2022 303(d) Assessment Methods

UTAH DEPARTMENT *of* ENVIRONMENTAL QUALITY
WATER QUALITY

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Abbreviations

Abbreviation	**Definition**
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
AGRC	Automated Geographic Reference Center
ATTAINS	The Assessment, Total Maximum Daily Load, Tracking and Implementation System. This EPA-maintained database is an online system for accessing information about the conditions of the Nation’s surface waters.
AU	assessment unit
Ca	calcium
CFR	Code of Federal Regulations
Chl-a	chlorophyll *a*
CWA	Clean Water Act
DEQ	Utah Department of Environmental Quality
DO	dissolved oxygen
DWQ	Utah Division of Water Quality
E	expected
E. coli	Escherichia coli
EPA	U.S. Environmental Protection Agency
ER	ecosystem respiration
g	grams

GIS	geographic information systems
GPP	gross primary productivity
GSL	Great Salt Lake
GRAMA	Government Records Access and Management Act
HAB(s)	harmful algal bloom(s)
HH	human health
HUC	hydrologic unit
IR	Integrated Report
kg	kilogram
L	liter
Mg	magnesium
mg	milligram
mg/kg	milligram per kilogram
mg/L	milligram per liter
mL	milliliter
MLID	monitoring location identifier
MPN	most probable number
NHD	National Hydrologic Dataset
O	observed
O/E	observed/expected
Pc	probability of capturing
ppm	parts per million

QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
QAPP	quality assurance project plan
RIVPACS	River Invertebrate Prediction and Classification System
SAP(s)	sample analysis plan(s)
SD	standard deviation
SDD	Secchi disk depth
SOP(s)	standard operating procedure(s)
T	temperature
TDS	total dissolved solids
TMDL	total maximum daily load
TN	total nitrogen
TP	total phosphorus
TSI	trophic state index
UAC	Utah Administrative Code
UDOH	Utah Department of Health
USGS	U.S. Geological Survey
WMU	watershed management unit
WQP	(EPA's) Water Quality Portal
WQS	water quality standard
µg/L	microgram per liter

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Introduction

THE CLEAN WATER ACT AND THE INTEGRATED REPORT

The rules and regulations of the federal Clean Water Act (CWA) require the Utah Division of Water Quality (DWQ) to report the condition or health of all Utah surface waters to the U.S. Congress every other year. The Integrated Report (IR) contains two key reporting elements defined by the CWA:

Statewide reporting under CWA Section 305(b): Section 305(b) reporting summarizes the overall condition of Utah's surface waters and estimates the relative importance of key water quality concerns. These concerns can include pollutants, habitat alteration, and sources of water quality problems.

Water quality assessments under CWA Section 303(d): Section 303(d) requires states to identify waters that are not supporting beneficial uses according to state water quality standards (Utah Administrative Code [UAC] R317-2-7.1). Utah's Section 303(d) list (hereafter the 303(d) list) also prioritizes the total maximum daily loads (TMDL) required for each listed waterbody and the cause of nonattainment. This list includes waters impaired as a result of nonpoint sources, point source discharges, natural sources, or a combination of sources.

In addition to Utah's 303(d) list, DWQ also identifies

- Waterbodies meeting water quality standards
- Waterbodies with water quality problems that DWQ cannot confirm due to insufficient sample size, uncertainty regarding the nature of the data or other factors
- Waterbodies either currently addressed by DWQ through a TMDL or other pollution-control mechanism

Full descriptions of these and other U.S. Environmental Protection Agency (EPA)-identified waterbody assessment classifications are described and summarized in Table 1.

ASSESSMENT CATEGORIES FOR SURFACE WATERS

DWQ uses five categories defined by EPA to assess surface waters of the state (EPA, 2005). These categories are described in Table 1.

Table 1. U.S. Environmental Protection Agency categorization of assessed surface waterbodies for Integrated Report purposes.

EPA Assessment Category	Assessment Category Description
1	**Supporting.** All beneficial uses assigned to a waterbody are evaluated against one or more numeric criteria and each use is found to meet applicable water quality standards.
2	**No Evidence of Impairment.** Some, but not all, beneficial uses assigned to a waterbody are evaluated against one or more numeric criteria, and each assessed use is found to meet applicable water quality standards.
3	**Insufficient Data and/or Information.** There are insufficient data and information to conclude support or nonsupport of a use. The category may be applied when: (1) the dataset is smaller in size and has water quality criteria exceedances OR no water quality criteria exceedances; (2) a secondary review applied to a waterbody found it was not meeting water quality standards; (3) water quality criteria and/or beneficial use support assessment methods are not yet developed (or are undergoing development or revisions) so use attainment has not been determined; (4) waterbodies were assessed against water quality parameters and characteristics that require further investigations as defined in UAC R317-2; (5) assessment units (AUs) have improper use designations, lack use designations, or contain other inconsistencies in the dataset. In cases where no recent data are available, historic-listing determinations will be maintained.
4A	**TMDL-Approved**. Waterbodies impaired by a pollutant with a TMDL(s) developed and approved by EPA. Where more than one pollutant is associated with the impairment, the waterbody and the parameters that have an approved TMDL are listed in this category. If a waterbody has other pollutants that need a TMDL, the waterbody is listed in Category 5 with an Approved TMDL.
4B	**Pollution Control**. Waterbodies that are not supporting designated uses where other pollution-control requirements, such as best management practices required by local, state, or federal authority, are stringent enough to bring the waters listed in this category back into attainment in the near future with the approved pollution-control requirements in place, consistent with 40 Code of Federal Regulations (CFR) 130.7(b) (I) (ii) and (iii). All waterbodies placed in this category must have a pollution control requirement plan developed and approved by EPA. Similar to Category 4A, if the waterbody has other pollutants that need a TMDL, or there is already a TMDL in place for another pollutant, the waterbody may also be listed in Categories 5 and 4A. Therefore, an AU with a pollution control in place may be listed in Categories 4B, 4A, and 5.
4C	**Non-Pollutant Impairment**. Waterbodies not supporting designated uses are placed in this category if the impairment is not caused by a pollutant but rather by pollution (for example, hydrologic modification or habitat degradation). Similar to Categories 4A and 4B, if the waterbody has other pollutants that need a TMDL, or there is an approved TMDL or pollution-control mechanism in place, the waterbody may also be listed in Categories 4A, 4B, and 5. Therefore, an AU with a pollution control in place may be listed in Categories 4C, 4B, 4A, and 5.
5	**Not Supporting**. The concentration of a pollutant or several pollutants exceeds numeric water quality criteria, or beneficial uses are not-supporting based on violation of the narrative water quality standards. Waterbodies identified as “threatened” may also be placed in this category. In a “threatened” waterbody, one or more of its uses are likely to become impaired by the next IR cycle and water quality may be exhibiting a deteriorating trend if pollution control actions are not taken. Both impaired and threatened waterbodies constitute Utah’s formal Section 303(d) list and are prioritized for future TMDL development.
5-Alt	**TMDL Alternatives**. The 303(d) program vision promotes the identification of alternative approaches to TMDL development for impaired waters where these approaches would result in a more rapid attainment of water quality standards. Note: This category is referenced in DWQ’s “303(d) Vision Document.”

UTAH'S NUMERIC CRITERIA AND BENEFICIAL USES

DWQ assesses the impacts of measured pollutant concentrations on environmental and human health to determine the appropriate assessment categories for a waterbody (see Table 1). Utah has developed and adopted water quality numeric criteria (chemical concentrations that should not be exceeded) to protect the water quality of surface waters and the uses these waterbodies support (UAC R317-2-14). As noted in UAC R317-2-14, the water quality criteria for a pollutant can vary depending on the beneficial use assigned to a waterbody.

Utah adopted beneficial use classifications that identify the use and value of a waterbody for source water for domestic water systems, aquatic wildlife, recreation, agriculture, and Great Salt Lake (see UAC R317-2-6). DWQ currently designates five beneficial use classes of surface waters within the state:

- Class 1. Protected for use as a raw water source for domestic water systems
- Class 2. Protected for recreational use and aesthetics
- Class 3. Protected for use by aquatic wildlife
- Class 4. Protected for agricultural uses including irrigation of crops and stock watering
- Class 5. The Great Salt Lake (GSL)

Subclassifications for several of these categories are further defined in Table 2.

Table 2. Subclassifications of Utah's beneficial uses.

Beneficial Use Subclassification	Use Definition
1C*	Protected for domestic purposes with prior treatment by treatment processes as required by the Utah Division of Drinking Water
2A	Protected for frequent primary contact recreation where there is a high likelihood of ingestion of water or a high degree of bodily contact with the water. Examples include, but are not limited to, swimming, rafting, kayaking, diving, and water skiing.
2B	Protected for infrequent primary contact recreation. Also protected for secondary contact recreation where there is a low likelihood of ingestion of water or a low degree of bodily contact with the water. Examples include, but are not limited to, wading, hunting, and fishing.
3A*	Protected for cold water species of game fish and other cold water aquatic life, including the necessary aquatic organisms in their food chain.
3B*	Protected for warm water species of game fish and other warm water aquatic life, including the necessary aquatic organisms in their food chain.
3C*	Protected for nongame fish and other aquatic life, including the necessary aquatic organisms in their food chain.
3D*	Protected for waterfowl, shore birds and other water-oriented wildlife not included in Classes 3A, 3B, or 3C, including the necessary aquatic organisms in their food chain.
3E*	Severely habitat-limited waters. Narrative standards will be applied to protect these waters for aquatic wildlife.
4	Protected for agricultural uses including irrigation of crops and stock watering.
5A	**Gilbert Bay** Geographical Boundary: All open waters at or below approximately 4,208-foot elevation south of the Union Pacific Causeway, excluding all of the Farmington Bay south of the Antelope Island Causeway and salt evaporation ponds. Beneficial Uses: Protected for frequent primary and secondary contact recreation, waterfowl, shore birds and other water-oriented wildlife including their necessary food chain.

Beneficial Use Subclassification	Use Definition
5B	**Gunnison Bay** Geographical Boundary: All open waters at or below approximately 4,208-foot elevation north of the Union Pacific Causeway and west of the Promontory Mountains, excluding salt evaporation ponds. Beneficial Uses: Protected for infrequent primary and secondary contact recreation, waterfowl, shore birds and other water-oriented wildlife including their necessary food chain.
5C	**Bear River Bay** Geographical Boundary: All open waters at or below approximately 4,208-foot elevation north of the Union Pacific Causeway and east of the Promontory Mountains, excluding salt evaporation ponds. Beneficial Uses: Protected for infrequent primary and secondary contact recreation, waterfowl, shore birds and other water-oriented wildlife including their necessary food chain
5D	**Farmington Bay** Geographical Boundary: All open waters at or below approximately 4,208-foot elevation east of Antelope Island and south of the Antelope Island Causeway, excluding salt evaporation ponds. Beneficial Uses: Protected for infrequent primary and secondary contact recreation, waterfowl, shore birds and other water-oriented wildlife including their necessary food chain.
5E	**Transitional Waters along the Shoreline of the Great Salt Lake** Geographical Boundary: All waters below approximately 4,208-foot elevation to the current lake elevation of the open water of the Great Salt Lake receiving their source water from naturally occurring springs and streams, impounded wetlands, or facilities requiring a UPDES permit. The geographical areas of these transitional waters change corresponding to the fluctuation of open water elevation. Beneficial Uses: Protected for infrequent primary and secondary contact recreation, waterfowl, shore birds and other water-oriented wildlife including their necessary food chain.
***Footnote: There are human health (HH) criteria associated with these beneficial uses (see UAC R317-2-14). For uses with a HH criteria, (see Table 2.14.6 in UAC R317-2-14), the following use notation will be used in 303(d) data and assessment reports: HH1C, HH3A, HH3B, HH3C, and HH3D.**	

Every beneficial use with numeric criteria and credible and readily available data is assessed and reported for 303(d) assessment purposes. DWQ does not just assess and report on the most environmentally protective criterion and/or use for a parameter and waterbody. Where waterbodies are unclassified and do not have assigned beneficial uses in DWQ data records, DWQ may assign default beneficial uses as articulated in UAC R317-2-13.9,13.10,13.11,13.12, and 13.13. Alternately, these undefined waterbodies may be classified as an EPA Assessment Category 3 or not reported in the IR if an Assessment Unit has not been established.

For more information on how DWQ develops, adopts, and updates the numeric criteria and beneficial uses in UAC R317-2, please refer to DWQ's Standards website.

PRIORITY AND ASSESSED PARAMETERS

DWQ developed a priority parameter list for routine water quality monitoring to make the list of pollutants with numeric criteria in UAC R317-2-14 more manageable for monitoring and assessment purposes. This priority list is a subset of the pollutants listed in UAC R317-2-14 and reflects the following constraints:

- Laboratory resources that limit the ability to assess all parameters in UAC R317-2-14
- Significant monitoring and/or analytical costs associated with processing a sample or measuring a pollutant
- Logistical constraints due to monitoring location and holding times for certain parameters

As a result, water quality assessments may not report on all parameters listed in UAC R317-2-14. Instead, assessments reflect all parameters with adopted numeric criteria that also have readily available and credible datasets from the IR period of record.

To view DWQ's list of priority parameters, please refer to Appendix 1. Please be aware that priority parameters can change from one reporting cycle to the next if laboratory and financial constraints and monitoring priorities within a sampling area change.

Assessment Process and Time Frames

DEVELOPING THE METHODS

This document describes the most up-to-date assessment methods that will be applied to Utah's current IR cycle. Although most of the methods described have been applied in past assessment cycles, other methods are new or modified from previous reporting cycles. Some of the assessment method revisions are intended to clarify ongoing DWQ practices. Other more substantive revisions may be based on comments that were raised during the previous IR's 303(d) assessment methods and draft IR public comment periods.

DWQ updates and revises the 303(d) methods when concerns are raised or when program developments are released by DWQ. Additional modifications or clarifications to the assessment methods may also be made based on feedback provided by EPA during and after a reporting cycle or from the EPA's cycle-specific 303(d) guidance memorandum.

All changes made to the 303(d) assessment methods are typically reviewed and updated on even-numbered years in anticipation of developing the Draft IR and 303(d) list in the following odd-numbered year. This process allows DWQ to consider comments and suggestions on assessment methods before a formal analysis is conducted. This reduces the need to rework analyses from changes in methods. In the 2022 IR cycle, however, methods will be reviewed and updated in an odd-numbered year in time for an even-numbered year submission for EPA approval.

PUBLIC REVIEW OF THE METHODS PROCESS AND SCHEDULE

The development and acceptance of the Assessment Methods includes a public review process and occurs on the following schedule:

a. DWQ releases the proposed Assessment Methods for a 30-day public comment period. The notice for public comments on the Assessment Methods are advertised on DWQ's News and Announcements webpage, DWQ's Public Notices webpage, and Utah's Integrated Report program webpages.
b. DWQ compiles and responds to the comments received within the 30-day public comment period. DWQ's responses to comments are posted on the Utah's Integrated Report program webpages.
c. If substantial revisions to the Assessment Methods are adopted by DWQ based on comments received in the public comment period, DWQ has the discretion to hold a second public comment period of 30 days or less. Should DWQ proceed with a second public comment period, notifications will be advertised, at a minimum, on DWQ's News and Announcements and/or Public Notices webpages, and the Utah's Integrated Report program webpages.
d. Following the conclusion of the public comment period(s), DWQ posts responses to comments on the Utah's Integrated Report program webpages. Any changes or additions that were made in response to public comments will be documented and issued with the draft IR and 303(d) list. If stakeholders have concerns with the final Assessment Methods released during the draft IR, the public should submit their comments during the next IR cycle, when future calls for public comments on the Assessment Methods are issued.

Concerns and comments not received through the above processes may not be considered for current and future 303(d) methods updates and modifications.

CALL FOR READILY AVAILABLE DATA AND SCHEDULE

DWQ issues a request for all readily available data (i.e., the IR Call for Data) after November 1 of even-numbered years.

Existing and Readily Available Data Defined

DWQ assembles and evaluates all existing and readily available data to determine whether a waterbody is supporting or not supporting the assigned beneficial uses and numeric criteria in UAC R317-2 as mandated in 40 CFR 130.7(b)(5). For the purposes of the IR, existing and readily available data may include:

- Data and information referenced in 40 CFR 130.7(b)(5)(i),(iii), and (iv)
- Data collected by DWQ or DWQ cooperators for assessment purposes
- Data collected for other DWQ programs, such as waste load allocations, TMDL development, watershed planning, and use attainability analyses
- Data collected for narrative assessments (see Narrative Assessment: Biological Assessments and Narrative Standards for All Waters)
- Data obtained through EPA's Water Quality Portal (WQP)
- Data and information obtained through the IR's public Call for Data
- Data and information submitted to EPA's Water Quality Exchange System or DWQ's Call for Data to support a credible data submission (e.g., Tables 5-8)
- Data included in the Data Types Matrix in Table 10

Data and information (as described above) that are not brought forward during the IR's Call for Data or presented to DWQ in accordance with the schedule as outlined in this document and on Utah's Integrated Report program webpages will not be treated as readily available for the purpose of assessment decisions during the current assessment cycle.

Data that are submitted to DWQ or obtained by DWQ during the IR data compilation process are integrated into DWQ's assessments as described in Table 3 and subject to DWQ's data management and quality assurance/quality control (QA/QC) processes. Should any data and information not be included in the assessment process, DWQ will clearly document which dataset (or datasets) were not included and why (as described and required in 40 CFR 130.7(b)(6)(iii)

Table 3. DWQ's data-availability matrix.

Data Availability	Description	Processing required	Uses for Assessments
Readily available	Data are incorporated into EPA's WQP database and can interface directly with DWQ's IR data processing and assessment tools. Data is submitted by stakeholders or data submitters through DWQ's data submission templates or electronic submission processes which are provided on the Call for Data webpage.[1,2]	None	Fully incorporate into DWQ's assessment tools
	Additional "other" sources of data included in the Data Types Matrix in Table 10 that described the waterbodies in 40 CFR 130.7(b)(5)(i), (iii), and (iv) and are submitted through DWQ's electronic submission process as described on the Call for Data webpage.	None	Fully incorporate into DWQ's Conflicting Assessments of Water Quality Standards and Secondary Review processes
Readily available (additional processing may be required by DWQ)	Quantitative data and information may be stored in and routinely uploaded to a queryable, regularly maintained database that is available on the web or electronically submitted to DWQ during the public call for data. Database format is consistent and allows repeatable queries with predictable results (e.g., parameter names, location descriptions, and parameter units are consistent), making development of automated interface tools practicable.	Full incorporation into IR assessment tools requires DWQ development of interface tools for aggregating, translating, and harmonizing data to appropriate formats. In particular, sampling locations and dates, parameter names, fractions, units, analysis methods, and detection limits require translation and interpretation prior to assessment.	Fully incorporate into IR assessment tools if interface tools have been developed.[2] If interface tools are still in the development phase, (1) screen data for exceedances for the waterbodies described in 40 CFR 130.7(b)(5)(i), (iii), and (iv), or (2) manually assess data for specific sites, dates, and parameters at the request of stakeholders or data submitters for waterbodies described in 40 CFR 130.7(b)(5)(i), (iii), and (iv). Results are fully incorporated into DWQ's Conflicting Assessments of Water Quality Standards and Secondary Review.

Data Availability	Description	Processing required	Uses for Assessments
[1] DWQ data submission templates and processes are designed to allow for data and information that may not fit the data structure of EPA's Water Quality Exchange System. They may also be used to support a credible data review (Tables 5-8) or perform narrative or high frequency data assessments. [2] DWQ requests data submitters inform the Division which data system contains their data so DWQ can work with submitters prior to the IR's Call for Data to develop interface tools.			

DEVELOPING THE COMPONENTS OF THE DRAFT INTEGRATED REPORT AND 303(D) LIST

DWQ reviews all data and assigns a credible data "grade" following its response to public comments on the draft 303(d) Assessment Methods and compilation of all existing and readily available data. All non-rejected, credible data are then assessed. The final 303(d) Assessment Methods, 305(b) Summary, and 303(d) List of Impaired Waters are the minimum reporting elements included in the Integrated Report. These reporting elements are available for public review and comment.

Final 303(d) Assessment Methods

The final version of the publicly-vetted 303(d) Assessment Methods, including any changes or additions made in response to the Assessment Method public comment period(s) is posted on the Utah's Integrated Report program webpages.

305(b) Summary

This summary, at a minimum, will address the following elements for current assessments and previous assessments where new data and information did not result in an EPA-defined categorical change:

- A unique identifier assigned to the Assessment Unit
- The name and location description of the Assessment Unit
- An indicator of whether the Assessment Unit is currently active, or if the Assessment Unit identifier was retired and being kept for historical tracking purposes and is part of an Assessment Unit history of another Assessment Unit
- The geographic state within which the Assessment Unit is contained
- The waterbody type for the Assessment Unit
- The size and the unit of measure for the assessed waterbody type
- The EPA-defined assessment category for each defined and evaluated Assessment Unit

303(d) Assessment Results

At a minimum, the following information will be provided for current assessments and previous assessments where new data and information did not result in an EPA-defined categorical change:

- The minimum elements discussed above in the 305(b) Summary
- The cycle the Assessment Unit was last assessed, which can include any conclusions related to this Assessment Unit and delisting decisions (if appropriate)
- The beneficial use(s) designated to the Assessment Unit and the EPA-defined assessment categories associated with the beneficial use after assessment
- The name of the parameter assessed, the beneficial use associated with the assessed parameter, and the EPA-defined assessment category status for the parameter and beneficial use
- An indicator of the water quality trend representing the beneficial use or parameter assessment
- A flag indicating whether or not the cause of the attainment status is a pollutant
- The agency responsible for identifying the EPA-defined assessment category status for the waterbody
- The IR cycle the Assessment Unit was first listed for a cause
- The name of the source of the EPA-defined assessment category status and if that source has been confirmed
- The reason(s) and the agency responsible for identifying the delisting of a waterbody and cause

305(b) Summary and 303(d) Assessment Metadata

DWQ will provide (at a minimum) the following supporting information and documentation as referenced in CFR 130.7 (b)(6) to support its decision to list or not list waters:

- A description of, and access to, the data records and information used in the IR's current period of record
- A rationale for, and access to, any data and information that was obtained or submitted to DWQ during the call for data but did not meet DWQ's readily available or credible data requirements and was not used for 305(b) and 303(d) assessments
- A rationale for, and access to, any rejected data records and information

For archiving purposes and to assist with the review of the IR and 303(d) List, DWQ will also provide the following as time and resources allow*:*

- The assessment method type and the assessment method context as defined in ATTAINS
- Geolocation information on the waterbodies assessed
- The date and version of UAC R317-2 used in the assessment cycle
- The list of approved TMDLs used in the assessment cycle
- A fact sheet summarizing the Final IR results

Note: In odd-numbered years, DWQ will "freeze" and establish file versions of several working files to maintain consistency and data integrity. These files include geographic information system (GIS) point files of monitoring locations, layers of AUs, beneficial uses, and water quality standards.

PUBLIC REVIEW OF THE 303(D) LIST

There will be a formal public review process for the IR and 303(d) list using the following steps:

a. Any person who has a pollution-control mechanism plan for a waterbody and would like to submit that plan for consideration and EPA approval as a Category 4B must submit that information to DWQ by July 1 of even-numbered years (Appendix 5). If approved by DWQ, this information will then be submitted to EPA for review and final approval. It should be noted, however, that it takes a long time for successful Category 4B determinations to receive EPA approval and they may not be received in time to be included in the current IR cycle.
b. Waters and pollutants that are considered for a potential Category 4A (approved TMDLs) must be approved by DWQ's Water Quality Board per UAC R317-1-7 and by EPA per 40 CFR 130.7 by September 30 of even-numbered years. TMDLs that are approved by DWQ and EPA after that date will be considered in future IRs.
c. DWQ will release the proposed IR and 303(d) list for a 30-day public comment period after July 1 of odd-numbered years and no later than February 1 of even-numbered years. At a minimum, the notice for public comments on the IR will be advertised on DWQ's News and Announcements and/or Public Notices webpages, and the Utah's Integrated Report program webpages.
d. Stakeholders who wish to submit data for listing or delisting considerations are encouraged to submit that data and information during the Utah's IR program's Call for Data. However, DWQ may consider data that are submitted during the public comment period of the draft IR and 303(d) list when the commenter can show that submitted data results could result in a change to a specific waterbody assessment decision. Data that are submitted during the public comment period for the draft IR must be submitted in the format articulated in this document and on the IR Call for Data website and be of Grade A or B quality to be used in an assessment decision (see the Data Quality Matrices on the IR Call for Data website). Information submitted during the public comment period will undergo a secondary review (see Secondary Review and Appendix 3).
e. DWQ will compile and respond to comments that were received within the 30-day public comment period after the close of the public comment period.
f. DWQ may offer a second public comment period of 30 days or fewer if substantial revisions to the IR and 303(d) list are adopted on the basis of comments received during the first public comment

period. Should DWQ proceed with a second public comment period, notifications will be advertised, at a minimum, on DWQ's News and Announcements and/or Public Notices webpages, and the Utah's Integrated Report program webpages.

g. DWQ will submit a response to the public comments that were received during the 30-day public comment period and a final version of the IR and 303(d) list to EPA for final approval no later than April 1 of even-numbered years. DWQ will post a status update on the Utah's Integrated Report program's webpages to let stakeholders know that a final IR was submitted to EPA for final approval. Any concerns or rebuttals from stakeholders regarding the IR will not be considered for the recently submitted IR after the submission of the IR to EPA for final approval. If stakeholders continue to have concerns with the IR and 303(d) list, they should submit their comments during the next IR cycle.
h. EPA has 30 days to approve or disapprove the 303(d) list after receiving DWQ's formal submission letter, IR chapters, 303(d) list, categorization of non-303(d) waterbodies, public comments received and DWQ's response to them, delisting tables and justifications, list of approved TMDLs/pollution-control mechanisms, and GIS files of all assessment results. If EPA disapproves a state 303(d) list, EPA has 30 days to develop a new list for the state, although historically EPA has rarely established an entire list for a state. EPA may also partially disapprove a list because some waters have been omitted, and EPA may add these waters to the state's list. If EPA's final approval of the IR takes longer than the timeframe identified above, DWQ will post updates on the Utah's Integrated Report programs webpages.
i. Any concerns and comments not received by DWQ through the above processes will not be addressed in the IR.

FINALIZING THE INTEGRATED REPORT AND 303(D) LIST

DWQ will release the following information on the Utah's Integrated Report program webpages following approval by EPA:

- A final version of 303(d) Assessment Methods, including the public comments received and DWQ's response to comments
- Final IR chapters and 303(d) lists, including public comments received, DWQ's response to comments, all assessment information considered and evaluated in the finalization of the IR and 303(d) list, and a GIS file of the final assessments and 303(d) list

EPA maintains a database of state IR results and TMDL status. Additional information not available on the Utah's Integrated Report program's webpages may be obtained through a Government Records Access and Management Act request. These requests can be submitted at any time.

Scope of the Assessment

WATERS OF THE STATE

As defined in UAC R317-1-1, DWQ characterizes waters of the state as follows:

… all streams, lakes, ponds, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, which are contained within, flow through, or border upon this state or any portion thereof, except that bodies of water confined to and retained within the limits of private property, and which do not develop into or constitute a nuisance, or a public health hazard, or a menace to fish and wildlife, shall not be considered to be "waters of the state" under this definition (Section 19-5-102).

For 303(d) assessment purposes, DWQ reports on the following waterbodies:

- Flowing surface waters of the state
- Canals as identified in site-specific standards or named in the list of waters with designated use classifications in UAC R317-2
- Lakes, reservoirs, and ponds

All other waters are currently reported through other programs within DWQ. For more information on these waterbodies and their reports, please visit DWQ's website.

WATERBODY TYPES

Utah assesses surface waters of the state at the monitoring-site level and then summarizes the site-level assessments at a larger spatial scale (the Assessment Unit (AU) scale). DWQ uses the descriptions in Table 4 to determine appropriate assessment sites and categorize monitoring locations.

Table 4. Assessed waterbody types used for categorizing monitoring locations.

Assessed Waterbody Type	Description
Rivers and streams*	Perennial and intermittent surface waters are included in this type. Springs and seeps are also included in this waterbody type, provided they are flowing and connect, contribute, or are influencing water quality in a downstream river or stream.
Canals (general, irrigation, transport, or drainage)*	A human-made water conveyance with flowing water. Note: Canals are only assessed when identified in the site-specific numeric criteria in UAC R317-2-14 or are named in the list of waters with designated use classifications in UAC R317-2-13.
Lakes, reservoirs, and ponds*	An inland body of standing fresh or saline water that is generally too deep to permit submerged aquatic vegetation to take root across the entire body. This type may include expanded parts of a river or natural lake, a reservoir behind a dam, or a natural or excavated depression containing a waterbody without surface water inlet and/or outlet.
***Footnote: Sites associated with these waterbody types that have readily available and credible data are also subject to secondary reviews as described in the Secondary Review section and Appendix 3.**	

ASSESSMENT UNITS

Assessment Unit Delineation and Identification

Surface waters identified for 303(d) assessments are delineated into discrete units called assessment units (AUs). AUs identify waters of the state assessed for support of their designated beneficial uses. Lakes, reservoirs, and ponds are delineated as individual AUs, and their size is reported in acres. Flowing surface waters of the state and canals are delineated by specific rivers or one or more surface water reaches in subwatersheds

Additional Guidelines for Delineating Assessment Units

DWQ follows the guidelines listed below when delineating AUs for flowing surface waters of the state. The first two guidelines are fixed rules.

- The entire AU is within a single 8-digit USGS HUC.
- Each AU comprises reaches with identical designated beneficial use classifications. For example, a waterbody that has beneficial uses of Class 1C, 2B, and 3A in one portion and Class 2B and 3B in another portion would have at least two distinct AUs because of the difference in beneficial use classifications.
- Large flowing surface waters of the state, such as the Green River, Colorado River, and portions of other large rivers (e.g., the Bear River and Weber River) are delineated into "linear" or "ribbon" AUs containing no tributaries. Where a major tributary enters these rivers, or hydrological features such as dams exist, the river is further delineated into two or more AUs.
- Tributaries and headwaters were delineated primarily using the 5th- and 6th-level HUC boundaries to define the AUs.
- Additional AUs were defined by combining or splitting 5th- or 6th-level watersheds using hydrological and ecological changes such as geology, vegetation, or land use.
- Small tributaries to larger flowing surface waters that could not be incorporated into a watershed unit are combined into separate, unique AUs.
- AU boundaries generally follow hydrologic units, but may also be delineated to reflect beneficial use designation changes, major tributaries or other observed hydrologic or chemical changes, administrative boundaries such as at some U.S. Forest Service boundaries, or notable road crossings as stated in water quality standards at UAC R317-2-13.

Individual AUs for flowing surface waters of the state are assigned a unique identification code for indexing. Each AU identifier begins with the prefix “UT,” followed by the associated 8-digit HUC, and ends in a 3-digit DWQ sequential number. Similarly, lake, reservoir, and pond AUs are identified by adding the prefix “UT-L-” to the 8-digit HUC, followed by a 3-digit sequential number.

Figure 1 provides an example of how DWQ uses these guidelines to delineate and identify AUs within a major watershed. The Weber River is delineated as a linear AU from its confluence with Chalk Creek upstream to the Wanship Dam and designated as UT16020101-017. South Fork Chalk Creek (UT16020101-011) in the Chalk Creek watershed is delineated by combining two 12-digit HUCs comprising the South Fork Chalk Creek sub-basin. The first AU (UT16020101-010) in the Chalk Creek watershed above Echo Reservoir is delineated using the confluence of the South Fork as the upstream endpoint. This necessitated splitting the 12-digit HUC into two AUs, one for Chalk Creek below the confluence with South Fork (UT16020101-010) and another AU for Chalk Creek above the South Fork confluence and below the Huff Creek confluence to form UT16020101-012. UT16020101-019 AU is an example of small tributary streams that could not be combined into a hydrological based AU. These are very small tributaries, and the Weber River is not reflective of their stream order or the habitat that they flow through. Echo Reservoir (UT-L-16020101-001) and Rockport Reservoir (UT-L-16020101-002) are examples of lake or reservoir AUs.

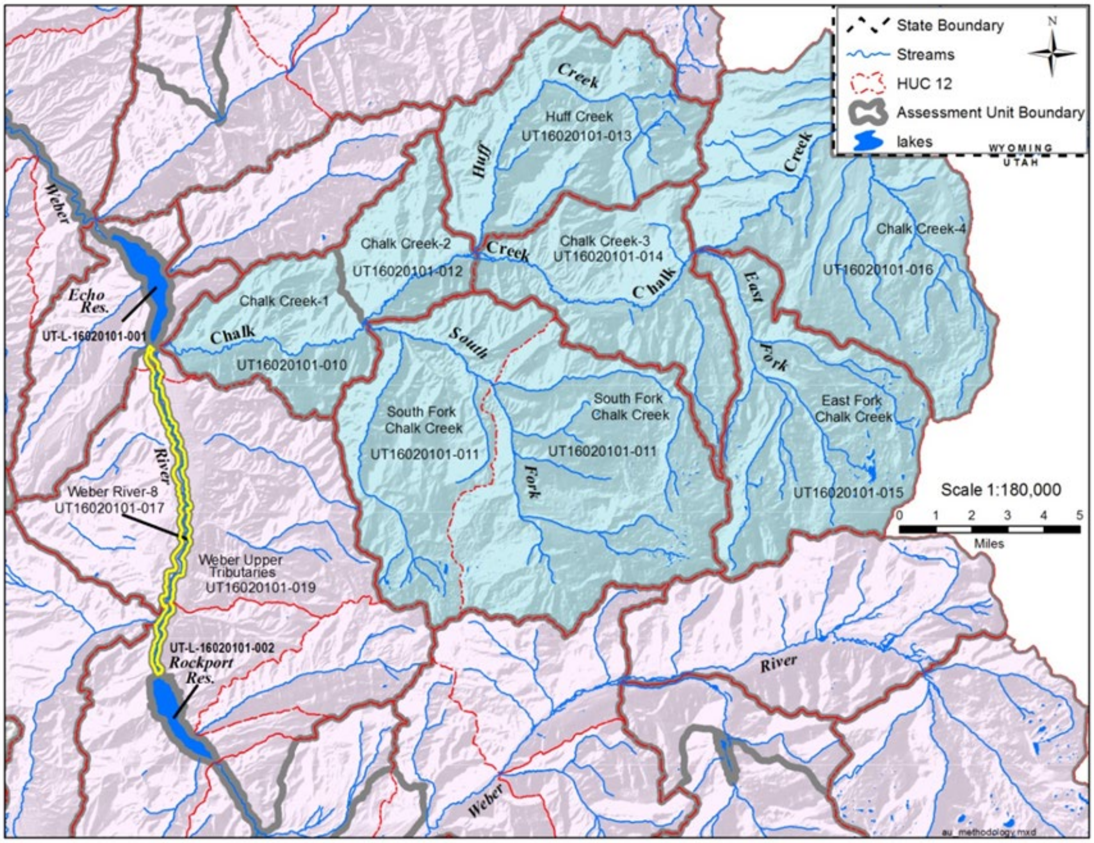

Figure 1. Utah Division of Water Quality assessment unit delineations.

AU Stream Mileage Estimation for Flowing Surface Waters and Canals

Flowing surface water assessments are summarized by stream mileage in each assessment category. Stream mileage within each AU is estimated using a streams GIS layer generated by the Utah Automated Geographic Reference Center (AGRC). This layer was derived from the high resolution (1:24,000 scale) National Hydrologic Dataset (NHD). Stream mileage within an AU is estimated as the sum of the lengths of all perennial streams and canals identified in the site-specific numeric criteria in UAC R317-2-14 or named in the list of waters with designated use classifications in UAC R317-2-13.The NHD-based layer is only used to estimate stream mileage within an AU and is not used to define individual monitoring locations as perennial or intermittent or remove monitoring locations from the assessment process..

WATERS WITHIN AND SHARED WITH OTHER STATES

Though readily available data may exist from locations near Utah's state boundaries, DWQ only assesses monitoring sites that are within the jurisdictional boundaries of the state for 303(d) purposes. Assessment units or sites on lands under tribal jurisdiction are not assessed in the IR. Assessed surface waters of the state (as defined in Table 4) that flow into Utah but originate outside of Utah's borders will be assessed using DWQ monitoring locations within state boundaries. Lakes, reservoirs, and ponds that overlap with other state jurisdictions (e.g., Lake Powell, Bear Lake, and Flaming Gorge) will be assessed using the monitoring locations that fall within Utah state jurisdictional boundaries.

DWQ will work with neighboring states, as resources allow, on any impairments that fall close to jurisdictional boundaries by notifying the neighboring state of the impairments or exceedances and available data relevant to the impairment.

Data Quality

CREDIBLE DATA DEFINED

All readily available data and information that are submitted to the Utah's Integrated Report program (Utah's IR program) or obtained during the IR's data compilation process must be of high quality to be considered for 303(d) assessments.

Utah's IR program defines credible data as a complete and validated data submission consisting of

- Water quality samples and field measurements (data) that are collected using appropriate quality assurance (QA) and quality control (QC) procedures, including proper documentation
- Environmental data that are representative of water quality conditions at the time of sampling
- Documented field sample collection, processing, and laboratory analyses that are documented and follow established protocols, procedures, and methods. Further information on proper adherence to these requirements is available upon request.

Utah's IR program relies on documentation from project planners, sample collectors, and laboratories to help ensure that data are of known quality and defensible. External entities are not obligated to collect data under the specifications of any of DWQ's or EPA's currently established quality assurance protocols to be considered credible, but all sources of data must meet the definition of credible data. DWQ will evaluate the credibility of data using the criteria and documentation described in the following sections.

Please note that the definition of credible data outlined in this document is specific to Utah's IR program and does not restrict other programs (e.g., water quality standards development, TMDLs, etc.) within DWQ from using data for other Division reporting analyses and actions. Data used for a Watershed Plan, for example, may not necessarily meet the credible data requirements for Utah's IR program but may meet the needs of a Watershed Plan.

COMPONENTS FOR CREDIBLE DATA

Quality Assurance Program Plan Guidance and Example

Utah's IR program requires that all assessment-related decisions that use data are supported by a Quality Assurance Project Plan (QAPP). QAPPs *"integrate all technical and quality aspects of a project, including planning, implementation, and assessment." The purpose of a QAPP is to document planning results for environmental data operations and to provide a project-specific "blueprint" for obtaining the type and quality of environmental data needed for a specific decision or use. The QA Project Plan documents how quality assurance (QA) and quality control (QC) are applied to an environmental data operation to assure that the results obtained are of the type and quality needed and expected"* (EPA, 2002).

DWQ does not require entities to follow a specific QAPP. However, external entities should be prepared to share the QAPP they relied on for the data collection associated with a particular submission. External entities may choose to follow one of the example QAPPs below or develop a QAPP specific to their entity or sampling program(s).

Example QAPPs

- Environmental Protection Agency's Quality Assurance Quality Program Guidance & Requirements. EPA's requirements and guidance documents for ensuring that all environmental data are of a known quality and defensible. Utah's IR program encourages DWQ staff, cooperators, and all other parties interested in submitting high quality data to the IR program to review QA/R-5 and QA/G-5.

- DWQ Quality Assurance Program Planning (QAPP). DWQ's document outlining the minimum Quality Assurance and Quality Control (QA/QC) requirements for environmental data generated by DWQ and used by most of its cooperators.

Sampling Analysis Plan Guidelines and Examples

Sampling Analysis Plans (SAPs) are the second type of documentation that Utah's IR program requires when compiling information for assessments and other programmatic decisions. SAPs *"are intended to assist organizations in documenting the procedural and analytical requirements for one-time, or time-limited, projects involving the collection of water, soil, sediment, or other samples taken to characterize areas of potential environmental contamination. It combines the basic elements of a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan"* (EPA, 2014).

DWQ does not require that entities follow a specific SAP. However, external entities should be prepared to share the SAP relied upon for data collection associated with a particular submission. External entities may choose to follow one of the example SAPs below or develop a SAP specific to their sampling program(s).

