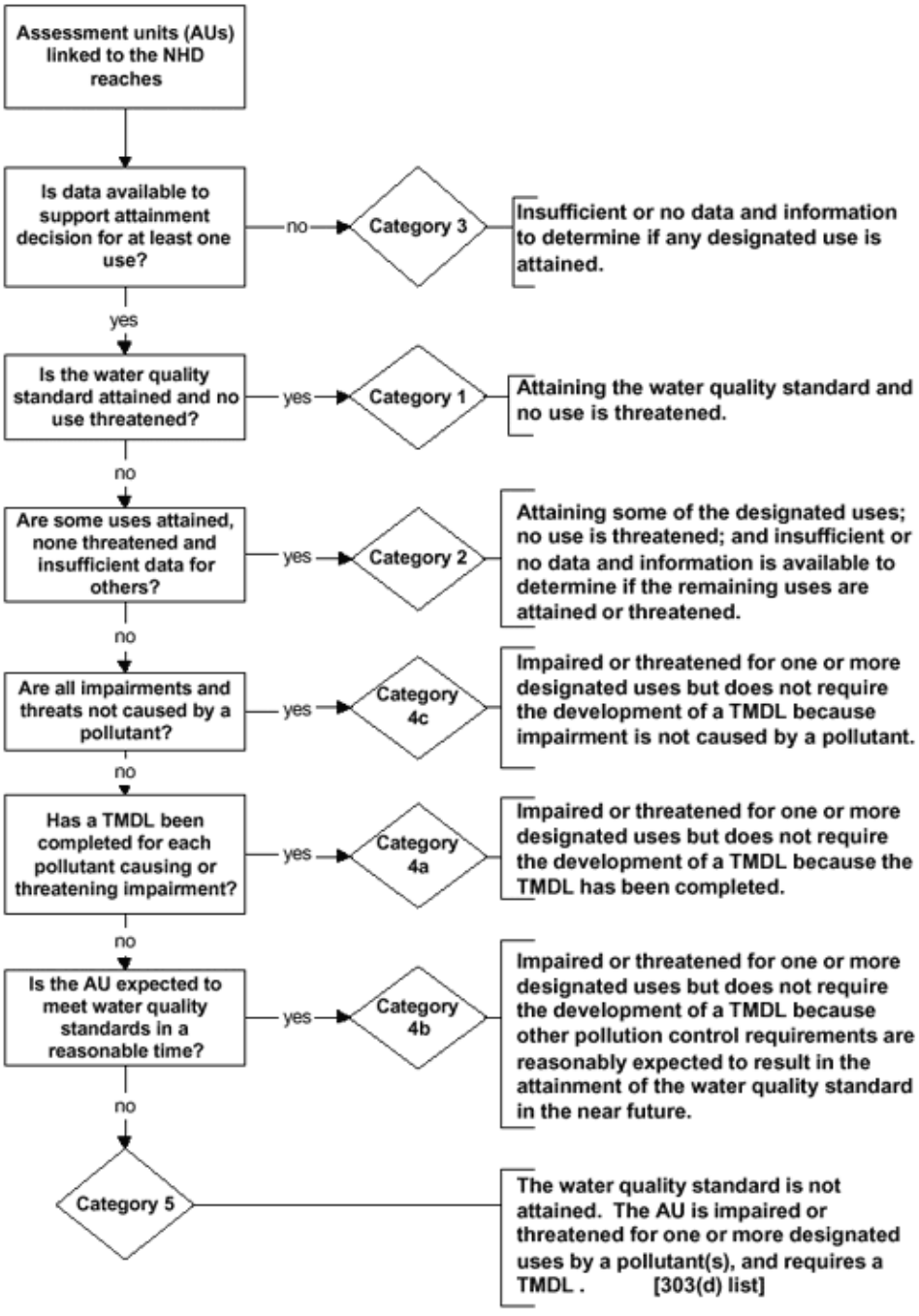


Figure 4.1. Generalized summary of logic for attainment categories (USEPA 2001). Category 5 was further expanded by New Mexico into categories 5A, 5B, and 5C.

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5.0 PUBLIC PARTICIPATION

The assessment protocols are periodically revised based on new USEPA guidance, changes to the WQS, and the need to clarify various assessment procedures for staff. When the protocols are revised, a draft is first sent to USEPA Region 6 for initial review and comment. If significant changes to the overall assessment procedures and/or format of the document are being proposed, SWQB also releases a public comment draft to solicit public review and comment. For example, a draft of this assessment protocol was opened for a 30-day public comment period beginning on April 20, 2009. Eight sets of comments were received from stakeholders around the state. Comments were considered and incorporated as appropriate. Response to Comments were prepared by SWQB and provided to the parties who commented and USEPA Region 6.

The final version of this protocol is provided to USEPA Region 6. USEPA considers the assessment protocols in its review and approval of Category 5 waters in the integrated report. The assessment protocol is also posted on the SWQB website: http://www.nmenv.state.nm.us/swqb/protocols/index.html.

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APPENDIX A

LIST OF COMMON ACRONYMS

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JUNE 19, 2009

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LIST OF COMMON ACRONYMS

4Q3	4-Day, 3-Year Low Flow
ADB	Assessment Database
AU	Assessment Unit
CALM	Consolidated Assessment and Listing Methodology
CWA	Clean Water Act
DO	Dissolved Oxygen
M-SCI	Mountain Stream Condition Index
MDL	Method Detection Limit
NHD	National Hydrographic Dataset
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMSA	New Mexico Statues Annotated
NMWQCC	New Mexico Water Quality Control Commission
NPDES	National Pollutant Discharge Elimination System
PAH	Poly Aromatic Hydrocarbon
PCBs	Polychlorinated Biphenyls
PQL	Practical Quantification Limit
QA	Quality Assurance
QC	Quality Control
QAPP	Quality Assurance Project Plan
RBP	Rapid Bioassessment Protocols
ROD	Record of Decision
SDL	Sample Detection Limit
SLD	State Laboratory Division
SSC	Suspended Sediment Concentration
STORET	Storage and Retrieval System
SWQB	Surface Water Quality Bureau
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
UAA	Use Attainability Analysis
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WET	Whole Effluent Toxicity
WQC	Water Quality Criterion
WQS	Water Quality Standard

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APPENDIX B

DATA ASSESSMENT PROCEDURE AND FORMS

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JULY 8, 2009

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Introduction:

Comprehensive assessments of watershed surveys or other monitoring projects to determine designated use attainment status on an assessment unit basis are performed after all field data have been collected, all laboratory data have been received, and all data have been verified and validated in accordance with the most recent version of the Quality Assurance Project Plan (QAPP). In general, the Project Coordinator from the Monitoring and Assessment Section (MAS) Stream Studies Team performs the chemical/physical and E. coli data assessments while members of the MAS Biological Assessment Team perform the biological, sedimentation, and large dataset assessments (i.e., assessments using sonde and/or thermograph data). Members of the MAS Nutrient & Lakes Team perform stream nutrient assessments as well as chemical/physical and E. coli lake assessments. The Assessment Coordinator performs ambient toxicological assessments. The Assessment Coordinator and TMDL writers verify assessments. During verification of assessments, it is assumed that all relevant data have been compiled and that the data validation process or any other QA procedures were correctly performed.

This outline is to be used in conjunction with the *Procedures of Assessing Standards Attainment for the State of New Mexico CWA §303(d) /§305(b) Integrated Report* (Assessment Protocols), and is intended to detail the general steps that occur during the assessment process for each of the main categories of data. This outline will be updated and expanded as new and revised assessment protocols are developed and implemented.

I. Assessment Procedures Common to All Data Types:

A. Pre-Assessment: Data Collation and QA

1. Ensure that all field data and lab data from the survey have been received and uploaded into the SWQB in-house water quality database and/or spreadsheets templates as needed.
2. Validate and verify the data per the most recent version of the *Quality Assurance Project Plan (QAPP)* – found at http://www.nmenv.state.nm.us/SWQB/MAS/index.html.
3. After any necessary changes to the SWQB in-house water quality database based on the QA Checklist and all Data Validation codes have been entered into the database, inform the Database Manager that the dataset is ready for upload to STORET/WQX.
4. Search for any readily available sources of outside data (such as recent water quality from active USGS stream gages [http://waterdata.usgs.gov/nwis], USFS data, EPA National Survey data [http://www.epa.gov/owow/streamsurvey/web_data.html], etc.) to incorporate into the assessment as appropriate. If there are any USGS water quality stations in any assessment units in the study, download available data since the last SWQB survey from NWIS: http://waterdata.usgs.gov/nwis. Contact current USGS cooperative agreement contact (ask MAS Program Manager for current contact info) to acquire any provisional water quality data from the recent year which they expect to be finalized by the projected date of the final integrated list in progress. Ask SWQB WPS watershed lead if he/she is aware of any other entities collecting water quality data in the study area. Ask MAS staff if they are aware of any other entities collecting water quality data in the study area.
5. Determine whether data qualities of these additional data sources are sufficient to incorporate into assessments. (NOTE: USGS data downloaded from NWIS are assumed to meet SWQB data quality requirements; level of QA/QC of USGS provisional data however must be determined). To be considered for development of the Integrated List, these data must, at a minimum, meet the QA/QC requirements described in SWQB's

QAPP. Particular emphasis should be placed on ensuring that the analytical methods used meet the requirements specified in Section 2.4 of this QAPP, that the methods of data collection were the same as or comparable to those included in the Standard Operating Procedures (SOPs) referenced within the QAPP, and that the QC criteria used to verify and validate the data were the same or similar to those listed in Table 2.4 and Appendix B of the QAPP. If uncertain, consult with the QA Officer or Assessment Coordinator.

6. If outside data are of adequate quality for assessment, collate into assessment spreadsheet and merge with SWQB data in the spreadsheet, including a Data Source column. If the data are not of adequate quality, document why and keep in assessment folder.

B. Assessment

1. Download the latest version of the Assessment Protocols – found at http://www.nmenv.state.nm.us/swqb/protocols/index.html. If in doubt, consult with Assessment Coordinator.
2. Download latest version of the EPA-approved WQS (20.6.4 NMAC) – found at http://www.nmenv.state.nm.us/swqb/Standards. If in doubt, consult with Standards Coordinator.
3. Start an electronic Administrative Record folder (i.e., assessment packet) for your assessments by creating a directory on your hard drive to house all assessment documentation (Ex: Jemez 2005 Assessments -- to include MS Excel data spreadsheets, assessment forms, etc.)
4. Follow below assessment procedures by Data Type (see below sections).
5. Complete and print the Assessor's Worksheet (Attachment B-2).
6. Submit signed hardcopy of completed Assessor's Worksheet, and electronic copies of completed assessment forms and all supporting information (i.e., the electronic Administrative Record folder from step B1) to the Assessment Coordinator. Specifically, submit the following electronic files:
    - All completed Assessment Forms
    - Any supporting data spreadsheets used during the assessment procedure
    - Any supporting data called for on the Assessment Form

C. Assessment verification

1. Retrieve assessment packet (as described in B3) for all data types from the Assessment Coordinator.
2. Retrieve up-to-date sample tracking spreadsheet from \SWQB Public\MAS Core Documents\ or the survey lead(s) to identify any data holes.
3. Ensure available data were accurately assessed in accordance with the most recent EPA-approved WQ standards and associated Assessment Protocols.
4. Verify that the forms were filled out correctly by verifying correct WQS reference, correct assignment of stations to assessment units, and checking all calculations and impairment conclusions.
5. If discrepancies arise or assessments were not properly performed, discuss any proposed changes to the assessment with the original assessor.
6. Revise assessment forms as necessary.
7. Complete and print the Assessment Verification Worksheet (Attachment B-3).
8. Submit signed hardcopy of the Assessment Verification Worksheet, and electronic copies of the sample tracking spreadsheet, completed assessment forms and all supporting information (i.e., the final electronic Administrative Record) to Assessment Coordinator

for inclusion on the upcoming draft Integrated List and eventual filing in the Administrative Record and the project binder.

II. Specific Assessment Steps by Data Type

A. Chemical/Physical and E. coli Grab Data

1. Export all field and lab data from the WQ dbase using the "Export Data" functions. Collate with any available outside data determine to be of sufficient data quality following the procedures above in Section I.A.
2. Fill out the **Summary Chemical/Physical and E. coli Assessment Form** for chemical/physical, bacteriological, organic, and pesticide data (Attachment B-1 of this document and electronically located in MAS Core Documents) for each assessment unit.
3. Determine exceedance ratios for all applicable criteria based on applicable tables in the most recent version of the Assessment Protocols, utilizing MS Excel functions such as autofilter and sort. Include comments and notes regarding extraordinary field conditions that may have influenced results, Data Validation flags, the need for AU splits, questionable designated uses, etc., in the Comments section of this form.

    a. Hardness-dependent metals: When all metals results are **below** the quantification limit, there is no need to calculate the hardness-dependent metals criteria, and the Exceedence Ratio field on the **Summary Chemical/Physical and E. Coli Assessment Form** should be filled in with "BLW QL" for "below quantification limit." When there are metals results **above** the quantification limit, a screening level using the lowest measured hardness value in the data set to calculate hardness-dependent criteria may first be employed to determine the potential for any exceedences in the data set. If any measured values are above the associated criteria determined in this way, the assessor must calculate appropriate hardness-dependent metals criteria for the sampling event(s) using concurrently-collected hardness and the formulas in 20.6.4.900 NMAC (see the hardness-dependent calculator spreadsheet in \SWQB Public\MAS Core Documents). If concurrently-collected hardness data are not available, the lowest available hardness value within a seven-day period of the sample collection date may be used with a note in the Comments section of the appropriate Assessment Form explaining why concurrently-collected data were not used. If no hardness data (or adequate data to calculate hardness) are available within a seven-day period of the sample collection date, it is permissible to use conservative hardness estimates determined by qualified natural resources agencies or entities as appropriate for that water body. This deviation must be noted on the appropriate Assessment Form. Generate a spreadsheet that details the station, date/time, hardness, hardness-dependent criteria, and sample result. This spreadsheet must be included as part of the electronic record.

    b. pH, temperature, and fish life stage dependent ammonia: When all ammonia results are **below** the quantification limit, there is no need to determine the pH, temperature, and life stage -dependent ammonia criteria, and the Exceedence Ratio field on the **Summary Chemical/Physical and E. Coli Assessment Form** should be filled in with "BLW QL" for "below quantification limit." When there are ammonia results **above** the quantification limit, determine the appropriate ammonia criteria for the sampling event(s) using Tables K through M of 20.6.4.900 NMAC, and the notes in

Table 3.4 of the main assessment protocol. Generate a spreadsheet that details the station, date/time, pH, temperature, appropriate criteria, and sample result. This spreadsheet must be included as part of the electronic record.

c. Nitrate as N vs. Nitrite+Nitrate in 20.6.4.900 NMAC: Because data are generally reported from the State Laboratory Division (SLD) as Nitrite+Nitrate (N), and nitrite is generally negligible, the Nitrite+Nitrate (N) results can assessed against the Domestic Water Supply criterion of 10 mg/L expressed as "Nitrate as N" in 20.6.4.900 NMAC.

Chronic aquatic life use assessments

4. Fill out an **Individual Chemical/ Physical Data (chronic AL use) Assessment Form** (Attachment B-1 of this document and electronically located in MAS Core Documents) by assessment unit for any parameter with **2 or more** exceedence(s) of the applicable chronic aquatic life criterion.
5. As needed, determine whether or not there were hydrologically stable conditions at the time of data collection (STEP 3 on the form) using the procedure discussed in Section 3.1.2.1 of the Main Assessment Protocol.
6. Include comments and notes regarding field conditions that may have influenced results, etc., in the Comments section of this form.

All non-chronic aquatic life chemical/physical or E. coli assessments

7. Fill out an **Individual Chemical/ Physical Data (except chronic AL use) or E.coli Assessment Form** (Attachment B-1 of this document and electronically located in MAS Core Documents) by assessment unit for any non-chronic aquatic life use parameter either **a)** determined to be "Non Support" or **b)** previously listed as "Non Support" on the most recent CWA 303(d)/305(b) Integrated List (http://www.nmenv.state.nm.us/swqb/MAS/#ListReport). These forms are extremely important because they constitute the primary record for both new listings and de-listings. Include comments and notes regarding field conditions that may have influenced results, etc., in the Comments section of this form.

B. Ambient Toxicological Data

NOTE: The data utilized for these assessments are downloaded from EPA's toxicological program. It is therefore assumed that these data are thoroughly validated and verified before EPA uploads them to this site.

1. Download the most recent New Mexico toxicological data at www.epa.gov/earth1r6/6wq/ecopro/watershd/monitrng/toxnet/nm.pdf. This website collates all EPA toxicological tests performed in New Mexico for SWQB and EPA Region 6 over the years in one place.
2. Determine use attainment status based on the applicable table in the most recent version of the Assessment Protocol.
3. Fill out **Ambient Toxicity Monitoring Assessment Form** (Attachment B-1 and MAS Core Documents) for each assessment unit for which there are data. Include comments and notes regarding field conditions that may have influenced results, etc., in the Comments section of this form.

C. Biological/Habitat Data

1. Determine Level III ecoregion.
2. Determine appropriate reference site for percent fines comparisons.
3. Determine percent fines (% of pebble count with intermediate axis < 2mm) for both the study site and the reference site.
4. If study site is in Ecoregion 21 or 23, determine M-SCI score.
5. If study site is in Ecoregion 20, 22, 24, 25, or 26, determine RBP index for both the study site and reference site.
6. Fill out **Sedimentation/Siltation (Stream Bottom Deposit) Assessment Form** (Attachment B-1 of this document and electronically located in MAS Core Documents) by station according to the most recent version of the **Sedimentation/Siltation (Stream Bottom Deposits) Protocol for Wadeable Perennial Streams** appendix in the Assessment Protocol. Include comments and notes regarding extraordinary field conditions that may have influenced results, etc., in the Comments section of this form.
7. If there is more than one station in the AU, repeat all steps above and fill out new form(s). Follow the procedures detailed in the "Multiple stations in one assessment unit" section in the Main Assessment Protocol.

D. Nutrient Data

1. Collate all data necessary to apply the weight-of-evidence approach detailed in the most recent version of the **Nutrient Assessment Protocol for Wadeable Perennial Streams,** Appendix **E of** the Assessment Protocol.
2. Fill out **Level II Nutrient Assessment Worksheets** and **Level II Nutrient Assessment Forms,** (Attachment B-1 and MAS Core Documents) as necessary according to the protocol (NOTE: Level I Nutrient Assessment Forms are completed before August to indicate where Level II is needed – see Appendix E for details). Include comments and notes regarding extraordinary field conditions that may have influenced results, etc., in the Comments section of this form.
3. If there is more than one station in the AU, repeat all steps above and fill out new form(s). Follow the procedures detailed in the "Multiple stations in one assessment unit" section in the Main Assessment Protocol.

E. Large Data Sets

Thermograph data:

1. Locate and collate available thermograph MS Excel files in \SWQB PUBLIC\Gary S Public\. Collate with any available outside data determine to be of sufficient data quality following the procedures above in Section I.A.
2. Determine the aquatic life use (ALU) of the water body being assessed (see 20.6.4 NMAC).
3. Use the "Conditional Formatting" option or other MS Excel functions to assess the data. If the ALU is high quality coldwater or coldwater, assess data using the most recent **Temperature Assessment Protocol,** Appendix C in the Assessment Protocol. Otherwise, use Table 3.4 of the main Assessment Protocol.

4. Fill out **Temperature Data Logger (Thermograph) Assessment Form** (Attachment B-1 of this document and electronically located in MAS Core Documents). Include comments and notes regarding extraordinary field conditions that may have influenced results, Data Validation flags, the need for AU splits, questionable designated uses, etc., in the Comments section of this form.
5. If there is more than one station in the AU, repeat all steps above and fill out new form(s). Follow the procedures detailed in the "Multiple stations in one assessment unit" section in the Main Assessment Protocol.

Sonde data:

1. Locate available sonde MS Excel files in \SWQB PUBLIC\Gary S Public\. Collate with any available outside data determine to be of sufficient data quality following the procedures above in Section I.A.
2. Assess data using the most recent **Large Data Set Assessment Protocol,** Appendix F&G of the Assessment Protocol.
3. Fill out **pH and Dissolved Oxygen Sonde Data Assessment Form** (Attachment B-1 of this document and electronically located in MAS Core Documents). Include comments and notes regarding extraordinary field conditions that may have influenced results, Data Validation flags, the need for AU splits, questionable designated uses, etc., in the Comments section of this form.
4. If there is more than one station in the AU, repeat all steps above and fill out new form(s). Follow the procedures detailed in the "Multiple stations in one assessment unit" section in the Main Assessment Protocol.
5. Provide copies of complete assessment forms to Nutrient & Lakes Team for use in the nutrient assessments.

F. Interim turbidity assessments

1. Export all available turbidity data from the WQ dbase using the "Export Data" functions. Collate with any available outside data determine to be of sufficient data quality following the procedures above in Section I.A.
2. Assess data using the most recent **Interim Turbidity Assessment Protocol,** Appendix H of the Assessment Protocol.
3. Fill out **Turbidity Assessment Assessment Form** (Attachment B-1 of this document and electronically located in MAS Core Documents). Include comments and notes regarding extraordinary field conditions that may have influenced results, Data Validation flags, the need for AU splits, questionable designated uses, etc., in the Comments section of this form.
4. If there is more than one station in the AU, repeat all steps above and fill out new form(s). Follow the procedures detailed in the "Multiple stations in one assessment unit" section in the Main Assessment Protocol.

Attachment B-1: Assessment Forms

Page of Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

Summary Chemical/Physical and E.coli Assessment Form

Study Year|Study Name: _____

1. Name of assessment unit (stream reach) in the SWQB WQ database or 303d/305b list: _____
2. Segment number from NM WQ standards: _____
3. All designated uses (and known existing) from NM WQ standards: _____
4. Current IR Category from most recent Integrated List _____ Causes of Impairment (if any)_____
5. Sites used for assessment: _____
6. Evaluation of data compared to applicable uses, expressed as a ratio of exceedences / total number of samples (**Bold** the use(s) and associated criteria being assessed. When the lowest applicable criterion is exceeded and multiple criteria apply, must also document the exceedence ratio for the next lowest applicable criterion until there are "0 / #"). If all hardness-dependent metals are below the QL, insert "ALL BLW QL" in the "Exceedence Ratio(s)" column:

KEY: DWS = domestic water supply, **IRR** = irrigation, **LW** = livestock watering, **WH** = wildlife habitat, **AL** = aquatic life, **HH** = human health, **DL ABV WQS** = Detection limit greater than WQS, **NA** = not applicable, **BLW QL** = below quantification limit, **NO DATA =** no data available, **S.A**. = see attached spreadsheet

Pollutants	Designated Use(s) [1],[2]	Numeric Criteria	Exceedence Ratio(s)[3]
Aluminum, Dissolved	AL chronic | AL acute | IRR	87 | 750 | 5000 µg/L	_____
Antimony, dissolved	DWS | HH	5.6 | 640 µg/L	_____
Arsenic, dissolved	DWS | HH | IRR | AL chronic | LW | AL acute	2.3 | 9.0 | 100 | 150 | 200 | 340 µg/L	_____
Boron, dissolved	IRR | LW	750 | 5000 µg/L	_____
Cadmium, dissolved	AL chronic[4] | AL acute[4] | DWS | IRR | LW |	**S.A**. | **S.A**. | 5 | 10 | 50 | µg/L	_____
Chromium, dissolved	DWS | IRR | AL chronic[4] | AL acute[4] | LW	100 | 100 | **S.A**. | **S.A**. | 1000 µg/L	_____
Cobalt, dissolved	IRR | LW	50 | 1000µg/L	_____
Copper, dissolved	AL chronic[4] | AL acute[4] | IRR | LW | DWS	**S.A**. | **S.A**. | 200 | 500 |1300µg/L	_____
Lead, dissolved	AL chronic[4] | DWS | LW | AL acute[4] | IRR	**S.A**. | 50 | 100 | **S.A**. | 5000 µg/L	_____
Mercury, total	WH | DWS | LW	0.77 | 2 | 10 µg/L	_____
Mercury, dissolved	AL chronic | AL acute	0.77 | 1.4 µg/L	_____
Nickel, dissolved	DWS | AL chronic[4] | AL acute[4] | HH	100 | **S.A**. | **S.A**. | 4600 µg/L	_____
Selenium, dissolved	DWS | LW | IRR[5] | HH	5.0 | 50 | _____ | 4200 µg/L	_____
Selenium, total recoverable	WH | AL chronic | AL acute	5.0 | 5.0 | 20 µg/L	_____
Silver, dissolved	AL acute[4]	**S.A**. µg/L	_____
Thallium, dissolved	DWS | HH	1.7 | 6.3 µg/L	_____
Uranium, dissolved	DWS	5000 µg/L	_____
Vanadium, dissolved	IRR | LW	100 | 100 µg/L	_____
Zinc, dissolved	AL chronic[4] | AL acute[4] | IRR | DWS | LW | HH	**S.A**. | **S.A**. | 2000 | 7400 | 25000 | 26000 µg/L	_____
_____	_____	_____	_____

METALS:

[1] Per 20.6.4.11.G NMAC, human health criteria listed in 20.6.4.900.J NMAC shall apply to any waters with aquatic life use. For waters with **limited aquatic life use** (20.6.4.97 and 20.6.4.128), only the persistent (P) human health criteria apply.
[2] Chronic AL criteria do not apply to **limited aquatic life** use as stated in 20.6.4.97 and 20.6.4.128.
[3] **Not Assessed** if n=1, **Full Support** in most cases if <2 for n≤10 or >10% for n>10 (see Main AP for exceptions), must also complete Individual Assessment Forms if **Non Support** or **previously listed**
[4] Hardness-dependent criteria calculated using equations (see 20.6.4.900.I NMAC). Attach spreadsheet for any results above the quantification limit
[5] Applicable criterion depends on presence of sulfate (see 20.6.4.900.C NMAC – note units are in **mg/L**).

OTHER:

Pollutant	Designated Use(s)	Numeric Criteria	Exceedence Ratio(s)
Ammonia, total	Based on life stages, pH, and temperature (see 20.6.4.900.L NMAC and Table 3.4 of main Assessment Protocol)	See attached spreadsheet for any applicable criteria for any results above the quantification limit	_____
Cyanide, weak acid dissociable	AL chronic | WH | AL acute | DWS | HH	5.2 | 5.2 | 22.0 | 700 | 220000 µg/L	_____
E. coli	Primary or Secondary Contact	_____ cfu/100mL	_____
Nitrite + nitrate (N)	DWS | LW	10 | 132 mg/L	_____
Temperature (grab)	_____	Celsius	
pH (grab)	_____		
DO (grab)	_____	mg/L	
_____	_____	_____	_____
_____	_____	_____	_____

RADIONUCLIDES:

Pollutant	Designated Use(s)	Numeric Criteria	Exceedence Ratio(s)
Adjusted gross alpha	DWS | LW	15 | 15 pCi/L	_____
Radium 226 +228	DWS | LW	5 | 30.0 pCi/L	_____
_____	_____	_____ pCi/L	_____
_____	_____	_____ pCi/L	_____

8260 ORGANICS (Volatiles) – Assess any pollutants with results above the quantification limit.

Pollutant	Designated Use(s)	Numeric Criteria	Exceedence Ratio(s)
_____	_____	_____ µg/L	_____
_____	_____	_____ µg/L	_____

8270 ORGANICS (Semi-volatiles) -- Assess any pollutants with results above the quantification limit.

Pollutant	Designated Use(s)	Numeric Criteria	Exceedence Ratio(s)
_____	_____	_____ µg/L	_____
_____	_____	_____ µg/L	_____

8081 PESTICIDES (Organochlorines) -- Assess any pollutants with results above the quantification limit.

Pollutant	Designated Use(s)	Numeric Criteria	Exceedence Ratio(s)
_____	_____	_____ µg/L	_____
_____	_____	_____ µg/L	_____

Additional comments about the assessments: _____

Revised 8 July 2009 (LG)

Page of Assessor:_____

Date of Assessment: _____ Date of Assessment Protocol used**:** _____ Date of WQS used: _____

Individual Chemical/ Physical Data (*chronic AL use*)

Study Year/Study Name: _____

1. Name of assessment unit (AU) in the SWQB WQ database or 303d/305b list: _____
2. Station Name(s): _____
3. Segment number from NM WQ standards: _____
4. Parameter [a]: _____
5. Chronic aquatic life criterion [b]: _____
6. Evaluation of data:

STEP 1a: For a given site, are there 2 or more sample results available within a 4-day period?
☐ No – Use the grab sample result and Table 3.4 in Assessment Protocol to assess against chronic aquatic life criteria
☐ Yes – Use the arithmetic mean and Table 3.4 in Assessment Protocol to assess against chronic aquatic life criteria [c]

STEP 1b: Complete table with data ***expressed as the number of exceedences/number of samples***:

Data Source	Snowmelt (Mar – May)	Summer/Fall Baseflow (Jun - Oct)	Winter Baseflow (Sept - Nov)	Storm Event [d]	Exceedence Ratio (# exceedences/#samples)
SWQB Station: _____	_____	_____	_____	_____	_____
SWQB Station: _____	_____	_____	_____	_____	_____
Outside data source: _____	_____	_____	_____	_____	_____
Outside data source: _____	_____	_____	_____	_____	_____
AU Totals	_____	_____	_____	_____	_____

STEP 2: Are there two or more exceedences of the WQS? [d]
☐ No – List as **Full Support**
☐ Yes – Complete STEP 4

STEP 3: Were data for the two or more exceedences collected during hydrologically stable conditions?
☐ No – Remove data from periods of unstable conditions and reassess against chronic aquatic life criteria
☐ Yes – List as **Non Support**

7. Are there multiple stations in the AU?

☐ No – complete number 8

☐ Yes – are the use support designations for individual stations in agreement?

