State of the Waters: Cape Cod

2021 Cape Cod Water Health Report and Action Plan

Association to Preserve Cape Cod
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Website: Cape Cod Waters.org (https://capecodwaters.org)

1. Introduction

The **State of the Waters: Cape Cod** is an annual assessment of the Cape's water quality, designed to help you understand the water quality problems that we face and the actions that are needed to address these problems. The Association to Preserve Cape Cod (APCC) launched this project in 2019 in order to answer the question: "How healthy are Cape Cod's waters?" The State of the Waters: Cape Cod website is the place to find out about the Cape's water quality and what can be done to address water pollution and achieve clean water.

This is a multi-year project in which an annual water health report is provided each year assessing the most recent available water quality data up to and including the previous year (e.g., this report assesses available water quality data up to and including 2020). To prepare annual assessments and reports, APCC collected existing data on water quality on Cape Cod in order to assess the health of Cape Cod's waters. APCC evaluated surface water quality in coastal waters (saltwater) and freshwater ponds and lakes using scoring methods to assess water quality. Scores were assigned into two grade levels for water quality to distinguish between degraded surface waters with unacceptable water quality where immediate action is needed to restore water quality vs. surface waters with acceptable quality where ongoing protection is needed to avoid a decline in quality. The results are summarized in this annual water health report. The quality of public drinking water supplies was assessed on a Poor/Good/Excellent scale. To guide public action, APCC prepared a Water Action Plan that contains recommendations for changes in policies, actions, and regulations to improve and protect our waters.

2. Why This Project is Needed

APCC is well-positioned to provide this Cape-wide assessment of our water quality. Since our inception in 1968, APCC has worked with numerous partners to protect and improve the Cape's water resources and aquatic habitat through policy, science, and education. APCC's successes include:

- Designation of Cape Cod's groundwater as a sole source aquifer to protect our drinking water;
- Designation of the ocean waters around Cape Cod as state ocean sanctuaries;
- Designation of Stellwagen Bank as a National Marine Sanctuary;
- Passage of the Cape Cod Land Bank Act to preserve open space;
- Creation of the Cape Cod Water Protection Collaborative to address water pollution due to wastewater;
- Passage of the Cape Cod Commission Act to create a regional planning agency and promote regional planning;
- Designation of the ocean waters surrounding Cape Cod as a No Discharge Area for boat sewage;
- Coordination of Congressional authorization and funding of the Cape Cod Water Resources Restoration Project, a 10-year Cape-wide restoration program to restore impaired salt marsh and fish runs and shellfish beds;
- Assistance to towns on efforts to restore salt marsh and fish runs and remediate stormwater runoff throughout the Cape;
- Coordination of a regional stormwater partnership;
- Establishment of programs to monitor salt marsh, herring runs and harmful cyanobacteria blooms;
- Evaluation of the effect of future sea level rise on the Cape's aquifer; and
- Passage of legislation creating and funding the Cape and Islands Water Protection Fund.

APCC recognized that while the Cape's waters are well-studied and pollution issues are well-documented, this wealth of information on water quality is usually buried in reports, studies and websites and is not readily available in one place. More importantly, the data are often not translated into clear, easily understood results. Too often, reports that contain gold nuggets of information are mired in complex terminology understood, and seen, only by experts.

3. Goals

APCC's State of the Waters: Cape Cod report is intended to plainly and clearly inform the public about the conditions of our waters. APCC collects water quality data from credible sources and translates the data into clear, easily understood terms in order to identify water quality problems that need to be addressed. Our goals are to: 1) Help people to understand the health of our waters and the need to protect and improve water quality; 2) Identify the actions needed to protect and improve water quality; and 3) Motivate public action to achieve clean water.

4. Products

APCC has produced the following products for the State of the Waters, available through the State of the Waters website at https://capecodwaters.org:

- Interactive maps of water quality scores and grades for coastal embayments, ponds, and drinking water supplies;
- Information on how water quality data were evaluated, scored and graded;
- Annual Water Health Reports summarizing findings;
- Water Action Plan containing recommendations for actions to protect and improve water quality;
- Atlas of Water Restoration Needs and Solutions;
- Frequently Asked Questions (FAQs); and
- References and sources of information.

5. Partners and Collaboration

Collaboration with partners is an essential feature of the State of the Waters: Cape Cod, as the project involves a gathering and summation of water quality data from many organizations. Partners also provide advice, support, funding, information, and networking.

Advisory Committee: To help advise this project at its inception, APCC convened an Advisory Committee composed of experts in Cape Cod's water pollution issues, water monitoring, drinking water, aquatic ecosystems, fisheries, natural resource management and municipal management. Members represent local, regional and state agencies, environmental nonprofit organizations, and partnerships. Advisory Committee members provide advice, guidance, and data used in this project. Members of the Advisory Committee are listed below:

- Rachel Jakuba, Ph.D., Science Director, Buzzards Bay Coalition
- Erin Perry, Deputy Director, Cape Cod Commission
- Tim Pasakarnis, Ph.D., Water Resources Analyst, Cape Cod Commission
- Richard Delaney, President, Center for Coastal Studies
- Amy Costa, Ph.D., Director of Cape Cod Bay Monitoring Program, Center for Coastal Studies
- Robert Duncanson, Ph.D., Director, Department of Natural Resources, Town of Chatham
- Jane Crowley, Director, Department of Health and Environment, Town of Eastham
- Ivan Valiela, Ph.D., Distinguished Scientist, Ecosystems Center, Marine Biological Laboratory
- Javier Lloret, Ph.D., Research Scientist, Ecosystems Center, Marine Biological Laboratory
- Andrew Marks, Supervisor, Mashpee Water District
- Pam DiBona, Executive Director, Massachusetts Bays National Estuary Program
- Prassede Vella, Staff Scientist, Massachusetts Bays National Estuary Program
- Todd Callaghan, Coastal and Marine Scientist, Massachusetts Office of Coastal Zone Management

- Brad Chase, Diadromous Fisheries Project Leader, Massachusetts Division of Marine Fisheries
- Brian Howes, Ph.D., Chancellor Professor, School for Marine and Atmospheric Sciences and Technology (SMAST), University of Massachusetts at Dartmouth
- Ed Eichner, TMDL Solutions
- Jordan Mora, Research Technician, Waquoit Bay National Estuarine Research Reserve (now with APCC)
- R. Max Holmes, Ph.D., Deputy Director and Senior Scientist, Woods Hole Research Center

Sources of data: APCC relies upon water quality data collected by other organizations (see Sources of Water Quality Data, below).

Funding: APCC received startup funding for this project from a number of sources. They include the Massachusetts Environmental Trust (MET), an important supporter of environmental projects and funded by the sale of environmental license plates through the Registry of Motor Vehicles. Over the years, additional funding was provided by a U.S. Environmental Protection Agency Southeast New England Coastal Watershed Restoration Program (SNEP) grant to the Cape Cod Commission, the Friendship Fund, and the Cape Cod Five Foundation. APCC dues and donations now fund the annual updates.

6. About APCC

The Association to Preserve Cape Cod (APCC) is a 501(c)3 environmental non-profit organization founded in 1968 to promote policies and programs that foster preservation of Cape Cod's natural resources. APCC is a Cape-wide organization with members representing all 15 towns on the Cape. Our goals include protection of water and wetlands; preservation of open space; promotion of responsible, planned growth; and the achievement of an environmental ethic. To achieve these goals, we provide technical assistance, outreach, advocacy, science-based policies and partnership-building. APCC has established itself as the Cape's environmental leader, earning a reputation for effective policies and actions to protect our precious natural resources (APCC.org).

7. Why We Need Clean Water

Clean water is central to the health of the Cape's natural ecosystems. Our coastal waters, estuaries and embayments support valuable shellfish such as oysters and clams, as well as important finfish such as winter flounder and striped bass. Waterbirds, migrating waterfowl, raptors and wildlife feed on fish, shellfish and aquatic plants. Freshwater ponds and streams support numerous fish and wildlife species, including important diadromous species such as river herring and American eels, which live in both fresh water and the ocean. The Cape's ecosystems and food webs depend upon clean water.

Clean water is also important for our economy. The Cape's economy is a "blue economy" where our residents, visitors and businesses rely upon clean water and healthy natural resources. The economic benefits of clean water and healthy ecosystems are demonstrated by the fact that coastal tourism and commercial and recreational fishing and shellfishing and their supporting

industries bring in more than $1 billion to the local economy. For example, in 2018 tourists visiting Cape Cod spent $1.32 billion that supported 10,844 tourism-related jobs and $357.7 million in wages, and generated $133 million in state and local taxes (Cape Cod Chamber of Commerce).

Commercial and recreational fishing and shellfishing also bring in additional millions of dollars each year. For example, from 2000 – 2004, the average annual value of commercial and recreational shellfishing was $11.4 million. In 2009 alone the value of commercial fishing was $19 million, while the value of commercial fishing for species that eat river herring was over $37 million (NRCS, *Cape Cod Water Resources Restoration Project: Why It Matters to Massachusetts Economy*). These numbers do not include water-focused organizations such as oceanographic institutions and businesses, non-governmental organizations, educational institutions and laboratories that employ people and provide services and products.

Finally, clean drinking water is critically important for human health. The water we drink comes from Cape Cod's sole-source aquifer, a vast underground natural reservoir of groundwater. Federal, state and local laws are designed to protect a sole-source aquifer from pollution. However, as we discuss below, our groundwater, ponds, lakes, estuaries and embayments are all interconnected.

8. Waters of the Cape

Cape Cod enjoys a wealth of water resources. These include salt water and freshwater resources. Each major resource is summarized below. More information can be obtained at the Cape Cod Commission's website on water resources.

Coastal waters (saltwater) surround most of the Cape, creating over 559 miles of coastline bordering the Atlantic Ocean, Nantucket Sound, Vineyard Sound, Buzzards Bay and Cape Cod Bay. This long coastline contains 53 distinct saltwater **embayments**, places where there is a recess or indentation in the coastline that forms a bay bordering the ocean. Estuaries are places where rivers meet the sea. Estuaries typically contain a range of wetlands including freshwater, brackish and tidal wetlands (aka salt marshes) and tidal channels. On Cape Cod, rivers, streams and groundwater flow into estuaries and embayments that border the ocean.

Freshwater ponds and lakes: Few people know that the Cape is the land of nearly a thousand lakes. At least 996 freshwater ponds and lakes cover nearly 11,000 acres, and individual ponds and lakes range in area from less than one acre to 735 acres and include 166 "great ponds" of 10 acres or greater in size. Because the Cape's ponds and lakes are fed by groundwater, they are often referred to as "windows on our aquifer." The sandy soils of the Cape allow groundwater to flow into and out of ponds. For this reason, pollution of ponds will likely also pollute groundwater and vice versa.

Groundwater: Groundwater is the lifeblood of the Cape. Rain and melting snow quickly soak into our sandy soils where it collects to form a huge underground reservoir of groundwater that lies beneath most of the Cape. Water seeks the lowest elevation, so groundwater continues to

move, seeking sea level, flowing into and out of ponds, feeding streams and flowing towards the coast, finding sea level when it enters our estuaries and embayments.

Groundwater is also the sole source of our **drinking water**. In 1982, the U.S. Environmental Protection Agency designated Cape Cod's groundwater as a sole-source aquifer for drinking water under the federal Clean Water Act and Safe Drinking Water Act. All of the Cape's drinking water comes from this sole-source aquifer, which is protected by local, regional, state and federal regulations. Nearly all of the Cape's public water supplies are from groundwater wells, with one exception being Long Pond in Falmouth which is itself groundwater-fed.

Watersheds connect our waters: Nearly all of the Cape's waters are connected by watersheds that collect water and discharge it into the ocean. Watersheds are the land areas that collect rain and snow, which drains into ponds, lakes, streams and groundwater, which in turn discharge into estuaries, embayments and the ocean. Cape Cod has a total of 101 watersheds that discharge to the ocean. Of these, 53 discharge to embayments, which are susceptible to nitrogen pollution, and the remainder discharge directly to the ocean. Through the Section 208 Water Quality Management Plan for Cape Cod, the Cape Cod Commission has created a regional blueprint for protecting and improving water quality and tracks progress in implementation.

9. Water Pollution

Most of the Cape's coastal embayments and many freshwater ponds and lakes are suffering from water pollution, based on years of studies and reports on water quality and water pollution. These studies and reports indicate that the Cape's waters suffer from pollution due to the following pollutants and pollution sources.

Nutrient pollution: Excess nutrients (nitrogen in coastal waters and phosphorus in fresh water) have caused severe eutrophication and severe ecological damage. **Eutrophication** refers to the harmful effects of excess nutrients on an aquatic ecosystem, resulting in increased growth of phytoplankton and depletion of oxygen. Excess nutrients in water stimulates the growth of phytoplankton (microscopic algae), which depletes the water of oxygen. Oxygen depletion leads to fish kills and impacts on shellfish and other aquatic life. Excess phytoplankton also causes water to become cloudy, reducing the amount of light in the water column, which impacts the growth of other beneficial aquatic plants such as eelgrass. When algae die, their remains settle to the bottom and decompose, causing more oxygen depletion and releasing nutrients back into the water, feeding the nutrient cycle. Also, the buildup of decaying organic matter on the bottom of ponds, lakes and embayments often results in thick muck that is unhealthy for shellfish, fish and other aquatic organisms.

Many of the Cape's estuaries and embayments are suffering from eutrophication caused by excess nitrogen, as demonstrated by the Massachusetts Estuaries Project and by the Section 208 Water Quality Management Plan for Cape Cod.

Ponds and lakes are also suffering from eutrophication caused by excess phosphorus (Cape Cod Commission, Ponds and Lakes).

On Cape Cod, excess nutrients originate largely from human sources and activities. Excess nitrogen comes from poorly treated wastewater (e.g., Title 5 septic systems) as well as fertilizers used on lawns, gardens, golf courses and farms. Some nitrogen also falls out from the atmosphere in precipitation, and this atmospheric nitrogen largely originates from burning fossil fuels. Excess phosphorus comes from septic systems that discharge phosphorus into groundwater that enters ponds and lakes, as well as fertilizers used on lawns, gardens, golf courses and farms that is carried into ponds and lakes in stormwater runoff.

Harmful bacteria include bacteria that originate from fecal wastes (humans and/or animals). Examples of fecal bacteria are *Escherichia coli (E. coli)* and enteric bacteria. Fecal bacteria can cause illness in both humans and animals. On Cape Cod, most fecal bacteria contamination originates from domestic animals and wildlife. Failed septic systems (including flooded septic systems) are another source of bacteria. Bacteria are carried into water by stormwater runoff. State and federal water quality standards limit the amounts of fecal bacteria that can be present in waters where swimming and shellfishing are conducted. Swimming beach water quality is monitored by Barnstable County**.** The Massachusetts Division of Marine Fisheries monitors water quality in shellfish beds and limits shellfishing to waters that meet a stringent water quality standard for fecal bacteria.

Harmful algal and cyanobacteria blooms include toxic red tides in coastal waters and toxic cyanobacteria blooms in freshwater ponds and lakes. In coastal waters red tide is the common name for several species of toxic phytoplankton, including toxic dinoflagellates. Shellfish that ingest such toxic phytoplankton become toxic themselves, posing a threat to humans who eat contaminated shellfish and impacting the shellfishing industry. In fresh water harmful cyanobacteria that produce toxins thrive in nutrient-rich and warm waters. APCC's Cyanobacteria Monitoring Program has documented cyanobacteria blooms in dozens of ponds throughout the Cape and we anticipate that this will be an increasing problem as nutrient pollution continues and the climate warms. This year is the second year that APCC has incorporated cyanobacteria monitoring data into our grading system for freshwater ponds as another indicator of nutrient pollution.

Mercury pollution occurs in waters throughout the Northeast. As of October 2021 the Massachusetts Department of Public Health listed 32 ponds and lakes on Cape Cod with fish consumption advisories that warn people (i.e., children under 12, pregnant women, nursing mothers, women of childbearing age, and the general public) to limit or avoid eating fish from that lake due to mercury pollution (**MA DPH Fish Consumption Advisories**). Mercury pollution is caused by fallout of mercury from the atmosphere, which originates from coal-burning fuel plant emissions. Incineration of medical wastes and municipal wastes also contributes mercury to the atmosphere. Our assessment does not address mercury pollution, but the State of the Waters; Cape Cod website provides information on mercury pollution and state fish consumption advisories for freshwater lakes and ponds on Cape Cod.

Emerging contaminants and pharmaceutical compounds have been found both in groundwater and surface water throughout Cape Cod. This group of pollutants contains a wide variety of compounds, including endocrine-disrupting compounds, pharmaceutical drugs (including antibiotics), insect repellant, flame retardant, fluorinated compounds and PFAS (per-

and polyfluoroacetate substances). The Silent Spring Institute has been monitoring the Cape's waters emerging contaminants. The Center for Coastal Studies and Silent Spring Institute also found pharmaceutical compounds in Cape Cod Bay and in groundwater near septic systems, pointing to septic systems as the source of these pharmaceutical compounds.

PFAS (per- and polyfluoroacetate substances) are manmade chemicals used widely in diverse items (e.g., fireproof clothing, non-stick pans, stain-and-waterproof fabrics, fire-fighting foam, dental floss, cleaning products, paints, electronics manufacturing and other industries and household products). PFAS are long-lasting compounds that have been found worldwide in humans, wildlife, water, soil and the air. PFAS have been found in Cape Cod water supplies, groundwater, and ponds (five of the ponds which have fish consumption advisories due to mercury also have fish consumption advisories due to PFAS). PFAS have been linked to human health impacts such as developmental disorders, immune system disorders, thyroid hormone disruption and cancer. Information on PFAS is provided in APCC's PFAS Primer. In our next report in 2022, PFAS will be addressed in our drinking water grades for 2021. PFAS was not a scoring factor in this year's report because state drinking water regulations for monitoring and reporting on PFAS did not become effective until January 2021.

10. How We Graded Water Quality

To help people understand where water quality is acceptable vs. unacceptable, APCC has created this State of the Waters: Cape Cod project and website to collect existing information on water quality and translate it into easily understood terms by grading water quality. This website is a key means of collecting and distributing information to the public. Our intent is to guide public policy and investment in restoration and protection efforts.

Using existing data, APCC graded the following water resources:

- **Coastal waters in embayments and estuaries**;
- **Freshwater ponds and lakes**; and
- **Public water supplies for drinking water** (i.e., drinking water after it is treated by the public water supplier and before it is distributed to consumers).

APCC used three grading systems, one system for grading coastal waters, a second system for grading ponds and lakes, and a third system for grading drinking water. Each of the grading systems scores water quality parameters. The scores were then translated into grades. APCC chose grading systems that meet the following criteria:

- Are scientifically sound;
- Have been used before to evaluate water quality;
- Use key water quality parameters to evaluate water quality problems;
- Are easily understood and can be replicated by others (e.g., it does not require complex methods, modeling or software); and
- Evaluates the most pressing water quality problems.

Each year the grades are updated on a moving basis by dropping older data and adding newer data through the previous year. The grading systems are explained below.

10.1. Grading Coastal Waters: Buzzards Bay Eutrophic Index

APCC chose an existing method of grading the severity of nitrogen pollution of coastal waters. The method is called the Buzzards Bay Eutrophic Index (aka "Bay Health Index"), developed in 1992 by the Buzzards Bay National Estuary Program. The Eutrophic Index was based on an earlier method developed by Hillsborough County, Florida, to evaluate coastal water quality.

The Buzzards Bay Eutrophic Index (EI) was developed to help the Buzzards Bay Coalition (BBC) evaluate citizen water quality monitoring data for Buzzards Bay embayments and to help rank each embayment with respect to its relative health for the purpose of prioritizing remedial management measures (i.e., Bay Health). The goal was to evaluate nitrogen loading inputs and to provide accurate and reliable water quality data for most of the major embayments around Buzzards Bay to assist environmental managers to:

- Establish baseline water quality;
- Characterize and identify sources of pollution;
- Document long-term environmental trends in water quality;
- Evaluate the relative success of cleanup efforts;
- Facilitate implementation of management efforts in the CCMP; and
- Evaluate the appropriateness of the Buzzards Bay Project's recommended nitrogen limits.

In addition to the BBC, the Eutrophic Index has also been used by the Center for Coastal Studies, the Pleasant Bay Alliance, and the town of Chatham to evaluate nitrogen pollution in Buzzards Bay, Cape Cod Bay and coastal waters around the Cape, Pleasant Bay, and Chatham. The Eutrophic Index is considered by practitioners to be a well-tested method.

The Eutrophic Index scores parameters that measure the degree of eutrophication: dissolved oxygen saturation, water clarity (measured using either Secchi disk or a turbidity meter), chlorophyll, dissolved inorganic nitrogen (DIN), and total organic nitrogen (TON). Water quality data for these parameters is used to calculate a numerical score that indicates the degree of eutrophication. To translate scores into an assessment of water quality, the BBC uses three categories to "grade" scores: scores of 65 to 100 indicate Good water quality; scores between 35 and 65 indicated Fair water quality; and scores below 35 indicate Poor water quality.

Following the BBC's method, APCC calculated numerical Eutrophic Index scores for water quality from stations in coastal embayments and coastal waters around Cape Cod. However, APCC "graded" the numerical scores for water quality from individual stations in a manner that differs from the BBC. APCC assigned scores to two grading categories based on whether they indicate acceptable water quality or unacceptable water quality. The two grading categories were chosen to indicate the type of action needed to protect or restore water quality.

Grading coastal water quality at coastal stations:

EI scores greater than 65 (> 65) are graded as: "Acceptable: requires ongoing protection."

EI scores of 65 or below (≤ 65) are graded as: "Unacceptable: requires immediate restoration."

Waters that are graded as "**Acceptable: requires ongoing protection**" are waters that are healthy and free of excess nutrients. These waters need ongoing protection to remain healthy and free of pollution.

