State of the Waters: Cape Cod

2020 Cape Cod Water Health Report and Action Plan

Association to Preserve Cape Cod
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Website: 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.

For this multi-year project, APCC collected existing data on water quality on Cape Cod for the purpose of determining the health of Cape Cod's waters. APCC evaluated water quality in coastal waters (saltwater), freshwater ponds and lakes, and public drinking water supplies. APCC used scored and graded water quality and used the grades to distinguish between degraded surface waters where immediate action is needed to improve water quality vs. surface waters with acceptable quality where ongoing protection is needed to avoid any decline in quality. The results are summarized in this annual water health report which provides updated information based on data available as of August 2020. 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 approval 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 Trust 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 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 (added in 2020);
- 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-in 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, 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 non-profit 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
- 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 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. 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, the Cape Cod Five Foundation, and APCC dues and donations.

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 emerged as the Cape's environmental leader, earning a reputation for effective policies and actions to protect our precious natural resources (http://www.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 our 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 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. Red tide is the common name for several species of 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, toxic cyanobacteria 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 this will be an increasing problem as nutrient pollution continues and the climate warms. This year, APCC incorporated cyanobacteria monitoring data from 2019 into our grading system for freshwater ponds as another indicator of nutrient pollution.

Mercury pollution occurs in waters throughout the Northeast. On Cape Cod, the Massachusetts Department of Public Health has listed at least 24 ponds and lakes where there are fish consumption advisories that warn people (pregnant mothers) to limit or avoid eating fish from that lake due to mercury pollution. Mercury pollution is caused by fallout of mercury from the atmosphere, which originates from combustion of coal in coal-burning fuel plants. Incineration of medical wastes and municipal wastes also contributes mercury to the atmosphere.

Emerging contaminants and pharmaceutical compounds have been found in groundwater near septic systems and in coastal waters of the Cape. 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. They have been linked to human health impacts such as developmental disorders, immune system disorders, thyroid hormone disruption and cancer. Information on PFAS can be found on the websites of the EPA and the Commonwealth of Massachusetts.

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. In doing so, we hope to guide public policy and investment in restoration 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.

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 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.

Since then, 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, and 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 in a manner that differs from the BBC. APCC assigned scores to two 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:

> **Scores greater than 65 are graded as: "Acceptable: requires ongoing protection."**
>
> **Scores of 65 and below 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.

APCC also 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 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 freshwater ponds and lakes, APCC uses a scoring method that 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 from 50 to 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 from 0 to 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 from 40 to 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 scores:

> **Scores of less than 50 are graded as: "Acceptable: requires ongoing protection."**
>
> **Scores of 50 and above 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.

In 2020, APCC adopted new criteria for water quality data to be used for grading ponds using the Carlson Trophic Index. These are described below.

Grading Ponds and Lakes: Method 2: Using Cyanobacteria Monitoring Data

Many pond water quality data 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 these older data were collected. APCC tested screening out pond data older than 2015 and ponds

where there was less than three years of data. Using these more stringent data quality requirements for grading resulted in only 29 ponds having sufficient 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.

Beginning this year, to help fill the gap in freshwater pond data, APCC utilized cyanobacteria monitoring data to provide an additional measure of pond health. 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 the Cyanobacteria Monitoring Collaborative. The 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 when toxin concentrations 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.

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 interpret cyanobacteria monitoring data, APCC developed a new cyanobacteria grading system utilizing "Low," "Moderate" and "High" tiers (where High represents levels where pets and humans are advised to avoid contact with pond water). The new cyanobacteria grading system was applied to grade ponds monitored in 2019 by APCC and by town officials. If a town posted a cyanobacteria advisory in 2019, that pond was placed in the same category as those ponds in APCC's "High" tier. Similarly, ponds monitored by town officials that never required the posting of an advisory for cyanobacteria in 2019 were placed in the same category as those that only reached the "Low" or "Moderate" tier in APCC's Cyanobacteria Monitoring Program. Learn more about APCC's Cyanobacteria Monitoring Program.

Updated Pond Grading System

Beginning this year (2020), APCC's pond grading system was revised to include both Carlson Trophic Index grades and cyanobacteria data, as described below:

1) Carlson Trophic Index scores and grades for ponds were calculated only for ponds where more recent water quality data from 2015 on was available, and where at least three years of data were available.
2) Cyanobacteria monitoring data from 2019 were used to grade ponds using APCC's tiered cyanobacteria system described above:
    a. Ponds with "High" cyanobacteria levels were graded as "Unacceptable: requires immediate restoration";
    b. Ponds with "Low" or "Moderate" cyanobacteria levels 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. Conversely, a 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 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 your tap, which can be affected by pipes and plumbing in the distribution system and in your 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 used publicly available Consumer Confidence Reports for 2019 to determine if water quality met existing state and federal drinking water standards (i.e., Maximum Contaminant Levels, or MCLs). **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."**

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 include the following:

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

- Association to Preserve Cape Cod: cyanobacteria monitoring data from ponds located in the Upper Cape, Mid-Cape, Outer Cape and Lower Cape;
- Buzzards Bay Coalition: Eutrophic Index scores for Buzzards Bay coastal stations;
- Center for Coastal Studies: coastal water quality data collected from stations in 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 is 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);

Municipal and local watershed data:

- Barnstable Clean Water Coalition: coastal water quality data and pond water quality data for the Three Bays watershed;
- Town of Barnstable: coastal water quality data and cyanobacteria data;
- Town of Chatham: coastal water quality data and Eutrophic Index scores for Chatham coastal stations;
- Town of Dennis: pond water quality data for ponds;
- Town of Eastham: coastal and pond water quality data;
- Town of Falmouth: pond water quality data;
- Town of Harwich: coastal and pond water quality data;
- Town of Mashpee: pond water quality data;
- Town of Orleans: coastal and pond water quality data;
- Town of Sandwich: pond water quality data;
- Pleasant Bay Alliance: Eutrophic Index scores for Pleasant Bay coastal stations; and
- Waquoit Bay National Estuarine Research Reserve (WBNERR): coastal water quality data for Waquoit Bay.

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 the 2020 report, APCC collected the most recent and available coastal water quality data from the data sources listed above. For most coastal stations and embayments, the most recent data available were for 2019; the only exceptions were Sesuit Harbor and Pleasant Bay, where the most recent data available were from 2018.

Water quality data for ponds and lakes: Since 2000, the Cape Cod Pond and Lake 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 the 2020 report, APCC collected pond water quality data from the sources listed above.

Cyanobacteria data for ponds and lakes: Cyanobacteria monitoring data were provided by APCC's Cyanobacteria Monitoring Program and by the town of Barnstable, which conducts a similar cyanobacteria monitoring program for ponds in Barnstable.

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

12. Results

Our grades for coastal embayments and stations, ponds and lakes, and public water supplies are provided as maps (Figures 1-4) and summarized in tables (Tables 1-7). Detailed scores and grades for specific coastal stations and embayments are provided in tables (Tables 8-14). Our findings are provided below, first as a Summary and then as Detailed Findings.

12.1 Summary

For coastal embayments, the number (38) and percentage (79%) of Unacceptable embayments increased from last year. Embayments newly graded as Unacceptable this year face Vineyard Sound, Nantucket Sound, Cape Cod Bay and Buzzards Bay. The number (10) and percentage (21%) of Acceptable embayments decreased from last year (Figure 1 and Tables 1-3).

For coastal embayment stations, the number (106) and percentage (70%) of Unacceptable embayment stations increased from last year. The number (46) and percentage (30%) of Acceptable embayment stations decreased from last year (Figure 2 and Table 4).

For ponds, the percentage (42%) of Unacceptable ponds increased from 39% in 2019. The number (54) and percentage (58%) of ponds that are Acceptable decreased from 2019, when 91, or 61%, of ponds were Acceptable (Figure 3 and Tables 5-6).

Ponds this year were graded using a combination of Carlson Trophic Index grades based on water quality data, in addition to cyanobacteria grades based on cyanobacteria monitoring data from 2019 that utilizes APCC's monitoring tiers of High (Unacceptable), Moderate and Low (Acceptable). Carlson Trophic Index grades were based on new, more stringent criteria for utilizing pond water quality data; i.e., data sets utilized must include at least three years of data collected no earlier than 2015. Only 29 ponds met these criteria. The Cape has 996 freshwater ponds. The fact that only 29 ponds have sufficient newer data represents a huge data gap that needs to be addressed if ponds are to be restored and protected, based on data reflecting current and recent conditions. Cyanobacteria grades were added to provide another measure of nutrient enrichment and to address a huge gap in pond water quality data.

Ponds continue to show the impacts of nutrient loading, whether they are graded using the Carlson Trophic Index or cyanobacteria.

For public water supplies, all public water supplies on the Cape continued to have Excellent water quality based on meeting existing drinking water regulations (Figure 4 and Table 7). APCC is monitoring the implementation of recently finalized regulations for PFAS and will apply these to public water supplies when regulations go into effect in 2021.