☐ Yes – complete number 8

☐ No – examine AU breaks and reassess, or provide comments below

8. What is the use support designation according to the SWQB Assessment Protocol:

☐ Full support

☐ Not supported

☐ Not Assessed (n=1[e])

Additional comments about the assessment [f]:

--***Attach raw and averaged data used to make impairment determination.*** *Any data lab or SWQB qualifier codes must be included.*

a. *If parameter is **Adjusted Gross Alpha**, include documentation regarding how the data were corrected.*

b. *Do not use this form for assessment non chronic aquatic life uses.*

c. *If a given sample is j-flagged use the j-flagged value; if it is below detection limit use ½ the DL.*

d. *Do not include samples from storm events in assessment of chronic aquatic life criteria*

e. *Assessment of Domestic Water Supply is possible with n=1.*

f. *Note especially any single exceedence of a criterion*

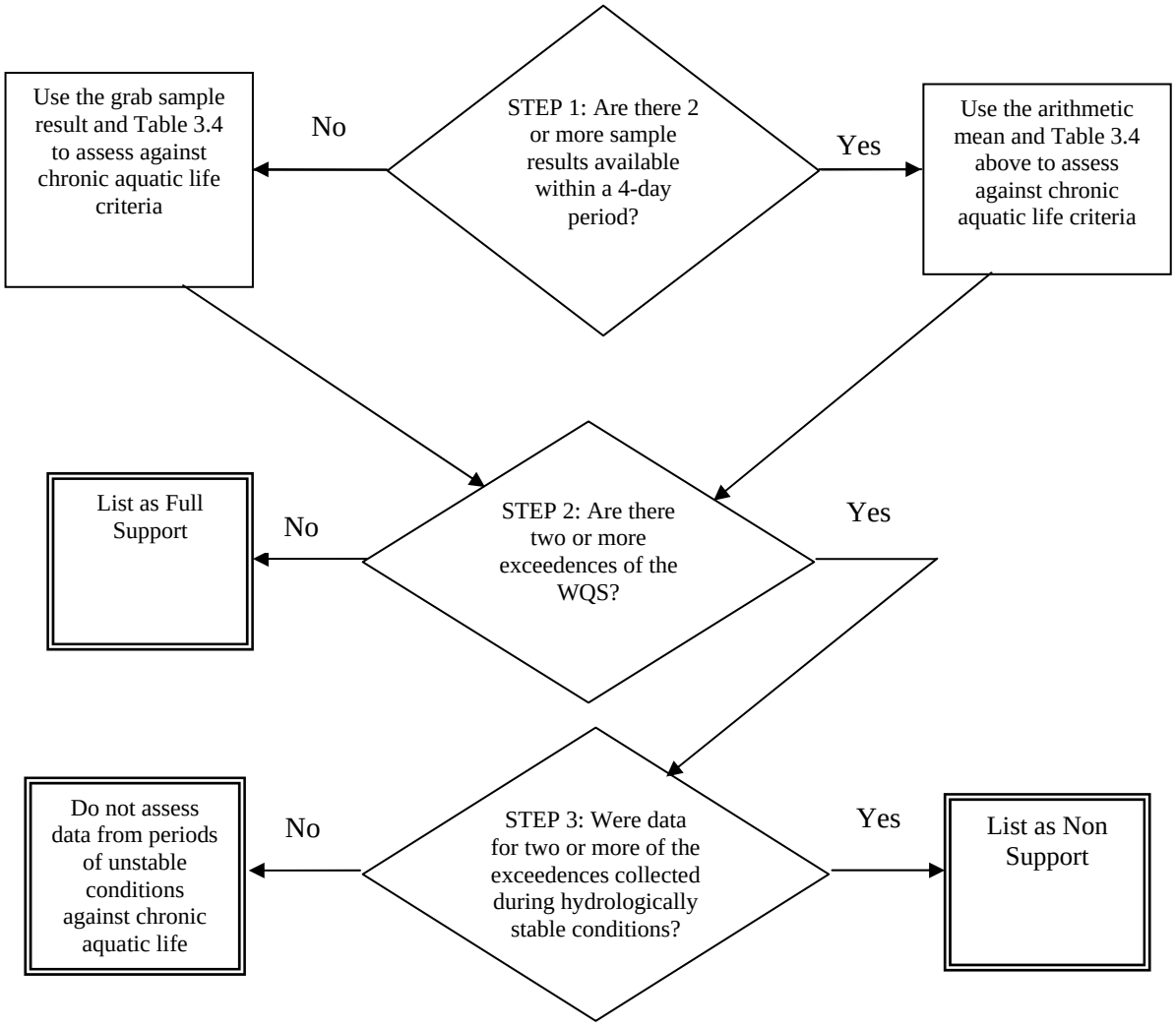

Figure 3.1 *(from Main AP).* Decision process for assessing against chronic aquatic life criteria

Revised 19 June 2009 (JH)

Page of Assessor:_____

Date of Assessment: _____ Date of Assessment Protocol used**:** _____ Date of WQS used: _____

Individual Chemical/ Physical Data (*except chronic AL use*) or E.coli Assessment Form

Study Year/Study Name: _____

1. Name of assessment unit (AU) in the SWQB WQ database or 303d/305b list: _____
2. Station Name(s): _____
3. Segment number from NM WQ standards: _____
4. Parameter*: _____
5. Designated use(s)** and associated criteria: _____
6. Evaluation of data, ***expressed as the number of exceedences/number of samples***:

Data Source	Spring (Mar – May)	Summer (Jun - Aug)	Fall (Sept - Nov)	Winter (Dec - Feb)	Exceedence Ratio (# exceedences/#samples)
SWQB Station: _____	_____	_____	_____	_____	_____
SWQB Station: _____	_____	_____	_____	_____	_____
Outside data source: _____	_____	_____	_____	_____	_____
Outside data source: _____	_____	_____	_____	_____	_____
AU Totals	_____	_____	_____	_____	_____

9. Are there multiple stations in the AU?
   - ☐ No – complete number 8
   - ☐ Yes - are the use support designations for individual stations in agreement?
     - ☐ Yes – complete number 8
     - ☐ No – examine AU breaks and reassess, or provide comments below

10. What is the use support designation according to the SWQB Assessment Protocol:
    - ☐ Full support
    - ☐ Not supported
    - ☐ Not Assessed (n = 1***)

Additional comments about the assessment****:

_____

--**Attach data used to make impairment determination.** Any data qualifier codes from either the lab or SWQB must be included.

* If parameter is **Adjusted Gross Alpha**, include documentation regarding how the data were corrected.

** Do not use this form for assessment of chronic aquatic life uses.

*** Assessment of Domestic Water Supply is possible with n=1.

**** Note especially any single exceedence of a criterion

Revised 19 June 2009 (JH)

 Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used**:** _____ Date of WQS used: _____

Ambient Toxicity Monitoring Assessment Form

Study Year/Study Name: _____

1. Name of assessment unit (stream reach) in the SWQB WQ database or 303d/305b list: _____
2. List all ambient water toxicity monitoring test with significant differences compared to control:

Station(s) used in assessment	Date of test	Acute or chronic[a] test?	Number of tests with significant difference
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

2. Are there multiple stations in the AU?
   - ☐ No – complete number 3
   - ☐ Yes - are the use support designations for individual stations in agreement?
     - ☐ Yes – complete number 3
     - ☐ No – examine AU breaks and reassess, or provide comments below
3. What is the use support designation according to the SWQB Assessment Protocol:
   - ☐ Full support
   - ☐ Not supported

Additional comments about the assessment:

_____

[a]Chronic test durations are 7 days, while acute tests are 4 days according to USEPA Region 6.
-- Attached printout of data related to this from http://www.epa.gov/earth1r6/6wq/ecopro/watershd/monitrng/toxnet/nm.pdf

Revised 19 June 2009 (LG)

 Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used**:** _____ Date of WQS used: _____

Sedimentation/Siltation (Stream Bottom Deposit) Assessment Form

Study Name and Year: _____

Assessment Unit: _____

Station ID:	Lat.:	Long.:	Watershed Area:	Elevation:	Ecoregion:
_____	_____	_____	_____	_____	__
Reference Station ID:	Lat.:	Long.:	Watershed Area:	Elevation:	Ecoregion:
_____	_____	_____	_____	_____	__

Circle ecoregion (Level III):
21 – Southern Rockies 22 – NM/AZ Plateau 23 - AZ/NM Mountains 24 - Chihuahuan Desert
25 – Western High Plains 26 – Southwestern Tablelands

Comments: on Reference Site selection and/or Study Site

Percent Fines at Station: __ Percent Fines at Reference: __ **%Increase**: ____

If ecoregion 21 or 23:
M-SCI Bio Score at Station: __
If ecoregion 22, 24, 25, or 26:
RBP Bio Score at Station:__ RBP Bio score at Reference: __ **RBP Bio Score as a % of Ref: __**

What is the use support designation according to the SWQB Assessment Protocol:

Biological / **Physical**	**Impaired (Non Support)** RBP Index < 79% of ref [1] M-SCI Score < 56.70 [2]	**Non-impaired (Full Support)** RBP Index > 84% of ref [1] M-SCI Score > 56.70 [2]
Non-Support Percent Fines >28% increase over reference	☐ Non-Support	☐ Full Support
Full Support Percent Fines <27% increase[3] over reference	☐ Full Support (Sedimentation/Siltation); ☐ Non-Support (Unidentified Biological Impairment)[4]	☐ Full Support

[1] RBP Index should be used in Ecoregions 22, 24, 25, and 26. RBP Index score based on Plafkin et al. (1989). The 4% gap allows for some best professional judgment.

[2] M-SCI should be used in Ecoregions 21 and 23. M-SCI and Score based on Jacobi et al. (2006).

[3] Raw percent values of ≤20% fines (pebble counts) at a study site should be evaluated as fully supporting regardless of the percent attained at the reference site.

[4] Reduction in the relative support level for the aquatic life use in this particular matrix cell is probably not due to sediment. It is most likely the result of some other impairment (temperature, D.O., pH, toxicity, etc.), alone or in combination with sediment. Label as Category 5C on the Integrated §303(d)/305(b) list to indicate that further study is needed.

Additional comments about the assessment: _____

*Attach associated pebble count and benthic macroinvertebrate raw or summary data / metrics.

Revised 4 January 2008 LG)

Page of Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

Temperature Data Logger (Thermograph) Assessment Form

Year/Watershed: _____

Assessment Unit: _____

Station name: _____ **STORET ID:** _____

Lat: N _____ **Lon:** W _____

Thermograph file name: _____

WQS segment: 20.6.4. ___ **Aquatic Life use:** _____

First data point: Date/Time

Last data point: Date/Time

Recording interval: 1 hr. **Data points:** n = _____

Criterion: °C **Segment specific and higher than default?** ☐ no ☐ yes

Maximum recorded: °C **Exceedences of criterion:** n =

High Quality Cold: > 3°C above default criterion (or above segment specific criterion)? ☐ no ☐ yes

Cold/Marginal Cold: > 4°C above default criterion (or above segment specific criterion)? ☐ no ☐ yes

Warm/Marginal Warm: Any excursion above criterion? ☐ no ☐ yes

High Quality Cold: Criterion exceeded ≥ 4 consecutive hours for > 3 consecutive days? ☐ no ☐ yes

Cold/Marginal Cold: Criterion exceeded ≥ 6 consecutive hours for > 3 consecutive days? ☐ no ☐ yes

Use support designation: ☐ **Supporting** ☐ **Non-supporting**

Comments:

Revised 16 March 2009 (GS)

 Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

pH and Dissolved Oxygen Sonde Data Assessment Form

Year/Watershed: _____

Assessment Unit: _____

Station name: _____

STORET ID: _____

Lat: N _____ **Lon:** W _____ **Elevation:** ____ m

WQS segment: 20.6.4. ___ **Designated use:** _____

Sonde data file name: _____

First data point: Date/Time

Last data point: Date/Time

Recording interval: 1 hr. **Data points:** n = _____

---

pH Assessment

Criterion range: ☐ 6.6 – 8.8 ☐ 6.6 – 9.0 ☐ Other (specify)

Minimum recorded: _____ **Maximum recorded:** _____ **≥ 0.5 units above criterion?** ☐ no ☐ yes

Number of data points outside criterion: ___ **% data points outside criterion:** ____

Maximum contiguous duration outside criterion: ___ hours

Use support designation: ☐ Supporting ☐ Non-supporting

Dissolved Oxygen Assessment

Applicable value: ☐ coldwater (early life stages) 8.0 mg/L; 95% **OR** 85%

☐ coldwater (other life stages) 6.0 mg/L; 90% **OR** 75%

☐ warmwater (all life stages) 5.0 mg/L; 90% **OR** 75%

Combined instantaneous minimum: _____ mg/L; ____ % saturation Exceedences: n = ___ ; ____ %

Percent saturation instantaneous minimum: _____ Exceedences: n = ___ ; ____ %

Combined values exceeded for ≥ 4 hours contiguously? ☐ no ☐ yes

Minimum % saturation exceeded for ≥ 4 hours contiguously? ☐ no ☐ yes

Use support designation: ☐ Supporting ☐ Non-supporting

Information pertinent to nutrient assessment:

Below DO concentration minimum? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

> 120% saturation? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

< 75% saturation? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

Comments:_____

Revised 27 February 2009 (GS)

Page of Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

Level II Nutrient (Office) Assessment Worksheet

Sonde: Use the *Protocol for Assessment of Large pH Data Sets* and the *Protocol for Assessment of Dissolved Oxygen Data Collected with Continuous Recording Devices* to assess pH and D.O. if multiple day Sonde data are available. Attach Assessment Form. If sonde data are not available, use grab sample data to calculate an exceedence ratio for pH, local D.O. percent saturation, and D.O. concentration.

Site Location: _____	
Multiple-day Deployment	**Grab Samples**
Assessment of dissolved oxygen:	D.O. % saturation exceedence ratio: _____
☐ Supporting ☐ Not supporting	
Assessment of large pH datasets :	D.O. minimum exceedence ratio: _____
☐ Supporting ☐ Not supporting	
DO fluctuations > 3mg/L: ☐ Yes ☐ No	pH exceedence ratio: _____
Notes: _____	

Nutrient Survey Water Chemistry: attach updated nutrient report from SWQB database and calculate the exceedence ratio for the entire assessment unit.

Total Nitrogen (mg/L)	Total Phosphorus (mg/L)
Ecoregion/ALU Threshold (see Table 1): _____	Ecoregion/ALU Threshold (see Table 1): _____
Exceedence Ratio: _____	Exceedence Ratio: _____
Notes: _____	

Algal Sampling: record results of chlorophyll *a*.

Ecoregion chlorophyll *a* threshold value in μg/cm^2 (see Table 4 of Appendix E): _____
Chlorophyll *a* (μg/cm^2): _____
Notes: _____

Benthic Diatoms (OPTIONAL): see notes on following page.

Date: _____ Sample method: _____
Reference site: _____
Stream Condition Index (SCI) Score: _____
Notes: _____

Algal Bioassays (OPTIONAL): Attach results.

Date collected: _____	Limiting nutrient: _____
Algal productivity: ☐low ☐moderate ☐moderately high ☐high	
Notes: _____	

NOTES: Total Nitrogen is calculated by adding Total Kjeldahl Nitrogen plus Nitrate + Nitrite. In the event that Nitrate + Nitrite or Total Kjeldahl Nitrogen is below the detection limit, a value of one half the detection limit will be used (Gilbert 1987).

Put NA (not available) in boxes for parameters that were not collected. Benthic diatom indicators will be added to the assessment once an index is developed and threshold values are verified for New Mexico.

Comments:_____

Revised 4 January 2008 (LG)

 Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

Level II Nutrient Assessment Form (using Threshold Values)

Assessment Unit: _____	
Site Location(s): _____	
	Ecoregion: _____
	Aquatic life Uses: _____

An Assessment Unit will be determined to be not supporting if **three or more** of the following indicators are present (if not all of the indicators have been measured, the presence of two of the following indicators will be assessed as not supporting). Check all indicators that exceed the threshold values below.

- ☐ Total nitrogen is above the ecoregion/ALU threshold in >15% of samples
- ☐ Total phosphorus is above the ecoregion/ALU threshold in >15% of samples
- ☐ Dissolved Oxygen threshold is exceeded
  - (☐) determined to be **not supporting** using the assessment protocol for Data Collected with Continuous Recording Devices
  - (☐) >15% of grab samples exceeded 120%
  - (☐) >15% of grab samples are below the applicable standard
- ☐ pH threshold is exceeded
  - (☐) determined to be **not supporting** using the assessment protocol for large pH data sets
  - (☐) >15% of grab samples exceeds appropriate criterion
- ☐ The Algal Bioassay indicates moderately high or high algal production
- ☐ Chlorophyll *a* ecoregion threshold is exceeded

Check One:	☐ Fully supporting	☐ Not supporting
Notes: _____		

Comments:_____

Revised 4 January 2008 (LG)

 Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

Level II Nutrient Assessment Form (using a Reference Site)

Assessment Unit: _____	
Site Location(s): _____	
Reference Site: _____	
	Ecoregion: _____
	Aquatic life Uses: _____

If the study reach is believed to have naturally high productivity because of geology, flow regime, or other natural factors, a reference site approach may be used. An Assessment Unit will be determined to be **not supporting** if **two or more** of the following indicators of the study site are notably different from those of the reference site. If the number of samples from each site is sufficient (n is >4), then the rank-sum test (a.k.a. Wilcox or Mann-Whitney test) will be used to test if there is a high (>75%) probability that the study site is different than the reference site. If the number of measurements is ≤4, then best professional judgment utilizing the general guidelines in the table from the "notes" section below will be used to determine if the parameters are different at the sites.

Indicator	Reference Site	Study Site
D.O. saturation exceedence ratio*	_____	_____
pH exceedence ratio*	_____	_____
DO concentration exceedence ratio*	_____	_____
Total nitrogen exceedence ratio	_____	_____
Total phosphorus exceedence ratio	_____	_____
Chlorophyll *a* concentration	_____	_____
Algal Bioassay algal production	_____	_____

* the exceedence ratio for large data sets refers to the number of days with exceedences divided by the number of full days that the sonde was deployed, not the number of data points. Use grab sample data if multiple day Sonde data is not available for both sites.

Check One:	☐ **Fully supporting**	☐ **Not supporting**
Notes: _____		

NOTES: Put NA (not available) in boxes for parameters that were not collected. Complete and attach a Level II Nutrient Assessment Worksheet for the reference site as well as the study site.

The table below provides general guidelines of what constitutes a "difference" between the reference and study site for parameters with < 5 measurement.

Indicator	Reference Site	Study Site
D.O. saturation exceedence ratio	_____	> 1 exceedence more than reference
pH exceedence ratio	_____	> 1 exceedence more than reference
DO concentration exceedence ratio	_____	> 1 exceedence more than reference
Total nitrogen exceedence ratio*	_____	> 1 exceedence more than reference*
Total phosphorus exceedence ratio*	_____	> 1 exceedence more than reference*
Chlorophyll *a* concentration	_____	≥20% difference
Algal Bioassay algal production	_____	≥ 1 classification higher than reference

* Also consider how much greater the concentrations are at the study site, and how close the concentrations are to the detection limit (d.l.). If one or both of concentrations are <2 times the d.l., then a value of 4 times the reference site concentration would be considered "different". If the concentrations are >2 times the d.l. then a value 2 times the reference concentration would be considered "different."

Comments:_____

Revised 4 January 2008 (LG)

Page of Assessor:_____

Date of Assessment: _____ Date of Assessment Protocol used**:** _____ Date of WQS used: _____

Turbidity Assessment Form

Study Year/Study Name: _____

1. Name of assessment unit (AU) in the SWQB WQ database or 303d/305b list: _____
2. Station Name(s): _____
3. Segment number from NM WQ standards: _____
4. Parameter: Turbidity
5. Interim numeric translator for Attachment A of Interim Turbidity Protocol: _____
6. Evaluation of data:

STEP 1: Physical Assessment using Numeric Turbidity Translators

Complete table with data ***expressed as the number of exceedences/number of samples***:

Data Source	Spring (Mar – May)	Summer (Jun - Aug)	Fall (Sept - Nov)	Winter (Dec - Feb)	Exceedence Ratio (# exceedences/#samples)
SWQB Station: _____	_____	_____	_____	_____	_____
SWQB Station: _____	_____	_____	_____	_____	_____
Outside data source: _____	_____	_____	_____	_____	_____
Outside data source: _____	_____	_____	_____	_____	_____
AU Totals	_____	_____	_____	_____	_____

STEP 2: Do turbidity data indicate Full Support?

☐ Yes – Skip to item 7 below

☐ No

Are benthic macroinvertebrate data available?

☐ No – Skip to item 7 below and noted as 5C

☐ Yes – Complete STEP 3

STEP 3: Combined Physical and Biological Assessment

Table 3. Combined assessment matrix for determining aquatic life use support

Physical \ Biological	**Impaired (Non Support)** RBP Index < 79% of ref [1] M-SCI Score < 56.70 [2]	**Non-impaired (Full Support)** RBP Index > 84% of ref [1] M-SCI Score > 56.70 [2]
Non-Support **A)** 1 to 7 samples: more than one exceedence of numeric turbidity translator **B**) ≥ 7 samples: numeric turbidity translator exceeded in ≥ 15% of measurements.	☐ Non-Support	☐ Full Support
Full Support **A)** 1 to 7 samples: no more than one exceedence of the numeric turbidity translator. **B**) ≥ 7 samples: numeric turbidity translator exceeded in <15% of measurements.	☐ Full Support (Turbidity) *Benthic macroinvertebrates not assessed*	

[1] RBP Index should be used in Ecoregions 22, 24, 25, and 26. RBP Index score based on Plafkin et al. (1989). The 4% gap allows for some best professional judgment.
[2] M-SCI should be used in Ecoregions 21 and 23. M-SCI and Score based on Jacobi et al. (2006).

11. Are there multiple stations in the AU?
☐ No – complete number 8

☐ Yes - are the use support designations for individual stations in agreement?

☐ Yes – complete number 8

☐ No – examine AU breaks and reassess, or provide comments below

12. What is the use support designation according to the SWQB Assessment Protocol:

☐ Full support

☐ Not supported (5C - no macroinvertebrate data)

☐ Not supported (5A – macroinvertebrate data confirmed)

☐ Not Assessed (n = 1)

Additional comments about the assessment*:

_____

--**Attach data used to make impairment determination.** Any data qualifier codes from either the lab or SWQB must be included.
* Note especially any single exceedence of a criterion

30 June 2009 (LG)

Attachment B-2: Assessor's Worksheet

Assessor's Worksheet

Study Name: _____ **Year:**_____

Assessor:_____ **Date of assessment completion:** _____

Specific data type covered by this worksheet (mark all that apply):

☐ **Chem/Physical** ☐ **Ambient Tox** ☐ **Bio/Hab** ☐ **Large Data Set** ☐ **Nutrient** ☐ **Turbidity**

Step 1: Data collation and verification/validation

Were all applicable data verification and validation steps completed for the SWQB data identified above in accordance with the procedures described in the most recent SWQB QAPP?

☐ Yes Date of QAPP used: _____ Date V/V completed: _____
☐ No **STOP** -- DATA VERIFICATION AND VALIDATION MUST BE COMPLETED PRIOR TO ASSESSMENT.
☐ N/A Why? _____

Were all readily-available data, quality data identified and collated prior to assessment of data (example – USGS data)?

☐ Yes

Were these outside data checked for quality? To be considered for development of the Integrated List, these data must, at a minimum, meet the QA/QC requirements described in the SWQB's *Quality Assurance Project Plan for Water Quality Management Programs 2007* (QAPP). Particular emphasis should be placed on ensuring that the analytical methods used meet the requirements specified in Section 2.4 of this QAPP, that the methods of data collection were the same as or comparable to those included in the Standard Operating Procedures (SOPs) referenced throughout this QAPP, and that the QC criteria used to verify and validate the data were the same or similar to those listed in Table 2.4 and Appendix B of the QAPP.

☐ Yes
☐ No **STOP** -- DATA VERIFICATION AND VALIDATION MUST BE COMPLETED PRIOR TO ASSESSMENT.

☐ No **STOP** -- READILY-AVAILABLE QUALITY DATA MUST BE COLLATED PRIOR TO ASSESSMENT.

Step 2: Completion of assessment per data type

Are all data identified above assessed according to applicable instructions in most recent Assessment Protocol as assessed against the most recent WQS for each Assessment Unit in the study?

☐ Yes Date of Assessment Protocol(s) used: _____ Date of WQS used: _____
☐ No Explain why (data not available for all AUs, etc.): _____

Are applicable forms completely filled out?

☐ Yes ☐ No If not, explain why: _____

Are required data detailed at bottom of assessment forms attached and/or provided electronically?
☐ Yes ☐ No If not, explain why: _____

Step 3: Completeness of forms (fill out relevant subsection for data type(s) circled in intro)

A. Chemical/Physical Data –
Did you fill out the Summary Chemical/Physical Assessment Form for each AU for which there are available data?
☐ Yes ☐ No

Did you fill out separate Individual Chemical/Physical (chronic AL use) Assessment Forms for any parameter with 2 or more exceedences of the applicable chronic AL criterion?
☐ Yes ☐ No ☐N/A -- Chronic AL do not apply because Limited AL is the designated use

Did you fill out separate Individual Chemical/Physical (non-chronic AL use) Assessment Forms for data regarding any existing WQ impairment listing from the most recent Integrated Clean Water Act §303d/§305b list?
☐ Yes ☐ No ☐N/A (no previous impairment listings)

Did you fill out separate Individual Chemical/Physical Assessment Forms for any new WQ impairment determinations?
☐ Yes No ☐N/A (no new impairment listings)

B. Biological/Habitat Data–
Did you fill out the Sedimentation/Siltation (Stream Bottom Deposit) Assessment Form for each AU for which there are available data?
☐ Yes ☐ No

C. Large Data Sets (Thermograph and Sonde)–
Did you fill out the Temperature Data Logger (Thermograph) Assessment Form for each AU for which there are available data?
☐ Yes ☐ No

Did you fill out the pH and Dissolved Oxygen Sonde Data Assessment Form for each AU for which there are available data?
☐ Yes ☐ No

D. Nutrient Assessment Set Data --
Did you fill out Level I Nutrient Assessment Forms for each AU for which there are available data?
☐ Yes ☐ No

Did you fill out the applicable Level II Nutrient Assessment Worksheet for each AU for which there are available data?
☐ Yes ☐ No

- -

COMPLETION OF ASSESSMENT PROCESS

After the above steps have been completed, save and print the worksheet, attach all assessments and applicable supplemental information, sign below, and give the electronic Administrative Record (via your public directory) and worksheet to the Assessment Coordinator.

I acknowledge that the assessment process for the above data type has been completed in accordance with the most recent EPA-approved WQ standards (20.6.4 NMAC) and the most recent Assessment Protocols.

______________________________ ______________
Assessor's Signature Date

Attachment B-3: Assessment Verification Worksheet

Assessment Verification Worksheet

Study Name: _____ **Year:_____**

Assessor:_____ **Date of assessment completion: _____**

Assessment verifier:_____ **Date of assessment verification:_____**

Specific data type covered by this worksheet (check all that apply):

☐ **Chem/Physical** ☐ **Ambient Tox** ☐ **Bio/Hab** ☐ **Large Data Set** ☐ **Nutrient** ☐ **Turbidity**

NOTE: During verification of assessments, it is assumed that all relevant data have been compiled and that the data validation process or any other QA procedures were correctly performed.

Step 1: Verify most recent WQS and Assessment Protocols were utilized

Were the most recent EPA-approved applicable WQS used for these assessments?
☐ Yes ☐ No Date of WQS used: _____

Were the most recent SWQB Assessment Protocols used for these assessments?
☐ Yes ☐ No Date of Assessment Protocol(s) used: _____

If no to either of these, data assessments must be re-done if the changes to either the applicable WQS or Assessment Protocols would result in different impairment conclusions based on application of the same data. Discuss with Assessor and Assessment Coordinator.

Step 2: Verify correct application of assessment protocols

Are all data identified above correctly assessed according to instructions in most recent Assessment Protocol?
☐ Yes ☐ No

If not, were appropriate corrections made on the applicable Assessment Form?
☐ Yes ☐ No

Were these corrections discussed with the original data assessor?
☐ Yes ☐ No

Step 3: Verify completeness of forms

Are applicable forms completely filled out?
☐ Yes ☐ No If not, discuss deficiencies with original data assessor.

Are required data detailed at bottom of assessment forms attached and/or provided electronically?
☐ Yes ☐ No If not, acquire from original data assessor.

A. Chemical/Physical Data –

Are there separate Summary Chemical/Physical Assessment Forms for <u>each</u> AU for which there are available data?
☐ Yes ☐ No

Are there separate Individual Chemical/Physical (chronic AL use) Assessment Forms for any parameter with 2 or more exceedences of the applicable chronic AL criterion?
☐ Yes ☐ No ☐ N/A -- Chronic AL do not apply because Limited AL is the designated use

Are there separate Individual Chemical/Physical (non-chronic AL use) Assessment Forms for data regarding any <u>existing</u> WQ impairment listing from the most recent Integrated Clean Water Act §303d/§305b list?
☐ Yes ☐ No ☐ N/A (no existing impairment listings)

Are there separate Individual Chemical/Physical Assessment Forms assessment forms for any new WQ impairment listings?
☐ Yes ☐ No ☐ N/A (no new impairment listings)

B. Biological/Habitat Data–
Are there separate Sedimentation/Siltation (Stream Bottom Deposit) Assessment Forms for each AU where there are available data? ☐ Yes ☐ No

Are site characteristics (such as watershed area and elevation) comparable between reference and study site? ☐ Yes ☐ No If not, discuss with assessor and Bio/Hab Team survey lead.

C. Large Data Sets (Thermograph and Sonde)–
Are there separate Temperature Data Logger (Thermograph) Assessment Forms for each AU for which there are available data?
☐ Yes ☐ No

Are there separate pH and Dissolved Oxygen Sonde Data Assessment Forms for each AU for which there are available data?
☐ Yes ☐ No

D. Nutrient Assessment Set Data --
Are there separate Level I Nutrient Assessment Forms for each AU for which there are available data?
☐ Yes ☐ No

Are there separate applicable Level II Nutrient Assessment Worksheet for each AU for which there are available data?
☐ Yes ☐ No

- -

COMPLETION OF ASSESSMENT VERIFICATION PROCESS

After the above steps have been completed, save and print the worksheet, attach all assessments and applicable supplemental information, sign below, and give the electronic Administrative Record (via your public directory) and worksheet to the Assessment Coordinator.

I acknowledge that the assessment verification process for the above data type has been completed.

_____ _____
Assessment Verification Signature Date

APPENDIX C

TEMPERATURE ASSESSMENT PROTOCOL

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JUNE 19, 2009

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Purpose and Applicability

This document establishes an assessment protocol for determining impairment due to excessively high temperature in streams, rivers, lakes, and reservoirs. This protocol is not applicable to the following water body types because the research and implementation procedures necessary have not been investigated or developed by the Surface Water Quality Bureau (SWQB):

- Ephemeral streams
- Wetlands

1.0 Background

Prior to 1998, temperature monitoring by SWQB was limited to instantaneous measurements taken by a staff member conducting a water quality survey. Water temperature was routinely measured once during each site visit, and designated use support status related to temperature criteria was determined by applying a percent-of-exceedences formula to these instantaneous temperature data. This resulted in limited information concerning actual dynamics of temperature in New Mexico waters. Periodic instantaneous temperature data do not provide information on maximum daily temperatures, duration of excessive temperatures, or the diurnal and seasonal fluctuations of water temperature aspects pertinent to aquatic life use.

During 1998, the SWQB began using continuously-recording temperature data loggers (i.e., thermographs), to collect more complete temperature data. Thermographs provide an extensive multiple-day record of hourly temperatures over the critical time period when temperatures are generally highest. These devices may be deployed for extended periods of time, and collect data at preset intervals. SWQB protocols for use of these devices call for deployment during the critical summer period of June through August, with a data collection interval of no more than one hour (NMED/SWQB 2007). Following deployment, devices were collected and data were downloaded and interpreted. Data review at that time indicated only one stream (Sulphur Creek) of more than 20 evaluated in 1998 had no exceedences of the 20°C standard. Many of these monitoring sites were established on what were considered to be minimally-impacted stream reaches. These preliminary results seemed to indicate that the streams evaluated had temperatures that may not support their coldwater fishery designated use.

Procedures for assessing designated use support were conducted using 1997 SWQB protocols. Under these protocols, all physical parameters, including temperature, were evaluated based on a percent-of-exceedences formula. Review of data generated by thermographs brought into question the usefulness of this method of evaluation, as it did not recognize a maximum allowable temperature. In response, SWQB initiated an effort to review current temperature criteria and to determine the most appropriate method to monitor and assess potential aquatic life use impairment due to elevated water temperature. This effort involved: 1) convening an interdisciplinary multiagency workgroup to review existing scientific literature and US Environmental Protection Agency (EPA) guidance in order to recommend methods to assess current temperature criteria, and 2) development of a standard operating procedure for deployment of thermographs during intensive water quality surveys.

The Workgroup was comprised of representatives from the EPA Region 6, the US Department of Interior, Fish and Wildlife Service – New Mexico Ecological Services Field Office, New Mexico Department of Game and Fish – Conservation Services and Fisheries Management Divisions, and SWQB. The Workgroup held four meetings beginning in December 1998. The Workgroup's task was to develop an assessment protocol for high quality cold water and cold water aquatic life designated uses that would evaluate designated use support status of New Mexico streams using detailed temperature data collected by SWQB. The Workgroup was informed of implementation of new sampling procedures and given a general summary of preliminary results. It was SWQB's wish that the Workgroup develop an assessment protocol independent of any data or *a priori* beliefs that could have been developed from a review of data collected. For this reason, the Workgroup was not given any specific thermograph data, nor were members made aware of specific data collection sites.