Waters that are graded as "**Unacceptable: requires immediate restoration**" are waters that are suffering from excess nutrients. These waters need immediate restoration in order to improve water quality.

Grading water quality in coastal embayments:

APCC took the additional step of **identifying embayments where at least one monitoring station had Unacceptable water quality and graded these embayments as "Unacceptable: requires immediate restoration." Embayments where all monitoring stations had Acceptable water quality were graded as "Acceptable: requires ongoing protection."** This approach to grading embayments provides a clear summary of which embayments have portions with poor water quality that requires restoration vs. embayments with good water quality that require protection.

10.2 Grading Ponds and Lakes

Method 1: Carlson Trophic Index

To grade water quality in freshwater ponds and lakes, APCC uses two methods. The first method is the Carlson Trophic Index (CTI) which evaluates the trophic state of the water body in terms of three important water quality parameters: total phosphorus, chlorophyll, and water transparency. The **Carlson Trophic Index** was developed in 1996 to assess the trophic state of a freshwater pond or lake, where trophic state refers to the ecological response (algal biomass) to nutrients (Carlson, 1977). Since then, it has been widely used for evaluating freshwater ponds and lakes.

Using the Carlson Trophic Index, a pond with high nutrient concentrations (**eutrophic to hypereutrophic**) would be characterized by high concentrations of algae, algal scums, poor water clarity due to dense algae and low to no dissolved oxygen. A eutrophic to hypereutrophic pond would have scores between 50 and 100. At the opposite end of the spectrum, a pond with low nutrient concentrations (**oligotrophic**) would be characterized by clear well-oxygenated water, healthy aquatic plants and little to no algal growth. An oligotrophic pond would have scores between 0 and 40. A pond with intermediate nutrient concentrations (**mesotrophic**) would be characterized by moderately clear water, intermediate amounts of aquatic plants and algae, and low dissolved oxygen during the summer. A mesotrophic pond would have scores

between 40 and 50. The Carlson Trophic Index is analogous to the Buzzards Bay Eutrophic Index in that it can be used to evaluate the degree of eutrophication in fresh water.

APCC adopted a grading system that assigns the following grades to Carlson Trophic Index (CTI) scores:

CTI scores of less than 50 (< 50) are graded as: "Acceptable: requires ongoing protection."

CTI scores of 50 or above (≥ 50) are graded as: "Unacceptable: requires immediate restoration."

Ponds that are graded as "**Acceptable: requires ongoing protection**" are ponds that are healthy and free of excess nutrients. These ponds need ongoing protection to remain healthy and free of pollution.

Ponds that are graded as "**Unacceptable: requires immediate restoration**" are ponds that are suffering from excess nutrients. These ponds need immediate restoration in order to improve water quality.

Data quality for CTI scoring: Many datasets for pond water quality for Cape Cod ponds are older, i.e., at least five years old or more. Using older data to grade ponds would cause grades to reflect conditions that existed at the time when water samples were collected and analyzed. Conditions in ponds may have changed since such older data were collected. APCC screened out pond data older than 2016 and ponds where there was less than three years of data. In addition, since chlorophyll is a key component of the CTI grade, ponds where there was no chlorophyll data were not scored. As a result, this year there were 36 ponds with sufficient water quality data to grade. Application of these stringent data quality requirements for grading resulted in only 36 of 996 ponds having sufficient water quality data to enable grading using the Carlson Trophic Index. This points out the severe shortage of newer Cape-wide pond monitoring data to inform pond management and protection measures.

Method 2: Using Cyanobacteria Monitoring Data

Since 2018, APCC has been monitoring cyanobacteria and cyanobacteria blooms in dozens of freshwater ponds on Cape Cod. Cyanobacteria blooms occur when there are sufficient nutrients to stimulate growth of these photosynthetic bacteria. Warmth and sunlight are other factors that stimulate cyanobacteria growth, but in the absence of nutrients or when nutrient concentrations are very low, cyanobacteria growth is minimal. Cyanobacteria blooms therefore represent another way to describe nutrient enrichment in freshwater ponds.

APCC's Cyanobacteria Monitoring Program uses an EPA-approved protocol developed by EPA for the Cyanobacteria Monitoring Collaborative and refinements added under the guidance of Dr. James Haney (emeritus professor, University of New Hampshire) and Nancy Leland of Lim-tex, Inc. (Leland and Haney, 2018 ; Leland, Haney, Conte, Malkus-Benjamin and Horseley, 2019). The EPA protocol utilizes a combination of field observations, microscopy and fluorometry to analyze samples from freshwater lakes and ponds for cyanobacteria. The data collected includes

photographs and field observations, digital microscopy to identify composition (type of cyanobacteria present) and dominance, and concentrations of phycocyanin and chlorophyll pigments indicative of the amounts of cyanobacteria vs. general algae and phytoplankton, respectively. By monitoring biweekly from June to October, APCC tracks changes in cyanobacterial composition, dominance and abundance. At this sampling frequency, APCC is often able to forecast when cyanobacteria blooms may be forming or leading to toxin concentrations that may be approaching harmful levels. These signs instruct APCC to increase the frequency of testing and to inform town officials to be aware of potential threats and to plan for proactive management actions to protect public safety. To learn more, visit APCC's Cyanobacteria Monitoring Program.

In contrast to traditional cyanobacteria testing involving cell counts, APCC's method is less costly, offers a faster turn-around time for results and is often able to predict cyanobacteria bloom formation. Additionally, numerous other points of data collected support research efforts that will expand our understanding about the health of the ponds.

To address the shortage of recent pond water quality data, last year APCC adopted a second method of grading ponds using cyanobacteria monitoring data to provide an additional measure of pond health. The additional grading method helps to fill the gap in freshwater pond data by providing a different measure of trophic status. APCC's cyanobacteria grading system utilizes our warning tier system for assigning monitored cyanobacteria concentrations into "Low," "Moderate" and "High" tiers describing potential risks following ingestion of water by humans and pets. The previous year's monitoring results are used. This year, APCC again utilized cyanobacteria data to grade ponds as described below.

Cyanobacteria grading system used in this 2021 State of the Waters report: In 2020 APCC revised our cyanobacteria warning tiers in order to better define risk in terms of exposure to children, pets, exposure during recreational activities, toxin concentrations, and presence of visible cyanobacteria blooms. The revision enabled a wider range of risks to be defined but still within a 3-tiered system:

- "Low" (BLUE) indicates general safety for recreational activities according to our data.
- "Moderate" (YELLOW) indicates the cyanobacteria concentrations in the pond are particularly dangerous to children or pets if ingested
- "High" (RED) indicates APCC found either toxin levels approaching or exceeding state standards for recreation or found a visible cyanobacteria scum; each poses a considerable risk for human and pet interactions with the pond.

Using these tiers, APCC graded ponds in the "Moderate" **or** "High" tiers for cyanobacteria as Unacceptable, for the reasons given below:

- APCC's "Moderate" tier discourages children and pets from interacting with ponds due to cyanobacteria concerns.
- The town of Barnstable posts "Pet Advisories" due to cyanobacteria concerns, cautioning parents and pet owners to keep children and pets away from the water, when a pond is in APCC's "Moderate" tier.

- In keeping with scientific consensus, APCC updated our warning tier criteria in 2020. The update resulted in 2020's "Moderate" tier being similar to the "High" tier in 2019.

The resulting cyanobacteria grading system is as follows:

Cyanobacteria grades for 2020 ponds in the "Low" tier were graded as: "Acceptable: ongoing protection is needed"; and

Cyanobacteria grades for 2020 ponds in the "Moderate" and "High" tiers were graded as "Unacceptable: requires immediate restoration".

Combined Pond Grading System

APCC's combined pond grading system combinesdavailable Carlson Trophic Index grades and cyanobacteria grades, as described below and updated with more recent data and revised cyanobacteria grading system (see above):

1) Carlson Trophic Index scores and grades for ponds were calculated only for ponds where more recent water quality data from 2016 on was available, and where at least three years of data were available.
2) Cyanobacteria monitoring data from 2020 were used to grade ponds using APCC's revised tiered cyanobacteria system described above:
    a. Ponds in the "High" and "Moderate" cyanobacteria tiers were graded as "Unacceptable: requires immediate restoration";
    b. Ponds in the "Low" cyanobacteria tier were graded as "Acceptable: requires ongoing protection."
3) **If a pond had both Carlson Trophic Index grades and Cyanobacteria grades**:
    a. The pond was graded as **"Acceptable: requires ongoing protection" only if both grades were Acceptable**;
    b. The pond was graded as **"Unacceptable: requires immediate restoration" if at least one of the grades was Unacceptable**.
4) **If a pond had only one grade (i.e., Carlson Trophic Index grade or Cyanobacteria grade), that grade was used as the sole determinant of the overall pond grade.**

10.3. Grading Public Water Supplies of Drinking Water

The grading system for drinking water is based on a modification of a method developed by the Natural Resources Defense Council (NRDC) to grade drinking water. The NRDC grading system evaluates three areas of drinking water: water quality and compliance, source water protection, and right-to-know compliance. APCC chose to evaluate water quality and compliance of public water supplies after treatment and before distribution to consumers, the so-called "finished water." This represents the underlying quality of the public water supply before it is distributed to customers, not the quality of the water as it comes out of the tap which can be affected by pipes and plumbing in the distribution system and in homes and businesses. APCC chose to evaluate public water supplies in this manner because underlying water quality

represents the first line of defense in ensuring safe drinking water supplies and because many water protection measures are aimed at protecting source water quality.

To grade public water supplies, APCC uses publicly available Consumer Confidence Reports (CCRs) for the previous year to determine if water quality met existing state and federal drinking water standards (i.e., Maximum Contaminant Levels, or MCLs). This year, APCC did a preliminary review of CCRs and decided to apply a revised grading system. The original and revised grading systems are described below.

Original grading system used in 2019 and 2020 State of the Waters: If a public water supply met all existing state and federal drinking water standards, it was graded as "Excellent" if not, it was graded as "Poor." In the 2019 report on 2018 CCRs and the 2020 report on 2019 CCRs, all public water suppliers met all existing state and federal drinking water standards. Resulting grades were all "Excellent".

Revised grading system used this year: Review of 2020 CCRs for Cape Cod public water suppliers showed that there were seven instances where public water suppliers reported that state and federal water quality standards were not met and/or required corrective actions. In particular there were varying degrees of potential risk posed by violations, e.g., ranging from one or two violations of the total coliform standard followed by compliance, to several violations of two standards occurring at different locations on different dates requiring issuance of a boil-water order representing a high potential risk level. APCC felt it was important to distinguish the different levels of potential risk. Accordingly, our public water supply grading system was revised to the following:

Excellent: Public water supply met all existing state and federal health and reporting standards (unchanged).

Good: Public water supply had one or more exceedance of total coliform MCL and/or no more than one violation of an existing state and/or federal standard that posed a risk to public health and that violation was neither chronic nor repeated.

Poor: Public water supply had two or more violations of an existing state and/or federal standard that posed a risk to public health or a violation that was repeated or persisted through more than one sampling round.

11. Sources of Data

Cape Cod is fortunate to have many environmental organizations and agencies that have monitored water quality for many years. Over the years, hundreds of citizen scientists, local, state and federal government agencies, scientists, environmental organizations, consulting firms, and APCC interns and volunteers have collected water samples for different water quality monitoring programs. With the assistance of our Advisory Committee and partners, our sources of water quality data that met our criteria (see below) included the following organizations and agencies listed below. It is important to note that these organizations and agencies followed quality assurance protocols for sampling and analysis.

Regional data (i.e., data collected from multiple embayments or large regions of the Cape):

- Association to Preserve Cape Cod: 2020 cyanobacteria monitoring data from ponds located in Barnstable, Brewster, Chatham, Dennis, Eastham, Falmouth, Harwich, Mashpee, Orleans, Sandwich, Wellfleet, and Yarmouth;
- Barnstable Clean Water Coalition: coastal water quality data for the Three Bays watershed;
- Buzzards Bay Coalition: Eutrophic Index scores for Buzzards Bay coastal stations;
- Center for Coastal Studies: coastal water quality data for stations along coasts of Cape Cod Bay, Nantucket Sound and Vineyard Sound;
- Cape Cod Commission: coastal and pond water quality data collected by and for the Cape Cod Regional Water Quality Database, a project to collect and make publicly available all water quality monitoring data for the Cape. The project was funded by the EPA Southeast New England Coastal Watershed Restoration Program (EPA SNEP);
- Cape Cod Commission and University of Massachusetts at Dartmouth, School of Marine and Atmospheric Science and Technology (SMAST): Pond and Lake Stewards (PALS) data for pond water quality (note: most of the pond data provided by towns and organizations listed below was provided by PALS and SMAST for the towns and organizations);
- Pleasant Bay Alliance: coastal Eutrophic Index scores for Pleasant Bay coastal stations;
- Waquoit Bay National Estuarine Research Reserve (WBNERR): coastal water quality data for Waquoit Bay.

Municipal data:

- Town of Barnstable: coastal water quality data, pond water quality data, and cyanobacteria data;
- Town of Chatham: coastal Eutrophic Index scores for Chatham coastal stations;
- Town of Dennis: pond water quality data;
- Town of Eastham: coastal water quality data;
- Town of Harwich: coastal and pond water quality data;
- Town of Mashpee: coastal and pond water quality data;
- Town of Orleans: coastal and pond water quality data;
- Town of Sandwich: pond water quality data.

Types of water quality data are summarized below. Data are also posted on this State of the Waters: Cape Cod website under Resources.

Water quality data for coastal embayments: For this 2021 report, APCC collected the most recent and available coastal water quality data up to and through 2020 from the data sources listed above. Our criteria for grading coastal water quality data included at least 5 years of data from 2016 on (e.g., 2016, 2017, 2018, 2019, and 2020). There was one exception made; i.e., Harwich coastal water quality data where 2020 data were not collected due to suspension of their monitoring program due to the COVID-19 pandemic (data from 2015-2019 were used for grading).

Water quality data for ponds and lakes: Since 2000, the Cape Cod Ponds and Lakes Stewardship Program (PALS) has worked with volunteers and organizations who monitor many ponds across the Cape. The PALS program was developed by the Cape Cod Commission, APCC and SMAST, in coordination with organizations and towns that monitor water quality on an annual snapshot basis. Other pond associations and organizations have gathered a considerable amount of data with their member volunteers. For this 2021 report, APCC collected pond water quality data from the sources listed above. Our criteria for grading pond water quality data included at least three (3) years of data from 2016 on, and a requirement for chlorophyll data, as well as transparency and total phosphorus.

Cyanobacteria data for ponds and lakes: For this 2021 report, APCC utilized 2020 cyanobacteria monitoring data collected by APCC's Cyanobacteria Monitoring Program and cyanobacteria data collected by the town of Barnstable for ponds in Barnstable.

Water quality data for public water supplies: For this 2021 report, APCC collected each town's public-right-to-know reports for 2020 monitoring results, also known as the Consumer Confidence Reports (CCRs) for drinking water. CCRs are posted on each town's website and links to the CCRs are provided in our Public Water Supplies grading sheet under Resources. APCC used the CCRs for 2020 to grade water quality and compliance with existing drinking water regulations.

12. Results

Our 2021 grades for coastal embayments and stations, freshwater ponds and lakes, and public water supplies are provided as maps (Figures 1-4) and summarized in tables (Tables 1-7). Tables 1, 4, and 6 summarize grades from 2019, 2020, and 2021. Detailed scores and grades for embayments and coastal stations are provided in tables (Tables 8-16). Our findings are described below.

12.1 Coastal embayments and coastal stations

Coastal embayments:

- The 2021 embayment grades showed an increase in the number and percentage of Unacceptable embayments compared to previous years. There were 41 Unacceptable embayments, representing 87% of graded embayments. Last year in our 2020 report, 38 embayments or 79% were Unacceptable. In our 2019 report, 32 embayments or 68% were Unacceptable (Table 1).
- The 2021 embayment grades showed a decrease in the number and percentage of Acceptable embayments compared to previous years. This year only six (6) of the 47 graded embayments were Acceptable, representing 13% of graded embayments. Last year in our 2020 report, 10 of 48 embayments or 21% were Acceptable. In our 2019 report, 15 of 47 embayments or 32% were Acceptable (Table 1).
- The three new Unacceptable embayments this year include two on Cape Cod Bay and one on Buzzards Bay. (Figure 1 and Table 2).
- There were 47 embayments graded this year, compared to 48 in 2020 and 47 in 2019 (Table 1).

- There were no embayments that showed an improvement from Unacceptable to Acceptable (Tables 1, 2).

Coastal stations:

- The 2021 station grades showed an increase in the number of Unacceptable stations from previous years., with over two-thirds of stations graded as Unacceptable. There were 133 Unacceptable coastal stations, representing 68% of graded stations. In our 2020 report there were 106 Unacceptable stations or 70% of graded stations. In our 2019 report there were 98 Unacceptable stations or 64% of graded stations (Tables 1, 3).
- The 2021 station grades showed an increase in the number of Acceptable stations from previous years; however, the percentage of Acceptable stations was less than one-third of graded stations. There were 64 Acceptable coastal stations, representing 32% of graded stations. Last year there were 46 Acceptable stations or 30% of graded stations. In our 2019 report there were 54 Acceptable stations or 36% of graded stations (Tables 1, 3).
- There were 197 coastal stations graded this year, reflecting an increase from previous years. The increase in the number of coastal stations with sufficient data to grade was due to new data from several towns (e.g., Barnstable, Harwich, and others) (Tables 1, 3, Figure 2).

12.2 Ponds

This year more ponds were graded (109) than last year (93). Only 36 ponds had sufficient water quality data to grade using the Carlson Trophic Index. To address the data gap, APCC used cyanobacteria monitoring data to grade 87 ponds. This resulted in 73 additional ponds being graded (there were only 14 ponds which both CTI and cyanobacteria grades). Results are summarized below (see Tables 4 and 5 and Figure 3).

- The 2021 pond grades show that approximately one-third of all graded ponds were Unacceptable. There were 38 Unacceptable ponds, or 35% of all graded ponds. Last year there were 39 Unacceptable ponds or 42% of all graded ponds. In 2019 there were 58 Unacceptable ponds or 39% of all graded ponds (Table 4).
- The 2021 pond grades show that nearly two-thirds of all graded ponds were Acceptable. There were 71 Acceptable ponds, representing 65% of all graded ponds. Last year there were 54 Acceptable ponds representing 58% of graded ponds. In 2019 there were 91 Acceptable ponds or 61% of graded ponds (Table 4).
- A total of 109 ponds were graded this year using the Carlson Trophic Index and/or cyanobacteria tiers for cyanobacteria data collected in 2020 (Tables 4, 5). This represents only 11% of the Cape's 996 ponds. Last year 93 ponds were graded using either the Carlson Trophic Index and/or cyanobacteria tiers. In 2019 a total of 149 ponds were scored; however, many of these had older water quality data (e.g., some dating back to 2003). For the 2020 and 2021 reports, APCC used stricter data quality standards, requiring at least 3 years of data from 2015 on and 2016 on, respectively.
- This year only 36 ponds had sufficient water quality data to grade using the Carlston Trophic Index (i.e., at least three (3) years of data from 2016 on, including chlorophyll) (Tables 4, 5). Of these ponds, 24 or 67% were Acceptable and 12 or 33% were unacceptable.

- This year a total of 87 ponds were graded using 2020 cyanobacteria monitoring data. Of these ponds, 52 ponds (60%) were Acceptable and 35 ponds (40%) were unacceptable (Tables 4, 5).
- Only 14 ponds had both Carlson Trophic Index and Cyanobacteria grades. Of these ponds with dual grades, six (6) ponds had Acceptable grades, and eight (8) had Unacceptable grades (Tables 4, 5).
- The percentages of Acceptable vs. Unacceptable grades for ponds graded using either the Carlson Trophic Index or cyanobacteria were as follows; 67% of ponds with CTI grades were Acceptable compared to 60% of ponds with cyanobacteria grades of Acceptable. Likewise, 33% of ponds with CTI grades were Unacceptable compared to 40% of ponds with cyanobacteria grades of Unacceptable (Tables 4, 5). More data are needed to determine whether this similarity is incidental or reflects a more fundamental underlying commonality.
- This year most of the ponds graded were located in the mid-Cape region (Figure 3).

12.3. Public Water Supplies

This year APCC applied a revised grading system to grade public water supplies based on their 2020 Consumer Confidence Reports and state and federal drinking water regulations in effect in 2020 (see section 10.3 Grading Public Water Supplies). The results are described below and in Tables 6 and 7 and Figure 4.

- A total of 20 public water supplies were graded. (Note that the towns of Provincetown and Truro share a public water supply system which was graded as a single system).
- Thirteen (13) public water supplies on the Cape continued to have Excellent water quality: Barnstable Fire District, Cotuit Water Department, Hyannis Water System, Otis Air National Guard Base, Brewster Water Department, Chatham Department of Public Works Water Division, Dennis Water District, Town of Eastham Water Department, Town of Falmouth Water Department, Town of Harwich Water Department, Mashpee Water District, Town of Orleans Water Department, and Provincetown Water Department (Tables 6, 7).
- Six suppliers were graded as having Good water quality: Barnstable Center-ville-Osterville-Marstons Mills (COMM), Bourne Water District, Buzzards Bay Water District, North Sagamore Water District, Sandwich Water District, and Yarmouth Water Department (Tables 6, 7).
- One supplier (Wellfleet Municipal Water System) received a grade of "Poor" due to violations of two drinking water standards (E. coli and total coliform bacteria) and several violations at different locations which required the town to issue a "boil water order" to protect public health. (Tables 6, 7).

