WELLFLEET POND MANAGEMENT PLAN – 2024

NATURAL RESOURCES ADVISORY BOARD

Town of Wellfleet, MA

By:
NRAB, Pond Committee
Herb Gstalder
Laura Hewitt

NRAB
John Duane
Jake Puffer
Tom Slack

August 2024

DRAFT

INTRODUCTION

Many of Wellfleet's ponds are the last "pristine" ponds on Cape Cod. As the last of their kind, if they deteriorate, clear, pristine ponds will be lost forever on the outer Cape. Their location entirely in the Cape Cod National Seashore (CCNS) has protected them as nowhere else on the Cape. The eight great ponds are an asset of incalculable value to Wellfleet. However, their value and uniqueness leave Wellfleet with a stewardship responsibility to its citizens and the entire population of Cape Cod.

Consequently, this document is not an update to the 2011 Pond Management Plan - it is an entirely different approach.

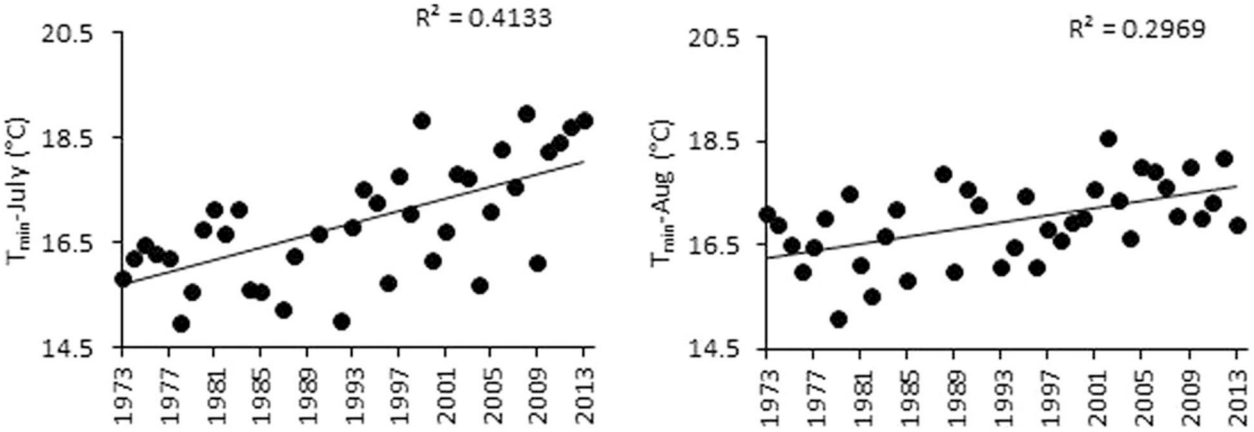
PRISTINE POND

Figure 1: Gull Pond Aerial Photo (June 2024)

Figure 2: Williams Pond Aerial Photo (June 2024)

While many of the Wellfleet ponds are currently “pristine”, the ponds are threatened by the impact of an unprecedented rise in air temperature (and resultant water temperature) of recent decades. Both the absolute rise in temperature with global warming and the pattern of the higher heat are dangers to the ponds. Warmer nights disrupt the historical daily cycle of cooling and warmer Falls disrupt the annual cooling cycles.

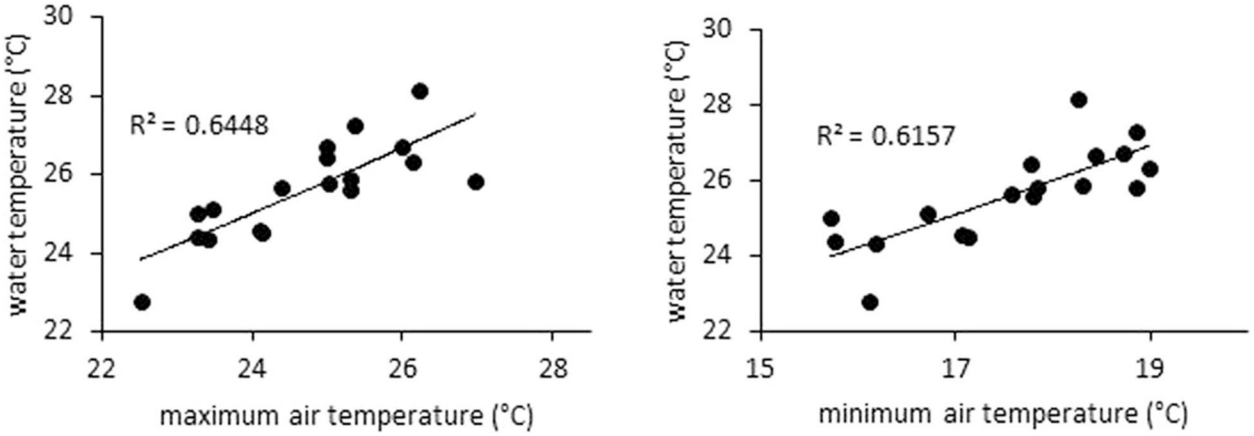
On the next page, we show combined data for Duck, Dyer, Great (in Wellfleet and in Truro), Gull, Herring, Long, Ryder, Snow and Spectacle Ponds from 1973 to 2014. Climate change is not a new phenomenon, however the increase in temperature changes has accelerated in the last couple decades. Our purpose in providing this context is to acknowledge the increasing impact of rising temperatures and determine what the town can do to minimize the change to the pond health from other elements which are exacerbated from rising temperatures.