The Workgroup decided to conduct a literature review, and to base any recommendations on results of this review and internal discussions held with other agency or department staff. Information collected, that formed the basis for recommendations, is summarized in Attachment A, along with the specific conclusions of the Workgroup.

2.0 Assessment of Temperature Data to Determine Aquatic Life Use Support

Given the broad literature support for temperature evaluations employing a concept of short-term thermal maximum and long-term average value, the Workgroup recommended such an approach be applied in New Mexico. Because the current default criterion for high quality coldwater aquatic life (HQCWAL) and coldwater aquatic life (CWAL) uses is 20°C, this value was used as the basis of the assessment protocol proposed by the Workgroup and can be considered the proposed temperature value that protects against chronic impacts. The instantaneous temperature values proposed below can be considered the values necessary to protect against acute impacts (acute, as used in this document, does not necessarily mean resulting in death of organisms).

SWQB has been deploying thermographs and applying the recommendations of the Workgroup since the 2000-2002 CWA §303(d) listing cycle. This protocol is more technically defensible than simply applying percentages to limited instantaneous temperature data, and better addresses the intent of the Clean Water Act to use best available technology as well as incorporate magnitude, frequency, and duration concerns into water quality monitoring, assessment, and standards development. This protocol addresses biases introduced when using instantaneous data to assess water quality parameters with significant diurnal fluctuation. Based on the success of this effort, SWQB is exploring the steps necessary to potentially incorporate these changes into the water quality standards and to initiate additional efforts to address other parameters with known diurnal fluxes, such as pH and dissolved oxygen.

The specific recommendations regarding thermograph assessments from the Workgroup for HCWAL and CWAL are presented below in Tables 1.0 and 2.0. Recently, SWQB has consulted with staff from various state and federal agencies to develop assessment procedures for the remaining aquatic life uses. The general consensus resulting from these consultations is that extending the CWAL assessment protocol to include MCWAL is appropriate, as 25°C (the default temperature for MCWAL) approximates a reasonable chronic criterion for fish whose tolerances fall between cold water and warm water species, and 29°C (*i.e.*, 4°C above the default criterion) approximates a reasonable acute criterion for fish with intermediate temperature tolerance. Additionally, there is general consensus that 32.2°C

approximates a reasonable acute criterion for most warm water fish species (see Table 3.0 below). This is the default criterion for warmwater aquatic life (WWAL) and marginal warm water aquatic life (MWWAL) uses in New Mexico's current WQS (NMWQCC 2007). Slight revisions of these values may be appropriate in the future as water quality standards and numeric criteria are revised.

For some water quality standards segments, segment-specific temperature criteria have been established. In almost all of these segments, the criteria approximate a reasonable acute value, hence the exception noted in Tables 1.0 and 2.0.

The assessment tables also provide information on how to assess grab data if no thermograph data are available. Thermograph data takes precedence over grab data in all cases and is preferred. During reproductive seasons, temperatures must not impede successful migration, egg incubation, fry rearing, and other reproductive functions of target species. Sampling for assessment of these criteria will be accomplished using continuously recording thermographs with a maximum interval of one hour. Data will be collected from at least June through August for any aquatic life use when possible.

Table 1.0 Interpreting temperature data to assess HQCWAL Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
Instantaneous (grab) temperature data			
A) Lotic waters (e.g., rivers or streams)	A) Not assessable (cannot determine fully supporting with grab data only).	A) Any exceedence more than 3.0°C above the applicable temperature criterion (see exception below, which applies in this case).	See 20.6.4.14 NMAC Subsection C Paragraph (3) for additional information regarding lake sampling.
B) Lentic waters (e.g., lakes or reservoirs)	B) No exceedences more than 3.0°C above the applicable criterion and no more than one exceedence of the applicable criterion.	B) Any exceedence more than 3.0°C above the applicable criterion or more than one exceedence of the applicable criterion.	
•**Thermograph data**	Instantaneous (hourly) temperatures do not exceed 3.0°C above the applicable criterion, and temperatures do not exceed the applicable criterion for four or more consecutive hours in a 24-hour cycle for more than three consecutive days. **EXCEPTION**: When a segment specific criterion is higher than the default criterion as defined in 20.6.4.900, temperature does not exceed the segment specific criterion at any time.	Instantaneous (hourly) temperatures exceed 3.0°C above the applicable criterion, or temperatures exceed the applicable criterion for four or more consecutive hours in a 24-hour cycle for more than three consecutive days. **EXCEPTION**: When a segment specific criterion is higher than the default criterion as defined in 20.6.4.900, temperature exceeds the segment specific criterion at any time.	

Table 2.0 Interpreting temperature data to assess CWAL and MCWAL Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
Instantaneous (grab) temperature data **A)** Lotic waters (e.g., rivers or streams)	A) Not assessable (cannot determine fully supporting with grab data only).	A) Any exceedence more than 4.0°C above the applicable criterion (see exception below, which applies in this case).	See 20.6.4.14 NMAC Subsection C Paragraph (3) for additional information regarding lake sampling.
B) Lentic waters (e.g., lakes or reservoirs)	B) No exceedences more than 4.0°C above the applicable criterion and no more than one exceedence of the applicable criterion.	B) Any exceedence more than 4.0°C above the applicable criterion or more than one exceedence of the applicable criterion	
•**Thermograph data**	Instantaneous (hourly) temperatures do not exceed 4.0°C above the applicable criterion, and temperatures do not exceed the applicable criterion for six or more consecutive hours in a 24-hour cycle for more than three consecutive days. **EXCEPTION**: When a segment specific criterion is higher than the default criterion as defined in 20.6.4.900, temperature does not exceed the segment specific criterion at any time.	Instantaneous (hourly) temperatures exceed 4.0°C above the applicable criterion, or temperatures exceed the applicable criterion for six or more consecutive hours in a 24-hour cycle for more than three consecutive days. **EXCEPTION**: When a segment specific criterion is higher than the default criterion as defined in 20.6.4.900, temperature exceeds the segment specific criterion at any time.	

Table 3.0 Interpreting temperature data to assess WWAL or MWWAL Use Support

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
Instantaneous (grab) temperature data **A**) Lotic waters (e.g., rivers or streams)	**A**) Not assessable (cannot determine fully supporting with grab data only)	**A**) Any exceedence of the applicable criterion.	
B) Lentic waters (e.g., lakes or reservoirs)	**B**) No exceedences of the applicable criterion	**B**) Any exceedence of the applicable criterion.	
•**Thermograph data**	Applicable criterion not exceeded at any time.	Applicable criterion exceeded at any time.	

Attachment A. Workgroup Process and Findings

I. Introduction

Water temperature influences the metabolism, behavior, and mortality of fish and other aquatic organisms that affect fish. Natural temperatures of a waterbody fluctuate daily and seasonally. These natural fluctuations do not eliminate indigenous populations, but may affect existing community structure and geographical distribution of species. In fact, such temperature cycles are often necessary to induce reproductive cycles and may regulate other aspects of life history (Mount, 1969). Behnke and Zarn (1976), in a discussion of temperature requirements for endangered western native trout, recognized that populations cannot persist in waters where maximum temperatures consistently exceed 21-22°C, but they may survive brief daily periods of higher temperatures (25.5-26.7°C). Anthropogenic impacts can lead to modifications of these natural temperature cycles, often leading to deleterious impacts on the fishery. Such modifications may contribute to changes in geographical distribution of species and their ability to persist in the presence of introduced species.

II. Review of the EPA Criteria Document for Temperature

Following is a summary of temperature information from EPA's September 1988 document "*Water Quality Standards Criteria Summaries: A Compilation of State/Federal Criteria*."

Preamble: Temperature standards are set to control thermal pollution, or the amount of heated wastes discharged into a waterbody. The following guidelines were developed by the EPA and published in *"Quality Criteria for Water, 1986"* (Gold Book).

Freshwater Aquatic Life

For any time of year, there are two upper limiting temperatures for a location (based on the important sensitive species found there at that time):

1. One limit consists of a maximum temperature for short exposures that is time and species dependent, and

2. The second value is a limit on weekly average temperature that:

    a. In the cooler months, will protect against mortality of important species if the elevated plume temperature is suddenly dropped to the ambient temperature, with the limit being the acclimation temperature minus two °C when the lower lethal threshold temperature equals ambient water temperature;

or

    b. In the warmest months, is determined by adding to the physiological optimum temperature (for growth) a factor calculated as 1/3 of the difference between the ultimate upper incipient lethal temperature and the optimum temperature for the most sensitive species that are normally present at that location and time;

or

    c. During reproductive seasons, the limit is the temperature that meets site-specific requirements for successful migration, spawning, egg incubation, fry rearing, and other

reproductive functions of important species. These local requirements should supersede all other requirements when applicable;

or

d. There is a site-specific limit that is found necessary to preserve normal species diversity or prevent appearance of nuisance organisms.

Upper and lower limits have been established for many aquatic organisms. Tabulations of lethal temperatures for fish and other organisms are available. Factors such as diet, activity, age, general health, osmotic stress, and even weather contribute to the lethality of temperature. Aquatic species, thermal acclimation state, and exposure time are considered critical factors.

Effects of sublethal temperatures on metabolism, respiration, behavior, distribution and migration, feeding rate, growth, and reproduction have been summarized by De Sylva (1969). Brett (1960) illustrated that inside the tolerance zone, there is a more restrictive temperature range in which normal activity and growth occur, and an even more restrictive zone inside that in which normal reproduction occurs.

The upper incipient lethal temperature and the LT50 (the highest temperature at which 50% of a sample of organisms can survive) for any given species are determined at that species' highest sustainable acclimation temperature. Generally, the lower end of temperature accommodation for aquatic freshwater species is 0°C.

The following requirements are currently considered necessary and sufficient for development of a protective temperature criteria definition:

1. Maximum sustained temperatures are consistent with maintaining desirable levels of primary and secondary productivity.

2. Maximum levels of metabolic acclimation to warm temperatures that permit return to ambient winter temperatures should artificial sources of heat cease.

3. Time-dependent temperature limitations for survival of brief exposures to temperature extremes, both upper and lower.

4. Restricted temperature ranges for various states of reproduction, including (for fish) gametogenesis, spawning migration, release of gametes, development of embryo, commencement of independent feeding (and other activities) by juveniles, and temperature required for metamorphosis, emergence, or other activities of lower forms.

5. Thermal limits for diverse species composition of aquatic communities, particularly where reduction in diversity creates nuisance growth of certain organisms, or where important food sources are altered.

6. Thermal requirements of downstream aquatic life (in rivers) where upstream diminution of a coldwater resource will adversely affect downstream temperature requirements.

The temperature-time duration for short-term maximum (STM) exposure, such that there is 50%

survival, is expressed mathematically by fitting experimental data with a straight line on a semi-logarithmic plot. Time is shown on the log scale; temperature is on the linear scale. To provide for safety, an experimentally derived safety factor of 2°C is applied. In equation form, this is:

Equation 1. $STM = (\log(time)-a)/b$

Where:

STM = short-term maximum temperature
$\log_{10}$ = logarithm to base 10 (common log)
a = intercept on "y" axis (or logarithmic axis) of the line fitted to experimental data that is available for some species from Water Quality Criteria 1972, Appendix II-C (USEPA, 1972).
b = Slope of the line fitted to experimental data and available for some species from Water Quality Criteria 1972, Appendix II-C (USEPA, 1972).
time = minutes

For extensive exposure, the maximum weekly average temperature (MWAT) is expressed as:

Equation 2. $MWAT = OT + ((UUILT - OT)/3)$

Where:

MWAT = maximum weekly average temperature.
OT = a reported optimum temperature for the particular life state or function.
UUILT = ultimate upper incipient lethal temperature (the upper temperature at which tolerance does not increase with increasing acclimation temperature)

One caveat in determining maximum weekly average temperature is that the limit for short-term exposure must not be exceeded. Some calculated values are available in the literature for species considered important in New Mexico.

EPA Calculated Values for Maximum Weekly Average Temperatures for Growth and Short-term Maxima for Survival of Juveniles and Adults During Summer Months are given in the following table.

Species	Growth[a]	Maxima[b]
Rainbow trout	19	24
Brook trout	19	24
Brown trout	--	25

[a]Calculated according to the maximum weekly average formula (Equation 2).
[b]Based on the short term maximum formula (Equation 1), with acclimation at the weekly average temperature for summer growth (does not indicate exposure period).

III. Review of Other Literature References

Numerous literature references (Armour, 1991; USEPA, 1986) also recognize the concept of using short-term maxima and weekly average temperatures to protect for temperature effects on fisheries. Of primary importance are protections necessary to support reproducing populations of salmonids in stream segments designated as high quality coldwater aquatic life.

Armour (1991) cited the following findings for the calculated short-term maxima (STM) = (log of time - *a*)/*b*. Values for *a* and *b*, intercept, and slope of a line from experimental data, are taken from National Academy of Sciences, Water Quality Criteria (1972) for juvenile brook trout (*Salvelinus fontinalis*), where time = 120 min. This yields a calculated STM of 25.6°C (25.5°C for juvenile brown trout, *Salmo trutta*). To provide a margin of safety for all organisms, this value was reduced by 2°C, resulting in a calculated STM of 23.6°C.

This calculated STM value is consistent with data found in other literature. USEPA (1986) short-term lethal threshold for brook trout and rainbow trout (*Oncorhynchus mykiss*) is given as 24°C, after reduction by the 2°C safety factor. Grande and Andersen (1991) experimentally determined in controlled studies a LT50 for brook trout, brown trout, and rainbow trout to be 25.2°C, 26.2°C, and 26.6°C, respectively. Applying a safety factor of 2°C results in 23.2°C, 24.2 °C, and 24.6°C, respectively, which are similar to USEPA findings. Eaton (1995) developed a Fish Temperature Database Matching System (FTDMS) to document temperatures at which various species were found in natural settings. He reported a 95th percentile temperature (i.e. 95% of all individuals collected were found at temperatures below this value) of 22.3°C for brook trout, 24.1°C for brown trout, and 24.0°C for rainbow trout.

IV. Workgroup Recommendations

Given the broad literature support for temperature evaluations employing a concept of short-term thermal maximum and long-term average value, the Workgroup recommended such an approach be applied in New Mexico. Because the current default criterion for high quality coldwater and coldwater aquatic life uses is 20°C, this value was used as the basis of the assessment protocol and can be considered the proposed temperature value that protects against chronic impacts. The instantaneous temperature values proposed below can be considered the values necessary to protect against acute impacts.

The specific recommendations from the Workgroup are as presented below. During reproductive seasons, temperatures must not impede successful migration, egg incubation, fry rearing, and other reproductive functions of target species. Sampling for assessment of these criteria will be accomplished using continuously recording thermographs with a maximum interval of one hour. Data will be collected from at least June through August.

A. Temperature in High Quality Coldwater Aquatic Life (HQCWAL)

Full Support Instantaneous (hourly) temperatures do not exceed 3.0°C greater than the applicable temperature criterion, and temperatures do not exceed the applicable criterion for more than four consecutive hours in a 24-hour cycle for more than three consecutive days.

Non Support Instantaneous (hourly) temperatures exceed 3.0°C greater than the applicable temperature criterion, or temperatures exceed the applicable criterion for more than four consecutive hours in a 24-hour cycle for more than three consecutive days.

B. Temperature in Coldwater Aquatic Life (CWAL)

Full Support Instantaneous (hourly) temperatures do not exceed 4.0°C greater than the applicable temperature criterion, and temperatures do not exceed the applicable criterion for more than six consecutive hours in a 24-hour cycle for more than three consecutive days.

Non Support Instantaneous (hourly) temperatures exceed 4.0°C greater than the applicable temperature criterion, or temperatures exceed the applicable criterion for more than six consecutive hours in a 24-hour cycle for more than three consecutive days.

V. Other Recommendations

Additional recommendations by the Workgroup:

- Language should be included in any future standard indicating temperature limits are established to protect the entire aquatic community, not just fish species. (NOTE: The term "fishery" was changed to "aquatic life use" during the 2005 triennial review).
- Additional data should be collected on varying stream types, thought to be representative of least impacted streams, to establish an expected or reference range of temperatures.
- Fish population data should be collected on reference streams in order to evaluate appropriateness of designated uses.
- The need for a regionalized temperature standard should be reviewed.
- This proposal should be evaluated over time, and a new standard criterion should be developed from this review that will eventually be proposed to replace the single-value temperature criterion currently specified in the New Mexico Surface Water Quality Standards.

SWQB plans to re-convene the workgroup in 2008 to expand these magnitude and duration-based assessment approaches to cover other aquatic life uses (namely, marginal coldwater, warmwater, and marginal warmwater).

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* The date on the publication that DM Tarzwell edited is 1960, Brett's title conflicts.

Page of Assessor

Date of Assessment: Date of Assessment Protocol used**:** Date of WQS used:

Temperature Data Logger (Thermograph) Assessment Form

Year/Watershed:

Assessment Unit:

Station name: **STORET ID:**

Lat: N **Lon:** W

Thermograph file name:

WQS segment: 20.6.4. **Aquatic Life use:**

First data point: Date/Time

Last data point: Date/Time

Recording interval: 1 hr. **Data points:** n =

Criterion: °C **Segment specific and higher than default?** ☐ no ☐ yes

Maximum recorded: °C **Exceedences of criterion:** n =

High Quality Cold: > 3°C above default criterion (or above segment specific criterion)? ☐ no ☐ yes

Cold/Marginal Cold: > 4°C above default criterion (or above segment specific criterion)? ☐ no ☐ yes

Warm/Marginal Warm: Any excursion above criterion? ☐ no ☐ yes

High Quality Cold: Criterion exceeded ≥ 4 consecutive hours for > 3 consecutive days? ☐ no ☐ yes

Cold/Marginal Cold: Criterion exceeded ≥ 6 consecutive hours for > 3 consecutive days? ☐ no ☐ yes

Use support designation: ☐ **Supporting** ☐ **Non-supporting**

Comments:

Revised 16 March 2009 (GS)

Page of Assessor

Date of Assessment: Date of Assessment Protocol used**:** Date of WQS used:

Temperature Data Logger (Thermograph) Assessment Form

Year/Watershed:

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Station name: **STORET ID:**

Lat: N **Lon:** W

Thermograph file name:

WQS segment: 20.6.4. **Aquatic Life use:**

First data point: Date/Tim e

Last data point: Date/Tim e

Recording interval: 1 hr. **Data points:** n =

Criterion: °C **Segment specific and higher than default?** ☐ no ☐ yes

Maximum recorded: °C **Exceedences of criterion:** n =

High Quality Cold: > 3°C above default criterion (or above segment specific criterion)? ☐ no ☐ yes

Cold/Marginal Cold: > 4°C above default criterion (or above segment specific criterion)? ☐ no ☐ yes

Warm/Marginal Warm: Any excursion above criterion? ☐ no ☐ yes

High Quality Cold: Criterion exceeded ≥ 4 consecutive hours for > 3 consecutive days? ☐ no ☐ yes

Cold/Marginal Cold: Criterion exceeded ≥ 6 consecutive hours for > 3 consecutive days? ☐ no ☐ yes

Use support designation: ☐ **Supporting** ☐ **Non-supporting**

Comments:

Revised 16 March 2009 (GS)

APPENDIX D

SEDIMENTATION/SILTATION ASSESSMENT PROTOCOL FOR WADEABLE, PERENNIAL STREAMS

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JUNE 19, 2009

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Purpose and Applicability

This document establishes an assessment protocol for determining impairment due to excessive sedimentation/siltation (otherwise referred to as stream bottom deposits or SBD) in perennial, wadeable streams with representative riffle or run areas. This assessment is only conducted in wadeable perennial streams at this time because the existing research used to develop this assessment protocol is based upon data and information collected in perennial streams.

This protocol was developed to support an interpretation of the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* narrative standard for bottom deposits found at NMAC 20.6.4.13 (NMWQCC 2007):

> A. Bottom Deposits and Suspended or Settleable Solids:
> (1) Surface waters of the state shall be free of water contaminants including fine sediment particles (less than two millimeters in diameter), precipitates or organic or inorganic solids from other than natural causes that have settled to form layers on or fill the interstices of the natural or dominant substrate in quantities that damage or impair the normal growth, function, or reproduction of aquatic life or significantly alter the physical or chemical properties of the bottom.

This protocol is not applicable to the following water body types because the research and implementation procedures necessary have either not been investigated by SWQB or are not yet developed:

- Lakes, reservoirs, ponds, and playas
- Sand bed streams (generally defined as streams with a D84 of <2mm)
- Large rivers (non wadeable)
- Intermittent streams
- Ephemeral streams
- Wetlands

"Rivers" are defined as systems that cannot be monitored effectively with methods developed for wadeable streams and generally have drainage areas greater than 2,300 square miles. The systems included in the "rivers" waterbody type, and consequently exempt from this protocol, are: 1) the San Juan River from below Navajo Reservoir to the Colorado border near Four Corners, 2) the Animas River from the Colorado border to the San Juan River, 3) Rio Grande in New Mexico, 4) the Pecos River from below Sumner Reservoir to the Texas border, 5) the Rio Chama from below El Vado Reservoir to the Rio Grande, 6) the Canadian River below the Cimarron River , and 7) the Gila River below Mogollon.

This assessment protocol is a dynamic document that will be refined as more data are collected, enabling better definition of relationships between sedimentation and associated biological indicators in New Mexico streams. New Mexico has several initiatives in place in order to better define reference condition by Level II ecoregions (Commission for Environmental Cooperation 1997, 2006) and plans to initiate a Sediment Workgroup starting in early 2008 to develop a revised sedimentation assessment protocol for future listing cycles.

I. Introduction

Clean stream bottom substrates are essential for optimum habitat for many fish and aquatic insect communities. Excessive fine sediment, or substrate fining, occurs when biologically-important habitat components such as spawning gravels and cobble surfaces are physically covered by fines (Chapman and McLeod, 1987). Substrate fining results in decreased intergravel oxygen and reduced or eliminated quality and quantity of habitat for fish, macro invertebrates, and algae (Lisle, 1989; Waters, 1995). Chapman and Mcleod (1987) found that bed material size is related to habitat suitability for fish and macroinvertebrates and that excess sediment decreased both density and diversity of aquatic insects. Specific aspects of sediment-invertebrate relationships can be described as follows: 1) abundance of certain invertebrate taxa is correlated with substrate particle size; 2) fine sediment reduce the abundance of sediment intolerant taxa by reducing interstitial habitat normally available in large-particle substrate (gravel, cobbles); and 3) community composition changes as substrate particle size changes from large (gravel, cobbles) to small (sand, silt, clay) (Waters, 1995).

Sediment loads that exceed a stream's sediment transport capacity often trigger changes in stream morphology (Leopold and Wolman, 1964). Streams that become overwhelmed with sediment often go through a period of accelerated channel widening and streambank erosion before returning to a stable form (Rosgen, 1996). These morphological changes accelerate erosion, reduce habitat diversity (pools, riffles, etc.) and place additional stress on the designated use.

This protocol is similar to the approach originally proposed by the State of Colorado (CDPH&E, 1998) and represents a simple, but quantitative, three-step assessment procedure for determining whether the narrative standard is being attained in a particular perennial stream reach by: 1) comparing changes or differences, if any, between the site of concern and a best available reference site or reference condition, 2) directly evaluating instream habitat by measuring the amount of fine particles (defined in NMAC 20.6.4.13 as 2 mm or less), and 3) verifying or confirming results obtained in number 2 by assessing and comparing benthic macroinvertebrate communities at the same sites. The State of Colorado has since modified their approach to determining impairment due to sedimentation (CDPH&E 2005).

II. Biological Monitoring by Reference Site or Condition

In order to properly assess a study site or stream reach for impairment due to excessive sedimentation, a specific reference site must be selected, or a reference condition empirically defined, for comparison. Then exposure and biological response indicators are measured and compared between the two sites. To assess for stream bottom deposits, the percent of fine substrate less than 2 mm, is the exposure indicator expressing the filling of interstitial space within the substrate, and the response indicator is the biological condition measured through macroinvertebrate community composition. Under this protocol, the reference site or condition serves as a quantitative control or yardstick to which a site may be compared and evaluated. Reference conditions are used to scale the assessment to the "best attainable" situation. This approach is critical to the assessment because stream characteristics vary dramatically across different regions (Barbour *et al.*, 1996), watersheds, or even stream segments. **The ratio between the score for the study site and the reference site (or condition) provides a percent comparability measure for each station**. The station of interest is then classified on the basis of its similarity to the reference condition and its apparent potential to support an acceptable level of biological health (Barbour *et al.*, 1999).

Reference Site Selection

The first step in determining a reference site is to identify a pool of best available sites in all geographic regions of New Mexico that have the lowest amount of anthropogenic impacts to the stream's ecosystem. Once the biological, physical, and chemical integrity of a reference site is determined to be of highest available quality, it can be compared to a similar survey site. The reference and study sites should share analogous characteristics, to the extent possible, such as elevation, gradient, geology, hydrology, watershed size, in-stream habitat (pools, substrate, etc), and riparian vegetation. If the study site is severely impaired such things as channel morphology, habitat, and streamside vegetation may be different from the reference site as a result of a departure from the reference condition. Characteristics that cannot change over time should be used as primary attributes of similarity between reference and study sites. Examples of similar attributes are elevation, geology, precipitation, gradient, etc. These characteristics of similarity between a reference and study site can be ensured through the use of ecoregion designations. Simply put, **the study site and the reference site need to be in the same ecoregion**. The Surface Water Quality Bureau (SWQB) primarily utilizes the ecoregion system developed for the United States Environmental Protection Agency (USEPA) by Griffith et al. (2006). SWQB has several initiatives in progress to further refine reference condition.

Additional or secondary characteristics that can be used to supplement and further refine the ecoregion similarity between reference and study sites are those that can be readily measured at each site such as stream type (Rosgen, 1996) and channel cross-sectional area. In other words, reference and study sites in the same ecoregion, having the same stream type (McGarrell, 1998) and cross-sectional area are extremely similar and can be readily compared. Use of these secondary characteristics in evaluating similarities for pairing of sampling sites needs further study. However, their use as an additional tool for evaluation of sites is encouraged (Barbour et al, 1999). These data can then be used in a statistical analysis to determine whether use of these characteristics is valid in site selection protocols.

In summary, the classification of streams based on ecoregions and stream type (Rosgen 1994, 1996) reduces the complexity of biological information and improves the resolution or sensitivity of biological surveys by partitioning or accounting for variation between sites. The best classification variables are those that are readily obtained from maps or regional water characteristics such as ecoregion, gradient, alkalinity, and hardness. Stream characteristics that are readily affected by human activities or occur as a biological response to physical conditions (i.e., land use, habitat condition, or nutrient concentrations) should not be used as classification variables (McGarrell, 1998; Barbour *et al;* 1999).

III. Physical Assessment

In order to assess the stream channel for excessive sedimentation that may damage or impair aquatic life and significantly alter the physical properties of the bottom, physical measurements of the stream bottom substrate must be made alongside measurements being made of the biological component. Percent fine measurements or other indicators of settled sediment should represent characteristics that can promote the best physical habitat or environment for aquatic life independent of chemical water quality. This concept is described in Figure 1 (Plafkin *et al.*, 1989), which shows the relationship between habitat and biological condition. More specifically, substrate which is sufficiently large and varied, and is not

surrounded or buried by fines, appears to offer the best attributes for habitat suitability for many aquatic organisms adapted to such conditions.

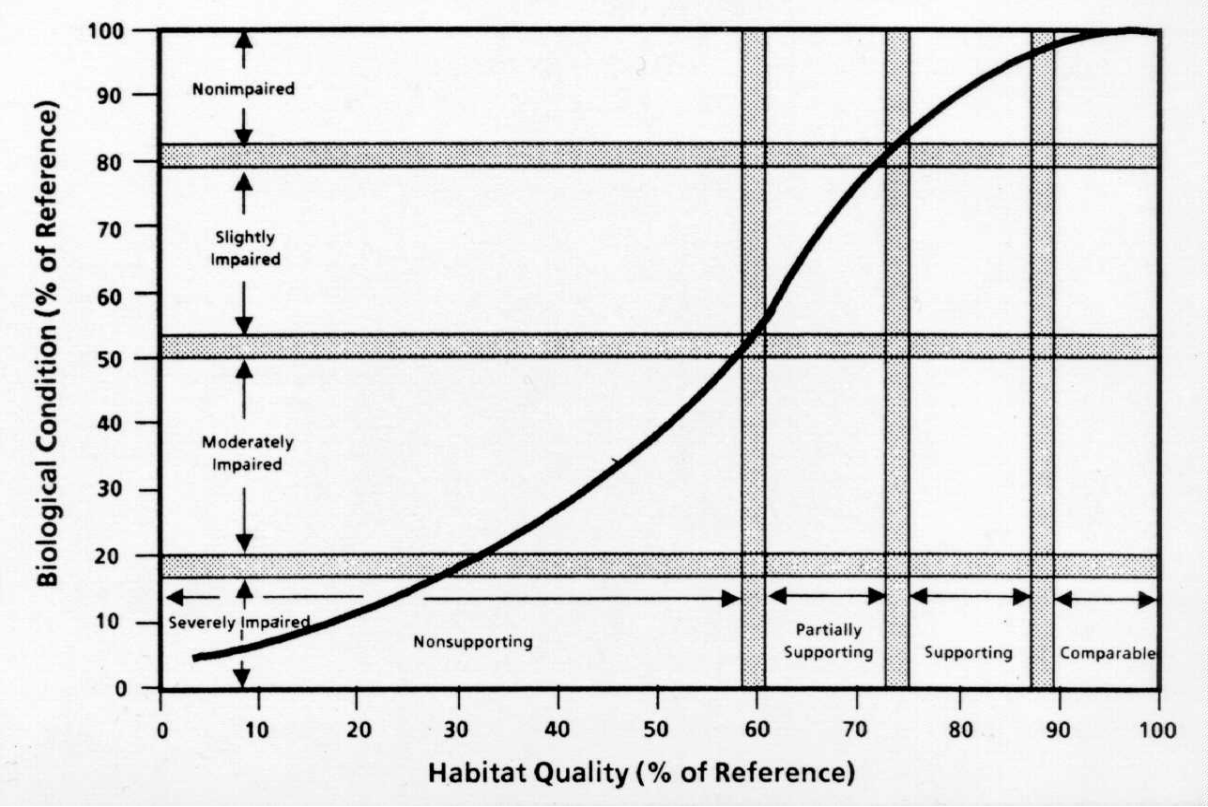

Figure 1. The relationship between habitat and biological condition (from Plafkin *et al.*, 1989).

In a study of 562 streams located in four northwestern states (namely Idaho, Oregon, Washington, and Wyoming), Relyea *et al.* (2000) suggested that changes to invertebrate communities as a result of fine sediment (2mm or less) occur between 20-35% fines throughout the reach. The most sensitive species were affected at 20% surface fines. This is the primary basis this protocol states that study sites with less than 20% fines should be considered non-impaired (fully supporting) with respect to sedimentation/siltation regardless of the percent fines determined at the reference site (Table 1, footnote 3). However this limit will be subject to review as more information is available. It is important to note some of the limitations of the data set used in the study, including that the sediment and benthic macroinvertebrate data were collected by several different methods, the sites were mainly first through fourth order streams, and 77% of the streams used in the study contained less than 30% fines. This study was expanded upon later to include 1139 western streams (Relyea 2005).