PFAS in public water supply wells was not graded because state and federal drinking water regulations requiring monitoring and limits on PFAS concentrations did not become effective until January of this year. APCC is monitoring the implementation of recently finalized regulations for PFAS and will apply these to public water supplies in the 2022 update of this report. It is known that increased testing in 2021 will reveal PFAS in public water supplies beyond what is currently know. The extent of the presence of PFAS in drinking water supplies

will become an issue of greater public concern, discussion and expense in the year ahead. For more information on PFAS, see the PFAS Primer .

12.4. Discussion

In 2019, APCC presented results of the first year of the State of the Waters: Cape Cod, an assessment of water quality in coastal embayments, ponds and public water supplies. The 2019 results were based on water quality data available through 2017. In 2020 APCC updated grades to incorporate data collected through 2019. This year, APCC updated water quality grades using water quality data available through 2020. Collectively these reports, posted at our State of the Waters: Cape Cod website, and this report show that the Cape's coastal waters and ponds continue to suffer from eutrophication due to nutrient loading, primarily from septic systems (Figure 5). Public water supplies were generally excellent but the exceptions indicate that public water supplies can still be vulnerable to bacterial contamination and, in one case (Yarmouth) to nitrite that was likely derived from septic systems and/or fertilizers.

Coastal embayments and stations

The increase in the number and percentage of Unacceptable embayments this year shows that coastal eutrophication continues and is expanding. For the first time, there were two new Unacceptable embayments (Barnstable Harbor, Quivett Creek) along the north coast of Cape Cod on Cape Cod Bay. The increase in the number of Unacceptable stations this year was likely related to an increase in the total number of stations graded combined with the percentage of Unacceptable stations (68%) remaining similar to last year (70%).

A number of towns have made significant steps toward managing nutrients by approving construction of modern wastewater treatment projects. While water quality has yet to improve as a result, as these projects are implemented over the next few years the region should begin to see lower nutrient loadings that should be reflected in improving water quality in selected embayments.

Ponds

This year pond grades again indicated that approximately one-third of the 109 ponds monitored were Unacceptable.

As APCC's monitoring has expanded much has been learned about the scope of the impairment of ponds. While lacking a sufficiently robust and lengthy data record upon which to base trend analyses, APCC is beginning to understand that while approximately one-third of ponds achieve Unacceptable status in any given year, that there is great variability year to year in which ponds trigger that designation. While the prerequisite conditions to impairment exist in many ponds, perhaps a majority of ponds Cape-wide, the actual confluence of events that drive poor water quality conditions in any given pond in a particular year remain hard to predict given the lack of detailed and multi-year data.

A comprehensive review and assessment of overall pond health is also hampered by data quality issues. To grade water quality, APCC uses the Carlson Trophic Index, an index of water quality

that describes the trophic status of a water body based on total phosphorus, chlorophyll and transparency; i.e., it is a measure of phytoplankton productivity due to nutrient loading where phytoplankton include algae and cyanobacteria). Many pond data are older, e.g., five years old or more. Using older data to grade ponds would cause grades to reflect conditions that existed at the time when water samples were collected and analyzed. Conditions in ponds may have changed since these older data were collected. This year APCC screened out pond data older than 2016 and ponds with less than three years of data collected. Using these more stringent requirements for grading resulted in only 36 ponds having sufficient water quality data to enable grading using the Carlson Trophic Index. This points out the severe shortage of more recent Cape-wide pond monitoring data to inform pond management and protection measures.

To help fill the gap in freshwater pond data, APCC utilized the results of our cyanobacteria monitoring program. Since 2018, APCC has been monitoring cyanobacteria and cyanobacteria blooms in dozens of freshwater ponds on Cape Cod. Cyanobacteria blooms occur when there are sufficient nutrients to stimulate growth of these photosynthetic bacteria. Warmth and sunlight are other factors that stimulate cyanobacteria growth, but in the absence of nutrients or when nutrient concentrations are very low, cyanobacteria growth is minimal. Cyanobacteria blooms represent another way to assess phytoplankton productivity due to nutrient enrichment in freshwater ponds and is complementary to the use of the Carlson Trophic Index. Of the 36 ponds with sufficient water quality data to be graded using the Carlson Trophic Index, 33% were Unacceptable. Of the 87 ponds graded using cyanobacteria tiers, 40% were Unacceptable. While 33% and 40% are not identical, the fact that the two grading methods yielded percentages of Unacceptable grades that were within 7 percentage points indicates that the cyanobacteria grades and the Carlson Trophic Index grades generally agree. This is consistent with the two grading systems measuring eutrophication, albeit in different ways: the Carlson Trophic Index measures phytoplankton while the cyanobacteria grade measures cyanobacteria (a component of phytoplankton).

Public Water Supplies

This was the first year since our State of the Waters program was initiated in which some public water supplies experienced contamination due to bacteria and in one case (Yarmouth) nitrite. In Wellfleet, repeated violations of E.coli and total coliform bacteria standards led to the town having to issue a “boil-water order” to residents in order to protect public health. These results show that ongoing vigilance is needed to protect our public water supplies from contamination by already-regulated contaminants such as bacteria and nutrients. In next year’s report, APCC will include PFAS as a regulated contaminant of concern.

Other water quality issues of concern

- Consumer tap water quality was not evaluated and would require testing of the water coming out of consumers’ taps as well as monitoring data from water distribution systems. Water quality coming out of the tap will be affected by the age and type of pipes in the distribution system and in consumers’ homes and businesses.

- Drinking water consumers and regulators alike need to consider that there may be other unregulated contaminants affecting drinking water quality. These include:

  - PFAS in drinking water and in aquatic ecosystems, from a wide variety of sources. APCC is monitoring the results of newly required PFAS sampling and will apply these to public water supplies when evaluating drinking water quality in 2021. Results will be reported in our 2022 State of the Waters: Cape Cod report. For more information on PFAS, see our PFAS Primer.
  - Emerging contaminants in surface water and/or groundwater:
    - Endocrine-disrupting compounds and pharmaceuticals from inadequately treated wastewater;
    - Microplastics from wastewater, stormwater runoff and atmospheric fallout;
    - Cyanobacteria (aka blue-green algae) in freshwater ponds produce toxins that are harmful to humans and animals if ingested. Public surface water supplies can become contaminated by cyanotoxins, and public water suppliers elsewhere are taking precautions to guard against cyanotoxins in drinking water. This issue is of limited scope on Cape Cod as only Falmouth utilizes a surface water source for a portion of its public drinking water. APCC has been monitoring cyanobacteria since 2018 and has incorporated cyanobacteria into our pond grading system since 2019.

- Harmful bacteria in coastal waters and freshwater ponds, lakes and streams include fecal coliform bacteria and enteric bacteria that are indicators of human and/or wildlife fecal matter. Bacteria can impact swimming beach water quality and water quality in shellfish beds. Beach water quality and shellfish bed water quality are monitored by Barnstable County and the state, respectively.

- Mercury contamination of surface water continues to be of concern, based on the fact that this year 32 ponds and lakes on the Cape have fish consumption advisories due to high levels of mercury. Last year the number was 29, and the year before 24. Mercury originates from atmospheric fallout of mercury emissions from coal-burning power plants.

- Climate change impacts for the Northeast are predicted to include warmer air and water temperatures year-round; more precipitation; more intense storms; longer and warmer growing seasons coupled with shorter and warmer winters; shifts in populations of fish, wildlife and invertebrates; rising sea level; changes in groundwater elevations; more flooding; and changes in dynamic landforms such as those found on the Cape (e.g., dunes, beaches, floodplains). Many of these climate change predictions will impact water quality and exacerbate the harmful effects of existing pollutants.

12.5. Filling the gaps: recommendations for monitoring

Monitoring is crucially important to understand current conditions and for tracking progress in improving and protecting water quality. Based on our findings, APCC provides the following recommendations for monitoring:

- Coastal embayments need ongoing monitoring to collect up-to-date information on water quality in order to assess whether wastewater management measures and protection measures are working and to determine when success has been achieved.

- Monitoring of at least four more coastal embayments is needed (Chase Garden Creek in Yarmouth, Red River in Harwich, Hatches Harbor in Provincetown and Great Sippewissett Marsh in Falmouth). These embayments are listed in the 208 Water Quality Plan as coastal embayments receiving nutrients from their watersheds.

- Pond monitoring should be expanded to many more ponds and lakes throughout the Cape, particularly those where there are swimming beaches, public access, and/or sensitive resources (e.g., diadromous fish, rare species, wildlife). The Cape Cod Commission has proposed a 208-scale study of ponds across the Cape. **APCC strongly supports this initiative as responsive to the knowledge gaps around pond water quality and encourages the Barnstable County Commissioners and County Assembly of Delegates to approve this program early in 2022.**

- Cyanobacteria monitoring of ponds should be expanded as it provides a useful measure of eutrophication and a complement to water quality monitoring.

- The PALS program is useful as a "screening tool" to identify ponds where more in-depth monitoring and assessment is needed to determine causes, extent and severity of problems. However, pond monitoring should be conducted more frequently than the once-a-year snapshot that is typically provided by the PALS program.

- Newer, more recent pond data should be utilized to assess pond conditions and inform restoration and protection efforts.

- Monitoring of pond water quality and cyanobacteria blooms should be conducted hand-in-hand so that water quality data can be used to help predict where serious cyanobacteria blooms may occur, and vice versa.

- Public water suppliers should expand their monitoring of PFAS, emerging contaminants and cyanobacteria to help safeguard public health.

13. State of the Waters Action Plan

The most common threats to our water quality are:

- Nutrient pollution from septic system wastewater (Figure 5) and from fertilizers
- Stormwater runoff containing roadside pollutants, including nutrients and bacteria
- Contaminants of emerging concern such as pharmaceuticals, personal care products, PFAS and industrial chemicals

Action is needed now, especially on the municipal level. Moving forward immediately on water quality restoration efforts that produce measurable results must be the first priority. Securing and using both the new (short term rental tax and Cape and Islands Water Protection Trust Fund) and traditional (State Revolving Fund and local debt) funding sources, now supercharged by recent landmark federal appropriations legislation, to pay for water quality restoration and for monitoring water resources is critical. The towns of Cape Cod must lead the effort on protecting and improving water quality. State agencies must be a partner in this process. Enhanced municipal, regional and state regulatory standards that increase protections of water resources are crucial. The Cape and Islands Water Protection Fund awarded $71 million to eight Cape towns to support water quality projects in 2021, making the promise of critical financial assistance a reality. Towns realize there is now a 25% subsidy of capital costs and should accelerate their construction plans, especially with additional subsidy available for water quality projects due to recently approved federal legislation. The next few years represent a generational opportunity for the Cape to draw on unprecedented availability of federal funds to leverage water quality improvement on a very cost-effective basis.

Great progress has been made on developing the necessary understanding, scope and nature of estuarine water quality problems as well as the realistic and cost-effective management options. Development of the Cape Cod Commission's 208-water quality report was the turning point that enabled recent progress on implementation to begin. The 208 report identified, but did not address, the need for an equivalent level of assessment of the water quality of the ponds of Cape Cod. The expanded monitoring APCC has undertaken the last few years, and more fully reflected for the first time in this report's current edition, underscores and makes plain the need for a Cape-wide assessment of, and strategy for the restoration of, freshwater pond water quality. The time is now, and APCC calls on the Barnstable County Commissioner and the Assembly of Delegates to fully fund the Commission's plan to initiate a 208-scale effort for the freshwater ponds of Cape Cod.

Of course, public involvement is essential. Residents should support municipal investments in local water quality improvement projects. The participation of citizen groups and individuals are necessary to achieving local and regional water quality improvement goals. Be aware of your role in the health of Cape Cod's water resources. Individual actions by homeowners and businesses—both by the actions you take on your property and by making sure your voice is heard in the local decision-making process—can make a difference in the protection of Cape Cod's water resources.

Because the quality of groundwater directly affects the quality of the Cape's coastal embayments, ponds and drinking water, many of the following recommendations in this action plan focus on groundwater protection and crosscut all three resource areas studied in the State of the Waters: Cape Cod report. Action at the municipal level is most impactful and this plan emphasizes municipal actions and the importance of residents in forcing action at the town level.

13.1. Recommended Actions for Coastal Embayments

- <u>For Municipalities:</u>
    - Comprehensive Wastewater Management Planning:

        - Towns with plans that are consistent with the Cape Cod 208 Plan must begin to implement their long-term strategy for managing wastewater and improving water quality in the town's watersheds.
        - Towns without a plan must make the development and adoption of a plan a municipal priority.
        - Towns whose plans include shared estuary watersheds should adopt intermunicipal agreements that establish nitrogen responsibility and cooperative wastewater management strategies. Obtaining a state-issued Watershed Permit will provide additional accountability and enforceability.
    - Dedicate at least 50 percent of short-term rental tax revenue to infrastructure investments that include wastewater infrastructure and use the revenue to fund appropriate programs.
    - Develop financing plans that take full advantage of zero percent loans from the State Revolving Fund (SRF), the principle forgiveness offered by the Cape and Islands Water Protection Fund and new federal funds for Covid recovery and for infrastructure investment.
    - Expand monitoring of embayment restoration efforts to assess the effectiveness of management measures. Results should be used for adaptive management and course correction if needed.
    - Adopt local zoning bylaws and planning policies that encourage and facilitate future growth at greater densities in strategic locations where wastewater infrastructure can support additional development. Adopt local zoning bylaws, regulations and policies that direct growth away from sensitive watershed areas that do not have supportive wastewater infrastructure.
    - Prioritize water resources protection in municipal regulatory review. Establish consistency across town boards and commissions regarding municipal bylaws and regulations relating to water resource protection. For example, local planning boards, boards of health and conservation commissions should adopt the same regulations for requiring advanced denitrifying septic systems for development and redevelopment in nitrogen-sensitive watersheds.
    - Explore viable, alternative wastewater treatment strategies to augment municipal investments in wastewater infrastructure.
    - Stormwater planning and treatment:
        - Complete and implement stormwater plans (i.e., mapping, stormwater pollution prevention plan, bylaws, elimination of illicit discharges, prioritizing stormwater projects, funding maintenance) and include all roads that drain to wetlands and waters. Address both nutrients and bacteria.
        - Invest in stormwater remediation efforts in every road project going forward. Prioritize projects with the greatest water quality benefit. Adopt stormwater best management practices that include low impact development techniques.
        - Use the revised 208 Technologies Matrix that now includes stormwater Best Management Practices (BMPs) and their removal efficiencies for

pollutants (including nutrients, bacteria and solids) to select BMPs for projects.
    - Maintain adequate natural vegetated buffer zones around roads and parking lots near water bodies to capture stormwater runoff.
    - Eliminate fertilizer and pesticide use on municipal properties. Establish fertilizer and pesticide reduction outreach programs for residents and businesses, including a call for residents to eliminate fertilizer use.
    - Support ecological restoration programs and projects that will improve water quality and habitat.
    - Incorporate climate change into pond monitoring, planning and protection.

- <u>For Homeowners/Business Owners:</u>
    - Organize locally and demand action by town officials to protect and restore coastal embayments.
    - At town meetings and the ballot box, support municipal investments in wastewater infrastructure and the use of viable, alternative wastewater treatment strategies to augment the development of wastewater infrastructure.
    - Don't dump contaminants down house drains. Household chemicals, paints, thinners, solvents, pharmaceuticals and other hazardous materials can leach into groundwater and pollute water bodies. Properly dispose of hazardous wastes during designated collection days at local transfer stations.
    - Eliminate the use of fertilizers and pesticides on your property. Reduce, or better yet, eliminate turf grass lawns and replace with native plantings and ground cover.
    - Encourage your town, local school and golf courses to reduce or eliminate fertilizer and pesticide use.
    - For coastal waterfront properties, establish protective buffers of native vegetation at least 100 feet deep along shorelines to reduce the potential for stormwater runoff.
    - Work to achieve zero stormwater runoff from your property. Direct roof runoff from downspouts away from paved areas. Install rain gardens or rain barrels to collect water. Maximize permeable areas and native plantings that help absorb stormwater and prevent water runoff to roads.
    - Work with your neighborhood association to address stormwater problems and ensure proper maintenance of stormwater controls on private roads, especially where stormwater directly discharges into embayments.
    - Help your town properly maintain stormwater systems and report problems, remove debris and litter around storm drains. Never dump oil or other contaminants down storm drains.
    - Encourage your town to use more pervious surfaces instead of pavement and to allow roadside vegetation to grow instead of mowing so it can filter stormwater pollutants.
    - Be a responsible boater. Never dump trash or debris overboard. Discharge of any boat sewage, whether treated or not, is prohibited by federal and state law in coastal waters; use designated pump out facilities.

  - If using an on-site septic system, maintain it properly by having it pumped regularly—every three years is recommended. Consider an advanced wastewater treatment system to treat nutrients.

- For State Government:
  - Utilize and support watershed permitting for municipalities that promotes and addresses alternative technologies for wastewater treatment, requires sewering if alternatives do not work, and that also assures enforceability.
  - Prioritize investments in stormwater control for state roads that improve water quality by removing nutrients as well as bacteria when allocating funding for state road infrastructure projects.
  - Provide timely reporting on the state's list of impaired waters.
  - Support monitoring of harmful algal blooms (HABs) in marine and freshwater environments and address causes of HABs using ecologically safe methods.
  - Provide additional state funding to the county and municipalities for water quality improvement projects and for monitoring programs.
  - Support ecological restoration programs and projects that will improve water quality and habitat.

- For Regional Government:
  - Reinvest resources to focus on regional water quality efforts.
  - Invest in monitoring and regional data collection and the dissemination of collected data.
  - Provide evaluation of efficacy of alternative Title 5 systems.
  - Restore the effectiveness of the Cape Cod Water Protection Collaborative.
  - Eliminate interest charges on community septic management financing to provide support to those in need of assistance upgrading or connecting to sewers.
  - Support tighter regulation of development in areas not serviced by sewer.
  - Support ecological restoration programs and projects that will improve water quality and habitat.

13.2 Recommended Actions for Ponds

- For Municipalities:
  - Make protection of ponds and restoration of pond water quality a priority. Initiate detailed assessments of water quality for every pond, including promoting and supporting citizen water quality monitoring projects for ponds, including monitoring for cyanobacteria blooms.
  - Accelerate nutrient management, including sewering, of pond watersheds to improve pond water quality.
  - Establish, in partnership with APCC or individually, a cyano monitoring program and companion public notice protocol that ensures the public is advised of the presence of cyano blooms and provided with real-time guidance on the need to restrict contact with ponds with high cyano levels.
  - Eliminate fertilizer and pesticide use on municipal properties. Establish fertilizer and pesticide reduction outreach programs for residents and businesses, including a call for residents to eliminate fertilizer use.

- Adopt local bylaws and regulations that increase protections of ponds. Require placement of septic systems at least 300 feet back from the edge of a pond when located on the up-gradient side of groundwater flow toward a pond. Develop homeowner financial assistance programs for upgrading septic systems to comply with updated pond-front septic regulations.
- Invest in stormwater remediation efforts around ponds. Adopt stormwater best management practices that include low impact development (LID) techniques. Conduct routine street sweeping and catch basin cleaning to help prevent sediments and contaminants from reaching water bodies through stormwater. Maintain up-to-date GIS mapping and ground-truthing of storm drain locations. Maintain adequate natural vegetated buffer zones around roads and parking lots near ponds to capture stormwater. Conduct the comprehensive stormwater management and implementation described above in the section for coastal embayments.
- Establish consistency across town boards and commissions regarding municipal regulations and bylaws relating to water resource protection. For example, local planning boards, boards of health and conservation commissions should adopt consistent language for septic system technologies and siting in proximity to ponds.
- Promote development and testing of non-traditional, alternative wastewater treatment for single and shared systems.
- Weigh the pros and cons of pond management options such as alum treatment, macrophyte (vegetation) removal, or dredging to improve a pond's water quality. Each pond is unique, therefore methods to address water quality issues should be carefully considered.
- Invest in open space acquisitions of pond-front property as well as property within pond watersheds.
- Adopt site plan review standards that take topography into account. Require appropriate setbacks from water bodies and minimize impervious surfaces.
- Incorporate climate change into pond monitoring, planning and protection.
- Support ecological restoration programs and projects that will improve water quality and habitat.
- Sponsor pond education and stewardship programs.

- <u>For Homeowners/Business Owners:</u>
  - Organize locally and demand action by town officials to restore and protect ponds.
  - At town meeting and the ballot box, support municipal investments to restore and protect pond water quality.
  - Support the adoption of local bylaws and regulations that increase protections of ponds.
  - Upgrade septic system so that it is at least 300 feet back from the edge of a pond when located on the upgradient side of groundwater flow toward a pond.
  - Eliminate the use of fertilizers and pesticides on your property.
  - Reduce, or better yet, eliminate turf grass lawns and replace with native plantings and ground cover.

- Encourage your town, local schools and golf courses to reduce or eliminate fertilizer and pesticide use.
- Don't dump contaminants down house drains. Household chemicals, paints, thinners, solvents, pharmaceuticals and other hazardous materials can leach into groundwater and pollute water bodies. Properly dispose of hazardous wastes during designated collection days at local transfer stations.
- Work to achieve zero stormwater runoff from your property. Direct roof runoff from downspouts away from paved areas. Install rain gardens or rain barrels to collect water. Maximize permeable areas and native plantings that help absorb stormwater and prevent water runoff to roads.
- Establish protective vegetative buffers of native vegetation at least 100 feet wide along pond shorelines to reduce the potential for stormwater runoff to a pond.
- Support town and local land trust open space acquisitions of property with pond frontage or within pond watersheds.
- Help organize and participate in citizen water quality monitoring projects for area ponds, including monitoring for cyanobacteria blooms.
- For homeowners, become active in your local pond association, or if there isn't one for your pond, start one.
- Work with your neighborhood association to address stormwater problems and ensure proper maintenance of stormwater controls on private roads, especially where stormwater directly discharges into ponds.
- Help your town properly maintain stormwater systems and report problems, remove debris and litter around storm drains. Never dump oil or other contaminants down storm drains.
- Encourage your town to use more pervious surfaces in place of pavement and to allow roadside vegetation to grow instead of mowing it so it can filter pollutants from stormwater.
- Pick up after pets and deposit waste in the trash. Pet waste can introduce harmful bacteria and other pathogens into ponds.
- Do not wash cars on paved driveways or parking lots, which allows oil, fuel and soap to make their way into ponds.
- Be a responsible boater. Never dump trash or debris overboard.
- Attend education workshops to learn more about pond issues and how you and your community can protect ponds.
- If using an on-site septic system, maintain it properly by having it pumped regularly—every three years is recommended. Consider an advanced wastewater treatment system to treat nutrients.