MINIMUM DAILY TEMPERATURE TRENDS IN JULY & AUGUST

(Page 4 of 11 Water Air Soil Pollut (2016) 227:237)

And below are mean pond surface water temperatures (all ponds) plotted against mean annual daily maximum and minimum air temperature for the month of July 1996–2013



The warmer temperature coincides with an increased use of the ponds. Houses along the shores have grown from cottages to large houses that are occupied for longer times in the year, feeding the ponds with nutrients from septic systems and fertilizer. The popularity of the ponds brings more visitors. Finally, even the generally beneficial elimination of acid rain following the Clean Air Acts has a dark side for the ponds. The ponds have become 10 to 20 times more alkaline over the past few decades making them more hospitable to plant growth.

Natural progression of all freshwater ponds is from pristine condition to grass field over time, scientifically described as *Eutrophication*. Some of Wellfleet's ponds are already advanced in this process. However, the timing of progression is directly determined by environment and available nutrients – warm weather and added nutrients speed up the eutrophication process dramatically.

There is a misconception that if we don't change anything, everything will stay as it was. Mankind is not in complete control of the process, but our actions can exacerbate or mitigate eutrophication of our ponds. The impact of the temperature shifts is not isolated, impacting the pond water quality in many ways.

- Surface water temperature
- Shift in thermal ranges (harder for stratified layers and oxygen to mix)
  - Lower ice duration
  - Increased stratification
  - Reduced oxygen
- Longer growing season (increase in algae and other plant life)
- Increase in cyanobacteria blooms
- Stress on wildlife and ecosystems
  - Fish kills

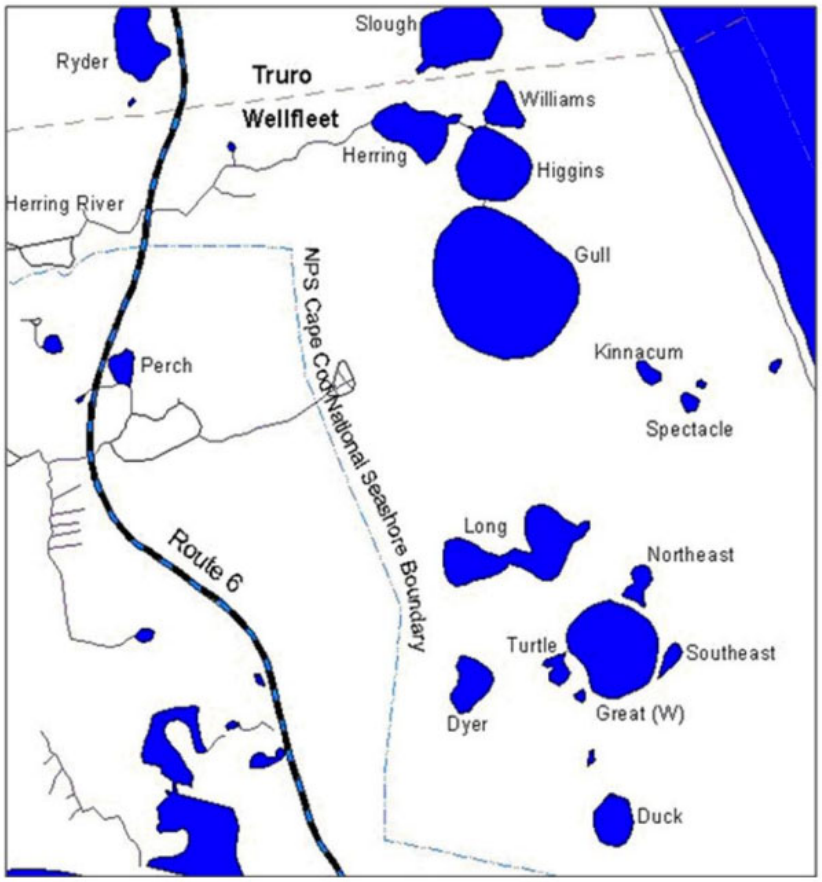
Wellfleet must begin immediately to actively manage the protection of its Crown Jewels — its Great Ponds.

Over the past few decades there has been exponential change in the health indicators of Wellfleet's ponds. As noted earlier, the unprecedented rise in water and air temperature, coupled with human usage, is a threat to the short- and long-term health of our ponds. Like other Cape towns, it is important for the town of Wellfleet to actively manage our ponds to ensure their survival.

GOAL OF THE PLAN

Maintain the natural health of the eight Great Ponds of Wellfleet (with shoreline owned by the Town of Wellfleet and/or Wellfleet taxpayers) for the next 10 years without acceleration of the natural eutrophication process.

The eight Great Ponds of Wellfleet include: Gull, Long, Great, Duck, Higgins, Herring, Williams, Dyer. Although the ponds are envisioned as fully within the CCNS, **all defined access points to the ponds are from Town Beaches or private property under jurisdiction of/regulated by the town of Wellfleet** except for the "pocket park" at Long Pond. [Spectacle Pond is not classified as a great pond and oversight is by CCNS.]