Chapman and McLeod (1987) suggest that geometric particle size and percent of the bed surface covered by fines should both be used to define habitat quality. These two criteria can be ascertained by performing a pebble count. The pebble count procedure provides not only particle size distributions (D50, D84, etc.) and percent class sizes (% sand, % cobble, etc.), but offers a relatively fast and statistically reliable method for obtaining this information. In addition, relatively rapid temporal and spatial comparisons can be made at a number of sites within a watershed. Although sufficient and varied sizes of stream bottom substrate are necessary for biological colonization, protection, and reproduction,

its full potential may not be realized if the substrate surfaces are surrounded by fine sediment. In streams where the sediment load exceeds the transport capacity, the coarser particles often become surrounded or partially buried by fine sediment. Embeddedness quantitatively measures the extent to which larger particles are surrounded or buried by fine sediment (Mc Donald *et al*., 1991). Studies by Bjorn *et al.* (1974, 1977) concluded that approximately one-third embeddedness (33%) or less is probably the normal condition in proper functioning streams. Above this condition, however, insect populations decline substantially as habitat spaces become smaller and filled. By performing a pebble count, the substrate can be characterized as an aquatic habitat by quantifying fine sediment, which is compared to a reference site, and evaluated for impairment due to stream bottom deposits. Verification of impairment takes place when a stream site is biologically assessed as not attaining the designated use by sampling the macroinvertebrate community in the same location.

Pebble Count Procedure

The pebble count (Wolman, 1954) may be performed separately or as part of a larger stream inventory and assessment study (Rosgen, 1996). It is recommended that biological sampling and pebble counts always be performed concurrently to capture an accurate picture of the stressor and response, as the amount of fine substrate present and the biological community changes with stream flow and season. The intermediate axis of particles should be measured within the wetted perimeter of the channel and tallied using standard Wentworth size classes (Bunte and Abt, 2001) from 10 equidistant transects (10 particles/transect as a minimum) selected along a longitudinal stream section of the single habitat representative riffle being biologically sampled or evaluated. Habitat type must be documented. For application of this protocol developed for perennial wadeable non sand bed streams, the specific habitat sampled is representative riffle or run areas. Pebble counts may be recorded, tallied, and represented either by using the Riffle Count Tally Sheet (preferred), forms provided by Rosgen in the *Reference Reach* field book (Rosgen, 1998), or on a computer laptop at streamside using the *Reference Reach* (channel materials) software package (Mecklenberg, 1998) which can be downloaded from the State of Ohio Department of Natural Resources website (www.dnr.state.oh.us/odnr/soil+water/streammorphology.htm). These forms and additional information regarding pebble counts can be found in the NMED SWQB Standard Operating Procedures (NMED 2007a).

From the raw data, D35, D50, and D84 values can then be calculated along with percent composition values for six classes of channel materials ranging from fines (silt, clay, and sand) to bedrock. The percent fines (i.e., the percentage of measured particles <2mm in diameter) at the study site and the reference site are compared in accordance with Table 1. **Study sites showing fines of 20% or less should be considered non-impaired (fully supporting) with respect to sedimentation/siltation regardless of the percent fines** determined at the reference site. If the percent fines at the study site are lower than that of the reference site, one might consider using the study site as a new reference site provided that the other criteria mentioned previously for reference site nomination are equal or better.

Table 1. Degree of aquatic life use support affected by stream bottom deposits (sediment) evaluated by increases in percent fines relative to a reference site.[1] Adapted and modified from Figure 1, i.e. 100 - 90% = 0 - 10%).

Pebble Count Fines ≤ 2 mm (% increase over reference) [1]	Degree of Aquatic Life Use Support (Presumptive [2])
0 – 27%	Full Support, Comparable to Reference [1,3]
≥ 28%	Non-Support[1]

[1] Raw data values used for these percent comparisons between reference and study sites needs to meet adequate sampling size requirements.

[2] Biological assessment is necessary for confirmation and statistical database.

[3] Raw percent values of ≤20% fines (pebble counts) at a study site should be evaluated as fully supporting regardless of the percent attained at the reference site.

Optional Additional Procedures

If a "Rosgen" Level II classification is being performed in addition to the sediment protocol assessment, a separate pebble count analysis should be done to account for the larger bankfull widths, increased longitudinal distances, and multiple habitats used in various "Rosgen" protocols.

With respect to the pebble count procedure described in the sections above, SWQB has typically performed n=100 pebble counts for these sedimentation assessments (i.e., the intermediate axis of 100 substrate particles is measured and recorded). If there is a need to determine quantitative confidence levels and decrease the chance of Type I and Type II errors, a higher "n" pebble count is needed and can be determined as follows:

> In order to ascertain and/or evaluate increases in fines by pebble count methodology and its potential effect on aquatic life at the study (or impacted) site relative to the reference site, the following steps should be taken. First, download a copy of the pebble count software tool *Size-Class Pebble Count Analyzer V1 2001.xls* (651KB) by John Potyondi and Kristin Bunte from the US Forest Service's Stream System Technology Center (aka "Stream Team") website (www.stream.fs.fed.us) under their Download PDF Documents and Software Tools menu. Specific information concerning its use, application, sample size, data input, statistical analysis, and case studies are included in various document sections of the software and should be read prior to setting up a study and collecting any data. Next, select a reference site for each group of study sites being assessed or evaluated. Visit each reference site and collect the necessary biological samples (benthic macroinvertebrates) along with a pebble count (n≈200-300) from the same habitat unit(s) that the biological samples were collected. Using the USFS pebble count software

(preferably streamside at the reference site) calculate the percent fines (< 2 mm) encountered at the reference site under the data input tab. The percent fines can be also calculated using the *Reference Reach* channel materials software (Mecklenberg, 1998) package. Using the percent fines value at the reference site, determine the increase in percent fines needed at the study site to classify them as non-supporting (28% increase) according to Figure 1 and Table 1. This can be accomplished by multiplying the percent fines at the reference site by 1.28. Under the sample size tab in the software package, the sample sizes of both the reference and study sites can be estimated for statistical significance by filling in the worksheet provided which requires the following fields to be filled: 1) Type 1 error probability (use 0.1), 2) Type 2 error probability (use 0.2), 3) ratio of study site sample size to reference site sample size (1 is recommended, but unequal sample sizes can be used), 4) reference site percent fines or proportion (entered as a decimal percent i.e. 0.1 for 10%) , 5) and the study site percent fines or proportion (reference site fines plus 28%). Find the sampling number to cover a 28% increase. If the percent value for fines at the reference site is determined to be 20% or less, calculate the percent fines to be used in step 5 (study site fines or proportion) by choosing the greater value between either a 28% increase (reference fines multiplied by 1.28) or the percent increase obtained by using 21% as a raw fines percent at the study site(s). The program will then calculate an estimated reference and study site sample size necessary to determine whether an increase in fines of 28% is statistically valid at the 10% level of significance (90% confidence level). Once the statistical sampling size(s) of both the reference and study site has been determined, the data can be collected, entered, and compared under the analysis section of the software and then subsequently used according to Tables 1 and 3.

IV. Biological Assessment (Macroinvertebrates)

Since the narrative standard for bottom deposits is dependant on biological condition, the assessment of this physically-based narrative sedimentation criteria should be determined using a biological response variable that will link excess settled sediment levels to designated use attainment. New Mexico has chosen the community composition of macroinvertebrates as the most informative biological response in determining sedimentation impacts to aquatic life. Prior to collection of macroinvertebrates, a habitat assessment (Plafkin *et al.*, 1989; Barbour *et al.*, 1999) of the site should be performed using both visual observation and measurements made in association with any other studies (EMAP, representative pebble counts, Rosgen Level II or III, longitudinal profiles, etc.). This should include the quantification of fines for sediment assessment, but other information can be compared with the habitat information at the reference site to yield additional information as to other potential sources of use impairment other than sediment.

To utilize this protocol, benthic macroinvertebrates at the study site should be collected in a representative riffle area and may consist of either three quantitative samples using a Hess sampler or three composited kick samples (semi-quantitative) covering an area of approximately one meter for one minute. For valid biological comparisons to an individual reference site, sampling procedures should be identical between the reference and study site(s). Procedures for preservation, sorting, enumeration, identification, and analysis need to follow standard Surface Water Quality Bureau and USEPA procedures (Barbour *et al.*, 1999; NMED 2007a).

Depending on the ecoregion of the study site, a benthic macroinvertebrate impairment determination utilizing either the Rapid Bioassessment Protocols (RBPs) or Mountain Stream Condition Index (M-SCI) as described in the main assessment protocol must be performed (see NMED/SWQB 2007b for additional details). Impairment determination procedures are presented in Tables 2 and 3 below. Application of the biological assessment or degree of impairment is a percentage comparison of the sum of selected metric scores at the study site compared to a selected reference site or condition. For example, a study site in ecoregion 24 achieving a biological assessment score greater than 83 percent of the reference site would be deemed non-impaired (full-support).

Table 2. Biological Integrity Attainment Matrix using the RBP Index [1] for Ecoregions 22, 24, 25, and 26

% Comparison to Reference Site(s)	Biological Condition Category [2]	Attributes [1]
>83%	Non-impaired (Full Support)	Comparable to best situation to be expected within ecoregion (watershed reference site). Balanced trophic structure. Optimum community structure (composition & dominance) for stream size and habitat quality.
79 – 54%	Slightly Impaired (Non Support)	Community structure less than expected. Composition (species richness) lower than expected due to loss of some intolerant forms. Percent contribution of tolerant forms increases.
50– 21%	Moderately Impaired (Non Support)	Fewer species due to loss of most intolerant forms. Reduction in EPT index.
<17	Severely Impaired (Non Support)	Few species present. Densities of organisms dominated by one or two taxa.

[1] RBP Index, percentages, and biological attributes are taken from Plafkin *et al.*, 1989. Percentage values obtained that are in between the above ranges will require best professional judgment as to the correct placement.

[2] New Mexico has combined all but the "non-impaired" category into "Non Support" per USEPA Region 6 suggestion.

Table 3. Biological Integrity Attainment Matrix using M-SCI [1] for Ecoregions 21 and 23

% Comparison to Reference Condition	Biological Condition Category [2]
>78.35	Very Good (Full Support)
78.35 – 56.70%	Good (Full Support)
56.70 – 37.20%	Fair (Non Support)
37.20 – 18.90%	Poor (Non Support)
<18.90	Very Poor (Non Support)

[1] M-SCI Index and percentages based on Jacobi et al. (2006).

[2] New Mexico has combined the "very good" and "good" categories into "Full Support," while the remaining categories are lumped into "Non Support."

V. Final Assessment: Combined Application of Physical and Biological Assessments

Upon completion of physical and biological assessments detailed above, a final assessment can be determined from the matrix in Table 4. This is accomplished by taking the increases between percent fines and matching it with the appropriate physical assessment use support category in the far left column. The physical assessment use category can then be matched with the biological assessment use category located on the top row to obtain a use support category for aquatic life use based on biological and physical indicators of increased stream bottom sediment.

It is noteworthy that under certain situations, the physical indicators (i.e., percent fines) may indicate full support, while the biological assessment may indicate non support. In these cases, factors other than sediment alone, such as extremes in pH, low oxygen, temperature, lack of stream flow, and toxicity, etc. may be responsible for a reduction in biological integrity at a particular site. In this case, the assessment unit should be listed under Category 5C with an impairment of "Benthic-Macroinvertebrate Bioassessments (Streams)" on the Integrated Clean Water Act §303(d)/305(b) list until the exact cause of impairment is determined. Potential causes of impairment such as those listed above will then be quantified by examining such things as chemical and physical data collected at or near the site in question.

Table 4. Final assessment matrix for determining aquatic life use support categories by combining physical and biological assessments as sediment indicators

Physical \ Biological	**Impaired (Non Support)** RBP Index < 79% of ref [1] M-SCI Score < 56.70 [2]	**Non-impaired (Full Support)** RBP Index > 84% of ref [1] M-SCI Score > 56.70 [2]
Non-Support Percent Fines >28% increase over reference	☐ Non-Support	☐ Full Support
Full Support Percent Fines <27% increase[3] over reference	☐ Full Support (Sedimentation/Siltation); ☐ Non-Support (Unidentified Biological Impairment)[4]	☐ Full Support

[1] RBP Index should be used in Ecoregions 22, 24, 25, and 26. RBP Index score based on Plafkin et al. (1989). The 4% gap allows for some best professional judgment.

[2] M-SCI should be used in Ecoregions 21 and 23. M-SCI and Score based on Jacobi et al. (2006).

[3] Raw percent values of ≤20% fines (pebble counts) at a study site should be evaluated as fully supporting regardless of the percent attained at the reference site.

[4] Reduction in the relative support level for the aquatic life use in this particular matrix cell is probably not due to sediment. It is most likely the result of some other impairment (temperature, D.O., pH, toxicity, etc.), alone or in combination with sediment. Label as Category 5C on the Integrated §303(d)/305(b) list as described in the text above to indicate that further study is needed.

VI. Step by step Evaluation Procedure to Determine Impairment

1. Select study site(s) along with a comparable reference site or reference condition (depending on ecoregion determination).

2. Perform a bio survey of the benthic macroinvertebrate community at each reference in which a pebble count procedure is to be performed.

3. Do a pebble count evaluation at the reference sites. For application of this protocol, pebble counts must be done in the same habitat unit(s) where the macroinvertebrates were collected. If it is necessary to document confidence levels and reduce Type 1 and 2 error, it is necessary to determine the exact sample size (see page7) needed at each study site based on the evaluated sample size and determined percent fines at each reference site. This calculation should preferably be done streamside at the reference site using the pebble count analyzer software so that sufficient data can be collected with one visit. However, it is acceptable to do the calculations in the office, but realize that an additional visit to the stream may be required if your sample size is inadequate.

4. Perform a bioassessment of the benthic macroinvertebrate community at each study site, accompanied by collection of a pebble count of sufficient size to be statistically significant.

5. Compare the physical data between the study and reference sites by dividing the results obtained at the study site by that of the reference site to obtain percent "comparability."

6. Compare the biological data between the study site and reference site (if using RBP index) or reference conditions (if using M-SCI) by dividing the results obtained at the study site by that of the reference site to obtain percent "comparability."

7. Using the final assessment matrix (Table 4), locate the proper support cells for both the physical and biological percentages calculated in steps 5 and 6, and determine the final degree of support for the applicable aquatic life use.

VII. Future Development

The various support categories along with the ranges of percents used to quantify them are based on slight modifications of those used in EPA's Rapid Bioassessment Protocols (Plafkin *et al.*, 1989) and the State of Colorado Sediment Task Force original sediment protocol (CDPH&E, 1998). They are intended to provide an initial base or reference point from which to proceed in the collection and interpretation of data regarding the adverse effects of sediment on biological communities in the State of New Mexico. As this guidance is applied and data from various sites are collected, it will be necessary to adjust the standards attainment matrices in terms of the percentage of reference conditions for physical stream bottom substrate "indicators" and biology. It is imperative to the validity, growth, and evolution of this document that the Surface Water Quality Bureau establish a proper database from which the valid statistical treatment may be employed to strengthen and adjust the matrix tables when deemed necessary through the addition of data generated from this protocol. Also, it is critical that the metrics (EPT, diversity, standing crop, shredders/total, etc.) used for evaluating the macroinvertebrate communities also undergo review in order to select those metrics that are most sensitive to changes or increases in stream bottom sediment. In addition, it may be prudent to engage the services of a statistician to review and strengthen these endeavors. SWQB has initiated the above items, and is planning to propose and implement several improvements to the sedimentation impairment determination protocol for development of the 2010 Integrated List.

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APPENDIX E

NUTRIENT ASSESSMENT PROTOCOL FOR WADEABLE, PERENNIAL STREAMS

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JUNE 19, 2009

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I. Purpose and Applicability

This document establishes an assessment protocol for determining nutrient impairment status of wadeable perennial streams. While a few streams have segment specific numeric criteria for total phosphorus, New Mexico currently has no general numeric criteria for nutrients. The narrative criterion in *State of New Mexico Standards for Interstate and Intrastate Surface Waters* states that, "Plant nutrients from other than natural causes shall not be present in concentrations which will produce undesirable aquatic life or result in a dominance of nuisance species in surface waters of the state" (NMWQCC 2007). Excess amounts of nitrogen and phosphorus can cause undesirable aquatic life (i.e. community composition shifts or toxic algal blooms) and/or result in a dominance of nuisance species (i.e. excessive and/or unsightly algal mats or surface plankton scums). Nutrient pollution can be described as excess amounts of nitrogen and phosphorus and the associated high algal biomass. Nutrient impairment occurs when algae and other aquatic vegetation (macrophytes) interfere with designated uses such as contact recreation, domestic water supply, or coldwater aquatic life.

This protocol will be used to determine if a stream reach (i.e., assessment unit) is meeting the narrative criterion. If an assessment unit is determined to be impaired, it will be added to the Integrated Clean Water Act §303(d)/§305(b) List of Assessed Waters as impaired, and a total maximum daily load (TMDL) planning document will be written. This protocol is a dynamic document that will be refined as more data are collected, enabling more precise classification of streams and definition of relationships between nutrient concentrations, indicators, and impairment in New Mexico streams.

II. Background

The presence of some aquatic vegetation is normal in streams. Algae and macrophytes provide habitat and food for aquatic organisms. However, excessive aquatic vegetation is not beneficial to most stream life and may change the aquatic community structure. High nutrient concentrations may promote an overabundance of algae and floating and rooted macrophytes. The types and amounts of aquatic vegetation often reflect the level of nutrient enrichment. Algae are either the direct (excessive periphyton mats or surface plankton scums) or indirect (diurnal swings of dissolved oxygen and pH and high turbidity) cause of most problems related to excessive nutrient enrichment. In addition, algal blooms often cause taste and odor problems in drinking water supplies. Blooms of certain types of blue-green (cyanobacteria) and golden (*Prymnesium* spp.) algae can produce toxins that are detrimental to animal and human health. One of the most expensive problems caused by nutrient enrichment is increased treatment required for drinking water.

Some increases in primary productivity can increase the abundance of invertebrates and fish in streams. However, excessive plant growth and decomposition can limit aquatic populations by decreasing dissolved oxygen (D.O.) concentrations. Plant respiration and decomposition of dead vegetation consume D.O. Lack of D.O. stresses aquatic organisms and can cause fish kills. Nocturnal respiration can cause oxygen depletion in waters with high primary productivity and low aeration rates. Even relatively small reductions in D.O. can have adverse effects on both invertebrate and fish communities (USEPA 1991). Dissolved oxygen saturation levels of greater than 120% may be harmful to aquatic life (Behar 1996). Development of anaerobic conditions will alter a wide range of chemical equilibria and may mobilize certain pollutants and generate noxious odors (USEPA 1991).

The variables referred to in this document are measurable water quality parameters that can be used to evaluate the degree of eutrophication in streams. The variables consist of causal variables (nutrient concentrations), and response variables (algal biomass, pH, and D.O.). Relationships between these variables are not as tightly coupled in rivers and streams as they are in lakes. Many other factors come into play in lotic systems, including flow regime, channel morphology, bed composition, degree of shading, and grazing by invertebrates. Many of these factors will be noted during the nutrient survey to aid in interpretation of measured variables.

The highly variable flows and spatially interrupted nature of many streams in arid landscapes can have great influence on both nutrient loading and biomass production. In the arid southwest, low and middle elevation streams may have naturally high levels of productivity due to the long growing season, high temperatures, open canopy, and the consequential tight cycling of available nutrients (AZDEQ 1996, Fisher and Grimm 1983).

III. Nutrient Threshold Development Process

In February of 2002, the US Environmental Protection Agency (EPA) released nine nutrient water quality criteria documents. These documents contained EPA's recommended criteria for total phosphorus (TP) and total nitrogen (TN) for aggregate ecoregions. The criteria were derived using procedures described in the *Rivers and Streams Nutrient Criteria Technical Guidance Manual* (USEPA 2000). These aggregate ecoregion nutrient criteria were intended as a starting point for states and authorized tribes to develop more refined nutrient criteria.

Refinement of the recommended draft ecoregion nutrient criteria was conducted by Evan Hornig (EPA), a former USGS employee assisting states in EPA Region 6 with development of nutrient criteria. Hornig used regional nutrient data from EPA's Storage and Retrieval System (STORET), the U.S. Geological Survey (USGS), and the Surface Water Quality Bureau (SWQB) to create a regional dataset for New Mexico. The revised threshold values were calculated based on EPA procedures and the median for each Level III ecoregion (Omernik 2006).

A third round of analysis was conducted by SWQB/MAS to produce nutrient threshold values for streams based on ecoregion and designated aquatic life use. For this analysis, total phosphorus (TP), total Kjeldahl nitrogen (TKN), and nitrate plus nitrite (N+N) data from the National Nutrient Dataset (1990-1997) was combined with Archival STORET data for 1998, and 1999-2006 data from the SWQB in-house database.

Once the dataset was compiled, the data were divided by waterbody type, removing all rivers, reservoirs, lakes, wastewater treatment effluent, and playas. For this project "rivers" were defined as systems that cannot be monitored effectively with methods developed for wadeable streams and generally have drainage areas greater than 2,300 square miles. The systems included in the "rivers" waterbody type and consequently exempt from this protocol are: 1) the San Juan River from below Navajo Reservoir to the Colorado border near Four Corners, 2) the Animas River from the Colorado border to the San Juan River, 3) Rio Grande in New Mexico, 4) the Pecos River from below Sumner Reservoir to the Texas border, 5) the Rio Chama from below El Vado Reservoir to the Rio Grande, 6) the Canadian River below the Cimarron River , and 7) the Gila River below Mogollon. GIS was used to identify data from river sites as defined above.

Figure 1. Level III and IV Omernik ecoregions

Level III and IV Omernik ecoregions (Figure 1) as well as the designated aquatic life use were assigned to all stream sites using GIS coverages and the station's latitude and longitude. New Mexico has 7 aquatic life uses: high quality coldwater, coldwater, marginal coldwater, warmwater, marginal warmwater, aquatic life, and limited aquatic life. Aquatic life and limited aquatic life sites were removed from the dataset used in this analysis as they generally represent waters with ephemeral or intermittent flow, naturally occurring rapid environmental changes, high turbidity, fluctuating temperatures, low dissolved oxygen content or unique chemical characteristics and are not wadable perennial streams. The 5 other aquatic life uses were divided into 3 groups:

1. Coldwater (CW) – those segments having only coldwater uses (high quality coldwater or coldwater)
2. Transitional (T)– waterbodies with marginal coldwater or both cold and warmwater uses
3. Warmwater (WW) - waterbodies having only warmwater uses (warmwater or marginal warmwater)

Because of the limited area and number of sites in the Madrean Archipelago (79), Western High Plains (25), and Colorado Plateau (20) ecoregions, these data where grouped with the most similar ecoregions; the Madrean Archipelago with the Chihahuan Desert and the Colorado Plateau with the Arizona New Mexico Plateau. The Western High Plains had no stream data as the only surface waters are playas, therefore this ecoregion was not included in the analysis.

The stream data were divided first by ecoregion then by aquatic life use (ALU). When there were less than 60 data points in the warmwater group, these data were combined with the transitional group to form the Trans/WW group. The 50th percentiles (medians) were calculated for each parameter and ecoregion/aquatic life use group. The results are shown in **Table 1**. The total nitrogen value was calculated by adding the percentiles for TKN and N+N.

There was no difference in the TP threshold values for the coldwater and trans/ww groups in ecoregion 21. However, when examining the different level IV ecoregions there was a significant difference in the TP data from the volcanic and the other groups. This led to the development of a separate threshold value for the ecoregion 21 volcanic group. The threshold value was calculating by determining the median of the data from ecoregions 21g and 21h as well as 21j in the Jemez Mountains. The Grassland Parks (21j) of the Jemez Mountains were included in this group as they are of volcanic origin and have the characteristic higher background TP.

Table 1. Ecoregion and Aquatic Life Use Nutrient Thresholds for Streams (mg/L), using regional data and the 50th percentile (SWQB 2007).

	21-Southern Rockies		22-AZ/NM Plateau		23-AZ/NM Mountains		24-Chihuahuan Desert	26-SW Tablelands		
TN	0.25		0.35		0.25		0.53	0.38		
TP	0.02		0.05		0.02		0.04	0.03		
ALU	CW	T/WW (volcanic)	CW	T/WW	CW	T/WW	T/WW	CW	T	WW
TN	0.25	0.25	0.28	0.48	0.25	0.29	0.53	0.25	0.38	0.45
TP	0.02	0.02 (0.05)	0.04	0.09	0.02	0.05	0.04	0.02	0.03	0.03

IV. Assessment Procedure

The primary question to be answered is: **Is this reach impaired due to nutrient enrichment?** Nutrient impairment occurs where algal and/or macrophyte growth interferes with designated uses, thus preventing the reach from supporting these uses. Algal biomass is the most important indicator of nutrient enrichment, as algae cause most problems related to excessive nutrient enrichment. Algae and macrophytes may be a nuisance when 1) there are large amounts of rotting algae and macrophytes in the stream; 2) the stream substrate is choked with algae; 3) large diurnal fluctuations in D.O. and pH occur; and/or 4) there is a release of sediment-bound toxins.

This protocol uses a two-tiered approach to nutrient assessment. The two levels of assessment are used in sequential order to determine if there is excessive nutrient enrichment. If a Level I assessment indicates nutrient enrichment, a Level II assessment will be used to test this finding and provide more quantitative indicators. Level I is a screening level assessment that is observational with limited measurements. It is based on a review of available data, including on-site observations and measurements of chemical parameters. Level II is based on quantitative measurements of selected indicators. If these measurements exceed the numeric nutrient threshold values, indicate excessive primary production (i.e., large D.O. and pH fluctuation and/or high chlorophyll *a* concentration), and/or demonstrate an unhealthy benthic community, the reach is considered to be impaired. Both assessments use data that are collected during water quality and nutrient surveys and compiled on the Nutrient Survey Forms. These data, along with reports from the Surface Water Quality Bureau (SWQB) in-house water quality database, are used to complete the Nutrient Assessment Form and conduct the assessment.

SWQB has adopted a multi-indicator approach to conduct a more robust assessment and account for diverse lotic systems and dynamic nutrient cycling. Both cause and response variables are used. It is important to incorporate response variables into the assessment as ambient water column nutrient "concentrations cannot indicate supply because large biomass of primary producers may have a very high nutrient demand and render inorganic nutrient concentrations low or below detection" (Dodds and Welch 2000). The response variables of algal biomass, D.O., and pH are incorporated into the assessment. For D.O. concentration and pH, criteria are based on designated uses of an assessment unit, as indicated in the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* (NMWQCC 2007) (**Table 2**).

Table 2. Criteria for dissolved oxygen concentration and pH

Designated Use	**Dissolved Oxygen**	**pH**
High Quality Coldwater Aquatic Life	6.0 mg/L	6.6 – 8.8
Coldwater Aquatic Life	6.0 mg/L	6.6 – 8.8
Marginal Coldwater Aquatic Life	6.0 mg/L	6.6 – 9.0
Warmwater Aquatic Life	5.0 mg/L	6.6 – 9.0
Marginal Warmwater Aquatic Life	5.0 mg/L	6.6 – 9.0

The assessment may use either a reference or threshold approach (USEPA 2000). For most streams, indicators will be compared to thresholds from published literature. If, however, the researcher feels that these thresholds are not appropriate for the class of stream being assessed, a reference site approach will be used. A suitable reference reach will be surveyed and indicators

from the study reach will be compared to those of the reference reach rather than established thresholds. This is to account for streams that may have naturally high productivity because of regional geology, flow regime, or other natural causes.

A. Level I Nutrient Assessment

> NOTE: If the assessment unit was previously listed for nutrients, a Level II assessment must be performed and the Level I assessment does not need to be conducted.

Level I Nutrient Assessment will use water quality data and field observations that have been compiled for each assessment unit. Data from the SWQB database, field sheets, and other readily available sources (such as USGS and NPDES permittees) should be utilized. These data are compiled on the Level I Nutrient Survey Form and used to complete the Level I Assessment Form. This assessment should be conducted during the summer, just prior to the nutrient and benthic macroinvertebrate index period (August 15 – November 15). The Level I assessment will be conducted at this time to utilize as much water quality survey data as possible and leave enough time to conduct the Level II Nutrient Survey at those sites that the Level I Assessment indicates the need. The following parameters are used in the Level I assessment:

Algae and Macrophyte Coverage:

Macrophyte is a general term that applies to many types of aquatic vegetation including flowering vascular plants, mosses, and ferns. Nutrients supplied from sediments combined with those in solution are usually adequate to meet nutritional demands of rooted aquatic plants, even in oligotrophic systems (Barko and Smart 1986). Macrophyte growth in streams is usually controlled by temperature, substrate characteristics, light limitation, or flow regimes. Phosphorus, nitrogen, and other nutrients may be taken up by submerged macrophytes from sediment, uncoupling rooted macrophyte growth from water column nutrient concentrations (Welch 1992). As bottom sediments act as the primary nutrient source for rooted macrophytes, they will not be used as indicators of nutrient enrichment. However, abundance of rooted macrophytes will be noted during nutrient surveys to explore their relationships with other variables.

Algae are non-vascular plants without true roots, stems, or leaves. They are mostly aquatic and range from tall stalks of kelp to fuzzy growths of green filamentous algae to microscopic, silica-encased diatoms. In the context of this document, “algae” refers to the visible growth of non-rooted aquatic vegetation attached to the stream substrate. The extent of algal coverage of a streambed can be an important indicator of algal biomass problems (USEPA 2000). As nutrient enrichment increases, the percent of streambed covered with algae increases (Welch et al. 1987, Lohman et al. 1992, Biggs 1996). The Level I assessment uses percent algal coverage as a qualitative indicator of algal biomass.

A visual estimate of the percent of both algal and macrophyte coverage will be recorded. Generally, this will be determined at each site once in the spring, summer, and fall as part of SWQB water quality surveys. Coverages of greater than 50% in any season may indicate nutrient enrichment. On the Nutrient Assessment Form, indicate if this 50% threshold is exceeded during any season.

Periphyton Abundance:

Periphyton is an assemblage of organisms that grow on underwater surfaces and includes a complex matrix of algae and heterotrophic microbes including bacteria, fungi, protozoa, and other organisms (Allaby 1985). Periphyton is composed primarily of microscopic organisms, while algae noted in the percent coverage is mainly macroalgae. The extent of periphyton coverage of a streambed can be an important indicator of algal biomass problems (USEPA 2000). A rating of periphyton abundance will be recorded during the nutrient survey. The rating is from 0 to 5 as follows: **0)** rough with no apparent growth; **1)** thin layer of periphyton is visible (tracks can be drawn in the film with the back of your fingernail); **2)** 0.5 to 1 mm thick; **3)** 1 to 5 mm thick; **4)** 5 to 20 mm thick; and **5)** >20 mm thick. Periphyton thickness of >l mm (rating of >2) may indicate nutrient enrichment. On the Nutrient Assessment Form, indicate if the rating is greater than 2 during any season.

Anaerobic conditions:

Anaerobic conditions can be indicative of excessive plant growth and decay. Decomposition of organic material uses oxygen, and excessive decomposition can create anoxic conditions. Anaerobic decomposition that takes place in anoxic conditions produces hydrogen sulfide with an associated "rotten egg" smell and black color. Note on the Nutrient Assessment Form if an anoxic layer is found under rocks and/or in depositional areas.