- <u>For State Government:</u>
  - Increase funding to municipalities and nonprofits for pond restoration, management and monitoring initiatives. Increase funding to state agencies—e.g., the Department of Conservation and Recreation—for management of ponds under state control.
  - Develop better protocols for monitoring of, and responding quickly to, toxic cyanobacteria (blue-green algae) blooms that could impact public health and ecosystems. Work with municipalities and environmental nonprofits to develop standardized monitoring and reporting programs.

- Establish Total Daily Maximum Loads (TMDL) for phosphorus for high priority Cape Cod ponds.
- Support ecological restoration programs and projects that will improve water quality and habitat.
- Provide timely reporting on the state's list of impaired waters.
- Incorporate climate change into pond monitoring, planning and protection.

- For Regional Government:
  - Fully fund the Cape Cod Commission's 208 Plan for ponds to include a comprehensive focus on pond water quality similar to the county's focus on the nutrient problem in Cape Cod embayments.
  - Current pond monitoring protocols (e.g., PALS) and data are insufficient for producing reliable determinations of pond health. Invest in the development of a much more rigorous and expanded pond monitoring program, which should include information sharing on collected data.
  - Support ecological restoration programs and projects that will improve water quality and habitat.
  - Incorporate climate change into pond monitoring, planning and protection.

13.3 Recommended Actions for Drinking Water Supplies

- For Municipalities:
  - Make protection of water supply sources a municipal priority.
  - Adopt local bylaws and regulations that increase protection of public water supplies, such as natural resource protection zoning, restriction of uses that involve hazardous materials storage or use, standards for construction projects, and waste disposal procedures.
  - Acquire permanently protected open space in public water supply areas to protect water quality.
  - Expand public water supply sampling to include testing for unregulated contaminants of emerging concern that are more likely to be present in the region, including testing for per- and polyfluoroalkyl substances (PFAS).
  - Conduct or update the town's source water assessment and protection (SWAP) plan to rate the susceptibility of public drinking water supplies compared to the collected inventory of likely contamination threats, such as gas stations, landfills and other uses. Make the assessment available to the public on the town's website. Adopt measures to address specific risks with the water supply area.
  - Promote water conservation and limited outdoor watering to protect source water and as a response to climate change.
  - Encourage and promote homeowners and businesses to use native species in landscaping and to reduce or eliminate lawns to reduce use of fertilizers, pesticides and water. Do the same for municipal properties such as offices, public parks, schools and other landscaped areas.
  - Improve water supply infrastructure to ensure high water quality delivery standards for homeowners and businesses.

  - Identify and address stormwater runoff sources that could carry contaminants to drinking water supplies.
  - Develop, update and implement contingency planning strategies that address water supply contamination or emergency service interruptions.
  - Adopt public education programs to increase awareness of threats to drinking water sources, encourage source water protection, and build support for local water protection initiatives. Make sure businesses and households are aware if they are located within a water supply protection area.
  - Incorporate climate change into the town's water resource planning and protection.

- <u>For Homeowners/Business Owners:</u>
  - Organize locally and demand action by town officials to protect water supplies.
  - At town meeting and at the ballot box, support investments to improve water supply protection.
  - Support the adoption of local regulations that increase protection of water supplies, such as natural resource protection zoning, restriction of uses that involve the storage or use of hazardous materials, and other protective measures.
  - Support town and local land trust efforts to acquire permanently protected open space in public water supply areas.
  - Know where your town's water supply protection areas are located. If your home or business is located within a water supply protection area, avoid activities in and around your home or business that could pollute the groundwater beneath it. Even a small spill of a hazardous substance (see the list below) can cause major contamination of groundwater.
  - Don't dump hazardous substances down the drain. Household chemicals, paints, thinners, solvents, pharmaceuticals and other hazardous materials can leach into groundwater and drinking water supplies. Properly dispose of hazardous wastes during designated collection days at local transfer stations.
  - Work to achieve zero stormwater runoff from your property. Direct roof runoff from downspouts away from paved areas. Install rain gardens or rain barrels to collect water. Maximize permeable areas and native plantings that help absorb stormwater and prevent water runoff to roads. Native plants are also more drought tolerant and require less watering.
  - Eliminate the use of fertilizers and pesticides. Reduce, or better yet, eliminate turf grass lawns. Encourage your town, local school and golf courses to reduce or eliminate fertilizer and pesticide use.
  - Conserve water usage inside and outside your house or business. For example, avoid watering the lawn during summertime drought conditions.
  - If using a private well, conduct regular testing, including testing for contaminants of emerging concern that are more likely to occur in the region.
  - Maintain your on-site septic systems properly by having it pumped regularly—every three years is recommended. Consider an advanced wastewater treatment system to treat nutrients.

- For State Government:
  - Adopt more protective standards to address unregulated contaminants and contaminants of emerging concern.
  - Adopt regulations to address per- and polyfluoroalkyl substances (PFAS).
  - Incorporate climate change into water resource planning and protection.

- For Regional Government:
  - Maintain, and where possible, improve, rigorous protections of drinking water supply areas within the Cape Cod Commission's regulatory review jurisdiction.
  - Cleanup municipal drinking water supplies in locations where county-controlled activities are responsible for contaminating groundwater.
  - Incorporate climate change into water resource planning and protection.

14. Success Stories

Despite the challenges and the need for much greater action in every town, there have been some successes in addressing nutrient pollution. These successes include the following:

- Passage of state legislation in 2018 that established the Cape Cod and Islands Water Protection Fund to provide a non-property tax-based source of funds to help Cape Cod and the Islands pay for necessary wastewater infrastructure and water quality remediation efforts. In 2021 the first round of funding awards were awarded to a number of towns to assist them with wastewater management.

- Barnstable County's alternative septic system testing center has been testing efficacy of different alternative septic systems and has identified several as being potentially useful;

- Sewer expansion projects in Chatham and in Falmouth;

- Alternative wastewater treatment methods are being tested or utilized in towns, including permeable reactive barriers in Falmouth and Orleans and shellfish aquaculture projects in Falmouth, Barnstable, Mashpee, Yarmouth, Dennis, Orleans and Wellfleet;

- Partnering agreements between towns to share public wastewater treatment facilities (e.g., Harwich and Chatham); including first-ever sewers installed in Harwich;

- Groundbreaking in 2020 for the Orleans wastewater treatment facility and collection system;

- The state's first Watershed Permit for four towns in the Pleasant Bay watershed, designed to facilitate a coordinated effort by the towns of Brewster, Chatham, Harwich and Orleans and the Pleasant Bay Alliance to control nutrient pollution in Pleasant Bay (see Pleasant Bay Watershed Permit);

- Intermunicipal agreement between Mashpee, Sandwich and Barnstable for nitrogen load sharing for the cleanup of Popponesset Bay;

- Pond restoration success stories have been compiled by the Cape Cod Commission. Success stories for freshwater ponds are fewer because ponds have not received the attention that coastal embayments have received;

- Additional water quality improvement success stories can be found on the Cape Cod Commission's website.

Finally, ecological restoration projects provide benefits for water quality as well as ecological benefits for fish and wildlife habitat. Several restoration projects that are planned, underway or completed include: Parkers River tidal restoration, Herring River tidal restoration, Childs River freshwater wetland restoration, Coonamessett River restoration, Sesuit Creek salt marsh restoration, Three Bays stormwater remediation project, Stony Brook salt marsh and fish passage restoration, and others. APCC's Restoration Coordination Center is assisting with many of these projects and provides Cape Cod communities with assistance in planning and implementing successful restoration projects. For more information on restoration projects on Cape Cod, visit APCC's website.

15. References and Resources

Cape Cod's water resources:

Cape Cod Commission website on Water Resources. Posted at: https://www.capecodcommission.org/our-work/topic/water-resources/

Economic value of the blue economy:

Cape Cod Chamber of Commerce website on economic value of Cape Cod's tourism industry, at: Cape Cod Chamber of Commerce) http://www.whycapecod.org/stats.html

Natural Resources Conservation Service (NRCS), Cape Cod Water Resources Restoration Project, Why It Matters to Massachusetts Economy, https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_013852.pdf).

Definitions:

Embayments: https://www.yourdictionary.com/embayment

Estuaries: NOAA https://oceanservice.noaa.gov/facts/estuary.html .

Watersheds:

Cape Cod Commission watershed reports. Posted at https://www.capecodcommission.org/our-work/208-plan-implementation/#WatershedReports . Click on an individual watershed to get the report for that watershed.

Nutrient pollution:

Cape Cod Commission. 2015. Cape Cod Areawide 208 Water Quality Management Plan. Posted at: https://www.capecodcommission.org/our-work/208 .

Massachusetts Estuaries Project. See state website at: https://www.mass.gov/guides/the-massachusetts-estuaries-project-and-reports

Massachusetts Estuaries Project, University of Massachusetts at Dartmouth, School of Marine and Atmospheric Science and Technology (SMAST) website at: http://www.smast.umassd.edu/Coastal/research/estuaries/estuaries.html .

Cape Cod Commission, Ponds and Lakes website at: https://www.capecodcommission.org/our-work/ponds-and-lakes/ .

Beach water quality monitoring:

Barnstable County webpage on bathing beach water quality at https://www.barnstablecountyhealth.org/health-topics/recreational-water-quality

Shellfish water quality monitoring:

Massachusetts Division of Marine Fisheries webpage on shellfish sanitation and management, at: https://www.mass.gov/shellfish-sanitation-and-management

Cyanobacteria monitoring:

Association to Preserve Cape Cod, Cyanobacteria monitoring program webpage at: https://apcc.org/our-work/science/community-science/cyanobacteria/

Leland, N.J., J.F. Haney, K. Conte, K. Malkus-Benjamin and B. Horseley. 2019. Evaluation of size structure in freshwater cyanobacteria populations: methods to quantify risk associated with changes in biomass and Microcystin concentrations. Journal of Water Research and Protection, 2019, 11, 810-829. Posted at: https://www.scirp.org/journal/paperinformation.aspx?paperid=93424 Hyperlink: Leland, Haney, Conte, Malkus-Benjamin and Horseley, 2019

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populations in a shallow mesotrophic pond. Natural Resources, 2020, 11, 394-419. Posted at: https://m.scirp.org/papers/102960 . Hyperlink: Leland et al., 2020

Leland, N.J. and Haney, J.F., 2018. Alternative Methods for Analysis of Cyanobacterial Populations in Drinking Water Supplies: Fluorometric and Toxicological Applications Using Phycocyanin. Journal of Water Resource and Protection, 10, 740-761. Posted at: https://www.scirp.org/journal/PaperInformation.aspx?paperID=86671& Hyperlink: Leland and Haney, 2018

U.S. Environmental Protection Agency (EPA). 2017. Cyanobacteria Monitoring Collaborative Program (CMC). 2017. Quality Assurance Program Plan (QAPP) for the Cyanobacteria Monitoring Collaborative Program. Rev: 0, April 26, 2017: Posted at: https://cyanos.org/wp-content/uploads/2017/04/cmc_qapp_final.pdf . Hyperlink: CMC 2017

Mercury in ponds and lakes:

https://www.mass.gov/info-details/eating-fish-safely-in-massachusetts

https://www.nrdc.org/stories/mercury-guide

https://capecodchronicle.com/en/5428/harwich/4677/Mercury-Contamination-Found-In-Freshwater-Fish;-White-And-Mill-Ponds-In-Harwich-Impacted-Health-Environment.htm

Emerging contaminants and pharmaceutical compounds in Cape Cod's waters:

Silent Spring Institute website at https://silentspring.org/news/contaminants-pervasive-cape-cods-drinking-water-supply/faqs-emerging-contaminants-cape-cod).

Center for Coastal Studies webpage on pharmaceuticals in marine waters, at: -program/monitoring-projects/contaminants-of-emerging-concern/pharmaceuticals-in-the-waters-of-cape-cod-bay-and-nantucket-sound/).

PFAS:

EPA website on PFAS, at: https://www.epa.gov/pfas

Massachusetts website on PFAS, at: https://www.mass.gov/info-details/per-and-polyfluoroalkyl-substances-pfas .

PFAS Primer , on APCC's State of the Waters: Cape Cod website.

Buzzards Bay Eutrophic Index for evaluating coastal eutrophication:

Costa, J. E., B. L. Howes, A. Giblin, and I. Valiela. 1992. Monitoring Nitrogen and indicators of nitrogen to support management action in Buzzards Bay, p. 497-529. In McKenzie et al.(eds) Ecological Indicators, Elsevier, London.

Buzzards Bay National Estuary Program webpage on the Buzzards Bay Eutrophic Index, at http://buzzardsbay.org/technical-data/status-trends/citizen-wq-monitoring/eutroindex/ ,

Gunn, E., D.S. Janik and J.E. Costa. 1994. Quality Assurance Project Plan (QAPP) for the Buzzards Bay Project. https://buzzardsbay.org/download/qappcitz1994.pdf .)

Buzzards Bay Coalition website on Bay Health Index, at: https://www.savebuzzardsbay.org/bay-health/ .

Center for Coastal Studies website on water quality monitoring program, at: https://coastalstudies.org/cape-cod-bay-monitoring-program/ .

Carlson Trophic Index for evaluating freshwater ponds and lakes:

Carlson, R.E. and J. Simpson. 1996. A Coordinator's Guide to Volunteer Lake Monitoring Methods. North American Lake Management Society. 96 pp. Posted at: https://www.nalms.org/secchidipin/monitoring-methods/trophic-state-equations/

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Grading drinking water:

Natural Resources Defense Council (NRDC). 2003. What's on Tap: Grading Drinking Water in U.S. Cities. Posted at: https://www.nrdc.org/sites/default/files/whatsontap.pdf .

Pond water quality (PALS Program):

Cape Cod Commission, Ponds and Lakes website at: https://www.capecodcommission.org/about-us/newsroom/monitoring-fresh-water-on-cape-cod/ .

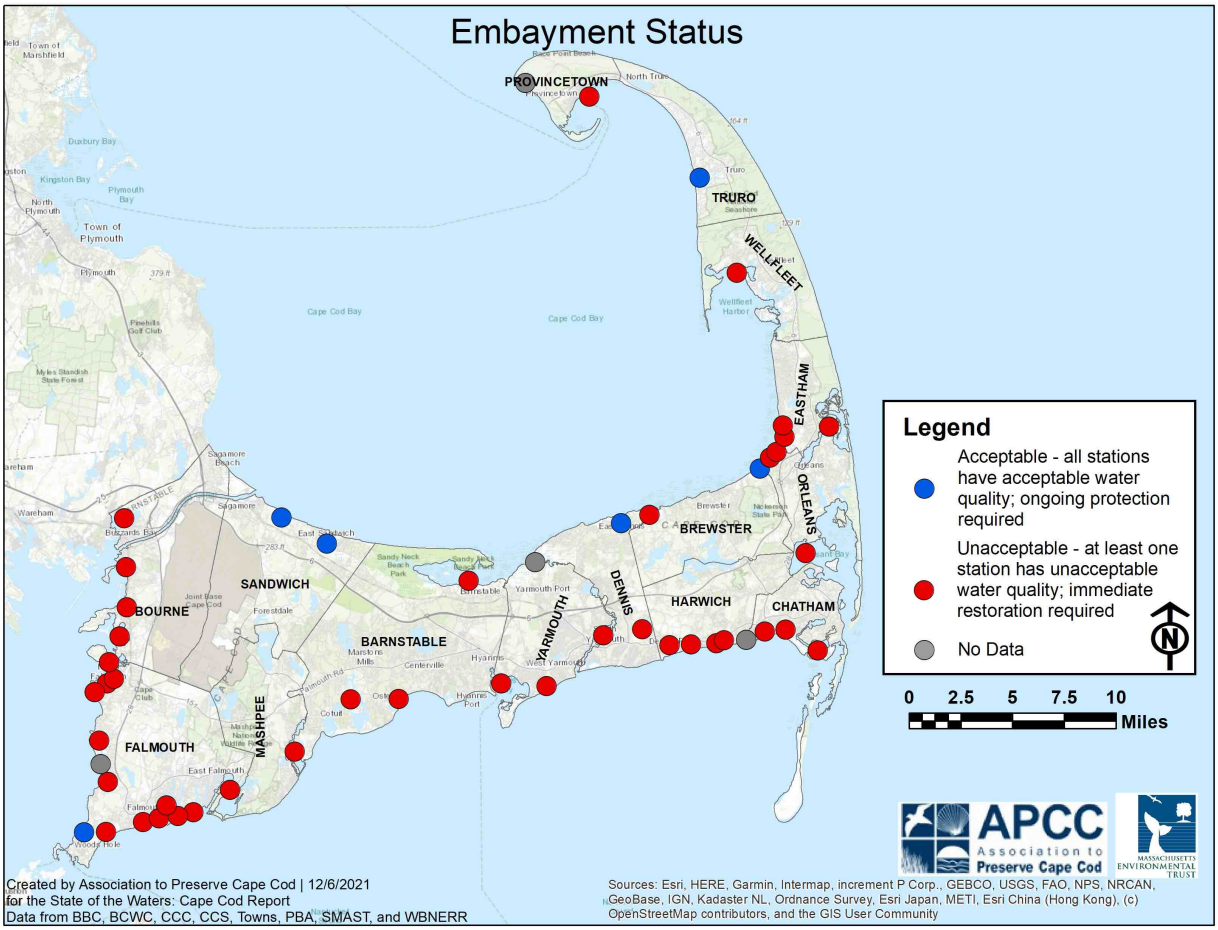

Figure 1. 2021 Map of Water Quality Grades for Coastal Embayments. Water quality grades for individual stations in embayments were reviewed. If there was at least one station in the embayment with Unacceptable water quality, the embayment received a grade of Unacceptable: requires immediate restoration. If all stations in an embayment had Acceptable water quality, the embayment received a grade of Acceptable: requires ongoing protection. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

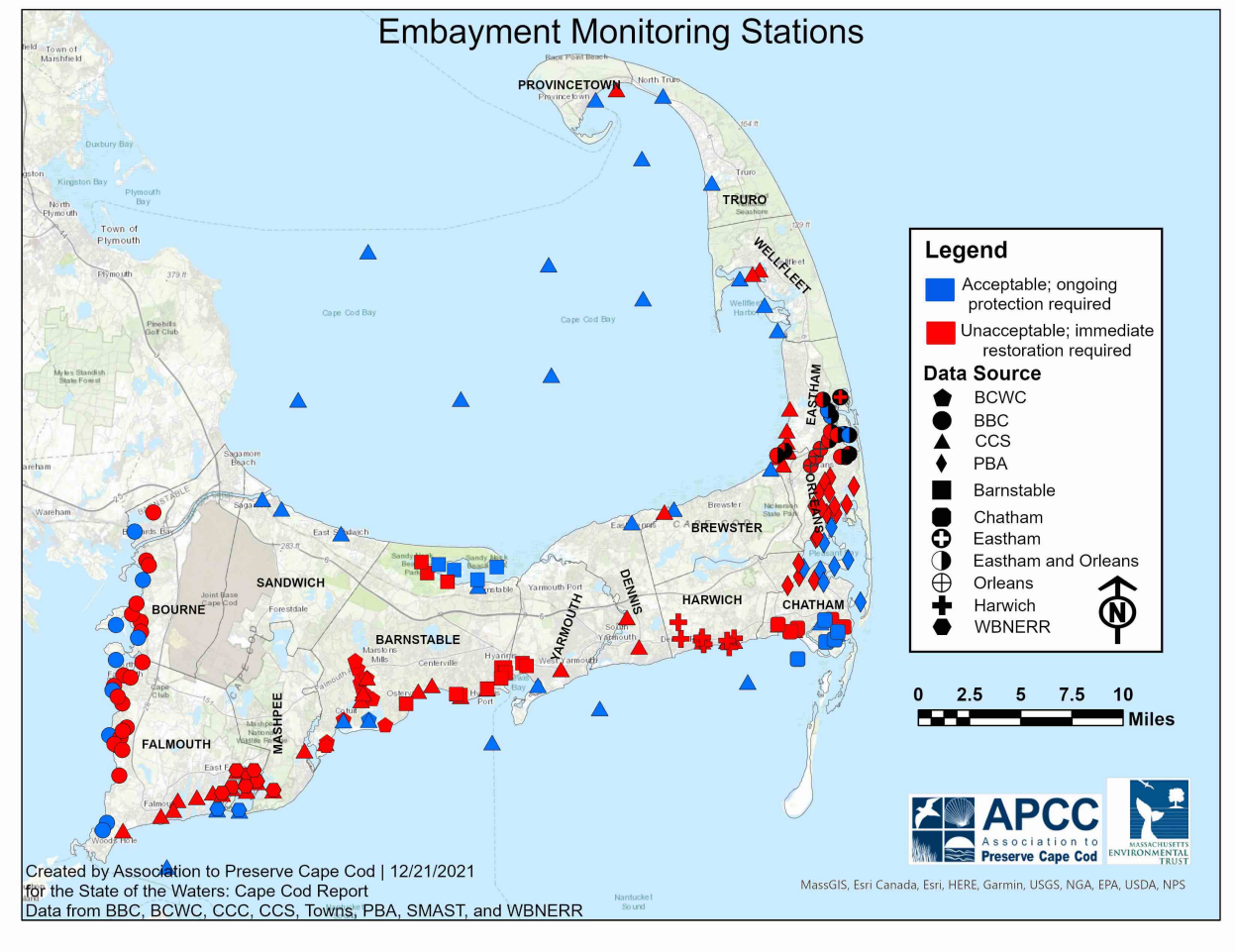

Figure 2. 2021 Map of Water Quality Grades for Coastal Embayment Stations. Water quality data for individual stations were scored using the Buzzards Bay Eutrophication Index and scores were converted into grades as described in Section 10. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