BASIS OF THE PLAN

Coordination of existing and new activities in a newly created Pond Management office staffed by a full or half-time Pond Coordinator position.

NRAB will periodically evaluate and update the plan in its 10-year duration.

ELEMENTS OF THE PLAN

A. **DEVELOP AND MAINTAIN A DATABASE OF POND CONDITIONS** (in conjunction with CCNS)

Each pond is different. "If you know one pond, you know one pond". Size, depth, location in watershed, and adjacent development make each pond unique; however, there are common trends.

- The NRAB has created an initial database for the Wellfleet Ponds and populated it with CCNS data currently available in the Spring of 2024. The Ponds Database is attached and is part of the plan. The ability to make fact-based decisions is crucial to administration of a plan. Natural events and scientific advancements will require pond management decisions that may be different for each pond. It will be imperative to know *and understand* the trends and current state of each pond.

- Extract annual data for Wellfleet ponds from Cape Cod National Seashore (CCNS) monitoring program and maintain the database for the following indicators: pH, Nitrogen, Phosphorus, Water and Air Temperature, Clarity, Dissolved oxygen, Chlorophyll. (NRAB is working to expand an initial database and has monitoring output from 2010, 2011, 2021 and 2022.)
  ** Responsibility: Pond Coordinator

- Add CCNS historical data when released by CCNS to indicate or identify emerging trends. Manager responsibility to liaise with analysts to understand the significance of changes in the indicators (pH, N, P, etc.). Such analysis to not only identify emerging trends in the data but help determine potential action required.
  ** Responsibility: Pond Coordinator

- Add Cape Cod Commission/Fresh Water Initiative data for Wellfleet Ponds. Monitor for other future sources of data and add to data base.
  ** Responsibility: Pond Coordinator

- Commit to collecting *and analyzing* pond data each year. If CCNS is not able to monitor ponds in any year, Wellfleet should contract with CCNS for monitoring of ponds three times a year: Spring, Summer, Fall, following established CCNS protocol at estimated cost of $60,000 to $75,000, or contract with another laboratory. (Cost estimate based on 2023 figures)
  ** Responsibility: Selectboard / Pond Coordinator oversight

- Create and maintain a data base of Cyanobacteria concentrations in the ponds from monitoring programs of the CCNS, Association to Preserve Cape Cod (APCC) and other agencies.
  ** Responsibility: Pond Coordinator

- Manage water sample collection for APCC Cyanobacteria monitoring program every other week from May to November. Continue to use citizen volunteers as possible.
  ** Responsibility: Pond Coordinator

- Create and maintain a database of Coliform Bacteria levels in ponds from Wellfleet
  ** Responsibility: Health Agent monitoring

- Review impact of Herring River restoration on change in flow from ponds, groundwater flow to ponds, and tested water elements.
  **Responsibility: Pond Coordinator

- Consider shared watershed data review, analysis, and management with Truro, as Truro ponds share Wellfleet ponds underlying aquifer system.
  **Responsibility: Selectboard and Pond Coordinator

B. MINIMIZE GROUND FLOW OF PHOSPHORUS AND NITROGEN INTO PONDS

Scientific consensus now is that Phosphorus and Nitrogen are co-limiting nutrients in freshwater ponds. If one is missing or minimal, the other will be the dominant nutrient. Ground water flow into the ponds is the dominant source of these nutrients. Rising water temperature accelerates the effect of nutrients on the growth of algae and other plants in the ponds. Wellfleet needs to minimize the introduction of Phosphorus and Nitrogen into the groundwater. There are means to do this:

- Condemn all cesspools in pond watersheds. Cesspools do not treat or disperse household wastewater. Leaks and overflows go directly to groundwater.
  ** Responsibility: Health Agent

- Monitor development of septic systems, working closely with the Mass Alternative Septic System Test Center. Title V septic systems do not remove Nitrogen or Phosphorus from wastewater, but they do distribute to septic fields with some absorption from plants and some evaporation,
  ** Responsibility: Pond Coordinator & Health Agent

- Mandate or encourage use of tax rebates or loan upgrades to IA septic systems in pond watershed areas when IA systems that remove both Nitrogen and Phosphates are available. Currently septic systems are available to remove Nitrogen. As soon as systems are available that also remove Phosphorus, they should be used in pond watersheds. [Educate citizens on what grants and state funding are available.]
  ** Responsibility: Selectboard

- Ban use of fertilizer on private and town property within 300 feet of ponds. Ask for citizen pledges.
  ** Responsibility: Selectboard

- Pond health and water quality are linked to freshwater watershed overall and are indicators for healthy drinking water. Coordinate freshwater strategy with all town agencies involved with Wellfleet water issues.
  **Responsibility: Selectboard, Health Agent, Pond Coordinator, Wastewater

C. CONTROL POND USAGE AND PROTECT BANKS

- Permit no commercial activity in or on Wellfleet property adjacent to ponds
  ** Responsibility: Selectboard

- Evaluate whether/how to restrict limits of public access in environmentally sensitive areas beyond the defined access areas of Town Public Beaches and landings
  ** Responsibility: Beach Administrator / Pond Coordinator

- Enforce Wellfleet parking permits for all posted seasonal hours
  ** Responsibility: Beach Administrator