12.2. Detailed Findings

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 2018. This year, APCC updated water quality grades using water quality data available through 2019. The embayment data used in our 2020 update includes data from 2019, with the exception of Pleasant Bay and Sesuit Harbor in Dennis, where the latest data available were from 2018. Ponds were graded using water quality data from no earlier than 2015 and included for the first time the results of APCC's cyanobacteria monitoring. Results are described below.

Embayments

The number of embayments assessed as having Unacceptable water quality increased in 2020. Of the embayments graded, 79%, or 38 of 48, were Unacceptable, up from 68%, or 32 of 47 in 2019 (Figure 1, Tables 1-2). Meanwhile, in 2020 the number of Acceptable embayments decreased. In 2019, the number of embayments graded as Acceptable was 15, or 32% of graded embayments, while in 2020 the number of Acceptable embayments decreased to 10, or 21% of graded embayments.

The increase in Unacceptable embayments is due to five embayments facing Buzzards Bay, Cape Cod Bay and Nantucket Sound changing from Acceptable in 2019 to Unacceptable in 2020, and one embayment facing Vineyard Sound that had no data in 2019 being graded as Unacceptable in 2020 (Table 3).

The results show that more coastal embayments are being impacted by nutrients. There was no embayment that showed an improvement from Unacceptable to Acceptable.

Embayment stations

Of the 152 embayment stations graded in 2020, 106, or 70%, had Unacceptable water quality, while 46, or 30%, had Acceptable water quality (Figure 2, Table 4). In 2019, a total of 152 embayment stations were graded and 98 stations, or 64%, had Unacceptable water quality and 54 stations, or 36%, had Acceptable water quality. The 2020 grades show an increase in the number of Unacceptable embayment stations.

Ponds

The percentage of ponds assessed as having Unacceptable water quality increased in 2020. Of the ponds graded, 42%, or 39 of 93, were graded as Unacceptable, up from 39% in 2019. Meanwhile, the percentage of Acceptable ponds decreased to 58%, down from 61% in 2019. The results show that ponds continue to be impacted by nutrients (Figure 3, Table 5).

In addition, a comprehensive review and assessment of overall pond health is 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 Secchi disk. Ponds that have scores placing them in the mesotrophic to eutrophic range were graded as Unacceptable, while ponds that have scores in the oligotrophic range were graded as Acceptable. Many pond data 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 these older data were collected. APCC screened out pond data older than 2015 and ponds with less than three years of data collected. Using these more stringent requirements for grading resulted in only 29 ponds having sufficient 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 therefore represent another way to describe nutrient enrichment in freshwater ponds.

APCC used our 2019 cyanobacteria monitoring data and cyanobacteria tiers of Low, Moderate and High (where High represents levels where pets and humans are advised to avoid contact with pond water) to grade ponds monitored in 2019. Cyanobacteria monitoring data collected by town officials in 2019 that were available to APCC were also included. If a town posted a cyanobacteria advisory in 2019, that pond was placed in the same category as those ponds that reached APCC's High tier. Similarly, ponds monitored by town officials that never required the posting of an advisory for cyanobacteria in 2019 were placed in the same category as those that only reached the Low or Moderate tier in APCC's Monitoring Program.

This report reflects revisions adopted in 2020 to the APCC pond grading system in the following ways:

1) Carlson Trophic Index scores and grades for ponds were calculated only for ponds where more recent water quality data from 2015 on was available, and where at least three years of data were available.
2) Cyanobacteria monitoring data from 2019 were used to grade ponds using APCC's tiered cyanobacteria system described above:

   a. Ponds with “High” cyanobacteria levels were graded as “Unacceptable: requires immediate restoration”;
   b. Ponds with “Low” or “Moderate” cyanobacteria levels 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. Conversely, a 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 overall pond grade.

Only 29 ponds had sufficient water quality data to calculate Carlson Trophic Index grades based on our more stringent criteria for grading, while 81 ponds had cyanobacteria data that enabled grading. A total of 78 ponds either had no data, data that were too old, or insufficient data to calculate the Carlson Trophic Index grades. There were only 17 ponds with both Carlson Trophic Index grades and cyanobacteria grades (Table 5).

For comparison, in 2019 APCC graded 149 ponds based on pond monitoring data available through the Pond and Lake Stewards (PALS) program. Of these 149 ponds, 91 were graded as Acceptable representing 61% of graded ponds, while 58 were graded as Unacceptable, representing 39% of graded ponds. Grading in 2019 did not incorporate our more stringent data quality criteria and thus a number of pond grades were based on older data.

Public Water Supplies

Public water supply grades for drinking water are based on publicly available Consumer Confidence Reports for 2019. Grades are based on whether water quality meets existing state and federal drinking water standards (i.e., Maximum Contaminant Levels, or MCLs). Based on 2019 CCRs, all Cape Cod public water supplies were graded as Excellent (Figure 4, Table 7). The 2019 State of the Waters grades for public water supplies were all Excellent, so there has been no change.

APCC is monitoring the implementation of recently finalized regulations for PFAS and will apply these to public water supplies when regulations go into effect in 2021.

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 implementation of recently finalized regulations for PFAS and will apply these to public water supplies when regulations go into effect in 2021.
  - 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 water supplies can be contaminated by cyanotoxins, and public water suppliers elsewhere are taking precautions to guard against cyanotoxins in drinking water. APCC has been monitoring cyanobacteria since 2018 and incorporated cyanobacteria into this year's State of the Waters grading of ponds.

- 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 29 ponds and lakes on the Cape have fish consumption advisories due to the high levels of mercury. Last year the number was 24. Mercury originates from atmospheric fallout of mercury emissions from fossil-fuel-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.

12.3. Filling the gaps: recommendations for monitoring

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

- 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 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.

- 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 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.

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 Commission to initiate a 208-scale effort for the freshwater ponds of Cape Cod.

And 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 local residents in forcing action at the town level.

Recommended Actions for Coastal Embayments

- For Municipalities
    - 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) and the principle forgiveness offered by the Cape and Islands Water Protection Trust to support the water quality plan adopted by the community.
    - 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.
    - 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.

- <u>For State Government</u>
  - 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.

- <u>For Regional Government</u>
  - 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.
  - Fund and support 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.

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.
  - 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.
  - 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.

- For Homeowners/Business Owners:
    - 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.

- For State Government
  - 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
  - Update the Cape Cod 208 Plan 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.

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:

- 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 are underway in Chatham and already completed in Falmouth for the New Silver Beach neighborhood ;

- 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;

- 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;

- 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.

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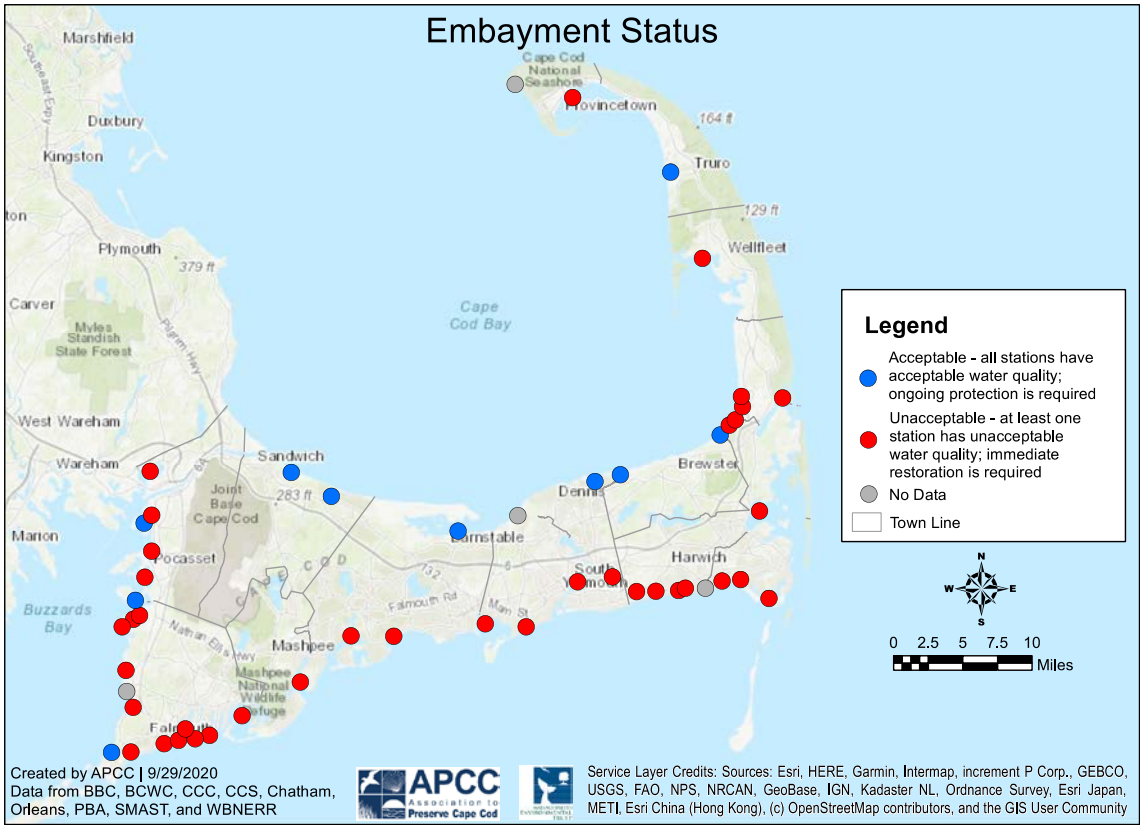

