STATE OF CONNECTICUT

DEPARTMENT OF ENERGY AND ENVIRONMENTAL PROTECTION

2022 INTEGRATED WATER QUALITY REPORT

September 15, 2022

This document has been established pursuant
to the requirements of Sections 305(b) and 303(d)
of the Federal Clean Water Act

Graham J. Stevens, Bureau Chief
Water Protection and Land Reuse

September 26, 2022
Date

Katie S. Dykes, Commissioner

Bureau of Water Protection and Land Reuse
79 Elm Street
Integrated Water Quality Report
Hartford, CT 06106-5127
(860) 424-3704

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Appendices

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303(d)	Section 303(d) of the Federal Clean Water Act, which requires states to develop lists of waters based on support of designated uses and water quality standards and develop plans to restore or protect water quality within those waters.
305(b)	Section 305(b) of the Federal Clean Water Act, which requires states to assess and report on the status of their waters every two years
319(a)	Section 319(a) of the Federal Clean Water Act, which requires states to prepare a report that identifies waters impaired by nonpoint source pollution, its sources and programs to reduce such pollution
ADB	Assessment Database (Former database, replaced by ATTAINS in 2018)
ALUS	Aquatic Life Use Support
ATTAINS	Assessment, Total Maximum Daily Load (TMDL) Tracking and Implementation System is the new online replacement for the obsolete ADB
AU	Assessment Unit; a section of a waterbody for which water quality is determined
CFU	Colony Forming Unit for bacteria enumeration
CSO	Combined Sewer Overflow
CT CALM	Connecticut Consolidated Assessment and Listing Methodology
CT DA/BA	Connecticut Department of Agriculture, Bureau of Aquaculture
CT DEP	Connecticut Department of Environmental Protection (previous name of Connecticut Department of Energy and Environmental Protection)
CT DPH	Connecticut Department of Public Health
CT WQS	Connecticut Water Quality Standards
CWA	(Federal) Clean Water Act
CWF	Connecticut Clean Water Fund
CT DEEP	Connecticut Department of Energy and Environmental Protection formally known as Connecticut Department of Environmental Protection
IWQR	Integrated Water Quality Report
MMI	Multimetric Index; used to assess the biological communities for Aquatic Life Use Support (ALUS)
NHD	National Hydrography Dataset
NSSP-MO	National Shellfish Sanitation Program Model Ordinance
QAPP	Quality Assurance Project Plan
RBP	Rapid Bioassessment Protocols
RBV	River Bioassessment for Volunteers
SDWA	(Federal) Safe Drinking Water Act
TMDL	Total Maximum Daily Load
US EPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WQS	Water Quality Standards
WQX	EPA's National Data Water Quality Data Exchange

Introduction

This report was prepared to satisfy statutory reporting requirements pursuant to Sections 305(b) and 303(d) of the federal Clean Water Act (CWA). CWA Section 305(b) requires each State to monitor, assess and report on the quality of its waters relative to attainment of designated uses established by the State's Water Quality Standards (CT WQS). In Connecticut, the Department of Energy and Environmental Protection (CT DEEP) is the agency with primary responsibilities to report on these CWA activities. Section 303(d) of the CWA requires each State identify and prioritize water quality limited waterbodies and develop Total Maximum Daily Loads (TMDLs) or other management actions consistent with Water Quality Standards. These reports are brought together in the Integrated Water Quality Report (IWQR) which is submitted to the United States Environmental Protection Agency (US EPA) every two years for review and, in the case of waters identified pursuant to Section 303(d), US EPA approval.

Water quality in Connecticut has improved over the last few decades as a result of protective laws, remediation efforts and a substantial investment in improved wastewater treatment. For example, the latest statewide assessment showed that 76% of the wadeable streams in Connecticut are healthy and meet aquatic life use support goals. Although difficult to compare with historic data because statistical surveys were not completed in the early years, it is appropriate to point out that the percentage of streams meeting aquatic life goals during the late 1970's and early 1980's was much lower.

In spite of tremendous progress in water quality, there are still gains to be made particularly in the area of nonpoint source (NPS) stormwater management, and infrastructure maintenance and improvements. Many of the remaining causes of impairment of Connecticut surface waters are difficult to identify (e.g., "cause unknown") and/or correct (e.g., Combined Sewer Overflows, urban stormwater runoff). Initiatives to maintain and improve water quality will require input and cooperation from numerous public and private interests that regulate and oversee land use management and environmental policy, especially at the local level.

Water Pollution Control Programs

Maintenance and Improvements of Infrastructure

Public funding for improved sewage system infrastructure in Connecticut is substantial. The Connecticut Clean Water Fund (CWF) is the state's environmental infrastructure assistance program. The CWF program is defined by Sections 22a-475 through 22a-483 of the Connecticut General Statutes (CGS) and by regulations adopted February 19, 1992 pursuant to CGS 22a-482. The CWF is a nationally recognized program administered by the Office of the Treasurer and DEEP that provides grants and low interest loans to municipalities for wastewater infrastructure improvement projects.

Since its inception in 1986 through FY 2002, the CWF program was supported with an average annual authorization of $48 million in General Obligation bonds, which support the grants. This investment has reaped great benefits to public health, water quality, economic development, and the beginning of restoring an oxygen depleted area in western Long Island Sound.

At no time in the history of the CWF has the demand for construction funding been higher. CT DEEP estimates wastewater infrastructure needs of nearly 5 billion dollars over the next twenty years. The projects include combined sewer overflow (CSO) correction projects to eliminate the discharge of nearly 2 billion gallons of combined sewage into Connecticut's waterways each year, denitrification projects necessary to restore the health of Long Island Sound, emerging water quality issues such as phosphorus removal, the need

for increased treatment capacity for the state's growth and economic development and the continued maintenance of existing wastewater infrastructure.

The priority list typically funds projects to support wastewater infrastructure projects whose implementation is considered significant to reduce serious negative impacts on water quality in our state. These projects include nitrogen removal projects in order to meet the TMDL for the Long Island Sound; phosphorus removal projects in order to comply with effluent limits that are being incorporated into NPDES permit renewals; and CSO improvement projects in our state's largest cities. Details of fundable project and program detail can be found in the Clean Water Fund Priority List.

Prediction of the economic costs to meet the goals of the Clean Water Act is accomplished through the federally sponsored Clean Watersheds Needs Survey .The survey, which is a joint venture among the individual states and the US EPA, results in a report to the United States Congress delineating the level of economic needs necessary to address water quality problems related to municipal wastewater conveyance and treatment, municipal stormwater management, combined sewer overflow correction, and non-point source pollution control.

Major gains in water quality have been achieved through these public investments, their analogs in the private sector, and protective legislation. Further maintenance and improvement of the quality of water resources will require continued public and private financial support. Essentially all aspects of Connecticut's clean water programs create long and short-term jobs. Upgrading of sewage treatment facilities, the extension of sewer lines, installation of industrial treatment facilities and ground water remediation all generate jobs in the design, engineering and construction industries. Operation and maintenance of these facilities creates long-term employment.

Nonpoint Source Pollution

Most nonpoint source pollution (NPS) is the result of human activities that generate diffuse pollutants over a wide geographic area. Precipitation washes these pollutants off of the landscape, creating polluted runoff that impacts the waterbodies into which it flows. However, NPS pollution may also be associated with non-precipitation events such as: malfunctioning septic systems, hydromodifications, atmospheric deposition, eroding streambanks and mine drainage. CT DEEP's NPS efforts work to abate known water quality impairments and prevent significant threats to water quality from nonpoint source pollution. For more information, see the Connecticut Nonpoint Source Management Program Plan which outlines Connecticut's approach to addressing NPS pollution for the next 5 years.

Additionally, a Total Maximum Daily Load for Long Island Sound was implemented to address the excessive discharge of nitrogen which is causing hypoxia (very low levels of dissolved oxygen) that impacts the survival of marine animals. To further nitrogen reduction implementation from point and NPS pollution to the Sound, CT DEEP developed a Second Generation Nitrogen Strategy which combines existing efforts with new initiatives under one plan. It engages nitrogen reduction efforts in three main focus areas: wastewater treatment plants, nonpoint source and stormwater, and embayments. Near term actions that can be taken at the state level to enhance nutrient reduction efforts are proposed for each of the three main focus areas.

Connecticut's NPS efforts includes all the components required under the CWA Section 319(h) (Nonpoint Source Pollution Management Programs). CT DEEP has developed a watershed management strategy that establishes a framework to work through a networked approach with federal, state, and municipal governments and non-government agencies and organizations to conduct watershed management and strengthen the state's ability to control nonpoint source pollution. CT DEEP has organized and focused base program staff, establishing three "major basin" managers, and continues to target grant funds based on

watershed priorities. Consistent with this approach, CT DEEP offers competitive annual Section 319 NPS grants to watershed initiatives for the priority watersheds, and to statewide nonpoint source initiatives.

CT DEEP NPS efforts are supported by both federal and state funds. CWA Section 319 funds support staff involved in NPS efforts as wells as grants for planning and implementation of environmental programs and projects with the goal of improving water quality. CT DEEP State and federal funds support staff in other units that are involved in various aspects of NPS management. State bond and other special legislative acts provide funds for projects and grant programs targeting specific resources that address NPS pollution. Coastal Zone Management Act funds, awarded by the National Oceanic and Atmospheric Administration, support CT DEEP Office of Long Island Sound Programs NPS efforts in the coastal area. Numerous other funding sources, from other federal and state agencies, and private foundations, are utilized when available.

Unlike wastewater infrastructure initiatives, the costs and benefits accrued from NPS pollution management measures are not as easily measured. This is due to several factors: projects are often funded by contributions from a combination of state, federal and local agencies as well as from landowners, volunteer groups, foundations, businesses which may include monetary support as well as in-kind services; NPS controls take many shapes and forms and can be applied as structural or non-structural measures; projects can span several years; and many NPS efforts are focused on education, as a way to encourage adoption of recommended practices.

Educational components of NPS Programs often focus on preventative measures to keep high quality waters healthy. For example, maintenance of high-quality potable water supplies is critical to the health and economic well-being of every resident. Likewise, clean water for swimming, fishing, and boating is extremely important to quality of life issues such as commercial fishing, marine industries and recreation all of which have associated economic benefits to citizens and generate tax revenues. CT DEEP has initiated research on Healthy Watersheds in Connecticut and these studies help to identify high quality water resources to the attention of Connecticut's citizens.

CT DEEP has focused on increasing awareness of Low Impact Development (LID) techniques for reducing stormwater and NPS runoff by working with our partners at the federal, state and local levels to provide information, educational materials and technical assistance in the application of LID techniques, building on existing programs such as the Governor's Responsible Growth Initiative, the University of Connecticut's Nonpoint Education for Municipal Officials (NEMO) program and US EPA's Smart Growth Program. The goal is to build better relationships and promote LID management practices with local land use agencies, academic institutions, nonprofit groups, the building industry and the public. Incorporating LID into land use plans can decrease impervious surfaces and limit runoff, leading to improved water quality and recharge of our rivers, streams and groundwater supplies.

IWQR Report Overview

Chapter 1, *Consolidated Assessment and Listing Methodology* (CT CALM) describes the procedure used by the CT DEEP to assess the quality of the State's waters relative to attainment of Connecticut Water Quality Standards (CT WQS). The CT CALM serves to document the protocols used by CT DEEP to assess water quality data as well as establishing minimum standards for data acceptability to ensure that only credible data are used to perform the assessments. Although CT DEEP relies primarily on data collected as part of our Ambient Monitoring and Assessment Program, data from other state and federal agencies, local governments, drinking water utilities, volunteer organizations, and academic sources are also solicited and considered when making assessments. The listing methodology section of Chapter 1 discusses the various EPA and Connecticut category definitions and how waterbodies can move from one category to another.

Chapter 2, Clean Water Act Section *305(b) Assessment Results* provides summary tables and figures presenting the results of CT DEEP's assessment of all readily available data relating to designated use attainment in Connecticut waters. Designated uses include "habitat for fish and aquatic life", also referred to as Aquatic Life Use Support (ALUS), "recreation", and "fish consumption", reflecting the principal designated uses assigned to all waters. Assessment results are provided in more detailed tables by waterbody type in Appendix A. Waterbody assessment results are presented in ascending order by waterbody ID number. Inland water (rivers, streams, and lakes) are presented first in Appendix A-1 and A-2, followed by estuarine waterbody segments in Appendix A-3.

Chapter 3, *Waterbodies Identified for Restoration and Protection Strategies Pursuant to Section 303 of the Clean Water Act,* provides additional information concerning water quality limited waterbodies, such as those assessed waters that do not currently meet water quality standards, commonly referred to as "impaired waters". This Chapter also provides information on the identification of stressors which impact water quality and the development of TMDLs or other appropriate management actions to restore or protect surface waters in Connecticut.

Chapter 1 -Connecticut Consolidated Assessment and Listing Methodology (CT CALM)

Introduction

CT DEEP submits an IWQR to the US EPA to fulfill the reporting requirements of CWA Sections 305(b) and 303(d). The CT CALM documents the decision-making process for assessing and reporting in the IWQR on the quality of surface waters of the state. The assessments conducted during this report cycle are based on the CT WQS established on October 10, 2013 and approved by EPA on December 11, 2013. CT WQS are adopted as regulations and are contained in Sections 22a-426-1 through 22a-426-9 of the Regulations of Connecticut State Agencies.

The assessment and listing process outlined here should be viewed in context of the CWA and CT WQS. The CWA is the primary federal law that protects our nation's surface waters, including lakes, rivers, wetlands, estuaries and ocean waters. In authorizing the Act, Congress declared as a national goal the attainment, wherever possible, of "water quality, which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water". This goal is popularly referred to as the "fishable / swimmable" requirement of the CWA. In 1967, predating the CWA, the State of Connecticut adopted Water Quality Standards as required under Section 22a-426 of the Connecticut General Statutes to accomplish this and other water quality goals.

The CT WQS contains policy statements addressing the protection of water quality and a classification of state waters. Described for each class are: 1) water quality classifications; 2) numeric or narrative criteria for various parameters or conditions to maintain water quality; and 3) designated uses that should be supported. For example, the designated uses for Class A waters are: habitat for fish and other aquatic life and wildlife; potential drinking water supplies; recreational use; and water supply for industry and agriculture. CT DEEP assesses whether the state waters meet the designated uses by categorizing them into levels of support. Table 1-1 identifies the designated uses for which waterbodies are assessed and associates these uses with the appropriate water quality classification.

Level of Support of Designated Uses

In making water quality assessments, each designated use of a waterbody is assigned a level of support (i.e., either fully supporting, not supporting, insufficient information, not assessed), which characterizes whether or not the water is suitable for that use. The level of use support attainment is based upon available data and other reliable information. The following use support categories are currently used for reporting in the IWQR. These are general definitions. Refer to the section in this report entitled *Assessment Methodology* for specific information regarding the criteria for determining levels of support for each designated use.

Fully Supporting: The designated use is fully achieved in the waterbody.

Not Supporting: The designated use is not supported in the waterbody

Insufficient Information: Insufficient data/information available to support an evaluation of attainment of designated uses in the waterbody.

Not Assessed: No current readily available information is available to assess use support.

Table 1-1. Designated uses for surface waters as described in CT WQS and the IWQR.

Designated Use	Applicable Class of Water or Class Goal	Functional Definition
Recreation	AA, A, B, SA, SB	Swimming, water skiing, surfing or other full body contact activities (primary contact), as well as boating, canoeing, kayaking, fishing, aesthetic appreciation or other activities that do not require full body contact (secondary contact).
Habitat for fish and other aquatic life and wildlife.	AA, A, B, SA, SB	Waters suitable for the protection, maintenance and propagation of a viable community of aquatic life and associated wildlife.
Fish Consumption is not specified independently as a use in the CT WQS, but implicit in "Habitat for fish and other..."[a] However, CT will continue to report on Fish Consumption as a separate use for 305(b)/303(d)	AA, A, B, SA, SB	Waters supporting fish populations that are free of contaminants at concentrations that would limit human consumption.
Shellfish harvesting for direct human consumption where authorized.	SA	Waters from which shellfish can be harvested both recreationally and commercially and consumed directly without depuration or relay. Waters may be conditionally approved.
Commercial shellfish harvesting where authorized.	SB	Waters supporting commercial shellfish harvesting for transfer to a depuration plant or relay (transplant) to approved areas for purification prior to human consumption (may be conditionally approved); also support seed oyster harvesting
Existing or proposed[b] drinking water supplies.	AA	Waters presently used for public drinking water supply or officially proposed for future public water supply.
Potential drinking water supplies.	A	Waters that have not been identified, officially, but may be considered for public drinking water supply in the future.
Navigation	AA, A, B, SA, SB	Waters capable of being used for shipping, travel or other transportation by private, military or commercial vessels.
Water Supply for Industry	AA, A, B, SA, SB	Waters suitable for industrial supply.
Agriculture	AA, A, B	Waters suitable for general agricultural purposes.

[a] Also addressed in CT WQS policy statement #14: "Surface waters… shall be free of chemical constituents in concentrations or combinations which will… bioconcentrate or bioaccumulate in tissues of fish, shellfish and other aquatic organisms at levels which will impair the health of aquatic organisms or wildlife or result in unacceptable tastes, odors or health risks to human consumers…"

[b] Surface waters identified as potential drinking water supplies as specified in Section 22a-426-4(b) of the Regulations of Connecticut State Agencies.

Information Used to Assess Use Support

Depending on the waterbody and data availability, any one or combination of several types of data may be used to assess water quality and use support: ambient physical and chemical; benthic macroinvertebrate and fish community; indicator bacteria; indicators of productivity and enrichment/eutrophication; aquatic toxicity; tissue contaminant; sediment chemistry/toxicity; and effluent analysis. Following guidance from US EPA (2005), the following sources of data and information are considered in conducting assessments:

- Results from recent ambient monitoring;
- Recent Section 305(b) reports, 303(d) lists, and 319(a) nonpoint assessments;
- Reports of water quality problems provided by local, state, territorial or federal agencies, volunteer monitoring networks, members of the public or academic institutions;
- Fish and shellfish advisories, restrictions on water sports or recreational contact;
- Reports of fish kills;
- Safe Drinking Water Act source water assessments;
- Superfund and Resource Conservation and Recovery Act reports;
- Results from predictive modeling, dilution calculations or landscape analysis; and
- Results from analysis of water quantity impacting aquatic life and other designated uses.

The primary sources of assessment information for rivers are ambient monitoring data collected by CT DEEP monitoring staff, and physical, chemical and bacteria data collected at fixed sites by the United States Geological Survey (USGS). Lake assessments and trophic status are generally determined from studies conducted by CT DEEP, the Connecticut Agricultural Experiment Station, USGS and Connecticut College since 1979 (Frink and Norvell, 1984; Canavan and Siver, 1995; Healy and Kulp, 1995; CT DEP, 1998) as well as recent studies by professional contractors. For estuaries, use assessments are based primarily on physical, chemical and biological monitoring by the CT DEEP Long Island Sound Study and National Coastal Assessment (Strobel, 2000), bacterial monitoring for shellfish sanitation by the Connecticut Department of Agriculture, Bureau of Aquaculture (CT DA/BA), and bathing beach monitoring by state and local authorities.

Data from other state and federal agencies, municipalities, utilities, consultants, academia, and volunteer monitoring groups are also used for assessments. CT DEEP directs a monitoring program for volunteers from which monitoring information is obtained. The details of this program, A Tiered Approach to Citizen – Based Monitoring of Wadeable Streams and Rivers, can be obtained from the CT DEEP website.

Other types of information that may be used for assessments include water quality surveys conducted by municipalities and discharge monitoring data from municipal sewage treatment plants, industries and remediation projects. CT DEEP staff may conduct effluent or ambient toxicity tests as a follow-up to investigate suspected problems. Knowledge of a condition known to cause water quality impairment is also considered valid information for determining use support. For example, the presence of a CSO in a stream segment may automatically preclude recreational use support.

Schedule and Degree of Confidence in Assessment Information

CT DEEP will consider information for assessments up to November 1 prior to the year when the IWQR is due to US EPA. Data and information submitted after November 1 will be considered for the next IWQR reporting cycle and data quality will be evaluated for use in assessments using a three-tiered system (Table1-2).

Table 1-2. Timeline for submitting data to CT DEEP.