- Enforce parking regulations on town roads adjacent to ponds
  ** Responsibility: Wellfleet Police Department

- Prohibit storage of watercraft on pond banks
  ** Responsibility: Selectboard

- Coordination of increased educational efforts to visitors and citizens regarding careful usage of ponds, related wildlife, shores and banks.
  ** Responsibility: Pond Coordinator

D. CONTROL INVASIVE PLANT SPECIES

- Remove Phragmites and Purple Loosestrife from all town property adjacent to ponds and mandate removal of Phragmites and Purple Loosestrife from all private property adjacent to ponds.
  ** Responsibility: Selectboard oversight, Pond Coordinator

- In cooperation with CCNS staff, remove or kill Phragmites growing in pond waters.
  ** Responsibility: Pond Coordinator

E. **ESTABLISH AND MAINTAIN CLOSE CONTACT WITH CCNS, AND CAPE COD (Barnstable County), COMMONWEALTH, AND FEDERAL AGENCIES CONCERNED WITH CAPE COD FRESH WATER PONDS**.

List includes but is not limited to CCNS, APCC, Cape Cod Commission, Center for Coastal Studies, Cape Cod Commission Fresh Water Initiative, MASSTC (Mass Alternative Septic System Test Center), Mass DEP, Cape Cod National Seashore Homeowners Association, Wellfleet Seasonal Residents Association, Gull Pond Area Conservation Association (GUPACA)

- Establish/Maintain strong communication line with CCNS
  ** Responsibility: Pond Coordinator and Beach Administrator

- Represent Wellfleet in pond association meetings and studies with other Cape towns and Freshwater efforts (Freshwater Initiative, other town Pond Coalitions)
  ** Responsibility: Pond Coordinator

- Monitor opportunities for grants and manage applications for appropriate grants.
  ** Responsibility: Pond Coordinator

F. **PLAN FOR PERIODIC POND CLOSURES**

Increasing occurrences of Cyanobacteria blooms in all Cape ponds will inevitably cause seven-to-ten-day closures of ponds. Cyanobacteria growth is believed to be linked more to warming water than to increased nutrients, making it even more difficult to control or predict. Prepare public information and increase use of other ponds.
** Responsibility: Beach Administrator with Health Agent and Pond Coordinator

G. **HIRE POND COORDINATOR**

Full time position or Half-time position. Position reports to Town Administrator, Health Agent or Beach Administrator. Review for effectiveness of position after 24 months.

Selectboard to prepare, sponsor, and support an Article for Pond Coordinator position in Fall Town Meeting.

CARING FOR WELLFLEET PONDS

Pond Management	Stakeholders						
Challenges:	Select board	Health Agent	Beach Administrator	Pond Coordinator	CCNS	Wellfleet Pond Coalition/Volunteers	Other
General Management							
Water Testing					Current responsibility		
**Cyanobacteria	volunteer network helpful but need to establish formal network	oversight/closures	volunteer network helpful but need to establish formal network	volunteer network helpful but need to establish formal network	closures with Health Agent	volunteers currently collect samples	APCC lab work
**Panel of elements including N, P, clarity, temp; 3 x annually	Need to engage with CCNS				currently performed by CCNS 3 x per year		
Management of data collected & maintain library of documents and Pond studies	What are trends saying and what can town do to mitigate eutrophication speed up?	What are trends saying and what can town do to mitigate eutrophication speed up?	What are trends saying and what can town do to mitigate eutrophication speed up?	What are trends saying and what can town do to mitigate eutrophication speed up?	currently performed by CCNS		
Analysis of data and implications				Oversight of lab work and analysis			
**specific pond actions							
Cyanobacteria will increasingly require closures. Prepare public information and increase use of other ponds.		Oversight with Pond Admin	Oversight		Oversight with Health Agent and Pond Admin		
Nutrient Loading & Chemical Pollutants							
Septic Systems	Provide incentives to upgrade to AI/most efficient as improvements to remove both N and P	Monitor existing					
Remaining Cesspools	Provide financial assistance or tax incentives to upgrade	Condemn, especially in pond watershed areas					
Fertilizers	Ban use of fertilizer on private and town property within 300 feet of ponds	Ban use of fertilizer on private and town property within 300 feet of ponds					
Waste management at ponds		Health Agent	Beach Admin	Pond Coordinator			
Protecting Shoreline and Banks							
Planting and beach landing access			Beach Admin	Pond Coordinator	CCNS plantings and coordination		
Evaluate whether/how to restrict limits of public access in environmentally sensitive areas beyond the defined access areas of Town Public Beaches and landings			Oversight of environmentally sensitive areas and defined access	Oversight of environmentally sensitive areas and defined access			
Permit no commercial activity in or on Wellfleet property adjacent to ponds	Selectboard						
Enforce Wellfleet parking permits for all posted seasonal hours			Beach Admin with police				
Enforce parking regulations on town roads adjacent to ponds			Beach Admin with police				
Prohibit storage of water craft on pond banks	Selectboard		Beach Admin				
Protection against invasive species					CCNS in conjunction with town		
Mandate removal of Phragmites and Purple Loosestrife from all private property adjacent to ponds	Selectboard						
Monitor Phragmites and Purple Loosestrife growth on Wellfleet owned lands adjacent to ponds and growing in pond waters. In cooperation with CCNS staff, remove or kill plants				oversight	Cooperation between CCNS and town		
Advocacy & Coordination with other agencies/entities							
Pond health and water quality are linked to freshwater watershed overall and are indicators for healthy drinking water. Coordinate freshwater strategy with all town agencies involved with Wellfleet water issues.	Select board	Health Agent		Pond Coordinator oversight			Wastewater, Board of Water Commissioners
Coordination of increased educational efforts to visitors and citizens regarding careful usage of ponds, related wildlife, shores and banks.				Pond Coordinator			
Represent Wellfleet in pond association meetings and studies with other Cape towns and Freshwater efforts (Freshwater Initiative, other town Pond Coalitions)				Pond Coordinator			

