

Nauset Marsh South/Mill Pond

Orleans, MA

2001-2023 Water Quality Summary

2023 WATER QUALITY STATUS

ESTUARY SETTING

Nauset Marsh is a complex, 1,500 acre, estuary shared by Orleans and Eastham and includes a number of terminal basins, including Mill Pond and Woods Cove (and Town Cove and Salt Pond, each addressed separately). The system inlet to the Atlantic Ocean is dynamic, regularly moving along a barrier beach managed by Cape Cod National Seashore. The 2012 Nauset Marsh Massachusetts Estuaries Project (MEP) ecosystem assessment noted that the main portion of the marsh had healthy conditions, but the terminal basins were all significantly impaired including high loss of eelgrass, regular low dissolved oxygen (DO), and degraded sediment habitats. MEP staff concluded that total nitrogen (TN) concentrations in Town Cove (*i.e.*, sentinel station WMO-27) should be limited to 0.45 mg/L in order to restore ecological health throughout the system.



WATER COLUMN SAMPLING HISTORY

Nauset Marsh water column sampling began in 2001 at 16 stations for the MEP assessment, but was generally reduced to three key stations in 2005-2015, including Mill Pond (WMO-34). Sampling at most of the original MEP sites was started again beginning in 2016. Sampling

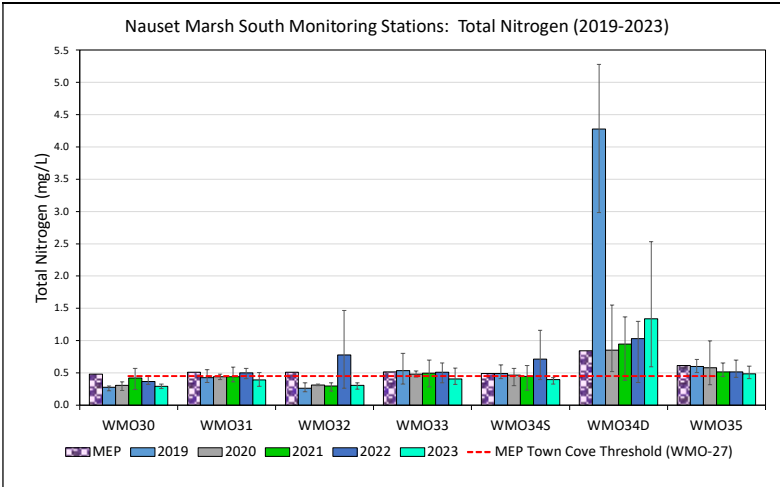
results from 2001-2004 were used in the MEP assessment, which was a refined ecosystem assessment including review of sediment habitat and species, macroalgal accumulation and continuous dissolved oxygen (DO) and tidal measurements. Recent summer sampling occurs 4-5 times each year. Sampling includes DO and temperature readings and lab assays for chlorophyll-a (CHL), ortho-phosphorus, and particulate and dissolved species of nitrogen.

Most of Nauset Marsh South has acceptable water quality conditions, except for Mill Pond and Woods Cove, which were impaired during the MEP and continue to be impaired in recent 2019-2023 samplings. 2016-2020 average TN levels at all monitoring stations were similar to 2001-2004 MEP averages, but had varied between 2005 and 2020. 2019-2023 data showed similar conditions with much more impaired conditions in the deep portions of Mill Pond. At all stations, key ecosystem measures (DO, pigments, etc.) had high variability from year to year. This variability is thought to be due to relatively rapid changes in the system inlet, but other key data to help explain recent water column changes has not been collected (*e.g.*, sediment TN release, watershed TN inputs). Since all water sampling has been completed using the same MEP protocols, data throughout the historical record can be compared. In addition, since all MEP protocols were approved by the state Department of Environmental Protection (MassDEP), all data may be used in regulatory decisions. MassDEP has not established a system-specific nitrogen limit (or TMDL) for Mill Pond, Woods Cove or other portions of Nauset Marsh.