IWQR Reporting Year	Deadline for Data Submission
2020	11/1/2019
2022	11/1/2021
2024	11/1/2023
2026	11/1/2025
2028	11/1/2027
2030	11/1/2029

Tiered data quality considerations for assessments of the State's waters

Tier 1- Data typically are in the form of digital photos or written descriptions of observations. These data can be helpful as a record of an episodic event. Tier 1 data are not likely to provide sufficient information to formalize an assessment, but can provide supporting information when other data exists for a waterbody.

Tier 2- Data collected may not have been collected under a formal Quality Assurance Project Plan (QAPP). Tier 2 data are not likely to be enough information to formalize an assessment, but can provide supporting information when other data exists for waterbody.

Tier 3- Data are collected under a formal monitoring plan which follows a QAPP approved by CT DEEP or US EPA. QAPPs shall include laboratory tests to be used and data quality objectives. Standard Operating Procedures for field procedures and lab techniques should be explained as well as a plan for data management. Chemistry results should be provided from a state-certified laboratory. Taxonomic identifications should be from a taxonomist with sufficient experience to provide reliable taxonomic identifications, preferably with certifications by the Society for Freshwater Science and American Fisheries Society. Project objectives should be consistent with CT DEEP's use of data for waterbody assessment purposes. Tier 3 data may be used to support use assessments.

Geographic and Temporal Extent of Assessment Coverage

Assessment Units

Waterbodies, such as streams, lakes or estuaries are divided into water quality assessment units (AUs). Each unit is considered to have homogenous water quality (*i.e.*, use support is uniform throughout the unit). Generally, stream units are delimited by features that may cause a change in water quality or habitat, such as a confluence with a tributary, a point source discharge, an impoundment or a significant change in land use. Lakes are generally assessed as one segment. Long Island Sound, including its embayments and river-mouth estuaries, was divided into 211 AUs based primarily on designated uses such as shellfishing and recreation and physical features such as depth and distance from shore.

All AUs are organized by a unique identification number called the Waterbody Segment ID, which tracks assessment information stored in the online EPA Assessment, Total Maximum Daily Load Tracking and Implementation System (ATTAINS) database through each assessment cycle. Both river and lake AUs are derived from CT basin numbers (Figure 1-1) explained and cataloged in the Gazetteer of Drainage Areas of Connecticut (Nosal, 1997). Stream and river segments are indexed to the National Hydrography Dataset (NHD) at a scale of 1:24,000, and lakes are geographically indexed to the CT DEEP lakes data layer. Estuary segments were completely reorganized following the 2006 reporting cycle (Figure 1-2) to better consider bathymetry, water quality, shellfish classification maps, and geographic extent detailed in *Summary Report & Users Guide Connecticut Coastal Assessment and Segmentation Project Final – May 11, 2006 Amended – October 3, 2007* (Streich, 2007). All AUs are created and geographically indexed using USGS extension tools and ArcGIS software.

Management of Assessment Information

All assessment data (*e.g.*, AU descriptions, assessment methods, use support, causes and sources of impairment) will be stored electronically in the new online EPA ATTAINS database. Raw monitoring data collected by CT DEEP staff since 1997 are stored and managed in an electronic database that contains sampling results and meta-data. While CT DEEP uses this in-house database for monitoring and assessment purposes, US EPA's National Data Warehouse (WQX) will be the ultimate repository for all monitoring results. CT DEEP is in the final stages of a long-term project that will provide seamless transfer of all water related data to the EPA's WQX.

Data used for Rivers and Stream Assessments

There are 7,772 river miles in the State of Connecticut based on the National Hydrography Dataset at the 1:24,000 scale. CT DEEP has developed an Ambient Water Quality Monitoring Program Strategy (CT DEEP, 2015) that incorporates a combination of targeted and probabilistic sampling designs for an ALUS assessment of rivers and streams. This strategy is intended to provide sufficient targeted data to answer questions about the effectiveness of specific water pollution control activities and also support a statewide probabilistic ALUS assessment. Sampling includes evaluations of benthic and fish community reference sites, focused monitoring (physical, chemical and/or biological) for TMDL development or other management actions, and follow-up to reported problems.

Physical, chemical and bacteria data from the cooperative CT DEEP/USGS long-term fixed-network were also reviewed for this report. This network of approximately thirty sites provides data for up to eight sampling events at each site per year on several major rivers and streams throughout the State.

Rivers and streams with new physical, chemical, and biological data collected during 2016-2020 were evaluated and assessed for this reporting cycle using the most recent available information from the CT DEEP

water monitoring and fisheries, USGS, municipalities, watershed groups and other quality assured volunteer groups. Updated assessment information can be found in Appendix A-1 of this report.

A Generalized Random Tessellation Stratified (GRTS) survey design (Stevens and Olsen 2004) was provided to CT DEEP from EPA and implemented with a target population of streams based on the National Hydrography Dataset at the 1:24,000 scale. No stratification was included in the survey design. A total of 62 wadeable stream sites were sampled to obtain a statewide estimate of aquatic life use attainment.

Data Used for Lake Assessments

There are 72, 509 acres of lakes in the State of Connecticut based on the National Hydrography Dataset at the 1:24,000 scale. Historically, Connecticut has assessed between 105 and 115 "significant public" lakes statewide for 305(b) reporting. Significance was based on a lake having state or federal public access or providing unique or otherwise important habitats. CT DEEP reviewed assessment information on 182 lakes currently in ATTAINS. Lakes with new physical, chemical, and biological data collected during 2019-2021 were evaluated and assessed for this reporting cycle using the most recent available information from our CT DEEP water monitoring and fisheries, USGS, macrophyte data from the Connecticut Agricultural Experiment Station and CT DEEP Natural History Survey staff, municipalities, consultants, watershed groups and other quality assured volunteer groups, and surveys with data from CT DEEP administered grants applied for and awarded to local entities. Updated assessment information can be found in Appendix A-2 of this report.

Beach closure data from CT DEEP's State beach program, from the State Department of Public Health (CT DPH) and local municipalities from the summers of 2019 and 2020 were evaluated to determine recreation use support.

CT DEEP participates in the US EPA sponsored nationwide project called the National Lakes Assessment (NLA). This project is based on a probabilistic sampling design that randomly selects lakes from across the United States for the purpose of producing a comprehensive assessment of trophic status of the nation's lakes. CT DEEP samples all lakes randomly selected in Connecticut for this study, which averages 10-15 lakes every 5 years.

Connecticut Water Basin Drainage Areas

Connecticut Water Basin Drainage as explained in the CT DEEP Gazetteer of Drainage Areas of Connecticut

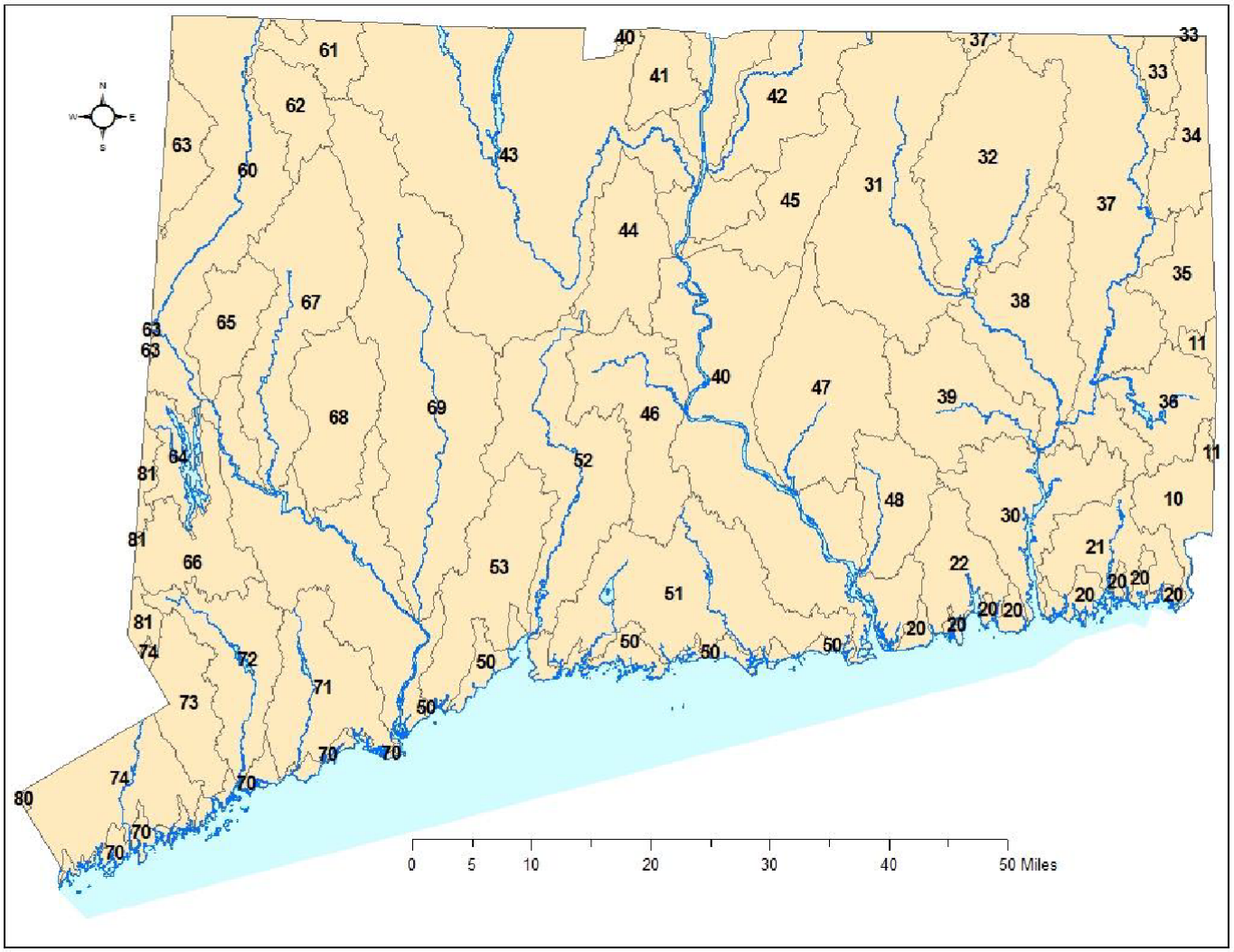
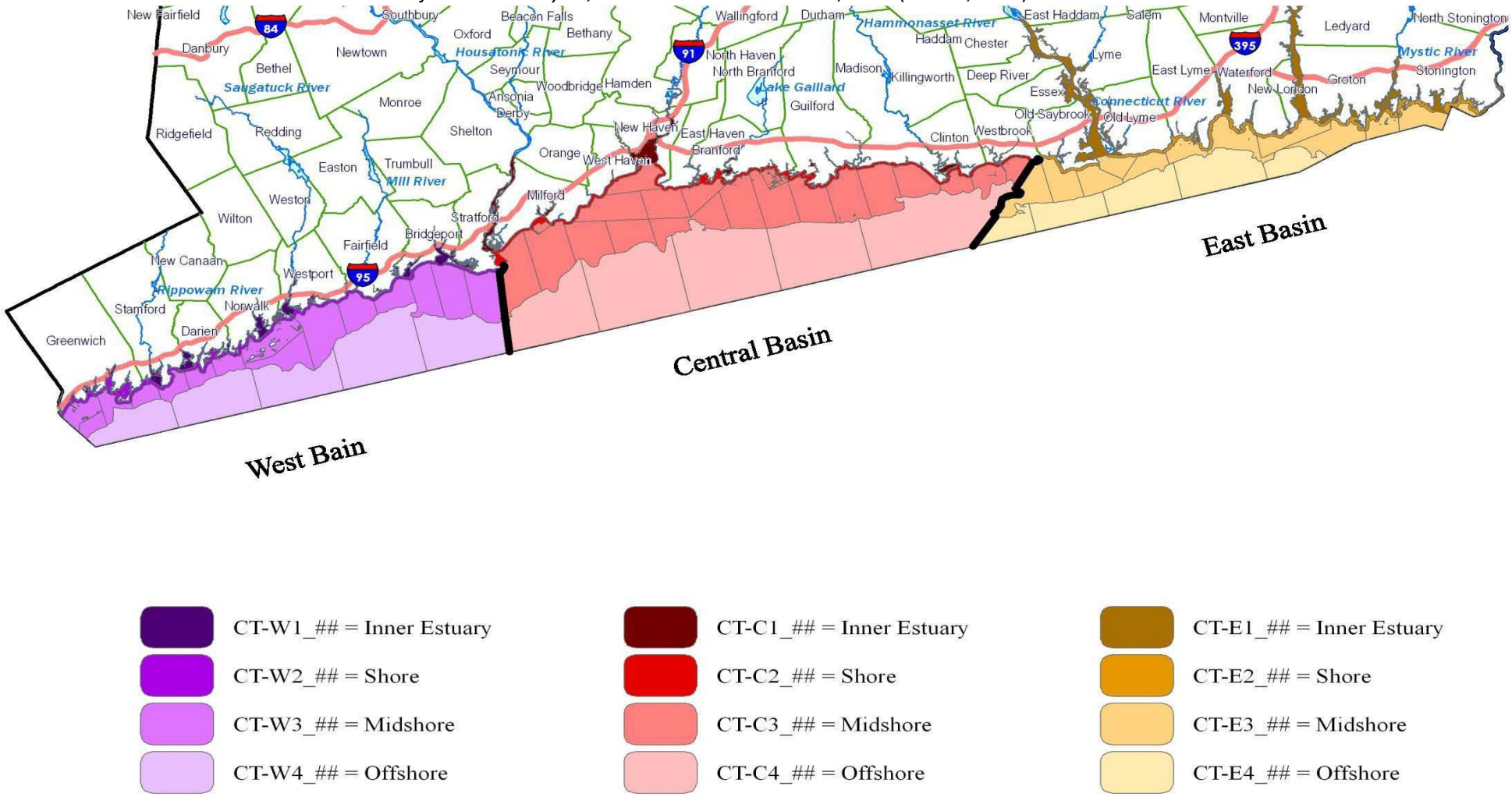


Figure 1-1. Connecticut Rivers and Lake Basins Index

Number	Regional Name
10	Pawcatuck Main Stem
11	Wood
20	Southeast Shoreline
21	Southeast Eastern Complex
22	Southeast Western Complex
30	Thames Main Stem
31	Willimantic
32	Natchaug
33	French
34	Fivemile
35	Moosup
36	Pachaug
37	Quinebaug
38	Shetucket
39	Yantic
40	Connecticut Main Stem
41	Stony Brook
42	Scantic
43	Farmington
44	Park
45	Hockanum
46	Mattabesset
47	Salmon
48	Eightmile
50	South Central Shoreline
51	South Central Eastern Complex
52	Quinnipiac
53	South Central Western Complex
60	Housatonic Main Stem
61	Blackberry
62	Hollenbeck
63	Tenmile
64	Candlewood
65	Aspetuck
66	Still
67	Shepaug
68	Pomperaug
69	Naugatuck
70	Southwest Shoreline
71	Southwest Eastern
72	Saugatuck
73	Norwalk
74	Southwest Western Complex
81	Croton

Connecticut Estuarine Segmentation

Connecticut Estuarine Segmentation Basins as explained in CT DEEP *Summary Report & Users Guide Connecticut Coastal Assessment and Segmentation Project Final – May 11, 2006 amended – October 3, 2007* (Streich, 2007).



CT-W1_## = Inner Estuary
CT-W2_## = Shore
CT-W3_## = Midshore
CT-W4_## = Offshore

CT-C1_## = Inner Estuary
CT-C2_## = Shore
CT-C3_## = Midshore
CT-C4_## = Offshore

CT-E1_## = Inner Estuary
CT-E2_## = Shore
CT-E3_## = Midshore
CT-E4_## = Offshore

Figure 1-2. Connecticut Estuary Basins Index.

Data Used for Estuary Assessments

There are 611.91 square miles of estuarine waters in the State of Connecticut, all of which are tracked for 305(b) reporting.

Long Island Sound (LIS) is monitored by CT DEEP on a monthly schedule for dissolved oxygen and nutrients at 17 fixed stations. In addition, 25-30 stations are added to the core 17 stations and monitored bi-weekly monitoring during summer months for dissolved oxygen. This monitoring is funded by the US EPA Long Island Sound Study. From 2000-2006 and in 2010 concurrent with this effort, CT DEEP collected water quality, sediment, biological community and tissue data at as many as 40 offshore and harbor sites for a US EPA probabilistic monitoring program, the National Coastal Condition Assessment (NCCA; Strobel, 2000). For the NCCA, representative stations in coastal harbors and offshore waters are chosen randomly to represent conditions of the entire Sound. Data from the LIS monitoring program and the NCCA provide the basis for aquatic life use assessments.

Annual shellfish bed monitoring and sanitary surveys conducted by the CT Department of Agriculture/Bureau of Aquaculture (DA/BA) provide assessment information for shellfish use support. Beach closure information and data from volunteer organizations as well as known sources of pollution, such as CSOs, are used to determine recreation use support.

All estuarine waters were re-assessed for this reporting cycle using the most recent available information. Dissolved oxygen data collected during the summers of 2019-2021 were used for this reporting cycle assessments. Beach closure information obtained from CT DPH for the 2019-2020 beach seasons was used for the assessment cycle. The Growing Area Classification data layer supplied by CT DA/BA, and annual, triennial and 12-year reports were evaluated for this assessment. Volunteer monitoring data collected during 2019-2021 and submitted to CT DEEP from estuary groups CUSH (Clean Up Sound and Harbors), Save the Bay - Westerly, Save the Sound, Harbor Watch, the Unified Water Study and the Millstone Environmental Laboratory, and local university researchers including UCONN (University of Connecticut), were also reviewed for the 2022 assessment cycle.

Assessment Methodology

CT DEEP's assessment methodology is listed in this section by designated use. Assessment procedures generally follow guidance provided by US EPA (1997) using a variety of information and data types. CT DEEP applies a "weight of evidence" approach using best professional judgment when using multiple types of data. A waterbody is generally considered impaired when one or more sources of data or information indicate a water quality standard is not attained, providing that information is considered sufficient and credible. In resolving discrepancies in conflicting information, consideration is given to data quality, age, frequency and site-specific environmental factors. If reconciliation of conflicting data is not possible or the data are determined to be insufficient, the assessment unit is flagged for further monitoring.

Aquatic Life Use - Rivers and Streams

Because the biological community of a stream integrates the effects of pollutants and other conditions over time, biological community assessment is the best and most direct measure of Aquatic Life Use Support (ALUS), or as stated in the CT WQS "Habitat for fish and other aquatic life and wildlife". CT DEEP uses a weight of evidence approach based on biological, stream flow, and chemical indicators to make use support determinations for wadeable rivers and streams (Table 1-3). In addition, CT DEEP has developed a methodology for determining when nutrient enrichment by phosphorus is the cause of an Aquatic Life Use Support impairment (Becker *et al*., 2018). The following sections provide more details about the indicators and assessment protocols.

Biological Indicators

CT DEEP developed Biological Condition Gradient models for two of Connecticut's aquatic life communities (fish and macroinvertebrates). The Biological Condition Gradient (BCG) is a conceptual model that describes changes in aquatic communities. The BCG model provides a more refined way of assigning stream health than a pass/fail approach. Incorporation of the BCG into Connecticut's water quality assessment process allows CT to better define and identify stream condition in Connecticut.

The approach for using the BGC models and other biological data for assessments are described in technical support documents. For the BCG model for macroinvertebrates, please refer to the CT DEEP report: Calibration of the Biological Condition Gradient for High Gradient Streams of Connecticut. The fish community data are evaluated using one of two multimetric indices based upon upstream watershed area (Kanno *et al.* 2010), a Fish BCG Assessment Model, and best professional judgment of fisheries and water quality monitoring staff biologists. Methods for fish monitoring are described in CT DEEP (2013), Plafkin *et al*. (1989) and Barbour *et al*. (1999).

Figure 1-3 shows the sites assessed for the 2022 reporting cycle using the BCG Assessment Models for macroinvertebrates and fish. For a closer look at the data that supports the BCG tier for each biological community CT DEEP has developed an interactive BCG web application that allows a user to interface with the data spatially. This application can be used to identify the healthiest streams in the state (Tiers 1 and 2) and the most stressed streams (Tiers 5 and 6).

