STATE OF NEW HAMPSHIRE

2020/2022 Section 305(b) and 303(d) Consolidated Assessment and Listing Methodology

February 18, 2022

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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STATE OF NEW HAMPSHIRE
DEPARTMENT OF ENVIRONMENTAL SERVICES
29 HAZEN DRIVE
CONCORD, N.H. 03302

ROBERT R. SCOTT
Commissioner

MARK A. SANBORN
Assistant Commissioner

RENE PELLETIER
Water Division Director

Prepared by:
Matthew A. Wood and Ken Edwardson

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New Hampshire Department of Environmental Services
PO Box 95, Concord, NH 03302-0095
www.des.nh.gov | (603) 271-3503

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CHAPTER 1 INTRODUCTION

1.1 PURPOSE

The Federal Water Pollution Control Act [PL92-500, commonly called the Clean Water Act (CWA)], as last reauthorized by the Water Quality Act of 1987, requires each state to submit two surface water quality documents to the U.S. Environmental Protection Agency (USEPA) every two years. Section 305(b) of the CWA requires submittal of a report (commonly called the "305(b) Report"), that describes the quality of its surface waters and an analysis of the extent to which all such waters provide for the protection and propagation of a balanced population of shellfish, fish and wildlife, and allow recreational activities in and on the water.

The second document is typically called the "303(d) List," which is so named because it is a requirement of Section 303(d) of the CWA. The 303(d) List includes surface waters that are:

1. Impaired or threatened by a pollutant or pollutant(s).
2. Not expected to meet water quality standards within a reasonable time even after application of best available technology standards for point sources or best management practices for nonpoint sources.
3. Require development and implementation of a comprehensive water quality study (i.e., called a Total Maximum Daily Load or TMDL study) that is designed to meet water quality standards.

The primary purpose of this document is to describe the process used to make surface water quality attainment decisions for 305(b) reporting and 303(d) Listing purposes. This document is called the Consolidated Assessment and Listing Methodology (CALM) because it includes the methodology for assessing and listing waters (a term used to describe the process for placing waters on the 303(d) list).

Before proceeding, it is important to recognize that assessment methodologies are dynamic and likely to change as new information and assessment techniques become available. Such changes can also impact monitoring strategies designed to determine if waterbodies are attaining water quality standards. Periodic updates of the methodology will hopefully result in even more accurate and reliable assessments and, therefore, better management of water resources in the future.

1.2 IMPROVEMENTS TO THE ASSESSMENT PROCESS

1.2.1 Assessment and Listing Methodology

This assessment and listing methodology is the most comprehensive and detailed assessment strategy prepared to date for New Hampshire. Such detail promotes consistency in assessments and allows the public to clearly see how assessment decisions were made.

Any data submitted to the New Hampshire Department of Environmental Services (the department or NHDES), is first reviewed against the existing protocols in the CALM document. In the event that the CALM does not include protocols to adequately assess a particular data set, NHDES staff then review the data in the context of New Hampshire's water quality standards and prepare a written summary that includes a review of the data, the applicable water quality standards, and a recommendation of attainment status. The CALM is a guidance document. As such, the assessment program utilizes the CALM to the extent it can but often, additional datasets or professional judgment may yield assessment decisions outside of the CALM descriptions. Finally, the approved state water quality standards are the ultimate basis for assessment decisions, not the CALM.

1.2.2 Integrated Approach for 305(b) / 303(d)

Prior to 2002, New Hampshire, along with many other states, submitted separate 305(b) Reports and 303(d) Lists. To some, this was confusing as it was unclear how waters listed in the two documents were related. In an effort to eliminate this confusion and to simplify reporting for the public as well as regulatory agencies, USEPA developed guidance (USEPA, July 2002) and a computer database (the Assessment Database or ADB) to facilitate integration of the 305(b) and 303(d) List. In 2018, USEPA retired their ADB following the development of the new Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS). The goal of ATTAINS is to move the integrated reporting process to a paperless process using Exchange Network technology.

Based on a state's assessment and listing methodology, the guidance recommends that surface waters within state boundaries be placed into one (and only one) of the following five categories:

Category 1: Attaining all designated uses and no use is threatened.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened (i.e., more data is needed to assess some of the uses).

Category 3: Insufficient or no data and information are available to determine if any designated use is attained, impaired, or threatened (i.e., more monitoring is needed to assess any use).

Category 4: Impaired or threatened for one or more designated uses but does not require development of a TMDL because:

4A: a TMDL has been completed, or

4B: other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future, or

4C: the impairment is not caused by a pollutant.

Category 5: Impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL (this is the 303(d) List).

Waters that are meeting water quality standards and are not threatened are included in Categories 1 and 2, with the difference being that all designated uses are supported in Category 1 whereas in Category 2, some, but not all uses are meeting standards. Category 2 and Category 3 waters require more monitoring before a complete assessment can be made. For Category 2 waters, monitoring is needed for those uses that lack sufficient data or information to make an assessment. For Category 3 waters, more monitoring is needed before an assessment can be made for any designated use.

Impaired waters or threatened waters are included in Categories 4A, 4B, 4C and 5. Category 4A includes waters impaired or threatened by a pollutant(s) and a TMDL study has been completed and approved by EPA. Category 4B includes waters impaired by a pollutant(s), but don't need a TMDL as other pollution control requirements such as technology standards for point sources (i.e., secondary treatment limits) or best management practices for nonpoint sources (i.e., capping of a landfill) are reasonably expected to meet water quality standards in the near future. Category 4C represents waters that are not impaired by a pollutant, such as a lack of sufficient flow to support aquatic life.

If a water is impaired or threatened and does not fall under any of the Category 4 waters, it must, by default, fall under Category 5, which is the 303(d) List. These are waters that are impaired or threatened by a pollutant(s) and require a TMDL.

As discussed, under the integrated approach, all surface waters fall into one of the seven categories. Therefore, this reporting approach satisfies the 305(b) requirement to report on the water quality status of all surface waters. The Integrated Approach also clearly shows how the 303(d) List relates to other waters by assigning it a separate category (Category 5). As indicated, the 303(d) List does not include all impaired or threatened waters; rather it is a subset of the impaired or threatened waters (i.e., waters that are impaired by pollutant(s) and require a TMDL). More information regarding categories used in the Integrated Approach is provided in Section 3.1.3.

1.2.3 Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS)

To facilitate electronic assessments, USEPA developed the "Assessment Database," or ADB, in the 1990s. Though not required, states were strongly encouraged to use this reporting tool to submit electronic reports to USEPA. In 2002, USEPA released a new Oracle-based version of the ADB that was based on the new integrated approach and its seven categories. For the 2002 cycle, New Hampshire was one of the first states in the nation to use the new ADB.

From 2015 through 2017, the USEPA worked to develop a new electronic submittal and reporting interface called the "Assessment and Total Maximum Daily Load Tracking and Implementation System" or ATTAINS. The new system went live in the spring of 2018. The goal of ATTAINS is to move the integrated reporting process to a paperless process using Exchange Network technology and to make the process more transparent to the public. The ATTAINS

system replaces the existing ADB and all states are required to use ATTAINS to submit their integrated reports to USEPA beginning with the 2018 cycle. Once finalized by the state, the information is made publically available via web reports. The ATTAINS web reports are intended to provide users with easy access to view the information on the status of waters at the national, state and waterbody levels. For waterbody specific details, NHDES continues to encourage the user to access NHDES' Surface Water Quality Assessment Viewer[1].

1.2.4 Assessment Units (AUs) and NHD coverage

Assessment Units (AU) are the basic unit of record for conducting and reporting water quality assessments. Prior to 2010, all assessment units were based on 1:100,000 scale hydrography linked to the National Hydrography Dataset (NHD); the national coverage used by USEPA. This was a great initial effort, however, one major disadvantage was that it did not show many of the smaller surface waters because of the coarse mapping scale. To resolve this, NHDES undertook and successfully completed a major effort in 2009 to transition all assessment units from 1:100,000 scale to 1:24,000 scale hydrography linked to the NHD, which was used since the 2010 assessment, updated biennially, and has been updated once again for the 2020 assessments. As a result of transitioning to higher resolution mapping (which now captures the smaller waterbodies) the number and total size of surface waters (i.e., miles of rivers, acres of lakes, etc.) reported for New Hampshire has increased dramatically from previous assessments. For example, the size of reported rivers has increased by approximately 7,000 miles, the number of impoundment assessment units have increased by approximately 450 (1,500 acres) and the number of lakes assessment units have increased by approximately 375 (4,600 acres) over the 2008 sizes. These improvements have greatly enhanced the ability of NHDES to manage and report on the status of the State's water resources. Additional information regarding AUs and the NHD coverage is provided in section 3.1.1.

1.2.5 Probabilistic Assessment

In 2004, New Hampshire was one of the first states to include probabilistic assessments in its report to help satisfy the Section 305(b) goal for States to assess all surface waters (NHDES, 2004) (NHDES, 2004). For 2012, a probabilistic assessment of estuaries in New Hampshire was conducted from the National Coastal Assessment (2002 to 2005) and the New Hampshire Estuaries Probability Based Monitoring Program (2006-2007) datasets. The 2006, 2008, and 2010 assessments also included probabilistic assessments for wadeable rivers for 2002/2003 aquatic life use data and 2005 bacteria data for primary contact which has been updated for the 2018 assessment cycle based on probabilistic river sampling conducted from 2013-2016. A probabilistic assessment of lakes was last updated for the 2012 cycle based on a 2008/2009 survey. For more information about probabilistic assessments, see Section 3.1.27.

[1] https://nhdes-surface-water-quality-assessment-site-nhdes.hub.arcgis.com/

CHAPTER 2 WATER QUALITY STANDARDS

2.1 OVERVIEW

Before proceeding with details of the assessment methodology, it is important to obtain a basic understanding of water quality standards since they are the basis of all water quality assessments and ultimately it is the water quality standards that dictate the assessment status of a waterbody.

In general, water quality standards provide the baseline quality that all surface waters of the State must meet in order to protect their intended uses. They are the "yardstick" for identifying where water quality violations exist and for determining the effectiveness of regulatory pollution control and prevention programs.

Env-Wq 1700[2] includes the State's surface water quality regulations (NHDES, 2016). The standards are composed of three parts: designated uses, water quality criteria and antidegradation. Each of these components is briefly discussed below.

2.2 DESIGNATED USES

All surface waters of the State are either classified as Class A or B, with the majority of waters being Class B. NHDES maintains a list that includes a narrative description of all the legislative classified waters. Designated uses represent the uses that a waterbody should support. As indicated below, State statute RSA 485-A:8 is quite general with regards to designated uses for New Hampshire surface waters. A more complete list of designated uses may be found Env-Wq 1702.17 of the state surface water quality regulations (see Section 3.1.2).

Classification	Designated Uses as described in RSA 485-A:8
Class A	These are generally of the highest quality and are considered potentially usable for water supply after adequate treatment. Discharge of sewage or wastes is prohibited to waters of this classification
Class B	Of the second highest quality, these waters are considered acceptable for fishing, swimming and other recreational purposes, and, after adequate treatment, for use as water supplies

[2] https://www.des.nh.gov/rules-and-regulatory/administrative-rules?keys=envwq1700&purpose=&subcategory=Water+Quality

2.3 WATER QUALITY CRITERIA

The second major component of the water quality standards is the "criteria." Criteria are designed to protect the designated uses of all surface waters and may be expressed in either numeric or narrative form. A waterbody that meets the criteria for its assigned classification is considered to meet its intended use. Water quality criteria for each classification may be found in RSA 485-A:8, I-V and in the State's surface water quality regulations Env-Wq 1700 (NHDES, 2016).

2.4 ANTIDEGRADATION

The third component of water quality standards is antidegradation, which is a provision designed to preserve and protect the existing beneficial uses and to minimize degradation of the State's surface waters. Antidegradation regulations are included in Part Env-Wq 1708 of the State's surface water quality regulations (NHDES, 2016). According to Env-Wq 1708.03, antidegradation applies to the following:

- Any proposed new or increased activity, including point and nonpoint source discharges of pollutants that would lower water quality or affect the existing or designated uses.
- A proposed increase in loadings to a waterbody when the proposal is associated with existing activities.
- An increase in flow alteration over an existing alteration.
- All hydrologic modifications, such as dam construction and water withdrawals.

CHAPTER 3 ASSESSMENT AND LISTING METHODOLOGY

3.1 GENERAL RULES

3.1.1 Waterbody Coverage, Waterbody Types and Assessment Units

Waterbody Coverage: This assessment is based on surface waters shown on the 1:24,000 National Hydrography Dataset (NHD), which is consistent with USEPA's national coverage. Surface waters for which data was available to make an assessment, but which were not shown on the base NHD coverage, were added to this coverage on a case-by-case basis and linked to the NHD.

Wetland complexes were constructed from the National Wetlands Inventory (NWI) base layer completed by US F&WS in the mid-1980s. This derived coverage was created by constructing wetland complexes from the individual NWI wetland polygons in accordance with the 2011 "Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire" (NH Method[3]).

Waterbody Types and Sizes: Based on the NHD coverage and NWI based wetland basemap and to facilitate reporting, surface waters were separated into the six waterbody types shown in Table 3-1. The total size of each waterbody type, based on the coverage discussed in the previous section, is also provided.

Table 3-1: Waterbody Types and Sizes

Waterbody Type	Total Size		Total Number of Assessment Units
Rivers and Streams	16,963	Miles	5,923
Impoundments	22,435	Acres	1,235
Lakes and Ponds	162,743	Acres	1,558
Estuaries	17.98	Square Miles	72
Ocean	81.48	Square Miles	26
Wetland	286,696	Acres	52,313
		Total	61,131 (8,818 without wetlands)

Assessment Units (AUs): Each waterbody type was divided into smaller segments called assessment units (AUs). In general, AUs are the basic unit of record for conducting and reporting the results of all water quality assessments.

AUs are intended to be representative of homogenous segments; consequently, sampling stations within an AU can be assumed to be representative of the segment. In general, the size of AUs should not be so small that they result in an unmanageable number of AUs for reporting.

[3] http://nhmethod.org/

On the other hand, AUs should not be so large that they result in grossly inaccurate assessments.

Wetland complexes were constructed from the National Wetlands Inventory (NWI) base layer completed by US F&WS in the mid-1980s. This derived coverage was created by constructing wetland complexes from the individual NWI wetland polygons in accordance with the 2011 "Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire" (NH Method[4]).

Many factors can influence the homogeneity of a segment. Factors used to establish homogenous AUs for this assessment are presented in the following table. Based on the criteria shown in Table 3-2, lake, river, impoundment, ocean and estuarine surface waters in New Hampshire were divided into over 8,800 AUs for assessment and reporting purposes.

Since the creation of the Assessment Units for the 2002 assessment some discrepancies have arisen between the AU IDs and HUC-12 boundaries due to NRCS recoding of some HUC-12 regions. NHDES will reconcile these differences once the HUC-12 boundaries are fully incorporated into the NHD, and the department formally becomes the steward of the NHD HUC boundary dataset.

Table 3-2: Factors Used to Establish Homogenous and Manageable AUs

Factor	Comments
Waterbody Type	Different waterbody types (i.e., river, lake, impoundment, estuary, ocean) have different water quality standards and may respond differently to pollutants. Consequently, to help ensure homogeneity, different AUs are needed for different waterbody types.
HUC-12 Boundaries	HUC stands for hydrologic unit code. Separate AUs were established wherever 12 digit HUC boundaries were crossed to prevent AUs from becoming too large and to facilitate the naming convention for AUs (discussed below).
Water Quality Standards	All waters represented by an AU should have the same water quality standard; otherwise it's possible that a portion of an AU could meet standards while the other portion is in violation. This would lead to inaccurate assessments.
Pollutant Sources:	The presence of major point and / or no point sources of pollutants can have a significant impact on water quality and, therefore, homogeneity within an AU.
Maximum AU size for rivers and streams	To keep AUs for rivers and streams from becoming too large, the following criteria were applied: AU $\leq$ 10 miles for rivers and streams of 3rd order or less AU $\leq$ 25 miles for rivers and streams greater than 3rd order
Major changes in Land Use	Land use can have a significant impact on pollutant loading and quality of surface waters.
Stream Order/Location of Major Tributaries	Stream order and location of major tributaries can have a significant impact on the quantity and quality of water due to the amount of dilution available to assimilate pollutants.

[4] http://nhmethod.org/

Factor	Comments
Public Water Supplies	Separate AUs were developed for these important surface waters to facilitate reporting.
Outstanding Resource Waters	Outstanding Resource Waters are defined in the surface water quality regulations (NHDES, 2016) as surface waters of exceptional recreational or ecological significance and include all surface waters of the national forests and surface waters designated as natural under RSA-483-7-a, I.
Shellfish Program Categories	Tidal waters were divided into AUs based on the classification system for the shellfish program to facilitate reporting.
Designated Beaches	Designated beaches have more stringent bacteria criteria; consequently separate AUs were established for these waterbodies.
Cold water fish spawning areas	Coldwater fish spawning areas have different dissolved oxygen criteria than other surface waters; consequently, separate AUs were established for these waterbodies where information was available from New Hampshire Fish and Game.

AU Naming Convention: Each AU must have a unique identification number (i.e., AU ID) to facilitate tracking and reporting of assessment results for each AU. An explanation of the AU ID naming convention used in this assessment is provided in Table 3-3.

Table 3-3: Explanation of AU ID Naming Convention

Example AUID: NHRIV801060405-01-01				
NH	**RIV**	**801060405 -**	**01-**	**01**
State abbreviation to readily identify the waterbody as being in New Hampshire (NH)	3 letters to readily identify the waterbody type where: RIV = Rivers and Streams LAK = Lakes and Ponds IMP = Impoundments EST = Estuary OCN= Ocean FWT= Freshwater Wetland MWT=Marine Wetland	Last 9 digits of the 12 digit HUC. Note that the first 3 digits of all NH HUCs are "010". The first 3 digits (010) were purposely left off in an effort keep the AU ID as short as possible. Inclusion of the last 9 digits readily identifies the general location of the waterbody. 12 digit HUCs do not exist for the ocean (they do, however exist for the estuaries). For the ocean, 000000000 was input into this field.	AU segment number. Segments were divided into homogenous units using the criteria above. For rivers, segment numbering starts upstream and proceeds downstream. (Note that for wetlands, this is a three-digit code.)	AU sub-segment number. Used for further subdivision of AU if necessary. For example, this field was used if it was necessary to divide a lake into 2 or more segments.

3.1.2 Designated Uses

Designated uses are the desirable uses that surface waters should support such as swimming (i.e., primary contact recreation) and fishing (i.e., aquatic life). Env-Wq 1702.17 of the state's surface water quality regulations (Env-Wq 1700) includes the designated uses for New Hampshire surface waters. As shown in Table 3-4, there are six designated uses in Env-Wq 1707.17. Each of these designated uses, with the exception of wildlife, was assessed for this reporting cycle. An assessment methodology for wildlife has not yet been developed but will be included in future assessments. Because they have different assessment indicators, the designated use of "Swimming and Other Recreation In and On the Water," was individually assessed for "Primary Contact Recreation (i.e. swimming)" and for "Secondary Contact Recreation (i.e. boating)."

Table 3-4: Designated Uses for New Hampshire Surface Waters

<table>
<tr><th>Designated Use</th><th colspan="3">NH Code of Administrative Rules (Env-Wq 1702.17) Description</th><th>Applicable Surface Waters</th></tr>
<tr><td>Aquatic Life Integrity</td><td colspan="3">The surface water can support aquatic life, including a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of the region.</td><td>All surface waters</td></tr>
<tr><td>Fish Consumption</td><td colspan="3">The surface water can support a population of fish free from toxicants and pathogens that could pose a human health risk to consumers.</td><td>All surface waters</td></tr>
<tr><td>Shellfish Consumption</td><td colspan="3">The tidal surface water can support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.</td><td>All tidal surface waters</td></tr>
<tr><td>Potential Drinking Water Supply</td><td colspan="3">The surface water could be suitable for human intake and meet state and federal drinking water requirements after adequate treatment.</td><td>All surface waters</td></tr>
<tr><td rowspan="3">Swimming and Other Recreation In and On The Water</td><td rowspan="3">The surface water is suitable for swimming, wading, boating of all types, fishing, surfing, and similar activities.</td><td colspan="2">NHDES Clarification</td><td rowspan="3">All surface waters</td></tr>
<tr><td>Primary Contact Recreation (i.e. swimming)</td><td>Waters suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water</td></tr>
<tr><td>Secondary Contact Recreation (i.e. boating)</td><td>Waters that support recreational uses that involve minor contact with the water.</td></tr>
<tr><td>Wildlife</td><td colspan="3">The surface water can provide habitat capable of supporting any life stage or activity of undomesticated fauna on a regular or periodic basis.</td><td>All surface waters</td></tr>
</table>

3.1.3 Integrated Approach Categories

Each assessment unit (AU) was assigned to one (and only one) of the following seven assessment categories in the Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) :

AU Category 1: Attaining the all designated uses and no use is threatened.

AU Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information is available to determine if the remaining uses are attained or threatened (i.e., more data is needed to assess some of the uses).

AU Category 3: Insufficient or no data and information is available to determine if any designated use is attained, impaired, or threatened (i.e., more monitoring is needed to assess any use).

AU Category 4A: Impaired or threatened for one or more designated uses but does not require the development of a TMDL because a TMDL has been completed.

AU Category 4B: Impaired or threatened for one or more designated uses but does not require the development of a TMDL because other pollution control requirements are reasonably expected to result in attainment of the water quality standard in the near future.

AU Category 4C: Impaired or threatened for one or more designated uses but does not require the development of a TMDL because the impairment is not caused by a pollutant, and

AU Category 5: Impaired or threatened for one or more designated uses by a pollutant(s), and requires a TMDL (this is the 303(d) List).

To determine which AU Category a surface water should be placed in, each impairment was first assigned an Impairment Category of 4A, 4B, 4C, or 5 based on definitions similar to the AU Categories provided above. For example, if an impairment already had a USEPA approved TMDL done for it, it would be assigned to Impairment Category 4A. Similarly, if the impairment was not a pollutant, it would be assigned to Impairment Category 4C.

In many cases, an AU was impaired by pollutants and/or non-pollutants with different Impairment Categories. For example, an AU could be impaired by a pollutant assigned to Impairment Category 4C, another pollutant assigned to Impairment Category 4B, as well as a non-pollutant in Impairment Category 4C. For situations such as these, ATTAINS uses the following protocols to determine which AU Category the surface water should be placed. As indicated in Table 3-5, the AU for the previous example would be assigned to AU Category 4C.

Table 3-5: ATTAINS Protocols for Assigning AU Categories

Impairment Category 4A	Impairment Category 4B	Impairment Category 4C	Impairment Category 5	AU Category
Number of Impairments in the AU				
≥ 1	0	≥ 0	0	4A

Impairment Category 4A	Impairment Category 4B	Impairment Category 4C	Impairment Category 5	AU Category
Number of Impairments in the AU				
≥0	≥1	≥ 0	0	4B
0	0	≥ 1	0	4C
≥0	≥0	≥ 0	≥1	5

3.1.4 Use Support Attainment Options and Threatened Flag

Each designated use for each assessment unit (AU) was assigned one of the following four use support attainment options in ATTAINS:

Fully Supporting: A use is fully supporting if, in accordance with this document, there is sufficient data or evidence for the core indicators (see Section 3.1.13) to determine that the use is fully supporting and, there is no other data or evidence indicating an impaired or threatened status.

Not Supporting: A use is not supporting (i.e., impaired) if, in accordance with this document, there is sufficient data or evidence to indicate impairment.

Insufficient Information: This option is assigned to any use associated with any AU which, in accordance with this document, has some, but not enough useable data or information to make a final assessment decision.

Not Assessed: This option is assigned to any use associated with any AU, which does not have any useable data or information to make an assessment decision.

Threatened: For any of the use support options noted above, ATTAINS allows any parameter in an AU to also be flagged as threatened. For this assessment cycle, threatened waters were defined as follows:

- Waters which are expected to exceed water quality standards by the next listing cycle (every two years) and/or,
- Waters that do not have any measured instream violations but other data indicate the potential for water quality violations [i.e. see Sections 3.1.20(predictive models) and 3.1.21(NPDES permit effluent violations)].

3.1.5 NHDES Supplemental ADB and Sub-Categories of Support for Parameters, Uses and Assessment Units

The USEPA built Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) currently only tracks parameters causing impairment and does not give an indication of the degree that a parameter, use, or assessment unit meets water quality standards, or is impaired. Comments received from the public on the 2004 report indicated that assignment of sub-categories to Uses and AUs, which indicated the degree of use support (i.e., just how good or bad is the condition of the surface water), would be beneficial. In response to

the public and the desire of NHDES to better track all information associated with a waterbody (i.e., not just impairments), NHDES created a database called the "Supplemental-ADB" in 2005.

The Supplemental-ADB allows NHDES to track and report on information associated with all data used to make an assessment and to assign sub-categories indicating the degree of support as shown in Table 3-6 and Table 3-7. Table 3-6 describes the additional sub-categories of support and associated protocols assigned at the parameter, Use, or AU level. Table 3-7 shows the same information as Table 3-6, but in a more concise hierarchal form.

In general, degrees of full support include "G" which means Good and "M" which means Marginal. Degrees of Not Support include "M" for Marginal, "P" for Poor, and "T" for Threatened. Definitions of G, M and P for full supporting and impaired waters are provided in Table 3-6.

Table 3-6: **Definition of NHDES Sub-Categories for Parameters, Uses and Assessment Units**

ATTAINS Category	NHDES Sub-Category	Definition of NHDES Sub-Category for PARAMETERS	Definition of NHDES Sub-Category for USES	Definition of NHDES Sub-Category for ASSESSMENT UNITS
2	2-G	All samples for a given parameter meet water quality standards by a relatively large margin, as defined below: For parameters where the 10% rule applies, there are a total of at least 10 samples with 0 exceedences of criteria. Where there are no geometric means, all bacteria samples are < 75% of the geometric mean. Where there are geometric means all single bacteria samples are < the SSMC and all geometric means are < geometric mean criteria. The Benthic Index of Biological Integrity (B-IBI) ratio (score/threshold) is >1.2. The Cold Water Fish Assemblage Index of Biological Integrity (CW-IBI) >38. The Transitional Water Fish Assemblage Index of Biological Integrity (TW-IBI) >38. For parameters in sediment for which the concentration was less than TEC screening values. For trophic class based assessments, the calculated median ≤ ½ criteria.	CORE parameters indicate FS per the CALM and are 2-G. There may be one or more, but not all, 2-OBS. All other available parameters for the Use are either 2-G or 3-PAS.	At least 1 Use is 2-G. All other Uses are either 2-G or 3-PAS.
	2-M	All samples for a given parameter meet water quality standards but only marginally, as defined below: For parameters where the 10% rule applies, there are at least 10 samples and the number of exceedences is between 1 and the maximum number of exceedences shown on Table 3-13that are needed to assess the parameter as impaired. There are geometric means and all geometric means are < geometric mean criteria; and there are less than 2 single sample exceedences. The Benthic Index of Biological Integrity (B-IBI) ratio (score/threshold) is ≥ 1.0 but ≤ 1.2. The Cold Water Fish Assemblage Index of Biological Integrity (CW-IBI) is ≥ 30 but ≤ 38. The Transitional Water Fish Assemblage Index of Biological Integrity (TW-IBI) is ≥ 28 but ≤ 38.	CORE parameters meet water quality standards per the CALM with at least one CORE parameter being 2-M. OR CORE parameters meet water quality standards per the CALM with at least one CORE parameter being 2-OBS (no 2-G). OR One non-core parameter is 3-PNS All other parameters for the Use are either 2-G, 2-M, 3-PAS or 3-PNS.	At least 1 Use is 2-M. All other Uses are either 2-G, 2-M, 3-PAS, or 3-PNS.

ATTAINS Category	NHDES Sub-Category	Definition of NHDES Sub-Category for PARAMETERS	Definition of NHDES Sub-Category for USES	Definition of NHDES Sub-Category for ASSESSMENT UNITS
		For parameters in sediment for which the concentration was greater than TEC screening values, but no impacts to the benthos were observed in toxicity tests or community studies. For trophic class based assessments, the calculated median < criteria and > ½ criteria.		
	2-OBS	Parameter exceeds water quality criteria due to naturally occurring conditions (Section 3.1.7) and but for the naturally occurring conditions the parameter would be marked as Category 4 or 5.	NA	NA
3	3-PAS	There is some but insufficient data to assess the parameter per the CALM, however, the data that is available suggests that the parameter is Potentially Attaining Standards (PAS)	All parameters for the Use are 3-PAS.	All Uses are 3-PAS.
	3-PNS	There is some but insufficient data to assess the parameter per the CALM, however, the data that is available suggests that the parameter is Potentially Not Supporting (PNS) water quality standards (e.g., there is one exceedence).	At least 1 parameter for the Use is 3-PNS. All other parameters for the Use are either 3-PAS or 3-PNS.	At least 1 Use is 3-PNS. All other Uses are either 3-PAS or 3-PNS.
	3-ND	There is no current data available for the parameter.	There is no current data available for the use.	There is no current data available for the AU.
4A	4A-M	The parameter is a pollutant which is assessed as an impairment per the CALM, and an EPA-approved TMDL has been completed. However, the impairment is relatively slight or marginal, as defined below: For parameters where the 10% rule applies, the number of exceedences equals or exceeds the number of exceedences needed to assess the parameter as impaired in Table 3-13, however, all of the exceedences are < the MAGEX threshold. For bacteria, there are no magnitude of exceedences of the geometric mean and/or no MAGEX of the single sample criterion. The Benthic Index of Biological Integrity (B-IBI) ratio (score/threshold) for marginal category is under development. The Cold Water Fish Assemblage Index of Biological Integrity (CW-IBI) is > 24 but < 30. The Transitional Water Fish Assemblage Index of Biological Integrity (TW-IBI) is > 25 but < 28. For trophic class based assessments, the calculated median > criteria.	At least one parameter for the Use is 4A-M and none of the other parameters for the Use are 4A-P, 4B-M, 4B-P, 5-M or 5-P.	At least 1 Use 4A-M and none of the Uses are 4A-P, 4B-M, 4B-P, 5-M or 5-P.
	4A-P	The parameter is a pollutant which is assessed as an impairment per the CALM, and an EPA-approved TMDL has been completed. However, the impairment is more severe and causes poor water quality conditions, as defined below: For parameters where the 10% rule is violated, at least 1 violation is an exceedence of the MAGEX threshold; or Non-support is based upon 2 or more exceedences of the MAGEX threshold; or For bacteria, there is at least one magnitude of exceedence of the geometric mean or there are two or more exceedences of the single sample criterion with at least one exceeding the MAGEX. The Benthic Index of Biological Integrity (B-IBI) ratio (score/threshold) is $\leq$ 1.0.	At least 1 parameter for the Use is 4A-P and none of the other parameters for the Use are 4B-M, 4B-P, 5-M or 5-P.	At least 1 Use is 4A-P and none of the other Uses are 4B-M, 4B-P, 5-M or 5-P.

