2025

ECOSYSTEM MONITORING REPORT

Edgartown Great Pond

Great Pond foundation ®

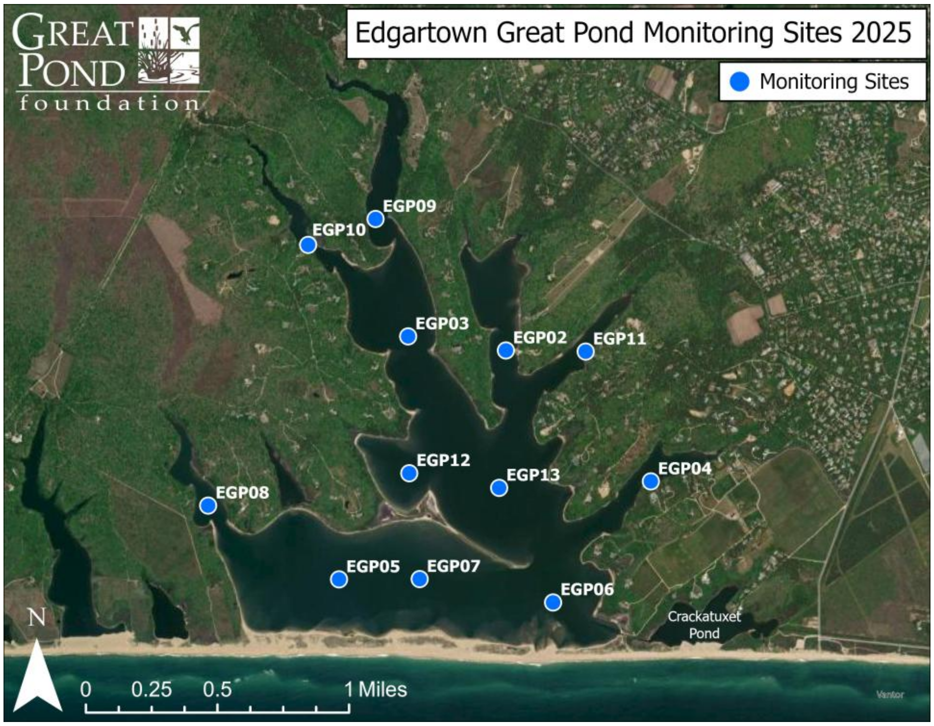
EDGARTOWN GREAT POND

Executive Summary

2025

Study Area

Edgartown Great Pond (EGP) is a coastal estuary approximately 890 acres in size located on the southern shoreline of Martha's Vineyard in the Town of Edgartown, MA. The Pond encompasses a roughly 4,850-acre watershed. The barrier beach separating EGP from the ocean is manually breached 3-5 times/year as a nutrient and elevation management tool.

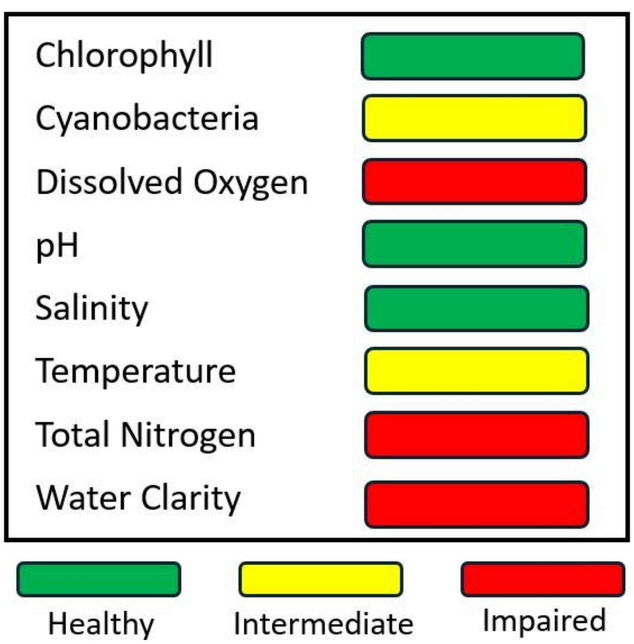


Sampling Regime 2025

In 2025, Great Pond Foundation (GPF) continued its ecosystem monitoring program on EGP for the 10th consecutive year. A total of 24 weekly monitoring trips were conducted between May and October. During each trip, water quality data was obtained for 12 monitoring sites (see map to left). Nutrient samples were collected at 8 of the regular 12 monitoring sites once a month.

A total of 299 water samples were collected from EGP in 2025 and tested for cyanobacteria as part of MV CYANO$_{TM}$, a collaborative program between GPF and the Island Boards of Health.

Summary of Metrics, 2025



*The "Summary of Metrics" tool assigns health rankings to individual water quality metrics. Refer to the *Appendix* for information on how rankings are assigned.

Cut Dates 2025

Date of Opening	Date of Closure	Cut Duration
Mar 10th	Mar 18th	8 days
Jun 9th	Jun 16th	7 days
Dec 6th	Dec 7th	1 day

Pond Summary 2025

Following more than 2 years of absence, 2025 saw the return of eelgrass shellfish habitat to EGP. In addition to providing critical ecosystem services, eelgrass has historically been used as the Pond's main indicator of water quality and health. As such, the seagrass' return in 2025 showcases the resilience and rebound of the ecosystem following an initial rise in nitrogen stress in 2022. Despite its return, the eelgrass habitat observed in 2025 was sporadic and exhibiting clear signs of stress, indicating that the Pond remains in a degraded state. This primarily owes to EGP continuing to house excess nitrogen since 2022, likely as a result of increased loading and reduced cut effectiveness. Nitrogen levels must decrease if EGP is to see a full return to health.