Pond Statistics: Gull Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975						3.02-10.3	1.50-7.6	0.61		1 and 3
1976								0.52		1
1977										1
1978										1
1979										1
1980	2.8-25	.8-132.3	0.1-12.4							1
1981										1
1982								0.27		1
1983				6.4-6.68	2.5-3.2					1
1984				6.52-6.65	2.9-3.1					1
1985				6.73	3					1
1986				6.65-7.16	3.0-3.5					1
1987				6.55-7.22	3.3-3.8					1
1988				6.32-6.8	2.9-3.7					1
1989				6.36-6.7	2.8-3.4					1
1900				6.57-6.76	2.2-3.2					1
1991				6.51-6.77	3.1-4.1					1
1992				6.52-6.9	2.9-3.8					1
1993				6.52-6.74	3.5-3.6					1
1994				6.46-6.7	3.3-3.8					1
1995				6.71-7.4	3.25-3.6					1
1996				6.52-6.95	3.25					1
1997				6.4-6.79	1.25-2.75					1
1998				6.75-6.92	3.25-3.5					1
1999				6.48-7.07	3.75-4					1
2000				6.59-6.83	3.75-4.9					1
2001				6.63-6.82	3.5-3.75					1
2002				6.77	3.45-3.6					1
2003				6.79-6.92	3.45-3.85					1
2004				6.78-7.05	3.6-4.05					1
2005								0.2-0.2	16.2-20.2	1
2006				5.86-6.71	2.1-4.65			0.2-0.3	15.3-24.0	1
2007								0.2-0.3	14.6-23.5	
2008										
2009										
2010	7.4-27.4	94.1-11.9	8.2-12.3	6.6-7.7	5.2-6.2	3.4-7.6	1.8-16.1			
2011	8.6-26.2	99.7-106.1	8.1-11.9	6.4-8.0	5.8-14.4	3.4-9.2	1.1-15.9			
2012										
2013								0.2-0.6	9.6-42.6	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	5.1-26-2	85.4-106.4	8.2-13.4	7.0-8.1	5.3-5.9	4.0-8.8	0.5-4.4	.25-.34	18.85-23.8	
2022	5.5-27.7	97.8-105.5	7.8-13.3	7.0-7.7	5.7-6.0	4.3-7.9	1.1-4.5	.18-.29	18.1-23.3	2

Sources

1 Gull Pond Data for GUPACA 102607

2 CCNS 11/22 data

3 Kettle Pond Data Atlas

Pond Statistics: Duck Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975										1 and 3
1976-2004										1
2005								0-0	5.9-6.2	1
2006								0.3-0.4	46.4-46.4	1
2007									3-8-6.7	
2008										
2009										
2010	10.7-28.4	91.6-106.4	8.0-11.4	4.9-5.6	0.4-0.6	3.8-8.5	2.1-4.5			
2011	10.9-27.3	88.9-106.3	8.2-11.1	5.0-6.7	0.0-0.4	4.1-13.9	1.1-6.4			
2012										
2013								0.2-0.3	0-37.5	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	8.6-27.4	100.2-106.2	8.3-12.4	5.9-7.3	.4-.6	5.0-13.9	.4-2.7	.28-.31	7.28-13.7	
2022	6.8-28.2	96.0-105.4	7.9-12.6	6.0-6.9	.5-.8	5.1-12	.5-2.8	.18-.18	9.50-13.4	2

Sources

1 Gull Pond Data for GUPACA 102607
2 CCNS 11/22 data
3 Kettle Pond Data Atlas

Pond Statistics: Great Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975										1 and 3
1976-2004										1
2005								0-0.2	6.3-7.2	1
2006									4.4-7.2	1
2007									3.8-6.3	
2008										
2009										
2010	10.6-27.8	94.1-104.2	7.9-11.6	5.0-6.0	0.0-0.3	5.6-12.5	1.2-4.0			
2011	7.7-26.1	94.6-101.0	7.9-11.9	5.0-6.5	0.1-0.8	4.4-11.4	1.6-6.0			
2012										
2013								0.1-0.2	0-42.2	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	5.8-28.0	95.5-104.9	8.0-13.1	5.9-7.1	0.6-.09	6.0-12.6	0.2-1.5	.16-.19	11.8-14.05	
2022	5.8-28.2	95-6-103.2	7.8-12.9	6.1-7.0	0.7-1.0	5.2-10.4	0.4-1.9	.16-.26	13.2-13.7	2

