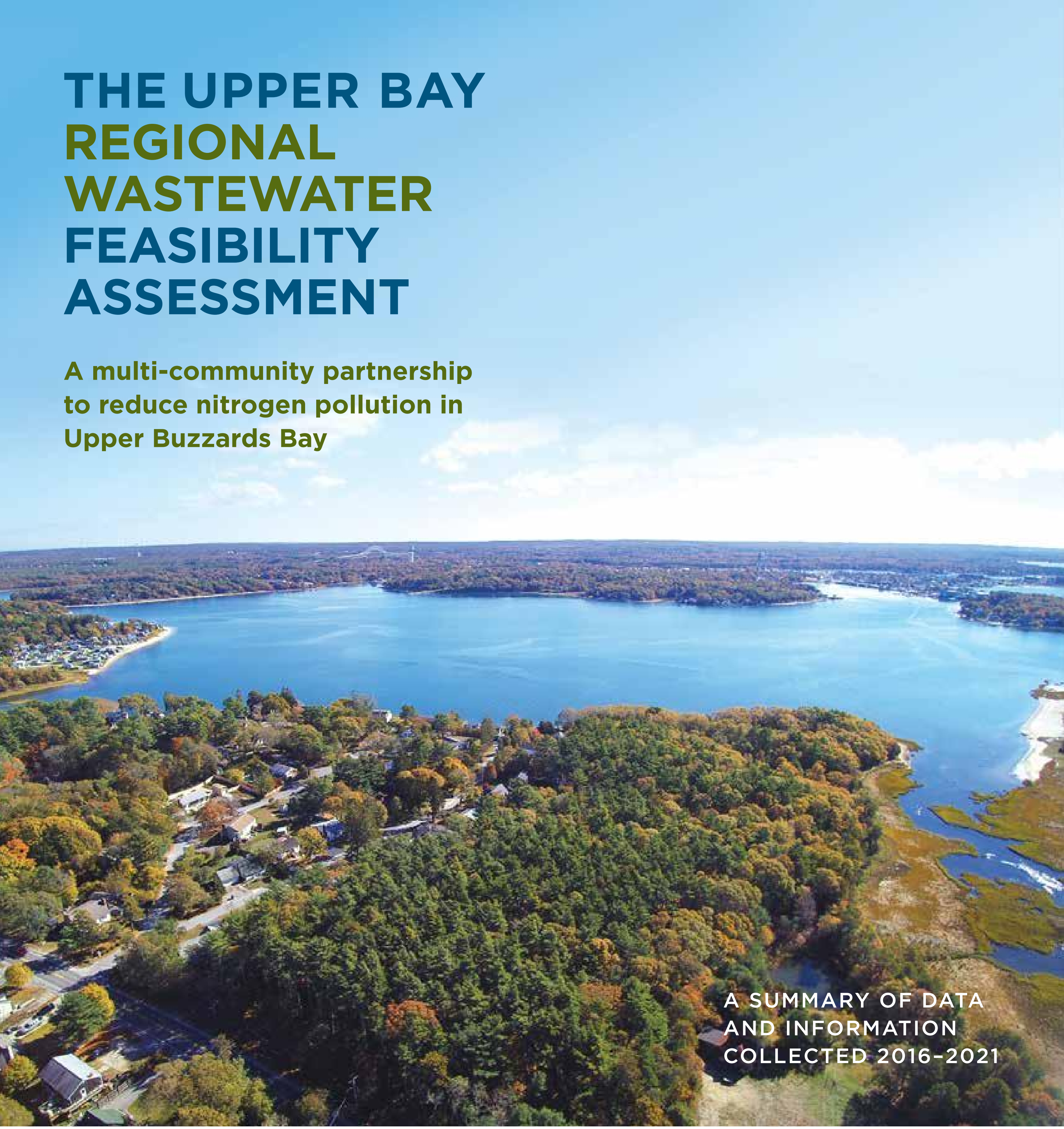
THE UPPER BAY REGIONAL WASTEWATER FEASIBILITY ASSESSMENT

A multi-community partnership to reduce nitrogen pollution in Upper Buzzards Bay



A SUMMARY OF DATA AND INFORMATION COLLECTED 2016–2021

PROJECT PARTNERS

KEY FINDINGS

- Nitrogen pollution from septic systems, including those installed in recent years under Title 5, are the primary source of pollution degrading our coastal waters and harming our fish, shellfish and marine habitats.
- The Wareham Water Pollution Control Facility (WPCF) currently reduces nitrogen pollution from wastewater **by more than 90% and has space available to be expanded** to meet the current and future sewer needs of Marion, Wareham, Bourne, South Plymouth and the Massachusetts Maritime Academy (MMA).
- Relocating the Wareham WPCF discharge to the location of MMA's existing discharge at the Cape Cod Canal is a viable alternative that **could be implemented today** with technology such as horizontal directional drilling.
- The extraordinary volumes of water flowing through the Cape Cod Canal make it a suitable location for discharge of highly-treated wastewater effluent. Scientists at the Woods Hole Oceanographic Institution concluded that an Upper Bay Regional Wastewater Solution, as described in their report, would **not have an adverse impact** on water quality in the canal or surrounding waters.
- A regional Upper Bay Wastewater Treatment Plant solution would **reduce pollution** to the entire upper Buzzards Bay area by an estimated 100,000 lbs/year – the equivalent of eliminating the pollution from 3,457 septic systems and 3 existing wastewater discharges.
- Total capital cost of an Upper Bay regional wastewater solution is estimated at **$150 Million**: $100 Million to expand the size of the current Wareham WPCF to serve all communities and $48 Million to relocate the discharge.
- Completion of **Comprehensive Wastewater Management Plans (CWMPs)** in Bourne, Wareham and Marion are critical to allow for cost/benefit comparisons between town 'go it alone' alternatives or a regional solution such as the Upper Bay Project.
- Massachusetts is slated to receive $1 Billion through the 2021 federal Infrastructure Bill for wastewater projects. The **next five years** will be a critical period for communities to settle on wastewater strategies and secure these funds.

The Upper Bay Project was made possible with the financial support of the Southeast New England Program Watershed Grants. SNEP Watershed Grants are funded by the U.S. Environmental Protection Agency through a collaboration with Restore America's Estuaries.

COMMUNITIES THROUGHOUT southeastern Massachusetts and Cape Cod depend on coastal water quality to support their quality of life, fish and wildlife habitats, and local economies. It is why so many of us choose to live on or near the shores of upper Buzzards Bay. Yet, nitrogen pollution from conventional septic systems is currently driving significant declines in the health of our coastal waters, and Bay communities struggle with how to reduce nitrogen in an effective, affordable, and sustainable way. The Upper Bay Regional Wastewater Feasibility Assessment (aka Upper Bay Project) joined all of the communities in upper Buzzards Bay – Marion, Wareham, Bourne, and South Plymouth – together with the Massachusetts Maritime Academy (MMA) and the Buzzards Bay Coalition (Coalition) – to evaluate whether a regional wastewater solution to reduce nitrogen pollution in upper Buzzards Bay was feasible.

The Upper Bay Project hypothesized that if these communities worked together, they may be able to expand wastewater treatment, reduce pollution and restore water quality, and support the economic needs of their communities at a lower cost and better environmental outcome than taking on municipal wastewater projects individually.

Since 2015, the Project secured $737,000 in federal funding through grants from the US Environmental Protection Agency's Southeast New England Program to complete the preliminary engineering, science and economic analysis to answer the feasibility question. This report summarizes work completed to date on determining project feasibility and provides important information each community needs in order to evaluate whether a regional wastewater project is preferred over an individual community's investment in, and long term management of, its own individual wastewater solutions.

As of the date of this report, Bourne and Marion are both engaged in the development of detailed Comprehensive Wastewater Management Plans (CWMPs) to determine all of the present and long-term wastewater needs of their communities and assess alternatives. In the absence of final CWMPs, the Upper Bay Project was required to make assumptions using the best information from each of the communities available at the time. Final CWMPs will allow for critical refinement of the information contained in this report.

Each community should evaluate this information carefully to determine whether a regional option is in its best interest. This report does not seek to answer every question about this concept, rather it is a summary of work completed to date.

All reports completed by this project and cited in this report are available at **savebuzzardsbay.org/upper-bay-project/**

Nitrogen pollution from wastewater threatens our coastal waters. Communities need a solution to restore water quality that people can afford.

Nitrogen pollution is the greatest long term threat to the health of Buzzards Bay.

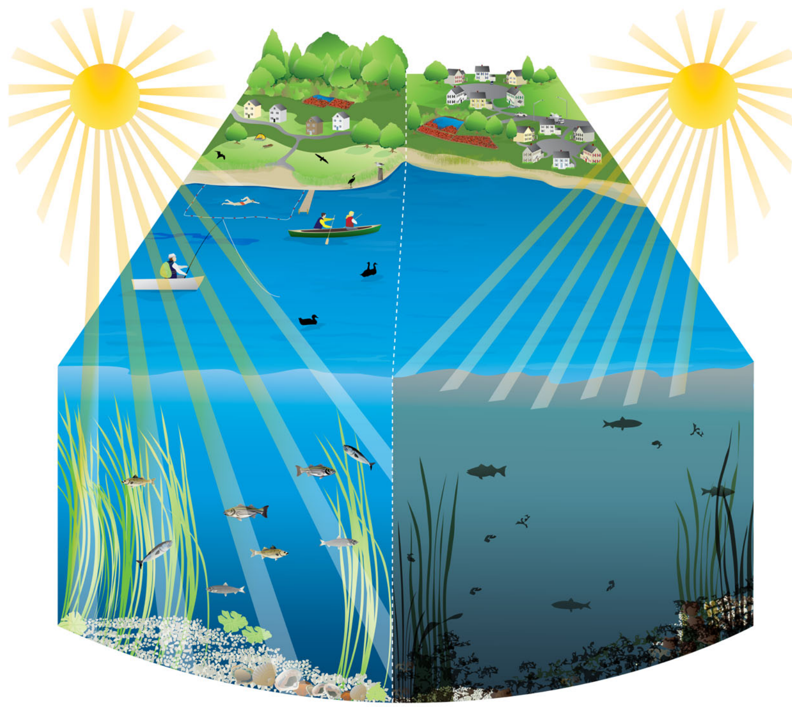
Thirty years of data collected by the Coalition, the Woods Hold Oceanographic Institution, Marine Biological Laboratory, and the UMass School for Marine Science and Technology, document how increasing levels of nitrogen are decreasing the quality of coastal ecosystem habitat. The data show high levels of nitrogen and chlorophyll and low levels of dissolved oxygen and water clarity – symptomatic of nitrogen pollution. Nearly all of the more than 30 harbors and coves around Buzzards Bay suffer from the ill effects of too much nitrogen including the Agawam/Wareham River, Buttermilk and Little Buttermilk Bay, Aucoot Cove, Sippican Harbor and the Weweantic River, all the upper Bay estuaries.

Bay Health scores for upper Bay near shore estuaries rank as only fair or poor.

Upper Bay waters are so polluted by nitrogen that they do not meet state water quality standards and are listed on the state's 303(d) integrated list of impaired waters, otherwise known as the federal dirty waters list.

Such federal designation compels the state and towns to take action to reduce pollution and restore water quality and protect important natural resources.

Combined, the subwatersheds to these upper Bay estuaries make up 35% of the entire Buzzards Bay watershed. Reducing nitrogen for these waters reduces nitrogen to the Bay overall and solves the nitrogen pollution problem for an entire third of all of Buzzards Bay.



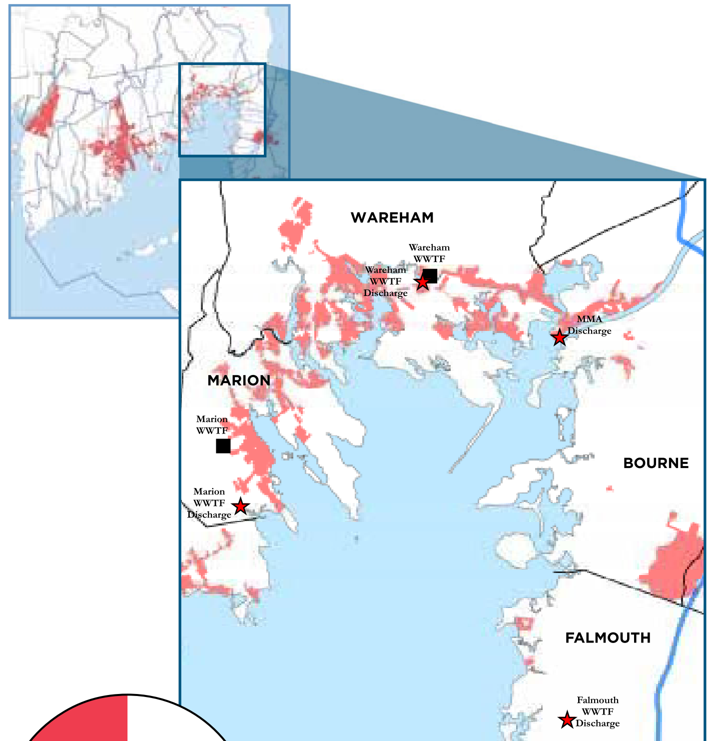
In clean water (left), fish and shellfish thrive, and people can enjoy the water. But when the water is polluted with nitrogen (right), it becomes cloudy and murky. Eelgrass can't grow, and fish and shellfish disappear.