Example SAPs

- EPA's Sampling Analysis Plan Guidance & Requirements.
- DWQ's recommended Sampling Analysis Plan Requirements. These requirements are currently used by DWQ and its cooperators This document contains information on what DWQ looks for in a SAP (see Appendix 2)

Standard Operating Procedures Guidelines and Examples

Standard Operating Procedures (SOPs) are documented procedures that describe the routine operations of a monitoring program in full detail. Utah's IR program requires SOPs as part of data submission packages to ensure consistency and comparability across sampling techniques from disparate data sources.

DWQ does not require that entities follow a specific SOP. However, external entities should be prepared to share the SOPs relied upon for data collection associated with a particular submission. External entities may choose to follow the example SOPs below or develop SOPs specific to their sampling program(s).

Example SOPs

- EPA's Guidance for Preparing Standard Operating Procedures (G-6). EPA's guidance for developing and providing the necessary documentation when generating an SOP. DWQ recommends referring to EPA's guidance if not using DWQ's SOP.
- DWQ Standard Operating Procedures. DWQ generates SOPs for any procedure that becomes routine, even when published methods are utilized. The use of SOPs ensures data comparability, defensibility, and accuracy, and reduces bias. DWQ has published the following final SOPs on its website:

    a. Aquatic Benthic Macroinvertebrate Collection in Rivers and Stream
    b. Calibration, Maintenance, and Use of Multiparameter Water Quality Sondes
    c. Chain of Custody Samples
    d. Collection and Handling of Total Coliform and *Escherichia coli (E. coli)* Samples
    e. Collection and Preparation of Fish Tissue for Analysis
    f. Lake Water Sampling and Data Collection
    g. Collection of Water Chemistry Samples in Streams
    h. Collection and Filtering of Water Column and Benthic Chlorophyll a Samples
    i. Phytoplankton Collection to Detect Harmful Algal Blooms
    j. Secchi Disk Depth Measurements

k. Stream Flow Measurement

Sampling Observations and Laboratory Comments

Utah's IR program requires documentation of field conditions that may affect data quality or laboratory comments on QA/QC issues encountered during analysis. Appendix 2 includes an example of sampling observations DWQ recommends documenting in the field for grab sample collections, and the credible data matrices included in Table 5 - Table 9 describe additional sampling and laboratory observations and comments required by Utah's IR program.

Monitoring Location Information

DWQ must review all of the monitoring location information associated with datasets to assess waterbodies against the numeric criteria assigned in UAC R317-2-14. This process involves validating the location's geospatial information in GIS, assigning beneficial uses to DWQ-validated locations, and merging monitoring locations and their associated data where locations are representative of the same waterbody or segment. Information that must be included with a monitoring location measurement:

- Monitoring Location ID (organization's unique identifier for the sample site)
- Waterbody type description
- Monitoring location, latitude/longitude measurements and associated metadata as defined on Utah's IR program's Call for Data webpages.

A monitoring location and its associated data will not be included in the assessment if DWQ's geospatial review of the monitoring location information finds insufficient or inaccurate information (e.g., it cannot be mapped or is improperly recorded by the sampler in the field).

CREDIBLE DATA MATRICES

DWQ will consider the scientific rigor of the sampling information and measurements associated with sites where beneficial uses can be assigned to a DWQ-validated monitoring location. DWQ uses a data-type–specific, credible-data matrix to assess the validity of the sampling and analytical protocols associated with a sample measurement, As noted in the credible-data matrices, each credible-data matrix considers the field and laboratory QA/QC protocols, sampling and laboratory methods, analytical detection or instrumentation limits, and field observations associated with a sample measurement. DWQ assigns a grade level (A–C) to the associated sample measurement(s) based on the level of information provided and the strength of the metadata associated with the sample measurement.

DWQ considers measurements that receive an A or B grade to be of high quality and will consider and use them to assign an EPA-derived assessment category to a waterbody (i.e., the IR's 305(b) and 303(d) assessments). Measurements that receive a C grade are considered to be of insufficient quality for assessment and 303(d) listing purposes. Details on the required data quality criteria for inclusion in the IR and use by Utah's IR program are included in Table 5.

Table 5. Data validation criteria for water quality field grab sample parameters.

Data Quality Grade	Quality Assurance	Essential Metadata[1]	Calibration Documentation	Field Documentation	Flow Data	Calibration: Water Temperature Methods*	Calibration: pH Methods*	Calibration: Dissolved Oxygen, Percent Saturation for Calibrated Meter*	Calibration: Dissolved Oxygen, Concentration Methods for Calibrated Meter*
A	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is included with the data submission.	Available for DWQ review if requested for all field parameters	Available for DWQ review if requested	Submitted or available for DWQ review if requested	Checked against NIST A ≤ ± 0.1 ºC	Calibrated pH Probe A ≤ ± 0.2	0-200 %Sat: A ≤ ± 6%	0-8 mg/L: A ≤ ± 0.1mg/L > 8mg/L: A ≤ ± 0.2 mg/L
B	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is provided to DWQ upon request.	Available for DWQ review if requested, for field parameters	Unavailable	Not submitted or unavailable	A ≤ ± 0.1 ºC	Calibrated pH Probe A ≤ ± 0.2	0-200 %Sat: A ≤ ± 10%	0-20 mg/L: A ≤ ± 0.2 mg/L
C	QAPP, SAP, or SOP is unavailable Not Submitted	Essential metadata is missing from the data submission and is unavailable.	Unavailable	Unavailable	Not submitted or unavailable	A ≥ ± 0.5 ºC OR not a calibrated meter, missing, or rejected data	Not a calibrated meter, missing, or rejected data	Not a calibrated meter, missing, or rejected data	Not a calibrated meter, missing, or rejected data

[1] Essential metadata elements are sample location (latitude/longitude), sample date and time, parameter name, result value and unit.
***Footnote: A = accuracy, values based on technical specifications of commonly used YSI, Hydrolab, and In-Situ smarTROLL sondes.**

Table 6. Data validation criteria for water quality high frequency dissolved oxygen data.

Data Quality Grade	Quality Assurance Quality Assurance Project Plan (QAPP)	Essential Metadata[1]	Calibration Documentation	Data QA/QC Information or Report	Field Documentation	Flow Data	Calibration: Dissolved Oxygen*, Percent Saturation for Calibrated Meter	Calibration: Dissolved Oxygen*, Concentration Methods for Calibrated Meter
A	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is included with the data submission.	Mandatory-calibration record(s) (e.g., field records of calibration and/or fouling)	Documentation describing the QA/QC process on the raw data	All pertinent deployment data (i.e., information necessary for interpreting data)	Submitted or available for DWQ review if requested	0-200%: A ≤ ± 6%	0-8 mg/L: A ≤ ± 0.1 mg/L > 8mg/L: A ≤ ± 0.2 mg/L
B	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is provided to DWQ upon request.	Mandatory-calibration record(s) (e.g., field records of calibration and/or fouling)	Documentation describing the QA/QC process on the raw data	All pertinent deployment data (i.e., information necessary for interpreting data)	Not submitted or unavailable	0-200%: A ≤ ± 10%	0-20 mg/L: A ≤ ± 0.2 mg/L
C	QAPP, SAP, or SOP is unavailable	Essential metadata is missing from the data submission and is unavailable.	Unavailable	Unavailable	Unavailable	Not submitted or unavailable	missing, or rejected data	

[1] **Essential metadata elements are sample location (latitude/longitude), sample date and time, parameter name, result value and unit.**
***Footnote: A = accuracy, values based on technical specifications of commonly used YSI, Hydrolab, and In-Situ smarTROLL sondes.**

Please note**: Raw and QA/QC data records *must be* submitted to qualify for consideration in 303(d) assessments.**

Table 7. Data validation criteria for water quality chemistry grab sample parameters.

Data Quality Grade	Quality Assurance Project Plan (QAPP)	Essential Metadata[1]	Laboratory Method	Detection Limits	Lab Certification	QC Data	Laboratory Comments	Field Documentation	Metals*	Organics*	Inorganics*
A	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is included with the data submission.	Standard Methods	Below applicable water quality standard	Utah Bureau of Laboratory Improvement certification, NELAC, or equivalent	Available for DWQ review if requested	Laboratory Comments Associated with Sample	Available for DWQ review if requested	Chronic: Aluminum submitted with Ca and Mg OR Lab Hardness and field pH; Cadmium, Chromium (III), Copper, Lead, Nickel, Silver, and Zinc submitted with Ca and Mg OR Lab Hardness	Pentachlorophenol submitted with field pH	Total Ammonia as N submitted with field pH or field Temperature
B	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is provided to DWQ upon request.	Standard Methods	Below applicable water quality standard	Documentation of laboratory procedures	Available for DWQ review if requested	Laboratory Comments Associated with Sample	Unavailable	Chronic: As above, but Aluminum submitted without Hardness or field pH will be assessed at 750 ug/l; As above, but samples submitted without Ca, Mg, or Lab Hardness **	Pentachlorophenol submitted without field pH	Total Ammonia as N submitted with field pH or field Temperature
C	QAPP, SAP, or SOP is unavailable	Essential metadata is missing from the data submission and is unavailable.	Missing or Non-Standard Methods	Above applicable water quality standards	No certification or laboratory documentation	Unavailable	No Laboratory Comments	Unavailable	Chronic: As above, but Aluminum without Hardness or field pH will not be assessed;	Pentachlorophenol submitted without field pH	Total Ammonia as N submitted with field pH or field Temperature

[1] Essential metadata elements are sample location (latitude/longitude), sample date and time, parameter name and fraction, parameter units, analytical method, result value or non-detect limitation, and laboratory name.
***Footnote: Please also refer to UAC R317-2 to confirm that all the necessary data is submitted to DWQ so correction factors and equations may be fully calculated for 303(d) assessment purposes.**
****Footnote: Please refer to the 303(d) Assessment Methods for corrections to assessment due to missing values of hardness or pH.**

Table 8. Data validation criteria for macroinvertebrate data.

Data Quality Grade	Quality Assurance Project Plan (QAPP)	Essential Metadata[1]	Field Documentation	Qualified taxonomy lab
A	EPA-approved Lab QAPP available for DWQ review if requested; SAP and SOP or equivalents available for DWQ review if requested	Essential metadata is provided to DWQ upon request.	Available for DWQ review if requested	Required
B	Lab QAPP or equivalent is available for DWQ review if requested; SAP and SOP or equivalents available for DWQ review if requested	Essential metadata is provided to DWQ upon request.	Unavailable	Required
C	QAPP, SAP, or SOP is unavailable	Essential metadata is missing from the data submission and is unavailable.	Unavailable	Unavailable

[1] Essential metadata elements are sample location (latitude/longitude), sample date and time, parameter name and fraction, analytical method, result value and unit, and laboratory name.

Table 9. Data validation criteria for *Escherichia coli (E. coli)* data.

Data Quality Grade	Quality Assurance	Essential Metadata[1]	EPA Approved Method	Lab Documentation	QA/QC
A	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is provided to DWQ upon request.	IDEXX Colilert	Bench Sheet Present and Complete	Information on holding time, incubation*, and expiration dates provided.
B	QAPP, SAP(s), and SOP(s) or equivalents are available for DWQ review if requested	Essential metadata is provided to DWQ upon request.	IDEXX Colilert or EasyGel	Bench Sheet Present, incomplete, or not available	Not provided
C	QAPP, SAP, or SOP is unavailable	Essential metadata is missing from the data submission and is unavailable.	IDEXX Colilert or EasyGel	Unavailable	Not provided

[1] Essential metadata elements are sample location (latitude/longitude), sample date and time, parameter name and fraction, analytical method, result value and unit, and laboratory name.
***Footnote: "incubation" refers to data and information that is recorded on DWQ's *E. coli* bench sheets and relates to time and temperature (i.e., time samples were placed in and taken out of the incubator and the temperature of the incubator when samples were placed in and taken out of it). For an example of how DWQ records this information, please refer to Appendix 3 of DWQ's** Standard Operating Procedure for Collection, Handling, and Quantification of *Escherichia coli (E. coli)* Samples.

Data Submission Process

TYPE OF DATA TO SUBMIT

As referenced in 40 CFR 130.7(b)(5), Utah's IR program considers all existing and readily available data as defined in Table 3. Both quantitative and qualitative data may be used to evaluate whether physical, chemical, and biological characteristics of a waterbody are sufficient to support that waterbody's designated uses. However, based on the type of data submitted to or obtained by DWQ during Utah's IR program's Call for Data, some of these data may not be appropriate for assessments. DWQ considers several quantitative and qualitative types of data described in Table 10 for water quality assessments and analyses as recommended in EPA's July 29, 2005, guidance (EPA, 2005).

Table 10. Summary of data types considered by Utah's IR program.

Utah's IR program Data Uses	Quantitative Data	Qualitative Data	Other
305(b) and 303(d) Assessments (Grade A and B Data in credible data matrices)	(1) Assessment parameters contained in Utah Water Quality Standards (UAC R317-2) and Safe Drinking Water Act Standards (see Appendix 1), (2) segment-specific ambient monitoring of analytical, physical, and/or biological conditions, (3)simple dilution calculations, and (4) human health/consumption closures, restrictions, and/or advisories	(1) Observed effects (e.g., fish kills), (2) complaints and comments from the public, and (3) human health/consumption closures, restrictions, and/or advisories	Landscape analysis (when applicable)
Monitoring Planning and Training (Grade C and D Data in credible data matrices)	See above	See above	(1) Landscape analysis (when applicable), (2) technical reports, (3) white papers, (4) articles from referred journals, and (5) other scientific publications

PERIOD OF RECORD

DWQ uses water years to define the period of record and uses the same definition of water years as the U.S. Geologic Survey. USGS defines the water year as the 12-month period between October 1 and September 30 of the following year. For the 2022 IR, the period of record is October 1, 2014, to September 30, 2020, (water years 2015-2020).

Data and information from the IR's period of record are considered to be most reflective of the current conditions of a waterbody. DWQ will analyze and assign EPA-derived assessment categories to the assessed waterbodies from this record period, provided the data meet the interpretive, sampling, and analytical considerations and protocols outlined in this document and on Utah's IR program's Call for Data webpages (see Table 1). Note that DWQ will retain all accepted data from the Combined 2018/2020 Integrated Report within the current period of record for assessment. DWQ will combine this dataset with additional data received through the Call for Data as well as any data collected between October 1, 2018, and September 30, 2020, and submitted to readily available data sources.

Older Data and Information

DWQ will not consider data and other information older than the period of record in the current IR and 303(d) list unless the data are used to support a secondary review of an impairment determination. Instead, DWQ will encourage the data submitter to collect newer information and submit that data and information in future calls for data. The IR's period of record does not preclude DWQ from using older or longer-term datasets for programs other than assessments (e.g., water quality standards development, TMDLs, etc.).

Newer Data and Information

Quantitative and qualitative data types that are considered in 303(d) assessments but are collected or represent conditions after the closing date specified in the above period of record will not be considered in the current reporting cycle. DWQ does not include these newer datasets because of the time required to compile data, perform data quality checks, format data from different sources, assess, review assessments, and generate the IR and 303(d) for public comment by April 1 of even-numbered years.

DATA SUBMISSION TOOLS

Data should be submitted in a form that is compatible with the Utah's IR program's existing data-management and QA capabilities. Please refer to Table 3 and the Utah's IR program's Call for Data webpages for more information on how to submit data for consideration in the IR.

Data Preparation for Conventional and Toxic Assessments for All Waters

DWQ compiles all high quality credible data within the period of record of concern following the readily available and credible data reviews, and then standardizes, validates, and prepares the data for assessments. To assist reviews and increase transparency to reviewers, DWQ uses a series of database comments and flags rather than altering raw data and accompanying metadata. Though High Frequency Dissolved Oxygen (DO) and *E. coli* assessments are considered conventional assessments (see Table 11), these parameters have data preparation protocols that are unique to those datasets. Please refer to the High Frequency and *E. coli* assessment sections of this document for more details.

RESULTS BELOW DETECTION LIMITS

Environmental chemistry laboratories often report sample results as below their detection limit for a given analytical method. These limits are variously reported as minimum detection limit, minimum reporting limit, and/or minimum quantitation limit. DWQ screens and flags laboratory result values that are empty and have detection limits higher than the water quality criteria in UAC R317-2-14.These flagged data records are not considered for the analysis. The reported result value or a value of 0.5 times the lowest reported detection limit for sample results below detection is applied for purposes of the assessment. However, if the detection limit is above the water quality standard, the data will not be used in the assessment.

DUPLICATE AND REPLICATE RESULTS

Datasets often contain duplicate and replicate sample results due to QA/QC procedures, reporting errors, or sampling design. In these cases, a single daily value is determined by accepting the highest result for parameters with not-to-exceed criteria in UAC R317-2-14, or the lowest reported value for parameters with minimum criteria in UAC R317-2-14. All data are retained in the assessment dataset and flagged as rejected because of replicate or duplicate values.

INITIAL ASSESSMENT: MONITORING LOCATION SITE LEVEL

DWQ determines attainment or nonattainment of numeric standards by assessing credible data at the monitoring location site level against the numeric criteria in UAC R317-2-14. DWQ developed this protocol because individual assessments offer a more direct measure of the support or non-support of water quality standards in UAC R317-2.

Multiple parameter assessments at an individual monitoring location and results from multiple monitoring locations within the same AU are summarized and combined using the procedures outlined in the Determination of Impairment: All Assessment Units section of this report.

Assessments Specific to Flowing Surface Waters of the State and Canals

CONVENTIONAL PARAMETER ASSESSMENTS

DWQ currently assesses five parameters within UAC R317-2-14 as conventional parameters and assesses them against the beneficial-use specific criteria established in UAC R317-2. Several waterbodies with conventional numeric criteria have site-specific standards articulated in self-explanatory footnotes within DWQ's surface water standards (UAC R317-2-14). Site-specific standards that require further clarification for 303(d) assessment purposes are noted and explained in Table 11. Sites that do not meet water quality standards as described below are not supporting of beneficial uses for 303(d) assessment purposes.

Table 11. Conventional parameters and associated designated uses as identified for assessment purposes.

Parameters	Designated Use	Notes
DO*	Aquatic life	DO measurements collected by instantaneous/grab samples are assessed against the instantaneous minimum criteria in UAC R317-2-14 and follow the assessment process in Figure 2 for flowing surface waters and the "Assessments Specific to Lakes, Reservoirs, and Ponds" section of the methods. DO measurements that are collected by high frequency data probes are assessed against the 30- and 7-day averages and minimums in UAC R317-2-14 and follow the assessment process in Figures 3-5. Note: for high frequency DO assessments and stream grab sample assessments, DWQ assumes early life stages are present for the 7-day and minimum. Some site-specific standards have been generated for assessment purposes.
Maximum temperature*	Aquatic life	Some site-specific standards are used for assessment purposes.
pH*	Domestic, Recreation, Aquatic life	Criteria are identical across uses.

Parameters	Designated Use	Notes
Total dissolved solids (TDS)**	Agriculture	Many site-specific standards are used for assessment purposes. Clarification on how three site-specific standards are used for 303(d) purposes are provided below: (1) For South Fork Spring Creek from the confluence with Pelican Pond Slough Stream to U.S. Route 89, two seasonal assessments are not performed. Instead, each sample is compared to the monthly corrected criteria in the footnote in UAC R317-2. (2) Ivie Creek and its tributaries from the confluence with Muddy Creek to the confluence with Quitchupah Creek. If TDS exceeds the site-specific standard, the site is not meeting site-specific criteria. If TDS is not exceeding, total sulfate is assessed. (3) Quitchupah Creek from the confluence with Ivie Creek to Utah State Route 10: If TDS exceeds the site-specific standard, it is not meeting site-specific criteria. If TDS is not exceeding, total sulfate is assessed. (4) Blue Creek and tributaries, Box Elder County, from Bear River Bay, Great Salt Lake to Blue Creek Reservoir. The only site to be assessed within this area is 4960740. (All other sites within this area description will not be assessed for TDS). Site-specific standard associated with sulfate for the following areas: (1) Ivie Creek and its tributaries from the confluence with Muddy Creek to the confluence with Quitchupah Creek: When TDS is not exceeding site-specific criteria and total sulfate exceeds site-specific criteria, the area does not meet water quality standards. (2) Quitchupah Creek from the confluence with Ivie Creek to Utah State Route 10: When TDS is not exceeding site-specific criteria and total sulfate exceeds site-specific criteria, the area does not meet water quality standards.
Sulfate**	Agriculture	Site-specific standard associated with sulfate for the following areas: (1) Ivie Creek and its tributaries from the confluence with Muddy Creek to the confluence with Quitchupah Creek: When TDS is not exceeding site-specific criteria and total sulfate exceeds site-specific criteria, the area does not meet water quality standards. (2) Quitchupah Creek from the confluence with Ivie Creek to Utah State Route 10: When TDS is not exceeding site-specific criteria and total sulfate exceeds site-specific criteria, the area does not meet water quality standards.
***Footnote: Indicate that assessments are performed from field measurement only.** ****Footnote: Indicate that assessments are performed from lab measurements only.**		

Grab Sample Assessments

A minimum of 10 samples for conventional parameters are required to determine if a site is meeting or not meeting water quality standards (Figure 2). Where locations have sufficient sample sizes of 10 or more, an exceedance percentage is calculated for each applicable beneficial use by dividing the number of samples exceeding the numeric criterion by the total number of samples. If the calculated percentage is less than or equal to 10%, the site is supporting its beneficial use and the next beneficial use is assessed. If the calculated percentage is greater than 10%, the site is not supporting its beneficial use and the next beneficial use is assessed. In the case of waterbodies with site-specific standards for TDS and sulfate, both criteria must be met or the waterbody will be listed as not supporting its agricultural use.

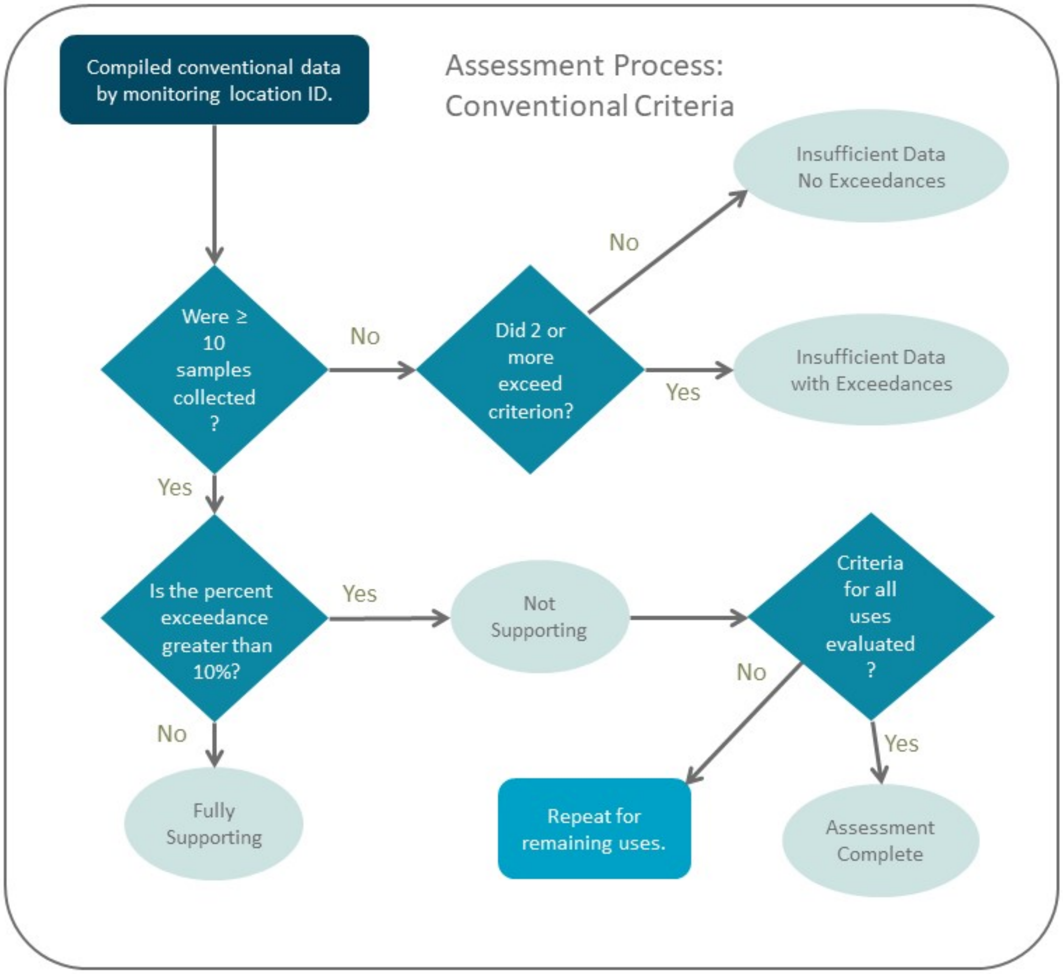

Figure 2. Overview of the assessment process for conventional parameters using grab sample data.

High Frequency Assessments for Dissolved Oxygen

Data Preparation

High frequency data are often screened and corrected to account for sensor drift, calibration shift, strange anomalous points, and battery issues before data analysis and interpretation begins. These data screens are particularly important for dissolved oxygen (DO) sensors because they are subject to bio-fouling, especially in nutrient-rich water where they have the higher potential to become covered in algal growth. When bio-fouling occurs, it results in erroneous logger measurements or sensor drift. DWQ will use corrected high frequency data as documented by the data submitter for assessments. DWQ will contact the data submitter for clarification and additional information if it determines additional corrections may be required.

Data sufficiency

High frequency data must capture complete days to ensure daily minima are captured and daily averages can be accurately calculated. DWQ defines a complete day as a calendar day (i.e., 12:00 a.m. – 11:59 p.m.) in which at least one measurement is made in each hour. Incomplete days will not be included in the high frequency DO assessment.

Assessment Process

A daily minimum and daily average are calculated for each complete day in a dataset. Moving 7- and 30-day averages are then calculated from the daily averages for each 7- or 30-day period within the dataset. These values are then compared to the applicable daily minimum, 7-day average, and 30-day average criteria to determine use impairment or support.

A site does not meet the daily DO minimum criterion if the percentage of total daily minima that fall below the applicable standard is greater than 10% within the period of record (Figure 3).

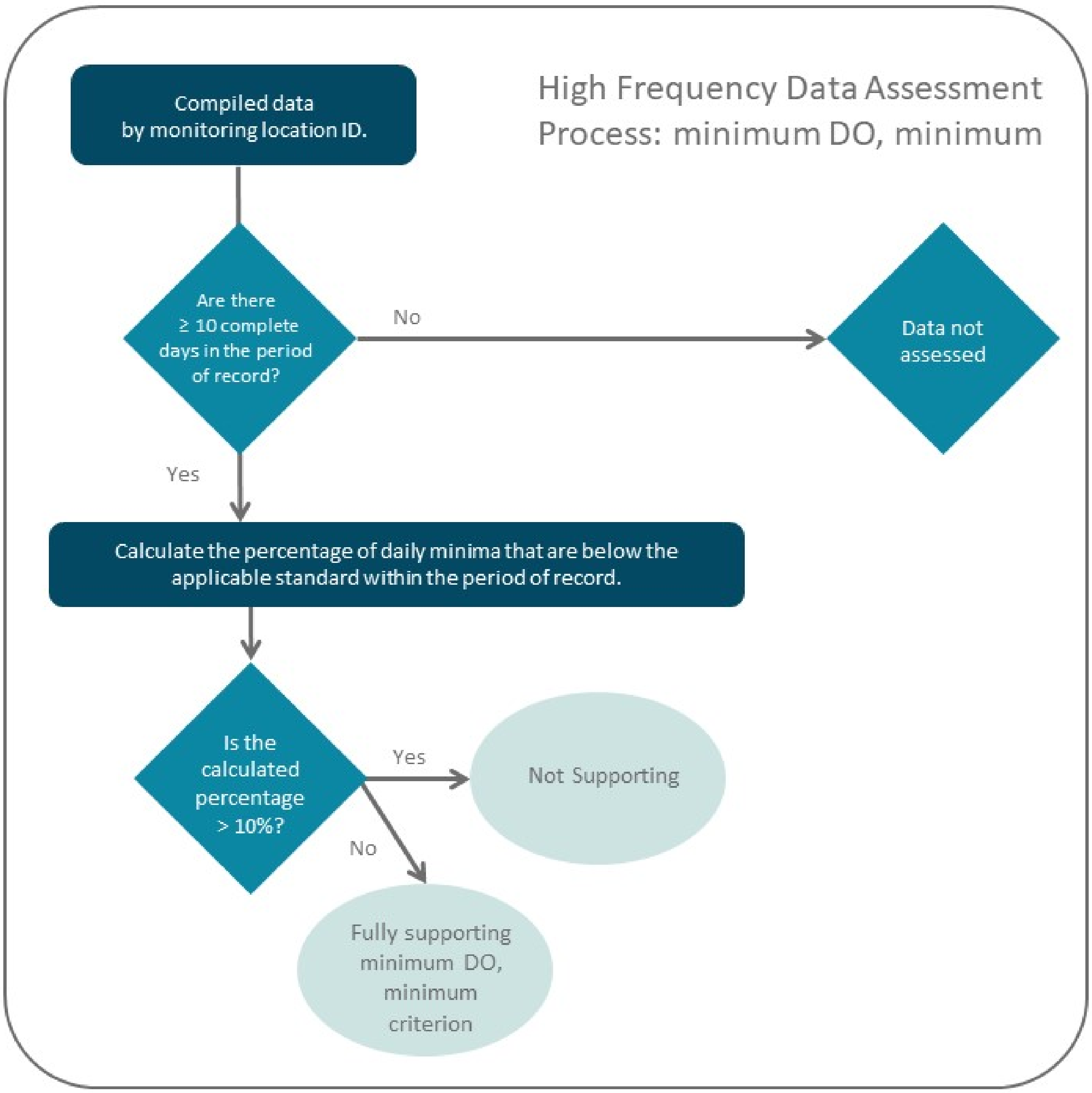

Figure 3. Overview of the assessment process for the minimum dissolved oxygen, minimum, using high frequency data.

A site does not meet the 7-day average criterion if the percentage of 7-day averages that fall below the applicable standard is greater than 10% within the period of record (Figure 4).

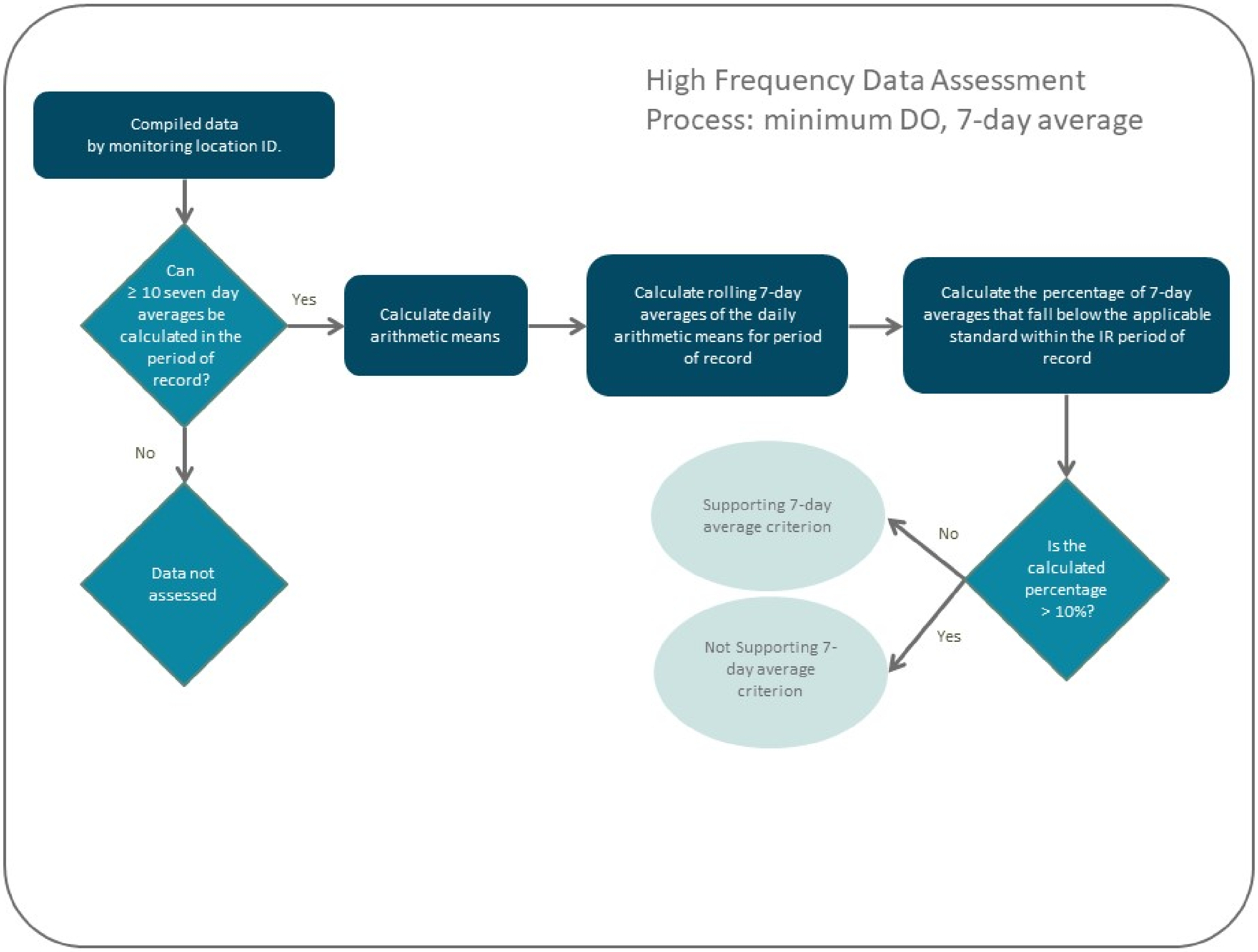

Figure 4. Overview of the assessment process for the minimum dissolved oxygen, 7-day averages using high frequency data.

A site does not meet the 30-day average criterion if the percentage of 30-day averages that fall below the applicable standard is greater than 10% within the period of record (Figure 5).

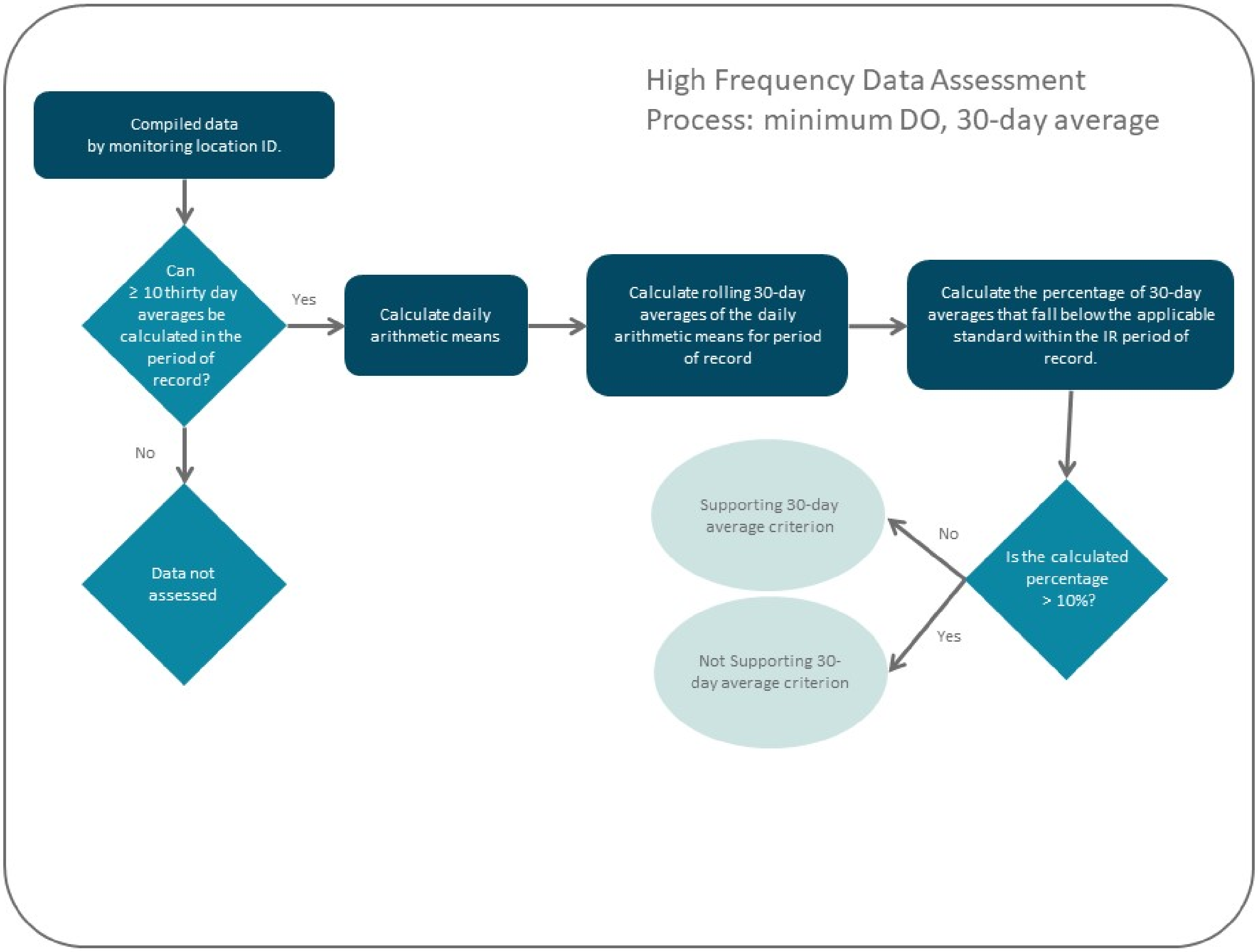

Figure 5. Overview of the assessment process for the minimum dissolved oxygen, 30-day averages, using high frequency data.

A site is considered not supporting if it is not meeting either of the daily minimum, 7-day average, or 30-day average criteria. A site is considered fully supporting if less than 10% violation is observed for all three criteria. This process (Figure 3 - Figure 5) is repeated until each beneficial use has been assessed.

Analyzing Multiple DO Datasets at a Site

DWQ assesses grab and high frequency data independently during the initial assessment of DO at a site and reviews these assessments in the context of one another during the secondary review for determining impairment. These processes are discussed in greater detail in Determinations of Impairment: All Assessment Units.

NUTRIENT ASSESSMENTS SPECIFIC TO HEADWATER STREAMS

Utah's Numeric Nutrient Criteria (NNC) require consideration of both ambient nutrient concentrations and ecological response data for headwater streams, which are defined as streams where antidegradation category 1 or 2 protections have been established (UAC R317-2-3). Generally, this includes streams above United States Forest Service (USFS) boundaries—about 50% of all perennial streams statewide

Support of Aquatic Life Uses

The NNC applicable to aquatic life include two thresholds for total nitrogen (TN) and total phosphorus (TP) based on the arithmetic average of a minimum of four samples obtained during the growing season (UAC R317-2-14.8). The growing season is defined by the NNC as the period of algal growth through senescence. For assessment purposes, DWQ assumes that the growing season includes the months of June through November, although this may be lengthened where additional information demonstrates that a longer period of growth is warranted.

The arithmetic average of TN or TP, derived from four or more growing season samples, is used to place headwater streams into one of three enrichment tiers (Table 12). Lower criteria thresholds of 0.4 mg/L TN and 0.035 mg/L TP differentiate between low and moderate enrichment streams. Higher thresholds of 0.80 mg/L TN and 0.080 mg/L TP differentiate between moderate and high enrichment streams. The higher of TN or TP enrichment tiers is used to determine whether or not nutrient enrichment has degraded aquatic life uses at a site.