Table 1-3. Aquatic Life Use Support (ALUS) categories and contributing decision criteria for wadeable streams.

Aquatic Life Use	Criteria / Indicators
Fully Supporting	Biological community with ecological attributes consistent with Biological Condition Gradient Tiers 1-4 as adopted in Connecticut Water Quality Standards Section 22a-426-5 of the Regulations of Connecticut State Agencies. Benthic community: benthic MMI, value >48 (Gerritsen and Jessup, 2007) and meets narrative criteria in CT WQS*. Screening Approach data with 6 or more "Screening Taxa" RBV data submitted to CT DEEP listed 4 or more pollution sensitive "Most Wanted" invertebrates Fish community: species composition, trophic structure, and age class distribution as expected for an unimpaired stream of similar watershed size. Conventional physical/chemical criteria are not exceeded. Measured toxicants do not exceed chronic toxicity criteria. Biological communities show no evidence of impact from anthropogenic manipulations to stream flow. No evidence of chronic toxicity in ambient waters.
Not Supporting	Biological community with ecological attributes consistent with Biological Condition Gradient Tiers 5-6 as adopted in Connecticut Water Quality Standards Section 22a-426-5 of the Regulations of Connecticut State Agencies Benthic community: benthic MMI < 43 (Gerritsen and Jessup, 2007), and does not meet narrative criteria in CT WQS*. Screening Approach data with 2 or less "Screening Taxa" Fish community: species composition, trophic structure and age class distribution significantly less than expected for a non-impacted stream of similar watershed size; diversity and abundance of intolerant species reduced or eliminated; top carnivores rare or absent; trophic structure skewed toward omnivory. Physical/chemical or toxicant criteria exceeded in $\geq$ 10% of samples. Biological communities show evidence of impact from anthropogenic manipulations to stream flow. Stream completely enclosed in conduit or cleared concrete trough.
Insufficient Information	Some community data exist, but sampling was very limited and/or the results are ambiguous or conflicting, requiring follow-up monitoring.

* When a bioassessment falls on the border between two use support categories, use support is determined by staff biologists giving consideration to site conditions, certain sensitive taxa present, and other available data. Occasionally, where habitat conditions are not optimal, a non-quantitative sample may be used to infer ALUS as a best professional judgment assessment.

Starting with the 2014 Assessment Cycle, CT DEEP began using a model that predicts macroinvertebrate multi-metric index (MMI) (Bellucci *et al*., 2013) score using GIS derived landscape variables (percent impervious land cover, percent wetlands, and stream slope) in the upstream watershed for any monitored wadeable stream location (Figure1-4) to predict stream health across Connecticut. This model provides an expected baseline of MMI score to compare to actual results when evaluating an aquatic life assessment. This is especially helpful when sampling a stream reach for the first time without the benefit of existing data for comparison. Although not used alone to assess aquatic life, the model results can provide another line of evidence to support stream data, lending more confidence to assessments The results shown in Figure 1-4 predicts, that 76% of stream miles should pass aquatic life goals and 24% of stream miles should fail aquatic life goals using modeled MMI values. Percent values were obtained by summing the stream miles with an MMI >48 (pass) and MMI < 48 (fail) and dividing by total stream miles.

Volunteer monitoring data from the CT DEEP-sponsored River Bioassessment for Volunteers are also used in assessments. The presence of four or more pollution sensitive "most wanted" invertebrate taxa reported at a given site can be considered for an assessment category of "Fully Supporting". CT DEEP also developed a Treasure Hunt for Healthy Waters Story Map to highlight work conducted by Volunteers focusing on the healthy streams in the state and to help guide future sampling using where volunteer map applications by prioritizing un-sampled watersheds that are predicted to be healthy based on the MMI Model (Bellucci et al 2013).

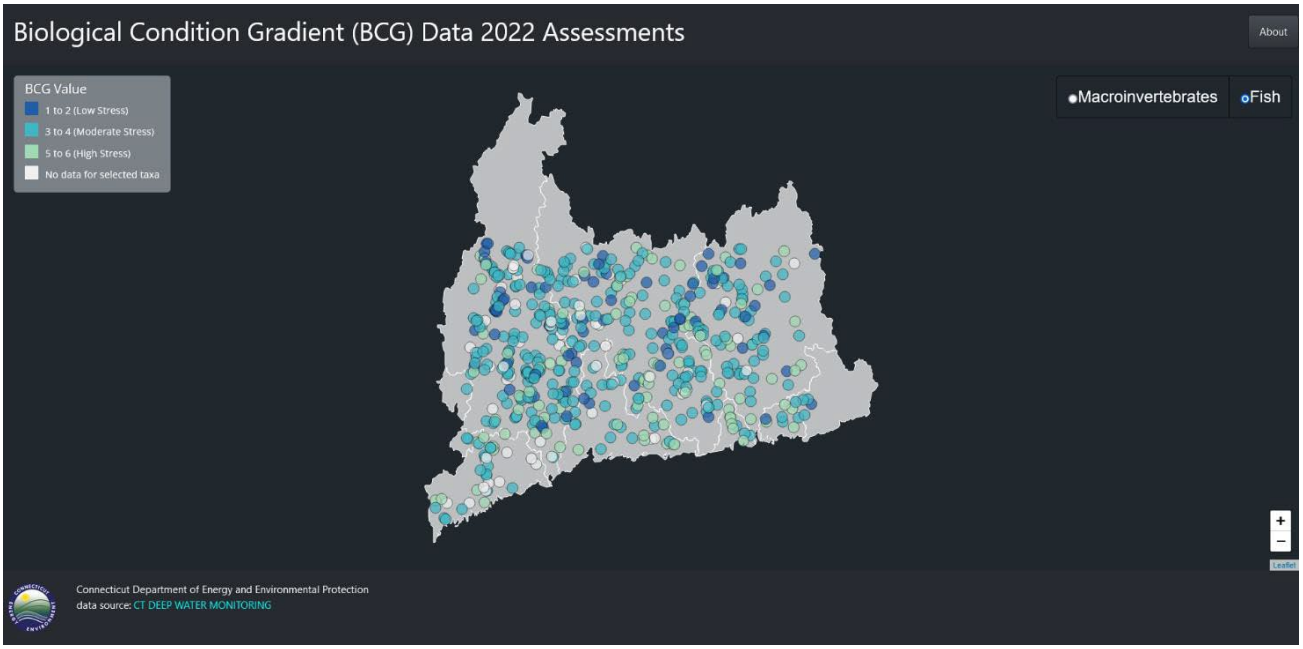


Figure 1-3. CT DEEP Monitoring BCG Value Results Map collected from 2016-2020 and assessed for the 2022 reporting cycle. For a closer look at the data that supports the BCG tier, go to this BCG web application .

Connecticut Macroinvertebrate Multimetric Index (MMI) Model

Connecticut stream health condition as predicted by CT DEEP MMI model.

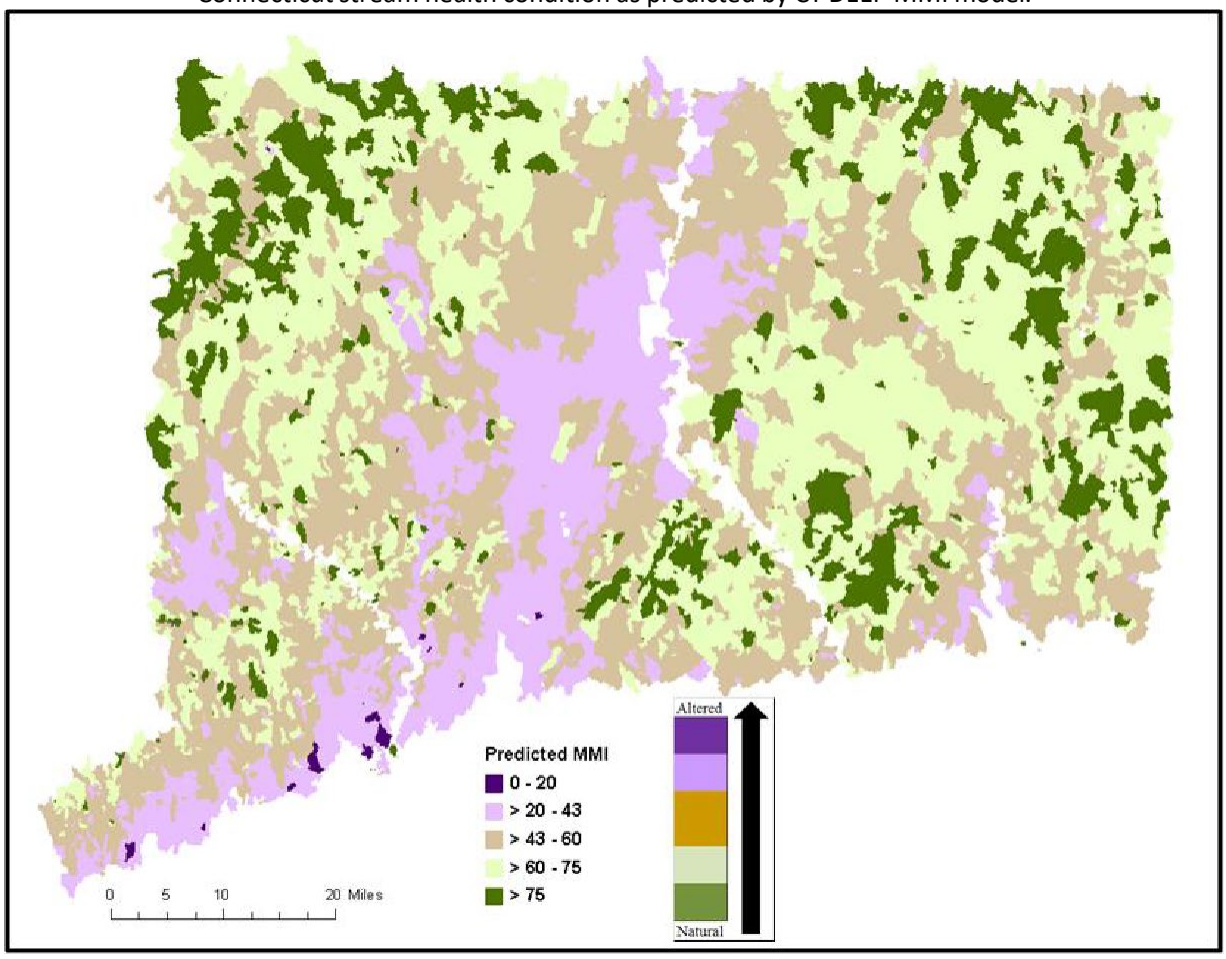


Figure 1-4. Macroinvertebrate Multimetric Index (MMI) model results showing the predicted stream health condition.

Stream Flow Indicators

CT DEEP has made a significant effort to balance human and ecological needs relative to water quantity. Stream flow classes for the entire state have been adopted under the Connecticut Stream Flow Standards and Regulations. These stream flow classes can be useful to determine potential impacts due to hydrologic alteration since stream flow classes are scaled based on the natural flow paradigm (Poff et al 1997) and can provide a line of evidence to support biological community assessments that may be impacted by hydrologic alteration. Stream flow classes have narrative standards that represent a range of flow conditions (Table 1-4), and these classifications can be considered when making judgments on flow altered streams.

CT DEEP staff have developed a GIS application and a method using digital photos to help with documenting low flow conditions throughout the state to assist with aquatic life assessments. Assessments metrics developed from digital images are combined with other factors in the GIS to determine flow alteration as a cause of impairment. CT DEEP uses a weight of evidence approach following metrics based on best professional judgment. Flow conditions that result in disconnected flow and that limit habitat to fish and

other aquatic life from non-natural causes are documented and listed under Category 4C. The following information is considered when making these assessments:

- Biological metrics such as MMIs and BCGs for fish and macroinvertebrates;
- Surficial geology in the watershed;
- Location of diversions and dams;
- Statistical summaries of streamflow or flow measurements in the field that indicate a deviation from the natural hydrograph that results in habitat alteration that can impact aquatic life;
- Stream flow classification adopted under the Connecticut Stream Flow Standards and Regulations;
- Dry or nearly dry streams with severely limited aquatic habitat documented by digital photos influenced by water diversions or registrations that alter the natural hydrologic regime.

Table 1-4. Stream flow classes adopted under the Connecticut Stream Flow Standards and Regulations

Stream flow Class	Narrative Standard
Class 1	River or stream segment shall exhibit, at all times, the depth, volume, velocity and variation of stream flow and water levels necessary to support and maintain habitat conditions supportive of an aquatic, biological community characteristic of that typically present in free-flowing river or stream systems of similar size and geomorphic characteristics under the prevailing climatic conditions.
Class 2	River or stream segment shall exhibit, at all times, the depth, volume, velocity and variation of stream flow and water levels necessary to support and maintain habitat conditions supportive of an aquatic, biological community minimally altered from that typically present in free-flowing river or stream systems of similar size and geomorphic characteristics under the prevailing climatic conditions.
Class 3	River or stream segment shall exhibit, at all times, the depth, volume, velocity and variation of stream flow and water levels necessary to support and maintain habitat conditions supportive of an aquatic, biological community moderately altered from that typically present in free-flowing river or stream systems of similar size and geomorphic characteristics under the prevailing climatic conditions.
Class 4	River or stream segment may exhibit substantially altered stream flow conditions caused by human activity to provide for the needs and requirements of public health and safety, flood control, industry, public utilities, water supply, agriculture and other lawful uses; and shall, while giving consideration to societal needs, economic costs, and environmental impacts, exhibit to the maximum extent practicable the depth, volume, velocity and variation of stream flow and water levels consistent with the narrative standard for Class 3 river and stream segments.

Chemical Indicators

Indirect measurements of ALUS such as ambient physical/chemical data, discharge monitoring reports, aquatic toxicity monitoring reports, and sediment chemistry data are also evaluated against water quality criteria established in CT WQS. These data may be used independently or supplement the weight of evidence for Assessment Units with benthic invertebrate or fish community data. We generally consider samples that exceed the water quality criteria > 10% of time for chemical or toxicant data as a potential for an impaired waters listing.

Nutrient Enrichment Indicators

Nutrient enrichment has also been identified as one of the most pressing water quality issues facing the nation as a whole. As a result, US EPA has directed states to take aggressive action to limit the quantity of phosphorus being discharged to surface waters. In Region 1, US EPA has mandated that all New England states establish limitations on phosphorus (TP) in all wastewater discharge permits where the potential exists for the discharge to contribute to eutrophication and impair designated uses in downstream waters.

When there is an impairment to aquatic life in wadeable streams, CT DEEP has a weight of evidence approach to determine whether TP is the cause of this impairment. This procedure includes using a combination of three measures: stream aquatic life biological assessments, TP concentrations, and diatom TP tolerance metrics. Detail to the method is summarized in a technical support document (Becker and Bellucci 2019). The approach draws on previous research conducted on phosphorus in CT (Becker 2012, Smucker et al 2013, Becker et al 2018) and follows recommendations in the phosphorus strategy report pursuant to CT public act 12-155 to use a stressor response model with multiple response parameters to establish phosphorus impairment (PA 12-155 Coordinating Committee, 2017).

Aquatic Life Use – Lakes

The most recent available information from the CT DEEP Monitoring Program, government agencies and/or reliable contractors and lake associations are used to determine levels of support for aquatic life use in lakes. CT DEEP monitoring and assessment staff evaluate these data into lake trophic classifications to determine attainment of ALUS using a weight of evidence approach and best professional judgment. Factors taken into consideration are known problems, such as chronic algal blooms, the extent of coverage by exotic invasive plants, severe sedimentation, and results of surveys by fisheries biologists.

Lake trophic classifications, as listed in Section 22a-426-6 of the CT WQS are based on ambient measurements of four parameters: total phosphorus, total nitrogen, chlorophyll a, and Secchi disc transparency in specified seasons. Lakes are classified as either oligotrophic, mesotrophic, eutrophic, or highly eutrophic based on the range of values for these four parameters. Macrophyte coverage and density are used to adjust the trophic classification based on water column data described above. While trophic status is not a direct measure of aquatic community health, highly eutrophic conditions, beyond what is naturally expected (given the relative size of the lake/pond and watershed, the origin of the lake/pond, and other physiographic parameters), or a documented trend toward cultural eutrophy may indicate impairment or a threat to aquatic life. A naturally eutrophic lake, having nutrient concentrations that support high levels of biological activity without any significant anthropogenic source, would not be considered impaired. Lake trophic classifications were assigned for all lakes that had new monitoring data collected since the previous reporting cycle.

Table 1-5. Aquatic Life Use Support (ALUS) categories and contributing decision criteria for lakes.

Aquatic Life Use	**Criteria / Indicators**
Fully Supporting	Lake Trophic Classification: classification is as naturally expected (given the relative size of the lake/pond and watershed, the origin of the lake/pond, and other physiographic parameters). Fish community: species composition, and age class distribution as expected for a lake of similar watershed size. Conventional physical/chemical criteria are not exceeded. Macrophyte species composition and density supports a healthy biological community. Measured toxicants do not exceed chronic toxicity criteria. No evidence of chronic toxicity in ambient waters.
Not Supporting	Lake Trophic Classification: Highly eutrophic conditions, beyond what is naturally expected (given the relative size of the lake/pond and watershed, the origin of the lake/pond, and other physiographic parameters), or a documented trend toward cultural eutrophy. Fish community: species composition, and age class distribution significantly less than expected for a non-impacted lake of similar watershed size; diversity and abundance of intolerant species reduced or eliminated; top carnivores rare or absent; trophic structure skewed toward omnivory. Known problems, such as chronic algal blooms, extensive coverage by exotic invasive plants, severe sedimentation. Physical/chemical or toxicant criteria exceeded in $\geq$ 10% of samples Evidence of chronic toxicity in ambient waters.
Insufficient Information	Some data exist, but sampling was very limited and/or the results are ambiguous or conflicting, requiring follow-up monitoring.

Aquatic Life Use – Estuaries

Aquatic life use assessments for estuaries are based primarily on dissolved oxygen and nutrient data (eutrophication assessments) collected by CT DEEP's Long Island Sound monitoring staff as part of the US EPA Long Island Sound Study. Evaluations are supplemented by special studies, intensive surveys, fish trawl surveys and National Coastal Assessment (NCA) samples, when available. Dissolved oxygen data used for the assessments included data from the University of Connecticut/NERACOOS MySound Western and ARTG buoys (bottom water data); and the USGS/UConn gaging station on the Connecticut River at Essex (01194750). In reviewing available data, measured values for a specific parameter are compared to water quality criteria as defined in the CT WQS. CT DEEP revised its dissolved oxygen criteria in 2011 for marine waters and this is the primary indicator evaluated. Low dissolved oxygen (Table 1-6), or hypoxia (Figure 1-5) in offshore waters and some embayments is the most frequently cited impairment of aquatic life. Benthic community analyses conducted as part of the NCA (Strobel, 2000) are being used to support other findings on ALUS, but the coverage of LIS is not yet spatially or temporally adequate to support assessments on its own. CT DEEP Marine Fisheries trawl data are also used to support low dissolved oxygen findings with respect to ALUS. Other information sources include tissue analyses, sediment analyses, irregular sampling (*e.g*., for spills, site assessments or research projects), and professional judgment evaluations of pollutant sources and water quality conditions. Tier 3 quality assured dissolved oxygen data collected by volunteer researchers (CUSH, Harbor Watch/River Watch, and Save the Bay-Westerly) in nearshore waters are also used to assess the Aquatic Life Use.

Assessments of Dissolved Oxygen Using Data from Individual Stations

Assessment units are evaluated against the dissolved oxygen criteria where data/measurements are available. Data are reviewed for the summer period from May-September. If more than 10% of the Dissolved oxygen concentration measurements are less than 3.0 mg/L, this results in an assessment of "Impaired" for the Aquatic Life Use (Table 1-6). The 10% exceedance allowance is based on US EPA assessment guidance (US EPA, 1997).

Table 1-6. Aquatic Life Use Support (ALUS) in estuaries as determined by dissolved oxygen levels.