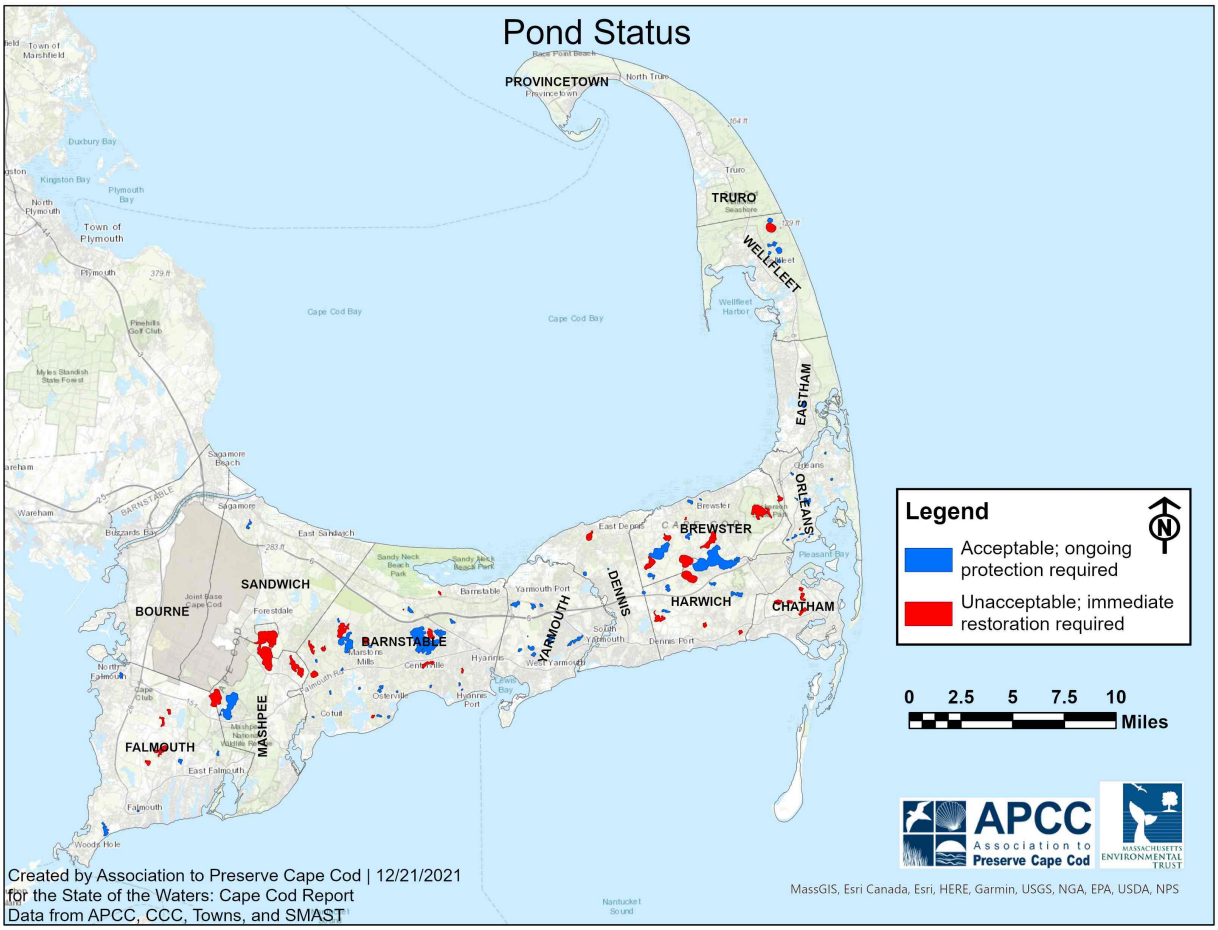

Figure 3. 2021 Map of Water Quality Grades for Ponds and Lakes. Ponds were graded using the Carlson Trophic Index and/or cyanobacteria tiers as described in Section 10. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

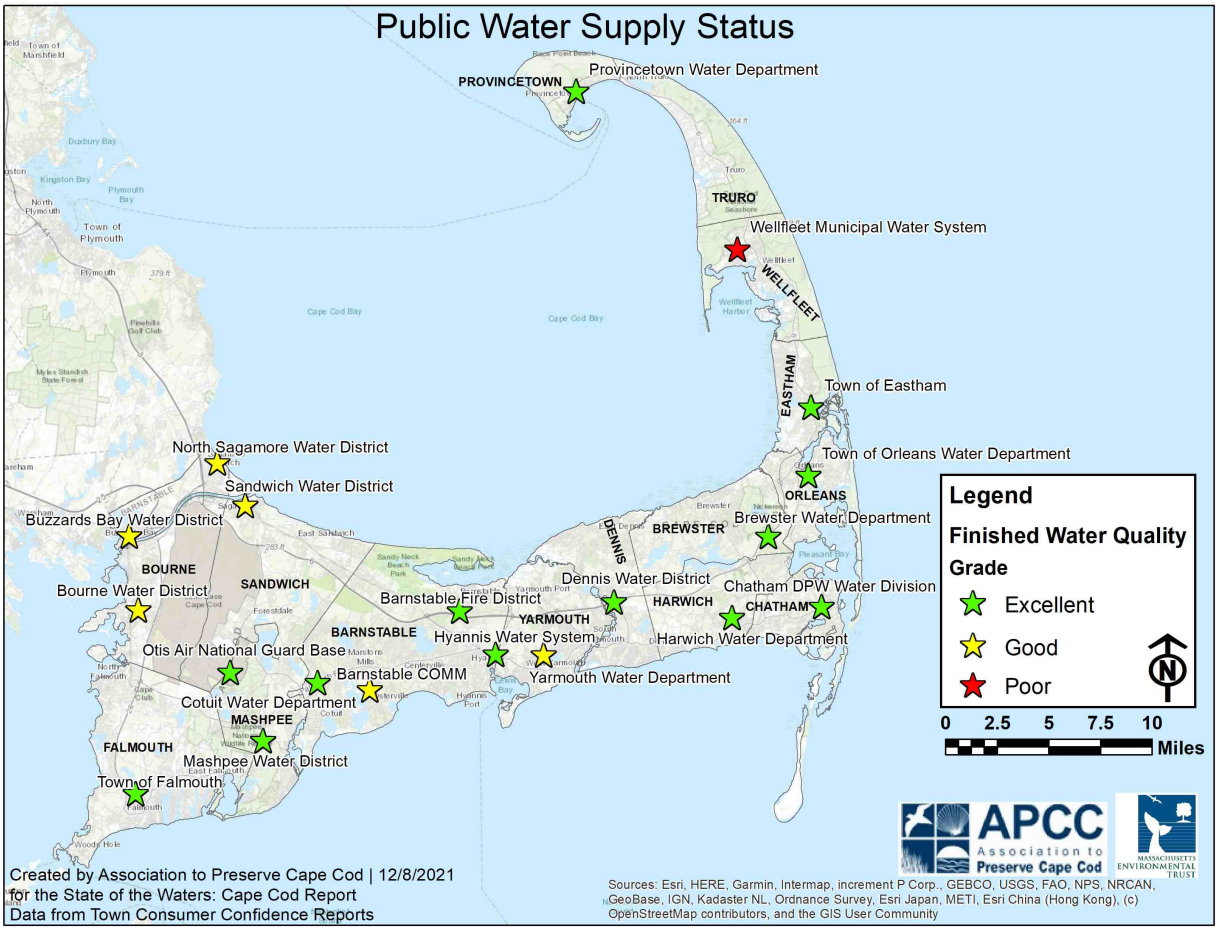

Figure 4. 2021 Map of Grades for Public Water Supplies of Drinking Water. Consumer Confidence Reports from 2020 were used to grade water quality in public water supplies prior to distribution to consumers. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

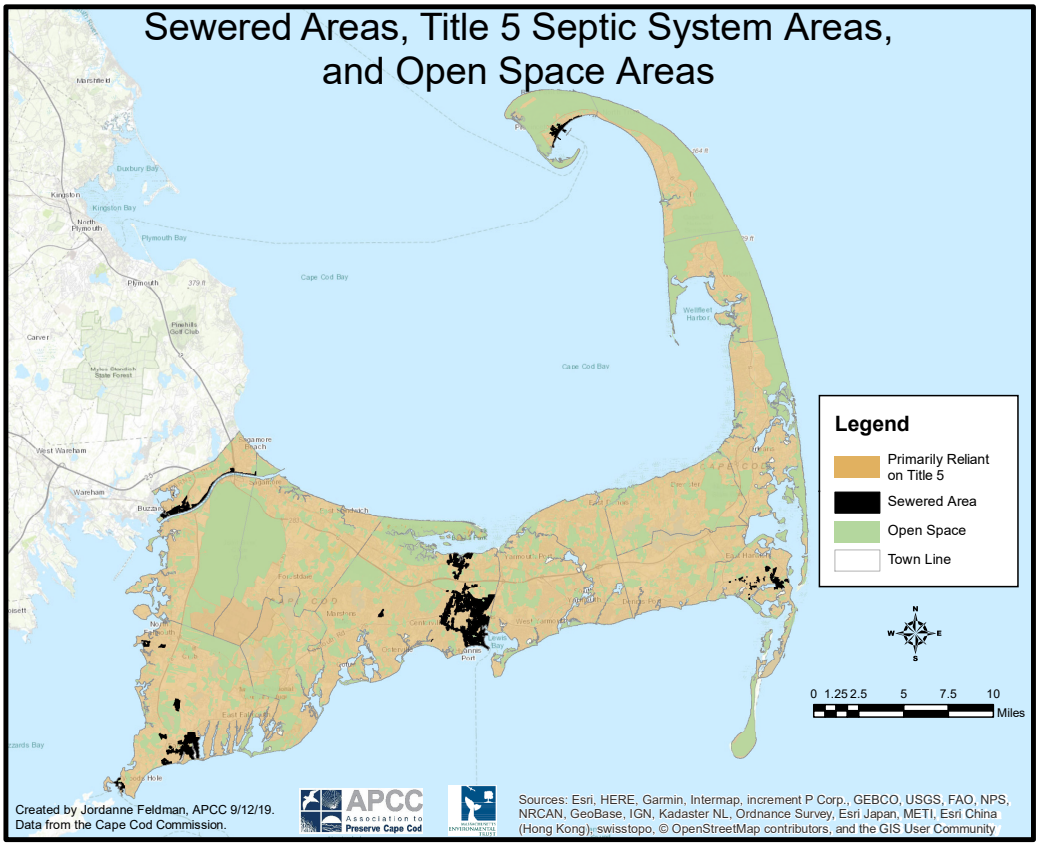

Figure 5. Map of Areas Served by Title 5 Septic Systems and Publicly-Owned Wastewater Treatment Facilities and Open Space.

Table 1. Summary of 2019, 2020 and 2021 State of the Waters Grades for Coastal Embayments and Stations. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

COASTAL	**2019 Grades**		**2020 Grades**		**2021 Grades**		
	No.	% of graded embayments	No.	% of graded embayments	No.	% of graded embayments	
Embayments							
Acceptable:	15	32%	10	21%	6	13%	
Unacceptable:	32	68%	38	79%	41	87%	
No Data:	5		4		4		
Total Graded Embayments:	47		48		47		
Total:	52		52		51		
Embayment Stations			No.	%	No.	% of graded stations	Change from 2020
Acceptable:	54	36%	46	30%	64	32%	18
Unacceptable	98	64%	106	70%	133	68%	27
Total:	152		152		197		45

Notes:
Station grades were based on a 5-year moving average of Eutrophic Index scores as follows:
2021 grades used 2016-2020 data, with some exceptions (e.g., Harwich) where data in this date range were not available.
2020 grades used 2015-2019 data, with some exceptions where data in this date range were not available.
2019 grades largely utilized station data from 2013-2017, with some exceptions made to use older data for stations not recently monitored.
Embayment grades:
An embayment was graded as Acceptable only if all graded stations in that embayment were Acceptable.
An embayment was graded as Unacceptable grades if one or more graded stations in that embayment were Unacceptable.

Table 2. 2021 Embayment Grades. A coastal embayment was graded as Acceptable if all stations in the embayment were Acceptable; if at least one station was Unacceptable, the embayment was graded as Unacceptable. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Embayment_Name	Overall_Embayment_Grade
Allen Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Back River/Eel Pond/Phinney's Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Barnstable Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Bass River	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Boat Meadow River	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Bournes Pond	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Buttermilk Bay	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Centerville River	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Chase Garden Creek	No data
Falmouth Inner Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Fiddlers Cove	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Great Pond	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Green Pond	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Great Sippewisset Creek	No data
Hatch's Harbor	No data
Herring River (EA)	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Herring River (HA)	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Lewis Bay	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Little Namskaket Creek	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Little Pond	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Little Sippewisset Marsh	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Megansett Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Namskaket Creek	Acceptable: All stations have acceptable water quality; ongoing protection required
Nauset Marsh	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Oyster Pond (FA)	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Pamet River	Acceptable: All stations have acceptable water quality; ongoing protection required
Parkers River (YA)	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Pleasant Bay	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Pocasset Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Pocasset River	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Popponesset Bay	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Provincetown Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Quisset Harbor	Acceptable: All stations have acceptable water quality; ongoing protection required
Quivett Creek	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Rand Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Red River	No data
Rock Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Sandwich Harbor	Acceptable: All stations have acceptable water quality; ongoing protection required
Saquetucket Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Scorton Harbor	Acceptable: All stations have acceptable water quality; ongoing protection required
Sesuit Harbor	Acceptable: All stations have acceptable water quality; ongoing protection required
Stage Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Sulfur Springs/Bucks Creek	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Swan Pond River	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Taylor's Pond/Mill Creek	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Three Bays	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Waquoit Bay	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Wellfleet Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
West Falmouth Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Wild Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required
Wychmere Harbor	Unacceptable: At least one station has unacceptable water quality; immediate restoration required