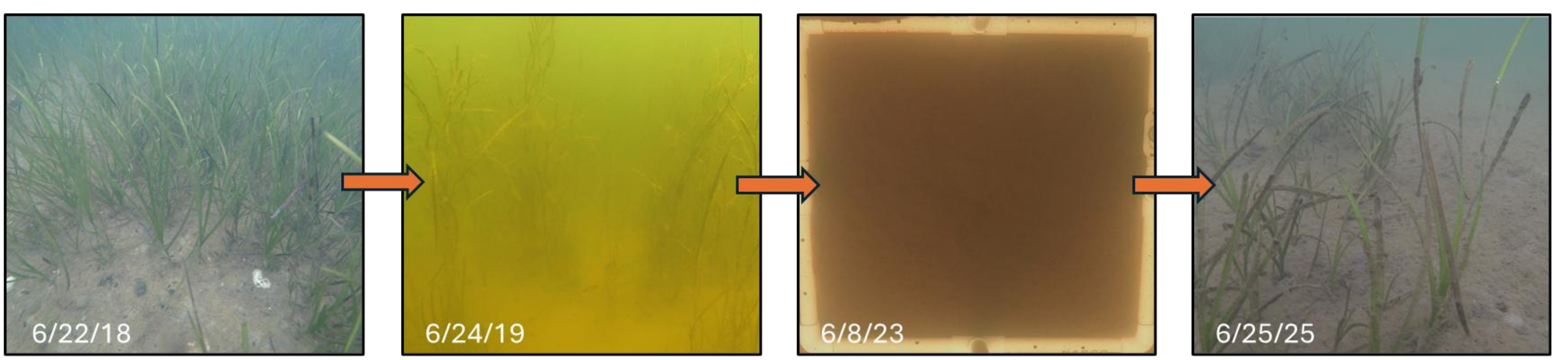
Introduction: Eelgrass Returns in 2025

Edgartown Great Pond (EGP) is an ecologically rare coastal estuary located on the southern shoreline of the island of Martha's Vineyard, MA. The Pond has historically supported vast meadows of eelgrass (*Zostera marina*), a submerged, native seagrass that grows on the pond bottom. Eelgrass provides essential ecosystem services, such as improving water quality through nutrient absorption and sediment retention, sequestering carbon, supplying oxygen, and acting as nursery habitat for juvenile finfish and other aquatic organisms. Eelgrass is also critical to the local economy due to its role in supporting EGP's long-time shellfishery. The seagrass helps to maintain water quality (important for filter-feeders) and acts as habitat for certain shellfish species, including oysters and ribbed mussels.

Beyond its immense ecological and economic importance, eelgrass' need for clean water in order to grow makes it an effective indicator of overall water quality, with abundant eelgrass generally indicating that healthy, stable conditions have existed for an extended period of time. As such, the story of EGP's ecosystem health and recovery can largely be told in the context of eelgrass (**Figure 1**).

During the 1990s and 2000s, the health of the Pond and its eelgrass beds was largely degraded, with the Massachusetts Estuaries Project (MEP) stating in its 2008 report that only sparse patches of eelgrass habitat could be found in EGP at that point in time (Howes et al., 2008). The struggling state of the ecosystem prompted decades of community-led restoration dating back to the 1990s aimed at reducing nutrient loading (namely that of nitrogen) into the Pond. This included upgrades to the Town of Edgartown's wastewater facility, the expansion of the existing sewer network, and a decade of regular dredging to improve pond cuts from 2009-2019. These actions proved effective, with widespread eelgrass habitat returning to EGP by the mid-2010s.

Unfortunately, after enduring several years of murky water from 2019-2021, EGP's eelgrass beds all but disappeared during the summer of 2022 when a sharp rise in nitrogen levels prompted a widespread phytoplankton bloom, preventing sunlight from reaching the bottom. During the summers of 2023 and 2024, drop camera surveys performed by Great Pond Foundation (GPF) revealed a dark, barren bottom devoid of nearly any vegetation. Following more than 2 years of absence, eelgrass finally returned to EGP in the spring of 2025, showcasing the resilience of both the seagrass and the ecosystem as a whole.



June of 2018: Eelgrass beds thriving in clear water conditions.

June of 2019: Eelgrass beds present but under turbidity stress.

June of 2023: Eelgrass beds absent after a significant rise in nitrogen and turbidity.

June of 2025: Scattered eelgrass beds present following more than 2 years of absence.

Figure 1. *Photo log depicting changes in eelgrass shellfish habitat in EGP's Lyle's Bay from 2018-2025.*

Patches of eelgrass shellfish habitat were observed in June and July of 2025 at several locations where EGP has historically housed eelgrass beds, including Wintucket Cove, Turkeyland Cove, Lyle's Bay, and the Pond's southern basin (**Figure 2**). GPF only performed eelgrass surveys in 2025 for the locations shown in **Figure 2**. This doesn't necessarily mean that eelgrass was absent from the parts of the Pond that weren't surveyed; rather, the state of eelgrass in 2025 at these locations is unknown.