Aquatic Life Use Assessment	Criteria
Fully Supporting	ACUTE: Measured dissolved oxygen concentrations of 3.0 mg/L and greater in 90% or more of samples Map interpolations indicate at least 90% of AU area with dissolved oxygen concentrations of 3.0 mg/L and higher CHRONIC: Cumulative periods of dissolved oxygen in the 3.0 – 4.8 mg/L range resulting in a decimal fraction of less than 1.0. Benthic or fish communities are not impacted. No violations of water quality criteria or excessive levels of sediment contamination.

Not Supporting	ACUTE: Measured dissolved oxygen concentrations less than 3.0 mg/L in more than 10% of the samples Map interpolations indicate dissolved oxygen concentrations <3.0 mg/L for more than 10% of assessment unit area on multiple cruises over the assessment period CHRONIC: Cumulative periods of dissolved oxygen in the 3.0 – 4.8 mg/L range resulting in a decimal fraction of greater than 1.0. Benthic or fish communities are impacted. Exceedances of water quality criteria or excessive levels of sediment contamination.

Assessments of Dissolved Oxygen Using Hypoxia Maps

Dissolved oxygen Hypoxia map interpolations are created based on near bottom water conditions and used to determine the ALUS status in those offshore AUs that do not contain LIS sampling stations. Using ArcGIS software, CT DEEP LIS Monitoring Program staff creates maps that depict the extent of low dissolved oxygen in the bottom waters of Long Island Sound based upon the data collected during the LISS bi-weekly hypoxia surveys from June through September. Maps are only created when concentrations fall below 4.8 mg/L. Concentrations between sampling stations are interpolated using the Spatial Analyst Tool from ESRI, Inc.(Inverse Distance Weighted Average Method, see http://www.esri.com/) Hypoxia maps are available on the CT DEEP website.

Additional details related to map production can be found in the Standard Operating Procedure document *Preparation of Hypoxia Maps and Summaries.* The GIS raster data files are incorporated into a GIS map document created for assessment purposes. The files are overlain on a layer file of AUs to determine the location of sampling stations relative to AUs and to determine the frequency of excursions below the dissolved oxygen criterion (Figure 1-6). Using the zonal histogram tool in ArcGIS, the area of each segment that falls within the defined dissolved oxygen concentration classification scheme for each survey/cruise is calculated. For LIS, the classifications are: 0-0.99 mg/L, 1-1.99 mg/L, 2-2.99 mg/L, 3-3.49 mg/L, 3.5-4.79 mg/L, and >4.8 mg/L. If >10% of the assessment unit area falls below 3.0 mg/L, ALUS is assessed as impaired. The frequency of low dissolved oxygen events is determined based on the number of times the maps indicate dissolved oxygen concentrations fell below the criterion (i.e., X number of cruises < criterion/total number of cruises * 100).

Assessments of Aquatic Life Use Support Using Sediment Contamination Indicators

Historic impairments based on dissolved oxygen data or sediment contamination are carried forward until new data shows parameters meeting criteria. Many of these impairments were documented in old Water Quality Reports to Congress and date back to the late 1980s/early 1990s. Impairments were based on interviews with staff engineers and reports that indicated elevated levels of sediment contaminants (Stacey, 2007). Additional historic sources of data included the National Oceanic and Atmospheric Administration's Benthic Surveillance Program and Mussel Watch Program, a project developed to analyze chemical and biological contaminant trends in sediment and bivalve tissue from over 280 coastal sites based on data collected from 1986 to the present. Data collected for the NCA program (Strobel 2000), data compiled into a sediment dredge geodatabase by the CT DEEP Office of Long Island Sound Program, and data provided by the CT DEEP TMDL program were also used as supplemental sources.

Connecticut Long Island Sound Hypoxia Map

CT DEEP estuarine segments with station locations and Hypoxia interpolations

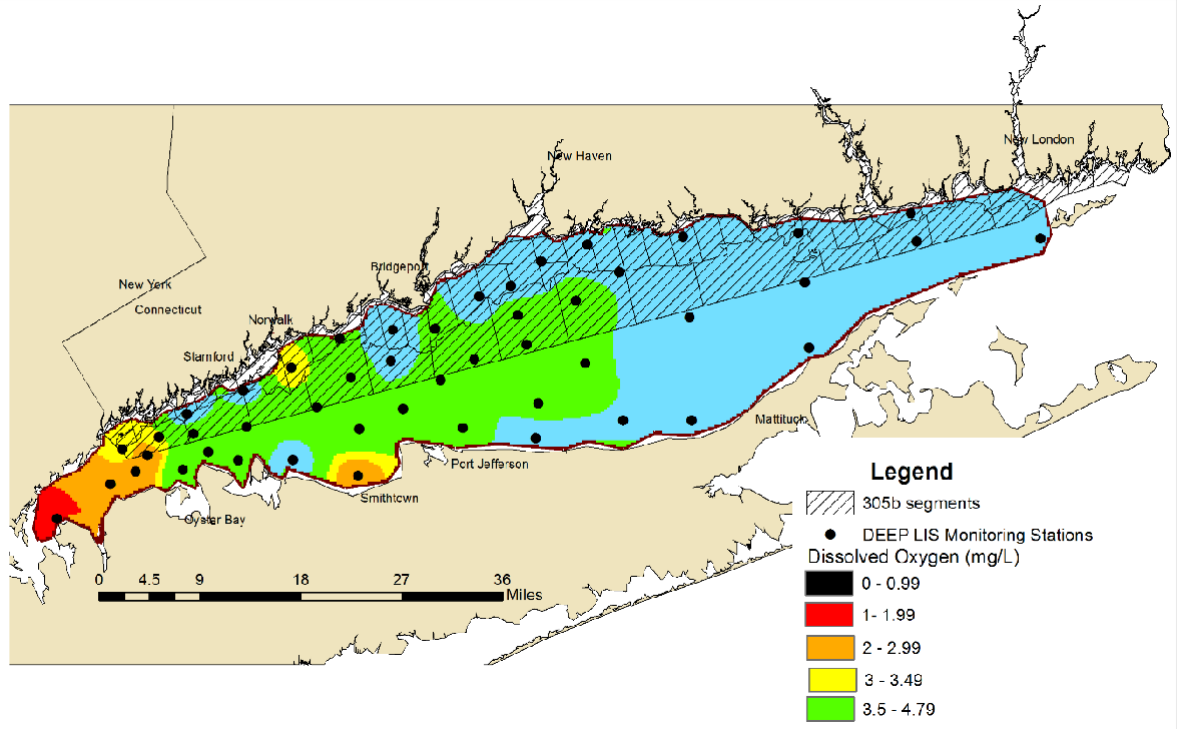


Figure 1-5. Map of Hypoxia interpolations overlain on sampling station locations and Connecticut assessment units to evaluate excursions below the dissolved oxygen criterion.

Fish Consumption

Fish consumption advisories are issued by the Connecticut Department of Public Health. The advisories are based on risk assessments conducted by CT DPH using fish tissue contaminant data. A statewide fish consumption advisory was issued for all species except trout < 15 inches in length in the mid-1990s due to mercury contamination. This advisory was based on statewide surveys of mercury contamination in fish from lakes (Neumann et. al., 1996) and rivers (CT DEP, unpublished). A follow up study was completed in 2008 (Vokoun and Perkins, 2008) and the statewide fish consumption advisory was continued based on these data.

Therefore, in addition to fish consumption use support as determined by the criteria below (Table 1-7), all freshwaters of the State have a fish consumption advisory due to mercury contamination. Likewise, all estuarine waters have fish consumption advisories due to a statewide advisory for PCB contamination in migratory striped bass and bluefish. Refer to CT DEEP Fishing Guide or CT DPH Connecticut's Fish Consumption Advisory and the Safe Eating of Fish Caught in Connecticut for more information about fish consumption advisories. Waterbodies listed in this report in Connecticut 305b Site Specific Fish Consumption Advisories (Appendix A-4), have site specific fish consumption advisories in addition to the statewide consumption advisories.

Table 1-7. Fish consumption use support and criteria.

Fish Consumption Assessment	Criteria
Fully Supporting	No site-specific consumption advisory for any fish species or any consumer group.
Not Supporting	A site-specific consumption advisory exists for all or some fish species or for all or certain consumer groups.

Shellfish Harvesting in Estuaries

Starting with the 2006 reporting cycle, shellfish harvesting has been divided into two designated uses as specified in the CT WQS: shellfish harvesting suitable for direct human consumption (SA waters), and shellfish harvesting suitable for commercial operations requiring depuration or relay (SB waters).

The CT DA/BA is responsible for regulating shellfish harvesting. A shellfish growing area is defined by CT DA/BA as any area that supports or could support the growth and/or propagation of molluscan shellstock. Shellfish are defined by CT DA/BA as oysters, clams, mussels, and scallops, either shucked or in the shell, fresh or frozen, whole or roe-on. All shellfish growing areas are classified by CT DA/BA in accordance with the Interstate Shellfish Sanitation Conference (ISSC) National Shellfish Sanitation Program Model Ordinance (NSSP-MO) and CT General Statutes Chapter 491, Sec 26-192e. These classifications, summarized below, are established to minimize health risks and may restrict the taking and use of shellfish from some areas. They are based on fecal coliform bacteria standards as provided in the NSSP-MO .

APPROVED- Open for harvest of shellfish for direct human consumption

CONDITIONALLY APPROVED- A shellfishing area classification that predictably does not conform to "Approved" area criteria due to the occurrence of specified hydrologic or meteorological events or conditions, but will predictably return to the "Approved" area criteria.

RESTRICTED-RELAY/DEPURATION: A shellfishing area classification that conforms to NSSP-MO criteria that allows the area to be used by CT DA/BA licensed operations for the relaying of shellfish to a depuration plant for controlled purification, to designated beds in Approved or Conditionally Approved areas for natural cleansing, or to areas satisfactory to the CT DA/BA, excluding Prohibited, Conditionally Restricted-Relay, and Restricted-Relay areas. These shellfish may not be directly harvested for market nor consumed prior to the purification process involving relay or depuration.

RESTRICTED-RELAY: A shellfishing area classification where CT DA/BA allows aquaculture, relay or transplant activities in conformance to NSSP-MO criteria. Operations may be licensed to relay shellfish to designated beds in Approved or Conditionally Approved areas for natural cleansing. These shellfish may not be directly harvested for market or consumed prior to a minimum purification period of 14 consecutive days after being relayed to Approved or Conditionally Approved “open” areas with a water temperature of 50 degrees Fahrenheit (10 degrees Celsius) or greater. CT DA/BA may require the shellfish purification time to be longer than 14 consecutive days, based upon shellfish purification verification studies.

CONDITIONALLY RESTRICTED-RELAY: A shellfishing area classification that predictably does not conform to Restricted-Relay area criteria due to the occurrence of specified events or conditions, but predictably returns to the Restricted-Relay area criteria.

PROHIBITED: A shellfishing area classification that prohibits the harvesting of shellfish for any purpose except depletion or aquaculture operations (such as seed oystering) licensed by the CT DA/BA.

US EPA guidance (Grubbs and Wayland, 2000 and US EPA, 2002) identifies that areas closed to shellfish harvesting due to administrative closures, and not based on monitoring data that indicated a water quality impairment, should not be assessed as Not Supporting. These updates are incorporated into the CT CALM and were utilized for this reporting cycle. To determine attainment of water quality standards and for integrated reporting purposes, CT DEEP utilizes CT DA/BA shellfish growing area classifications as listed in Table 1-8.

Administrative closures are established in areas around potential pollution sources, such as sewage outfalls and marinas/mooring fields, as a preventative measure to safeguard human health and preclude the harvest of possibly contaminated shellfish. A marina is defined in the NSSP-MO as "any water area with a structure (docks, basin, floating docks, etc.) which is used for docking or otherwise mooring vessels, and constructed to provide temporary or permanent docking space for more than ten boats".

Areas may also be classified as prohibited due to incomplete sanitary surveys, lack of water quality data, or insufficient resources/interest. Areas classified as prohibited for administrative reasons (i.e., around outfalls, marinas, no resources/interest) will not be considered as violating water quality standards and will be listed in the Integrated Water Quality Report as Not Assessed. Areas classified as prohibited due to incomplete sanitary surveys will also not be considered as violating water quality standards but will be listed in the Integrated Water Quality Report as Insufficient Information. This approach is consistent with US EPA guidance published in 2000 (Grubbs and Wayland, 2000) and in Chapter 3 of the 2002 US EPA document Consolidated Assessment and Listing Methodology Toward a Compendium of Best Practices. Additionally, other coastal states within US EPA Regions 1 and 2 have adopted this approach.

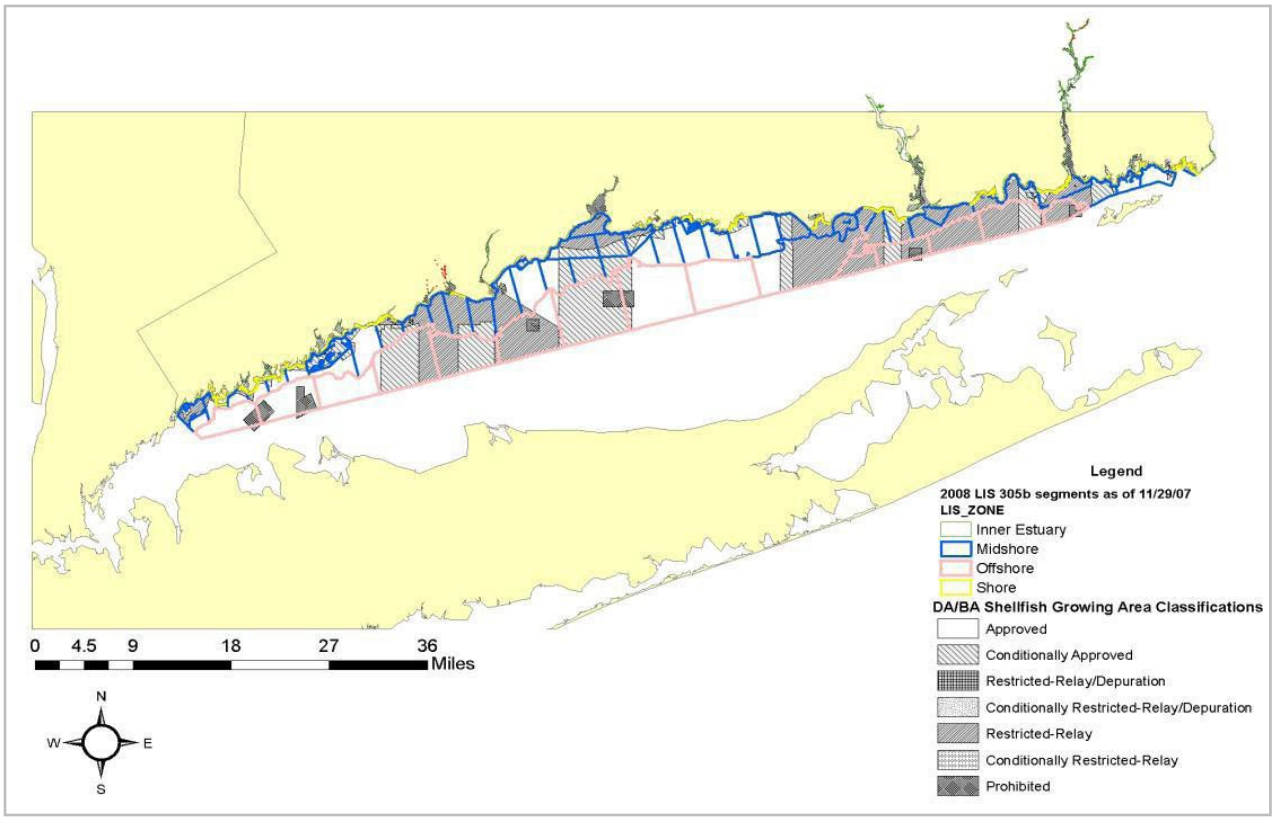
In a number of towns, the CT DA/BA has placed restrictions on direct harvest of shellfish from the shoreline out to the mid-Sound state boundary. However, beyond a depth of 50 feet, there is essentially no shellfishing conducted at this time, and these waters are not regularly monitored. Therefore, for Integrated Reporting purposes, shellfish harvesting is not evaluated as a use in waters between the 50-foot depth contour and the state line. The lack of monitoring should not be construed to mean these deeper offshore waters do not achieve applicable water quality criteria for indicator bacteria.

It should be noted that CT DA/BA shellfish growing areas do not necessarily coincide with CT DEEP waterbody segments (Figure 1-6). To determine use support, GIS is utilized. All CT DEEP segments from the various geographic areas (i.e., inner estuary, shore, midshore, and offshore) are merged into a single layer file. Then the shellfish area classifications are "unioned" with the merged layer file. The attribute table from this new layer is exported (as a .dbf file). Using Microsoft Excel, pivot tables are created that list each classification present per segment along with size of the area falling completely within the segment. A total area is calculated for each class. The segment is then assessed based on the guidelines in Table 1-8. Sources of impairment are based on shellfish reports compiled by CT DA/BA on an annual, triennial or twelve-year basis.

Table 1-8. Shellfish harvesting use support as determined by shellfish growing area classifications.

Class SA waters: Shellfish harvesting for direct human consumption where authorized.	Criteria
Fully Supporting	Waters classified by CT DA/BA as Approved.
Not Supporting	>10% of segment area classified by CT DA/BA as Prohibited, Conditionally Approved, Conditionally Restricted-relay, Restricted-relay, or Restricted-relay/depuration
Not Assessed	Waters closed administratively due to a safety management zone around wastewater treatment plants or marinas, no water quality data available, or lack of resources.
Insufficient Information	Waters closed administratively due to a lack of a current sanitary survey or insufficient monitoring data.
Class SB waters: Shellfish harvesting with depuration or relay where authorized.	Criteria
Fully Supporting	Waters classified by CT DA/BA as Approved, Conditionally Approved, Conditionally restricted-relay, Restricted-relay/depuration.
Not Supporting	>10% of segment area classified by CT DA/BA as Prohibited
Not Assessed	Waters closed administratively due to a safety management zone around wastewater treatment plants or marinas, no water quality data available, or lack of resources.
Insufficient Information	Waters closed administratively due to a lack of a current sanitary survey or insufficient monitoring data.

Connecticut Long Island Sound Segment and Shellfish Map



Connecticut CT DEEP estuarine segments with shellfish growing area classifications in Long Island Sound

Figure 1-6. Assessment units overlain on shellfish growing area classifications in Long Island Sound.

Recreation

Recreation assessments are based on sanitary/safety considerations and aesthetic/practical usability. Sanitary condition is determined from indicator bacteria data provided by CT DEEP, USGS, volunteer, or municipal monitoring, along with sanitary surveys where appropriate (see Table 1-9 Decision criteria). For lakes, aesthetic and practical usability is considered based on algae and/or macrophyte surveys.

Enterococci group bacteria are used as the primary sanitary indicator organism in estuarine water, and *Escherichia coli* in fresh water per the most current version of Connecticut's WQS. For salt water, 104 Colony Forming Units (CFU)/100 ml of e*nterococci* is the single sample criterion for designated bathing areas, 500 CFU/100 ml for other recreational uses, and 35 CFU/100 ml is the geometric mean criterion for any recreational use. In fresh water, 235 Colony Forming Units or CFU/100 ml of *Escherichia coli* is the single sample criterion for designated bathing areas, 410 CFU/100 ml for non-designated swimming areas, 576 CFU/100 ml for other recreational uses, and 126 CFU/100 ml is the geometric mean criterion for any recreational use.

For AUs with designated bathing areas, beach closure information is generally used to determine use support. Closures of public bathing areas are, for the most part, based on the results of weekly sampling for indicator bacteria during the swimming season. A complete discussion of Connecticut's practices related to beach monitoring and closure may be found in "Guidelines for Monitoring Bathing Water and Closure Protocol" developed jointly by CT DEEP, the Connecticut Department of Health, the Connecticut Environmental Health Association, and the Connecticut Association of Directors of Health (CT DPH and CT DEP, 2003).

Additionally, beach personnel conduct daily inspections of shoreline bathing areas for evidence of contamination. State and local officials also utilize sanitary surveys of shorelines and watersheds as a primary tool to determine sanitary quality. Evidence of waste materials indicative of untreated sewage or human fecal contamination can be sufficient justification to support a beach closure decision by local or state authorities. Small quantities of temporary and/or transient sources of human fecal contamination transported to a site (*e.g.,* diapers / medical items) would likely result in a beach closure. Significant sources of contamination from a fixed location within the AU, such as a CSO, would automatically result in an assessment of impairment.