Table 3. 2021 Coastal Station Grades. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Embayment	Years covered	Location	Source of Data	Station	Site_Name	Eutrophic Index Score	Grade
Phinneys Harbor	2016-2020	Buzzard's Bay	BBC	EP3	Back River	56.0	Unacceptable; Immediate Restoration Required
Buttermilk Bay	2016-2020	Buzzard's Bay	BBC	BB4	Buttermilk Bay	65.7	Acceptable; Ongoing Protection Required
Phinneys Harbor	2016-2020	Buzzard's Bay	BBC	EP2	Eel Pond, Bourne	38.4	Unacceptable; Immediate Restoration Required
Fiddlers Cove	2016-2020	Buzzard's Bay	BBC	FC1N	Fiddlers Cove	60.5	Unacceptable; Immediate Restoration Required
Great Sippewissett Marsh	NA	Buzzard's Bay	NA	GSM	Great Sippewissett Marsh	no data	no data
Pocasset Harbor	2016-2020	Buzzard's Bay	BBC	HC2	Hen Cove	59.3	Unacceptable; Immediate Restoration Required
Buttermilk Bay	2016-2020	Buzzard's Bay	BBC	Approx. location	Little Buttermilk Bay	57.6	Unacceptable; Immediate Restoration Required
Little Sippewissett Marsh	2016-2020	Buzzard's Bay	BBC	LSM1	Little Sippewisset Marsh	62.0	Unacceptable; Immediate Restoration Required
West Falmouth Harbor	2016-2020	Buzzard's Bay	BBC	MAC1	Mashapaquit Creek	2.5	Unacceptable; Immediate Restoration Required
Megansett Harbor	2016-2020	Buzzard's Bay	BBC	MG4	Megansett Harbor	83.4	Acceptable; Ongoing Protection Required
Phinneys Harbor	2016-2020	Buzzard's Bay	BBC	PH2	Phinneys Harbor	69.6	Acceptable; Ongoing Protection Required
Pocasset Harbor	2016-2020	Buzzard's Bay	BBC	PC1	Pocasset Harbor Inner	49.7	Unacceptable; Immediate Restoration Required
Pocasset Harbor	2016-2020	Buzzard's Bay	BBC	PC3	Pocasset Harbor Outer	72.5	Acceptable; Ongoing Protection Required
Pocasset Harbor	2016-2020	Buzzard's Bay	BBC	PR3	Pocasset River	52.5	Unacceptable; Immediate Restoration Required
Wild Harbor	2016-2020	Buzzard's Bay	BBC	Approx. location	Potters Hole Pond	20.4	Unacceptable; Immediate Restoration Required
Quissett Harbor	2016-2020	Buzzard's Bay	BBC	QH2	Quissett Harbor Inner	87.1	Acceptable; Ongoing Protection Required
Quissett Harbor	2016-2020	Buzzard's Bay	BBC	QH1	Quissett Harbor Outer	89.8	Acceptable; Ongoing Protection Required
Rands Harbor	2016-2020	Buzzard's Bay	BBC	RH1	Rands Harbor	35.7	Unacceptable; Immediate Restoration Required
Pocasset Harbor	2016-2020	Buzzard's Bay	BBC	RB4	Red Brook Harbor Inner	63.9	Unacceptable; Immediate Restoration Required
Pocasset Harbor	2016-2020	Buzzard's Bay	BBC	RB2	Red Brook Harbor Outer	77.2	Acceptable; Ongoing Protection Required
Megansett Harbor	2016-2020	Buzzard's Bay	BBC	SQ1N	Squeteague Harbor	56.7	Unacceptable; Immediate Restoration Required
West Falmouth Harbor	2016-2020	Buzzard's Bay	BBC	WF4N	West Falmouth Harbor Head	52.5	Unacceptable; Immediate Restoration Required
West Falmouth Harbor	2016-2020	Buzzard's Bay	BBC	WF9N	West Falmouth Harbor Outer	74.2	Acceptable; Ongoing Protection Required
West Falmouth Harbor	2016-2020	Buzzard's Bay	BBC	WF1N	West Falmouth Harbor Town Dock	61.9	Unacceptable; Immediate Restoration Required
West Falmouth Harbor	2016-2020	Buzzard's Bay	BBC	WF5N	West Falmouth Mid-Harbor	64.3	Unacceptable; Immediate Restoration Required
West Falmouth Harbor	2016-2020	Buzzard's Bay	BBC	WF8	West Falmouth Oyster Pond	33.3	Unacceptable; Immediate Restoration Required
West Falmouth Harbor	2016-2020	Buzzard's Bay	BBC	WF2	West Falmouth Snug Harbor	24.1	Unacceptable; Immediate Restoration Required
Wild Harbor	2016-2020	Buzzard's Bay	BBC	WH1N	Wild Harbor Inner	57.0	Unacceptable; Immediate Restoration Required
Wild Harbor	2016-2020	Buzzard's Bay	BBC	WH3	Wild Harbor Outer	82.5	Acceptable; Ongoing Protection Required
Wild Harbor	2016-2020	Buzzard's Bay	BBC	WH2	Wild Harbor River	64.6	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	Mill Pond	Site 1	30.7	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	South Prince's Cove	Site 2	37.3	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	North Prince's Cove	Site 3	39.5	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	Warren's Cover	Site 4	35.3	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	North N. Bay	Site 5	37.4	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	South N. Bay	Site 6	49.6	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	South West Bay	Site 9	67.9	Acceptable; Ongoing Protection Required
Three Bays	2016-2020	Three Bays	BCWC	South Cotuit Bay	Site 13	55.0	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	Cotuit Sentinel	Site 18	49.2	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Three Bays	BCWC	Old Mill	Site E	37.2	Unacceptable; Immediate Restoration Required
Cape Cod Bay	2016-2020	Cape Cod Bay	CCS	1	5N	99.1	Acceptable; Ongoing Protection Required
Cape Cod Bay	2016-2020	Cape Cod Bay	CCS	2	5S	99.4	Acceptable; Ongoing Protection Required
Cape Cod Bay	2016-2020	Cape Cod Bay	CCS	3	6M	100.0	Acceptable; Ongoing Protection Required
Cape Cod Bay	2016-2020	Cape Cod Bay	CCS	4	6S	100.0	Acceptable; Ongoing Protection Required
Cape Cod Bay	2016-2020	Cape Cod Bay	CCS	5	7S	100.0	Acceptable; Ongoing Protection Required
Cape Cod Bay	2016-2020	Cape Cod Bay	CCS	6	8M	99.6	Acceptable; Ongoing Protection Required
Cape Cod Bay	2016-2020	Cape Cod Bay	CCS	8	9S	99.9	Acceptable; Ongoing Protection Required
Barnstable Harbor	na	Cape Cod	CCS	9	Barnstable Harbor	Non-scored: I	na
Wellfleet Harbor	2016-2020	Cape Cod	CCS	10	Blackfish Creek	69.9	Acceptable; Ongoing Protection Required
Boat Meadow River	2016-2020	Cape Cod	CCS	11.5	Boat Meadow	53.1	Unacceptable; Immediate Restoration Required
	2016-2020	Cape Cod	CCS	15	Canal	82.9	Acceptable; Ongoing Protection Required
na (Duxbury)	2016-2020	Cape Cod	CCS	17	D1	65.6	Acceptable; Ongoing Protection Required
na (Duxbury)	2016-2020	Cape Cod	CCS	19	D3	42.9	Unacceptable; Immediate Restoration Required
Boat Meadow River	2016-2020	Cape Cod	CCS	21.5	First Encounter	46.7	Unacceptable; Immediate Restoration Required
Wellfleet Harbor	2016-2020	Cape Cod	CCS	22	Great Island Channel	70.4	Acceptable; Ongoing Protection Required
Provincetown Harbor	2016-2020	Cape Cod	CCS	23	Holiday Inn	64.3	Unacceptable; Immediate Restoration Required
Provincetown Harbor	na	Cape Cod	CCS	na	na	Non-scored: I	na
Pamet River	2016-2020	Cape Cod	CCS	25	Inner Pamet Harbor	76.6	Acceptable; Ongoing Protection Required
Rock Harbor	2016-2020	Cape Cod	CCS	26.5	Inner Rock Harbor	30.7	Unacceptable; Immediate Restoration Required
Sesuit Harbor	2016-2020	Cape Cod	CCS	27	Inner Sesuit Harbor	79.5	Acceptable; Ongoing Protection Required
Wellfleet Harbor	2016-2020	Cape Cod	CCS	28	Inner Wellfleet Harbor	50.1	Unacceptable; Immediate Restoration Required
Provincetown Harbor	2016-2020	Cape Cod	CCS	30	MacMillan	92.1	Acceptable; Ongoing Protection Required
Namskaket Creek	na	Cape Cod	CCS	31	Namskaket	Non-scored: I	na
Sandwich Harbor	na	Cape Cod	CCS	32	Old Harbor	Non-scored: I	na
na (Plymouth)	2016-2020	Cape Cod	CCS	33	P1	67.2	Acceptable; Ongoing Protection Required
Pamet River	na	Cape Cod	CCS			Non-scored: I	na
Rock Harbor	2016-2020	Cape Cod	CCS	39.5	Rock Harbor	55.3	Unacceptable; Immediate Restoration Required
Scorton Harbor	na	Cape Cod	CCS	40	na	Non-scored: I	na
Sesuit Harbor	na	Cape Cod	CCS	41	na	Non-scored: I	na
Wellfleet Harbor	2016-2020	Cape Cod	CCS	42	Sunken Meadow	84.3	Acceptable; Ongoing Protection Required
Wellfleet Harbor	2016-2020	Cape Cod	CCS	43	Wellfleet Harbor	56.5	Unacceptable; Immediate Restoration Required
Cape Cod Bay		Cape Cod Bay	CCS	44	F01	Not included	Unacceptable; Immediate Restoration Required
Cape Cod Bay		Cape Cod Bay	CCS	45	F02	021 data dow	Unacceptable; Immediate Restoration Required
Cape Cod Bay		Cape Cod Bay	CCS	46	F29	021 data dow	Unacceptable; Immediate Restoration Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	47	NTKS_1	96.6	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	48	NTKS_3	89.0	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	49	NTKS_4	97.9	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	50	NTKS_6	88.9	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	51	NTKS_8	99.0	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	52	NTKS_10	91.5	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	53	NTKS_13	94.9	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	54	NTKS_16	96.0	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Nantucket Soun	CCS	60	NTKS_14	97.6	Acceptable; Ongoing Protection Required
null	2016-2020	null	CCS	65	NTKS_12	96.2	Acceptable; Ongoing Protection Required
Sandwich Harbor	2016-2020	Cape Cod	Volunteer	101	Boardwalk	85.3	Acceptable; Ongoing Protection Required
null	2016-2020	null	null	102	Boat Meadow (inner)	29.0	Unacceptable; Immediate Restoration Required
Wellfleet Harbor	2015-2019	Cape Cod	Volunteer	na	Herring River Wellfleet	Non Scored (I	na
Little Namskaket Creek	2016-2020	Cape Cod	Volunteer	107	Little Namskaket	63.4	Unacceptable; Immediate Restoration Required
Namskaket Creek	2016-2020	Cape Cod	Volunteer	108	Namskaket (inner?)	79.7	Acceptable; Ongoing Protection Required
Quivett Creek	2016-2020	Cape Cod	Volunteer	110	Paines Creek	76.5	Acceptable; Ongoing Protection Required
Scorton Harbor	2016-2020	Cape Cod	CCS	114	Scorton	82.1	Acceptable; Ongoing Protection Required
	2016-2020			117	Pamet River	56.6	Unacceptable; Immediate Restoration Required
Truro Cape Cod Bay	na		CCS	na	Pilgrim Lake	Non scored (I	na
Truro Cape Cod Bay	2016-2020		CCS	119	Pilgrim Lake East	76.7	Acceptable; Ongoing Protection Required
	2016-2020			123	Old Harbor-Dewey	68.4	Acceptable; Ongoing Protection Required
	2016-2020			124	Scorton Creek 6A	77.0	Acceptable; Ongoing Protection Required
	2016-2020			125	Scorton Creek Jones Lane	47.6	Unacceptable; Immediate Restoration Required
Wellfleet Harbor	na	Cape Cod	CCS	na	Duck Creek	Non scored (I	na
Quivett Creek	2016-2020		CCS	128	Quivet Marsh	34.7	Unacceptable; Immediate Restoration Required
Herring River (EA)	2016-2020	Cape Cod	CCS	129	Cole Road Brook	64.9	Unacceptable; Immediate Restoration Required
	2016-2020			130	Sesuit Creek	24.9	Unacceptable; Immediate Restoration Required
Barnstable Harbor	2016-2020	Cape Cod	CCS	131	Millway Beach	74.7	Acceptable; Ongoing Protection Required
Pamet River	2016-2020		CCS	135	Upper Pamet River	25.7	Unacceptable; Immediate Restoration Required
	2016-2020			136	Bluefish Creek	31.2	Unacceptable; Immediate Restoration Required
Little Namskaket Creek	2016-2020		CCS	137	Little Namskaket Creek	19.0	Unacceptable; Immediate Restoration Required
Wellfleet Harbor	na		CCS	WH-5	Wellfleet Harbor	Not scored-in	na
	2016-2020			202	Channel	37.3	Unacceptable; Immediate Restoration Required
	2016-2020			205	Transect 2	41.3	Unacceptable; Immediate Restoration Required
	2016-2020			212	DB-pipe	23.9	Unacceptable; Immediate Restoration Required
	2016-2020			303	RH-culvert	24.2	Unacceptable; Immediate Restoration Required
Rock Harbor	2016-2020	Cape Cod	CCS	304	RH-bend	33.9	Unacceptable; Immediate Restoration Required
	2016-2020			306	RH-pipe	54.1	Unacceptable; Immediate Restoration Required
Bournes Pond	2016-2020	Cape Cod	CCS	500	B3	45.4	Unacceptable; Immediate Restoration Required
Lewis Bay	2016-2020	Cape Cod	CCS	501	BC-14	44.0	Unacceptable; Immediate Restoration Required
Centerville River	2016-2020	Cape Cod	CCS	502	BCT-1	29.0	Unacceptable; Immediate Restoration Required
Centerville River	2016-2020	Cape Cod	CCS	503	BCT-2	36.9	Unacceptable; Immediate Restoration Required
Lewis Bay	2016-2020	Cape Cod	CCS	504	BHY-3	66.6	Acceptable; Ongoing Protection Required
Bass River	2016-2020	Cape Cod	CCS	505	BR-7	39.4	Unacceptable; Immediate Restoration Required
Taylor's Pond/Mill Creek	2016-2020	Cape Cod	CCS	506	CM-10	39.4	Unacceptable; Immediate Restoration Required
Stage Harbor	2016-2020	Cape Cod	CCS	507	CM-1A	74.5	Acceptable; Ongoing Protection Required
Stage Harbor	2016-2020	Cape Cod	CCS	508	CM-5A	69.9	Acceptable; Ongoing Protection Required

(Table 3, Coastal Station Grades, continued).

Embayment	Years covered	Location	Source of Data	Station	Site_Name	Eutrophic Index Score	Grade
Sulfur Springs/Bucks Creek	2016-2020	Cape Cod	CCS	S09	CM-8	42.2	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Cape Cod	CCS	S10	Cotuit Bay	70.3	Acceptable; Ongoing Protection Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S11	Site 7 - CR-2	22.6	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S17	Site 8 - ER-2	47.5	Unacceptable; Immediate Restoration Required
Falmouth Inner Harbor	2016-2020	Cape Cod	CCS	S18	FHx	42.9	Unacceptable; Immediate Restoration Required
Green Pond	2016-2020	Cape Cod	CCS	S20	G4	43.9	Unacceptable; Immediate Restoration Required
Great Pond	2016-2020	Cape Cod	CCS	S21	GT-5	42.2	Unacceptable; Immediate Restoration Required
Saquetucket Harbor	2016-2020	Cape Cod	CCS	S22	HAR-2	44.7	Unacceptable; Immediate Restoration Required
Wychmere Harbor	2016-2020	Cape Cod	CCS	S23	HAR-3	47.4	Unacceptable; Immediate Restoration Required
Allen Harbor	2016-2020	Cape Cod	CCS	S24	HAR-4	43.3	Unacceptable; Immediate Restoration Required
Herring River (HA)	na	Cape Cod	CCS	na	Herring River Harwich	not scored-ins	na
Waquoit Bay	2016-2020	Cape Cod	CCS	S26	Site 3 - HPu	51.2	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S27	Site 4 - JHP	48.4	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Cape Cod	CCS	S32	Narrows	56.2	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Cape Cod	CCS	S33	North Bay	48.3	Unacceptable; Immediate Restoration Required
Oyster Pond (FA)	2016-2020	Cape Cod	CCS	S34	OP-3	57.3	Unacceptable; Immediate Restoration Required
Popponesset Bay	2016-2020	Cape Cod	CCS	S35	PBh	58.2	Unacceptable; Immediate Restoration Required
Parkers River (YA)	2016-2020	Cape Cod	CCS	S36	PR-2	44.4	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S37	Site 5 - QRm	36.7	Unacceptable; Immediate Restoration Required
Rushy Marsh Pond	2016-2020	Cape Cod	CCS	S38	RM-2	37.0	Unacceptable; Immediate Restoration Required
Lewis Bay	2016-2020	Cape Cod	CCS	S42	Stewarts Creek	32.0	Unacceptable; Immediate Restoration Required
Swab Pond River	2016-2020	Cape Cod	CCS	S43	SWP-2	48.6	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Cape Cod	CCS	S51	Warrens Cove	38.9	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S52	Site 10 - WBu/Metoxit	64.5	Unacceptable; Immediate Restoration Required
Three Bays	2016-2020	Cape Cod	CCS	S53	West Bay	78.2	Acceptable; Ongoing Protection Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S64	Site 1 - Seapit	46.5	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S65	Site 2 - WB north	54.1	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S66	Site 9 - WB south	81.1	Acceptable; Ongoing Protection Required
Waquoit Bay	2016-2020	Cape Cod	CCS	S67	Site 6 - Menauhant	76.3	Acceptable; Ongoing Protection Required
Little Pond	2016-2020	Cape Cod	CCS	S68	LP-2	33.3	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 1	Seapit River	44.2	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 2	North Basin-WB*	53.1	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 3	Hamblin Pond	49.6	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 4	Jehu Pond	44.2	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 5	Quashnet River	35.4	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 6	Menauhant	72.4	Acceptable; Ongoing Protection Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 7	Childs River	21.7	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 8	Eel River	47.8	Unacceptable; Immediate Restoration Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 9	South Basin-WB*	75.0	Acceptable; Ongoing Protection Required
Waquoit Bay	2016-2020	Waqoit Bay	Volunteer	Site 10	Site 10 - WBu/Metoxit	59.7	Unacceptable; Immediate Restoration Required
Waquoit Bay		Waqoit Bay	Volunteer	CR	CR	Not included in 2021 data update from WBNERR	
Waquoit Bay		Waqoit Bay	Volunteer	SL	SL	Not included in 2021 data update from WBNERR	
Cape Cod Bay	2016-2020			na	WMO15	35.6	Unacceptable; Immediate Restoration Required
Cape Cod Bay	2016-2020			na	WMO19	35.0	Unacceptable; Immediate Restoration Required
Cape Cod Bay	2016-2020			na	WMO22	38.3	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham	WMO25	WMO25	39.9	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham	WMO26	WMO26	57.3	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham	WMO27	WMO27	52.8	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO28	WMO28	58.0	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO29	WMO29	63.0	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO30	WMO30	80.1	Acceptable; Ongoing Protection Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO31	WMO31	60.5	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO32	WMO32	84.8	Acceptable; Ongoing Protection Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO33	WMO33	58.6	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO34	WMO34	37.1	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO35	WMO35	54.0	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO36	WMO36	66.1	Acceptable; Ongoing Protection Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO37	WMO37	66.9	Acceptable; Ongoing Protection Required
Nauset Marsh	2016-2020	Nausset Marsh	Eastham/Or	WMO38	WMO38	40.1	Unacceptable; Immediate Restoration Required
Nauset Marsh	2016-2019	Nausset Marsh	Eastham	WMO39	WMO39	59.5	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-1	Chatham Harbor	85.0	Acceptable; Ongoing Protection Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-3	Inner Ryder's Cove	46.1	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-4	Crows Pond	79.0	Acceptable; Ongoing Protection Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-5	Muddy Creek	55.8	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-5A	Muddy Creek - Upper	24.8	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-6	Big Bay - SW	84.5	Acceptable; Ongoing Protection Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-8	Big Bay - NE	80.5	Acceptable; Ongoing Protection Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-9	Round Cove	43.7	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-10	Quanset Pond	56.7	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-11	Paw Wah Pond	42.1	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-12	Namequoit Point - South	65.0	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-13	Namequoit Point - North	62.4	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-14	Areys Pond	19.9	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-15	Kescayo Gansett Pond	27.3	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-16	Pochet-mouth	17.4	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-19	Strong Island - NE	81.6	Acceptable; Ongoing Protection Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-20	Nickerson's Neck	85.3	Acceptable; Ongoing Protection Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	PBA-21	Little Pleasant Bay	78.4	Acceptable; Ongoing Protection Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	WMO-3	Pochet-mouth	56.1	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	WMO-5	Pochet-Upper	17.4	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	WMO-6	Namequoit River-Upper	28.0	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	WMO-10	Meetinghouse-Rattles dock	39.4	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Pleasant Bay	Pleasant Ba	WMO-12	Little Quanset Pond	46.0	Unacceptable; Immediate Restoration Required
Pleasant Bay	2016-2020	Chatham	Pleasant Ba	CM-13	Outer Ryder's Cove	75.5	Acceptable; Ongoing Protection Required
Stage Harbor	2016-2020	Chatham	Town of Ch	CM-1	Oyster Pond	54.0	Unacceptable; Immediate Restoration Required
Stage Harbor	2016-2020	Chatham	Town of Ch	CM-1A	Oyster Pond-Outer	70.8	Acceptable; Ongoing Protection Required
Stage Harbor	2016-2020	Chatham	Town of Ch	CM-3	Outer Stage Harbor	77.2	Acceptable; Ongoing Protection Required
Stage Harbor	2016-2020	Chatham	Town of Ch	CM-4	Inner Stage Harbor	76.9	Acceptable; Ongoing Protection Required
Stage Harbor	2016-2020	Chatham	Town of Ch	CM-5	Mill Pond - Inner	63.5	Unacceptable; Immediate Restoration Required
Stage Harbor	2016-2020	Chatham	Town of Ch	CM-5A	Mill Pond - Outer	66.8	Acceptable; Ongoing Protection Required
Nantucket Sound	2016-2020	Chatham	Town of Ch	CM-7	Nantucket Sound	93.7	Acceptable; Ongoing Protection Required
Sulfur Springs/Bucks Creek	2016-2020	Chatham	Town of Ch	CM-8	Upper Bucks Creek	37.4	Unacceptable; Immediate Restoration Required
Taylor's Pond/Mill Creek	2016-2020	Chatham	Town of Ch	CM-10	Taylors Pond	42.2	Unacceptable; Immediate Restoration Required
Sulfur Springs/Bucks Creek	2016-2020	Chatham	Town of Ch	CM-12	Lower Cockle Cove Creek	23.5	Unacceptable; Immediate Restoration Required
Saquetucket Harbor	2015-2019			HAR2	SAQUATUCKET HARBOR	30.2	Unacceptable; Immediate Restoration Required
Wychmere Harbor	2015-2019			HAR2A	WYCHMERE OUTER HARBOR	48.2	Unacceptable; Immediate Restoration Required
Wychmere Harbor	2015-2019			HAR3	WYCHMERE HARBOR	37.9	Unacceptable; Immediate Restoration Required
Allen Harbor	2015-2019			HAR4	ALLENS HARBOR MARINA	37.6	Unacceptable; Immediate Restoration Required
Allen Harbor	2015-2019			HAR4A	ALLEN HULSE PT	38.8	Unacceptable; Immediate Restoration Required
Allen Harbor	2015-2019			HAR5	ALLENS HARBOR CREEK	41.8	Unacceptable; Immediate Restoration Required
Herring River (HA)	2015-2019			HAR7	HERRING RIVER 7 - 28 BRIDGE	50.8	Unacceptable; Immediate Restoration Required
Herring River (HA)	2015-2019			HAR9	HERRING RIVER 9 - NORTH RD	31.0	Unacceptable; Immediate Restoration Required
	2016-2020			BM1	BARNSTABLE HARBOR	73.2	Acceptable; Ongoing Protection Required
	2016-2020			BM2	BARNSTABLE HARBOR	77.2	Acceptable; Ongoing Protection Required
	2016-2020			BM3	BARNSTABLE HARBOR	84.2	Acceptable; Ongoing Protection Required
	2016-2020			BM10	CALVES PASTURE	58.7	Unacceptable; Immediate Restoration Required
	2016-2020			BM11	SPRING CREEK	52.6	Unacceptable; Immediate Restoration Required
	2016-2020			BM12	SCORTON CREEK	65.1	Acceptable; Ongoing Protection Required
	2016-2020			BM13	SCORTON CREEK	45.7	Unacceptable; Immediate Restoration Required
	2016-2020			BC10	EAST BAY	36.3	Unacceptable; Immediate Restoration Required
	2016-2020			BH1	LEWIS BAY	39.1	Unacceptable; Immediate Restoration Required
	2016-2020			BH2	LEWIS BAY	44.9	Unacceptable; Immediate Restoration Required
	2016-2020			BH3	LEWIS BAY	48.4	Unacceptable; Immediate Restoration Required
	2016-2020			BH4	SNOW'S CREEK	25.1	Unacceptable; Immediate Restoration Required
	2016-2020			BH7	STEWART'S CREEK	42.0	Unacceptable; Immediate Restoration Required
	2016-2020			MC1	MILL CREEK	46.8	Unacceptable; Immediate Restoration Required
	2016-2020			MC2	MILL CREEK	44.1	Unacceptable; Immediate Restoration Required
	2016-2020			BC14	HALLS CREEK	58.4	Unacceptable; Immediate Restoration Required
	2016-2020			BC15	HALLS CREEK	59.0	Unacceptable; Immediate Restoration Required

Table 4. Summary of 2019, 2020 and 2021 State of the Waters Grades for Ponds. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

PONDS	**2019 Grades**		**2020 Grades**		**2021 Grades**		
Overall	No.	%	No.	%	No.	%	
Acceptable:	91	61%	54	58%	71	65%	
Unacceptable:	58	39%	39	42%	38	35%	
Total:	149		93		109		
Carlson Trophic Index						% of ponds w/CTI grades	% of all 109 ponds
Acceptable:					24	67%	22%
Unacceptable:					12	33%	11%
Total with CTI grades:	149		29		36		33%
Cyanobacteria	NA					% of ponds w/Cyano grades	% of all 109 ponds
Acceptable:					52	60%	48%
Unacceptable:					35	40%	32%
Total with Cyano grades:			81		87		80%
						% of ponds w/both grades	% of all 109 ponds
Ponds with CTI & Cyano grades:	NA		17		14	100%	13%
Acceptable (CTI and Cyano):					6	43%	6%
Unacceptable:					8	57%	7%
Unacceptable Cyano grades:					7	50%	6%
Unacceptable CTI grades:					4	29%	4%
Unacceptable for both CTI & Cyano:					3	21%	3%

Notes:
The higher number of ponds graded in 2019 reflects a wide range of years of water quality data used for grading,
e.g., the oldest data were from 2003 and the most recent data were from 2017.
In the 2020 and 2021 reports, data quality requirements for water quality data were tightened so that the most recent data and at least 3 years of data were used,
e.g., in the 2020 report, water quality data used for Carlson Trophic Index scoring and grading required at least 3 years of data from 2015 on.
and in the 2021 report, water quality data used for Carlson Trophic Index scoring and grading required at least 3 years of data from 2016 on.
NA Not applicable

Table 5. 2021 Pond Grades. Pond water quality data were provided by towns and organizations, SMAST and the Cape Cod Commission. Cyanobacteria data were provided by APCC and the Town of Barnstable. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