Moderate enrichment streams, with average nutrient concentrations between the upper and lower thresholds, require additional measures of ecological condition to determine whether or not a headwater stream is attaining the NNC water quality standards (Table 12). Nutrients can degrade aquatic life uses via mechanisms related to increased growth of plants/algae (autotrophs) and/or microbes/fungi (heterotrophs). In the case of plant/algae growth, two ecological responses are not-to-be-exceeded at any headwater stream: (1) a daily gross primary production (GPP) rate higher than 6 g O_2/m^2/day or (2) an aerial percent filamentous algae cover exceeding 1/3 of the stream bed. Adverse heterotrophic responses are addressed using ecosystem respiration (ER), which measures the net metabolic activities of all stream biota and is used to understand linkages among microbes/fungi, nutrients, and aquatic life uses. NNC establishes a not-to-be-exceeded rate for ER of 5 g O_2/m^2/day. Any site where TN or TP falls between the NNC thresholds is categorized as not supporting its aquatic life uses if any of the three responses exceeds the adverse effect thresholds, even if a complete set of responses is not available (Table 13). However, a moderately enriched stream site must have all three response parameters collected and occurring below their adverse effect thresholds to obtain a full support assessment for the site. If any response parameters are unavailable despite other response parameter(s) meeting criteria, the site will be assessed as insufficient data (3A) and the division will prioritize the data collection necessary to make a site assessment.

Any site where the growing season average of both TP and TN falls below the lower NNC thresholds (lowest enrichment tier) is considered to be supporting aquatic life uses with respect to nutrient enrichment (Table 13) provided that all three ecological responses have been measured and fall below the threshold that demarcates degraded conditions. If any response parameters fall above their degraded condition threshold, the site will be assessed as impaired (Category 5)

At the other end of the enrichment gradient, any site where the average TN or TP concentration exceeds the upper NNC threshold (high enrichment tier) is categorized as threatened unless degradation is confirmed by an ecological response, in which case it is considered impaired (not supporting aquatic life uses). Threatened AUs are designated as category 5 due to highly enriched conditions, but the Division commits to more thoroughly evaluate the AU for adverse nutrient-related responses.

Table 12. Numeric Nutrient Criteria and Associated Ecological Responses (Bioconfirmation Criteria) to Protect Aquatic Life Uses in Antidegradation Category 1 and 2 (UAC R317-2-12) Headwater Perennial Streams.

Nutrient Enrichment Level	Summertime Average Nutrients		Ecological Response	Assessment Notes
Low	TN < 0.40[a,b]	TP < 0.035[a,b]		Fully supporting biological uses if the average of ≥ 4 summertime samples is below the specified nutrient concentration of either TN and TP unless ecological responses specified for moderate enrichment streams are exceeded. Sites with fewer samples will not be assessed for nutrients.
Moderate	TN 0.40–0.80[a]	TP 0.035–0.080[a]	Plant/Algal Growth[c]< 1/3 or more filamentous algae cover[d,e] OR GPP[c] of < 6 g O_2/m^2/day OR Plant and Microbial Growth ER[c] < 5 g O_2/m^2/day	Headwater streams within this range of nutrient concentrations will be considered impaired (not supporting for nutrients) if any response exceeds defined thresholds. Streams without response data will be listed as having insufficient data and prioritized for additional monitoring if either TN or TP falls within the specified range.
High	TN > 0.80[a,b]	TP > 0.080[a,b]		Streams over these thresholds will initially be placed on Utah's Section 303(d) list as threatened. Threatened streams will be further evaluated using additional data such as nutrient responses, biological assessments, or nutrient-related water quality criteria (e.g., pH and DO) both locally and in downstream waters.

Notes: Criteria would be applicable unless more restrictive total maximum daily load (TMDL) targets have been established to ensure the attainment and maintenance of downstream waters. DO = dissolved oxygen, ER = ecosystem respiration, GPP = gross primary production, TN = total nitrogen in mg/L, and TP = total phosphorus in mg/L.

[a] Seasonal average of ≥ 4 samples collected during the summertime growing season (June 1–September 30) will not be exceeded. Sites will be assessed using the higher of TN and TP threshold classifications.

[b] Response data, when available, will be used to assess aquatic life use support or as evidence for additional site-specific investigations to confirm impairment or derive and promulgate a site-specific exception to these criteria.

[c] Daily whole stream metabolism obtained using open-channel methods. Daily values are not to be exceeded on any collection event.

[d] Filamentous algae cover means patches of filamentous algae > 1 cm in length or mats > 1 mm thick. Daily values are not to be exceeded at any time during the growing season (June 1–September 30).

[e] Quantitative estimates are based on reach-scale averages with at least three measures from different habitat units (i.e., riffle, run) made with quantitative visual estimation methods.

[f] Excluded waters identified in UAC R317-2-13.2 (c).

Table 13. Decision Matrix That Will Be Used to Assess Support of Headwater Aquatic Life Uses for Nutrient-related Water Quality Problems

Nutrient Data (TN or TP)		Ecological Responses		
		No Data	< All Criteria	> Any Criterion
	No Data or < 4 Samples	Not Assessed[a]	Not Assessed[a]	Impaired (5)[b]
	< Low Threshold	Not Assessed[a]	Fully Supporting (1 or 2)[d,f]	Impaired (5)[b,e]
	Between Lower and Upper Threshold	Insufficient Data (3A)[c]	Fully Supporting (1 or 2)[d,g]	Impaired (5)
	Above Upper Threshold	Threatened (5)[f,]	Threatened (5)[e,f]	Impaired (5)

Note: Associated *Integrated Report* categories are in parentheses.
[a]There are insufficient nutrient-related data to assess whether or not aquatic life uses are supported; however, aquatic life uses may be assessed with other water quality parameters.
[b]Sites where an ecological response threshold has been exceeded, but the lower TN and TP thresholds have not will be listed as impaired on the basis of a biological assessment; cause will be listed as unknown pending follow-up investigations.
[c]Sites where TN or TP fall below the upper threshold, but above the lower threshold, and lack measures for at least one response variable will not be assessed with respect to nutrients. These sites will be prioritized for follow-up monitoring.
[d]The integrated report distinguishes between sites where at least one parameter has been evaluated for all uses (Category 1) and sites where some uses are supported, and other uses are either not supported or not assessed (Category 2).
[e]Sites where nutrient and ecological response data are in conflict may be candidates for site-specific criteria.
[f]Sites below the both lower TN and TP thresholds with at least one response below the lower threshold will be considered to be fully supporting aquatic life uses unless another nutrient-related criterion (e.g., pH, DO) suggests otherwise. Sites without at least one measured response are not assessed.
[g]Sites between the lower and upper threshold require all three response parameters to be considered fully supporting with respect to nutrient enrichment.

Support of Recreational Uses

Excessive nutrients can also degrade recreational uses. To protect these uses in headwater streams the NNC establish a not-to-be-exceeded benthic algae concentration of 125 mg/chlorophyll-a (chl-a)/m^2, or the equivalent 49 g ash free dry mass (AFDM)/m^2 (UAC R317-2-14.7).A site where any reach-scale biomass value exceeds either threshold will be categorized as not supporting recreational uses (Figure 7).

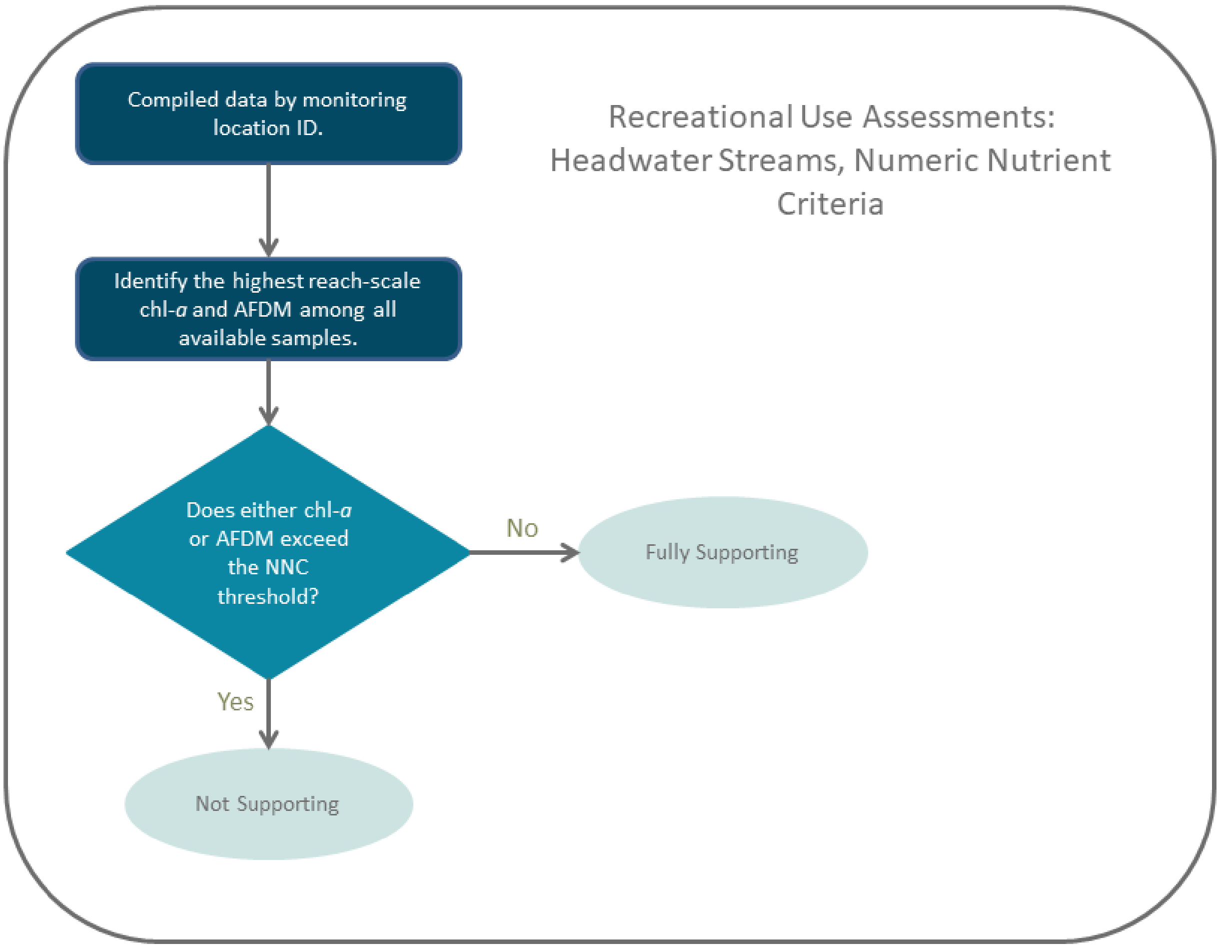

Figure 6. Overview of the assessment process to determine support of recreational life uses based on nutrient enrichment in headwater streams.

NARRATIVE STANDARDS: BIOLOGICAL ASSESSMENTS

Utah's beneficial uses for aquatic life require the protection of fish (cold water or warm water species) and the organisms on which they depend (UAC R317-2-6.3). DWQ historically assessed these beneficial uses using water chemistry sampling and associated standards that are protective of aquatic organisms. DWQ now uses an empirically based model that directly assesses support of aquatic life uses by quantifying the integrity of macroinvertebrate assemblages. Measuring biological communities directly has the advantage of integrating the combined effects of all pollutants, which allows a direct examination of how pollutants are interacting to affect the condition of a stream ecosystem (Karr,1981). Moreover, because aquatic macroinvertebrates spend most of their life in aqueous environments, they are capable of integrating the effects of stressors over time, providing a measure of past and transient conditions (Karr and Dudley,1981).

Biological assessments are often conducted by comparing the biological assemblage observed at a site with the expected biological assemblage. Ideally, these comparisons are made using historical data to measure changes to the current biological community. However, in most cases, historical data are not available. As a result, biological conditions representing least-human-caused disturbance are typically set using reference sites as benchmarks or controls. The biological integrity of sites can be evaluated by comparing the biological composition observed at a site against a subset of ecologically similar reference sites. Such comparisons are collectively referred to as biological assessments.

Reference sites in aquatic biological assessments are selected to represent the best available condition for waterbodies with similar ecological, physical, and geographical characteristics (Hughes et al.,1986; Suplee et al.,2005; Western Center for Monitoring and Assessment of Freshwater Ecosystems website). Conditions at reference sites selected for water quality programs vary regionally depending on adjacent historical land use. For example, reference sites in Utah mountains are generally more pristine than in valleys. As a result, there are more biological benchmarks in areas of the state that receive less-human-made disturbance than those with more disturbances.

A numeric index is a useful tool that quantifies the biological integrity, or biological beneficial use, of stream and river segments. Data obtained from biological collections are complex, with hundreds of species that vary spatially and temporally found throughout Utah. Similarly, the physical template on which biota depends also varies considerably across streams. A robust index of biological integrity should simultaneously account for naturally occurring physical and biological variability and summarize these conditions through a single, easily interpretable number (Hawkins, 2006; Hawkins et al. 2010).

River Invertebrate Prediction and Classification System Models

DWQ uses the River Invertebrate Prediction and Classification System (RIVPACS) model approach to quantify biological integrity (Wright, 1995). RIVPACS is a classification of freshwater sites based on macroinvertebrate fauna. It was first derived in 1977 and has subsequently been used in numerous biological assessment programs worldwide. In the early 1970s, scientists and water managers recognized a need to understand the links between the ecology of running waters and macroinvertebrate communities. A four-year project was initiated to create a biological classification of unpolluted running waters in Great Britain based on the macroinvertebrate fauna (Clarke et al.,1996; Furse et al.,1984; Moss et al.,1999; Wright,1995).

Over the past 30 years, equivalent RIVPACS models have been developed for aquatic ecosystems throughout the world, including Australia (Davies et al., 2000; Marchant and Hehir, 2002; Metzeling et al., 2002) and Indonesia (Sudaryanti et al., 2001). Additionally, scientists in the United States have developed RIVPACS models to assess the biological integrity of the country's aquatic habitats (Hawkins et al., 2000; Hawkins and Carlisle, 2001).

RIVPACS models compare the list of taxa that are observed (O) at a site to the list of taxa expected (E) with the least-human-caused disturbance for a similar site to quantify biological condition. Predictions of E are obtained empirically from reference sites that together are assumed to encompass the range of ecological variability observed among streams in the region where the model was developed. In practice, these data are expressed as the ratio O/E, the index of biological integrity (Figure 8).

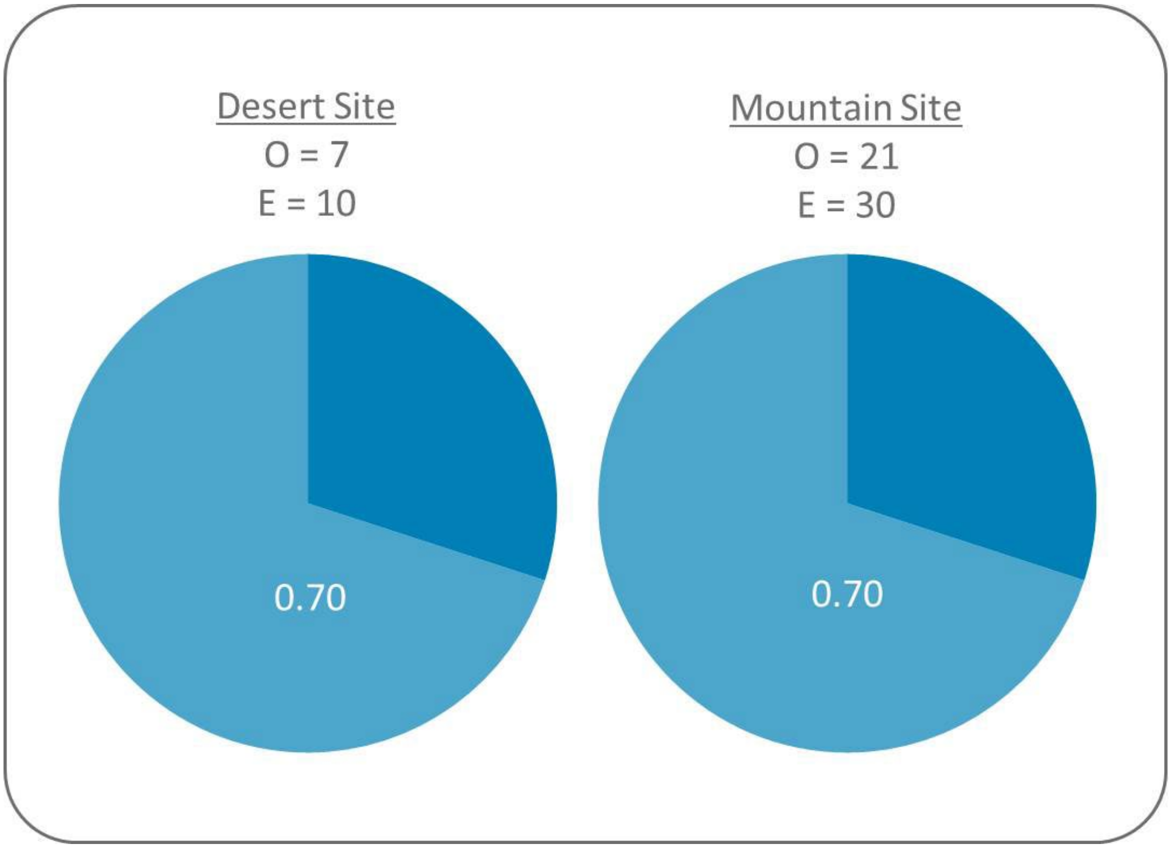

Figure 7. A hypothetical example of O/E as a standardization of biological assessments.

O/E has some very useful properties as an index of biological condition. First, it has an intuitive biological meaning. Species diversity is considered the ecological capital on which ecosystem processes depend; therefore, O/E can be easily interpreted by researchers, managers, policy-makers, and the public. Second, O/E is universally spatial, which allows direct and meaningful comparison throughout the state on a site-specific scale. This is particularly important for Utah, where streams vary considerably from high-altitude mountain environments to arid desert regions. Third, its derivation and interpretation do not require knowledge of stressors in the region as it is simply a biological measuring tool. Finally, the value of O/E provides a quantitative measure of biological condition.

Model Construction and Performance

Construction of a RIVPACS model for Utah began in 2002 and involved the development and evaluation of dozens of models. Details of model development procedures can be found elsewhere (Clarke et al.,1996; Moss et al.,1999; Wright et al.,1993; Wright1995). Additionally, specific detailed instructions can be viewed at the Western Center for Monitoring and Assessment of Freshwater Ecosystems website and there are numerous resources found online. DWQ's model was verified and reconstructed by the USU BugLab that can provide O/E output for samples if appropriate field and lab procedures were followed. A brief summary is provided here to help the reader better understand Utah's model results and subsequent assessments.

Predictions of expected “E” taxa are obtained empirically from reference site collections made throughout Utah. Reference sites represent the reference conditions in different biogeographical settings throughout the state. The initial list of candidate reference sites is independently ranked by different scientists familiar with the waterbodies. Only reference sites with a consensus representing best available conditions are used in model development. Subsequent reference sites are added using scores from reference-scoring metrics developed during site visits and averaged with independent rankings from field scientists.

Some of the calculations used to obtain the list of expected taxa are complex. A heuristic description of the steps involved in predicting “E” provides some context of the assessment methods. The first step in model development is to classify reference sites into groups of sites with similar taxonomic composition using a cluster analysis. Next, models are developed based on watershed descriptors such as climatic setting, soil characteristics, and stream size to generate equations that predict the probability of a new site falling within each group of reference sites. These equations account for environmental heterogeneity and ensure that when a new site is assessed, it is compared against ecologically similar reference sites. When a new site is assessed, predictions of group membership are then coupled to the distributions of taxa across groups of reference sites to estimate the probability of capturing (Pc) each taxon from the regional pool of all taxa found across all reference sites. E is then calculated as the sum of all taxa Pcs that had a greater than 50% chance of occurring at a site given the site’s specific environmental characteristics. Using a Pc limit set at greater than 50% typically results in models that are more sensitive and precise, which results in a better ability to detect biological stress (Hawkins et al., 2000; Simpson and Norris, 2000; Ostermiller and Hawkins, 2004; Hawkins, 2006; Van Sickle et al., 2007, Hawkins et al., 2015; Hawkins and Yuan, 2016; Mazor et al., 2016).

The accuracy and precision of RIVPACS models depend in part on the ability of the models to discriminate among groups of biologically similar reference sites. An extensive list of 74 GIS-based watershed descriptors is evaluated for potential predictor variables in models that predict the probability of membership within biological groups for sites not used in model construction. Site-specific, GIS-based predictor variables, such as soils, meteorology, and geography, instead of field-derived descriptors, are evaluated for a couple of reasons. First, GIS-based descriptors are unlikely to be influenced by human disturbance and are therefore unlikely to bias estimates of expected conditions (Hawkins, 2004). Second, these predictors are easily obtained for any location on a site-specific basis. This allows inclusion of additional macroinvertebrate samples collected by others. Various subsets of potential predictors are evaluated in an iterative, analytical process that explores different combinations of predictors to explain the biological variability among reference sites. The current RIVPACS model used by DWQ includes 15 variables that resulted in the most precisely predictive model (Table 13).

Table 14. Final predictor variables used in model construction.

General Category	Description
Geography	Mean watershed elevation (meters) from National Elevation Dataset
Geography	Minimum watershed elevation (meters) from National Elevation Dataset
Geography	Watershed area in square kilometers
Geography	Latitude of the sample location.
Climate	Watershed average of the mean day of year (1–365) of the first freeze derived from the PRISM data
Climate	Watershed average of the annual mean of the predicted mean monthly precipitation (millimeters) derived from the PRISM data
Climate	Watershed average of the annual maximum of the predicted mean monthly precipitation (millimeters) derived from the PRISM data

General Category	Description
Climate	Watershed average of the annual mean of the predicted mean monthly air temperature derived from PRISM data
Climate	Average of the annual mean of the predicted maximum monthly air temperature at the sample location derived from PRISM data
Climate	Watershed average of the annual mean of the predicted maximum monthly air temperature derived from PRISM data
Climate	Watershed average of the annual mean of the predicted minimum monthly air temperature derived from PRISM data
Climate	Watershed average of the annual mean of the predicted mean monthly relative humidity derived from PRISM data
Climate	Average of the annual mean of the predicted mean monthly air temperature at the sample location derived from PRISM data
Climate	Watershed maximum of mean 1961–1990 annual number of wet days
Vegetation	Watershed maximum of mean 2000–2009 annual enhanced vegetation index

The RIVPACS model used for the current assessments was reconstructed to accommodate broader spatial and temporal data. Models used earlier were limited to samples from streams ranging from second to fifth order and were collected during a fall window of September–November. The updated model accepts data collected from first- to eighth-plus-order rivers and streams with no limitations on season of collection. In addition, new predictor variables were tested, and new and updated reference site data were included. However, the taxon levels required adjustment to include data collected from agencies using different taxonomic laboratories. This resulted in a coarser resolution of taxonomy. However, the resulting model was capable of scoring nearly 1,800 samples collected across the state by various agencies.

The updated model is nearly as accurate and precise as previous models. If the model was perfectly accurate and precise, the O/E score for all reference sites would equal 1.00. Instead, reference O/E values are typically spread in a roughly normal distribution centered on 1.00 (Wright, 1995). Model precision is often expressed as the standard deviation (SD) of reference O/E values, with lower SDs indicating higher model precision. The RIVPACS model used for the current IR assessments has an SD of 0.19, which is within the range of “accepted” water quality models. The precision was likely affected by the coarser resolution of taxonomy and the inclusion of a few large river sites as reference. The average reference O/E score for the current model is 1.00, which means that the model has high precision calculating O/E values. The accuracy of the model was evaluated by examining the distribution of reference O/E scores across environmental settings and determining that reference O/E values are not biased by stream size, elevation, or ecoregion.

Assessing Biological Use Support

DWQ does not have numeric biological criteria. However, DWQ has narrative biological criteria (UAC R317-2-7.3) that specify how quantitative model outputs are used to guide assessments. A systematic procedure to make the narrative assessments as rigorous as possible was devised to use the RIVPACS model O/E values to determine aquatic life beneficial use support (Figure 9). The goal of this assessment process is to characterize each AU as fully supporting or not supporting aquatic life beneficial uses.

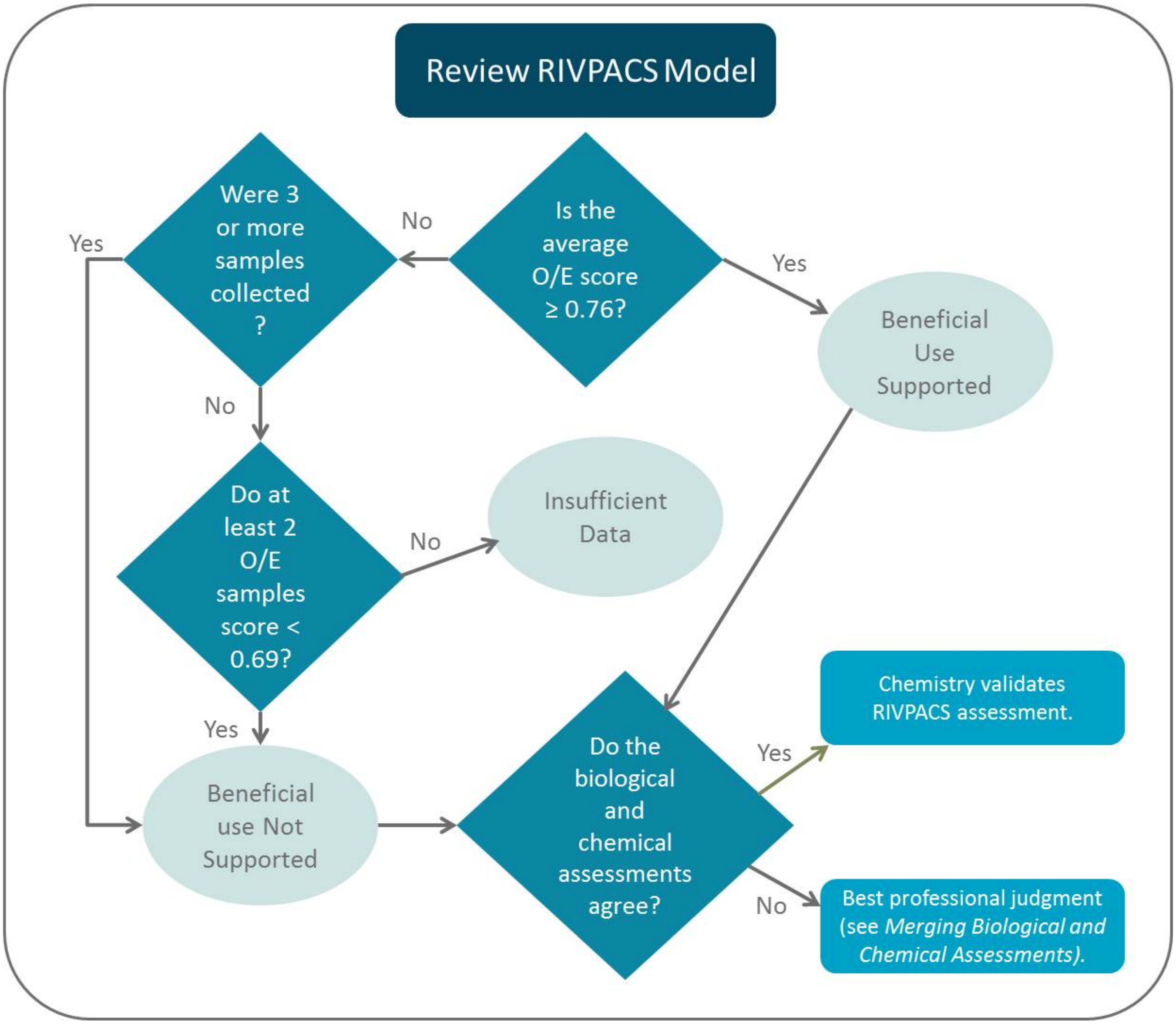

Figure 8. Decision tree for making biological assessment decisions.

Utah currently assesses watersheds based on established AUs. Although many AUs contain a single biological monitoring location, some AUs contain multiple sites. In such instances, DWQ staff examines available data to determine if multiple sites in an AU score similarly. When comparisons suggest that sites in one AU are ecologically similar, O/E scores from all sites in an AU are averaged for assessment purposes, provided that conclusions of biological condition are similar. If O/E scores differ appreciably among multiple sites in an AU, DWQ will investigate possible explanations for such discrepancies (see the Assessment Unit Re-segmentation discussion for more information on that process). Additionally, if only one site is sampled in an AU, it is examined to determine whether it is an appropriate representation of the AU.

To translate the O/E values into assessment categories, it is necessary to devise thresholds, or O/E scores that indicate whether or not a site is meeting biological beneficial uses (Table 14). The 10th and 5th percentiles of reference sites were used for these assessments. Essentially, the data used for the current assessment calculate the threshold based on 5th percentile at 0.69, whereas the 10th percentile is 0.76. These thresholds will provide the bounds according to sample strength. The data will be averaged across six years since the most recent year of available data. Multiple years are preferred for assessments because O/E scores can vary from year to year and assessments are based on average conditions. Assessments based on the average condition of three or more samples reduce the probability of making an error of biological beneficial-use support as a result of an unusual sampling event (e.g., following a flash flood, or a sample that was preserved improperly).

Table 15. Beneficial use support determination for O/E values obtained from different sample sizes.

Sample Size	O/E Threshold	Use Determination	Comments
≥ 1 sample collected over 6 years	Mean O/E score ≥ 0.76	Fully Supporting	Threshold based on 10th percentile of reference sites
≥ 3 samples collected over 6 years	Mean O/E score < 0.76	Not Supporting	Threshold based on 10th percentile of reference sites
< 3 samples	Mean O/E score ≥ 0.69–≤ 0.76	Insufficient Data	Lower threshold based on 5th percentile of reference sites
< 3 samples	2 O/E scores < 0.69	Not Supporting	Threshold based on 5th percentile of reference sites
< 3 samples	< 2 O/E scores < 0.69	Insufficient Data	Threshold based on 5th percentile of reference sites

AUs not meeting biological thresholds will be assessed as not supporting. Assessments of more than three samples with average O/E scores of greater than or equal to 0.76 have a low probability of being misclassified as nonsupport. Alternatively, assessments with fewer than three samples with an average O/E score of less than 0.69 have a 5% probability of being misclassified as nonsupport. To ensure that one sample was not incorrectly misapplied, at least two samples with a score of 0.69 or less will be required to consider an AU not meeting the aquatic life use. Assessments with fewer than three samples that have a mean O/E score of greater than or equal to 0.69 and less than 0.76 will be placed in Category 3 (insufficient data and information with exceedances), which indicates that there are insufficient data to make an assessment. All sites listed as Category 3 with exceedances will be given a high priority for future biological monitoring.

Assessments Specific to Lakes, Reservoirs, and Ponds

ASSESSMENT OVERVIEW

Lakes, reservoirs, and ponds are classified by basin in UAC R317-2-13.12, with the accompanying tables listing their designated beneficial uses. Waterbodies not specifically listed are assigned beneficial uses by default to the classification(s) of the tributary stream(s). Numeric water quality criteria for both toxic and conventional parameters are assigned for each designated use in UAC R317-2-14, Deeper lakes naturally stratify thermally, which affects how conventional water quality parameters are assessed (UAC R317-2-14),so each waterbody is evaluated for thermal stratification and assessed appropriately.

Utah lake and reservoir assessments are divided into two tiers:

Tier I

The Tier I assessment is the preliminary determination of beneficial use support for recreational use (Class 2), aquatic life (Class 3), and agricultural (Class 4), classes based on conventional parameters such as DO, temperature, and pH, toxic parameters, and *E. coli*. When Tier I data are not available, DWQ may rely on Tier II data to make an initial assessment. The waterbody will be classified as mixed or stratified based on the depth profile information when considering aquatic life use support within this tier. If it is a stratified waterbody, the evaluation of conventional parameters will follow the protocol designed to evaluate the sufficiency of aquatic life habitat. If the waterbody is mixed, it will follow the assessment protocol that evaluates the entire depth profile.

Tier II

The Tier II assessment looks further into specific weight of evidence criteria (trophic state index [TSI], fish kills, and algal composition) through secondary reviews. The Tier I preliminary support status may be modified through evaluation of the TSI, water quality related fish kills, and the composition and abundance of cyanobacteria, also known as harmful algal blooms. The Tier II evaluation could adjust the preliminary support-status ranking if at least two of the three criteria indicate a different support status.

TIER I ASSESSMENT

Drinking Water Use Support

Drinking water use support is assessed through evaluations of pH, toxics, *E. coli*, and harmful algal blooms (HABs). Please review the Toxics Parameter Assessments for All Waters, *Escherichia Coli* Assessment for All Waters, and Harmful Algal Blooms (HAB) assessment sections for further information regarding drinking water use assessments for toxics, *E. coli,* and HABs. The evaluation process of pH is the same as the requirements for aquatic life uses described below.

Recreational Use Support

Recreational use support is assessed through evaluation of pH, *E. coli*, and HABs. The pH evaluation is the same as the requirements for aquatic life uses described below. Please review the *Escherichia Coli* Assessment for All Waters and HAB assessment sections for further information regarding recreational use assessments for *E. coli* and HABs.

Aquatic Life Use Support

Lake monitoring routinely involves collecting pH, temperature, and DO measurements at approximately one-meter intervals throughout the water column from the surface to the lake bottom. (Note: the measurement interval may be modified in the field depending on waterbody depth). These water column measurements are compared against Utah water quality standards to assess beneficial use support (Figure 10). A separate process is used to determine whether sufficient habitat is available for aquatic life for waterbodies that are thermally stratified (Figure 11).

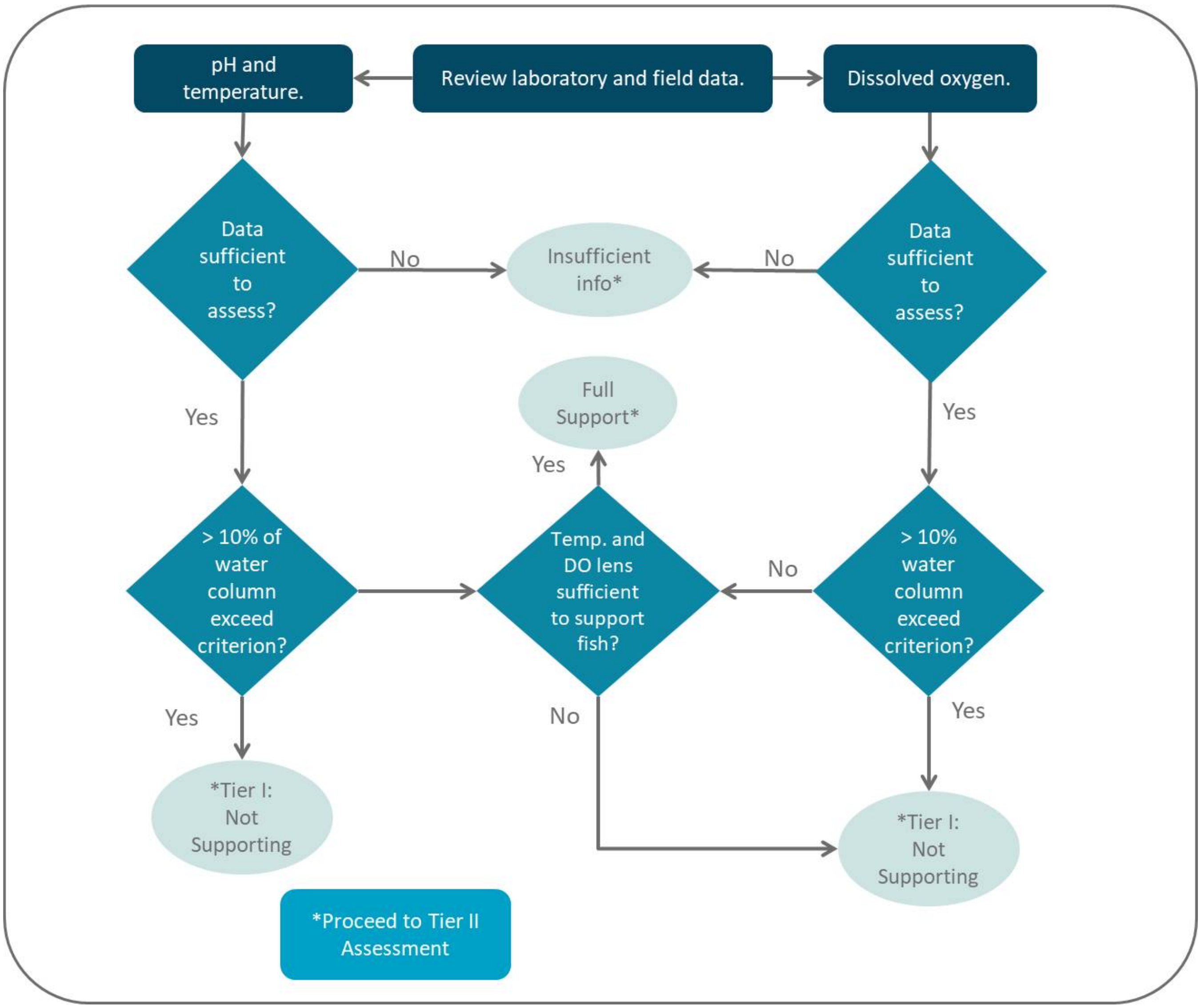

Figure 9. Process using conventional (nontoxic) parameters to assess lakes that are mixed.

pH, All Lakes and Reservoirs

Beneficial Use Supported

The beneficial use is supported if the number of violations are less than or equal to 10% of the measurements (see Figure 11, Panel A).

Beneficial Use Not Supported

The beneficial use is not supported if greater than 10% of the measurements (minimum of two discrete measures outside thresholds) violate the pH criterion (Figure 11, Panel B).

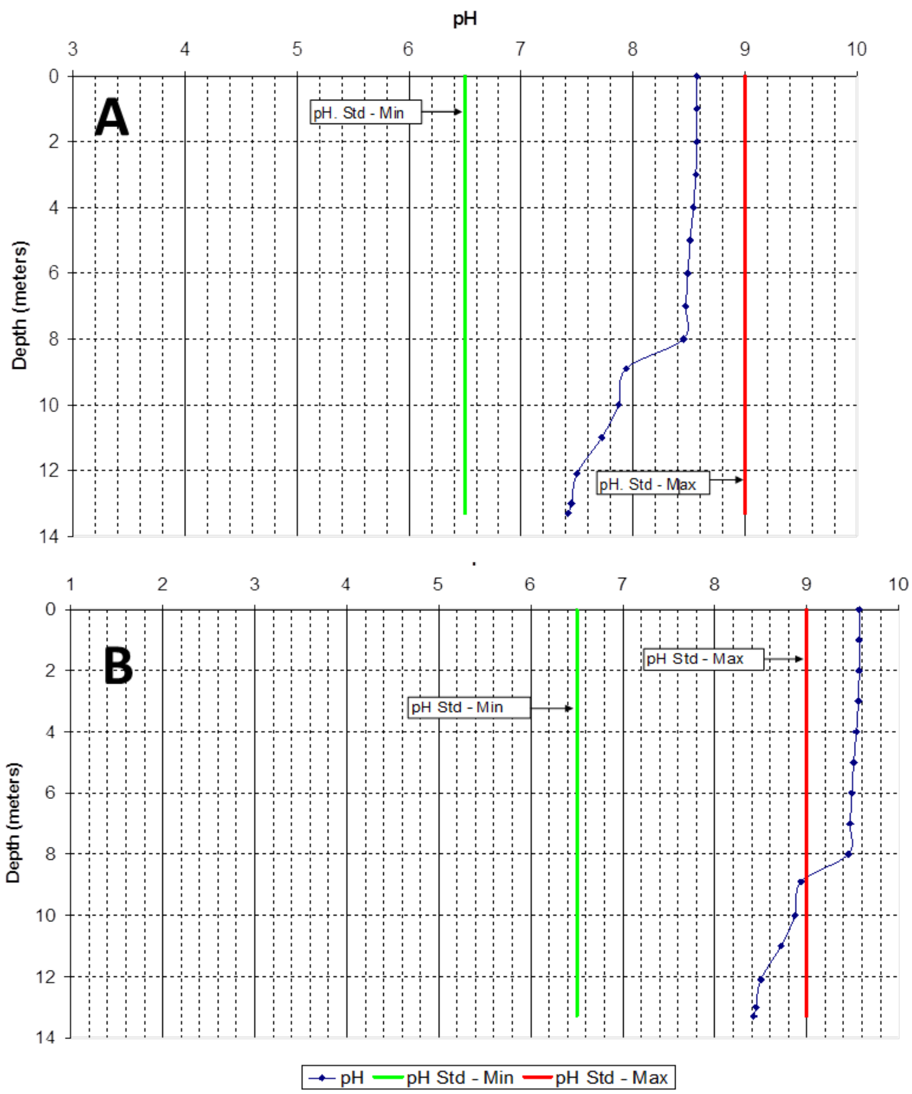

Figure 10. Plots of pH measurements (blue dots) against lake depth for a waterbody meeting (Panel A) and violating (Panel B) the pH water quality standards.