ATTAINS Category	NHDES Sub-Category	Definition of NHDES Sub-Category for PARAMETERS	Definition of NHDES Sub-Category for USES	Definition of NHDES Sub-Category for ASSESSMENT UNITS
		The Cold Water Fish Assemblage Index of Biological Integrity (CW-IBI) is < 24. The Transitional Water Fish Assemblage Index of Biological Integrity (TW-IBI) is < 25. For trophic class based assessments, the calculated median > 2X criteria.		
4B	4B-M	Parameter is a pollutant that is causing impairment as per the CALM but a TMDL is not necessary since other controls are expected to attain water quality standards within a reasonable time. The impairment is marginal as defined in NHDES sub-category 4A-M above.	At least 1 parameter for the Use is 4B-M and none of the other parameters for the Use are 4B-P, 5-M or 5-P.	At least 1 Use is 4B-M and none of the other Uses are 4B-P, 5-M or 5-P.
	4B-P	Parameter is a pollutant that is causing impairment as per the CALM but a TMDL is not necessary since other controls are expected to attain water quality standards within a reasonable time. The impairment is more severe and causes poor water quality as defined in NHDES sub-category 4A-P above.	At least 1 parameter for the Use is 4B-P and none of the other parameters for the Use are 5-M or 5-P.	At least 1 Use is 4B-P and none of the other Uses are 5-M or 5-P.
4C	4C-M	Parameter is not a pollutant but is causing impairment per the CALM. The impairment is marginal as defined in NHDES sub-category 4A-M above.	At least 1 parameter for the Use is 4C-M and none of the other parameters for the Use are 4A-M, 4A-P, 4B-M, 4B-P, 4C-P, 5-M or 5-P.	At least 1 Use is 4C-M and none of the other Uses are 4A-M, 4A-P, 4B-M, 4B-P, 4C-P, 5-M or 5-P.
	4C-P	Parameter is not a pollutant but is causing impairment per the CALM. The impairment is more severe and causes poor water quality as defined in NHDES sub-category 4A-P above.	At least 1 parameter for the Use is 4C-P and none of the other parameters for the Use are 4A-M, 4A-P, 4B-M, 4B-P, 5-M or 5-P.	At least 1 Use is 4C-P and none of the other Uses are 4A-M, 4A-P, 4B-M, 4B-P, 5-M or 5-P.
5	5-M	Parameter is a pollutant that requires a TMDL. The impairment is marginal as defined in NHDES sub-category 4A-M above.	At least 1 parameter for the Use is 5-M and none of the other parameters for the Use are 5-P.	At least 1 Use is 5-M and none of the other Uses are 5-P.
	5-P	Parameter is a pollutant that requires a TMDL. The impairment is more severe and causes poor water quality as defined in NHDES sub-category 4A-P above.	At least 1 parameter for the Use is 5–P.	At least 1 Use is 5–P.

Notes:
G = Good
M = Marginal
P = Poor
PAS = Potentially Attaining Standards
PNS = Potentially Not Supporting
T = Threatened

Table 3-7: Definition of NHDES Sub-Categories for Parameters, Uses and Assessment Units

NHDES Parameter or Use Category														NHDES Use or AU Category
2-G	2-M	2-OBS	3-PAS	3-PNS	3-ND	4A-M	4A-P	4B-M	4B-P	4C-M	4C-P	5-M	5-P	
Number of Parameters or Uses in each Category														
> 1	0	> 0	> 0	0	> 0	0	0	0	0	0	0	0	0	2-G
> 1	0	> 1	> 0	0	> 0	0	0	0	0	0	0	0	0	2-G
0	> 0	> 1	> 0	> 0	> 0	0	0	0	0	0	0	0	0	2-M
> 0	> 1	> 0	> 0	> 0	> 0	0	0	0	0	0	0	0	0	2-M
> 1	> 0	> 0	> 0	> 1	> 0	0	0	0	0	0	0	0	0	2-M
0	0	0	> 1	0	> 0	0	0	0	0	0	0	0	0	3-PAS

NHDES Parameter or Use Category														NHDES Use or AU Category
2-G	2-M	2-OBS	3-PAS	3-PNS	3-ND	4A-M	4A-P	4B-M	4B-P	4C-M	4C-P	5-M	5-P	
Number of Parameters or Uses in each Category														
0	0	0	> 0	> 1	> 0	0	0	0	0	0	0	0	0	3-PNS
0	0	0	0	0	> 1	0	0	0	0	0	0	0	0	3-ND
> 0	> 0	> 0	> 0	> 0	> 0	> 1	0	0	0	> 0	> 0	0	0	4A-M
> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 1	0	0	> 0	> 0	0	0	4A-P
> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 1	0	> 0	> 0	0	0	4B-M
> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 1	> 0	> 0	0	0	4B-P
> 0	> 0	> 0	> 0	> 0	> 0	0	0	0	0	> 1	0	0	0	4C-M
> 0	> 0	> 0	> 0	> 0	> 0	0	0	0	0	> 0	> 1	0	0	4C-P
> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 1	0	5-M
> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 0	> 1	5-P

Notes:

1. If the sub-categories above represent parameters for a particular Use, then the far right column represents the NHDES Use Category.
2. If the sub-categories above represent Uses for a particular Assessment Unit, then the far right column represents the NHDES Assessment Unit Category.
3. Categories 4A-M, 4B-M, and 5-M cover 4A-T, 4B-T, and 5-T respectively in the impairment hierarchy.
4. Core parameters must all be Category 2G or 2-M for the designated use to be 2-G or 2-M.
5. See Table 3-6 for a description of each NHDES Sub-Category for Parameters, Uses and Assessment Unit.

3.1.6 Causes (Pollutants and Nonpollutants) and Sources of Impairment

The Assessment and Total Maximum Daily Load Tracking and Implementation System (ATTAINS) requires input of causes (i.e. impairments such as low dissolved oxygen) of threatened or impaired waters and sources (such as stormwater runoff). These terms are defined below.

Causes: The "cause" of a threatened or impaired water is an assessment term used to describe the pollutant or non-pollutant, which is causing, or threatening to cause, a water quality violation. In general, a pollutant can be thought of as something which can be expressed in terms of a loading (i.e. pounds per day) and physically allocated. For example, phosphorus and iron are considered pollutants. Only waters which are threatened or impaired by pollutants are required to have Total Maximum Daily Load (TMDL) studies.

Conversely, a non-pollutant cannot be expressed in terms of a loading. TMDLs are not required for waters impaired by non-pollutants. Examples of non-pollutants include the following:

- Exotic non-native invasive species.
- Flow alterations or other hydrologic modifications.
- Habitat degraded by physical conditions.

In ATTAINS, each cause of impairment must be flagged as either a pollutant or non-pollutant.

Sources: The "source" of a threatened or impaired water means the source of the pollutant or non-pollutant, which is threatening or causing water quality violations. For example, atmospheric deposition (acid rain) could be listed as the source of low pH, or CSOs as the source of bacteria violations.

In ATTAINS, any AU can have more than one cause or source of impairment.

3.1.7 Observed Effects

According to EPA's User's Guide (RTI, August 13, 2003), an observed effect is defined as "…any parameter which a State monitors, but that is not defined as an impairment to a designated use in the State's water quality standards." Depending on a State's surface water quality standards, examples of observed effects may include such things as secchi disk readings or fish kills where the cause was indeterminate. Though not impairments of water quality standards, observed effects are nevertheless useful for water quality managers to track.

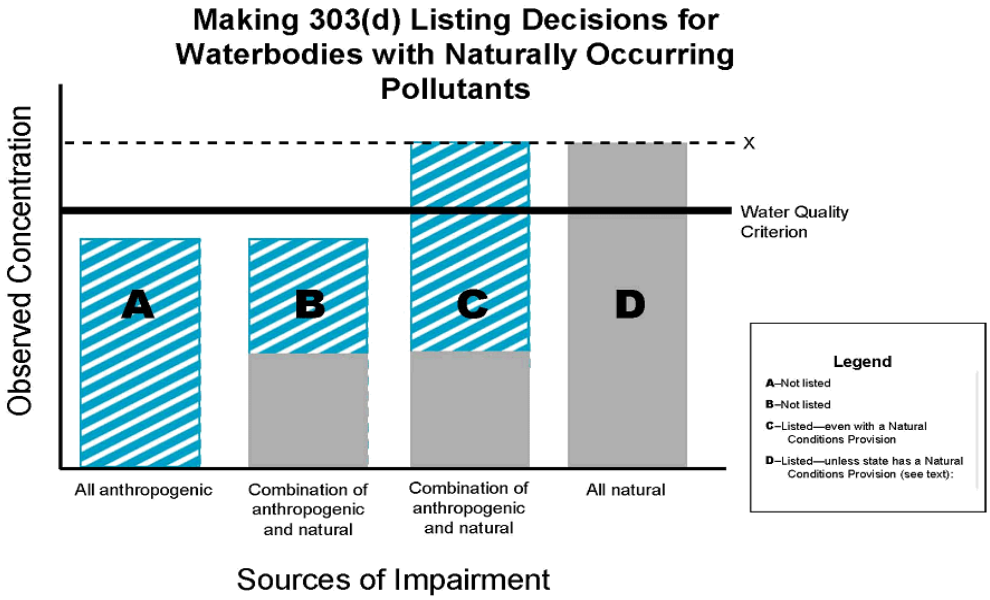
For this reporting period, only pollutants or non-pollutants which exceeded water quality criteria due to naturally occurring conditions were flagged as observed effects in ATTAINS. As explained in Section 3.1.8, exceedences of water quality criteria due to naturally occurring conditions are not considered violations (i.e. impairments) of the water quality standards. Conditions which were considered naturally occurring for this reporting cycle are discussed in Section 3.1.8.

3.1.8 "Naturally Occurring" Water Quality Exceedences

In New Hampshire, exceedences of most water quality criteria due to naturally occurring conditions are not considered violations of the water quality standards. According to Env-Wq 1702.28 of the State's surface water quality regulations (NHDES, 2016), naturally occurring conditions means "conditions which exist in the absence of human influences."

USEPA's guidance for the 2008 assessment cycle (USEPA, October 12, 2006) provided a useful graphic (Figure 3-1) which is in keeping with New Hampshire's, "conditions which exist in the absence of human influences" definition of naturally occurring conditions in Env-Wq 1702.28.

Figure 3-1: Conceptual Diagram for Making 'Natural' Determinations (not to scale) (USEPA, October 12, 2006)



Column A – The waterbody receives only anthropogenic pollutant loadings. The waterbody does not have to be included on the 303(d) list or placed into Category 5 because the applicable numeric criterion is not exceeded.

Column B – The waterbody receives pollutant loadings from both natural background and anthropogenic sources, but because the applicable numeric criterion is not exceeded, the waterbody does not have to be included on the 303(d) list or placed into Category 5.

Column C – The waterbody receives pollutant loadings from both natural background and anthropogenic sources. The applicable numeric criterion is exceeded, and therefore, the waterbody is considered impaired and belongs the 303(d) list or Category 5.

Column D – The waterbody receives pollutant loadings from only natural background sources, and the applicable numeric criterion is exceeded. The waterbody is considered impaired and belongs on the 303(d) list or Category 5 unless the State's water quality standards include a natural conditions provision consistent with the standards provision quoted above.

The level of documentation needed to determine if the source is natural is dependent on the pollutant. Mathematical analyses or computer modeling, for example, may be needed for estimating natural levels of dissolved oxygen in some cases. On the other hand, a simple field reconnaissance with bracketed sampling may suffice to determine if a bacteria exceedence is likely due to man's activities or to wildlife. In either case, documentation is needed to support the "natural" determination.

For this assessment, only the following was considered naturally occurring (see Section 3.2.4):

- pH values greater than 8.0 but less than or equal to 8.5 in tidal waters unless there was evidence to indicate the elevated pH levels were due to human activity.

Although there are other exceedences that are suspected to be of natural origin (such as bacteria exceedence due to wildlife), the source was listed as unknown for this cycle since a process has not yet been clearly defined for determining when the source can be considered natural. As more processes for determining naturally occurring conditions are developed and implemented, it is expected that the number of waterbodies with exceedence attributed to natural sources will increase.

Currently, ATTAINS is not set up to specifically address situations where water quality standards allow for excursions of criteria due to natural sources. As previously mentioned, such exceedences are not, by definition, violations of the water quality standards. Consequently, it is not appropriate to assess such waters as impaired in ATTAINS. Nevertheless, water quality managers find it very useful to keep track of waters with naturally occurring water quality exceedence. For this reporting cycle, this was done by assigning the pollutant or non-pollutant as an Observed Effect (rather than an impairment) in ATTAINS. For more information on Observed Effects, see Section 3.1.7.

3.1.9 Data Sources

On September 12, 2019, a request for data/information for the 2020 305(b)/ 303(d) submission was sent to the following organizations and was placed on the NHDES website[5] for the general public. The request included guidance and a form to facilitate electronic or mailed submissions and was sent to a wide variety of groups including but not limited to;

Appalachian Mountain Club
Audubon Society
Connecticut River Joint Commissions
Conservation Law Foundation
County Conservation Districts
DPW Directors of the MS4 Communities
Manchester Conservation Commission
Merrimack River Watershed Council
National Park Service
Natural Resources Conservation Service
New Hampshire Lakes Association
New Hampshire Rivers Council
North Country Council
Piscataqua Region Estuaries Partnership
Regional Planning Commissions
Society for the Protection of National Forests
Souhegan River Watershed Association
The Great Bay Municipal Coalition
The Nature Conservancy
University of New Hampshire
Upper Merrimack River Local Advisory Committee
U.S. Environmental Protection Agency
U.S. Geological Survey
U.S. Fish and Wildlife Service
U.S. Forest Service

Information/data received from the above was assessed in accordance with this methodology. Other data sources consulted for this assessment included but were not limited to the following:

2018 NH Section 305(b)/303(d) Surface Water Quality Assessment[6]
Baker River Watershed Association
NHDES Acid Rain-Lake Monitoring Program
NHDES Ambient Rivers Monitoring Program (ARMP)

[5] https://www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment
[6] https://www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment/swqa-publications#faq38806

NHDES Beach Program (freshwater and coastal beaches)
NHDES Biomonitoring Program
NHDES Juvenile Camp Inspection Program (administered by the WSEB)
NHDES Lake Diagnostic Feasibility Studies
NHDES Lake trophic surveys
NHDES Permits and Compliance Section (NPDES permits)
NHDES Section 319 Program (nonpoint source projects)
NHDES Section 401 Water Quality Certification Program
NHDES Shellfish Program
NHDES State Clean Lakes program (nuisance aquatic growths including exotic species)
NHDES TMDL Program
NHDES / UNH National Coastal Assessment, Water Quality Monitoring Program
NHDES Volunteer Lakes Assessment Program (VLAP – includes volunteer data from over 180 lakes)
NHDES Volunteer Rivers Assessment Program (VRAP – includes data from approximately 30 volunteer monitoring groups)
NHDES Waste Management Division (hazardous waste sites, landfills, etc.)
NHDES Watershed Assistance Section (nonpoint source investigations)
NHDES Water Supply Engineering Bureau (public water supplies)
NHDES Water Quality Complaint files
Great Bay Coast Watch Water Quality Monitoring Program
NH Department of Health and Human Services (fish/shellfish consumption advisories)
NH Estuary Project (NHEP) Monitoring
NH Fish and Game National Estuarine Research Reserve (NERR) System Wide Monitoring Program
Piscataqua Region Estuaries Partnership Water Quality Monitoring Program
US Navy Interim Offshore Monitoring Program for the Portsmouth Naval Shipyard

3.1.10 Data Age

Surface water quality assessments are intended to determine the current designated use support. Use of outdated information can result in assessments that are not representative of actual conditions in the waterbody. It is therefore important to establish data age requirements to increase the accuracy of assessments.

Intuitively, the more current the data the more accurate the assessment. However, setting a maximum data age of one year, for example, would result in very few waters ever being assessed due to a lack of resources to collect the necessary data each year. Consequently, establishment of data age requirements must strike a balance between:

- the desire to have the most current data possible;
- incorporating datasets from water quality limiting time periods;
- the amount of data needed to make an assessment; and
- the resources and time needed to collect the data.

Bearing these factors in mind, maximum data age requirements for making use support decisions are shown in Table 3-8.

The data age requirements shown in Table 3-8 apply in all cases except waters previously listed as threatened or impaired that have not since been removed from the threatened or impaired waters list for any of the reasons specified in section 3.1.25. In such cases, the data used to make the original assessment, regardless of its age, was included in the reassessment provided it met all other data requirements (including the minimum number of samples) stipulated elsewhere in this assessment methodology. This was done to prevent removal of waters from a threatened or impaired category based solely on data age.

As shown in Table 3-8, the maximum data age requirement for lakes and ponds is 10 years (versus five years for the other waterbody types). This is because the water quality of many lakes and ponds do not change dramatically with time due to their large volume and retention times (often on the order of years). Consequently, use of 10-year-old data for lakes and ponds, though not ideal, is believed to provide a reasonably accurate assessment of water quality conditions in most cases.

Table 3-8: Maximum Age of Data for Use in Assessments

Waterbody Type	Maximum Age of Data Eligible for Making Assessments (except for waters previously listed as threatened or impaired)*
Rivers and Streams Impoundments Estuaries Ocean	5 years
Lakes and Ponds	10 years

* In earlier assessment cycles (2002, 2004,…) the process of getting data from field notebooks to electronic databases was rather slow. To get a full 5 or 10 years' worth of data to use for assessments the department went back 6 and 11 years. While the speed of data upload has greatly increased for most waterbodies, the department still goes back 6 years in marine waters in recognition that the most recent year's data will be incomplete.

3.1.11 Values Beyond Detection Limits

Results of many water quality samples are reported as below the analytical detection limit (non-detects). In such cases, the actual value is not known. When non-detect values were reported and an actual value was needed for making an assessment, 50 percent of the analytical detection limit was used as the value. For bacteria results reported as "0" counts, the zero values were replaced with 1 counts so that the geometric mean could be calculated. Care has been taken to ensure that waters were not listed based upon values below the detection limit where the detection limit was greater than the standard criteria.

Results of some water quality samples are reported as above the analytical detection limit. In such cases, the actual value is not known. When detection limit exceedence values were reported and an actual value was needed for making an assessment, the maximum detection limit of the analytical detection limit was used as the value. For example, bacteria results

reported as “>2000” counts, were replaced with 2000 counts so that the geometric mean could be calculated.

3.1.12 Data Quality

Data used to make final assessment decisions, must be defensible. Consequently, it is extremely important that the quality of the data is known. Information about the procedures used for sample collection, sample analysis, data analysis and data reporting are requested in the data request process described in Section 3.1.9.

ATTAINS requires documentation of the data quality used to make a final assessment decision. In terms of ATTAINS, this is called the “level of information” for which there are four options to select from:

1. Low.
2. Fair.
3. Good.
4. Excellent.

General criteria for determining the appropriate level of data confidence are provided in Table 3-9. As shown, only data which is considered to be Fair, Good or Excellent can be used to make a final assessment and from Fair to Excellent there is an increasing confidence in the datasets precision and accuracy. As a reference, quality assurance/quality control (QA/QC) procedures used by the NHDES are considered Good to Excellent and were used to help determine appropriate levels for data collected by others.

Data or information that is assigned a Low level is not considered defensible for use in final assessments. Such data, however, can and is used for making preliminary or screening level assessments, which help guide future monitoring efforts.

Table 3-9: Generalized Level of Information Descriptions for Data Quality

Level of Information - or - Data Confidence	Hallmarks of Datasets within this Confidence Level*	Assessment Applicability	Use Support Option(s) that can be used with this level of information
Low	SOPs or QA/QC plan are not available or were not provided. SOPs or QA/QC plan is available but protocols were not followed, QA/QC results are inadequate, and /or there is inadequate metadata.	Screening Level assessments only	"Not Assessed" “Insufficient Information”
Fair	SOPs or a QA/QC plan is available; SOPs were used for field and lab;	Final Assessments	“Insufficient Information”

Level of Information - or - Data Confidence	Hallmarks of Datasets within this Confidence Level*	Assessment Applicability	Use Support Option(s) that can be used with this level of information
	QA/QC protocols were followed and QA/QC results and metadata are adequate; Samplers had some training;		"Fully Supporting" (with caution) "Not Supporting" (with caution)
Good	An acceptable QA/QC plan is available; SOPs were used for field and lab; QA/QC protocols were followed and QA/QC results and metadata are adequate; Samplers were well trained.	Final Assessments	"Insufficient Information" "Fully Supporting" "Not Supporting"
Excellent	An acceptable QA/QC plan is available; SOPs were used for field and lab; QA/QC protocols were followed and QA/QC results and metadata are adequate; Samplers were well trained and audited.	Final Assessments	"Insufficient Information" "Fully Supporting" "Not Supporting"

*SOP stands for Standard Operating Protocols
*QA/QC stands for Quality Assurance/ Quality Control

Use of Volunteer Data: In New Hampshire there are two very active volunteer monitoring programs coordinated by NHDES: the Volunteer Lake Assessment Program (VLAP) and the Volunteer River Assessment Program (VRAP). The quality of this data is considered to be Good to Excellent in most cases; consequently, the majority of volunteer data collected was used to help make assessment decisions for this reporting cycle.

3.1.13 Core Parameters

For any designated use, there are often many parameters that can be used to determine if the water is impaired (not supporting) or threatened. Criteria for making these decisions are described in this document. If any one of the parameters indicate a threatened or impaired status, as defined in this document, then the water will be reported as threatened or impaired in ATTAINS and placed in category 4A, 4B, 4C or 5.

However, to determine if an AU is fully supporting a particular use, it is necessary to identify the minimum number of parameters needed to make this decision. This is because it is not feasible to sample every parameter that may affect a use.

The parameters comprising the minimum data set needed to assess an AU as fully supporting are called core indicators. Core indicators are often different for each designated use. As a minimum, monitoring strategies designed to make use support assessments need to include the core indicators.

Table 3-10 shows what the final attainment status would be in ATTAINS based on the individual attainment status of the core indicators or other parameters. As shown, in order for a use to be assessed as fully supporting, all of the core indicators for that use must be fully supporting, and none of the data associated with the core indicators, or any other parameter used in the assessment, can indicate a threatened or impaired status, as defined by this document. If there is insufficient information for the core indicators to make an attainment decision, and there are no other parameters that indicate a threatened or impaired status, the attainment status will be reported as "insufficient information." This is true even if the attainment status of other parameters (which are not core indicators) are fully supporting. If however, any of the core indicators and/or other parameters are threatened or impaired, the use will be reported as threatened or impaired. Core indicators for each designated use are presented in Section 3.2.

Table 3-10: Use Support Options Based on Core Indicators and Other Parameters

Use Support Status based on Assessment of Core Indicator(s)	Use Support Status based on Assessment of Other Parameters	Final Use Support Status listed in ATTAINS
Fully Supporting	Fully Supporting	Fully Supporting
Fully Supporting	Insufficient Information	
Insufficient Information or Not Assessed	Fully Supporting	Insufficient Information or Not Assessed
Insufficient Information	Not Supporting	Not Supporting
Fully Supporting	Not Supporting	
Not Supporting	Not Supporting	
	Fully Supporting	
	Insufficient Information	

3.1.14 Definition of Independent Samples

As discussed in Section 3.1.16, assessments for most uses are very dependent on the number of "independent samples" taken. It is therefore necessary to define what constitutes an "independent sample" for assessment purposes.

For this assessment, independent samples were defined as:

- Samples taken at least 500 feet (horizontally) from each other regardless of when the samples were taken or, samples taken on different calendar days regardless of the horizontal separation between samples.

Where there were multiple samples (including samples taken at different depths) taken on the same calendar day and located less than 500 feet horizontally from each other, the worst case

value was used as the independent sample for that day and location unless otherwise noted in Section 3.2. For Class B lakes, ponds and large impoundments, it should be noted that only data from the upper layers (i.e., the epilimnion in stratified waterbodies or the top 25% in non-stratified waterbodies) was used for assessment of dissolved oxygen. For all other parameters samples from all depths were considered and the worst case value was used as the independent sample for that day and location.

3.1.15 Aggregation of Samples within an Assessment Unit

As stated in Section 3.1.1, one of the basic premises governing the establishment of assessment units (AUs) was that they should be homogenous. Assuming all AUs were created to be relatively homogenous, it follows that any independent sample taken from an AU is representative of conditions in the AU. Since each independent sample is considered to be representative of the AU, aggregation of independent samples within an AU to assess an AU was allowed.

3.1.16 Spatial Coverage per Sample Site

Spatial coverage is the miles of river or acres of lake, for example, which are assumed to be represented by an independent sample. This statistic is critical for assessments because without it, it would not be possible to estimate the size of waters for the various use support options (e.g., the miles of rivers and streams that are fully supporting or not supporting).

Assuming a very large coverage per station (e.g., 500 miles per sample site) would result in many miles of river being assessed per sample site. However, the assessment would not be very accurate or defensible unless the upstream watershed was relatively homogenous with regards to the many factors which can influence the impact of a pollutant on a surface water (i.e., waterbody type, physical characteristics, land use, pollutant sources, etc.). It is doubtful that all surface waters in such a large watershed would be that homogenous.

As discussed in section 3.1.1, assessment units (AUs) were established with the intent that they would be homogenous. Consequently, it is appropriate to assume that any independent sample site within an AU is representative of water quality conditions within the AU. With regard to spatial coverage per independent sample site, this translates to the ranges shown in Table 3-11, which assumes only one site per AU. In many cases there were multiple independent sample sites within an AU, which would decrease the average coverage per site. Also presented in Table 3-11, for comparison purposes, are coverages recommended or referenced in USEPA guidance (USEPA, 1997).

Table 3-11: Spatial Coverage per Independent Sample

Waterbody Type	Units	Spatial Coverage assuming 1 independent sample site per AU	Spatial Coverage recommended or referenced in USEPA guidance (USEPA, 1997)
Freshwater Rivers and Streams	Miles	Average: 2.86 Minimum: 0.002 Maximum: 49.06 (Note: The new large AUIDs are primarily networks of headwater systems in the White Mountain National Forest and other similar unpopulated areas.)	Wadeable Streams: No more than 5 to 10 miles per station. Large rivers: No more than 25 miles per station
Freshwater Impoundments	Acres	Average: 18.82 Minimum: 0.010 Maximum: 3800	None discussed in USEPA guidance
Freshwater Lakes and Ponds	Acres	Average: 107.79 Minimum: 0.082 Maximum: 44,315	Site specific
Estuaries	Square Miles	Average: 0.26 Minimum: 0.0025 Maximum: 4.09	Per USEPA guidance (USEPA, 1997) the Washington Department of Ecology uses the following coverage: Open waters: Within a 4-mile radius, which translates to 50 square miles per sampling site. Bay stations: Within a 2-mile radius, which translates to 14 square miles per sampling site. Highly sheltered bays: within a ½ mile radius, which translates to 0.8 square miles per sample site.
Ocean	Square Miles	Average: 3.25 Minimum: 0.0027 Maximum: 76.64	See Estuaries

For most waterbody types and AUs, information pertaining to an AU was used to assess just that AU. That is, data from one AU was not used to assess another AU. Exceptions to this rule include certain Estuary, Ocean and Designated Beach AUs, as explained below.

Estuary and Ocean AUs are spatially coincident with the designated shellfishing zones; this was done so that the shellfishing classification could be applied to the assessment of the shellfishing designated use. As these zones are not strictly hydrologically based, it was recognized that it may be appropriate to apply data collected in one AUID to a bordering AUID based upon the hydrologic mixing characteristics in the area. For the 2020 assessment, major stations within the body of Little Bay and Great Bay or within 1000 feet of the body/tributary interface were evaluated to determine if the data should apply to one or both AUs.

3.1.17 Minimum Number of Samples - 10% Rule (of Thumb)

The number of samples needed to make a use support decision plays a large role in an assessments defensibility and believability. Calling a waterbody impaired based on only one sample, for example, always seems questionable no matter how reliable the data may be. This raises the question, what is minimum number of samples needed for a robust assessment?

One can never have enough data. The more data there is, the more confident one can be that the data represents actual conditions. In statistical terms the entire collection of all measurements is called the population. Since it is impossible to sample the entire population, it is necessary to try to describe the population based on a subset of the measurements. By doing so, some error is always introduced.

For water quality assessments, there are basically two types of error; Type I and Type II, which are defined in Table 3-12.

Table 3-12: Definition of Type I and Type II Errors for Assessments

Error	Definition
Type I	The waterbody is assessed as impaired when it is really fully supporting
Type II	The waterbody is assessed as fully supporting when it is really impaired

In an effort to minimize the Type I error caused by erroneous data while limiting the Type II error caused by discounting data, NHDES employed the “binomial approach” in previous reporting cycles. The binomial approach, however, was criticized by some as being too lenient because the number of exceedence needed for a waterbody to be considered impaired increased with total sample size, and at least 3 exceedence were needed for total sample sizes of 10 or less. The concern was that some waterbodies were not being listed which were actually impaired. In response to these concerns NHDES decided to abandon the binomial approach starting with the 2006 cycle and adopt the slightly more stringent ten percent rule (i.e. 10% rule) for determining use support. In general, the 10% rule simply means that at least 10% of the samples must violate water quality criterion before a waterbody will be listed as impaired. Like the binomial approach, the number of samples needed to list a water as impaired increases with the total sample size (see Table 3-13), although fewer exceedence are needed using the 10% rule.

There are a few exceptions to the 10% rule. The first is for situations where 10% of the total number of samples is less than two. In such cases, a minimum of two samples is used to determine compliance. This is consistent with the previously stated premise that an assessment will not be based on just one sample. The second exception is for relatively large exceedence of the criterion. In such cases, only two exceedences are needed to assess the water as impaired. This is discussed in more detail in section 3.1.18“Magnitude of Exceedence Thresholds.” The third exception is that the 10% rule is not used for probabilistic assessments (see section 3.1.27). Finally, the fourth exception is that this rule only applies to certain parameters. To

determine the parameters which were dependent on the 10% rule for making assessments, see Section 0.

The 10% rule is primarily intended to address situations where samples violate criterion but not by large amounts (i.e. values are within the accuracy of sampling and method of analysis). For example, consider a data set containing 20 dissolved oxygen (DO) samples where the accuracy of sampling and measurement is +/- 0.5 mg/L. Further, assume only one of the samples (less than 10% of the total samples) violates the instantaneous D.O. criterion of 5 mg/L but by less than 0.5 mg/L (assume the value is 4.6 mg/L). Assuming that all 20 samples were collected under critical conditions and applying the 10% rule, the AU would be assessed as fully supporting for DO and the single 4.6 mg/L value would be interpreted as due to measurement error. If, however, 2 or more of the 20 samples (i.e. greater than or equal to 10% of the samples) had values less than 5.0 mg/L, the AU would be assessed as impaired for DO. In other words, the fact that 10% or more of the samples exceeded the criterion is reason enough to conclude that the exceedences are not due to measurement error alone and that violations of the water quality criterion actually exist.