Dissolved Oxygen and pH:

High rates of primary production can cause D.O. supersaturation and high pH during the day. Photosynthesis and respiration alter the amount of carbon dioxide (CO_2) in water, which affects pH. Photosynthesis removes CO_2 from water, which forces buffers to remove hydrogen ions, increasing pH. Respiration takes place at night (when photosynthesis does not occur) and adds CO_2 to water resulting in an increase in the number of hydrogen ions, thereby lowering the pH. Diurnal pH fluctuation will be greater in streams with low buffering capacity, so this may not be a responsive indicator in many NM streams. Dissolved oxygen deficit and high pH are the algal related problems most affecting aquatic life (Dobbs and Welch 2000). Unfortunately, it is difficult to test for D.O. deficit, as it usually occurs in the early morning after respiration has been occurring all night. Thus, D.O. percent saturation, which typically peaks in late afternoon, will be used as an indicator in the Level I Assessment. The data set should include all of the measurements taken in the Assessment Unit. Note on the Nutrient Assessment Form if any D.O. saturation readings are above 120%. Determine if any pH readings exceed 8.8 for high quality coldwater and coldwater aquatic life uses and 9.0 for marginal coldwater and warmwater aquatic life uses.

Water Chemistry:

Print out and attach the Nutrient Report from the SWQB water quality database. Use the data in the report to calculate the exceedence ratio for TN and TP. The exceedence ratio is the number of times that the TN or TP concentration is above the ecoregion nutrient threshold values (see Table 1), divided by the total number of samples in the data set. The data set should include all of the samples taken in the Assessment Unit, i.e. if more than one site occurs in the assessment unit, combine the data from all sites in calculating the exceedence ratio. It may also be helpful to calculate the exceedence ratio for individual sites in an assessment unit to determine where nutrient impairment and/or loading are occurring. Record the exceedence ratios

for the entire dataset on the Level I nutrient Assessment Form. An exceedence ratio of >15% may indicate nutrient enrichment (NMED/SWQB 2007). TN and TP are the causal variables in nutrient impairment.

Analysis and Interpretation:

Record appropriate data on a **Level I Nutrient Assessment Form**. If **two or more** of the observations noted above indicate nutrient enrichment, a Level II Assessment should be conducted because attainment status is uncertain. As the causal variable, TN and TP are treated as one observation, i.e. if one or both exceed the established threshold it will only count as one observation. If one or none of the above observations indicate enrichment, the assessment unit is considered to be Fully Supporting with respect to New Mexico's narrative nutrient standard.

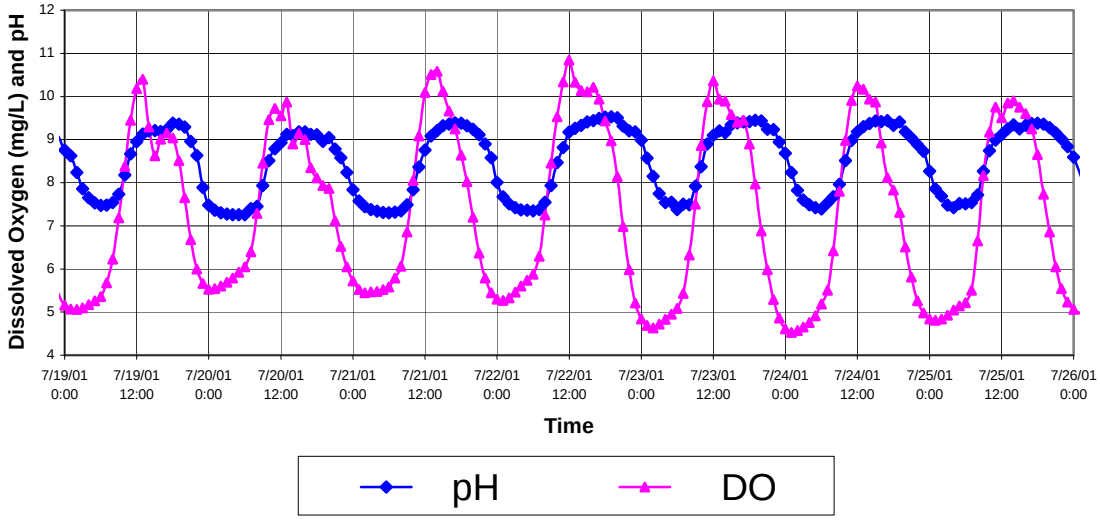
B. Level II Nutrient Assessment

A Level II Assessment is based on quantitative measures of indicators. It is conducted if the Level I Assessment indicates potential nutrient impairment. The Level II Assessment uses data that will be collected during a Level II Nutrient or EMAP Surveys and compiled on the Level II Nutrient Survey or EMAP Forms.

Diurnal Cycles:

Algal biomass above nuisance levels often produces large diurnal fluctuations in D.O. and pH (Figure 1). Photosynthesis and respiration by dense algal mats commonly cause water quality criteria exceedences. Dissolved oxygen concentration, local D.O. percent saturation, and pH are all used as indicators of nuisance levels of algal biomass. The magnitude of diurnal swings in D.O. and pH will depend on several factors, such as turbulence (which affects aeration), light, temperature, buffering capacity, and the amount and health of algal and/or macrophyte biomass.

Figure 2. Diurnal patterns in dissolved oxygen and pH in East Fork Jemez, below La Jara Creek (July 18 - 26,2001)



Higher temperatures tend to enhance algal growth and may increase photosynthesis and respiration, resulting in greater variation in diurnal D.O. and pH values. Observe pre-dawn measurements for minimum D.O. concentrations and afternoon hours for maximum pH and D.O. percent saturation. Aquatic organisms are most affected by maximum pH and minimum D.O., rather than by daily means of these variables (USEPA 2000).

Assessment of D.O. and pH may be made with large sonde dataset or from grab samples. Grab sample assessments will only be used when a large sonde data set is not available. Large sonde datasets are generated by deploying a sonde (multi-parameter, continuous recording device) set to take hourly readings of D.O., pH, specific conductance, temperature, and turbidity for multiple days. These datasets provide a more robust assessment as the diurnal cycles of D.O. and pH are recorded over multiple dates and times. The *Protocol for Assessment of Large pH Data Sets* and the *Protocol for Assessment of Dissolved Oxygen Data Collected with Continuous Recording Devices* should be used to assess pH and D.O. data from a sonde (appendix in NMED/SWQB 2007). The D.O. thresholds presented in **Table 3** are based on both the designated use and the life stage present at the time of sampling. Based on these assessments, note on the Nutrient Assessment Form whether or not the designated use is being supported.

Table 3. Water Quality Threshold Values for Dissolved Oxygen

	Coldwater values		**Warmwater values**
	Early life stages (1 Nov - 31 Jul at ≥ 2750 m; 1 Nov - 30 Jun at < 2750 m)	**Other life stages**	**All life stages**
Combined Instantaneous Minimum	8.0 mg/L; 95% saturation	6.0 mg/L; 90% saturation	5.0 mg/L; 90% saturation
Local percent saturation instantaneous minimum	85	75	75

If a sonde was not deployed for multiple days, use field data from the water quality and nutrient surveys to calculate an exceedence ratio for pH, local D.O. percent saturation, and D.O. concentration. Be sure to use data from all of the sites in the assessment unit, not just the site where nutrient survey was conducted. For D.O. percent saturation, a threshold of 120% is used. For grab sample assessments, D.O. percent saturation is used in addition D.O. concentration as it tends to be collected during the day when D.O. is high and not during pre-dawn time period when low levels occur. The criteria for D.O. concentration and pH are based on designated use (see **Table 2**). For D.O., the criterion is 6 mg/L for coldwater aquatic life uses and 5 mg/L for warmwater aquatic life uses. The threshold value for pH is 8.8 for high quality coldwater and coldwater aquatic life uses and 9.0 for marginal coldwater and warmwater aquatic life uses. If an assessment unit has both warmwater and coldwater uses, the more stringent criterion should be

used to be protective of all uses. An exceedence ratio of greater than 15% may indicate nutrient enrichment (NMED/SWQB 2007). Sondes will not be deployed if there is a high risk of damage to, or loss of, the instrument due to high flows or vandalism.

Water Chemistry:

Use the nutrient report from the SWQB water quality database. Print and attach a current report so that all available data are used. Record the TN and TP concentrations collected during the nutrient survey as well as the exceedence ratio for the entire dataset. Be sure to use data from all of the sites in the assessment unit, not just the site where nutrient survey was conducted, i.e. if more than one site occurs in the assessment unit, combine the data from all sites in calculating the exceedence ratio. The exceedence ratio is the number of times that the TN or TP concentration is above the nutrient threshold values (**Table 1**), divided by the total number of samples in the dataset. An exceedence ratio of >15% may indicate nutrient enrichment (NMED/SWQB 2007).

Algal Sampling:

In streams, benthic algae production and biomass are the most useful parameters in monitoring changes in water quality (USEPA 1991). Chlorophyll *a* concentration is used as a surrogate for algal biomass and is generally the most appropriate variable to monitor (USEPA 2000). Record the results of chlorophyll *a* concentration in $\mu g/cm^2$. If more than one chlorophyll *a*, record the average for each site visit. Do not average samples taken on different days.

In *Rapid Bioassessment Protocols (RBP) for Use in Streams and Wadeable Rivers* (USEPA 1999), nuisance levels of algal biomass are defined as: greater than 10 micrograms chlorophyll *a* per square centimeter (>10 $\mu g/cm^2$). EPA's *Nutrient Criteria Technical Guidance Manual for Rivers and Streams* lists a number of algal biomass thresholds ranging from 100 – 200 mg/m^2 (10 to 20 $\mu g/cm^2$) (USEPA 2000). SWQB measured the chlorophyll *a* concentration at reference sites in each of the ecoregions and calculated the 95^{th} percentile for each ecoregion. These threshold values are shown in the **Table 4**.

Table 4. Chlorophyll *a* Ecoregional Threshold Values in $\mu g/cm^2$

21-Southern Rockies	22/20-AZ/NM Plateau	23-AZ/NM Mountains	24/79-Chihuahuan Desert	26/25-SW Tablelands
n = 32	n = 12	n = 18	n = 14	n =12
5	8	7	17	11

Benthic Diatoms (OPTIONAL COMPONENT UNDER DEVELOPMENT):

SWQB is currently in the process of developing a regional SCI and assigning tolerance values for diatom communities of New Mexico. Once a SCI has been developed for New Mexico and organism tolerance values are verified these biological indicators will be used in the weight of evidence nutrient assessment.

Algal Bioassays (OPTIONAL COMPONENT INCLUDED IF NECESSARY):

If stream observations indicate that algal biomass may be a problem and/or there is an NPDES permit that discharges within the assessment unit, a limiting nutrient analysis and algal growth potential test may be performed. Currently, researchers at the University of New Mexico (UNM) are conducting these analyses for SWQB.

The procedures for determining limiting nutrients and algal growth potential are outlined in *The Selenastrum capricornutum Prinz Algal Assay Bottle Test* (USEPA 1978) and *Biostimulation and Nutrient Assessment Workshop* (USEPA 1975). Results are given in dry weight measurements in accordance with the EPA procedure. Dry weight is used to define the Productivity Classification as described in **Table 5**. Moderately High Productivity and High Productivity may be indicative of nutrient enrichment.

Table 5. Productivity Classifications from algal bioassay results.

Algal Growth (mg dry wt./L)	**Classification**
0.00 – 0.10	Low Productivity
0.11 - 0.80	Moderate Productivity
0.81 – 6.00	Moderately High Productivity
6.10 – 20.00	High Productivity

Analysis and Interpretation:

Record appropriate data on a **Level II Nutrient Assessment Worksheet**. Compare each indicator to the associated threshold value. Note those indicators that exceed the threshold value on the **Level II Nutrient Assessment using Threshold Values** Form. If **three or more** indicators exceed the threshold, the assessment unit is determined to be not supporting.

If the study reach is believed to have naturally high productivity because of geology, flow regime, or other natural factors, a reference site approach may be used. Identify an appropriate reference reach for the study area and conduct a Level II Nutrient Survey of the reference reach near the same time that the study reach is surveyed. Whenever possible, select an existing survey site as a reference, as existing sites will have associated water quality data. Compare each indicator from the two sites, including algal biomass, and chemical and physical parameters, as well as benthic community composition, when appropriate. Use statistical tests to determine significant difference when feasible. When the number of samples from each site is sufficient (n is greater than 4), the rank-sum test (a.k.a. Wilcox or Mann-Whitney test) will be used to test if there is a high probability that the study site is different than the reference site. If the number of measurements is ≤4, then best professional judgment will be used to determine if the parameters are different at the sites (see notes on the **Level II Assessment using a Reference Site** Form for general guidelines). If indicators from the sites are in the same range, the assessment unit will not be listed. If, however, two or more indicators are substantially different, the assessment unit will be determined to be not supporting.

Page of Evaluator:

Date of Assessment: Date of Assessment Protocol used: Date of WQS used:

Level I Nutrient Assessment Form

Assessment Unit:	
Site Location:	
	Ecoregion:
	Aquatic Life Uses:

Algae and Macrophytes: mark **True** if the indicator is present during one or more seasons.

Percent algal cover is greater than 50%: True False
Percent macrophyte cover is greater than 50%: True False

Periphyton and Substrate: mark **True** if the indicator is present during one or more seasons.

0 - rough with no apparent growth, **1 -** thin layer of periphyton is visible, **2 -** thickness of 0.5-1 mm, **3 -** 1 mm to 5 mm thick, **4 -** 5 mm to 20 mm thick, **5 -** >20 mm thick Rating of the periphyton on coarse substrate is >2: True False
Anoxic layer present (black, H_2S layer): True False

D.O. Percent Saturation and pH: mark **True** if the indicator is present at any time
The pH criterion is 8.8 for high quality coldwater and coldwater aquatic life (CWAL) uses, and 9.0 for marginal coldwater and warmwater aquatic life (WWAL) uses.

D.O. percent saturation (local) is greater then 120%: True False
pH value is greater then 8.8 for CWF or 9.0 for WWF: True False

Water Chemistry: attach nutrient report from SWQB database.

Total Nitrogen (mg/L):	**Total Phosphorus (mg/L):**
Ecoregion/ALU Threshold (see Table 1):	Ecoregion/ALU Threshold (see Table 1):
Exceedence Ratio:	Exceedence Ratio:

Move to a Level II Assessment if two or more of the following occur:

Response Variables

- ____ Algae cover on stable substrate is >50%
- ____ Periphyton rating is >2
- ____ Anoxic layer is present
- ____ D.O. percent saturation (local) is greater than 120%
- ____ pH value is greater then appropriate criterion

Causative Variables

- ____ Total nitrogen and/or total phosphorus exceedence ratio is >15%
    - ____ Total nitrogen exceedence ratio is >15%
    - ____ Total phosphorus exceedence ratio is >15%

Level II Assessment: YES NO–Reach is Full Support for nutrients NOT ASSESSED–Insufficient Data

Level II Nutrient (Office) Assessment Worksheet

Sonde: Use the *Protocol for Assessment of Large pH Data Sets* and the *Protocol for Assessment of Dissolved Oxygen Data Collected with Continuous Recording Devices* to assess pH and D.O. if multiple day Sonde data are available. Attach Assessment Form. If sonde data are not available, use grab sample data to calculate an exceedence ratio for pH, local D.O. percent saturation, and D.O. concentration.

Site Location: _____	
Multiple-day Deployment	**Grab Samples**
Assessment of dissolved oxygen:	D.O. % saturation exceedence ratio: _____
☐ Supporting ☐ Not supporting	
Assessment of large pH datasets :	D.O. minimum exceedence ratio: _____
☐ Supporting ☐ Not supporting	
DO fluctuations > 3mg/L: ☐ Yes ☐ No	pH exceedence ratio: _____
Notes: _____	

Nutrient Survey Water Chemistry: attach updated nutrient report from SWQB database and calculate the exceedence ration for the entire assessment unit.

Total Nitrogen (mg/L)	**Total Phosphorus (mg/L)**
Ecoregion/ALU Threshold (see Table 1): _____	Ecoregion/ALU Threshold (see Table 1): _____
Exceedence Ratio: _____	Exceedence Ratio: _____
Notes: _____	

Algal Sampling: record results of chlorophyll *a*.

Ecoregion chlorophyll *a* threshold value in µg/cm^2 (see Table 4 of Appendix E): _____
Chlorophyll *a* (µg/cm^2): _____
Notes: _____

Benthic Diatoms (OPTIONAL): see notes on following page.

Date: _____ Sample method: _____
Reference site: _____
Stream Condition Index (SCI) Score: _____
Notes: _____

Algal Bioassays (OPTIONAL): Attach results.

Date collected: _____	Limiting nutrient: _____
Algal productivity: ☐low ☐moderate ☐moderately high ☐high	
Notes: _____	

NOTES: Total Nitrogen is calculated by adding Total Kjeldahl Nitrogen plus Nitrate + Nitrite. In the event that Nitrate + Nitrite or Total Kjeldahl Nitrogen is below the detection limit, a value of one half the detection limit will be used (Gilbert 1987).

Put NA (not available) in boxes for parameters that were not collected. Benthic diatom indicators will be added to the assessment once the index is developed and threshold values are verified for New Mexico.

Comments:_____

Page of Evaluator:

Date of Assessment: Date of Assessment Protocol used: Date of WQS used:

Level II Nutrient Assessment Form (using Threshold Values)

Assessment Unit: _____	
Site Location(s): _____	
	Ecoregion: _____
	Aquatic life Uses: _____

An Assessment Unit will be determined to be not supporting if **three or more** of the following indicators are present (if not all of the indicators have been measured, the presence of two of the following indicators will be assessed as not supporting). Check all indicators that exceed the threshold values below.

- ☐ Total nitrogen is above the ecoregion/ALU threshold in >15% of samples
- ☐ Total phosphorus is above the ecoregion/ALU threshold in >15% of samples
- ☐ Dissolved Oxygen threshold is exceeded
  - (☐) determined to be **not supporting** using the assessment protocol for Data Collected with Continuous Recording Devices
  - (☐) >15% of grab samples exceeded 120%
  - (☐) >15% of grab samples are below the applicable standard
- ☐ pH threshold is exceeded
  - (☐) determined to be **not supporting** using the assessment protocol for large pH data sets
  - (☐) >15% of grab samples exceeds appropriate criterion
- ☐ The Algal Bioassay indicates moderately high or high algal production
- ☐ Chlorophyll *a* ecoregion threshold is exceeded

Check One:	☐ **Fully supporting**	☐ **Not supporting**
Notes: _____		

Comments:_____

Revised 4 January 2008 (LG)

Page of Evaluator:

Date of Assessment: Date of Assessment Protocol used: Date of WQS used:

Level II Nutrient Assessment Form (using a Reference Site)

Assessment Unit: ____	
Site Location(s): ____	
Reference Site: ____	
	Ecoregion: ____
	Aquatic life Uses: ____

If the study reach is believed to have naturally high productivity because of geology, flow regime, or other natural factors, a reference site approach may be used. An Assessment Unit will be determined to be **not supporting** if **two or more** of the following indicators of the study site are notably different from those of the reference site. If the number of samples from each site is sufficient (n is >4), then the rank-sum test (a.k.a. Wilcox or Mann-Whitney test) will be used to test if there is a high (>75%) probability that the study site is different than the reference site. If the number of measurements is ≤4, then best professional judgment utilizing the general guidelines in the table from the "notes" section below will be used to determine if the parameters are different at the sites.

Indicator	Reference Site	Study Site
D.O. saturation exceedence ratio*	____	____
pH exceedence ratio*	____	____
DO concentration exceedence ratio*	____	____
Total nitrogen exceedence ratio	____	____
Total phosphorus exceedence ratio	____	____
Chlorophyll *a* concentration	____	____
Algal Bioassay algal production	____	____

* the exceedence ratio for large data sets refers to the number of days with exceedences divided by the number of full days that the sonde was deployed, not the number of data points. Use grab sample data if multiple day Sonde data are not available for both sites.

Check One:	☐ **Fully supporting**	☐ **Not supporting**
Notes:____		

NOTES: Put NA (not available) in boxes for parameters that were not collected.Complete and attach a Level II Nutrient Assessment Worksheet for the reference site as well as the study site.

The table below provides general guidelines of what constitutes a "difference" between the reference and study site for parameters with < 5 measurement.

Indicator	Reference Site	Study Site
D.O. saturation exceedence ratio	_____	> 1 exceedence more than reference
pH exceedence ratio	_____	> 1 exceedence more than reference
DO concentration exceedence ratio	_____	> 1 exceedence more than reference
Total nitrogen exceedence ratio*	_____	> 1 exceedence more than reference*
Total phosphorus exceedence ratio*	_____	> 1 exceedence more than reference*
Chlorophyll *a* concentration	_____	≥20% difference
Algal Bioassay algal production	_____	≥ 1 classification higher than reference

* Also consider how much greater the concentrations are at the study site, and how close the concentrations are to the detection limit (d.l.). If one or both of concentrations are <2 times d.l., then a value of 4 times the reference site concentration would be considered "different". If the concentrations are >2 times the d.l. then a value 2 times the reference concentration would be considered "different"

Comments:_____

Revised 4 January 2008 (LG)

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APPENDIX F

LARGE DISSOLVED OXYGEN DATASET ASSESSMENT PROTOCOL

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JUNE 19, 2009

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Introduction

Most of the information available concerning oxygen requirements of fish is based on salmonids, although a substantial number of studies also involve warmwater species. The consensus that has emerged from the literature is that salmonids and other coldwater species are generally more sensitive to low levels of dissolved oxygen than warmwater species, and that early life stages (embryos and larvae) of all species have higher dissolved oxygen requirements than their respective adult stages. Although few data are available on the effects of reduced dissolved oxygen on benthic macroinvertebrates, "historical consensus states that, if all life stages of fish are protected, the invertebrate communities, although not necessarily unchanged, should be adequately protected" (USEPA, 1986) although there may be exceptions to this generalization.

Based on the above statements, this protocol recommends values for coldwater and warmwater aquatic life uses, as well as early life stages and other life stages.

Oxygen content in fresh waters is determined by several factors acting in concert. These factors include temperature, atmospheric pressure, salinity, turbulence, and photosynthetic activity of algae and plants in the water. Healthy aquatic systems have dissolved oxygen content that at least approaches 100% saturation[1]. Oxygen content may fall substantially below 100% saturation during the night when respiration and oxidation of decaying organic matter exceed production from photosynthesis (Deas and Orlob, 1999). This type of situation is particularly pronounced in systems with excessive nutrient enrichment and resulting algal and plant growth.

Currently, New Mexico's criteria for dissolved oxygen are expressed only as mass per volume (mg/L). However, in certain circumstances, such as high altitude, where atmospheric pressure is comparatively low, or high temperatures that reduce oxygen solubility, criteria may be physically impossible to attain. For this reason, this assessment protocol proposes a combined assessment of both dissolved oxygen concentration (i.e., mg/L) and percent saturation, as this integrates several factors that influence the amount of oxygen that water can contain. Additionally, when the percent saturation drops too low, the resulting reduction of the oxygen tension gradient across the gill epithelium of a fish decreases the ease of oxygen diffusion from the water into the blood, with deleterious physiological effects (Davis, 1975). For this reason, this assessment protocol includes a minimum percent saturation value that is independent of oxygen concentration. Apparently, oxygen supersaturation has no negative impact on fish (Wiebe and McGavock, 1932), thus this protocol addresses only minimum saturation levels.

Procedures

Ideally, dissolved oxygen data should be collected using continuous recording devices (sondes) in order to observe diurnal fluctuations, as opposed to the "snapshot" that grab data provide. However, in some cases, grab sample data will be all that are available. In those cases, grab samples should be taken as near to sunrise as possible to ensure that the lowest concentration for a given day is recorded. Areas where excessive aquatic plant growth is evident should be prioritized for sonde deployment because diurnal fluctuations in dissolved oxygen concentrations will likely be greater due to variation in photosynthetic activity.

[1] All references to saturation are defined as percent saturation at the local elevation, as opposed to global percent saturation (the percent saturation a given concentration would be at sea level).

Interstitial dissolved oxygen concentration may be substantially lower than that of the adjacent water column. In order to be protective of fish embryos and larvae that develop in the interstitial environment (e.g., salmonids), early life stages values are higher than those of other life stages (see Table 1). Early life stage values do not apply to the marginal coldwater aquatic life use, as this designated use is intended to protect cold season use of warm waters.

Early life stage values shall apply to data that are collected during the time period when early life stages are likely to occur in a given water body. The period of applicability for early life stages values shall be defined for high quality coldwater and coldwater aquatic life uses as 1 November through 31 July for elevations at or above 2750 m and 1 November through 30 June for elevations below 2750 m.

In Table 1, coldwater values apply to high quality coldwater, coldwater, and marginal coldwater aquatic life uses (with the exception, as noted above, that early life stages values do not apply to marginal coldwater aquatic life uses). Warmwater values include warmwater and limited warmwater aquatic life uses. All values are given in milligrams per liter (mg/L) and/or local percent saturation.

Table 1. Water Quality Values for dissolved oxygen

	COLDWATER VALUES		**WARMWATER VALUES**
	Early life stages (1 Nov - 31 Jul at ≥ 2750 m; 1 Nov - 30 Jun at < 2750 m)	**Other life stages**	**All life stages**
Combined Instantaneous Minimum	8.0 mg/L; 95% saturation	6.0 mg/L; 90% saturation	5.0 mg/L; 90% saturation
Local percent saturation instantaneous minimum	85	75	75

NOTE: When assessing data for the combined instantaneous minimum, only simultaneous data are considered. In other words, both the concentration and saturation values must fail to meet minimum values at the same time for an exceedence to occur. If the local percent saturation value falls below 85 during early life stages in coldwater streams or 75 at any other time or in warmwater streams, regardless of the corresponding concentration value, it shall be considered an exceedence.

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•**Dissolved oxygen – continuously recorded data** (e.g., sonde data)	All of the following must be met: 1) Combined instantaneous minimum values are not exceeded simultaneously for four or more consecutive hours, and 2) minimum saturation value is not below 85% (coldwater early life stages) or 75% (coldwater other life stages and warmwater all life stages) for four or more consecutive hours.	Any one of the following is met: 1) Combined instantaneous minimum values are exceeded simultaneously for four or more consecutive hours, or 2) minimum saturation value is below 85% (coldwater early life stages) or 75% (coldwater other life stages and warmwater all life stages) for four or more consecutive hours.	When available, biological assessment data shall be considered in determination of support status. When single excursions substantially below minimum values occur; when such excursions occur during a critical life cycle period, such as during spawn periods for coldwater fish species; or when severe events lead to fish kills (or other serious water quality impairment), best professional judgment and other available data will be used to determine aquatic life use support status.

NOTE: Information derived from analysis of dissolved oxygen data according to the above protocol may be useful for purposes other than determining support status. Included on the form used to document dissolved oxygen assessment from data collected with continuous data logging devices is a section for information that can be used as a screening tool for nutrient assessments (see attached form).

References:

Davis, J.C. 1975. Minimal dissolved oxygen requirements of aquatic life with emphasis on Canadian species: a review. *Journal of the Fisheries Research Board of Canada* 32(12):2295-2332.

Deas, M.L. and G.T. Orlob. 1999. Klamath River Modeling Project. Project #96-HP-01. Assessment of Alternatives for Flow and Water Quality Control in the Klamath River below Iron Gate Dam. University of California Davis Center for Environmental and Water Resources Engineering. Report No. 99-04. Report 236 pp.

United States Environmental Protection Agency (USEPA). 1986. Ambient Water Quality Criteria for Dissolved Oxygen. EPA 440/5-86-003. Office of Water. Washington, DC.

Wiebe, A.H. and A.M. McGavock. 1932. The ability of several species of fish to survive on prolonged exposure to abnormally high concentrations of dissolved oxygen. *Transactions of Americ. Fisheries Soc*. 63: 267-274.

 Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

pH and Dissolved Oxygen Sonde Data Assessment Form

Year/Watershed: _____

Assessment Unit: _____

Station name: _____

STORET ID: _____

Lat: N _____ **Lon:** W _____ **Elevation:** ____ m

WQS segment: 20.6.4. ___ **Designated use:** _____

Sonde data file name: _____

First data point: Date/Time

Last data point: Date/Time

Recording interval: 1 hr. **Data points:** n = _____

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pH Assessment

Criterion range: ☐ 6.6 – 8.8 ☐ 6.6 – 9.0 ☐ Other (specify)

Minimum recorded: _____ **Maximum recorded:** _____ **≥ 0.5 units above criterion?** ☐ no ☐ yes

Number of data points outside criterion: ___ **% data points outside criterion:** ____

Maximum contiguous duration outside criterion: ___ hours

Use support designation: ☐ **Supporting** ☐ **Non-supporting**

Dissolved Oxygen Assessment

Applicable value: ☐ coldwater (early life stages) 8.0 mg/L; 95% **OR** 85%

☐ coldwater (other life stages) 6.0 mg/L; 90% **OR** 75%

☐ warmwater (all life stages) 5.0 mg/L; 90% **OR** 75%

Combined instantaneous minimum: _____ mg/L; ____ % saturation Exceedences: n = ___ ; ____ %

Percent saturation instantaneous minimum: _____ Exceedences: n = ___ ; ____ %

Combined values exceeded for ≥ 4 hours contiguously? ☐ no ☐ yes

Minimum % saturation exceeded for ≥ 4 hours contiguously? ☐ no ☐ yes

Use support designation: ☐ **Supporting** ☐ **Non-supporting**

Information pertinent to nutrient assessment:

Below DO concentration minimum? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

> 120% saturation? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

< 75% saturation? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

Comments:_____

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APPENDIX G

LARGE pH DATASET ASSESSMENT PROTOCOL

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JUNE 19, 2009

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Introduction

The pH of a solution is a measure of its hydrogen ion concentration and is calculated as the inverse log of the hydrogen ion concentration ($pH = -\log_{10} [H^+]$). A pH value of 7.0 is considered neutral. That is, at pH 7, the concentration of hydrogen ions ($[H^+]$) is equal to that of hydroxide ions ($[OH^-]$). In natural waters, pH is a measure of the acid-base equilibrium resulting from various dissolved compounds and gases. The principal system regulating pH in natural waters is the carbonate system, composed of carbon dioxide (CO_2), carbonic acid (H_2CO_3), bicarbonate ion (HCO_3), and carbonate ion (CO_3).

There is no absolute pH range outside of which there are detrimental effects to freshwater aquatic life. Rather, gradual deterioration occurs as pH values move away from neutral. A range of pH values from 5.0 to 9.0 is not directly lethal to fish; however, the toxicity of some pollutants (e.g., ammonia) can be substantially affected by pH changes within this range (USEPA, 1986). At pH values above 9.0, fish have difficulty excreting ammonia across the gill epithelium, but they are generally able to survive pH values up to 9.5 for 2-3 days (McKean and Nagpal, 1991). Benthic macroinvertebrates may be more sensitive to lower pH values than fish. A pH range from 6.5 to 9.0 appears to adequately protect both fish and benthic macroinvertebrates (USEPA, 1986).

In New Mexico, typical pH values in surface waters that are largely unaffected by anthropogenic disturbance vary approximately from 7.5 to 8.7. Some streams, depending on local geology, have documented natural background pH values as low as 3.0 (e.g., Sulphur Creek in the Jemez River watershed), but this is atypical on a statewide basis.

An increase in pH values can result from the decrease of carbonic acid when carbon dioxide, carbonate, and bicarbonate are used by plants during photosynthesis. Thus, when high levels of nutrients lead to excessive plant growth, pH values above 9.0 may occur during the daylight hours. During the night, when photosynthesis does not occur, the pH value drops. The result is a diurnal fluctuation of pH values that lags a few hours behind the diurnal fluctuation observed in dissolved oxygen concentrations. For this reason, it is best to use continuous recording devices (sondes) to record pH values where excessive aquatic plant growth is evident. If this is not possible, grab samples should be taken at the end of the day when pH values will be at their highest.