Temperature and Dissolved Oxygen, Mixed Lakes and Reservoirs

Temperature

The criteria used to assess the beneficial use support are based on profile data. If the temperature criterion is exceeded in more than 10% of the measurements, with a minimum of two discrete measures exceeding criteria from any individual sampling event, the site is considered to be not supporting of aquatic life uses.

Beneficial Use Fully Supported

The beneficial use is supported if the number of violations is less than or equal to 10% of the measurements (see Figure 12, Panel A).

Beneficial Use Not Supported

The beneficial use is not supported if more than 10% of the measurements violate the temperature standard (see Figure 12, Panel B).

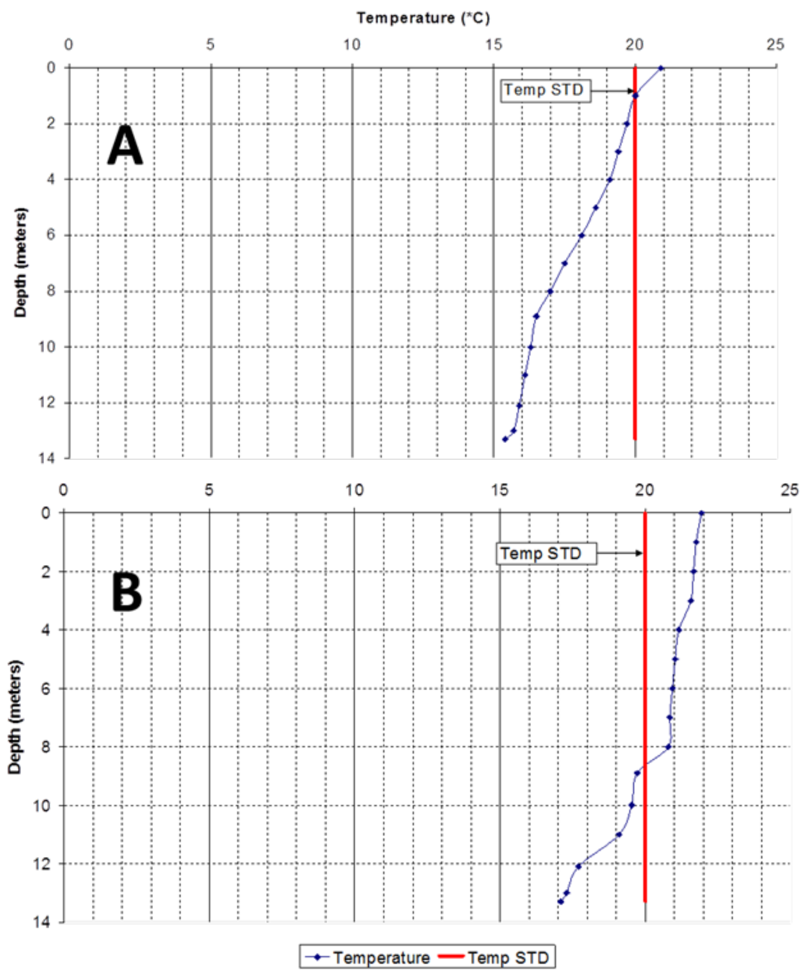

Figure 11. Plots of temperature measurements (blue dots) against lake depth for two sites to provide an example of assessment procedures. Note: The red line illustrates a temperature criterion of 20 degrees Celsius: Class 3A beneficial use. Panel A (top) illustrates a site supporting the beneficial use because less than 10% of the temperature measures are greater than the criterion, whereas Panel B (bottom) illustrates a site not supporting the beneficial use because greater than 10% of the temperature measures exceed the criterion.

Dissolved Oxygen

The DO assessment uses data gathered from profiles. The DO assessment uses the minimum criteria of 4.0 mg/L for Class 3A waters and 3.0 mg/L for Class 3B and 3C waters (UAC R317-2-14, Table 2.14.2). State standards account for anoxic or low DO conditions that may exist in the bottoms of deep waterbodies (UAC R317-2-14). For that reason, DO assessments for stratified lakes and reservoirs follow the stratified lakes and reservoirs assessment methods below.

Beneficial Use Supported

The beneficial use is supported if at least 90% of the oxygen measurements are greater than the standard.

Beneficial Use Not Supported

The beneficial use is not supported if greater than 10% of the oxygen measurements are below the DO standard during any single sampling event.

Stratified Lakes and Reservoirs

Temperature and Dissolved Oxygen: Aquatic Life Use Assessment

When sample locations demonstrate stratification, a separate assessment technique for temperature and DO is used to ensure that sufficient habitat for aquatic life exists. Habitat is considered sufficient if at least three continuous meters of the water column are meeting the criteria for both temperature and DO. The rationale for a conclusion of beneficial use support based on the existence of adequate habitat follows the decision diagram (Figure 13). Figure 14 provides an example of supporting and not supporting beneficial uses based on the DO and temperature data above the thermocline.

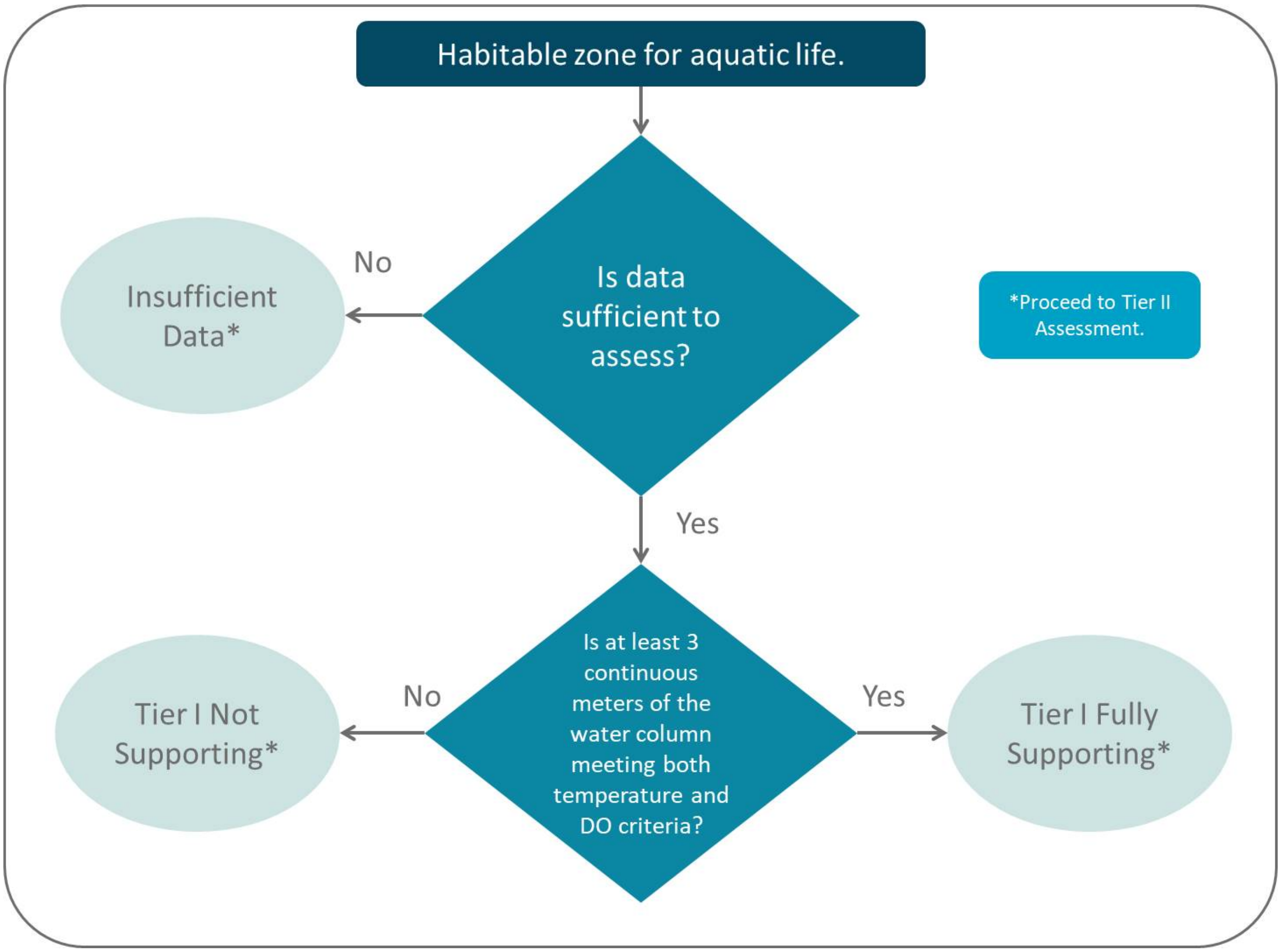

Figure 12. Beneficial use support based on the existence of adequate habitat.

Beneficial Use Supported

The beneficial use is supported if there is sufficient habitat, defined as three continuous meters of the water column meeting the criteria for both temperature and DO.

Beneficial Use Not Supported

The beneficial use is not supported if there is insufficient habitat for aquatic life based on the DO and temperature profile.

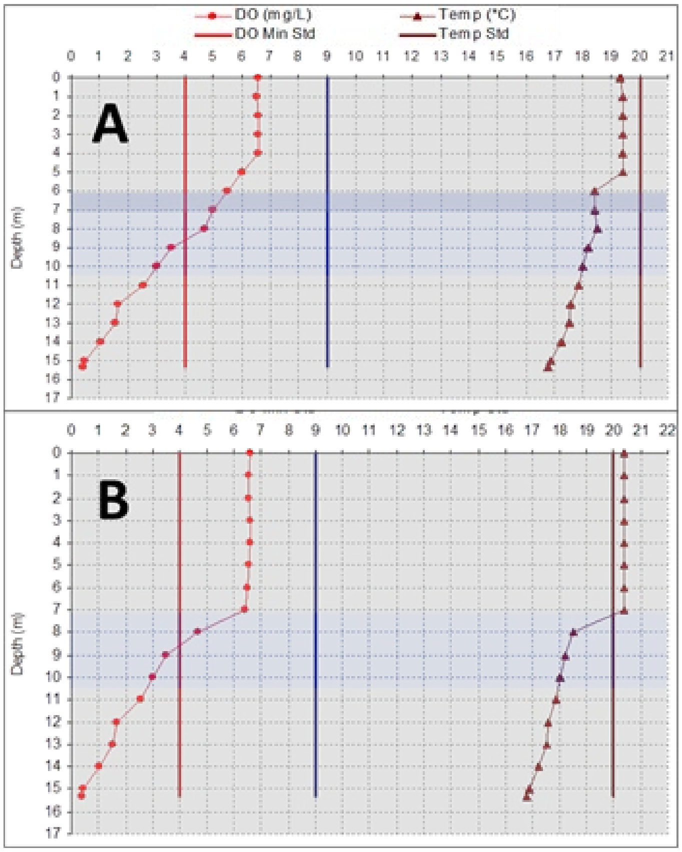

Figure 13. Concept of the habitable zone where both DO and temperature are suitable for aquatic life. The site depicted on the top (Panel A) would be considered supporting because the lens where both temperature and DO provide sufficient habitat is greater than three continuous meters (>=3 m). Conversely, the site on the bottom (Panel B) is not supporting aquatic life uses because although there are regions in the water column where dissolved oxygen and temperature criteria are met separately, the region of overlap in the water column for both temperature and dissolved oxygen criteria (approximately 8 meters depth) is less than three meters.

Total Dissolved Solids: Agricultural Use Support

The following rules are used to determine whether a lake is supporting its agricultural beneficial use (Figure 15):

Beneficial Use Supported

The beneficial use is supported if the standard is exceeded in 10% or fewer of TDS samples.

Beneficial Use Not Supported

The beneficial use is not supported if the TDS standard is exceeded in more than 10% of TDS samples.

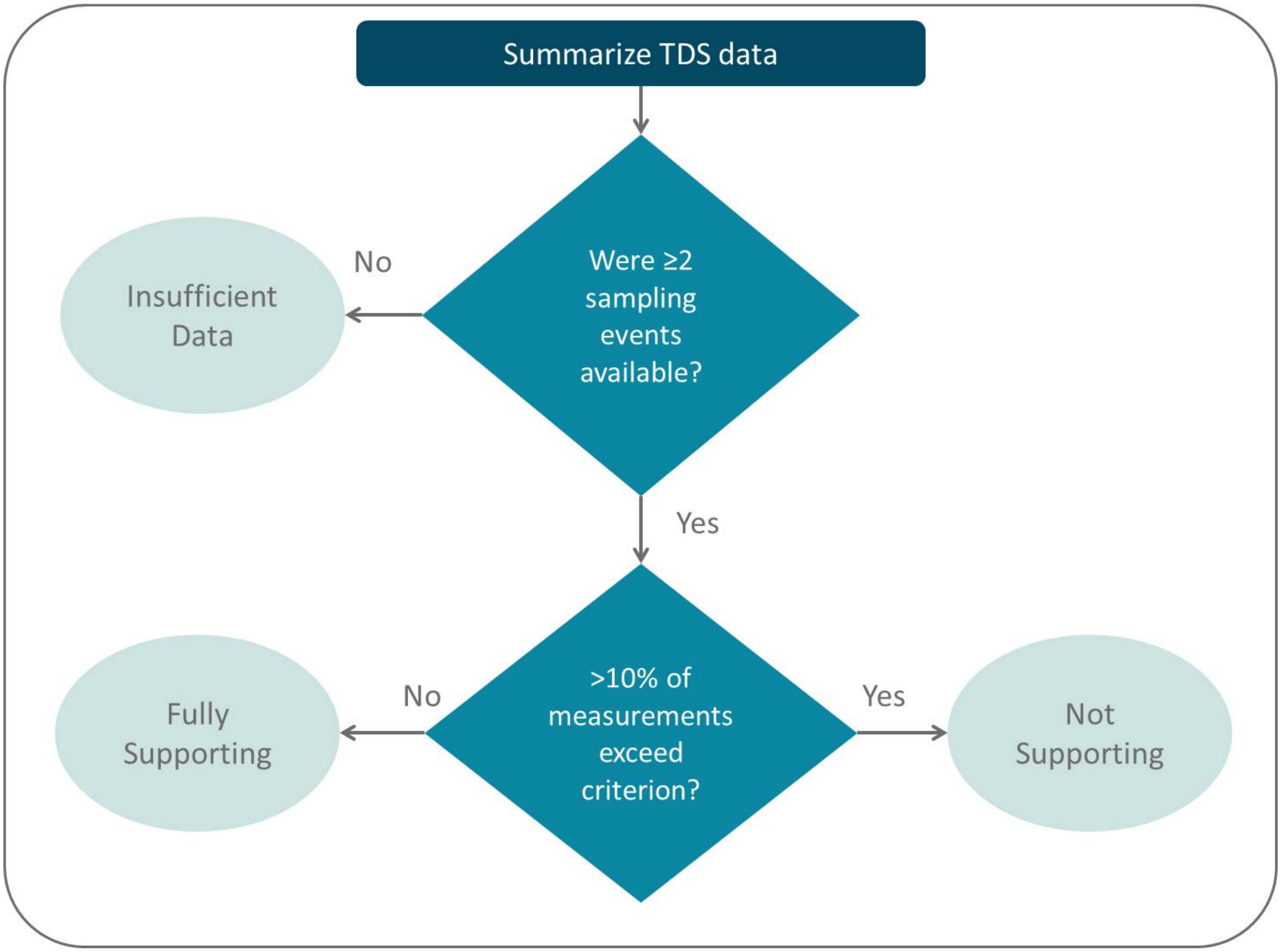

Figure 14. Assessment process to determine support of the agricultural beneficial use with TDS data.

TIER II ASSESSMENT

Weight of Evidence Criteria

The weight of evidence criteria allows DWQ to use key lines of evidence for assessing a waterbody's beneficial use support, including evaluations of Utah's narrative standard.

The weight of evidence evaluation consists of three components:

- Increasing trophic state index (TSI) trend over the long term (approximately 10 years) or a TSI-Chl-a greater than 50 (see Carlson's Trophic State Index section below for more information)
- The observation of water quality based fish kills (see the Narrative Standards for All Waters for more information) or winter DO measures not meeting the criterion when measured
- Evaluation of phytoplankton community

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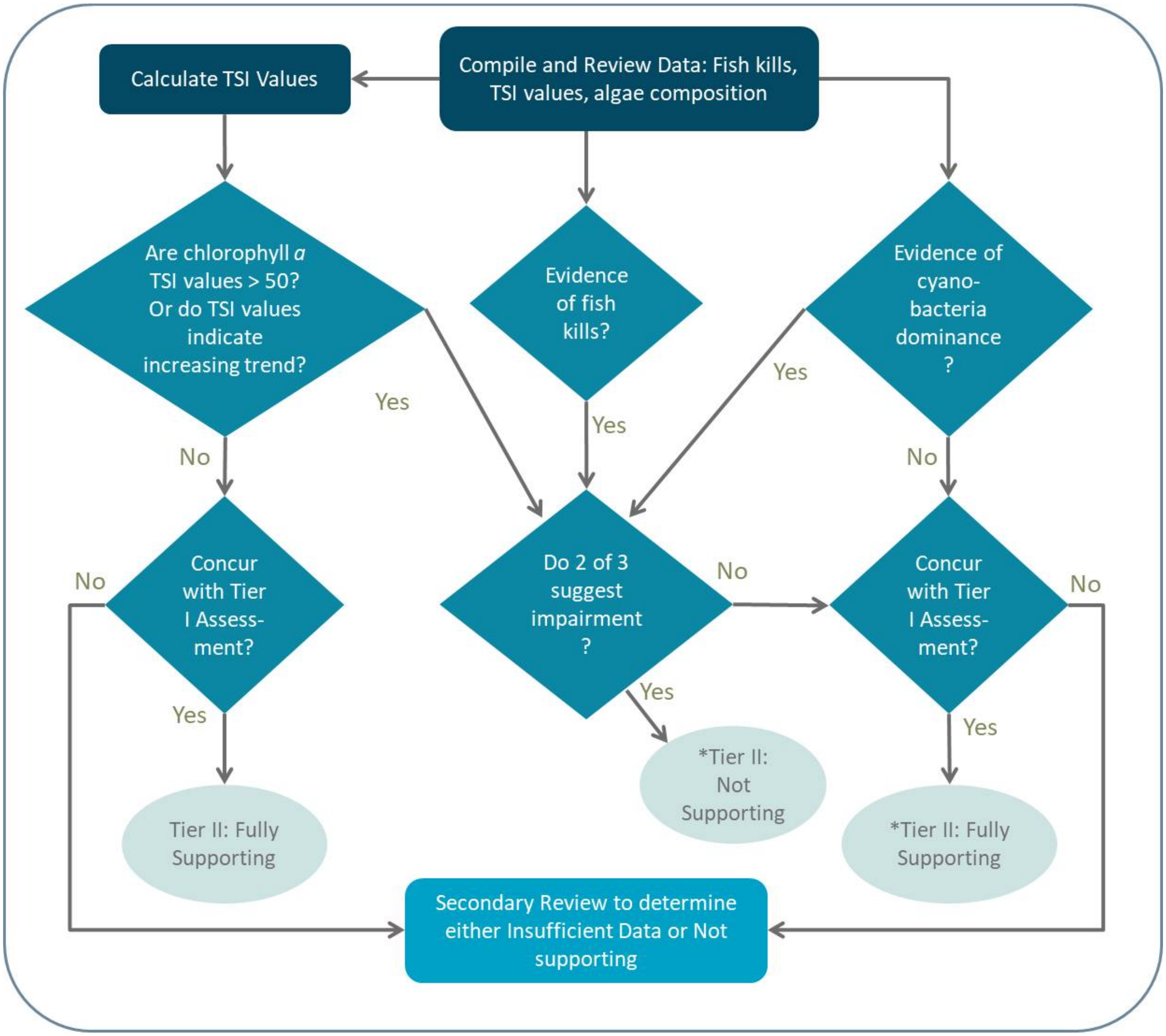

Figure 15. Tier II assessment process for lakes, reservoirs, and ponds.

Carlson's Trophic State Index

The Carlson's TSI is calculated using Secchi disk transparency, total phosphorus, and chlorophyll a. TSI value ranges from 0 to about 100, with increasing values indicating a more eutrophic condition. TSIs are calculated independently for each indicator (i.e., Secchi disk, chlorophyll a, and total phosphorus) and are not averaged. Chlorophyll a (TSI-Chl-a) is generally considered the most reliable indicator of trophic status, followed by Secchi disk (TSI-SDD), and total phosphorus (TSI-TP) (Carlson, 1977).

Carlson's TSI estimate for chlorophyll a is calculated using the following equation:

- Trophic status based on Chlorophyll a (TSI-Chl-a): TSI-Chl-a = 9.81 ln (Chl-a) + 30.60, where Chl-a = chlorophyll a concentrations in µg/L.

Phytoplankton Community

DWQ routinely collects phytoplankton to evaluate the composition and relative abundance of algae and cyanobacteria. These data are used to identify waterbodies potentially undergoing cultural eutrophication that may negatively impact beneficial uses. Phytoplankton data are used in the Tier II assessment process because they may reflect nutrient availability and nutrient ratios. The observation that a waterbody has a diverse assemblage of diatoms or green algae relative to cyanobacteria or other potentially harmful taxa is used as a line of evidence that the waterbody is supporting its designated uses. In contrast, a phytoplankton assemblage dominated by cyanobacteria may be indicative of eutrophication, an increased potential for harmful algal blooms, and a loss of aquatic biodiversity.

GREAT SALT LAKE

The Great Salt Lake (GSL) is assigned its own beneficial use class (Class 5) and is further divided into five subclasses (5A–5E) that represent the four main bays (Gilbert, Gunnison, Bear River, and Farmington) and transitional waters (UAC R317-2-6). The only numeric water quality criterion currently applicable to GSL is a selenium bird- egg tissue criterion for Gilbert Bay (Class 5A). The beneficial uses of GSL are protected and assessed by Utah's narrative water quality standard (UAC R317-2-7.2) in addition to this criterion. The Great Salt Lake Water Quality Strategy outlines the process for monitoring and criteria development for GSL.

Gilbert Bay Bird-Egg Tissue Assessment

Bird eggs are collected annually during each nesting season from representative locations within the Gilbert Bay AU or adjacent transitional wetlands (UAC R317-2-6.5). Selenium concentrations from eggs collected each year are assessed against the criterion in UAC R317-2-14. Gilbert Bay's beneficial use will be identified as impaired if the geometric mean of selenium concentrations from five or more eggs collected in any year exceeds the 12.5 mg/kg criterion. If the geometric mean of selenium concentrations from five or more eggs collected in any year exceeds 9.8 mg/kg dry weight, DWQ will identify Gilbert Bay's beneficial use as threatened and initiate preliminary TMDL studies to evaluate selenium loading sources. If Gilbert Bay is identified as impaired for selenium, five consecutive nesting seasons meeting selenium criteria will be considered sufficient for delisting the impairment.

The Gilbert Bay selenium criterion also includes thresholds below 9.8 mg/kg that trigger management actions (Table 15). DWQ evaluates egg concentrations against these thresholds to inform management decisions, but these thresholds are not used for use attainment determinations in the IR.

Eggs are also collected as part of discharge monitoring programs for certain dischargers to GSL. Eggs collected as a part of these programs are specifically intended to characterize discharge outfall conditions and are therefore not relevant to assessing more general GSL conditions. Eggs collected under these programs are only used for evaluating discharge permits and are not used in 303(d) assessment of the GSL AUs.

Table 16. Selenium trigger levels and DWQ responses (UAC R317-2-14.2(14)).

Se concentration (mg/kg dry weight)	DWQ Response
< 5.0	Routine monitoring with sufficient intensity to determine if selenium concentrations within the Great Salt Lake ecosystem are increasing
5.0	Increased monitoring to address data gaps, loadings, and areas of uncertainty identified from Great Salt Lake selenium studies
6.4	Initiation of a Level II Antidegradation Review (ADR) by the State for all discharge permit renewals or new discharge permits to Great Salt Lake. The Level II ADR may include an analysis of loading reductions.

Se concentration (mg/kg dry weight)	DWQ Response
9.8	Aquatic life use declared as threatened. Initiate preliminary TMDL studies to evaluate selenium loading sources.
12.5	Aquatic life use declared as impaired. Formalize and implement TMDL.

Toxics Parameter Assessments for All Waters

DWQ identifies toxics as all parameters within UAC R317-2-14 that are not defined as conventional parameters (see Table 11 and the Lakes, Reservoirs, and Ponds Assessment section).

Data are compared against one or more toxic criteria, depending on the beneficial use, to ensure protection of designated beneficial uses. One daily measurement at each monitoring location is compared to the chronic and/or acute criteria for 303(d) assessment purposes. DWQ targets dissolved metals sample collection in lakes at one meter above the bottom of the deepest site of the waterbody, as this location is the most likely to identify dissolved metal exceedances in a lake. Dissolved metals are also assessed through this method when additional metals data are available for other lake locations or depths. The acute and chronic averaging periods defined in UAC R317-2-14 are not currently applied for 303(d) assessment analysis because monitoring and sampling frequencies are different and more widely spaced than the acute and chronic periods typically defined in this rule.

EQUATION-BASED TOXIC PARAMETERS

A number of toxic criteria are specified as equations rather than specific values (see footnotes in UAC R317-2-14). The equations include variables of other chemical constituents or water properties that either reduce or magnify the extent to which a toxic is harmful to aquatic life. In order to properly apply the correction factor equations, DWQ uses measured data for the variables in the equation to calculate the appropriate numeric criteria for the sample. In order to calculate the correct criterion for a pollutant-result value, the monitoring location site and date of sample must match for the pollutant of concern and the additional parameter(s) that are needed to complete the equation. In the case where there are missing supplemental data values to apply the equation, the following rules will be applied.

- **Hardness-dependent toxics:** For hardness-dependent criteria where a calcium (Ca) or magnesium (Mg) value is missing and the hardness cannot be calculated, a hardness value reported from the laboratory will be used. Data without a hardness value are removed from assessments.
-
- **Aluminum, chronic only:** If either a field pH or calculated or laboratory hardness is missing, the aluminum acute default value of 750 microgram per liter (µg/L) provided in Table 2.14.2 of UAC R317-2 will be applied. Otherwise, the following pH and hardness combination and numeric criteria are applied:

  a. pH ≥ 7.0 and (calculated or laboratory reported) hardness ≥ 50 parts per million (ppm): 750 µg/L
  b. pH < 7.0 and (calculated or laboratory reported) hardness ≥ 50 ppm: 87 µg/L
  c. pH ≥ 7.0 and (calculated or laboratory reported) hardness < 50 ppm: 87 µg/L
  d. pH < 7.0 and (calculated or laboratory reported) hardness < 50 ppm: 87 µg/L

- **Ammonia, chronic:** DWQ assumes fish early life stages are present at all monitoring locations. The following equation is used: ((0.0577/(1+107.688-pH)) + (2.487/(1+ 10pH-7.688))) * MIN (2.85, 1.45*100.028*(25-T)).Where (1.45*100.028*(25-T)) is ≤ 2.85, (1.45*100.028*(25-T)) is applied and if (1.45*100.028*(25-T)) is > 2.85, 2.85 is applied. However, if a field pH or temperature reading is unavailable, a correction factor cannot be made and the result value for ammonia will be removed from the assessment.
-
- **Ammonia, acute**: If a field pH is missing, a correction factor cannot be made, and the result value for ammonia will be removed from the assessment.

ASSESSMENT PROCESS

Once chronic and acute criteria are calculated, toxicant sampling results, where applicable, are compared to the criteria to determine if the monitoring location is supporting beneficial uses or is impaired due to exceedances of the standard. Sites with sufficient data (four or more samples) with two or more exceedances of the acute and/or chronic criteria will result in non-support of the beneficial use. Four or more samples will be required with one or zero samples exceeding acute or chronic criteria for sites to meet beneficial uses. In cases where there are fewer than four samples, and one or zero samples are exceeding the acute or chronic criteria, sites will be placed in Category 3, insufficient data (Figure 17).

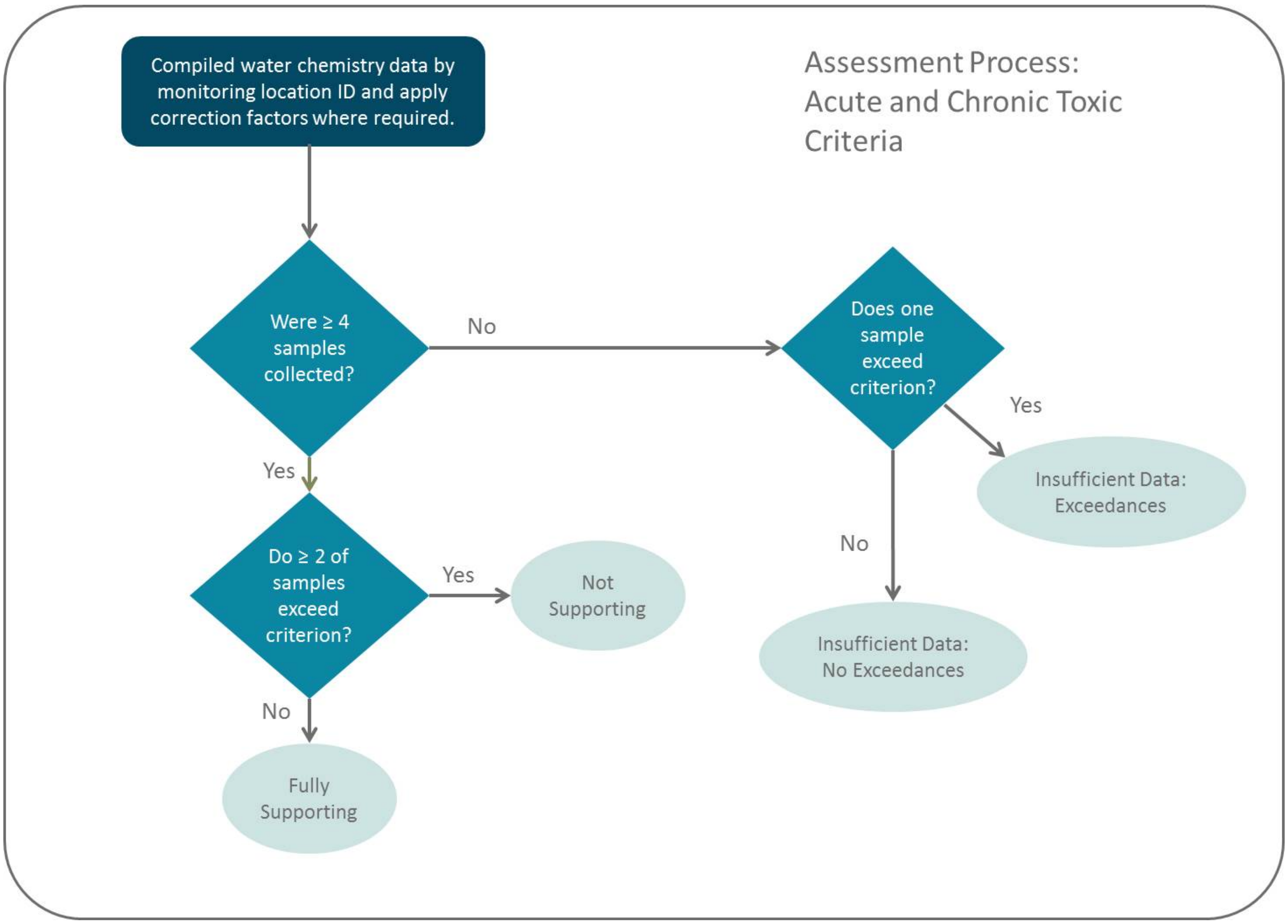

Figure 16. Overview of the assessment process for toxic parameters.

Escherichia Coli Assessment for All Waters

DATA PREPARATION

Following a credible data review and additional QA/QC checks as outlined in DWQ's Quality Assurance Program Plan for Environmental Data Operations (DWQ, 2014), DWQ compiles all credible data within the period of record of concern and makes several adjustments based on the reported limits and sampling frequencies necessary to conduct the assessment. Similar to the other QA/QC and assessment procedures outlined in this document, the raw data and accompanying metadata values in *Escherichia coli (E. coli)* datasets are not altered. Instead, DWQ uses a series of database comments and flags.

Recreation Season

To ensure protection of recreation uses, *E. coli* assessments will be conducted on data collected during the recreation season from May 1 through October 31. The recreation season may be adjusted to be either longer or shorter based on site-specific conditions. Any site-specific adjustments made to the recreation season will be documented.

Escherichia coli Collection Events and Replicate Samples

Datasets at a single monitoring location may contain replicate samples or multiple samples collected in the same day due to sampling design. Single daily values or collection events are required for *E. coli* assessments. DWQ defines a collection event as one of the following:

- The daily most probable number (MPN) result value
- A geometric mean of replicates where multiple samples are collected on the same day
- The daily MPN as a quantified value reported as being obtained from a dilution

In cases where replicate samples were taken and there is 1) a quantified MPN value reported from a dilution and 2) the MPN value reported is greater-than-detect, the quantified MPN value will be used as the collection event for assessment purposes. In this scenario, MPNs reported as greater-than-detect are not used to calculate the geometric mean for the collection event.

Data Substitution for Calculating the Geometric Mean

Assessments use the geometric mean of representative samples to determine if *E. coli* standards are met. *E. coli* data that are reported as less- than-detect (< 1) or 0 will be treated as a value of 1 to allow for the calculation of a geometric mean. Similarly, *E. coli* data that are reported as greater-than-detect (> 2,419.6) will be treated as 2,420 to allow for the calculation of the geometric mean.

Use Designation

DWQ assesses use support for each monitoring location once the data are compiled. All waters of the state are classified for contact recreation (Class 2), and some waters are classified as drinking water sources (Class 1C). These uses have specific associated *E. coli* standards that are used to determine use support. The numeric criteria within UAC R317-2-14 are applied to Class 2 and Class 1C uses based on the beneficial use assignments to a waterbody or segment within a waterbody.

Annual Recreation Season Assessment

DWQ begins the assessment process by gathering information on health advisories and/or closures issued during the recreation season. If a waterbody had two or more *E. coli*–related beach closures and/or health advisories in a recreation season, or if a health advisory and/or closure was issued for recreational access to a waterbody for two or more weeks, the waterbody is considered impaired and no further assessment is conducted (Figure 18). If there were fewer than two closures or advisories, or if the closure lasted less than two weeks, the assessment process continues using *E. coli* concentrations.

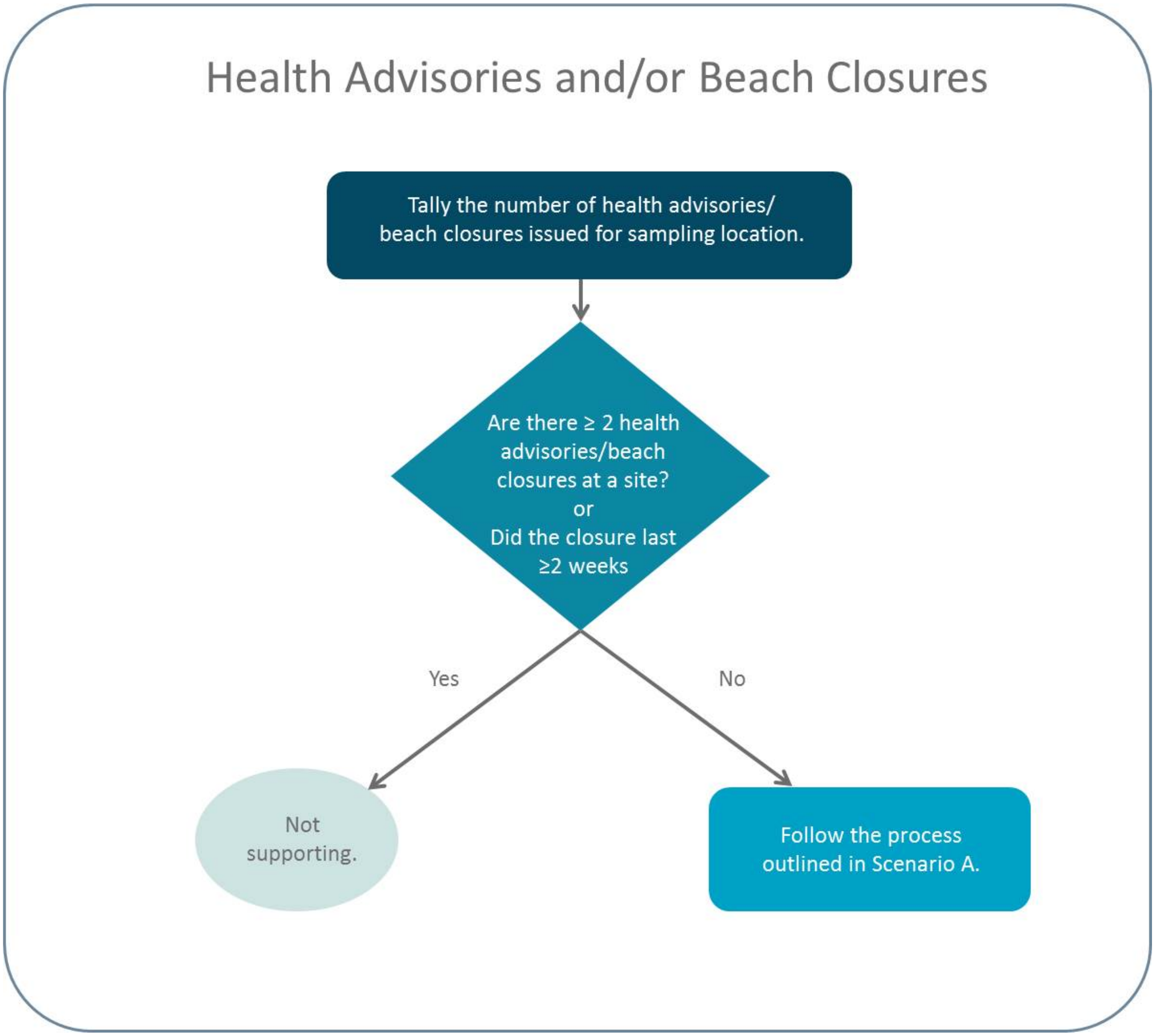

Figure 17. Considering *E. coli*-related beach closures and/or health advisories.

To ensure protection of recreation and drinking water uses of assessed waterbodies of the state, DWQ considers three scenarios based on sampling frequency and the number of collection events at a monitoring location:

- Scenario A**:** A seasonal assessment against the maximum criterion (Figure 19)
- Scenario B: A 30-day geometric mean assessment (Figure 20)
- Scenario C: A seasonal geometric mean assessment (Figure 21)

Scenario A

If there are greater than or equal to five collection events spaced 48 hours or more apart within a recreation season, then all collection events within the recreation season are used to make an assessment (see Figure 19).

- DWQ does not make impairment decisions based on one exceedance. If the monitoring location has less than 10 collection events within a recreation season, then one collection event may exceed the numeric criterion and the site will still be considered in Scenarios B and C. If two or more collection events exceed the numeric criterion, then the monitoring location is not supporting the beneficial use, and the next beneficial use is assessed.
- If there are 10 or more collection events within a recreation season, a percent exceedance is calculated by dividing the number of collection events that exceed the maximum criterion by the total number of collection events. If the calculated percentage is 10% or less, the monitoring location is then assessed using Scenarios B and C. If the calculated percentage is greater than 10%, the monitoring location is not supporting its beneficial use, and the next beneficial use is assessed.
- If there are less than five collection events spaced 48 hours or more apart within a recreation season, then the monitoring location is placed in the insufficient data category.
- If one or more collection events exceed the maximum criterion, then the monitoring location is placed in the insufficient data with exceedances category.
- If no collection events exceed the maximum criterion, then the monitoring location is placed in the insufficient data, no exceedances category.