Figure 1. 2020 Map of Water Quality Grades for Coastal Embayments. Water quality grades for individual stations in embayments were reviewed. If there was at least one station in the embayment with Unacceptable water quality, the embayment received a grade of Unacceptable: requires immediate restoration. If all stations in an embayment had Acceptable water quality, the embayment received a grade of Acceptable: requires ongoing protection. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

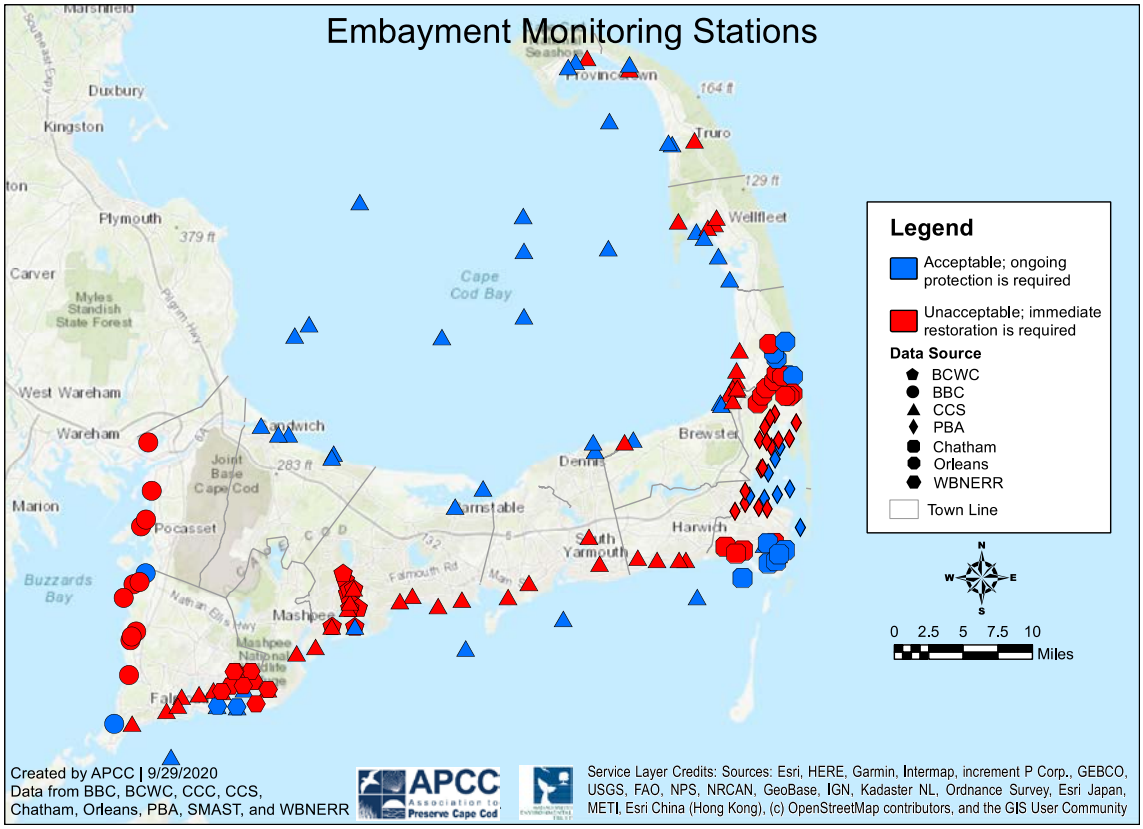

Figure 2. 2020 Map of Water Quality Grades for Coastal Embayment Stations. Water quality data were scored using the Buzzards Bay Eutrophication Index and scores were converted into grades as described in Section 10. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

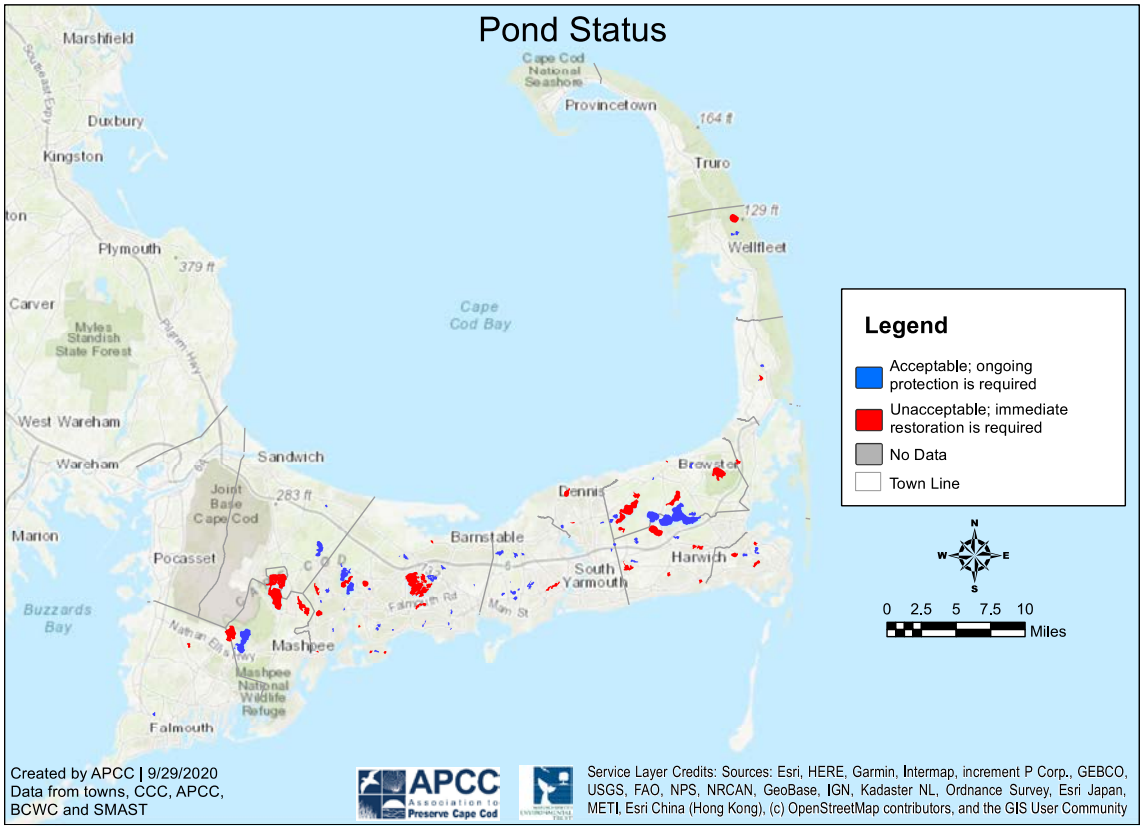

Figure 3. 2020 Map of Water Quality Grades for Ponds and Lakes. Pond water quality data from the PALS program were scored using the Carlson Trophic Index and scores were converted into grades as described in Section 10. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