Table 3-13 shows the number of exceedence needed to assess a waterbody as impaired increases as the total sample size increases. For example, if the total number of samples is less than 24, a parameter would be considered in violation of its criteria if there are 2 or more exceedences. If there are between 25 and 34 samples (inclusive), the number of exceedences required to call a waterbody impaired increases to three.

Table 3-13: Sample Size and Minimum Number of Exceedences (10% Rule of Thumb)

Sample Size	Minimum # of exceedences to assess a waterbody as impaired
2-24	2
25-34	3
35-44	4
45-54	5
55-64	6
65-74	7
75-84	8
85-94	9

3.1.18 Magnitude of Exceedence Thresholds (MAGEX)

The 10% rule discussed in the previous section provides a reasonable tool for determining the minimum number of water quality violations needed to assess a water as impaired under most conditions (i.e. when sample exceedences are generally within the range of sampling and analysis error). It does not, however, account for situations where water quality criteria are exceeded by large amounts and it is obvious that there is an impairment. In such cases, just a few samples should be needed to make an impairment decision.

To address these situations, “Magnitude of Exceedence Thresholds” (MAGEX) were established for many of the assessment parameters presented in Section 3.2. As shown in Section 3.2, MAGEX are typically set well beyond the standard water quality criteria or as a function of measurement precision +/- the standard criteria; consequently, when MAGEX thresholds are exceeded, one can be reasonably confident that there is an exceedence of the water quality criteria. As a general rule, if two or more samples exceeded the MAGEX, waters were assessed as impaired (i.e. not supporting), regardless of the total number of samples taken. Exceptions may be made when there are few other measurements, rare conditions (such as very low or high flow), or when there are no other “regular” exceedence (non-MAGEX exceedences).

3.1.19 7Q10 Low Flow and Mixing Zone Criteria

7Q10 low flow: According to Env-Wq 1705.02 of the State’s surface water quality regulations (NHDES, State of New Hampshire Rules for the Protection of Instream Flow on Designated Rivers, Chapter 1900. Last revised 5/28/11, 2011), the flow used to calculate permit limits (i.e. NPDES permits for wastewater discharges) for aquatic life criteria and human health criteria for non-carcinogens, shall be the 7Q10 low flow, which is the average seven-day low flow that occurs, on the average, once every 10 years. This implies that water quality criteria for human health and non-carcinogens do not apply at flows below the 7Q10 in waters receiving wastewater discharges. Consequently, assessment of surface waters downstream of wastewater discharges were only based on samples taken when river flows were at or above the 7Q10 low flow, as determined by NHDES. 7Q10 low flows are not used to calculate permit limits for nutrients.

Mixing Zones: Env-Wq 1702.26 of the State’s surface water quality regulations (NHDES, 2016), defines a mixing zone as a defined area or volume of the surface water surrounding or adjacent to a wastewater discharge where the surface water, as a result of the discharge, might not meet all applicable water quality standards. Mixing zones are prohibited in Class A waters (Env-Wq 1707.01(a)) but are allowed in Class B waters, where designated by NHDES, if they meet the conditions stipulated in Env-Wq 1707.02 (Minimum Criteria) and Env-Wq 1707.04 (Technical Standards).

Consistent with the above, water quality data used to make assessments were based on samples taken outside of NHDES designated mixing zones for wastewater treatment facilities. For wastewater treatment facilities where NHDES has not yet designated an official mixing zone, water quality data used for assessment purposes were from samples taken at least 500 feet downstream of the WWTF discharge.

3.1.20 Use of Predictive Models

A waterbody with potential violations based on predictive modeling was assessed as threatened (not supporting), to reflect the fact that the violation is predicted and not based on actual measured in-stream violations, provided that the following conditions apply:

- The model is calibrated and verified and is considered to be representative of current conditions.
- The model predicts water quality violations under existing loading conditions, and/or under enforceable pollutant loadings stipulated in a NPDES permit.

Assuming that modeling predicts a violation, and assuming that this is the only violation in the waterbody, such waters were assessed as threatened and assigned an Impairment Category of 4A-T, 4B-T, 4C-T, or 5-T depending on the cause of the threat (pollutant or non-pollutant), the source(s) of the threat, if a TMDL was necessary or if other controls would result in attainment of water quality standards.

Impairment Category 5-T was assigned if the surface water was threatened by a pollutant, a TMDL had not yet been done, and the remedy to meet water quality standards was not clear. A good example is when modeling indicates that advanced treatment at a NPDES WWTF, as well as nonpoint source controls, are necessary to meet dissolved oxygen standards. In such cases the TMDL process would identify all sources and pollutant reductions necessary to meet water quality standards (including NPDES effluent limits).

Impairment Category 4A-T was assigned if the surface water was threatened by a pollutant and a TMDL has been completed.

Impairment Category 4B-T was assigned when modeling predicted a violation for a pollutant where the primary source and the remedy is clearly known and that remedy is part of an enforceable measure. An example is when dilution calculations used to determine NPDES permit effluent limits for toxic substances (such as chlorine or ammonia), that are normally below detection limits in surface waters, indicates a potential for in-stream violations based on measurements in the effluent. In such cases there is no need to allocate loads among sources as the primary source and solution is clear: include effluent limits for the toxics of concern in the NPDES permit for the WWTF (which are enforceable) and require the WWTF to implement measures that will bring it in compliance with its NPDES permit.

3.1.21 NPDES Permit Effluent Violations

Waters receiving effluent from Wastewater Treatment Facilities (WWTF) that have recently violated their NPDES permit effluent limits, were assessed as threatened with the following conditions:

- The WWTF is currently in "significant non-compliance" of its NPDES permit (as defined by EPA[7]), or is on the "exceptions list" (i.e. facilities that are in significant non-compliance for two or more quarters), for one or more of its permitted water quality based pollutant effluent limits. Water quality based effluent limits are limits based on modeling or dilution calculations to meet water quality standards.
- Violations of technology based permitted effluent limits (i.e. secondary limits for municipal WWTFs) were not listed as threatened.

[7] https://echo.epa.gov/resources/general-info/echo-faq#in_snc

Such waterbodies were assessed as threatened and assigned to Impairment Category 4B-T because the allowable pollutant loading needed to meet water quality standards has already been established in the NPDES permit (an enforceable document); consequently, a TMDL is not needed. Since the target for meeting water quality standards is known, the next step is to develop and implement a plan to bring the discharger into compliance with its NPDES permit as soon as possible.

3.1.22 Pollutants with Unknown Sources

Pollutants with unknown sources causing impairment or threatened conditions were assessed as threatened or impaired and assigned to Impairment Category 5. If future investigations indicate that the source is natural (Env-Wq 1702.28), the water will be removed from the impaired waters list for reasons discussed in section 3.1.8.

3.1.23 Weight of Evidence Approach for Aquatic Life Use Support Decisions

As indicated in Section 3.2, physical, chemical, toxicological, biological and/or habitat indicators can be used to assess the aquatic life use. If data for more than one indicator is available for assessments this can sometimes lead to conflicting assessment results. That is, one indicator might suggest that the designated use is Not Supporting (NS) while others may indicate a Fully Supporting (FS) use attainment status.

To resolve cases with conflicting data, NHDES uses a weight of evidence approach to make final assessment decisions. In general, this approach involves “weighing” the factors shown in the Table 3-14 for each of the indicators. The assessment is then based on the indicator(s) with the highest weight (i.e. score). More specific criteria for resolving differences between biological and habitat assessments are provided in Section 3.2.4.

Table 3-14: Factors Considered in the Weight of Evidence Approach

Factor	Comments
Data Quality (Sampling and Analysis Protocols)	Data of high quality is given more weight than data of low quality.
Sample Time	Usually more weight is given to data which is the most recent, but one must also consider if samples were taken at times when exceedence are most likely to occur (i.e. the critical period). For example, when sampling for dissolved oxygen in rivers, water quality exceedences are most likely to occur during the summer months in the early morning when river flows are low, temperatures are high, and photosynthesis has not actively added dissolved oxygen since the preceding afternoon. If data for Indicator A indicated FS and was more recent but was not collected during the critical period, and data for Indicator B was older but indicated NS, more weight would be given to Indicator B as Indicator A data was not collected during the critical period.

Factor	Comments
Sample Location	Although AUs are theoretically homogenous, in reality, water quality differences can and do occur within an AU. In general, more weight is given to data that is collected the furthest downstream in an AU as it is more representative of all conditions affecting the AU. However, if a particular location within an AU is suspected or known to have a greater likelihood of criteria exceedence, samples from that site would likely be given weight over a downstream site where water quality may have recovered.
Quantity of Samples	In general, more weight is given to the indicator which has the most data as it is more likely to be representative of the population being sampled, provided that a sufficient number of samples were collected during the critical period when violations are most apt to occur. In other words, quantity of data is not permitted to override critical condition data.
Type of Data (i.e. physical, chemical, toxicological, habitat and/or biological)	It is generally believed that for making aquatic life use assessments, biological data should be weighted more heavily than physical, chemical, habitat or toxicological data. This is because high quality biological data provide a direct measure of aquatic life and can detect the cumulative impact of multiple stressors on the aquatic community including new or previously undetected stressors over time. Physical/chemical data, on the other hand, provides a snapshot of river conditions when the samples were taken and do not account for the long-term effects of stressors or the presence of other pollutants which may be impairing the biota.

3.1.24 Process for Determining Waters that Belong on the 303(d) List (Category 5)

Pollutants assigned to Impairment Category 5 (and their associated AUs), constitute the 303(d) List (see Section 3.1.3).

De-listing is the term commonly used to describe the process of removing a pollutant from the 303(d) list (Impairment Category 5). According to federal regulation (40 CFR 130.7), states must demonstrate “good cause” for not including waters on the list. Good cause can include, but is not limited to:

- More recent or accurate information.
- More sophisticated water quality modeling.
- Flaws in the original analysis that led to the water being listed.
- Changes in conditions (e.g. new control equipment, or elimination of discharges).

Consistent with the above, the following process was used to determine which impaired or threatened waters belonged on the 303(d) list (Impairment Category 5) and which should be listed in the other Impairment Categories (4A, 4B, or 4C). This process was carried out for each individual pollutant that threatens or causes impairment in an AU, as it is possible that one cause of impairment may require a TMDL but another does not.

Step 1: Is the cause of the threatened or impaired water a pollutant?

To be eligible for assignment to Impairment Category 5, the waterbody must be threatened or impaired by pollutant(s) rather than non-pollutant(s) as defined and discussed in Section 3.1.6

If the cause is known to be a pollutant, or, if it is not known if the cause is a pollutant or non-pollutant, proceed to step 2.

If the cause was due to a non-pollutant, the cause of impairment was flagged as a non-pollutant and assigned to Impairment Category 4C.

Step 2: Has a TMDL already been completed for the pollutant?

Having determined that the cause is due (or possibly due) to a pollutant, the next step is to determine if a TMDL has already been conducted for that pollutant in that waterbody.

If a TMDL has not been conducted, proceed to step 3.

If a TMDL has been conducted and has been assigned a TMDL ID approval number by EPA, the pollutant was placed in Category 4A.

Step 3: Is the source of the exceedence due to natural conditions?

The next step is to determine the source of the pollutant as this can influence whether a TMDL is needed and, consequently, if the pollutant should be assigned to Impairment Category 5.

As discussed in Section 3.1.8, exceedence of most water quality criteria due to naturally occurring conditions are allowed and are not considered violations of the water quality standards. Since such waters are not technically in violation of the standards, a TMDL is not necessary for waters impaired or threatened by naturally occurring sources.

If the sources are not solely natural (USEPA, Sep. 3, 2014), proceed to step 4.

If the source of the pollutant was confirmed as natural in accordance with Section 3.1.8 the waterbody was no longer considered impaired or threatened by that pollutant. In such cases the cause of exceedence was changed from a Pollutant to an Observed Effect in ATTAINS (see Section 3.1.7).

Step 4: Are there other pollution control requirements that are reasonably expected to result in attainment of water quality standards in the future?

The last step for determining if a waterbody should be assigned to Impairment Category 5 is to evaluate whether controls other than a TMDL are likely to result in attainment of water quality standards in the near future. According to USEPA guidance (USEPA, 2005), a pollutant may be assigned to Impairment Category 4B instead of 5 if it can be demonstrated that other pollution control requirements required by local, state, or federal authority are stringent enough to implement any water quality standard applicable to such water. The process of placing a pollutant in Impairment Category 4B instead of 5 is often called “Off-Ramping.”

Off-Ramping situations are handled on a case-by-case basis. Examples of situations that have been approved by USEPA in the past for Off-Ramping include the following:

- Bacteria impairments due primarily to discharges of untreated human sewage (i.e., due to illicit connections or combined sewer overflows) where an enforceable order or evidence that the source has been removed, and that will result in attainment of water quality standards.
- Waters where restoration efforts are underway or complete and there is an enforceable permit in place that requires attainment of water quality standards. Examples include landfills that have been closed and capped to control iron and/or manganese violations in adjacent surface waters and have Groundwater Management Permits in place which require compliance with NH Surface Water Quality Regulations (NHDES, 2016).
- Waters listed as threatened due to NPDES permit effluent violations of toxics such as copper or zinc (see Section 3.1.21).
- Waters listed as impaired primarily due to the residual effects of an NPDES discharge which is now meeting its NPDES permit limits. An example is the paper mill in Berlin, NH, which used to discharge significant amounts of dioxin to the Androscoggin River. This resulted in the issuance of a fish consumption advisory due to elevated dioxin levels in fish tissue. In the 1990's the mill changed its bleaching process which reduced dioxin levels to below detection levels and allowed the mill to meet its NPDES permit limit for dioxin. In time it is expected that fish tissue concentrations will continue to drop to levels low enough to allow the dioxin fish consumption advisory to be rescinded.
- Section 319 Nonpoint Source restoration projects which have funding and where it can be demonstrated that controls will be implemented and there is reasonable assurance that the project will result in attainment of water quality standards.

If a pollutant was not eligible to be placed in Impairment Category 4A or 4B, and if water quality exceedences were not due to natural conditions, the pollutant was, by default, assigned to Impairment Category 5 and included on the 303(d) List.

3.1.25 Reasons Why a Waterbody May Change Categories (including De-listing)

Once a waterbody is in a particular AU Category (see Section 3.1.3) for one or more reporting cycles, it may be switched to another AU Category for any of the reasons shown below. This also applies to removing or "de-listing" waters from the 303(d) list.

- If *new data or information* (including more sophisticated modeling) indicates that the category previously assigned to the AU should be changed based on the most current assessment methodology.
- If *flaws are found in the original analysis* which indicates that the AU was improperly assessed and that the AU should be placed in another category.
- If there are *changes in the assessment methodology* and reassessment indicates that the AU should be placed in another category. This includes changes in water quality standards and/or changes in surrogate water quality criteria used to make use support decisions.

3.1.26 TMDL Priority Ranking

Section 303(d) of the Clean Water Act requires that waters on the 303(d) List be ranked in order of priority that the TMDLs will be developed. For this cycle, and in accordance with USEPA guidance (USEPA, 2005), the priority for TMDL development is indicated by the TMDL priority ranking shown on the 303(d) List. The assumption is that the sooner a TMDL will be initiated, the higher its priority.

The tables below give an idea of the two-step thought process used to help prioritize TMDLs in New Hampshire. As shown in Table 3-15, a preliminary rank of high, medium, or low is first established based on the water resource that is impacted and whether the pollutants pose a threat to human health or to federally listed threatened or endangered species. Knowing the preliminary water resource ranking, the final TMDL priority ranking is then determined by consulting Table 3-16, which includes other important institutional and technical factors that can influence the priority of TMDLs.
As previously mentioned, the intent is to first work on TMDLs ranked as high, followed by medium and low priority TMDLs. A list of TMDLs currently being worked on may be found on the NHDES website[8].

It should be understood that rankings and TMDL schedules are dynamic and subject to revision due to changes in any one of the institutional or technical factors shown in Table 3-16. It should also be noted that TMDL priority rankings are not always a good indicator of when a TMDL will be completed. For example, a high priority TMDL could take five to 10 years to complete because it is very complex, very controversial, and requires a large amount of data to be collected before the TMDL can be completed. Using the TMDL schedule as an indicator of priority, any TMDL with a completion date of less than 5 years would be assumed to have a higher priority, which may, or may not be true.

Before proceeding, it should be noted that for waters threatened or impaired by regional pollutants which are beyond the ability of the State to control, it is recommended that USEPA take the lead in conducting TMDLs. Examples of regional pollutants include acid rain, mercury, polychlorinated biphenyls (PCBs), and dioxin associated with fish and/or shellfish consumption advisories.

Table 3-15: Preliminary TMDL Priority Based on Water Resource Factors

Water Resource Impacted	Entity at Risk	Preliminary water resource based TMDL priority rank
Do the pollutant(s) pose a threat to the **1. viability of a potable water supply,** **2. an Outstanding Resource Water as defined in Env-Wq 1700** **3. waters designated as "natural" under the Rivers Management and Protection Act (RSA 483), and/or** **4. a designated beach?**	**Do the pollutant(s)** **1. threaten human health and/or** **2. pose a threat to Federally listed threatened or endangered species?**	
Yes	Yes	High
No	Yes	High
Yes	No	Medium
No	No	Low

[8] https://www.des.nh.gov/water/rivers-and-lakes/water-quality-assessment

Table 3-16: Final TMDL Priority Ranking

Preliminary water resource based TMDL priority rank (from Table 3-15)	Is there a substantial amount of public interest and support?	Are there adequate resources available to conduct the TMDL?	Are there other administrative or legal factors (i.e. the need to support the NPDES program or a court order) that require the TMDL to be completed in the near future?	Is it very likely that the TMDL, once developed, can or will be implemented (is it technologically possible and economically feasible)?	Final TMDL priority rank
High, Medium or Low	-	Yes	Yes	-	High
High, Medium or Low	-	No	Yes	-	Low
High	-	Yes	No	Yes	High
High	Yes	Yes	No	No	Medium
High	Yes	No	No	No	Low
High	No	-	No	No	Low
Medium	Yes	Yes	No	Yes	High
Medium	Yes	Yes	No	No	Medium
Medium	No	Yes	No	Yes	Medium
Medium	Yes	No	No	No	Low
Medium	No	-	No	No	Low
Low	Yes	Yes	No	Yes	High
Low	No	Yes	No	Yes	Medium
Low	No	Yes	No	No	Low
Low	Yes	No	No	No	Low
Low	No	-	No	No	Low

Note: "-" means Yes or No.

3.1.27 Probabilistic Assessments

One of the goals of Section 305(b) of the CWA is to assess all surface waters. To assess a large population such as surface waters, there are two generally accepted data collection schemes. The first is a census which requires examination of every unit in the population. This, however, is usually very expensive and often impractical.

A more practical and economic approach is to conduct a sample survey which involves sampling a portion of the population through probability (or random) sampling. Random sampling ensures that no particular portion of the population being sampled is favored (or biased) over another. Results of sample surveys can be used to make statistically based inferences (i.e., probabilistic assessments) about the condition of the population as a whole. For example, if a sample survey was conducted on lakes and 30% of the random samples indicated aquatic life use impairment, it could be stated that 30% of the all lakes were impaired for aquatic life.

Another benefit of sample surveys is that statistical analyses can also be conducted to determine the margin of error or confidence limits in the assessment.

Probabilistic assessments are useful for Section 305(b) reporting purposes because they can provide a general overall idea of the condition of an entire waterbody type (i.e., all rivers or lakes), which might otherwise be impossible to do using the census approach. General rules for conducting and using probabilistic assessments for surface water quality assessments in New Hampshire, include the following:

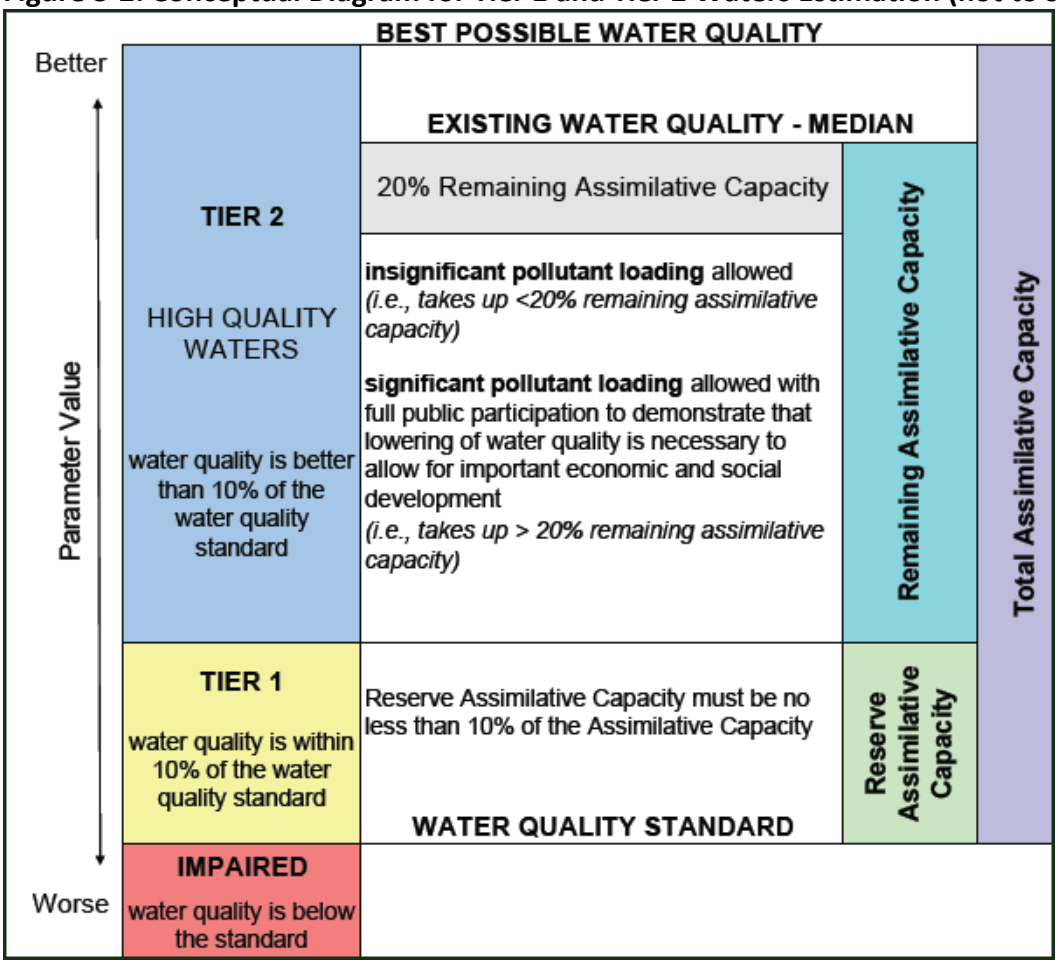
- Probability assessments shall be conducted in accordance with accepted statistical practices.
- Sampling shall be based on a random sampling design.
- Sample surveys should be designed to produce an estimate of the percent of the resource (e.g. all lakes) in any use support category (e.g. fully supporting, not supporting, etc.) that are no more than +/- 20% at the 95% confidence limits.
- Criteria for determining use support shall be in accordance with this document with the exception of the minimum number of samples required. That is, when conducting probabilistic assessments, each random sample can, by itself, be used to make a discrete use support decision within the probabilistic survey.
- The percentage of discrete random samples meeting each use support category can be used as an estimate of the percentage of the resource meeting each use support category. For example, if 20% of the discrete random samples taken in lakes indicate full support of aquatic life, then it can be reported that 20% of the lakes fully support aquatic life.
- Probabilistic assessment results shall have no bearing on the Section 303(d) List other than the fact that samples collected for the probabilistic assessment can be combined with other samples within an assessment unit (AU) and assessed in accordance with this document (including the minimum sample size) to determine if the AU should be included on the Section 303(d) List.

In 2004, New Hampshire conducted its first probabilistic assessment. For the 2004 cycle, probabilistic assessments for Aquatic Life Use and both Primary and Secondary Contact Recreation were conducted for the estuaries (NHDES, 2004). The estuarine probabilistic assessment was then refreshed for the 2012 assessment cycle based on data from the National Coastal Assessment (2002 to 2006) and the New Hampshire Estuaries Probability Based Monitoring Program (2007) datasets. Rivers first received a probabilistic assessment for the 2006 assessments cycle covering Aquatic Life Use (2002/2003 datasets) and both Primary and Secondary Contact Recreation (2005 data) in wadeable rivers. Rivers now have a refreshed probabilistic assessment for the 2018 cycle based on data collected from 2013-2016. Lakes were first surveyed in 2008-2009 for a probabilistic assessment reported in the 2012 assessment cycle.

3.1.28 Antidegradation Tier Calculations

Last implemented for the 2010 assessment, screening level estimates of the Anti-degradation Tiers (see Conceptual Diagram, Figure 3-2) for each measured parameter in each Assessment Unit were determined in accordance with the following protocols. Parameters that are not impaired were designated as either Potentially Tier 1 (PT1) or Potentially High Quality Tier 2 (PHQ-T2). To confirm if a parameter is Tier 1 or 2 it is likely that more data will be needed to determine if data was actually collected under critical conditions (i.e. such as low flow and high temperature for dissolved oxygen). In the future, NHDES will develop protocols for collecting and analyzing data to confirm each parameter's antidegradation tier. Parameters with data that meet the future antidegradation confirmation protocols will be designated as either Marginal Quality - Tier 1 (T1) or High Quality - Tier 2 (HQW-T2) and can be used for antidegradation reviews in accordance with Env-Wq 1708. Finally, all parameters in any Outstanding Resource Water (ORW) will be automatically assigned an antidegradation designation of ORW-Tier 3 (ORW-T3).

Figure 3-2: Conceptual Diagram for Tier 1 and Tier 2 Waters Estimation (not to scale).



Note that the existing water quality is not always best represented by the median condition. Determining Fixed Values within the Antidegradation Tiers

Table 3-17: Parameters and Thresholds for "Best Possible" and "10% Reserve Tier 1/Tier 2"

PARAMETER	BEST POSSIBLE WATER QUALITY	10% RESERVE ASSIMILITIVE CAPACITY (TIER 1–to– TIER 2 Threshold)	WATER QUALITY STANDARD (Impairment Threshold)
D.O. ppm	Set at 100% saturation at a sample by sample level based upon water temperature, conductivity and elevation. Example: 25^{o}C, 100 µS, & 100ft.= 7.56 mg/L	10% Reserve = [(Best Possible-WQStd * 0.1) + WQStd] Example: If Class A → 6.16 If Class B → 5.26	5 mg/L (Class B) or 6 mg/L (Class A) Except for natural CWF = 9.5 mg/L, 7 day mean & 8 mg/L instantaneous (Oct 1 to May 14th)
ALUS – Chla & TP	Olig, TP = 0.0 Olig, Chla = 0.0 Meso, TP = 8 Meso, Chla = 3.3 Eutro, TP = 12 Eutro, Chla = 5	Olig, TP = 7.2 Olig, Chla = 3.0 Meso, TP = 11.6 Meso, Chla = 4.8 Eutro, TP = 26.4 Eutro, Chla = 10.4	Olig, TP = 8.0 Olig, Chla = 3.3 Meso, TP = 12.0 Meso, Chla = 5.0 Eutro, TP = 28.0 Eutro, Chla = 11.0
PCR – Chla	Zero	13.5 µg/L	15 µg/L
PCR – Bacteria	Zero	FW, A, SSMC = 137.7 FW, A, GM = 42.3 FW, A, Bch, SSMC = 79.2 FW, A, Bch, GM = 42.3 FW, B, SSMC = 365.4 FW, B, GM = 113.4 FW, B, Bch, SSMC = 79.2 FW, B, Bch, GM = 42.3 MW, B, SSMC = 93.6 MW, B, GM = 31.5 MW, B, Bch, SSMC = 93.6 MW, B, Bch, GM = 31.5	FW, A, SSMC = 153 FW, A, GM = 47 FW, A, Bch, SSMC = 88 FW, A, Bch, GM = 47 FW, B, SSMC = 406 FW, B, GM = 126 FW, B, Bch, SSMC = 88 FW, B, Bch, GM = 47 MW, B, SSMC = 104 MW, B, GM = 35 MW, B, Bch, SSMC = 104 MW, B, Bch, GM = 35
Toxics	Zero	10% Reserve = [WQStd - (WQStd * 0.1)]	From Env-Wq 1700
Ammonia	Zero	10% Reserve = [WQStd - (WQStd * 0.1)]	From Env-Wq 1700 (dependent upon temperature, pH, & salinity)
Nitrogen	0.2 mg N/L	10% Reserve = [WQStd - (WQStd * 0.1)]	From developed translator for narrative criteria
Biological Integrity Metrics	Maximum for the metric	10% Reserve = [(Best Possible-WQStd * 0.1)+ WQStd]	From developed translator for narrative criteria
Clarity (turbidity or secchi disk)	TBD	10% Reserve = [(Best Possible-WQStd * 0.1)+ WQStd]	From Env-Wq 1700 or from developed translator for narrative criteria

Protocols for Estimating Existing Water Quality for Impaired, Potential T1 and Potential HQ-T2 Designations

- Data requirements
  - Where critical period and/or critical times are relevant, only those samples will be factored into the existing Water Quality (WQ) determination.
  - If data outside of the critical period or critical times indicate non-support, that data will be factored into the existing WQ determination.
  - All samples must meet the age requirements for the waterbody type. If older data indicates lower water quality, that data shall be included in the analysis unless newer data collected under the same conditions indicates water quality has improved.
  - For parameters where the 10% rule (see section 3.1.17) is used the minimum number of samples for the existing WQ determination equals 10.
  - For *Escherichia coli* and *enterococcus* there must be sufficient data to calculate a 60-day geometric mean.
  - For toxics where sufficient data exists to calculate a 4-day average (chronic) or 1-hour average (acute), that data will be weighted higher then grab samples so long as those averages are collected in times representing the critical time and period.
- Calculations
  - The lower 90th percentile of existing WQ data will be compared to the Tier 1/Tier 2 threshold shown in Table 3-18 for parameters where high quality means the existing WQ should be greater than the water quality standard (WQStd) [WQ should be > WQStd]
- In the case of Dissolved Oxygen (DO) concentration, if 10% or more of samples fall between the WQStd and the Tier 1/Tier 2 thresholds shown in Table 3-18, DO will be designated as Tier 1.
  - The upper 90th percentile of existing WQ data will be compared to the Tier 1/Tier 2 thresholds shown in Table 3-18 for parameters where high quality means the existing WQ should be less than the WQStd [WQ should be < WQStd]
- In the case of *Escherichia* coli and *enterococcus* each geometric mean and each single sample will be compared to the Tier 1/Tier 2 thresholds shown in Table 3-18.
- Any final assessment overrides the antidegradation tier.
  - A final assessment of category 4 or 5 means the waterbody is impaired and there is no remaining assimilative capacity regardless of the calculated existing WQ using the protocols above.
  - A final assessment of Cat 2-M means the parameter will be designated as Potentially Tier 1 (PT1) regardless of the calculated existing WQ using the protocols above.
- All parameters in any Outstanding Resource Water (ORW) shall be automatically assigned an antidegradation designation of ORW-Tier 3 (ORW-T3) regardless of assessed condition.