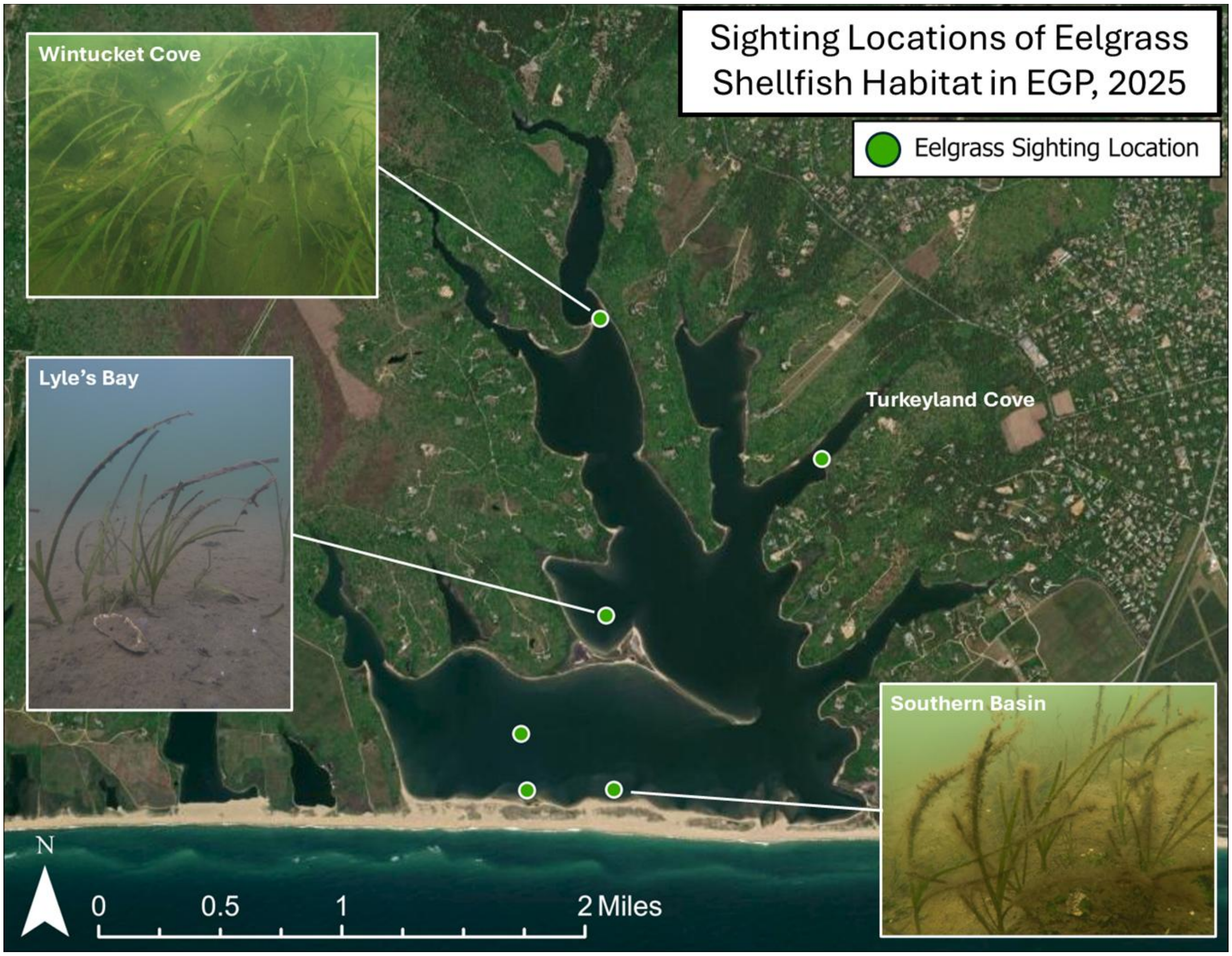


Figure 2. *Map of EGP indicating where eelgrass shellfish habitat was sighted in 2025. All eelgrass surveys were conducted in June and July of 2025 before water conditions became too murky to continue.*

So, what might explain the return of eelgrass to EGP in 2025? Before tackling this question, it's important to note that certain ecological conditions must be met for eelgrass to grow and thrive (**Figure 3**). As a seagrass, eelgrass requires salinity levels (i.e. the concentration of salt in the water) to remain in the upper-brackish range, preferably above 15 parts per thousand (ppt). For context, the salinity of freshwater is 0 ppt while the salinity of the ocean is 34-36 ppt; any salinity level falling in between is considered to be "brackish", or a mixture of fresh and saltwater. If salinity levels fall below 15 ppt, eelgrass will become stressed, potentially to the point of death.

The primary mechanism through which saltwater is added to EGP are periodic "cuts", in which the barrier beach separating the Pond from the ocean is intentionally breached 3-4 times per year to allow for a period of tidal exchange with the sea. The longer a given cut stays open, the higher EGP's salinity will rise, making the duration of these breaches integral in maintaining eelgrass.

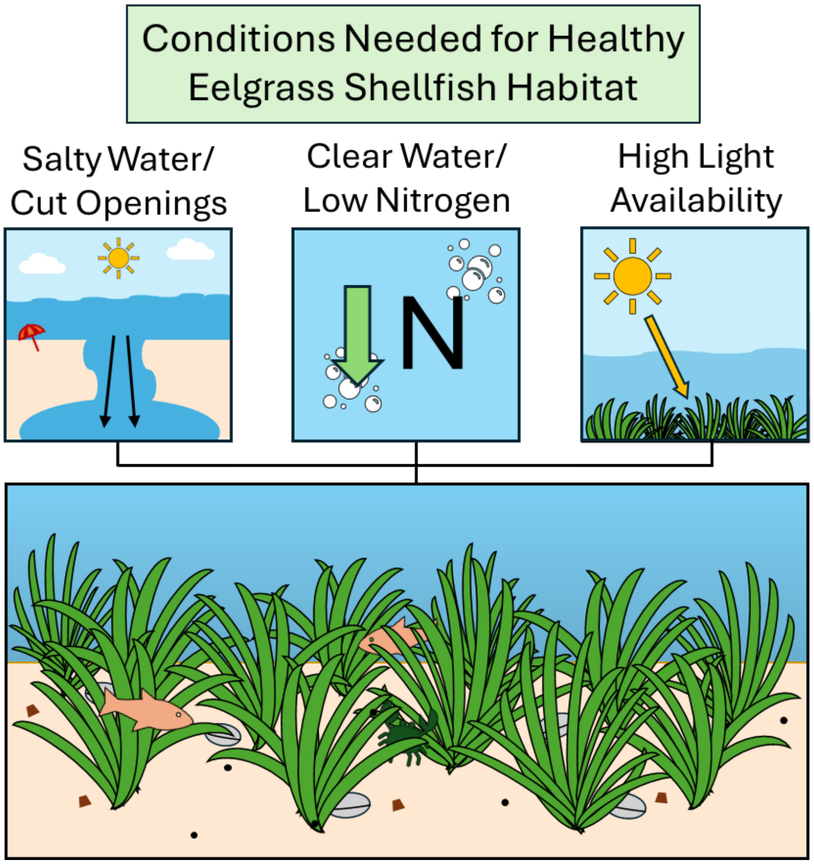


Figure 3. *Graphic showing the environmental conditions needed to support healthy eelgrass shellfish habitat.*

In addition to salinity, eelgrass requires clear water conditions that enable sufficient sunlight to reach the pond bottom (**Figure 3**). Water clarity in EGP is largely dependent on internal nitrogen levels, as an excessive amount of this key nutrient can promote an overgrowth of phytoplankton within the water column (often referred to as a "bloom"), which can restrict sunlight from reaching eelgrass on the bottom and prevent the seagrass from photosynthesizing (during which sunlight is converted to energy).