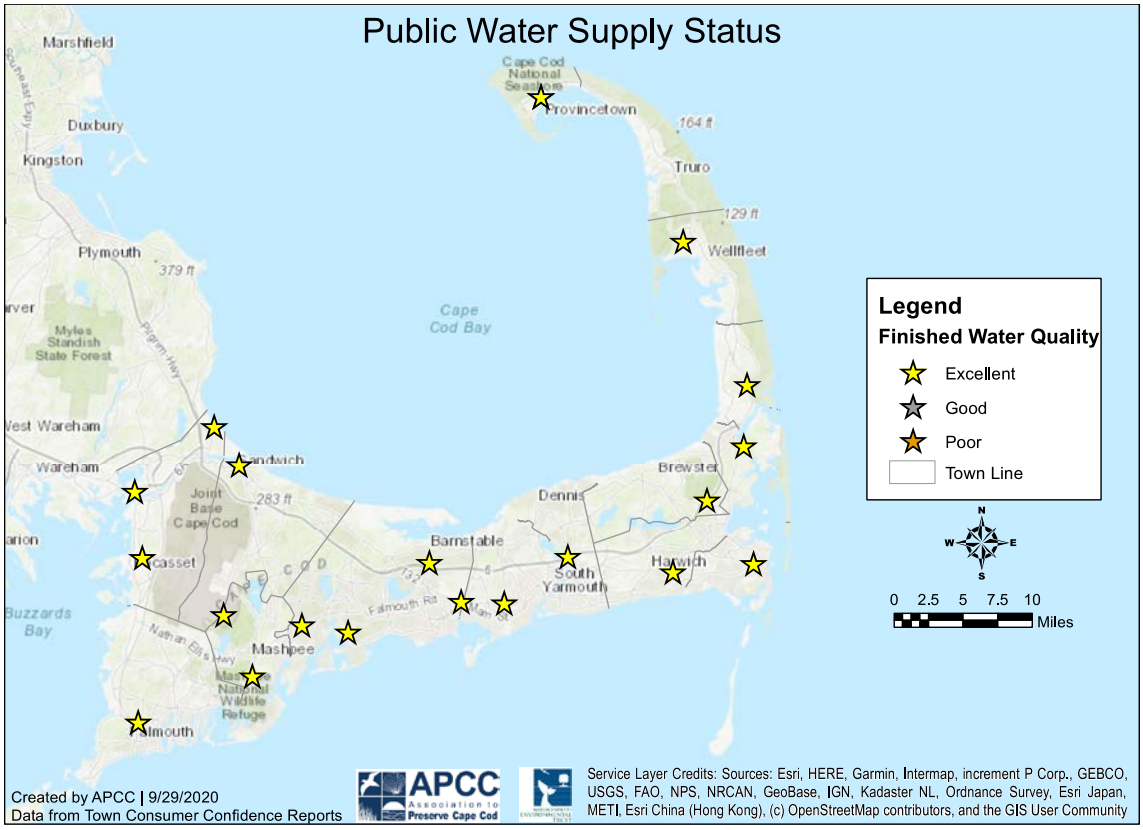

Figure 4. 2020 Map of Grades for Public Water Supplies of Drinking Water. Consumer Confidence Reports from 2019 were used to evaluate water quality in public water supplies prior to distribution to consumers. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

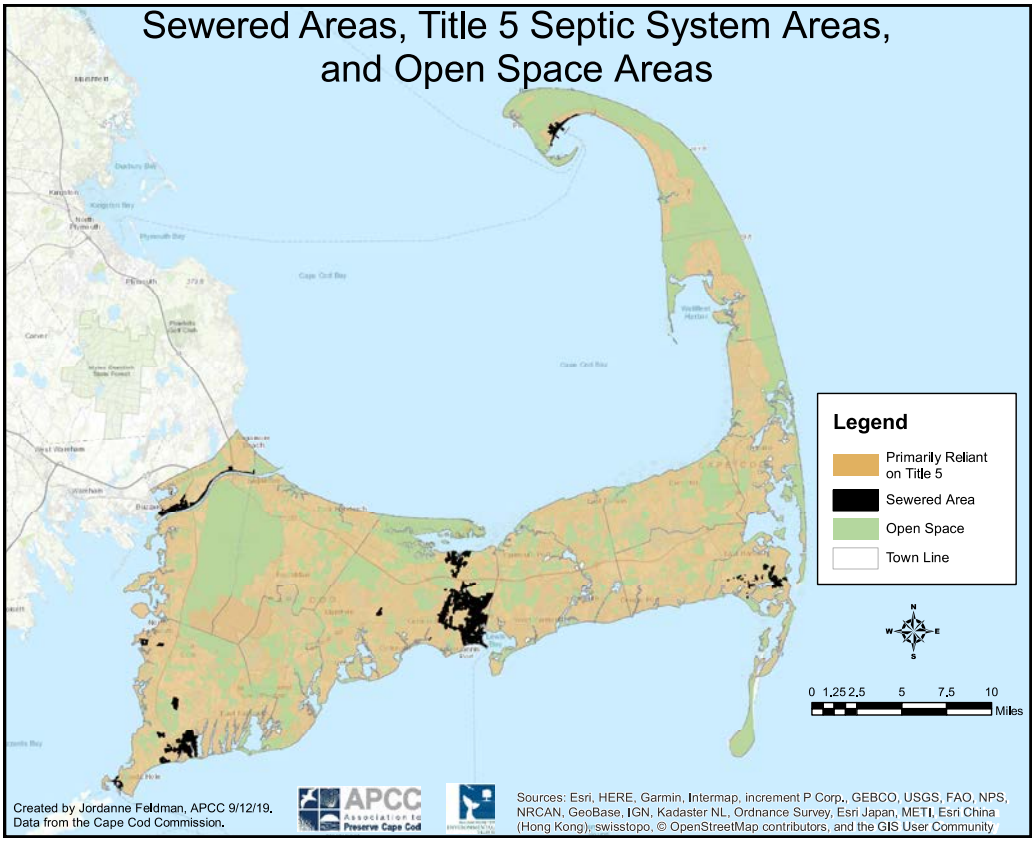

Figure 5. Map of Areas Served by Title 5 Septic Systems and Publicly-Owned Wastewater Treatment Facilities and Open Space.

Table 1. Embayment Grades for 2020. Embayments were graded as Acceptable if all stations in the embayment were Acceptable; if at least one station was Unacceptable, the embayment was graded as Unacceptable.

2020 SOTW			
EMBAYMENTS			
	Acceptable	**Unacceptable**	**No data (ND)**
Allen Harbor		U	
Back River		U	
Barnstable Harbor	A		
Bass River		U	
Boat Meadow		U	
Bournes Pond		U	
Buttermilk Bay		U	
Centerville River		U	
Chase Garden Creek			ND
Falmouth Inner Harbor		U	
Fiddler's Cove		U	
Great Pond		U	
Great Sippewissett Creek			ND
Green Pond		U	
Hatches Harbor			ND
Herring River, Eastham		U	
Herring River, Harwich		U	
Lewis Bay		U	
Little Namskaket Creek		U	
Little Pond		U	
Little Sippewissett Marsh		U	
Megansett Harbor	A		
Namskaket Creek	A		
Nauset Marsh		U	
Oyster Pond, FA		U	
Parnet River	A		
Parkers River		U	
Phinneys Harbor	A		
Pleasant Bay		U	
Pocasset Harbor		U	
Pocasset River		U	
Popponessett Bay		U	
Provincetown Harbor		U	
Quissett Harbor	A		
Quivett Creek	A		
Rand Harbor		U	
Red River			ND
Rock Harbor		U	
Sandwich Harbor	A		
Saquetucket Harbor		U	
Scorton Harbor	A		
Sesuit Harbor	A		
Stage Harbor		U	
Sulfur Springs/Buck Creek		U	
Swan Pond River		U	
Taylors Pond/Mill Creek		U	
Three Bays		U	
Waquoit Bay		U	
Wellfleet Harbor		U	
West Falmouth Harbor		U	
Wild Harbor		U	
Wychmere Harbor		U	
Totals:	**10**	**38**	**4**

Table 2. Comparison of 2019 and 2020 State of the Waters Grades for Coastal Embayments.

	2019 SOTW		2020 SOTW		
	Number	Percentage	Number	Percent %	Change
Embayments graded	47		48		
Unacceptable	32 *	68%	38	79%	Increased by 6
Acceptable	15	32%	10	21%	Decreased by 5
No data (not graded)	5		4		Decreased by 1 (1 became Unacceptable)

* Note: in 2019 SOTW Rushy Marsh Pond (U) was included and the number of Unacceptable was 33. In 2020 it was dropped because it is a salt pond not an embayment, thus for this comparison it was also dropped from 2019. This reduces the number of Unacceptables in 2019 to 32, and changes the percentages of U and A as well as the total number of embayments graded in 2019).

Table 3. Embayment Grades by Water Body.

Embayment Grades	Nantucket Sound, Vineyard Sound, Pleasant Bay	Buzzards Bay	Cape Cod Bay	Total number
Unacceptable	23	9	6	38
Acceptable	0	3	7	10
No data	1	1	2	4

Table 4. Comparison of 2019 and 2020 State of the Waters Grades for Coastal Embayment Stations.

	2019 SOTW		2020 SOTW	
	Number	Percentage	Number	Percentage
Embayment stations graded	152		152	
Unacceptable	98	64%	106	70%
Acceptable	54	36%	46	30%

Table 5. 2020 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.