Two new fields for the assessment database will be “Antidegradation Tier” and “Existing Water Quality.” Values will be stored at the waterbody/designated use/parameter level. Existing water quality will be a numeric field. The Antidegradation Tier will be populated in accordance with Table 3-18.

The “Antidegradation Tier” and “Existing Water Quality” calculations will be made in upcoming cycles as time allows.

Table 3-18: Database Antidegradation Tier Codes and Descriptions.

Antidegradation Tier Code	Description
NC	Not Calculated. Where there is insufficient information to estimate the existing water quality the field will be left blank.
Imp	Where a given parameter is impaired there is no remaining assimilative capacity, the antidegradation tier will be impaired (Imp).
PT1	Where the estimated existing water quality falls into the reserve assimilative capacity using the protocols for determining screening level antidegradation tiers described in above the field will be set to Marginal Quality - Potentially Tier 1 (PT1).
T1	Where existing WQ data is confirmed to be in Marginal Quality - Tier 1 in accordance with future protocols to be developed by the department, the field will be set to Marginal Quality - Tier 1 (T1). Such data can be used for antidegradation reviews in accordance with Env-Wq 1708.
PHQW-T2	Where the estimated existing water quality exceeds the reserve assimilative capacity using the protocols for determining screening level antidegradation tiers described above, the field will be set to Potentially High Quality Water, Tier 2 (PHQW -T2).
HQW-T2	Where existing WQ data is confirmed to exceed the reserve assimilative capacity in accordance with future protocols to be developed by the department, the field will be set to High Quality Water Tier 2 (HQW-T2). Such data can be used for antidegradation reviews in accordance with Env-Wq 1708.
ORW-T3	Outstanding Resource Waters are Tier 3 waters regardless of the existing water quality condition. Tier 3 waters may have no permanent degradation. Env-Wq 1708.05 "Protection of Water Quality in ORW" defines ORWs as "Surface waters of national forests and surface waters designated as natural under RSA 483:7-a, I". As such, all parameters are Tier 3 in Outstanding Resource Waters and the field will be set to ORW-T3.

3.2 ASSESSMENT METHODOLOGY BY DESIGNATED USE

3.2.1 Overview

The following sections provide specific assessment methodology for each of the seven assessed designated uses. Each section includes a definition of the use, the applicable surface waters, and the core indicators for the use. There is then the detailed assessment methodology and regulatory authority for assessed parameters of water quality pertinent to the use, including methods and thresholds for the core indicators. These assessment methods are supplemental to the general assessment criteria provided in Section 3.1. The regulatory authority for the assessment methodology resides within RSA 485-A:1-22[9] and Env-Wq 1700 Surface Water Quality Regulations[10].

[9] http://www.gencourt.state.nh.us/rsa/html/L/485-A/485-A-mrg.htm
[10] https://www.des.nh.gov/rules-and-regulatory/administrative-rules?keys=envwq1700&purpose=&subcategory=Water+Quality

3.2.2 Use: Primary Contact Recreation

Definition: Waters that are suitable for recreational uses that require or are likely to result in full body contact and/or incidental ingestion of water**.**

Applicability: All surface waters

Core Indicator(s): Bacteria (Pathogens)

Assessment Criteria: The following criteria are in addition to the general assessment and listing criteria provided in Section 3.1.

Indicator 1: Bacteria (Pathogens)

Elevated bacteria levels in waters present a public health risk to people who have contact with those waters. Acceptable bacteria levels to protect primary contact recreation (i.e. swimming) reside in Env-Wq 1703.06 and RSA 485-A:8, I, II, & V.

FS: See criteria presented in Table 3-19.

NS: See criteria presented in Table 3-19.

Table 3-19: Use Support Matrix for Bacteria (Primary Contact Recreation)

<table>
<tr><th colspan="4">May 24 – September 15
(Critical Period)</th><th colspan="4">September 16 - May 23</th><th rowspan="3">Use Support</th></tr>
<tr><th colspan="2">Geometric Mean (GM)</th><th colspan="2">Single Samples (SS)</th><th colspan="2">Geometric Mean (GM)</th><th colspan="2">Single Samples (SS)</th></tr>
<tr><th># of GM Calculations</th><th>Results</th><th># SS</th><th>Results</th><th># of GM Calculations</th><th>Results</th><th># SS</th><th>Results</th></tr>
<tr><td>≥ 1</td><td>< GMC</td><td>≥ 0</td><td>< SSMC</td><td rowspan="3">≥ 0</td><td rowspan="3">< GMC</td><td rowspan="3">≥ 0</td><td rowspan="3">< SSMC</td><td rowspan="3">FS</td></tr>
<tr><td>≥ 1</td><td>< GMC</td><td>≥ 0</td><td>1 > SSMC</td></tr>
<tr><td>≥ 0</td><td>< GMC</td><td>≥ 2</td><td>< 75% of GMC</td></tr>
<tr><td>0</td><td></td><td>≤ 1</td><td>< SSMC</td><td rowspan="2">≥ 0</td><td rowspan="2">< GMC</td><td rowspan="2">≥ 0</td><td rowspan="2">< SSMC</td><td rowspan="3">INSUFFICIENT INFORMATION or NOT ASSESSED</td></tr>
<tr><td>0</td><td></td><td>≥ 2
and
≥ 1</td><td>< SSMC

≥ 75% GMC but < SSMC</td></tr>
<tr><td colspan="8">0 exceedence of the GMC and only 1 exceedence of the SSMC</td></tr>
<tr><td colspan="8">≥ 1 exceedence of the GMC
and/or
≥ 2 exceedences of the SSMC</td><td>NS</td></tr>
</table>

Notes:

1. Water Quality Criteria (WQC) - RSA 485-A:8, I, II, & V and Env-Wq 1703.06

Designated Beach	Waterbody Type	Bacteria	Geometric Mean Criteria (GMC)	75% of GMC	Single Sample Maximum Criteria (SSMC)
No	Class A Fresh water	*Escherichia coli* (cts/100mL)	47	35	153
	Class B Fresh water	*Escherichia coli* (cts/100mL)	126	95	406
	Class B Tidal water	*Enterococcus* (cts/100mL)	35	26	104
Yes	Class A Fresh water	*Escherichia coli* (cts/100mL)	47	35	88
	Class B Fresh water	*Escherichia coli* (cts/100mL)	47	35	88
	Class B Tidal water	*Enterococcus* (cts/100mL)	35	26	104

2. Assessments shall be based on the most current data. “Current” data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-17 and must include at least 2 samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedence occurred.
3. As indicated in Table 3-19, to be FS, there must be sufficient data to make an assessment during the peak contact recreation season (May 24 to September 15).
4. Calculation of the geometric mean (GM) shall be based on a rolling average, and
    a. at least 3 independent samples collected within 60 consecutive days in the same AU, but on different days, or
    b. at least 3 independent samples collected within 60 consecutive days within the Assessment Unit provided that at least 2 of the samples are separated by a period of at least 1 day.
5. A designated beach is an area on a waterbody that is operated for bathing, swimming, or other primary water contact by any municipality, governmental subdivision, public or private corporation, partnership, association, or educational institution, open to the public, members, guests, or students whether on a fee or free basis.

6. Assessments of the geometric mean criteria at designated beaches shall be based upon the highest valid reading at the beach for a given date. Single sample maximum criteria comparisons will be based upon all valid samples at the designated beach.
7. Where there is insufficient information to calculate a geometric mean and all samples are less than 75 percent of the geometric mean, those samples can be used as indicators that the geometric mean is unlikely to be exceeded.
8. Magnitude of Exceedence criteria of the geometric means and Single Sample Maximum Criteria for use in determining the NHDES Categories (Section 3.1.5) are defined as two times the given criteria.
9. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 2: Discharges of Untreated Sewage

Elevated bacteria levels in waters present a public health risk to people that have contact with those waters. To protect public health there shall be no discharge of sewage or waste to Class A waters (RSA 485-A:8, I) nor discharges of sewage or waste to Class B waters without adequate treatment (RSA 485-A:8, II). Bacteria levels in Combined Sewer Overflows (CSOs) are explicitly limited in Env-Wq 1703.06. The General Water Quality Criteria (Env-Wq 1703.03) require that surface waters be free of substances which: form harmful deposits; float as foam, debris, or scum; produce odor, color, taste, or turbidity making the water unsuitable for the designated use; or interfere with recreational activities (Env-Wq 1703.03 (c)(1) a, b, c, & e). For assessment purposes, evidence of pollutants in pipes (other than CSOs and WWTFs) that discharge may be used as an indicator of prohibited sewage or waste in a waterbody.

FS: There are no known discharges of untreated sewage.

NS: There are known or highly suspected discharges of untreated sewage.

Notes:

1. The primary pollutant of concern in untreated sewage is bacteria (pathogens).
2. Examples of sources of untreated sewage discharges include connections of sanitary sewer pipes to storm drains (i.e., illicit connections), combined sewer overflows (CSOs), sanitary sewer overflows (SSOs) and failing septic systems that discharge to surface waters.
3. Investigations may find evidence of discharges of untreated sewage include physical evidence (feces, toilet paper, etc.), odors of sewage, chemical evidence (i.e., chlorine or elevated levels of ammonia in a pipe) and / or elevated bacteria concentrations in the pipe ($\geq$ 2,000 cts/100mL). An in-pipe concentration of $\geq$ 2,000 cts/100mL is an indicator of illicit sewage or waste discharge as it is five times the highest acceptable surface water bacteria listed in RSA 485-A:8, I, II, or V and not likely to result from sampling error. Additionally, such high levels are likely to cause surface water concentrations exceeding the criteria in RSA 485-A:8, I, II, or V. Confirmation of such concentrations shall occur before impairment determinations based on in-pipe bacteria concentrations.
4. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 3: Chlorophyll-a (Chl-a)

Excessive algal growth (high biomass and high chlorophyll-a values) can impair the public safety and aesthetic enjoyment of surface waters. The General Water Quality Criteria (Env-Wq 1703.03) require that surface waters be free of substances which: produce color or turbidity making the water unsuitable for the designated use, or interfere with recreational activities (Env-Wq 1703.03 (c)(1) c & e). For assessment purposes, chlorophyll-a concentrations in excess of 15 µg/L in fresh water and 20 µg/L in salt water are indicators of excessive algal growth that interferes with recreational activities.

FS: See criteria presented in Table 3-20.

NS: See criteria presented in Table 3-20.

Table 3-20: Use Support Matrix for Chlorophyll-a

May 24 – September 15 (Critical Period) Sample Size	September 16 - May 23 Sample Size	Total Sample Size	Total # WQC Exceedences	Total # of MAGEX Exceedences	Use Support
≥ 10	≥ 0	≥ 10	< # exceedences shown on the Table 3-13 for the total sample size	≤1	FS
		< 10	< 2	≤ 1	INSUFFICIENT INFORMATION or NOT ASSESSED
< 10	≥ 1	≥ 10	< # exceedences shown on Table 3-13 for the total sample size	≤ 1	
		≤ 10	≥ 2	≥ 0	NS
		> 10	≥ # exceedences shown on Table 3-13 for the total sample size	≥ 0	
		≥ 2	≥ 2	≥ 2	

Notes:

1. Assessments using chlorophyll-a concentrations shall be based on the most current data. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-20 and must include at least 2 samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedence occurred.
2. In deciding which sample to use for a given sampling date at a station the first choice will be where depth zone is “Composite”, if no “Composite” sample then where depth zone is

"Epilimnion," if no Epilimnion sample then where depth zone is "Upper." If the depth zone is not defined the sample must be collected at a depth of ≤ 4m and the average of those ≤ 4 m samples will be compared to the criteria.

3. Exceedences of the water quality criteria (WQC) are defined as:

Freshwater: Chl-a ≥ 15 ppb (NHDES, 2003)

Tidal Waters: Chl-a ≥ 20 ppb (NHDES, 2003)

4. Exceedences of the Magnitude of Exceedence Threshold (MAGEX) for chlorophyll a are defined as:

Freshwater: Chl-a ≥ 30 ppb

Tidal Waters: Chl-a ≥ 40 ppb

5. As indicated in Table 3-20, to be FS, there must be sufficient data to make an assessment during the peak contact recreation season (May 24 to September 15).

6. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 4: Nitrogen in Estuarine Waters

Excessive algal growth (high biomass and high chlorophyll-a values) can impair the public safety and aesthetic enjoyment of surface waters. The General Water Quality Criteria (Env-Wq 1703.03) require that surface waters be free of substances which: produce color or turbidity making the water unsuitable for the designated use; or interfere with recreational activities (Env-Wq 1703.03 (c)(1) c & e). Further, Env-Wq 1703.14(b) states that, "Class B waters shall contain no phosphorus or nitrogen in such concentrations that would impair any existing or designated uses, unless naturally occurring." The estuarine eutrophication model used by the National Oceanic and Atmospheric Administration relates external nutrient inputs to primary and secondary symptoms of eutrophication (Bricker, et al., 2007). Elevated chlorophyll-a concentrations and proliferation of macroalgae are primary symptoms of eutrophication.

FS: No chlorophyll-a impairment

NS: Chlorophyll-a impairment

Notes:

1. The estuarine eutrophication model used by the National Oceanic and Atmospheric Administration relates external nutrient inputs to primary and secondary symptoms of eutrophication (Bricker, et al., 2007). Elevated chlorophyll-a concentrations and proliferation of macroalgae are primary symptoms of eutrophication, while low dissolved oxygen, loss of submerged aquatic vegetation (e.g., eelgrass), and harmful algal blooms are secondary symptoms. This approach is consistent with the conceptual model of coastal eutrophication presented by Cloern (Cloern, 2001). Therefore, the most direct link between nutrient inputs to an estuary and eutrophic effects is for chlorophyll-a concentrations in the water and macroalgae growth.

2. The primary symptoms of eutrophication are useful as a means to detect eutrophication before secondary symptoms develop. Phytoplankton blooms (as measured by chlorophyll-a concentrations) can impair primary contact recreation.
3. Assessment units are impaired for nutrients per Env-Wq 1703.14 if there is an impairment for one of the primary symptoms of eutrophication. A quantitative assessment methodology for primary contact is only available for chlorophyll-a concentrations in water. The impairments will be specifically for nitrogen because nitrogen is the limiting nutrient in marine waters.

Indicator 5: Color, Foam, Debris, Scum, Slicks, Odors, Surface Floating Solids

The General Water Quality Criteria (Env-Wq 1703.03) require that surface waters be free of substances which: float as foam, debris, or scum; produce odor, color, taste, or turbidity making the water unsuitable for the designated use; or interfere with recreational activities (Env-Wq 1703.03 (c)(1) b, c, & e). Two common examples of scums are those produced by cyanobacteria blooms, which produce a human health risk, and iron scums that may be the result of landfill leachate or fill activities.

FS: The surface water does not contain color, foam, debris, scum, slicks, odors, and/or surface floating solids in amounts and for durations that significantly interfere with the primary contact recreational use, unless naturally occurring.

NS: The surface water contains color, foam, debris, scum, slicks, odors and/or surface floating solids in significant amounts and for durations that significantly interfere with the primary contact recreational use, and they are not naturally occurring.

Notes:

1. It is not the intent of this indicator to assess a surface water as impaired for an occasional case of litter or debris. Rather this indicator is intended to address more significant, chronic cases of pollution.
2. This indicator can be used for iron hydroxide deposits due to iron in groundwater from landfills and other sources of fill that produce objectionable scums of iron hydroxide floc and taint the water orange.
3. See Section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 6: Cyanobacteria

The General Water Quality Criteria (Env-Wq 1703.03) require that surface waters be free of substances which: float as foam, debris, or scum; produce odor, color, taste, or turbidity making the water unsuitable for the designated use; result in nuisance species; or interfere with recreational activities (Env-Wq 1703.03 (c)(1) b, c, d, & e). In addition, the Water Quality Standards for Designated Beaches require that the beach owner shall post a cyanobacteria advisory provided by the department whenever a toxic cyanobacteria scum is present in the bathing area that is dominant and represents more than 50% of the algal cell count or the total cell count of cyanobacteria at the beach area is greater than 70,000 total cells/mL of water (Env-Wq 1105.14 (e)). The process for lake warnings is the same as for beach advisories. A lake

warning is intended to alert lake users to water quality issues when cyanobacteria appears in large amount in lakes without a beach or far from a beach on a large lake. Cyanobacteria blooms may produce a severe human health risk.

FS: There is no conclusive evidence that cyanobacteria blooms in the most recent 10-year period have occurred in amounts and for durations that significantly interfere with the primary contact recreational use.

NS: There is conclusive evidence that cyanobacteria blooms in the most recent ten-year period, have occurred in amounts and for durations that significantly interfere with the primary contact recreational use.

Notes:

1. It is not the intent of this indicator to assess a surface water as impaired for an infrequent or minor cyanobacteria occurrence. Rather this indicator is intended to address more significant and/or chronic public health risks.
2. This indicator can be used to assess waters as impaired based on surface scum caused by documented cyanobacteria scum per the method described in Env-Wq 1105.14 (e).
3. Factors that shall be considered in the assessment determination:
    a. The frequency and duration of documented cyanobacteria blooms in the last 10 years;
    b. The type(s) of cyanobacteria present in the samples and the type(s) of toxins produced per the currently available literature;
    c. The total phosphorus concentration in the waterbody;
    d. The chlorophyll-a concentration distribution in the waterbody;
    e. The frequency of department staff visits to the waterbody;
    f. The inferred reporting likelihood by citizens on the waterbody;
    g. The dissolved oxygen condition of the waterbody;
    h. The season of the bloom; and,
    i. Whether the bloom(s) could be due solely to natural occurring conditions.
4. If a beach on a lake was impaired because of cyanobacteria, the entire lake (including the beach area) may be assessed as impaired due to the likelihood of cyanobacteria scum to spread by wind and wave action.
5. Please call NHDES to report a cyanobacteria bloom at (603) 419-9229.
6. See Section 3.1.24 for determining waters that should be placed in Assessment Category 5.

3.2.3 Use: Secondary Contact Recreation

Definition: Waters that support recreational uses that involve incidental contact with the water**.**

Applicability: All surface waters

Core Indicator(s): Bacteria (Pathogens)

Assessment Criteria: The following criteria are in addition to the general assessment and listing criteria provided in Section 3.1.

Indicator 1: Bacteria (Pathogens)

Elevated bacteria levels in waters present a public health risk to people who have contact with those waters. Acceptable bacteria levels to protect primary contact recreation (i.e. swimming) reside in Env-Wq 1703.06 and RSA 485-A:8, I, II, & V. Given the reduced likelihood and duration of incidental contact that comes with secondary contact recreation, a higher indicator threshold is used compared to primary contact. For assessment purposes, bacteria concentrations five times those in Env-Wq 1703.06 and RSA 485-A:8, I, II, & V are used as indicators that a particular waterbody may pose and unacceptable public health risk from secondary contact recreation.

FS: See methods presented in Table 3-21.

NS: See methods presented in Table 3-21.

Table 3-21: Use Support Matrix for Bacteria (Secondary Contact Recreation)

<table>
<tr><th colspan="4">May 24 – September 15
(Critical Period)</th><th colspan="4">September 16 - May 23</th><th rowspan="3">Use Support</th></tr>
<tr><th colspan="2">Geometric Mean (GM)</th><th colspan="2">Single Samples (SS)</th><th colspan="2">Geometric Mean (GM)</th><th colspan="2">Single Samples (SS)</th></tr>
<tr><th># of GM Calculations</th><th>Results</th><th># SS</th><th>Results</th><th># of GM Calculations</th><th>Results</th><th># SS</th><th>Results</th></tr>
<tr><td>≥ 1</td><td>< GMI</td><td>≥ 0</td><td>< SSMI</td><td rowspan="3">≥ 0</td><td rowspan="3">< GMI</td><td rowspan="3">≥ 0</td><td rowspan="3">< SSMI</td><td rowspan="3">FS</td></tr>
<tr><td>≥ 1</td><td>< GMI</td><td>≥ 0</td><td>1 > SSMI</td></tr>
<tr><td>≥ 0</td><td>< GMI</td><td>≥ 2</td><td>< 75% of GMI</td></tr>
<tr><td>0</td><td></td><td>≤ 1</td><td>< SSMI</td><td rowspan="2">≥ 0</td><td rowspan="2">< GMI</td><td rowspan="2">≥ 0</td><td rowspan="2">< SSMI</td><td rowspan="3">INSUFFICIENT INFORMATION or NOT ASSESSED</td></tr>
<tr><td>0</td><td></td><td>≥ 2
and
≥ 1</td><td>< SSMI
≥ 75% GMI but < SSMI</td></tr>
<tr><td colspan="8">0 exceedence of the GMI and only 1 exceedence of the SSMI</td></tr>
<tr><td colspan="8">≥ 1 exceedence of the GMI
and/or
≥ 2 exceedences of the SSMI</td><td>NS</td></tr>
</table>

Notes:

1. Water Quality Indicators

Waterbody Type (both beaches and non-beaches)	Bacteria	Geometric Mean Indicator (GMI)	75% of GMI	Single Sample Maximum Indicator (SSMI)
Class A Fresh water	*Escherichia coli*	235	176	765
Class B Fresh water	*Escherichia coli*	630	473	2,030
Class B Tidal water	*Enterococcus*	175	131	520

2. Assessments shall be based on the most current data. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-19 and must include at least two samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedence occurred.
3. As indicated in Table 3-21, to be FS, there must be sufficient data to make an assessment during the peak contact recreation season (May 24 to September 15).
4. Calculation of the geometric mean (GM) shall be based on a rolling average and,
   a. at least three independent samples collected within 60 consecutive days at the same station, or
   b. at least three independent samples collected within 60 consecutive days from different stations within the Assessment Unit provided that at least two of the samples are separated by a period of at least 2 days.
5. Magnitude of Exceedence indicator of the geometric means and Single Sample Maximum Indicator for use in determining the NHDES Categories (Section 3.1.5) are defined as two times the given indicator.
6. See Section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 2: Discharges of Untreated Sewage

Elevated bacteria levels in waters present a public health risk to people who have contact with those waters. To protect public health there shall be no discharge of sewage or waste to Class A waters (RSA 485-A:8, I) nor discharges of sewage or waste to Class B waters without adequate treatment (RSA 485-A:8, II). Bacteria levels in Combined Sewer Overflows (CSOs) are explicitly limited in Env-Wq 1703.06. The General Water Quality Criteria (Env-Wq 1703.03) require that surface waters be free of substances which: form harmful deposits; float as foam, debris, or scum; produce odor, color, taste or turbidity making the water unsuitable for the designated use; or interfere with recreational activities (Env-Wq 1703.03 (c)(1) a, b, c, & e). For assessment purposes, evidence of pollutants in pipes (other than CSOs and WWTFs) that discharge may be used as indicators of prohibited sewage or waste in a waterbody.

FS: There are no known discharges of untreated sewage.

NS: There are known or highly suspected discharges of untreated sewage.

Notes:

1. The primary pollutant of concern in untreated sewage is bacteria (pathogens).
2. Examples of sources of untreated sewage discharges include connections of sanitary sewer pipes to storm drains (i.e., illicit connections), combined sewer overflows (CSOs), sanitary sewer overflows (SSOs), and failing septic systems that discharge to surface waters.
3. Investigations may find evidence of discharges of untreated sewage include physical evidence (feces, toilet paper, etc.), odors of sewage, chemical evidence (i.e., chlorine or elevated levels of ammonia in a pipe), and / or elevated bacteria concentrations in the pipe ($\geq$ 2,000 cts/100mL). An in-pipe concentration of ≥ 2,000 cts/100mL is an indicator of illicit sewage or waste discharge as it is five times the highest acceptable surface water bacteria listed in RSA 485-A:8, I, II, or V and not likely to result from sampling error. Additionally, such high levels are likely to cause surface water concentrations exceeding the criteria in RSA 485-A:8, I, II, or V. Confirmation of such concentrations shall occur before impairment determinations based on in-pipe bacteria concentrations.
4. See Section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 3: Obstructions to Boating (Navigation)

The obstruction of normal navigational routes by fill not associated with a permitted activity or by sedimentation due to human activities interferes with recreational activities The General Water Quality Criteria require that surface waters be free of substances which: settle to form harmful deposits; or interfere with recreational activities (Env-Wq 1703.03 (c)(1) a & e).

FS: Navigational channels normally used for boating have not been intentionally or unintentionally filled in as a result of human activity such that passage of boats is now obstructed. This excludes navigational channels filled with proper permitting.

NS: Navigational channels normally used for boating have been unintentionally filled in as a result of human activity or intentionally filled without proper permitting such that passage of boats is now obstructed.

Notes:

1. See Section 3.1.24 for determining waters that should be placed in Category 5.

3.2.4 Use: Aquatic Life Integrity

Definition: Waters that can support aquatic life, including a balanced, integrated and adaptive community of organisms having a species composition, diversity and functional organization comparable to that of similar natural habitats of the region.

Applicability: All surface waters

Core Indicator(s):

Core Indicator(s)	Applicable Surface Waters
Biological based on benthic macroinvertebrates	Rivers/Streams $\leq 4^{th}$ order
Biological based on Fish Assemblage	Applicable Rivers/Streams
Biological based on at least 2 assemblages (fish and benthic macroinvertebrates) **OR** a minimum of dissolved oxygen, pH and documentation by a water quality professional trained in biology that there is no obvious impairment to the biological community	All surface waters (fresh and tidal)
Chlorophyll-a	Lakes, ponds, & impoundments
Total Nitrogen	Waters of the Great Bay Estuary

Assessment Criteria: The following criteria are in addition to the general assessment and listing criteria provided in Section 3.1. The indicators and their associated criteria are presented in two groups: Full Assessment Indicators and Screening Level Indicators. Full Assessment Indicators are those parameters which can be used to make definitive assessments of attaining [i.e., fully supporting (FS)] or not attaining [i.e., not supporting (NS)] the water quality standard or threshold for those parameters. Screening Level Indicators are parameters which cannot be used to make a definitive assessment or attaining or not attaining standards. That is, Screening Level Indicators can only be used to make a screening level assessment such as potentially attaining standards (PAS) or potentially not attaining standards (PNS).

3.2.4.1 Full Assessment Indicators

Indicator 1: Dissolved Oxygen Concentration (DO mg/L)

Dissolved oxygen is critical to the balanced, integrative, and adaptive community of organisms as described in Env-Wq 1703.19. As such, the water quality standard provide criteria for Class A waters, Class B waters, waters with cold water fish species, and in both thermally stratified and unstratified lakes, impoundments, and reservoirs in Env-Wq 1703.07 (a), (b), (c), and (d). For the purposes of assessment, the methodologies below will be used to make the greatest use of all available valid data.

FS: See criteria presented in Table 3-22.

NS: See criteria presented in Table 3-22.

Table 3-22: Use Support Matrix for Dissolved Oxygen

Total Sample Size	Total # WQC Exceedences	Total # of MAGEX Exceedences	Use Support
$\geq$ 10	< # shown Table 3-13 for the total sample size	$\leq$ 1	FS
< 10	< 2	$\leq$1	INSUFFICIENT INFORMATION or NOT ASSESSED
< 10	$\geq$ 2	$\geq$ 0	NS
$\geq$ 10	$\geq$ # shown on Table 3-13 for the total sample size	$\geq$ 0	
$\geq$ 2	$\geq$ 2	$\geq$ 2	

Notes:

1. Assessments shall be focused on the most current data. “Current” data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-22 and must include at least 2 samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.
2. To be assessed as FS for dissolved oxygen concentration:
    a. For each dissolved oxygen (DO) criteria there must be sufficient data to indicate that the appropriate criteria are met (i.e., instantaneous minimum concentration and in some cases, the 7-day mean concentration as well).
    b. Samples must be taken during critical times of day (see Note 1 & 2 below) and seasons depending on the water type and use:
        1) If the surface water is not a cold water natural reproducing fishery, at least 50% of the number of independent samples (i.e. n$\geq$5) needed for FS, shall be taken between June 1 and September 30 (i.e., the critical season) and during the critical time of day (i.e. between 05:00 and 08:00). This is when DO is most apt to be lowest due to high temperatures, low flows, and after periods with minimal photosynthesis driven

reaeration. The remainder of the minimum number of independent samples needed for FS shall also be collected during the critical time of day but do not need to be collected during the critical season, noted above. In cases where there are numerous non-critical season and non-critical time of day samples, the overall sample count will not be used to artificially increase the needed exceedences to exceed the 10% rule of thumb.

2) In surface waters that are cold water natural reproducing fisheries, 100 % of the minimum number of independent samples (i.e. $n \geq 10$) needed for FS determination shall be taken between October 1 and May 14 (i.e. the spawning period).

3) Each 7-day mean calculation is considered an independent sample for comparison to 7-day mean criteria. For comparison to the instantaneous minimum criteria or MAGEX threshold, independent samples shall be those taken on different calendar days. If more than one sample is taken on a given calendar day, the worst case sample will be the independent sample for that day. If there are multiple vertical profile measurements at a station, the worst case sample shall be the independent sample for that day (see note 5 regarding lake profiles).