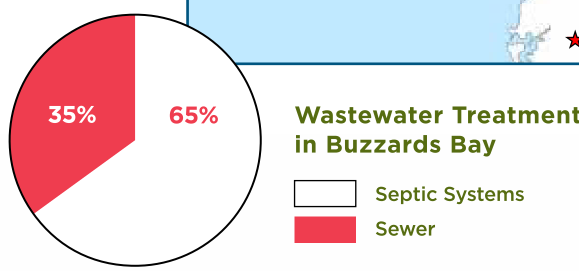
SEPTIC SYSTEMS ARE THE MAJOR SOURCE OF NITROGEN POLLUTION

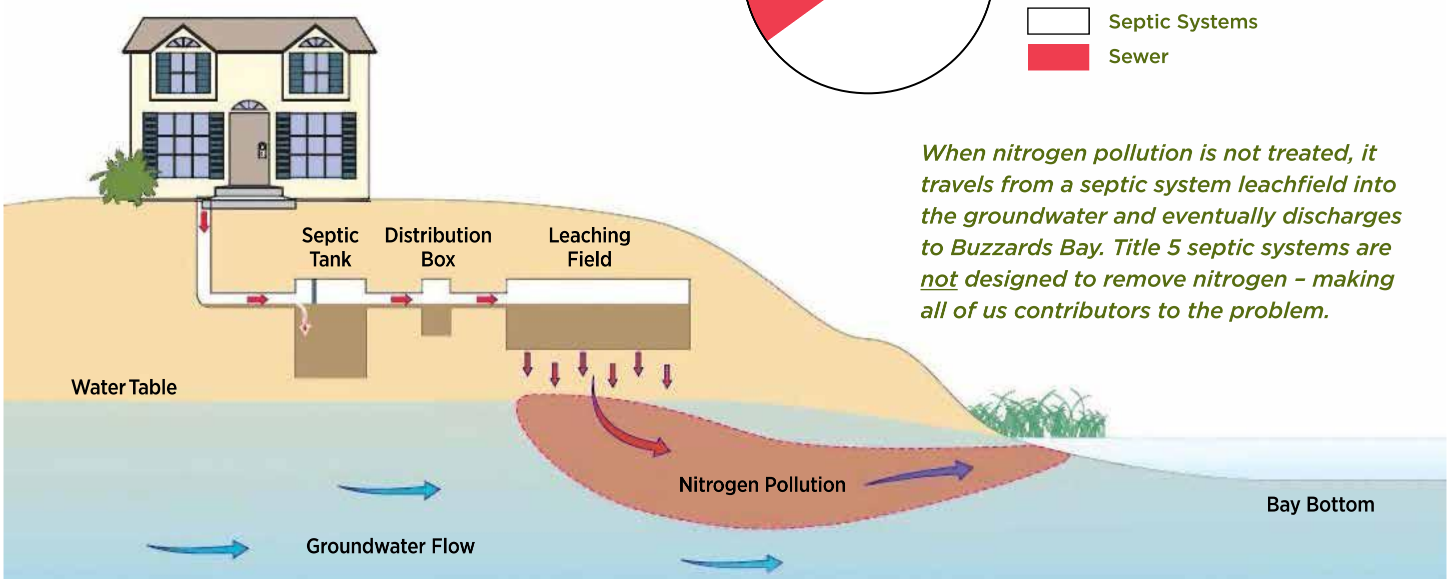
It is widely understood that nitrogen from residential wastewater is the predominant source of pollution adversely impacting our coastal waters. Approximately 65% of the Buzzards Bay watershed is served by on-site septic systems. These more than 50,000 septic systems are the major source of nitrogen to our coastal waters. Conventional Title 5 septic systems, which are not designed to remove nitrogen, discharge pollution through their leaching fields into groundwater where it moves directly to our sensitive water resources.

Wastewater treatment facilities, on the other hand, can reduce nitrogen pollution by as much as 95%. Expanding municipal sewer is the single most effective way to reduce nitrogen pollution. While many communities around the Bay are devoid of any municipal sewer infrastructure, the upper Bay communities are fortunate in that they have existing sewer infrastructure that can be expanded to eliminate on-site septic systems.

Constructing and expanding sewer infrastructure can be costly. The Upper Bay Project was developed to determine whether the upper Bay communities could capitalize on shared assets to restore water quality for all the communities.







When nitrogen pollution is not treated, it travels from a septic system leachfield into the groundwater and eventually discharges to Buzzards Bay. Title 5 septic systems are <u>*not*</u> *designed to remove nitrogen – making all of us contributors to the problem.*

EXISTING WASTEWATER INFRASTRUCTURE IN UPPER BUZZARDS BAY

The following section provides a brief description of the existing wastewater infrastructure in the towns of Marion, Wareham, Bourne and the Massachusetts Maritime Academy.

Wareham

Wareham's WPCF provides exceptional treatment. This image shows raw sewage on the left, Wareham's treated discharge is center, drinking water on right.

The town of Wareham owns and operates the Wareham WPCF located at Tony's Lane in Wareham. It has the design capacity to treat an average of 2 million gallons of wastewater each day and regularly achieves 90%+ nitrogen removal.[1] The average daily flow to the Wareham WPCF is made up of approximately 1,070,000 gallons per day (gpd) from the estimated 6,800 customers in the town of Wareham paying approximately $646/year in sewer fees.[2] An intermunicipal agreement between the town of Bourne and town of Wareham allows the town of Bourne to send 200,000 gpd of untreated wastewater to the Wareham WPCF for treatment and disposal into the Agawam River.[3] As of this report, it was estimated that Bourne generates an estimated 101,000 gpd from 1,070 users from the Main Street area in Buzzards Bay Village and Hideaway Village.[4]

While the WPCF has the design capacity to treat 2 million gallons per day (mgd), it is limited by its federal discharge permit from the US Environmental Protection Agency (EPA) to 1.56 mgd due to the sensitive nature of its discharge location. The WPCF discharges to the Agawam River – a shallow and poorly flushed estuary. While a 2005 upgrade to the WPCF significantly reduced the amount of nitrogen discharged from the WPCF to the Agawam River, the river is simply too sensitive to receive additional nitrogen discharges even at the WPCF's high level of treatment. If an alternative discharge location could be identified and pursued, it would immediately create 440,000 gpd of treatment capacity available to connect existing septic systems.

Agawam River at Wareham's 1.56 mgd discharge

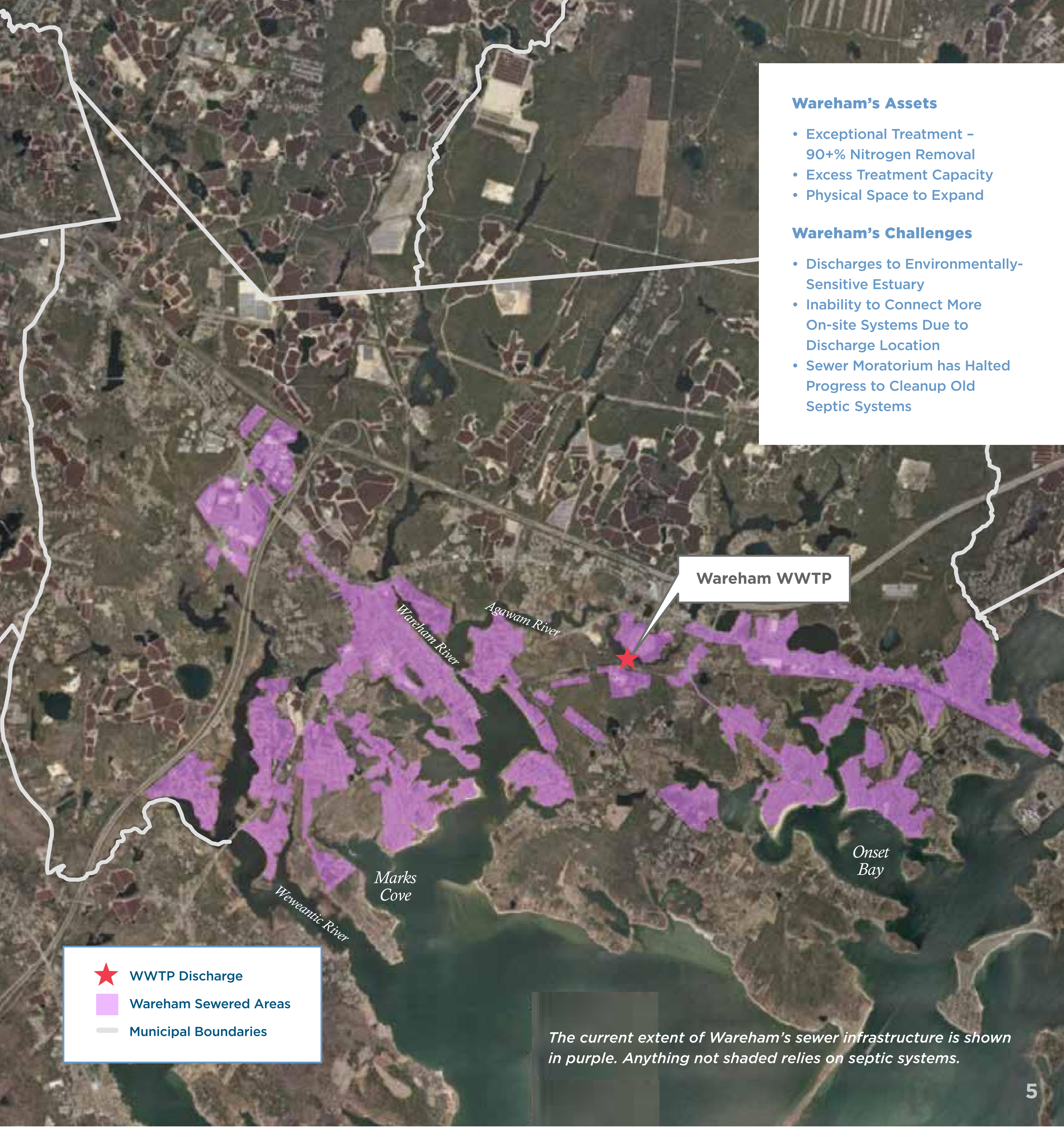
The limitation on Wareham's discharge location has resulted in a sewer hookup moratorium, slowed economic development, and most importantly, prevented the extension of the collection system to densely developed areas currently relying on on-site septic systems to dispose of wastewater – septic systems that do not treat for nitrogen and continue to degrade waters.

Wareham's Assets

- Exceptional Treatment – 90+% Nitrogen Removal
- Excess Treatment Capacity
- Physical Space to Expand

Wareham's Challenges

- Discharges to Environmentally-Sensitive Estuary
- Inability to Connect More On-site Systems Due to Discharge Location
- Sewer Moratorium has Halted Progress to Cleanup Old Septic Systems



The current extent of Wareham's sewer infrastructure is shown in purple. Anything not shaded relies on septic systems.

Bourne

Pursuant to the 2010 intermunicipal agreement with Wareham, Bourne can send 200,000 gpd to Wareham for treatment and disposal at the Agawam River. At the time of this report, it is estimated that only about 101,000 gpd flow from Bourne to Wareham, leaving Bourne with approximately 99,000 gpd of sewer capacity available at the Wareham WPCF.[5] Bourne recently completed the construction of a new wastewater treatment plant on Armory Road to treat 100,000 gpd of wastewater from new commercial growth in the downtown area. Downtown Bourne, also known as Buzzards Bay Village, is a Cape Cod Commission designated economic development district where investment in commercial growth and revitalization is a priority. The new plant is designed to remove approximately 75% of the nitrogen from new sources of wastewater. The wastewater is discharged to the ground where it flows to the Cape Cod Canal. This discharge is permitted by the Massachusetts Department of Environmental Protection (Mass DEP).