Town	Pond	Most Recent Year	Years Covered	Carlson Eutrophic Index	Carlson Eutrophic Index Grade	Cyanobacteria Grade	Final Grade	Basis for Grade
Barnstable	Garrett	2019	2019			A	A	Cyanobacteria only
Barnstable	No Bottom	2019	2019			A	A	Cyanobacteria only
Barnstable	Sloney	2017	2015-2017	36.3	A		A	CBI only
Barnstable	Hathaway	2019	2019			A	A	Cyanobacteria only
Barnstable	Mystic	2019	2019			A	A	Cyanobacteria only
Barnstable	Wequaquet	2019	2019			U	U	Cyanobacteria only
Barnstable	Bearse	2019	2019			U	U	Cyanobacteria only
Barnstable	Shallow	2019	2019			A	A	Cyanobacteria only
Barnstable	Middle	2019	2019			U	U	Cyanobacteria only
Barnstable	Shubael	2019	2019			U	U	Cyanobacteria only
Barnstable	Hamblin	2019	2019			A	A	Cyanobacteria only
Barnstable	Lewis	2019	2019			A	A	Cyanobacteria only
Barnstable	Long Pond Marstons Mills	2019	2019			U	U	Cyanobacteria only
Barnstable	Round	2019	2019			A	A	Cyanobacteria only
Barnstable	Muddy Pond	2019	2019			A	A	Cyanobacteria only
Barnstable	Phillys	2019	2019			A	A	Cyanobacteria only
Barnstable	Long Pond Centerville	2019	2019			U	U	Cyanobacteria only
Barnstable	Mill	2018	2015-2018	44.7	A		A	CBI only
Barnstable	Farwell	2019	2019			A	A	Cyanobacteria only
Barnstable	Lovells	2018	H15_2017-2018	44.2	A	U	U	CBI and Cyanobacteria
Barnstable	Red Lily Pond	2019	2019			A	A	Cyanobacteria only
Barnstable	Simmons	2019	2019			A	A	Cyanobacteria only
Barnstable	Lake Elizabeth	2019	2019			A	A	Cyanobacteria only
Barnstable	Micah	2018	2015-2018	32.7	A	A	A	CBI and Cyanobacteria
Barnstable	Bog	2018	2015-2018	50.8	U		U	CBI only
Barnstable	Schoolhouse	2019	2019			A	A	Cyanobacteria only
Barnstable	Joshua	2018	2015-2018	31.6	A	A	A	CBI and Cyanobacteria
Barnstable	Eagle	2018	H15_2017-2018	38.1	A	A	A	CBI and Cyanobacteria
Barnstable	North	2019	2019			A	A	Cyanobacteria only
Barnstable	Neck	2018	2015-2018	35.7	A	A	A	CBI and Cyanobacteria
Barnstable	Parker Pond	2018	2016-2018	60.5	U	A	U	CBI and Cyanobacteria
Barnstable	Crystal Lake	2018	2016-2018	45.3	A	U	U	CBI and Cyanobacteria
Barnstable	Lewis	2018	H15_2017-2018	58.4	U	A	U	CBI and Cyanobacteria
Barnstable	Gooseberry	2019	2019			U	U	Cyanobacteria only
Barnstable	Hindley	2019	2019			U	U	Cyanobacteria only
Brewster	Cliff	2019	2019			U	U	Cyanobacteria only
Brewster	Myricks	2019	2019			U	U	Cyanobacteria only
Brewster	Blueberry	2019	2019			A	A	Cyanobacteria only
Brewster	Schoolhouse	2019	2019			A	A	Cyanobacteria only
Brewster	Sheep	2019	2019			U	U	Cyanobacteria only
Brewster	Lower Mill	2019	2019			U	U	Cyanobacteria only
Brewster	Upper Mill	2019	2019			U	U	Cyanobacteria only
Brewster	Long Pond	2019	2019			A	A	Cyanobacteria only
Brewster	Greenland	2019	2019			A	A	Cyanobacteria only
Brewster	Walkers	2019	2019			U	U	Cyanobacteria only
Brewster	Slough	2019	2019			A	A	Cyanobacteria only
Brewster	Pine	2019	2019			A	A	Cyanobacteria only
Brewster	Elbow	2019	2019			U	U	Cyanobacteria only
Chatham	Stillwater	2019	2019			U	U	Cyanobacteria only
Chatham	Lovers Lake	2019	2019			A	A	Cyanobacteria only
Chatham	Goose	2019	2019			U	U	Cyanobacteria only
Chatham	Schoolhouse	2019	2019			A	A	Cyanobacteria only
Chatham	Whale	2019	2019			U	U	Cyanobacteria only
Dennis	Scargo	2018	2015-2018	49.2	A	U	U	CBI and Cyanobacteria
Dennis	Bakers	2018	H15_2017-2018	38.4	A		A	CBI only
Dennis	Run	2018	H15-2016_2018	51.3	U		U	CBI only
Dennis	Flax	2018	2015-2018	39.5	A		A	CBI only
Dennis	Eagle	2018	H15-2016_2018	34.8	A		A	CBI only
Dennis	Whites	2018	2015-2018	47.5	A		A	CBI only
Eastham	Ministers	2019	2019			A	A	Cyanobacteria only
Eastham	Depot	2019	2019			U	U	Cyanobacteria only
Eastham	Little Depot	2019	2019			A	A	Cyanobacteria only
Falmouth	Deep	2019	2019			U	U	Cyanobacteria only
Falmouth	Green	2019	2019			A	A	Cyanobacteria only
Harwich	Seymour	2019	2019			A	A	Cyanobacteria only
Harwich	Findleys	2018	2015-2018	59.7	U	U	U	CBI and Cyanobacteria
Harwich	Aunt Edies	2018	2015-2018	45.7	A		A	CBI only
Harwich	Robbins	2018	2015-2018	41.2	A		A	CBI only
Harwich	John Josephs	2018	2015-2018	49.9	A	U	U	CBI and Cyanobacteria
Harwich	Bucks	2018	2015-2018	41.2	A	U	U	CBI and Cyanobacteria
Harwich	Sand	2018	2015-2018	46.9	A	A	A	CBI and Cyanobacteria
Harwich	West Reservoir	2019	2019			U	U	Cyanobacteria only
Harwich	Grass	2018	2015-2018	61.3	U		U	CBI only
Harwich	Skinnequit	2018	2015-2018	62.0	U	A	U	CBI and Cyanobacteria
Mashpee	Mashpee-Wakeby	2018	2016-2018	53.2	U		U	CBI only
Mashpee	Santuit	2018	2016-2018	56.8	U	U	U	CBI and Cyanobacteria
Mashpee	Ashumet	2018	2016-2018	47.8	A	U	U	CBI and Cyanobacteria
Mashpee	Johns	2018	2016-2018	46.3	A		A	CBI only
Orleans	Bakers	2019	2019			U	U	Cyanobacteria only
Sandwich	Hoxie	2019	2019			A	A	Cyanobacteria only
Sandwich	Lawrence	2019	2019			A	A	Cyanobacteria only
Wellfleet	Gull	2019	2019			U	U	Cyanobacteria only
Wellfleet	Long	2019	2019			A	A	Cyanobacteria only
Yarmouth	Dennis	2019	2019			A	A	Cyanobacteria only
Yarmouth	Greenough	2019	2019			A	A	Cyanobacteria only
Yarmouth	Elisha's	2019	2019			A	A	Cyanobacteria only
Yarmouth	Plash's	2019	2019			A	A	Cyanobacteria only
Yarmouth	Long	2019	2019			U	U	Cyanobacteria only
Yarmouth	Flax	2019	2019			A	A	Cyanobacteria only
Yarmouth	Bassetts	2019	2019			A	A	Cyanobacteria only
Yarmouth	Horse	2019	2019			A	A	Cyanobacteria only
Yarmouth	Little Sandy	2019	2019			A	A	Cyanobacteria only
Yarmouth	Big Sandy	2019	2019			A	A	Cyanobacteria only

Table 6. Comparison of 2019 and 2020 State of the Waters Grades for Ponds.

	2019 SOTW		2020 SOTW	
	Number	Percentage	Number	Percentage
Total number of ponds on Cape Cod	996		996	
Ponds graded	149	15% of all ponds on Cape Cod	93	9% of all ponds on Cape Cod
Unacceptable	58	39% of graded ponds	39	42% of graded ponds
Acceptable	91	61% of graded ponds	54	58% of graded ponds
Ponds with CTI grades	149	100% of graded ponds	29 *	31% of graded ponds
Ponds with cyanobacteria grades	NA	NA	81	87% of graded ponds
Ponds with both CTI and cyanobacteria grades	NA	NA	17	18% of graded ponds

* Note: Carlson Trophic Index grades in 2020 were calculated only for ponds that met more stringent data quality criteria described in the Overview.
NA – Not applicable.

Table 7. 2020 Grades for Public Water Supplies. Grades were based on publicly available Consumer Confidence Reports and meeting existing state and federal regulations for drinking water.