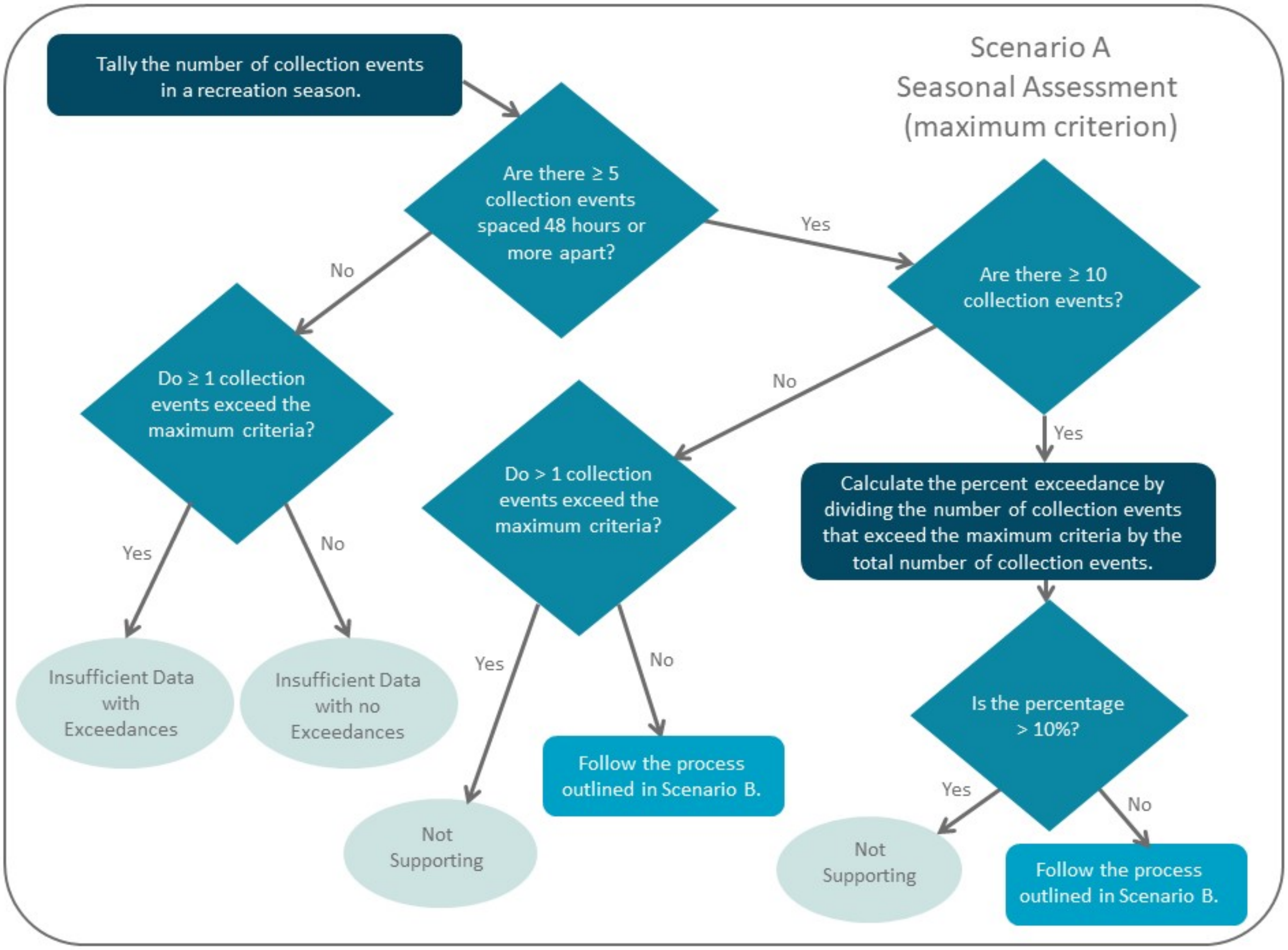

Figure 18. Scenario A: A seasonal assessment using the maximum criterion at a monitoring location.

Scenario B

If the site's calculated percent exceedance of the maximum criterion is less than or equal to 10%, the site is then assessed using the 30-day geometric mean criterion (see Figure 20). There must be a minimum of five collection events in 30 days with at least 48 hours between collection events in order to assess against the 30-day geometric mean criterion directly. This ensures that collection events are adequately spaced and are representative of ambient conditions.

Step 1: Determine if there are ≥5 collection events within a 30-day period.

- Count the number of collection events collected between each sample date (day 1) and the sample date plus 29 days (day 30).

Step 2: Determine if the collection events are representative (must have ≥5 collection events within a 30-day period).

- Count the number of collection events collected between each sample day (day 0) and the sample date plus 2 days (day 3).
- If there are two collection events within this period, only one sample will be considered representative.

Step 3: Calculate the 30-day geometric mean.

- If there are ≥5 representative samples in a 30-day period, then all collection events will be used to calculate the 30-day geometric mean.
- If ≥1 30-day geometric mean exceeds the 30-day criteria, the site is not supporting beneficial uses. If there are not representative data for Scenario B, or if the 30-day geometric mean did not exceed the 30-day criteria, the site is assessed using Scenario C.

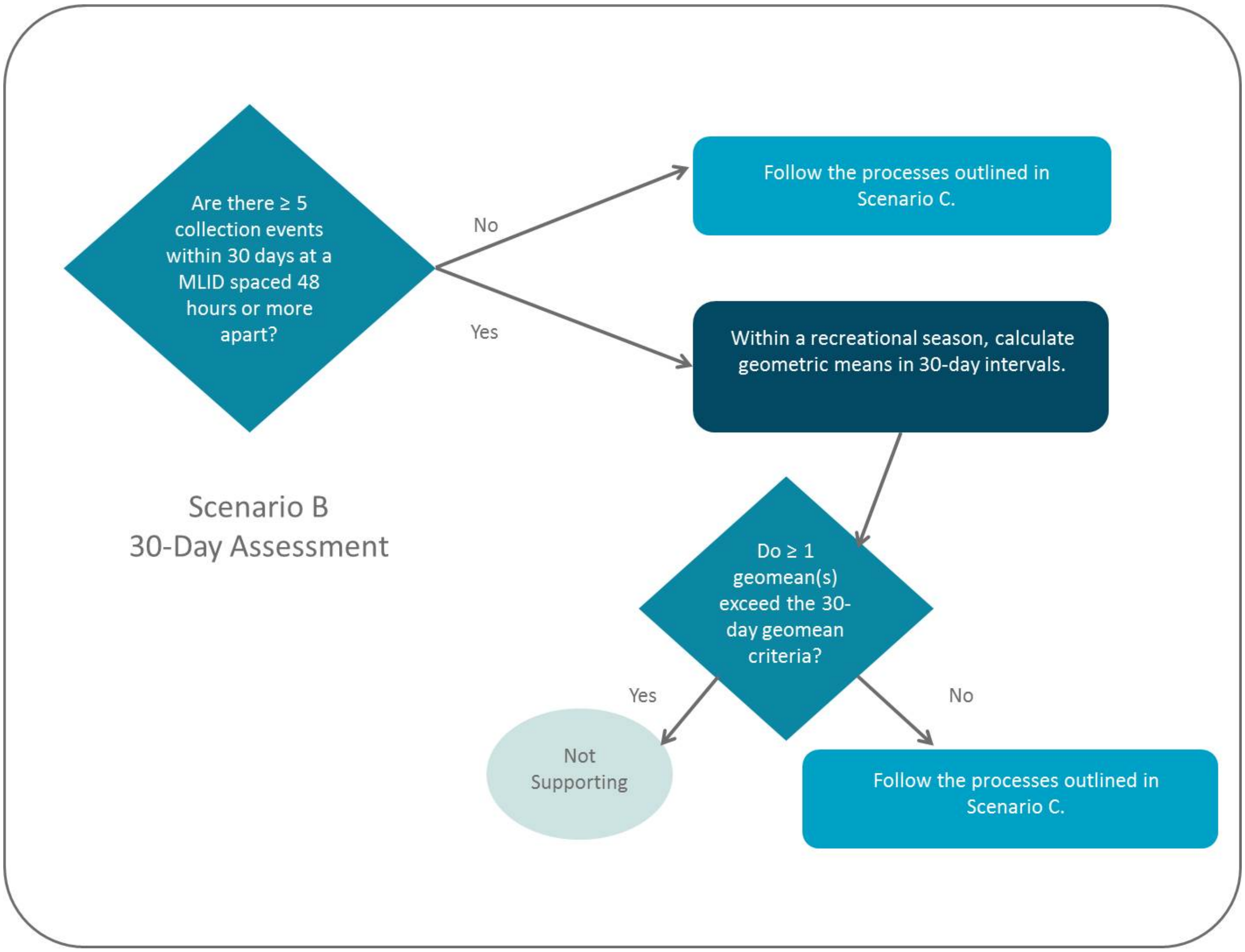

Figure 19. Scenario B: An assessment using the 30-day geometric mean for monitoring locations with five or more collection events within 30 days.

Scenario C

If adequate (at least five samples) and/or representative data spaced by at least 48 hours are not available to assess against the 30-day geometric mean, DWQ will assess *E. coli* data for the recreation season, provided there are at least five collection events during the defined recreational season. Exceedances of the geometric mean criterion will result in the site being classified either as impaired (minimum of 10 collection events in a recreation season) or as insufficient data (sample size is more than five but fewer than 10) (see Figure 21).

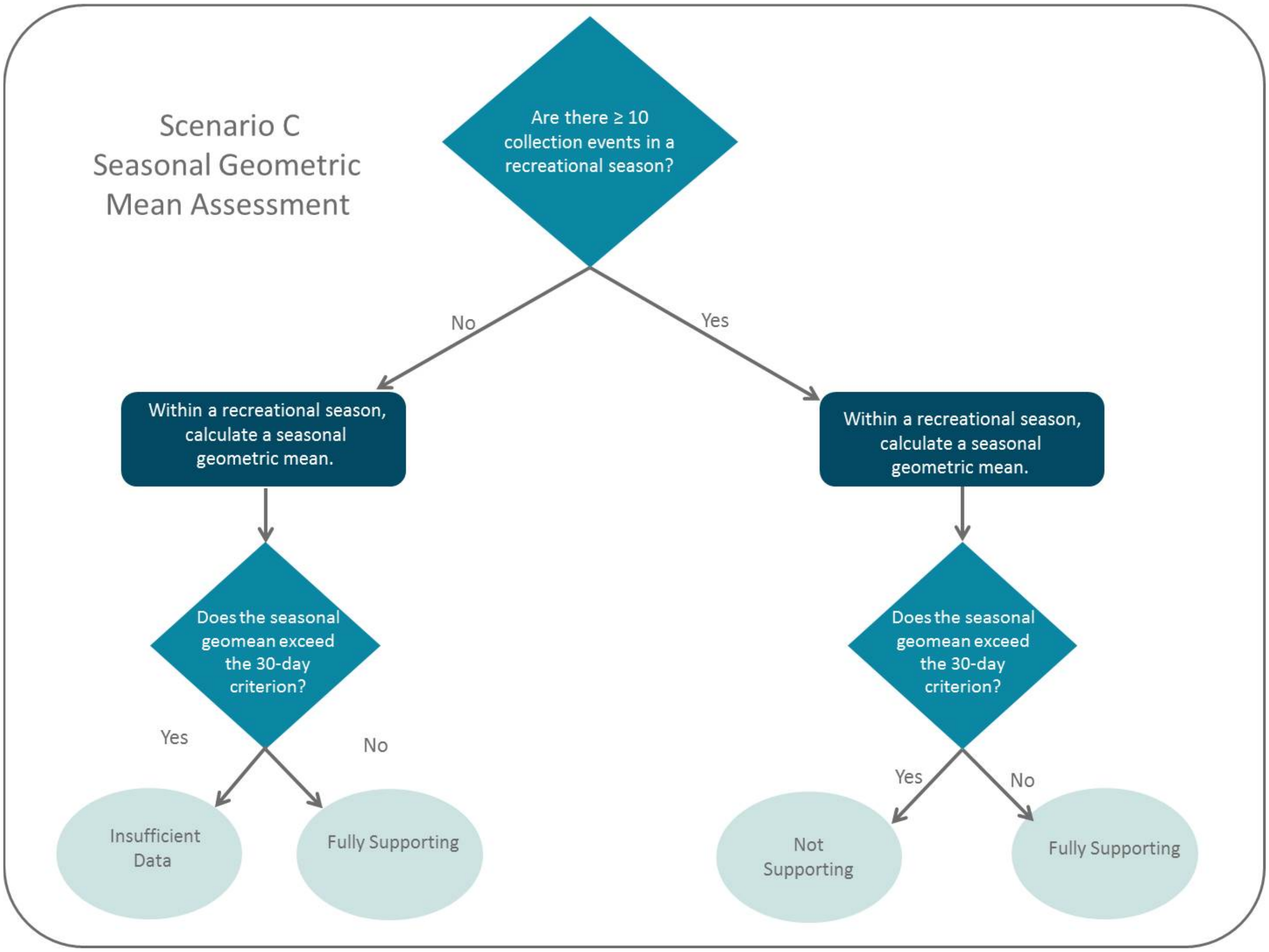

Figure 20. Scenario C: A seasonal geometric mean assessment.

Summarizing Assessment Results

When determining beneficial use support of a monitoring location with assessment results across multiple years, the following rules are applied, in the following order:

Not Supporting (Category 5)

- A lake, reservoir, or pond has two or more posted health advisories or beach closures during any recreation season.
- Any monitoring location with five to nine collection events and two or more collection events that exceed the maximum criterion.
- Any monitoring location where the calculated percent exceedance of the maximum criterion within a recreation season for *E. coli* concentrations is greater than 10% for 10 or more collection events.
- Any monitoring location where the 30-day geometric mean exceeds the 30-day geometric mean criterion (minimum five collection events with at least 48 hours between collection events).
- Any monitoring location where the recreational season geometric mean exceeds the 30-day geometric mean criterion (minimum of 10 collection events).

Insufficient Data or Information Assessment Considerations (Category 3, with exceedances)

- Sites with four or fewer samples in all seasons evaluated will be listed as insufficient data, provided impairment is not suggested by a posted health advisories or beach closures.

Combinations of Category 3 (with no exceedances), 2, and/or 1

- If there is no evidence of impairment at a site by any of the assessment approaches over the period of record, the assessment analysis from the most recent year outweighs the results from previous years. DWQ's process for merging assessment results from multiple locations within an AU is discussed in more detail in Determinations of Impairment: All Assessment Units.

Supporting (Category 1 or 2)

- No evidence of impairment by any assessment approach for all recreation seasons over period of record. A fully supporting determination can be made with a minimum of five collection events during the recreational season.

Combining *E. coli* with Other Parameter Assessment Results

Until the determination of impairment and the review of additional supporting information are completed by reviewers, parameter assessments at an individual monitoring location and results from multiple monitoring locations within the same AU are not summarized and combined (see Determination of Impairment for more details).

Pollutions Indicator Assessments for All Waters

Several parameters and beneficial uses in UAC R317-2 are identified as pollution indicators and have footnotes indicating that further investigations should be conducted when levels are exceeded. To capture this footnote in the assessment process, DWQ reviews preliminary pollution indicator assessments during the Secondary Review process to determine whether pollution indicators demonstrate clear and convincing evidence of supporting or not supporting the beneficial uses assigned to the waterbody in UAC R317-2. Secondary reviews incorporate pollution indicator data into assessment-category determinations and rely on multiple lines of evidence, including pollution indicator thresholds, the presence or absence of other indicator-associated water quality issues, potential pollutant sources, and other site- or watershed-specific knowledge, to determine whether listing or delisting on a pollution indicator parameter is appropriate or whether to prioritize waterbodies for additional monitoring.

Narrative Standards for All Waters

Utah's water quality standards contain narrative criteria that protect beneficial uses in addition to the numeric criteria used to perform water quality assessments. The narrative criteria state:

It shall be unlawful, and a violation of these rules, for any person to discharge or place any waste or other substance in such a way as will be or may become offensive such as unnatural deposits, floating debris, oil, scum, or other nuisances such as color, odor to taste; or cause conditions which produce undesirable aquatic life or which produce objectionable tastes in edible aquatic organisms; or result in concentration or combinations of substance which produce undesirable human health effect, as determined by bioassay or other tests performed in accordance with standard procedures; or determined by biological assessments in (UAC) Subsection R317-2-7.3.

DWQ will apply the narrative criteria to protect human health and aquatic life where evidence exists that human-caused actions have produced any of these undesirable outcomes in a waterbody. Narrative standards may be used to make an impairment determination for drinking-water closures, fish kills, harmful algal blooms (HABs), beach closures for swimming, and health advisories for the consumption of fish. Assessment of *E. coli* data and associated beach closures to protect human health provide an additional weight of evidence for defining the impairment of recreational uses and is addressed in more detail earlier in this document in the *Escherichia Coli* Assessment for All Waters section.

DWQ will assess a site as impaired for 1C uses if the Utah Division of Drinking Water or a local municipality issues an advisory or closure for a surface drinking water source, unless data show that the problem has been resolved.

FISH KILLS

DWQ requests information on reported fish kills from the Utah Division of Wildlife Resources and other stakeholders. These data are used with water quality data to make final assessment decisions. For example, sites that would generally not be assessed due to small sample sizes may be listed as impaired if fish kills have also been observed in the waterbody.

HARMFUL ALGAL BLOOMS (HAB)

For this IR cycle, harmful algal bloom (HAB) assessments are currently on hold while DWQ develops and reviews implementation guidance and assessment methods based on recent EPA recommendations for water quality criteria for cyanotoxins (see *Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsins*). In future IR cycles, DWQ expects to continue assessing recreational uses for the occurrence of HABs.

FISH TISSUE ASSESSMENTS AND CONSUMPTION HEALTH ADVISORIES

DWQ has collected fish tissue samples for mercury analysis in waterbodies throughout the state since 2000. Consumption advisories have been issued for 24 waterbodies since then.

DWQ currently uses the EPA-published ambient water quality criterion for methylmercury for the protection of people who eat fish and shellfish. This criterion is 0.3 milligram (mg) methylmercury per kilogram (kg) fish tissue wet weight. If all fish (small and large) of the same species at a monitoring location have a mean mercury concentration of > 0.3 mg/kg, additional statistical tests are used to determine if a consumption advisory is necessary. If the mean is < 0.3 mg/kg, no advisory is issued. In several instances, size class advisories have been issued when it is apparent that only the larger size class exceeds the safe consumption criterion.

The p-value is considered for locations with a mean mercury concentration of > 0.3 mg/kg, The p-value refers to the probability of obtaining a result equal to or greater than those that were measured at that location. DWQ uses a p-value of 0.05 to be 95% certain an advisory is not issued unnecessarily. Therefore, if a species has a mean of > 0.3 mg/kg and a p-value < 0.05, a consumption advisory is issued. If a species has a mean of > 0.3 mg/kg but a p-value of > 0.05, an advisory is not issued. The consumption advisories are based on long-term consumption; therefore, the mean is the most appropriate and commonly used parameter to estimate exposure.

In an effort to control for false negatives, DWQ calculates 95% confidence limits of the mean mercury concentration. If the upper confidence limit is above 0.3 mg/kg, that site is targeted for additional sampling.

When an advisory is warranted, DWQ sends the data to the Utah Department of Health toxicologist, who uses the mean mercury concentration to calculate the actual consumption recommendations. Those calculations are based on the following:

- Average adult weight: 70 kg (154 pounds). Average adult meal size: 227 grams (8 ounces)/meal
- Average child weight: 16 kg (35 pounds). Average child meal size: 113 grams (4 ounces)/meal

Consumption amounts are calculated for three target populations: pregnant women and children < 6 years old; women of child-bearing age and children between 6–16 years old; and adult women past child-bearing age and men >16 years old.

Mercury Assessment Process

The current approach for mercury assessments for aquatic life is different than the consumption advisory process. The assessment is based on the U.S. Food and Drug Administration (FDA) recommended value of 1.0 mg/kg. The FDA set the consumption concentration at 1.0 mg/kg, which correlates to the water column mercury concentration of 0.012 µg/L identified in previous studies by EPA (EPA, 1985). Utah's water quality standard for mercury is 0.012 µg/L as a four-day average. Therefore, the corresponding fish tissue concentration of 1.0 mg/kg is used for assessment.

Beneficial Use Supported (Category 1)

- No fish consumption advisories for mercury are in place.
- Mean fish tissue mercury concentration for all individuals of the same species at a location is less than 0.3 mg/kg and p-value is < 0.5.

Insufficient Data with Exceedances (Category 3)

- Fish consumption advisories for mercury are in place, but the mean fish tissue mercury concentration for all individuals of the same species at a location is less than or equal to 1.0 mg/kg.

Beneficial Use Not Supported (Category 5)

- Fish consumption advisory for mercury is in place.
- Mean fish tissue mercury concentration is greater than 1.0 mg/kg.

For additional information and the most up-to-date list of consumption advisories, please visit fishadvisories.utah.gov.

Determinations of Impairment: All Assessment Units

Each use and parameter within a waterbody is assigned a provisional EPA-derived assessment category after the initial assessment of credible data against the numeric criteria in UAC R317-2. To verify the use and parameter-specific assessment results and consolidate the often multiple parameter assessments into one result per waterbody, DWQ must consider the quantity of data and the extent to which such data demonstrate clear and convincing evidence of supporting or not supporting the beneficial uses assigned to the waterbody DWQ considers the following information to determine whether a waterbody is supporting or not supporting its beneficial uses:

- Individual assessment of water quality standards at a single site
- Independent applicability
- Multiple lines of evidence and several levels of secondary reviews

INDIVIDUAL ASSESSMENT OF WATER QUALITY STANDARDS

DWQ first considers the individual use and parameter-specific assessment results from the monitoring-location level data to determine whether a waterbody is supporting or not supporting the beneficial uses assigned in UAC R317-2, Each use and parameter assessed for the waterbody is assigned a provisional EPA-derived assessment category. Unless noted in the waterbody-specific data assessment protocols, the assessment policies outlined in this document provide a direct and quantifiable method and documentation of data supporting or not supporting DWQ's water quality standards versus data and information that are developed using surrogate parameters or indicators. Because individual assessments at a single monitoring location site offer a more direct measure of supporting or not supporting water quality standards in UAC R317-2, DWQ places a greater weight on individual assessment decisions that follow the data assessment protocols in this document.

DWQ looks across the multiple parameter-specific assessment results that exist for a location and consolidates the results into a preliminary assessment at the individual site level after review of the individual water quality standard assessments for a beneficial use. DWQ then assigns one EPA-derived assessment decision category as defined in Table 1 to each monitoring location.

CONFLICTING ASSESSMENTS OF WATER QUALITY STANDARDS

DWQ applies the policy of independent applicability to address the possibility of conflicting results among different types of data (e.g., biological versus conventionals, toxics versus *E.coli*) at the site and AU level and goes through a series of considerations to determine if discrepancies are due to

- Differences in data quality
- Environmental factors such as the application of the water-effects ratio, development of site-specific criteria, revision to numeric criteria in UAC R317-2, or completion of a use attainability analysis

Figure 22 describes DWQ's use of the independent applicability policy.

Sites with conflicting assessment results may be listed as Category 3 (insufficient data and information). This allows DWQ to examine conflicting lines of evidence when concerns about the quality of independent datasets cannot be resolved through evaluation and documentation of the QA/QC issues that led to acceptance of one dataset and the resulting assessment result. Specific assumptions regarding model applicability applied during the biological assessment process are discussed in the Biological Assessment section. Similarly, if the application of water-effects ratio, justifiable site-specific criteria change, or change in beneficial uses based on a use attainability analysis cannot rectify the difference in the assessment results, then a Category 3 may be warranted. All evaluations of conflicting assessment decisions will be made in consultation with EPA on a case-by-case basis.

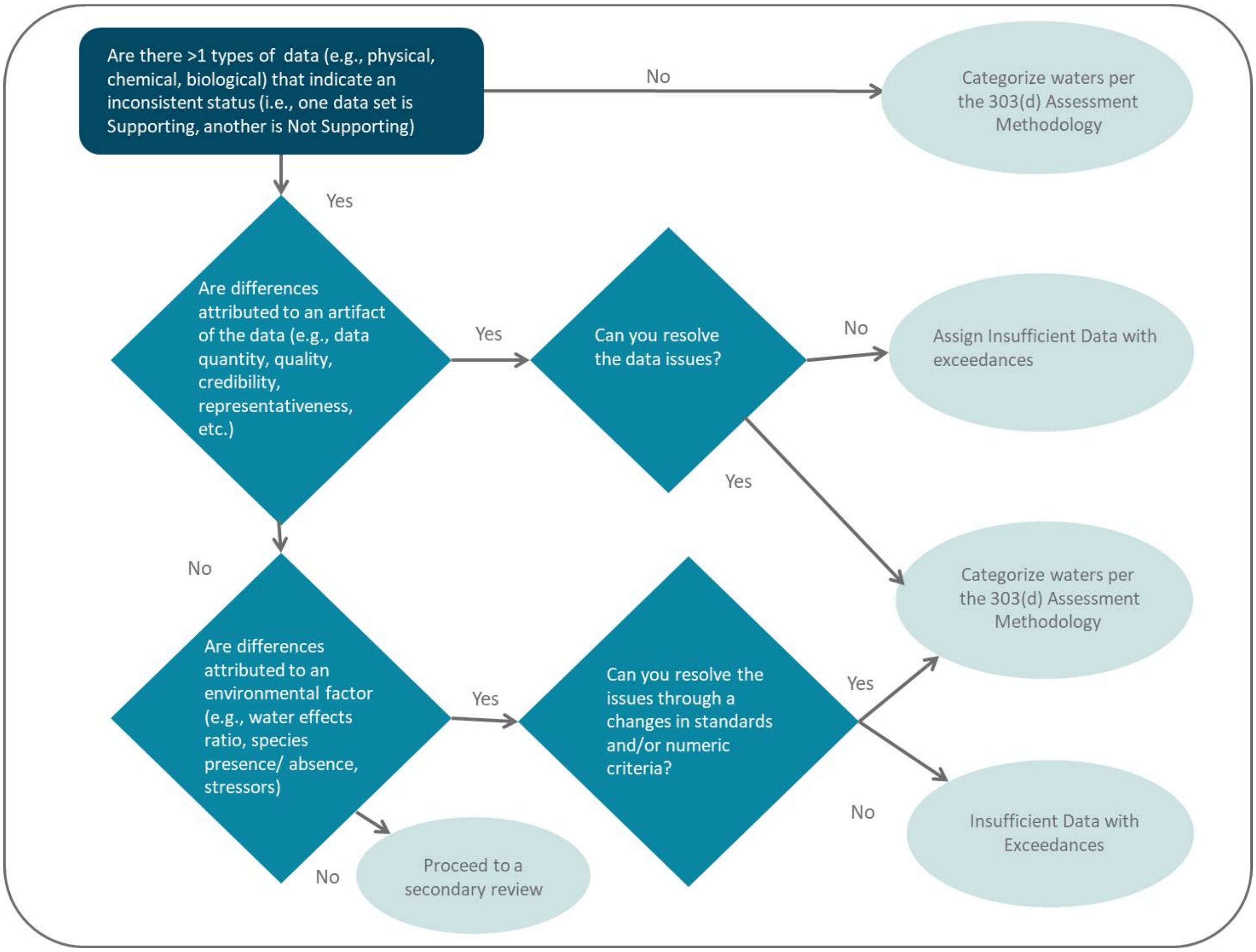

Figure 21. Overview of independent applicability process. Note: These judgment decisions are based in part on EPA's Consolidated Assessment and Listing Methods guidance published in 2002.

AGGREGATION OF SITE-SPECIFIC ASSESSMENTS TO ASSESSMENT UNIT CATEGORIES

For reporting purposes, DWQ aggregates all site-specific water quality assessments within an AU to a single assessment category for that AU as described in Table 1. A flowchart describing this process is presented in Figure 23 (see Appendix 4 for additional detail).

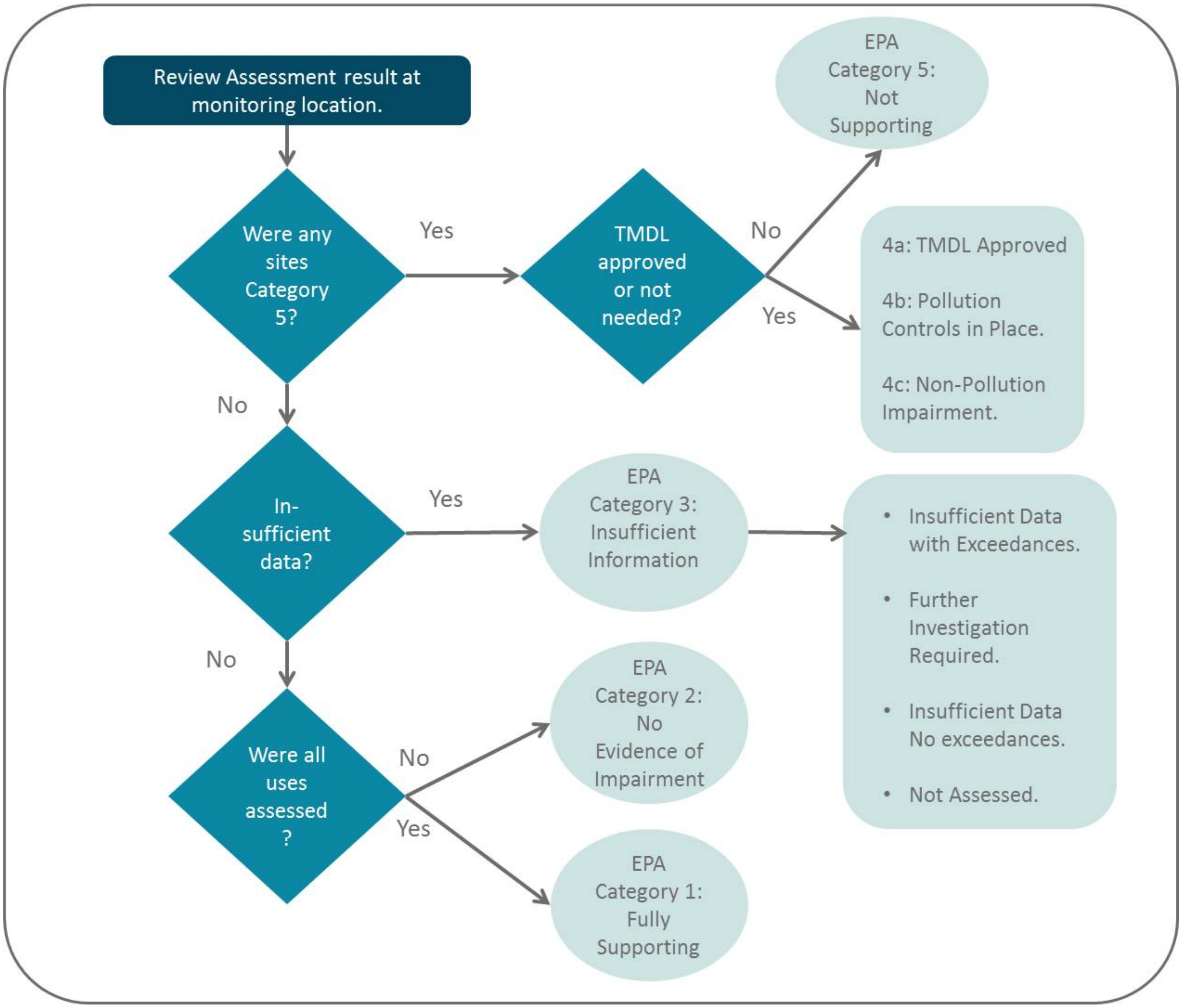

Figure 22. Process of assigning EPA categories to AUs based on results of monitoring location assessments.

SECONDARY REVIEW

DWQ conducts a secondary review of listing determinations after consolidation of all individual assessment results and assignment of preliminary assessment category(s) for an AU, The secondary review process allows DWQ to apply site/waterbody-specific knowledge and additional data quality controls to evaluate the extent to which data used in the preliminary assessment demonstrate clear and convincing evidence of supporting or not supporting the beneficial uses assigned to the waterbody in UAC R317-2-6. DWQ recognizes that input from reviewers during public comment periods, in addition to the internal secondary review process, may provide key information on the data used in listing decisions. To ensure consistency in its use among different professionals, the secondary review process will be applied in a select number of scenarios using a standard set of guidelines as outlined in Appendix 3.

If documentation from the secondary review provides sufficient evidence to modify the basis and result of the preliminary assessment, the preliminary assessment decision based on the data assessment procedures outlined in this document will be overwritten. For example, preliminary listings for Category 5. Category 1, or Category 2 waters could be re-assigned as Category 3, insufficient data and information.

The preliminary assessment decision based on the data assessment procedures outlined in this document will carry forward when documentation to override a preliminary assessment decision is insufficient, vague, or cannot be provided,

DWQ will document the original category assignment and a justification for the secondary review to ensure tracking and transparency.

Assessment Unit Re-segmentation

DWQ may decide it is appropriate to re-segment (i.e. "split") an existing AU polygon into two or more new AUs rather than aggregate those conflicting assessments into a single AU scale category when site-specific assessments within a single AU conflict. AUs where water quality criterion exceedances are clearly isolated to a relatively small, hydrologically distinct portion of the larger AU may be re-segmented to more accurately reflect that variation in water quality. For example, a large AU with an impairment isolated to a single tributary may be re-segmented into two AUs: one for the impaired tributary and another for the rest of the existing AU. Assessment categories for both AUs are then determined following standard aggregation (Figure 22 and the delisting procedures discussed in the Delistings section). This results in a higher resolution and overall more accurate assessment. DWQ does not consider it appropriate to re-segment an AU when exceedances are observed in multiple locations throughout an AU or where impaired sites are not hydrologically distinct from unimpaired portions of the AU.

If after aggregating all of the assessments into one assessment category for an AU, DWQ determines that the supporting or not supporting assessment result decision is not representative of the entire AU, DWQ will investigate further to determine whether the supporting or not supporting decision is widespread or limited to individual portions of the waterbody, such as specific tributaries or reaches. Results from the analysis will be categorized as follows:

Entire AU not supporting (Category 5): DWQ will recommend that the AU not be re-segmented and the entire AU be listed as not supporting. When data from multiple sites or tributaries within an AU indicate multiple (or a combination of) sites that do not support beneficial uses (Category 5) and insufficient data with exceedances (Category 3)

Not supporting tributaries listed as not supporting (Category 5): DWQ may recommend the AU be re-segmented into two AUs and that only the tributaries with data indicating impairment are listed as not supporting if data from one or more tributaries indicate a combination of any of the following:

- Insufficient Data with Exceedances (Category 3)
- No Evidence of Impairments (Category 2)
- Supporting (Category 1)
- Needs Further Investigations (Category 3)
- Insufficient Data with No Exceedances (Category 3)
- Not Assessed (Category 3)

The rest of the AU will be assigned a category following procedures as outlined in Figure 23.

Identifying Causes of Impairments

DWQ will determine if the impairment or impairments are driven by pollutants, pollution, unknown, or natural causes once an AU is assigned an EPA assessment category that is representative of conditions in the AU (see Table 1). DWQ will identify causes of impairment by a pollutant with specific numeric water quality criteria identified in UAC R317-2-14. Pollution is a generalized term for causes of water quality impairment that can include multiple pollutants and other factors such as the absence or lack of water, lack of riparian vegetation, and other modifications that affect a waterbody's ability to support aquatic habitat and other designated uses. With the exception of naturally occurring causes, only one cause will be applied to a not-supporting waterbody and parameter. Procedures on how DWQ identifies the cause of impairments are described in the section below.

POLLUTANTS

DWQ uses CWA's definition as a guide to define pollutant-driven impairments (Category 5) as those resulting from the following:

… dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials (except those regulated under Atomic Energy Act of 1954, as amended), heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (UAC R317-2)

DWQ also includes certain radiological constituents that are regulated under the state's Water Quality Control Act.

For the purpose of the 303(d) list, causes for impairments due to toxic parameters will be identified as the parameter for which there is an impairment. In the case of conventional parameters such as DO, temperature, pH, and biological scores, the cause will be assigned as the parameter that was assessed until a TMDL or pollution prevention plan identifies an alternative cause of the impairment.

DWQ will list the waterbody and the not-supporting parameter(s) as impaired for that pollutant (cadmium, iron, etc.) when an impairment for a waterbody or segment within a waterbody is identified as pollutant-driven. Waterbodies that are not supporting their beneficial uses due to pollutant impairments require future development of a TMDL or application of a TMDL alternative.

Where DWQ can identify that an impairment was not driven by a pollutant, it may consider whether the not-supporting assessment was driven solely by pollution versus a pollutant or by an unknown cause. DWQ will use CWA's definition of pollution as a guide when determining if an impairment resulted from "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." Waterbodies with not-supporting parameters that are driven solely by pollution problems do not require the future development of a TMDL and are candidates for a non-pollutant impairment (4C) assessment category. Details on DWQ's process for using EPA's 4C assessment category are described in section Category 4C.

UNKNOWN SOURCES

For the purpose of the IR, sources of pollution contributing to an impairment will be reported in the 303(d) list to EPA as "unknown" until a TMDL or special study identifies the sources and any additional causes of impairment.

NATURAL CONDITIONS

DWQ will retain the not-supporting assessment decision in cases where it or a stakeholder can demonstrate that the natural conditions of the waterbody or segment within a waterbody are the key factors for an impairment(s). However, DWQ's response to such exceedances differs unless a site-specific standard has been promulgated. Site-specific standards require documentation that demonstrates the extent to which the violations were due to natural conditions. Proposed changes to standards will be developed once this documentation is assembled   Please review DWQ's Standards website for more information on the review and approval process for developing standards and numeric criteria for exceedances caused by naturally occurring conditions.

Revising the 303(d) List and Other Categorical Assessments

Upon validating the strength and extent of the impairments within a waterbody or segment within a waterbody, DWQ includes newly proposed and previously listed not supporting (Category 5) waterbodies on the updated 303(d) list unless the waterbody or waterbody segment(s) is currently included in the IR's TMDL-approved (Category 4A), pollution control (Category 4B), non-pollutant impairment (Category 4C), or delisting lists. Details on how and when DWQ will not apply or carry an impaired listing (not supporting, Category 5) forward on DWQ's 303(d) list are described below.

CATEGORY 4A

DWQ may choose to not list or remove an impaired waterbody or segment within a waterbody on the state's 303(d) list by calculating the maximum amount of a pollutant that a waterbody can receive while still meeting the state's water quality standards. This calculation and analysis work must be formalized in a TMDL and go through a thorough internal and external review process. This calculation and analysis work must be formalized in a TMDL that is provided to the public for review and comment, submitted to the Water Quality Board for approval, provided to the Legislative Natural Resources, Agriculture, and Environment Interim Committee for review if implementation costs exceed $10 million or the full State Legislature for approval if implementation costs exceed $100 million, and ultimately to EPA for their approval. Information on DWQ's process for developing and implementing a TMDL can be found on DWQ's Watershed Management Program website and EPA's TMDL 303(d) website. Where DWQ has documentation of a TMDL approved by the Water Quality Board and EPA for an impaired parameter within a not-supporting waterbody or segment within a waterbody, DWQ will override a current or previous not-supporting Category 5 listing decision at the AU level as follows:

Whole AU Category 4A, TMDL-approved if:

The only impairments within the waterbody or segment within the waterbody are included in the approved TMDL.

There are additional impairments within the waterbody or segments within the waterbody that are addressed in a Category 4B demonstration plan (described in section Category 4B and Appendix 5) and are not included in the approved TMDL. If the parameters included in the approved Category 4B demonstration plan are still not supporting or are insufficient data with exceedances in the current assessment cycle, DWQ will indicate that those parameters have an approved Category 4B demonstration plan in place.

There are additional impairments within the waterbody or segments within the waterbody that are pollution-driven (Category 4C) and not included in the approved TMDL. DWQ will indicate that those parameters are pollution versus pollutant driven if the pollution-driven parameters are still not supporting or are insufficient data with exceedances in the current assessment cycle.