Sources

1 Gull Pond Data for GUPACA 102607
2 CCNS 11/22 data
3 Kettle Pond Data Atlas

Pond Statistics: Dyer Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975										1 and 3
1976-2004										1
2005								0.1-0.1	6.6-9.6	1
2006									6.0-15.4	1
2007									7.5-8.9	
2008										
2009										
2010	10.8-28.7	89.5-104.8	7.8-11.1	5.1-6.1	0.0-0.4	4.6-8.2	1.8-16.4			
2011	11.1-27.4	89.4-100.7	7.6-11.1	5.1-7.2	0.2-0.8	4.2-10.0	1.0-6.4			
2012										
2013								0.1-0.5	0.1-33.5	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	8.7-28.4	97.7-104.9	8.0-12.6	5.7-6.4	0.2-0.4	4.8-9.9	0.4-2.0	.14-.20	9.87-17.4	
2022	6.0-28.4	91.2-105.3	8.1-12.8	5.8-6.4	0.4-0.5	5.0-9.5	0.4-1.8	.14-.18	10.05-12.05	2

Sources

1 Gull Pond Data for GUPACA 102607
2 CCNS 11/22 data
3 Kettle Pond Data Atlas

Pond Statistics: Long Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975										1 and 3
1976-2004										1
2005								0.1-0.1	7.4-7.8	1
2006								0.2-0.2	10.8-17.2	1
2007									3.5-8.2	
2008										
2009										
2010	10.3-28.1	91.6-107.1	7.6-11.3	4.7-5.0	0.2-0.7	4.8-9.6	1.4-4.8			
2011	10.8-26.7	93.0-100.8	7.5-11.1	4.6-6.7	0.2-0.8	7.9-11.4	1.3-7.4			
2012										
2013								0.1-0.2	0.7-48.9	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	8.1-27.8	96.4-102.2	8.0-13.3	5.5-6.5	0.3-0.4	2.8-9.7	0.6-8.3	.12-.16	12.95-15.45	
2022	6.4-27.9	90.1-104.6	7.7-12.9	5.6-6.4	0.1-0.3	5.7-15.7	0.5-2.1	.18-.19	11.9-14.2	2

Sources

1 Gull Pond Data for GUPACA 102607
2 CCNS 11/22 data
3 Kettle Pond Data Atlas

Pond Statistics: Higgins Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975										1 and 3
1976-2004										1
2005								0.1-0.1	14.0-17.1	1
2006								0.2-0.3	17.0-18.6	1
2007								0.2-0.3	11.7-19.7	
2008										
2009										
2010	9.9-26.3	97.7-104.8	8.4-11.2	6.3-7.1	6.2-7.2	3.3-6.1	3.1-10.5			
2011	10.0-25.2	98.0-100.9	8.3-11.1	6.8-7.4	5-8-8.2	3.7-6.4	2.0-5.5			
2012										
2013								0.2-0.4	9.1-42.5	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	7.1-26.7	101.7-104.2	8.2-12.6	*******(4)	7.0-8-6	5.0-5.8	1.3-1.3	.22-.27	18.15-19	(5) Sechi
2022	7.3-24.9	97.2-104.7	8.0-12.6	*******(4)	6.3-10.1	3.0-5.6	1.2-5.5	.17-.39	16.45-20.5	2, (5) Sechi

Sources

1 Gull Pond Data for GUPACA 102607
2 CCNS 11/22 data
3 Kettle Pond Data Atlas
4 no measurements taken this year
5 Mean readings only

Pond Statistics: Williams Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975										1 and 3
1976-2004										1
2005								0.5-0.5	29.6-31.3	1
2006								0.4-0.7	19.1-30.1	1
2007								0.4-0.6	21.2-31.4	
2008										
2009										
2010	9.9-25.9	81.6-94.5	7.1-10.7	6.2-6.7	4.8-8.6	1.5-1.8	6.2-16.7			
2011	8.4-24.9	87.1-130.4	8.6-10.3	6.6-7.4	4.5-12.7	1.3-1.7	4.0-10.3			
2012										
2013								0.3-1.0	23.7-49.4	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	9.7-26.1	81.1-105.4	3.4-11.8	****(4)	7.3-9.0	1.1-1.6	1.4-4.5	.25-.55	21.2-33.0	(5) Sechi, Chlorophyl
2022	9.3-24.3	82.3-97.2	0.6-12.0	****(4)	5.5-9.8	1.5-1.8	2.0-14.0	.31-92	23.25-39.4	2, (5) Sechi, Chlorophyl

Sources

1 Gull Pond Data for GUPACA 102607
2 CCNS 11/22 data
3 Kettle Pond Data Atlas
4 ****no measurements taken this year
5 Mean readings only

Pond Statistics: Herring Pond

YEAR	Temperature Range	DO (%) Range	DO (PPM) Range	pH Range	Alkalinity Range	Sechi Depth Range	Chlorophyl Range	TP Range	TN Range	Source
1975										1 and 3
1976-2004										1
2005								0.4-1.1	18.0-28.5	1
2006								0.3-0.7	18.3-21.5	1
2007								0.6-1.2	13.6-29.4	
2008										
2009										
2010	8.6-28.1	80.8-117.2	7.2-11.2	6.5-7.1	2.5-9.0	1.7-4.4	4.2-22.9			
2011	11.0-26.6	93.6-108.4	7.7-10.8	6.3-7.6	7.1-11.6	1.6-4.6	2.0-28.6			
2012										
2013								0.7-1.2	14.7-61.2	
2014										
2015										
2016										
2017										
2018										
2019										
2020										
2021	8.7-26.7	84.3-117.3	7.2-12.5	7.4-8.8	7.1-9.1	1.7-4.6	2.0-11.8	.33-.83	21.55-39.10	
2022	8.8-28.6	77.2-`08.3	6.5-11.7	7.3-7.3	6.2-9.7	1.5-3.3	2.1-11.0	.28-.59	17.3-28.45	2