Public Water Supplies Finish Water: 2020 Grades

ID	Year	Grade	Latitude	Longitude	Consumer Confidence Reports
Barnstable - COMM	2019	Excellent	41.637364	-70.390412	https://town.barnstable.ma.us/Departments/watersupply/News_and_Updates/C.O.M.M-Drinking-Water-Quality-Report.pdf
Barnstable Fire District	2019	Excellent	41.691585	-70.305312	http://www.barnstablefiredistrict.com/wp-content/uploads/CCR-2019.pdf
Bourne	2019	Excellent	41.695299	-70.60582	http://bournewaterdistrict.com/ccr2019.pdf
Buzzards Bay	2019	Excellent	41.747107	-70.613397	https://www.buzzardsbaywaterdistrict.com/student-life
North Sagamore	2019	Excellent	41.797504	-70.530402	https://www.northsagamorewaterdistrict.com/2019-water-quality-report
Otis	2019	Excellent	41.65091	-70.520445	https://www.102iw.ang.af.mil/Portals/2/documents/community/CCR_FINAL_2019.pdf
Brewster	2019	Excellent	41.740402	-70.015269	http://records.brewster-ma.gov/WebLink/0/doc/128262/Page1.aspx
Chatham	2019	Excellent	41.690799	-69.966547	https://www.chatham-ma.gov/sites/g/files/vyhlif2926/f/uploads/ccr_-_2019.pdf
Cotuit	2019	Excellent	41.642862	-70.438897	http://3wu0r2vavr91ojzun2xnfoc4-wpengine.netdna-ssl.com/waterdepartment/files/2020/02/Cotuit-Water-Brochure-2019-1.pdf
Dennis	2019	Excellent	41.696396	-70.160876	https://www.denniswater.org/sites/g/files/vyhlif4326/f/uploads/2019awqr_1.pdf
Eastham	2019	Excellent	41.83035	-69.973168	https://www.eastham-ma.gov/sites/g/files/vyhlif4371/f/pages/2020-townofeastham.pdf
Falmouth	2019	Excellent	41.566794	-70.609927	http://www.falmouthmass.us/DocumentCenter/View/7895/Consumer-Confidence-Report-2019
Harwich	2019	Excellent	41.68413	-70.050651	http://www.harwichwater.com/assets/CCR/2019%20CCR%20Harwich.pdf
Hyannis	2019	Excellent	41.661114	-70.272168	https://townofbarnstable.us/Departments/watersupply/Reports_and_Regulations/Hyannis-Water-System-Quality-Report-.pdf?tm=6/26/2020%205:11:30%20PM
Mashpee	2019	Excellent	41.602791	-70.490523	http://www.mashpeewaterdistrict.com/waterquality/Mashpee%20Water%20Qual%20Rpt%201-16%20REV.pdf
Orleans	2019	Excellent	41.782569	-69.97669	https://www.town.orleans.ma.us/sites/g/files/vyhlif3631/f/uploads/2019_water_quality_report.pdf
Provincetown	2019	Excellent	42.054058	-70.188757	https://www.provincetown-ma.gov/ArchiveCenter/ViewFile/Item/24128
Sandwich	2019	Excellent	41.76764	-70.504489	http://www.sandwichwater.com/sandwich-2020-ccr.pdf
Truro	2019	Excellent	42.054058	-70.188757	https://www.provincetown-ma.gov/ArchiveCenter/ViewFile/Item/24128
Wellfleet	2019	Excellent	41.941909	-70.03993	https://www.wellfleet-ma.gov/sites/g/files/vyhlif5166/f/uploads/2019-wellfleetmunicipal-final-05.28.20.pdf
Yarmouth	2019	Excellent	41.659972	-70.227188	https://www.yarmouth.ma.us/DocumentCenter/View/13520/2019-WATER-REPORT?bidId=

Table 8. 2020 Coastal Water Quality Scores and Grades for Cape Cod Stations. Data were provided by the Center for Coastal Studies. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

						Updated:	10/8/20
		MC Grading System		APCC System			
		Score					
		65 to 100	Excellent	Acceptable, Ongoing Protection Required			
		35 to 65	Fair	Unacceptable, Intermediate Intervention Required			
		< 35	Poor	Unacceptable, Immediate Intervention Required			
Number	Station	Score	MC Grading System	APCC System	No. of Years	Years Counted	
1	SB	99.4	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
2	SS	99.3	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
3	GH	99.3	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
4	65	99.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
5	75	99.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
6	BM	99.7	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
7	SW	99.9	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
8	95	99.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
9	Bournedale Tributary	99.1	Excellent	Acceptable, Ongoing Protection Required	5.0	2007-2018,2015	
10	Monkey Bush Creek	66.6	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
11	Bass Meadow	46.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
14	C5	91.7	Excellent	Acceptable, Ongoing Protection Required	5.0	2011-2015	
15	Canal	86.9	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
16	Canal Inland	100.0	Excellent	Acceptable, Ongoing Protection Required	5.0	2006-2018	
17	D5	62.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
19	D1	43.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
20	Eel River Flanagan	62.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2011-2015	
21	Flax Pond outer	44.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
22	Grass Island Channel	67.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
23	Hadley Pond, Provincetown Site	59.8	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
24	Herring Creek, Provincetown Site	99.5	Excellent	Acceptable, Ongoing Protection Required	4.0	2007-2018	
25	Inner Pamet, Pamet River, TR	74.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
26	Inner Rock Harbor	96.9	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
27	Inner Town Harbor	83.6	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2017	
28	Inner Wellfleet Harbor	46.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
29	Jones River	57.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2011-2015	
30	MacMillan	95.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
31	Main Inlet	76.9	Excellent	Acceptable, Ongoing Protection Required	5.0	2013-2016	
32	Old Town Cove, Sandwich	91.5	Excellent	Acceptable, Ongoing Protection Required	4.0	2007-2018	
33	P1	69.7	Excellent	Acceptable, Ongoing Protection Required	5.0	2013-2017	
34	P2	88.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2011-2015	
35	P3	87.1	Excellent	Acceptable, Ongoing Protection Required	5.0	2011-2015	
36	Pamet_TR	91.1	Excellent	Acceptable, Ongoing Protection Required	4.0	2007-2018	
37	Rock Harbor	51.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
38	Scorton	93.7	Excellent	Acceptable, Ongoing Protection Required	4.0	2007-2018	
41	Town Harbor	97.7	Excellent	Acceptable, Ongoing Protection Required	5.0	2007-2011	
42	Town Meadow	83.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
43	Well Fleet Harbor	54.1	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
44	W1	99.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2013-2016	
45	W2	96.3	Excellent	Acceptable, Ongoing Protection Required	5.0	2013-2016	
46	W3	99.4	Excellent	Acceptable, Ongoing Protection Required	5.0	2013-2016	
47	WHS_1	97.4	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
48	WHS_2	98.3	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
49	WHS_4	99.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
50	WHS_5	99.4	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
51	WHS_8	99.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
52	WHS_10	95.7	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
53	WHS_13	97.3	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
54	WHS_16	97.4	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
55	WHS_24	97.3	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
101	Beaudouin - Seabed ch	88.9	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
102	Inner Town Meadow	76.4	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
104	Herring River	59.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
105	Herring River, Wellfleet	99.8	Poor	Unacceptable, Intermediate Intervention Required	4.0	2015-2019	
106	Inner Town Harbor	8.4	Poor	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
107	Uncle Tom's Island	57.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
108	Main Outlet	75.5	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
109	North Truro Meadow	46.1	Fair	Unacceptable, Intermediate Intervention Required	5.0	2006-2018	
110	Pamet Creek	78.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
111	Pamet A	69.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2007-2009	
112	Pamet Tributary	75.7	Excellent	Acceptable, Ongoing Protection Required	2.0	2009-2018	
113	Plymouth Harbor	93.3	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
114	Scorton Creek	79.4	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
115	Upper Meetinghouse, CB	99.6	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
117	Pamet River	53.6	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
118	Pilgrim Lake	55.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
119	Inner Harbor	68.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
121	Old Mash or -GA	57.8	Fair	Unacceptable, Intermediate Intervention Required	4.0	2010-2015	
123	Old Mash or Outside	64.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
124	Scorton Creek GA	76.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
125	Scorton Creek Inside Lane	58.6	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
127	Duck Creek	56.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2017	
128	Quivett Marsh	93.5	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
129	Cole Road Brook	54.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
130	Smack Creek	19.8	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
131	Jeffreys Beach	69.7	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
133	Jones River Landing	94.9	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2017	
134	Old Mash or PO	47.7	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
135	Upper Pamet River	91.4	Poor	Unacceptable, Intermediate Intervention Required	4.0	2016-2019	
136	Monkfish Creek	98.5	Poor	Unacceptable, Intermediate Intervention Required	5.0	2016-2018	
137	Uncle Tom's Island Creek	54.5	Poor	Unacceptable, Intermediate Intervention Required	4.0	2016-2019	
138	WHS	65.6	Excellent	Acceptable, Ongoing Protection Required	5.0	2017-2019	
139	Bay Shore Drive	64.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2017-2019	
140	White Crest Beach	65.6	Excellent	Acceptable, Ongoing Protection Required	5.0	2017-2019	
182	Dyer Prince	56.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
183	Mill-Culvert	37.6	Poor	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
184	Mill-Pond	99.5	Poor	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
580	BC1 Bourne Pond	45.7	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
581	BC14 Hall's Creek	51.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
582	BC7-1 Centerville-E	58.5	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
583	BC7-2 Centerville-W	59.3	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
584	BM7-1 Louis Bay	64.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
585	BB-7 Bass River	53.1	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
586	Chk-1 D'Eagle's Pond	56.6	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
587	Chk-1 A Oyster Pond, CB	75.6	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
588	Chk-5 A Millcreek Estuary, CB	67.9	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
589	Chk-2 Seafood Spring, CB	61.6	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
510	Cotuit Bay	64.8	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
511	Ch-3 Childs River	88.8	Poor	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
517	FB-2 Eel River, Falmouth	48.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
518	Falmouth Inner Harbor	48.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
520	G4-Green Pond, Falmouth	45.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
521	Green Pond	48.6	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
522	Mill-2 Sequanset Harbor	58.8	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
523	Mill-1 Wrights Cove Harbor, MA	45.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
524	Mill-4 Allen Harbor, MA	41.1	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
525	Mill-7 Herring River, MA	59.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
526	Sam Mills Pond	51.9	Fair	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
527	John Pond	57.5	Fair	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
532	Harwich	51.8	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
533	North Bay	46.8	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
534	Oyster Pond, FA	51.6	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
535	Pilot Poppenomoo Bay	55.4	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
536	Poponesset River, YA	44.2	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
537	Quashnet River, Waquoit Bay	48.6	Fair	Unacceptable, Intermediate Intervention Required	5.0	2014-2018	
538	Rocky Marsh, BA	54.5	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
542	Seamans Creek	59.4	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
543	Seine Pond Mouth, DE	58.1	Fair	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
551	Warrens Cove, BA	88.3	Poor	Unacceptable, Intermediate Intervention Required	5.0	2015-2019	
552	Waquoit Bay	65.8	Excellent	Acceptable, Ongoing Protection Required	5.0	2014-2018	
553	West Bay	74.9	Excellent	Acceptable, Ongoing Protection Required	5.0	2015-2019	
566	Waquoit Bay Beach	79.7	Excellent	Acceptable, Ongoing Protection Required	5.0	2016-2018	
567	Moonchaser	76.8	Excellent	Acceptable, Ongoing Protection Required	3.0	2016-2018	
568	Uncle Pond	98.9	Poor	Unacceptable, Intermediate Intervention Required	4.0	2016-2019	