CCC_GIS_ID_21	Town_Data_Source21	Pond Name	Years-Water Quality	Carlson Trophic Index (CTI) score	CTI Grade	2020 Cyanobacteria Tier	Cyanobacteria Grade	Final Grade	Grade based on:
BA-617	Barnstable	Bearse	2020			Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-802	Barnstable	Bog	2016-2018	47.8	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
BA-694	Barnstable	Crocker Pond (aka Muddy Pond)	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-878	Barnstable	Crystal Lake	2016-2018	45.2	Acceptable; Ongoing Protection is Required	Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	CTI and Cyanobacteria
BA-815	Barnstable	Eagle	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-748	Barnstable	Fawcett	2020			Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-510	Barnstable	Garrett	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-606	Barnstable	Gooseberry	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-668	Barnstable	Hamblin	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-565	Barnstable	Hathaway	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-511	Barnstable	Hinkley	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-807	Barnstable	Joshua	2016-2018	33.7	Acceptable; Ongoing Protection is Required	Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	CTI and Cyanobacteria
BA-795	Barnstable	Lake Elizabeth	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-881	Barnstable	Lewis (Cotuit)	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-737	Barnstable	Long Pond Centerville	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-675	Barnstable	Long Pond Marstons Mills	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-759	Barnstable	Lovells	2020		not enough data to score CTI in 2021	High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-797	Barnstable	Micah	2016-2018	31.7	Acceptable; Ongoing Protection is Required	Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	CTI and Cyanobacteria
BA-640	Barnstable	Middle	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-746	Barnstable	Mill	2016-2018	43.6	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
BA-584	Barnstable	Mystic	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-874	Barnstable	Neck	2016-2018	39.5	Acceptable; Ongoing Protection is Required	Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	CTI and Cyanobacteria
BA-395	Barnstable	Night Heron Pond	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-523	Barnstable	No Bottom	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-816	Barnstable	North	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-875	Barnstable	Parker Pond	2016-2018	59.9	Unacceptable; Immediate Restoration is Required	High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	CTI and Cyanobacteria
BA-731	Barnstable	Pattys	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-691	Barnstable	Round	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-806	Barnstable	Schoolhouse	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-626	Barnstable	Shallow	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-664	Barnstable	Shubael	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BA-789	Barnstable	Simmons	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BA-564	Barnstable	Stoney	2016-2018	42.2	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
BA-605	Barnstable	Wequaquet	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-1028	Brewster	Cliff	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BR-179	Brewster	Cobbs	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-357	Brewster	Elbow	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-248	Brewster	Griffith's	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-192	Brewster	Little Cliff	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BR-279	Brewster	Long Pond	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-245	Brewster	Lower Mill	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BR-177	Brewster	Myricks	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-205	Brewster	Schoolhouse	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
HA-306	Brewster	Seymour	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BR-240	Brewster	Sheep	2020			Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
BR-314	Brewster	Smalls	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-272	Brewster	Upper Mill	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
BR-313	Brewster	Walkers	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
CH-458	Chatham	Goose	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
CH-428	Chatham	Lovers Lake	2020			Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
CH-463	Chatham	Schoolhouse	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
CH-396	Chatham	Stillwater	2020			Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
CH-516	Chatham	White	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
DE-347	Dennis	Clay	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
DE-355	Dennis	Flax	2016-2018	38.8	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
DE-236	Dennis	Scargo	2016-2018	46.1	Acceptable; Ongoing Protection is Required	Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	CTI and Cyanobacteria
HA-414	Dennis	Whites	2016-2018	49.4	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
EA-96	Eastham	Depot	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
FA-761	Falmouth	Cedar Lake	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
FA-884	Falmouth	Crooked	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
FA-857	Falmouth	Deep	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
FA-937	Falmouth	Flax	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
FA-933	Falmouth	Fresh	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
FA-918	Falmouth	Jenkins	2020			Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
FA-938	Falmouth	Mares	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
FA-995	Falmouth	Nyes	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
FA-1005	Falmouth	Oyster Pond	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
HA-376	Harwich	Aunt Edies	2016-2020	48.5	Acceptable; Ongoing Protection is Required	Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	CTI and Cyanobacteria
HA-420	Harwich	Bucks	2016-2019	41.4	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
HA-579	Harwich	Grass	2016-2019	58.9	Unacceptable; Immediate Restoration is Required			Unacceptable; immediate restoration required	CTI Only
HA-353	Harwich	Hinckleys	2016-2020	52.9	Unacceptable; Immediate Restoration is Required	Low	Acceptable; ongoing protection required	Unacceptable; immediate restoration required	CTI and Cyanobacteria
HA-416	Harwich	John Josephs	2016-2019	39.4	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
HA-386	Harwich	Robbins	2016-2018	42.8	Acceptable; Ongoing Protection is Required	Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	CTI and Cyanobacteria
HA-525	Harwich	Sand	2016-2019	42.5	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
HA-629	Harwich	Skinnequit	2016-2020	56.4	Unacceptable; Immediate Restoration is Required	High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	CTI and Cyanobacteria
HA-530	Harwich	West Reservoir	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
MA-808	Mashpee	Ashumet	2016-2020	47.4	Acceptable; Ongoing Protection is Required	High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	CTI and Cyanobacteria
MA-818	Mashpee	Johns	2016-2020	46.6	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
MA-634	Mashpee	Mashpee-Wakeby	2016-2020	47.0	Acceptable; Ongoing Protection is Required	High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	CTI and Cyanobacteria
MA-718	Mashpee	Santuit	2016-2020	64.4	Unacceptable; Immediate Restoration is Required	High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	CTI and Cyanobacteria

(Table 5, 2021 Pond Grades, continued).

CCC_GIS_ID_21	Town_Data_Source21	Pond Name	Years-Water Quality	Carlson Trophic Index (CTI) score	CTI Grade	2020 Cyanobacteria Tier	Cyanobacteria Grade	Final Grade	Grade based on:
OR-167	Orleans	Bakers	2016-2018, 2020	32.0	Acceptable; Ongoing Protection is Required	Moderate	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	CTI and Cyanobacteria
OR-136	Orleans	Boland	2016-2019	56.0	Unacceptable; Immediate Restoration is Required			Acceptable; ongoing protection required	CTI Only
OR-262	Orleans	Deep	2016-2019	48.0	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
OR-174	Orleans	Gould	2016-2019	47.3	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
OR-113	Orleans	Ice House	2016-2017, 2019	45.4	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
OR-256	Orleans	Meadow Bog	2016-2019	55.2	Unacceptable; Immediate Restoration is Required			Acceptable; ongoing protection required	CTI Only
OR-176	Orleans	Pilgrim Lake	2016-2019	47.0	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
OR-249	Orleans	Sarah's Pond	2017-2019	52.3	Unacceptable; Immediate Restoration is Required			Acceptable; ongoing protection required	CTI Only
OR-253	Orleans	Shoal	2016-2019	58.7	Unacceptable; Immediate Restoration is Required			Acceptable; ongoing protection required	CTI Only
OR-247	Orleans	Twinings	2016-2019	48.5	Acceptable; Ongoing Protection is Required			Acceptable; ongoing protection required	CTI Only
OR-142	Orleans	Uncle Harvey's	2016-2019	54.3	Unacceptable; Immediate Restoration is Required			Acceptable; ongoing protection required	CTI Only
OR-228	Orleans	Uncle Israel's	2016-2019	64.5	Unacceptable; Immediate Restoration is Required			Unacceptable; immediate restoration required	CTI Only
OR-264	Orleans	Uncle Seth's	2016-2019	50.8	Unacceptable; Immediate Restoration is Required			Acceptable; ongoing protection required	CTI Only
SA-210	Sandwich	Lower Shawme Lake	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
WE-76	Wellfleet	Duck Pond	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
WE-71	Wellfleet	Dyer Pond	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
WE-67	Wellfleet	Great Pond	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
WE-59	Wellfleet	Gull	2020			High	Unacceptable; immediate restoration required	Unacceptable; immediate restoration required	Cyanobacteria Only
WE-57	Wellfleet	Higgins Pond	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
WE-65	Wellfleet	Long	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-711	Yarmouth	Big Sandy	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-472	Yarmouth	Dennis	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-493	Yarmouth	Elisha's	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-659	Yarmouth	Flax	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-492	Yarmouth	Greenough	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-692	Yarmouth	Horse	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-700	Yarmouth	Little Sandy	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-657	Yarmouth	Long	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only
YA-653	Yarmouth	Plash's	2020			Low	Acceptable; ongoing protection required	Acceptable; ongoing protection required	Cyanobacteria Only

Table 6. Summary of 2019, 2020 and 2021 State of the Waters Grades for Public Water Supplies. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Public Water Supply Grades	**2019 Grades**		**2020 Grades**		**2021 Grades**	
	No.	%	No.	%	No.	%
Excellent	20	100%	20	100%	13	65%
Good	NA		NA		6	30%
Poor			0	0%	1	5%
Total:	20		20		20	100%

Notes:
In the 2019 and 2020 reports, only two grade levels were possible: Excellent and Poor.
In the 2021 report, three grade levels were possible: Excellent, Good, and Poor.
The change in grading reflects the wider range of results reported in 2020 Consumer Confidence Reports.
NA not applicable

Table 7. 2021 Grades for Public Water Supplies. Grades were based on publicly available Consumer Confidence Reports and existing state and federal regulations for drinking water for 2020. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Public Water Supplier	Grade	Reason for Grade
Barnstable COMM (Centerville, Osterville, and Marstons Mills)	Good	One violation of E. coli MCL in one month; repeat testing was negative.
Barnstable Fire District	Excellent	Met all existing state and federal standards (MCLs)
Cotuit Water Department	Excellent	Met all existing state and federal standards (MCLs)
Hyannis Water System	Excellent	Met all existing state and federal standards (MCLs)
Bourne Water District	Good	One violation of Total Coliform MCL in one month; management actions were carried out, and repeat testing was negative.
Buzzards Bay Water District	Good	Violation of Total Coliform MCL in two successive months; no corrective actions were required.
North Sagamore Water District	Good	One violation of Total Coliform MCL; repeat testing was negative.
Otis Air National Guard Base	Excellent	Met all existing state and federal standards (MCLs)
Brewster Water Department	Excellent	Met all existing state and federal standards (MCLs)
Chatham Department of Public Works Water Division	Excellent	Met all existing state and federal standards (MCLs)
Dennis Water District	Excellent	Met all existing state and federal standards (MCLs)
Town of Eastham	Excellent	Met all existing state and federal standards (MCLs)
Town of Falmouth	Excellent	Met all existing state and federal standards (MCLs).
Harwich Water Department	Excellent	Met all existing state and federal standards (MCLs)
Mashpee Water District	Excellent	Met all existing state and federal standards (MCLs)
Town of Orleans Water Department	Excellent	Met all existing state and federal standards (MCLs)
Provincetown Water Department	Excellent	Met all existing state and federal standards (MCLs)
Sandwich Water District	Good	Three violations of Total Coliform MCL in finish water in one month. Corrective actions were taken and repeat testing was negative.
Truro		Same as Provincetown
Wellfleet Municipal Water System	Poor	Violation of two MCLs (Total Coliform, E. coli), with repeated violations of E. coli MCL on different dates at different locations. A "Boil Water Order" was required. Four corrective actions were required and completed.
Yarmouth Water Department	Good	One violation of Nitrite MCL.
Summary:		**13 Excellent**
		6 Good
		1 Poor
Total:		**20**

Table 8. 2021 Coastal Water Quality Scores and Grades for Town of Barnstable Stations. Data were provided by the Town of Barnstable. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Station ID	Station name	Years	No. Years	Eutrophic Index Score	Grade
BM1	BARNSTABLE HARBOR	2016-2020	5	73.19	Acceptable; Ongoing Protection is Required
BM2	BARNSTABLE HARBOR	2016-2020	5	77.19	Acceptable; Ongoing Protection is Required
BM3	BARNSTABLE HARBOR	2016-2020	5	84.22	Acceptable; Ongoing Protection is Required
BM10	CALVES PASTURE	2016-2020	5	58.70	Unacceptable; Immediate Restoration is Required
BM11	SPRING CREEK	2016-2020	5	52.62	Unacceptable; Immediate Restoration is Required
BM12	SCORTON CREEK	2016-2020	5	65.05	Acceptable; Ongoing Protection is Required
BM13	SCORTON CREEK	2016-2020	5	45.69	Unacceptable; Immediate Restoration is Required
BC10	EAST BAY	2016-2020	5	36.27	Unacceptable; Immediate Restoration is Required
BH1	LEWIS BAY	2016-2020	5	39.12	Unacceptable; Immediate Restoration is Required
BH2	LEWIS BAY	2016-2020	5	44.90	Unacceptable; Immediate Restoration is Required
BH3	LEWIS BAY	2016-2020	5	48.44	Unacceptable; Immediate Restoration is Required
BH4	SNOW'S CREEK	2016-2020	5	25.05	Unacceptable; Immediate Restoration is Required
BH7	STEWART'S CREEK	2016-2020	5	41.95	Unacceptable; Immediate Restoration is Required
MC1	MILL CREEK	2016-2020	5	46.80	Unacceptable; Immediate Restoration is Required
MC2	MILL CREEK	2016-2020	5	44.15	Unacceptable; Immediate Restoration is Required
BC14	HALLS CREEK	2016-2020	5	58.43	Unacceptable; Immediate Restoration is Required
BC15	HALLS CREEK	2016-2020	5	59.05	Unacceptable; Immediate Restoration is Required
BY1	LEWIS BAY	2016-2019	4	64.26	Unacceptable; Immediate Restoration is Required
BY2	LEWIS BAY	2016-2019	4	54.70	Unacceptable; Immediate Restoration is Required
BY3	LEWIS BAY SENTINEL	2016-2019	4	53.87	Unacceptable; Immediate Restoration is Required
BC3	SCUDDER BAY	2016-2019	4	25.34	Unacceptable; Immediate Restoration is Required
BC4	BUMPS RIVER	2016-2019	3	20.22	Unacceptable; Immediate Restoration is Required
BC8	CENTERVILLE RIVER	2016-2019	4	31.97	Unacceptable; Immediate Restoration is Required
BC9	CENTERVILLE RIVER	2016-2019	4	31.19	Unacceptable; Immediate Restoration is Required
BCSS	EAST BAY SENTINEL	2016-2019	4	30.47	Unacceptable; Immediate Restoration is Required

Table 9. 2021 Water Quality Scores and Grades for Buzzards Bay. Eutrophic Index scores for 2020 were provided by the Buzzards Bay Coalition. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Station	Station for grading	2020 BBC score	Grade
Back River	EP3	56	Unacceptable; Immediate Restoration is Required
Briarwood Harbor			OMIT-Not enough data to score for SOTW
Buttermilk Bay	BB4	66	Acceptable; Ongoing Protection is Required
Eel Pond, Bourne	EP2	38	Unacceptable; Immediate Restoration is Required
Fiddlers Cove	FC1N	60	Unacceptable; Immediate Restoration is Required
Gunning Point Pond	GPP1	28	Unacceptable; Immediate Restoration is Required
Hen Cove	HC2	59	Unacceptable; Immediate Restoration is Required
Herring Brook	HB2	46	Unacceptable; Immediate Restoration is Required
Little Buttermilk Bay	not in document that contains lat/longs.- location is approximate	58	Unacceptable; Immediate Restoration is Required
Little Sippewisset Marsh	LSM1	62	Unacceptable; Immediate Restoration is Required
Mashapaquit Creek	MAC1	3	Unacceptable; Immediate Restoration is Required
Megansett Harbor	MG4	83	Acceptable; Ongoing Protection is Required
Phinneys Harbor	PH2	70	Acceptable; Ongoing Protection is Required
Pocasset Harbor Inner	PC1	50	Unacceptable; Immediate Restoration is Required
Pocasset Harbor Outer	PC3	72	Acceptable; Ongoing Protection is Required
Pocasset River	PR3	52	Unacceptable; Immediate Restoration is Required
Potters Hole Pond	not in document that contains lat/longs.- location is approximate	20	Unacceptable; Immediate Restoration is Required
Quissett Harbor Inner	QH2	87	Acceptable; Ongoing Protection is Required
Quissett Harbor Outer	QH1	90	Acceptable; Ongoing Protection is Required
Rands Harbor	RH1	36	Unacceptable; Immediate Restoration is Required
Red Brook Harbor Inner	RB4	64	Unacceptable; Immediate Restoration is Required
Red Brook Harbor Outer	RB2	77	Acceptable; Ongoing Protection is Required
Squeteague Harbor	SQ1N	57	Unacceptable; Immediate Restoration is Required
West Falmouth Harbor Head	WF4N	53	Unacceptable; Immediate Restoration is Required
West Falmouth Harbor Outer	WF9N	74	Acceptable; Ongoing Protection is Required
West Falmouth Harbor Town I	WF1N	62	Unacceptable; Immediate Restoration is Required
West Falmouth Mid-Harbor	WF5N	64	Unacceptable; Immediate Restoration is Required
West Falmouth Oyster Pond	WF8	33	Unacceptable; Immediate Restoration is Required
West Falmouth Snug Harbor	WF2	24	Unacceptable; Immediate Restoration is Required
Wild Harbor Inner	WH1N	57	Unacceptable; Immediate Restoration is Required
Wild Harbor Outer	WH3	82	Acceptable; Ongoing Protection is Required
Wild Harbor River	WH2	65	Unacceptable; Immediate Restoration is Required

Table 10. 2021 Coastal Water Quality Scores and Grades for Three Bays, Barnstable. Data were provided by the Barnstable Clean Water Coalition. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Name	Site Number	Eutrophic Index Score	APCC Status	No. Years	Years
Mill Pond	Site 1	30.7	Unacceptable; Immediate Restoration is Required	5	2016-2020
South Prince's Cove	Site 2	37.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
North Prince's Cove	Site 3	39.5	Unacceptable; Immediate Restoration is Required	5	2016-2020
Warren's Cove	Site 4	35.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
North N. Bay	Site 5	37.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
South N. Bay	Site 6	49.6	Unacceptable; Immediate Restoration is Required	5	2016-2020
	Site 7				
	Site 8				
South West Bay	Site 9	67.9	Acceptable; Ongoing Protection is Required	5	2016-2020
	Site 10	58.1	Unacceptable; Immediate Restoration is Required	5	2016-2020
	Site 12				
South Cotuit Bay	Site 13	55.0	Unacceptable; Immediate Restoration is Required	5	2016-2020
	Site 14				
	Site 16				
Cotuit Sentinel	Site 18	49.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
Old Mill	Site E	37.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
	RM1				
	RM2				
	Site RM3	33.5	Unacceptable; Immediate Restoration is Required	5	2016-2020
	Site RM4	34.6	Unacceptable; Immediate Restoration is Required	5	2016-2020

Table 11. 2021 Coastal Water Quality Scores and Grades for Cape Cod Stations. Data were provided by the Center for Coastal Studies. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