Sources

1 Gull Pond Data for GUPACA 102607
2 CCNS 11/22 data
3 Kettle Pond Data Atlas

CONTACTS FOR WELLFLEET POND MANAGEMENT PLAN

ORGANIZATION / ADDRESS / WEBSITE	Contact Name	Title
Association to Preserve Cape Cod (APCC) 482 Main Street, Dennis, MA 02638 www.apcc.org	Jo Ann Muramoto, Ph.D.	Director of Science Programs / MassBays Regional Coordinator
	Andrew Gottlieb	Executive Director
	Julie Hambrook	Project Director, Pond and Cyanobacteria Monitoring Programs
Brewster Pond Coalition	Marty Burke	(Board Member, citizen scientist)
Brewster Town Manager	Peter Lombardi	Town Manager
Cape Cod Commission - Freshwater Initiative	Tim Pasakarnis & colleagues	
Cape Cod Commission/Cape Pond Network	Tim Pasakarnis / Erin Perry	Water Resource Analyst (Pasakarnis)/Deputy Director (Perry)
Cape Cod National Seashore (CCNS) 99 Marconi Site Road Wellfleet, MA 02667	Sophia E. Fox Ph.D.	Aquatic Ecologist
	Lauren McKean	Park Planner
	Stephen Smith	Plant Ecologist
Center for Coastal Studies	Amy Costa	Director
Falmouth Pond Coalition	Kim Comart	
Mass Alternative Septic System Test Center (MASSTC) 3195 Main Street; PO Box 42 Barnstable, MA02630	Brian Baumgaertel, B.A., R.S.	Director, Science Environmental Specialist
	Sara Wigginton, PhD	Program Manager + Wastewater Division Deputy Manager
	Bryan Horsley, B.A.	Project Assistant
	George Heufelder, M.S.	Project Specialist
National Park Service, U.S. Department of Interior Region 1	Casey Reese	Biologist/Regional IPM Cocoridator
	Emily Booth	Natural Resources Specialist/IPMT Liaison
Orleans Pond Coalition	Judith Bruce	
Town of Eastham	Jane Crowley	Director of Health and Environment
Town of Harwich	Carole Ridley	Conservation Trust
Town of Wellfleet	Suzanne Thomas	Director of Community Services - Wellfleet Ponds
	Hillary Greenber-Lemos	Health Agent (past)
	Heith Martinez	Health Agent (current)

NRAB July 2024

WELLFLEET POND MANAGEMENT PLAN RESOURCE MATERIAL

PUBLICATIONS

1. Water Quality Monitoring and Research Plans for Kettle Ponds. Cape Cod National Seashore. Report of a Workshop, March 2-3, 1992. Larry Martin, John Portnoy and Charles Roman. Technical Report NPS/NRWRD/NRTR-93/15

2. Hydrobiologia (2006) 571:201–211 Ó Springer 2006 DOI 10.1007/s10750-006-0239-4. Primary Research Paper. Responses of periphyton to artificial nutrient enrichment in freshwater kettle ponds of Cape Cod National Seashore. Stephen M. Smith* & Krista D. Lee.

3. Nitrogen-stimulated growth of algae in surface-water samples collected from freshwater kettle ponds of Cape Cod National Seashore (Massachusetts, USA). S.M. Smith* and K.D. Lee. Journal of Freshwater Ecology. Vol. 27, No. 1, March 2012, 151–157.

4. Changes in Air Temperature and Precipitation Chemistry Linked to Water Temperature and Acidity Trends in Freshwater Lakes of Cape Cod National Seashore (Massachusetts, USA) Stephen M. Smith, Sophia E. Fox & Krista D. Lee. Water, Air, & Soil Pollution. An International Journal of Environmental Pollution. ISSN 0049-6979 Volume 227 Number 7.

5. Changes in the thermal structure of freshwater lakes within Cape Cod National Seashore (Massachusetts, USA) from 1996 to 2014. Stephen M. Smith, Sophia E. Fox, Holly K. Plaisted, K. Medeiros & Krista D. Lee. Inland Waters. ISSN: 2044-2041 (Print) 2044-205X (Online) Journal homepage: http://www.tandfonline.com/loi/tinw20.

6. Secchi depths in lakes of Cape Cod National Seashore from 1996–2016 and relationships with morphometry, water chemistry, and housing densities. Stephen M. Smith, Sophia E. Fox, Krista D. Lee, Kelly Medeiros & Holly C. Plaisted. Lake and Reservoir Management. ISSN: 1040-2381 (Print) 2151-5530 (Online) Journal homepage: http://www.tandfonline.com/loi/ulrm20.