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

	BBC Grading System Score	APCC Status
Excellent	> 65	Acceptable; Ongoing Protection is Required
Fair	35 to 65	Unacceptable; Immediate Restoration is Required
Poor	< 35	Unacceptable; Immediate Restoration is Required

Stations	2015	2016	2017	2018	2019	BBC	APCC Status
Back River	45	45	51	60	55	Fair	Unacceptable; Immediate Restoration is Required
Briarwood Harbor	47	47	54			Fair	Unacceptable; Immediate Restoration is Required
Buttermilk Bay	62	60	64	67	66	Excellent	Acceptable; Ongoing Protection is Required
Eel Pond, Bourne	42	45	46	48	43	Fair	Unacceptable; Immediate Restoration is Required
Fiddlers Cove	61	64	66	67	63	Fair	Unacceptable; Immediate Restoration is Required
Flume Pond	25					Poor	Unacceptable; Immediate Restoration is Required
Gunning Point Pond	30	29	29	28	27	Poor	Unacceptable; Immediate Restoration is Required
Hen Cove	51	58	67	64	63	Fair	Unacceptable; Immediate Restoration is Required
Herring Brook	52	51	53	54	46	Fair	Unacceptable; Immediate Restoration is Required
Little Buttermilk Bay	57	55	56	58	57	Fair	Unacceptable; Immediate Restoration is Required
Little Sippewisset Marsh	60	61	64	64	62	Fair	Unacceptable; Immediate Restoration is Required
Mashapaquit Creek	9	12	9	3	3	Poor	Unacceptable; Immediate Restoration is Required
Megansett Harbor	72	74	81	83	82	Excellent	Acceptable; Ongoing Protection is Required
Phinneys Harbor	66	70	75	74	70	Excellent	Acceptable; Ongoing Protection is Required
Pocasset Harbor Inner	62	58	60	60	55	Fair	Unacceptable; Immediate Restoration is Required
Pocasset Harbor Outer	77	73	76	76	73	Excellent	Acceptable; Ongoing Protection is Required
Pocasset River	52	53	57	59	54	Fair	Unacceptable; Immediate Restoration is Required
Potters Hole Pond		14	19	19	21	Poor	Unacceptable; Immediate Restoration is Required
Quissett Harbor Inner	80	81	84	86	86	Excellent	Acceptable; Ongoing Protection is Required
Quissett Harbor Outer	86	85	88	90	91	Excellent	Acceptable; Ongoing Protection is Required
Rands Harbor	45	44	43	44	41	Fair	Unacceptable; Immediate Restoration is Required
Red Brook Harbor Inner	43	49	60	58	62	Fair	Unacceptable; Immediate Restoration is Required
Red Brook Harbor Outer	56	63	80	79	79	Excellent	Acceptable; Ongoing Protection is Required
Squeteague Harbor	57	57	59	59	56	Fair	Unacceptable; Immediate Restoration is Required
West Falmouth Harbor Head	37	45	50	51	51	Fair	Unacceptable; Immediate Restoration is Required
West Falmouth Harbor Outer	64	69	76	78	77	Excellent	Acceptable; Ongoing Protection is Required
West Falmouth Harbor Town Dock	56	54	59	61	61	Fair	Unacceptable; Immediate Restoration is Required
West Falmouth Mid-Harbor	61	63	67	68	64	Fair	Unacceptable; Immediate Restoration is Required
West Falmouth Oyster Pond	37	38	41	40	40	Fair	Unacceptable; Immediate Restoration is Required
West Falmouth Snug Harbor	25	26	24	24	25	Poor	Unacceptable; Immediate Restoration is Required
Wild Harbor Inner	46	48	51	55	52	Fair	Unacceptable; Immediate Restoration is Required
Wild Harbor Outer	75	77	85	87	84	Excellent	Acceptable; Ongoing Protection is Required
Wild Harbor River	57	61	67	69	67	Excellent	Acceptable; Ongoing Protection is Required

Table 10. 2020 Coastal Water Quality Scores and Grades for Three Bays, Barnstable. Data were provided by the Barnstable Clean Water Coalition. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

		BBC Grading System		APCC Status		
		Score				
		65 to 100	Excellent	Acceptable; Ongoing Protection is Required		
		35 to 65	Fair	Unacceptable; Immediate Restoration is Required		
		<35	Poor	Unacceptable; Immediate Restoration is Required		
Name	**Site Number**	**Score**	**BBC**	**APCC Status**	**No. Years**	**Years**
Mill Pond	Site 1	24.69692056	Poor	Unacceptable; Immediate Restoration is Required	4	2014-2018
South Prince's Cove	Site 2	29.11763067	Poor	Unacceptable; Immediate Restoration is Required	4	2014-2018
North Prince's Cove	Site 3	31.7990786	Poor	Unacceptable; Immediate Restoration is Required	4	2014-2018
Warren's Cover	Site 4	28.61231725	Poor	Unacceptable; Immediate Restoration is Required	4	2014-2018
North N. Bay	Site 5	30.00912251	Poor	Unacceptable; Immediate Restoration is Required	5	2014-2018
South N. Bay	Site 6	39.91520143	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
South West Bay	Site 9	51.91647293	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
	Site 10	39.01995699	Fair	Unacceptable; Immediate Restoration is Required	3	2016-2018
South Cotuit Bay	Site 13	44.96571767	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
Cotuit Sentinel	Site 18	37.14490202	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
Old Mill	Site E	35.01841038	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
	Site RM3	26.36836005	Poor	Unacceptable; Immediate Restoration is Required	5	2014-2018
	Site RM4	34.70564726	Poor	Unacceptable; Immediate Restoration is Required	4	2014-2018

Table 11. 2020 Coastal Water Quality Scores and Grades for Waquoit Bay. Data were provided by Waquoit Bay National Estuarine Research Reserve (WBNERR). Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

BBC Grading System Score		APCC Status
65 to 100	Excellent	Acceptable; Ongoing Protection is Required
35 to 65	Fair	Unacceptable; Immediate Restoration is Required
<35	Poor	Unacceptable; Immediate Restoration is Required

Site Name	Site #	Score	BBC	APCC Status	No. Years	Years
Seapit River	Site 1	53.5013881	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
North Basin-WB*	Site 2	55.2530836	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
Hamblin Pond	Site 3	51.7181525	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
Jehu Pond	Site 4	56.8361514	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
Quashnet River	Site 5	36.3293741	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
Menauhant	Site 6	83.8977116	Excellent	Acceptable; Ongoing Protection is Required	5	2014-2018
Childs River	Site 7	27.5001446	Poor	Unacceptable; Immediate Restoration is Required	5	2014-2018
Eel River	Site 8	54.3875421	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
South Basin-WB*	Site 9	85.8428902	Excellent	Acceptable; Ongoing Protection is Required	5	2014-2018
	Site 10	55.737007	Fair	Unacceptable; Immediate Restoration is Required	4	2015-2018
Childs River	CR	20.00878368	Poor	Unacceptable; Immediate Restoration is Required	4	2015-2018
	SL	59.9641072	Poor	Unacceptable; Immediate Restoration is Required	4	2015-2018

Table 12. 2020 Coastal Water Quality Scores and Grades for Nauset Estuary. Data were provided by the Town of Orleans. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