Bourne's Assets

- Existing Sewer Connections to Wareham
- Location Along Well-flushed Cape Cod Canal
- New Small Wastewater Treatment Facility Completed in 2020

Bourne's Challenges

- Inability to Increase Flow to Wareham Due to Wareham's Discharge Location
- Needs More Treatment Capacity to Provide Sewer Service to Existing Septic Systems

Among the many coastal assets in Bourne are Buttermillk and Little Buttermilk Bay – coastal waters polluted by nitrogen. There are 858 unsewered homes within the Buttermilk Bay watershed in Bourne. Many of these systems are failed, creating a public health concern in addition to a coastal water quality issue.

The town of Bourne has an estimated 1,070 ratepayers paying an average of $902/year in annual sewer rates.[6]

In 2020 the town of Bourne hired Environmental Partners to complete a town-wide CWMP, a process which is expected to be completed by 2023.

Massachusetts Maritime Academy

The Massachusetts Maritime Academy (MMA) is a Commonwealth of Massachusetts State University and owns and operates a wastewater treatment facility (WWTF) serving the campus. The WWTF is permitted by the US EPA to treat and discharge up to 77,000 gpd through a pipe directly to the Cape Cod Canal, but the average discharge is about 35,000gpd.[7] MMA eliminates bacteria in their discharge through treatment with an array of Ultraviolet (UV) disinfection lights but does not remove nitrogen.

MMA's Assets

- Permitted Discharge to Cape Cod Canal

MMA's Challenges

- Need to Expand Treatment Capacity to Accommodate Student Body

In order to grow the campus and student body, MMA needs additional treatment capacity.

Plymouth

The neighborhood in south Plymouth on the banks of Buttermilk Bay and directly adjacent to the Wareham/Bourne existing sewer network is miles away from Plymouth's municipal sewer system and includes 475 homes.

The on-site septic systems in south Plymouth are old and many are failing, creating both a public health concern as well as discharging nitrogen directly to Buttermilk Bay.

Plymouth's Assets

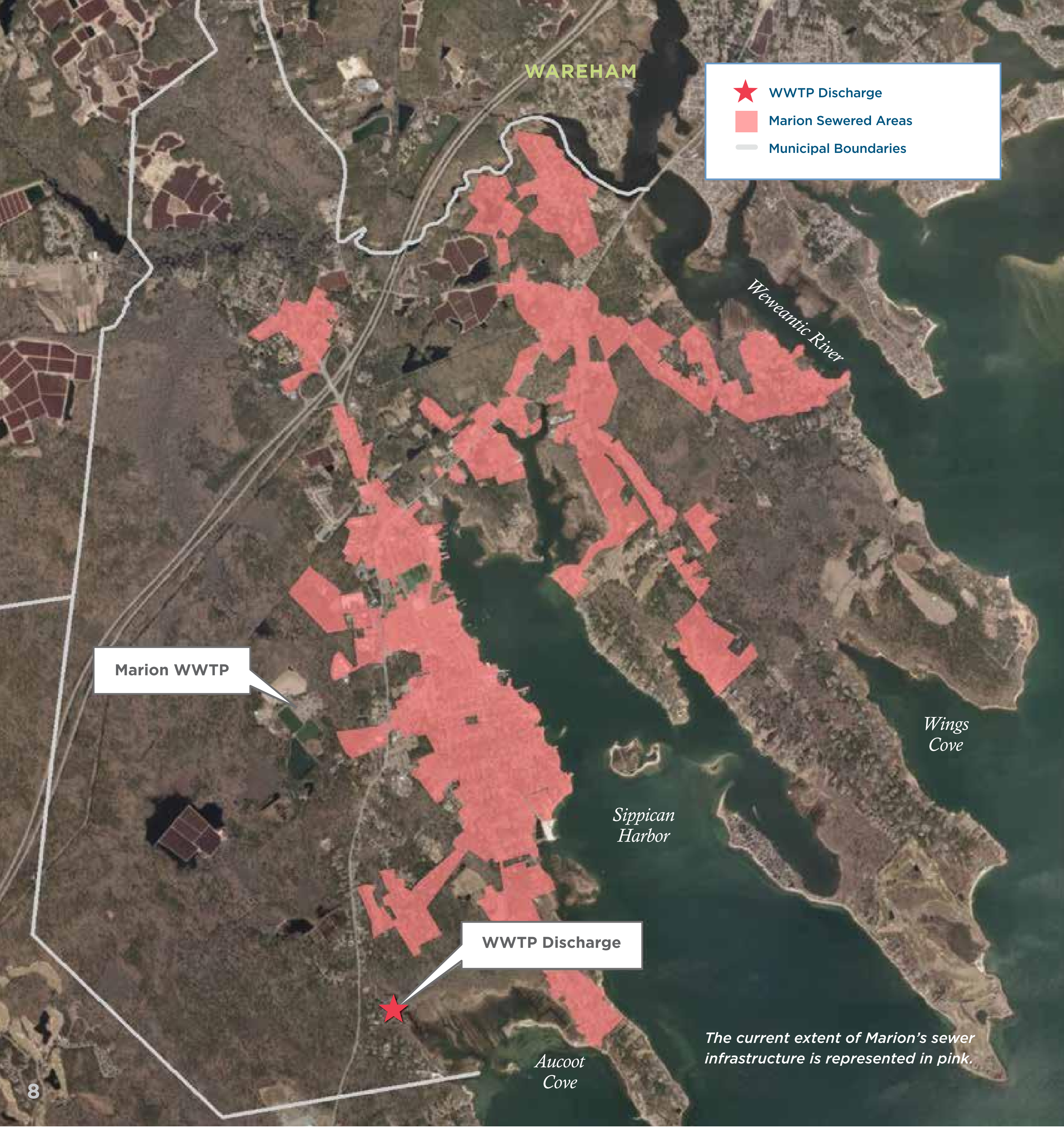
- Adjacent to Existing Sewer Infrastructure in Wareham

Plymouth's Challenges

- Need to Expand Sewer to Reduce Public Health Risks from Failed Septic systems and Reduce Nitrogen to Buttermilk Bay

In order to reduce or eliminate pollution from these septic systems and provide municipal sewer to this neighborhood, the town could consider connecting to the Wareham/ Bourne sewer network.

The current extent of Bourne's sewer infrastructure is represented in yellow. Bourne can send up to 200,000 gpd to Wareham for treatment and discharge. Bourne's new WWTP can treat and discharge up to 100,000 gpd to the groundwater which discharges to the Cape Cod Canal. MMA is identified in blue.


WAREHAM
WWTP Discharge
Marion Sewered Areas
Municipal Boundaries
Weweantic River
Marion WWTP
Wings Cove
Sippican Harbor
WWTP Discharge
Aucoot Cove
The current extent of Marion's sewer infrastructure is represented in pink.

Marion

Marion currently owns and operates a WWTF permitted by the US EPA and Mass DEP to treat and discharge an average of 588,000 gpd to a freshwater creek flowing to Aucoot Cove.[8]

Marion's current wastewater collection system provides wastewater treatment for an estimated 1,700 users with a rolling average daily discharge in 2018 of 571,000 gpd.[9] The average sewer user pays an estimated $1,532/year in sewer fees.

In 2018, EPA required Marion to meet a nitrogen limit of 4mg/L total nitrogen (90+% nitrogen removal). EPA also required Marion to reduce the amount of phosphorus discharged to the freshwater creek. In order to comply with the federal discharge permit, Marion must consider the following alternatives:

1. Upgrade the WWTF to meet a phosphorus limit and continue to discharge into the creek,
2. Relocate the wastewater outfall to a location that is beyond the freshwater stream, deeper into Aucoot Cove, or
3. Connect to a regional facility.

In 2020, the town of Marion hired Weston & Sampson to complete a CWMP and evaluate treatment and discharge alternatives, a process which is expected to be completed by 2022.

Marion's Assets

- WWTP Achieves 90%+ Nitrogen Removal
- Immediately Adjacent to Wareham Sewer Infrastructure

Marion's Challenges

- Discharges to Sensitive Stream
- Required to Upgrade Treatment for Phosphorus or Relocate Outfall
- At Treatment Capacity and Must Consider WWTP Expansion to Expand Sewer
- Limited Ratepayers Makes it an Expensive System to Operate

ESTIMATING THE SIZE OF A REGIONAL FACILITY

In order to restore water quality and coastal habitats, communities need to reduce dependency on conventional on-site septic systems. The Upper Bay Project evaluated how these communities could expand existing infrastructure, enhance treatment, and evaluated a discharge location to achieve potentially historic reductions in nitrogen pollution.

In order to estimate the size of the wastewater treatment facility needed to accommodate all communities. The project used best available information from each community to estimate future sewer needs.

The Project hired GHD to estimate sewer flows. GHD worked with each of the partners to develop potential future wastewater flows within Bourne, Wareham, Marion and Plymouth and MMA. The project intentionally used conservative wastewater volume assumptions in order to overestimate the need. These numbers will be refined as each community completes the CWMP process.

Initial flow estimates were completed in 2017 by GHD in an April 21, 2017 Technical Memorandum "Projected Wastewater Flows."

Flow Estimates by Community:

Bourne

GHD reviewed the 2012 buildout analysis completed by the Cape Cod Commission and CH2MHill, which projected theoretical build-out wastewater flows for downtown Bourne at 222,000 gpd from residential use and 943,000 gpd from future commercial use.[11]

Later, using Bourne's 2019 Long Term Management Plan, downtown Bourne sewer needs were reduced to 243,138 gpd. In addition to the downtown area, GHD estimated the wastewater flows from the 858 parcels in the potential sewer expansion area in the Queen Sewell Neighborhood.[12] Using 90% of the town of Bourne's average daily water use per residential property of 135 gpd, GHD estimated a potential average daily wastewater need from the Queen Sewell Neighborhood of 104,000 gpd. The total estimated sewer need for Bourne (existing and new) is 448,138 gpd. Assuming 100,000 gpd is treated at Bourne's new treatment plant, Bourne may send about 348,000 gpd to a regional WWTP.

Estimated Need:
348,000 gpd

Massachusetts Maritime Academy

MMA is considering growing the student body by about 250 students which would require additional wastewater treatment capacity. MMA would be looking to increase treatment capacity from 77,000 gpd to 100,000 gpd. MMA could consider abandoning its wastewater treatment facililty and instead send 100,000 gpd to a regional WWTP.

Estimated Need:
100,000 gpd

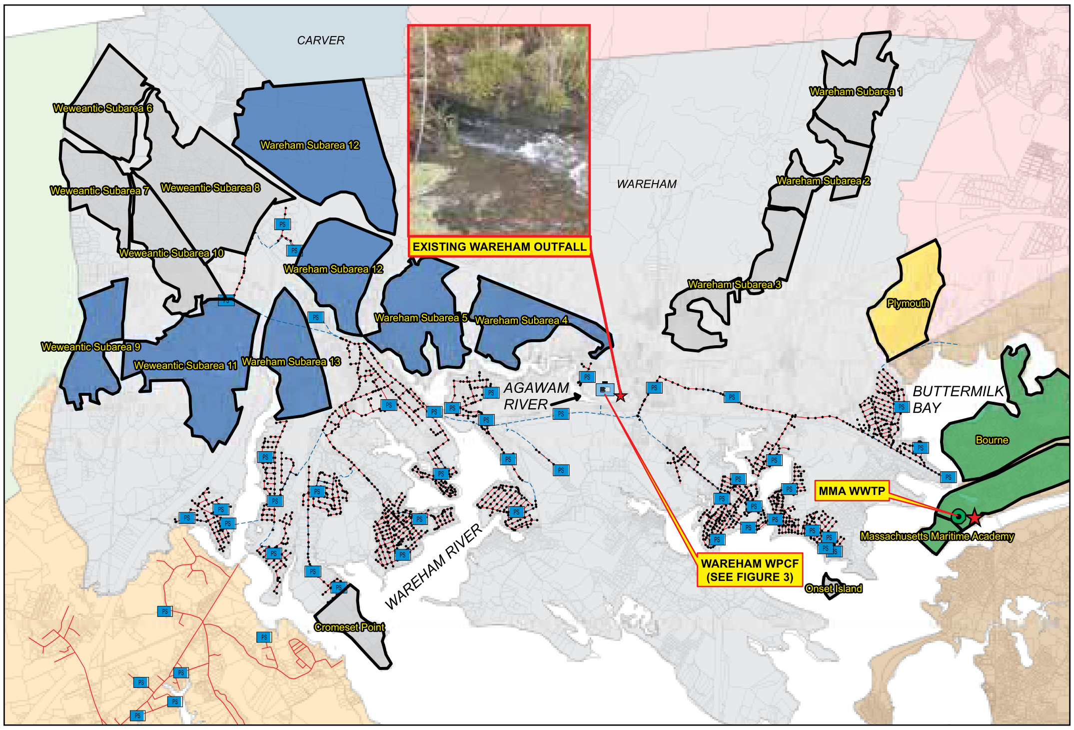
Plymouth

Working closely with the town of Plymouth, GHD estimated wastewater flows from the south Plymouth expansion area in 2016. GHD identified 475 parcels with on-site septic systems. No water use data exists for this neighborhood because these properties are on private wells. GHD used water use information from the town of Bourne and the town of Wareham to estimate water use. The average water use was calculated to be approximately 137 gpd per residential property. Using 90% of the water flow, the wastewater flow from Plymouth was estimated at 63,000 gpd.[13]