The return of eelgrass to EGP in 2025 likely owes to a combination of factors, including sufficient salinity levels and water clarity during the seagrass' primary growing period in the spring and early summer. A pair of pond openings in March (8-day cut) and June (7-day cut) served to maintain salinity above the 15 ppt eelgrass threshold for the majority of the early growing season. Additionally, total nitrogen levels across the Pond remained relatively low from May to July, limiting phytoplankton growth and allowing sunlight to reach the pond bottom. These conditions, combined with 2 consecutive summers of gradually improving water quality in 2023 and 2024, likely enabled the return of eelgrass in 2025.

Despite its return, eelgrass was only observed in June and July. Beginning in late July, water clarity declined dramatically in conjunction with increased nitrogen levels and phytoplankton growth, preventing GPF staff from being able to see the pond bottom or conduct further surveys. As such, it's unclear how the Pond's eelgrass fared during the late summer and early fall. It should be noted that even at the start of the summer when conditions were comparatively better, observed patches of the seagrass were sporadic and sparsely populated, while epiphytic algae could be seen growing on the blades of most plants (**Figure 4**), a textbook sign of nitrogen-induced turbidity stress (Costa, 2026). This indicates that EGP continues to exhibit impaired water quality, as will be discussed in the next section.

Figure 4. *Photo of epiphytic algae covering eelgrass in 2025.*

Water Quality in EGP Remains Impaired

As previously noted, EGP suffered a significant decline in health during the summer of 2022 when a sharp rise in nitrogen levels spurred the development of a concentrated phytoplankton bloom, leading to depleted oxygen reserves, murky water, and the disappearance of the Pond's eelgrass beds. During each of the last 3 monitoring seasons (2023-2025), water quality in EGP was improved relative to that of 2022; however, EGP continues to exhibit worsened water quality relative to pre-2022 conditions.

The Pond's persisting water quality issues have been largely driven by the continued presence of excess nitrogen within the water column. This is evident in comparing total nitrogen and turbidity (a measure of murkiness) before and after 2022 (**Figure 5**). Prior to the ecosystem's detrimental shift in 2022, most total nitrogen (TN) measurements collected between 2016 and 2021 fell below the State's 0.5 mg/L threshold, helping to keep phytoplankton growth (and in turn turbidity) at a reasonable level. Conversely, most TN measurements collected since the start of 2023 have exceeded the State's threshold, in turn driving elevated phytoplankton growth and turbidity. It should be noted that water quality in 2024 was slightly improved relative to 2023 and 2025; this will be discussed later on.