3. Exceedences of the Water Quality Criteria for DO are defined in Env-Wq 1703.07 as:

Applicable waters	7-Day Men Measurements	Instantaneous Measurement
Class A: Applies to any depth	-	< 6 mg/L
Class B: Applies to any depth in free flowing rivers and tidal waters and in the epilimnion (if stratified) or in the top 25% of depth (if not stratified) in lakes, ponds, impoundments and reservoirs. Note that DO in lower depths of lakes, ponds impoundments and reservoirs must support existing and designated uses.	-	< 5 mg/L
Class A or B cold water fish spawning areas whose early life stages are not directly exposed to the water (i.e., cold water naturally reproducing fisheries). Applies to any depth in free flowing rivers and tidal waters and in the epilimnion (if stratified) or in the top 25% of depth (if not stratified) in lakes, ponds, impoundments and reservoirs.	From 10/1 to 5/14, a 7 day mean DO of < 9.5 mg/L	From 10/1 to 5/14, DO < 8 mg/L

4. Continuous dataloggers in all waterbody types:
   a. The preferred method of determining compliance is through the use of continuous dataloggers.
   b. Preferred data/conditions for assessing DO:

1) Compliance with instantaneous minimum DO concentration (mg/L) criteria shall be based on the minimum of a time series of dissolved oxygen measurements taken at the same location and a maximum of one hour apart for 24 continuous hours except as noted in 5, 6, and 7 below. High frequency datasonde measurements generally provide the most accurate and representative data.
2) Time series datasets shall generally be considered complete if there are reading covering 75% of a day.
3) Lakes, Ponds, and Impoundment samples shall follow the depth and stratification considerations of Note 5 below.
4) Exceedences of the Magnitude of Exceedence (MAGEX) Threshold for DO are defined as:

Class A: DO < 5.5 mg/L

Class B: DO < 4.5 mg/L

Cold Water Fish Spawning Area (Class A or B): DO <7.5 mg/L

5. Lakes, Ponds, and Impoundments considerations for assessing DO with discrete (a.k.a. instantaneous or grab) samples:

   a. Stratification shall be considered present in a profile if the top to bottom temperatures differ by five or more degrees Celsius. Epilimnion waters are those parts of the lake within one degree Celsius of the temperature at, or closest to (within 0.5 meter), the one-meter depth. Visual interpretations of temperature profiles may override the automated procedures.

   b. In Class B lakes, ponds, and impoundments, if preferred data is not available (see Note 4), a lake may be assessed for compliance with DO criteria as shown below, provided that minimum value samples from the epilimnion for stratified lakes or upper 25% of depth for unstratified lakes respectively are collected from a profile taken between 10:00 and 14:00 (NHDES, 2003).

   c. In Class A lakes, ponds, and impoundments the bottom DO measurement(s) shall not be used in assessments due to natural boundary layer conditions that result in decreased DO at the sediment to water column interface. Where the lake is greater than 3 meters deep, DO readings in the bottom 1 meter are generally not used in assessment. Where the lake is less than or equal to 3 meters deep, the deepest DO reading is generally not used in assessment.

   d. Discrete sample DO assessment thresholds to approximate continuous data collection methods for Lakes, Ponds, and Impoundments shall be as below;

Use Support	DO Class A (all time periods)	DO Class B (all time periods)	DO Any Class (Cold Water Spawning Period)
FS	$\geq$ 7 mg/L	$\geq$ 6 mg/L	$\geq$ 9 mg/L
Insufficient Information	$\geq$ 6 mg/L but < 7 mg/L	$\geq$ 5 mg/L but < 6 mg/L	$\geq$ 8 mg/L but < 9 mg/L
NS	< 6 mg/L	< 5 mg/L	< 8 mg/L

6. Rivers and Streams considerations for assessing DO with discrete (a.k.a. instantaneous or grab) samples:

a. If preferred data is not available (see Note 4), rivers and streams may be assessed for compliance with the instantaneous minimum DO concentration (mg/L) criterion as well as the MAGEX threshold based on grab sample taken between 05:00 and 08:00 (i.e. critical times of day). Exceedences shall be per Note 3 and MAGEXs per Note 4.b.4).

7. Tidal Waters considerations for assessing DO with discrete (a.k.a. instantaneous or grab) samples:

   a. If preferred data is not available (see Note 4), tidal waters may be assessed for compliance with the instantaneous minimum DO criteria as well as the MAGEX thresholds using a series of DO measurements at the same location and a maximum of one hour apart for at least 18 hours within the day.

   b. If preferred data is not available (see Note 4), tidal waters may be assessed for compliance with the instantaneous minimum DO criteria as well as the MAGEX thresholds based on the lowest sample from a pair of grab samples taken at concurrent high and low tides.

8. See Section 3.1.24 for determining waters that should be placed in Category 5

Indicator 2: Dissolved Oxygen Percent Saturation (DO % Sat)

Dissolved oxygen is critical to the balanced, integrative, and adaptive community of organisms as described in Env-Wq 1703.19. As such, the water quality standard provide criteria for Class A waters, Class B waters, waters with cold water fish species, and in both thermally stratified and unstratified lakes, impoundments, and reservoirs in Env-Wq 1703.07 (a), (b), (c), and (d). For the purposes of assessment, the methodologies below will be used to make the greatest use of all available valid data.

FS: See indicator presented in Table 3-23.

NS: See indicator presented in Table 3-23.

Table 3-23: Use Support Matrix for Dissolved Oxygen (Percent Saturation)

Total Sample Size	Total # WQC Exceedences	Total # of MAGEX Exceedences	Use Support
$\geq$ 10	< # shown Table 3-13 for the total sample size	$\leq$ 1	FS
< 10	< 2	$\leq$1	INSUFFICIENT INFORMATION or NOT ASSESSED
< 10	$\geq$ 2	$\geq$ 0	NS
$\geq$ 10	$\geq$ # shown on Table 3-13 for the total sample size	$\geq$ 0	
$\geq$ 2	$\geq$ 2	$\geq$ 2	

1. Assessments shall be focused on the most current data that is most representative of critical conditions. “Current” data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-20 and must include at least 2 samples collected at the same or more

water quality limited site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older indicator exceedences occurred.

2. To be assessed as FS for dissolved oxygen percent saturation:
    a. For each dissolved oxygen saturation (DO % sat) indicator there must be sufficient data to indicate that the appropriate indicator is met (i.e., daily average saturation).
    b. Samples must be taken during critical times of day (see Note 4, 5, 6, & 7 below) and seasons depending on the water type and use:
        1) If the surface water is not a cold water natural reproducing fishery, at least 50% of the number of independent samples (i.e. $n \geq 5$) needed for FS, shall be taken between June 1 and September 30 (i.e., the critical season) and during the critical time of day. This is when DO is most apt to be lowest due to high temperatures and low flows. The remainder of the minimum number of independent samples needed for FS shall also be collected during the critical time of day but do not need to be collected during the critical season noted above. In cases where there are numerous non-critical season and non-critical time of day samples, the overall sample count will not be used to artificially increase the needed exceedences to exceed the 10% rule of thumb.
        2) Each daily average percent saturation calculation is an independent sample for comparison to daily average percent saturation indicator. For comparison to the MAGEX threshold, independent samples shall be those taken on different calendar days. If more than one sample is taken on a given calendar day, the worst case sample will be the independent sample for that day. If there are multiple vertical profile measurements at a station, the worst case sample shall be the independent sample for that day.
3. Exceedences of the Water Quality Indicator for DO percent saturation are defined as:

Applicable waters	Daily Average Measurement
Class A: Applies to any depth	< 75% saturation
Class B: Applies to any depth in free flowing rivers and tidal waters and in the epilimnion (if stratified) or in the top 25% of depth (if not stratified) in lakes, ponds, impoundments and reservoirs. Note that DO in lower depths of lakes, ponds impoundments and reservoirs must support existing and designated uses.	< 75% saturation

4. Continuous dataloggers in all waterbody types:
    a. The preferred method of determining compliance is through the use of continuous dataloggers.
    b. Preferred data/conditions for assessing DO % sat:
        1) Comparison with average daily DO percent saturation indicator shall be based on the time weighted average of DO measurements taken at the same location and a maximum of one hour apart for 24 continuous hours except as noted in Note 5, 6, and 7 below.

2) Time series datasets shall generally be considered complete if there are reading covering 75% of a day.
3) Lakes, Ponds, and Impoundment samples shall follow the depth and stratification considerations of Note 5 below.
4) Exceedences of the Magnitude of Exceedence (MAGEX) Threshold for DO percent saturation are defined as:

Class A: DO <65% saturation

Class B: DO <65% saturation

5. Lakes, Ponds, and Impoundments considerations for assessing DO percent saturation with discrete (a.k.a. instantaneous or grab) samples:

   a. Stratification shall be considered present in a profile if the top to bottom temperatures differ by five or more degrees Celsius. Epilimnion waters are those parts of the lake within one degree Celsius of the temperature at, or closest to (within 0.5 meter), the 1-meter depth. Visual interpretations of temperature profiles may override the automated procedures.

   b. In Class B lakes, ponds, and impoundments, if preferred data is not available (see Note 4), a lake may be compared for assessed with DO percent saturation indicator as shown below, provided that minimum value samples from the epilimnion for stratified lakes or upper 25% of depth for unstratified lakes respectively are collected from a profile taken between 10:00 and 14:00 (i.e. critical times of day; (NHDES, 2003)).

   c. In Class A lakes, ponds, and impoundments the bottom DO measurement(s) shall not be used in assessments due to natural boundary layer conditions that result in decreased DO percent saturation at the sediment to water column interface. Where the lake is greater than 3 meters deep, DO readings in the bottom 1 meter are not used. Where the lake is less than or equal to 3 meters deep, the deepest DO reading is not used.

   d. Discrete sample DO assessment indicators collected between 10:00 and 14:00 to approximate continuous data collection methods for Lakes, Ponds, and Impoundments shall be as below;

Use Support	**DO Class A (all time periods)**	**DO Class B (all time periods)**	**DO Any Class (Cold Water Spawning Period)**
FS	$\geq$ 85% saturation	$\geq$ 85% saturation	$\geq$ 85% saturation
Insufficient Information	$\geq$ 75% saturation but < 85% saturation	$\geq$ 75% saturation but < 85% saturation	$\geq$ 75% saturation but < 85% saturation
NS	< 75% saturation	< 75% saturation	< 75% saturation

6. Rivers and Streams considerations for assessing DO percent saturation with discrete (a.k.a. instantaneous or grab) samples:
   a. If preferred data is not available (see Note 4), rivers and streams may be compared in assessments with the 75% average daily saturation DO indicator based on a grab samples as shown below as an approximation of continuous data collection methods, provided that samples are taken within the specified times shown below (NHDES, 2003);

Use Support	Time of Single Sample	DO (% saturation)
FS	05:00 – 10:00 or 14:00 – 19:00	≥ 80% saturation or ≥ 100% saturation
Insufficient Information	05:00 – 10:00 or 14:00 – 19:00	> 45% but < 80 % or > 70% but < 100 %
NS	05:00 – 10:00 or 14:00 – 19:00	≤ 45% saturation or ≤ 70% saturation

7. Tidal Waters considerations for assessing DO percent saturation with discrete (a.k.a. instantaneous or grab) samples:

   a. If preferred data is not available (see Note 4), tidal waters may be compared in assessments with the 75% average daily saturation DO indicator as well as the MAGEX thresholds using a series of DO measurements at the same location and a maximum of one hour apart for at least 18 hours within the day.

   b. If preferred data is not available (see Note 4), tidal waters may be compared in assessments with the 75% average daily saturation DO indicator based on the average of 2 grab samples provided that the samples are taken at concurrent high and low tides.

   c. Discrete sample DO percent saturation assessment thresholds to approximate continuous data collection methods for Tidal waters shall be as below (NHDES, 2004);

Use Support	DO (% saturation)
FS	> 80%
Insufficient Information	≥ 65% but ≤ 80%
NS	< 65%

Indicator 3: pH

pH is an important controlling factor is the chemical and biological processes. The toxicity of some material is impacted by pH shifts which also partially controls the solubility of toxic metals. RSA 485-A, II and Env-Wq 1703.18 define the acceptable pH range of surface waters. For the purposes of assessment, the methodologies below will be used to make the greatest use of all available valid data.

FS: See criteria presented in Table 3-24.

NS: See criteria presented in Table 3-24.

Table 3-24: Use Support Matrix for pH

Total Sample Size	Total # WQC Exceedences	Total # of MAGEX Exceedences	Use Support
≥ 10	< # shown Table 3-13 for the total sample size	≤1	FS

Total Sample Size	Total # WQC Exceedences	Total # of MAGEX Exceedences	Use Support
< 10	< 2	1	INSUFFICIENT INFORMATION or NOT ASSESSED
< 10	≥ 2	≥ 0	NS
≥ 10	≥ # shown Table 3-13 for the total sample size	≥ 0	
≥ 2	2	2	

Notes:

1. Assessments shall be based on the most current data. "Current" data shall be as described in section 3.1.10. If however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-24 and must include at least 2 samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedence occurred.
2. Exceedences of the Water Quality Criteria (WQC) for pH are defined as:

   pH < 6.5 or pH > 8.0
3. Exceedences of the Magnitude of Exceedence Thresholds (MAGEX) for pH are defined as:

   pH < 5.5 or pH > 9.0
4. In lakes, ponds, and impoundments the bottom pH shall generally not be used in assessments due to natural boundary layer conditions that result in increased carbon dioxide (CO_2) and depressed pH at the sediment to water column interface.
5. In tidal waters, pH exceedence greater than 8.0, but less than or equal to 8.5, were considered natural unless there was evidence to suggest that the source was due to human activity (NHDES, 2003). As discussed in Section 3.1.8, such naturally occurring exceedences are flagged as "Observed Effects" in ATTAINS.
6. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 4: Biological Assessments – Use Support Matrix for Benthic Index of Biological Integrity

Measuring whether a waterbody has a balanced, integrated, and adaptive community of benthic organisms is one of the direct measures of the Aquatic Life designated use. Env-Wq 1703.19 'Biological and Aquatic Community Integrity' provides the framework for what the biological community in New Hampshire's waters should look like and requires that those communities be subject to only non-detrimental differences in structure and function from naturally occurring conditions. For the purposes of assessment, the methodologies below will be used to identify which benthic communities are, or are not, meeting Env-Wq 1703.19.

FS: See indicator thresholds presented in

Table 3-25.

NS: See indicator thresholds presented in

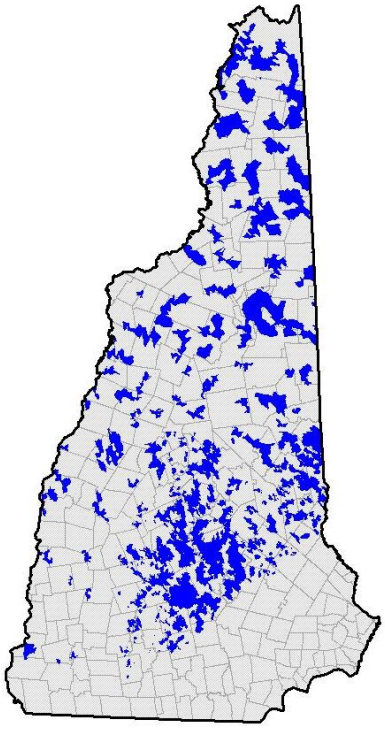
Table 3-25.

Table 3-25: Use Support Matrix for Benthic Index of Biological Integrity

Classification	Benthic Index of Biologic Integrity Indicator Threshold (see note 7)	Use Support
Mountains	≥ 64.8	FS
	< 64.8	NS
Hills	≥ 58.1	FS
	< 58.1	NS
Plains	≥ 53.1	FS
	< 53.1	NS
Hybrid	≥ Weighted indicator	FS
	< Weighted indicator	NS

Notes:

1. Classification defines distinct macroinvertebrate community types as determined from 74 "reference" sites. Site classification is determined by a site's latitude, longitude, drainage area, elevation, USEPA Level IV ecoregion, and to a lesser extent pH. "Hybrid" sites share the characteristics of multiple classes (NHDES, 2011).
2. Weighted indicator thresholds are computed by multiplying a site's likelihood of membership to each class by the respective class indicator threshold and summing the products.
3. Justification for the classification of macroinvertebrate community types, and respective benthic IBI indicator thresholds can be found in NHDES report WD-2011-24 entitled *Site classification for the New Hampshire Benthic Index of Biotic Integrity (B-IBI) using a non-linear predictive model*, prepared by Benjamin Jessup and David Neils (NHDES, 2011).
4. Assessments shall be based on the most current data. "Current" data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in
5.
6. Table 3-25 and must include biomonitoring data collected in the same general area and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.



7. Assessments shall be based on data collected in accordance with NHDES biomonitoring protocols, which include the deployment and collection of rock baskets during the summer months. A description of the protocols can be found in *New Hampshire Department of Environmental Services (NHDES) Protocols for Collection, Identification and Enumeration of Aquatic Macroinvertebrates* (NHDES, 2013).
8. Scores for the Benthic Index of Biologic Integrity represent an average of 7 biological "metrics" calculated in the NHDES version of the Ecological Data Application System database (EDAS) that include:
    1) Total taxonomic richness.
    2) Stonefly (Order *Plecoptera*) taxonomic richness.
    3) Tolerant taxa richness (where tolerant taxa are defined as taxa with a tolerance value >6 in the EDAS).
    4) Percent midge (Family *Chironomidae*) individuals.
    5) Percent "clinger" individuals (as defined under "habit-type" in the EDAS).
    6) Percent "intolerant" individuals (where intolerant taxa are defined as taxa with a tolerance value <4 in the EDAS).
    7) Percent non-insect individuals (defined as taxa not in the Class *Insecta*).
9. The indicator threshold for use support was defined as 90% of the 25th percentile of the distribution of B-IBI scores for reference sites with a 100% likelihood of membership to a particular class or 90% of the 25th percentile of the weighted indicator thresholds for sites with memberships to multiple classes.
10. Biologists review all assessment outcomes. Where there is uncertainty in the applicability to a site of the developed B-IBI, or where multiple samples within an assessment unit conflict, the biologists may recommend an assessment category of insufficient information – potentially attaining standards (3-PAS) or insufficient information – potentially not supporting (3-PNS) as applicable.
11. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 5: Biological Assessments – Use Support Matrix for Coldwater Fish Assemblage Index of Biotic Integrity (CWFA-IBI).

Measuring whether a waterbody has a balanced, integrated, and adaptive community of cold water fish is one of the direct measures of the Aquatic Life designated use. Env-Wq 1703.19 "Biological and Aquatic Community Integrity" provides the framework for what the biological community in New Hampshire's waters should look like and requires that those communities be subject to only non-detrimental differences in structure and function from naturally occurring conditions. For the purposes of assessment, the methodologies below will be used to identify which cold water fish communities are, or are not, meeting Env-Wq 1703.19.

FS: See indicator thresholds presented in Table 3-26

NS: See indicator thresholds presented in Table 3-26

Table 3-26: Use Support Matrix for Coldwater Fish Assemblage Index of Biologic Integrity

Coldwater Fish Assemblage Index of Biologic Integrity (CWFA- IBI)	Use Support
≥ 30	FS
< 30	NS

Notes:

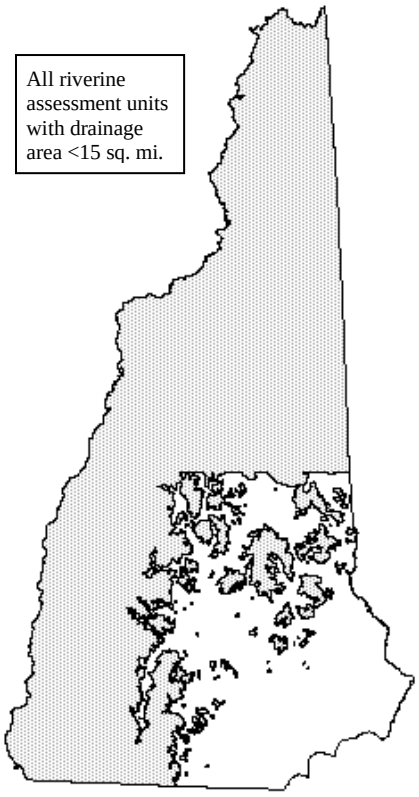
1. The CWFA-IBI applies only to riverine assessment units meeting the following conditions (NHDES, 2007):

   a. All sampling locations north of 43.75 degrees latitude and having a drainage area less than 15 square miles (minimum 1 square mile).

   b. All sampling locations in the Connecticut River basin south of 43.75 degrees latitude and having a drainage area less than 15 square miles (minimum 1 square mile).

   c. All sampling locations in the Merrimack, Saco, or Piscataqua Basins south of 43.75 degrees latitude, greater than 775 feet in elevation, and having a drainage area less than 15 square miles (minimum 1 square mile).

   d. Other sites not meeting these conditions if documented naturally reproducing populations of Eastern brook trout or slimy sculpin exist and the expected natural species richness is between two and four.



2. Assessments shall be based on the most current data. "Current" data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decisions must meet the requirements in Table 3-26 and must include biomonitoring data collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when older exceedences occurred.

3. Assessments shall be based on data collected in accordance with NHDES biomonitoring protocols, which include the collection, identification, and enumeration of fish within a representative stream reach of at least 150 meters using backpack electrofishing equipment (or suitable alternative fish sampling gear) to obtain a representative sample of the resident fish community (NHDES, 2013).

4. Assessment using the CWFA-IBI shall be based on collections with a minimum of 30 individuals and at least 2 species unless the department determines otherwise based on additional data indicate that an assessment using the CWFA-IBI is most appropriate for the conditions.
5. The CWFA-IBI score ranges from 9 – 45 and is the summation of six individual metrics including;
    1) The percentage of generalist feeder individuals.
    2) The percentage of coldwater specialist individuals.
    3) The percentage of top carnivore individuals.
    4) The percentage of brook trout individuals.
    5) The number of tolerant species.
    6) The age class structure of brook trout individuals.
6. The indicator threshold for use support of 30 was defined as the 25th percentile score of the reference condition (i.e., minimally impacted). Details of the development of the CWFA-IBI can be found in NHDES publication #R-WD-07-33 entitled "Coldwater fish assemblage index of biotic integrity for New Hampshire wadeable streams." (NHDES, 2007).
7. Biologists review all assessment outcomes. Where there is uncertainty in the applicability to a site of the developed CWFA-IBI, or where multiple samples within an assessment unit conflict, the biologists may recommend an assessment category of insufficient information – potentially attaining standards (3-PAS) or insufficient information – potentially not supporting (3-PNS) as applicable.
8. See section 3.1.24 for determining waters that should be place in Category 5.

Indicator 6: Biological Assessments – Transitional Water Fish Assemblage Index of Biotic Integrity (TWFA-IBI).

Measuring whether a waterbody has a balanced, integrated, and adaptive community of transitional water fish (i.e. between a warm and cold water assemblage) is one of the direct measures of the Aquatic Life designated use. Env-Wq 1703.19 "Biological and Aquatic Community Integrity" provides the framework for what the biological community in New Hampshire's waters should look like and requires that those communities be subject to only non-detrimental differences in structure and function from naturally occurring conditions. For the purposes of assessment, the methodologies below will be used to identify which transitional water fish communities are, or are not, meeting Env-Wq 1703.19.

FS: See indicator thresholds presented in Table 3-27

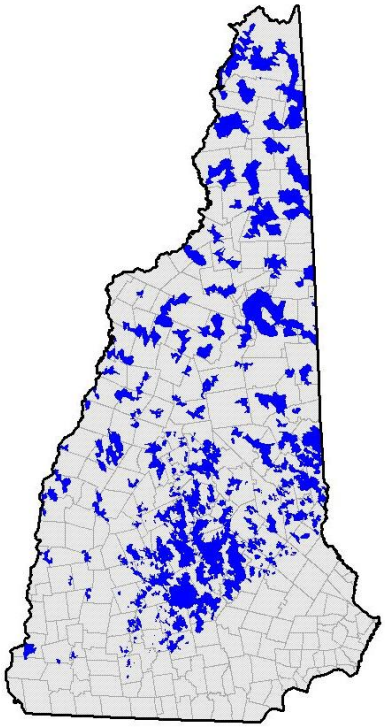
NS: See indicator thresholds presented in Table 3-27

Table 3-27: Use Support Matrix for Transitional Fish Assemblage Index of Biologic Integrity

Transitional water Fish Assemblage Index of Biologic Integrity (TWFA- IBI)	Use Support
$\geq$ 28	FS
< 28	NS

Notes:

1. The TWFA-IBI applies only to riverine assessment units meeting the following conditions (NHDES, 2007):
    a. All sampling locations falling within shaded areas of the map to the right.
    b. TWFA-IBI areas were defined as watersheds with a probability of supporting coldwater fish species equal to or greater than 0.50 (50%) as predicted by a logistic regression equation that includes latitude, longitude, and drainage area as the dependent variables less areas where the CWFA-IBI applies.
    c. Other waters deemed suitable for the TWFA-IBI based on determinations by the NHDES biomonitoring program.
2. Assessments shall be based on the most current data. "Current" data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decisions must meet the requirements in Table 3-27 and must include biomonitoring data collected in the same general area and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when older exceedences occurred.



3. Assessments shall be based on data collected in accordance with NHDES biomonitoring protocols, which include the collection, identification, and enumeration of fish within a representative stream reach of at least 500 feet using backpack electrofishing equipment (or suitable alternative fish sampling gear) to obtain a representative sample of the resident fish community.
4. Assessment using the TWFA-IBI shall be based on collections with a minimum of 30 individuals and at least 3 fish species unless the department determines otherwise based on additional data that indicate an assessment using the TWFA-IBI is most appropriate for the conditions.
5. The TWFA-IBI score ranges from 9 – 45 and is the summation of eight individual metrics (NHDES, 2011) including:
    1) The percentage of benthic insectivore individuals.
    2) Percentage of brook trout and slimy sculpin individuals.
    3) Number of coldwater species.
    4) Age class structure of brook trout.
    5) Percentage of generalist feeder individuals.
    6) Percentage of individuals as common shiner, creek chub, and fall fish.
    7) Percentage of tolerant species.
    8) Percentage of fluvial specialists excluding blacknose dace.
6. The indicator threshold for use support of 28 was defined as the 25th percentile score of the reference condition (i.e., minimally impacted). Details of the development of the TWFA-IBI can be found in NHDES publication "Transitional Water Fish Assemblage Index of Biotic Integrity for New Hampshire Wadeable Streams" (NHDES, 2011).

7. Biologists review all assessment outcomes. Where there is uncertainty in the applicability to a site of the developed CWFA-IBI, or where multiple samples within an assessment unit conflict, the biologists may recommend an assessment category of insufficient information – potentially attaining standards (3-PAS) or insufficient information – potentially not supporting (3-PNS) as applicable.
8. See section 3.1.24 for determining waters that should be place in Category 5.

Indicator 7: Habitat Assessments

The maintenance of a balanced, integrated, and adaptive community described in Env-Wq 1703.19 will be limited if the suitable habitat for that natural community has been severely degraded. The requirement to restore surface waters for designated uses and maintain the physical integrity of surface waters is described in Env-Wq 1703.01(b) and Env-Wq 1703.03(c). For the purposes of assessment, the methodologies below will be used to make habitat physical integrity assessment.

FS: See indicator thresholds presented in Table 3-28.

NS: See indicator thresholds presented in Table 3-28.

Table 3-28: Use Support Matrix for Habitat Assessment Score

Habitat Assessment Score	Use Support
≤ 10 for no more than one parameter and biological assessment supports the designation	FS
≤ 10 for more than one parameter and biological assessment was assigned NS status	NS
≤ 10 for more than one parameter and biological assessment was assigned FS status	Insufficient Information

Notes:

1. Habitat information for habitat scoring is collected when bioassessments are conducted. Data is based on visual observations using standard protocols and assessment sheets that address ten specific habitat parameters for low and high gradient streams. Habitat parameters include epifaunal substrate/available cover, pool substrate characterization, pool variability, sediment deposition, channel flow status, channel alteration, channel sinuosity, bank stability, vegetative protection and riparian vegetative zone width. Each parameter was then given a score from one to twenty. These values were then compared to Table 3-28 to determine use support.
2. A FS habitat score is indicative of naturally occurring stream morphology, substrate composition, natural riparian physical and vegetative structure and stability, flow regime and minimal to no anthropogenic influences within a spatial range that could induce stressed or impaired habitat conditions.
3. A NS habitat score is indicative of obvious non-naturally occurring influences that are considered marginal to severe.
4. An insufficient information determination is given in cases where clear evidence of non-naturally occurring influences have degraded habitat but biological assessment does not indicate impairment.

5. A NS biological assessment is given priority over a FS habitat assessment in making a final NS use determination as non-habitat related factors could influence aquatic life use suitability.
6. A NS habitat assessment by this method is typically only used when the habitat score meets Table 3-28 and one or more of the indexes of biological integrity indicate NS.
7. In some instances, best professional judgment (BPJ) was used in making an "insufficient information" use support determination. Decisions based on BPJ are only used when clear evidence of natural abiotic variables were believed to limit overall biologic integrity.
8. In cases were habitat data were unavailable, use determination was based solely on the biologic assessment.
9. As discussed in section 3.1.6 and 3.1.24, habitat is considered a non-pollutant; consequently waters impaired solely because of habitat will not be placed in Category 5.

Indicator 8: Chlorophyll-a (Chl-a) & Total Phosphorus (TP) in Lakes

The acceptable levels of nutrients in surface waters are governed by Administrative Rule Env-Wq 1703.14, which requires that there be a natural level of nutrients in Class A waters or no nutrients in such quantities as to impair any designated uses in Class B waters. Therefore, assessments to determine compliance with Env-Wq 1703.14 need to consider both indicators of nutrients and nutrient-related impairments. In freshwater lakes, the indicators for nutrient levels are Chlorophyll-a and Total Phosphorus concentrations because phosphorus is the limiting nutrient in freshwaters.

In lake systems, the maintenance of a balanced, integrated, and adaptive community of organisms described in Env-Wq 1703.19 is reflected in a stable level of productivity. Phosphorus, as the limiting nutrient in lake systems, controls the ability of algae, the foundation of lake productivity, to grow and reproduce. The biomass of algae is indicated by the concentration of chlorophyll-a. Lakes are commonly categorized into productivity regimes or trophic classes. While trophic class will shift over long geologic periods, it should not shift within the modern era.

In order to assess compliance with Env-Wq 1703.14 for the freshwater lakes, the indicator of nutrients and nutrient-related impact indicator are combined using a stressor-response decision matrix. The response indicator is chlorophyll-a concentrations (a measure of algae growth). The stressor indicator is total phosphorus concentrations, because phosphorus is the limiting nutrient in freshwater lakes. Following the decision matrix, if there are both elevated nutrients and an adverse response in the same assessment unit, then that assessment unit would be considered to have excess nutrients in violation of Env-Wq 1703.14. For the purposes of assessment, a lake will be considered to have a balanced, integrated, and adaptive community described in Env-Wq 1703.19 if the summer median chlorophyll-a is within the normal range as describe in the methods below. The steps used for this assessment process are discussed in detail in the following sections.

Indicator Part 8a: Chlorophyll-a (Chl-a) in Lakes Indicator

FS: Median Chl-a values are ≤ threshold in table below note 5

NS: Median Chl-a values are > threshold in table below note 5

Notes:

1. Indicator Part 7a is the response indicator that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community described in Env-Wq 1703.19.
2. Data Requirements
    a. Assessments shall be based on data collected between May 24th to September 15th that is 10 years or less in age and the median value is used to make the indicator comparison.
    b. Median calculations for chlorophyll-a must have five or more independent sampling dates on a given waterbody to be considered for Full Support or Not Support designations.
    c. Samples shall represent the open water condition of the waterbody where depth zone is Epilimnion, Composite, or Upper. If the depth zone is not defined the sample must be collected at a depth of ≤ 2m.
    d. If there is more than one result for chlorophyll-a at the same station on the same date with the same depth zone, the two values are averaged. If there is a "composite" sample, that value is preferentially selected over other values to represent a station visit. "Epilimnion" is the next preferred sample, then "upper," and finally the average of samples collected ≤ 2m depth.
    e. If older data indicated NS, the more recent data used to make a FS decision must meet the requirements in this section and must include at least two samples collected at the same or more water quality limited sites and under similar conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.
3. The ALUS chlorophyll-a thresholds shall only be applied to waterbodies where the best trophic class has been determined.
4. The ALUS chlorophyll-a thresholds vary by lake best trophic class. Trophic class for a given lake shall be determined through the process outlined in Sources of Information and Explanation of Lake Trophic Data[11], pg. 12-13). Where multiple trophic class evaluations have been conducted over the years, the "cleanest" (aka "best") trophic class observed shall be used to set the TP and Chl-a thresholds.
5. The ALUS chlorophyll-a thresholds by trophic class are depicted below.