Estimated Need:
63,000 gpd

above *Sewer expansion area outlined in orange, with approximately 475 homes. Wareham sewer infrastructure shaded in purple.*

right *Existing sewer area shaded in yellow. Sewer expansion area outlined in orange, which includes approximately 858 homes. The blue line represents the Buttermilk Bay watershed.*



Wareham

In preparation for a future CWMP, in 2015 the town of Wareham hired BETA Inc., to complete a study of potential sewer areas. Thirteen sub areas were identified for future potential sewer expansion. Using water use records to estimate average daily flow, BETA estimated an average daily wastewater flow of 500,000 gpd for subareas 1-11 and 13.[14] Subarea 12, the Business Development Overlay District, was estimated to have a future wastewater flow of 500,000 gpd. Average daily wastewater flows were estimated by GHD in 2017 for Cromeset Point, 7,200 gpd, and Onset Island, 8,400 gpd, as well. Wareham later revised the priority sewer expansion areas estimating a new total flow of 726,000 gpd for a total need of 1,796,000 gpd.[15]

Estimated Need:
1,796,000 gpd

above ***Wareham priority sewer expansion area in blue generating approximately 726,000 gpd of new flow to a regional facility.***

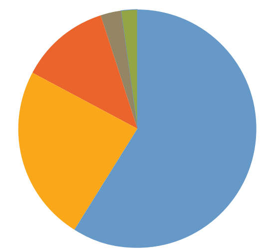
Marion

In 2017 GHD completed a flow estimate analysis to determine the maximum long-term sewer needs in the town of Marion and estimate how much flow Marion may send to a regional WWTP. This analysis estimated that if each buildable parcel was developed, Marion would require an additional 152,000 gpd for residential development and 112,000 gpd for commercial development beyond its existing flow.[16] In 2018, the rolling average daily flow from the town of Marion was 571,000 gpd, for a total estimated need of approximately 835,000 gpd. GHD presented these figures to the Marion Board of Selectmen on October 9, 2019. It was determined during that meeting, that the 835,000 gpd was likely too high. In early 2020, after Marion had hired Weston & Sampson to complete the CWMP, Marion estimated a future need of only 150,000 gpd for a revised total need of 721,000 gpd.[17] The final CWMP will better refine these estimates. In early 2020, Marion had not yet determined the location of additional sewer areas.

Estimated Need:
721,000 gpd

Total Estimated Regional Wastewater Treatment Need From All Partners:

ESTIMATED EXISTING AND FUTURE AVERAGE DAILY FLOWS*				
PARTNER	**EXISTING AVG DAILY FLOW (GDP)**	**NEW AVG DAILY FLOW (GDP)**	**TOTAL AVG DAILY FLOW (GDP)**	**% OF TOTAL REGIONAL DAILY FLOW**
Wareham	1,070,000	726,000	1,796,000	59%
Marion	571,000	150,000	721,000	25%
Bourne	101,000	247,000	348,000	12%
MMA	35,000	65,000	100,000	3%
Plymouth	0	63,000	63,000	2%
Regional Total			**3,028,000**	



*Figures rounded.

The table above shows existing average daily flows from each of the partners together with the estimated new flows from each partner for a total regional wastewater flow need of 3,028,000 gpd.

Further details on the original needs analysis completed in 2017 can be found in **GHD's April 21, 2017 Technical Memorandum "Projected Wastewater Flows"**.

The flow numbers used in this report are not the result of town-specific analysis completed by CWMPs, but were estimates taken from the best available information at the time. More refined CWMP estimates from each of the towns will likely continue to change future estimates of sewer needs. As those estimates evolve, the size of a wastewater treatment facility and the volume of discharge of treated water may also evolve.

POTENTIAL ESTIMATED NITROGEN REDUCTIONS

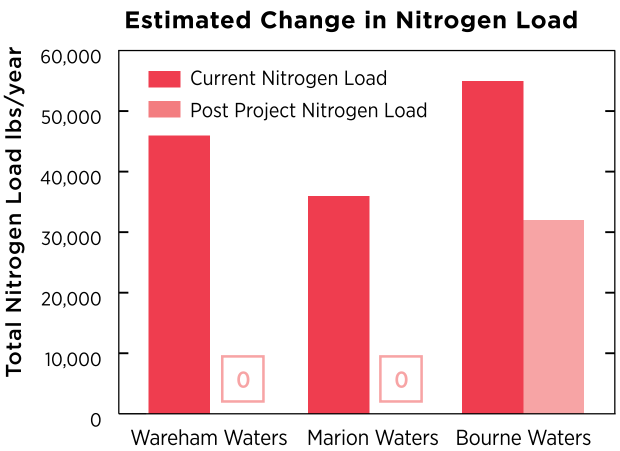
If the Wareham WPCF served as the regional WWTP for existing and future needs, the Project could eliminate nitrogen from an estimated 3,400 existing septic systems based on the analysis described above.

If the treated wastewater pipe was relocated from the Agawam to the Cape Cod Canal and sewer expanded to the estimated needs areas discussed above to discontinue the use of on-site septic systems, **an estimated 100,000 lbs of nitrogen pollution could be reduced from Buzzards Bay waters.**

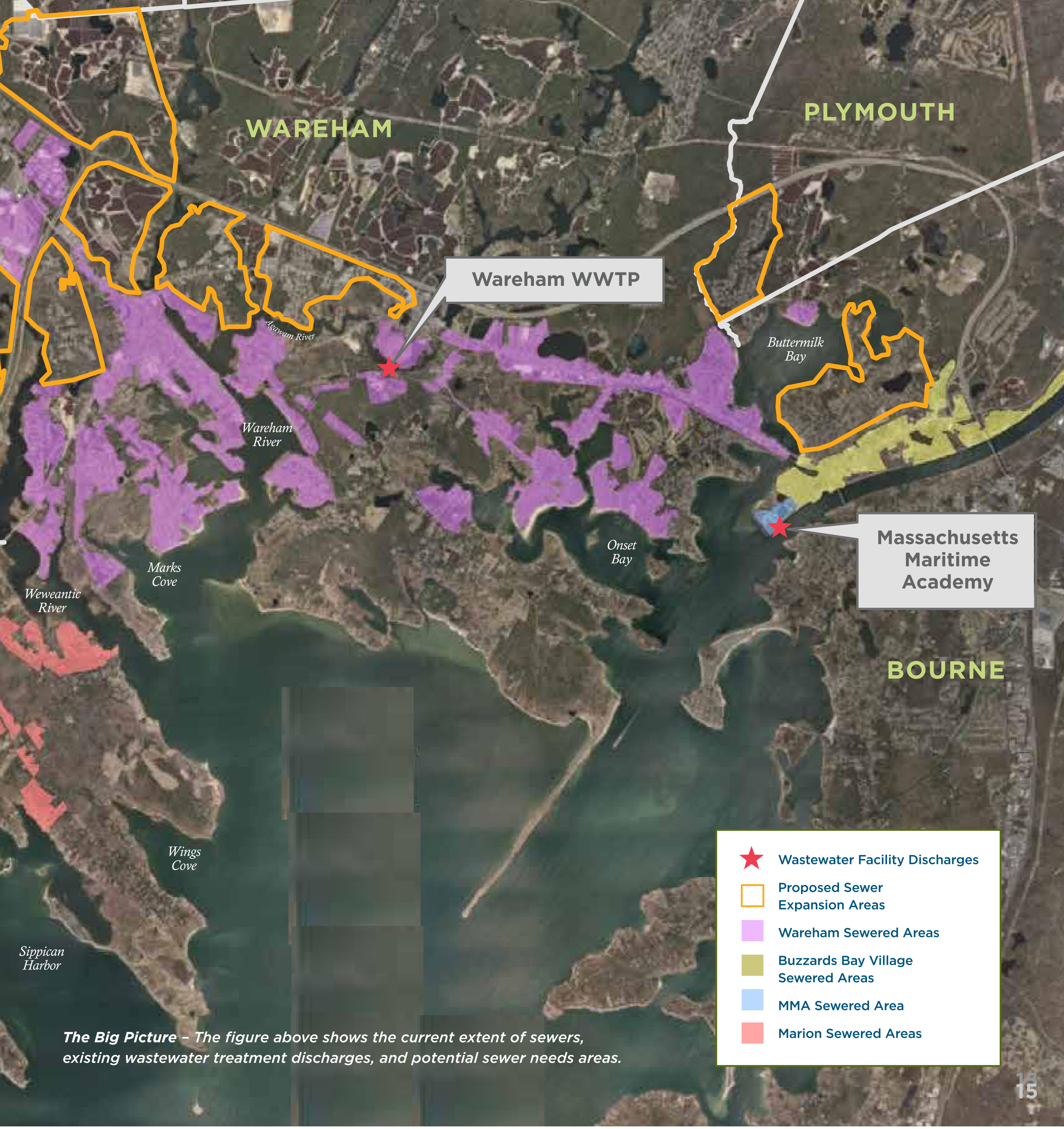
The following table provides the current load of nitrogen from existing wastewater treatment facilities and septic systems in the assumed needs areas.

	Estimated Nitrogen Load from Current Outfalls (LBS/YEAR)	Estimated Number of Existing Septic Systems in Needs Area Adding Nitrogen to Sensitive Waters	Estimated Nitrogen Load from Existing Septics (LBS/YEAR)	Total Nitrogen to Impaired Estuaries WWTP and Septics (LBS/YEAR)
Wareham	13,000	926	24,000	37,000
Marion	7,000	1,216	29,000	36,000
Plymouth	0	457	12,000	12,000
Bourne	0	858	20,000	20,000
MMA	1,000	0	0	1,000
TOTAL		**3,457**		**106,000**

If the current outfalls and existing 3,400 septic systems were all connected to one WWTP that reduced nitrogen by 95% and discharged to a less vulnerable location, an estimated 100,000 lbs of nitrogen would be eliminated from upper Buzzards Bay.



This graph shows the nitrogen reduction in each community with the Upper Bay Project.



The Big Picture *– The figure above shows the current extent of sewers, existing wastewater treatment discharges, and potential sewer needs areas.*

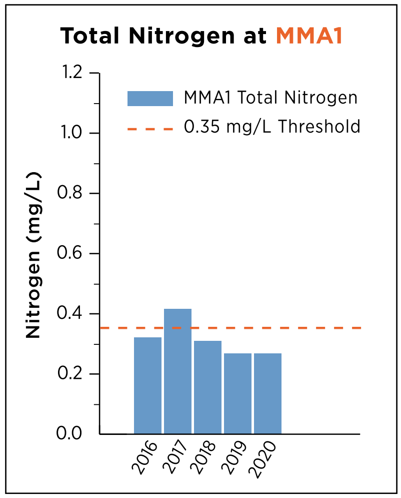
EVALUATING THE CAPE COD CANAL AS A DISCHARGE LOCATION

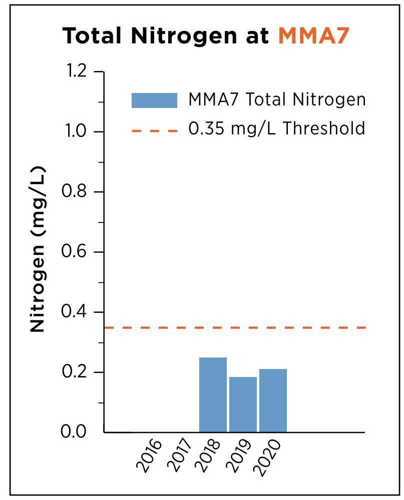
With potential flows estimated, the Project focused on the threshold question of whether the Cape Cod Canal is an appropriate discharge location for the estimated volume of treated wastewater.