In some lakes, recreation may also be impaired by cyanobacteria blooms, excessive growth of aquatic invasive plants or algae, which hampers use by physical means (*e.g.*, dense weeds prevent boat mobility) or creates aesthetically offensive conditions. Lakes for which no bacteria data exist may be considered Fully Supporting of recreation if the lake is situated completely within an undeveloped area or if there have been no complaints of illness or excessive aquatic plant growth, or, as in the case of some urban ponds, swimming is not allowed but other recreation activities are supported.

Table 1-9. Decision criteria for various categories of recreational use support.

Recreation Assessment	Criteria / Indicators for designated public bathing areas
Fully Supporting	Designated bathing area closed 10 % of swimming seasons[a] or less for a reporting cycle, and sanitary survey indicates no significant source [b] of human fecal contamination. Recreational use is not hindered by weed or algal growth.
Not Supporting	Designated bathing area closed more than 10% of swimming seasons[a] for a reporting cycle, or sanitary survey indicates potential for significant source of human fecal contamination. Algal or exotic weed growth precludes normal recreational use.
	Criteria / Indicators for areas not designated as public bathing areas
Fully Supporting	Sanitary survey indicates no significant source of human fecal contamination, and There are a minimum of 8 samples for the assessment period, and no more than 15% of samples exceed the single sample criterion for *Escherichia coli* (410 CFU [c]/ 100 ml for non-designated swimming areas, 576 CFU/100 ml for all other areas), and there is no exceedance of the geometric mean criterion (126 CFU/100 ml). Recreational use is not hindered by excessive weed or algal growth.
Not Supporting	Sanitary survey indicates potential for significant source of human fecal contamination; or There are a minimum of 8 samples for the assessment period, and more than 15% of samples exceed the single sample criterion for *Escherichia coli* (410 CFU [c]/ 100 ml for non-designated swimming areas, 576 CFU/100 ml for all other areas), and there is an exceedance of the geometric mean criterion (126 CFU/100 ml) or Algal or exotic weed growth precludes normal recreational use.
Insufficient Information	Less than 8 samples in the assessment period [d].

[a] Swimming season is from Memorial Day to Labor Day. The swimming season for the report cycle consists of 2 summers of swimming days combined.

[b] A significant source of human fecal contamination is one that originates from a fixed location and is transported to or within the waterbody (*e.g.*, an untreated sewage discharge or a community with failing septic systems).

[c] CFU refers to colony-forming-unit, which is the unit of measure for indicator bacteria. It is the general equivalent of one bacterium (one bacterium will grow into one colony when incubated on a plate of growth medium.)

[d] In certain cases, best professional judgment can result in an assessment when there are fewer than 8 samples.

Drinking Water Supply

The Connecticut Department of Public Health (CT DPH) implements the federal Safe Drinking Water Act (SDWA) in Connecticut and CT DEEP cooperates with those efforts. The CT DPH tracks and reports on the water quality of public drinking water supplies within the context of the SDWA. CT DEEP periodically surveys water utilities for updated information concerning closures, trophic status, and potential causes and sources of pollution.

Class AA drinking water reservoirs and Class AA tributaries, which is where Drinking Water is a designated use, are considered Fully Supporting for the CT DEEP Drinking Water Designated Use when filtration and disinfection are reliably maintained in accordance with State Public Drinking Water Standards (Regulations of Connecticut State Agencies Section 19-13-B102), unless CT DEEP finds chemical or physical evidence of conditions not meeting standards during targeted field assessments. These waters are regulated by programs at CT DPH that coordinate, manage, and ensure treatment and source protection through oversight of

existing treatment and source protection laws and regulations, coupled with water supply planning, education of local land use officials, and involvement with stakeholders on a continuous basis.

Many Class AA drinking water reservoirs and tributaries to drinking water reservoirs are tracked and assessed for aquatic life use support of ambient conditions (see discussion of ALUS assessment methodologies in the previous sections).

Navigation

Navigation is assumed to be fully supported for all waters suitable for navigation.

Agriculture, Industry

Agricultural uses are assumed to be fully supported for all AA, A, and B waters. Industrial use is assumed to be fully supported for all AA, A, B, SA and SB waters.

Listing Methodology

The CWA requires states to track attainment of water quality goals for each waterbody using a five-category approach (Categories 1,2,3,4, and 5) developed by the US EPA and amended by Connecticut. Categories 1, 2 and 3 are used for waters that are meeting some or all of the designated uses or for which insufficient information is available to allow for an assessment. These categories do not pertain to impaired waters but may include water bodies prioritized for action plans (see sub-category descriptions below). Waterbodies that have been identified as impaired are assigned to Categories 4 and 5 under the reporting requirements of CWA Section 303(d).

Category 4 has been assigned to waterbodies where the planning and implementation of pollution control and management measures have been initiated with the expectation to achieve CT WQS attainment in future assessments discussed in more detail in Chapter 3 of this document.

Category 5 constitutes the regulatory 303(d) list of impaired waterbodies for which a TMDL or equivalent plan is required, which is subject to US EPA review and approval pursuant to federal regulation 40 CFR 130.7. The list of impaired waters is updated by CT DEEP and approved by US EPA every two years as required under the CWA. Updates to impaired waterbodies may include changes to waterbody assessments in Category 5, and also revisions to segments in Category 4a, 4b, and 4c.

The biannual review of surface waters for 305(b) and 303(d) reporting may result in a change in the placement of waters within the US EPA categories for any given waterbody as new information is obtained. For example, a waterbody listed in Category 5 may be reassigned to Category 4b if other pollution control requirements, such as a consent order for remedial action, are determined to be the most effective option for attaining water quality standards in place of a TMDL. Thus, the 305(b) and 303(d) reporting is an iterative process that may result in the re-classification of waterbodies to different categories based on new assessment data or changes in US EPA regulations or guidance relating to the assessment and listing process.

Subcategories for Connecticut Water Quality Management Plans

Waterbodies can move around the various categories as their water quality status changes. This happens when new water quality data become available indicating that the waterbody is meeting WQS for a designated use, a Water Quality Action Plan is developed (such as a TMDL) or if data becomes out of date or insufficient to determine if a waterbody is meeting WQS. However, as waters move through the EPA status categories, the Water Quality Restoration or Protection Plan remains in place. CT DEEP has created subcategories to reflect both the appropriate EPA category (categories 1-5) as well as the plan that has been developed for restoration or protection that is associated with the waterbody. The different types of plans

that are developed to restore or protect water quality is discussed in further detail in Chapter 3 of this document. The addition of the sub-categories will allow for better tracking of the attainment status of those waterbodies that have a restoration or protection plan associated with it. The majority of TMDLs remain in category 4a with a small amount that have attained water quality standards or have been moved to category 3 (insufficient information). If a segment becomes impaired that is associated with protection plan that segment will require a TMDL and move back to category 5.

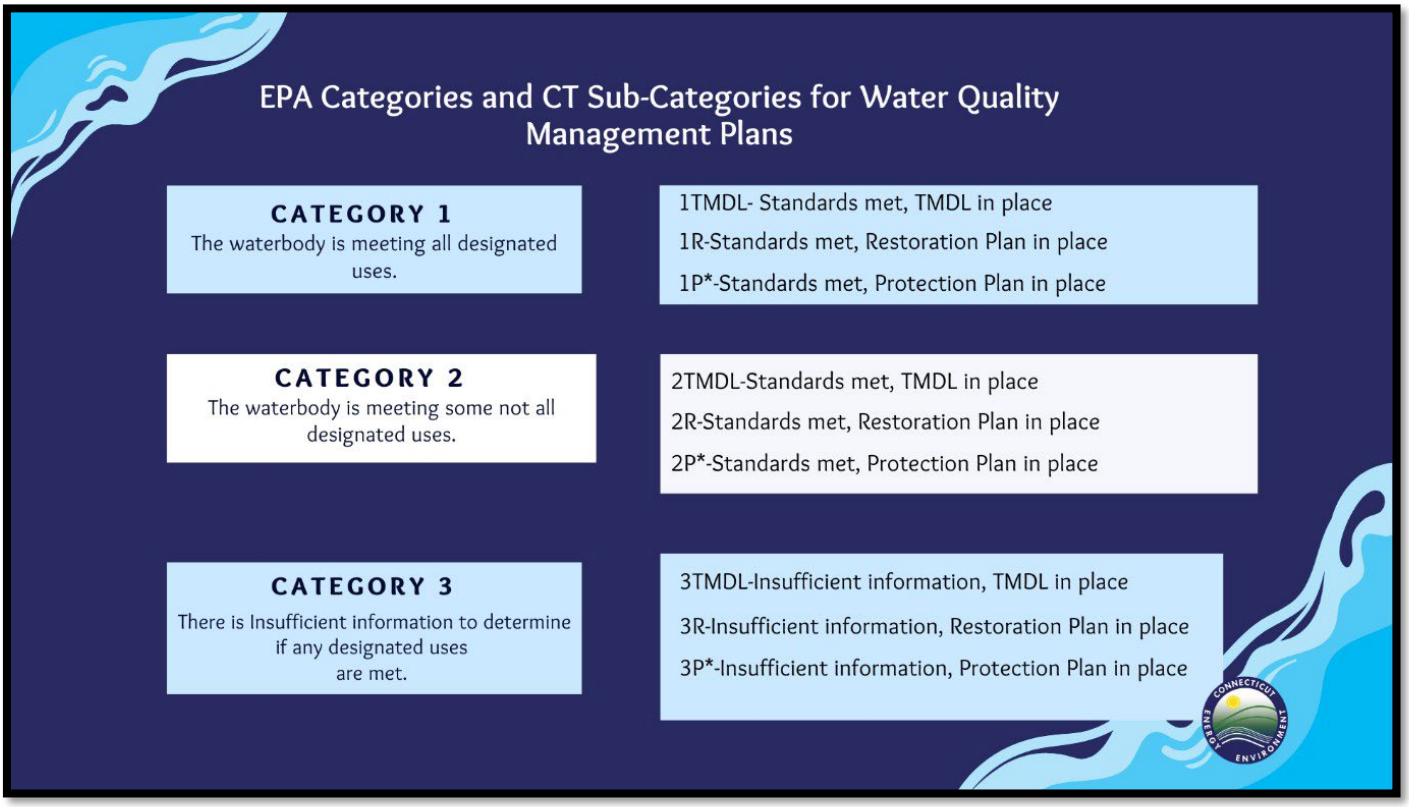


Figure 1-7. The EPA categories and the CT sub-categories are defined as follows. Please note that; *segments with protection plans that are not meeting WQS will go back to category 5 and require a TMDL*

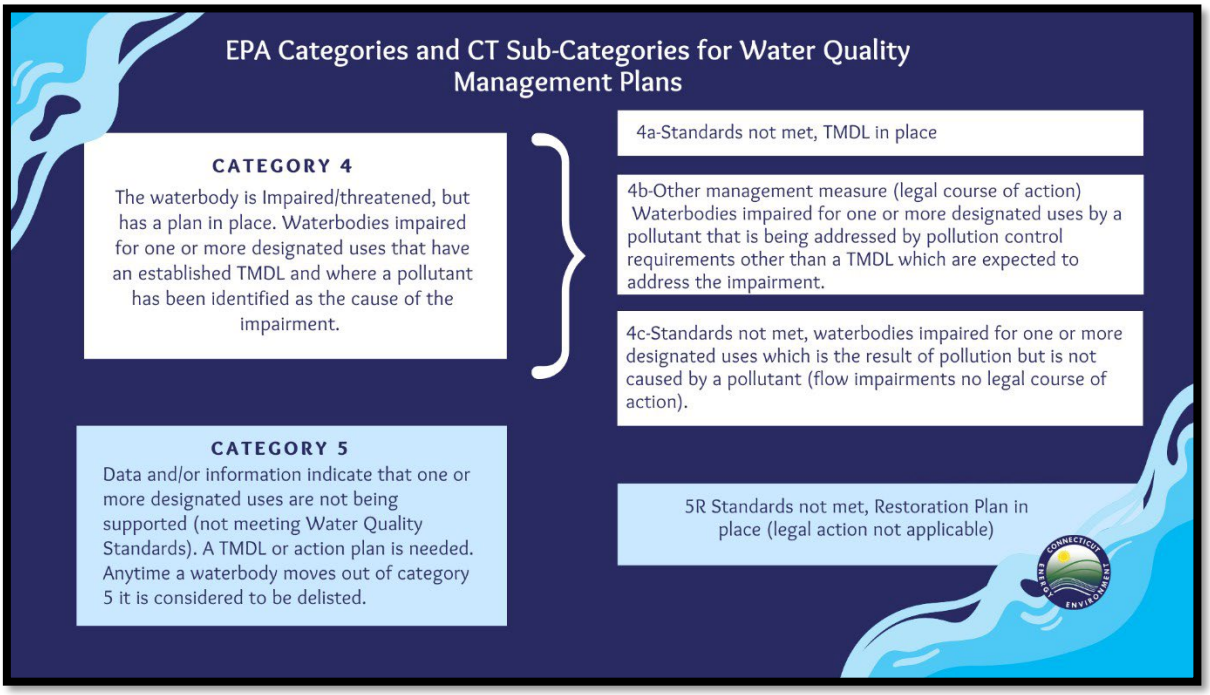


Figure 1-7 (continued). The EPA categories and the CT sub-categories are defined as follows. Please note that *segments with protection plans that are not meeting WQS will go back to category 5 and require a TMDL*

Reconciliation List of 303(d) Delistings and Listings

The assessment of surface waters is an on-going process that will result in the removal of some waterbodies from the category 5, indicating a water quality impaired water that needs a TMDL or other plan, and the addition of others. Removal of waters from Category 5 is considered "delisting" while addition of waters to this category is considered "listing". A waterbody is delisted when it is no longer impaired based on an assessment of relevant data conducted in accordance with the CT CALM that confirms attainment of water quality standards. Additionally, waterbodies may be delisted when:

- An error was made in the initial listing causing an incorrect listing. These listings include those based on anecdotal information (information, often transmitted orally and undocumented, which cannot be confirmed through direct observation or measurement using generally accepted, reproducible analytical methods). In these circumstances, the waterbody usually was moved into US EPA Category 2 (supporting for some uses, other uses not assessed) or more often Category 3 (no or insufficient data available to make any assessment).
- Quality controlled data, which are acceptable to CT DEEP, demonstrate that designated uses are being met for the waterbody (with or without implementation of a TMDL or other type of Action Plan).
- Revisions in Water Quality Standards and Criteria and/or assessment methodologies result in a change in assessment from non-attainment to attainment.
- The waterbody meets conditions described in Categories 4a, 4b, 4c as described above, however it will continue to be considered Not Supporting for one or more designated uses until water quality standards and designated uses are met, although the regulatory requirement to adopt a TMDL will no longer apply

Based on the waterbody assessments where data were available for this reporting cycle, these changes include all segments that were proposed for the listing and delisting of impaired waterbodies. Appendix B-5 *Reconciliation List of Impaired Waters (Delistings and Listings)* was compiled where a change in an assessment affected the status of the impaired waterbodies (US EPA Categories 4 or 5). A total of 23 segments have been delisted based on new data from the Impaired Waters List. 5 Segments have been delisted due to resoration activities and 4 segments have been delisted due to an established restoration plan. There are 18 new segments that have been added to the 303 (d) list of impaired waters for the 2022 IR cycle.

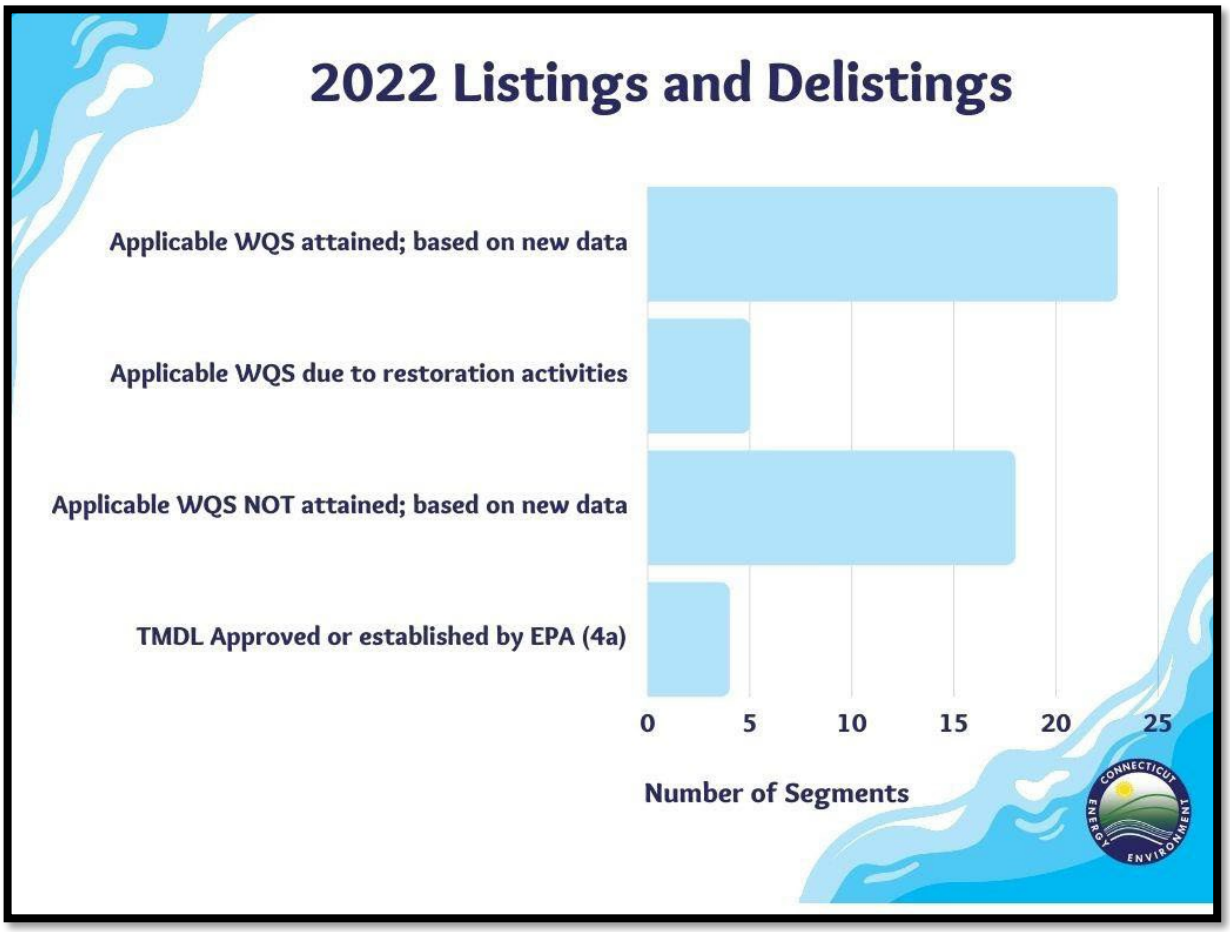
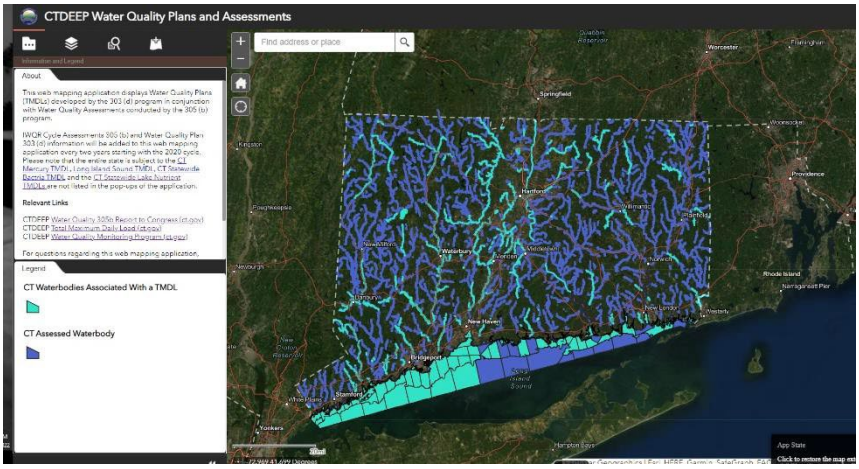


Figure 1-8. Listings and Delistings 2022 IR

Chapter 2 – 305(b) Assessment Results

Water Quality Assessments and Plans Web Mapping Application



CT DEEP's assessment results by waterbody type and designated use are summarized on the following pages. This information is now available on a new interactive map available on CT DEEP's IWQR website. The application will also allow users to add their own geographic data for analysis. The application contains 2020 IR information and will reflect future IR cycles however, it will not reflect cycle data prior to 2020. For previous Cyle information please refer to the Previous IR Webpage

List of assessment figures and tables:

- Figure 2-1 is a map showing all waterbody type segments assessed for any designated use over the entire state of Connecticut
- Table 2-1 summarizes the total river miles or acres of lakes and estuaries that were determined to be either Fully Supporting, Not Supporting, Insufficient Information, or Not Assessed for each designated use
- Figure 2-2 is a map showing the assessment results for the Aquatic Life designated use over the entire state of Connecticut
- Figure 2-3 is a map showing the assessment results for the Recreational designated use over the entire state of Connecticut
- Figure 2-4 is a map showing the assessment results for the Shellfishing designated used in the estuaries in Connecticut
- Table 2-2 contains the assessment results for the Aquatic Life Designated Use for all of the wadeable streams in Connecticut based on a probabilistic sampling design
- A short summary of segments that were determined to be Not Supporting for the Drinking Water designated use.