	BBC Grading System Score		**APCC Status**		
	65 to 100	Excellent	Acceptable; Ongoing Protection is Required		
	35 to 65	Fair	Unacceptable; Immediate Restoration is Required		
	<35	Poor	Unacceptable; Immediate Restoration is Required		
Station ID	Score	BBC	APCC Status	No. Years	Years
WMO25	30.65691969	Poor	Unacceptable; Immediate Restoration is Required	3	2016-2018
WMO26	51.56317713	Fair	Unacceptable; Immediate Restoration is Required	3	2016-2018
WMO27	48.04774254	Fair	Unacceptable; Immediate Restoration is Required	5	2014-2018
WMO28	43.6412101	Fair	Unacceptable; Immediate Restoration is Required	4	2016-2019
WMO29	50.60568949	Fair	Unacceptable; Immediate Restoration is Required	4	2016-2019
WMO30	67.95525912	Excellent	Acceptable; Ongoing Protection is Required	3	2016-2018
WMO31	43.44086466	Fair	Unacceptable; Immediate Restoration is Required	3	2016-2018
WMO32	78.12028903	Excellent	Acceptable; Ongoing Protection is Required	3	2016-2018
WMO33	50.31617555	Fair	Unacceptable; Immediate Restoration is Required	3	2016-2018
WMO34	16.47518339	Poor	Unacceptable; Immediate Restoration is Required	5	2014-2018
WMO35	47.58592203	Fair	Unacceptable; Immediate Restoration is Required	3	2016-2018
WMO36	74.62050506	Excellent	Acceptable; Ongoing Protection is Required	4	2016-2019
WMO37	73.95597187	Excellent	Acceptable; Ongoing Protection is Required	4	2016-2019
WMO38	30.42529184	Poor	Unacceptable; Immediate Restoration is Required	5	2015-2019
WMO39	72.14036802	Excellent	Acceptable; Ongoing Protection is Required	4	2016-2019
Total Average=	51.97003797	Fair			

Table 13. 2020 Coastal Water Quality Scores and Grades for Pleasant Bay. Eutrophic Index scores were provided by the Pleasant Bay Alliance. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

							BBC Grading System Score		APCC Status
							65 to 100	Excellent	Acceptable; Ongoing Protection is Required
							35 to 65	Fair	Unacceptable; Immediate Restoration is Required
							<35	Poor	Unacceptable; Immediate Restoration is Required
Station	**Name**	**2013**	**2014**	**2015**	**2016**	**2017**	**Average**	**BBC**	**APCC Status**
PBA-3	Inner Ryder's Cove	49.8	64.4	54.2	45.6	63.1	55.42188	Fair	Unacceptable; Immediate Restoration is Required
PBA-4	Crows Pond	64.6	71.2	60.6	61.5	85.4	68.65461	Excellent	Acceptable; Ongoing Protection is Required
PBA-5	Muddy Creek	28.4	52.9	40.3	31.8	64.1	43.50906	Fair	Unacceptable; Immediate Restoration is Required
PBA-5A	Muddy Creek - Upper	6.8	9.1	28.6	10	77.9	26.48795	Poor	Unacceptable; Immediate Restoration is Required
PBA-6	Big Bay - SW	71.6	77.3	81.6	65.6	88.1	76.83211	Excellent	Acceptable; Ongoing Protection is Required
PBA-8	Big Bay - NE	53.2	78.9	66.3	73.9	86.1	71.67857	Excellent	Acceptable; Ongoing Protection is Required
PBA-9	Round Cove	46.1	40.9	42.9	41	57.2	45.61836	Fair	Unacceptable; Immediate Restoration is Required
PBA-10	Quanset Pond	44.7	52.3	58.6	44.5	66.6	53.33521	Fair	Unacceptable; Immediate Restoration is Required
PBA-11	Paw Wah Pond	25.2	37.3	43.3	40	54.5	40.06916	Fair	Unacceptable; Immediate Restoration is Required
PBA-12	Namequoit Point - South	67.3	63.8	71	65.6	70.5	67.64048	Excellent	Acceptable; Ongoing Protection is Required
PBA-13	Namequoit Point - North	51.5	61.1	67.1	64.1	71.4	63.03134	Fair	Unacceptable; Immediate Restoration is Required
PBA-14	Areys Pond	31.9	34.9	25	19.9	43.6	31.0604	Poor	Unacceptable; Immediate Restoration is Required
PBA-15	Kescayo Gansett Pond	51.2	44.8	48.6	27.2	49.5	44.25673	Fair	Unacceptable; Immediate Restoration is Required
PBA-16	Pochet-mouth	30.7	41.3	27.1	11.7	34.0	28.95852	Poor	Unacceptable; Immediate Restoration is Required
PBA-19	Strong Island - NE	95	59.2	70.1	75.1	81.2	76.12281	Excellent	Acceptable; Ongoing Protection is Required
PBA-20	Nickerson's Neck	79.6	60.5	84.2	77.9	91.8	78.80193	Excellent	Acceptable; Ongoing Protection is Required
PBA-21	Little Pleasant Bay	69.3	74.6	69.7	72.3	79.2	73.02373	Excellent	Acceptable; Ongoing Protection is Required
WMO-3	Pochet-mouth	57.4	51.3	56.7	54.3	61.5	56.24535	Fair	Unacceptable; Immediate Restoration is Required
WMO-5	Pochet-Upper	26.9	27.6	24.6	23.2	26.7	25.80571	Poor	Unacceptable; Immediate Restoration is Required
WMO-6	Namequoit River-Upper	40.6	42.5	53.9	23.3	50.3	42.12687	Fair	Unacceptable; Immediate Restoration is Required
WMO-8	Lower River	54.9	45.3	48.5	43.7	60.4	50.55757	Fair	Unacceptable; Immediate Restoration is Required
WMO-10	Meetinghouse-Rattles dock	44.7	53.4	55.3	30.6	55.8	47.96374	Fair	Unacceptable; Immediate Restoration is Required
WMO-12	Little Quanset Pond	35.1	37.8	47.1	35.3	48.1	40.67358	Fair	Unacceptable; Immediate Restoration is Required
CMI-13	Outer Ryder's Cove	38.9	59.1	72.4	63.5	76.7	62.11828	Fair	Unacceptable; Immediate Restoration is Required
					Total Average =		52.91642	Fair	Unacceptable; Immediate Restoration is Required

Table 14. 2020 Coastal Water Quality Scores and Grades for the Town of Chatham. Scores were provided by the Town of Chatham. Note: 2020 refers to this updated 2020 State of the Waters: Cape Cod report, not the year(s) in which water quality was monitored.

BBC Grading System Score		APCC Status
65 to 100	Excellent	Acceptable; Ongoing Protection is Required
35 to 65	Fair	Unacceptable; Immediate Restoration is Required
<35	Poor	Unacceptable; Immediate Restoration is Required

Station	Name	2013	2014	2015	2016	2017	Average	BBC	APCC Status
CM-1	Oyster Pond	58.3	60.3	48.8	47.0	63.2	55.5286	Fair	Unacceptable; Immediate Restoration is Required
CM-1A	Oyster Pond-Outer	57.8	82.5	88.3	72.0	75.5	75.21564	Excellent	Acceptable; Ongoing Protection is Required
CM-3	Outer Stage Harbor	62.8	72.4	80.7	78.4	72.2	73.28533	Excellent	Acceptable; Ongoing Protection is Required
CM-4	Inner Stage Harbor	66.9	78.2	62.4	74.3	73.0	70.95122	Excellent	Acceptable; Ongoing Protection is Required
CM-5	Mill Pond - Inner	67.3	75.6	68.1	62.1	71.3	68.8716	Excellent	Acceptable; Ongoing Protection is Required
CM-5A	Mill Pond - Outer	64.6	72.9	75.4	56.6	72.9	68.4811	Excellent	Acceptable; Ongoing Protection is Required
CM-7	Nantucket Sound	84.9	87.6	84.3	84.1	89.2	86.0315	Excellent	Acceptable; Ongoing Protection is Required
CM-8	Upper Bucks Creek	34.4	31.4	34	35.9	29.1	32.94618	Poor	Unacceptable; Immediate Restoration is Required
CM-10	Taylors Pond	23.5	36	30.4	49.0	49.0	37.57957	Fair	Unacceptable; Immediate Restoration is Required
CM-12	Lower Cockle Cove Creek	20	20.8	23.2	21.9	23.0	21.77589	Poor	Unacceptable; Immediate Restoration is Required
CM-13	Outer Ryder's Cove	38.9	59.1	72.5	63.5	76.7	62.14741	Fair	Unacceptable; Immediate Restoration is Required
PBA-1	Chatham Harbor	84.7	66.3	76.8	87.2	80.5	79.09958	Excellent	Acceptable; Ongoing Protection is Required
PBA-3	Inner Ryder's Cove	49.6	64.4	54.3	45.6	63.1	55.39194	Fair	Unacceptable; Immediate Restoration is Required
PBA-4	Crows Pond	64.4	71.2	60.7	61.5	85.4	68.63389	Excellent	Acceptable; Ongoing Protection is Required
PBA-5	Muddy Creek	28.4	53	40.4	31.8	64.1	43.54357	Fair	Unacceptable; Immediate Restoration is Required
PBA-5A	Muddy Creek - Upper	6.8	9	28.6	10.0	46.8	20.24605	Poor	Unacceptable; Immediate Restoration is Required
					Total Average =		57.48307	Fair	Unacceptable; Immediate Restoration is Required