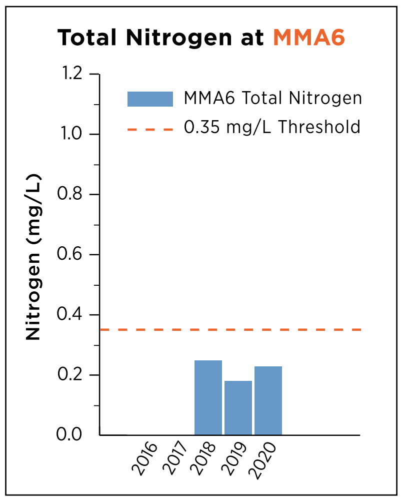
The purpose of the Project was to solve nitrogen pollution problems and not relocate nitrogen to a place where it would have an adverse impact. Understanding whether relocating Wareham's treated discharge pipe from the Agawam River to the Cape Cod Canal would have an impact on water quality in the Canal and surrounding nitrogen impaired estuaries was a critical evaluation.

The Massachusetts State Ocean Sanctuaries Act requires a robust suite of scientific studies to be performed to determine whether a wastewater outfall is environmentally sound.[18] The project worked with state agencies to design and carry out the necessary studies.

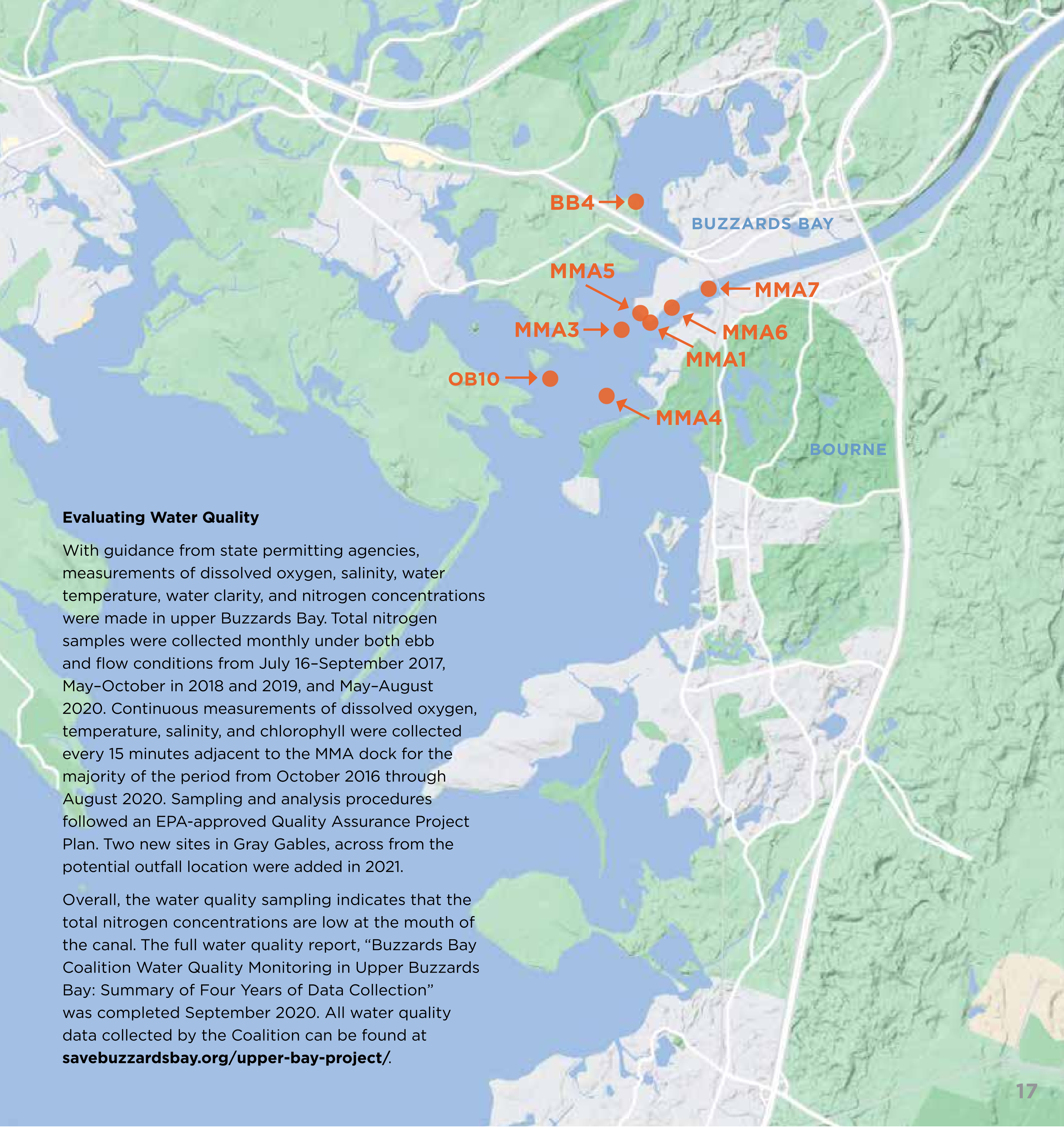
The project began collecting water quality data in 2016, completed an eelgrass survey in 2019, a finfish assessment in 2020, and an analysis of bottom habitat in 2020.







Nitrogen levels below .35 mg/L are considered healthy and contribute to good water clarity and fish and shellfish deversity.



Evaluating Water Quality

With guidance from state permitting agencies, measurements of dissolved oxygen, salinity, water temperature, water clarity, and nitrogen concentrations were made in upper Buzzards Bay. Total nitrogen samples were collected monthly under both ebb and flow conditions from July 16–September 2017, May–October in 2018 and 2019, and May–August 2020. Continuous measurements of dissolved oxygen, temperature, salinity, and chlorophyll were collected every 15 minutes adjacent to the MMA dock for the majority of the period from October 2016 through August 2020. Sampling and analysis procedures followed an EPA-approved Quality Assurance Project Plan. Two new sites in Gray Gables, across from the potential outfall location were added in 2021.

Overall, the water quality sampling indicates that the total nitrogen concentrations are low at the mouth of the canal. The full water quality report, “Buzzards Bay Coalition Water Quality Monitoring in Upper Buzzards Bay: Summary of Four Years of Data Collection” was completed September 2020. All water quality data collected by the Coalition can be found at **savebuzzardsbay.org/upper-bay-project/**.

Benthic Analysis – Bottom Habitat

The sediment characteristics and the organisms present in the sediments at the bottom of the ocean provide valuable information about overall ecosystem health.

Sediments with a high number of many different species typically indicate healthy habitats. Sediment samples were collected at five stations in Upper Buzzards Bay; MMA3, MMA4, MMA5, MMA6, and MMA7. The seafloor located in the fast current of the Cape Cod Canal, was predominately a mussel bed and cobble. The seafloor at site MMA4 consisted of eelgrass and coarse and medium sand bottoms, whereas MMA3, had a coarse sand bottom without eelgrass present. Lastly, the seafloor at MMA5 was covered with a slipper shell community and was where the highest number of species and individual organisms were present.

While each area is unique, stations located outside of the canal (MMA3, MMA4, MMA5) had higher species diversity compared to stations located within the canal (MMA6 and MMA7). This is consistent with the extremely strong currents through the canal that can scour sediments making it a challenging environment for many species to survive despite the excellent water quality.

The full Benthic Analysis was completed in January 2020.

FinFish Resource Assessment

The goal of this study was to document the baseline conditions with respect to finfish in the area of a potential discharge. This baseline analysis is required by state law before any approval of an ocean discharge can occur. To assess the baseline conditions of finfish resources near the proposed discharge, trawl data from the Massachusetts Division of Marine Fisheries was compiled for a 10-year period from Upper Buzzards Bay and Cape Cod Bay near the Canal exits. Data from 250 trawls were analyzed. The study found that with vigorous currents and tidal flows and an estimated 56-80 billion gallons of water flowing through the canal every day, the Canal environment serves primarily a short-term habitat used by fish, with migrating fish passing through the Canal and the type of fish in the Canal changing over the course of the year. Establishing this finfish baseline under current conditions is important to assess whether any changes occur to finfish populations with any potential future changes in wastewater discharges.

Eelgrass

Eelgrass beds are highly productive underwater areas that act as a nursery, habitat, and feeding ground for many fish, waterfowl, and invertebrates. The Buzzards Bay National Estuary Program's Comprehensive Conservation and Management Plan identifies loss of eelgrass due to excess nitrogen as a priority concern. The sensitivity of eelgrass to nitrogen pollution also make it an ideal indicator species for changes in water quality. The Project assessed two eelgrass beds, one in close proximity to a potential new discharge and one in an area considered out of the area of influence of a potential new discharge location.

The location in close proximity to the discharge (off Taylor's Point) was mapped in order to have a baseline near the potential discharge. The location out of the area of influence (off of Mashnee Island) could provide a control bed for comparison in order to account for impacts unrelated to the discharge (e.g., temperature, disease).

The Eelgrass Survey was completed by the MA Division of Marine Fisheries from 2018-2019.

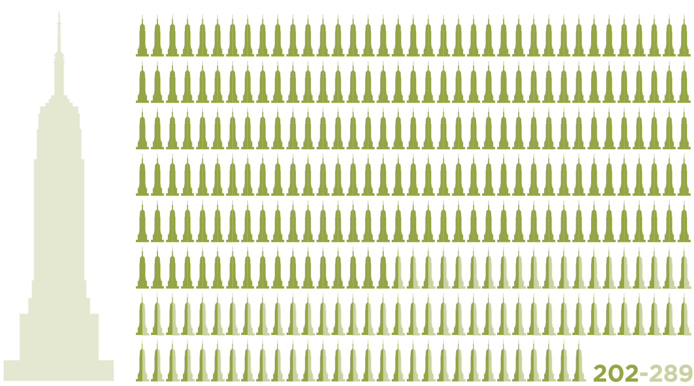

Benthic Stations
Existing MMA Outfall
Eelgrass
Massachusetts Maritime Academy
Taylor Point
MMA5
MMA3
MMA6
MMA7
MMA4
Onset Bay
Cape Cod Canal
Widows Cove
Phinneys Harbor
Mashnee Island
Tobys Island

Will an increase discharge at the canal adversely impact water quality?

Hydrodynamic Study

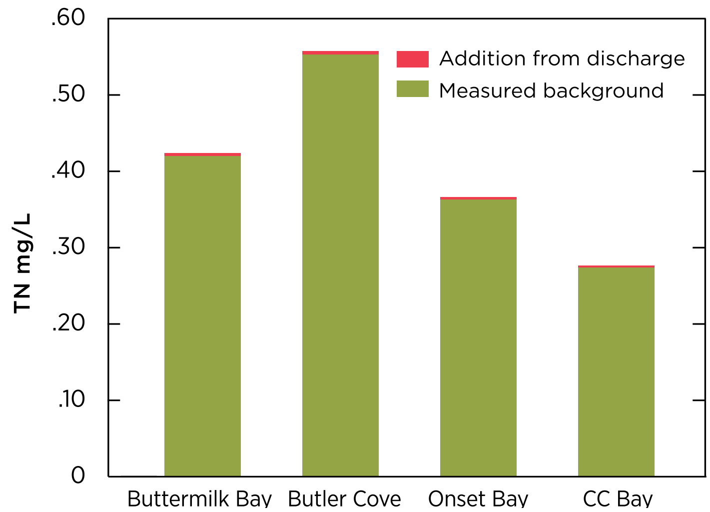
To answer this question the Project retained the Woods Hole Oceanographic Institution (WHOI) in 2017 to build a model to determine the effect an increased discharge of treated wastewater at an outfall at MMA would have on water quality. The analysis was completed in two parts. First, WHOI estimated how the nitrogen is currently distributed in the water at the MMA discharge location. Second, they used hydrodynamic and plume-tracking models to estimate how increased nitrogen at this location will impact water quality.

Even though the estimated treated discharge is 3.5 mgd, the hydrodynamic and plume-tracking model used a high flow estimate of 10 mgd and a low end flow estimate of 3 mgd to measure a range of impacts. WHOI estimates the Canal moves approximately 56-80 billion gallons of water each day – a staggering volume equal to filling 202-289 Empire State buildings every day.



After running the model with a hypothetical discharge of 10 mgd and 3 mgd, the model results consistently show that the discharge would not adversely impact the coastal environment.

The Hydrodynamic Analysis, "Assessing the Impact of Increased Effluent Discharge into Cape Cod Canal" was completed in 2017.