Note: Not all waterbodies in Connecticut are assessed for all possible designated uses and some waterbodies that were assessed previously as Fully Supporting may have dropped to Not Assessed in this reporting cycle due to use-specific data age limitations, which are important to maintain quality control in assessment information. Any waterbody assessed as Not Supporting in a prior report retains that assessment until new monitoring data confirm that use is supported (meeting standards).

Assessment results are provided in more detailed tables by waterbody type in Appendix A. Waterbody assessment results are presented in ascending order by waterbody ID number. Inland water (rivers, streams, and lakes) are presented first in Appendix A-1 and A-2, followed by estuarine waterbody segments in Appendix A-3. Figures 1-1 and 1-2 will assist readers in spatial overview and segmentation enumeration that corresponds with assessment results and impaired waters tables found in the appendices. An interactive geographic information system map viewer and map services hosted by the University of Connecticut called Connecticut Environmental Conditions online (CTECO) can be used to view assessment results found in this

report. Click to follow the link to CTECO, then using the simple map viewer, select the assessment layers for the reporting cycle you would like to view in the Water Resources tab. Layers can also be downloaded for use in GIS software. DEEP also produces a fact sheet that highlights important findings and provides an overall summary for each assessment cycle. Contact the report coordinator for specific assessment questions.

CT DEEP Waterbody Assessment Segments

Map of CT DEEP Waterbody Assessment Segments assessed for one or more designated uses

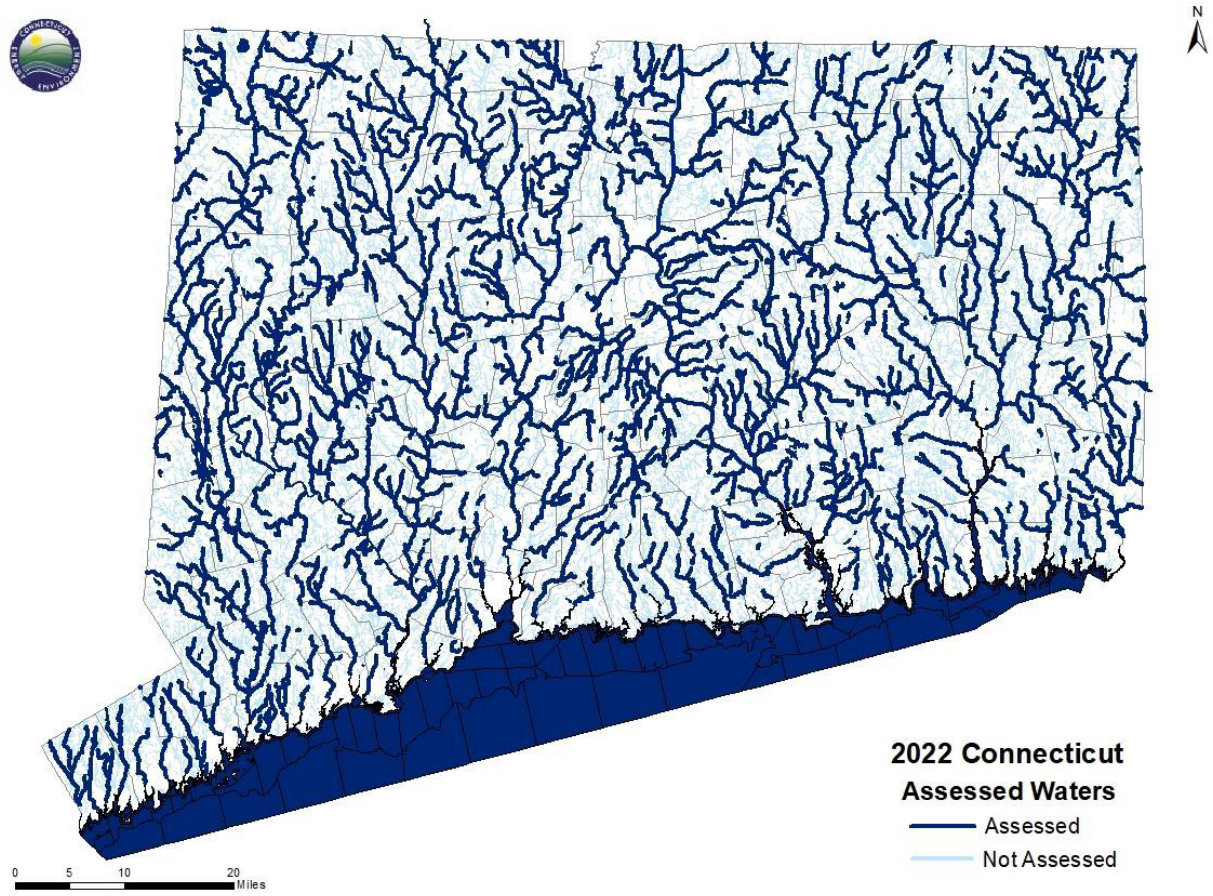


Figure 2-1. Waterbody segments assessed for one or more designated uses

Table 2-1. Designated Use support summaries for rivers, lakes, and estuaries

USE SUPPORT 2022		FULLY SUPPORTING	NOT SUPPORTING	INSUFFICIENT INFORMATION	TOTAL ASSESSED	NOT ASSESSED	TOTAL TRACKED [a]
Rivers [b]							
Aquatic Life	Segments	628	208	201	1037	255	1292
	Miles	1967.28	578.71	478.23	3445.98	421.76	3445.98
Recreation	Segments	134	270	96	500	792	1292
	Miles	549.09	843.54	236.81	1629.44	1816.54	3445.98
Fish Consumption[c]	Segments	0	14	1278	1292	0	1292
	Miles	0	110.72	3335.26	3445.98	0	3445.98
Lakes							
Aquatic Life	Segments	91	17	24	132	50	182
	Acres	23538.02	1158.9	2256.49	26953.41	3484.05	30437.46
Recreation	Segments	71	31	23	125	57	182
	Acres	16280.93	6711.7	1919.65	24912.28	5525.18	30437.46
Fish Consumption[c]	Segments	0	13	169	182	0	182
	Acres	0	3639.01	26798.45	30437.46	0	30437.46
Estuaries							
Marine Aquatic Life	Segments	42	74	5	121	90	211
	Mi^2	248.797	309.414	3.451	561.662	50.247	611.91
Recreation	Segments	55	26	3	84	127	211
	Mi^2	28.837	15.471	0.375	44.683	567.226	611.91
Fish Consumption[c]	Segments	0	4	207	211	0	211
	Mi^2	0	8.63	603.279	611.91	0	611.91
Shellfish Harvesting, Class SA Waters	Segments	11	113	0	124	10	134
	Mi^2	49.39	196.27	0	245.66	0.77	246.42
Shellfish Harvesting, Class SB Waters	Segments	20	28	0	48	12	60
	Mi^2	34.98	21.05	0	56.03	9.08	65.11

[a] "Total Tracked" refers to the waterbody sizes tracked in the ATTAINS Database. The total estuarine waters of 611.91 square miles in Connecticut are tracked, but only a fraction of river miles and lake acres are tracked in ATTAINS. Referencing the United States Geological Survey, National Hydrography Dataset at 1:24,000 high resolution scale the total number of river miles estimated for Connecticut is 7,772 and the total number of lake acres is 72,509.

[b] Probabilistic or statistical sampling is the best way to make inferences about the totals by waterbody type. CT DEEP conducts probabilistic monitoring in freshwater streams and rivers. For those results, please see Statewide Assessments using a Probabilistic Sampling Design section below.

[c] All freshwaters in Connecticut are included in the statewide limited fish consumption advisory for all freshwater fish, except trout, due to atmospheric deposition of mercury. All estuarine waters in Connecticut are included in the statewide limited fish consumption advisory on striped bass and bluefish due to PCB contamination. Waters summarized in this table as NOT SUPPORTING contain fish consumption advisories beyond the statewide advisories. See Appendix A-4 for details.

CT DEEP Waterbody Assessments, Aquatic Life Use Support

Map of Connecticut CT DEEP Waterbody Assessment Segments showing Aquatic Life Use Support

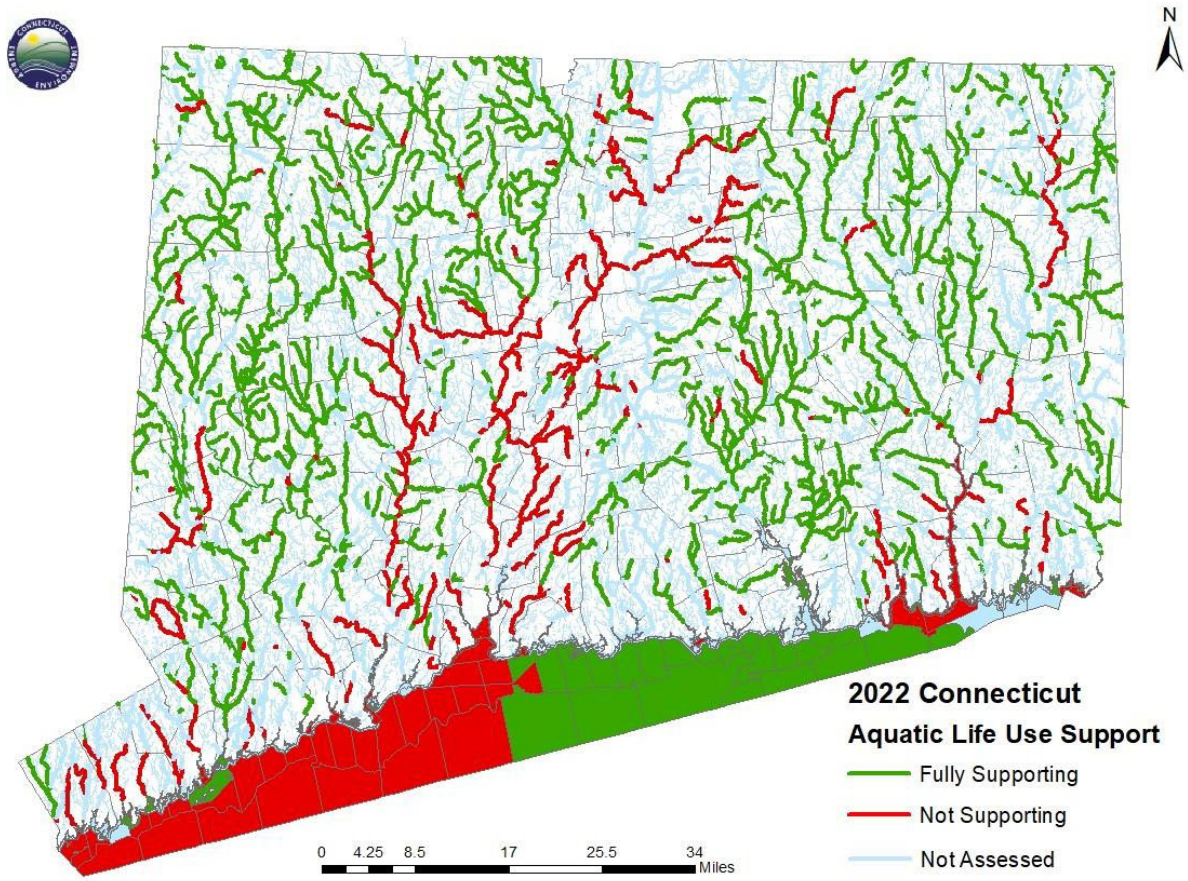


Figure 2-2. Waterbody segments assessed for Aquatic Life Use Support

CT DEEP Waterbody Assessments, Recreational Use Support

Map of Connecticut CT DEEP Waterbody Assessment Segments showing Recreational Use Support

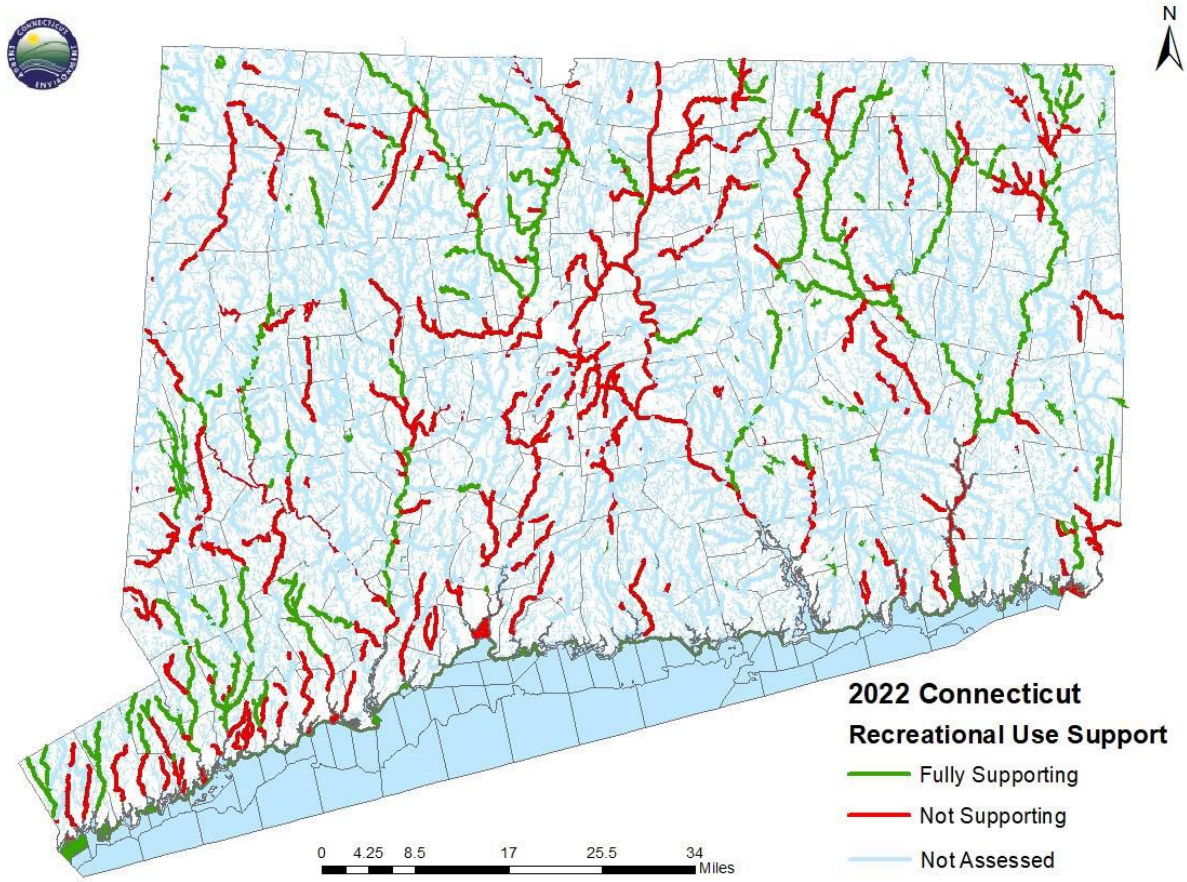


Figure 2-3. Waterbody segments assessed for Recreational Use Support

Connecticut Estuary Square Miles Assessed for Shellfish Use

Connecticut estuaries evaluated by CT DEEP for support of Shellfishing Use.

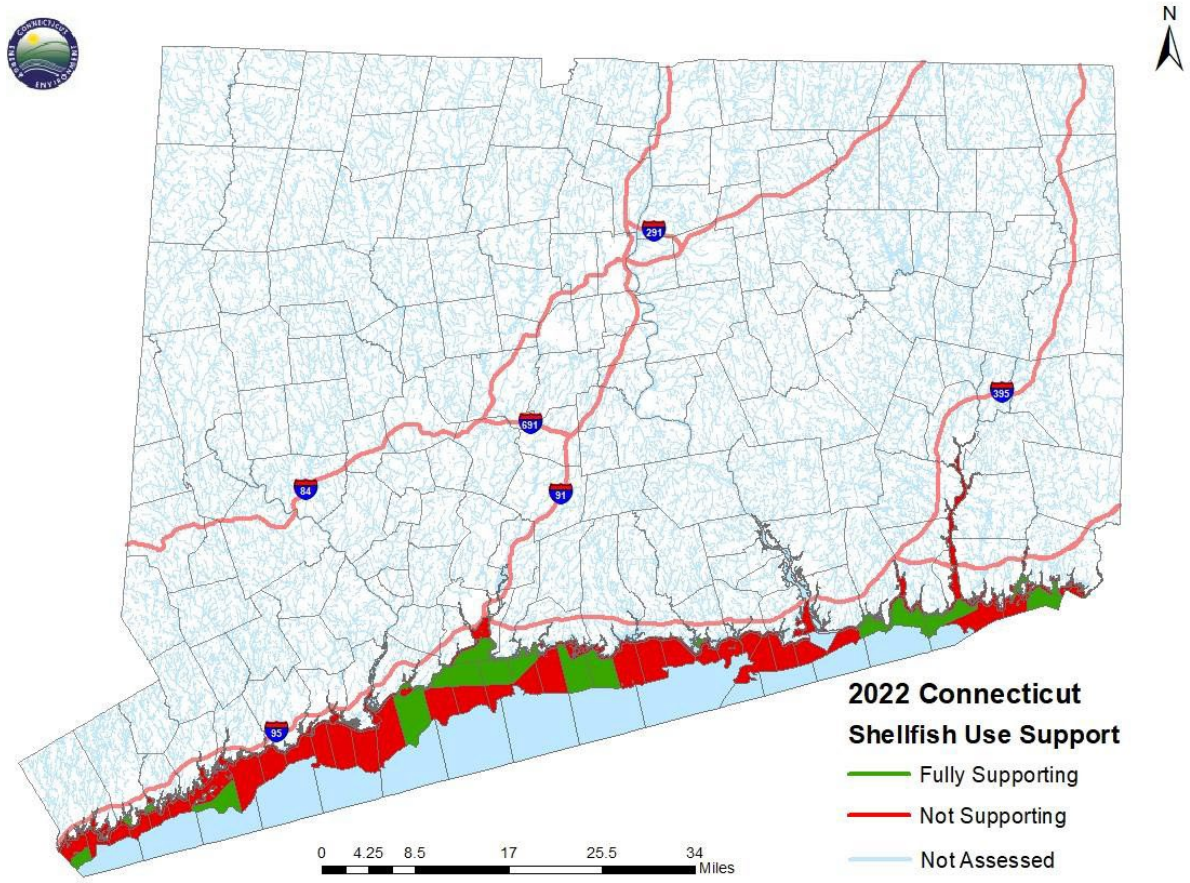


Figure 2-4. Waterbody segments assessed for Shellfishing Use Support

CT DEEP evaluated current and available monitoring data to assess Shellfishing Use Support for 312 square miles of estuary in Connecticut (Figure 2-4). An important note for shellfish in estuarine waters is assessment criteria are only applied to inner, shore, and midshore waters where growth is viable, which is approximately 50% of Connecticut's estuarine waters. Percentages are based upon the area viable for shellfish use and not the total estuarine waters in Connecticut.