If exceedences of water quality criteria are to be detected, the use of grab samples for recording pH in areas of excessive aquatic plant growth poses a logistic problem when viewed with the need to also detect exceedences of the dissolved oxygen criterion. Dissolved oxygen is at its lowest (i.e., most likely to exceed criteria) in the early morning in areas of excessive aquatic plant growth. This is in contrast to the diurnal pattern of pH values, which are most likely to exceed criteria late in the day. This dilemma underscores the need to use sondes for collecting these kinds of data.

Recommendations

When continuously recorded pH data are available, instantaneous (hourly) pH values shall not be outside the range of the criterion for the water body in question in greater than 15% of the measurements, pH shall not exceed the range of the criterion for the water body in question for more than 24 contiguous hours, and pH shall never exceed 0.5 units above the upper limit of the criterion.

The following table shall be used to determine the degree of aquatic life use support.

TYPE OF DATA	FULLY SUPPORTING	NOT SUPPORTING	NOTES
•**pH – continuously recorded data** (e.g., sonde data)	All of the following must be met: 1) pH is outside the range of the criterion for the water body in question in <15% of measurements, 2) pH exceeds the range of the criterion by 0 to 0.5 units for less than 24 contiguous hours, and 3) pH is never 0.5 or more units above the upper limit of the criterion at any time.	Any one of the following is met: 1) pH is outside the range of the criterion for the water body in question in ≥ 15% of measurements, 2) pH exceeds the range of the criterion by 0 to 0.5 units for 24 or more contiguous hours, or 3) pH is 0.5 or more units above the upper limit of the criterion at any time.	Assessments shall be based upon floating 24-hour periods; data from partial 24-hour periods shall not be included in assessments in order to avoid skewing the percentage of exceedences. The only exception to this rule is if there is an instantaneous reading that exceeds 0.5 units above the upper limit of the criterion within the partial day data. When available, biological assessment data shall be considered in determination of support status. When single excursions substantially above the criteria occur; when such excursions occur during critical life cycle period, such as during spawn periods for coldwater fish species; or when severe events lead to fish kills (or other serious water quality impairment), best professional judgment and other available data will be used to determine aquatic life use support status.

References

McKean, C. J. and N. K. Nagpal. 1991. Ambient water quality criteria for pH. British Columbia Ministry of Environment, Water Quality Branch, Water Management Division. http://wlapwww.gov.bc.ca/wat/wq/BCguidelines/pH.html

United States Environmental Protection Agency (USEPA). 1986. Quality criteria for water 1986. EPA 440/5-86-001. Office of Water, Washington, D.C.

Page of Assessor: _____

Date of Assessment: _____ Date of Assessment Protocol used: _____ Date of WQS used: _____

pH and Dissolved Oxygen Sonde Data Assessment Form

Year/Watershed: _____

Assessment Unit: _____

Station name: _____

STORET ID: _____

Lat: N _____ **Lon:** W _____ **Elevation:** ____ m

WQS segment: 20.6.4. ___ **Designated use:** _____

Sonde data file name: _____

First data point: Date/Time

Last data point: Date/Time

Recording interval: 1 hr. **Data points:** n = _____

---

pH Assessment

Criterion range: ☐ 6.6 – 8.8 ☐ 6.6 – 9.0 ☐ Other (specify)

Minimum recorded: _____ **Maximum recorded:** _____ **≥ 0.5 units above criterion?** ☐ no ☐ yes

Number of data points outside criterion: ___ **% data points outside criterion:** ____

Maximum contiguous duration outside criterion: ___ hours

Use support designation: ☐ **Supporting** ☐ **Non-supporting**

Dissolved Oxygen Assessment

Applicable value: ☐ coldwater (early life stages) 8.0 mg/L; 95% **OR** 85%

☐ coldwater (other life stages) 6.0 mg/L; 90% **OR** 75%

☐ warmwater (all life stages) 5.0 mg/L; 90% **OR** 75%

Combined instantaneous minimum: _____ mg/L; ____ % saturation Exceedences: n = ___ ; ____ %

Percent saturation instantaneous minimum: _____ Exceedences: n = ___ ; ____ %

Combined values exceeded for > 3 hours contiguously? ☐ no ☐ yes

Minimum % saturation exceeded for > 3 hours contiguously? ☐ no ☐ yes

Use support designation: ☐ **Supporting** ☐ **Non-supporting**

Information pertinent to nutrient assessment:

Below DO concentration minimum? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

> 120% saturation? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

< 75% saturation? ☐ no ☐ yes If yes, maximum contiguous duration: ___ hours

Comments:_____

APPENDIX H

INTERIM TURBIDITY ASSESSMENT PROTOCOL FOR PERENNIAL STREAMS

NEW MEXICO ENVIRONMENT DEPARTMENT
SURFACE WATER QUALITY BUREAU

JUNE 19, 2009

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Purpose and Applicability

This document establishes an interim assessment protocol for determining impairment due to excessive turbidity in perennial streams. This assessment protocol is only applicable to perennial streams because the research used to develop it is based upon data collected from perennial streams. This protocol is not applicable to the following water body types because the research and implementation procedures necessary have either not been investigated by the Surface Water Quality Bureau (SWQB) or are not yet developed:

- Intermittent streams
- Ephemeral streams
- Wetlands

This interim protocol was developed to assess the first sentence of the *State of New Mexico Standards for Interstate and Intrastate Surface Waters* narrative criterion for turbidity currently found at 20.6.4.13 NMAC (NMWQCC 2007):

> *J.* ***Turbidity****: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water.*

This protocol addresses the narrative turbidity criterion through the use of numeric translators with biocriteria confirmation for listing of impairment to aquatic life due to excessive turbidity. A "translator" identifies a process, methodology, or guidance that a State or Tribe uses to quantitatively interpret narrative criteria statements (USEPA 2009). For this interim protocol, the numeric translators are based on segment-specific numeric turbidity criteria values used in the standards prior to the adoption of the 2005 amendments.

SWQB did not have a turbidity assessment protocol in place to address the narrative turbidity criterion during development of the 2006-2008 and 2008-2010 State of New Mexico Clean Water Act (CWA) §303(d)/§305(b) Integrated Lists. Therefore, this interim protocol will be used to assess turbidity data that would have been assessed for the 2006-2008 and 2008-2010 Integrated Lists, as well as data available for the 2010-2012 Integrated List, for the development of the 2010-2012 Integrated List. SWQB is developing a workplan and timeline for the development of a final turbidity assessment protocol. Subject to staffing and resource constraints, SWQB expects the final protocol will be ready for development of upcoming Integrated Lists.

I. History of New Mexico's Turbidity Criterion

Prior to the 2003-2005 triennial review of water quality standards, New Mexico had established segment-specific numeric turbidity values for water quality standard segments as detailed in Sections 101-899 of 20.6.4 NMAC (NMWQCC 2002).

The 2005 amendments to the standards removed these numeric turbidity values and revised the narrative turbidity criterion to read as follows in 20.6.4.13 NMAC (NMWQCC 2007):

***J. Turbidity**: Turbidity attributable to other than natural causes shall not reduce light transmission to the point that the normal growth, function, or reproduction of aquatic life is impaired or that will cause substantial visible contrast with the natural appearance of the water. Turbidity shall not exceed 10 NTU over background turbidity when the background turbidity is 50 NTU or less, or increase more than 20 percent when the background turbidity is more than 50 NTU. Background turbidity shall be measured at a point immediately upstream of the turbidity-causing activity. However, limited-duration activities necessary to accommodate dredging, construction or other similar activities and that cause the criterion to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and all appropriate permits and approvals have been obtained.*

According to testimony provided by SWQB, and reiterated in the New Mexico Water Quality Control Commission's (NMWQCC) statement of reasons, part of the intent of the change from numeric criteria to a narrative turbidity criterion was to protect "*…waters from activities that cause turbidity to exceed background levels, while avoiding an inappropriate determination of impairment during periods of naturally-caused sediment transport, such as runoff*" (NMWQCC 2005). This interim assessment protocol relies on the previously established turbidity values but includes a verification step to address the Commission's concern regarding inappropriate impairment determinations.

The assessment protocol does not address the portion of the criterion, beginning with the second sentence, that pertains to authorizing and controlling turbidity-causing activities. To clarify the distinction between determining designated use attainment status (i.e., "assessment") for the biennial Clean Water Act 303d/305b Integrated List vs. authorizing specific turbidity-causing activities, SWQB is proposing minor changes to the language in the criterion as part of the current triennial review.

II. Proposed Interim Assessment Methodology

A. STEP 1: Physical Assessment using Numeric Turbidity Translators

The protocol utilizes the segment-specific numeric turbidity criteria detailed in the 2002 version of 20.6.4 NMAC Sections 101-899 as numeric translators. If no segment-specific criterion is provided in Sections 101-899 and high quality coldwater aquatic life is a current designated or existing use, then the previous default numeric criterion of 10 NTU identified in Subsection C of 20.6.4.900 of the 2002 version will be used. (The 2002 version of 20.6.4 NMAC is available on the SWQB website at http://www.nmenv.state.nm.us/NMED_regs/swqb/20_6_4_nmac.html and upon request.)

The resulting numeric translators are listed in Attachment A. If a particular assessment unit lacks both a segment-specific turbidity numeric criterion and a default criterion, then turbidity cannot be assessed under this interim protocol. The numeric translators are utilized with the percentage exceedence approach in order to determine designated use support as described in Table 1.

Table 1. Interpreting turbidity data to determine aquatic life use support

Type of Data	Fully Supporting	Not Supporting	Notes
A) 1 to 7 samples	**A**) For any one pollutant, no more than one exceedence of the numeric translator.	**A**) For any one pollutant, more than one exceedence of the numeric translator.	Turbidity exceedence attributable to natural causes are not considered exceedences of the criteria (20.6.4.13 Subsection J).
B) > 7 samples	**B**) For any one pollutant, numeric translator exceeded in <15% of measurements.	**B**) For any one pollutant, numeric translator exceeded in ≥ 15% of measurements.	

If the turbidity data indicate no impairment according to application of Table 1, the assessment process stops here and the water is classified as full-support. If assessment of turbidity data results in a determination of not supporting, then available benthic macroinvertebrate data will be utilized as a second step to verify impairment. Specifically benthic macroinvertebrate will be used to evaluate if if the turbidity values observed in step 1 are due to natural increases in turbidity that may be included in the physical assessment data set. This process is detailed below in steps 2 and 3.

B. STEP 2 (if turbidity data indicate Not Supporting): Biological Verification using Benthic Macroinvertebrates

Since the narrative standard for turbidity is intended to prevent impairment of aquatic life, it is appropriate to verify a determination of impairment based on turbidity data with an assessment of biological indicators. The biological verification step addresses the concern of the NMWQCC about "… *avoiding an inappropriate determination of impairment during periods of naturally-caused sediment transport, such as runoff"* (see section I above), and reiterated by USEPA in its Record of Decision (USEPA 2006b -- specifically to prevent *"....streams from inappropriate impairment determinations when the source of the sediment is naturally occurring..."*). If temporary increases in suspended sediment or turbidity are naturally occurring, the biota in the system will be adapted to these temporary increases. Conversely, turbidity inputs beyond the natural condition will impose cumulative stress on the biological community.

Verification of turbidity impairment takes place when a stream site is biologically assessed as not attaining the designated use by sampling the macroinvertebrate community in the same location. In New Mexico, benthic macroinvertebrate data are collected during the fall index period during stable conditions.

Currently, benthic macroinvertebrate sampling is the primary form of biomonitoring utilized by SWQB. As integrators of water quality over time (one to two years depending on their particular lifecycles), benthic macroinvertebrates provide an integrated measure to determine whether or not the normal growth, function, or reproduction of aquatic life has been impacted. To determine potential aquatic life use impairment, the assessment approach is based on the concept of comparing the actual conditions of a specific stream with a reference condition, or a reference stream, to determine attainment of the applicable aquatic life use. This approach is consistent with USEPA guidance (Gibson et al. 1996, Barbour et al. 1999).

To perform a biological assessment, a specific reference site or condition must first be identified or determined, respectively, for comparison. The ratio between the score for the study site and the reference site (or condition) provides a percent comparability measure for each station. The station of interest is then classified on the basis of its similarity to the reference condition and its apparent potential to support an acceptable level of biological health (Barbour *et al.*, 1999). Depending on the ecoregion (Griffith et al. 2006) of the study site, a benthic macroinvertebrate impairment is determined using either the Rapid Bioassessment Protocols (RBPs) (Plafkin et al. 1989) for ecoregions 22, 24, 25, and 26; or the Mountain Stream Condition Index (M-SCI) (Jacobi et al. 2006) for ecoregions 21 and 23. Impairment determination procedures for each method are presented in Tables 2 below. Application of the biological assessment or degree of impairment is a percentage comparison of the sum of selected metric scores at the study site compared to a selected reference site or condition. For example, a study site in ecoregion 24 achieving a biological assessment score greater than 83 percent of the reference site would be deemed non-impaired (full-support). For a more complete discussion on assessing aquatic life uses using biological data, see Section 3.1.1 of the Main Assessment Protocol. Table 2 explains how to interpret macroinvertebrate data to determine aquatic life use support.

Table 2. Interpreting macroinvertebrate data to determine Aquatic Life Use Support

Type of Data	Fully Supporting	Not Supporting	Notes
Macroinvertebrate assemblages in Ecoregions 22, 24, 25, and 26 using RBP Index	Reliable data indicate functioning, sustainable macroinvertebrate assemblages not modified significantly beyond the natural range of reference condition (>83% of reference site(s)).*	Reliable data indicate macroinvertebrate assemblage with moderate to severe impairment when compared to reference condition (≤79% of reference site(s)). *	Reference condition is defined as the best situation to be expected within an ecoregion. Reference sites have balanced trophic structure and optimum community structure (composition & dominance) for stream size and habitat quality.
Macroinvertebrate assemblages in Ecoregions 21 and 23 using M-SCI	Reliable data indicate functioning, sustainable macroinvertebrate assemblages not modified significantly beyond the natural range of reference condition (> 56.70 score). **	Reliable data indicate macroinvertebrate assemblage with moderate to severe impairment when compared to reference condition (<56.70 score). **	

NOTE: *Percentages are based on Plafkin et al. (1989). The 4% gap allows for some best professional judgment.

** Percentages based on Jacobi et al. (2006).

C. STEP 3 (if turbidity data indicate Not Supporting): Combined Physical and Biological Assessment

Upon completion of physical and biological assessments detailed above, a combined assessment for turbidity can be determined from the matrix in Table 3.

When benthic macroinvertebrate data are not available, the impairment will be noted as Category 5C – needing additional data - until the impairment can be verified using macroinvertebrate data or other approaches that may be developed in future versions of the turbidity assessment protocol.

Table 3. Combined assessment matrix for determining aquatic life use support

Biological / Physical	**Impaired (Non Support)** RBP Index < 79% of ref [1] M-SCI Score < 56.70 [2]	**Non-impaired (Full Support)** RBP Index > 84% of ref [1] M-SCI Score > 56.70 [2]
Non-Support **A)** 1 to 7 samples: more than one exceedence of numeric turbidity translator **B**) > 7 samples: numeric turbidity translator exceeded in ≥ 15% of measurements.	☐ Non-Support	☐ Full Support
Full Support **A)** 1 to 7 samples: no more than one exceedence of the numeric turbidity translator. **B**) > 7 samples: numeric turbidity translator exceeded in <15% of measurements.	☐ Full Support (Turbidity) *Benthic macroinvertebrates not assessed*	

[1] RBP Index should be used in Ecoregions 22, 24, 25, and 26. RBP Index score based on Plafkin et al. (1989). The 4% gap allows for some best professional judgment.

[2] M-SCI should be used in Ecoregions 21 and 23. M-SCI and Score based on Jacobi et al. (2006).

References:

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadable Rivers: Periphyton, Benthic Macroinvertebrates and Fish*, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washinton, D.C.

Gibson, G. R., M. T. Barbour, and J. R. Karr. 1996. U. S. Environmental Protection Agency. *Biological Criteria Technical Guidance for Streams and Small Rivers Revised Edition*. EPA 822B96001. Office of Science and Technology Health and Ecological Criteria Division. Washington, D.C.

Griffith, G.E., J.M. Omernik, M.M. McGraw, G.Z. Jacobi, C.M. Canavan, T.S. Schrader, D. Mercer, R. Hill, and B.C. Moran. 2006. *Ecoregions of New Mexico* (color poster with map, descriptive text, summary tables, and photographs): Reston, Virginia, U.S. Geological Survey (map scale 1:1,400,000).

Jacobi G.Z., M.D. Jacobi, M.T. Barbour, E.W. Leppo. 2006. *Benthic macroinvertebrate stream condition indices for New Mexico wadeable streams*. Jacobi and Associates and Tetra Tech, Inc. for New Mexico Environment Department, Surface Water Quality Bureau. Santa Fe, NM.

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U.S. Environmental Protection Agency (USEPA). 2006a. *Framework for developing suspended and bedded sediment (SABS) water quality criteria*. EPA-822-R-06-001. Office of Water, Office of Research and Development, Washington, D.C.

_____. 2006b. *Record of decision* for EPA review of Title 20 Environmental Protection, Chapter 6 water quality, Part 4 Standards for Interstate and Intrastate Surface Waters. Available at: http://www.nmenv.state.nm.us/SWQB/Standards/ROD-EPAReviewDRAFT11-16-06.pdf.

_____. 2009. *What is a new or revised water quality standard?* Powerpoint presentation at EPA Region 6 Water Quality Standards Program Meeting. February 2009. Dallas, TX.

ATTACHMENT A -- Numeric translators for narrative turbidity criterion

BASIN	WQS segment from 20.6.4 NMAC (2007)	INTERIM NUMERIC TRANSLATOR	BASIS FOR INTERIM NUMERIC TRANSLATOR						
				Aquatic Life Use from 20.6.4 NMAC (2002)					
			Aquatic Life Use from 20.6.4 NMAC (2007)	High Quality Coldwater Fishery	Coldwater Fishery	Marginal Coldwater Fishery	Warmwater Fishery	Limited Warmwater Fishery	Segment-specific numeric turbidity criterion from 20.6.4 NMAC (2002)
Rio Grande	101	--	MWW					X	NC
Rio Grande	102	50	WW				X		50
Rio Grande	103	--	MCW / WW			X	X		NC
Rio Grande	104	50	WW				X		50
Rio Grande	105	--	MWW					X	NC
Rio Grande	106	--	MWW					X	NC
Rio Grande	107	25	CW		X				25
Rio Grande	108	25	HQCW	X					25
Rio Grande	109	25	CW		X				25
Rio Grande	110	--	CW / WW		X		X		NC
Rio Grande	111	10	HQCW		X				NC
Rio Grande	112	25	CW / WW		X		X		25
Rio Grande	113	50	MCW / WW			X	X		50
Rio Grande	114	50	MCW / WW			X	X		50
Rio Grande	115	10	HQCW	X					10
Rio Grande	116	--	CW / WW		X		X		NC
Rio Grande	117	--	CW / WW		X		X		NC
Rio Grande	118	--	CW / WW		X		X		NC
Rio Grande	119	25	HQCW	X					25
Rio Grande	120	25	CW		X				25
Rio Grande	121	10	HQCW	X					10
Rio Grande	122	50	CW		X				50
Rio Grande	123	25	HQCW	X					25
Rio Grande	124	--	LAL						NC
Rio Grande	125	--	CW						NC
Rio Grande	126	--	CW						NC
Rio Grande	127	--	CW						NC
Rio Grande	128	--	LAL						NC
Rio Grande	129	10	HQCW						NC
Pecos River	201	--	WW				X		NC
Pecos River	202	--	WW				X		NC
Pecos River	203	25	WW				X		25
Pecos River	204	--	WW				X		NC
Pecos River	205	--	WW				X		NC
Pecos River	206	--	WW				X		NC
Pecos River	207	--	MWW					X	NC
Pecos River	208	--	CW		X				NC
Pecos River	209	10	HQCW	X					10
Pecos River	210	25	WW				X		25
Pecos River	211	--	MWW					X	NC
Pecos River	212	--	CW		X				NC
Pecos River	213	--	CW		X				NC
Pecos River	214	25	CW / WW		X		X		25
Pecos River	215	10	HQCW	X					10
Pecos River	216	--	MCW			X			NC
Pecos River	217	10	HQCW	X					10
Pecos River	218	--	WW						NC
Pecos River	219	--	WW						NC
Pecos River	220	--	MCW						NC
Pecos River	221	--	WW						NC
Canadian River	301	--	MWW					X	NC
Canadian River	302	25	WW				X		25
Canadian River	303	--	MWW					X	NC
Canadian River	304	25	WW				X		25
Canadian River	305	--	MWW					X	NC
Canadian River	306	--	WW				X		NC
Canadian River	307	--	MCW / WW			X	X		NC
Canadian River	308	--	CW / WW		X		X		NC
Canadian River	309	25	HQCW	X					25
Canadian River	310	--	WW						NC
San Juan River	401	--	MCW / WW			X	X		NC
San Juan River	402	--	MCW /			X		X	NC
San Juan River	403	--	MCW / WW			X	X		NC
San Juan River	404	--	CW		X				NC
San Juan River	405	10	HQCW	X					10
San Juan River	406	25	CW / WW		X		X		25
San Juan River	407	--	CW		X				NC
San Juan River	408	--	MCW / WW						NC
Gila River	501	--	MWW					X	NC
Gila River	502	--	MCW / WW			X	X		NC
Gila River	503	10	HQCW	X					10
Gila River	504	--	CW		X				NC
San Francisco River	601	--	CW / MWW			X		X	NC
San Francisco River	602	--	CW		X				NC
San Francisco River	603	10	HQCW	X					10
Dry Cimarron River	701	--	MCW / WW			X			NC
Dry Cimarron River	702	--	WW						NC
Closed Basins	801	--	CW		X				NC
Closed Basins	802	10	HQCW	X					10
Closed Basins	803	--	CW		X				NC
Closed Basins	804	10	HQCW	X					10
Closed Basins	805	10	MCW			X			10
Closed Basins	806	--	CW						NC

NOTES:
-- = no interim numeric translator because no 2002 segment-specific criterion and not a HQCWAL
NC = no segment-specific turbidity criteria were provided

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RESPONSE TO COMMENTS ON PUBLIC COMMENT DRAFT OF "PROCEDURES FOR ASSESSING WATER QUALITY STANDARDS ATTAINMENT FOR THE STATE OF NEW MEXICO CWA §303(d) /§305(b) INTEGRATED REPORT"

Prepared by NMED SWQB

June 19, 2009

Comment Set A: LANL

ENCLOSURE 1

COMMENTS ON "DRAFT 2009 PROCEDURES FOR ASSESSING WATER QUALITY STANDARDS ATTAINMENT FOR THE STATE OF NEW MEXICO CWA 303(D)/305(B) INTEGRATED REPORT"

1. Use of Substitution Method for Non-detects in Assessments

In Sections 2.1.1, 2.1.8 and 3.1.2.1, NMED's Assessment Protocol has certain provisions regarding the use of non-detect data when determining assessment of WQC attainment. We have the following two comments on how the Assessment Protocol directs assessors to handle non-detect data.

A. In section 3.1.2.1 *Assessing chronic aquatic life WQS*, paragraph three, for data below the PQL, the Assessment Protocol directs assessors to substitute one-half the Practical Quantification Limit (PQL), or substitute the detection limit if the PQL is not reported. There is no clear guidance on what to do for data below the detection level except some footnotes in Attachment B - Assessment Forms. To provide a more appropriate method for assessing non-detect data, we recommend the Assessment Protocol use the following approach as a first choice (as taken from Section 4.1.3 (pp 4-3 through 4-4) in Water Environment Research Foundation (WERF) (2007)):

> Non-detects, or low-level values below the lab's reporting level, are often found in datasets of environmental data and, depending on how they are handled, can introduce errors into estimations of central tendency, variability and the outcome of statistical tests. Helsel (2005a) highlights the weaknesses of the three main approaches used by environmental data analysts to handle non-detects: (1) substitution using a fraction (usually one-half) of the reporting limit, (2) use of the "machine readings" rather than allowing the lab to use a reporting limit, and (3) substitution with the reporting limit value. Recent U.S. EPA guidance (2004) also has recognized the fallibility of substitution methods, and does not recommend them; therefore, the use of substitution methods are not considered appropriate for data analysis used to determine water quality impairment. However, guidance still recommends older methods such as Cohen's method, which is valid only for data with one detection limit, and

Aitchison's method, which essentially is substitution (usually but not always with 0) by another name.
Instead, Helsel (2005a) recommends three more accurate methods for computing statistics on data with non-detects: (1) maximum likelihood estimation (MLE), (2) imputation, and (3) the Kaplan-Meier method. Details of computing these and other methods for data with non-detects, along with examples, are found in Helsel (2005b). Each of these methods is available in the survival analysis or reliability analysis sections of commercial statistics software such as Minitab or SYSTAT. In particular, the Kaplan-Meier method is easy (just a counting procedure), non-parametric, and is the standard method for determining percentiles in medical and industrial statistics. The Kaplan-Meier method incorporates the proportion of observations occurring below each detection limit when calculating percentiles (Helsel, 2005b).

***SWQB Response**: SWQB recognizes the limitations of substitution methods, and has looked into switching to one of the above mentioned methods in WERF (2007). These methods are not appropriate for the small sample size that would be typical for the situation described in Section 3.1.2.1, generally n = 2 to 4. Specifically, Helsel (2005) summarizes MLE limitations related to sample size on page 13 and states on page 58 that "MLE methods have not been found to work well for estimating the mean or variance of small (n < 30) samples in any of the papers reviewed later, particularly those assuming a lognormal distribution" which is often the case with environmental data. Page 77 discusses the She (1997) paper where Kaplan-Meier performed the best with a moderate sample size (n=21). Again, given the very small sample sizes that generally occur in the implementation of Section 3.1.2.1 of the Assessment Protocols, the value of a ranking based statistical method such as Kaplan-Meier is unclear.*

B. The Assessment Protocol provides conflicting guidance on the use of "J" flagged data (i.e. values that were registered by lab instruments but should be considered estimated because they are below the lowest concentration on the calibration curve). In Assessment Protocol Section 2.1.1 *Data qualifiers and validation codes*, paragraph three states that J-flagged data "…may be used in assessments when the detection limit is greater than the Water Quality Criterion (WQC)…". This guidance contradicts Section 2.1.8 which states: "If the reporting limit is above the applicable criterion and the laboratory result is reported as below this limit, the result cannot be used for a listing decision". This conflict should be resolved to provide consistent guidance directing assessor's use of J flagged data where applicable criteria are below detection or quantitation limits. We would reiterate that data in this region may be useful if assessed appropriately using the approach suggested above.

***SWQB Response**: These two sections are not in conflict as they address different calsses of data. Section 2.1.1 addresses J flagged data which indicates that a result is estimated because the result was less the quantification limit but greater than the detection limit. Section 2.1.8 is referring to the situation where the lab reports the result as not detected, typically denoted as "<XX,"and flagged with a "U" although flags often vary among laboratories.*

An example would be a parameter with an applicable water quality (WQ) criterion of 0.5 mg/L, with a detection limit of 1.0 mg/L and quanitification limit of 3.0 mg/L. If the result were 2.0 mg/L with a J flag, this data would be used for assessment because although it's an estimate, it is known to be greater than the WQ criterion of 0.5 mg/L because the detection limit is 1.0 mg/L. Alternatively, if the data were reported as a non-detect (i.e., < 1.0 mg/L), this data would not be used for assessment because the result provides no information as to whether the data are actually above or below the applicable criterion.

The wording has been revised in these sections to clarify the difference between the two situations. Specifically, the term reporting limit has been replaced with detection limit as appropriate and the above example was added.

2. Assessment of Numeric Criteria Applicable to Wildlife Habitat Designated Use

In Section 3.6 of the Assessment Protocol, NMED determines wildlife habitat use support when no more than one exceedance of the applicable WQC occurs during the assessment period. The numeric criteria applicable to the wildlife habitat designated use in the New Mexico Administrative Code (20.6.4.900.J NMAC) consist of selected chronic aquatic life criteria known to cause problems in wildlife, such as bioaccumulative pollutants (the criteria magnitude are identical to chronic aquatic life values). In an earlier (pre-2005) version of Section 20.6.4.900.G of the NMAC, the code indicated that the wildlife habitat criteria were chronic. Therefore, the numeric criteria applicable to wildlife habitat use should be assessed consistently using the same time averaging basis and allowable exceedance frequency as the chronic aquatic life criteria (e.g. 4-day average with an allowable exceedance frequency of once in three years).

The Assessment Protocol provides chronic aquatic life criteria assessment procedures in Section 3.1.2.1. However, there is no procedure provided for assessing the allowable exceedance frequency for chronic criteria, even though it is properly called out in 20.6.4.12.NMAC. Also, given the chronic aquatic life basis for wildlife habitat criteria, it would not be appropriate to base corresponding assessments on storm flow data without regard to the unstable stream flow provisions of Section 3.1.2.1. Therefore, wildlife habitat assessments of Section 3.5 should also require the same consideration of varying flows as described for chronic aquatic life in 3.1.2.1.

If a permittee is willing to do the appropriate assessment such as sampling an appropriate time period and/or averaging multiple samples, then the Assessment Protocol should provide the means to recognize and use that data appropriately in an assessment.

***SWQB Response**: Section 3.1.2.1 appropriately applies only to assessment of chronic aquatic life criteria. The current wildlife habitat criteria have the chronic aquatic life criteria as their basis, but that has not always been the case and it may not always be the case in the future. The water quality standards do not specify that the wildlife habitat criteria should be implemented in the same manner as chronic aquatic life criteria, and SWQB does not agree there is a sound basis for making that interpretation*

Please also note that NMAC section 20.6.4.12 is not relevant to this discussion as the beginning clariifies that "… the following provisions apply to dermining compliance for enforcement purposes; they do not apply for the purposes of determining attainment of uses. The department has developed assessment protocols for the purposes of determining attainment of uses…" The distinction was thoroughly debated during the last triennial review. In its Statement of Reasons on the 2005 amendments, the WQCC stated, "The Commission adopts NMED's proposal to add a preamble to clarify that the section is used only to guide enforcement determinations …. " The Water Quality Act allows direct enforcement of water quality standards, and Section 20.6.4.12 provides guidance on the type of evidence that should be collected for such cases, e.g., an illegal dumping incident. The Water Quality Management Plan provides additional guidance on implementation of 20.6.4.12 and therefore also speaks to enforcement only.

3. Assessment of Numeric Criteria Applicable to the Livestock Watering Designated Use for Ephemeral and Intermittent Waters

Section 3.5 of the Assessment Protocol addresses how to interpret chemical/physical data to determine livestock watering use support, without mention of the nature of the receiving water (i.e. perennial or ephemeral). Livestock watering is not addressed by any current EPA guidance or recommended water quality criteria, nor is it one of the beneficial uses recognized by Section 101(a)(2) of the Clean Water Act. The most relevant recent federal guidance is for domestic water supply and human health. Most of these criteria are directly carried over from the domestic water supply standards, which, in turn, come from the Safe Drinking Water Act Maximum Contaminant Levels of the National Primary Drinking Water Standards that are applicable to drinking water systems. These criteria, with the major exception of nitrate and nitrite, are generally chronic criteria designed to protect against ingestion of carcinogens in drinking water consumed by humans every day for 70 years. As such, these criteria are extremely conservative, especially when applied to intermittent and ephemeral streams that may only flow a few days per year. Because these criteria are either identical to, or have been derived in a similar manner to human health and domestic water supply criteria, compliance should be assessed similarly using the annual arithmetic or geometric mean, or median (US EPA 2002, Table 4-3, page 4-17).

In the case of intermittent and ephemeral water bodies, these means or medians should be adjusted for the potential exposure of the livestock; when the water bodies are dry, livestock do not ingest the contaminant in drinking water. Thus, for days when the water body is dry, the level of the contaminant is zero. If a permittee is willing to do the

appropriate assessment such as sampling an appropriate time period and/or averaging multiple samples and accounting for no-flow periods, then the Assessment Protocol should provide the means to recognize and use that data appropriately in an assessment.