Whole AU Category 5, Not Supporting if:

There are any additional pollutant impairments within the waterbody or segments within the waterbody that are not included in the approved TMDL. DWQ will indicate that those parameters have an approved TMDL in place if the parameters included in the approved TMDL are still not supporting or are insufficient data with exceedances in the current assessment cycle.

CATEGORY 4B

DWQ may choose to not list or remove an impaired waterbody or segment within a waterbody on the state's 303(d) list by developing a plan that ensures, upon implementation, that the waterbody will meet state water quality standards within a reasonable time period and through state- and EPA-approved pollution-control mechanisms. Similar to a TMDL, a Category 4B demonstration plan must go through a robust internal and external review process. Once DWQ or a stakeholder develops a plan for consideration, DWQ will present the plan to the Water Quality Board and submit the board-approved plan to EPA for final approval. More information on the Category 4B demonstration plan process can be found in Appendix 5 and in EPA's Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act and Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions.

Where DWQ has documentation of an EPA-approved Category 4B demonstration plan for an impaired parameter within a not-supporting waterbody or segment within a waterbody, DWQ will override a current (or previous) not-supporting Category 5 listing decision at the AU level as follows:

Whole AU Category 4A, TMDL-approved if:

There are any additional impairments within the waterbody or segments within the waterbody that are addressed in an approved TMDL (Category 4A) and are not included in the approved Category 4B demonstration plan. DWQ will indicate that those parameters have an approved Category 4B demonstration plan in place if the parameters included in the approved Category 4B demonstration plan are still not supporting or are insufficient data with exceedances in the current assessment cycle.

Whole AU Category 4B, Pollution Control if:

The only impairments within the waterbody or segment within the waterbody are included in the approved Category 4B demonstration plan.

There are additional impairments within the waterbody or segments within the waterbody that are pollution driven (Category 4C) and are not included in the approved Category 4B demonstration plan. DWQ will indicate that those parameters are pollution rather than pollutant driven if the pollution-driven parameter impairments are still not supporting or are insufficient data with exceedances in the current assessment cycle.

Whole AU Category 5, Not Supporting if:

There are any additional pollutant impairments within the waterbody or segments within the waterbody that are not included in the approved Category 4B demonstration plan. DWQ will indicate that those parameters have an approved Category 4B demonstration plan in place if the parameters included in the approved Category 4B demonstration plan are still not supporting or are insufficient data with exceedances in the current assessment cycle.

CATEGORY 4C

DWQ may choose to not list or remove an impaired waterbody or segment within a waterbody on the state's 303(d) List is to demonstrate that the parameter-specific impairment (or impairments) is driven by pollution and not by a pollutant or pollutant that causes pollution. Unlike a TMDL or Category 4B demonstration plan, the analysis tries to determine if the cause of impairment is driven by pollution and does not require formal approval from the Water Quality Board or EPA. Pollution analysis work is instead reviewed internally by DWQ and by stakeholders during the public comment period of the draft IR and 303(d) list.

For the draft IR and 303(d) list, DWQ will temporarily assume "approval" of any pollution-driven analysis work and supersede a current or previous not supporting Category 5 listing decision at the AU level as follows:

Whole AU Category 4A, TMDL-approved if:

All impairments within the waterbody or segments within the waterbody are addressed in an approved TMDL (Category 4A). DWQ will indicate that those parameters are pollution- rather than pollutant-driven for pollution-driven impairments that are still not supporting or are insufficient data with exceedances in the current assessment cycle.

Whole AU Category 4B, Pollution Control if:

All impairments within the waterbody or segments within the waterbody are addressed in an approved Category 4B demonstration plan. DWQ will indicate that those parameters are pollution driven for pollution-driven impairments that are still not supporting or are insufficient data with exceedances in the current assessment cycle.

Whole AU Category 4C, Non-Pollutant Impairment if:

The only impairments within the waterbody or segment within the waterbody are included in the approved Category 4B demonstration plan.

Whole AU Category 5, Not Supporting if:

There are any additional pollutant impairments within the waterbody or segments within the waterbody. DWQ will indicate that those parameters are pollution-driven for pollution-driven impairments that are still not supporting or are insufficient data with exceedances in the current assessment cycle.

DWQ will provide stakeholders with draft IR and 303(d) list documentation during the public comment period to demonstrate why the impaired parameter within the waterbody or segment within the waterbody is pollution- and not pollutant-driven and will not require the future development of a TMDL.

DELISTINGS

The fourth and final alternative DWQ has at its disposal is to demonstrate good cause to stakeholders and EPA that a previously impaired parameter and waterbody or segment within a waterbody is now meeting water quality standards in UAC R317-2. Good cause occurs when DWQ can demonstrate one or more of the following categories and scenarios:

Improvements in Watershed Conditions

The waterbody has improved due to implementation of nonpoint source projects and/or revised effluent limits and post-implementation data indicate that the impairment has been resolved. This assessment may be based on additional data beyond that which is typically used in assessments, including before–and-after project implementation monitoring. In some cases, demonstration of improvement may be based on a different time period for data collection that corresponds with known watershed improvements.

Changes to Water Quality Standards

Adoption of revised water quality standards and/or uses so the waterbody now meets the revised standards and/or uses.

Changes to the 303(d) Assessment Methods

Development of a new listing method consistent with the state water quality standards and classifications and federal listing requirements. This includes all information contained in this document and posted on DWQ's Call for Data webpages.

Reassessment (new data and information)

Assessment and interpretation of older data that was not originally included in the previous assessment and/or more recent or more accurate data that demonstrate that the applicable classified uses and numeric and narrative standards are being met.

Geo-location Information Error

Inappropriate listing of a water that is located within Indian country as defined in 18 United States Code 1151.

Analysis Errors

Flaws in the original analysis of data and information that led to the waterbody-pollutant combination being incorrectly listed. Such flaws may include the following: (1) calculation errors in the data assessment methods outlined in the 303(d) assessment methods from that assessment cycle; (2) errors produced when reviewing credible and representative data information; (3) mapping errors generated during the validation of monitoring location information and assigning AU designations; (4) discrepancies between the beneficial use assignments in UAC R317-2 and the IR geo-location information files for internal and external data; (5), incorrect identification and assessment of a waterbody type; and (6) application of the wrong numeric criteria to a beneficial use.

New Modeling

Results of more sophisticated water quality modeling that demonstrate that the applicable classified uses and numeric and narrative standards are being met.

Effluent Limitations

Demonstration pursuant to 40 CFR 130.7(b)(1)(ii) that there are effluent limitations required by state or local authorities that are more stringent than technology-based effluent limitations required by the CWA and that these more stringent effluent limitations will result in support of classified uses and numeric and narrative standards for the pollutant causing the impairment.

Other

There is other relevant information that supports the decision not to include the segment on the Section 303(d) list.

In order to justify a delisting of an AU for a given parameter based on new data, the dataset must be of sufficient quantity and quality to make an assessment. There are two mechanisms for justifying a delisting based on assessment results:

- Delisting an AU for all parameters
- Delisting individual parameters for an AU

DWQ will compare the previous IR cycle's final assessment categories and 303(d) list to the current IR's assessment categories and 303(d) list to demonstrate good cause. Where differences in categorical assignments exist, DWQ will only further investigate the following scenarios for good cause:

- The AU/waterbody or segment within the waterbody was previously not supporting (Category 5) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).
- The AU/waterbody or segment within the waterbody was previously not supporting but had an approved TMDL (Category 4A) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).
- The AU/waterbody or segment within the waterbody was previously not supporting but had an approved Category 4B demonstration plan and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).
- The AU/waterbody or segment within the waterbody was previously not supporting but had pollution-driven impairment (Category 4C) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).

Note: The next set of scenarios describes the methods that apply to delisting individual parameters rather than entire AUs.

- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting (Category 5) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).
- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting but had an approved TMDL (Category 4A) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).
- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting but had an approved Category 4B demonstration plan and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).
- A parameter within an AU/waterbody (or segment within the waterbody) was previously not supporting but had pollution-driven impairment (Category 4C) and is now supporting (Category 1), shows no evidence of impairment (Category 2), or has insufficient data with no exceedances (Category 3).

Where assessment category assignments at the AU- and parameter-level warrant a further investigation for good cause, DWQ will reevaluate the data using the following:

- The period of record from when the AU and/or parameter was first listed
- The period of record in the current assessment cycle
- The data that were collected between when the AU and/or parameter were first listed and the period of record considered in the current assessment cycle

DWQ will review the data from all assessed sample locations (as defined in Table 4) in the three above scenarios as part of the demonstration-of-good-cause process to confirm whether there were exceedances at the sample sites. Where exceedances occur, DWQ must demonstrate that the exceedances no longer exist, no longer are of concern, or that water quality has improved. DWQ will provide documentation and a justification as to why the site was not re-sampled and/or whether water quality conditions have improved if a sample site had exceedances and newer data do not exist. If documentation cannot be provided, the AU and parameter will not be delisted, and the previous categorical assignment will carry forward.

Delisting Categorical Pollutant Causes

When TMDLs or special studies identify parameters contributing to a cause of impairment that is not the original cause for listing on the 303(d) list, there may be good cause justification for delisting the categorical cause if the original impaired parameter is no longer impaired and a linkage of the additional causes can be documented in a TMDL or other study. For instance, in some circumstances DWQ has identified phosphorus as a contributing cause of impairment to an existing DO listing and subsequently made a categorical listing for phosphorus as a cause on subsequent 303(d) lists. Since DWQ does not have assessment methods for phosphorus, a delisting based on the process outlined here is not feasible. Therefore, if the assessment results for the original DO listing can justify a delisting, any additional parameters associated with that cause may also be delisted with proper documentation of a direct linkage.

Appendix 6 elaborates on the process DWQ will follow when evaluating good cause at the AU-level and also describes, in more detail, the process DWQ will go through when evaluating good cause at the parameter level. DWQ applies several delisting codes for EPA review and approval (also included in Appendix 6).

If a waterbody or parameter is shown to have good cause for not being listed or removed as an impaired waterbody or segment within a waterbody on the state's 303(d) list, DWQ will state the good cause and provide a detailed description of the good cause. Details of the good-cause evaluation process, such as the data-analysis work, will not be posted online during the draft public comment period or after the final approval and publication of the final IR and 303(d) list. DWQ will, however, summarize the data analysis work in the description of the good cause. The analyses will be available to the public upon request through Utah's Government Records Access and Management Act (GRAMA) process.

PREVIOUS CATEGORICAL LISTINGS

303(d) Listings

DWQ must continue to list all previous impairments absent proper documentation to support changing a previous not-supporting (Category 5) listing decision to a TMDL-approved (Category 4A), pollution control (Category 4B), non-pollutant impairment (Category 4C), or delisting (demonstration of good cause). At a minimum, this includes carrying forward all waterbodies or segments within a waterbody that were previously not supporting (Category 5), indicating the cause of impairment, listing the beneficial use or uses failing to meet water quality standards, providing the priority of developing a TMDL, and indicating the assessment cycle the waterbody or segment within the waterbody was first listed.

Non-303(d) Categorical Listings

Where DWQ has the proper documentation to support changing a previous not-supporting (Category 5) listing decision to a TMDL-approved (Category 4A), pollution control (Category 4B), non-pollutant impairment (Category 4C), or delisting (demonstration of good cause), it will do so as outlined by the policies and procedure described throughout this document.

DWQ will also carry forward all previous categorizations of waterbodies or segments within a waterbody if the waterbody does not have any credible or representative data from the period of record of the current assessment cycle. This includes carrying the following forward:

- Previous TMDL-approved (Category 4A), pollution control (Category 4B), and non-pollutant impairment (Category 4C) categorizations that do not demonstrate good cause.
- Previous categorizations that have insufficient data with exceedances (Category 3), require further investigations (Category 3), have insufficient data with no exceedances (Category 3), are not assessed (Category 3), show no evidence of impairment (Category 2), or are supporting (Category 1).
- Historical Category 3 waters that had insufficient data with exceedances will remain in that category unless there is new data for assessment.

Waterbodies or segments within a waterbody that are supporting or show no evidence of impairment (Categories 1 and 2, respectively) may carry forward for six consecutive assessment (or two rotating basin) cycles. On the seventh consecutive assessment cycle, DWQ will no longer carry forward a supporting or no evidence of impairment categorization for waterbodies or segment within a waterbody that do not have any new data collected in the last 12 years. Data older than the period of record may not be reflective of current conditions and will not be used for assessment purposes unless there is information or a rationale with supporting documentation that shows the data are reflective of current conditions.

If there is evidence that the data are reflective of current conditions, the previous supporting (Category 1) or no evidence of impairment (Category 2) categorization will carry forward for one more assessment cycle (the current one) and be re-evaluated in the next cycle. DWQ will not carry forward the supporting or no evidence of impairment categorization for a seventh consecutive assessment cycle if there is no (or not enough) supporting evidence that the data are reflective of current conditions. DWQ will instead change the categorization to insufficient data with no exceedances (Category 3).

303(d) Vision and TMDL Priority Development

DWQ must ensure that TMDLs will be developed following the final release of the current IR and 303(d) list for waterbodies or segments within a waterbody that are impaired by a pollutant. Recognizing that all TMDLs cannot be completed at once and that certain risks may be greater than others, CWA Section 303(d) allows states to prioritize impaired waterbodies or segments within a waterbody on the Section 303(d) list for the future development of TMDLs.

On December 5, 2013, EPA announced a collaborative framework for implementing the CWA Section 303(d) program to help guide states on how to best prioritize TMDL development and demonstrate progress on addressing the water quality concerns highlighted and reported on in the IR and 303(d) list (See A Long-Term Vision for Assessment, Restoration, and Protection under the Clean Water Act Section 303(d) Program). This EPA document provides a framework that states can use to optimize their resources when developing TMDLs and other water quality improvement programs such as the anti-degradation program, nonpoint source implementation program, and the 401 water quality certification program. DWQ worked with stakeholders after the release of this document and developed new policies and procedures for the following IR and 303(d) reporting-specific elements:

- Assigning TMDL priorities to impaired waterbodies and segments within waterbodies on DWQ's 303(d) list
- Performing cost–benefit analyses that estimate the environmental, economic, and social costs and benefits, and time needed to achieve the objectives of CWA and state water quality standards
- Tracking the status and development of TMDLs

Please refer to Appendix 7 to learn more about DWQ's prioritization process for the development of future TMDLs contained on DWQ's 303(d) list.

Revision Requests between Cycles

DWQ will, barring unforeseen circumstances, only propose to revise the IR and 303(d) list during the regularly scheduled reviews, which are currently biennially and on even-numbered years. Interested persons may petition DWQ at any time to request a revision to the IR and 303(d) list, whether it is an addition or deletion to the final 303(d) list. However, such revisions may only be considered if failing to add a segment to the list or delete a segment from the list before the next scheduled review will result in a substantial hardship to the party or parties requesting the revision(s). DWQ will take the potential revision under strong consideration and begin a dialogue with the interested party or parties and EPA if such hardship is shown.

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Appendix 1

PRIORITY PARAMETERS

DWQ Parameter Name	DWQ Parameter Fraction	Recommended CAS Number	Parameters impacted by New/ Revised Assessment Methodology	DWQ Parameters Routinely Measured for Assessment Purposes	Required Additional Parameter Submissions for Complete Assessment Purposes	Additional Submission Considerations for QAQC
Fish Mercury		n/a				
Flow	n/a	Field Measurement		X		
pH	n/a	Field Measurement		X		
Secchi Depth	n/a	Field Measurement		X	for Lake Samples only	
Temperature, Air	n/a	Field Measurement			Accompanying Fluoride, Dissolved for Fluoride Assessment	
Temperature, Water	n/a	Field Measurement		X		
Total Dissolved Gases	Total	Field Measurement				
Bromate	Total	15541-45-4				
Chlorine (Total Residual)	Total	Field Measurement				
Chlorite	Total	14998-27-7				
Cyanide	Dissolved	57-12-5				(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Cyanide	Total	57-12-5				
Fluoride	Total	16984-48-8			Accompanying Air Temperature measurement	
Hardness	Dissolved	Calculated		X		

Hydrogen Sulfide	Total	7783-06-4			Accompanying Field pH Measurement	
Sulfate	Total	14808-79-8			Accompanying Total Dissolved Solids measurements for Site-specific locations located on Ivie Creek and its tributaries from the confluence with Muddy Creek to the confluence with Quitchupah Creek, and Quitchupah Creek from confluence with Ivie Creek to U-10	
Total Dissolved Solids	Total	n/a		X		
BOD	Total	n/a				
Total Nitrogen			X			
Total Phosphorus			X			
Chlorophyll a	Total	n/a		X	for Lake Samples only; Accompanying Secchi Depth	
Chlorophyll a, uncorrected for pheophytin	Total	n/a		X	for Lake Samples only; Accompanying Secchi Depth	
Fillamentous algae cover	n/a		X		for Headwater Numeric Nutrient Criteria ecological response; Accompanying Total Nitrogen and/or Total Phosphorus	
Gross primary productivity	n/a		X		for Headwater Numeric Nutrient Criteria ecological response; Accompanying Total Nitrogen and/or Total Phosphorus	
Periphyton	n/a		X		for Headwater Numeric Nutrient Criteria only	Must be expressed as a chlorophyll concentration or as ash free dry mass
Ecosystem respiration	n/a		X		for Headwater Numeric Nutrient Criteria ecological response; Accompanying Total Nitrogen and/or Total Phosphorus	
Dissolved Oxygen (% Sat)	n/a	Field Measurement				Recommend submitting Water Temperature

Dissolved Oxygen (Concentration)	n/a	Field Measurement	X	Please refer to the credible data requirements and DWQ's Call for Data Website.	Please refer to the credible data requirements and DWQ's Call for Data Website.
Aluminum	Dissolved	7429-90-5	X	Accompanying Field pH Measurement AND Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Antimony	Total	7440-36-0			
Arsenic	Dissolved	7440-38-2	X		Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Arsenic (Trivalent)	Dissolved	7440-38-2	O - DWQ unable to routinely measure this parameter due to analytical constraints		(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Asbestos	Total	1332-21-4			
Barium	Dissolved	7440-39-3	X		Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Beryllium	Dissolved	7440-41-7	X		Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Boron	Total	7440-42-8	X		
Cadmium	Dissolved	7440-43-9	X	Accompanying Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Calcium	Dissolved	7440-70-2	X	Accompanying Magnesium, Dissolved for Hardness calculation	Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Chromium	Dissolved	7440-47-3	X		Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.

Chromium (Hexavalent)	Dissolved	18540-29-9	O - DWQ unable to routinely measure this parameter due to analytical constraints		(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Chromium Trivalent	Dissolved	16065-83-1	O - DWQ unable to routinely measure this parameter due to analytical constraints	Accompanying Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Copper	Dissolved	7440-50-8	X	Accompanying Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Iron	Dissolved	7439-89-6	X		(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Lead	Dissolved	7439-92-1	X	Accompanying Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Magnesium	Dissolved	7439-95-4	X	Accompanying Calcium, Dissolved for Hardness calculation	Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.

Mercury	Dissolved	7439-97-6	X		(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Nickel	Dissolved	7440-02-0	X	Accompanying Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Selenium	Dissolved	7782-49-2	X		(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Silver	Dissolved	7440-22-4	X	Accompanying Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
Thallium	Total	7440-28-0			
Uranium	Total	7440-61-1			
Zinc	Dissolved	7440-66-6	X	Accompanying Hardness or Calcium, Dissolved AND Magnesium, Dissolved Measurement	(1) The dissolved metals method involves filtration of the sample in the field, acidification of the sample in the field, no digestion process in the laboratory, and analysis by EPA approved laboratory methods for the required detection levels. (2) Recommended that the **Total** fraction result value is also submitted in the data package for QA/QC purposes.
E. coli	n/a	n/a	X		
Beach Closures		n/a			
Drinking Water Closures		n/a			

Fish Kills		n/a			
Harmful Algal Blooms: Cyanobacteria cell density		n/a	X - assessments on hold	X	for Lake Samples only
Harmful Algal Blooms: Cyanobacteria taxanomic composition (i.e., phytoplankton)		n/a	X - assessments on hold	X	
Harmful Algal Blooms: Cyanobacteria toxin concentrations		n/a	X - assessments on hold	X	
Nitrate as N	Total and/ or Dissolved	14797-55-8		X	
Total Ammonia as N	Total	7664-41-7		X	Accompanying Field pH AND Field Water Temperature Measurement
Total Phosphorus as P	Total	7723-14-0		X	
1,1,1-Trichloroethane	Total	71-55-6			
1,1,2,2-Tetrachloroethane	Total	79-34-5			
1,1,2-Trichloroethane	Total	79-00-5			
1,1-Dichloroethane	Total	75-34-3			
1,1-Dichloroethylene	Total	75-35-4			
1,2 -Trans-Dichloroethylene	Total	156-60-5			
1,2,4-Trichlorobenzene	Total	120-82-1			
1,2-Dichlorobenzene	Total	95-50-1			
1,2-Dichloroethane	Total	107-06-2			
1,2-Dichloropropane	Total	78-87-5			

1,2-Diphenylhydrazine	Total	122-66-7
1,3-Dichlorobenzene	Total	541-73-1
1,3-Dichloropropene	Total	542-75-6
1,4-Dichlorobenzene	Total	106-46-7
2,4,5-TP	Total	93-72-1
2,4,6-Trichlorophenol	Total	88-06-2
2,4-D	Total	94-75-7
2,4-Dichlorophenol	Total	120-83-2
2,4-Dimethylphenol	Total	105-67-9
2,4-Dinitrophenol	Total	51-28-5
2,4-Dinitrotoluene	Total	121-14-2
2,6-Dinitrotoluene	Total	606-20-2
2-Chloroethyl vinyl Ether	Total	110-75-8
2-Chloronaphthalene	Total	91-58-7
2-Chlorophenol	Total	95-57-8
2-Methyl-4,6-Dinitrophenol	Total	534-52-1
2-Nitrophenol	Total	88-75-5
3,3'-Dichlorobenzidine	Total	91-94-1
3-Methyl-4-Chlorophenol	Total	59-50-7
4,4-DDD	Total	72-54-8
4,4-DDE	Total	72-55-9
4,4'-DDT	Total	50-29-3
4-Bromophenyl Phenyl Ether	Total	101-55-3
4-Chlorophenyl Phenyl Ether	Total	7005-72-3
4-Nitrophenol	Total	100-02-7
Acenaphthene	Total	83-32-9
Acenaphthylene	Total	208-96-8

Acrolein	Total	107-02-8
Acrylonitrile	Total	107-13-1
Alachlor	Total	15972-60-8
Aldrin	Total	309-00-2
alpha-BHC	Total	319-84-6
alpha-Endosulfan	Total	959-98-8
Anthracene	Total	120-12-7
Atrazine	Total	1912-24-9
Benzene	Total	71-43-2
Benzidine	Total	92-87-5
Benzo(a)Anthracene	Total	56-55-3
Benzo(a)Pyrene	Total	50-32-8
Benzo(b)Fluoranthene	Total	205-99-2
Benzo(ghi)Perylene	Total	191-24-2
Benzo(k)Fluoranthene	Total	207-08-9
beta-BHC	Total	319-85-7
beta-Endosulfan	Total	33213-65-9
Bis(2-Chloroethoxy)Methane	Total	111-91-1
Bis(2-Chloroethyl)Ether	Total	111-44-4
Bis(2-Chloroisopropyl)Ether	Total	39638-32-9
Bis(2-Ethylhexyl)Phthalate	Total	117-81-7
Bromoform	Total	75-25-2
Butylbenzyl Phthalate	Total	85-68-7
Carbofuran	Total	1563-66-2
Carbon Tetrachloride	Total	56-23-5
Chlordane	Total	57-74-9

Chlorobenzene	Total	108-90-7
Chlorodibromomethane	Total	124-48-1
Chloroethane	Total	75-00-3
Chloroform	Total	67-66-3
Chlorpyrifos	Total	2921-88-2
Chrysene	Total	218-01-9
Dalapon	Total	75-99-0
Di(2-ethylhexl)adipate	Total	103-23-1
Diazinon	Total	333-41-5
Dibenzo(a,h)Anthracene	Total	53-70-3
Dibromochloropropane	Total	96-12-8
Dichlorobromomethane	Total	75-27-4
Dichloroethylene (cis-1,2)	Total	156-59-2
Dieldrin	Total	60-57-1
Diethyl Phthalate	Total	84-66-2
Dimethyl Phthalate	Total	131-11-3
Di-n-Butyl Phthalate	Total	84-74-2
Di-n-Octyl Phthalate	Total	117-84-0
Dinoseb	Total	88-85-7
Dioxin	Total	1746-01-6
Diquat	Total	85-00-7
Endosulfan Sulfate	Total	1031-07-8
Endothall	Total	145-73-3
Endrin	Total	72-20-8
Endrin Aldehyde	Total	7421-93-4
Ethylbenzene	Total	100-41-4
Ethylene Dibromide	Total	106-93-4
Fluoranthene	Total	206-44-0
Fluorene	Total	86-73-7

gamma-BHC (Lindane)	Total	58-89-9	
Glyphosate	Total	1071-83-6	
Haloacetic acids	Total	n/a	
Heptachlor	Total	76-44-8	
Heptachlor epoxide	Total	1024-57-3	
Hexachlorobenzene	Total	118-74-1	
Hexachlorobutadine	Total	87-68-3	
Hexachlorocyclohexane (Lindane)	Total	58-89-9	
Hexachlorocyclopentadiene	Total	77-47-4	
Hexachloroethane	Total	67-72-1	
Ideno 1,2,3-cdPyrene	Total	193-39-5	
Isophorone	Total	78-59-1	
Methoxychlor	Total	72-43-5	
Methyl Bromide	Total	74-83-9	
Methyl Chloride	Total	74-87-3	
Methylene Chloride	Total	75-09-2	
Mirex	Total	2385-85-5	
Naphthalene	Total	91-20-3	
Nitrobenzene	Total	98-95-3	
N-Nitrosodimethylamine	Total	62-75-9	
N-Nitrosodi-n-Propylamine	Total	621-64-7	
N-Nitrosodiphenylamine	Total	86-30-6	
Nonylphenol	Total	84852-15-3	
Oxamyl (vydate)	Total	23135-22-0	
Parathion	Total	56-38-2	
PCB's	Total	1336-36-3	
Pentachlorophenol	Total	87-86-5	Accompanying Field pH Measurement

Phenanthrene	Total	85-01-8	
Phenol	Total	108-95-2	
Picloram	Total	1918-02-1	
Polychlorinated Biphenyls	Total	1336-36-3	
Pyrene	Total	129-00-0	
Simazine	Total	122-34-9	
Styrene	Total	100-42-5	
Tetrachloroethylene	Total	127-18-4	
Toluene	Total	108-88-3	
Toxaphene	Total	8001-35-2	
Trichloroethylene	Total	79-01-6	
Vinyl Chloride	Total	75-01-4	
Xylenes	Total	1330-20-7	
Tributyltin	Dissolved	n/a	Please refer to appropriate method for QC requirements and to ensure that method sensitivity is sufficient to accurately quantify constituent concentration from natural waters
Gross Alpha	Total	12587-46-1	
Gross Beta (Combined)	Total	12587-47-2	
Radium 226	Total	13982-63-3	
Radium 228	Total	15262-20-1	
Strontium 90	Total	10098-97-2	
Tritium	Total	10028-17-8	

NOTE: This list and accompanying information may not be complete. Please check UAC R317-2 for the most current list of parameters and the 303(d) Methods for additional information on what parameters are assessed, readily available, and credible.

Appendix 2

DATA QUALITY GUIDELINE EXAMPLES

DWQ Sampling Analysis Plan Requirements

Revision 1.1 July 6, 2016

Utah Division of Water Quality

Checklist of Essential Elements for Sampling and Analysis Plans (SAPs)

Monitoring Project/Program:____

Preparer(s):____

Reviewer(s):____

Date Submitted for Review:____

Date of Review:____

Parent QAPP or Equivalent Document:_____________________________________

Instructions for Preparers:

As required by DWQ's Quality Assurance Program Plan for Monitoring Programs (DWQ QAPP), ***any monitoring activity*** conducted or overseen by DWQ ***must*** have a SAP, excluding one-time response actions (such as a spill) or compliance sampling. The SAP must be reviewed and revised for each field season/monitoring year. SAPs are approved and kept on file by the Monitoring Section QA Staff and must be distributed to everyone involved with a monitoring project. Use the template and checklist below to help create your SAP. The SAP should contain or reference all the elements in this checklist but need not have the same format. Rather than extensive text, include as much information as possible in the form of tables, which are easier to refer to in the field.

The SAP should be a usable, stand-alone document that can be taken into the field by Monitors. Therefore, if you choose to use an element directly from the DWQ QAPP that needs to be viewable when reading the SAP, copy and paste it into the SAP rather than just referencing the QAPP so that Monitors do not have to read through both documents while in the field. The Monitoring- and Data and Information-Section's QA Staff are available to assist you in preparing your SAP and you may view other DWQ SAP examples on the Monitoring Council Webpage at http://www.waterquality.utah.gov/Monitoring/Council.

Definitions and Acronyms:

DPM - Designated Project Manager. As defined by DEQ's Quality Management Plan (QMP), the DPM is the staff member responsible for a specific project and has immediate managerial or technical control of that project. The DPM is responsible for specifying the quality of the data required for each project and initiating corrective actions when quality control is not being met. The DPM may also be a program manager. The DPM is responsible for designing monitoring strategies, setting project-specific data quality objectives (DQOs), and developing project-specific SAPs. DPMs are responsible for making sure all personnel involved with the project are briefed and/or trained on the procedures to be used. Roles of DPMs are further discussed throughout the DWQ QAPP.

IR –Integrated Report

SMP – Strategic Monitoring Plan

Introduction and Background Information (This can be brief if it references some previous documentation or the IR or SMP, etc.)

- Site history
- Regulatory framework
- Summary of previous investigations
- Location/characteristics of any known pollution sources at the site or in the area
- Site location map showing area at a broad scale

Objectives and Design of the Investigation (This should be very specific to the project and should be a result of discussions between DPM, data users, stakeholders, science panel, etc.)

- Specific objectives of this study (describe how they support broader program goals/objectives or regulatory framework)
- Study design (i.e. spatial/temporal limits, sample characteristics, the smallest population, area, volume, or time frame for which decisions will be made).
- Representative sampling conditions and instructions for field personnel if they encounter non-representative sampling conditions
- Parameters of concern (narrative – must conform to list(s) in sections 4 and 6)
- Number, location, and frequency of samples and quality control samples
- Sampling Site Locations
- Rationale for site selection
- Site map(s) showing sampling locations and “control” sites and any other pertinent features such as land use, etc. within the sampling area

Special Precautions and Safety Plan

- Detailed itemization of any specific safety concerns
- Reference to an applicable safety plan
- Any additional safety training required for project
- Documentation that field personnel comply with your Invasive Species Plan and SOPs to prevent spread of invasive species

Field Sampling Methods and Documentation

- Any special training needed beyond those discussed in DWQ QAPP and where training documentation will be kept
- A table listing each field instrument to be used (equipment, describe operation or indicate where operation manual is kept for field event, include calibration procedures, if any)
- A table listing each sampling method to be used (sampling equipment if needed, cite method in SAP, attach applicable SOPs)
- Operation of any sampling equipment used or location of operation manual for field event, include decontamination procedures, if any, attach applicable SOPs
- Equipment lists and sampling trip organizing checklists if not found in SOPs
- Corrective actions for problems that may occur in the field
- Field documentation required and how field records shall be generated and stored

Laboratory Sample Handling Procedures

- Sample containers, preservatives, holding times

- Field documentation (COC) and sample labeling procedures
- Shipping plan for sample transport to laboratory

Analytical Methods and Laboratory Documentation

- Chemical – list parameter, cite preparation method and analytical method, list required sensitivity or detection limits
- Biological – cite method or desired taxonomic level and organism target count, etc.
- Required reporting procedures (e.g. hardcopy, electronic deliverables) and turn-around times
- Be sure DWQ has obtained QA documentation for each laboratory used (check with Monitoring Section QA Staff), reference this information and any new/research analytical methods being used (obtain these protocols if available from lab)
- List the required data package contents from the analyzing laboratories [or reference a service contract or Memorandum of Understanding (MOU)]

Project Quality Control Requirements

- Table of QC limits for field instruments (operation range, accuracy, and precision)
- Table listing each Data Quality Indicator (precision, accuracy, bias, etc.), how it will be measured, and the performance criteria against which it will be evaluated (use the table in the DWQ QAPP and adapt it to this project if needed): (1) analytical (internal to lab) QC limits for chemical analyses (acceptable precision, accuracy, and negative control – lab method blank, (2) field sample QC limits for chemical analyses [Acceptable precision (field duplicates) and negative control (field or trip blanks)], and (3) QC limits for biological analysis [Acceptable precision (% diff in enumeration, 5 taxonomic difference)]
- QC limits, schedule, and descriptions of planned field/lab audits/assessments
- Data quality assurance review procedures: (1) describe system of data qualification, (2) describe measure of completeness relative to planned design, and (3) corrective actions for non-conformance

Data Analysis, Record Keeping, and Reporting Requirements

- Data interpretation approach (include means to temper decision-making if limited completeness of design occurs)
- Project record keeping procedures and archive (hardcopies, electronic data)
- How and when DPM wishes to be notified of available laboratory/field results
- Expected content and format of final project report and who will receive original/copies.

Schedule and Budget

- Table or figure showing project schedule with key project milestones
- List funding sources for project and include anticipated equipment, consumables, personnel purchases/costs
- Sample costs/lab resources per fee schedule

Project Team and Responsibilities

- Project team responsibilities and personnel
- Sampling personnel
- Subcontractors (e.g. chemical and biological labs)

References (include references to DWQ-prepared documents)

Appendices and Attachments (include SOPs, chain of custody forms, field forms, sample labels, etc.

Example Field Observation Form for Grab Samples

Version 2.0

Monitoring Location ID: ____________________

Monitoring Location Name: ____________________

Monitoring Location Description: ____________________

Sample Date: ____________________

Sample Time: ____________________

Check the water color desciption that best fits the sampling location:

□ Brown/Gray (turbid) □ Black □ Clear □ Stained (tea-look) □ Green □ Other (describe) ____________________

Indicate the level of coverage of *Didymosphenia geminata* (didymo) in reach

□ Absent (0%) □ Sparse (<10%) □ Moderate (10-75%) □ Heavy (>75%)

<-- Example of didymo.
Photo fromhttp://www.wvdnr.gov/fishing/didymo.shtm

Indicate the level of coverage of Filmentous algae in reach

□ Absent (0%) □ Sparse (<10%) □ Moderate (10-75%) □ Heavy (>75%)

<-- Example of filamentous algae
Photo from http://www.dep.wv.gov/WWE/Programs/
/wqs/Pages/FilamentousAlgaeinWestVirginia.aspx

(Lake sampling) Is there blue green algae? □ Y □ N

<-- Example of blue green algae
Photo courtesy of Utah County Health Dept

Is there an Algal Mat? ☐ Y ☐ N Fish kill?: ☐ Y ☐ N Number of Fish Observed: ______ Type of Fish: ____________________

Does the underside of the rock look black AND have a straong sulfur/ rotten eggs smell? ☐ Y ☐ N Sheen present?: ☐ Y ☐ N Odor at the site?: ☐ Y ☐ N

Anthropogenic disturbances present at site that may affect sample results? ☐ Y ☐ N

If yes to any above, explain here: ____________________

Were any photos take from the site visit? ☐ Y ☐ N

Circle all weather codes that apply

1 Windy
2 Dust
3 Rain in the last 24/48 hrs
4 Rain (presently
5 Runoff (indicate if you are sampling/ trying to capture runoff)

Circle all flow codes that apply

1 Standing Water (no flow BUT measurement/ sample taken
2 Measurement/ sample taken from backwater
3 Swift and deep
4 Shallow/trickle
5 Ice Present: evidence of flow beneath surface
6 Ice Present: unsure if flowing beneath surface

Circle all field condition codes that apply

1 Fire (evidence of)
2 Landslide/ Mudslide (evidence of)
3 Flooding (evidence of)
4 Presently Flooding/ Water Rising
5 Livestock (present)
6 Livestock (not present but evidence of)
7 Beaver Dam (sample taken upstream)
8 Beaver Dam (sample taken downstream)
9 Dam (sample taken downstream of resevoir tailrace)

FIELD COMMENTS: ____________________

Other comments/concerns/issues: ____________________

Appendix 3

APPLICATION OF SECONDARY REVIEW PROCESS

Data Concern	Secondary Review Process	Data Application
Temporal variation within a dataset	Insufficient sampling frequency within an assessment period of record	Individual data records
Bias in sampling design	(1) Event monitoring (review flow, weather, and spill/response/incident data; narrative criteria; field observations and photographs; satellite imagery; other data types collected in same (and around the) period of concern, etc.), (2) sample time of day (literature review to determine if parameter is impacted by the time of day sample is collected), (3) sampling a specific season (unless approved by DWQ in a SAP or is data-type specific (e.g., *E. coli* sampling during the recreation season)], (4) and locational bias	Individual data records
Data quality	(1) Quality Assurance Program Plan For Environmental Data Operations, (2) field calibration documentation, (3) laboratory methods, (4) standard operating procedures, (5) demonstration of capability (if applicable to data type), and (6) discussion with sample collector	Individual data records, and/or, parameter(s) in period of record, and/or monitoring location
Wrongly monitored	(1) Measured point source (vs. main water body), review imagery of area, flow, etc., (2) waterbody type DWQ does not assess, (3) grab sample vs. composite, (4) flow conditions (too low or not flowing), and (5) field observation that impacts quality of data	Individual data records and/or monitoring location
Outlier	(1) Need more than a statistical test. Should be based on scientific or QA basis, (2) QA/QC field sampling blanks, duplicates/replicate, (3) laboratory Analytical Batch QC, (4) value is nonsensical (e.g., cannot be measured with field/laboratory method), and (5) refer to data quality (above)	Individual data records
Magnitude of exceedance	(1) Significant figures and (2) narrative criteria review	Individual data records
QA/QC concerns	(1) Holding time, (2) laboratory comment, (3) dilutions, spikes, and (4) other laboratory QC performance checks	Individual data records

Data Concern	Secondary Review Process	Data Application
Assessment unit grouping/spatial variation	(1) Multiple locations not grouped correctly (either should or should not have been grouped), (2) AUs where water quality criterion exceedances are clearly isolated to a relatively small, hydrologically distinct portion of the larger AU and may need to be re-segmented to more accurately reflect that variation in water quality (please refer to 303(d) Assessment Methods section on "Assessment Unit Re-segmentation" for more information on the process), and (3) a surface water (e.g., a spring or seep) was sampled in the AU and was assessed but additional information indicates that the surface water may not have been flowing or did not connect, contribute, or influence downstream water quality	Monitoring location
Credible data	(1) Data type applied incorrectly and (2) data type not considered. (Data type must meet credible and representative data requirements in 303(d) Assessment Methods, and if included in the assessment analysis would result in a change in the categorization of the waterbody and parameter	Individual data records and/or parameter(s) in period of record, monitoring location
Other	(1) Parameters wrongly grouped (by CAS, fraction, or methods), (2) data type is laboratory measurement (when the data assessment requires a field measurement), (3) IR QA/QC flagged data, and (4) errors in standards	Individual data records. Entire parameter assessments
Conflicting DO assessments between grab and high frequency data	Scenario: Two types of data available at the site(s) (i.e., grab or high frequency data) do not have the same preliminary assessment result. Reviews to consider: (1) sampling period captured, (2) duration of conditions below criterion, (3) frequency of recurrent low DO events, (4) magnitude of exceedance, (5) spatial extent of low DO, and (6) diel flux of DO	Individual data records. Entire parameter assessments
Representativeness and Environmental Factors*	Examples of extreme events include the following: (1) accidental spills of toxic chemicals, (2) scouring storm flows that lead to diminished aquatic-life beneficial uses, and (3) extreme drought conditions. Given the scope of these assessments, it is not always possible to identify where such circumstances may be influencing a specific sample, but DWQ will consider any evidence presented that a sample is not representative of ambient conditions. Examples of such a review may include reviewing flow, weather, spill data, narrative criteria, field observations and photographs, satellite imagery, other data types collected in the same (and around the) period of concern, etc.	Individual data records

Data Concern	Secondary Review Process	Data Application
Pollution Indicators	Secondary reviewers will incorporate indicator data into assessment category determinations, relying on multiple lines of evidence, including pollution indicator thresholds, the presence or absence of other indicator-associated water quality issues, potential pollutant sources, and other site or watershed-specific knowledge to determine whether listing or delisting on a pollution indicator parameter is appropriate or whether to prioritize waterbodies for additional monitoring.	(1) Pollution indicator evaluations will be posted with the report(s (e.g. exceedance counts & frequencies), so DWQ programs and stakeholders can consider the results when planning for future monitoring, studies, evaluations, etc, (2) pollution Indicator evaluations may be included in a narrative assessment/standard not supporting or supporting assessment decision, (3) pollution indicators may be reported by the IR as a cause of pollution impairment, and (4) pollution indicators may be reported by the IR as the source of an impairment

*Footnote: Where these conditions are present in a dataset, DWQ will run the analysis without the extreme events/data record and will apply and document an appropriate assessment result for the waterbody using the methods outlined below.
Category 1: Supporting: If analyses with and without the extreme events are supporting (Category 1.
Category 2: No evidence of impairment: If analyses with the extreme events are supporting (Category 1), but the analyses without the extreme events show no evidence of impairment (Category 2)
Category 2: No evidence of impairment: If analyses with and without the extreme events do not indicate evidence of impairment (Category 2)
Category 2: No evidence of impairment: If analyses with the extreme events are evidence of impairment (Category 3 with exceedances), but the analyses without the extreme events show no evidence of impairment (Category 2)
Category 2: No evidence of impairment: If analyses with the extreme events are not supporting (Category 5), but the analyses without the extreme events show no evidence of impairment (Category 2)
Category 3: Insufficient Data, Exceedances: If analyses with and without the extreme events show evidence of impairment (Category 3)
Category 3: Insufficient Data, Exceedances: If analyses with the extreme events are not supporting (Category 5), but the analyses without the extreme events are supporting (Category 1)
Category 5: Not supporting: If analyses with the extreme events are evidence of impairment (Category 3), but the analyses without the extreme events are not supporting (Category 5)
Category 5: Not supporting: If analyses with the extreme events are not supporting (Category 5), but the analyses without the extreme events show evidence of impairment (Category 3)
Category 5: Not supporting: If analyses with and without the extreme events are not supporting (Category 5)

Appendix 4

SUMMARIZING ASSESSMENTS FROM SITE TO ASSESSMENT UNIT LEVEL

Going from multiple beneficial uses assessments for a parameter (i.e., a Parameter Summary Report) to One Parameter Category per Monitoring Location ID (MLID)*.