Trophic Class	Chl-a (µg/L)
Oligotrophic	< 3.3
Mesotrophic	≤ 5.0
Eutrophic	≤ 11

(NHDES, 2009)

Indicator Part 8b: Preliminary Total Phosphorus (TP) Indicator

FS (Preliminary): Median TP values are ≤ threshold in table below note 5

NS (Preliminary): Median TP values are > threshold in table below note 5

Notes:

1. Indicator Part 8b is the preliminary stressor indicator that will be used to assess if there are excess nutrients per Env-Wq 1703.14.
2. Data Requirements

[11] https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/laketrophic-explain-current.pdf

a. Assessments shall be based on data collected between May 24th to September 15th that is 10 years or less in age and the median value is used to make the indicator comparison.
b. Median calculations for TP must have five or more independent sampling dates on a given waterbody to be considered for Full Support or Not Support designations.
c. Samples shall represent the open water condition of the waterbody where depth zone is Epilimnion, Composite, or Upper. If the depth zone is not defined the sample must be collected at a depth of ≤ 2m.
d. If there is more than one result for phosphorus at the same station on the same date with the same depth zone, the two values are averaged. If there is a "composite" sample, that value is preferentially selected over other values to represent a station visit. "Epilimnion" is the next preferred sample, then "upper," and finally the average of samples collected ≤ 2m depth.
e. If older data indicated NS, the more recent data used to make a FS decision must meet the requirements in this section and must include at least two samples collected at the same or more water quality limited sites and under similar conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedence occurred.

3. The ALUS nutrient thresholds shall only be applied to waterbodies where the best trophic class has been determined.
4. The ALUS nutrient thresholds vary by lake best trophic class. Trophic class for a given lake shall be determined through the process outlined in Sources of Information and Explanation of Lake Trophic Data[12], pg. 12-14). Where multiple trophic class evaluations have been conducted over the years, the "cleanest" (aka "best") trophic class observed shall be used to set the TP thresholds.
5. The ALUS nutrient thresholds by trophic class are depicted below.

Trophic Class	TP (µg/L)
Oligotrophic	< 8.0
Mesotrophic	≤ 12.0
Eutrophic	≤ 28

(NHDES, 2009)

Indicator Part 8c: Stressor-Response Matrix Assessment to Determine Compliance with Env-Wq 1703.14 Relative to Total Phosphorus Concentrations (TP) and Chlorophyll-a (Chl-a) in Lakes

FS: See Note 1

NS: See Note 1

Notes:

1. The values of Indicators 8a and 8b will be combined using a stressor-response matrix for a unified assessment of compliance with the water quality standard for nutrients (Env-Wq 1703.14). For the unified nutrient assessment, chlorophyll-a (Indicator 8a) will be considered the response indicator. The nutrient stressor indicator will be the median total phosphorus concentration (Indicator 8b) because phosphorus is the limiting nutrient in freshwater lakes. The decision matrix in Table 3-29 illustrates how information from the stressor and response indicators will be integrated in all cases. Following the decision matrix, a phosphorus (stressor) impairment would be assigned, indicating a violation of Env-Wq 1703.14, if both the response

[12] https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/laketrophic-explain-current.pdf

indicator and the stressor indicator exceeded thresholds. Conversely, if either the stressor indicator or the response indicator were acceptable, then Env-Wq 1703.14 would not be in violation. However, if there were conflicting results between indicators, a weight-of-evidence approach, considering the quality of the underlying data for each indicator, will be used to make impairment determination and a narrative justification will be provided.

2. The values of Indicators 8a and 8b are only used for lakes and impoundments for which the best trophic class has been determined. Trophic class for a given lake shall be determined through the process outlined in Sources of Information and Explanation of Lake Trophic Data[13], pg. 12-14). Where multiple trophic class evaluations have been conducted over the years, the "cleanest" (aka "best") trophic class observed shall be used for Indicators 7a, 7b, and 7c.

Table 3-29: Decision Matrix to Assign a Final Assessment Category to Phosphorus for lakes and Impoundments Using the Results from Both Response (i.e. Chlorophyll-a) and Stressor (i.e. Nutrient) Indicators. Chlorophyll Will Be Assigned the Use Support Category Determined by the Chlorophyll Concentration.

		Preliminary Assessment for Stressor Indicator (TP)					
		Category 4 or 5 (Not Supporting)	Category 2 (Fully Supporting)	Category 3 (Insufficient Information) (See Note b)			
Final Assessment for Response Indicator	Category 4 or 5 (Not Supporting)	Category 4 or 5	Category 3-PNS (Category 4 or 5 if response is Chl-a) See Note e	Category 3-PNS (Category 4 or 5 if response is Chl-a) See Note e			
	Category 2 (Fully Supporting)	Category 3-PNS	Category 2	Category 3 See Note b			
	Category 3 (Insufficient Information) (See Note b)	If Response Indicator is 3-PNS, then Category 4 or 5. If Response Indicator is 3-PAS or 3-ND, then Category 3-PNS. See Note c	If Response Indicator is 3-PAS, then Category 2. If Response Indicator is 3-PNS or 3-ND, then Category 3-PAS. See Note c		3-ND	3-PAS	3-PNS
					3-ND	3-ND	3-PAS	3-PNS
					3-PAS	3-ND	3-PAS	See Note d
					3-PNS	3-ND	See Note d	3-PNS

Table Notes:

a. If the conditions warrant, NHDES reserves the right to deviate from this matrix.

b. Full descriptions of the insufficient information categories are provided in Section 3.1.5. 3-PAS = "Insufficient Information- Potentially Attaining Standards," 3-PNS = "Insufficient Information- Potentially Not Attaining Standards," or 3-ND = "No Current Data."

c. If there are incomplete data for the response indicator which are consistent with the category for the nutrient indicator, then the category for the nutrient indicator will be used. If the incomplete data for the response indicator are inconsistent with the nutrient indicator or if there are no current data for the response indicator, the category for the nutrient will be 3-PNS or 3-PAS as shown in the matrix.

[13] https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/laketrophic-explain-current.pdf

d. In the case where there are incomplete or missing data for both the nutrient and the response indicators, the sub-table in the lower right corner will be used. The category for the nutrient indicator will be used for the nutrient category except for the two cases marked by Note c. For these cases, where the available data for the response indicator and nutrient indicator conflict, the category for the higher quality dataset will be used. If data quality is the same for the two indicators, then the category for the nutrient indicator will be used.

e. The nutrient indicator will only be assessed as not supporting when the nutrient in question is phosphorus and the response indicator is chlorophyll-a.

Indicator 9: Eelgrass (*Zostera marina*) Cover in the Great Bay Estuary

Eelgrass (*Zostera marina*) is the base of the estuarine food web in the Great Bay Estuary. Healthy eelgrass beds filter water, stabilize sediments (Short & Short, 1984), and provide habitat for fish and shellfish (Duarte, 2001) (Heck, Hays, & Orth, 2003). While eelgrass is only one species in the estuarine community, the presence of eelgrass is critical for the survival of many species. Maintenance of eelgrass habitat is considered critical in order to maintain a balanced, integrated, and adaptive community of organisms (Env-Wq 1703.19). Loss of eelgrass habitat would change the species composition of the estuary resulting in a detrimental difference in community structure and function. In particular, if eelgrass habitat is lost, the estuary will likely be colonized by macroalgae species which do not provide the same habitat functions as eelgrass (Short, Burdick, & Kaldy, 1995) (Hauxwell, Cebrian, & Valiela, 2003) (McGlathery, Sundbäck, & Anderson, 2007). Therefore, eelgrass habitat as percent cover is a valid indicator of biological integrity in portions of the Great Bay Estuary. For the purposes of 305b/303d assessments, this indicator will be used to interpret the narrative water quality standard for biological integrity (Env-Wq 1703.19).

FS: No historical loss > 20% and no decreasing trend that shows a loss of 20% of the resource

NS: Historical loss > 20% or decreasing trend that shows a loss of 20% of the resource

Notes:

1. NHDES developed an assessment methodology for determining compliance with water quality standards for biological integrity (Env-Wq 1703.19) using eelgrass (*Zostera marina*) cover in the Great Bay Estuary as an indicator. NHDES reviewed eelgrass cover data from 1948 to present.
2. Two methods for assessing eelgrass cover data are evaluated,
    a. If there are reliable historic and current maps of eelgrass cover for an area, NHDES will use the percent decline from the historic level to determine impairments. If eelgrass was only seen in the historic (e.g. 1948, 1962, & 1981) mapping and not since that time, a suitability evaluation (such as (Short, Davis, Kopp, Short, & Burdick, 2002)) should occur before that data is used in the assessments. A region will be considered to have significant eelgrass loss if the change from historic levels is >20%. This threshold value was determined from natural variability observed in recent eelgrass cover in the Great Bay Estuary. To avoid spurious impairments from one year of data, the median eelgrass cover from the last three years of data will be compared to the historic eelgrass cover.

b. If sufficient data from annual surveys are available, NHDES will evaluate recent trends in the eelgrass cover indicator. Trends will be evaluated using linear regression of eelgrass cover in a zone versus year. The assessment zone will be considered to have significant eelgrass loss if there is a statistically significant ($p<0.05$), decreasing trend that shows a loss of 20% of the resource with 95% confidence (i.e., the 95^{th} percentile upper confidence limit of the regression for the most recent date is less than 20% of the maximum value of the cover over the time series).

3. NHDES will consider a zone to be impaired if either of the two methods indicates significant eelgrass loss. In the USEPA Assessment Database, impairments due to significant eelgrass loss will be coded as "Estuarine Bioassessments." For assessment zones with significant eelgrass loss, NHDES will review available records for dredging, mooring fields, and other activities to identify potential impacts to eelgrass from these activities.

NHDES may also consider trends in eelgrass biomass as supplemental information when making some assessments. Eelgrass cover does not account for thinning of beds, which is also a loss of habitat and ecosystem services. Biomass is calculated by multiplying the eelgrass area by the eelgrass density (PREP, 2012). In addition, NHDES may consider published reports about eelgrass impacts due to the proliferation of macroalgae as supplemental information for eelgrass assessments.

Indicator 9a: Water Clarity (Light Attenuation Coefficient, Kd) Indicator for Eelgrass (Zostera marina) Growing Areas in the Great Bay Estuary

FS: Median Kd values are ≤ threshold in table below note 4

NS: Median Kd values are > threshold in table below note 4

Notes:

1. Eelgrass is sensitive to water clarity among other factors (Short, Burdick, & Kaldy, 1995). Light attenuation in the water column by water, phytoplankton blooms, and non-algal particles, and colored dissolved organic matter (CDOM) reduce the light available to eelgrass for growth. Therefore, water clarity can be used as an indicator of suitable conditions for eelgrass survival. The assessment makes no assumptions regarding the relative weight of the various factors. General water quality criteria require that waterbodies be free of substances in kind or quantity, such as color and turbidity that affect water clarity, which would render it unsuitable for its designated uses (Env-Wq 1703.03(c)(1)c.).
2. Data Requirements
    a Assessments shall be based on Kd data that is five years or less in age and the median Kd value shall be used to make the threshold comparison.
    b The median Kd value shall be calculated from representative data that cover all four seasons of the year.
    c The minimum sample size of independent results to be considered complete for Kd shall be 15 for a given waterbody.

d If older data indicated Non Support, the more recent data used to make a Full Support decision must have been collected at the same site(s) and under similar or more limiting conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.

e The waterbody being assessed must have been assigned an eelgrass restoration depth. The default restoration depth is 2 m below Mean Water Level (MWL). Restoration depths of 2.5 and 3.0 m below MWL should be considered for deeper waterbodies.

3. The Kd thresholds vary by eelgrass restoration depth. The thresholds for different depths are depicted in the table below.

Restoration Depth (m below MWL)	Median Kd (m^{-1})
2.0	0.75
2.5	0.60
3.0	0.50

a. Target restoration depth is 2 meters for all areas except the Lower Piscataqua River-South, Portsmouth Harbor and Little Harbor/Back Channel areas where the target depth is 3 meters (NHDES, 2009b) (NHDES, 2009a).

Indicator 10: Total Nitrogen Concentrations (TN) and Associated Eutrophication Impacts in the Great Bay Estuary

The acceptable levels of nutrients in surface waters are governed by Administrative Rule Env-Wq 1703.14 which requires that there be a natural level of nutrients in Class A waters and no nutrients in such quantities as to impair any designated uses in Class B waters. Therefore, assessments to determine compliance with Env-Wq 1703.14 consider both direct measure of nutrients and indicators of nutrient-related impairments (i.e. eutrophication). In the Great Bay Estuary, the measure for nutrient levels is total nitrogen concentrations because nitrogen is the limiting nutrient in estuaries.

In order to assess compliance with Env-Wq 1703.14 for the Great Bay estuary, NHDES utilizes a "preponderance of evidence" approach that looks at a stressor-response relationship between total nitrogen and various indicators. In that approach, a collection of water quality criteria, assessment thresholds and measures collectively act as the indicators of nutrient-related impacts. Each individual indicator has varying degrees of linkage to total nitrogen and those linkages are likely to differ by assessment zone. This variability of linkages, coupled with the lack of data about some of the indicators, is such that not all indicators can individually be used to make full-support/non-support determinations. Inherent in this evaluation is a consideration of the quality, currentness, representativeness, completeness, applicability, frequency, magnitude and duration of each indicator. The response indicators include but are not limited to; dissolved oxygen concentrations, chlorophyll-a concentrations (a measure of water column algae growth), macroalgae, epiphytes, water clarity (a measure of light availability to the plants), and eelgrass extent. Each of these indicators is assessed independently using the methods described below. If nutrient levels (as measured by total nitrogen concentrations) are

elevated and adverse responses exist in the same assessment unit, then that assessment unit may be considered to have excess nutrients in violation of Env-Wq 1703.14 when a preponderance of evidence warrants such a determination.

The indicators used for this assessment process are discussed in detail in the following sections.

Indicator 10a: Dissolved Oxygen Assessment

Suggests FS: Dissolved oxygen criteria are met per the methodology in Aquatic Life Use: Indicator 1 and Indicator 2

Suggests NS: Dissolved oxygen criteria are not met per the methodology in Aquatic Life Use: Indicator 1 and Indicator 2

Notes:

1. Low dissolved oxygen is a well-established indicator of elevated nutrients in estuaries (NRC, 2000) (Cloern, 2001) (Bricker, et al., 2007) (USEPA, October 2001) (Diaz & Rosenberg, 2008). Fish and other species require sufficient concentrations of dissolved oxygen in the water to survive. In nitrogen-limited systems, such as estuaries (Howarth & Marino, 2006), increasing nitrogen inputs will increase primary productivity in the form of both pelagic phytoplankton and rooted or free-floating macroalgae. Respiration of the organic matter created by the primary productivity consumes oxygen from the water column and sediments. The resulting low oxygen conditions affect fish and benthic communities (Diaz & Rosenberg, 2008) (Cloern, 2001) (Bricker, et al., 2007). Effects on species include death, compressed habitats, and shifts in species composition to opportunistic benthic species with short life spans and smaller body sizes (Diaz & Rosenberg, 2008) (NRC, 2000).
2. Indicator Part 10a is a response indicator that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain an adequate dissolved oxygen (concentration and percent saturation) per Env-Wq 1703.07.
3. NHDES uses direct measurements of dissolved oxygen and compares those to the numeric water quality criteria in Env-Wq 1703.07. Aquatic Life Use: Indicator 1 and Indicator 2 outline the methodologies used to go from raw water quality data to an assessment of dissolved oxygen (concentration and percent saturation) as related to the criteria in Env-Wq 1703.07.

Indicator 10b: Chlorophyll-a Concentration (Chl-a) Threshold to Protect Dissolved Oxygen

Suggests FS: 90^{th} Percentile Chl-a concentrations are ≤ 10 µg/L

Suggests NS: 90^{th} Percentile Chl-a concentrations are > 10 µg/L

Notes:

1. Chlorophyll-a growth is stimulated by eutrophication processes. Chlorophyll-a represents a potential draw on available dissolved oxygen in two principle ways. Initially, live phytoplankton must consume oxygen during the night to maintain biological functions. Once phytoplankton dies, the remaining organic matter is available to bacteria and additional oxygen consumption from the water column.

2. Indicator Part 10b is a response threshold that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain an adequate dissolved oxygen concentration per Env-Wq 1703.07.
3. The final assessment decision for this indicator is dependent on the distribution of chlorophyll-a data, the distribution of the dissolved oxygen data and consideration of the quality, currentness, representativeness, completeness, applicability, frequency, magnitude and duration of each data component.
4. Data Requirements
    a Assessments shall be based on Chl-a data that is 5 years or less in age and the 90th percentile Chl-a concentration shall be used to make the threshold comparison.
    b The 90th percentile Chl-a concentration shall be calculated from representative data that cover all four seasons of the year.
    c The minimum sample size of independent results to be considered complete for Chl-a shall be 15 for a given waterbody.
    d If older data indicated Non Support, the more recent data used to make a Full Support decision must have been collected at the same site(s) and under similar or more limiting conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.

Indicator 10c: Water Clarity (Light Attenuation Coefficient, Kd) Threshold

Suggests FS: Median Kd values are ≤ threshold in table below note 4

Suggests NS: Median Kd values are > threshold in table below note 4

Notes:

1. Eelgrass is sensitive to water clarity among other factors (Short, Burdick, & Kaldy, 1995). Light attenuation in the water column by water, phytoplankton blooms, and non-algal particles, and colored dissolved organic matter (CDOM) reduce the light available to eelgrass for growth. Therefore, water clarity can be used as an indicator of suitable conditions for eelgrass survival. The assessment makes no assumptions regarding the relative weight of the various factors. General water quality criteria require that waterbodies be free of substances in kind or quantity, such as color and turbidity that affect water clarity, which would render it unsuitable for its designated uses (Env-Wq 1703.03(c)(1)c.).

2. Indicator Part 10c is a response threshold that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community per Env-Wq 1703.19.

3. Data Requirements
    a. Assessments shall be based on Kd data that is five years or less in age and the median Kd value shall be used to make the threshold comparison.
    b. The median Kd value shall be calculated from representative data that cover all four seasons of the year.
    c. The minimum sample size of independent results to be considered complete for Kd shall be 15 for a given waterbody.

d. If older data indicated Non Support, the more recent data used to make a Full Support decision must have been collected at the same site(s) and under similar or more limiting conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.

e. The waterbody being assessed must have been assigned an eelgrass restoration depth. The default restoration depth is 2 m below Mean Water Level (MWL). Restoration depths of 2.5 and 3.0 m below MWL should be considered for deeper waterbodies.

4. The Kd thresholds vary by eelgrass restoration depth. The thresholds for different depths are depicted in the table below.

Restoration Depth (m below MWL)	Median Kd (m^{-1})
2.0	0.75
2.5	0.60
3.0	0.50

a. Target restoration depth is 2 meters for all areas except the Lower Piscataqua River-South, Portsmouth Harbor and Little Harbor/Back Channel areas where the target depth is 3 meters (NHDES, 2009b) (NHDES, 2009a).

Indicator 10d: Chlorophyll-a Concentration (Chl-a) Threshold as a Component of Water Clarity

Suggests FS: 90th Percentile Chl-a concentrations are not elevated

Suggests NS: 90th Percentile Chl-a concentrations are elevated

Notes:

1. Indicator Part 10d is a response threshold that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community per Env-Wq 1703.19.
2. Chlorophyll-a is one of several light attenuation substances in the water column along with non-algal particles and colored dissolved organic matter (CDOM).
3. Chlorophyll-a growth is stimulated by eutrophication processes. Chlorophyll-a represents one controllable component of water clarity.
4. The calculation methods in Indicator Part 10b may be used as one approximation of peak chlorophyll-a concentrations that reduce water clarity. Where the short-term variability in the system is heavily confounded by the multitude of physical and biological process time scales, the 5-year 90th percentile chlorophyll-a indicator allows the multitude of physical and biological process time scales in the estuary to reveal the balance of the system (Lawton, 1999) (Li, Lewis, & Harrison, 2010).
5. The final assessment decision for this indicator is dependent on the distribution of chlorophyll-a data, the distribution of the light attenuation data, any information about other light attenuating substances and consideration of the quality, currentness, representativeness, completeness, applicability, frequency, magnitude and duration of each data component.

Indicator 10e: Macroalgae Measure

Suggests II-PAS:Documented little to no macroalgae growth.

Suggests II-PNS:Documented moderate to heavy macroalgae growth.

Notes:

1. Indicator Part 10e shall be part of the overall weight of evidence for cultural eutrophication. At this time there are no set break points for how much macroalgae growth is acceptable and how much is unacceptable. The scientific literature contains many studies showing that macroalgae nutrient requirements exceed those for eelgrass (Pedersen & Borum, 1996), macroalgae growth is stimulated by increased nutrients (Cloern, 2001), and macroalgae can alter the nutrients release dynamics from the sediment (McGlathery K. , 2002). Macroalgae may affect seagrasses due to light competition (Burkholder, Mason, & Glasgow, 1992) (Deegan, et al., 2002) (Kennish, Fertig, & Sakowicz, 2011), that light competition can exceed that from phytoplankton and epiphytes (Hauxwell J. , Cebrian, Furlong, & Valiela, 2001), it can lower the benthic boundary dissolved oxygen, reduce macrofaunal abundance and species richness (Green, Sutula, & Fong, 2014), and lower fish abundance and biomass (Deegan, et al., 2002). Macroalgae beds can shift the microbial community in ways that make recolonization by seagrasses difficult (Gribben, et al., 2017). Some macroalgae growth in the absence of other stressors may be just fine whereas some macroalgae growth in conjunction with additional stressors can combine to create a degraded ecosystem. Overall, macroalgae growth is a useful as an indicator of cultural eutrophication.
2. Indicator Part 10e is a response threshold that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community per Env-Wq 1703.19.

Indicator 10f: Epiphyte Measure

Suggests II-PAS:Documented little to no epiphytic growth.

Suggests II-PNS:Documented moderate to heavy epiphytic growth.

Notes:

1. Indicator Part 10f shall be part of the overall weight of evidence for cultural eutrophication. At this time there are no set break points for how much epiphytic growth is acceptable and how much is unacceptable. The literature contains many studies showing that epiphyte growth is stimulated by added nutrients ((Twilley, Kemp, Staver, Stevenson, & Boynton, 1985), (Short, Burdick, & Kaldy, 1995), (Neckles, Wetzel, & Orth, 1993)). Further, the light attenuation by epiphytes has been documented to be sufficient to reduce eelgrass growth ((Brush & Nixon, 2002), (Short, Burdick, & Kaldy, 1995), (Sand-Jensen, 1977), (Twilley, Kemp, Staver, Stevenson, & Boynton, 1985)). It has also been documented that the peak level of light attenuation by epiphytes is below the peak level of epiphytic biomass (Brush & Nixon, 2002). Some epiphyte growth in the absence of other stressors may be acceptable whereas some epiphyte growth in conjunction with additional stressors can combine to create a degraded ecosystem. Overall, epiphyte growth is a useful as an indicator of cultural eutrophication.
2. Indicator Part 10f is a response measure that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community per Env-Wq 1703.19.

Indicator 10g: Dissolved Oxygen Percent Saturation Measure

Suggests 3-PAS: Dissolved Oxygen Percent Saturation demonstrates moderate daily/tidal swings and no, or limited, high super-saturation.

Suggests 3-PNS: Dissolved Oxygen Percent Saturation demonstrates large daily/tidal swings and instances of high super-saturation.

Notes:

1. The direct comparison of dissolved oxygen percent saturation criteria is considered in Indicator Part 10a.
2. Indicator Part 10g is a response measure that will be used to assess if there are excess nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community per Env-Wq 1703.19.
3. Indicator Part 10g shall be part of the overall weight of evidence for cultural eutrophication. Because dissolved oxygen percent saturation measures the level of productivity in a water body, it is useful as an indicator of cultural eutrophication

Indicator 10h: Eelgrass Cover Assessment Threshold

Suggests FS: Eelgrass Cover Indicator meets the methodology in Aquatic Life Use: Indicator 9

Suggests NS: Eelgrass Cover Indicator does not meet the methodology in Aquatic Life Use: Indicator 9

Notes:

1. Eelgrass (*Zostera marina*) is the base of the estuarine food web in the Great Bay estuary. Healthy eelgrass beds filter water and stabilize sediments (Short & Short, 1984) and provide habitat for fish and shellfish (Duarte, 2001) (Heck, Hays, & Orth, 2003). While eelgrass is only one species in the estuarine community, the presence of eelgrass is critical for the survival of many species. Maintenance of eelgrass habitat is considered critical in order to maintain a balanced, integrated, and adaptive community of organisms (Env-Wq 1703.19). Loss of eelgrass habitat would change the species composition of the estuary resulting in a detrimental difference in community structure and function. In particular, if eelgrass habitat is lost, the estuary will likely be colonized by macroalgae species which do not provide the same habitat functions as eelgrass (Short, Burdick, & Kaldy, 1995) (Hauxwell, Cebrian, & Valiela, 2003) (McGlathery, Sundbäck, & Anderson, 2007). Therefore, significant losses of eelgrass habitat would not meet the narrative standard for biological integrity (Env-Wq 1703.19) and create a water quality standard violation for biological integrity.
2. Indicator Part 10h is a response threshold which shall be part of the overall weight of evidence for cultural eutrophication to assess if there are excess nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community per Env-Wq 1703.19.
3. NHDES already uses measurements of biological community integrity by the eelgrass cover indicator as it relates to water quality criteria in Env-Wq 1703.19. Aquatic Life Use: Indicator 9 outlines the methodologies used to go from eelgrass cover data to an assessment of the biological community as related to the criteria in Env-Wq 1703.19.

Indicator 10i: Calculation of Total Nitrogen Concentration (TN)

There are no numeric values for Total Nitrogen that define a set breakpoint between Full-Support and Non-Support. This Indicator section is to outline the general calculation methodology used by the department to estimate the "current" concentration of TN.

Notes:

1. Data Requirements
    a The indicator shall be calculated on TN data that is five years or less in age and the median TN concentration shall be used to make the threshold comparison.
    b The median TN concentration shall be calculated from representative data that cover all four seasons of the year.
    c The minimum sample size of independent results to be considered complete for TN shall be 15 for a given waterbody.
    d Total nitrogen may be calculated from the different nitrogen species measurements according the following hierarchy. If multiple values of TN are available for the same date / time / station, the hierarchy is 1 over 2 over 3.
        i. If total dissolved nitrogen and particulate nitrogen were measured, sum these two values
        ii. If TN was measured directly, use that value.
        iii. If total Kjeldahl nitrogen and nitrate+nitrite were measured, sum these two values.
    e Multiple samples collected at a date / station combination are averaged before incorporated into the overall waterbody median.
    f If older data indicated Non Support, the more recent data used to make a Full Support decision must have been collected at the same site(s) and under similar or more limiting conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.

Indicator 10j: Final Total Nitrogen Concentration (TN) Assessment

FS / II-PAS / II-PNS / NS There are no numeric values for Total Nitrogen which define a set breakpoint between Full-Support and Non-Support. The assessment zone appropriate weight of evidence shall apply. In some cases, Insufficient Information, Potential Attaining Support or Potential Non-Support may be appropriate.

Notes:

1. Indicator Part 10j is the stressor indicator that will be used to assess if there are excess nutrients per Env-Wq 1703.14. Parts a-i will be factored into the final assessment while considering for each dataset; completeness, applicability, representativeness, frequency, magnitude, duration currentness, data quality, and other possible water quality and environmental measures. Nutrient levels may also be influenced by known reduction efforts, such as waste water

treatment plan upgrades. Other indicators beyond a-i may be factored into the final assessment as additional relevant data becomes available.

2. The growing season (May-September) TN concentration average is factored into the final assessments. While no definitive numeric criteria for TN concentration currently exists, consideration of nutrient level is based on existing studies and analysis. For example, Dr. Howes, the Director of the Coastal Systems Program in the University of Massachusetts Dartmouth, School for Marine Science and Technology (SMAST), indicated a growing season (May-Sept) average of 320-350 µg/L should be protective of that eelgrass resource in the Great Bay system (Howes, 2019). Although an interim report, the SMAST methodology (Howes, Samimy, & Dudley, 2003) remains a key element of the Massachusetts Estuary Project methods and continues to be cited by the primary author. Dr Howes and the Massachusetts Estuary Project generally use 500 µg/L as the break between "Good to Fair" and "Moderate Impairment" except is some systems where they use 400 µg/L. Here, the frequency of samples over 500 µg/L has been considered as "high".

Indicator 11: Stream Channel Stability

The maintenance of a balanced, integrated, and adaptive community of organisms described in Env-Wq 1703.19 will be limited if the existing stream channel is unstable. The requirement to restore surface waters for designated uses and maintain the physical integrity of surface waters is described in Env-Wq 1703.01(b) and Env-Wq 1703.03(c). For the purposes of assessment, the methodologies below will be used to make physical integrity assessment.

FS: Stream channel is stable. That is, the site lies within the 95 percent confidence interval (95% CI) of the hydraulic geometry curves or the site lies within the 95% CI of the reference sites.

NS: Stream channel is unstable as a result of hydromodification. That is, the site lies beyond the 95% CI of the hydraulic geometry curves or the site lies beyond the 95% CI of the reference sites.

Notes:

1. Hydraulic geometry curves will be used for streams of the type and size represented in the 2005 "Provisional Regional Hydraulic Geometry Curves for the State of New Hampshire" (Schiff, MacBroom, & Armstrong Bonin, 2007); available on the web at https://www.des.nh.gov/organization/commissioner/pip/publications/wd/documents/r-wd-06-37.pdf.
2. Reference sites will be used for streams not represented in type and size presented in the 2005 "Provisional regional hydraulic geometry curves for the State of New Hampshire" (Schiff, MacBroom, & Armstrong Bonin, 2007). For these non-represented streams, size and type reference conditions may be developed. Reference conditions shall be represented by at least three reference reaches of the same stream type, in the same region, with no more than a 10% difference in watershed area from the "altered" site in question.
3. Streams in the 2005 "Provisional regional hydraulic geometry curves for the State of New Hampshire" have watersheds ranging from 2.9 to 385 square miles, average basin slopes of 9.3 to 38.7 percent, and main channel slopes of 16.1 to 552 feet/mile.
4. Stream stability is defined as "the ability of the stream, over time, to transport the flows and sediment of its watershed in such a manner that the dimension, pattern, and profile of the river are maintained without either aggrading or degrading (Rosgen & Silvey, 1996).