Statewide Assessments using a Probabilistic Sampling Design

Probabilistic Monitoring of Rivers and Streams

Statistical surveys were implemented in accordance with Connecticut's Ambient Water Quality Monitoring Strategy (CT DEEP 2015) to characterize use support in wadeable streams for aquatic life and recreation on a statewide basis. A Generalized Random Tessellation Stratified (GRTS) survey design (Stevens and Olsen 2004) was provided to CT DEEP from EPA and implemented with a target population of streams based on the National Hydrography Dataset at the 1:24,000 scale. No stratification was included in the survey design.

A total of 62 wadeable stream sites were sampled in 2011-2015 to obtain a statewide estimate of aquatic life use attainment. In 2017, these stream samples were evaluated and summarized for Aquatic Life Use support assessment (Table 2-2) resulting in 76% Fully Supporting and 24% Not Supporting the statewide statistical assessment for aquatic life in wadeable streams.

Table 2-2. CT DEEP Probabilistic Monitoring Aquatic Life Use Support in Wadeable Streams Summary

Use Support Category	Percent of Target	Standard Error	Upper and Lower 95% Confidence Intervals
Fully Supporting	76	4.3	67.3-84.3
Not Supporting	24	4.3	15.7-32.7

Drinking Water Use

Connecticut has 1 waterbody assessed as not supporting drinking water use. The segment CT5112-00_02, named Farm River (North Branford)-02 is a 1.24-mile section of the Farm River described as from the confluence of Burrs Brook just downstream of the Route 80 crossing, upstream to Pages Mill Pond outlet dam (Upstream side of Mill Road crossing, North Branford). Issues in this watershed are heavily influenced by commercial operations and are being reviewed and evaluated to identify best management practices to support water quality improvements.

Chapter 3 - Waterbodies Identified for Restoration and Protection Strategies Pursuant to Section 303 of the Clean Water Act

Background Information

In authorizing the Clean Water Act, Congress declared as a national goal the attainment, wherever possible, of "water quality, which provides for the protection and propagation of fish, shellfish and wildlife and provides for recreation in and on the water". This goal is popularly referred to as the "fishable / swimmable" requirement of the CWA. In 1967, predating the CWA, the State of Connecticut adopted Water Quality Standards as required under Section 22a-426 of the Connecticut General Statutes to accomplish this and other water quality goals.

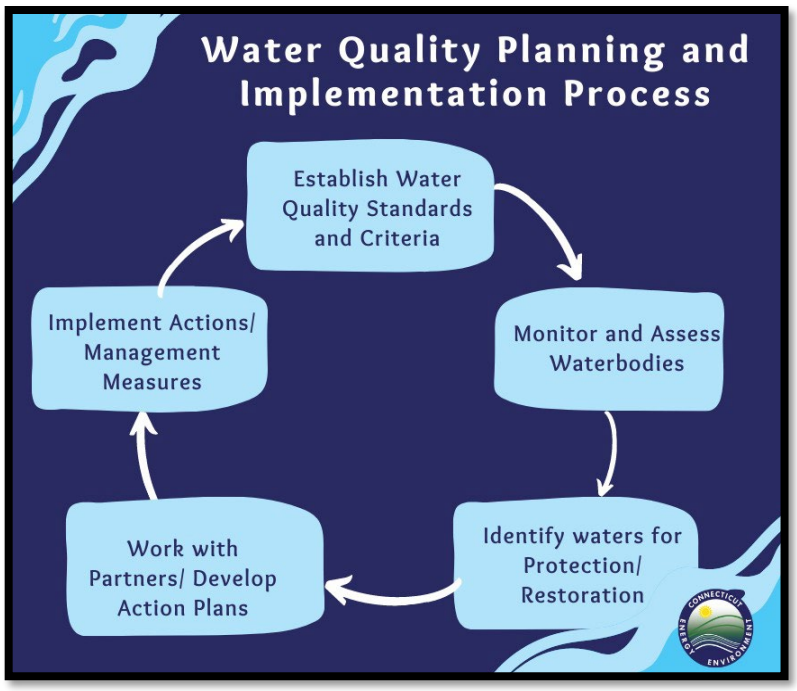


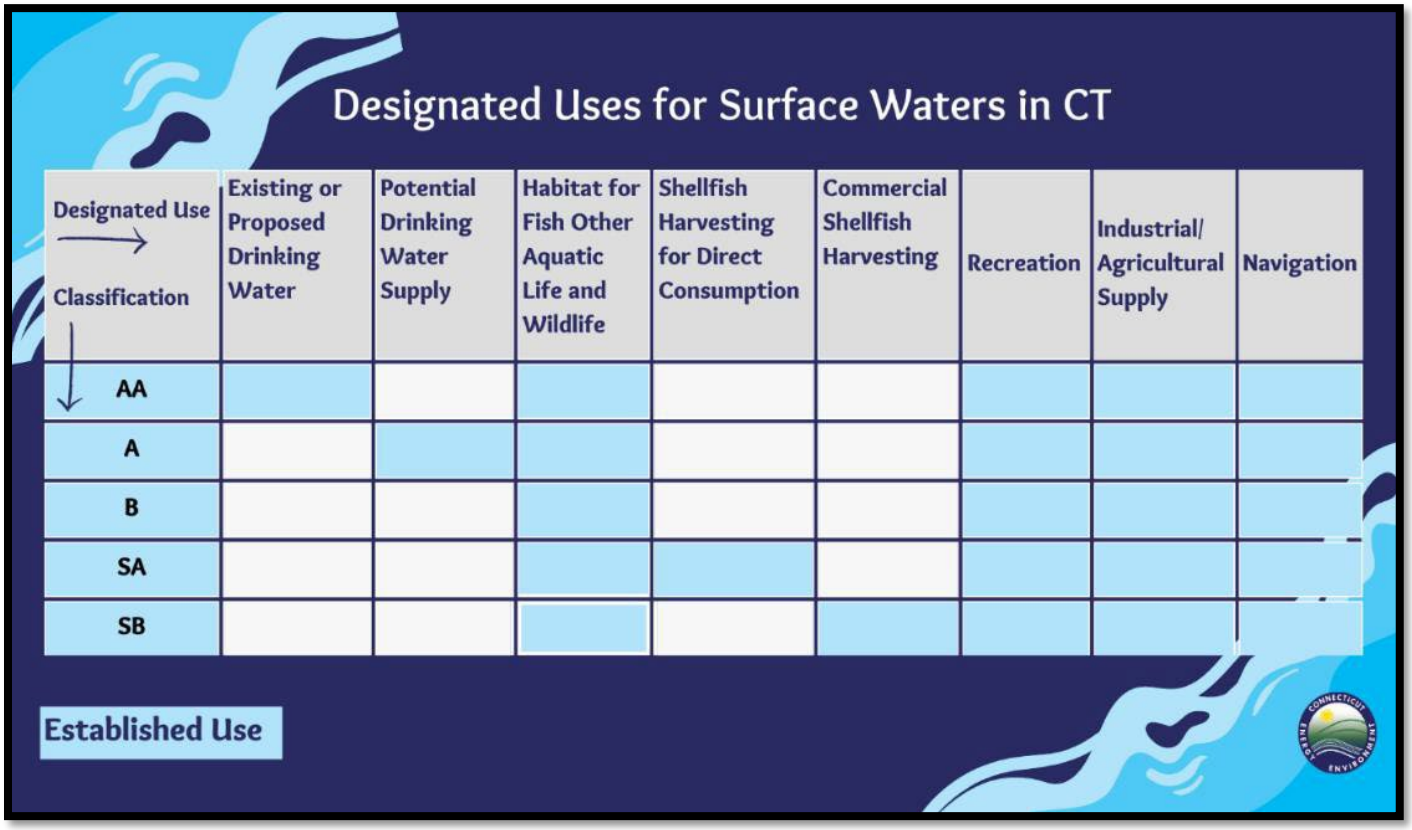
Figure 3-1 Water Quality Planning and Implementation Process

Using the information that is provided by the assessment of surface water quality described in Chapters 1 and 2 of the document, CT DEEP evaluates CT surface water bodies for the development of restoration and protection plans in accordance with section 303 of the Clean Water Act (CWA).

The water quality planning process includes: 1) adoption of Connecticut Water Quality Standards (CT WQS); 2) monitoring and assessment of surface waters to evaluate consistency with those standards; 3) evaluating and prioritizing those waters for development of action plans; 4) working with partners and stakeholders to develop action plans; and 5) implementation of action plans, achieving consistency with the CT WQS illustrated in figure 3-1.

There are two elements of the CT WQS critical to the development of restoration or protection strategies. They are 1.) the establishment of waterbody designated uses (Table 3-1), and 2.) the specified narrative and numeric Water Quality Criteria and Standards to protect and support those uses. Physical, chemical, and biological monitoring data or other applicable information is compared to the Water Quality Criteria and Standards to assess whether a waterbody is meeting the attainment of designated uses discussed in Chapter 1 (CT CALM). Table 3-1 describes the designated uses that are associated with each Water Quality Classification for surface waters in Connecticut.

Table 3-1 Designated Uses by Water Quality Classification



Designated Uses for Surface Waters in CT

Designated Use → / Classification ↓	Existing or Proposed Drinking Water	Potential Drinking Water Supply	Habitat for Fish Other Aquatic Life and Wildlife	Shellfish Harvesting for Direct Consumption	Commercial Shellfish Harvesting	Recreation	Industrial/ Agricultural Supply	Navigation
AA								
A								
B								
SA								
SB								

Established Use

Integrated Water Resource Management

Connecticut initiated Integrated Water Resource Management (IWRM) to improve the effectiveness of the Department's water quality restoration and protection planning actions. This effort is a collaboration between the states and EPA to develop enhancements to the 303d Program, within the current framework of the Federal Clean Water Act. This approach is referred to by EPA as the "Long-Term Vision for Assessment, Restoration and Protection under the Clean Water Act Section 303(d) Program" or the 303d Vision in short.

The foundation of Integrated Water Resource Management is to identify water quality focus areas and waters for protection and/or restoration Action Plan development. Alternative approaches can be tailored to the specific water quality concerns and pollution sources for a waterbody. The 303(d) Program at CT DEEP broadly collaborated within CT DEEP and with outside partners and the public to identify these focus areas.

Protection Plans protect water quality by preserving waters that are not impaired but are meeting water quality standards for their Designated Use. CT has worked with various stakeholders in the Natchaug Watershed and is drafting CT's first Water Quality Protection Plan which will be available for public comment in the coming months. More detail is provided on the Integrated Water Resource Management web page.

Determining Causes and Sources of Impairment

Monitoring and assessment data used to determine the attainment of CT WQS and designated uses are generally insufficient to provide specific indication of causes or sources of impairment or potential sources of stress to a water body. The causes and sources contributing to waterbody impairments or stress can best be determined through a stressor identification study conducted in support of development of TMDLs or alternative approaches. Once a segment is designated for development of a TMDL or other restoration plan, an investigative study is conducted to identify causes and sources of impairment. These investigations may include

more intensive ambient water quality sampling, aquatic toxicity studies, sediment or fish tissue analysis, dilution calculations of known discharges or other evaluations.

General information, where available, can help to identify sources potentially contributing to the observed impairments. For example, there are circumstances that are generally prone to contribute pollutants to waterbodies which may have an impact on designated uses. Some examples are described in the following paragraphs. Bacterial contamination that poses a risk to human health can originate from waterfowl, wildlife, domestic animals (dogs, horses, poultry, swine and cattle) and human waste from malfunctioning septic systems, private/public sewers, and sewage discharges from watercraft. Potential sources of bacteria recognized by US EPA include Non-Point Source Pollution, Urban Stormwater, Sources Outside State Jurisdiction or Borders, Illicit Connections/Hook-ups to Storm Sewers, Combined Sewer Overflows, and Municipal Point Source Discharges.

Land uses can contribute pollutants that vary depending on the type of land cover or activity. Developed areas whether industrial, commercial, residential or urban can contribute pollutants through stormwater runoff. These pollutants originate from human activities that generally include heavy metals, nutrients, and petroleum-based products. Impervious cover, stormwater drainage systems and over land flow are primary factors in the transport of these pollutants to surface waters. Small and large agricultural operations can contribute nutrients, pesticides, bacteria and sediment to surface waters.

Point Source Discharges are regulated by the state through applicable wastewater discharge permits. Industrial and municipal permittees may generate wastewater that is treated and discharged to a waterbody which has been determined to have a specific discharge assimilative capacity. However, short-term discharge violations of the permit limits can occur due to equipment malfunction, changes to wastewater processes and human error. The pollutants contributed to surface waters vary depending on the type of wastewater generated.

Industrial contamination occurs in Connecticut which has had a long history of industrial activities such as textiles, firearms, glassware, metal finishing, and much more. Unfortunately, historical contamination from many industrial activities contributed pollutants directly to surface waters and sediments as well as groundwater which eventually discharge to surface water. Many sites have been remediated by eliminating the contaminant source, but others remain or need further investigation to determine the contaminant(s) that may be present and may be contributing to impairments.

Some of the more common sources of stressors associated with the various use impairments are identified in Table 3-2. Reporting the sources of impairment is not a listing requirement of Section 303(d) and is not subject to US EPA review and approval. As stated above, identifying sources is most appropriately done within a TMDL or similar evaluation. Generally, the identification of potential sources is not comprehensive, however in certain situations a source of an impairment could be identified if the weight of evidence is more conclusive. Source contributions will be refined within the stressor identification and TMDL/Action Plan development process.

Table 3-2: Summary of Designated Uses with Common Stressors

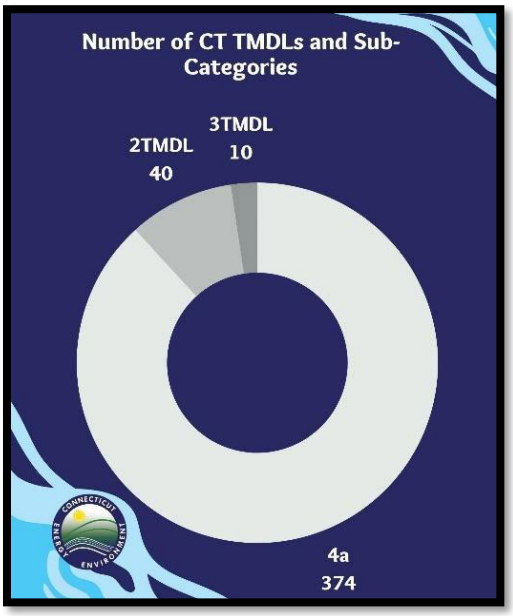
Summary of Designated Uses with Common Stressors

Impaired Use	Examples of Common Stressors	Examples of Common Sources	Potential Stressors Types		
			Chemical	Physical	Biological
Existing or Proposed Drinking Water	Bacteria	Stormwater, illicit discharges, agricultural runoff	x	x	x
Fish Consumption	Mercury, PCBs, Pesticides	Atmospheric deposition, industrial discharges, municipal wastewater treatment discharges hazardous waste sites, oil and chemical spills, land use, stormwater	x	x	
Marine and Freshwater Habitat for Fish, Other Aquatic Life and Wildlife	Habitat alterations, flow regime changes, Toxics, Nutrients, Interactions between multiple pollutants, Low Dissolved Oxygen, other pollutants	Industrial discharges, municipal wastewater treatment discharges hazardous waste sites, oil and chemical spills, land use, stormwater	x	x	x
Recreation	Bacteria	Stormwater, illicit discharges, agricultural runoff	x	x	x
Shellfish Harvesting for Direct Consumption	Bacteria	Stormwater, illicit discharges, agricultural runoff		x	x
Commercial Shellfish Harvesting	Bacteria	Stormwater, illicit discharges, agricultural runoff		x	x

CT Water Quality Management Plans in Place

As previously mentioned in Chapter 1 of this document, Category 4 has been assigned to waterbodies where the planning and implementation of pollution control and management measures have been initiated with the expectation to achieve CT WQS attainment. This section describes categories 4a, 4b and 4c.

Segments assigned to US EPA Category 4a

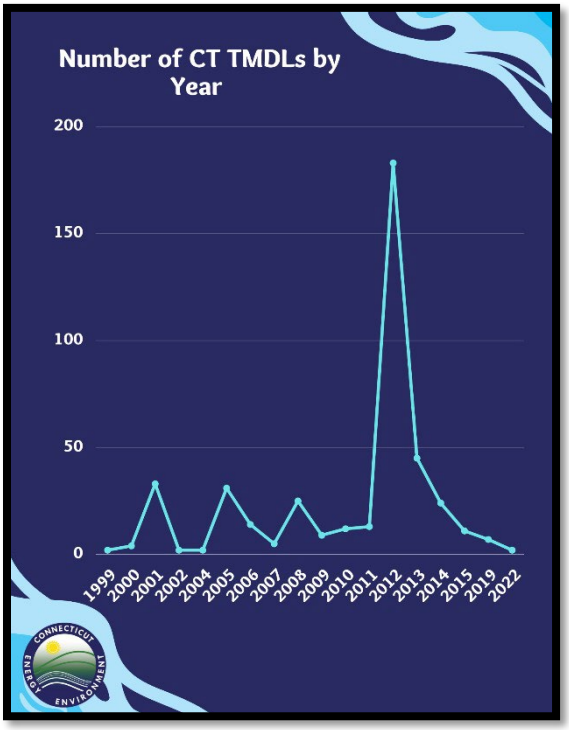


Water quality for many Connecticut waterbodies is being addressed in various pollution control and management programs within CT DEEP. Information about waters for which TMDLs have been established and approved by USEPA is provided as Appendix B-2. This includes impaired segments in EPA Category 4a (*Impaired waters with adopted TMDLs)* for which a TMDL has been established but water quality has not yet been restored. A TMDL is specific to a designated use and impairment cause, so segments can have a number of TMDLs for each designated use and/or cause. Figure 3-2 shows the number of TMDLs where the impairment is restored, however the TMDL document or implementation management plan remains in effect to ensure protection of designated uses in the waterbody.

Figure 3-2 Number of CT TMDLs in Subcategories

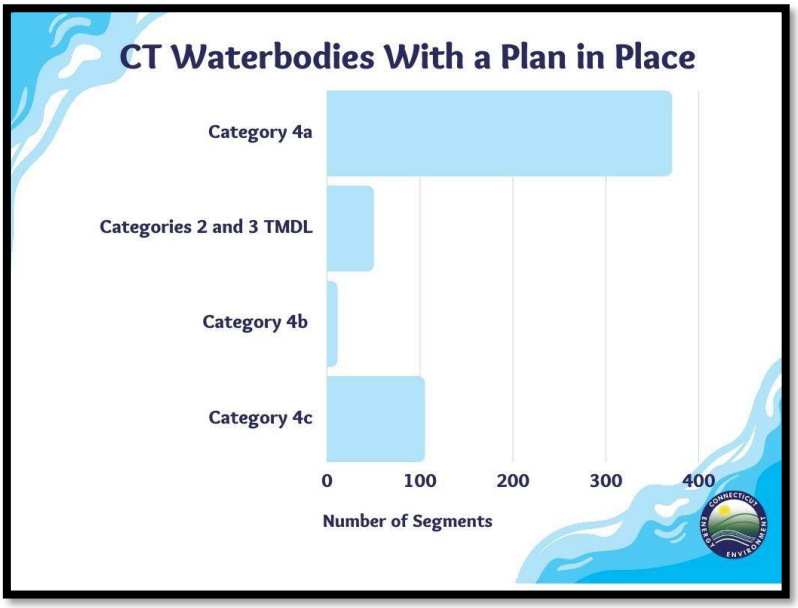
These segments are in either category 2 or 3 TMDL and not category 4a. Please refer to the Connecticut Assessment and Listing Methodology section for more details regarding CT Sub-Categories for Water Quality Plans.