This graph illustrates the small addition of nitrogen from a 3.5 mgd discharge at MMA's Cape Cod Canal discharge location. This table does not reflect the reduction in nitrogen due to the expansion of sewer and elimination of approximately 100,000 lbs of nitrogen currently being discharge to Buzzards Bay.

CONCLUSION

The science completed to date indicates that an increased discharge of highly treated wastewater at an estimated volume of 3.5 mgd at the canal will not have an adverse impact on existing water quality in the surrounding area. In fact, the overall nitrogen load to the upper Bay will be reduced by an estimated 100,000 lbs yielding anticipated large improvements to water quality and fisheries.

ALTERNATIVES FOR MOVING THE DISCHARGE PIPE

The next question the Project sought to answer was how to relocate the discharge pipe from the Agawam River to the Cape Cod Canal. Two separate environmental engineering firms were consulted to evaluate the pipe realignment. Those reports are summarized here.

The BETA Group Report

The project engaged BETA Group based in Lincoln, Rhode Island in 2018 to complete the preliminary realignment evaluation. BETA assessed three primary routing alternatives including a roadway (Route-6/Route-28), a railway, and Hybrid approach together with a variety of construction techniques to relocate a new treated effluent force main. In order to evaluate whether the Railway line was a feasible alternative, BETA relied on a survey completed by the Project in 2016 by Green Seal Environmental which provided a right-of-way (ROW) survey of the rail line between Wareham and Bourne. This 2016 survey provided an update to an 1878 survey of the rail line.

BETA concluded that relocating the discharge from the Agawam River to the Cape Cod Canal will require construction of approximately 4.4 miles of new 24 inch force main and a new outfall to the Cape Cod Canal.

BETA evaluated the estimated 4.4 mile stretch in 3 different segments:

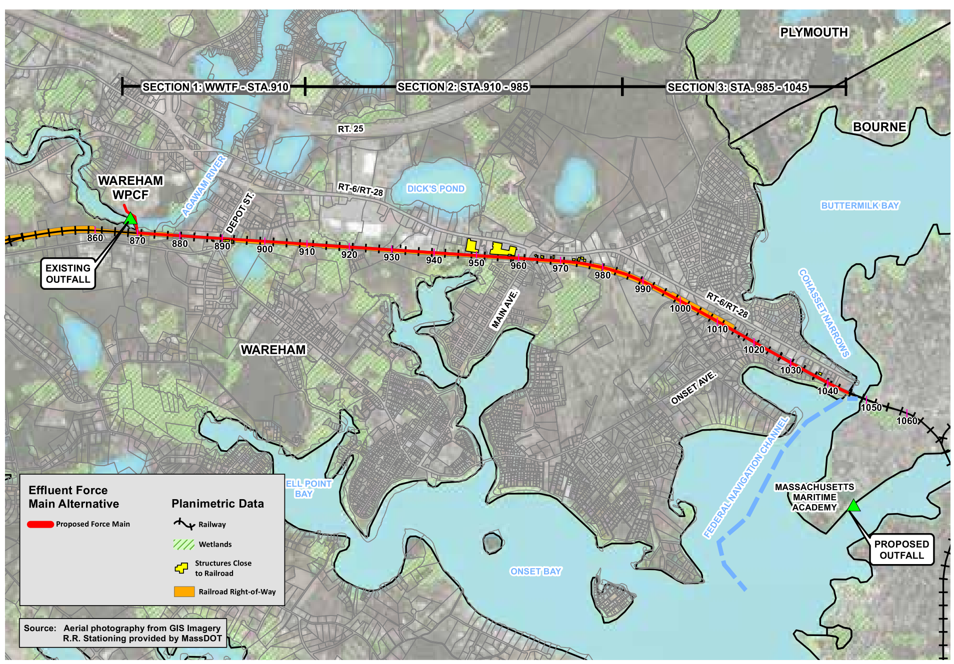
Segment 1: Wastewater Treatment Facility to Cohasset Narrows (a total of 3.8 miles).

Segment 2: Cohasset Narrows Crossing.

Segment 3: Cohasset Narrows to the Canal at MMA's current discharge location.

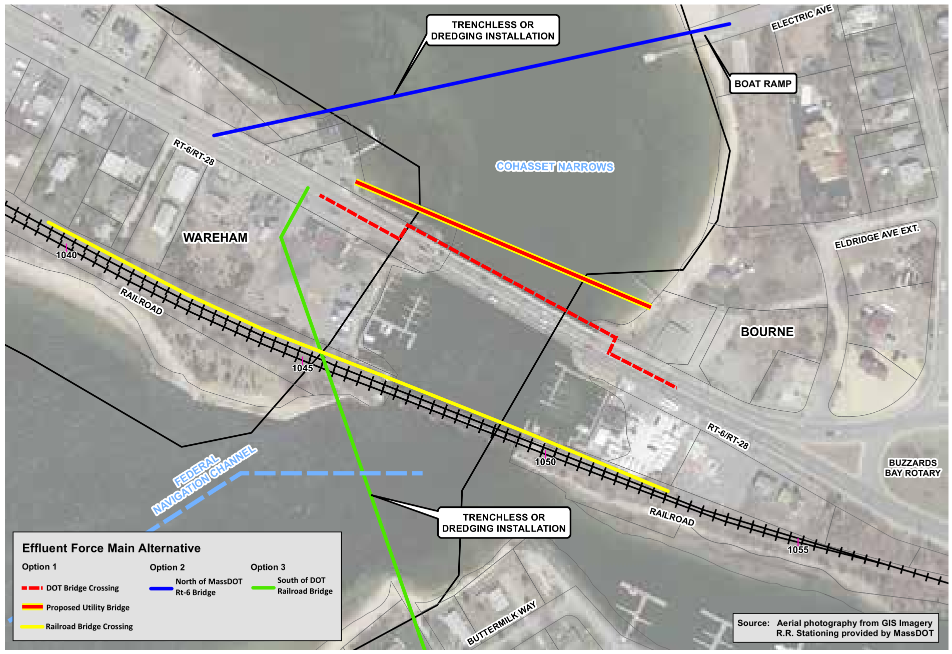
Segment 1

BETA recommended routing the effluent force main along Route-6/Route-28 through open cut construction. This alternative avoids construction within wetlands and their jurisdictional areas. While open-cut construction along Route-6/Route-28 will call for lane closures and traffic disruptions, BETA concluded that the benefits of installation within this route outweigh the challenges associated with approvals, permitting, construction and cost for the installation of the pipeline with the railway ROW.



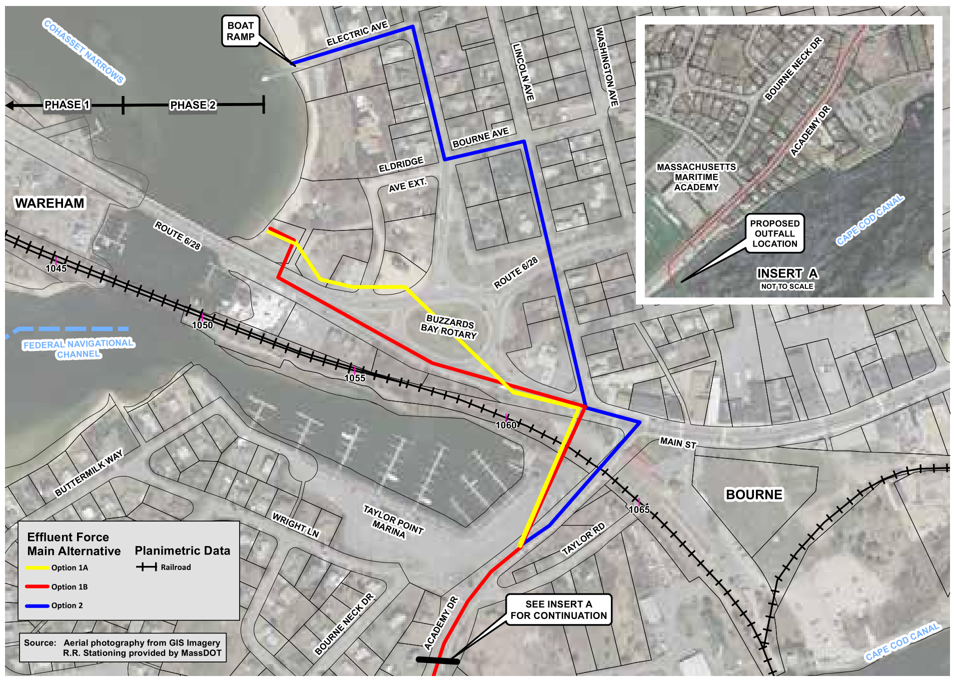
Segment 2

Unfortunately, the existing bridges were not designed to carry the weight of a 24-inch force main. BETA evaluated whether a sub-aquatic crossing could occur via dredging or trenchless directional drill north or south of the existing bridges. BETA was reluctant to recommend trenchless without a more thorough subsurface investigation to determine whether the presence of boulders would present challenges. Ultimately, BETA recommended that a new utility bridge be constructed. BETA concluded that a utility bridge proposes fewer risks, challenges, and permitting restrictions, and provides an opportunity to provide a dedicated pedestrian crossing of the narrows.



Segment 3

BETA evaluated three routes from Cohasset Narrows to the proposed outfall location in the Cape Cod Canal off Academy Drive. BETA's preferred alternative continues from the hypothetical utility bridge, passes through the middle of the Buzzards Bay Rotary (thereby avoiding Rt-6/Rt-28 and work hour restrictions) with less impact on traffic.



BETA Opinion of Probable Cost

The total estimated cost for construction of a treated force main for all 3 segments, a new pump station at the Wareham WPCF and the reconstruction of the MMA Outfall at the Cape Cod Canal, including engineering is $64,100,000.

Preliminary opinion of probable costs are based on 2018 dollars and includes a planning level contingency of 30%. If the project progresses it is critical that the costs are updated at each stage of the planning and design process.

The BETA report, "WPCF Effluent Force Main Routing Alternatives Analysis" was completed in September 2020.

Overall Project Opinion of Cost
Concept Plan Level

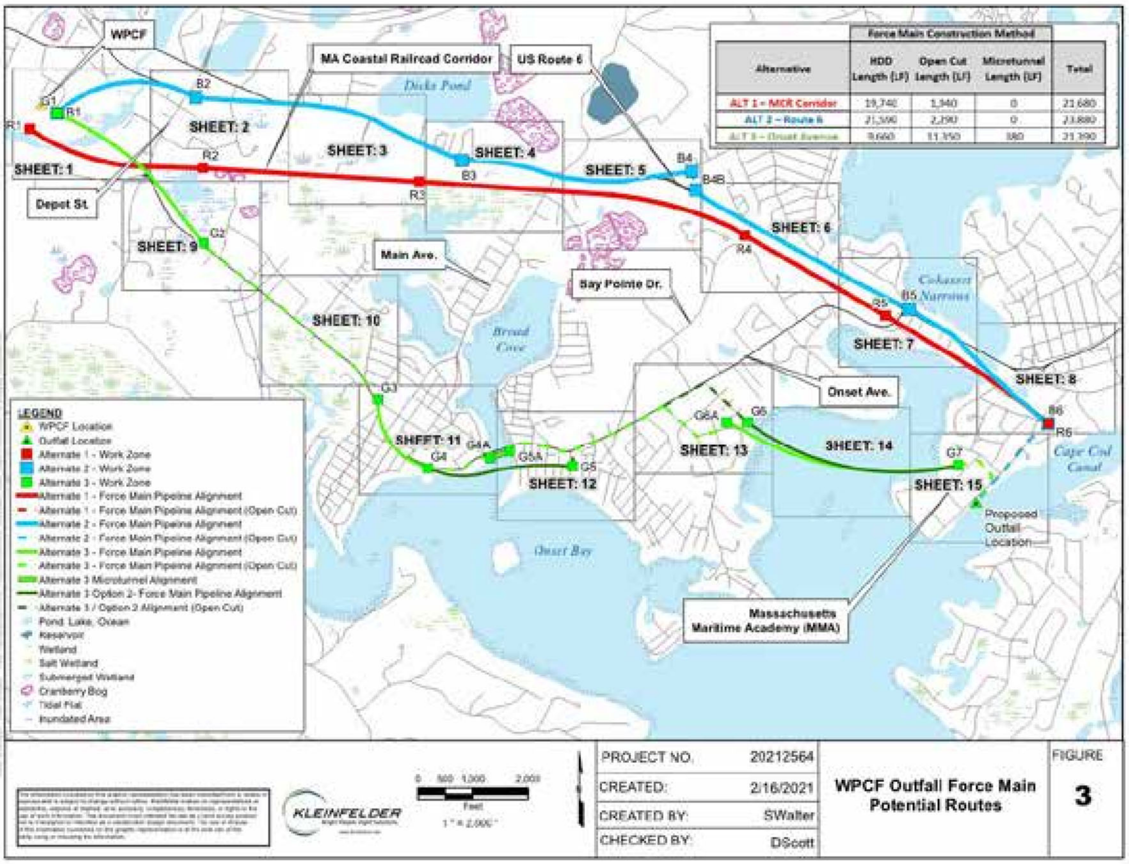
CONSTRUCTION COSTS	
Phase I Construction	$22,400,000
Phase 2 Construction	$4,300,000
Phase 3 Construction	$10,300,000
Effluent Pump Station	$10,000,000
Effluent Force Main Outfall	$4,000,000
Construction Subtotal	**$51,000,000**
ENGINEERING	
Design (10%)	$5,300,000
Construction – Resident Inspection (15%)	$7,800,000
Project Total	**$64,100,000**

Kleinfelder Report

In 2020 the town of Wareham hired the engineering firm, Kleinfelder, to do a further evaluation on constructing a force main for treated wastewater from the Wareham WPCF to the Cape Cod Canal through horizontal directional drilling. Horizontal directional drilling is a trenchless method of installing underground pipe where a directional drilling machine drills a deep hole (approximately 100 feet underground) to install pipe. Kleinfelder assessed three alternatives including, the railway, route 6/28 and Onset Avenue. Kleinfelder reviewed the boring logs from MassDOT plans for the existing Bourne-Wareham bridge over Cohasset Narrows as well as boring data from the reconstruction of route 6 and 28 to better understand subsurface conditions. Klenifelder concluded that the railway route was the best alternative for subsurface drilling as the majority of the construction can be completed with minimal impact to the public and has the most advantages from a constructability standpoint. Kleinfelder anticipates that construction would take approximately 29 months including planning and permitting with actual construction lasting approximately 11 months.