5. Hydromodification[14] is defined as a change in a streams physical structure and its natural function that is associated with channelization and channel modifications due to human activity.
6. Stream channel instability is a non-pollutant; consequently, waters impaired by channel instability, will not be placed in category 5.
7. Geomorphic Assessment data shall be collected in accordance with the NHDES Stream Geomorphology QAPP or other NHDES approved methodology (i.e. VT DEC Stream Geomorphic Assessment Protocols).
8. Two of the three primary curves must fail for the geomorphology to be considered out of equilibrium. The primary three are; bankfull area, bankfull width and bankfull depth.
9. This approach will not be used to determine NS at sites solely based upon non-equilibrium under a crossing. Some non-equilibrium must also exist upstream or downstream of the crossing as a direct result of the crossing point's dis-equilibrium.

Indicator 12: Water Quality Criteria for Toxic Substances in the Ambient Water

Toxic substances can have a wide range if impacts to aquatic life, plants, and humans. The chronic and acute criteria for toxic substances are identified in Env-Wq 1703.21 and Table Env-Wq 1703.1. The chronic and acute criteria for total ammonia nitrogen in freshwater resides in Env-Wq 1703.25 and 26 and Env-Wq 1703.27 through 33 for salt waters with a range of salinities. For the purposes of assessment, the methodologies below pertain to aquatic life use support and will be used to make the greatest use of all available valid data.

FS: See criteria presented in Table 3-30.

NS: See criteria presented in Table 3-30.

Table 3-30: Use Support Matrix for Toxic Substances Grab Samples

Total Sample Size	Total # WQC Exceedences	Total # of MAGEX Exceedences	Use Support
≥ 10	< # shown Table 3-13 for the total sample size	≤1	FS
< 10	< 2	1	INSUFFICIENT INFORMATION or NOT ASSESSED
< 10	≥ 2	≥ 0	NS
≥ 10	≥ # shown Table 3-13 for the total sample size	≥ 0	
≥ 2	2	2	NS (for acute criteria only)

Notes:

1. Assessments shall be based on the most current data. Current" data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-30 and must include at least two samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.

[14] http://www.epa.gov/owow/nps/hydromod/index.htm

2. Acute and chronic Water Quality Criteria (WQC) for chemical specific toxic substances in the water column may be found in the State's surface water quality regulations (NHDES, 2016), Table 1703.1 and Env-Wq 1703.21 Acute and chronic Water Quality Criteria (WQC) for ammonia may be found in Env-Wq 1703.25 and 26 (fresh water) and Env-Wq 1703.27 through 33 (marine water).

3. Where sufficient continuous datasets exist for toxic substances found in the State's surface water quality regulations (NHDES, 2016), Env-Wq Table 1703.1, the data sets will be assessed based on the values in Env-Wq Table 1703.1, the Magnitude of Exceedence Criteria discussed in Note 4, in concert with the duration of exposure and frequency of exceedence used to derive the toxic water quality criteria as described below.

    a. For comparison to Acute Toxic Criteria, continuous datasets means samples taken at least every 15 minutes for a duration that equals or exceeds the duration that the acute criteria were derived (i.e., usually 1 hour). The average concentration of the samples taken over the duration that the acute criteria was derived shall be compared to the acute criteria to determine compliance or noncompliance.

    b. For comparison to Chronic Toxic Criteria, continuous datasets means samples taken at least every hour for a duration that equals or exceeds the duration that the chronic criteria were derived (i.e., usually 4 days). The average concentration of the samples taken over the duration that the chronic criteria was derived shall be compared to the chronic criteria to determine compliance or noncompliance.

    c. For a continuous dataset to be considered complete and comparable to the toxic criteria, samples must have been collected over a time period that encompass 95% of the exposure period that the criteria are based on (i.e., typically 1 hour for acute and 96 hours for chronic criteria).

    d. Rolling averages are calculated for all possible blocks of 1-hour (acute criteria) or 96-hours (chronic criteria). The time blocks overlap. For example, the 1-hour average value is calculated if four specific conductance measurements were made within the hour at 15 minute increments and the 96-hour average value was calculated if 365 specific conductance measurements were made with the four-day period (95% data completeness).

    e. For comparison of continuous datasets to the Frequency of Exceedence, the average of either the acute or chronic exceedences shall not exceed the frequency of exceedence used to derive the criteria (i.e., for most toxics, the frequency of exceedence is an average of no more than 1 exceedence every 3 years).

    f. Where multiple years of data exist the exceedences will be evaluated against the frequency of exceedence specified in the derivation of those standard criteria unless evidence exists indicating that conditions that would influence the toxic of concern have changed (i.e., pollution controls have been implemented and recent data indicates there are no exceedences for the toxic of concern).

4. Exceedences of the Magnitude of Exceedence Threshold (MAGEX) for chemical specific toxic substances in the water column are defined as greater than or equal to two times the acute WQC for grab samples and greater that the acute criteria for datalogger derived one hour averages.

5. While Chloride is not a core parameter for Aquatic Life Use Support it is important that decisions made on the support of the chloride criteria cover the critical periods and not allow for biased

sampling that would result in false support or non-support decisions. In cases where there are numerous non-critical season and non-critical time of day samples, the overall sample count will not be used to artificially increase the needed exceedences to exceed the 10% rule of thumb.

a. For a Full Support determination at least 50% of the minimum number of independent chloride samples needed (i.e. n≥5) for FS, shall be taken between June 1 and September 30 when base flow has the greatest likelihood of showing impacts due to long term groundwater loading and from ion exchange water softeners that rely on chloride for recharge. Samples shall not be collected during storm events (e.g., antecedent dry period of three days when rainfall does not exceed 0.25" during those three days) to avoid "false" low concentrations due to dilution

b. At least 50% of the minimum number of independent samples needed (i.e. n≥5) for FS, shall be taken during melt events (i.e., between December 1 and March 15), when the melt of "managed snow" in paved area is likely to contain the highest chloride levels.

c. Specific conductance may be used as a surrogate for chloride. It is preferred but not required to collect at least 2 chloride samples within each time period that the specific conductance to chloride relationship is to be used. These samples will be used to confirm that the site fits the statewide or regional specific conductance to chloride relationship (see regression equation and statistics below)

Statewide:

*Chloride (in mg/L) = 0.2893 * Specific Conductance (in µS/cm) – 11.7.*

95th percentile confidence limit for each prediction = +/- 28 mg/L, R^2 = 0.97.

In the event that the confirmation samples do not adequately fit the relationship a site specific relationship may be developed. Criteria for determining what adequately fits the statewide relationship and for determining a site specific relationship shall be in accordance with the April 12, 2006, NHDES Policy on the Use of the NHDES State-Wide Chloride Regression for Other Datasets available through the Watershed Management Bureau.

Five areas have been identified for site specific relationships.

1) Hodgson Brook (map below):

*Chloride (in mg/L) = 0.2721 * Specific Conductance (in µS/cm) – 24.656.*

95th percentile confidence limit for each prediction = +/- 38 mg/L, R^2 = 0.98.

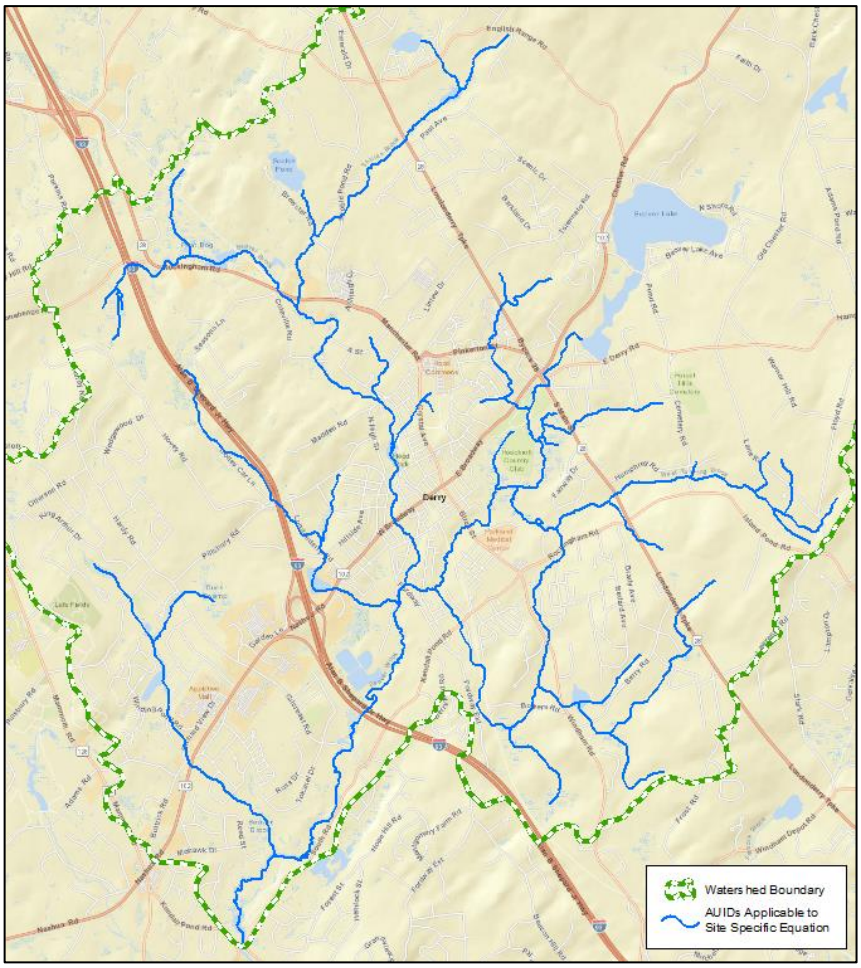
The Hodgson Brook site specific relationship applies to the following assessment units: NHRIV600031001-04, NHRIV600031001-05, NHRIV600031001-06, NHRIV600031001-09, and NHRIV600031001-10.

2) Beaver Brook (map below):

*Chloride (in mg/L) = 0.2608 * Specific Conductance (in µS/cm) – 13.604.*

95th percentile confidence limit for each prediction = +/- 8 mg/L, R^2 = 0.95.

The Beaver Brook site specific relationship applies to the following assessment units: NHIMP700061203-04, NHIMP700061203-06, NHIMP700061203-07, NHIMP700061203-08, NHIMP700061203-12, NHIMP700061203-13, NHLAK700061203-03-01, NHLAK700061203-04, NHLAK700061203-10, NHRIV700061203-09, NHRIV700061203-11, NHRIV700061203-12, NHRIV700061203-13, NHRIV700061203-14, NHRIV700061203-15, NHRIV700061203-16, NHRIV700061203-23, NHRIV700061203-24, and NHRIV700061203-45.

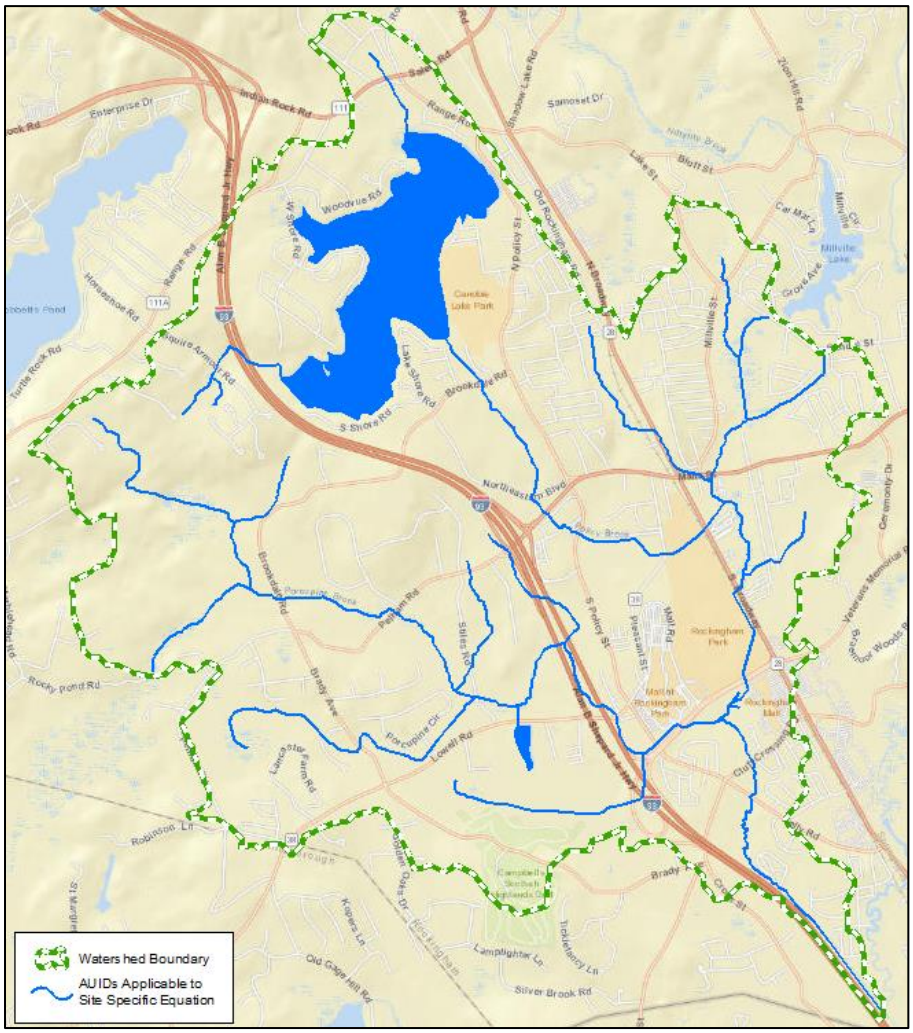


3) Policy Brook (map below):

*Chloride (in mg/L) = 0.2913 * Specific Conductance (in µS/cm) – 23.361.*

95th percentile confidence limit for each prediction = +/- 15 mg/L, R^2 = 0.98.

The Policy Brook site specific relationship applies to the following assessment units: NHIMP700061102-03, NHLAK700061102-02, NHLAK700061102-13-02, NHRIV700061102-16, NHRIV700061102-17, NHRIV700061102-18, NHRIV700061102-20, NHRIV700061102-22, and NHRIV700061102-36.

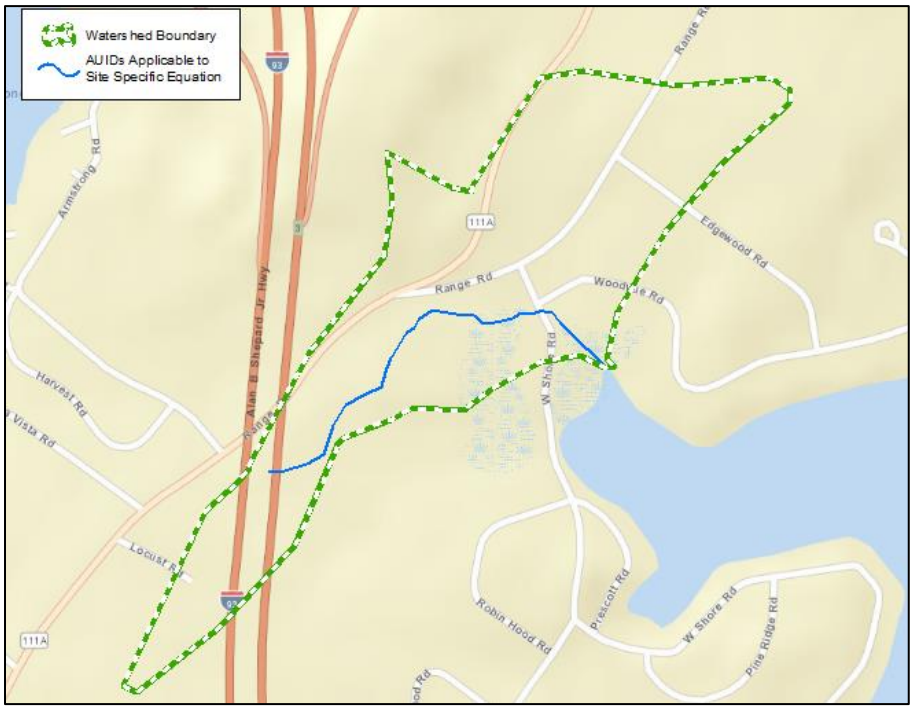


4) North Trib. to Canobie Lake (map below):

*Chloride (in mg/L) = 0.2806 * Specific Conductance (in µS/cm) – 19.748.*

95th percentile confidence limit for each prediction = +/- 24 mg/L, R^2 = 0.92.

The North Trib. to Canobie Lake site specific relationship applies to the following assessment unit: NHRIV700061102-23



5) Dinsmore Brook (map below):

*Chloride (in mg/L) = 0.1813 * Specific Conductance (in µS/cm) – 2.8338.*

95th percentile confidence limit for each prediction = +/- 34 mg/L, R^2 = 0.55.

The Dinsmore Brook site specific relationship applies to the following assessment unit: NHIMP700061204-01, NHIMP700061204-02, NHRIV700061204-01, and NHRIV700061204-13.

If no site specific samples are collected and there is no evidence to suggest that a site specific curve is needed, the statewide chloride to specific conductance curve will be used. It should be noted that the difference between natural background (5-10 mg/L) and the chloride chronic criteria of 230 mg/L is far greater than the differences between the six specific conductance to chloride equations.

The specific conductance thresholds (µS) that represent the chronic (230 mg/L) and acute (860 mg/L) chloride criteria are as follows;

Region	Chronic Indicator (µS)	Acute Indicator (µS)
State-wide	835.5	3,013.1
Hodgson Brook	935.9	3,251.2
Beaver Brook	934.1	3,349.7
Dinsmore Brook	1,284.2	4,759.1
North Trib. to Canobie Lake	890.0	3,135.2
Policy Brook	869.8	3,032.5

6. If clean techniques equivalent to USEPA Method 1669 (USEPA, 1995) were NOT used for sampling and/or analysis, WQC for determining NS & FS shall be in accordance with the criteria shown in Table 3-31 and Table 3-32 below for total and dissolved metals respectively. These

tables account for moderate levels of contamination (i.e. the Contamination Concentration) that are likely to occur when clean techniques are not implemented. The values shown are for a hardness of 20 mg/L. Information supporting these thresholds may be found in (NHDES, 2003)

7. If clean techniques equivalent to USEPA Method 1669 (USEPA, 1995) were NOT used for sampling and/or analysis, and the result indicate concentrations between the clean and non-clean criteria shown in Table 3-31 and Table 3-32 below for total and dissolved metals respectively, then that data will be considered to yield insufficient information. Under such instances, re-sampling using clean techniques is recommended.

Table 3-31: Total Metals– WQC for Determining NS without Clean Techniques

TOTAL METALS									
Metal	WQC for determining NS & FS if clean techniques are used or for determining FS if clean techniques were not used *				*Contamination Concentration*	WQC for determining impairment (NS) if clean techniques are NOT used *			
	Acute-Fresh	Chronic-Fresh	Acute-Marine	Chronic-Marine		Acute-Fresh	Chronic-Fresh	Acute-Marine	Chronic-Marine
	µg/L	µg/L	µg/L	µg/L	*µg/L*	µg/L	µg/L	µg/L	µg/L
Aluminum**	750.0	87.0	NC	NC	*20.0*	770.0	107.0	NC	NC
Antimony	9,000	1,600	NC	NC	*20.0*	9,020	1,620	NC	NC
Arsenic	340.0	150.0	69.0	36.0	*20.0*	360.0	170.0	89.0	56.0
Beryllium	130.0	5.3	NC	NC	*20.0*	150.0	25.3	NC	NC
Cadmium*	0.40	0.22	33.20	7.95	*7.46*	7.85	7.71	40.66	15.41
Chromium (Total)	595.62	39.12	11,408	NC	*19.56*	615.2	58.7	11,428	NC
Chromium +3*	482.6	23.1	10,300	NC	*13.84*	496.4	36.9	10,314	NC
Chromium +6	16.29	11.43	1,108	50.35	*5.72*	22.0	17.2	1,114	56.1
Copper*	3.07	2.36	5.78	3.73	*12.84*	15.9	15.2	18.6	16.6
Lead*	10.5	.41	220.82	8.52	*4.25*	14.8	4.7	225.1	12.8
Mercury	1.65	0.91	2.12	1.11	*17.21*	18.9	18.1	19.3	18.3
Nickel*	120.2	13.37	74.75	8.28	*4.15*	124.4	17.5	78.9	12.4
Selenium	NC	5.00	290.50	71.10	*20.0*	NC	25.0	310.5	91.1
Silver*	0.24	NC	2.24	NC	*2.24*	2.48	NC	4.48	NC
Thallium	1,400	40.0	2,130	NC	*20.0*	1,420	60.0	2,150	NC
Zinc*	30.6	30.6	95.14	85.62	*37.02*	67.7	67.7	132.2	122.6

*Values are based on a hardness of = 20 mg/L.
**See note 10 below regarding aluminum.

Table 3-32: Dissolved Metals – WQC for Determining NS without Clean Techniques

DISSOLVED METALS									
Metal	WQC for determining NS & FS if clean techniques are used or for determining FS if clean techniques were not used *				*Contamination Concentration*	WQC for determining impairment (NS) if clean techniques are NOT used *			
	Acute-Fresh	Chronic-Fresh	Acute-Marine	Chronic-Marine		Acute-Fresh	Chronic-Fresh	Acute-Marine	Chronic-Marine
	µg/L	µg/L	µg/L	µg/L	*µg/L*	µg/L	µg/L	µg/L	µg/L
Aluminum**	750.0	87.0	NC	NC	*20.0*	770.0	107.0	NC	NC
Antimony	9,000	1,600	NC	NC	*20.0*	9,020	1,620	NC	NC
Arsenic	340.0	150.0	69.0	36.0	*20.0*	360.0	170.0	89.0	56.0
Beryllium	130.0	5.3	NC	NC	*20.0*	150.0	25.3	NC	NC
Cadmium*	0.40	0.21	33.0	7.90	*7.46*	7.86	7.70	40.46	15.36
Chromium (Total)	199.07	34.81	11,400	NC	*19.56*	218.6	54.4	11,420	NC
Chromium +3*	152.49	19.84	10,300	NC	*13.84*	166.3	33.7	10,314	NC

DISSOLVED METALS									
Metal	WQC for determining NS & FS if clean techniques are used or for determining FS if clean techniques were not used *				*Contamination Concentration*	WQC for determining impairment (NS) if clean techniques are NOT used *			
	Acute-Fresh	Chronic-Fresh	Acute-Marine	Chronic-Marine		Acute-Fresh	Chronic-Fresh	Acute-Marine	Chronic-Marine
	µg/L	µg/L	µg/L	µg/L	*µg/L*	µg/L	µg/L	µg/L	µg/L
Chromium +6	16	11	1,100	50.0	*5.72*	21.7	16.7	1,106	55.7
Copper*	2.95	2.26	4.80	3.10	*12.84*	15.8	15.1	17.6	15.9
Lead*	10.8	0.42	210.0	8.10	*4.25*	15.0	4.67	214.25	12.35
Mercury	1.4	0.77	1.8	0.94	*17.21*	18.6	18.0	19.0	18.2
Nickel*	120.00	13.33	74.0	8.20	*4.15*	124.14	17.48	78.15	12.35
Selenium	NC	4.61	289.92	70.96	*20.0*	NC	24.6	309.9	91
Silver*	0.20	NC	1.9	NC	*2.24*	2.44	NC	4.14	NC
Thallium	1,400	40.0	2,130	NC	*20.0*	1,420	60.0	2,150	NC
Zinc*	30.00	30.21	90.00	81.00	*37.02*	66.99	67.23	127.02	118.02

*Values are based on a hardness of = 20 mg/L.
**See note 10 below regarding aluminum.

8. To determine if a particular sample meets water quality standards in accordance with the New Hampshire surface water quality regulations (NHDES, 2016) for hardness less than 20 mg/L, a hardness of 20 mg/L shall be used in the equations hardness-dependent metals.
9. For comparison to the USEPA report "Guidance on the Calculation of Hardness-Dependent Metals Criteria" (USEPA, 2002), the hardness-dependent metals thresholds is also calculated without the 20 mg/L minimum hardness cap. This calculated threshold is for reference and not used to determine if a particular sample meets water quality standards in accordance with the New Hampshire surface water quality regulations (NHDES, 2016). The preferred data for calculating hardness dependent toxic criteria is site/date specific hardness sampling. Where a site/date specific hardness sampling value is not available but hardness concentrations for the site on different dates are available those values shall be used to calculate the hardness dependent toxic criteria. Where no site specific hardness data is available, the 8-digit hydrologic unit code hardness median (Table 3-33) shall be used to calculate the hardness dependent toxic criteria.
10. On July 1, 2014, NHDES formally clarified to USEPA that the aluminum criteria in the NH surface water quality regulations is acid-soluble aluminum, consistent with USEPA's 1988 ambient water quality criteria document for aluminum. As such, in cases where acid-soluble aluminum was collected, those samples will be used preferentially over any co-sampled dissolved or total fraction samples.

Table 3-33: 8-Digit Hydrologic Unit Code Hardness Medians

HUC8	HUC8 Name	Median Hardness (Ca+Mg) (mg/L)
01040001	Upper Androscoggin River	11.0
01040002	Lower Androscoggin River	10.9
01060002	Saco River	7.7
01060003	Salmon Falls-Piscataqua Rivers	19.0
01070001	Pemigewasset River	7.8
01070002	Winnipesaukee River	22.2

HUC8	HUC8 Name	Median Hardness (Ca+Mg) (mg/L)
01070003	Contoocook River	13.0
01070004	Nashua River	35.0
01070006	Merrimack River	14.3
01080101	Upper Connecticut River	20.0
01080103	Connecticut -Johns River to Waits River	19.0
01080104	Connecticut River -Waits River to White River	35.8
01080106	Connecticut –White River to Bellows Falls	22.3
01080107	Connecticut-Bellow Falls to Vernon Dam	18.4
01080201	Connecticut -Ashuelot River - Vernon Dam to Millers River	16.0
01080202	Connecticut River -Millers River	6.9

Indicator 13: Toxicity Tests of the Ambient Water

Surface waters shall be free from toxic substances or chemical constituents in concentrations or combinations that injure or are inimical to plants, animals, humans or aquatic life (Env-Wq 1703.21(a)(1)). Toxicity tests conducted with organisms in the ambient water are a direct measure of whether the water supports a balanced, integrated, and adaptive community of organisms described in Env-Wq 1703.19. Such toxicity tests integrate the combined effect of multiple toxic substances. For the purposes of assessment, the methodologies below will be used to identify which benthic communities are, or are not, meeting Env-Wq 1703.21(a).

FS: See criteria presented in Table 3-34.

NS: See criteria presented in Table 3-34.

Table 3-34: Use Support Matrix for Toxicity Tests

Total Sample Size	Total # Acute and/or chronic toxicity tests indicating toxicity	Use Support
$\geq$ 10	< # shown in Table 3-13 for the total sample size	FS
< 10	< 2	INSUFFICIENT INFORMATION or NOT ASSESSED
< 10	$\geq$ 2	NS
$\geq$ 10	$\geq$ # shown in Table 3-13 for the total sample size	
$\geq$ 2	2	NS (for acute criteria only)

Notes:

1. Assessments shall be based on the most current data. “Current” data shall be as described in section 3.1.10. If, however, older data was used in a NS decision, the more recent data used to make a FS decision must meet the requirements in Table 3-34 and must include at least two

samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedences occurred.

2. Acute and chronic toxicity tests shall be in accordance with the USEPA protocols.
3. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 14: Sediment Quality

Sediments in surface waters are habitat for many forms of aquatic life. This bottom-dwelling aquatic life is intimately linked via nutrient and energy exchange to additional ecological resources including finfish, shellfish, birds and other wildlife associated with surface water ecosystems. Env-Wq 1703.19 Biological and Aquatic Community Integrity and Env-Wq 1703.21 Water Quality Criteria for Toxic Substances are applicable to sediment chemistry and biology. In addition, Env-Wq 1703.08 Benthic Deposits applies to sediments and refers to the physical, chemical, and biological nature of these substrates. For the purposes of assessment, the methodologies below will be used to identify which benthic sediments are, or are not, meeting water quality standards.

FS: See indicator thresholds presented in Table 3-35.

NS: See indicator thresholds presented in Table 3-35.

Table 3-35: Use Support Matrix for Sediment Quality

Sediment Chemistry		Sediment Toxicity Bioassays		Sediment Biological Community Survey	
Sediment Chemistry Sample Size	Number of samples that are "high priority" (e.g., one or more HQ-TEC>1)?	Bioassay Sample Size within 2 years of sampling	Number of bioassay samples that fail the toxicity test (i.e., acute or chronic impacts of >20%)	Do benthic biological survey results within 2 years of bioassays indicate impairment as compared to a reference site(s)?	Assessment determination
≥2	0	Not assessed	Not measured	Not assessed	FS
≥2	1	Not assessed	Not measured	Not assessed	II
≥2	1	1	0	Not assessed	FS
≥2	1	1	1	Not assessed	II
≥2	1	≥2	1	Not assessed	FS
≥2	≥2	Not assessed	Not measured	Not assessed	NS
≥2	≥2	≥2	≤1	No	FS-WOE**
≥2	≥2	≥2	≥2	No	NS-WOE**
≥2	≥2	≥2	≤1	Yes	NS-WOE**
≥2	≥2	≥2	≥2	Yes or not assessed	NS
1	1	Not assessed	Not measured	Not assessed	II
1	1	Not assessed	Not measured	Yes	NS-WOE**
1	1	1	1	Not assessed	II
1	1	≥2	≥2	No	FS-WOE**
1	1	≥2	≥2	Yes	NS-WOE**
1	1	≥2	≥2	Not assessed	NS

*Hazard Quotient-Threshold Effect Concentrations (HQ-TEC) = Contaminant Concentration / TEC Concentration
**WOE stands for Weight of Evidence - see Note 3.

Notes:

1. Use support indicator thresholds shown in Table 3-30 are based on the sediment quality triad approach (NHDES, 2005).
2. The Hazard Quotient-Threshold Effect Concentrations (HQ-TEC) applied to a sample that is analyzed for multiple parameters is the highest Hazard Quotient of individual parameters.
3. Impairment determinations in Table 3-35 with a trailing "WOE" indicate that the determination will be made based on the weight of evidence provided by the sediment chemistry, sediment toxicity, and benthic community data. The assessment determination listed for each of these rows is the likely determination but it can be changed to another if the weight of evidence indicates otherwise. This flexibility was added to allow the analyst to account for inappropriate toxicity tests, inconclusive benthic community tests, extremely high sediment chemistry concentrations, and other factors that would affect the impairment determination.
4. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 15: Exotic Macrophytes

Exotic macrophytes are non-native, fast-growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Examples of exotic macrophytes include variable milfoil (*Myriophyllum heterophyllum*), Eurasian milfoil (*Myriophyllum spicatum*), fanwort (*Cabomba caroliniana*) and water chestnut (*Trapa natans*). Such infestations are in violation of Env-Wq 1703.19, which states that surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity and functional organization comparable to that of similar natural habitats of a region. For the purposes of assessment, the methodologies below will be used to identify which surface waters are, or are not, meeting the biological integrity criteria due to exotic macrophytes.