Figure 3-3 Number of CT TMDLs by Year



For the 2022 cycle there are a total of 424 established TMDLs on CT waterbody segments, 374 of which have impaired designated uses within Category 4a, 40 segments within category 2 TMDL and 10 segments in category 3TMDL. Figure 3-8 depicts the cumulative development of TMDLs for Connecticut waterbodies over time, since 1999. In recent years, there was an increase in established TMDLs mostly due to a number of bacteria TMDLs. Connecticut was able to establish a more efficient process for developing bacteria TMDLs. TMDLs for over 180 waterbody segments were developed in 2012 and 2013. However, there is a sharp decline in TMDL development after 2015. During this time, CT DEEP worked to develop new Water Quality Planning approaches including the IWRM process, development of statewide modeling efforts to support nutrient related water quality analyses that are currently underway, in response to CT 303(d) program focus areas and Long Island Sound initiatives, development of updates for future bacteria TMDLs as well as development of new approaches for water quality protection planning. The program was also affected by staffing shortages for several years during this period. Connecticut is currently developing TMDLs for over 87 segments, which includes 53 new freshwater segments, 16 revised freshwater segments, and 18 new marine water segments for bacteria which will be reflected in the 2024 cycle.

Figure 3-4 CT Waterbodies with a Plan in Place



Segments assigned to US EPA Category 4b

Pollution Control Measures for Waterbody Segments are provided as Appendix B-3 and includes a description of the non TMDL-based pollution control requirements expected to result in full attainment of CT WQS. Examples of other pollution control requirements include Consent Orders, Combined Sewer Overflow Control Plans, Remedial Action Plans, Restoration Plans, other plans or studies where activities in progress are expected to result in attainment of the applicable water quality standards and designated uses. Waters are not assigned to this category unless there is reasonable assurance that compliance with the requirements will result in attainment of uses and there are provisions for follow-up monitoring to track progress.

In the event that follow-up monitoring indicates that the other pollution control requirements will fall short of achieving the goal of attaining standards, segments will be reassigned to Category 5 for TMDL development. There are many other waters, not listed under Category 4b, for which water quality-based pollution control measures have been established. There are a variety of these alternative measures, such as water quality-based permitting or ecological risk assessment activities. These efforts are designed to support restoration or protection of water quality but may not be selected for inclusion in Category 4b.

Category 4c nonpollutant causes include waterbodies that are impacted by flow alterations.

Information on the segments identified in US EPA Category 4c with impairment not due to a pollutant is provided as Appendix B-4. The Clean Water Act defines pollution as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water". In this case, the pollution is not from a chemical contaminant, but it is from a human impact. While a TMDL is not typically prepared for 4c waters, this type of pollution does require management measures to meet the applicable water quality standards. Some examples of this pollution include flow alterations, stream channelization, and invasive species. For more information, please refer to the Streamflow Regulations in CT.

CT DEEP has developed a methodology for assessing flow impairments when sufficient information is available (Aquatic Life Use - Rivers and Streams, Assessment Methodology, p.16). CT DEEP previously reported the cause of these types of flow impaired waters as “other flow regimes” or “flow alterations” based on the reporting structure that was available at the time. However, the term “other flow regimes” does not accurately reflect the impairments which are predominantly due to flow alterations that serve public needs and safety. While the historical assessments remain the same, US EPA has modified the reporting structure such that “other flow regimes” and “flow alterations” were consolidated into the term “flow regime modification”. For this report cycle, Connecticut waterbodies with flow impairments were reported in Category 4c as a “flow regime modification” impairments.

Appendix B-4 of Category 4c segments is not to be considered a comprehensive listing of all impaired segments in this category. Current assessment protocols have not covered the entirety of waterbodies across the State of Connecticut to determine all impairments due to nonpollutant sources.

CT Action Plans Currently in Development

This report identifies waters where Action Plans are currently in development and will be completed within the next two years (2022-2024) in Appendix C-1. Appendix C-2 identifies Action Plans that will be in development prior to 2024. CT DEEP continues to work in support of key statewide 303(d) Program initiatives including CT DEEP’s Second-Generation Nitrogen Strategy for the Long Island Sound TMDL, the Statewide Bacteria TMDL, other projects identified under Integrated Water Resource Management and the cleanup of the Housatonic River as a result of PCB contamination. The waters listed in Appendix C-1 were selected because they were either part of long-standing projects or sufficient data, information and resources were available to initiate or continue development of action plans during the next two years. Despite CT DEEP’s focus on the selected water bodies for action plans, some level of water quality program effort will continue for all waters of Connecticut. Not all efforts require the development of a new plan under Section 303(d) of the Clean Water Act. This includes other program work in CT DEEP, assistance from Department staff and sharing resources with non-government organizations and municipalities, as they are available. Projects already underway will continue. In addition to the waters identified in the List of Waters for Action Plan Development in Appendix C-1. CT DEEP also, supports various implementation programs such as the Watershed Management Program, as well as State NPDES permitting and Remediation Programs through development of risk-based approaches to water quality restoration and protection. A summary of the status of water quality-based plans identified for development under Section 303(d) of the Clean Water Act is provided below in Table 3-2. These waters are also placed in the various lists associated with this report based on water quality assessment information and the status of plan

development. For more information on the listing process, please refer to the listing guidance provided in Chapter 1 of this report.

The review of water quality focus areas and identification of waters for plan development is updated periodically, including a public process for review and comment, both through the Integrated Water Quality Report and Integrated Water Resource Management processes. The next Integrated Water Resource Management review period is expected in 2023.

Table 3-2. Status of Water Quality Plan Development Under Section 303(d) of the Clean Water Act

TMDLs	
Bacteria TMDLs	An update to the Statewide Bacteria TMDL is currently in development. In addition to updating the core document, TMDLs are indevelopment for waterbodies identified in Appendix C-1.
TMDL Revision for Rainbow Brook and Seymour Hollow Brook	A revised TMDL for Rainbow Brook and Seymour Hollow Brook is currently in development. The TMDL will address water quality-based loadings necessary to protect aquatic life from exposures to de-icing compounds. Information on other nearby waterbodies and other pollutants such as chlorides and metals will also be reviewed to determine if load allocations for these waterbodies or parameters should also be included in the revised TMDL. See table C-1 for more information.
Lake Nutrient TMDL	A new TMDL approach based on a translation of narrative criteria for lakes in the Water Quality Standards and using watershed and water quality modeling to develop a Statewide Lake TMDL for Nitrogen and Phosphorus was completed in 2021. A TMDL for Bantam Lake was established at that time. Additional TMDLs for other lakes will be developed in the future. See table C-1 for more information.
Pawcatuck Watershed& Estuary and Little Narragansett Bay Nutrient TMDL	CT DEEP is working in collaboration with Rhode Island Department of Environmental Management, to develop and implement a new TMDL approach using HSPF watershed modeling to evaluate nutrient conditions in upland watersheds and to identify and evaluate sources contributing nutrients to the tidal estuaries of the Pawcatuck River and Little Narragansett Bay. Results from the upland model will be linked to estuary WASP and EFDC models to evaluate nutrient impacts on water quality indicators such as dissolved oxygen and water clarity. This project is supported in part by a grant from the Southeast New England Program (SNEP), which is funded by the U.S. EPA in collaboration with Restore America's Estuaries. (*www.snepgrants.org*) Monitoring in the upland area by USGS has been completed along with the HSPF model. The WASP and EFDC models for the estuary is in development at the EPA Atlantic Coastal

	Science Environmental Laboratory. More information can be found the Pawcatuck Watershed Nutrient Project website. See table C-1 for more information.
Other Estuaries	Efforts are on-going to extend the approach developed for the Pawcatuck Watershed/Estuary and Little Narragansett Bay to other coastal embayments in Connecticut identified for plan development through Integrated Water Resource Management. Data collection and model development is underway to develop an updated HSPF model for the rest of Connecticut. Studies have been conducted to evaluate water quality data and modeling needs for embayments across Connecticut. Data collection for the Mystic River and Norwalk River estuaries is underway. Data collection is planned for the Southport and Saugatuck Harbor estuaries this year. This effort also supports CT DEEP's Second-Generation Nitrogen Strategy for the Long Island Sound TMDL. See table C-1 for more information.
Protection Plans	
Natchaug River Watershed	In collaboration with the CT DEEP Water Planning and Management Division, a protection plan for these watersheds is in development. This plan supports the implementation analysis previously conducted by the Eastern Connecticut Conservation District in collaboration with CT DEEP. The goal is to develop and implement an approach that can be translated to other watersheds identified for protection activities. This work is supported in part by a Healthy Watersheds grant from EPA. See table C-1 for more information.
Niantic Watershed	A protection plan will be developed for this watershed based on previously conducted local studies and analysis conducted by the Niantic Estuary Workgroup. The plan is expected to address nutrient impacts on the Niantic River Estuary.

Alternative Water Quality Restoration Plans	
Phosphorus Discharges To Freshwater Wadable Streams	A TMDL Alternative Plan is in development using a "straight to implementation approach" which documents water quality based permitting efforts to address phosphorus discharges to nontidal fresh waters through the NPDES permitting program, focusing on discharges from sewage treatment plants and stormwater. See table C-1 for more information.
Remediation Projects	A TMDL Alternative Plan is in development using a "straight to implementation approach" which documents efforts to address contaminated surface waters,

Alternative Water Quality Restoration Plans	
	groundwaters and sediments at certain sites through Remediation Program activities. See table C-1 for more information.
Impervious Cover Watershed Response Plan	A TMDL Alternative Plan is in development using a "straight to implementation approach" which documents efforts to address the impacts of stormwater on water quality through Impervious Cover Watershed Response Plans as well as the stormwater permitting program. See table C-1 for more information.

Figure 3-5. CT Selected Waters for Action Plan Development for Bacteria (does not show waterbodies chosen for Alternative Action Plan Development.)

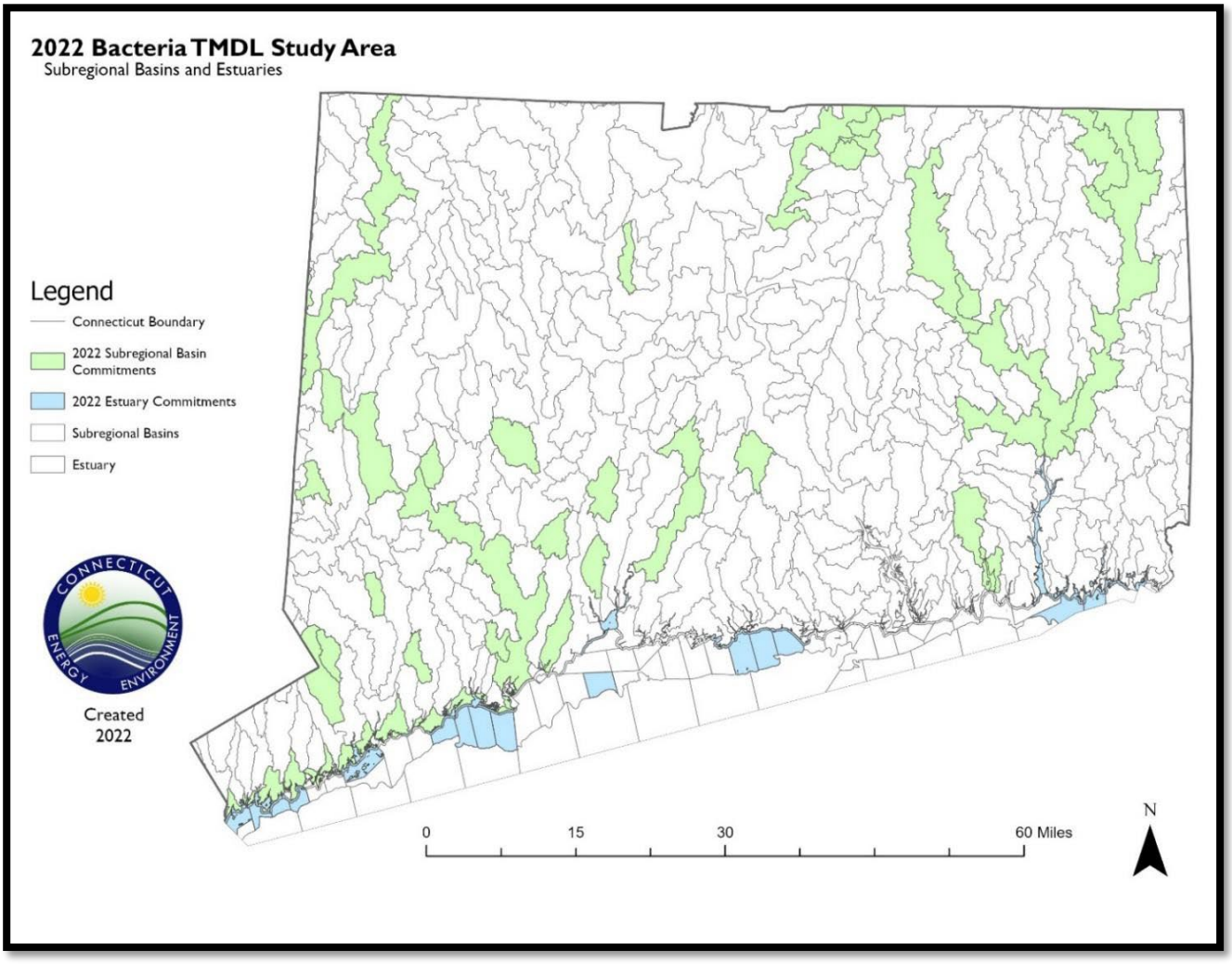
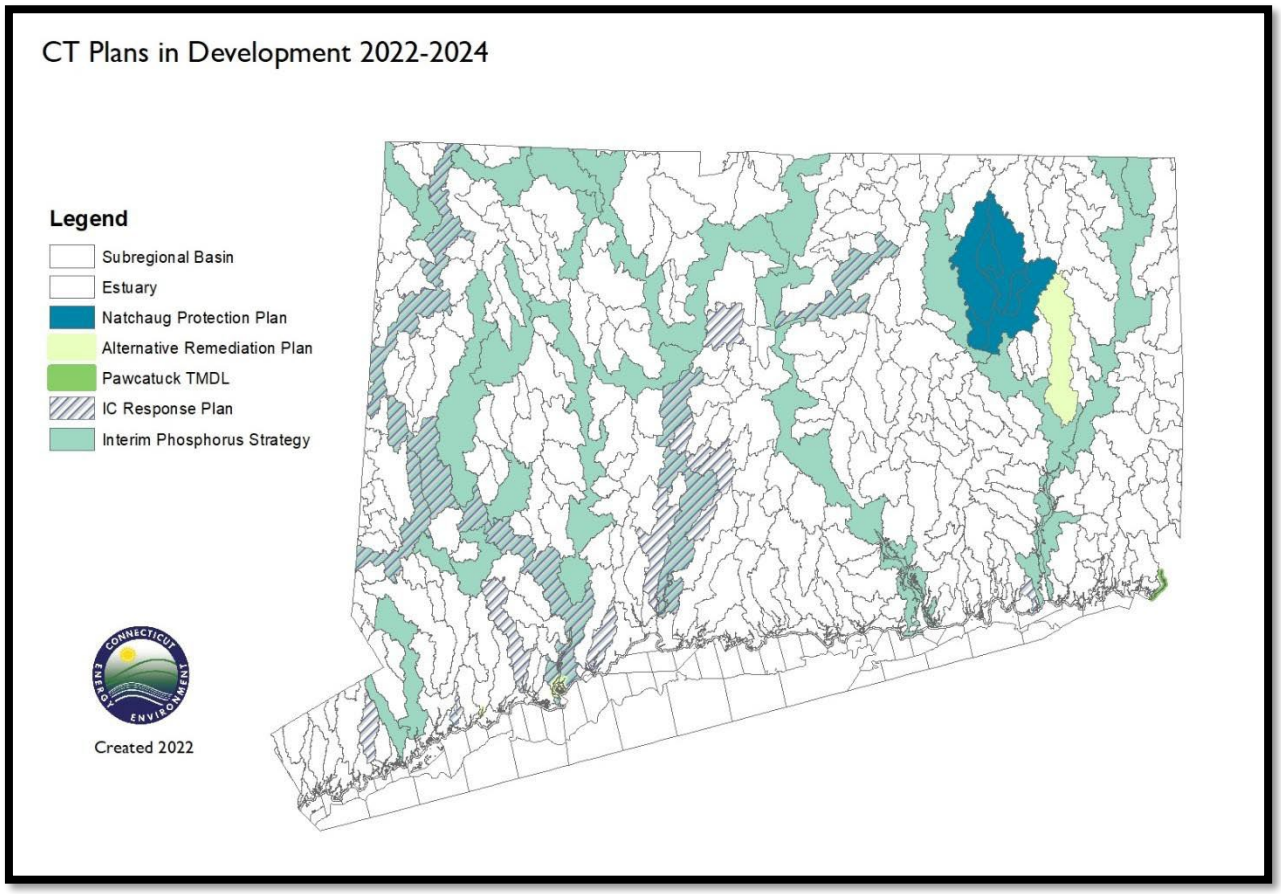
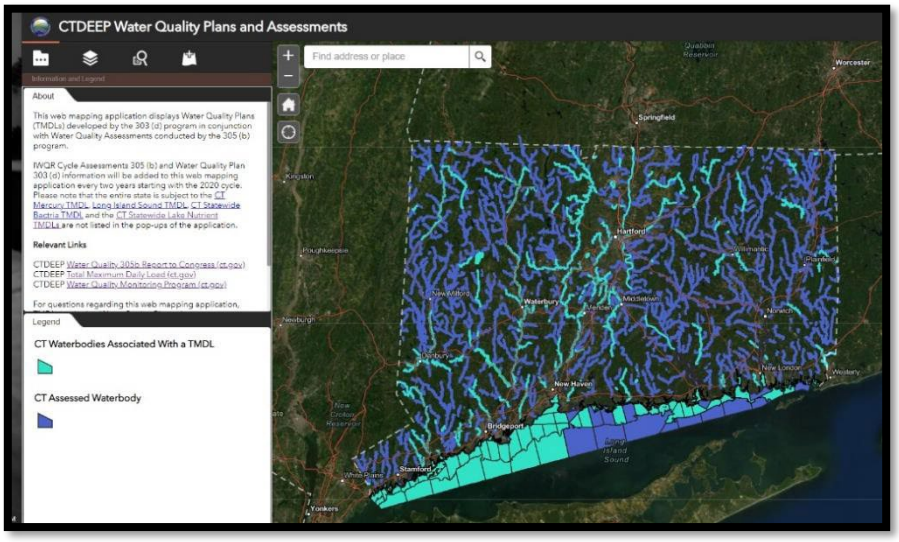


Figure 3-6 Alternative/Protection Action Plan Development 2022-2024



Water Quality Assessments and Plans Web Mapping Application

New to the 2022 IR cycle, CT DEEP has created an interactive web mapping application for users to view and download 305 (b) and 303 (d) geospatial information. The application will also allow users to add their own geographic data for analysis. The application contains 2020 IR information and will reflect future IR cycles however, it will not reflect cycle data prior to 2020.



Public Engagement and Outreach

The 2022 IWQR document was noticed for public comment on **June 6, 2022,** the comment period was open from **June 6, 2022 to July 6, 2022.** Notice of the public comment period was placed on **June 6, 2022**, in the following newspapers; **The Connecticut Post, The Hartford Courant, The New Haven Register, The Day, Waterbury Republican-American, and The Advocate.** A copy of the public notice document was signed by the WPLR Bureau Chief (Graham Stevens) and posted on the IWQR webpage. In addition, environmental groups, tribal nations, and municipal officials and other interested parties maintained on our general mailing list were notified by email of the comment period. A list of all people notified by email was documented and submitted to the EPA upon approval and signature of the Final 2022 IWQR document by WPLR Management. There was be two social media postings on **June 6, 2022** on the CT DEEP Facebook and Twitter accounts.

A public informational meeting took place on **June 15, 2022 from 10:30 a.m. - 12:00 p.m.** via ZOOM. All comments were received by Rebecca Jascot at **DEEP.IWQR@ct.gov** and summarized. Various programs in WPLR, including Water Quality, Water Quantity, Monitoring, and the Dam Safety Program assisted with comments as necessary.

The meeting recording and presentation slides are posted on the IWQR webpage. All original received comments will be linked to the commenter's name in a Response to Comments Document after the Public Comment Period has closed.

IWQR Appendices

In previous report cycles, many of the tables (Assessment Results, TMDLs approved, Impaired Waters, etc.) were found within the report as one large electronic file, but now these tables are included as appendices and as separate electronic files for this report cycle. The list of appendices can be found in the Table of Contents (p. iii) of this report.

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