**ECOSYSTEM STATUS:
Impaired Mill Pond and
Woods Cove, Other
Portions Acceptable**

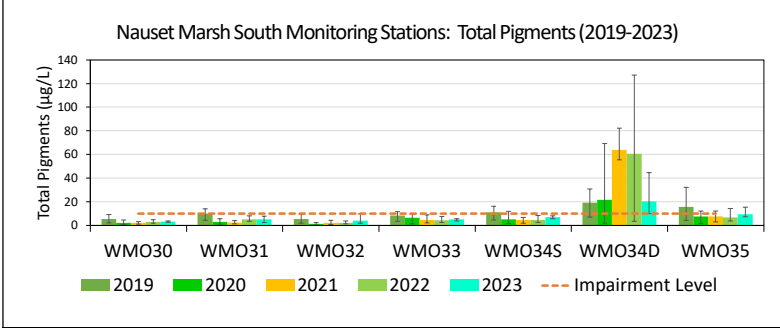
Nauset Harbor Massachusetts Estuaries Project report is available on the MassDEP website:

<https://www.mass.gov/doc/nauset-harbor-embayment-system-orleans-eastham-ma-2012/download>



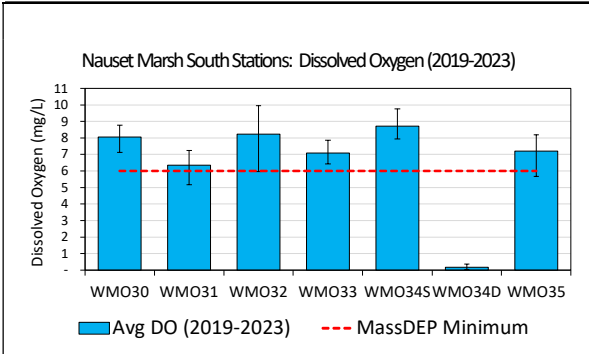
TOTAL NITROGEN

Nitrogen is a limiting nutrient in salt marsh and estuary ecosystems and is necessary for plant, phytoplankton, and algae growth, but excessive N can be harmful. Based on the 2012 MEP ecosystem assessment of Nauset Marsh, a total nitrogen concentration of 0.45 mg/L at the Town Cove station (WMO-27) was recommended as a maximum level in order to attain a healthy ecosystem throughout the Marsh. 2019-2023 water column data showed most southern Marsh stations had acceptable TN levels, but Mill Pond (WMO-34) and Woods Cove (WMO-31) levels tended to be at the maximum level, while deep levels in Mill Pond were exceptionally high, probably isolated by temperature stratification.



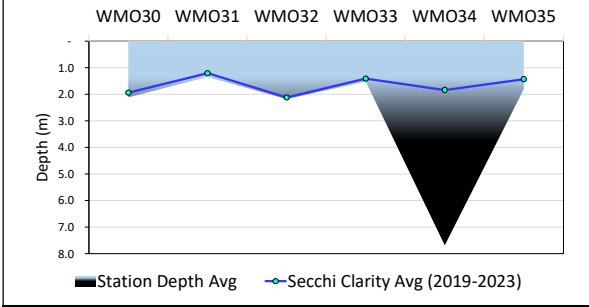
TOTAL PIGMENTS

The primary pigments used for photosynthesis by microscopic plants floating in water are summed for the total pigment concentration, which can be used as a measure of the amount of phytoplankton. Excessive levels generally correspond to higher nutrient levels, but these relationships can get complex when eelgrass has disappeared and extensive seaweeds, like the sea lettuce in Nauset Marsh, are part of the ecosystem. Recent pigment levels in southern Nauset Marsh have generally been acceptable except for deep Mill Pond, which tended to be 2X to 5X the MEP average (2001-2006).



Dissolved Oxygen

DO concentrations in southern Nauset Marsh are generally acceptable except for the deep levels in Mill Pond, which generally have no meaningful oxygen and were notably less than the MassDEP regulatory minimum DO level of 6 mg/L. Woods Cove readings were generally between 6 and 6.6 mg/L. Recent (2019-2023) individual station mid-depth DO levels at other southern Nauset Marsh stations have generally ranged from 7 to 8 mg/L.



Water Clarity

Water clarity measured with a Secchi disk is an easy way to measure how deep light can penetrate into an estuary water column. Clarity is an indirect measure of phytoplankton density and where plants can grow well on the bottom of an estuary. Because the depth in an estuary will vary with the tide, measuring the total depth is also an important monitoring task when measuring clarity. Recent clarity in Mill Pond has averaged 1.8 m, which is greater than the average depth at the other Southern Marsh stations, but is <25% of the average total depth at Mill Pond (WMO-34).