StationNumber	StationName	Latitude	Longitude	StationID	Station	Site Name	Site # "internal ID"	Eutrophic Index Score	APCC Status	No. Years	Years
1	5N	42.009	-70.139	5N	1	5N	1	99.1	Acceptable; Ongoing Protection is Required	5	2016-2020
2	5S	41.91	-70.14	5S	2	5S	2	99.4	Acceptable; Ongoing Protection is Required	5	2016-2020
3	6M	41.935	-70.229	6M	3	6M	4	100.0	Acceptable; Ongoing Protection is Required	5	2016-2020
4	6S	41.857	-70.228	6S	4	6S	5	100.0	Acceptable; Ongoing Protection is Required	5	2016-2020
5	7S	41.841	-70.314	7S	5	7S	6	100.0	Acceptable; Ongoing Protection is Required	5	2016-2020
6	8M	41.946	-70.4	8M	6	8M	7	99.6	Acceptable; Ongoing Protection is Required	5	2016-2020
7	9N	42.02	-70.494	9N	7	9N	8	100.0	Acceptable; Ongoing Protection is Required	5	2016-2020
8	9S	41.842	-70.468	9S	8	9S	9	99.9	Acceptable; Ongoing Protection is Required	5	2016-2020
10	Blackfish Creek	41.904	-70.025	Blackfish Cre	10	Blackfish Creek	11	69.9	Acceptable; Ongoing Protection is Required	5	2016-2020
11	Boat Meadow	41.807	-70.006	Boat Meadov	11.5	Boat Meadow	13	53.1	Unacceptable; Immediate Restoration is Required	5	2016-2020
15	Canal	41.772	-70.503	Canal	15	Canal	15	82.9	Acceptable; Ongoing Protection is Required	5	2016-2020
17	D1	42.036	-70.667	D1	17	D1	16	65.6	Acceptable; Ongoing Protection is Required	5	2016-2020
19	D3	42.048	-70.649	D3	19	D3	17	42.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
21	First Encounter	41.815	-70.006	First Encount	21.5	First Encounter	21	46.7	Unacceptable; Immediate Restoration is Required	5	2016-2020
22	Great Island Channe	41.923	-70.048	Great Island	22	Great Island Channel	22	70.4	Acceptable; Ongoing Protection is Required	5	2016-2020
23	Holiday Inn	42.058	-70.162	Holiday Inn	23	Holiday Inn	23	64.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
25	Inner Pamet	41.991	-70.073	Inner Pamet	25	Inner Pamet Harbor	25	76.6	Acceptable; Ongoing Protection is Required	5	2016-2020
26	Inner Rock Harbor	41.8	-70.006	Inner Rock Ha	26.5	Inner Rock Harbor	27	30.7	Unacceptable; Immediate Restoration is Required	5	2016-2020
27	Inner Sesuit Harbor	41.752	-70.154	Inner Sesuit I	27	Inner Sesuit Harbor	28	79.5	Acceptable; Ongoing Protection is Required	5	2016-2020
28	Inner Wellfleet Harl	41.929	-70.029	Inner Wellfle	28	Inner Wellfleet Harbor	29	50.1	Unacceptable; Immediate Restoration is Required	4	2016-2020
30	MacMillan	42.051	-70.182	MacMillan	30	MacMillan	31	92.1	Acceptable; Ongoing Protection is Required	5	2016-2020
33	P1	41.964	-70.662	P1	33	P1	35	67.2	Acceptable; Ongoing Protection is Required	5	2016-2020
39	Rock Harbor	41.801	-70.01	Rock Harbor	39.5	Rock Harbor	41	55.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
42	Sunken Meadow	41.886	-70.013	Sunken Mea	42	Sunken Meadow	44	84.3	Acceptable; Ongoing Protection is Required	5	2016-2020
43	Wellfleet Harbor	41.926	-70.036	Wellfleet Ha	43	Wellfleet Harbor	45	56.5	Unacceptable; Immediate Restoration is Required	5	2016-2020
~~47~~	~~NTKS_1~~	~~41.343~~	~~-70.382~~	~~NTKS-1~~	~~47~~	~~NTKS_1~~	~~49~~	~~96.6~~	~~Acceptable; Ongoing Protection is Required~~	~~5~~	~~2016-2020~~
~~48~~	~~NTKS_3~~	~~41.355~~	~~-70.103~~	~~NTKS-3~~	~~48~~	~~NTKS_3~~	~~50~~	~~89.0~~	~~Acceptable; Ongoing Protection is Required~~	~~5~~	~~2016-2020~~
~~49~~	~~NTKS_4~~	~~41.486~~	~~-70.015~~	~~NTKS-4~~	~~49~~	~~NTKS_4~~	~~51~~	~~97.9~~	~~Acceptable; Ongoing Protection is Required~~	~~5~~	~~2016-2020~~
~~50~~	~~NTKS_6~~	~~41.479~~	~~-70.262~~	~~NTKS-6~~	~~50~~	~~NTKS_6~~	~~52~~	~~88.9~~	~~Acceptable; Ongoing Protection is Required~~	~~5~~	~~2016-2020~~
~~51~~	~~NTKS_8~~	~~41.44~~	~~-70.498~~	~~NTKS-8~~	~~51~~	~~NTKS_8~~	~~53~~	~~99.0~~	~~Acceptable; Ongoing Protection is Required~~	~~5~~	~~2016-2020~~
52	NTKS_10	41.513	-70.597	NTKS-10	52	NTKS_10	54	91.5	Acceptable; Ongoing Protection is Required	5	2016-2020
53	NTKS_13	41.598	-70.289	NTKS-13	53	NTKS_13	55	94.9	Acceptable; Ongoing Protection is Required	5	2016-2020
54	NTKS_16	41.638	-70.047	NTKS-16	54	NTKS_16	56	96.0	Acceptable; Ongoing Protection is Required	5	2016-2020
60	NTKS_14	41.621	-70.187	NTKS-14	60	NTKS_14	57	97.6	Acceptable; Ongoing Protection is Required	5	2016-2020
65	NTKS_12	41.5738	-70.40684	NTKS-12	65	NTKS_12	58	96.2	Acceptable; Ongoing Protection is Required	5	2016-2020
101	Boardwalk	41.765	-70.485	Old Harbor	101	Boardwalk	59	85.3	Acceptable; Ongoing Protection is Required	5	2016-2020
102	Inner Boat Meadow	41.807	-69.996	Boat Meadov	102	Boat Meadow	60	29.0	Unacceptable; Immediate Restoration is Required	5	2016-2020
107	Little Namskaket	41.796336	-70.013658	Little Namsk	107	Little Namskaket	65	63.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
108	Inner Namskaket	41.788202	-70.021771	Namskaket	108	Namskaket (inner?)	66	79.7	Acceptable; Ongoing Protection is Required	5	2016-2020
110	Paines	41.761	-70.114	Paines Creek	110	Paines Creek	68	76.5	Acceptable; Ongoing Protection is Required	5	2016-2020
113	Plymouth Harbor	41.96479	-70.669526	Plymouth Ha	113	Plymouth Harbor	71	36.5	Unacceptable; Immediate Restoration is Required	5	2016-2020
114	Inner Scorton Creek	41.747	-70.429	Scorton Cree	114	Scorton	72	82.1	Acceptable; Ongoing Protection is Required	5	2016-2020
117	Pamet River	41.992	-70.071	Pamet River	117	Pamet River	75	56.6	Unacceptable; Immediate Restoration is Required	5	2016-2020
119	East Harbor	42.053	-70.118	East Harbor -	119	Pilgrim Lake East	77	76.7	Acceptable; Ongoing Protection is Required	5	2016-2020
123	Old Harbor-Dewey	41.757913	-70.48954	Old Harbor-D	123	Old Harbor-Dewey	80	68.4	Acceptable; Ongoing Protection is Required	5	2016-2020
124	Scorton Creek-6A	41.734711	-70.426693	Scorton Cree	124	Scorton Creek 6A	81	77.0	Acceptable; Ongoing Protection is Required	5	2016-2020
125	Scorton Creek-Jones	41.731	-70.406	Scorton Cree	125	Scorton Creek Jones Lar	82	47.6	Unacceptable; Immediate Restoration is Required	5	2016-2020
128	Quivet Marsh	41.759	-70.123	Quivet Marsl	128	Quivet Marsh	84	34.7	Unacceptable; Immediate Restoration is Required	5	2016-2020
129	Cole Road Brook	41.830423	-70.002748	Cole Road Br	129	Cole Road Brook	85	64.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
130	Sesuit Creek	41.745138	-70.162474	Sesuit Creek	130	Sesuit Creek	86	24.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
131	Millway	41.708604	-70.300106	Millway Bea	131	Millway Beach	87	74.7	Acceptable; Ongoing Protection is Required	5	2016-2020
135	Upper Pamet River	41.994	-70.05		135	Upper Pamet River	91	25.7	Unacceptable; Immediate Restoration is Required	5	2016-2020
136	Bluefish Creek	42.047	-70.672		136	Bluefish Creek	92	31.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
137	Little Namskaket Cr	41.791	-70.01		137	Little Namskaket Creek	93	19.0	Unacceptable; Immediate Restoration is Required	5	2016-2020
202	Channel	41.93042	-70.0272	Channel	202	Channel	97	37.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
205	Transect 2	41.9309	-70.02648	Transect 2	205	Transect 2	98	41.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
212	DB-pipe	41.9306472	-70.029611	Mayo Creek	212	DB-pipe	99	23.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
303	RH-culvert	41.797	-69.992	Rock Harbor	303	RH-culvert	102	24.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
304	RH-bend	41.801	-70.005	Rock Harbor	304	RH-bend	103	33.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
306	RH-pipe	41.799	-70.007	Rock Harbor	306	RH-pipe	104	54.1	Unacceptable; Immediate Restoration is Required	5	2016-2020
500	Bournes Pond	41.565	-70.553	B3	500	B3	105	45.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
501	Halls Creek	41.631	-70.318	BC-14	501	BC-14	106	44.0	Unacceptable; Immediate Restoration is Required	5	2016-2020
502	Centerville-E	41.639	-70.345	BCT-1	502	BCT-1	107	29.0	Unacceptable; Immediate Restoration is Required	5	2016-2020
503	Centerville-W	41.635	-70.358	BCT-2	503	BCT-2	108	36.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
504	Lewis Bay	41.638	-70.245	BHY-3	504	BHY-3	109	66.6	Acceptable; Ongoing Protection is Required	5	2016-2020
505	Bass River	41.685	-70.16	BR-7	505	BR-7	110	39.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
506	Taylors Pond	41.678	-70.017	CM-10	506	CM-10	111	39.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
507	Oyster Pond-Chatha	41.679	-69.977	CM-1A	507	CM-1A	112	74.5	Acceptable; Ongoing Protection is Required	5	2016-2020
508	Mitchel River	41.671	-69.962	CM-5A	508	CM-5A	113	69.9	Acceptable; Ongoing Protection is Required	5	2016-2020
509	Sulfur Spring	41.674	-70.002	CM-8	509	CM-8	114	42.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
510	Cotuit Bay	41.615	-70.429	Cotuit	510	Cotuit Bay	115	70.3	Acceptable; Ongoing Protection is Required	5	2016-2020
511	Childs River	41.58	-70.53	CR-2	511	Site 7 - CR-2	116	22.6	Unacceptable; Immediate Restoration is Required	5	2016-2020
517	Eel River Falmouth	41.564	-70.544	ER-2	517	Site 8 - ER-2	117	47.5	Unacceptable; Immediate Restoration is Required	5	2016-2020
518	Falmouth Inner Har	41.549	-70.602	FHx	518	FHx	118	42.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
520	Green Pond	41.562	-70.568	G4	520	G4	119	43.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
521	Great Pond	41.56	-70.586	GT-5	521	GT-5	120	42.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
522	Saquatucket Harbor	41.667	-70.059	HAR-2	522	HAR-2	121	44.7	Unacceptable; Immediate Restoration is Required	5	2016-2020
523	Wychmere	41.667	-70.066	HAR-3	523	HAR-3	122	47.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
524	Allen Harbor	41.667	-70.089	HAR-4	524	HAR-4	123	43.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
526	Hamblin Pond	41.572	-70.511	HPu	526	Site 3 - HPu	125	51.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
527	Jehu Pond	41.566	-70.496	JHP	527	Site 4 - JHP	126	48.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
532	Narrows	41.629	-70.412	Narrows	532	Narrows	127	56.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
533	North Bay	41.634	-70.41	North Bay	533	North Bay	128	48.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
534	Oyster Pond-Falmou	41.539	-70.638	OP-3	534	OP-3	129	57.3	Unacceptable; Immediate Restoration is Required	5	2016-2020
535	Popponesset Bay	41.594	-70.466	PBh	535	PBh	130	58.2	Unacceptable; Immediate Restoration is Required	5	2016-2020
536	Parkers River	41.649	-70.223	PR-2	536	PR-2	131	44.4	Unacceptable; Immediate Restoration is Required	5	2016-2020
537	Quashnet River	41.58	-70.514	QRm	537	Site 5 - QRm	132	36.7	Unacceptable; Immediate Restoration is Required	5	2016-2020
538	Rushy Marsh	41.599	-70.446	RM-2	538	RM-2	133	37.0	Unacceptable; Immediate Restoration is Required	5	2016-2020
542	Stewarts Creek	41.636	-70.293	Stewarts	542	Stewarts Creek	134	32.0	Unacceptable; Immediate Restoration is Required	5	2016-2020
543	Swan Pond River	41.664	-70.149	SWP-2	543	SWP-2	135	48.6	Unacceptable; Immediate Restoration is Required	5	2016-2020
551	Warrens Cove	41.645	-70.406	Warens Cove	551	Warrens Cove	136	38.9	Unacceptable; Immediate Restoration is Required	5	2016-2020
552	Waquoit Bay	41.566	-70.521	WBu	552	Site 10 - WBu/Metoxit	137	64.5	Unacceptable; Immediate Restoration is Required	5	2016-2020
553	West Bay	41.615	-70.405	West Bay	553	West Bay	138	78.2	Acceptable; Ongoing Protection is Required	5	2016-2020
564	Seapit River	41.568	-70.535	Site 1	564	Site 1 - Seapit	139	46.5	Unacceptable; Immediate Restoration is Required	5	2016-2020
565	Waquoit Bay North	41.577	-70.52	Site 2	565	Site 2 - WB north	140	54.1	Unacceptable; Immediate Restoration is Required	5	2016-2020
566	Waquoit Bay South	41.552	-70.528	Site 9	566	Site 9 - WB south	141	81.1	Acceptable; Ongoing Protection is Required	5	2016-2020
567	Menauhant	41.553	-70.549	Site 6	567	Site 6 - Menauhant	142	76.3	Acceptable; Ongoing Protection is Required	5	2016-2020
568	LP-2	41.553136	-70.590229		568	LP-2	143	33.3	Unacceptable; Immediate Restoration is Required	5	2016-2020

Table 12. 2021 Coastal Water Quality Scores and Grades for the Town of Chatham. Scores were provided by the Town of Chatham.

Station	Name	2016 Eutrophic Index scores	2017 Eutrophic Index scores	2018 Eutrophic Index scores	2019 Eutrophic Index scores	2020 Eutrophic Index scores	Average 2016-2020 Eutrophic Index Score	Grade
CM-1	Oyster Pond	47.0	63.2	57.1	49.7	53.1	54.0	Unacceptable; Immediate Restoration is Required
CM-1A	Oyster Pond-Ou	72.0	75.5	82.4	67.3	56.7	70.8	Acceptable; Ongoing Protection is Required
CM-3	Outer Stage Ha	78.4	72.2	79.3	79.6	76.8	77.2	Acceptable; Ongoing Protection is Required
CM-4	Inner Stage Har	74.3	73.0	79.7	74.3	83.1	76.9	Acceptable; Ongoing Protection is Required
CM-5	Mill Pond - Inn	62.1	71.3	57.4	58.9	67.8	63.5	Unacceptable; Immediate Restoration is Required
CM-5A	Mill Pond - Ou	56.6	72.9	67.0	66.4	70.9	66.8	Acceptable; Ongoing Protection is Required
CM-7	Nantucket Soun	84.1	89.2	99.1	97.0	98.9	93.7	Acceptable; Ongoing Protection is Required
CM-8	Upper Bucks C	35.9	29.1	45.3	34.3	42.7	37.4	Unacceptable; Immediate Restoration is Required
CM-10	Taylors Pond	49.0	49.0	36.6	29.8	46.5	42.2	Unacceptable; Immediate Restoration is Required
CM-12	Lower Cockle C	21.9	23.0	25.8	25.4	21.3	23.5	Unacceptable; Immediate Restoration is Required
CM-13	Outer Ryder's C	63.5	76.7	73.1	84.6	79.7	75.5	Acceptable; Ongoing Protection is Required
PBA-1	Chatham Harbo	87.2	80.5	90.9	80.1	86.5	85.0	Acceptable; Ongoing Protection is Required
PBA-3	Inner Ryder's C	45.6	63.1	46.9	32.6	42.4	46.1	Unacceptable; Immediate Restoration is Required
PBA-4	Crows Pond	61.5	85.4	89.9	76.5	81.7	79.0	Acceptable; Ongoing Protection is Required
PBA-5	Muddy Creek	31.8	64.1	54.0	65.8	63.4	55.8	Unacceptable; Immediate Restoration is Required
PBA-5A	Muddy Creek -	10.0	46.8	15.7	12.3	8.3	18.6	Unacceptable; Immediate Restoration is Required

Table 13. 2021 Coastal Water Quality Scores and Grades for the Town of Harwich. Data were provided by the Town of Harwich. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Site Name	Site #	Years	No. Years	Eutrophic Index Score	Grade
SAQUATUCKET HARBOR	HAR2	2015-2019	5	30.2	Unacceptable; Immediate Restoration is Required
WYCHMERE OUTER HARBOR	HAR2A	2015-2019	5	48.2	Unacceptable; Immediate Restoration is Required
WYCHMERE HARBOR	HAR3	2015-2019	5	37.9	Unacceptable; Immediate Restoration is Required
ALLENS HARBOR MARINA	HAR4	2015-2019	5	37.6	Unacceptable; Immediate Restoration is Required
ALLEN HULSE PT	HAR4A	2015-2019	5	38.8	Unacceptable; Immediate Restoration is Required
ALLENS HARBOR CREEK	HAR5	2015-2019	5	41.8	Unacceptable; Immediate Restoration is Required
HERRING RIVER 6	HAR6	2015-2019	5	52.2	Unacceptable; Immediate Restoration is Required
HERRING RIVER 7 - 28 BRIDGE	HAR7	2015-2019	5	50.8	Unacceptable; Immediate Restoration is Required
HERRING RIVER 9 - NORTH RD	HAR9	2015-2019	5	31.0	Unacceptable; Immediate Restoration is Required

Table 14. 2021 Coastal Water Quality Scores and Grades for Towns of Eastham and Orleans. Data were provided by the Towns of Eastham and Orleans. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Station ID	Years	No. Years	Eutrophic Index Score	Grade
WMO15	2016-2020	5	35.6	Unacceptable; Immediate Restoration is Required
WMO19	2016-2020	5	35.0	Unacceptable; Immediate Restoration is Required
WMO22	2016-2020	5	38.3	Unacceptable; Immediate Restoration is Required
WMO25	2016-2020	5	39.9	Unacceptable; Immediate Restoration is Required
WMO26	2016-2020	5	57.3	Unacceptable; Immediate Restoration is Required
WMO27	2016-2020	5	52.8	Unacceptable; Immediate Restoration is Required
WMO28	2016-2020	5	58.0	Unacceptable; Immediate Restoration is Required
WMO29	2016-2020	5	63.0	Unacceptable; Immediate Restoration is Required
WMO30	2016-2020	5	80.1	Acceptable; Ongoing Protection is Required
WMO31	2016-2020	5	60.5	Unacceptable; Immediate Restoration is Required
WMO32	2016-2020	5	84.8	Acceptable; Ongoing Protection is Required
WMO33	2016-2020	5	58.6	Unacceptable; Immediate Restoration is Required
WMO34	2016-2020	5	37.1	Unacceptable; Immediate Restoration is Required
WMO35	2016-2020	5	54.0	Unacceptable; Immediate Restoration is Required
WMO36	2016-2020	5	66.1	Acceptable; Ongoing Protection is Required
WMO37	2016-2020	5	66.9	Acceptable; Ongoing Protection is Required
WMO38	2016-2020	5	40.1	Unacceptable; Immediate Restoration is Required
WMO39	2016-2019	4	59.5	Unacceptable; Immediate Restoration is Required

Table 15. 2021 Coastal Water Quality Scores and Grades for Pleasant Bay. Eutrophic Index scores were provided by the Pleasant Bay Alliance. Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Station	Name	2016 Eutrophic Index scores	2017 Eutrophic Index scores	2018 Eutrophic Index scores	2019 Eutrophic Index scores	2020 Eutrophic Index scores	Average Eutrophic Index score, 2016-2020	Grade
PBA-3	Inner Ryder's Cove	45.6	63.1	46.9	32.6	42.4	46.1	Unacceptable; Immediate Restoration is Required
PBA-4	Crows Pond	61.5	85.4	89.9	76.5	81.7	79	Acceptable; Ongoing Protection is Required
PBA-5	Muddy Creek	31.8	64.1	54.0	65.8	63.4	55.8	Unacceptable; Immediate Restoration is Required
PBA-5A	Muddy Creek - Upper	10	77.9	15.7	12.3	8.3	24.8	Unacceptable; Immediate Restoration is Required
PBA-6	Big Bay - SW	65.6	88.1	87.6	94.6	86.9	84.5	Acceptable; Ongoing Protection is Required
PBA-8	Big Bay - NE	73.9	86.1	79.4	84.6	78.5	80.5	Acceptable; Ongoing Protection is Required
PBA-9	Round Cove	41	57.2	34.5	56.1	29.6	43.7	Unacceptable; Immediate Restoration is Required
PBA-10	Quanset Pond	44.5	66.6	53.7	50.9	67.7	56.7	Unacceptable; Immediate Restoration is Required
PBA-11	Paw Wah Pond	40	54.5	30.8	28.6	56.2	42.1	Unacceptable; Immediate Restoration is Required
PBA-12	Namequoit Point - South	65.6	70.5	58.4	63.6	66.9	65	Unacceptable; Immediate Restoration is Required
PBA-13	Namequoit Point - North	64.1	71.4	64.8	54.5	57.2	62.4	Unacceptable; Immediate Restoration is Required
PBA-14	Areys Pond	19.9	43.6	18.0	10.8	7.3	19.9	Unacceptable; Immediate Restoration is Required
PBA-15	Kescayo Gansett Pond	27.2	49.5	21.7	15.1	23.1	27.3	Unacceptable; Immediate Restoration is Required
PBA-16	Pochet-mouth	11.7	34	12.9	14.5	13.8	17.4	Unacceptable; Immediate Restoration is Required
PBA-19	Strong Island - NE	75.1	81.2	84.0	84.0	84.0	81.6	Acceptable; Ongoing Protection is Required
PBA-20	Nickerson's Neck	77.9	91.8	85.6	85.6	85.6	85.3	Acceptable; Ongoing Protection is Required
PBA-21	Little Pleasant Bay	72.3	79.2	80.1	80.1	80.1	78.4	Acceptable; Ongoing Protection is Required
WMO-3	Pochet-mouth	54.3	61.5	54.9	54.9	54.9	56.1	Unacceptable; Immediate Restoration is Required
WMO-5	Pochet-Upper	23.2	26.7	12.8	7.3	16.8	17.4	Unacceptable; Immediate Restoration is Required
WMO-6	Namequoit River-Upper	23.3	50.3	22.8	27.9	15.8	28	Unacceptable; Immediate Restoration is Required
WMO-8	Lower River	43.7	60.4	43.8	17.1	44.6	41.9	Unacceptable; Immediate Restoration is Required
WMO-10	Meetinghouse-Rattles doc	30.6	55.8	47.3	32.2	30.9	39.4	Unacceptable; Immediate Restoration is Required
WMO-12	Little Quanset Pond	35.3	48.1	53.1	50.9	42.7	46	Unacceptable; Immediate Restoration is Required
CM-13	Outer Ryder's Cove	63.5	76.7	73.2	84.6	79.7	75.5	Acceptable; Ongoing Protection is Required

Table 16. 2021 Coastal Water Quality Scores and Grades for Waquoit Bay. Data were provided by the Waquoit Bay National Estuarine Research Reserve (WBNERR). Note: 2021 refers to this updated 2021 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

Site Name	Site #	Years	No. Years	Eutrophic Index Score	Grade
Seapit River	Site 1	2016-2020	5	44.2	Unacceptable; Immediate Restoration is Required
North Basin-WB*	Site 2	2016-2020	5	53.1	Unacceptable; Immediate Restoration is Required
Hamblin Pond	Site 3	2016-2020	5	49.6	Unacceptable; Immediate Restoration is Required
Jehu Pond	Site 4	2016-2020	5	44.2	Unacceptable; Immediate Restoration is Required
Quashnet River	Site 5	2016-2020	5	35.4	Unacceptable; Immediate Restoration is Required
Menauhant	Site 6	2016-2020	5	72.4	Acceptable; Ongoing Protection is Required
Childs River	Site 7	2016-2020	5	21.7	Unacceptable; Immediate Restoration is Required
Eel River	Site 8	2016-2020	5	47.8	Unacceptable; Immediate Restoration is Required
South Basin-WB*	Site 9	2016-2020	5	75.0	Acceptable; Ongoing Protection is Required
	Site 10	2016-2020	5	59.7	Unacceptable; Immediate Restoration is Required