FS: There are no known communities of exotic macrophytes present in the surface water.

NS: Exotic macrophytes are present in the surface water.

Notes:

1. Exotic macrophytes are non-native, fast growing aquatic plants, which can quickly dominate and choke out native aquatic plant growth in the surface water. Examples of exotic macrophytes include variable milfoil (*Myriophyllum heterophyllum*), Eurasian milfoil (Myriophyllum spicatum), fanwort (*Cabomba caroliniana*) and water chestnut (*Trapa natans*). Such infestations are in violation of Env-Wq 1703.19, which states that surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
2. As discussed in section 3.1.6, exotic macrophytes are considered nonpollutants. Consequently, waters impaired by exotic macrophytes will not be placed in Category 5.

Indicator 16: Flow (General)

Without adequate flow there is no way to maintain a balanced, integrated and adaptive community of organisms having a species composition, diversity and functional organization comparable to that of similar natural habitats of a region (Env-Wq 1703.19). Flows must be

maintained at adequate levels to protect existing and designated uses for surface waters (Env-Wq 1703.01(d)). For the purposes of assessment, the methodologies below will be used to identify which surface water have, or do not have, adequate flow.

FS: There is no documented evidence that non-naturally occurring flows were less than the Aquatic Base Flow (ABF), or less than minimum flow requirements established by NHDES through the Section 401 Water Quality Certification Program over the past two years.

NS: There is documented evidence that there have been 2 or more instances over the last two years where, of non-naturally occurring flows that were less than the ABF or less than minimum flow requirements established by NHDES through the Section 401 Water Quality Certification Program.

Notes:

1. Determination of the Aquatic Base Flow shall be in accordance with the US Fish and Wildlife Service "Interim Policy for New England Streams Flow Recommendations" (USFWS, May 1981).
2. Section 401 Water Quality Certifications must be obtained from NHDES for any project requiring a federal permit or license. This includes most wetland dredge or fill projects as well as Federal Energy Regulatory Commission (FERC) projects (i.e., hydropower projects). As part of this process, NHDES has the obligation to establish conditions to ensure that the construction and operation of the project will not result in violations of water quality standards. This includes establishment of flow conditions where necessary to ensure that aquatic life is not adversely impacted.
3. As discussed in section 3.1.6 and 3.1.24, flow is considered a nonpollutant; consequently waters impaired by flow, will not be placed in Category 5.

Indicator 17: Benthic Deposits

Sediments in surface waters are habitat for many forms of aquatic life. This bottom-dwelling aquatic life is intimately linked to additional ecological resources including finfish, shellfish, birds and other wildlife associated with surface water ecosystems. Excessive deposition of sediments results in an unhealthy biological community in a constant state of recovery and some benthic deposits can be toxic to aquatic organism. Env-Wq 1703.19 Biological and Aquatic Community Integrity and Env-Wq 1703.08 Benthic Deposits applies to sediments and refers to the physical, chemical, and biological nature of these substrates. For the purposes of assessment, the methodologies below will be used to identify which benthic sediments are, or are not, meeting water quality standards.

FS: Benthic deposits are not present in amounts sufficient to have a significant detrimental effect on the benthic community, other than those that are naturally occurring.

NS: Significant benthic deposits exist which are causing an obvious detrimental impact to the benthic community and, are not naturally occurring.

Notes:

1. Examples of NS for this indicator include major sediment deposits resulting from significant erosion and major iron hydroxide deposits due to increased iron levels in groundwater from landfills or other fill activities.
2. See section 3.1.24 for determining waters that should be placed in Category 5.

3.2.4.2 Screening Assessment Indicators

Indicator 18: Exotic Algae – Didymo

Exotic algae are non-native, fast-growing aquatic plants, which can quickly dominate and choke out other flora and fauna in the surface water. *Didymosphenia geminata* (also known as "Didymo" or "rock snot") is an example of one possible exotic alga. Such infestations could be in violation of Env-Wq 1703.19, which states that surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region. New research indicates that Didymo is in fact likely a native species that under certain conditions may result in what we consider a bloom. For the purposes of assessment, the methodologies below will be used to identify which surface water may, or may not, be meeting the biological integrity criteria due to the exotic macroalgae – didymo.

II-PAS: There are no known communities of exotic algae present in the surface water.

II-PNS: Exotic algae are present in the surface water.

Notes:

1. Exotic algae are non-native, fast-growing aquatic plants, which can quickly dominate and choke out other native flora and fauna in the surface water. *Didymosphenia geminata* (also known as "Didymo" or "rock snot") is an example of one such possible exotic algae. Such infestations could be a violation of Env-Wq 1703.19, which states that surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region.
2. In the summer of 2007, NHDES issued an alert about an invasive algae "*Didymosphenia geminata*" also known as "rock snot" or "Didymo." The algae had been found in the northern reaches of the Connecticut River as well as in the White River near Bethel, Vermont. Beyond New Hampshire, other similar blooms had been documented in rivers in Western Canada, Norway, New Zealand, and in other parts of the United States.

   Didymo is a freshwater species of diatom, which has the potential to "bloom" and form dense matted carpets of fibrous growths on the rocks linking stream and river beds. Not only does such a bloom detract from the aesthetics of a river, but it can cause physical, biological, and chemical changes in the river, ultimately impacting the aquatic food web.

   Recent research by Dr. Max Bothwell (Bothwell, Taylor, & Kilroy, 2014) suggests that the previous assumptions about Didymo and its spread may be incorrect. Employed by Environment Canada in British Columbia, Dr. Bothwell has extensively studied Didymo since its appearance in British Columbia in 1989, and he has collaborated with New Zealand researchers on cutting edge science related to this species. His new data refute the notion that Didymo is a non-native,

invasive species, based on data from sediment cores showing the presence of Didymo as far back as 10,000 years in some areas. Dr. Bothwell's data show that these Didymo fossil records exist globally, and that in New Zealand and Western Canada, Didymo was present in streams in low number well before blooms of this species were documented. In his newest publication, Bothwell argues that blooms are caused by changes in environmental conditions, specifically by reduced levels of available phosphorus in streams.

Bothwell's hypothesis is that Didymo may be present in normal algal communities in a stream when phosphorus is above a certain threshold, but when phosphorus concentrations dip unusually low, the alga can trigger stalk production resulting in what we consider a bloom.

While the status of Didymo have changed from that of an invasive species to one of a probable native species responding to changes in environmental conditions, the risk of spread of other potentially problematic aquatic species has not changed.

For this reporting cycle, waterbodies with no known communities of exotic algae present in the surface water have been assessed as Insufficient Information – Potentially Attaining Standards (3-PAS) and waterbodies that have exotic algae present in the surface water have been assessed Insufficient Information – Potentially Not Attaining Standards (3-PNS).

Indicator 19: Alkalinity

Alkalinity describes the ability of a solution to resist changes in pH by neutralizing the acidic input. Higher alkalinity waters have a greater resistance to pH suppression. Table Env-Wq 1703.1 provides alkalinity criteria. For the purposes of assessment, the methodologies below will be used to identify which surface water may, or may not, have sufficient alkalinity.

II-PAS: Waterbodies with one or more alkalinity $\geq$ 20 mg/L.

II-PNS: Waterbodies where all measured alkalinity is < 20 mg/L.

Notes:

1. The Red Book (USEPA, 1976) states that, "...the National Technical Advisory Committee (NTAC, 1968) recommended a minimum alkalinity of 20 mg/L and the subsequent NAS Report (1974) recommended that natural alkalinity not be reduced by more than 25 percent but did not place an absolute minimum value for it. The use of the 25 percent reduction avoids the problem of establishing standards on waters where natural alkalinity is at or below 20 mg/L. For such waters, alkalinity should not be further reduced." Given the geologic setting of New Hampshire the expectation is for low alkalinity. However, the state has also undergone a prolonged period of anthropogenic derived acid deposition. At this time, we have no process for differentiating between natural alkalinity and alkalinity resulting from anthropogenic impacts. For this reporting cycle, waterbodies with one or more alkalinity $\geq$ 20 mg/L have been assessed as Insufficient Information - Potentially Attaining Standards (3-PAS) and waterbodies where all measured alkalinity is < 20 mg/L have been assessed Insufficient Information - Potentially Not Attaining Standards (3-PNS).

Indicator 20: Turbidity

Turbidity is a measure of the cloudiness, or lack of clarity of water, caused by the scattering or absorption of light by sediment, algae, or other particulates suspended in water. Chronic and high levels of turbidity can impair designated uses such as aquatic life. Env-Wq 1703.03(c)(1)c provides general statements requiring turbidity not be so high as to render a surface water unsuitable for its designated uses. Further, Env-Wq 1703.11 states that Class A waters shall

have only natural levels of turbidity and Class B waters shall only have turbidity not more than 10 NTU over naturally occurring conditions. As the naturally occurring condition is often not readily available in the assessment process most of the methodologies below will be used to identify which surface water may, or may not have, adequately low turbidity.

II-PAS: Waterbodies with all measured turbidity < 10 NTU above the monthly reference value for the waterbody type.

II-PNS: Waterbodies where one or more turbidity is > 10 NTU above the monthly reference value for the waterbody type.

Notes:

1. In cases where site specific studies bracket and identify specific turbidity sources which cause exceedences of Env-Wq 1703.11, the results of those studies will override the process described in this indicator and may result in either full support or non-support determinations.
2. Monthly reference values have been calculated for River, Lake, and Impoundment waterbody types.
3. Reference value is based on the average of the upper 75th percentile for all reference waterbodies and the lower 25th percentile for all waterbodies within a given waterbody type.
4. Reference stations were those where the average specific conductance was below 50 µS.

	Average Reference Turbidity NTU		
Month	**River**	**Lake**	**Impoundment**
January	0.602	0.626	0.614
February	1.029	0.360	0.694
March	1.039	0.600	0.819
April	0.834	0.912	0.873
May	0.776	0.985	0.881
June	0.875	0.855	0.865
July	0.831	0.855	0.843
August	0.813	0.889	0.851
September	0.800	0.990	0.895
October	0.700	0.863	0.781
November	0.600	0.550	0.575
December	0.395	0.650	0.523

5. At this time, we have no automated process for differentiating between natural turbidity and turbidity resulting from anthropogenic impacts. For this reporting cycle, waterbodies with one or more turbidity > 10 NTU above the monthly reference value for the waterbody type have been assessed as Insufficient Information - Potentially Not-Attaining Standards (3-PNS) and waterbodies where all measured turbidity is < 10 NTU above the monthly reference value for the waterbody type have been assessed Insufficient Information - Potentially Attaining Standards (3-PAS).
6. Sites with routine Insufficient Information – Potentially Not Attaining Standards (3-PNS) assessments should be investigated.

Indicator 21: Total Phosphorus (Rivers & Riverine Impoundments)

The acceptable levels of nutrients in surface waters are governed by Administrative Rule Env-Wq 1703.14, which requires that there be a natural level of nutrients in Class A waters or no nutrients in such quantities as to impair any designated uses in Class B waters. Therefore, assessments to determine compliance with Env-Wq 1703.14 (NHDES, 2016) need to consider both indicators of nutrients and nutrient-related impairments. In freshwater rivers, the current indicators for nutrient levels are benthic algae, macrophytes, chlorophyll-a, dissolved oxygen, and total phosphorus concentrations because phosphorus is the limiting nutrient in freshwaters.

In order to assess compliance with Env-Wq 1703.14 (NHDES, 2016) for the freshwater rivers and riverine impoundments, the indicator of nutrients and nutrient-related impact indicator are considered together. The response indicators at this time include dissolved oxygen and algae. The stressor indicator is total phosphorus concentrations, because phosphorus is the limiting nutrient in freshwater systems. The steps used for this assessment process are discussed in detail in the following sections.

II-PAS: Median total phosphorus is below 50 µg/L and there are no dissolved oxygen impairments.

II-PNS: Median total phosphorus is above 50 µg/L or there are dissolved oxygen impairments.

Notes:

1. It is not the intent of this indicator to assess a surface water as impaired for an infrequent or minor occurrences of elevated total phosphorus. Rather this indicator is intended to address more significant and/or chronically elevated total phosphorus.
2. This indicator can be used to assess waters as insufficient information potentially attaining or potentially not attaining the narrative water quality criteria regarding nutrients per Env-Wq 1703.14 to maintain a balanced, integrated, and adaptive community described in Env-Wq 1703.19.
3. Factors that shall be considered in the assessment determination:
    a. The frequency and duration of documented filamentous algae blooms in the last ten years.
    b. The frequency and duration of documented macrophyte community growth in flowing waters in the last 10 years.
    c. The total phosphorus concentration in the waterbody.
    d. The chlorophyll-a concentration distribution in the waterbody.
    e. The frequency of dissolved oxygen criteria exceedences.
    f. The frequency of dissolved oxygen supersaturating events.
    g. The condition of the macroinvertebrate community.
    h. The extent of macrophytes and or benthic algae coverage.
    i. The water clarity.
    j. Could the conditions be purely due to natural causes.
4. Data Requirements

a. Evaluations of the total phosphorus concentration used in assessments shall be based on data collected between May 24th to September 15th that is five years or less in age and the median value of that data is used to make the indicator comparison.
b. If there is more than one result in an assessment unit on the same date, those values are averaged before incorporation into the assessment unit median.
c. Median calculations must have five or more independent sampling dates on a given waterbody to be considered for insufficient information potentially attaining or potentially not attaining designations.
d. Samples shall represent the open water condition of the waterbody.

5. This indicator is intended to apply only to impoundments that are riverine in character. Impoundments that have had trophic surveys conducted will be addressed for total phosphorus under Indicator 8.
6. Triggers for insufficient information potentially not attaining designations will include;
    a. Total phosphorus median in excess of 50 µg/L.
    b. Dissolved oxygen concentration impairment.
    c. Dissolved oxygen percent saturation impairment.
    d. Benthic macroinvertebrate community that fails to meet the applicable B-IBI.
    e. Documentation of excessive macrophytes/filamentous algae.

Indicator 22: Other Exotic Aquatic Species

Exotic species are non-native organisms that have a tendency to spread to a degree which can cause ecological damage to the environment. Such infestations could be in violation of Env-Wq 1703.19, which states that surface waters shall support and maintain a balanced, integrated, and adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of similar natural habitats of a region. *Corbicula fluminea* (also known as “Asian clam”) and *Clinostomus funduloides* (also known as “Rosyside Dace”) are two examples of exotic species that have been identified in New Hampshire waterbodies. For the purposes of assessment, the methodologies below will be used to identify which surface water may, or may not, be meeting the biological integrity criteria due to the exotic aquatic species.

II-PAS: There are no known communities of exotic species present in the surface water.

II-PNS: Exotic species are present in the surface water.

3.2.5 Use: Potential Drinking Water Supply

Definition: Waters that could be suitable for human intake and meet state and federal drinking water requirements after adequate treatment.

Applicability: All surface waters

Core Indicator(s): Treatment technologies exist to produce safe drinking water.

Assessment Criteria: The following criteria are in addition to the general assessment and listing criteria provided in Section 3.1.

Indicator 1: Waters May be Treated to Allow for Compliance with Safe Drinking Water Act (SDWA) Standards in the Finished Drinking Water

Both Class A and Class B waters shall be considered potentially acceptable for water supply uses after adequate treatment (RSA 485-A:8 I & II). As no definition of "adequate" exists in RSA 485-A:8 or Env-Wq 1700, everything is considered treatable for assessment purposes.

FS: Treatment methods exist that will produce compliance (as defined by USEPA) with the Safe Drinking Water Act (SDWA) standards in the finished drinking water.

NS: No treatment methods exist that will produce compliance (as defined by USEPA) with the Safe Drinking Water Act (SDWA) standards in the finished drinking water.

Indicator 2: Water Quality Criteria for Toxic Substances in the Ambient Water

Both Class A and Class B waters shall be considered potentially acceptable for water supply uses after adequate treatment. (RSA 485-A:8 I & II). As no definition of adequate exists in RSA 485-A:8 or Env-Wq 1700, everything is considered treatable for assessment purposes. However, toxic substances in drinking water pose a human health risk and early detection in the source water rather than treatment within a water supply facility provides an added level watershed management opportunities and thereby safety. Three indicators of source water criteria exist that will be used in the assessments as screening values; 1) Human Health Criteria for Water and Fish Ingestion water quality criteria in Table Env-Wq 1703.1, 2) Maximum Contaminant Levels (MCLs) in public drinking water supplies (Env-Dw 702 - Env-706 MCLs and MCLGs), and 3) Ambient Groundwater Quality Standards (Env-Or 603.03). For the purposes of assessment, the methodologies below will be used to identify parameters which may, or may not, be meeting water quality standards pre-treatment for water supplies.

II-PAS: See criteria presented in Table 3-36.

II-PNS: See criteria presented in Table 3-36.

Table 3-36: Drinking Water Use Support Matrix for Toxic Substances in Grab Samples

Total Sample Size	Total # WQC Exceedences	Use Support
No assessment methodology yet established to determine Full Support		FULLY SUPPORTING

Total Sample Size	Total # WQC Exceedences	Use Support
> 1	0	INSUFFICIENT INFORMATION-POTENTIALLY ATTAINING STANDARDS (II-PAS)
>1	> 0	INSUFFICIENT INFORMATION-POTENTIALLY NOT SUPPORTING STANDARDS (II-PNS)
No assessment methodology yet established to determine Non Support		NOT SUPPORTING

Notes:

1. Potential attainment or potential nonsupport assessments shall be based on exceedences of any one of the following criteria: Human Health Criteria for Water and Fish Ingestion water quality criteria in Table Env-Wq 1703.1, Maximum Contaminant Levels (MCLs) in public drinking water supplies (Env-Dw 702 - Env-706) and/or Ambient Groundwater Quality Standards (Env-Or 603.03)
2. Human Health for Fish Consumption Only Water Quality Criteria are to protect against long-term (chronic) human health effects. For carcinogens a 70-year time period of exposure is typically considered. For other pollutants some developmental, age-specific, and gender specific factors are included.
3. The Maximum Contaminant Levels (MCLs) of the rules in Env-Dw 702 - Env-706 establish maximum contaminant levels (MCLs) for radiological, microbiological, organic, and inorganic contaminants in public drinking water supplies to protect human health.
4. The Ambient Groundwater Quality Standards (AGQS) in Env-Or 603.03 set procedures and requirements for the investigation, management, and remediation of contamination from the discharge of regulated contaminants that adversely affect human health or the environment resulting from human operations or activities.
5. Due to complexity of the criteria the evaluation of Protection of Human Health for Fish Consumption Only Water Quality Criteria, Maximum Contaminant Levels, and Ambient Groundwater Quality Standards in the 305(b) is not intended to replace the detail risk assessments performed by the NHDES Environmental Health Program. Rather, these evaluations are intended to help inform that program by evaluating the diverse datasets that go into the 305(b) and possibly reveal state-wide patterns in need of more detailed analysis.
6. Protection of Human Health for Fish Consumption Water Quality Criteria (WQC) for chemical specific toxic substances in the water column can be found in the State's surface water quality regulations (NHDES, 2016), Table 1703.1 and Env-Wq 1703.21.
7. The Maximum Contaminant Levels (MCLs) for chemical specific toxic substances in water can be found in Env-Dw 705.
8. The Ambient Groundwater Quality Standards (AGQS) for chemical specific toxic substances in water can be found in Env-Or 603.03.
9. Assessments shall be based on the most current data. "Current" data shall be as described in section 3.1.10. If, however, older data was used in a PNS decision, the more recent data used to make a PAS decision must meet the requirements in Table 3-36 and must include at least two samples collected at the same site(s) and under similar or more water quality limited conditions (e.g. wet weather, dry weather, season, etc.) as when the older exceedences occurred.

10. Assessments of PNS shall not be made based upon values below the analytical detection limits as described in Section 3.1.11.

3.2.6 Use: Fish Consumption

Definition: Waters that can support a population of fish free from toxicants and pathogens that could pose a human health risk to consumers.

Applicability: All surface waters

Core Indicator(s):

Fresh waters:	Fish Consumption Advisories based on health risk analyses to determine if advisories are necessary due to mercury in fish tissue.
Tidal waters:	Fish Consumption Advisories based on health risk analyses to determine if fish consumption advisories are necessary due to mercury and polychlorinated biphenyls (PCBs) in fish tissue.

Assessment Criteria: The following criteria are in addition to the general assessment and listing criteria provided in Section 3.1.

Indicator 1: Fish Consumption Advisories Due to Toxics

Toxic substances are taken up and may accumulate in aquatic organisms. Env-Wq 1703.21(a)(2) specifies that surface waters be free from toxic substances or chemical constituents in concentrations or combinations that persist in the environment or accumulate in aquatic organisms to levels that result in harmful concentrations in edible portions of fish, shellfish, or other aquatic life. The NHDES Environmental Health Program performs detailed fish consumption assessments and where warranted publishes fish consumption advisories. For assessment purposes, these published advisories qualify as indicators that the criteria in Env-Wq 1703.21(a)(2) are not being met.

FS: No fish "restricted consumption" or "no consumption" advisories or bans are in effect.

NS: "Restricted consumption" or "no consumption" advisories or bans for fish are in effect.

Notes:

1. Fish consumption advisories are issued by the NHDES Environmental Health Program. The advisories are based on risk assessments to determine if any portion of the human population would be at risk eating fish due to pollutant concentrations in fish tissue. A summary of fish consumption advisories in NH is available on the web[15].
2. All waters with fish consumption advisories or bans due to pollutants that do not need a TMDL for reasons discussed in section 3.1.24 shall not be placed in category 5 for that particular pollutant. For this assessment, this applies to the fish consumption advisory on the Androscoggin River due to dioxin. The primary source of dioxin was from a paper mill in Berlin. In 1994, the mill changed its bleaching process to a much cleaner, elemental chlorine free process. As a result, dioxin measurements have dropped below minimum detection levels and

[15] https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/ard-ehp-25.pdf

fish tissue concentrations have declined. Since the source has been essentially eliminated, a TMDL is not needed for this situation.

3. For this cycle, all surface waters in New Hampshire are considered impaired primarily as a result of the statewide fish consumption advisory for mercury in fresh waters and for mercury and polychlorinated biphenyls (PCB) in tidal waters. For regionally generated pollutants such as mercury, PCBs and dioxins (in some cases), which are beyond the ability of the State to control, it is recommended that USEPA take the lead in conducting the TMDLs.
4. In 2007, USEPA approved the Northeast Regional Mercury TMDL prepared by the Northeast States and the New England Interstate Water Pollution Control Commission (NEIWPCC, 2007). This TMDL addresses all fresh surface waters in NH that are impaired for the fish consumption use primarily due to atmospheric deposition of mercury. Consequently, all fresh waters are impaired for fish consumption due to mercury where atmospheric deposition is the primary source of mercury are on Category 4A as the TMDL has been completed.

Indicator 2: Water Quality Criteria for Toxic Substances in the Ambient Water

Toxic substances are taken up by, and may accumulate in, aquatic organisms. Waters with toxic substances in the water column in sufficient quantities to be toxic to humans by fish consumption may be compared to the values in Table Env-Wq 1703.1. However, the criteria in Table Env-Wq 1703.1 are to protect against long-term (chronic) human health effects while factoring in some developmental, age, and gender specifics. As such, due to complexity of the criteria, the evaluation of Protection of Human Health for Fish Consumption Only in the assessment process is not intended to replace the detailed risk assessments performed by the NHDES Environmental Health Program. Rather, these evaluations are intended to help inform that program by evaluating the diverse datasets used in the 305(b) report and possibly reveal state-wide patterns in need of more detailed analysis. For the purposes of assessment, the methodologies below will be used to identify which surface waters and toxics may, or may not, be meeting the fish consumption water quality standards.

II-PAS: See criteria presented in Table 3-37.

II-PNS: See criteria presented in Table 3-37.

Table 3-37: Fish Consumption Use Support Matrix for Toxic Substances in Grab Samples

Total Sample Size	Total # WQC Exceedences	Use Support
No assessment methodology yet established to determine Full Support		FULLY SUPPORTING
> 1	0	INSUFFICIENT INFORMATION-POTENTIALLY ATTAINING STANDARDS (II-PAS)
>1	> 0	INSUFFICIENT INFORMATION-POTENTIAALLY NOT SUPPORTING STANDARDS (II-PNS)
No assessment methodology yet established to determine Non Support		NOT SUPPORTING

Notes:

1. Human Health for Fish Consumption Only Water Quality Criteria are to protect against long-term (chronic) human health effects. For carcinogens a 70-year time period of exposure is typically considered. For other pollutants, developmental, age, and gender specific factors are included. Due to complexity of the criteria the evaluation of Protection of Human Health for Fish Consumption Only Water Quality Criteria in the 305(b) is not intended to replace the detail risk assessments performed by the NHDES Environmental Health Program. Rather, these evaluations are intended to help inform that program by evaluating the diverse datasets that go into the 305(b) and possibly reveal state-wide patterns in need of more detailed analysis.
2. Assessments shall be based on the most current data. “Current” data shall be as described in section 3.1.10. If, however, older data was used in a PNS decision, the more recent data used to make a PAS decision must meet the requirements in Table 3-37 and must include at least 2 samples collected at the same site(s) and under similar or more water quality limited conditions (i.e., wet weather, dry weather, season, etc.) as when the older exceedence occurred.
3. Protection of Human Health for Fish Consumption Water Quality Criteria (WQC) for chemical specific toxic substances in the water column may be found in the State’s surface water quality regulations (NHDES, 2016), Table 1703.1 and Env-Wq 1703.21.
4. Assessments of PNS shall not be made based upon values below the analytical detection limits as described in Section 3.1.11.

3.2.7 Use: Shellfish Consumption

Definition: Waters that can support a population of shellfish free from toxicants and pathogens that could pose a human health risk to consumers.

Applicability: All tidal surface waters.

Core Indicator(s): Classification of shellfish waters based on fecal coliform concentrations (pathogens) in the water column in accordance with the National Shellfish Sanitation Program (NSSP).

Shellfish Consumption Advisories based on health risk analyses to determine if shellfish consumption advisories are necessary due to mercury and polychlorinated biphenyls (PCBs) in fish tissue.

Assessment Criteria: The following criteria are in addition to the general assessment and listing criteria provided in Section 3.1.

Indicator 1: NSSP Classifications Based on Fecal Coliform Concentrations (Pathogens) in the Water Column.

Consumption of shellfish with elevated fecal coliform bacteria poses a direct public health risk. RSA 485-A:8, V. states that, "Those tidal waters used for growing or taking of shellfish for human consumption shall, …, be in accordance with the criteria recommended under the National Shellfish Program Manual of Operation, United States Department of Food and Drug Administration." For the purposes of assessment, the NHDES Shellfish Program NSSP classifications shall be used to assign a designated use support for shellfishing.

FS: The surface water is classified as "approved" based on fecal coliform violations measured and assessed in accordance with the NSSP criteria**.**

NS: The surface water is not classified as "approved" based on fecal coliform violations measured and assessed in accordance with the NSSP criteria.

Notes:

1. The NHDES Shellfish Program is responsible for implementing the NSSP program and for determining NSSP classifications.
2. Shellfish areas lacking sufficient fecal coliform data to classify them in accordance with NSSP criteria shall be assigned an attainment status of "insufficient information" (e.g. shellfish areas closed for administrative reasons such as lack of a current sanitary survey).

NSSP Classification	NHDES Sub-Class	305(b)/303(d) Category
Prohibited	N/A	5-P (4A-P when TMDL completed)
Restricted	N/A	5-P (4A-P when TMDL completed)
Conditionally Restricted	N/A	5-M (4A-M when TMDL completed)
Conditionally Approved	N/A	5-M (4A-M when TMDL completed)
Prohibited	Prohibited/Safety Zone	3-PNS
Prohibited	Prohibited/Unclassified	3-ND
Approved	N/A	2-G

3. See section 3.1.24 for determining waters that should be placed in Category 5.

Indicator 2: Shellfish Consumption Advisories Due to Toxics

Toxic substances are taken up by, and may accumulate in, aquatic organisms. Env-Wq 1703.21(a)(2) specifies that surface waters be free from toxic substances or chemical constituents in concentrations or combinations that persist in the environment or accumulate in aquatic organisms to levels that result in harmful concentrations in edible portions of fish, shellfish, or other aquatic life. The NHDES Environmental Health Program performs detailed consumption assessments and where warranted publishes consumption advisories. For assessment purposes, these published advisories qualify as indicators that the criteria in Env-Wq 1703.21(a)(2) are not being met.

FS: There are no "restricted consumption" or "no consumption" advisories or bans for shellfish in effect.

NS: "Restricted consumption" or "no consumption" advisories or bans for shellfish are in effect.

Notes:

1. Shellfish consumption advisories are issued by the NHDES Environmental Health Program. The advisories are based on risk assessments to determine if any portion of the human population would be at risk eating shellfish due to toxics in shellfish tissue. A summary of fish consumption advisories in NH is available on the web[16].
2. All waters with shellfish consumption advisories or bans shall be listed as impaired and either placed in Category 4B or 5 depending on the status of efforts to reduce shellfish tissue pollutant concentrations to levels that do not warrant an advisory.
3. For this cycle, all tidal waters in New Hampshire were placed in Category 5 primarily as a result of the shellfish consumption advisory for mercury and polychlorinated biphenyls (PCB) and dioxins. For regionally generated pollutants such as mercury, PCBs and dioxins (in some cases) which are beyond the ability of the State to control, it is recommended that USEPA take the lead in conducting the TMDLs.
4. Red Tide is a natural algae present in the offshore area each year which can cause paralytic shellfish poisoning (PSP). The impact of red tide on shellfishing is dependent on is the intensity of the offshore bloom, and if weather patterns are favorable for transporting the bloom to the nearshore environment. As of yet there is no evidence to indicate that red tide is a human induced issue. Consequently, red-tide is considered a natural occurrence and any tidal water impacted by red tide is therefore documented as an "Observed Effect" rather than Not Supporting, as described in Section 3.1.7.

[16] https://www.des.nh.gov/sites/g/files/ehbemt341/files/documents/2020-01/ard-ehp-25.pdf

3.2.8 Use: Wildlife

Definition: Waters that can provide habitat capable of supporting any life stage or activity of undomesticated fauna on a regular or periodic basis.

Applicability: All surface waters.

Core Indicator(s): Under development.

Assessment Criteria: Criteria for determining use support are under development. For this cycle, all surface waters will be assessed as “Not Assessed” for this use.

CHAPTER 4 REFERENCES

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