7. Indicators of Ecological Stress and Their Extent in the Population of Northeastern Lakes: A Regional-Scale Assessment. THOMAS R. WHITTIER, STEVEN G. PAULSEN, DAVID P. LARSEN, SPENCER A. PETERSON, ALAN T. HERLIHY, AND PHILIP R. KAUFMANN . *March 2002 / Vol. 52 No. 3* • BioScience

8. Aquatic Vegetation and Trophic Conditions of Cape Cod (Massachusetts, U.S.A) Kettle Ponds. Charles T. Roman, Nels E. Barrett and John Portnoy. Hydrobiologia 443 2001. Note: also have pre-publication draft

9. Kettle Pond Data Atlas. Paleoecology and Modern Water Quality. Cape Cod National Seashore. J.W. Portnoy, M.G. Winkler, P.R. Sanford, C.N. Farris. April, 2001

10. The Massachusetts Lake and Pond Guide. Michelle Robinson. Massachusetts Department of Conservation and Recreation Lakes and Ponds Program. 2004

11. Evaluation of Methods to Control Phosphorus in Areas Served by Onsite Septic Systems. A special issue of Environment Cape Cod. George Heufelder and Keith Mroczka. June 2006

12. Aluminum treatments to control internal phosphorus loading in lakes on Cape Cod, Massachusetts. Kenneth J. Wagner[a], Dominic Meringolo[b], David F. Mitchell[c], Elizabeth Moran[d], and Spence Smith[e] LAKE AND RESERVOIR MANAGEMENT

13. Nutrient Limitation of Periphyton and Phytoplankton in Cape Cod Coastal Plain Ponds. Authors: Kniffin, Maribeth, Neill, Christopher, McHorney, Richard, and Gregory, George. Source: Northeastern Naturalist, 16(3) : 395-408 Published By: Eagle Hill Institute, URL: https://doi.org/10.1656/045.016.n307. 2009

UNPUBLISHED REPORTS

1. Protocol for a Shoreline Survey of Septic Leachate at Gull Pond, Wellfleet, September, 1991. John Portnoy.

2. Short graph reports for Temperature, Sechi depth and Acid Rain for Gull Pond, 1991-1992.

3. Groundwater Withdrawal from Municipal Wellfields: Ecological Effects on Aquatic Resources of Cape Cod National Seashore. Charles Roman, John Portnoy, Thomas Cambareri and Robert Sobczak, June 1, 1995

4. Cultural Impacts on Pond Water Quality. Project Statement 8.1. Develop a Kettle Pond Recreational Management Plan; and Project Statement 8.2. Managing the Gull Pond Sluiceway. 1998

5. Adaptive Management Strategies for the Kettle Holes. 1998

6. Seasonal and Climatic Influences of the Hydrology for the Gull-Higgins Kettle Pond Complex, Wellfleet, MA. Cape Cod National Seashore, 1998.

7. A Management Plan for Gull Pond. Suzanne Grout Thomas. 2005 (?)

8. Responses of Periphyton to Artificial Enrichment in Freshwater Kettle Ponds of Cape Cod National Seashore. Stephen Smith and Krista D. Lee. 2006 (?).

9. Report on the Status of Gull Pond. Prepared for the Board of Selectmen, Town of Wellfleet. Gull Pond Area Conservation Association. 2008

10. Spatial and Temporal Patterns of Plant Growth in Gull Pond. Report prepared by Stephen Smith, Cape Cod National Seashore, for the Gull Pond Area Conservation Association. 2009 (?).

11. Enterococci Counts that Cause Gull and Higgins Reach Closings. Hillary Greenberg, July 26, 2011

12. CCNS Sophia Fox. Pond Resource Plan. 2021

13. Town of Orleans. Article 32. Authorize Special Act to Prohibit the Application of Fertilizer. Fertilizer Home Rule Petition. Warrant Article 32, Final Draft 9/9/22

14. Town of Wellfleet Septic Regulations. Wellfleet Board of Health Regulations. Draft April 2022.

15. Study Plan. Kettle Ponds Macrophytes at Cape Cod National Seashore: Species Composition and Biomass Assessment. Charles T. Roman and John Portnoy. January 12, 1995.

16. Revised Draft General Management Plan. Cape Cod National Seashore. May, 1997

17. A Ponds Management Plan. Wellfleet Natural Resources Advisory Board. February, 2011

18. Pond Condition Progress Report and Work Plan 2015. Cape Cod National Seashore. Lauren Markram.

19. Pond Condition Progress Report and Work Plan 2016-2017. Cape Cod National Seashore. Victoria Babcock.

US GOVERNMENT DOCUMENTS CONCERNING CAPE COD NATIONAL SEASHORE.

1. Superintendent's Compendium-Cape Cod National Seashore (U. S. National Park Service} (nps.gov).
   Code of Federal Regulation Title 36 Chapter 1, Parts 1 through 7. Statement of CCNS Superintendent's authority.

CORRESPONDENCE FILES

Richard Langerman with the Cape Cod National Seashore and United States Department of the Interior regarding the legal status of the private roads on the east side of Gull Pond, Aunt Sally's Landing on Gull Pond, and the east side of the Sluice between Gull and Higgins ponds. 1988-1995

File of Various letters and email from Wellfleet residents to the NRAB, collected by John Riehl.