IR Analysis Action: 3: (Insufficient Data with Exceedances)

- 1,2, or 3 exceedances (with no data rejected for a use). Param Cat: 3 insufficient data with exceedances → Param EPA Cat: 3
- 1,2, or 3 exceedances (with some data rejected for a use). Param Cat: 3 insufficient data with exceedances → Param EPA Cat: 3
- 0 exceedances (with no data rejected for a use). Param Cat: 3 insufficient data with no exceedances → Param EPA Cat: 3
- 0 exceedances (with some data rejected for a use). Param Cat: 3 insufficient data with no exceedances → Param EPA Cat: 3
- All data removed for every use. Param Cat: 3 insufficient data because not assessed → Param EPA Cat: 3

IR Analysis Action: Not Assessed

- All data removed for every use. Param Cat: 3 insufficient data because not assessed → Param EPA Cat: 3

IR Analysis Action: Not Assessed

- IR Analysis Comment: "Non-Rejected data available for MLID/AU, but data available for individual use assessment was all rejected." Param Cat: 3 insufficient data because not assessed →Param EPA Cat: 3

IR Analysis Action: Not Assessed

- IR Analysis Comment: "No Uses assigned to site." Param Cat: 3 insufficient data because not assessed →Param EPA Cat: 3

IR Analysis Action: Assessed By Use

- FS Only →Param EPA Cat: 1
- FS Only + some data rejected by use →Param EPA Cat: 2
- Contains an NS →Param EPA Cat: 5
- All data was rejected for a use →Param EPA Cat: 3, insufficient data because not assessed
- FS Only + exceedances by Use + some data rejected by use →Param Cat: 3 insufficient data with exceedances →Param EPA Cat: 3
- FS Only + no exceedances by Use + some data rejected by use →Param EPA Cat: 2
- FS Only + exceedances by Use + NO data rejected by use →Param Cat: 3 insufficient data with exceedances →Param EPA Cat: 3
- FS Only + no exceedances by Use + NO data rejected by use →Param EPA Cat: 2
- Exceedances by Use + some data rejected by use →3 insufficient data with exceedances →Param EPA Cat: 3
- No exceedances by Use + some data rejected by use →3 insufficient data with no exceedances →Param EPA Cat: 3

- Exceedances by Use + NO data rejected by use →3 insufficient data with exceedances →Param EPA Cat: 3
- No exceedances by Use (NO exceedances) + NO data rejected by use →3 insufficient data with no exceedances →Param EPA Cat: 3
- BOD, TP**, and Nitrate (for non 1C uses) →Parameter Cat: MLID Cat =3 Further Investigations →Param EPA Cat: 3

*Note: after this rollup there will be multiple parameter assessment categories for one MILD. For example, MLID "X" will have one Iron, one Copper, one Temperature, one Dissolved Oxygen, etc.

Going from many Parameter Categories within an MLID to 1 Category for the MLID take MLID_Param Cats and Group them by MLID. Then assign the MLID category by the following logic:

- **Parameter Cat = 5 →MLID Cat = 5 AND MLID EPA Cat = 5
- Parameter Cat = 3 with exceedances →MLID Cat =3 with exceedances AND MLID EPA Cat = 3
- Parameter Cat = 1 → (Cat1 Matrix Check is a match) →MLID Cat =1 AND MLID EPA Cat = 1
- Parameter Cat = 1 → (Cat1 Matrix Check is a NOT a match) → MLIDCat =2 AND MLIDEPACat = 2
- Parameter Cat = 2 →MLID Cat =2 AND MLID EPA Cat = 2
- Parameter Cat = 3 further investigations needed →MLID Cat =3 further Investigations Needed AND MLID Cat = 3
- Parameter Cat = 3 no exceedances →MLID Cat =3 no exceedance AND MLID EPA Cat = 3
- Parameter Cat = 3 not assessed →MLID Cat =3 no assessed AND MLID EPA Cat = 3

** Should be able to see a concatenation of the uses for a parameter that created a Category 5 (needs validation too)

Going from many MLID Categories within an Assessment Unit (AU) to 1 Category for the AU take MLID Cats and Group them by AUID. Then assign the AUID category by the following logic:

- **MLID Cat = 5 →AUID Cat = 5 AND AUID EPA Cat = 5
- AUID Cat = 5 (and TMDL in Place) →AUID Cat = 5 AND AUID EPA Cat = 4A
- AUID Cat = 5 (and non-TMDL in Place) →AUID Cat = 5 AND AUID Cat = 4B
- **MLID Cat = 5 → (and TMDL is in place & only parameter assessed for that AUID is being considered) →AUID Cat = 4a AND AUID EPA Cat = 4A
- AUID Cat = 5 (and non-TMDL in place) →AUID Cat = 4a AND AUID EPA Cat = 4B
- **MLID Cat = 5 → (and non-TMDL is in place & only parameter assessed for that AUID is being considered) →AUID Cat = 4b AND AUID Cat = 4B
- MLID Cat = 3 with exceedances →AUIDCat =3 with exceedances AND AUID EPACat = 3
- MLID Cat = 2 →AUID Cat =2 AND AUID EPA Cat = 2
- MLID Cat = 1 →AUID Cat =1 AND AUID EPA Cat = 1
- MLID Cat = 3 further investigations needed →AUID Cat =3 further investigations needed AND AUID Cat = 3
- MLID Cat = 3 no exceedances →AUID Cat =3 no exceedances AND AUID Cat = 3
- MLID Cat = 3 not assessed →AUID Cat =3 not assessed AND AUID Cat = 3

** Should be able to see a concatenation of the uses for a parameter that created a 5 category (needs validation too)

Extra Checks: Biological assessments only assess 3A, 3B, 3C, or 3D beneficial uses. For an AU to be Category 1, all assigned beneficial uses must be assessed. Query AUs with biological assessments in them and confirm that the AU assessment category follows the roll up process described in this document. One example: a biological assessment is performed for an AU and the AU is Category 1 (should be changed to a Category 2).

Appendix 5

4B SUBMISSION POLICIES AND PROCEDURES: PROCESS FOR DETERMINING CATEGORY 4B CLASSIFICATION

An approved Category 4B demonstration plan is an alternative to listing an impaired segment on the state's 303(d) list. A Category 4B demonstration plan, when implemented, must ensure that all applicable water quality standards are met through agreed-upon pollution-control mechanisms within a reasonable time period. These pollution-control mechanisms can include approved compliance schedules for capital improvements or plans enforceable under other environmental statutes (such as Comprehensive Environmental Response, Compensation, and Liability Act) and their associated regulations. A Category 4B demonstration can be used for segments impaired by point sources and/or nonpoint sources. Both DWQ and EPA must accept a Category 4B demonstration plan for the affected segment to be placed in Category 4B. In the event that the Category 4B demonstration plan is not accepted, the segment at issue will be included on the 303(d) list, Category 5.

Generally speaking, the following factors will be considered necessary for Category 4B demonstration plan acceptance: 1) appropriate voluntary, regulatory, or legal authority to implement the proposed control mechanisms through permits, grants, compliance orders for Utah Pollutant Discharge Elimination System permits, etc.; 2) existing commitments by the proponent(s) to implement the controls; 3) adequate funding; and 4) other relevant factors appropriate to the segment.

The following evidence must be provided as a rationale for a Category 4B demonstration plan:

A statement of the problem causing the impairment

1. A description of
    a. The pollution controls to be used
    b. How these pollution controls will achieve attainment with all applicable water quality standards
    c. Requirements under which those pollution controls will be implemented
2. An estimate of the time needed to meet all applicable water quality standards.
3. A schedule for implementation of the necessary pollution controls.
4. A schedule for tracking progress, including a description of milestones.
5. A commitment from the demonstration plan proponent to revise the implementation strategy and pollution controls if progress toward meeting all applicable water quality standards is not shown.

Timing for proposal submittal and acceptance by DWQ and EPA

- Category 4B demonstration plans should be submitted to DWQ by July 1 of even numbered years, in order for DWQ to submit the plan to EPA by September 1 of even numbered years. Parties are encouraged to work with DWQ before this date as states are the entity required to submit these plans to EPA.
- Acceptance from EPA must be obtained by October 31 of even numbered years; otherwise, DWQ will continue to propose that the segment in question is included on the current cycle's 303(d) list.
- If EPA and DWQ accept the Category 4B plan, DWQ will notify the Water Quality Board and the public through proposed statement of basis and purpose language in its proposal that a Category 4B demonstration plan is accepted and is appropriate for this segment.

EPA has several documents that contain additional information on Category 4B demonstration requirements, including: "2006 Integrated Report Guidance"; and "Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions".

Appendix 6

Guidelines

Does the AU/AU-parameter combination warrant further investigation? (See 303(d) Assessment Methods for more details).

What was the original cause of impairment for the AU?

What IR assessment cycle was the AU and parameter first listed?

- What datasets were used for that listing (e.g., the agency/sample collector)?
- What was the period of record? (If unknown, use the longer period of record).
- What MLIDs are in the AU?

For impairments listed in the previous assessment cycle, compile the data. (Query data for all MLIDs in the AU. Ignore waterbody types).

- What MLID has > = 1 exceedances?
- For MLIDs with impairments/exceedances and not assessed in the current IR cycle: why did DWQ (or someone else) not resample? (Provide documentation as to why resampling was not done and why (by not re-sampling) the site should meet water quality standards. Please refer to the good cause descriptions in the 303(d) methods. Check for good cause. If it is a reason other than good cause, the documentation will need to be EPA-approved).
- Where all MLIDs with exceedances are assessed in the current IR cycle: (1) For MLIDs with impairments/exceedances and the current parameter assessment for the MLID is not 1, 2, or 3 no exceedances –> no delisting or (2) is the current parameter Category 1, 2, or 3 no exceedances? Was there a secondary review applied to this parameter (e.g., an assessment category overwrite for the whole):

    a. Parameter? If the secondary review created a Category 1, 2, or 3 no exceedances, the secondary review justification will need to be EPA-approved if it is considered to be a delisting. Check for good cause.
    b. MLID? If the secondary review created a Category 1, 2, or 3 no exceedances, the secondary review justification will need to be EPA-approved if it is considered to be a delisting. Check for good cause.
    c. AU? If the secondary review created a Category 1, 2, or 3 no exceedances, the secondary review justification will need to be EPA-approved if it is considered to be a delisting. Check for good cause.

- Is the current parameter Category 1, 2, or 3 no exceedances? (No secondary review applied to this parameter) → Check for good cause.

Note: Need to confirm that if no new data are collected, the new assessment analysis is not a Category 1,2, or 3 no exceedances, because the exceedances are out of the period of record for assessment analysis (i.e., not a delisting).

Double check before delisting:

- If the current Parameter Category 1, 2, or 3 no exceedances – what is the oldest date in that period of record for that MLID/Parameter combo in the current assessment cycle?
- For every MLID in the AU (ignore waterbody types), compile all data for that parameter between the max date from the cycle the parameter was first listed and the oldest date in that period of record for that MLID/Parameter combo in the current assessment cycle?
- What MLID has > = 1 exceedances

- For MLIDs with impairments/exceedances and not assessed in the current IR cycle: why did DWQ (or someone else) not resample? (Provide documentation as to why resampling was not done and why (by not re-sampling) the site should meet water quality standards. Please refer to the good cause descriptions in the 303(d) methods. If it is a reason other than good cause, the documentation will need to be EPA-approved). Check for good cause.
- Where all MLIDs with exceedance are assessed in the current IR cycle: (1) for MLIDs with impairments/exceedances and the current parameter assessment for the MLID is not 1, 2, or 3 no exceedances –> no delisting or (2) is the current parameter Category 1, 2, or 3 no exceedances? Was there a secondary review applied to this parameter (e.g., an assessment category overwrite for the whole):

    d. Parameter? If the secondary review created a Category 1, 2, or 3 no exceedances, the secondary review justification will need to be EPA-approved if it is considered to be a delisting. Check for good cause.
    e. MLID? If the secondary review created a Category 1, 2, or 3 no exceedances, the secondary review justification will need to be EPA-approved if it is considered to be a delisting. Check for good cause.
    f. AU? If the secondary review created a Category 1, 2, or 3 no exceedances, the secondary review justification will need to be EPA-approved if it is considered to be a delisting. Check for good cause.

- Is the current parameter Category 1, 2, or 3 no exceedances? (No secondary review applied to this parameter) →Check for good cause

Note: Need to confirm that if no new data are collected, the new assessment analysis is not a Category 1,2, or 3 no exceedances, because the exceedances are out of the period of record for assessment analysis.

EPA DELISTING CODES

Delisting Reason Code	Comment
WQS_NO_LONGER_THREATENED	Applicable WQS attained; threatened water no longer threatened
WQS_NEW_ASMT_METHOD	Applicable WQS attained, according to new assessment method
DELISTING_4C	Not caused by a pollutant (4c)
DELISTING_WQS_NOT_APPLICABLE	WQS no longer applicable
DELISTING_4B	Other pollution control requirements (4b)
DELISTING_4A	TMDL Approved or established by EPA (4a)
WQS_NEW_DATA	Applicable WQS attained; based on new data
WQS_LISTING_INCORRECT	Applicable WQS attained; original basis for listing was incorrect
REFINEMENT	Clarification of listing cause
WQS_RESTORATION_ACTIVITIES	Applicable WQS attained, due to restoration activities
WQS_RECOVERY_UNSPECIFIED	Applicable WQS attained; reason for recovery unspecified
DELISTING_NOT_IN_JURISDICTION	Listed water not in state's jurisdiction
WQS_STANDARDS_CHANGED	Applicable WQS attained, due to change in WQS
NOT_SPECIFIED	Not specified
DELISTING_NOT_WATER_OF_STATE	Water determined to not be a water of the state
DELISTING_ORIG_INCORRECT	Data and/or information lacking to determine WQ status; original basis for listing was incorrect

Appendix 7

TMDL PRIORITIZATION PROCESS

The Clean Water Act (CWA) requires total maximum daily loads (TMDLs) be developed for all impaired waterbodies on the 303(d) list. The CWA recognizes the many limitations in data, time, and staff resources to accomplish this, so the statute also requires states to prioritize where they will dedicate resources toward TMDL development. However, defining an impaired waterbody as high priority does not necessarily mean that a TMDL will be developed before lower priority segments Development of some high-priority TMDLs ,may take considerably longer due to data collection, stakeholder involvement, and other factors.

DWQ prioritizes impairments to human and ecological health as described in the Division of Water Quality's (DWQ) 303(d) vision document. These priorities translate into the protection and restoration of waters designated for culinary, recreational, and aquatic life uses. Considerations for TMDL prioritization in Utah also include the level of partner agency and stakeholder involvement and potential for restoration as defined by the Recovery Potential Screening tool. Other factors considered in setting TMDL priorities include programmatic needs such as permitting and addressing watershed-wide water quality issues.

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/16/2021	Mark Allen		**POLLUTANTS:** Heavy Metals bonded to sediment, not dissolved metals.	Assessments are based on existing water quality criteria (UAC R317-2) that do not include standards for sediment. Additional criteria for sediment bound metals would require water quality standards changes which are beyond the scope of the Integrated Report. Recommendations or comments on water quality standards can be provided to DWQ's Water Quality Standards Workgroup.	Out of Scope
2/16/2021	Mark Allen		**POLLUTION:** There needs to be a standard for heavy metals bonded to sediment which end up in Tibble Fork. Also, there should be signage of the heavy metals which are in Tibble Fork so the public can be alerted to wash off. Perhaps a wash station would be appropriate.	Assessments are based on existing water quality criteria (UAC R317-2) that do not include standards for sediment. Additional criteria for sediment bound metals would require water quality standards changes which are beyond the scope of the Integrated Report (IR). Recommendations or comments on water quality standards can be provided to DWQ's Water Quality Standards Workgroup. Recommendations for public health measures such as signage or wash stations are also beyond the scope of the IR. These recommendations should be referred to the appropriate local health agency.	Out of Scope
2/16/2021	Mark Allen		**UNKNOWN SOURCES:** Upper Mary Ellen Gulch, Yankee and Globe Mine Complexes need more remediation per EPA studies and recommendations.	DWQ appreciates the comment and underlying concern; however, this comment is not within the scope of the Integrated Report. There are two abandoned mine remediation activities under way in Mary Ellen Gulch. The first is a voluntary effort led by Snowbird resort focused on slope stabilization practices. Please contact Snowbirds Director of Sustainability, Hilary Arens (harens@snowbird.com) for up to date information. The second effort resulted from the the EPA Mary Ellen Gulch Preliminary Assessment (PA). Following the completion of the PA, Mary Ellen Gulch was referred to EPA's Removal Program for evaluation. The EPA Removal program is currently reviewing PA results and working with Snowbird and the Utah Department of Environmental Quality's Division of Environmental Response and Remediation to find a path forward. DWQ is unaware of the current status of this effort.	Out of Scope
2/16/2021	Mark Allen		**NATURAL CONDITIONS:** Tibble Fork is filling up with microloading of heavy metals. What is the clean up plan? Who has the responsibility for the clean up and what is the schedule for such?	DWQ appreciates the comment and underlying concern; however, this comment is not within the scope of the Integrated Report. There is currently no active plan for sediment metal remediation in Tibble Fork Reservoir. The Utah Department of Health is finalizing a Health Consultation to evaluate risks associated with sediment metals in Tibble Fork Reservoir. Once completed DWQ will coordinate with the appropriate state and federal agencies to determine the appropriate next steps.	Out of Scope
2/25/2021	David Richards		**A few specific comments upfront concerning RIVPACs models development.** What was the unit area used to develop models? There are three conflicting units in the draft: From Page 53. "Predictions of expected "E" taxa are obtained empirically from reference site collections made throughout Utah. Reference sites represent the reference conditions in different biogeographical settings throughout the state. " From Page 52. "Predictions of E are obtained empirically from reference sites that together are assumed to encompass the range of ecological variability observed among streams in the region where the model was developed." From page 53. "An extensive list of 74 GIS-based watershed descriptors is evaluated for potential predictor variables in models that predict the probability of membership within biological groups for sites not used in model construction". From Page 55. "Utah currently assesses watersheds based on established AUs." DWQ states the use of different biogeographical settings, region, watershed, and AUs for model development. It can't possibly be all four. Which unit was it? These differences will have major consequences on how the model is applied to streams, particularly E, the expected number of taxa the sole denominator and half of the equation in the so called easy to interpret model.	Biological assessments are conducted at the watershed scale using site-specific watershed characteristics. Watershed are delineated from each specific sample location upstream. Sites are then characterized using GIS-based characteristics that describe the specific sample location (e. g., elevation) or the range of conditions from the sample specific sample location upstream to the headwaters. The first two quotes are general statements about the need for reference sites to encompass the range of conditions and geographic settings. For biological assessments to be as broadly applicable as possible, the suite of all reference sites needs to capture natural variation in biological composition (first quote from p. 53) and the physical and chemical stream attributes that cause resident biota to differ among streams (second quote from p. 52). When models are constructed, site-specific, GIS-based watershed descriptors are used to quantify important watershed attributes (quote 3 from p. 53). Those attributes best able to differentiate among groups (clusters) of reference sites with similar biological composition are included in the final model. When the models are used to assess a new site, a chi-square test is conducted to ensure that it falls within the range of watershed attributes among all of the reference sites used for model construction. Biological assessments are ultimately conducted at the spatial scale of an Assessment Unit (AU). Occasionally, this involves the interpretation of multiples sample sites within AU watersheds, in which case any impairment within the AU results in an impairment decision. This "one out, all out" impairment determination process is consistent with how among site discrepancies are handled for all water quality parameters in the IR.	No Action

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/25/2021	David Richards		**E, expected number of taxa is irrelevant.** Choice of area is especially important for derivation of E, expected number of taxa. For example, whichever unit was used in DWQ models, the expected number of taxa, E would be the same within that unit. That is how the model is designed. E, is therefore a constant within any area unit be it region, watershed, AU, biogeographical setting, and dividing by that constant for all sample location benthic invertebrate results within that unit would be meaningless unnecessary confusing irrational and nonsensical. Division by a constant E would only result in O, the observed number of taxa in a sample, or as every aquatic ecologist is familiar with, the taxa richness metric.	E is not irrelevant, it is a site-specific prediction of the specific taxa expected in the absence of human-caused stress. O/E is more than richness. It is sensitive to shifts in composition. Many studies have been published in peer reviewed, scientific literature that demonstrate that O/E provides more precise and sensitive measure of stream condition that richness. Predictions of E are site-specific, so it is not true that E would be the same for all sites in, for instance, an AU. Watershed are delineated from the sample location upstream. The watershed predictors used to make E predictions either describe conditions at the collection site (e.g., latitude, minimum elevation) or the average conditions from the specific sample site upstream (e. g., watershed average of predicted mean monthly air temperature). For E to be the same for different sites all 15 predictor variables would need to be identical, which is highly unlikely. O is not the observed number of taxa; it quantifies the number of taxa observed that were predicted to occur based on composition observed among comparable reference site. This distinction is important because human-caused stress sometimes creates conditions that are favorable for taxa that would not naturally occur at the location. For instance, riparian degradation could increase stream temperature creating conditions favorable to warm water taxa. If the models are sufficiently accurate, these taxa would not be included in the calculation of O, which is one of the reasons why O/E is a more sensitive measure of human-caused stress than taxa richness.	No Action
2/25/2021	David Richards		**Website links useless** I also went to the links provided on page 52. The WCMAFE website had no information on how Utah DWQ models were made. Hence, there is no available mechanism to understand the model components and assumptions. For example, I have no way of knowing what reference condition expected taxa were for the Jordan River. As I have stated many, many, times to DWQ there is no reference condition for the Jordan River and no valid E can be used to evaluate. Also, the link to the EPA website was invalid.	Thank you for pointing out the dated website links. DWQ has updated the appropriate links in the methods and is working with the entities to ensure their links are updated. Each stream and river segment is unique; not just those along the Jordan River. RIVPACS uses real reference site data to estimate the most probable set of taxa that would occur at a given stream. In this sense, the model is heavily weighting reference sites that are physically/chemically similar to the assessed site when estimating the taxa that should occur (E). E is more than a general, hypothetical community that applies everywhere (unless a null model is used). Larger rivers offer more of a challenge to assess because they are more regional rather than isolated to a state. DWQ's model incorporates reference river locations from the Intermountain West rather than being limited to Utah-based locations. In addition, DWQ runs a chi-square test to ensure that each assessed site fits within the bounds of the model. Sites that fail this test are not used in the assessment. For example, the Jordan River sites passed that test and were appropriate for this model and assessment. As DWQ stated to the commenter previously, models require additional information and some instruction to be used properly, so they have traditionally been provided to interested stakeholders upon request. PRISM data are not proprietary and are freely available. They have been independently tested and validated. They are used by a very large community of scientists across a wide range of disciplines and are continually updated and corrected. Please visit EPA's StreamCAT website to access spatial base files used to develop RIVPACs models. StreamCAT includes PRISM data used in these models.	Methods Clarified (p. 49)

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/25/2021	David Richards		**River Invertebrate Prediction and Classification System Models Entire section.** Comment: There is no reason to justify using a single measure to describe highly complex biological integrity and report as one numeric index just to summarize into a single, easily interpretable number. Biological integrity/beneficial use is one of the main reasons DWQ conducts biological assessments, determines criteria, and sets regulations. UDWQ is mandated to protect beneficial uses, including aquatic life. To simplify biological integrity into one number just because it is easily interpretable (by who? DWQ trained biologists? Citizens of UT?) is a disservice to citizens of UT and is not the best protection criterion of our waterbodies. I do not know of any other state, federal, tribal, or county agency that relies solely on one biological assessment metric. Utah DWQ is the only one that does this, as far as I know. This section "River Invertebrate Prediction and Classification System Models" in the draft appears to be written primarily to justify the use of RIVPACS models by UDWQ. The draft states that 'Recently, many western states have adopted the RIVPACS model… such as Colorado, Montana, and Wyoming. These States indeed use O/E models, but the O/E metric is just one of many in a multimetric assessment program (see Table 1, DWQ: see original comment letter PDF to view table). To claim that these states also use O/E models leads the public to believe that UDWQ's use of O/E as a stand-alone metric is valid, which it is not. I don't agree that using a single taxon richness-based metric, RIVPACS O/E would constitute a robust index of biological integrity. It is only one metric that does not address anything other than richness and apparently does not do an adequate job of that (Richards 2016). There is also no reason to make a 'robust IBI' easily interpretable. Ecological interactions between dozens of organisms and their responses to human caused impairment are anything but easily interpretable. RIVPACS O/E models themselves are not easily interpretable. The data and algorithms used in these models are extremely difficult to obtain and often not available, thus not transparent. Other metrics used by other agencies, such as taxa richness, functional feeding group, etc. are very transparent and easily calculable. Although O/E may have an intuitive biological meaning, there are so many assumptions, generalizations, and errors associated with derivation of results that its accuracy in assessing loss of taxa and impairment is highly questionable. There are several other diversity metrics in use throughout the world that are much simpler to derive and interpret than RIVPACS O/E (Table 1 for example and see Literature Cited). These metrics can easily substitute for O/E or at least supplement it. For example, richness and evenness are better indicators than O/E for several reasons, 1) they are not confounded with other models (e.g. PRISM, a costly and proprietary model that is not transparent except for those who can afford to pay for its use), 2) they are independently verifiable, and 3) they allow assessment of change at local-scale due to point source impacts. As I have emphasized to UDWQ on numerous occasions, RIVPACS O/E models do not quantify loss of predicted taxa. In the case of UDWQ assessments, O/E quantifies only those taxa that were identified from a single (N = 1) composite sample collected from several types of habitats (including riffles and runs) that can exhibit much variability between the macroinvertebrate assemblages. Samples were also identified in the laboratory using a subsample (typically 600 organisms, with large and rare counts). O/E simply quantifies what was observed in a sample, nothing more. Taxa not identified may have or may not have been lost from the waterbody UDWQ can only conclude that they simply weren't observed.	Ecological interactions can be complex, but assessment tools need not try to expose all of the complexity. As previously stated, DWQ does not claim that O/E is biological integrity, but it is an important aspect of it. Other measures such as indices based on tolerances are not measures of overall biotic integrity either. All biological assessment methods have intrinsic assumptions and errors. From an aquatic life use support context, DWQ simply uses O/E to assess whether aquatic life has been impaired. DWQ and the primary scientific literature disagree with your opinion about the effectiveness of using O/E models for impairment determination purposes (e. g., please review: Hawkins, C.P. 2006. Quantifying biological integrity by taxonomic completeness: its utility in regional and global assessments. Ecological Applications 16(4): 1277-1294). Well over 100 peer-reviewed studies, many of which have been cited in the biological assessment chapter associated with the Integrated Report, have evaluated the assumptions and errors associated with RIVPACS methods and have found the approach to be on par or superior to other methods for purposes of accurately identifying sites that have experienced biological degradation. Based on the results of these investigations it is reasonable to conclude that other metrics, such as those recommended by the author could be reported, but doing so would not improve on DWQ's principle use of macroinvertebrate data, which is identifying biologically degraded streams. DWQ also disagrees that richness and evenness would be a suitable substitute for O/E. Diversity measures were abandoned long ago by the ecological assessment community because they are strongly influenced by natural settings and are not easily interpretable when used in this context. In that sense, they are not at all substitutable for O/E, which attempts to parse out natural signals from stressor signals. Please review Hawkins and Carlisle 2001 for an example that shows how O/E is preferable to plain taxa richness. Finally, DWQ did not intend to mislead the public by providing examples of other states that use O/E. Given the widespread use of O/E worldwide, pointing out specific examples is not really needed. This text has been removed from the methods.	Methods Clarified (p. 48)

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/25/2021	David Richards		**Probability of Capture > 50%** Again, as I have discussed on numerous occasions, probability of captures (Pc's) >50% preclude those very macroinvertebrate taxa that constitute biological integrity in a water body. As an example, waters in the Bonneville Basin and in some other parts of UT have unique mollusk assemblages found nowhere else in the world. Most of Utah's mollusks, including native mussels, clams, and non pulmonate snails do not occur in UT waters at Pc rates > 50%. By relying on RIVPACS O/E > 50% Pc, UDWQ failed to protect the unique mollusk assemblages in UT and apparently was completely unaware of their declines during the time period when continued molluscan viability may have been protected/ensured. This reliance on a single metric with > 50% Pc to assess biological integrity also likely is not protecting other rare and uncommon macroinvertebrates (< 50% Pc) that are again, by definition biological integrity. Calculating 'E' using a probability of capture (Pc) of >50% is extremely problematic and results in a poor assessment of biological integrity. Taxa with Pcs < 50% are likely the most sensitive taxa and the very taxa that respond to impairment more that those with Pc > 50%. The statement that "Using a Pc limit set at greater than 50% typically results in models that are more sensitive and precise, which results in a better ability to detect biological stress" is based on two relatively limited studies that evaluated precision using their own methods, i.e., circular reasoning and these were hardly typical. UDWQ is setting a precedent by using Pc > 50% based on results that are not solidly supported in the literature and not established scientific fact but based on a vague ill-defined term in the two studies, 'sensitivity'. From the lengthy discussion in the draft, it appears that UDWQ is more interested in the continued reliance on a single metric (O/E) that had good statistical properties (e.g., more sensitive and precise) than incorporating other metrics or using a < 50% Pc that may prevent loss of rare, uncommon, and unique taxa and provide greater insights into the types of impairments that Utah waterbodies experience. It is my opinion that O/E models may be able to detect large levels of biological stress, but not biological integrity.	DWQ is not setting precedent by using a Pc >0.5. The methods include eight peer reviewed articles on the topic that provide these results and also include extensive discussion about why this is the case. In the early stages of RIVPACS approaches, models were routinely constructed using both a Pc >0 and Pc >0.5; however, most biological assessment programs throughout Europe, Australia, New Zealand, and the United States that use RIVPACS methods have settled on a Pc >0.5 because they are almost always more accurate, precise and sensitive to anthropogenic degradation than lower Pc values. It is true that these O/E calculations may result in a failure to consider rare taxa. Rare taxa are often relatively low in abundance, in which case their presence or absence at a site is strongly influenced by sampling error. This is likely why the use of Pc >0.5 is more sensitive to degradation and precise than the use of Pc >0. In other cases, rare taxa are limited to a small number of locations, which all biological assessment methods cannot easily incorporate because they are dependent on comparisons against regional reference composition. Rare species are important, but their identification and protection is beyond the scope and intent of biological assessments conducted for purposes of the Integrated Report. The protection of rare and endangered species is an important concern, addressed through the Endangered Species Act, not the Clean Water Act. This is why the US Fish and Wildlife Service is working with Utah's Division Wildlife Resources to address the loss of mussels; a problem that predates DWQ conducting any biological assessments.	No Action
	David Richards		**Seasonality effects** Seasonality also affects macroinvertebrate assemblages. Summer season has fewer taxa in larval stages that are needed for taxonomic identification and O/E derivation. Comparing summer collected vs. late autumn to early spring samples increases variability and thus O/E results (e.g., summer samples likely will have fewer taxa and lower O). Because of these pitfalls, I caution UDWQ not to try to accommodate broader spatial and temporal data into O/E models simply to cut costs. This will result in loss of predictive power in ability to detect impairment. Remember that all assessments and monitoring efforts will eventually have to be measured at the watershed or site-specific level and a macroinvertebrate assessment program that reduces variability at the onset will be more cost effective in the long run. UDWQ is in an ideal situation to vastly improve macroinvertebrate biological assessments. UDWQ has a strong working relationship with the USU Bug lab including the leading developers of RIVPACS models at USU and other entities. They should take full advantage of this opportunity to develop a robust biological assessment program comparable to other federal, state, tribal, and county agencies in the region. It appears to me that many millions of dollars have been spent developing RIVPACs O/E regional models when it would have been much more prudent to train UDWQ staff to recognize the macroinvertebrate taxa that occur in UT and become proficient in understanding their ecology, natural and life history, examine sample results and easily evaluate which taxa were missing and why at the watershed level.	The RIVPACS model was constructed from reference sites with repeat visits across seasons. Therefore, the temporal range of variability across seasons is implicit in the model. DWQ has not spent millions of dollars developing regional O/E models. Much of the data that was used to develop models was collected from EPA-funded projects that used the information for other purposes. DWQ has partnered with the US Forest Service, BLM, EPA, and Salt Lake County—who all use O/E—to offset costs and ensure that biological data meet the needs of multiple agencies. Model construction was conducted by DWQ staff working in collaboration with national experts. The types of heuristic evaluations that the commenter recommends are not well suited to making assessment decisions because they are difficult to conduct consistently and objectively. Instead they are better positioned to assist with further evaluations of impairments identified through empirically derived indices such as O/E.	No Action

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/25/2021	David Richards		**RIVPACS O/E precision and predictive ability** The new O/E model in the draft is claimed to be a less precise predictive model than the previous used by UDWQ. A loss of precision in the updated model should be critically reevaluated. Was this updated model selected because in saves time and money? Several problems in simplifying the model are as follows: Incorporation of 1rst order and 8th plus order streams and rivers. All aquatic ecologists know that there is a big difference in macroinvertebrate assemblages in typical 1rst order vs. 2nd to 5th streams and between 8th plus rivers and 2nd to 5th order stream (please review the River Continuum Concept by Vannote et al.). Taxonomic resolution. A coarser taxonomic resolution results in a major loss of valuable information provided by individual taxa when 'rolled up' to higher taxonomic level. It also means that some unique or ecologically valuable taxa may be unaccounted for and lost from the AU without knowledge by UDWQ. For example: combining all species of caddisflies in the genus Rhyacophila at least 5 species or more could be lost without UDWQs knowledge. Or by combining all species of the mayfly genus Baetis, several of the more sensitive species may have been lost. UDWQ is well aware that taxonomic (phylogenetic) similarity has very little predictive power for sensitivity to different types of impairment (Richards 2016, UDWQ 2017).	The new model incorporates a wider range of reference sites, including larger rivers and has an expanded index period. This is the most likely explanation for the slight decrease in model accuracy and precision. However, the accuracy and precision of the current model are at a level considered acceptable for conducting biological assessments by regulatory agencies worldwide. Cost was not the driver for model revision, DWQ was simply updating the model to incorporate new data and information. DWQ is aware of naturally-occurring longitudinal changes in biological composition in stream ecosystems and the seminal article on this topic cited by the commenter. Several predictor variables in the RIVPACS model were included (e.g., watershed area, mean watershed elevation) so the model predictions could account for such differences. This means that the model's predictions for the taxa expected at a site (E) explicitly account for stream size. Utah's model uses the finest level of taxonomic resolution that was possible given the information reported by the taxonomists and agency programmatic requirements. A relatively large amount of literature empirically shows that the use of coarse (family) taxa can often provide similar assessment scores as fine level taxonomic resolution in O/E models. There are many states that use just family level data. There are tradeoffs in the use of fine versus coarse taxonomic resolution data. Coarse data are easier to model (more precise) but use of fine resolution data may produce more responsive indices. Please review Hawkins 2006 to understand a few good examples of these tradeoffs. DWQ's model is perhaps less sensitive, but more precise while also providing the cost effectiveness of incorporating water quality partner collected invertebrate data; creating critical efficiency of agency resources.	No Action
2/25/2021	David Richards		**Model Construction and Performance** Page 49. Table 12. Comment: These predictor models and variables are mostly watershed based. It is highly commendable that UDWQ is now assessing biological integrity at the watershed level rather than at the region wide level, which it has done in the past. By assessing biological integrity at the watershed level more accurate and precise conclusions will be made. However, watershed averages are just that, averages. Macroinvertebrate assemblages can easily change from the top of a watershed to the bottom and an average value likely will not capture those responses. As discussed in earlier comment letters; PRISM models are proprietary black box and as such are not independently verifiable and thus are scientifically invalid. The scientific method requires the possibility of independent validations. PRISM models are not reproducible or transparent, which as we all agree, is what we are all striving for. PRISM models rely on historic data (e.g., most of the climate data metrics in Table 12). As an example, "Watershed maximum of mean 1961-1990 annual number of wet days' was 28-year-old past data. Conditions likely have changed substantially in 28 years. Clearly the past has absolutely nothing to do with the macroinvertebrates collected next year. Similarly, the average of multiple years has nothing to do with invertebrate assemblages that are mostly multivoltine or univoltine. Their lives are shaped only by the conditions in the years during which they lived… not over multiyear averages. Variables in Table 12 had nothing to do with environmental conditions during the time when the sampled invertebrates lived. This introduces an unmeasurable and significant error to every Pc calculated and prevents the use of field data, which would be site specific. It may have been useful in developing regional models… but it has no place in continued assessment/monitoring and should never be used as such. Only field measurements should be used when possible. PRISM data errors are also spatially derived mostly from misuse of regional models to monitor local scale changes. These models will complicate every O/E assessment conducted anywhere that there are natural gradients, introducing error in every local assessment. PRISM data often are not precise, and values can change substantially between small changes in elevation within a watershed and sometimes within a few hundred meters. In addition, PRISM values are model predicted values and subject to error.	While the model building methodology is explained in the methods, including why GIS-based predictor variables are used rather than in-stream physical data, it is worth reiterating. While the model predictions are site-specific, the overarching objective is to use the watershed descriptors to determine the suite of reference sites that are most comparable to the site of interest. Variables such as "Watershed maximum of mean 1961-1990 annual number of wet days" was likely statistically significant because it helped distinguish between wetter and dryer areas of the state, a distinction that the commenter would likely agree to be important when accounting for natural variation in macroinvertebrate composition statewide. It is true that this has likely changed in the past 29 years, but this would only matter with respect to model predictions if they changed disproportionately. In other words, if areas of Utah that were once dry are now among the wetter areas of the state. Similar reasoning also explains why averaging over a longer period of record is preferable to contemporary data. Weather patterns vary from year-to-year. In any given year, it is often true that some areas of the state receive above average precipitation while other areas receive below average precipitation. As a result, averaging over several years provides a better indication of climatic difference from one place in the state to another. PRISM data are not proprietary and are freely available. They have been independently tested and validated. They are used by a very large community of scientists across a wide range of disciplines and are continually updated and corrected. Please visit EPA's StreamCAT website to access spatial base files used to develop RIVPACs models. StreamCAT includes PRISM data used in these models. Other predictor variables help address other types of natural variation. As mentioned in other responses, watersheds are delineated from the sample site upstream to the headwaters. As a result, "Minimum watershed elevation" is the site elevation and especially when combined with some of the PRISM temperature information allows the model to account for things like temperature. Similarly, watershed area is a measure of stream size, which means that the model doesn't consider all stream orders equivalent.	No Action