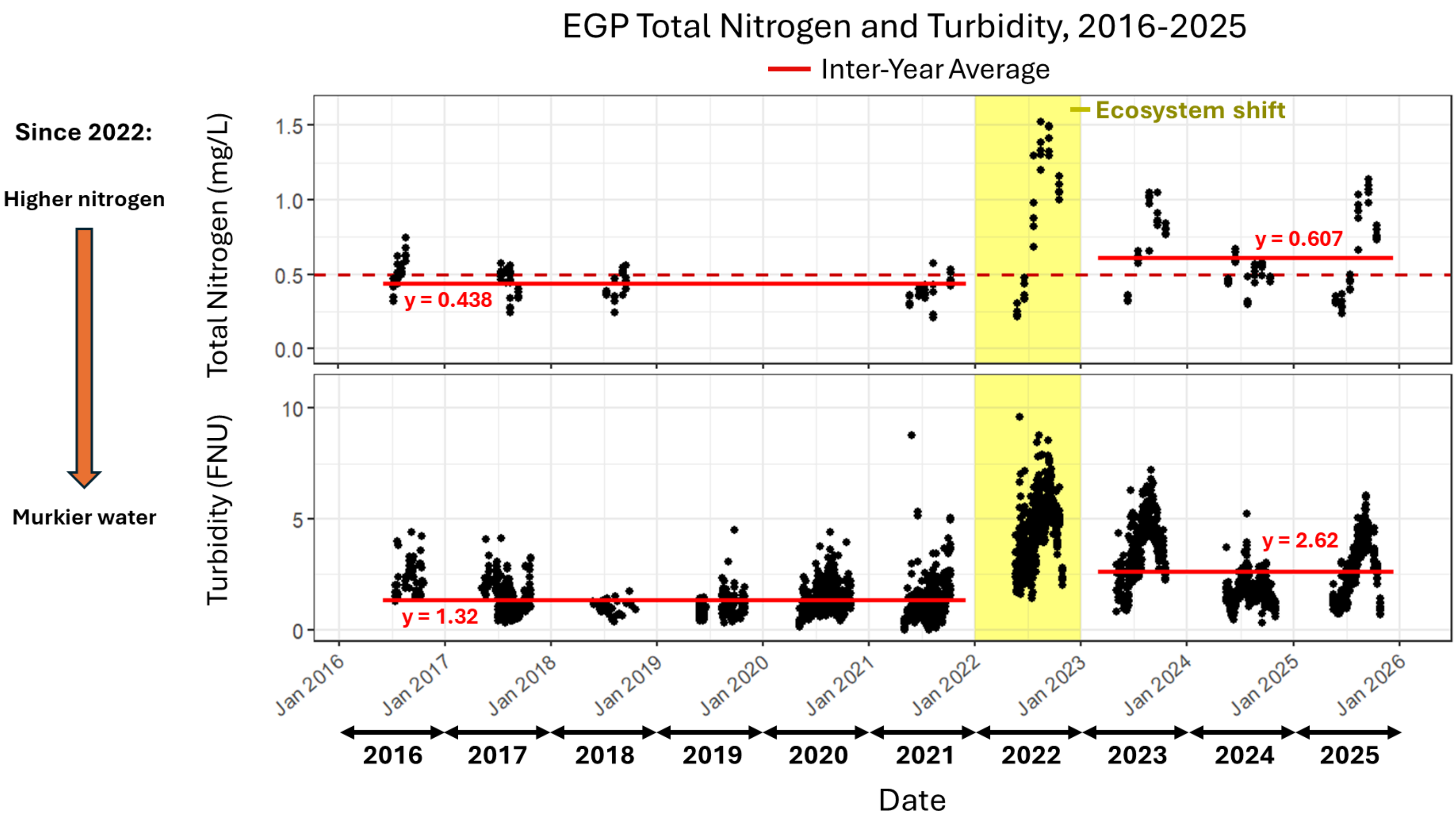


Figure 5. *Scatterplots of total nitrogen (in mg/L) and turbidity (in FNU) measurements taken in EGP during the core monitoring season (May-Oct) each year from 2016 to 2025. The dashed red line on the nitrogen plot represents the State's 0.5 mg/L total nitrogen (TN) threshold. Continuous red lines represent the average of all measurements collected between either 2016-2021 (left of 2022) or 2023-2025 (right of 2022). Plotted TN points only pertain to stations included in the EGP "sentinel station" (EGP02, EGP03, EGP05, EGP06, & EGP09), as defined by the Pond's 2008 MEP report (Howes et al., 2008). Plotted turbidity points include all of GPF's normal 12 monitoring stations. TN data for 2016, 2017, and 2018 were provided by the Martha's Vineyard Commission.*

EGP's higher nitrogen levels since 2022 are likely due to 2 main factors; 1) continued development within the watershed, and 2) declining cut effectiveness over time. Before diving into how these variables may act to increase nitrogen loading into the Pond, it's important to understand how loading occurs (**Figure 6**). The 3 main external sources of nitrogen to the island's coastal ponds are wastewater, fertilizers, and atmospheric deposition. Preliminary findings from a 2021 study conducted by GPF and the Marine Biological Laboratory revealed wastewater as the leading source of external nitrogen to EGP, followed by fertilizer runoff (Lloret et al., 2021).

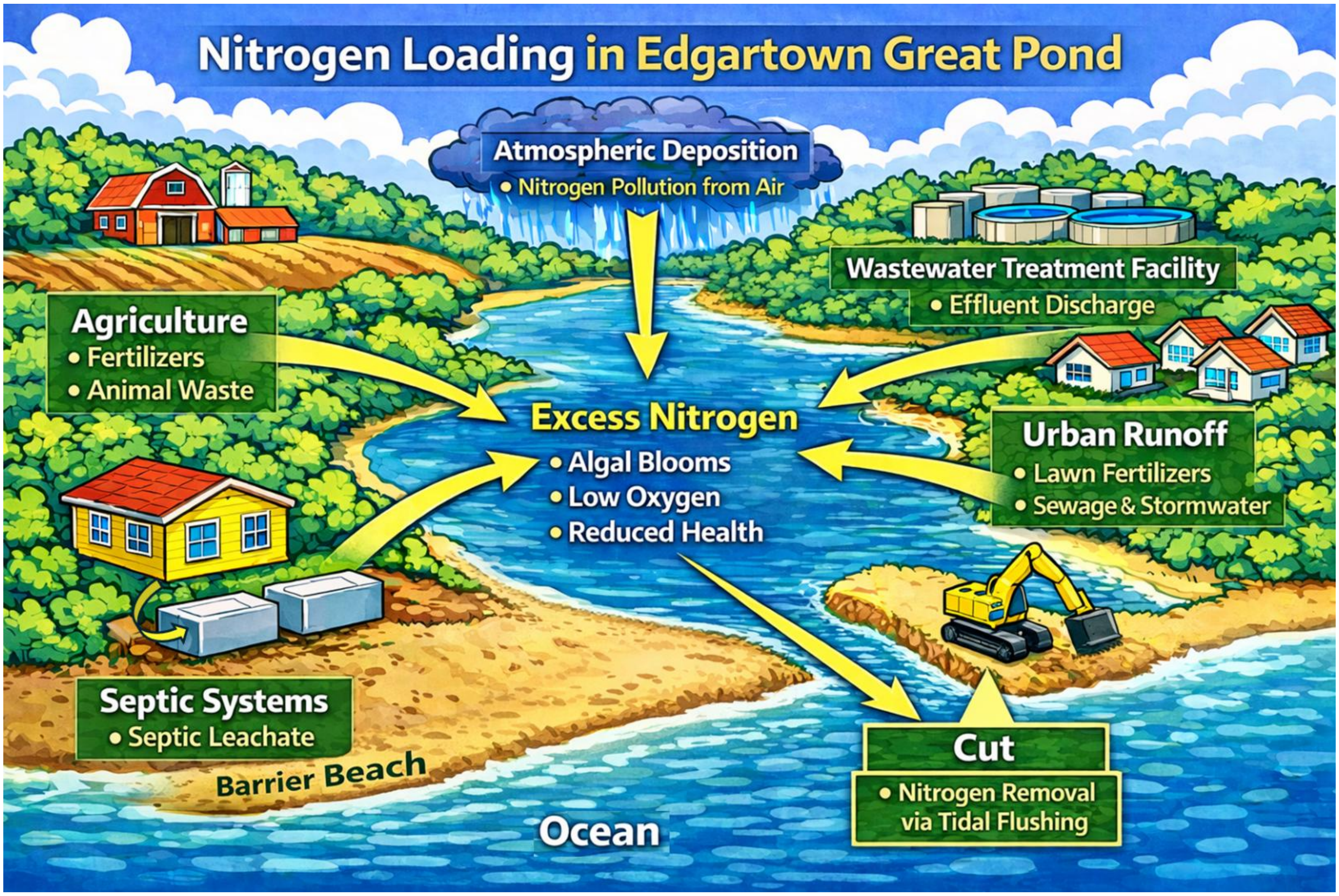


Figure 6. *Graphic showing the different sources that contribute to excess nitrogen loading in EGP. The ability of periodic cuts to remove nitrogen from the Pond is also shown. This graphic was generated using OpenAI's ChatGPT.*

Using data obtained from the National Land Cover Database, GPF estimates that developed land area within the EGP watershed (i.e. the area of land that drains to the Pond) could have increased by as much as 10.21% between 2015 and 2024, although this number is likely overestimated (see **Figure A1** in the Appendix for more information). Regardless, this indicates that a considerable amount of development occurred over the last decade, presumably increasing the Pond's overall nitrogen load through elevated wastewater discharge (from both septic systems and the Town of Edgartown's Wastewater Facility) and fertilizer runoff (both residential and agricultural).