***SWQB Response**: Most livestock watering criteria in 20.6.4.900.J stem from EPA's 1972 Water Quality Criteria document (Blue Book). They are not human health criteria and are not based on EPA's human health methodology. The water quality standards do not indicate that livestock watering criteria are to be understood as long-term averages, and SWQB does not believe there is adequate basis to make this interpretation. Also, permit compliance issues are not covered in the Assessment Protocols.*

Regarding assessment of intermittent and ephemeral water bodies, USEPA provides no guidance on how assessments from intermittent and ephemeral waters should differ from those for perennial waters for the purposes of assessing designated use attainment under CWA Section 303(d). Several states, including New Mexico, have repeatedly requested such guidance from USEPA.

4. Application of Assessment Methodology to Ephemeral Streams

The lack of discussion throughout the Assessment Protocol regarding the assessment of use support for ephemeral or intermittent waters raises the question of how these types of streams will be evaluated by NMED and ranked in Categories 1 – 5 for the 2010 listing cycle. EPA has recognized that guidance is needed regarding this issue and has stated that they will spend time during 2009 "collaborating with the States to provide recommendations and options for a number of issues raised during the 2008 listing cycle"…including "options for ephemeral waters" (EPA 2009). It is unclear whether NMED anticipates that their proposed "hydrology protocol" would have some eventual bearing on this issue that could be addressed in future updates to the Assessment Protocol. NMED has proposed development of the "hydrology protocol" for ephemeral and intermittent stream use attainability analyses (UAAs) as proposed in the 12/16/08 Proposed Amendments to Standards as part of the 2009 Triennial Review.

***SWQB Response**: SWQB is eager for the above-mentioned collaboration with USEPA on assessment pf ephemeral waters, however beyond this brief note in USEPA guidance for the 2010-2012 listing cycle (EPA 2009), we know of no efforts underway. The "hydrology protocol" to be proposed will contain a method to determine the hydrologic nature of an water body – ephemeral, intermittent, or perennial. This information assists in identifying the applicable WQ standard or the need for standard revisions for a specific water body. As such the "hydrology protocol" does not contain methods for the assessment of chemical data to determine whether or not designated uses are attained. These methods are and will continue to be housed in the Assessment Protocols.*

5. Distinguishing Between Data Collected from Receiving Waters and Discharges (i.e. stormwater)

In Section 1.0, page 5 (last few bullets) the Assessment Protocol states data sources to be used in assessing standards could include NPDES storm water permit compliance monitoring and Discharge Monitoring Record (DMR) data. However, there is little additional discussion of how discharger data will be evaluated except as implied in Section 3.1.2.1 chronic criteria assessments, and Section 3.1.3 Toxicological data. It would be important to limit initial assessments of chemical and toxicological data to receiving water samples. The numeric criteria are intended to apply to the receiving waters of the state that support the designated uses, hence direct assessments of attainment of applicable criteria should be limited to waters clearly representative of these receiving waters. However, when needed, we recognize the potential to further inform a receiving water data assessment by looking at nearby NPDES discharge data. However, Integrated Report listings based solely on discharge samples should be avoided. The Assessment Protocol should have a section covering this issue with clear pathways for handling NPDES permittee's data and where and how it would be used for the respective sample matrix.

***SWQB Response**: SWQB agrees that receiving water data should be the primary source of data for assessment purposes. The wording in Section 1.0 has been clarified.*

6. Assessment of Aquatic Life Use Acute Criteria

Table 3.4 in the Assessment Protocol provides the methodology by which a waterbody will be assessed against applicable aquatic life acute and chronic criteria. The wording of the assessment methodology is unclear for toxic substances measured against the acute criteria, whether no more than one exceedance is allowed, or no more than one exceedance in three years, to be deemed fully supporting of aquatic life use. Clarification of NMED's methodology is needed.

***SWQB Response**: The reference to "…in three years" is only applicable to chronic criteria. Table 3.4 was clarified through separation of the acute and chronic assessment requirements.*

7. Method Quantitation Limits for PCBs

Section 2.1.1 of the Assessment Protocol states: "For calculating total PCB concentration using USEPA Method 1668A or 1668B congener methods, 'J' flagged values for individual congeners are to be included in the sum which is used for assessment." This is consistent with methodologies for analyzing surface water and storm water as proposed in the draft PCB Regional Background Assessment that is being developed by NMED with input from LANL. However, it is in contrast to the LANL recommendations for analysis of discharges authorized under the outfall permit (NPDES permit No. NM0028355). LANL has proposed that "the result for a congener should be expressed as '<RL' if the result is less than the reporting limit for that congener… in such a case, the amount of the congener should be counted as zero, since a result below the reporting limit cannot be reliably quantified" (LANL 2008).

The use of individual congener data above the detection limit but below the method quantitation limit for calculation of total PCB concentrations is acceptable, as long as blank correction procedures are used (see comment 8 below).

8. Blank Correction for PCBs

Section 2.1.7 of the Assessment Protocol states: "When a constituent concentration is determined using ultra-low level methods (such as USEPA Method 1668A or 1668B for analysis of PCBs), the data will first be blank-corrected using the procedures recommended in the method assuming adequate data are available to perform the recommended procedure. These blank-corrected values will then be compared against New Mexico's WQS to determine impairment". This statement is vague about how data will be used if adequate data are not available to perform the recommended blank correction procedure. This should be clarified. It is recommended that water column PCB concentrations should not be used to assess impairment unless adequate data are available to perform blank corrections.

***SWQB Response**: SWQB believes the intention to first blank-correct PCB data before assessment is clear. Blank-correction is a recommended practice in USEPA Method 1668, but it is not required. As such, SWQB does not believe it would be appropriate to include a statement that PCB data would not be used for assessment if adequate data to perform blank correction were not available.*

Additional information regarding SWQB's blank-correction of the PCB data collected on the Pajarito Plateau 2006-2007 will be included in the introduction notes to the 2010-2012 Integrated List.

9. Integration of Methodologies to Assess Natural Background Conditions

Lacking in the Assessment Protocol are tools for assessing natural background conditions that may be contributing to findings of nonsupport of designated uses (i.e. naturally high levels of certain metals in waterbodies due to local geochemistry). Several states are currently addressing this issue through their water quality standards-setting process (Arizona Department of Environmental Quality and Idaho Department of Environmental Quality). However, if during the preparation of the NMED's Integrated Report, an assessment of natural background conditions is made, this step could provide valuable information regarding the causes of non-attainment and allow better classification of the waterbody and determination if a TMDL is warranted.

***SWQB Response**: SWQB agrees that New Mexico needs a way to address natural background conditions. USEPA advises that the issue should be addressed in the state's water quality standards rather than in the Assessment Protocols. SWQB has been researching this approach.*

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Comment Set B: Amigos Bravos

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May 20, 2009

Re: Assessment Protocol and Water Quality Data for the 2010-2012 Integrated 303d/305b Report

Dear Ms. Guevara:

As a statewide river conservation organization dedicated to protecting and restoring water quality in New Mexico's rivers and streams, Amigos Bravos submits the following comments on the draft "Procedures for Assessing Water Quality Standards Attainment for the State of New Mexico CWA 303d/305b Integrated Report". In addition, we have provided water quality monitoring data that we urge the Department to use when developing the 2010-2012 Integrated Report.

Compliance with human health criteria- 20.6.4.12.D

The language in the water quality standards (20.6.4.12 (D)) very clearly states that the "human health criteria shall not be exceeded." This language indicates that no exceedences of the human health criteria are allowed, and any exceedences would indicate noncompliance with water quality standards. Yet the language in the draft Assessment protocol and the Water Quality Management Plan give two different requirements for determining compliance/noncompliance, and both allow one or more exceedence of the human health criterion. This is especially troubling as it is Amigos Bravos' understanding that during typical Department sampling only one grab sample is collected, yet, the requirements for determining compliance with the human health criteria, as detailed in both the Water Quality Management Plan and the Draft Assessment Protocol, take more than one sample to determine noncompliance:

Water Quality Management Plan:
"A minimum of three individual grab samples, separated in time by no less than 15 minutes each, shall be taken during the same sampling event from the same location. For the purpose of determining noncompliance, the analytical results of 2 or more of these samples must be greater than the applicable human health criteria. Results of all grab samples shall be recorded and reported." *Water Quality Management Plan – Work Element 10.*

The April 20th draft Assessment Protocol in section 3.7:
The draft protocol states that when 1 to 10 samples are collected there shall be "no more than one exceedence for the criterion" for the assessment unit to be considered "fully supporting" the human health criteria. For the assessment unit to be considered "not supporting" the human health criteria, "more than one exceedence must be detected."

The language in the draft protocol makes it possible to have a "fully supporting" finding even when the one and only sample collected exceeded the criterion. Under this language, the typical practice of collecting only one grab sample would skew data towards more "fully supporting" findings. Amigos Bravos suggests changing the language in this section to read that when 1-10 samples are taken "no exceedences must be detected" for the assessment unit to be considered "fully supporting" the human health criterion. And, for the assessment unit to be considered "not supporting" the human health criterion "one or more exceedences must be detected". This language would more fully represent the strong language in the standards that specifies that the "human health criteria shall not be exceeded."

Language in the Water Quality Management Plan should also be changed to reflect a finding of noncompliance when one or more grab sample shows an exceedence.

***SWQB Response**: The beginning of 20.6.4.12 clarifies that "… the following provisions apply to determining compliance for enforcement purposes; they do not apply for the purposes of determining attainment of uses. The department has developed assessment protocols for the purposes of determining attainment of uses…" The distinction was thoroughly debated during the last triennial review. In its Statement of Reasons on the 2005 amendments, the WQCC stated, "The Commission adopts NMED's proposal to add a preamble to clarify that the section is used only to guide enforcement determinations …." The Water Quality Act allows direct enforcement of water quality standards, and Section 20.6.4.12 provides guidance on the type of evidence that should be collected for such cases, e.g., an illegal dumping incident. The Water Quality Management Plan provides additional guidance on implementation of 20.6.4.12 and therefore also speaks to enforcement only. The comments made are therefore not germane. However, in the interest of providing correct information, it is not SWQB's practice to collect only one grab sample for a particular parameter during rotational watershed surveys. Generally, between 4 and 8 samples are collected over the hydrograph between March and October, along with long-term deployments for temperature, dissolved oxygen, and pH.*

Assessing Aquatic Life Use Support – Section 3.1.2

Similar issues as mentioned above arise in this section. In particular Amigos Bravos is concerned about situations where only sample has been collected. Under the guidelines presented in table 3.4 there could be a situation where only one sample is collected that shows an exceedence of the standard yet the assessment unit could still get a "fully supporting" listing.

In addition, at the very least for toxic substances and ideally for all parameters, one exceedence of the acute criterion should require a "Not Supporting" listing.
The definition of "Acute Toxicity" in 20.6.2.7.A. states "Acute Toxicity means toxicity involving a stimulus severe enough to induce a response in 96 hours of exposure or less." Thus acute toxicity affects aquatic organisms very quickly and any exceedence of the acute standard should require a "not supporting" listing.

***SWQB Response**:*

Section 2.1.4 was revised to state: "A minimum of two data points for field and chemical parameters is necessary to apply the procedures in Section 3.0 in order to determine attainment status for an associated designated use in a particular AU. If data from only one sampling event are available (n=1) to assess an applicable designated use, there are insufficient data to determine attainment status for that particular designated use. The use will be noted as will be noted as "Not Assessed" on the list as well as noted in the associated AU Comments field. If there are data from more than one sampling event available (n>1) with one exceedence, the attainment status will be noted as "Full Support" according to the procedures in Section 3.0. The exceedence will be noted in the AU Comments field and additional data will be collected as resources allow to determine impairment status. The exception is the assessment of Domestic Water Supply which only requires one exceedence and therefore one data point to list as impaired (see Section 3.2)."

One of SWQB's primary goals during assessment of impairment is to balance Type I and Type II errors inherent in attempting to determine impairment status based on limited data sets. In general, SWQB goal is to list water bodies with a high degree of confidence that they are indeed impaired. The main challenge in this assessment is a small dataset size, although it should be noted that these datasets are typical far greater than one. The requirement for a second sample is an effort to balance these errors providing greatest confidence for any impairment listing and ensuring few if any false impairment listings due to analytical or sampling errors.

SWQB does not agree that any short-term exceedence of an acute criterion should result in a "not supporting" listing, nor does USEPA guidance require such a position. SWQB does however share Amigos Bravos' concern that single exceedences of a water quality criterion, especially with small datasets, are of concern. SWQB position is that the proper way to address this issue is through additional data collection rather than impairment listing. To partially address this problem, SWQB will track these single

exceedences as stated above in the revised section 2.1.4 and schedule additional data collection at these sites to determine impairment status as resources allow. Priority will be given to toxic substances (i.e., generally the parameters in Table 20.6.4.900).

Assessing Other Uses:
The same concerns in situations when only one sample is collected, as mentioned in the two sections immediately above, apply to all other use support determinations. Specifically, when only one sample is collected from an assessment unit, and it shows an exceedence, this assessment unit should not be listed as "fully supporting".

***SWQB Response**: Please see above response.*

Multiple Stations in One Assessment Unit- Section 2.1.6:
Amigos Bravos understands that in the past it has been common practice by the Department when determining compliance in a particular assessment unit to average the results from all sampling stations within that unit. This practice is inadequate and must be changed. This practice is especially inadequate when there are sample stations above and below a discharge. It appears that efforts have been made to change this practice in the language proposed in the April 20th draft protocol. Amigos Bravos approves of these efforts.

***SWQB Response**: Thank you for your comment.*

Data to support E. coli impairment listing for the 2010-2012 Integrated List:
Amigos Bravos, along with the Water Sentinels of Taos has been collecting water quality data from the Rio Hondo, Rio Pueblo de Taos and Rio Fernando de Taos for the past several years. The data we collected in 2008 indicates that all three rivers should be listed as impaired for E. coli. Please find attached to this comment letter our full report for 2008 sampling and associated attachments. Our QAPP has been included as an attachment for your review. Please contact me, Rachel Conn at 575-758-3874 or at rconn@amigosbravos.org for any information about the attached report or data collection methods.

***SWQB Response**: Thank you for submitting your data and associated QAPP.*

Thank you for considering our comments.

Sincerely,

Rachel Conn
Policy Analyst
Amigos Bravos

Comment Set C: San Juan Water Commission

May 20, 2009

Lynette Guevara
Assessment Coordinator
Surface Water Quality Bureau
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Via U.S. Mail and E-mail (*lynette.guevara@state.nm.us*)

Re: Comments of San Juan Water Commission on April 20, 2009, Draft State of New Mexico Assessment Protocols

Dear Ms. Guevara:

Thank you for publishing, and accepting public comment on, the New Mexico Environment Department's ("NMED") new draft of its Procedures for Assessing Water Quality Standards Attainment for the State of New Mexico CWA §303(d)/§305(b) Integrated Report: Assessment Protocol (April 20, 2009) (the "General Assessment Protocol") and the more specific protocols attached as appendices to the General Assessment Protocol. Through this letter, I hereby submit San Juan Water Commission's ("SJWC") comments on the draft protocols. The comments below primarily address the General Assessment Protocol and the more specific sediment (Appendix D) and nutrient (Appendix E) protocols. SJWC appreciates the opportunity provided by NMED to comment on the draft protocols.

SJWC commends NMED's statements throughout the draft protocols regarding the recognized need for refinement and development of more site specific information for inclusion in the protocols and strongly supports NMED's efforts to obtain and incorporate such information. SJWC also specifically requests that NMED make any future changes to the protocols subject to public comment, as it has for its current proposals.

***SWQB Response**: Thank you for your support. SWQB intends to continue soliciting public comment for assessment protocol revisions as they occur.*

GENERAL CONCERNS

SJWC's general concerns with the draft assessment protocols include the following:

1. Application of the "reference condition" or "reference stream" approach to certain unique streams and stream segments in New Mexico is not scientifically

supportable. For example, SJWC has seen no data indicating that there are reference streams for the San Juan River segments below Navajo Dam that demonstrate what conditions "should be" in those segments. The same concern applies to the lower La Plata River and the lower Animas River, as well as many other rivers and large streams in New Mexico. It is scientifically inappropriate to define reference conditions based on other streams and apply such criteria to the unique conditions in the San Juan, Animas, and La Plata watersheds.

***SWQB Response**: USEPA has promoted utilization of the "reference condition" approach through a variety of guidance documents related primarily to nutrient and biocriteria development. SWQB acknowledges the challenges associated with this approach, but also believes it is a valid and acceptable way to determine numeric translators for various parameters with narrative criteria based on ecoregion and additional stream classification for state-wide water quality standards. As an additional note, if conditions in the rivers mentioned are suitably unique, the proper approach is to develop segment- specific criteria within New Mexico's Surface Water Quality Standards rather than through modification of the assessment protocol.*

SWQB has clarified the language in section 3.1.1 to indicate that NM is utilizing these bioassessment approaches in only wadeable, perennial streams at this time. At this time, SWQB is not applying these approaches to large rivers (generally non-wadeable), lakes and reservoirs, or non-perennial streams. SWQB has developed a web page devoted to providing additional information regarding the development of biological numeric translators and possible eventual biocriteria in New Mexico (http://www.nmenv.state.nm.us/swqb/biology/).

2. The "reference condition" and "reference stream" approach will result in stream segments in New Mexico being listed as "impaired" when, in fact, they may not be. The "impairment" may simply be an artifact of the condition of the stream when limited monitoring data was collected or the result of applying the reference approach inappropriately. The monitored physical and biological conditions may be appropriate for that particular stream, but different from reference stream conditions or the ecoregion median.

***SWQB Response**: The reality is that the reverse could also be true – the "reference condition" and "reference stream" approach could also result in stream segments in New Mexico being listed as "full support" when, in fact, they are actually impaired – and may be more likely. As noted elsewhere in SJWC's comments, the majority of New Mexico streams and rivers have been human-altered and thus our reference sites represent "best available" rather than a true natural reference. Under this situation, sites that are actually impaired will be listed as "full support" as they are compared to a best available site rather than a true reference.*

3. Use of the reference method should be substantially refined and altered in order to be scientifically valid for large rivers and streams in New Mexico.

***SWQB Response**: See response to number 1 above. At this time, SWQB does not apply the same reference condition to streams and rivers. Rivers are a separate water body category.*

4. New Mexico rivers and streams are subject to prolonged droughts, as well as large annual and seasonal fluctuations in flow, water quality, turbidity, and biota. The limited data required by the protocols to identify impairments is likely to mischaracterize the range of conditions that occur in streams and result in improper "impaired" classifications. SJWC therefore recommends certain adjustments to the methods currently set out in the protocols, as described below.

Our more detailed comments on the assessment protocols follow.

GENERAL ASSESSMENT PROTOCOL

1.0 **Assessment Process Overview (at 4).** In the third full paragraph on page four, a statement is made that "[r]ecent data take precedence over older data if new data indicate a change to water quality . . . ." Limits on the use of recent data need to be stated; *i.e*., if recent data reflects a unique, non-representative event or a short duration condition, then the recent data should not be used. Longer term data is likely more representative, given the variable nature of New Mexico streams. This needs to be recognized in the protocol. Also, the term "representative data" should be included and defined in the General Assessment Protocol and in each of the specific protocols. The definition should reflect the significant annual and seasonal variations in conditions that normally occur in New Mexico streams.

***SWQB Response**: The use of long-term dataset without consideration of more recent data when they differ is not appropriate for the CWA 303d list. As a biennial report, the list is specifically designed to note conditions near that period of time not integrated over the entire period of all data ever collected. Because the list is prepared every two years, from listing cycle to cycle identified water quality impairments can both be added or removed as conditions change, whatever the cause, depending on the availability of new data.*

The definition of representativeness is contained in SWQB's Quality Assurance Project Plan (available at: http://www.nmenv.state.nm.us/swqb/QAPP/index.html). This definition is included in section 3.1.2.1. The intent of adding the statement regarding "[r]ecent data…" taking precedence over older data was to acknowledge and allow a mechanism to take into consideration trends in water quality while determining attainment with designated uses, particularly in cases where multi-year data are available. This is particularly important when assessing parameters using the 15% exceedence rule. For example, if all available data for multiple years following a catastrophic event such as a large fire were simply lumped together and a percentage

determined, the conclusion could be "non support" even though the last two years of data were all below the water quality criterion. Extensive, multiple year water quality data sets are rare, but do occur in some areas of the state where additional non-SWQB monitoring is occurring on a regular basis.

2.0 Data Usability and Quality Determinations.

2.1.1 Data qualifiers and validation codes (at 6): Reference is made to the Surface Water Quality Bureau's ("SWQB") in-house database and the process whereby chemical/physical data collected by SWQB "are eventually uploaded to the national STORET database." Affected parties should have access to all data used by SWQB to determine use attainability. SWQB should ensure that data on its in-house "ambient" database is provided and made accessible to all parties if it is used to identify impaired segments. An affirmative statement to that effect should be included in all protocols.

***SWQB Response**: Data from SWQB's current in-house database(s) are available upon request (this statement was added to section 2.1.1 to clarify), and available directly from STORET/WQX once they have been uploaded (http://www.epa.gov/storet/). In addition, information regarding data used to make impairment determinations is provided in the Record of Decision (ROD) that accompanies the Integrated List.*

Lab Qualifier Codes (at 6): The second paragraph discusses use of concentrations detected at a level below which accurate quantification is possible. The statement should be modified to state: "These reported values may be used in an assessment *only when the lowest* detection limit is greater than the applicable water quality criterion (WQC) because the concentration is known to be greater than the WQC even though it is an estimate." Otherwise, the estimated concentration also may be below the water quality standard.

***SWQB Response**: The suggested addition of "…the lowest" implies there could be more than one detection limit per the one analytical method utilized for that particular data point and would only add confusion to this issue. An example was added to this section to clarify the intent of the type J-flag data that may be used for assessment .*

The statement is made (at 6): "Results from samples that are flagged by the laboratory as 'exceeding holding time' will be considered estimates and may be used during the assessment process unless the result is deemed 'rejected' based on best professional judgment. . . . Therefore, data exceeding holding time may be considered for use in assessments." This type of data needs to be clearly identified, along with an assessment of the accuracy of laboratory results for each pollutant, and the implications of using this data in assessments. Cases where use of such data is the determining factor should be identified.

***SWQB Response**: SWQB has historically acknowledged in the Record of Decision (ROD) and on the respective Assessment Form when data used to make an impairment determination have any lab qualifiers code or SWQB verification/validation process codes, and will continue to do so. This is noted in both section 2.1.1 and Appendix B.*

2.1.2 Duplicates and compliance monitoring sampling data (at 7): Regarding multiple data values on the same day, the draft protocol states "the maximum value should be counted as one exceedence. . . . Another example would be when QA/QC duplicates are taken within a one hour time frame. These data are considered replicates for the purpose of assessment and the maximum values should be used for assessment purposes." There is no scientific or statistical basis for using the maximum value. The data should be averaged to determine if there is an exceedence.

***SWQB Response**: SWQB believes it is appropriate to use the maximum value to be conservative in assessment of use attainment. This text was added to clarify why the maximum value is used.*

2.1.3 Continuous recording equipment (thermographs and sondes) (at 7): Reference is made to "sonde data." A definition needs to be included.

***SWQB Response**: Sondes are defined as a "…multi-parameter, continuously recording devices..." in this section per SJWC's comments on the 2008 Assessment Protocols.*

2.1.4 Limited data sets (at 8): SJWC recognizes financial limitations in monitoring and data analyses. However, adequate data should be used to draw statistically valued *(sic)* conclusions. If the limited data points indicate impairment, then additional sampling should be required before impairment is determined based on a requirement to use "representative data." Such segments should be placed on a "monitoring and evaluation" subcategory and additional data should be collected before the segment is designated as "non-supporting" (*see* SJWC comment on Section 4.0 below). This is important in New Mexico, where streams are subject to extreme droughts and large annual and seasonal flow and water quality fluctuations.

***SWQB Response**: USEPA discourages the setting of minimum data, as stated in their listing guidance. SWQB agrees that larger datasets are desired. To this end, SWQB currently designs intensive rotational watershed surveys to conduct 4 to 8 sampling events for core parameters whenever resources allow. SWQB also uses thermographs and multi-parameter sondes to generate large data sets for temperature, pH, dissolved oxygen, specific conductance, and turbidity. The statement regarding a minimum number of data points to apply assessment procedures was added during the 2008 Assessment Protocol revision (now in section 2.1.4) in response to SJWC's concern to acknowledge that only two data points are necessary to apply the procedures for field and chemical parameters in assessment tables in Section 3.0 of the Assessment Protocols.*

Section 2.1.4 was revised to state: "A minimum of two data points for field and chemical parameters is necessary to apply the procedures in Section 3.0 in order to determine attainment status for an associated designated use in a particular AU. If data from only one sampling event are available (n=1) to assess an applicable designated use, there are insufficient data to determine attainment status for that particular designated use. The use will be noted as will be noted as "Not Assessed" on the list as well as noted in the associated AU Comments field. If there are data from more than one sampling event available (n>1) with one exceedence, the attainment status will be noted as "Full Support" according to the procedures in Section 3.0. The exceedence will be noted in the AU Comments field and additional data will be collected as resources allow to determine impairment status. The exception is the assessment of Domestic Water Supply which only requires one exceedence and therefore one data point to list as impaired (see Section 3.2)."

2.1.5 Application of WQS during low flow conditions (at 8): The statement is made that "[d]ata collected during all flow conditions, . . . including low flow conditions (i.e., flows below the 4Q3), will be used to determine designated use attainment status during the assessment process." SJWC objects to including data obtained during flows below the 4Q3 in the assessment. 4Q3 values, as stated, are "utilized as minimum dilution assumptions for developing discharge permit effluent limitations." At flows below this limitation, there may be a violation of standards from permitted discharges, or from nonpoint sources. Such violations are not representative of normal conditions, as they would not be allowed. This needs to be taken into consideration in determining the use attainment status during the assessment process. SJWC has long objected to using data from drought conditions in water quality assessment and continues that objection. The protocol should recognize the need for excluding data collected during drought events. If data collected during drought or low flow conditions indicates an impairment, additional "representative" data collection should be required before an impairment determination is made.

The statement is made that "[t]he intent of the CWA would not be met if some entity would suddenly, for example, be allowed to dump pollutants in a stream in violation of WQS simply because the stream was currently below some pre-established low flow value." This sentence is completely out of place in the discussion regarding application of WQS during low flow conditions and application of data "to determine designated use attainment status during the assessment process." SJWC's intent in excluding such data is not to allow violations by dischargers. Furthermore, SJWC does not believe that excluding data from flows below the 4Q3 would allow a discharger "to dump pollutants into a stream in violation of a WQS." Other rules and regulations take effect. This sentence should be deleted. Discharge standards apply under all circumstances, and do not allow "dumping." The 4Q3 simply states under what conditions the water quality standards will be met in the stream. SJWC believes that data collected during drought conditions (*i.e.*, flows below the 4Q3) should not be used to identify impairments. Such data is not representative of water quality in the stream.

***SWQB Response**: SWQB agrees the sentence referenced above is out of place – it has been deleted. For assessment purposes, water quality criteria apply under all flow conditions, with the exception of water quality data collected under unstable conditions with respect to chronic aquatic life assessments as detailed in section 3.1.2.1.*

2.1.6 Multiple stations in one assessment unit (at 8): SJWC supports the approach identified in the first two paragraphs regarding reassessment of assessment units based on non-homogenous data. SJWC objects to the procedure identified in the last paragraph that, when replicates are available, "the maximum value should be used for assessment purposes." Use of the maximum value is not statistically or scientifically supportable when replicates are available. This procedure ensures that the maximum number of segments will be listed as impaired, regardless of data to the contrary.

***SWQB Response**: SWQB believes it is appropriate to use the maximum value to be conservative. The text was modified to clarify why the maximum value is used. This does not ensure the maximum number of segments will be listed because both the maximum value and average value could be less than the applicable WQ criterion.*

2.1.7 Blank-correction for constituents measured using ultra-low level procedures (at 9): Additional explanation is needed. The terms "blank-corrected" and "blank-corrected values" need to be defined.

***SWQB Response**: The language was revised. The specific analytical method should be reviewed because blank-correction methods vary depending on the analytical method. It is not practical or necessary to describe the blank correction technique for all analytical methods in the Assessment Protocols.*

2.1.8 "Non-detects" from a sample method with a reporting limit greater than the criterion (at 9): SJWC supports this approach.

***SWQB Response**: Thank you for your comment.*

2.2 Data Quality Levels (at 9). "Tables 2.1 through 2.4 classify the data level or rigor of data type" required to achieve various confidence levels ranging from low to excellent. However, there is no reference to the relationship between the level of information described in these tables and the application of data in water quality assessments per the protocols. SJWC believes that the tables (Tables 2.1 through 2.4) are significant and should be applicable to identifying data that should and should not be used in water quality assessments and impairment determinations. Links need to be established in each of the protocols to the confidence levels on data quality described in these tables.

***SWQB Response**: The preface to these tables explains the intent of the tables and how there are utilized. Specifically, they are used during aquatic life use assessments*

when different classes of data (i.e., chemical vs. biological) indicate different impairment results. There is also additional information in Section 3.1.6.

3.0 Individual Designated Use Support Determinations (at 13-14). SJWC supports the last sentence of this section: "To those AU's for which there are no available data that meet the QA/QC requirements for any criteria within an applicable designated or existing use, a designation of Not Assessed will be assigned that use."

3.1.1 Biological data (at 14): Regarding application of the "reference condition approach" and "reference site approach," *see* SJWC's comments on application of the reference condition to New Mexico streams. SJWC does not believe that the reference approach is scientifically valid for most streams, particularly lower elevation plains streams, which are non-perennial or subject to extreme variations in flows in New Mexico.

The reference approach may be scientifically valid for determining impairments in some circumstances, such as in high mountain streams. In those circumstances, comparable conditions may exist or have existed prior to intervention by humans, such as the imposition of mining activity on high mountain streams. However, the reference approach is not valid for large streams, particularly those which have been impacted by human use through diversions, return flows, or adjoining land use modifications. SJWC has not seen any scientific evidence indicating there is a reference condition or a reference stream for the San Juan River, the lower La Plata River, the lower Animas River or other large streams in New Mexico, such as the Gila, the Rio Grande, or the Pecos. These streams have been significantly altered physically (from a flow standpoint) and biologically (with the legal or illegal introduction of non-native species). The assumption that some stream somewhere, or some mean/median ecoregion conditions, describe what these major rivers *should* look like is not valid.

In addition to the factors mentioned above, southwestern rivers are subject to periodic, and in some cases long-term, drought, as well as large seasonal variations in flow, water quality, sediment loading, etc. These factors are not taken into account under the "reference condition" or "reference stream" approach. Water quality, physical conditions, and aquatic biota can fluctuate substantially from one year to the next, and among seasons. These normal fluctuations in arid areas streams are not captured in short term data or data from "reference" sites. There simply are no scientifically valid reference conditions or reference streams for medium to large streams in New Mexico. SJWC, therefore, recommends that the reference condition for medium and large streams in New Mexico that have been impacted by human use, or subject to drought conditions and widely fluctuating flows, should be the stream itself. Long-term data will define the variations in physical and chemical conditions and aquatic biota that occur in these streams. A few samples are not representative of long-term fluctuations, and most likely misrepresent long-term conditions.

Another factor which is not taken into account in the "reference" approach is that where federally listed endangered species occur, such as in the San Juan River, efforts

are being made to eliminate non-native species, such as catfish, carp and smallmouth bass. These deliberate efforts are changing the biological gradient in such streams. This needs to be taken into account when considering "reference conditions" or numeric biological criteria. The objective is to eliminate, if possible, non-native species, or, at a minimum, reduce abundance and distribution of non-native species to enhance federally and/or state listed/threatened/endangered species.