The estimated cost of horizontal directional drilling is $48 million or 24% cheaper than the over land option evaluated by BETA.

Kleinfelder produced a Technical Memorandum in 2021 for Wareham "WPCF Outfall Force Main Feasibility and Routing Analysis". The town of Wareham continues to work with Kleinfelder in refining the potential costs of this alternative.



CONSTRUCTION COSTS	
Mobilization/Demobilization (5% less Outfall and Pump Station)	$786,300
HDD Related Costs	$14,885,270
Open Cut Related Costs	$273,000
Microtunnel Costs	$0
Outfall (24-inch and including mobilization)	$4,000,000
Pump Station (7 MGD and including mobilization)	$10,000,000
Misc. Costs (Restoration, Traffic Management, Utility Relocation, etc.)	$567,800
Construction Total Cost (Rounded)	**$30,512,000**
Trenchless Risk Contingency (30%)	$3,101,400
General Construction Contingency (20%)	$6,102,400
Total Construction Cost Including Contingencies (Rounded)	**$39,716,000**
ENGINEERING COSTS	
Preliminary and Final Design (12%)	$4,765,900
Engineering Services During Construction (10%)	$3,971,600
Total Engineer Cost (Rounded)	**$8,738,000**
Total Construction and Engineering Costs (Rounded)	**$48,454,000**

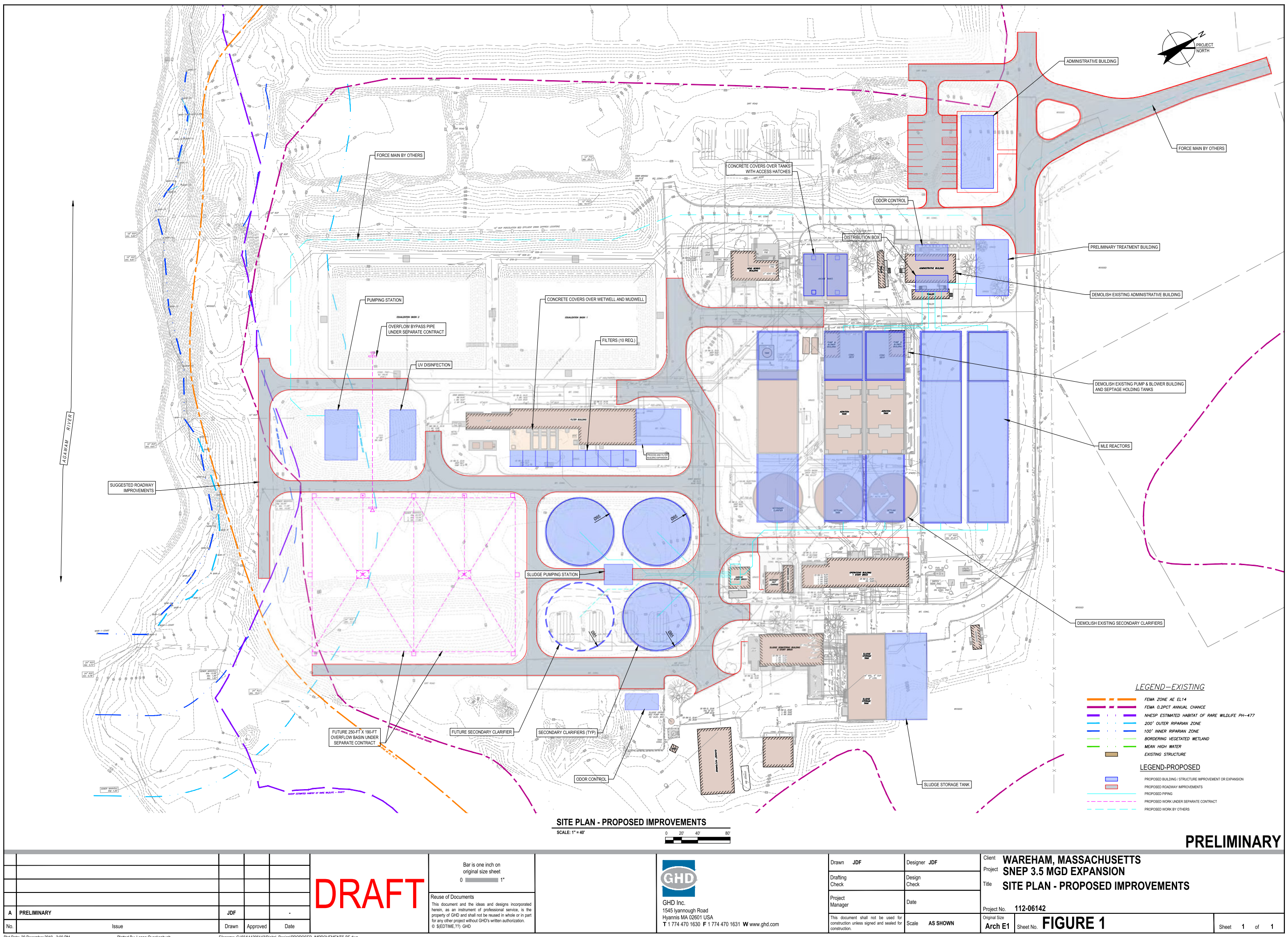
WASTEWATER TREATMENT EXPANSION REQUIREMENTS

While the Wareham WPCF has excess capacity of approximately 440,000 gpd, the WPCF would need to be expanded by 1.5 mgd to accommodate the sewer needs of all the partners. This estimate assumes that all partners elect to participate in a regional solution and that the sewer needs estimated in this report are close to those needs determined through each town's CWMP process. The entire project needs a wastewater treatment facility capable of treating 3.5 mgd average daily flow.

Fortunately, the Wareham WPCF site has space for expansion outside of the flood zone.

In 2018 the project contracted with GHD to complete a plant expansion alternatives analysis to determine the best way to provide the best treatment to meet the needs of all communities.

Three separate treatment options were considered for the WPCF expansion including; alternative technology,



Conceptual layout of 3.5 mgd WWTP

a new treatment plant, or additional tanks and processes to the existing facility. GHD concluded that adding tanks and process to the existing facility was the preferred alternative as the existing technology has shown to operate well and meet treatment limits. The current treatment system has moderately lower capital construction costs as well as lower operating and maintenance costs compared to other technologies.

Alternatives for solids treatment were also considered. Ultimately, flexibility to switch between thickened and dewatered sludge was required due to the volatility in the sludge disposal market and a shortage of disposal locations. This gives the plant the flexibility to dispose of thickened sludge when the thickened sludge market is favorable and dewatered sludge when the dewatered sludge market is favorable. One of the major disadvantages of the other alternatives considered was the cost to construct the additional processes.

Engineers' Opinion of Probable Costs for infrastructure were developed as part of this initial planning process and are based on 2018 dollars. It is important to note that as the project progresses, it is critical that these costs are refined and updated. The total capital costs to upgrade the existing 2 mgd plant to 3.5 mgd is estimated at $100,000,000.

Engineers' Opinion of Probable Construction Costs for MLE

COMPONENT	INCREMENTAL COST EXISTING PLANT TO 2.5 MGD	INCREMENTAL COST EXISTING 2.5 MGD TO 3 MGD	INCREMENTAL COST 3 MGD TO 3.5 MGD	TOTAL UPGRADE PROBABLE COST EXISTING PLANT TO 3.5 MGD
Preliminary Treatment	$2,100,000	$0	$0	$2,100,000
MLE Reactors	$8,700,000	$2,300,000	$2,300,000	$14,100,000
Clarifiers	$4,400,000	$1,700,000	$0	$6,000,000
Denitrification Filters	$3,200,000	$400,000	$400,000	$4,000,000
UV Disinfection	$1,800,000	$200,000	$200,000	$2,200,000
Effluent Pump Station	$3,600,000	$100,000	$0	$3,600,000
Solids Treatment	$3,300,000	$200,000	$200,000	$3,600,000
Septage Receiving Building Rehab	$400,000	$0	$0	$400,000
Odor Control	$900,000	$900,000	$0	$1,800,000
Process & Filter Building	$1,500,000	$700,000	$0	$2,200,000
Operations Building Allowance	$0	$0	$500,000	$500,000
Administration Building	$0	$1,100,000	$0	$1,100,000
Electrical & Instrumentation	$4,500,000	$1,100,000	$500,000	$6,200,000
HVAC	$900,000	$200,000	$100,000	$1,200,000
Yard Piping	$1,500,000	$400,000	$200,000	$2,100,000
Site Work	$1,500,000	$400,000	$200,000	$2,100,000
Plumbing, Painting	$600,000	$100,000	$100,000	$800,000
General Conditions	$3,600,000	$900,000	$400,000	$5,000,000
Subtotal of Construction Costs	**$42,000,000**	**$11,000,000**	**$5,000,000**	**$59,000,000**
Contingency	$12,700,000	$3,200,000	$1,500,000	$17,700,000
Total Construction (ENR – Oct 2019 = 11326)	**$55,000,000**	**$14,000,000**	**$7,000,000**	**$77,000,000**
Fiscal, Legal, Engineering Allowance	$16,500,000	$4,200,000	$2,100,000	$23,100,000
Total Capital Costs (ENR – Oct 2019 = 11326)	**$72,000,000**	**$18,000,000**	**$9,000,000**	**$100,000,000**

It is possible, and even probable, that not all communities decide to pursue a regional partnership as an option. Changes in participation will change the amount of wastewater required to be treated and therefore may change the size of the plant constructed. In order to take those contingencies into account, the cost estimates to expand the WPCF were broken down into increments.

The design phase is approximately 16 months, the bidding is approximately 5 months, and the construction is approximately three and a half years. Notably, this is an ambitious schedule and assumes all partners complete their individual CWMPs.

If this project moves forward, the design of the wastewater treatment facility will include redundant treatment measures in order to avoid discharges that would impact receiving waters and the natural resources contained therein.

Operating Costs

The current operations and maintenance costs of the Wareham WPCF are $5,700,000. That cost would increase by $1,200,000 (2025 dollars) with an expansion to 3.5 mgd. These costs could be spread among all the partners in proportion of partner usage.

THIRD PARTY REVIEW

While the Project had every confidence in the contract engineers selected, the magnitude of this project warranted a third party review of the work completed. In 2020, the Project selected Wright Pierce to review the BETA and GHD reports. Wright Pierce offered comments and questions on both reports and concluded that the alternatives analysis, cost assumptions, and overall recommendations presented in the reports are consistent with industry practice, reasonable, and sound.

COSTS

The cost to each community will depend on several factors including but not limited to, which communities decide to move forward with this wastewater alternative and how much wastewater treatment each community needs.