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/25/2021	David Richards		**Assessments Specific to Lakes, Reservoirs, and Ponds** Starting on page 53 Methods are lacking in the draft to evaluate biological integrity/aquatic beneficial uses. There are no zooplankton, benthic macroinvertebrate, or fish numeric or narrative metrics. Without such metrics, there likely is no possibility of evaluating whether biological beneficial uses are supported or not supported. A program needs to be started by UDWQ to develop robust multimetric biological assessments for lentic waters. In many instances UDWQ refers to cold-water vs. warm water uses. Temperatures that exceed 20 dC do not necessarily mean impaired. It is possible that the water body is naturally a warm water fishery and may have been misclassified or that increased temperatures due to climate change have affected temperatures. This is a problem with stream assessments as well (e.g., Jordan River). There is also no reason for UDWQ to infer that a cold-water fishery is superior to a warm water fishery by stating that cold water uses are a 'higher' use than warm water use. For example, UDWQ states their goal is to meet the highest attainable use. We need to get away from the idea that cold-water mountain streams and lakes have some greater innate value than lower elevation warm-water bodies. Global climate change may insure this, eventually.	DWQ agrees that the development of biological assessment tools for additional assemblages would be useful and has taken preliminary steps to accomplish this task. It would also be useful to expand biological assessments in lentic ecosystems. DWQ has participated in the national assessment of lakes and reservoirs. Some of the biological indicators that EPA and academic partners have developed nationally could potentially be incorporated into lake assessments, resources permitting. As explained in UTAH'S NUMERIC CRITERIA AND BENEFICIAL USES section in the Assessment Methods, current data are compared to current water quality criteria in the Integrated Report (IR) process. If the current temperature criterion is 20º C in R317-2, Standards of Quality for Waters of the State, and the data exceed 20º C, the waterbody is impaired for temperature. An identified impairment is typically followed by more intense monitoring. One potential outcome of these investigations is that the beneficial use for a waterbody may be misclassified which can be corrected by a Water Quality Standards change. Standards changes are beyond the scope of the IR. Recommendations for use classification changes should be made to DWQ's water quality standards program. DWQ does not infer differences in value among aquatic life use classes. Water quality criteria to protect aquatic life uses may be more or less stringent from use class to use class depending on the sensitivity of organisms occurring in those use classes to various pollutants, but this does not imply higher or lower intrinsic value of various types of ecosystems.	No Action
2/25/2021	David Richards		My overall conclusion is that the UDWQ 2018 Draft reflects a concerted effort by UDWQ to manage Utah's waters that are protective of biological integrity (and other uses) and is to be commended. However, the draft is heavy on numeric -criteria –based- measures such as DO and weak on how these metrics actually relate to biological integrity, the real measure of water quality as mandated by the Clean Water Act. Finally, there seems to be no clear scientific or otherwise causal link between the numeric based metrics and the 'beneficial uses' particularly biological, that UDWQ is evaluating. The State of Utah Department of Water Quality (UDWQ) is responsible for assessing, monitoring, and protecting the 'physical, chemical, and biological integrity' of its waters based on the Clean Water Act (CWA) and by UDWQ's designated 'beneficial uses' under state law. Biological integrity is the cornerstone upon which the health of a river or stream is measured, and biological assessments are one of the most important and useful management tools available for restoring and maintaining biological integrity. Bioassessments have been developed for many years and are widely used by management agencies for wadeable waters throughout the world, however, Utah is the only state in the western USA that entrusts its river and stream bioassessments entirely to a single taxa richness based metric, "River Invertebrate Prediction and Classification System" (RIVPACS O/E). All other western state water quality programs in the region integrate multimetric methods. O/E models are complex and are based on many assumptions and generalizations; some of which lead to a poor evaluation of biological integrity. An impaired listing based on O/E can have significant economic penalties on water users. Consequently, the reliance on any single metric such as O/E in a bioassessment program may not be prudent.	The Clean Water Act aims to prevent, reduce, and eliminate pollution in the nation's waters in order to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters", as described in Clean Water Act section 101(a). In practice, the protection of chemical integrity involves regular assessments to determine whether or not numeric chemical criteria are violated. Some of these numeric criteria were established to protect aquatic life uses, so an evaluation of these criteria provides an indirect evaluation of biological integrity objectives. Sites that meet these criteria infer supporting aquatic life uses. Similarly, biological assessments are intended as another indicator of biological integrity objectives. As the commenter notes elsewhere, biological integrity is an abstract idea that cannot be measured directly or completely, so DWQ and other regulatory agencies depend on indicators that quantify important components of this CWA objective. The biological assessment process is based on Utah's Narrative Water Quality Standard. Applicability of the narrative standard is not wholly dependent on the specific beneficial uses ascribed to an individual waterbody. Nevertheless, from an aquatic life use support context, DWQ assesses whether aquatic life has been impaired. O/E is not biological integrity but an important aspect of it. Numerous studies have demonstrated that O/E can quantify biological degradation to a wide range of human-caused stressors, which provides confidence in the metric as a robust measure of condition. More nuanced investigations of the nature and extent of the degradation that has occurred, and the stressors that caused the degradation to occur, can be evaluated once impairments are identified (i.e., 303(d) list). All biological assessment methods have their strengths and weaknesses. Scientists have argued about whether MMIs or RIVPACS methods are superior for over 20-years. Many empirical tests have been conducted and generally find that O/E are slightly better or roughly equivalent. To our knowledge, no study has suggested that O/E was not a defensible measure of biological condition. DWQ could ultimately incorporate MMI methods into biological assessment procedures, but this would require extensive resources that are now directed towards more urgent initiatives. In the interim, the lack of an MMI does not mean that current assessments are not scientifically defensible measures of biological degradation.	No Action

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/25/2021	David Richards		For this comment letter, I include statistical analyses I conducted several years ago. A statistical evaluation of O/E as it relates to evenness and other metrics and the effects of subsampling on these metrics was conducted. A discussion of the consequences of a > 50% probability of capture criterion in O/E models and their ability to actually monitor biological integrity is also discussed, as well as some other concerns including a comparison between bioassessment programs in UT and surrounding states. Macroinvertebrate datasets were obtained from the Bureau of Land Management/Utah State University Buglab database and the Utah Department of Water Quality data that were used in their 2016 draft Integrated Report. Compatible data were merged and filtered to reduce spatial variability. Several metrics reported by the Buglab were examined; O/E score, Taxa Richness, % Labsplit, Abundance, Shannon Diversity, Simpson Diversity and Evenness. Pairwise correlations, linear and quadratic Ordinary Least Squares (OLS) regressions, simultaneous quantile regressions at the 25th, 50th, and 75th quantiles and Path Diagrams and Structural Equation Models (SEM) were developed. Evenness and taxa richness were the most important metrics directly and indirectly effecting O/E scores. SEM results suggest that a 1 standard deviation change in evenness (0.14) equaled a 0.96 standard deviation change in O/E scores = 0.22 (0.18 to 0.26, 95% CIs). As little of a change in evenness of approximately 5% can lead to a change from an O/E score of 0.76 (fully supporting) to 0.69 (not supporting) and unrelated to impairment. A hypothetical but realistic example of the effects of evenness and subsampling on taxa richness resulted in a detection of all taxa in the completely even sample compared to a detection of < 50% of the taxa in an uneven sample when in fact all the same taxa occurred in the original uneven and even samples. Thus, natural fluctuations in evenness in a river or stream without a loss or extinction event resulting from human caused impairment could trigger an unjustified management response from 'fully supporting' to 'not supporting'. A realworld example is the Jordan River, listed as impaired by UDWQ. Analysis showed that O/E scores should have been rated higher if the effects of subsampling and evenness were considered. Reliance on a complicated, computationally expensive, generalized, non-site-specific metric such as that produced by a RIVPACS O/E model may not be prudent. Replacing the O/E metric with one or several of the other correlated metrics should be considered. At the minimum, these metrics should also be included in a bioassessment program. The decision to use a probability of capture > 50% in an O/E model has very strong negative consequences for assessing the biological integrity of Utah's river or streams. Uncommon and rare taxa should always be included in ecological assessments. Detection of impacts will be enhanced by including these taxa because they are often the first to become extinct due to human disturbance. Uncommon and rare taxa have also been shown to disproportionally contribute to ecosystem function and integrity. Their unmeasured loss could fail to warn of an impending ecological shift. Many RIVPAC O/E users continue to insist that a reduction in O/E scores reflects the extent to which taxa have become locally extinct due to human activities. This is clearly not the case. In many instances, taxa weren't lost; they just weren't found. To continue to assume that native taxa have become locally extinct because O/E scores have decreased reflects a gross misinterpretation of RIVPACS O/E models. There is also no shortage of additional informative metrics used by other state water quality management agencies, including those with fewer resources and human populations than Utah. Utah should follow suit, otherwise it will lag far behind. Even though a RIVPACS O/E model has the potential to be a useful summary metric: its use as a stand-alone metric is not recommended. O/E relies on too many assumptions, constraints, and inherent errors that necessitates its inclusion into a more comprehensive macroinvertebrate multimetric program. Fewer incorrect assessments of impairment will be made by incorporating the O/E metric into a multimetric program than if used alone. Unfortunately, all metrics are affected by the evenness of a sample and subsampling. This phenomenon needs to be considered in any bioassessment program. The O/E probability of capture < 50% constraint results in a poor evaluation of macroinvertebrate assemblages and thus fails to measure true biological integrity. With Utah's booming economy and exponentially growing population, UDWQ now has the opportunity to build a bioassessment program worthy of its unique rivers and streams.	There have been numerous, peer reviewed, scientific investigations into the statistical properties of O/E in relation to ecological diversity metrics, which these analyses do not acknowledge. Many studies have also been conducted that compare O/E and Multimetric Indices (MMIs) biological assessments, but such comparisons are not trivial (see Cao and Hawkins, 2011, The comparability of bioassessments: a review of conceptual and methodological issue, Journal of Freshwater Science: 30(3)).The central challenge is that these methods, indeed all biological composition measures, are altered by systematic differences in data structure and analytical methods (see Figure 1 of Cao and Hawkins 2011). Despite these challenges, almost all of the studies have concluded that O/E performed similarly or better than MMIs. Also, most authors conclude that both methods are capable of quantifying biological degradation. The use of one method does not preclude the use of another, but this does not mean that the use of both is required to quantify biological degradation, which is the principle objective of IR assessments. It is not surprising that richness and diversity show a positive, linear relationship to O/E. Various measures of richness and evenness are frequently combined to measure biological diversity. It would be more concerning if O/E did not increase as biological diversity increases because losing functional and structural diversity is integral to biological degradation. Numerous peer reviewed, scientific studies have been published showing a positive relationship between O/E and MMIs. The commenter's analysis also demonstrates several other DWQ responses. The range of richness values demonstrates that O/E is not simply a measure of richness as the commenter claims. For example, at a richness of 10, O/E values may vary from ~0.4 to 1.1. Richness varies naturally while the site-specific O/E predictions are able to account for this natural variation; meaning that sites would not be automatically determined to be biologically degraded at streams that are naturally lower in taxonomic richness. This would not be the case if DWQ used the richness metric, as the commenter suggests; creating costly false-positive errors. Similarly, the paucity of low O/E scores at the most diverse streams demonstrates that O/E is unlikely to lead to an impairment determination at streams where biological degradation is most unlikely to have occurred. Similar patterns can also be observed with evenness. DWQ uses a Pc >0.5 because we evaluated Pc >0 (use of all taxa) early in the model development process and found that the latter models were less precise. As DWQ has pointed out to the commenter previously, many studies have been published in scientific, peer reviewed literature that have evaluated different Pc values and these have almost universally concluded that Pc >0.5 is more precise and sensitive to anthropogenic degradation. This is why biological assessment programs that use O/E in Europe, Australia, New Zealand, and the United States use a Pc >0.5 when calculating O/E. Citations for these investigations have been provided to the commenter (including eight in the assessment methods). Rare taxa are often relatively low in abundance, in which case their presence or absence at a site is strongly influenced by sampling error. This is true for O/E and the constituent metrics in an MMI. This is likely why the use of Pc >0.5 is more sensitive to degradation and precise than the use of Pc >0. In other cases, rare taxa are limited to a small number of locations, which all biological assessment methods cannot easily incorporate because they are dependent on comparisons against regional reference composition. Improvements to all programs can always be made and it is important to seek advice from others when making a change to any water quality program. However, DWQ and the primary scientific literature disagree with your opinion about the effectiveness of using O/E models for evaluating stressor disturbance (e.g., please review: Hawkins, C.P. 2006. Quantifying biological integrity by taxonomic completeness: it's utility in regional and global assessments. Ecological Applications 16(4): 1277-1294). The fact that O/E is scientifically defensible and a well- established method for assessing biological degradation does not mean that other methods are invalid. All biological assessment approaches have strengths and weaknesses. DWQ is open to expanding on the existing biological assessment methods in the future, provided that resources can be deflected from other water quality priorities to do so.	No Action
2/25/2021	David Richards		**ADDITIONAL COMMENTS:** My comments are in the pdf attached. I spend hours preparing my comments to help DWQ protect Utah's waters and I find it a waste of my time to go through DWQ's submission steps process and always use a pdf	DWQ thanks you for the time you spent preparing your responses. Using the form entry fields saves DWQ a significant amount of time and resources in sorting and assigning comments to appropriate staff for response. This improves the timeliness and quality of our responses to public comments. DWQ will continue to offer the option to upload a comment letter file for commenters who wish to provide a PDF instead. We are always open to alternatives that improve public comment period efficiency and effectiveness.	No Action

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/26/2021	Shera Reems	EPA Region 8	**GRAB SAMPLE ASSESSMENTS:** Table 11 on Page 41 states that, DO measurements collected by instantaneous/grab samples are assessed against the 30-day averages in UAC R317-2-14. UDWQ does not specify in the assessment method how grab samples are compared against the 7-day average criteria or instantaneous minima. All three sets of DO criteria apply simultaneously and should be compared to all data sets containing sufficient data for a given 30-day, 7-day or instantaneous duration. See Table 2.14.2 Numeric Criteria for Aquatic Wildlife (8) available at https://rules.utah.gov/publicat/code/r317/r317-002.htm#/T16. The approach outlined in the Draft 2022 303(d) Assessment Methods may miss exceedances, especially for Class 3A and 3C waters, that may otherwise result in identifying the waterbody as impaired and placed on the 303(d) list for DO. Minimum Dissolved Oxygen Recreated from Table 2.14.2 Parameter (mg/L) (2)(2a) Aquatic Wildlife Use Class 3A 3B 3C 3D 30 Day Average 6.5 5.5 5.0 5.0 7 Day Average 9.5/5.0 6.0/4.0 Minimum 8.0/4.0 5.0/3.0 3.0 3.0 Where two values are shown: 1st number is protective of Early Life Stages (ELS) present; 2nd number for ELS absent.	In response to this comment, DWQ revised the assessments methods for dissolved oxygen (DO) grab samples. The DO criteria in R317-2 table 2.14.2 apply to all waterbodies with those assigned uses. However, not all datasets provide sufficient information to evaluate all criteria. DO grab samples do not provide sufficient data to evaluate whether the 7 or 30 day average criteria are met. DWQ has revised the assessment methods to specify that DO grab samples are assessed using the instantaneous minimum criteria for aquatic life uses, assuming the presence of early lifestages for class 3A and 3B streams. Datasets meeting the data requirements specified in the high frequency DO assessment methods will be assessed against all applicable DO criteria as stated in that section, including 7 and 30 day averages as appropriate.	Methods Changed (p. 38)
2/26/2021	Shera Reems	EPA Region 8	**HIGH FREQUENCY DO ASSESSMENTS:** While the application of the DO assessment methods to high elevation streams is not discussed, there may be situations where, because of the barometric pressure at higher altitudes, DO concentrations may be naturally lower. In these situations, the EPA-approved criteria found in the Utah Administrative Code R317-2-14 apply and should be used to make assessment decisions that follow the states DO assessment method described from pages 40 to 45. If there are concerns with the applicable water quality standards for high elevation streams, UDWQ may consider revising those criteria through the water quality standards triennial review process. Additionally, according to 40 CFR §130.7(b)(5), Each State shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by §130.7(b)(1) and 130.7(b)(2). (see §130.7 Total maximum daily loads (TMDL) and individual water quality-based effluent limitations). To ensure UDWQ is meeting this requirement, EPA expects UDWQ to consider high frequency data in the development of the 2022 303(d) list.	As specified in the methods and consistent with the commenter's recommendations, DWQ assesses available high frequency dissolved oxygen datasets against all dissolved oxygen criteria for which there are sufficient data. DWQ will consider secondary reviews and draft IR comments when making a final assessment decision. Changes to water quality standards are beyond the scope of the IR. Recommended changes to dissolved oxygen criteria can be provided to DWQ's Water Quality Standards Workgroup.	No Action

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/26/2021	Shera Reems	EPA Region 8	**HEADWATER NUTRIENT CRITERIA:** On page 46, under the nutrient numeric criteria the growing season is defined, as the period of algal growth through senescence. For assessment purposes, UDWQ assumes that the growing season includes the months of June through September, although this may be lengthened where additional information demonstrates that a longer period of growth is warranted. EPA recommends that UDWQ extend the end of the timeframe from September to November be considered as part of the assessment period to ensure senescence conditions that may affect respiration are represented. To clearly communicate the decision framework for applying Utah's Numeric Nutrient Criteria (NNC) EPA recommends that UDWQ review the Assessment section in the Proposed Nutrient Criteria and EPA's Action Letter , and update figures and tables in the assessment methods document as follows: - delete Figure 6, - move up Table 12 to the beginning of this section, and - add Table 8 (provided below [DWQ: see original comment letter for Table 8]). Lower Nutrient Enrichment Level: Page 47 states, Any site where the growing season average of both TP and TN falls below the lower NNC thresholds (lowest enrichment tier) is considered to be supporting aquatic life uses with respect to nutrient enrichment (Figure 6). The assessment methodology should be updated to indicate that: the waterbody will be considered as not assessed in situations where no ecological response data are available (see Table 8); a full support (Category 1 or 2) attainment decision requires collection of all three ecological response metrics with supporting data (see Table 8); and if any ecological response threshold is exceeded, the waterbody is placed on the 303(d) list as impaired on the basis of a biological assessment, and the cause will be listed as unknown pending follow-up investigations (see Table 12 on page 50 and Table 8 above). Upper Nutrient Enrichment Level: Page 47 states, At the other end of the enrichment gradient, any site where the average TN or TP concentration exceeds the upper NNC threshold (high enrichment tier) is categorized as threatened unless degradation is confirmed by an ecological response, in which case it is considered impaired (not supporting aquatic life uses). Threatened AUs are designated as category 5 due to highly enriched conditions, but the Division commits to more thoroughly evaluate the AU for adverse nutrient-related responses. If no adverse responses are identified within the AU watershed or downstream, the site will be considered to be supporting aquatic life uses and reclassified accordingly in subsequent IR reports. The last sentence contradicts Table 8 provided above, which communicates that in all cases an exceedance of the upper threshold is clear evidence of an impairment and results in the waterbody being considered threatened or impaired. In its approval of the upper thresholds, EPA noted, The upper thresholds, reflective of the upper tail of the distribution of nutrient enrichment observed in Utah streams, are at levels where it is reasonable to conclude impairment and that confirmation with response indicators is not necessary. [underline added] Based on this information, EPA recommends UDWQ delete the following sentence on page 47 in the assessment methods document, "If no adverse responses are identified within the AU watershed or downstream, the site will be considered to be supporting aquatic life uses and reclassified accordingly in subsequent IR reports." Moderate Nutrient Enrichment Level: In Figure 6, Page 48, UDWQ indicates that a waterbody will be considered as "fully supporting" its aquatic life uses when the TN and TP values fall within the "moderate"□ range and when one of the ecological response indicators is meeting its associated threshold. This approach does not align with EPA's CWA-approval of the moderate range as a "combined criterion". The EPA views the data and analysis [UDWQ] submitted as supporting the construction of the combined criterion that includes the threshold for filamentous algae cover as a component of the full suite of all three response variables to determine that a stream fully supports its aquatic life uses. [underline added] Therefore, for moderate enriched streams, EPA recommends UDWQ revise the assessment methodology to align with the EPA action that requires a demonstration that all three ecological response indicators meet their associated thresholds for a stream to be considered as "fully supporting" its aquatic life uses.	DWQ thanks the commenter for their input. The methods have been revised as suggested to clarrify assessment nuances that more closely align with the intent of the newly adopted headwater nutireint criteria.	Methods Clarified (p. 44-46)

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2/26/2021	Shera Reems	EPA Region 8	**HARMFUL ALGAL BLOOMS:** UDWQ stated that, For this IR cycle, harmful algal bloom (HAB) assessments are currently on hold while UDWQ develops and reviews implementation guidance and assessment methods based on recent EPA recommendations for water quality criteria for cyanotoxins (see Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsins). In future IR cycles, UDWQ expects to continue assessing recreational uses for the occurrence of HABs. EPA recommends that UDWQ update the assessment method that was used for the 2018 / 2020 303(d) Cycle (see Final 2018 / 2020 303(d) Assessment Methods) to include EPA's recommended criteria for microcystins and cylindrospermopsins and apply this method for the 2022 303(d) Cycle. According to 40 CFR §130.7(b)(5) requires that, "Each State shall assemble and evaluate all existing and readily available water quality-related data and information to develop the list required by §130.7(b)(1) and 130.7(b)(2)." (see §130.7 Total maximum daily loads (TMDL) and individual water quality-based effluent limitations). To ensure UDWQ is meeting this requirement, EPA expects UDWQ to consider all available cyanotoxin and cyanobacteria cell count data in the development of the 2022 303(d) list.	For the 2022 IR cycle, DWQ has put the harmful algal bloom (HAB) assessments on hold in order to develop appropriate assessment methods using EPA's recommended water quality criteria for cyanotoxins and the draft implementation guidance. During this time, DWQ is working towards adopting the cyanotoxin criteria into our Water Quality Standards. DWQ will be working with EPA and stakeholders to evaluate and establish HAB assessment methodologies that are appropriate for assessment in the Integrated Report context.	No Action
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Specific Comment Regarding Nutrient Assessments Specific to Headwater Streams** The Cooperative recognizes the extensive effort that was involved in the process of defining nutrient assessments specific to headwater streams and that the DWQ served a pivotal role in meeting with involved stakeholders, receiving and processing input, and defining outcomes. The Division of Water Quality was able to develop an innovative approach to nutrient criteria by combining numeric nutrient criteria and associated ecological responses. The cooperative is fully supportive of the process and the outcome of this effort.	DWQ appreciates the many hours that stakeholders, including Cooperative scientists, spent advising DWQ throughout standards development. Development of these criteria had many technical challenges and the final rules were more scientifically robust. Thanks to your input.	No Action
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Specific Comment and Concerns Regarding Data Acceptance Process** The Draft 2018/2020 Document placed arbitrary restrictions on the acceptability of datasets which did not conform to the format of the EPA Water Quality Portal. Our concern was that valid data could be rejected if DWQ staff did not have the time to reformat it. We appreciate the fact that this appears to have been addressed in the 2022 document and that the details for submitting data are found in the "call for data" presented by DWQ. We are aware of the fact that the acceptance of data may require the development of "interface tools" by DWQ to allow the data to be imported in the correct format. If those tools have not been developed at time of data submission, they cannot be fully incorporated into DWQ's assessment tools and they will be placed in the DWQ Conflicting Assessments of Water Quality Standards and Secondary Review rather than rejected outright. Based on this understanding we want to ensure that stakeholders can request that DWQ manually screen and assess the data for specific parameters, sites, or dates if necessary and that a reasonable effort is made by DWQ to accommodate data. Whereas, the current Draft 2022 Document reveals a willingness of DWQ to work with outside entities in formatting their data for inclusion in the 303(d) process, it still leaves a substantial grey area. DWQ states that it wants "to balance consideration of all data with reasonable expenditure of resources", yet this does not obligate DWQ to accept all data if they judge the expenditure of resources to be unreasonable. The criteria for making this judgment is not given, and thus outside entities must assume acceptance of data decisions are made in good faith and that they support a positive working relationship between stakeholders and DWQ.	DWQ appreciates submissions by stakeholders during the Call for Data and considers all submissions for use in the 305(b)/303(d) assessment. Data that do not pass credible data requirements are still available for use during the secondary review process. In the publicly available data export files, DWQ publishes the reasons for not considering particular data records in assessment. The Draft Integrated Report (IR) public comment period serves as a time for data submitters to ensure their data were used as intended and raise questions about the process. Questions will be investigated and addressed by DWQ. Furthermore, as an iterative process, the IR provides multiple opportunities to consider data from stakeholder submissions. If the data do not meet credible data requirements or interface incorrectly with assessment tools at the time of EPA approval, stakeholders are encouraged to resubmit their reformatted data for consideration in the subsequent IR cycle. At any time, stakeholders are welcome to open a dialogue with DWQ staff on the appropriateness of their data for assessment in preparation for consideration during the next Call for Data/IR assessment.	No Action
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	In our comments on the Draft 2018/2020 Document we expressed concern about the exclusion of historic data for interpretation of current limnological and ecological conditions of bays of GSL. We remain of the opinion that historic data have merit and that inclusion in the process of interpretation of current results remains valid and necessary.	The main focus of the Integrated Report (IR) is to evaluate data collected during the period of record against existing criteria to determine the attainment status of waterbodies. DWQ agrees with the commenter that data outside of the period of record may be important for characterizing historic conditions, determining the sources and causes of impairments, or designating standards for a waterbody. These types of analyses are outside the scope of the IR and are typically addressed by other programs (e.g., TMDL, Nonpoint Source, Standards, etc.). However, this type of waterbody specific knowledge can be considered as part of the IR's secondary review process.	No Action

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Specific Comment and Concerns Regarding Data Credibility** The Draft 2018/2020 Document contained a fairly restrictive set of categories for data considered "credible" and sufficient to be included in 303(d) assessments. The Draft 2022 Document has modified these criteria in a way that seems to be more permissive of datasets without such onerous adherence to DWQ QAPP procedures. According to our interpretation of the Draft 2022 Document credible data from external entities is now defined, on page 30, as being under no obligation to follow precisely the DWQ or EPA quality assurance protocols. However, the data collection and QA process must still be evaluated by DWQ to ensure credibility. This means that outside entities will need to develop a QAPP, SAPs, and SOPs, collect their data under its guidance, and the documents will need to be furnished to the DWQ at their request. DWQ will then make a judgement about whether the QAPP is sufficient for the data to be considered in 303(d) decisions. This is required in order for the data to receive a Quality Grade of A or B and be considered in 303(d). The lack of QAPP, SAP, and SOP for DWQ review will result in a C grade, and exclusion from 303(d) consideration. We want to ensure that DWQ will dedicate the time to review submitted QAPP, SAP, and SOP documents from participating stakeholders and that there is an open and interactive process that supports a stakeholder's ability to collect and submit data that meets the definition of "credible". In this process of working with DWQ to develop and implement QAPP, SAPs, and SOPs stakeholders want to ensure that such guidance from DWQ combines the goal of ensuring the reliable acquisition and documentation of data with a realistic understanding of the constraints that time, personnel and money can impose on the collection of data. Ultimately we strongly encourage the DWQ to proceed in an unbiased and open-minded manner when considering the merits of an outside entity's QAPP.	DWQ appreciates the review of credible data requirements. Indeed, DWQ does not require data submitters to follow DWQ-specific QAPPs, SAPs, and SOPs; these are offered in the document as guidance. DWQ does require data submitters to have credible data documentation that may be reviewed should the data records be questioned at any point in the Integrated I26R assessment process. Credible data documents should confirm that data fit into the Grade A or B categories defined by the credible data matrices. DWQ will ask for clarification when needed and work with the data submitter to understand and solve any discrepancies between credible data documentation and credible data requirements.	No Action
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	Regarding the temperature and dissolved oxygen, we have concerns about the instrument calibration requirements for accuracy and range in Tables 5 and 6. First, we believe the term "range" should be changed to "resolution" in the table footnotes, as the units provided for R in the tables suggests that resolution is being specified. Second, the calibration accuracy requirement for dissolved oxygen exceeds the manufacturer's instrument specifications for the YSI 556 sonde we currently use, which is a standard hand held device routinely used in limnological studies. YSI 556 oxygen sensors are rated for an accuracy of 0.2 mg/L. The minimum criteria for dissolved oxygen accuracy is 0.1 mg/L for Quality Grade B, which would downgrade data collected by a YSI 556 to Quality Grade C, excluding it from consideration in 303(d) assessments. We believe this would be a mistake, because the YSI 556 service life extended throughout the 2015-2020 period of record DWQ is considering and therefore any data collected with this common instrument by other entities would also be at risk of dismissal. While the YSI 556 has recently been discontinued, the contemporary YSI ProPlus replacing it has the same dissolved oxygen accuracy and resolution specifications as the YSI 556, yet is approved by the EPA for wastewater and drinking water analysis (https://www.ysi.com/File%20Library /Documents/News%20Briefs/N B13-0116- 01-EPA-Approved-Methods. pdf). Similarly, the DWQ water temperature minimum resolution of 0.05 degrees Celsius excludes data from the YSI 556 and the contemporary ProPlus and ProDSS, which are rated to 0.1 degree Celsius resolution. We recommend the dissolved oxygen accuracy requirement for Data Quality Grade B be raised to 0.2 mg/Land temperature resolution to 0.1 degree Celsius to accommodate valid data collected from commonly used water quality sondes over the period of record. To be clear, these comments pertain to GSL and the various subclassifications therein, and we are not trying to recommend alternative instrument standards for fresh water streams, rivers or lakes. The other requirements-metadata, flow data, field documentation, laboratory comments, detection limits, and lab certifications-appear reasonable. With respect to lab certification we expect that labs outside the State of Utah that have specific national or state level certificates meet the requirements of DWQ.	DWQ agrees with the commenter that the term "range" is inappropriate in this table and has removed this specification from the data matrix. DWQ also agrees with the commenter's suggestions regarding the required accuracy of dissolved oxygen and temperature calibrations. Based on this comment, DWQ has reviewed field sonde calibration documentation for several widely used professional water quality sonde makes and models and updated the accuracy requirements to better reflect those documents. These changes include updating the temperature and DO credible data matrix requirements for Grades A and B to include the specifications typical of YSI 556 and YSI ProPlus sondes.	Methods Changed (p. 30)
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	In the Draft 2018 Document, it was somewhat unclear how data that does not fully meet the criteria for inclusion into the Integrated Report program for EPA 303(d) actions might be used for state DWQ Watershed Plans, TMDLs, and development of water quality standards. However, in the Draft 2022 Document it is evident that data which are not sufficiently credible according to acceptance criteria may still have merit and can be used in a capacity outside of the specific 303(d) assessment. We feel that at least this level of inclusion is an important process. DWQ's statement that they will no longer require outside entities to conform specifically to their QA/QC reduces the risk of highly restrictive practices such as the "clean hands/dirty hands" nutrient sampling protocol and instrument washing that are applicable under certain circumstances and data quality objectives yet are excessive or not specifically warranted for other sample types or alternative data quality objectives.	DWQ thanks you for this comment. In addition to potential usage in TMDLs, standards, and other non-Integrated Report (IR) DWQ programs, data and information that do not meet the primary credible data requirements can also still be considered as part of the secondary review process of the IR which allows for the consideration of additional waterbody specific knowledge in making final assessment determinations.	No Action

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2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Specific Comment and Concerns Regarding Beneficial Use Subclassification and Bays of GSL** Subclassifications 5A through 5E are all GSL-specific, recognizing the individual bays as separate water bodies with unique characteristics and unique criteria. Whereas the recognition of GSL as a unique waterbody continues to be a positive and scientifically defensible designation the Cooperative strongly urges DWQ to include the interconnection of bays of GSL within the framework of assessing beneficial uses. It is abundantly clear from years of research on the bays of GSL that there is substantial biological and limnological connectivity between the GSL subclassifications such that changes in one bay can have significant and long-lasting impacts on other bays. Regulatory solutions designed to alleviate nonsupport of beneficial uses of a particular GSL bay must take into account potential impacts on beneficial uses in other bays before being implemented.	With the exception of a selenium bird-egg tissue criterion for Gilbert Bay, DWQ has yet to develop criteria for the individual bays of Great Salt Lake. DWQ agrees that the connectivity of the individual bays is a complex and important consideration when evaluating water quality and management decisions and while this comment is outside the scope of the Integrated Report methods, we encourage the Cooperative to provide data and expertise during the standards development process.	Out of Scope
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Specific Comment and Concerns Regarding Potential Conflicts Generated Among Beneficial Uses** One of the concerns we have is that the implementation of regulatory measures to mitigate or resolve perceived impairment of a particular beneficial use may then create harm to other beneficial uses for a particular waterbody. Based on this concern we examined the Draft 2022 Document for the procedural process to remedy conflicts that arise between beneficial uses of a particular waterbody. Specifically we are most concerned with those conflicts that develop out of implementation of measures to correct impairment of one of the beneficial uses yet causes demonstrable or highly probable harm to other beneficial uses. As it is unclear how such conflicts are resolved we urge DWQ to inform stakeholders if such potential conflicts are anticipated and if so, then what is the process to resolve such conflicts. As it may result in setting priorities of one beneficial use over another, then how are the beneficial uses prioritized?	Potential actions to resolve an identified impairment are beyond the scope of the Integrated Report (IR). Therefore, a description of the implementation processes is not included in the IR methods. Resolution of an impairment may include point source controls, non-point source reduction projects, water quality standards changes, or other actions. For further information on these processes, please contact the DWQ staff overseeing your watersheds or waterbodies of concern as identified on DWQ's Watershed Management Program page. Defining, altering, or prioritizing beneficial use classifications is beyond the scope of the IR. Beneficial uses are part of Utah's water quality standards. Criteria to protect the uses must protect the most sensitive use (40 CFR §131.11(a)(1)). Specific recommendations or comments to modify the existing beneficial use classifications and criteria can be provided to DWQ's Water Quality Standards Workgroup.	Out of Scope
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Specific Comment and Concerns Regarding Sampling Bias** The Draft 2022 Document does include recognition that there can be both spatial and temporal bias in sampling and that this could influence the interpretation of water quality within an AU. DWQ has presented details on the possibility to "split" or "re-segment" an AU given information on the spatial specifics and how this influences the perceived compliance and support of beneficial uses. However, with respect to the bays of GSL it is unclear how the potential for a temporal bias may influence the interpretation of attainment or impairment. It has been thoroughly documented that there are demonstrable temporal differences in algal and aquatic invertebrate community structure and population dynamics in the various bays of GSL. Sampling at a particular time versus another time for the same location can lead to nearly opposite conclusions regarding water quality. For example, chlorophyll-a assessments in Gilbert Bay in January vs July can lead to conclusions of highly eutrophic (i.e., a high Carlson's TSI) vs oligotrophic (i.e., low Carlson's TSI). Yet both conditions are a "normal" situation for Gilbert Bay and constitute a healthy system. Similarly, in Farmington Bay there typically is both a profound temporal and spatial pattern of algal and aquatic invertebrate community structure and population size throughout the year. Sampling must take into account these spatial and temporal differences and understand whether or not it represents "healthy" ecological dynamics or risk and impairment to the system. In short, the Cooperative would like to see more details in the final version of the Draft 2022 Document that more clearly addresses the potential for spatial and temporal bias and how such biases are managed.	DWQ agrees that timing of data collection for assessment can play a significant role in determining attainment of beneficial uses. However, since criteria have yet to be developed for the areas and constituents you cite, the comments are not within the scope of the Integrated Report methods. It would be premature to discuss specific issues of spacial and temporal bias in determining attainment without criteria or a complete assessment framework developed for the bays of Great Salt Lake (GSL). As DWQ further develops criteria for GSL, we encourage the Cooperative to provide their expertise and input.	Out of Scope

Date	Commenter	Organization (if provided)	Comment	Response	Action (page # affected in methods)
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Specific Comment and Concerns Regarding use of the term Harmful Algal Bloom (HAB)** We support the conclusion by DWQ that "For this IR cycle, harmful algal bloom (HAB) assessments are currently on hold while DWQ develops and review implementation guidance and assessment methods based on recent EPA recommendations for water quality criteria for cyanotoxins". The Cooperative believes that cyanobacteria cell counts alone are not sufficient to define an algal bloom as harmful, or a waterbody as impaired, or as an impact on beneficial use without further assessments of impact. There needs to be more specific accounting of the species of cyanobacteria, the type and concentration of toxin produced, and the impact on other aquatic biota, community structure or the ecosystem that a cyanobacteria bloom has on the bays of GSL. In particular the Cooperative opines that nitrogen fixation by cyanobacteria is an essential and typical event that captures nitrogen and introduces it into the GSL ecosystem and therefore has value. Repeated studies have demonstrated that GSL is predominantly a nitrogen limited system and that sufficient nitrogen is essential to maintain the massive demand on energy, nutrients, and carbon transfer required for the aquatic and aquatic-dependent biota of GSL. It is yet unclear the full extent of the role that nitrogen fixation has on the nutrient balance of the GSL ecosystem, but there is accumulating evidence that it plays and important and beneficial role.	Thank you for your comment. For the 2022 Integrated Report cycle, DWQ has put the harmful algal bloom (HAB) assessments on hold in order to develop appropriate assessment methods using EPA's recommended water quality criteria for cyanotoxins and the draft implementation guidance. During this time, DWQ is working towards adopting the cyanotoxin criteria into our Water Quality Standards. DWQ will be working with EPA and stakeholders to evaluate and establish HAB assessment methodologies that are appropriate for assessment in the Integrated Report context.	No Action
2/26/2021	THOMAS BOSTEELS	Great Salt Lake Brine Shrimp Cooperative, Inc.	**Conclusion** The Cooperative remains concerned about the inclusion of valuable data from stakeholders that can inform DWQ and that offers an historical perspective as well as insight into complex ecological, toxicological, biological and hydrochemical conditions or interactions that influence the integrity of the GSL ecosystem. While we understand the guidelines and steps required to meet data credibility standards we still urge the DWQ to recognize the realistic constraints on data acquisition and the limitations of time, personnel and money that constrain the scope and frequency of sample collection and analysis. We understand the designation of the bays of GSL as separate beneficial use subclassifications, yet we still adhere to the opinion that the GSL is an integrated system and that all bays interact, contribute to, and influence water quality and biotic composition of other bays. We therefore urge consideration of impacts on other bays if, and when, management decisions are made for a particular bay. We support the on-going effort to truly understand the role that nitrogen-fixing cyanobacteria have on nutrient loading and balance in GSL and the need to understand when an algal bloom becomes problematic rather than beneficial. We worry about potential conflicts between beneficial uses and we would prefer to see more definitive information on how such conflicts are resolved. Overall, we applaud the effort DWQ has made to listen to stakeholders and to incorporate their valid contributions to the process of completing the Draft 2022 Document. We strongly believe such cooperation and interaction helps to propel the document in a manner that enhances the likelihood of positive outcomes for waterbodies in Utah and especially for the GSL ecosystem. If there is further information, clarification, or services that we can provide for the DWQ's 303(d) listing process, please let us know and we will respond.	We appreciate the thoughtful input provided by the Cooperative and look forward to continued cooperation with our valued partners as we further develop standards for Great Salt Lake. The concerns summarized here are largely out of scope with regards to the Integrated Report assessment methods; however, we agree that historic data may be valuable to the efforts of criteria development as well as the importance of considering the connectivity of bays to standards and future assessment method development.	Out of Scope