In addition to continued development, EGP's high nitrogen inventories have likely been exacerbated by reduced cut effectiveness. The Pond's periodic breaches (or "cuts") of the barrier beach can serve as a nutrient release valve, helping to flush excess nitrogen out of the Pond while they remain open (**Figure 6**). Cuts are only possible when the Pond is high enough (at least 3.5 feet above sea level). This means that only a limited number of cuts can be attempted each year (typically 3-4), as it generally takes several months of rainfall for EGP to return to opening elevation once a given cut closes. This means that the capacity of these periodic cuts to remove nitrogen depends on how long they remain open.

Since 2022, the EGP cut has generally remained open for fewer days each year relative to years falling before 2022 (**Figure 7**). Excluding 2020, each year from 2017 to 2021 experienced more than 50 days with the cut open. Conversely, not a single year from 2022 to 2025 saw more than 33 days with the cut open. *Ultimately, EGP's increased nitrogen levels are likely the result of more nitrogen in (increased development) and less nitrogen out (shorter cuts).*

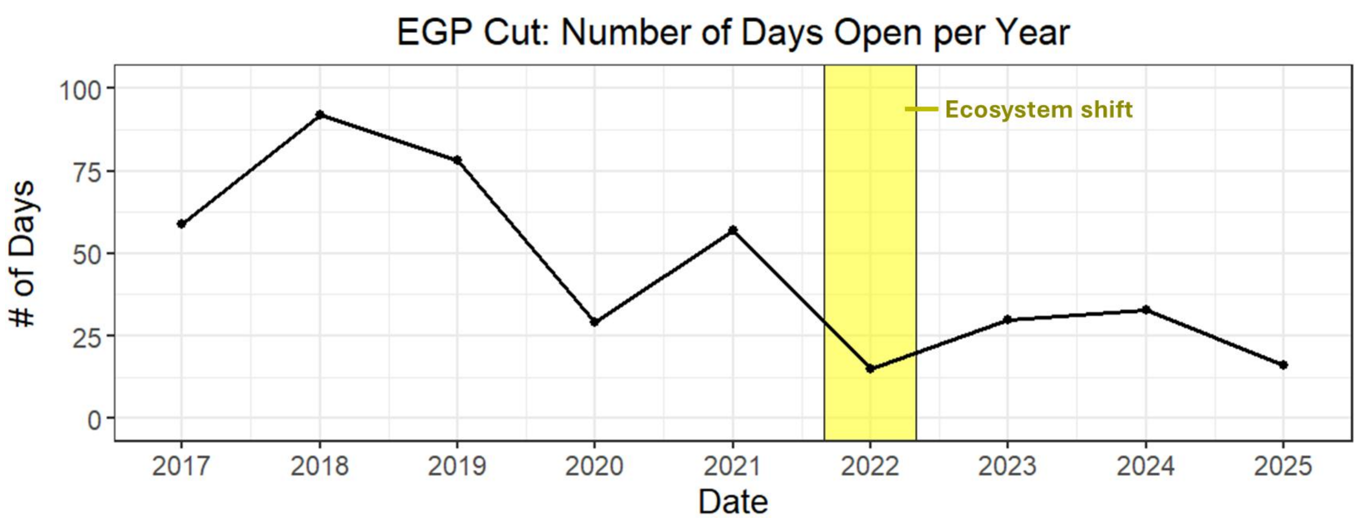


Figure 7. *The total annual number of days that the EGP cut was open for is shown for each year from 2017 to 2025. Both natural and man-made openings are included; 2024 was the only year to have a natural opening.*

Past data collected in EGP has shown that at least 9-11 days of tidal exchange is required for a successful flush of the system. In comparing cut trends each year since 2022, only 2024 experienced a cut during the May-October monitoring season that reached at least 9-11 days of flushing, this being an 11-day opening in July (**Figure 8**). The impacts of 2024's summer opening are apparent, with TN dropping noticeably during the duration of the cut before staying near or below the State's TN threshold for the remainder of the season. By contrast, TN levels in 2023 and 2025 far exceeded the State's threshold during the late summer and early fall. These trends suggest that moving forward, water quality conditions in EGP under its current nitrogen load are likely to resemble those observed in 2023 and 2025, unless cut efficiency can be improved during the year to mitigate loading, as was the case in 2024.