The estimated costs presented here assume all partners participate and the sewer needs estimated are accurate. The total costs include the costs generated by GHD for the expansion of the existing WPCF to 3.5 mgd and Kleinfelder for the pipe relocation. Kleinfelder's estimated costs were used as horizontal directional drilling is the preferred construction method at this point in the Project's evaluation due to the low environmental construction impact, quick construction timeframe, and cost.

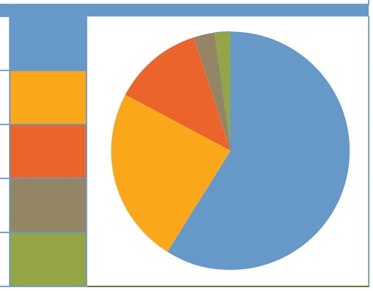
The cost assumptions developed for the Project have been developed over the course of the last three to four years and do not necessarily reflect actual inflation. Communities should escalate the costs provided in this report for inflation when comparing a regional solution to independent wastewater solutions.

Assuming that all partners participate and estimated capital costs are allocated proportionally to the estimated volume of wastewater flow from each partner, costs for relocating the discharge pipe using Kleinfelder's directional drilling costs and upgrading the wastewater treatment facility are as follows:

Estimated Project Capital Costs

Pipe Realignment	$48,454,000
WPCF Upgrade to 3.5 mgd	$100,000,000
Total Cost	**$148,454,000**

PARTNER	COST	% OF TOTAL
Wareham	$87,600,000	59%
Marion	$35,600,000	24%
Bourne	$17,800,000	12%
MMA	$4,500,000	3%
Plymouth	$3,000,000	2%



The costs are allocated to each community based on the percentage of flow treated at the WPCF and include engineering and contingencies. All costs are rounded to the nearest $100,000.

Operating Costs

GHD estimates 2025 operating costs for a 3.5 mgd WWTP at $6,900.000/year. Operating costs should be based on the amount of flow treated at the WWTP from each of the communities on an annual basis. For the purposes of this report, the project assumes that each of the communities contributes their maximum allotment, the operating costs would be apportioned as follows:

Estimated Annual Operation and Maintenance of Regional WWTP

	Wareham	Marion	Bourne	Mma	Plymouth
Plant Operation	$4,071,000	$1,656,000	$828,000	$207,000	$138,000

These operating costs cover the shared infrastructure. These costs do not include the existing and on-going operation and maintenance costs of each partners' individual existing sewer collection systems and pump stations or any future collection systems.

Important Note On Relative Costs: It is important to understand that if the volume of wastewater that needs to be treated changes through refined numbers from CWMPs or if some partners decide to purse this option and others do not, the relative cost to each partner will change.

Additional Future Cost Considerations

How neighboring communities connect to Wareham's existing infrastructure to send wastewater to a WWTP will result in additional costs. The partnership received a grant in 2020 to develop a model of all the existing sewer infrastructure in the town of Wareham to clearly understand the available capacity to existing pipes in the ground. This model will allow the partners to identify suitable connection points and estimate the cost of connection.

This model can be run to evaluate whether Bourne's existing connection has sufficient capacity to transport increased flow to the WPCF as well as determine where in Wareham's infrastructure Marion could connect in order to transport Marion's existing flow.

RATEPAYER ANALYSIS

Understanding the impact to ratepayers is a critical detail communities will evaluate.

The Project created a financial model for partners to use to evaluate the impact wastewater capital projects, together with on-going operations and maintenance, will have on new and existing ratepayers and tax base over time. The model allows communities to compare how current sewer rates may be impacted by the costs of a regional project or an independent "go-it-alone" solution. The model will help determine whether it is more economical to participate in a regional solution or upgrade individual wastewater treatment facilities to attain the same environmental benefit. Finally, the model allows communities to compare different financing opportunities.

The project contracted with Abrahams Group in 2019 to create the model. The Abrahams Group has worked with several of the communities in the SNEP Region including developing sewer financing plans for Orleans and Provincetown, and served as a consultant to the Cape's 208 Area Wide Management Plan.

The Project provided the Abrahams Group with current wastewater budgets as well as current and planned capital projects, and debt service schedules for all partners. This information was used to populate a model for each partner with their current funding information including current sewer rates, tax rates, annual operation and maintenance budgets as well as current and known debt service for capital projects.

The model was created in such a way as to provide sufficient flexibility for partners to amend cost estimates, projected grant revenues and financing assumptions. Once each community has a final CWMP with more refined cost estimates, those new costs can be input into the model to run the cost comparison.

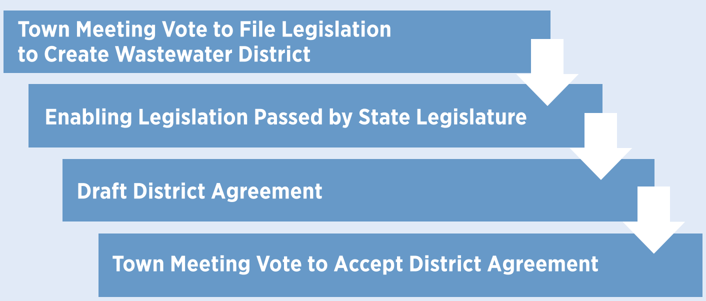
In an effort to verify the utility of the model, it was presented to three municipal financial experts, former Dartmouth, Fairhaven, and Mattapoisett Town Administrators, Jeff Osuch and Michael Gagne, and former Executive Director of the Boston Water & Sewer Commission and Water Resource Financial Consultant to the Cape Cod Commission, Robert Ciolek, for review and feedback. All agreed that the financial model was an asset to communities determining ratepayer level impact of the project. The model is now available to each community together with a tutorial.

HOW TO WORK TOGETHER – The Creation of a Wastewater District

Multiple communities and a state university sharing a regional wastewater treatment facility and outfall requires consensus on how such a partnership might operate. The Project evaluated whether the group might create a regional wastewater district or negotiate multiple inter-municipal agreements. Between 2018 and 2020 representatives from all the partners met to consider whether the communities should work through separate inter-municipal agreements or create a separate regional wastewater district. Ultimately, the creation of a regional wastewater district was considered the preferred approach as it evenly distributes the authority among participating communities.

A regional sewer district is created by an act of the state legislature. The purpose of a District is to manage and control the wastewater treatment plant, interceptors, discharge locations and to provide for the collection, treatment, discharge of effluent for the member towns. The district is a body politic and corporate and political subdivision of the Commonwealth. The duties, powers, and liabilities of the District are defined by the enabling legislation and through a District Agreement. A District Authority is not bound by proposition 2½ and includes its own borrowing authority.

Process to Create a Wastewater District



The project evaluated Mansfield-Foxborough-Norton (MFN) Regional Wastewater District as a model and met with the MFN Executive Director. The MFN was established in 2015 and contained the mix of infrastructure assets, including a wastewater treatment facility located in one town and a discharge located in a neighboring community, providing an analogous model to the mix of assets and ownership for the upper Bay communities.

In the case of MFN, the District Agreement includes but is not limited to:

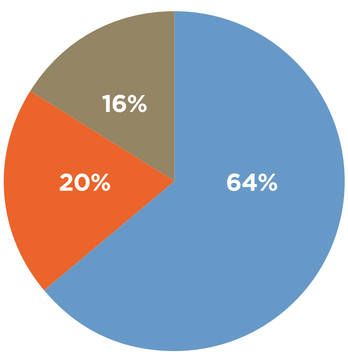
- **Defining the common sewer infrastructure owned by the District.**
- **Defining the make-up of the governing Commission including representation from each of the communities, the terms of those representatives, the process for member resignation or removal, vacancy management, quorum definition, and officer selection.**
- **The budgetary process including when the draft budget of the District presents to member towns and how each town is billed by the district.**
- **How to incur debt.**
- **How to amend the Agreement and add or remove a member town.**

The creation of a regional District would require at least two town meeting votes from each of the participating communities. The first vote would be to authorize the filing of special legislation to create a regional wastewater district. If successful, a second town meeting vote would be required to approve a District Agreement. While no community has committed to creating such a District, the Project drafted hypothetical legislation and a hypothetical District Agreement based largely on the successful MFN model. These documents are currently in draft form and can serve as a starting point if partners decide to move forward with a regional District.

MAKING IT HAPPEN.

Mansfield–Foxborough–Norton Regional Wastewater District

AFTER MANY YEARS of working towards regionalization, in 2019 the Mansfield–Foxborough–Norton Regional District cut the ribbon on an upgraded regional wastewater treatment facility that treats 3.14 million gallons of wastewater each day from the towns of Mansfield, Norton, Foxborough, Easton and Wheaton College. While the idea for the project was over 20 years in the making, after the legislation was passed in 2010 the final district agreement was signed in 2014. It took 3 years and $38M to complete the construction of the expanded wastewater treatment facility.



Ownership of the MFN Wastewater District is based on each town's sewage capacity allocation to the regional plant.

- Mansfield
- Foxborough
- Norton

Learn more at **www.mfndistrict.com**

List of Studies Completed by the Upper Bay Project

All available for download at **savebuzzardsbay.org/UpperBay**

Massachusetts Year 2016 Integrated List of Waters; Final Listing of the Condition of Massachusetts' Waters Pursuant to Sections 305(b), 314 and 303(d) of the Clean Water Act. Available at: http://www.mass.gov/eea/agencies/massdep/water/watersheds/total-maximum-daily-loads-tmdls.html

Inter-municipal Agreement for Wastewater Collection, Treatment and Disposal between the town of Wareham, Massachusetts and Town of Bourne, Massachusetts Signed February 23, 2010

Projected Wastewater Flows, GHD Technical Memorandum, April 21, 2017

Marion Projection of Wastewater Flow, GHD Memorandum, March 29, 2017

Wastewater Management Planning for Bourne's Downtown, Cape Cod Commission and CH2MHill Report, June 20, 2012

Assessing the Impact of Increased Effluent Discharge into Cape Cod Canal, Woods Hole Oceanographic Institution. 2017

Green Seal Survey 2017

WPCF Effluent Force Main Routing Alternatives Analysis, BETA, September 2020

Draft Agreement Establishing the Bourne Marion Wareham Regional Wastewater District, September 2020

Draft Legislation Establishing a Regional Wastewater Partnership, September 2020

Wright Pierce Third Party Review, September 2020

Buzzards Bay Coalition Water Quality Monitoring in Upper Buzzards Bay, September 2020

Upper ay Benthic Report 2020

Massachusetts Division of Marion Fisheries, Eelgrass Surveys, Annual Report to Buzzards Bay Coalition, 2018-2019

Upper Buzzards Bay Fisheries Resource Analysis, September 2020

Kleinfelder, Technical Memorandum, WPCF Outfall Force Main Feasibility and Routing Analysis, February 17, 2021

Bourne Local Comprehensive Plan 2019

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1 Town reported average nitrogen discharge of 1.5mg/L from the Wareham WPCF from April 2018 to October 2018. NPDES Permit No. MA 0101893. Assuming an influent concentration of 40mg/L, this results in a 95% reduction in nitrogen.

2 Town reported average daily flow to the Wareham WPCF from January 2018 to July 2019 was 1.18MGD. The town reports 6,800 customers paying $646/year/EDU.

3 Inter-Municipal Agreement for Wastewater Collection, Treatment and Disposal between the town of Wareham, Massachusetts and Town of Bourne, Massachusetts Signed February 23, 2010 for a 20-year term.

4 Town reported on July 10, 2020 – 263 users in Hideaway Village from the Bourne Water District, 630 downtown residential users and 177 commercial users for a total of 1,070 users.

5 The 101,000 gpd was estimated by taking 90% of the water use from Hideaway Village and residential and commercial water use from Downtown Bourne.

6 Number of current sewer users reported by town of Bourne on July 13, 2020. Sewer rates reported by town August 26, 2019.

7 Average flow from 2016-2017 was approximately 35,000 gpd for NPDES Permit No. MA0024368.

8 NPDES No. MA 0100030

9 2018 rolling annual average flow was approximately 571,000 gpd.

10 Calculated based on average water use of 132 gpd at $164.05 cubic ft/day and a basic charge of $475.16.

11 2012 CH2MHill Report

12 Projected Wastewater Flows, GHD Technical Memorandum, April 21, 2017

13 Projected Wastewater Flows, GHD Technical Memorandum, April 21, 2017

14 Projected Wastewater Flows, GHD Technical Memorandum, April 21, 2017

15 Estimates provided by town staff

16 March 29, 2017 GHD Memorandum

17 Town consultant correspondence July 10, 2020

18 Chapter 259 of the Acts of 2014

COVER PHOTO: RUSS KLEEKAMP

Learn more at

www.savebuzzardsbay.org/upper-bay-project/