The second paragraph in section 3.1.1 states that "SWQB is in the process of developing a Human Disturbance Gradient through GIS . . . ." This procedure should be made available for public review before it is incorporated into the assessment document. This paragraph also states that "SWQB is refining current biological and habitat monitoring and assessment protocols and incorporating new data for analyses. These new analyses will aid us in determining appropriate numeric thresholds which will eventually be proposed as numeric biological criteria." SWQB needs to ensure that the numeric biological criteria reflect the wide variations in most New Mexico streams that occur seasonally and annually.

***SWQB Response**: SWQB does not compare biological conditions in small, high elevation mountain streams to large, low elevation rivers. As stated above, the beginning of Section 3.1.1 was modified to clearly state that we have only developed and utilized reference condition or reference stream approaches for wadeable, perennial streams at this time.*

SWQB has established several long-term reference stations across a variety of ecoregions to be able to factor in annual variation when developing biologically-based numeric translators for wadeable, perennial streams. To account for seasonal differences, an index period has been established for biological monitoring (August 15 – November 15). We are also exploring the development of a Human Disturbance Gradient utilizing GIS and other tools to incorporate and acknowledge this watershed component.

SWQB currently does not utilize the presence or absence of fish in our biologically-based reference condition numeric translators. Inclusion of fish into this process is under consideration. SWQB staff working on these issues are very aware of the efforts around the state with respect to non-native species and are taking this into consideration.

Table 3.3 Re: applicability to ecoregions 22, 24, 25, and 26 (at 16): To the extent that this applies to the San Juan River below Navajo Dam, see our comments regarding application of the reference approach.

3.1.2 Chemical/physical data (at 16): In the second paragraph, it is noted that SWQB plans to develop a revised turbidity assessment protocol for future listing cycles. This protocol should be subject to public comment. Because the revised protocol apparently will apply to the next listing cycle, SJWC is not commenting on the interim protocol but will wait and comment on the revised protocol. However, SJWC does wish to point out

that, in the San Juan River, flow recommendations for endangered fish species have been developed that include increasing peak flows by releasing water from Navajo Dam to move sediment. These peak flow releases from Navajo Dam will increase turbidity. Data collected during peak flow releases should not be used in water quality assessments. Also, the turbidity assessment protocol should not be applied to determine impairment on the San Juan River below Lagos Canyon. Large sediment loads are naturally contributed from the Canyon. The chief function of the river is to move sediment, thus increasing turbidity. If the sediment is not moved, detrimental environmental consequences for endangered fish and other aquatic life occur. This needs to be taken into account in assigning impairments for turbidity.

***SWQB Response**: SWQB recognized that turbidity will increase with discharge, whether under natural conditions or due to reservoir releases. SWQB agrees that turbidity data collected during scheduled Navajo Dam releases to meet the objective of the San Juan River Implementation Recovery Program should not be the sole basis for impairment determination. No listing decisions have been made solely with data collected under these conditions. As stated in the introductory notes to the 2006-2008 Integrated List, all numeric segment-specific turbidity criteria were removed during the 2005 triennial review, and a new subsection J of General Criteria 20.6.4.13 NMAC added to address turbidity. SWQB has developed an interim turbidity assessment method to determine turbidity impairment based on this new language. Additional initiatives are under way to develop methods to assess turbidity for future listing cycles; the methods developed, as will all assessment protocols, will be available for public review and comment.*

Table 3.4 – Interpreting chemical/physical data to assess Aquatic Life Use Support (at 17): Under conventional parameters for one to ten samples, more than one exceedence will indicate a use is not supported. This is not adequate statistically for determining a non-supporting use. If there is one exceedence, then additional sampling should be required to determine if the segment is non-supporting. The segment should be placed in the "monitoring and evaluation" subcategory proposed by SJWC in Section 4.0.

Regarding toxic substances, segments are non-supporting if there are either two exceedences of the acute criteria or two exceedences of the chronic criteria in three years. SJWC believes that two exceedences of the chronic criteria is not adequate for determining that a segment is non-supporting, particularly when the data may include only two samples. A statistically valid approach for determining exceedences should be developed by NMED and applied to identify non-supporting segments. Such segments should be placed in the "monitoring and evaluation" subcategory proposed by SJWC in Section 4.0.

***SWQB Response**: Table 3.4 requires more than one exceedence make a determination of non support. If only one data point is available, and that data exceed an applicable criterion, SWQB agrees that additional data should be collected as*

resources allow to determine if designated use support (see above response regarding this topic). SWQB intends to note this circumstance when it occurs in the AU Comments field on the Integrated List.

3.1.2.1 Assessing chronic aquatic life WQS (begins on 18): The last paragraph on page 18 references "hydrologically stable conditions." The same phrase is referenced in Figure 3.1. The phrase should be changed to "hydrologically representative" conditions to ensure that neither storm events nor extreme drought conditions are used in the assessment.

In the first paragraph on page 19, an attempt is made to define "unstable hydrologic conditions." "Extreme low flow events" need to be added to this definition. On page 20, additional examples of unstable conditions are listed, and "extreme low flow events or drought conditions" need to be added to this list.

***SWQB Response**: SWQB believes the correct phrase is "hydrologically stable conditions." Seciton 3.1.2.1 is not intended to include low flow or drought conditions because these typically occur for more than a 4-day period. This section is only intended to cover sampling during short duration (less than 4 day), high intensity flow events.*

Table 3.6 - Interpreting toxicological data to assess Aquatic Life Use Support (at 21): The criteria for "fully supporting" for chronic standards allow exceedence of no more than one water test in three years. This standard is excessively stringent, given the variations that can occur at low flow. One exceedence in three years does not indicate that a stream is "not supporting" a designated use. Exceedence data could be collected when flows are less than the 4Q3, resulting in a violation of the standard even when discharge permit conditions are being met. Such findings (one or more exceedences) should result in additional sampling before an impairment determination is made.

The notes section in this table states that, "[i]f toxicity testing results are from multiple years, the most recent results will be used to make the final impairment determination for the reasons stated in Section 3.1.3." This provides for eliminating valuable historic data, which may be far more representative than the "most recent results." The criterion regarding "most recent results" is not scientifically based and may result in elimination of reliable representative data. Furthermore, in widely fluctuating streams, such as those that occur in New Mexico, the "most recent results" do not reflect long-term conditions if they are based on only one or two samples. "Not supporting" determinations should not be based on one sample. If the data results in a "not supporting" determination, additional testing of representative conditions should be required.

***SWQB Response**: Regarding ambient toxicity testing described in section 3.1.3, SWQB acknowledges the inherent challenges with ambient toxicity testing and clearly states that " … repeat toxicity testing is necessary to verify that the water is correctly listed due*

to acute or chronic toxicity." Impairment listings based on toxicity testing are placeholders because additional data are needed to determine the specific cause of impairment before TMDLs can be developed.

3.1.5 Special considerations for lake data (at 22): This discussion mainly includes assumptions about lakes that are sampled. It is not clear whether these assumed samplings are the result of the "Clean Lakes Program Guidance Manual" referenced in this section or other materials available to NMED. Generally, this section does not adequately provide guidance on complex lake sampling or conclusions regarding evaluation of water quality data from lakes. Evaluation of water quality data from lakes and reservoirs is much more complex than the evaluation water quality data from streams. Additional discussion and guidance need to be provided.

***SWQB Response**: Section 3.1.5 regarding lake assessment will be expanded in future assessment cycles as resources allow.*

Table 3.8 Interpreting bacteriological data to assess Contact Use Support (at 26): Defining "not supporting" as based on two exceedences is not statistically valid. If there are two exceedences, additional monitoring should be conducted before determining that a waterbody is not supporting this use. The segment should be placed in the SJWC-proposed "monitoring and evaluation" subcategory set out in Section 4.0.

***SWQB Response**: SWQB believes it is valid to determine non support based on two or more exceedences in small sample sizes (i.e., 1 to 10).*

3.4 Assessing Irrigation Use Support (at 26). Determining "not supporting" based on two exceedences is not scientifically supportable. Application of irrigation water resulting in toxicity to plants is a complex process involving highly specific local conditions, including water applications, soils, drainage and plant uptake on a seasonal basis. These factors need to be considered in determining whether or not the use is supported or not supported. This is particularly true in New Mexico, given the highly variable conditions under which irrigation occurs.

***SWQB Response**: SWQB believes it is valid to determine non support based on two or more exceedences in small sample sizes (i.e., 1 to 10). The above-mentioned complexities are considered during WQ criteria development not during assessment.*

For salinity parameters: The same comment above applies. In addition, no explanation is provided for the change from "15 percent" of measurements to "10 percent" in the "fully supporting" and "not supporting" columns.

***SWQB Response**: All the assessment tables that previously discussed a 15% exceedence rate for n>7 were changed to a 10% exceedence rate for n>10 to be consistent with USEPA guidance and other states.*

General comment on Section 3.5 Assessing Livestock Watering Support; Section 3.6 Assessing Wildlife Habitat Use Support; and Section 3.7 Assessing Human Health Criteria (at 27-28). Listing a waterbody as "not supporting" because of more than one exceedence (*i.e.*, two exceedences) is not statistically valid for these categories. If two exceedences are found, additional sampling should be required before the segment is listed as "not supporting." The segment should be placed in the SJWC-proposed "monitoring and evaluation" subcategory set out in Section 4.0.

***SWQB Response**: SWQB believes it is valid to determine non support based on two or more exceedences in small sample sizes (i.e., 1 to 10).*

4.0 Assessment Unit Category Determinations for Integrated Lists (beginning at 29). Existing category no. 3, titled "No reliable data and/or information to determine if any designated or existing use is attained," should have the following subcategory added:

> **Monitoring and Evaluation:** This identifies water bodies where there is reason to suspect water quality problems, but there also is uncertainty regarding one or more factors, such as the representative nature of the data.

Segments with limited data, such as those with only two chronic exceedences, should be placed in this subcategory until representative data is collected. Such a subcategory is acceptable to EPA, per its *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act*, which states:

> **C. May a state use subcategories or additional categories in its Integrated Report?**
>
> Yes, in order to refine their classifications, states may choose to establish new or additional subcategories in addition to the proposed five major categories. For example, a state may decide to divide Category 3 into two subcategories in order to distinguish between those segments for which no data and/or information exist from those segments for which some data and/or information exist, but the data are insufficient to make a determination whether the segment is attaining applicable standards. A state may also choose to use subcategories for segments placed into Category 3 when establishing monitoring priorities. For example, the state may place its segments into different subcategories depending on whether the segment is high, medium, or low priority for follow-up monitoring based on information from probability-based monitoring, landscape or water quality models, land use data, or limited site specific monitoring.

***SWQB Response**: Per USEPA's encouragement, SWQB houses assessment information in USEPA's Assessment Database (ADB). ADB automatically determines Categories 1, 2, 3, 4A, 4B, 4C, and 5 for each Assessment Unit (AU) based on designated use support conclusions (i.e., fully supporting, not supporting, insufficient information, or not assessed) for each associated designated use and USEPA approval of associated TMDLs. As stated in section 4.0 of the draft 2010 Assessment Protocols, "AUs are listed in this category where data to support an attainment determination for any (emphasis added) use are not available, consistent with requirements of the assessment and listing methodology." Therefore, the subdivision of Category 3 as suggested above to indicate limited datasets would not be appropriate.*

APPENDIX D - SEDIMENTATION/SILTATION ASSESSMENT PROTOCOL FOR WADEABLE, PERENNIAL STREAMS

Purpose and Applicability (at 2). The draft sediment protocol does not appear to apply to the San Juan River, Animas River, or La Plata River, given the exclusions indicated in the third paragraph of this section. Is this correct?

***SWQB Response**: The draft sedimentation protocol found at Appendix D would not be applied to the San Juan or Animas Rivers as written because they do not fall under the category of perennial, wadeable streams. This is why SWQB developed a different approach for these waters with assistance from the National Sedimentation Lab to develop the San Juan River Watershed TMDLs. In contrast, the La Plata River has perennial reaches and is clearly wadeable even though it has a large drainage area, and thus this draft sedimentation protocol could be applied if an applicable reference site or reference condition was determined.*

The list of "rivers" from page 3 of the nutrient protocol was added to the beginning of the sedimentation protocol to clarify.

The fourth paragraph references NMED's intention to initiate a Sediment Workgroup in early 2008 to develop a revised sedimentation assessment protocol for future listing cycles. Has that Workgroup been formed? If so, please include SJWC in that group.

***SWQB Response**: SWQB initiated an internal sedimentation workgroup February 2008 to review and revise the current sedimentation/siltation assessment protocol for wadeable, perennial streams as appropriate for inclusion in the 2012 Assessment Protocols. The workgroup agreed to use the stepwise criteria development approach described in Framework for Developing Suspended and Bedded Sediments (SABS) Water Quality Criteria (EPA 2006) for the sedimentation/siltation assessment protocol framework, except the goal at this time is to propose numeric translators for New Mexico's narrative sedimentation water quality standard at this time rather than actual water quality criteria.*

USEPA Region 6 provided funding to support contractor assistance for this effort. The proposed revised sedimentation assessment protocol will be opened for public comment. The final revised protocol will be used to develop the 2012 - 2014 Clean Water Act 303(d)/305(b) Integrated List where adequate data are available.

I. Introduction (at 3). The last paragraph of this section states that the procedure set out in this protocol is similar to a 1998 protocol developed by the State of Colorado. However, as the last sentence indicates, "[t]he State of Colorado has since modified their approach to determining impairment due to sedimentation (CDPH&E 2005)." Given that Colorado has modified its approach, the following question is raised: Why isn't the New Mexico approach based on the more recent Colorado approach?

***SWQB Response**: The statement was added to acknowledge the origins of New Mexico's current protocol, and that Colorado has since made modifications they deem appropriate given their needs and monitoring strategy. Colorado's as well as other state's current approaches were researched by SWQB's sedimentation workgroup.*

II. Biological Monitoring by Reference Site or Condition (at 3-4). SJWC has concerns regarding the use of the reference site approach to identify impaired stream segments. The paragraph entitled "Reference Site Selection" indicates that the first step is to "identify a pool of best available sites in all geographic regions of New Mexico that have the lowest amount of anthropogenic impacts to the stream's ecosystem." Few streams in New Mexico have low amounts of anthropogenic impacts. In fact, most streams in New Mexico reflect significant anthropogenic impacts, including diversions, return flows, on-stream reservoirs, and off-stream land uses, such as grazing, utilities, urbanization, etc. Streams that may have the lowest amounts of anthropogenic impacts are those in high mountain areas where there has been little human activity. In these cases, the reference site selection may work and be scientifically valid.

In the case of the San Juan River, the La Plata River, and the Animas River, significant anthropogenic impacts have occurred. Thus, these segments are not comparable to upstream segments because of the way they are managed. The reference approach is simply not applicable. Furthermore, these streams are greatly affected by long-term droughts and wet periods, extreme seasonal variations in flows, and localized natural conditions, including sediment sources. These factors are not accounted for in the reference site approach. The most likely scientifically valid approach is to establish a long-term database of conditions.

The ecoregion approach (discussed on page 4) is far too broad to provide comparison among streams, particularly among reference sites in different drainage basins that may occur within an ecoregion. For example, in the San Juan basin, the

upper San Juan River, including upstream of Navajo Reservoir, is included in the same ecoregion as the lower San Juan River below Farmington to the state line. These are two entirely different streams with entirely different biota, flow and substrate conditions. Selecting a reference stream for the upper San Juan basin and applying it to conditions in the lower San Juan to determine impairment is not scientifically valid.

SJWC supports the statement in the first paragraph on page 4 that "SWQB has several initiatives in progress to further refine reference condition." SJWC would be willing to participate in those discussions and/or review the draft proposals from those efforts.

***SWQB Response**: Please see above responses addressing the use of reference condition and reference site(s) to determine impairment. SWQB appreciates that SJWC supports our initiative to further refine reference condition. There will be several opportunities of public comment as noted above.*

III. Physical Assessment (at 5-7). NMED has adopted data from the Relyea 2000 study that indicates that "study sites with less than 20% fines should be considered non-impaired . . . ." The applicability of this data to New Mexico is not discussed. It was collected primarily in Idaho, Oregon, Washington, and Wyoming in the initial study. There is no indication of the scope of the later 2005 study that included 1,139 western streams. Therefore, it is not possible to evaluate the applicability of this data to New Mexico. The assumption that New Mexico streams with less than 20 percent fines are not impaired, while streams with greater than 20 percent fines are impaired, is not supported.

SJWC does not argue with the methodology for quantifying sediment conditions. However, SJWC questions whether or not "approximately one-third embeddedness (33%) or less is probably the normal condition in proper functioning streams" in New Mexico (see page 6). No information is provided to indicate that these studies are applicable to the broad range of conditions that occur in New Mexico.

SJWC appreciates the clarification provided by NMED that these procedures are developed for "non sand bed streams." A definition of "non sand bed streams" should be included in the introductory sections of this draft protocol.

Table 1 (at 7) defines the degree of aquatic life use support affected by stream bottom sediments. It is based on Figure 1 on page 5 of the draft protocol. SJWC questions the broad application of Figure 1 to streams in New Mexico and, therefore, the application of Table 1, which is derived from that Figure. No information is provided indicating the applicability of either Figure 1 or Table 1 to streams in New Mexico.

SJWC supports footnotes 1 and 2 on Table 1 regarding adequate sampling size requirements and the need for biological confirmation in applying this table.

***SWQB Response**: SWQB has already begun scrutinizing the Relyea 2000 and 2005 studies, and will continue through the sediment workgroup, to better determine applicability of these studies to New Mexico streams. A sand bed stream is defined in the introductory text as generally having a D84 of <2mm. Therefore, a non-sand bed stream would not meet these conditions, and under natural or non impaired conditions, the bed of a non-sand bed stream would not be predominantly sand.*

IV. Biological Assessment (Macroinvertebrates).

Table 2 - Biological Integrity Attainment Matrix using the RBP Index for Ecoregions 22, 24, 25, and 26: This table is supposedly applicable to a broad range of conditions. SJWC questions whether the percent comparisons to the reference sites, taken from the RBP Index, are applicable to the broad range of conditions reflected in those very large ecoregions: 22 Arizona/New Mexico Plateau; 24 Chihuahua Deserts; 25 High Plains; and 26 Southwestern Table Lands. These regions represent a vast assortment of ecological conditions. SJWC also notes that the biological condition category of "Slightly Impaired" results in a "non-support" determination. "Slightly impaired" should not result in a "non-support" impairment determination that results in the addition of the segment to the section 303(d) list. NMED is not bound by the "USEPA Region 6 suggestion," as indicated in footnote 2 to this table.

***SWQB Response**: USEPA Region 6 staff who review and approve NM's Integrated Lists advised us during development of the 2004 Assessment Protocol to set the cut off for Full Support at the "slightly impaired" percentage defined in Plafkin et. al 1989. Although USEPA does not approve assessment protocols, they do approve NM's Integrated List as a Clean Water Act Section 106 deliverable so we believe they agree with our protocols because the protocols form the basis of our proposed listings and de-listings.*

Table 3 - Biological Integrity Attainment Matrix using M-SCI for Ecoregions 21 and 23: This table indicates that the comparison to reference conditions from 56.7 percent to 78.35 percent is good and results in "full support." We recognize that the methodologies in Tables 2 and 3 are, perhaps, somewhat different. However, it is difficult to rationalize that in Table 2 a comparison of 54 percent to 79 percent represents "slightly impaired," and results in a "non-support" determination, while the nearly identical percentage range results in a "full support" determination under Table 3. What is the basis for this inconsistent application of percentiles?

***SWQB Response**: The RBP Index from Plafkin et al (1989) is based on eight benthic macroinvertebrate metrics. Metrics each have their own value and different ranges of values. These values are then lumped into a range, and based on where they fall in that range, assigned a score of 0, 2, 4, or 6. These scores for each metric are then summed to generate a final RBP Index score, with a maximum score of 48 for any*

individual site (i.e., 8 x 6). Therefore, a score of 48 would indicate a perfect reference site. If, for example, a study site had a score of 38 and the reference site had a score of 48, the final % of reference site value would be equal [(38/48) x 100], or 79.17%. USEPA Region 6 advised SWQB to set the impairment break at >83% starting with the 2004 listing cycle because they believed this cutoff was most appropriate to meet Clean Water Act goals.

The M-SCI scores were normalized in a different way. The total index score was normalized to a range of 0 - 100 rather than a range of 0 - 48. The M-SCI score was based on inclusion of the top 75th percentile of sites consider to be reference streams, and used the 95th percentile of the metric values from this top 75th percentile of reference streams, to be conservative. Five rating categories were developed for the M-SCI scores which include Very Good, Good, Fair, Poor, Very Poor. SWQB made the decision that all study sites with M-SCI scores in the Very Good and Good categories should be considered Full Supporting (non-impaired), because if the benthic macroinvertebrate community is rated Good or better, then it would meet Clean Water Act goals.

V. Final Assessment: Combined Application of Physical and Biological Assessments (at 10). The second paragraph indicates that where differences between the reference site and the study site indicate biological non-support, the assessment unit should be listed under category 5C with an impairment of "Benthic-Macro Invertebrate Bioassessments (Streams)" in the section 303(d) list until the exact cause of impairment is determined. It would be more appropriate to list the segment as needing additional data before a determination is made.

***SWQB Response**: It is appropriate to list these waters under Category 5C because they are impaired based on the biological assessment. Section 3.1.1 of the main assessment protocol is the basis of the biological portion of the sedimentation protocol.*

VII. Future Development (at 12). SJWC supports refinement of the procedures and protocols as discussed in this section. SJWC supports the process through which NMED makes draft proposals and modifications subject to public review prior to their incorporation into the protocols.

SJWC believes the "reference conditions" that are applied in this and other protocol documents are among the necessary items requiring future development and refinement. SJWC has a fundamental problem with the manner in which reference conditions may be applied to New Mexico streams based on (i) information from other areas of the country, (ii) data from broad ecoregions, and (iii) inappropriate selection of reference sites.

APPENDIX E - NUTRIENT ASSESSMENT PROTOCOL FOR WADEABLE, PERENNIAL STREAMS

I. Purpose and Applicability (at 2). An initial statement says: "This document establishes an assessment protocol for determining nutrient impairment status of wadeable perennial streams." The term "wadeable perennial" should be defined, and any types of streams or rivers excluded should be stated. On page 3, it is stated that the San Juan River is considered a "river" and not a wadeable stream. The document needs to specifically state whether the protocols apply to the La Plata and Animas Rivers, because both may have drainage areas greater than 2,300 square miles, even though some of that drainage is in the State of Colorado.

***SWQB Response**: The classification breakdown between streams and rivers is challenging. It is generally based on the watershed size but also if the system can reliably be monitored with wadeable techniques. In addition, substrate characteristics may also be used to further classify non wadeable systems. The Animas River was added to the list of "rivers" on page 3. The La Plata River was not added because it can adequately be monitored with wadeable techniques.*

As stated on page 3, for the purposes of this protocol, "…"rivers" were defined as systems that cannot be monitored effectively with methods developed for wadeable streams and generally have drainage areas greater than 2,300 square miles. The systems included in the "rivers" waterbody type [and consequently exempt from this protocol] are: 1) the San Juan River from below Navajo Reservoir to the Colorado border near Four Corners, 2) the Animas River from the Colorado border to the San Juan River, 3) Rio Grande in New Mexico, 4) the Pecos River from below Sumner Reservoir to the Texas border, 5) the Rio Chama from below El Vado Reservoir to the Rio Grande, 6) the Canadian River below the Cimarron River , and 7) the Gila River below Mogollon.

III. Nutrient Threshold Development Process (at 3-4). The statement is made (at 2) that "[t]his protocol will be used to determine if a stream reach (i.e., assessment unit) is meeting the narrative criterion." Numerous unstated assumptions are made regarding the relationship between total nitrogen and total phosphorus, and whether or not the narrative criterion is met. Relationships are not established in the protocol that would provide a basis for determining whether the narrative criterion is met—or not—based on nitrogen and phosphorous levels.

***SWQB Response**: The narrative criterion can be challenging to assess because relationships between nutrient levels and impairment of designated uses are not defined and distinguishing nutrients from "other than natural causes" is difficult. To address these problems, SWQB has adopted a multi-indicator, or weight-of-evidence, approach to conduct a more robust assessment that accounts for the chemical, physical, and biological connections to the narrative standard. The weight-of-evidence approach uses both causal (total nitrogen and total phosphorus) and response variables (dissolved oxygen, pH, and periphyton chlorophyll a) for assessment purposes. The variables*

referred to in this protocol are measurable water quality parameters that can be used to evaluate the degree of eutrophication in wadeable, perennial streams.

The relationship between nuisance algal growth and nutrient enrichment in stream systems has been well documented in the literature (Welch 1992; Van Nieuwenhuyse and Jones 1996; Dodds et al. 1997; Chetelat et al. 1999). Threshold values in this protocol were developed for each causal and response variable using literature values, EPA guidance, and the national nutrient database. In 2007, total nitrogen, total phosphorus, and chlorophyll a threshold values for wadeable, perennial streams were refined using regional data, ecoregional attributes, and designated aquatic life uses as defined by NMAC 20.6.4. These values are used to translate the current narrative nutrient criterion into quantifiable endpoints. SWQB has also contracted with the Philadelphia Academy of Natural Sciences to develop a regional stream condition index (SCI) and assign tolerance values for diatom communities of New Mexico, which are known to be good indicators of nutrient enrichment. Once the SCI has been developed for New Mexico and organism tolerance values are verified these biological indicators will be incorporated into the weight-of-evidence nutrient assessment.

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Dodds, W. K., V. H. Smith, and B. Zander. 1997. Developing nutrient targets to control benthic chlorophyll levels in streams: A case study of the Clark Fork River. Water Res. 31:1738-1750.

Van Nieuwenhuyse, E. E. and J. R. Jones. 1996. Phosphorus-chlorophyll relationship in temperate streams and its variation with stream catchment area. Can. J. Fish. Aquat. Sci. 53:99-105.

Welch, E. B. 1992. Ecological Effects of Wastewater. Chapman and Hall, London.

Table 1 (at 5): This Table identifies five ecoregions and the 50th percentile of the nitrogen and total phosphorus data. SJWC does not agree that the 50th percentile ecoregion data provides a basis for determining impairment on any specific stream. A wide variety of streams occur within these ecoregions, some of which have had historic levels exceeding the 50th percentile ecoregion level. These ecoregions include a variety of stream conditions, and there is no indication that the median for any ecoregion is applicable to any particular stream. Furthermore, no relationship is established between temperature and other factors that would affect the relationship between total nitrogen, and/or total phosphorus, and the presence of nuisance species or undesirable aquatic life. Application of the ecoregion characteristics to define impacts associated with nutrients is not scientifically supportable.

***SWQB Response**: A map was included in the protocol (Figure 1) and a link to the webpage was included. The approach used to compile this map is based on the premise that ecological regions can be identified through the analysis of the spatial patterns and the composition of biotic and abiotic phenomena that affect or reflect differences in ecosystem quality and integrity (Wiken 1986; Omernik 1987, 1995).*

These phenomena include geology, physiography, vegetation, climate, soils, land use, wildlife, and hydrology.

As stated in the first paragraph of the protocol, "[t]his protocol is a dynamic document that will be refined as more data are collected, enabling more precise classification of streams and definition of relationships between nutrient concentrations, indicators, and impairment in New Mexico streams." Nutrient criteria development is an iterative process that will continue to be refined as more data and information are gathered. If, through further analyses, it is found that the ecoregional threshold values are inappropriate for a specific waterbody, they will be adjusted accordingly. Nevertheless, SWQB feels confident about its nutrient criteria development program thus far and has worked collaboratively with Federal and regional agencies throughout this process. EPA Region 6, the regional technical advisory group, and the U.S. Geological Survey support the decisions and processes that SWQB has gone through to develop the threshold values defined in the nutrient assessment protocol for wadeable, perennial streams.

REFERENCES

Omernik, J.M., 1987. Ecoregions of the conterminous United States (map supplement): Annals of the Association of American Geographers, v. 77, no. 1, p. 118-125, scale 1:7,500,000.

Omernik, J.M., 1995. Ecoregions – a framework for environmental management, in Davis, W.S. and Simon, T.P., eds., Biological assessment and criteria-tools for water resource planning and decision making: Boca Raton, Florida, Lewis Publishers, p. 49-62.

Wiken, E., 1986. Terrestrial ecozones of Canada: Ottawa, Environment Canada, Ecological Land Classification Series no. 19, 26 p.

IV(B). Level II Nutrient Assessment.

Algal Sampling (at 11): The draft protocol contains language regarding SWQB-measured chlorophyll concentrations at reference sites in ecoregions; however, no guidance is provided on how these are to be applied. It is noted that the chlorophyll concentrations in ecoregions 21, 22/20, and 23 are less than the EPA's nuisance level of algal biomass. Which one applies to the assessment?

SWQB Response: *The values in Table 4 are the chlorophyll a threshold values that were calculated for each ecoregion based on a regional dataset. As stated on the Level II Nutrient (Office) Assessment Worksheet and the Level II Nutrient Assessment Form (using Threshold Values), the ecoregional threshold values in Table 4 are used for assessment purposes.*

Analysis and Interpretation (at 12): It is stated that if the Level II assessment results in "three or more indicators exceed[ing] the threshold, the assessment unit is determined to be not supporting [for nutrients]." The implication is that a TMDL will be established for nutrients based on some threshold, such as ecoregion thresholds. The corresponding assumption is that attainment of those values will result in the segment

becoming “fully supporting.” These assumptions are not demonstrated to be valid (*i.e.*, the conditions for not supporting, or the assumption that attainment of ecoregion values in a specific stream will result in a designation of “fully supporting”). The relationships among dissolved oxygen, phosphorus, nitrogen, and algae in a stream are extremely complex, and are not necessarily driven by a threshold criteria. Attainment of TMDLs based on ecoregion thresholds may not result in elimination of undesirable aquatic life or nuisance species. In the case of nutrients, SJWC recommends that if the Level II analysis indicates problems, additional data be collected to identify the cause so that meaningful, effective measures can be taken to solve actual nutrient problems.

***SWQB Response**: SWQB has adopted this multi-indicator, weight-of-evidence approach to conduct a more robust assessment that accounts for the chemical, physical, and biological connections to the narrative standard. SWQB has also contracted with the Philadelphia Academy of Natural Sciences to develop a regional stream condition index (SCI) and assign tolerance values for diatom communities of New Mexico, which are known to be good indicators of nutrient enrichment. Once the SCI has been developed for New Mexico and organism tolerance values are verified these biological indicators will be used in the weight-of-evidence nutrient assessment.*

During TMDL development, SWQB has chosen to address the causal indicators of nutrient impairment (total phosphorus and total nitrogen) because they can be more readily controlled through best management practices and NPDES permitting. Through the use of local, ecoregion-specific threshold values, SWQB feels that it is addressing the “other than natural causes” clause in the narrative nutrient criterion. It is assumed that by limiting or reducing phosphorus and nitrogen concentrations to regional levels, undesirable aquatic life, nuisance species, and large fluctuations of dissolved oxygen and pH will also be limited or reduced.

Thank you for your consideration of these comments. If you have any questions about SJWC’s position, or would like to discuss these issues in more detail, please do not hesitate to call Randy Kirkpatrick, Executive Director of SJWC. We look forward to receiving your responses to these comments, as promised on page 32 of the General Assessment Protocol. Also, SJWC looks forward to commenting on the revised turbidity protocol when it is available.

Sincerely,

Mark Duncan
Chairman
San Juan Water Commission