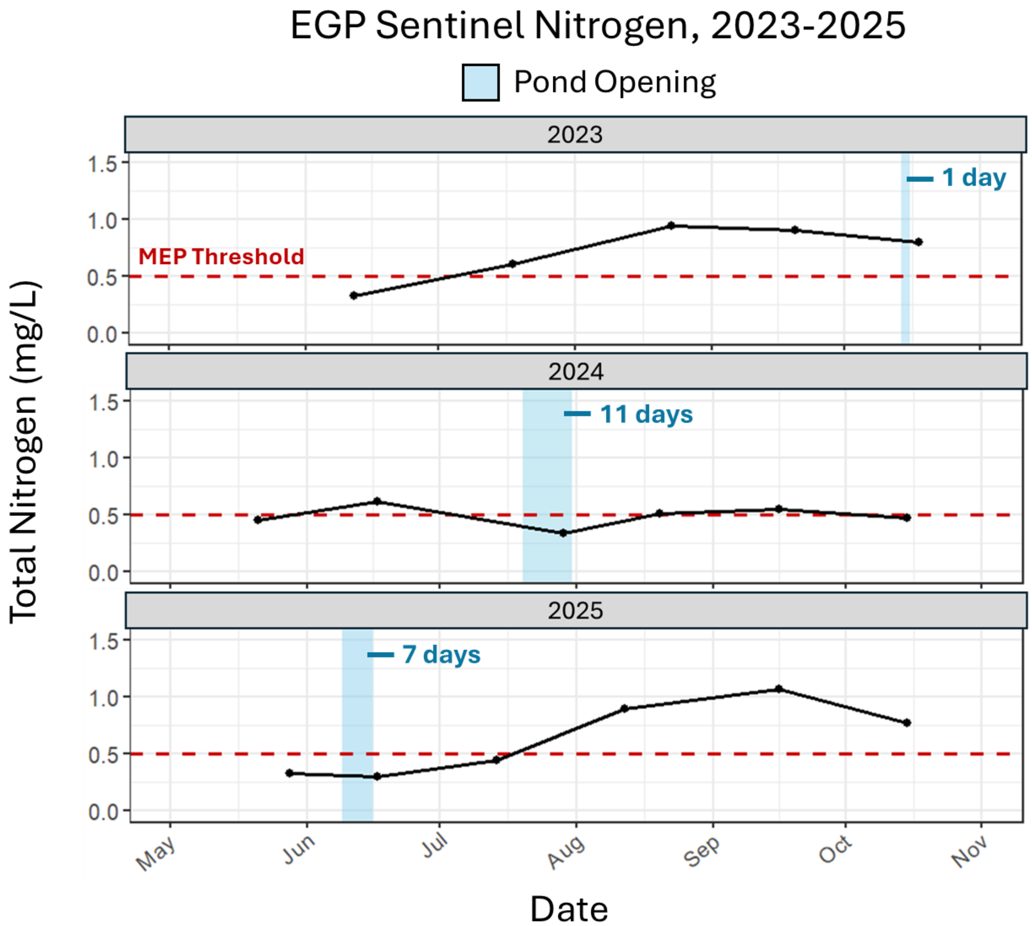


Figure 8. Total nitrogen for the EGP "sentinel station" (average of stations EGP02, EGP03, EGP05, EGP06, and EGP09) for the years 2023-2025. Dashed red lines represent the State's 0.5 mg/L management threshold.

Conclusion

In the spring of 2025, patches of eelgrass shellfish habitat returned to EGP following more than 2 years of absence. This showcases the resilient nature of the EGP ecosystem and its eelgrass in the face of climate change and excess nitrogen loading. However, the eelgrass observed by GPF in 2025 was sporadic and typically covered in epiphytic algae, signaling nitrogen-induced turbidity stress.

In thinking about restorative action, it's important to consider the conditions that were present when its eelgrass meadows were still thriving. Total nitrogen and turbidity trends in EGP are shown from 2016-2025 in **Figure 9**. From 2016 to 2018, a period during which EGP's eelgrass beds were healthy and abundant, nitrogen levels were steadily declining and comparatively low, enabling clear water conditions (i.e. low turbidity). This was in part enabled by effective pond openings that consistently allowed for at least 9-11 days of tidal flushing, helping to remove excess nitrogen and maintain sufficient salinity.

From 2019 to 2021, eelgrass shellfish habitat persisted across much of EGP despite an uptick in nitrogen and turbidity stress (**Figure 9**). The resilience of the Pond's eelgrass was also on display in the summer of 2025, when the seagrass returned to EGP despite sub-optimal water quality.

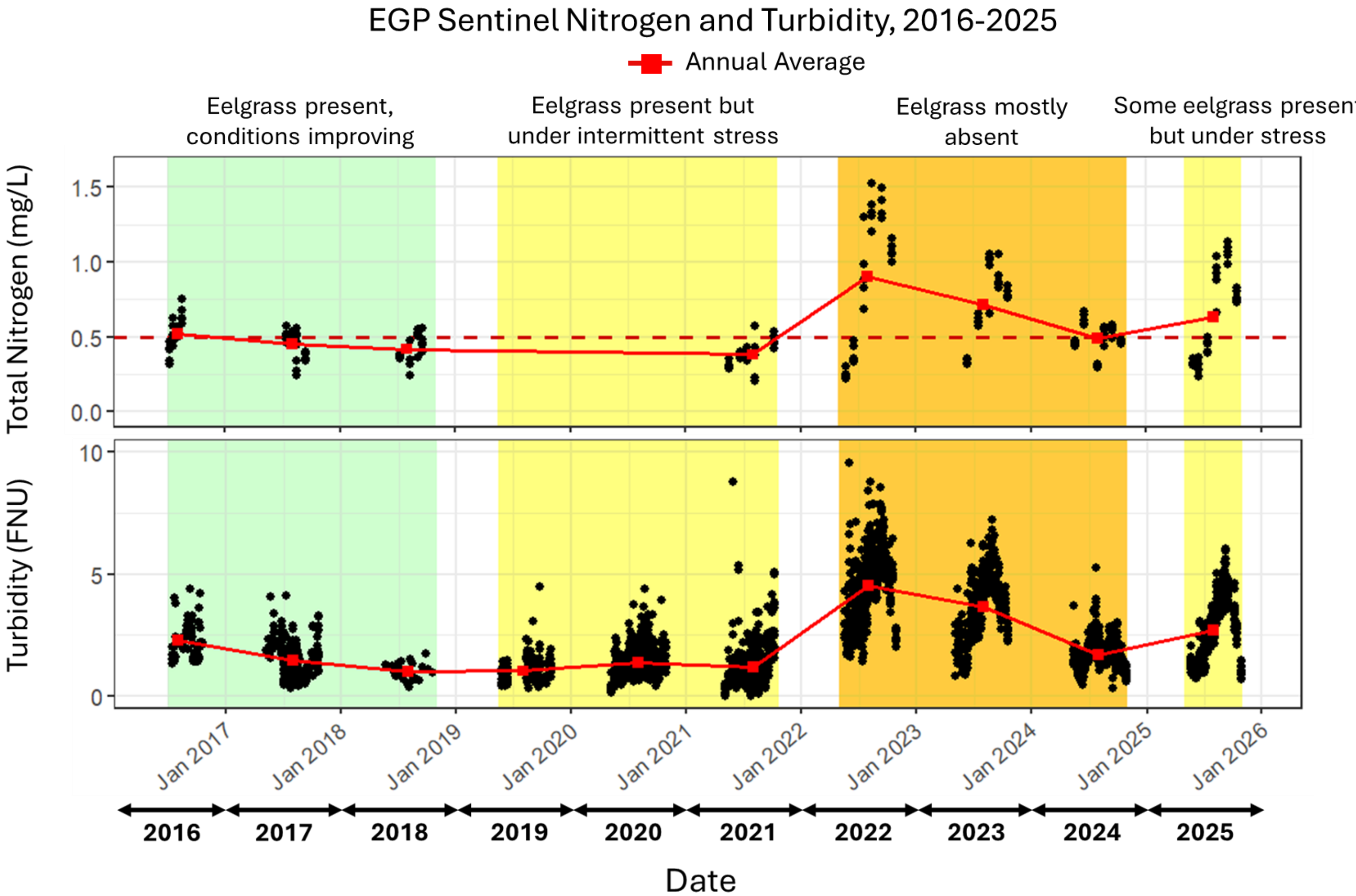


Figure 9. *Scatterplots of total nitrogen (in mg/L) and turbidity (in FNU) measurements taken in EGP during the core monitoring season (May-Oct) each year from 2016 to 2025. The dashed red line on the nitrogen plot represents the State's 0.5 mg/L total nitrogen (TN) threshold. Overlying red lines represent annul averages for each year shown. Plotted TN points only pertain to stations included in the EGP "sentinel station" (EGP02, EGP03, EGP05, EGP06, & EGP09), per the Pond's 2008 MEP report. Plotted turbidity points include all 12 normal stations. TN data for 2016, 2017, and 2018 were provided by the Martha's Vineyard Commission.*

After more than 2 years of recovery since the Pond's initial decline in 2022, eelgrass is back in a position where it can once again persist but cannot truly thrive like the bountiful eelgrass meadows of the past. For EGP to see a full return to health and the reestablishment of its eelgrass beds, it's essential that nitrogen levels within the Pond decrease. This will likely require a combined approach focused on reducing nitrogen entry from sources within the watershed, as well as optimizing cuts to maximize their flushing potential.

Works Cited

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Acknowledgements

We would like to thank the Martha's Vineyard Commission for providing total nitrogen data for the years 2016-2018.

Appendix

Refer to GPF's **[Summary of Metrics Methodology]** page for information on how the Summary of Metrics rankings included in this report's executive summary are assigned.

Supplementary Figures

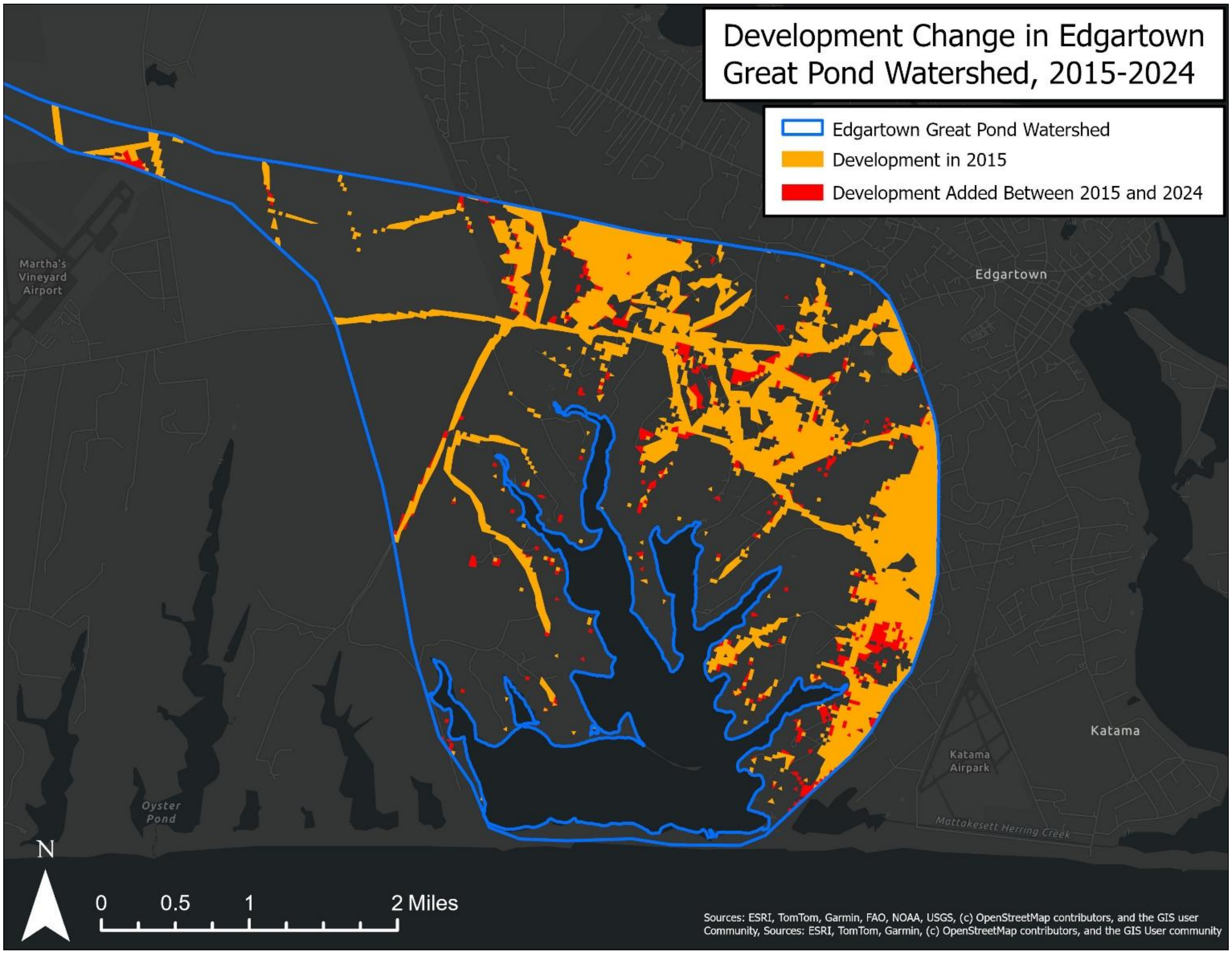

Figure A1. *A map of the EGP watershed depicting the change in developed land area between 2015 and 2024. The total amount of developed land area present in 2015 is shown in orange. Land developed between 2015 and 2024 is shown in red; the total amount of developed land area present in 2024 is the combination of all the orange and red areas. Developed land area was defined as all buildings, impervious surfaces (paved and dirt), manicured lawns, and agricultural land. This analysis was performed using data obtained from the National Land Cover Database (USGS, 2026). It should be noted that developed land area calculations are likely overestimated given the dataset's lack of precision (one land use code is applied to every 30 x 30-meter area). Analyis reveals that developed land area in the watershed may have increased by as much as 10.21% between 2015 and 2024.*